Table 5-38 Estimated Volumes of Export of Concentrates through Callao Port

Year	Volume of Cargoes (1,000 tons)
1981	1,411
1987	1,641
1990	1,782
2000	2,252

5-3-5 Forecasting of Volume of Petroleum Products Handled at Callao Port

(1) Present Situation of Oil Production in Peru

Production of crude oil in Peru sharply increased after the completion of the northern pipeline in April 1977. Peru had until recently imported more than 60% of its domestic needs from abroad, but achieved self-sufficiency of crude oil in 1979.

The production was 193,000 B/D in 1981, as shown in Fig. 5-18. Table 5-39 and Fig. 5-19 show the distribution of oilfields.

Peru refines 153,000 B/D of crude oil. Its rate of self-sufficiency in crude oil increased from about 64% in 1977 to 98% in 1978 to 100% after 1979. (see Fig. 5-20)

Table 5-40 shows volumes of refined oil by oil refinery. Two oil refineries, one in the oilfield district of Talara in Northern Peru and the other at La Pampilla in the metropolitan area of Lima where plenty of petroleum products are consumed, account for about 98% of the total production.

The domestic consumption of petroleum products is 129,400 B/D (See Fig. 5-21) and its average annual rate of increase during the past several years is about 3%.

15.78 million barrels of petroleum and petroleum products were exported in 1981. 9.285 million barrels of this were crude oil accounting for 22.4% of the domestic crude oil production. The rest comprised automobile gasoline, diesel oil and industrial oil.

The import volume amounts to 317,000 barrels – mainly lubricating oil and jet fuel.

The confirmed petroleum reserves in Peru are 834 million barrels as of 1981 (See Fig. 5-22), which is enough for about 11 – 12 years, taking the 1981 production level of 70.4 million barrels as average annual production. Peru will be an oil importer again is 1985 unless new reserves are discovered.

Table 5-41 shows the estimated reserves and prospecting for new oilfields is an important national project.

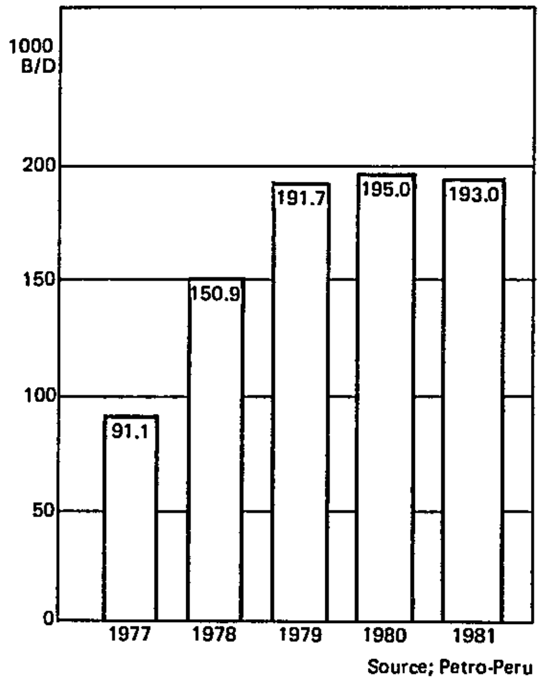


Fig. 5-18 Production of Crude Oil

Table 5-39 Production of Crude Oil by Area (1981)

Area	Production B/D	Company
Costa Norte	42,116 (21.8)	PETROPERU
Zócal Continental	26,757 (13.9)	Belca Pet
Selva Nortle	18,395 (9.5)	PETRO DERU
	104,737 (54.3)	Occidental Det
Selva Central	957 (0.5)	PETRODERU
Total	192,962 (100.0)	

Source: Petro-Perú

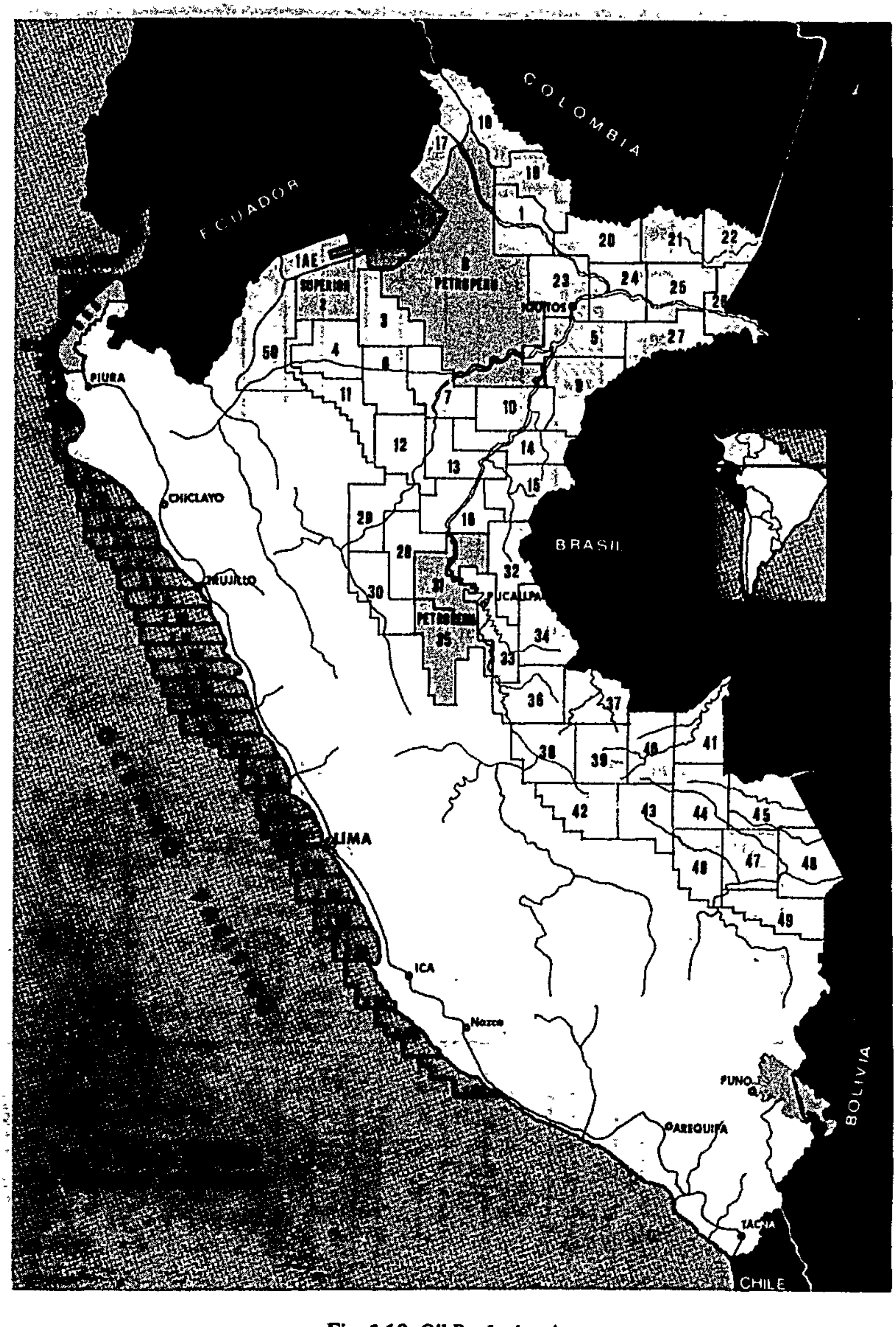


Fig. 5-19 Oil Producing Areas

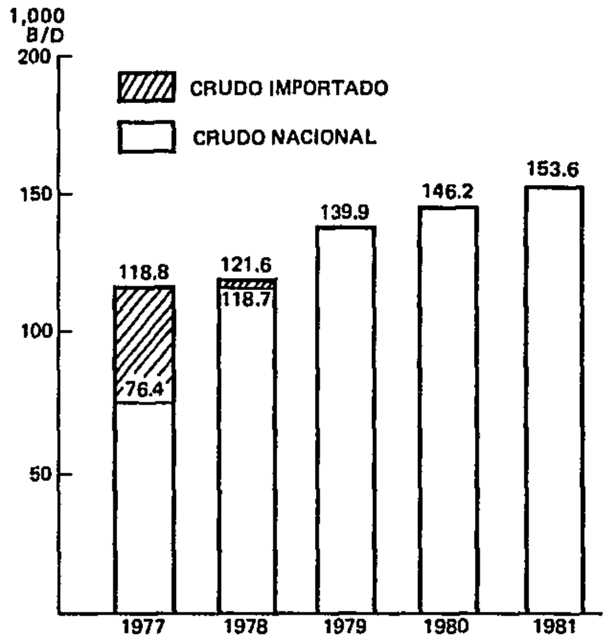


Fig. 5-20 Trend of Volume of Refined Oil

Table 5-40 Volume of Refined Oil by Oil Refinery

Oil refinery	Volume of refined oil B/D
Talara	61,262 (40.0)
La Pampilla	88,669 (57.9)
Luis F. Diaz	1,043 (0.7)
Pucallpa	2,058 (1.3)
Marsella	175 (0.1)
Total	153,207 (100.0)

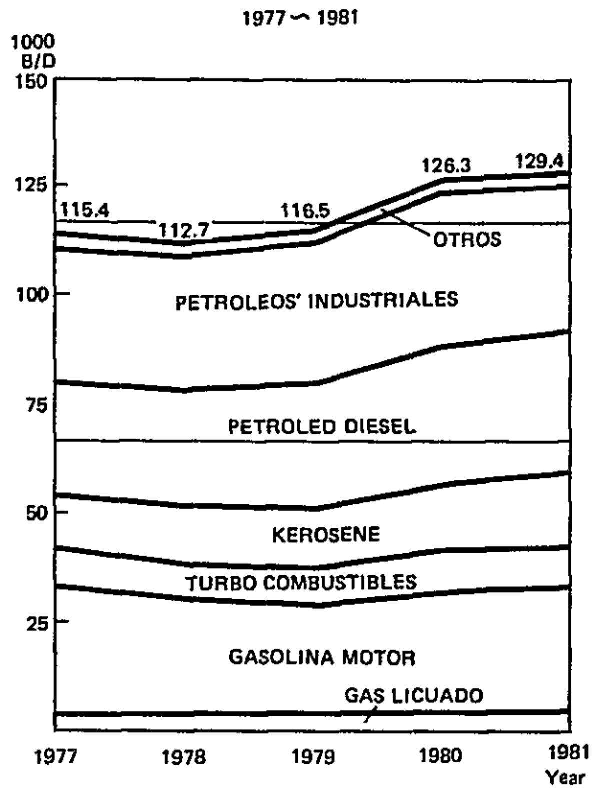


Fig. 5-21 Domestic Consumption of Refined Petroleum

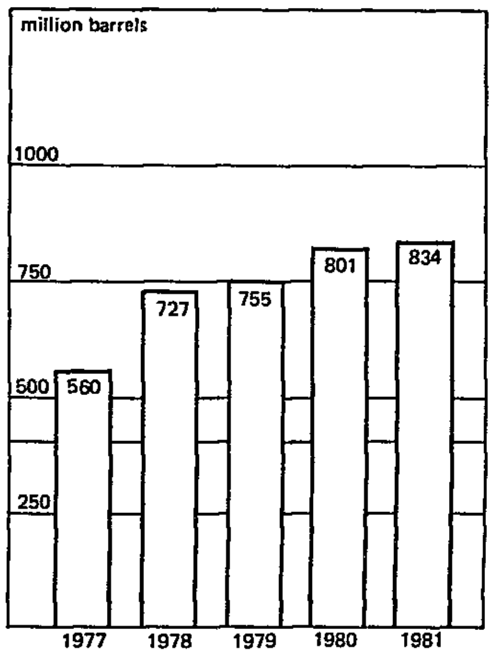


Fig. 5-22 Confirmed Reserves of Crude Oil

Table 5-41 Reserves of Crude Oil in 1979

Area	Probadas	Probables	Posibles	Potencial
No.-Oesto	147,776,000	31,619,000	243,801,000	425,196,000
Zócolo	70,430,000	62,100,000	426,250,000	558,780,000
Selvo	547,810,000	197,490,000	8,217,000,000	8,962,300,000
Total	768,016,000	291,209,000	8,887,051,000	9,946,276,000

Source: Estadísticos PETROPERU
Los Recursos Naturales del Peru-ONERN, Moyo 1981

(2) Past Figures of Handling of Petroleum Products at Callao Port

Table 5-42 shows the volume of petroleum products handled at Callao Port in 1979 – 1981. The imports are mostly comprised of lubricating oil and liquid chemicals unloaded through pipelines. The rest represents small quantities of jet fuel, liquefied gas and other petroleum products. The exports are mostly comprised of industrial oil. Domestic-trade import represents most of the total volume of petroleum products handled (about 93% in 1981). These are petroleum products consumed in the hinterland of Callao Port. Domestic-trade export consists of petroleum products transported to oil distributing bases in other parts of the country.

(3) Forecasting of the Volume of Petroleum Products Handled at Callao Port

The future volume of petroleum products handled at Callao Port is now studies separately for each category; foreign-trade, import and export, and domestic-trade import and export.

Foreign-trade import: This is mainly comprised of such advanced products as lubricating oil and jet fuel. The importation of these products will increase according to the expansion of the economic activities of the country.

Foreign-trade export: It is expected that more oilfields will be developed and the nation's status as a petroleum exporter will be maintained. Even if, in the worst case, the production cannot keep up with the domestic consumption, some petroleum products would continue to be exported, which is likely in view of the past achievements.

The export of petroleum products through Callao Port, depends on the handling capacity of Callao Port itself, but it will probably continue at the present level because the new petroleum products will be exported directly from ports where oil refineries are located rather than from Callao Port because of the convenience transportation.

Domestic-trade import: Lubricating oil, gas and liquefied gas are supplied to the whole hinterland of Callao Port but other petroleum products are for consumption in the central mountainous states of Juniin, Pasco, Hauncabelica and Huanuco in the hinterland of Callao Port. They are transported by the Central Railway. Petroleum products refined at La Pampilla, north of Callao Port, are supplied by truck to the metropolitan area of Lima which is a major place of consumption. Since this pattern of oil transportation will remain unchanged in the future, the volume of petroleum products brought in by domestic-trade will be affected by the level of economic activities in the central mountainous part of the hinterland of Callao Port.

Domestic-trade export: This consists of transportation to the oil distributing bases in other parts of the country and can be assumed to continue at the present level.

According to the above considerations volumes of foreign-trade imports and domestic-trade imports are estimated using the growth rate of gross domestic product, on the assumption that the growth rate of the level of economic activities in the hinterland of Callao Port is same as that of gross domestic product. Volumes of foreign-trade exports and domestic-trade exports, meanwhile, are estimated on the assumption that they will continue at the present level. Table 5-43 shows the results of estimation.

Table 5-42 Past Results of Handling of Petroleum Products at Callao Port

Unit; 1,000 tons

Petroleum	Import			Export			Domestic-trade Import			Domestic-trade Export			Total		
	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981	1979	1980	1981
Lubricating Oil	46.3	49.1	45.7	0.01	0.02	0.06	5.7	4.5	3.8	0	0	0	52.0	53.6	49.6
Tar	0.01	0.05	0.08	0	0	0	0	0	0	0	0	0	0.01	0.05	0.08
Gas and liquefied gas	0	17.7	5.2	0	0	0	51.6	45.4	59.9	0	0	0	51.6	63.1	65.1
Gasoline	2.6	10.8	9.1	0	0	0									
Kerosene	0	0	0	0	0	0									
Petroleum	0	13.7	1.0	208.7	160.5	237.8	850.0	991.7	1,361.2	124.9	92.3	113.3	1,186.4	1,270.2	1,728.4
Other petroleum products	0.2	1.2	6.0	0	0	0									
Liquefied chemicals	28.3	24.3	27.3	0	0	0	0	0	0	0	0	0	28.3	24.3	27.3
Total	77.4	116.9	94.4	208.7	160.5	237.9	907.3	1,041.6	1,424.9	124.9	92.3	113.3	1,318.3	1,411.3	1,870.5

Source: ENAPU

Table 5-43 Estimated Volume of Petroleum Products Handled at Callao Port

(Foreign Trade)

Case	1981			1987			1990			2000		
	Import	Export	Total	Import	Export	Total	Import	Export	Total	Import	Export	Total
I	94.4	237.8	332.2	137	238	375	165	238	403	295	238	533
II				122	238	360	141	238	379	230	238	468
III				117	238	355	132	238	370	195	238	433

(Domestic trade)

Case	1981			1987			1990			2000		
	Import	Export	Total	Import	Export	Total	Import	Export	Total	Import	Export	Total
I	1,424.9	113.3	1,538.2	2,064	113	2,177	2,483	113	2,596	4,447	113	4,560
II				1,841	113	1,954	2,131	113	2,244	3,471	113	3,584
III				1,772	113	1,885	1,993	113	2,106	2,950	113	3,063

5-3-6 Estimates of Cargo Volume at Callao Port

Table 5-44 shows the volume of cargo, by commodity, handled at Callao Port in the target years.

Table 5-45 shows the increase over the base year of 1981 and the annual average increase rate of the total volume of cargoes in each target year.

Regarding the forecast of future cargo volume, estimations were made assuming three cases concerning future increases in the GDP rate as already mentioned.

Among these three cases, Case II (which assumes a 5% GDP increase rate) is used as the cargo handling target volume (one condition for setting the scale of the port plan) for the following reason:

① The annual average GDP increase rate in Peru over the past 20 years has been 4.1% (see Table 5-4). Further, comparison of Peru with developed countries (OECD nations) in regard to recent economic growth shows that while growth rates decreased in the developed countries, a high rate of about 4% has been maintained in Peru since 1979 due to the fact that regular exports of petroleum were begun and the fact that exports of processed mineral products were further developed. In the future, too, it can be expected that Peru will continue its development through advancing its industries and making use of its natural resources. In this way Peru's growth rate should continue to surpass those of developed nations.

② The overview of the world economy, carried out by the Long-Term Prospect Committee of the Japanese Economic Deliberation Council, noted that the world economy experienced many difficulties in the 1970's – mainly in developed countries – such as declining economic growth, increasing unemployment, continuing inflation, perennial deficits in the balance of current accounts, and a declining productivity increase rate due to stagnated investment – these maladies all being the result of the two oil crises that occurred during the decade. Repeated trial and error efforts at international cooperation will be necessary during the 1980's to overcome these problems, so that the 1990's may bring us closer to success in dealing with such global issues as population, food, energy and the environment. According to this overview, the assumed economic growth rate for developing countries until 2000 is 4.0 ~ 6.0%, as compared with 3.2% for the world as a whole during this same period, as indicated in Table 5-47.

③ The national development plan of Peru presupposes a target economic growth rate of about 6.0%.

Above, the assumption was made that Peru can exceed its actual past economic growth rates and can maintain an economic growth of at least about 5%, which is higher than the average for developing nations. The Case II cargo volume forecast for each year until 2000 is indicated in Table 5-48.

Table 5-44 Estimated Volume of Cargoes Handled at Callao Port

Unit: 1,000 tons

Case	Year	General cargoes Import	General cargoes Export	General cargoes Total	Container cargoes Import	Container cargoes Export	Container cargoes Total	Imported grains	Exported mining products	Petroleum products Import	Petroleum products Export	Petroleum products Domestic-trade Import	Petroleum products Domestic-trade Export	Petroleum products Total	Total
	1981	1,487	591	2,078	97	73	170	1,101	1,411	94	238	1,425	113	1,870	6,630
I (6.37% ~ 6.00%)	1987	1,739	677	2,416	519	415	934	1,368	1,461	137	238	2,064	113	2,552	8,731
	1990	1,691	572	2,263	1,037	729	1,766	1,658	1,782	165	238	2,483	113	2,999	10,468
	2000	1,378	620	1,998	3,545	1,319	4,864	2,562	2,252	295	238	4,447	113	5,093	16,769
II (5%)	1987	1,547	640	2,187	462	392	854	1,368	1,641	122	238	1,841	113	2,314	8,364
	1990	1,447	531	1,978	887	676	1,563	1,658	1,782	141	238	2,131	113	2,623	9,604
	2000	1,073	561	1,634	2,759	1,192	3,951	2,562	2,252	230	238	3,471	113	4,052	14,451
III (4%)	1987	1,488	629	2,117	444	385	829	1,368	1,641	117	238	1,772	113	2,240	8,195
	1990	1,352	514	1,866	828	655	1,483	1,658	1,782	132	238	1,993	113	2,476	9,265
	2000	910	531	1,441	2,340	1,129	3,469	2,562	2,252	195	238	2,950	113	3,496	13,220

Table 5-45 Increase in Volume of Cargoes Handled at Callao Port

Case	Increase over the base year (times)			Annual average increase rate (%)		
	1987/1981	1990/1981	2000/1981	1981 – 1987	1981 – 1990	1981 – 2000
I	1.33	1.56	2.51	4.90	5.06	4.96
II	1.25	1.44	2.17	3.84	4.10	4.15
III	1.23	1.39	1.98	3.50	3.70	3.67

Table 5-46 Comparison Between Developed Countries and Peru Regarding Economic Growth Rates

Unit: %

Year	Total for OECD Nations	Peru
1976	5.1	2.0
1977	3.7	Δ0.1
1978	3.9	Δ0.5
1979	3.4	4.1
1980	1.2	3.8
1981	1.2	4.0

Table 5-47 Outlook on World Economy

Region		Real Economic Growth Rate (Annual)	
		1970 – 1979	1980 – 2000
	Japan	5.2	4.0
	U.S.A.	3.1	2.5
	EC and Other OECD Nations	3.1	
Developed Industrial Countries		3.3	2.8
	Newly Developed Industrial Countries	8.0	6.0
	Other Developing Countries	5.7	4.0
Developing Countries		6.3	4.6
	U.S.S.R.	5.1	3.0
	Eastern Europe, etc.	5.9	
	China	5.8	4.0
Socialist Economic bloc		5.4	3.2
The World (Total for 125 Countries)		4.3	3.2

Source: The Long-Term Prospect Committee of the Japanese Economic Deliberation Council.

Table 5-48 Estimated Volume of Cargoes Handled at Callao Port (Case II)

	General Cargoes			Container Cargoes			Imported Grains	Exported Mining Products	Petroleum Products					Total
	Import	Export	Total	Import	Export	Total			Import	Export	Domestic-trade Import	Domestic-trade Export	Total	
1981	1,487	590	2,077	97	73	170	1,101	1,411	94	238	1,425	113	1,870	6,629
82	1,469	712	2,181	111	97	208	1,146	1,405	96	238	1,456	113	1,903	7,024
83	1,496	734	2,230	148	110	258	1,190	1,452	100	238	1,514	113	1,965	7,240
84	1,522	727	2,249	207	160	367	1,235	1,499	105	238	1,590	113	2,046	7,505
85	1,545	699	2,244	273	233	506	1,279	1,546	111	238	1,670	113	2,132	7,780
86	1,549	666	2,215	363	314	677	1,324	1,593	116	238	1,753	113	2,220	8,065
87	1,547	702	2,249	462	330	792	1,368	1,641	122	238	1,841	113	2,314	8,364
88	1,521	587	2,108	591	500	1,091	1,465	1,688	128	238	1,933	113	2,412	8,764
89	1,487	550	2,037	733	595	1,328	1,561	1,735	134	238	2,030	113	2,515	9,176
1990	1,447	531	1,978	887	676	1,563	1,658	1,782	141	238	2,131	113	2,623	9,604
91	1,370	500	1,870	1,077	749	1,826	1,748	1,829	148	238	2,238	113	2,737	10,010
92	1,341	479	1,820	1,237	816	2,053	1,839	1,876	156	238	2,349	113	2,856	10,444
93	1,273	483	1,756	1,436	859	2,295	1,929	1,923	163	238	2,487	113	2,981	10,884
94	1,196	488	1,684	1,651	905	2,556	2,020	1,970	172	238	2,590	113	3,113	11,343
95	1,167	491	1,658	1,825	954	2,779	2,110	2,017	180	238	2,720	113	3,251	11,815
96	1,132	495	1,627	2,012	1,006	3,018	2,200	2,064	189	238	2,856	113	3,396	12,305
97	1,090	514	1,604	2,214	1,045	3,259	2,291	2,111	199	238	2,999	113	3,549	12,814
98	1,076	535	1,611	2,395	1,085	3,480	2,381	2,158	209	238	3,149	113	3,709	13,339
99	1,058	539	1,597	2,589	1,145	3,734	2,472	2,205	219	238	3,306	113	3,876	13,884
2000	1,073	561	1,634	2,759	1,192	3,951	2,562	2,252	230	238	3,471	113	4,052	14,451

In regards to domestic marine transportation, only petroleum and iron ore are at present transported by this means. Virtually no other commodity is domestically transported in this way.

In the future, domestic marine transportation will continue to play an important part in the transportation of petroleum and iron ore. And Callao Port will be responsible for handling petroleum. Meanwhile, several studies concerning the development of a domestic transport system are being conducted with the object of effectively utilizing marine transportation to reduce transportation costs. There is, for example, a study* concerning coastal mass transportation by Ro/Ro barges of agricultural and industrial container cargoes. However this is still at the conceptual stage and many problems remain to be solved. Thus, it appears that there are as yet too many unresolved uncertainties for a forecast to be attempted at this time concerning the target demand for these cargoes.

Yet, there can be little doubt that the use of domestic marine transportation will increase in the future, so that there may be a time when Ro/Ro ships are in use. This being the case, it is necessary for the Callao Port development plan to provide room for construction of facilities to receive these ships.

*'Transporte Multimodal Palalelo al Litoral' INP, UNI

CHAPTER 6
Master Plan for Callao Port Development Project

CHAPTER 6. MASTER PLAN FOR CALLAO PORT DEVELOPMENT PROJECT

6-1 Strategy of the Master Plan

Callao Port's basic development goals will be met through the establishment of an appropriate operation/management system and the build-up of port facilities.

The port planning strategy for accomplishing these goals is considered as follows:

(1) Expansion of room for Port Development

An expanded site and creation of new port space will be necessary for the increased port functions planned for Callao. For this purpose, the water areas north and south of the port are being considered. On the north side, there are many obstacles to port development. First there is the mouth of the Rimac River. In addition there are the existing naval ports. If the port is expanded to the north side with naval ports intervening between the existing port facilities and development area, it will be difficult to make integrated use of the port facilities and it will be hard to effectively arrange the facilities.

The south sea area is most calm as its water areas are protected by San Lorenzo Island and La Punta Peninsula. In addition, integrated use of existing and new port facilities would be highly feasible, and the development would have easy access to major roads. Therefore, future development space for Callao Port will be developed at the southern sea area on the south breakwater.

(2) Promotion of Development of Container Terminals

The No. 5 Berth and related areas at Callao Port will be improved in order to cope with the increasing container transportation traffic along the west coast of South America. But these are merely temporary measures and there is still a limit to the berthing of large full-container ships at the No. 5 Berth.

Meanwhile, at other ports on the west coast of South America, various measures are being studied or are in effect regarding the berthing of large full-container ships.

If the development of container terminals at Callao Port is allowed to lag behind the container terminal construction in other countries, Callao Port will fall from its central position as a foreign trade port, and will be reduced to the lowly role of a feeder port.

Therefore, it is important to actively promote the development of container terminals at Callao Port in order to facilitate the berthing of large container ships and thus stay ahead of ports in other countries.

(3) Specialization of Use of Berths

At Callao Port, specialization of cargo handling by berth, streamlining of loading and unloading, and the quick dispatch of ships, are in practice even at present.

The forecast increase in cargo volume will result in the construction of large ships and special carriers. It will thus become necessary to develop special berths. At this port, this trend is expected to grow, particularly in regard to grain and ores. Therefore, cargo-handling machines suited to these cargoes will need to be developed. Loading efficiency will thus be increased and the overall functions of the port will be improved.

(4) Securing of Protected Waters

The height of waves hitting Callao Port, to be discussed later, is comparatively low due to the protective presence of San Lorenzo Island. But a wave period as long as 10 – 14 sec., causes the rolling of ships, consequently lowering loading efficiency and sometimes damaging the port facilities. For any port, calm water areas protected by breakwaters are indispensable.

The port plan prescribes breakwaters in order to insure calm water areas in front of the berths. The water areas inside the present port are preserved as much as possible.

(5) Promotion of Redevelopment of the Port

The existing wharves at Callao Port were constructed over the period of time between 1930 and 1960's.

Wharves number one through four were constructed in the 1930s and almost 50 years have passed. At the time of construction, ships of less than 5,000 DWT were predominant and so the port plan was then considered to have sufficient capacity. Today, the ships have grown larger and cargo work at the wharf has been mechanized. The existing water areas between the piers, the width of the aprons and the areas of the port site, etc. no longer meet the modern standards of economy.

After many decades, many of the facilities have about reached their limit in terms of physical usefulness. From the standpoint of safety, some measures must be taken soon as a matter of necessity.

The land behind the wharves had been developed in accordance with the needs of the time. However, what was built earlier no longer suits many of the modern-day requirements.

