CHAPTER 3 PORT PLANNING

1. Scale of the Port Facilities

1.1 Maximum Ship Size

The maximum ship size for the Short-term Development Plan shall be the same as under the Master Plan as shown in Table II.3.2, 20,000 DWT.

1.2 Basin and Channel

The basins and the channel shall also be the same as under the Master Plan.

1.3 Wharfs

(1) Rough Estimation of the Number of Berths

According to the port traffic forecast in Part III Chapter 2 and the proposed cargo handling efficiencies in Part II Chapter 3, the ship mooring days are estimated as shown in Table III. 3.1. This Table does not consider ferry boats and the official use wharf.

The total mooring days are calculated as 856.9 days. Assuming that the target berth occupancy ratio is 60% and the berths can be used 365 days/year, the required number of berths except facilities for ferries and official use vessels is roughly estimated as follows:

$$N = \frac{M}{D \times ro}$$

where, N: Required number of berths
M: Total mooring days (856.9 days)
D: Available days (365 days)
ro: Berth occupancy ratio (60%)

Table III.3.1 Ship Mooring Days by Commodity (1995)

Commodity	Cargo Volume (tons)	Av. Cargo Vol/Ship (tons)	Av. Mooring Days (days)	Number of Ship Calls (ships)	Mooring Days (days)
- Export -					
Sugar					
(in bulk)	136,000	7,000	5.4	19	106
(in bags)	15,000	600	4.0	25	100
Molasses	56,000				
Fertilizer (in bags)	39,000	1,000	3.6	39	140
Cement (in bags)	99,000	3,000	5.7	33	188
Clinker (in bulk)	90,000	5,000	3.0	18	54
Free Zone (container)	24,000	-	1.0	52 (weekly)	52
Ag. Products (container)	38,000	} -	2.0	52 (weekly)	104
Other G. Cargo (container)	51,000				
Passenger Boat		(1,000/max) (persons/day)	0.5	24	12
- Import -					
Fertilizer (in bulk)	130,000	6,000	3.1	22	68
Coal (in bulk)	113,000	15,000	3.0	8	24
Fuel Oil	120,000	15,000	1.0	8	8
Free Zone (container)	22,000	Weekly	*	*	*
Other G. Cargo (container)	69,000	Weekly	*	*	*
Total	1,002,000				856

* : included in - Export -

Accordingly,

N = 3.91

Thus, the required number of berths is estimated to be 4.

(2) Estimation of the Required Number of Berths by Queuing Simulation

In order to determine the optimum number of berths, three alternatives are considered. None of these alternatives includes facilities for ferries or official use vessels.

- Alternative - 1 3 berths

- Alternative - 2 4 berths

- Alternative - 3 5 berths

Conceptual layouts of the three alternatives are shown in Fig. III.3.1.

Comparing the berth construction cost and the maintenance cost with the benefit (the reduction of the ship staying cost), the optimum number of berths is determined based on the queuing simulation.

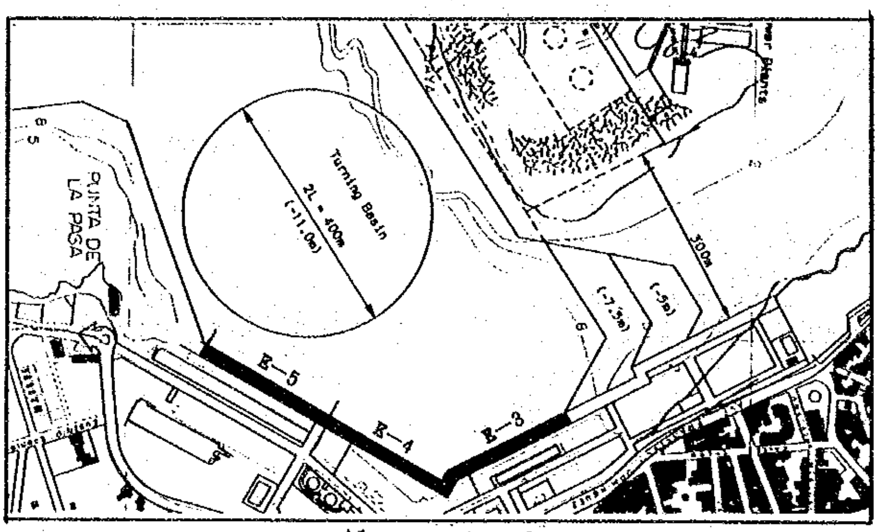
Ship arrival conditions are assumed as follows:

i) The ship arrival interval distribution is an Erlung phase I curve.

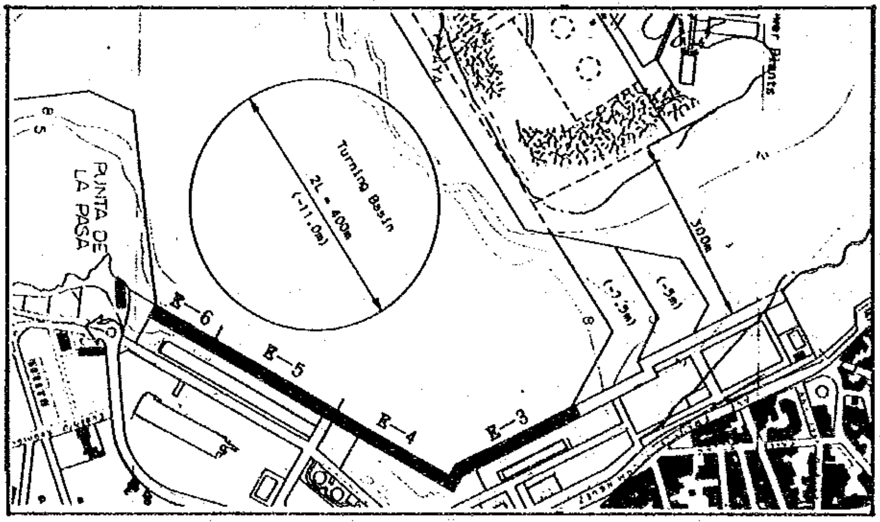
ii) The arrivals of liner ships, free zone ro/ro container ships and general cargo lo/lo container ships are approximated as an Erlung phase X curve as shown in the Master Plan.

iii) Queuing simulations are conducted for the years 1995, 2000 and 2005.

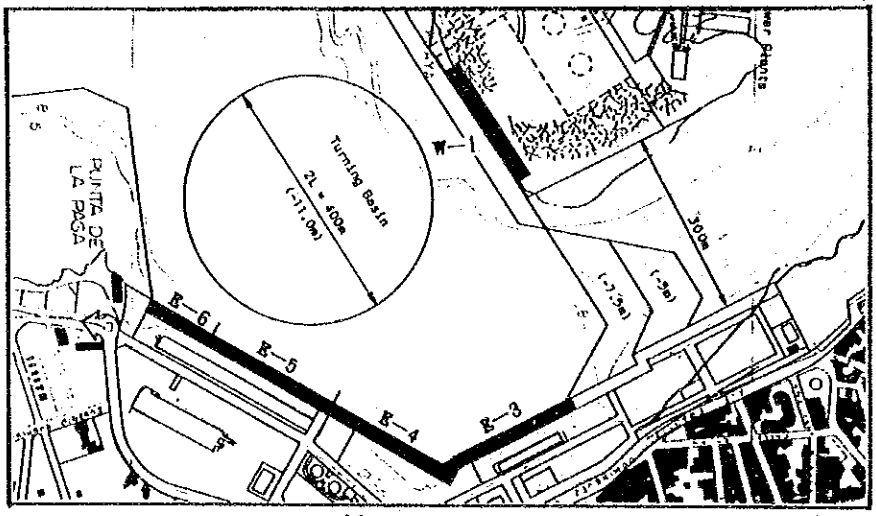
iv) The ship arrivals and the ship mooring time are the same under all 3 alternatives.



Alternative-1



Alternative-2



Alternative-3

Fig. III.3.1 Conceptual Layouts of the Three Alternatives

1) Queuing Simulation of Alternative - 1

i) Wharf Utilization Condition
Table III.3.2 shows the wharf utilization condition of Alternative-1.

ii) Number of Ship Calls
The number of ship calls in 2000 and 2005 is estimated based on the traffic forecast as shown in Table III.3.3 - Table III.3.4.

iii) Results of the Simulation
The results of the simulation for Alternative-1 are shown in Table III.3.5.

2) Queuing Simulation of Alternative-2

i) Wharf Utilization Condition
Table III.3.6 shows the wharf utilization condition for Alternative-2.

ii) Results of the Simulation
The results of the simulation for Alternative-2 are shown in Table III.3.7.

3) Queuing Simulation of Alternative-3

i) Wharf Utilization Condition
Table III.3.8 shows the wharf utilization condition for Alternative-3.

Table III.3.2 Wharf Utilization Condition of Alternative-1

Wharf No.	Acceptable cargo
E-3	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Fuel oil Passenger boat
E-4	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Dry bulk (sugar, clinker, coal) Fuel oil
E-5	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Dry bulk (sugar, clinker, coal) Dry bulk (fertilizer)

Table III.3.3 Number of Ship Calls in 2000

Commodity	Cargo Volume (tons)	Av. Cargo Vol/Ship (tons)	Av. Mooring Days (days)	Number of Ship Calls (ships)	Mooring Days (days)
- Export -					
Sugar	136,000(Bulk) 15,000(Bags)	7,000 600	5.4 4.0	19 25	102.6 100.0
Molasses	56,000	-	-	-	
Fertilizer	48,000	1,000	3.6	48	216.0
Cement	116,000	3,000	5.7	39	250.8
Clinker	105,000	5,000	3.0	21	72.0
Free Zone	31,000	Weekly	1.0	52	52.0
Ag. Products Other G. Cargo	52,000 61,000	Weekly	2.0	52	104.0
Passenger Boats	Weekly		0.5	38	26.0
- Import -					
Fertilizer (Raw Mat.)	160,000	6,000	3.1	27	102.3
Coal	132,000	15,000	3.0	9	27.0
Fuel Oil	139,000	15,000	1.0	9	9.0
Free Zone	29,000		-	-	-
Other G. Cargo	74,000		-	-	-
					1,065.7

Table III.3.4 Number of Ship Calls in 2005

Commodity	Cargo Volume (tons)	Av. Cargo Vol/Ship (tons)	Av. Mooring Days (days)	Number of Ship Calls (ships)	Mooring Days (days)
-Export					
Sugar	136,000(Bulk) 15,000(Bag)	7,000 600	5.4 4.0	19 25	102.6 100.0
Molasses	56,000	-	-	-	
Fertilizer	60,000	1,000	3.6	60	216.0
Cement	132,000	3,000	5.7	44	250.8
Clinker	120,000	5,000	3.0	24	72.0
Free Zone	38,000	Weekly	1.0	52	52.0
Ag. Products Other G. Cargo	66,000 71,000	Weekly	2.0	52	104.0
Passenger Boats	Weekly	1,000/max	0.5	52	26.0
-Import					
Fertilizer (Raw Mat.)	200,000	6,000	3.1	33	102.3
Coal	150,000	15,000	3.0	10	30.0
Fuel Oil	157,000	15,000	1.0	10	10.0
Free Zone	36,000		-	-	-
Other G. Cargo	79,000		-	-	-
					1,065.7

Table III.3.5 Results of the Simulation for Alternative-1

1995

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	1,182.1	48.0	52	2,496	3,678.1
2-1 Fertil(bag)	1,000	2,290.2	86.4	39	3,370	5,659.8
2-2 Sugar(bag)	700	1,482.7	96.0	25	2,400	3,882.7
2-3 Cement(bag)	3,000	1,918.6	136.8	33	4,514	6,433.0
3-1 Free zone(cont)	3,000	1,450.8	24.0	52	1,248	2,698.8
4-1 Sugar(dry bulk)	7,000	1,600.7	129.6	19	2,462	4,063.1
4-2 Clinker(dry bulk)	5,000	1,285.5	72.0	18	1,296	2,581.5
4-3 Coal(dry bulk)	13,000	537.4	72.0	8	576	1,113.4
5-1 Fertil(dry bulk)	7,000	2,590.5	74.4	22	1,637	4,227.3
6-1 Fuel oil(liq bulk)	13,000	496.7	24.0	8	192	688.7
7-1 Passenger	20,000	800.3	12.0	24	288	1,088.3
Total		15,635.5		300	20,479	36,114.7

2000

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	1,702.4	48.0	52	2,496.0	4,198.4
2-1 Fertil(bag)	1,000	6,717.1	86.4	48	4,147.2	10,864.3
2-2 Sugar(bag)	700	3,583.6	96.0	25	2,400.0	5,983.6
2-3 Cement(bag)	3,000	5,350.6	136.8	39	5,335.2	10,685.8
3-1 Free zone(cont)	3,000	1,923.9	24.0	52	1,248.0	3,171.9
4-1 Sugar(dry bulk)	7,000	3,295.8	129.6	19	2,462.4	5,758.2
4-2 Clinker(dry bulk)	5,000	3,794.0	72.0	21	1,512.0	5,306.0
4-3 Coal(dry bulk)	13,000	1,257.1	72.0	9	648.0	1,905.1
5-1 Fertil(dry bulk)	7,000	5,317.5	74.4	27	2,008.8	7,326.3
6-1 Fuel oil(liq bulk)	13,000	1,538.8	24.0	9	216.0	1,754.8
7-1 Passenger	20,000	1,478.8	12.0	38	456.0	1,934.8
Total		35,959.6		339	22,929.6	58,889.2

2005

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	2,338.1	48.0	52	2,496.0	4,834.1
2-1 Fertil(bag)	1,000	51,390.2	86.4	60	5,184.0	56,574.2
2-2 Sugar(bag)	700	20,740.9	96.0	25	2,400.0	23,140.9
2-3 Cement(bag)	3,000	35,817.3	136.8	44	6,019.2	41,836.5
3-1 Free zone(cont)	3,000	2,517.0	24.0	52	1,248.0	3,765.0
4-1 Sugar(dry bulk)	7,000	18,097.7	129.6	19	2,462.4	20,560.1
4-2 Clinker(dry bulk)	5,000	21,153.6	72.0	24	1,728.0	22,881.6
4-3 Coal(dry bulk)	13,000	7,393.3	72.0	10	720.0	8,113.3
5-1 Fertil(dry bulk)	7,000	31,220.3	74.4	33	2,455.2	33,675.5
6-1 Fuel oil(liq bulk)	13,000	9,221.5	24.0	10	240.0	9,461.5
7-1 Passenger	20,000	2,739.4	12.0	52	624.0	3,363.4
Total		202,629.3		381	25,577	228,206.1

Table III.3.6 Wharf Utilization Condition of Alternative-2

Wharf No.	Acceptable cargo
E-3	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Fuel oil Passenger boat
E-4	Container (agr. products & other general cargo) Container (free zone) Dry bulk (sugar, clinker, coal) Fuel oil
E-5	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Dry bulk (sugar, clinker, coal) Dry bulk (fertilizer)
E-6	Loose cargo in bags (fertilizer, sugar, cement) Dry bulk (fertilizer)

Table III.3.7 Results of the Simulation for Alternative-2

1995

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	528.5	48.0	52	2,496	3,024.5
2-1 Fertil(bag)	1,000	293.7	86.4	39	3,370	3,663.3
2-2 Sugar(bag)	700	246.6	96.0	25	2,400	2,646.6
2-3 Cement(bag)	3,000	274.4	136.8	33	4,514	4,788.8
3-1 Free zone(cont)	3,000	696.3	24.0	52	1,248	1,944.3
4-1 Sugar(dry bulk)	7,000	619.3	129.6	19	2,462	3,081.7
4-2 Clinker(dry bulk)	5,000	454.9	72.0	18	1,296	1,750.9
4-3 Coal(dry bulk)	13,000	196.8	72.0	8	576	772.8
5-1 Fertil(dry bulk)	7,000	356.8	74.4	22	1,637	1,993.6
6-1 Fuel oil(liq bulk)	13,000	117.1	24.0	8	192	309.1
7-1 Passenger	20,000	370.9	12.0	24	288	658.9
Total		4,155.3		300	20,479	24,634.5

2000

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	756.0	48.0	52	2,496.0	3,252.0
2-1 Fertil(bag)	1,000	826.1	86.4	48	4,147.2	4,973.3
2-2 Sugar(bag)	700	383.4	96.0	25	2,400.0	2,783.4
2-3 Cement(bag)	3,000	696.5	136.8	39	5,335.2	6,031.7
3-1 Free zone(cont)	3,000	830.9	24.0	52	1,248.0	2,078.9
4-1 Sugar(dry bulk)	7,000	790.8	129.6	19	2,462.4	3,253.2
4-2 Clinker(dry bulk)	5,000	762.6	72.0	21	1,512.0	2,274.6
4-3 Coal(dry bulk)	13,000	322.9	72.0	9	648.0	970.9
5-1 Fertil(dry bulk)	7,000	539.3	74.4	27	2,008.8	2,548.1
6-1 Fuel oil(liq bulk)	13,000	239.2	24.0	9	216.0	455.2
7-1 Passenger	20,000	736.5	12.0	38	456.0	1,192.5
Total		6,884.2		339	22,929.6	29,813.8

2005

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	748.8	48.0	52	2,496.0	3,244.8
2-1 Fertil(bag)	1,000	1,397.8	86.4	60	5,184.0	6,581.8
2-2 Sugar(bag)	700	482.7	96.0	25	2,400.0	2,882.7
2-3 Cement(bag)	3,000	1,124.9	136.8	44	6,019.2	7,144.1
3-1 Free zone(cont)	3,000	817.3	24.0	52	1,248.0	2,065.3
4-1 Sugar(dry bulk)	7,000	872.7	129.6	19	2,462.4	3,335.1
4-2 Clinker(dry bulk)	5,000	986.6	72.0	24	1,728.0	2,714.6
4-3 Coal(dry bulk)	13,000	352.5	72.0	10	720.0	1,072.5
5-1 Fertil(dry bulk)	7,000	798.0	74.4	33	2,455.2	3,253.2
6-1 Fuel oil(liq bulk)	13,000	474.6	24.0	10	240.0	714.6
7-1 Passenger	20,000	1,689.6	12.0	52	624.0	2,313.6
Total		9,745.5		381	25,577	35,322.3

Table III.3.8 Wharf Utilization Condition of Alternative-3

Wharf No.	Acceptable cargo
E-3	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Fuel oil Passenger boat
E-4	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Fuel oil
E-5	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Dry bulk (fertilizer)
E-6	Loose cargo in bags (fertilizer, sugar, cement) Dry bulk (fertilizer)
W-1	Container (agr. products & other general cargo) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Dry bulk (sugar, clinker, coal)

ii) Results of the Simulation

The results of the simulation for Alternative-3 are shown in Table III.3.9.

