2.4 The Master Plan

2.4.1 The Port Facilities Layout Plan

Plan A, which is a plan to concentrate development of port functions at Kuala Perlis Port, was selected as the basic port facilities layout plan for the Perlis State master port development plan, according to the results of the evaluation in Section 2.3. The master plan was drawn up by adding the following technical considerations to Plan A (see Fig. 2.4.6).

(1) The Alignment of the Navigation Channel

In determining the alignment of the waterways, natural conditions such as waves, winds, current, geographical features, etc. and the maneuverability of ships should be considered.

The most important factor to take into consideration in planning the waterways at Kuala Perlis Port is the geography. The navigation channel alignment should be laid out so as to minimize the length of waterways and the siltation in them.

From this point of view it is preferable to plan it along a channel naturally maintained by the flow of the river or the tidal current. However, since the dredging for a man-made waterway, being constructed for flood mitigation, was started in September 1983 and is to be completed in June 1984, it is better to use this waterway for the navigation channel after it is completed.

Therefore, the waterway presently being dredged for the purpose of flood mitigation will be used as the main navigation channel but an approach channel connecting the quay to this waterway must be newly dredged.

(2) The Location of the Entrance to the Port

The entrance to the port should be located so as to keep the basins calm, by retarding the entrance of the waves, and by avoiding the flow of sediments due to waves, tides and the river.

Two alternatives for the location of the entrance to Kuala Perlis Port are proposed as shown as Plan I and Plan II in Fig. 2.4.1.

In Plan I the entrance is located on the north side to facilitate approach to the berths and to prevent the advance of waves into the basin.

In Plan II the entrance is located toward the west to avoid the flow of sediments due to tides and the river.

Alternative plans I and II have the following merits and demerits as shown in Table 2.4.1.

The siltation at Kuala Perlis Port is, from a long range view point, due to the supply of sediments brought by the Perlis River are very fine particles and the flow of sediments during flood is gradual rather than instantaneous, the estuary is not expected to develop rapid shoaling.

The siltation seems to be caused mostly by tidal current, due a tidal range as great as 2.84 m max., and by the small waves hitting the beach which disturb the sea bottom in the mud flat area raising sediments.

Both Plan I and Plan II assume the same siltation mechanism, siltation by tidal current.

But siltation by waves can be better prevented by the breakwaters in Plan I, so it far excels Plan II in this regard.

It also excels Plan II from the viewpoint that waterway should be planed as far as possible, so as not to interfer with the natural topography of the sea bottom.

From the foregoing results of the study, Plan I has been chosen as the port facilities layout plan for the Master Plan.

(3) The Water Area Use Plan within the Port

The basins of the new port are expected to be congested by various kinds of ships such as freighters, passenger boats, vehicular ferries and fishing boats. Therefore, the basins should have a sufficiently wide water area and an adequate shape to allow safe anchorage and smooth ship operation. Furthermore, in order to secure greater safety of navigation and maneuvering, the water area within the port will be devided into a commercial port area and a fishing port area as shown in Fig. 2.4.2.

Table 2.4.1 Comparison of Alternative Plans

	Merits	Demerits
Plan I	o Calm water inside the port o Flow of sediments into the port by waves is prevented. o Easy approach to the main channel	o May cause flow of river sediment into the port. o May cause flow of sediments into the port due to tidal currents, since the port is located in path of the predominant coastal current.
Plan II	o Can prevent flow of sediments carried into the port by rivers and coastal currents.	o There are some problems with regard to calmness within the port due to the invasion of waves. o Flow of sediments into the port is expected, carried by waves. o Longer approach to the main channel

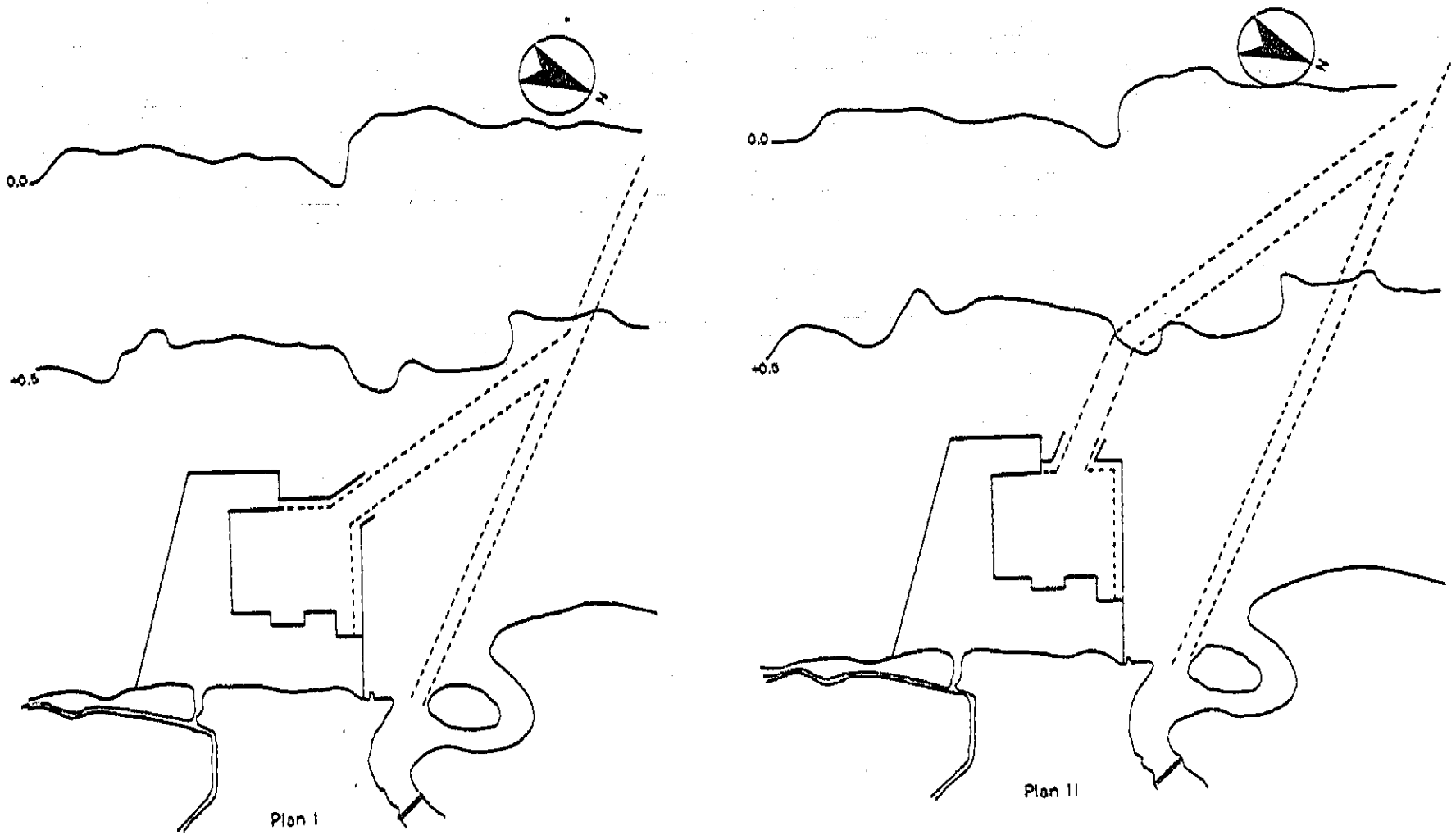


Fig. 2.4.1 Alternative Plans Relating to the Location of the Entrance to the Port

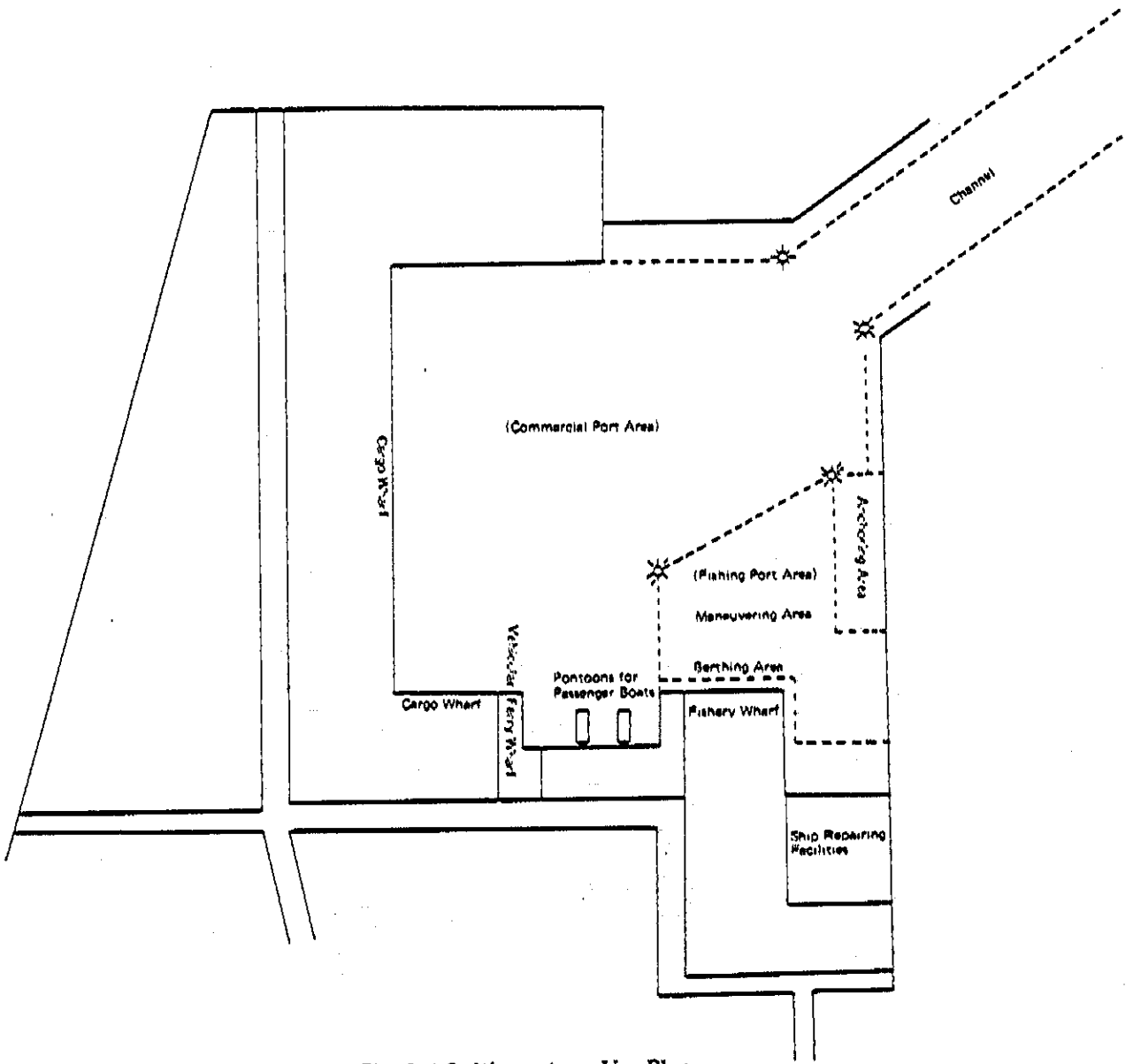


Fig. 2.4.2 Water Area Use Plan

(4) The Training Wall Layout Plan

For the berthing area of the new port, the breakwaters to be constructed around the basin would be laid out in order to prevent expected siltation and to secure calmness of the water surface. As reviewed in 2.3.3, three alternatives were considered as means to secure the approach of ships to the wharves, namely the access channel with maintenance dredging, the access channel with training walls and the trestle extending out to the required water depth. The alternative of maintenance dredging for securing the navigation channel was selected as the most preferable. However, the review did not include a plan to combine these three alternatives. In this section, we will discuss the optimum extension of training walls for a plan combining maintenance dredging and training walls.

The optimum training wall length is examined in view of the total cost of the training wall construction and the maintenance dredging, because longer training walls retard siltation of the navigation channel and reduce the cost of maintenance dredging.

At first, the shoaling rate in depth along a model navigation channel is estimated to assess the effect of training walls on channel siltation. The degree of siltation along the navigation channel is calculated upon the assumption that the amount of sediment accumulation is proportional to the reduction of sediment discharge driven by the current at the excavated channel bottom and sea bottom. The Einstein-Brown formula*) is employed in order to obtain the sediment discharge at an arbitrary water depth, because the E-B formula easily produces the total sediment load, including suspended load and bed load, caused by steady flow. This formula, however, can not deal with unsteady flow, such as the periodic tidal current, and does not take the effects of waves into account. Actually, siltation phenomenon at the site is too complicated to reproduce precisely in a numerical model. In order to consider the effect of unsteady flow and wave in a rough estimation of siltation rate, a field observation data was applied for a calibration of computation results of E-B formula as to a representative tidal current velocity.

The shoaling rates along the navigation channel are computed on the assumptions that the average velocity for tidal current flowing perpendicular to the channel is 0.25 knot, the median diameter of sediment particles is 0.1 mm, the specific gravity of sediment is 2.6, and that the tidal level is 1.4 meters above the chart datum (half of the maximum tidal range). The resulting shoaling distribution spectrum is converted into actual shoaling rates using field data at Satun Port of Thailand where the annual siltation rate is 60 – 100 cm/year derived from the bathymetric change in the approach channel between the water depth of -0.9 and +1.1 meters. The annual siltation rates along the navigation channel for the two representative cases are shown in Fig. 2.4.3.

These figures are then used to seek the relation among the costs for constructing the training walls to an arbitrary length and for maintenance dredging of the rest of the channel on the basis that the channel is rectangular, 100 meters in width, 4 meters in depth, and that the unit cost of dredging is M$3.5/m^3, while the construction unit cost at the training walls (Raft and Rock Type) is M$3,465/m/year (20 year durability). The relations between the separate costs and the total cost thus obtained are shown in Fig. 2.4.4 and Fig. 2.4.5.

The optimum training wall length, which indicates the minimum total cost, varies depending on the presumed annual siltation rate. The optimum length of the training walls is estimated as

*) Einstein, H.A.: Formulas for the Transportation of Bed Load, Transaction, ASCE, Vol. 107, No. 2140, pp. 561–573, 1942

500 meters for a siltation rate of 60 cm/year and 1,000 meters for the rate of 100 cm/year.

According to the above, the total cost of channel maintenance may be reduced by M$56,000 to M$270,000 per year or 6 to 17% of the total maintenance dredging cost by constructing the training walls.

In these calculations, the siltation of the navigation channel is assumed to be negligible for the portion where the training walls are to be constructed. Actually, the siltation in this area is not negligible because of the sediments transported by intruding waves and currents, so that the saving due to the construction of the training walls is not supposed to be as much as discussed above. Thus, we cannot really expect much benefit from constructing the training walls. However, we recommend construction of short training walls, extending from the tip of each breakwater, in order to control the river current and to prevent sediment flowing into the port berthing area.