For instance the locations of customs, guardhouses and the repair shops are actually a hinderence to the efficient flow of cargoes. It is also important to investigate the necessity of the harbor railway. Redevelopment of the port will be actively promoted to make maximum use of limited space, keeping in mind future developments in transportation style.

(6) Coordination with City Planning

The Plaza Grau and the adjacent historical naval facilities of Castillo Real Felipe and Muelle de Guerra, are community assets. They arouse citizen interest in the sea. The calm waters in front of them are used for marine recreation, primarily, pleasure boating.

CORDE CALLAO, the city planning agency of Callao City, is planning to build a park on the land areas mentioned above. The port plan will be worked out keeping in mind the enhancement of the planned park facing the sea.

In addition, port roads will be planned so as not to interfere with the lives of the inhabitants. Roads will be planned in accordance with the overall road planning of CORDE CALLAO.

(7) Optimization of Investment Size and Time of Investment

It takes an enormous investment to develop a port and much time is necessary before the facilities are operational.

Therefore, in port planning, consideration must be given not only to minimizing the total investment size, but also to the timing of each investment to maximize its effect at each stage.

The port plan must propose an appropriate construction program to eliminate concentrations of investments and excessive advance investments.

6-2 Estimate of the Scale of the Plan

6-2-1 Present facilities Capacity of Callao Port

In order to determine the required scale of the plan for future cargo traffic, it is necessary to figure the present cargo-handling capacity of the port. Port capacity is generally calculated in terms of the volume of cargo.

Since port capacity varies according to the type of the cargo, size of the lot, size of the berth, method of loading and unloading, etc., it is often represented simply as the volume of cargo handled at the port.

The present capacity of Callao Port was estimated by analyzing the relationship between the volume of cargo handled at each berth and the size of the berth, in terms of general cargoes, minerals, grains, and petroleum products. The values used for the analysis are 1981 data unless otherwise noted.

(1) General Cargoes

1) Cargo handling capacity at wharfs

Some of the data related to the handling of general cargoes is as shown below.

ⓐ Average loading/unloading capacity per gang .... 15 tons/hour
ⓑ Average actual hours worked per shift .... 5.4 hours
ⓒ Average number of gangs per ship .... 3 gangs
ⓓ Average number of shifts per day .... 2.2 shifts
ⓔ Average No. mooring days per ship .... 3.75 days
(See Fig. 2-6 & Table 2-8)
ⓕ Number of berths for general cargo at Callao Port .... 13 berths
ⓖ Working days per year .... 364 days

Using this data we can estimate the annual port capacity for handling general cargo.

The number of ships which can dock at the general cargo berths per year is obtained from ⓔ, ⓕ and ⓖ above. This figure is about 1,260. The actual number of general cargo ships entering the port in 1981 was 1,119. This indicates that the calculated berth occupancy rate is 89%.

The annual cargo-handling capacity is estimated at about 2,520 thousand tons. This figure is obtained from the daily cargo handling volume of 534 tons calculated from ⓐ, ⓑ, ⓒ, and ⓓ above. This annual figure works out to be about 1,000 tons of handling volume per year per 1 m length of berth. The volume of general cargo handled at Callao Port in 1981 was 2,250 thousand tons. This shows that Callao Port is being operated roughly at full capacity according to the berth data analysis.

2) Capacity of Cargo Handling Areas

Next, port capacity is estimated according to warehouse and outdoor storage space behind the piers. The present warehouse area is 48,700 m^2, and the open storage area is 39,700 m^2. Since data about the cargo handling capacity of Callao Port from the view point of storage space is not enough, using the actual values for Yokohama Port in Japan, transit shed capacity is estimated at 0.55 t/m^2, and that of the open storage area, 1.05 t/m^2. Assuming a twice-a-month cargo turnover rate the capacity of Callao Port is estimated at 4,160 thousand tons. In view of the present handling volume of 2,250,000 tons, the accommodating capacities of transit sheds can open storage area seem to be more than sufficient.

3) Situation of Ship Entry

Next, the number of general cargo ships entering the port is analyzed. The required time from a ship's arrival outside the port to final berthing is minimumly 0.5 hrs. As shown in Fig. 2-5 which indicates elapsed time from arrival of a general cargo ship of final berthing, 39% are forced to wait outside the port for more than 24 hours.

A future study will be necessary to further evaluate these figures. But, they at least indicate that ships have to wait at Callao Port.

4) Evaluation

Judging from all the above, the capacity for handling general cargo at Callao Port may be said to have nearly reached its limit. However, it will be possible to increase the cargo handling capacity of Callao Port beyond the present level by improving on the use of its transit sheds, the location of its aprons, warehouses, and open storage yards, the method of transportation between these and also improving the process of stevedoring.

(2) Grains

1) Capacity of Cargo Handling Equipment

Cargo handling equipment, working hours and other items concerning grain cargo handling are as follows:

ⓐ Cargo handling equipment: 3 Rail travelling type pneumatic unloaders

	Nominal capacity	Actual capacity
Machine #1	200 t/h	79.4 t/h
Machine #2	200 〃	80.2 〃
Machine #3	300 〃	90.4 〃
Total	700 〃	250.0 〃

ⓑ Working hours: 15 hrs/day

ⓒ Average mooring days: 4.46 days/ship

ⓓ Annual working days: 364 days

These are used to estimate the annual grain handling capacity.

The volume of grains that can be handled in a year by these equipments is estimated from the relation of ⓐ, ⓑ and ⓓ, to be about 1,365 thousand tons.

The volume of grains handled in 1981 was 1,101 thousand tons. The mooring capacity at the grain wharf has, as stated in 2-3-3(4), already reached its limit and the cargo handling machines are operating at nearly full capacities.

2) Silo capacity

The storage capacity of silos at Callao Port was 26,700 tons but has decreased to 54% of this figure since the earthquake of 1974. Grains which are directly deposited in silos by belt conveyance are 56% of the imported grains. The remaining 44% is directly dumped at the quay and hauled out of the yard by truck. The annual volume handled at silos in 1981 is estimated at 617 thousand tons since the year's grain handling volume is 1,101 thousand tons. The annual silo turnover rate of 42.4 turns can be obtained from the relation between this value and the silo capacity (14,550 tons). The silo turnover rate at Callao Port is exceedingly high, compared with the normal Japanese silo turnover rate of about 10, presumably because the silos serve like transit sheds for temporary keeping and because their capacity has declined by one half.

(3) Container Handling Capacity

The container handling capacity is estimated for the temporary container terminal planned for berth No. 5B and its related areas (see details of operation method etc. in Chapter 8).

Making the following assumptions, we calculated the number of containers handled per year according to stevedoring capacity.

ⓐ Number of containers loaded/unloaded per ship
600 TEU

ⓑ Capacity of mobile crane
15 TEU/hr x 2 units = 30 TEU/hr

ⓒ Actual working hours per shift
1st shift, 08:00 – 17:00, 8 hrs
2nd shift, 19:00 – 04:00, 8 hrs

It will take 20 hours to load/unload 600 TEU. Thus it is necessary for container ships to berth at least 1.5 days. The maximum number of container ships which can be berthed per month is estimated at 15.

The annual number of containers handled is therefore estimated at 108,000 TEU. The actual number is given at 86,000 TEU which is 80% of the estimate, (calculated in terms of berth occupancy, loading efficiency, etc.)

The maximum number which can be stored is 1,509 judging from the amount of yard area. With an average of 2.5 tiers for storage, and a twice-a-month rate of turnover, the annual number handled will be 90,500 TEU.

From the above, the capacity of the temporary container handling facilities, is determined by the number of containers stored, and is estimated to be around 650 thousand tons per year.

6-2-2 Methods to Determine Number of Berths

One of the most important factors in determining the scale of a wharf is the number of its berths. Methods used to determine the number of berths include the following: ① Method to determine the number macroscopically by giving the standard value of handled tonnage per-meter of berth length as a postulate. ② Method to determine the number of berths by assuming the frequency of ship entries and the cargo handling capacity. ③ Method to determine the number of berths by applying queuing theory. Here, the ② and ③ methods are used to determine the number of berths for Callao Port. These methods are, therefore, explained below.

(1) Method by Number of Ship Entry and Handling Capacity

$$\text{Number of berths} = \frac{\text{Total number of mooring hours}}{\text{Annual number of workable hours x berth occupancy ratio}}$$

Total number of mooring hours:

Per-ship average number of mooring hours x number of calling ships

Per-ship average number of mooring hours:

$$\frac{\text{Cargo volume per ship}}{\text{Average cargo handling capacity}} + \text{number of hours necessary}$$

for purposes other than cargo handling

Number of calling ships: Annaul cargo volume handled/loaded cargo volume per ship

Berth occupancy ratio: 0.4 ~ 0.7 (Target volume of the berth occupancy ratio depends on the number of berths and the types of berths exclusively used.)

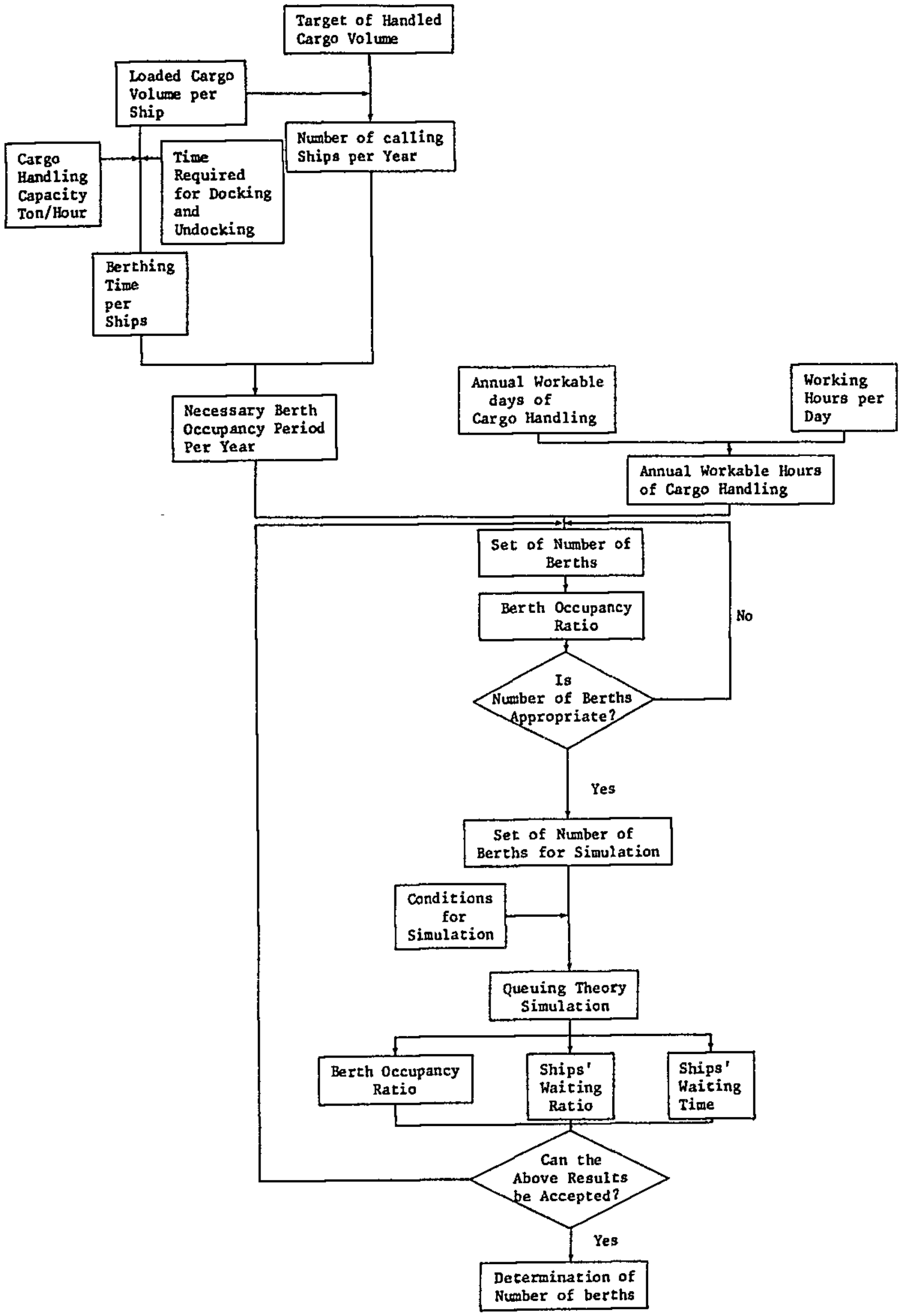
(2) Method of simulation by queuing theory

1) Application of queuing theory to port planning

Ships calling at a port expect to be moored at a designated berth immediately, in the order of arrival, and carry out cargo handling. If ship is already berthed at the quay and there is no room for the present ship to be berthed, the latter ship has to wait until after the first ship completes its cargo handling and leaves. (The ship expects to be berthed as soon as it enters a port. However, the port management body wants to minimize the number of quays in order to increase the efficiency of use of quays. How to balance these desires of both sides, namely, what service level should be set is important in port planning.)

This phenomenon of ships arriving and leaving a port can be analyzed by queuing theory, as in the analysis of the situation at a bank, where variables include the number of windows and the time each customer takes at the windows. Using this example of a bank, if the arrival of customers, the number of windows and the service time for customers at the windows are compared respectively to the arrival of ships, the number of berths and the berthing time by ships, the model of ship arrivals and departures at a port is, basically, the same as the model used for the phenomenon of window service at a bank, etc. Yet, in spite of this similarity between ships waiting at a port and the above phenomenon at a bank, etc., a queuing theory unique to ports must be developed for two reasons: the difference between the arrival of customers and the arrival of ships, and the difference between the service time for customers by clerks and the berthing time by ships. To this end, the pattern of ship entries and the pattern of the berthing time must be found out. Great efforts are being exerted to clarify these patterns at ports. As to the pattern of ship entries, normally it is random; Poisson arrivals, namely, entry time intervals are of exponential distribution.

In the pattern of the berthing time by ships as expressed by a histogram normally there is one peak that is rather on the left side and it often conforms to the Erlung distribution in Phase 2 or Phase 3. (See Fig. 6-2).



Remarks: 1) The above study is carried out by each ship type.
2) Details of queuing theory will be explained at 6-2-2(2).

Fig. 6-1 Flowchart for Determining Number of Berths

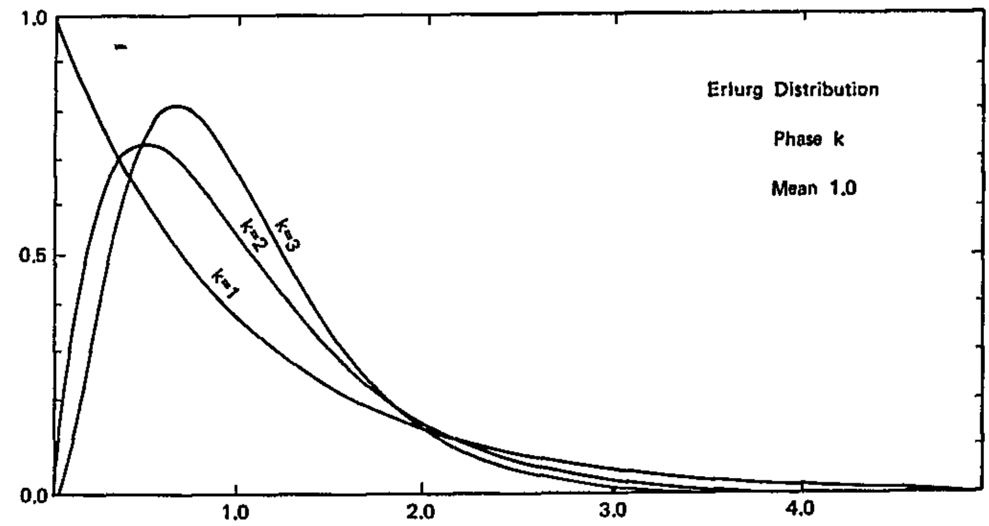


Fig. 6-2 Erlung Distribution

As is known already, the following four factors are indispensable to the determination of the queuing phenomenon:

1 Distribution of arrivals of ships to be berthed
2 Distribution of berthing time
3 Number of berths
4 Methods of service

Factor 4 concerns such matters as service in the order of arrival or preferential service. Normally, service in the order of arrival predominates but, in the case of a container port, preferential service is considered for full-container ships.

2) Methodology of Simulation Test

Ships entering the port take a berth according to their order of arrival and then start loading/unloading work. If the berths are occupied, the ships wait until the preceding ships leave. Queing theory has been used to make a projection concerning the situation of ships calling at or leaving the port. However, theoretical analysis alone cannot cope with the complicated reality of port activities. For this reason, a computer is used to follow the movement of ships i.e. entering – berthing, – loading/unloading and leaving.

A simulation has been used for the analysis of port congestion at the target year of the short-term development plan of Callao Port and for its long-term development plan. The flow of the simulation model used on this occasion is shown in Fig. 6-3.

Input data are comprised of ship types, number of berths, frequency distribution of calling ships, and frequency distribution of mooring time. Output data are comprised of the number of waiting ships, their waiting time and berth occupancy.

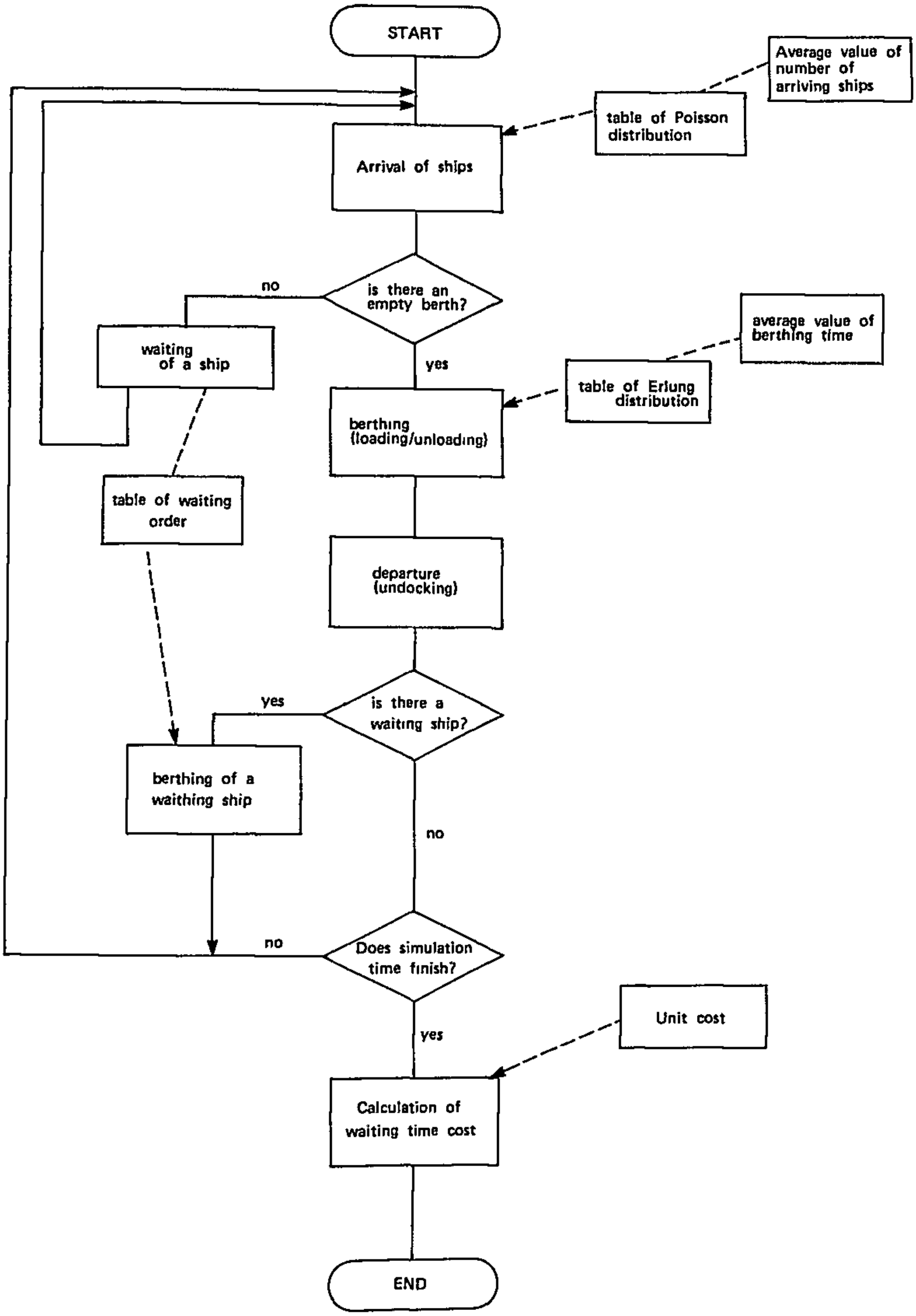
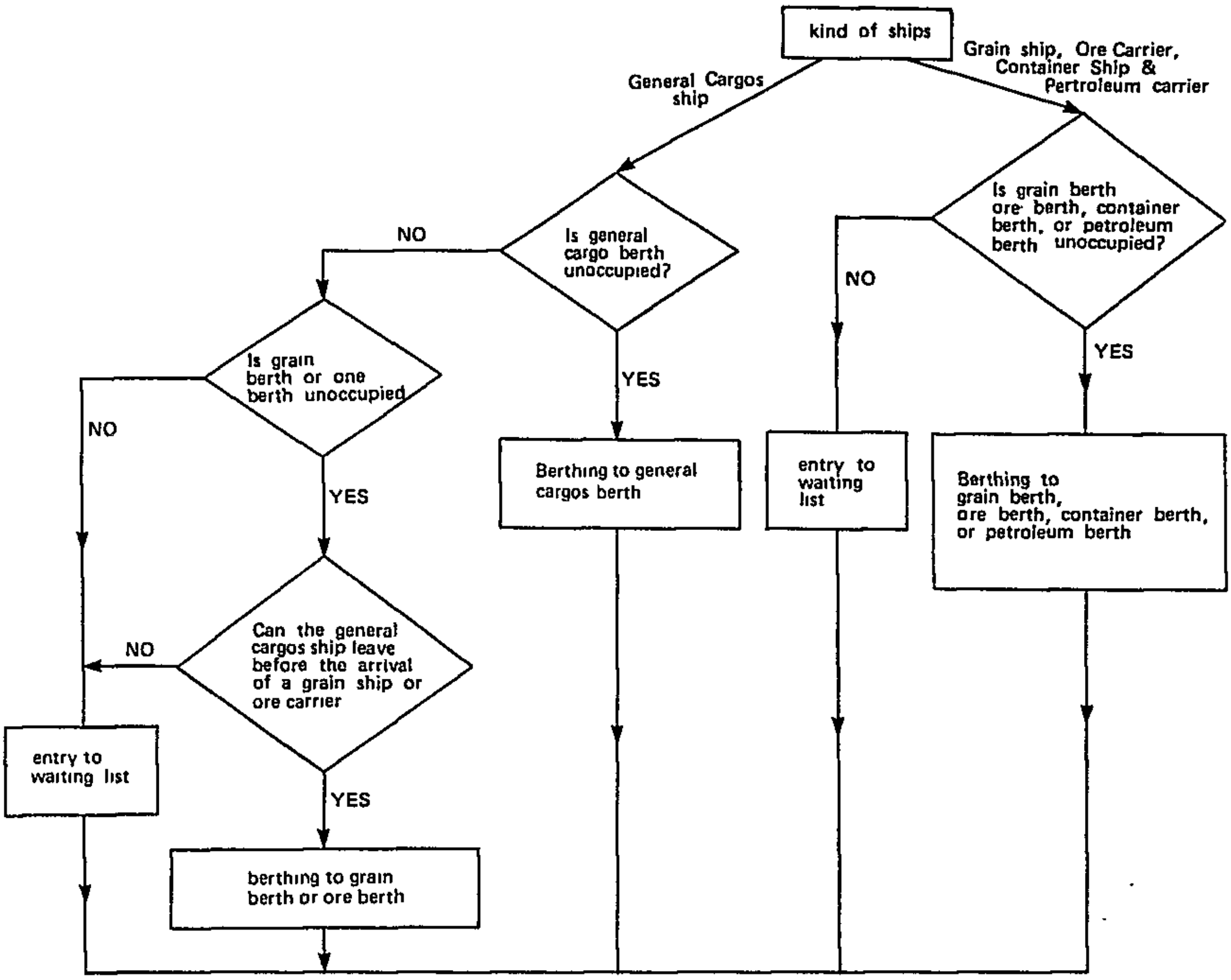


Fig. 6-3(1) Flowchart of Simulation Model



Renarks. Container ship, petroleum carrier, Ore carrier, or grain ship can be berthed only at the berth which is allocated to each ship.
General cargos ship can be berthed at general cargos berth, ore berth, and grain berth.

Fig. 6-3(2) Flowchart of ship's arrival

3) Conditions of Simulation Test

1 A per-ship cargo volume (lot) and the number of ships are assumed from actual results.

2 As indicated in Fig. 6-4, An Erlung distribution of Phase 2 applies well to the berthing time of general cargo ships. This distribution is used for other ship types, too, because the distribution of their berthing time is nearly in accordance with Phase 2 distribution.

3 General cargo ships use general cargo berths, in principle. But general cargo ships can use mineral ore berths or grain berths, too, if these are unoccupied and if general cargo ships can leave before ore carriers or grain ships enter the port.

4 Ships loading cargoes other than general cargo must use the respective berths exclusively used by these ships only.

5 Container berths are of two types: large berths with an alongside water depth of −12 m and small berth with −10 m.

The large berth caters to all container ships while the small berth caters to container ships of up to 20,000 DWT handling less than 500 TEU at Callao Port.

6 Simulation tests will be done for both the long-term plan and the short-term plan.

The following table 6-1 shows simulation test input data by type of ships:

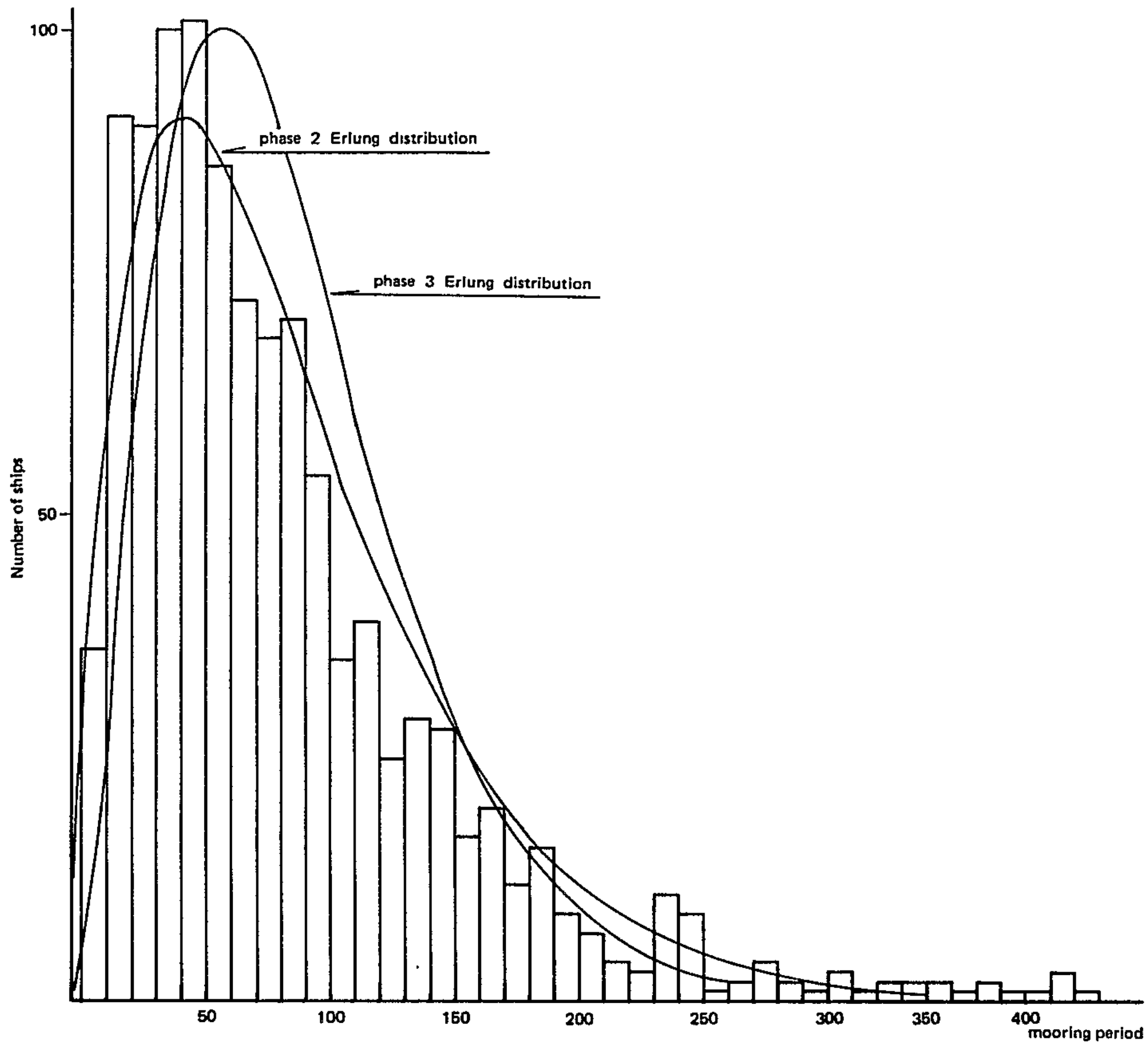


Fig. 6-4 Relation between mooring period and Number of ships
(general cargoes, 1981)

Table 6-1 Input data

Type of berth	1987 (short-term plan) Number of berths	Lot (tons)	Number of ships	Service time	2000 (long-term plan) Number of berth	Lot (tons)	Number of ships	Service time
General Cargoes	9			(54t/hr)	8			(54t/hr)
		5,000	22	94.6		5,000	16	94.6
		4,000	66	76.1		4,000	49	76.1
		3,000	131	57.6		3,000	98	57.6
		2,000	547	39.0		2,000	409	39.0
		1,000	328	20.5		1,000	245	20.5
		Sub-total	1,094			Sub-total	817	
Mineral products	2			(350t/hr)	2			(560 t/hr)
		15,000	8	44.9		15,000	11	28.8
		10,000	25	30.6		10,000	34	19.9
		6,000	131	19.1		6,000	180	12.7
		3,000	164	10.6		3,000	225	7.4
		Sub-total	328			Sub-total	450	
Grains	1			(480t/hr)	2 (only one grain berth can be used by general cargo ships)			(480t/hr)
		40,000	3	85.3		50,000	8	106.2
		30,000	16	64.5		40,000	19	85.3
		25,000	16	54.1		30,000	26	64.5
		20,000	14	43.7		25,000	15	54.1
		15,000	5	33.3		20,000	13	43.7
		Sub-total	54			Sub-total	81	
Petroleum	2			(500t/hr)	4			(500t/hr)
		25,000	14	52.0		25,000	24	52.0
		20,000	17	42.0		20,000	30	42.0
		15,000	39	32.0		15,000	68	32.0
		10,000	69	22.0		10,000	122	22.0
		5,000	46	12.0		5,000	81	12.0
		1,000	116	4.0		1,000	203	4.0
		Sub-total	301			Sub-total	528	
Container cargoes	large 1, small 1	(TEU)		Gantry [37.5 TEU/hr] / Mobile [22.5 TEU/hr]	large 4, small 1	(TEU)		Gantry [37.5 TEU/hr] / Mobile [22.5 TEU/hr]
		700	33	20.7 / 33.1		700	392	20.7 / 33.1
		500	115	15.3 / 24.2		500	549	15.3 / 24.2
		300	115	10.0 / 15.3		300	457	10.0 / 15.3
		Sub-total	263	large berth / small berth		Sub-total	1398	large berth / small berth

Table 6-2 Hours Available for Cargo Handling per a Year

Type of cargoes	hours per day	annual workable days	annual workable hours
General cargoes	16.5	364	6,000
Mineral products	16.5	364	6,000
Grains	20.0	364 x 0.95	6,900
Petroleum	16.5	364	6,000
Container cargoes	22.0	364 x 0.95	7,600

0.95 is in consideration of the effects of waves, etc. during hours available for cargo handling.

