As shown in this table, the future cargo of SPM Port is limited to certain specified commodities, except for miscellaneous general cargo which will be transferred from the metropolitan port complex. Thus, a macro forecast is not appropriate, and a micro forecast is used for the future cargo volume estimate.

The future volume of miscellaneous general cargo is estimated using a macro forecast of the cargo volume of the metropolitan port complex and the share of the Subregion del Yuma.

4.2 Forecast by Commodity

(1) Export

1) Sugar

Fig. II.2.2 shows the location of sugar mills in San Pedro de Macoris. There are six sugar mills in San Pedro de Macoris. Four mills, Quisqueya, Consuelo, Santa Fe and Porvenir, belong to CEA and the other two, Cristobal Colon and Angelina, belong to the VICINI group. However, Angelina is now closed.

In the Subregion del Yuma, there are also sugar mills in La Romana and Boca Chica. Sugar produced in La Romana is exported from the port of La Romana and that produced in Boca Chica is exported from the port of Haina, both in bulk. From Boca Chica, Haina is 1.5 times farther than San Pedro de Macoris. Moveover, cargo carried between Boca Chica and Haina must pass through the congested streets of the city of Santo Domingo. So, if the cargo handling productivity of bulk sugar at San Pedro de Macoris is improved, the sugar from Boca Chica is likely to be transferred to SPM Port.

Table II.2.11 and Fig. II.2.3 show the production volume of sugar in the Dominican Republic and the national export volume as well as the export volume from San Pedro de Macoris and Boca Chica.

Sugar is the biggest export commodity of the Dominican Republic, and it accounted for 31% of the national export on a value basis and 53% of the total export of SPM Port on a volume basis in 1984.

Both production and export volumes fluctuate annually, but the export volume has generally been decreasing over the last ten years.

It is very difficult to forecast the future world demand of sugar. In recent years, world sugar demand has been stagnant as people are consuming less sugar and the use of high fructose corn syrup (HFCS) has expanded. Moreover the United States, the biggest importer of Dominican sugar, recently cut its worldwide sugar import quota.

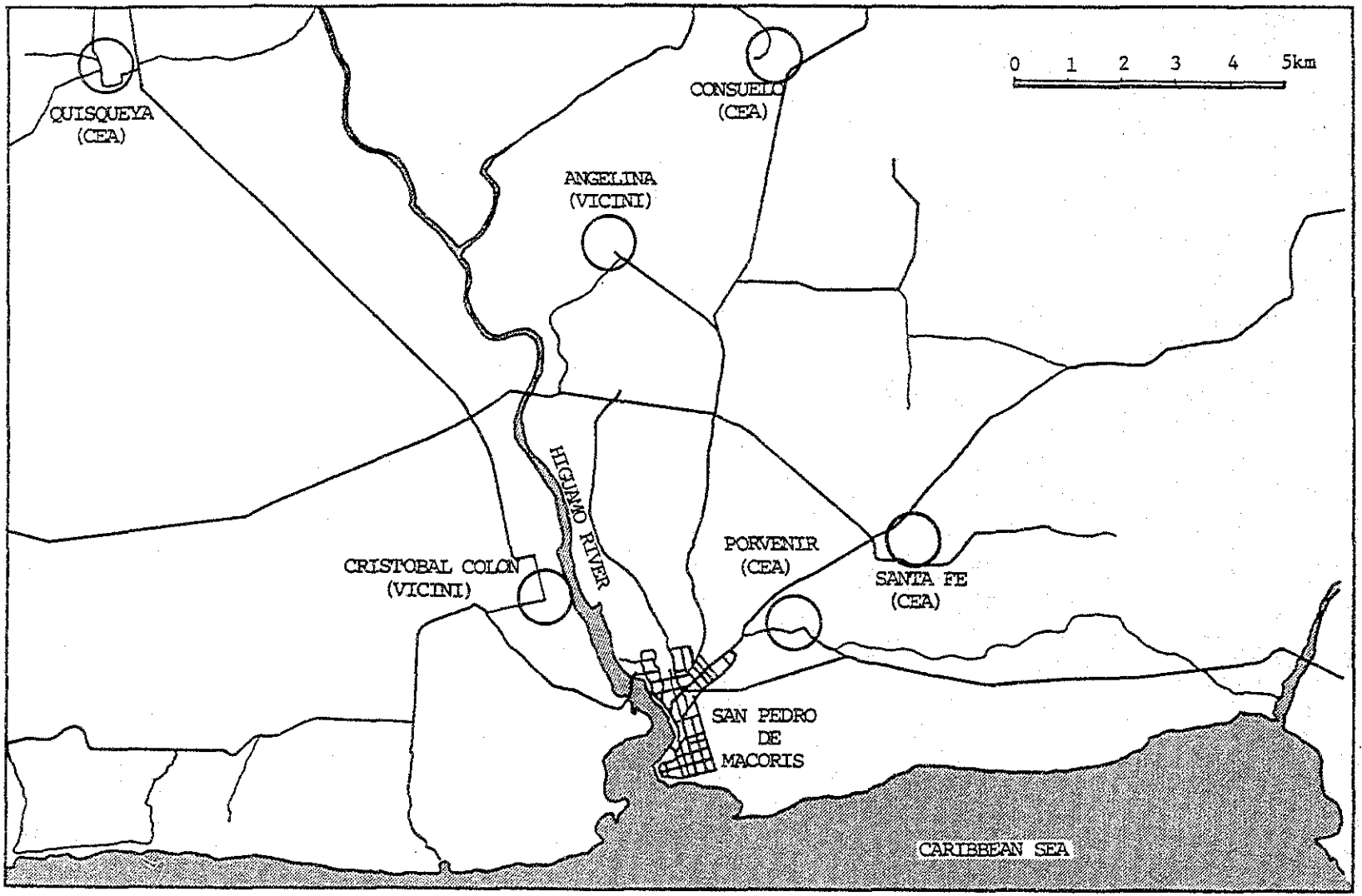


Fig. II.2.2 Location of Sugar Mills in San Pedro de Macoris

Table II.2.11 Production and Export of Sugar

(Unit: 1,000 tons, %)

Year	National Production	Export Volume		
		National (1)	SPM & BC (2)	(2)/(1) x 100
1974	1,230	1,055	-	-
1975	1,170	975	271	27.8
1976	1,287	999	229	22.9
1977	1,258	1,117	276	24.7
1978	1,199	937	242	25.8
1979	1,201	1,035	266	25.7
1980	1,013	793	247	31.1
1981	1,108	864	199	23.0
1982	1,285	850	209	24.6
1983	1,209	956	267	27.9
1984	1,130	885	226	25.5
Average	-	-	-	25.9

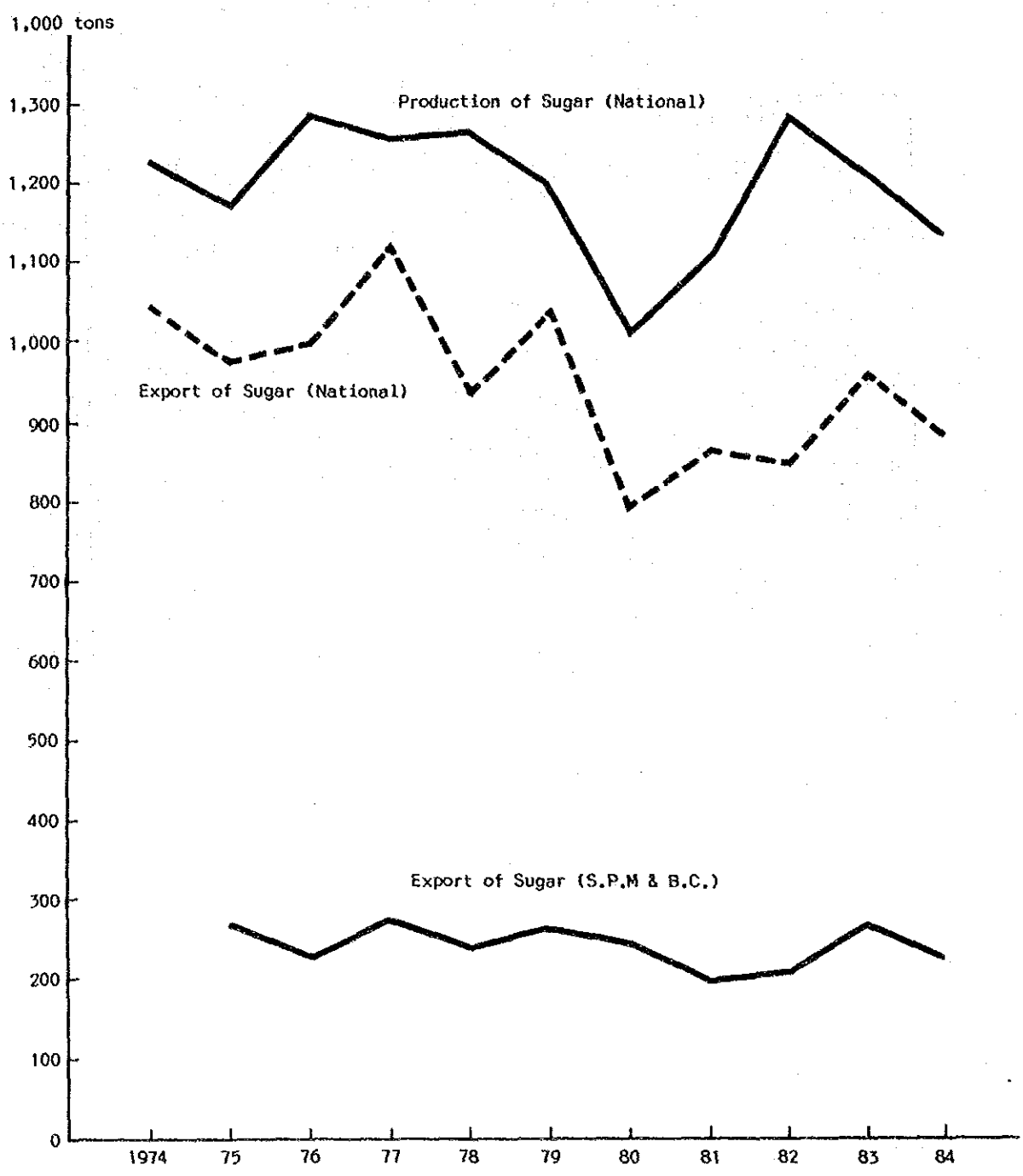


Fig. II.2.3 Production and Export of Sugar

Under this situation, it seems that the export volume of sugar of the Dominican Republic will continue to decrease for some time.

In this study, the national export volume of sugar is analyzed through a time series analysis using three year moving averages.

The correlation equation is obtained as follows:

$Y = -22.817\ t + 46{,}101.96 \qquad (R = 0.84)$

where Y: Export Volume of Sugar (1,000 tons)
t: Year
R: Correlation Coefficient

The export volume of sugar of the Dominican Republic in 1995 is estimated as 583,000 tons by this equation. The average share of San Pedro de Macoris and Boca Chica in national sugar exports over the past 10 years is 25.9% as shown in Table II.2.11. Assuming that this percentage will not change, the export volume of sugar at SPM Port in 1995 is estimated as 151,000 tons. It is also assumed that the export volume in 2005 will be the same as the volume in 1995.

Currently, 85% of the sugar exported from SPM Port is in bulk and 15% is in bags. All the sugar of Boca Chica is exported in bulk. So it is presumed that 90% of the sugar exported from SPM Port in the future will be in bulk and 10% will be in bags.

2) Molasses

Molasses is a by-product of sugar production and is exported as feed for livestock.

Fig. II.2.4 shows the export volume of sugar and molasses at SPM Port from 1974 to 1984. The fluctuation of the export volume of molasses is almost the same as that of sugar, and the average molasses volume is 37% of the sugar volume.

Then, the export volume of molasses of SPM Port in 1995 and 2005 is estimated as 56,000 tons, that is 37% of the projected export volume of sugar in those years.

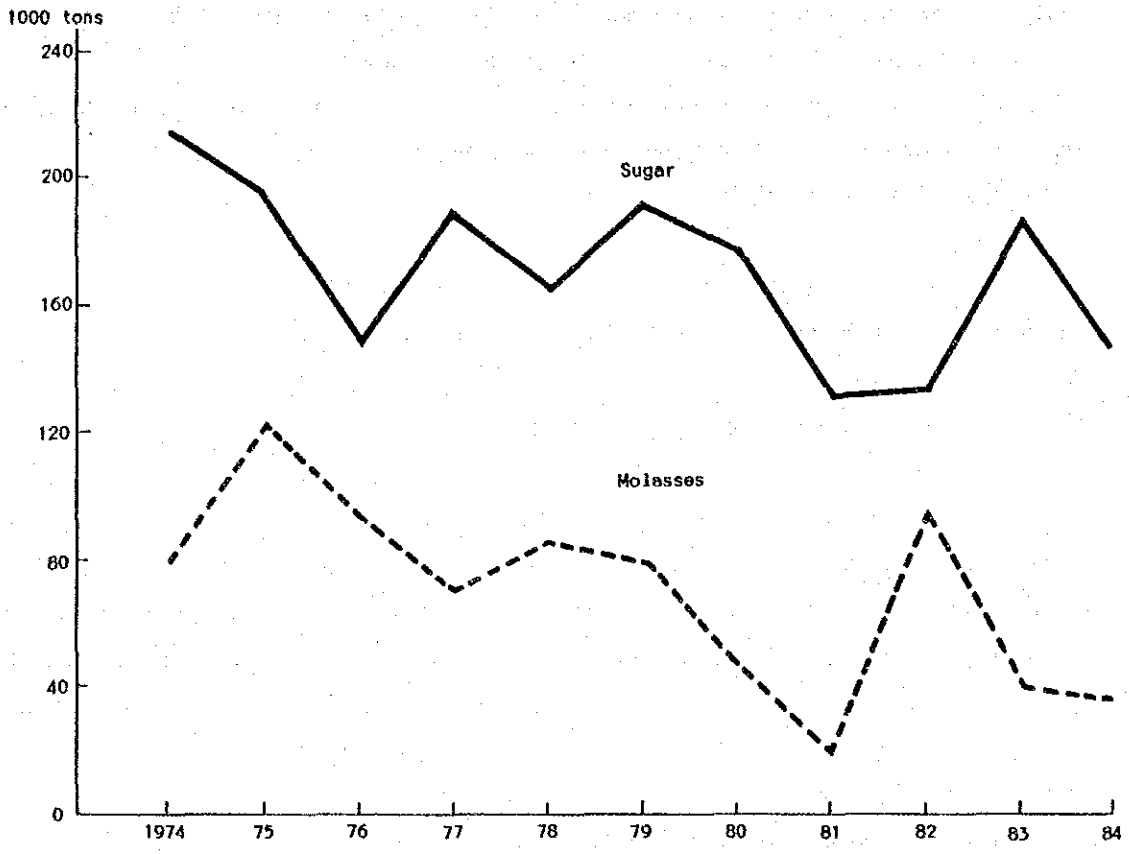


Fig. II.2.4 Export Volume of Sugar and Molasses at the Port of San Pedro de Macoris

3) Fertilizer

Fig. II.2.5 shows the export volume of fertilizer at SPM Port. All the fertilizer exported from San Pedro de Macoris is produced at the FERQUIDO factory located just behind wharf No.3 (refer to Fig. II.2.6). The maximum production volume was 132,000 tons and the maximum export volume was 25,000 tons, both in 1973. FERQUIDO plans to produce 92,000 tons of fertilizer and to export 30% of the production in 1987. The company plans to produce 200,000 tons per year and to export 30% of the production in the future.

So, in this study, it is assumed that the production of fertilizer will be 200,000 tons per year and that 30% of the production will be exported in 2005.

Assuming that the annual increase rate of the production will be constant from 1987, the future production and export of fertilizer is estimated as follows:

Annual increase rate of production: 4.4%

	Production	Export
1995	130,000 tons	39,000 tons
2005	200,000 tons	60,000 tons

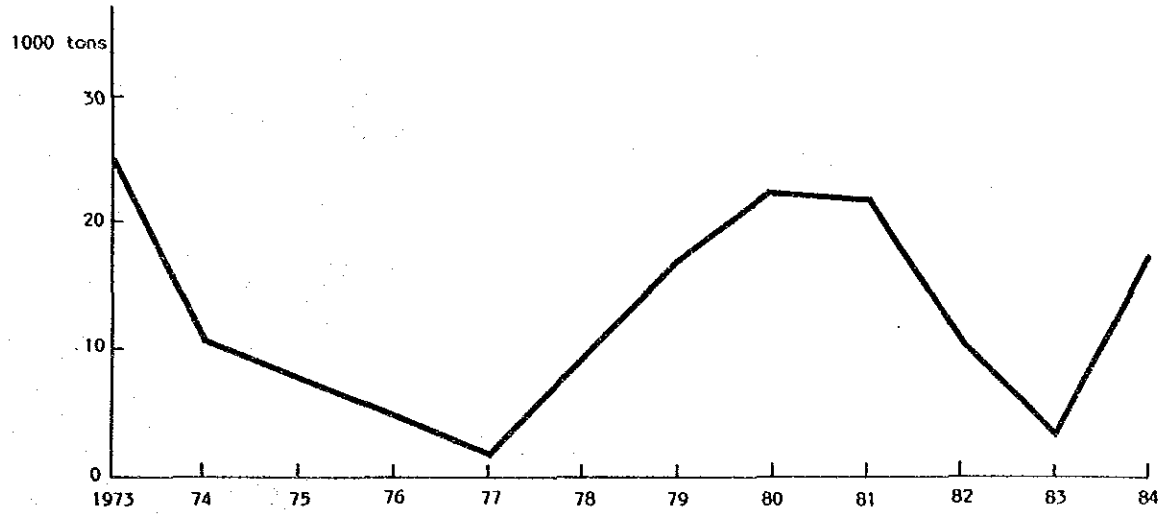


Fig. II.2.5 Export Volume of Fertilizer at the Port of San Pedro de Macoris

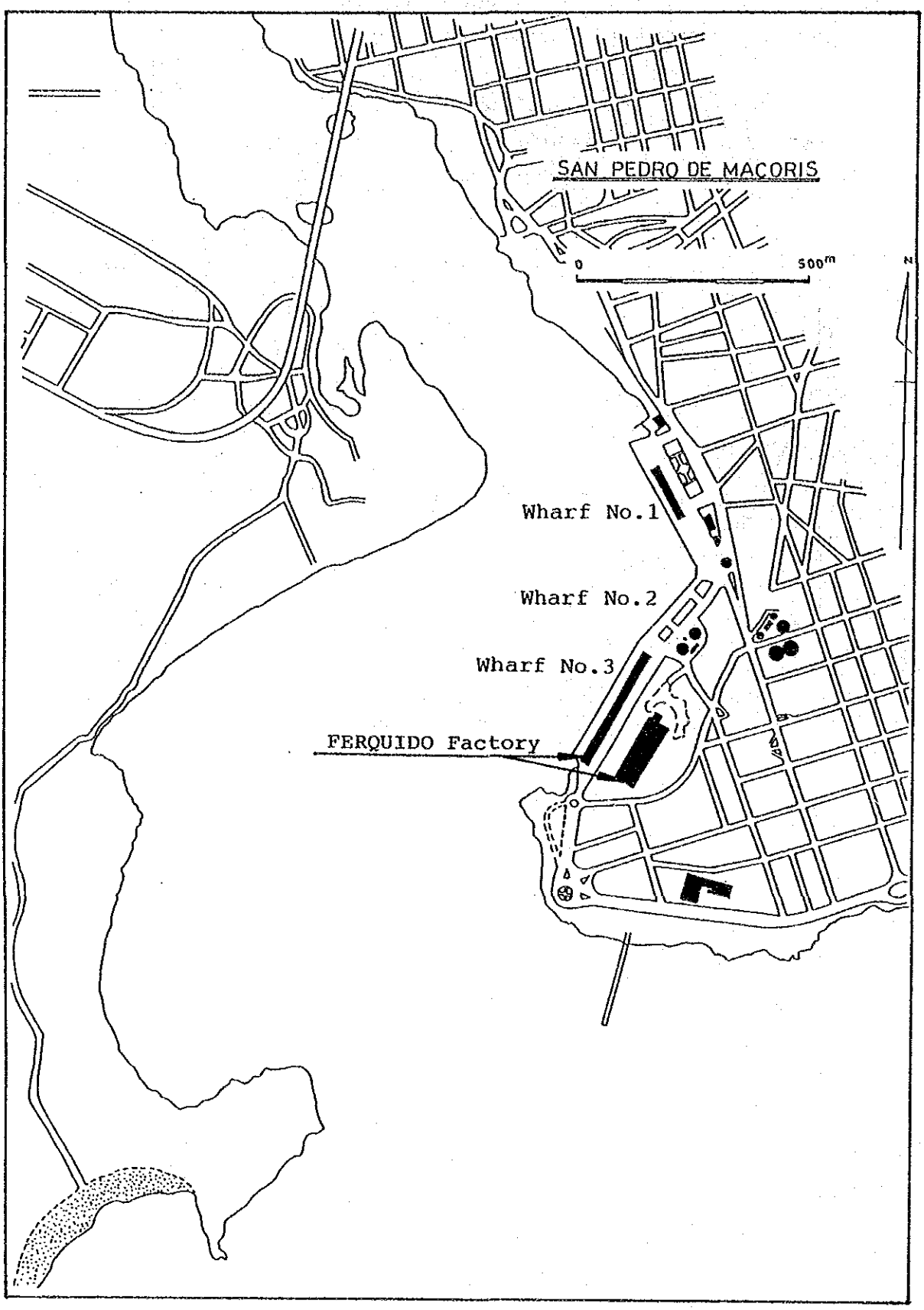


Fig. II.2.6 Location of FERQUIDO Factory

4) Cement and Clinker

Fig. II.2.7 shows the export volume of cement at SPM Port. The volume fluctuates greatly year by year and there is no constant trend. Cement exported at San Pedro de Macoris is produced at the Cementos Nacionales S.A. factory located upstream on the Higuamo River (refer to Fig. II.2.8).