Table III.3.9 Results of the Simulation for Alternative-3

1995

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	150.9	48.0	52	2,496	2,646.9
2-1 Fertil(bag)	1,000	54.4	86.4	39	3,370	3,424.0
2-2 Sugar(bag)	700	52.1	96.0	25	2,400	2,452.1
2-3 Cement(bag)	3,000	60.5	136.8	33	4,514	4,574.9
3-1 Free zone(cont)	3,000	196.1	24.0	52	1,248	1,444.1
4-1 Sugar(dry bulk)	7,000	1,135.9	129.6	19	2,462	3,598.3
4-2 Clinker(dry bulk)	5,000	960.2	72.0	18	1,296	2,256.2
4-3 Coal(dry bulk)	13,000	476.4	72.0	8	576	1,052.4
5-1 Fertil(dry bulk)	7,000	241.5	74.4	22	1,637	1,878.3
6-1 Fuel oil(liq bulk)	13,000	51.6	24.0	8	192	243.6
7-1 Passenger	20,000	196.7	12.0	24	288	484.7
Total		3,576.3		300	20,479	24,055.5

2000

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	260.9	48.0	52	2,496.0	2,756.9
2-1 Fertil(bag)	1,000	158.2	86.4	48	4,147.2	4,305.4
2-2 Sugar(bag)	700	80.4	96.0	25	2,400.0	2,480.4
2-3 Cement(bag)	3,000	125.9	136.8	39	5,335.2	5,461.1
3-1 Free zone(cont)	3,000	301.8	24.0	52	1,248.0	1,549.8
4-1 Sugar(dry bulk)	7,000	1,349.7	129.6	19	2,462.4	3,812.1
4-2 Clinker(dry bulk)	5,000	1,222.5	72.0	21	1,512.0	2,734.5
4-3 Coal(dry bulk)	13,000	525.6	72.0	9	648.0	1,173.6
5-1 Fertil(dry bulk)	7,000	225.4	74.4	27	2,008.8	2,234.2
6-1 Fuel oil(liq bulk)	13,000	68.5	24.0	9	216.0	284.5
7-1 Passenger	20,000	427.0	12.0	38	456.0	883.0
Total		4,745.9		339	22,929.6	27,675.5

2005

Ship kind	Average ship size (GRT)	Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total time(hrs)
1-1 Agr.& Gen.Cargo	8,000	360.6	48.0	52	2,496.0	2,856.6
2-1 Fertil(bag)	1,000	570.1	86.4	60	5,184.0	5,754.1
2-2 Sugar(bag)	700	201.4	96.0	25	2,400.0	2,601.4
2-3 Cement(bag)	3,000	432.1	136.8	44	6,019.2	6,451.3
3-1 Free zone(cont)	3,000	460.7	24.0	52	1,248.0	1,708.7
4-1 Sugar(dry bulk)	7,000	259.7	129.6	19	2,462.4	2,722.1
4-2 Clinker(dry bulk)	5,000	299.9	72.0	24	1,728.0	2,027.9
4-3 Coal(dry bulk)	13,000	111.4	72.0	10	720.0	831.4
5-1 Fertil(dry bulk)	7,000	570.0	74.4	33	2,455.2	3,025.2
6-1 Fuel oil(liq bulk)	13,000	83.3	24.0	10	240.0	323.3
7-1 Passenger	20,000	1,322.5	12.0	52	624.0	1,946.5
Total		4,671.7		381	25,577	30,248.5

(3) Evaluation of the Alternatives

Cost (the berth construction cost and maintenance cost) and benefit (the reduction of the ship staying cost) are compared for all three Alternatives.

1) Cost

Table III.3.10 shows the construction and maintenance cost of the Alternatives based on the proposed project cost of the Master Plan presented in Table II. 4.1.

Table III.3.10 Cost of Additional Berths

	Additional Wharf Number	Additional Cost (1,000 RD$)
Alternative-1 (3 berths)	-	see Table III.3.11
Alternative-2 (4 berths)	E-6	see Table III.3.11
Alternative-3 (5 berths)	W-1	see Table III.3.11

2) The Benefit of the Additional Berths

The ship staying time is the sum of the ship waiting time and the ship mooring time. Among the three alternatives, the ship mooring times are the same, because the arrival ships are the same and the cargo handling productivities are also the same. Thus, only the ship waiting time is considered in the evaluation of the benefit.

The unit cost of the ship waiting time is estimated in Part III Chapter 6.

Table III.3.12 presents a summary of the ship waiting costs in 1995, 2000 and 2005.

Alternative-1 is considered to be the base case and the costs and benefits of the other alternatives are compared with those under Alternative-1. As the direct benefit of reducing waiting time will go to the ship operators, half of the total ship waiting cost reduction is assumed to accrue to the Dominican Republic.

The benefits are summarized in Table III.3.13.

According to Table III.3.13, the benefit in 2005 is very large. It can be said that under Alternative-1 the port traffic in 2005 exceeds the

Table III.3.11 Construction and Maintenance Cost of the Alternatives

Year		Annual Cost (1,000 RD$)		
		A1-1	A1-2	A1-3
1	1989	1,844.1	1,844.1	1,971.3
2	1990	922.0	922.0	985.6
3	1991	0.0	0.0	0.0
4	1992	23,105.5	23,112.5	30,809.4
5	1993	34,371.7	34,378.3	71,303.6
6	1994	74,954.3	85,472.3	92,578.2
7	1995	1,946.3	2,051.6	2,564.4
8	1996	1,946.3	2,051.6	2,564.4
9	1997	1,946.3	2,051.6	2,564.4
10	1998	1,946.3	2,051.6	2,564.4
11	1999	2,324.0	2,429.3	2,942.1
12	2000	1,946.3	2,051.6	2,564.4
13	2001	1,946.3	2,051.6	2,564.4
14	2002	1,946.3	2,051.6	2,564.4
15	2003	1,946.3	2,051.6	2,564.4
16	2004	13,009.6	13,115.0	13,627.7
17	2005	1,946.3	2,051.6	2,564.4
18	2006	1,946.3	2,051.6	2,564.4
19	2007	1,946.3	2,051.6	2,564.4
20	2008	1,946.3	2,051.6	2,564.4
21	2009	2,324.0	2,429.3	2,942.1
22	2010	1,946.3	2,051.6	2,564.4
23	2011	1,946.3	2,051.6	2,564.4
24	2012	1,946.3	2,051.6	2,564.4
25	2013	1,946.3	2,051.6	2,564.4
26	2014	18,064.9	18,170.3	18,683.1
27	2015	1,946.3	2,051.6	2,564.4
28	2016	1,946.3	2,051.6	2,564.4
29	2017	1,946.3	2,051.6	2,564.4
30	2018	1,946.3	2,051.6	2,564.4

capacity and thus the ship waiting time is greatly increased. In order to evaluate the appropriate alternative, it is assumed that the benefit in 2000 is the maximum benefit and remains constant from 2000 until the end of the project life. Assuming that the benefit between 1995 and 2000 increases linearly, the annual cost and benefit is presented in Table III.3.14.

Here, the IRR (Internal Rate of Return) is used to evaluate the annual cost and benefit of the three alternatives throughout the project life. The IRR, one of the methods of cost-benefit analysis, is explained briefly in Chapter 6.

Assuming that Alternative-1 is the "Without" investment case, the IRRs of the "With" investment cases, Alternative-2 and Alternative-3, are 27.9% and 2.5% respectively. Thus, Alternative-2 is determined to be the best alternative. The required wharfs are as follows:

- E.1 Official use wharf (-5.0m) L = 100m
- E.2 Ferry berth (-7.5m) L = 130m
- E.3 Main wharf (-11.0m) L = 210m
- E.4 Main wharf (-11.0m) L = 210m
- E.5 Main wharf (-11.0m) L = 210m
- E.6 Main wharf (-7.5m) L = 130m

Table III.3.12 Summarized Ship Waiting Cost

Alternative - 1 (3 berths)

Ship kind	Average Ship cost			1995		2000		2005	
	ship size (GRT)	$/GRT/Mon	RD$/hour (RD$3.08/$)	Waiting time(hrs)	Waiting Cost (RD$)	Waiting time(hrs)	Waiting Cost (RD$)	Waiting time(hrs)	Waiting Cost (RD$)
1-1 Agr.& Gen.Cargo	8,000	11.670	399	1182.1	472,099	1,702.4	679,893	2338.1	933,775
2-1 Fertil(bag)	1,000	33.570	144	2290.2	328,884	6,717.1	964,609	51390.2	7,379,890
2-2 Sugar(bag)	700	40.180	120	1482.7	178,394	3,583.6	431,167	20740.9	2,495,478
2-3 Cement(bag)	3,000	19.250	247	1918.6	473,974	5,350.6	1,321,821	35817.3	8,848,365
3-1 Free zone(cont)	3,000	19.250	247	1450.8	358,408	1,923.9	475,283	2517.0	621,804
4-1 Sugar(dry bulk)	7,000	12.500	374	1600.7	599,151	3,295.8	1,233,636	18097.7	6,774,070
4-2 Clinker(dry bulk)	5,000	14.850	318	1285.5	408,307	3,794.0	1,205,069	21153.6	6,718,912
4-3 Coal(dry bulk)	13,000	9.094	506	537.4	271,778	1,257.1	635,750	7393.3	3,738,995
5-1 Fertil(dry bulk)	7,000	12.500	374	2590.5	969,639	5,317.5	1,990,370	31220.3	11,685,932
6-1 Fuel oil(liq bulk)	13,000	9.094	506	496.7	251,195	1,538.8	778,213	9221.5	4,663,566
7-1 Passenger	20,000	11.670	998	800.3	799,046	1,478.8	1,476,483	2739.4	2,735,108
Total				15635.5	5,110,875	35,959.6	11,192,296	202629.3	56,595,894

Alternative - 2 (4 berths)

Ship kind	Average Ship cost			1995		2000		2005	
	ship size (GRT)	$/GRT/Mon	RD$/hour (RD$3.08/$)	Waiting time(hrs)	Waiting Cost (RD$)	Waiting time(hrs)	Waiting Cost (RD$)	Waiting time(hrs)	Waiting Cost (RD$)
1-1 Agr.& Gen.Cargo	8,000	11.670	399	528.5	211,069	756.0	301,926	748.8	299,051
2-1 Fertil(bag)	1,000	33.570	144	293.7	42,177	826.1	118,632	1397.8	200,731
2-2 Sugar(bag)	700	40.180	120	246.6	29,670	383.4	46,129	482.7	58,077
2-3 Cement(bag)	3,000	19.250	247	274.4	67,788	696.5	172,065	1124.9	277,897
3-1 Free zone(cont)	3,000	19.250	247	696.3	172,015	830.9	205,267	817.3	201,907
4-1 Sugar(dry bulk)	7,000	12.500	374	619.3	231,807	790.8	296,001	872.7	326,656
4-2 Clinker(dry bulk)	5,000	14.850	318	454.9	144,488	762.6	242,221	986.6	313,369
4-3 Coal(dry bulk)	13,000	9.094	506	196.8	99,527	322.9	163,299	352.5	178,269
5-1 Fertil(dry bulk)	7,000	12.500	374	356.8	133,552	539.3	201,863	798.0	298,696
6-1 Fuel oil(liq bulk)	13,000	9.094	506	117.1	59,221	239.2	120,970	474.6	240,018
7-1 Passenger	20,000	11.670	998	370.9	370,319	736.5	735,346	1689.6	1,686,953
Total				4155.3	1,561,633	6,884.2	2,603,719	9745.5	4,081,624

Alternative - 3 (5 berths)

Ship kind	Average Ship cost			1995		2000		2005	
	ship size (GRT)	$/GRT/Mon	RD$/hour (RD$3.08/$)	Waiting time(hrs)	Waiting Cost (RD$)	Waiting time(hrs)	Waiting Cost (RD$)	Waiting time(hrs)	Waiting Cost (RD$)
1-1 Agr.& Gen.Cargo	8,000	11.670	399	150.9	60,265	260.9	104,197	360.6	144,014
2-1 Fertil(bag)	1,000	33.570	144	54.4	7,812	158.2	22,718	570.1	81,869
2-2 Sugar(bag)	700	40.180	120	52.1	6,269	80.4	9,673	201.4	24,232
2-3 Cement(bag)	3,000	19.250	247	60.5	14,946	125.9	31,103	432.1	106,747
3-1 Free zone(cont)	3,000	19.250	247	196.1	48,445	301.8	74,557	460.7	113,812
4-1 Sugar(dry bulk)	7,000	12.500	374	1135.9	425,174	1,349.7	505,200	259.7	97,207
4-2 Clinker(dry bulk)	5,000	14.850	318	960.2	304,984	1,222.5	388,297	299.9	95,256
4-3 Coal(dry bulk)	13,000	9.094	506	476.4	240,929	525.6	265,810	111.4	56,338
5-1 Fertil(dry bulk)	7,000	12.500	374	241.5	90,395	225.4	84,368	570.0	213,354
6-1 Fuel oil(liq bulk)	13,000	9.094	506	51.6	26,096	68.5	34,642	83.3	42,127
7-1 Passenger	20,000	11.670	998	196.7	196,392	427.0	426,331	1322.5	1,320,428
Total				3576.3	1,421,705	4,745.9	1,946,897	4671.7	2,295,384

Table III.3.13 Benefit of the Alternatives

(in RD$)

Year	1995		2000		2005	
Alternative	Total Waiting Cost	1/2 Waiting Cost	Total Waiting Cost	1/2 Waiting Cost	Total Waiting Cost	1/2 Waiting Cost
Alternative-1	0	0	0	0	0	0
Alternative-2	3,549,242	1,774,621	8,588,577	4,294,288	52,514,270	26,257,135
Alternative-3	3,689,170	1,844,585	9,245,399	4,622,700	54,300,510	27,150,255

Table III.3.14 Annual Cost and Benefit of the Alternatives

Year		Annual Cost (1,000 RD$)			Cost Difference between A1 & A1-1			Benefit (1,000 RD$)		
		A1-1	A1-2	A1-3	A1-1	A1-2	A1-3	A1-1	A1-2	AL-3
1	1989	1,844.1	1,844.1	1,971.3	0.0	0.0	127.2	0.0	0.0	0.0
2	1990	922.0	922.0	985.6	0.0	0.0	63.6	0.0	0.0	0.0
3	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1992	23,105.5	23,112.5	30,809.4	0.0	7.0	7,703.9	0.0	0.0	0.0
5	1993	34,371.7	34,378.3	71,303.6	0.0	6.6	36,931.9	0.0	0.0	0.0
6	1994	74,954.3	85,472.3	92,578.2	0.0	10,518.0	17,623.9	0.0	0.0	0.0
7	1995	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	1,744.6	1,844.6
8	1996	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	2,278.6	2,400.2
9	1997	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	2,782.5	2,955.8
10	1998	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	3,286.4	3,511.5
11	1999	2,324.0	2,429.3	2,942.1	0.0	105.3	618.1	0.0	3,790.4	4,067.1
12	2000	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
13	2001	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
14	2002	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
15	2003	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
16	2004	13,009.6	13,115.0	13,627.7	0.0	105.4	618.1	0.0	4,294.3	4,622.7
17	2005	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
18	2006	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
19	2007	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
20	2008	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
21	2009	2,324.0	2,429.3	2,942.1	0.0	105.3	618.1	0.0	4,294.3	4,622.7
22	2010	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
23	2011	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
24	2012	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
25	2013	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
26	2014	18,064.9	18,170.3	18,683.1	0.0	105.4	618.2	0.0	4,294.3	4,622.7
27	2015	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
28	2016	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
29	2017	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7
30	2018	1,946.3	2,051.6	2,564.4	0.0	105.3	618.1	0.0	4,294.3	4,622.7

1.4 Breakwater

The existing breakwater length is sufficient and the repair work of the damaged portion is proposed.

1.5 Container Yard

As noted in Part II Chapter 3, the required area for the containers in 1995 is estimated as follows:

Free zone containers	(chassis)	6,000m^2
General cargoes	(forklift)	9,500m^2
"	(reefer)	800m^2
Total:		16,300m^2

1.6 Other Facilities

(1) Coal Stock Yard

Under the Short-term Development Plan, coal will be tentatively stocked at the open area behind the apron between Wharfs E-4 and E-5.

Unloaded coal is directly transported by dump trucks working on the apron. Coal which cannot be immediately transported by dump trucks is temporarily stocked in the yard.

The difference of the productivity of the dump trucks and the ship unloading is the volume of coal to be stocked.

Assuming that the productivity of trucks for four gangs is 3,200 tons/day and that 15,000 tons of coal is unloaded from a ship in three days, then the volume of stock is

15,000 tons - 3,200 tons x 3 = 5,400 tons

Thus, the required area of the coal stock yard is

5,400 tons / (2 tons/m^2) = 2,700m^2

(2) Clinker

Clinker is assumed to be handled at the same yard together with coal because both coal and clinker are cargoes of the same shipper, the cement factory, and they will not be handled at the same time. The average lot size of clinker is estimated to be 5,000 tons which is smaller than that of coal, so it is not necessary to prepare any additional facilities for the handling of clinker.

(3) Parking Area for Ferry Boats

The parking area for ferry boats is the same as under the Master Plan.

$A = 16,800m^2$

(4) Port Commander's Office

Under the Master Plan, the Port Commander's Office will move next to the port administration office, but in 1995 the Port Commander's Office will remain at the present location.

The required land area for the future construction of the office is reserved at the proposed site.

