(1) Volume to be handled

The forecast of fish catches in the Tuxpan administrative region were as already described in Chapter VI-2 and the catches in Tuxpan are estimated at 112 thousand tons in the year 2000. Assuming that, of these catches, about 10% is handled out of Tuxpan port and 40% is handled by the existing fishery port area (zona de pesca) on the right bank of the Tuxpan river, the volume to be handled by the proposed new fishery port is obtained in Table VII-3-(11). It is also assumed that catches for direct human consumption are mainly handled by the existing port area and those for processing mainly by the proposed new port area.

Table VII-3-(11) Volume Handled by Fishery Port

(Unit: 1,000 tons)

Area	Purpose	1980	1988	2000
Existing fishery port area	For direct human consumption		12	30
	Processing		3	10
	Total	1.5	15	40
Proposed new fishery port area	For direct human consumption		5	10
	Processing		20	50
	Total		25	60
Total		1.5	40	100

(2) Number and size of fishing boats

The existing fishing boats of Tuxpan Port are divided into small boats of less than three tons with outboard motors used for catching oysters and shrimps and net laying boats of 20 – 60 tons used for shrimps.

Statistical data are available for the Tuxpan administrative region in 1982, as indicated in Table VII-3-(12), but no data are available for Tuxpan Port alone.

As for future fishing boats, trawlers to catch fish for processing seem to be necessary. Further, with the increasing of catches, fishing boats will also increase in size. Under these circumstances and from the examples of other fishery ports, the maximum size of future fishing boats is supposed to be 200 gross tons.

Table VII-3-(12) Present Number of Fishing Boats and Estimated Volume of Landing

Item \ Ship size (GT)	Unit	Symbol	1-3 ton	3-5 ton	5-10 ton	10-20 ton	20-40 ton	40-60 ton	60-80 ton	Total
Number of fishing boat		A	296	3	6	3	13	16	11	348
Average volume of landing	ton/ship	B	0.05	0.1	0.7	1.5	3.0	5.0	7.0	
Voyage day		C	1	1	1	1	2	3	5	
Volume of landing	ton	D=A·B/C	11.8	0.2	3.4	3.6	13.0	26.7	11.0	69.7

Note: Boat less than 20 GT is presumed 80% of operation

(a) Number of fishing boats

The number of fishing boats is estimated by the following methods.

1) The relation between standard volume of landing (average daily landing volume of the highest 10 days selected from the past two consecutive months) and annual volume of landing differs by fish type, fishing time and ship size.

   However, the ratio of annual volume of landing to standard volume of landing is usually in the range of 100 – 200.

   If a ratio of 150 is assumed here, the standard volume of landing is 60,000/150 = 400 t/day.

2) The number of fishing boats now used in Tuxpan administrative region and the volume of landing estimated was shown in Table VII-3-(12).

3) The future number of fishing boats and standard volume of landing are estimated in Table VII-3-(13) in the expectation of the introduction of trawlers suitable for processing fish catches, of the increase of ship size, and of the increase of per-boat volume of landing.

Table VII-3-(13) Estimation of Future (2000) Number of Fishing Boats and Volume of Landing

Item \ Ship size (GT)	Unit	Symbol	1-5 ton	5-20 ton	20-50 ton	50-100 ton	100-200 ton	Total
Number of fishing boat		A	450	50	100	80	30	710
Average volume of landing	ton/ship	B	0.05	1.5	4.0	8.0	15.0	
Voyage day		C	1	1	3	5	7	
Number of standard fishing boat		D=A/C	360	40	33	16	4	
Volume of landing	ton	E=D・B	18	60	132	128	60	398

Note: Boat less than 20 GT is presumed 80% of operation

(b) Size of fishing boat

Fishing boat size differs by ship type and form of fishing. Fig. VII-3-(6)~(8) is based on the results of a fact-finding survey in Japan. Size of fishing boats that can represent each class in facility planning is shown in Table VII-3-(14).

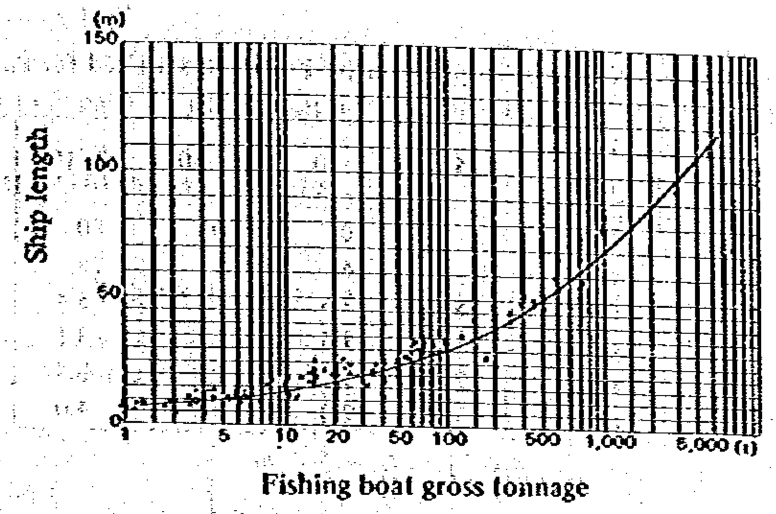


Fig. VII-3-(6) Fishing Boat Tonnage – Length

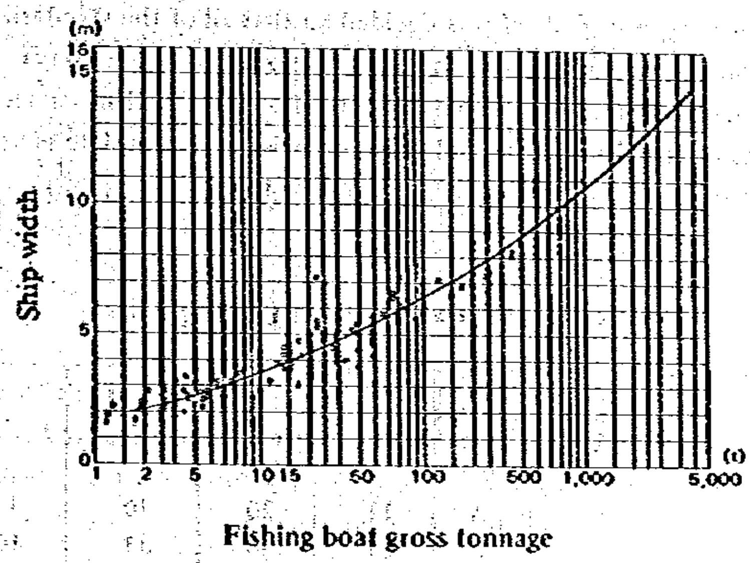


Fig. VII-3-(7) Fishing Boat Tonnage – Width

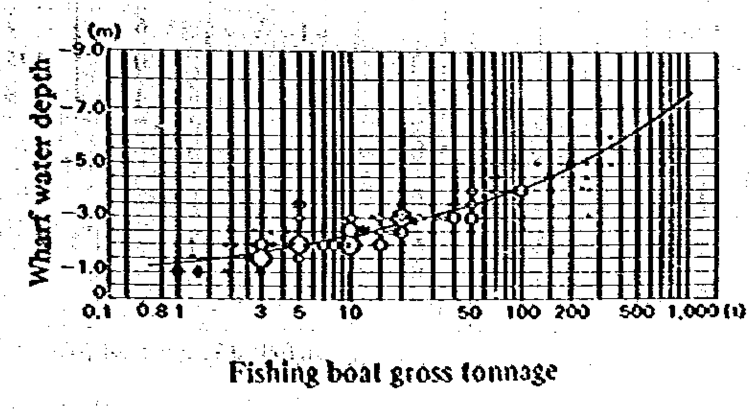


Fig. VII-3-(8) Fishing Boat Tonnage -- Wharf water depth

Table VII-3-(14) Standard Size of Representative Fishing Boat Used for Planning

Item	Ship size (GT) / Unit	1–5	5–20	20–50	50–100	100–200
Representative ship size	GT	3	10	40	80	150
Length	m	10	16	22	29	35
Width	m	2.5	3.5	4.4	5.4	6.5
Maximum draft	m	1.1	1.6	2.5	3.1	3.6
1.1 x (Maximum draft)	m	1.2	1.8	2.8	3.4	4.0
Berth water depth	m	1.5	2.0	3.0	4.0	4.5

(3) Basic facilities plan

(a) Landing wharf

The length of the landing wharf was decided so that all of the standard fishing boats can complete their landing within the time the market in open (6 hours a day). The calculation is based on the assumption that larger boats of 5 tons or more will moor alongside the wharf while small boats of less than 5 tons will moor endwise and complete landing of fish within two hours. The results are summarized in Table VII-3-(15).

Table VII-3-(15) Calculation of Landing Wharf

Item	Ship size (GT) / Unit	Symbol	3	10	40	80	150
Berth length	m	A	12	20	30	35	45
Number of boat		B	360	40	33	16	4
Volume of landing	t/ship		0.05	1.5	4.0	8.0	15
Landing time	min	C	10	20	1 hr	2 hr	3 hr
Wharf occupying time	hr	D	2	6	6	6	6
Required wharf length	m	E	105	44	165	187	90
Proposed number of berth				3	6	5	2
Total length of berth	m		105	60	180	175	90
Berth water depth	m		2	2	4	4	4.5

Note: (1) Landing volume for large boat 5 MT/hour

(2) $E = \left(\frac{BC}{D}\right) A$

(3) Total length of berth: 610 m

(b) Preparatory wharf

The length of the preparatory wharf were calculated from time required for preparation (actual data in Japan) on the assumption that it serves only standard fishing boats of 5 tons or more.

Table VII-3-(16) shows the results.

Table VII-3-(16) Calculation of Preparatory Wharf

Item \ Ship size (GT)	Unit	Symbol	10	40	80	150
Berth length	m	A	20	30	35	45
Number of boat		B	40	33	16	4
Preparing time per boat	min	C	20	40	60	80
Wharf occupying time	hr	D	8	8	8	8
Required length of wharf	m	E	33	83	70	30
Proposed number of berth			2	3	2	1
Total length of berth	m		40	90	70	45
Berth water depth	m		2.0	4.0	4.0	4.5

Note: (1) $E = \left(\frac{BC}{D}\right) A$

(2) Total length of berth is 245 m

(c) Rest wharf

The length of the rest wharf is shown in Table VII-3-(17) assuming endwise mooring of standard fishing boats. This calculation is based on the assumption that half of the smaller boats of less than 5 tons will moor outside the port in places like Tampamachoco lagoon or the Tuxpan river.

Table VII-3-(17) Calculation of Rest Wharf

Item \ Ship size (GT)	Unit	Symbol	3	10	40	80	150
Ship width	m		2.5	3.5	4.4	5.4	6.5
Ship width + allowance	m	A	2.8	4.0	5.0	6.0	7.5
Number of boat		B	180	40	33	16	4
Required length of wharf	m	A·B	504	160	165	96	30
Total length	m		500	160	160	100	30
Water depth	m		2.0	2.0	4.0	4.0	4.5

Note: Total length of Rest Wharf is 950 m.

(d) Anchorage basin

Table VII-3-(18) is calculated anchorage basin.

Table VII-3-(18) Required Anchorage Basin

Purpose	Area	Details of calculation
For landing	9,150 m²	610 m (required length of wharf) x 15 m (length of boat of less than 5 tons + 3.0 m)
For preparation	2,450	245 (required length of wharf) x 10 (average ship width + allowance)
For resting	40,720	1,018 (required length of wharf) x 40 (average ship length + allowance)
Total	52,320	

(4) Function facilities

The following are necessary as functional facilities:

1) Freight handling place
2) Ice making and cold storage facility
3) Water supplying facility
4) Oil supplying facility
5) Administration office
6) Land for fishing port facilities (warehouse, open storage yard and fishing gear drying space)
7) Roads
8) Parking space
9) Illuminating facility
10) Lavatories
11) Greens
12) Others

Among these facilities, Table VII-3-(19) are the scale of the main facilities, which are derived from calculation and past examples.

Table VII-3-(19) Calculation on Functional Facilities for Fishery Port

Facility	Scale capacity	Details of calculation
Freight handling place (transit shed)	13,350 m²	Standard landing volume (t) 400 / handling volume (kg/m²) 75 / occupancy rate 0.4
Ice making	570 t/day	Landing volume by boats to more than 5 GT (t) 380 x for use of freight handling facility and fishing boats 1.5
Ice storage	1,140 t	Volume for 2-day consumption Building area is 650 m² or more. (according to the examples)
Oil supply	129 kℓ/day	Calculated by average fuel consumption to standard boats. 10 days oil supply is possible. 500 kℓ tank (10 m diameter, 8 m height) x 3 tank.
Open storage	10,000 m² more	Average landing volume 400 t / handling volume 40 kg/m² Open storage for small boat is used as net and fish drying space.
Parking lot	10,300 m² more	Accomodate the complete volume of regional traffic Landing volume (t), truck capacity (t/car), afford factor (car) (400 x 1/2 / 8) x 2 = 50 (400 x 1/2 / 2) x 1 = 100 Area was decided by Japanese standard in Fig. VII-3-(9)
Road		Width is 12 m for 4 lanes. Road connecting large fishing boat area with small boat fishing area has the width of 20 m as reference of the Fig. VII-3-(10)
Apron		Width is 10 m

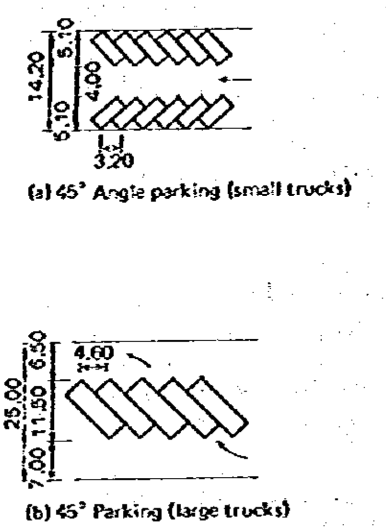


Fig. VII-3-(9) Parking Lot Plan

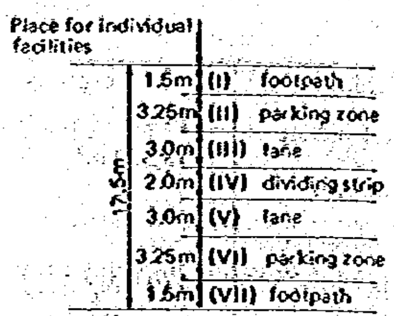


Fig. VII-3-(10) Width of port road Connecting Inter-facility

(5) Plan

The plan based on the above studies is shown in Table VII-3-(20) – (21). The layout is indicated in Fig. VII-3-(11) and the location is shown in Fig. VII-3-(12).

Table VII-3-(20) Fishery Wharf

Type of wharf	Berth length (m)	Landing wharf		Preparatory wharf		Rest wharf		Total length (m)
		Number of berth	Length (m)	Number of berth	Length (m)	Number of berth	Length (m)	
-2 m	-	-	165	-	40	-	700	905
-4	30	6	180	3	90	-	160	430
-4	35	5	175	2	70	-	100	345
-4.5	45	2	90	1	45	-	30	165
Total		13	610	6	245	-	990	1,845

Table VII-3-(21) Proposed Functional Facilities for the Fishery Port

The name of facilities	Calculated	Proposed
Anchorage basin	52,320 m² or more	149,000 m²
Freight handling place	13,350 m²	21,600 m²
Ice making and cold storage facility	650 m²	2,800 m²
Oil supplying facility	129 kℓ/day x 10 day = 1,290 kℓ	500 kℓ x 3 = 1,500 kℓ 2,100 m²
Open storage yard	10,000 m² or more	21,300 m²
Parking lot	10,300 m² or more	10,250 m²
Apron width	–	10.0 m²
Road width	–	20.0 m for section between small fishing boat area and large fishing boat area; 10 m for other sections.

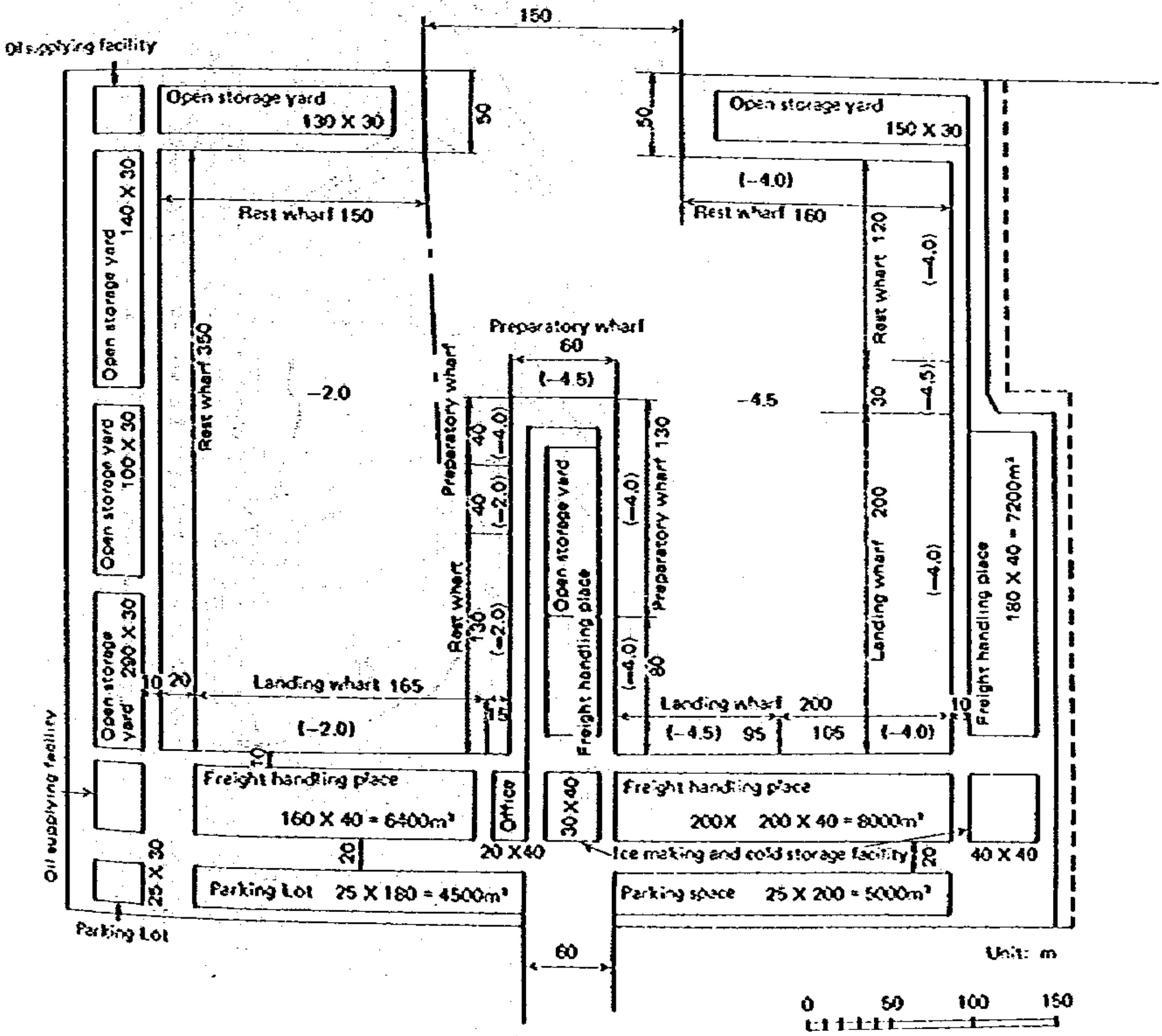


Fig. VII-3-(11) Fishery Port Plan

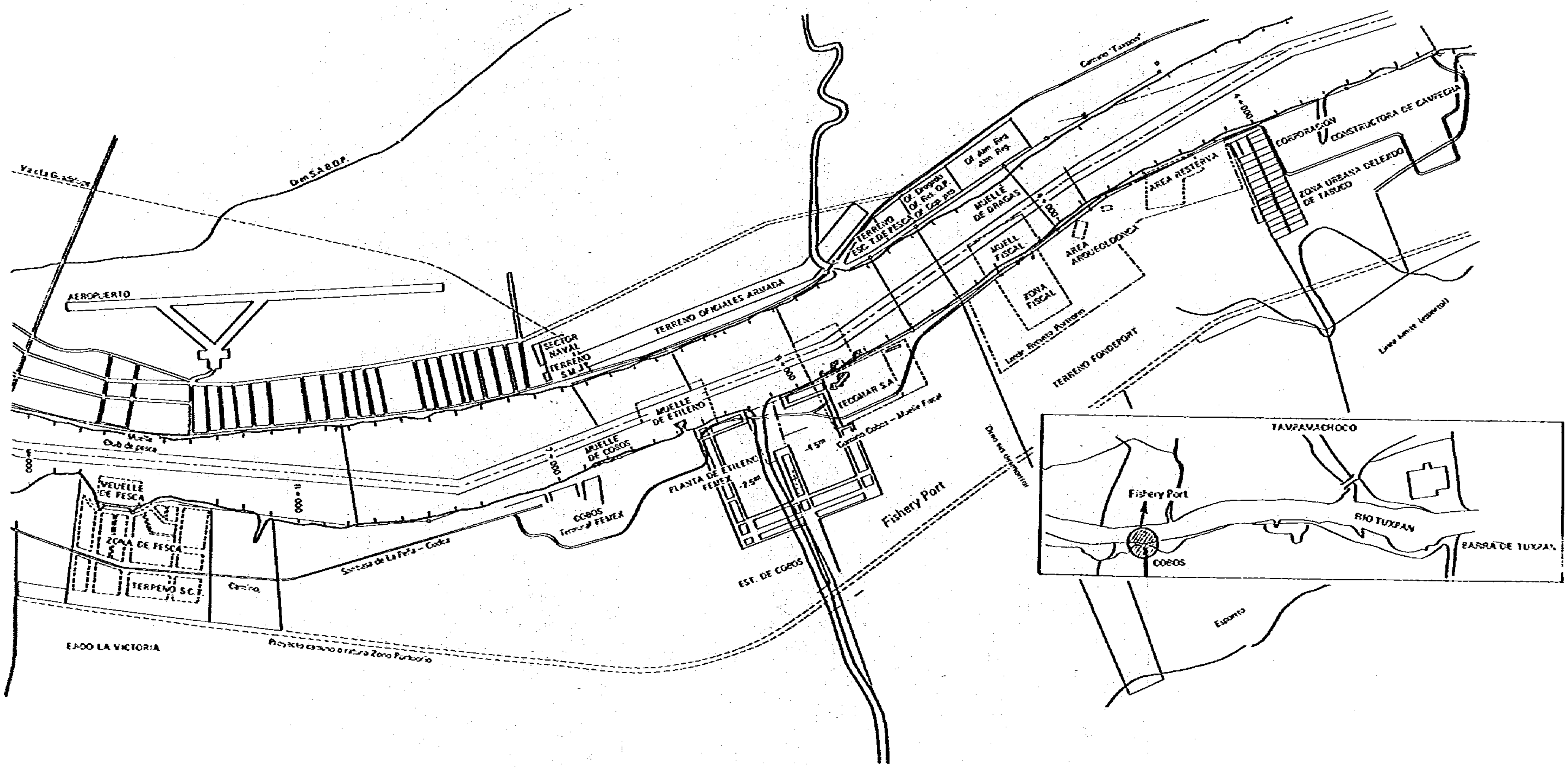


Fig. VII-3-(12) Location of Fishery Port

3-7 Marina Plan

(1) Number of pleasure boats

The number of pleasure boats was forecast by the following two methods.

