3. Port Planning

3-1 Basic Policy

The short term development plan is prepared as a first stage plan for the target year 1988 following the recommended master plan B, so as to meet the industrialization and commercial port handling cargo forecasts of the preceding section. In this connection, a minimum of the necessary facilities will be completed by 1988 so that they can be effectively used and the rest of the facilities will be constructed after 1989 in accordance with the requirements.

The construction of port facilities and industrial plants will be started in 1984 and 1986 respectively and, by the end of 1988, industrial production will be under way according to the types and scales, decided in Table VIII-1-(1).

The commercial port, which must be operated as early as possible for such purposes as supplementing Veracrùz port, will be initially constructed on the right bank of the Tuxpan river, which can be easily improved for use. Of the 12 berths required by the master plan, three, namely, two conventional berths and one container berth will be provided on the right bank of the river. As for the existing public wharf and the TECOMAR S.A. berth in the existing port, cargo handling capacity can be increased at a relatively low cost by improving the facilities. (This, however, is not specifically included in the present study.)

Regarding the fishery port, firstly the existing fishery port will be expanded and then a new fishery port will be constructed.

The marina will be constructed after 1989. This is because

1) No great increase in the number of tourists visiting Tuxpan is likely for the next several years
2) The number of people using the marina will increase with the increase of factory workers from 1989 on
3) The construction priority may be given to the industrial foundation first and then to improving the living environment and the recreational facilities.

These are the basic policies used to establish the short term development plan.

3-2 Industrial Port Plan

The arrangement and the scale of industrial port berths must be decided in relation with the layout of industrial plants. These berths can serve as private wharves.

Since the plant layout and equipment can not be decided now, the detailed plan will not be completed. So in this study only the required number of berths will be dealt with. Table VIII-3-(1) shows cargo volume handled by the industrial port and the number of private berths. This is conducted considering berth capacity, ship size and type of cargo handled.

From the table, it is found that 15 berths totaling 3,550 m are necessary. To prevent over investments and to consider the ship size in consideration at this stage, the channel from outside the harbor up to the iron ore wharf will be executed at a depth of −16.0 m, for ships of up to 100,000 DWT. For the inner harbor channels, a water depth of −10.0 m will be kept for ships of up to 15,000 DWT.

Table VIII-3-(1) Cargoes Handled by Industrial Port and Private Berth

Type of industry		Production capacity		Area		Volume of port cargoes handled (1,000 t)				Necessary number of berths (tentative calculation)		
							1988					
		2000	1989	2000	1989	Total	Total	Foreign and domestic trade import	Foreign and domestic trade export	Water depth m	Number of depth	Total length m
		tons 1,000	tons 1,000									
Fishery food products	Fishery product processing	100 t/yr	45 t/yr	20 ha	9 ha	(Handled at fishery port and commercial port)						
Flour	Flour	116 "	60 "									
Vegetable oil	Vegetable oil	26 "	0 "	100 "	100 "	324	95	05		[12]	[1]	[240]
Food	Food	120 "	60 "									
Paper and pulp	Paper and pulp	500 "	150 "	200 "	200 "	810	243	228	15	10	1	185
Oil refining	Petroleum products	500 BSPD	250 BSPD	1,000	1,000	(24,100)	(14,050)	4,000	(10,050)		(5)	(1,555)
				Crude oil: outgoing		13,600	6,800		6,800	[19]	[1]	[500]
				Crude oil: incoming		4,000	4,000			16	1	450
		tons		Products: outgoing		4,800	2,400		2,400	11	2	420
		1,000		Products: incoming		1,700	850		850	10	1	185
Petrochemical	Ethylene	500 t/yr	0 t/yr	500 ha	500 ha	538	0					
Iron and steel	Crude steel	500	250 "	1,500 "	1,500 "	(12,130)	(6,065)	(5,065)	(1,000)		(7)	1,440
				Iron ore: incoming		7,000	3,500	3,500		[18]	[1]	[330]
				Coal: incoming		2,240	1,120	1,120		14	1	270
				Limestone: incoming		760	380	380		[11]	[1]	[210]
		tons		Scrap iron: incoming		130	65			10	2	370
		1,000	1,000	Products: outgoing		2,000	1,000		1,000	7.5	2	260
Machinery	Marine structures	24 t/yr	24 t/yr									
	Construction equipment	4,000 tons	2,000 tons									
	Chemical machines	50 1,000	50 1,000	200 ha	200 ha	109	87	20	67	7.5	1	130
	Heavy electrical machine	80	80									
		10,000										
Automobile	Automobile	36 pc/yr	0	220 "	0	2,250	0					
Shipbuilding	Ship	250,000 t 5 yr	0	200 "	0	101	0					
Total				3,940	3,509	40,362	20,540	9,408	11,132		15	3,550

[ ]: Water depth is temporary.
( ): Sub total

3-3 Commercial Port Plan

The required number of berths is decided by using the same values for handling cargo volume per berth per year that were used to decide the number of commercial berths for the master plan as described in Chapter VII-3.

Table VIII-3-(2) shows cargo volume handled by the commercial port and necessary number of berths in the year of 1988.

At present, containers totaling about 168 thousand tons (1980) are handled by two berths in the existing port: one is the public wharf on the right bank of the Tuxpan river (water depth: -6.0 m, length: 150 m, apron width: 13 m) and the other is the TECOMAR S.A. berth (water depth: −6.0 m, length: 30 m).

Table VIII-3-(2) Volume of Cargoes Handled by Commercial Port and Number of Berths (1988)

	Cargoes handled (1,000 tons)		Number of berth		Per-berth volume of cargoes handled (1,000 tons)	
	Total	New Port	Total	New Port	Total	New Port
Container berth						
For small ships	257		1	–	257	
General cargo berth						
Special carrier	312		1	–	312	
Conventional ships	101	101	1	1	101	101
Bulk cargo berth	523	523	2	2	262	262
Total	1,193	624	5	3	239	208

Based on the basic policy mentioned above a container wharf which seems to be required for urgent use is proposed to be constructed on the right bank of the Tuxpan river after the extension of the river breakwater and the construction of the CFE berth. These three berths, one newly constructed berth and the two existing berths will handle 257 thousand tons of container cargoes and 312 thousand tons of general cargoes for specialized ships.

Therefore in the new port area, one conventional berth for general ships and two berths for bulk cargo, one exclusively for cement (250,000 tons, berth occupancy rate 0.22) and another for fertilizer and nonferrous metal ores (273,000 tons, berth occupancy rate: 0.11), will be constructed. In this case, −10 m is tentatively proposed as the water depth of the wharf. Fig. VIII-3-(1) is commercial port plan.

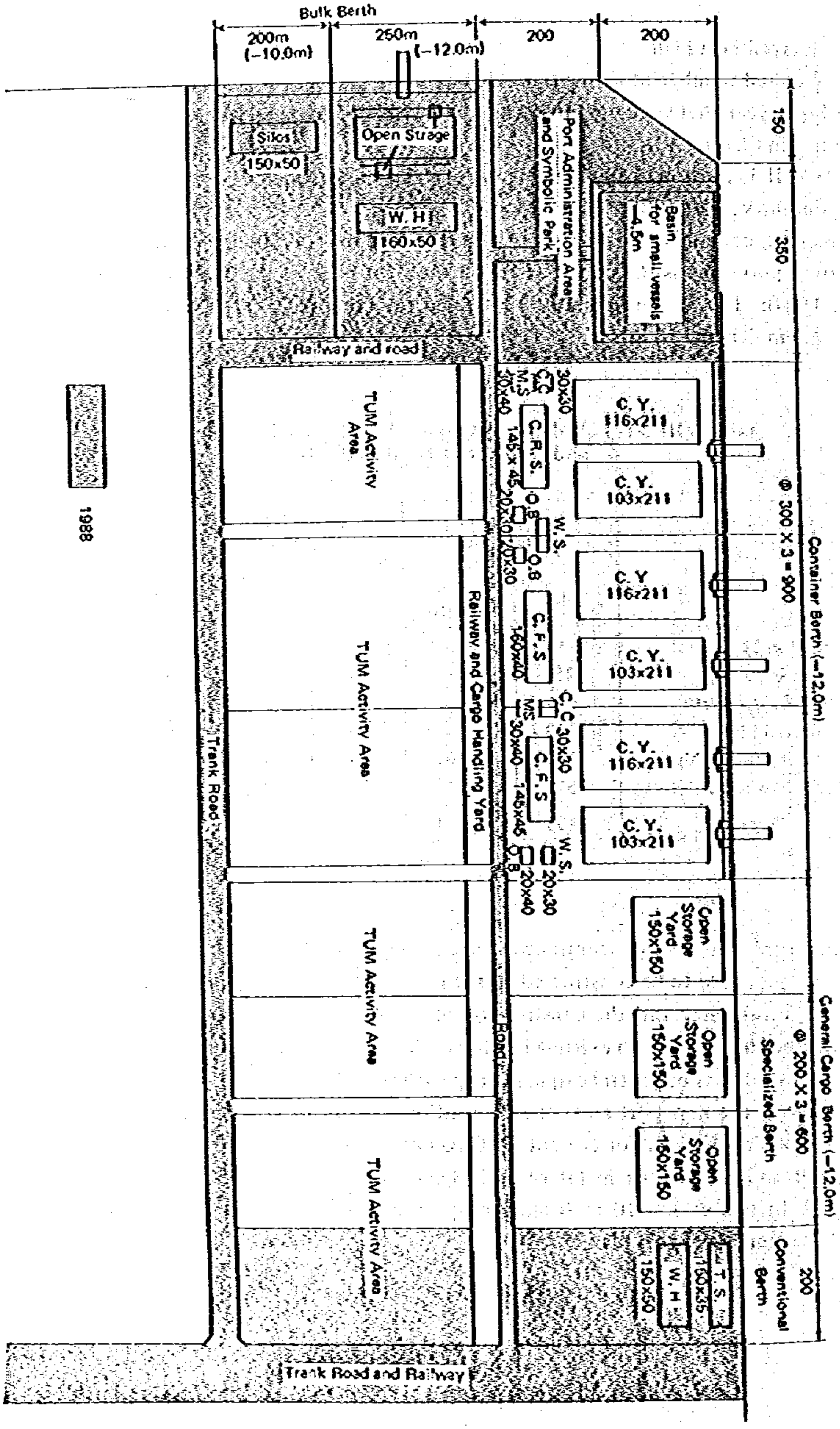


Fig. VIII-3-(1) Commercial Port Plan (1988)

The berth occupancy rates for the general cargo, the cement, fertilizer and nonferrous metal are as follows:

(i) General cargo berth for conventional ships

Cargo volume: 101,000 tons

Average volume of loaded cargo per ship: 1,000 tons

Cargo handling equipment: Ship's gear

Cargo handling capacity: 15 t/h x 3 gang = 45 t/h

Cargo handling hours per ship: 1,000/45 = 22.2 hours

Number of calling vessels: 101,000/1,000 = 101 vessels

Berth occupying hours per ship: 22.2 + 2 = 24.2 hours

Total berth occupying hours: 101 x 24.2 = 2,444.2 hours

Berth occupancy rate per berth: 2,444.2/6,000 (300 days x 20 hours/day) = 0.41

(ii) Cement

Cargo volume: 250,000 tons

Average ship size: 6,000 DWT (Maximum: 15,000 DWT)

Cargo handling equipment: Pneumatic loader

Cargo handling capacity: 210 t/h

Cargo handling hours per ship: 6,000/210 = 28.6 ÷ 29 hours

Number of calling vessels: 250,000/6,000 = 42 vessels

Berth occupying hours per ship: 29 + 2 = 31 hours

Total berth occupying hours: 42 x 31 = 1,302 hours

Berth occupancy rate per berth: 1,302/6,000 (300 days x 20 hours/day) = 0.22

(iii) Fertilizer and non ferrous metal

Cargo volume: 273,000 tons

Average volume of loaded cargo per ship: 10,000 tons

Cargo handling equipment: Unloader

Cargo handling capacity: 480 t/h

Cargo handling hours per ship: 10,000/480 = 20.8 ÷ 21 hours

Berth occupying hours per ship: 21 + 2 = 23 hours

Number of calling vessels: 273,000/10,000 = 28 vessels

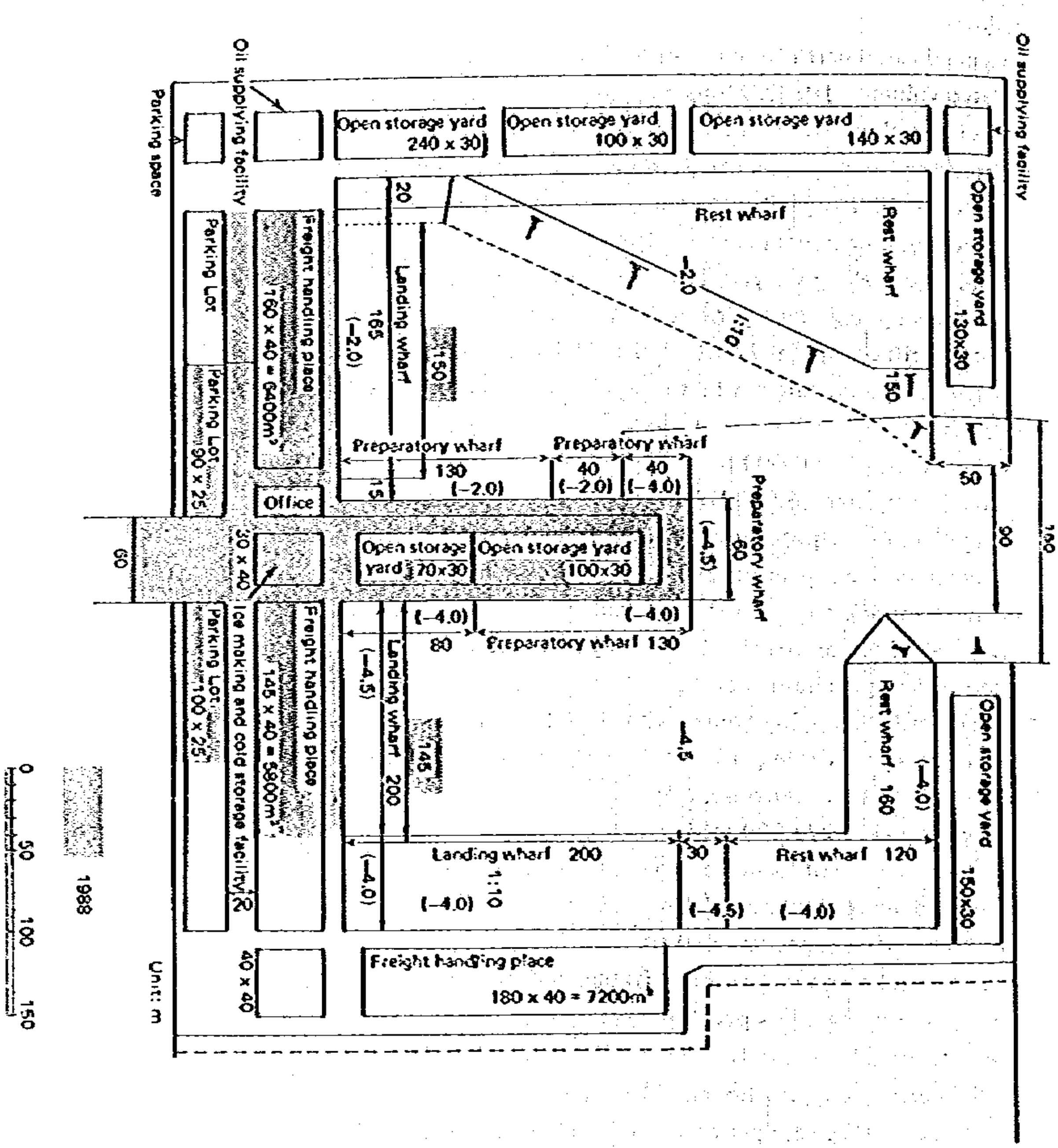
Total berth occupying hours: 23 x 28 = 644 hours

Berth occupancy rate per berth: 644/6,000 (300 days x 20 hours/day) = 0.11

3-4 Fishery Port Plan

The fishery port in the short term plan is designed to handle 25,000 tons of fish which is 41% of the 60,000 tons planned for the year 2000. Therefore about 40% of the facilities proposed in the master plan must be provided under the short-term plan, both basic and functional facilities, as indicated in Table VIII-3-(3) and Fig. VIII-3-(2).

The plan is for the landing, preparatory and rest wharves to be used concurrently during this period. The −4.5 m wharves will be used to cover the shortage of −4.0 m wharves and the proposed total length of wharves is 775 m.



Freight handling place	12,200m²
Open storage yard	5,100
Ice making and cold storage facility	1,200
Parking Lot	4,750
Office	800

	Water depth	Length
Quay	-2.0m	320m
	-4.0	250
	-4.5	205
	Total	775

Fig. VIII-3-(2) Fishery Port Plan (1988)

Table VIII-3-(3) Requirements of Basic Facilities, for Fishery Port (Calculated)

Wharf water depth	Berth length	Landing wharf		Preparatory wharf		Rest wharf		Total Length
		Number of berths	Length	Number of berths	Length	Number of berths	Length	
-2.0	–	–	54	–	16	–	280	350
-4.0	30	2	60	1	30	–	64	154
-4.0	35	2	70	1	35	–	40	145
-4.5	45	1	45	1	45	–	12	102
Total		5	229	3	126		396	751

3-5 Breakwaters, Channels and Basin

(1) Breakwater

The length of North breakwater was decided to be 2,500 m, that is 1,000 m from the shore to the bending point and 1,500 m from the bending to the offshore end point. Consideration was given to the following items.

1) To provide a stopping distance of more than 1,500 m for the 100 thousand DWT oil tankers arriving at the oil dolphins on the land side.
2) To shelter the entrance channel

The south breakwater will be extended by a total of 1,400 m: namely, 1,000 m from the shore to the bending point and 400 m from the bending point to the offshore tip, assuming a water depth of −10 m as the critical water depth where bottom material movement by normal waves is most unlikely.

(2) Channel

400 m is used as the channel width so as to be adequate for 100 thousand DWT tankers, assuming that it should be 1.5 L (L = ship length).

250 m (1.5 L = 250 m) is used as the width of the inner harbor channels so as to be adequate for 15 thousand DWT ships. (See Fig. VIII-3-(3))

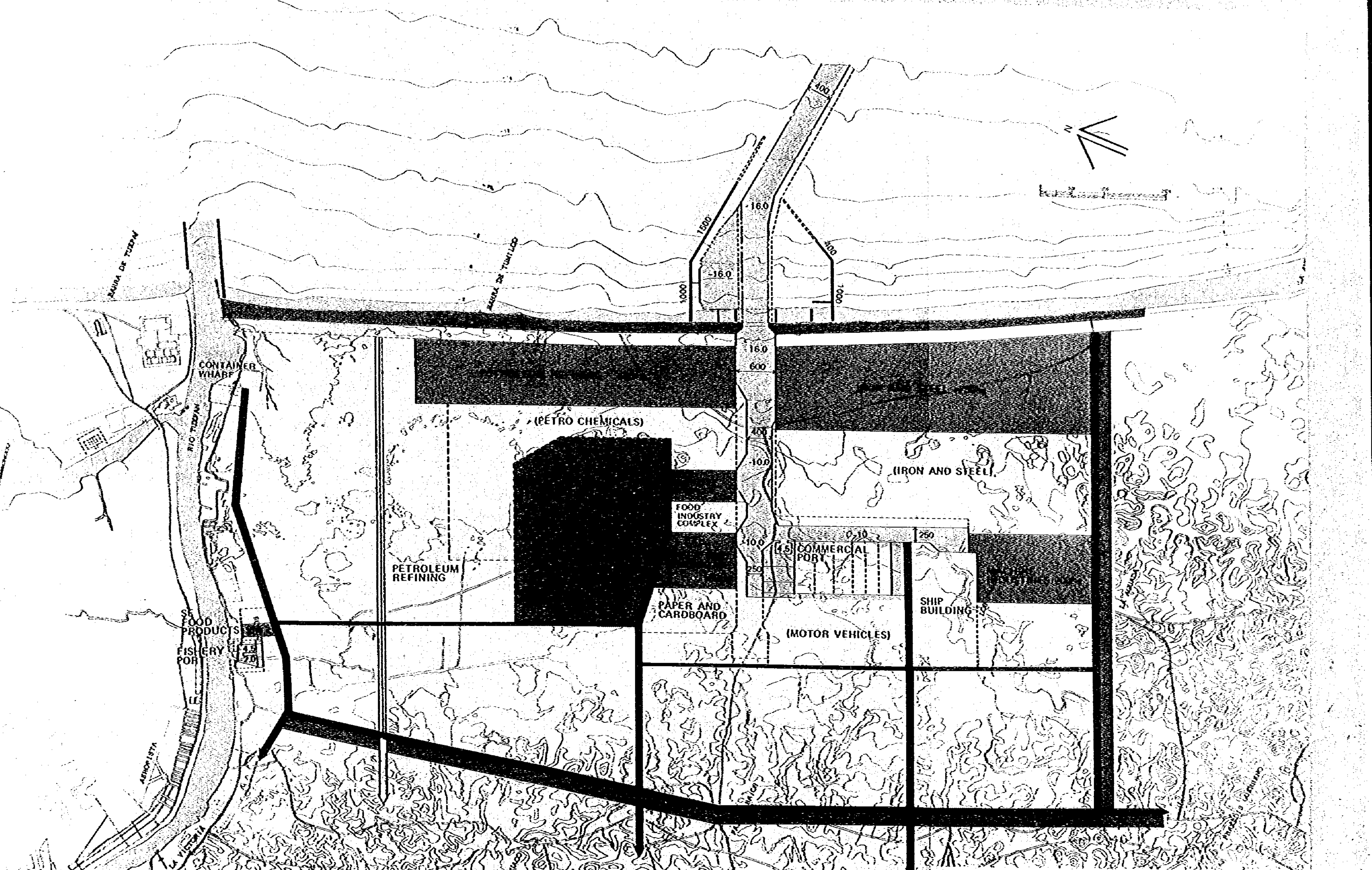


Fig. VIII-3-(3) Short Term Plan of Tuxpan Industrial Port (1988)

(3) Wave height inside the port

(a) Condition of computation

In order to examine whether the breakwater length for short-term plan is enough or not, wave height distribution inside the port was calculated in both the case of master plan and short-term plan.

The conditions of computation are as follows:

Incident wave height	:	3.5 meter
Incident wave period	:	10 seconds
Direction of the wave	:	NE
Reflection ratio		
Quay wall	:	0.8
Others	:	0

The wave is treated as an irregular wave.

(b) Result

Fig. VIII-3-(4) and (5) show the results of computation which are drawn as ratio of the wave height to the incident wave height for the master plan and short-term plan respectively.

For the master plan, since the maximum wave height ratio in the inner port is mostly less than 0.3, there seems not to be a problem.

On the other hand, for the short-term plan, a maximum wave height ratio of 0.5 is found in the inner port. It is said that in case of calm sea conditions, there may occur no problem. But if large waves caused by a hurricane come, small problems for the mooring ship and quay walls themselves would be occurred.

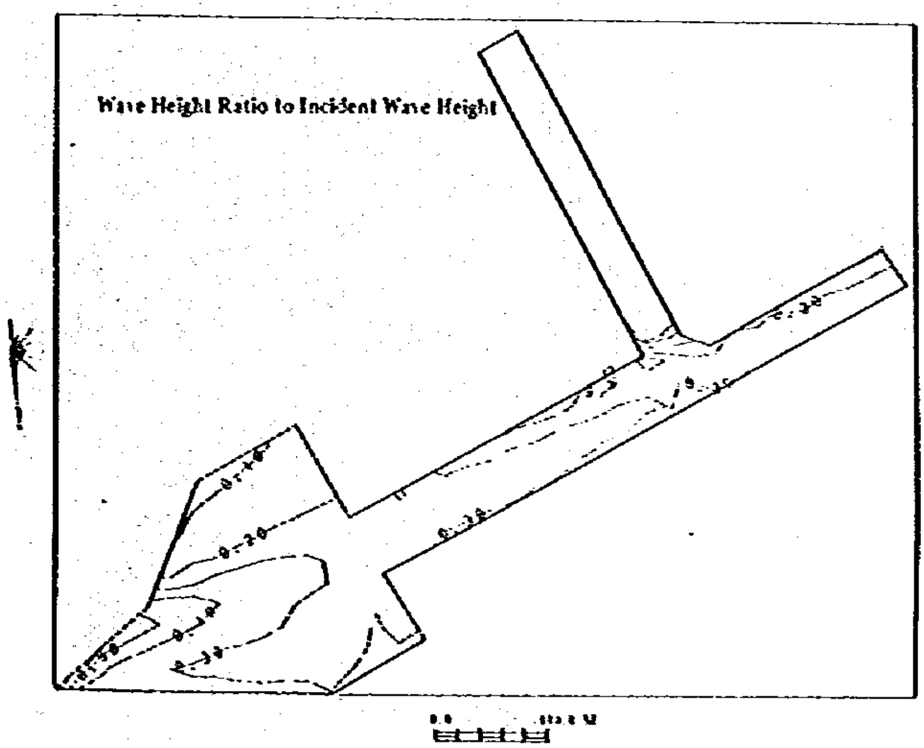


Fig. VIII-3-(4) Wave Height Distribution in Tuxpan-Port (Master Plan)

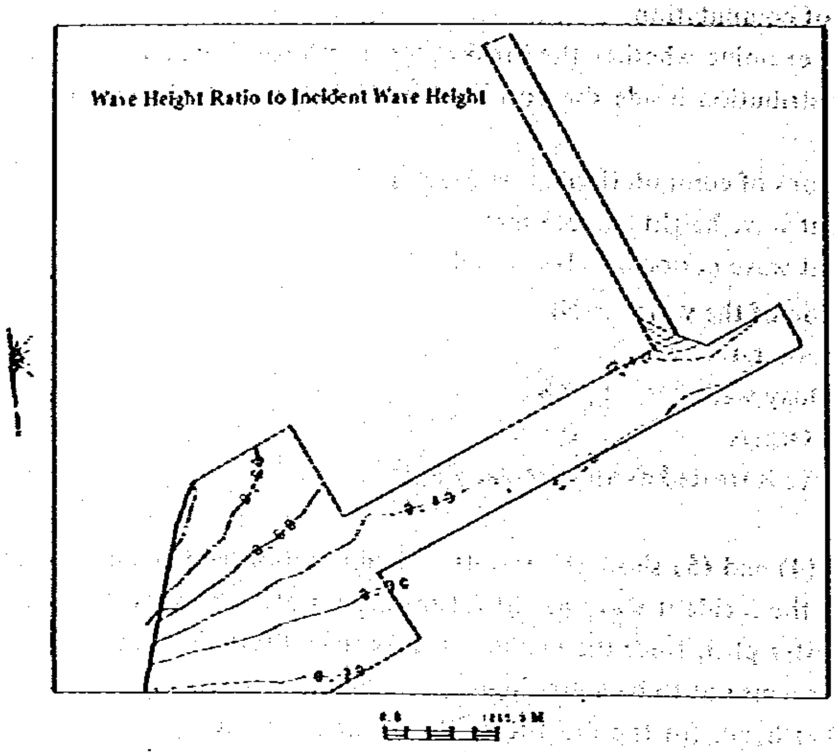
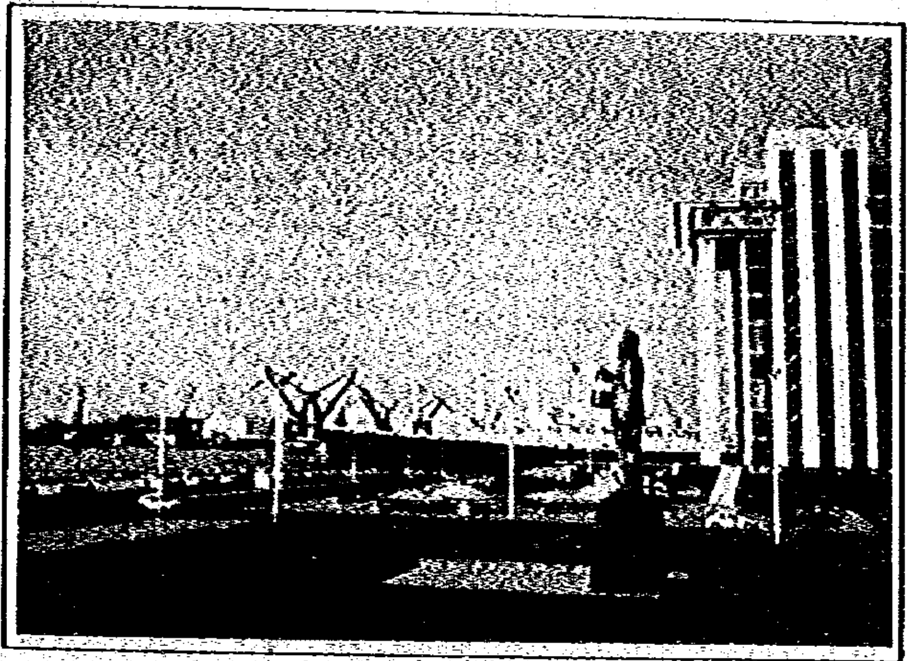


Fig. VIII-3-(5) Wave Height Distribution in Tuxpan-Port (Short Term Plan)

CHAPTER IX
DESIGN CONSTRUCTION AND COST ESTIMATION



Port of Veracruq

CHAPTER IX. DESIGN, CONSTRUCTION AND COST ESTIMATION

1. Design

1.1 Breakwater

(1) Structural types of breakwaters

The characteristics of the rubble mound breakwater are described as follows.