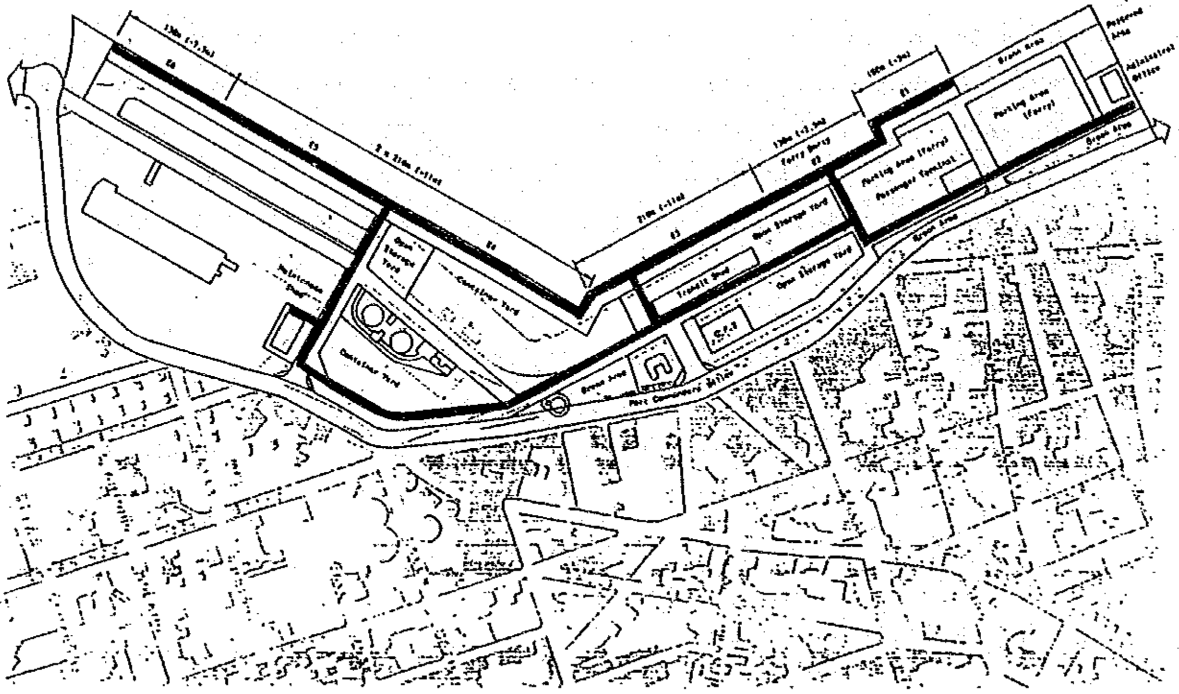
(5) Fuel Oil Tanks

The two 25,000kl tanks recommended under the Master Plan are not necessary in 1995, because Wharf E-1 is not included in the Short-term Development Plan.

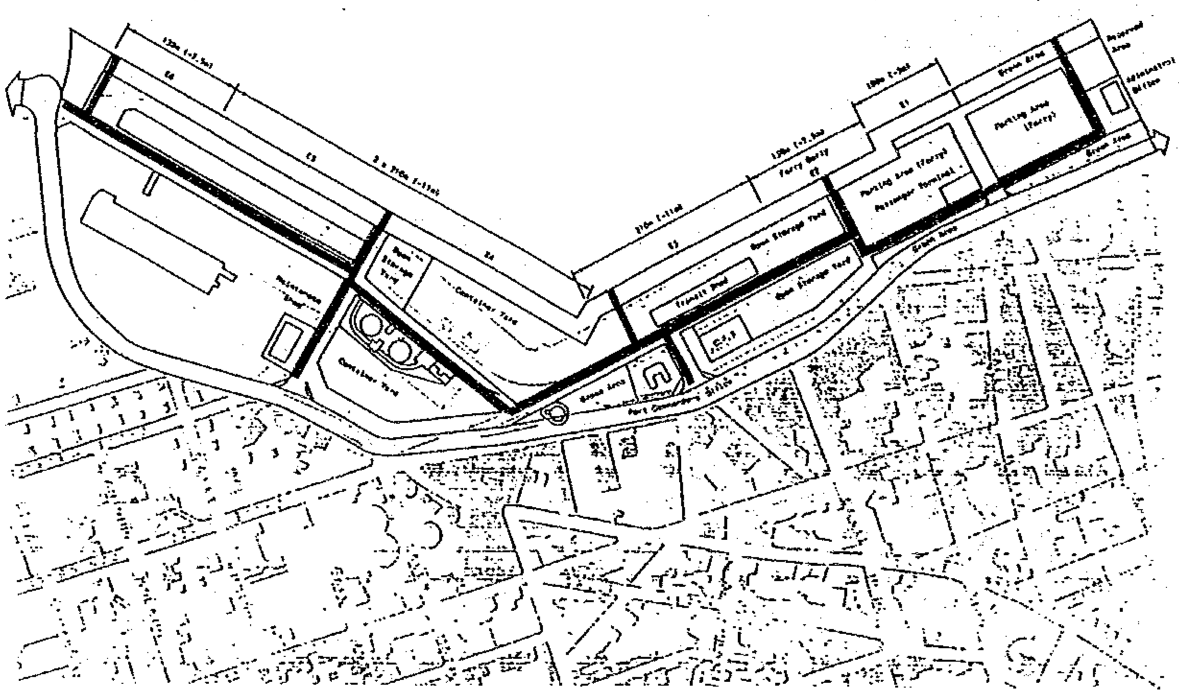
(6) Other Facilities

Water supply pipe and the drain pipe are planned as shown below.

The scale of the other required facilities is estimated in Part II Chapter 3 above, and a summary of the facilities is shown in Table III.3.15.



Layout Plan of Water Supply Pipe



Layout Plan of Drain Pipe

1.7 Proposed Principal Port Facilities

The proposed principal port facilities for the Short-term Development Plan are summarized in Table III.3.15.

2. Port Layout and Land Use

The layout of the Short-term Development Plan (Alternative-2) is proposed as shown in Fig. III.3.2. All the wharfs will be constructed on the east bank of the Higuamo river.

2.1 Layout of Port Facilities for the Short-term Development Plan

The land use and the layout of the port facilities for the Short-term Development Plan are shown in Fig.III.3.3.

The face line of the wharfs shall be shifted 22 - 25m into the river to provide an additional land area as well as to ease the construction work.

The face line of Wharfs E-4 - E-6 is set to be straight to accommodate ships of various sizes.

Passenger boats will be accommodated at Wharf E-3.

Ferry boats will be accommodated at Wharf E-2 on an exclusive basis.

All the existing wharfs will be retired. CDE's floating power plant "Weber" will be moved upstream on the west side bank of the river.

2.2 Removal of the Existing Facilities

The major existing facilities to be removed by 1995 are listed below.

- FERQUIDO factory behind Wharf E-4, about 18m long.
- CDE storage.
- Abandoned customs office
- Agriculture office and adjacent customs office

Table III.3.15 Proposed Port Facilities for the Short-term Development Plan of the Port of San Pedro de Macoris

Facility		Function	Dimensions or Contents
i)	Basin and channel	(a) Turning basin	Diameter = 400m, Depth = -11.0m
		(b) Channel	Width = 130m, Depth = -11.0m
ii)	Breakwater		Repair work of the existing structure
iii)	Mooring facilities	(a) Service boat wharf (E-1)	L = 100m Depth = -5.0m
		(b) Ferry berth (E-2)	L = 130m Depth = -7.5m
		(c) Main wharf (E-3)	L = 210m Depth = -11.0m
		" (with ro-ro ramp) (E-4)	L = 210m Depth = -11.0m
		" (E-5)	L = 210m Depth = -11.0m
		" (E-6)	L = 130m Depth = -7.5m
iv)	Storage facilities	(a) Container yard (Chassis)	$6,000m^2$
		" (Forklift)	$9,500m^2$
		" (Reefer)	$800m^2$
		(b) CFS	$50m \times 30m = 1,500m^2$
		(c) Transit shed	$2,100m^2$
		(d) Open yard (coal and clinker)	$2,700m^2$
v)	Ferry terminal	(a) Terminal building	$20m \times 40m \times 2$ stories $= 1,600m^2$
		(b) Parking area	$16,800m^2$
vi)	Port administration facilities	(a) Administration office (Building)	$600m^2$
		(Parking)	$1,500m^2$
		(b) Reserved area for the port commander's office	$1,700m^2$
vii)	Maintenance shop	Maintenance shop (Building)	$800m^2$
		(Area)	$1,750m^2$
viii)	Road		
ix)	Green area		