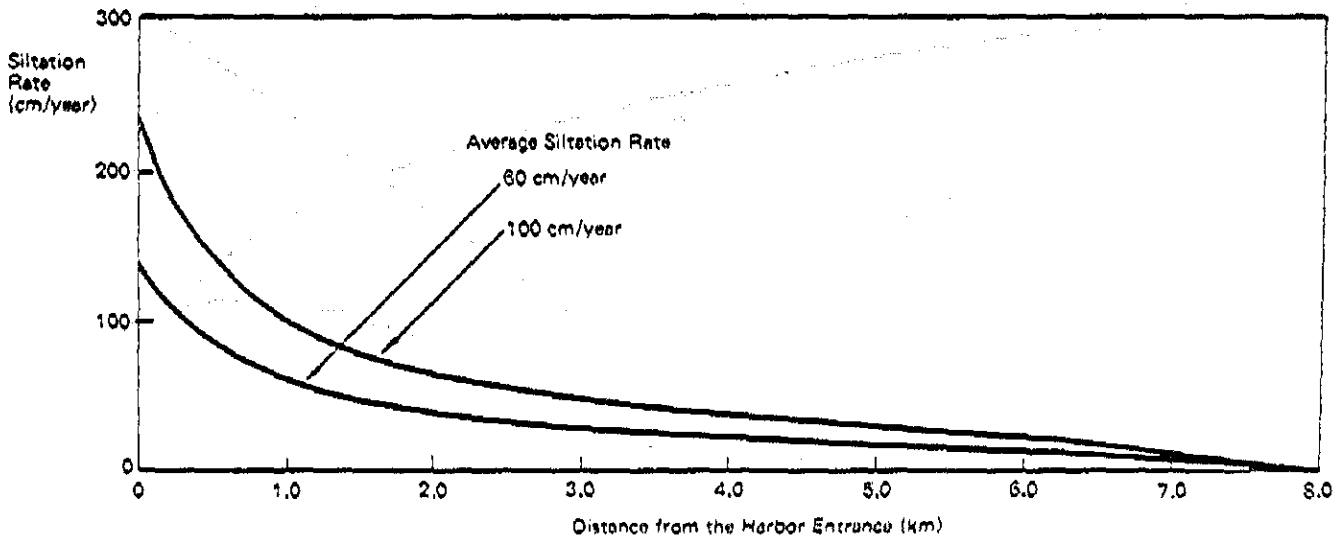


Fig. 2.4.3 Siltation Rate Distribution along the Navigation Channel

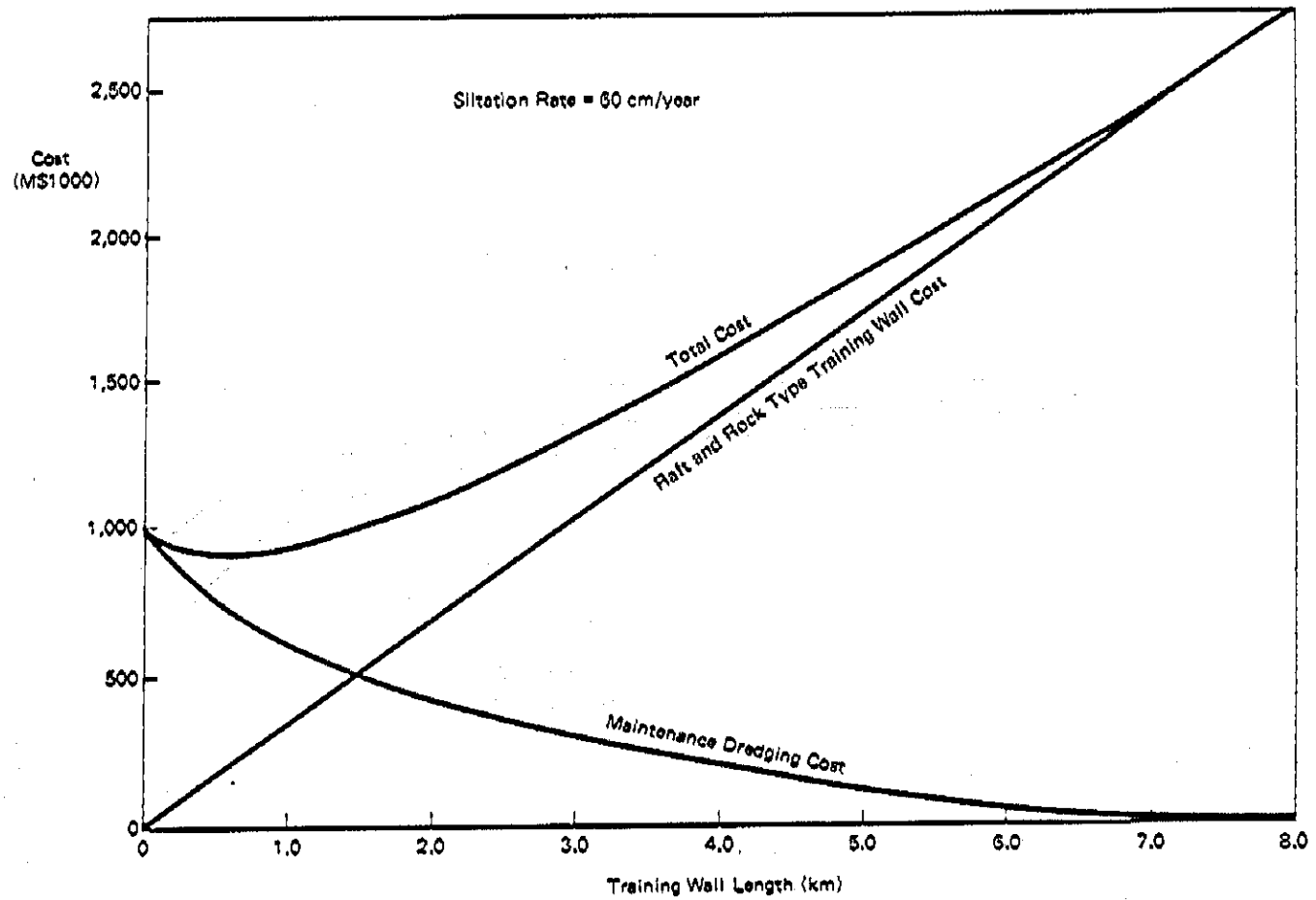


Fig. 2.4.4 Optimum Length of Training Wall

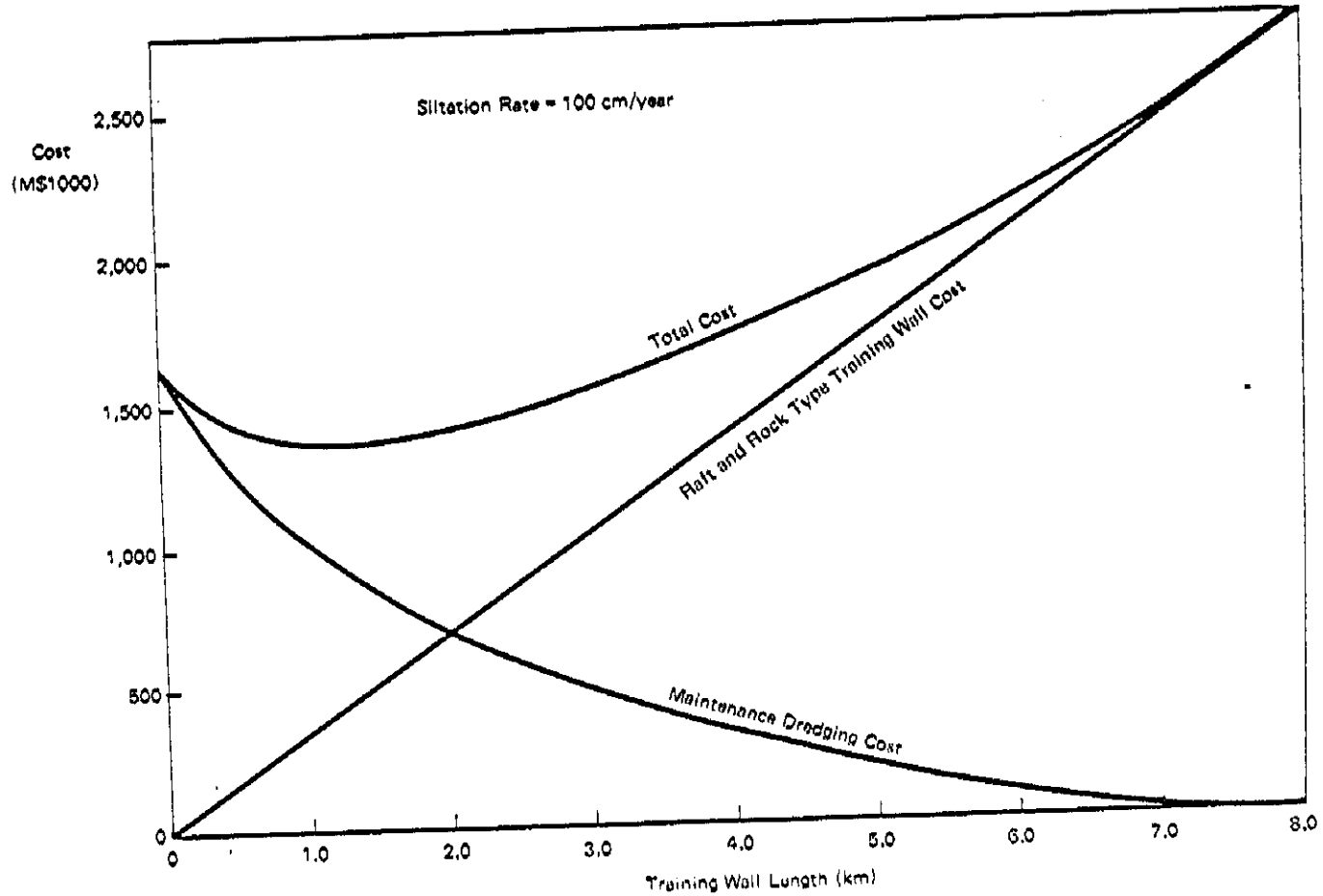


Fig. 2.4.5 Optimum Length of Training Wall

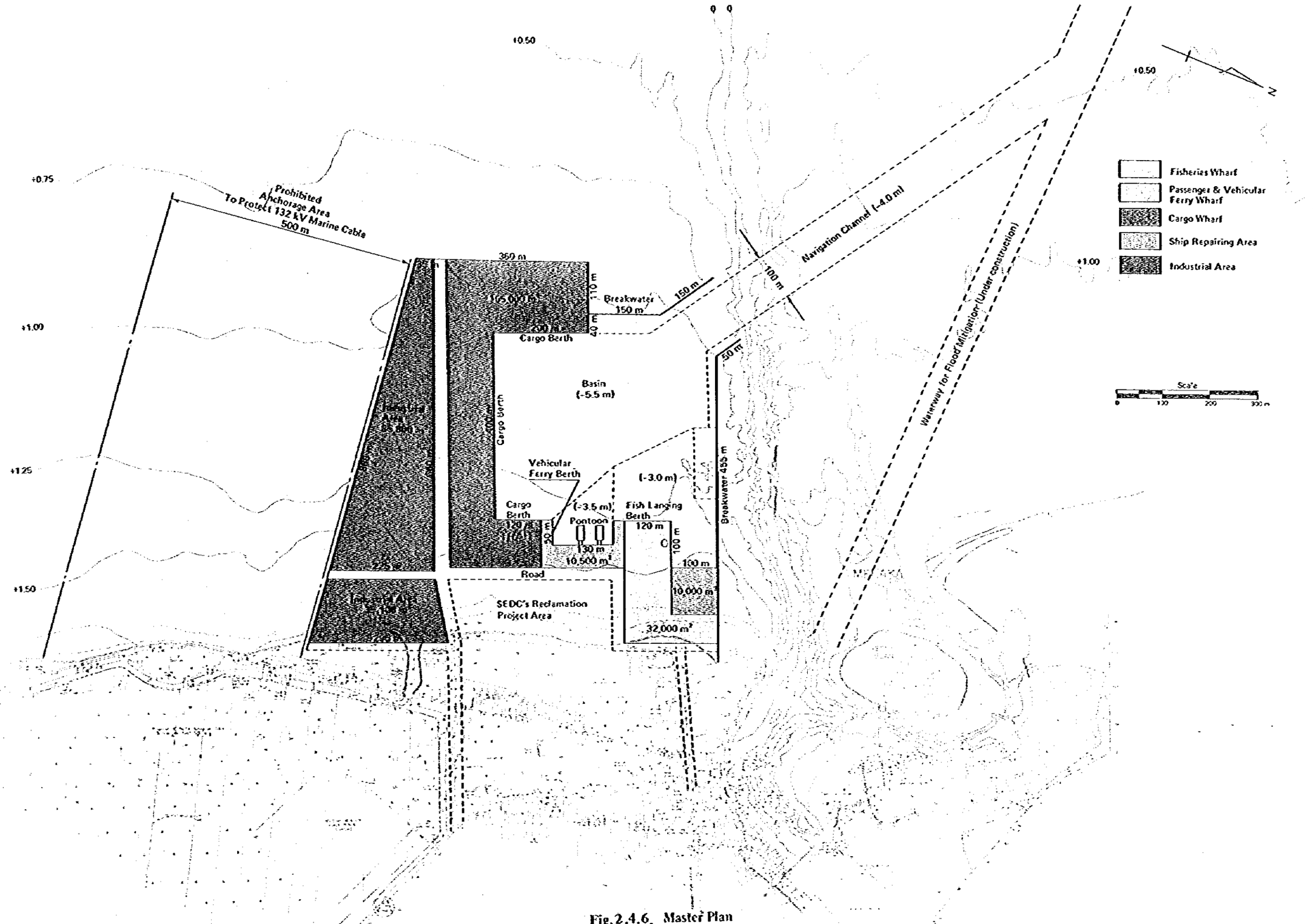


Fig. 2.4.6. Master Plan

2.4.2 The Construction Plan

Construction schedule of master plan is shown in Table 2.4.2. Estimated construction cost of master plan is shown in Table 2.4.3.

As shown in Table 2.4.2, the construction plan with a target year of 2000 shall be executed in gradual stages. First is the short term development plan which is mentioned in Chapter 3, second is the additional part. The cost estimation is carried out based on the unit price of 1983. Total amount of estimated construction cost is M$67,934,000.

Table 2.4.2 Construction Schedule of Master Plan

Item			1980'				1990'									
Description	Unit	Quantity	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Quay Wall	m	1,270														
Dredging	m^3	2,877,600														
Reclamation	m^3	1,453,280														
Revetment, Breakwater	m	R; 1,785														
		B; 1,195														
Facilities of Fishery	L.S.	1														
Ship Repairing Facilities	L.S.	1														
Pontoon	Set	2														
Facilities of Car Ferry	L.S.	1														
Tank, Oil Supply	L.S.	1														
Office	L.S.	1														
Road	m^2	58,450														

The 2.4.3 Construction Cost of Master Plan

Item	Unit	Quantity	Unit Price M$	Amount x10³ M$
Mobilization/Demobilization	L.S.	1		1,110
Quay Wall (-5.5 m)	m	720	15,927.0	11,467
(-3.5 m)	m	550	14,517.0	7,984
Dredging (Channel)	m^3	1,622,000	3.5	5,677
(Basin)	m^3	1,255,600	3.5	4,395
Reclamation (Port Area)	m^3	874,130	8.5	7,430
(Industrial Area)	m^3	579,150	8.5	4,923
Revetment (Port Area)	m	775	354.1	274
(Industrial Area)	m	1,010	354.1	358
Breakwater	m	1,195	947.5	1,132
Road (Port Area)	m^2	50,650	25.0	1,266
(Industrial Area)	m^2	7,800	25.0	195
Facilities of Fishery	L.S.	1		6,000
Ship Repairing Facilities	L.S.	1		800
Pontoon	Set	2	400,000.0	800
Facilities of Car Ferry	L.S.	1		1,000
Tank, Oil Supply	L.S.	1		1,000
Office	L.S.	1		800
Sub Total				56,611
Engineering Study				2,831
Contingency				8,492
Sub Total				11,323
G. Total				67,934

CHAPTER 3
THE SHORT TERM DEVELOPMENT PLAN

3. The Short Term Development Plan

3.1 The Port Facilities Layout Plan

The short term development plan (target year 1990) is regarded as the first stage of the master plan, drawn out in Chapter 2. In the case of the Kuala Perlis Port, since this project has a character similar to a new port development in a place where there were no existing port functions before, and as it is difficult to forecast when the next stage plan should be implemented, the short term development plan by itself should be prepared to efficiently and safely cope with future port demands.

As for the sizes for the port facilities the port facilities in the short term development plan are planned to be no smaller than the figures in Table 3.1.1.

The port facilities layout plan of the short term development plan based on the above considerations is as shown in Fig. 3.1.1 and the proposed scale is as shown in Table 3.1.2.

The detailed layout plans for each port facility are as follows.

(1) The Navigation Channel

The waterway presently being dredged for the purpose of flood mitigation will be used as the main navigation channel but an approach channel connecting the quay to this waterway must be newly dredged.

Since there is no immediate prospect of ships of 2,000 D/W class entering the port, the width of the channel is set at 60 m, the same as the width of the waterway for the flood mitigation and it's water depth is set at 4.0 m.

(2) The Basins

For preventing siltation of the basins by tidal current and waves, it is necessary to surround them with breakwaters. The construction of breakwaters can be of a temporary nature in those sections which will become wharves in the future, so simple and low cost breakwaters will be built wherever possible.

For this reason, the area to be enclosed is made the same as in the Master Plan but the basin area to be dredged to the required water depth will be on the same scale as the wharves constructed under the short term development plan.

The water depth of the basins will be 3 – 4 m.

(3) The Fishing Port Facilities (Fig. 3.1.2 ~ Fig. 3.1.9)

The fishing port facilities are arranged to allow smooth and safe operations, including maneuvering and anchorage of fishing boats, fish landing, loading of fishery materials and equipments, and handling and shipping of fish.

The anchorages for fishing boats are planned within the fishing port water area, in order to raise the utilization efficiency of the berthing facilities by transferring ships there as soon as possible after landing and loading and also to use this anchorage for large fishing boats because of the lack of facilities for these boats within the existing port.

The ship repairing facilities are arranged so as not to hinder the operations of fishing boats within the port.

(4) The Wharves for passenger Boats and Vehicular Ferries (Fig. 3.1.10 ~ Fig. 3.1.11)

A ferry berthing facility with an access bridge is planned adjacent to the cargo wharf, while the parking area for cars using the ferry is arranged close to the ferry berthing facility.

Of the two planned pontoons, one is for passenger boats for the Langkawi Island sea route and the other is for port service boats necessary for port management and operation.

The terminal building in the passenger wharf is arranged close to the passenger boat pontoon. For the convenience of passengers and visitors to the port, restaurants, coffee shops and souvener shops are planned within the building and small parks and parking lots are arranged around the building.

(5) The Cargo Handling Wharf (Fig. 3.1.12)

The width of the apron is 20 m to allow smooth cargo handling.

The oil tank area and the cement silo area are the same as in the master plan in order to avoid having several separate areas in the future.

The areas for warehouses and for open storage are also secured to be sufficiently wide for smooth cargo handling.

(6) Roads (Fig. 3.1.13)

Inner port trunk roads and access roads connecting to the federal road are planned to be 25 m wide with 4 lanes.

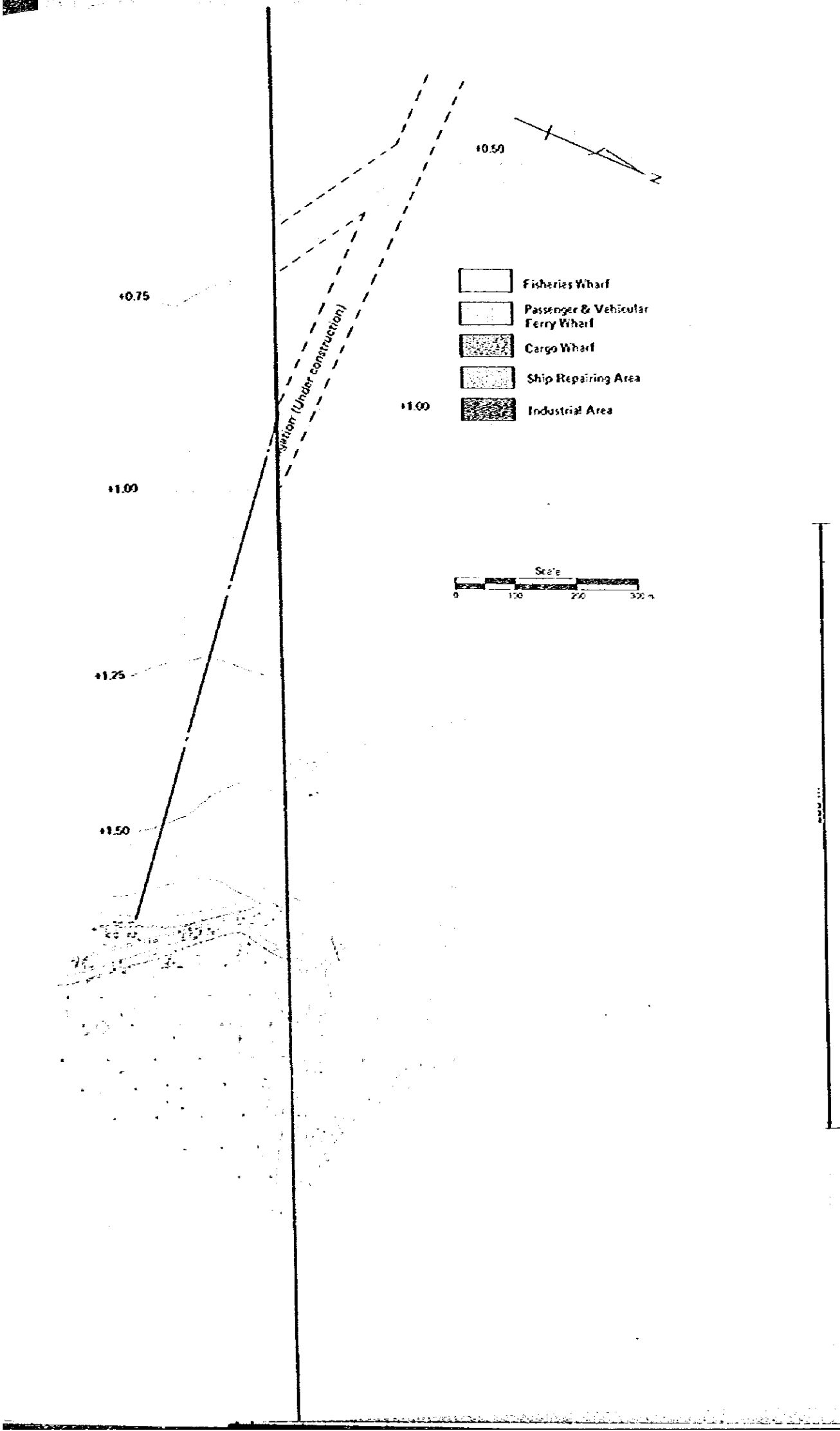
And 2 lane roads with a width of 15 m are proposed for other inner port roads.

Table 3.1.1 The Minimum Required Sizes for the Port Facilities in the Short Term Development Plan

Functions	Facilities	Size of Required Facilities until the Year 1990	Remarks
Commercial Facilities			
Passenger Wharf	Berthing Facilities	Pontoon 2 unit	Length 30 m, width 10 m
	Passenger Terminal	304 m² x 2 places	One for Langkawi route, the other for Thai route
Vehicular Ferry Wharf	Berthing Facilities	Length 40 m, water depth 3.5 m	
	Parking Area	768 m²	
Cargo Wharf	Berthing Facilities	Length 371 m, water depth 4.0 m	With a access bridge
	Warehouse	3,630 m²	
	Open Storage	11,280 m²	
	Cement Silo	2,500 m²	Storage capacity 8,000 tons
	Oil Tank	2,000 m²	Storage capacity 1,300 kℓ
Fishing Port Facilities	Berthing Facilities	Length 80 m, water depth 3 m	
	Fish Market	1,019 m²	Daily handling volume 88 tons
	Ice Making Facilities	160 m²	Automatic ice machine, three stories
	Ice Storage	130 m²	Capacity 150 tons
	Cold Storage	87 m²	Capacity 100 tons
	Freezer	19 m²	Capacity 20 tons
	Water Supply Facilities	200 tons tank	
	Oil Tank	50 kℓ tank	
	Other Sites		
Industrial Area		97,000 m²	

Table 3.1.2 The Proposed Scale of the Short Term Development Plan

	Items	Planned Scale
Port Facilities	Waterway	length 970 m, width 60 m, water depth 4.0 m
	Basin	area 180,600 m², water depth 3.0 ~ 4.0 m
	Breakwater	length 1,195 m
	Groin	length 1,000 m
	Berthing Facility	
	Fish Landing Berth	length 150 m, water depth 3.0 m
	Vehicular Ferry Berth	length 50 m, water depth 3.5 m
	Passenger Berth	pontoon (length 30 m, width 10 m) 2 units, water depth 3 m
	Cargo Handling Berth	length 410 m, water depth 4.0 m (tentative)
Land Use	Fishing Port Area	32,000 m²
	Dockyard Area	10,000 m²
	Passenger & Vehicular Ferry Terminal	10,500 m²
	Cargo Handling Area	49,000 m²
	Road	51,950 m²
	Industrial Area	102,100 m²
	Total	255,550 m²


+0.50
+0.75
+1.00
+1.00
+1.25
+1.50
gation (Under construction)
Fisheries Wharf
Passenger & Vehicular Ferry Wharf
Cargo Wharf
Ship Repairing Area
Industrial Area
Scale
0
150
250
300 m

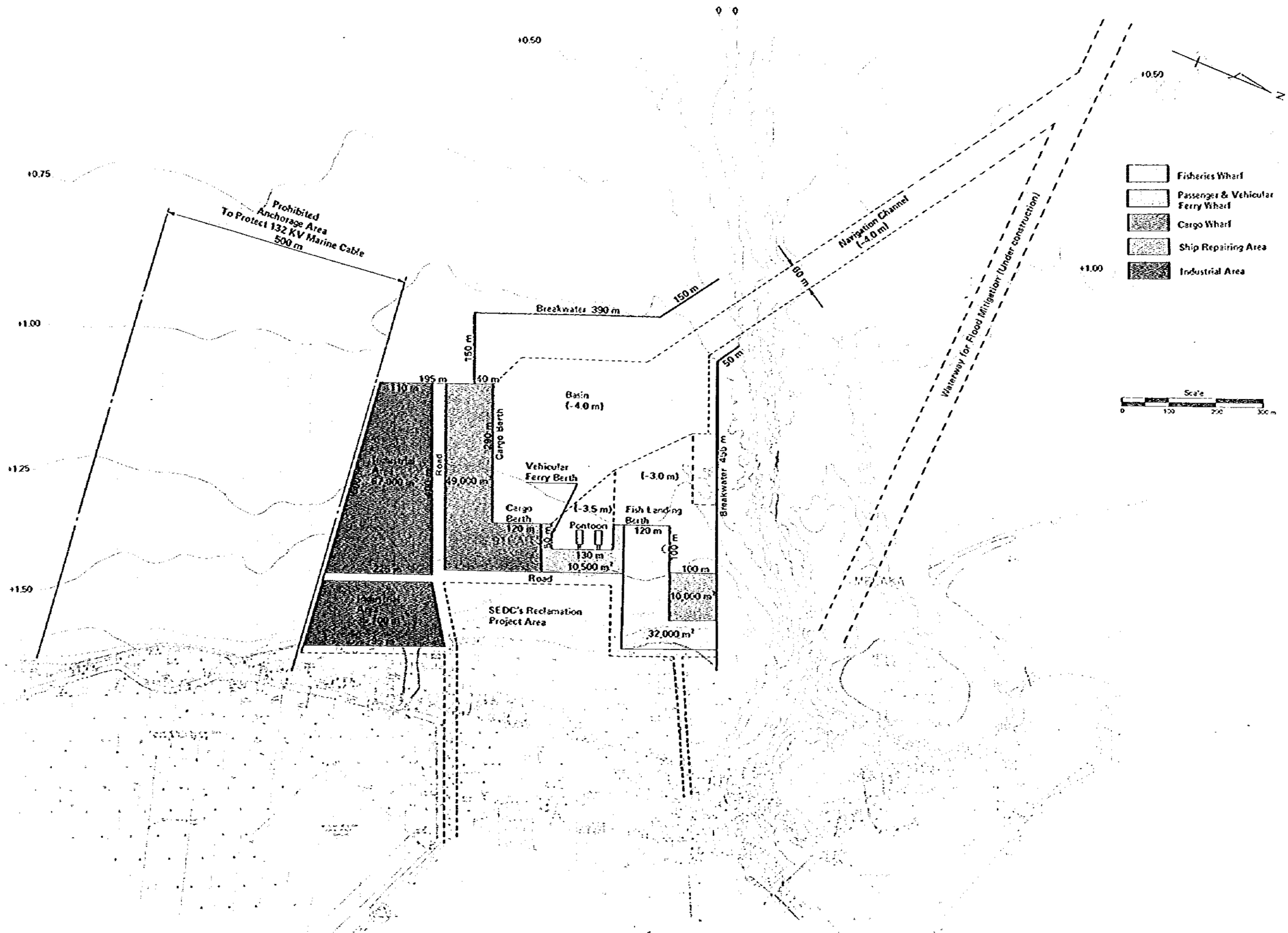


Fig. 3.1.1 Short Term Development Plan

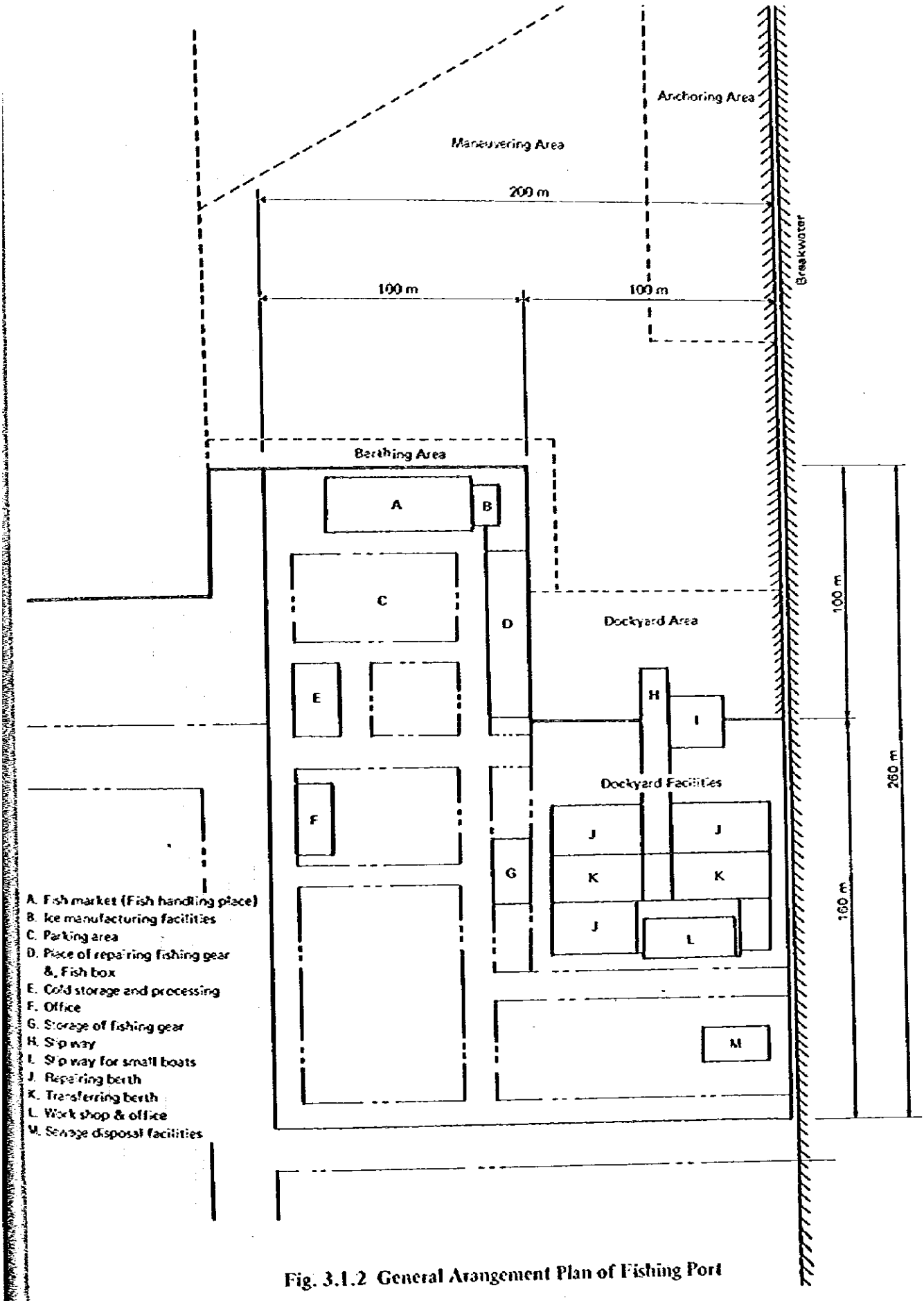


Fig. 3.1.2 General Arangement Plan of Fishing Port

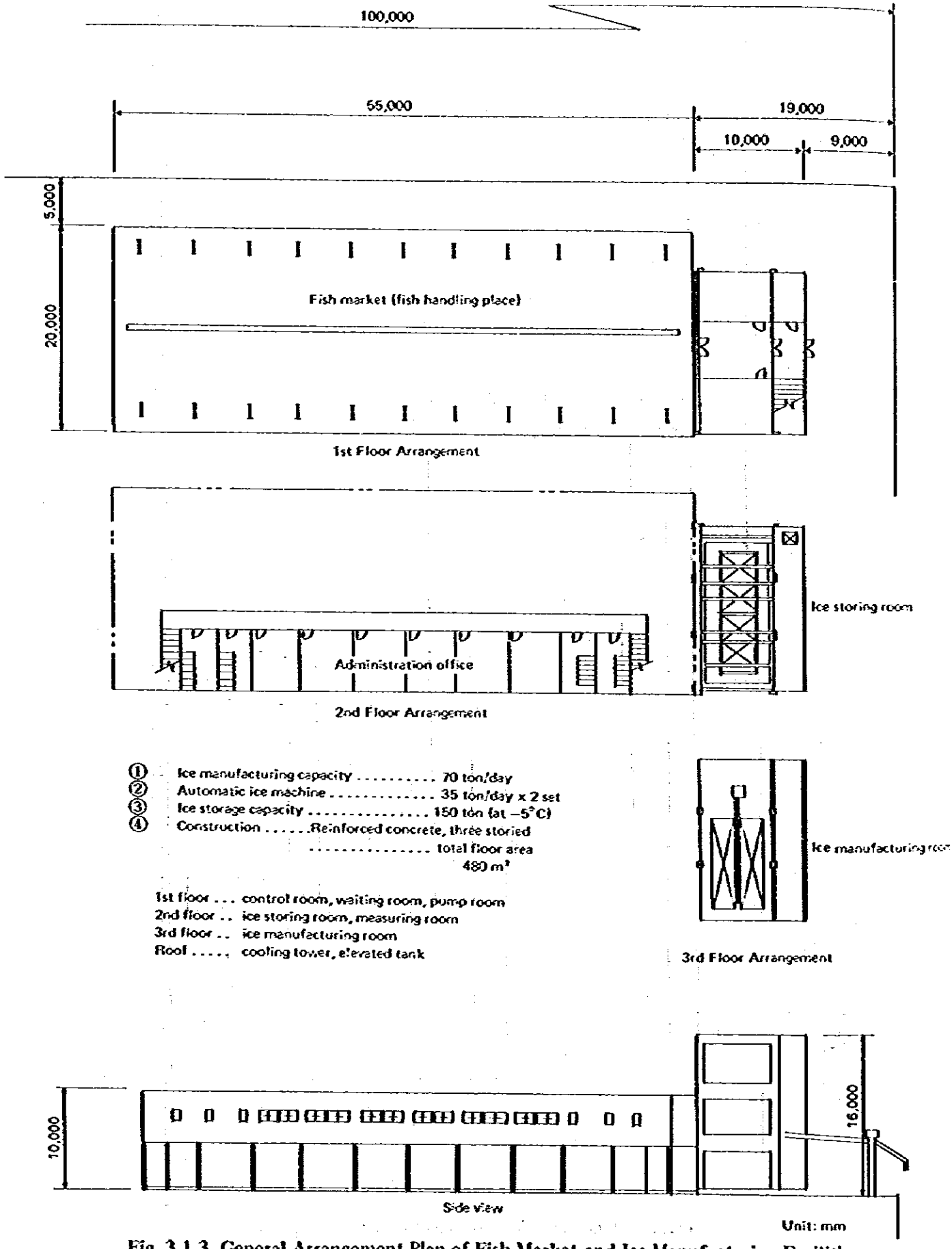


Fig. 3.1.3 General Arrangement Plan of Fish Market and Ice Manufacturing Facilities