1) Quarries have been found in and around the site, and its easy to provide materials.
2) Rubble mound breakwaters have in the past been constructed in Tuxpan Port, Veracruz Port, and elsewhere in the region. Also at present there is one under construction at Altamira Port. To continue this trend, rubblemound breakwaters might be most appropriate in terms of the knowledge and expertise of all parties concerned.
3) Simple facilities will suffice to execute the construction. Waves have no influence on the construction, and the execution controls can be simple.
4) Variation in the depth of the ground and variation of the soil conditions have no influence on the execution of the construction.
5) The area of the crossection of the rubble mound breakwater is comparatively large, and greater amount of materials are required. This means a long construction period.
6) The weight of armour concrete blocks increase accordingly as the design wave hight increases. Especially in a site where the design water depth is great, the construction cost will increase because of high cost of fablicating and placing concrete blocks.
7) Cost for maintenance and repair is generally high.

On the other hand, the characteristics of the caisson composite type breakwater are described as follows.

1) Requisite materials are comparatively few.
2) The efficient width of the harbour entrance is easily insured.
3) The maintenance and repair of the structure does not have to be carried out so frequently.
4) Many kind of techniques and facilities are required to execute the construction.

According to the short term development plan, 3,400 m of breakwater will be constructed within a short term. At the point where the water depth becomes comparatively deep, the caisson composite type breakwaters should be adopted, because the rubble mound type breakwaters need a great amount of rubble and large armour concrete blocks. On the contrary, at the vicinity of the foot of the breakwaters, the rubble mound type breakwater, which is constructed by the spreading method, seems to be advantageous. The South and the North breakwaters are arranged as shown in Fig. IX-1-(1), in consideration of above mentioned factors, the direction of the breakwaters, water depth of the site and the importance of the breakwaters.

(2) Crosssection design of breakwaters

(a) Design conditions

(i) Tidal level

H.H.W.L.	+1.12 m
H.W.L.	+0.50 m
L.W.L.	±0.00 m

(ii) Wave hight

Section N1	$H_{1/3}$ = 3.5 m
Section N2	$H_{1/3}$ = 5.0 m
Section N3	$H_{1/3}$ = 6.5 m
Section N4	$H_{1/3}$ = 7.5 m
Section S1	$H_{1/3}$ = 3.5 m
Section S2	$H_{1/3}$ = 5.0 m
Section S3	$H_{1/3}$ = 6.5 m
Section S4	$H_{1/3}$ = 7.5 m

(b) Crosssection design

The standard cross section of the breakwaters are shown in Fig. IX-1-(2) through Fig IX-1-(9). As a rule, the crown hight of the breakwater shall be 0.6 $H_{1/3}$ above H.W.L. or more.

On the section N1, N2, the crown hight is 5.0 m, the same as on the section N3, N4 considering the influence of the overtopping of waves.

The cross section of the south breakwater is somewhat lighter than that of the north breakwater in consideration of the direction of the waves. The weight of the armour stones on the basin side of the north breakwater shall be large enough to stand the invading waves from the harbor entrance.

The crown width of the rubble mound breakwater is 6 m, including an allowance for the execution of work.

The thickness of the rubble mound laid under the caisson is 1.5 m or more in consideration of the clayey foundation. the bearing power of the ground has to be reaffirmed after getting results of the soil borings.

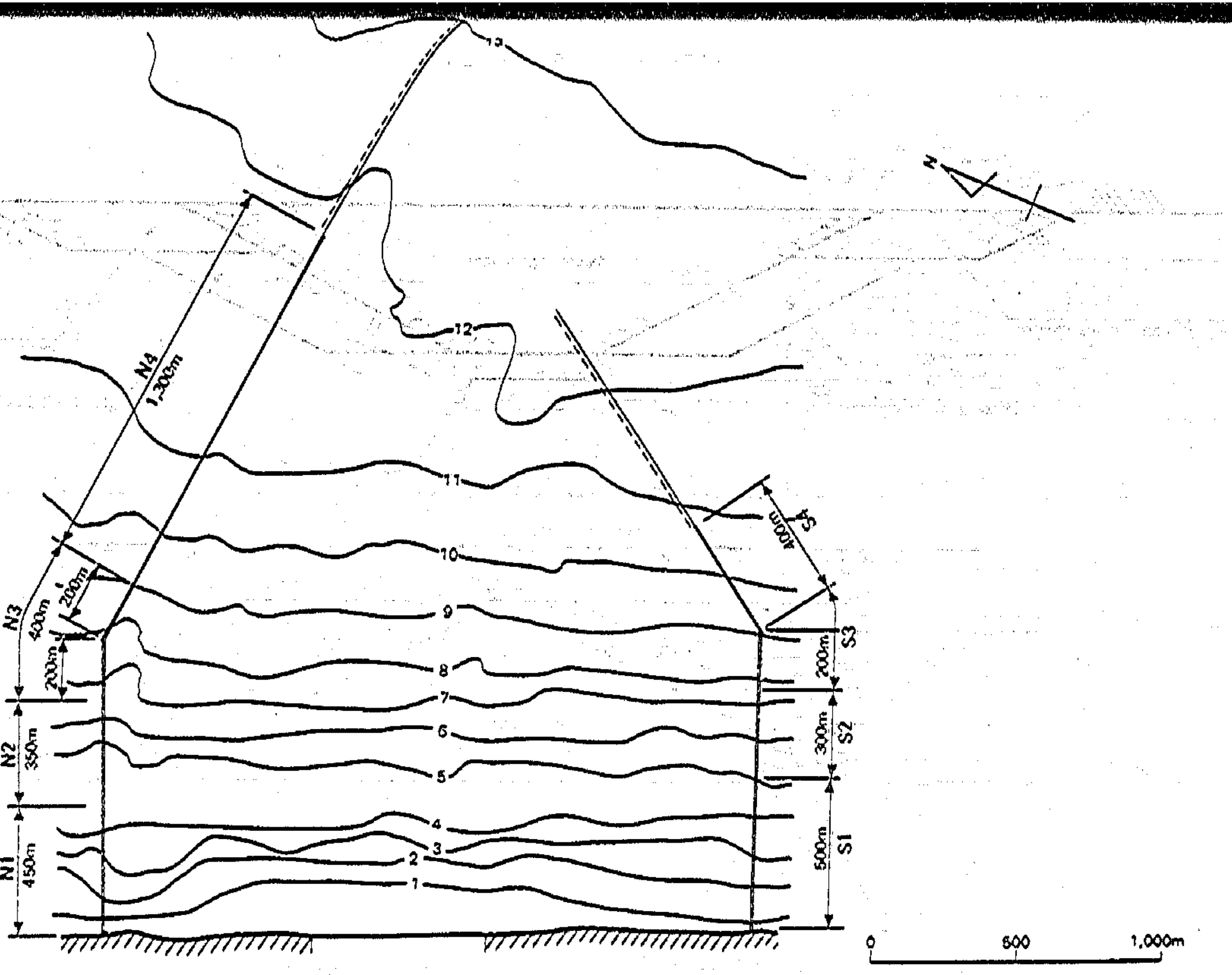


Fig. IX-1-(1) Arrangement of Breakwater

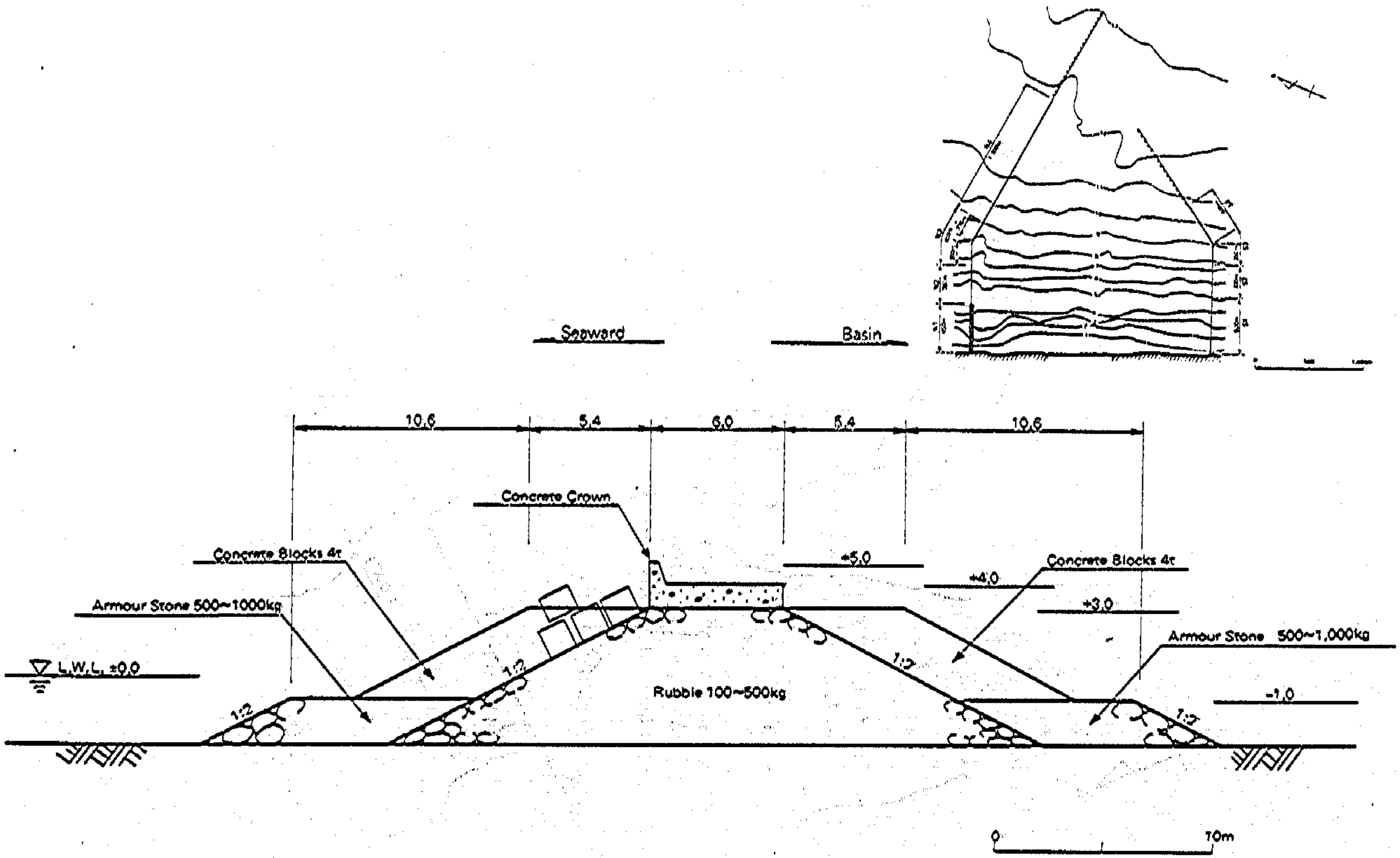


Fig. IX-1-(2) Standard Crossection of Breakwater (N1 Section)

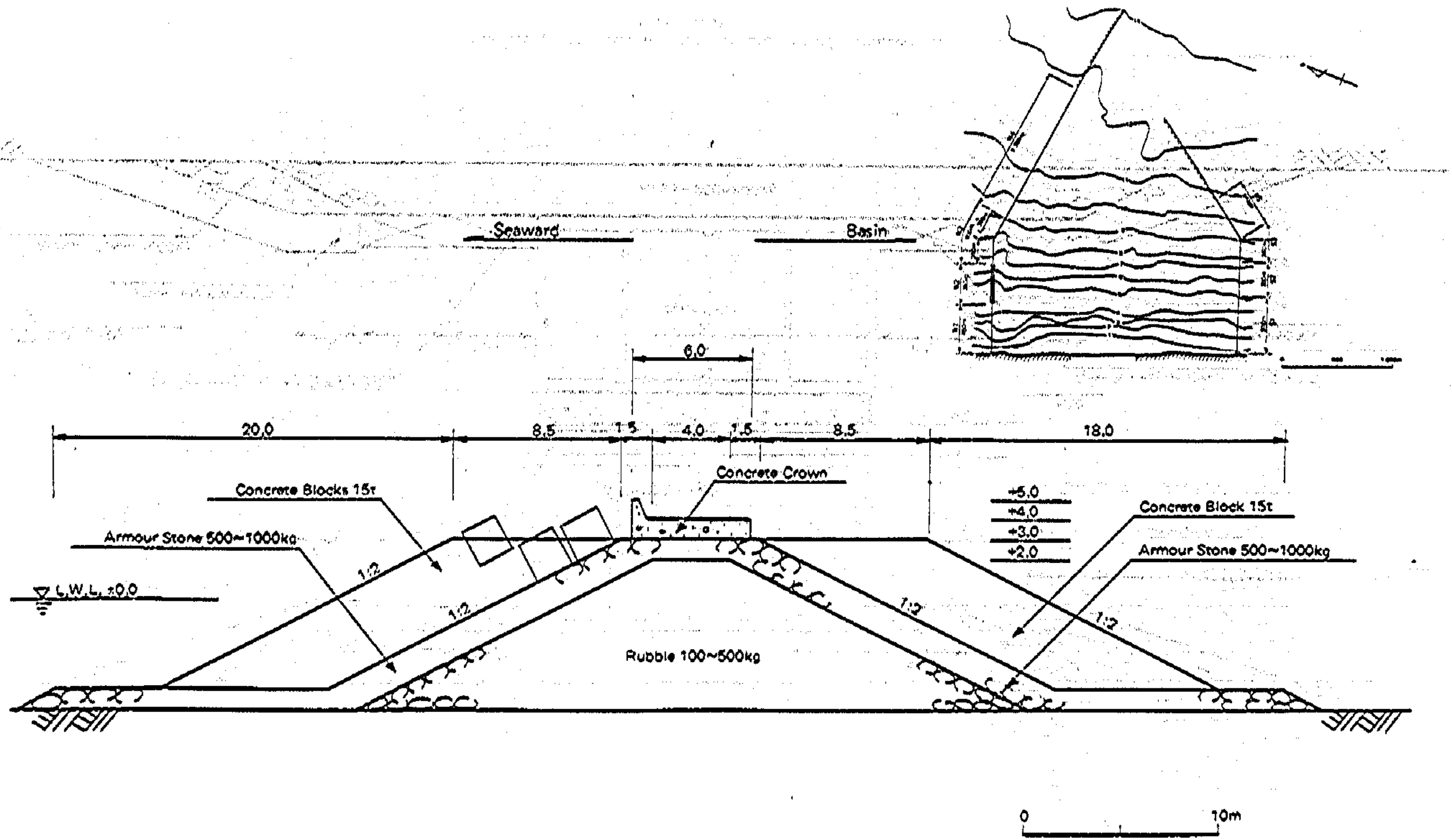


Fig. IX-1-(3) Standard Crosssection of Breakwater (N2 Section)

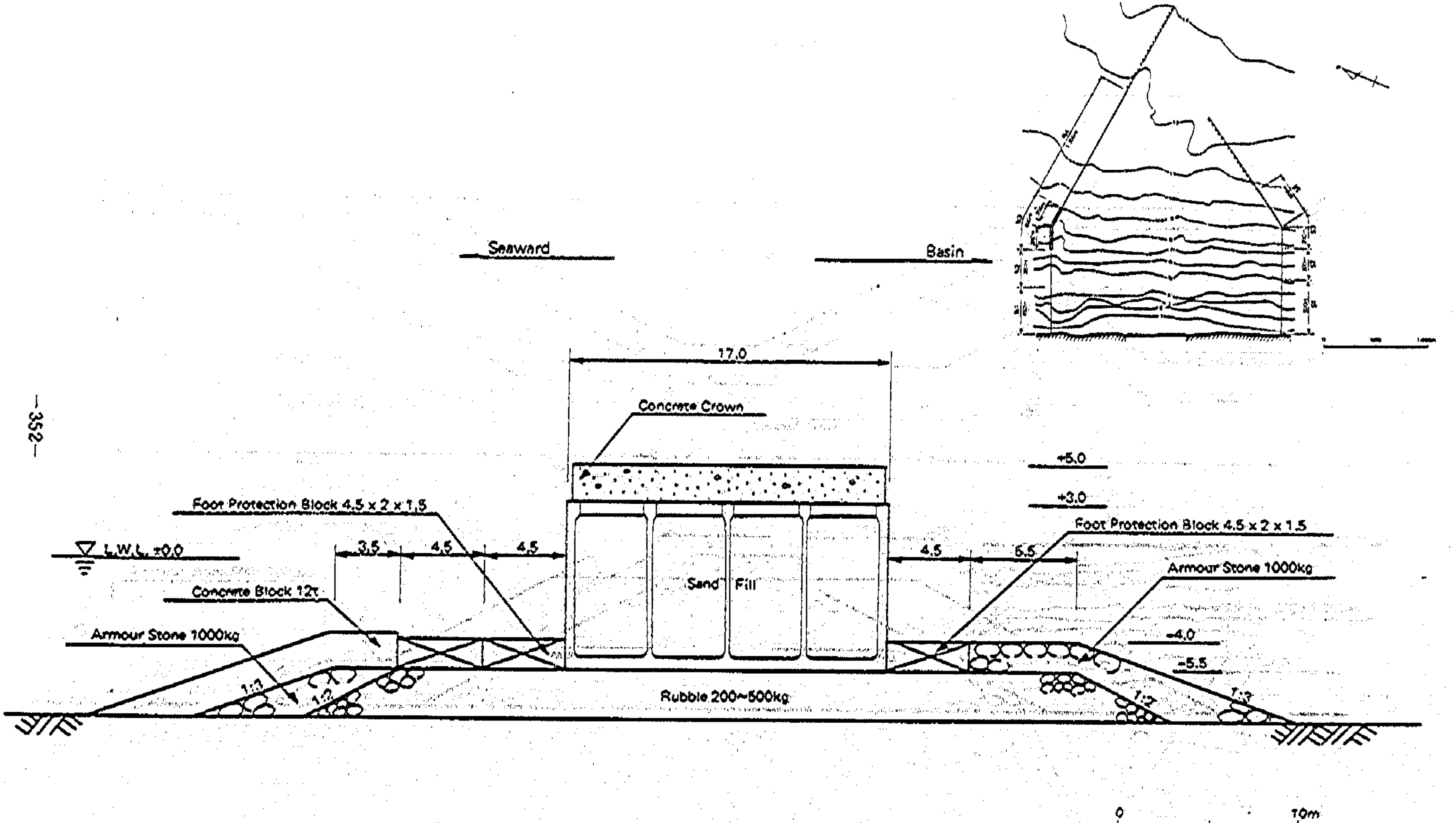


Fig. IX-1-(4) Standard Crosssection of Breakwater (N3 Section)

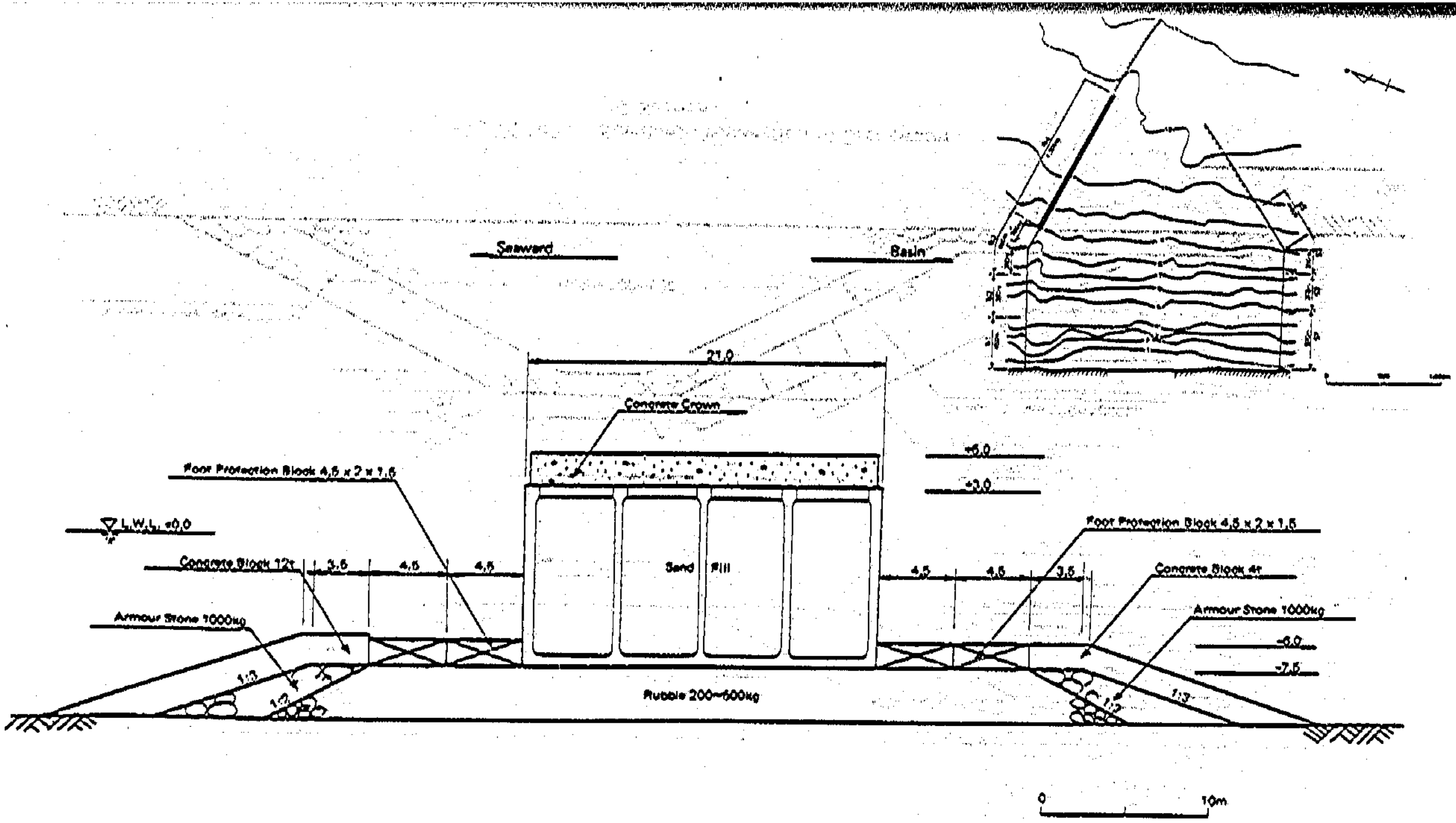


Fig. IX-1-(5) Standard Crosssection of Breakwater
(N4 Section)

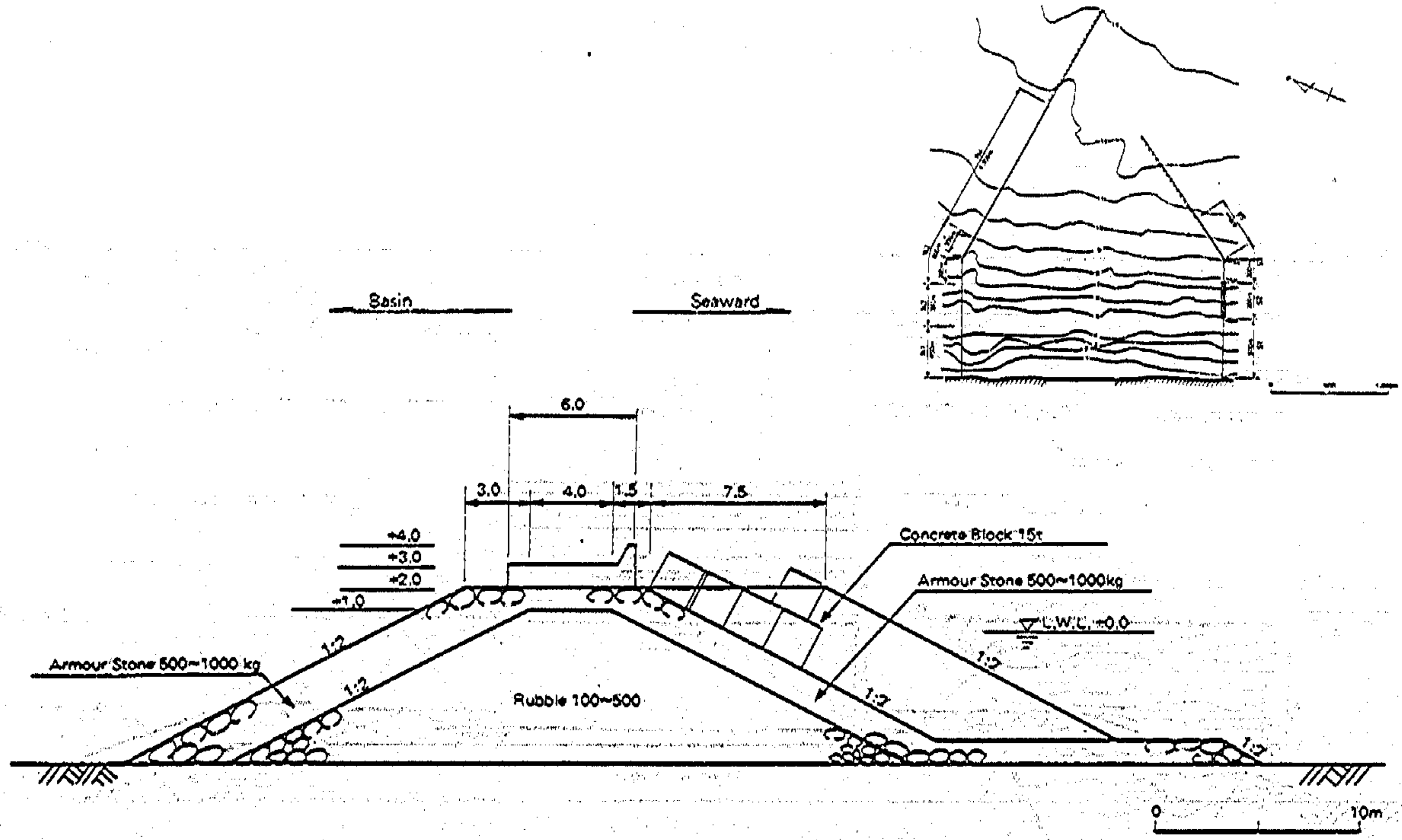


Fig. IX-1-(7) Standard Crosssection of Breakwater (S2 Section)

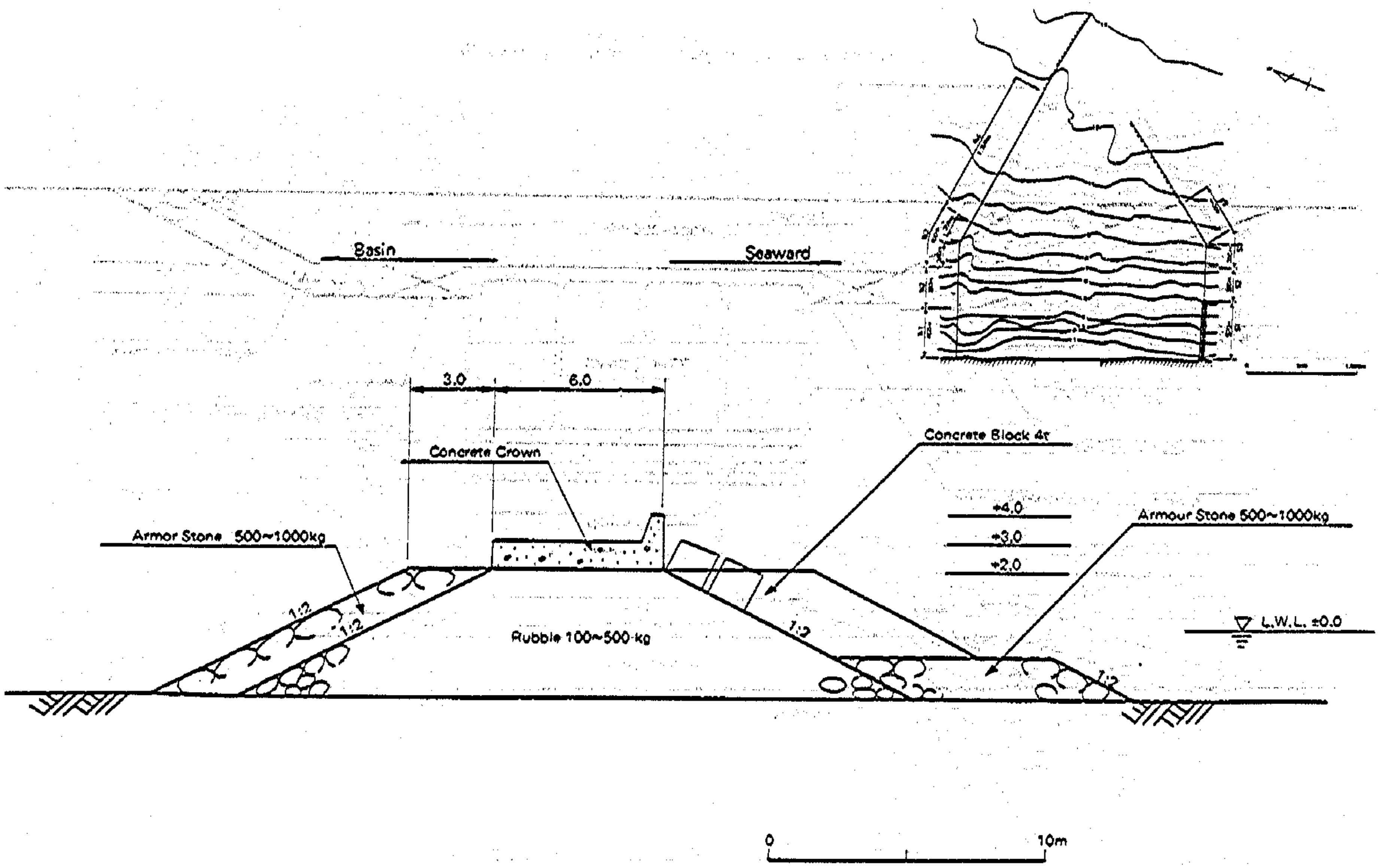


Fig. IX-1-(6) Standard Crosssection of Breakwater (S1 Section)