Clinker is also produced at this factory and was exported from San Pedro de Macoris in 1980, 1981, 1984 and 1985, and also shows no constant trend. This cement company produces about 660,000 tons of cement and 600,000 tons of clinker annually and exports 10% of the production. The company plans to expand its facilities to double its capacity in the future. So, in this study, it is presumed that the production of cement and clinker will increase linearly and will reach to double the present production in 2005, and that 10% of the production will be exported every year from SPM Port. Thus, the export volume of cement in 1995 and 2005 is estimated as 99,000 tons and 132,000 tons respectively, and the export volume of clinker in 1995 and 2005 is estimated as 90,000 tons and 120,000 tons respectively.

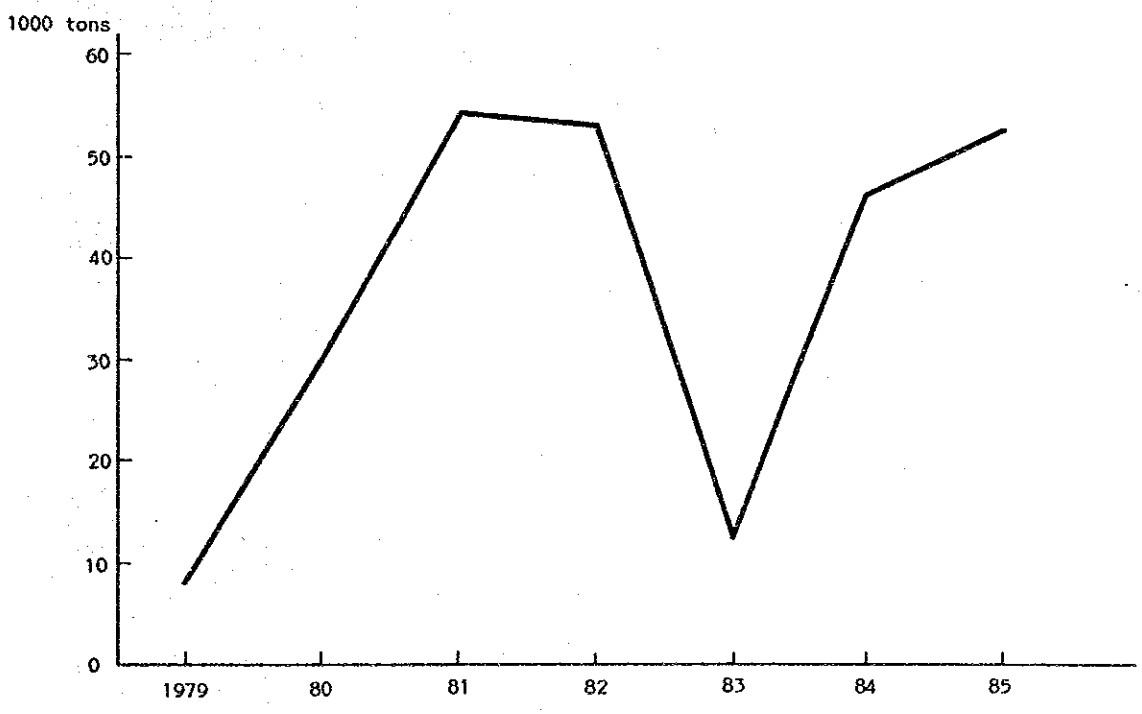


Fig. II.2.7 Export Volume of Cement at the Port of San Pedro de Macoris

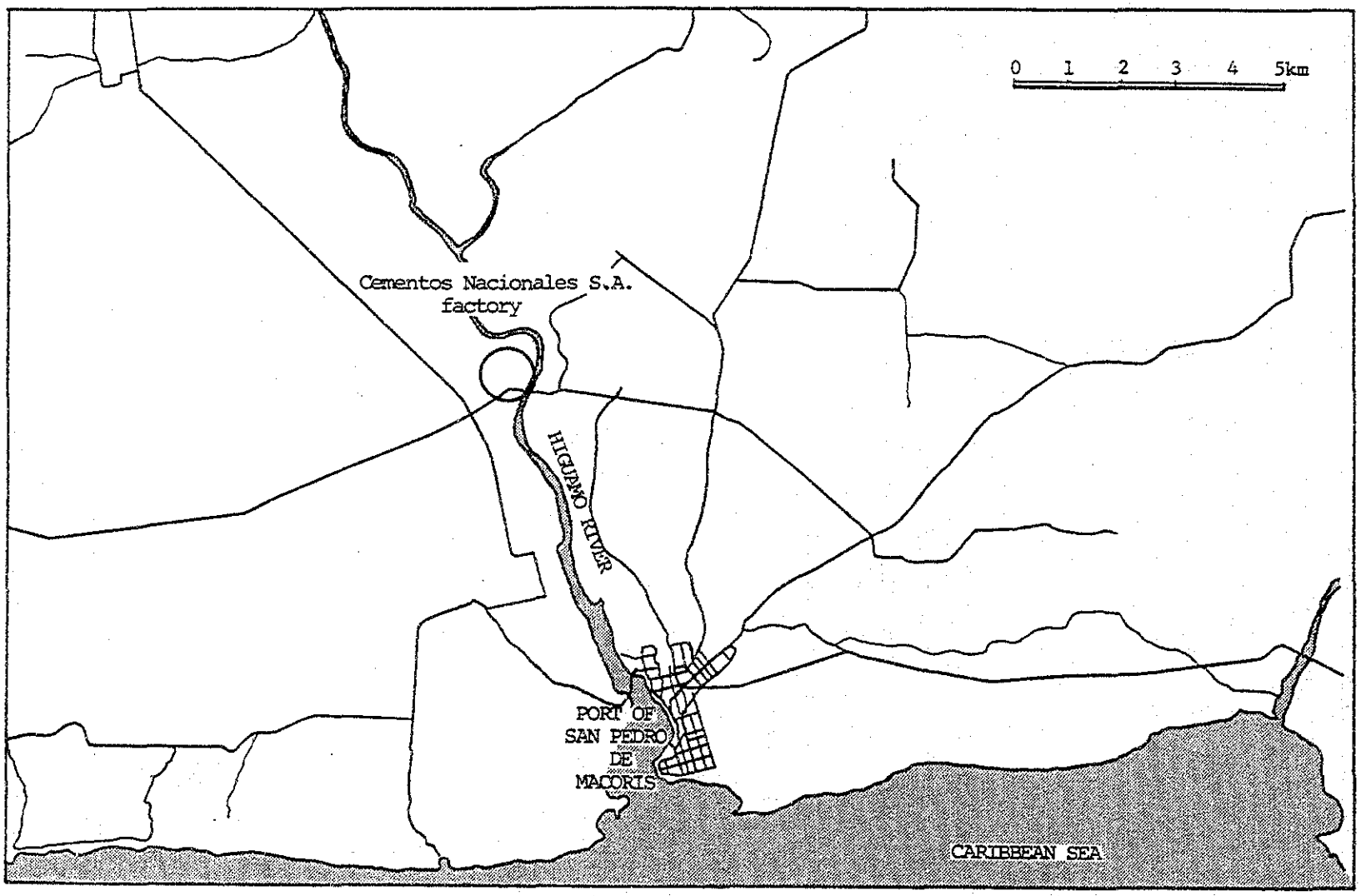


Fig. II.2.8 Location of Cementos Nacionales S.A. Factory

5) Agricultural Products

The forecast import and export volumes of the main agricultural products of the Dominican Republic are shown in Section 2. Here, the volume of agricultural products for export which will be harvested in the Subregion del Yuma, the hinterland of SPM Port, is estimated.

The forecast is based on the following assumptions:

(i) The ratio of the export volume of agricultural products harvested in the Subregion del Yuma to the national export volume is equal to the ratio of regional production to national production.

(ii) The regional share of the agricultural production of the Dominican Republic in 1990 shown in Table II.2.8 will not change in the future.

(iii) The export volume of the main agricultural products will increase after 1995 at the same annual rate of increase as during the ten years from 1986 to 1995.

Table II.2.12 shows the results of the estimation.

Table II.2.12 Estimated Export Volume of Traditional Agricultural Products

(Unit: tons)

Products	1995		2005	
	National	Subregion del Yuma	National	Subregion del Yuma
Sweet potatoes	13,880	180	21,544	280
Name	590	261	789	350
Yautia	29,619	7,346	44,142	10,948
Yuca	7,802	554	10,558	750
Guandul	12,610	252	16,437	329
Pumpkins	5,942	-	8,492	-
Beef	3,538	1,015	3,867	1,110
Cacao	42,048	6,685	53,288	8,472
Total		16,293		22,239

In addition to these traditional agricultural products, domestic and foreign capitalists are planning to produce and export new types of agricultural and fishery products, and some of the projects have been put into practice. Among these projects, production of fuel alcohol as a diversification of sugar production, processing of citrus fruits and shrimp culture are being promoted.

In the Subregion del Yuma, several projects are being promoted in Sabana Grande, El Valle and Hato Major and some of them have already started producrtion. The future export volume of these products is projected as follows:

(Unit: tons)

Products	1995	2005
Oranges	3,100	6,200
Juice	4,600	9,200
Processed citrus fruits	1,400	2,800
Palm oil, etc.	12,900	25,800
Total	22,000	44,000

Thus, the future export volume of agricultural products and processed goods at SPM Port is estimated as follows:

1995	38,000 tons
2005	66,000 tons

Among this volume, beef, oranges, processed citrus fruits and juice are likely to be transported by reefer containers and the cargo volume of these products is estimated as follows:

1995	10,100 tons
2005	19,300 tons

(2) Import

1) Raw Materials for Fertilizer

Raw materials for fertilizer imported at SPM Port are mixed and sacked at the FERQUIDO factory located just behind Wharf No.3. As mentioned in Section 4.2 (1) 3), the company's projected fertilizer production is

130,000 tons in 1995 and 200,000 tons in 2005. Then, the import volume of raw materials at SPM Port is estimated as follows:

1995	130,000 tons
2005	200,000 tons

2) Coal and Coke

Coke was imported from 1981 to 1984, and the import volume fluctuated remarkably. But coal was imported instead of coke in 1985 and 1986. Coke and coal imported at SPM Port are consumed as fuel by the cement factory Cementos Nacionales S.A. located upstream on the Higuamo River. Recently, this company has imported 75,000 tons of coal per year in order to produce 660,000 tons of cement and 600,000 tons of clinker per year. The company is going to import coal from Colombia or the U.S.A. from now on.

As mentioned in Section 4.2.(1) 4), this company plans to expand its production capacity, and it is presumed that the production of coal and clinker will increase linearly and will reach to double the present production in 2005. It is assumed that the consumption of coal will also increase at the same rate.

Thus, the coal volume to be imported at SPM Port is estimated as follows:

1995 $\quad 75,000 \times \frac{990,000}{660,000} = 113,000$ (tons)

2005 $\quad 75,000 \times \frac{1,320,000}{660,000} = 150,000$ (tons)

3) Fuel Oil

Fuel oil has been imported at SPM Port since 1983, but the volume fluctuates year by year. The demand for fuel oil is assumed to increase with the increase of the population of San Pedro de Macoris and its hinterland and with the increase of industrial activity, such as the expansion of the industrial free zone, in the area.

A barge mounted power plant with a capacity of 30,000 Kw is going to be set in SPM Port in 1988. The main fuel for this power plant will be bagasse and barbojo, two by-products of sugar production, and oil will be used as a backup fuel. But if the supply of barbojo and bagasse is not sufficient, it will be necessary to increase the consumption of fuel oil.

Considering the unstable supply of barbojo and bagasse, it is assumed that 50% of the fuel will be fuel oil. So, it will be necessary to provide 37,000 tons of fuel oil per year.

Then, the volume of fuel oil to be imported at SPM Port in 1995 is estimated as 120,000 tons, adding 37,000 tons for the power plant to the past maximum import volume.

According to the forecast by CDE, "Twenty-five year forecast of electric power needs, April 1986, MAIN" it is estimated that power demand in 2005 will be 2.4 times that in 1995. So, in this study, it is assumed that another power plant with the same output capacity will be set in 2005.

Then, the volume of fuel oil to be imported at the Port of San Pedro de Macoris in 2005 is estimated as 157,000 tons, adding 37,000 tons to the volume in 1995.

4) Agricultural products

The forecast import and export volumes of the main agricultural products of the Dominican Republic are shown in Section 2. Here, the volumes of imported corn and wheat to be consumed in the Subregion del Yuma, the hinterland of the Port of San Pedro de Macoris, are estimated.

a. Corn

Corn is imported as feed for chickens. The following assumptions are made to estimate the future demand.

(i) The consumption of imported corn in each subregion corresponds to its production of chickens.

(ii) The regional share of agricultural production of the Dominican Republic in 1990 shown in Table II.2.8 will not change in the future.

(iii) The import volume of corn will increase after 1995 at the same annual rate of increase as during the ten years from 1986 to 1995.

The future demand of corn is estimated as follows:

Year	National import of corn	Share of chicken production of the Subregion del Yuma	Demand of corn in the Subregion del Yuma
1995	337,879 tons	0.5 %	1,689 tons
2005	563,903 tons	0.5 %	2,820 tons

b. Wheat

Presently, wheat is imported at the port of Santo Domingo and then distributed to the entire country.

The following assumptions are made to estimate the future demand.

(i) The consumption of imported wheat in each subregion corresponds to its population.

(ii) The regional share of population in 1990 shown in Table II.2.4 will not change in the future.

(iii) The import volume of wheat will increase after 1995 at the same annual rate of increase as during the ten years from 1986 to 1995.

The future demand of wheat is estimated as follows:

Year	National import of wheat (tons)	National Population (persons)	Population of the Subregion del Yuma (persons)	Share of Population of the Subregion del Yuma (%)	Demand of wheat in the Subregion del Yuma (tons)
1995	282,405	7,915,317	720,294	9.1%	25,699
2005	409,728	9,282,536	844,711	9.1%	37,285

Generally, grain, such as corn and wheat, is transported by large size bulk carriers and handled in large quantities. Moreover, exclusive storage facilities such as silos are necessary in the port area. Therefore, it is not appropriate to handle grain considering the scale merit if the cargo volume to be handled at the port is less than around 100,000 tons per year.

The estimated demand of corn and wheat in the hinterland of SPM Port is too small to justify handling at the Port, and so it is assumed that neither corn nor wheat will be handled at the Port in the target year.

(3) Cargo of the Industrial Free Zones

The Dominican Republic has established industrial free zones in San Pedro de Macoris, Santiago, La Romana, Puerto Plata and at some other places. At these industrial free zones, imported raw materials are processed or assembled exclusively for export. The majority of the import and export cargoes of the industrial free zones are containerized.

These industrial free zones have certain merits as follows:

(i) Manufacturers can import raw materials and export manufactured products free of tax.

(ii) The industrial free zones provide employment.

(iii) The tenants of the industrial free zones can obtain foreign currencies.

(iv) The workers can learn manufacturing techniques.

The current conditions of the industrial free zones are as follows:

Location	Number of Tenants	Number of Workers
San Pedro de Macoris	65	8,993
Santiago	43	13,500
La Romana	22	9,581
Puerto Plata	8	646
Others	10	3,000
Total	148	35,720

1) Current Cargo Volume of the Industrial Free Zone in San Pedro de Macoris

Fig. II.2.9 shows the location of the industrial free zone in San Pedro de Macoris.

There are no statistics about the volume of the import and export cargoes of the industrial free zone in San Pedro de Macoris. So, in this study, the current cargo volume is estimated by two methods: a) through questionnaires and interviews and b) based on the foreign trade statistics

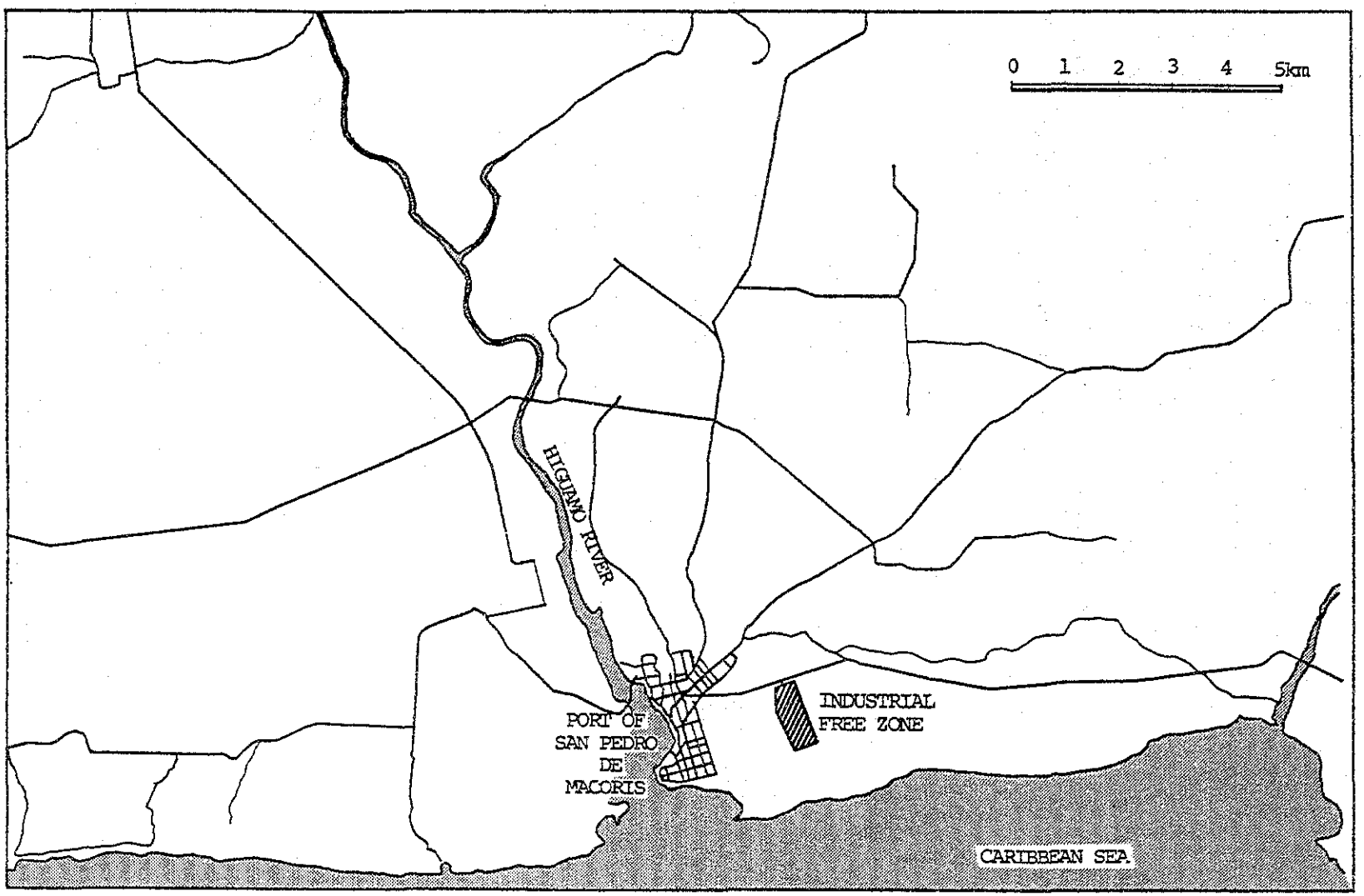


Fig. II.2.9 Location of Industrial Free Zone in San Pedro de Macoris

of all the industrial free zones in the Dominican Republic.

a. Estimation by Questionnaires and Interviews (Case 1)

Interviews were carried out with each tenant of the industrial free zone in San Pedro de Macoris using questionnaires as part of this study. The questionnaires ask each tenant about import and export commodities, loading and unloading ports (or airports), size of containers, cargo volume per ship, cargo volume per month, and import and export cargo volume in 1985. The tenants were also asked about actual annual production volume, planned annual production volume from 1987 to 1991 and opinions on the utilization of SPM Port.

