社会開発協力部報告書

No. 8

THE STUDY ON THE NATIONAL TRANSPORT PLAN IN THE ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT

Part III - B SECTORAL STUDIES

Ports
Shipping
Inland Water Transport
Airport/Aviation

March 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

THE STUDY
ON
THE NATIONAL TRANSPORT PLAN
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT

Part III - B SECTORAL STUDIES

Ports
Shipping
Inland Water Transport
Airport/Aviation

March 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

PORT PLANNING

TABLE OF CONTENTS

PORT PLANNING

LIST OF TABLES AND FIGURES

PORT PLANNING

CHAPTER 1 PRESENT CONDITIONS AND PROBLEMS

CHAPTER 1 PRESENT CONDITIONS AND PROBLEMS

1.1 Introduction

It is evident that the international trade ports play an important role and are essential pre-requisites for national economic development. This was clearly demonstrated in 1978, when Port Karachi became badly congested. Long waiting for berthing and delays in the clearance of cargoes resulted in high costs for demurrage and other surcharges, and the high transport costs indirectly limited the expansion of the Pakistani economy.

Pakistan's coastline is approximately 1,100 km in length, of which 330 km is in Sind Province and 770 km is in Baluchistan Province.

Along the coastline there are several ports including two international ports: Port Karachi and Port Qasim. Almost all foreign trade passes through these two ports. Other ports are mostly small fishery ports such as Jiwani, Gwadar, Pasni, Kalmat, Ormara, Sonmiani and Nargar Parkar.

People in these areas depend on coastal fishery for their livelihood. These ports are not used for international or domestic trade due to the lack of fundamental port facilities.

Thus, only Port Karachi and Port Qasim are studied here in association with the national transport network development plan. Local ports should be studied separately in appropriate local/regional plans.

In this chapter, first, natural and social conditions relevant to these ports are summarized, and then, current port activities including management systems, cargoes, passengers and calling ships are reviewed. Second, the current port facilities and their utilization at both ports are studied, and the productivity of these facilities are analysed. Third, the Sixth Five Year Plan (1983/84 - 1987/88) and the achievements under the plan are reviewed. Fourth, current problems at these ports are investigated.

1.2 Natural and Social Conditions

1.2.1 Geography

Port Karachi is located to the west of the mouth of the Indus River. The port is situated between the so-called Western and Eastern Backwaters, as seen from Fig. 1.2.1. The harbour entrance channel of 3.9 km from the Arabian Sea is partly protected by Manora Breakwater (480 m) and the Keamari Groyne (177 m). Western Backwater is an area of approximately 35 km^2. The surface is mostly covered with mud and many shallow creeks.

Eastern Backwater is an area of about 6 km^2 and some of the area is covered with mangroves. There are numerous stream channels running among the mangrove trees.

Port Qasim is situated approximately 30 km to the east of Karachi in the former river bed of the Indus River (now the Phitti, Kadiro and Gharo Creeks). The long entrance channel of 43.7 km is divided into the outer channel (approximately 14.1 km) and the inner channel (approximately 29.6 km). Half of the channel is open to the waves approaching from the southwest during the monsoon season, while the other half is in the protected creek.

1.2.2 Tide and Tidal Currents

According to Pakistan Tide Tables, the major tidal levels are as shown in Table 1.2.1.

Table 1.2.1 Tidal Levels

Tidal Level		Karachi	Phitti
Highest Astronomic Tide	(H.A.T)	3.20 m	3.44 m
Mean Higher High Water	(M.H.H.W)	2.68	2.93
Mean Lower High Water	(M.L.H.W)	2.19	2.26
Mean Sea Level	(M.S.L)	1.65	1.74
Mean Higher Low Water	(M.H.L.W)	1.10	1.22
Mean Lower Low Water	(M.L.L.W)	0.43	0.55
Chart Datum		0	0
Lowest Astronomic Tide	(L.A.T)	-0.43	-0.58

Source: Pakistan Tide Tables

Tidal differences between M.H.H.W. and M.L.L.W. are 2.25 m and 2.38 m at Port Karachi and Port Qasim, respectively.

Fig. 1.2.2 shows the maximum current velocities and directions at Port Karachi observed by the Danish Institute of Applied Hydraulics in July and August, 1971. The observation was carried out at points K and L.

