CHAPTER 6 PLAN OF PORT FACILITIES

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6-1 Commercial Port Facilities

6-1-1 Planning Conditions

(1) Dimension of Planned Vessels

The dimension of the planned vessels for a commercial port is a vitally important element to determine the scale of port facilities, such as channel, basin, quay, dolphin. The dimensions are used from the planning standard of Japan for designing port facilities, and are shown below;

Tonnage (D.W.T.)	Length (m)	Width (m)	Depth (m)	Full Load Draft (m)
Conventional Cargo Vessel				
1,000	58	9.5	5.1	4.2
5,000	103	15.4	8.4	6.8
Oil Tanker				
1,000	57	9.4	4.5	4.2

6-1-2 Channel and Basin

(1) Channel

The access channel to the commercial port is planned to be in a north-south direction, considering the length and the direction of the east breakwater (I) which has a dominant influence on the project cost, the prevailing wind in the north-west monsoon season from November to March, etc.

The distance of the channel from the tip of the breakwater to the berth is about 900 meters, including the straight part of 600 meters to the center of the turning basin, which is longer than the required stopping distance of the five-time planned ship length.

The channel width is planned to be 110 meters, slightly wider than the planned ship length, or the required width in the standard.

The channel depth is designed for 7.5 meters below the Datum Level, considering the full located inside the River Kemasin. This channel runs between the east breakwater (II) and the meters deep from the Highest High Water Level which enables 10,000 DWT class cargo vessels to call at the port.

The rest of the access channel is for oil tankers, berthing the petroleum product dolphin to be located inside the river of Kemasin. This channel runs between the East Breakwater (II) and the revetment of the general cargo wharf, which will function as a training wall for the river.

The width and depth of the channel are planned to be 60 meters and 5.0 meters below the Datum Level respectively, considering the dimensions of the 1,000 DWT class oil tanker.

A tug boat will be provided to assist in the navigation of ships because the channels are relatively long.

(2) Basin

A basin is generally planned by taking into consideration the maneuver of arrival and depar-

ture of vessels.

But, at Kelantan Port, the width of the basin for 5,000 DWT class berth is planned to assure not only ship navigation, but also the necessary width for the slip to cater to four vessel berthings at the same time, and the future port development for 10,000 DWT class cargo vessels. Accordingly, the basin should be planned to have a 210 meter width.

The berthing basin for oil tankers will be utilized combined with the turning basin described below.

The turning basins for 5,000 DWT class cargo vessels, and 1,000 DWT class oil tankers have respectively a diameter of 330 meters and 180 meters, three times bigger than the designed ship length, or the required length in the standard.

The depth of the basins is determined in the same way for the channels, therefore, those for general cargo vessels and oil tankers require a 7.5 meters depth and 5.0 meters below the Datum Level respectively.

The location of the channel and the basin is shown in Fig. 6-1

6-1-3 Breakwater and Groin

(1) Breakwater

The east breakwater (I) is planned to secure the necessary calmness of the basins, mainly for the commercial port.

The main important factor to decide the direction of the breakwater is the strong waves, generated by the north-west monsoon winds. So the east breakwater (I) is planned for a north-south direction against the waves.

This breakwater should be extended to a point off the coast, where water has the critical depth for completely active movement, considering siltation of the channel by littoral drifts. The critical depth is calculated as 6 meters by using natural condition data, significant wave height, and mean diameter of sea bed materials which were obtained by the survey carried out in 1979 and 1980 by the study team.

Less than the critical depth for completely active movement, surface sands or soils of the sea bed shows critical movements with the change of water depth by the waves of significant wave height.

The east breakwater (II) which will protect the channel for oil tankers, and fishing boats from strong waves is planned to be built straight through the surf zone, considering the difficulty of construction work, erosion of the sea bed after completion of the structure, etc. This breakwater will act as a training wall to flash sands and soils transported by the River Kemasin.

(2) Groin

The groin (mole) is palnned to protect the basin for the commercial port from siltation of littoral sands which drift along the coast line by the southwestern tidal currents. The groin is to be built parallel to the quay wall line till the tip reaches the same point of that of the quay.

The location of the breakwater and the groin is shown in Fig. 6-2.

Fig. 6-1 Location of Channels and Basins

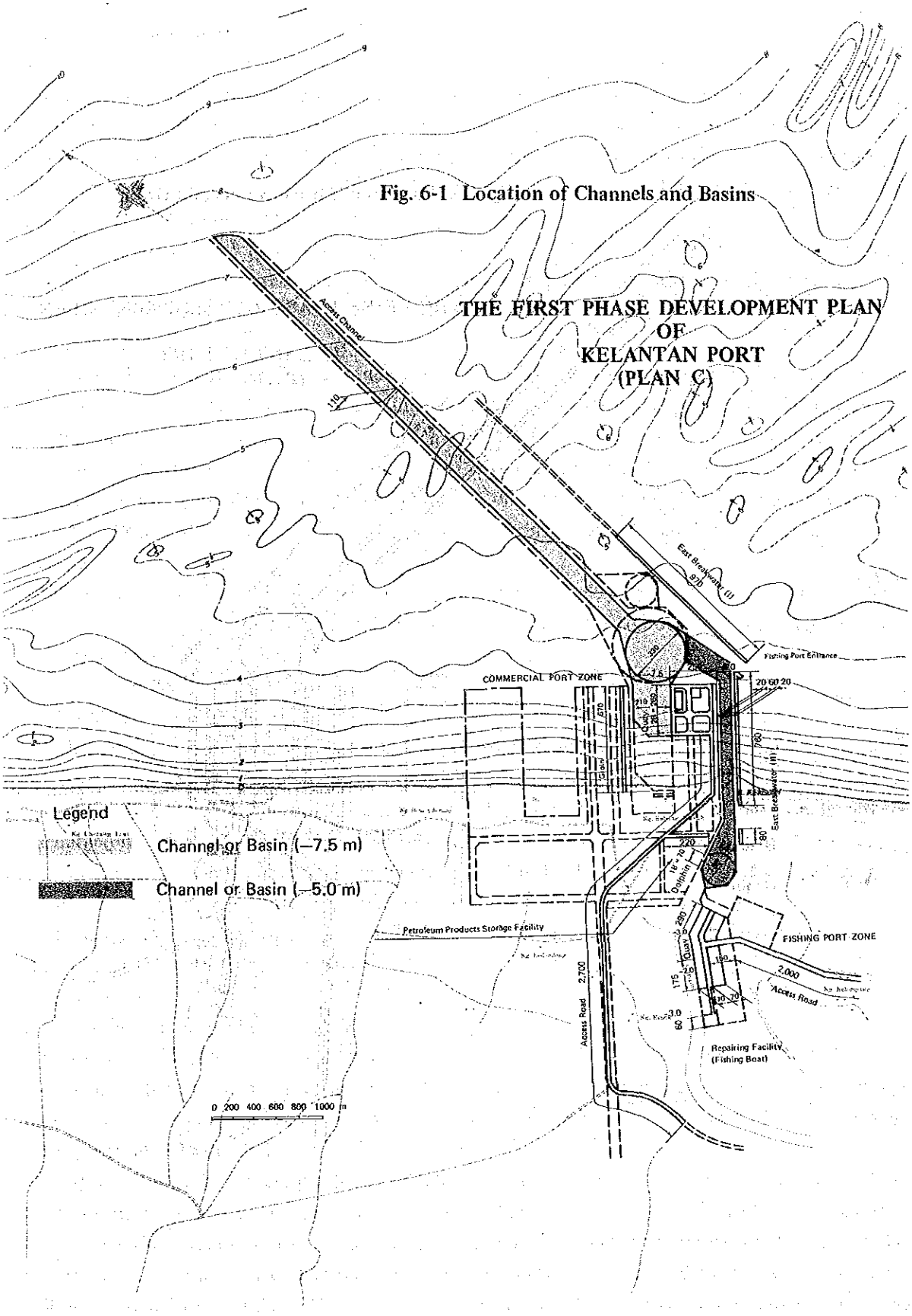
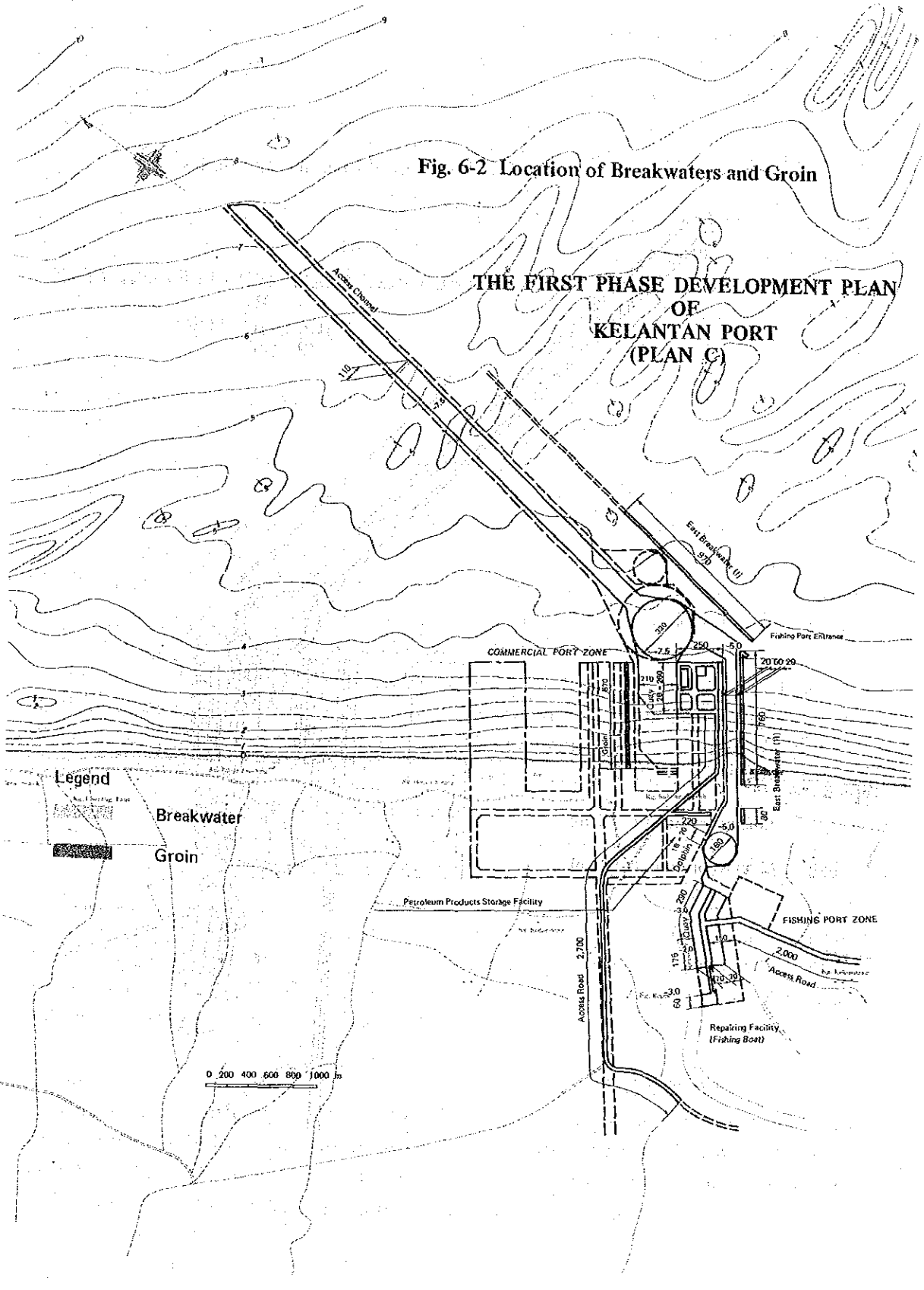


Fig. 6-2 Location of Breakwaters and Groin



6-1-4 Quay and Dolphin

(1) Quay

In general, the wharf is divided into three types; (i) marginal type (ii) jetty type (iii) compound type. These types of wharf have their own advantages and disadvantages. In this project, the jetty type is applied mainly for economical reasons. If the marginal type is planned, a very long breakwater will be needed to keep the basin calm, and the construction cost will increase remarkably compared with the jetty type.

The direction of the quay wall is planned at an angle of about fifteen degree from north to east to keep the ship from receiving strong eastern winds in the north-east monsoon period.

The number of berths are determined by the cargo traffic volume and cargo handling capacity at the wharf.

The cargo traffic in 1987, the target year for the First Phase Development Plan has already been estimated at 352,000 tons, excluding petroleum products which will be discharged at the dolphin inside the Kemasin River. And the capacity of the cargo handling at the 5,000 DWT class vessel berth is estimated at 18,000 tons per year, based upon the data of Kelang Port and Penang Port. Therefore two berths should be necessary at Kelantan Port by 1987. The length of the quay for two 5,000 DWT class vessel berths is 260 meters, considering the ship length and the mooring method.

Considering the construction cost for the First Phase Development Plan, the location of these two berths is planned to be farther side of the wharf where the 10,000 DWT class vessel's quays are located in the Master Plan.

(2) Dolphin

The location of the dolphin for unloading petroleum products is planned within the River of Kemasin, considering the construction cost, maintenance works, etc.

One dolphin berth will be necessary on the basis of the volume of petroleum products discharged in 1987, or 139,000 tons, and the cargo handling capacity at the dolphin.

The length of the 1,000 DWT class tanker dolphin is planned to be 70 meters, taking into consideration the dimension of the tanker.

It goes without saying that safety measures should be taken in case of emmergency such as oil leakage and fire at the dolphin berth.

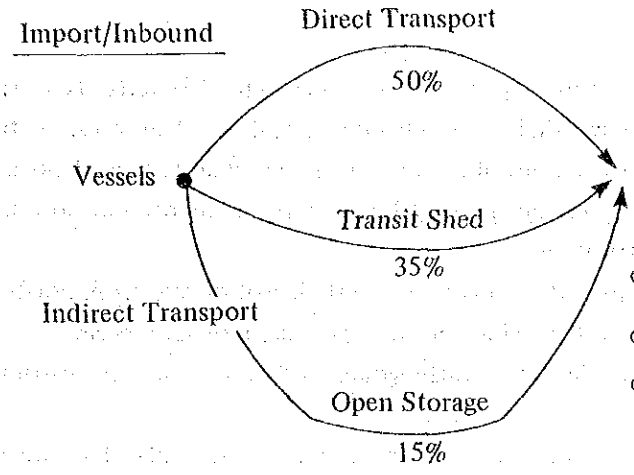
6-1-5 Transit Shed and Storage Facilities

(1) Distribution of Cargoes at the Wharf

Cargo traffic through the terminal facilities such as transit shed, open storage and storage tank, can be estimated according to kind of commodities handled, the present cargo flows at Kelang Port and Penang Port, etc.

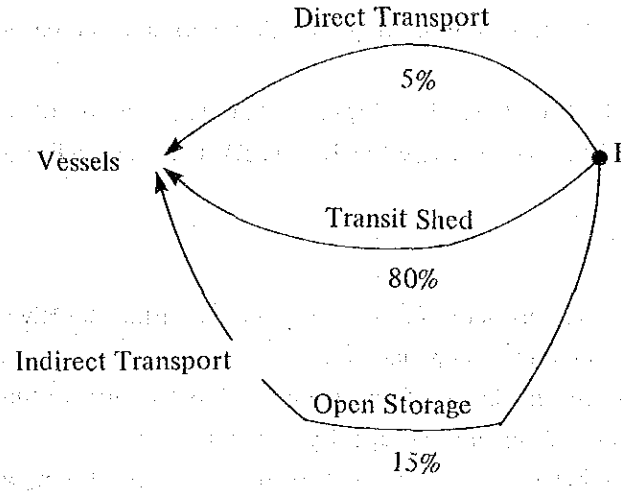
Dry cargoes such as wood products, rubber, fertilizer, cement, rice and miscellaneous cargoes, are transported to and from the wharf, directly or indirectly. Indirect transportation of cargoes means that the cargoes are distributed to the hinterland or loaded to the vessels by way of the transit shed or open storage. The ratio of direct and indirect transport differs whether the cargo will be imported or exported. The ratios are assumed as follows, based on the data on the cargo flow at the Port of Kelang.

Import/Inbound



	(tonnes)
o Fertilizer	41,000
o Miscellaneous Cargo	49,000
o Cement	72,000
Total	162,000

Export/Outbound



	(tonnes)
o Wood Product	49,000
o Rubber	41,000
o Rice	53,000
Total	143,000

From the above cargo distribution, in 1987, 171,000 tons of cargoes will be stored at the transit shed, 46,000 tons at the open storage, and the remainder of the 88,000 tons will be transported directly to and from the hinterland.

Palm oil for export will be shipped by lolly from the mills and stored in the storage tanks at the wharf. Export of palm oil is estimated at 47,000 tons in 1987.

Petroleum products will be discharged at the dolphin berth, stored in the oil tanks, and then distributed to the northern part of Kelantan. Petroleum products of 739,000 tons will be handled at the storage tanks in 1987.

(2) Transit Shed

The size of the required transit shed is calculated by the following formula.

$S = N/R\alpha w$

where, S: Area of Transit Shed (m^2)

N: Annual Cargo Traffic through Transit Shed (tons/year)

R: Rotation (times/year)

W: Quantity of Cargo Storage per Unit Area (tons/m^2)

α: Cargo Storage Ratio

In the case of Kelantan Port, N = 171,000 tons, R = 40 times/year, w = 2.0 tons/m^2, α = 0.6.

Although the area of the transit shed required will be 3,600 sq. meters in 1987 from the above calculation, a transit shed of 4,800 sq. meters ($120^m \times 40^m$) is planned considering future location plan of the transit shed, and future increase of cargo handling volume.

(3) Open Storage

The required area of open storage is obtained by the following formula.

$S = N/R\alpha w$

where, S: Area of Open Storage (m^2)

N: Annual Cargo Traffic through Open Storage (tons/year)

R: Rotation (times/year)

W: Quantity of Cargo Storage per Unit Area (tons/m^2)

α: Cargo Storage Ratio

In this study, N = 46,000 tons, R = 20 times/year, W = 2.0 tons/m^2, α = 0.5.

Therefore the area of open storage required is 2,300 sq. meters from the formula. But an area of 4,400 sq. meters is planned, by taking into consideration the location of open storage and the increase of cargo traffic after 1987.

(4) Storage Tanks for Plan Oil

The required capacity of palm oil storage tanks is calculated by the following formula.

$V = N/R\alpha\gamma$

where, V: Capacity of Tanks (m^2)

N: Annual Palm Oil Volume Stored (tons)

R: Rotation (Times/year)

γ: Density of Palm Oil (tonne/m^3)

α: Storage Ratio

In this case, N = 47,000 tons, R = 36 times/year, γ = 0.9 tonnes/m^3, α = 0.9.

Therefore the required capacity of the tanks will be 1,600 cu. meters in 1987 by the formula. Accordingly four tanks are planned to be installed at the site, and each tank has 550 cu. meters (D = 8.7 m, H = 9.1 m), considering future growth of palm oil export.

The site for the storage tanks is assured of 2,500 sq. meters at the top of the wharf.

(5) Storage Tanks for Petroleum Products

Petroleum products should be stored in different tanks by kind, and the capacities of tanks should be calculated by kind of petroleum products, separately. Petroleum products of 139,000

tons will be discharged at Kelantan Port in 1987. Out of the total petroleum products, it is estimated that gasoline will account for 62 percent, kerosene 11 percent, diesel (fuel) oil 21 percent and aviation fuel 6 percent, respectively, considering the present transportation of each petroleum product by the Malayan Railway into Kelantan. Therefore, 86,200 tons of gasoline, 15,400 tons of kerosene, 29,400 tons of diesel (fuel) oil, and 8,000 tons of aviation fuel will be stored in the storage tanks.

The required capacity of tanks can be obtained by the following formula;

$V = N/R\alpha\gamma$

where, V: Capacity of Tank (m^3)
N: Annual Petroleum Products Stored (tons/year)
R: Rotation (times/year)
γ: Density of Petroleum Products (tonne/m^3)
α: Storage Ratio

(1) Gasoline

N = 86,200 tons, R = 40 times/year, γ = 0.87 tonnes/m^3, α = 0.90

Therefore, the required capacity of tanks will be 2,750 cu. meters, and five tanks (D = 8.7 m, H = 9.1 m) are planned in the storage area for petroleum products.

(2) Kerosene

N = 15,400 tons, R = 40 times/year, γ = 0.87 tonnes/m^3, α = 0.90

Therefore, the required capacity of tanks is 490 cu. meters, and three tanks (D = 5.8 m, H = 7.6 m) will be located in the storage area.

(3) Diesel (Fuel) Oil

N = 29,400 tons, R = 40 times/year, γ = 0.87 tonnes/m^3, α = 0.90

Therefore, the capacity of tanks required is 940 cu. meters, and four tanks (D = 6.8 m, H = 7.6 m) are planned in the storage area.

(4) Aviation Fuel

N = 8,000 tons, R = 40 times/year, γ = 0.87 tonnes/m^3, α = 0.90

Therefore, the capacity of tanks is 260 cu. meters, and three tanks (D = 4.8 m, H = 6.1 m) are planned.

The site of the petroleum product storage tanks should be about 10,000 sq. meters behind the dolphin, based on the number and dimension of the planned tanks mentioned above, and the safety standard for these dangerous facility as planed in Japan.

6-1-6 Access Road and Port Road

(1) Vehicle Traffic Volume

The planned traffic volume generated from the commercial port area is obtained by the following formula.

$$T = \frac{C}{W} \times \frac{\beta}{12} \times \frac{\gamma}{\epsilon} \times \frac{1+\delta}{\epsilon} \times \sigma$$

where, T: Planned Traffic Volume (vehicles/hour)

C: Volume of Cargoes Transported by Vehicle (tons/year)

W: Actually Loaded Cargo Volume per Vehicle (tons/vehicle)

β: Monthly Variation Rate

$$= \frac{\text{Cargo Volume in Peak Month}}{\text{Average Monthly Cargo Volume}}$$

γ: Daily Variation Rate

$$= \frac{\text{Cargo Volume on Peak Day}}{\text{Average Annual Cargo Volume}}$$

ζ: Average Number of Working Days per Month (day)

δ: Related Vehicle Rate

$$= \frac{\text{Number of Related Vehicles}}{\text{Total Number of Vehicles}}$$

ϵ: Rate of Actually Loaded Vehicles

$$= \frac{\text{Number of Vehicles Loaded with Cargoes}}{\text{Total Number of Vehicles}}$$

σ: Time Change Rate

$$= \frac{\text{Traffic Volume at Peak Hour}}{\text{Daily Traffic Volume}}$$

In this study, C = 491,000 tons/year, W = 4 tons/vehicle, β = 1.2, γ = 1.5, ζ = 30, δ = 0.5, ϵ = 0.5, σ = 0.16 are assumed. Therefore, the planned traffic volume is 300 vehicles per hour in 1987.

(2) Access Road

Since the hourly design traffic volume per lane is considered as 1,000 – 1,300 vehicles, two lanes of access road will be needed to cater to the traffic of 300 vehicles per hour generated from the commerical port area, and the general traffic to and from the area along the access road.

This two-lane road can probably be secured ty improving the existing road from the port area to Tawang which runs almost parallel to the River Kemasin, and no land acquisition will be needed.