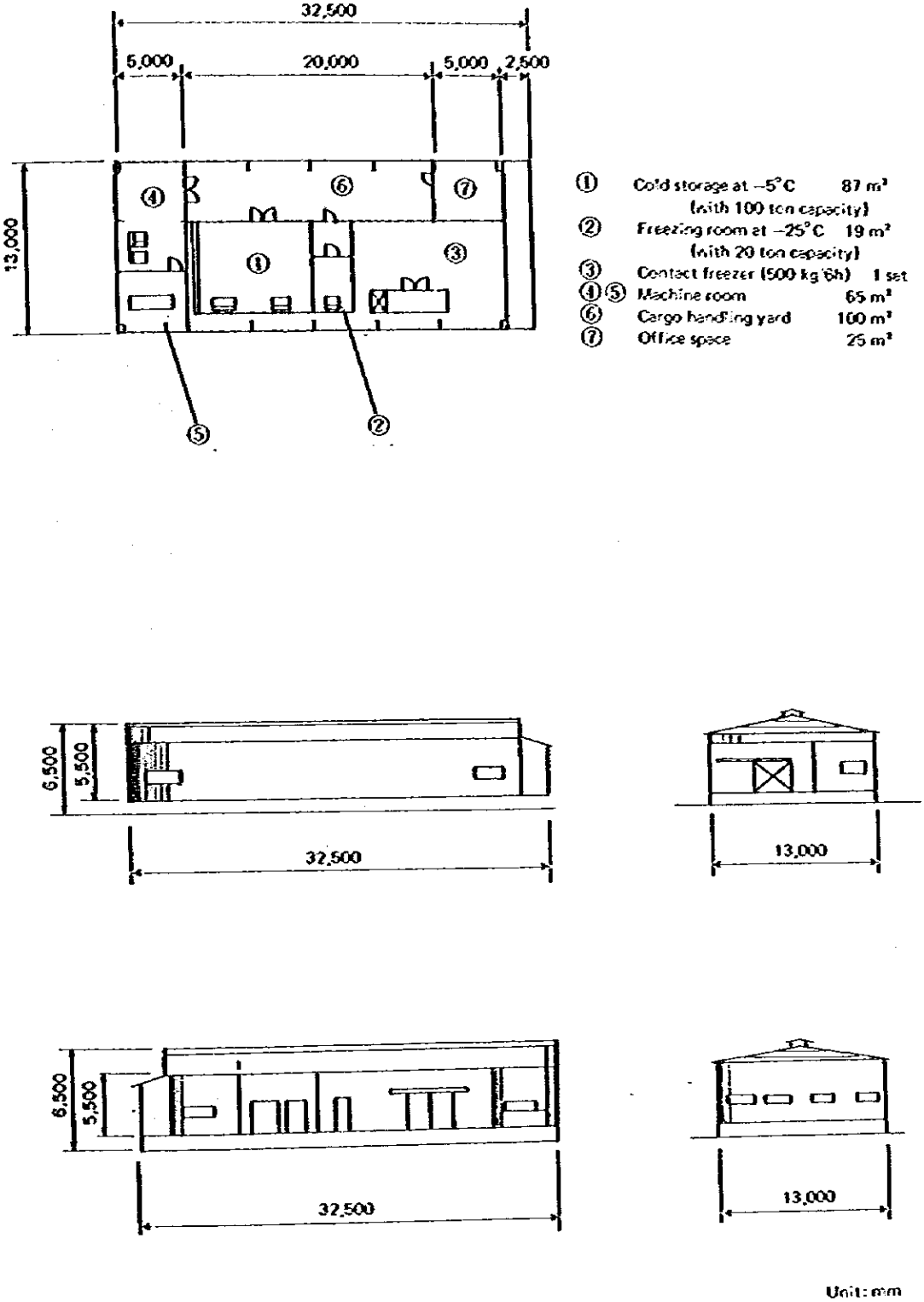


Fig. 3.1.4 Cold Storage and Processing Plan

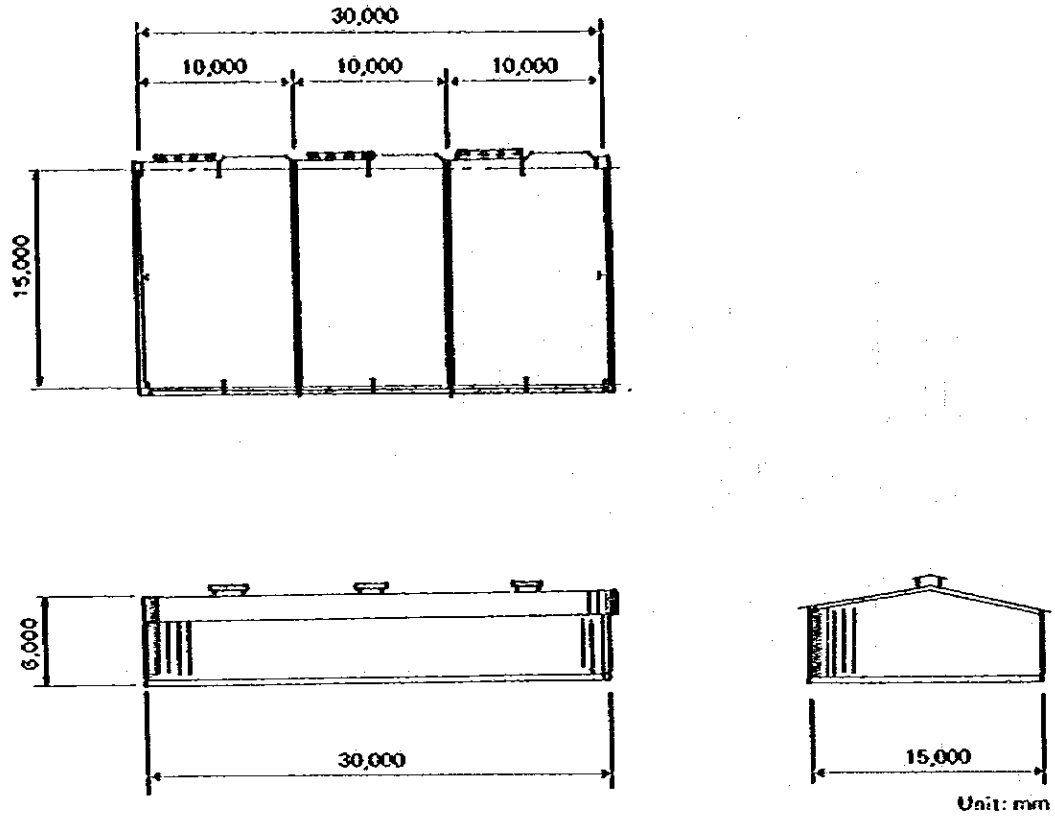


Fig. 3.1.5 Warehouses (to store fishing gear, materials, equipments and fish boxes, etc.)

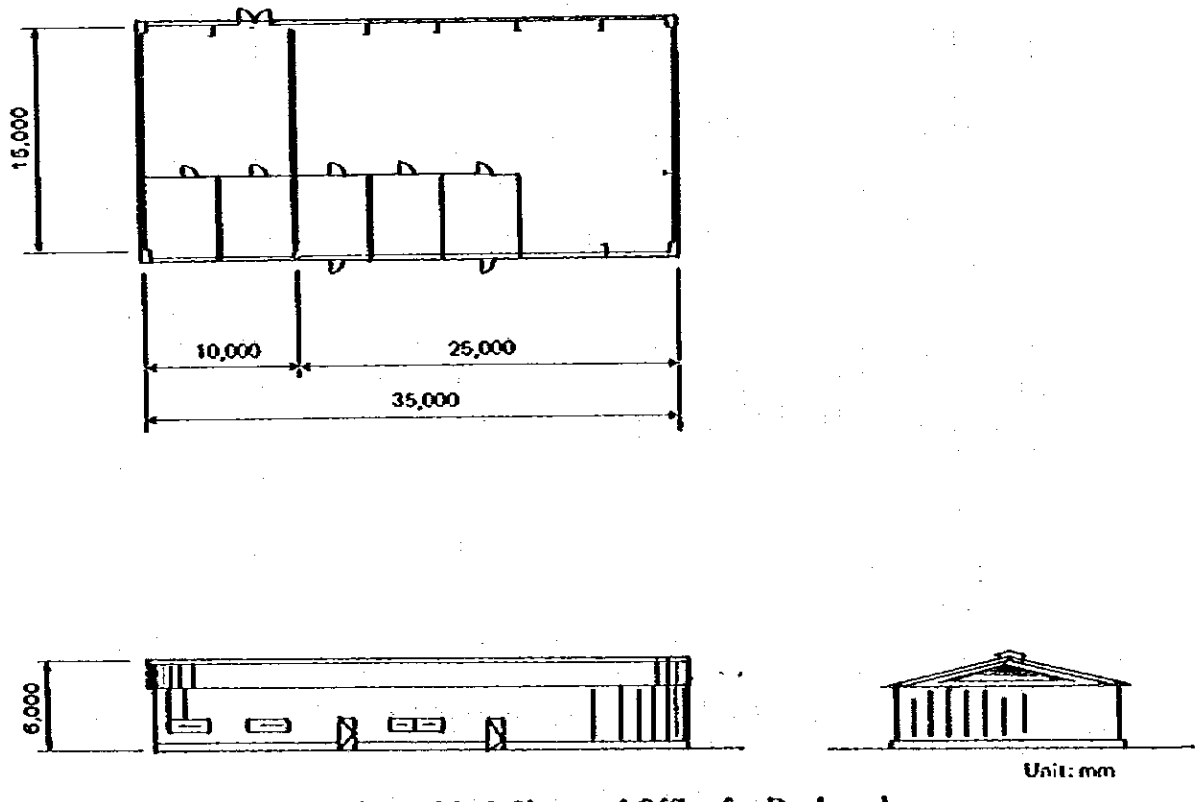
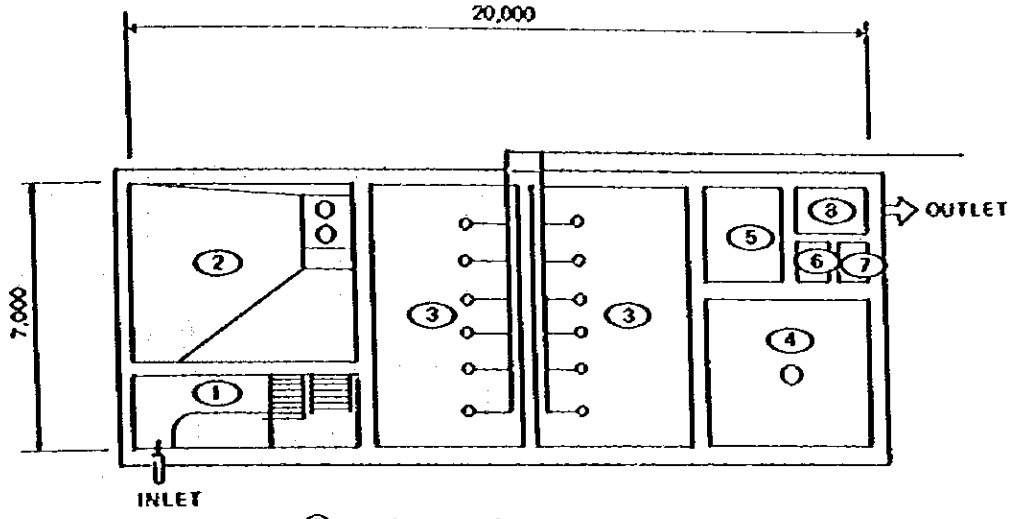
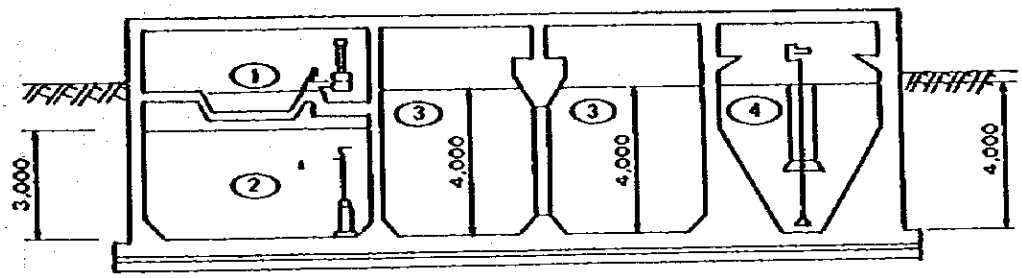


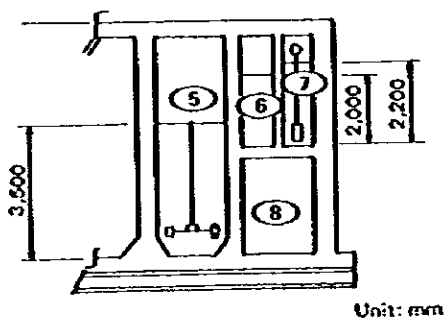
Fig. 3.1.6 Work Shop and Office for Dockyard



① 1st Settling tank
② Control tank
③ Refine tank
④ 2nd Settling tank
⑤ Stock tank wasted mud
⑥ Destroy germs tank
⑦ Scum disposal tank
⑧ Outlet tank

Capacity of disposition ..... 100 m³/Day





Unit: mm

Fig. 3.1.7 Sewage Disposal Facilities

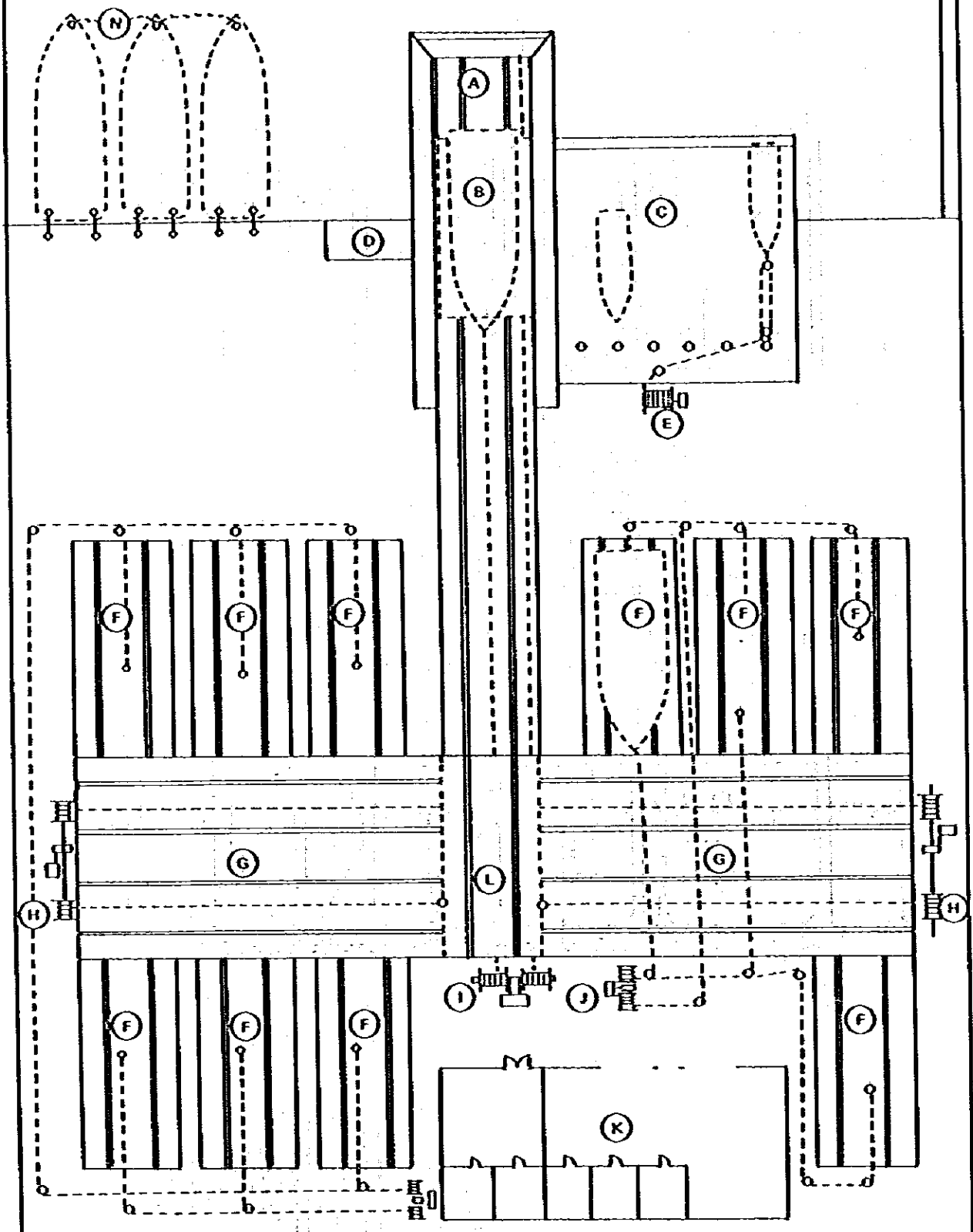
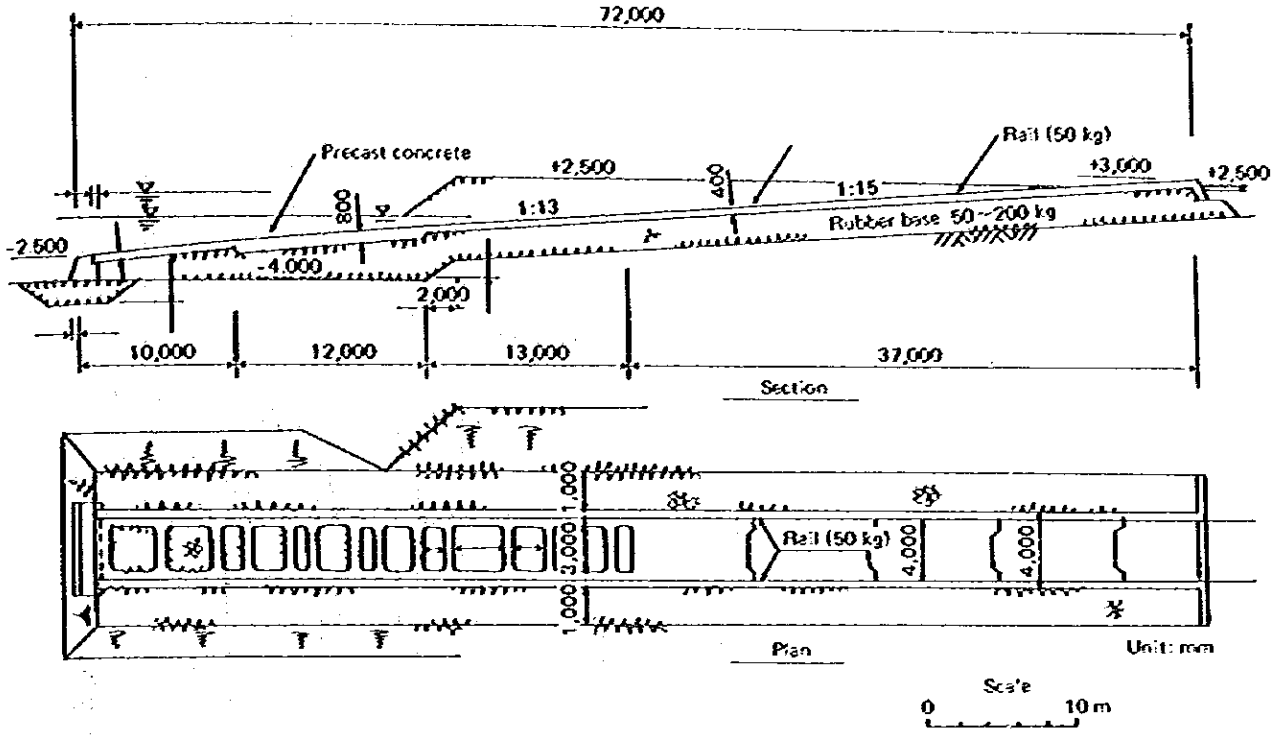
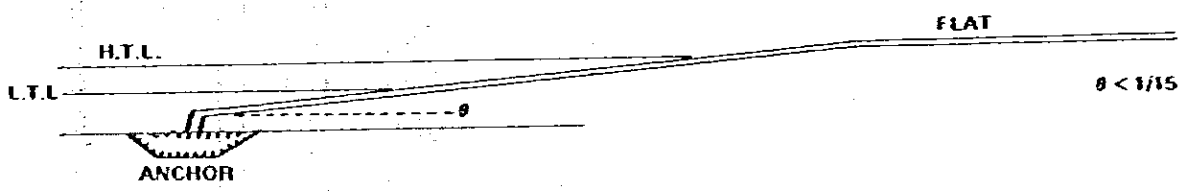