Fig. 1.2.1 Ports Karachi and Qasim

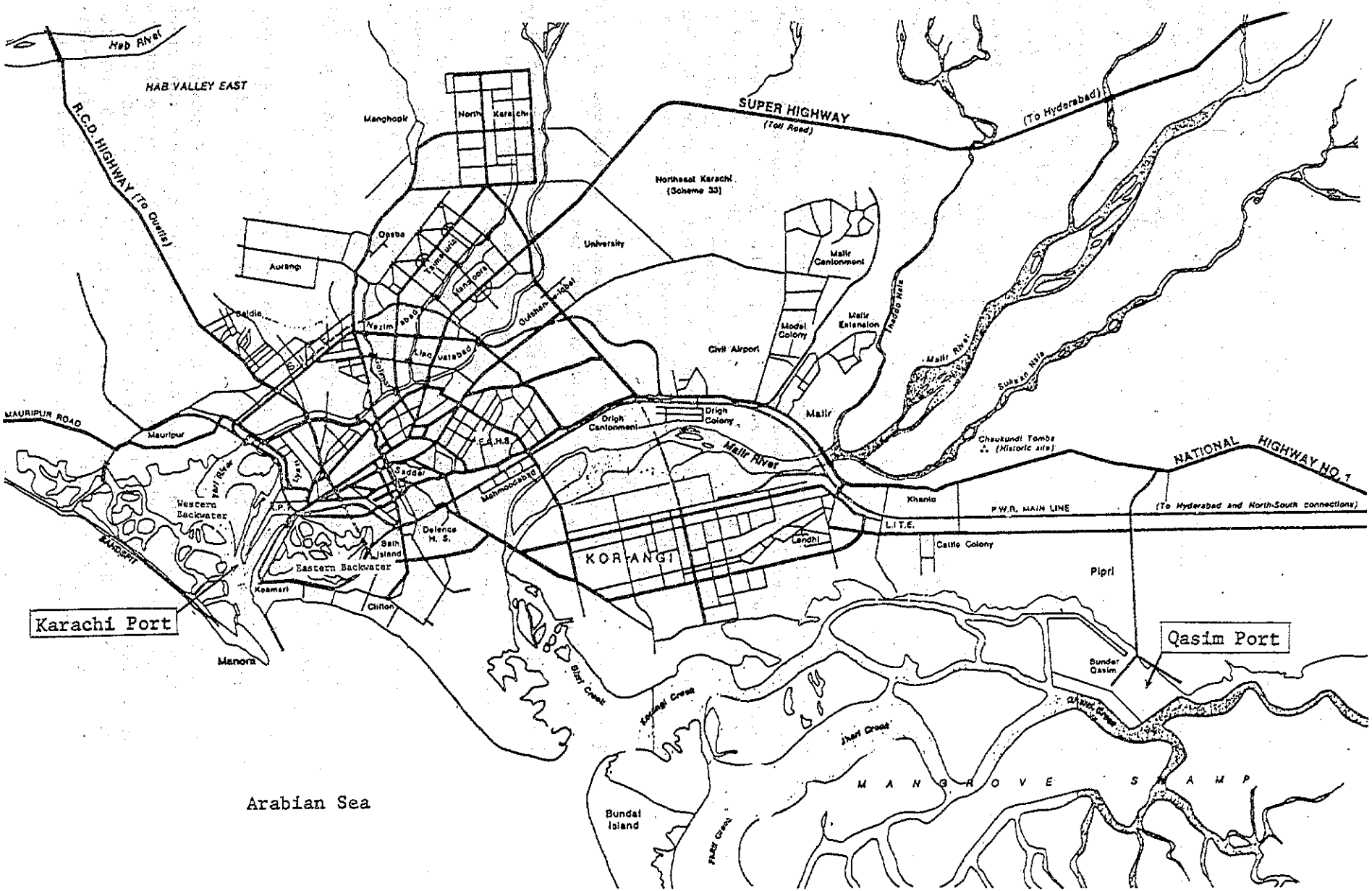
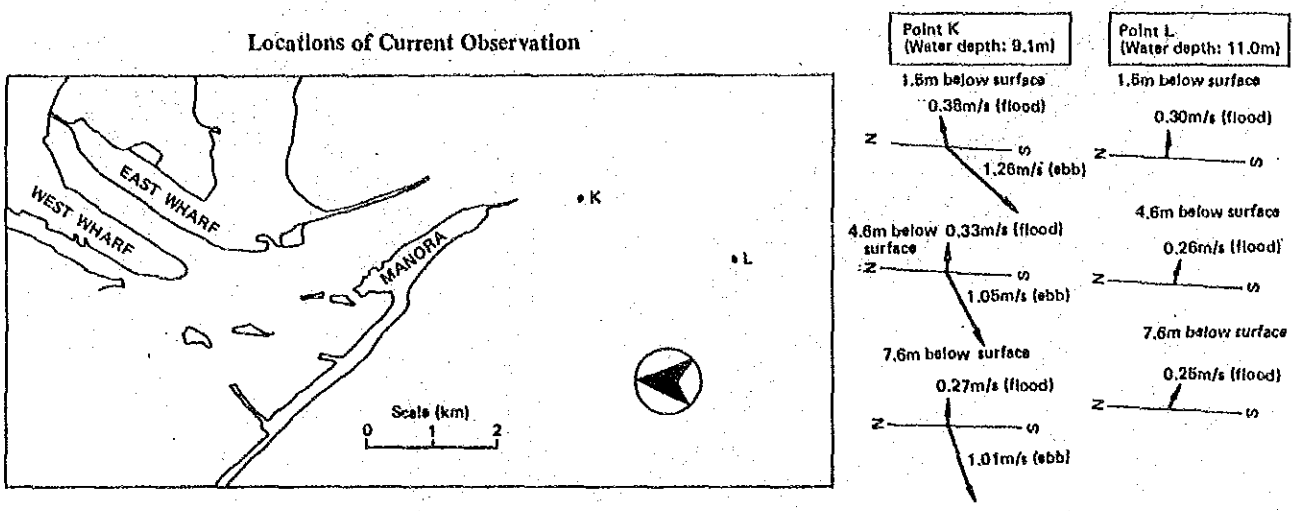


Fig. 1.2.2 Maximum Velocity and Direction of Currents at Port Karachi



Values of velocities and directions shown are averages of several data. The directions of the flood currents are eastward at both points K and L. The velocity of the flood current is approximately 0.3 m/s. The direction of the ebb current at point K is southwestward and the velocity is between 1 and 1.25 m/s. No observations of ebb currents was carried out at point L, but judging from the observations by the Hydraulics Research Station, velocity is about 0.30 m/s.

These velocities are relatively low and can be considered not to affect the navigation of vessels on the open sea.

Fig. 1.2.3 shows the maximum velocity and direction of the currents at Port Qasim during spring tide at the outer channel. The main features are:

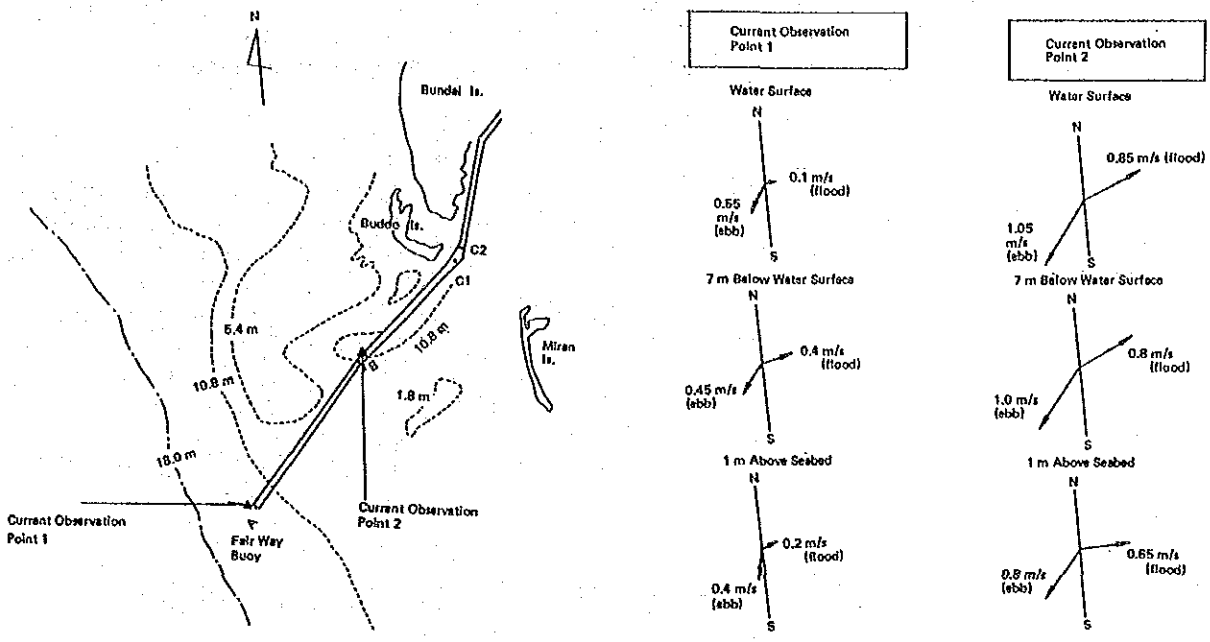
1) Direction of the ebb current is almost parallel to that of the channel, whilst the flood current crosses the channel obliquely. The angle between the direction of the flood current and that of the channel is 20 - 40°.