(a) The number of pleasure boats is correlated with the GDP, and the personal consumption expenditure, and so on. In 1982, it was one for every 1,100 peoples in Japan.
The Mexican per-capita GDP in 2000 is expected to be 3.7 times of the level in 1980, or about the same as present day Japan. Supposing, therefore, that the Mexican rate of possession of pleasure boats is the same as the present Japanese rate, the number is obtained as 468 boats because 514,800 persons (population of Tuxpan Port City) divide 1,100 person/boat.

(b) At present Tuxpan port has a pleasure boat club (club de pesca) and 30 ~ 50 pleasure boats, mainly motorboats, are moored in the port.
Since the population of Tuxpan (1980) is 83,400, the per-boat population corresponds to 2,780 ~ 1,670 person/boat. Supposing that the per-boat population in the year 2000 is 1,500, then 514,800 ÷ 1,500 = 340 (boats) are obtained.
Moreover, the number of tourists visitng Tuxpan in 2000 for sea pleasure is estimated at 104,000 a year (a daily average of 285), and if they use a pleasure boat in a group of two or three persons, 100 ~ 140 boats will be necessary. Thus,
340 + (100 ~ 140) = 440 ~ 480 (boat)
is obtained.

(2) Accommodation of pleasure boats

(a) Number of boats to be accommodated

The total number of pleasure boats to be accommodated is estimated at 500 by adding about 50 boats for visitors, to the number forcast above in (a) and (b).

And also the examples Table VII-3-(22) are used for reference.

Table VII-3-(22) Scale of Marina Facility

	Specification of National Atheletic Meet Yacht Harbour (Japan)	Shonan (Japan)	Acapulco
Land area	10,000 m²	19,700 m²	35,000 m²
Parking lot	4,000 "	400 cars	
Boat yard	6,000 "	11,000 m²	
Club house	800 "		
Boathouse	400 "		
Basins	15,000 m²	33,000 m²	30,000 m²
Number of vessels accommodated	200	500	500
Playing sea area	R = 2,000 m 3,140 m²		

(b) Number of pleasure boats by class

The Japanese ratio of yachts and motorboats is 40% -- 50% for motorboats and 60% – 50% for yachts while the American composition is 70% – 80% for motorboats and 20% – 30% for yachts.

Though the exact composition ratio at the marina of Acapulco is unknown, it may be considered that yachts account for somewhat more than a half of the total.

Here, the plan is based on the assumption of 50% for yachts and 50% for motorboats.

The ratio between the smaller type with a boat length of less than 20 feet (dinghy type) and the larger type with a length of 20 feet or more (cruiser type) is assumed to be 70% for the smaller type and 30% for the larger type.

The Japanese example is 70 – 80% for the smaller type and the Acapulco example is 75% for the smaller type.

Table VII-3-(23) is the number and standard size of smaller and larger types of boat.

Table VII-3-(23) The Number of Pleasure Boats for Planning

	Smaller type (less than 20 feet)	Larger type (20 feet or more)	Total
Yachts	180	70	250
Motorboats	180	70	250
Total	360	140	500
Average length	6.0 m (20 feet)	9.0 m (30 feet)	
Average width	2.0 m	3.5 m	
Draft	1.0 – 2.0 m	1.5 – 2.5 m	

(3) Facilities plan

(a) Anchorage basin

At least the following area is to be procured considering the peak season of November and December when sea pleasuring concentrates:

(boats) (concentration rate) (per boat occupied area)

500 x 0.4 $150\ m^2/boat = 30{,}000\ m^2$

(b) Mooring facility

1) Smaller boats: (boats) (concentration rate) (boats)

360 x 0.4 = 144

2) Larger boat: When it is assumed that the larger boats are always moored at the anchorage basin, 140 boats are considered as the target number.

3) Required waterline length: Case of mooring endwise

Smaller boat: (boat) (width) (allowance)

144 x (2.0 + 1.0) m = 432 m

Larger boat: (boat) (width) (allowance)

140 x (3.5 + 1.5) m = 700 m

(c) Boat yard

1) Dinghy yard: 180 boats x 25 m^2/boat = 4,500 m^2

2) Motorboat yard: 180 boats x 25 m^2/boat = 4,500 m^2

3) Cruiser yard; 140 boats x 80 m^2/boat = 11,200 m^2

Assuming that 50% of cruiser-type boats are always kept on the sea surface,

11,200 x 0.5 = 5,600 m^2

So the total area of 14,600 m^2 is obtained.

(d) Parking lot

Assuming that the average number of cars per boat is 1.5, the concentration rate 0.4, and 45° of parking angle, parking area is given below

(boat)		(concentration rate)		(car/boat)		(m^2/car)	
500	x	0.4	x	1.5	x	23	= 6,900 m^2

Therefore, 6,900 m^2 plus a little allowance is proposed, taking trailer-use visitors into consideration.

(e) Repair shop

20 m x 35 m = 700 m^2 or more is proposed so that four 30-ft cruisers can be repaired at the same time.

(f) Lifting facility

Ships will be used for all smaller boat of less than 20 feet.

The necessary length can be calculated at 24 x 3 = 72 m on the assumptions that concentration rate is 0.4 (360 boats x 0.4 = 144 boats), 6 boats per lane can be lifted (144 ÷ 6 ÷ 24 lanes) and the lane width is 3.0 m.

Lifts will be used for boats of 20 feet or more. So, three table lifts are proposed. (About 18 boat an hour can be lifted up and down)

(g) Clubhouse

Assuming that the average number of persons using a boat is 3 for a boat of less than 20 feet and 5 for a boat 20 feet or more, the total number of persons using the clubhouse on peak days is 712: namely,

Less than 20 ft: 360 x 0.4 x 3 person/boat = 432

20 ft or more; 140 x 0.4 x 5 person/boat = 280

Assuming 8 m^2 as the per-capita area of the clubhouse and 0.3 as the utilization rate, the area of the clubhouse becomes.

712 x 8 x 0.3 ÷ 1,700 m^2

If the building-to-land ratio is 60%, total compound 2,833 m^2 of the clubhouse is required.

An example of the functional layout of the clubhouse is shown in Fig. VII-3-(13).

(h) Greens, recreation area, etc.

At least 30% of the entire land area should be reserved for recreation area including green zone, flower bed, lawn, swimming pool, plaza and so on.

(i) Channel width and water depth

A channel width of 50 m is proposed which is double the length of the maximum target boat and more than five times the lenght of a boat without an engine.

As for water depth, 3.5 m is proposed as representing the draft of the maximum target boat, plus an allowance water depth.

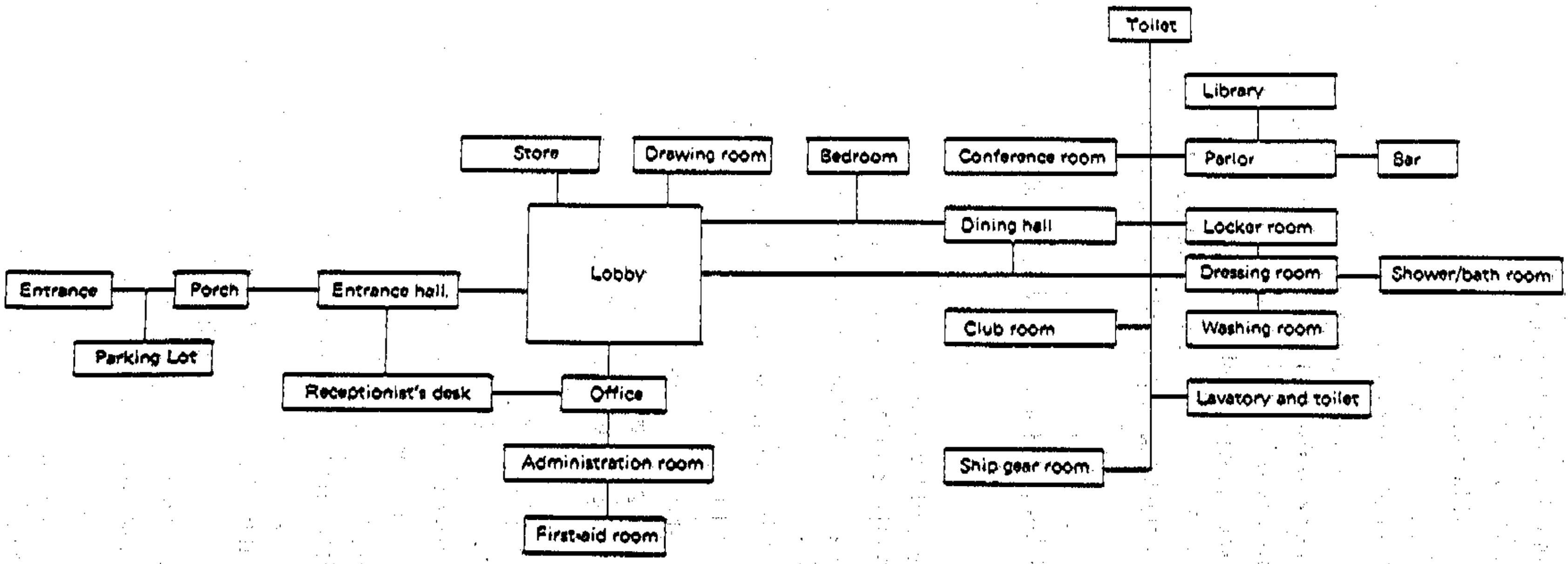


Fig. VII-3-(13) Functional Layout of Clubhouse

(4) Others

The primary sailing area to be cruised by pleasure boats will be offshore sea area north of the Tuxpan river. Since this coast is a bathing beach, the area for motorboats must be divided distinctly from the swimming area, to ensure safety.

The Tuxpan river will be the main access channel to and from the sea area. So, the existing bridge at the mouth of Tampamachoco lagoon must be improved so as to have sufficient clearance for the mast height of pleasure boats. As was shown in Fig. VII-3-(14), the necessary clearance is found to be about 14 m more from LWL because the weight of 30-feet cruiser type yacht is 5.5 – 13 tons.

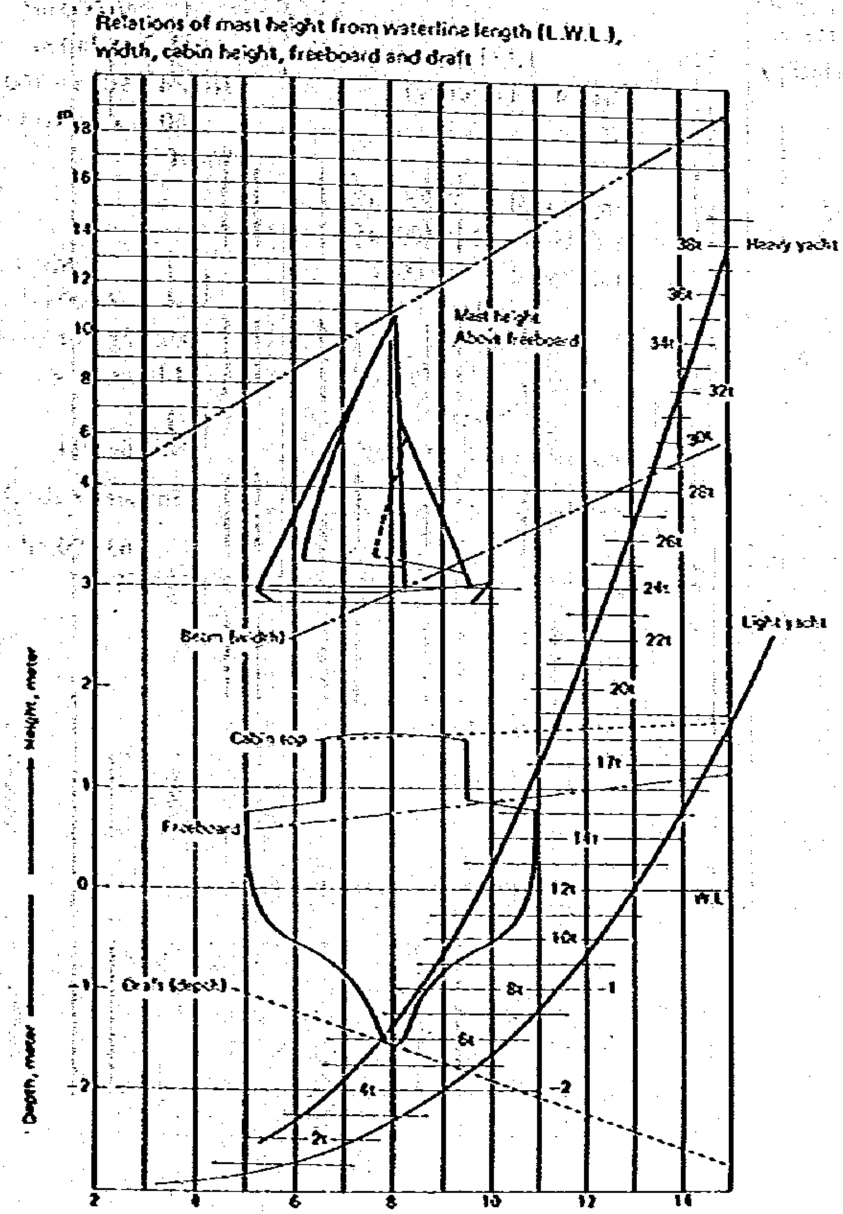


Fig. VII-3-(14) Standard Dimensions of Yachts

(5) Plan

The facilities plan based on the above studies is as indicated in Table VII-3-(24). The layouts are shown in respectively, Fig. VII-3-(15) and Fig. VII-3-(16) and the location is shown in Fig. VII-3-(17).

Table VII-3-(24) Facilities for Marina

	Calculated	Proposed
Anchorage basin	30,000 m²	37,500 m²
Water area		40,000 m²
Mooring facility	1,132 m (Case of end mooring)	1,240 m Jetty 4 x 90 m = 360 m 360 m x 2 pieces = 720 m Wharf 520 m
Boat yard	Dinghy yard 4,500 m² Motorboat yard 4,500 m² Cruiser yard 5,600 m²	4,800 m² 4,500 m² 5,600 + 2,400 m²
Parking lot	6,900 m²	7,000 m²
Repair shop	700 m²	Building area 1,600 m²
Ramp	24 lanes 72 m	31 lanes 90 m
Clubhous	1,700 m² Building area 2,830 m²	Building area 3,200 m²
Greens, recreation area etc.	Land area x 30%	Land area x about 50%
Total land area		63,600 m²