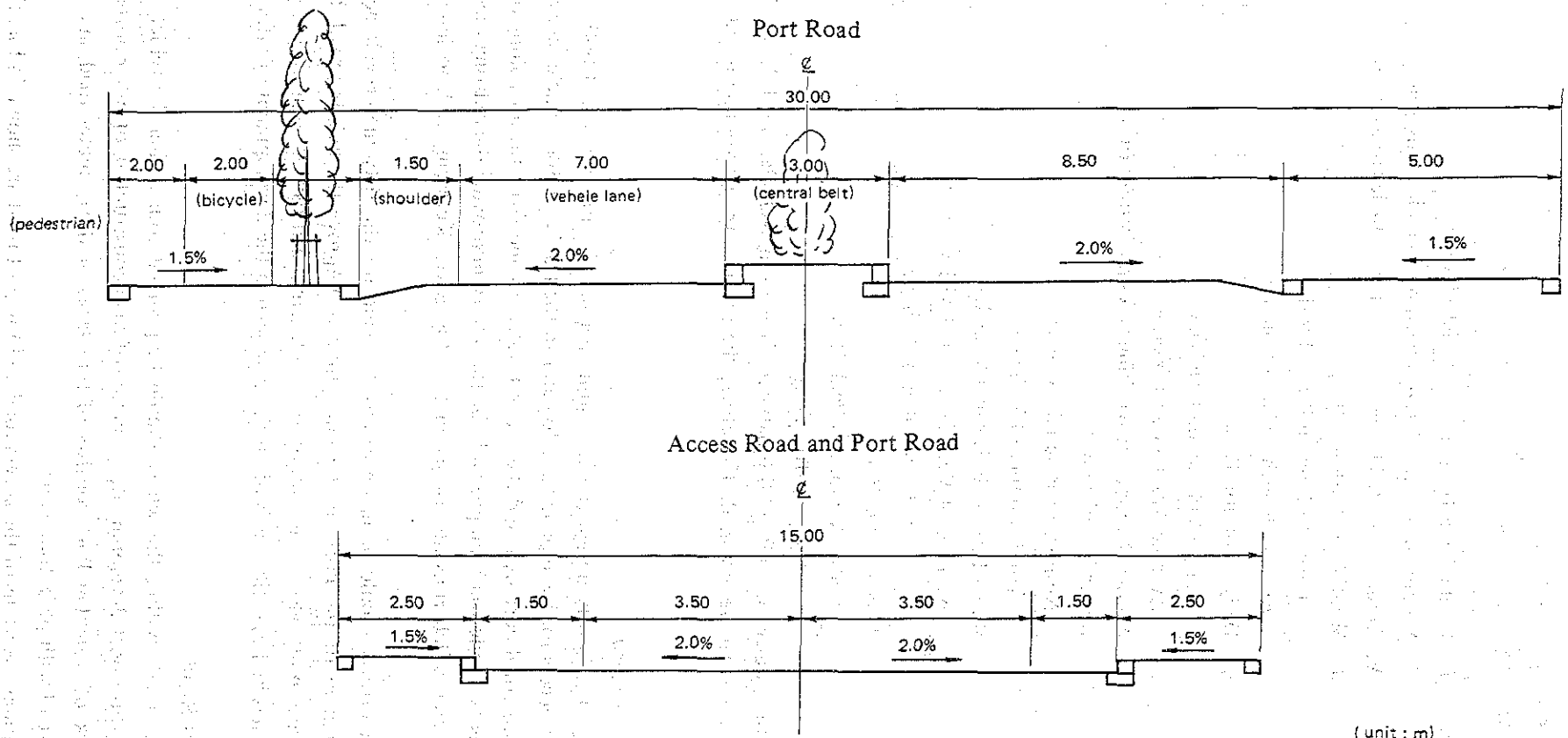
But efforts should be made to buy the land for the fifty meter-wide access road for future development of the Port, at the same time to improve the existing road. Because if houses or shops are built along the improved road, land acquisition will face many difficulties, or sometimes be impossible as is often the case seen in the development of infrastructures.

(3) Port Road

Port roads within the wharf should be planned considering the vehicle traffic of the target year, future port development, examples of road construction of other ports, etc. The port road network of Kelantan Port consists of four lanes of thirty meter road, and two lanes of fifteen meter road with pedestrian lanes.

Standard sections of the access road and the port road are shown in Fig. 6-3.

Fig. 6-3 Standard Sections of Access Road and Port Road (Commercial Port)



6-2 Fishing Port Facilities

6-2-1 Planning Conditions

(1) Dimension of Planned Fishing Boats

The dimension of planned fishing boats is one of the essential factors to determine the scale of fundamental facilities such as channel, basin, quay. According to the present statistics on the size of Kelantan's fishing boats, published by the fisheries Department of Kelantan, the dimensions are summarized as follows.

Tonnage (G.T.)	Length (m)	Width (m)	Depth (m)	Planned Water Depth (m)
– 9.9	11	3	1.2	2
10 – 19.9	14	4	1.5	2
20 – 49.9	21	5	2.1	3

Note: Full load draft is considered ninety percent of the depth of the boat.

(2) Condition of Fishing Boat Operation

Considering present operation methods, the operation condition of fishing boats which will use Kelantan Port is assumed as follows;

Gear Tonnage (G.T.)	Operation Trip
Trawl Net	
– 19.9	One Day Trip
20 – 49.9	Three Day Trip
Purse Seine Net	
10 – 19.9	One Day Trip
20 – 49.9	Three Day Trip
Drift/Gill Nets	
– 19.9	One Day Trip
Lift Net	
10 – 19.9	One Day Trip
Hook & Line	
– 19.9	One Day Trip

There are two types of operation for one day trip of trawl net, purse seine net, drift/gill net, lift net, and hook & line. One is a day-time operation of going out fishing in the morning and returning a port toward the evening, and the other is a night-time operation of going out fishing at night and returning to port in the morning. Out of the total fishing boats, seventy percent would be operated under the former type of fishing, and the remaining thirty percent would be under the latter type.

And, on the basis of the operation conditions of trawlers and purse seiners of between 20 to 49.9 gross tonnage class, two thirds of the total boats will operate at the fishing grounds, and the rest will use the facilities in the port in one day.

(3) Daily Marine Fish Landings

Average daily marine fish landings can be obtained by the following formula;

$$Ld = \Sigma N \times \frac{La}{T}$$

where, Ld: Average Daily Marine Fish Landings (tonnes)

N: Daily Number of Fishing Boats Landing Fish by Tonnage by Gear

La: Annual Landing of Marine Fish by Tonnage by Gear (tonnes)

T: Annual Number of Trips per Boat by Tonnage by Gear

$$= \frac{\text{Annual Operation Days by Tonnage by Gear}}{\text{Operation Days per Trip by Tonnage by Gear}}$$

The process and the result of calculation are shown in Table 6-1. It shows that the average daily marine fish landings is expected to be 58.5 tonnes at Kelantan Port in 1987.

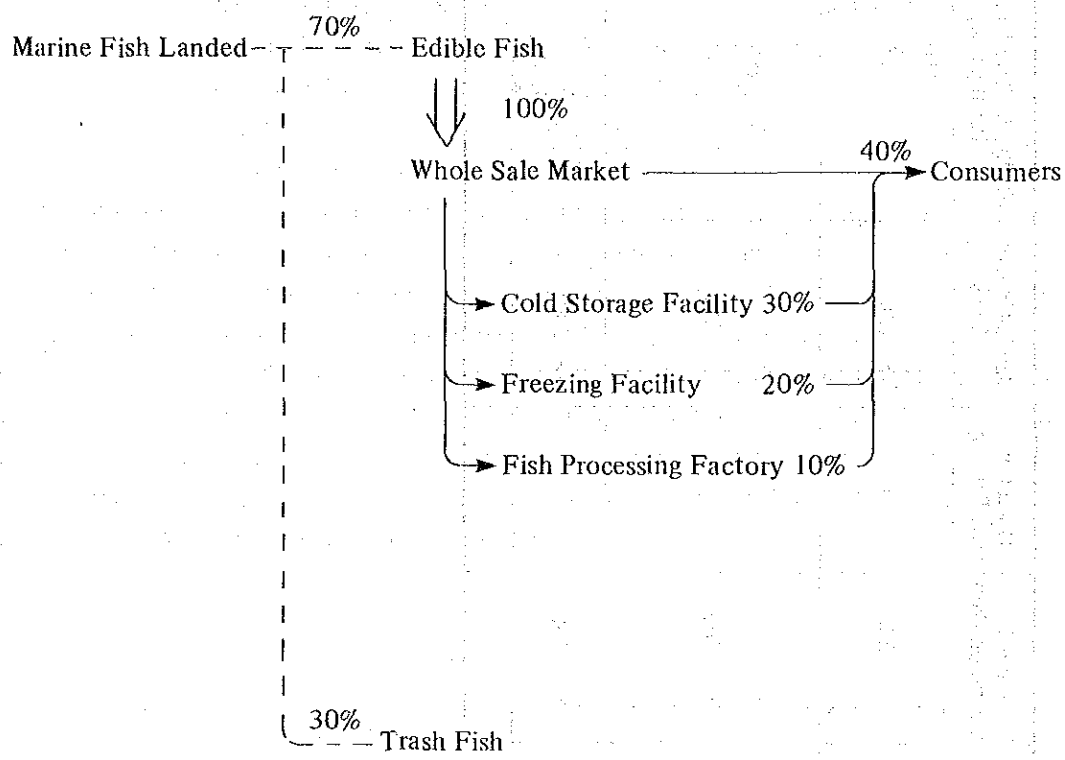
It is essential to estimate maximum daily fish landings in order to decide functioning facilities such as wholesale market, cold storage, freezing facility, ice factory, ice storage. The maximum daily fish landing can be calculated by multiplying the average daily landing estimated above, by the daily variation rate, which is the ratio of the fish landings on peak days to the average fish landings. The daily variation rate is assumed as 1.5, considering an actual monthly variation rate in Kelantan and Trengganu, and present daily landing of fish in Trengganu. Therefore, the maximum daily landings will be 87.8 tonnes in 1987.

Table 6-1 Average Daily Landings of Marine Fish (1987)

Tonnage	Gear	Daily No. of Fishing Boats	Annual Landings (tonne)	Annual Operation Days	Operation Days Per Trip	Annual No. of Trips	Dailly/Per Trip Landings Per Boat (kg)	Daily Landings (kg)
– 9.9	Trawl Nets	10	50	200	1	200	250	2,500
	Drift/Gill Nets	20	15				75	1,500
	Hook & Lines	20	15				75	1,500
10–19.9	Trawl Nets	20	80	200	1	200	400	8,000
	Lift Nets	20	90				450	9,000
	Purse Seine Nets	10	20				100	1,000
	Drift/Gill Nets	10	15				75	750
	Hook & Lines	10	15				75	750
20–49.9	Trawl Nets	8	110	250	3	80	1,375	11,000
	Purse Seine Nets	5	360				4,500	22,500
Total								58,500

(4) Distribution of Marine Fish

Edible marine fish, seventy percent of the total marine fish landed at Kelantan Port, will be distributed to consumers through various fishing port facilities, such as wholesale market, cold storage, and freezing facility. The distribution of marine fish and its porportion through each facility in 1987 are assumed as follows;



Therefore, the design daily volume of fish which will be handled at each facility in 1987, is calculated by multiplying the maximum daily fish landings by the proportions of the fish distribution flow.

Therefore, planned fish volume through each facility is estimated;

Wholesale Market	61.5 tonnes/day
Cold Storage Facility	18.5 tonnes/day
Freezing Facility	12.3 tonnes/day

6-2-2 Channel and Basin

(1) Port Entrance

The entrance of the fishing port is planned to be located between the east breakwater (I) and the east breakwater (II) to assure different navigation routes for cargo vessels and fishing boats. If the entrance is not planned at the proposed location, and fishing boats sail through or across the main access channel and the turning basin for cargo vessels, there would be greater possibilities of sea traffic accidents.

(2) Channel

Fishing boats can sail through the channel and the turning basin for oil tankers with a depth of 5.0 meters below the Datum Level from the fishing port entrance. But beyond the basin, an exclusive access channel for fishing boats is needed up to mooring facilities.

A basic method to determine the channel scale of a fishing port is the same as that of a commercial port. Full load draft of the planned fishing boat, triming, pitching, etc. should be considered to decide the depth of the channel. And the width of the planned fishing boat, the boat traffic, physical conditions, etc. should be taken into consideration in deciding the width of the channel.

Therefore from the dimension of the planned fishing boat, the planned depth and width of the channel should require 3.0 meters below the Datum Level and 40 meters, more than seven times the width of the boat, respectively. But actually the River Kemasin is wide and deep enough for fishing boats, and only maintenance work will be needed in the future.

(3) Basin

The scale of the basin for fishing boats is determined by the planned fishing boat dimension, mooring methods, etc.

The required width of the basin can be planned on the condition that the boat will enter parallel to the quay line and then berth at the quay vertically. According to the navigation of fishing boats, 3.8 times the planned length of the boat, or 80 meters of the width of the basin should be required in front of −3.0 meter quays, and 50 meters in front of −2.0 meter quays, including turning basins. In the first Phase Development Plan, or 80 meter wide basin is planned and maintained, considering operational convenience of the boats.

6-2-3 Mooring Facilities

Location of mooring facilities is planned parallel to the water flow on the right bank of the River Kemasin, considering commercial port facilities located on the opposite side of the river, wind direction at the north-west monsoon season, etc.

Mooring facilities are grouped by function into landing quay, preparation quay, and mooring quay.

It is necessary to decide one berth length, or required length of the quay when a boat lies alongside a quay, and one mooring length, or required length of the quay when a boat lies lengthwise on a quay, in order to calculate the scale of each mooring facility. According to the dimensions of the planned fishing boats already mentioned in the previous section, these deciding factors are as follows.

Tonnage (G.T.)	Once Berth Length (m)	One Mooring Length (m)	Planned Water Depth (m)
− 9.9	15	4	2
10 − 19.9	15	5	2
20 − 49.9	20	6	3

Number of fishing boats which will use Kelantan Port is shown in Table 5-57. Daily number of fishing boats which will land fish catches, and moor at quays can be obtained by dividing the

number of fishing boats by operation trip days. They are shown below.

Gear Tonnage	No. of Fishing Boats	Dail No. of Fishing Boats
Trawl Net		
– 9.9	10	10
10 – 19.9	20	20
20 – 49.9	24	8
Purse Seine Net		
10 – 19.9	10	10
20 – 49.9	15	5
Drift/Gill Net		
– 9.9	20	20
10 – 19.9	10	10
Lift Net		
10 – 19.9	20	20
Hook & Line		
– 9.9	20	20
10 – 19.9	10	10

(1) Landing Quay

Landing quay is a kind of quay where fishing boats land fish exclusively and usually berth alongside.

The required length of the quay can be calculated by the following formula, which is called "Alongside Quay Rotation Method".

$$L = \Sigma \frac{N}{\gamma} \times \ell$$

where, L: Required Length of Landing Quay (m)

N: Daily Number of Fishing Boats Using Landing Quay by Type

γ: Rotation by Type (times/day)

$$= \frac{\text{Daily Landing Hours at the Quay}}{\text{Landing Time per Boat}}$$

ℓ: One Berth Length by Type (m)

Daily landing hours at the port are assumed to be three hours both in the morning and in the evening. And the landing time will require half an hour for trawlers and purse seiners of 20 – 49.9 G.T., and ten minutes for the remaining fishing boats, considering present operations.

The process of calculation is shown in Table 6-2.

The Table shows that the required length of –3.0 meter landing quay is 50 meters, and that of –2.0 meter is 75 meters.

(2) Preparation Quay

The preparation quay, where fuel oil and ice will be supplied to the fishing boats, should be located nearer the port entrance, if possible.

The "Alongside Quay Rotation Method" is also employed to decide the required length of the preparation quay. That is, the length can be obtained by the formula;

$$L' = \Sigma \frac{N'}{\gamma'} \times \ell$$

where, L': Required Length of Preparation Quay (m)

N' Daily Number of Fishing Boats Using Preparation Quay by Type

γ' Rotation by Boat Type (times/day)

$$= \frac{\text{Daily Supply Hours at the Quay}}{\text{Supply Time per Boat}}$$

ℓ: One Berth Length by Type (m)

Daily supply time at the quay is assumed to be two hours both in the morning and in the evening.

And the supply time will be six minutes for ice, and five minutes for fuel oil, taking into consideration present operations.

The calculation process is shown in Table 6-3, and the result shows that the required length of 3.0 meter deep quays is 25 meters, and that of 2.0 meter is 60 meters.

(3) Mooring Quay

Mooring Quays would be provided in the inner side of the port in order to avoid interruption of sailing out to sea, and coming into the landing quays of fishing boats. Usually the boat uses the quay by mooring lengthwise in one or two rows.

The required length of mooring quay is gained by the following formula.

$L = \Sigma n \times B \times \alpha$

where, L: Required Length of Mooring Quay (m)

n: Daily Number of Fishing Boats Using Mooring Quay by Type

B: One Mooring Length by Type (m)

α: Mooring Method (Single or Double File) by Type

Fishing boats of less than 10 G.T. are supposed to use their own existing mooring facilities at the river side, therefore, those boats are excluded from the planned number of daily fishing boats.

The process of calculation is shown in Table 6-4, and the required length of 3.0 meter quay and 2.0 meter quay are 78 meters and 175 meters, respectively.

(4) Required Length of Quay for Refuge

At rough seas which make fishing operation impossible at fishing grounds, all fishing boats except for less than 10 G.T. class boats should be allowed to anchor safely at the port.

It is desirable that all boats can berth at relevant mooring quays during heavy seas, but this is very uneconomical. Therefore, the boats should be moored vertically in double file at the quay.

The calculation of the required length of the mooring quay for refuge is made as shown in Table 6-5, which says the necessary length will be assured if the required landing, preparation and mooring quays are constructed in the port.

Table 6-2 Required Length of Landing Quay (1987)

Boat Tonnage	Gear	No. of Boats	Depth of Water (m)	1 Berth Length (m)	Trip Days	Daily No. of Boats		Daily Landing Hours at Quay (hr)		Landing Time per Boat (min)	Rotation	No. of Berths Required		Required Length of Quay (m)	
						(M)	(A)	(M)	(A)			(M)	(A)	(M)	(A)
−9.9	Trawl Nets	10	2	15	1	3	7	3	3	10	18	0.2	0.4	2x15 =30	5x15 =75
	Drift Gill Nets	20				6	14					0.3	0.8		
	Hook & Lines	20				6	14					0.3	0.8		
10−19.9	Trawl Nets	20	2	15	1	6	14	3	3	10	18	0.3	0.8		
	Lift Nets	20				6	14					0.3	0.8		
	Purse Seine Nets (Others)	10				3	7					0.2	0.4		
	Drift Gill Nets	10				3	7					0.2	0.4		
	Hook & Lines	10				3	7					0.2	0.4		
20−49.9	Trawl Nets	24	3	25	3		8		3	30	6		1.3		2x25 =50
	Purse Seine Nets (Fish)	15					5						0.8		

Note (M): Morning
(A): Afternoon

Table 6-3 Required Length of Preparation Quay (1987)

Boat Tonnage	Gear	No. of Boats	Ice Oil	Depth of Water (m)	1 Berth Length (m)	Trip Days	Daily No. of Boats (M)	Daily No. of Boats (A)	Daily Supply Hours at Quay (hr) (M)	Daily Supply Hours at Quay (hr) (A)	(min)	Rotation	No. of Berths Required (M)	No. of Berths Required (A)	Required Length of Quay (m) (M)	Required Length of Quay (m) (A)
10–19.9	Trawl Nets	14	Ice	2	15	1	14		2		6	20	0.7		4×15 =60	4×15 =60
			Oil					14		2	5	24		0.6		
		6	Ice					6		2	6	20		0.3		
			Oil				6		2		5	24	0.3			
	Lift Nets	14	Ice				14		2		6	20	0.7			
			Oil					14		2	5	24		0.6		
		6	Ice					6		2	6	20		0.3		
			Oil				6		2		5	24	0.3			
	Purse Seine Nets (Others)	7	Ice				7		2		6	20	0.4			
			Oil					7		2	5	24		0.3		
		3	Ice					3		2	6	20		0.2		
			Oil				3		2		5	24	0.1			
	Drift Gill Nets	7	Ice				7		2		6	20	0.4			
			Oil					7		2	5	24		0.3		
		3	Ice					3		2	6	20		0.2		
			Oil				3		2		5	24	0.1			
	Hook & Lines	7	Ice				7		2		6	20	0.4			
			Oil					7		2	5	24		0.3		
		3	Ice					3		2	6	20		0.2		
			Oil				3		2		5	24	0.3			
20–49.9	Trawl Nets	24	Ice	3	25	3	8		2		6	20	0.4		25	25
			Oil					8		2	5	24		0.3		
	Purse Seine Nets (Fish)	15	Ice				5		2		6	20	0.3			
			Oil					5		2	5	24		0.2		

Note (M): Morning
(A): Afternoon

Table 6-4 Required Length of Mooring Quay (1987)

Tonnage	Gear	No. of Boats	Depth of Water (m)	1 Mooring Length (m)	Daily No. of Boats	Mooring Method	Required length of Quay (m)
10–19.9	Trawl Nets	20	2	5	20	Double	50
	Lift Nets	20			20		50
	Purse Seine Nets (Others)	10			10		25
	Drift/Gill Nets	10			10		25
	Hook & Lines	10			10		25
							175
20–49.9	Trawl Nets	24	3	6	8	Single	48
	Purse Seine Nets (Fish)	15			5		30
							78

Table 6-5 Required Length of Quay for Refuge (1987)

Tonnage	Gear	No. of Fishing Boats	Water Depth (m)	1 Mooring Length (m)	Required Length of Quay (m)
10–19.9	Trawl Nets	20	2	5	175
	Lift Nets	20			
	Purse Seine Nets	10			
	Drift/Gill Nets	10			
	Hook & Lines	10			
20–49.9	Trawl Nets	24	3	6	117
	Purse Seine Nets	15			

Mooring Method: Double file system for less than 49.9 tonnage class boats

(5) Planned Length of Quays

The planned length of mooring facilities is determined based on the required length of each quay, and taking into consideration the layout of each quay.

As a result, the −3.0 meter quays of 290 meters and −2.0 meter quays of 175 meters are planned, despite the fact that the former require 153 meters and the latter needs 310 meters from the calculation.

6-2-4 Wholesale Market

The wholesale market (Selling Place) is planned to be located just behind the landing quays considering convenience of fish handling, and to have loading places for trucks which transport fish to the consuming area.

The scale of the wholesale market can be obtained by the following formula.

$$S = \frac{N \times a}{R \times \alpha}$$

where, S: Necessary Area for Wholesale Market (m^2)
N: Quantity of Fish Handled Per Day (tonnes/day)
a: Unit Area Per Tonne (m^2/tonne)
R: Rotation (times/day)
α: Occupancy Ratio

N is 61.5 tonnes as already gained in the previous section, and a, R, and α are assumed 34 m^2/tonne, 2 times/day and 0.4, respectively in 1987. Therefore, the necessary area is 2,600 sq. meters, but a wholesale market of 3,000 sq. meters (30 m x 100 m) is planned, considering future increase of fish landing. The market width is planned for 30 meters, in order to make it possible to use handling machines such as fork lifts, belt conveyors, etc.

6-2-5 Cold Storage and Freezing Facilities

(1) Cold Storage Facility (C_2 Class, −5°C)

Location of cold storage is planned to be near the wholesale market, and accessible to port roads and access roads leading to the hinterland.

The capacity and scale of the cold storage are designed as follows.

The maximum daily marine fish which will be stored in a cold storage facility in 1987, is estimated at 18.5 tonnes. Assuming that seven times the maximum daily fish are stored at the cold storage facility, the capacity will require 130 tonnes. The facility is, however, planned to have a capacity of 150 tonnes, taking into account the future increase of the landings. Therefore, the normal storage capacity of the facility is 380 tonnes on the assumption that the occupancy ratio is 40 percent.

The required area of the cold storage facility is approximately 1.2 times the dimension of the normal storage capacity, considering storage capacity per cu. meter, effective height of the cold room, etc. Therefore, the facility is planned to have 450 sq. meters.

And the site area of the facility is three times larger than the required area obtained above, accordingly 1350 sq. meters will be needed.

(2) Freezing Facility (F Class, −30°C)

The freezing facility is planned to be located adjacent to the cold storage facility.

The capacity and scale of the freezing facility are planned in almost the same way as those of the cold storage facility.

Maximum daily volume of fish, stored in the facility in 1987, is calculated at 12.3 tonnes in the previous section. The required capacity of the facility should be 90 tonnes on the assumption that seven times the maximum daily fish storage will be kept in the facility. Therefore the capacity is planned at 100 tonnes, considering the growth of future fish landings at the port.

And the normal freezing capacity is 200 tonnes since the occupancy ratio is assumed to be a bit larger than that of cold storage facility, or fifty percent.

The planned areas of the facility and the construction site are obtained in the same manner as those for the cold storage facility. Therefore, the facility area of 250 sq. meters and a site area of 750 sq. meters should be planned respectively.

6-2-6 Ice Factory and Ice Storage Facility

The ice factory and ice storage facility should be located near the preparation quay and the wholesale market. So the ice factory and ice storage facility are planned to be just behind the preparation quay, and next to the wholesale market, what is called the first line site, and in this case, the road should be built between the facility and the apron for the convenience of ice supply and transportation of fish.