   The velocity of the ebb current is higher than that of the flood current.

2) Current velocity at Location 2 is 0.65 - 1.05 m/s, and higher than at Location 1 where the velocity is 0.1 - 0.55 m/s.

The direction of the current inside Phitti creek is determined by the tides. The discharges of the rivers flowing into the creek are small, so their contributions are negligible. According to the Pakistani Chart (PAK-20), the maximum current velocity in the channel (near Buddo Island) during spring tide is 1.5 m/s for flood current and 2.5 m/s for ebb current. Velocities in Phitti creek are 1.25 m/s for flood current and 1.5 m/s for ebb current.

Fig. 1.2.3 Maximum Velocity and Direction of Currents at Port Qasim



It is understood that the current speed is generally not strong, but during the spring tide period the maximum current could affect the navigation of ships in the narrow channel.

1.2.3 Earthquakes

In the Karachi region no severe earthquakes causing considerable damage has ever been reported. However, Pakistan lies in the active seismic region which runs through Indonesia to the Himalayas.

According to a seismic zone map prepared by the Department of Meteorology and Geophysics of West Pakistan, the seismic factor in the Karachi region ranges from g/10 to g/20. On the other hand, according to "Soil Investigation for Marginal Wharf Project in Port Qasim" by NESPAK, the Port Qasim area lies in a minor seismic zone, with acceleration ranging from g/20 to g/15, on the basis of the data published by the Geophysical Centre Quetta.

These seismic factor values affect the design of port facilities and equipment considerably.

1.2.4 Social and Economic Conditions

The economy of Pakistan is based on agriculture. Therefore export commodities are mainly agricultural products such as cotton and rice, and are produced mostly in Punjab and Sind Provinces.

The port city of Karachi, however, is quite different from the social and economic viewpoints. The population of Karachi is 5.21 million as of 1981/82, which is equivalent to 6.2% of the national population. Lahore ranks second with 2.95 million, and Faisalabad is third with 1.1 million. According to the Census of Manufacturing Industries, manufacturing activities are also concentrated in Karachi. Karachi's industrial production totals Rs. 33.96 billion in 1980/81 (which is 40% of the national total), the number of the business establishments is 1,245 (32.6%), the number of employed workers is 142,196 (31.4%) and the value added is Rs. 9.2 billion (32.3%). In short, Karachi, with a comparatively small percentage of the total population, produces one-third of the nation's industrial output.

Table 1.2.2 Distribution of Industrial Production (1980/81)

(Rs. Million)

	No. of Business Establishments	Fixed Assets	No. of Employed Workers	Industrial Production	Value Added
Whole Country	3,815 (100.0)	22,719 (100.0)	451,710 (100.0)	84,288 (100.0)	28,692 (100.0)
Punjab	2,070 (54.3)	10,492 (46.2)	226,861 (50.2)	33,468 (39.7)	12,274 (42.8)
Rawalpindi	64	1,147	18,560	3,372	2,382
Jhelum	20	356	8,861	2,246	1,572
Lahole	532	949	35,816	4,698	1,535
Shekhupura	133	1,304	22,675	4,897	1,411
Faisalabad	340	1,720	36,981	4,033	1,242
Sind	1,557 (40.8)	10,109 (44.5)	191,251 (42.3)	44,937 (53.3)	13,789 (48.1)
Karachi	1,245	5,738	142,196	33,961	9,271
Hyderabad	94	561	17,182	3,317	1,058
Dadu	42	733	11,104	1,771	856
NWPF	164 (4.3)	1,709 (7.5)	28,981 (6.4)	5,276 (6.3)	2,445 (8.5)
Peshawar	73	620	13,628	2,827	1,384
Baluchistan	24 (0.6)	408 (1.8)	4,617 (1.0)	608 (0.7)	185 (0.7)

Source: G.D.P., Census of Manufacturing Industries 1980/81

1.3 Port Management

1.3.1 General

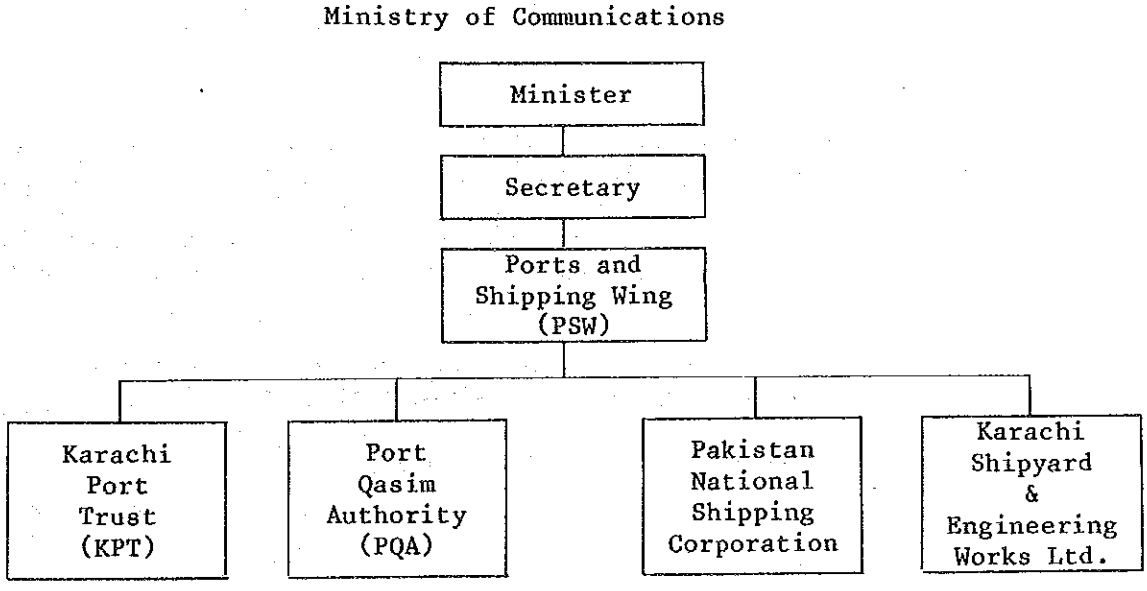
The Ministry of Communication controls the administration of ports and shipping in Pakistan, and the Ports and Shipping Wing (PSW) is in charge of the overall administration of the various organizations related to ports and shipping. All practical works are conducted by organizations which are autonomous bodies under the control of PSW.