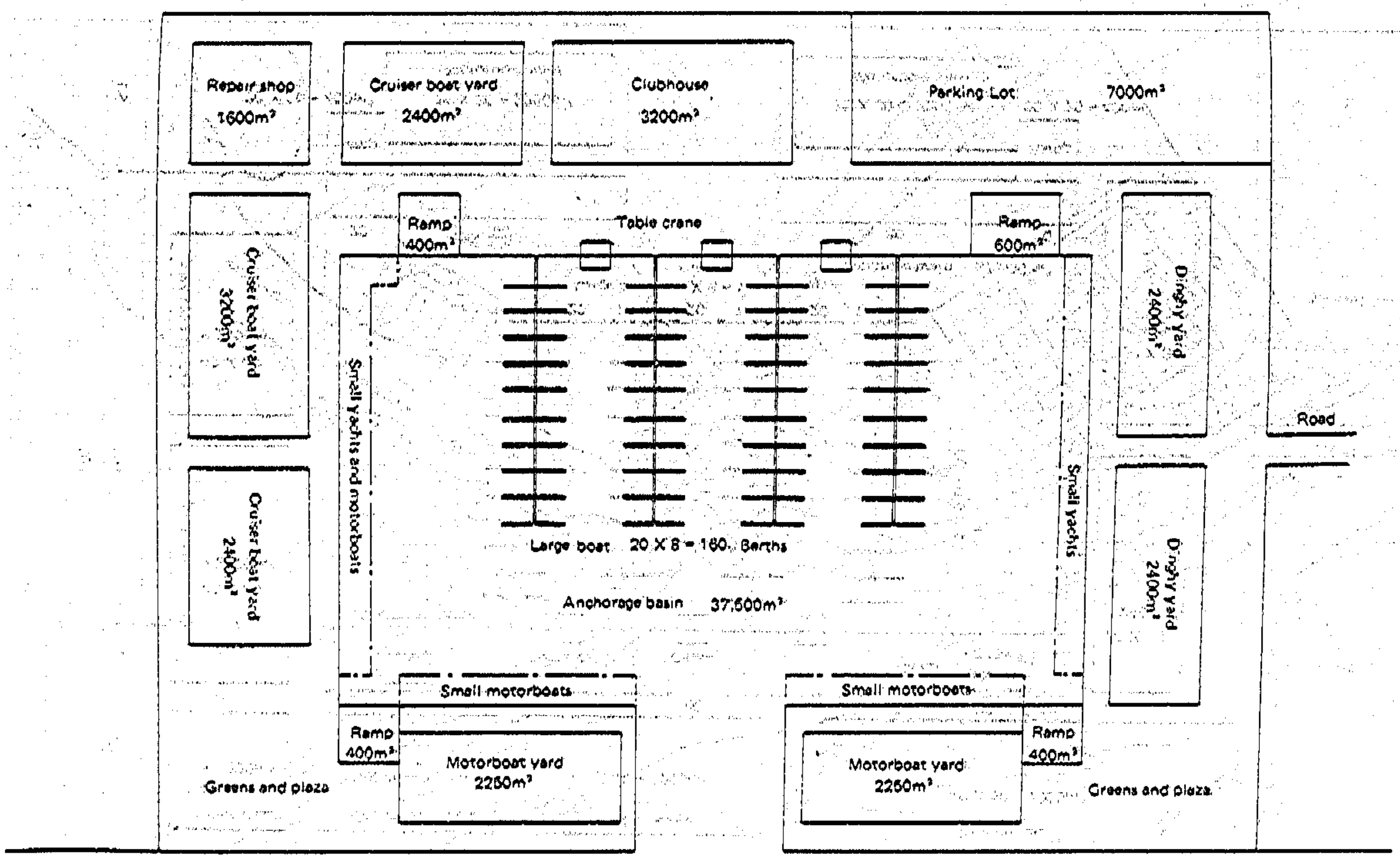


Fig. VII-3-(15) Marina Layout

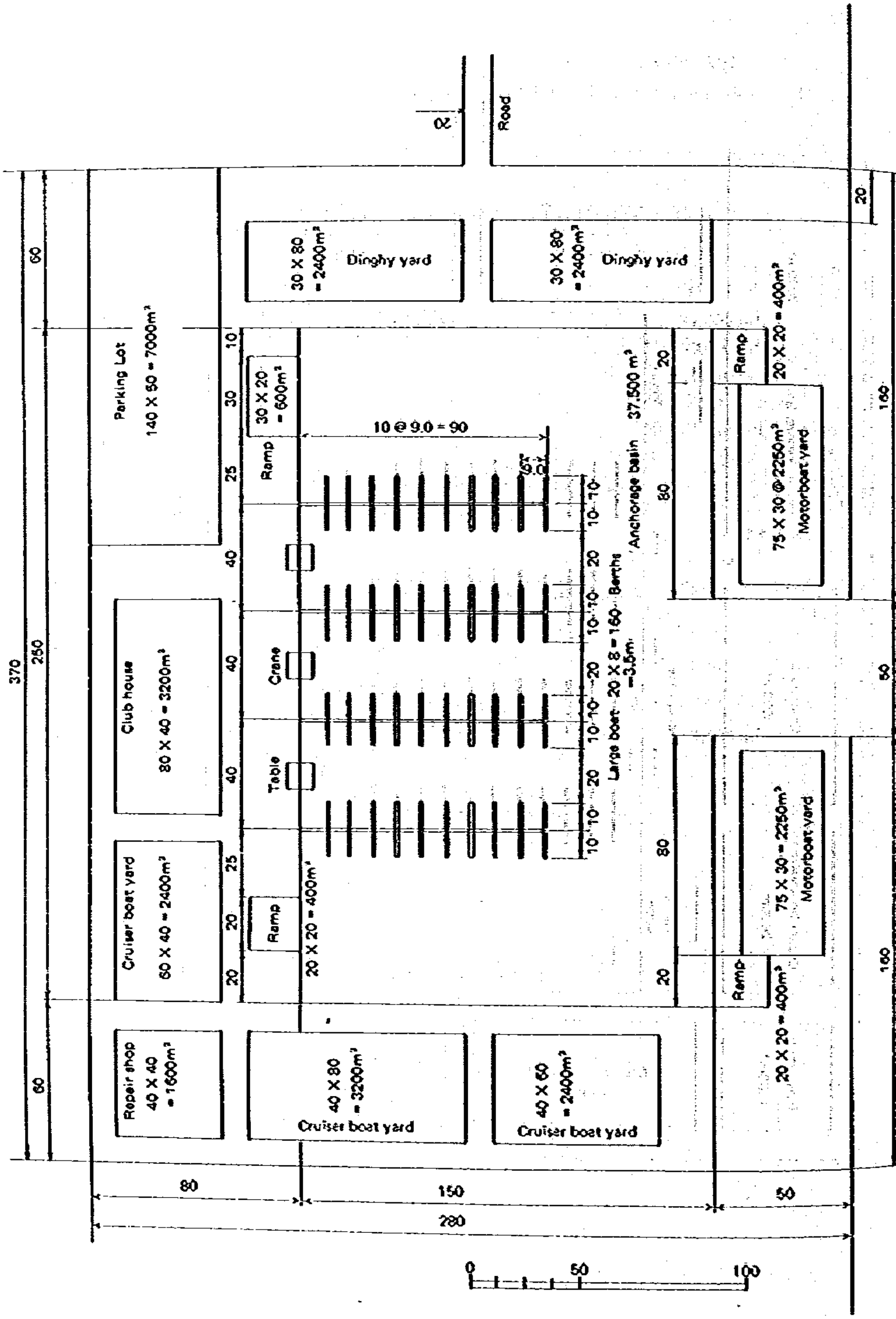


Fig. VII-3-(16) Marina Plan

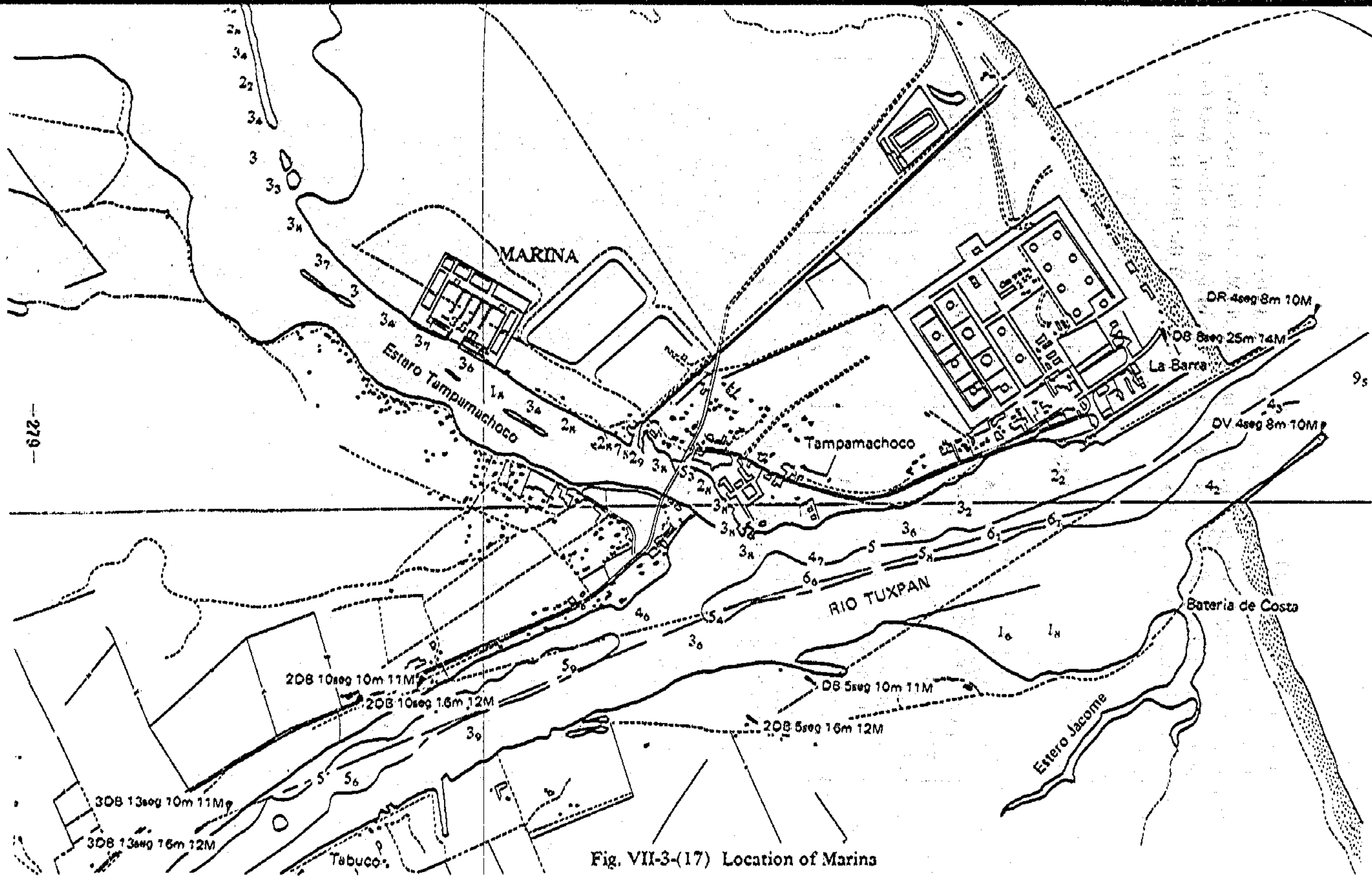


Fig. VII-3-(17) Location of Marina

3-8 Alternative Plan and Land Use

As a result of the foregoing planning, Plan A, Plan B and Plan C are made as Fig. VII-3-(18) Master Plan A, Fig. VII-3-(19) Master Plan B and Fig. VII-3-(20) Master Plan C respectively.

For the industrial site, 3,940 ha is used and the use of land for wharf, road (including railroad), park, green zone, channel basin (where constructed on the land) is shown in Table VII-3-(25).

Table VII-3-(25) Land Use

	A	B	C
Channel and basin	571 ha	443 ha	522 ha
Wharf space	160	192	142
Industrial space	3,940	3,940	3,940
Space for roads (including Railway)	207	482	402
Park and greens	1,011	1,323	1,240
Total	5,889	6,380	6,246

The space for marina is 63,600 m^2.
The space for fishery port is 132,200 m^2.

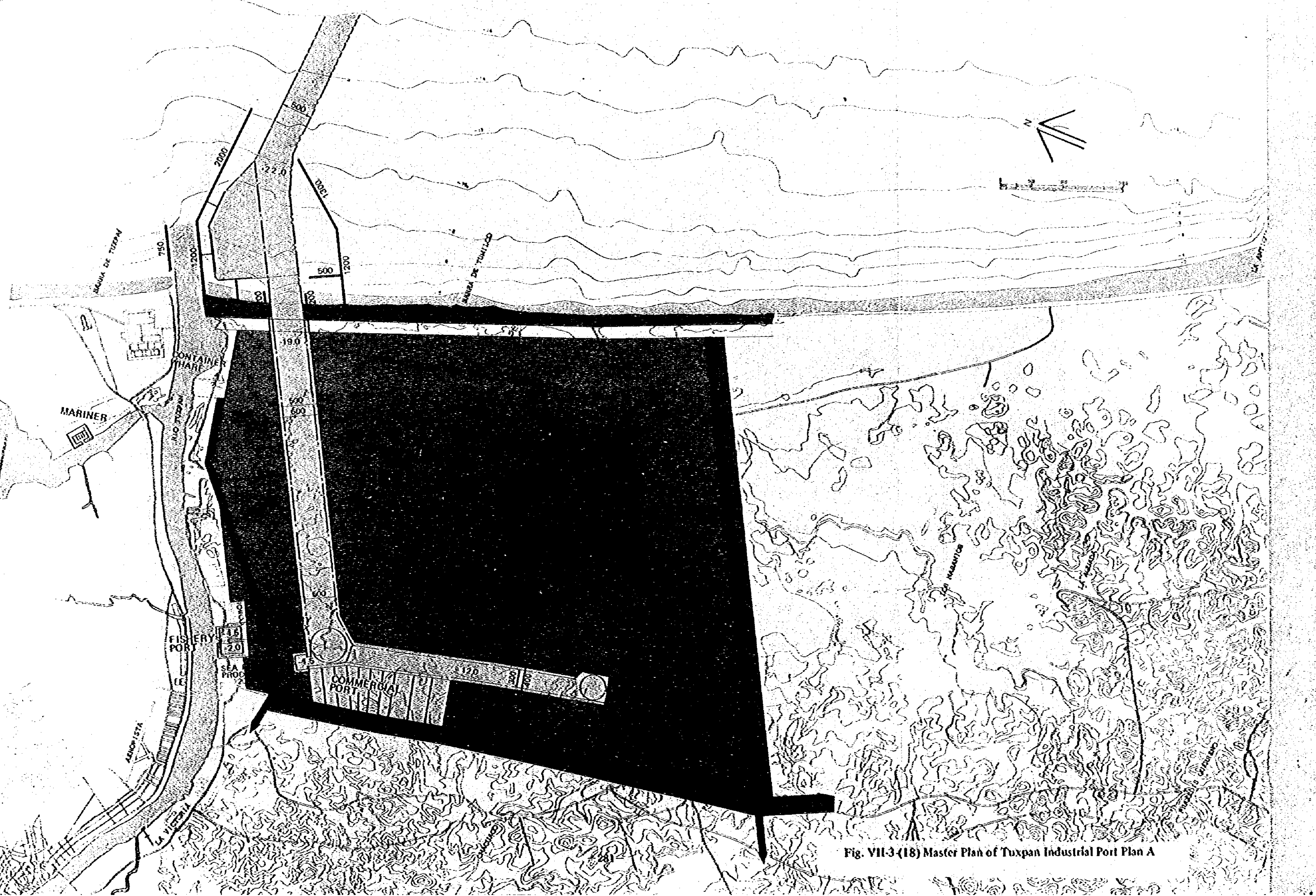


Fig. VII-3 (18) Master Plan of Tuxpan Industrial Port Plan A

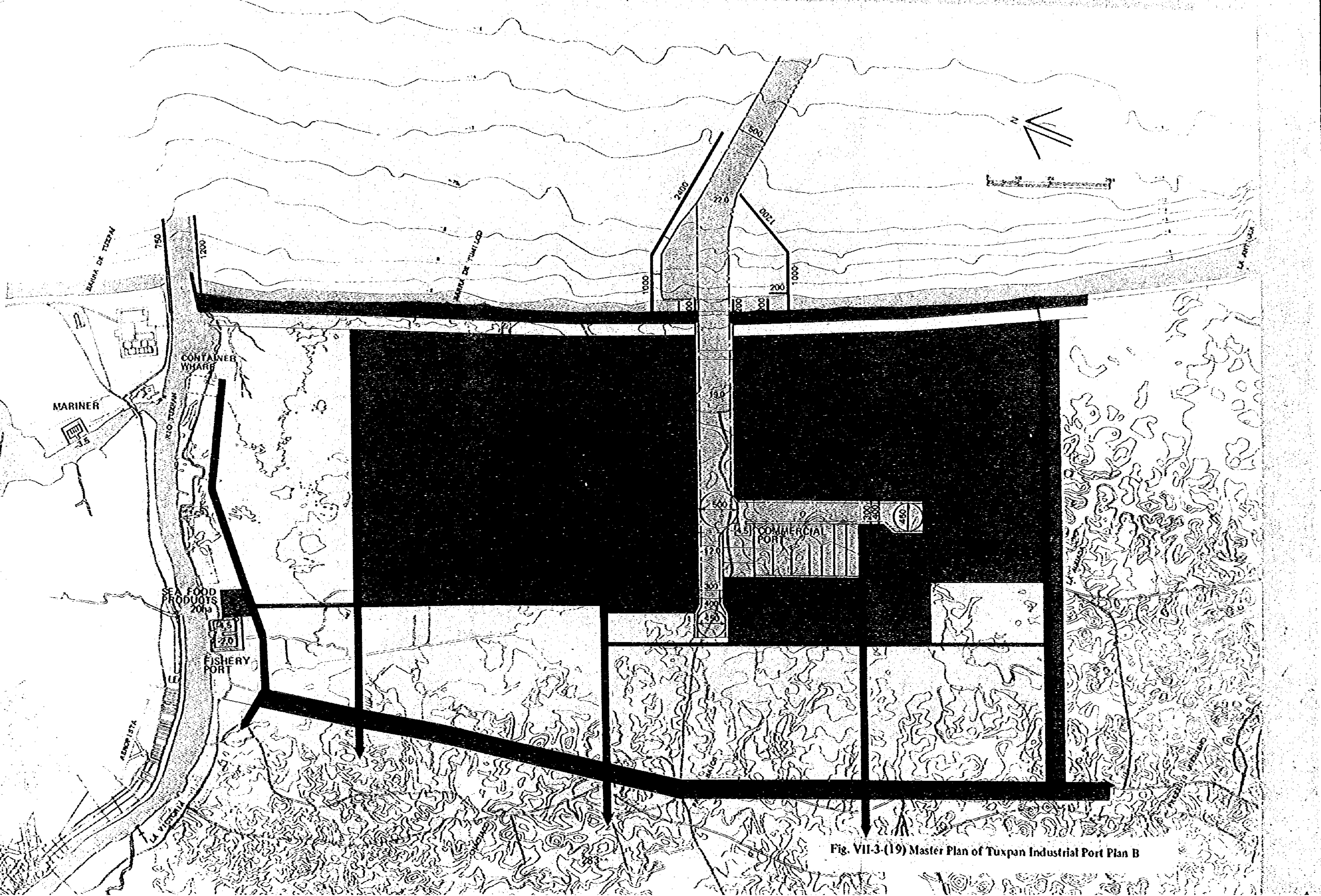


Fig. VII-3-(19) Master Plan of Tuxpan Industrial Port Plan B

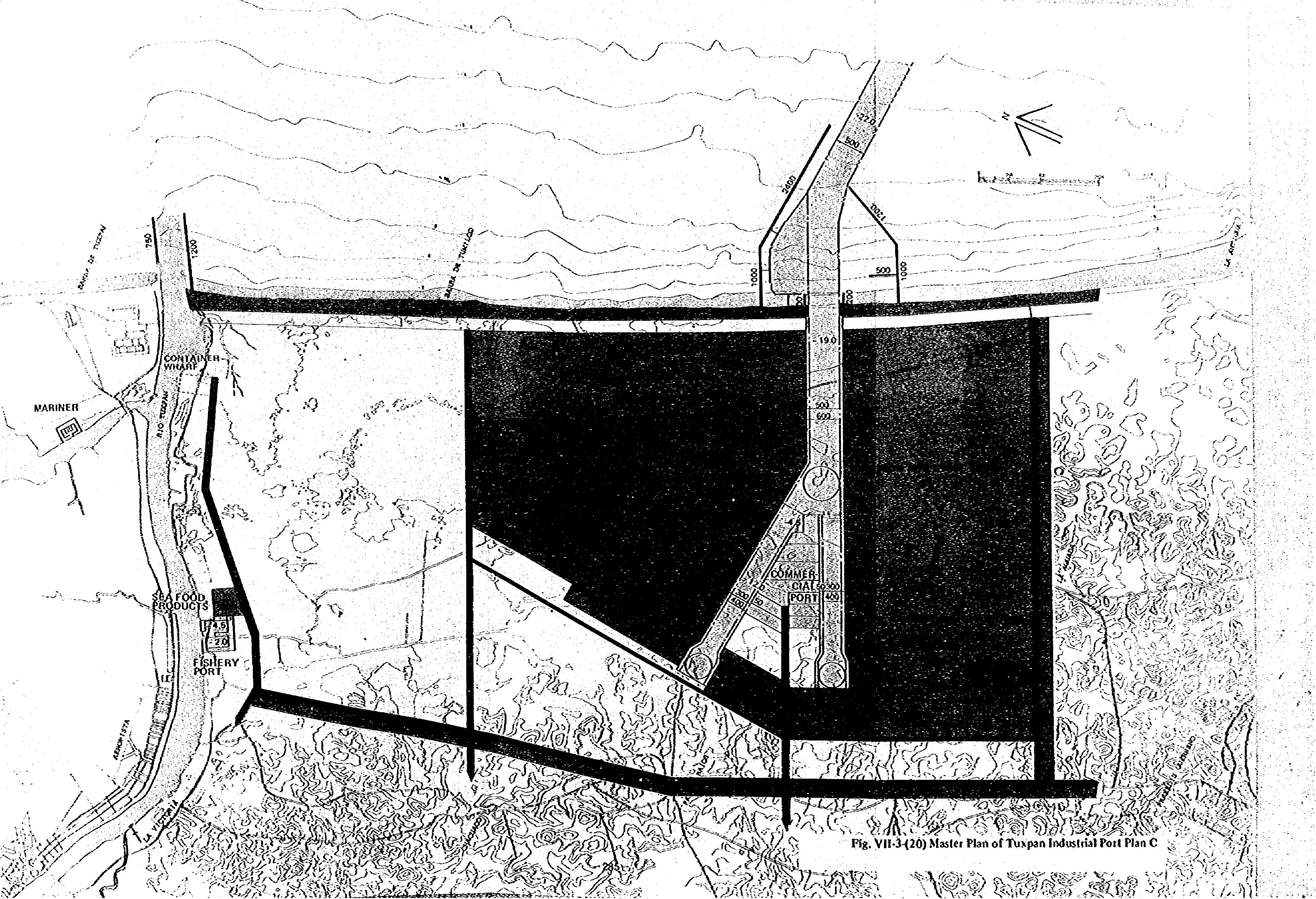


Fig. VII-3-(20) Master Plan of Tuxpan Industrial Port Plan C

4. Environmental Assessment and Planning

4-1 General

Table VII-4-(1) and Table VII-4-(2) show the various effects upon the natural environment expected due to construction and operation of the large scale development at Tuxpan. During construction, the environment will be greatly affected by development factors such as logging, land reclamation, altering the courses of rivers and streams, waterway excavation, collection of sand and gravel for cement and soil for land fill material, etc. During operation of the planned development, the local air and water quality will be greatly affected by the presence of industrial plants along the coast, an industrial waste treatment station, a thermal power station, motor vehicles, etc. This section will present a general survey of the impact of the project or various aspects of the natural environment, and will propose measures to reduce this impact.

