In the tertiary highland, the condition of irrigation is not favourable but the soil is rich so that the upland rice, maize, vegetables, cassava, etc. are cultivated.

In regard to land utilization, 30% of total land area is used as rice field, 23% as farms and 20% is forest (see Fig. A-5-4).

The weather in Central Java is a typical tropical weather where the monsoon is predominant.

The rainy season varies from year to year but is generally from November to May with precipitation as much as 200 mm/month to 300 mm/month.

The dry season is from May to October and the precipitation remains only at 50 mm/month to 100 mm/month normally.

The average temperature in Central Java is nearly constant throughout the year and the monthly average is within the range of 25°C to 28°C.

Looking the social and economic features of Central Java, it is a province of the highest density of population in the highly populated island of Java, yet from the industrial aspect, it is dependent largely on agriculture.

It may also be described as an area with the per capita GDP falling far below the national mean, although it is located in the favored island of Java among other islands of Indonesia.

5-2 Population

Total population of Indonesia is 123 millions in 1973, and 78 millions which is 63%, is living in Java and Madura. Namely, in the area of 6.9% of total national land, population of 63% is concentrated and this is why Java is called population concentrated area.

The population of Central Java in the same year is 22.6 millions which corresponds to 29% of the population of Java and Madura. In other words, about 1/3 of the population of Java and Madura is living in Central Java.

In view of population density of Central Java, the national average density is 65 persons/km^2, and density for Java and Madura is 589 persons/km^2 while it is 478 persons/km^2 for West Java, and 542 persons/km^2 for East Java but Central Java has 660 persons/km^2 which means that Central Java is the most densely populated area when taking regional means of population (see Table 5-1).

Now let examine the population distribution within Central Java province.

Densely populated areas with density greater than 1,000 persons/km² are three districts of Klaten, Sukoharjo and Tegal, and thinly populated areas with population density lower than 500 persons/km² are four districts of Rembang, Blora, Grobogan and Wonogiri which are adjacent to boundary of East Java. And districts other than those shown above have density from 500 persons/km² to 1,000 persons/km².

The population density of D.I. Yogyakarta is 806 persons/km² which is creating another densely populated area (see Table A-5-1 and Fig. A-5-5).

There are six Kotamadya which are equivalent to city, within Central Java.

Among these cities, provincial capital Semarang has largest population of 710 thousands and next one is Surakarta with population of 470 thousands.

5-3 GDP

GDP per capita of Central Java is low and it was about 70% of national average from 1969 to 1971. But this difference was further widened from year of 1972 to 1975, and it dropped to 55% of national average in 1975. When comparing to other areas it was lower than those of South Kalimantan and Maluk, and Central Sulawesi which had been lower than this area exceeded Central Java in 1973 (see Table 5-2).

Examining the growth of GDP in the past of Central Java, GDP's mean annual growth rate between years 1969 and 1975 in the area was 4.3% which was only 60% of mean national growth rate of 7.2%.

Examining GDP per capita, mean annual growth rate of Central Java was 2.6% during the same period and this was only 58% of its mean national growth rate of 4.5% (see Table A-5-2).

In D.I. Yogyakarta, growth rate of GDP per capita was almost the same as that of national average though the data were available only for years from 1969 to 1972.

Examining distribution of GDP per capita in Central Java province, the districts with GDP per capita higher than 40,000 Rp. were Kudus and Kendal in 1973 and the districts with GDP per capita between 30,000 Rp. and 40,000 Rp. were Pekalongan and Batang located along the coast of the Java Sea, inland districts of Klaten, Sokoharjo and Karanganyar, Cilacap and neighbouring districts of Banyumas and Pati, Rembang and Blora which are located in northeast region of Central Java near the border to East Java.

Table 5-1 Distribution of Population in Indonesia, 1961 ~ 1973

Province	Area (x 1,000 Km²)	Population 1961 (x 1,000 persons)	Population 1973 (x1,000 persons)	Annual Growth Rate 1961/1973	Density in 1973 (Persons/Km²)
Central Java	34.2 (1.8%)	18,407	22,575 (18.3%)	1.7	660
D.I. Yogyakarta	3.2 (0.2%)	2,241	2,553 (2.1%)	1.1	806
Total Java and Madura	132.2 (6.9%)	62,993	77,852 (63.3%)	1.8	589
Total Indonesia	1,904.6 (100%)	97,019	123,086 (100.0%)	2.0	65

Source: (1) Java Regional Study, Central Java, Japan International Cooperation Agency
(2) Statistical Yearbook of Indonesia 1975, Biro Pusat Statistik Jakarta

Table 5-2 Relative Per Capita GDP of Several Provinces, 1969 ~1975

Province	1969	1970	1971	1972	1973	1974	1975
Central Java	100	100	100	100	100	100	100
D.K.I. Jakarta	303	319	327	370	357	431	
South Kalimantan	154	146	116	153	163		
Central Sulawesi	64	68	72	93	117		
Maluku	130	130	151	152	175		
All Indonesia	137	145	139	160	171	210	182

Source: Java Regional Study, Central Java, Japan International Cooperation Agency

The districts in central mountainous area are underdeveloped in general and GDP per capita was 20,000 Rp. to 30,000 Rp..

D.I. Yogyakarta had 39,000 Rp. per person in average in 1973.

The cities had all more than 40,000 Rp. per person and maximum was 60,000 Rp. per person of Pekalongan (see Fig. A-5-6 and Table A-5-3).

Examining growth rate of GDP by industrial sector in Central Java for the years from 1973 to 1975, it was lower than objective value of national average of PELITA II except the transport sector.

Particularly, the growth rate for mining and industrial sector during the above period was 5.5%, which was away lower than PELITA II objective value of 9.0% (mining) and 13.0% (industrial). This is considered to be one of main causes of stagnation of the overall development of Central Java (see Table 5-3).

Table 5-3 Real Growth Rate of GDP by Sector in Central Java

Sector	Average Annual Growth Rate			Remarks
	Pelita I 1969 - 1973	Real Growth Rate 1973 - 1975	Pelita II (All Indonesia) 1974 - 1978	
	(%)	(%)	(%)	
Agriculture	2.9	3.1	4.6	
Industry & Mining	4.9	5.5	9.0 - 13.0	9.0 for Mining 13.0 for Industry
Construction, Electric, Drinking Water & Gas	7.2	7.2	9.2	
Transportation	5.7	10.0	10.0	
Trade, Insurance & Banking	6.7	8.0	7.6	
House Rent, Governmental Services	2.5	2.4		
Average	4.1	4.8	7.5	

Source: (1) Java Regional Study, Central Java, Japan International Cooperation Agency
(2) PELITA II 1974/75 - 1978/79

5-4 Industry

5-4-1 Agriculture

In regard to food crops in 1973, the share of Java and Madura to the national gross production is extremely high, 64% of wet land paddy and more than 70% of maize, cassave, peanuts and soybeans are produced in these islands and that is why Java is called a granary of Indonesia.

On the other hand, when comparing provinces in Java, West Java and D.K.I. Jakarta are producing most of wet land paddy and sweet potatoes; East Java is producing most of maize; and Central Java and D.I. Yogyakarta are producing most of cassava.

Thus it seems to be that there is no outstanding difference among these three provinces (see Table A-5-4).

Analyzing production of food crops in Central Java, several features can be pointed out as described below.

Namely, production of lowland rice is steadily increasing.

Increase in rice production is mainly due to increase of productivity and increase of productivity has been achieved by promotion of Intensification Programs such as BIMAS and INMAS and promotion of irrigation programs.

Production of maize greatly fluctuates each year, and a peak production of 710-thousand tons was achieved in 1973 but production is decreasing after that year. Cassava and sweet potatoes are remaining on the same level or gradually decreasing.

On the other hand, production of peanuts and soybeans is relatively small but its tendency of high increasing rate is continuing (see Table A-5-5).

As far as amount of trades of food crops of whole Java is concerned, 380-thousand tons of rice was imported and 230-thousand tons was domestic export with remainder of 150-thousand tons in 1975. Export of maize was 10-thousand tons and its domestic import was also 10-thousand tons resulting no remainder. Dried cassava of 30-thousand tons was exported.

Major non-food crops are tobacco, sugar, coconut, rubber and tea. These crops are cultivated by both estates and small holders, but the area of cultivation by the latter is far greater and constitutes 95% of the total area of cultivation at 1,340,000 hectares.

Tobacco is produced mainly by small holders concentrated in both Temanggung and Kendal.

Only few virginia and vorstenland tobacco is produced but its cultivation is concentrated in Klaten and Sragen.

The production of tobacco is remaining on the same level both by estates and small holders during past several years.

National tobacco production is also remaining on the same level after it reached a peak of 120-thousand tons (dry product) in 1972.

In the production of sugarcane sugar, Central Java is second in this product next to East Java. The cultivation of sugarcane is mainly performed by estate plantations and their total cultivating area is about seven times more compared to that of small holders. Main producing areas in Central Java are the districts of Brebes, Tegal, Pemarang and Pekalongan in the west along the Java Sea and the districts of Sragen, Karanganyar and Klaten in the southeast of Central Java.

Production of sugarcane by the estate plantations after the year of 1969, reached a peak in 1971 but it is remaining on the same level in the following years.

National production of sugarcane is now steadily increasing both in estate plantations and small holders sides.

Indonesia is world's second coconut export country but its export has reduced in recent years due to increase of demand within the country. Cultivation of coconut is mostly performed by small holders and its main production centers are Banyumas and Cilacap district and Karanganyar and Wonogiri district.

Production of coconut in Central Java is gradually increasing and this coincides with gradual increase of national coconut production.

As well as coconut, Indonesia is also world's second rubber producing country but share of rubber production of Central Java is low. This is mostly being cultivated in estate plantations and main production areas are the districts of Cilacap, Kendal and Semarang.

The estates operated by the native capital have the rubber plants less renewed than the government or foreign-own estates, and as far as the present condition is concerned, are of lower productivity than the others.

Productions in estate plantations of Central Java remain completely on the same level since 1969 and national productions are also indicating similar tendency.

Tea is cultivated by both estate plantations and small holders and major production areas are highlands in the districts of Pemalang and Banyumas.

Tea production in estate plantations in Central Java is gradually increasing but national productions are completely remaining on the same level.

5-4-2 Forestry

Forest area in Central Java is 650,000 ha and this is about 20% of total area of the province. Among the forest products, the teak is most famous in Central Java.

Area of teak forests is 350,000 ha and yearly production of 250,000 m^3 is being achieved on an average. Main production areas are the districts of Blora and Purwodadi where 75% of all teak products is yielded. In each year, about 15 thousand-tons to 20-thousand tons of teak is exported from the port of Semarang. Other useful forest resources are coniferous trees such as Merkusii and Agathis. According to the Regional Studies conducted in Central Java by Japan International Cooperation Agency, the coniferous trees are possible to utilize as good quality material for paper industry and also export of the trees is very promising.

5-4-3 Fishing Industry

The fishing industry in Central Java can be classified into marine fishery, inland fishery and fish culture. The marine fishery is mainly performed in the north coast along the java Sea, and only few fishing is being performed along the south coast facing the Indian Ocean.

Catch of fish is steadily increasing every year and this is mainly due to the increase of the marine fishing. The share of catch of fish by the marine fishery to the total catch of fish is approximately 80%, and main types of fishes are flying fishes and horse mackerels. Share of catch of fish by the inland fishery and share of production by the fish culture is about 10% respectively and both productions are remaining on the same level (see Table A-5-6).

5-4-4 Mining and Industries

Production of mining in Central Java is very small and GDP by sector in 1973 (see Table A-5-7) is indicating the share of only 1.1%. The mine exploited presently is the iron sand in Cilacap. But, recently, with mass production prospected, limestone has been regarded as a promising material for cement industry. For quarrying, road construction is expedited urgently. Thus development of mineral products in this area is expectable.

Currently, the share of GDP in industrial sector to GDP in Central Java is 12.8% which approximately coincides with the national mean objective value of 12.5% in 1978/79 of PELITA II.

Analyzing distribution by region of the national industrial establishments, about 72.1% of all establishments are located in the island of Java and, especially, 83.4% of large-scale establishments with employees greater than 100 are concentrically located within this island.

On the other hand by studying their distribution within the island of Java, the share of the number of establishments is 30.3% for Central Java and D.I. Yogyakarta, 36.5% for West Java and D.K.I. Jakarta and 33.2% for East Java so that the share of Central Java is lower than other provinces. Particularly in regard to the large-scale establishments, its share of Central Java is 25.0% and this is much smaller than 41.7% of West Java and D.K.I. Jakarta and 33.3% of East Java. Half of 41.7% share of West Java and D.K.I. Jakarta of the large-scale establishments is owned by D.K.I. Jakarta (see Table A-5-8).

In view of the statistics illustrated above, the main reason of accepting lower level and stagnation in the industrial production in Central Java, is lack of industrial center for large-scale industries within Central Java comparable to D.K.I. Jakarta in West Java, and Surabaya in East Java.

One of causes of this is probably the manual industry traditionally performed in Central Java such as batik industry but other important cause will be the insufficient arrangement of infrastructure, especially, of the port of Semarang, in comparison with other provinces.

Analyzing the locations of industrial zones within Central Java, the zones which are making high industrial productions are northern coastal zone ranging from Tegal to Semarang, inland zone connecting the districts of Kalaten, Sukoharjo and Karanganyar northeastern province connecting the districts of Jepara, Kudus and Pati, and zone of Cilacap. Of the industrial production of the cities, the production of Semarang is the highest and next one is Surakaruka (see Fig. A-5-7 and Fig. A-5-8).

Analyzing the industries of Central Java by kind, No. 1 share is textile with 24.7% share in number of the establishments currently in operation. Following this share the second is foods and beverage with 17.3% share and the third is clay and stone products with 8.2% share. However, as far as large-scale establishments are concerned, the largest in number of establishments is textile followed by foods and beverage, papers and printing, wood and furniture, and tobacco in the order of numbers (see Table A-5-9).

The centers of textile industry are Pekalongan, Surakarta and Semarang. Since the raw materials of this industry such as cotton and synthetic fibres have to be imported, location of this industry is usually set around ports, or along roads and railways.

In the sector of textile industry, the traditional batik industry is having difficulty in making increase in sales while ready-made western style clothes and underwears are increasing in production. It is expected that the demand for textile in Central Java will be greatly increased when people's incomes are improved in future since current amount of consumption of textile in this area is lower than that of national average.

Industry for processing the agricultural products probably will greatly increase further without any choice since the area of Central Java has high agricultural production as its major products. For this reason, the provincial government has placed high priority on the processing industry for agricultural products, and it has been greatly developed during PELITA I and production of certain types of products is further progressing after entering into the phase of PELITA II.

Processing manufactures for coconut oil, copra oil cake, dried copra and so forth are gradually having difficulties in obtaining the raw coconut since consumption within the production area has increased and also many factories have been established in the outside areas of the island of Java.

On the other hand, raw material cassava for tapioca flour and tapioca pellet has a potential of further production increase so that they will be further developed in future.

As far as peanuts and soybeans are concerned, they will be further utilized as raw materials for traditional foods such as Tahu, Tempe and vegitable oil. Production of such raw materials is steadily growing in recent years and its further development by promoting mechanization of processing is much expected.

Tobacco industry has become one of the most important industries in view of employment policies. Its largest production center is Kudus in view of amount of production and next one is Surakarta. These areas are more advantageous since they are located near the producing center of raw material, the leaf tobacco.

In importing clove which is used as raw material for Kretek tobacco, large-scale enterprises are more advantageous in securing this so that small-scale enterprises are apt to lose in competition.

One of outstanding industries associated with the tobacco industry is printing industry. For this reason, Kudus has become the largest center of printing industry in Central Java and they are printing wrapping papers and packages of tobacco. In addition, needs for automobile repair shops are growing since many trucks are being used for transporting the tobacco.

Chemicals, rubber and plastics are the materials consumed in manufacturing the soaps, detergents, tires for bicycles, plastic products, medicines, cosmetics, etc., and production of these materials are rapidly increasing in recent years. However, competitions with foreign capitals and imported goods are so keen that the rationalization of production facilities will be the governing factors of the future development.

Also, it may be said that the industrial structures will be completely changed if heavy industries are developed in Cilacap.

Clay and stone products are roofing slates and bricks, and majority of them are developed in most of areas in the province in form of small-scale household industry.

Its production is drastically rising in response to the increase in demand but it is hoped to modernize production facilities, and to improve the productivity and quality in order to assure the further development in future.

Most of wood and wood products are lumbers, furnitures, wood carving, etc.. However, lumbering is greatly depending upon the domestically imported logs in addition to locally available teak material so that improvement of ports is indispensable for the development of lumber industry in future. On the other hand, wood carving is concentrated in Jepara and its development is greatly depending upon the tourist industry.

Chapter-6

Prediction of the Port Traffic and Shipping of the Port of Semarang

CHAPTER 6
PREDICTION OF THE PORT TRAFFIC AND SHIPPING OF THE PORT OF SEMARANG

6-1 General

This Chapter is intended to estimate the service area of the port of Semarang, predict the future of the port cargo to be handled at the port and analyze the relationship with the shipping through analysis of the present condition, as seen from the aspects of traffic and transportation, of the hinterland of the port, that is, Central Java and D.I. Yogyakarta.

6-2 Characteristics of Transportation in the Hinterland of the Port of Semarang

6-2-1 Ports

Now looking the cargo handled at the ports in the islands of Indonesia, Sumatra represents 71.3%, Java 19.9%, Kalimantan 6.8%, and the remaining islands only 2% as of 1975.

In both foreign and domestic trades, Sumatra holds very high shares at 78.7% and 54.0% respectively due mainly to shipping of a large amount of crude oil. Actually, in 1975, the foreign export of crude oil amounted to 42 million tons and the domestic export to 7.7 million tons. Sumatra also exports rubber and wood and is an area where the shipment of the so-called primary products is predominant (see Table 6-1).

Table 6-1 Share of Cargo Handled at Ports in Indonesia by Island, 1975

Island	Foreign	Domestic	Total
	(%)	(%)	(%)
Sumatra	78.7	54.0	71.3
Java	14.5	32.6	19.9
Kalimantan	6.5	7.4	6.8
Sulawesi	0.3	3.7	1.3
Bali and Nusatengara	-	2.1	0.6
Maluku and Irian Jaya	-	0.2	0.1
Indonesia	100.0	100.0	100.0

Source: Cargo Loading and Unloading at Ports in Indonesia, 1970 ~ 1975.

Whereas, Java may be said to be an area where discharge of the manufactured products is predominant in the foreign as well as domestic trade mainly at the ports of Tg. Priok and

Surabaya.

In 1975, in Sumatra, the loading cargo constituted 90.4% of the total cargo, while in Java, the unloading cargo accounted for 81.4% conversely. This is clearly indicative of the difference in character of these two areas.

Kalimantan and Sulawesi are far smaller in the port handling cargo than in the foregoing two islands, but Kalimantan is generally characterized by loading of the primary products such as logs, while Sulawesi by balanced loading and unloading.

Now looking the trend of fluctuation of the shares in the port handling cargo of the respective islands, Sumatra has decreasing shares in both foreign and domestic trades, but Java shows conversely an increasing trend in both shares, particularly a sharp increase being noted in the share of the unloading cargo in the domestic trade (see Table A-6-1). It will be seen that in the densely populated Java, there is an inflow of large amounts of mechanical equipment, construction materials, consumption commodities, etc. through ports with increasing population and developing economy.

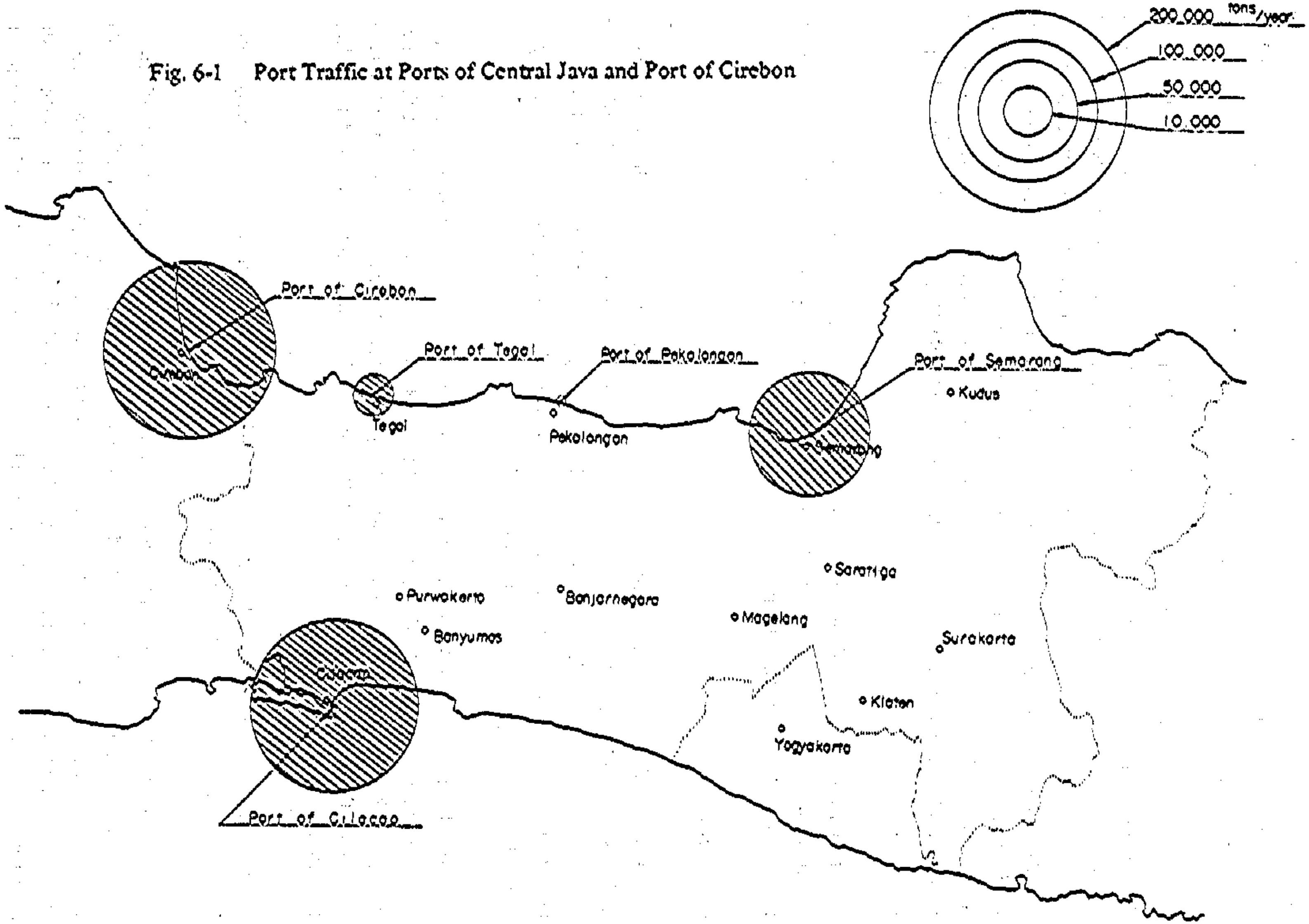
Next, seeing the cargo handling volumes of the ports in the island of Java, the largest in the cargo handling is the port of Tg. Priok holding a share of 49.4% of the total cargo of loading and unloading as of 1975. The second is the port of Surabaya at 20.6%. Thus, these two ports handle as much as 70% of the whole cargo of the island of Java, and when the foreign trade alone is taken, the share of these ports is as high as 73% to indicate how concentrative are the cargo to these two ports.

In Central Java are located four major ports including the port of Semarang, but the total of the cargo handled at these four ports is only 13.1% of the whole cargo of the island of Java as of 1973. The Central Java has no foreign trade commercial ports comparable to the port of Tg. Priok or Surabaya and thus shows such a low share which in turn suggests that the land transport flowing into Central Java via the ports of Tg. Priok and Surabaya is of a considerable amount (see Table A-6-2).

In the ports in Central Java, the port of Cilacap has the largest cargo handling, and the share of this port to the ports in Central Java in 1975 is 62.9%, followed by the port of Semarang at 33.6%. Thus, these two ports account for 96.5%, and the ports of Tegal and Pekalongan are of very slight cargo handling (see Fig. 6-1).

Here, looking the movement of cargo handled in the respective ports in the island of Java during 1970 to 1975, a trend of decrease, although slightly, is noted in the share of the port of Tg. Priok from 52.6% to 49.4% and that of the port of Surabaya from 22.8% to 20.6%, this indicating improvement of the other ports and distribution of the cargo to these ports. For example, the ports of Cilacap and Cirebon noted a remarkable increase of the

Fig. 6-1 Port Traffic at Ports of Central Java and Port of Cirebon



share during the same period, from 5.5% to 8.3% in the case of Cilacap and from 3.9% to 8.7% in the case of Cirebon. Further, the share of the total cargo of the ports in Central Java shows a trend of increase from 10.6% to 13.1% (see Table A-6-2).

Looking the cargoes handled at the ports of Cilacap and Semarang which are the representative ports of Central Java, the port of Cilacap holds a dominant position so far as the cargo handling is concerned as described in the foregoing. But, both ports are somewhat different in the character. The port of Semarang handles a variety of commodities consisting mainly of consumption goods and is thus characterized as a commercial port, while the port of Cilacap handles specialized products, unloading petroleum products (transported to Yogyakarta and Bandung by means of pipelines) and construction materials, and loading iron sand etc., and thus reflects the difference in the foreland and hinterland from the port of Semarang.

From the foregoing, these two ports in Central Java may be developed simultaneously, but there will be no possibility of a competitive relationship produced between them such that one prospers while the other not.

6-2-2 Road

The condition of road improvement in the respective islands of Indonesia is: Java, 248 m/km^2 , Sulawesi, 76 m/km^2 ; Sumatra, 69 m/km^2 and Kalimantan, 9 m/km^2 ; or average 50 m/km^2 throughout the country. The road improvement is thus most advanced in Java. In the island of Java, D.I. Yogyakarta and Central Java are high in the road density at 326 m/km^2 over the other areas (see Table 6-2).

Now looking the trunk road network in Central Java, the national road has two routes coming from Jakarta and Bandung in the west join at Cirebon and runs to connect the cities of Tegal, Pekalongan and Semarang located along the coast of the Java Sea but at Semarang it turns to the south and is bifurcated at Bawen, one leading to Surakarta and the other through Magelang to Yogyakarta.

On the other hand, the national road branching east from Surakarta runs nearly along the axis of the island of Java to Surabaya.