These organizations include Karachi Port Trust (KPT) and Port Qasim Authority (PQA). The relationship among the various organizations is illustrated in Fig. 1.3.1.

1.3.2 Karachi Port Trust

KPT is based on the Karachi Port Trust Act enacted in 1868. The highest decision-making organ is the Board of Trustees which consists of 11 members including the Chairman. The Chairman is appointed by the Federal Government, and the Trustees are representatives of ship owners, shippers, port labourers and the Government. Important matters such as the lease, sale and transfer of property, the general budget, major investments and the revision of port fees require prior approval by the Government.

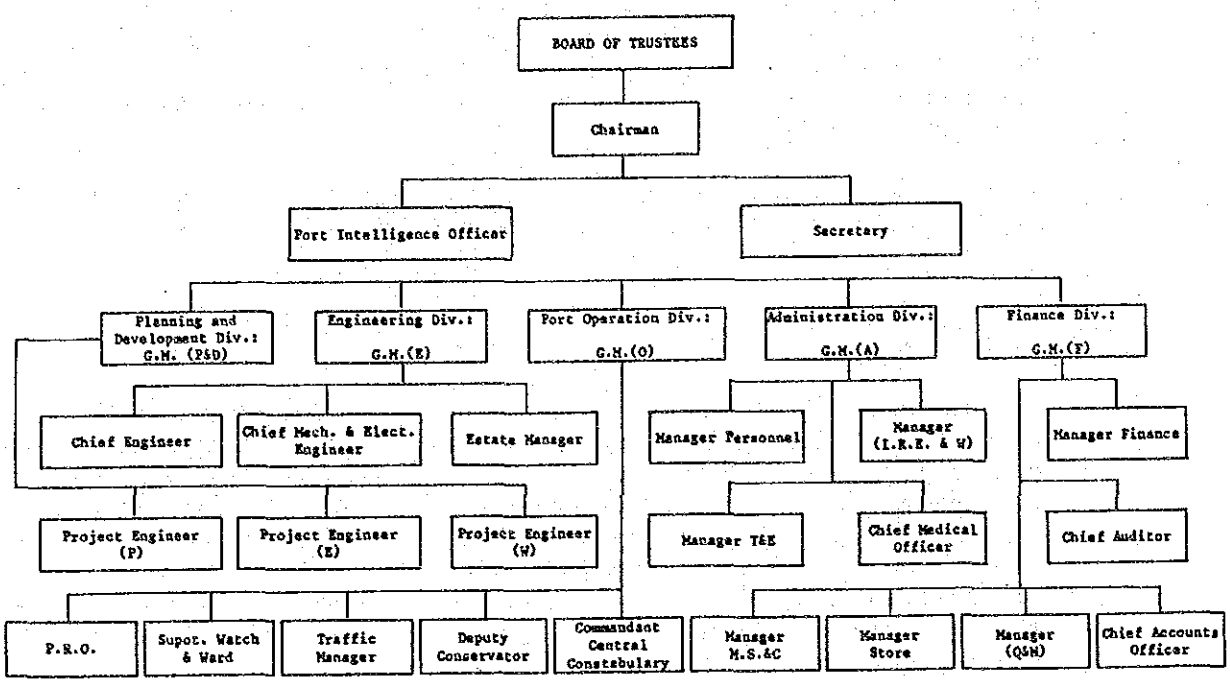
Fig. 1.3.1 Port and Shipping Administrative Organization



Source : P.S.W.

The organization chart of KPT is shown in Fig. 1.3.2.

Fig. 1.3.2 Organization Chart of Karachi Port Trust



Source: KPT

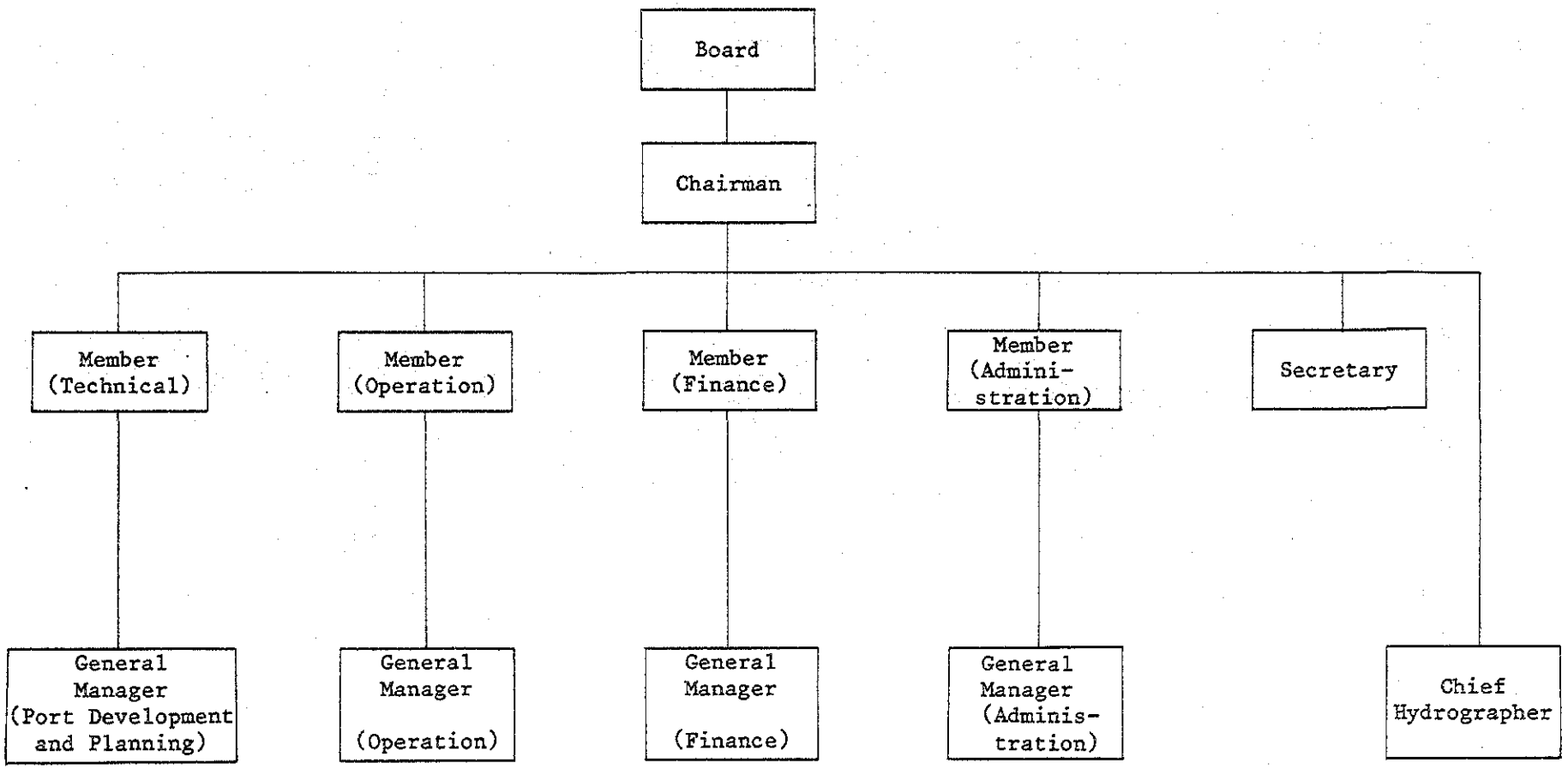
1.3.3 Port Qasim Authority

The Port Qasim Authority (PQA) is based on the Port Authority Act of 1973. PQA controls the land, water and various facilities inside the port area as prescribed by the Act. The highest decision-making organ is the Board consisting of not less than 3 and not more than 7 members including the Chairman, who is appointed by the Government.