A summary of the survey results is presented below.

Number of tenants:	65
Number of interviewed tenants:	43
Number of answers:	40
Number of tenants which export using seaports:	28 (1,079 TEU)
Number of tenants which Import using seaports:	32 (1,350 TEU)

Concerning the tenants which answered the question about import and export cargo volume in 1985, the results are summarized as follows:

Export	12 tenants	4,725 tons	731 TEU
Import	12 tenants	6,075 tons	906 TEU

So, the total cargo of the industrial free zone in San Pedro de Macoris is estimated as follows:

(Export)	12 tenants	4,725 tons	731 TEU
	28 tenants	X_2 tons	1,079 TEU

Then, $X_2 = 4,725 \times \frac{1,079}{731} = 6,974$ tons

now, for all the tenants (65 tenants)

Cargo Volume: $6,974 \times \frac{1}{28} \times (65 \times \frac{28}{40}) = 11,333$ tons

Number of Containers: $1,079 \times \frac{1}{28} \times (65 \times \frac{28}{40}) = 1,753$TEU

(Import)	12 tenants	6,075 tons	906 TEU
	32 tenants	X_1 tons	1,350 TEU

Then, $X_1 = 6,075 \times \frac{1,350}{906} = 9,052$ tons

now, for all the tenants (65 tenants)

Cargo Volume: $9,052 \times \frac{1}{32} \times (65 \times \frac{32}{40}) = 14,710$ tons

Number of Containers: $1,350 \times \frac{1}{32} \times (65 \times \frac{32}{40}) = 2,194$ TEU

b. Estimation Based on Foreign Trade Statistics (Case 2)

Table II.2.13 and Fig. II.2.10 show the import and export cargo volumes of all the industrial free zones in the Dominican Republic obtained from the statistics of ONE.

The cargo volume of the industrial free zones of the Dominican Republic (148 companies) in 1985 is as follows:

Export:	22,614 tons
Import:	27,199 tons

It is assumed that the cargo volume per company of all the industrial free zones in the Dominican Republic is equal to the cargo volume per company at the industrial free zone in San Pedro de Macoris.

Table II.2.13 Cargo Volume of Industrial Free Zones in the Dominican Republic

(Unit: tons)

Year	Export	Import	Total
1974		2,081	
1975	3,467	2,752	6,219
1976	6,075	5,368	11,443
1977	8,855	7,929	16,784
1978	11,160	10,774	21,934
1979	12,659	10,868	23,527
1980	15,541	14,297	29,838
1981	15,993	13,262	29,255
1982	17,195	13,494	30,689
1983	18,011	16,883	34,894
1984	19,709	23,705	43.414
1985	22,614	27,199*	49,813

Source: ONE

* Import volume in 1985 is estimated from import volume in 1984 using the increase rate of export volume from 1984 to 1985.

Then, the cargo volume of the industrial free zone in San Pedro de Macoris (65 companies) is estimated as follows:

Export: $22,614 \times \frac{65}{148} = 9,932$ tons

Import: $27,199 \times \frac{65}{148} = 11,946$ tons

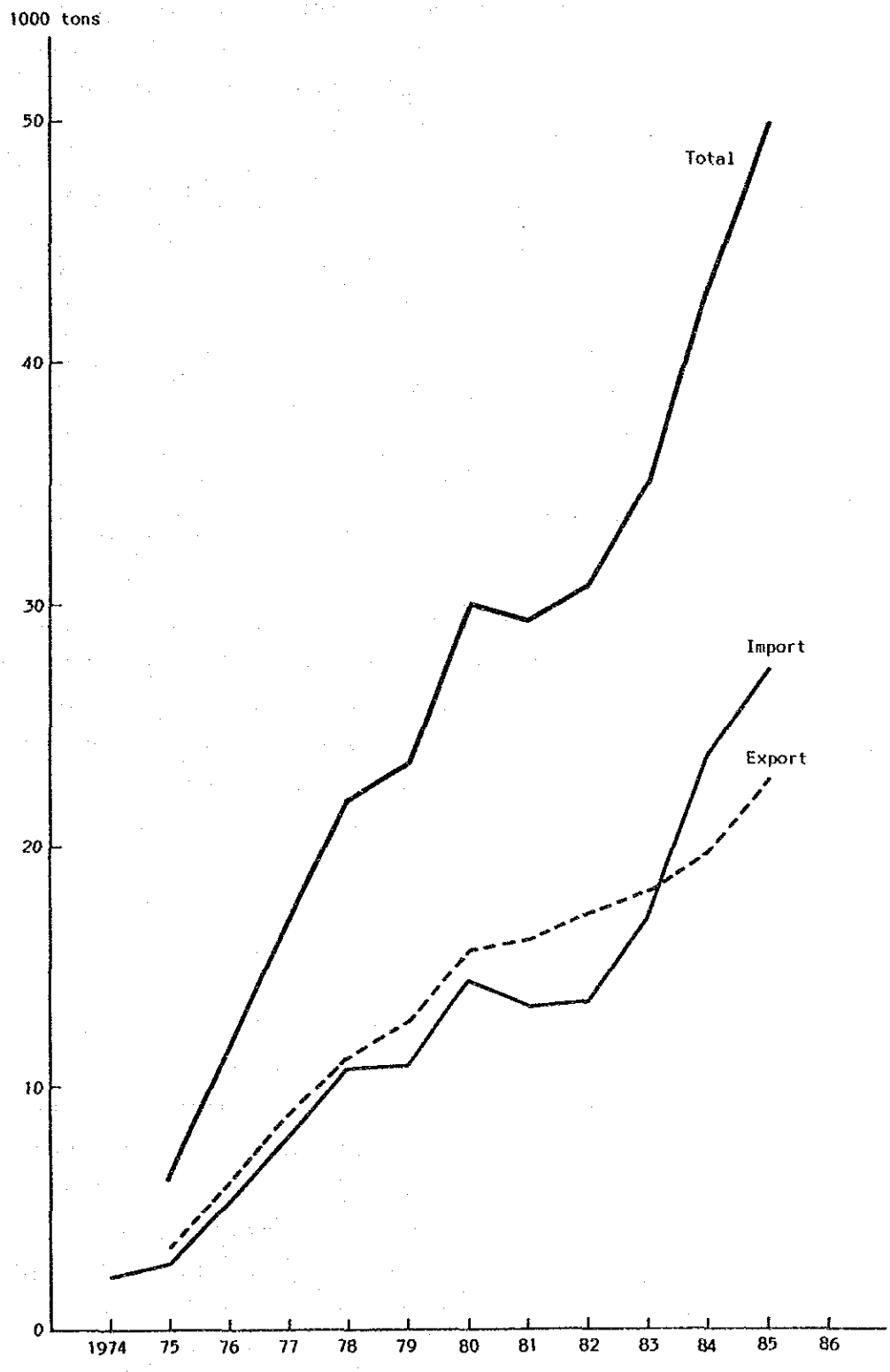


Fig. II.2.10 Cargo Volume of the Industrial Free Zones in the Dominican Republic

Table II.2.14 shows the estimated cargo volume of the two cases.

Table II.2.14 Estimated Cargo Volume of the Industrial Free Zone in San Pedro de Macoris

(Unit: tons)

	(a) Case 1	(b) Case 2	(a) - (b)
Export	11,333 (1,753 TEU)	9,932	1,401
Import	14,710 (2,194 TEU)	11,946	2,764
Total	26,043 (3,947 TEU)	21,878	4,165

There is some difference between the two cases. Case 1 is considered to be more reliable because it is based on direct interviews. Furthermore, the industrial free zone in San Pedro de Macoris was established more than ten years ago and each tenant is considered to have progressed in productivity. So, the estimation of case 1 is adopted as the cargo volume of the industrial free zone in San Pedro de Macoris in this study.

2) Future Cargo Volume of the Industrial Free Zones in San Pedro de Macoris and its Hinterland

During the interviews, some tenants replied that they have plans to greatly expand their production. Moreover, the number of tenants in the industrial free zone in San Pedro de Macoris is expected to increase to more than 70 by the end of 1987. On the other hand, the establishment of a second industrial free zone in San Pedro de Macoris was approved in September 1986. Some new private industrial free zones are currently waiting for approval for establishment in the hinterland of San Pedro de Macoris including the cities of Hato Mayor, Higuey and El Seibo. Each of them will have 15 to 20 tenants. Container cargo to and from these industrial free zones is expected to be handled at SPM Port.

The following assumptions are made to estimate the future cargo volume.

(i) The future proportion of the cargo volume of the industrial free zones in San Pedro de Macoris and its hinterland to the total cargo volume of all the republic's industrial free zones will be equal to the proportion of the cargo volume of the industrial free zone in San Pedro de Macoris to the total cargo volume of all the republic's industrial free zones in 1985.

(ii) The weight of the cargo per TEU in the industrial free zones in San Pedro de Macoris and its hinterland in the future will be equal to the weight of the cargo per TEU in 1985.

The total import and export cargo volumes of the industrial free zones in the Dominican Republic shown in Table II.2.13 are analyzed based on their correlation with the GDP of the manufacturing sector shown in Table II.2.6.

The correlation equations are obtained as follows:

Export: Y = 114.55004 X - 45,616.71 (R=0.98)
Import: Y = 99.402259 X -39,405.55 (R=0.96)

where Y : Cargo Volume (tons)
X : GDP of Manufacturing Sector (mn pesos)
R : Correlation Coefficient

For the estimation, the future GDP is given in Table II.2.7. The future GDP of the manufacturing sector is estimated based on its correlation with GDP.

The correlation equation is:

Y = 0.156968 X + 73.6 (R = 1.00)

where Y: GDP of Manufacturing Sector (mn pesos)
X: GDP (mn pesos)
R: Correlation Coefficient

Table II.2.15 shows the estimated future cargo volume. The estimated cargo volume is 1.8 times larger than the 1985 volume in 1995 and 2.8 times larger in 2005.

Table II.2.15 Estimated Future Cargo Volume

(Unit: mn pesos, tons, TEU)

Year	GDP	GDP of Manufac-turing Sector		Industrial Free Zones in San Perdro de Macoris and its hinterland		All the Industrial Free Zones
				Cargo Volume	Number of Containers	Cargo Volume
1995	4,696.4	810.8	Exp.	23,684	3,663	47,260
			Imp.	22,277	3,323	41,190
2005	6,311.6	1,064.3	EXP.	38,237	5,915	76,299
			Imp.	35,905	5,355	66,388

(4) Miscellaneous General Cargo

As mentioned in Section 3, almost all the miscellaneous general cargo for the Subregion del Yuma is currently handled at the metropolitan port complex and transported by land. However, if the port facilities of San Pedro de Macoris were improved, these cargoes would be handled at SPM Port and the transport cost would be reduced greatly.

1) Future Cargo Volume of the Metropolitan Port Complex

Table II.2.16 shows the actual cargo volume handled at the metropolitan port complex from APD data by cargo type and by import and export. Table II.2.17 shows the volume of container cargo to and from industrial free zones handled at the metropolitan port complex from the statistics of ONE.

Here, the future cargo volume handled at the metropolitan port complex is estimated through a time series analysis. The container cargo volume of the industrial free zones is estimated separately from the other general cargo. It is obtained from the total cargo volume of all the republic's industrial free zones estimated in (3) considering the future share by port. The export volume of liquid bulk in the future is presumed to be the same as the present volume. Table II.2.18 and Fig. II.2.11 show the estimation results.

Table II.2.16 Historical Cargo Volume of Foreign Trade of the Metropolitan Port Complex by Cargo Type

(Unit: 1,000 tons)

Cargo type		1982	1983	1984	1985
Export	General cargo	332	273	335	390
	Dry bulk	262	340	306	343
	Liquid bulk	63	65	60	42
	Total	657	678	701	775
Import	General cargo	621	670	634	682
	Dry bulk	547	694	684	822
	Liquid bulk	1,995	2,196	2,332	2,173
	Total	3,163	3,560	3,650	3,677
Export	General cargo	953	943	969	1,072
	Dry bulk	809	1,034	990	1,165
	Liquid bulk	2,058	2,261	2,392	2,215
	Total	3,820	4,238	4,351	4,452

Source: APD

Table II.2.17 Historical Cargo Volume of Industrial Free Zones Handled at the Metropolitan Port Complex

(Unit: 1,000 tons)

	1982	1983	1984	1985
Export	12	14	14	16
Import	12	13	17	22
Total	24	27	31	38

Source: ONE

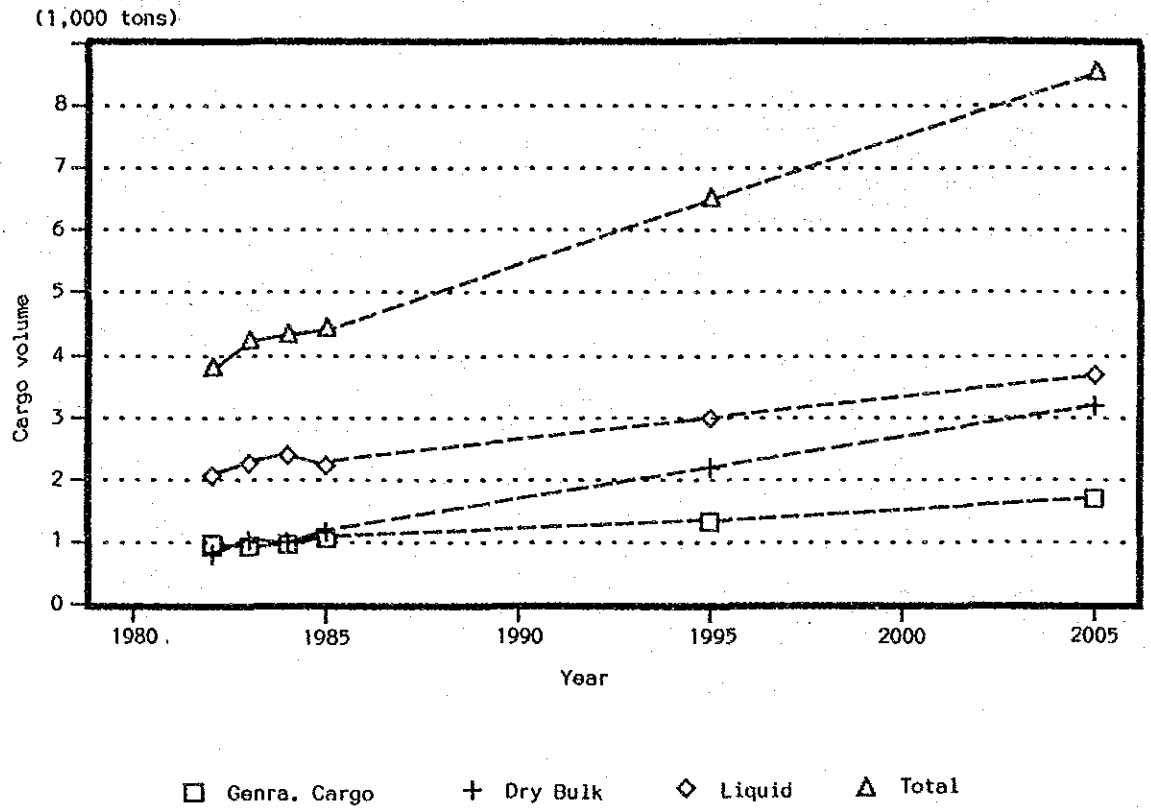


Fig. II.2.11 Future Cargo Volume of the Metropolitan Port Complex

Table II.2.18 Estimation of Future Cargo Volume of the Metropolitan Port Complex

Cargo type	Total cargo volume (1,000 tons) (1995)	(2005)	Forecast method	Correlation coefficient (%)	Remarks
Export					
General cargo	577	801	Time series analysis Y = 21.6 x -42,527.1	61.5	(1)
Dry bulk	553	762	" Y = 20.9 x -41,142.4	71.4	
Liquid bulk	60	60	Fixed at 60,000 tons	-	
Total	1,190	1,623	Time series analysis Y = 35.7 x -70,124.2	94.8	(2)
Import					
General cargo	768	883	Time series analysis Y = 10.9 x -20,987.4	53.3	(1)
Dry bulk	1,624	2,439	" Y = 81.5 x -160,968.5	93.6	
Liquid bulk	2,945	3,615	" Y = 67.0 x -130,720.5	62.5	
Total	5,337	6,937	" Y = 159.4 x -312,676.4	88.0	(2)
Total					
General cargo	1,345	1,684	Time series analysis Y = 32.5 x -63,514.5	79.0	(1)
Dry bulk	2,177	3,201	" Y = 102.4 x -202,110.9	89.8	
Liquid bulk	3,005	3,675	Total of export and import volume	-	
Total	6,527	8,560	Time series analysis Y = 195.1 x -382,800.6	93.0	(2)

Remarks: (1) Container cargo volume of industrial free zones is estimated separately and then added.

(2) Estimated cargo volume is the total of each cargo type. Time series analysis is also carried out for reference.

2) Future Cargo Volume of Miscellaneous General Cargo Transferred to the Port of San Pedro de Macoris

The future volume of general cargo of the metropolitan port complex estimated in 1) includes cargo for San Pedro de Macoris and its hinterland because it is estimated based on the present cargo volume. Here, the future cargo volume of miscellaneous general cargo which will be transferred to SPM Port is estimated. The share of the cargo volume for the Subregion del Yuma is assumed to be equal to the proportion of the subregional population to the national population. The container cargo volume of the industrial free zones is estimated separately in (3) and is not counted here. Table II.2.19 shows the estimated future cargo volume.

Table II.2.19 Estimated Future Cargo Volume of Miscellaneous General Cargo

Year		Cargo volume of the metropolitan port complex (1,000 tons)	Proportion of subregional population (*) (%)	Cargo share of SPM Port (1,000 tons)
1995	Export	565	9.1	51
	Import	758		69
	Total	1,323		120
2005	Export	781	9.1	71
	Import	867		79
	Total	1,648		150

(*) Refer to (2) 4) b. (Future demand of wheat).

3) Containerized Ratio of Miscellaneous General Cargo

Table II.2.20 shows the containerized ratio of miscellaneous general cargo of the metropolitan port complex other than the container cargo of the industrial free zones.