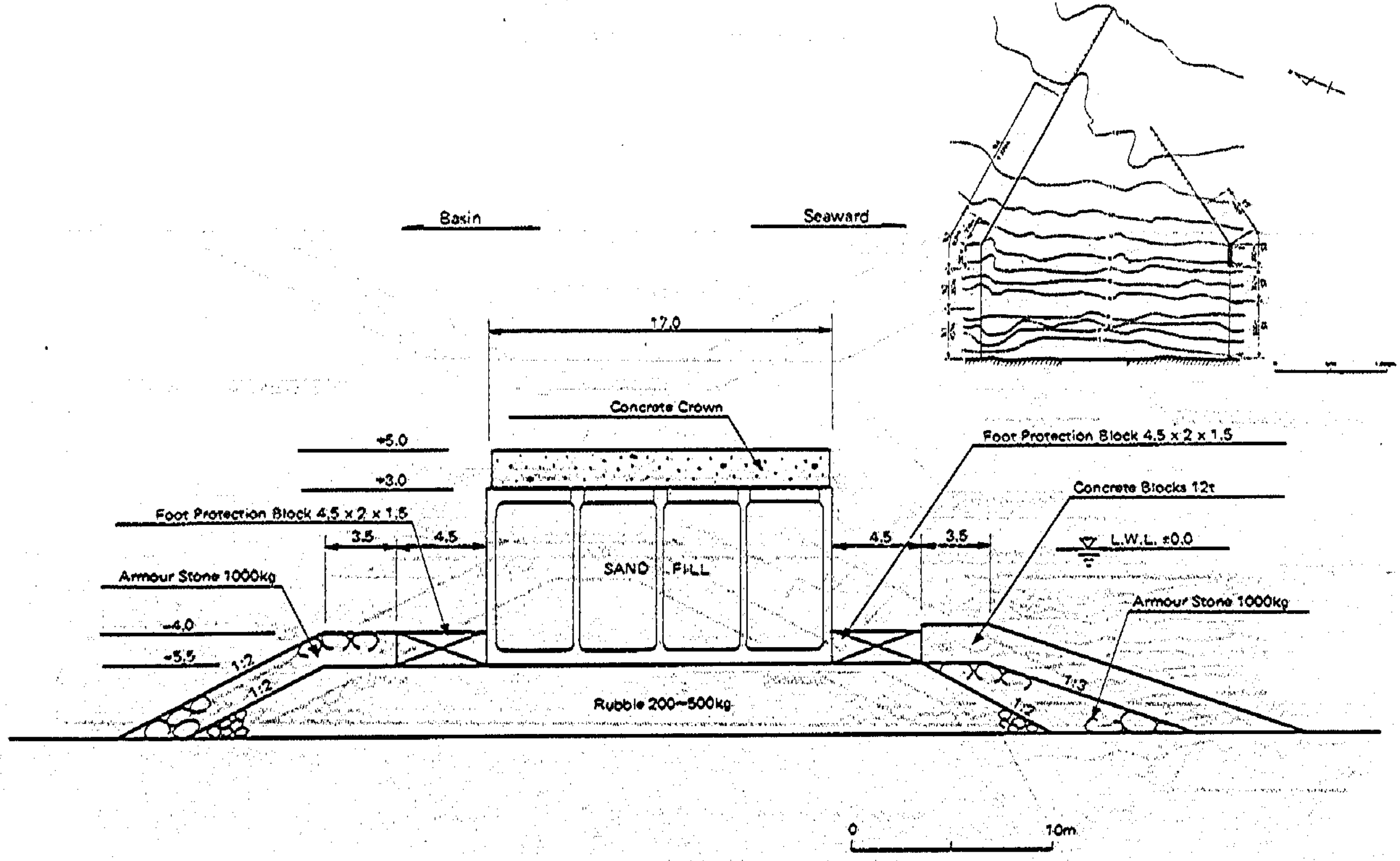


Fig. IX-1-(8) Standard Crosssection of Breakwater (S3 Section)

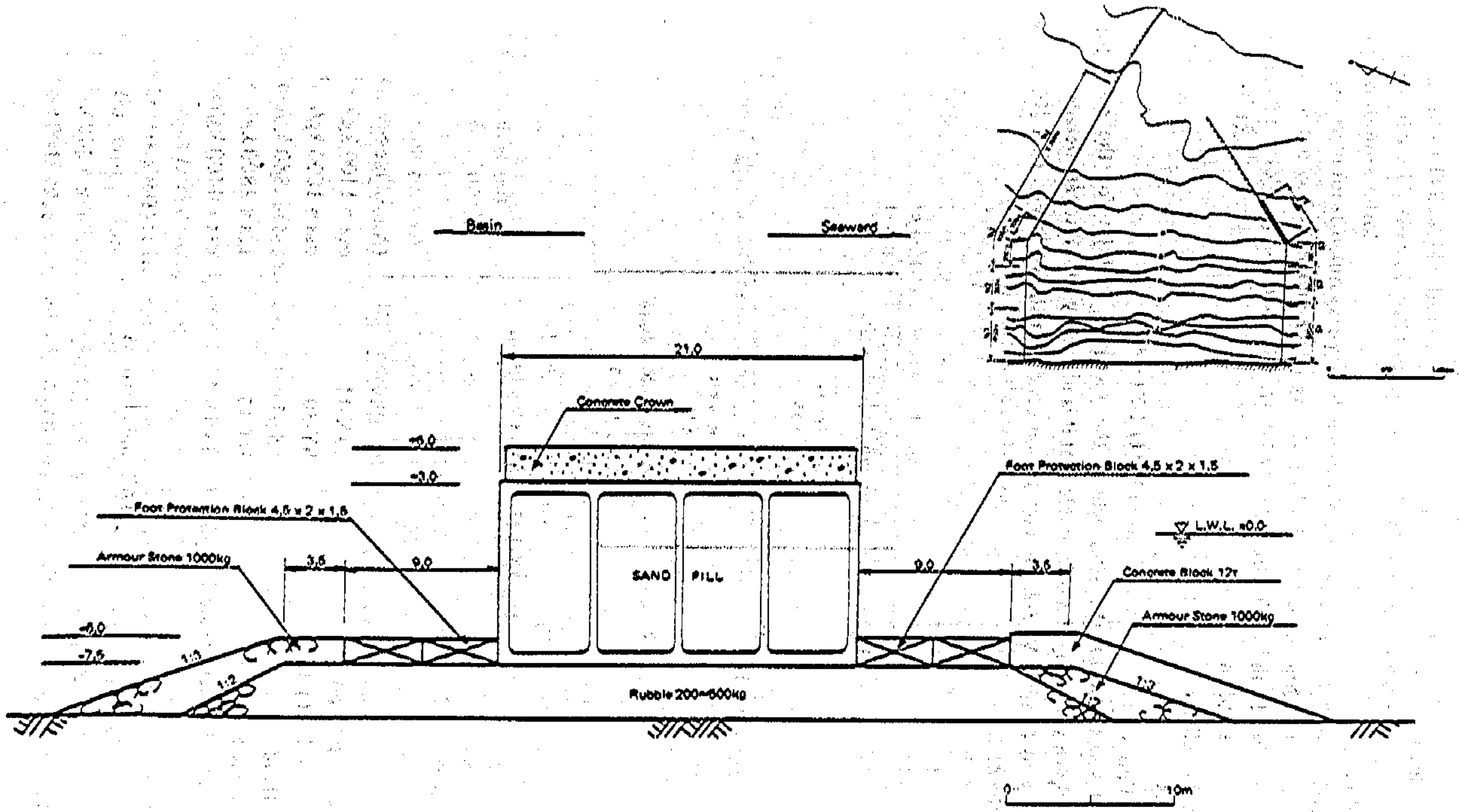


Fig. IX-1-(9) Standard Crosssection of Breakwater (S4 Section)

1-2 Mooring Facilities

(1) Design conditions

(a) Tidal level

H.H.W.L.	+1.12 m
H.W.L.	+0.50 m
L.W.L.	±0.00 m

(b) Earthquake activity

Kh = 0.05

(c) Soil conditions

The soil condition of the sites where the mooring facilities for the short term development plan are arranged is so unstable that it is necessary to investigate details.

According to Chapter V. 3-2, the average soil condition shown in Fig. IX-1-(10) can be applied to the design.

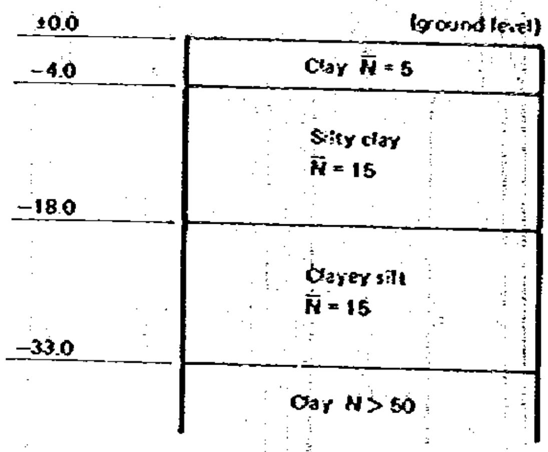


Fig. IX-1-(10) Soil Condition

(d) Allowable stress

	(Quality)	(Allowable Stress)
Steel pipe pile	STK-41	σsa = 1400 kg/cm²
Steel sheet pile	SY-30	σsa = 1800 kg/cm²
Tie rod	SS 41	σsa = 880 kg/cm²
Tie rod	HT 45	σsa = 1800 kg/cm²
General structural steel	SS 41	σsa = 1400 kg/cm²

	(Allowabel stress)	(Design standard strength)
Cast-in-place concrete	σca = 80 kg/cm²	σck = 240 kg/cm²
Mass concrete	σca = 60 kg/cm²	σck = 180 kg/cm²

(e) Increase of allowable stresses

The allowable stresses shall be increased by 50% for short term loads.

(f) Corrosion control

Steel used for structures are provided corrosion allowance for 50 years.

Since the corrosion rate varies greatly with changes in the environment, a proper rate cannot be absolutely selected. The typical values of corrosion rate used for design are shown in Table IX-1-(1).

Table IX-1-(1) Corrosion rate

Corrosion environment		Corrosion rate (mm/year)
Sea side	Above H.W.L	0.3
	Between H.W.L and the sea bottom	0.1
	Below the sea bottom	0.03
Land side	In marine atmosphere	0.1
	In soil (above the residual water level)	0.03
	In soil (below the residual water level)	0.02

(g) Others

Other design conditions of mooring facilities are shown in Table-IX-1-(2).

Table IX-1-(2) Design Conditions

	General cargo berth	Bulk berth (I)	Bulk berth (II)	Small crafts berth (I)	Small crafts berth (II)
Crown height (m)	+3.0	+3.0	+3.0	+2.5	+2.5
Surcharge (t/m²)	3.0	2.0	2.0	1.0	0.5
Depth (m)	−12.0	−12.0	−10.0	−4.5	−2.0
Size of vessels (D.W.T.)	30,000	30,000	15,000		
Cargo handling facilities	Mobile crane	Unloader			

(2) Structural design of mooring facilities

(a) Crosssection design

The comparative analysis on the structural types of general cargo berth, a typical facility for the short term development plan, is carried out.

As the representative structural types of berth, three types (open type, steel sheet pile type, gravity tipe) are designed respectively. The standard cross sections of these three structural types are shown in Fig. IX-1-(11), Fig. IX-1-(12), Fig. IX-1-(13) respectively.

Sheet pile type with relieving platform and cellular cofferdam type are also generally conceivable types. But, as for the sheet pile type with relieving platform, the structure is disadvantageous because of its structural complicatedness and high construction cost, unless the soil condition of the site is extremely soft.

As for the cellular cofferdam type, the soil condition of the site exerts an influence upon applicability of the structure, and serious execution controls are needed. These two structural types are therefore excluded as objects of comparative analysis.

The characteristics and conceptions of the three structural types are described as follows.

(i) Gravity (concrete caisson) type

1) The wall made of concrete is comparatively strong and durable.
2) Large-scale fabricating facilities, including concrete caisson yard and concrete block yard are required, and a fleet of floating cranes, tugboats, etc. is also required.
3) As the design water depth is deep compaired to the present level, a large amount of soil will have to be excavated.
4) A large amount of work is required, and the construction period is comparatively long.
5) The construction of this type of structure will be less advantageous in economy and more difficult in execution than other types of structures, except where the bearing capacity of the foundation can be secured.
6) The structure is weak against settlement of the foundation ground.
7) The berthing impacts by ships are absorbed by the weight of the concrete caisson and the earth pressure.
8) Rubble of quality is used for backfilling the concrete caisson to reduce the earth pressure.

(ii) Steel sheet pile type

1) The wall being very light and elastic, uneven settlement is allowable to a certain extent.
2) Comparatively simple facilities will suffice to execute the construction.
3) Since no underwater works are required, rapid construction is possible.
4) In sites where the design water depth is very great, the continuous steel pipe pile is used in place of the steel sheet pile because the section modulus of the steel sheet pile may be insufficient.
5) The berthing impacts by ships are absorbed by the earth pressure.
6) Rubble of quality is used for backfilling the steel sheet pile to reduce the earth pressure.
7) The horizontal external forces act on the coupled anchorage piles.
8) Concrete lining is applied on the steel pipe pile above L.W.L (±0.0 m)

(iii) Open type

1) The superstructure is a cast-in-place reinforced concrete structure.
2) All the foundation piles are regarded as bearing piles.
3) The structure can be constructed even on a place where the foundation is so soft that the construction of other types of berth might be difficult.
4) The structure is comparatively weak against horizontal external forces.

5) The berthing impacts by ships are absorbed by rubber fenders, and the reaction force is transmitted through the superstructure and foundation piles into the earth.

6) The piled pier and the revetment are structurally independent.

7) Concrete lining is applied on the steel pipe pile above L.W.L (±0.0 m).

(b) Comparison of the structural types

The result of comparative analysis of these structural types is summarized in Table IX-1-(3).

Table IX-1-(3) Comparison Table (types of structure)

Item \ Type	Gravity (caisson) type	Steel Sheet pile type	Open type
Simplity of offshore works	△	◎	○
Simplity of execution control	○	○	◎
Amount of works	△	◎	○
Construction speed	△	◎	◎
Adaptability to soil conditions	△	○	◎
Adaptability to settlement	△	○	◎
Durability (corrosion)	◎	△	△
Readiness of local procurement of materials	○	△	△
Construction cost ratio (Open type = 1.0)	1.3	1.2	1.0

Note: ◎ is better than ○ ○ is better than △

As a result, the open type structure, which excels in construction speed, adaptability and construction cost, is adopted.

When the concrete pile structure is adopted as the type of foundation structure for the open type berth, it is conceivable that the concrete pile structure is better than the steel pipe pile structure in readiness of local procurement and for another reasons. So, brief investigations are carried out.

The characteristics of the concrete pile structure used as the foundation structure for the open type are described as follows.

1) A large number of piles are required because the section modulus of the concrete pile is small.

2) Coupled battered piles are required against horizontal forces.

3) There may be a wide variation in the depth of the bearing stratum and, so, it is reasonably expected that the foundation piles will have to be driven to varied depths. From this point of view, a study as to whether the proposed execution method can cope effectively with this seems essential.

4) There is every possibility of the existence of a hard layer in the intermediate strata. It must be carefully studied whether or not the pile driving through the hard stratum will be permissible.

5) Prior studies should be made on corrosion of steel reinforcement for prestressed concrete resulting from cracking in the concrete.

The results of the studies and compraisons are shown in Table IX-1-(4).

Table IX-1-(4) Comparison Table (Foundation structures)

Item \ Type	Steel pipe pile type	Concrete pile type
Simplity of offshore works	◎	○
Simplity of execution control	○	△
Amount of works	◎	○
Construction speed	◎	○
Adaptability to soil conditions	○	△
Durability	△	○
Readiness of local procurement of materials	△	○
Construction cost ratio (steel pipe pile type = 1.0)	1.0	1.1

Note: ◎ excels ○ ○ excels △

In the overall result, the open type with steel pipe pile is considered adequate as the representative structural type of the general cargo berth for the short term development plan. (See Fig. IX-1-(11))

Standard crosssections of the other berths are shown in Figs. IX-1-(14) through IX–1-(17) respectively.

(3) Other facilities

Figures of the typical berth facilities (warehouse, crain, lift, unloader, etc.) are shown in Figs IX-1-(18) through IX-1-(24).

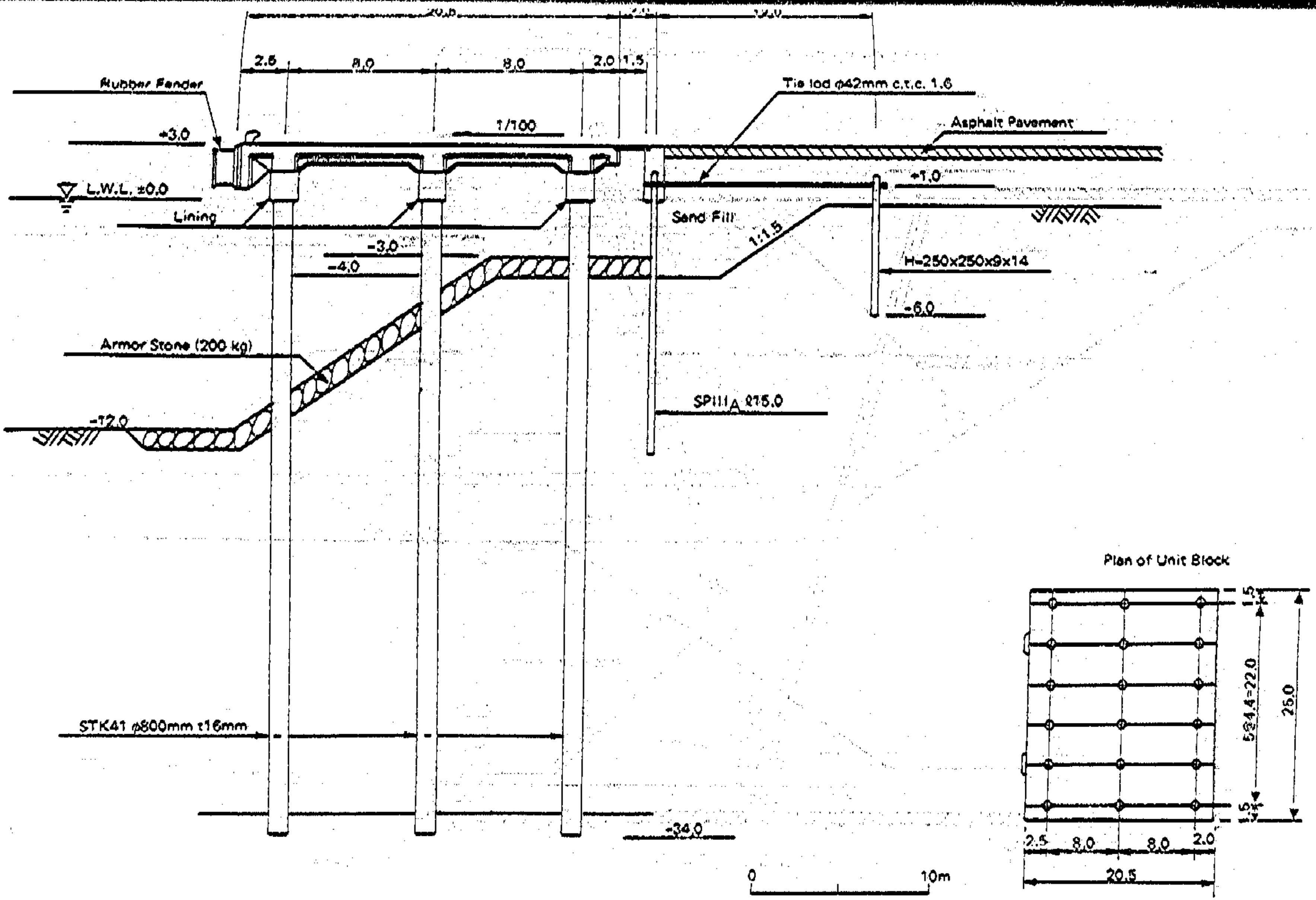


Fig. IX-1-(11) Standard Crosssection of General Cargo Berth
(Open Type with Vertical Piles)

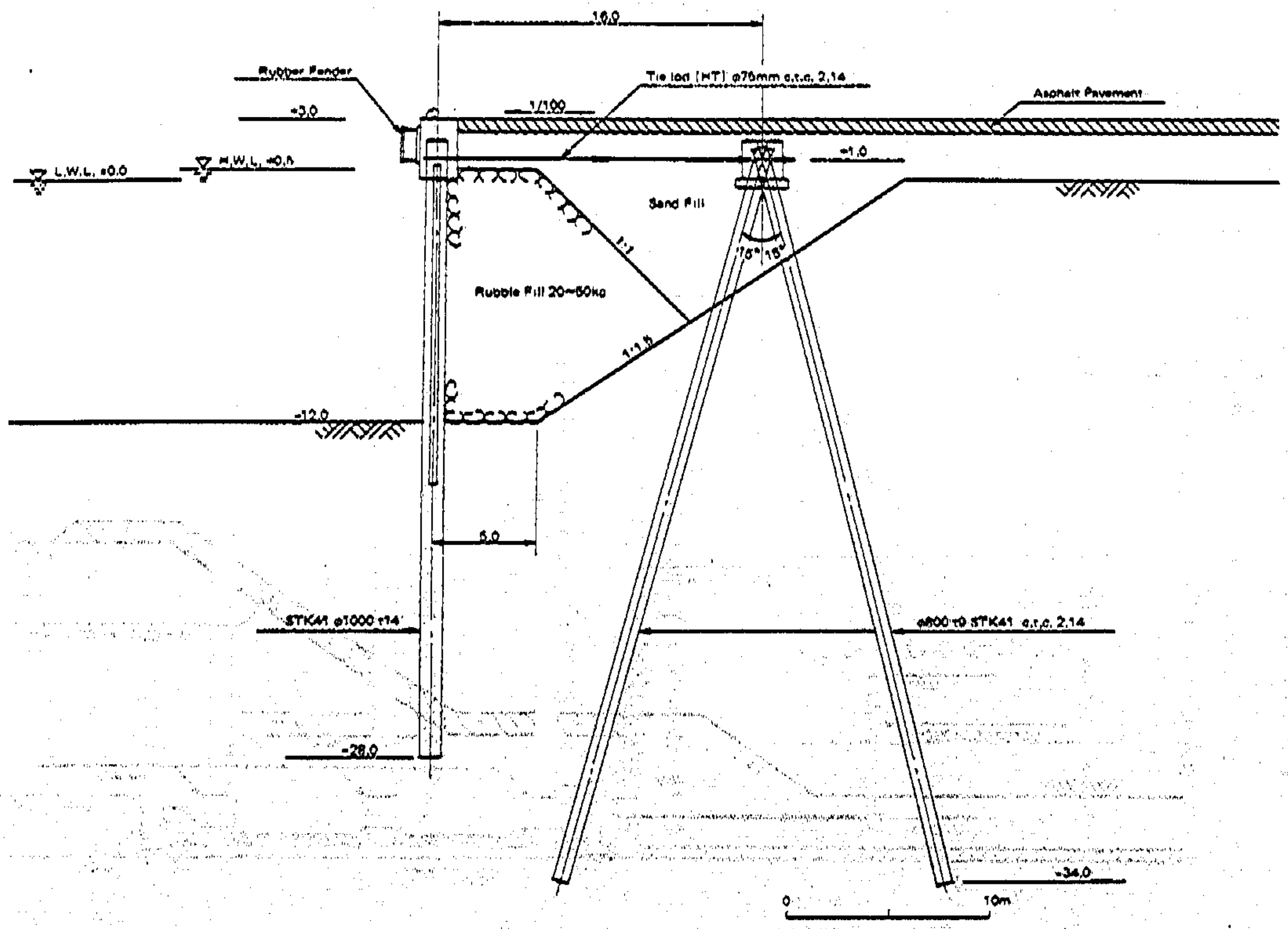


Fig. IX-1-(12) Standard Crosssection of General Cargo Berth
(Sheet Pile Type)

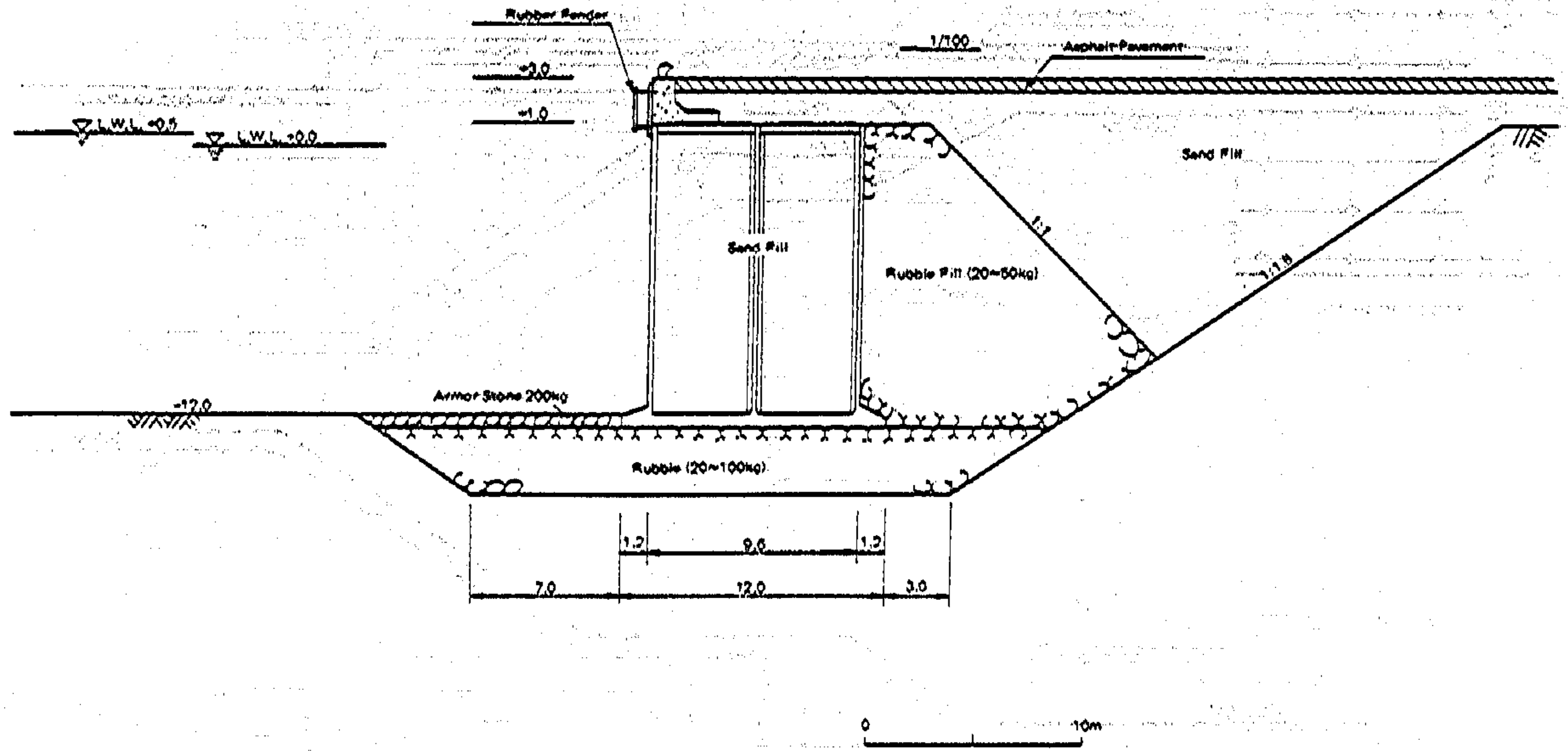


Fig. IX-1-(13) Standard Crosssection of General Cargo Berth (Gravity Type)

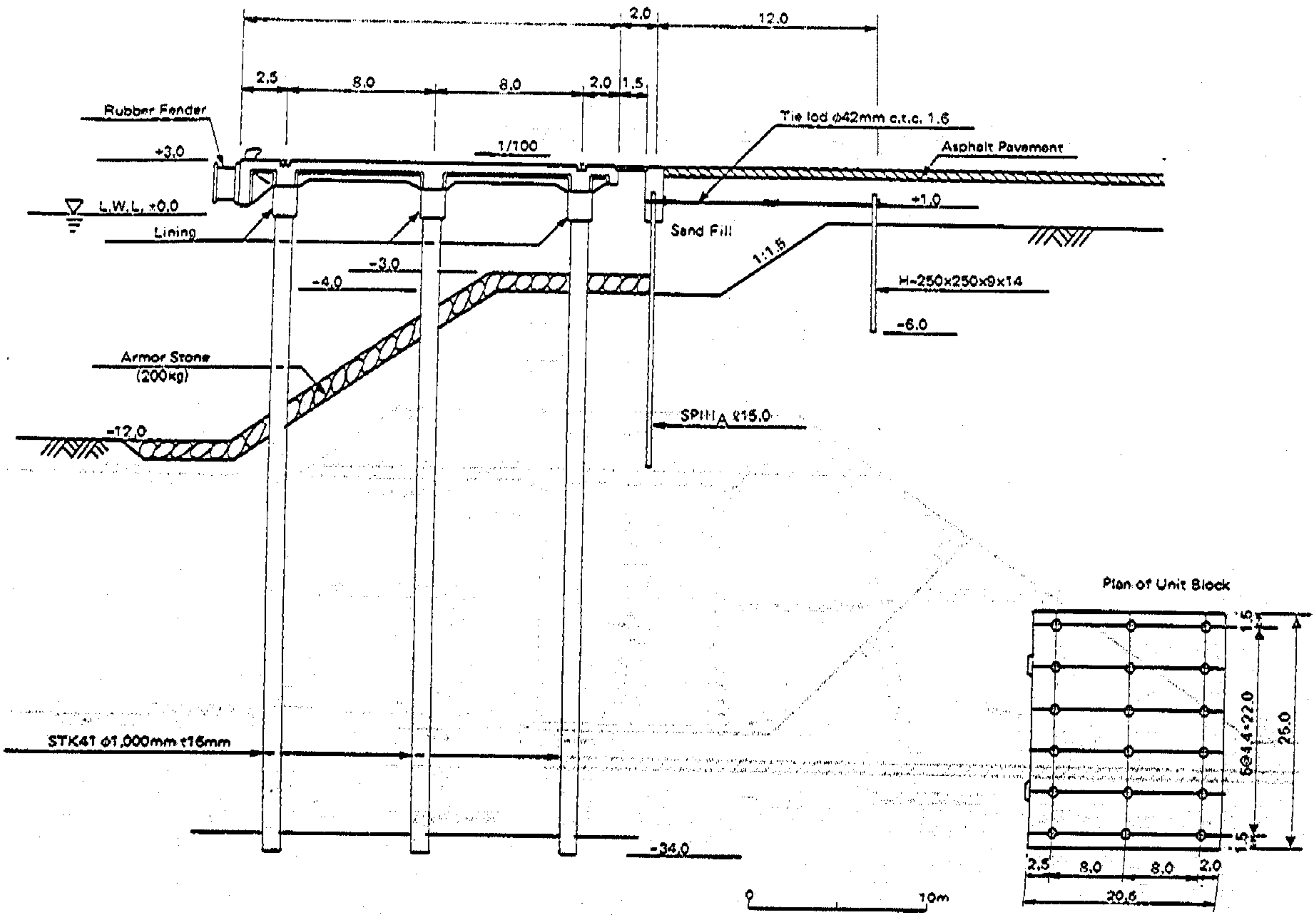


Fig. IX-1-(14) Standard Crossection of Bulk Berth (I)