As at Karachi, PQA must obtain the prior approval of the Government concerning important matters at Qasim.

Fig. 1.3.3 shows the organization chart of PQA.

Fig. 1.3.3 Organization Chart of Port Qasim Authority



Source: PQA

1.3.4 Financial Status

(1) Port Karachi

The income and expenditure of Port Karachi in 1984/85 and in the past are shown in Tables 1.3.1 and 1.3.2.

Table 1.3.1 Income and Expenditure of Port Karachi (1984/85)

Income	Rs. Million
Cargo Handling	254,296
Ship Movement & Services	134,571
Cargo Storage	248,171
Property Management	105,793
Misc. Income	65,479
Total Income	808,310
Expenditures	
Labour	342,549
Stevedoring	70,385
Material & Supplies	56,249
Fuel	20,615
Outside Repairs & Maintenance	20,615
Administration & Overhead	27,916
Depreciation	80,838
Loan Interest	46,900
Bad Debts	4,000
Total Expenditures	675,208

Source: KPT Year Book

Table 1.3.2 Financial Status of Port Karachi in the Past

(Rs. Million)

Year	Income	Expenditure	Balance
1973/74	189.2	197.1	-7.9
1974/75	218.4	218.3	0.1
1975/76	322.3	219.5	102.8
1976/77	328.6	232.6	96.0
1977/78	377.7	272.6	105.1
1978/79	375.3	409.0	-33.7
1979/80	654.9	438.1	216.8
1980/81	669.7	422.0	247.7
1981/82	739.3	668.5	70.8
1982/83	744.2	584.3	159.9
1983/84	820.2	787.6	32.6
1984/85	808.3	675.2	133.1

Source: KPT Year Book

According to these tables, the major sources of income are cargo handling (31%) and cargo storage (30%), and the largest expenditure is for labour (50%). KPT's financial situation has generally been very satisfactory, and the Port draws no funds from the Government for either operations or capital improvements. Funding is mostly based on foreign loans.

(2) Port Qasim

The income and expenditure of Port Qasim in 1985/86 and in the past are shown in Tables 1.3.3 and 1.3.4, below.

Table 1.3.3 Income and Expenditure of Port Qasim (1985/86)

Income	Rs. Million
A. Iron ore and coal berth	134.79
B. Marginal Wharf	61.21
Port Dues	10.50
Berthage	9.54
Wharfage	27.46
Storage	6.37
Cargo Handling	2.61
Equipment Hire	4.73
C. Other Income	8.55
Total Income (A+B+C)	204.55
Expenditure	
Operating Expenses	85.95
Maintenance Dredging	56.22
Interest on Foreign Loans	85.14
Repayment of Foreign Loans	86.05
Total Expenditure	313.36

Source: PQA

Table 1.3.4 Financial Status of Port Qasim in the Past

(Rs. Million)

Year	Income	Expenditure	Balance
1980/81	115.038	55.120	59.918
1981/82	168.619	121.187	47.432
1982/83	169.097	191.621	-22.524
1983/84	171.217	237.495	-66.278
1984/85	170.37	298.79	-128.42
1985/86	204.55	313.36	-108.81

Source: PQA

At Port Qasim there are two separate budgets, i.e. the development budget and the revenue budget. The development budget is used for development projects, whereas the revenue budget covers regular operations and administrative expenses.

From the planning stage, all the development works at Qasim have been financed by the Government using Government funds and foreign loans arranged and guaranteed by the Government. More than half of the port income is from the lease of the iron ore and coal berth (IOCB) to the Pakistan Steel Mill (PSM). The financial status of PQA has been poor since 1982/83, although the total income is sufficient to cover operating costs (excluding interest payments and repayment of principal).

It is said that the large increase in maintenance dredging costs is due to foreign exchange factors and that acquisition of a dredger would greatly reduce this cost.

1.3.5 Tariff Structure

The present port charges at both ports are shown in Table 1.3.5.

As shown in the Table, the wharfage charge at Port Qasim is three times that at Port Karachi.

Table 1.3.5 Tariff Comparison between KPT and PQA

Item	KPT (Revised in August 1979)	PQA (Revised in Sept. 1984)
Tug Charges	Rs.2500 / inward Rs.5000 / outward	Rs.4.5 / NRT
Pilot Charges	Rs. 1 / NRT	
Port Dues	Rs. 3 / NRT	
Berth Fee	Rs. 0.5 / NRT·day	Rs.0.4 / NRT·day
Wharfage		
General Cargo	Rs. 16 / ton	Rs.48 / ton
POL	Rs. 6 / m^3	-
Wheat	Rs. 4 / ton	Rs.12 / ton
Fertilizer	Rs. 3.2 / ton	Rs. 9 / ton
Container	Rs. 300 / TEU* (Empty)	Rs.450 / TEU (Loaded or Empty)

Source: The Gazette of Pakistan

*) For loaded containers the tariff is levied on the cargo content.

1.4 Port Facilities

1.4.1 Port Karachi

Port Karachi comprises East Wharf, West Wharf, Juna Bunder Wharf, Barge Wharf and the Oil Piers. Lists of the berth and storage facilities and channels are presented in Tables 1.4.1-3. There are 28 berths in total, 17 at East Wharf and 11 at West Wharf including 4 berths at Juna Bunder Wharf. Of the 28 berths, 11 berths have transit sheds, and the rest have paved open storage areas. At Juna Bunder there are 4 new medium draft berths. Berths 26 and 27 have transit sheds, and Berths 25 and 28 have open paved areas. Four Oil Piers and 2 lighterage berths are located at the eastern side of the lower harbour. Oil Piers 2 and 3 are time-worn and can actually handle little oil cargo. Besides the oil berths, Berth 20 at West Wharf is used for unloading vegetable oil.