Table II.2.20 Containerized Ratio of Miscellaneous General Cargo of the Metropolitan Port Complex

Year	1981	1982	1983	1984	1985
Containerized Ratio (%)	40.9	59.6	53.5	54.7	56.2

In this study, the future containerized ratio of miscellaneous general cargo is estimated using the least squares method. A logistic curve is adopted as an approximation model. The correlation equation is obtained as follows:

$$Y = \frac{100}{1 + 1.2099641 \exp.\ (-0.1034498(t - 1980)} \qquad (R = 0.57)$$

where, Y : Containerized Ratio (%)

t : Year

R : Correlation Coefficient

Here, the upper and lower limit of the containerized ratio are set as 100% and 0% respectively. The future containerized ratio is obtained by this equation as follows:

t = 1995 Y = 79.6

t = 2005 Y = 91.6

Then, the future containerized ratio of miscellaneous general cargo is set as 80% in 1995 and 90% in 2005 in this study.

(5) Ferry Traffic

In this study, it is assumed that the regular ferry service five times a week between Mayagüez, Puerto Rico and SPM Port will not change in the future.

(6) Passenger Boats

The Caribbean Sea is the largest cruising market in the world in all seasons. Currently, several shipping companies are operating many cruising ships between Miami, Florida; San Juan, Puerto Rico; St. Thomas and other small islands. Table II.2.21 shows the number and the annual growth rate of the cruise passengers from Miami.

Table II.2.21 Miami Cruise Passengers

Year	1983	1984	1985
Passengers (1,000 persons)	1,040	1,150	1,300
Annual growth (%)	14	10	12

One of the shipping companies operating in the Caribbean Sea estimates the annual growth of Caribbean cruise passengers as 10% and the annual growth of capacity as 14%, and is positive about the development of new demand. The ship size is also increasing. One of the shipping companies is reportedly building a new passenger boat that will be the largest in the world (74,000 GRT). The new vessel will be put into service soon.

Currently the Dominican Republic has only one regular passenger cruise boat service connecting with Puerto Plata and Miami twice a week. Occasionally, some passenger boats call at the Sans Souci passenger terminal in Santo Domingo and at the port of La Romana. But the Dominican government is strongly promotiong the development of tourism all over the country and is also constructing facilities for tourists around San Pedro de Macoris. Considering this situation, it is presumed that Caribbean cruise passenger boats will call at SPM Port twice a month in 1995 and once a week in 2005.

4.3 Summary of the Port Traffic Forecast of the Port of San Pedro de Macoris

Table II.2.22 is a summary of the port traffic forecast for SPM Port. Fig. II.2.12 shows the current and estimated future cargo volume.

Fig. II.2.13 shows the change of cargo flow to and from the hinterland of San Pedro de Macoris.

Table II.2.22 Summary of Estimated Future Port Traffic at the Port of San Pedro de Macoris

(Unit: 1,000 tons, TEU)

Commodity		1995		2005	
		Cargo Volume	TEU	Cargo Volume	TEU
Export	Sugar	151	-	151	-
	Molasses	56	-	56	-
	Fertilizer	39	-	60	-
	Cement	99	-	132	-
	Clinker	90	-	120	-
	Cargo of the F.Z.	24	3,700	38	5,900
	Agr. products*,**	38	3,000	66	5,900
	Miscellaneous general cargo**	51	4,100	71	6,400
	Total Export Cargo	548	10,800	694	18,200
Import	Raw materials for fertilizer	130	-	200	-
	Coal	113	-	150	-
	Fuel Oil	120	-	157	-
	Cargo of the F.Z.	22	3,300	36	5,400
	Miscellaneous general cargo**	69	5,500	79	7,100
	Total Import Cargo	454	8,800	622	12,500
Total		1,002	19,600	1,316	30,700
Regular ferry service Regular passenger boats		5 times a week twice a month		5 times a week once a week	

Remarks: *) Containerized ratio of exported agricultural products is presumed to be the same as that of miscellaneous general cargo, 80% in 1995 and 90% in 2005.

**) The number of containers is estimated assuming that the unit load is 10 tons per TEU.

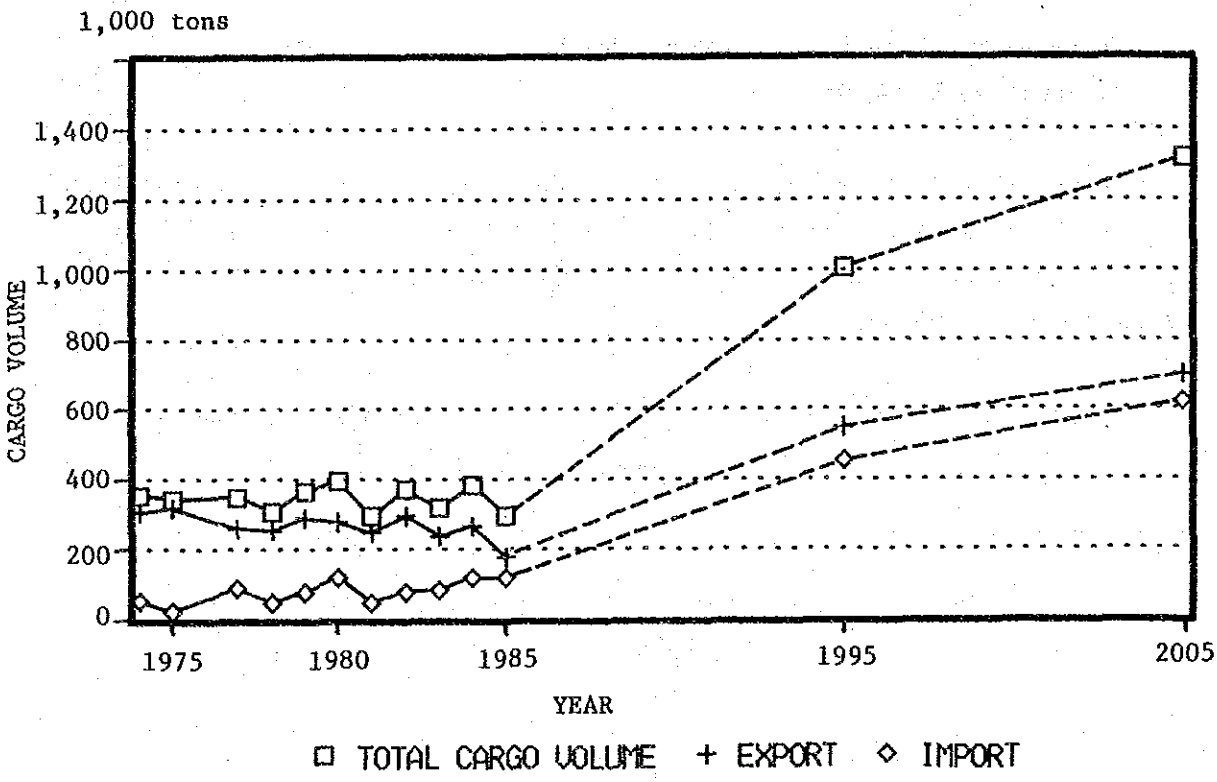


Fig. II.2.12 Current and Estimated Future Cargo Volume of the Port of San Pedro de Macoris

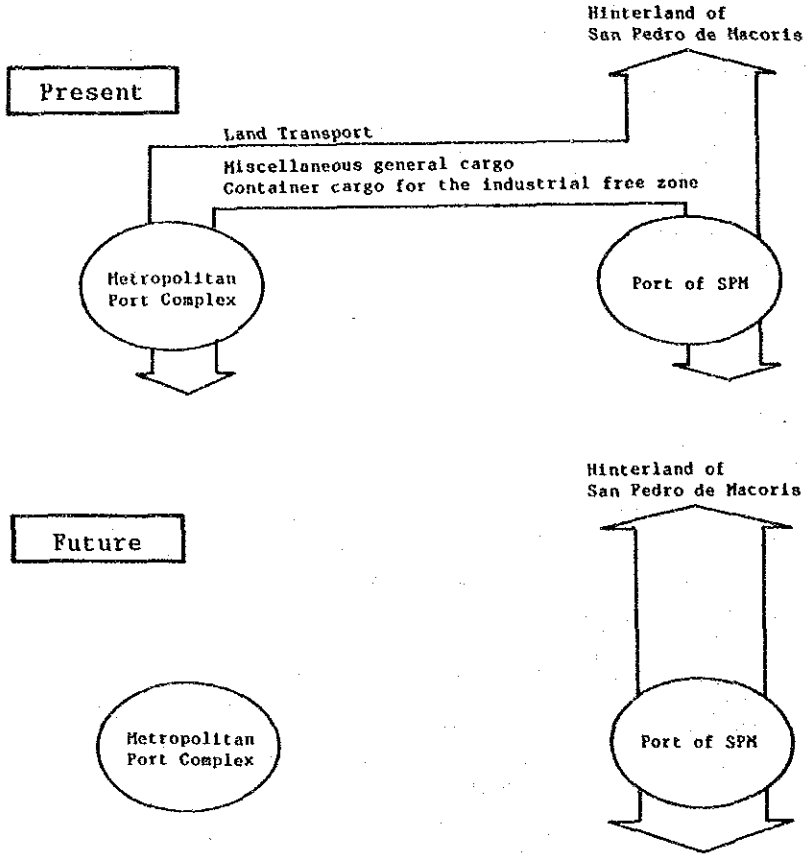


Fig. II.2.13 Change of Cargo Flow to and from the Hinterland of San Pedro de Macoris

5. Future Shipping

In planning to determine the size and number of berths required, the first thing is to determine the size and number of ships which will utilize the port in the future. The future size of ships is usually predicted by considering the present ship size, the estimated future cargo throughput, trends in worldwide maritime trade, and so on.

A detailed analysis of actual vessel movement at SPM Port is presented in Part I Chapter 3 Section 5. The maximum size of calling cargo vessels at SPM Port is around 15,000 DWT.

As mentioned in Part I Chapter 3 Section 3, the present wharf depth of the Port of San Pedro de Macoris is only 4.0 - 4.5 m. Moreover, the serious damage of the concrete decks hampers efficient cargo handling. So, the size and type of calling ships are limited by the port facilities.

Several port users have requested deeper port facilities. CEA, one of the sugar exporters, says that wharfs with a 30 foot depth as at the port of Haina are necessary. FERQUIDO, a fertilizer company, states that the biggest problem at the Port is the small water depth at the wharfs, and this directly limits the possible increase of ship size. In this situation, the Dominican government has decided to dredge the entrance channel and water area of SPM Port to a 35 foot depth within a few years.

The majority of the cargo handled at SPM Port is transported to and from Puerto Rico, other Caribbean countries and the United States. Thus, the worldwide tendency of increasing ship size may not influence the maximum ship size at SPM Port greatly.

Overall, it seems appropriate to presume that the maximum average size of vessels which will call at SPM Port in the future will be 20,000 DWT for cargo ships and 20,000 GRT for passenger boats. Table II.2.23 shows the estimated average ship size at SPM Port in the future.

Table II.2.23 Estimated Average Ship Size

	1995					2005				
	Average Ship Size		Cargo Volume	Average Cargo Volume per Ship	Number of Ship Calls	Average Ship Size		Cargo Volume	Average Cargo Volume per Ship	Number of Ship Calls
	(GRT)	(DWT)	(tons/year)	(tons)		(GRT)	(DWT)	(tons/year)	(tons)	
Exp. Cargo										
Sugar (bags)	700	1,050	15,000	600	25	700	1,050	15,000	600	25
Sugar (bulk)	7,000	10,500	136,000	7,000	19	7,000	10,500	136,000	7,000	19
Fertilizer (bags)	1,000	1,500	39,000	1,000	39	1,000	1,500	60,000	1,000	60
Cement (bags)	3,000	4,500	99,000	3,000	33	3,000	4,500	132,000	3,000	44
Clinker (bulk)	5,000	7,500	90,000	5,000	18	5,000	7,500	120,000	5,000	24
Free Zone (containers)	3,000	4,500	24,000	460	52	3,000	4,500	38,000	730	52
General Cargo	8,000	12,000	89,000	1,700	52	8,000	12,000	137,000	2,600	52
Imp. Cargo										
Fertilizer (bulk)	7,000	10,500	130,000	6,000	22	7,000	10,500	200,000	6,000	33
Coal (bulk)	13,000	19,500	113,000	15,000	8	13,000	19,500	150,000	15,000	10
Fuel Oil (bulk)	13,000	19,500	120,000	15,000	8	13,000	19,500	157,000	15,000	10
Free Zone (containers)	3,000	4,500	22,000	420	52	3,000	4,500	36,000	690	52
General Cargo	8,000	12,000	69,000	1,300	52	8,000	12,000	79,000	1,500	52
Ferry	3,000	4,500	-	-	260	3,000	4,500	-	-	260
Passenger Boats	20,000	30,000	-	-	24	20,000	30,000	-	-	52

CHAPTER 3 PORT PLANNING

In this chapter, the required port facilities are identified in accordance with the basic concept and the demand forecast.

The main required facilities are as follows.

(1) Exclusive ferry wharf
(2) Wharfs for ro/ro ships and containers
(3) Wharfs for general cargo and bulk cargo
(4) Transit shed
(5) Open storage yard and parking area
(6) Cargo handling equipment
(7) Building for offices and other purposes

Generally, the Study evaluates the existing facilities and determines the best use of these facilities as part of the development plan. Most wharfs will function as multipurpose wharfs, and will not be for exclusive use.

Existing projects, like CDE's power plant and the shipyard, are incorporated as part of the long-term development plan.

1. Scale of the Port Facilities

The Master Plan is defined so that the facilities can accommodate the estimated traffic demand in 2005.

According to the demand forecast, the total annual cargo volume at the Port in 2005 will be 1.315 million tons as described in Part II Chapter 2. In this section, the size of the required facilities is estimated.

1.1 Maximum Ship Size

According to the record of the calling ships at the Port from 1985 to 1986, the largest ship in DWT was the oil tanker "Intermar Trader" (23,843 GRT) with a maximum draft of 11.418m.

Data on other large ships which transported fuel oil and coal are presented in Table II. 3.1.

Among these ships the maximum draft is 11.5m. It is clear that these large ships were not fully loaded because the depth of the Port is about 9m, and they moored some distance from the wharf line where the water depth is less than 7m.

Table II.3.1 Large Ships which called at SPM Port

Fuel Oil

DATE ENTERED Y.M.D	SHIP NAME	SHIP NATIONALITY	GRT (tons)	DWT (tons)	MAX
84.1.12	EXPLORER	Panama			
84.2.06	INTERMAR TRADER	Liberia	23,843	45,306	11.4
84.3.03					
84.4.03	PARIATA	Venezuela	19,298	32,386	"
4.25	CARUAL	"	19,298		
5.28	PARIATA	"	19,298	32,386	11.4
8.05	CARUAL	"	"		
8.23	"	"	"		
9.12	"	"	"		
12.24	"	"	"		

Coal

85.6.01	ANTONIO MACHADO	Spain	9,633	15,721	8.9
8.09	"	"	"	"	"
11.10	BALAO	Liberia	16,137	27,178	11.0
86.2.09	HAINA	D.R.	9,607	16,245	9.1
2.13	BETH	Norway	22,076	34,232	11.5
4.29	TRYM	"	18,052	27,258	11.0
7.22	ATLANTIC EXPRESS	Panama	15,000	23,500	9.6

In order to accommodate these ships under full draft, the required depth of the wharf will be 13m. However, a large size wharf would be very costly. The maximum depth at Haina Port is presently 35 feet (10.7m) and the basin for the recently completed container terminal is 35 feet deep with a structural stability allowing dredging up to 40 feet (12m). It would be ideal for the facilities at SPM Port to have a depth of 12m in accordance with Haina Port. However, a 45,000 ton lot size is not always necessary and the construction of a 12m wharf at the Port especially on the east side of the river would be very expensive and also technically difficult because of the soft subsoil condition.

It is thus recommended that the maximum depth of the wharf be set at -11.0m (36.1') which corresponds to a ship size of 20,000 DWT and also permits 20,000 GRT passenger boats, which are common in the Caribbean, to enter the Port.

The dimensions of the maximum ship are shown in Table II 3.2.

Table II.3.2. Maximum Ship Size

Type of Ship	Size (tons)	LOA (Overall Length)	Breadth (m)	Moulded Depth (m)	Draught (m)
Cargo	20,000 DWT	177m	23.4	13.8	10.0
Passenger	20,000 GRT	197m	25.1	15.1	9.2

1.2 Basin and Channel

(1) Basin

Turning basins are formulated considering a circular area with a diameter of 2 x LOA assuming accompanying tug boats.

The diameter D(m) is calculated using the length of target passenger boats (20,000 GRT), 197m.

D = 2 x 197m = 394 m → 400m

(2) Channel

Channel width B is estimated as 5 x (width).

5 x 25.1 = 125.5m ⟶ 130m

Thus, the channel width is estimated as 130m.

The design basin and channel are shown in Fig. II.3.1.

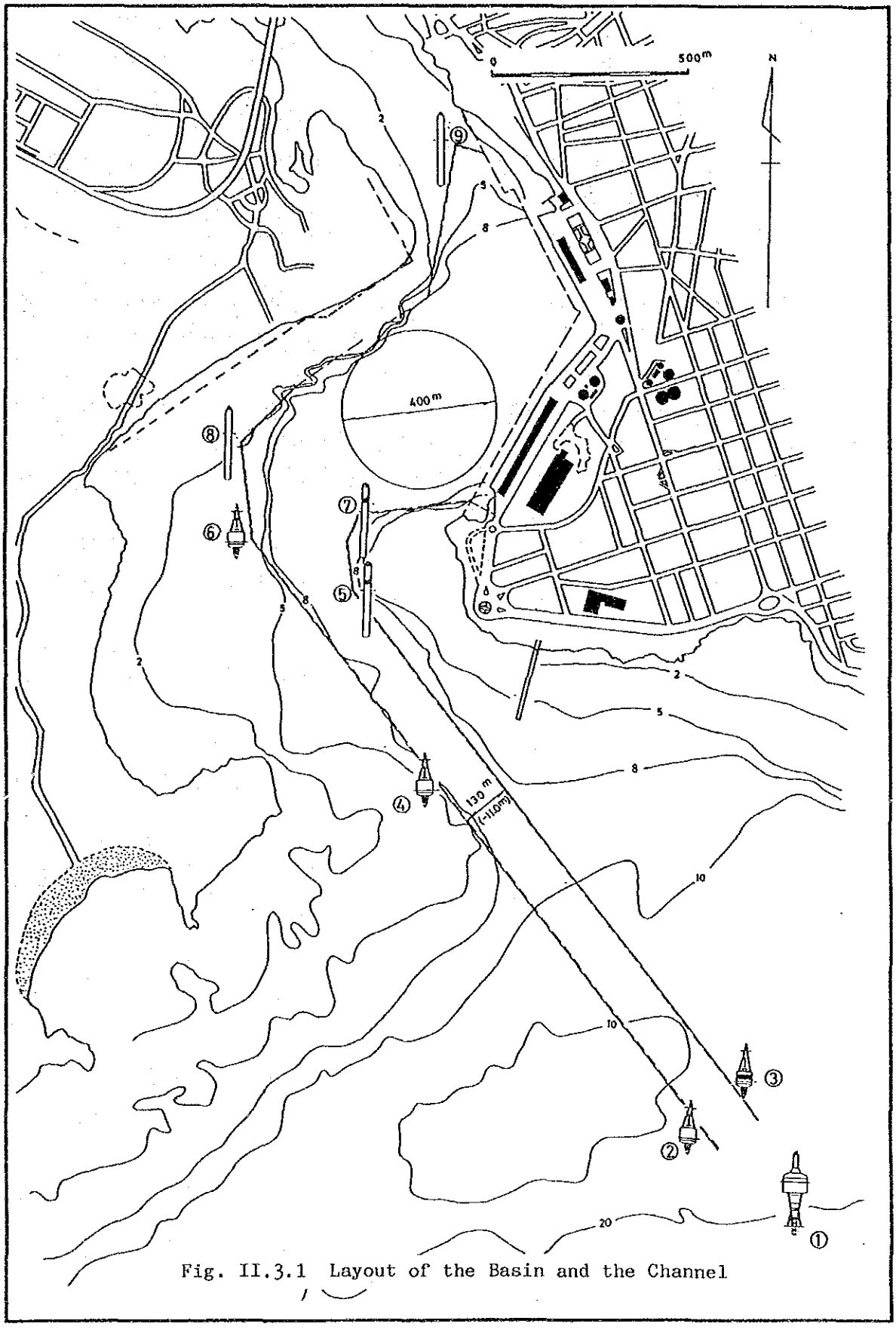


Fig. II.3.1 Layout of the Basin and the Channel

1.3 Wharfs

(1) Types of Wharfs

Wharfs are required for ferry boats, containers including ro/ro, dry and liquid bulk and general cargo.