The provincial road includes five routes: western south-north route running south from Tegal via Purwokerto to Cilacap; inland east-west route from Purwokerto via Wonosobo to Magelang; south coast east-west route from Cilacap via Kebumen to Yogyakarta; north coast east-west route from Semarang via Kudus and Rembang to the east; and eastern south-north route from Kudus via Surakarta to Wonogiri. These routes are connected with the national roads to form a trunk road network in Central Java (see Fig. 6-2).

Fig. 6-2 Road Network in Central Java

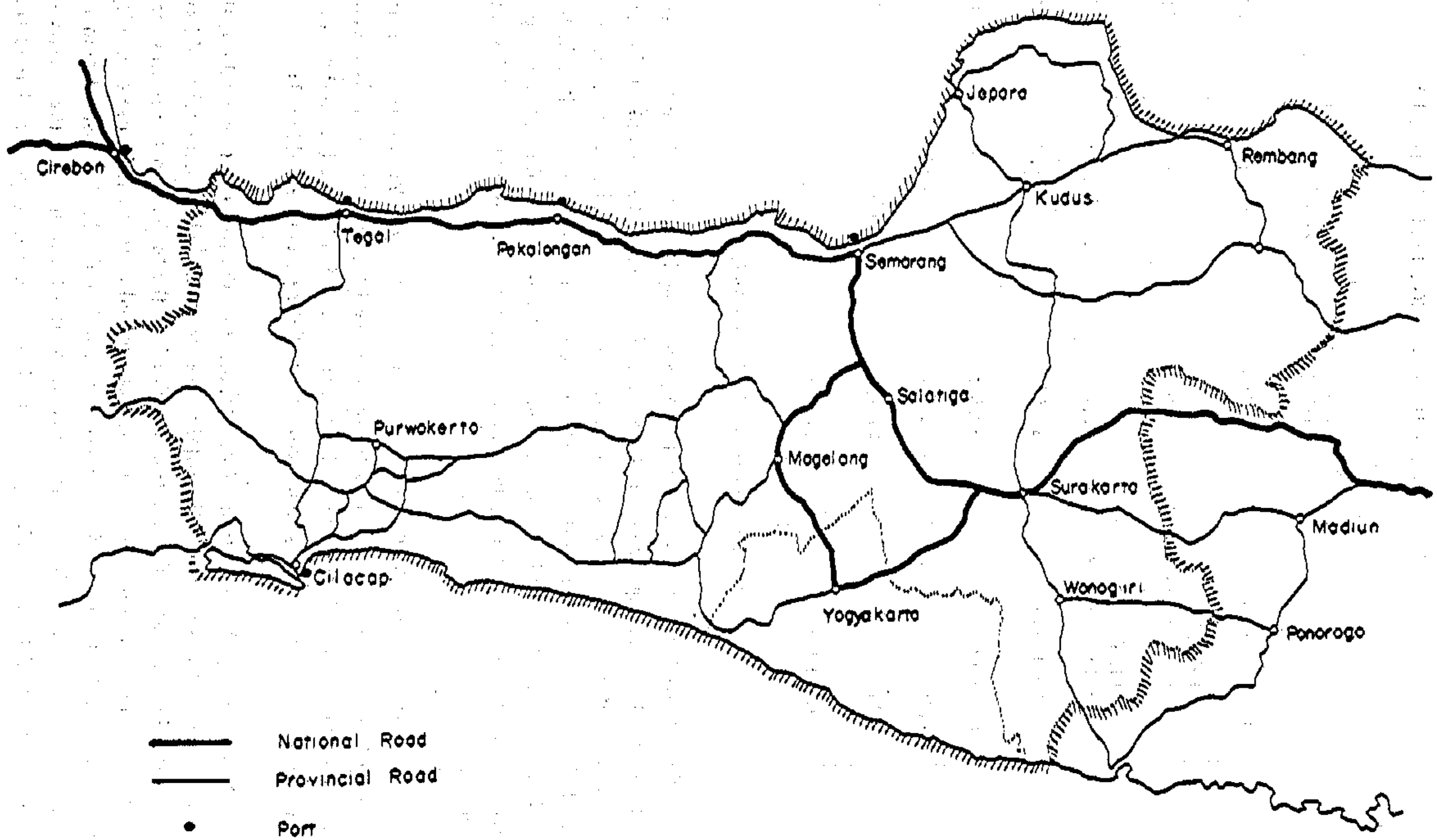


Table 6-2 Network Density of Road in Indonesia, 1972

Region	Network Length (Km)	Land Area (Km2)	Density (m/Km2)
Java and Madura	32,790	132,187	248
D.K.I. Jakarta and West Java	10,014	46,890	214
D.I. Yogyakarta and Central Java	12,171	37,375	326
East Java	10,605	47,922	221
Sumatra	32,586	473,606	69
Kalimantan	5,119	539,460	9
Sulawesi	14,372	189,216	76
Total Indonesia	95,463	1,901,569	50

Source: Statistical Yearbook of Indonesia, 1975

Seeing from such trunk road network, Semarang is located along the most important national road connecting the east and the west of the island of Java and, at the same time, at the center of the road network connecting the main cities in Central Java. Thus, it is located, no doubt, at the most advantageous position over the other cities in the province with respect to the road transportation, and from such point of view, propriety of developing the port of Semarang into a pivotal commercial port in Central Java may well be understood.

Now seeing the freight flow by mode in Central Java and Yogyakarta, the transport by means of the foregoing roads constitutes a share of 66.6% and is thus overwhelmingly predominant over the shipping at 25.3% and railway at 8.0%. Here is also shown the sluggish shipping activities due to delay in improvement of the ports (see Table 6-3).

Now, looking the condition of development of the roads in Central Java, the asphalt pavement constitutes 62.5% of the total road extension, and the national road has only two lanes for inbound and outbound traffics. Further, the bridges on the routes are generally shortcoming in the width, and near the villages, mixed traffics with horse cabs, bicycles, etc. are increasing. With such and other problems, unless the land transportation network is developed drastically with an enormous amount of investment, the merits of marine transportation will be more clearly presented with increasing volume of road transport in the future (see Table 6-4).

Table 6-3 Freight Flow by Mode in Central Java and Yogyakarta

Year	Highway		Sea		Railway		Total	
	Million tons	Share(%)	Million tons	Share(%)	Million tons	Share(%)	Million tons	Share(%)
1974	5.63	66.6	2.14	25.3	0.68	8.0	8.45	100.0
1971	1.12	40.1	1.03	36.9	0.64	22.9	2.79	100.0
Average Annual Growth Rate (%)	49.8		20.1		1.5		31.9	

Source: Java Regional Study, Central Java, Japan International Cooperation Agency

Table 6-4 Length of Roads by Surface Type and Status, 1974

(Unit: Km)

Surface Type	National Road	Provincial Road	Kabupaten Road	Kotamadya Road	Total
Asphalt	407.8	1,751.6	4,405.9	582.2	7,147.5
	(99.8%)	(96.9%)	(55.0%)	(47.9%)	(62.5%)
Others	1.0	55.9	3,604.1	632.4	4,293.5
	(0.2)	(3.1)	(45.0)	(52.1)	(37.5)
Total	408.8	1,807.5	8,010.0	1,214.6	11,441.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Share (%)	3.6	15.8	70.0	10.6	100.0

Source: Java Regional Study, Central Java, Japan International Cooperation Agency

6-2-3 Railway

The islands where the railway is present in Indonesia are only Java, Madura and Sumatra, with an extension of 4,684 km in Java and Madura and 1,953 km in Sumatra as of 1974. In the island of Java, an extension of 1,673 km which corresponds to 36.4% of the total extension of 4,592 km is present in the middle region, followed by the east region at 34.8% or 1,599 km and the west region at 28.8% or 1,320 km. In terms of the network density, then, the middle region is 44.8 m/km^2, the east region 33.4 m/km^2 and the west region 28.2 m/km^2, the middle region thus taking a predominant position (see Table 6-5).

With respect to the railway network in Central Java, the east-west lines running parallel to the axis of the island form the trunk lines as in the case of the road network, and they are the north coast line along the Java Sea and the south coast line along the Indian Ocean. The former runs from the direction of Jakarta through Cirebon into Central Java and via the

Table 6-5 Network Density of Railways in Java and Madura for 1.067 M Gauge, 1974

Region	Network Length		Land Area		Density
	(Km)	(%)	(Km^2)	(%)	(m/Km^2)
West Region	1,320	28.8	46,890	35.5	28.2
Middle Region	1,673	36.4	37,375	28.3	44.8
East Region	1,599	34.8	47,922	36.2	33.4
Total	4,592	100.0	132,187	100.0	34.7

Source: Java Regional Study, Central Java, Japan International Cooperation Agency

northern cities such as Tegal, Pekalongan and Semarang toward Surabaya. Toward east from Semarang, it has branches to Kudus and Rembang and to Blora which join again at Tjepu and leads to Surabaya. The latter runs from the direction of Bandung through Banjar into Central Java and via Kroja and Kotoardjo to Yogyakarta. From here to the east, it turns to the inland and, via Surakarta and Madiun, leads to Surabaya. To connect these east-west lines, there is a south-north line in the west and east respectively. The south-north line in the west runs south from Tegal through Purwokerto to Kroja, while the other south-north line in the east runs south from Semarang to Yogyakarta. This line is bifurcated as it runs south, one via Magelang and the other via Surakarta to Yogyakarta (see Fig. 6-3).

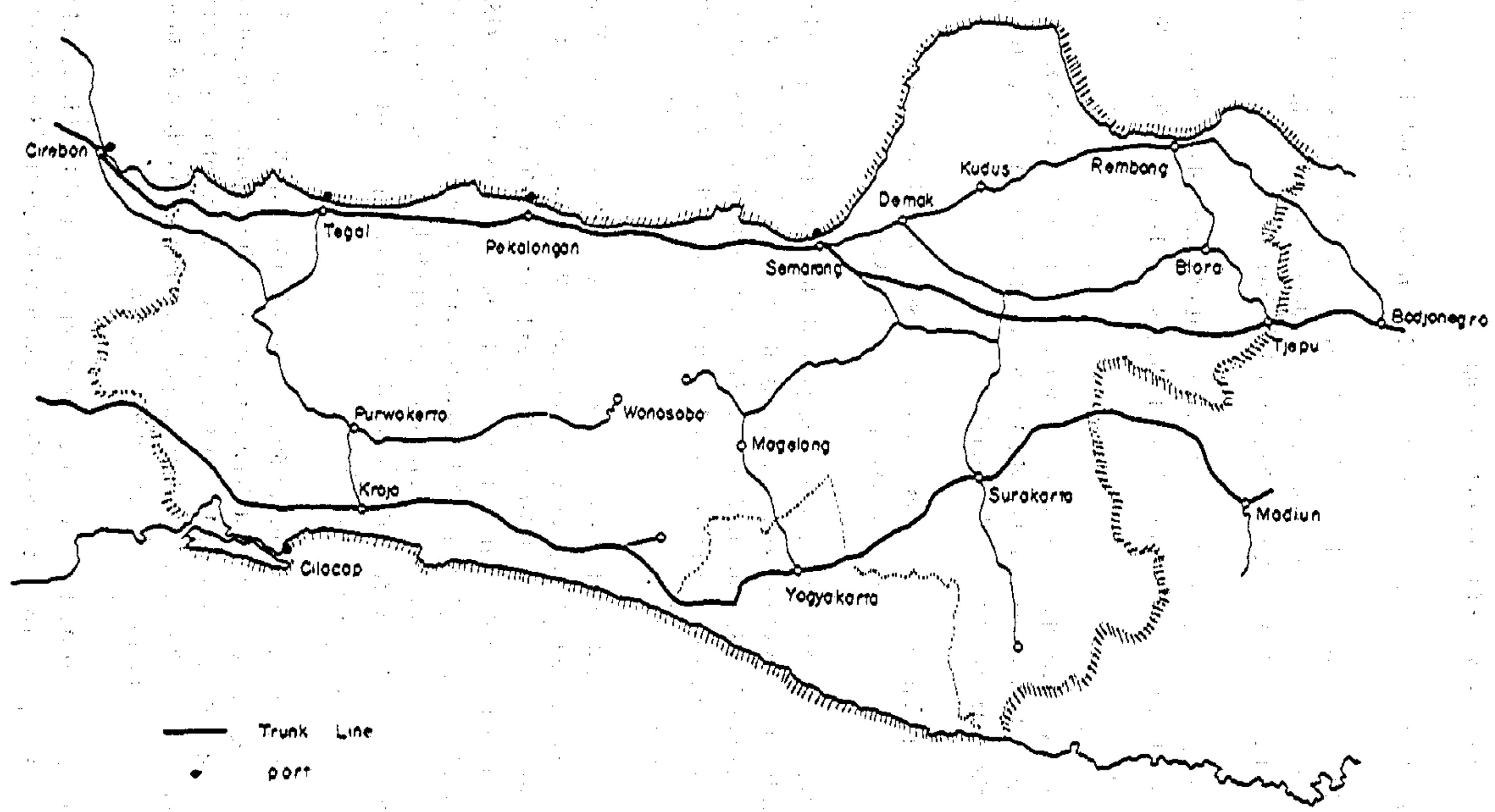
As described in the foregoing, predominance of the city of Semarang from the point of view of railway transport is considered to be the same as that in the case of the road.

As seen from the foregoing Table 6-3, the share of the railway freight transportation in the land transportation is low at 8% as of 1974, and the growth rate is also of a low level.

Principal commodities of railway transportation are presently petroleum, lumber and fertilizers, and for the petroleum and fertilizers, the intra-transportation is predominant.

Recent growth of the railway transport is attributable to the increasing transport of petroleum, but such transport is competitive with the pipeline so that it is hardly expectable that the railway transport will continue to grow in the future. Thus, it should be considered that the role of the railway transport would remain, at the best, as it is presently.

Fig. 6-3 Railway Network in Central Java



6-3 The Service Area of the Port of Semarang

6-3-1 Analysis upon port arrangement and road and railway networks in the island of Java

This section is intended to establish the service area of the port of Semarang upon the result of the examination made in the preceding section of the characteristics of transportation in the hinterland of the port of Semarang.

First, let us look into the overall arrangement of ports in the island of Java. The main ports on Java Sea side are, from the west, the ports of Tg. Priok, Cirebon, Semarang and Surabaya.

As seen from the sea distances shown below, these four ports are located at an approximately equal interval along the Java Sea coast and are thus adequately arranged to share the sea transportation on Java Sea side.

Tg. Priok ←→ Cirebon ←→ Semarang ←→ Surabaya
280 km 200 km 340 km

On the other hand, there is only one port which is important along the Indian Ocean coast. It is the port of Cilacap located nearly at the center of the island of Java. While the four pourts on Java Sea side are all commercially oriented, the port of Cilacap on Indian Sea side has a character of industrial port handling mainly particular commodities such as petroleum, iron sand, etc..

Now looking the port arrangement around the port of Semarang, the adjacent port of Cirebon on the west side is located at the east end of West Java province near the boundary to Central Java province. In 1970, it had a cargo handling of 350-thousand tons which was smaller than that of the port of Semarang at 470-thousand tons. But, in 1975, the cargo handling increased sharply to 1,540-thousand tons or twice the cargo handling of the port of Semarang at 780-thousand tons. Further, the port of Cirebon is carrying out an additional installation of wharves. It is thus a promising commercial port with a potentiality for expansion of the service area in the future.

Apart from the port of Cirebon for a distance of 65 km over the sea toward the port of Semarang is located the port of Tegal in Central Java. It is a port concerned mainly with loading of molasses, rubber and tea and unloading of lumber, but the port activity is in a trend of leveling off or decline with the cargo handling in 1976 only at 80-thousand tons. Thus, it is likely to remain as a local port in the future.

On the side of the Indian Ocean due south of the port of Tegal is located the port of Cilacap. This port is connected through Purwokerto to the ports of Cirebon and Tegal on

Java Sea side by way of road and railway.

In determining the service area of the port of Semarang, it is important to consider the competitive relationship with the service areas of the three ports discussed above. Therefore, the area along said transportation route will have to be excluded from the service area of the port of Semarang in Central Java.

Further, since it is ecpected that the port of Cilacap will enhance its function as a commercial port with Australia and Europe as the foreland in the future, it will be required to exclude from the service area of the port of Semarang, the area along the road and railway line to Yogyakarta along the coast of the Indian Ocean which is to be included in the service area of the port of Cilacap.

Now, looking the area on the east side of the port of Semarang, it is only the port of Surabaya that is likely to produce a competitive relationship on both Java Sea and Indian Ocean sides.

Semarang and Surabaya are connected for land transportation by trunk lines of road and railway via Surakarta, and the distance between them is about 370 km by railway, and the midpoint of this distance is in the vicinity of Paron and is located nearly at the boundary of Central Java and East Java province.

Taking the northern railway line going through Tjepu, the distance between Semarang and Surabaya is 280 km, the midpoint being Tjepu and located on the boundary of both provinces.

From the foregoing examination, the provincial bounday may be taken as the east limit of the service area of the port of Semarang.

6-3-2 Analysis of the potentials of the ports in Central Java

The next method tested in determining the service area of the port of Semarang is that of analysis and comparison with one another of the potentials which the respective ports have on the service areas in use of the distances of road transport from the port to the central and other cities of the respective districts and GDP's of the districts and cities.

Since the GDP of an area is considered to be an index representing the volume of cargos coming in and going out along with productive activities of the area, and since the distance of road transportation is an index representing the cost or time of transportation, it has been attempted to represent the degree of intensity of the connection of a certain port with a certain area by an index of GDP/(Road transportation distance).

Such indexes, if summed up about a particular port over the area concerned, are considered to reflect, although relatively, the size of the potential which the port has on the whole area concerned.

Table A-6-3 shows the result of examination according to the foregoing method for establishing the service areas of the ports of Semarang, Tegal and Cilacap. It will be seen with ease how advantageously the port of Semarang is located with Central Java and Yogyakarta in the background over the ports of Cilacap and Tegal.

In establishing the service area of the port of Semarang, the result of calculation according to Table A-6-3 was corrected for the port of Tegal which would be maintained as a local port to serve for a small area around the district of Tegal, while the districts of Pekalongan, Batang and Pemarang were included in the service area of the port of Semarang (see Fig. 6-4).

The service area thus established is confined within the range of methodology for forecasting the port cargo and by no means covers all of the actually complex movements of cargo. Further, with petroleum transported from Cilacap to Yogyakarta by means of pepeline, for example, separate adjustment is, of course, required for the cargo the movement of which is clearly grasped.

6-4 Forecasts of Population and Production

6-4-1 Forecast of Population

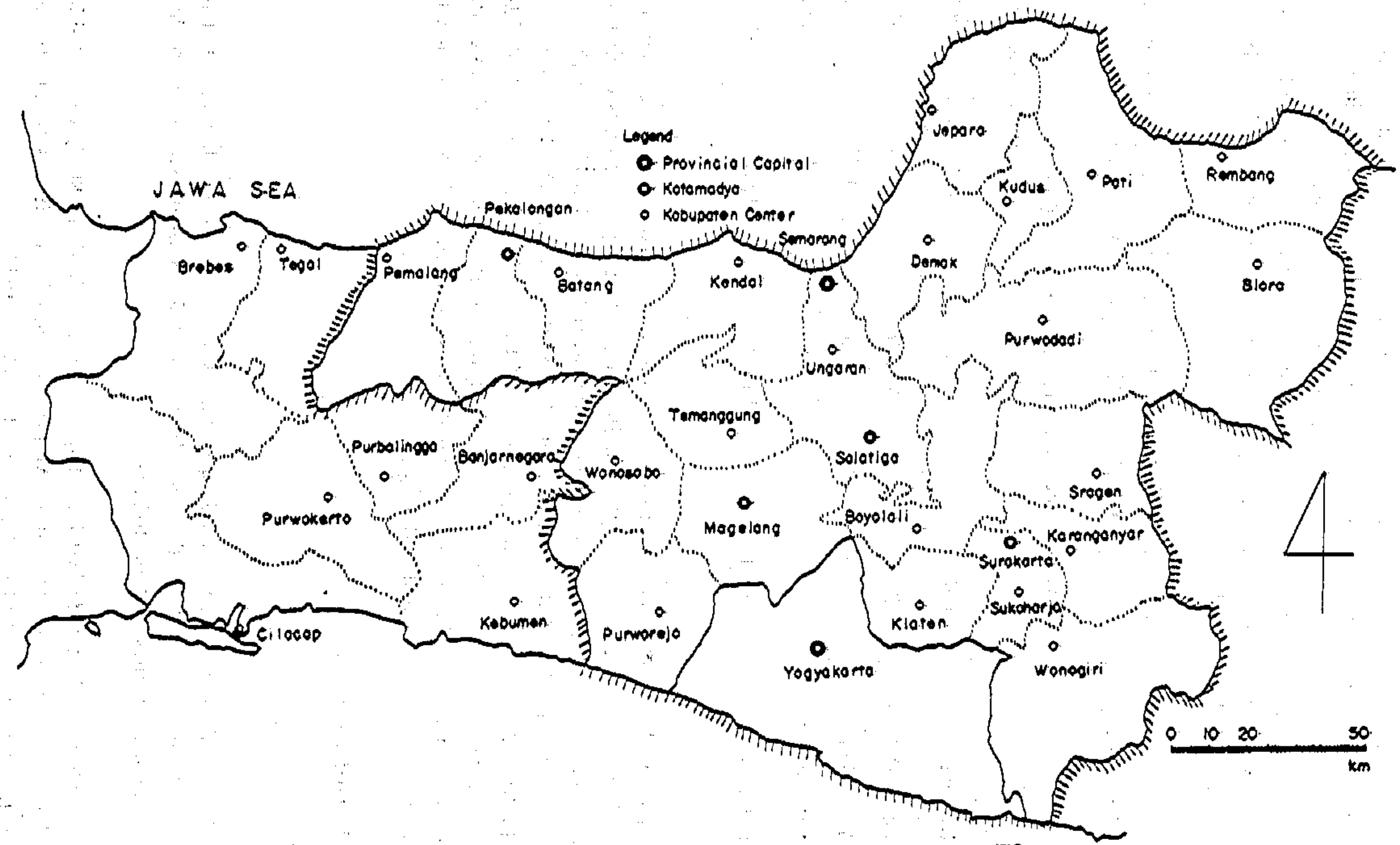
Future populations of Central Java province and D.I. Yogyakarta were obtained by the method described in the following.

(1) Population of Central Java province was estimated with the registered population of 23,180,000 of the province in December 1975 taken as a base and the growth rate according to the prediction of the provincial government or r = 1.764% was used.

This growth rate represents that which will be realized when the emigration of the inhabitants in the province to the other areas is accelerated. According to said method, the population of the province was calculated as 27,610,000 in 1985 or 35,890,000 in 2000.

(2) For D.I. Yogyakarta, the 1971 Census population of 2,490,000 among other BAPPEDA predictions was taken as a base, and the growth rate in the case of low growth or r = 1.5% was employed, and the populations of 3,000,000 in 1985 and 3,800,000 in 2000 thus calculated were used.

Fig. 6-4 Service Area of the Port of Semarang



Source: Java Regional Study, Central Java, JICA

(3) The service area of the port of Semarang comprises the northern and eastern parts of Central Java and D.I. Yogyakarta as discussed in 6-3. Thus, in obtaining the population of the service area from the foregoing results, the population to be deducted from Central Java was determined in use of the regional distribution of the 1975 population and the average growth rate of population in 1971 to 1976 of the respective districts and cities.

According to the above described method, the population of the service area was calculated as 22,300,000 in 1985 or 28,200,000 in 2000 (see Table 6-6).

Table 6-6 Estimated Growth of Population

(Unit: million persons)

Region	1973	1976	1985	2000
Central Java	22.60	23.59	27.61	35.89
Yogyakarta	2.55	2.65	3.02	3.81
Service Area	18.62	19.36	22.30	28.15
Indonesia	126.1	135.0	165.7	220.0

Except the prediction of the Central Java provincial government, there is a prediction available as a reference made by Mr. Sumitro in 1977. According to this prediction, the population of Java including Madura is forecasted as 102,000,000 in 1985 and 130,000,000 in 2000. In formulating the development plan of the province, the Japan International Cooperation Agency estimates the population of Central Java province at 28,400,000 in 1986 and 31,500,000 in 1991. These are the forecasts of population with no control of increasing population taken into account and thus show respectively a more or less higher value than the estimation used in this report.

6-4-2 GDP Prediction

(1) Per capita GDP

As described in § 5, Central Java embraces an enormous population, yet it is still unable to come out of the agriculture oriented industrial structure so that the economic activities continue to be stagnant.

Now looking the trend of GDP per Capita from Java Regional Study conducted by the Japan International Cooperation Agency, in Central Java, it was about 70% of the national mean in 1969-1971 but declined to 55% in 1975.

This is an unbelievable situation against its location at the central part of Indonesia. Thus, for future development of Central Java left behind the economic growth in this way, political considerations are made from various aspects, but no definite targets are yet indicated clearly.

The GDP prediction which we will make in this report is not an objective by itself but is intended for use as a clue for prediction of the cargo handling in preparing a Master Plan for the port of Semarang. Thus, here, the following prerequisites are assumed.

a) For the national GDP, there will be employed the actual values for 1973-1975, target growth rate of 7.5% in PELITA II for 1976-1978 and a uniform growth rate of 7.0% for 1979 and subsequent years.

b) For improvement of the retarded per capita GDP of Central Java at 55% of the national mean as of 1975 as described in the foregoing, a range of forecast would be made. That is, there were assumed, as a high projectlion (hereafter referred to as H.P.), a case where Central Java would realize a higher rate of growth than the national mean so that the per capita GDP would overtake the national mean in 2000 and, as a low projection (hereinafter referred to as L.P.), another case where the GDP of Central Java in and after 1979 would show an equal rate of growth to the national mean at 7%.

Calculating upon the foregoing premises, the GDP in the national scale will increase from 6,753 billion Rp. in 1973 (constant 1973 price; same in the following) to 42,218 billion Rp. in 2000 representing a growth of 6.3 times, and the per capita GDP from U.S.$129 in 1973 to U.S.$462 in 200 or growth of 3.6 times.

With respect to the service area of the port of Semarang, the GDP at 624.3 billion Rp. in 1973 will grow to maximum 6,019 billion Rp., growth of 9.6 times, or minimum 3,500 billion Rp., growth of 5.6 times, in 2000, and the per capita GDP will grow from U.S.$80.8 to maximum U.S.$515, 6.4 times, or minimum U.S.$300, 3.7 times, similarly (see Table 6-7).