6-3 Proposed Scale in Master Plan

The proposed scale in the master plan (2000) must be in accordance with the volume of cargoes handled. According to Table 5-44, the volume of cargoes that will be handled at Callao Port in 2000 is 1,634 thousand tons for general cargoes, 3,951 thousand tons for container cargoes, 2,562 thousand tons for grains, 2,252 thousand tons for mineral products and 4,052 thousand tons for petroleum. The port facilities necessary to handle these are determined by referring to the past performance at Callao Port.

6-3-1 General Cargo Wharf

(1) Number of berths

In planning, the following conditions are set:

ⓐ The volume of general cargoes handled in 2000 is 1,634 thousand tons.

ⓑ In principle, ship gear is used for cargo handling and its capacity of 18 tons/hour is used for calculation.

ⓒ Cargoes are handled by three gangs.

ⓓ The average per-ship loading/unloading volume is 2,000 tons.

ⓔ Available time for using berths is 6,000 hours per year (16.5 hours/day x 364 days).

ⓕ The size of ships is considered to be 15,000 DWT.

ⓖ Necessary time for processing for entry and departure is 2 hours per ship.

Based on the above data, the necessary number of general cargo berths in 2000 is determined as follows: The hourly volume of handled cargoes is 54 tons. The per-ship berthing time of about 39 hours is derived from the relation between the average per-ship loading/unloading volume and the cargo handling productivity. Since the annual number of ships calling at this port is 817, the total berthing time is 31,945 hours. Since the available time for using berths is 6,000 hours, the berth occupancy ratio is 76.0% for seven berths, 66.5% for eight berths, and 59.1% for nine berths. Based on these results, the necessary berth number was decided to be eight.

According to the simulation of the queuing theory, the berth occupancy rate is 67.1%, the ship waiting ratio between the number of waiting ships and total calling ships is less than 2% and the per-waiting ship waiting time is 5.1 hours in the case of eight berths. Therefore, eight berths were considered reasonable.

(2) Quay length and alongside water depth

General cargo ships of 15,000 DWT belong to the category of large vessels. According to Figs. 5-5, 6, 15,000 DWT ships measure about 160 m in length and about 9 m in full-load draft. The length of a quay for a 15,000 DWT ship normally is 185 ~ 200 m which represents the ship's length plus length for the bow line and the stern line. Water depth alongside a quay is −10 m which represents the full load draft plus the keel clearance.

(3) Planning of cargo handling area

The scale of transit sheds and open storage yards have to be decided in consideration of the types and quantities of cargoes and the conditions of handling. For Callao Port, they are planned

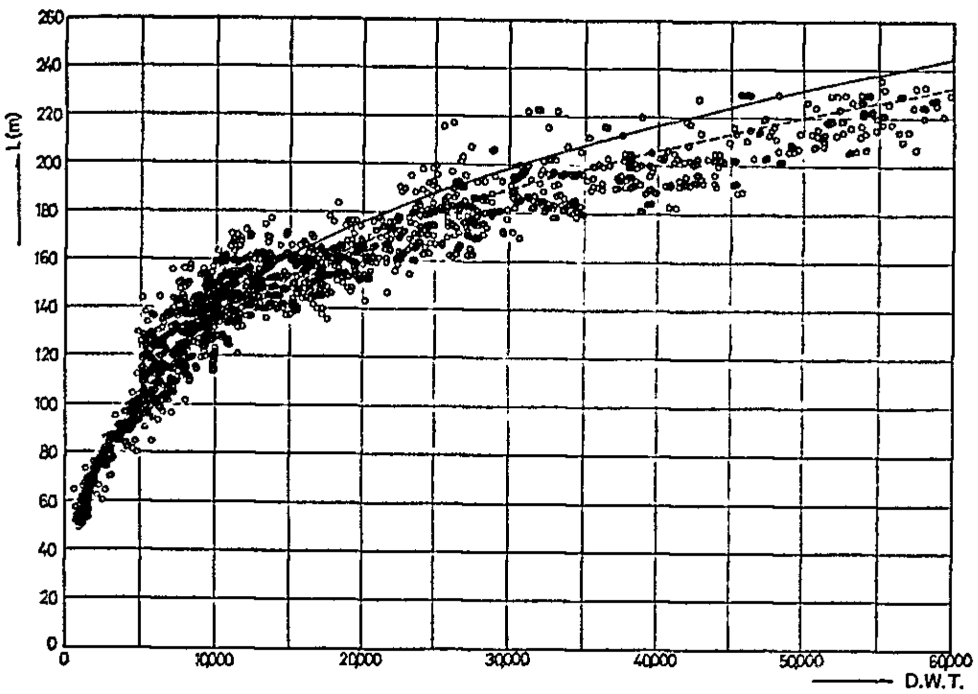


Fig. 6-5 Relation between ship size (DWT) and Length (L)

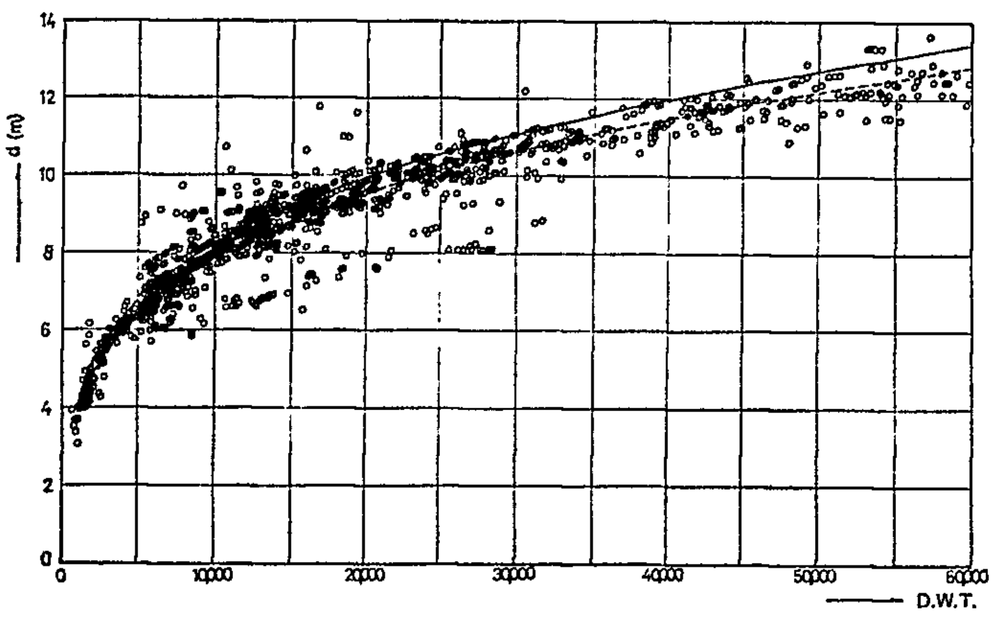


Fig. 6-6 Relation between ship size (DWT) and Full-Load Draft (d)

on the assumption that 1/3 of all cargoes pass through transit sheds and the remaining 2/3 passes through open storage yards based on the small precipitation and the present shares.

In 2000 the volume of cargoes passing through transit sheds is 545 thousand tons and the volume of cargoes passing through open storage yards is 1,089 thousand tons.

1) General cargo transit shed

The necessary area of transit sheds is determined by the following formula:

$$A = \frac{N}{R\alpha W}$$

A: Necessary area of transit shed (m^2)

N: Annual volume of cargoes handled: 545 thousand tons

α: Utilization rate: 0.5

R: Turnover of transit shed: 24 times a year

W: Volume of cargoes per unit area: 1 t/m^2

Table 6-3 shows the necessary size of the transit shed.

Table 6-3 Required area of a transit shed

Volume of cargo handled N (10^3 tons)	Annual storage volume RαW ($tons/m^2$)	Required area N/RαW (m^2)
545	12	45,000

2) Open storage yards

The necessary area of the open storage yards is determined by the following formula:

$$A = \frac{N}{R\alpha W}$$

A: Necessary area of open storage yards (m^2)

N: Annual volume of cargoes handled, 1,089 thousand tons

α: Utilization rate, 0.7

R: Turnover of the open storage yards, 24 times a year

W: Volume of cargoes stacked per unit area, 1 t/m^2

Table 6-4 shows the necessary size of the open storage yards.

Table 6-4 Required size of open storage yard

Volume of cargo handled N (10^3 tons)	Annual storage volume RαW ($tons/m^2$)	Required area N/RαW (m^2)
1,089	16.8	65,000

6-3-2 Container Wharf

The container ships to be deployed on the South American West Coast line, will be capable of carrying about 1,800 TEU, judging from the volume of traffic and the estimated number of ports of call.

Figs. 6-7 ~ 9 show the relationship between container ship capacity and type of container ship. Judging from the above, the largest container ship calling at Callao Port will be in the 30,000 DWT (250 m long, 12 m draft) class, taking into account future increase in ship size.

The container ships that the Consortium Eurosal is now constructing for runs to the west coast of South America are generally as follows:

Seven container ships were under construction as of June 1983. They are scheduled to be delivered to their owners from the end of 1983 to May 1984.

The upper limit of the container load draft of these container ships on their South America west coast runs is 9.15 m. In which case, their container load is about 1,500 TEU.

Each ship will have on board a 40-ton crane (MP40) with a cargo handling capacity of 20 TEU/hour.

Principal Particulars

Length (o.a.) 200 ~ 203 m

" (b.p.) 190 ~ 192 m

Berth (mld.) 32 ~ 32.2 m

Depth (mld.) 18.7 ~ 18.8 m

Draft (max. mld.) 11.5 ~ 12.0 m

" (operation. mild.) 9.15 m

Deadweight 22,000 ~ 25,000 t (Draft 9.15 m)

" 34,500 ~ 37,500 t (" 11.5 ~ 12.0 m)

Gross tonnage 32,500 t

Container capacity max. 1,900 TEU

operation approx. 1,500 TEU

including 99 ~ 320 TEU ref. container

These container ships are characterised by the fact that the two lowest levels the bottom of the hold are without cell guides to permit the loading of copper, etc. and by the fact that the stern part is built to permit the handling of general cargoes.

The capacity of container terminals varies according to the system of operation, the skill of the crane operator, the number of containers being loaded and unloaded per ship, and many other factors. The capacity of the terminals also varies depending on whether they have a single berth or multiple berths. The capacity of a standard terminal (single berth) of 300 m length and with a yard area of 105 thousand m^2 is calculated by model simulation.

Such things as traffic breakdown by type of ship, number of days per complete trip, number of containers handling etc., are simulated in a model drawn from actual experience at Tokyo Port.

The annual handling capacity of a standard berth is 120 ~ 130 thousand TEU according to the simulated conditions.

These results may not be completely applicable to the container terminal capacity of Callao Port but they may be taken as a rough approximation. If the annual handling capacity at Callao Port is set at the above value, the volume of cargo handled annually is estimated at 850,000 tons.

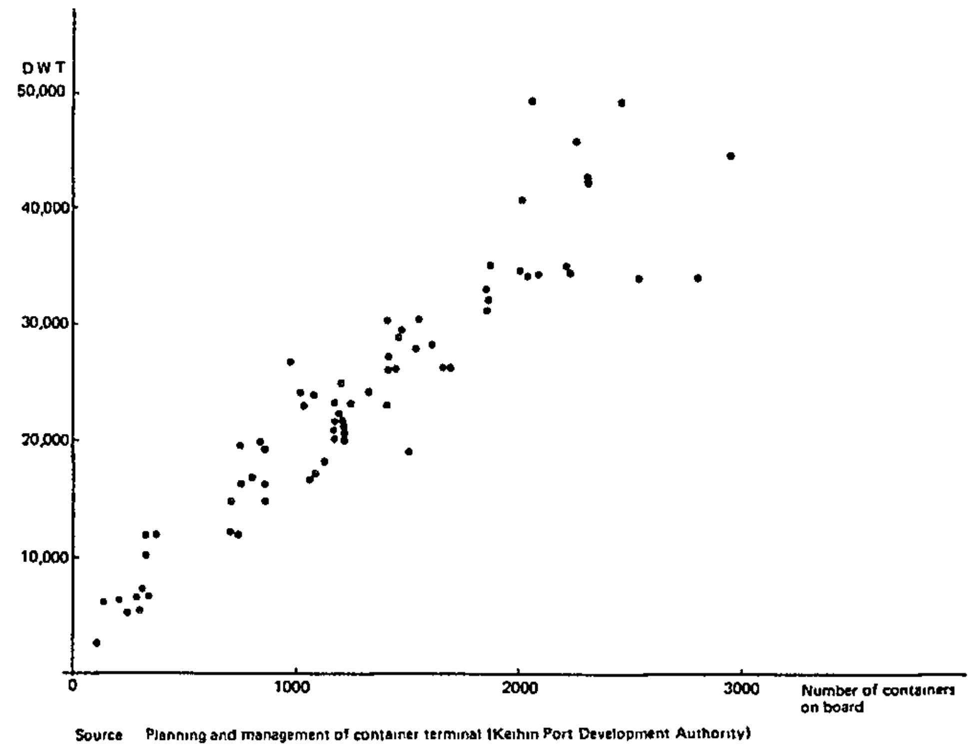


Fig. 6-7 Size and Loading Capacity of Container Ships

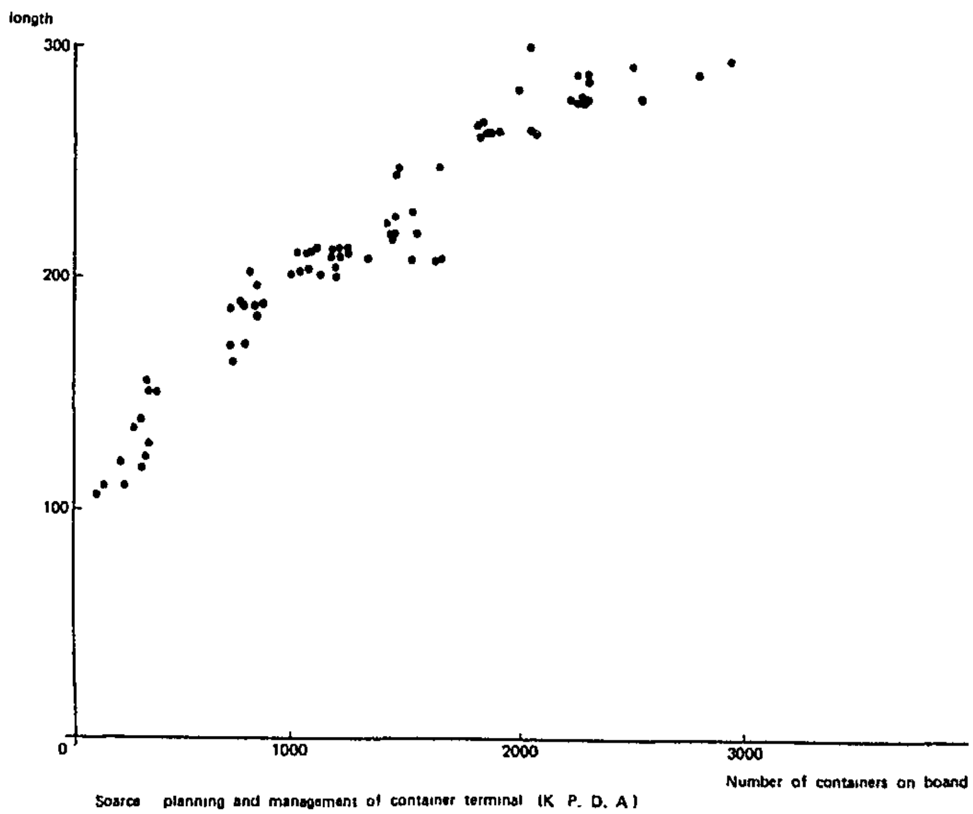


Fig. 6-8 Length and Loading Capacity of Container Ships

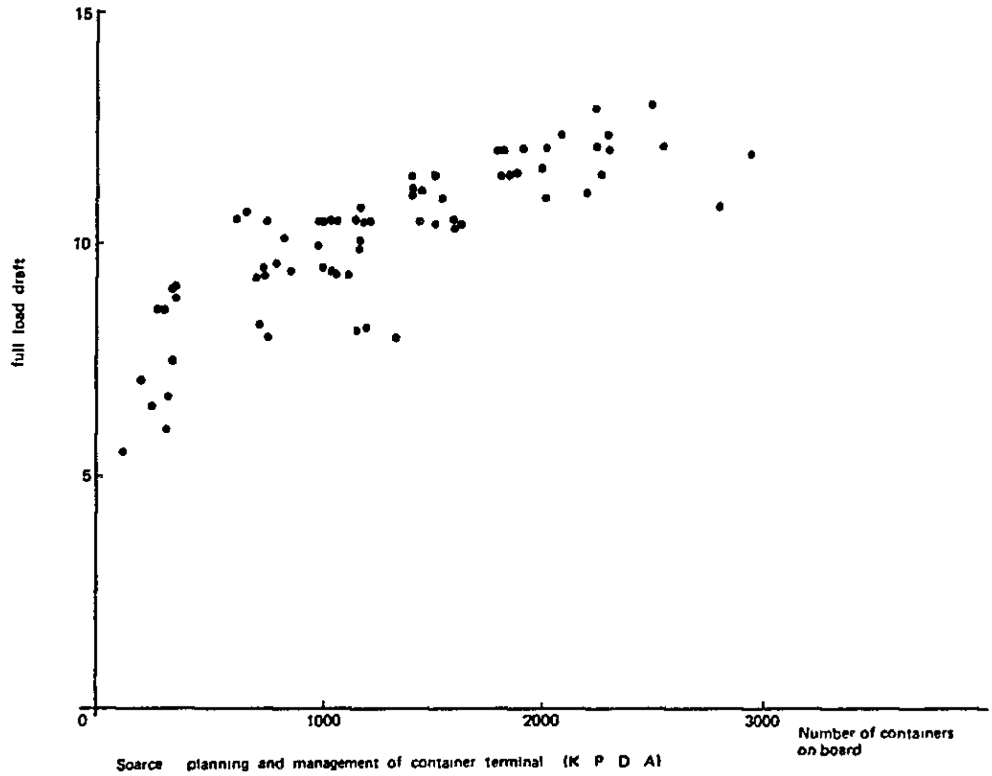


Fig. 6-9 Full-load Draft and Loading Capacity of Container Ships

(1) **Number of container berths**

In planning, the following conditions are set:

ⓐ The volume of container cargoes in 2000 is 3,951 thousand tons but, since 650 thousand tons is handled at No. 5B berth, the volume to be handled at new container berths is 3,301 thousand tons.

ⓑ All container ships are Lo/Lo type ships.

ⓒ Based on 1981 results, 8.1 tons is used as the per-container cargo volume.

ⓓ No empty containers are allowed to stay in Callao Port.

ⓔ The handling capacity of a container crane is 25 TEU/hour and its work efficiency is 0.75.

ⓕ The per-berth number of container cranes is 2 units.

ⓖ It is assumed that the per-ship number of loaded containers that are loaded or unloaded is 500 TEU. Since the import/export ratio in 2000 is 70% for import and 30% for export, the ratio of empty containers to loaded containers is 40.5%. So, the per-ship number of containers handled is 700 TEU.

ⓗ The per-berth annual hours available for use are 7,600 hours (22 hours/day x 364 days x 0.95). Here, 0.95 of workable rate is used in consideration of the effect of waves, etc.

ⓘ The per-ship hours necessary for processing for entry and departure are 2 hours.

The number of container berths required in 2000 is calculated as follows: Since the total number of containers in 2000 is 573 thousand TEU, the number of ships calling at the port is

818 based on the per-ship number of containers loaded or unloaded (700 TEU). Since the per-ship berthing time (including time for docking and undocking) is 21 hours, the annual total berthing hours are 17, 115 hours. Since the per-berth annual hours available for use are 7,600 hours, berth occupancy rate is 75% for three berths, 56.3% for four berths, and 45.0% for five berths. Based on the result, it was judged that four berths are necessary.

According to simulation by queuing theory, the berth occupancy rate is 59.6%, the ship waiting rate is 16% and the per-waiting ship waiting time is 7.8 hours for four berths. Therefore, the proposed four container berths are considered reasonable.

According to a simulation for No. 5B berth, the occupancy rate is 75%, the ship waiting rate is 48% and the per-waiting ship waiting time is 14 hours.

6-3-3 Grain Wharf

The type of grain ship serving Callao Port is mostly in the 25,000 ~ 30,000 ton class.

KAVO XIFIAS, the largest grain ship serving Callao Port in 1981, has a length of 204 m and a draft of 11.8 m.

Since the berths 11A – 11C have a water depth of –10.5 m, the ship must have entered the berth during favorable tide conditions and with a shallow draft.

With imports expected to increase in the future, larger ships will be increasingly used.

Table 6-5 shows grain shipments by ship size. It shows that ships below 40,000 DWT, which have been mainly used in the past, have gradually decreased and, with the demand for rational transportation, ship size tends to increase. So, the grain wharf is planned with a view to the maximum ship size of 60,000 DWT.

Table 6-5 Grain Shipments by Vessel Size 1970/1985
(% of total trade volume)

DWT (1,000 t) \ Year	1970	1975	1980	1985
Below 40	89	69	52	44
40/60	10	15	20	19
60/80	1	7	17	20
80/100	–	2	2	2
100+	–	7	9	15

Source: Cargo Systems Research/Consultancy Division

The standard dimensions for 60,000 DWT are as follows: Length 224 m, width 32.2 m, hatch width 14.0 m, number of hatches 7, and maximum draft 12 m. Table 6-6 shows the relation between the capacity of cargo handling equipment at the grain wharf and the size of grain ships. According to it, the mean discharge rate for ships of 35,000 DWT to 50,000 DWT is 850 t/hr. Therefore, 800 t/hr (400 t/hr x 2) is proposed as the capacity of cargo handling equipment at the grain wharf.

Table 6-6 Grain Terminal Facilities
Average Handling Rates Analysed by Ship Size

DWT (1,000 t)	35/50	50/70	70/100	100/150	150 +	Overall Average
Loading rate (t/h)	1,100	1,600	2,150	2,575	2,700	1,400
Discharge rate (t/h)	850	1,150	1,300	1,825	2,400	1,100
Dis/load %	77%	71%	60%	71%	89%	78%

Source: Cargo Systems Research/Consultancy Division

(1) Number of grains berths

In planning, the following conditions are set:

ⓐ The volume of grain cargoes in 2000 is 2,562 thousand tons.

ⓑ The cargo handling equipment consists of two pneumatic unloaders for each berth. The work efficiency is 0.6 because dumping to trucks is not efficient.

ⓒ The per-berth available time for use is 6,900 hours per year (20 hours/day x 364 days x 0.95).

ⓓ The per-ship necessary time for processing for entry and departure is 2 hours.

The number of grain berths required in 2000 is calculated as follows: Supposing that the per-ship average volume of unloading is 35,000 tons, the annual number of ships calling at the port is 74. Since the per-ship berthing time is 75 hours based on the volume of unloading and the cargo handling capacity, the total berthing time is 5,543 hours. Since the per-berth available time for use is 6,900 hours per year, the berth occupancy rate is 80% for one berth and 40% for two berths. So, it was judged that two berths are necessary.

According to the simulation by queuing theory, the berth occupancy rate is 40.3%, the ship waiting rate is 15% and the per-waiting ship waiting time is 32 hours. Therefore, proposing two berths is considered reasonable.

(2) Planning of grain silos

In planning, the following conditions are set:

ⓐ It is assumed from past performance, that in the future, 60% of the volume of cargoes will be routed through silos and 40% will be directly dumped to trucks and hauled out of the yard.

ⓑ Therefore, the volume of grains through silos in 2000 is 1,540 thousand tons.

ⓒ The turnover rate of silos is 24 times.

The silo capacity required in 2000 is calculated to be 64,000 tons.

In planning the arrangement of silos, two systems of facilities will be constructed so that cargo handling can be performed independently by each system.

The necessary per-berth silo capacity is more than 32 thousand tons.

Assuming 1,700 m^3 (diameter 8.0 m, height 40.0 m) as the size of a silo, its storage capacity is 1,250 tons (apparent specific gravity of grain: 0.75 t/m^3). If a system of silos is composed of 27 silos (3 rows x 9 silos), as illustrated in Fig. 6-10, it is possible to secure a total capacity of 33,750 tons (1,250 t x 27). Hence, contructing two systems of this scale by 2000 was proposed.

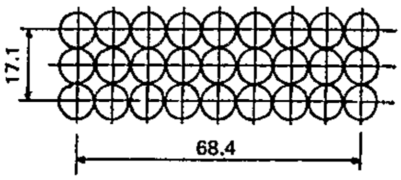


Fig. 6-10 Layout of silos

Also, hoppers for loading onto trucks are proposed. The hopper capacity is set to accommodate the stock volume required to load a truck load every two hours, considering the truck arrival distribution. If the capacity of a truck is 14 m^3, the per-truck loading time is 6.5 minutes and the number of hoppers is four, the total hopper capacity corresponding to two hours of loading is 1,000 m^3.

Table 6-7 Steel silo volume

Inside diameter of silo (D m)	Volume (m^3) Height of silo H m				
	H = 28	H = 31.5	H = 35.5	H = 40	H = 45
6.00	653.9	752.8	865.9	993.1	1,135
6.30	715.5	824.6	949.2	1,090	1,245
6.70	801.0	924.4	1,065	1,224	1,400
7.10	888.0	1,026	1,184	1,362	1,560
7.50	982.7	1,137	1,314	1,513	1,734
8.00	1,103	1,279	1,480	1,707	1,958
8.50	1,229	1,428	1,655	1,910	2,194
9.00	1,359	1,582	1,836	2,122	2,441
9.50	1,493	1,741	2,025	2,344	2,698
10.00	1,631	1,906	2,220	2,574	2,967

6-3-4 Mineral Ore Wharf

The volume of mineral ores to be handled in 2000 will be 2,252 thousand tons or about 1.6 times the present level. Therefore, quays in this port must be used as efficiently as possible. Cargo handling equipment has to be introduced to the mineral ore berths to enable the quick dispatch of ships. Quay facilities catering to 20,000 DWT ships are proposed on the assumption that the per-ship loaded volume will remain the same as at present.