The ferry berth requires a stern or bow ramp considering the present ferry system.

Ro/ro berths do not always require stern or bow ramps, because ro/ro ships with side ramps are also common. However it is better that at least one ro/ro berth be provided with a ramp.

Liquid bulk requires a pipeline system. Liquid bulk cargo does not always require a marginal wharf. A detached dolphin or open type pier is sufficient if only liquid bulk is handled. It depends on the cargo volume, construction cost, etc.

In order to allow most wharfs to function as multipurpose wharfs and to make them flexible, the water depth of all the wharfs should be the same whenever possible.

(2) Cargo Handling Efficiency and Ship Mooring Time

The details of the proposed cargo handling system and equipment are presented in Part III Chapter 3. This section presents the outline of the cargo handling efficiency to estimate the ship mooring time as required for the queuing simulation.

Table II.3.3 shows the cargo handling productivity at the Port in 2005.

Table II.3.3 Productivity and Ship Mooring Days by Commodity (2005)

Commodity	Productivity *		Av. Cargo Vol/Ship in 2005 (tons)	Av. Mooring Days in 2005 (days)
	in 1985 (tons/day)	in 2005 (tons/day)		
- Export -				
Sugar				
(in bulk)	346	1,300	7,000	5.4
(in bags)	108	150	600	4.0
Fertilizer				
(in bags)	143	280	1,000	3.6
Cement				
(in bags)	88	520	3,000	5.7
Clinker				
(in bulk)	2,223	2,223	5,000	3.0**
Free Zone				
(container)	-	40TEU x 8	230 TEU/S	1.0
Ag. Products other G. Cargo				
(container)	-	40TEU x 8	473 TEU/S	2.0
- Import -				
Fertilizer				
(in bulk)	1,174	1,900	6,000	3.1**
Coal				
(in bulk)	3,853	5,000	15,000	3.0**
Fuel Oil	3,022	15,000	15,000	1.0**

* Effective productivity (Cargo Volume/Total Mooring Days)

** Estimated from actual mooring time

(3) Rough Estimation of the Required Number of Wharfs

1) Ferry Boat

i) Number of berths

. Ferries will provide the most frequent service at the Port, five calls per week, and it is recommended that one berth be provided for exclusive use by ferries.

. The ship size and type is estimated to be the same as the present ferry.

. When the demand increases the ferry service may become more frequent, for example two or three services a day, and the capacity can be increased.

. So, one exclusive ferry berth is included in the Master Plan.

ii) Berth requirements

The wharf should be - 7.5m deep and 130m long in accordance with the ship dimensions, and the wharf ramp is also used as the bow or stern ramp of the ship.

iii) Parking area for ferry

The ferry boat has a capacity of 280 automobiles, and this capacity is assumed not to change in 2005. The parking lot area required for the ferry is estimated using the following formula:

$A = \alpha \times \beta \times a \times N$

where, A: Parking area (m^2)

α: Coefficient of utilization of area for both embarking and disembarking (2.0)

β: Peak value (1.2)

a: Required area per vehicle ($25m^2$)

Accordingly,

A: $2.0 \times 1.2 \times 25 \times 280 = 16,800m^2$

2) Ro/ro Berth

A ro/ro berth equipped with a ramp is necessary for the industrial free zone containers. A wharf ramp is not always necessary for ro/ro ships, because ro/ro ships equipped with a side ramp are also common. However, it is assumed that a wharf with a ro/ro ramp will be necessary for ro/ro vessels without side ramps.

Agricultural products and other general cargo are also containerized cargo. They will be handled using a lo/lo container system.

Ro/ro and lo/lo container services are assumed to be weekly services and their mooring days are 1 day and 2 days respectively.

If one container berth which can be used 350 days/year is provided, the berth occupancy ratio will be 44.6%. Thus, one container berth is proposed under the Master Plan.

3) Bulk Cargo Wharf

A wharf for bulk cargo except fertilizer is planned on the west bank side of the river. The bulk cargo volume to be handled at this wharf is as follows:

- Sugar in bulk 136,000 tons
- Coal 150,000 tons
- Clinker 120,000 tons
- Fuel Oil 157,000 tons

The number of ship calls and the mooring time is calculated as shown Table II. 3.4.

Table II.3.4 Number of Ship Calls and Mooring Time (Bulk Cargo)

Commodity	Cargo volume per year (tons)	Average cargo volume per ship (tons/ship)	Number of ship calls	Average Mooring time(days)	Mooring time(days)
Sugar (in bulk)	136,000	7,000	19	5.4	102.6
Coal	150,000	15,000	10	3.0	30.0
Clinker	120,000	5,000	24	3.0	72.0
Fuel Oil	157,000	15,000	10	1.0	10.0
Total					214.6

If the wharf can be used 350 days per year, the berth occupancy ratio is 61%. Thus, one berth for bulk cargo is proposed.

4) Wharfs for Loose Cargo and Fertilizer

The mooring time is estimated as shown in Table II. 3.5.

Table II.3.5 Number of Ship Calls and Mooring Time
(Loose Cargo and Fertilizer)

Commodity	Cargo volume per year (tons)	Average cargo volume per ship (tons/ship)	Number of ship calls	Average Mooring time(days)	Mooring time(days)
Sugar (in bags)	15,000	600	25	4.0	100.0
Cement (in bags)	132,000	3,000	44	5.7	250.8
Fertilizer (in bags)	60,000	1,000	60	3.6	216.0
Fertilizer (in bulk)	200,000	6,000	33	3.1	102.3
Total					669.1

Assuming 3 berths and 350 working days per year, the berth occupancy ratio will be 63.7%. Thus, 3 loose cargo and fertilizer wharfs are proposed.

5) Passenger boats

Passenger boats with total mooring days estimated as 52 times/year x 0.5 days/time = 26 days do not require an exclusive wharf.

6) Service Boat (Official Use Wharf)

A wharf for tug boats, pilot boats and other small boats is necessary. One wharf of 100m long and -5.0m deep is proposed.

7) Molasses wharf

Presently, molasses is handled at the south end of Wharf No.1. Considering that molasses ships are small and that most other ships do not occupy an entire berth, molasses ships are assumed to moor together with other ships at the same wharf. Thus a special wharf for molasses is not provided.

(4) Required Number of Berths by Queuing Simulation

In order to estimate the optimum number of berths, a queuing

simulation is carried out. The simulation scheme is shown in Fig. II.3.2.

Before estimating the required number of berths for the Master Plan, the present conditions of the Port are analyzed.

1) Present Conditions

i) Simulation Conditions

The present conditions of the Port are explained in Part I Chapter 3.

As there is no record of the queuing at the port, a queuing simulation is conducted in order to estimate the present ship waiting time.

Shipping conditions and berth utilization are explained in Part I Chapter 3, so in this section only additional information is provided.

Ferry boats already call at the Port five times per week, and one berth for exclusive use by ferries is necessary, so the number of berths is calculated excluding ferry traffic.

- Ship Arrival Interval

The ship arrival interval is calculated using the port commander's data, and the berthing date is assumed to be the date of the arrival.

The ship arrival distribution is shown in Fig. II.3.2. A phase I Erlang curve closely approximates the arrival distribution.

The simulation conditions and the wharf utilization for 1985 are summarized in Table II.3.6 and Table II.3.7.

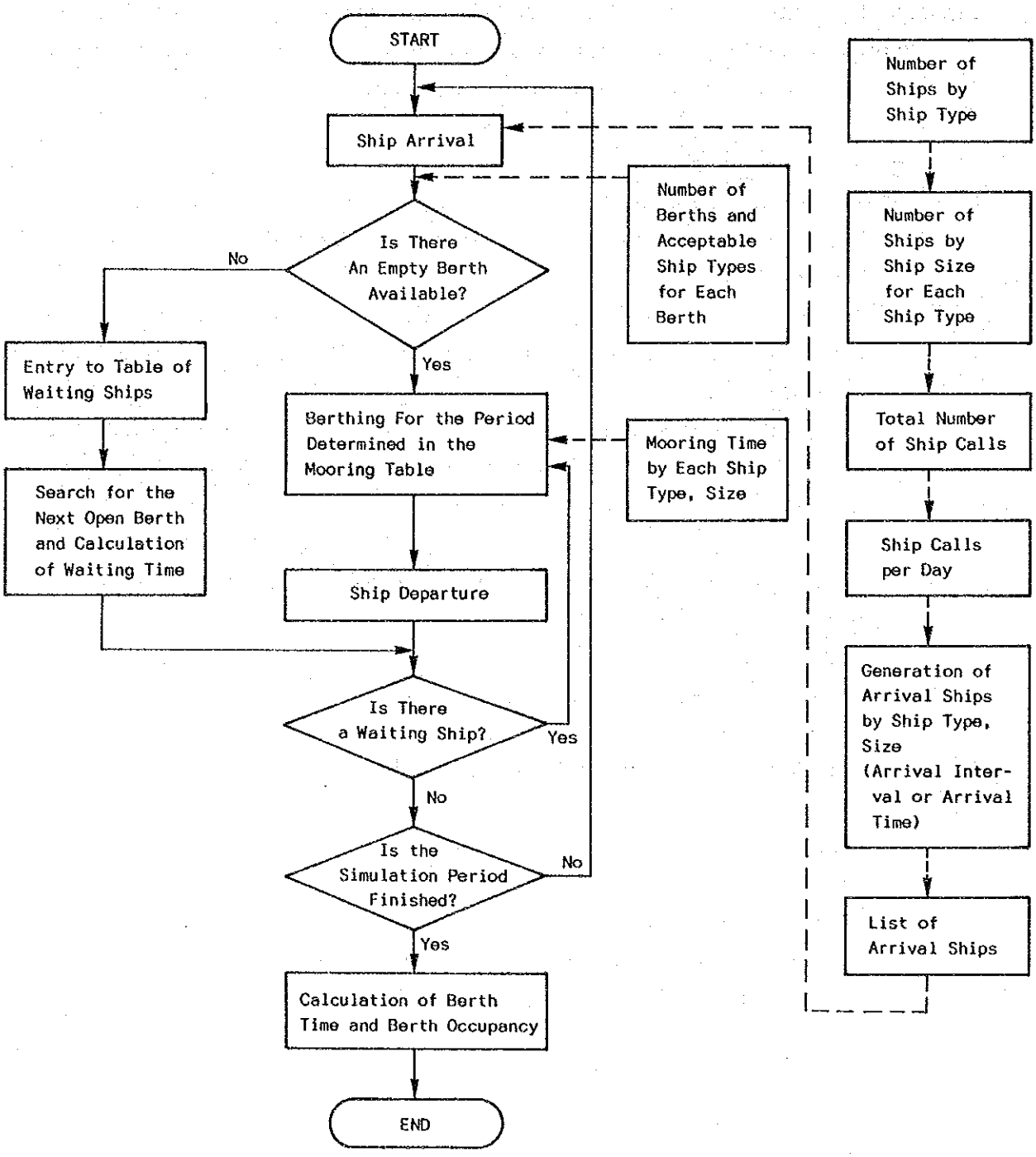


Fig. II.3.2 Simulation Scheme

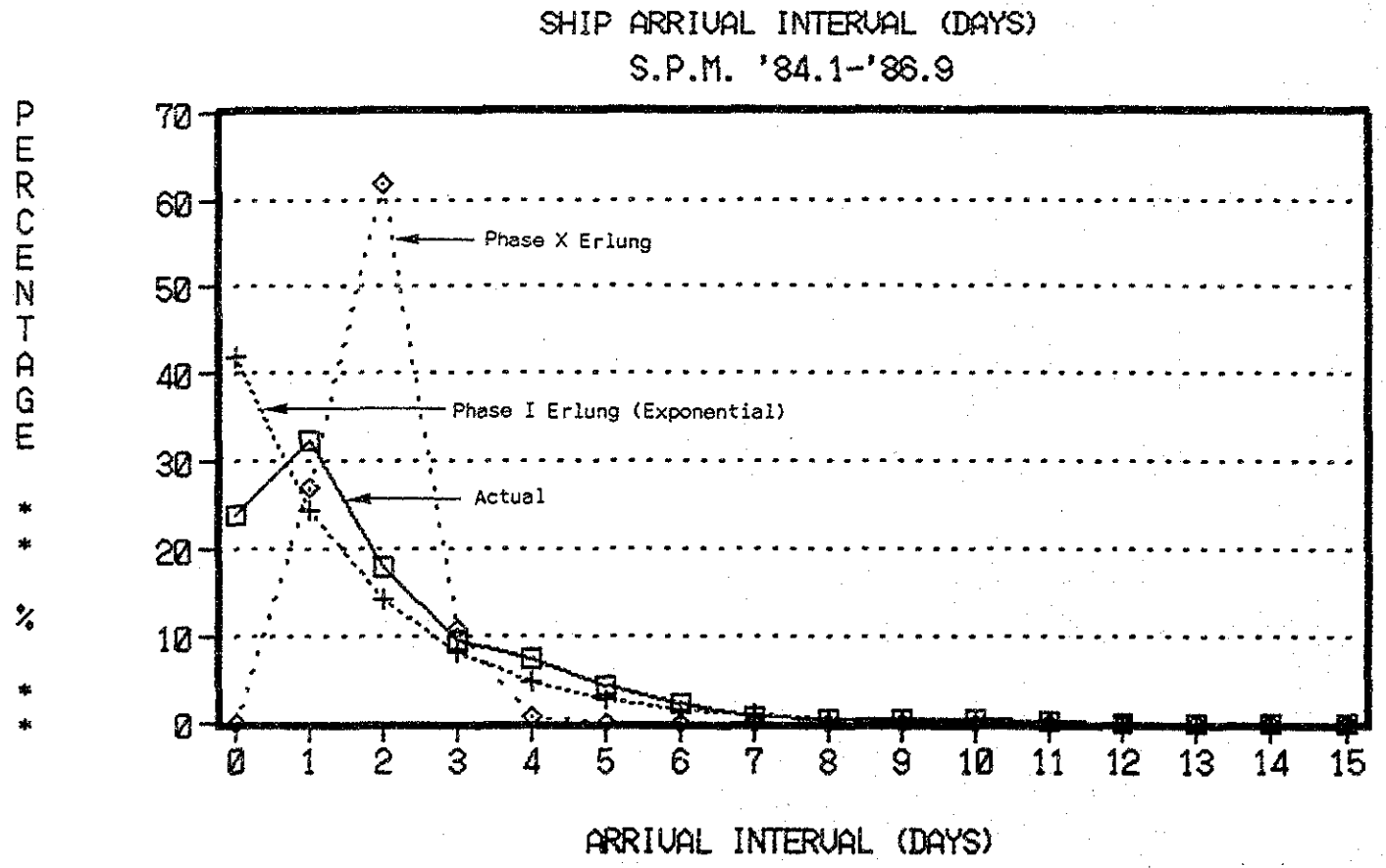
Table II.3.6 Summary of Present Shipping at SPM in 1985

		Number of Ship Calls	Share (%)	Average Ship Size (GRT)	Cargo Volume (tons/yr)	Avg. Cargo Volume per Ship (tons)	Average Mooring days
Export	Sugar	28	19.10	2,800	75,715	3,493	10.8(1)
	Fertilizer	8	5.40	850		686	4.8(2)
	Cement	88	59.90	560			6.3(3)
	Clinker	2	1.40	2,890			2.8(3)
Import	Fertilizer	14	9.50	3,510		3,640	3.1(2)
	Coal	3	2.00	12,700		13,100	3.4(3)
	Fuel Oil	4	2.70	11,200		3,928	1.3(3)
T o t a l		147	100.00				

Notes:(1) Average from Jan. 1984 to Sep. 1986, excluding extremely long mooring data.
This data is used in the simulation.

(2) Average mooring time in 1985 based on the cargo volume data.

(3) Overall average of the data from Jan. 1984 to Sep. 1986.



$$f(x) = \frac{(\nu\alpha)^{\nu} x^{\nu-1}}{(\nu-1)!} e^{-\alpha\nu x} \qquad (x \geqq 0)$$

where $f(x)$: probability
α : $1/(x_{mean})$
ν : phase of Erlang
x : arrival time interval

Fig. II.3.3 Ship Arrival Distribution at SPM

Table II.3.7 Wharf Utilization at SPM in 1985

Berth Number	Commodity	
	Export	Import
Wharf No.1	Sugar, Molasses	Fuel Oil
Wharf No.2	Ferry	Ferry
Between No.2 & No.3	Sugar, Molasses	Coal
Wharf No.3	Fertilizer	Fertilizer

Table II.3.8 Results of the Simulation for the Present Situation (1985)

Ship kind	Average ship size (GRT)	1985				
		Total waiting time (hrs)	Mooring time per ship (hrs)	Number of ship calls	Total mooring time	Total staying time
1 Sugar	2,800	710.4	259.2	28	7,257.6	7,968.0
2 Fertilizer(ex.)	850	146.2	115.2	8	921.6	1,067.8
3 Clinker	2,890	62.1	67.2	2	134.4	196.5
4 Fertilizer(im.)	3,510	216.0	74.4	14	1,041.6	1,257.6
5 Coal	12,700	191.7	81.6	3	244.8	436.5
6 Fuel oil	11,200	146.0	31.2	4	124.8	270.8
Total		1,472.4		59	9,724.8	11,197.2

ii) Results of the Simulation

The results of the simulation for 1985 are shown in Table II.3.8 and are summarized as follows:

- Total ship waiting time per year is 1,472 hours.
- The average waiting time for total arrival ships is 25.0 hours.
- The average waiting time for total waiting ships is 97.5 hours.
- The average berth occupancy ratio is 37.3 %.

2) Future Conditions (2005)

i) Simulation Conditions

The average cargo volume by commodity is estimated and the number of ship calls is calculated using the forecast cargo volume. The average mooring time of each ship is estimated considering the improved cargo handling system which is explained in Part III Chapter 3. The wharf utilization condition is estimated as shown in Table II.3.9 in accordance with multipurpose use. The ship arrivals of liner ships, free zone ro/ro and general cargo lo/lo container ships are approximated as an Erlang phase X curve as shown in Fig. III.3.2. A summary of the simulation conditions is shown in Table II.3.10. Molasses vessels are excluded from the simulation, because a molasses pipe is provided at wharf No. 1 and molasses ships are assumed to moor at the end of wharf No.1 even when the wharf is occupied by another ship of around 5,000 DWT.

The results of the simulation are shown in Table II.3.11, and are summarized as follows:

- Total ship waiting time per year is 6,988 hours.
- The average waiting time for total arrival ships is 18.2 hours.
- The average waiting time for total waiting ships is 50.3 hours.
- The average berth occupancy ratio is 59.1 %.

1.4 Breakwater

The existing breakwater length is sufficient to protect both sides of the estuary.

The result of the wave simulation is shown in Fig. II.3.4 - Fig. II.3.6 and Table II. 3.12.