(2) GDP by sector

Now let us see the GDP in 1973 by sector. For the agriculture, the service area is higher at 46.4% than the whole country at 40.1%, but for the mining and quarrying, it is only at 1.3% against the national mean at 12.3%. For the manufacturing, the service area shows a higher value at 14.2% than the whole country at 9.6%, but for the construction, transportation and communication, it shows lower values than the mean

Table 6-7 Forecast for GDP in the Service Area of the Port of Semarang, 1973~2000

(Constant 1973 price)

	1973	1976	1985		2000	
			H.P.	L.P.	H.P.	L.P.
Central Java						
1) GDP (Billion Rp.)	706.9	813.7	1,744	1,474	6,887	4,066
2) Per Capita GDP (Rp.)	31,260	34,490	63,170	53,390	191,900	113,290
(U.S.$)	(75.4)	(83.1)	(152)	(129)	(462)	(273)
Yogyakarta						
1) GDP (Billion Rp.)	99.1	126.7	236	201.5	902	482.4
2) Per Capita GDP (Rp.)	38,860	47,810	78,150	66,710	236,750	126,610
(U.S.$)	(93.6)	(115)	(188)	(161)	(570)	(305)
Service Area						
1) GDP (Billion Rp.)	624.3	731.3	1,532	1,297	6,019	3,503
2) Per Capita GDP (Rp.)	33,530	37,770	68,700	58,160	213,820	124,440
(U.S.$)	(80.8)	(91.0)	(166)	(140)	(515)	(300)
Indonesia						
1) GDP (Billion Rp.)	6,753	8,246	15,302		42,218	
2) Per Capita GDP (Rp.)	53,550	61,080	92,350		191,900	
(U.S.$)	(129)	(147)	(223)		(462)	

values of the whole country (see Table 6-8).

The GDP values by sector in 1985 and 2000 to be used for estimation of the port handling cargos were estimated with reference to the actual values of growth rate in 1973-1975 of Central Java shown in Table 5-4 and the national mean target growth rate by sector of PELITA II. That is, when the composition of the GDP by sector in 2000 is taken against that in 1973, the agriculture has the share reduced from 46.2% to 23.0%, while the mining and manufacturing have the share increased greatly from 16.0% to 30.8%, and the construction, transportation and communication have also the share increased, and so the service sector owing to development of the sightseeing industry, etc. (see Table 6-9).

Here, for each of the high and low cases of GDP projection, the cargo handling in 2000 is predicted upon assumption that there will be no change in the GDP composition by industrial sector.

Table 6-8 Estimated GDP by Sector in the Service Area of the Port of Semarang, 1973

	Central Java		Jogjakarta		Service Area		Indonesia	
	Billion Rp.	Share (%)	Billion Rp.	Share (%)	Billion Rp.	Share (%)	Billion Rp.	Share (%)
Agriculture	344.2	48.7	37.9	38.3	289.4	46.4	2,710	40.1
Farm Food Crops	269.7							
Farm Non Food Crops	30.7							
Estate Crops	21.2							
Animal Husbandry	11.8							
Forestry	5.7							
Fishery	5.1							
Mining & Quarrying	7.8	1.1	1.0	1.0	8.2	1.3	831	12.3
Manufacturing	90.7	12.8	11.4	11.6	88.7	14.2	650	9.6
Large & Medium	63.4							
Small & Household	27.3							
Construction	14.5	2.0	3.3	3.3	14.5	2.3	262	3.9
Electricity, Gas & Water Supply	3.2	0.5	0.6	0.6	3.0	0.5	30.4	0.5
Transportation & Communication	16.6	2.3	3.1	3.1	15.2	2.4	257	3.8
Land Transport	11.3							
Air Transport	1.8							
Sea Transport	2.3							
Communication	1.2							
Trade, Restaurants & Hotels	148.4	21.0	26.1	26.3	128.2	20.5		
Banking & Other Financial Intermediaries	13.1	1.9	2.6	2.6	13.0	2.1	2,013	29.8
Public Administration Ownership of Dwelling & Services	68.5	9.7	13.1	13.2	64.3	10.3		
Gross Domestic Product	707.0	100.0	99.1	100.0	624.5	100.0	6,733.4	100.0

Source: (1) Java Regional Study, Central Java, Japan International Cooperation Agency
(2) Regional Development of Yogyakarta, United Nations Centre for Regional Development, Nagoya-Japan
(3) Statistical Yearbook of Indonesia, 1975.

Table 6-9 Forecast for GDP by Sector in the Service Area of the Port of Semarang, 1976 ~ 2000

Industrial Sector	1973		1976		1985		2000	
	Billion Rp.	Share (%)	Billion Rp.	Share (%)	Billion Rp.	Share (%)	Billion Rp.	Share (%)
Agriculture	289	46.2	321	43.9	544	35.5	1,384	23.0
Mining & Manufacturing	100	16.0	120	16.4	339	22.1	1,854	30.8
Construction	15	2.4	21	2.9	54	3.5	259	4.3
Transportation & Communication	15	2.4	20	2.7	56	3.7	343	5.7
Services	206	33.0	249	34.1	539	35.2	2,179	36.2
Total	625	100.0	731	100.0	1,532	100.0	6,019	100.0

6-4-3 Prediction of Cargo Handling

(1) Cargo except petroleum products

With the cargo handling in 1976 taken as a base and using the population, GDP and GDP by industrial sector forecasted in 6-4-1 and 6-4-2, the cargo handlings in 1980, 1985 and 2000 are forecasted as shown in Table 6-10.

Table 6-10 Prediction of Cargo Handling at the Port of Semarang

(Unit: 1,000 tons)

	1976	1980				1985				2000			
		H.P.	1980/1976	L.P.	1980/1976	H.P.	1985/1976	L.P.	1985/1976	H.P.	2000/1976	L.P.	2000/1976
Foreign Trade	569.6	690	1.2	650	1.1	870	1.5	780	1.4	3,000	5.3	1,930	3.4
Export	77.8	100	1.3	100	1.3	130	1.7	130	1.7	330	4.2	280	3.6
Import	491.8	590	1.2	550	1.1	740	1.5	650	1.3	2,670	5.4	1,650	3.4
Domestic Trade	238.5	420	1.8	380	1.6	860	3.6	740	3.1	3,360	14.1	1,980	8.3
Outward	102.3	150	1.5	140	1.4	230	2.2	200	2.0	1,180	11.5	710	6.9
Inward	136.2	270	2.0	240	1.8	630	4.6	540	4.0	2,180	16.0	1,270	9.3
Total	808.1	1,110	1.4	1,030	1.3	1,730	2.1	1,520	1.9	6,360	7.9	3,910	4.9

Note: H.P. : High Projection
L.P. : Low Projection

For forecasting, such method was employed as to take the cargo handlings by group according to the commodity classification in 1976 (or mean of 3 years of 1974 to 1976 for the cargos fluctuating greatly from year to year) as a base and use the growth rates of the industrial sectors related to the respective groups of commodities, and for the consumption commodities, use the growth rates of population and per capita GDP, for calculation of the cargo handlings.

The result of calculation is shown in Table A-6-4. As seen, it is forecasted that the cargo handling of 808,000 tons in 1976 will increase to maximum 6,360,000 tons,7.9

times, or minimum 3,940,000 tons, 4.9 times, in 2000.

(2) Petroleum products

Handling of petroleum products at the port of Semarang is now performed using jetty for small vessels in the port and offshore buoy berth by PERTAMINA, and this handling is mainly consisting of unloading of kerosene, heavy oil and premium through the pipelines for moving fuels from jetty and buoy to the tank yard in the hinterland of the wharf. Amount of petroleum products handled in 1976 was 650-thousand tons and average annual growth rate between 1966 and 1976 is 13.8% which seems to be a rapid increase.

On the other hand, the annual growth rate of GDP by industrial sector is considered to be 12.3% from the estimate made in 6-4-2. Using these figures in the paragraph by assuming that the amounts of petroleum products handled will increase at an annual growth rate of 13%, the amounts of products handled in the target years in future will be as indicated in Table 6-11.

Table 6-11 Estimates of Amounts of Inbound Petroleum Products

Domestic Trade	1976	1980	1985	2000
Unloading of Oil (x 1,000 tons)	650	840	1,550	9,710

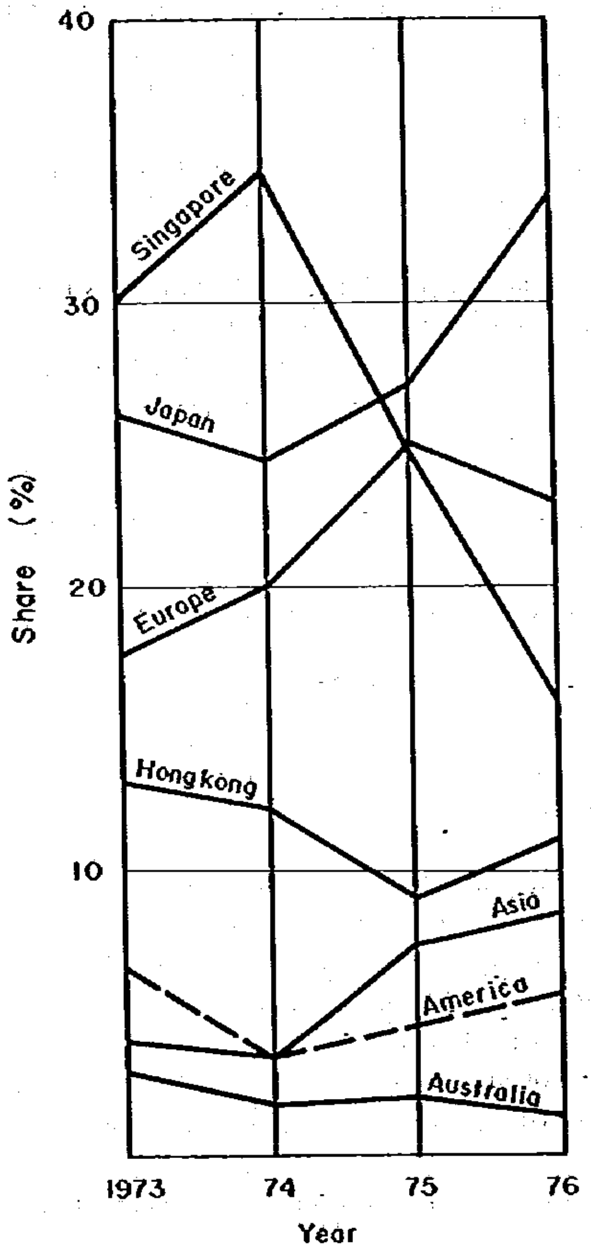
6-4-4 Prediction of passengers

The passengers getting in and out of vessels at the port of Semarang were 3,800 in 1976 and number of those who got in the vessels was almost the same as that of those who got out of vessels. Of these passengers, most of them are tourists and those who move domestically for settlement, each amounting to approximately 1,000, and rests of them are general passengers and pilgrims to Meccas. Since most of these passengers are considered to be Indonesians, the numbers of passengers in future are estimated and shown in Table 6-12 on the basis of growth rate of GDP per capita within the service area.

Table 6-12 Estimates of Passengers through the Port of Semarang

	1976	1980	1985	2000
Number of Passengers (x 1,000 persons)	3.8	5.0	6.9	21.6

Fig. 6-5 Trend of Share of Ocean Going Vessels Calling at the Port of Semarang by Line



Source: ADPEL of Semarang

6-5 Present Sea Transport and Its Future

6-5-1 Ocean Going Vessels

Transition in sizes of ocean going vessels called at the port of Semarang, in the years from 1969 to 1976 are shown in Table 6-13, and average vessel size is 12,000 m^3 to 14,000 m^3. Outstanding variation in sizes of vessels called at the port of Semarang is not seen in these figures but number of calling vessels is gradually increasing and average growth rate of calling vessels in the years from 1969 to 1976 is 5.6%.

The average sizes of vessels called at the port of Semarang in 1976 by kind of vessel are shown in Table 6-14. Average sizes of Indonesian vessels, foreign vessels and average of total of the both are 7,500 D.W.T, 6,800 D.W.T and 7,000 D.W.T, respectively.

Table 6-13 Flow of Ocean Going Vessels Calling at the Port of Semarang (1969 ~ 1976)

	1969	1970	1971	1972	1973	1974	1975	1976
Number of ships calling	331 (100)	355 (105)	404 (122)	425 (128)	359 (118)	387 (117)	451 (136)	485 (147)
Total gross volume x 1,000 m^3	3,912 (100)	4,459 (115)	5,614 (144)	5,944 (152)	4,871 (125)	5,054 (129)	5,960 (152)	6,406 (164)
Average ship size m^3/vessel	11,800 (100)	12,500 (106)	13,900 (118)	14,000 (119)	12,500 (106)	13,100 (111)	13,200 (112)	13,200 (112)

Source: ADPEL of Semarang
Note : Average growth rate is 5.6% in number of ships calling

Table 6-14 Scale of Vessels calling at the Port of Semarang by Kind of Vessel in 1976/77

Kind of Vessel	Number of Vessels	Total D.W.T x 1,000 D.W.T	Average D.W.T tons
1. Ocean going vessel	454	3,193	7,000
(1) National vessel	150	1,126	7,500
(2) Foreign vessel	304	2,067	6,800
2. Interinsular vessel	244	170	700
(1) RLS	203	126	600
(2) RLS Deviasi	19	29	1,500
(3) Non-RLS	3	4	1,400
(4) DBS	19	11	600
3. Local boat	234	36	150
4. Sailing vessel	1,098	87	80

Source: This figure is on the basis of data from ADPEL of Semarang.

Notes : RLS denotes vessels with port of registry in the port of Semarang.
RLS Deviasi denotes vessels with tentative registry in the port of Semarang approved by Port Administration for route changes. They call at the port of

Semarang mostly for transporting subsistence commodities such as rice and cane sugar.
Non-RLS denotes those vessels which are not registered in the port of Semarang.
DBS denotes vessels used mostly as tugboat for carrying construction materials from Batan Island to the port of Semarang.

Numbers of ship calling vessels in the port of Semarang by accumulative percentage of D.W.T class, of tonnage in D.W.T and of tonnage in loaded & unloaded cargos in 1976 are shown in previous Chapter 3 in Fig. 3-3, and they indicate extremely high share of large ocean going vessels called at the port. According to the Fig. 3-3, the shares of large vessels larger than 5,000 D.W.T class are 70% in number of vessels, 92% in D.W.T and 77% in tonnage of loaded and unloaded cargos. These figures also indicated that the share of large vessels is extremely large compared to present facilities of the port of Semarang. This is mainly due to the fact that the port of Semarang is located almost at center between two major ports of Tg. Priok in the west and Surabaya in the east and vessles on the seaway connecting these two ports frequently stop over at the port of Semarang. Therefore, sizes of vessels calling this port are rather suited to scales of the ports of Tg. Priok and Surabaya, and share of vessels with 10,000 D.W.T class calling the port of Semarang in future will be maintained at a high level.

Average D.W.T of ocean going vessels calling at the port of Semarang is 7,000 D.W.T but it greatly varies if it is examined by line as shown in Table 6-15. The maximum is about 12,000 D.W.T for the European and American lines, the Asian line has about 6,000 D.W.T and the minimum is 1,300 D.W.T for the Singapore line.

Table 6-15 Shares of Ocean Going Vessels calling at the Port of Semarang by Line and Average D.W.T (1973~1976)

(Unit: tons, %)

Name of Line	1973	1974	1975	1976	Average DWT in 1976
	%	%	%	%	tons
Singapore	30.1	34.7	24.6	16.1	1,300
Hongkong	13.0	12.1	8.9	11.0	3,700
Japan	25.9	24.4	27.1	34.1	6,500
Others in Asia	3.9	3.5	7.7	8.7	5,900
Europe	17.6	20.0	25.1	23.0	11,700
America	6.6	3.5	4.7	5.7	12,500
Australia	2.9	1.8	1.9	1.4	9,200
Total	100	100	100	100	7,000

Source: ADPEL of Semarang.

As indicated in Fig. 6-5, share of called vessels by line in the port of Semarang in the years from 1973 to 1976 is gradually declining for the Singapore line with "minimum vessel size", on the other hand, it was increasing for the Japanese line. The share of "maximum vessel size" of the European and American lines is rising or remaining on the same level.

From these data, it is clear that share of large ocean going vessels calling at the port of Semarang will be increased as a future tendency. This is why the facilities improvement equipped with berthing facilities capable to make direct cargo-handling at wharf for large vessels is required in the port.

By summarizing above description, it is considered that the size of ocean going vessels calling at the port of Semarang will be 10,000 D.W.T for a time being but in future the size will be 15,000 D.W.T in majority.

As indicated in Table 6-16, 55% (440-thousand tons) of annually handled cargos of 808-thousand tons in 1976 and surprisingly 77% of foreign trade cargos are now relying upon the offshore cargo-handling by lighters. Parts of foreign trade cargos are directly approached to Coaster Harbour for cargo-handling which amount to 130-thousand tons or 23% of total foreign trade cargos.

Table 6-16 Cargo Handling Volume and Its Share by Trade and Facility in the Port of Semarang in 1976

Kind of Trade	Cargo Amount x 1,000 ton	Cargo Handling Volume by Port Facility				
		Offshore Anchorage	Coaster Harbour	Inner Harbour	Kali Baru	Total
		(77)	(23)			(100)
Foreign Trade	570	440	130			570
Export	78					
Import	492					
			(41)	(14)	(45)	
Domestic Trade	238		97	34	107	238
Outward	102					
Inward	136					
		(55)	(28)	(4)	(13)	(100)
Total	808	440	227	34	107	808

Source: ADPEL of Semarang.

Note : 1. ( ) denotes share of cargo handling volume by facility.

2. Figures of cargos by facility were calculated basing upon data shown in records for each facility by ADPEL of Semarang.

From the shares of loaded and unloaded cargos by D.W.T class as previous chapter shown in Fig. 3-3, the vessels with approximately, 3,000 D.W.T class seem to be doing cargo-handling at wharf of Coaster Harbour and these vessels seem to be calling at the port with light draft. By considering extent of facilities of 320 meters of Coaster Harbour and foreign and domestic cargos of 227-thousand tons in 1976, the cargo-handling capacity of Coaster Harbour is approximately 710 tons/m and handling capacity will be improved in future by mechanization of the cargo-handling. However, sizes of ocean going vessels are being increased presently so that the offshore cargo-handling cannot be reduced unless the Deep Sea Port is realized.

6-5-2 Domestic Vessels

The shares of vessel volumes for interinsular vessels (including local boats) and sailing vessels in the years from 1969 to 1976 are shown in Table 6-17. It is considered that total gross volume of interinsular vessels is increasing but size of vessels is becoming smaller. Also, total gross volume of sailing vessels is increasing but its size is remaining on the same level.

Table 6-17 Flow of Total Ship Volume in Domestic Trade in the Port of Semarang (1969~1976)

Year	Interinsular Vessels		Sailing Vessels		Total	
	Share by Ship Volume %	Average Vol. per Vessel m³	Share by Ship Volume %	Average Vol. per Vessel m³	Percentage %	Gross Volume x 1,000 m³
1969	86.9	2,910	13.1	100	100	529
1970	86.6	2,190	13.4	100	100	688
1971	65.8	2,010	34.2	330	100	997
1972	84.3	1,400	15.7	90	100	800
1973	84.1	1,350	15.9	80	100	817
1974	91.0	910	9.0	50	100	1,052
1975	88.4	850	11.6	110	100	1,013
1976	88.4	940	11.6	140	100	1,076
Average/Total	84.3	1,210	15.7	110	100	6,972

Source: ADPEL of Semarang.

The shares of interinsular vessels and sailing vessels in the years from 1969 to 1976 are shown in Table 6-18. Assuming that these shares are correlated with shares of cargos handled and using value of 0.85 tons per D.W.T of interinsular vessels (inlcuding local boats) and value of 0.57 tons per D.W.T of sailing vessels in the year 1976 for the calculations, the share of cargoes handled by interinsular vessels will become 80% and share by the sailing vessels will become 20% in the year of 1985.

Table 6-18 Prediction of Share of Domestic Trading Cargo Handling Volume by Kind of Vessel in the Port of Semarang in 1985

Kind of Vessel	Vol. of Cargo in 1976 x 1,000 tons	DWT in 1976 x 1,000 tons	Cargo/D.W.T	Share in 1985
Interinsular vessel	121 (56%)	159	0.76	60%
Local boat	45 (21%)	36	1.25	20%
Interinsular vessel & Local boat	166	195	0.85	80%
Sailing vessel	51 (23%)	87	0.57	20%

Source: ADPEL of Semarang.

Note : ( ) denotes persentage distribution of volume of cargo.

In the same manner for the shares of cargos handled by interinsular vessels and local boats, value of 0.76 ton per D.W.T for interinsular vessels and value of 1.25 tons per D.W.T for local boats in the year of 1976 were used for the calculations, and the shares for both interinsular boats and local vessels in the year of 1985 will become 60% and 20% respectively.

Considering the progresses in the past, it can be forecasted that the shares in the year of 2000 will be 70% for interinsular vessels, 20% for local vessels and 10% for sailing vessels.

The cargo-handling capacity of each facility for domestic trade in 1976 is 340 tons/m/year with extent of 1,384 meters of Inner Harbour with 474-thousand tons of cargos handled, and 100 tons/m/year with extent of 1,085 meters of Kalibaru with 107-thousand tons of cargos handled.

6-6 Development of Semarang Coastal Industrial Area

As the development of the port of Semarang makes a progress and permits incoming of large ocean going vessels and cargo handling at wharf, the plants located and operating in the industrial area near the port of Semarang or the so-called coastal industrial area are privileged for the following merits.

(1) It is enabled to import steels and semi - or low-processed petrochemical products stably to permit location and operation of the industries using such semi - or low-processed import products as raw materials.

(2) Being able to use the marine transport service of low cost extensively, it is possible to seek the domestically produced raw materials from a wide range of area.

(3) Being located in the area adjacent to the port, secondary transport of the foreign and domestic import raw materials can be reduced or eliminated so that the production cost is decreased.

(4) Not only the export of products is enabled but the secondary transport of products on land is saved so that the international competitive force of the product price can be increased.

(5) Energies such as electric power, petroleum, etc. are readily available.

(6) Acquistion of cooling water and discharge of warm waste water are facilitated.

Now looking over Central Java as a whole, presence of limestone and many other mineral resources is reported, as shown in Table 6-19. But, the present condition is such that not only the investigation of the explorable amount of deposit and that of applicability as

Table 6-19 Known Mineral Potentials of Central Java

Mineral	Location	Estimated Deposit
Limestone	Scattered throughout the Province	Millions of tons
Coal	Rembang, Brebes, Wonogiri, Kebumen	Considered to be a very young type
Asbestos and Talc	Kebumen	500,000 tons; under exploration
Sulphur	Dieng Plateau, Wonosobo	250,000 tons of mud with a 20% S. content
Marble	Klaten	50,000 tons of an Eocene deposit
	Banjarnegara	100 million tons; awaiting further exploitation. A Tertiary deposit
Kaolin	Klaten	100,000 tons
	Kudus	Quantity still unknown
	Karimunjawa Islands	Reported deposit needs further study
Quartz Sand	Rembang	6 million tons
Phosphate	Kebumen Pati	Already being exploited at both sites

Source: Central Java Provincial Industry & Mining Directorate

an industrial raw material but that of the transport means are not yet made satisfactorily Introduction of the industries of the type based on resources should, therefore be tested along with development of the mineral resources.

The mineral resources present in the vicinity of the port of Semarang and cosidered to be usable as an industrial raw material are:

(1) Trass -- Semarang, Pekalongan and Jepara;
(2) Quicksilver -- Demak;
(3) Limestone -- Kudus and Pekalangan;
(4) Kaolin -- Kudus;
(5) Iron sand -- Jepara;
(6) Quartz sand -- Rembang;
(7) Coal -- Rembang;
(8) Gypsum -- Rembang; and
(9) Phosphates -- Kudus.

The industries having a high possibility of location in the Semarang coastal industrial area may be classified largely into the following two types:

(1) Weight and large quantities starting material dependent industries (so-called Weight Industries) – Raw material or product being of a great weight relative to the price of product, and the starting material used in a great quantity, with little change in weight between the starting material and the product, thus the transport expense constituting a great proportion of the production cost, so that it is advantageous to depend on the sea transportation; and

(2) Foreign trade dependent industries – Dependent greatly for purchase of the raw materials or sales of the products on foreign countries, and in order to reduce the inland transport cost, being located close to the port or coming to possess by themselves the quaywall/jetty or other port facilities

Since the Semarang area comprises no big river nor lake rich in the quantity of water, location of, for example, paper making and pulp industries using a large quantity of industrial water in the process of production or the so-called water type industries is considered to be difficult. However, if the supply of water is sought in a deep well and the drain is properly processed, location of those water type industries which are of relatively small consumption of water such as, for example, medium scale chemical fiber plant, may be possible.

The city of Semarang now having a population of about 740,000 is the political and economic center of Central Java. It is great in urban accumulation and has a general level of city functions provided. However, it is retarded in industrial development, and in the vicinity of the city of Semarang, there are noted small plants started from household industries in operation but no location and operation of the consumption dependent industry to meet the urban demand or urban type industry indispensable for urban development.

Hereafter, it will be required to introduce such industries positively But, for such purpose, it is important to plan specifically the reclamation of industrial site aligned to the sea and land transportation networks, positive financial support and benefits in taxation. Particularly, the reclamation of industrial site should be incorporated in the urban development plan so that it is in harmony with the development of the city as a whole.

For location of the industries in the coastal industrial area in the periphery of the port of Semarang, it is desirable to give preference to the coastal industries, and it will be effective for advancement of the industrial development in a relatively short period to arrange the related industries in the back of the coastal industries for organic connection to the layout of the urban type and consumption dependent industries in the vicinity of the city of

Semarang.

In the following will be listed, for the sake of illustration, the industries which are introduced in the Semarang Port coastal industrial area advantageously for industrial development and are considered to be of high potential of location and operation. Where the industries to be located are chosen, a detailed industrial development survey including easiness of acquisition of the starting/raw materials, prospect of demands for products and examination of the sale prices should be carried out so that appropriate industries are chosen.