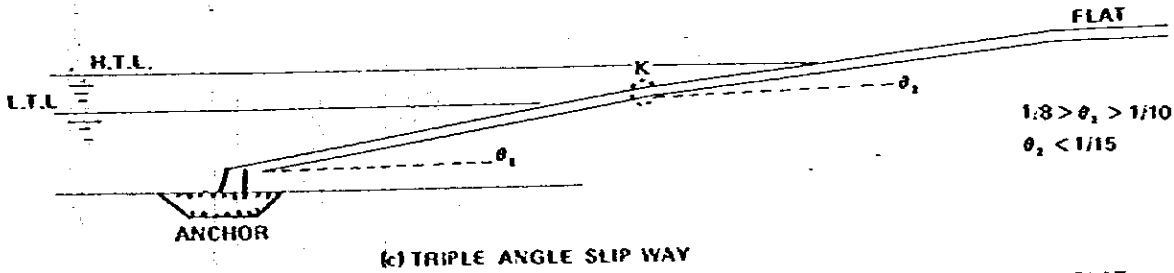
Fig. 3.1.8 Dockyard Facilities for Repairs of Fishing Boats



(a) STRAIGHT SLIP WAY



(b) DUAL ANGLE SLIP WAY



(c) TRIPLE ANGLE SLIP WAY

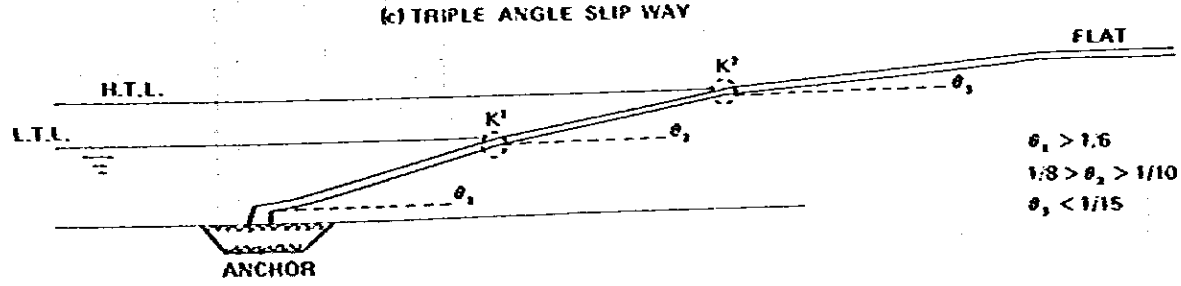


Fig. 3.1.9 Layout of Slip Way

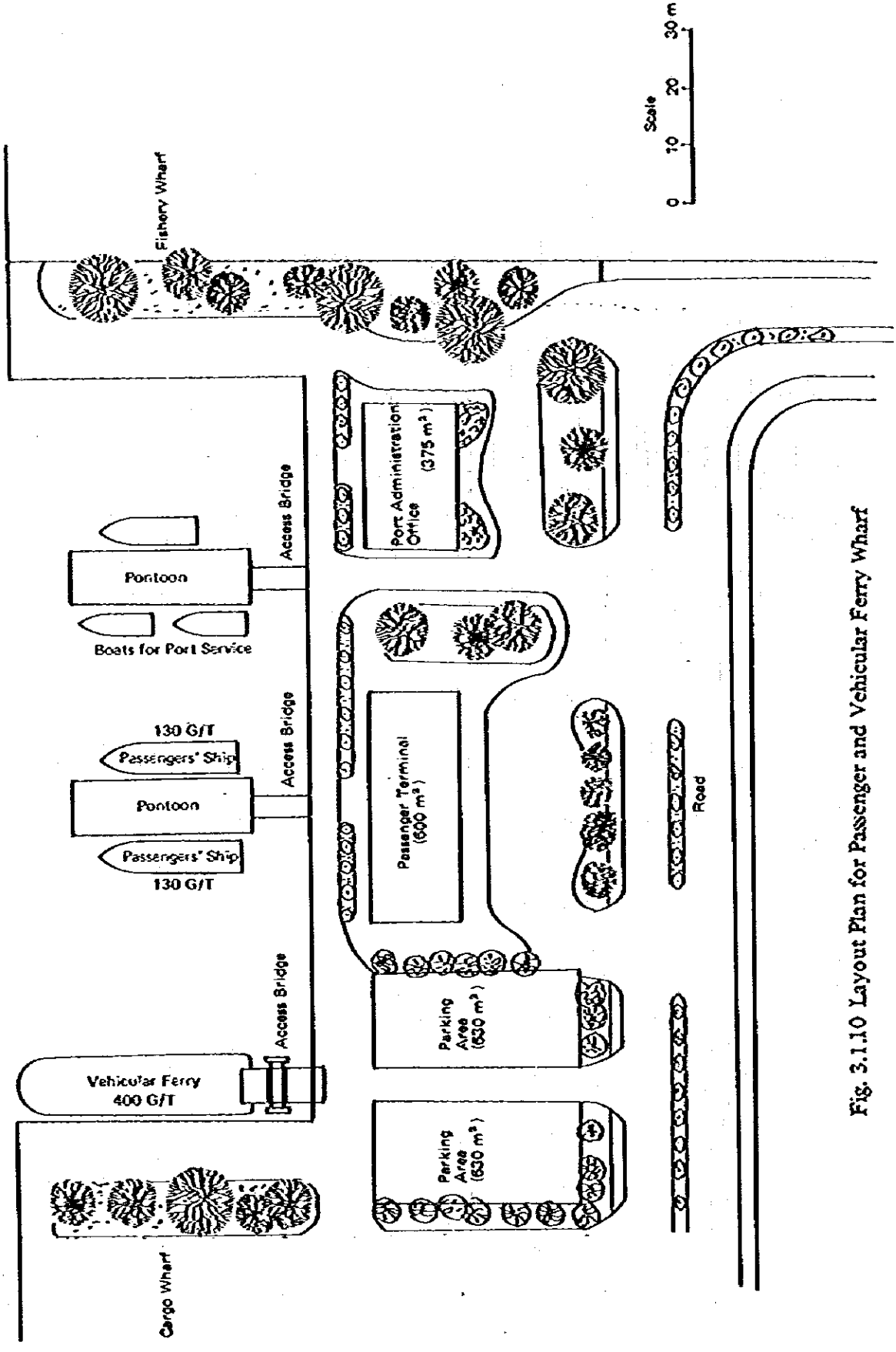


Fig. 3.1.10 Layout Plan for Passenger and Vehicular Ferry Wharf

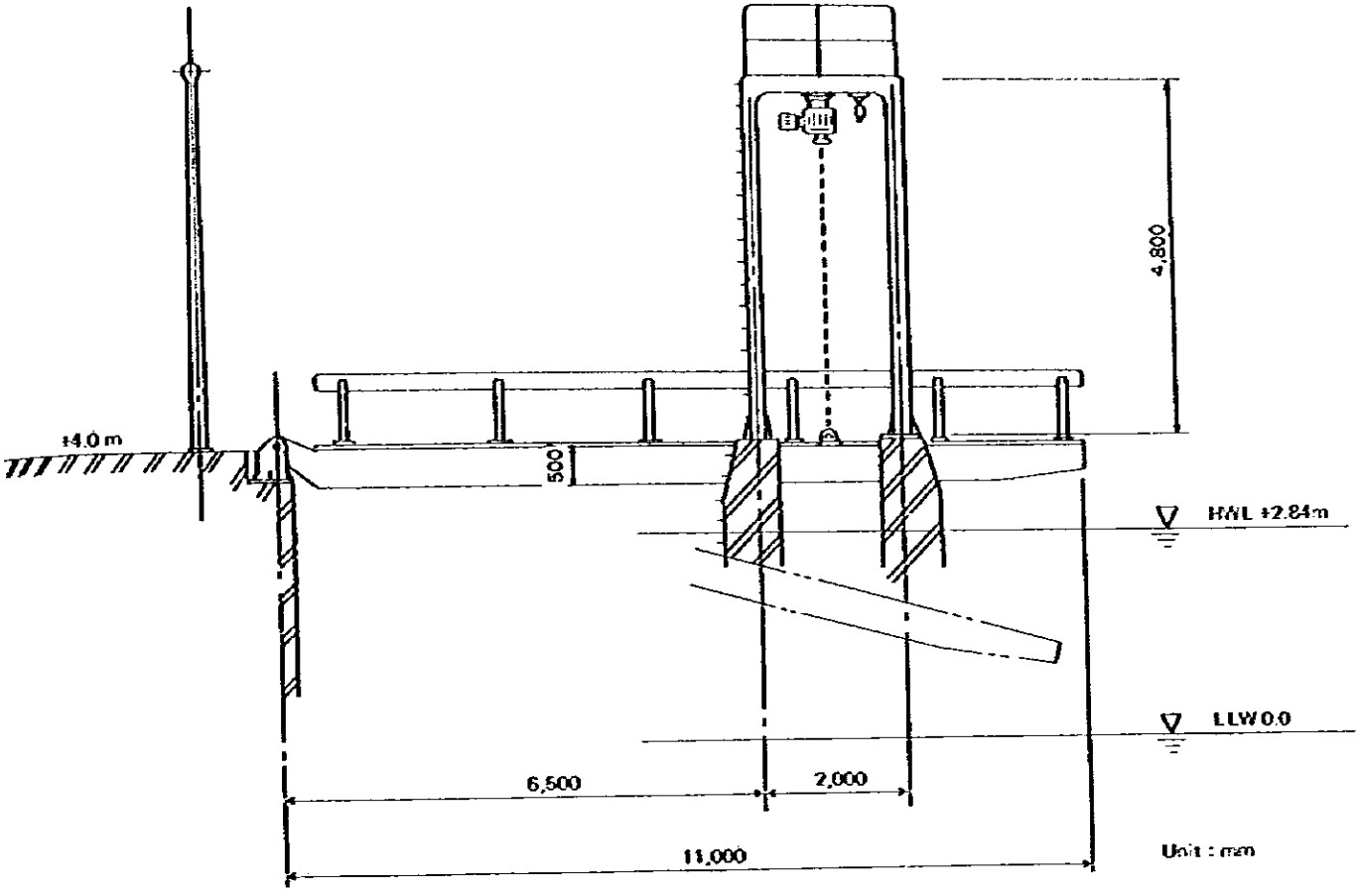


Fig. 3.1.11 Ferry Access Bridge

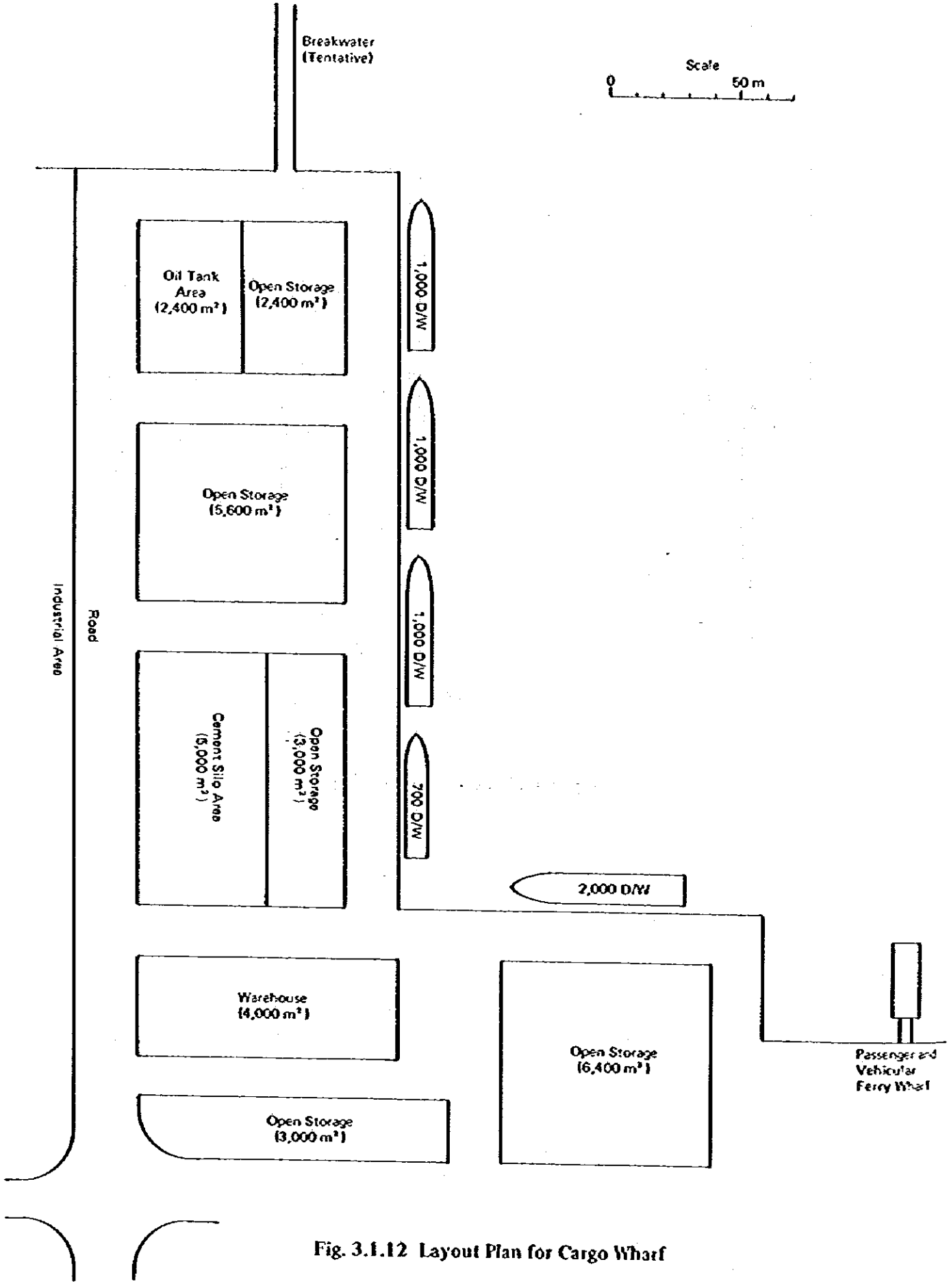


Fig. 3.1.12 Layout Plan for Cargo Wharf

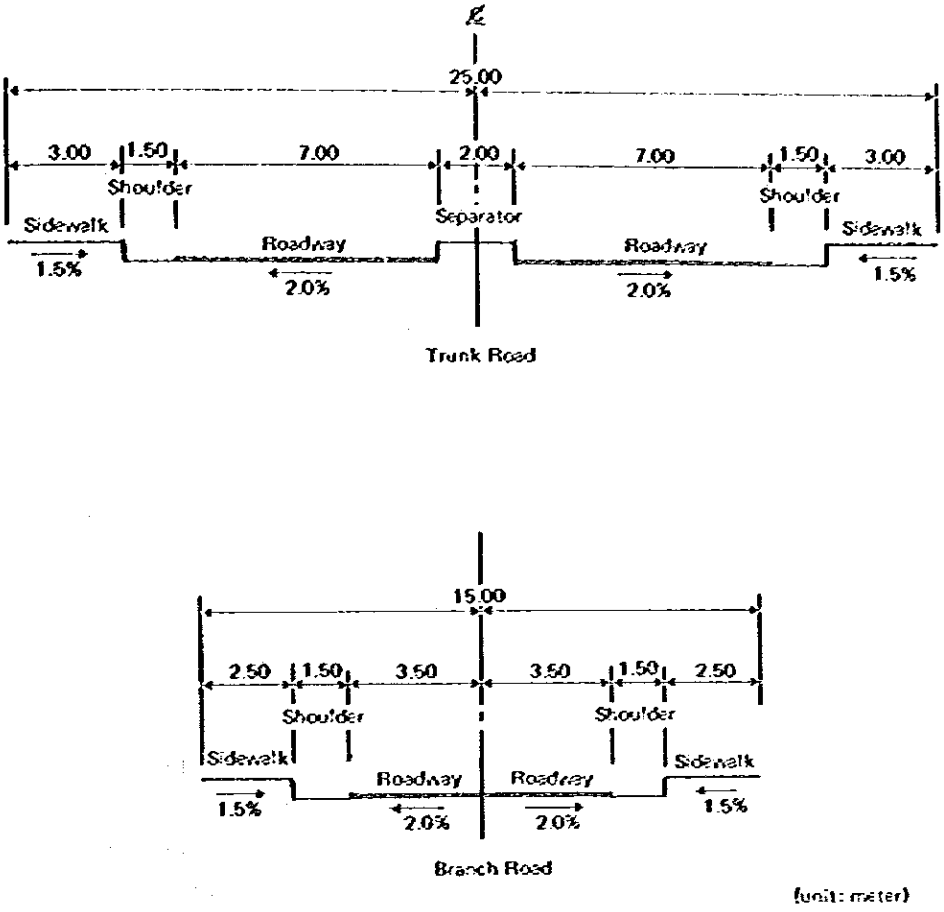


Fig. 3.1.13 Standard Sections of Port Road

3.2 Construction Plan

3.2.1 Design of Berth Structures

(1) Design Conditions

In this section, the design conditions which will be applied to the wharf structures in Kuala Perlis Port are described.

1) Object Vessels

General Cargo Ship	:	2,000 DWT
Fishing Boat	:	80 GT
Ferry Boat	:	400 GT

2) Water Depth

Cargo Handling Wharf	:	-5.5 m
Fishery Wharf	:	-3.0 m
Ferry Berth	:	-3.5 m

3) Berth Crown Height : +4.0 m

4) Tidal Range : 2.84 m

5) Height of Residual Water : +1.9 m

6) Surcharge

Cargo Handling Wharf	:	Ordinary condition	2.0 ton/m²
		Particular condition	1.0 ton/m²
Fishery Wharf	:		1.0 ton/m²
Ferry Berth	:		2.0 ton/m²

7) Seismic Condition : Nil

8) Berthing Velocity : 0.15 m/sec

9) Fender System

Material	:	Rubber
Capacity of Energy Absorption	:	3.0 ton · m

10) Tractive Force : 35 ton

11) Maximum Wave Height : 1.0 m

12) Life Time : 50 years

13) Corrosion Control

The steel materials are protected from corrosion by cathodic protections, concrete coating and an increase in material thickness.

14) Soil Condition

On the basis of the geotechnical surveys, the typical soil conditions used for wharf design are show in Table 3.2.1.

Table 3.2.1 Typical Soil Conditions

Depth (m)	Soil Classification	N. Value	Angle of Internal Friction (Degree)	Unit Weight (ton/m^3)	Cohesion (ton/m^2)
Surface ~ -12.0	Very Soft Marine Clay	0 ~ 4	0	1.5	C = 0.79 + 0.17Z GL = 0 : Z = 0
-12.0 ~ -15.0	Stiff Clay	10 ~ 30	0	1.6	ditto

15) Strength of Materials

Characteristic Strength of Concrete : 25 N/mm^2

Allowable Stress of Steel : 165 N/mm^2

16) Safety Factors

Safety Factors are shown in Table 3.2.2

Table 3.2.2. Safety Factors

Condition	Safety Factor
Circular Slip	1.3
Sliding of Gravity Structure	1.2
Overturning of Gravity Structure	1.2
Bearing of Pile	2.5
Pulling of Pile	3.0
Penetration of Sheet Pile	1.5

(2) Comparative Design of Cargo Handling Wharf

For the Cargo Handling Wharf (Water depth: -5.5m), the following three alternative plans (Plan A, B and C) are compared with one another.

1) Alternative Plan A (Sheet Pile Quaywall)

As soil conditions at the wharf construction site are relatively poor, the sea bed should be stabilized using sand compaction piles driven down to -12m and preload. The depth and width of the stabilized area have been determined in accordance with calculations of the circular slip.

The steel sheet piles are continuously driven and connected with the concrete wall anchorage by tie ropes, thus forming a wall.

The width of a sheet pile is 500mm and its thickness 24.3mm. The sheet pile length is

16.0m while the penetration length is 7.5m.

Considering settlement of the ground, tie ropes are used for connecting the sheet piles and anchorages. A tie rope is set for every four piles, that is, at intervals of about 1,700mm.

The standard cross section is shown in Fig. 3.2.1.

2) Alternative plan B (Open Type Wharf with Vertical Piles)

The outside diameter of the piles is 600mm and their thickness is 14.0mm. The piles are protected from corrosion by cathodic protection, concrete coating and increased thickness. The pile is driven down to -14m in order to obtain axial bearing capacity. The total length of piles is 17.5m. The block size for the wharf is 15.0m x 23.0m square. The apron width has been determined by considering cargo handling efficiency.

In order to obtain a sufficient back area so as to facilitate as smooth a cargo handling operation as possible, it is necessary to construct a bulkhead for reclamation just behind the open type wharf, as shown in Fig. 3.2.2. Soil stabilization by means of sand compaction piles is required for the bulkhead construction. Sheet piles will be driven into this stabilized foundation.

3) Alternative Plan C (L-Shaped Concrete Block Type Quaywall)

As mentioned before, soil conditions are not good, so soil stabilization is necessary for constructing a gravity type quaywall. As shown in Fig. 3.2.3, the sea bed will be stabilized by sand compaction piles down to -12m. The stabilized depth and width have been determined in accordance with stability analysis against a circular slip.

The rubble mound foundation should be 1.0m thick, in consideration of the ground bearing capacity. The concrete blocks are 8.0m wide, 13.0m long and 8.8m high, with a dry weight of approximately 300 tons. Rubble stones are piles behind the blocks. Mats are placed on the joins of the concrete blocks to prevent reclaimed material from spilling out.

These three alternative designs have been compared from the viewpoints of construction workability and construction cost. As shown in Table 3.2.3, the construction cost of Plan-A is the lowest and it is more easily constructed than the other two plans. It has been decided to adopt Alternative Plan A (Sheet Pile Type Quaywall).