1.4.2 Port Qasim

Port Qasim comprises one iron ore/coal berth and seven multipurpose berths. Lists of the berths, storage facilities and channels are presented in Tables 1.4.4-6. The port also has a 4,000 hectare industrial area. The entrance to Port Qasim consists of a navigation channel approximately 44 km in length which allows the passage of 50,000 DWT ships at high tide and 25,000 DWT ships in all weather conditions.

The iron ore and coal berth exclusively handles the raw materials of Pakistan Steel Mill.

Table 1.4.1 Berth Facilities at Port Karachi

Wharf	Berth No.	Length (m)	Depth (m)	Construction Year
East Wharf	No. 1-4	626.36	10.36	1975
	No. 5-7	462.68	8.53	1964
	No. 8	167.64	9.44	1964
	No. 9-17	1,408.16	10.36	1964
Total:	17	2,664.84		
West Wharf	No. 18	167.64	9.75	1930
	No. 19-21	541.02	10.36	1930
	No. 22	213.36	11.58	1973
	No. 23	192.02	11.58	1973
	No. 24	154.40	11.58	1973
Total:	7	1,268.44		
Juna Bunder	No. 25-28	645.56	9.14	1981
Barge Wharf				
East	No. 17 A	36.58	3.05	1960
West	No. 24 A	49.07	3.05	1973
	No. 18 A	376.73	7.32	1968
Return Wharf		112.78	7.32	1975
NMB Wharf		555.96	3.66	1914
Total:	4	1,131.12		
Oil Berths (Keamari)	No. 1	300.84	11.28	1966
	No. 2	196.29	9.44	1956
	No. 3	122.83	9.44	1910
	No. 4	321.56	13.41	1978
Total:	4	941.52		

Source: KPT

Table 1.4.2 Storage Facilities at Port Karachi

Location	Transit Shed (m^2)	Marshalling Yard (m^2)	Open Stowage (m^2)
East Wharf	53,918	99,021	
West Wharf	50,690	174,750	
Juna Bunder	12,450	26,115	
Total	117,058	299,886	
Container Yard			
East Wharf			16,375
Keamari			101,208
Pak Shaheen			9,222
M1 Yard			87,034
Total			213,839

Source: KPT

Table 1.4.3 Channels at Port Karachi

Name of Channel	Length	Width	Depth
Entrance	3.9 km	183 m	12.2 m
Lower Harbour	3.3 km	183 m	11.3 m
Upper Harbour	3.5 km	300 m	10.4 m

Source: KPT

Table 1.4.4 Berth Facilities at Port Qasim

Wharf	Berth No.	Length (m)	Depth (m)	Construction Year
Iron and Coal Berth		279	12.0	1980
Multi Purpose Berths	No. 1-4	4x200	10.0	1981
	No. 5-7	3x200	12.0	
Total:	7	1,400		

Source: PQA

Table 1.4.5 Storage Facilities at Port Qasim

Location \ Facilities	Transit Shed (m^2)	Marshalling Yard (m^2)
Multi Purpose Terminal		
No. 1 - 4	20,000	116,000
No. 5 - 7		116,000
Total	20,000	232,000

Source: PQA

Table 1.4.6 Channels at Port Qasim

Name of Channel	Length	Width	Depth
Approach	14.1 km	185 m	12.4 m
Inner	25.1 km	180 m	11.3 m
Reach	4.5 km	180 m	10.0 m

1.5 Cargo Handling Equipment and Floating Craft

1.5.1 Port Karachi

The cargo handling equipment at Port Karachi is summarized in App. Table 1-5-1. Some of the outstanding characteristics are the arrangement of 73 three-ton quay portal cranes on East and West Wharves, the recent introduction of two large mobile cranes for container handling at Berth 24 on West Wharf and Berth 25 on Juna Bunder Wharf, and the disposition of various ordinary equipment such as small mobile cranes, forklift trucks and others. The serviceability of this ordinary equipment was quite good, from 75% to 100%, in 1984/85 according to KPT's Year Book.

Equipment for bulk cargoes such as hoppers and evacuators is also employed by the National Logistic Cell (NLC). A 40 ton crawler crane for handling containers was recently introduced on Berth 24 by the American President Line. However, equipment for handling containers is not sufficient.

With regard to floating craft, KPT owns six dredgers, five hopper barges, 13 tugs and several service boats, as shown in App. Tables 1-5-2 and 1-5-3. Dredgers and hopper barges are for the maintenance dredging of the channel and basin. In the past, the fleet has dredged an average of approximately one million cubic meters per year, according to KPT.

1.5.2 Port Qasim

PQA's cargo handling equipment and floating craft are tabulated in App. Tables 1-5-4 and 1-5-5. At present the utilization of this equipment is reported to be low.

In addition to PQA's equipment, bulk handling equipment for wheat has been introduced by the private sector at the multipurpose berths.

On the iron ore and coal berth, Pakistan Steel Mill has two unloaders with 1,200 tons per hour nominal capacity and a 4.5 km conveyor system from the berth to the stockyard of Pakistan Steel Mill.

As for dredging, PQA does not own a dredger and hence maintenance dredging works have been contracted to foreign firms. According to PQA, the dredging volume amounts to about 2.4 million cubic meters per year, which has been a burden on the Port finances. Under such circumstances, the Government agreed in 1987 to procure a trailing suction hopper dredger which will be built after 1990 using a foreign loan.

1.6 Cargo Throughput

1.6.1 Historical Trend

Fig. 1.6.1 and App. Table 1-6-2 show the historical trends of cargo tonnage, berth length and cargo tonnage per unit berth length over the past twenty years. From 1965 to 1977 the cargo tonnage growth rate was rather slow. On the other hand, from 1977 to 1986 the rate was remarkably high.

In these 9 years cargo tonnage almost doubled. From 1974 to 1980 there was not much berth construction, but cargo tonnage increased by around 4.2 million tons from 10.5 million tons to 14.7 million tons. Total cargo tonnage including Port Qasim increased by around 5 million tons in the five years from 1980/81 to 1985/86.