(1) Number of ore berths

In planning, the following conditions are set:

ⓐ The volume of ore cargoes in 2000 is 2,252 thousand tons.

ⓑ Commodities handled are concentrate of barite, copper, zinc, lead, etc.

ⓒ The cargo handling equipment is ship loaders (800 t/hr). One loader will be provided for each berth.
The work efficiency is 0.7.

ⓓ The per-berth available time for use is 6,000 hours per year.

ⓔ The per-ship necessary time for processing for entry and departure is 2 hours.

The necessary number of ore berths in 2000 is determined as follows. Since the per-ship average handled volume is 5,000 tons, the annual number of calling ships is 451. The per-ship berthing time is 11 hours from the relation between the per-ship handled volume and the cargo handling capacity. Therefore, the total berthing time is 4,916 hours. Since the per-berth available use time is 6,000 hours per year, the berth occupancy rate is 82.0% for one berth and 41.0% for two berths. So, it was judged that two berths are necessary.

According to simulation by queuing theory, the berth occupancy rate is 44.2%, the ship waiting rate is 12% and the per-waiting ship waiting time is 5.7 hours for two berths. Therefore, proposing two berths is considered reasonable.

It is assumed that the MINPECO storage place immediately behind the port will continue to be used in the future as an ore stockyard and that ores will be brought to the ore berths by belt conveyor.

6-3-5 Petroleum Wharf

(1) Number of petroleum berths

In planning, the following conditions are set:

ⓐ The volume of petroleum cargoes in 2000 is 4,052 thousand tons.

ⓑ Ship pumps are used for discharge from the ship and the average discharging capacity is 500 tons/hour.

ⓒ Average loaded cargo volume per ship is 7,700 tons based on the past performance.

ⓓ The per-berth available time for use is 6,000 hours per year.

ⓔ The per-ship necessary time for processing for entry and departure is 2 hours.

The necessary number of petroleum berths in 2000 is determined as follows: Since the per-ship average handled volume is 7,700 tons, the annual number of calling ships is 527. The per-ship berthing time of 17.5 hours is derived from the relation between the handled volume and the cargo handling capacity. Therefore, the total berthing time is 9,170 hours. Berth occupancy rate is 76.5% for two berths, 51.0% for three berths, and 38.2% four berths. Based on this result, it was judged that three berths are necessary.

According to the simulation by queuing theory, the berth occupancy rate is 39%, the ship waiting rate is 2% and the per-waiting ship waiting time is 5.1 hours for three berths. Therefore, proposing three berths is considered reasonable.

It is assumed that petroleum will be temporarily stored immediately behind the port, as at present, and that petroleum will be transported by pipeline.

6-3-6 Summary of Proposed Scale Under Master Plan

The wharves necessary to handle cargoes in 2000 are shown in Table 6-8.

6-3-7 Harbor Facilities

In planning harbor facilities for the present port, the present channel lines and the present calm waters inside the breakwaters will be maintained as much as possible. Changing the channel lines is deemed unnecessary due to natural conditions, such as waves and winds, and from the opinions of pilots and others. The channel width of 180 m is prescribed by the distance between the tips of both breakwaters. Though the maximum size of ships calling at the port is likely to increase in the future, the widening of channels is given up to ensure the calmness of waters in the harbor. Increase in the number of ships using the port is also likely but widening the channels will be unnecessary if the control system at the harbor entrance is improved as required.

Twelve meters is planned as the water depth of the channels and the anchorage by assuming 60,000 DWT as the target ship size so as to avoid the effects of the increase of ship size and tide waiting. The largest possible area will be secured for the harbor anchorage. The possibility of shoal formation due to the use of 12 m as the water depth of channels seems likely to be as follows. At the present level of research on sedimentation, it is not easy to predict the amount of channel shoaling. Yet, significant change to the water depth of the existing channels seems unlikely from ENAPU depth charts. Moreover, the channels are sheltered by San Lorenzo Island, waves are low and the flow of the tidal current is only about 15 cm/sec. So, channel shoaling will not amount to much.

Harbor facilities for the new port plan are planned as follows: Channels will branch from existing channels. However, the lines of these channels will be set so that the new port section cannot be affected by an accident that may occur at the entrance to the existing Callao Port and result in the deterioration of its functions. The anchorage of the new port section will, if necessary, be expanded by providing a new breakwater. In this case, depending on the length of the new breakwater, the tip of the existing southern breakwater will be removed, thus making it possible to widen the entrance to the present port. This must be studied by consolidating wave observation records and other data of long standing.

Table 6-8 Wharves proposed in the Master Plan

Type	Cargo volume (1,000 tons)	Number of berth	Berth length (m)	Water depth (m)	Ship size (DWT)	Cargo handling equipment
General cargo berths	1,634	8 (1)	185 ~ 200	10	15,000	Ship's Gear
Container-berth	3,951	large 4 small 1 (1)	300 185	12 10	30,000 15,000	Container Crane 2 per berth Mobile Crane 2 per berth
Grain berths	2,567	2	250	12	60,000	Pneumatic unloader 400 t/hr 2 per berth
Mineral berths	2,252	2 (2)	200	10	20,000	Ship loader 800 t/hr 1 per berth
Petroleum berths	4,052	3 (2)	250	12	35,000	Ship's pump
Total	14,451	20				

Note: In "number of berths" column, number of each parenthesis represents number of existing
In numeral outside parentheses shows total number of berths.

6-3-8 Port Traffic Facilities

An access road and an inner port road connecting to the proposed trunk road are proposed to smoothly distribute port traffic generated at the wharves. The railway transportation of cargoes will be planned in accordance with the future transportation demand.

(1) **Determination of traffic volume**

The volume of traffic generated at a port is determined by the following formula:

$$T = N \times \frac{\alpha}{W} \times \frac{\beta}{12} \times \frac{\gamma}{30} \times \frac{(1+\delta)}{\epsilon} \times \sigma$$

where, T: Proposed traffic volume (cars/hour)

N: Annual volume of cargoes handled (t/year)

α. Share of automobile = 1.0

β. Monthly rate of variation = 1.0 ~ 1.2

γ: Daily rate of variation = 1.1 ~ 1.5

W: Loaded volume per truck (t/car)

ϵ: Rate of loaded truck = 0.5

δ: Rate of related vehicles = 0.5

σ: Rate of hourly variation = 0.1

Table 6-9 shows generating traffic volume by wharf.

Daily port generated traffic volume is about 9,400 cars.

Table 6-9 Generated traffic volume in 2000

Type	Cargo volume (1,000 t)	Cargo weight of loaded (t/car)	Hourly generated traffic volume (car/hour)
General cargo berths	1,634	8	204
Container berths	3,951	8.1	488
Grain berths	2,562	10.5	244
Total	8,147		936

(2) **Road plan**

Traffic on the existing inner port roads is rather congested for such reasons as inappropriate management, coexistence with railroad right of way, and inadequate road capacity. Future port roads in the master plan have to be able to cope with such qualitative and quantitative changes as the increase of volume of port cargo and the introduction of container transportation. Taking the speciality of vehicles using inner port roads and the convenience of parking into consideration, four lanes and two lanes are proposed for, respectively, trunk and branch roads. Stoppage zones are also proposed. The width of each lane is 3.5 m for use of special vehicles including mobile cranes Figs. 6-11 ~ 13 show the standard sections of roads.

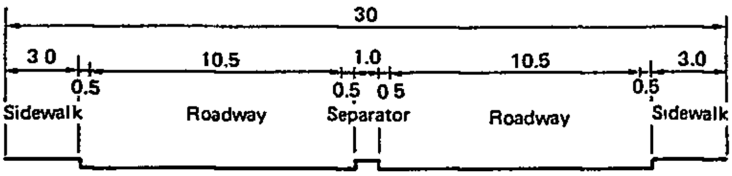


Fig. 6-11 Standard Section of Trunk Road

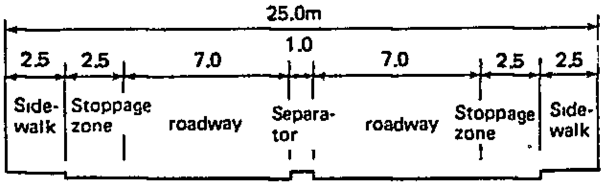


Fig. 6-12 Standard Section of Principal Road

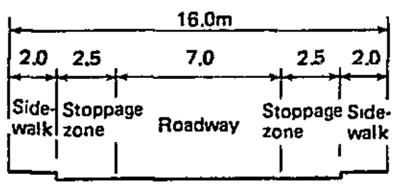


Fig. 6-13 Standerd Section of Branch Road

(3) Dock Railway Plan

Railway transportation at Callao Port has dwindled to less than 3% of the volume of port-handled cargoes, reflecting the expansion of motor transportation.

Under these circumstances, rails now existing on each apron will be removed and a marshaling yard capable of centrally sorting railway cargoes will be provided in the port area when this area is redeveloped. This can end the obstruction of efficient cargo handling by railway facilities. This plan proposes a railway siding on the apron for only one berth.

6-3-9 Other Facilities

(1) Small Craft Mooring Facilities

Wharf bases will be used to moor the small craft necessary for the operation of the commercial port – including government vessels and tugboats to help in the berthing and unberthing of ships.

(2) Parking lot

Disorderly parking in the wharf area obstructs not only traffic but also smooth port activities. To prevent this and enable the port to be efficiently operated, parking lots are provided inside the port. The total area of the parking lot was planned to be 35 thousand m^2.

Required parking spaces for automobiles are 30 m^2 and 100 m^2 respectively, for small and large sizes.

6-3-10 Port Environment Improving Plan

The master plan for improving Callao Port proposes not only to modernize and accelerate goods distribution at the port but also to realize a unique port agreeable to local environments by providing symbolic green space and scenery green space to eliminate alienation between the port and the local inhabitants and make the port likable to these people.

(1) Synbolic Green Space

The symbolic green space shown in Fig. 6-14 combines many functions including the function as a resting place for the local people, the educational function to enable them to understand the importance and the role of the port in reference to their civic life and furnish them with news and information about the sea and the function to give them opportunities for maritime recreation or sight-seeing. This site commanding the view of the container wharf, which is the main facility of the port, will be planted and provided notably with a symbol·tower designed with its sea ward appearance in mind, and a maritime recreation facility enabling yatching and pleasure-boating to be enjoyed in the calm sea around.

The symbol tower (80 m) will be taller than the container cranes and house an observatory, a marine museum and so forth. The maritime recreation facility caters to pleasure-boating. As for the character of the marina, its facility capacity must be decided in consideration of the types, demand and profitability of boats to be used. Here, the layout is planned as in Table 6-10 by assuming use conditions and for the convenience of understanding generally what its proportions should be.

Table 6-10 Scale of Marina Facility Plan

Type		Number	Clubhouse area (m^2)	Parking space (m^2)
Sailboat	large	100	750	1,800
	small	160	600	1,900
Motorboat	large	40	300	1,500
	small	40	200	
Total		340	1,850	5,200

Note: By "small" is meant boats (less than 16 feet) that can be pulled up or down by manpower, taking advantage of the slipway and using the stock.

(2) Scenery Green Space

Acenery green space importing scenic beauty to the port, intervening and demarcating the spaces of the port and the city and serving as a buffer between them is proposed for the central entrance to Callao Port. Characteristically, this green space is designed, primarily, to provide opportunities for the crew members of ships calling at the port, laborers working in the port and city people in general to engage in friendly exchanges through sports, as well as to provide opportunities for their relaxation. Therefore, it will comprise a multipurpose turfed open space available for soccer games, tennis courts and so forth. The area will be surrounded by a wooded belt, play space for children and other facilities. Thus the whole area will produce many pleasures as a sports park and green area. The scenery green space will have a size of 2 ha. The map of what is planned is given in Fig. 6-15.

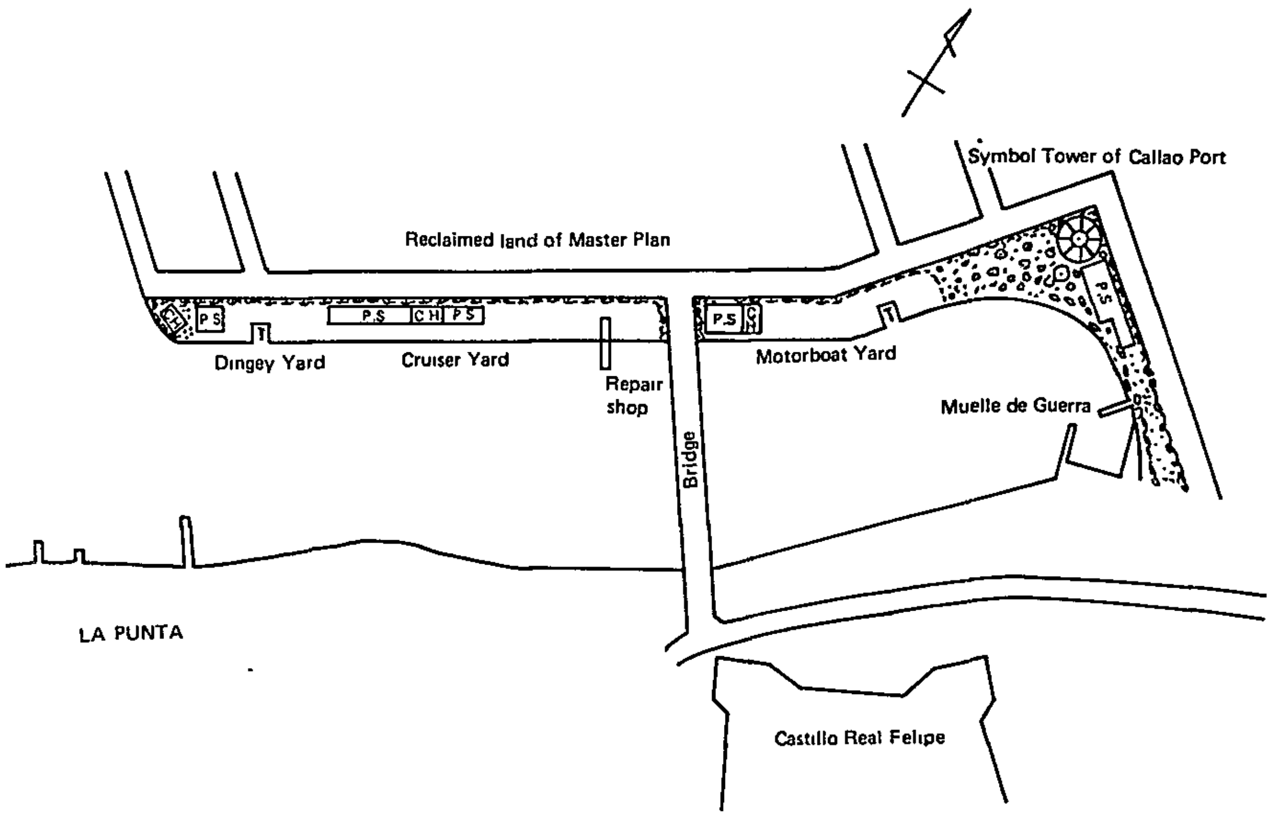


Fig. 6-14 Symbolic Green Space

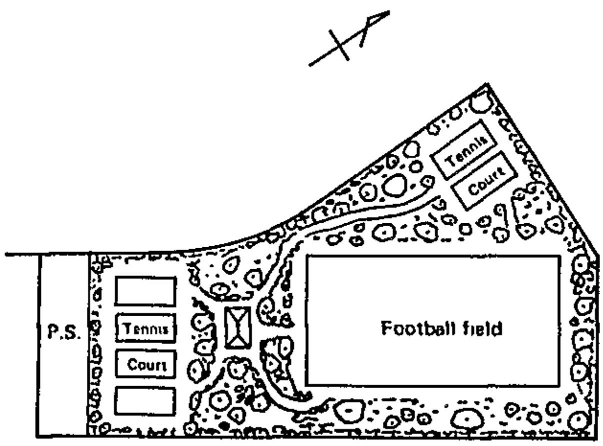


Fig. 6-15 Scenery Green Space

6-4 Master Plan and Evaluation

6-4-1 Preparation of Alternative Plans

(1) Basic Conditions for Preparing Alternative Plans

In order to prepare a mast plan it is first necessary to study the future pattern of space utilization.

This study will examine the water area south of the south breakwater as a new port development space. It will also look at the inside of the present commercial port as a port redevelopment space.

Redevelopment within the confines of the existing commercial port is aimed at improving obsolete facilities and increasing the loading capacity mainly through the reorganization of the No. 1 – No. 4 piers and the extension of the wharf areas. There is little room for rearrangement of existing facilities, nor is there much unused space, so there are few options concerning in-port plans for redevelopment. As for the area south of the present south breakwater as a new port development space, several restrictions and conditions must be considered. For example, the potential range of port development, and the scale of the port facilities to be developed, as well as the relations with the existing port facilities and with the city district, must be considered.

In particular, depending upon the extent to which development space in water area south of the present south breakwater is limited, then drafts of development plans must accordingly be prepared for maximum utilization of the limited space. This must be done independently of time considerations such as target years. Next, within this larger picture, a master plan must be drawn up establishing the area to be developed by the target year 2000.

When drawing up the alternative plans, the above points must be remembered together with the following premises:

1) Extent of possible development

The development space is surrounded by the present south breakwater on one side, and the La Punta coastline on the other. The limits in the direction away from La Punta (Northwest) and the direction along La Punta (Southwest) are as follows.

First in the northwest direction, there is the restricted area established by the Ministry of the Navy where a large number of battle ships and freighters are moored at all times, as well as a small fishery port.

Development plans must not disturb this restricted area. Whenever the port plan water area might extend into the restricted area, we must consider instead the securing of space in the south water area adjacent to the present restricted area.

In addition, the water depth in the northwest area would also preclude its use for construction of new facilities, for to be economically feasible, the maximum water depth should be –10 m or more.

Next, in a southwesterly direction, the coast line of La Punta extends along a 3 km stretch of gravel beach. Located here side by side on the northside of the peninsula are landing equipment for boats and yachts, piled jetties for mooring, boat houses and club houses. Set back from the shoreline is a residential district and the naval school's boat moorage.

In addition, the waters offshore are used for anchoring small crafts such as yachts and boats. In order to avoid interfering with the recreational use of the offshore waters as well as to preserve the view from the nearby park the boundary of development should be drawn within a distance of approximately 1.5 km from the existing south breakwater.

2) Scale of facilities

For the target year 2000, at least, 5 container berths (1 small berth), 8 general cargo berths, 2 grain berths, 2 mineral ore berths and 3 oil berths will be needed as shown in Table 6-8. However, in consideration of the total picture, the alternative plans call for construction of an even greater number of berths than stated above.

The standard size of these berths are shown in Fig. 6-16 'Model of container terminal' and Fig. 6-17 'Model of general cargo wharf'.

In addition, reclamation will provide room for an outdoor storage area, a warehouse area, a road area and other related facilities. More than 90 ha. are to be secured by reclaimation.

3) Relations with the existing commercial port facilities

Since the present port activities must not be interrupted during the construction of new port facilities, the effects on the present commercial port facilities must be minimized. For this reason, the new plan must take place in an area, by and large separate from existing port facilities and activities.

The center line down the present approach channel is regarded as an optimal center line, established over many years experience. Thus the new port facilities should be planned to allow smooth traffic following the established center line as much as possible.

Furthermore, the waterway should be maintained that leads to the original section of Callao Port, now functioning as a park, at the south end of the present port. This will preserve the scenic view and will allow passage of boats that operate between mooring ships and this original section.

4) Relations with neighboring city districts

Plans must be formulated in such a way that the above mentioned waterway can also serve as a buffer, in conjunction with the adjacent beach and park, separating the development project from the neighboring city districts. This waterway should be at least 250 meters wide, serving also as an anchorage for yachts and boats.

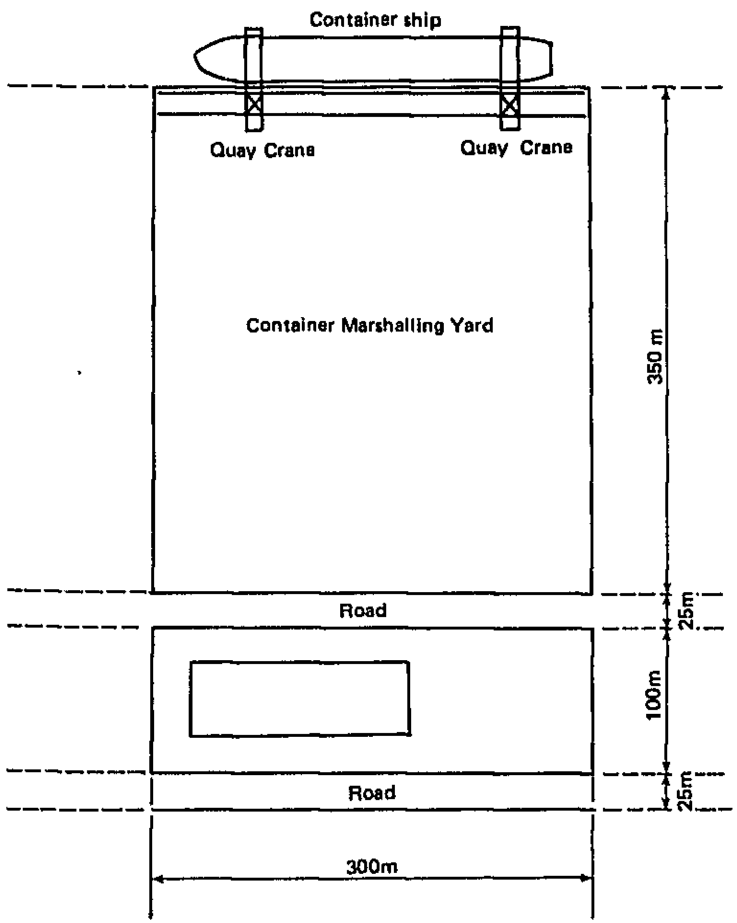


Fig. 6-16 Model of Container Terminal

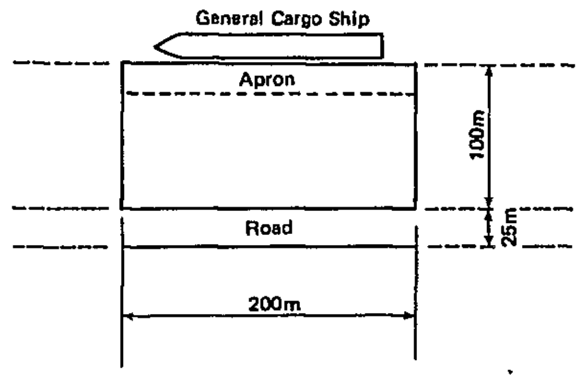


Fig. 6-17 Model of General Cargo Wharf

(2) **Alternative Master plans and Rationales for Each Plan**

The alternative master plans are termed A, B, C as shown in Fig. 6-18 ~ 20.

Special considerations have been made in preparing each alternative plan, as outlined below.

(Plan A)

In order that the construction of container terminals and the commencement of services be begun as soon as possible, the initial amount of work and the initial investments will be kept as small as possible.

By keeping the water line of berths within the limits of the present port, the present south breakwater is usable as is. The shape of the wharf and center line of the breakwater were studied in consideration of the possibility that there would be further expansion of Port Callao after the year 2000.

The center line of the breakwater was planned to increase its function to eliminate waves entering the port. It was also planned to allow emergency entry/exit of ships, as well as to give ample anchorage space for maneuvering ships.

According to this plan, 4 container berths and 4 general cargo berths are arranged to allow sufficient handling capacity of general cargo.

(Plan B)

Plan B is similar to Plan A. In regard to the container terminals, 4 container berths were arranged in a row to make for efficient use of facilities.

In this plan, 3 berths are planned for the general cargo terminal, but these will be constructed during the last stages of work.

(Plan C)

This plan is similar to Plans A and B in regard to early construction of the container terminal and the early commencement of service. Plan C shapes the development area so that the breakwater length is minimized. This shape also minimizes any interference in the present restricted water area.

Regarding the stages of work, funds will be invested carefully stage by stage so that investment at each stage can be as effective as possible.

In order to allow sufficient anchorage space, the present south breakwater can be removed, if necessary. For future expansion, the outer end of the south pier, which will be constructed in the 3rd and 4th stages, can be made available.

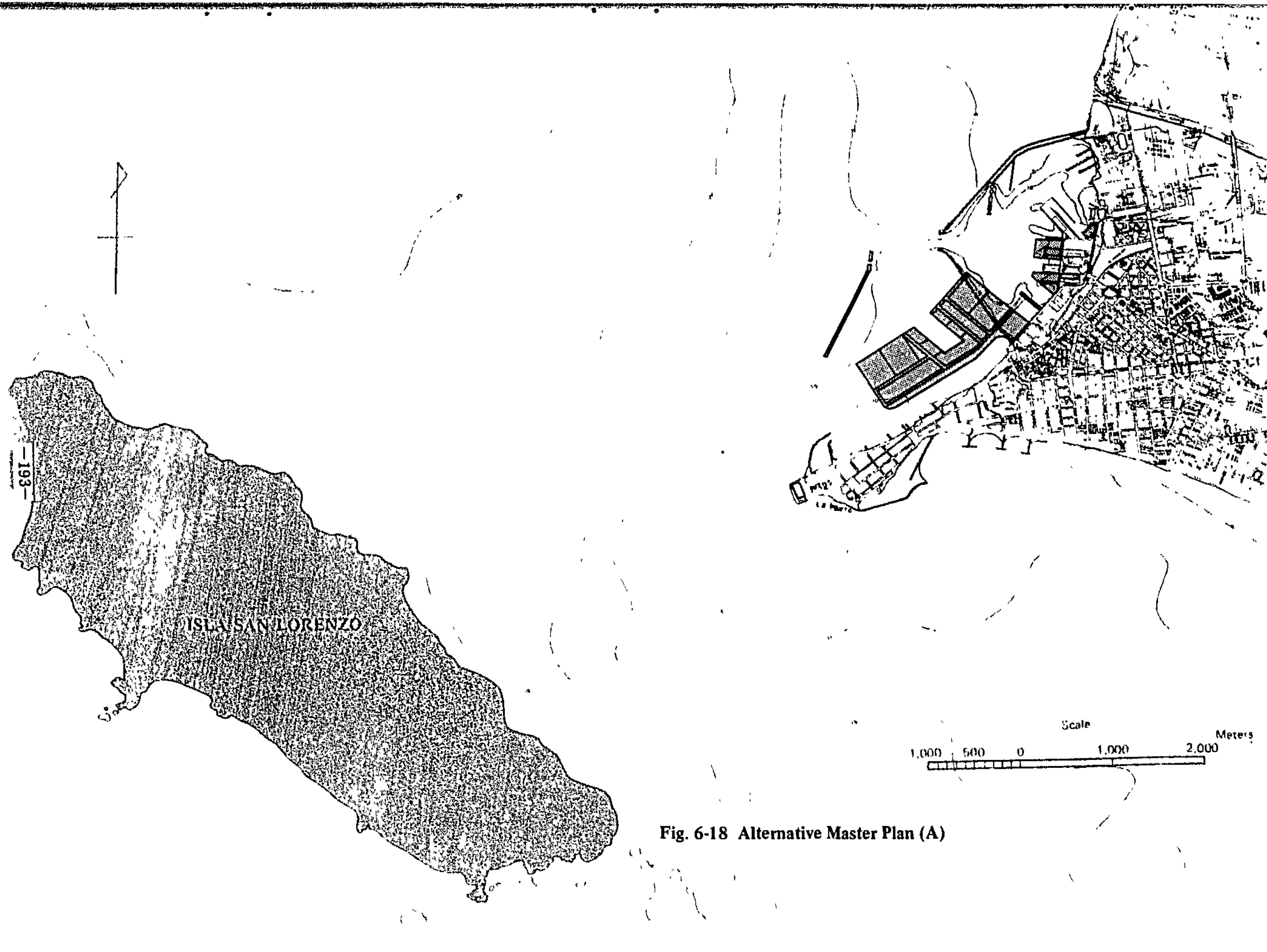


Fig. 6-18 Alternative Master Plan (A)