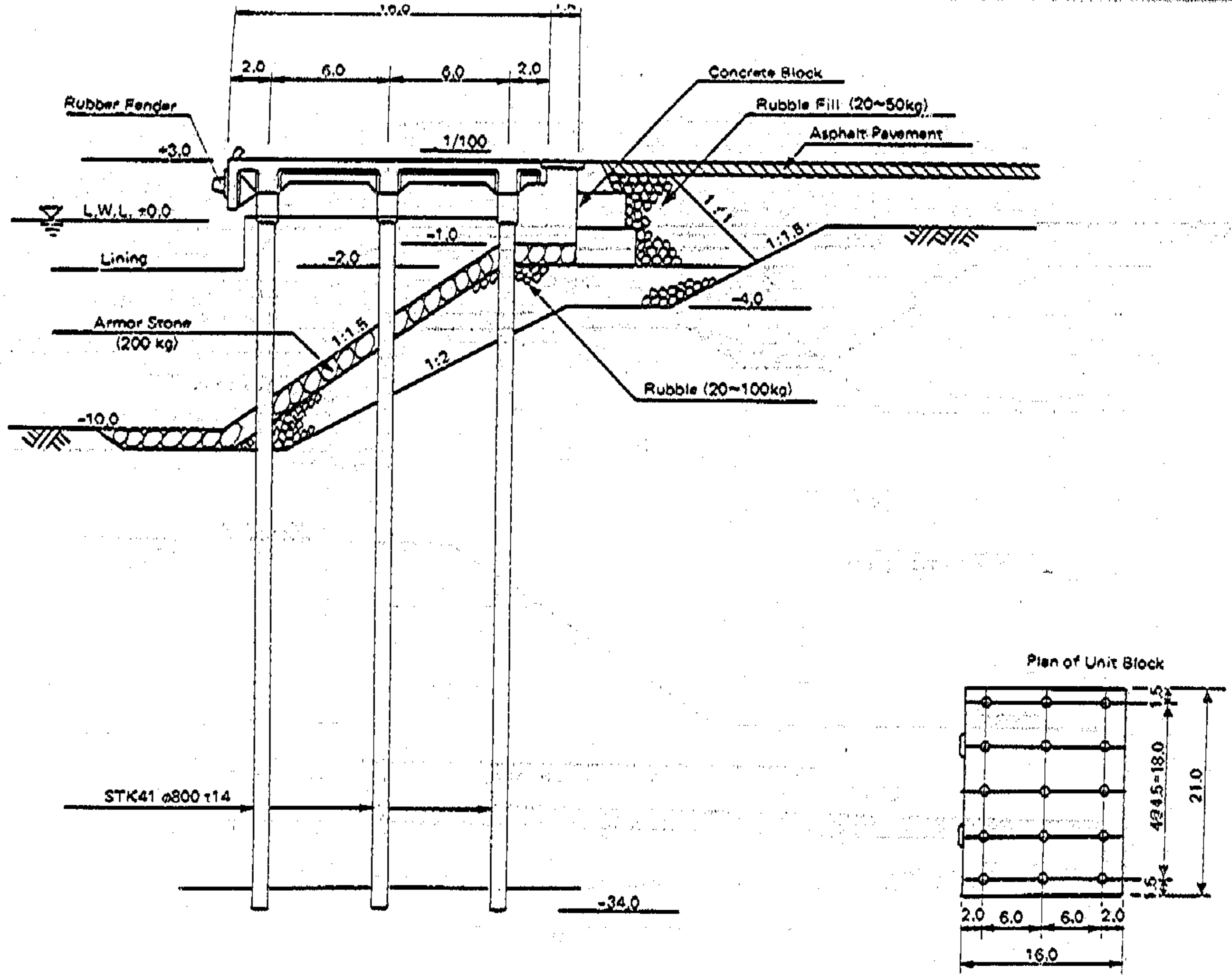


Fig. IX-1-(15) Standard Crosssection of Bulk Berth (II)

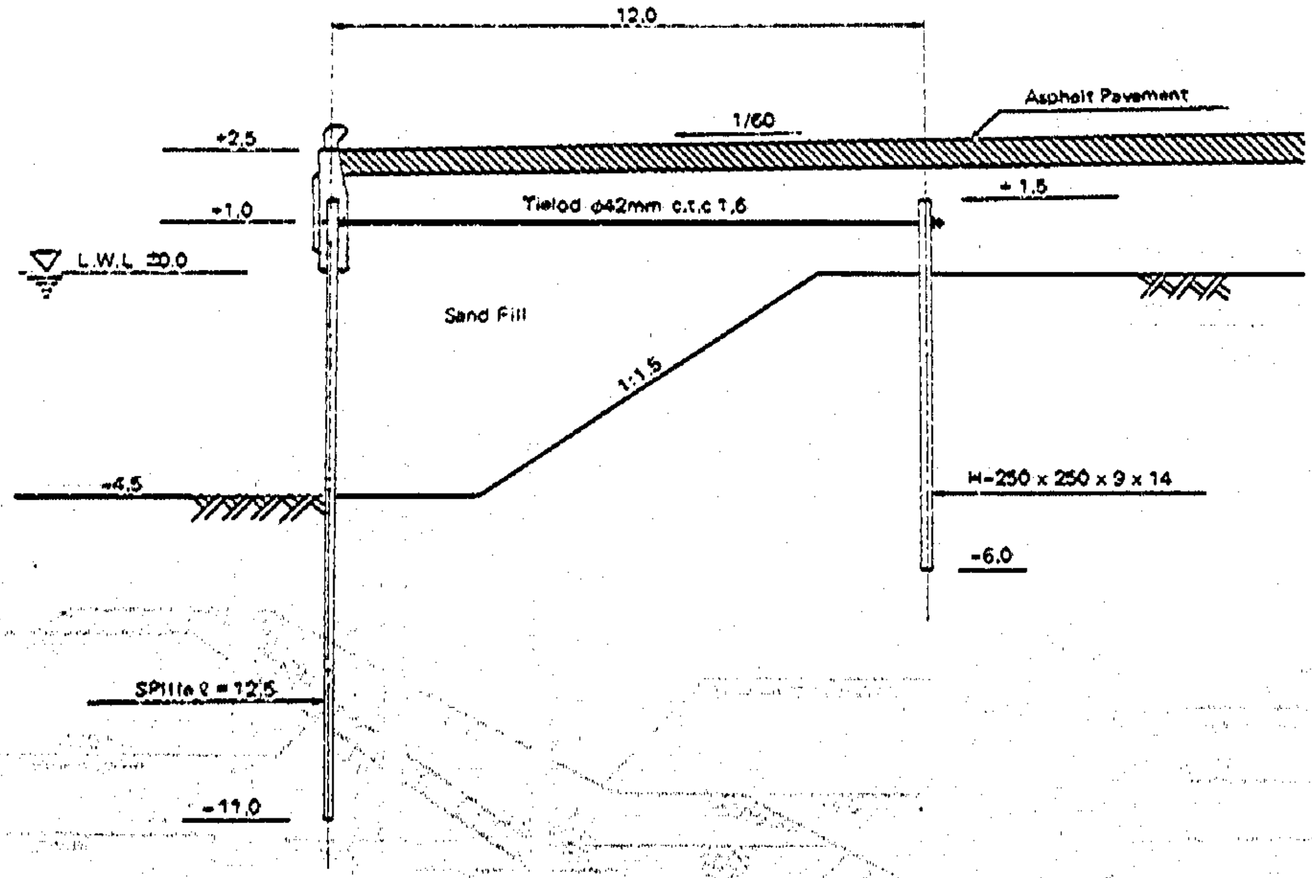


Fig. IX-1-(16) Standard Crosssection of Small Crafts Berth (I)

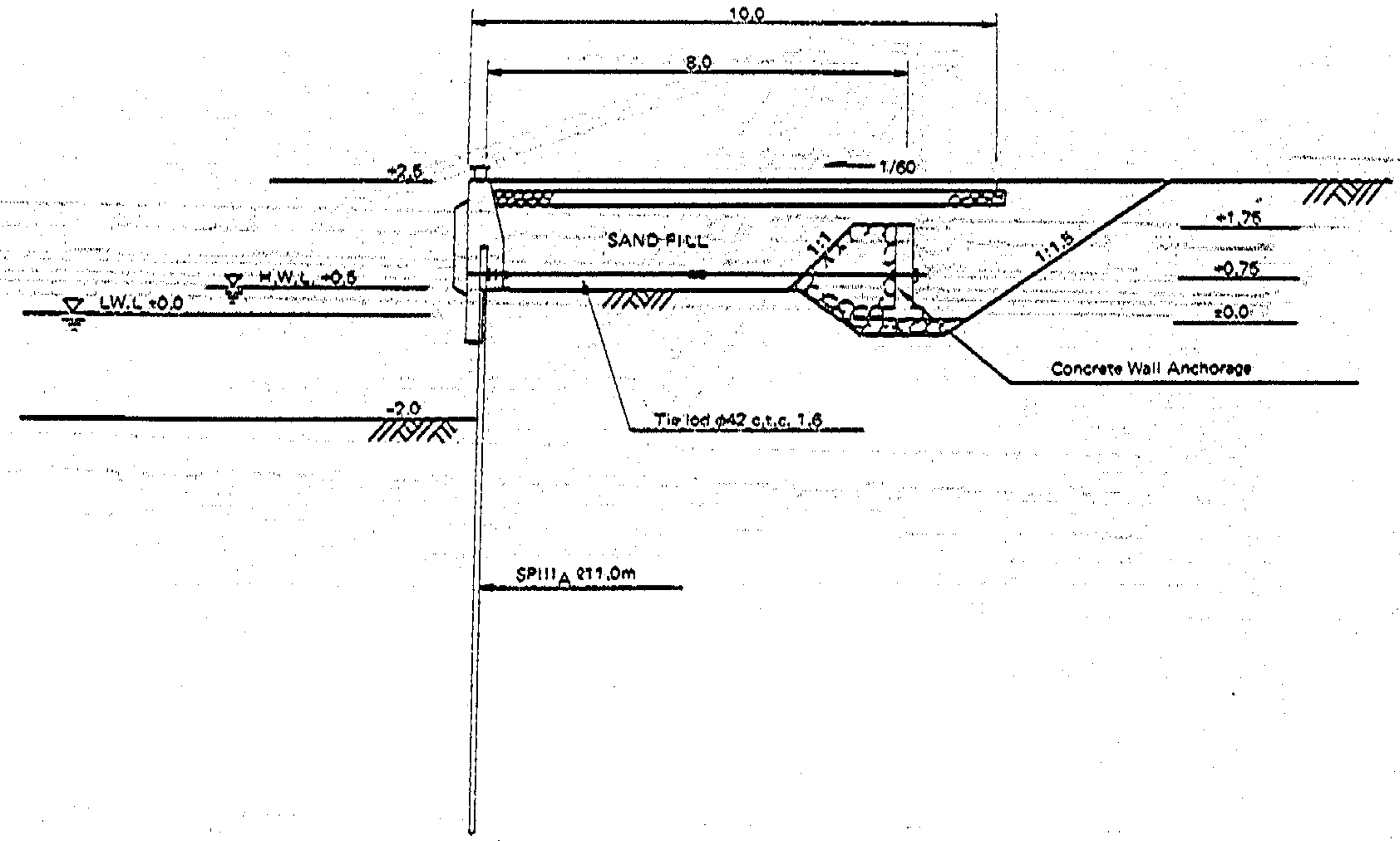


Fig. IX-1-(17) Standard Crosssection of Small Crafts Berth (II)