(1) Industries under classification of weight industries

(a) Inorganic chemical product manufacturing (in use of limestone and saline water as raw materials)

Soda industry
Electric furnace industry
Salt plant
Lime nitrogen plant
Lime plant
Carbide plant

(b) Ceramics and earth and stone product manufacturing (with trass and silica sand as raw materials)

Glass and glass product manufacturing
Cement and cement product manufacturing
Construction clay product manufacturing

(c) Timber product manufacturing (with teak and imported timber from Kalimantan as materials)

Sawing and timber product manufacturing

(2) Industries under classification of foreign trade dependent industries

(a) Foodstuff manufacturing (with foreign and domestic import agricultural products as raw materials)

Flour milling (Wheat flour manufacturing)
Vegetable oil manufacturing

(b) Non-ferrous metal industries (with iron sand as a material)

Primary smelting of titanium (products exported)

(c) Iron and steel industries (with iron sand and manganese as raw materials)

Ferroalloy manufacturing

(d) Plastics industry (with imported polymers and monomers as raw materials)

Livelihood plastics product manufacturing
Plastics plate, tube, rod and joint manufacturing
Plastics film and sheet manufacturing
Industrial plastics product manufacturing

(e) Transportation machinery and equipment manufacturing (assembly of imported parts)

Automobile assemblying
Bicycle assemblying

For reference, principal industries related to the coastal industries are shown below.

(1) Machining and repair
(2) Metallic product processing
(3) Box and bag making
(4) Transport machine manufacturing and repair
(5) Secondary and tertiary product processing

Chapter-7

Long Term Development Program

CHAPTER 7
LONG TERM DEVELOPMENT PROGRAM

7-1 General

Usually, the port improvement requires a large amount of investment and a long period of time. Further, the port facilities themselves constitute a transport infrastructure and often, as an industrual infrastructure, contribute greatly to the development of not only regional economy but national economy. Thus, they have a highly public nature and forms a nucleus of all infrastructures. This is why a master plan supported scientifically, formulated upon a long range view and harmonized integrally is required prior to development of a port.

Since the port is not only related closely to the development of regional economy but supporting the economic activities of the nation, the port development master plan must be in harmony with and tuned to the regional development plan as well as the national economic plan.

For development of the port of Semarang, the Long Term Development Program (PLAN-II) with 2000 A.D. taken as a target year was formulated. It was also examined carefully as a master plan required for development and improvement of the port of Semarang. To support the Long Term Development Program the Short Term Development Program with 1985 as a target year was interpolated to clearly define the particular objects of the tentative development.

7-2 Land Utilization Plan

The present situation of the land utilization around and behind the port of Semarang is as follows:

The port of Semarang is located at the east end of the shoreline of the city of Semarang facing the Java Sea, and the East and West Banjir Canal run into the sea flanking the both sides of the port.

The center part of the city of Semarang is situated just behind the port, flanked by the two canals and the East Banjir Canal makes itself the east side border line of the city of Semarang.

The outet zone of the both canals are not so much urbanized at present, and on the west side of the West Bajir Canal, an air port has been constructed which gives the shuttle service by jet planes to and from the capital, Jakarta. There are hills on the south side of the city, which are about 6 kilometers from the shore line, and developed as the residence or vegetable growing area. A national road from Jakarta is running parallel to the shoreline, about 3 km from the sea, leading to the city of Semarang. It turns to south in the city, and passing the hills, further leads to Yogyakarta and Surakarta.

In addition, there are two other provincial roads; one is running parallel to the shorline and leads to Demark and Kudus area, and the other leads to Purwodadi and Blora area.

The traffic in the downtown is very crowded. From the view point of the land utilization of the shoreline, the east and west shoreline flanking the port of Semarang are used as the fish-farming area, the area behind that are paddy or grass fields.

Considering the present conditions, the prospect of the development of the area around the port of Semarang would be as follows:

The urbanization of the east side might be hardly expected unless the borderline is moved eastward further, because the administrative expansion of the city is restricted by the East Banjir Canal.

The south side development is geologically limited by hills.

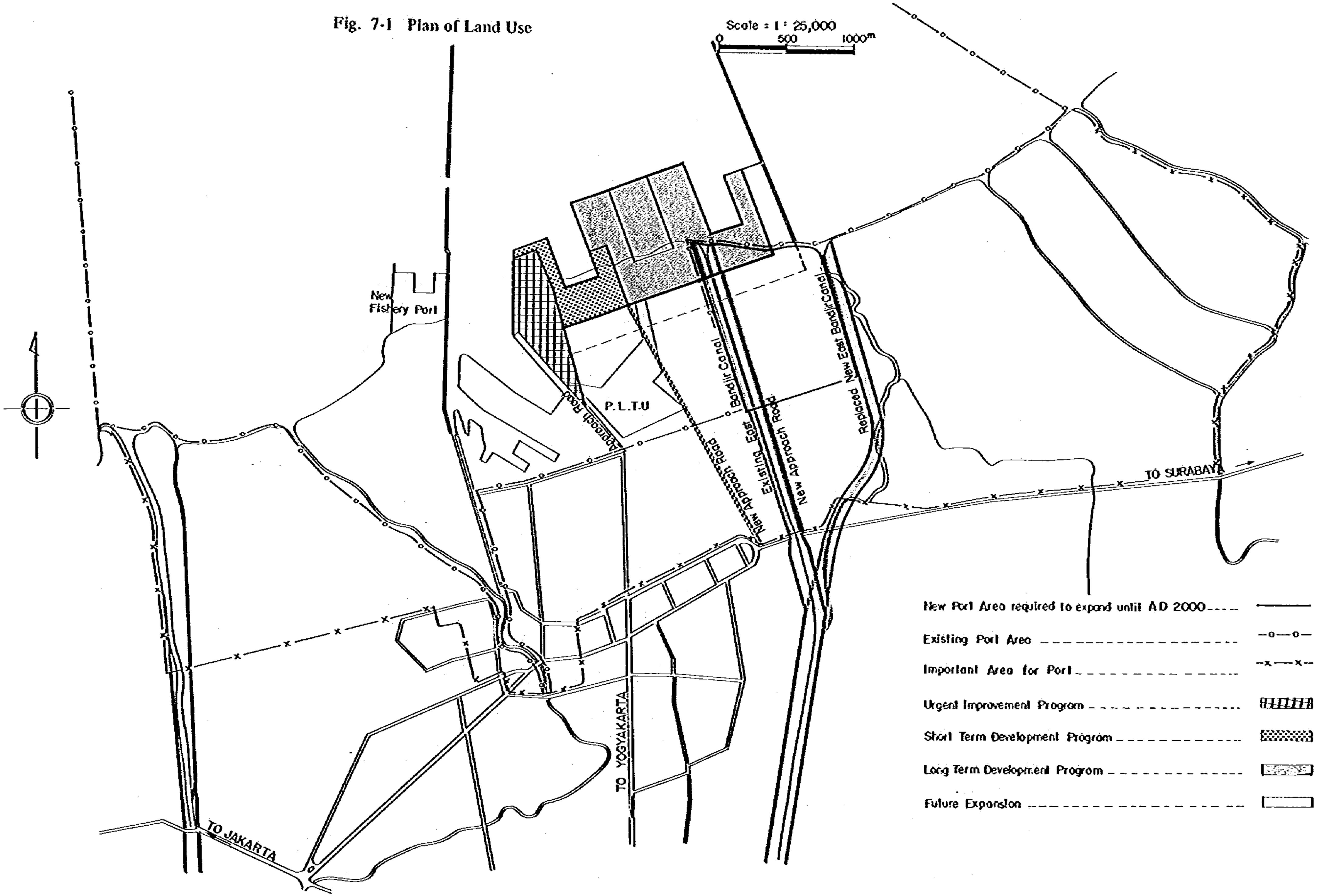
On the other hand, the west side of the West Banjir Canal, where the air port is located, is expected to urbanize rapidly. The trend of the development has already appeared along the national road leading to Jakarta, indicated by construction of factories, shops and houses.

Considering the historical development of the port of Semarang, utilization of the land and the trend of growth of the city, this development plan airms at the eastward expansion of the port facilities.

In 2000, according to the master plan, the port will be expanded eastward with the present East Canal as the center of the port area. Thus, the port terminal area is accessible through the provincial road leading to Demark and Kudus area, without crossing the crowded downtown, and moreover, this road can be connected directly to the provincial road to Purwodadi and national road to Yogyakarta and Surakarta, if the by-pass loop way is constructed along the East Banjir Canal (see Fig. 7-1).

Along with the aforementioned port development program, promotion of industrial use of land is required to expect the growth of the city and the development of the port service area. Although further investigation is necessary about what kinds of industries are best suited for the conditions of this area, it will be very important to promote the construction of the industrial estate as mentioned in PELITA II, as well as the port

Fig. 7-1 Plan of Land Use



development.

In this plan, it is recommended to reserve the east side area next to the port terminal area designed in 2000, as the future industrial zone.

7-3 Port Layout Plan

7-3-1 General

The directions of development of the port of Semarang described in detail in Chapter 2 will be summed up as set forth in the following:

(1) To expand and improve the port of Semarang as an indispensable major foreign trade port for Central Java;

(2) To develop and improve the port of Semarang with a view to regional economic promotion through acceleration of the economic development of Central Java;

(3) To improve the port of Semarang as a port provided with a coastal industrial area required for promoting the industrial development of Central Java and imparted with the functions as both a distribution port and an industrial port; and

(4) To terminate the offshore loading and unloading with lighters and realize the cargo handling at wharf as soon as practicable.

For improvement of the port of Semarang along the foregoing directions, consideration should be given to the following points:

(1) To convert the existing mooring facilities including the wharves of the port of Semarang for domestic trade of interinsular and other local boat for their more efficient use;

(2) To construct the new foreign trade wharf with berthing wharves for ocean going vessels adjacent to the existing Coaster Harbour berths aiming at the organised operation between foreign and domestic cargo handling and the performance of effective administration and operation of the port;

(3) to construct a by-pass road to connect the port terminal with local arterial road for the prevention from the mass transport of cargo through township and;

(4) To promote the improvement without being confined to the project site tentatively contemplated but looking over the master plan as a whole and thus assuring the

position of the center of the port in the future.

The layout of the port facilities to be provided in the port of Semarang was planned based on the following considerations:

(1) The seashore of the port of Semarang being characterized by shoaling, and utilizing such characteristic, to lay the wharf as far off the waterfront as practicable;

(2) To give consideration to the arrangement of the port facilities obtain the minimum harbour area with the minimum extension of the breakwaters, groins and other protective facilities;

(3) To locate the foreign trade wharf in the form of a finger type peir, on the eastern side of the existing harbour wharf;

(4) To provide the Access Channel at right angle to the contour lines of sea bottom with the minimum extension;

(5) To locate the West Breakwater with consideration given to insuring protection from waves and safety of navigation of the local boats, fishing boats and other small vessels, in addition to the primarily purpose for preventing siltation of the Access Channel due to inflow of the mud, with the water depth at the extreme end of the West Breakwater designed at -8 m;

(6) To remove the existing East Breakwater entirely for expansion of the width of the Access Channel, and design the new construction of East Groin being projected at right angle to the shoreline;

(7) To locate the North Breakwater in such a form as to oppose to the West Breakwater to be extended and embrace the Access Channel and, to prevent entry of the waves coming from the north at right angle to the shoreline as well as infiltration of littoral drift into the harbour;

(8) To locate a fishing port at the west side bottom of the West Breakwater to promote the fishery and, at the same time, prevent a disorder in the port due to entry of the fishing boats;

(9) To provide the channels of a width of 100 m between the northerly end of the existing West Breakwater and the southern end of the newly designed West Breakwater, and the extreme end of the new construction East Groin to the used for passage of fishing boats and other small boats; and

(10) The anchorage to be provided at a -10 m water area outside the port and shall not be inside basin of the port.

In order to satisfy the above considerations for the improvement of the port. the design criteria of the Access Channel, Basin, Berth, etc., were determined as below;

(1) Access Channel

Channel water depth:

Urgent Improvement Program with target year of 1980 .... -9 m for entry of 10,000 D.W.T ships.

Short Term Program with target year of 1985 .... -10 m for entry of 15,000 D.W.T ships.

Channel width:

Planned channel width $W = 1.2 \times L = 198\ m \fallingdotseq 200\ m$

Where L is the length of the objective vessel (taking the length of 165 m of the 15,000 D.W.T ship).

Further, in determining the channel width, it was thought from the prospected number of incoming vessels in the future that there would be no simultaneous navigation of incoming and outgoing vessels along the channel so that the channel would be controlled under the one way navigation.

(2) Basin

The required area of the basin was planned according to the following criteria;

i) For the basins used for anchorage or mooring other than those in front of a wharf or jetty, an area greater than that of a circle with a radius longer than the length of the objective vessel plus a value determined appropriately in consideration of the topography, climate, waves and other natural conditions at port of Semarang.

ii) For the basin used for anchorage or mooring located in fron of a wharf or jetty, an area with a length and a width chosen in excess of those of the objective vessel in consideration of arrangement of port facilities.

iii) The Basin-I facing the access channel for the incoming vessels to the regional barbour for domestic trade was planned with some allowance in addition to the above criteria.

In the case of the port of Semarang, planning a number of anchorages in the port results in increasing not only the quantity of mud to be dredged but the length of the breakwater and thus requires a large amount of investment. It was decided, therefore, to allocate a -10 m water area outside the port beyond the West Breakwater for the anchorage.

In the Urgent Improvement Program up to 1980, in order to reduce the construction cost and insure completion within the projected construction period, the turning basin for 10,000 D.W.T class vessels would not be provided, but the turn using anchor and thus an anchorage area was planned.

The depth of the basin is planned at -9 m in the Urgent Improvement Program up to 1980 and -10 m in the Short Term Development Program up to 1985 as well as the Long Term Program up to 2000 A.D.

In the case of a number of piers arrange of in parallel the width of the basin or slip between the piers was determined by the following value taken as a standard.

i) Where the pier is of three berths or less, the length of the objective vessel is taken as the standard — L = 185 m which is then taken as 250 m for convenience of use and allowance.

ii) Where the wharf is of four berths or more, the width of the slip is of the value 1.5 times the length of the objective vessel as the standard, or

$$185 \text{ m} \times 1.5 = 277.5 \text{ m} \fallingdotseq 300 \text{ m}.$$

(3) Scale of Wharf

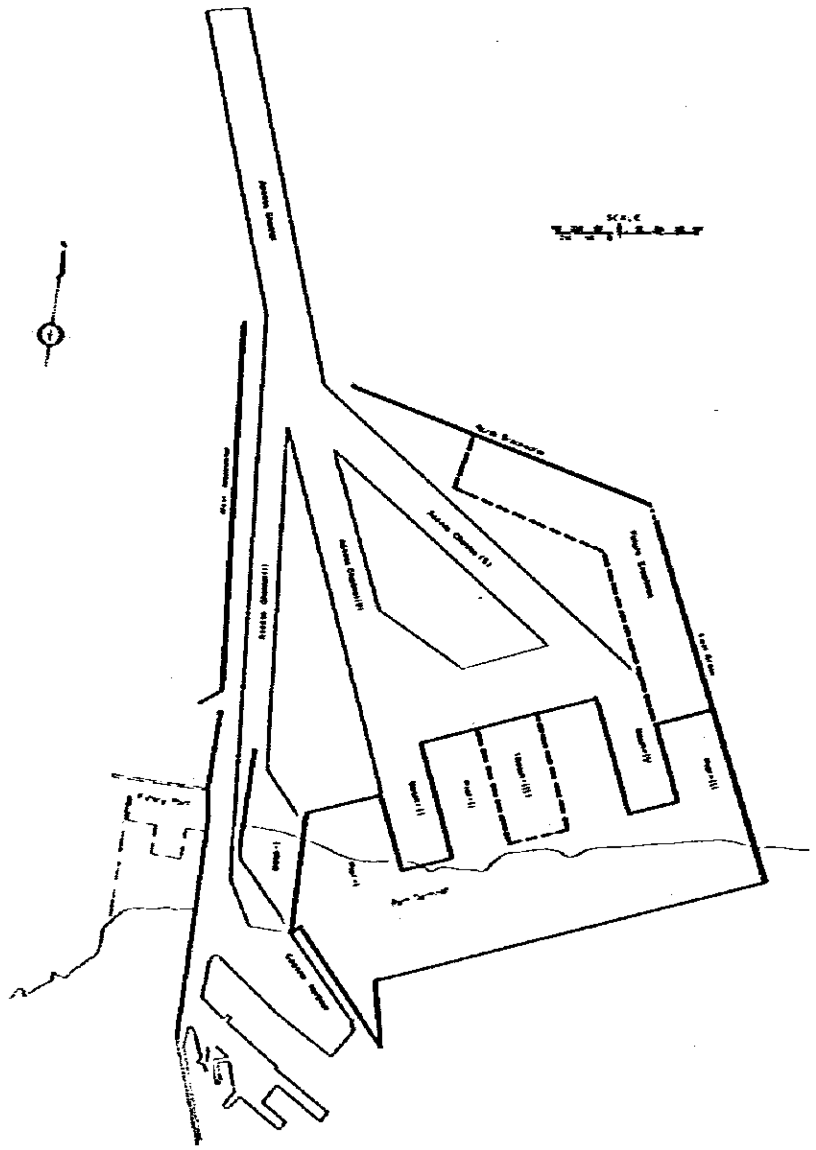
The foreign trade wharf would have a standard of 300 m width so that it would be able to cope with the prospected demand for transportation and be convenient for use. The wharves facing the slip were planned with three to four berths as the standard.

Based on the above criteria, the comparative examination was made among three alternative plans. (Fig. 7-2) (ditails of the comparative examination are discussed in Chapter-7 of the Interim Report)

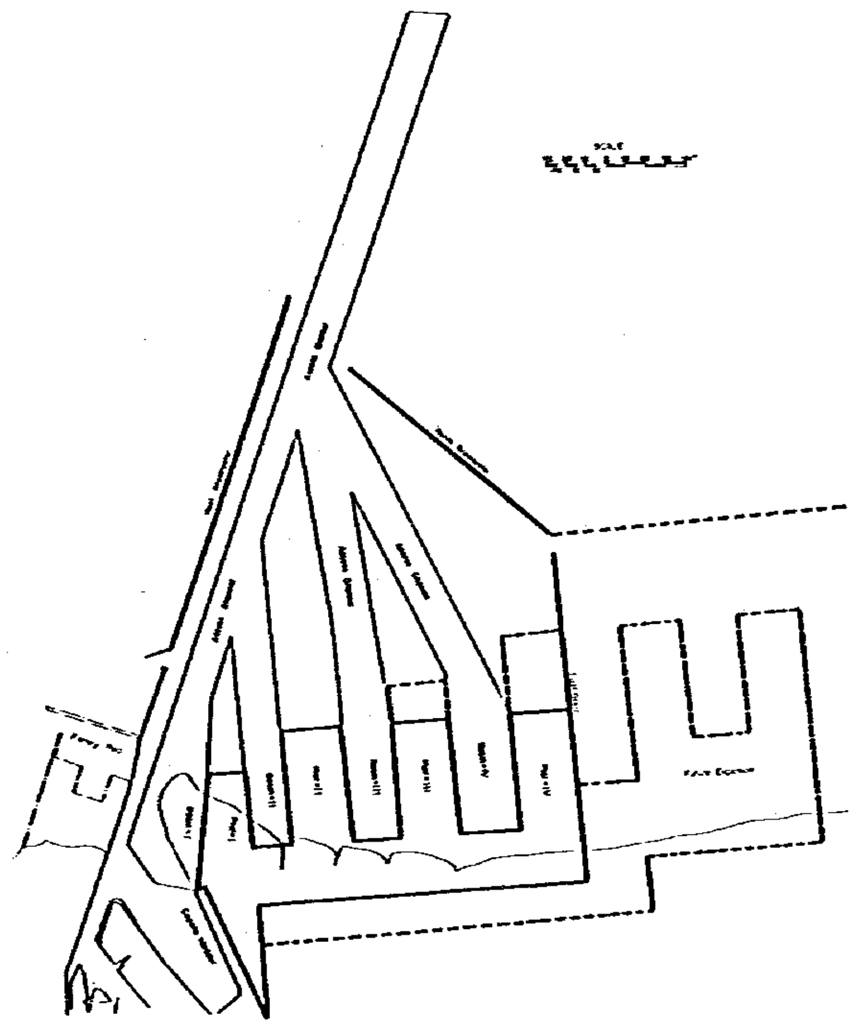
As a result, the alternative PLAN-A is selected for the purpose of this project. (See attached Fig. 7-3 and 7-4)

Fig. 7-2 MASTER PLAN OF PORT OF SEMARANG

MASTER PLAN OF PORT OF SEMARANG, PLAN-"A"



MASTER PLAN OF PORT OF SEMARANG, PLAN-"B"



MASTER PLAN OF PORT OF SEMARANG, PLAN-"C"

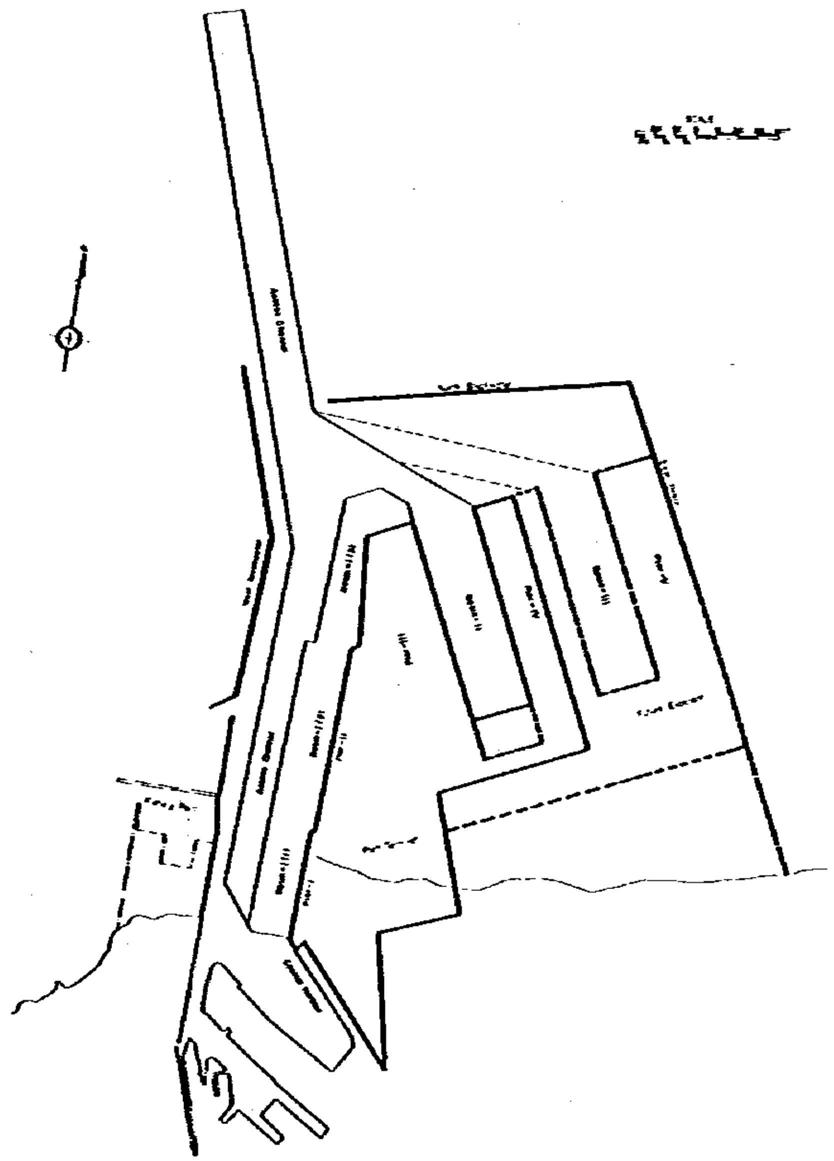


Fig. 7-3 Master Plan of Port of Semarang, PLAN A-1
(Unit in meters)