Table VII-4-(1) Breakdown of Environmental Impacts upon the Natural Environment during Construction

Affected Features of the Natural Environment		A. Alternation of the natural geography						B. Removal and transportation of material				C. Construction						
		a. Cutting down the trees	b. Dredging	c. Reclamation	d. River improvement	e. Waterway excavation	f. Drainage network reformation	a. Collection of sand and gravel for cement aggregate	b. Soil collection for land fills	c. Ocean transportation of materials	d. Land transportation of materials	a. Land cutting	b. Banking	c. Drilling and blasting	d. Foundation work and excavation	e. Pile driving	f. Concrete work	g. Pavement
1. Land	(1) Topographic features			O	O	O	O	O	O			O	O	O				
	(2) Soil	O					O	O	O			O	O				O	O
2. Water	(1) Surface water	O		O	O	O	O	O	O			O	O	O	O		O	O
	(2) Ground water	O	O	O	O	O	O	O	O			O	O		O	O	O	O
	(3) Ocean		O	O														
	(4) Water quality		O	O		O		O	O	O		O					O	O
	(5) Water temperature		O															
3. Air	(1) Air quality	O						O	O		O	O		O				
	(2) Air temperature	O											O				O	O
	(3) Wind direction and velocity	O				O		O	O			O	O					
	(4) Noise	O				O		O	O		O	O			O	O	O	O
	(5) Vibration	O				O		O	O		O	O			O	O	O	O
	(6) Offensive odors		O								O							O
4. Geophysical and meteorol-ogical mechanisms	(1) Rainfall run-off system	O		O	O	O	O	O	O			O	O				O	O
	(2) Land vibration system	O						O	O		O	O	O		O	O		
	(3) Micro-meterological situation	O		O	O	O	O	O	O		O	O	O	O			O	O
5. Flora	(1) Natural forest	O			O	O	O	O	O			O						
	(2) Artificial forest	O			O	O	O	O	O			O						
	(3) Agricultural products				O	O	O		O			O	O					
6. Fauna	(1) Wild animals	O		O	O		O	O	O			O	O					
	(2) Birds	O		O	O	O	O	O	O			O						
	(3) Fishes		O	O	O	O	O	O										
7. Ecosystem	(1) Forest ecosystem	O			O		O	O	O			O						
	(2) Arable land ecosystem						O						O		O			O
	(3) Rivers and lakes ecosystem		O	O	O	O	O	O										
	(4) Sea ecosystem		O	O														
8. Natural scenery	(1) Mountainous land	O						O										
	(2) Plateau and hilly land	O						O	O			O	O				O	O
	(3) Lowland and arable land				O	O	O	O	O			O	O	O			O	O
	(4) Rivers and lakes			O	O	O		O	O								O	O
	(5) Seashores			O		O				O								
	(6) Ocean									O								

Table VII-4-(2) Breakdown of Environmental Impacts upon the Natural Environment during Operation

Affected Feature of the Natural Environment		A. Coastal industrial complex: a. Marine products and foods industry	A. b. Paper and carboard industry	A. c. Oil refining industry	A. d. Petrochemical industry	A. e. Iron and steel	A. f. Machinery industry	A. g. Heavy electric equipment industry	A. h. Motor vehicle industry	A. i. Shipbuilding industry	A. j. Industrial waste treatment plant	B. Port: a. Excavated channels and anchorages	B. b. Breakwaters	B. c. Ships	B. d. Port roads and railway	C. Urban area: a. New town	C. b. Existing town	C. c. Light industry region	C. d. Sewage disposal plant	C. e. Garbage disposal plant	C. f. Airport	C. g. Marine recreational base	C. h. Motor vehicles	C. i. Roads, railways and bridges	D. Others: a. Thermal power plant	D. b. Power transmission facilities	Remarks
1. Air	(1) Air quality																										
	SOx	O	O	O	O	O	O		O		O			O		O		O		O			O		O		Mainly SO_2 and SO_3
	NOx		O	O	O	O					O					O		O		O			O		O		Mainly NO^2 and NO_2
	CO		O	O	O	O																	O				
	Dust	O	O	O	O	O	O		O		O							O		O					O		
	HC		O	O	O	O																	O				
	(2) Noise					O	O			O											O		O				
	(3) Vibration					O	O			O											O		O				
	(4) Offensive odors	O	O	O	O						O									O							
	(5) Air temperature	O	O	O	O	O	O	O	O	O	O	O			O	O		O	O	O	O	O		O	O		
	(6) Wind direction and velocity	O	O	O	O	O	O	O	O	O	O	O			O	O		O	O	O	O	O		O	O		
2. Water	(1) Water quality																										
	PH																										Normalized by treatment
	DO(COD)	O	O	O		O																					
	SS	O	O			O																					
	Coliform germ																		O								
	Oils		O	O	O									O													
	Transparency	O	O	O		O																			O		
	Warm water drainage																								O		
	(2) Ground water											O															Change in ground water level and conversion into salt water
	(3) Tidal current											O	O														
3. Land	(1) Soil										O																
4. Flora	(1) Natural forest		O	O	O	O						O											O		O		Mainly airborne salts and soot
	(2) Agricultural products		O	O	O	O						O											O		O		
5. Fauna	(1) Mammals																										
	(2) Birds																										
	(3) Aquatic animals	O	O	O	O	O						O													O		Warm drainage, dredging (fishes, shells, eggs, young fishes, benthos, plankton)
6. Natural Scenery		O	O	O	O	O	O	O	O	O	O	O	O		O	O		O	O	O	O	O		O	O	O	

(1) Impact of new industries on the environment

This section studies the amount of pollution that will be caused by the new industries, and the extent to which it is possible to minimize this pollution by means of pollution control equipment. As factors affecting air, sulfuric oxides (Sox) and soot are investigavated. As factors affecting water, COD (indicating the effluent load of organic maters) and SS (indicating the amount of suspended solids) are investigavated.

(a) Impact on air quality

Quantities of SOx and soot are indicated in terms of their amount of annual emission (t). These quantities have been estimated according to the following procedures. For the oil refining, petrochemicals and iron and steel industries, estimates have been based on actual calculations made in Japan when planning large industrial projects. For other industries, these estimates of pollution quantities have been based on surveys at leading Japanese plants of SOx and soot emission prior to filtration through air purification equipment.

Results are shown in Table VII-4-(3).

Large quantities of SOx are emitted in the oil refining industry through the process of removing sulfur contained in crude oil. Substantial SOx emissions are also emitted through fuel consumption by the iron and steel industry, the paper and cardboard industry and the petrochemicals industry. These four industries alone account for 85 percent of the total quantity. Soot pollution comes predominantly from the iron and steel industry which handles iron ore and coal. This industry alone accounts for 78 percent of the total quantity of soot.

Table VII-4-(3) Estimates of Air Pollutant Quantities

(Ton/Year)

Type of Industry	SOx	Soot and dust
Sea food products	490	90
Wheat flour	20	–
Vegetable oil	280	20
Feedstuff	10	–
Paper and cardboard	5,500	9,000
Petroleum refining	10,950	1,430
Oil refining	5,000	650
Iron and steel	8,460	45,000
Fabricated metals for ocean use	60	40
Construction machinery	210	110
Chemical machinery	800	430
Heavy electric machinery	60	10
Motor vehicles	2,070	830
Shipbuilding	140	60
Total	34,050	57,670

(b) Impact on water quality

COD and SS quantities are indicated in terms of daily emission (t). Quantities have been determined according to the following procedures. For the oil refining, petrochemicals and iron and steel industries, estimates have been based on actual calculations made in Japan when planning large industrial projects. For other industries, these estimates of pollution quantities have been based on surveys at leading Japanese plants of COD and SS levels in water prior to filtration through purification equipment.

Finally, the water pollution levels estimated through the above methods are multiplied by the volume of discharge water (as estimated from fresh water consumption).

Results are shown in Table VII-4-(4).

The largest quantity of COD is discharged from the paper and cardboard industry because of its handling of wood chips and organic matter. The iron and steel industry, discharging large quantities of polluted water, is the second largest source of COD pollution. These two industries account for 80 percent of the total COD discharge. As for the SS discharge, by far the largest amount comes from the iron and steel industry which handles ores and coal. This industry alone is responsible for 94 percent of the total SS discharge.

Table VII-4-(4) Estimation of Water Pollutant Quantities

Type of Industry	COD		SS	
	Density (ppm)	Load (ton/day)	Density (ppm)	Load (ton/day)
Sea food products	1,700	11	450	3
Wheat flour	–	–	–	–
Vegetable oil	3,100	3	2,600	3
Feedstuff	–	–	–	–
Paper and cardboard	280	86	180	31
Oil refining	50 – 100	1	50 – 100	1
Petrochemicals	5 – 46,000	18	10 – 100	3
Iron and steel	10 – 100	56	10 – 800	621
Fabricated metals for ocean use	–	–	–	–
Construction machinery	–	–	–	–
Chemical machinery	40	–	30	–
Heavy electric machinery	–	–	–	–
Motor vehicles	90	2	–	–
Shipbuilding	–	–	–	–
Total		177		662

(2) Environmental protection measures

Quantities of air and water pollution calculated in the above studies are not, of course, the actual quantities of pollution discharges. It is common practice in such countries as Japan to remove major-quantities of pollutants before discharge. The following sub-sections present a study on methods for pollution control, pollutant removal rates, and scale of investments. Figures regarding SOx emissions and COD discharges are based upon figures from the Japanese iron and steel industry, oil refining industry, petrochemicals industry and paper and cardboard industry.

(a) Air pollution control

Japanese industries employing advanced techniques of air pollution control have been able to reduce SOx and soot loads by 90 – 95%, in other words, reduced to 1/10 – 1/20 of former levels. The techniques that have made possible this degree of air pollution control can be summarized as follows:

In the iron and steel industry, SOx and soot are found largely in exhausts from sintering furnaces, heating furnaces and boilers. Soot can be extracted from these exhausts by wet and dry EP methods, while SOx can be removed by flue-gas desulfurization.

In the oil refining and petrochemicals industries. SOx is found largely in exhausts produced during the oil refining process and from combustion of fuel oil used for power generation.

SOx can be removed from these exhausts by flue-gas desulfurization. In the paper and cardboard industry, large amounts of SOx are emitted from the power generating boiler. In addition, large amounts of SOx and soot are emitted from the chemical liquid recovering boiler. From these exhausts, SOx is removed by flue-gas desulfurization, while soot is removed by an electrical dust collector.

In order to remove 90% of the SOx load, then the investment for air pollution control will amount to 3 – 4% of the total construction investment. If the SOx removal rate is increased to 95 percent, then the investment for air pollution control will increase to 7 – 15 percent.

Past experience at large Japanese industrial projects, similar to the Tuxpan Industrial port, has shown that strict environmental standards can be met by first treating exhausts by the methods explained above, and then exhausting the gas from a tall smokestack, thereby facilitating diffusion of the pollutants. (See Table VII-4-(5))

Table VII-4-(5) Required Air Quality Levels (Daily Average) in Japan and Other Countries (1975)

	SO_2 (ppm)	Suspended particulate matter (mg/m^3)
Japan	0.04	0.10
Canada	0.06	0.12
Finland	0.10	0.15
Italy	0.15	0.30
U.S.A.	0.14	0.26
West Germany	0.06	...
France	0.38	0.35
Sweden	0.25	...

Source: For SO_2 and suspended particulated matter: Wemer-Martin and Arthur C. Steam, The Collection, Tabulation, Codification and Analysis of the World's Air Quality Management Standards, School of Public Health, University of North Carolina at Chapel Hill, N.C., U.S.A., October 1974.

(b) Water pollution control

Japanese industries employing advanced techniques of water pollution control have been able to reduce COD loads by 90 -- 98% and SS loads by 97 – 98%, in other words, reduced respectively to 1/10 – 1/20 and 1/20 – 1/30 of their former levels.

COD is removed by the combined use of activated charcoal process, activated sludge process and ozone oxidation.

SS is removed by either aggregated pressuring combined with flotation process or by aggregated filtration process.

The investment for water pollution control requires only 0.4 – 0.6 percent of the total construction investment, assuming a COD removal rate of 90 – 95 percent. If the COD removal rate is increased to 94 – 98 percent, then the investment for water pollution control would increase to 15 – 20 percent.

Past experience at large Japanese industrial projects shows that high quality water standards can be achieved through the above-mentioned methods.

4-2 Planned Environmental Protection Facilities

(1) Industrial waste treatment plant

In drawing up plants for an industrial waste treatment plant, the following matters must be studied in detail.

1) boundaries of the area for which industrial wastes will be treated.
2) content and quantities of industrial waste.
3) quantity and percentage of recyclable waste.
4) quantity of waste requiring intermediate treatment as distinct from other non-recyclable waste.

5) nature of intermediate treatment methods.
6) total quantities to be disposed of (including waste after intermediate treatment).
7) calculation of the volume of space required for waste disposal, and selection of a disposal site.

The following is a summary of kinds of industrial waste expected as a consequence of this coastal industrial complex, and respective methods of intermediate treatment.

Industrial wastes	Intermediate treatment method
Cinders	—
Organic sludge	Incineration
Inorganic sludge	—
Waste oils	Incineration
Waste acids	Neutralization, dehydration
Waste alkalis	Neutralization, dehydration
Waste plastics	Crushing, cutting, melting
Waste paper	Incineration
Waste wood	Incineration
Waste metals	—
Animal and vegetable residues	Incineration
Waste rubber	Crushing, cutting
Slag	—
Industrial dusts	Granulation, concretion

Intermediate treatment methods include on-site systems and off-site systems. An on-site system is a system in which an intermediate treatment facility is installed at a particular source of industrial waste. This system is usually adopted by large enterprises or factories which generate large volumes of industrial waste. An off-site system is a system in which industrial wastes are collected from several industrial sites in a region for joint treatment. This system can be put into practice by co-operatives comprised of several industries, by regional public agencies, or by private industrial waste treatment contractors. As for the Tuxpan industrial complex, the borders must first be set for the area in which industrial wastes will be treated. That is, whether will only the coastal industrial complex be included, or will industrial wastes generated at existing industries in Tuxpan and Roza Rica also be included? Based upon the treatment capacity thus decided, the above alternative systems must be properly examined.

An industrial waste disposal plant would occupy about 2 to 4 ha. If the final disposal land is also calculated, then a total area of 20 to 50 ha would be required. As air pollutants such as SOx and NOx are expected to also be generated from the plant, environmental protection measures must also be considered, such as construction of a 100 m or higher centralized chimney in addition to stack gas desulfurization facilities and stack gas denitration facilities. Furthermore, in securing final disposal land, later use of the site must also be considered.

(2) Waste oil treatment facilities

It is assumed that oil contamination in the port is caused mainly by the following two sources.

1) Leaks from oil tankers

2) Drainage of waste oil

Oil leakage from tankers is discussed in the section on disaster prevention measures. Thus, this section deals with waste oil drainage.

Both bilge and ballast water will have to be treated, but since most waste oil occurs in ballast water, the treatment of ballast water will be discussed here.

(a) Amount of ballast water generated

Based on experience in Japan, the amount of ballast water generated is assumed to be 0.3 to 0.45 m^3 per D.W.T. at a density of 20 to 5,000 ppm. However, for this port project, the upper value of 0.45 m^3 per D.W.T. has been adopted.

(b) Calculation of facility scale

The average treatment capacity of such facilities in Japan are estimated according to the following premises:

minimum oil contained is less than 1 ppm and suspended particulate matter contained is less than 10 ppm for treated water; operational hours of the facilities are 8 hours.

Average facility scale	:	7,213 m^2
Treatment capability	:	Max. 3.15 ppm, min. 0.48 ppm, mean 1.17 ppm
Hourly treatment capacity	:	146.2 m^3/h

Based on these figures, the daily average treatment capacity is estimated at 8 hours x 146.2 ÷ 1,170 m^3/day. The site area per treatment capacity is estimated at 7,213 m^2 ÷ 1,170 m^3/day ÷ 6.2 m^2/m^3day.

In order to estimate the scale of facilities required for Tuxpan industrial port, the following equations are employed concerning the tanker berths and petroleum product loading berths, where it is assumed that ballast water will be generated in large volumes, and also concerning other exclusive berths and commercial berths.

Tanker berths: $\{(250,000 \times 1) + (100,000 \times 1) + (70,000 \times 1)\} \times 0.45 = 189,000$ m^3/day

Petroleum products loading berths: $40,000 \times 4 \times 0.45 = 72,000$ m^3/day

Required facility scale: $(189,000 + 72,000) \times 0.4^{*} \times 6.2$

÷ 64.7 ha (* Berth occupation rate)

If ballast water generated at other exclusive berths and commercial berths is considered, then the scale of facilities becomes: 64.7 x 1.1 ÷ 71 ha

In the treatment system for this port, every berth that handles liquid cargoes will be equipped with facilities to transport waste oils directly by pipeline to the treatment plant. The treatment plant will occupy an area of 72 ha including roads and green space.

Thoroughgoing measures will be taken to prevent oil leakage onto land or sea.

(3) Sewage disposal plant

As calculated in Chapter VII-2, 2-8, urban sewage volume has the following characteristics.

Maximum flow per day	:	210,000 m^3/day
Peak flow per hour	:	12,100 m^3/day
Average flow per day	:	160,700 m^3/day

To effectively treat the sewage, it is preferable that rainwater run-off and sewage be separated.

Facilities required for sewage treatment include conduits, relay pump stations, a final disposal plant, receiving, transforming and distribution equipment for the electricity supply, a control building, etc. As for BOD and SS removal rates at the final treatment station, the following standard values for Japan may be assumed.

Level of Treatment		Removal Rate (%) BOD	SS
Primary Treatment	Simple Treatment	25 – 35	30 – 40
Secondary Treatment	Medium Treatment	65 – 75	65 – 75
	Advanced Treatment	75 – 95	70 – 90

This disposal plant will be located together with the garbage disposal plant south of the industrial port area, since the treated water is discharged directly into the sea.

(4) Garbage Disposal

To effectively plan for garbage disposal, the following must be thoroughly studied:

1) boundaries for the collection area
2) forecast of types of refues (combustible or non-combustible materials)
3) method of collection
4) intermediate treatment methods
5) acquisition of final disposal land

As a first step, the volume to be intermediately treated will be estimated. This estimation will assume a collection area covering the new city and the existing urban area of Tuxpan.

(a) Estimation of the average treatment volume per year ($\bar{W}$)

Population covered: 463,900 (including the population in the existing urban area of Tuxpan in 2000)

Average discharge volume per day per capita: 1,000 g/day person (A slightly larger value has been estimated based on the actual value in major cities in various countries)

Volume carried in by non-public operated means: 20% of the total treatment volume (estimate based on actual values measure of 15 to 25%)

$\bar{W}$: 463,900 persons x 1,000 g/person day x 1.2 = 557 tons/day

(b) Estimating the maximum treatment voume per month (W^m)

Coefficient of variation: 1.2 (the actual Japanese value has been adopted)

W^m: 557 tons/day x 1.2 ≑ 668 tons/day

The disposal plant will be located together with the sewage disposal plant south of the industrial port area, in consideration of efficient collection and transport, access from truck roads, environmental protection, future expansion, distance from residential districts, etc.

Required land per ton of garbage has been calculated as follows, assuming incineration treatment.

Land for incineration treatment facilities: 120 m^2/t

Surrounding service land area (green space, etc.): 60 m^2/t

Required area of the site: 668 tons/day x (120 m^2 + 60 m^2) ≑ 12 ha

According to this plan, 25 ha will be obtained for both the sewage disposal and garbage disposal plants. (See Fig. VII-2-(5) and Fig. VII-2-(16))

(5) Green space planning

(a) Green space planning at Tuxpan Industrial Port

The following green spaces will be allocated in the industrial port area, in order to protect the environment of the industrial port and new city, and as places of rest and recreation for workers at the industrial complex.

1) Kinds of green space

Symbolic green space
Recreational green space
Leisure green space
Buffer zone green space
Scenic green space
Natural green sapce

2) Estimation of green space

Excluding buffer zone green space, scenic green space and natural green space, the following standards will be adopted, in light of the area reserved for parks in various major cities around the world.

Park areas per capital in major cities of various countries.

Washington D.C.	45.2 m²
New York	19.0
Chicago	7.9
London	10.0
Paris	8.9
Wien	26.7
Zürich	6.4
Frankfurt a.M.	9.1
Amsterdam	14.1
Moscow	10.9

Zone	Kinds of Green Space	Area (ha)
I	Recreational Green Space	5.3
II	Leisure Green Space	4.5
III	Recreational Green Space	8.3
IV	Recreational Green Space	6.8
	Leisure Green Space	4.5
V	Recreational Green Space	9.6
	Leisure Green Space	7.0
VI	Symbolic Green Space	9.0
	Recreational Green Space	10.0
	Total	65.0

If per worker green space of 15 m² in the industrial complex is to be obtained, then the following equation must hold true: 43,000 persons x 15 m² ÷ 65 ha

Fig. VII-4-(1) shows green space zoning in terms of proximity to various industries and kinds of green space.

A total of 65 ha of green space will be allocated proportionately to the number of workers in each zone, as will each kind of green space.