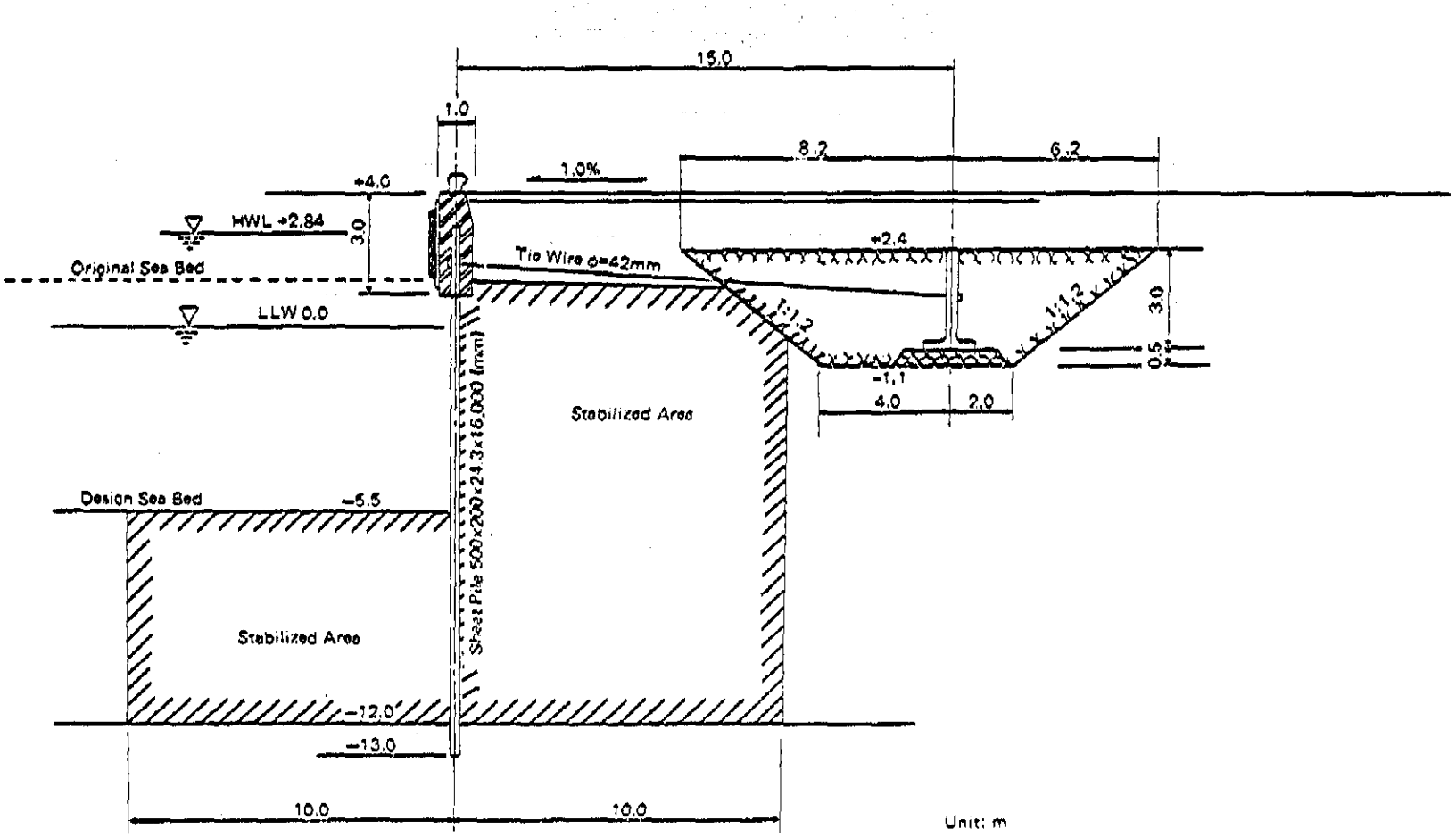


Fig. 3.2.1 Standard Cross Section of Alternative Plan A
(Sheet Pile Quaywall)

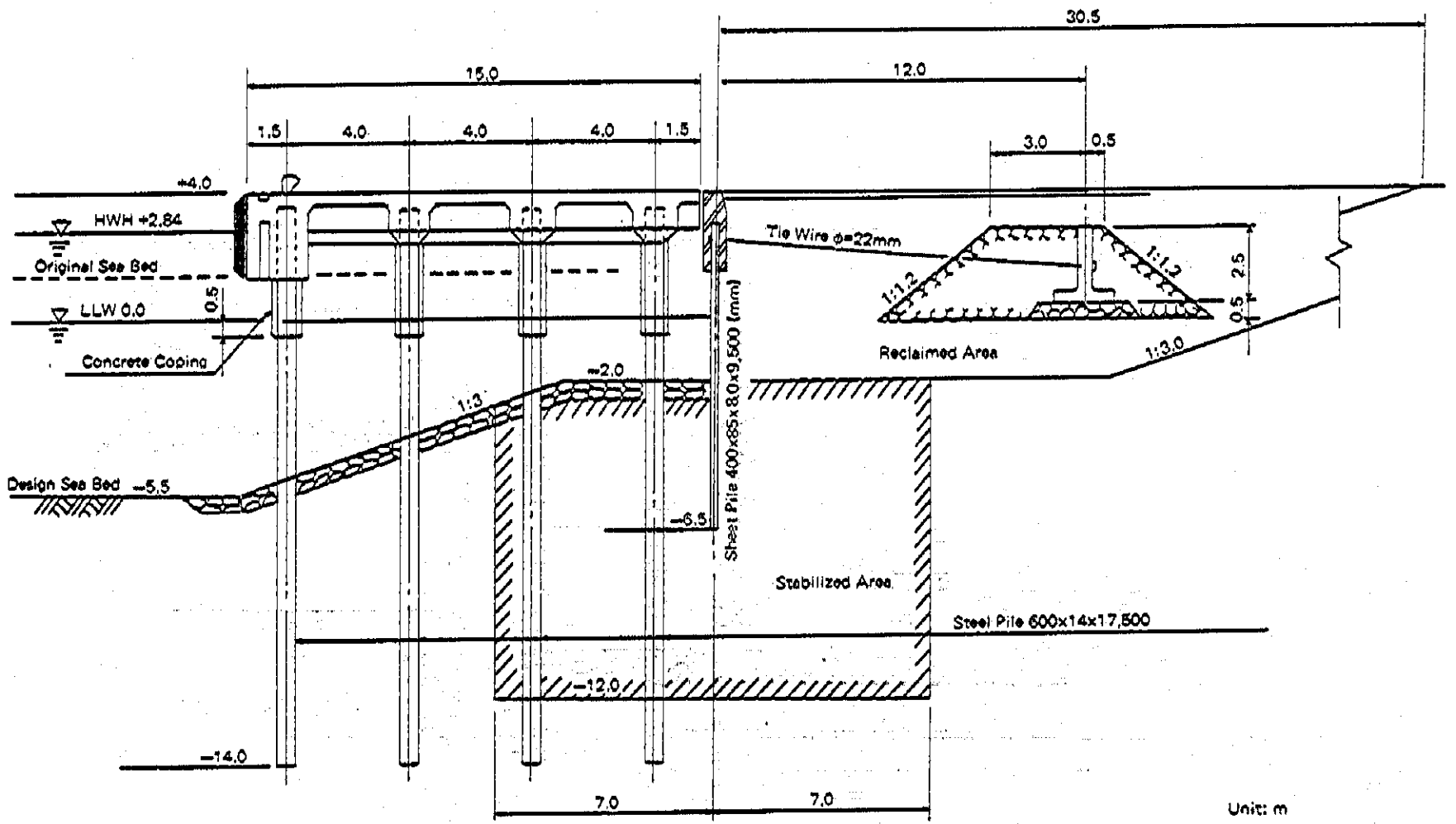


Fig. 3.2.2 Standard Cross Section of Alternative Plan B
(Open Type Wharf with Vertical Piles)

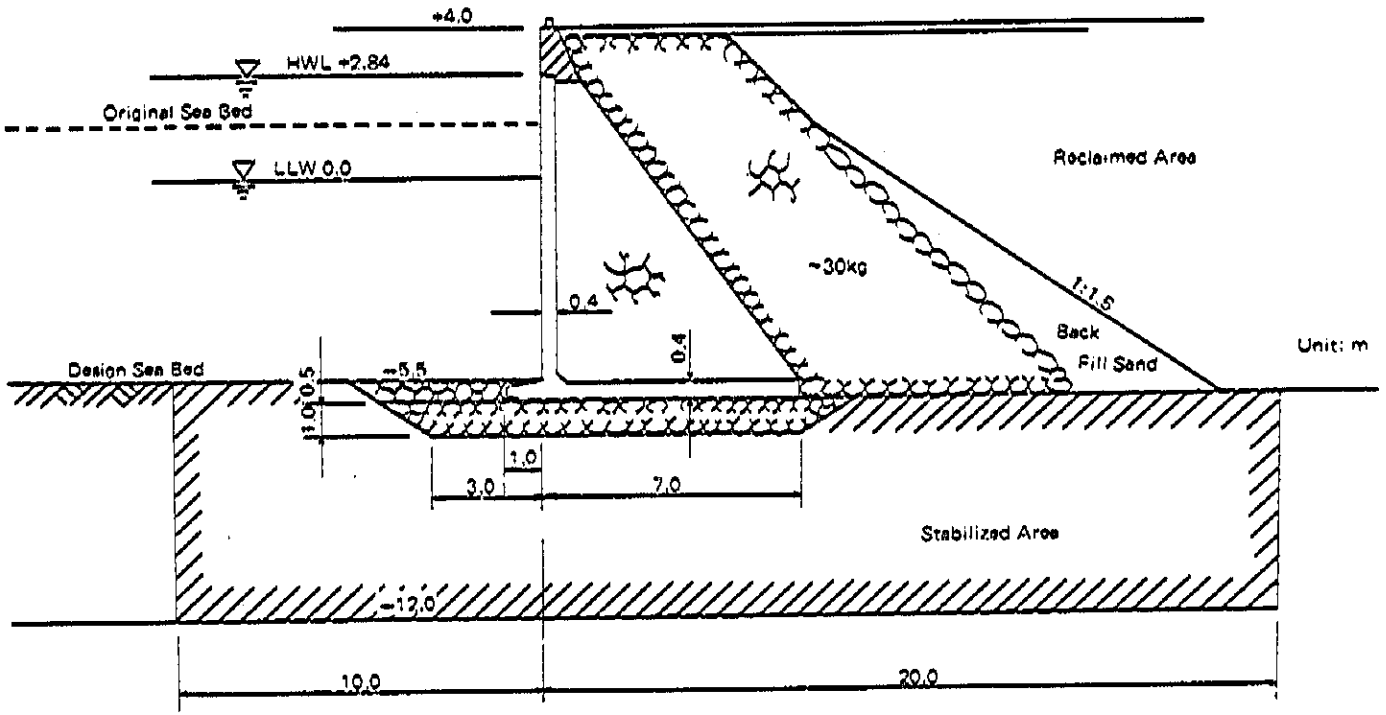


Fig. 3.2.3 Standard Cross Section of Alternative Plan C
(L-Shape Concrete Block Type Quaywall)

Table 3.2.3 Comparison of Economy and Workability

Item \ Type	Plan A Sheet pile type quaywall	Plan B Open type wharf with vertical piles	Plan C L-Shaped block type quaywall
Large construction craft	Pile driving crane Sand compaction crane Pump dredger	Pile driving barge Sand compaction barge Pump dredger	Floating dock Sand compaction barge Pump dredger
Warkability	Very easy	Easy	Not so easy
Construction control	Very easy	Very easy	Not so easy
Amount of work	Small	Much	Much
Adaptability to change in ground	Good	Good	Adaptable
Requirement of corrosion prevention	Required	Required	Not required
Dredging Volume (m^3/m)	0	60	210
Construction cost ratio (Plan A = 1.0)	1.00	1.33	1.47

(3) Breakwater and Revetment

1) Breakwater

The breakwater will be prepared to prevent large waves or silty mud from entering into basin. Some part of the breakwater will be demolished when the construction for the long term development plan starts.

A rock bank is applicable for this breakwater. The rock bank will be constructed on a timber mat and a vinyl plastic net. The mat and the net have a good positive effect on foundation stability, while, also preventing differential settlement.

The standard cross section is shown in Fig. 3.2.4.

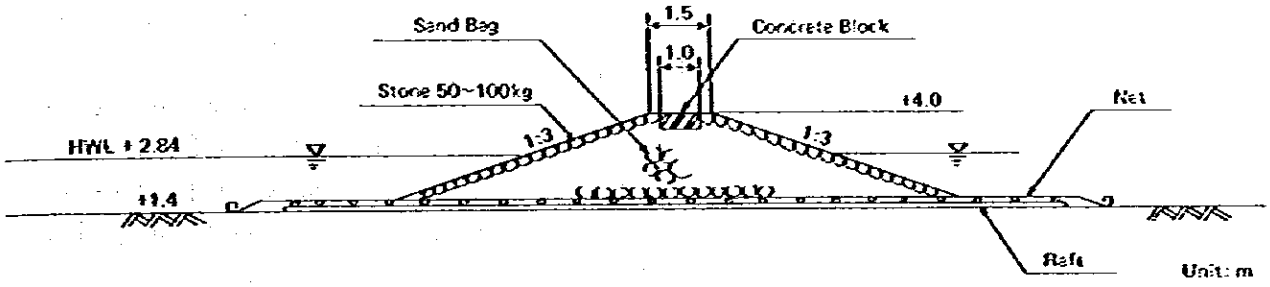


Fig. 3.2.4 Standard Cross Section of Breakwater

2) Revetment

The standard cross section of the revetment is shown in Fig. 3.2.5. The Revetment is constructed along the face line of the reclaimed industrial area. The total length of the revetment is 1025m.

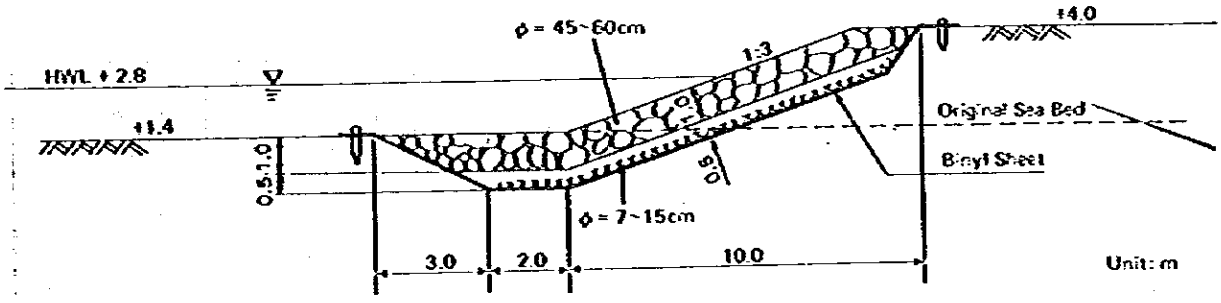


Fig. 3.2.5 Standard Cross Section of Revetment

(4) Reclamation

As shown in "Soil Conditions" (Section 2.3.2(3)), the thickness of the soft marine clay layer is about 12 meters. It is assumed that the settlement will be substantial and that consolida-

tion will require a long time. The result of the settlement calculation is shown in Table 3.2.4, and the relationship between consolidation time and settlement is shown in Fig. 3.2.5. As shown in these table and figure, the total settlement is 198cm and the residual settlement after one year is 140cm, in the case that no sort of counter measures are applied. These results will cause problems for the structures.

To prevent such unfavourable matters, the following counter measures will be taken generally.

① Sand Drain and/or Sand Compaction Pile + Surcharge or Preload
② Surcharge or Preload
③ Replacement by Good Materials
④ Pile Supporting

The comparison between these four counter measures is shown in Table 3.2.5. The result shows that ① is superior to the other measures. For the light structures (warehouse, wholesale-market, office, ship repairing facilities, etc.), the Sand Drain + Preload method will be applied, while areas without structures, it is better to apply as much surcharge as possible and absorb the settlement during the construction period. The relationship between consolidation time and settlement, when sand drain is applied, is shown in Fig. 3.2.6. In the area where soil stabilization is not applied, since it is assumed that the settlement will continue over a long period, proper and suitable maintenance should be provided in a timely fashion.

Table 3.2.4 Result of the Settlement Calculation

Formation Level of Reclamation	Settlement	Thickness of Fill
+4.0 m	198 cm	≒ 4.5 m

Table 3.2.5 Comparison of Counter Measures for Reclamation

	① Sand Compaction Pile, Sand Drain + Surcharge or Preload	② Surcharge or Preload	③ Replacement	④ Pile Supporting
Efficiency	◎	○	◎	◎
Construction Period	◎	△	△	◎
Construction Cost	○	◎	△	△
Evaluation	◎	△	△	○

◎ Very Good ○ Good △ Fair

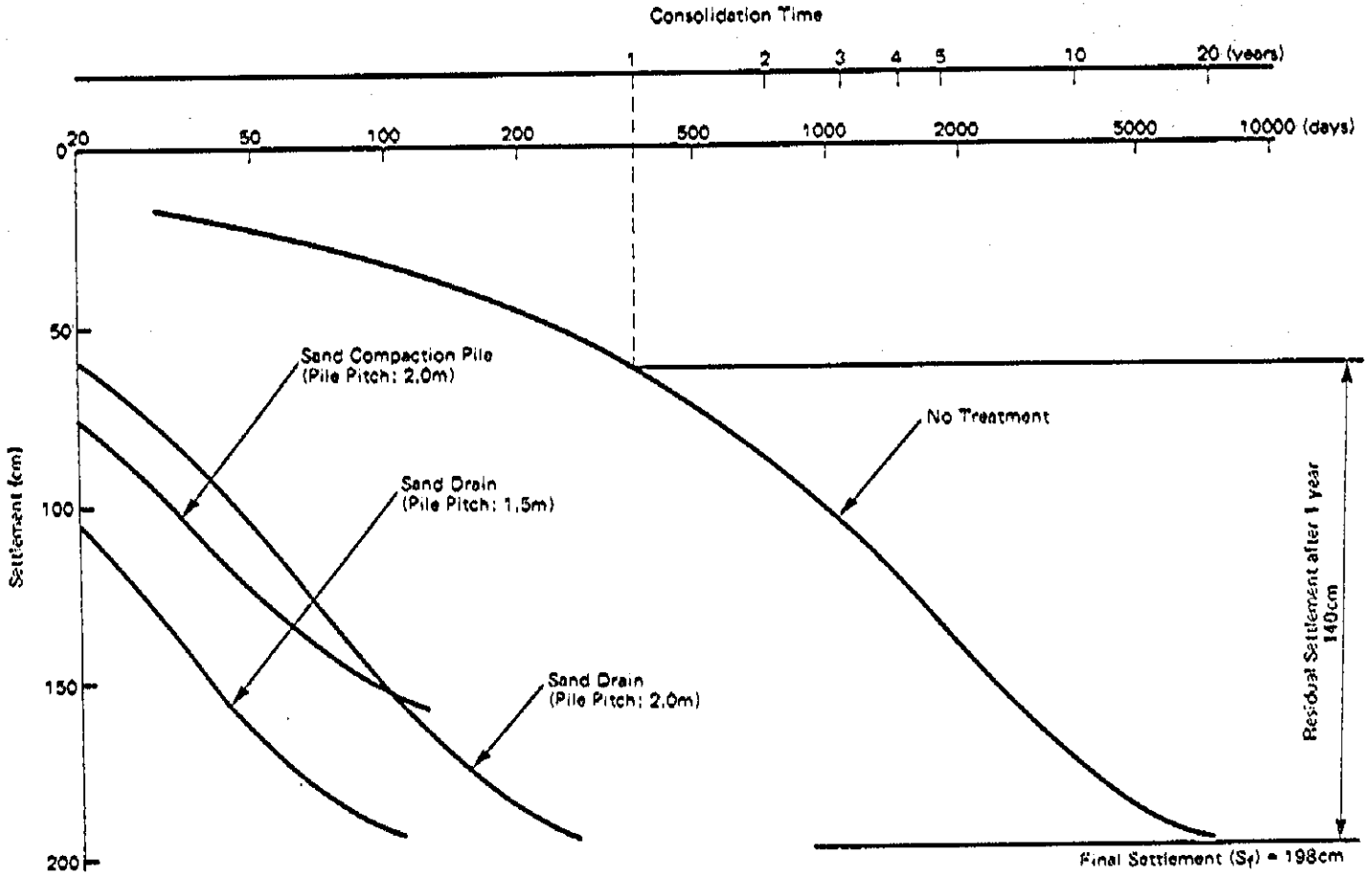


Fig. 3.2.6 Relationship between Consolidation Time and Settlement

(5) Other Facilities

Soil conditions in Kuala Perlis being poor, ground settlement is one of the biggest problems in the case of berth structure construction. But using a pile foundation for all the office buildings, factories and berth structures is very expensive and uneconomical. Only the main and/or important buildings should be supported by piles, and for the other structures, a mat foundation with sand drain and preload is applicable.

3.2.2 The Construction Plan

(1) The Construction Environment

The climate in the area of Perlis Port is relatively mild and calm. However, precipitation in the rainy season is more than 200 mm/month. Consequently, the efficiency of construction work may decrease, and this matter should be taken into account in planning the schedule of construction works.

(2) The Construction of Principal Facilities

1) Quaywall

The structure of the quay is a steel sheet pile type. Almost all the work is carried on reclaimed land, except the dredging of the front of quay. The construction procedure is shown in Fig. 3.2.7.

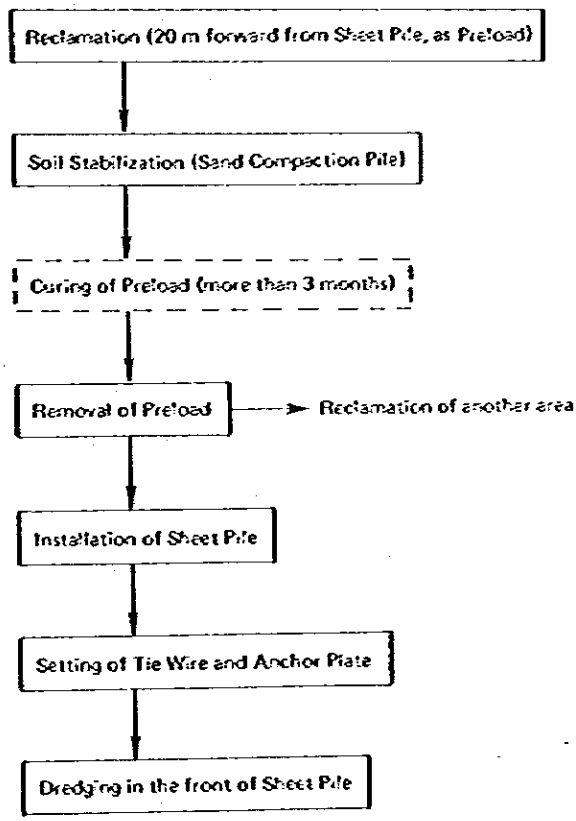


Fig. 3.2.7 The Procedure for Construction of the Quaywall

2) Reclamation

Of all the construction works the reclamation of port area should be carried out first, and the reclamation of the area where the soil is to be stabilized (sand compaction pile, sand drain) should be carried out at first. The material for reclamation will be carried from Utan Aji, about 9 km from the site. The amount of soil is very large, thus transportation

planning should be considered carefully. The curing period of preload and surcharge should be decided based on a precise survey and analysis of settlement. Prior to reclamation work, a sheet and sand mattress should be spread.

3) Dredging

Dredging work in the channel and the anchorage will be carried out using a pump dredger (minimum: 2600 ps) and in part a grab dredger. The procedure for dredging in the area close to the existing channel in shown in Fig. 3.2.8. It is desirable for the dredged soil to be dumped to the south, away from the proposed site.

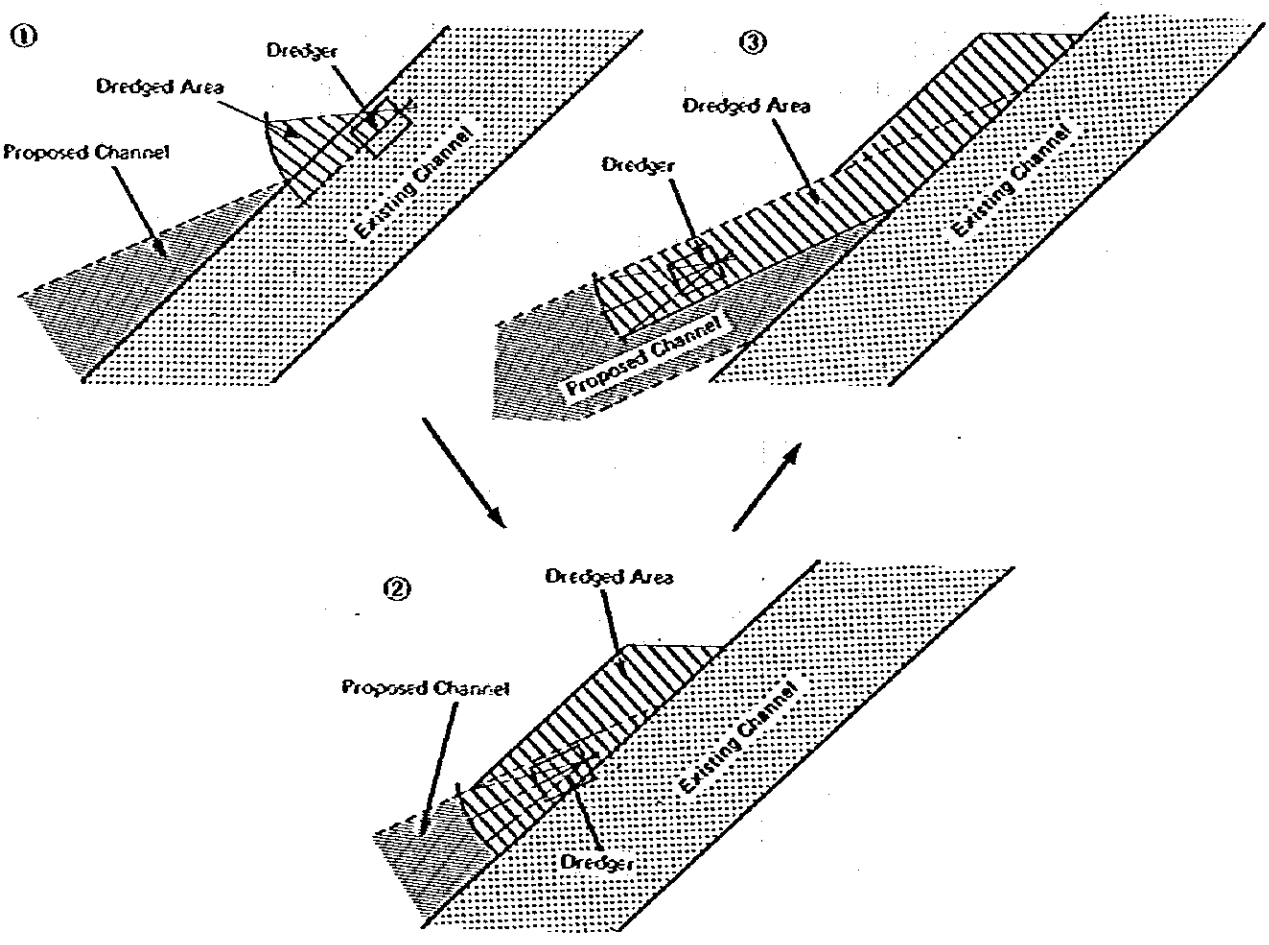


Fig. 3.2.8 Procedure for Dredging of the Channel

4) Revetment, Breakwater

The structure of the revetment and breakwater is a rock bank type. It is assumed that the amount of settlement is very large and that it will last for a long period, so proper and suitable maintenance should be provided in a timely way, so as to prevent the fall of the structure.