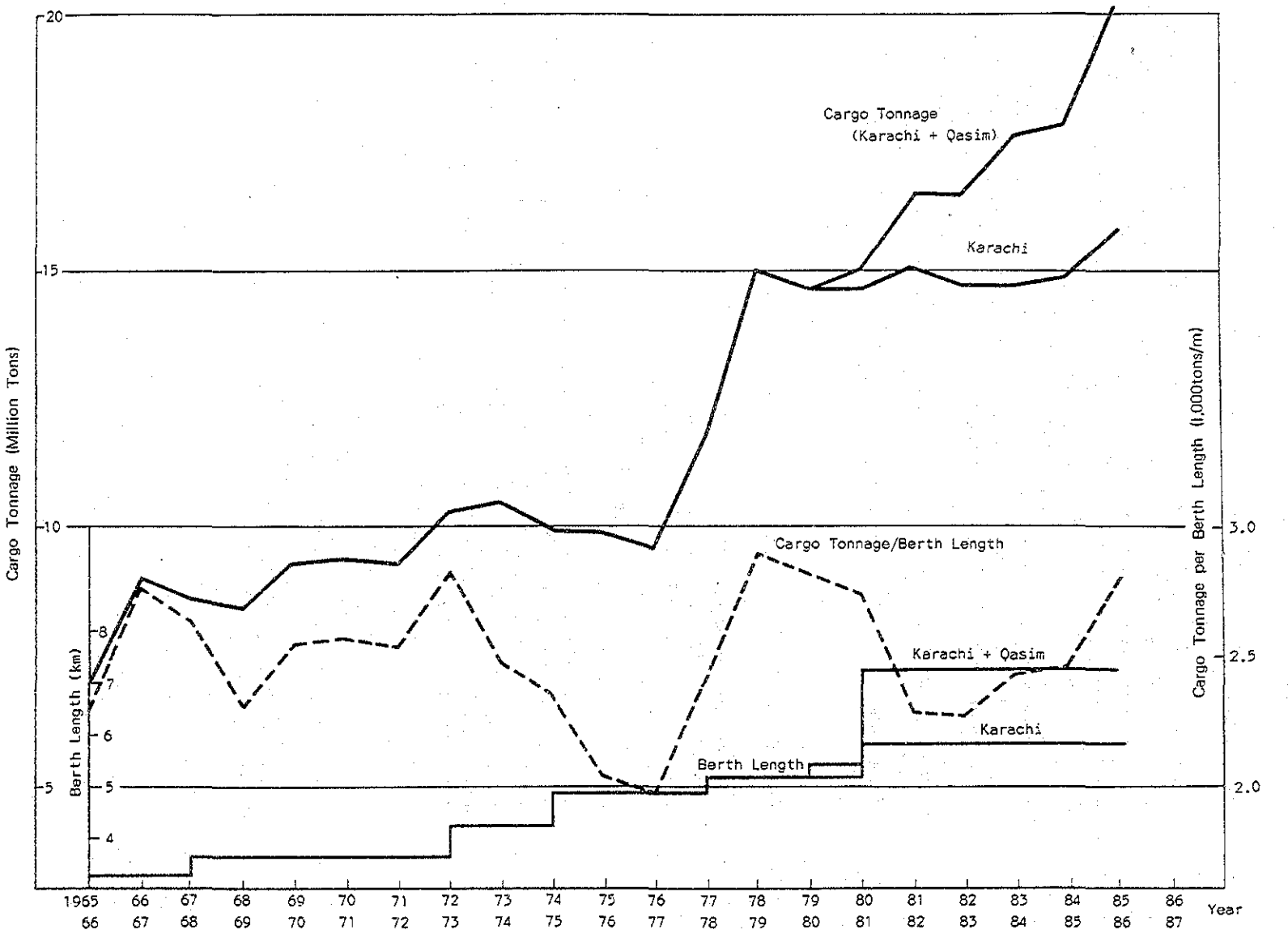
It seems that this increase of 5 million tons was mostly at Port Qasim.

1.6.2 Recent Cargo Throughput

The cargo tonnages handled at Port Karachi and Port Qasim during 1980/81 - 1985/86 are shown in Table 1.6.1 and App. Table 1-6-1. The annual cargo throughput at Port Karachi has remained at around 15 million tons during the past five years. In the table, it is found that export volumes at Port Karachi dropped by approximately 25% in 1983/84 due to the partial shift of rice export to Port Qasim. Meanwhile, the total cargo throughput at Port Qasim has been increasing year by year, and the growth rate from 1984/85 to 1985/86 is 47%. In 1985/86 Port Qasim handled 20% of Pakistan's total imports and 30% of the total exports on a tonnage basis. One reason why exports at Port Qasim dropped by almost 50% in 1984/85 was the decrease in rice exports which may have been caused by a smaller rice crop in Pakistan during that year.

In terms of the total of both ports, the average export share over the past five years was 22% and the import share was 78%, while the total tonnage increased at an average rate of 6% per annum during the same period. The larger exports in 1983/84 and 1985/86 were partially caused by increased rice exports (refer to App. Table 1-6-1).

Fig. 1.6.1 Historical Trend of Cargo Tonnage and Berth Length



Source: JICA Study Team

1.6.3 Container Cargo

As shown in Table 1.6.2, the recent growth rate of container cargo in Pakistan is remarkable despite the absence of a full-scale container terminal. The container cargo tonnage in 1985/86 is more than five times the 1980/81 tonnage, while the total dry cargo tonnage remained at approximately the same level over the five-year period. It is notable that the volume of containerized cargo has been increasing much more rapidly than the total dry cargo volume.

Container cargo grew from 419,000 tons in 1980/81 to 2,209,000 tons in 1985/86, showing a high growth rate of 39% per annum. This may be explained by the rapid development of containerization throughout the world. Almost one-third of the total dry cargo was containerized in 1985/86.

Judging from the recent statistics shown in Table 1.6.2, it is very likely that the container cargo tonnage at Port Karachi will reach 3 million tons per annum in the very near future. Cargo data shown in App. Table 1-6-1 indicate that there is still a considerable amount of potentially containerizable cargo which is not yet being transported by containers, especially among import commodities. From the economic point of view, round-trip container transport is more desirable than one-way container flow. This is clearly demonstrated by Table 1.6.3, which shows that container box traffic is almost balanced between import and export. It is also clear from Tables 1.6.2 and 1.6.3 that cargo volume is approximately 9 tons/TEU in both import and export for the past few years. The economic benefit of round-trip container flow may be the main reason why the volumes of container cargo in imports and exports remain at nearly the same level despite the great share differences between imports and exports in total dry cargo.