The capacity of ice making is determined by the estimate of ice demand for fishing operations and the transport of fresh fish to consuming areas, mainly, Kota Bharu. The required daily volume of ice is estimated at 45 tonnes, assuming that half of the fish catch for ice will be necessary to keep fish fresh while the boat is operating. And the necessary ice for transportation to the hinterland directly through the wholesale market, and the cold storage facility is also 45 tonnes on the assumption that the required volume of ice will be equal to the quantity of fresh fish to be carried. Therefore, the ice making capacity is planned for 100 tonnes per day, considering future increase of fish landings.

The planned storage capacity of ice would be 300 tonnes per day, three-day ice making capacity.

And necessary areas of the facility and the site are estimated to be approximately 1,000 sq. meters and 1,400 sq. meters respectively, according to the example in Japan.

6-2-7 Oil Tank

Daily supply of fuel oil for fishing boats can be calculated, based on the data of the daily number of fishing boats, horse power of the boat engine, fishing operation, etc. by tonnage by gear.

The process of the calculation is shown in Table 6-6, which shows that the total horse power is 57,200 H.P.

Assuming that the hourly oil consumption of an engine is 200 grams per HP, the required quantity of oil to be supplied to fishing boats is estimated at 12 tonnes or 15 kl daily. Since three times the daily oil consumption should be stored at the storage facility, the necessary oil tank capacity will be 50 kl in 1987.

Therefore, four movable oil tanks, whose capacity is 14 kl each, are planned.

Table 6-6 Total Daily Horse Power of Fishing Boats Using Kelantan Port (1987)

Tonnage	Gear	Daily No. of Fishing Boats	Average Horse Power of Fishing Boat	Sailing Hours	Operation Days	Total Horse Power
– 9.9	Trawl Nets	10	20	6	1	6,000
	Drift/Gill Nets	20				
	Hook & Lines	20				
10–19.9	Trawl Nets	20	25	6	1	10,500
	Lift Nets	20				
	Purse Seine Nets	10				
	Drift/Gill Nets	10				
	Hook & Lines	10				
20–49.9	Trawl Nets	8	110	12		31,680
	Purse Seine Nets	5	60	10		9,000
	Total					57,180

6-2-8 Access Road and Port Road

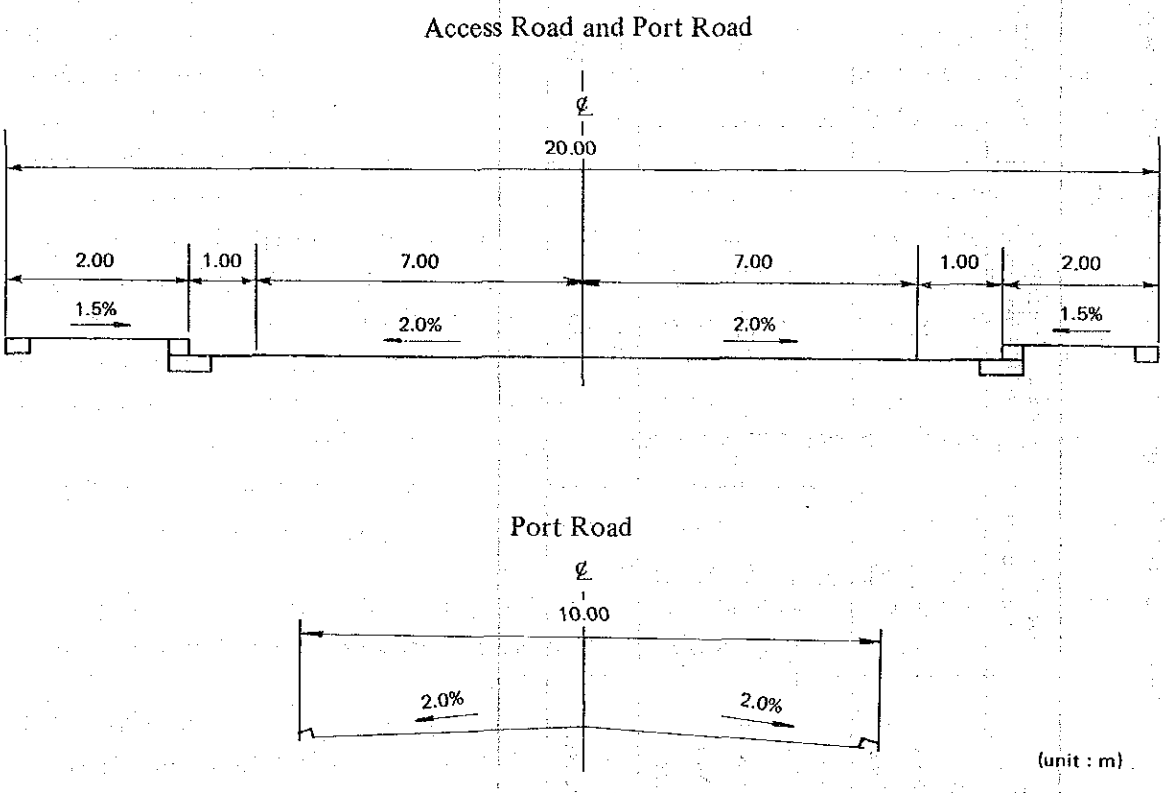
The access road connecting the fishing port to the hinterland is planned to be 20 meters wide with two lanes one way.

In the newly built section of the access road, the road should be constructed with a full scale 20 meter width, although within the section of improving the existing road, a one lane one-way access road could meet the actual traffic need for the time being, if land aquisition to siden the road faces too much difficulty. But, in that case, efforts should be made to buy land for the 20 meter road up to a point where it will connect with the truck road.

In the port area, two kinds of port roads are planned, one is a 20 meter wide road, facing important functioning facilities such as the wholesale market, cold storage, ice factory, and the other is a 10 meter wide road, joining the apron and the former port road.

Standard sections of the acess road and the port road are shown in Fig. 6-4.

Fig. 6-4 Standard Sections of Access Road and Port Road (Fishing Port)



6-3 Layout Plan of Port Facilities

The location of main commercial and fishing port facilities have already been described in the two previous sections, 6-1 and 6-2. As a whole, commercial port facilities are planned in the newly reclaimed land and on the left bank of the River Kemasin, and on the right bank of the river fishing port facilities. The overall layout of those port facilities is summarized as the First Phase Development Plan (Plan C), Fig. 6-5. The layout and cross section of terminal facilities of the commercial port zone are shown in Fig. 6-6 and 6-7, and those of fishing port facilities in land are designed as shown in Fig. 6-8 and 6-9.

Fig. 6-5 The First Phase Development Plan of Kelantan Port (Plan C)

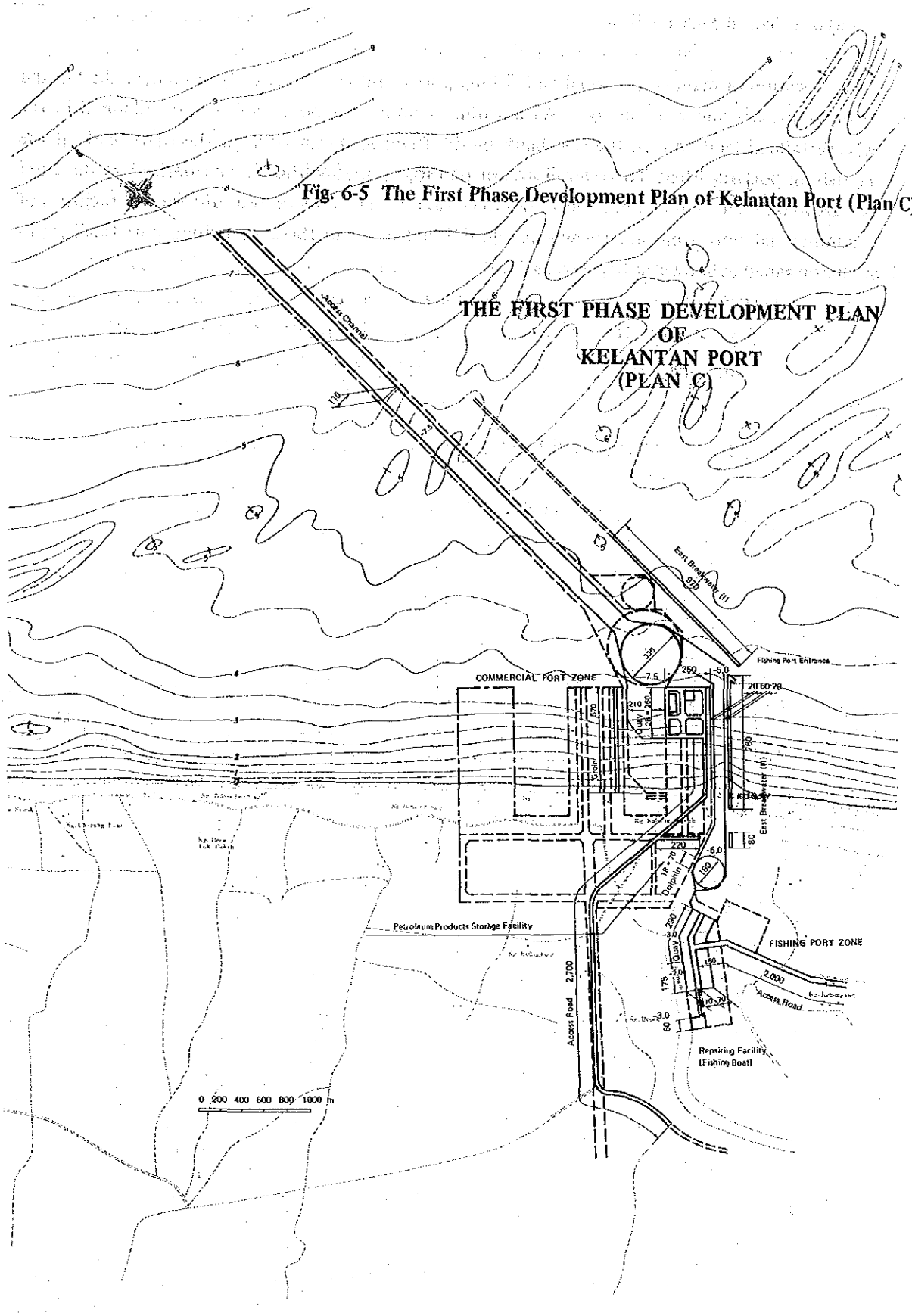


Fig. 6-6 Layout of Terminal Facilities

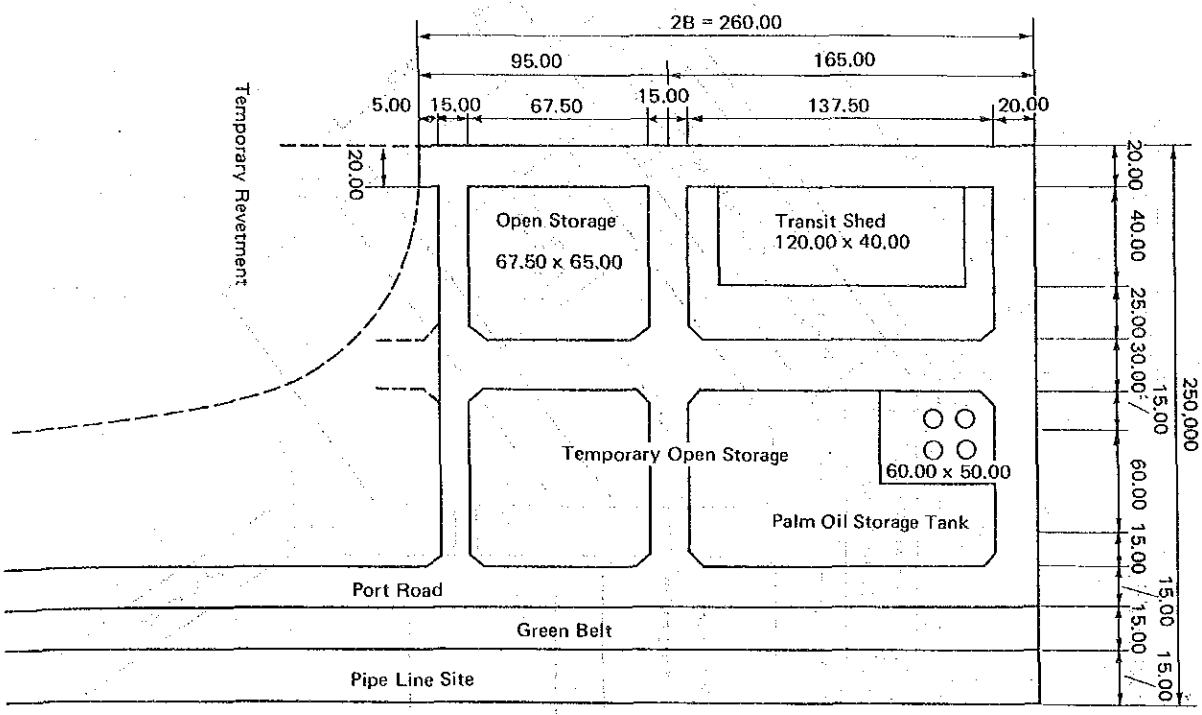


Fig. 6-7 Cross Section for Commercial Port Wharf

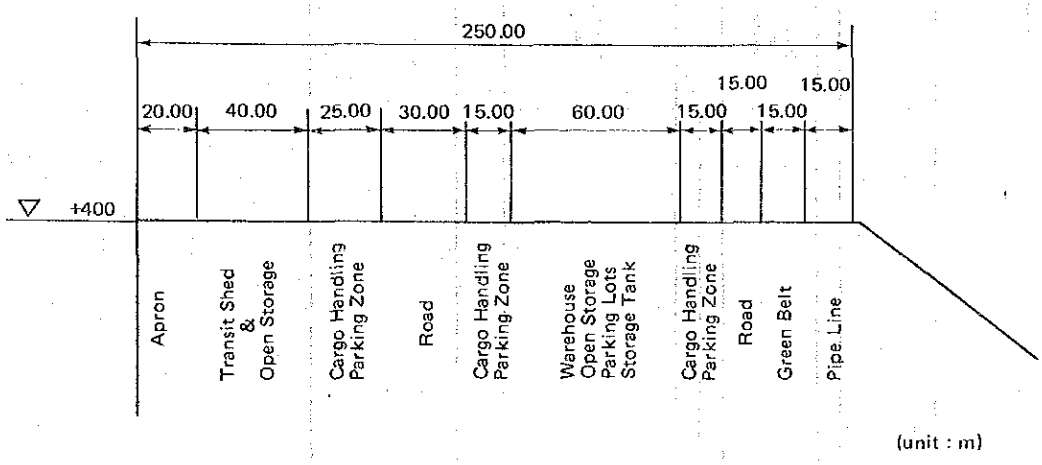


Fig. 6-8 Layout of Fishing Port Facilities

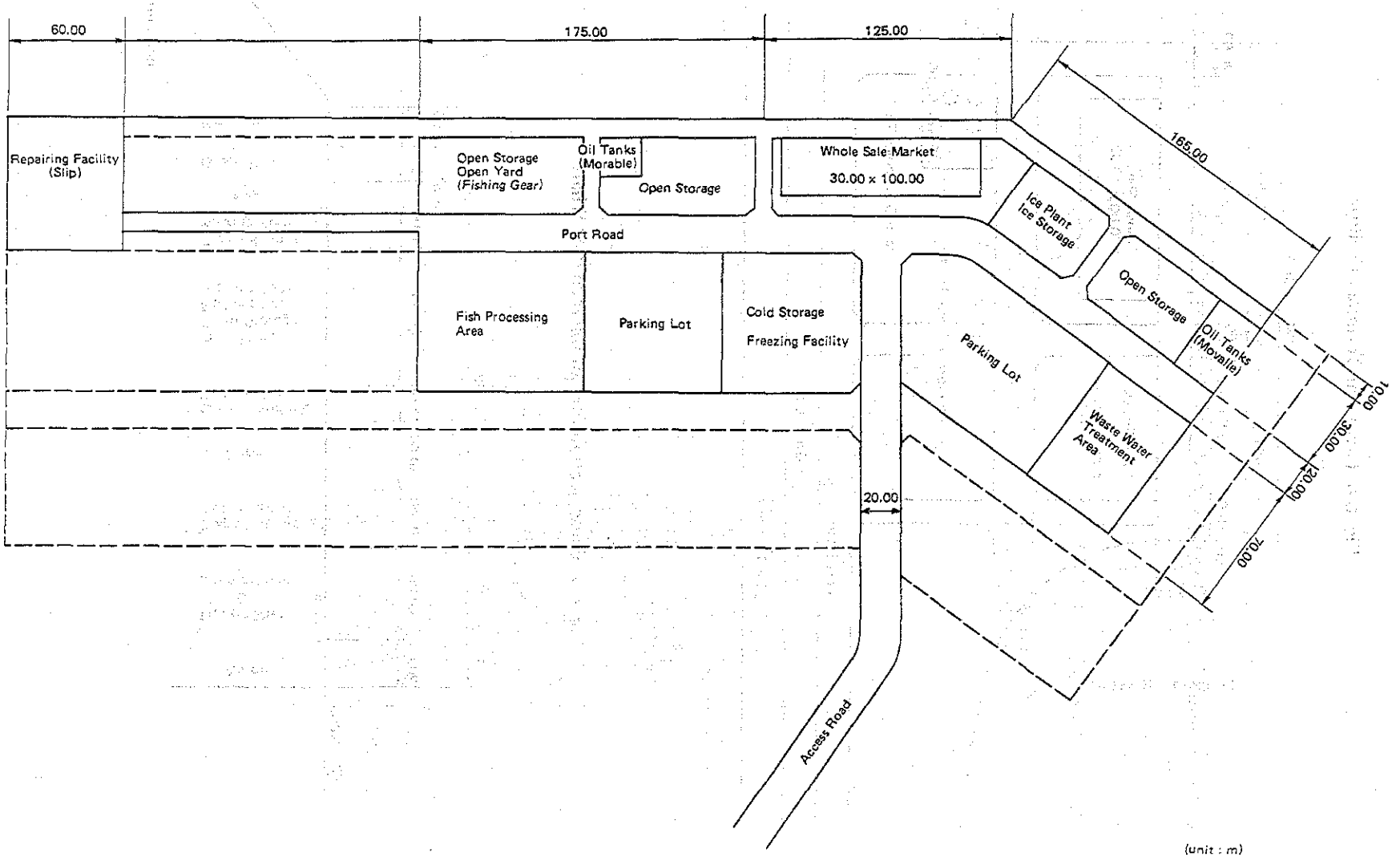
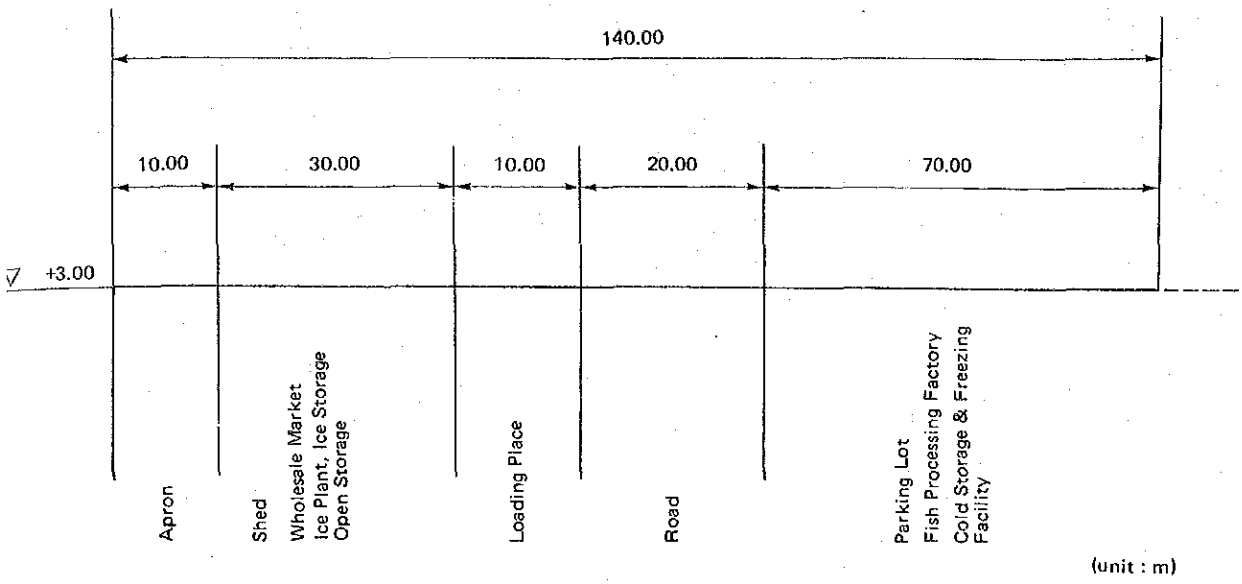


Fig. 6-9 Cross Section for Fishing Port



CHAPTER 7 DESIGN, CONSTRUCTION AND COST ESTIMATE

CHAPTER 7 DESIGN, CONSTRUCTION AND COST ESTIMATE

7-1 Design Conditions

① Tidal Levels

H.H.W.L.; +1,927 m, M.S.L.; +1,090 m
R.L.; +0.957 m, L.L.W.L.; +0.187 m
D.L.; ±0.000 m
(Reference should be made to "2-3-2 Tidal Levels")

② Design Wave

Design wave height; H 1/3 = 2.5 m
Design wave period; T 1/3 = 8 sec
Wave direction; NE -- ENE
(Reference should be made to "2-3-1 Waves")

③ Design Seismic Coefficient

Horizontal seismic coefficient Kh = 0.00
(Reference should be made to "1-1-6 Earthquakes")

④ Design Loads (Uniform Loads)

Transit shed/Open storage; $q = 3\ t/m^2$
Commercial port zone facilities (−7.5 m quay); $q = 2\ t/m^2$
Fishing port zone facilities (−2.0 m quay/−3.0 m quay); $q = 1\ t/m^2$

⑤ Top Elevation

Seawall; +4.0 m
East breakwater (I); +4.5 m (parapet; +5.5 m)
East breakwater (II); +4.0 m (parapet; +4.5 m)
Groin; +4.0 m (parapet; +4.5 m)
−7.5 m Quay; +4.0 m
−2.0 m Quay/−3.0 m Quay; +3.0 m

⑥ Objective Vessels

Approaching Velocity
5,000 D.W.T. General cargo ship; V = 0.15 m/sec
1,000 D.W.T. Oil tanker; V = 0.20 m/sec
50 G.T. – 20 G.T. Fishing boat; V = 0.50 m/sec

Table 7-1 Standard Size of Objective Vessels

Tonnage	Kind of vessels	Overall length (m)	Molded breadth (m)	Molded depth (m)	Full load draft (m)	Depth of basin (m)
5,000 D.W.T	General cargo ship	103	15.4	8.4	6.8	-7.5
1,000 D.W.T	Oil tanker	57	9.4	4.5	4.2	-5.0
50 G.T	Fishing boat	21	5.0	2.1	1.9	-3.0
20 G.T	Fishing boat	14	4.0	1.5	1.4	-2.0

⑦ Allowable stress intensities

Concrete; $\sigma ca1 = 100\ kg/cm^2$ (for P.C. pile)

$\sigma ca2 = 80\ kg/cm^2$ (for reinforced concrete)

$\sigma ca3 = 53\ kg/cm^2$ (for plain concrete)

($\sigma ca1$, $\sigma ca2$, $\sigma ca3$; allowable compressive stress intensity)

Reinforcing bar; $\sigma sa1 = 1{,}400\ kg/cm^2$

Steel structure; $\sigma sa2 = 1{,}400\ kg/cm^2$

Steel sheet pile; $\sigma sa3 = 1{,}800\ kg/cm^2$

($\sigma sa1$, $\sigma sa2$, $\sigma sa3$; allowable tensile stress intensity)

Under an unusual condition, 50% increase of the foregoing values respectively.

⑧ Safety Factors

Table 7-2 Safety Factors

Items	Safety Factors	
	Usual	Unusual
Circular failure	1.3	1.1
Sliding	1.2	1.1
Overturning	1.2	1.1
Bearing of Pile	2.5	2.0
Pulling of Pile	3.0	2.5

⑨ Durable Years

Durable years of seawall, breakwater, groin and quay are taken as 50 years.

⑩ Corrosion of Steel

Steel pipe pile and steel sheet pile are protected from corrosion by cathodic protection for

the first 20 years of the 50 years (durable years of the quay) and by increasing the material thickness for the remaining 30 years in this design. Corrosion rates on one side of the steel is shown in Table 8-3.