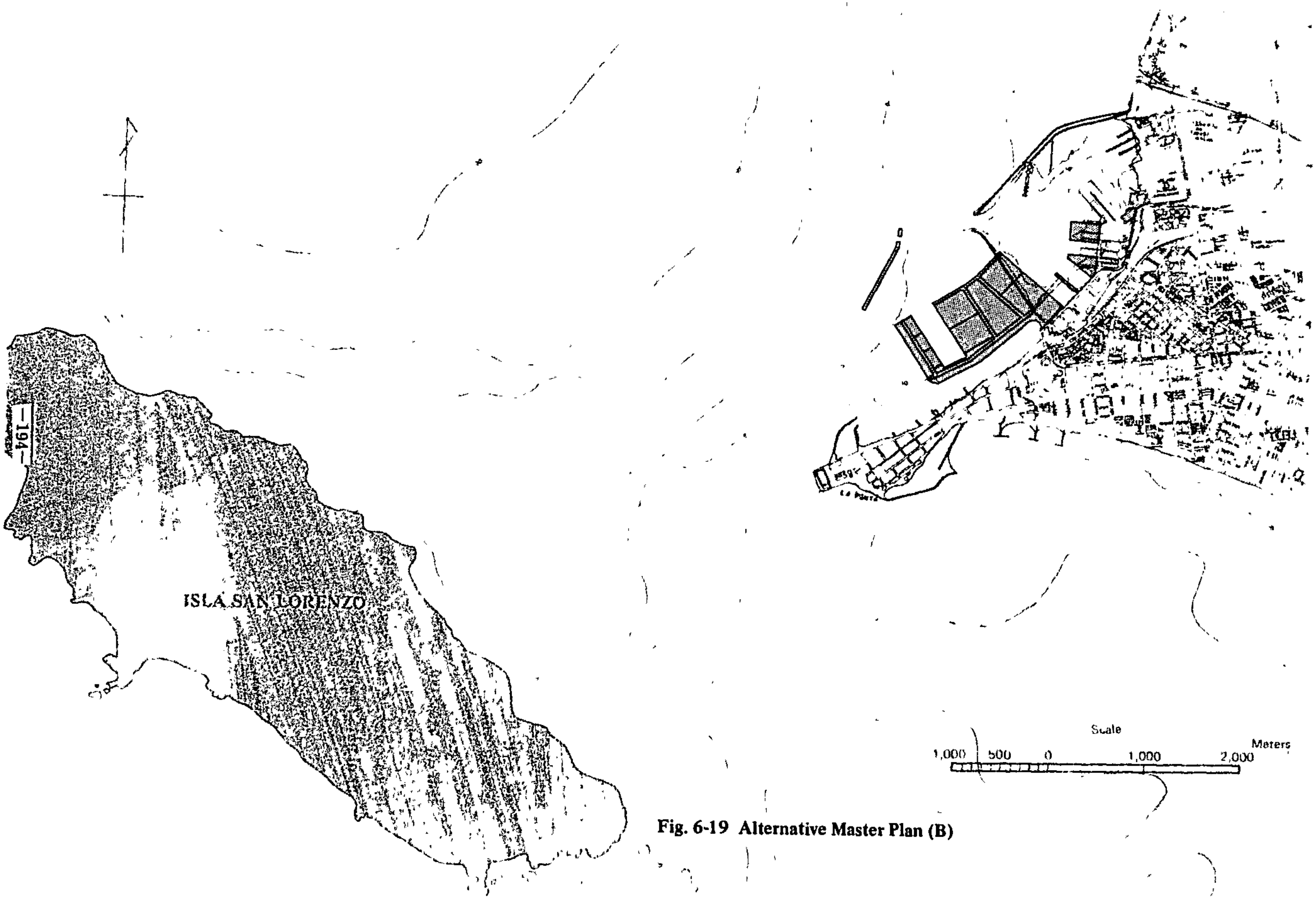


Fig. 6-19 Alternative Master Plan (B)

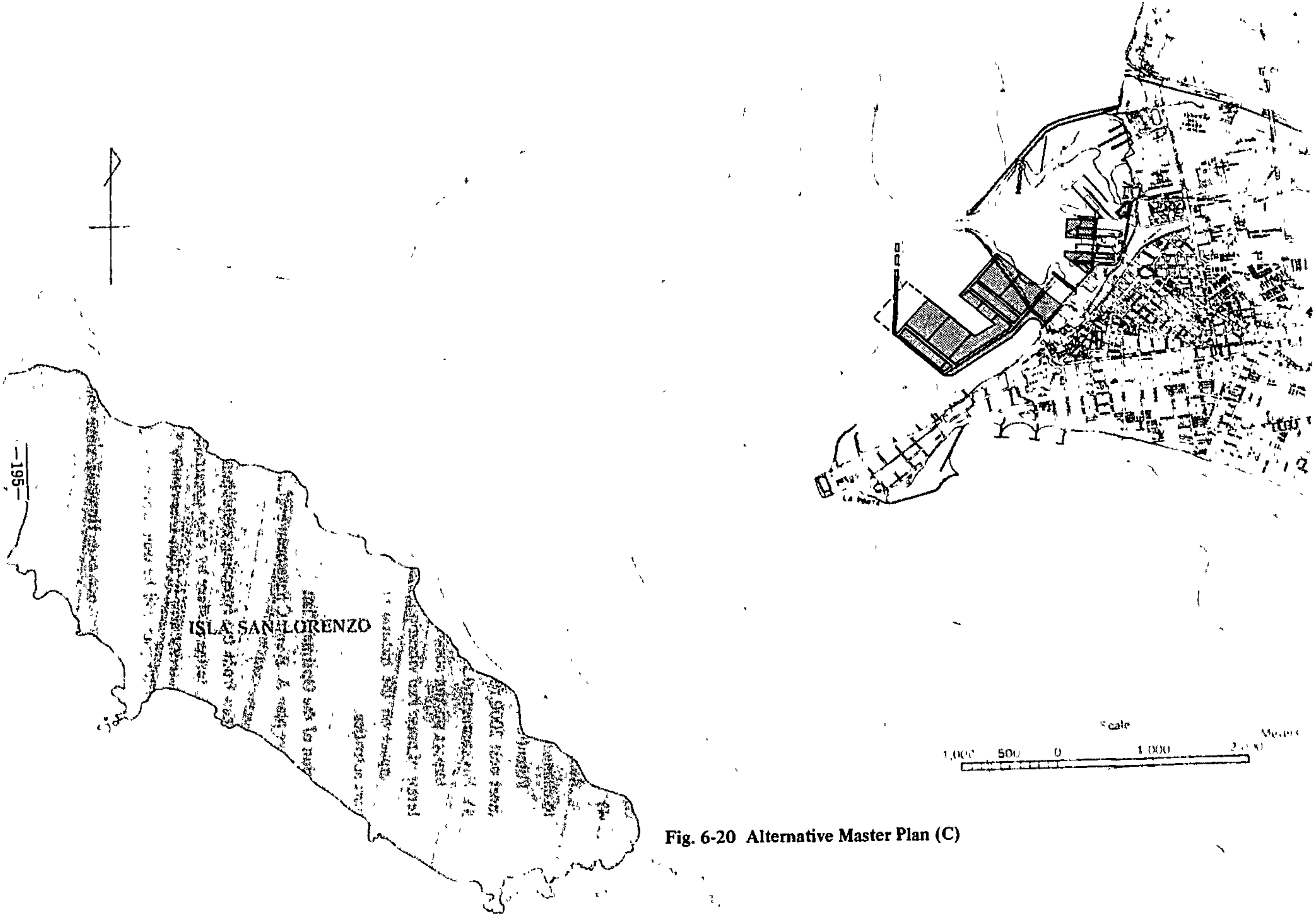


Fig. 6-20 Alternative Master Plan (C)

6-4-2 Evaluation of Alternative Plans

Alternative plans for each case are evaluated from the following viewpoints.

(1) Criteria for Evaluation

1) Convenience

Maneuverability of ships – Ease with which entry/departure and berthing/deberthing of ships is possible.

Land use – ease with which cargo can be stored or transported, from the standpoint of users, and with regard to shape of the reclaimed land and the arrangement of facilities and roads.

Operation of facilities – effectiveness with which port facilities and loading equipment can be operated.

2) Safety

Calm waters inside the port – sufficient width of calm water area secured against invading waves in front of the berths, for easy loading and unloading inside the port.

Emergency measures – effectiveness and adaptability of measures to deal with accidents occuring inside the port.

3) Economy

Total construction cost – minimization of the total construction budget, in consideration of costs for topography, soil conditions, balance between dredging volume and reclamation volume, etc.

Graduated investment – minimization of investment and maximization of effect while conforming to the requirements of early construction and early start of service.

4) Flexibility of the Plan

Adaptability to changing conditions – whether it is possible to adapt the plan according to changing circumstances.

Potential for future development – availability of room for future expansion in order to meet post 2000 future demands.

5) Environmental Protection

Impact on the social environment – Harmful effects on the living standards of citizens in terms of noise and vibrations created by port activities, and harmful effects on scenery.

Impact on the natural environment – the effect of pollution on marine life due to the port activities.

(2) Selection of the Optimal Plan

Alternative plan A, B and C have been evaluated according to the above mentioned criteria, as follows.

As can be seen from the foregoing evaluations, the plans do not differ much, but Plan C is especially flexible in terms of stage by stage construction.

Also, the port activity area in plan C is clearly defined so that it is unlikely that the water area south of the outer pier will be used both by ships entering/leaving Callao Port as well as by boats and yachts.

Plan C has only one enterance/exit. However, since the entrance/exit is quite wide, it will be possible to carry out emergency measures in the event an accident should occur within the port.

In consideration of these factors, Plan C has been selected as the most appropriate plan.

Table 6-11 Evaluations of Alternative Plans

Items of evaluation		Evaluation		
		Plan A	Plan B	Plan C
Convenience	Maneuvability of ship	○	◎	◎
	Land use	○	○	○
	Operation of the facilities	○	◎	○
Safety	Calmness of waters within the port	○	◎	◎
	Emergency measures	◎	◎	○
Economy	Total construction costs	○	○	◎
	Investments by stage	○	△	◎
Flexibility of planning	Measures for anticipated future change	△	△	◎
	Future development	◎	◎	○
Environment preservation	Effects on social environment	○	○	◎
	Effects on natural environment	○	○	○

Note: Ranking of evaluation ◎ Excellent
○ Ordinary
△ Some problems

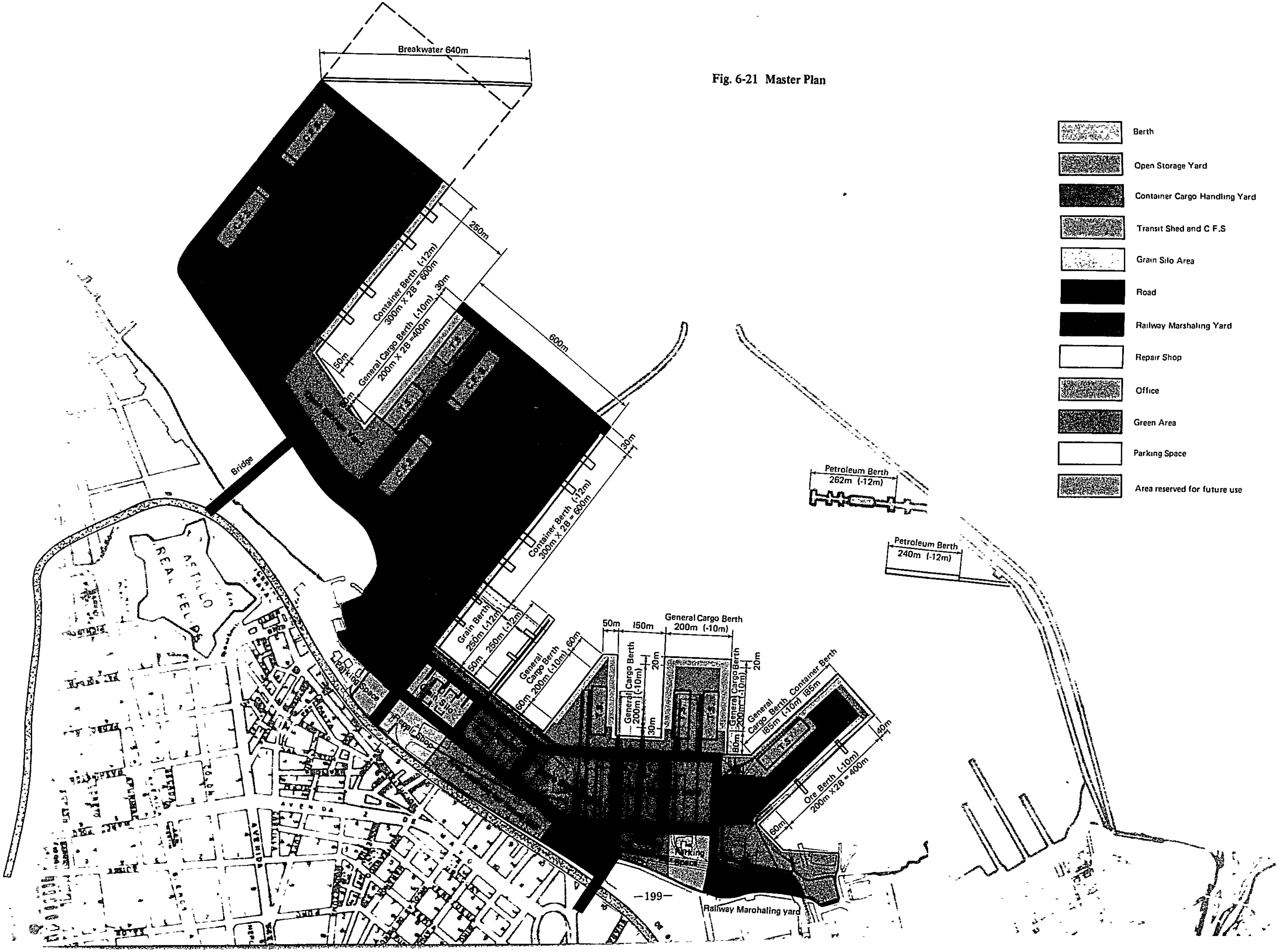


Fig. 6-21 Master Plan

6-5 Construction Plan of the Master Plan

The construction plan with a target year of 2000 must naturally the executed in gradual stages. When planning the construction, attention must be paid to the following points: 1 Availability of facilities to meet changing cargo volumes; 2 Minimization of the disruptive effects of construction on daily port operations. 3 Construction investment should be well-distributed so that it is not over-concentrated at any single development stage. Construction investments will continuously stimulate the regional economy, and will help the local economy achieve stability. As for the adequacy of the port's facilities to meet projected cargo volumes, two areas have particular importance: the container wharves and the general cargo wharves including redevelopment of the existing general cargo wharves. Construction of grain and mineral ore wharves will be timed and located to harmonize with the location and timing of container and general cargo wharf construction.

The container-handling capacity at the beginning of 1984 will be 650,000 tons (81,000 TEU), resulting from the improvement of Berth No. 5B. The general cargo handling capacity is estimated to be around 2,150,000 tons. However, by the middle of 1986, this container-handling capacity will fall short of the estimated container volume. On top of that, according to the construction schedule (Fig. 6-22), Container Wharf No. 1 (C_1) will not be ready for use until the end of 1987 at the earliest. Assuming that per-berth handling capacity for a container wharf is 850,000 tons, then container wharves built after the first container wharf must begin operation by 1990 for C_2, by the end of 1993 for C_3, and by 1997 for C_4, in order to meet container cargo volume increases.

Let us now examine for each case the schedule for construction or redevelopment of general cargo wharves, taking into account the above mentioned container wharf start-up schedule, and in accordance with the above stated basic ideas.

Prior to the construction of C_1, existing berths 9A – 9C must be removed from Port Area I. This will reduce the handling capacity of the general cargo wharves by about 600,000 tons, to a level insufficient to meet predicted cargo volumes. To deal with this 5F will be prepared in advance, thus increasing the handling capacity for general cargo. Even so, capacity will continue at a level less than the estimated cargo volume for some time. Additional increases in this capacity will be achieved through construction of general cargo berths behind C_2 in area IV. With these facilities in operation by the end of 1990, the general cargo handling capacity will be adequate.

But again by 1993, general cargo handling capacity will once more be insufficient to meet expected increases in cargo volumes. It would be desirable at this point to commence redevelopment of Area II. However, as construction of C_3 is scheduled to begin at that time, it will not be possible to simultaneously invest in Area II, so towards the end of 1993 cargo handling capacity will temporarily be insufficient.

In 1994 it will be possible to commence redevelopment of Area II. Redevelopment of Area II will be given priority over Area III as this will cause the least disruption to port operations. If Area III were to precede Area II, then five berths would be put out of commission during construction (2B, 3A, 3B, 4A, 4B). Construction in Area II will only put four berths out of commission (1A, 1B, 2A, 2B).

Redevelopment of Port Area III will be started immediately after the completion of work on

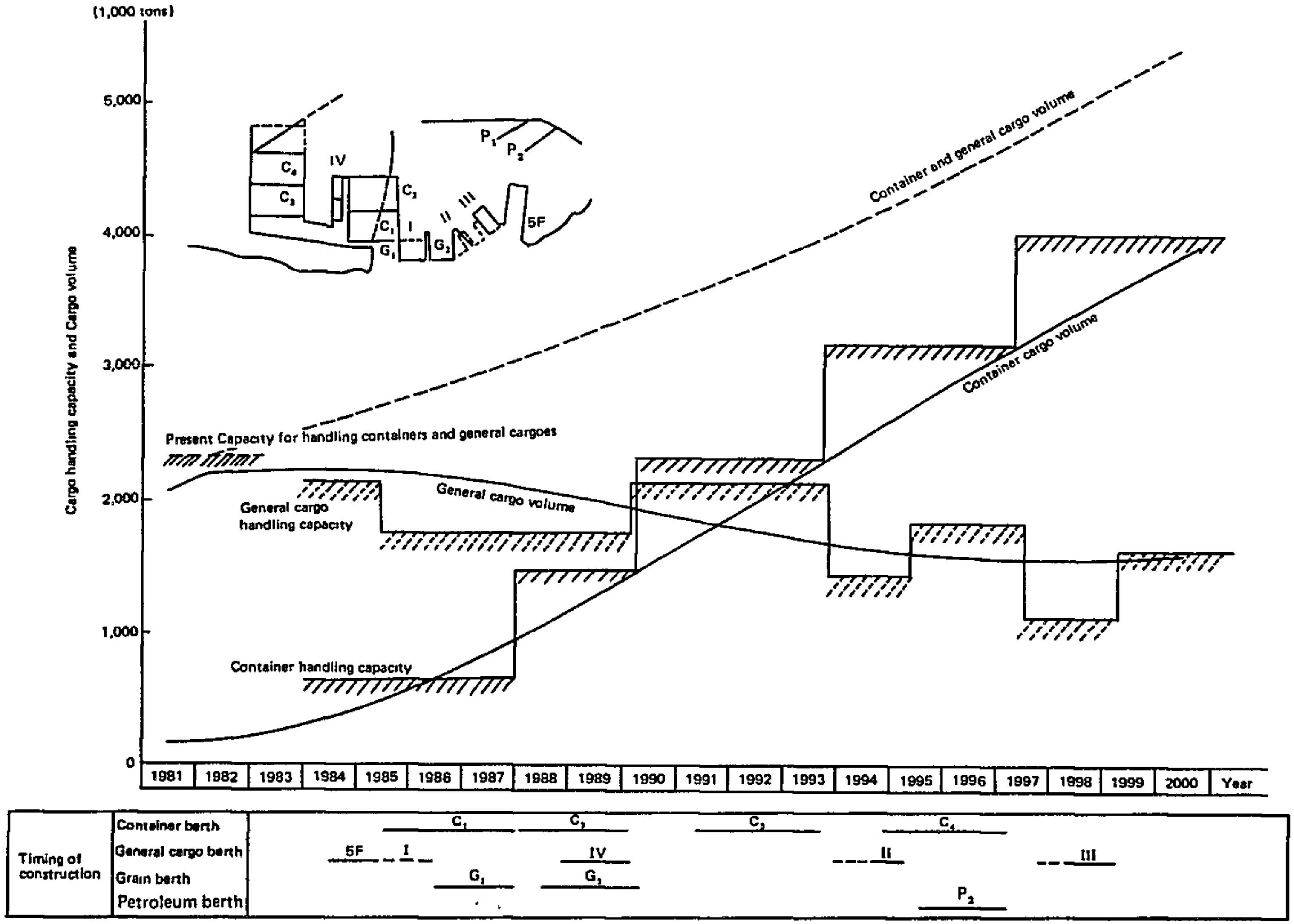


Fig. 6-22 Stage Plan for Constructing Berths of the Master Plan

C_3, at which time the capacity of the general cargo wharves will be more than sufficient for the anticipated cargo volume. Area III redevelopment will be completed in the beginning of 1999.

The capacity of the general cargo wharves will exceed the forecasted cargo volume from the around the beginning of 1996. At that time, port management will become stabilized.

Periods exist when the capacity of the general cargo wharves is lower than cargo volume (demand/supply gap). However, since the capacity of the container wharves will exceed container cargo volume during all these periods, except from 1985 – 1987, this demand/supply gap can be overcome by using the container wharves to full capacity. We have also proposed to carry out port redevelopment without interruption until completion at each port area. However, port areas to be redeveloped will have to be divided into several smaller engineering sub-categories so as to maintain an optimum demand/supply (capacity) balance.

Regarding container wharves, container cargoes can be effectively handled by the year 2000 through completing C_4 in the beginning 1997.

All the necessary channels, basins for ship maneuvering (turning and mooring basins), and breakwaters will be constructed in accordance with the planned improvement of container and general cargo wharves. A water depth of -12 meters will be necessary alongside C_1, and dredging for a channel and basin will be carried out at the same time as construction for C_1. To assure calmness in front of the general cargo wharves in Port Area IV, it will be necessary to build a breakwater. Furthermore, necessary improvements in the basin will be carried out to enhance the function of C_3 and C_4.

Speedy improvements are required in regards to the situation concerning the grain wharf, as its cargo volume already exceeds its capacity. Some improvement is possible through installation of larger capacity handling equipment. However, in the long run, it will be necessary to construct a larger grain wharf. We propose redevelopment of the present grain wharf before the larger wharf's capacity becomes insufficient in the face of increasing cargo volumes.

Mineral ores will be handled mainly at 5D and 5E. 5E and 5F will be provided with cargo-handling equipment for their exclusive use.

No. 2 Pier for oil will be developed around 1995 in consideration of increasing of cargo volume, and in consideration of the No. 1 Pier's operating condition.

As mentioned above, the construction plan through the year 2000 can be divided into 4 stages.

Figs. 6-23 ~ 26 show plans for the port at each stage. Table 6-12 shows the time period required for each stage and the main work being undertaken.

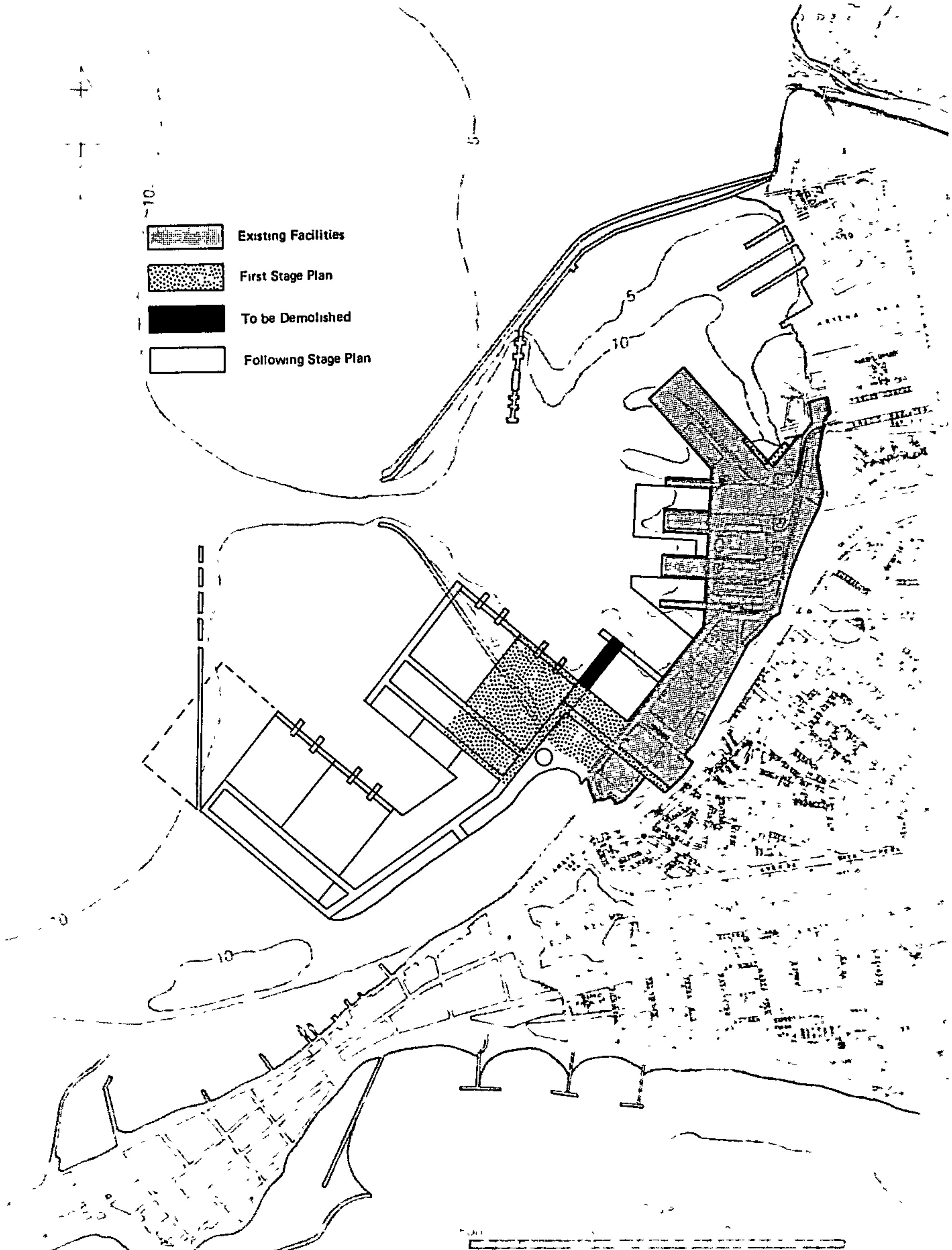


Fig. 6-23 Construction Program (First Stage)
1984 ~ 1987

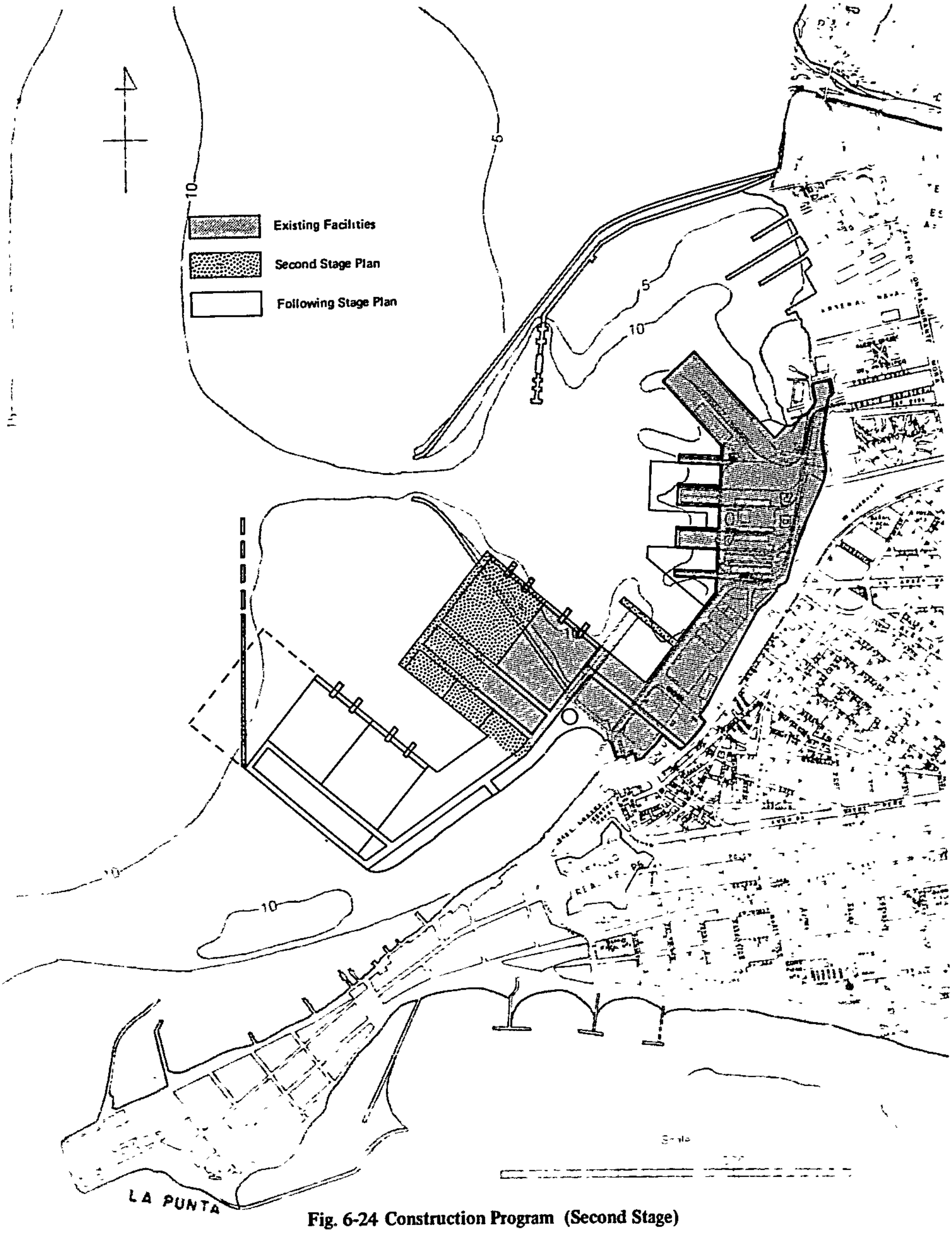


Fig. 6-24 Construction Program (Second Stage)