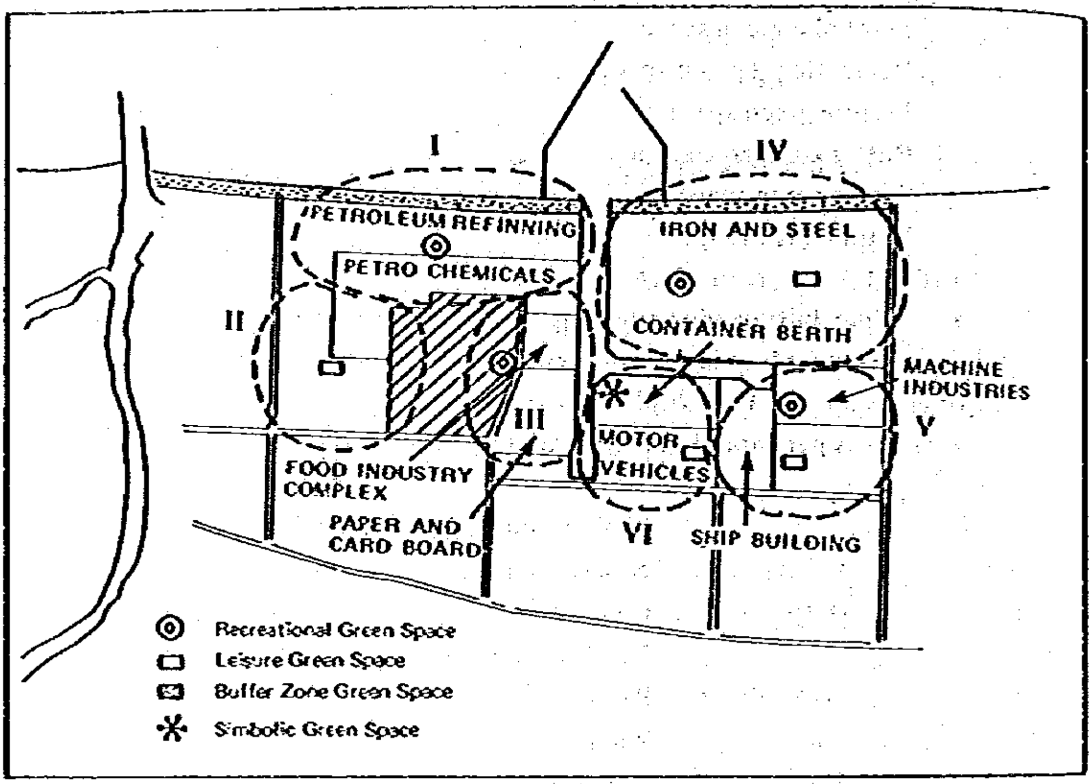


Fig. VII-4-(1) Zoning and Distribution of Green Space

3) Symbolic green space

This green space will be allocated at the center of the industrial port. Around it will be distributed such port functions as port administrative facilities, welfare facilities, port service facilities etc. It is planned not only for persons related to the industrial port and workers in the industrial complex, but also for all local citizens.

In this green space will also be situated an observatory, an industrial port development museum, recreational facilities, etc.

≪List of facilities≫ Observatory, Industrial port development museum, Open spaces, Food stands, Restaurants, Resting places, Parking lots, Promenades

4) Recreational green space

This type of green space is aimed at providing sport facilities and playing fields for people connected with the industrial port and for workers from the industrial complex

This type of green space will be allocated in zones I, III, IV, V and VI.

≪ List of facilities ≫ Plazas, Tennis courts, Swimming pools, Food stands, Resting places, Parking lots, Promenades

5) Leisure green space

This type of green space is aimed at providing space for strolling and relaxing for people connected with the industrial port and for workers from the industrial complex.

This type of green space will be allocated in zones II, IV and V.

≪ List of facilities ≫ Flower gardens, Ponds, Squares, Food Stands, Resting places, Promenades

6) Buffer zone green space

This type of green space is aimed at reducing noise as well as reducing the impact of accidents that may occur due to fires or explosions along the paths of industrial roads or pipelines.

Trees will be densely planted in 200 m wide green belts in order to enhance the buffer function.

≪ Estimated area ≫ 27,900 m x 200 m = 558 ha

7) Scenic green space

The scenic green space will block the view of the coastal industrial complex when observed from the sea.

This 200 m wide green belt will also project the natural shoreline.

≪ Estimated area ≫ 13,300 x 200 m = 266 ha

8) Natural green space

As the Tumilco area has relatively hard soil with an N value of over 50 at −5 to −10 m underground, and as it is important to protect the environment at the industrial port, this area will be left in its present condition as a natural green space.

≪ Estimated area ≫ 600 ha

(b) Parks and green space planning in the new city

Parks and green spaces in the new city are to have the following functions:

1) Recreational functions such as sports and leisure
2) A site for resting, strolling and appreciating the natural environment
3) Urban environmental protection
4) Emergency shelter in case of an urban disaster

Parks and green space in the new city will enhance city living conditions by providing a clean environment and opportunities, for outdoor activities. In this project, parks and green space shall be given precedence comprehensive city planning so as to create a urban functions in the favorable natural environment for Tuxpan.

(i) Kinds of parks and green spaces

To achieve the above mentioned goals, the following kinds of parks and green spaces are planned for the new city.

≪ Parks ≫
- Play lot
- Neighborhood play ground
- Neighborhood park
- District park
- Central park (Park for arts)
- Sports park

≪ Green Space ≫
- Natural green space
- Buffer green space
- Shelter green space
- Green way

(ii) Scale and allocation estimates

≪ Parks ≫

The residential district of the new city is divided into 11 neighborhood districts which are then each further divided into 4 neighborhood units, for a total of 45 neighborhood units, as described in the land use plan in Chapter VII, 2-4, (2).

Therefore in this paragraph, the allocation of parks will be planned based on the neighborhood unit theory.

Kind of parks	Allocation standards
Neighborhood play ground	4 parks per 1 neighborhood unit
Neighborhood park	1 park per 1 neighborhood unit
District park	1 park per 4 neighborhood units
Central park (Park for arts)	1 park for the entire city
Sports park	1 park for the entire city

Table VII-4-(6) shows examples of standards for park planning in various countries. Taking into account the above allocation standards and information contained in Table VII-4-(6), Table VII-4-(7) indicates the type, scale and average service distances of parks planned for the new city.

Table VII-4-(6) Park Planning Standard

	Recreation Society (U.S.A.)	Public Health Society (U.S.A)	Greater London (U.K.)	Los-Angels (U.S.A.)	Urban Planning Law (Japan)
Play Lot					
1. (m)	-	-	-		500
2. (m^2)	560	-	-	500	2,500
3. (m^2/person)	-	-	-	0.8 - 2.6	-
Neighborhood Play Ground					
1. (m)	400 - 800	400 - 800	540	400 - 600	
2. (m^2)	1.3 - 2.4 ha	1.1 - 2.4	0.4	20	
3. (m^2/person)	-	-	-	-	
Neighborhood Park					
1. (m)	400 - 800	400 - 800	-	400 - 1,200	500
2. (m^2)	1.3 - 2.4 ha	1.3 - 2.6	4.0	20	2.0
3. (m^2/person)	4.8 - 6.5	-	4.0	-	-
Sports Park					
1. (m)	800 - 1,600	-	-	1,200	-
2. (m^2)	4.8 - 8.0	-	12 - 24	60	-
3. (m^2/person)	5.0	-	12 - 24	-	-
General Park					
1. (m)	-	30 - 60 minutes	-	8,000	-
2. (m^2)	-	-	-	12	-
3. (m^2/person)	-	12 - 16	-	2.0	-
Park Area per Inhabitant (m^2/person)					
in the City	-	11.6 - 13.6	-	-	3
outside the City	-	12 - 16	-	-	3
Total	40	23.6 - 29.6	-	-	6
The Rate of Park Area in the City (%)	10	-	22.2 - 22.7	-	-

Note: 1. Service Distance 2. Standard Area
3. Park Area per Person

Table VII-4-(7) Type, Scale and Average Service Distance of Planned Parks

Kinds of Park	Planned Population for a Park (person)	Average Service Distance (m)	Average Area (m^2, ha)	No. of Parks (unit)	Total Area (ha)	Remarks
1. Play lot	560	130	500 m^2	720	36	16 Parks per a Neighborhood Unit
2. Neighborhood Play Ground	2,250	270	1.5 ha	180	270	4 Parks per a Neighborhood Unit
3. Neighborhood Park	9,000	535	3.0 ha	45	135	7 parks per a Neighborhood Unit
4. District Park	36,800	1,030	10.0 ha	11	110	7 Parks per 4 Neighborhood Unit
5. Central Park (Park for Arts)	405,000	3,600	50.0 ha	1	50	7 Parks per a City
6. Sports Park (Sports Garden)	405,000	3,600	70.0 ha	1	70	7 Parks per a City
Total				958	671	
inside residential district				956	551	
outside residential district				2	120	

Note: A central park and a sports park are to be located outside the residential district.

≪ Green Space ≫

1) Buffer green space

Green belts that are 100 m, 50 m and 20 m wide will be obtained and maintained in order to preserve the environment by creating a natural boundary between the residential districts and the light industry which might otherwise cause excessive pollution or lead to potentially dangerous accidents. Likewise, a buffer green space will be maintained between the commercial business districts and the residential districts because of their different land use characteristics. In addition, there will also be buffer green space between the residential districts and urban trunk and semi-trunk roads in order to safeguard against traffic generated noise and air pollution. The area required for the buffer green belts is estimated as follows;

100 m wide green belt: Total length 14 km x 100 m ≒ 140 ha

50 m wide green belt: Total length 6.1 km x 50 m = 30.5 ha

20 m wide green belt: Total length 61.25 km x 20 m = 122.5 ha

Total: 293 ha

2) Green space for shelter

In preparation for urban disasters such as earthquakes, fires and floods, green space for shelter will be allocated in each of the 11 neighborhood districts. As for the scale of the green space, 3 m² per capita (a total of 122 ha) will be obtained.

3) Green way

A green way will be laid out in the residential district so as to interlink various parks and green spaces, and also so that each facility can be reached without frequent crossing of roadways.

A total green way area of 247 ha will be reserved for the residential district.

4) Natural green space

As much as possible land will be kept as natural green space in the central park (park for arts), public medical facilities area, university, golf links and sports park. A total area of 485 ha will be reserved for this purpose.

Type, scale, and allocation of green space are indicated below.

Kind of Green Space	Scale (ha)	Distribution
Buffer Green space	293	Beside trunk and semi-trunk roads,
Shelter Green space	122	7 per neighborhood district in the residential district
Green way	247	
Natural Green space	485	In the central park, medical facilities area, university, golf links and sports park area
Total	1,147	

(inside the residential district 662)

(outside the residential district 485)

According to the above plan, the total area of parks and green space allocated in the new city will be 1,818 ha., summarized as follows;

	Total Area (ha)	Inside the Residential District (ha)	Outside the Residential District (ha)
Parks	671	551	120
Green Space	1,147	662	485
Total	1,818	1,213	605

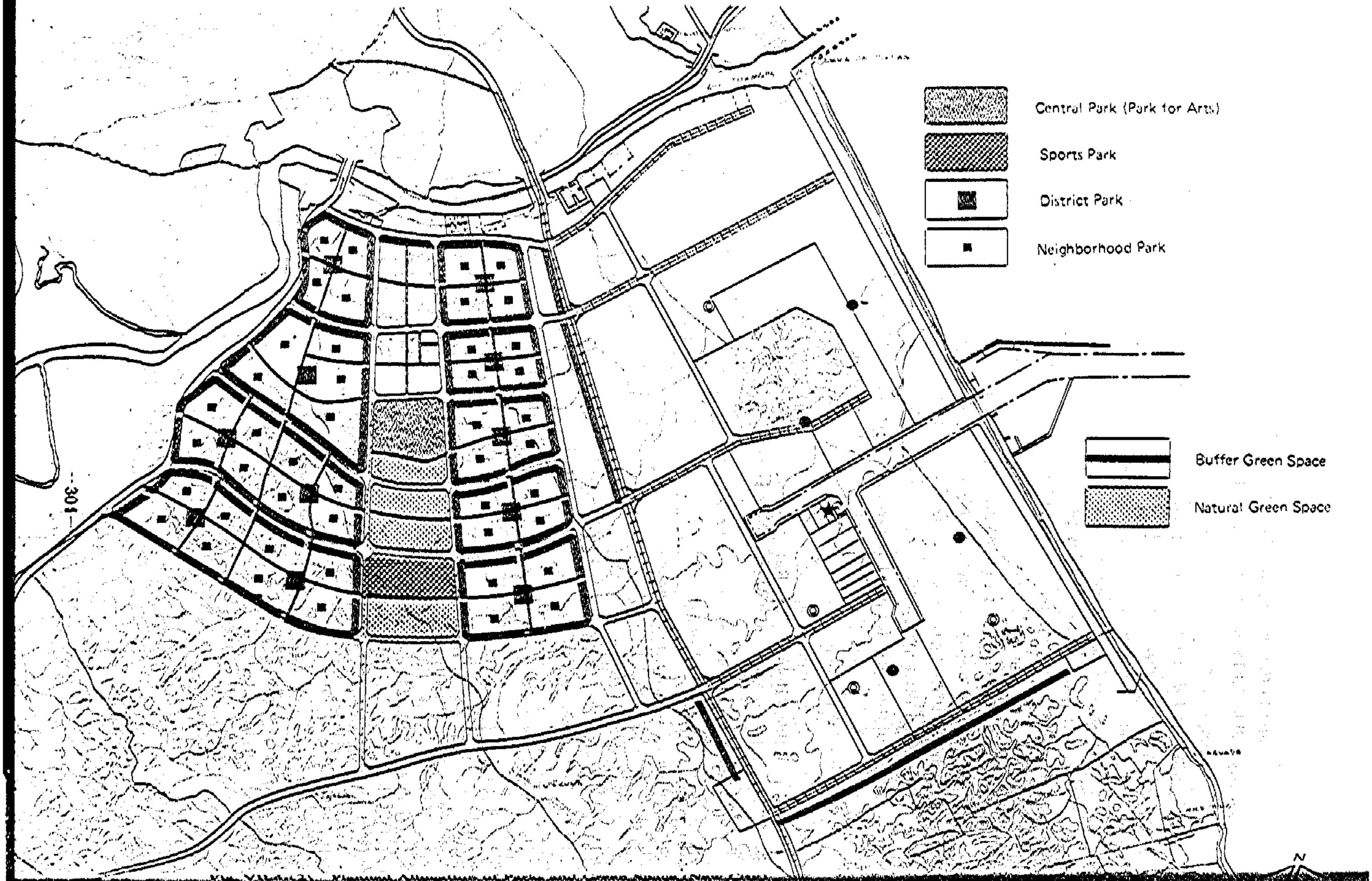
According to this plan, parks and green space area per inhabitant will be about 45 m^2 which is near the average international level for park and green space areas in new towns in various countries.

(See Table VII-4-8)

The allocation plan for parks and green space is shown in Fig. VII-4-(2).

Table VII-4-(8) The Rate of the Area of Parks and Green Space in Typical New Town

Country	Name of the New Town	Site Area (ha)	Percent of the Total Area taken up by Parks and Green Space (%)	Area per Inhabitant (m^2)
Japan	Senri	1,160	24.0	11.9
	Senboku	1,520	22.0	17.8
	Kohoku	2,530	32.8	23.7
England	Cumbernauld	1,136	33.0	51.9
	Thamesmead	525	12.6	11.0
	Runcorn	2,900	30.4	88.1
U.S.A.	Reston	2,800	23.0	85.9
	Columbia	5,480	23.0	114.6
Mexico	Tuxpan	6,200	29.3	44.9


Central Park (Park for Arts)
Sports Park
District Park
Neighborhood Park
Buffer Green Space
Natural Green Space
N

4.3 Disaster Prevention Measures

(1) Prevention measures at the port

Since large quantities of oils will be handled at the port, measures to prevent oil leakage are particularly important. In order to minimize the danger of an oil explosion, the following measures are recommended.

1) Facilities for handling dangerous materials must all be located at one site.
2) A disaster prevention organization staffed by representatives of port industries, the port administration, and other port related bodies must be established.
3) Facilities that handle dangerous materials must always be furnished with fire extinguishing equipment.
4) To prevent the spread of oil in the event of an accident, oil fences must be stored in each channel zone.
   Also, materials to combat oil slicks, such as emulsifier, will also have to be stored.
5) A sufficient number of fireboats, tugboats, etc. must be suitably allocated and a fire fighting team must be thoroughly trained.
6) A sufficient safety distance will have to be secured from each pipeline.

(2) Disaster prevention measures for the coastal industrial complex

Since large quantities of oils, combustible gas, toxic materials, etc. are handled in the complex, there is the possibility that both small-scale and large-scale disasters could occur. Therefore, the following small and large scale disaster prevention facilities must be provided at both individual plants and throughout the industrial complex.

(a) Facilities for prevention of disasters

1) Certain areas will have to be kept vacant so that high pressure gas equipment, electric equipment, boilers and other possibly explosive equipment can be isolated at safe distances from the rest of the industrial complex.
2) Storage tanks will have to be installed with leakage prevention devices and leakage detectors.
3) Ventilation and discharging equipment must be installed to prevent accumulation of dangerous gasses.
4) Fire extinguishing equipment must be installed at every installation.

(b) Facilities for prevention of spread of disasters

1) A special fire station will have to be built in the complex, with special equipment for extinguishing chemical fires.
2) Installations and tanks susceptible to potentially major accidents must be kept at safe distances from one another.
3) Concrete embankments will have to be builts surrounding oil storage tank areas to safeguard against spillage.
4) Fire walls will must be constructed.
5) Cooling equipments such as sprinklers and water spray machines will have to be installed to prevent the spread of possible fires.
6) Emergency power supply must be installed.

7) Communication and information equipment must be installed.

8) Danger signs must be appropriately affixed.

(c) Facilities to prevent large scale disasters from spreading to outlying areas.

1) Plants in the industrial complex must be located of a safe distance from the urban area.

2) Oil banks, fire or explosion preventing walls, and green belts will have to be properly arranged.

(3) Disaster prevention measures for the new city

The main disaster prevention measures for the new city are as follows;

1) To prevent major urban conflagrations, structures in the new city must be constructed from non-combustible materials. Firebreaks will be comprised of inflammable buildings open spaces, roads, parks, etc.

Furthermore, a central fire station and fire sub-stations, properly equipped, must be laid out at appropriate urban sites. There will be one fire sub-station per neighborhood district.

2) Though flooding of the Tuxpan River is highly unlikely, to prepare for this possible contingency, the residential district will have to be laid out on hilly land, and a proper drainage plan will also have to be drafted.

3) In preperation for a possible emergency or disaster, emergency shelter green space must be set aside in each neighborhood district.

In addition, an organizational plan must be drafted to provide for orderly use of the various parks and university sites as places of shelter.

4-4 Influence of the Project on Tuxpan River Flooding

We briefly study the possible influence of the Project on the Tuxpan river flooding. First, we classify the propable influence into two categories:

1) Direct Influences: Caused by constructing structures in the Tuxpan river;

2) Indirect Influences: Caused not by structure construction in the River but other factors due to the execution of the Project.

Hereinafter, with respect to our recommended master plan B, we will estimate the scale of effect.

(1) Direct influences

The following two facilities will be built in the Tuxpan river.

(a) The container wharf: one berth on the right bank, about 1.5 km upstream from the river mouth

(b) The fishery port: On the right bank about 5.5 km upstream from the river mouth

These facilities are to be built in the river where they will have at the least influence on the flow. Besides, these facility constructions will increase the cross-section of the river so they will not have an adverse effect on flooding.

However, we have to pay careful attention to the following factors which may affect river flooding.

1) The construction of the container wharf decreases the volume of the retarding basin and hinders the river flow into the flood plain.

2) Since the fishery port will be built at juncture with the drainage flowing down from Tumilco hill, it is important that it be preserved.

Prior to the Project, the expansion of the river mouth, as part of the plan for the power plant construction at Chile Frio, will increase the cross-sectional area of the river (to about twice as large as the current 2000 M^2), this factor will have an advantageous effect against flooding.

(2) Indirect influences

The following two factors seem to predominate.

(a) Decrease of the retarding function due to filling-up the flood plain at the river mouth.

Because of the lack of information on the Tuxpan river inundations, as well as on the topography along the river, it is difficult to know the situation in the case of river flooding. But there seems to be two flood plains, one is in the area 5 to 10 km upstream from the Tuxpan urban area and the other is at the river mouth.

The filled up land area designated for the industrial complex occupies about 70 percent of the low land on the right bank of the river mouth. Filling in such a large area of the flood plain will probably have an adverse effect on upstream flooding.

(b) Increase of rain water run of due to the construction of the new city and the new industrial complex.

As mentioned in Chapter VII, 2-6, the runoff of rain water from the new city is calculated to be 198 m^3/sec, of which half is designed to drain directly into the Tuxpan river. The run off capacity is calculated to be 197 m^3/sec for the whole Industrial Complex. It is more ecomical to drain the rain water directly into the sea or the port channel. Therefore, the increase of drainage water due to the constructions of the new city and the industrial complex will be approximately 90 m^3/sec. According to Table V-4-(1), the maximum discharge between 1960 and 1970 of the Tuxpan river was recorded at 1905 m^3/sec, so we can presume that the increase of run off due to the execution of the Project will be about 5 percent.

In other words it will not have a great influence on the flow.

(3) Counter measures

As already mentioned in Chapter V-4, it is absolutely necessary to build a resevoir dam in order to ensure the required fresh water. It is expected for the dam to function as a flood control. As a conclusion, it is advisable to formulate an overall river development plan for the rivers in the Area, i.e. the Cazones, the Tecolutla and the Tuxpan river. For the first step, it is desirable to conduct a survey on the Tuxpan river.

5. Cost Estimation and Evaluation

5-1 Design of Basic Port Facilities

(1) Breakwaters

(a) Design conditions of breakwaters

Fig. VII-5-(1) shows the water depth and the locations of the breakwaters adopted as alternatives for port planning. The breakwater cross sections are typically designed for a water depth of −0.9 m.

According to Chapter V. 3-3, design significant wave high (H 1/3) is 6.5 m.

(b) Crosssection design

The two types of structure, a rubble mound breakwater (Fig. VII-5-(2)) and a caisson composit type breakwater (a breakwater with concrete caisson placed on the rubble mound, Fig. VII-5-(3)) were preliminarily designed. Once a choice between the alternatives mentioned in the preceding section is made, then the detailed design of the North and South breakwaters relevant to the water depths should be carried out, including the breakwater head and bending point.