Table II.3.9 Wharf Utilization Condition of the Master Plan

Wharf No.	Acceptable cargo
E-1	Thg boat, Pilot boat etc. (Official use)
E-2	Ferry boat
E-3	Container (agri.products & other general cago) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone) Passenger boat
E-4	Container (agri.products & other general cago) Loose cargo in bags (fertilizer, sugar, cement) Container (free zone)
E-5	Container (agri.products & other general cago) 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	Liquid bulk (fuel oil) Dry bulk (sugar, clinker, coal)

Table II.3.10 Ship Mooring Days by Commodity (2005)

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	103
(in bags)	15,000	600	4.0	25	100
Molasses	56,000				
Fertilizer					
(in bags)	60,000	1,000	3.6	60	216
Cement					
(in bags)	132,000	3,000	5.7	44	251
Clinker					
(in bulk)	120,000	5,000	3.0	24	72
Free Zone					
(container)	38,000	-	1.0	52 (weekly)	52
Ag. Products					
(container)	66,000	-	2.0	52 (weekly)	104
Other G. Cargo					
(container)	71,000				
Passenger Boat		(1,000/max) (persons/day)	0.5	52	26
- Import -					
Fertilizer					
(in bulk)	200,000	6,000	3.1	33	102
Coal					
(in bulk)	150,000	15,000	3.0	10	30
Fuel Oil	157,000	15,000	1.0	10	10
Free Zone					
(container)	36,000	-	*	*	*
Other G. Cargo					
(container)	79,000	-	*	*	*
Total	1,316,000				1,066

* : included in - Export -

Table II.3.11 Results of the Simulation for the Master Plan

Ship kind	Average ship size (GRT)	2005				
		Total waiting time(hrs)	Mooring time per ship(hrs)	Number of ship calls	Total mooring time	Total staying time
1-1 Agr. & Gen. Cargo	8,000	297.3	48.0	52	2,496.0	2,793.3
2-1 Fertil. (bag)	1,000	438.5	86.4	60	5,184.0	5,622.5
2-2 Sugar (bag)	700	153.2	96.0	25	2,400.0	2,553.2
2-3 Cement (bag)	3,000	328.8	136.8	44	6,019.2	6,348.0
3-1 Free zone (cont.)	3,000	367.5	24.0	52	1,248.0	1,615.5
4-1 Sugar (dry bulk)	7,000	1,233.3	129.6	19	2,462.4	3,695.7
4-2 Clinker (dry bulk)	5,000	1,498.9	72.0	24	1,728.0	3,226.9
4-3 Coal (dry bulk)	13,000	669.4	72.0	10	720.0	1,389.4
5-1 Fertil. (dry bulk)	7,000	465.3	74.4	33	2,455.2	2,920.5
6-1 Fuel oil (liq bulk)	13,000	374.8	24.0	10	240.0	614.8
7-1 Passenger	20,000	1,160.9	12.0	52	624.0	1,784.9
T o t a l		6,987.9		381	25,576.8	32,564.7

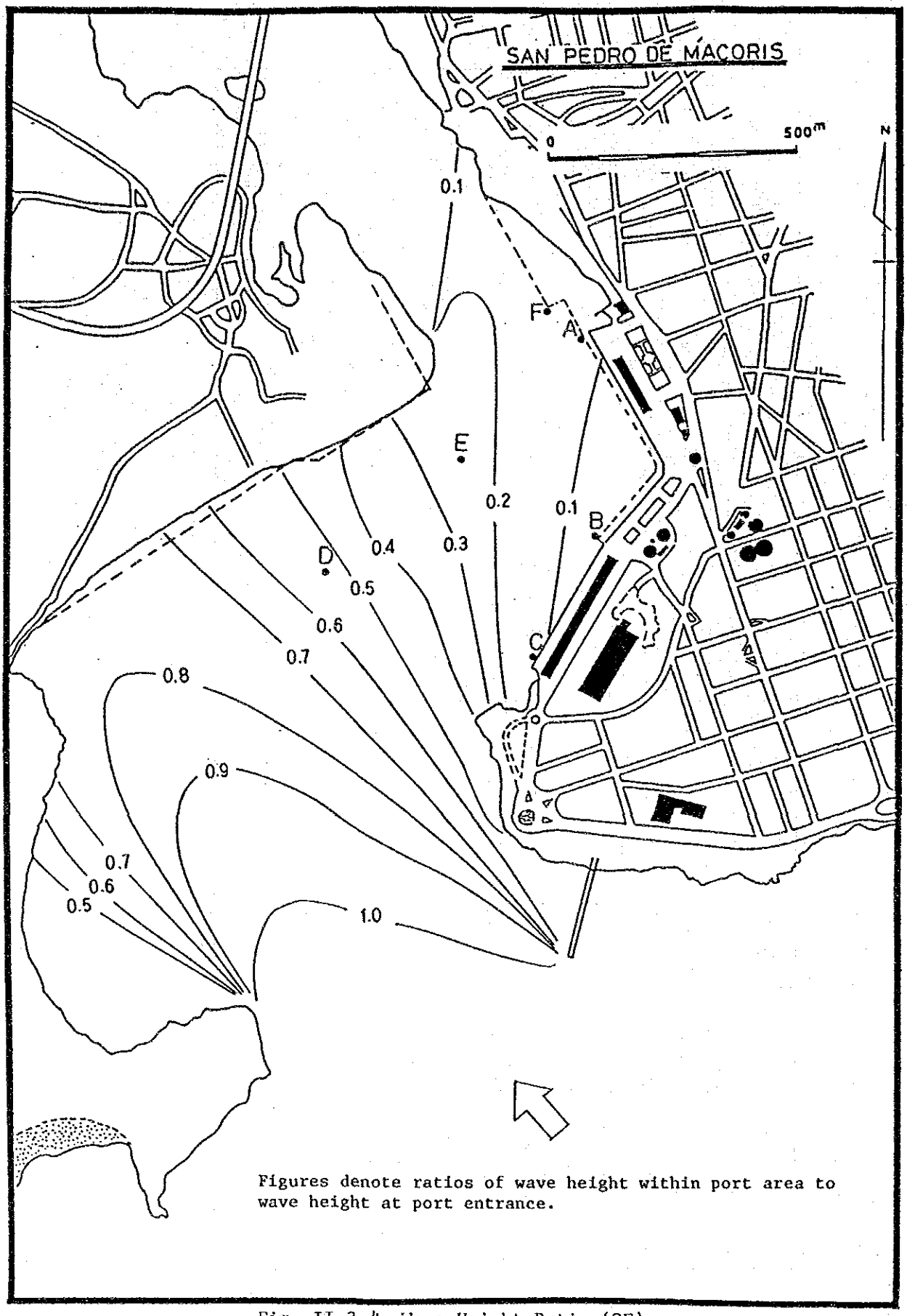


Fig. II.3.4 Wave Height Ratio (SE)

Fig. II.3.5 Wave Height Ratio (S)

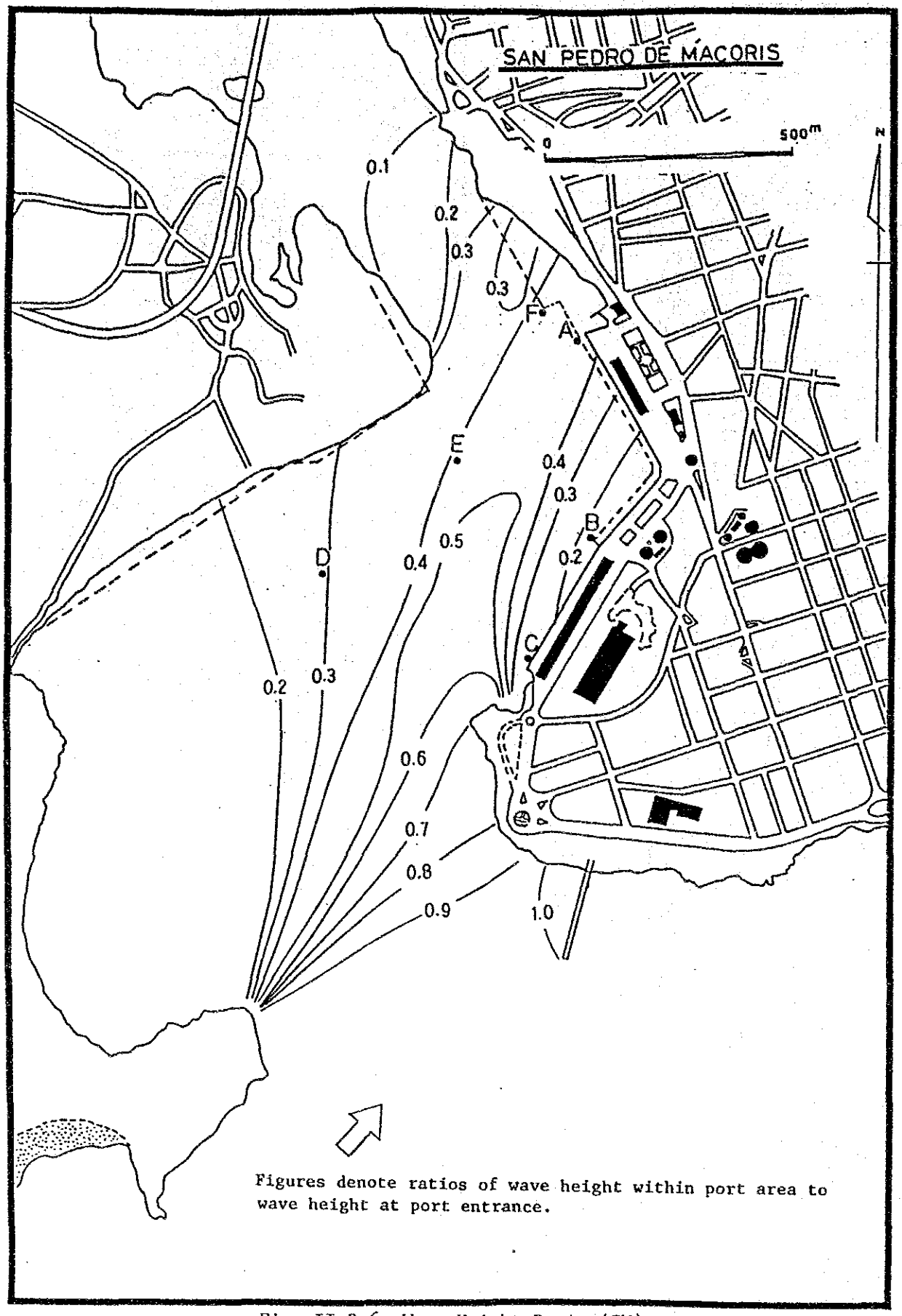


Fig. II.3.6 Wave Height Ratio (SW)

Table II.3.12 Berth Availability (%)

Limit of Wave Height / Point	0.30 m	0.50m	0.70m
A	94.9	98.9	99.5
B	99.4	100.0	100.0
C	99.4	100.0	100.0
D	79.4	91.2	96.1
E	88.5	96.9	99.0
F	94.9	98.9	99.5
G	77.7	89.3	95.6

1.5 Container Yard

(1) Type of Containers and FCL/LCL

Containers will be handled by both ro/ro and lo/lo systems. Containers to and from the industrial free zone are assumed to be ro/ro cargo, because at the industrial free zone each company has a container chassis system and transports containers to and from the port on chassis, and this system will not be changed in 2005. These containers are FCL cargo.

Agricultural products and general cargo are containerized and their containerized ratio is estimated as 80% in 1995 and 90% in 2005 as explained in Chapter 2. They are handled by forklifts and are assumed to be handled using a lo/lo system. Agricultural products are assumed to be FCL cargo. They are packed and containerized at the inland agricultural terminal. General cargo is assumed to be LCL cargo. It is transported to and from the Port through the container freight station.

(2) Required Area

Two weekly liner container services are estimated in 2005. One is for the industrial free zone and the other is for agricultural and other general cargo.

Considering that free zone containers will be moved on chassis and general cargo containers by forklift, it is best to estimate the area of the container yard independently.

1) Free Zone Cargo (FCL cargo)

The cargo volume in 1995 and 2005 is estimated as follows:

Year	1995	2005
Export	3,700	5,900 TEU (Loaded)
Import	3,300	5,400 TEU (Loaded)
	400	500 TEU (Empty)
Total	7,400	11,800 TEU

The average cargo volume per ship is calculated as follows:

$$N = \alpha \times v / n$$

where, N : Cargo volume per ship (TEU/ship)
α : Coefficient of concentration (1.2)
v : Cargo volume per year (TEU)
n : Number of ship calls per year (52)

Accordingly,

	1995	2005
N:	171	272

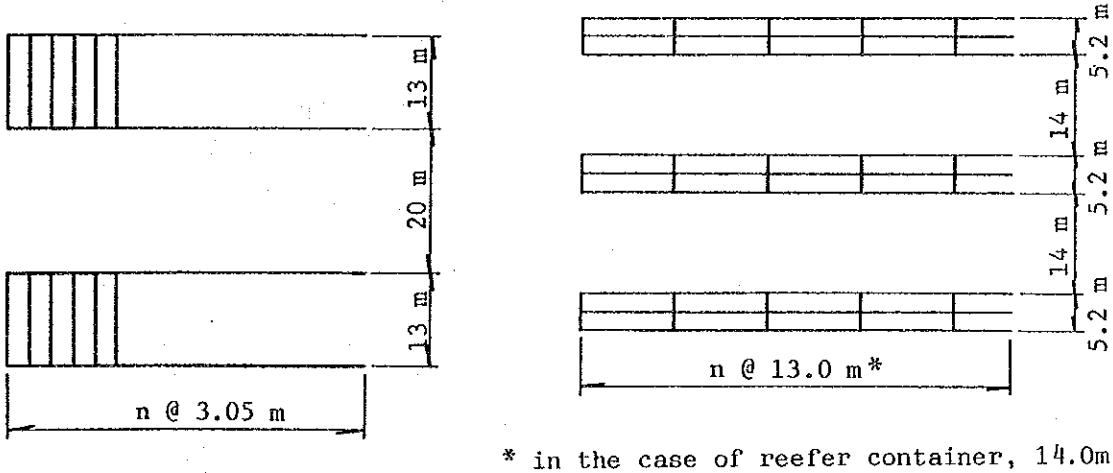
Assuming the storage as shown in Fig. II.3.6, the required area for one container (40') is 3.05 x (13 + 20 x 1/2) = 70.15 m².

Assuming that all containers will be 40' and considering that one 40' container is 2 TEU, the required area for the free zone containers is as follows:

$$A = 70.15 \times N \times 1/2$$

Accordingly,

	1995	2005
A:	5,998	9,540
	→ 6,000m²	→ 9,500m²



Chassis System

* in the case of reefer container, 14.0m

Forklift System

Fig. II.3.7 Assumed Storage Area

2) Agricultural Products and Other General Cargo

The cargo volume in 1995 and 2005 is estimated as follows:

Year	1995	2005
Export	7,100	12,300 TEU (Loaded)
Import	5,500	7,100 TEU (Loaded)
	1,600	5,200 TEU (Empty)
Total	14,200	24,600 TEU

The required area is calculated for reefer and other containers separately.

i) Reefer containers are for the following products:

	1995	2005
. Juice	4,600tons	9,200tons
. Oranges	3,100	6,200
. Processed citrus	1,400	2,800
. Beef	1,000	1,100
Total	10,100	19,300
Share of Reefers	8.0%	9.9%

The number of reefer containers per ship is calculated as follows:

$$NR = \alpha \times V_L \times r/n$$

where, NR : Volume of reefer containers per ship (TEU/ship)
α : Peak value (1.2)
V_L : Volume of loaded containers per year (TEU)
r : Share of reefers
n : Number of ship calls (52)

Accordingly,

	1995	2005
NR	23.3 TEU	44.3 TEU

Assuming that all containers are 40', the number of units is

	1995	2005
NR	12 units	22 units

The required area for reefers is estimated as follows assuming stacking two high.

The required area for one reefer (40') is 14.0m x (2.6m + 14.0m x 1/2) x 1/2 = 67.2m

	in 1995	in 2005
AR	67.2 x 12	67.2 x 22
	= 806	= 1,478
	⟶ 800 m²	⟶ 1,500 m²

ii) Others

The volume of containers per ship is calculated as follows:

$No = \alpha \times V/n - NR$

where, No : Volume of other containers per ship (TEU/ship)
α : Peak value (1.2)
V : Volume of containers per year (TEU)
n : Number of ship calls (52)
NR : Volume of reefer containers per ship (TEU/ship)

The required area for one container (40') is 13.0m x (2.6m + 14.0m x 1/2) x 1/2 = 62.4

	1995	2005
No	1.2 x 14,200/52 - 23	1.2 x 24,600/52 - 44
	= 304.6 TEU	= 523.7 TEU
	= 152 units	= 262 units
Ao	62.4 x 152	62.4 x 262
	= 9,484.8 m²	= 16,348.8 m²
	⟶ 9,500 m²	⟶ 16,300 m²

The summary of the required container yard is shown in Table II.3.13.

Table II.3.13 Summary of the Required Container Yard

	1995	2005
. Free zone containers (chassis)	6,000 m²	9,500 m²
. Agricultural products and other general cargo (forklift)	10,300 m²	17,800 m²
- Reefer	(800 m²)	(1,500 m²)
- Other than reefer	(9,500 m²)	(16,300 m²)
T o t a l	16,300 m²	27,300 m²

1.6 Other Facilities

(1) Coal Stock Yard

Under the Master Plan, coal will be handled on the west bank side of the Higuamo river.

The forecast annual cargo volume is 150,000 tons, and the cargo volume per ship is estimated as 15,000 tons. The rotation rate of coal per year may be larger then 12. Then the required area per ship is calculated as follows:

$A = N/w$

where, A : Required area for the coal (m^2)
N : Cargo volume (15,000 tons)
w : Unit capacity (2 tons/m^2)

Accordingly, $A = 15,000/2 = 7,500\ m^2$

(2) Clinker

Under the Master Plan, clinker will also be handled on the west bank side of the Higuamo river. The annual cargo volume is 120,000 tons. The cargo volume per ship is estimated as 5,000 tons. Clinker can not remain for a long time in an open storage area because it must be kept dry.

So, the required area per ship is estimated as follows.

$A = N/W$

where, A : The required area for clinker (m^2)
N : Cargo volume (5,000 tons)
W : Unit capacity (2 tons/m^2)

Accordingly, $A = 5,000/2 = 2,500\ m^2$

(3) Transit Shed

The cargoes which will pass through the transit shed are assumed to be cement (in bags) and other general cargo.

Sugar will be transported directly from the sugar mill factory to the wharf and then loaded on to the ship without any delay, and fertilizer will

be stored at the factory. The required area of the transit shed is calculated as follows:

1) Cement

The required area is estimated as follows:

$A = N/R\,\alpha\,W$

where, A : The required area of the transit shed (m^2)
N : Cargo volume per year (tons/year)
R : Rotation rate of cargo per year (equal to the number of ship calls)
α : Coefficient of shed utilization (0.7)
W : Average storage capacity (3.5 tons/m^2)

Accordingly,

	in 1995	in 2005
A	1,224 m^2	1,224 m^2

2) Other General Cargo

Other general cargo (non-containerized cargo) will pass through the transit shed. The required area is estimated as follows:

$A = N/R\,\alpha\,W$

where, A : The required area for other general cargo (m^2)
N : Cargo volume per year (tons/year)

	1995	2005
Non-contanerized ratio	20 %	10 %
Cargo volume	31,600 tons	21,600 tons

R : Rotation rate of cargo per year (25 times/year)
α : Coefficient of shed utilization (0.7)
W : Average storage capacity (2 tons/m^2)

Accordingly,

	in 1995	in 2005
A	903 m^2	617 m^2

Then, the total required area of the transit shed is estimated as follows:

1995	2005
2,127 m²	1,841 m²

(4) Container Freight Station (CFS)

LCL (less than container load) cargo cannot be transported directly. LCL cargo will pass through the CFS to be packed and unpacked. LCL cargo is estimated as other general cargo. The cargo volume of LCL is estimated as follows:

	1995	2005
Export	4,100 TEU	6,400 TEU
Import	5,500 TEU	7,100 TEU
Total	9,600 TEU	13,500 TEU

The required number of bays for the CFS is estimated as follows:

$$B = \frac{a \times N}{n \times d \times c}$$

where, B : Required number of bays
a : Peak value (1.2)
n : Number of ship calls (52 calls/year)
N : Cargo Volume per year (tons/year)
d : Working days per week (6 days/week)
C : Capacity of each bay per day (3 TEU/day)

Accordingly,

	1995	2005
B	12.3	17.3

Assuming that the necessary width is 7.5m/2 bays, the length of the CFS is as follows,

L = (7.5/2 x B)/ 2

Accordingly L is estimated as follows:

	1995	2005
L	50 m	70 m

The width of the CFS is estimated as 30m. Thus, the required area for the CFS is estimated as follows:

	1995	2005
Area of the CFS	50m x 30m = 1,500m²	70m x 30m = 2,100m²

(5) Ferry Terminal Building

The ferry terminal building for passengers, customs, immigration and quarantine is proposed to be 2 stories high with a base area of 20m x 40m. The total floor area is 20 x 40 x 2 = 1,600 m².