Table 7-3 Corrosion Rates

Corrosive Environment	Corrosion Rates (mm/yr)
In sea water:	
Above HWL	0.15
Portion between HWL and sea bottom	0.10
In soil:	
Above residual water level	0.025
Below residual water level	0.015

⑪ Soil Conditions

(Reference should be made to "2–4 Soil Conditions")

⑫ Weights of Armor Stones and Concrete Blocks

The weights of armor stones or concrete blocks covering the slope surface of a structure may be calculated by Hudson's formula.

$$W = \frac{\gamma r\, H^3}{K_D (S\gamma - 1)^3 \cot\alpha}$$

where W; Minimum weight of armor stone or concrete block (t)

γr; Unit weight of armor stone or concrete block in air (t/m^3)

Sr; Specific gravity of armor stone or concrete block to sea water

α; Angle of the slope to horizontal plane (degrees)

H; Significant wave height (m)

K_D; Constant determined by the armoring material and damage rate

i) Weight of Armor Stone

$\gamma r = 2.65\ t/m^3$, Sr = 2.57, $\cot\alpha = 1.333$, $K_D = 2.8$, H = 2.5 m, 2.0 m, 1.5 m

Case A-1; H = 2.5 m

$$WA\text{-}1 = \frac{2.65 \times (2.5)^3}{2.8 \times (2.57-1)^3 \times 1.333} = 2.9\ t < 4\ t$$

Case A-2; H = 2.0 m

$$WA\text{-}2 = \frac{2.65 \times (2.0)^3}{2.8 \times (2.57-1)^3 \times 1.333} = 1.5\ t < 2\ t$$

Case A-3; H = 1.5 m

$$WA\text{-}3 = \frac{2.65 \times (1.5)^3}{2.8 \times (2.57-1)^3 \times 1.333} = 0.6 < 1\ t$$

ii) Weight of Armor Concrete Block

$\gamma r = 2.3\ t/m^3$, $Sr = 2.23$, $\cot\alpha = 1.333$, $K_D = 5-8$, $H = 2.5\ m$

Case B-1; $H = 2.5\ m$, $K_D = 5$

$$WB\text{-}1 = \frac{2.3 \times (2.5)^3}{5.0 \times (2.23-1)^3 \times 1.333} = 2.9 < 4\ t$$

7-2 Construction Plan

There are no anchorage facilities for a construction craft near the proposed construction site. Accordingly, the construction of breakwater, seawall and groin should be started first of all to get a calm water area. These port facilities are constructed by the end-on system using construction equipments such as dump trucks and bulldonzers. Dredging and pile driving are carried out after a safe basin is provided for large construction crafts such as a pump dredger, a pile driving barge and so on.

7-2-1 Natural Conditions

Marine conditions are very important for the works at sea using construction craft. During the NE monsoon season from November to March, the sea is rough with many rainy days. Consequently, the work efficiency in dredging and pile driving may decrease, and this should be taken into account in planning the schedule of construction works.

7-2-2 Capability of Construction

Since there is no contractor having enough capability at the site and its vicinities, the contractor has to be introduced from the outside of the state. The construction work requires many skilled laborers, but they are scarcely recruited.

7-2-3 Construction Equipment

The construction work requires large construction crafts such as a pump dredger, a grab dredger and a pile driving barge. Since they are not available at the site, they must be brought from Singapore or any other areas. Construction equipments such as bulldozers, shovels, cranes and others may be partly available at the site, but most of them have to be grought from Kuala Lumpur and any other places.

7-2-4 Construction Materials

Available construction materials at the site and its vicinities are timber, sand and stone. There is no problem with timber as it is available in abundance. River sand which is used as fine aggregate for concrete is produced at the Sg. Kelantan. However, since the current production facilities are very small, it is necessary to increase the productive capacity.

There are three quarries in the vicinities of the site. They are Bt. Marak Quarry (private, 24 km from the site), Bt. Gunong Quarry (private, 32 km) and Bt. Buloh Quarry (private and public, 53 km) and they all produce good granite.

The Bt. Buloh Quarry is the largest in scale and is equipped with a large asphalt plant, but is is the farthest of the three from the site. The Bt. Marak Quarry is the nearest and produces granite of the best quality, thus making it easy to obtain armor stones (2 t – 1 t); but it is the smallest in scale.

Cement and reinforcing bars have to be brought from other areas.

Steel sheet piles and steel pipe piles have to beimported from abroad and transported overland from Penang Port or Port Kelang.

7-2-5 Construction Base

A part of the proposed site of the commercial port zone is to be used for the construction base.

7-3 Construction Plan

7-3-1 Commercial Port Zone Facilities (A)

(1) Seawall (A-1)

The structure of the seawall is a rubble mound type. Rubbles (50 – 200 kg) are deposited by the end-on system using dump trucks and bulldozers. Since the location of the seawall is inside of the port, the weight of armor stone is designed to be 1 t. The slope of the mound is set at 1:4/3. The leveling of rubbles and armor stones is made by diving boats (equipped with a 3 t winch) under water and by crawler cranes (capacity 25 t) above water. The total length of the seawall is as follows: $\ell = 40 + 570 + 250 + 20 = 880$ m. Fig. 7-1 shows the standard cross section of the seawall.

(2) Breakwater (A-2)

There are two kinds of breakwaters with the total length of 1,810 m: east breakwater (II) (length $\ell_{II} = 80 + 760 = 840$ m) and east breakwater (I) (length $\ell_I = 960$ m). The east breakwater (II) is a rubble mound type with rubbles (50 – 200 kg) deposited by the end-on system.

The weight of armor stones is designed to be 2 t for those facing the outside of the port and 1 t for those facing the inside. The top elevation of the east breakwater (II) is +4.0 m and that of the parapet is +4.5 m.

The east breakwater (I) is also a rubble mound type with rubbles (50 – 200 kg) deposited by the end-on system. Armor stones (200 – 400 kg) and armor concrete blocks (equivalent to 4 t) are used for the outer side as it will be directly hit by strong waves. An example with tetrapods is shown here. The armor stones (1 t) are used for the inner side.

Armor concrete blocks are set by a crawler crane (capacity 40 t) operating on land.

The top elevation of the east breakwater (I) is +4.5 m and that of the parapet is +5.5 m. Fig. 7-2 and Fig. 7-3 show the standard cross sections of the breakwater.

(3) Groin (A-3)

The structure of the groin is same as that of the east breakwater (II). The total length is $\ell = 570$ m. Fig. 7-2 shows the standard cross section of the groin.

(4) Dredging/Reclamation (A-4)

The total volume of dredging is 2,300,000 m^3, but the materials allocated for reclamation is 1,640,000 m^3. The remaining 660,000 m^3 will be dumped on the western side of the groin where shore erosion is anticipated and also in the swampy area around the estuary of Sg. Kemasin. Dredging work is carried out with one pump dredger (D4000PS) and two grab dredgers (D350PS with grab capacity 4 m^3).

The discharge length of the pump dredger is assumed to be 3,000 m, and the soil to be sand with N value at approximately 5. Assuming the working hour is 18 hours per day, the volume of dredging is 13,900 m^3/day.

$Q_D = 770\ m^3/h \times 18\ h/day = 13{,}900\ m^3/day$

It is assumed that they operate 10 hours per day, the volume of dredging by two grab

dredgers is 2,500 m^3/day.

Q_D = 125 m^3/h x 10 h/day x 2 vessels = 2,500 m^3/day

(5) −7.5 m Quay (A-5)

The structure of the −7.5 m quay is a steel sheet pile type. The −7.5 m quay under the first phase development plan (Plan C) is located at the place where the −9.0 m quay will be constructed under the master plan (Plan C). Accordingly, the −7.5 m quay should be designed so as to be able to increase the depth to −9.0 m in the future.

The driving work of steel pipe piles (ϕ812.8 x 16.0 t, ℓ = 14 m) and steel sheet piles (SP -VIL; ℓ ñ 22 m) is made by a pile driving barge equipped with a diesel pile hammer (D-22). It is made at a rate of 4.5 piles/day for steel pipe piles and 19 sheets/day for steel sheet piles. After the driving of steel pipe piles and steel sheet piles, tie-wire rope (F270T, ϕ55.5 mm, ℓ = 19 m) is set. After back filling of the steel sheet piles with rubbles (10 – 20 kg), the front of quay is dredged to water depth of −7.5 m.

The pile driving barge is brought from Singapore. Fig. 7-4 shows the standard cross section of the −7.5 m quay and Fig. 7-5 shows that of the −9.0 m quay.

(6) Transit shed (A-6)

One transit shed (120 m x 40 m) with the steel frame, the roof of corrugated asbesto cement slate, and concrete floor is designed.

(7) Building (A-7)

The building is made of reinforced concrete. The total floor space is 2,400 m^2 with 900 m^2 for an administration office, 200 m^2 for a clinic, 200 m^2 for a fire station, 200 m^2 for a canteen, 450 m^2 for a customoffice and 450 m^2 for others.

(8) Oil Tanks (Palm Oil) (A-8)

Four 500 kl oil tanks for storing palm oil are constructed together with 300 m of pipeline, 250 m of duct for pipeline and oil bank.

(9) Port Road (A-9)

The road is paved with asphalt. Materials for asphalt pavement are transported from the large asphalt plant at the Bt. Buloh Quarry. The total port road area is 39,000 m^2, which is broken down as follows:

30 m road x 250 m = 7,500 m^2

15 m road x 2,000 m = 30,000 m^2

Widening of apron 10 m x 150 m = 1,500 m^2

(10) Access Road (A-10)

The existing unpaved road from the terminal point of the paved road at Kg. Tawang to the commercial port zone is improved. The access road is paved with asphalt and the total access road area is 23,000 m^2.

15 m road x 1,500 m = 22,500 m^2 ≒ 23,000 m^2

(11) Asphalt Pavement (A-11)

A part of the open storage, the car park and the space around the transit shed are paved with asphalt concrete. The total area is 9,000 m^2

(12) Green Area (A-12)

A total green area of 4,000 m^2 is constructed for the conservation of environment.

(13) Drainage (A-13)

Main sewers (ϕ1.00 m) of 2,200 m, branch sewers (ϕ0.60 m) of 550 m, 30 manholds, and drainage ditch of 5,400 m are constructed.

(14) Water Supply (A-14)

A well is drilled at a point 1,000 m inland from the commercial port zone. A water tank (9 m x 9 m x 3 m) is also constructed on the top of a stage of steel structure 15 m above the ground. A water supply system is also constructed, including 2,500 m of main pipeline 1,500 m of branch pipeline and 300 m of feeding pipeline.

(15) Electric Power Supply (A-15)

A high-voltage cable line is constructed from a point near Kota Bahru to the commercial port zone via Kg. Tawang for a distance of 10 km with a substation in the commercial port zone. Power cable lines are constructed for a distance of 5.5 km from the substation to the commercial port zone, including power lines for alighthouse to be installed at the tip of the east breakwater (I) and another lighthouse to be installed at the tip of the groin. In addition, 150 units of lighting are installed for illuminating the quay, the open storage and port roads.

(16) Navigation Aids (A-16)

One large lighthouse at the tip of the east breakwater (I), one small lighthouse at the tip of the groin, 8 large buoy lights and 10 small buoy lights are installed.

(17) Port Service Vessels (A-17)

One tugboat (D600PS, 80GT) and one pilot boat (D30PS).

(18) Cargo Handling Equipment/Vehicles (A-18)

10 t truck crane x 1,
2 t fork lift x 8,
3 t fork lift x 5,
5 t fork lift x 2,
Fire truck x 1, motorcar x 1 and small truck x 1

(19) Mobilization/Demobilization (A-19)

The following construction crafts are brought from Singapore;
Pump dredger (D4000PS) x 1
Grab dredger (D350PS, grab capacity 4 m^3) x 2,

Barge (capacity 300 m^3) x 4 and
Pile driving barge (D22 diesel pile hammer) x 1

(20) Land Acquisition (A-20)

The area of 266,000 m^2 for public use in the commercial port zone and the area of 75,000 m^2 for the access road (50 m x 1,500 m) are acquired. The total area is 341,000 m^2.

7-3-2 Fishing Port Zone Facilities (B)

(1) −2.0 m Quay (B-1)

The structure of the −2.0 m quay is a steel sheet pile type quay. Construction of the −2.0 m quay and the −3.0 m quay in Plan C is carried out on land as the ground level is +3.0 m.

The structures of the −2.0 m quay and the −3.0 m quay in Plan A and Plan B are concrete block type quays and they are constructed at sea. Steel sheet piles (SP-II, ℓ = 8 m) are driven by a pile driver (diesel pile hammer D-12). The anchor wall is an inverted T-type wall made of reinforced concrete. After the construction of the quay, dredging is carried out to a depth of −2.0 m. Fig. 7-6 shows the standard cross section of the −2.0 m quay.

(2) −3.0 m Quay (B-2)

The structure of the −3.0 m quay is a steel sheet pile type quay. Steel sheet piles (SP-III, ℓ = 10 m) are driven by a pile driver (diesel pile hammer D-12). The anchor wall is an inverted T-type wall made of reinforced concrete. After the construction of the quay, dredging is carried out to a depth of −3.0 m. Fig. 7-7 shows the standard cross section of the −3.0 m quay.

(3) Slipway (B-3)

A slipway of 60 m in width and 80 m in length is constructed to repair fishing boats of under 50GT.

(4) Wholesale Market/Office (B-4)

The total floor space of the wholesale market is 3,000 m^2. An office of 1,000 m^2 is built on the wholesale market. They are made of reinforced concrete.

(5) Cold Storage/Freezing Facilities (B-5)

The cold storage/freezing facilities are made of reinforced concrete. The storage temperature of the cold storage is −5°C. Assuming the normal storage capacity to be 380 t and the occupancy ratio to be 40%, the real storage capacity of the cold storage is 150 t.

The freezing temperature of the freezing facilities is −30°C. Assuming the normal storage capacity to be 200 t and the occupancy ratio to be 50%, the real storage capacity of the freezing facilities is 100 t. The freezing capacity is 20 t/day.

(6) Ice Factory/Ice Storage Facilities (B-6)

Ice factory and ice storage facilities are made of reinforced concrete. The ice-making capacity is 100 t/day and the ice storage capacity is 300 t/day.

(7) Oil Tank (Movable) (B-7)

Four 14 kl oil tanks (movable) and 40 m of pipeline are constructed to supply lightoil to fishing boats.

(8) Port Road (B-8)

The total port road area is 16,000 m^2.

20 m road x 600 m = 12,000 m^2

10 m road x 400 m = 4,000 m^2

(9) Access Road (B-9)

A 20 m-road is constructed from the intersection of the existing unpaved road and the paved road at Kg. Balai to the fishing port zone for a distance of 2,000 m.

The access road area is 40,000 m^2.

20 m road x 2,000 m = 40,000 m^2

The access road of 1,500 m will be assured by improving the existing unpaved road. The remaining access road of 500 m will be newly constructed.

(10) Asphalt Pavement (B-10)

A part of the open storage, the car parking place and the space around the wholesale market are paved with asphalt concrete. The total area is 15,000 m^2.

(11) Drainage (B-11)

600 m of the main sewer (ϕ1.00 m), 800 m of branch sewers (ϕ0.60 m), 20 manholes and 3,300 m of drainage ditch are constructed.

A settling pond for fish waste is constructed to prevent the water pollution in the port.

(12) Water Supply (B-12)

A well is drilled at a point 1,000 m inland from the fishing port zone. A water tank (9 m x 9 m x 3 m) is also constructed on the top of a stage of steel structure 15 m above the ground. A water supply system is also constructed, including 1,600 m of main pipeline, 900 m of branch pipeline and 500 m of feeding pipeline.

(13) Electric Power Supply (B-13)

A high-voltage cable line is constructed from a point near Bachok to the fishing port zone for a distance of 5.5 km with a substation in the fishing port zone. Power cable lines are constructed for a distance of 1.4 km from the substation to the fishing port zone.

In addition, 90 units of lighting are installed for illuminating the quay, the open storage and port roads.

(14) Mobilization/Demobilization (B-14)

A pile driver (diesel pile hammer D-12) is brought from Kuala Lumpur.

(15) Land Acquisition (B-15)

The area of 132,000 m^2 in the fishing port zone and the area of 40,000 m^2 for the access road (20 m x 2,000 m) are acquired.

The total area is 172,000 m^2.

7-3-3 Private Port Facilities (C)

(1) −5.0 m Oil Dolphin Berth (C-1)

The −5.0 m oil dolphin berth consists of one working platform (10.0 m x 5.0 m), two breasting dolphins (5.0 m x 5.0 m) and two mooring dolphins (4.0 m x 4.0 m). The length of the berth is 70 m. The structure of the berth is a P.C. pile type dolphin.

The −5.0 m oil dolphin berth is constructed at the bank of Sg. Kemasin under the first phase development plan (Plan C). Space for the future extension meet to the increase of cargo volume is provided at the inner side of the east breakwater (I) as shown in the Master Plan (Plan C) (Fig. 11-1).

The oil berty is planned at the inner side of the east breakwater (I) in Plan A and Plan B.

P.C. piles (0.5 x 0.5 m, $\ell = 24 - 26$ m) are driven by a pile driving barge equipped with a diesel pile hammer (D-40), which is brought from Singapore. The pile driving is made at a rate of 4 piles/day for vertical piles and 3 piles/day for batter piles. Fig. 7-8 shows the plan of the −5.0 m oil dolphin berth.

(2) Oil Storage Facilities (C-2)

Oil storage facilities to be constructed is as follows;

500 kl gasoline tank x 6,
200 kl kerosene tank x 3,
300 kl diesel (fuel) oil tank x 4,
100 kl aviation fuel tank x 3,
Pipeline of 300 m
Oil bank

(3) Mobilization/Demobilization (C-3)

A pile driving barge (diesel pile hammer D-40) is brought from Singapore.

(4) Land Acquisition (C-4)

The area of 195,000 m^2 for private use in the commercial port zone is acquired.

Fig. 7-1 Standard Cross Section of Seawall

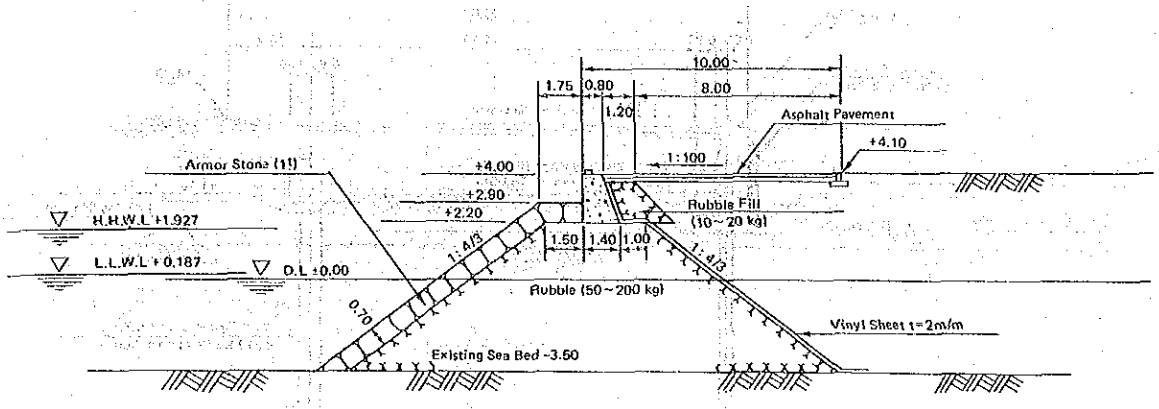


Fig. 7-2 Standard Cross Section of Groin/East Breakwater (Ⅱ)/West Breakwater (B=4.00)

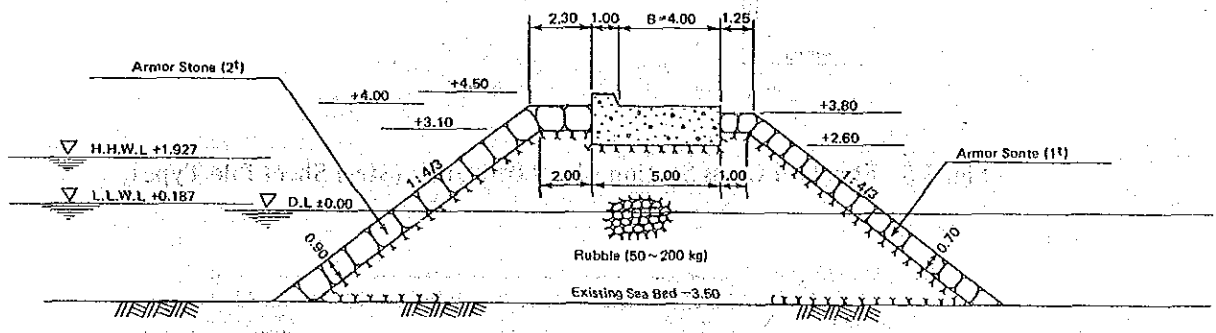


Fig. 7-3 Standard Cross Section of East Breakwater (I) (B=4.00m)

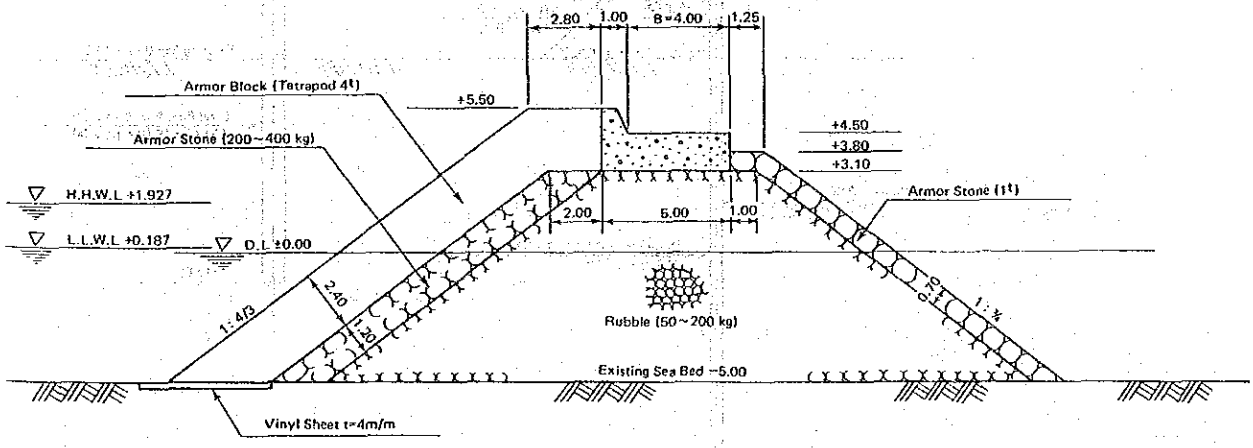


Fig. 7-4 Standard Cross Section of −7.5 m Quay (Steel Sheet Pile Type)

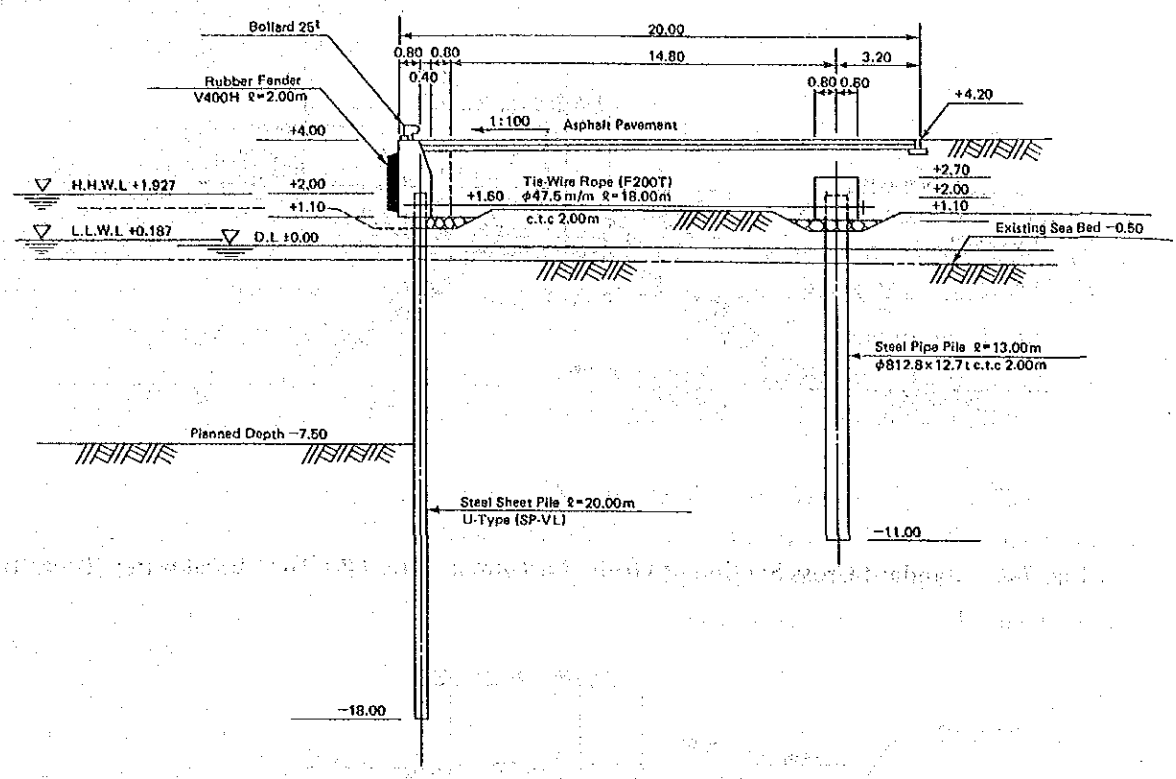


Fig. 7-5 Standard Cross Section of −9.0 m Quay (Steel Sheet Pile Type)