At present, a typical corsssection has been designed in order to roughly estimate the construction cost.

The height of the top of the breakwater above sea level is +5.0 m, as 0.6 $H_{1/3}$ or more. The front gradient of the rubble mound breakwater is 1:2, the rear gradient is 1:15. The front gradient is slightly gentler. The weight of the concrete brocks on the seaward face shall be 35 t. 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 concrete caisson is determined to be 4 m in consideration of the wave hight and soil condition.

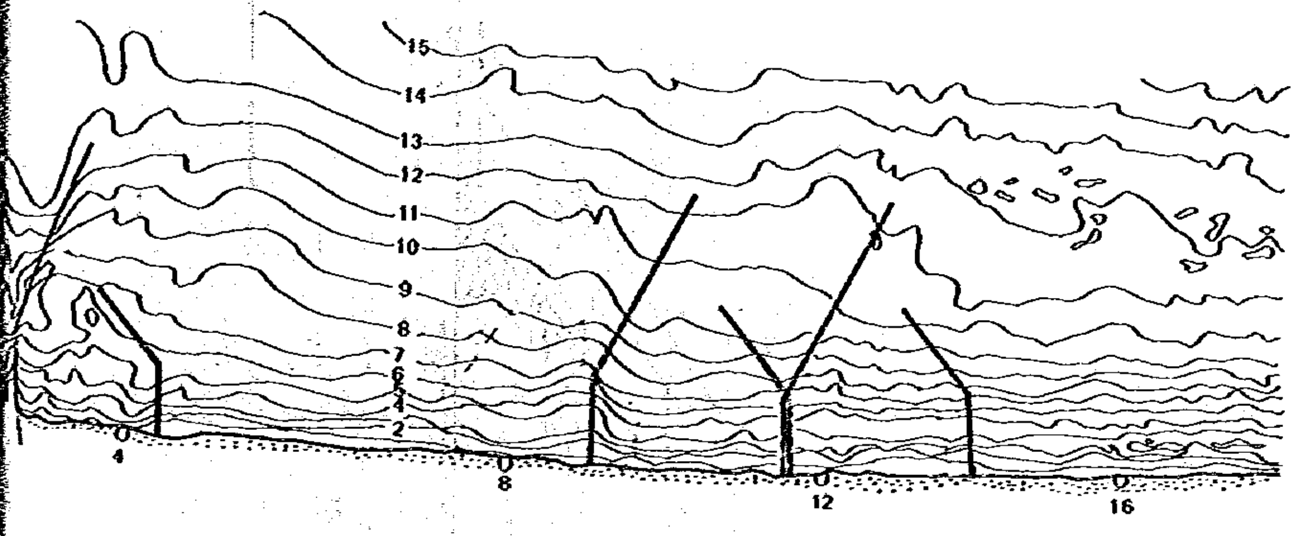
Soil borings under the sea in the area of the site for breakwaters are now being carried out. Since results from this test were not available, the design of the caisson type breakwater which requires higher ground bearing capacity, must be reaffirmed after getting results.

(c) Structural types of breakwaters

The roughly estimated construction cost of the rubble mound type breakwater (at typical cross section shown in Fig. VII-5-(2)) is almost same as the cost of the caisson composite type breakwater (shown in Fig. VII-5-(3)).

As for the caisson composite type breakwater, cost for a caisson fablicating yard must be included in the calculations. Nevertheless, it will be more economical of construction time and materials to use the caisson composite type when the design water depth is deeper than −9.0 m.

In the stage of the short term development plan, this point, too, should be discussed comparatively.



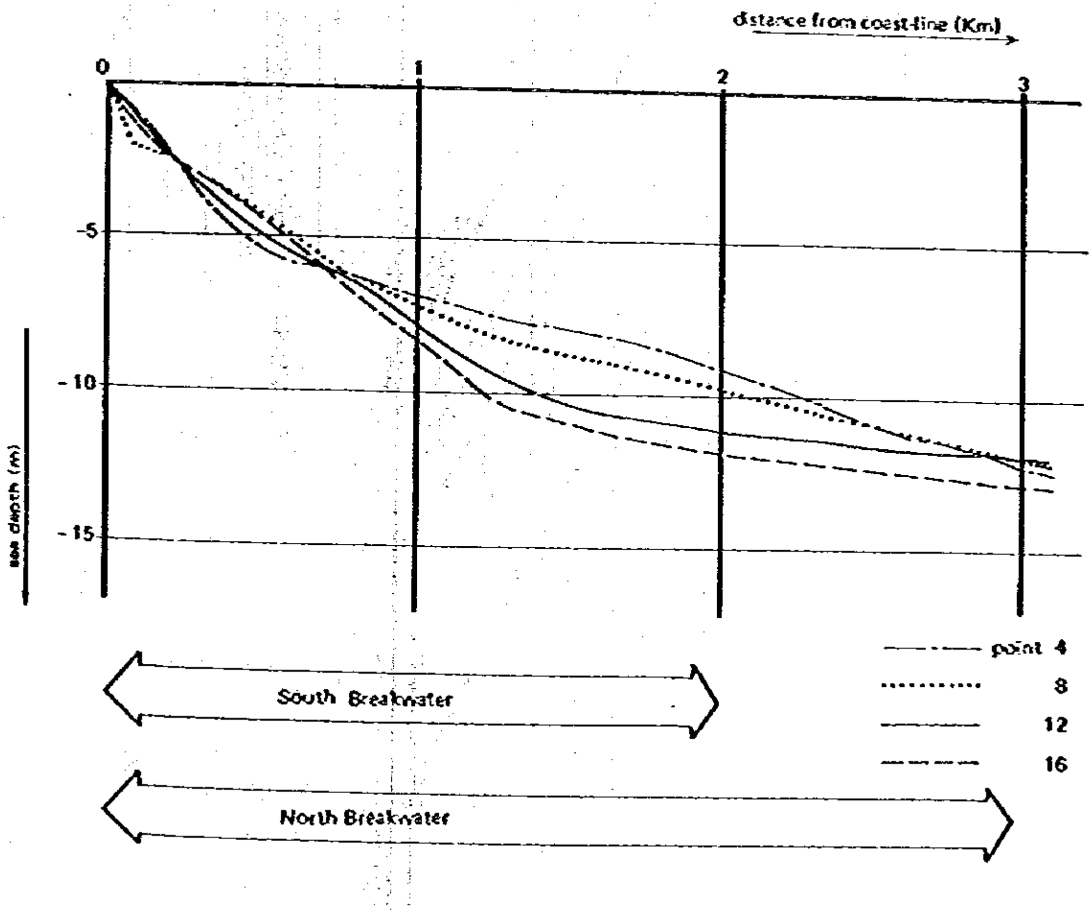


Fig. VII-5-(1) Location of Breakwaters and Water Depth

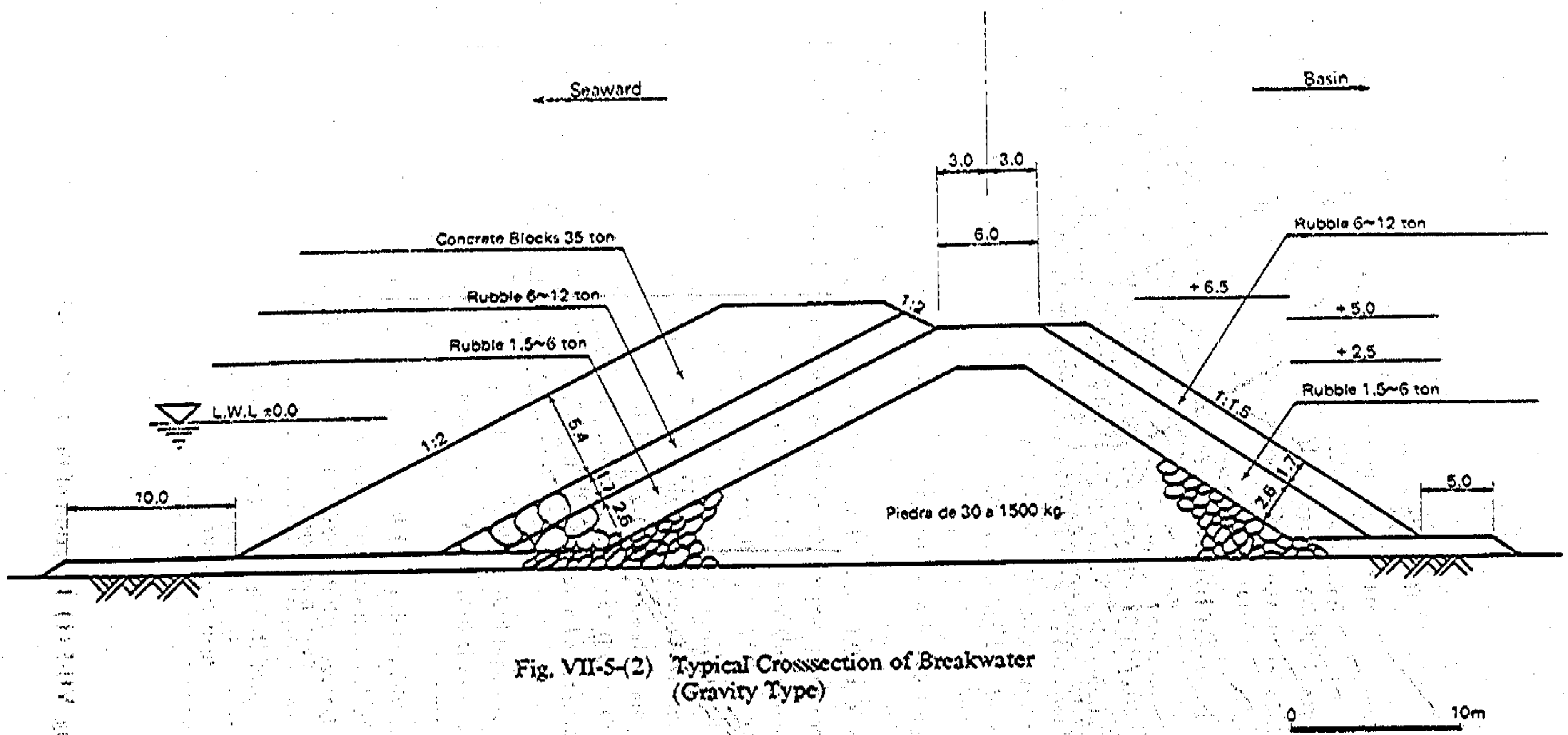


Fig. VII-5-(2) Typical Crosssection of Breakwater
(Gravity Type)

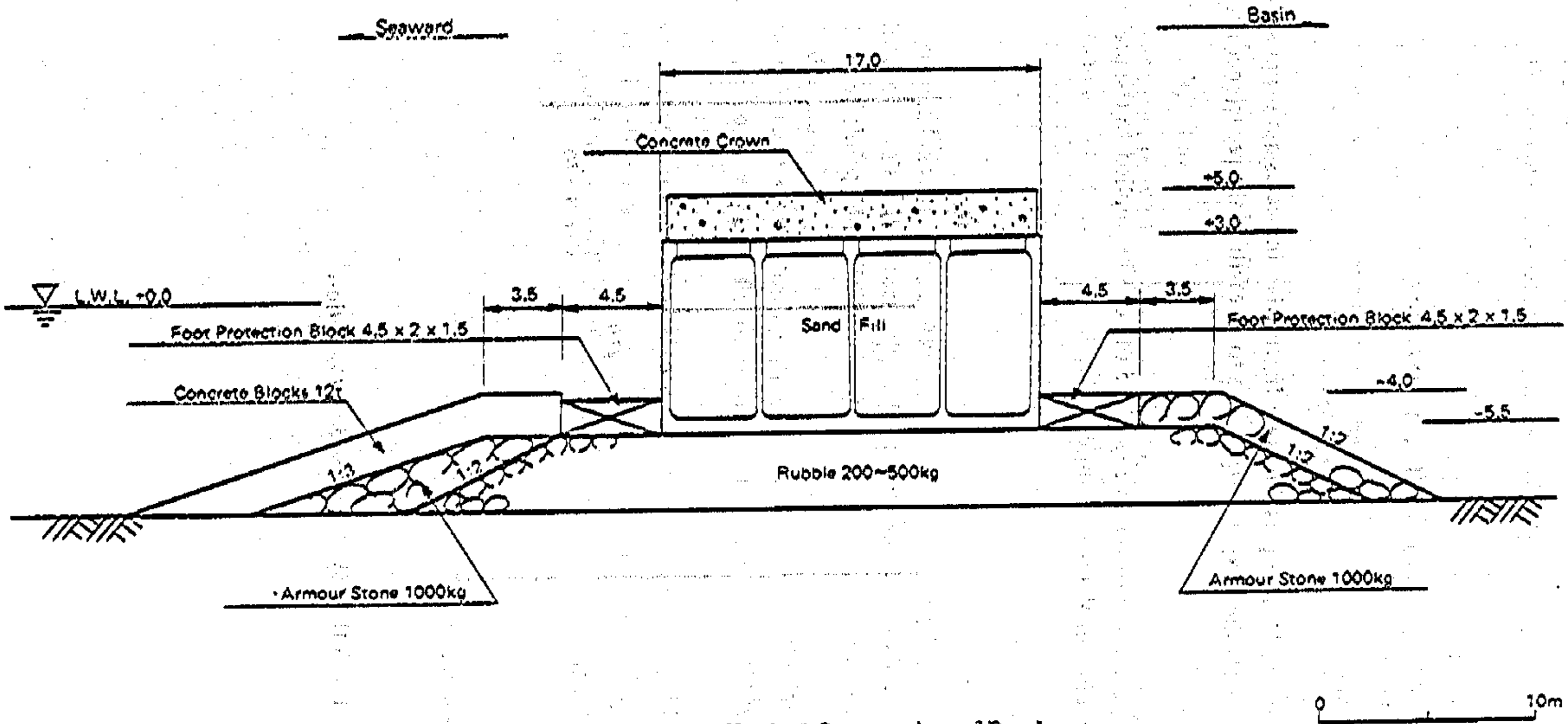


Fig. VII-5-(3) Typical Crosssection of Breakwater
(Caisson Composite Type)

(2) Mooring facilities

(a) Design conditions

1) Tidal level

H.H.W.L. +1.12 m

H.W.L. +0.50 m

L.W.L. ±0.00 m

2) Earthquake activity

Kh = 0.05

"Regional Sismica de Mexico para Fines de Ingenieria" indicates a maximum ground acceleration of 30 gal for the Tuxpan district, due to an earth-quake recurrence period of 100 years.

3) Soil conditions

The average soil condition shown in Fig. VII-5-(4) can be applied to the preliminary design, according to Chapter V. (Soil conditions).

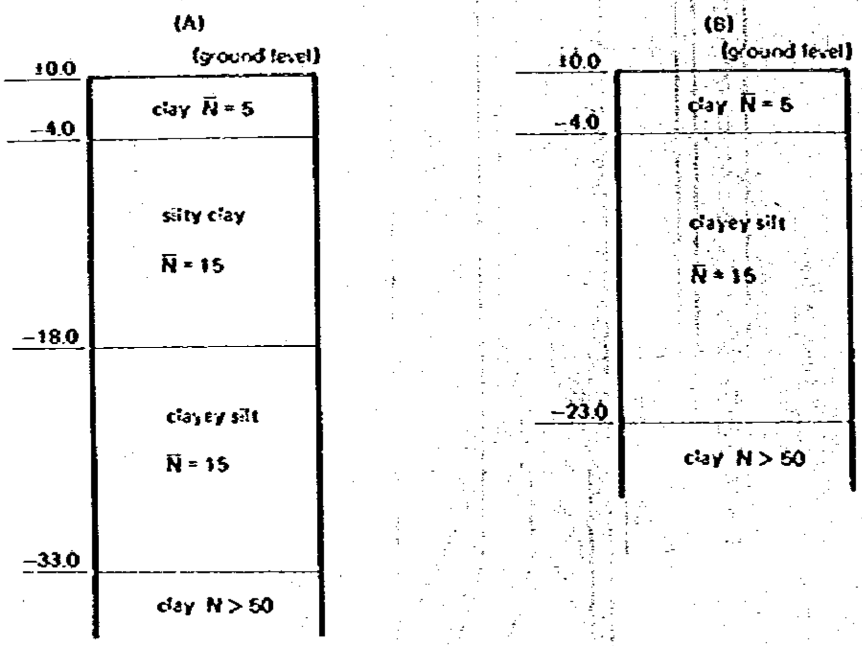


Fig. VII-5-(4) Supposed Soil Condition

4) Others

Design conditions of representative facilities are shown in Table VII-5-(1).

Table VII-5-(1) Design Conditions

	Container berth	General cargo berth	Small crafts berth
Crown height (m)	+3.0	+3.0	+2.5
Surcharge (t/m^2)	3.0	2.0	1.0
Design depth (m)	-12.0	-12.0	-4.5
Size of Vessels (D.W.T.)	50,000	20,000	
Cargo handling facilities	Container Crane (Net lifting load 30.5)	Mobile Crane	

(b) Structural types

In determining structural type, it is generally necessary to examine the site's natural conditions, the quality of construction work, and the type of vessels and cargoes to be handled, etc..

In this case, the following structural types were assumed after considering that the estimated costs will not fluctuate and that they are comparatively adaptable to changing circumstances.

Container berth and General cargo berth = Open type (Use of steel pipe pile)
Small craft berth = Steel sheet pile type

Standard cross section of the berths are shown in Fig. VII-5-(5) through VII-5-(7) respectively.