1988 ~ 1990

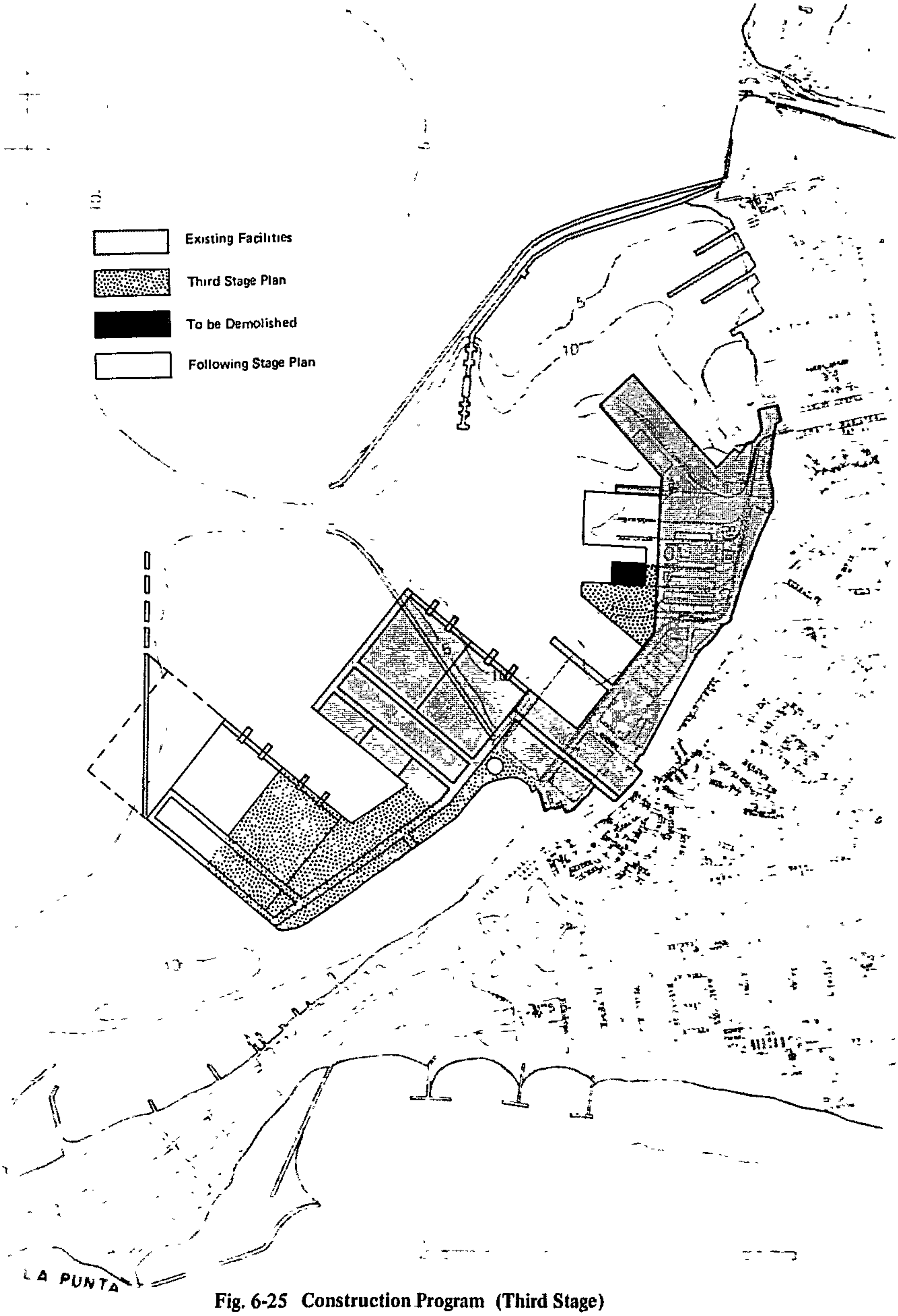


Fig. 6-25 Construction Program (Third Stage)
1991 ~ 1994

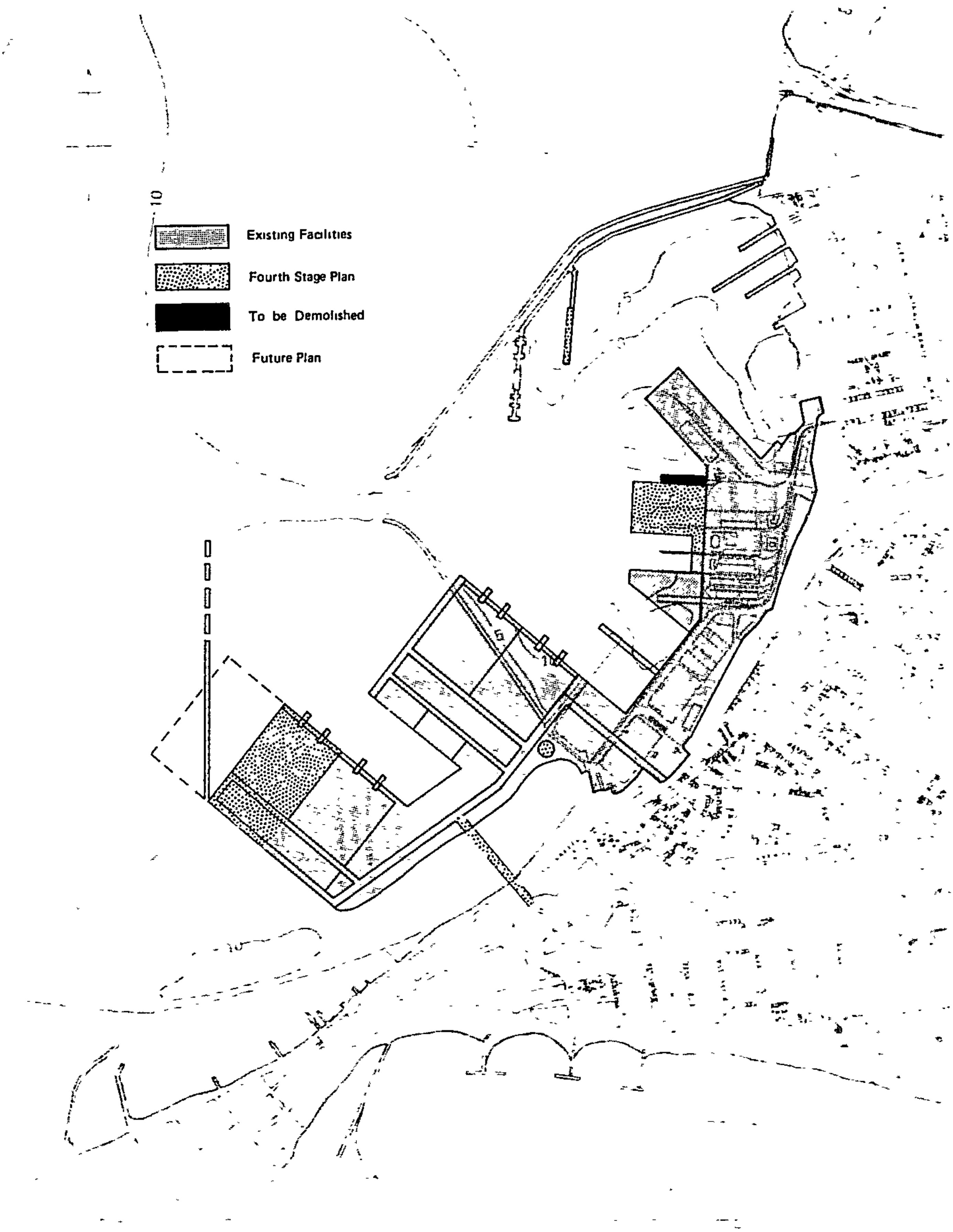


Fig. 6-26 Construction Program (Fourth Stage)

Table 6-12 Outline of Construction Plan

Stage of Construction	Construction Period	Outline of Development of Facilities					
		Wharf	Revetment	Site Preparation	Breakwater	Dredging of channel and anchorage	Loading and Unloading equipment, etc.
1st Stage	1984-1987	• 5F berth newly installed at No.5 wharf, water depth -10m, length 100m • Removal of No.9 wharf • Container berth newly installed, water depth -12m, Length 300m • Grain berth newly installed, water depth -12m, length 250m	• Temporary revetment	• Site for pier		• channel • Anchorage (for container and grain berths)	• A set of container loading equipment • Addition of grain loading gear and silo
2nd Stage	1988-1990	• Container berth newly installed, water depth -12m, length 300m • General cargo berth newly installed, water depth -12m, Length 500m • Grain berth newly installed, water depth -12m, length 500m	• Ship-mooring revetment • Wave absorbing revetment • Temporary revetment	• Site for pier	• New installation	• Channel • Anchorage (for container and grain berth)	• A set of container loading equipment • Addition of grain loading gear and silo
3rd Stage	1991-1994	• Removal of No.1 and No.2 Wharves • Construction of general cargo wharves (re-development), water depth -10m, Length 500m • Container berth newly installed, water depth -12m, Length 300m	• Ship mooring revetment • Wave absorbing revetment • Temporary revetment	• Site of the pier • Site for the pier (redevelopment)		• Anchorage (for container berth)	• A set of container loading equipment
4th Stage	1995-1998	• Removal of No.3 and No.4 wharves • Construction of general cargo wharves (re-development), water depth -10m, length 650m • Container berth newly installed, water depth -12m, length 300m • No.2 oil pier water depth -12m length 250 m	• Wave absorbing revetment	• Site for the pier		• Anchorage (for container berth)	• A set of container loading equipment

CHAPTER 7
Short-term Development Plan for Callao Port

CHAPTER 7. SHORT-TERM DEVELOPMENT PLAN FOR CALLAO PORT

7-1 Target for Short-term Plan

The major goals for Callao Port by 1987 include supplementation of facilities and improvement of operations.

With regard to the facilities, the notable problems include a shortage of facilities to adequately handle the large volume of cargo as well as the obsolescence of the facilities that do exist. Of these two problems, the shortage of facilities is more acute.

In particular, there is a pressing need for further development container wharves and grain wharves.

The container cargo handling capacity of berth No. 5B will soon be pushed to the limit, while at the same time, large container vessels are unable to gain access to the berth.

As for grain cargoes, in addition to the problem of ship congestion in the port, there are also obstacles to the entry into the port of large grain cargo ships.

Fewer general cargo berths are now needed due to the continuing progress of containerization. However, the present facilities must be maintained at their same level for the time being, as further improvements in the operation of these wharves can not be quickly achieved. Such operational improvements include the use of transit sheds and introduction of measures to prevent cargo damage during loading, unloading and storage. Although changing over to these new systems is desirable on the long run, a short term policy aimed at expanding the actual number of certain key facilities will ensure smooth implementation of the master plan.

7-2 Site Selection

The development of container berth and grain berth is indispensable under the short term plan. The planned location for the container berth in the Master Plan is the southern water-way area of the port.

Adoption of this site will necessitate demolishing the existing No. 9 berth, resulting in a decreased general cargo handling capacity. However, use of this berth will be subject, in any case, to substantial disruption after construction of new grain wharves proposed under the master plan. Therefore, demolition of the No. 9 berth is deemed to be an insignificant remification of adopting the south offshore site for construction of the short term plan container berths. Additionally, this site is the most economical option, and will most facilitate implementation of the master plan.

As for general cargo wharves, the redevelopment of these facilities comprises the bulk of the master plan. It is not considered advisable to focus on their redevelopment under the short term plan, as this would overly impair the Port's general cargo handling capacity.

7-3 Study Concerning Required Berths

7-3-1 Container Wharf

Container cargo volume will be 854,000 tons in 1987. 650,000 tons of this volume can be handled at berth No. 5B, so the required capacity for the new wharves will have to at least equal the remaining 204,000 tons. This required capacity necessitates the construction of one berth. In order to accommodate large container ships, the berth must have a water depth of −12 m, two container cranes, and a yard area of 150,000 m^2.

In order to forecast operating conditions of this berth, a simulation based upon queuing theory has been carried out.

The simulation assumes that all large container ships will berth at the new wharf, and that smaller container ships will be handled at both berth No. 5B and the new berth. For a complete list of premises upon which the simulation is based, please refer to the master plan which describes and employs the same simulation method.

Calculations drawn from the simulation concerning the new berth indicate an occupancy rate for large ships of 31.5%, a rate of waiting ships vis-a-vis berthed ships of 13.5%, and a waiting time per ship to 6.5 hours. As for berth No. 5B, the simulation indicates figures of 27.1%, 16.2% and 8.1 hours respectively for the above categories. Although these waiting times forecast by the simulation are somewhat long, they are still quite reasonable and confirm the appropriateness of constructing one berth under the short term plan.

7-3-2 Grain Wharf

The present grain wharf has a shallow water depth, and the capacity of its loading/unloading equipment is insufficient to handle increasing volumes of cargo.

It is estimated that the volume of grain in 1987 will reach the level of 1,367 thousand tons.

Therefore, the new grain wharf will be equipped with one modern berth having a water depth of −12 m (target ship type: 60,000 DWT) and large capacity loading equipment (2 units: 400 t/h x 2)

The results of simulation indicate a berth occupancy rate of 43.8%, a rate of waiting ships vis-a-vis entering ships of 27.0% and a waiting time of 47.5 hrs.

As for the silo attached to this wharf, 56% of the volume of present grain imports pass through this silo, while the remaining 44% is loaded directly onto trucks at the port. Assuming this ratio stays the same in the immediate future, then in 1987 the annual volume of grain to pass through the silo will be 766,000 tons.

Grain storage of the Callao Port silo is quite temporary, with the silo having an annual turnover of 24 times/yr. Assuming this turnover rate stays constant, then the required capacity for the grain wharf silo will be 32,000 tons in 1987. This being the case, the existing 26,700 ton silo will have to be replaced under the short term plan. A single new silo combined with a mechanized unloading system, as explained in the master plan, will be sufficient to meet the grain wharf's short term requirements.

7-3-3 Mineral Ore Wharf

Mineral ores will be loaded/unloaded by movable rotor (actual capacity 350 t/h), mostly at berths 5D and 5E as at present.

Cargo volume in 1987 is estimated at 1,641 thousand tons, and average loading capacity per ship is estimated at 5,000 tons. The results of simulation indicate a berth occupancy rate of 48.3%, a rate of waiting ships vis-a-vis entering ships of 14.0%, and a waiting time of 8.9 hrs.

Based on these estimations, it appears that an additional two berths will be sufficient for the short term.

7-3-4 Petroleum Wharf

Oil is currently pumped onto ships at the existing pier.

Oil cargo in 1987 is expected to reach 2,314 thousand tons, while the average load per ship should be 7,700 tons. The results of simulation indicate a berth occupancy rate of 44.5%, a rate of waiting ships vis-a-vis entering ships of 12.0%, and a waiting time of 8.4 hrs.

Accordingly the capacity of the existing pier should be sufficient for the short term.

7-3-5 General Cargo Wharf

The volume of general cargo in 1987 is estimated at 2,187,000 tons. It is necessary to study the feasibility of handling this total volume at only nine wharves, since four of the ports existing berths will be out of use, due to demolition of the No. 9 berth (as part of the short term expansion plan south of the port) and due to the consequent re-routing of container cargo to berth No. 5B.

Under these conditions, in the event that all the general cargo wharves are full, and if grain and mineral ore berths are not occupied, it would then be appropriate for general cargo ships to use these empty berths. To put it more precisely, use by general cargo ships of these berths is allowable in so far as mineral ore and grain ships are not displaced or obliged to wait.

The foregoing has been entered as a premise (along with the premise that only nine wharves will be in use) in the simulation of 1987 port operations. Results of the simulation indicate a berth occupancy rate of 75.7%, a rate for waiting ships vis-a-vis entering ships of 2.0%, and an average waiting time per ship of 4.4 hrs.

In addition, during the simulation test period (prototype period: 1 year), 9 general cargo ships were unloaded at the mineral ore berth and 12 general cargo ships made use of the grain berth.

Based on these simulation test results, it appears that there will be somewhat of a shortage of general cargo facilities. As it will be difficult to quickly replace the No. 9 berth facilities, it will thus be necessary to improve operating efficiency to make up for this shortage.

7-4 Alternative Options for the Short-term Development Plan

In preparing the short-term development plan factors to be considered include: (a) effective handling of containers, (b) minimizing investment, (c) smooth shifting to the next plan, and (d) quick completion of the project. Of course, consideration must also be given in terms of design and construction to protecting the reclamation from settlement.

Judging from the shape in the master plan, it is not only economical but also convenient for the use of port facilities if container berths and grain berths requiring rapid construction under these conditions are constructed from the base of the southern breakwater. The plan is as indicated in Fig. 7-1. Plan A lays emphasis on carrying out container operation in an ideal form to as great an extent as possible. Towards this end a large area would be obtained to permit the most functional layout of container handling facilities.

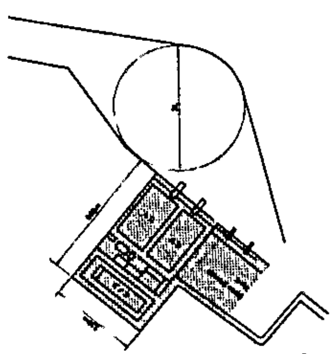
No drastic change will be made in the use of existing land, thus, temporary revetment of a great length is necessary under the short-term development plan. This will take 140 million dollars in construction investment. Such heavy investment in temporary revetment is wasteful, even if it is reasonable to attach importance to the function of the terminal.

Another approach is to dispense with temporary revetment construction since the improvement of Callao Port will continue rather than end with completion of the short-term project. Yet, in spite of the relative calmness of the sea involved, there is the fear that reclamation earth will be washed away by waves and of the sea pollution resulting from this. Therefore, reclamation without revetment even of temporary nature is, in practice, difficult.

It was thus that Plan B was devised. Plan B agrees with Plan A in the number of berths but stresses reducing construction investments. This plan is remarkable for the fact that it not only retrenches investments as much as possible by taking advantage of the existing southern breakwater as a temporary revetment but also limits reclamation within the bounds of the existing port. Therefore, the rear of the grain berths and part of the existing freight handling area must be used as space for the container yard. It cannot be denied that, as far as the efficiency of container handling is concerned, Plan B is somewhat inferior to Plan A because of the unusual topography involved. This will take 100 million dollars in construction investment.

Both Plan A and Plan B call for a 20 m wide apron on the grain berth to facilitate handling of general cargo. Also, both plans call for installation of a conveyor belt to transport grain to the back area.

Plan A



Plan B

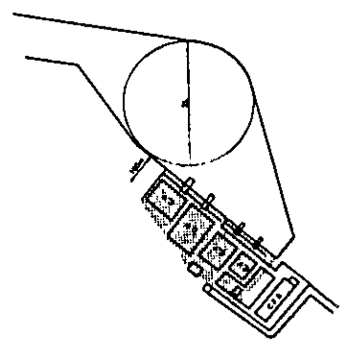


Fig. 7-1 Alternative Short Term Plans

7-5 Container Terminal Plan

7-5-1 Container Terminal Operation System at Callao Port

Reasons for recommending a rubber-tired transtainer crane system are as follows:

1) The straddle carrier system is an excellent operational system because of its high cargo handling capability and flexibility in handling large cargo volumes in short periods of times. However, since the straddle carrier is a machine having the functions of lifting/lowering heavy containers (up to 30.5 t) as well as the function of being driven around, its hydraulic and driving systems are apt to breakdown. To maintain normal container terminal operation, it is necessary to establish a good supporting system in case of mechanical breakdowns, and for maintenance of machines. It also is necessary to have enough stocks of parts for machines that are liable to breakdown.
   Considering the difficulty of repairing and maintaining foreign made straddle carriers in Peru, the straddle carrier system can not be recommended.
2) The Chassis system is a good simple system which has little trouble handling containers. However, it needs a huge container terminal 3 or 4 times larger than that required for other systems. Therefore, considering the expensive reclamation costs and the narrow port area at Callao, this system also can not be recommended.
3) There are two kinds of transtainer crane systems i.e. the rail-mounted transtainer crane system and the rubber-tired transtainer crane system. In terms of the ease of carrying out future container terminal improvements, the Japanese mission recommends the rubber-tired transtainer crane system.

7-5-2 Container Terminal Plan A

Dimensions

Length of berth water front	:	300 meters
Berth length from front to end	:	500 meters

The container terminal area is separated roughly into two parts. One part is the container yard area, including the container yard, office buildings maintenance shops, gate house, etc., which is the main container yard operation. Its area is 105,000 m^2 (300 m x 350 m).

The other area is used mainly for the CFS shed and the area surrounding the CFS. Its area is 30,000 m^2. (Fig. 7-2)

The reasons why this plan A separates the CFS area and the CY and the administration areas, by 25 meters road, is as follows:

1) Effective use of CY operation.
2) In case of twin berths each CFS shed can be used with both terminal berths.

In the future, when the new container terminal has been constructed along side, if CFS space is not greatly needed, this area of the second terminal will be usable for other purposes such as an empty container stock yard or a trailer parking space, etc.

The gate house and the administrative building are put together, and placed at the left end. This area will be the center of the new twin container terminals when construction of master plan is completed in the future, and both container terminals will be able to use it in common.

Then, construction costs of the new terminal can be saved, and scale of the administrative building can support this double use.

This situation is shown in the plan. (Fig. 7-4)

Water Depth : −12 m

Amount of available container storage

Dry container storage	1 tier	:	1,512 slots (TEU)
	2.5 tiers	:	3,780 TEU
	(3 tiers	:	4,536 TEU maximum)
Reefer container storage	1 tier	:	172 slots (TEU)
	2 tiers	:	334 TEU maximum
Total storage	3,780 + 334 = 4,124 TEU		

If turnover is 30 times per year, the maximum amount of available container storage per one container terminal equals 123,720 TEU. (4,124 x 30)

CFS shed

Number of dry containers handled annually : 3,780 x 30 = 113,400 TEU

Imported full containers : 113,400 x 1/2 = 56,700 TEU

LCL (CFS handled) containers

(LCL container comprise 50% of all imported full containers)

: 56,700 x 0.5 = 28,350 TEU

Average cargo weight of imported containers at Callao is 8.1 K/T per 20' container.

Total imported CFS (LCL) cargo : 28,350 x 8.1 = 229,635 K/T

Exported full containers : 56,700 x 0.5 = 28,350 TEU

(50% is a ratio of full container which is used for determining CFS size.)

LCL (CFS handled) containers : 28,350 x 0.5 = 14,175 TEU

Average cargo weight of export containers at Callao is 8.1 K/T per 20' container.

Total exported CFS (LCL) cargo : 14,175 x 8.1 = 115,000 K/T

Necessary CFS space : $FS = \frac{(I + E) \times D}{WD \times (K/T/m^2) \times k}$

I : Imported cargo weight, E : Exported cargo weight

D : Average length of stay for CFS cargo (7 days)

WD : Annual working days (364 days of Callao)

$K/T/m^2$: One kilo ton per square meter

k : $\frac{\text{Actual available space excluding the fork-lift passage}}{\text{Total CFS space}} = 0.7$

$$FS = \frac{(229{,}635\ K/T + 115{,}000\ K/T) \times 7\ \text{days}}{364 \times 1 \times 0.7} \doteqdot 9{,}500\ m^2$$

Designated CFS space

shed space : 200 m x 55 m = 11,000 m^2

office space : 20 m x 55 m = 1,000 m^2

7-5-3 Container Terminal Plan B

This plan B is more highly realistic than plan A as it saves construction costs by saving reclamation costs.

Though the container yard in Plan B is designed with a greater width because of part of the south break-water also being used for the yard, while the one in Plan A has a greater depth, the number of containers to be situated in either space will be about the same.

The administrative building which is next door to the gate house, is placed on the foot of pier No. 9 for the following reason.

The yard control section of the terminal operation department must keep close contact with the gate clerk for good terminal operation. (Fig. 7-3)

In this terminal plan B layout, the position of gate house and the administrative building will be a little inconvinent, when the adjacent berth is constructed in the future.

It is unavoidable, because saving of construction costs has the first priority. But if ENAPU would control both berths exclusively, it is possible to use this administrative building and gate house as it is, by operational methods which should have been considered.

Dimensions

Length of berth water front	:	300 meters
Berth length from front to end	:	150 – 250 meters (see container terminal plan)
Maximum side to side length	:	710 meters
Total yard space	:	147,052 m^2
Container yard area	:	121,402 m^2
CDF area	:	25,650 m^2

Amount of available container storage

Dry containers	1 tier	:	1,518 slots (TEU)
	2.5 tiers	:	3,795 TEU
	(3 tiers	:	4,554 TEU maximum)
Reefer containers	1 tier	:	180 TEU
	2 tiers	:	360 TEU maximum
Total storage	3,795 + 360 = 4,155 TEU		

If turnover is 30 times per year, the maximum amount of container storage per one container terminal equals 124,650 TEU (4,155 x 30)

CFS shed

I = 28,463 TEU x 8.1 K/T = 230,550 K/T

E = 14,232 〃 x 8.1 K/T = 115,279 K/T

$$FS = \frac{(230{,}550 + 115{,}279) \times 7 \text{ days}}{364 \times 1 \times 0.7} = 9{,}500 \text{ m}^2$$

Designated CFS space

CFS shed space	:	175 m x 60 m = 10,500 m^2
CFS office space	:	20 m x 40 m = 800 m^2