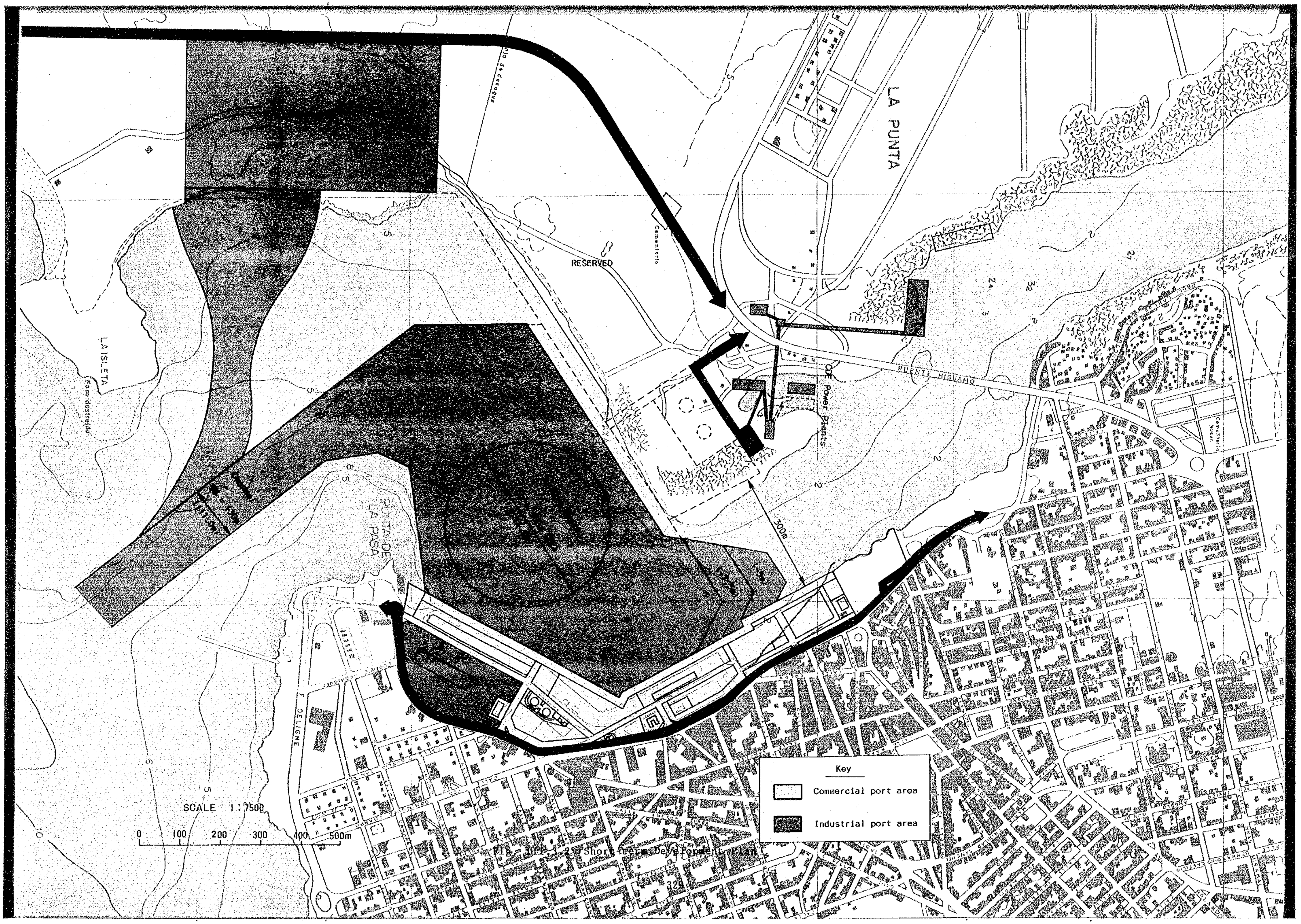


Fig. III.3.2 Short-term Development Plan

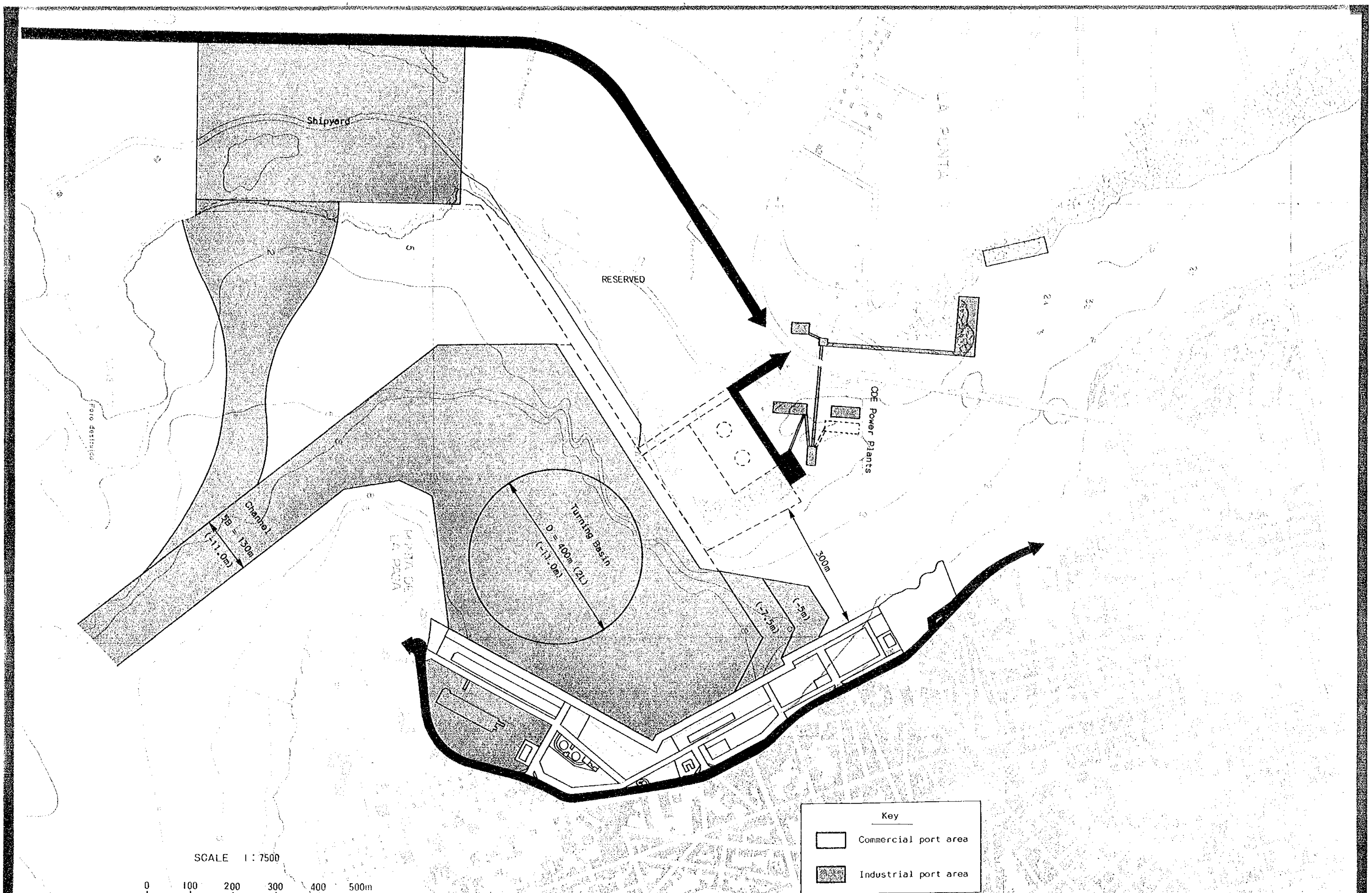


Fig. III.3.2 Short-term Development Plan

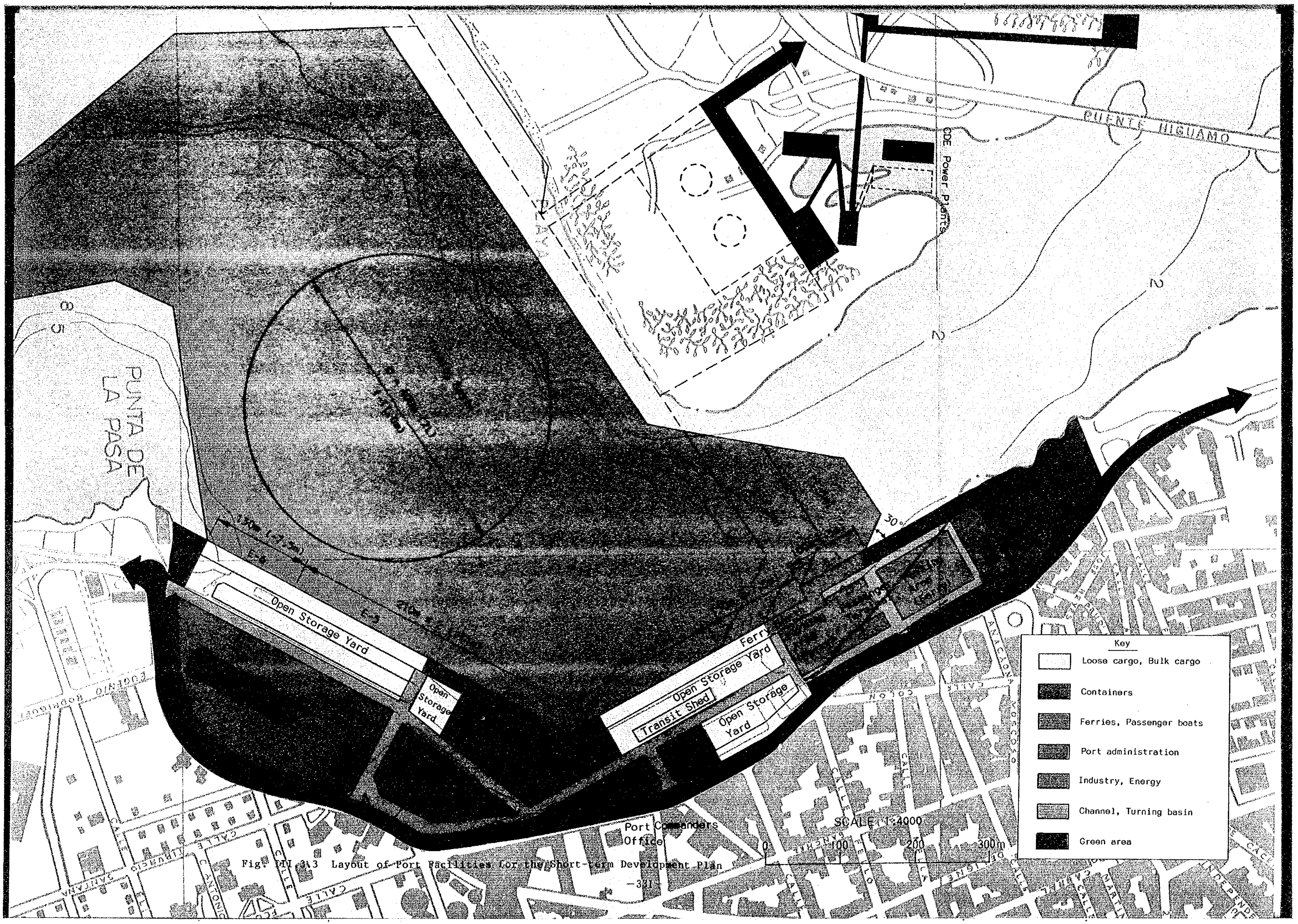


Fig. III.3.3 Layout of Port Facilities for the Short-term Development Plan

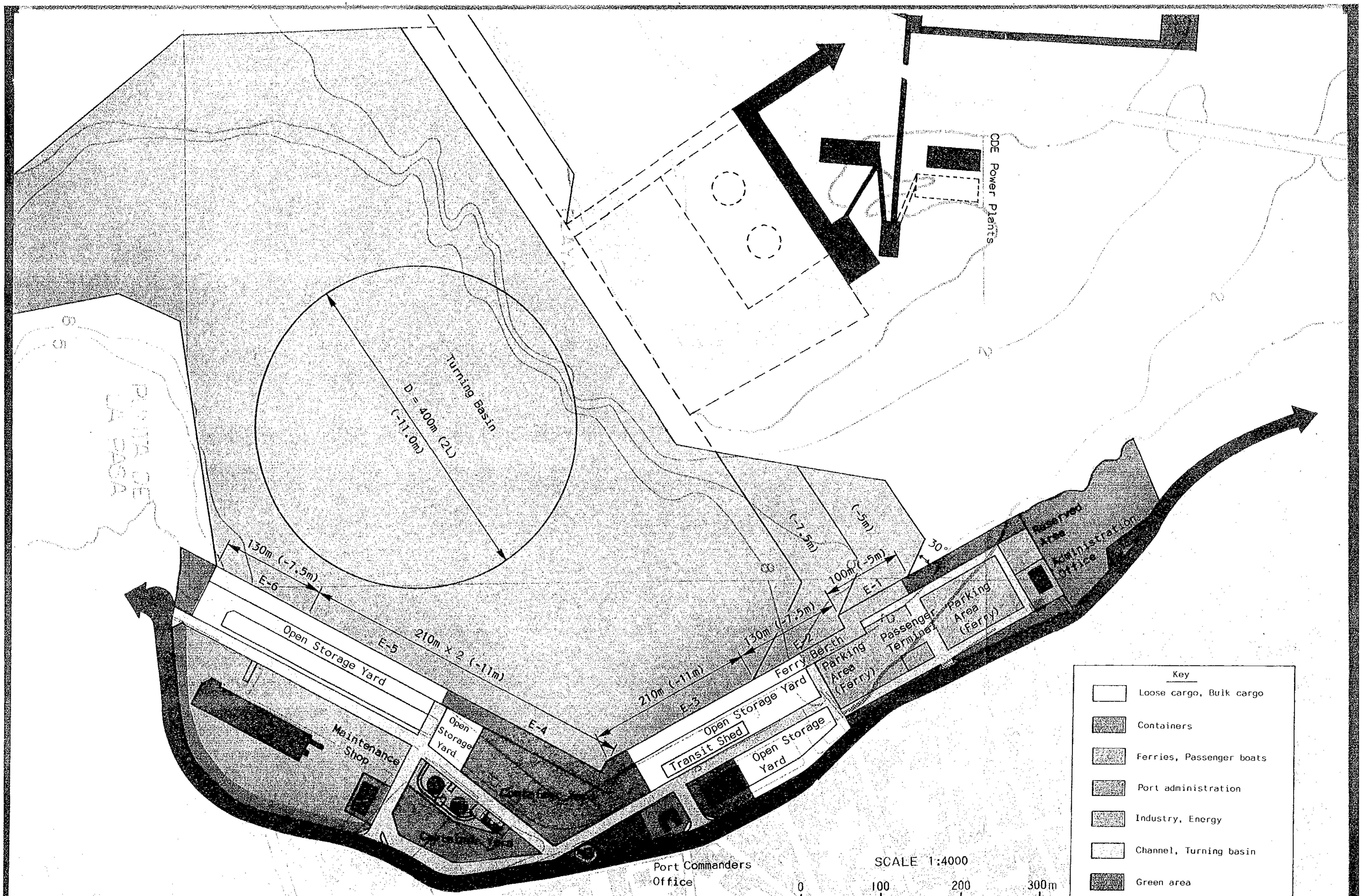


Fig. III.3.3 Layout of Port Facilities for the Short-term Development Plan

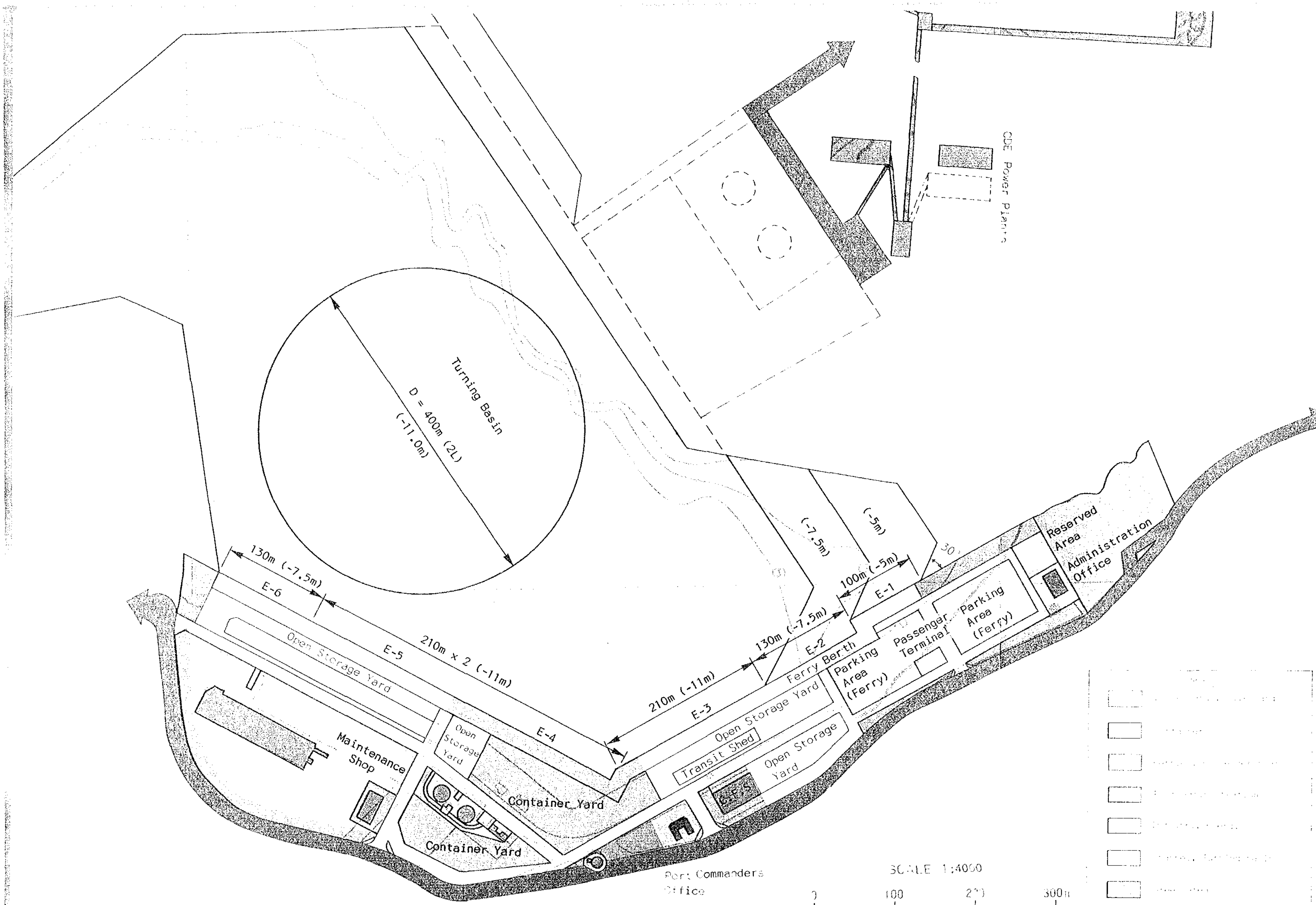


Fig. III.3. Layout of Port Facilities for the Short-term Development Plan

3. Cargo Handling and Harbor Craft

3.1 Improvement of Cargo Handling

It is important to improve cargo handling and promote rationalization of marine cargo movement in order to realize efficient utilization of the Port. Improvement of cargo handling includes improvement of the safety, reliability and productivity of cargo handling. This will be realized by mechanizing cargo handling and unitizing the cargo.

(1) Bulk Sugar (Export)

Currently, bulk sugar is bagged at the sugar mills, transported to the wharfs by trucks, loaded onto the ships using ship cranes and opened on the deck. So, the cargo handling productivity is considerably low and the loose threads from opened bags sometimes cause trouble to pneumatic unloaders at the unloading ports.

A fixed sugar loader connected with a warehouse located just behind the wharf is the most popular mechanized system of bulk sugar loading. This system is adopted at the ports of Haina and La Romana. A tire mounted sugar loader which consists of a hopper and belt conveyers is used when the handling volume is not very big as at the port of Puerto Plata.

The cargo volume of bulk sugar at SPM Port in 1995 is estimated as 136,000 tons per year. This volume will not justify the exclusive use of a wharf or the high costs of an exclusive system. So, an original sugar container is devised in this study considering the transport from the sugar mills and the loading at the wharfs. Fig. III.3.4 shows the general plan of the sugar container. Three systems of sugar loading including the proposed sugar container are compared in Table III.3.16 and Fig. III.3.5. This sugar container can be fabricated remodeling standard 20 foot containers and can be carried and handled in the same way as ordinary containers. It is convenient for transport and storage. The sugar container is an open top type and it would be easy to put sugar into the containers at the sugar mills. Moreover, the special container can be used for grain and beans too.

The containers will be transported to the apron and lifted up using a 100 ton truck crane or a large capacity ship crane and the hoppers will be opened above the hatch to throw the sugar down to the hold.

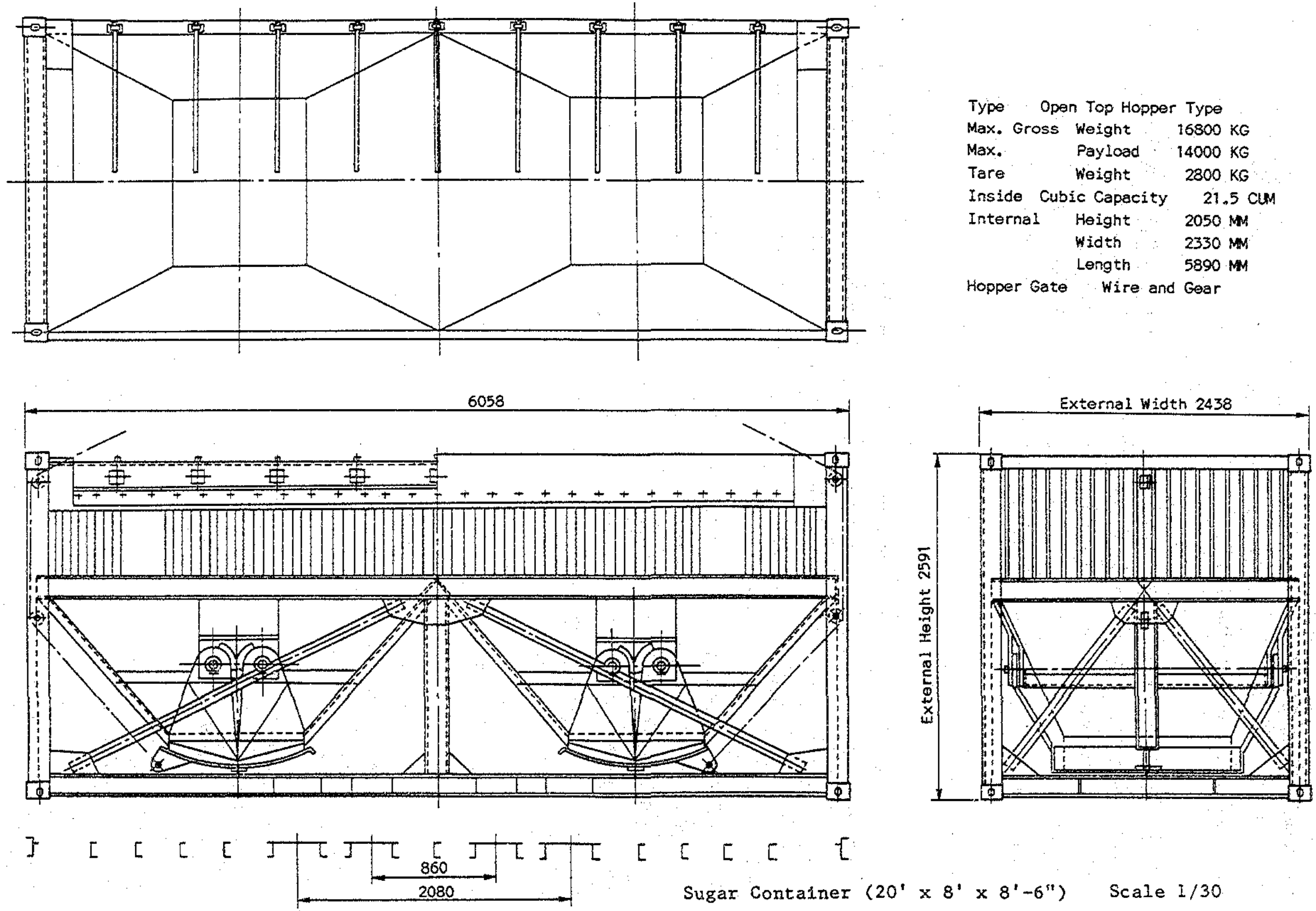


Fig. III.3.4 General Plan of the Sugar Container

Table III.3.16 Comparison of Sugar Loading Systems

		Fixed Sugar Loader	Tire Mounte Sugar Loader	Sugar Container
Function	Area	△	○	◎
	Berth occupancy	△	○	◎
	Operation	◎	△	◎
	Productivity	◎	○	◎
	Ability to handle different types of cargo	△	△	◎
	Required number of workers	◎	○	◎
	Maintenance/Repairs	△	△	◎
	Flexibility for cargo Volume change	△	○	◎
Cost	Initial cost	△	○	◎
	Operation/Maintenance	△	○	◎
Total Evaluation		△	○	◎
Remarks for use at the Port of San Pedro de Macoris		Expensive and requires exclusive use of the wharf	Expensive and less flexible	Reasonable cost, does not require exclusive use of the whraf and flexible for cargo volume change

Key ◎ Excellent
○ Good
△ Some problems

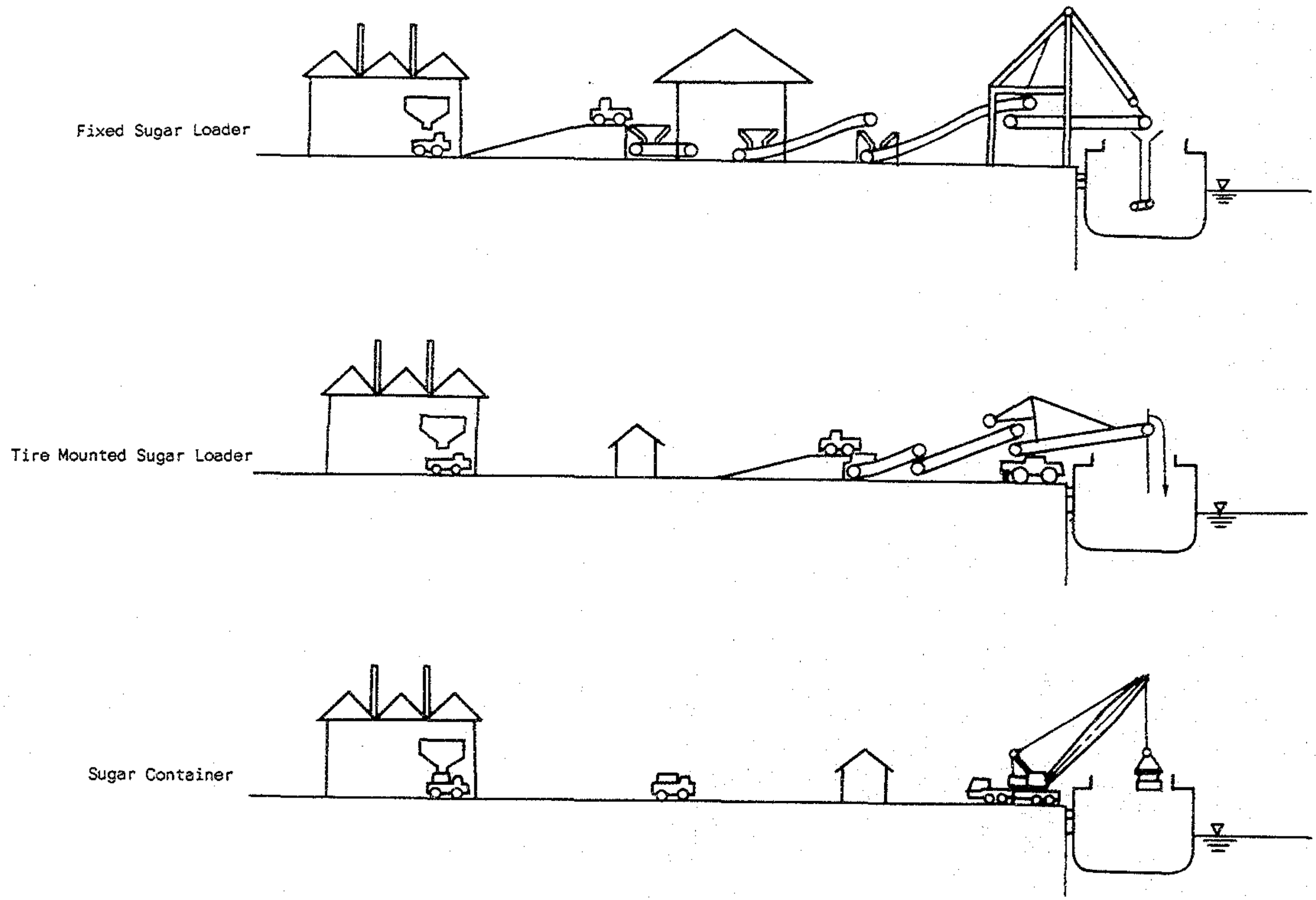


Fig. III.3.5 Three Systems of Sugar Loading

The loading productivity of this system is estimated as follows:

Volume of sugar per container	14 tons
Cycle time of crane operation	6 minutes
Working hours per day	8 hours
Efficiency Coefficient	0.8
Number of working hatches	2 hatches
$14 \times (60 \div 6) \times 8 \times 0.8 \times 2 =$	1792 tons/day

Considering the additional time for mooring/unmooring, preparation for loading, etc., the effective loading productivity is estimated as 1,300 tons/day, while current effective loading productivity is 346 tons/day.