(6) Port Administration Facilities

1) Required area for the port administration offices

The required offices and areas are estimated as follows:

APD	500 m²
Customs	500 m²
Pilot	50 m²
Tug Boat	50 m²
Others	100 m²
Total	1,200 m²

The building is assumed to be two stories high and the base area is 1200/2 = 600 m².

2) Parking Lot

The parking lot for the port administration office should accommodate 60 vehicles, and the required area is 25m²/unit x 60 units = 1,500m².

3) Port Commander's Office

In the year 2005, the port commander's office will move to next to the port administration office.

The required area is estimated as the same as the present area, 1,700m².

The existing area will be used for the entrance gate office area, the port worker's welfare facilities and a reserved area for future development. This area is classified as a green area in the Master Plan.

4) Total Area

The total area for the port administration facilities is 3,800 m².

(7) Maintenance Shop

The size of the maintenance shop is proposed as follows:

-Building 20m x 40m = 800m²

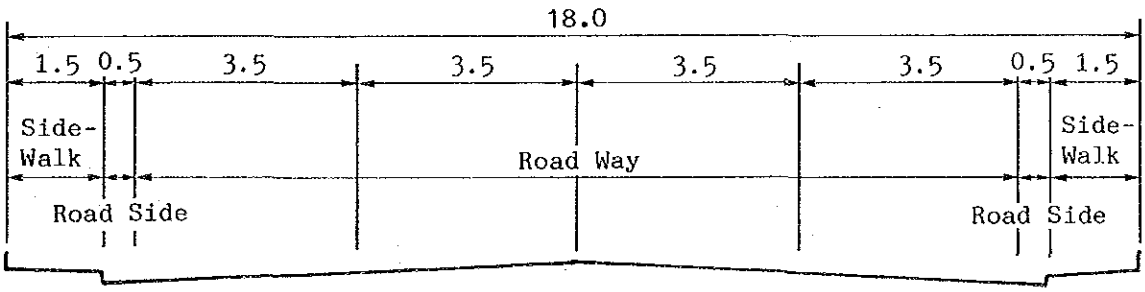
-Area 35m x 50m = 1,750m²

(8) Fuel Oil Tank

The required capacity of the fuel tank is estimated as 50,000kl, and two units of 25,000kl tanks are recommended. The dimensions of the tanks are 40m (dia) x 22m (high). The required area for the oil tanks is estimated as 26,400m².

(9) Roads

Roads are one of the most important facilities of the port. In view of the expected growth in the cargo volume, the standard section of the roads is proposed as shown in Fig. II.3.7.



Road Way 3.5 x 4 = 14.0m
Side-Walk 1.5 x 2 = 3.0m
Road Side 0.5 x 2 = 1.0m

Fig. II.3.8 Standard Section of the Road

1.7 Proposed Principal Port Facilities for the Master Plan

The proposed principal port facilities for the Master Plan are summarized as shown in Table II.3.10.

Table II. 3.14 Proposed Port Facilities for The Master 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
		" (W-1)	L = 210m Depth = -11.0m
iv)	Storage facilities	(a) Container yard (Chassis)	9,500m²
		" (Forklift)	16,300m²
		" (Reefer)	1,500m²
		(b) CFS	70m x 30m = 2,100m²
		(c) Transit shed	1,840m²
		(d) Open yard (coal)	7,500m²
		(e) Fuel oil tanks	50,000 kl (26,400m³)
v)	Ferry terminal	(a) Terminal building	20m x 40m x 2 stories = 1,600m²
		(b) Parking area	16,800m²
vi)	Port administration facilities	(a) Administration office (Building)	600m²
		(Parking)	1,500m²
		(b) Commander's office	1,700m²
vii)	Maintenance shop	Maintenance shop (Building)	800m²
		(Area)	1,750m²
viii)	Road		
ix)	Green area		

2. Evaluation of the Existing Port Facilities

As already explained in Part I Chapter 3 Section 4, "Results of the investigation," the deterioration of the concrete decks and sub-beams of the wharfs is remarkable.

The major reasons for this severe damage are as follows:

i) Surcharge over the design load
ii) Deterioration of concrete/steel

This wharf was not originally designed for a mechanized cargo handling system using heavy trucks and mobile cranes.

Only the railway transportation system and ship gear were considered in the original design.

In the Master Plan a mechanized cargo handling system is introduced, and the wharf decks and sub-beams must be improved to meet the requirements under the Master Plan.

If the present wharfs were to be utilized under the Master Plan, they would have to be completely remodeled to assure a sufficient bearing capacity. This would involve:

i) Removal of all concrete decks,
ii) Removal of all concrete sub-beams, and
iii) Connection of the sub-beams with the main beams.
The connection work could be difficult depending on the condition of the steel reinforcing bars, and removal of the concrete mainbeams would likely be necessary. The work would also require:
iv) Construction of the sub-beams, and
v) Construction of the concrete decks

Even if this large-scale reconstruction work were to be carried out, additional settlement of the piles would still be likely due to the additional surcharge of the superstructure, even if the bearing capacity of the piles were sufficient.

If the bearing capacity of the concrete piles were insufficient, additional piling would be necessary. Additional piling would be difficult considering the soft subsoil condition at the port, where pile resistance

is by surface friction. The surface friction conditions of the new piles and the old piles would be different.

Furthermore, the existing wharfs are insufficient in terms of water depth, and this problem would remain even if the wharfs were reconstructed. Thus, to meet the requirements of the Master Plan, completely new wharfs with sufficient water depth must be constructed, and all of the existing wharfs should be retired.

3. Port Layout and Land Use

Based on the basic concept and the facilities requirements estimated in Sections 1 and 2 of this chapter, the proposed Master Plan is shown in Fig. II.3.8.

3.1 Layout of Port Facilities for the Master Plan

The land use and layout of port facilities for the Master Plan are shown in Fig.II.3.9.

The Port will be divided into two areas, the east side and the west side.

The west side is planned as an industrial area where CDE's power plant, a shipyard and wharfs for industrial materials will located.

The east side is for the general cargo, containers, ferries and passengers.

A total of seven wharfs are proposed under the Master Plan, as follows.

1 ferry wharf (-7.5m)
1 shallow multipurpose wharf (-7.5m)
4 deeper multipurpose wharfs (-11.0m)
1 official use berth (-5.0m)

The face line of the east wharfs is planned to be shifted about 20 m into the river to create an additional land area. The face line of Wharfs E-4 to E-6 is set to be straight to accommodate ships of various sizes.

CDE's 60,000 kw electric floating power plants will be located at the west bank side below the first bridge in accordance with CDE's plan. The existing power plant "Weber" will be moved to the proposed site from the existing wharf No.1 by 1995.