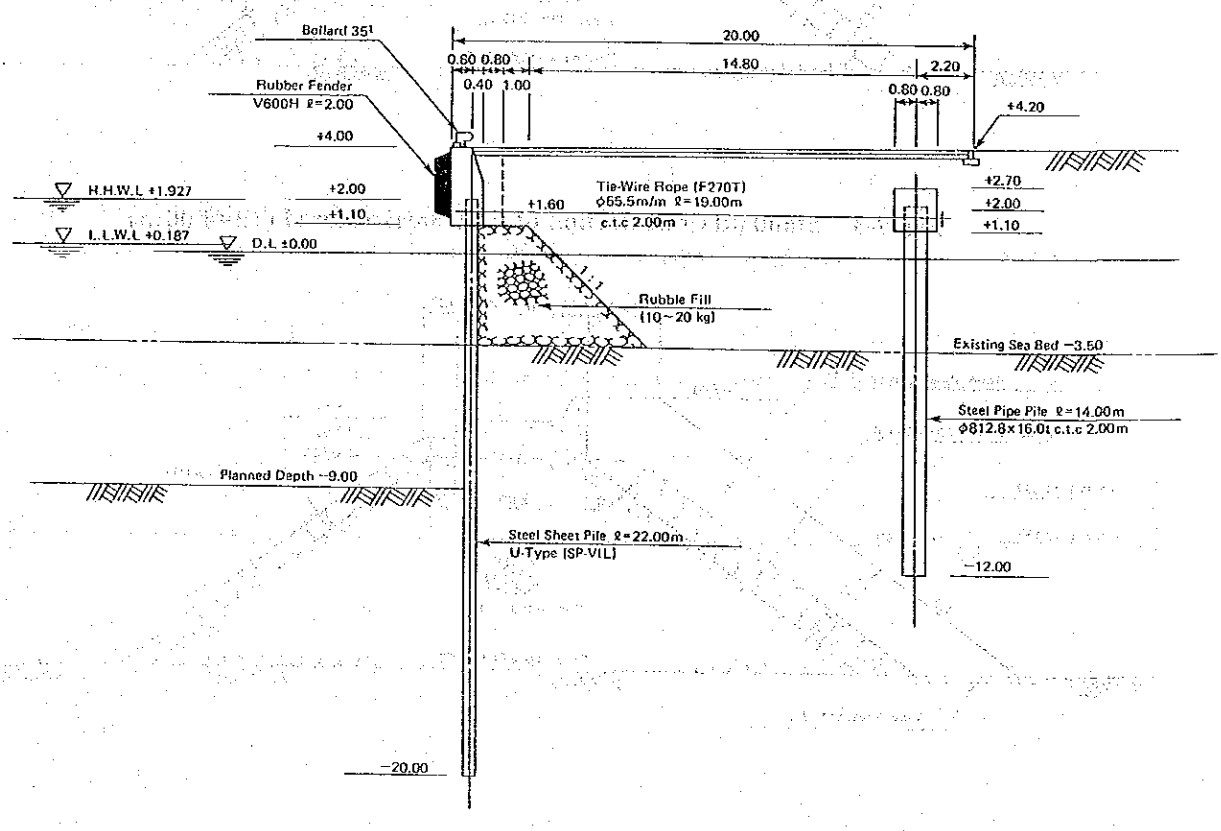


Fig. 7-6 Standard Cross Section of −2.0m Quay (Steel Sheet Pile Type)

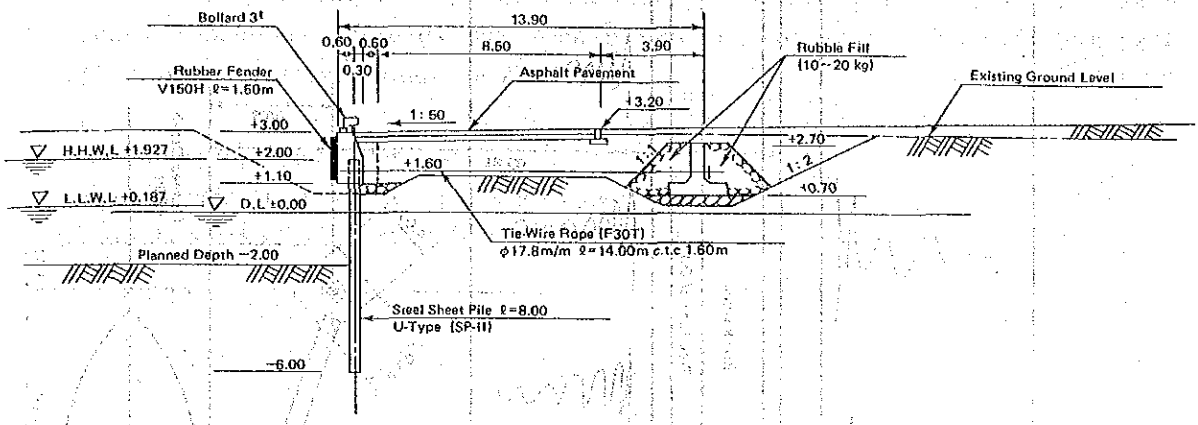
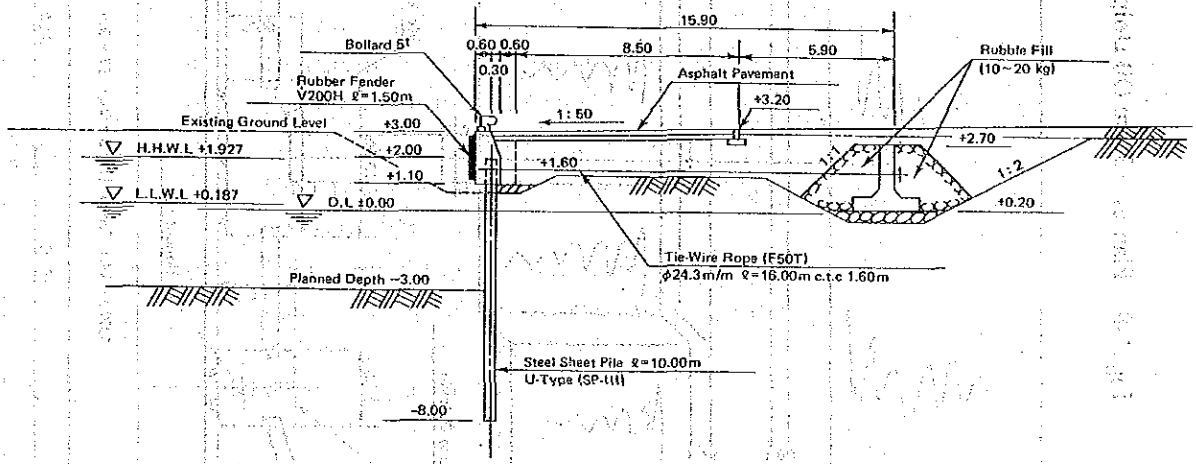


Fig. 7-7 Standard Cross Section of −3.0m Quay (Steel Sheet Pile Type)



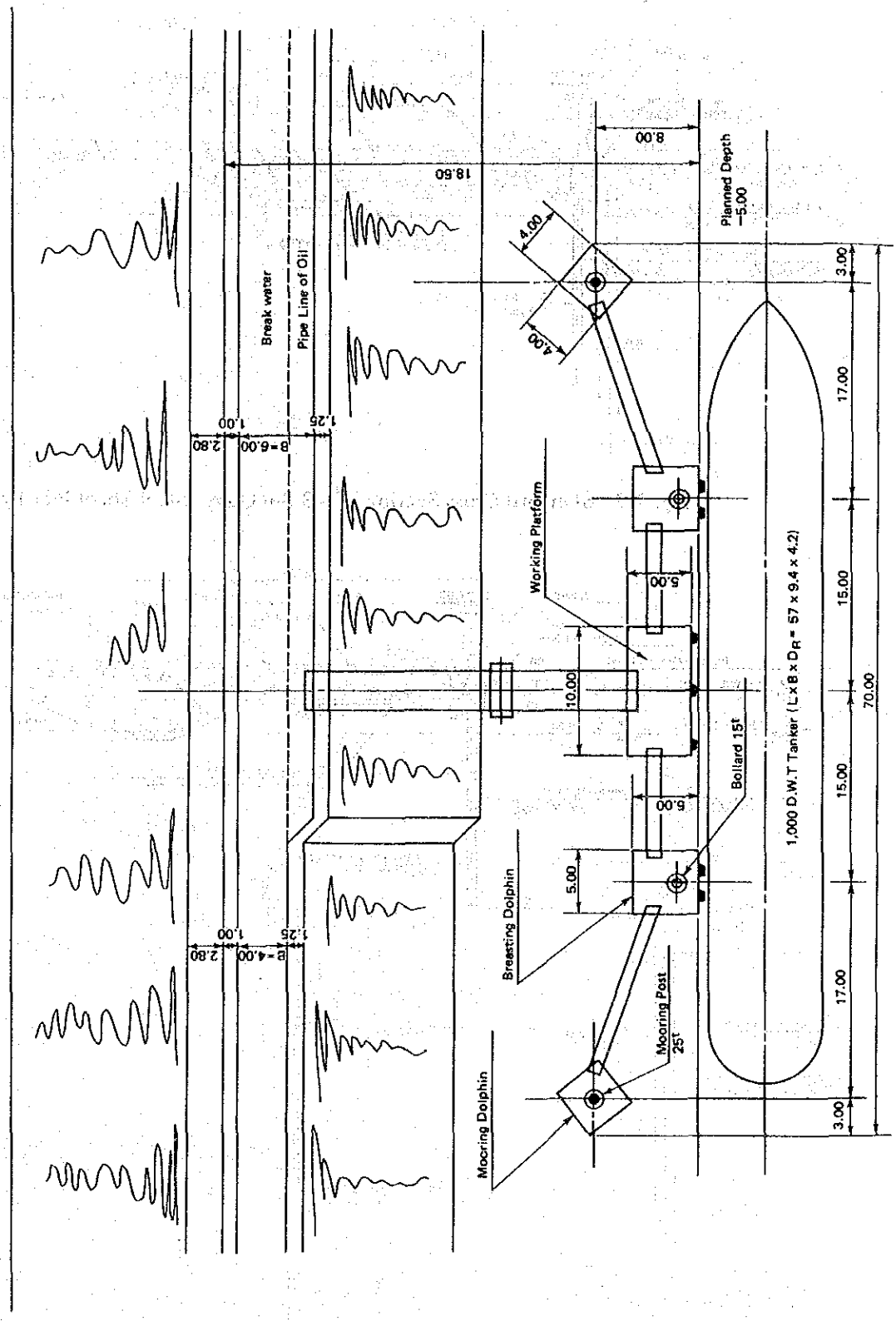


Fig. 7-8 Plan of −5.0m Oil Dolphin Berth

7-4 Maintenance Dredging

There still are many unsolved coastal engineering problems about the mechanism of littoral drift. It is considerably difficult to accurately estimate the volume of maintenance dredging of the channel. Though many formulas have been suggested to estimate the volume of littoral drift, we apply two representative formulas as followings;

7-4-1 Formula proposed by Manohar

The formula proposed by Manohar is as follows;

$QY = 1.41 \times \phi^{6.9} \times 10^{-1.4}$ ($m^3/m/sec$)

$$\phi = \frac{(\pi H/T)(\sinh 2\pi h/L)^{-1}}{(\frac{\sigma}{\rho}-1)^{0.4} g^{0.4} \nu^{0.2} d^{0.2}}$$

where, QY: Littoral drift ($m^3/m/sec$) per unit width (m) and per unit time (sec).

H: Wave height (average wave height during the NE monsoon season) 1 m.

T: Wave period 8 sec.

h: Water depth (depth from M.S.L. at the site)

1.09 m − (−5.5 m) = 6.6 m.

L: Wave length 60 m.

σ: Density of bottom materials 2.65 t/m^3.

ρ: Seawater density 1.05 t/m^3.

g: Accleration of gravity 9.8 m/sec^2.

ν: Coefficient of kinematic viscosity of water

1.0×10^{-6} m^2/sec

d: Grain size of bottom materials

Grain sizes are obtained from survey results:

$d75 = 0.43 \times 10^{-3}$ m

$d50 = 0.28 \times 10^{-3}$ m

$d25 = 0.12 \times 10^{-3}$ m

where, d75, d50, d25; Respective grain sizes of 75%, 50% and 25% passing weight

Substituting all these factors in the above-mentioned formula,

$\phi 75 = 13.130$ $\phi 50 = 14.332$ $\phi 25 = 16.956$

As for the littoral drift,

$QY75 = 0.7298 \times 10^{-6}$ $m^3/m/sec$

$QY50 = 1.3343 \times 10^{-6}$ $m^3/m/sec$

$QY25 = 4.2582 \times 10^{-6}$ $m^3/m/sec$

As for the average littoral drift,

$QY = (0.7298 \times 0.75 + 1.3343 \times 0.50 + 4.2582 \times 0.25) \div (0.75 + 0.50 + 0.25) \times 10^{-6}$ $m^3/m/sec = 1.5194 \times 10^{-6}$ $m^3/m/sec$

The monthly volume of littoral drift is;

QY (m) = 3.94 $m^3/m/month$

If it is assumed here that the NE monsoon season lasts for 5 months from November to March, the volume of littoral drift during the NE monsoon season is;

QY (5 m) = 3.94 m^3/m/month x 5 months = 19.7 m^3/m/year

The average shoaling velocity of the channel (width B = 110 m) is obtained as below.

V = 19.7 m^3/m/year ÷ 110 m = 0.18 m/year

7-4-2 Formula proposed by H.R.S. and C.E.R.C.

The formula proposed by the Hydraulics Research Station in England and the Coastal Engineering Research Center in U.S.A. is as follows;

$$QY = \frac{516\,H^6}{T^5\,h^2} \times \left(\frac{1}{\sinh 2\pi h/L}\right)^6 \text{ (kg/m/sec)}$$

where, QY: Littoral drift (kg/m/sec) per unit width (m) and per unit time (sec).
H: Wave height 1 m.
T: Wave period 8 sec.
h: Water depth 6.6 m.
L: Wave length 60 m.

In the above formula, the grain size of bottom materials is assumed to be $d = 0.2 \times 10^{-3}$ m. The sand density is assumed to be 1600 kg/m^3. Substituting all these factors in the above-mentioned formula,

QY = 1.3021×10^{-6} m^3/m/sec

The monthly volume of littoral drift is;

QY (m) = 3.38 m^3/m/month.

The volume of littoral drift during the 5-month NE monsoon season is;

QY (5 m) = 3.38 m^3/m/month x 5 months = 16.9 m^3/m/year

The average shoaling velocity of the channel (width B = 110 m) is obtained as below.

V = 16.9 m^3/m/year ÷ 110 m = 0.15 m/year

7-4-3 Volume of Maintenance Dredging (Plan C)

The average shoaling velocity is 0.18 m/year by Manohar's formula and 0.15 m/year by the formula proposed by H.R.S. and C.E.R.C. On the basis of these figures, the average shoaling velocity is estimated to be 0.25 m/year making allowances for safety reasons.

The channel area in Plan C is:

3130 m x 110 m = 344,300 m^2 ≒ 345,000 m^2

If maintenance dredging is carried out every two years,

Volume of maintenance dredging V_1 = 345,000 m^2 x (0.25 m/year x 2 years)
= 172,500 m^3

If a depth allowance for dredging is 0.4 m,

Volume of extra dredging V_2 = 345,000 m^2 x 0.4 m = 138,000 m^2

Total volume $V = V_1 + V_2$ ≒ 310,000 m^3

Maintenance dredging is carried out by two grab dredgers (D350PS, grab capacity 4 m^3) brought from Singapore. The spoil is dumped on the western side of the groin where shore erosion is anticipated.

7-5 Construction Schedule

Table 7-4 shows the construction schedule for the first phase development plan (Plan C). A natural conditions survey and an engineering study are conducted in 1981 and 1982, including detail design, preparation of tender documents, tender evaluation and awarding.

The construction is expected to start in 1983 and complete in December, 1987. The construction period is five years.

The construction of the breakwater, the seawall and the groin is started in 1983. Dredging by a pump dredger is carried out in 1985 and the spoil is used for reclamation. Even after the completion of reclamation, it will take at least 4 – 6 months for the reclaimed ground to settle to a certain extent. Accordingly, construction of the building, the transit shed, the wholesale market and the office is made from 1986 to 1987. Dredging is completed in 1987 with grab dredgers. Other works are as shown in the construction schedule.

Table 7-4 Construction Schedule for the First Phase Development Plan (Plan C)

Item				1981				1982				1983				1984				1985				1986				1987			
No.	Description	Unit	Quantity	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
A-1	Seawall	m	880																												
A-2	Breakwater	m	1,810																												
A-3	Groin	m	570																												
A-4	Dredging/Reclamation	m³	2,300,000																												
A-5	-7.5 m Quay	m	260																												
A-6	Transit Shed	m²	4,800																												
A-7	Building	m²	2,400																												
A-8	Oil Tank (Palm Oil)	sum	1																												
A-9	Port Road	m²	39,000																												
A-10	Access Road	m²	23,000																												
A-11	Asphalt Pavement	m²	9,000																												
A-12	Green Area	m²	4,000																												
A-13	Drainage	sum	1																												
A-14	Water Supply	sum	1																												
A-15	Electric Power Supply	sum	1																												
A-16	Navigation Aids	sum	1																												
A-17	Port Service Vessels	sum	1																												
A-18	Cargo Handling Equipment/Vehicles	sum	1																												
A-19	Mobilization/Demobilization	sum	1																												
A-20	Land Acquisition	m²	341,000																												
B-1	-2.0 m Quay	m	175																												
B-2	-3.0 m Quay	m	290																												
B-3	Slip Way	sum	1																												
B-4	Wholesale Market/Office	m²	4,000																												
B-5	Cold-storage/Freezing Facilities	sum	1																												
B-6	Ice Factory/Ice Storage Facilities	sum	1																												
B-7	Oil Tank (Movable)	sum	1																												
B-8	Port Road	m²	16,000																												
B-9	Access Road	m²	40,000																												
B-10	Asphalt Pavement	m²	15,000																												
B-11	Drainage	sum	1																												
B-12	Water Supply	sum	1																												
B-13	Electric Power Supply	sum	1																												
B-14	Mobilization/Demobilization	sum	1																												
B-15	Land Acquisition	m²	172,000																												
C-1	-5.0 m Oil Dolphin Berth	berth	1																												
C-2	Oil Supply	sum	1																												
C-3	Mobilization/Demobilization	sum	1																												
C-4	Land Acquisition	m²	195,000																												
D-1	Natural Conditions Survey	sum	1																												
D-2	Engineering Study	sum	1																												
D-3	Supervision	sum	1																												

7-6 Cost Estimate

The comparison of the construction cost of the first phase development plan (Plans A, B and C) is shown in Table 7-5. Detail of the construction cost (Plan C) is given by Table 7-6. Plans A and B include the construction cost of 7,700,000 M$ of the training wall at the estuary of Sg. Kemasin. This cost is not added to Plan C as Plan C contains the function equivalent to or superior to the training wall (East Breakwater II and seawall).

Table 7-7 shows the yearly construction cost of the first phase development plan (Plan C) (1983 – 1987).

7-6-1 Cost Estimate Conditions

① The prices are expressed by M$ based on the 1980 prices.
② The exchange rate is 2.2 M$ = 1 US$.
③ Customs duties for the imported construction materials and equipments are not included.
④ The sales tax is not considered for the foreign currency.
⑤ The sales tax of 5% is considered for the local currency. However, this does not apply to land acquisition.
⑥ The physical contingency of 15% is considered, but this does not apply to engineering (natural conditions survey, engineering study and supervision).
⑦ The price contingency is not considered.
⑧ The following costs are regarded as a foreign currency:
   a) The construction materials imported from abroad because 1) they are not produced in Malaysia; and 2) they are produced in insufficient quantities in Malaysia.
   b) Rentals for large construction crafts and equipments difficult to procure in Malaysia.
   c) Wages for foreign skilled laborer.