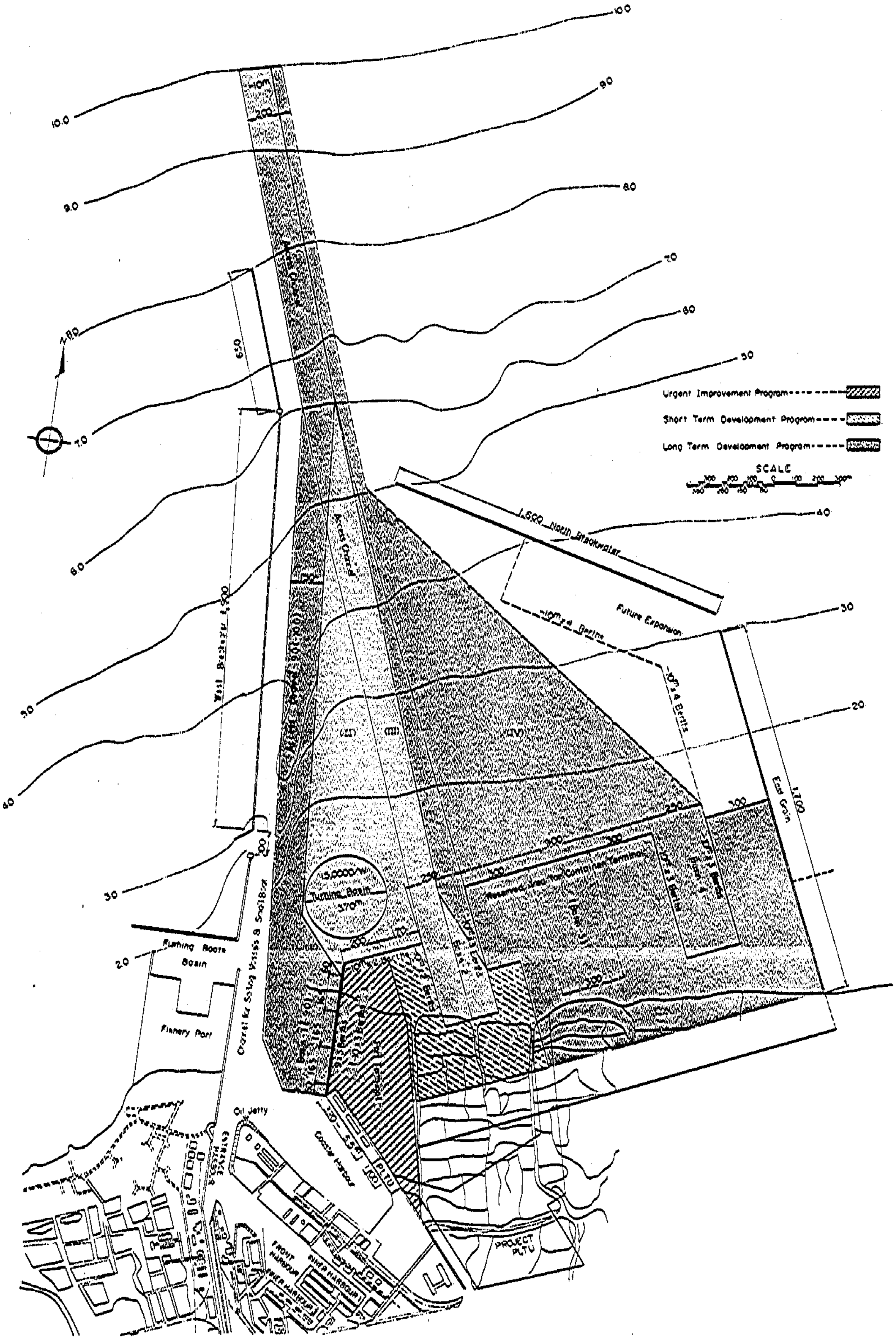
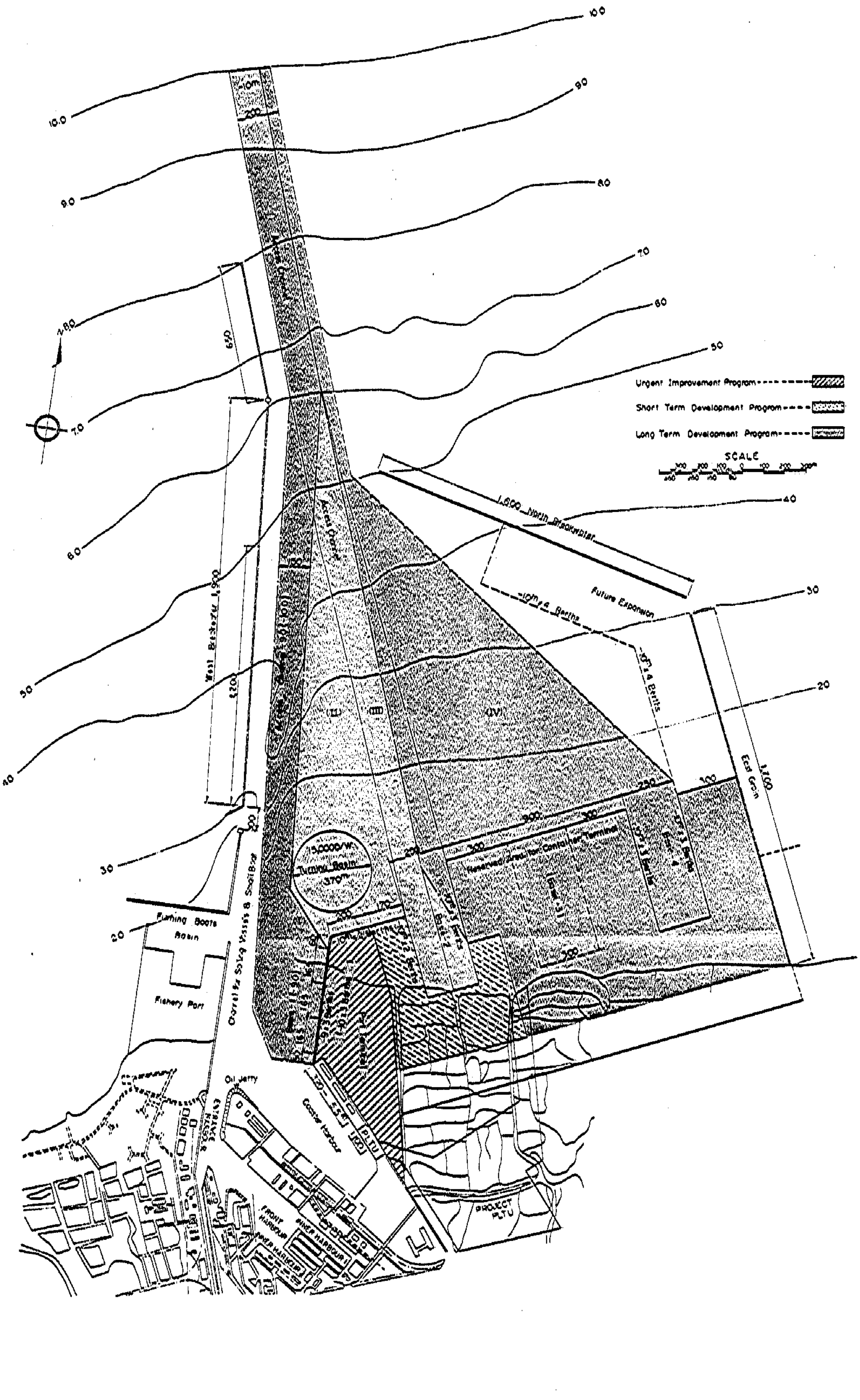


Fig. 7-4 Master Plan of Port of Semarang, PLAN A-2
(Unit in meters)



7-3-2 Alternative PLAN-A for Long Term Development Program

The basic concept of the Alternative PLAN-A is given below.

(1) Utilizing the shoaling characteristic of the coast in and around the port of Semarang, the foreign trade wharf having deep sea general cargo berths was planned to extend as far offshore as possible. The foreign trade wharf would be constructed adjacent to the existing Coaster Harbour and in the shallow water area in the form of a finger-type pier with mud obtained by dredging of the access channel, basins, etc. during the construction.

(2) The reclamated land located nearly at the center of the whole project would be included in the Urgent Improvement Plan with the width of 900 m as initially designed, and the arrangement of berths along the wharf would not be made before the demand for transportation in the future and trend of the technical innovation in the shipping were grasped.

(3) The foreign trade wharf would be constructed next to the existing Coaster Harbour and extended and improved successively toward east along the east coast.

(4) As an area to be expanded after 2000 A.D., the areas inside of the North Breakwater and the East Groin beyond the east end wharf would be assigned.

(5) The water area of a width of 100 m covered by the West Breakwater on the west side of the Access Channel would be planned as a channel for small boats to insure safety for navigation of the vessels.

(6) The foremost end of the first wharf to be erected in the Urgent Improvement Program would be used for mooring of smaller vessels and as a bunker oil terminal for the time being, but a width of 370 m at the foremost end would be secured so that the pier would be usable as a -10 m two berths when expansion was required in the future.

(7) A fishing port would be planned along the coast on the west side of the base of the West Breakwater.

The planned scales of the major port facilities under PLAN-A are as given below.

(a) -10 m wharves, 17 berths (Total extension of the wharf, 3,085 m)

1st Pier 5 Berths (Extension, 865 m).
Designed for 15,000 D.W.T class ships.
Including 3 berths (Extension, 495 m) planned as -9 m wharf until

1980 and as -10 m wharf thereafter.

The top of this pier will be used as bunker oil berth (200 m) and port service vessels's berth (170 m).

2nd Pier 10 Berths (Extension, 1,850 m).
Designed for 15,000 D.W.T class ships.
Calculated as not excavating the Basin-III.

3rd Pier 2 Berths (Extension, 370 m).
Designed for 15,000 D.W.T class ships.
Wharf beyond the Basins-II and III were planned as the mooring facilities for small boats and government vessels.

(b) Breakwaters – Total extension, 3,550 m.
West Breakwater – Extension, 1,950 m, and
North Breakwater – Extension, 1,600 m.

(c) Groin

East Groin – Extension, 1,700 m.

(d) Access Channel

Width, 200 m; water depth, -10 m.
Provided, in the Short Term Development Program up to 1985, the width is 150 m and the water depth is -10 m.

7-4 Maintenance of Access Channel

7-4-1 Present Situation of Siltation

Gradual shoaling spreads widely in front of the port of Semarang and maintenance dredging is continuously performed there presently to maintain the access channel at a depth of minimum 5 m. Using trailing hopper suction type dredgers the dredging is being performed over 50 m channel width for an area from the tip of the breakwater to the entrance of the inner harbour anchorage and over 60 m channel width for an offshore area beyond the tip of the west breakwater.

On the other hand, for dredging of inner harbour, two bucket type dregers are used, and annual maintenance dregding of about 100,000 m^3 is being performed there. Amount of yearly maintenance dreging for both inner harbour and channel will amount to approximately 400,000 m^3.

The access channel is silted mainly in the northwest monsoon season. The echo-sounder actually records the water depth 0.5 to 1.0 m shallower than that sounded by a lead and also shows different values depending upon the time elapsed after silted sediment. Judging from the present maintenance dredging, the following analysis can be made:

Siltation of access channel in the present port of Semarang is assumed to be separated into two different conditions with the tip of the west breakwater as a dividing point. Access channel and submarine topography on the longitudinal sections which are separated along the channel and at a distance of 300 m to the east of and to the west of the channel are named section I-I, II-II and III-III respectively. The longitudinal slope of the sea bottom is 1/400 and is uniform from seashore to near the beach, and bar and trough featured by wave breaking are not seen. This is probably because its bottom material is silt and wave attenuation is remarkable due to gradual shoaling of sea bed causing no apparent wave breaking and also because waves are irregular causing no fixing of wave breaking point. At the section 300 m to the west of the channel, the bottom is 1 m deeper uniformly for a certain distance than the bottom on the east side of the channel. Presently, the channel seems to be located at the west end of an area which is under the influence of the East Canal. It is considered that the water depth changes little with season and is almost stable.

Reflecting the siltation and dredging which have been repeated, variation in water depth is very outstanding along the access channel. (Refer to Appendix). The influenced area is extending about 1,200 meters from the tip of the west break-water to offshore and to beach side respectively. The extent of siltation on the seashore side coincides with the extent of dredging, or unsheltered area by the breakwater. On the other hand, the water area sheltered by the breakwater on the shore side is within the sheltered area by the west breakwater, but sheltering effect of the east breakwater which has a low crown due to its sinking is scarecely expectable. Siltation in this area is probably caused by long hours of suspension of silty floating mud with low terminal falling velocity riding on the counter-clockwise current in relatively calm area, also by going in and out of suspended materials through the mouth of port and also by lifting of bottom materials by sailing of vessels.

Cross-sections taken at the tip of the east breakwater, the tip of the west breakwater and its 200 m offshore are respectively called sections A-A, B-B and C-C, and shown in Figs. 7-5, 7-6 (Refer also to Appendix). Fig. 7-5 indicates that the slope on the west side of access channel is sheltered by the west breakwater and its grade of slope is 1/10, while the slope on the east side is gentle with a 1/20 grade as same as that of section B-B.

Fig. 7-7 indicates conditions of siltation in the channel. Siltation is considered to be

Fig. 7-5. Depth Change on Line A-A

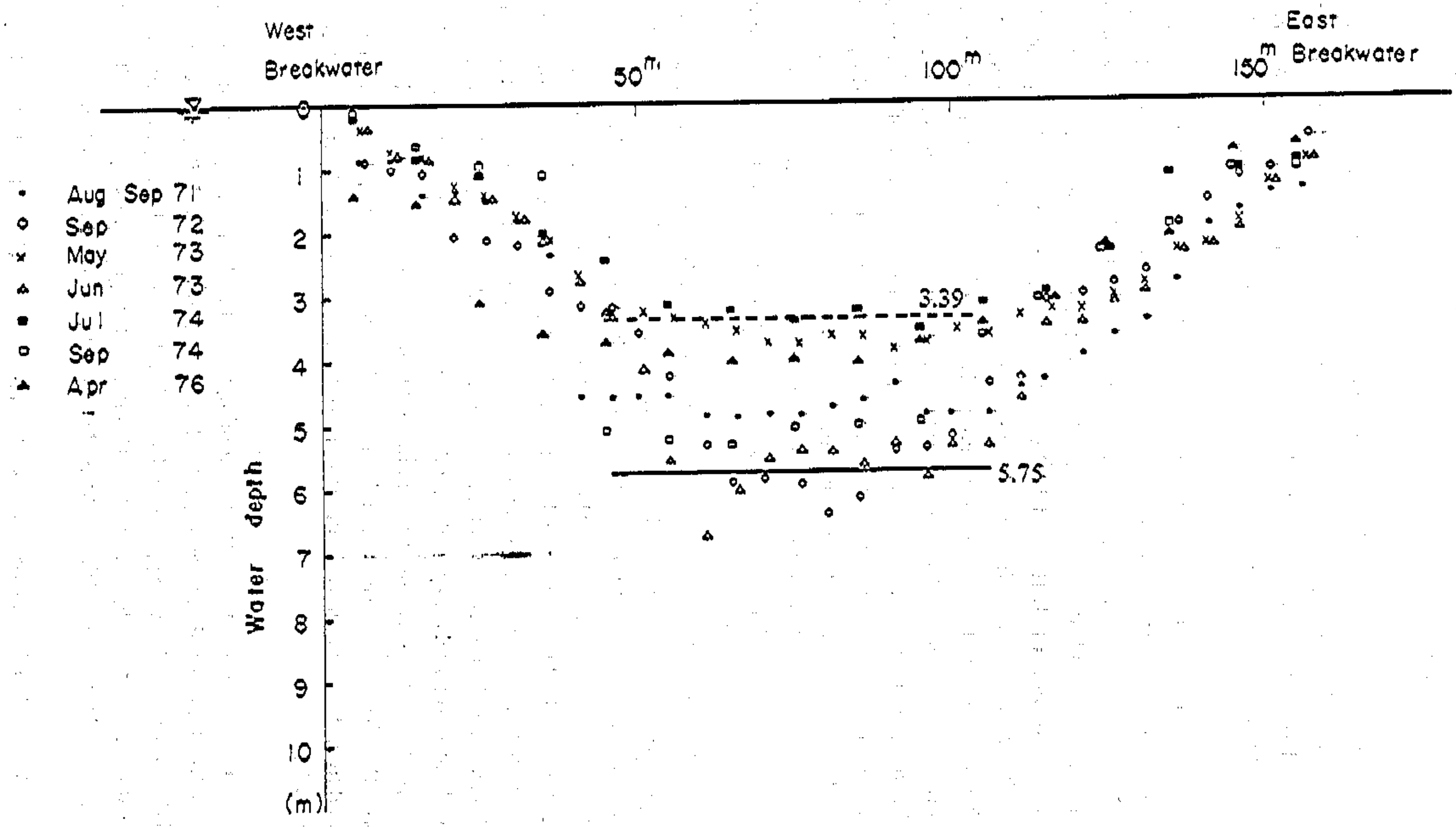


Fig. 7-6. Depth Change on Line B-B

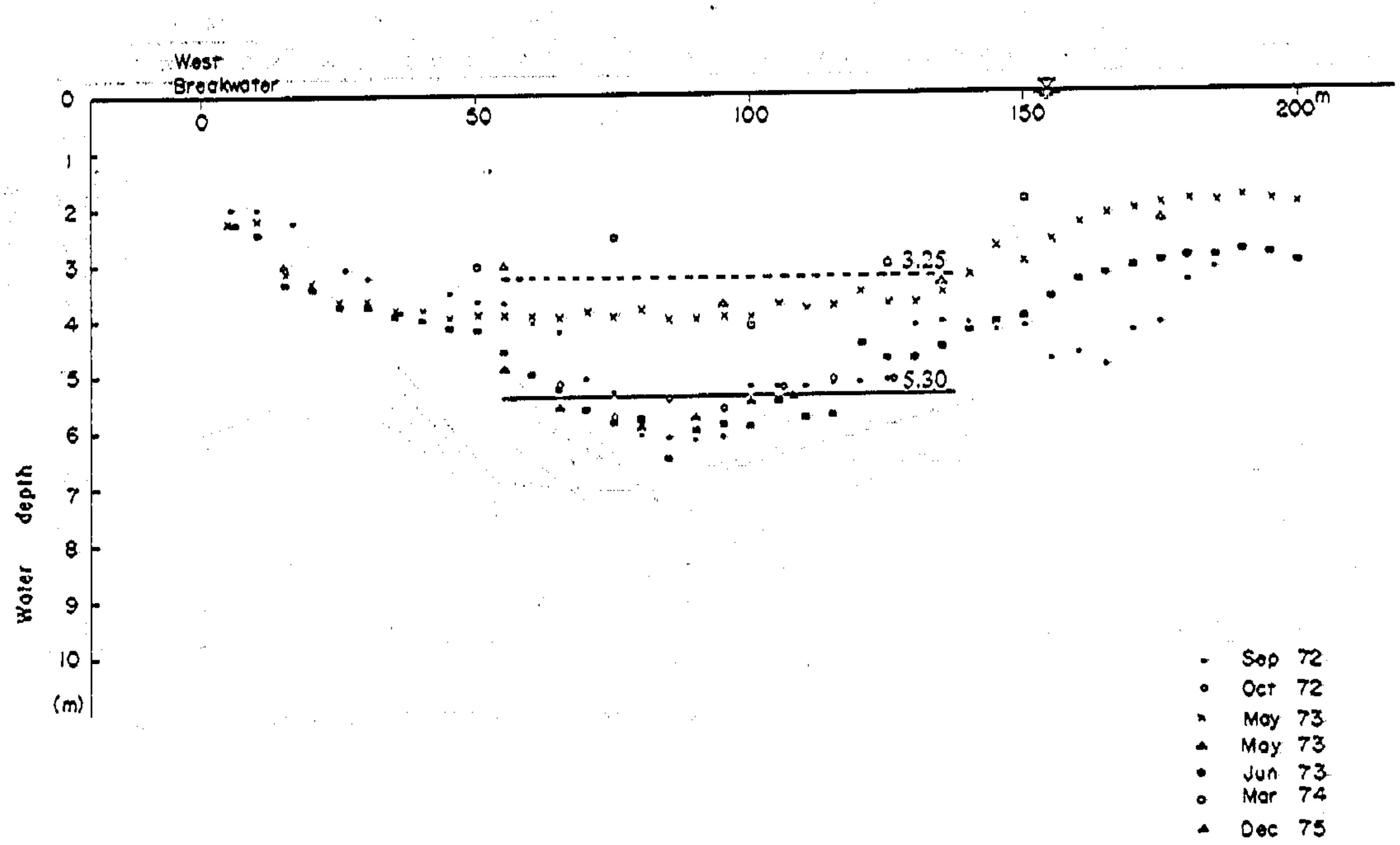
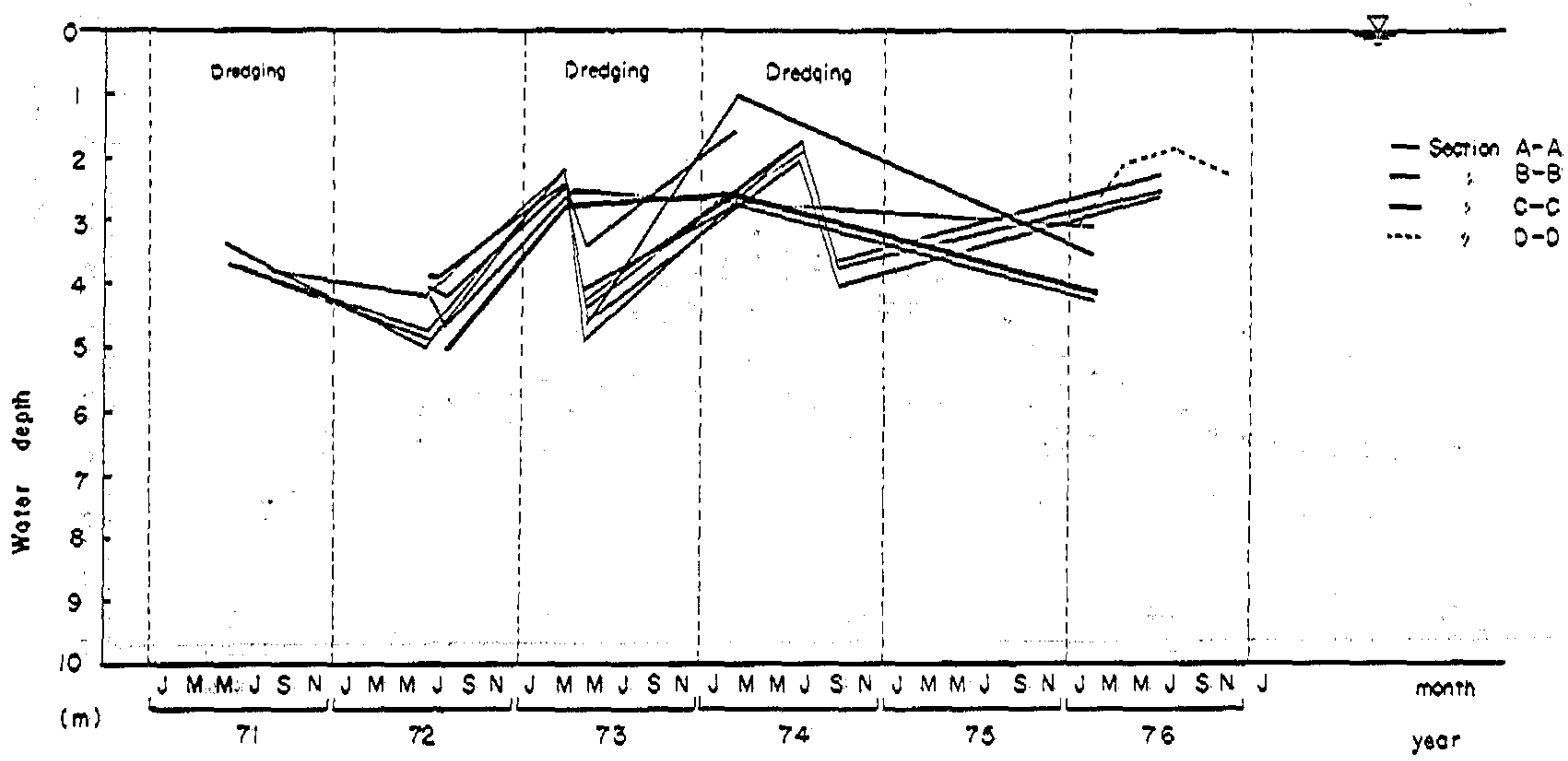


Fig. 7-7 Depth Change near the Center Line of Channel



most active during the northwest monsoon, but dredging working is generally very difficult due to rough weather. Thus, the maximum depth is created by dredging after passage of the northwest monsoon season.

Since the water depth of 5.75 m in June 1973 is reduced to 3.39 m in July 1974 in the section A-A, the yearly means speed of siltation is given by:

(5.75 - 3.39) x 12 mos/13 mos. = 2.18 m/year
In section B-B, change in water depth from June 1973 to March 1974 given is similarly by:
(5.30 - 3.25) x 12 mos./9 mos. = 2.74 m/year

7-4-2 Field Survey for Siltation Analysis

In regard to the hydrological phenomena in the port of Semerang and its vicinity, there is no other data than those surveyed by Gadjah Mada University described before. Therefore, various types of wide survey should be conducted further from now on in order to perform the detailed design for the port structures.

The field survey made this time was conducted in a mild wave season and in neap tidal period so that it would not be proper to directly relate the survey results with the situation analysis. But technology transfer in the area of hydrological observation and survey for siltation has been conducted quickly and effectively so that it is expected that periodic observation including northwest monsoon season and spring tide period are to be conducted by technical staff of Directorate General of Sea Communications and ADPEL of the port for rapid progress in future in the area of analyses of hydrological phenomena including siltation.

The hydrological survey for the port of Semarang by our survey team was conducted from August 31, 1977 to September 6, 1977 for the items shown below. The locations where measurements were taken are shown in Appendix.

1) 25 hours continuous observation:
Items; current direction, velocity, density of sea water, water temperature and concentration of suspended materials
Interval; One hour
Water depths; 1 m, 4 m and 7 m below water surface, but 7 m depth only for measurement of concentration of suspended materials
Measuring instruments: CMII type current velocity and direction meter, Akanuma-type hydrometer, bar thermometer, water bottles
Location: Point A

2) Auxiliary observation

Items; Same as 1)

Interval; Every 30 minutes shifting among 3 points

Water depths; 1 m and 2 m below water surface

Measuring instruments; Same as 1)

Location: B1, B2 and B3

3) Sampling of bottom materials

Locations; 6 points in each measuring line of C, D and E

Instruments; SK type soil sampler

The tide in this survey period was in the neap tide of strictly regular semidiurnal tide with tidal range of approximately 0.35 m.

The measured Point A for 25-hour continuous observation was located near the tip of access channel where future deepening of sea bottom was anticipated and was presently not considered to be sheltered by the breakwater. Auxiliary survey points B1 to B3 had water depth of about 2.5 m where sea bottom was most turbulent at the wave breaking point during rough weather or slightly offshore.

Point B1 is at the tip of the present west breakwater, and Points B2 and B3 are respectively at the front of East Canal and West Canal where effects of rivers will possibly be seen during rainy season. Measuring lines C, D and E where bottom materials were sampled, are in the lines extended offshore from East and West Canals and the port. Measuring Points 1 to 6 were so choosen that a difference of 2.5 m in water depth would be provided between adjacent points where littoral drift was assumed to occur by waves and currents.

At Point A, water temperature and concentration of salt are almost uniform from the sea surface to the sea bottom. Daily change in water temperature, high during day and low in dawn, is noticed but difference in temperature between days is very small with average of 1°C (Refer to Appendix).

Since the specific gravity of sea water generally varies depending upon the atmospheric temperature, the specific gravity converted to a value corresponding to standard temperature of 15°C is shown in the figure in reference to compare with salt concentrations in various locations in the world (Refer to Appendix). If the standard specific gravity is constant, it means that salt concentration is in balance as a whole between fresh water supplied from outside and water lost by evaporation from sea surface. The standard specific gravity is gradually increased during September 1st and 2nd and this will offer a very firm basis for making a conclusion of presence of sea water exchange with period of longer than one day.

On the other hand, by comparing the values observed at Points B1, B2 and B3 to those at Point A, the atmospheric temperature is about 1°C higher and salt content is slightly lower there (Refer to Appendix). This can be considered as a result of difference in heat exchange due to difference in water depth. But standard specific gravity (Sept. 3) is to be rather connected to gradually increasing specific gravity at Point A so that it will be more natural to consider that this is caused by the flow of sea water with period of several days.

Maximum velocity at Point A is 0.2 m/sec and predominant current direction is N - NNE on the surface and SE at the bottom. Permanent current is in NNE direction with a velocity of 4 to 6 cm/sec. Time of this survey was at the end of southeast monsson and sea current to the west was still predominant offshore so that this current in reverse to main current probably occurred at the front of the port of Semarang due to its topographically concaved coast line.

On the contrary, the maximum velocity at Points B1, B2 and B3 are 0.25 m/sec, and the current flows in east-west direction in parallel to the coastal line in very close relationship with tide. It flows to east during the falling tide and to west during the rising tide, and this difference is very clearly noticed. (Refer to Appendix). Assuming from these measured values, the tidal current during the spring tide will have a velocity reaching almost to a maximum of 0.5 m/sec.