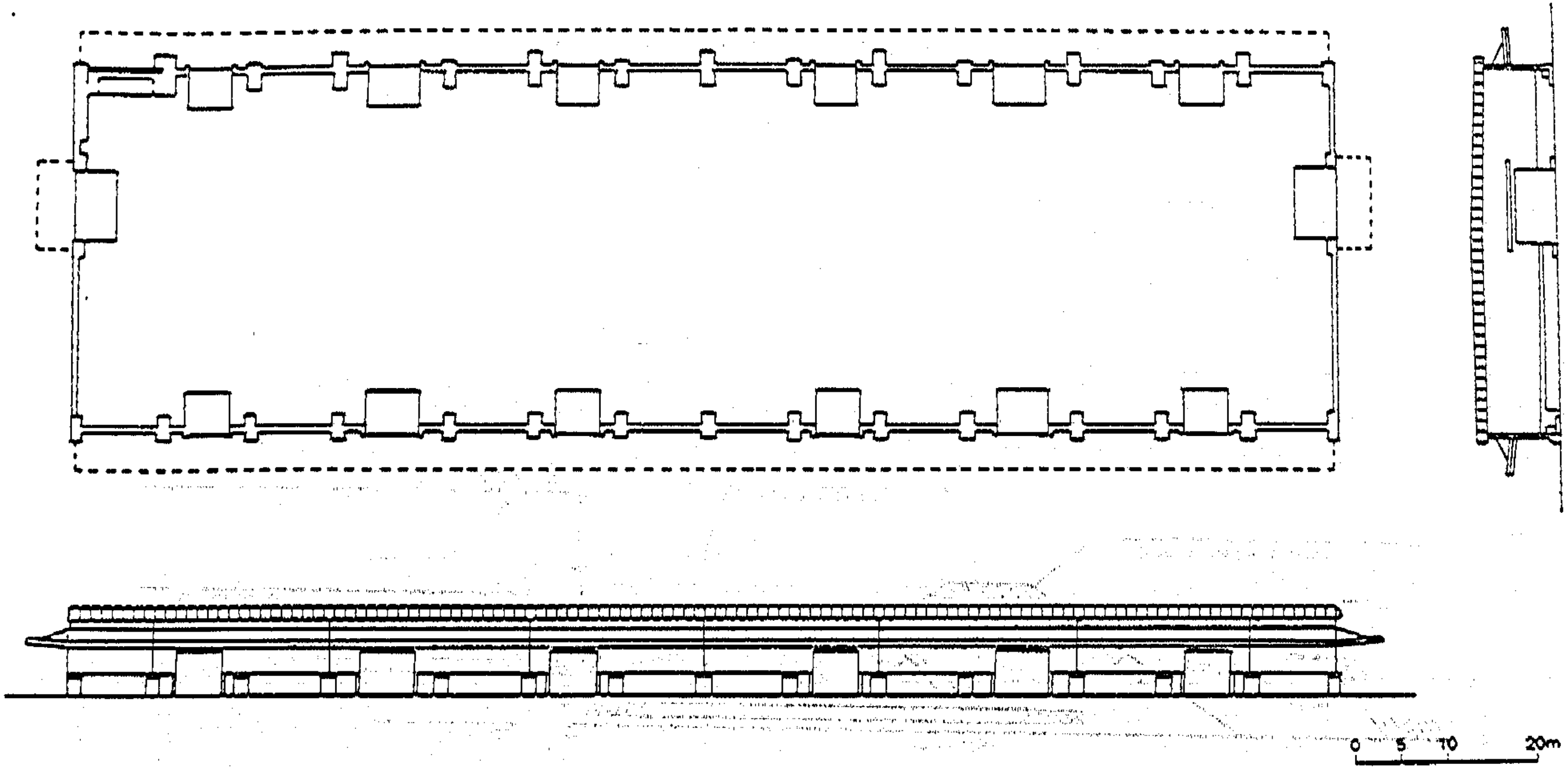


Fig. IX-1-(18) Transit Shed

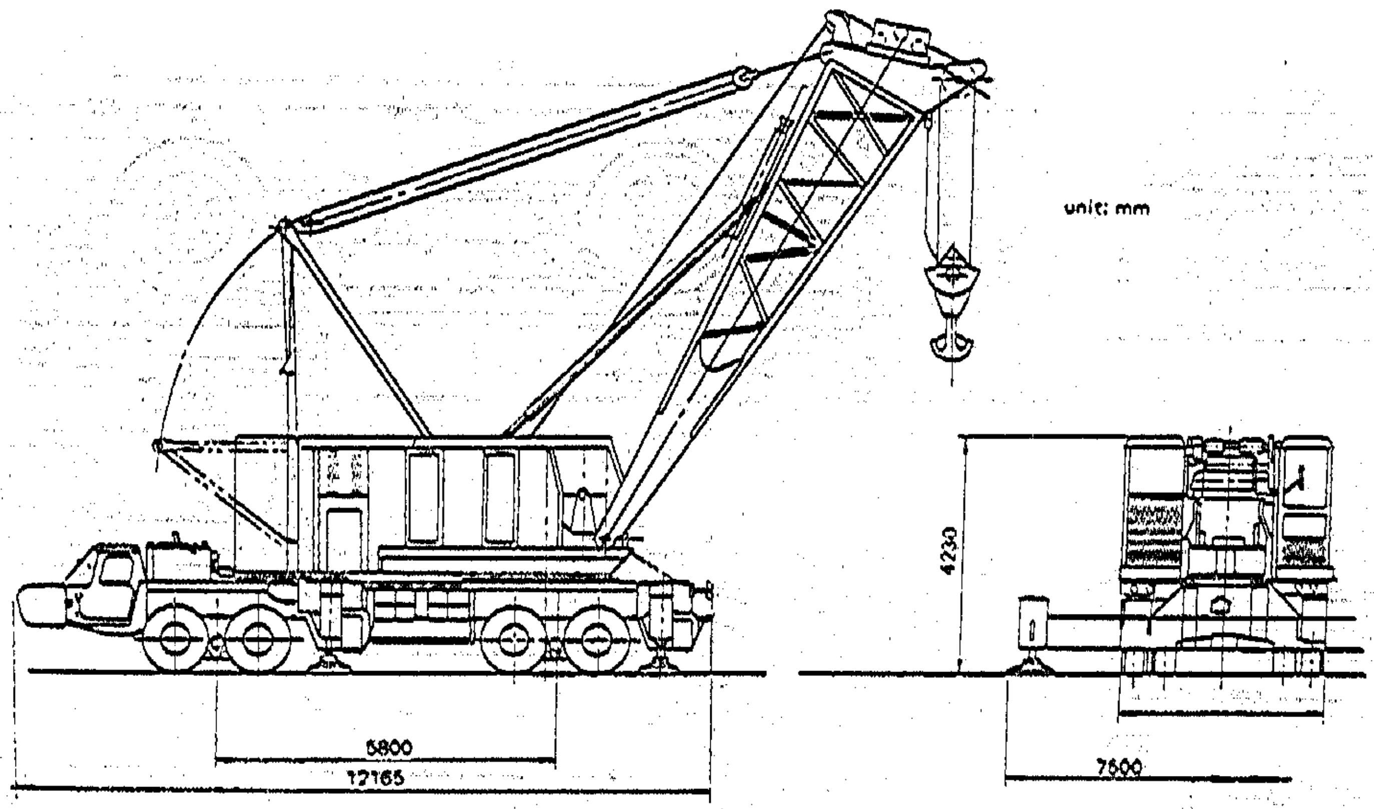


Fig. IX-1-(19) Mobile Crain

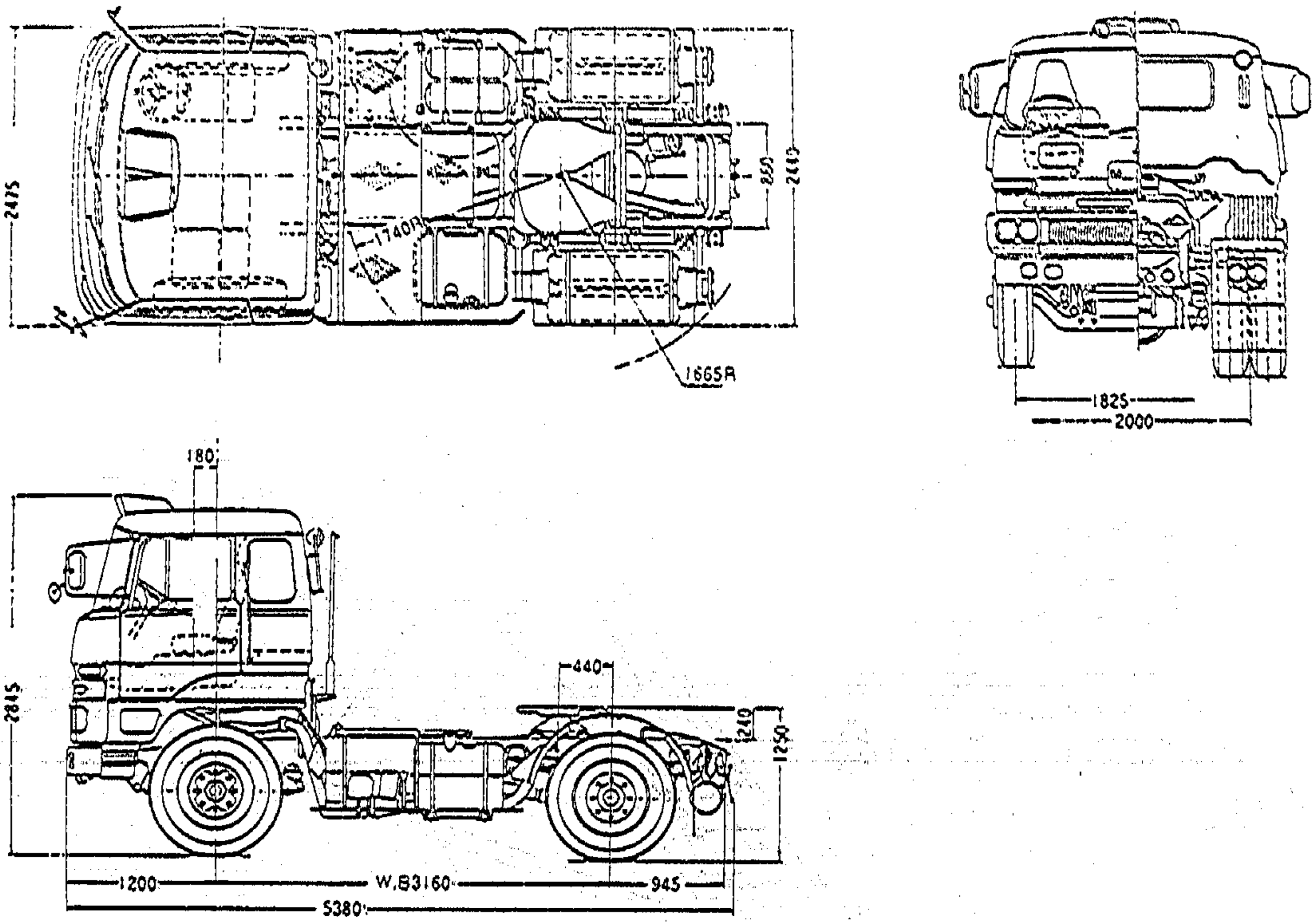


Fig. IX-1-(20) Tractorhead

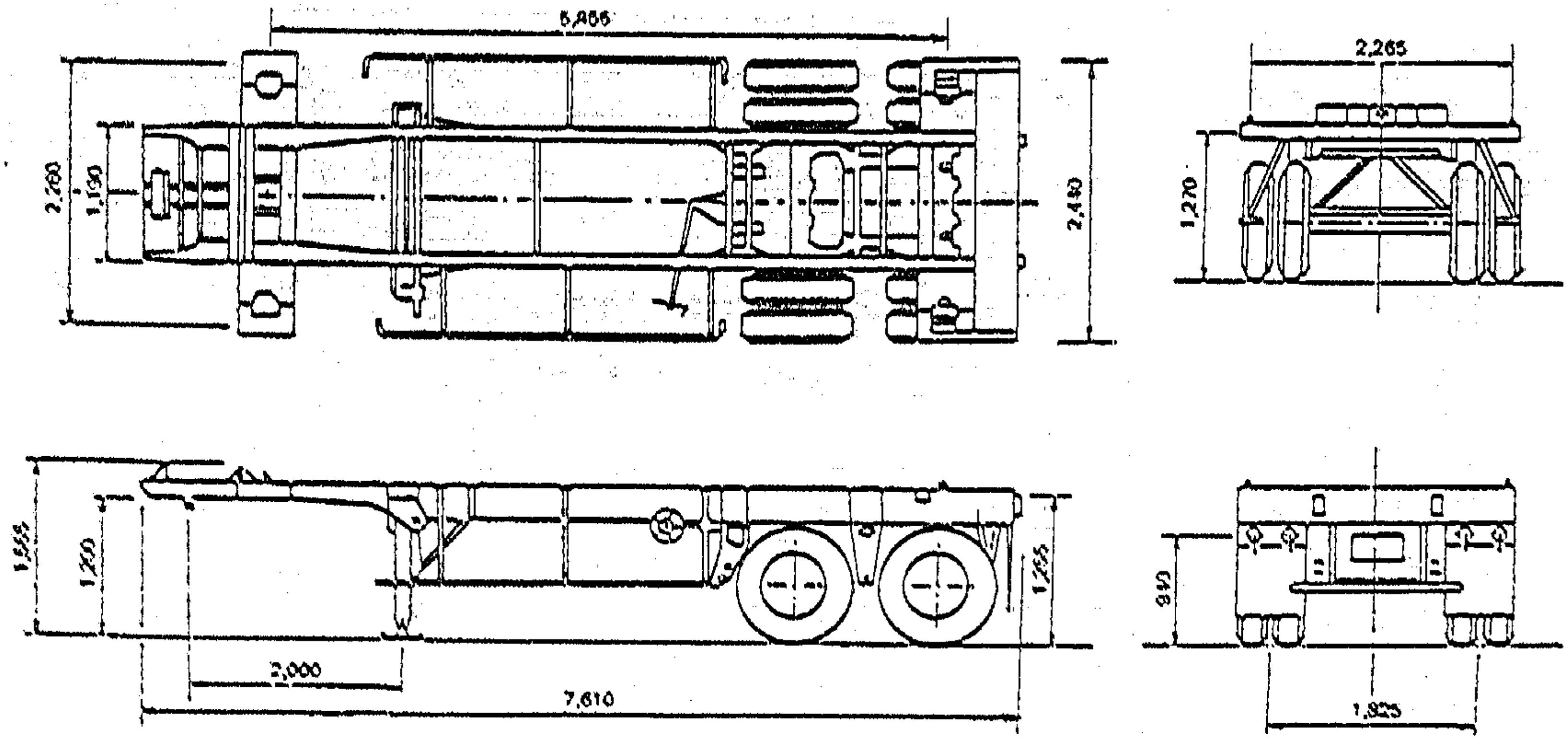


Fig. IX-1-(21) Chassy

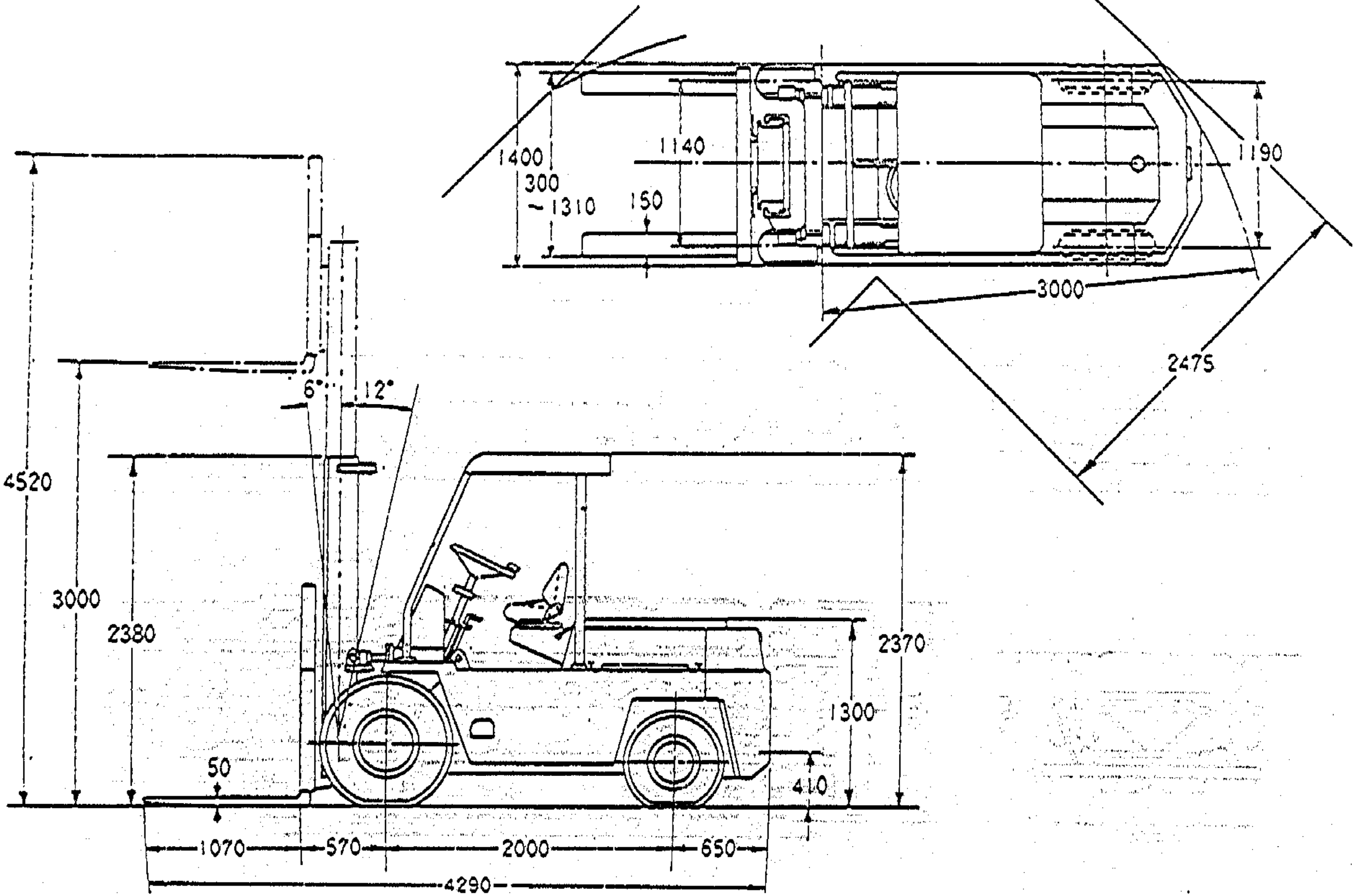


Fig. IX-1-(22) Forklift truck, 3t

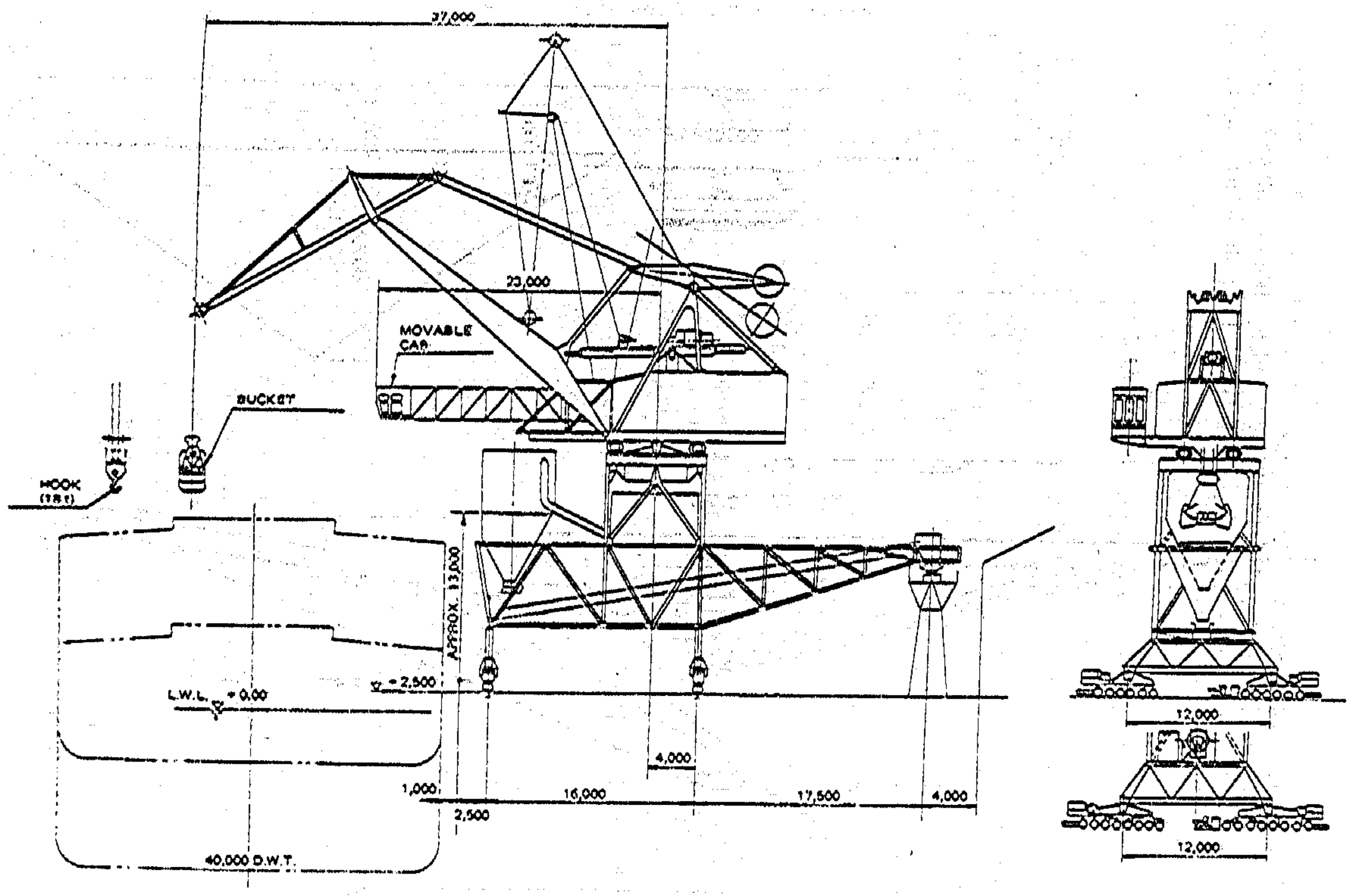


Fig. IX-1-(23) 600 t/h Unloader

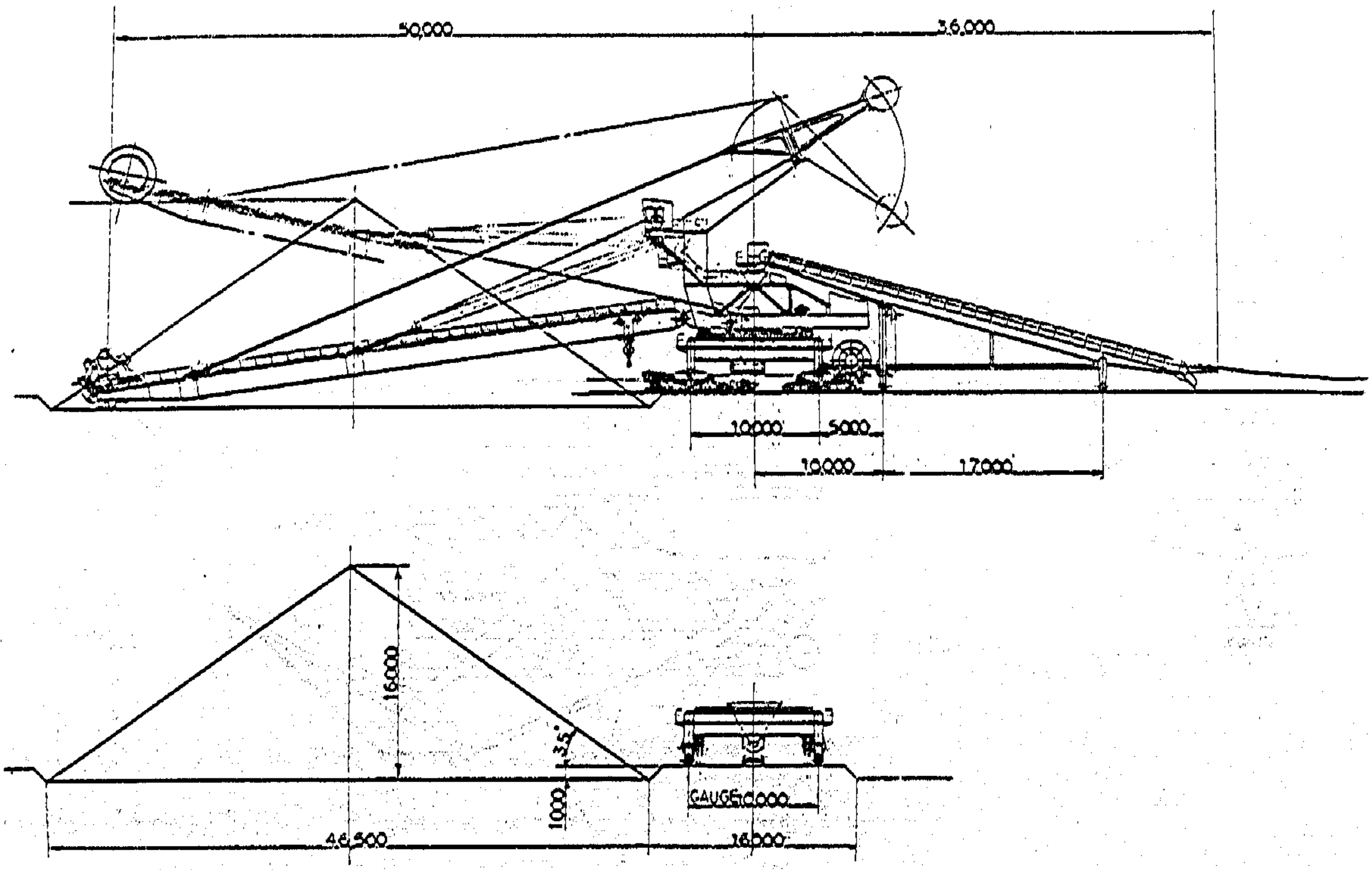


Fig. IX-1-(24) 500t/h Stacker/Reclaimer

2. Construction and Cost Estimation

In this section, a construction plan, a construction schedule and a cost estimate will be examined based on the port plan mentioned in VIII, 2 and the port facility design in IX, 1.

List of facilities under the short term plan is shown in Table IX-2-(1).

Table IX-2-(1) List of Facilities

Facilities	Classification		Quantities
Breakwater	Rubble Mound Breakwater		2,600 m
	Caisson Type Breakwater		2,300 m
Wharf	Commercial Port District	−12 m Piled Wharf	450 m
	〃	−10 m 〃	200 m
	〃	−4.5 m Sheet Pile Quaywall	650 m
	Fishery Port District	−4.5 m 〃	455 m
	〃	−2.0 m 〃	320 m
	Industrial Port District	−22 m ~ −7.5 m Wharf	3,550 m
Access Channel and Basin	Channel	(−10 m ~ −16 m)	469 ha
	Basin	(−2 m ~ −16 m)	100 ha
Land Reclamation	Commercial Port District		47 ha
	Fishery Port District		5 ha
	Industrial Port District		1,609 ha
Road, Railway			42,000 m
Port Related Facilities	Commercial Facilities		1 set
	Fishery Facilities		1 set

2-1 Construction Plan

(1) Principal facilities and main works

Principal facilities for which a construction plan is prepared, and main works to be executed are shown below.

(a) Breakwater .... rubble mound (riprap) work, armor stone work, concrete work (caisson, concrete block, parapet)

(b) Wharf .... excavation and removal, driving of steel pipe piles, driving of steel sheet piles, armour stone work, backfilling work, concrete work (beems and slabs), asphalt penetration paving work

(c) Access channel and basin ...... dredging work

(d) Land reclamation .... filling work

(e) Road, Railway .... base and subbase work, asphalt penetration paving work

As listed above, the main tasks related to the port facilities construction can be classified into mound (riprap) work, filling work, armor stone work, dredging work, pile and sheet pile driving work, concrete work, and paving work.

(2) Quantities of tasks

The quantities of main tasks by facility are shown in Table IX-2-(2).

(3) Outline of construction methods

The outline of construction methods for main facilities is as follows:

(a) Preparation and temporary work

The following preparation and temporary work is required for the execution of this project.

1) Preparation

Ordering construction materials and equipment, and delivering them to the site.

2) Temporary work

- o Field office and accommodations
- o Material warehouse
- o Workshops for reinforcing bars and concrete forms
- o Machine repair shop
- o Construction roads
- o Water supply, drainage, and electric power supply

(b) Breakwater work

It is necessary to perform the breakwater work at the earliest possible stage in order to create calm water area for the subsequent dredging and piling works.

1) Riprap work

Stone materials such as riprap and armor stone are available in quarries at El Aguila, La Concha where are about 40 – 50 km away from Tuxpan.

Quarried riprap stones are transported by dump trucks and moved into place by bulldozers.

As already mentioned above, this work must precede the dredging and piling work, so large-size dump trucks should be used in order execute it efficiently.

2) Armor stone work

Quarried armor stones are transported by dump trucks and installed on the rubble mound.

It is possible that riprap stones are scoured by waves as time goes on, so armour stone work must be executed immediately after the execution of riprap stone work.

3) Caisson concrete work

Caisson for breakwater must be fabricated in a caisson yard which is required near construction. It is toward by tugboat and installed in the proposed position.

There are two methods for filling the caissons with sand; one is to dump sand from land by dump trucks, and the other is to fill them from the sea side by using sand carrier with a grab bucket.

In this study, dumping from land by dump trucks is adopted from viewpoint of safety and certainly.

Table IX-2-(2) Quantities of Main Works

Facilities \ Works	Quantities	Riprap, land reclamation (m^3)	Armour stone (m^3)	Pile driving (number)	Sheet pile driving (number)	Concrete (m^3)	Backfilling (m^3)	Base and subbase (m^3)	Asphalt pavement (m^2)	Dredging (m^3)
Breakwater	4,900 m	769,300	291,100			412,200	415,300			
Commercial port district −12 m pile wharf	450 m		18,000	324	113	7,700	32,800		7,700	86,900
〃 −10 m pile wharf	200 m		8,000	144	50	3,400	14,600		3,400	38,600
〃 −4.5 m sheet pile quaywall	650 m				1,625	900	58,000		25,900	38,000
Fishery port district −4.5 m sheet pile quaywall	455 m				1,138	600	40,600		18,100	26,600
〃 −2.0 m 〃	320 m				800	600	1,300		3,000	11,900
Industrial port district −22 m ~ −7.5 m wharf	3,550 m		28,200	2,005	975	130,000	92,100		15,600	938,300
Access channel and basin	569 ha									68,708,000
Land reclamation	1,661 ha	61,937,000								
Road, Railway	42,000 m							1,050,000	1,260,000	

Note: (1) Backfilling of breakwater means filling sand into caisson.
(2) Dredging of the access channel and basin is included in a dredging of foreshore in the proposed site.

The work of putting the concrete covers in the caissons must be done immediately after filling them with sand.

4) Concrete block work

Concrete blocks such as foot protection blocks and armoring concrete blocks will be fablicated in a block yard.

These are transported by trucks and installed by crawler cranes. Concrete blocks are optionally to be installed from land, but if land installation is impossible because of the short arm length of crawler cranes, they are installed by crawler cranes fixed on a pontoon from sea side.

(c) Piled wharf

1) Steel pipe pile driving

The steel pipe piles are driven by diesel hammer placed on a pile-driving barge since land piling seems to be impossible because of the short arm length of pile driver.

Dumping of armor stones is done from sea side after pile driving.

2) Bulkhead

The retaining wall is made of steel sheet pile.

Steel sheet piles are driven by land pile-driver and after piles are driven, backfilling is done immediately.

3) Concrete work

As concrete placing is not affected by tides, concrete casting at site for all portions are possible.

(d) Quaywall

1) Steel sheet pile driving

Steel sheet piles are driven by pile-driver from land.

2) Anchorage work

Anchorage are made of H-shaped steels and concrete blocks. H-shaped steels are driven by pile-driver and concrete blocks are cast on site. Tie rods are installed after anchorage work.

3) Concrete work

Coping concrete is cast on site.

(e) Dredging work for access channel and basin

For dredging the access channel and basin, a pump dredger is desirable judging from the large quantity of dredging soil and high efficiency. Dredging work must be started in the early stages because of the tremendous volume of dredging soil. But dredging in the sea must be started after being sheltered to some extent by the breakwater, because dredging work in the open sea is dangerous and of low efficiency.

There may exist stiff soil (with N value of 50 or more) somewhere in the dredging area, so it might be necessary to use grab dredgers at the same time.

(f) Land reclamation work

Reclamation work will be carried out by making use of sand dredged in the channel basin and foreshore discharged. Reclamation work will progress from seashore inland, through pipe, keeping pace with the dreading work.

(g) Road work

After crushed subbase materials are leveled and compacted by bulldozers, it is paved with asphalt and finished by rolling and compacting by macadam roller.

Road work is executed as early as possible because they are to be used as the construction roads.

2-2 Construction Schedule

Port facilities construction work will have to be started by 1985, because they will be operated in 1988.

Table IX-2-(3) shows port facilities construction schedule.

2-3 Cost Estimation

(1) Estimate conditions

Construction costs must be estimated at internal and foreign currency including transportation expenses of import materials, installation expenses of cargo handling equipment, because of the necessity from economic and financial analysis of the Project.

1) Estimate of construction costs is based on the prices as of April 1982.
2) Unit prices of construction materials are based on the data obtained through the site survey.
3) Cost estimation for the industrial port is concerned with berths only and does not cover such items as facilities.
4) Taxes such as import duties and enterprise taxes are not included at all.
5) Land rents and compensations related to this project are not included.
6) The exchange rates between Mexican currency, Japanese and U.S. Dollars are assumed to be as follows.

   US $ 1.0 = MN $ 50 = ¥250

(2) Approximate construction cost

Approximate construction costs of the short term plan are shown in Table IX-2-(4), IX-2-(5).

Table IX-2-(3) Construction Schedule

Classification of facilities	Quantities	First year												Second year												Third year												Remarks
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Port facilities																																						
Breakwater	4,900 m				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Wharf																																						
Commercial district																																						
−12 m piled wharf	450 m																												—	—	—	—	—					
−10 m 〃	200 m																									—	—	—										
−4.5 m sheet pile quaywall	650 m																				—	—	—	—	—													
Fishery district																																						
−4.5 m 〃	455 m																—	—	—	—																		
−2.0 m 〃	320 m													—	—	—																						
Industrial district																																						
−22 m ~ −7.5 m wharf	3,550 m										—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Dredging of channel and basin	68,608,000 m³							—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Port related facilities																																						
Commercial facilities	1 set																									—	—	—	—	—	—	—	—	—	—	—	—	
Fishery facilities	1 set																			—	—	—	—	—	—													

Table IX-2-(4) Rough Construction Cost (Mexican pesos)

(Unit: thousand pesos)

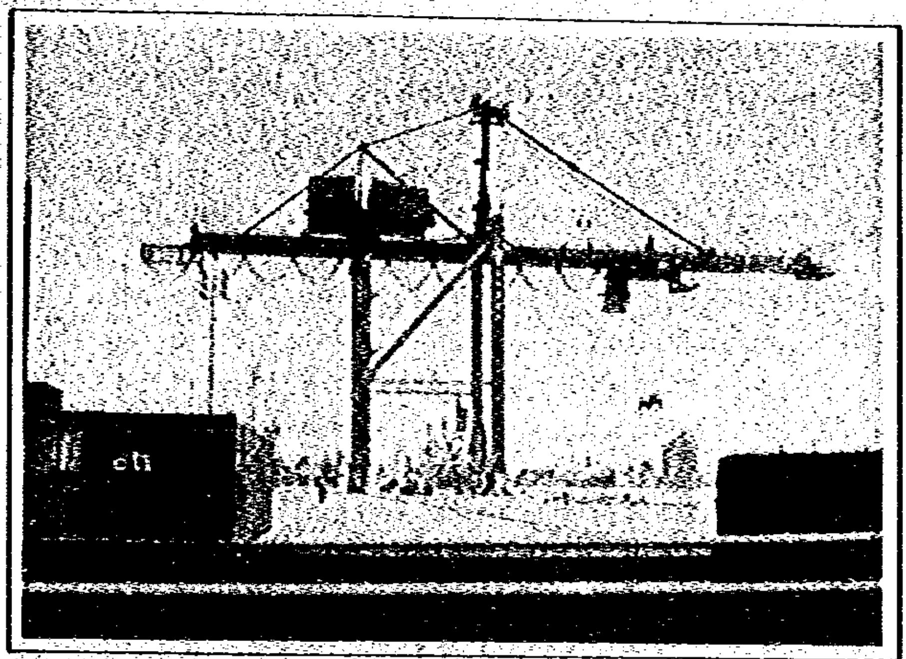
	First year			Second year			Third year			Total		
	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total
Port Facilities	3,808,400	1,907,600	5,806,000	7,824,200	3,004,400	10,828,800	8,130,400	3,215,800	11,346,200	19,853,000	8,128,000	27,981,000
Breakwater	350,000	1,263,800	1,613,800	466,400	1,684,800	2,151,200	466,400	1,684,800	2,151,200	1,282,800	4,633,400	5,916,200
Wharf												
Commercial District												
-12m piled wharf							298,000	158,400	456,400	298,000	158,400	456,400
-10m ″							114,000	69,600	183,600	114,000	69,600	183,600
-4.5m sheet pile quaywall				84,200	93,400	177,600				84,200	93,400	177,600
Fishery District												
-4.5m ″				59,000	70,800	129,800				59,000	70,800	129,800
-2.0m ″				25,000	28,400	53,400				25,000	28,400	53,400
Industrial District -22m ~-7.5m wharf	393,800	343,400	737,200	640,600	503,200	1,143,800	703,000	678,800	1,381,800	1,737,400	1,525,400	3,262,800
Dredging of Channel and Basin	3,154,600	300,400	3,455,000	6,549,000	624,000	7,173,000	6,349,000	624,000	7,173,000	16,252,600	1,548,600	17,801,200
Port related Facilities	-	-	-	429,000	381,400	810,400	1,035,800	1,274,200	2,310,000	1,464,800	1,655,600	3,120,400
Commercial Facilities							1,035,800	1,274,200	2,310,000	1,035,800	1,274,200	2,310,000
Fishery Facilities				429,000	381,400	810,400				429,000	381,400	810,400
Total	3,808,400	1,907,600	5,806,000	8,253,200	3,386,000	11,639,200	9,166,200	4,490,000	13,656,200	21,317,800	9,783,600	31,101,400

Table IX-2-(5) Rough Construction Cost (U.S. dollar)

(Unit: thousand U.S. dollars)

	First year			Second year			Third year			Total		
	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency	Total
Port Facilities	77,968	38,152	116,120	156,484	60,092	216,576	162,608	64,316	226,924	397,060	162,560	559,620
Breakwater	7,000	25,276	32,276	9,328	33,696	43,024	9,328	33,696	43,024	25,656	92,668	118,324
Wharf												
Commercial District												
-12m Piled Wharf							5,960	3,168	9,128	5,960	3,168	9,128
-10m ″							2,280	1,392	3,672	2,280	1,392	3,672
-4.5m Sheet Pile Quaywall				1,684	1,868	3,552				1,684	1,868	3,552
Fishery District												
-4.5m ″				1,180	1,416	2,596				1,180	1,416	2,596
-2.0m ″				500	568	1,068				500	568	1,068
Industrial District -22m ~ -7.5m Wharf	7,876	6,868	14,744	12,812	10,064	22,876	14,060	13,576	27,636	34,748	30,508	65,256
Dredging of Channel and Basin	63,092	6,008	69,100	130,980	12,480	143,460	130,980	12,480	143,460	325,052	30,972	356,024
Port related Facilities	-	-	-	8,580	7,628	16,208	20,716	25,484	46,200	29,296	33,112	62,408
Commercial Facilities							20,716	25,484	46,200	20,716	25,484	46,200
Fishery Facilities										8,580	7,628	16,208
Total	77,968	38,152	116,120	165,064	67,720	232,784	183,324	89,800	273,124	426,356	195,672	622,028

CHAPTER X
ADMINISTRATION AND OPERATION



Container Wharf (Port of Veracruq)

CHAPTER X. ADMINISTRATION AND OPERATION

1. Development and Authority of Administration and Operation

1-1 Authority of administration and operation and authority of development

The system of port administration and operation throughout the world greatly varies by country and by port. It is summarized in "Report of study on the development plan of industrial ports in MEXICO (Second Phase) 1982: JICA". Each port has not always followed the same system since its beginning but its system has, of course, changed as required by the times and according to the difference of geographical, social and historical circumstances. In a way, this bespeaks how profoundly the port affects the prosperity of the region and the nation.

If something is ever common to the administration and operation systems of major ports in advanced nations, it seems to be in the conflict between the public participation of the nation, the province or the city in the work of the port and the idea of port management based on the principle of economy. Generally, the development and administration of a port costs a tremendous amount of money and public participation is somehow inevitable for this reason. The Dutch port of Rotterdam, for example, is being soundly managed by selfsupporting accounting as a city-run autonomous port but the government pays 1/3 for the maintenance and administration of rivers in the port area, the rivers are under government control and, in effect, the government plays an important role in the management of the port. In France, Le Havre and some other ports are administrated and operated by public corporations as autonomous ports but they are under strong financial control by the government and the government finances 60 – 80% of the construction of their infrastractures. These public financial actions apply to other ports, too, in different degrees. (See aforementioned report.)

What must be noted in this connection is the fact that, in spite of this public participation, these major ports are all managed with certain independence as autonomous ports. This is, indeed, because of the historical experience which shows that attaching importance to the function of the port as a management body and managing the port by the principle of economy are indispensable to the existence of the port and the development of the region.

In Japan, ports have been unitarily administrated and operated by local autonomous entities or independent port administration organizations since the enactment of the Port and Harbour Law in 1950 and these ports have played a vital role in developing their regions and the nation.

In any event, a port must, as a management body, be able to repeat management and development that sensitively reflect the change of economic and social conditions relative to the port. To this end, such elements as planning, coordination and control must systematically function in the activities of management. It is, therefore, most natural that development, administration and operation should be handled by a single organization.

In developing the Industrial port of Tuxpan with the object of opening a new industrial port and developing the region, immense prior investments mainly by the governments will be made based on the position that ports are a kind of social capital in view of the economic and social development of Tuxpan area. Management efforts to make effective use of investments and recover them soon are all the more necessary for this reason. Further, well-coordinated development is only possible if the attraction of industries, the administration of plant sites and the operation of facilities are planned and executed at the responsibility of a consistent authority.

1-2 Setting of administration and operation authority

Table X-1-(1) lists general acts of port administration and operation. Fig. X-1-(1) shows how these acts are systematized so as to be related in as organized a manner as possible.

(② Maintenance and administration, ③ procedure and ④ operation in Table X-1-(1) are all included in the "administration and operation" in the figure. As for ⑤ inspection and supervision, it is excluded from the system since it is common practice for organizations in charge of individual pertinent matters to handle inspection and supervision.)

Hereunder, the administration and operation authority of the industrial port of Tuxpan is set in accordance with this system.

(a) Regulation of administration and operation authority

The power and organization of the authority are defined by law. Further, facilities and port areas under the jurisdiction of the authority are designated and the adjoining areas are clarified.

(b) Planning and coordination

The administration and operation authority forms long-term and single-year management plans and shows its management policy both at home and abroad and coordinates with such related circles as national government, autonomous entities and private companies. Its plans must be approved by SCT, which is its supervisory agency, to coordinate them with the basic policy and financial plans of the government.

(c) Financial aid

As is clear from the Financial Analysis, government financial aid is vital to the development for some time. Systematic development must be assured by defining facilities to receive aid, proportions of aid and periods of application.

(d) Administration

It is most desirable for such properties as land and facilities to belong all together to the administration and operation authority. For the present, land acquisition by SCT or SAHOP is being considered but all properties should finally be transferred to the administration and operation authority.

The existing port facilities of Tuxpan Port can be flexibly and effectively used by being entirely under the control of the authority and this enables the port functions to be maintained at the beginning of the development. In the future, area environments can be improved through allotment of function to the industrial port area.

(e) Industries

Preferential taxational treatment and other government consideration for industries are, of course, necessary but industries must be arranged effectively from the standpoint of the port and the region. It is also important for the administration and operation authority to properly execute in acted regulations in the port area and regulations for environmental protection. If this control is not properly executed, friction with the region may result and the purpose of developing the region and increasing settled regional population may not be accomplished.

(f) Urban plan

The administration and operation authority coordinates and regulates urban planning for not

Table X-1-(1) Acts of Port Administration and Operation

① Development
- a. Performance of port construction – Improvement of port area
- b. Regulation of construction work, etc. – Regulating construction work, etc. in the port area and the neighboring areas in order to assure port functions.
- c. Urban planning and restriction of harmful structures – Coordination aimed at the sound development of the region.
- d. Regulation of water reclamation.