Table 7-5 Comparison of Construction Cost of the First Phase Development Plan

Item \ Plan	Plan A	Plan B	Plan C
Construction cost M$1,000	103,620	100,540	88,250
Proportion with Plan C as 1.00	1.17	1.14	1.00

Table 7-6 Construction Cost of the First Phase Development Plan (Plan C)

Item No.	Description	Unit	Quantity	Unit Price			Amount		
				Local Currency M$	Foreign Currency M$	Total Unit Price M$	Local Currency M$ 1,000	Foreign Currency M$ 1,000	Total Amount M$ 1,000
A	Commercial Port Zone Facilities								
A-1	Seawall	m	880	2,100	1,000	3,100	1,848	880	2,728
A-2	Breakwater	m	1,810	5,800	3,300	9,100	10,498	5,973	16,471
A-3	Groin	m	570	3,400	1,000	4,400	1,938	570	2,508
A-4	Dredging/Reclamation	m^3	2,300,000	0.9	3.1	4	2,070	7,130	9,200
A-5	-7.5 m Quay	m	260	2,800	19,900	22,700	728	5,174	5,902
A-6	Transit Shed	m^2	4,800	100	150	250	480	720	1,200
A-7	Building	m^2	2,400	250	100	350	600	240	840
A-8	Oil Tank (Palm Oil)	sum	1				340	510	850
A-9	Port Road	m^2	39,000	33	2	35	1,287	78	1,365
A-10	Access Road	m^2	23,000	37	3	40	851	69	920
A-11	Asphalt Pavement	m^2	9,000	28	2	30	252	18	270
A-12	Green Area	m^2	4,000	10	0	10	40	0	40
A-13	Drainage	sum	1				1,970	670	2,640
A-14	Water Supply	sum	1				260	610	870
A-15	Electric Power Supply	sum	1				400	1,050	1,450
A-16	Navigation Aids	sum	1				300	1,200	1,500
A-17	Port Service Vessels	sum	1				0	950	950
A-18	Cargo Handling Equipment/Vehicles	sum	1				0	750	750
A-19	Mobilization/Demobilization	sum	1				179	938	1,117
A-20	Land Acquisition	m^2	341,000	4	0	4	1,364	0	1,364
A-21	Sales Tax (5%)	sum	1				1,202	0	1,202
	Sub Total (A)						26,607	27,530	54,137
B	Fishing Port Zone Facilities								
B-1	-2.0 m Quay	m	175	1,500	3,200	4,700	263	560	823
B-2	-3.0 m Quay	m	290	1,900	4,700	6,600	551	1,363	1,914
B-3	Slip Way	sum	1				400	200	600
B-4	Wholesale Market/Office	m^2	4,000	250	100	350	1,000	400	1,400
B-5	Cold-storage/Freezing Facilities	sum	1				800	2,000	2,800
B-6	Ice Factory/Ice Storage Facilities	sum	1				500	1,300	1,800
B-7	Oil Tank (Movable)	sum	1				16	24	40
B-8	Port Road	m^2	16,000	33	2	35	528	32	560
B-9	Access Road	m^2	40,000	37	3	40	1,480	120	1,600
B-10	Asphalt Pavement	m^2	15,000	28	2	30	420	30	450
B-11	Drainage	sum	1				1,090	380	1,470
B-12	Water Supply	sum	1				200	460	660
B-13	Electric Power Supply	sum	1				200	520	720
B-14	Mobilization/Demobilization	sum	1				12	38	50
B-15	Land Acquisition	m^2	172,000	4	0	4	688	0	688
B-16	Sales Tax (5%)	sum	1				373	0	373
	Sub Total (B)						8,521	7,427	15,948
C	Private Port Facilities								
C-1	-5.0 m Oil Dolphin Berth	berth	1	290,000	400,000	690,000	290	400	690
C-2	Oil Supply	sum	1				890	1,370	2,260
C-3	Mobilization/Demobilization	sum	1				32	78	110
C-4	Land Acquisition	m^2	195,000	4	0	4	780	0	780
C-5	Sales Tax (5%)	sum	1				61	0	61
	Sub Total (C)						2,053	1,848	3,901
D	Engineering								
D-1	Natural Conditions Survey	sum	1				370	160	530
D-2	Engineering Study	sum	1				240	240	480
D-3	Supervision	sum	1				1,200	960	2,160
	Sub Total (D)						1,810	1,360	3,170
E	Physical Contingency (15%)								
E-1	Physical Contingency ((A+B)×15%)	sum	1				5,269	5,242	10,511
E-2	Physical Contingency (Cx15%)	sum	1				307	276	583
	Sub Total (E)						5,576	5,518	11,094
	Total (A+B+D+E-1)						42,207	41,559	83,766
	Total (A+B+C+D+E)						44,567	43,683	88,250
							50.5%	49.5%	100%

Table 7-7 Yearly Construction Cost of the First Phase Development Plan (Plan C)

Unit: 1,000 M$

No.	Item Description	Unit	Quantity	1983 Local	1983 Foreign	1983 Total	1984 Local	1984 Foreign	1984 Total	1985 Local	1985 Foreign	1985 Total	1986 Local	1986 Foreign	1986 Total	1987 Local	1987 Foreign	1987 Total	Grand Total Local	Grand Total Foreign	Grand Total Total
A	Commercial Port Zone Facilities			5,053	1,790	6,843	4,646	1,968	6,614	5,746	11,794	17,540	5,904	4,768	10,672	5,258	7,210	12,468	26,607	27,530	54,137
A-1	Seawall	m	880	924	440	1,364	924	440	1,364										1,848	880	2,728
A-2	Breakwater	m	1,810	2,100	1,194	3,294	2,100	1,194	3,294	2,100	1,194	3,294	2,100	1,194	3,294	2,098	1,197	3,295	10,498	5,973	16,471
A-3	Groin	m	570	484	143	627	930	284	1,254	484	143	627							1,938	570	2,508
A-4	Dredging/Reclamation	m³	2,300,000							1,620	5,580	7,200				450	1,550	2,000	2,070	7,130	9,200
A-5	-7.5 m Quay	m	260							485	3,449	3,934	243	1,725	1,968				728	5,174	5,902
A-6	Transit Shed	m²	4,800													480	720	1,200	480	720	1,200
A-7	Building	m²	2,400										600	240	840				600	240	840
A-8	Oil Tank (Palm Oil)	sum	1										170	255	425	170	255	425	340	510	850
A-9	Port Road	m²	39,000										858	52	910	429	26	455	1,287	78	1,365
A-10	Access Road	m²	23,000				426	35	460	423	35	460							851	69	920
A-11	Asphalt Pavement	m²	9,000													252	18	270	252	18	270
A-12	Green Area	m²	4,000													40	0	40	40	0	40
A-13	Drainage	sum	1										1,313	447	1,760	657	223	880	1,970	670	2,640
A-14	Water Supply	sum	1							65	153	218	130	304	434	65	153	218	260	610	870
A-15	Electric Power Supply	sum	1							200	525	725	200	525	725				400	1,050	1,450
A-16	Navigation Aids	sum	1													300	1,200	1,500	300	1,200	1,500
A-17	Port Service Vessels	sum	1													0	950	950	0	950	950
A-18	Cargo Handling Equipment/Vehicles	sum	1													0	750	750	0	750	750
A-19	Mobilization/Demobilization	sum	1	5	13	18	5	16	21	93	715	808	9	26	35	67	168	235	179	938	1,117
A-20	Land Acquisition	m²	341,000	1,364	0	1,364													1,364	0	1,364
A-21	Sales Tax (5%)	sum	1	176	0	176	221	0	221	274	0	274	281	0	281	250	0	250	1,202	0	1,202
B	Fishing Port Zone Facilities			688	0	688	778	62	840	935	438	1,373	3,395	4,105	7,500	2,725	2,822	5,547	8,521	7,427	15,948
B-1	-2.0 m Quay	m	175										263	560	823				263	560	823
B-2	-3.0 m Quay	m	290										551	1,363	1,914				551	1,363	1,914
B-3	Slip Way	sum	1										200	100	300	200	100	300	400	200	600
B-4	Wholesale Market/Office	m²	4,000										500	200	700	500	200	700	1,000	400	1,400
B-5	Cold-storage/Freezing Facilities	sum	1										267	666	933	533	1,334	1,867	800	2,000	2,800
B-6	Ice Factory/Ice Storage Facilities	sum	1										167	433	600	333	867	1,200	500	1,300	1,800
B-7	Oil Tank (Movable)	sum	1													16	24	40	16	24	40
B-8	Port Road	m²	16,000										352	21	373	176	11	187	528	32	560
B-9	Access Road	m²	40,000				740	60	800	740	60	800							1,480	120	1,600
B-10	Asphalt Pavement	m²	15,000													420	30	450	420	30	450
B-11	Drainage	sum	1										727	253	980	363	127	490	1,090	380	1,470
B-12	Water Supply	sum	1							50	115	165	100	230	330	50	115	165	200	460	660
B-13	Electric Power Supply	sum	1							100	260	360	100	260	360				200	520	720
B-14	Mobilization/Demobilization	sum	1	0	0	0	1	2	3	1	3	4	6	19	25	4	14	18	12	38	50
B-15	Land Acquisition	m²	172,000	688	0	688													688	0	688
B-16	Sales Tax (5%)	sum	1	0	0	0	37	0	37	44	0	44	162	0	162	130	0	130	373	0	373
C	Private Port Facilities			780	0	780	0	0	0	249	358	607	556	802	1,358	468	688	1,156	2,053	1,848	3,901
C-1	-5.0m Oil Dolphin Berth	berth	1							207	286	493	83	114	197				290	400	690
C-2	Oil Supply	sum	1										445	685	1,130	445	685	1,130	890	1,370	2,260
C-3	Mobilization/Demobilization	sum	1	0	0	0	0	0	0	30	72	102	1	3	4	1	3	4	32	78	110
C-4	Land Acquisition	m²	195,000	780	0	780													780	0	780
C-5	Sales Tax (5%)	sum	1	0	0	0	0	0	0	12	0	12	27	0	27	22	0	22	61	0	61
D	Engineering			850	592	1,442	240	192	432	240	192	432	240	192	432	240	192	432	1,810	1,360	3,170
D-1	Natural Conditions Survey	sum	1	370	160	530													370	160	530
D-2	Engineering Study	sum	1	240	240	480													240	240	480
D-3	Supervision	sum	1	240	192	432	240	192	432	240	192	432	240	192	432	240	192	432	1,200	960	2,160
E	Physical Contingency (15%)			978	268	1,246	814	304	1,118	1,039	1,888	2,927	1,477	1,451	2,928	1,268	1,607	2,875	5,576	5,518	11,094
E-1	Physical Contingency ((A+B)x15%)	sum	1	861	268	1,129	814	304	1,118	1,002	1,835	2,837	1,394	1,331	2,725	1,198	1,504	2,702	5,269	5,242	10,511
E-2	Physical Contingency (Cx15%)	sum	1	117	0	117	0	0	0	37	53	90	83	120	203	70	103	173	307	276	583
	Total (A+B+D+E-1)			7,452	2,650	10,102	6,478	2,526	9,004	7,923	14,259	22,182	10,933	10,396	21,329	9,421	11,728	21,149	42,207	41,559	83,766
	Total (A+B+C+D+E)			8,349	2,650	10,999	6,478	2,526	9,004	8,209	14,670	22,879	11,572	11,318	22,890	9,959	12,519	22,478	44,567	43,683	88,250
				9.5%	3.0%	12.5%	7.3%	2.9%	10.2%	9.3%	16.6%	25.9%	13.1%	12.8%	25.9%	11.3%	14.2%	25.5%	50.5%	49.5%	100%

CHAPTER 8 PORT ADMINISTRATION AND MANAGEMENT

CHAPTER 8 PORT ADMINISTRATION AND MANAGEMENT

8-1 Outline of Port Administration in Malaysia

8-1-1 Outline of Port Administration in Peninsular Malaysia

Ports in the Peninsular Malaysia comprise "major ports" and other called "minor ports". The major ports are Port Kelang, Port of Penang, Johore Port and Kuantan Port, each with a Port Authority as the port management body which administers and manages the port independently of the Government.

The minor ports, such as Port Dickson, Port of Malacca, Port of Muar and Port of Batu Pahat, are under the direct and central control of the Marine Department, Ministry of Transport.

In short, the ports of Peninsular Malaysia are administered and managed by two different formulae in accordance with their types.

8-1-2 Legal Basis of Port Administration

The Port of Penang, which is among the major ports, is administered and managed by its Port Commission established under the Penang Port Commission Act 1955 but the other three major ports are administered and managed by their Port Authorities established under the Port Authority Act 1963.

The details of the two acts are generally identical since the Port Authority Act 1963 (to be referred to hereafter as "the Act") was enacted in general accordance with the Penang Port Commission Act 1955. Therefore, the Port Commission and the Port Authorities are similar organizations and, after its enactment, the Act became what may be termed the basic law governing port administration.

The Act prescribes basic matters concerning port administration including 1) establishment of port authorities, 2) their functions and powers, 3) their organizations and personnel affairs, 4) their finance, 5) their right to collect changes and 6) their right to enact by-laws.

8-1-3 Role of the Ministry of Transportation in Port Administration

The competent federal agency for port administration is the Ministry of Transport which performs the following main functions:

(1) Planning of port development, surveys, etc.

(2) Supervision of the Port Authorities and the Port Commission of the major ports as MOT-controlled statutory bodies through the following actions:

① Appointment or approval of Port Authority executives (general manager and board members except the chairman).

② Approval of the setting or revision of tariffs.

③ Approval of annual budgets

④ Approval of financial statements.

⑤ Approval of by-laws.

(3) Central administration of minor ports.

The organization chart of the Ministry of Transport is as shown in Fig. 8-1.

8-1-4 Port Authorities

The organization and business scope of the Port Authorities (or Port Commission) which, as stated already, administer and manage the major ports as their administrative bodies are similar since they are under the same system.

(1) Administrative area of the ports

① Sea: Waters prescribed in accordance with the Merchant Shipping Ordinance 1952, including approach and anchorage.

② Land: Directly necessary for port administration and management and surrounded by fences maintained by the Authority.

(2) Scope of Businesses

The Port Authorities handle mainly the following businesses to administer and manage their ports:

① Provision of pilot and tugboat services to ships entering or leaving the port.

② Allotment of berths for ships entering the port and control of their movements in the port.

③ Loading, unloading and storage of cargoes.

④ Provision of such services and machines as water supply, telephone and cargo handling machines to ships that are berthed for loading or unloading.

⑤ Setting and collecting of port charges.

⑥ Construction, maintenance and repair of port facilities.

⑦ Development and improvement of the port.

⑧ Enactment of by-laws prescribing detailed procedures concerning the use of the port.

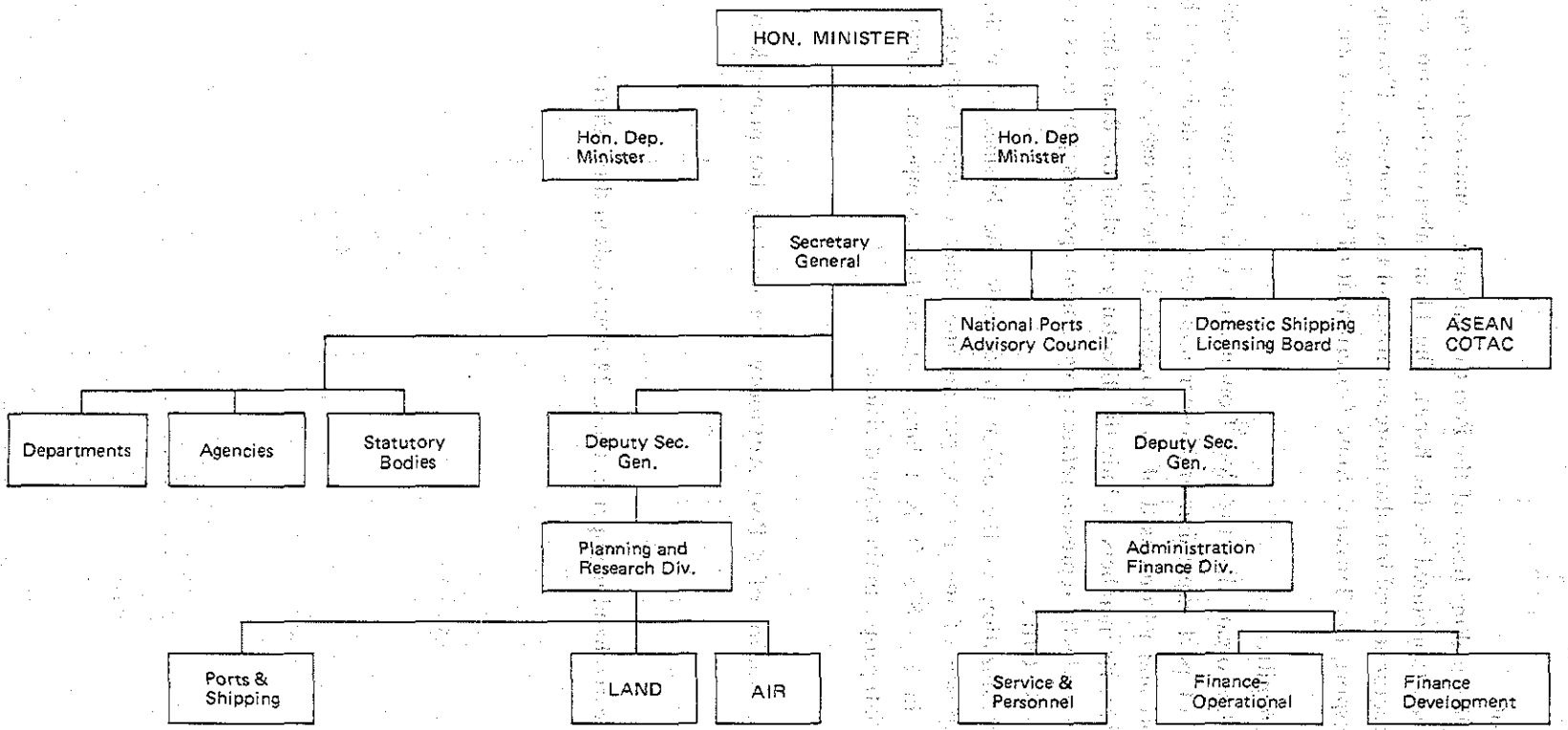
Regarding the loading, unloading and storage of cargoes in ③, the cargo handling system, namely, the provision of stevedoring and cargo handling service varies from port to port. At the Port Kelang and Johor Port, the Port Authorities give their directly managed services by providing their own hired labour. At Penang, meanwhile, stevedoring is provided by private enterprises through the arrangements made by shipping companies or agents. As for cargo handling service, operation of mechanical equipment, such as forklifts, is the responsibility of the Commission; but labor is supplied by private cargo handling companies. At the Port of Penang, the Port Labour Board controls port labour.

(3) Port Finance

A Port Authority settles its accounts independently of the government and in accordance with an enterprise accounting system and raises necessary funds for itself.

Port charges are set by the cost principle but the level of tariffs at other ports is taken into full consideration.

Fig. 8-1 Organization Chart of Ministry of Transport



(4) Organization of Port Authority (Port Commission)

Fig. 8-2 is the organization chart of the Penang Port Commission, which is the administrative body of the Port of Penang.

① Members of the Board

The Board is the policy-making body of the Port Commission, composed of 11 members including the chairman (appointed by the King). The 11 members include not only the chairman and the director general but also representatives of the Economic Planning Unit, the Ministry of Transport, the Treasury, State Government of Penang, port users, labour unions, etc.

② Port Consultative Committee

This Committee is the organ that the Port Commission consults over the revision of tariffs, the planning of port expansion and other important matters designated by the Minister of Transport and is composed of 27 members. Its chairmanship is held by the chairman of the Board. Its members include the director general of the Board and a wide range of people concerned who represent related government agencies, port users, etc.

③ Organization of Excutive Office

The management organization as the office to execute the businesses of the Port Commission is composed of the director general and other principal officers of the Commission shown in Fig. 8-2. It is a large organization comprising about 3,000 personnel including 650 people in the ferry division.

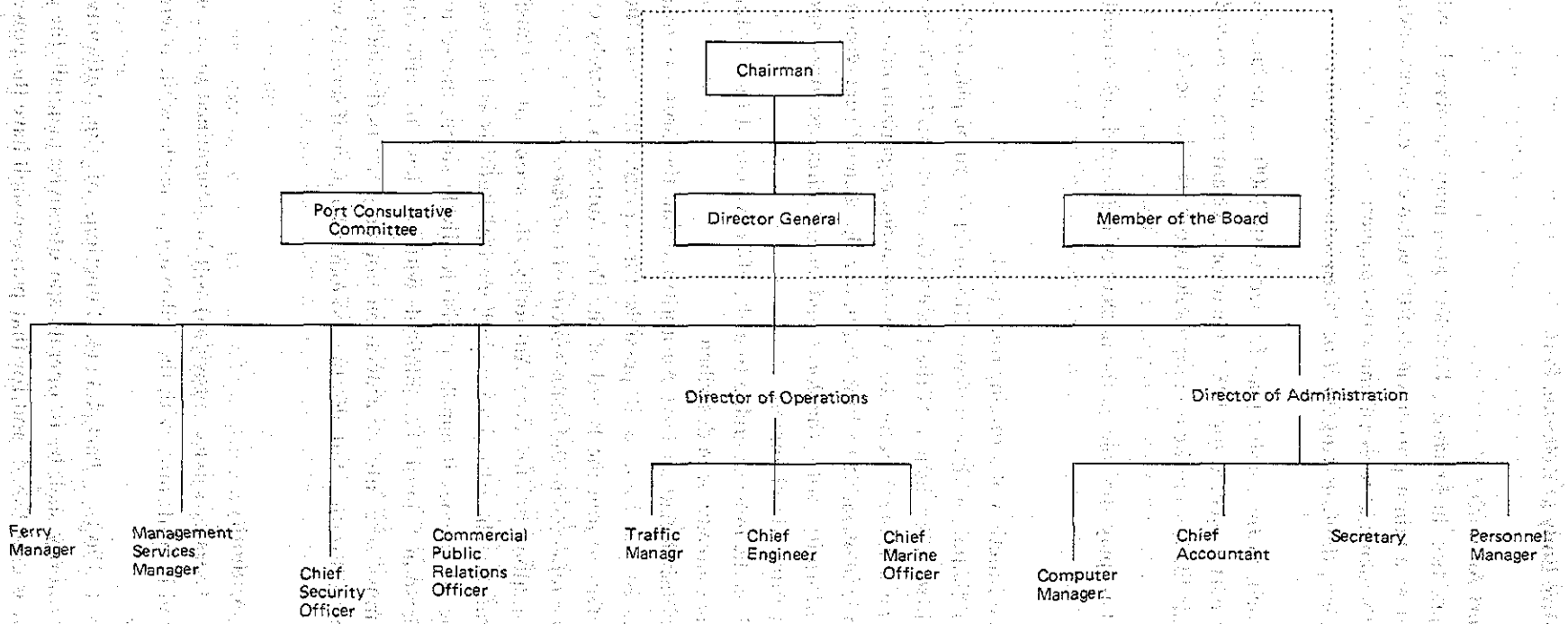
(5) Use of Port Facilities

Port facilities under the control of a Port Authority are used by the principle of open utilization.

(6) Operating Hours of Ports

At the major ports, port cargo handling operates on a 24-hour basis in three shifts.

Fig. 8-2 Organization Chart of Penang Port Commission



8-2 Study of the Port Administrative Body at Kelantan Port

8-2-1 Necessity of Establishing Port Authority

According to the common practice in Malaysia, Port Kelantan may be placed under the control of the Marine Department as a minor port in view of the volume of cargoes handled and the scale of its facilities based on the demand forecast under this project.

But as stated already in Chapter 4, the following must be taken into consideration:

(1) This project is for Phase I which, in the master plan formed with 2000 as the target year of development, concerns the urgent part projected for 1987. Therefore, Kelantan Port may develop in the future into a port with a scale likely to make it comparable to other major ports.

(2) Kelantan is an important port to play the role as the nucleus of regional development in the State of Kelantan.

(3) It is also expected to fullfill the function of a foreing trade port.

It is not appropriate for Port Kelantan, with its potentialities and role, to be placed like other minor ports under the central control of an agency of the Federal Government. On the contrary, it is necessary for a body with the corporate status as an autonomous organization to exercise routine control over this port while allowing it to function under the general supervision of the Federal Government and in conformity with the local and actual circumstances and have responsible arrangements aimed at future development.

To accomplish this purpose, it is the most desirable to make effective use of the existing legal system of Port Authority, which has already been described.

Hence, it is proposed to establish Kelantan Port Authority to run the port and handle its administration and management. By so doing is it possible for representatives of the state inhabitants and the state government to join the Board of the Port Authority, thereby enabling the wishes of the local people to be reflected in the management of the port.

We shall now study the functions of this Port Authority, the scope of its businesses, organization, personnel and operation. The basic idea underlying this study is as follows: Since the port is small and the volume of cargoes it handles is also relatively small, the scope of its businesses, organization and personnel must be minimal with a view to efficient port management. Further, the plan must take into consideration not only the port administrative system necessary for efficient port utilization but also the economical aspect of services which it provides.

8-2-2 Scope of Businesses of Port Authority

The scope of main businesses (types of services provided) will be determined in accordance with the stipulations of the Act and in confirmity with the following principles while referring to the examples of other major ports.

Note: Port Authority Act 1963 – Part I-3-(1); Functions of the Authority: The function of the Authority shall be to operate and otherwise maintain the port in respect of which it is established, and for that purpose shall have the powers and duties provided under this Act.

① To provide minimal services necessary for the Port Authority to implement the administration and management of this port.

② To allow private enterprises to provide labour for port cargo handling (stevedoring and longshoring) in order to reduce the burden on the management and to cope with fluctuations in cargo handling demand.

③ To allow private enterprises to provide related services including bunker service.

Under these principles, the services to be provided to users by the Port Authority are as follows:

(1) Services for ships

① Pilotage for ships entering or leaving the port.

② Tugboat service for ships entering or leaving the port.

③ Provision of berths.

④ Services including line handling and water supply to ships.

(2) Services for cargoes

① Cargo handling service: The Port Authority presides over cargo handling in the port area by providing equipment and operators and lets private cargo handling companies to provide laborers. Stevedoring is provided through the arrangements made by shipping companies or agents. This system is in accordance with the example of the Port of Penang.

② Storage of cargoes.

(3) Other services

① Lease of cargo handling equipment, wharf side sites, etc.

② Security, fire fighting and rescue.

8-2-3 Study of Organization and Personnel of Port Authority

The results of our study concerning the organization and the size of personnel required for the administration and management of this port are shown in Fig. 8-3 and Table 8-1. The basic ideas underlying this study are as follows:

① The minimal necessary organization and the size of personnel must be determined simply and clearly on the basis of the scale of the facilities and the volume of cargoes, referring to the examples of other major ports.

② A Board as a policy-making organ and a consultative committee as an advisory organ must be set up.

③ Three executive departments: Administration, Operation and Engineering are necessary in consideration of the future development and efficiency of the port.

(1) The Board

The Board will be established as the policy-making organ of the Port Authority. Though the Act stipulates that a Board be composed of five to nine members besides the chairman and the general manager, it is desirable for this Board to be as simple as possible. Its members may be, for example, as follows:

① Chairman
② General Manager
③ A representative of the Economic Planning Unit
④ A representative of the Ministry of Transport
⑤ A representative of the Treasury
⑥ A representative of the State Government
⑦ A representative of the State People
⑧ A representative of shipping companies

(2) The Port Consultative Committee

This Committee will be established as the advisory organ to the Port Authority and the Authority will, in accordance with the stipulations of the Act, consult the Committee on important matters. The Committee members will be appointed by the Minister of Transport but it is desirable for the Committee to be so composed as to reflect the views of local people and users as much as possible.