The concentration of suspended materials is 200 g/m³ near the bottom of Point A and almost constant at all times indicating less influence of the tidal current (Refer to Appendix). On the other hand, the concentration of suspended materials at Points B1, B2 and B3 is widely varying a value of ranging from 30 to 280 g/m³.

The concentration of suspended materials scarecely differs at the surface and the bottom. But muddy water supplied from canals is in contact with the sea water with an apparent line therebetween and the concentration of suspended materials in the muddy water area is considered to be very high.

Analysis results of bottom materials are shown in Appendix. Weight of each sample is 30 g but calculation of water content was unpractical because of mixture of nearby water during sampling.

As regards the trend of bottom materials, the sand content is very small with less than 5% at many measuring points, but in certain areas it reaches over 50%. Silt is dominant at the front of the port of Semarang but it should be noted that many places at the front of East and West Canals are deposited with sand discharged from canals during a flood.

The grading analysis was made using hydrometer, which indicates larger gain size than that determined by visual and tactile judgement, mainly because of the aggromeration of soil.

7-4-3 Estimation of Siltation in Future

After the execution of future port project containing the Urgent Improvement Program in the port of Semarang, situation of siltation will naturally changed. Forecasting of this new situation is possible by solving many present problems which are to be analyzed from now on. The estimation of future siltation will be discussed here with a few comments on its technical difficulty.

Since the siltation is a result of suspension and sedimentation of material carried by kinetic energy of wave and current, wave conditions and properties of suspended sediment must be clarified first continuously performing observation and survey from now on.

Now, the critical velocity of movement will vary depending upon the size of bottom materils and water current, and especially the critical velocity of movement of fine grains smaller than silt is governed by the degree of progress of its consolidation which has been made up to now (Refer to Appendix). Here, let read 0.16 m/sec for critical velocity of movement of bottom materials for the convenience.

Wave height at shallow sea area, maximum velocity in the sea bottom and mass transport velocity for the wave with 2.0 m wave height and 6.0 sec period are indicated in Appendix. The wave height begins to gradually decrease after 25 m water depth and reaches to a maximum at wave breaking point but for the practical purposes it can be considered as constant. On he other hand, velocity at the bottom of the sea will increase simply and rapidly. The critical velocity of 0.16 m/sec will occur at the water depth of 21 m, and bottom materials are vibrated at the period of wave where water is shallower than 21 m. The mass transport velocity is a velocity of a whole mass of water moving toward shore resulting continuous movement of the bottom material.

Wave with NW direction will have angle of wave breaking of 12° (an angle between depth contour and wave crest) at the water depth of 2.5 m, causing longshore current with 0.35 m/sec mean current speed of breaker zone to occur. When the breakwater is extended, the current toward offshore along the breakwater will change so that longshore current speed near the breakwater will be slightly affected.

When both east and west breakwaters are constructed in future, coming in and out of sea water accompanied with changes of tide level in the port will be naturally made through the port mouth. The maximum current speed as a simple harmonic motion for the semidiurnal tide with 0.5 m tidal range is 0.065 m/sec, and moving distance for one period is approximately 900 m if widening of width behind the both breakwaters is ignored. Thus, it is considered that intrusion of suspended materials by the tidal current with maximum speed within this range from the tip of breakwater to the inside of the port will occur.

It is also considered that the amount of movement of littoral drift by the wave is proportional to square or more of orbital motion velocity of the water particle.

Deriving the maximum velocity Umax of water particle in the range from a point of 3 m water depth at the tip of the present breakwater to a point of 5.5 m water depth in the access channel referring to Appendix, a mean value of 1.45 m/sec is obtained. In the same manner, mean value for the range from a point of 6 m water depth of front end of future breakwater to a point of 9 m water depth of channel is read out to be Umax = 0.88 m/sec. Thus, the amount of movement of littoral drift should be proportional to these $Umax^n$ ($n > 2$), but water depth of future access channel is planned to be increased than that of present channel resulting in increase of its relative height to the shallow water area at both sides of the access channel so that increase of siltation speed is also anticipated. In addition, as a result of an extension of the breakwater, a higher possibility of speed increase of tidal current as a major longshore current should be also noted.

Now, let calculate the amount of movement of littoral drift using n=1 and assuming that the amount of littoral drift is proportional to the velocity of water particle (concentration of suspended materials is constant), as indicated below.

By expressing the amount of movement of littoral drift by the siltation speed, the siltation speed at the present access channel is equal to mean value given by (2.18 + 2.74) ÷ 2 = 2.46 m/year shown in sections A-A and B-B. Assuming that future silting velocity is propertional to water particle velocity,

$$2.46 \times 0.88/1.45 = 1.49 \text{ m/year}$$

That is, about 1.5 m/year can be considered for this value. The length of channel which is affected by siltation is approximately 1.5 km from the tip of west breakwater to outer side of port and, within the port, distance of sea water movement during a diurnal tide is approximately 1 km. Width of channel can be 200 m. Then, the amount of siltation in the access channel is given by

$$\underbrace{(1{,}500 \text{ m} + 1{,}000 \text{ m})}_{\text{length}} \times \underbrace{200 \text{ m}}_{\text{width}} \times \underbrace{1.5 \text{ m/year}}_{\text{silting velocity}} = 750{,}000 \text{ m}^3/\text{year}$$

However, the amount of present maintenance dredging in the port is about 120,000 m^3/year as shown in Table 7-1 so that about 0.8 m/year of mean siltation speed can be computed.

The supply source of this siltation is considered to be sediment from Semarang River and waste materials from the city of Semerang and port vicinity. However, due to future in-

Table 7-1. Siltation in Inner Harbour (1974/1975)

Place	Area	Dredged Volume	Silting Velocity
	m^2	m^3/year	m/year
Alur dalam	21,000	12,600	0.60
Pintu pelabuhan	10,500	4,988	0.48
Pelabuhan muka	18,000	8,663	0.48
Turn table	52,500	65,981	1.26
Pelabuhan dalam I	6,000	6,693	1.12
Pelabuhan dalam II	15,000	4,706	0.31
Kali baru	24,000	15,319	0.64
Total	147,000	118,949	0.81

crease of water depth in the port, increase of utilized water area in the port and increased turbulence by sailing of vessels, the sediment of siltation will increase in future over the value shown above. On the other hand, due to river improvement, city improvement and pavement constructed for roads in future, amount of supply of sediment of the inside of the port will decrease.

Thus, the amount of sediment of siltation in the port in future will remain on the same level as present.

Thus, the amount of siltation in the port of Semarang in future will be

750,000 + 120,000 = 870,000 m^3/year
channel inner harbour annual siltation
or approximately 900,000 m^3 a year.

This amount of siltation is the value estimated of the condition after completion of the Urgent Improvement Program according to PLAN A-1.

For the Urgent Improvement Program, there is an alternative PLAN A-2, according to which construction of the North Breakwater and East Groin is not carried out in the Urgent Improvement Program but in the Short Term Program. Further, for the sake of indicating the effects of North Breakwater and East Groin more clearly, an unreal plan of dredging the basin and continuing the maintenance dredging without installing the breakwater and groin was tested, and the result is also shown in Table 7-2 along with the present condition of maintenance dredging.

In the foregoing, it is assumed that the siltation occurs in the access channel only but this is not correct in a strict sense.

As the basis of calculation in A-1, it is assumed that as there is a tidal change over the whole water area within the port, sea water flows in and out during a tide through the opening between the West and North Breakwaters the current entering for about 1 km along the access channel keeping the same speed as it is at the opening without expanding the width in the port. Actually, however, the basin is dredged to the same depth to that of the access channel so that the current spreads fanwise in disregard of the channel and basin, thus producing siltation in the channel as well as basin. However, the area of siltation of the channel will be reduced to a range of 1 km or less from the opening, while the basin will be silted to the same extent. As it is assumed that the amount of siltation is defined by the concentration of suspended sand outside of the port and the rate of flow at the opening, the amount of siltation may be regarded to be nearly constant if the foregoing "siltation of the access channel" is rewritten as "siltation of the access channel and basin." On the other hand, the siltation of the Inner Harbour will not be limited to the area of Inner Harbour but spread to the basin or the area closer to land in front of the wharf due to river improvement or pavement of road in the city, but the amount of siltation may be regarded as to be unchanging.

However, in the Urgent Improvement Program according to the PLAN A-2, the siltation occurs only in the access channel, and the basin not yet dredged is not silted.

It will be noted that there is little difference in the siltation between PLAN A-1 and A-A-2 for the Urgent Improvement Program, because in A-1, the amount of siltation in the basin is included, while in A-2 the siltation is limited to the access channel alone. As noted in Table 7-2, the following examination was made of whether or not the construction of North Breakwater and East Groin should be delayed farther and be included in the Long Term Program.

The mud silting the basin is fed from the sea bottom adjacent to the east. This area is of a water depth of -3 ~ -5 m, and the waves are not blocked by the West Breakwater but proceed directly to the basin. The velocity of flow of water particles by the waves is 1.48 m/sec, and the speed of siltation is calculated, as in the foregoing case, as

$$2.46 \text{ m/year} \times \frac{1.48 \text{ m/sec}}{1.45 \text{ m/sec}} = 2.51 \text{ m/year.}$$

The area of the basin except the wharf slip is about 2.1 km^2. If the siltation occurs evenly in this area, the amount of siltation in the basin is 5,300,000 m^3/year as shown in Table 7-2.

The speed of siltation is a function of the concentration of mud suspended by waves and velocity of the flow (ocean and tidal currents). The current prevailing in the basing will

Table 7-2 Calculation of the Siltation.

Length (m)			Velocity of water particles by waves (m/sec)	Velocity of siltation (m/year)	Area of siltation			Amount of siltation (m^3/year)			Total	Adjacent bed depth (m)	Remarks
					Access channel (m)		Basin (km^2)						
West Break-water	North Break-water	East Groin			Outside the port	Inside the port		Access Channel	Basin	Within the port			
1,900	1600	1,700	0.88	1.49	1,500	1,000	-	750,000	-	120,000	870,000	-6 ~ -9	PLAN A-1 Short and Long Term Programs. The access channel siltation includes the siltation in the basin.
1,200	0	0	0.94	1.59	2,200	1,000	0	1,020,000	0	120,000	1,140,000	-5 ~ -9	PLAN A-2 Urgent Improvement Program.
1,200	0	0	1.48	1.49 (channel) 2.51 (basin)	1,500	1,000	2.1	750,000	5,300,000	120,000	6,170,000	-6 ~ -9 (channel) -3 ~ -5 (basin)	Basin dredging without North Breakwater and East Groin.
0	0	0	1.45	2.49	1,200	1,000	-	280,000	0	120,000	400,000	-3 ~ -5.5	Present condition.

probably be the tidal current, and the mud floated by the waves in the water on the east side will spread easily over the whole area of the basin during a cycle of tide.

The foregoing value of estimation is of trial. The siltation is subject to the influences of the speed of sedimentation governed by the extent of coagulation of the floating mud, change in the condition of flow of the tidal current due to the West Breakwater, etc. so that it is difficult to estimate the amount of siltation precisely. Anyway, dredging the basin without constructing the North Breakwater is apt to involve a risk of increasing the amount of maintenance dredging.

7-5 Plan of Deep Sea General Cargo Wharves

7-5-1 Scale of Wharf

As discussed in detail under Paragraph 6-4, the projected volume of foreign trade cargos for year 2000 A.D. is estimated to be 3 million tons at high projection, of which roughly 90% (2.67 million tons) is considered as improted products. It was forecasted that of the import products about 70% (1.81 million tons) will be industrial materials and construction materials and some 20% (470 thousand tons) will be manufacturing products. On the basis of these projections, it has been envisaged that in planning the foreign trade wharf for the year 2000, greater weight should be placed on the determination of the sizes and arrangement of the various facilities to be installed so as to conviniently handle the expected bulk and general cargos. Due consideration should also be given to the expected changes in port operation, shipping · technologies and other related aspects and the possibility of introduction of containerization into the scheme.

As indicated in Fig. 7-8, 17 berths of 3,085 m in total length and -10 m in depth will be required to handle the total forecasted foreign trade cargos. For the cargos of 1.96 million tons to be handled at low projection, 11 berths of -10 m in depth will be required. In this case, the annual wharf throughput is estimated at 185,000 tons or 1,000 tons/m.tear.

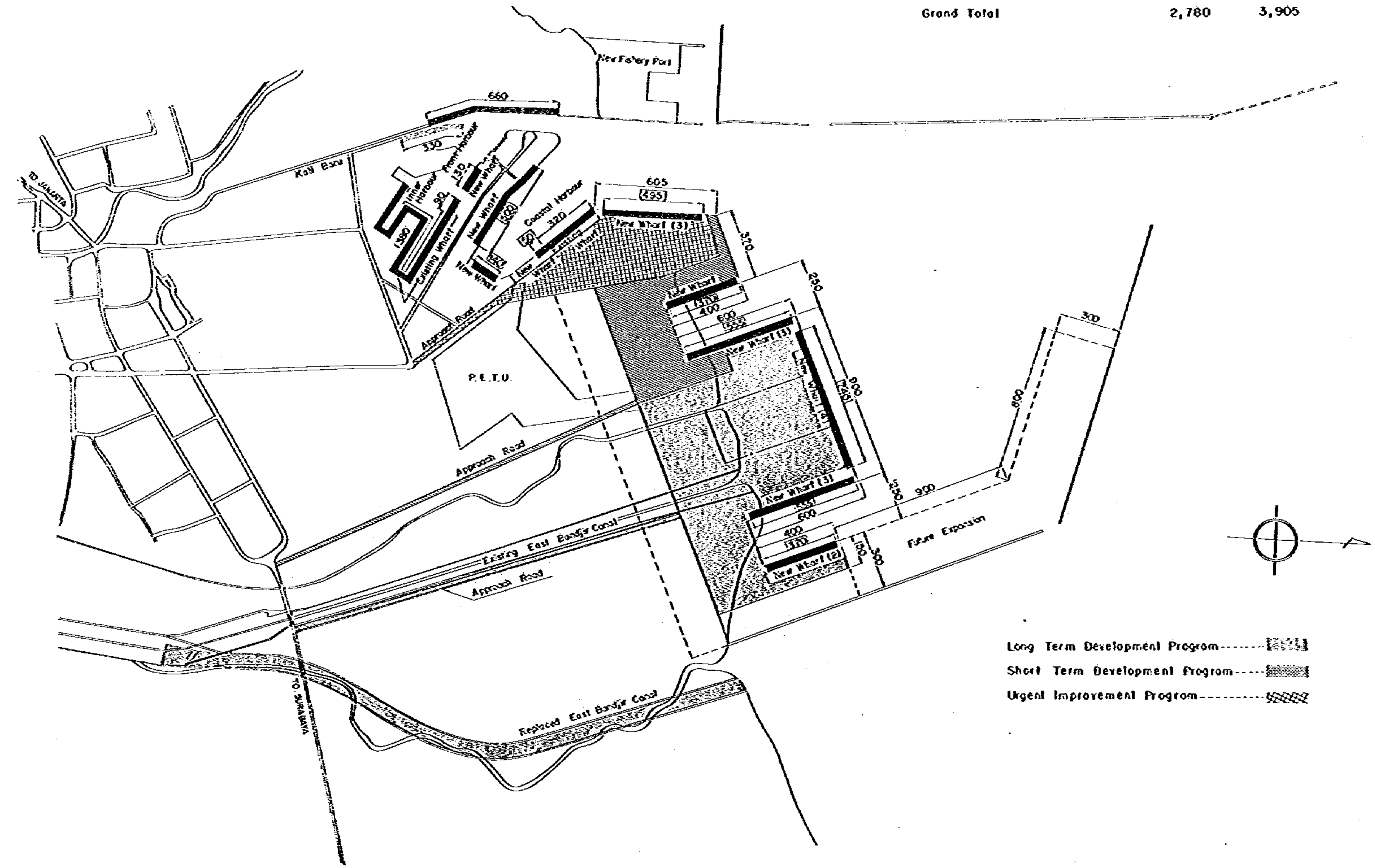
7-6 Plan of Regional Harbour Facilities

7-6-1 Configuration and Scale of Wharf

As shown under Paragraph 6-4, the projected volume of domestic trade cargos for the year 2000 is 3.36 million tons at high projection, of which the domestic inbound cargos is forecasted to be about 65% (2.18 million tons) and the domestic outbound cargos to be about 35% (1.18 million tons). A breakdown of cargos by categories indicate that approximately 35% comprise industrial materials, equipment and construction materials, 30% consist of manufacturing products and 30% accounts for fertilizer. It can thus be concluded that the goods consist mainly of bulk and general cargos.

Fig. 7-8 Wharf Plan of Long Term Development Program

	Wharf Length (m) Existing Wharf	New Wharf
Foreign Trade Wharf	-	3,085
Domestic Trade Wharf		
Interinsular Vessel	1,790	820
Local Boat	660	
Sailing Vessel	330	
Total	2,780	820
Grand Total	2,780	3,905



Vessels expected to handle the domestic trade cargos are classified into three types as follows:

- interinsular vessels
- local boats
- sailing vessels

The volume of cargos to be handled by each type for the year 2000 are as described in Paragraph 6-5, 70% for interinsular vessels, 20% for local boats and 10% for sailing vessels. The capacity for each wharf were analyzed based on the expected share of cargo to be handled by each type of vessels and the results are complied in Table 7-3. Therefore expected scale of wharf will be as follows;

(1) Wharf for Interinsular Vessels

The expected total volume of cargos to be handled at the interinsular wharf at high projection is estimated to be 2.35 million tons. The existing total berth length is 1,790 m, however, of which 320 m is the Coaster Harbour, 90 m for the Front Harbour which is under study for repair works in 1978 and 1,380 m for the Inner Harbour. Based on the findings, it is apparent that these existing wharves are insufficient to handle the total projected cargo. To cover the insufficiency, it is recommended that a new wharf of 690 m in length be constructed and the Front Harbour be extended by 130 m. The total volume of cargo at low projection, however, is estimated to be 1.38 million tons, and it is considered that construction of new wharves will not be required, since the capacity of the existing wharves would be sufficient to handle these cargos.

Table 7-3 Volume of Cargo and Ratio of Domestic Seaborne Traffic by Types of Vessel

Year / Cargo / Type of Vessel	1976		1980			1985			2000		
	Volume of cargo 1,000 t	Ratio %	Volume of Cargo 1,000 t		Ratio %	Volume of Cargo 1,000 t		Ratio %	Volume of Cargo 1,000 t		Ratio %
			At high projection	At low projection		At high projection	At low projection		At high projection	At low projection	
Interinsular vessel	130	56	230	210	55	520	440	60	2,350	1,350	70
Local Boat	60	21	90	80	21	170	150	20	670	400	20
Sailing Vessel	50	23	100	90	23	170	150	20	340	200	10
Total	240	100	420	350	100	860	740	100	3,360	1,950	100

(2) Wharf for Local Boats

The expected volume of cargos to be handled at high projection at the local boats wharf is estimated to be 670 thousand tons. The 650 m west side berth of the existing Kali Baru wharf including the 470 m quaywall presently being used by the fishing boats can be used for this purpose, hence, it is considered that construction of new berths will not be required. The required total berth length was calculated on the basis that is annual wharf throughput 600 tons/m of cargos.

(3) Wharf for Sailing Vessels

The expected cargos to be handled in this wharf is estimated to be 340 thousand tons for the year 2000. Based on this projection, a 570 m long berth is utilize. However the existing 1,000 m long Kali Baru quaywall at east side can be used for this purpose. In this plan, it has been assumed that wharf throughput annual 600 tons/m of cargos.

(4) Facilities for Fishing Boats

Some 200 fishing boats are engaged in the fishing industry of the area and they are using the West Breakwater as their mooring base. However, a part of the harbour entrance is being blocked due to this operation and it is causing problem to ship entrance and departure.

Furthermore, the growing needs of marine products of the city of Semarang will require further increase of fishing boats.

In preparing the development plan for the port of Semarang, the present port facilities which are inadequately being utilized must be thoroughly reexamined and the necessity for basic fishing port improvement plan should be fully recognized. The location for the construction of a new fishing port will be on a coastal marsh of outside of the West Breakwater. Plan for the construction of a new fishing port is described in detail in Chapter 7-8.

7-7 Construction Costs and Investment Schedule

7-7-1 Condition of Cost Estimation

The estimation made herein are based on the following assumptions:

(1) Exchange rate: U.S.$1.0 = Rp. 415 = ¥240.
(2) The estimations are based on the costs of labour and materials as of August 1977.

Allowance for future inflation were excluded.

(3) All estimations do not include import duties, tax and the like.

(4) Local Currency component includes sales tax of 5 percent.

(5) The construction cost for approach road is considered only for inside of port area, however, for outside it will be included in the related project.

(6) Construction cost of warehouse, replacement of East Bandjil Canal and domestic trade wharf are included in the related project cost.

7-7-2 Construction Costs

Construction costs at high and low projection for Long Term Development Program are estimated as shown in Table 7-4 and 7-5.

7-7-3 Investment Schedule

Investment Schedule of the following four cases are shown in Table 7-6.

Table 7-4 Construction Cost at High Projection for Long Term Development Program

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE			AMOUNT		
				LOCAL CURRENCY U.S.$	FOREIGN CURRENCY U.S.$	TOTAL RATE U.S.$	LOCAL CURRENCY U.S.$1,000	FOREIGN CURRENCY U.S.$1,000	TOTAL RATE U.S.$1,000
1.	Port Facilities								
1)	Dredging	m³	10,000,000	0.3	1.6	1.9	3,000	16,000	19,000
2)	Reclamation (Grading)	"	900,000	0.1	0.5	0.6	90	450	540
3)	-10 m Wharf	m	2,300	4,900	7,600	12,500	11,270	17,480	28,750
4)	Transit Shed (Foundation)	"	1,000	7,000	3,900	10,900	7,000	3,900	10,900
5)	" (Superstructure)	m²	37,000	70	130	200	2,590	4,810	7,400
6)	Approach Road	m	1,050	760	-	760	800	-	800
7)	Pavement & Drainage	Sum	1				4,312	-	4,312
8)	Building	m²	3,000	220	110	330	660	330	990
9)	Utilities (Water and Electric)	Sum	1				1,846	1,322	3,168
10)	Cargo Handling Equipment	"	1				-	2,530	2,530
11)	Miscellaneous	"	1				904	988	1,892
12)	Mobilise/demobilise	"	1				880	1,980	2,860
13)	Sales Tax (5%)	"	1				1,668	-	1,668
	Sub-total						35,020	49,790	84,810
2.	Port Service Vessels								
1)	Tug Boat (1,000PS x 2, 800PS)	Vessel	3				-	2,660	2,660
2)	Pilot Boat (100,50 ton)	"	2				-	1,320	1,320
3)	Motor Boat	"	3				-	130	130
	Sub-total						-	4,110	4,110
3.	Consulting Service								
1)	Soil Investigation, Topographic and Hydrographic Survey	Sum	1				120	320	440
2)	Engineering Study	"	1				360	1,350	1,710
3)	Supervision	"	1				440	1,650	2,090
4)	Engineering Study for Port Service Vessels	"	1				-	120	120
	Sub-total						920	3,440	4,360
4.	Contingency								
1)	Contingency for Port Facilities a. Physical Contingency (Approx. 15% of above 1.)	Sum	1				5,250	7,460	12,710
2)	Contingency for Port Service Vessels a. Physical Contingency (Approx. 15% of above 2.)	"	1				-	610	610
3)	Contingency for Consulting Service a. Physical Contingency (Approx. 15% of above 3.)	"	1				140	510	650
	Sub-total						5,390	8,580	13,970
	TOTAL						41,330 (38.5%)	65,920 (61.5%)	107,250 (100%)

Table 7-5 Construction Cost at Low Projection for Long Term Development Program

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	RATE LOCAL CURRENCY U.S.$	RATE FOREIGN CURRENCY U.S.$	RATE TOTAL RATE U.S.$	AMOUNT LOCAL CURRENCY U.S.$1,000	AMOUNT FOREIGN CURRENCY U.S.$1,000	AMOUNT TOTAL RATE U.S.$1,000
1.	Port Facilities								
1)	Dredging	m^3	8,200,000	0.3	1.6	1.9	2,460	13,120	15,580
2)	Reclamation	m^3	765,000	0.1	0.5	0.6	77	382	459
3)	-10m Wharf	m	1,485	4,900	7,600	12,500	7,277	11,286	18,563
4)	Temporary Revetment	"	150	410	2,140	2,550	62	321	383
5)	Transit Shed (Foundation)	"	560	7,000	3,900	10,900	3,920	2,184	6,104
6)	" (Superstructure)	m^2	22,000	70	130	200	1,540	2,860	4,400
7)	Approach Road	m	1,050	760	-	760	800	-	800
8)	Pavement & Drainage	Sum	1				2,695	-	2,695
9)	Building	m^2	3,000	220	110	330	660	330	990
10)	Utilities (Water and Electric)	Sum	1				1,096	871	1,967
11)	Cargo Handling Equipment	"	1				-	1,320	1,320
12)	Miscellaneous	"	1				466	546	1,012
13)	Mobilise/Demobilise	"	1				880	1,980	2,860
14)	Sales Tax (5%)	"	1				1,097	-	1,097
	Sub-total						23,030	35,200	58,230
2.	Port Service Vessels								
1)	Tug Boat (1,000PS x 2, 800PS)	Vessel	3				-	2,660	2,660
2)	Pilot Boat (100,50 ton)	"	2				-	1,320	1,320
3)	Motor Boat	"	3				-	130	130
	Sub-total						-	4,110	4,110
3.	Consulting Service								
1)	Soil Investigation, Topographic and Hydrographic Survey	Sum	1				100	250	350
2)	Engineering Study	"	1				360	1,350	1,710
3)	Supervision	"	1				440	1,650	2,090
4)	Engineering Study for Port Service Vessels	"	1				-	120	120
	Sub-total						900	3,370	4,270
4.	Contingency								
1)	Contingency for Port Facilities								
	a. Physical contingency (Approx. 15% of above 2.)	Sum	1				3,450	5,280	8,730
2)	Contingency for Port Service Vessels								
	a. Physical Contingency (Approx. 15% of above 2.)	"	1				-	610	610
3)	Contingency for Consulting Service								
	a. Physical Contingency (Approx. 15% of above 3.)	"	1				140	500	640
	Sub-total						3,590	6,390	9,980
	TOTAL						27,520 (35.9%)	49,070 (64.1%)	76,590 (100%)

Table 7-6 Investment Schedule

Unit : U.S.$1,000

Description	1978 – 1980 Urgent			1981 – 1985 Short Term			1986 – 2000 Long Term		
	Local Currency	Foreign Currency	Total	Local Currency	Foreign Currency	Total	Local Currency	Foreign Currency	Total
(1) PLAN A-1 at High Projection	24,220	60,740	84,960	30,440	58,690	89,130	41,330	65,920	107,250
(2) PLAN A-1 at Low Projection	24,220	60,740	84,960	22,550	50,870	73,420	27,520	49,070	76,590
(3) PLAN A-2 at High Projection	18,030	41,430	59,460	37,940	82,220	120,160	41,330	65,920	107,250
(4) PLAN A-2 at Low Projection	18,030	41,430	59,460	30,000	74,450	104,450	27,520	49,070	76,590

Note:
1) The wharf's scale at high and low projection for the Urgent Improvement Plan are the same, thus, the investment costs are euqal.
2) The Urgent and Short Term Development Plans at high and low projection have been classified as PLAN A-1 and A-2 as shown. The long Term Development Plan has been classified as PLAN A only.
3) PLAN A-1 includes the construction of West Breakwater up to a water depth of -6 m, North Breakwater and East Groin in the Urgent Improvement Program.
4) PLAN A-2 includes the construction of the West Breakwater up to a water depth of -5 m in the Urgent Improvement Program, the remaining portion of the West Breakwater, North Breakwater and East Groin will be installed during the Short Term Development Program.
5) Price contingency 7 percent per one year are considered in above.
   Urgent : 15 percent per 2 years Short Term : 40 percent per 5 years Long Term : not including

(1) PLAN-A at high projection include the construction of the following items in the Urgent Improvement Program;

- West Breakwater upto a water depth of -6 m
- North Breakwater
- East Groin

(2) PLAN A-1 is applicable for Low Projection

(3) PLAN A-2 at high projection include the construction of the West Breakwater up to a water depth of - 5.0 m in the Urgent Improvement Program, the remaining portion of the West Breakwater, North Breakwater and East Groin will be installed during the Short Term Development Program.