(2) Cargo in Bags (Export) and Miscellaneous General Cargo (Import)

Currently, cargo in bags is transported to the wharfs from the factories by trucks and loaded on the ships using slings and ship cranes. So, the cargo handling productivity is considerably low.

In order to improve the cargo handling productivity, it is proposed to palletize this cargo and to handle the cargo using forklifts. Palletization will also decrease the cargo damage greatly. The cargo handling productivity is supposed to be improved as follows:

	Current Condition	Future Condition		
	Effective (tons/day)	Rated (tons/day)	Effective (tons/day)	Remarks
Sugar	108	240	150	1 hatch
Fertilizer	143	480	280	2 hatches
Cement	88	720	530	3 hatches

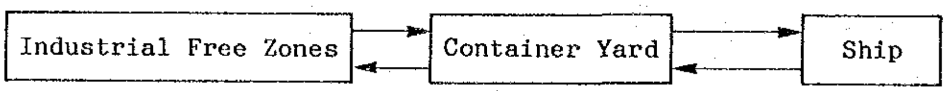
It is also necessary to take advantage of palletization for the handling of miscellaneous general cargo. Pallets used for cargo handling must be returned to the wharf from the ship hold.

(3) Containers of the Industrial Free Zones (Export & Import)

The advantages of containerization are listed as follows:

1) Exact schedule of calling ships
2) Rapid cargo handling
3) Less cargo damage and loss
4) Rapid customs clearance, transport in bond
5) Lower packing costs
6) Lower cargo handling cost through mechanization

Containers of the industrial free zones will be handled using the chassis system. Containers will be loaded or unloaded by the ro/ro system using the yard trucks. The cargo handling productivity is estimated as 40 TEU per hour (20 units of 40' containers per hour). The flow chart of the containers is shown below.



(4) Containers of Miscellaneous General Cargo and Agricultural Products (Export & Import)

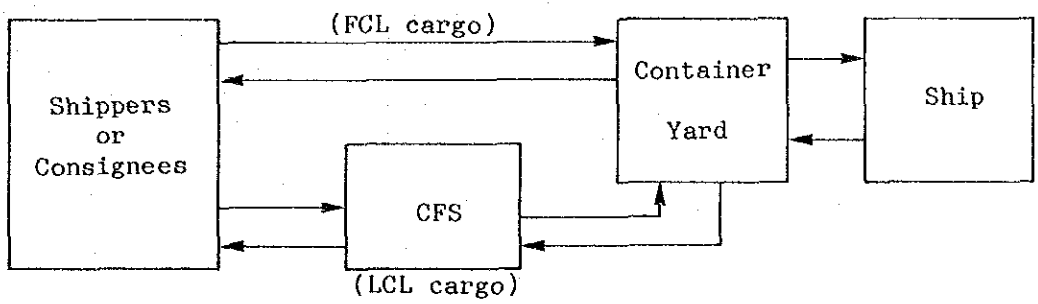
In the case of FCL cargo, containers will be transported to and from the container yard directly.

In the case of LCL cargo, cargo to be exported will be carried into the CFS at first and consolidated into containers. Then, the consolidated containers will be carried to the container yard. Imported containers are carried to the CFS from the container yard and devanned in the CFS. Customs clearance is also carried out inside the CFS. Vanning and devanning in the CFS are carried out using 2.5 ton electric forklifts.

Containers will be set on the chassis at the dockside of the CFS and carried to and from the container yard using yard trucks.

Containers will be handled using a 30 ton forklift and stacked in two layers in the container yard. Reefer containers will be stacked in a specified area provided with exclusive electric facilities. Containers will be carried between the container yard and the apron using chassis and yard trucks. For loading and unloading, a 30 ton forklift and a 100 ton truck crane or large capacity ship cranes will be used in the case of the lo/lo system. Containers will be carried into or out of ships directly in the case of the ro/ro system.

The cargo handling productvity is estimated as 40 TEU per hour (20 units of 40' containers per hour). The flow chart of the containers is shown below.



(5) Other Cargoes

Mechanization and improvement of cargo handling should also be promoted for those cargoes not mentioned above.

3.2 Harbor Craft

As mentioned in Chapter 2 Section 2, the average maximum size of vessels which will call at the port of San Pedro de Macoris in 1995 will be 20,000 DWT for cargo ships and 20,000 GRT for passenger boats. Then two tug boats, one 1,500 HP and one 500 HP, will be needed. A pilot boat will also be needed.

3.3 Required Cargo Handling Equipment and Harbor Craft

Table III.3.17 shows the summary of the required cargo handling equipment and harbor craft. The procedure used to estimate the required equipment is explained in APP. III.3.

Table III.3.17 Required Cargo Handling Equipment and Harbor Craft

Item	Capacity	Number	Remarks
(Cargo Handling Equipment)			
Truck crane	100 ton	2	Wire rope truck crane
Forklift	30 ton	2	
"	2.5 ton (D)	6	
"	2.5 ton (E)	4	Used exclusively in the CFS
Truck	10 ton	2	
Chassis	40 foot	17	
Yard truck	320 HP	9	
Sugar container	14 ton (Net)	60	
Pallet	1.5 ton	3,300	
(Harbor Craft)			
Tug boat	1500 HP	1	
"	500 HP	1	
Pilot boat	50 HP	1	

Notice : (D) Disel engine
(E) Electric power

CHAPTER 4 DESIGN, CONSTRUCTION AND COST ESTIMATE

The required port facilities to meet the future traffic demand are discussed in the previous chapters, and in this chapter their structural designs, construction plan and costs are discussed in detail.

1. Structural Design

1.1 Design Conditions

The design conditions are set based on the results of the site surveys and the requirements for future port planning as detailed below.

Soil Conditions

The soil conditions in the port area are detailed in Part I and summarized in Table III.4.1. The sub-soil in the project area is broadly classified as sandy for the area of Wharfs E-1, E-2, E-3 and W-1 and as silty for the area of Wharfs E-4, E-5 and E-6. The conditions are outlined below.

- Area from Wharf E-1 to Wharf E-3
  The sub-soil is sandy consisting of an upper layer of N value 3 - 40 and a bearing stratum of N value 50 about 20 m below datum.
- Area of Wharf E-4
  The sub-soil is silty consisting of an upper layer of cohesion 5 - 20 t/m^2 and a bearing stratum of N value 30 about 40 m below datum.
- Area of Wharf E-5 and E-6
  The sub-soil is silty consisting of a soft upper layer of cohesion 5 - 25 and a bearing stratum of N value 30 about 45 m below datum.
- Area of Wharf W-1
  The sub-soil is sandy consisting of an upper layer of average N value 10 and a bearing stratum of N value 60 about 20 m below datum.

Table III.4.1 (1) Soil Conditions, Wharf E-3 (Bore hole No.1)

Elevation	N Value	Cohesion (t/m^2)
DL -11.0 -14.8 m	3	0
DL -14.8 -16.3 m	18	0
DL -16.3 -17.6 m	8	0
DL -17.6 -19.1 m	38	0
DL -19.1 -20.8 m	54	0
DL -20.8 -22.3 m	40	0
DL -22.3 -23.6 m	62	0

Table III.4.1 (2) Soil Conditions, Wharf E-4 (Bore hole No.6)

Elevation	N Value	Cohesion (t/m^2)
DL -11.0 -14.0 m	28	0
DL -14.0 -16.3 m	14	0
DL -16.3 -17.8 m	0	9
DL -17.8 -19.3 m	0	5
DL -19.3 -22.3 m	0	4
DL -22.3 -25.3 m	0	5
DL -25.3 -27.0 m	0	9
DL -27.0 -29.5 m	0	7
DL -29.5 -31.8 m	0	20
DL -31.8 -34.0 m	0	9
DL -34.0 -36.0 m	0	12
DL -36.0 -38.0 m	0	13
DL -38.0 -40.3 m	0	11
DL -40.3 -41.8 m	0	13
DL -41.8 -43.3 m	0	16
DL -43.3 -47.0 m	29	0

Table III.4.1 (3) Soil Conditions, Wharf E-5 (Bore hole No.4)

Elevation	N Value	Cohesion (t/m^2)
DL -11.0 -12.8 m	28	0
DL -12.8 -16.8 m	0	3
DL -16.8 -21.3 m	0	3
DL -21.3 -24.5 m	0	4
DL -24.5 -27.5 m	0	5
DL -27.5 -29.5 m	0	8
DL -29.5 -31.0 m	0	7
DL -31.0 -34.0 m	0	7
DL -34.0 -36.8 m	0	15
DL -36.8 -38.3 m	0	16
DL -38.3 -39.8 m	0	21
DL -39.8 -41.3 m	0	22
DL -41.3 -42.8 m	0	20
DL -42.8 -44.3 m	0	21
DL -44.3 -45.8 m	0	25
DL -45.8 -47.3 m	31	0
DL -47.3 -50.0 m	49	0

Table III.4.1 (4) Soil Conditions, Wharf W-1 (Bore hole No.5)

Elevation	N Value	Cohesion (t/m^2)
DL -11.0 -12.5 m	12	0
DL -12.5 -14.0 m	13	0
DL -14.0 -15.8 m	5	0
DL -15.8 -18.3 m	0	8
DL -18.3 -21.0 m	0	3
DL -21.0 -25.0 m	62	0

Design Conditions

The wharfs are designed under the conditions shown in Table III.4.2.

Wharfs E-3, E-4, E-5 and W-1 are designed with a water depth of -11 m, deep enough to accommodate 20,000 t class ships. Wharfs E-2 and E-5 are designed with a water depth of -7.5 m for 5,000 t class ships. The water depth of Wharf E-1 is -5.0 m to accommodate harbor craft such as tug boats and a pilot boat.

All the wharfs will be provided with adequate fender systems and the steel members will be protected from corrosion by cathodic protection, concrete coating and increasing steel thickness.

1.2 Wharfs

All the existing wharfs were constructed in 1946, and by the year 1995 their service lives will reach about 50 years. A time span of 50 years is usually taken as the economic service life of concrete structures. As mentioned in previous sections, the quality of the concrete has deteriorated and its strength has decreased to less than 100 kg/cm^2 in certain areas. It is judged that all the existing wharfs will reach the end of their economic service lives by 1995 and should be totally reconstructed in the Short-term Development Plan. The faceline of the wharfs is planned to be shifted seawards by 22-25 m to create an additional land area as well as to ease the construction work.

(1) Comparison of the Structural Types of Wharfs

The following three structural types can be considered as possible structural types applicable for the wharfs planned in this project:

- gravity type bulkhead wharf (caisson)
- steel sheet pile type bulkhead wharf
- steel pipe pile open type wharf

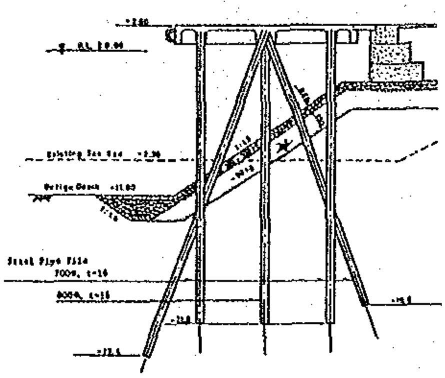
The merits and demerits of the above three types are compared as shown in Table III.4.3 and summarized as follows:

Table III.4.2 Design Conditions of Wharfs

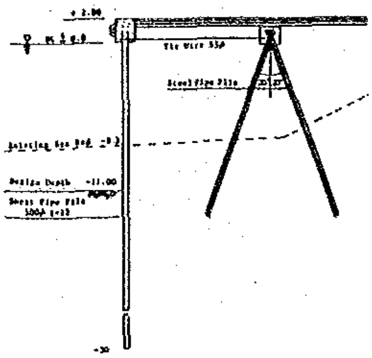
1)	Design Ship Size	20,000 DWT	5,000 DWT	1,000 DWT
2)	Water Depth	-11.0 m	-7.5 m	-5.0 m
3)	Apron Height	+2.0 m	+2.0 m	+2.0 m
4)	Tidal Plane			
	M.H.W.L.	+0.36 m	+0.36 m	+0.36 m
	M.S.L.	+0.24 m	+0.24 m	+0.24 m
	M.L.W.L.	+0.14 m	+0.14 m	+0.14 m
	L.W.L.	DL ±0.00 m	DL ±0.00 m	DL ±0.00 m
5)	Surcharge			
	Ordinary Condition	3.0 t/m^2	2.0 t/m^2	1.0 t/m^2
	Seismic Condition	1.5 t/m^2	1.0 t/m^2	0.5 t/m^2
6)	Seismic Coefficient			
	Horizontal	0.1	0.1	0.1
	Vertical	0.0	0.0	0.0
7)	Berthing Velocity	0.10 m/sec	0.10 m/sec	0.10 m/sec
8)	Rubber Fender System			
	Energy Absorption	6.2 t/m	2.6 t/m	0.6 t/m
	Reaction Force	39.0 t/m	26.8 t/m	10.1 t/m
9)	Tractive Force	70 t	35 t	15 t
10)	Wave force	not considered	not considered	not considered
11	Service life	50 years	50 years	50 years

Table III.4.3 Comparison of Structural Types

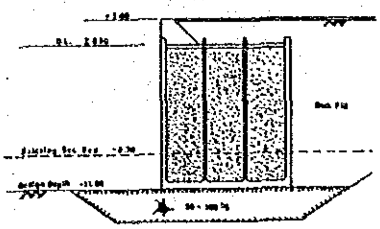
Steel Pile Open Type



Steel Sheet Pile Type



Caisson Type



Type / Item	Steel Pile Open Type	Steel Sheet Pile Type	Caisson Type
Required Work	Pile Driving	Pile Driving	Floating Dock
Vessel	Barge	Barge	
Workability	Easy	Easy	Difficult
Construction Speed	High	High	Low
Suitability to Poor Sub-soil	Good	Fair	Poor
Effect on Current	Lowest	High	High
Construction Cost	1.0	1.1	Highest

The gravity type bulkhead wharf is not suitable for sites where the sub-soil is silty with poor bearing capacity and a wide construction area or where special construction equipment are not readily available. It requires in many cases a replacement of the poor soil layer with sand involving a higher construction cost and difficult construction work.

The steel sheet pile type bulk head wharf has demerits similar to those of the gravity type bulkhead wharf and its construction cost is higher than that of the steel pipe pile open type wharf. This type could be a suitable option for sites where the sub-soil is a hard sandy layer.

The steel pipe open type wharf is suitable to be constructed in areas with poor soil conditions and does not disturb water flow nearby, and hence possible effects like scouring or silting up of the sea bed are minimized.

Based on the structural aspects, the gravity type bulkhead wharf can be ruled out from this project.

It should be taken into consideration that the new wharfs are planned to be constructed with their facelines 22-25 m seawards from the existing ones and this will narrow the width of the river possibly causing an acceleration and disturbance of river water flow.

The steel pipe pile open type wharf is selected in preference of its minimal effect on river water flow, lower construction cost and its overall suitability to the entire length of the planned wharf area which consists of silty and sandy sub-soil conditions.

The type of steel pipe pile structure is selected through comparison of the quality, reliability, workability, cost, etc. of the steel and concrete piles.

(2) Structure of Wharf

The standard cross sections of the wharfs are shown in Fig. III.4.1. As shown in the figures the wharfs are supported by steel pipe piles decked with a concrete superstructure with a rubble mound slope underneath. The horizontal force acting on the wharf is resisted by the batter piles and the vertical load by both vertical and batter piles. The existing soft surface layer should be removed and replaced by sand to secure the stability of the rubble slope and the retaining wall of concrete blocks. The apron of the existing wharfs will be demolished and paved with asphalt.

Fig. III.4.1(1) Standard Cross Section of Wharf E-1 (Unit:m)

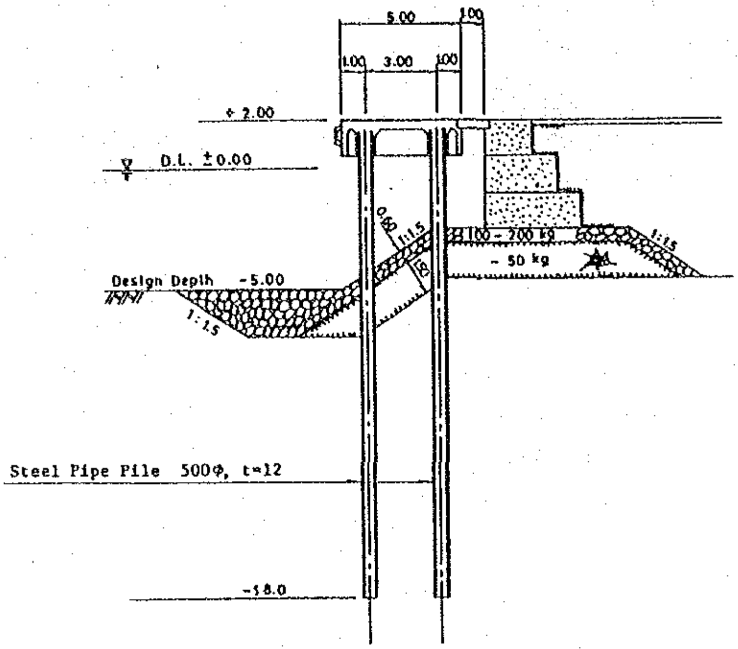


Fig. III.4.1(2) Standard Cross Section of Wharf E-2 (Unit:m)