(3) Organization of the Management as Executive Organ

Based on the above principles, the organization of the offices of the director general and other executives and the number of personnel must be kept to a minimum, as indicated in Fig. 8-3 and Table 8-1.

In the organization chart, "promotion and publicity" have an important place because of the character of this port. Also, port planning, port management, port charges, port statistics and the training of personnel are stressed as specific businesses. In figuring out the number of personnel, a shift of 10 men is assigned to security and fire prevention, a shift of eight men is assigned to operation and storage in the traffic section and a shift of 12 men is assigned to cargo handling. The maintenance dredging of the channels and the anchorage, estimated at 155,000 m^3 a year, is to be contracted to private enterprises.

Full specialization is not necessarily required in view of the scale of facilities of this port and the volume of cargoes but, in determining the organization and the personnel size, care efforts have been made to define duty assignments and responsibilities as clearly as possible.

8-2-4 Cargo Handling

(1) Study of Cargo Volume and Types of Packing

Of the cargoes to be handled in the demand forecast in Chapter 5, petroleum products will be handled at the private berth of a private enterprise to be constructed in the Kemashin River. So, the volume of cargoes to be handled by the Port Authority and the types of packing of these cargoes are assumed to be as follows:

Fig. 8-3 Organization Chart

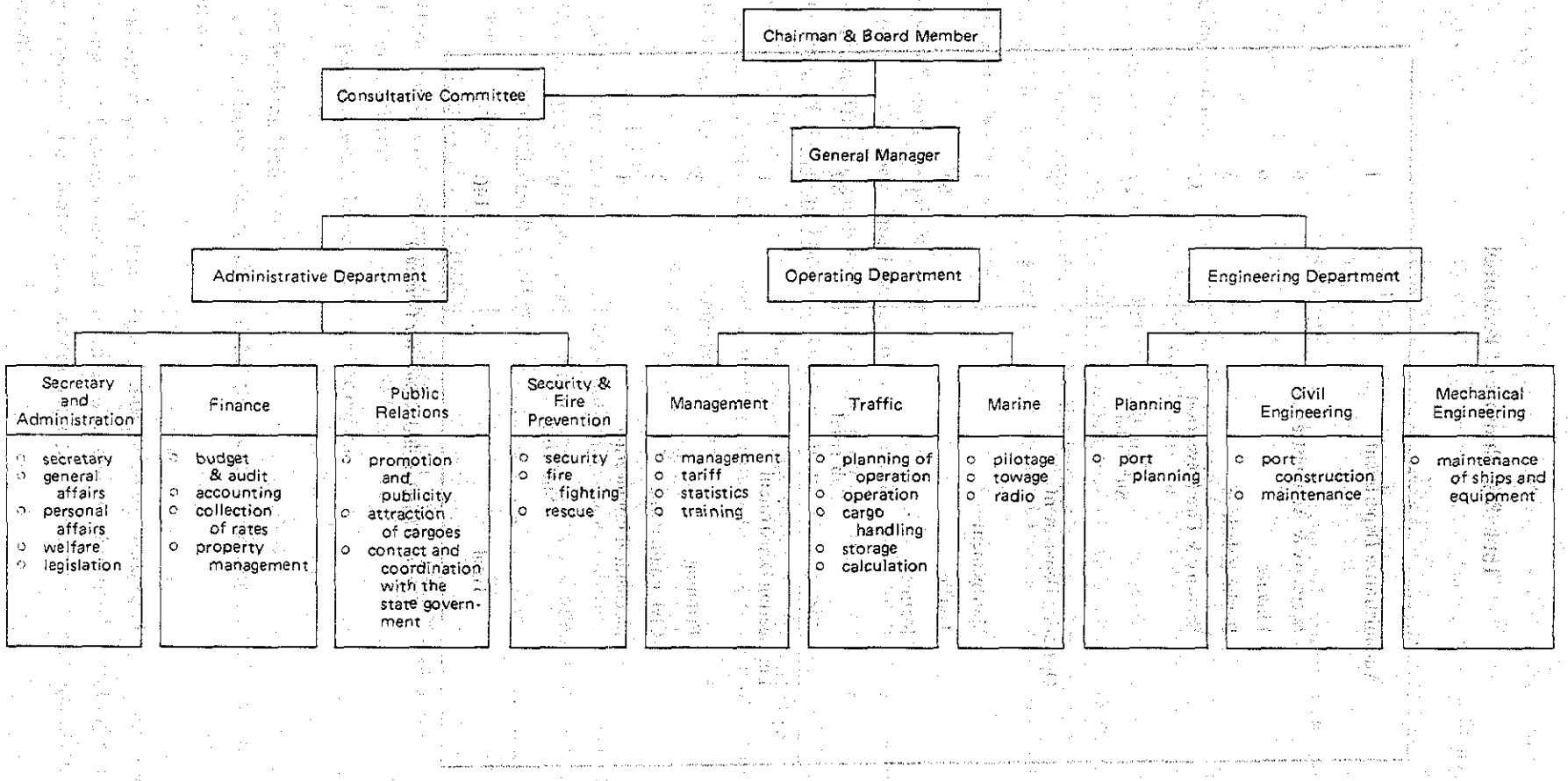


Table 8-1 Number of Personnel

Administrative Department	1
Secretary & Administration	8
Finance	6
Public Relations	3
Security & Fire Prevention	32
Sub Total	50
Operating Department	1
Management	4
Traffic	64
Marine	11
Sub Total	80
Engineering Department	1
Planning	2
Civil Engineering	2
Mechanical Engineering	4
Sub Total	9
Total	140

(Note: Total includes Director General)

Woods products	49,000 t	Mainly banded timber
Rubber	49,600 t	Irregular box shape
Palm oil	49,500 t	Liquid (Handled by specialized facility)
Fertilizer	43,800 t	Bag goods
Cement	86,100 t	Bag goods
Rice	55,400 t	Bag goods
Miscellaneous	55,000 t	Carton and various other types
Total	388,400 t	

The above volume of 388,400 tons is the demand forecast for 1988. Since this is nearly the limit to cargoes that can be handled by two berths for 5,000-ton ships, we consider it to be the maximum of the volume of cargoes that can be handled by the port.

Though the number of commodities handled is small, they include cargoes, such as woods products and rubber, that are difficult to handle with efficiency. But at the same time, it seems likely that skill in cargo handling can be easily acquired for the very reason that the number of commodities handled is small.

(2) Methods of Cargo Handling

Like others, this port must help to speed up loading and unloading work by providing economical and efficient cargo handling services for goods that will be brought there.

In the case of Kelantan Port, this purpose can be accomplished by making effective use of forklifts and pallets for most cargoes other than palm oil. So, a sufficient number of forklifts and pallets must be available. The necessary number of these may be tentatively estimated as follows:

1 Forklifts: 15 ..... 2 ≒3 tonners 12
5 tonners 3
2 × 6 × 1.2 ≒15
Here, number of longshoring gangs equivalent to stevedoring gangs: 6 (maximum)
Number of forklifts per gang: 2 (longshore, shed and open shed, cargo delivery)
Rate of forklift non-operation: 20%

2 Pallets: 1,000
238,000/120 × 2 ≒1000
Here, cargoes for which pallets are used: 338,900 × 0.7 = 238,000 tons
Pallet turnover: 120 times/year
Per-pallet amount handled: 2 tons/time

8-2-5 Port Working Hours

Twenty-four-hour work is adopted for this port as in other ports. Study by types of business is as follows:

(1) Arrival and departure of ships: This is limited to daytime (example: 7.00 a.m. – 5.00 p.m.). Judging from the facilities plan of this port and the number of ships calling at the port, there is no need to permit the night-time arrival or departure of ships; daytime operation is considered to be sufficient.

(2) Cargo handling hours: Cargo handling will be performed on a 24-hour basis by three shifts. We studied 16-hour work by two shifts but concluded that around-the-clock operation is necessary in view of the volume of cargoes handled. The maximum volume of cargoes per berth is tentatively estimated at about 180,000 – 190,000 tons on the basis of the average volume of cargoes handled by stevedoring at Malaysian ports.

$13.8 \times 3 \times 18 \times 360 \times 0.7 = 187{,}790 \times 2 \fallingdotseq 380{,}000$

Here, 13.8 = Average amount of stevedoring work/h/gang
3 = Number of gangs/berth
18 = Number of actual working hours/day (Six of the eight hours for one shift)
360 = Number of working days/year
0.7 = Berth occupancy ratio
2 = Number of berths

The annual volume of cargoes other than palm oil, which is a liquid cargo, is 340,000 tons. Assuming $13.8 \times 3 \times 18 \times 360 \times 0.6 = 160{,}000 \times 2 = 320{,}000$, this annual volume of cargoes (340,000 tons) is more than the port can handle if the berth occupancy ratio is 0.6.

The case of Port Kelang may be mentioned below as an example of working hours.

1st shift	0700 – 1500 hours
2nd shift	1500 – 2300 hours
3rd shift	2300 – 0700 hours

(3) Office hours: Ordinary daytime work (Example: 0800 – 1600 hours)

8-2-6 Provision of Port Labour – Establishment of Cargo Handling Company

As stated, the Port Authority will provide cargo handling (longshoring) services but labout will be supplied by private enterprises and stevedoring will be performed by private enterprises through the arrangements made by shipping companies. This is based on the example of Port of Penang. It is considered that, in the case of Port Kelantan also, it is desirable as a labour policy if the Port Authority, which is a public organization, leaves the supply of cargo handling labour in the hand of a private cargo handling company rather than directly hires cargo handling labourers; this is especially so in view of the fluctuation of demand for cargo handling work.

As a matter of fact, Kelantan abounds in cheap but excellent labour force. Further, to establish a cargo handling company it suffices if there is only the capital power to prepare cargo handling gear including various slings, several small forklifts, vehicles and other equipment. What is necessary after all is to be able to secure sufficient labour; so, it is not difficult to establish a cargo handling company. Further, the establishment of cargo handling companies will contribute to regional development. In view of the volume of cargoes going through the port, a single company will be sufficient for the present.

Since, however, cargo handling is important to the administration and management of the port, it must, of course, be placed under the supervision and control of the port authority to enable the port to be used efficiently. This means the licensing of the business of a cargo handling company and the authorization of its cargo handling charges – both in accordance with the stipulations of the Act. It is also necessary for the port authority to give adequate guidance to the

company regarding the improvement of cargo handling methods and the training of labourers.

We shall now tentatively estimate the number of cargo handling gangs and labourers to be required by this port.

(1) Stevedoring

Number of persons in a gang: 13 (average for Malaysia)

Maximum necessary number of gangs in a shift: 6

Working hours: 3 shifts

$13 \times 6 \times 3 \times 1.1 \fallingdotseq 260$

Thus, 18 gangs totaling 260 persons are necessary for stevedoring.

(2) Longshoring

Number of persons in a gang: 5 (average for Port of Penang)

Maximum necessary number of gangs in a shift: 6 (gangs)

Working hours: 3 shifts

$5 \times 6 \times 3 \times 1.1 = 100$

Thus, 18 gangs totaling 100 persons are necessary for longshoring.

Therefore, 360 port labourers are necessary for this port and about 400 people including the administrative personnel of the cargo handling company will have opportunities of employment.

8-3 Training of Port Authority Personnel (Preparing for Opening of the port)

As seen in the preceding section, 140 are necessary as port authority personnel in order to open Kelantan Port under a newly established port authority. Since this is a new port, all these personnel must be newly recruited. Even with efficient facilities and fine administrative organization, a port cannot effectively function unless well-trained, capable personnel are available at the various posts of the port authority. When preparing to open the port, therefore, it is, indeed, important – and difficult – how the necessary people should be recruited and trained.

Port authority personnel must learn the general policy of port management and the main objectives and about the needs and interests of port users and, at the same time, acquire knowledge about marine transportation and port cargo handling. In short, they must have knowledge and skill as experts.

Senior staffs, pilots and ship crew members can be secured from other ports and private enterprises but most middle-level staffs designate must receive on-the-job training at some existing port prior to the opening of the new port so that they may be familiarized with their duties.

Particularly important is the training of personnel in the "management" and "traffic" sections of the Operating Department. This is because it involves the guidance and training of subordinates which must be carried out by middle-level staffs while performing their own duties. It is not too much to say that the efficiency of the port itself depends on how efficient the staff of these divisions are at their jobs.

So, we shall here study the training of the staffs in the management and traffic sections.

(1) Training port: Port of Penang

Port of Penang is considered to be most suitable as the place of training because it is nearest from Port Kelantan, because it is an excellent port with a long history and an accumulation of abundant know-how in port management and because the cargo handling system of Port Kelantan is similar to that of Port of Penang.

(2) Training period: 1 year

The training should be started at least a year before the opening of the port. This period is absolutely necessary to assure efficient port management after the opening of the port.

(3) Number of trainees: 10

Prospective middle-level staff in the sections of the Operating Department other than the marine section should be dispatched for this training. It is considered that at least 10 trainees are necessary in consideration of the types of work and the following items of training.

(4) Subjects of Training

The following may be mentioned as the main subjects of this training:

① General knowledge about foreign trade, marine transportation and ships
② Ships and berth management
③ Characters and classification of cargoes

④ Management of transit sheds and open sheds
⑤ Cargo handling techniques and cargo handling equipment
⑥ Charge system and computation of charges
⑦ Training of personnel and control of cargo handling labourers
⑧ Safety and sanitation measures for ports
⑨ Contact with customs house and other related government agencies
⑩ Regulations

Besides the above, the short-term training of other personnel at Port Kelang, the largest port in Malaysia, and the port of Singapore which is a neighboring country would be, indeed, effective. Further, the training of prospective senior staffs in Japan or other countries with advanced port management should be considered.

Table 8-2 (Reference)

1. Annual volume of cargoes to be handled by the Port Authority

Foreign trade cargoes	Woods products	49,000 t
	Rubber	49,600 t
	Palm oil	49,500 t
	Miscellaneous	55,000 t
	Fertilizer	43,800 t
Domestic trade cargoes	Cement	86,000 t
	Rice	55,400 t
	Total	388,400 t

2. Number of ships calling at the port
   General cargo ships
   3,500 G.R.T.: 49
   700 G.R.T.: 177 (coasters)
   Oil tankers
   2,000 G.R.T.: 25
   700 G.R.T.: 204 (coasters)
3. Ships, cargo handling equipment, etc.
   Tugboat (600 H.P.): 1
   Pilot boat: 1
   Mobile crane (10 t): 1
   Forklifts (5 t, 3 t, 2 t): 15
   Fire engine truck: 1
   Vehicles: 2

8-4 Administration and Management of the Fishing Port

8-4-1 Present Situations of Fishing Port Administration

There are regulations and subsidies and other systems concerning fisheries in Malaysia today but it has no systems concerning "fishing ports" worthy of special mention. Though a considerable number of "fishing ports" do exist in the Malay Peninsula, the nation's fishery circles regard them not as fishing ports but as "landing centers" or "fisheries complexes". There is no special organization to administer fishing ports. No charges for using fishing ports are being collected and all expenses necessary for the maintenance and administration of fishing ports are borne by the Federal Government.

The management of "fishing ports" is participated in by the Fisheries Department, the MAJUIKAN and the Fisheries Cooperative. In the case of Kuala Buset, five persons from the Fisheries Department, four from the MAJUIKAN and four from Fisheries Cooperative are stationed there. The MAJUIKAN is central to the management of fishing ports.

The construction or repair of fishing ports is requested of the Fisheries Department by the MAJUIKAN, which is the management organization. The Fisheries Department plans it and the Public Works Department takes over, designing and performing the work. When completed, the facilities are managed mainly by the MAJUIKAN.

8-4-2 Improvement of Fishing Port Administration

The Malaysian system of administration and management of fishing ports which is outlined above is rather unclear. Hence, the necessity of improving the fishing port administration.

This project proposes to spend as much as M$19,022,000 on the construction of fishing port facilities and to land and handle an annual total of more than 13,000 tons of fish catches. Administration and management are, of course, most important to enable the new facilities to function to the full extent. Further, the fishing port is an important public facility serving as the base of the fishery activity to supply fish, a major source of protein for the people of the state.

It is, therefore, necessary to establish a field organ of the Fisheries Department at Kelantan Port in order to increase the efficiency of its administration and management and enable it to be properly maintained and repaired. Namely the establishment of a fishing port administration office is desirable for the purpose of defining and improving the system of administering fishing port as a public facility.

The MAJUIKAN will be central to the operation of fishing boats and the management of such functional facilities for fishery as fish markets, cold storages and refrigerators.

8-4-3 Business, Organization and Personnel of Fishing Port Administration Office

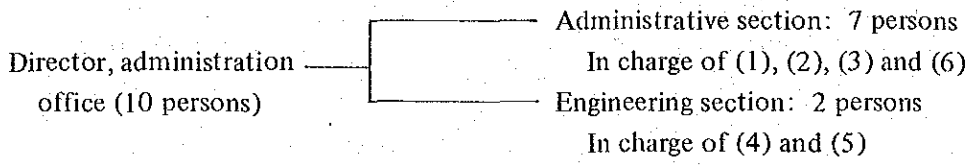
The following may be mentioned as the businesses of administration office necessary to maintain fishing port facilities always in the best conditions, ensure the safe entry and departure of fishing boats and thereby contribute to the smooth landing of catches by fishing boats:

(1) Control of the entry and departure of fishing boats and coordination regarding the assignment of berths.

(2) Coordination and guidance of work in the port premises.
(3) Maintenance of order in the port area and guidance of cleaning.
(4) Maintenance and repair of fishing port facilities.
(5) Maintenance dredging of channels and anchorage.
(6) Statistical work concerning fisheries.

The administration office should cooperate with the Port Aurthority in the maintenance dredging of channels and anchorage.

The minimal organization and personnel necessary for the conduct of these activities are as follows:



As the number of the MAJUIKAN personnel to be charged with the fishery functional facilities comprising fish market, ice making, refrigeration, cold storage, water supply and bunkering facilities, about 10 people seem likely to be necessary for administration and management, and maintenance and repair.

CHAPTER 9 ECONOMIC ANALYSIS

CHAPTER 9 ECONOMIC ANALYSIS

9-1 General

9-1-1 Outline

As stated already, the development of a port in Kelantan State which presently lacks useful port facilities will have immeasurable impact on the exploitation of this state, whose development lags behind other states in West Malaysia in spite of its immense potentialities.

However, the range for quantitative economic analysis is, indeed, limited as follows:

This master plan project has been planned with the target year of 2000. For an extremely long-term project which is partly intangible, quantitative economic analysis looks alike meaningless. What is more, the initial investment ought to concentrate on break-waters and other facilities that will yield low profits in view of the natural conditions of Kelantan Port. Therefore, it is common that the contents of the Phase I development plan are expected to produce the worst results. We can judge that it suffices for the following economic analysis to be conducted on only Phase I project planned in accordance with the demand forecast for 1987.

9-1-2 Comparative Alternative Plan

In executing this economic analysis, we variously discussed possibilities for what might be used as a comparative alternative plan. We also took into consideration trends of cargo transportation in the Malay Peninsula, road projects presently in progress, relations with other ports, the present fisheries situation and the distribution of fish catches.

Eventually, we made a comparative alternative plan for the case of study where, as can be seen from many examples, investment was not made for this project, namely, where the port did not exist and could not be utilized.

In other words, we decided to conduct a cost-benefit analysis for the difference caused by cases of "with" and "without the port".

9-1-3 Prices Used in the Cost-Benefit Analysis

All costs and benefits analyzed quantitatively here are indicated by 1980 prices, the year of this survey.

But regarding average fish prices used in computing benefits related to fisheries, 1978 prices, the latest data available, will be used.

9-2 Benefits

9-2-1 Estimation of Benefits

The purpose of the development of Kelantan Port is to improve the conditions of transportation by providing a goods distribution base, to promote foreign trade and to accelerate the growth of fish catches in the State of Kelantan.

The followings may be specifically mentioned as the economic benefits of the development of this port:

(1) Effect on Regional Development

The industrial development projects now under way will make further progress from the impact of this port development. Port-related industries consisting mainly of export and import industries are expected to be located around this area. It must be said that the role to be played by the development of the port in the regional development is, indeed, important.

(2) Effect on Increasing Opportunities of Employment and Incomes of Inhabitants

The inducement of industries which will accompany the development of this port will supply opportunities of employment for local inhabitants and increase their incomes. As a direct benefit, one may mention that, after Port Kelantan opens, about 600 people will have opportunities of employment as personnel for port administration and management and as personnel for cargo handling.

(3) Reduction of Transportation Costs for Port Cargoes

(4) Promotion of Trade with East Asia and Southeast Asia

The project will directly connect Kelanta State with East Asia and Southeast Asia by a port and trade among these areas will be promoted because of the geographical advantages of the State.

(5) Benefit of Fish Catch Increases

(6) Stabilization of Fish Prices Through the Stabilized Supply of Fish

The completion of this all-weather port will enable fishing boats to operate throughout the year. In addition, fishing boats of larger sizes will be used. Besides, waiting for tides will no longer be necessary. Therefore, fishing activities will be stabilized, the supply of fish will be stabilized and, as a result, fish prices will be stabilized.

Of the above items, (1), (2), (4) and (6) are extremely difficult to measure in currency-base. So, only (3) Reduction of Transportation Costs and (5) Benefit of Fish Catch Increases are quantitatively analyzed below.

The annual volume of cargo handled by this port and the annual volume of fish landed there are shown in Table 9-1 based on the demand forecast in Chapter 5.

9-2-2 Benefit of Reducing Transportation Cost for Port Cargoes

(1) Change in the Cargo Flow

Kelantan State will have no port facilities without the development of Kelantan Port. Therefore, export/import cargo and imbound/outbound cargo will have to be transported between Kelantan State and Port Penang, Port Kuantan and other areas by road or railway. If, on the contrary, this port is developed and ocean-going and coastal ships can call there, it will handle cargo with annual volumes shown in Table 9-1.

Therefore, cargo flow will change, depending on the existence of this project.

Fig. 9-1 presents the assumed cargo transportation routes and the means of transportation used.

The bases for these assumptions on routes are as follows:

① Without Port Kelantan, two ports – Port Penang and Port Kuantan – would be used because of land transportation distances from Kelantan State.
Here, the port nearer to the places of cargo origins or the destinations of the cargoes would be used, in principle.

② East West Highway and other road projects now in progress would be already available.

③ The places of cargo origin and the destinations of the cargo would, in principle, be regarded as two key points, item by item, for the demand forecast.

④ Transportation routes with lower transportation costs would be, in principle, selected in accordance with economic principles, but present trends of transportation and the transporting capacity of each means of transportation would also be taken into consideration.

This figure shows that if Kelantan Port is used for foreign trade, land transportation distances will be drastically reduced, compared to the case when the port is not used. The form of transportation for domestic trade cargo will change from land transportation to the combined use of land transportation and coastal transportation.

(2) Cargo Volume for Each Route

The volume of cargoes passing through Port Kelantan is presented in Table 9-2 by commodity and by place of origin or destination.

In computing these figures, ratios by items were established as in Table 9-3 on the basis of production, population and goods distribution in the area centered around each place of origin or destination of cargoes.

(3) Computation of Transportation Cost Reductions

The benefit of transportation cost reductions consists of the difference between the cost necessary for the means of transportation on the route in the "with the port" case, namely the case where this project exists, and the cost necessary in the "without the port" case, namely the case where the project does not exist, as determined on the basis of Fig. 9-1 assumed in the preceding section.

The transportation cost required for each transportation route is computed as follows:

① Transportation costs by commodity and by means of transportation are established as in Table 9-4.