(4) PLAN A-2 is applicable only for Low Projection.

7-8 Fishing Port

7-8-1 General

At present time, the fishing boats operating with their fishing base in the port of Semarang are using 380 meter long revetment at a section leading to the Kali Baru Canal near the root of the West Breakwater.

The most of the fishing boats are 5 to 20 GT class and total of 160 boats are registered in the port but it is reported that about 200 fishing boats were in operation during a season suitable for the fishing.

As the problems associated with the fishing boats under present circumstances, the following items can be pointed out:

(1) The revetment presently being used by the fishing boats is located just at an entrance to domestic trade wharf of the port of Semarang resulting in the narrowed access channel and blocking of sailing of the incoming and outgoing vessels.

(2) Oil jetty of Entrance Harbour is located at the opposit side of the basin for fishing boats. Thus, not only unloading of oil from tankers but also sailing of outgoing and incoming of tankers are restricted by these boats.

(3) Many crews of the fishing boats are living on the boats and a danger of fire is in presence due to the boats' location adjacent to the oil jetty.

(4) Location of moored fishing boats is now facing the passage of sailing vessels leading to the peir of Kali Baru so that sailing of the sailing vessels is apt to be blocked by the fishing boats.

(5) Since existing revetment is now being used in a planless manner for mooring the fishing boats so that area for fishhandling and market area are not arranged.

In originating the master plan for the Semarang Port development, plan of fishing port must be re-examined for achieving fishery promotion, and very basic plan for fishing port must be prepared due to the surrounding environment. In making the basic plan for the improvement of the fishing port, the following items have been taken into consideration:

(1) Use of area within the domestic trade wharf of the port of Semarang must be discontinued and an area separated from the commercial port area must be planned.

(2) Housing of crews of fishing boats and warehouses are presently distributed near the root of West Breakwater due to historical backgrounds and partially have formed streets. In may be ideal to make a very basic city planning but such historical and human background cannot be neglected. Thus, the fishing port is planned with location as close as possible to the root of the West Breakwater.

(3) The merit of shallow sea area which is one of main features of the sea area near the port of Semarang, will be positively utilized in the plan.

(4) Since dispersion of facilities creates unfocused investment resulting in the unconvenient fishing port, a very compact plan with strict functionalism is sought in the planning.

(5) Preparation quaywall for departure and landing quaywall of fishes are partly combined for both used in order to reduce the investment.

(6) Many fishing boats are made of wood with small sizes so that entry of waves or swells will be avoided by making proper arrangement of breakwater.

Number of calls made by fishing boarts at the port of Semarang was reported 877 boats in 1975 and 1,317 boats in 1976.

7-S-2 Planned Sizes of Boats

The sizes of fishing boats registered in the port of Semarang are almost very similar with approximately 5 to 10 GT and total number of registered boats is 160 in 1976. Forecasting of number of boats and changes of boat sizes in future will be very difficult to make. However, in view of past transition of fishing boats in the area being considered, number of fishing boats in future will be increased by imporving the fishing port and by enforcing appropriate fishery promoting policies but, on the other hand, they will become larger, be powered and be made of steel in a very rapid pace in order to improve the operating efficiency.

Main sizes of shing boats presently registered and based in the port of Semarang are:

1)	Fishing boats with engine:	Wooden boat, 6 m wide, 12 to 15 m long
2)	Sailing fishing boats:	Wooden boat, 4 m wide, 11 to 12 m long

These boats are mainly engaging in the coastal fishing operation. The numbers of registed fishing boats by kind are:

1)	Fishing boats with engine (middle size) :	10 boats
	(small size) :	40 boats
2)	Sailing fishing boats:	110 boats

Sizes and number of fishing boats calling the port of Semarang in the year 1985 are forecasted as indicated below.

1)	Fishing boats with engine:	60 GT class:	2 boats
		30 GT class:	15 boats
		15 GT class:	63 boats
2)	Sailing fishing boats:	5 to 10 GT class:	120 boats
		Total	200 boats

Standard sizes by class of the fishing boat will be:

Class GT	Boat Length in m	Boat Width in m	Max. Draught in m
15	17.0	3.7	1.8
30	18.0	3.8	2.0
50	25.0	4.7	2.7

However, in regard to the sizes of fishing boats presently operating near and in the port of Semarang, the boat length to width ratio is 2:1 for boats with engine and 3:1 for sailing fishing boats.

7-8-3 Selection of the Project Site of Fishing Port

As stated in the foregoing, the fishing boats are presently in use of the bulkhead at the base of the West Breakwater located near the port entrance to land the catches. In developing the port of Semarang, if the fishing boats are allowed to use this site continuously as they do now, the future development of the port of Semarang will be impeded greatly so that it will be required to relocate the fishing port site to any other place.

The Semarang fishing port supplies the catches as an important source of proteins to the city of Semarang and its peripheral area. Thus, if located at a remote place from the city of Semarang, it will be difficult to have its function exhibited fully.

As a planned site of the nee fishing port, there may be considered a point in the west side of the existing West Breakwater as well as a point in the east side of the planned East Groin of the port of Semarang.

When the fishing port is planned at a point in the west side of the West Breakwater, its advantages and disadvantages set forth in the following.

(1) Merits of the site planned in the west

1) The site is located close to the port facilities used by the fishermen currently so that the fishermen will entertain no sense of incompatibility. Further, shift from the existing functional facilities to the new facilities will involve little problem.

2) It is also located close the city of Semarang which is the largest area of demand and along the extension of the city road used presently so that there is no need of planning the construction of a new road.

3) With the fishing village in the background, it is convenient for the fishermen to use. Relocation of the dwelling houses is not required.

4) The existing West Breakwater is usable economically as a bulkhead for the planned iste of fishing port created by reclamation work.

5) The location does not at all impede the development of the commercial port in the future.

(2) Demerits of the site planned in the west

1) The fishing port is planned in a direction in which largest waves are coming so that installation of a breakwater is required.

2) The fishing boats going to the field in the east for fishing will have to cross the access channel of the port of Semarang.

With the fishing port planned in the east side of the East Groin, its merits and demerits may be summarized as given below, provided for convenience of the comparison with the site of plan in the west, merits and demerits equally applicable are omitted, and those which are different are listed.

(1) Merits of the site of plan in the east

1) It is enabled to separate the fishing port from he commercial port nearly completely.

2) The fishing port is protected from the large waves by the breakwater of the commercial port so that the scale of the breakwater of fishing port can be reduced.

(2) Demerits of the site of plan in the east

1) The seashore at the site of plan comprises fish ponds and salt fields so that not only the fishing port but the fishing village or dwelling area will have to be developed with a large scale of reclamation executed.

2) It is required to construct an access road in a length of 4 km to connect the planned site to the main road of the city.

3) Power and water supply facilities will also have to be installed newly over the length of 4 km.

4) The fishermen must have their dwelling houses moved to the vicinity of the planned site, but actually this seems to be very difficult. This will not be resolved by the administrative guidance alone, and a large amount of compensation will be required.

5) Not only the fishermen but a number of people comprising those living on fishing activities and engaged in processing, transport and sales of the catches will have to move, and to have such movement realized in a relatively short period may cause a social unrest.

From the foregoing result of analysis, it is concluded that the point in the west side of the existing West Breakwater is preferable as the site of plan of the new fishing port.

One of the demerits of the west point, that is, location on the largest wave coming side, does not constitute a fatal shortcoming in that the prospected waves are deepwater waves with not so large a height as 2 m and that the scheduled point of construction of the breakwater is not of a great water depth but only -3 m so that the breakwater can be planned in not so large a scale.

Provided, the fishing boats going to the fishing field on the east side will have to cross the ship course, but this should be handled by the port management technology, which will be conducted by the port administrater.

7-8-4 Planned Scales of Facilities

(1) Quaywall for landing fishes and fish-handling facilities

Area for fish-handling and quaywall for landing catch of fishes should be located as close as possible in order to make the moving of catch of fish to a minimum within the base. The facilities required for the fishing boats forecasted for the year 1985 can be estimated as described hereinafter.

Size of Boats	(1) Number of Boats	Catch of Fish per Day	Number of uses of Quaywall per Day	(2) Actually Required Length	(3) Actually Utilized Facility Length	(4) Number of Berths
GT		t		m	m	berths
5 - 10	120	60	4	180	180	12
15	63	126	3	210	220	11
30	15	150	2	188	200	8
60	2	40	1	60	60	2
Total		376 t		638 m	660 m	33 berths

Note: 1. The length of berth for fishing boat is indicated as follows:

5 – 10 GT .... 6 m (stem mooring)
15 GT .... 10 m (stern mooring)
30 GT .... 25 m (berthing)
60 GT .... 30 m (berthing)

2. Catch of fish per boats by one day is estimated;

5 – 10 GT .... 0.5 t
15 GT .... 2 t
30 GT .... 10 t
60 GT .... 20 t

3. Number of Uses of Quaywall per Day is determined by possible hours of use of quaywall and mean time required for landing catch of fish per boat.

4. 2 hours is assumed as hours of quaywall usage and 10 minutes is used as time required for landing catch of fish per boat with 5 to 10 GT class.

Standard value of berth length for fishing boats for mooring them alongside the quaywall are calculated and indicated below.

Sizes of Fishing Boat	Berth Length	Water Depth of Berth
5 to 10 GT	15 m	1.5 m
15 GT	20	2.0
30	25	2.5
60	30	3.0

Previously calculated (2) Actually Required Length is examined using values shown above and (3) Actually Utilized Quaywall Length is derived from the results. That is, required quay length is 660 m, and 33 berths for fishing boats from 5 to 60 GT are planned. Separating the quaywall for landing catch of fish from departure-preparation quaywall may be desirable in actual use but in view of economic consideration quaywall will be planned for common use providing space for each class of boat size.

Most of amll boats of 5 to 10 GT class are generally moored perpendicular to quaywall in an area surrounded by quaywall and breakwater so that a considerable allowance for the use space can be expected in the port. For instance, if boats are moored at all extension of quaywall and inside of breakwater where entry of waves is prevented, total of 207 fishing boats can be moored at the same time as indicated below.

5 to 10 GT class:	120 boats (perpendicular mooring at rear side of breakwater partially in two rows)
15 GT class:	68
30 GT class:	16
60 GT class:	3
Total	207 boats

7-8-5 Facilities Arrangement

(1) Breakwater

To cope with waves expected during west monsoon season, 500 meter long North Breakwater is planned in parallel with shoreline and this will be connected to base root of existing West Breakwater of the port of Semarang. For the use of fishing boats outgoing for fishing operation along east coast, length of 100 m of existing West Breakwater of the port of Semarang will be removed and used as port mouth for the Fishery Port.

West entrance of Fishery Port is provided to the west of the North Breakwater and 100 m long West Breakwater is established to cover the inner basin and to prevent the entering of waves. Mooring rings will be provided inside of the breakwater for mooring of fishery boats.

(2) Fish-handling area

Area required for fish-handling can be obtained from the Table shown below.

Size of Boat	Number of Boats	Planned Catch of Fish per Day	Required Area for Handling Unloaded Fish	Required Area for Handling Unloaded Fish with Rotatory Use	
	boat	t	(I) m²		(II) m²
5 - 10 t	120	60	5,000	2	2,500
15	63	126	6,300	2	3,150
30	15	150	1,875	1.5	1,250
60	2	40	500	1.5	333
Total	200	376	13,675		7,233

(3) Quaywalls and Basin

- 3 m quaywall with length of 700 m is planned with a shape surrounding the basin at the center.

Water depth of - 3 m is planned for basin and its area planned is about 10 ha.

(4) Wharf area

Area for fishing port to be used for hundling unloaded fish and other purposes is planned for the area of 14 ha which can be made available by reclamation work of present shallow water area with 1 to 2 m water depth.

Area of handling unloaded fish is located behind the apron of the quaywall with road connecting to city streets. Office, transit sheds and weighing station will be located in the wharf area and open storage, ice producing plant, cold storage and warehouses will placed behind this area. It is desired to have fish-box manufacturing factory and fish-box stocking area in the nearby location.

Area required for handling unloaded fish to meet the requirements of planned number of fishing boats and planned catch of fish is 1.4 ha but this can be reduced to 0.7 ha if speed of handling rotation can be increased by mechanization.

(5) Other Facilities

Repairing shops related to minor repair of boats and maintenance of engines, dry yard for fishing nets, storages for fishing tools and other warehouses should also be located behind the fish cargo handling area. In addtiion, to meet the demand of smooth fuel supply as powered boats increase, land for installation of fuel supply facilities and associated oil tanks must also be included in the plan.

7-9 Oil Terminal and Oil Berth

Petroleum products are now being handled by oil jetty at Entrance Harbour and oil terminal comprising floating pontoon installed adjacent to the oil jetty facing Coaster Harbour, and oil sea berth located outside of the port.

Bunkering is mainly performed by oil barges but oil supply to large vessels staying at offshore anchorage is rarely requested and is made mainly to small boats with engine, local boats and interinsular vessels.

In order to respond to future increase of oil demand in the service area of the port of Semarang, present oil terminal in the port is improper and absolutely new oil terminal and oil berth must be planned.

On the other hand, present oil terminal located at entrance of domestic trade wharf should be, as it seems, relocated as quick as possible in order to assure the safety for sailing of vessels, to prevent port fire and to proevent the water from being polluted by the oil.

Amount of petroleum products which are forecasted for the year of 2000 A.D. being handled in the port of Semarang is 9.7 million tons. Since Deep Sea General Cargo Berth in the port of Semarang will be developed at the eastern coastal site which is connected to the existing Coaster Harbour, center of gravity of the port will be shifted to No.2 Pier at east side of No.1 Pier so that locating the oil terminal within the deep sea general cargo berths covered with breakwaters will create some problems in planning.

In consideration of future of the port of Semarang together with the tendency of increase in sizes of interinsular tankers, present sea berth should be extended and strengthened and this should be used as oil berth for the port of Semarang in the planning.

This sea berth should be connected to stock yard of oil distribution center in the suburbs of the city of Semarang behind the port with several oil pipe lines, and in a same manner pipe lines should be extended from sea berth to the stock oil tank of the thermal power station for supplying the oil.

On the other hand, number of vessels calling the port of Semarang will be rapidly increased and demand for bunkering within the port of Semarang will be increased. To meet with this, the following two methods can be considered:

(1) To provide pipe lines to oil distribution center in the suburbs of the city of Semarang and to Pier, and to supply oil from the secondary oil tanks to vessels.

(2) To provide oil berth at the pier of the port of Semarang, receive the bunker oil to store it in the tanks and supply the oil to vessels when required.

In the Long Term Development Program, oil terminal and oil berth are planned under the following considerations:

(1) Oil berth as oil receiving facilities for general oil demand will not be provided within the port.

(2) Present sea berth will be extended and strengthened as petroleum receiving facilities.

(3) A distance of 100 m from east end of front side of foreign trade Pier No.1 is determined as oil berth for handling oil for bunkering, and properly scaled oil storage facilities should be established at the front end of the No.1 Pier. In order to maintain a stable oil supply system, it is desired to connect this oil storage facilities to oil tanks in the oil distribution center in suburbs of the city of Semarang with oil pipe lines.

(4) Oil supply by barges to the vessels should be considered as basic method, and oil should be supplied to oil barges from oil storage facilities at the front end of No.1 Pier.

(5) Oil handling facilities such as oil jetty in Entrance Harbour should be removed.

Present pipe line location connecting from offshore sea berth with the oil distribution center will be included in the plan for construction of foreign trade wharf access channel and anchorage of the Long Term Development Program of the port of Semarang. After completion of Short Term Development Program projected for the year of 1985, location of installation and relocating of the pipe lines should be reviewed while subsequent improvement plan for the port of Semarang is being prepared.

Chapter-8

Short Term Development Program

CHAPTER 8
SHORT TERM DEVELOPMENT PROGRAM

8-1 General

The Short Term Development Program covers up to 1985 and corresponds to the first stage of the Long Term Development Program mentioned in Chapter 7.

The important part of the above-mentioned program, which must urgently be completed up to 1980, is called the Urgent Improvement Program.

The amount of cargo to be handled at the port of Semarang was 808 thousand tons in 1976, excluding oil to be handled by PERTAMINA. This amount of cargos in the case of high projection is expected to increase to 1.11 million tons in 1980, and 1.73 million tons in 1985.

To meet the increasing amount of cargos to be handled, -10 m wharf with six berths, navigation channel and anchorage -10 m in depth and a breakwater must be constructed by 1985. Out of these facilities, the Urgent Improvement Program includes -10 m wharf with three berths, navigation channel and anchorage of -9 m in depth and minimum extension of breakwater.

The reason why the number of berth with -10 m wharf seems large when compared with the total number of berth required for the Short Term Development Program is to improve the off-shore cargo handling by barges to the direct handling along side the wharf.

Concerning the facilities for the domestic cargo handling, as the result of bringing the off-shore cargo handling by barges to the direct cargo handling alongside the wharf, the wharf presently used by barges will become idle, and thus the construction of new wharf or drastic improvement of existing wharf for the domestic cargo handling will not be required.

8-2 Plan of Deep Sea General Cargo Wharf

8-2-1 Scale of Wharf

As stated in Paragraph 6-4, it is forecasted that 570 thousand tons of the foreign trade cargos handled in 1976 in the port of Semarang will be increased to 870 thousand tons in 1985. 740 thousand tons of these cargos or about 85% of the total will be imported goods and about 50% of the goods (350 thousand) will account for industrial materials, equipment and construction materials, about 30% (200 thousand) for manufacturing products and about 16% (120 thousand) for food crops. In the category of export cargos, about 60% of the total (80 thousand) will account for food and estate crops.

In order to handle these cargos, the Long Term Development Program (target year: 2000) should be prepared. For the Short Term Development Program, however, whereby the target year is 1985, 6 berths of -10 m in depth for 15,000 D.W.T class vessels and mooring facilities (1,050 m long) as shown in Fig. 8-1 must be planned.

For the volume of cargos, at low projection, 5 berths of -10 m in depth will be required.

The wharf throughput used in this plan is 900 tons/m-year. Wharves will be on the same alignment with pile supported structure.

8-2-2 Wharf Facilities

(1) Transit Sheds, Warehouses and Dock Road

The apron, transit shed and warehouse are as indicated in Fig. 8-2. The areas of the transit shed and warehouse are estimated to be 29,200 m² and 19,200 m² respectively. The port service vessel berth and the bunker berth will be located at the corner west and east respectively of Pier No. 1. The Operation Terminal will be located at the back of the bunker berth.

As indicated in Fig. 8-2, the main dock road will have 4 lanes and the center line separated by the medium belt. Its width is 20 m and the branch roads are 15 m.

The main road will be connected to the existing Coaster Harbour and the wharves as shown in Fig. 8-2. The branch roads are arranged in the shape of ribs and will be linked to the main road for efficient use. Auxiliary roads are provided behind the transit shed for cargo transport convenience.

The open storage areas are located at the front of Pier No.1 on both sides of the warehouse. The total area of the two open storage areas is 25,000 m². Installation of dock railroad is not envisaged.

(2) Administration Building

Administration building and Custom Office area are as shown in Fig. 8-2. The total floor area is 1,500 m². Various governmental bodies and offices for various firms will be located in this area.

(3) Water, Oil and Power Supplies

Fig. 8-1 Wharf Plan of Short Term Development Program

	Wharf Length (m) Existing Wharf	New Wharf
Foreign Trade Wharf		1.050
Domestic Trade Wharf		
Interinsular Vessel	870	
Local Boat	340	
Sailing Vessel	340	
Total	1.550	1.050
Grand Total	1.550	1.050

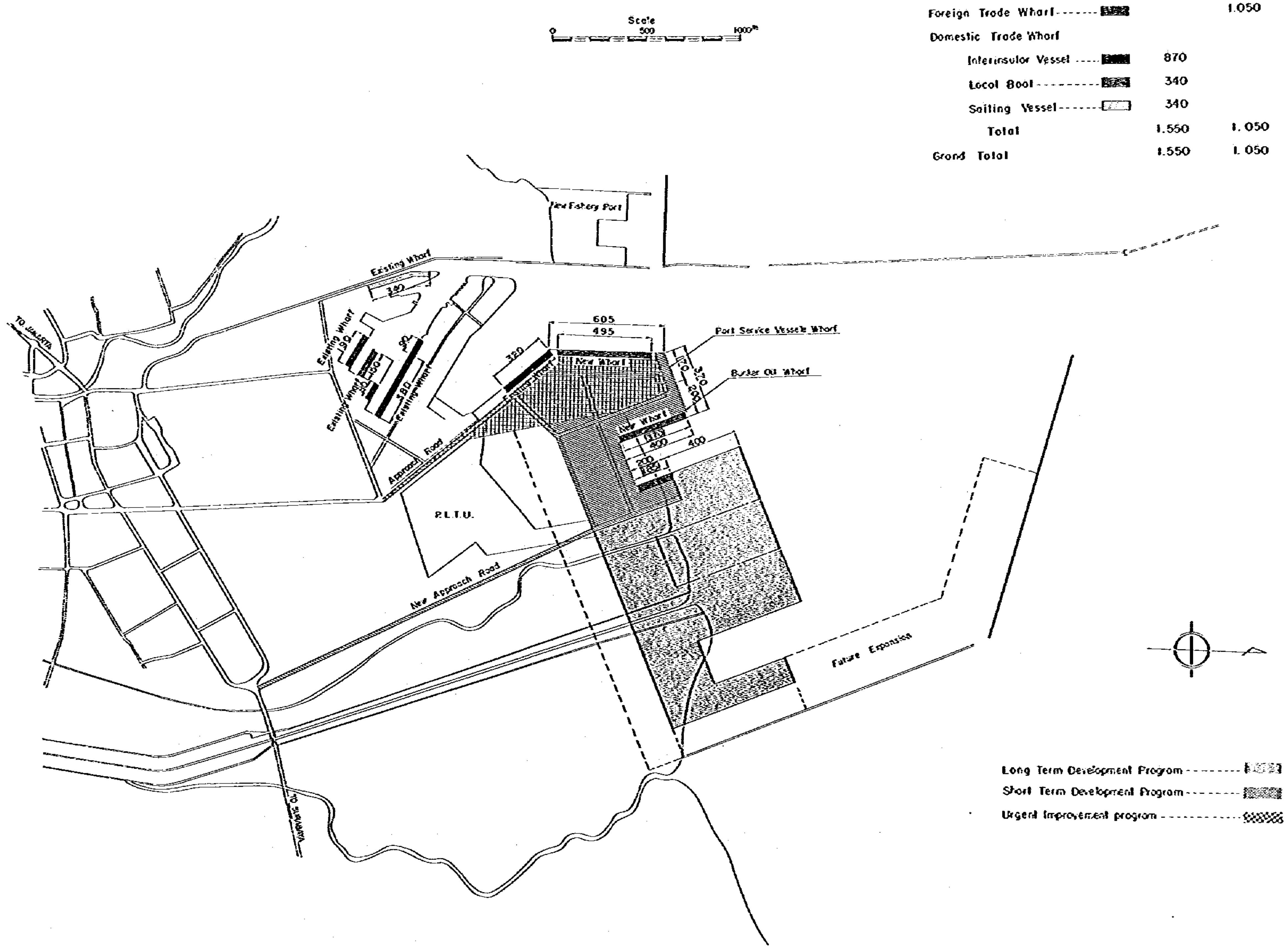
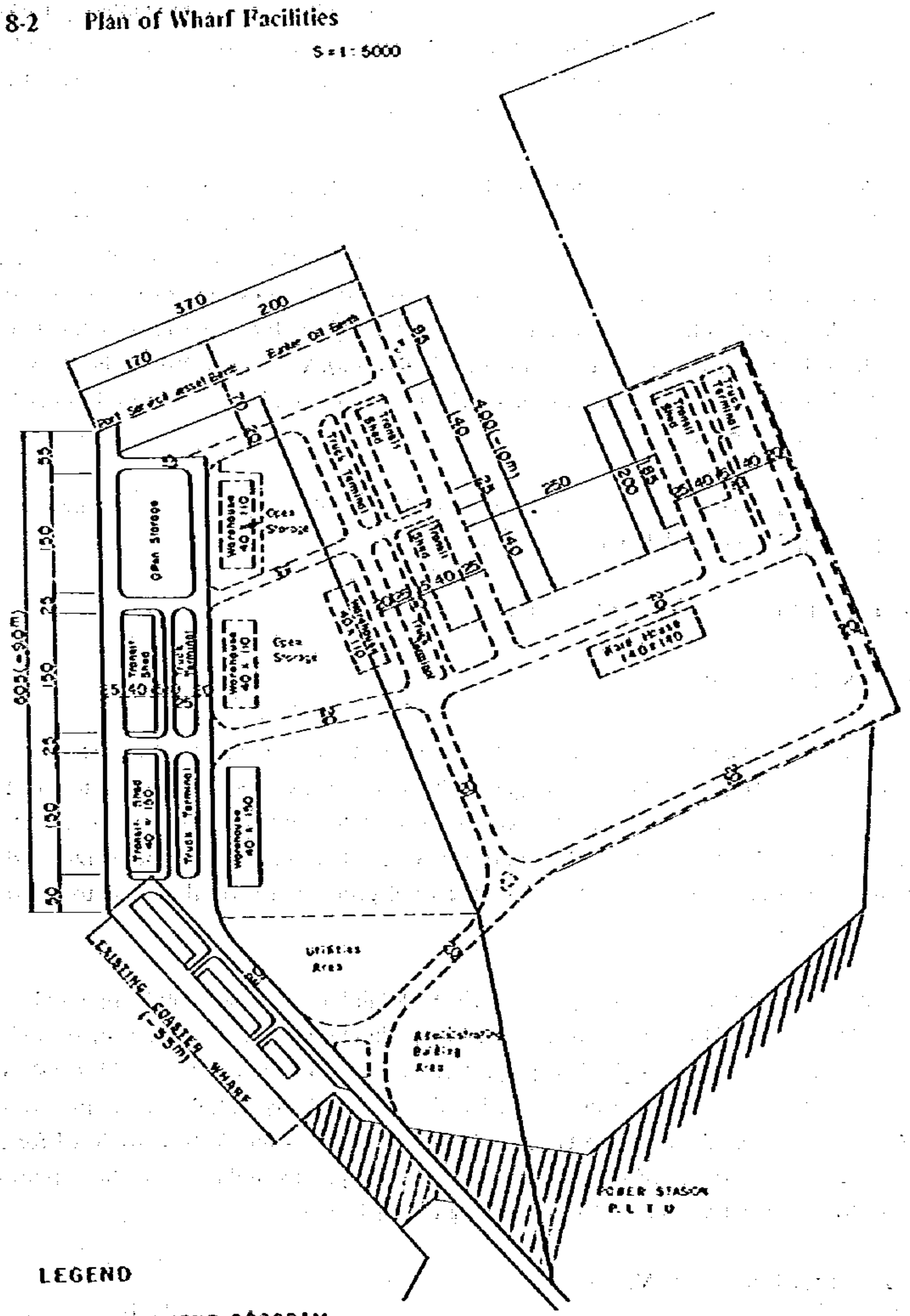


Fig. 8-2 Plan of Wharf Facilities

S = 1 : 5000



LEGEND

—— URGENT IMPROVEMENT PROGRAM

- - - SHORT TERM PROGRAM

-·- LONG TERM PROGRAM

Water supply to vessels and port facilities within the wharf will be independently provided by deep wells within the port site. Pipe lines, pressure-regulating tanks and hydrants will be provided. Hydrants for supplying water to vessels will be provided at the new berth for the foreign trade wharf, but new pipe line will not be installed to the existing domestic trade wharf, water boats will be utilized instead.