5) Fishery Facilities

The foundation type for light structures, such as the warehouse and the wholesale market, is the raft foundation. Before construction of the structures, Sand Drain + Preload should be applied as counter measures to prevent problems caused by settlement and lack of stability. The type of foundation for the ice making factory is a footing and concrete slub type supported by R.C. piles.

6) Ship Repair Facilities

Before the construction of ship repair facilities, sand drain and preload should be applied in the same way as for the light structures in fishery facilities.

7) Buildings

The office building will be a two-story reinforced concrete building with raft foundation, and prior to construction, sand drain and preload should be applied.

(3) The Construction Schedule

The construction schedule is shown in Table 3.2.6. As shown in this table, engineering studies are conducted from the middle of 1985 to the middle of 1986, and the construction work is expected to start at the middle of 1986 and be completed by the end of 1988.

Table 3.2.6 Construction Schedule of Short Term Development Plan

Item			1985		1986				1987				1988				1989			
Description	Unit	Quantity	9	12	3	6	9	12	3	6	9	12	3	6	9	12	13	6	9	12
Engineering Study	L.S.	1																		
Mobilization/Demobilization	L.S.	1																		
Quaywall -4.0 m	m	410																		
-3.5 m	m	550																		
Sheet Pile																				
Sand Compaction Pile																				
Others																				
Dredging																				
Channel	m^3	497,210																		
Basin	m^3	915,130																		
Reclamation																				
Port Area	m^3	592,880																		
Industrial Area	m^3	494,550																		
Revetment																				
Port Area	m	300																		
Industrial Area	m	700																		
Breakwater	m	1,195																		
Facilities of Fishery	L.S.	1																		
Ship Repairing Facilities	L.S.	1																		
Pontoon	Set	2																		
Facilities of Car Ferry	L.S.	1																		
Tank, Oil Supply	L.S.	1																		
Office	L.S.	1																		
Road																				
Port Area	m^2	44,150																		
Industrial Area	m^2	7,800																		

(4) Important Matters Involved in Construction

1) A large amount of sand (about 200,000 m^3) will be necessary for the sand mattress and the soil stabilization (sand compaction pile and sand drain). So, prior to the start of construction, the possibility of transporting the sand from Thailand and Langkawi should be considered.

2) In this construction, soil stabilization (sand compaction pile, sand drain, surcharge and/or preload) is applied to prevent problems caused by settlement and lack of stability. The control of such soil stabilization methods should be more severe than the common construction work.

3) It is assumed that the amount of settlement is very large and the settlement will last for a long period in the unstabilized areas such as the revetment and breakwater, etc.
So, proper and suitable maintenance should be provided in a timely fashion after the completion of construction.

(5) Maintenance Dredging

The amount of maintenance dredging is shown below.

S = 60 cm/year (channel), 20 cm/year (basin) : 343,570 m^3/year

S = 100 cm/year (channel), 30 cm/year (basin) : 566,590 m^3/year

For the maintenance dredging, the most suitable type of dredger is the drug suction dredger. However, the pump dredger is also applicable, because one side of the channel is navigable even during the dredging work (refer to Fig. 3.2.9).

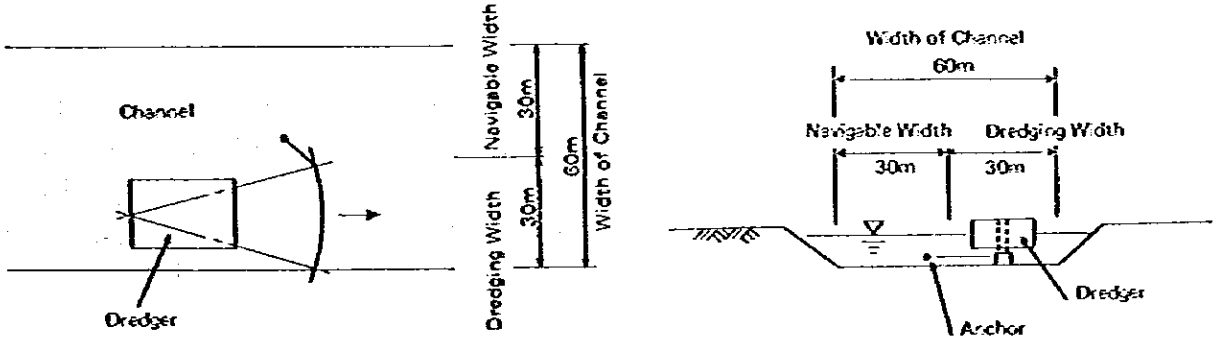


Fig. 3.2.9 The Procedure of Maintenance Dredging of Channel

And for reference, in the case that the siltation rate is 100 cm/year, the amount of dredging will be 1,940 m^3/day, and in the case 60 cm/year, the amount will be 1,175 m^3/day. The capacity of pump dredger will be more than 1,350 ps for 100 cm/year siltation rate and more than 600 ps for 60 cm/year siltation rate. The comparison of maintenance dredging cost between following cases are shown in Table 3.2.7.

Case I: Maintenance dredging will be carried in outside order by some private sector.

Case II: Maintenance dredging will be carried in direct operation by official organization. The dredger, equipments and workers belong to this organization and the dredger

will be a newly-made one.

Case III: Ditto. But the dredger will be a secondhand one.

Table 3.2.7 Comparison of Maintenance Dredging Cost

Case	Ratio of Maintenance Dreding Cost	
	S = 100 cm/year	S = 60 cm/year
I	100	100
II	154	162
III	146	151

Note: ① The cost of Case I is equal to 100.
② Maintenance dredging cost of Case I is M$3.5/m³.
③ The period of maintenance dredging is considered as 25 years.
④ The cost are converted into net present value using a discount rate of 10%.

As shown in Table 3.2.7, Case-I is the cheepest. And from the viewpoint of difficulties of repairing, operation, and control, it can be assumed that Case I is superior to Case II and Case III.

3.2.3 The Cost Estimation

(1) Construction Materials

The construction materials available at the site and in its vicinity are timber, sand, stone, cement and soil for reclamation. However, since sand production is very small, it is necessary to take into account the possibility of transporting the sand from Thailand and/or Langkawi. Reinforcing bars should be brought from another area. Steel sheet piles and steel pipe piles should be imported from abroad and transported overland from Penang Port or Port Kelang.

(2) Construction Equipment

The principal pieces construction equipment are a pump dredger, crawler cranes for piling and soil stabilization, truckcranes, bulldozers, shovels and so on. Since a pump dredger is not available at the site, this equipment should be brought from Singapore or other area. A small capacity crane and limited numbers of bulldozers and shovels are available at the site, but almost all the construction equipment should be brought from Kuala Lumpur and/or other places.

(3) Capability of Construction

Since there is no contractor having enough experience at the site or in its vicinity, the contractor should be introduced from outside the state.

The construction work requires many skilled laborers, but they are scare at the site, so they must be recruited from outside the state.

(4) Construction Base

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

(5) Conditions of Construction Cost Estimation

1) Unit prices used for the cost estimation are as of August 1983.
2) The exchange rate is US$1 = M$2.3
3) Customs duties for the imported construction materials and construction equipment are not included.
4) Physical contingency is considered as 15% of net construction cost, but this does not apply to the engineering study.
5) Price contingency is not considered.
6) The following costs are regarded as foreign currency costs.
   a) The construction materials imported from abroad because ① they are not produced in Malaysia; or ② they are produced in insufficient quantities in Malaysia
   b) Rentals for large construction craft and construction equipment difficult to obtain in Malaysia.
   c) Wages for foreign skilled laborers.

(6) Construction Cost

The estimated construction cost for the short term development plan is shown in Table 3.2.8, and the investment plan by year is shown in Table 3.2.9.

Table 3.2.8 Construction Cost of Short Term Development Plan

Item	Unit	Quantity	Unit Price (MS)	F/C (MS 10^3)	L/C (MS 10^3)	Total (MS 10^3)
Mobilization/Demobilization	L.S.	1		416	422	838
Quaywall (-4.0 m)	m	410	15,927.0	4,320	2,210	6,530
" (-3.5 m)	m	550	14,517.0	5,252	2,732	7,984
Dredging (Channel)	m^3	497,210	3.5	1,193	547	1,740
" (Basin)	m^3	915,130	3.5	2,196	1,007	3,203
Reclamation (Port Area)	m^3	592,880	8.5	771	4,268	5,039
" (Industrial Area)	m^3	494,550	8.5	643	3,561	4,204
Revetment (Port Area)	m	300	354.1	16	90	106
" (Industrial Area)	m	700	354.1	37	211	248
Breakwater	m	1,195	947.5	170	962	1,132
Road (Port Area)	m^2	44,150	25.0	110	994	1,104
" (Industrial Area)	m^2	7,800	25.0	20	175	195
Facilities of Fishery	L.S.	1		3,900	2,100	6,000
Ship Repairing Facilities	L.S.	1		360	440	800
Pontoon	Set	2	400,000.0	360	440	800
Facilities of Car Ferry	L.S.	1		600	400	1,000
Tank Oil Supply	L.S.	1		600	400	1,000
Office	L.S.	1		240	560	800
Sub Total				21,204	21,519	42,723
Engineering/Study				1,060	1,076	2,136
Contingency				3,181	3,227	6,408
Sub Total				4,241	4,303	8,544
G. Total				25,445	25,822	51,267
Port Area (Construction Cost)				20,490	17,493	37,983
" (E/S. Cont.)				4,098	3,498	7,596
Total				24,588	20,991	45,579
Industrial Area (Construction Cost)				714	4,026	4,740
" (E/S. Cont.)				143	805	948
Total				857	4,831	5,688

F/C : Foreign Currency L/C : Local Currency E/S : Engineering Service

Table 3.2.9 Yearly Investment of Short Term Development Plan

(MS 10^3)

Item	1985			1986			1987			1988			Total		
	F/C	L/C	Sub Total	F/C	L/C	Sub Total	F/C	L/C	Sub Total	F/C	L/C	Sub Total	F/C	L/C	Total
Mobilization/Demobilization				166	169	335	84	84	168	166	169	335	416	422	838
Quaywall (-4.0 m)							3,456	1,768	5,224	864	442	1,306	4,320	2,210	6,530
" (-3.5 m)							4,202	2,186	6,388	1,050	546	1,596	5,252	2,732	7,984
Dredging (Channel)							1,193	547	1,740				1,193	547	1,740
" (Basin)							1,757	806	2,563	439	201	640	2,196	1,007	3,203
Reclamation (Port Area)				308	1,707	2,015	463	2,561	3,024				771	4,268	5,039
" (Industrial Area)							322	1,781	2,103	321	1,780	2,101	643	3,561	4,204
Revetment (Port Area)							16	90	106				16	90	106
" (Industrial Area)							6	32	38	31	179	210	37	211	248
Breakwater							111	625	736	59	337	396	170	962	1,132
Road (Port Area)				28	249	277	17	149	166	65	596	661	110	994	1,104
" (Industrial Area)										20	175	195	20	175	195
Facilities of Fishery							975	525	1,500	2,925	1,575	4,500	3,900	2,100	6,000
Ship Repairing Facilities							54	66	120	306	374	680	360	440	800
Pontoon										360	440	800	360	440	800
Facilities of Car Ferry							90	60	150	510	340	850	600	400	1,000
Tank Oil Supply							90	60	150	510	340	850	600	400	1,000
Office							48	112	160	192	448	640	240	560	800
Sub Total				502	2,125	2,627	12,884	11,452	24,336	7,818	7,942	15,760	21,204	21,519	42,723
Engineering Study	530	538	1,068	530	538	1,068							1,060	1,076	2,136
Contingency				75	318	393	1,933	1,718	3,651	1,173	1,191	2,364	3,181	3,227	6,408
Sub Total	530	538	1,068	605	856	1,461	1,933	1,718	3,651	1,173	1,191	2,364	4,241	4,303	8,544
G. Total	530	538	1,068	1,107	2,981	4,088	14,817	13,170	27,987	8,991	9,133	18,124	25,445	25,822	51,267

L/C : Local Currency F/C : Foreign Currency

3.3 The Port Administration and Management

3.3.1 The Necessity of Establishing a Port Management Body

With regard to the present port administration in Peninsular Malaysia, the major ports (Port Kelang, Port of Penang, Johore Port and Kuantan Port) each have a port authority as a port management body which administers and manages the port independently of the Government.

The minor ports (others) are under the direct and central control of the Marine Department, Ministry of Transport.

As for fishing ports, though a considerable number of "fishing ports" do exist in the Peninsular Malaysia, 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. The management of "fishing ports" is participated in by the Fisheries Department, the MAJUIKAN, and the Fisheries Cooperative. In case of Kuala Perlis Port, private companies and the MAJUIKAN each manage their own facilities themselves.

According to the common practice in Malaysia, Kuala Perlis Port may be classed as a minor port, as it has been, in view of its proposed scale under this project, the commercial port facilities will be under the control of the Marine Department and the fishery facilities will be managed individually by their owners.

But in this project the following must be taken into consideration:

① Since Kuala Perlis Port is an important port designed to play the role of a nucleus for regional development in Perlis State, it is desiable for the state to take the initiative in administration and management of the port, exercising routine control over this port, having it function so as to be in conformity with the local and actual circumstances and having responsible arrangements aimed at future development.

② Since the fishery facilities and the commercial facilities in the new port area are planned in the same water area, and the breakwaters and the training walls are for both functions, it is desirable that the fishing port and the commercial port be controlled by one administrative body.

③ Furthermore, in order that the fishery functions at Kuala Perlis Port should be efficiently shared between the fishery facilities in the already developed area, especially those owned by private companies, and those in the new port area, it is necessary to establish a new organization enabling the wishes of port users to be reflecting in the management of the fishing port.

Hence, it is proposed to establish a port management body to administer and manage the fishing port and the commercial port together.

In order to develop this administrative system, it would be required for the Federal Government to carefully help the state with finances.

3.3.2 The Scope of Business of the Port Management Body

The scope of main business (types of services provided) of the Port Management Body will be determined in accordance with the following principles, referring to the examples of other ports.

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

② To allow private enterprises to provide labour for port cargo handling under the supervision and control of the Port Management Body 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 under the supervision and control of the Port Management Body.

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

1) Services for Ships
   ① Provision of berths.
   ② Services including line handling, water supply and fuel supply.
2) Services for Cargoes
   ① Cargo handling services.
   The Port Management Body presides over cargo handling in the port area by providing equipment and operators and lets private cargo handling companies to provide labourers. Stevedoring is provided through the arrangements made by shipping companies or agents. This system is in accordance with the example of Penang Port.
   ② Storage of cargoes.
3) Services for Fishing Boats
   ① Provision of fish market.
   ② Provision of cold storage and freezing facilities. Sales of ice.
   ③ Provision of ship repair facilities.
4) Provision of Site
   ① Sales of reclaimed land for the industrial estate.
   ② Lease of wharfside sites.
5) Other Services
   ① Security.
   ② Fire fighting and rescue.

3.3.3 A Study of the Organization and Personnel of the Port Management Body

The basic ideas 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, the volume of cargoes and the number of passengers, referring to the examples of other 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.

Organization, duties and the size of personnel required for the administration and management of this port are shown in Fig. 3.3.1 and Table 3.3.1.

The Board will be established having a chairman and some members and serve as the policy-making organ of the Port Management Body.

The Port Consultative Committee will be established as an advisory organ to the Port Management Body and the Port Management Body will consult the Committee on important matters. It is desirable for the Committee to be so composed as to reflect the views of local people and users as much as possible.

The organization of the offices of the general manager and other executives and the number of personnel must be kept to a minimum.

In the organization chart, three shifts of 13 persons are assigned to security and fire prevention. Three persons are assigned to public relations, because "promotion and publicity" have an important place in this port. Also, port planning, management, finance, statistics and training of personnel are stressed as special businesses. In figuring out the number of personnel, three shift of 30 persons are assigned to cargo handling and three shifts of 21 persons are assigned to operation and storage in the traffic section.

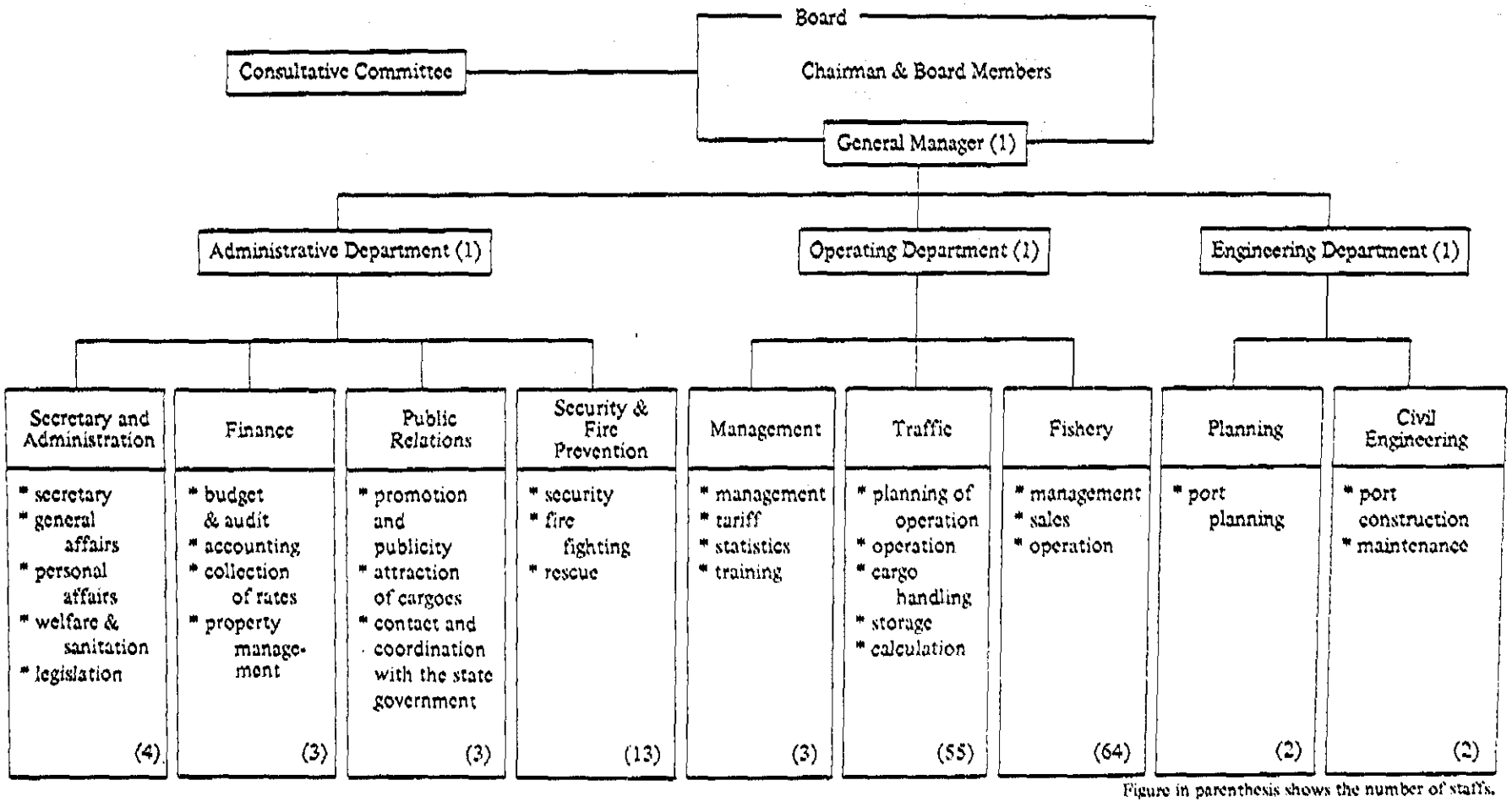


Fig. 3.3.1 Organization Chart of Port Management Body

Table 3.3.1 Number of Personnel

Administrative Department	1
Secretary & Administration	4
Finance	3
Public Relations	3
Security & Fire Prevention	13
Sub Total	24
Operating Department	1
Management	3
Traffic	55
Fishery	64
Sub Total	123
Engineering Department	1
Planning	2
Civil Engineering	2
Sub Total	5
Total	153

(Note: Total includes Director General.)

3.4 The Economic Analysis

3.4.1 General

(1) Outline

The development of Kuala Perlis Port in Perlis State which presently lacks useful port facilities will have immeasurable impact on the exploitation of this state, whose development lags behind other states in Peninsular Malaysia in spite of its immense potentialities.

However, the range for quantitative economic analysis is so limited that we will present qualitative social benefits as well as quantitative economic benefits.

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 meaningless. Therefore, we will execute economic analysis on only the Short Term Development Plan projected in accordance with the demand estimation for year 1990.

(2) The Comparison of the Alternative Plans

In executing this economic analysis, we have discussed the various possibilities that might be used as a comparative alternative plan.

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 Kuala Perlis Port did not exist and could not be utilized.

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

(3) The Prices Used in the Cost-Benefit Analysis

All costs and benefits analyzed quantitatively here are presented in prices in year 1983, the year of this survey, except for the average fish prices used in computing benefits related to fisheries, prices in year 1982, the latest data available, will be used.

3.4.2 The Benefits

(1) The Estimation of Benefits

The purpose of the development of Kuala Perlis Port is to improve the transportation conditions by providing a goods distribution base and passenger transportation base, to promote foreign trade and tourism and to accelerate the growth of fish landings in Perlis State. We will estimate the increase of Real National Income caused by the development of Kuala Perlis Port as benefits. Then, the following social benefits and economic benefits will be mentioned.

1) Social Benefits

The following may be specifically mentioned as social benefits of developing Kuala Perlis Port:

① Effects on Regional Development.

The industrial development projects now under way will make further progress due to the effects of this port development. Many factories will locate on the reclaimed

land adjacent to the port and port-related industries will locate in the state. It must be said that the role to be played by the development of this port in the regional development is, indeed, important.

② Stabilization of Commodity Prices through Promotion of Foreign Trade.
Foreign trade implies international division of labour. Therefore, increase of foreign trade makes it possible to import cheaper commodities, which causes stabilization of commodity prices within the country.

③ Development of Industries through Increase of Foreign Trade.
Productivity of industries will increase due to the availability of cheaper raw materials through foreign trade, which increase competitiveness of export industries. In this way, industries in the state will be developed.

④ Effects on Social and Regional Education through Port Development.
This project will cause effects such as acquisition of new techniques, systematization of training of port authority personnel and strengthening of the fishermen's association.

⑤ Activation of Commerce Caused by Increase of Passengers and Crews.

⑥ Improvement in Self-sufficiency of Fishery Products.

⑦ Realization of Powered and/or Larger Fishing Boats upon the Completion of the Modern and Larger Scale Fishing Port (Modernization of the Fishery by Functional Accumulation).

⑧ Stabilization of Fish Prices due to a Stable Supply of Fish.
The completion of this port will enable fishing boats to operate throughout the day. Waiting for tides will no longer be necessary. In addition, fishing boats of larger sizes will be used. Therefore, fishing activities will be stabilized, the supply of fish will be stabilized and, as a result, fish prices will be stabilized.

Through the above items are supposed as benefits of this projects, it is extremely difficult to measure them in currency-base.

2) Economic Benefits

The following may be specifically mentioned as quantitatively analyzable economic benefits of the development of Kuala Perlis Port:

① The Benefit of Reducing the Transportation Cost for Port Cargoes.
Benefits in transportation have two merits, that is, economy of time and reduction of transportation cost. The former means an increase in service and the latter means a reduction in expenditure. As the speed of sea transportation caused by the development of Kuala Perlis Port is estimated to be much faster than that of the present railway transportation, great economy of time will be achieved. But, as it is difficult to measure this benefit in currency-base, we will not analyze it quantitatively. Here, we will analyze quantitatively the benefit in reduction of transportation cost for port cargoes between the "with the port" case and the "without the port" case.

② The Benefit of Increasing the Fish Handling Volume.

③ Improvement in the Freshness of Fish through Increasing the Supply of Ice and Technical Innovation.

④ Benefit from the Ship Repair Facilities.