② Maintenance and administration
- a. Maintenance and administration of port facilities
- b. Maintenance and administration of channels
- c. Port survey and statistics
- d. Communications
- e. Police
- f. Fire defense

③ Procedure
- a. Procedure for port departure and entry
- b. Designation of anchorage positions
- c. Designation of mooring facilities
- d. Pilots
- e. Collection of entrance fees and various utilization charges
- f. Welfare
- g. Tax collection

④ Operation
- a. Pilotage
- b. Warehousing
- c. Harbor transport
- d. Other businesses

⑤ Inspection and supervision
- a. Customs
- b. Inspection of export and import cargoes
- c. Inspection of animals and plants
- d. Emigration and immigration control
- e. Quarantine

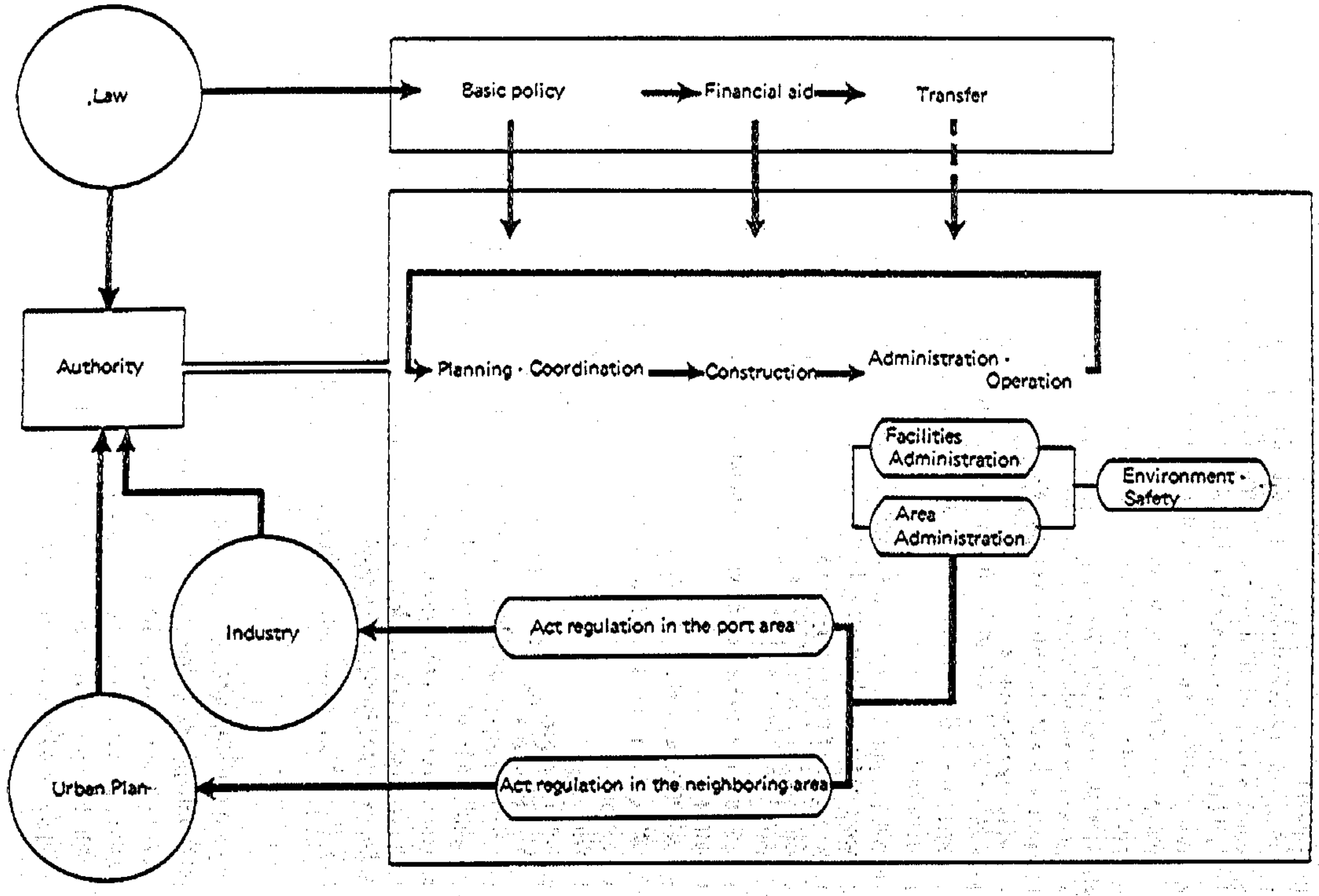


Fig. X-1-(1) Flowchart Outlining the Port Administration and Operation only the port area but also certain neighboring areas.

It must frequently coordinate with related organization on such foundation works as roads, railways, waterworks and power at the stages of planning, construction and operation. Regional development and evolution cannot be unrelated to the growth of the local autonomous entity, which is primarily responsible for the affairs of the region. There must be a system by which the exchange of view and coordination with the local government can be thoroughly carried out in executing administration and operation.

1-3 Administration and operation organization

The Government of Mexico is now studying a new method of administration and operation for the two industrial ports of Lazaro Cardenas and Altamira. It is pointed out that administration and operation there involves many difficulties through the mutual intervention and non-cooperation of the plural number of organizations that participate in it. The Government proposes to establish in each area an independent organization fully empowered to supervise, direct and coordinate maritime affairs, port activities and industrial activities in the industrial port area. This proposal is, indeed, most appropriate. To make the establishment of these independent organizations possible, Article 50 of Ley de Navigación y Comercio Maritimas has already been amended and it is expected that the Government will positively push the plan in the future.

It is desirable for the administration and operation of Tuxpan industrial port, too, to be handled unitarily by a similar independent organization to be established for it. In the case of Tuxpan industrial port, it is considered that the independent organization should be established early and caused to manage the port at its descretion from the stages of planning and construction. Fig. X-1-(2) shows the senior organization chart of this administration and operation. The Administration Committee is a deliberative organ to make decisions for the organization in a way to reflect the opinions of related organizations.

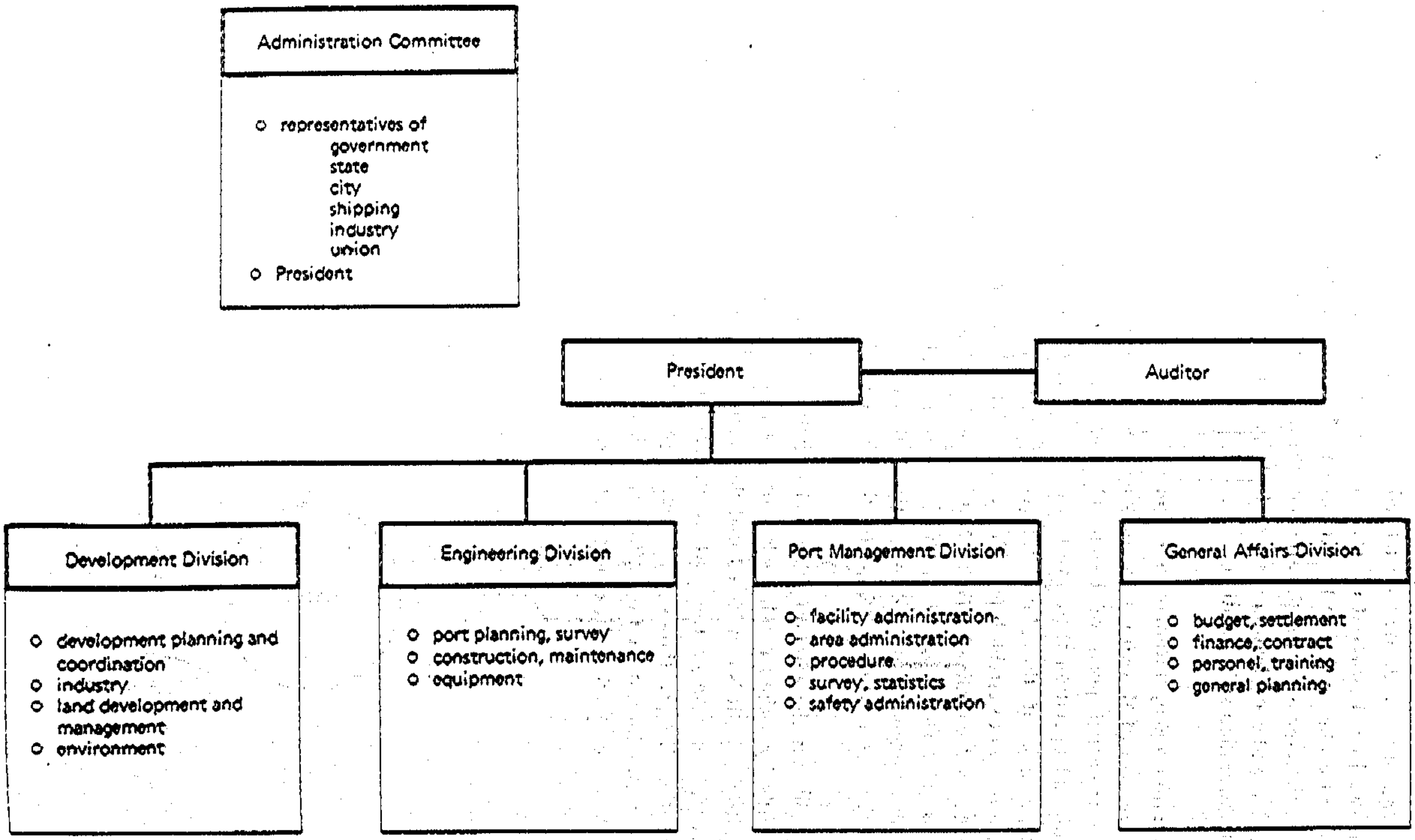


Fig. X-1-(2) Senior Management Organization

2. Administration and Operation System

2-1 Fundamental Concept

(1) Based upon the senior management organization shown in Fig. X-1-(2), the lower organization will be developed for administrating and operating the industrial port of Tuxpan under the Short Term Development Plan.

(2) Because of the similarity of port functions and scales, the Port of Kashima, a typical Japanese industrial port with a commercial port function, will be referred to as a model for the industrial port of Tuxpan, in terms of its administration and operation.

(3) Considering the existing system of Tuxpan Port and the task division at the Port of Kashima, the following services will be performed by private companies or the third sector* at the stage of the Short Term Development Plan under the supervision of the new management body ("Tuxpan Port Authority") for the industrial port of Tuxpan.

(a) Stevedoring services

(b) Pilotage services

(c) Towage services

(d) Warehousing services

(e) Sampan services (boat transportation services)

(4) Port facilities which are newly constructed in connection with the above services will be leased.

2-2 Organizational Development of Tuxpan Port Authority

(1) Similarities in port function and scale between the industrial ports of Tuxpan and Kashima Port

(a) Port function

Both ports are principally industrial ports, providing some commercial port functions as well as serving as centers of regional development.

(b) Cargo types and volume

Table X-2-(1) Cargo Volume

(10^3 MT)

	Tuxpan		Kashima	
	1988	2000	1981	Final Stage
Industrial cargo	20,140	40,362	41,245	–
Commercial cargo	1,193	4,860	245	–
Total	21,333	45,222	41,490	135,000

*Third sector: The third sector is an entity established through joint investment by the public (first) and private (second) sectors.

(c) Types of industries in the port areas

Table X-2-(2) Industry Activity

	Tuxpan	Kashima
Iron and steel	5,000 T.T/Y	11,150 T.T/Y
Petroleum refining	500 T.B/D	400 TB/D
Petrochemicals	500 T.T/Y	1,100 T.T/Y
Others	Machinery Wheat flour Feedstuff Auto Ship building	Machinery Wheat flour Feedstuff Fertilizer Ceramics, brick, clay etc.

Note: Figures show annual capacity for each industry.

(2) Lower organization and task division of Tuxpan Port Authority

The lower organization and task division of tuxpan Port Authority were studied based upon the analysis of those of Kashima Port, because they stem basically similar port functions and scales even if there is a big difference in the cargo volume handled at each port.

Fig. X-2-(1) shows the existing administrative organization of Kashima Port. The port office of the Ministry of Transport is mainly concerned with port construction and its supervision, while the port office of Ibaraki Prefecture is concerned with port management, maintenance, and operation. Therefore, it is necessary to combine the functions of both offices to develop the lower organization and task division of Tuxpan Port Authority.

① Administrative Organization of Kashima Port Office of Ministry of Transport

Organization (Position or Section Name)		Number of Personnel
Director	:	1
├ Deputy Director	:	1
├ General Affairs Div.	:	15
├ Engineering Div.	:	8
└ Construction Div.	:	20
(Sub-total		45)

② Administrative Organization of Kashima Port Office of Ibaraki Prefecture

Organization (Position or Section Name)		Number of Personnel
Director	:	1
├ General Affairs Div.	:	9
├ Port Management Div.	:	7
└ Engineering Div.	:	8
(Sub-total		25)
Total Number of Personnel		70

Fig. X-2-(1) Administrative Organizations of Kashima Port

Fig. X-2-(2) shows the study result for the lower organization and task division of Tuxpan Port Authority. In this respect, the following points were taken into due consideration:

(a) Present administrative situation of Kashima Port

(b) Reinforcement of planning and coordination function of Tuxpan Port Authority

(c) Difference in cargo volume handled at Kashima Port and Tuxpan industrial port. (Especially, commercial cargo volume handled at Tuxpan industrial port.)

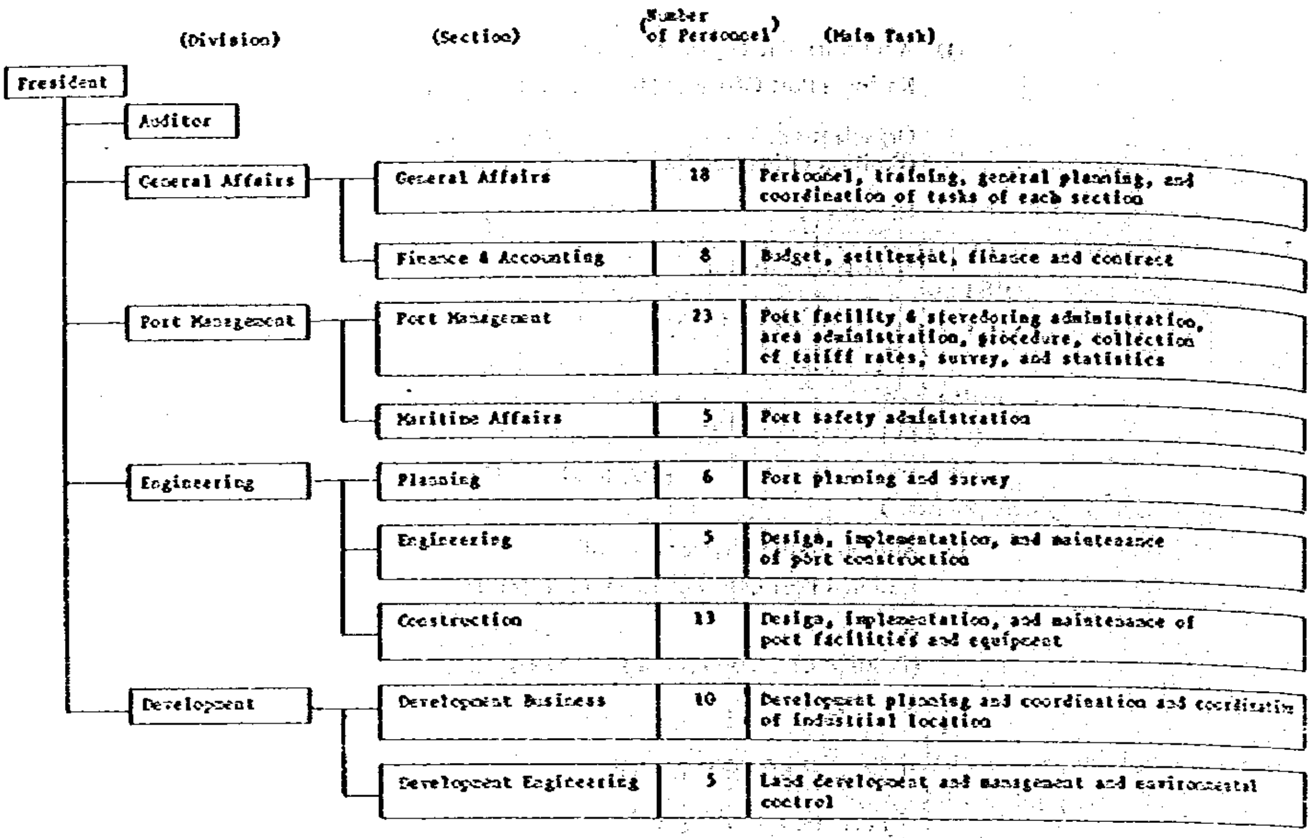


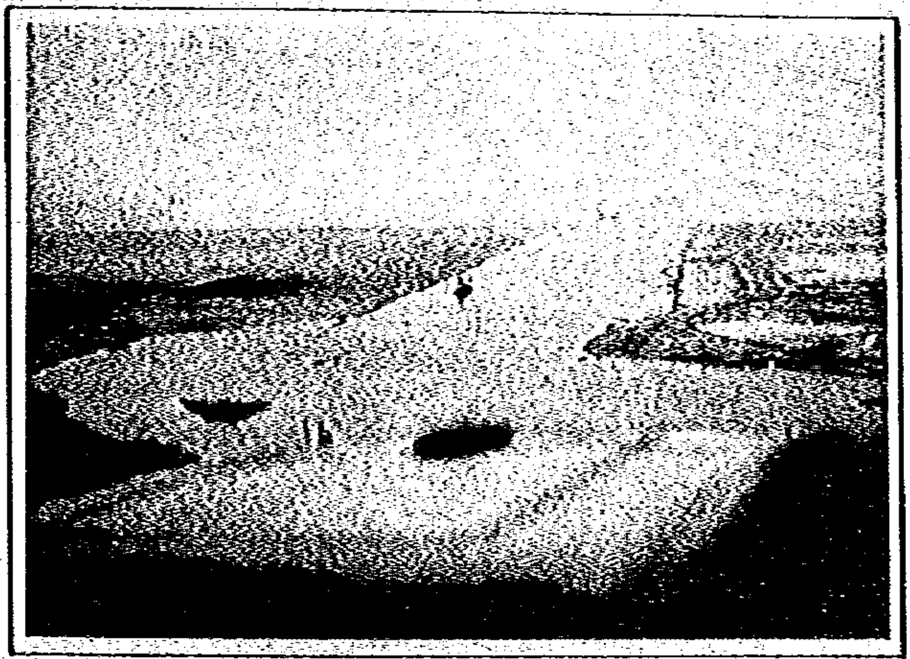
Fig. X-2-(2) Lower Organization and Task Division of Tuxpan Port Authority

Table X-2-(3) shows the number of personnel responsible for the administration by types of port such as industrial port and commercial port. This number of personnel of each port is related to the calculation of personnel cost in CHAPTER XII, Financial Analysis.

Table X-2-(3) Number of Personnel by Type of Port

Organization		Number of personnel		
Position Division	Section	Port function: Commercial	Port function: Industrial	Total
President			1	1
Auditor			3	3
General Affaires		13	14	27
	General Affairs			(18)
	Finance & Accounting			(8)
Port Management		20	9	29
	Port Management			(23)
	Maritime Affairs			(5)
Engineering		12	13	25
	Planning			(6)
	Engineering			(5)
	Construction			(13)
Development		2	14	16
	Development Business			(10)
	Development Engineering			(5)
Total		47	54	101

CHAPTER XI ECONOMIC ANALYSIS



Port of Altamira (Under construction)

CHAPTER XI. ECONOMIC ANALYSIS

1. General

(1) Objective

The profitability of this project is studied from the standpoint of national economy for the short term development plan (target year 1988). The profitability of the Project will be judged from an Internal Rate of Return (hereinafter referred to as the IRR) obtained by cost-benefit analysis. The IRR is given by the following equation.

$$\sum_{i=0}^{n-1} \frac{B_i - C_i}{(1 + IRR)^i} = 0 \quad \cdots\cdots \quad \text{(XI-1)}$$

Here, n: Period of calculation of IRR

B_i: Amount of benefit at i-th year

C_i: Amount of cost at i-th year

(2) Subject of analysis

The port plan for analysis is as shown in Fig. VIII-3-(3).

(3) Premises

Following premises are assumed in the analysis.

1) Costs of the construction of infrastructures which are closely related with the Project such as railroads, roads, industrial water works, water drainage, and power supply are excluded. But the cost of the port roads is included.
2) Among the commercial port facilities, the container berth planned on the right bank of the Tuxpan river is excluded from the analysis.
3) The analysis is made at the market prices. The same prices are used as for the cost estimation bescribed in Chapter IX-2, using the Mexican peso at its April 1982 value. The relationships with foreign currencies are as follows:

   1 US Dollar = 50 MN$(Peso) = 250 Japanese yen
4) The service life is fixed at 20 years.

(4) Deflater

Statistical figures used for this analysis have different base years. The figures must be converted to the equivalent of April 1982 prices. Table XI-1-(1) shows sectoral price ratios relative to the prices of 1975. Since no data of sectoral price ratios after 1980 were procured, the rate of consumer price increase in the country during this term was adopted as follows:

Domestic currency: 1982/1980 = 1.82

Foreign currency: 1982/1980 = 1.21

Table XI-1-(1) Deflator

Sector	1975	1976	1977	1978	1979	1980
Agriculture, Fishery	1.0	1.188	1.582	1.945	2.284	2.900
Mining	1.0	1.097	1.967	2.506	4.147	9.184
Industrial manufacture	1.0	1.232	1.717	2.146	2.784	3.837
Construction	1.0	1.295	1.584	2.118	2.949	4.195
Commerce and restaurant	1.0	1.220	1.608	2.022	2.683	3.607
Transport and communication	1.0	1.317	1.817	2.402	3.189	4.458
Consumer price*	1.0	1.161	1.467	1.715	2.021	2.555

(Source: Annuario Estadistico de E.U.M. 1980, * Informe anual 1980. Banco de Mexico)

(5) Procedure

1) Port facilities are classified according to port function, under either commercial port, industrial port or fishery port. The cost of channel dredging was allocated between commercial and industrial port according to the volume of the land fill used for each facility. The construction cost of the breakwaters was also allocated between the commercial and industrial port according to cargo volume ratio.
2) The construction cost for commercial, industrial and fishery ports are calculated. The cost is allocated to each year based on the construction schedule.
3) The benefit for each year is obtained for commercial port, industrial port and fishery port functions respectively.
4) IRR for each function is calculated. After that the IRR for the combined functions is obtained.

2. Commercial Port Function

(1) Premises

1) The alternative plan is Without Case.
2) Benefit is composed of:
   a) Saving of land transportation cost.
   b) Saving of ship staying cost.
3) Cost is composed of
   a) Construction cost of port facilities.
   b) Operation and maintenance cost of port facilities.
4) The allowable cargo volume handled at Tuxpan Port in Without Case is assumed as follows.

   Existing facilities (general and bulk cargo): 320 thousand MT/year
   Planned container facilities (container): 500 thousand MT/year
5) The allowable cargo volume handled at Tuxpan Port in With Case is presumed on the assumption that the cargo handling capacity of the new port facilities is possible up to the berth occupancy rate of 0.5.

Existing port	820 thousand MT/year
New port	1,350 thousand MT/year
among of which	
General cargo	150 thousand MT/year
Bulk (cement)	600 thousand MT/year
Bulk (fertilizer, nonferrous metal)	600 thousand MT/year

The allowable volume is estimated by type of packing as follows.

General cargo	470 thousand MT/year
Container cargo	500 thousand MT/year
Bulk cargo	1,200 thousand MT/year

(2) Saving of Land Transportation Cost

1) Demand forecast of cargo handled at Tuxpan Port

The volumes of cargo handled presently at Tuxpan Port which were shown in Tables VI-2-(21) and VI-2-(22) are classified by the Mexican origin or destination of the cargo into Metropolitan area or local area.

Then the cargo volume from 1988 to 2000 is calculated using a constant growth rate as shown in Table XI-2-(1).

Table XI-2-(1) Prospects of Commercial Cargo Volume from the Year 1988 through 2000

(Unit: 10^3 MT)

Year	Import						Export			
	General		Bulk		Container		General		Container	
	Met.	Local	Met.	Local	Met.	Local	Met.	Local	Met.	Local
①	8.47	7.69	5.08	6.75	21.16	21.27	14.61	12.25	23.32	21.76
1988	347	44	449	74	137	34	15	7	70	16
1989	376	47	472	79	165	41	17	8	86	20
1990	408	51	496	84	200	50	20	9	106	24
1991	443	55	521	90	242	61	22	10	131	29
1992	480	59	547	96	294	73	26	11	161	35
1993	521	64	575	103	357	89	29	12	200	42
1994	565	69	604	110	433	108	34	14	246	52
1995	613	74	635	117	524	131	39	16	303	63
1996	665	80	667	125	636	159	45	18	374	77
1997	721	86	701	133	771	193	51	20	461	94
1998	782	92	736	142	934	234	58	22	569	114
1999	849	99	774	152	1,131	284	67	25	700	139
2000	921	107	814	162	1,371	344	77	28	866	170

Note: ① Annual growth rate %
② Met: Metropolitan area including Mexico DF.

2) Cargo volume handled in With and Without Case

Based on the allowable cargo volume and the demand forecast mentioned above, the cargo handling volumes at Tuxpan Port for the With and Without Cases are given in Tables XI-2-(2) and XI-2-(3) respectively.

The difference between the figures given in Table XI-2-(2) and Table XI-2-(3) can be considered as the volume of cargo diverted to Tuxpan from neighbouring ports owing to the new port construction. To simplify the matter, cargoes are assumed to be shifted to the new Tuxpan port from Tampico and Veracruz port.

Table XI-2-(2) Expected Cargo Volume Handled at Tuxpan Port (With Case)

(Unit: 10^3 MT)

Year	Bulk			General					Container					Total
	Local	City	Total	Local		City		Total	Local		City		Total	
	IN	IN		IN	OUT	IN	OUT		IN	OUT	IN	OUT		
1988	74	449	523	44	7	347	15	413	34	16	137	70	257	1,193
1989	79	472	551	47	8	376	17	448	41	20	165	86	312	1,311
1990	84	496	580	51	9	408	2	470	50	24	200	106	380	1,430
1991	90	521	611	55	10	405	0	*	61	29	242	131	463	1,544
1992	96	547	643	59	11	400	*	*	73	35	294	98	500	1,613
1993	103	575	678	64	12	394	*	*	89	42	357	12	*	1,648
1994	110	604	714	69	14	387	*	*	108	52	340	0	*	1,684
1995	117	635	752	74	16	380	*	*	131	63	306	*	*	1,722
1996	125	667	792	80	18	372	*	*	159	77	264	*	*	1,762
1997	133	701	834	86	20	364	*	*	193	94	213	*	*	1,804
1998	142	736	878	92	22	356	*	*	234	114	152	*	*	1,848
1999	152	774	926	99	25	346	*	*	284	139	77	*	*	1,896
2000	162	814	976	107	28	335	*	*	344	156	0	*	*	1,946

Note: City is the Metropolitan area including Mexico DF.

Table XI-2-(3) Expected Cargo Volume Handled at Tuxpan Port (Without Case)

(Unit: 10^3 MT)

Year	Bulk			General					Container					Total
	Local	City	Total	Local		City		Total	Local		City		Total	
	IN	IN		IN	OUT	IN	OUT		IN	OUT	IN	OUT		
1988	74	0	74	44	7	195	0	246	34	16	137	70	257	577
1989	79	*	79	47	8	186	*	241	41	20	165	86	312	632
1990	84	*	84	51	9	176	*	236	50	24	200	106	380	700
1991	90	*	90	55	10	165	*	230	61	29	242	131	463	783
1992	96	*	96	59	11	154	*	224	73	35	294	98	500	820
1993	103	*	103	64	12	141	*	217	89	42	357	12	*	*
1994	110	*	110	69	14	127	*	210	108	52	340	0	*	*
1995	117	*	117	74	16	113	*	203	131	63	306	*	*	*
1996	125	*	125	80	18	97	*	195	159	77	264	*	*	*
1997	125	*	133	86	20	81	*	187	193	94	213	*	*	*
1998	142	*	142	92	22	64	*	178	234	114	152	*	*	*
1999	152	*	152	99	25	44	*	168	284	139	77	*	*	*
2000	162	*	162	107	28	23	*	158	344	156	0	*	*	*

3) Saving of land transportation cost

The volume of cargo diverted to Tuxpan is allocated to Tampico and Veracruz port. Using the percentages of Route Choice for 1988 in Table VI-2-(10), allocation to Tampico is 44% for imports and 71% for exports. The allocation to Veracruz is therefore 56% for imports and 29% for exports. Based on the tariff shown in Table VI-2-(9), the land transportation cost saving per unit of diverted cargo is given in Table XI-2-(4) in 1982 prices. Table XI-2-(5) shows results of the calculation for the savings in land transportation costs.

Table XI-2-(4) Economy of the Transportation Cost due to the Cargo Shift

(Unit: $/MT)

Port	IN	OUT
Tampico → Tuxpan	88.7	-61.5
Veracruz → Tuxpan	34.4	19.9

Note: 1. Positive: economy of the fee
2. Based on the weighted tariff in 2000

Table XI-2-(5) Economy of the Land Transportation Cost

(Unit: 10^6 pesos)

year	Shifted Cargo Volume (10^3 MT)						Economy of the Transportation				Total
	Import, In			Export, Out			Import, In		Export, Out		
	Tamp.	Vera.	Total	Tamp.	Vera.	Total	Tamp.	Vera.	Tamp.	Vera.	(10^6 pesos)
1988	264	337	601	11	4	15	23.4	11.6	-0.7	0.1	34.4
1989	291	371	662	12	5	17	25.8	12.8	-0.7	0.1	38.0
1990	320	408	728	1	1	2	28.4	14.0	0	0	42.4
1991	335	426	761	0	0	0	29.7	14.7	-	-	44.4
1992	349	444	793	-	-	-	31.0	15.3	-	-	46.3
1993	364	464	828	-	-	-	32.3	16.0	-	-	48.3
1994	380	484	864	-	-	-	33.7	16.6	-	-	50.3
1995	397	505	902	-	-	-	35.2	17.4	-	-	52.6
1996	414	528	942	-	-	-	36.7	18.2	-	-	54.9
1997	433	551	984	-	-	-	38.4	19.0	-	-	57.4
1998	452	576	1,028	-	-	-	40.0	19.8	-	-	59.8
1999	473	603	1,076	-	-	-	42.0	20.7	-	-	62.7
2000	495	631	1,126	-	-	-	43.9	21.7	-	-	65.6

Note: Unit of the economy of the transportation is million peso, 1980 value.

(3) Savings of Ship Stay Cost

1) Cargo volume and present condition of the facilities at Tampico and Veracruz Port

According to the statistics of 1980, the cargo volumes handled at Tampico and Veracruz Ports, excepting bulk liquid cargo, are as given in Table XI-2-(6).