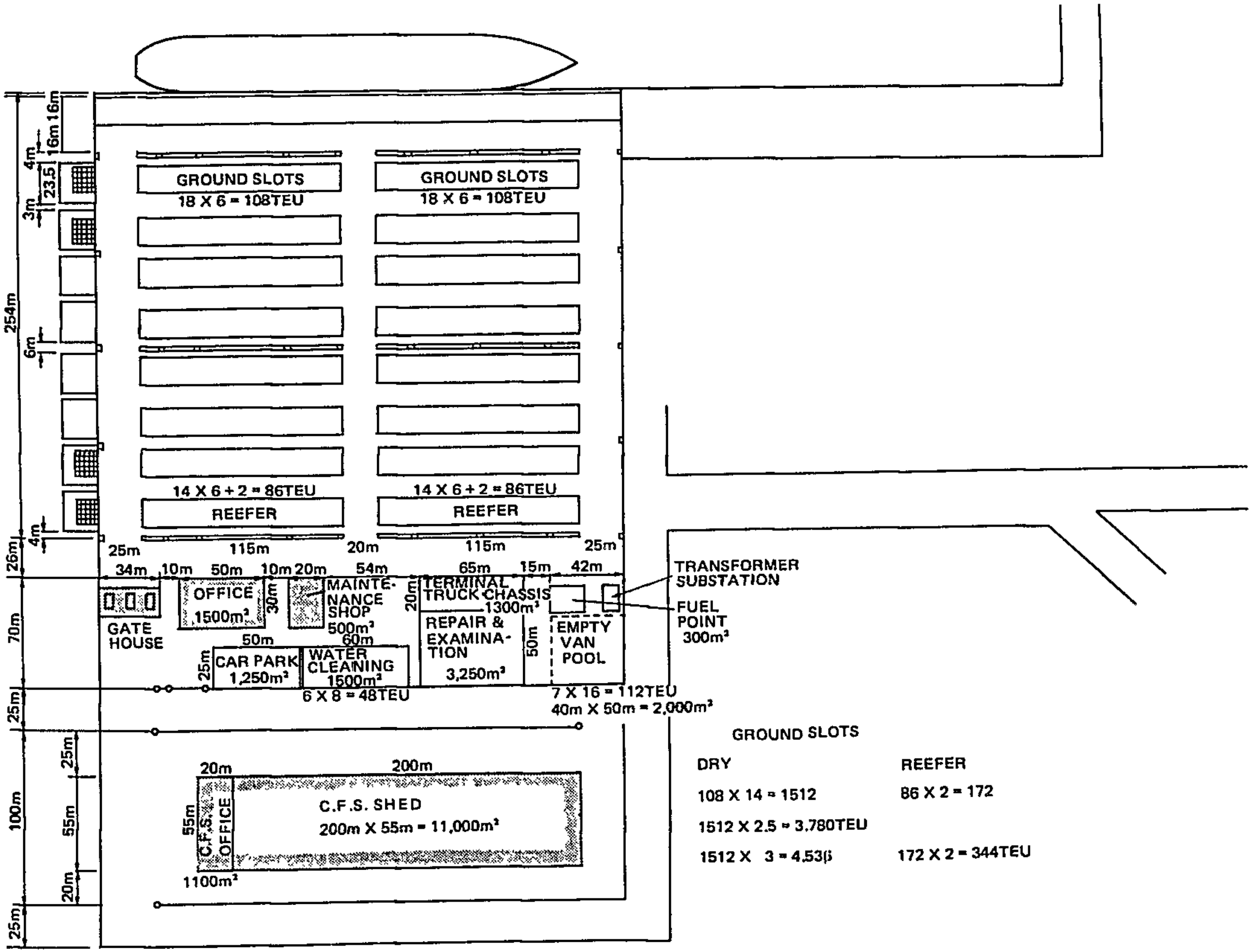
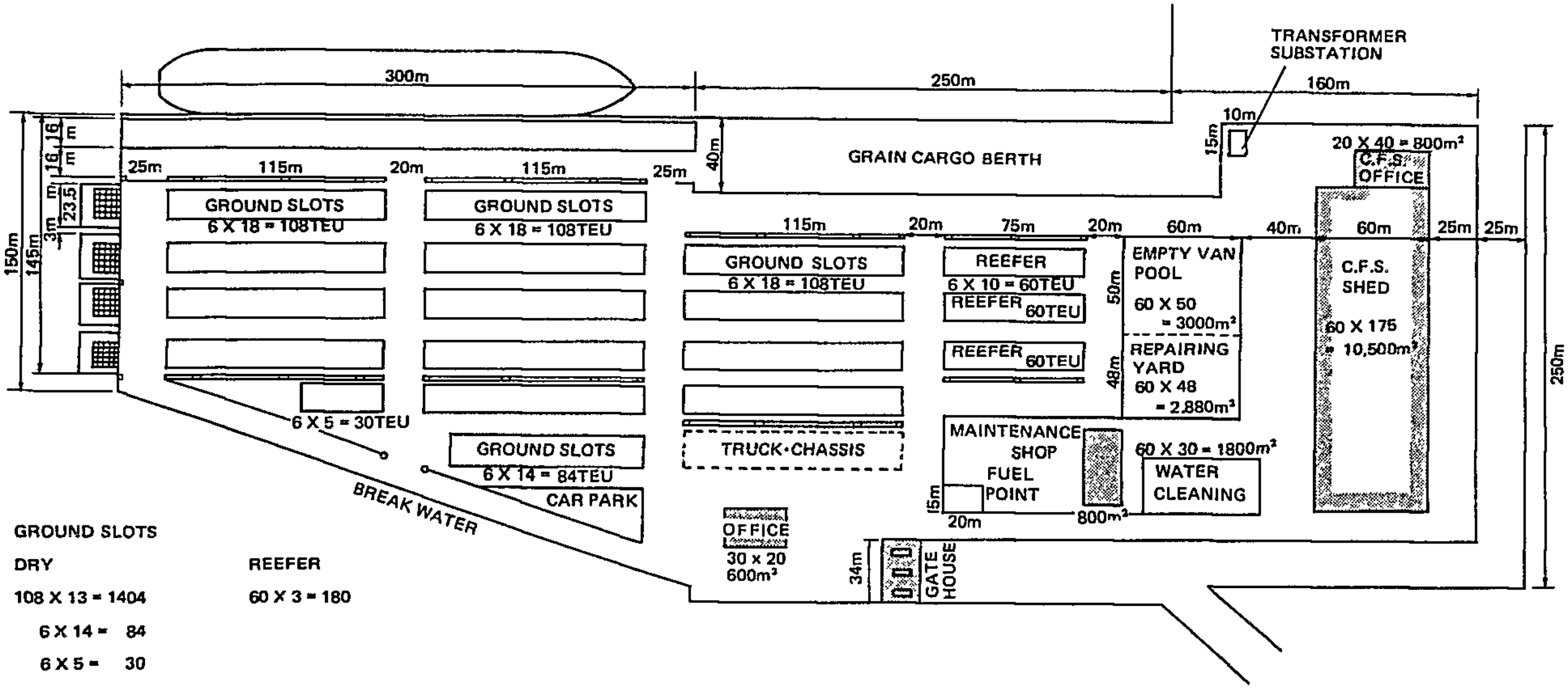


Fig. 7-2 Layout of Container Terminal Plan (A)



GROUND SLOTS

DRY	REEFER
108 X 13 = 1404	60 X 3 = 180
6 X 14 = 84	
6 X 5 = 30	
1518	
1518 X 2.5 = 3,795TEU	180 X 2 = 360TEU
1518 X 3 = 4,554	

Fig. 7-3 Layout of Container Terminal Plan (B)

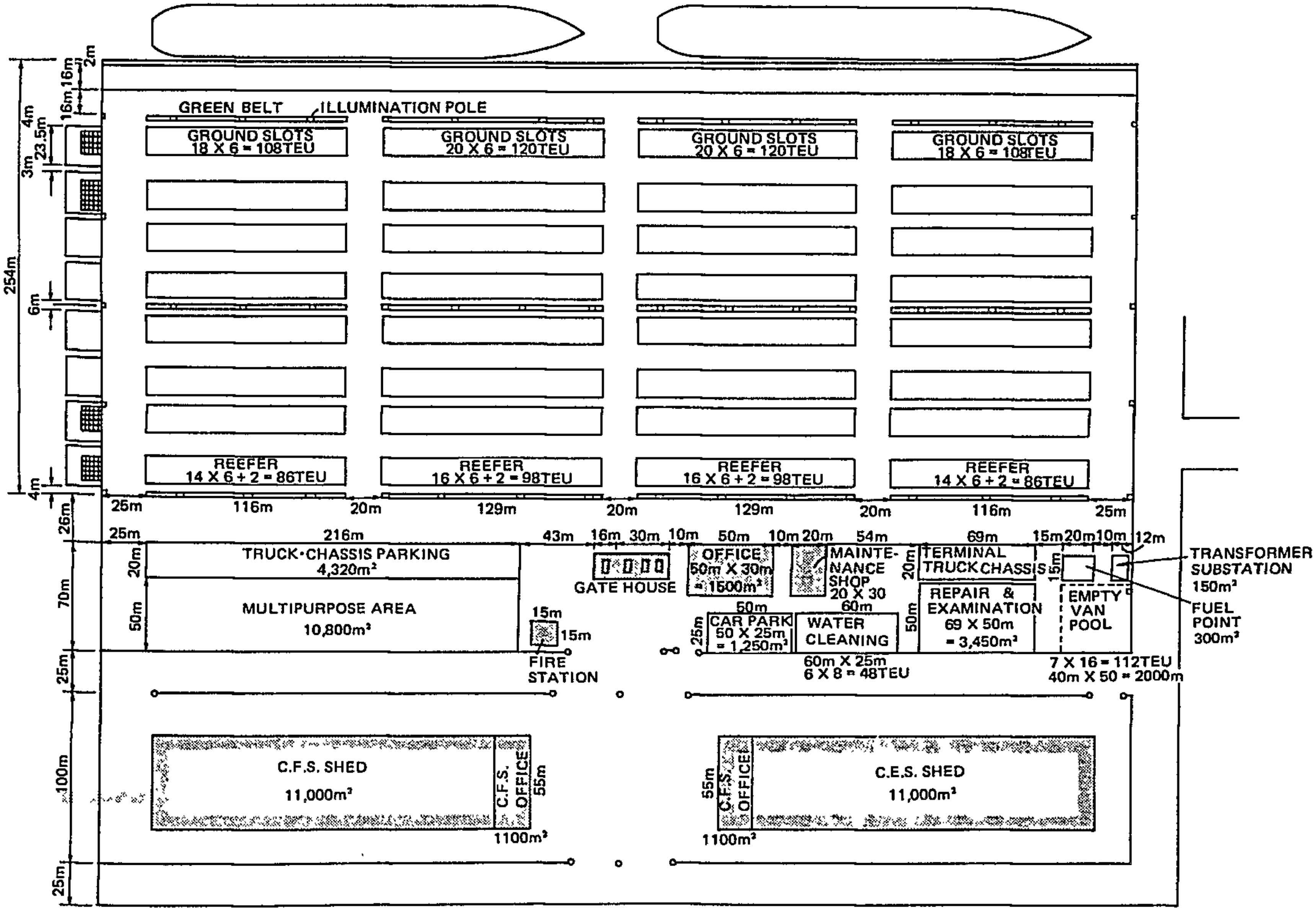


Fig. 7-4 Layout of two consecutive container berths (Reference)

7-6 Grain Terminal Layout Plan

The grain terminal shown in Fig. 7-5 can have two silos, each with a holding capacity of 33,000 tons, and two truck-loading hoppers, each with a stock capacity of 1,000 m^3, which will be necessary by the target year of 2000 and are sufficiently large for the smooth operation of the terminal. The area of the site is 22,000 m^2.

The number of silos and truck-loading hoppers required by the short-term development plan is one silo and one truck-loading hopper, as indicated in 6-3-2: Grain wharf. As to silos, a silo with a holding capacity of 26,700 tons is already in place but, since two pneumatic unloaders, each with a cargo handling capacity of 400 t/hr, will be provided as cargo handling machines to be installed for the new grain berths proposed by the short-term development plan and since the existing silo cannot cope because of its limited capacity, a silo with a holding capacity of 33,000 tons will be newly constructed in keeping with the construction of the wharf. The grain terminal will be provided with truck scales and other equipment (see Fig. 7-7) necessary for integrated terminal work from the receipt of imported grains to their shipment from the port area.

Regarding the existing silo, it is necessary to check for the degree of its aging and the capacity and durability of its accessory facilities while the new grain berths are not yet in full use. After the start of their use, it is necessary to study the adaptability of this silo for future applications and to take steps to ensure unhindered handling of the handling volume proposed by the master plan.

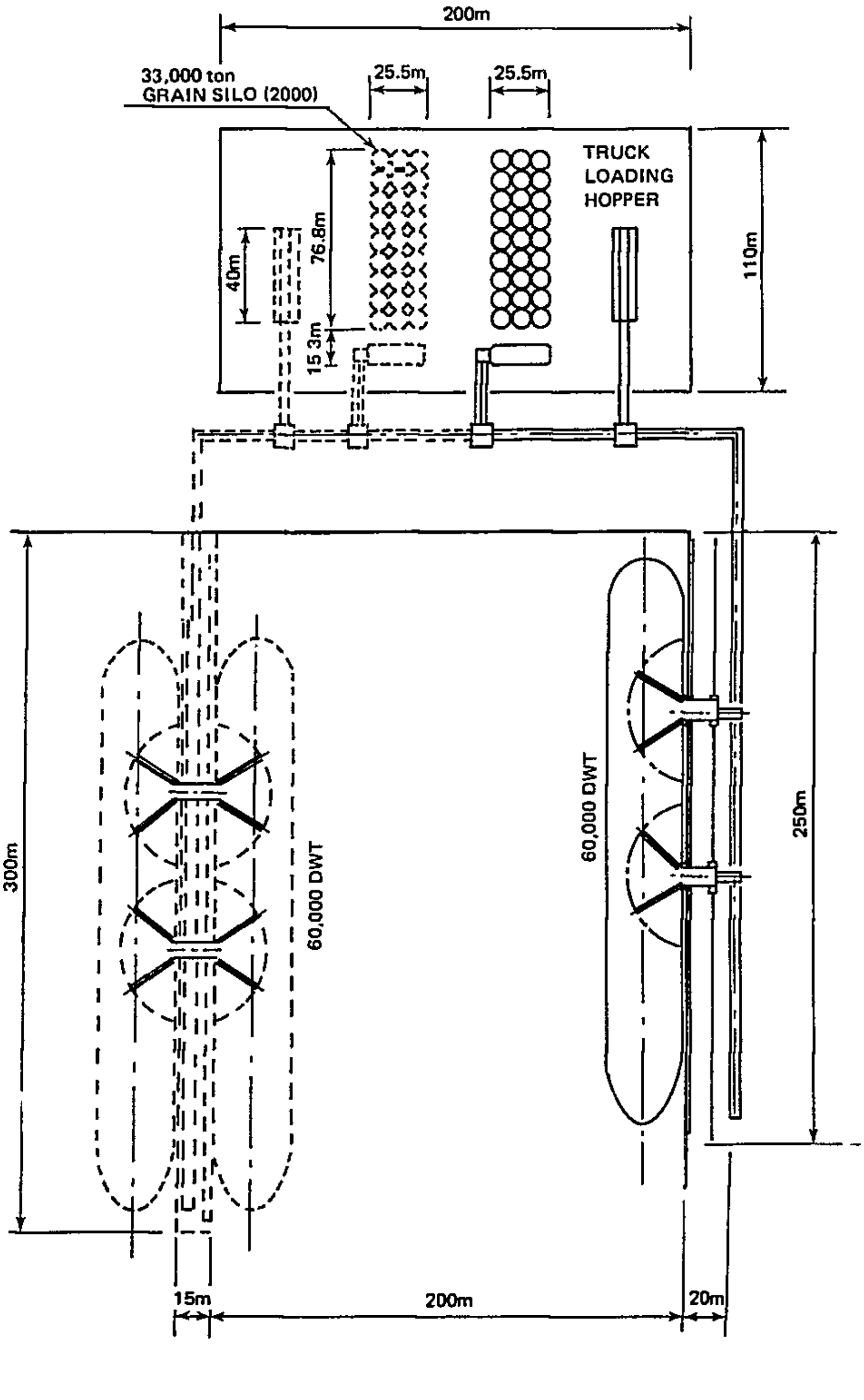


Fig. 7-5 Grain Terminal Plan

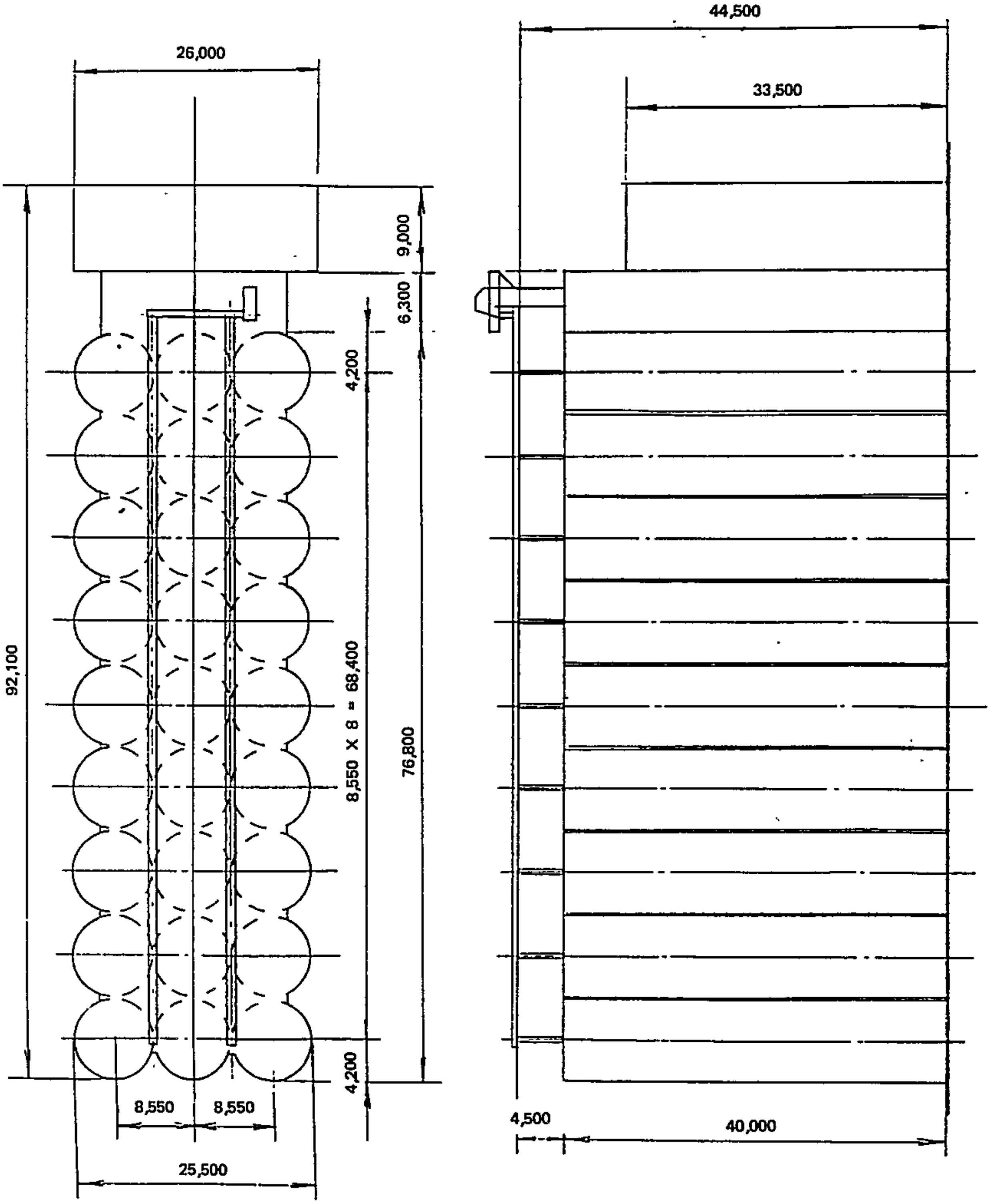
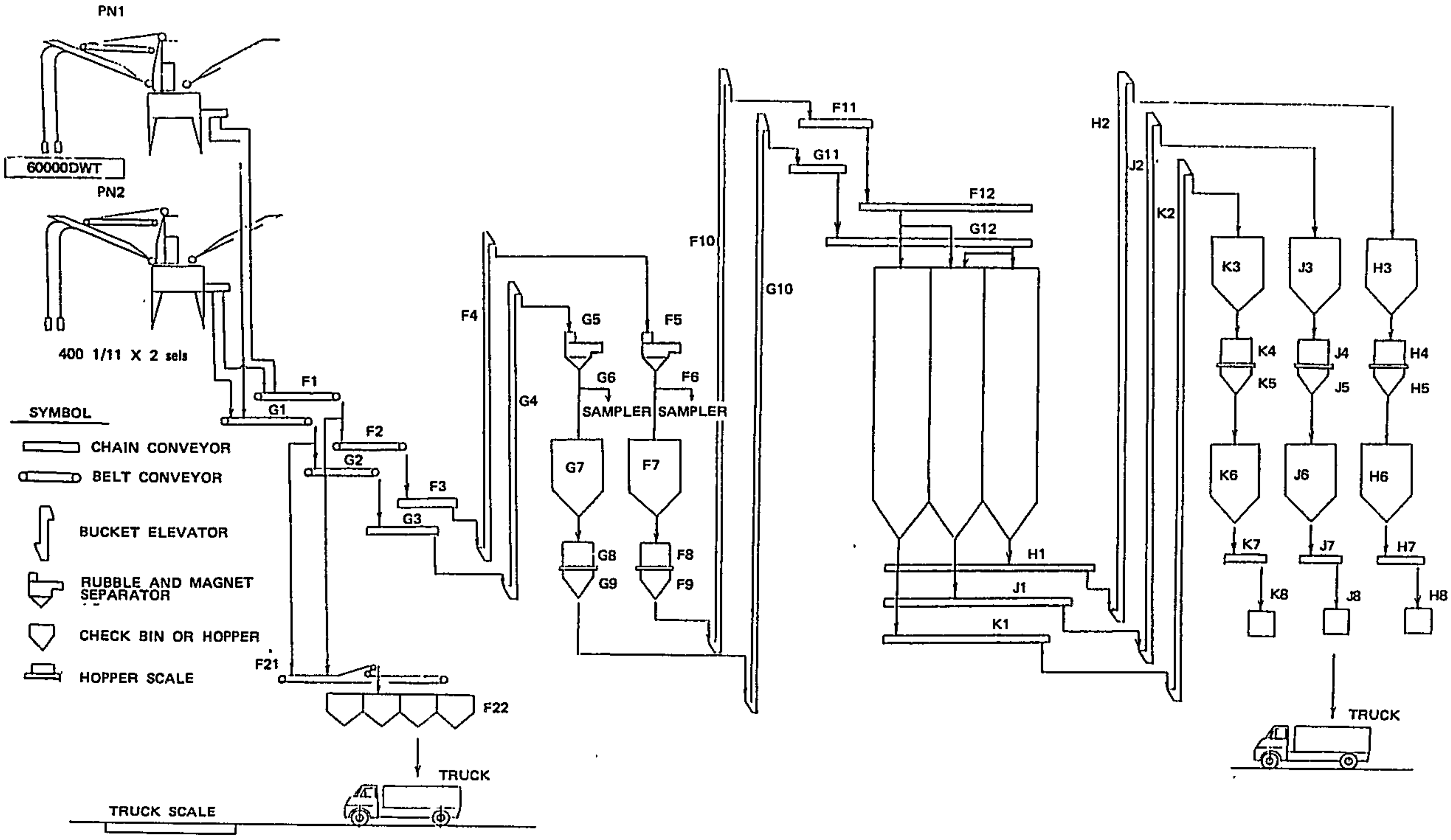


Fig. 7-6 33,000 Tons Grain Silo

Fig. 7-7 Flow Chart of Grain Silo System



Flow Diagram (Machine List)

1) Unloading Flow Diagram

Vessel		Max 60,000DWT	
↓			
Pneumatic Unloader	(PN1. PN2)	400 t/h X 2	Travelling type with two nozzles
↓			
Belt Conveyor	(F1. G1)	440 t/h X 2	
↓			
Belt Conveyor	(F2. G2)	440 t/h X 2	
↓			
Chain Conveyor	(F3. G3)	440 t/h X 2	
↓			
Bucket Elevator	(F4. G4)	440 t/h X 2	bucket elevator tower receiving equipment
↓			
Rubble & Magnet Separator	(F5. G5)		
↓			
Sampler	(F6. G6)		
↓			
Check Bin	(F7. G7)		
↓			
Hopper Scale	(F8. G8)	5 t/batch X 2	
↓			
Hopper	(F9. G9)		
↓			
Bucket Elevator	(F10. G10)	440 t/h X 2	
↓			
Chain Conveyor	(F11. G11)	440 t/h X 2	
↓			
Chain Conveyor	(F12. G12)	440 t/h X 2	
↓			
Chute			
↓			
Silo		33,000 t	

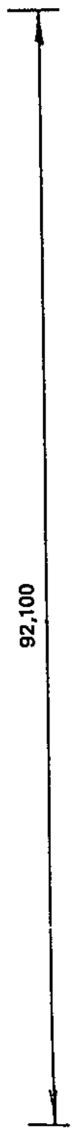
2) Loading Flow Diagram

Silo			
↓			
Chain Conveyor	(H_1, J_1, K_1)	150 t/h X 3	Bucket elevator tower discharge equipment
↓			
Bucket elevator	(H_2, J_2, K_2)	150 t/h X 3	
↓			
Check Bin	(H_3, J_3, K_3)		
↓			
Hopper Scale	(H_4, J_4, K_4)	1.5 t/batch X 3	
↓			
Hopper	(H_5, J_5, K_5)	150 t/h X 3	
↓			
Chain Conveyor	(H_6, J_6, K_6)	150 t/h X 3	
↓			
Loader	(H_7, J_7, K_7)	150 t/h X 3	
↓			
Truck			

Notes

1. The pneumatic unloader is not provided with truck loading equipment.
2. When loading a truck without being routed through a silo, a truck loading hopper is used for truck loading rather than the F_1 or G_1 belt conveyor.

Belt Conveyor	(F1, G1)	440 t/h X 2
↓		
Belt Conveyor	(F21)	440 t/h X 2 (with Tripper)
↓		
Truck Loading Hopper	(F22)	250m³ x 4
↓		
Truck		
↓		
Truck Scale		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7-7 Short Term Development Plan

The alternatives, Plan A and Plan B are evaluated from the following viewpoints.

(1) Flexibility in land utilization: Is it possible to secure large space and cope flexibly with unforeseen needs?

(2) Efficient layout of terminal: Does the shape of the land, the layout of facilities and the type of roads conform to the purpose of use of the port and are these conductive to its efficient operation?

(3) Continuity to master plan: Can facilities provided under the short-term plan be readily shifted for use under the master plan without being modified?

(4) Relation to existing freight handling facility: Can the plan fully satisfy scale and functional requirements without competing with the existing freight handling facility?

(5) Possibility of early start of construction and early start of use: Is there any factor to greatly hamper facility construction? Also, is there any problem about the performance of construction?

(6) Amount of investment: Will the money invested and the money put into the construction prove to have been spend wisely?

The results of assessment of Alternatives Plan A and Plan B by the above considerations are as tabulated below:

Table 7-1 Evaluations of Alternative Plans

Items of evaluation	Evaluation	
	Plan A	Plan B
Flexibility in land utilization	◎	△
Efficient layout of terminal	◎	○
Continuity to master plan	◎	○
Relation to existing open storage yard	○	○
Possibility of early start of construction and of use	△	◎
Amount of investment	△	◎

Note: Ranking of evaluation ◎ Excellent
○ Ordinary
△ Some problems

It seems from the above evaluation that Alternative Plan A is the more preferable as a short-term development plan as far as port planning relative to the control and operation of the terminal and smooth shift to the next plan is concerned. But judging by the realities of the amount of investment, early start of use and phased construction, Alternative Plan B, which is more or less equally functional, may be deemed superior as a short-term development plan.

Detailed study from the point of view of smooth shift to the next plan indicates that in

Alternative Plan B, the buildings of CFS, office, etc. (costing about 3.6 million dollars) must be removed at the next step. These are useful for only a brief period, temporary and seemingly wasteful. But in Alternative Plan A, about 12 million dollars will be invested on temporary revetment needed for only several years pending the construction of the container wharf, C_2. Alternative Plan B is the more practicable in light of the past situation of amounts of ENAPU investment in construction even though the layout of terminal facilities is temporary.

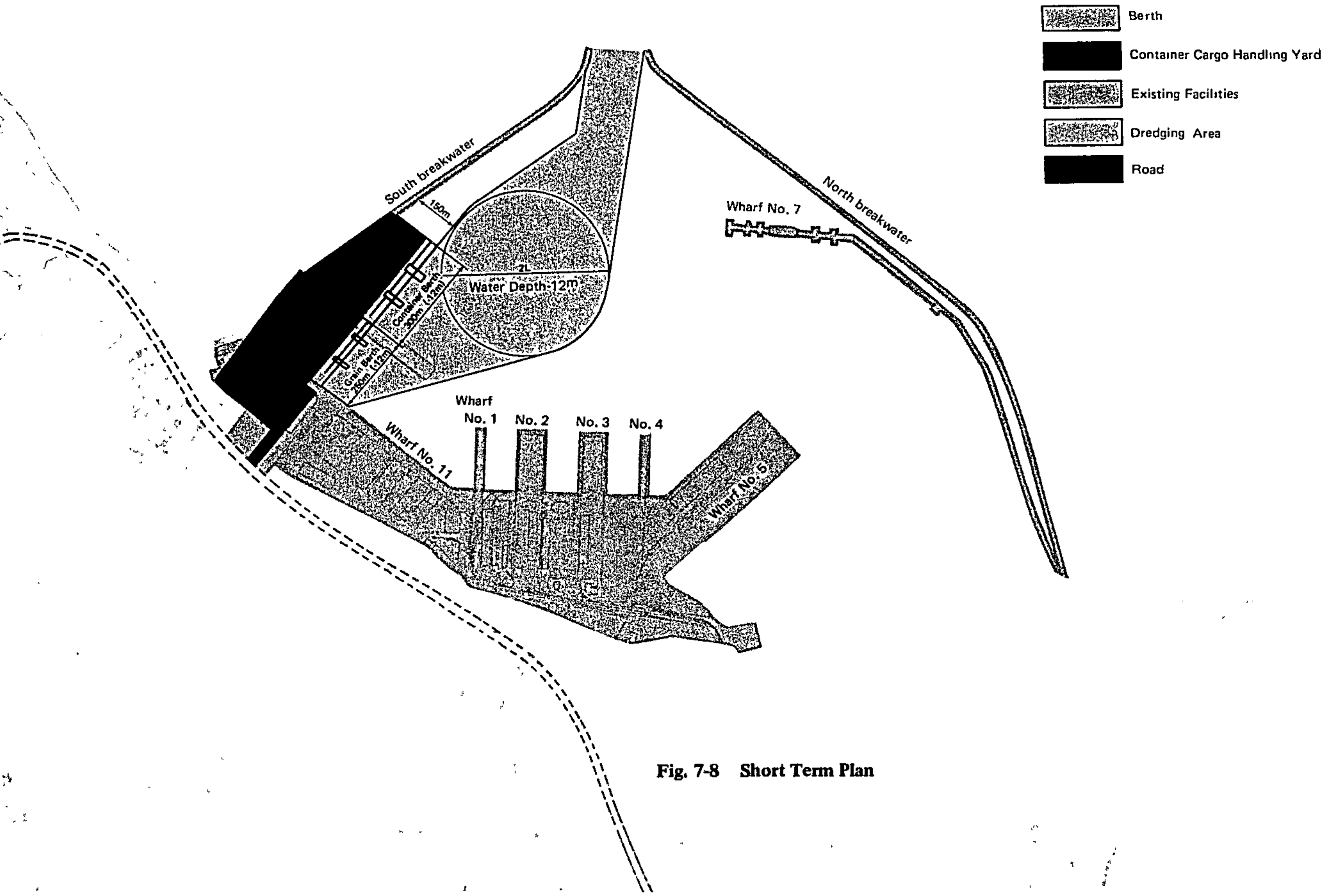

Fig. 7-8 Short Term Plan

CHAPTER 8

Container Terminal Operation and Organization

CHAPTER 8. CONTAINER TERMINAL OPERATION AND ORGANIZATION

8-1 Container Terminal Management

8-1-1 Container terminal management

The best management of container terminals is performed by a single organization which has enough skillful officers and workers, to be able to supply full service to customers (shipping companies, shippers/consignees), from receiving containers to loading them onboard ship, or from discharging containers to delivery to the consignee.