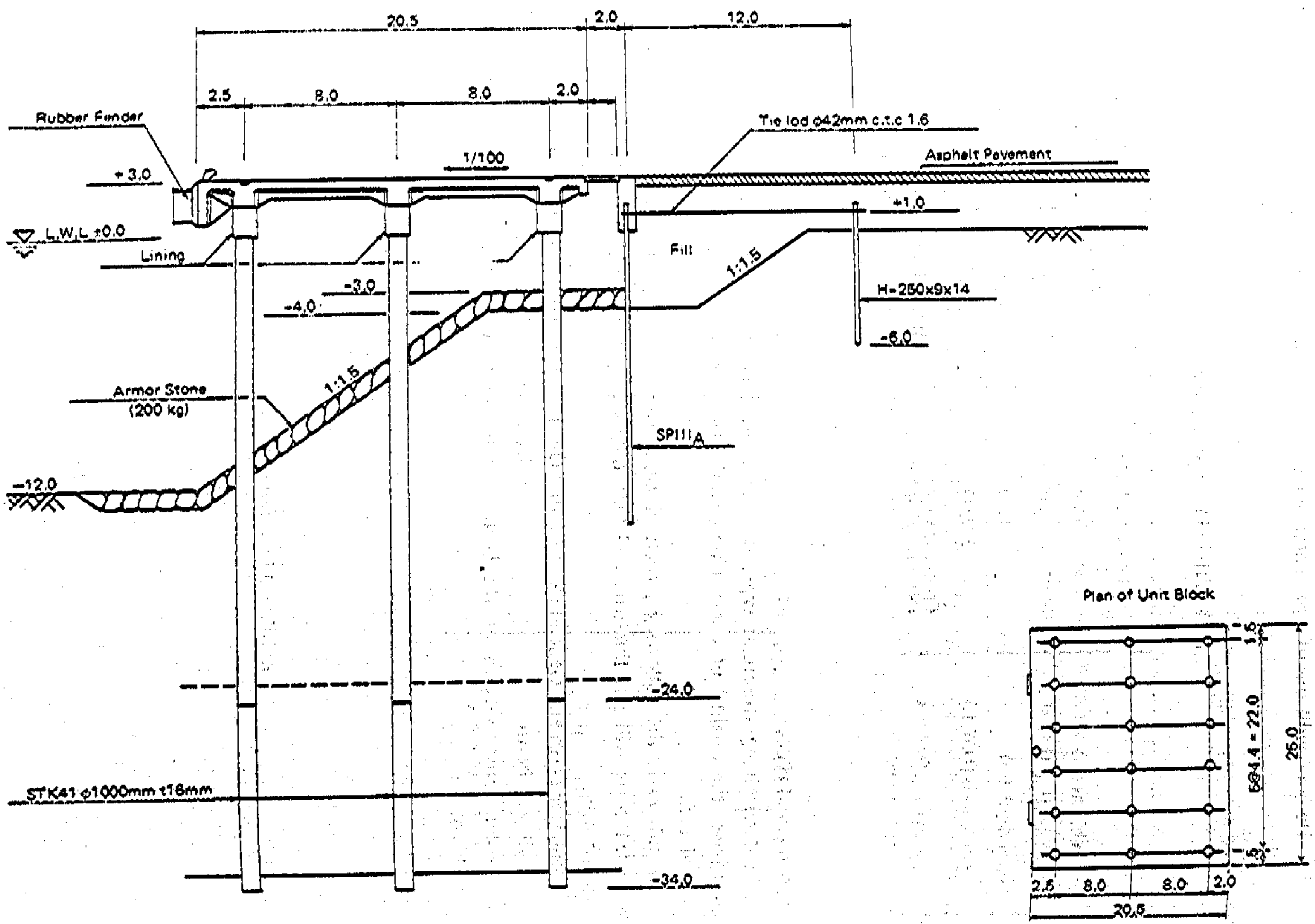


Fig. VII-5-(5) Standard Crossection of Container Berth

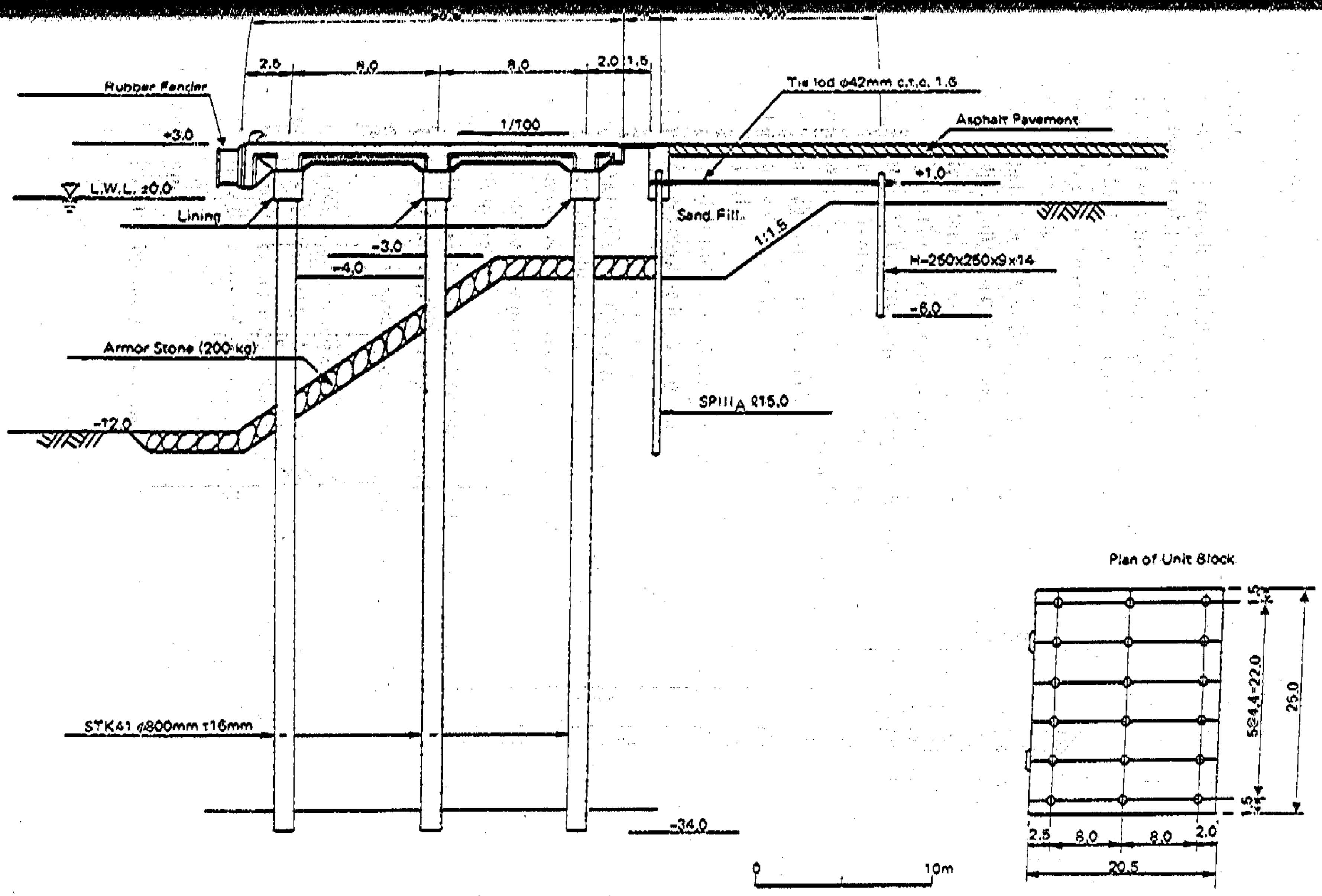


Fig. VII-5-(6) Standard Crosssection of General Cargo Berth

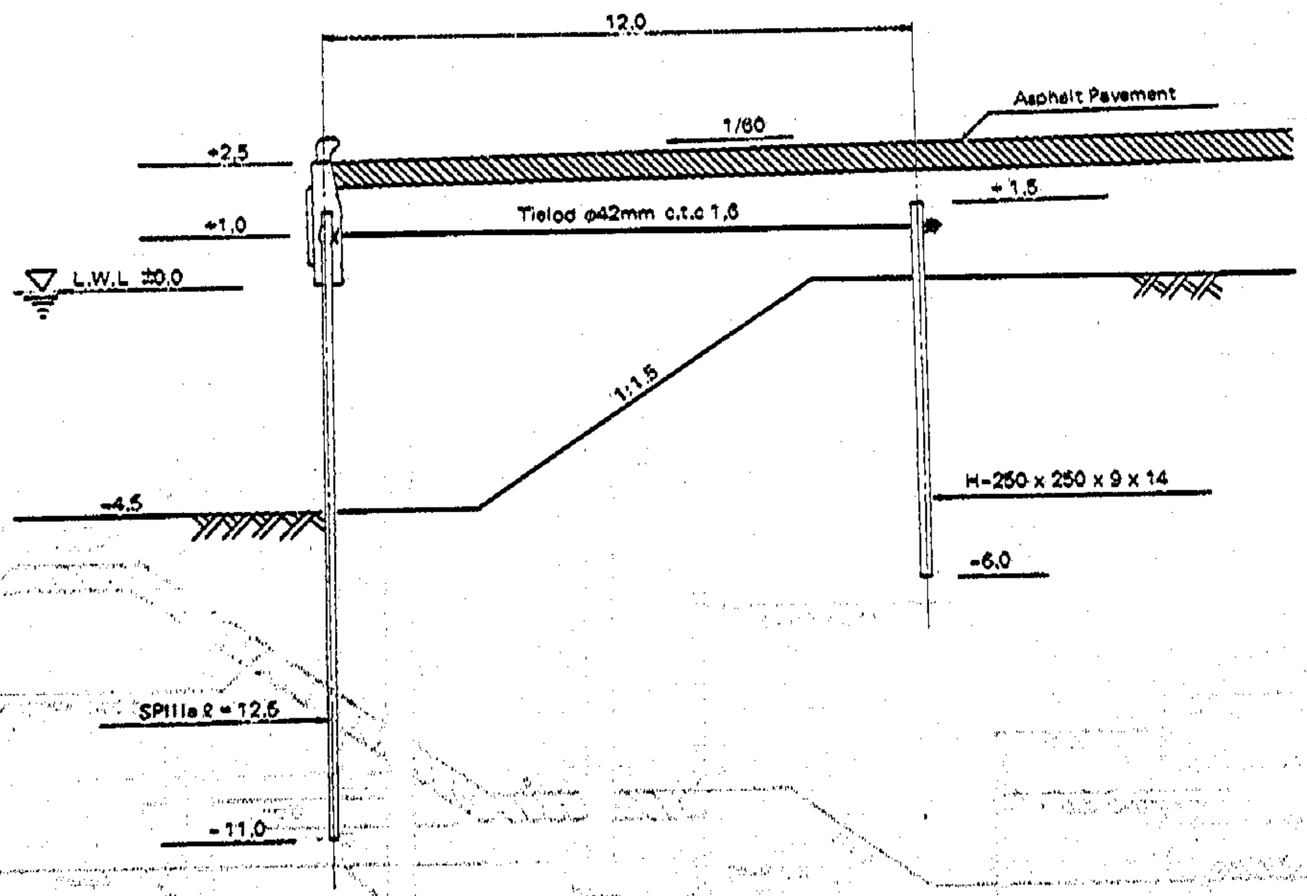


Fig. VII-5-(7) Standard Crosssection of Small Crafts Berth

5-2 Construction

(1) Materials

Main materials required for the project are as follows:

(a) Filling material for land reclamation

Dredged soil from the channel and the basin are used for land reclamation. If filling material for land reclamation is insufficient, dredged soil from the foreshore of the proposed site will be used for land reclamation.

(b) Stone materials

Stone materials such as riprap and armour stone for the breakwaters and piled wharfs are quarried at El Aguila, La Concha, etc. which are about 40 – 50 km away from Tuxpan.

(c) Concrete materials

Ordinary portland cement produced in Mexico is used.

Aggregate for concrete is quarried at Paso de Cazones, Paso Real, etc. which are about 30 km away from Tuxpan.

(d) Road materials

Base and subbase materials for roads are quarried at El Ojite which is about 15 km away from Tuxpan.

(e) Steel materials

Steel materials such as steel pipe pile, steel sheet pile, etc. are mostly produced in Mexico, but some of them may be imported from foreign countries.

(2) Construction machinery and craft

(a) Construction machinery

Mexican-made construction machines such as bulldozers, trucks, cranes, concrete plants, etc. are employed for this project.

(b) Construction craft

Construction craft such as crane barges, dredgers, etc. are not available in Mexico, foreign construction craft are chartered fro this project.

(3) Labor forces

Labor forces for construction works are available in Mexico and also skilled workers for civil and building works are available.

However, workers, crews and divers capable of marine works are almost non-existant, so it is necessary to secure them from foreign countries.

(4) List of facilities

The list of facilities by alternative plans is shown in Table VII-5-(2).

Table VII-5-(2) List of Facilities

Facilities \ Alternatives	Plan A	Plan B	Plan C
Breakwater	7,700 m	8,600 m	8,600 m
-12 m Piled Wharf	2,150 m	2,150 m	2,150 m
-4.5 m Quaywall	3,735 m	3,735 m	3,565 m
Land Reclamation	4,652 ha	4,647 ha	4,725 ha
Access Channel and Basin	1,103 ha	853 ha	930 ha
Road	—	12,400 m	9,800 m
Railway (including road)	20,700 m	42,000 m	35,300 m

Note: (1) Private wharf is not included.
(2) Land reclamation for future expansion is not included.
(3) Quaywall of fishery port and marine are included in -4.5 m quaywall.

(5) Outline of construction method

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

(a) Breakwater

1) Riprap work

Quarried riprap stones are transported by dump trucks and reclaimed and compacted by bulldozers. It is desirable to perform the riprap work as early as possible in order to secure calm water area for subsequent dredging and piling works.

2) Armour stone work

Quarried aromour stones are transported by dump trucks and are installed on the rubble mound. The installation of armour stones is done by using a crawler crane placed on a pontoon, since the width of breakwater is not sufficient and disturbance of the riprap work is to be avoided. Installation works should be performed under the direction of a diver.

3) Concrete block work

Concrete block is installed after fabrication in the block yeard. Concrete block is installed by crawler cranes which are fixed both on land and on pontoons.

Installation works should be performed under the direction of a diver.

(b) Piled wharf

1) Steel pipe pile driving

Steel pipe piles are driven by a diesel hammer fixed on a pile driving barge, since land piling is difficult because of the short of arm length of the pile driver.

2) Bulkhead

Dumping of armour stones is done from sea, and the designed alope is shaped.

The retaining wall is made of steel sheet pile and concrete block. Steel sheet piles are driven by land pile-driver and concrete block is installed by truck crane after fabrication in the block yard. Backfilling is done immediately after installation.

3) Concrete work

There are two methods for concrete work; one is to cast the concrete on site only for pile heads while beams and slabs are installed after fabrication in the block yard. The other is to cast all the concrete at the site.

In regard to this plan, concrete placing is not affected by tide, therefore casting all of the concrete on site is preferable.

(c) Quaywall

1) Steel sheet pile driving

Steel sheet piles are driven by pile driver from land.

2) Concrete work

Coping concrete is cast on site.

(d) Dredging work for access channel and basin

For dredging the access channel and basin, either a grab dredger or a pump dredger can be used, but a pump dredger is more desirable due to its capability for a large volume of dredging soil and to its high efficiency. In this case, large vessels, 8,000 H.P. class pump dredgers are required. The soil to be dredged is mostly clay. So it is necessary to survey whether or not this dredged soil can be adopted as material for reclamation. As there is a stiff soil layer (with N value at 50 or more) in part of the dredging area, it would be necessary to use a grab dredger too.

(e) Land reclamation work

Reclamation work will be carried out by making use of dredged soil from the channel, the basin, and the foreshore at the proposed site applying it through the discharge pipe.

The ground will be leveled by bulldozers after discharge.

Settlement characteristics of the soil in the proposed site are unknown. So it is necessary to anticipate extra-banking there of the land reclamation phase.

(f) 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.

5-3 Cost Estimation

(1) Estimate Conditions

Rough construction costs are estimated for the three plans mentioned above, based on the following conditions.

(a) Estimate of construction costs is based on prices as of April 1982.

(b) Unit prices of construction materials are based on the data obtained through the site survey.

(c) Transportation expenses of imported materials, construction machinery and construction craft are not included in the estimate.

(d) Taxes such as import duties and enterprise taxed are not included at all.

(e) Land rents and compensations related to this project are not included.

(f) The private wharf is regarded as the industrial equipment, and its construction cost is not included in the estimate.

(g) The exchange rates between Mexican, Japanese, and U.S. currencies are assumed to be as follows.

US$ 1.00 = MN $50 = ¥250

(2) Rough construction cost

Rough construction costs of the three plans are shown in Table VII-5-(3), VII-5-(4).

Table VII-5-(3) Rough Construction Cost (Mexican peso)

(Unit: thousand pesos)

Facilities \ Alternative	Plan A	Plan B	Plan C
Breakwater	11,452,000	12,856,000	12,856,000
−12 m Piled Wharf	1,763,000	1,718,000	1,608,000
−4.5 m Quaywall	751,600	751,600	710,800
Land Reclamation (dredging of channel and basin)	22,336,000	16,256,000	18,192,000
Land Reclamation (dredging of front sea)	—	12,000,000	6,300,000
Road	—	1,736,000	1,372,000
Railway (including road)	4,140,000	8,400,000	7,060,000
Total	40,442,600	53,717,600	48,098,800

Table VII-5-(4) Rough Construction Cost (U.S. dollar)

(Unit: thousand US dollars)

Facilities \ Alternative	Plan A	Plan B	Plan C
Breakwater	229,040	257,120	257,120
−12 m Piled Wharf	35,260	34,360	32,160
−4.5 m Quaywall	15,032	15,032	14,216
Land Reclamation (dredging of channel and basin)	446,720	325,120	363,840
Land Reclamation (dredging of front sea)	—	240,000	126,000
Road	—	34,720	27,440
Railway (including road)	82,800	168,000	141,200
Total	808,852	1,074,352	961,976

Note: Facilities of cargo handling equipment, etc. are not included.

5-4 Evaluation

Three alternative plans stated in Chapter VII-2, are evaluated in order to decide the most desirable plan.

It is thought that technical items for evaluation, including the impact on the environment, should be chosen rather than socio-economic items, considering that these are for the evaluation of Master Plan. Besides in the Plan, accurate forecasting of socio-economic changes is in general difficult and the technical feasibility is often made much more important than the socio-economic effects.

Items for evaluation are selected as follows.

(a) Ship maneuverability

(b) Port utilization

(c) Industry location

(d) Extention

(e) Construction work

(f) Siltation in channel

(g) Impact on environment

It is desirable that the evaluation is executed as quantitatively as possible. But in this study, judging from the accuracy of the Plan and the limited data sources, qualitative evaluation should meet the requirements. The evaluation method is four-grade marking in each item; Best, Good, Average and Bad. Judgement among the above four grades is based on the relative comparison of the three alternative plans on full technical considerations.

The result is shown in Table VII-5-(5).

As for the construction cost of each plan, (A) is the lowest, followed (C) and (B) is the highest. However, full examination taking into account, not only the costs but also the results mentioned above may lead to the conclusion that plan (B) is most desirable.

5-5 Zoning of Plant

Figure VII-5-(8) is an outline of the plant facility layout in the industrial complex drafted as the Plan B.

Table VII-5-(5) Evaluation of Alternative Plan

Items to be evaluated		Evaluation A	Evaluation B	Evaluation C	Comments
Ship maneuverity	Channel length	△	◎	○	As channel (inside port) becomes long, it takes long time for ships berthing and makes more congestion.
	Ship maneuverity (outside port)	△	○	○	A: Be affected with the current of the river
	Ship maneuverity (inside port)	○	○	◎	C: Ship can enter from main to secondary channel without tugboat.
Port utilization	Commercial port location	△	○	○	Location near the port entrance is favorable for construction
	Shape of the commercial wharf	○	○	△	C: Partly deformed shape.
	Fishery port location	◎	◎	◎	Fishery port is located at inner part of the river near existing facilities. Calm water is procured. Less crowded due to the separation with marina
	Steel iron wharf	○	○	△	L shaped water front is favorable for loading materials and unloading the products.
	Machine industry	○	○	△	C: Not procuring water front for machine industry.
Industry location	Iron and steel	×	○	○	A: Location of steel iron is inner part of petroleum refining and chemicals. Unfavorable of ship passing and cool water procurement.
	Shipbuilding	△	○	○	A: Shipbuilding location is a little distant from steel iron.
	Soil condition	△	○	○	A: Soil condition for industrial area is comparatively bad.
Extention	Open space	◎	○	△	A: Wide open space in south, B: Compact open space in west and north. C: Open space in west leaves partly narrow.
	Channel extention	△	○	○	A: Further channel extension is comparatively difficult.
Construction work	Soil balance	◎	△	○	Balance of the dredging and reclaimed volume is favorable.
	Dredging	○	○	△	C: Dredging area soil is somewhat solid.
	Work	△	○	○	A: Offshore construction work is affected by ship.
	Construction cost	○	△	○	A: lowest, B: highest
Siltation in channel	Outer channel	△	○	○	A: More siltation seems to be caused because of flat sea bottom.
	Existing channel	×	○	○	A: Construction of new north breakwater will increase the sand deposit at the existing approach channel.
Impact on environment	Air pollution	△	○	○	A: Iron and steel industry most effectable to air pollution is near residential area.
	Water pollution	△	○	○	A: Drainage water from paper and cardboard industry may pollute river or canal.

Note: ◎ Better ○ Good △ Average × not good

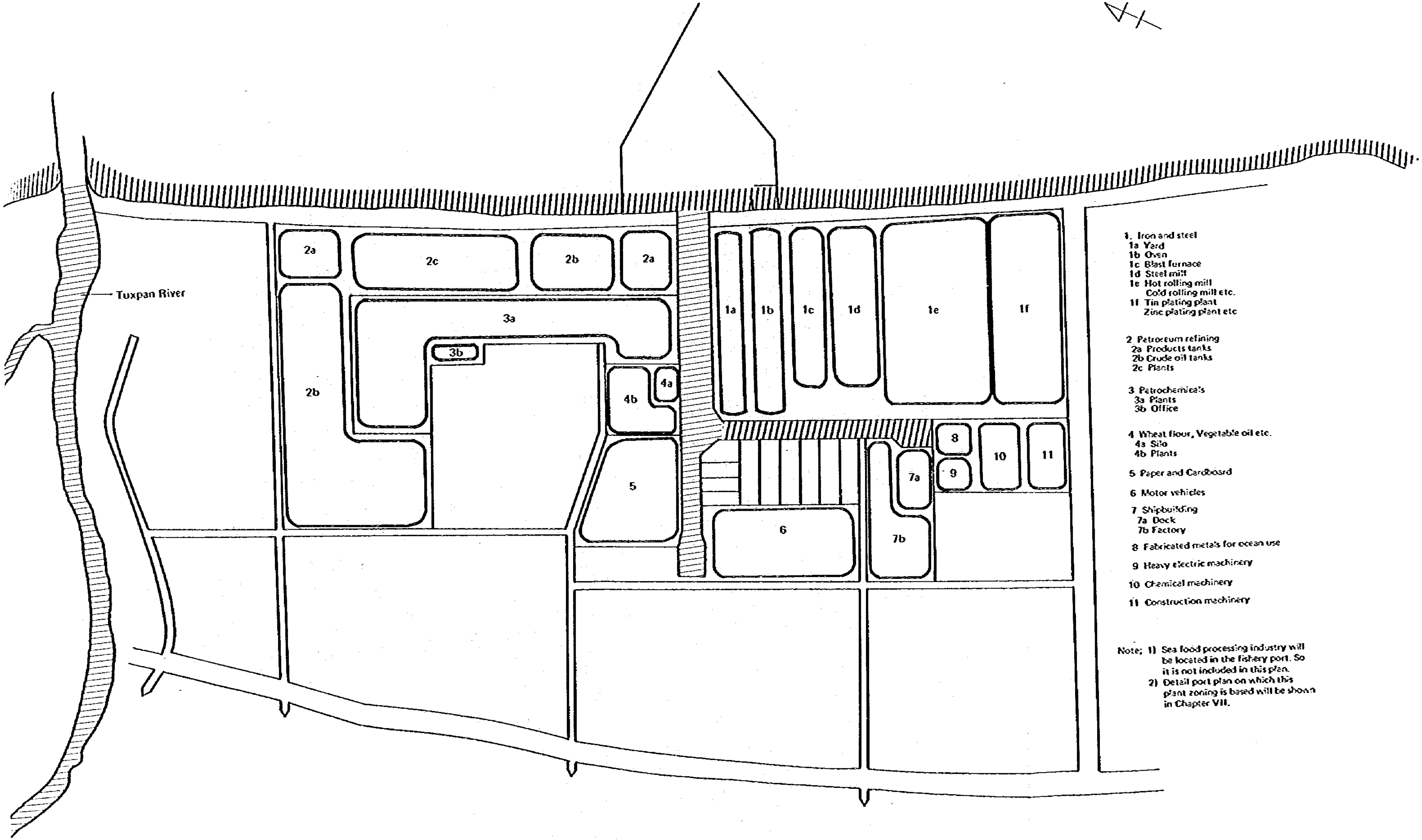
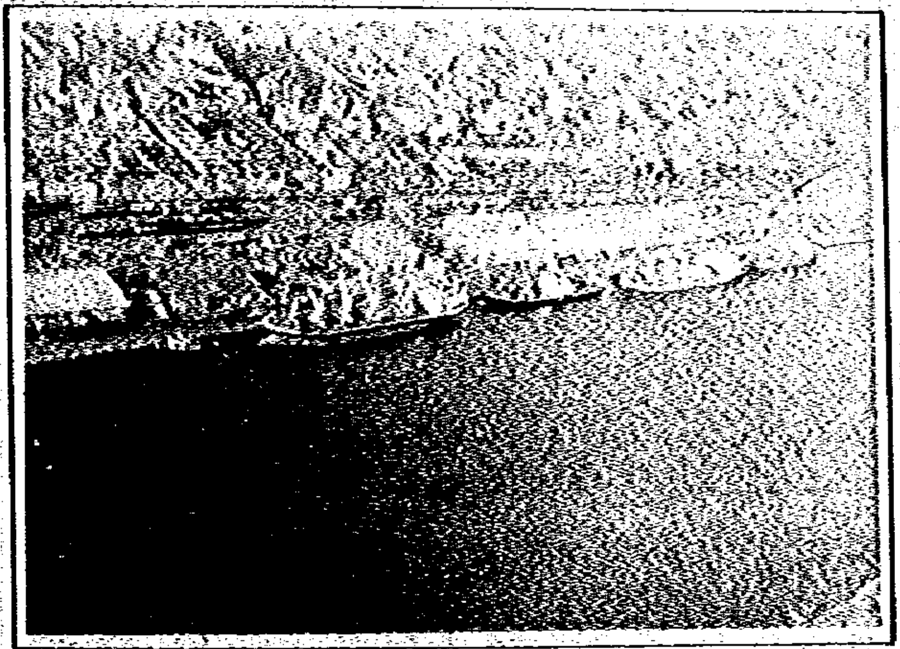


Fig. VII-5-(8) Plant Zoning of Industries

CHAPTER VIII
SHORT TERM DEVELOPMENT PLAN



Port of Tampico

CHAPTER VIII. SHORT TERM DEVELOPMENT PLAN

1. Premises of the Plan

1.1 Location of Industries

In this section the production scales of the located industries under the short term plan for the target year 1988 are determined and, on this basis, the site area necessary for plant operation, the fresh water consumption and the volume of port cargoes corresponding to industrial activities are determined.