At present, fuel supplying for vessels is being made by bunker barges. The oil jetty is located at the front end of the central pier facing the Harbour Entrance. However, the existing oil jetty is adjacent to the access channel so that relocation of this oil jetty is required to assure the safe access of vessels. Safety measures should be made and implemented until the Urgent Improvement Program for 1980 is completed. In the Short Term Development Program, an oil jetty should be provided at the head of Pier No.1 as soon as possible, and oil supply to vessels should be made by bunker barges utilizing this oil jetty.

Electric power within the port site should be taken directly from the new electric power station (P.L.T.U.) under construction.

8-3 Plan of Regional Harbour Facilities

8-3-1 Scale of Wharf

The total domestic trade cargos at high projection in 1985 is estimated to be 860 thousand tons. Domestic inbound cargos will be about 73% (630-thousand tons) of the total projection and a major of the cargos will be fertilizer and construction materials amounting to about 90% (570-thousand tons) of all domestic inbound cargos. Of the domestic outbound cargos, about 90% of the total projection (200 thousand tons) will be manufacturing products.

For handling these cargos approximately 1,550 m long of wharf will be required, but it is considered that this can be fully obtained by making minor modifications of the existing facilities. Handling cargos at the low projection is up to 740 thousand tons. This is showing that required landing line will be satisfied with approximately 1,330 m long. For assuring smooth operation of the port, the types and usage of facilities should be considered for each type of vessel. The shares of port cargos handled by type of vessels are 60% for interinsular vessels, 20% for local boats and 20% for sailing vessels in 1985.

(1) Wharf for Interinsular Vessels

The cargo to be handled in this wharf at high projection is estimated to be 520 thousand tons, and the overall wharf length required is 870 m including the existing 320 m Coaster Harbour, 90 m Front Harbour and 460 m Inner Harbour. The wharf throughput for the Coaster Harbour and Front Harbour is 700 ton/m·year. Common use of the existing Inner Harbour with the local boats is considered in the planning.

The wharf throughput in the Inner Harbour is 500 ton/m·year. The volume of cargos to be handled at each wharf are estimated as follows:

Coaster Harbour:	320 m }	x 700 t/m·year	= 287,000 tons
Front Harbour:	90 m }		
Inner Harbour:	460 m	x 500 t/m·year	= 230,000 tons (160,000)
		Total	521,000 tons (447,000)

The parentheses shows the volume of cargos at low projection.

(2) Wharf for Local Boats

The cargo to be handled by the local boats at high projection is estimated to be 170 thousand tons. The required wharf length is estimated to be 340 m when the annual wharf throughput is 500 tons/m·year. However, the actual usable wharf length of the Inner Harbour is 920 m and it is anticipated that sufficient room is attainable.

Annual Capacity = 340 m x 500 t/m·year
(300)
= 170,000 tons
(150,000)

The parentheses shows the volume of cargos at low projection.

(3) Wharf for Sailing Vessels

The cargo to be handled at this wharf at high projection is projected to be 170 thousand tons. Of the existing 1,000 m long Kali Baru quaywall, 340 m portion can be utilized for this purpose.

Annual Capacity = 340 m x 500 t/m·year
(300)
= 170,000 tons
(150,000)

The parentheses shows the volume of cargos at low projection.

8-4 Access Channel and Basin

Access Channel and basin provided by the Short Term Development Program are adjusted to the -10 m wharf with six berth (three berths are arranged by the Urgent Improvement Program and the other three are provided by the Short Term Development Program), so that their planned water depth is also -10 m.

Of the Access Channel planned for 200 m width in the Long Term Development Program projected for the year of 2000, the Access Channel planned for the Short Term Development Program projected for the year of 1985 will have a required minimum width of 150 m to maintain the economy of the investment.

The direction of incoming vessels in relation with the channel is approximately normal to the contour line.

This means that the vessels must approach with incoming direction that is fifteen degrees shifted to west from incoming direction for existing channel.

This channel is branched near the port entrance where the depth of water is -6 m and one runs along west breakwater to the -10m wharf with three berths at the west side of new pier. And other one goes to new slip at east side for connection.

Direction of the entrance of the Access Channel is determined by considering easiness of approach of vessels from Java Sea and also considering proper matching with port extension toward the year of 2000.

During the period of the Urgent Improvement Program, this channel has a fifteen degrees bent but it is a gradual curve so that sailing of vessels will not be affected by this.

The channel going to the slip at the east side of new pier is planned as a linear normal of the channel.

Planned length of the channel is about 5.8 km and amount of siltation to be dredged is 4.9 million m^3 including the Urgent Improvement Program. Also the width of entrance of the Access Channel is planned to be 150 m for the Short Term Development Program. However, widening of the channel in response to increase of calling vessels is rather easy since section to be required for the future widening is only about 1.5 km long.

It is planned that small vessels going to existing Inner Harbour are going to sail through the water area with 10 m width as a sub-channel between West Breakwater and main Access Channel, in order to separate the small vessels from the main channel as much as possible.

The basin planned for the Short Term Development Program has about 230-thousand m^2 at mooring basin in front of the -10 m wharf with three berths at the west side of the new pier, 120-thousand m^2 of slip at east side of new pier, and 540-thousand m^2 of water area between two branch channels in the harbour. Total area is 890-thousand m^2 and amount of siltation to be dredged is 4.3-million m^3. Within the central basin area of 540-thousand m^2 a turning basin with 370-m diameter is planned for 15,000 D.W.T class vessels in order to assure the safety for large scale vessels during their turning.

For the period of the Urgent Improvement Program up to 1980, the basin in front of the -10 m wharf with three berth is completely separated from the Access Channel and thus extra room is provided in the area so that turning of vessels is possible in front of the wharf. Thus turning basin is omitted for this period to provide a maximum effect from a minimum investment.

Central basin in the harbour may still have extra room even though the turning basin is provided. However, rest of the shallow area will be also completely dredged even though amount of dredging may increase since shallow area left over may affect to the safety of the vessel's operation. However, buoy berth or anchorage will not be provided within the basin in the harbour but anchorage outside of the harbour can be utilized when necessary as presently being done. Together with existing 51 ha of basin, total of 105 ha of basin will be provided in the harbour after completion of the Short Term Development Program.

8-5 Breakwater

8-5-1 Layout plan

The -10 m foreign trade wharf planned in the Short Term Development Program has a total of 6 berths, and the Access Channel to the wharf is planned to be -10 m deep 150 m wide and 4,400 m long.

In order to prevent the intrusion of waves and swells into the port during the west monsoon and also the inflow of littoral drift into the Access Channel and Basin. It is necessary to construct the West Breakwater of 1,900 m in length.

It is planned at a position separated for about 100 m from the head of the existing West Breakwater, swung for about 5° to the west from the extension of the face line of the existing West Breakwater and in parallel to the Access Channel.

At the opening of 100 m, the new breakwater will be extended for 50 m with an interior angle of 120° taken from the base of the new breakwater to prevent inflow and siltation of littoral drift through the opening. The opening is intended to provide a shortcut for the entry and exit of smaller vessels.

From the viewpoint of saving the investment necessary for the increased extension of the proposed breakwater, the head of the breakwater will be positioned at a depth of -6.0 m, the prevailing depth of littoral drift, and maintenance dredging will be performed to remove siltation of unprotected portion of the Access Channel.

Further, for prevention of the entry of diffracted waves during west monsoon, waves due to NE wind and littoral drift into the port, the North Breakwater with an extension of 1,600 m will be provided.

Also, for preventing intrusion of waves during east monsoon and inflow of littoral drift from along the east coast, the East groin with extension of 1,700 m will be provided.

For the Urgent Improvement Program three berths of -10 m depth will be provided as foreign trade wharf. However, considering that the size of vessels to be accommodated is up to 10,000 D.W.T. for the time being, the Access Channel should be provided in the depth of -9 m, width of 150 m and with the extension of 4 km.

8-5-2 Design conditions

The West Breakwater design conditions are:

- Design wave — Height H 1/3 = 2.0 m, and
  Period T 1/3 = 6.0 sec.
- Water level — High water level = +1.00 m
  Low water level = ±0.00 m
- Soil conditions — Shearing strength of cohesive soil
  $Cu = C_0 + kz$
  where C_0: Shearing strength at z = 0
  k : Coefficient of increase in relation to water depth.
  Then, $Cu = 0.4\ t/m^2 + 0.12Z$
  (Base, -4.0 m), and
  Minimum safety factor against circular failure Fs min. = 1.2.
- Crown height — Allowing a little overtopping, +2.40 m.
  Rc = D.H.W.L. + 0.6H 1/3 + α
  = 1.0 m + 0.6 × 2.00 m + 0.2 m
  = +2.4 m.

Following after the design conditions of West Breakwater, the same of the North and East Breakwaters may be summerized as shown in Table 8-1.

Table 8-1 Design Conditions of Breakwaters

Item	West Breakwater	North Breakwater	East Groin		Remarks
			Front end	Base Portion	
Wave Height H 1/3	2.0m	2.0	1.0	0.3	
Wave Period T 1/3	6.0 sec.	6.0	4.0	3.0	
Crown Height	+2.40 m	+2.40	+1.50	+1.50	RC=D.H.W.L. + 0.6 H 1/3 + α Provided D.H.W.L. + H.W.L. + 1.00
Co	0.4 t/m² + 0.12Z (base -4m)	0.4 t/m² + 0.12 Z (base -4m)	0.6 t/m² + 0.14Z (base± 0m)	0.6 t/m² + 0.14Z (base±0.0)	

8-5-3 Design of West Breakwater

In the design of West Breakwater, the following points were taken into consideration:

(1) As the consolidation settlement foreseeable in future will lead to the deformation or destruction of the breakwater structure, it should be reduced to minimum.

(2) Prevention of inflow of littoral drift to the Access Channel and port basin being the primary objective, an impermeable structure should be employed which would not allow flowing water to pass through the breakwater.

(3) The design wave height being small and thus allowing a relatively simple structure for the breakwater, as light a body as practicable should be employed for a measure against the soft ground.

(4) Since the current is a cause of littoral drift, it should be cut off.

(5) The structure should be such that maintenance and repair work may be done with ease.

From the foregoing points of view, three alternative types were proposed in the interim report. They are:

a) Steel pipe pile type,
b) Rubble mound sloping type, and
c) Coupled pile with steel sheet pile type.

Standard cross-sections of proposed types are shown in Figs. 8-3, 8-4.

To see which type is excellent and which is not, it is necessary to examine not only the construction cost but the problems involved in the structure, easiness of execution, availability of principal materials and working craft and maintenance after completion. The results of such examination are shown in Table 8-2.

Table 8-2 Comparison of West Breakwater Alternative Structures

Subject	(1) Steel Pipe Pile Type	(2) Sloping Type	(3) Coupled Pile Type
1. Structure and its stability	1. Practically free from the ill-effects of circular failure or settlement. 2. Can withstand the wave force and other external forces with lateral resistance of the piles. 3. As the countermeasure to siltation, joists are provided between the pipe piles.	1. Counterweight and wide flange beams mattress or bamboo mattress are used to provide against the circular failure. 2. Being of gravity type structure, settlement is unavoidable during and after construction. 3. As the countermeasure to siltation, crushed stone core is provided in the rubble mound. 4. Being composed mainly of rubble stone, structurally flexible.	1. Completely free from the ill-effects of circular failure or settlement. 2. Resistance to wave and other external forces is expected of the axial force (pull-out force, push-in force) of the coupled piles. 3. As the countermeasure to siltation, steel sheet pile wall is placed in front of coupled piles.
2. Easiness of execution	1. Steel pipe piles being driven vertically, the work is simple. 2. With no particular facility required for prevention of siltation, the work involves less process.	1. Being involved with such as dredging, sand replacement, mattress work, deposition of rubble, crusher run deposition for core, armoring and coping, a good work schedule will be essential. The execution will be difficult. 2. Foundation improvement work has to be carried out in coordination with the other works, and in this respect, difficulty involved to preclude prompt execution. 3. Divers and other technicians are required, so that the execution is by no means easy.	1. High level of technique as well as accuracy are required for driving battered piles of long length. 2. Involving placement of steel sheet pile wall and its coping, the execution will be rather complicated.
3. Principal materials and working craft	1. Steel Pipe Pile (ϕ1016mm x 12mm x 26m length) 2. Pile Driving Barge with driving hammer of D_{32} and leading tower equipped leader of 32m in length. 3. Floating barges, grab dredger	1. Rubble stone and crusher run. Good sand required for foundation. 2. Principal materials are relatively cheap in the unit price but required in a great quantity. Supply capacity is a problem. 3. Rubble stone carriers and stone barges. Dredgers (grab or pump dredger). Floating crane.	1. H-shaped steel piles 32.5m (400x400x13x21) and 35.0m (400x400x13x21), and steel sheet piles (U-IV L=9.0m). 2. Pile Driving Barge with driving hammer of D-22 and leader of 40m in length. Floating Barges. Grab dredger.
4. Maintenance and repair	1. Corrosion of steels by saline water is coped with increased thickness of steels so that no special anti-corrosive is required for maintenance. 2. Should uneven settlement occur in future, it can be easily amended.	1. Consisting mainly of rubble mound, additional rubble and coping concrete raising are required in the event of settlement so that the maintenance and repair works are relatively easy and cheap. 2. Settlement of the breakwater being well foreseeable, periodical surveys are required to check the progress of any settlement and any deviation of the face line.	1. Corrosion of steels by saline water being coped with increased thickness of steels, no special measure is required for anti-corrosion. 2. Repair of the front sheet pile wall is easy, but maintenance of the body involves difficulty.
5. Cost per unit extension	6,900 U.S.$/m	1. Using Bamboo Mattress 7,300 US$/m 2. Using wide Flange Beams Mattress 6,500 US$/m	6,600 US$/m

Fig 8-3 WEST BREAKWATER (COUPLED - PILE TYPE)

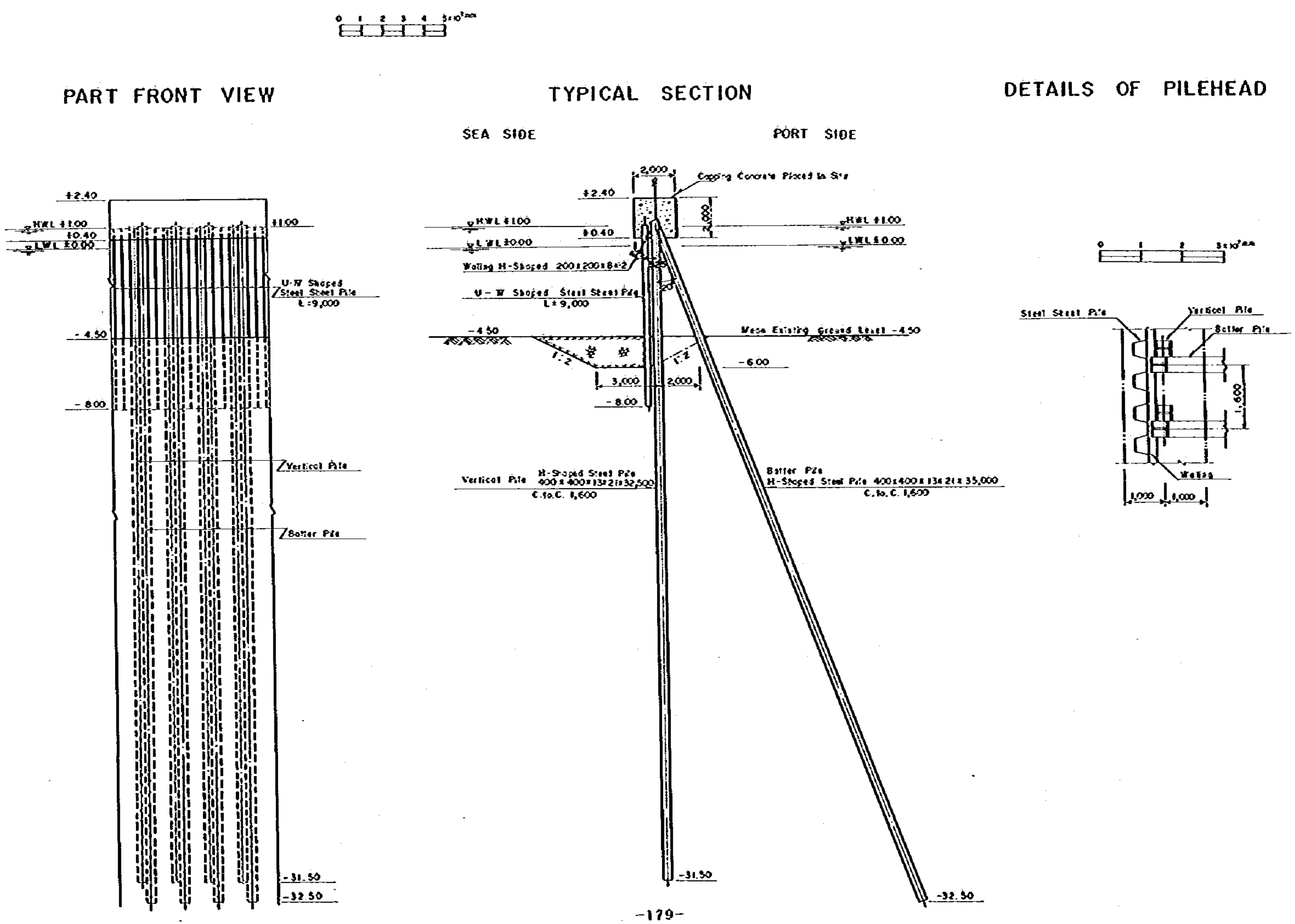
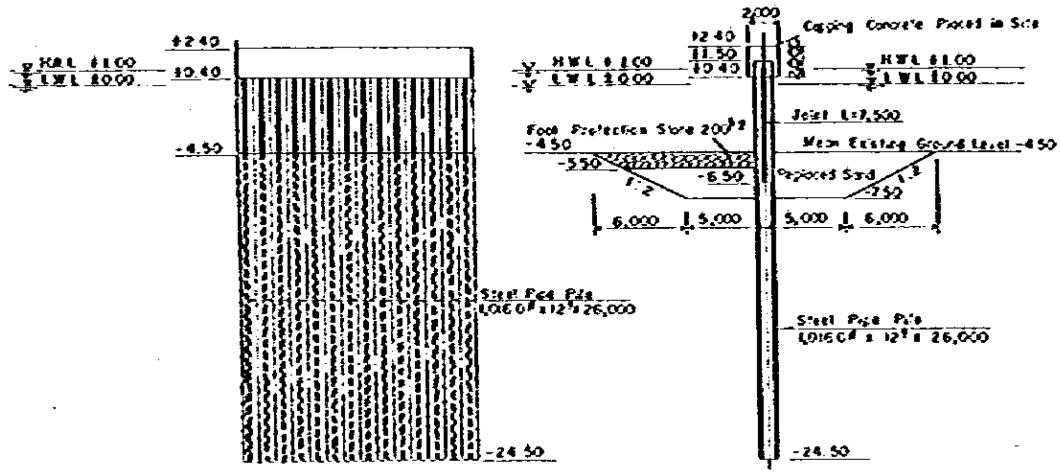


Fig8-4 WEST BREAKWATER (ALTERNATIVE DESIGN)

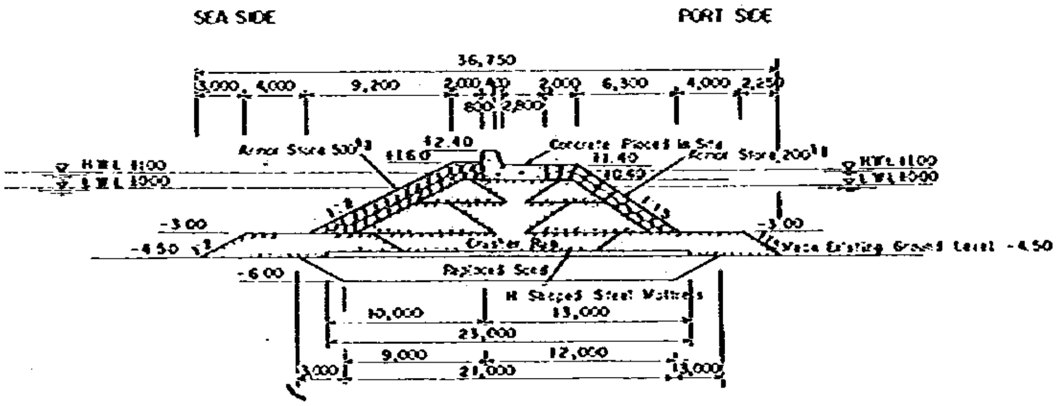
STEEL PIPE PILE TYPE

PARTIAL FRONT VIEW   TYPICAL SECTION



RUBBLE MOUND TYPE

TYPICAL SECTION



H- SHAPED STEEL MATTRESS PLAN

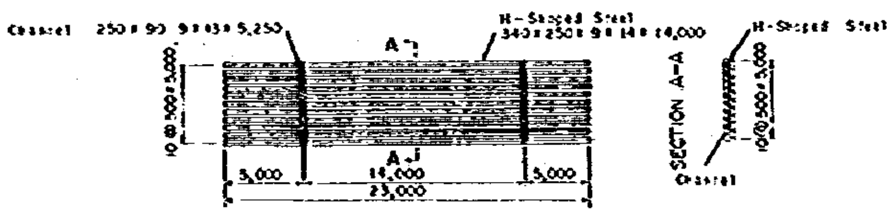


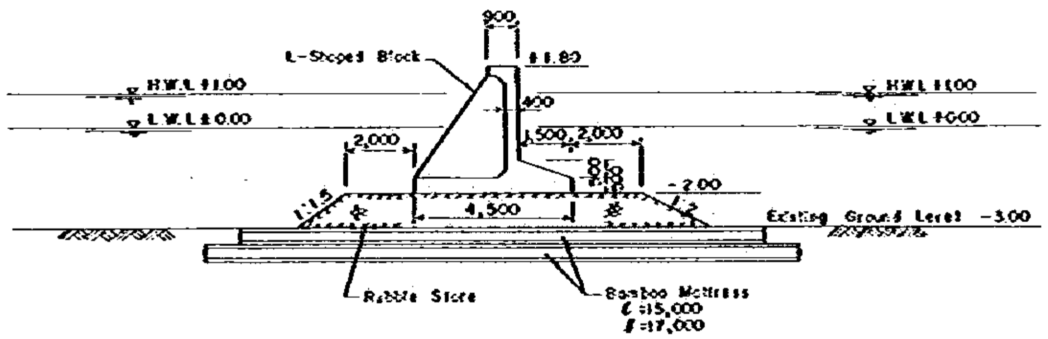
Fig 8-5 EAST GROIN

STRUCTURAL TYPE I
(L-SHAPED BLOCK)

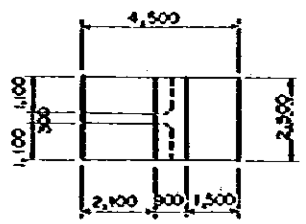
TYPICAL SECTION

PORT SIDE

SEA SIDE



PLAN

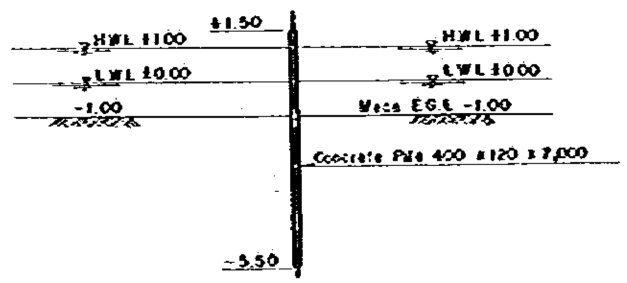


STRUCTURAL TYPE II
(CONCRETE PILE)

TYPICAL SECTION

PORT SIDE

SEA SIDE



DETAILS OF CONCRETE PILE