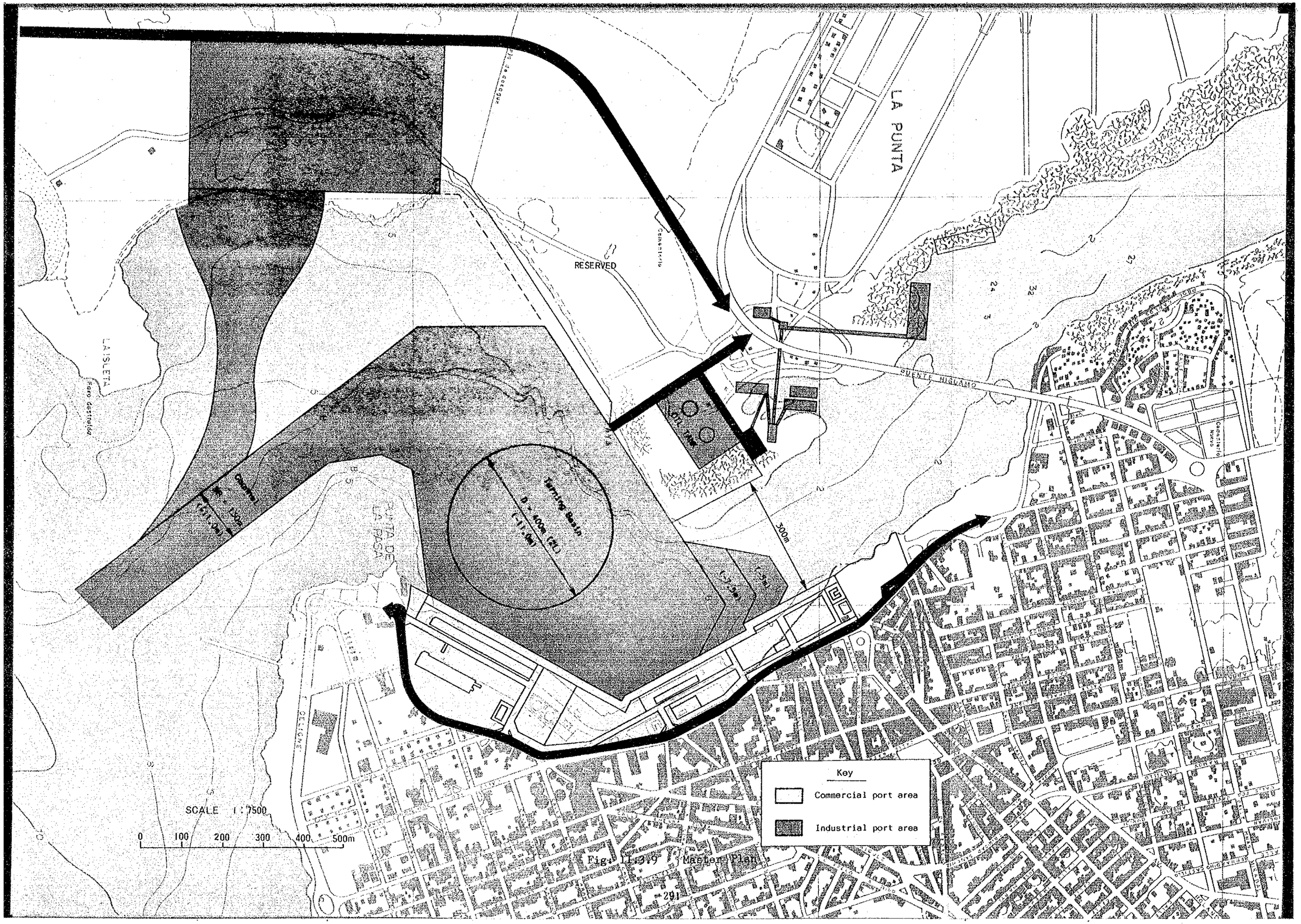


Fig. II.39 Master Plan

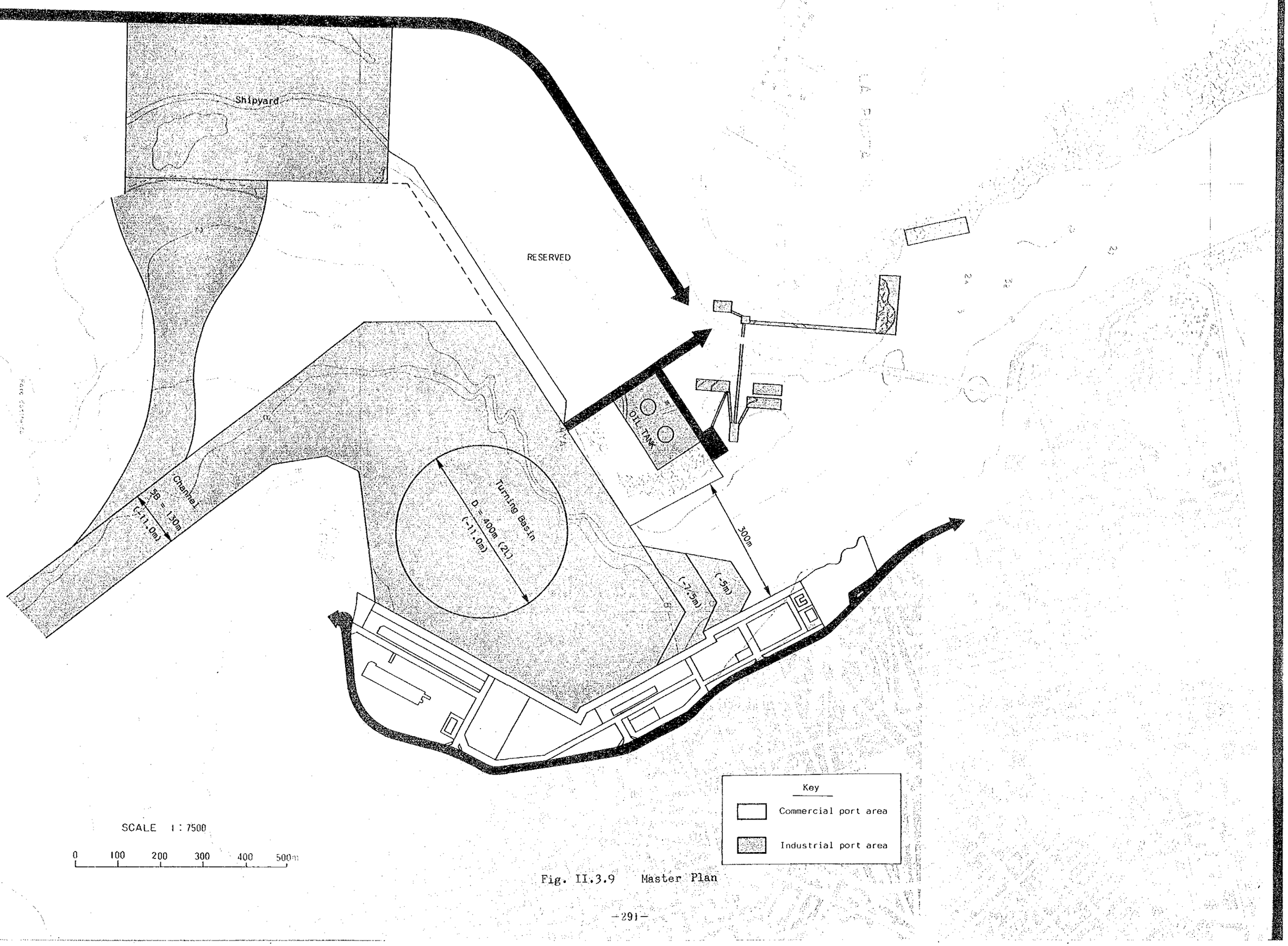


Fig. II.3.9 Master Plan

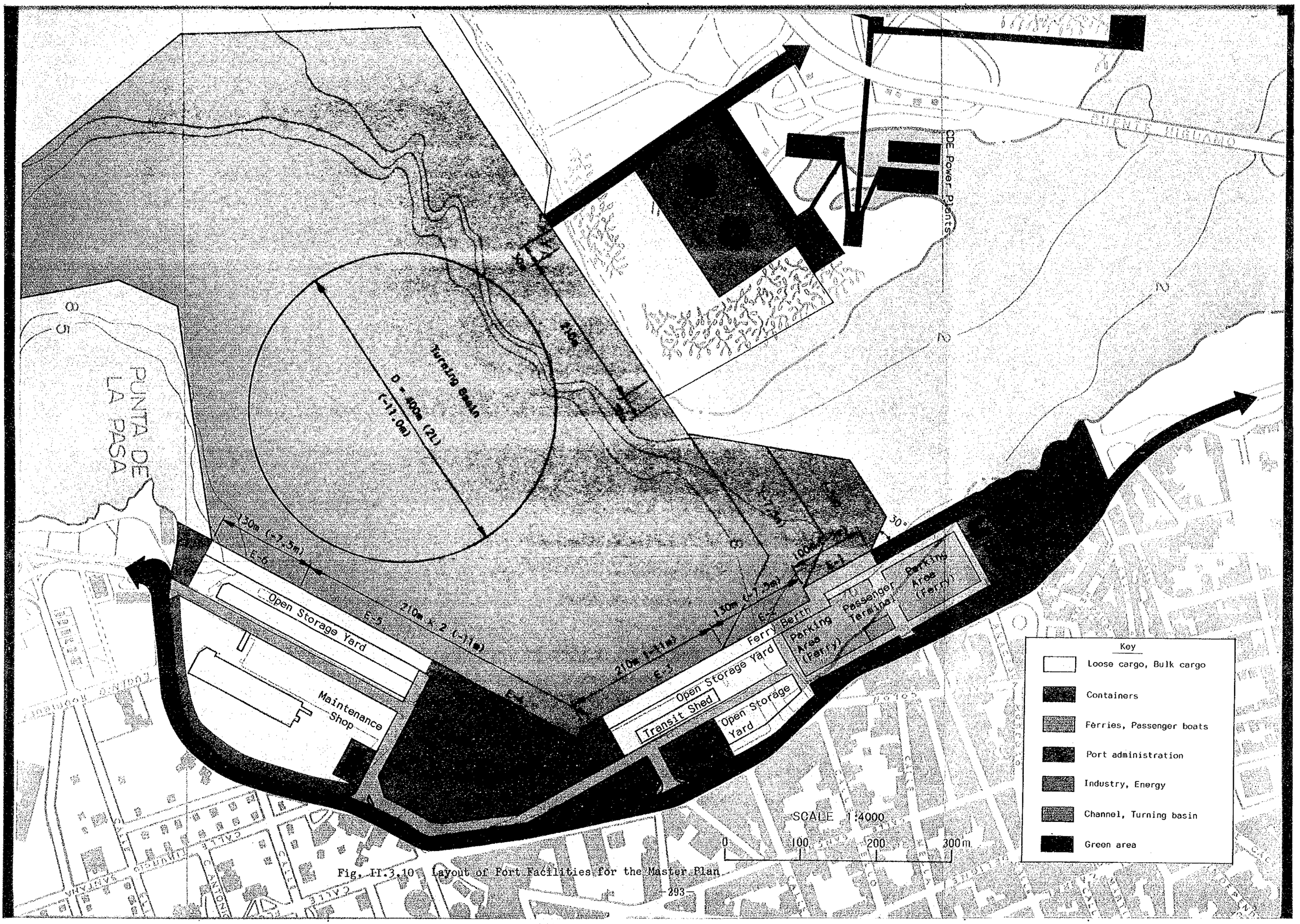


Fig. II.3.10 Layout of Port Facilities for the Master Plan

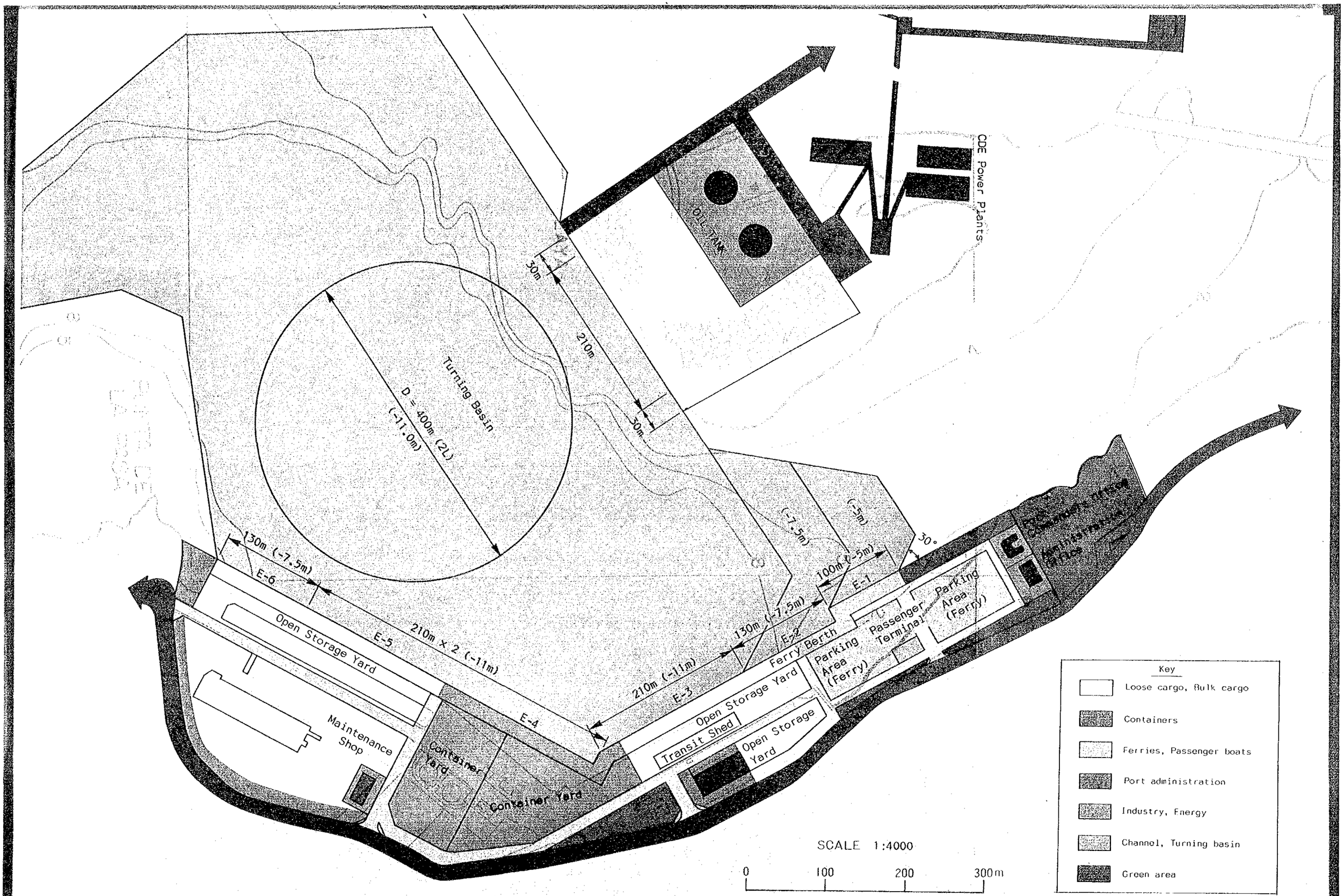
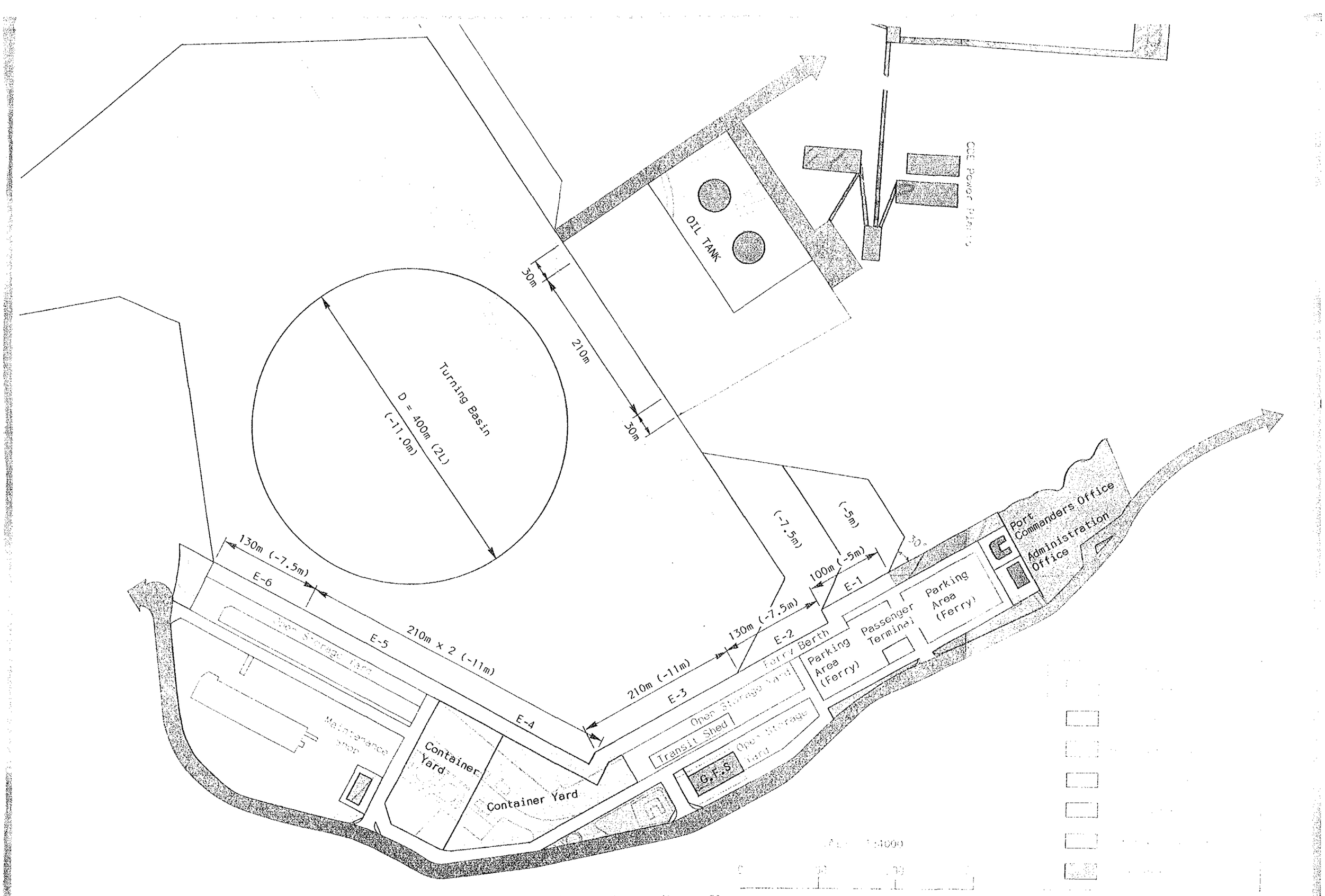


Fig. II.3.10 Layout of Port Facilities for the Master Plan



Layout of Port Facilities for the Master Plan

CHAPTER 4 STRUCTURAL DESIGN AND COST ESTIMATE

1. Structural Design

In this section the structural types of the project components proposed in the Master Plan are described. The project components of the Master Plan and their costs are tabulated in Table II.4.1.

Most of the project components shown in the table are planned to be constructed under the Short-term Development Plan, and their designs and costs are discussed in Part III. The following major port facilities are planned to be constructed newly under the Master Plan in 2005.

Facilities to be constructed newly under the Master Plan

Wharf W-1	210 m
Pavement	43,640 m²
- backup area of Wharf	33,000 m²
- container yard expansion	4,790 m²
- access road	5,850 m²
Oil Storage Tank (25,000 kl)	2 Nos
Connecting Pipeline (600 mm dia.)	200 m
CFS Expansion	600 m²
Port Commander's Office (removal/reconstruction)	380 m²
Cargo Handling Equipment	6 Nos
Truck Scale (removal/reconstruction)	1 No
Removal of Molasses Tanks	3 Nos

Wharf W-1 is 210 m long and its cross section is shown in Fig. II.4.1. The other port facilities planned under the Short-term Development Plan are detailed in Part III Chapter 4.

Wharf W-1 will be of the same structural type as the wharfs planned on the east river bank, namely an open type steel pile wharf.

The backup area of Wharf W-1 will be paved together with the 833 m long access road.

Table II.4.1 Project Cost of the Master Plan

(1,000RD$)

Project Items	Unit	Qnty	Unit Cost	Foreign Total	Local Total	Grand Total	Remarks
Wharf Construction				56867.6	31178.1	88045.7	
Wharf E-1 (-5)	m	100.0	41.22	2238.5	1883.7	4122.2	on east bank
" E-2 (-7.5)	m	130.0	56.27	4254.1	3060.5	7314.6	
" E-3 (-11)	m	210.0	68.27	8904.8	5432.4	14337.2	
" E-4 (-11)	m	210.0	100.61	13702.4	7426.5	21128.9	
" E-5 (-11)	m	210.0	86.07	12819.0	5255.6	18074.6	
" E-6 (-7.5)	m	130.0	67.47	5665.7	3106.0	8771.7	
" W-1 (-11)	m	210.0	68.08	9283.1	5013.4	14296.5	on west bank
Pavement				5966.0	9458.9	15424.9	
Heavy Duty	m^2	63620.0	.122	3031.9	4729.7	7761.6	Cont. Yard, etc.
Light Duty	m^2	77040.0	.098	2890.2	4659.7	7549.9	Open Storage, etc.
Concrete	m^2	950.0	.119	43.9	69.5	113.4	Maint. Shop Area
Breakwater Repair	m	51.0	41.81	1120.2	1012.4	2132.6	
Channel Buoy	Nos	5.0	78.14	371.2	19.5	390.7	
Office & Building				11753.7	4228.0	15981.7	
Administ'n Office	m^2	1200.0	2.44	2151.9	778.3	2930.2	2 stories
Port C. Office	m^2	380.0	2.44	681.4	246.5	927.9	
Passenger Terminal	m^2	1600.0	1.71	2008.4	726.4	2734.8	2 stories
CFS	m^2	2100.0	1.95	3012.6	1089.7	4102.3	
Maintenance Shop	m^2	800.0	1.71	1075.2	365.5	1440.7	
Transit Shed	m^2	2250.0	1.71	2824.3	1021.6	3845.9	
Cargo H. Equipment				10745.9	772.6	11518.5	
Sugar Container	Nos	60.0	19.08	572.3	572.3	1144.6	
Pallet	Nos	3300.0	.114	188.9	188.9	377.7	
Forklift (2.5t, B)	Nos	6.0	50.55	303.3	.0	303.3	
" (2.5t, B)	Nos	5.0	83.17	415.9	.0	415.9	for CFS use
" (30t, E)	Nos	2.0	820.30	1640.6	.0	1640.6	for yard use
Mobile Crane (100t)	Nos	2.0	2460.89	4921.8	.0	4921.8	
Tractor	Nos	9.0	162.15	1459.4	.0	1459.4	
Chassis	Nos	22.0	36.25	797.4	.0	797.4	
Truck (10t)	Nos	2.0	133.54	267.1	.0	267.1	
Truck Scale	No	1.0	190.77	179.3	11.4	190.8	
Oil Tank	Pcs	2.0	12438.2	16280.6	8595.8	24876.4	on west bank
Harbor Craft				5055.3	.0	5055.3	
Tug Boat (1500ps)	Nos	1.0	3605.49	3605.5	.0	3605.5	
" (500ps)	Nos	1.0	1354.44	1354.4	.0	1354.4	
Pilot Boat	No	1.0	95.38	95.4	.0	95.4	
Others	L/S	1.0	-	873.6	504.6	1378.2	drainage, etc
Mobilization/Demob.	L/S	1.0	-	7062.8	.0	7062.8	
Engineering Services			-	3643.6	1888.6	5532.2	
Detailed Design	L/S	1.0	-	1840.9	1116.0	2956.9	
Const. Supervision	L/S	1.0	-	1802.7	772.6	2575.4	
Physical Contingency	L/S	1.0	-	13658.3	8071.7	21730.0	0 - 15 %
Total				133398.8	65730.2	199129.0	

(Unit:m)

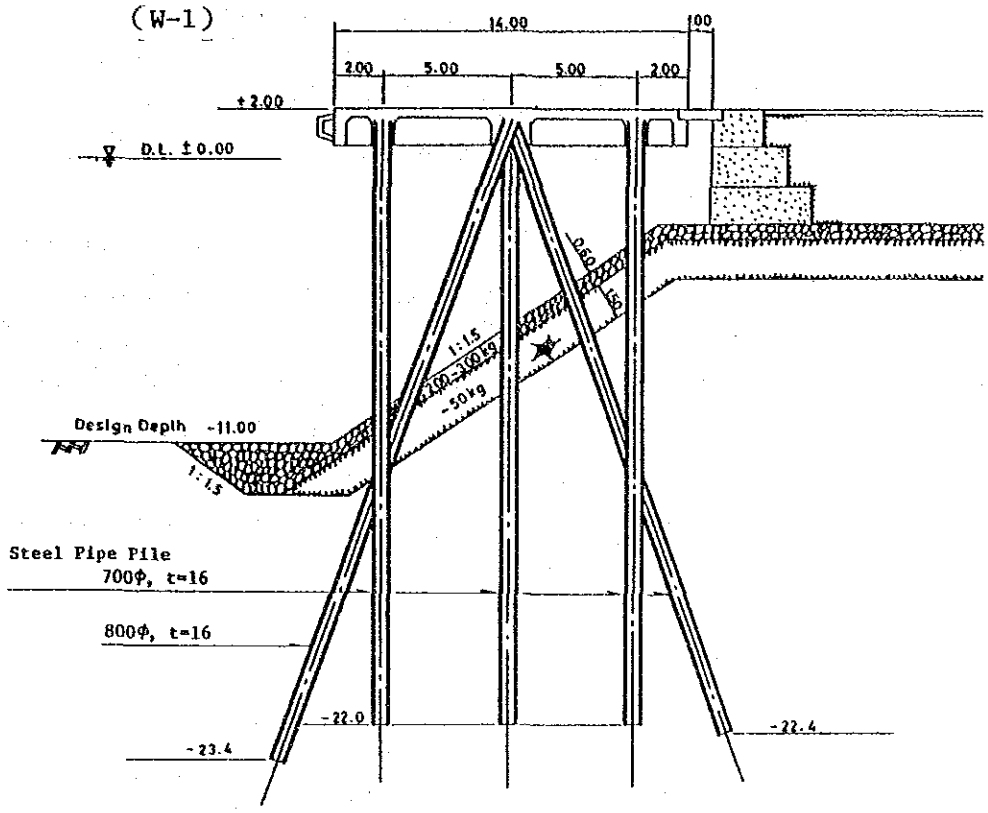


Fig. II.4.1 Standard Cross Section of Wharf

Two oil storage tanks with a storage capacity of 25,000 kl (22 m high, 40 m dia.) each will be installed in the innermost area at the back of Wharf W-1 and will be connected to the wharf front with a 200 m long pipeline 600 mm in diameter.

The three existing molasses tanks will be removed to streamline the port traffic. One is in the mid-lane of Av. Francisco Dominguez Charro and will be removed for providing smooth access to the container yard. The other two are in the center of the container yard planned under the Short-term Development Plan and will be removed to provide an integrated container yard.

At the same time, the existing truck scale adjacent to the above molasses tanks will be removed for the same purpose and reconstructed near the yard entrance.

The land area of 4,790 m^2 occupied by the existing molasses tanks and the truck scale will be paved after removal and used as a container yard integrated with the yard to be paved under the Short-term Development Plan.

To handle increasing container cargo, the floor area of the CFS will be ectended from 1,500 m^2 to 2,100 m^2 and one forklift and five chassis will be added.

The existing port commander's office will be demolished and rebuilt in the area adjacent to the administration office.

2. Cost Estimate

The total project cost of the Master Plan is estimated at about 199 million RD$ broken down into the foreign caurrency component of 133 million the local currency component of 66 million RD$.

The detailed construction cost of each project component is shown in Table II.4.1.

The project cost of the Master Plan is summarized below.

Wharf Construction	88 million RD$	44 %
Pavement	15	8
Offices and Buildings	16	8
Cargo Handling Equipment	12	6
Oil Storage Tank	25	13
Breakwater Repair	2	1
Harbor Craft	5	2
Others	2	1
Mobilization/Demobilization	7	3
Engineering Service	5	3
Physical Contingency	22	11
Total	199 million RD$	100 %

The construction cost of the project components to be constructed newly in the Master Plan in 2005 totals about 54 million RD$ broken down as follows:

Wharf W-1	14 million RD$
Pavement	5
Oil Storage Tank (25,000 kl)	25
Port Commander's Office (removal/reconstruction)	1
Others	9
Total	54 million RD$

PART III SHORT-TERM DEVELOPMENT PLAN

CHAPTER 1 BASIC CONCEPTS OF THE SHORT-TERM DEVELOPMENT PLAN

1. Basic Concepts

The Short-term Development Plan of the port of San Pedro de Macoris is a short-term plan for the development of the Port up until 1995. The Short-term Development Plan is formulated to meet the requirements of the Port in that year.

The overall development course and policy are determined in the Master Plan, and the Short-term Development Plan is formulated in accordance with the long-term development.

The purposes of Part III of this report are:

(1) To prepare alternative options for the Short-term Development Plan, and
(2) To select the best alternative plan

The basic concepts of the Short-term Development Plan are as follows:

(1) To improve the cargo handling system.
(2) To cope with containerization.
(3) To have continuity with the Master Plan.
(4) To be based on the evaluation of the existing facilities.
(5) To be designed and executed in such a way that the disturbnace of regular port activities by the construction works shall be minimized.

2. Goals of the Short-term Development Plan

The major goal of the Short-term Developmnet Plan is to improve the port facilities to meet the requirements of the Port in 1995.

The main problem at present is that the port facilities are insufficient and superannuated.

So, the goals of the Short-term Development Plan are set as follows:

(1) To evaluate the existing port facilities, improve the existing facilities and construct new facilities as necessary.

(2) To improve the wharf facilities to handle all types of cargoes including ro/ro and lo/lo containers.

(3) To increase the cargo handling productivity by introducing a mechanized cargo handling system

(4) To improve the entrance channel and the turning basins for safe ship navigation.

CHAPTER 2 PORT TRAFFIC FOR THE SHORT-TERM DEVELOPMENT PLAN

1. Port Traffic in 1995

Future cargo and port traffic at the Port of San Pedro de Macoris are estimated in Part II Chapter 2. Table III.2.1 shows the estimation results for 1995.

Table III.2.1 Summary of Estimated Port Traffic at the Port of San Pedro de Macoris in 1995.

(Unit: 1,000 tons, TEU)

		Cargo Volume	TEU
Export	Sugar	151	
	Molasses	56	
	Fertilizer	39	
	Cement	99	
	Clinker	90	
	Cargo of the F.Z.	24	3,700
	Agricultural products *,**	38	3,000
	Miscellaneous general cargo **	51	4,100
	Total Export Cargo	548	10,800
Import	Raw materials for fertilizer	130	
	Coal	113	
	Fuel oil	120	
	Cargo of the F.Z.	22	3,300
	Miscellaneous general cargo **	69	5,500
	Total Import Cargo	454	8,800
T o t a l		1,002	19,600
Regular ferry service		5 times a week	
Regular passenger boats		twice a month	

Remarks: *) Containerized ratio of exported agricultural products is presumed to be 80%, the same as that of miscellaneous general cargo.

**) The number of containers is estimated assuming that the unit load is 10 tons per TEU.

2. Calling Ships in 1995

As mentioned in Part II Chapter 2, it is considered appropriate to presume that the maximum average size of vessels which will call at the port of San Pedro de Macoris in the future will be 20,000 DWT for cargo ships and 20,000 GRT for passenger boats. Table III.2.2 shows the estimated average ship size.

Table III.2.2 Estimated Average Ship Size

	Average Ship Size		Cargo Volume	Average Cargo Volume per Ship	Number of Ship Calls
	(GRT)	(DWT)	(tons/year)	(tons)	
Exp. Cargo					
Sugar (bag)	700	1,500	15,000	600	25
Sugar (bulk)	7,000	10,500	136,000	7,000	19
Fertilizer (bag)	1,000	1,500	39,000	1,000	39
Cement (bag)	3,000	4,500	99,000	3,000	33
Clinker (bulk)	5,000	7,500	90,000	5,000	18
Free Zone (container)	3,000	4,500	24,000	460	52
General Cargo	8,000	12,000	89,000	1,700	52
Imp. Cargo					
Fertilizer (bulk)	7,000	10,500	130,000	6,000	22
Coal (bulk)	13,000	19,500	113,000	15,000	8
Fuel Oil (bulk)	13,000	19,500	120,000	15,000	8
Free Zone (container)	3,000	4,500	22,000	420	52
General Cargo	8,000	12,000	69,000	1,300	52
Ferry	3,000	4,500	-	-	260
Passenger Boats	20,000	-	-	-	24