Table 9-1 Cargo Handling Volume and Fish Landing
(1988)

(tons)

Commodities	Cargo Handling Volume Fish Landings
Woods products	49,000
Rubber	49,600
Palm oil	49,500
Fertilizer	43,800
Miscellaneous	55,000
Rice	55,400
Cement	86,100
Sub. Total	388,400
Petroleum	163,100
Total	551,500
Fish	13,370

Fig. 9-1 Assumption of Cargo Transportation

Cargo	With the Port	Without the Port
Woods Products	Kemubu/Manek Urai → Kelantan ⇝ Importing Countries Gua Musang → Kelantan ⇝ Importing Countries	Kenumu/Manek Urai → Penang ⇝ Importing Countries Gua Musang → Kuantan ⇝ Importing Countries
Rubber	Kota Bharu → Kelantan ⇝ Importing Countries Gua Musang → Kelantan ⇝ Importing Countries	Kota Bharu → Penang ⇝ Importing Countries Gua Musang → Kuantan ⇝ Importing Countries
Palm Oil	Gua Musang → Kelantan ⇝ Importing Countries Kemahang → Kelantan ⇝ Importing Countries	Gua Musang → Kuantan ⇝ Importing Countries Kemahang → Penag ⇝ Importing Countries
Fertilizer	Exporting Countries ⇝ Kelantan → Kota Bahru Exporting Countries ⇝ Kelantan → Gua Musang	Exporting Countries ⇝ Penang → Kota Bharu Exporting Countries ⇝ Kuantan → Gua Musang
Miscellaneous	Exporting Countries ⇝ Kelantan → Kota Bharu Exporting Countries ⇝ Kelantan → Gua Musang	Exporting Countries ⇝ Penang → Kota Bharu Exporting Countries ⇝ Kuantan → Gua Musang
Rice	Kota Bahru/Kemubu → Kelantan ⇝ East Malaysia Kota Bahru/Kemubu → Kelantan ⇝ Kuantan Kota Bahru/Kemubu → Kelantan ⇝ Johore ⇝ Johore Bahru	Kota Bahru/Kemubu → Kuantan ⇝ East Malaysia Kota Bahru/Kemubu → Kuantan Kota Bahru/Kemubu → Johore Bahru Kota Bahru/Kemubu ⇢ Johore Bahru
Cement	Pancing → Kuantan ⇝ Kelantan → Kota Bharu	Pancing → Kota Bharu
Petroleum Products	Kemaman ⇝ Kelantan → Kota Bharu Kemaman ⇝ Kelantan → Gua Musang	Kemaman → Kota Bharu Kemaman → Gua Musang

Note: → Road Transportation ⇝ Sea Transportation ⇢ Rail Transportation □ Port

Table 9-2 Cargo Volume of Districts (1988)

Cargo	Districts	Volume
Wood Products	Kemubu & Manek Urai	37,000
	Gua Musang	12,000
Rubber	Kota Bharu	23,500
	Gua Musang	26,100
Palm Oil	Kemahang	16,300
	Gua Musang	33,200
Fertilizer	Kota Bharu	26,300
	Gua Musang	17,500
Miscellaneous	Kota Bham	49,500
	Gua Musang	5,500
Rice	Kuantan	18,500
	Johore Bahru	24,600
	East Malaysia	12,300
Cement	Kota Bharu	86,100
Sub. Total		388,400
Petroleum Products	Kota Bharu	146,800
	Gua Musang	16,300
Total		551,500

Table 9-3 Ratio of Cargo Volume

Commodities	Areas	Ratio
Woods Products	Kemubu & Manek Urai	75.0%
	Gua Musang	25.0%
Palm Oil	Kemahang	32.9%
	Ulu Kelantan	67.1%
Rubber	Kota Bharu	47.4%
	Gua Musang	52.6%
Fertilizer	Kota Bharu	60.0%
	Gua Musang	40.0%
Miscellaneous	Kota Bharu	90.0%
	Gua Musang	10.0%
Rice	East Malaysia	22.2%
	Kuantan	33.4%
	Johore Bharu	44.4%
Cement	Kota Bharu	100 %
Petroleum Products	Kota Bharu	90.0%
	Gua Musang	10.0%

Table 9-4 Freight in Unit Cost

(M$/t)

Distance	Trucks (10t)	Tank Lorries (18t)	Cargo Ships (1,000t)	Oil Tanks (1,000t)
Kemubu Manek Urai —130 km→ Kelantan Port	16.0	–	–	–
Kemubu Manek Urai —310→ Penang Port	40.0	–	–	–
Gua Musang —190→ Kelantan Port	24.0	12.0	–	–
Gua Musang —380→ Kuantan Port	48.0	24.0	–	–
Kota Bharu —20→ Kelantan Port	3.0	2.0	–	–
Kota Bharu —330→ Penang Port	42.0	–	–	–
Kemahang —80→ Kelantan Port	–	5.0	–	–
Kemahang —260→ Penang Port	–	16.0	–	–
Kota Bharu Kemubu —90→ Kelantan Port	12.0	–	–	–
Kota Bharu Kemubu —430→ Kuantan	55.0	–	–	–
Kelantan Port —310→ Kuantan Port	–	–	20.0	–
Kelantan Port —680→ Johore Port	–	–	40.0	–
Johore Port —20→ Johore Bahru	3.0	–	–	–
Kota Bharu Kemubu —750→ Johore Bahru	85.0	–	–	–
Pancing —30→ Kuantan	4.0	–	–	–
Pancing —400→ Kota Bharu	50.0	–	–	–
Kemaman —280→ Kelantan Port	–	–	–	10.0
Kemaman —330→ Kota Bharu	–	20.0	–	–
Kemaman —410→ Gua Musang	–	25.0	–	–

② The same rate is used for transportation cost to or from East Malaysia

③ The same rate is used for necessary costs at all Malaysian ports.

The establishment of these transportation costs is based on the results of hearings from the MOT, MISC, shipping companies, transport firms, MARA Headquarters, etc. and data furnished by them.

The amount of transportation cost reduction for each route is computed by the following formula:

$$B = V \times (C_1 - C_2)$$

Here, B = Benefit

V = Volume of cargoes

C_1 = Cost of transportation in "without" case

C_2 = Cost of transportation in "with" case

Transportation cost reductions by commodity and by routes are as shown according to this formula in Table 9-5.

Table 9-5 Economy of Transportation Cost

Commodities	Amount (M$)
Woods Products	1,176,000
Rubber	1,542,900
Palm Oil	577,700
Fertilizer	1,445,700
Miscellaneous	2,062,500
Rice	1,015,400
Cement	1,119,300
Petroleum Products	1,060,200
Total	9,999,700

9-2-3 Benefit of Fish Catch Increases

(1) The Concept of Benefit

Generally, the computation of benefits for fishing ports is very difficult, compared with that for commercial ports, due to the scarcity of related data.

In this analysis, the increase in fish catches is determined first because fish catches would be larger if this port exists than in the case without the port. Next, the market price for the fish equivalent to the increase of the catch is computed. The remainder after subtracting the cost of fishing from the result of the market price computation will be considered the benefit of the increase in the fish catch. This is considered "added value" for the national economy.

(2) Computation of Fish Catch Increases and Benefits

No fishing port worthy of the name exists in Kelantan State except Geting. Nevertheless, the state produced 15,465 tons of fish in 1979.

The consumption of fish per capita in the state in 1978 was estimated at about 29 kg. Since the state's production can supply only about 40% of its demand, half of the 60% shoft-fall is

believed to be imported from Thailand and the remaining half seems to be supplied from Kuala Besut and Kuala Trengganu in the neighboring state.

In the future, fish will be increasingly important as a source of protein for the people of Kelantan state.

No fishing port facilities exist at Sabak-Kemashin, the site of development for this project, but, in reality, fishing is being practised by fishermen and fishing boats existing there. However, no statistics on fisheries in this area alone are available. The annual volume which would be handled if this project existed has been estimated at 13,370 tons, as indicated in Table 9-1. Since comparison between the "with" case and the "without" case is not easy, the benefit may be computed on the fish catch in the "with" case alone.

With the completion of the new fishing port, the fish catch will naturally increase as measures are taken to promote fisheries and as productivity improves. Reasons for the increase include:

① The operating time of fishing boats will increase because less time will be necessary for fuel and water supply, and fish landing. Fishing boats leaving or returning to the port will no longer have to wait for the tides to change.

② It will be possible to use larger fishing boats than ever.

③ The number of operating days will increase.

The demand forecast in Chapter 5 has estimated the fish catch of the entire State of Kelantan for the cases with and without this project. The forecasted values include the fish catch at the fishing port of Geting after its improvement. In this analysis also, the difference between the forecast values in the two cases is considered to be the increase brought about in the annual catch by the development of Port Kelantan.

"With": 26,740 t "Without": 20,710 t Difference: 6,030 t

Thus, the catch will increase by 6,030 tons, which is about half of the volume handled by this port.

The average price of fish is used as its unit price. Namely, it is M$2,187 a ton (M$132 per pikul). This was the wholesale market price in Kelantan State in 1978 (source: Annual Fisheries Statistics). It seems that, since there is sufficient demand, as stated already, the use of this price will present no problem even if the catch becomes larger. Correction to the 1980 price by a deflator may be considered, but this seems to be unnecessary in view of the nature of the fish price.

The following may be used as a computation method for benefits:

Benefit (B) is: $B = GI - C$

$$GI = P(Q_1 - Q_0)$$

$$C = C_1 - C_0$$

Here, GI = Gross income increase

C = Input cost increase

C_1 = Input cost in "with" case

C_0 = Input cost in "without" case

P = Average fish price

Q_1 = Catch in "with" case

Q_0 = Catch in "without" case

In the above instance, input cost means the operating costs of fishing boats. However, no sufficient data for substitution into this formula were available. So, the average added value of all fishing boats will be estimated by the following from the example of 40-ton trawlers belonging to the Majuikan:

The annual average catches of 40-ton trawlers operating on the east coast was 48 tons in 1978. Assuming that the annual input cost is M$52.300 (based on hearings with the Majuikan, Fisheries Department, Geting, Kuala Buset and Kuala Trennganu), the added value ratio is 50%. However, the average catch for all fishing boats was 37 tons in 1978 and, as can be seen from the above formula, factors responsible for the increase of input cost must be incorporated into the increase of the catch. The average catch for all fishing boats after the completion of the fishing port is estimated at 58 tons.

Here, to avoid over-estimation of the benefit, the average added value ratio of all fishing boats will be estimated at 25%, which is obtained by multiplying the above-mentioned added value ratio by 1/2.

From the above results, the benefit of the catch increase is computed in Table 9-6.

Table 9-6 Benefit of Catch Increase

1	Catches increase	tons	6,030
2	Average fish price	M$	2,187
3	Gross benefit (1 x 2)	M$	13,187,610
4	Net benefit (added value) (3 x 25%)	M$	3,296,900

9-3 Costs

The scope of costs covered by this analysis comprises the Phase I construction costs of Kelantan Port and costs for the maintenance and management of the port.

9-3-1 Construction Cost

The construction cost of this port, as of 1980 price, is M$88,250,000 as given in Chapter 8 and its annual breakdown for the five years from 1983 to 1987 is shown in Table 9-7. It includes the purchase costs of vessels and equipment.

9-3-2 Maintenance Costs and Operation Costs

① Costs for the administration and operation of the public commercial port: They will be computed in accordance with the financial analysis described in the next chapter. These funds are appropriated for the administration and operation costs of the Port Authority (See Table 9-8)

② Maintenance Costs: A certain percentage of the construction costs or purchase costs will be appropriated for annual maintenance and operation costs of each facility (see Table 9-9).

③ Costs for maintenance dredging: As stated in Chapter 7, the annual volume of maintenance dredging has been estimated 155,000 m^3 and the dredging cost per m^3 is M$5.

Table 9-7 Construction Cost

(M$)

1983	M$ 10,999,000
1984	9,004,000
1985	22,879,000
1986	22,890,000
1987	22,478,000
Total	88,250,000

Table 9-8 Administration & Maintenance Cost

Administration & Operation Cost	Maintenance Cost	Maintenance Dredging Cost	Total
M$ 1,563,000	M$ 934,600	M$ 775,000	M$ 3,272,600

Table 9-9 Rates of Maintenance Cost

(%)

Facilities	Rates
Seawall, Breakwater, Groin	0.2
Quay	1.0
Slipway	1.0
Transit Shed	1.0
Building	1.5
Wholsale Market/Office	2.0
Cold Storage/Freezing Facilities Ice Factory/Ice Storage Facilities	5.0
Oil Tanks (Palm Oil/Fish)	2.0
Roads, Pavement	1.0
Green Area	1.0
Drainage	0.5
Water/Power Supply	2.0
Navigation Aids	3.0
Vessel	10.0
Folklifts	15.0
Crane & Vehicles	5.0
Dolphin Berth	2.0
Oil Supply	4.0

9-4 Setting of Economic Prices

The benefits and costs that have already been computed are shown by market prices. They are, therefore, partially unsuited for use as prices for economic analysis. So, some of the market prices are modified as follows:

(1) Exclusion of Transfer Items

No customs duties are included in the cost of imported materials and equipment, which are the foreign currency portion of the construction costs shown in Chapter 8. However, a 5% sales tax is included in the amount shown in the local currency.

This is merely a transfer item that appears in the national economy without consuming material resources. So, it does not have to be included in the costs of the project in the analysis. Hence, it is excluded from consideration here.

(2) Adjustment of Unskilled Labor Costs

The above-mentioned construction cost includes wages for laborers hired under this project. These laborers are divided into the skilled labor force and unskilled labor force. The market wage rates by which wages are actually paid will be applied to the skilled laborers.

For the unskilled laborers, modified prices are determined by multiplying the market wage rate by the shadow wage rate, which can be obtained by the following formulation:

$SWR = C - (C - m)/S$

Here, SWR = Shadow wage rate
C = Wage in market price
m = Opportunity cost
S = Premium of Savings (or Investment)

Here, we will assume that when the premium part of the savings premium(S) is 0, S = 1, and SWR = m. The opportunity cost will be estimated by computing the per capita GDP of agricultural, forestry and fishery workers. Such method can be found in many cases. The GRDP in the agricultural, forestry and fishery sectors of Kelantan State in 1980 is M$266 million (forecast value – Source – EPU). The number of workers in these sectors is 179,500 (Source – SEPU). So, the daily rate is M$5 based on the assumption that they work 25 days a month. Thus, the opportunity cost can be estimated at M$5 a day. Since the wages for unskilled laborers to be hired under this project are will be payable at a daily rate of M$10, the opportunity cost is equivalent to 50% of this sum. Therefore, the ratio of the shadow wage rate to the market wage is 0.5.

The ratio for the shadow wage rate computed by the above method may be too small a value in consideration of the low unemployment rate (6%) in Malaysia. So, the subsequent computation of I.R.R. will be made for both the case where the unskilled labor cost is modified (case I) and the case where it is not modified (case II).

(3) Foreign Exchange Rate

Foreign exchange rate for Malaysia is not fixed but float. So, there will be no need to modify exchange rates for the foreign currency portion of the construction cost.

(4) Consideration for Shadow Price

The shadow pricing is not adopted in this analysis excluding unskilled labor wage. This is because the shortage of data makes it impossible to set conversion factors for consumption (CFC) included among the conversion factors for prices of labor and non-trade goods.

Since, however, the standard conversion factor is "1", as indicated in Table 9-10, it can be estimated that the conversion factor for consumption will be very close to 1. Therefore, as far as this figure is concerned, it may be unnecessary to adopt the shadow pricing.

The standard conversion factor (SCF) can be computed by the following formula:

$$SCF = \frac{\text{total imports + total exports}}{\text{total imports + total import taxes + total exports} - \text{total export taxes}}$$

(5) The construction cost amounts partially modified by the above are M$84,382,700 and M$86,368,600 in case I and case II, respectively, and their annual breakdown is shown in Table 9-11.

Table 9-10 Standard Conversion Factor

(M$ Million)

	Items	1974	1975	1976	1977	1978	mean
(1)	Export (FOB)	10,195	9,231	13,442	14,959	17,094	12,984
(2)	Import (CIF)	9,891	8,530	9,713	11,615	13,690	10,688
(3)	Import Duties and Surtax	893	801	978	1,140	*1,325	1,027
(4)	Export Duties	943	625	1,010	1,390	*1,462 *estimate	1,086
(5)	(1) + (2)	20,086	17,761	23,155	26,574	30,784	23,672
(6)	(1) + (2) + (3) - (4)	20,036	17,937	23,123	26,324	30,647	23,613
(7)	SCF = (5) ÷ (6)	1.00	0.99	1.00	1.01	1.00	1.00

(Source: Economic Report 1979/80)

Table 9-11 Modified Construction Cost

(M$)

Year	Case-I	Case-II
1983	10,657,500	10,796,600
1984	8,360,800	8,707,300
1985	22,122,400	22,499,500
1986	21,702,300	22,349,500
1987	21,539,700	22,015,700
Total	84,382,700	86,368,600

9-5 Economic Evaluation

9-5-1 Internal Rate of Return

There are several indices for evaluation of economic returns. Here, however, the economic returns are evaluated in terms of the internal rate of return (IRR). The I.R.R. is obtained by the following equation:

$$\sum_{i=0}^{n-1} \frac{Bi - Ci}{(1 + IRR)^i} + \frac{S}{(1 + IRR)^{n-1}} = 0$$

Here, n = Period of computation IRR
Bi = Amount of benefit at i-th year
Ci = Amount of costs at i-th year
S = Salvages at the final year of the computation

The life of this project is 30 years and the period of computation begins in 1983, the initial year of investment. It stretches until 2012. Since the life of each facility is different, an average life weighted by individual costs is given. The computation comes to 33 years according to the lives of facilities given by the financial analysis in the next chapter. (25 years for the slipway, 15 years for the cold and ice facilities and 25 years for the oil supply.) The post-computation period is to be covered with Salvages.

The results of the computation of I.R.R. by tabulating benefits and costs, as in Table 9-12 and Table 9-13, in accordance with the above are as follows:

(1) With modified labor cost (Case I, Table 9-12)
I.R.R. = 9.4%

(2) With unmodified labor cost (Case II, Table 9-13)
I.R.R. = 9.1%

9-5-2 Evaluation

There are many views concerning the percentage of internal rate of return to make judgement whether a project is feasible or not.

A prominent view is that feasibility requires at least a rate of 10%. From this, it can be seen that this project is generally feasible, since its internal rate of return is very close to this standard minimum value, though not quite reaching it. Further, since the I.R.R. value exceeds the Malaysian prime lending rate (7.5%) per annum), we can evaluate that the capital may be used efficiently.

The Asian Development Bank once assumed the opportunity cost of the Malaysian capital at 12%. By this standard, the I.R.R. is somewhat insufficient. In the appended reference case, however, the I.R.R. is gotton as 12.3%, which seems to make the project feasible.

Thus, considering the nature of the project, its potential and the possibilities of development, it can be concluded that this project is economically feasible.

Further, it is not always necessary to adhere too closely to the abovementioned I.R.R.

Table 9-12 Cost-Benefit Table Case I IRR = 9.4%

(MS)

No.	Year	Costs			Benefits			Salvage	Present Value (Discount Rate = 9.4%)
		Construction & Purchase	Operation & Maintenance	Total	Reduction of Transport Cost	Benefit of the Increase of Fish Catch	Total		
1	1983	10,657,500		10,657,500					-10,657,500
2	1984	8,360,800		8,360,800					- 7,642,413
3	1985	22,122,400		22,122,400					-18,484,070
4	1986	21,702,300		21,702,300					-16,575,010
5	1987	21,539,700		21,539,700					-15,037,317
6	1988		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		6,396,677
7	1989		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		5,847,054
8	1990		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		5,344,657
9	1991		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		4,885,426
10	1992		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		4,465,655
11	1993		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		4,081,951
12	1994		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		3,731,217
13	1995		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		3,410,619
14	1996		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		3,117,568
15	1997		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,849,696
16	1998		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,604,841
17	1999		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,381,025
18	2000		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,176,439
19	2001		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,989,433
20	2002		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,818,494
21	2003		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,662,243
22	2004		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,519,418
23	2005		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,388,865
24	2006		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,269,529
25	2007		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,160,738
26	2008		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,060,738
27	2009		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		969,596
28	2010		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		886,285
29	2011		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		810,132
30	2012		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600	20,927,000	2,286,506
Total		84,382,700	81,815,000	166,197,700	249,992,500	82,422,500	332,415,000	20,927,000	- 281,799

Table 9-13 Cost-Benefit Table Case II IRR = 9.1%

(M$)

No.	Year	Costs			Benefits			Salvage	Present Value (Discount Rate = 9.1%)
		Construction & Purchase	Operation & Maintenance	Total	Reduction of Transport Cost	Benefit of the Increase of Fish Catch	Total		
1	1983	10,796,600		10,796,600					-10,796,600
2	1984	8,707,300		8,707,300					- 7,981,027
3	1985	22,499,500		22,499,500					-18,902,679
4	1986	22,349,500		22,349,500					-17,210,503
5	1987	22,015,700		22,015,700					-15,539,373
6	1988		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		6,485,109
7	1989		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		5,944,188
8	1990		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		5,448,385
9	1991		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		4,993,937
10	1992		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		4,577,394
11	1993		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		4,195,595
12	1994		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		3,845,642
13	1995		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		3,524,878
14	1996		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		3,230,869
15	1997		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,961,383
16	1998		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,714,375
17	1999		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,487,969
18	2000		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,280,449
19	2001		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		2,090,237
20	2002		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,915,891
21	2003		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,756,087
22	2004		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,609,612
23	2005		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,475,355
24	2006		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,352,296
25	2007		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,239,501
26	2008		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,136,115
27	2009		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		1,041,352
28	2010		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		954,493
29	2011		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600		874,879
30	2012		3,272,600	3,272,600	9,999,700	3,296,900	13,296,600	20,927,000	2,476,036
Total		86,368,600	81,815,000	168,183,600	249,992,500	82,422,500	332,415,000	20,927,000	181,845

standards, which merely represent the lending terms of international financial institutes, etc., in executing this project.

Reference Case

Costs and benefits are analyzed for reference as follows:

1. Benefits

1-1 Reduction of Transportation Cost of Port Cargo

Precisely the same as in the text.

1-2 Benefit of Catch Increases

In estimating the average added value ratio for all fishing boats, "2/3" is used as the multiplier rather than "1/2", as in the text. This ratio was determined in the text, by multiplying 50%, the added value ratio of 40-ton trawlers, by "1/2". For this case, however, "1/2" may be too small

$$13,187,610 \times 33.3\% = M\$4,391,500$$

1-3 Benefit of Increased Employment Opportunities and Incomes

As stated in the text, about 600 people will have opportunities for employment after the start of use of Port Kelantan to be constructed under this project.

Of this number, 500 will be absorbed from the agricultural, forestry and fishery sectors of Kelantan State. As already mentioned, their wage rate is M$5 a day. The difference from M$400, the average monthly wage of personnel engaged in port operation an cargo handling, is considered as the benefit.

$$\{400\ M\$ - (5 \times 25)\ M\$\} \times 12\ \text{months} \times 500\ \text{men} = 1,650,000\ M\$$$

2. Costs

The Breakwater to be constructed at the estuary of the Kemasin River will not only function as a port facility but will also serve as a training wall. So, a portion of the construction cost is allocated to river works. Here, 1/2 of the construction cost of the breakwater on the right bank of the Kemasin River (East Breakwater II) is deducted from the construction cost of this project in accordance with the enforcement plan.

Amount to be deducted: 1983 – M$1,037,400
1984 – M$1,037,400

3. Internal Rate of Return

The result of computation of the I.R.R. made by partially modifying the benefits and costs in the text (Case I) in accordance with the above assumptions and computations is shown in Table 9-14 (Reference Case).

I.R.R. = 12.3%

Table 9-14 Cost-Benefit Table Reference Case IRR = 12.3%

(M$)

No.	Year	Costs			Benefits				Salvage	Present Value (Discount Rate = 12.3%)
		Construction & Purchase	Operation & Maintenance	Total	Reduction of Transport Cost	Benefit of the Increase of Fish Catch	Benefit of Increase of Employment	Total		
1	1983	9,620,100		9,620,100						- 9,620,100
2	1984	7,323,400		7,323,400						- 6,521,282
3	1985	22,122,400		22,122,400						-17,541,742
4	1986	21,702,300		21,702,300						-15,323,801
5	1987	21,539,700		21,539,700						-13,543,179
6	1988		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		7,148,987
7	1989		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		6,365,972
8	1990		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		5,668,720
9	1991		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		5,047,836
10	1992		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		4,494,956
11	1993		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		4,002,633
12	1994		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		3,564,232
13	1995		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		3,173,849
14	1996		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		2,826,223
15	1997		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		2,516,672
16	1998		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		2,241,026
17	1999		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		1,995,571
18	2000		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		1,777,000
19	2001		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		1,582,369
20	2002		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		1,409,055
21	2003		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		1,254,724
22	2004		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		1,117,296
23	2005		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		994,921
24	2006		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		885,949
25	2007		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		788,913
26	2008		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		702,505
27	2009		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		625,561
28	2010		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		557,044
29	2011		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200		496,032
30	2012		3,272,600	3,272,600	9,999,700	4,391,500	1,650,000	16,041,200	20,415,000	1,147,917
Total		82,307,900	81,815,000	164,122,900	249,992,500	109,787,500	41,250,000	401,030,000	20,415,000	- 164,141