Table XI-2-(6) Handling Cargo Volume at Public Wharves in Tampico, Veracruz Port

Port	IN. OUT	Cargo Volume (10^3 MT)			Total	Total
		General	Bulk	Other		
Tampico	IN OUT	859 477	934 978	6 –	1,799 1,455	3,254
Veracruz	IN OUT	1,323 182	2,192 –	– –	3,515 182	3,697

Note: Excluding liquid bulk

2) Estimate of cargo volumes handled at Tampico and Vleracruz Ports in 1988

The prospective cargo volumes handled at public wharves in Tampico and Veracruz Ports in 1988 are estimated.

a) Tampico Port

i) The cargo volume handled in 1980 at public wharves are as follows.

	General cargo	Bulk cargo	
Import, In	717	346	(10^3 MT)
Export, Out	365		

ii) It is assumed that the growth of bulk cargo is equal to the growth rate of industrial production in the hinterland (Table VI-2-(4)) and the growth of general cargo is equal to the growth rate of population (Table VI-2-(2)). Presumed cargo volume in 1988 is as follows.

	General cargo	Bulk cargo	
Import, In	2,109	401	(10^3 MT)
Export, Out	1,073		

iii) Total cargo volume handled in 1988 will be therefore 3,583 thousand tons.

b) Veracruz Port

i) Since there are no private wharves except PEMEX, the total cargo, excepting liquid bulk, is handled by the public wharves. It is assumed that the growth of general cargo from 1980 to 1988 is equal to the growth rate of the population in the hinterland and the bulk cargo remains at the same level as in 1980, since there is no space for expansion due to topographical restrictions.

ii) The cargo volume handled in 1988 is estimated at 4,227 thousand tons.

3) Cargo handling facilities at Tampico and Veracruz Port in 1988

a) Tampico Port

It is expected that some of the facilities at Altamira Port will be operating by 1988. According to a plan, Altamira Port will have 6 public wharf berths by 1988. Including the present facilities of Tampico Port, the total number of berths will be 14. We assumed that the number of berths will be reduced to 13, if the Project is realized. In this connection, we may regard construction and maintenance cost of one berth reduced in Altamira as a benefit.

b) Veracruz Port

In both With and Without Cases, the number of berths is assumed to be 15, the same as at present.

4) The flow of calculation for cost saving

The flow is shown in Fig. XI-2-(1).

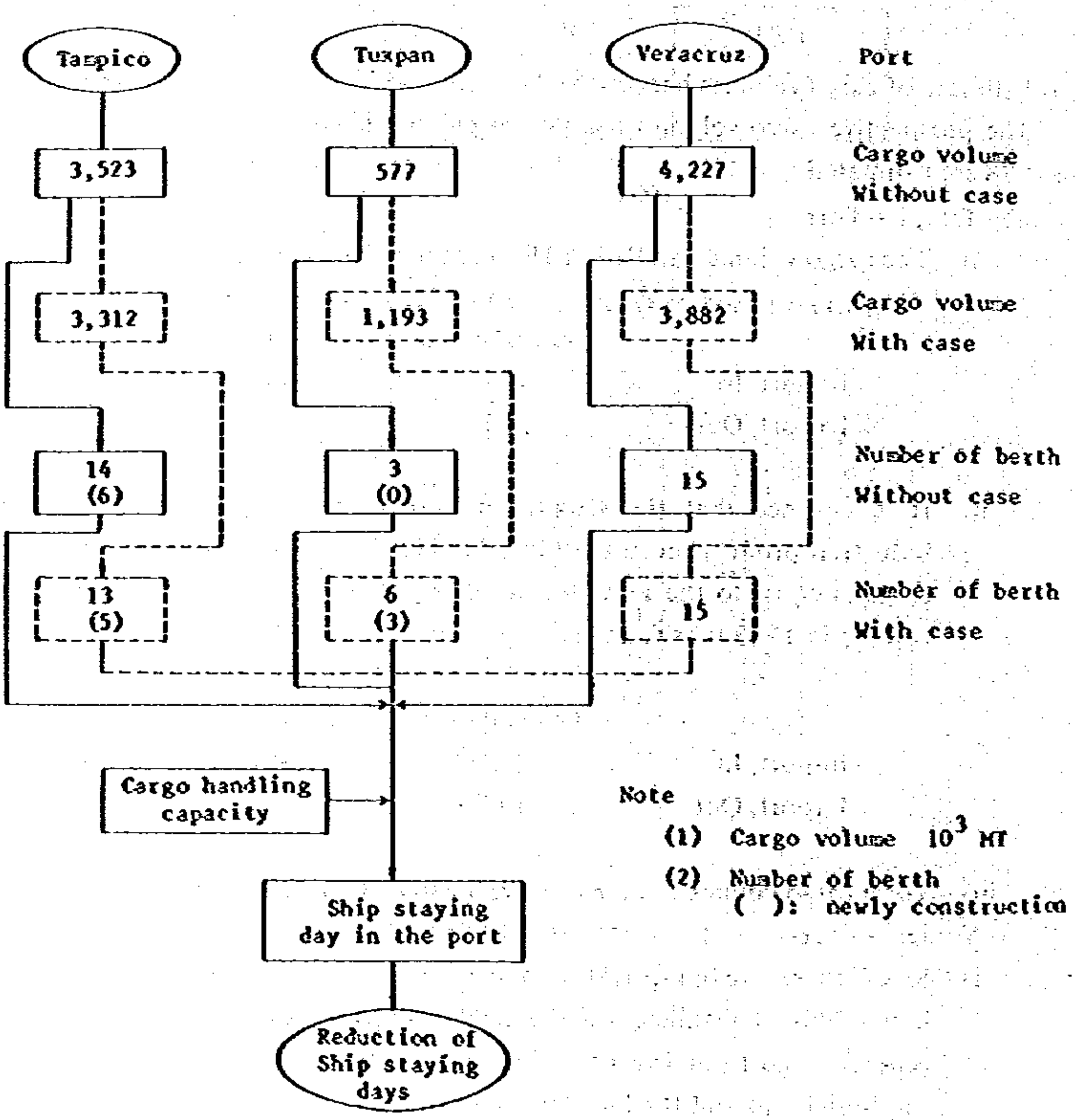


Fig. XI-2-(1) Calculation Flow of Reduction Ship Staying Days

5) Total number of stay days of ships in port

Based on such data as handling cargo volumes and number of berths, the total number of days spent in port, for Tuxpan, Tampico and Veracruz in 1988 are calculated, assuming that ship arrival is formulated by Phase II Erlung distribution. The results are shown in Table XI-2-(7).

Table XI-2-(7) Total Ships Stay Days in the Port

(Unit: days)

Port	Ship size	With	Without
Tampico	5,000 DWT	3,383	3,886
Veracruz	5,000 DWT	4,716	5,475
Tuxpan	4,000 DWT 2,700 DWT	593	439

Note: Ship size in Tuxpan With 4,000 DWT
Without 2,700 DWT

6) Benefit from reduction of ship stay days

The difference of the number of days between, Without and With, given in Table XI-2-(7), multiplied by the charterage of ship per day will indicate the benefit from the reduction of ship stay cost. From Fig. XI-2-(2), the charterage of 5,000 DWT class ship is estimated at 13 US dollar per DWT. Therefore, the benefit due to the reduction of ship stay is calculated as 106×10^6 \$/year.

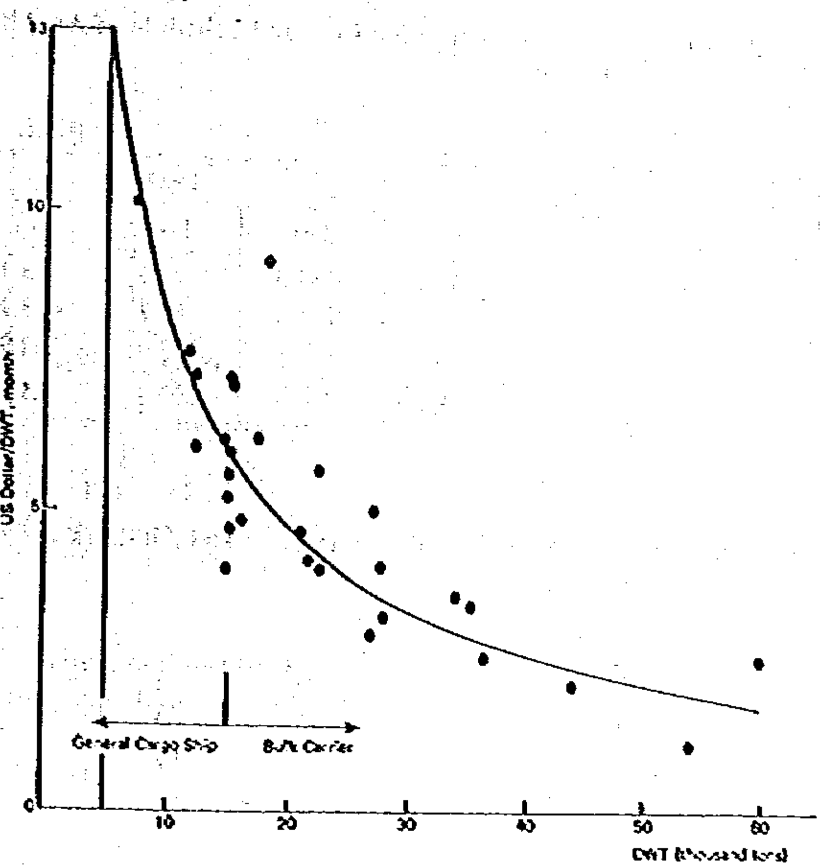


Fig. XI-2-(2) Time charterage of Vessels (as of 1982, July)

(4) Construction Cost

Table XI-2-(8) gives the construction cost of the commercial port facilities by year under the short term plan. Table XI-2-(9) is presumed construction cost and schedule of the reduced wharf in Altamira port.

Table XI-2-(8) Commercial Port Facility Construction Schedule

(Unit; million peso)

Facility	1985			1986			1987			Total
	For	Loc	Tot	For	Loc	Tot	For	Loc	Tot	
Breakwater	12.8	45.4	58.2	16.8	60.6	77.4	16.8	60.6	77.4	213
Quay Wall				84.2	93.4	177.6	412	228	640	818
Dreadging				259	24.6	283.6	259	24.8	283.8	567
Road								594.4	594.4	594
Handling Equip.							1,035.8	251	1,286.8	1,287
Transit Shed								428.8	428.8	429
Total	12.8	45.4	58.2	360	178.6	538.6	1,723.6	1,587.6	3,311.2	3,908

Note: For = Foreign Currency
Loc = Local Currency
Tot = Total Currency

Table XI-2-(9) Supposed Construction Cost and Schedule of An Altamira Port Wharf

(Unit: million peso)

Facility	1986			1987			Total
	For	Loc	Tot	For	Loc	Tot	
Quay Wall	28.1	31.1	59.2	137.3	76.0	213.3	372.5
Hand. Equip.				345.2	83.7	428.9	428.9
Transit Shed					142.9	142.9	142.9
Total	28.1	31.1	59.2	482.5	302.6	785.1	844.3

The annual maintenance and operating cost in Tuxpan and Altamira wharves are assumed to be 2 percent of the construction cost.

Port	Cost (million peso)
Tuxpan	78
Altamira	17

(5) Results of analysis

Table XI-2-(10) is the calculation sheet.

Table XI-2-(10) IRR Calculation Sheet (Commercial Port Function)

(Unit: 10^6 $)

Year	n	Cost		Benefit			Cost-Benefit	1%	2%
		Const.	Oper. Maint.	Transp.	Ship. Wait	Wharf Red.			
1984									
1985	0	58					8	58	58
1986	1	539				59	480	475	471
1987	2	3,311				844	2,467	2,418	2,371
1988	3		78	34	106	17	−79	−77	−73
1989	4		"	38	111	"	−88	−85	−81
1990	5		"	40	117	"	−96	−91	−87
1991	6		"	42	123	"	−104	−98	−92
1992	7		"	44	130	"	−113	−105	−98
1993	8		"	46	137	"	−122	−113	−104
1994	9		"	48	144	"	−131	−120	−110
1995	10		"	50	151	"	−140	−127	−115
1996	11		"	53	159	"	−151	−135	−121
1997	12		"	55	167	"	−161	−143	−127
1998	13		"	57	176	"	−173	−152	−134
1999	14		"	60	185	"	−184	−160	−139
2000	15		"	63	195	"	−197	−170	−146
2001	16		"	66	205	"	−210	−179	−153
2002	17		"	70	216	"	−225	−190	−161
2003	18		"	73	227	"	−239	−200	−167
2004	19		"	77	239	"	−225	−211	−175
2005	20		"	81	251	"	−271	−222	−182
2006	21		"	86	264	"	−289	−234	−191
2007	22		"	90	278	"	−307	−247	−199
Total		3,908	1,560	1,173	3,581	1,243	−530	−108	245
		5,468		5,997					

$$IRR = \frac{108}{108 + 245} = 1.31$$

Note: Benefit of Ship Wait Day reduction is assumed to increase annually at the rate of 5.2 percent, increase rate of cargo handling volume.

As observed in the table, IRR = 1.3 percent and B/C = 1.10 is obtained.

3. Industrial Port Function

(1) Premises

1) The alternative plan is the Without Case.
2) This report mentions the type and size of the industries having high possibility to locate around the industrial port of Tuxpan.
3) There are many industries, some of which do not presently exist in Mexico. Therefore, it is very difficult to estimate the cost and benefit caused by such industries. In order to analyse with more precision, it is necessary to make more detailed Feasibility Study for each industry, as will be discussed in CHAPTER XIII.
4) Therefore, this report will have many premises in order to simplify the process.
5) Benefit is considered as the added value created by industries located around the port.
6) Cost is the construction cost of plants (the cost of port facility construction is assumed to be included).

(2) Method of Measuring Benefit

As mentioned above, the benefit is given as added value created by factories located around the port. Added values are calculated by the following method.

1) From the industrial statistics in Mexico, added value per employee for the industries expected to be located in Tuxpan is obtained. Transforming into the prices of 1982, and multiplying this value with number of employees in 1988, the added value in each industry is obtained.
2) Added value per unit weight of produced commodity of each factory is multiplied by the production scale in 1988.
3) The Added value ratio is multiplied by the total output.

In actual practice, data obtained from 1) – 3) for the master plan are averaged and then multiplied by the ratio of production for the year 1988 to 2000. Table XI-3-(1) shows the added values.

Table XI-3-(1) Added Value Created by Located Industries

Sort of Industry	Employee (person)		Production (10^3 MT)		Added Value in 2000 (10^6 peso)				Added value in 1988
	1988	2000	1988	2000	(i)	(ii)	(iii)	Value	
Sea food products	770	1,700	45	100	580	1,220	1,200	1,000	450
Wheat flour			60	116					
Vegetable oil		300	0	26	220	590	600	470	215
Feed stuff			60	120					
Paper and cardboard	1,050	3,500	150	500	3,110	5,530	2,420	3,690	1,107
Petroleum refining	750	1,500	10^3 BPSD 250	10^3 BPSD 500	13,700			13,700	6,850
Petrochemicals		5,000	0	500	5,790			5,790	0
Iron and steel	3,750	7,500	2,500	5,000	15,700	16,800	18,600	17,030	8,515
Fabricated metal for ocean use	1,500	1,500	24	24	1,060				1,060
Construction machinery	750	1,500	2,000*	4,000*	1,260		580	920	460
Chemical machinery	5,500	5,500	50	50	3,390			3,390	3,390
Heavy electric machinery	1,000	1,000	80*	80*	620			620	620
Motor vehicles		10,000	0	(10^3 unit) 360	9,080		9,920	9,500	0
Shipbuilding		3,000	0	80x10^3…	1,290		1,650	1,470	0
Total								55,580	22,217

Note: Total is excluding sea food products

(3) Method of Cost Estimation

The cost is given as the amount of investment for the construction of factories. The amount of investment was estimated as follows.

1) For petroleum refining, petrochemical, iron and steel, automobile and ship building industries, the amounts of investment in model factories prepared in Japan were used.
2) For other industries, the amount of construction investment per capita employee was calculated from Japanese industrial statistics and the cost was obtained by multiplying by the number of employees of the industries located around the industrial port of Tuxpan.
3) The period of construction is assumed to be 2 – 4 years from the past example of Japan. Investment is considered even during the construction period. Completion of the first stage work is assumed to be at the end of 1987.

Table XI-3-(2) shows cost of construction.

Table XI-3-(2) Industrial Plant Construction Schedule

Sort of Industry	Construction Year		Construction Cost (10^6 $)		Construction Schedule (10^6 peso)							
					1st Stage				2nd stage			
	~1988	1989~	~1988	1989~	1984	1985	1986	1987	1990	1991	1992	1993
Sea food products	2	2	693	847			347	346			424	423
Wheat flour Vegetable oil Feedstuff	2	2	430	510			215	215			255	255
Paper and cardboard	2	3	8,280	19,320			4,140	4,140		6,440	6,440	6,440
Petroleum refining	3	3	33,750	33,750		11,250	11,250	11,250		11,250	11,250	11,250
Petrochemicals		4		45,000					11,250	11,250	11,250	11,250
Iron and steel	4	3	75,000	75,000	18,750	18,750	18,750	18,750		25,000	25,000	25,000
Fabricated metal for ocean use	2		650				325	325				
Construction machinery	2	2	880	1,760			440	440			880	880
Chemical machinery	3		4,640			1,550	1,550	1,540				
Heavy electric machinery	2		1,110				550	550				
Motor vehicles		4		44,100					11,100	11,000	11,000	11,000
Shipbuilding		3		12,800						4,300	4,300	4,200
Total (excluded sea food products)					18,750	31,550	37,220	37,210	22,350	69,240	70,375	70,275

(4) Results of analysis

Table XI-3-(3) shows the IRR calculation sheet.

From the table, it is seen that the IRR is 13.9%.

Table XI-3-(3) IRR Calculation Sheet (Industrial Port Function)

(Unit: 10^6 $)

Year	n	Cost	Benefit	Cost-Benefit	13%	14%
1984	0	18,750		18,750	18,750	18,750
1985	1	31,550		31,550	27,920	27,680
1986	2	27,220		37,220	29,140	28,660
1987	3	37,210		37,210	25,790	25,120
1988	4		22,217	−22,217	−13,620	−13,150
1989	5		•	•	−12,070	−11,530
1990	6		•	•	−10,670	−10,130
1991	7		•	•	−9,440	−8,890
1992	8		•	•	−8,350	−7,800
1993	9		•	•	−7,400	−6,840
1994	10		•	•	−6,550	−6,000
1995	11		•	•	−5,800	−5,270
1996	12		•	•	−5,130	−4,620
1997	13		•	•	−4,530	−4,040
1998	14		•	•	−4,020	−3,560
1999	15		•	•	−3,550	−3,110
2000	16		•	•	−3,160	−2,730
2001	17		•	•	−2,780	−2,400
2002	18		•	•	−2,470	−2,110
2003	19		•	•	−2,180	−1,840
2004	20		•	•	−1,930	−1,620
2005	21		•	•	−1,710	−1,420
2006	22		•	•	−1,510	−1,240
2007	23		•	•	−1,330	−1,090
Total		124,685	444,340	−319,655	−6,600	820

$$IRR = 13 + \frac{6,600}{6,600 + 820} = 13.9$$

4. Fishery Port Function

(1) Premises

1) The alternative plan is the Without Case, where there is no plan for construction of new fishery port and the amount of fish catches remains at the same level as at present.
2) This function includes fish processing industries to be located around the Tuxpan industrial port.
3) Benefit is the added value of caught fish and fish processing.
4) Costs are considered as the costs of construction of the fishery port, fish processing plant and fishing boats as well as operation and maintenance costs of the port.
5) The amount of fish landed at the new fishery port is estimated at 25×10^3 MT in 1988 from Table VII-2-(12).

(2) Cost

1) The number of fishing boats to be built

The number of fishing boats required at the year 2000 was shown in Table VII-2-(13), so in 1988, the number of boats are calculated considering the caught fish volume as shown in Table XI-4-(1).

Table XI-4-(1) Necessary Number of Fishing Boats

Size of the ship (GT)	1 ~ 5	5 ~ 20	20 ~ 50	50 ~ 100	100 ~ 200	Total
Number of ship	187	21	42	33	12	295

(Note: Number of ship is calculated as the number in Table VII-2-(3) x 25/60)

Table XI-4-(2) Construction Cost for Fishery Port and Fish-Processing Plant

Facility	Construction Cost (10^6 \$)			
	1985	1986	1987	Total
Port	10.2	993.6		1,004
Plant		346.5	346.5	693

2) Fishing boat construction cost

Since it is very difficult to estimate exactly the construction cost of fishing boats, the following steps are used. From the trade statistics of Japan the export cost of ships per 1 GT is calculated. This was multiplied by the total gross tonnage for new fishing boat shown in Table XI-4-(1), and then it is converted to pesos.

The result is 0.693 US dollar (\$34.7) per 1 GT and the total construction cost for 6,558

GT amounted to 227×10^6 \$.

They are to be constructed in 2 years, 1986 and 1987.

3) Construction cost of fishery port and fish processing plant

Table XI-4-(2) gives the amount of investment for the construction of fishery port and fish processing plant in the short term plan.

4) Maintenance and operation cost of fishery port

It is estimated at 2% of the fishery construction cost, or 20×10^6 \$/year.

(3) Benefit

All fish landed at the new fishing port are assumed to be used for fish processing.

1) Added value of the caught fish

According to Japanese statistics, about 40% of the revenue from fish catches is expected to be added value.

From the statistics in Mexico in 1975, average value of fish per 1 MT was 9.5 thousand peso. Converting this to the price as of 1982, it will be 50 thousand \$/MT.

Therefore, the added value from fish catches is expected to be 500×10^6 \$.

2) Added value by fish processing plant

According to Table XI-3-(1), added value from fish processing plant for the volume of 25×10^3 MT amounts to 250×10^6 \$.

(4) Results of Analysis

Table XI-4-(3) gives the IRR calculation sheet.

As noted in the sheet, the IRR of this function is very high at about 30%.

Table XI-4-(3) IRR Calculation Sheet (Fishery Port Function)

(Unit: million peso)

Year	n	Cost				Benefit		Cost Benefit	γ=30%	γ=31%
		Fish. boat	Proc. plant	Fish. port	Oper. maint.	Catched fish	Plant			
1984	0									
1985	1			10.2				10	10	10
1986	2	113.5	346.5	993.6				1,454	1,118	1,109
1987	3	113.5	346.5		20			480	284	280
1988	4				•	250	500	−730	−332	−325
1989	5				•	•	•	•	−255	−248
1990	6				•	•	•	•	−197	−189
1991	7				•	•	•	•	−151	−145
1992	8				•	•	•	•	−116	−110
1993	9				•	•	•	•	−89	−84
1994	10				•	•	•	•	−69	−64
1995	11				•	•	•	•	−53	−49
1996	12				•	•	•	•	−41	−37
1997	13				•	•	•	•	−31	−28
1998	14				•	•	•	•	−24	−22
1999	15				•	•	•	•	−19	−16
2000	16				•	•	•	•	−14	−12
2001	17				•	•	•	•	−10	−9
2002	18				•	•	•	•	−8	−7
2003	19				•	•	•	•	−6	−6
2004	20				•	•	•	•	−4	−4
2005	21				•	•	•	•	−3	−3
2006	22				•	•	•	•	−2	−2
2007	23				•	•	•	•	−2	−2
Total		227	693	1,004	420	5,000	10,000	−12,656	−14	37

$$IRR = 30 + \frac{14}{14 + 37} = 30.3$$

5. Economic Feasibility for the Short Term Plan

5-1 Combined Internal Rate of Return

An analysis is made combining the commercial, industrial and fishery ports function. Table XI-5-(1) gives the calculation sheet. As observed from the table, the IRR for the whole was 14%, nearly equal to that of the industrial port by itself. As noted in the table, the value of Cost – Benefit for the industrial port function is much higher compared with others.

Table XI-5-(1) Result of Economic Analysis

(Unit: 10^6 $)

Year	n	Cost-Benefit			Total	13%	14%
		Commercial	Industrial	Fishery			
1984	0		18,750		18,750	18,750	18,750
1985	1	58	31,550	10	31,618	27,982	27,735
1986	2	480	37,220	1,454	39,154	30,661	30,129
1987	3	2,467	37,210	480	40,157	27,833	27,106
1988	4	–79	–22,217	–730	–23,026	–14,122	–13,634
1989	5	–88	"	"	–23,035	–12,503	–11,964
1990	6	–96	"	"	–23,043	–11,068	–10,498
1991	7	–104	"	"	–23,051	–9,799	–9,211
1992	8	–113	"	"	–23,060	–8,675	–8,085
1993	9	–122	"	"	–23,069	–7,680	–7,094
1994	10	–131	"	"	–23,078	–6,799	–6,847
1995	11	–140	"	"	–23,087	–6,019	–5,462
1996	12	–151	"	"	–23,098	–5,329	–4,795
1997	13	–161	"	"	–23,108	–4,719	–4,203
1998	14	–173	"	"	–23,120	–4,178	–3,692
1999	15	–184	"	"	–23,131	–3,699	–3,241
2000	16	–197	"	"	–23,144	–3,275	–2,844
2001	17	–210	"	"	–23,157	–2,899	–2,496
2002	18	–225	"	"	–23,172	–2,567	–2,192
2003	19	–239	"	"	–23,186	–2,275	–1,922
2004	20	–255	"	"	–23,202	–2,014	–1,689
2005	21	–271	"	"	–23,218	–1,783	–1,481
2006	22	–289	"	"	–23,236	–1,580	–1,301
2007	23	–307	"	"	–23,254	–1,398	–1,142
Total		–530	–319,655	–12,656	–332,796	–7,155	–78

IRR=14.0

5-2 Economic Analysis Considering Benefit Caused by Construction Work

(1) General

In the former section, the Project was analysed economically by the cost-benefit method in which the benefit for the commercial port function was as follows.

1) Saving of the land transportation cost

2) Saving of ship stay cost

These benefits are caused by port utilization. In this section, we will estimate other benefit induced by port construction work, such as added value brought into the construction company, the material (stone, gravel, sand) extracting company, the cement production company, etc., making use of Mexican Input – Output Table, 1970.

(2) Methodology

The flow of evaluation of the effect caused by port construction is shown in Fig. XI-5-(1).

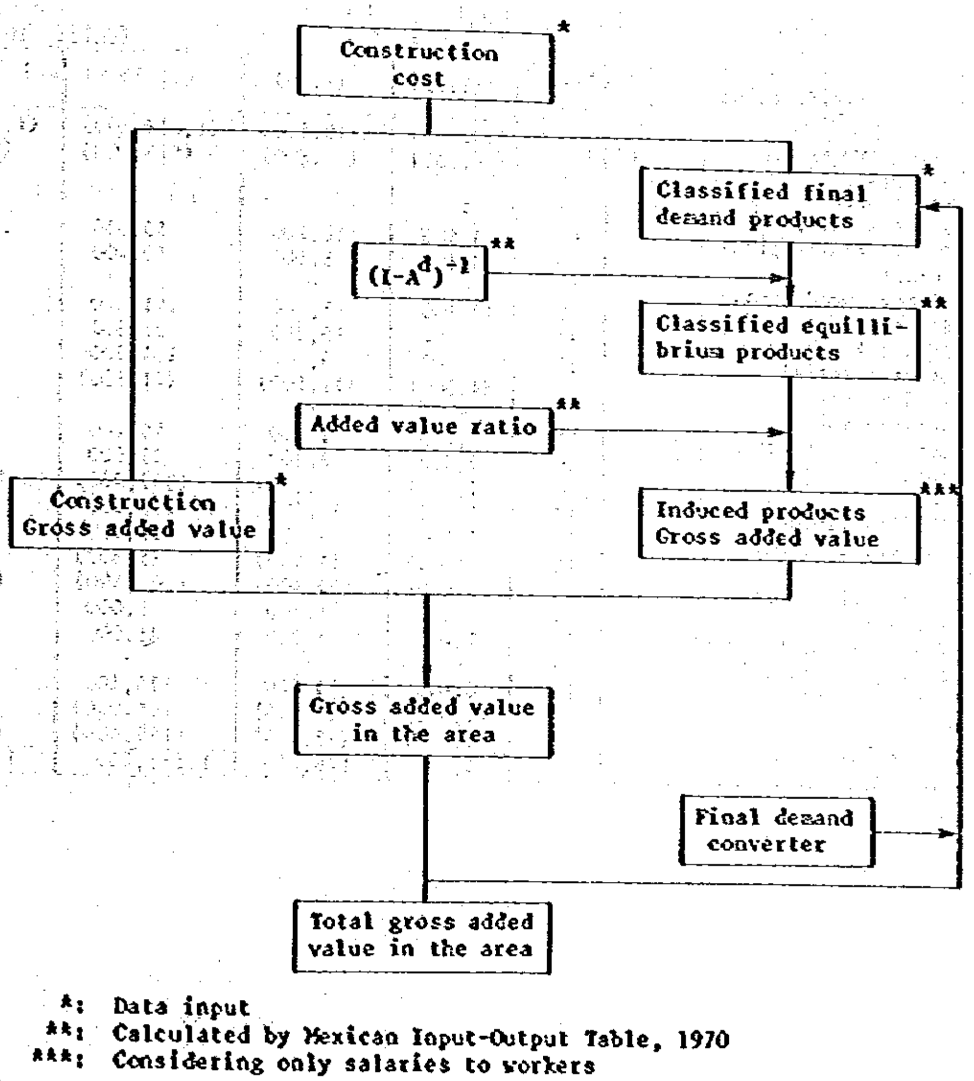


Fig. XI-5-(1) Calculation Flow-Chart

(3) Cost classification

Commercial port facility construction cost (only the local currency portion) is classified as Table XI-5-(2).

Table XI-5-(3) contains a summerised sectoral value corresponding to each sector of the Input – Output Table.