At present, the main parts of all Peruvian ports and harbours are administered and managed by ENAPU.

ENAPU is the most experienced organization in port operation and they have many officers and workers.

As for the scale of ports, Callao port is the largest, being much larger than, other Peruvian ports, but when compared with other world scale ports, it lacks sufficient cargo volume to keep several terminal operators working together at same time.

Considering the above situation, it is best that ENAPU, the present port administrator, should directly operate the container terminal.

Necessary preparations for this area as follows:

1) ENAPU will set up an exclusive terminal operator department to manage the container terminal in Callao port.
2) That department shall control the whole container operation, including loading onto ships and lashing/unlashing containers onboard.
3) Establishment of a mechanical maintenance and repair system for cargo handling machines is necessary to keep cargo handling machines always in good operating condition.
   For this purpose it is necessary to maintain a sufficient mechanical staff, to establish a mechanics training program, to ensure proper supplies and to arrange facilities for the orderly storage of mechanical parts.
4) In order to use effectively, the limited CY and CFS spaces of the container terminal, it is necessary to spread out the cargo volume and aboid congestion by spacing the work out evenly over a today free time period. This must be done for containers and general cargo.

By collecting adequate overtime charges for containers and cargoes which exceed the free time period, we can help to ensure that both shipping companies and shippers will not exceed the free time period. By this system we can prevent both the delay of delivery for imported containers and the early arrival of export containers.

As for CFS cargo, the free time system should be set and to maintain a good turning period, long term undeliveried cargo should be shifted to another warehouse.

8-1-2 Organization and necessary number of workers

Fig. 8-1 shows an example of organization chart and workers' arrangement which are necessary for container terminal operation. This was made based on the case of a typical container terminal, taking present circumstances of Callao Port into consideration.

The numbers of workers are determined, for a day time work shift. Following is a short explanation of the business of each section of the container terminal.

(1) **General affairs section:**

Administration of terminal properties and costs, labour costs and the flow of general administration funds. Other general affairs.

(2) **Accounting section:**

Issuing bills for loading and unloading containers, storage, delivering, and repairing. Receiving charges.

(3) **Claim section:**

Dealing with all claims which are concerned with human life injuries, container ships, terminal facilities, and equipment, containers, vehicles, etc.

(4) **Planning section:**

Planning of container ship stevedoring, container marshalling in the container yard, shifting within the container yard, etc.

(5) **Yard control section:**

(a) Arrangement of necessary equipment and their drivers, and other workers for performing the above operations.
(b) Controlling yard operation at the control center in the office. Controlling road trailers arranged for by the shipper/consignee, in the container terminal area.
(c) Clerical work of container delivery and receiving at a gate house, inspection of the exterior condition of loaded containers, and damage inspection of empty containers which are returned from the consignee, or discharged from a ship.

(6) **Documentation section:**

Issuing and typing of necessary documents for import/export containers. Arrangement for government official's inspection. Inventory control of empty containers, and the documentation of their delivery.

(7) **Equipment and facilities section:**

Maintenance of terminal equipment and facilities.

(8) **Container section:**

Inspection of damaged and dirty containers which are returned to a gate house or discharged from a container ship. Cleaning and damage repair of containers, and inventory control of repairing materials.

(9) **Electricity section:**

Maintenance, checking, and repair of electrical equipment which is concerned with the transformer substations, illumination of the terminal, refrigerated containers, and cargo handling (container gantry crane, transtainer, etc.).

(10) CFS operation section:

(a) Planning of cargo operation such as delivery/receiving, storage, container vanning and devanning at the CFS.

(b) Arrangement, operation orders, and supervising of necessary equipment, their drivers and other workers.

(c) Control of shipper/consignee's vehicles at the CFS.

(11) CFS documentation section:

Issuing and typing of necessary documents for import/export cargoes. Arrangement for government official's inspection.

(12) CFS general affairs section (including accounting):

Bill issuing for all charges for CFS operations, and collection.

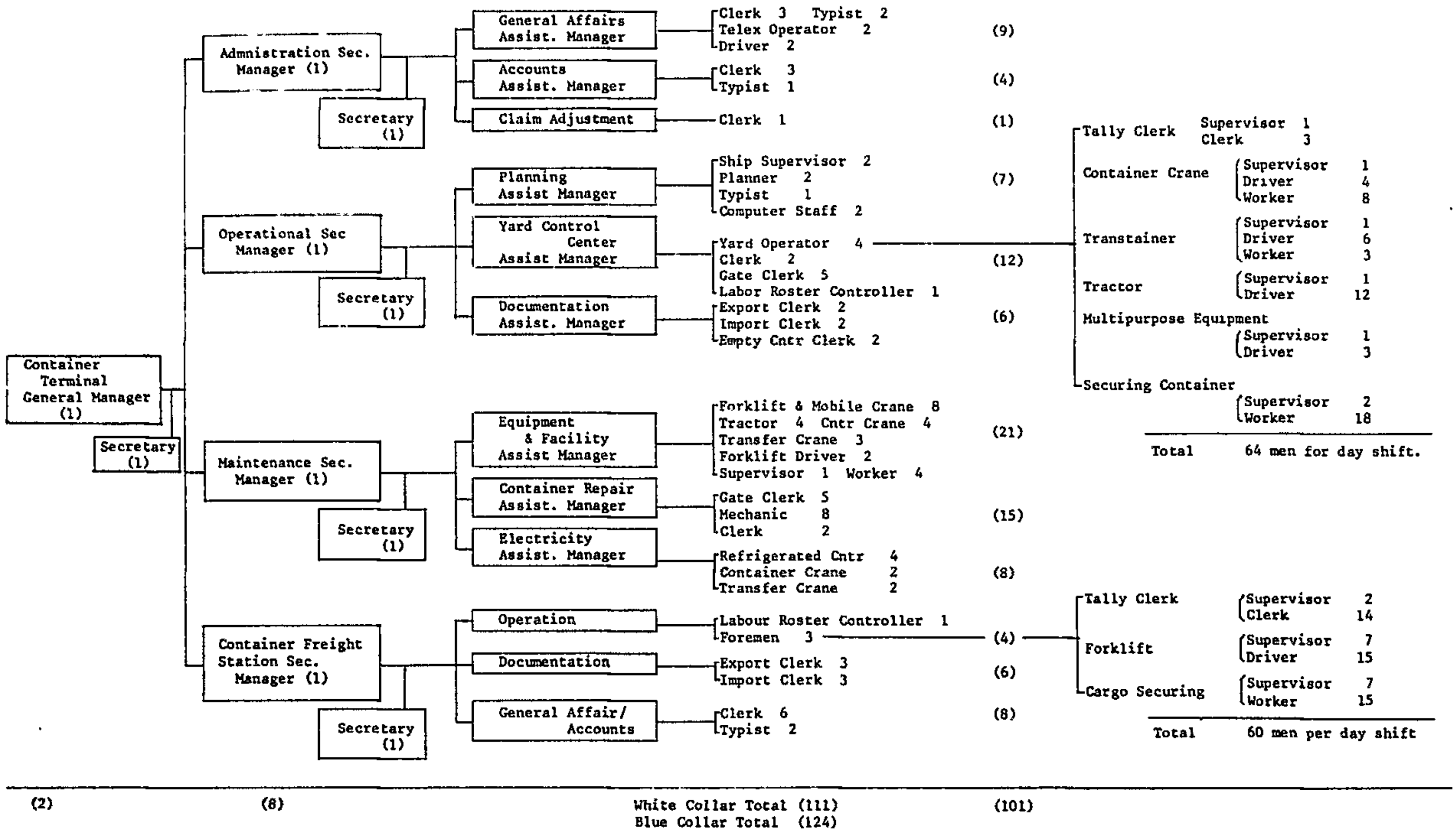

Fig. 8-1 Organization Chart of a Container Terminal

8-1-3 Desirable preparation for container system

It will be necessary to simplify Customs papers and Customs clearance procedure, for quick treatment of large numbers of containers and their cargoes which will be increased by the construction of the new container terminal, and also necessary to establish container depots outside the port area.

The government of Peru is advised to ratify "Customs convention on container and Customs convention on the international transport of goods under cover of TIR carnets" which are already followed by the principle countries already involved in the container system, and to change their domestic Customs law, and regulations in accordance with the above conventions.

Then, the government will simplify and standardize container Customs clearance procedures.

Following are examples of practices which are already generally used.

(1) Import Customs declaration of containers themselves will be done by attached container number list after completion of the entire container discharging operation. Export Customs declaration of containers themselves also has been done by attached loading container number list.

(2) Customs permission for moving containers in the domestic transportation system will be not necessary. But container tracking information needed by Customs office, in the course of tracking investigations, will be reported by the container administrator who must record all the container inventory under his custody, anytime, according to the Customs request.

(3) The Customs admit that if all the items which are necessary for Customs inquiry, are recorded on the shipping company's manifest, the copy of manifest itself can be used as Customs form paper.

(4) The Customs will permit that the seal of the shipping company be used as Customs' seal when bonded cargo is transported within the containers.

(5) When the cargoes which are stowed in TIR containers, pass the border of Ecuador, Bolivia and Chile by road transportation, the Customs will be simplify their Customs procedures.

(6) The Customs will be cooperative during Customs procedures and permit cargo stuffing/unstuffing and storing at the CFS area outside the port and at the container depot which is operated by reliable private container handling companies.

(7) The biggest goal of international sea container transportation is simplification and efficiency, and to prevent by door to door service shortage and damages of cargo at sea and on land, and at receiving/delivery terminals. It is quite necessary to simplify Customs inspection, and animal/plant quarantine inspection, which are factor disturbing container door to door service.

8-2 Container Terminal Operation

8-2-1 Export container flow (out line)

(1) Loaded containers which arrive at the gate house of the container terminal by shipper arranged trailer, will be checked for the following items such as seal, out side condition, height of cargoes, temperature of refrigerated container, etc.. The weight of the container will be measured.

Details of the container shown on the "gate in slip" (container number, name of shipping company, ship's name, discharging port, size, weight, kind of cargo, situation of Customs procedure) will be put into the terminal computer.

After the necessary inspection has been finished, the gate clerk will hand the receipt (E.I.R.) for the container to the trailer driver. (EIR is to be counter signed by both gate clerk and driver.)

(2) Yard stowage location (slot) of the container will be shown on the displays of both control center and gate house. The location is determined by the computer program for container yard stowage location planning.

The stowage slot will be given to the driver by the gate clerk and to a transtainer driver by a yard operator with VHF wireless phone.

The trailer driver will drive to the instructed bay passage under the transtainer, stop by the instructed bay slot, and wait for a transtainer.

A transtainer will be moved to that bay slot and the container is transferred from trailer to the designated stowage slot.

(3) After arrival of a container ship, according to "loading sequence check list" which was prepared by the terminal planner, a transtainer driver will transfer a container from a yard stowage slot onto a yard trailer.

The yard trailer brings the container to the side of the container ship, under the container crane.

A container crane driver will load the container from the trailer to the designated stowage location on board container ship.

In order to plan the "loading sequence check list" accurately it is necessary to finish receiving containers by 16:00 on the day before the ship's arrival.

(4) Most small lot cargo which does not reach one container capacity, is brought into the Container Freight Station (C.F.S.) by shipper arranged trucks.

The CFS clerk will issue a dock receipt after he has confirmed the items of that cargo such as the name of the ship it is to be loaded on, the name of shipping company, the discharging port, marks quantity, cargo condition, and Customs clearance.

Received cargo will be stacked on a CFS pallet according to marks, by CFS works under CFS foreman's instructure, and brought to the storage place by a forklift.

Empty containers will be shifted from a container yard to CFS by the order of the shipping company/agent for which the cargo will be loaded, and then container stuffing work will be done.

Stuffed containers will be shifted from CFS to the designated yard slot according to "shifting schedule". On the way to the designated slot, the container is brought to the gate house and it's weight is measured.

Closing time of cargo receiving at CFS is 16:00 two days before the container ship's arrival.

8-2-2 Import container flow (out line)

(1) The terminal planner receives import cargo documents such as container ship stowage plan, manifest, dangerous cargo list, special cargo information, refrigerated container details, etc., from a shipping company/agent not later than 3 – 7 days before scheduled container ship's

arrival.

(2) The terminal planner will study the above information carefully and make the "discharging work plan" which makes the berthing time of a container ship the shortest, (making discharging work schedule list, and discharging sequence check list.)

(3) After the berthing of a container ship, as quickly as possible, the container crane driver will discharge the containers onboard onto yard trailers according to sequence order of "discharging sequence check list".

(4) The yard trailer driver will bring the container to the designated container yard storage slot, according to the "discharging sequence check list".

(5) A transtainer driver waiting at the storage slot transfers the container from the yard trailer to the designated container yard storage slot.

(6) When the discharging from the container ship is completed, the shipping company/agent sends an arrival notice to their consignee. The consignee shows the B/L to the shipping company office, and exchanes it for a D/O (delivery order). Then the consignee gives delivery schedule of their containers to the container terminal office (documentation section).

(7) The documentation section confirms the D/O and Customs import clearance. If necessary collection of storage charge (for containers exceeding free time) and other charges will be done.

Then they send "gate out slip" to the yard control operation section. The yard clerk will check the gate out slip and the yard location plan and make up a "container gate out schedule list".

(8) The gate clerk of the yard control section receives "the gate out invoice" from the consignees truck driver who arrives at the gate house, and checks it against the "container gate out schedule list".

If the gate clerk finds the container number in the list, he gives a container yard storage slot to the trailer driver and lets the driver go. On the other hand, a yard operator gives a gate out instruction to a transtainer driver by VHF wireless phone.

(9) The instructed transtainer driver picks up a container at the designated storage slot and confirms the container number, then transfers it onto the consignee's trailer.

(10) The trailer driver stops at the outgoing lane of the gate house, and exterior condition and seal condition of the container will be checked. A gate clerk hands over EIR (out) to the driver and asks him to sign.

(11) According to "container unstuffing schedule" which is prepared by the CFS operation section, CFS containers are shifted from the container yard to CFS.

(12) Unstuffed cargoes are sorted separately by each B/L lot on the pallets. A forklift driver stores pallets at the designated storage place.

(13) The consignee prepares a delivery order (D/O), and Customs paper, and offers them to the CFS documentation section for taking out the cargo.

(14) The CFS documentation section checks the above papers and collection of necessary charges will be done.

(15) The CFS operation section delivers cargo to the consignee's truck

8-2-3 Container terminal operation

Container terminal operations consists of the following operations:

1. Container ship's operation
2. Container yard operation
3. Gate operation
4. Container CFS operation
5. Cargo documentation business
6. Maintenance business

1. Container ship's operation

Ship's operation means container loading and unloading operation to/from container ship. Normally, in the case of lift on/off type container ship, these operations are performed by container gantry cranes which are equipped on a pier. Capability of a container gantry crane is 20 – 25 containers per hour/per unit.

(1) Ship's operation planning

In order to make the staying time of a container ship at the terminal as short as possible, the ship's operation plan which produces the best cargo work efficiency, should be ready before the ship's berthing.

Each section of a terminal should make everything ready according to that plan. The ship's planner's duty is preparation of the above plan, and supervision of container unloading/loading operation performance.

Success of terminal operation depends on this operation planning.

SHIP'S PLANNER'S BUSINESS

Working schedule	Referred documents
1. About one week before ship's arrival, the planner contacts with the shipping company and confirms the schedule and arrival date.	1. Ship's schedule list.
2. Receiving cargo documents (dis/load), and the planner checks the following items, container quantity, which is separated into CY/CFS, container number, refrigerated container details, type (20'/40'), special containers, dangerous containers, special cargo (heavy cargo, large size cargo).	2. Ship's stowage plan. Discharging container list Manifest. Dangerous cargo list. Loading instructions.
3. For discharging, allocating container yard space according to quantity and type (20'/40') of imported containers, the planner puts CY available slots data into the computer memory.	
4. Considering the sequence of ship's discharging operation, the planner makes a ship's operation schedule (Schematic plan) for each container crane. The planner considers that the two container crane's handling loads should be as equal as possible.	4. Ship's schematic plan.
5. Referring to the ship's stowage plan, a computer operator puts the weights and container numbers into the computer according to the ships schematic plan sequence. Discharging sequence check list will be out put by the computer, based on a container yard location decision program.	5. Discharging sequence check list.
6. For loading, referred to loading instructions, the planner checks the necessary number of yard storage slots, and inputs available container storage slots instruction into the computer, which then sorts yard locations by ship's name (voy No.), destination, weight, size (20'/40').	
7. After completing export container receiving (at 16:00 on the day before the ship's arrival) a container yard location plan which shows the marshalling situation of containers in the yard, quantity, size and weight will be printed out from the computer.	7. Yard location plan.

Working schedule	Referred documents
8. The planner checks available empty stowage space for loading containers, referring to the ship's stowage plan. Considering export container condition, which was fixed after the close of the receiving time, such as destination, size (20'/40') weight, etc., the planner makes up the loading ship's stowage plan. At that time, the planner considers the following items such as discharging hours at destination, ship's stability, GM, trim, heel, draft of ship, and then decides the ship's loading stowage plan. This is just like the method that ship's captain or chief officer uses to consider her stowage problems. Accordingly, the planner should hopefully be a license holder who has the same ability as sea captain or chief officer. The planner must be relied on by users (shipping company), because it is impossible that after the ship's berthing, a chief officer changes the ship's stowage completely.	8. Loading ship's stowage plan.
9. The planner makes the loading operation schematic plan for each container crane. He should consider that each container crane handling volume should be as even as possible.	9. Ship's loading schematic plan.
10. A computer operator puts the ship's loading stowage plan, step (8), into computer, according to the sequence of the above schematic plan.	
11. The container number is picked up from the yard location plan according to the order of the hip's loading stowage plan. Then "Ship's loading sequence check list" is printed out.	11. Ship's loading sequence check list.
12. Loading and unloading operations are usually performed at the same time. It is necessary to combine both load and unload sequence check lists (see 5 and 11), according to the ship's schematic plan sequence.	

Working schedule	Referred documents
13. The necessary number of completed loading/ unloading sequence check lists are prepared. People to whom loading/unloading sequence check lists are distributed are as follows: ship's planner's copy 1 set control center's copy 1 set transtainer operators 2 sets yard tractor operators 4 sets container crane operators 2 sets 10 sets	
14. Arrangement of ship's lashers, one day before the ship's operation start.	

(2) **Discharging/loading operation**

1) Container crane driver:

Containers are carried to a position under the crane by yard trailer according to the loading sequence check list order.

A crane driver checks the container number against the loading sequence check list, and if the container is the right one, he picks it up by the crane's spreader, then takes it to the designated ship's stowage location. Discharging is done in the reverse order. The container crane operator reports every container number to the control center by VHF wireless phone.

2) Ship's supervisor:

One supervisor for one container crane, is onboard and he compares the ship's discharging/loading stowage plan with the numbers of the actually stowed containers. If he finds any problems, immediately he should report them to the ship's planner through the control center by VHF wireless phone. The ship's supervisor supervises lashers onboard and carries out lashing and unlashing of containers on deck.

3) Yard trailer:

Four yard trailers are usually allocated to one container crane. Before actual operation starts, a driver receives dis/load sequence check list. Then, he drives a trailer into the designated container yard storage slot, according to the "sequence check list" order. There, a transtainer driver puts a container onto the trailer. Then, the trailer driver drives the trailer under the container crane.

As four trailers belong to one team and work for one container crane, it is required not to get out of order, and not to wind up under another container crane. A driver checks the container number and order by the "sequence check list" and if the container is not the right one, he should report this to the control center by VHF wireless phone.

4) Transtainer:

Usually, one transtainer and one container crane pair off.

A driver takes in/out containers to/from container yard storage slots, according to the "sequence check list" and loads them onto/off of trailers. A transtainer driver checks a container number by the "sequence check list", and if he finds anything unusual, he should report it to the control center by VHF wireless phone.

5) Yard operator:

One man always stands by the Control center VHF wireless base, (one VHF base per crane) and watches ship and yard operations checking the "sequence check list".

When cargo equipment has troubles (out of order, etc.) he calls a maintenance team immediately, and arranges repairing order, and also informs the other concerned sections.

He should do the best he can to minimize the containers operation's interruption. He always keeps contact with ship's supervisor onboard, by VHF wireless phone and watches how the operation is going.

If necessary, consulting with a ship's planner, he changes and corrects the "sequence check list".

2. Container yard operation

As containers to be loaded/unloaded, pass through container yard once, and then are delivered/received to the consignee or from the shipper, the container yard is considered to be a part of a container ship.

The container yard which is a junction between sea and land transports, has the two functions of delivery place and storage place for container handling.

(1) Yard operation planning

This is container storage and marshalling planning at the container yard. The aim of this planning is to perform smooth operation of ship's loading, or delivery to consignees.

Within the limited space of the container yard, containers which are discharged/loaded under ship's planner's schematic plan, should be stored efficiently in container yard, and delivered to consignees according to prepared schedule of gate in/out.

The man who is in charge of this planning is the yard planner and he always, pays attention to yard container location and empty space, and tries to make the best yard plan.

Yard planner business

Working schedule	Referred documents
1. Yard planner decides storage slots for containers which go in and out of the container yard. By the shipping company's dis./load instruction the yard planner arranges container storage space. (assistance to ship's planner)	1. Container gate in slip
2. To make a yard location plan. (ship's name, destination, weight, container number)	2. Yard location plan
3. To make a discharging sequence check list using the ship's stowage plan. (assistance to ship's planner)	3. Discharging sequence check list.
4. To make a shift/reload sequence check list using ship's schematic plan, and to make a rehandling list.	4. Rehandling list (original stowage, loading port, discharging port, container number, weight, ship's reloaded stowage)
5. To make a gate out schedule list, comparing the yard location plan with the gate out order slip.	5. Gate out schedule list.
6. To make a despatch order and distribute it to, the relevant persons.	6. Despatch order (ship's name, B/L No., container No., consignee, forwarder, destination, cargo details.)
7. To make up statistic data such as yard handling tonnages.	7. Handling report.
8. Instruction and communication with gate clerk.	

3. Gate house operation

Operation at the gate house office, which is located at the entrance of the container terminal, is very important because the office is an exchange point between shipper/consignee and the terminal which works for shipping companies.

All the containers pass this place entering or leaving the container terminal area.

This place is the last check point to discover mistakes. If a gate clerk can not find the mistakes, both consignee and shipping company will have lots of trouble and confusion.

The delivering of containers is one of the most important functions of terminal operation.

The gate house is the border line between shipper/consignee and shipping company. It determines the limits of responsibility of each side.

That is why an equipment interchange receipt (E.I.R.) is exchanged between a terminal gate clerk (working for the shipping company) and a truck operator of a trucking company or Customs broker (working for shipper/consignee).

Gate clerk's business

Working schedule	Referred documents
1. Receiving/delivery of loaded or empty containers. Confirming container number, seal number and condition. Checking exterior condition of loaded containers, checking both exterior and interior of empty containers.	
2. Receiving and filing of gate in slip, Input of necessary data into computer. Assignment of a container yard storage slot to the shipper's trailer driver.	2. Gate in slip (ship's name, container No., shipper, forwarder, size, discharging port, weight, customs clearance, CY storage location.)
3. Receiving shipping documents (D/R, E/D, CLP) and checking their contents.	
4. Receiving D/O and confirming the driver's in/out instruction, Customs transport permission.	
5. Maintaining gate log (daily record).	5. Gate log (container number, full/ empty size, discharging port, shipper)
6. Checking container number, seal number, and damages.	6. To fill remark space of E.I.R.
7. Weighing of loaded containers.	
8. Completing equipment interchange receipt (E.I.R.) and asking a trailer driver to sign.	8. E.I.R. (ship's name, container No., chassis number, place of delivery, date destination, shipper/ consignee)
9. Input of E.I.R. into computer.	9. Inventory list.

4. Container CFS operation

Receiving, delivering, vanning and devanning works of L.C.L. cargo (less than container load), that which is not able to fill even one container, will be done at the CFS space.

According to Japanese data, about 15% of all containers passing CY and LCL cargo, but depending on road traffic conditions, this percentage of LCL cargo will increase, because of the difficulty of taking empty containers back from the consignee's place.

In this report, CFS facilities are planned depending on the supposition that about 50% of total imported cargo will be handled at CFS, considering the present situation of Callao port. But in the future, when container cargo volume increases, it is necessary to assume a higher ratio for door to door service containers (CY container), for the sake of keeping a high handling efficiency at the container terminal. Good cooperation by the Customs authority, and consignee/shippers is required.

(1) **Working action of export cargo**

Working schedule	Referred documents
1. About one week before the ship's arrival, receiving cargo booking list from the shipping company/agent. Summing up cargo kind, form, size, measurement, weight.	1. Cargo booking list
2. To confirm receiving date of cargo from shipper or Customs forwarder.	2. Cargo receiving schedule list
3. Receiving of scheduled cargo, with papers (S/O, D/R, E/D). To confirm cargo trucking invoice. Customs clearance. To sort by lot and store separately. To issue receipt signed by CFS clerk	3. S/O, D/R, E/D. Cargo trucking invoice (Receiving place, ship's name, shipping company, discharging port)
4. Registering on CFS storage book, and cargo numbering.	4. CFS storage book detailed list of received cargo.
5. Comparing D/R, E/D with actually received cargo and making an exceptions list.	5. Exception list
6. Making a cargo location plan, to know cargo storage condition in the CFS.	6. Cargo location plan.
7. As soon as cargo receiving is completed, making a container stuffing plan. To decide the number and size of the containers to be filled. To decide the date of container stuffing. To arrange container stuffing work. (Cut off time usually 16:00 two days before the ship's arrival.)	7. Stuffing plan.
8. According to the above stuffing plan, container stuffing work is performed. (Reconfirmation of cargo using E/D, D/R, quantity, destination.)	
9. Checking for leftover or overlooked cargo using the CFS cargo location plan.	
10. To seal container doors, soon after stuffing work is finished and to ask the control center to shift filled the container to the container yard.	
11. To make Container Load Plan. (CLP)	11. Container load plan

(2) **Working action of import cargo**

Working schedule	Referred documents
1. Receiving CFS cargo manifest (M/F) from the shipping company. Checking kind of cargo, measurement, weight. 2. Receiving B/L copy, CLP, from shipping company. Making a container unstuffing plan and a plan of delivery to the consignee.	1. Cargo manifest
3. To make container unstuffing instructions.	3. Container unstuffing instruction.
4. To perform container unstuffing work according to the unstuffing plan. Checking loose cargo quantity and condition using B/L copy, CLP remarks.	
5. To make an unstuffing report, and an exception report. 6. Arrangement for and attendance on Customs inspection. 7. Receiving D/O, and confirmation. 8. Delivery of cargo to consignees or their agents.	5. Unstuffing report Exception report
9. To make a delivery report. 10. Adding the following items on CFS cargo manifest such as delivery date, transferred place, Customs permission number, Customs broker name.	9. Delivery report

5. **Cargo documentation business**

In order to achieve the smooth flow of all cargoes and containers in the container terminal, the best cargo operation plan should be prepared. To perform the above operation, the terminal office always has to keep close contact with the shipping company, the shipper/consignee, and the Custom forwarder. These information and data should be delivered to every section of the terminal and the results of operation also should be passed onto the shipping company, the shipper/consignee, and the Custom forwarder.

For that purpose, there is a section in the terminal office which is in charge of cargo documentation business.

(1) **Documentation work for export.**

Working schedule	Referred documents
1. Receiving cargo the booking list from the shipping company. 2. Contacting with shippers and the shipping company to ask about cargo receiving schedule and necessary documents. 3. The final checking of shipping documents. (E/D, D/R, CLP) and issuing D/R. 4. Making a list of special cargo (dangerous cargo, frozen cargo, etc.) and sending it to relevant organizations. 5. Finding containers which have not been cleared by the Customs for export, and assigning their storage location. 6. Checking customs papers, and dealing with Customs problems. 7. General liaison with shippers and the shipping company and other related persons about export cargo.	4. Special cargo list (container number, commodity, shipper, forwarder, feature of cargo, setting temperature.

(2) **Documentation for import**

Working schedule	Referred documents
1. Checking ship's plan using manifest, CLP. 2. Making imported container list and distributing it to relevant organizations. 3. Making a special container list. 4. Necessary Customs procedures. 5. All liaison works with the shipping company, the consignee and the organizations related to imports.	2. Imported container list (loading port, CY/CFS, B/L No. size (20'/40'), consignee, forwarder, commodity, quantity, weight, measurement.) 3. Items of 2 plus dangerous cargo label, setting temperature of refrigerated container.