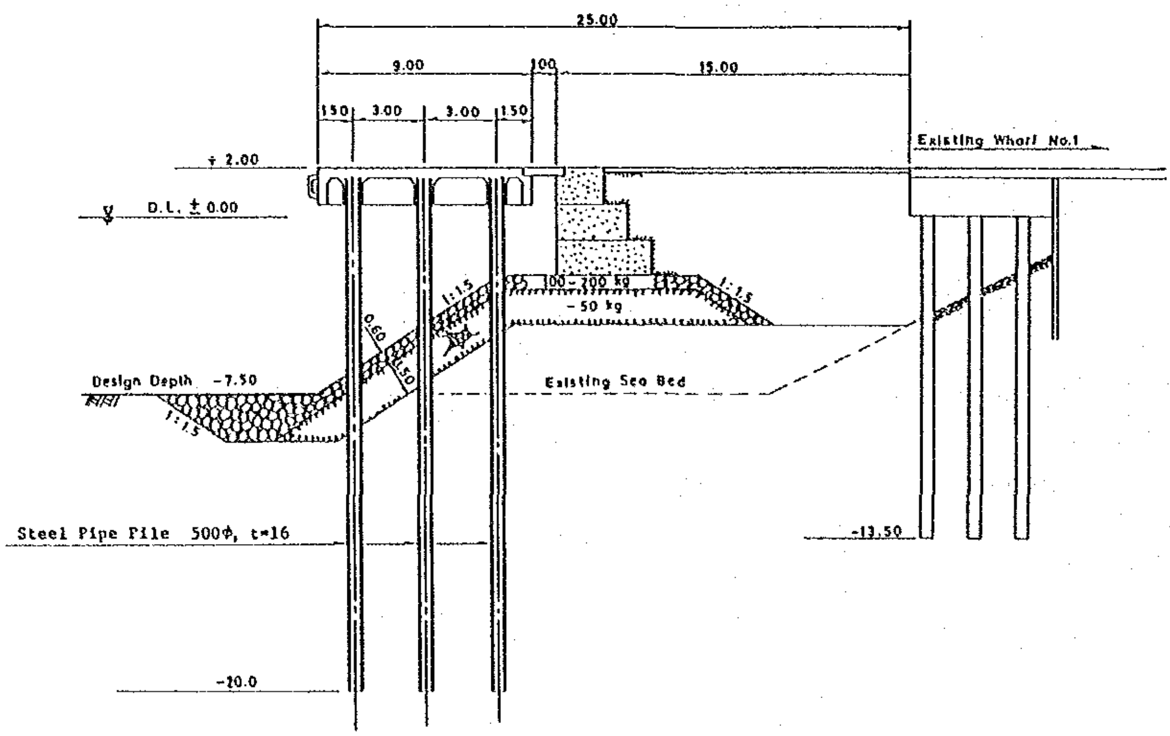


Fig. III.4.1(3) Standard Cross Section of Wharf E-3 (Unit:m)

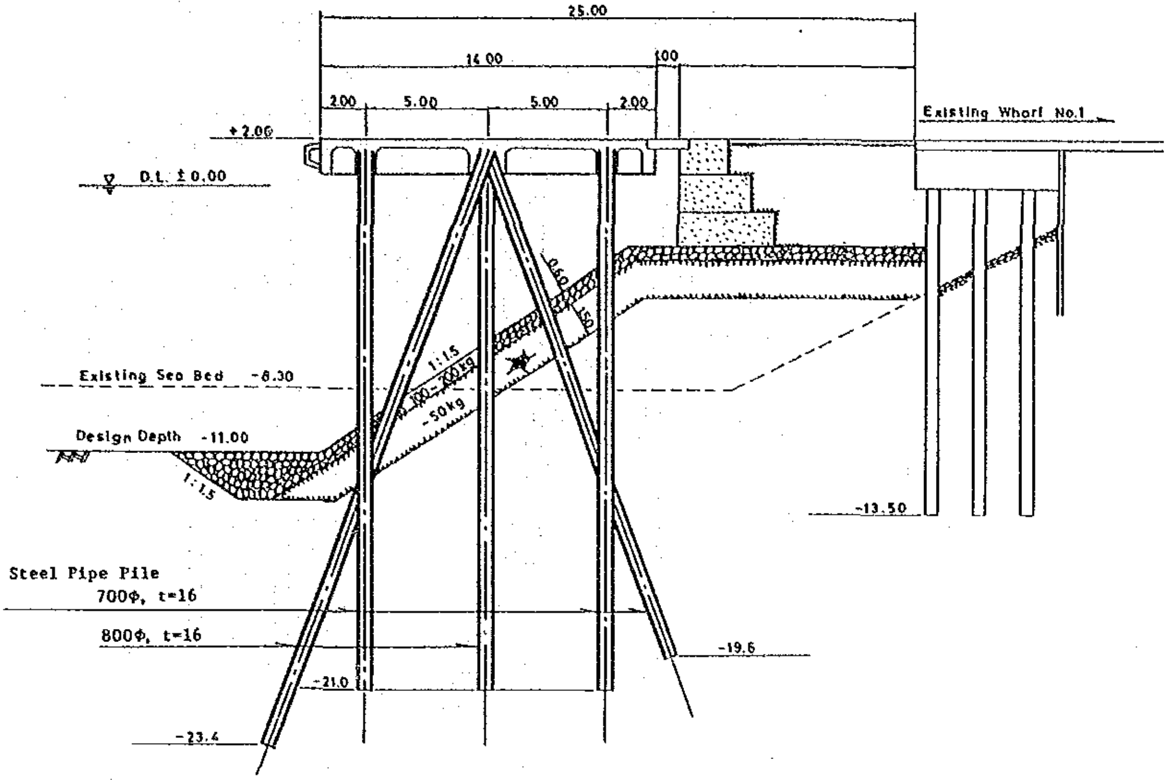


Fig. III.4.1(4) Standard Cross Section of Wharf E-4 (Unit:m)

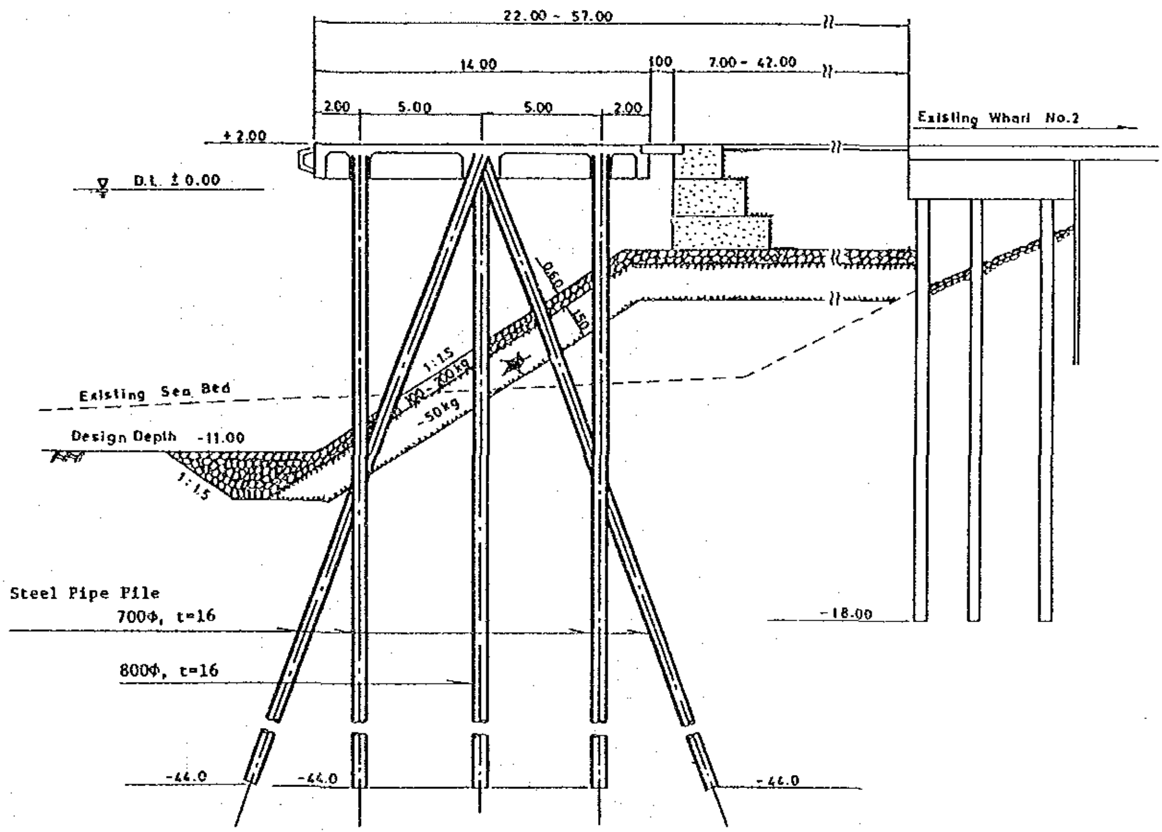


Fig. III.4.1(5) Standard Cross Section of Wharf E-5 (Unit:m)

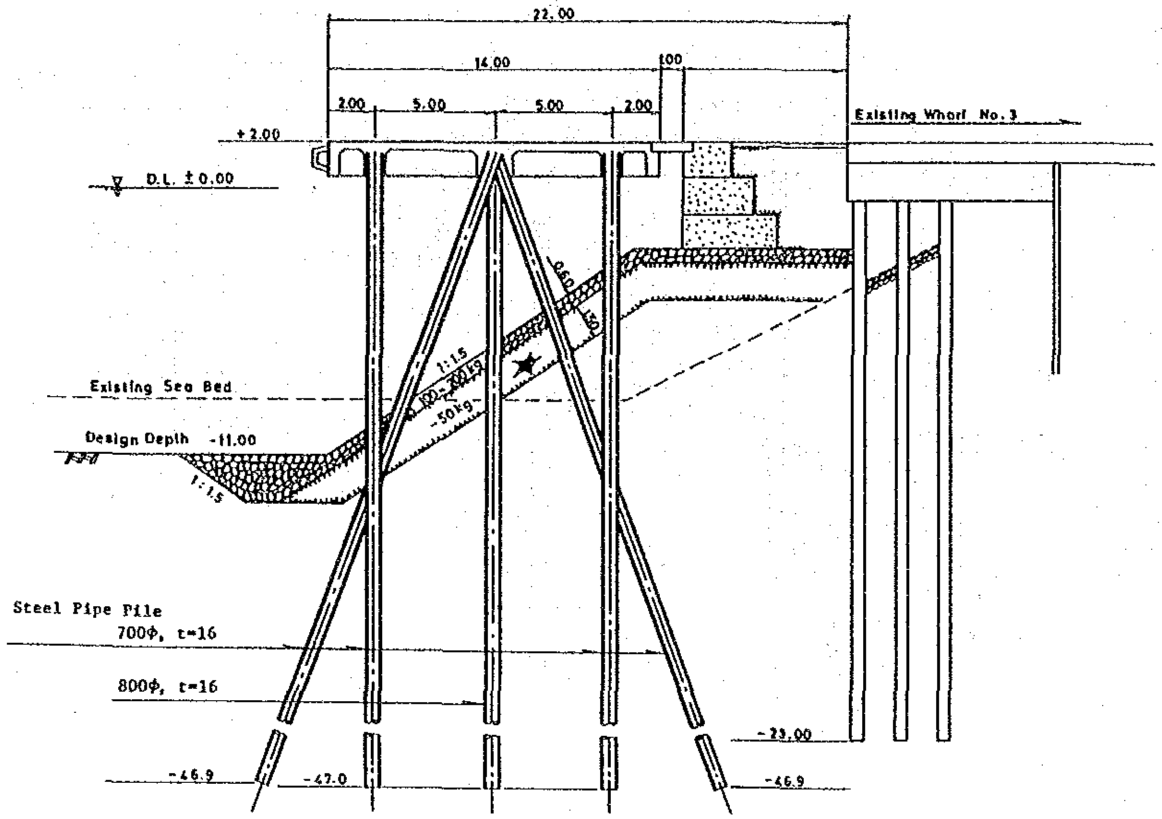
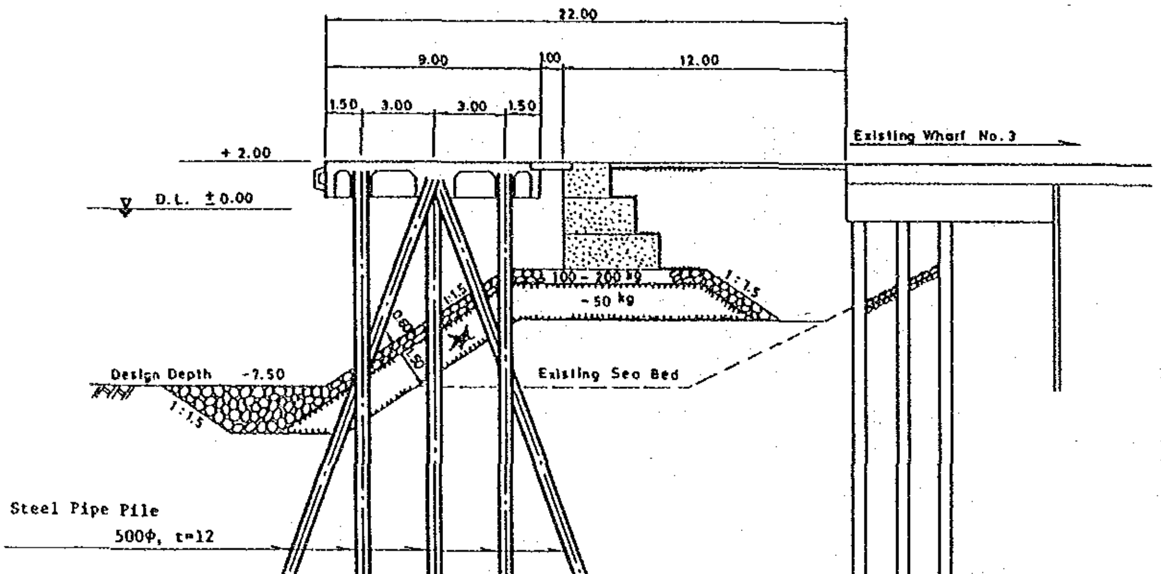


Fig. III.4.1(6) Standard Cross Section of Wharf E-6 (Unit:m)



1.3 Other Facilities and Equipment

(1) Pavement

All the pavement works will be bituminous except for the maintenance shop area, and the cross section of the pavement will be of two types according to the required strength in each location of the port as classified below:

- Heavy Duty Pavement
  container yard (both for the chassis system and the forklift system), in-port roads, coal storage area

- Light Duty Pavement
  open storage yards, parking areas, others

The cross sections of the pavements are shown in Fig. III.4.2.

(2) Offices and Buildings

The floor area of the administration office is designed wide enough to accommodate the port/customs/agriculture officials and related workers, and the structure of the building will be of the same standard as that of the office at Haina Port.

The transit shed replacing the existing shed at Wharf No.1 will be of the same structure as the present one.

The maintenance shop will be steel framed and walled with slate plate and will be wide enough to house the required maintenance equipment and for maintenance operations.

The container freight station will be steel framed and walled with corrugated slate plate and the floor will be elevated for efficient container cargo handling.

The passenger terminal will be a reinforced concrete structure adequately furnished to accommodate the ferry passengers and the operators.

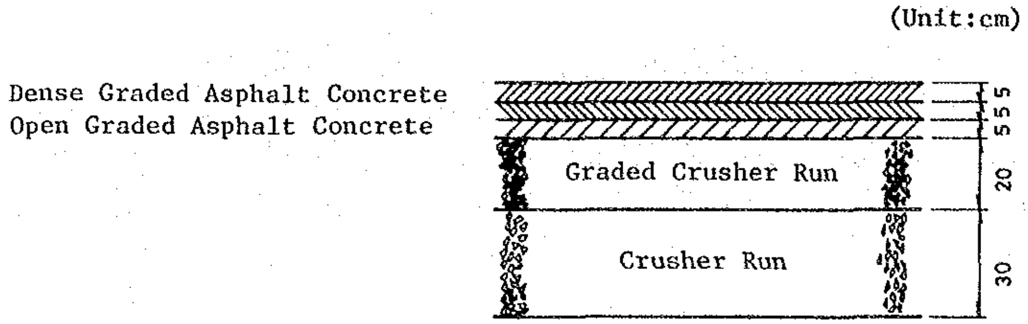


Fig. III.4.2(1) Standard Cross Section of Pavement, Heavy Duty

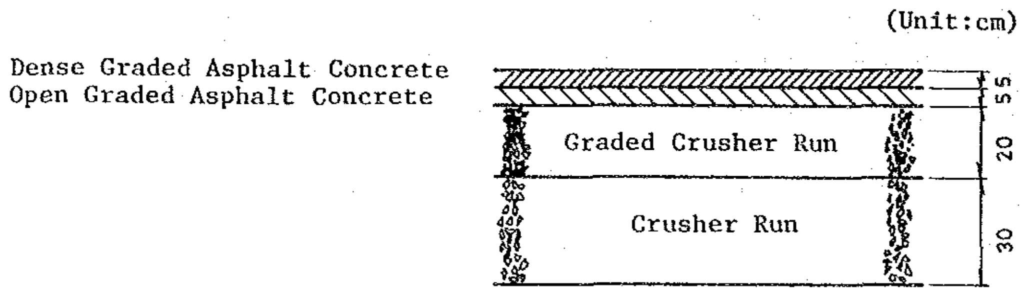


Fig. III.4.2(2) Standard Cross Section of Pavement, Light Duty

(3) Cargo Handling Equipment

The specifications of the cargo handling equipment are designed to meet the improved cargo handling productivities proposed in the previous chapter.

Mobile cranes with a lifting capacity of 100t are selected for handling 40 foot containers as well as sugar containers.

The design of the sugar containers, will be of a similar structural type as that of regular containers, and is detailed in Chapter 3.

The forklifts with a lifting capacity of 30 t are for yard use to handle 20 and 40 foot containers. The forklifts with a 2.5t lifting capacity driven by diesel engine are for handling general cargo in the yard and the transit shed. The battery drive forklifts are exclusively used in the container freight station.

(4) Breakwater Repair

The existing breakwater has been damaged and will be repaired with the cross section as shown in Fig. III.4.3.

(5) Harbor Craft

The harbor craft included in the Project are two tug boats of 1,500 HP and 500 HP which are strong enough for escorting the ships calling at the Port.

(6) Channel Buoys

The channel buoys proposed in the Short-term Development Plan include two additional buoys and three buoys replacing the present corroded units. The structures and the specifications of the buoys are summarized in Fig. III.4.4.