(4) Results

Fig. XI-5-(2) shows how the construction cost will propagate into other fields. Table XI-5-(4) shows the effect of sectors by classification. Added value of sectors by classification from 1985 to 1988 is listed in Table XI-5-(5). From these figures and tables it is seen that port construction work will activate such local industry as mining, construction, service and commerce. When such added value is taken into account, the ratio of B/C increase into 1.70 from 1.05.

Table XI-5-(2) Sectoral Costs for Local Currency

(Unit: 10^3 Peso)

Classification	I.O. number	(1985)	(1986)	(1987)	Total
Direct construction cost	-	(28,800)	(119,600)	(1,018,400)	(1,166,300)
Material cost	-	(18,600)	(85,800)	(578,600)	(683,000)
Steel pile					
Steel sheet pile	-	-	-	-	-
Other metalic product	50	1,600	10,200	55,000	66,800
Cement		5,600	8,600	50,400	64,600
Timber, wood prod.	30	-	-	-	-
Stone gravel sand	1	10,800	15,200	141,400	167,400
Fuel oil	33	400	15,200	37,600	53,200
Other material	34	200	36,600	294,200	331,000
Depreciation cost	-	(4,000)	(11,600)	(71,800)	(87,400)
Working ship	-	-	-	-	-
Other construction machine	51	2,000	2,800	46,200	51,000
Form	46	2,000	8,800	25,600	36,400
Labour cost	-	(5,800)	(20,600)	(362,200)	(388,600)
Skilled labour	77	3,200	11,600	297,000	311,800
Unskilled labour	77	2,600	9,000	65,200	76,800
Others	78	(400)	(1,600)	(5,800)	(7,800)
Indirect construction cost	-	(8,600)	(29,400)	(305,400)	(343,400)
Preparation	30	400	1,200	9,000	10,600
Transport of material	64	1,400	5,200	21,000	27,600
Towing of workship	-	-	-	-	-
Other expense	78	6,800	23,000	275,400	305,200
Engineering fee		(2,000)	(7,400)	(66,000)	(75,400)
Physical contigency		(5,600)	(22,400)	(198,400)	(226,400)
Total		45,000	178,800	1,588,200	1,812,000

Table XI-5-(3) Sectoral Final Input Value

(Unit: thousand peso)

Sector	No. of I.O.	Year			
		1985	1986	1987	Total
Stone, sand gravel excavation	9	12,995	18,240	169,642	200,853
Other wood industry	30	481	1,440	10,798	12,718
Petroleum refining	33	481	18,240	45,110	63,832
Basic petrochemical	34	241	43,920	352,960	397,147
Cement	44	6,738	10,320	60,466	77,510
Basic industry of steel iron	46	2,406	10,560	30,713	43,674
Other metalic product	50	1,925	12,240	65,985	80,149
Non electric machine	51	2,406	3,360	55,427	61,192
Transport	64	1,684	6,240	25,194	33,116
Added value of construction	77	6,979	24,720	434,542	466,258
	78	8,663	29,520	337,364	375,550
Total		45,000	178,800	1,588,200	1,812,000

Note: Engineering fee and physical contingency were allocated to each sector.

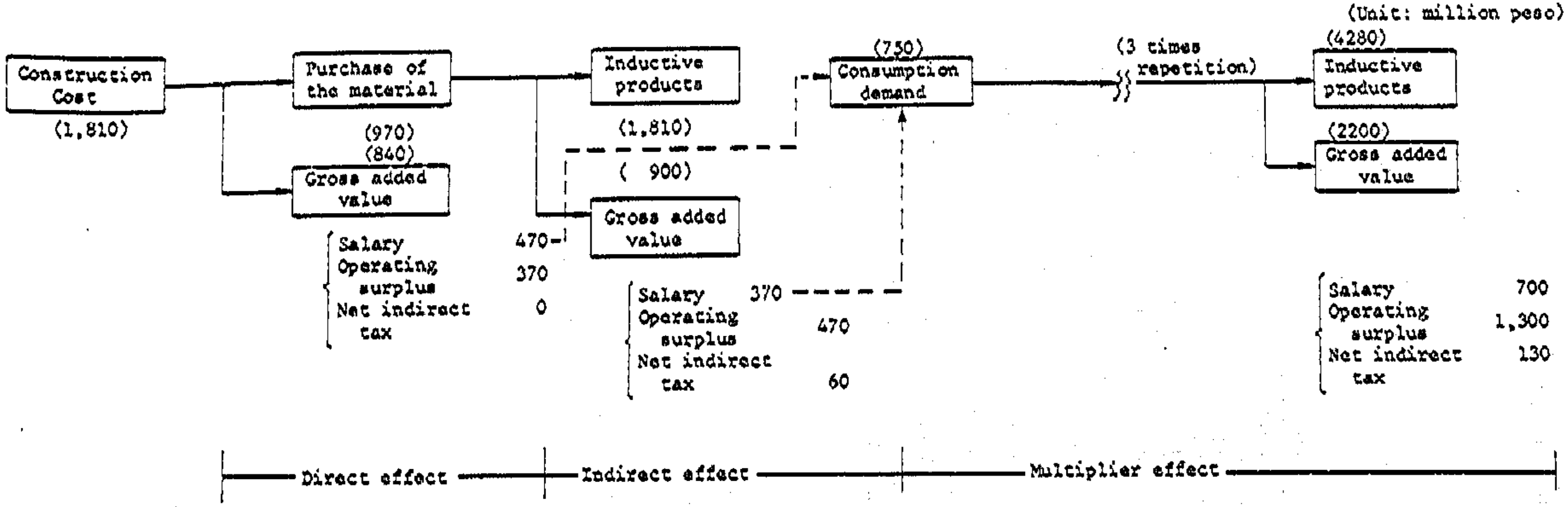


Fig. XI-5-(2) Propagation of the Effect

Table XI-5-(4) Effects of Classified Sectors

(Unit: 10^3 peso)

Sector	Direct effects		Indirect effects		Multiplier effects		Total	
	Products	Added value	Products	Added value	Products	Added value	Products	Added value
Agriculture	0	0	10,455	7,884	142,622	101,325	153,077	109,209
Forestry	0	0	6,107	5,166	20,980	17,747	27,087	22,913
Fishery	0	0	9,135	6,426	26,193	18,424	35,328	24,850
Mining	0	0	229,446	192,018	123,320	76,797	352,766	268,815
Industry manufact.	0	0	1,464,994	628,823	2,949,182	1,201,635	4,414,176	1,830,458
Construction	1,812,000	841,808	19,172	9,223	44,248	21,288	1,875,420	872,319
Electricity	0	0	6,178	4,923	19,782	15,763	25,960	20,686
Commerce	0	0	1,308	1,153	297,358	262,082	298,666	263,235
Restaurant, hotel	0	0	1,471	1,149	85,280	66,610	86,751	67,759
Transport	0	0	45,825	29,487	133,169	89,365	178,992	118,852
Service	0	0	14,527	10,320	442,072	321,140	456,599	341,460
Total	1,812,000	841,808	1,808,618	896,572	4,284,205	2,202,177	7,904,823	3,940,557

Table XI-5-(5) Yearly Added Value of Each Sectors

(Unit: 10^3 peso)

Sector	1985	1986	1987
Agriculture	2,395	10,396	96,416
Forestry	538	2,495	19,880
Fishery	565	2,994	21,291
Mining	13,533	26,237	229,066
Industry manufact.	40,725	197,571	1,592,152
Construction	16,592	57,748	797,960
Electricity	440	2,639	17,607
Commerce	5,965	23,865	233,402
Restaurant, hotel	1,538	6,227	59,993
Transport	3,281	13,888	101,684
Service	7,836	31,747	501,875
Total	93,408	375,807	3,471,328

CHAPTER XII FINANCIAL ANALYSIS

Marina (Acapulco)

CHAPTER XII. FINANCIAL ANALYSIS

1. General

(1) Purpose of Financial Analysis

Whereas economic analysis studies the effects of execution of a project and its period of execution from the view-point of the national economy, financial analysis examines the financial soundness of the organization designated to execute the project and the profitability of the project.

(2) Method of Analysis

The investment effects of this project are analyzed and evaluated by the following two methods:

(a) Financial statements analysis

The soundness of the project's financial affairs is analyzed and evaluated by preparing financial statements, such as an income statement, a source and application of funds statement, and a balance sheet.

(b) Discounted cash flow analysis

The profitability of the project is analyzed and evaluated by the financial rate of return (FRR).

The FRR is determined by the following formula:

$$\sum_{i=0}^{n} \frac{B_i - C_i}{(1+r)^i} = 0$$

n: Period of calculation

B_i: Benefit in i-th year

C_i: Cost in i-th year

r: Rate of discount

(3) Premises for Financial Analysis

(a) Due to the following reasons, only the investment effects of the public commercial wharves ("Public Commercial Wharves") constructed in the industrial port of Tuxpan will be evaluated:

(i) Breakwaters and channels in the industrial port require a very large prior investment and will be considered as its basic facilities. Also, they can be considered part of the national infrastructure, along with roads, railways, etc. Therefore, they will be assumed to be constructed by the Mexican government.

(ii) The newly-constructed fishing port will be leased to and operated by the fishermen's cooperative association of Tuxpan. Since its construction costs will be funded from leasing fees, the port can be managed on a self-supporting basis.

(b) The Public Commercial Wharves will start financial accounting in 1988, the target year of the Short Term Development Plan of the Project.

(c) The business accounting system is adopted for the analysis.

(d) The revenue will be calculated based on the current port and stevedoring tariff rates authorized by the Mexican government.

(e) The funds necessary to execute this project are to be raised as follows:

(i) Domestic currency portion: Government funds (government subsidy)

(ii) Foreign currency portion: Loans from a foreign country under the following loan conditions: – Interest rate 3% annually, and repayment term of 30 years (including 10-year grace period)

Interest on long-term loans for the construction period is indicated as Reserve and Net Current Assest. The prices of April, 1982 are used as basic prices.

(f) The depreciation is calculated by the straight line method, assuming no residual value. The period of depreciation is in accordance with the standard of the Mexican government.

2. Revenue

(1) Tariff Rates and Revenues

(a) Tariff Rates

Table XII-2-(1) shows the nationally uniform port tariff rates and the stevedoring tariff rates of Tuxpan Port.

Table XII-2-(1) Tariff Table

	Item	Tariff Rate
1	Port Dues	
	For ships in foreign trade	16.10 $/GRT
	For ships in domestic trade	8.05 "
2	Dockage	
	For ships in foreign trade	3.08 $/meter/hour
3	Wharfage	
	On export cargo	9.80 $/ton
	On import cargo	21.00 "
4	Mooring Charge*	939.40 $/ship
5	Hatchway Opening or Closing Charge*	469.70 "
6	Stevedoring Charge*	
	(1) Bulk cargo	97.35 $/ton
	(2) General cargo	
	Iron & steel	117.15 $/ton
	Capital & consumer goods	171.05 "
	Agricultural products	66.55 "

Note: 1) * Shows the current stevedoring tariff rates of Tuxpan Port which were increased by 10% from those as of January 1, 1982.

2) Tugboat and pilot services
These services in the Short Term Development Plan will be carried out based upon the existing system of Tuxpan Port.

(b) Administration Fee for Stevedoring Works

Based upon the existing system at Tuxpan Port, the fee of administrating stevedoring works is twenty percent (20%) of the total amount of stevedoring money.

(c) Leasing Fees for Facilities and Equipment

These leasing fees will be calculated on a cost basis. Only the construction cost and interest on long-term loans will be collected within life cycles of the facilities and equipment of the Public Commercial Wharves. Leasing Fees: 116,078 Thousand Peso/Year

(2) Cargo Volume

Table XII-2-(2) shows the cargo volume handled at the Public Commercial Wharves.

(3) Ship Sizes and Number of Ships

Table XII-2-(3) shows ship sizes and number of ships calling at the Public Commercial Wharves.

Table XII-2-(2) Cargo Volume

(Unit: thousand MT)

	Foreign Trade			Domestic Trade			Total
	Exp.	Imp.	Total	Out	In	Total	
(1) Bulk Cargo							
Non-ferrous Ore		174	174				174
Fertilizer		59	59		40	40	99
Cement					250	250	250
(2) General Cargo							
Salt					44	44	44
Capital Goods		19	19				19
Consumer Goods	7	16	23				23
Agricultural Products	15		15				15
Total	22	268	290		334	334	624

Table XII-2-(3) Ship Sizes and Number of Ships (1988)

	Ship Sizes (DWT)	Number of Ships
Ships in Foreign Trade		
For bulk cargo	10,000	24
For general cargo	5,000	12
Ships in Domestic Trade		
For bulk cargo	10,000	9
	6,000	42

3. Expenditure

(1) Construction Cost

Table XII-3-(1) shows the construction cost of the Public Commercial Wharves.

Table XII-3-(1) Construction Cost of the Public Commercial Wharves

(Unit: 1,000 Peso)

Facility	1986		1987		Total	
	F.C.	D.C.	F.C.	D.C.	F.C.	D.C.
Wharf & Quaywall	3,000	3,400	412,000	228,000	415,000	231,400
Cargo Handling Facilities (including foundation)	–	–	1,035,800	251,000	1,035,800	251,000
Wharehouse, Silos, etc.	–	–	–	428,800	–	428,800
Road	–	–	–	594,400	–	594,400
Total	3,000	3,400	1,447,800	1,502,200	1,450,800	1,505,600

Note: 1) F.C.: Foreign currency
D.C.: Domestic currency
2) The construction cost of the basin for small vessels is devided proportionally, according to the cargo volume handled at the industrial port and at the Public Commercial Wharves.

(2) Operating Expenses

The operating expenses are estimated for each of the following five categories: personnel cost, general administration cost, maintenance and operation cost, depreciation cost, and interest.

(a) Personnel Cost

(i) The average annual per capita personnel cost of the industrial port of Lazaro Cardenas is used for the personnel cost in this analysis.

Personnel cost: 283,395 Peso/person/year

Source: Problematica de la Operacion Portuaria en los Puertos Industriales de Lazaro Cardenas y Altamira (Junio De 1982)

(ii) The number of personnel responsible for the administration of the Public Commercial Wharves: 25 persons.

This was figured out based upon the following points:

1) Number of personnel in charge of administrating the commercial ports of Tuxpan. (See Table X-2-(1))

2) Commercial cargo volume handled at the Public Commercial Wharves and at the existing Commercial port along the Tuxpan River.

(b) General Administration Cost:

Twenty percent (20%) of the personnel cost.

This percentage stems from Japanese experience.

(c) Maintenance and Operation Cost:

Two percent (2%) of the construction cost of the Public Commercial Wharves. This also stems from Japanese expeience.

(d) Depreciation Expense

Depreciation is applied to the fixed assets shown in Table XII-3-(1). As for depreciable assets, service life and depreciation rate of each facility, see Table XII-3-(2), these are set according to the guide lines of the Mexican government. The average service life weighted by individual cost is 20.2 years. Based on this average service life, the annual amount of depreciation expense may be computed by the straight line method, assuming no residual value. The fixed assets schedule is as indicated in Table XII-3-(3).

Table XII-3-(2) Service Life & Depreciation Rate

Facility	Service Life in Years	Depreciation Rate (%)
Berth & Quaywall	30	3.33
Cargo Handling Facilities	20	5.00
Wharehouse, Silos, etc.	20	5.00
Road & Pavements	15	6.67

Table XII-3-(3) Fixed Assets Schedule

(Unit: 1,000 Peso)

Year	Balance Beginning	Investment (I)	Depreciation (D)	Balance at End
1986		6,400		6,400
1987		2,950,000		2,956,400
1988	2,956,400		146,954	2,809,446
1989	2,809,446		146,954	2,662,492
1990	2,662,492		146,954	2,515,538
1991	2,515,538		146,954	2,368,584
1992	2,368,584		145,954	2,221,630
1993	2,221,630		146,954	2,074,676
1994	2,074,676		146,954	1,927,722
1995	1,927,722		146,954	1,780,768
1996	1,780,768		146,954	1,633,814
1997	1,633,814		146,954	1,486,860
1998	1,486,860		146,954	1,339,906
1999	1,339,906		146,954	1,192,952
2000	1,192,952		146,954	1,045,998
2001	1,045,998		146,954	899,044
2002	899,044		146,954	752,090
2003	752,090		146,954	605,136
2004	605,136		146,954	458,182
2005	458,182		146,954	311,228
2006	311,228		146,954	164,274
2007	164,274		146,954	17,320

(e) Interest on Long-Term Loans

This is calculated as in Table XII-3-(4) on the assumption that the foreign currency portion of the project cost be met by the previously mentioned foreign loans.

Table XII-3-(4) Long Term Loan Schedule

(Unit: 1,000 Peso)

Year	Investment			Loan Repayment Amount	Loan Balance at End	Interest on Loan
	Government Fund	Long-Term Loan	Total			
1986	3,400	3,000	16,400		3,000	90
1987	1,502,200	1,447,800	2,950,000		1,450,800	43,524
1988–1995						348,192
1996				150	1,450,650	43,520
1997				72,540	1,378,110	41,343
1998				72,540	1,305,570	39,167
1999				72,540	1,233,030	36,991
2000				72,540	1,160,490	34,815
2001				72,540	1,087,950	32,639
2002				72,540	1,015,410	30,462
2003				72,540	942,870	28,286
2004				72,540	870,330	26,110
2005				72,540	797,790	23,934
2006				72,540	725,250	21,758
2007				72,540	652,710	19,581
2008				72,540	580,170	17,405
2009				72,540	507,630	15,229
2010				72,540	435,090	13,053
2011				72,540	362,550	10,877
2012				72,540	290,010	8,700
2013				72,540	217,470	6,524
2014				72,540	144,930	4,348
2015				72,540	72,390	2,172
2016				72,390	0	–

4. Financial Situation

(1) Preparation of Financial Statements

Financial statements are prepared according to the above estimate of revenues and expenditures. Table XII-4-(1) is a statement of revenue and expenditure, Table XII-4-(2) is a statement of sources and applications of funds and Table XII-4-(3) is a balance sheet.

Table XII-4-(1) Statement of Revenue and Expenditure

(Unit: 1,000 Peso)

Item \ Year	1986–1987	1988	1989–1995	1996–2000	2001–2007
Operating revenues		139,744	978,208	698,720	978,208
Operating expenses		67,489	472,423	337,445	472,423
Operating profit		72,255	505,785	361,275	505,785
Depreciation		146,954	1,028,678	734,770	1,028,678
Interest on Loan	(43,614)	43,524	304,668	195,836	182,770
Net profit	△43,614	△118,223	△827,561	△569,331	△705,663
Accumulated profit	△43,614	△161,837	△989,398	△1,558,729	△2,264,392

Table XII-4-(2) Statement of Source and Application of Funds

(Unit: 1,000 Peso)

Item \ Year	1986–1987	1988	1989–1995	1996–2000	2001–2007
Source of Funds (A)					
Depreciation		145,954	1,028,678	734,770	1,028,678
Profit after Depreciation		△74,699	△522,893	△373,495	△522,893
Total					
Application of Funds (B)					
Interest on Loan	(43,614)	43,524	304,668	195,836	182,770
Repayment of Long-Term Loan				290,313	507,780
Total		43,524	304,668	486,146	690,550
Increase/Decrease of Net Current Assets (C = A − B)	(△43,614)	28,731	201,117	△124,871	△184,765
Net Current Assets at Beginning of Year (D)		△43,614	△14,883	186,234	61,363
Net Current Assets at End of Year (E = C + D)	(△43,614)	△14,883	186,234	61,363	△123,402

Table XII-4-(3) Balance Sheet

(Unit: 1,000 Peso)

Item \ Year	1987	1988	1989–1995	1996–2000	2001–2007
Assets					
Fixed Assets	2,956,400	2,809,446	1,789,768	1,045,998	17,320
Net Current Assets	(△43,614)	△14,883	186,234	61,363	△123,402
Total	2,912,786	2,794,563	1,967,002	1,107,361	△106,082
Liabilities					
Capital	1,505,600	1,505,600	1,505,600	1,505,600	1,505,600
Long-Term Loan	1,450,800	1,450,800	1,450,800	1,160,440	652,710
Reserve	(△43,614)	△161,837	△989,398	△1,558,729	△2,264,392
Total	2,912,786	2,794,563	1,967,002	1,107,361	△106,082

(2) Financial Situation

The statement of revenue and expenditure shows that the operating revenue is sufficient to cover the operating expenditure. But it is impossible to depreciate after the interest on the loans. The statement of sources and applications of funds shows the cash flow after the execution of the project, mainly in order to ascertain the long term debt or the repayment position of the loans. According to it, fund shortage occurs soon after the beginning of the repayment of the principal of the loans starts.

From the above, it can be seen that the operating revenue based on the current level of tariff rates cannot cover all the necessary expenditures. Financial ratios defined below are as shown in Table XII-4-(4).

Working Ratio ...... to ascertain the income position

$$\frac{\text{Operating expenditure}}{\text{Operating revenue}} \times 100$$

Operating Ratio ..... to ascertain the income position

$$\frac{\text{Total operating expenses}}{\text{Total operating revenues}} \times 100$$

Table XII-4-(4) Financial Ratios

Item \ Year	1988	1995	2000
Working ratio (%)	48.3%	48.3%	48.3%
Operating ratio (%)	184.6%	184.6%	230.3%

The reasons for the situation are considered as follows:

(a) Level of Tariff Rates

As stated in the assumptions in this analysis the revenue is calculated according to the nationally uniform tariff rates and the stevedoring tariff rates of Tuxpan Port and cost-basis tariff rates for this project are not used.

(b) Depreciation Expense

This project is a big port development project, so the depreciation expense is a heavy burden.

(3) Countermeasures

It has been shown that, under the aforementioned conditions, the Public Commercial Wharves can afford not only the operating costs but also the payment of interest on loans. However, depreciation cannot be covered sufficiently and this is the problem with the account. So, some measures will be studied herein.

(a) Re-study of the level of tariff rates

The primary means suggested to supplement the insufficient amount of the revenue is to increase tariff rates.

If the financial accounting of this project is to be self-supporting on a cost basis, it is, of course, necessary to set tariff rates that can cover the operating costs, renew the facilities and repay debts. If the tariff rates are set six times higher than the existing rates, the financial situation of the project will be kept sound. However, in this study it is desirable to take into consideration the tariff rates of existing Mexican ports, the industrial ports under construction, and neighboring countries.

(b) Introduction of Public Funds

The measure to be considered after the raising tariff rates level is the introduction of public funds. This project is a prior investment aiming at regional development and can greatly contribute to the development of the region. It is, therefore, considered proper for the Government to subsidize the port finances. There are two conceivable methods.

(i) Subsidy for the following operating funds:

1) The payment of interest on the long-term loans

2) The repayment of long-term loan

3) The payment of depreciation expense

(ii) Government Fund (Investment Subsidy)

Although fifty-one percent (51%) of total construction cost is subsidized by the Government, it is desirable to increase the amount of investment subsidy to lessen the burden of the payment of interest.

5. Discounted Cash Flow Analysis

According to the discounted cash flow analysis of the project (See Table XII-5-(1)) the financial rate of return (FRR) is Δ 5.8 percent. As the average rate for loans is 1.5 percent in terms of total project cost, the FRR of Δ 5.8 percent underscores the financial difficulty of maintenance. In other words, it shows that it is impossible to repay the loans.

Table XII-5-(1) FRR Calculation Sheet

(Unit: 1,000 Peso)

Year	n	Project Cost	Profit	Present Value Discounted at −5.8%	
				Project Cost	Profit
1986	1	6,400		6,400	
1987	2	2,950,000		3,131,635	
1988	3		72,255		81,427
1989	4		72,255		86,440
1990	5		72,255		91,762
1991	6		72,255		97,412
1992	7		72,255		103,410
1993	8		72,255		109,777
1994	9		72,255		116,536
1995	10		72,255		123,711
1996	11		72,255		131,328
1997	12		72,255		139,415
1998	13		72,255		147,998
1999	14		72,255		157,111
2000	15		72,255		166,784
2001	16		72,255		177,053
2002	17		72,255		187,955
2003	18		72,255		199,527
2004	19		72,255		211,813
2005	20		72,255		224,854
2006	21		72,255		238,699
2007	22		72,255		314,136
Residual Value			17,320		
Total		2,956,400	1,462,420	3,138,035	3,107,148

FRR = −5.8%

6. Evaluation

The financial analysis shows that the soundness and the profitability of this project can not be ensured under the premises described in 1-(3). Namely, as stated above, the revenue and the expenditure are unbalanced and thus financial difficulties constantly prevail, making the operation of the Public Commercial Wharves on a self-supporting basis difficult.

Therefore, to maintain the financial soundness and the profitability of this project, it will be necessary to consider the following measures:

(1) Re-study of the level of tariff rates.

(2) Introduction of public funds

(a) Government subsidy for operating funds

(b) Additional government subsidy for investment funds

7. Additional Financial Analysis

In the previous sections, the analysis and evaluation covered only the investment effects of the Public Commercial Wharves. However, the Tuxpan Port Authority may well be responsible for administrating the industrial port areas, so it seems that an additional financial analysis should be made which includes both port areas.

(1) Additional Premises

In addition to the previous premises described in 1-(3), the following premises are added for the analysis in this section.

(a) Additional revenue: Port dues from the ships transporting industrial cargos

(b) Additional expenditure: Personnel cost of administrating the industrial port of Tuxpan

Further, cargo volume handled at the industrial port and the size of industrial cargo transport ships are based upon the industrial port plan for the Short Term Development Plan in CHAPTER VIII.

(2) Result of the Analysis

Tables XII-7-(1) ~ (4) show the financial statements and financial ratios, and Table XII-7-(5) shows the financial rate of return (FRR).

According to the results of the analysis, the operating revenue is sufficient to cover the operating expenditure and it is possible to depreciate after the interest on the loans. Since funds are still sufficient after beginning the repayment of the loan's principal, it can be said that the project is financially sound. In addition, the financial rate of return (FRR) is 3.6%, so it can be said that the profitability of the project can assured.

Table XII-7-(1) Statement of Revenue and Expenditure

(Unit: 1,000 Peso)

Item \ Year	1986–1987	1988	1989–1995	1996–2000	2001–2007
Operating Revenues		294,508	2,061,556	1,472,540	2,061,556
Operating Expenses		85,994	601,958	429,970	601,958
Operating Profit		208,514	1,459,598	1,042,570	1,459,590
Depreciation		146,954	1,028,678	734,770	1,028,678
Interest on Loan		61,560	430,920	307,800	430,920
Net Profit	△43,614	18,036	126,252	111,964	248,150
Accumulated Profit	△43,614	△25,578	325,962	817,500	2,420,132

Table XII-7-(2) Statement of Source and Application of Funds

(Unit: 1,000 Peso)

Item \ Year	1986–1987	1988	1989–1995	1996–2000	2001–2007
Source of Funds (A)					
Depreciation		146,954	1,028,678	734,770	1,028,678
Profit after Depreciation		61,560	430,920	307,800	430,920
Total		208,514	1,459,598	1,042,570	1,459,598
Application of Funds (B)					
Interest on Loan	(43,614)	43,524	304,668	195,836	182,770
Repayment of Long-Term Loan				290,310	507,780
Total	(43,614)	43,524	304,668	486,146	690,550
Increase/Decrease of Net Current Assets (C = A – B)	(Δ 43,614)	164,990	1,154,930	556,424	769,048
Net Current Assets at Beginning of Year (D)		Δ 43,614	4,314,422	7,617,396	15,075,320
Net Current Assets at End of Year (E = C + D)	(Δ 43,614)	121,376	5,469,352	8,173,820	15,844,368

Table XII-7-(3) Balance Sheet

(Unit: 1,000 Peso)

Item \ Year	1987	1988	1989–1995	1996–2000	2001–2007
Assets					
Fixed Assets	2,956,400	2,809,446	1,780,768	1,045,998	17,320
Net Current Assets	(Δ 43,614)	121,376	1,276,306	1,832,730	2,601,778
Total	2,912,786	2,930,822	3,057,074	2,878,728	2,619,098
Liabilities					
Capital	1,505,600	1,505,600	1,505,600	1,505,600	1,505,600
Long-Term Loan	1,450,800	1,450,800	1,450,800	1,160,490	652,710
Reserve	(Δ 43,614)	Δ 25,578	100,674	212,638	460,788
Total	2,912,786	2,930,822	3,057,074	2,878,728	2,619,098

Table XII-7-(4) Financial Ratios

Item \ Year	1988	1995	2000
Working ratio (%)	29.2	29.2	29.2
Operating ratio (%)	93.9	93.9	115.5
Return on net fixed assets* (%)	2.2	3.5	5.9
Interest earned ratio* (No. of times)	1.41	1.41	1.77

Note: * Financial ratios are defined below:

Return on Net Fixed Assets ..... to ascertain the earning capacity

$$\frac{\text{Profit after depreciation}}{\text{Net fixed assets at end of year}} \times 100$$

Interest Earned Ratio ..... to ascertain interest payment capacity

$$\frac{\text{Profit after depreciation}}{\text{Interest on long term loans}}$$

Table XII-7-(5) FRR Calculation Sheet

(Unit: 1,000 Peso)

Year	n	Project Cost	Profit	Present Value Discounted at 3.6%	
				Project Cost	Profit
1986	1	6,400		6,400	
1987	2	2,950,000		2,847,490	
1988	3		208,514		194,274
1989	4		208,514		187,524
1990	5		208,514		181,007
1991	6		208,514		174,718
1992	7		208,514		168,646
1993	8		208,514		162,786
1994	9		208,514		157,129
1995	10		208,514		151,669
1996	11		208,514		146,399
1997	12		208,514		141,312
1998	13		208,514		136,401
1999	14		208,514		131,661
2000	15		208,514		127,086
2001	16		208,514		122,670
2002	17		208,514		118,407
2003	18		208,514		114,294
2004	19		208,514		110,321
2005	20		208,514		106,488
2006	21		208,514		102,787
2007	22		208,514		107,457
Residual Value			17,320		
Total		2,956,400	4,187,600		

FRR = 3.6%