These scales will be determined on the basis of the demand forecast data showing in Chapter VI. The placement of plants assumes that, in the study of supply/demand balance before 1988, supply is smaller than demand, and that the necessary production capacity increase determined by the gap between demand and supply is above the economical scale of plants. Further, if the placement of plants is considered in various places in Mexico, as in the case of construction machinery, chemical machinery and so on, the share of Tuxpan should be determined on the basis of proper allotment of industrial functions to Tuxpan.

The site area, number of workers, fresh water consumption and volume of the port cargoes are calculated as follows:

Number of workers, fresh water consumption and volume of port cargoes corresponding to production scale of industries in 1988 are determined on the basis of those corresponding to final target production scale of industries in 2000.

A for site area, it is assumed that large plants for the paper and cardboard, the oil refining and the iron and steel industries which are likely to start their Phase I operation by 1988, will be constructed gradually by 2000 after securing the final site area in 1988.

The results are shown in Table VIII-1-(1) for scales of located industries and VIII-1-(2) for industrial port cargo volume.

Table VIII-1-(1) Industries Located around the Tuxpan Industrial Port in 1988

Type of Industry	Capacity of production	Unit	Capacity Ratio (%)	Area (ha)	Number of employees (persons)	Fresh Water (1000m³/day)
Sea food products	45	(1000 MT/Y	45	9	770	3
Meat flour Vegetable oil	60	(1000 MT/Y)	52		70	0
Feedstuff	60	(1000 MT/Y)	50	100	-	-
Paper and cardboard	150	(1000 MT/Y)	30	200	1,050	100*
Petroleum refining	250	(1000 BPSD)	50	1,000	750	100*
Iron and steel	2,500	(1000 MT/Y)	50	1,500	3,750	170**
Fabricated metals for ocean use	24	(1000 MT/Y)	100	30	1,500	1
Construction machinery	2,000	(UNIT/Y)	50	60	750	1
Chemical machinery	50	(1000 MT/Y)	100	80	5,500	9.
Heavy electric machinery	80	(UNIT/Y)	100	30	1,000	1
Total	-			3,009	15,180	385

Note: 1. Retrieval ratio *: 40%, **: 80%
2. Capacity ratio = Short term plan per long term plan

Table VIII-1-(2) Industrial Port Cargo Volume Handled at Tuxpan in 1988

(Unit: 1,000 Tons)

Commodity \ Item	Type of packing	Foreign Trade			Domestic Trade			Total	Private or Public
		Imp.	Exp.	Total	In.	Out.	Total		
Agricultural and fishery products									
Fish	G				23		23	23	
Grain	B	95		95				95	O
Forestal products									
Chip	B				228		228	228	O
Petroleum-products									
Oil	L.B		2,400	2,400		850	850	3,250	O
Petrochemical products									
Petrochemical products	L.B								O
Petrochemical products	B								O
Minerals and crude oil									
Salt	B								O
Crude oil	L.B		6,800	6,800	4,000		4,000	10,800	O
Iron ore	B	3,500		3,500				3,500	O
Coal	B	1,120		1,120				1,120	O
Limestone	B	380		380				380	O
Scrap iron	B	25		25				25	O
Scale	B	40		40				40	O
Iron and steel									
Steel	B		600	600		400	400	1,000	O
Consumer goods									
Sea food products	G		4	4				4	
Paper	G					15	15	15	
Capital goods									
Industrial machinery	G	3		3				3	O
Fabricated metals for ocean use	G					22	22	22	O
Machine equipment and parts	G	6		6				6	O
Construction machinery	G					17	17	17	O
Parts of chemical machinery	G	9		9				9	O
Chemical machinery	G					20	20	20	O
Parts of heavy electric machinery	G	2		2				2	O
Heavy electric machinery	G		2	2		6	6	8	O
Parts of motor vehicles	G								O
Motor vehicles	G								O
Parts of shipbuilding	G								O
Total		5,180	9,806	14,986	4,251	1,330	5,581	20,569	

Note: O : Handled at private berth
G : General Cargo
B : Bulk Cargo
L.B: Liquid Bulk Cargo

1-2 Demand Forecast

Demand forecasts for the short-term plan in 1988 are already shown in Chapter VI-2. In this paragraph, only a summary of them is briefly explained.

(1) Commercial port cargo

Cargo volume of Tuxpan is shown in Table VIII-1-(3).

Table VIII-1-(3) Cargo Volume of Tuxpan in 1988

(Unit: 1,000 Tons)

	Foreign Trade			Domestic Trade			Total
	Exp.	Imp.	Total	Out.	In.	Total	
(1) Bulk Cargo							
Non-ferrous Ores		174	174				174
Fertilizer		59	59		40	40	99
Cement					250	250	250
(2) General Cargo							
Iron & Steel		57	57				57
Steel Tubes & Pipes		255	255				255
Salt					44	44	44
Capital Goods		19	19				19
Consumer Goods	7	16	23				23
Agricultural Products	5		5				15
(3) Container Cargo							
Capital Goods		29	29				29
Consumer Goods	67	142	209				209
Agricultural Products	19		19				19
Total	108	751	859		334	334	1,193

Viewing this table, much attention has to be paid to the following premises:

1) The railway between Tuxpan and Mexico City will not be completed in 1988.
2) Both Altamira and Ostion will be almost completed in 1988, and will run at near capacity.
3) Veracruz port is assumed to maintain its present level, and new drastic investments are not considered.

The commercial port cargo volume of Tuxpan in 1988 will be 859 thousand tons in foreign trade and 334 thousand tons in domestic trade. High growth is expected, considering the forecast in comparison to the present cargo volume in 1980, which is 610 thousand tons in foreign trade and 40 thousand tons in domestic trade except crude oil cargo, shown in Table III-4-(8). Especially container cargo is expected to grow greatly from about 160 thousand tons in 1980 to about 260 thousand tons in 1988.

(2) Fish catch

The total fish catch of the Tuxpan administrative region is expected to be 860 thousand tons in 1988, as shown in Table VI-2-(23). This would be a large volume, considering the present (1980) volume of 3 thousand tons. To realize this future volume, it is quite necessary to develop the undeveloped fishery resources zealously and to invest in such basic facilities and equipment as fishing ports, fishing boats, processing facilities and so on.

2. Urban Planning of Tuxpan Port City

2-1 Estimation of the Population

According to the estimation method in 1-2, Chapter IV, the population and the number of households are estimated at 190 thousand and 42 thousand, respectively.

2-2 Composition of the Functions and Estimation of the Scale

Composition of the functions and the scale of each type are as shown in Table VIII-2-(1) – Table VIII-2-(7).

The development area for the residential district is given as 1,900 ha, assuming that the gross population density is 100 person per hectare.

It is composed of 5 districts and 21 neighborhood units. The criteria employed here for allocation of schools, neighborhood centers, clinics and parks and so on is same as that in masterplans. The scale of the facilities for administration, urban operation and the bus terminal is just same as that in masterplan. As for commercial/business facilities allocated surround the above facilities, the scale is estimated according to the population in 1988.

The kinds and scale of all other facilities, excluding the marine recreational base, the marine research institute and the fisheries experiment station, are planned in the same way as the masterplan.

The short-term plan of the Tuxpan Port City is shown in Fig. VIII-2-(1).

Table VIII-2-(1) Required Urban Facilities in the Year of 1988
– Residential Facilities –

Functions and Facilities		Service Unit per Neighbor-hood Unit (per a building)	No. of Facil-ities (Unit)	Unit Area	Total Area (ha)
RESIDENCE					
o Detached house (1–2F)	(5,640 Households)		5,640	300 m²	170
o Terrace house (2F)	(17,800 Households)	(5 Houses)	3,560	1,200	429
o Apartment house (4–5F)	(14,100 Households)	(30 Houses)	470	1,800	85
(14–18F)	(4,700 Households)	(96 Houses)	50	1,800	9
Total	(42,240 Households)				693
PUBLIC SERVICE					
o Kindergarten		2	42	0.15 ha	6
o Primary school		1	21	2	42
o Secondary school		1/2	10	4	40
o High school		1/4	5	5	25
o City office branch		1/4	5	0.1	0.5
o Post office branch		1	21	0.05	1
o Hospital		1/4	5	0.4	22.5
o Clinic		2	42	0.05	2
o Health center		1/22	1	0.05	0.5
o Police station		2	42	0.01	
o Fire station branch		1/4	5	0.36	2.5
o Church		1	21	0.1	2.5
o Library branch		1/2	10	0.22	2.2
o Day nursery		5	105	0.1	9.5
o Meeting hall		1	21	0.04	0.8
o Afternoon day care center		1/45	5	0.3	3
o Home for young men		1/4	1	0.2	
o Home for the aged		1/4	5	0.2	
Total					158
COMMERCE AND BUSINESS					
o District center for commerce, business, amusement and service industries		1/4	5	4.0 ha	20
o Neighborhood unit center		1	21	2	42
o Daily goods' shops and restaurants		25	525	0.01	5
o Parking		1	20	2	40
Total					107
OPEN SPACE					
o District park		1/4	5	10 ha	50
o Neighborhood park		1	21	3	63
o Neighborhood play-ground		4	84	1.5	126
o Play lots		16	336	0.05	17
Parks Sub-Total					256
o Green space					306
Total					562
Road					
Total					380
Ground Total					1,900

Table VIII-2-(2) Required Urban Facilities in the Year of 1988
– Public Service Facilities –

Functions and Facilities	No. of Facil-ities (Unit)	Unit Area	Total Area (ha)
ADMINISTRATIVE RELATED FACILITIES			
o Government office branch			
o State-government office branch			
o Court	1		
o Taxation office	1		
o Prison	1	0.2 – 1 ha	8
o City office	1		
o Central fire station	1		
o Police headquarters	1		
o Square	1	4	4
Total			12
URBAN OPERATIONAL FACILITIES			
o Central telegraph/telephone office	1		
o Broadcasting station	1	1 – 2 ha	5
o Central post office	1		
o Bus terminal	1	6	6
o Square	1	4	4
o Transformer substation	1	1	1
o Water purification plant	1	9	9
o Crematory	1		22
o Cemetery	1		
Total			47
CULTURURAL AND EDUCATIONAL FACILITIES			
o University	1	100 ha	100
o Teacher training center	1		3
o Business training school	1		
o Research institute	4	0.3 – 1	2
o Central library	1		
o Museum	1		
o Art museum	1		
o Theater	1	0.5 – 1	4
o Concert hall	1		
o Cathedral	1		
Total			109
WELFARE AND MEDICAL FACILITIES			
o General hospital	1		10
o Regional health center	1		
o Home for the aged	2		4
o Rehabilitation center	1		
Total			14
DISTRIBUTION BUSINESS CENTER			
o Warehouses complex			
o Wholesale complex			210
o Truck terminal			
Total			
Ground Total			392

Table VIII-2-(3) Required Urban Facilities in the Year of 1988
– Commercial/Business Facilities –

Functions and Facilities	No. of Facil-ities (Unit)	Unit Area (ha)	Total Area (ha)
COMMERCIAL FACILITIES			
o Department store	1	1	1
o Market	2	0.2 – 0.5	1
o Retail stores	4,700	0.02 – 0.05	118
o Restaurant			
BUSINESS FACILITIES			
o Bank, firm, office, newspaper office, etc.	700	0.3 – 1	35
OTHER SERVICE FACILITIES			
o Service industry	1,410	0.02 – 0.05	35
o Hotel	3	0.5 – 1	2
Ground Total			192

Table VIII-2-(4) Required Urban Facilities in the Year of 1988
– Amusement and Recreational Facilities –

Functions and Facilities	No. of Facilities (Unit)	Unit Area (ha)	Total Area (ha)
SHOW BUSINESS FACILITIES	10	0.1 – 0.3	1.5
AMUSEMENT FACILITIES			
o Restaurant/bar	45	0.05 – 0.2	4.5
o Game center			
o Dance hall			
o etc.			
LEISURE FACILITIES			
o Golf link (18 holls)	1	100	100
o Festival plaza	1	5	5
Ground Total			111

Table VIII-2-(5) Required Urban Facilities in the Year of 1988
– Industry and Open Space –

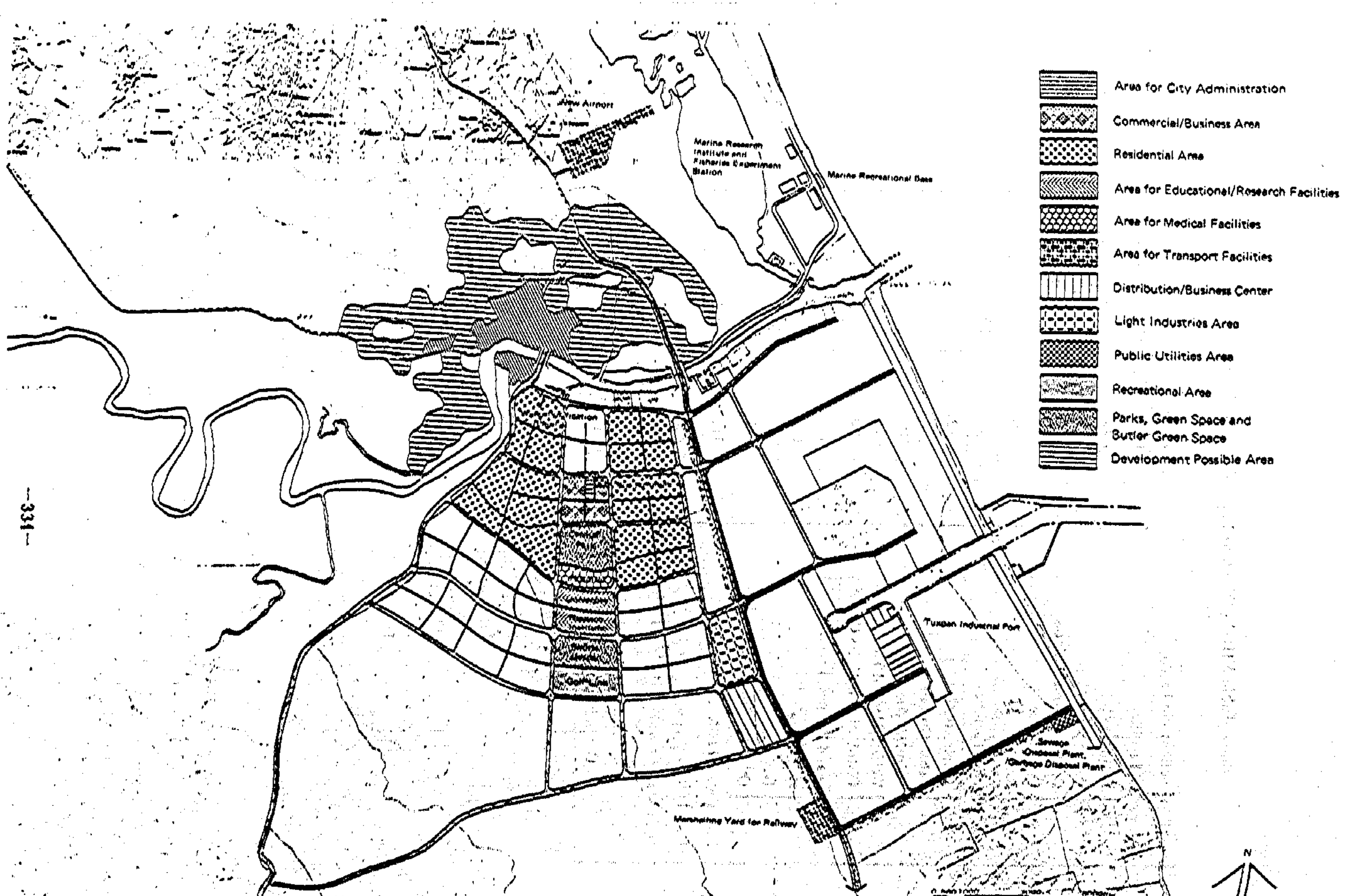
Functions and Facilities	Number of Facilities (Unit)	Total Area (ha)
LIGHT INDUSTRY		230
(secondary industry related economic activity population 37.1 thousand, population density in the day time 150/ha)		
Total		230
OPEN SPACE		
o Park for arts	1	50
o Recreational sports garden	1	70
o Green space as a buffer zone		485 (o Green space as a buffer zone, o Green space as an emergency shelter, o Green way)
o Green space as an emergency shelter		
o Green way		
Total		605
Roads		400

Table VIII-2-(6) Required Urban Facilities in the Year of 1988
– Other Facilities Located Outside the New City –

Functions and Facilities	Number of Facilities (Unit)	Total Area (ha)
TRANSPORTATION FACILITIES		
o Airport	1	200
o Railway marchalling yard	1	100
Total		300
SUPPLY AND DISPOSAL FACILITIES		
o Sewage disposal plant	1	25 (o Sewage disposal plant, o Garbage disposal plant)
o Garbage disposal plant	1	
Total		
Ground Total		325

Table VIII-2-(7) Land Use Composition (1988)

Functions and Facilities		Area (ha)		
Residential Facilities		1,900	49.6%	(100.0%)
	Residence	693		(36.5%)
	Public Service	158		(8.3%)
	Commerce and Business	107		(5.6%)
	Open Space	562		(29.6%)
	Road	380		(20.0%)
Public Service Facilities		392	10.2%	
	Administration	12		
	Urban Operation	42		
	Culture/Education	107		
	Welfare/Medical Treatment	11		
	Distribution Business Center	200		
Commerce and Business Facilities		192	5.0%	
	Commerce	120		
	Business	35		
	Other Service	37		
Recreational Facilities		111	2.9%	
Light Industry		230	6.0%	
Open Space		605	15.8%	
Road		400	10.5%	
Ground Total		3,830	100%	


Area for City Administration
Commercial/Business Area
Residential Area
Area for Educational/Research Facilities
Area for Medical Facilities
Area for Transport Facilities
Distribution/Business Center
Light Industries Area
Public Utilities Area
Recreational Area
Parks, Green Space and
Butler Green Space
Development Possible Area
Marine Research Institute and Fisheries Experiment Station
Marine Recreational Base
Tuxpan Industrial Port
Sewage Disposal Plant, Garbage Disposal Plant
Marshalling Yard for Railway
N