(7) Others

The other major port facilities not mentioned in the previous sub-sections include the following:

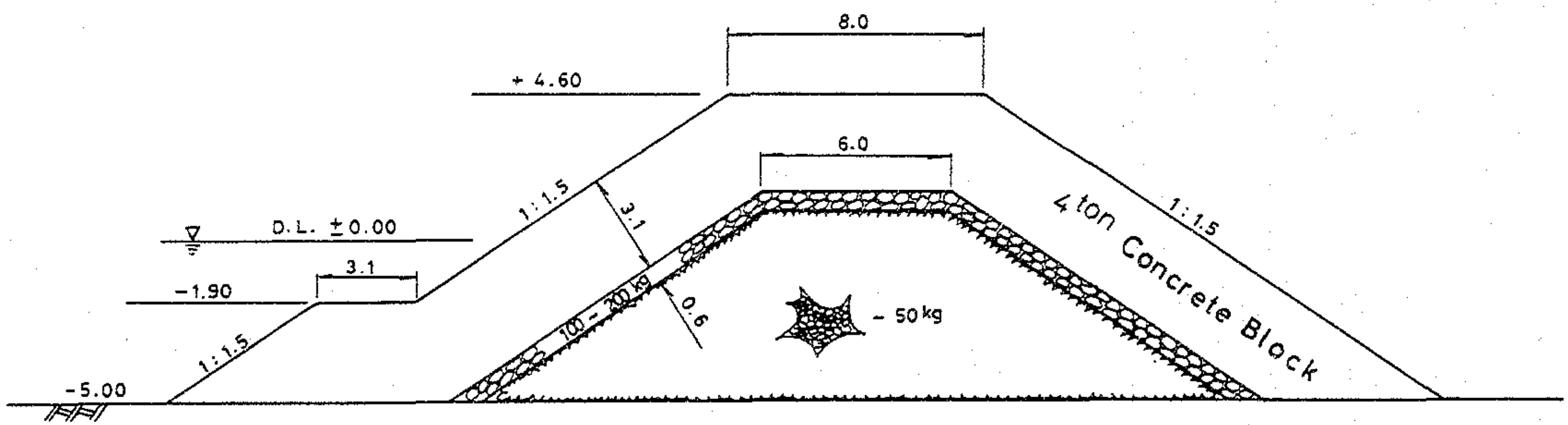


Fig. III.4.3 Standard Cross Section of Breakwater Repair (Unit:m)

Kind of Buoy	Color	Lantern Lens(mm)	Lamp	Light Character	Location No.	Symbol
Entrance Buoy	White	130	12V6W	Mo(A) 10.0sec 0.5+0.5+1.5+7.5	①	
Lighted Buoy	Green	130	6V6W	Fl 4.0sec 0.5+3.5	② ④ ⑥	
	Red				③	
(*) Lighted Spar Buoy	Green	-	-	Fl 4.0sec 0.5+3.5	⑧ ⑨	
	Red				⑤ ⑦	

(*) Lighted spar buoys already exist.

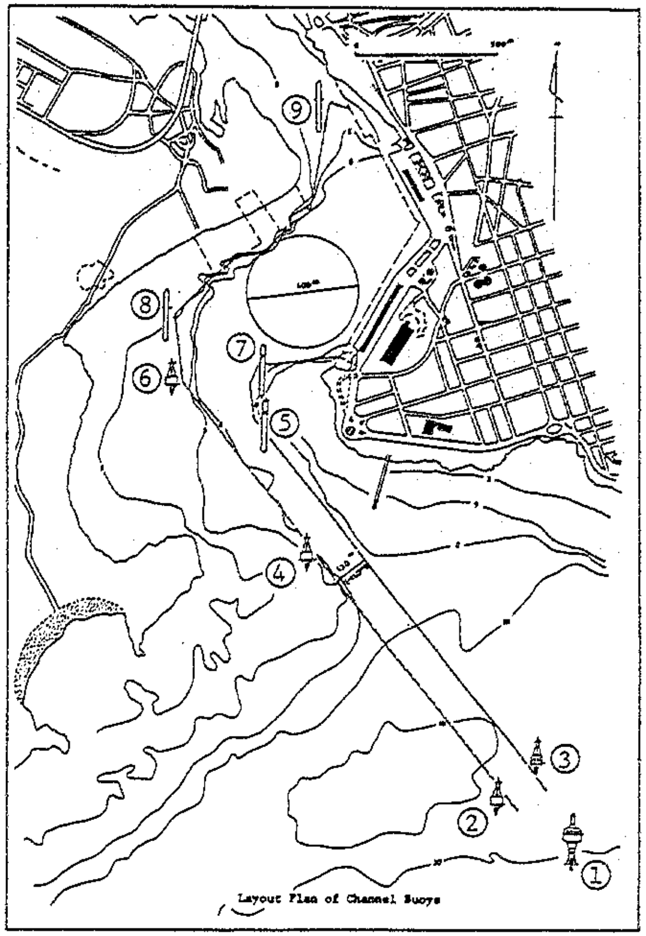


Fig. III.4.4 Specification and Structure of Buoys

- drainage system
- water supply
- lighting system
- fence
- removal of the existing offices and transit shed

2. Implementation Plan of the Project

2.1 Construction Execution Strategy

The execution plan of the Project should be formulated by paying special attention to the following:

- minimization of interference of the construction work with the daily port operations to secure efficient and safe port operation.

- considerations of the daily supply rate of each construction material and the speed of the construction work itself.

- completion of the Project by the end of 1994 and opening at the beginning of 1995 which is set as the target year of this project.

2.2 Construction Schedule

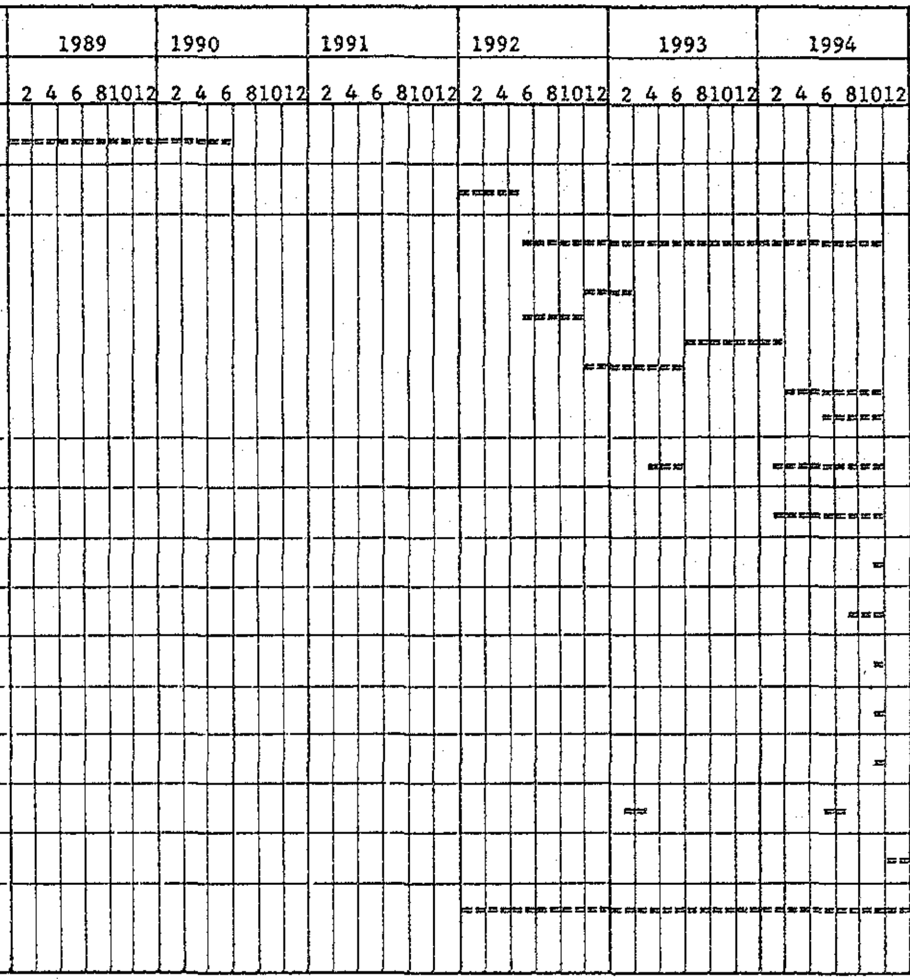
The construction schedule of the Short-term Development Plan is shown in Fig. III.4.5.

As shown in the figure, the detailed engineering services will commence in January 1989, allowing about one year after the submission of the final feasibility study report for the review of the Project and preparation of the detailed engineering services. The detailed engineering services will be completed within 18 months by July 1990.

Following the detailed engineering services, the project appraisal and tendering stage will require 18 months and will be completed in December 1991.

The actual construction work will commence in January 1992 and will be completed in December 1994 ready for service from January 1995. Each project component will be executed in the following sequence.

PROJECT ITEM	UNIT	QUANTITY	REMARKS
1 *Detailed Design*	L/S	1	
2 Mobilization	L/S	1	
3 Wharf Construction	m	990	
Wharf E-1 (-5.0 m)	m	100	
Wharf E-2 (-7.5 m)	m	130	
Wharf E-3 (-11.0 m)	m	210	
Wharf E-4 (-11.0 m)	m	210	
Wharf E-5 (-11.0 m)	m	210	
Wharf E-6 (-7.5 m)	m	130	
4 Pavement	m^2	97970	
5 Office & Building	m^2	7350	
6 Cargo H. Equipment	L/S	1	
7 Breakwater Repair	m	51	
8 Channel Buoy	Nos	5	
9 Harbour Craft	Nos	3	
10 Others	L/S	1	
11 Removal of Building	L/S	1	
12 Demobilization	L/S	1	
13 Const'n Supervision	L/S	1	



Note: Tendering and contract award will be conducted from 6/1990 to 12/1991.

Fig. III.4.5 Construction Schedule of Short-term Development Plan

(1) Mobilization

The mobilization of construction materials and construction equipment will take five months from the contract award involving the preparation, transportation and customs clearance of the construction materials and equipment. During this same period the general preparation work of the Project such as the establishment of the site office, preparation of the local material and equipment, arrangement of local labor, etc. will be completed.

(2) Construction of the Wharfs

The construction of the wharfs is scheduled so that the interference of the construction work to the present port operations may be minimized and will be executed in the following order;

Wharf E-2
Wharfs E-1 and E-4
Wharf E-3
Wharfs E-5 and E-6

Wharf E-2 is an additional wharf replacing the existing ferry wharf. The construction of Wharf E-2, which will not interfere with the daily port operations to any significant extent, will begin from May 1992. And following the completion of Wharf E-2 in October 1992 Wharf E-4 (the existing ferry wharf) will be demolished and reconstructed by June 1993. Wharf E-2 will be completed within 5 months and Wharf E-4 within 8 months.

Wharf E-1 will be constructed together with Wharf E-4 and completed in February 1993.

Wharf E-3 will then be constructed within 8 months and completed in February 1994.

Following the completion of Wharf E-3 the construction work of Wharf E-5 will commence in February 1994 and be completed in October 1994. In this same period Wharf E-6 extending from Wharf E-5 will be constructed from May 1994 and completed in October 1994.

(3) Pavement

Most of the pavement works are scheduled to be executed in 1994 in order to allow a settlement period for the reclaimed area and to avoid damages by heavy construction equipment during the construction work except for the areas used for container handling by forklifts and the coal storage at Wharf E-4. The pavement work for the latter will commence from April 1993 and be completed in July 1993 and the work for the former will start from February 1994 and be completed in October 1994.

(4) Construction of Offices and Buildings

The building work in the Short-term Development Plan includes the administration office, passenger terminal, container freight station, maintenance shop and transit shed, and all these buildings will be constructed in 1994 starting from February and will be completed in October.

(5) Cargo Handling Equipment

All the cargo handling equipment will be purchased and shipped to the Port in October 1994.

(6) Breakwater Repair

The existing damaged breakwater will be repaired within 3 months from August 1994.

(7) Channel Buoys

Three of the existing channel buoys will be replaced and two additional buoys will be added to the existing navigation aid system, and these will be built and installed in October 1994.

(8) Harbor Craft

The harbor craft including 2 tug boats and one pilot boat will be transported to the Port in October 1994.

(9) Others

The other works such as drainage, water supply, removal of the existing facilities, etc. will be synchronized with the related major works mentioned above.

(10) Demobilization

The last two months of November and December in 1994 will be devoted to the demobilization of construction equipment and the ancillary works of the Project.

All the Project works will be completed by the end of 1994 and the Port will be ready for service from January 1995 with improved facilities and equipment.

3. Cost Estimate

3.1 Scope of the Cost Estimate

The project cost for the Short-term Development Plan is estimated for both the investment and maintenance cost of each project component.

The costs of the works which are presently planned to be executed by either SEOPC or the private sector and completed before the commencement of this project are excluded in this cost estimation. The dredging work will be executed by the cutter suction dredger owned by SEOPC.

This dredging work is assumed to include widening and deepening of the approach channel and turning basin as proposed in this study. Also the proposed reclamation areas are assumed to be constructed by dumping the dredged soil made available during the above dredging operation.

The detailed specifications of the dredger owned by SEOPC are given in APP. III.4.

The reclamation and construction of the wharfs for CDE and the shipyard enterprise are also under planning. They will be completed before 1995, and their costs are excluded from the cost estimation.

3.2 Basic Premises of the Cost Estimate

The project cost is estimated under the following conditions:

i) All the imported construction materials and equipment are exempt from import tax and duty.

ii) The physical contingency is assumed as 15% for civil works, 10% for building works, 5% for mobilization and none for machinery and engineering services.

iii) The foreign exchange rate is fixed at US$1.00 = RD$3.08 and RD$1.00 = ¥ 52.42 as of October 1987.

iv) The dredging work of the approach channel and turning basin will have been executed by SEOPC prior to the start of the Project in January 1992.

v) The foreign portion of the project cost includes the following:
- materials not produced in the country; steel pipe pile, etc.
- materials available locally but originally imported; fuel and

lubricant, wood materials, etc.

- special skilled labor unavailable in the country; steel pile welder.

vi) Most of the operators of construction equipment are, based on the information collected, locally available after appropriate training, and their costs are included in the local portion.

3.3 Cost of Each Project Component

The cost of each facility and piece of equipment is estimated as shown in Table III.4.4. As shown in the table, the project cost of the Short-term Development Plan amounts to about 145.2 million RD$ broken down as follows:

Project Cost of Short-term Development Plan (mill. RD$, %)

	Foreign Material	Foreign Labor	Local Material	Local Skilled Labor	Local Unskilled Labor	Total
Wharfs	37.0 (50.2)	10.6 (14.4)	18.7 (25.4)	5.5 (7.5)	1.9 (2.5)	73.7 (100.0)
Pavement	2.7 (24.7)	1.5) (14.1)	6.1 (56.2)	0.4 (3.3)	0.2 (1.7)	10.9 (100.0)
Buildings	6.1 (43.9)	4.1 (29.6)	2.9 (21.0)	0.6 (3.9)	0.2 (1.6)	13.9 (100.0)
C.H. Equip.	10.3 (93.1)	-	-	0.8 (6.9)	-	11.1 (100.0)
Others	21.5 (59.9)	5.4 (15.0)	5.8 (16.2)	2.4 (6.7)	0.5 (1.4)	35.6 (100.0)
	77.6 (53.4)	21.6 (14.9)	33.5 (23.1)	9.7 (6.7)	2.8 (1.9)	145.2 (100.0)

The foreign currency portion accounts for 68.3% of the total project cost consisting of 32.8% for the wharfs, 7.1% for cargo handling equipment and 7.0% for the building work.

The local currency portion accounts for 31.7% of the total consisting of 18% for the wharfs and 4.6% for the pavement.

Table III.4.4 Detailed Construction Cost of Short-term Development Plan
(1,000 RD$)

Project Items	Unit	Qnty	Unit Cost	Foreign Material	Foreign Labor	Foreign Total	Local Material	Local L.S. Labor	Local L.U. Labor	Local Total	Grand Total
Wharf Construction				36998.0	10586.4	47584.5	18757.8	5539.0	1867.9	26164.7	73749.1
Wharf E-1 (-5)	m	100.0	41.22	1652.6	585.8	2238.5	1361.1	394.2	128.4	1883.7	4122.2
" E-2 (-7.5)	m	130.0	56.27	3213.4	1040.6	4254.1	2232.4	626.7	201.4	3060.5	7314.6
" E-3 (-11)	m	210.0	68.27	6873.4	2031.4	8904.8	3860.7	1185.8	386.0	5432.4	14337.3
" E-4 (-11)	m	210.0	100.61	10661.9	3040.6	13702.4	5588.7	1373.4	464.3	7426.5	21128.9
" E-5 (-11)	m	210.0	86.07	10214.3	2604.6	12819.0	3543.0	1275.4	437.2	5255.6	18074.6
" E-6 (-7.5)	m	130.0	67.47	4382.3	1283.4	5665.7	2171.9	683.4	250.6	3106.0	8771.7
Pavement				2686.8	1530.5	4217.3	6122.3	356.2	187.5	6666.0	10883.3
Heavy Duty	m^2	52980.0	.122	1617.1	909.6	2526.7	3638.5	202.1	101.1	3941.7	6468.4
Light Duty	m^2	44040.0	.098	1041.8	604.9	1646.7	2419.6	151.2	84.0	2654.8	4301.5
Concrete	m^2	950.0	.119	28.0	15.9	43.9	64.2	2.8	2.4	69.5	113.4
Breakwater Repair	m	51.0	41.81	820.3	299.9	1120.2	837.4	131.9	43.1	1012.4	2132.6
Channel Buoy	Nos	5.0	78.14	316.3	54.9	371.2	9.7	8.7	1.1	19.5	390.7
Office & Building				6101.9	4109.7	10211.6	2913.9	540.5	215.8	3670.2	13881.7
Administration Office	m^2	1200.0	2.44	1282.0	869.9	2151.9	618.1	114.5	45.8	778.3	2930.2
Passenger Terminal	m^2	1600.0	1.71	1196.5	811.9	2008.4	576.9	106.8	42.7	726.4	2734.8
CFS	m^2	1500.0	1.95	1282.0	869.9	2151.9	618.1	114.5	45.8	778.3	2930.2
Maintenance Shop	m^2	800.0	1.71	658.9	416.3	1075.2	289.6	54.6	21.4	365.5	1440.7
Transit Shed	m^2	2250.0	1.71	1682.6	1141.7	2824.3	811.2	150.2	60.1	1021.6	3845.9
Cargo H. Equipment				10302.2	.0	10302.2	.0	761.2	.0	761.2	11063.3
Sugar Container	Nos	60.0	19.08	572.3	.0	572.3	.0	572.3	.0	572.3	1144.6
Pallet	Nos	3300.0	.114	188.9	.0	188.9	.0	188.9	.0	188.9	377.7
Forklift (2.5t, E)	Nos	6.0	50.55	303.3	.0	303.3	.0	.0	.0	.0	303.3
" (2.5t, B)	Nos	4.0	83.17	332.7	.0	332.7	.0	.0	.0	.0	332.7
" (30t, E)	Nos	2.0	820.30	1640.6	.0	1640.6	.0	.0	.0	.0	1640.6
Mobile Crane (100t)	Nos	2.0	2460.89	4921.8	.0	4921.8	.0	.0	.0	.0	4921.8
Tractor	Nos	9.0	162.15	1459.4	.0	1459.4	.0	.0	.0	.0	1459.4
Chassis	Nos	17.0	36.25	616.2	.0	616.2	.0	.0	.0	.0	616.2
Truck (10t)	Nos	2.0	133.54	267.1	.0	267.1	.0	.0	.0	.0	267.1
Harbor Craft				5055.3	.0	5055.3	.0	.0	.0	.0	5055.3
Tug Boat (1500ps)	Nos	1.0	3605.49	3605.5	.0	3605.5	.0	.0	.0	.0	3605.5
" (500ps)	Nos	1.0	1354.44	1354.4	.0	1354.4	.0	.0	.0	.0	1354.4
Pilot Boat	No	1.0	95.38	95.4	.0	95.4	.0	.0	.0	.0	95.4
Others	L/S	1.0	-	489.9	333.0	822.9	251.5	124.1	32.2	407.8	1230.7
Mob./Demob.	L/S	1.0	-	6602.1	.0	6602.1	.0	.0	.0	.0	6602.1
Engineering Services			-	1116.0	2394.1	3510.1	448.3	1259.1	124.0	1831.4	5341.5
Detailed Design	L/S	1.0	-	858.5	848.9	1707.4	190.8	744.0	124.0	1058.8	2766.1
Const. Supervision	L/S	1.0	-	257.5	1545.2	1802.7	257.5	515.1	.0	772.6	2575.4
Physical Contingency	L/S	1.0	-	7089.5	2323.4	9413.0	4186.7	976.7	341.2	5504.6	14917.6
Total				77578.2	21632.0	99210.2	33527.5	9697.4	2812.7	46037.6	145247.9

3.4 Summary of the Cost Estimate

The project cost is summarized in Table III.4.5, and as shown the total project cost is estimated at about 145.2 million RD$ broken down into the foreign portion of about 99.2 million RD$ and the local portion of 46.0 million RD$.