⑤ Creation of Added Assets Value by Reclamation for the Industrial Estate.

⑥ Effect on Increasing Employment Opportunities.

Though the increasing employment opportunities during the port development construction work and the forward effect of the investment are counted as national economic benefits, we will not execute a quantitative analysis of them. Here, we will execute quantitative analysis only concerning the direct increases in employment opportunities caused by port development, that is, port management body staff, cargo handling labourers and workers in the new factories on the reclaimed land. The difference between the average wages of these employees and those of agriculture, forestry and fishing workers is counted as a benefit.

(2) The Benefit of Reducing the Transportation Cost for Port Cargoes

1) Change in the Cargo Flow

In case of the development of Kuala Perlis Port, port cargoes handled hitherto at Penang Port and Kuala Kedah Port will be handled at Kuala Perlis Port. Further, cargoes to Kuala Lumpur and Johor will utilize Kuala Perlis Port. Therefore, cargo flow will change depending on the existence of this project. Fig. 3.4.1 shows the assumed cargo transportation routes and the transportation mode used, in the "with the port" case and the "without the port" case.

The bases for these assumptions are as follows:

① Without Kuala Perlis Port, cargoes and increases of passengers to Langkawi Island will utilize Kuala Kedah Port and other cargoes will be handled at Penang Port.

② Without Kuala Perlis Port, increases in coal and cement will be transported by lorries, because of the limited capacity of railway transportation.

③ With and without Kuala Perlis Port, cargoes and passengers are the same on the Perlis-Thailand line.

④ Without Kuala Perlis Port, factories on the reclaimed land adjacent to Kuala Perlis Port will locate inland of Kuala Perlis.

⑤ Foreign trade freights after entry and before departure from Malaysia are handled here as object of analysis.

2) Computation of Transportation Cost Reductions

The transportation costs by transportation mode are established as shown in Table 3.4.1, which is based on the results of conversations with SEPU, CIMA, MISC, transport firms and shipping companies.

Cargo volumes for each route are shown in Table 3.4.2 as V.

Only the increases in coal, cement and passengers on Perlis-Langkawi line are computed.

The benefit of transportation cost reductions consists of the difference between the cost necessary for the transportation mode 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, based on Fig. 3.4.1.

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 = Cargo Volume

C_1= Transportation Cost in the "Without the Port" Case

C_2= Transportation Cost in the "With the Port" Case

The transportation cost reductions by commodities and by routes are shown in Table 3.4.2 according to this formula.

Cargo and Passenger			With the Port	Without the Port
Cargo	Perlis State	Rice – Foreign	Importing countries ~ [Kuala Perlis Port] — Kuala Perlis	Importing countries ~ [Penang Port] — Kuala Perlis
		Rice – Domestic	Perlis State — [Kuala Perlis Port] — Johor Bahru	Perlis State — [Arau] ++++ Johor Bahru
		Wood (For.)	Thailand ~ [Kuala Perlis Port] — Perlis State	Thailand — [Kuala Perlis] — Perlis State
		Coal (Dom.)	Importing countries ~ [Kuala Perlis Port] — Bukit Keteri	Importing countries ~ [Penang Port] — Bukit Keteri
		Phosphate (Dom.)	Kuala Perlis — [Kuala Perlis Port] ~ [Kelang Port] — Kuala Lumper	Kuala Perlis ——— Kuala Lumpur
		Cement (Dom.)	Bukit Keteri — [Kuala Perlis Port] ~ [Kelang Port] — Kuala Lumpur	Bukit Keteri ——— Kuala Lumpur
		Cement Product (Dom.)	[Kuala Perlis Port] ~ Penang Port	Kuala Perlis ——— Penang Port
		Petroleum (Dom.)	Penang Port ~ [Kuala Perlis Port] — Perlis State	Penang Port — [Kangar] — Perlis State
		Raw Sugar (For.)	Exporting countries ~ [Kuala Perlis Port] — Chuping	Exporting countries ~ [Penang Port] — Chuping
	Perlis-Langkawi Line (Dom.)		Perlis State / Kedah State — [Kuala Perlis Port] ~ Langkawi Island	Perlis State / Kedah State — [Kuala Kedah] ~ Langkawi Island
	Perlis-Thailand Line (For.)		Thailand ~ [Kuala Perlis Port] — Perlis State	Thailand ~ [Kuala Perlis] — Perlis State
Passenger	Perlis-Langkawi Line (Dom.)		Perlis State / Kedah State — [Kuala Perlis Port] ~ Langkawi Island	Perlis State / Kedah State — [Kuala Kedah] ~ Langkawi Island
	Perlis-Thailand Line (For.)		Thailand ~ [Kuala Perlis Port] — Perlis State	Thailand ~ [Kuala Perlis] — Perlis State

Notes: —— Road Transportation, ~~ Sea Transportation, ++++ Rail Transportation [Transit Point]

Fig. 3.4.1 Assumption of Cargo and Passenger Transportation

Table 3.4.1 Freight and Fare in Unit Cost

Distance			Cargo Freight (MS/ton)				Passenger Fare (MS/person)
			Lorries (8 t)	Tank Lorries (18 t)	Cargo Ships (500 D/W)	Oil Tankers (500 D/W)	Ferry Boats
Kuala Perlis Port	780 Km →	Johor Bahru	–	–	50.0	–	–
Kuala Perlis Port	440 →	Kelang Port	–	–	28.0	–	–
Kuala Perlis Port	130 →	Penang Port	–	–	9.0	5.0	–
Kuala Perlis Port	30 →	Langkawi Island	–	–	2.0	–	10.0
Kuala Perlis Port	30 →	Bukit Keteri	3.0	–	–	–	–
Kuala Perlis Port	30 →	Chuping	3.0	–	–	–	–
Kelang Port	30 →	Kuala Lumpur	4.0	–	–	–	–
Kuala Perlis	500 →	Kuala Lumpur	50.0	–	–	–	–
Kuala Perlis	140 →	Penang Port	14.0	–	–	–	–
Penang Port	150 →	Bukit Keteri	15.0	–	–	–	–
Bukit Keteri	500 →	Kuala Lumpur	50.0	–	–	–	–
Penang Port	140 →	Kangar	–	7.0	–	–	–
Penang Port	150 →	Chuping	15.0	–	–	–	–
Kuala Kedah	50 →	Langkawi Island	–	–	4.0	–	15.0

Table 3.4.2 Economy of Transportation Cost

Commodities	V	C_1	C_2	C_1-C_2	B
Rice	33,000 ton	M$ 14.0	M$ 0	M$ 14.0	M$ 462,000
Coal	43,200	15.0	3.0	12.0	518,400
Phosphate	6,000	50.0	28.0+4.0	18.0	108,000
Cement	50,000	50.0	3.0+28.0+4.0	15.0	750,000
Cement Product	8,000	14.0	9.0	5.0	40,000
Petroleum	25,000	7.0	5.0	2.0	50,000
Raw Sugar	21,000	15.0	3.0	12.0	252,000
Miscellaneous (Perlis-Langkawi Line)	41,000	4.0	2.0	2.0	82,000
Passenger (Perlis-Langkawi Line)	200,000 persons	15.0	10.0	5.0	1,000,000
Total					M$3,262,000/year

(3) The Benefit of Increasing the Fish Handling Volume

The increase of fish handling volume is taken as the volume difference between the "with the port" case and the "without the port" case. The increase of fish handling volume multiplied by the average fish price equals the gross benefit. The net profit is the gross benefit multiplied by the added value ratio. The added value ratio in case of 40-ton trawler operating on the east coast in year 1978 was 50%. Here, to avoid the over-estimation of the benefit, the average added value ratio of all fishing boats will be estimated at 35%, which is obtained by multiplying the above-mentioned added value ratio by 70%.

Table 3.4.3 Annual Benefit of Increase of Fish Handling Volume

No.	Items	Unit	Value
1	Average fish price (1982)	M$/ton	815
2	Fish handling volume in the "with the port" case (1990)	ton	21,900
3	Fish handling volume in the "without the port" case (1990)	ton	10,950
4	Volume increase (2 – 3)	ton	10,950
5	Gross benefit (1 × 4)	M$	8,924,250
6	Net benefit (5 × 35%)	M$	3,123,488

(4) Improvement in the Freshness of Fish through Increasing the Supply of Ice and Technical Innovation

In year 1983, the supply of ice at Kuala Perlis was insufficient, so that a certain quantity of ice was supplied from outside the state. Upon construction of the ice manufacturing facilities, it will be unnecessary to buy ice from outside the state. The difference between the two cases is taken as a benefit.

Benefit = (Ice price outside the state – Ice price in Kuala Perlis Port)
× Insufficient volume of ice
= (M$52/ton – M$43/ton) × 12,000 ton
= M$108,000/year

(5) Benefit from the Ship Repair Facilities

The lifespan of fishing boats presently averages 7 years. In the case of "with the port", the lifespan of fishing boats will become 8 years due to the ship repair facilities. As the number of fishing boats that will utilize the ship repair facilities. As the number of fishing boats that will utilize the ship repair facilities in year 1990 is estimated at 499, the benefit in Kuala Perlis Port due to the ship repair facilities is computed as follows.

$$\text{Benefit} = \frac{\text{Price of a fishing boat}}{7} \quad \frac{\text{M\$190,000}}{} \times 499 = \text{M\$13,544,000}$$

This benefit is spread out over an 8 year period, so an annual benefit of M$1,693,000 will occur.

(6) Creation of Added Asset Value by Reclamation for the Industrial Estate

By the end of year 1989, industrial estates of 102,100 m² will be reclaimed, at a construction cost that is calculated at M$5,688,000. The sale price of these estates is assumed to be M$11,376,000. In the "with the port" case, these estates will become assets. In the "without the port" case, the resources valuable of M$5,688,000 will be diverted to another purposes as the opportunity cost. Therefore, the benefit is M$5,688,000, namely, the difference between the "with the port" case and the "without the port" case, which will occur in year 1990.

(7) Effect on Increasing Employment Opportunities

The average monthly wages for agriculture, forestry and fishing workers are assumed to be M$200 per capita, based on the estimation from GDP in year 1980 and conversations in the state in year 1983.

In the "with the port" case, opportunities for employment of port management body staff, port labourers for cargo handling, and factory workers will total 393, whose average monthly wages are taken to be M$466 per capita, the average annual incomes thus amounting to M$2,197,656.

In the "without the port" case, the annual opportunity cost of these 393 employees totals M$943,200. Therefore, the annual benefit is estimated at M$1,254,456, namely, the difference between the with-case and the without-case.

3.4.3 The Costs

The scope of costs covered by this analysis comprises the Short Term Development Plan of Kuala Perlis Port and costs for the maintenance and management of the port.

(1) The Construction Cost

The construction cost of this port, in year 1983 prices, is M$51,267,000 and its annual breakdown for the four years from year 1985 to 1988 is shown in Table 3.4.4.

(2) The Maintenance Costs and Operation Costs

1) Operation Costs

Costs for administration and operation of the port will be computed in accordance with the financial analysis described in "3.5. Financial Analysis", as shown in Table 3.4.5.

2) Maintenance Costs

A certain percentage of the construction cost will be appropriated for annual maintenance and operation costs of each facility, as shown in Table 3.4.6.

3) Maintenance Dredging Costs

The annual volume of maintenance dreding is estimated at 566,590 m^3 and the dredging cost per m^3 is M$3.5. Therefore, the annual maintenance dredging costs is M$1,983,065.

Totaling the above-mentioned, the annual maintenance costs and operation costs are M$4,007,367.

Table 3.4.4 Construction Cost for 4 Years

1985	M$ 1,068,000
1986	4,088,000
1987	27,987,000
1988	18,124,000
Total	51,267,000

Table 3.4.5 Annual Administration and Operation Cost

Personnel Cost	M$ 1,428,000
General Administrative Cost	63,000
Labour Cost	360,000
Total	M$ 1,851,000

Table 3.4.6 Annual Maintenance Cost

Facilities	Rates of Maintenance Cost	Maintenance Cost
Quaywall	1.0%	M$ 145,140
Groin	0.2	708
Breakwater	0.2	2,264
Road	1.0	12,990
Facilities of Fishery	1.5	90,000
Ship Repair Facilities	1.5	12,000
Pontoon	1.0	8,000
Facilities of Car Ferry	1.5	15,000
Tank, Oil Supply	2.0	20,000
Office	1.5	12,000
Total of Depreciable Assets		318,102

3.4.4 The Setting of Economic Prices

The benefits and costs that have already been computed are shown using 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

Customs duties and sales tax are not included in the construction cost shown in Table 3.4.4. So, there will be no need to modify this.

(2) Adjustment of Unskilled Labour Costs

The above-mentioned construction cost includes wages for labourers hired under this project. These labourers are divided into the skilled labour force and unskilled labour force. The market wage rates by which wages are actually paid will be applied to the skilled labourers. For the unskilled labourers, modified prices are determined by multiplying the market wage rate by the shadow wage rate, which is estimated at 0.5 by computing per the capita GDP of agriculture, forestry and fishing workers. Wages for unskilled labourers take up M$850,560 of the construction cost, whose annual breakdown and modified cost are shown in Table 3.4.7.

(3) The Foreign Exchange Rate

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

Table 3.4.7 Modified Construction Cost (M$)

Year	Wages of Unskilled Labourer	Modification	Modified Construction Cost
1985	0	0	1,068,000
1986	12,246	△ 6,123	4,081,877
1987	605,424	△ 302,712	27,684,288
1988	219,471	△ 109,736	18,014,264
Total	837,141	△ 418,571	50,848,429

3.4.5 The Economic Evaluation

Here, the economic returns are evaluated in terms of the internal rate of return (I.R.R.).

The life of this project is 29 years and the period of computation begins in year 1985, the initial year of investment.

The I.R.R. is 9.9%, as shown in Table 3.4.8. At least, since the I.R.R. value exceeds the Malaysian prime lending rate, we can evaluate that the capital will be used efficiently.

On the other hand, the Asian Development Bank once assumed the opportunity cost of the Malaysian capital at 12.0%. By this standard, the I.R.R. is somewhat insufficient. But, in the computation of the I.R.R., we assumed that the salvage was zero.

Further, considering that this project has many social benefits, we can conclude that this project is feasible.

Table 3.4.8 Internal Rate of Return (I.R.R.)

(M$ thousand)

No.	Year	Costs (A)		Benefits (B)					(C) = (B) − (A)	(D)	(C) × (D)
		Construction & Purchase	Operation & Maintenance	Reduction of Transportation Cost	Benefit of Increasing the Fish Handling Volume	Improvement in Freshness of Fish	Repairing of Fishing Boats & Added Asset Value by Reclamation	Effect on Increasing Employment Opportunities	Net Benefit	Discount Rate (9.9%)	Present Value
1	1985	1,068							-1,068	1.00000	-1,068
2	1986	4,082							-4,082	0.90992	-3,714
3	1987	27,684							-27,684	0.82795	-22,920
4	1988	18,014							-18,014	0.75337	-13,571
5	1989		4,007	3,262	3,123	108	1,693	1,254	5,433	0.68550	3,724
6	1990		4,007	3,262	3,123	108	1,693 5,688	1,254	5,433 5,688	0.62375	3,389 3,548
7	1991		4,007	3,262	3,123	108	1,693	1,254	5,433	0.56756	3,084
8	1992		4,007	3,262	3,123	108	1,693	1,254	5,433	0.51644	2,806
9	1993		4,007	3,262	3,123	108	1,693	1,254	5,433	0.46991	2,553
10	1994		4,007	3,262	3,123	108	1,693	1,254	5,433	0.42758	2,323
11	1995		4,007	3,262	3,123	108	1,693	1,254	5,433	0.38907	2,114
12	1996		4,007	3,262	3,123	108	1,693	1,254	5,433	0.35402	1,923
13	1997		4,007	3,262	3,123	108	1,693	1,254	5,433	0.32213	1,750
14	1998		4,007	3,262	3,123	108	1,673	1,254	5,433	0.29311	1,592
15	1999		4,007	3,262	3,123	108	1,693	1,254	5,433	0.26671	1,449
16	2000		4,007	3,262	3,123	108	1,693	1,254	5,433	0.24268	1,318
17	2001		4,007	3,262	3,123	108	1,693	1,254	5,433	0.22082	1,200
18	2002		4,007	3,262	3,123	108	1,693	1,254	5,433	0.20093	1,092
19	2003		4,007	3,262	3,123	108	1,693	1,254	5,433	0.18283	993
20	2004		4,007	3,262	3,123	108	1,693	1,254	5,433	0.16635	904
21	2005		4,007	3,262	3,123	108	1,693	1,254	5,433	0.15137	822
22	2006		4,007	3,262	3,123	108	1,693	1,254	5,433	0.13774	748
23	2007		4,007	3,262	3,123	108	1,693	1,254	5,433	0.12533	681
24	2008		4,007	3,262	3,123	108	1,693	1,254	5,433	0.11401	620
25	2009		4,007	3,262	3,123	108	1,693	1,254	5,433	0.10377	564
26	2010		4,007	3,262	3,123	108	1,693	1,254	5,433	0.09442	513
27	2011		4,007	3,262	3,123	108	1,693	1,254	5,433	0.08591	467
28	2012		4,007	3,262	3,123	108	1,693	1,254	5,433	0.07817	425
29	2013		4,007	3,262	3,123	108	1,693	1,254	5,433	0.07113	386
Total		50,848	100,175	81,550	78,075	2,700	48,013	31,350	90,665		-285

3.5 The Financial Analysis

3.5.1 The Purpose and Assumptions of the Financial Analysis

The purpose of this financial analysis is to examine whether the Port Management Body will be financially self-supporting or not after the opening of the port, that is, to examine the operating revenue and expenditure, the source and application of funds, the profitability of investment and to make necessary recommendations.

The Port Management Body will be established as an autonomous body, which is not only independent institutionally, but also independent financially. Financial independence means to administer ports on a self-supporting basis employing the business accounting system. So, we will make the financial analysis under the following assumptions.

① The annual cargo volume handled and the number of calling ships annually at the port are shown in Table 3.5.1.

② The Port Management Body will inherit all the facilities from the Government, the commercial port and the fishing port at the beginning of 1989, and the industrial estate at the beginning of year 1990. The construction cost of the facilities is shown in Table 3.5.2. This financial analysis will be made on the business accounting system. Therefore, it is appropriate to suppose some investments as the capital and also the raising of funds and the repayment of principal and interest. So, we consider that the local currency of the development investment funds corresponds to capital and the foreign currency corresponds to long-term loans.

The opening balance sheet is shown in Table 3.5.3.

③ As regards the loans from overseas, low-interest loans are to be procured with the following conditions:

Interest: 4.0% per annum.

Term of Loan: 25 years (including 7-year deferment term for principal).

These conditions are the same as those for Bintulu Port as received from the Overseas Economic Cooperation Fund of Japan (1979).

Accordingly, repayment, balance and interest will become as shown in Table 3.5.4.

④ The Port Management Body is to adopt a self-supporting accounting system, enabling the Body to meet ordinary operating costs and to renew the facilities. Accounting is to be made according to the business accounting system.

⑤ The level of port charges, the source of revenue, is to be fixed within the range of charges imposed by competing ports.

From now, we will make the financial analysis based on these purpose and assumptions. Further, we will analyze the following cases, as a case study apart from the main analysis.

Case I: In the case that the Port Management Body will inherit all the facilities at no cost, it is not necessary for the port Management Body to be concerned with the raising of funds or the repayment of principal and interest on the raised funds.

Case II: In the case that all development investment funds are to be raised as long-term loans, statements of the sources and applications of funds will be examined.

Table 3.5.1 Estimation of Ships Calling at Kuala Perlis Port (1990)

	Ships			Cargoes		Annual Number of Calling Ships (N)
	Type of Ships		Size of Ships (S)	Commodities	Volume (V)	
Commercial Port	General Cargo Ships		500 D/W	Rice	41,000 ton	848
				Wood	5,000	
				Coal	108,000	
				Phosphate	6,000	
				Cement	150,000	
				Cement product	8,000	
				Raw Sugar	21,000	
				Sub Total	339,000 ton	
	Oil Tanker		500 D/W	Petroleum	25,000 ton	63
	Passenger Boats	High Speed Boats	130.08 D/W	Passenger	357,000 person	1,825
		Vehicular Ferries	400 G/T	Passenger and Vehicles	142,500 person (47,500 car)	2,190
Fishing Port	Fishing Boats		30 G/T			2,000
			50 G/T			1,500

Notes: 1) N = V/U, N = Annual number of calling ships, V = Annual cargo volume by type of ship (ton), U = Cargo loaded or discharged per ship (ton) = Planned ship size (S) x Cargo occupancy ratio (α), α = 0.80

2) A cargo volume of 41,000 tons in the Perlis-Langkawi Line is supposed to be transported by vehicular ferries.

3) A cargo volume of 96,000 tons in the Perlis-Thailand Line is supposed to be transported by small passenger boats, the same as the present state.

Table 3.5.2 Construction Cost

(M$ thousand)

		Foreign Currency	Local Currency	Total
Mobilization/Demobilization		416	422	838
Quaywall	(-4.0 m)	4,320	2,210	6,530
"	(-3.5 m)	5,252	2,732	7,984
Dredging	(Channel)	1,193	547	1,740
"	(Basin)	2,196	1,007	3,203
Reclamation	(Port Area)	771	4,268	5,039
"	(Industrial Area)	643	3,561	4,204
Groin	(Port Area)	16	90	106
"	(Industrial Area)	37	211	248
Breakwater		170	962	1,132
Road	(Port Area)	110	994	1,104
"	(Industrial Area)	20	175	195
Facilities of Fishery		3,900	2,100	6,000
Ship Repairing Facilities		360	440	800
Pontoon		360	440	800
Facilities of Vehicular Ferry		600	400	1,000
Tank, Oil Supply		600	400	1,000
Office		240	560	800
Sub Total		21,204	21,519	42,723
Engineering Study		1,060	1,076	2,136
Contigency		3,181	3,227	6,408
Total		25,445	25,822	51,267
Items	Port Area (Construction Cost)	25,445 (20,490)	20,991 (17,493)	45,579 (37,983)
	Industrial Area (Construction Cost)	857 (714)	4,831 (4,026)	5,688 (4,740)

Note: Figure in parentheses shows only the construction cost, excluding costs of engineering study and contingency.

Table 3.5.3 Opening Balance Sheet (Beginning of 1988)

(M$ thousand)

Assets		Liabilities	
Non-Depreciable Assets	23,568	Long-term Loan	25,455
		Capital	
Depreciable Assets	27,699	Government Funds	25,822
Total	51,267	Total	51,267

Table 3.5.4 Long-term Loan Schedule

(M$ thousand)

Year	Government Fund	Long-term Loan	Investment (Total)	Repayment of Loan	Balance of Loan	Interest on Loan (4.0%)
1985	538	530	1,068	–	530	0
1986	2,981	1,107	4,088	–	1,637	21
1987	13,170	14,817	27,987	–	16,454	65
1988	9,133	8,991	18,124	–	25,445	658
1989				–	25,445	1,018
1990				–	25,445	1,018
1991				–	25,445	1,018
1992				1,414	24,031	1,018
1993				1,414	22,617	961
1994				1,414	21,203	905
1995~1999				7,070	14,133	3,675
2000~2004				7,070	7,063	2,261
2005~2009				7,063	0	847
Total	25,822	25,445	51,267	25,445		13,465

3.5.2 Revenue

Revenue may be classified into seven items; port dues, wharfage, wharf handling charge, storage charge, ship repair facilities charge, miscellaneous and sales of reclaimed land.

In the light of the charge levels at competing ports, the charge of M$ 10 or less per ton for cargo handled at Kuala Perlis Port may be regarded as a realistic level with a sufficient competitive edge. The charge level of M$ 10 per ton of cargo handled is recommended for Kuala Perlis Port.

Revenue is to be computed as below.

(1) The Commercial Port

1) Port Dues

Port dues are to be established as M$ 0.5 per gross ton of entering ship.

2) Wharfage

Wharfage for cargo ships and oil tankers is to be established as M$ 2.5 per gross ton. But, passenger boats and vehicular ferries berth regularly and their berthing time is short. Accordingly, wharfages for passenger boats and vehicular ferries are to be established at M$ 1.5 per gross ton and M$ 1.2 per gross ton, respectively.

3) Wharf Handling Charge

Wharf handling charge is to be established at M$ 5.0 per ton of cargo.

4) Storage Charge

The storage charge is to be established at M$ 1.5 per ton of cargo. 70% of cargoes will use storage facilities.