The cost and share of each component of the Project are as follows:

Project Cost of the Short-term Development Plan

Construction of Wharfs	73.7 million RD$	50.7%
Pavement	10.9	7.5
Offices and Buildings	13.9	9.6
Cargo Handling Equipment	11.1	7.6
Breakwater Repair	2.1	1.5
Channel Buoys	0.4	0.3
Harbor Craft	5.1	3.5
Others	1.2	0.8
Mobilization/demobilization	6.6	4.5
Engineering Services	5.3	3.7
Physical Contingency	14.9	10.3
Total	145.2 million RD$	100.0%

Table III.4.5 Project Cost of the Short-term Development Plan (1,000 RD$)

Items	Unit	Qnty	Foreign Total	Local Total	Grand Total	Remarks
Wharf Construction	m	990.0	47,584.5	26,164.7	73,749.1	Wharfs E-1 - E-6
Pavement	m^2	97,970.0	4,217.3	6,666.0	10,883.3	Cont. Yard, etc.
Breakwater Repair	m	51.0	1,120.2	1,012.4	2,132.6	
Channel Buoy	Nos	5.0	371.2	19.5	390.7	
Offices & Buildings	m^2	7,350.0	10,211.6	3,670.2	13,881.7	
Cargo H. Equipment	L/S	1.0	10,302.2	761.2	11,063.3	Mobile Crane, etc.
Harbor Craft	Nos.	3.0	5,055.3	.0	5,055.3	Tug Boat, etc.
Others	L/S	1.0	822.9	407.8	1,230.7	Drainage, etc.
Mob./Demob.	L/S	1.0	6,602.1	.0	6,602.1	
Engineering Services	L/S	1.0	3,510.1	1,831.4	5,341.5	
Physical Contingency	L/S	1.0	9,413.0	5,504.6	14,917.6	
Total			99,210.2	46,037.6	145,247.9	

3.5 Annual Project Investment

The annual investment cost of the Project is shown in Table III.4.6. As shown in the table, the investment cost of the Project concentrates in the last year of the construction (1994) when most of the pavement work, building work and the purchase of the cargo handling equipment are planned.

The annual investment cost is summarized below:

Annual Investment Cost of the Short-term Development Plan

1989	1.8 million RD$	1.3%
1990	0.9	0.6
1991	-	-
1992	23.1	15.9
1993	34.3	23.6
1994	85.1	58.6
Total	145.2 million RD$	100.0%

Yearly Maintenance Cost

The yearly maintenance and renewal costs for each project component are estimated based on the assumptions given in Table III.4.7 and summarized in Table III.4.8.

Table III.4.6 Annual Investment Cost of Short-term Development Plan

(1,000 RD$)

Item \ Year	1989	1990	1991	1992	1993	1994	Total
Wharf Construction	.0	.0	.0	14657.9	28660.7	30430.5	73749.1
Wharf E-1 (-5)	.0	.0	.0	2061.1	2061.1	.0	4122.2
" E-2 (-7.5)	.0	.0	.0	7314.6	.0	.0	7314.6
" E-3 (-11)	.0	.0	.0	.0	10752.9	3584.3	14337.3
" E-4 (-11)	.0	.0	.0	5282.2	15846.7	.0	21128.9
" E-5 (-11)	.0	.0	.0	.0	.0	18074.6	18074.6
" E-6 (-7.5)	.0	.0	.0	.0	.0	8771.7	8771.7
Pavement	.0	.0	.0	.0	.0	10883.3	10883.3
Heavy Duty	.0	.0	.0	.0	.0	6468.4	6468.4
Light Duty	.0	.0	.0	.0	.0	4301.5	4301.5
Concrete	.0	.0	.0	.0	.0	113.4	113.4
Breakwater Repair	.0	.0	.0	.0	.0	2132.6	2132.6
Channel Buoy	.0	.0	.0	.0	.0	390.7	390.7
Offices & Buildings	.0	.0	.0	.0	.0	13881.7	13881.7
Administ'n Office	.0	.0	.0	.0	.0	2930.2	2930.2
Passenger Terminal	.0	.0	.0	.0	.0	2734.8	2734.8
CFS	.0	.0	.0	.0	.0	2930.2	2930.2
Maintenance Shop	.0	.0	.0	.0	.0	1440.7	1440.7
Transit Shed	.0	.0	.0	.0	.0	3845.9	3845.9
Cargo H. Equipment	.0	.0	.0	.0	.0	11063.3	11063.3
Sugar Container	.0	.0	.0	.0	.0	1144.6	1144.6
Pallet	.0	.0	.0	.0	.0	377.7	377.7
Forklift (2.5t, E)	.0	.0	.0	.0	.0	303.3	303.3
" (2.5t, B)	.0	.0	.0	.0	.0	332.7	332.7
" (30t, E)	.0	.0	.0	.0	.0	1640.6	1640.6
Mobile Crane (100t)	.0	.0	.0	.0	.0	4921.8	4921.8
Tractor	.0	.0	.0	.0	.0	1459.4	1459.4
Chassis	.0	.0	.0	.0	.0	616.2	616.2
Truck (10t)	.0	.0	.0	.0	.0	267.1	267.1
Harbor Craft	.0	.0	.0	.0	.0	5055.3	5055.3
Tug Boat (1500ps)	.0	.0	.0	.0	.0	3605.5	3605.5
" (500ps)	.0	.0	.0	.0	.0	1354.4	1354.4
Pilot Boat	.0	.0	.0	.0	.0	95.4	95.4
Others	.0	.0	.0	410.2	410.2	410.2	1230.7
Mob./Demob.	.0	.0	.0	4691.1	.0	1910.9	6602.1
Eng. Services	1844.1	922.0	.0	858.5	858.5	858.5	5341.5
Detailed Design	1844.1	922.0	.0	.0	.0	.0	2766.1
Const. Supervision	.0	.0	.0	858.5	858.5	858.5	2575.4
Ph. Contingency	.0	.0	.0	2494.8	4360.6	8062.2	14917.6
Total	1844.1	922.0	.0	23112.5	34290.0	85079.3	145247.9

Table III.4.7 Yearly Maintenance Cost and Service Life

Items	Maintenance Cost (% of Initial Cost)	Service Life (Years)	Remarks
Wharf	1.0	50	
Pavement	1.0	50	concrete/asphalt
Buildings	1.0	30	offices/sheds
C.H. Equipment	5.0	10	
Pallets	5.0	5	
Breakwater	1.0	50	
Channel Buoy	3.0	30	
Harbor Craft	5.0	20	

Table III.4.8 Annual Investment and Maintenance Cost of Short-term Development Plan (1,000RD$)

Year	Cap. Cost	M/T Cost	Total
1989	1844.1	.0	1844.1
1990	922.0	.0	922.0
1991	.0	.0	.0
1992	23112.5	.0	23112.5
1993	34290.0	88.3	34378.3
1994	85079.3	393.0	85472.3
1995	.0	2051.6	2051.6
1996	.0	2051.6	2051.6
1997	.0	2051.6	2051.6
1998	.0	2051.6	2051.6
1999	377.7	2051.6	2429.3
2000	.0	2051.6	2051.6
2001	.0	2051.6	2051.6
2002	.0	2051.6	2051.6
2003	.0	2051.6	2051.6
2004	11063.3	2051.6	13114.9
2005	.0	2051.6	2051.6
2006	.0	2051.6	2051.6
2007	.0	2051.6	2051.6
2008	.0	2051.6	2051.6
2009	377.7	2051.6	2429.3
2010	.0	2051.6	2051.6
2011	.0	2051.6	2051.6
2012	.0	2051.6	2051.6
2013	.0	2051.6	2051.6
2014	16118.7	2051.6	18170.3
2015	.0	2051.6	2051.6
2016	.0	2051.6	2051.6
2017	.0	2051.6	2051.6
2018	.0	2051.6	2051.6
	173185.3	49719.7	222905.0

CHAPTER 5 ADMINISTRATION, MANAGEMENT AND OPERATIONS

1. General

As mentioned in Part I Chapter 2 Section 3 and Chapter 3 Section 7, there is currently no management body which is responsible for the overall administration of the Port of San Pedro de Macoris, but SEOPC, the port commander and the customs office each carry out their own duties respectively. However, by the presidental decree of July 1987, all of the commercial ports of the Dominican Republic will be placed under the control of APD as determined by its regulations. Thus, SPM Port will be administered by APD in the near future. Therefore, the administration, management and operation of SPM Port by APD is considered in this study.

APD is an autonomous corporate institution and owns its own assets. According to its regulations, APD is a port authority, and owns and manages port facilities. APD has a mandate to direct, administrate, exploit, operate, watch, maintain, and improve the commercial maritime ports under its control and administration. APD is also empowered to study, program and carry out the expansion of existing ports and the construction of new ports as required in the future.

These are the guiding principles of port administration and management by APD, and the greatest effort must be made towards the realization of these principles. However, considering that there will still be a lot of social, economic and financial difficulties at SPM Port in 1995, it may be impossible for APD to carry out the administration and management of SPM Port at that time following these principles perfectly. Therefore, the following basic policy is set in this study.

(1) The Dominican government shall construct the main facilities of SPM Port including the entrance channel, the turning basin, the breakwater, the revetments and the wharfs.

(2) APD shall construct or purchase all the facilities of SPM Port except for those listed in (1) and shall own these as its own property.

(3) APD shall administer, manage, maintain and keep open for public use all the facilities of SPM Port.

(4) APD shall establish an organization for the administration and management of SPM Port.

(5) APD shall prepare financial plans for the administration and management of SPM Port including the determination of port tariffs, and APD shall operate the Port in accordance with these plans.

2. Administration, Management and Operations

2.1 Modern and Efficient Administration System

(1) Office Automation

Computer systems are very useful for carrying out many kinds of port management works including the collection of port charges, accounting, personnel administration, port statistics, management of port facilities and entrance and clearance of ships. Using computers, the management can function efficiently and accurately, and can minimize labor costs. Data processed using computer systems can be stored easily in a small space and can be accessed at any time. Adopting the same system, the same data can be utilized at the head office and the other branches of APD.

(2) Port Statistics

Currently, the port statistics of the Dominican Republic are not sufficient. Accurate, comprehensive port statistics are indispensable in preparing development and use plans of ports and in carrying out efficient management. The persons in charge of APD have to understand the uses of port statistics precisely, and must keep accurate, complete and timely records. The record-keeping system should be unified throughout the nation, and should be easy to use.

Generally, port statistics can be divided into three parts: statistics of cargo, ships and passengers. Cargo must be classified into appropriate commodity groups and ships must be classified by type and size. When designing a statistics system, it may be helpful to examine the systems presently being used at leading ports in various countries.

(3) Training

The head office of APD must watch and study the national marine cargo movement and lead each port administration office. In order to improve efficiency, the skills of port workers and managers must be developed. A regular program of staff training should be instituted, and some workers should study at advanced ports in foreign countries. Also, foreign experts may be invited to hold training sessions in the Dominican Republic.

2.2 Promotion of Port Utilization and Rationalization of Cargo Movement

Generally, ports play a significant role in national economic activities. Port management bodies are responsible for the rationalization of cargo movement. They have to promote efficient utilization of port facilities. They have to manage their ports properly to maximize the return on capital investment for the benefit of the general public.

In order to promote rationalization of cargo movement and maximum utilization of SPM Port, APD has to collect information about marine cargo movement, and has to attract shippers and consignees taking account of their needs and requests.

The following affairs are important.

(1) To improve cargo handling. Improvement of cargo handling includes improvement of the safety, reliability and productivity of cargo handling. This will be realized by mechanizing cargo handling and unitizing the cargo.

(2) To request the customs office to carry out customs clearance rapidly. To prevent the cargo from staying within the Port area too long. (The transit shed should not be used as a warehouse. APD may construct and operate a warehouse if necessary).

(3) To have rapid and exact communication with ships, shippers and shipping agents.

(4) To give certain calling ships priority considering the characteristics of the ships and the cargo.

(5) To consider the promotion of port workers' welfare.

2.3 Responsibility for Cargo Handling within the Port

Concerning the cargo handling within the port, the functions of APD are defined by regulation as follows:

(i) To direct and carry out all items related to the entrance and exit of the port areas; the loading, unloading, and deposit of cargo; and cargo warehousing.

(ii) Receiving, moving within the port and positioning in warehouses, deposits and yards and other sites assigned to that effect merchandise and other goods that are loaded or unloaded.

(iii) Delivery of merchandise to the ships, in the case of loading, or to consignees or their representatives, in the case of unloading, with strict submission to the customs authorities.

(iv) The handling of import and export cargo and the receiving, moving, warehousing, preservation and delivery of export and domestic use items subject to the legal mandate of customs.

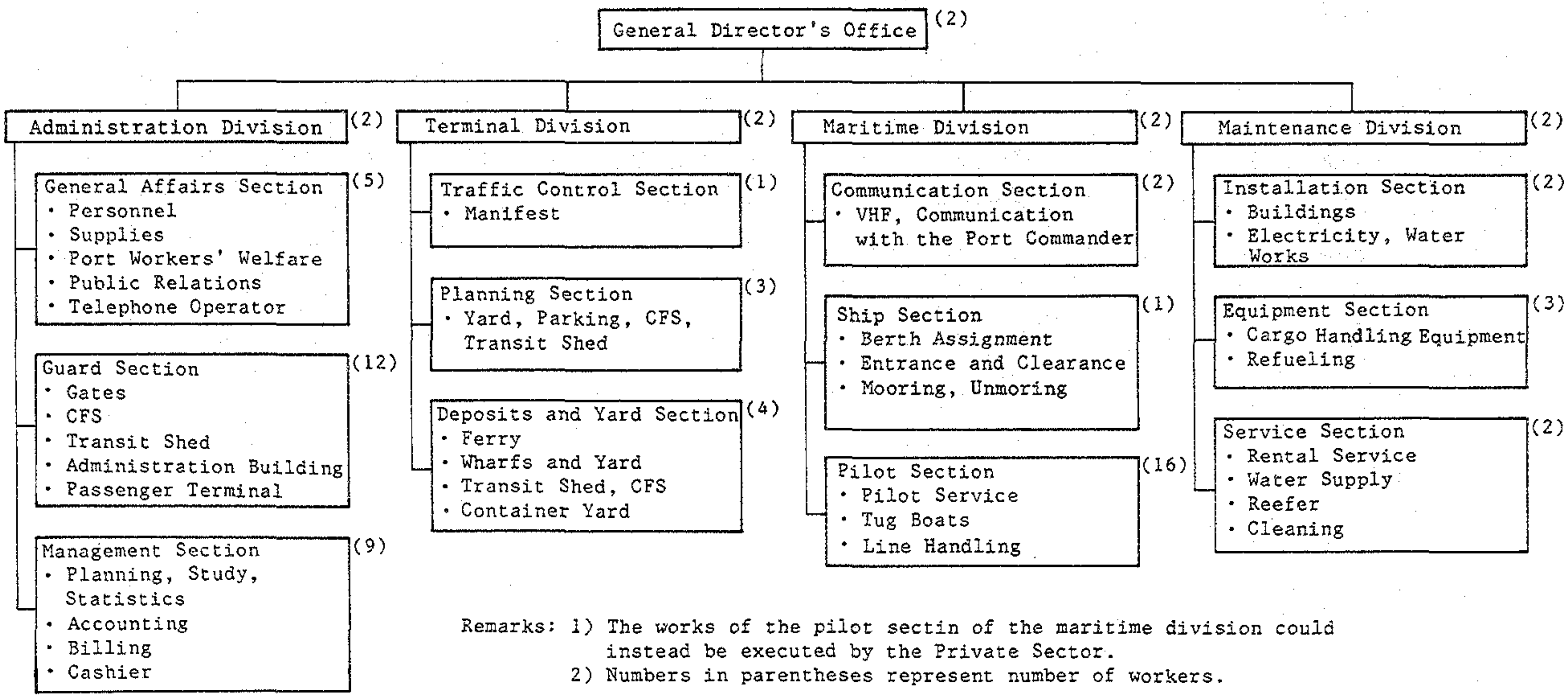
And APD is responsible for the integrity of the cargo under its control.

However, 87% of the total cargo of SPM Port in 1995 will be containers and cargoes loaded or unloaded directly by shippers or consignees. In the case of containers, usually shipping companies receive and deliver FCL cargo at container yards and LCL cargo at the CFS. Vanning and devanning of LCL cargo within the CFS is also carried out under the control of shipping companies. Only 13% of the total cargo will be loaded on ships or delivered to consignees through the transit shed or open storage yards.

Considering this situation, it is inappropriate for APD to engage directly in cargo handling between shippers or consignees and shipping companies or shipping agents and to be responsible for the integrity of the cargo. Rather, this should be carried out by and responsibility should rest with the private sector. APD should only rent out cargo handling equipment; maintain the transit shed, CFS and open storage yard for public use; collect charges, and supervise and arrange the utilization of these facilities. The cargo handling equipment should also be operated by the users.

2.4 Organization of the San Pedro de Macoris Port Administration Office

Organization for port administration and management must be as simple as possible. The responsibilities of each division or section must be defined clearly. Fig. III.5.1 shows the proposed organization of the San Pedro de Macoris Port Administration Office of APD. The total number of staff is estimated as 70.



Remarks: 1) The works of the pilot sectin of the maritime division could instead be executed by the Private Sector.
2) Numbers in parentheses represent number of workers.

Fig. III.5.1 Proposed Organization of the San Pedro de Macoris Port Administration Office of APD