5) Ship Repair Facilities Charge

Ships for the commercial port will not utilize these facilities.

6) Miscellaneous

Miscellaneous revenue is estimated at MS 0.5 per ton of cargo, including rentals of cargo handling equipment, rent of wharfside sites, etc.

(2) The Fishing Port

1) Port Dues

Port dues are to be established at MS 0.2 per gross ton of entering fishing boats.

2) Wharf Handling Charge

A charge for use of the fish handling place will be collected, including a quayside conveyance fee, a levy on fish brought to the market by land transportation vehicles, a transportation cost for ice in the fish landing place and maintenance cost. It is estimated at 1.0% of sales.

The Charge for Use of Fish Handling Place

= Fish Handling Volume x Average Fish Price x 1.0 (%)

= 21,900 ton x MS 815/ton x 1.0%

= MS 178,485/year

3) Storage Charge

① Cold Storage Charge

= Storage Volume x Storage Period x Turnover Rate

= 8 ton/day x 5 day x 2 time/month = 80 ton/month

Cold Storage Charge = 80 ton/month x 12 months x MS 25/ton

= MS 24,000/year

Here,

Cold Storage Charge = MS 25/ton

② Sales of Ice

Sales of Ice = Price of Ice x Ice Consumption

= MS 43/ton x 15,480 ton/year

= MS 665,640/year

4) Ship Repair Facilities Charge

This charge is composed of the following three items.

① Cradling and Launching Charge

Charge for fishing boat over 10 G/T

MS 50/boat x 363 boats/year x 2 = MS 36,300

Charge for fishing boat below 10 G/T

MS 20/boat x 96 boats/year = 1,920

Total = MS 38,220/year

② Berth Using Charge

Fishing boat below 10 G/T	MS 8 x 272 days/year	= MS	2,176
10 – 25	15 x 610	=	9,150
25 – 40	20 x 699	=	13,980
over 40	40 x 476	=	19,040
	Total	= MS	44,346/year

③ Repair Charge of Workshop

Repair charge M$ 1,000/boat x 147 boats/year = M$ 147,000

Totaling the above, the ship repair facilities charges are M$ 229,566/year.

5) Miscellaneous

① Sales of Water = Price of Water x Supplied Volume x Supplied Days
= M$ 0.45/ton x 25 ton/day x 250 days
= M$ 2,812/year

② Sales of Fuel = Price of Fuel x Supplied Volume x Supplied Days
= M$ 0.482/ℓ x 17,600 ℓ/day x 250 days
= M$ 2,120,800/year

③ Parking Fee = Parking Fee x Number of Cars x Used Days
= M$ 1.5/day/car x 20 car/day x 250 days
= M$ 7,500/year

Totalling the above, the miscellaneous revenue are M$ 2,215,862/year.

(3) Sales of the Reclaimed Land

An industrial estate of 102,100 m² adjacent to the port will be reclaimed by the end of 1989 and sold in 1990. The construction cost per m² is M$ 55.7. The selling price is assumed to be twice as large as the construction cost, bringing in a revenue of M$ 11,376,000 only in 1990.

Table 3.5.5 Annual Revenue

Items	Unit Charge		Revenue		
	Comercial Port	Fishing Port	Commercial Port	Fishing Port	Total
(1) Port Dues	M$ 0.5/G.T.	M$ 0.2/G.T.	M$784,375	M$27,000	M$811,375
(2) Wharfage	Cargo Ship M$ 2.5/G.T. Passenger Boat M$ 1.5/G.T. Vehicular Ferry M$ 1.2/G.T.	–	M$2,545,825	–	M$2,545,825
(3) Wharf Handling Charge	M$ 5.0/ton	–	M$1,695,000	M$178,485	M$1,873,485
(4) Storage Charge	M$ 1.5/ton	–	M$355,950	① Cold Storage Charge M$24,000 ② Sales of Ice M$665,640	M$1,045,590
(5) Ship Repair Facilities Charge	–	–	–	① Cradling and Launching Charge M$38,220 ② Berth Using Charge M$44,346 ③ Repair Charge of Workshop M$147,000	M$229,566
(6) Miscellaneous	M$ 0.5/ton	–	M$175,500	① Sales of Water M$2,812 ② Sales of Fuel M$2,120,800 ③ Parking Fee M$7,500	M$2,306,612
Sub Total			M$5,556,650	M$3,255,803	M$8,812,453
(7) Sales of Reclaimed Land (only in 1990)					M$11,376,000

3.5.3 Expenditure

Expenditure may be classified into ten items; personnel costs, general administrative costs, labour costs, maintenance/operation costs, maintenance dredging cost, raw material costs of water supply and fuel supply, miscellaneous costs, depreciation expense, interest on loan and tax.

Annual expenditure for Port Management Body is to be computed as below.

(1) The Personnel Cost

Based mainly on the financial data of Penang Port, per capita price has been established at M$ 700 per month as the average personnel cost for all occupations.

The size of the proposed port management body staff is 153 persons.

Personnel Cost = M$ 700 x 12 months x 153 persons = M$ 1,285,200

(2) The General Administrative Costs

The ratio of general administrative costs to the personnel costs at major ports is 5% or less; here, the annual total is estimated to be M$ 450 per employee.

General Administrative Costs = M$ 400 x 153 persons = M$ 61,200

(3) The Labour Costs

Cargo handling at Kuala Perlis Port is to be carried out by Port Management Body, but labourers are to be supplied by cargo handling companies. It is, therefore, necessary to take such costs into consideration; they are estimated to be M$ 300 monthly per head on the basis of the average wages of labourers at Penang Port. The number of labourers is assumed to be 100.

Labour Costs = M$ 300 x 12 months x 100 persons = M$ 360,000

(4) The Maintenance/Operation Costs

The maintenance/operation costs of various facilities have been computed on the basis of the ratio of such costs to the construction costs of various facilities as shown in Table 3.5.6, which total M$ 318,102.

(5) The Maintenance Dredging Cost

The annual volume of maintenance dredging is estimated to be 343,570 m^3 in case of a siltation rate of 60 cm/year and 565,590 m^3 in case of siltation rate of 100 cm/year. When we take the maximum volume, the annual volume of maintenance dredging is 565,590 m^3. The dredging cost per m^3 is M$ 3.5.

The Maintenance Dredging Cost = 565,590 m^3 x M$ 3.5/m^3 = M$ 1,983,065

(6) Raw Material Costs of Fuel-supply and Water-supply

The raw material costs for these supplies are 90% of the revenue from sales.

Raw Material Costs = (M$ 2,812 + M$ 2,120,800) x 90% = M$ 1,911,251

(7) Miscellaneous Costs

To estimate the miscellaneous costs, 2.5% of the total amount of the above costs is used.

(8) Depreciation

As for depreciable assets, the average service life weighted by individual costs is 25 years.

Based on this average service life, the annual amount of depreciation may be computed by the straight line method, assuming no residual value.

The fixed assets schedule is as shown in Table 3.5.8.

(9) Interest on Loans

The Schedule of Interest on Loans is 4.0% per annum, is as shown in Table 3.5.9.

(10) Tax

If there are profits (net profits) after depreciation and interest on Loans, 45% of the profit will be deducted for taxes (income tax: 40%; develpment tax: 5%).

The surplus is to be retained as internal reserve.

Table 3.5.6 Annual Maintenance Cost

(M$)

Facilities	Construction Cost	Percentage of Construction Cost (%)	Maintenance Cost
Quaywall	14,514,000	1.0	145,140
Groin	354,000	0.2	708
Breakwater	1,132,000	0.2	2,264
Road	1,299,000	1.0	12,990
Facilities of Fishery	6,000,000	1.5	90,000
Ship Repairing Facilities	800,000	1.5	12,000
Pontoon	800,000	1.0	8,000
Facilities of Vehicular Ferry	1,000,000	1.5	15,000
Tank, Oil Supply	1,000,000	2.0	20,000
Office	800,000	1.5	12,000
Sub-Total	27,699,000		318,102
Dredging	4,943,000		
Reclamation	9,243,000		
Mobilization/Demobilization	834,000		
Total	42,723,000		

Table 3.5.7 Annual Management and Operation Cost

(M$)

Items	Amount
(1) Personnel Cost	1,285,200
(2) General Administration Costs	61,200
(3) Labour Costs	360,000
(4) Maintenance/Operation Costs	318,102
(5) Maintenance Dredging Costs	1,983,065
(6) Raw Material Costs of Water Supply and Fuel Supply	1,911,251
(7) Miscellaneous Costs	147,970
Total	6,066,788

Table 3.5.8 Fixed Assets Schedule of Beginning of Year

(M$ thousand)

Items \ Year	1989	1990	1991	1992	1993	1994	2000	2005	2010	2013
Fixed Assets	51,267	50,159	43,363	42,255	41,147	40,039	33,391	27,851	22,311	18,987
Depreciable Assets	27,699	26,591	25,483	24,375	23,267	22,159	15,511	9,971	4,431	1,107

3.5.4 The Financial Statements

On the basis of the above, three financial statements have been prepared: Statement of Revenue/Expenditure (Table 3.5.9), Statement of Source/Application of Funds (Table 3.5.11) and Balance Sheet (Table 3.5.10).

According to the Statement of Revenue/Expenditure, profits are expected after depreciation and interest on loans, and net profits are also to be expected even after taxes.

Since it will be possible to meet ordinary operating costs and to depreciate the facilities with the proposed level of charges, no specific problem concerning the revenue/expenditure is expected to arise at Kuala Perlis Port.

In this sense, the proposed level of charges may be said to be a reasonable one.

The Statement of Source and Application of Funds (Table 3.5.11) and the Balance Sheet (Table 3.5.10) show that depreciation and repayment of principal and interest on raised funds will be made annually with the result that net current assets will accumulate. It will thus be possible to afford future investments. We may, therefore, conclude that the Port Management Body will be financially self-supporting.

3.5.5 The Financial Internal Rate of Return (F.I.R.R.)

In order to examine the investment effects from the financial standpoint, the financial internal rate of return (F.I.R.R.) may be obtained by comparing the invested amounts with the profit before depreciation and before the payment of interest.

The computation period is to be 29 years.

As shown in Table 3.5.12, the F.I.R.R. will be 4.1% in case of the maximum maintenance dredging volume, which is higher than the rate of interest on borrowing; it may thus be regarded as an appropriate figure from the viewpoint of investment in infrastructure.

Table 3.5.9 Statement of Revenue and Expenditure

(M$ thousand)

Items \ Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Revenue	8,812	11,376 8,812	8,812	8,812	8,812	8,812	8,812	8,812	8,812	8,812
Expenditure	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067	6,067
Depreciation	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108
Interest on Loans	1,018	1,018	1,018	1,018	961	905	848	792	735	678
Tax	279	5,398	279	279	304	329	355	380	406	432
Net Profit	340	6,597	340	340	372	403	434	465	496	527
(Accumulated)	(340)	(6,937)	(7,277)	(7,617)	(7,989)	(8,392)	(8,826)	(9,291)	(9,787)	(10,314)

Table 3.5.10 Balance Sheet at Beginning of Year

(M$ thousand)

Items \ Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Fixed Assets	51,267	50,159	43,363	42,255	41,147	40,039	38,931	37,823	36,715	35,607
(Depreciable)	(27,699)	(26,591)	(25,483)	(24,375)	(23,267)	(22,159)	(21,051)	(19,943)	(18,835)	(17,727)
Current Assets	–	704	8,409	9,857	9,891	9,957	10,054	10,182	10,341	10,531
Assets	51,267	50,863	51,772	52,112	51,038	49,996	48,985	48,005	47,056	46,138
Liability	744 25,445	25,445	25,445	25,445	24,031	22,617	21,203	19,789	18,375	16,961
Capital	25,822	25,822	25,822	25,822	25,822	25,822	25,822	25,822	25,822	25,822
Reserve	△ 744	401	505	845	1,185	1,557	1,960	2,394	2,859	3,355

Table 3.5.11 Statement of Source and Application of Funds

(M$ thousand)

Items / Year		1985 ~88	1989	1990	1991	1992	1993	1994	1995	1996	1997
Source of Funds	Depreciation	–	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108
	Profit after Depreciation	–	1,637	13,013	1,637	1,637	1,637	1,637	1,637	1,637	1,637
	Government Funds	25,822									
	Long-term Loans	25,445									
	(Total)	51,267	2,745	14,121	2,745	2,745	2,745	2,745	2,745	2,745	2,745
Applications of Funds	Capital Expenditure	51,267									
	Interest on Loans	744	1,018	1,018	1,018	1,018	961	905	848	792	735
	Repayment of Long-term Loans					1,414	1,414	1,414	1,414	1,414	1,414
	Tax		279	5,398	279	279	304	329	355	380	406
	Total	52,011	1,297	6,416	1,297	2,711	2,679	2,648	2,617	2,586	2,555
Net Current Assets	Increase/Decrease	△744	1,448	7,705	1,448	34	66	97	128	159	190
	at Beginning of Year		△744	704	8,409	9,857	9,891	9,957	10,054	10,182	10,341
	at End of Year	△744	704	8,409	9,857	9,891	9,957	10,054	10,182	10,341	10,531

Table 3.5.12 Financial Internal Rate of Return (F.I.R.R. = 4.1%)

(M$ thousand)

No.	Year	Project Cost	Revenue	Expenditure	Depreciation	Interest on Loans	Profit before on Tax	Tax	Net Revenue	Discounted at 4.1%	Present Value
1	1985	1,068				0		–	△1,068	1.00000	△ 1,068
2	1986	4,088				21		–	△4,088	0.96061	△ 3,927
3	1987	27,987				65		–	△27,987	0.92278	△25,826
4	1988	18,124				658		–	△18,124	0.88644	△16,066
5	1989		8,812	6,067	1,108	1,018	619	279	2,745	0.85153	2,337
6	1990		11,376 8,812	6,067	1,108	1,018	11,376 619	5,398	11,376 2,745	0.81799	11,551
7	1991		8,812	6,067	1,108	1,018	619	279	2,745	0.78577	2,157
8	1992		8,812	6,067	1,108	1,018	619	279	2,745	0.75483	2,072
9	1993		8,812	6,067	1,108	961	676	304	2,745	0.72509	1,990
10	1994		8,812	6,067	1,108	905	732	329	2,745	0.69653	1,912
11	1995		8,812	6,067	1,108	848	789	355	2,745	0.66910	1,837
12	1996		8,812	6,067	1,108	792	845	380	2,745	0.64275	1,764
13	1997		8,812	6,067	1,108	735	902	406	2,745	0.61744	1,695
14	1998		8,812	6,067	1,108	678	959	432	2,745	0.59312	1,628
15	1999		8,812	6,067	1,108	622	1,015	457	2,745	0.56976	1,564
16	2000		8,812	6,067	1,108	565	1,072	482	2,745	0.54732	1,502
17	2001		8,812	6,067	1,108	509	1,128	508	2,745	0.52576	1,443
18	2002		8,812	6,067	1,108	452	1,185	533	2,745	0.50505	1,386
19	2003		8,812	6,067	1,108	396	1,241	558	2,745	0.48516	1,332
20	2004		8,812	6,067	1,108	339	1,298	584	2,745	0.46605	1,279
21	2005		8,812	6,067	1,108	283	1,354	609	2,745	0.44770	1,229
22	2006		8,812	6,067	1,108	226	1,411	635	2,745	0.43006	1,181
23	2007		8,812	6,067	1,108	169	1,468	661	2,745	0.41313	1,134
24	2008		8,812	6,067	1,108	113	1,524	686	2,745	0.39686	1,089
25	2009		8,812	6,067	1,108	56	1,581	711	2,745	0.38123	1,046
26	2010		8,812	6,067	1,108	–	1,637	737	2,745	0.36621	1,005
27	2011		8,812	6,067	1,108	–	1,637	737	2,745	0.35179	966
28	2012		8,812	6,067	1,108	–	1,637	737	2,745	0.33793	928
29	2013		8,812	6,067	1,108	–	1,637	737	2,745	0.32462	891
Total		51,267	231,676	151,675	27,700	13,465	39,560	17,813	28,734		+31

3.5.6 Comments

We may thus conclude from the above result that the financial analysis of the project shows that it will be possible to meet ordinary operating costs, to renew the facilities and to repay debts.

3.5.7 Case-study

(1) Approach to these Case-studies

Changing the assumptions of the main analysis, we examine several alternative cases.

Case I: In the case that the Port Management Body inherits all the facilities at no cost, it is not necessary for the Port Management Body to be concerned with raising funds or the repayment of principal and interest.

Case II: In the case that all development investment funds are to be raised as long-term loans, statement of sources and application of funds will be examined.

(2) Case I

The Statement of Revenue and Expenditure is as shown in table 3.5.13.

The Balance Sheet is as shown in table 3.5.14. Net current assets serving as funds to cover future investment will accumulated annually with the result that the net current assets will, by 1998, be 2.3 times as great as in the main analysis.

(3) Case II

In the case that all development investment funds are to be raised as long-term loans, the Statement of Sources and Application of Funds is as shown in table 3.5.15.

After year 1995, the net current assets will be insufficient for the funds on this power to profit.

Judging from this, it will be necessary to raise the wharf handling charges revenue by 100% or that the Port Management Body be subsidized by the Government.

Table 3.5.13 Statement of Revenue and Expenditure in Case I

(M$ thousand)

Items \ Year	1989	1990	1995	1998
Revenue	8,812	20,188	8,812	8,812
Expenditure	6,067	6,067	6,067	6,067
Depreciation	1,108	1,108	1,108	1,108
Tax	737	5,856	737	737
Net Profit	900	7,157	900	900

Table 3.5.14 Balance Sheet at Beginning of Year in Case I

(M$ thousand)

Items \ at Beginning of Year	1989	1990	1995	1998
Fixed Assets	51,267	50,159	38,931	35,607
Current Assets		2,008	18,305	24,329
Total Assets	51,267	52,167	57,236	59,936

Table 3.5.15 Statement of Source and Application of Funds in Case II

(M$ thousand)

Items \ Year	1985 ~88	1989	1990	1991	1992	1993	1994	1995	1996	1997
Depreciation	–	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108	1,108
Profit after Depreciation	–	1,637	13,013	1,637	1,637	1,637	1,637	1,637	1,637	1,637
Government Funds	–									
Long-term Loans	51,267									
Source of Funds	51,267	2,745	14,121	2,745	2,745	2,745	2,745	2,745	2,745	2,745
Capital Expenditure	51,267									
Interest on Loans	1,575	2,051	2,051	2,051	2,051	1,937	1,823	1,709	1,595	1,481
Repayment of Long-term Loans					2,848	2,848	2,848	2,848	2,848	2,848
Tax	–	–	4,933	–	–	–	–	–	19	70
Application of Funds	52,842	2,051	6,984	2,051	4,899	4,785	4,671	4,557	4,462	4,399
Net Current Assets Increase/Decrease	△1,575	691	7,137	691	△2,154	△2,040	△1,926	△1,812	△1,717	△1,654
at Beginning of Year		△1,575	△ 884	6,256	6,950	4,796	2,756	830	△ 982	△2,699
at End of Year	△1,575	△ 884	6,256	6,950	4,796	2,756	830	△ 982	△2,699	△4,353

Items \ Year	1998	1999	2000	2009	2013
Source of Funds	2,745	2,745	2,745	2,745	2,745
Application of Funds	4,337	4,274	4,211	3,648	737
Net Current Assets Increase/Decrease	△1,592	△1,529	△1,466	903	2,008
Net Current Assets at End of Year	△5,945	△7,474	△8,940	△19,320	△11,288

3.5.8 Sensitivity Analysis

The results of the sensitivity analysis between the maintenance dredging cost, interest on loans and the F.I.R.R. are shown in Table 3.5.16 and Fig. 3.5.1.

In the main analysis, the F.I.R.R. is computed on the assumption that all of the maximum annual maintenance dredging cost are met by the Port Management Body. The smaller in the maintenance volume, the higher with the F.I.R.R..

The F.I.R.R. of this project lies between 4.1% and 6.3% in proportion to the annual maintenance dredging volume, without any subsidy. With some subsidy as shown in Table 3.5.16, this project will be feasible in case of 6.0% interest on loans.

Table 3.5.16 Relation between Maintenance Dredging Cost and F.I.R.R.

Case	Maintenance Dredging Volume	Maintenance Dredging Cost	Subsidy	Maintennace Dredging Cost met by Port Management Body	F.I.R.R.	Relation between Interest on Loans and Feasibility
(I)	m^3/year Max. (566,590)	M$1,983,065	0%	M$ 1,983,065	4.1%	This project is not feasible in case of 5.0% and 6.0% interest on loans.
(II)	Min. (343,570)	1,202,495	0	1,202,495	6.3	This project is feasible in case of 6.0% and less interest on loans.
(III)	Max. (566,590)	1,983,065	50	991,533	6.9	
(IV)	Min. (343,570)	1,202,495	50	601,248	7.9	
(V)	Max.~Min. (566,590 ~343,570)	1,983,065 ~ 1,202,495	100	0	9.4	

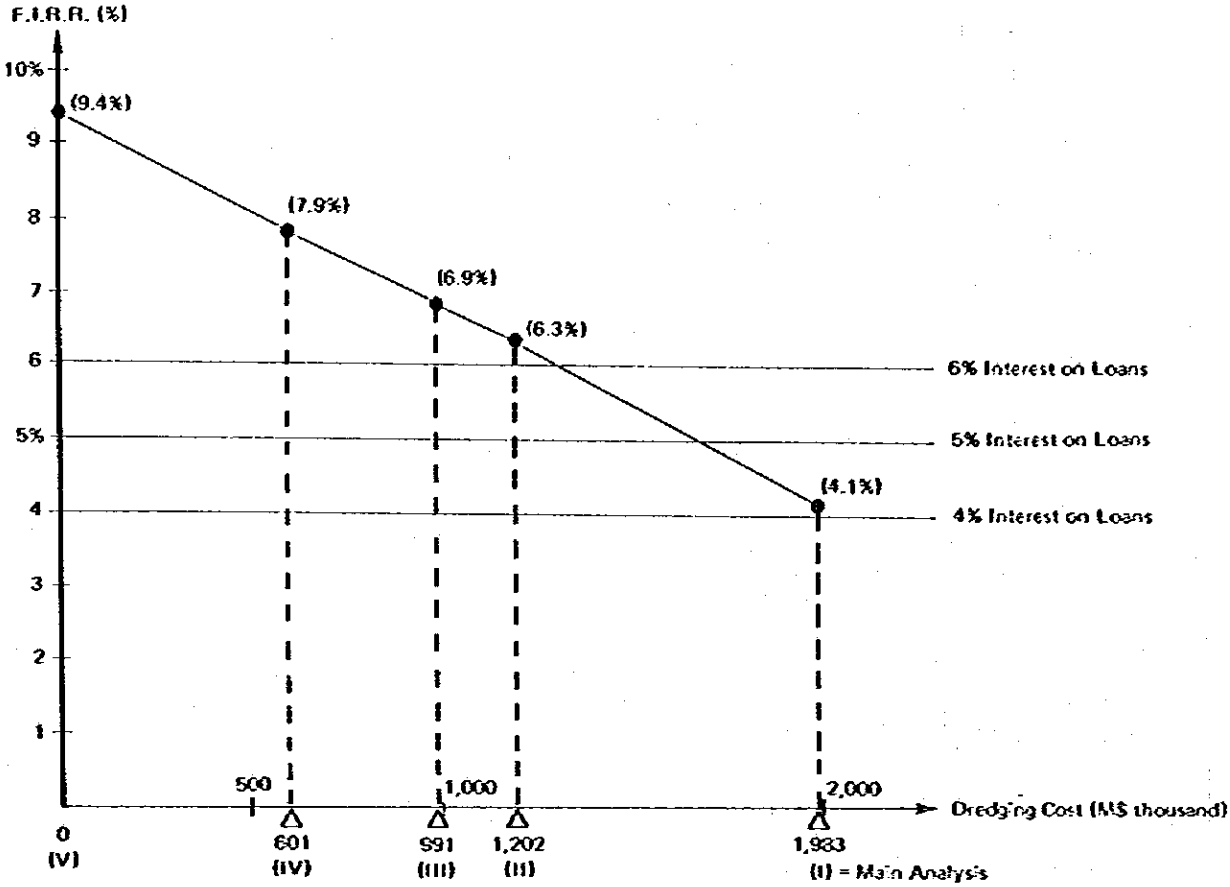


Fig. 3.5.1 Relation between Maintenance Dredging Cost and F.I.R.R.