Table 1.6.1 Cargo Tonnage by Port

(Unit: 1000 tons)

Port \ Year		1980/81	81/82	82/83	83/84	84/85	85/86
Karachi	import	11,307	11,589	11,709	12,412	12,401	12,511
	export	3,617	3,548	3,080	2,346	2,497	3,309
Total		14,654	15,137	14,789	14,758	14,898	15,820
Qasim	import	375	1,246	1,295	1,359	2,150	3,044
	export	1	164	445	1,564	861	1,389
Total		376	1,410	1,740	2,923	3,011	4,433
Grand Total		15,030	16,547	16,529	17,681	17,909	20,253

Note: Container Cargo is included

Source: KPT, PQA

Table 1.6.2 Container Cargo Tonnage and Share

Year	Dry Cargo: A (1000 tons)			Container: B (1000 tons)			Share: B/A (%)		
	Import	Export	Total	Import	Export	Total	Import	Export	Total
1980/81	4830 (1.00)	2358 (1.00)	7188 (1.00)	219 (1.00)	200 (1.00)	419 (1.00)	4.5	8.4	5.8
1981/82	4894 (1.01)	2041 (0.86)	6935 (0.96)	420 (1.92)	386 (1.93)	806 (1.92)	8.5	18.9	11.6
1982/83	4792 (0.99)	1918 (0.81)	6710 (0.93)	544 (2.48)	488 (2.44)	1033 (2.46)	11.3	25.4	15.4
1983/84	5012 (1.03)	1679 (0.71)	6691 (0.93)	782 (3.57)	519 (2.59)	1301 (3.10)	15.6	30.9	19.4
1984/85	5140 (1.06)	1532 (0.65)	6672 (0.92)	785 (3.58)	721 (3.60)	1506 (3.59)	15.2	47.0	22.5
1985/86	5216 (1.07)	2315 (0.98)	7531 (1.05)	993 (4.53)	1216 (6.08)	2209 (5.27)	19.0	52.5	29.3

Note: Figures in parentheses show the indicator with the 1980/81 figures set at 1.00

Source: KPT

Table 1.6.3 Container Traffic

(Unit: TEU)

Year	Import			Export			Total		
	Loaded	Empty	Total	Loaded	Empty	Total	Loaded	Empty	Total
1977/78	2,961	1,499	4,460	1,368	644	2,012	4,329	2,143	6,472
1978/79	7,135	4,880	12,015	9,743	1,010	10,753	16,878	5,890	22,768
1979/80	15,627	5,250	20,881	16,569	2,687	19,256	32,196	7,941	40,137
1980/81	26,118	5,399	31,517	25,934	2,719	28,653	52,052	8,118	60,170
1981/82	35,432	10,699	46,131	34,612	8,769	43,381	70,044	19,468	89,512
1982/83	55,783	11,783	67,566	45,119	11,544	56,663	100,902	23,327	124,229
1983/84	62,047	8,598	70,645	45,694	24,031	69,725	107,741	32,629	140,330
1984/85	63,698	20,672	84,370	64,187	20,858	85,045	127,885	41,530	169,415
1985/86	73,514	48,252	121,766	107,373	14,947	122,320	180,887	63,199	244,086

Source: KQT

1.7 Passenger Traffic

As shown in Table 1.7.1, the total number of passengers and pilgrims remained at around 30 thousand during the four years up to 1985/86.

In 1982/83, almost two-thirds of the passengers were pilgrims while one-third were regular passengers, and in 1985/86 about half of the passengers were pilgrims. As is well known, pilgrims tend to concentrate in a short period of the year. The data below show the peak traffic in the pilgrimage period of 1985/86.

Total number of passengers	29,331 persons
Pilgrims	14,846
Regular Passengers	14,485
Monthly number of passengers	
Pilgrimage period	8,630
Other Months	1,207

Note: assuming a 2-month duration for the pilgrimage

Table 1.7.1 Number of Passengers at Port Karachi

Year	PASSENGERS			PILGRIMS			TOTAL		
	Disem-barked.	Emba-rked.	Total	Disem-barked.	Emba-rked.	Total	Disem-barked.	Emba-rked.	Total
1980/81	17,029	4,379	21,408	7,657	7,781	15,456	24,704	12,160	36,874
1981/82	14,087	2,996	17,083	11,121	11,121	22,242	25,208	14,117	39,325
1982/83	5,977	2,012	7,989	11,072	10,871	21,943	17,049	12,883	29,932
1983/84	4,373	3,825	8,198	11,062	11,606	22,668	15,435	15,431	30,866
1984/85	5,301	5,629	10,930	8,819	9,077	17,896	14,120	14,706	28,826
1985/86	8,319	6,166	14,485	6,333	8,513	14,846	14,652	14,679	29,331

Source: KPT

1.8 Ship Calls, Waiting Time and Berth Utilization

1.8.1 Ship Calls

Tables 1.8.1 to 1.8.3 show the number of ocean-going ships calling at the two ports. The number increased from 1,550 in 1980/81 to 2,070 in 1985/86, a growth rate of 6% per annum. The number of port calls by bulk cargo ships at Port Karachi declined from 277 in 1980/81 to 132 in 1985/86, a decrease of 145 vessels. However, during this same period the number of bulk carriers calling at Port Qasim rose from 2 to 189, an increase of 187 vessels.

Table 1.8.1 Ship Calls at the Two Ports

Year	80/81	81/82	82/83	83/84	84/85	85/86
Karachi						
General Cargo Ships	1,033	1,265	1,276	1,299	1,258	1,383
Bulk Ships	277	230	161	110	135	132
Oil Tankers	273	276	296	280	256	313
Total	1,533	1,771	1,733	1,689	1,649	1,828
Qasim						
Bulk Ships	2	17	64	134	93	189
Iron Ore, Coal Ships	15	49	46	39	50	53
Total	17	66	110	173	143	242
Grand Total	1,550	1,837	1,843	1,862	1,792	2,070

Source: KPT, PQA

Table 1.8.2 Number of Calling Ships by Type at Port Karachi

Year	Container Ships	General Cargo	Bulk	Oil Tankers	Roll-on Roll-off.	Lash Vessels	Total
1983/84	404	871	110	280	110	12	1,787
1984/85	448	687	139	297	94	8	1,673
1985/86	599	679	132	313	96	9	1,828

Source: KPT

Table 1.8.3 Number of Calling Ships by Type at Port Qasim

	Bulk Ships at MPT			Iron Ore, Coal Ships			Total
	Wheat	Rice	Other	Iron Ore	Coal	Manganese	
1983/84	-	86	48	22	16	1	173
1984/85	9	51	33	29	21	-	143
1985/86	24	108	57	29	23	1	242

Source: PQA

Fig. 1.8.1 and App. Table 1-8-1 show cargo tonnage handled per ship. These values are closely related with calling ship size. Generally speaking, the larger the ship size, the higher the cargo handling efficiency. But maximum ship size is restricted by water depth, and the port sector cannot select the size of ships.

The cargo tonnage handled per ship of iron ore and coal cargo ships calling at Port Qasim shows a strong increase, but may be reaching its upper limit, restricted by the water depth. Oil ships at Karachi showed a maximum value of around 30,000 tons per ship in 1983/84. The volume handled per ship of general cargo ships calling at Port Karachi shows only a slight increase. The cargo volume handled per ship of bulk ships has increased for the past five years at both Ports Karachi and Qasim. The cargo volume handled per bulk vessel at Port Qasim is expected to increase to equal the level at Port Karachi in the future.

1.8.2 Waiting Time for Berthing

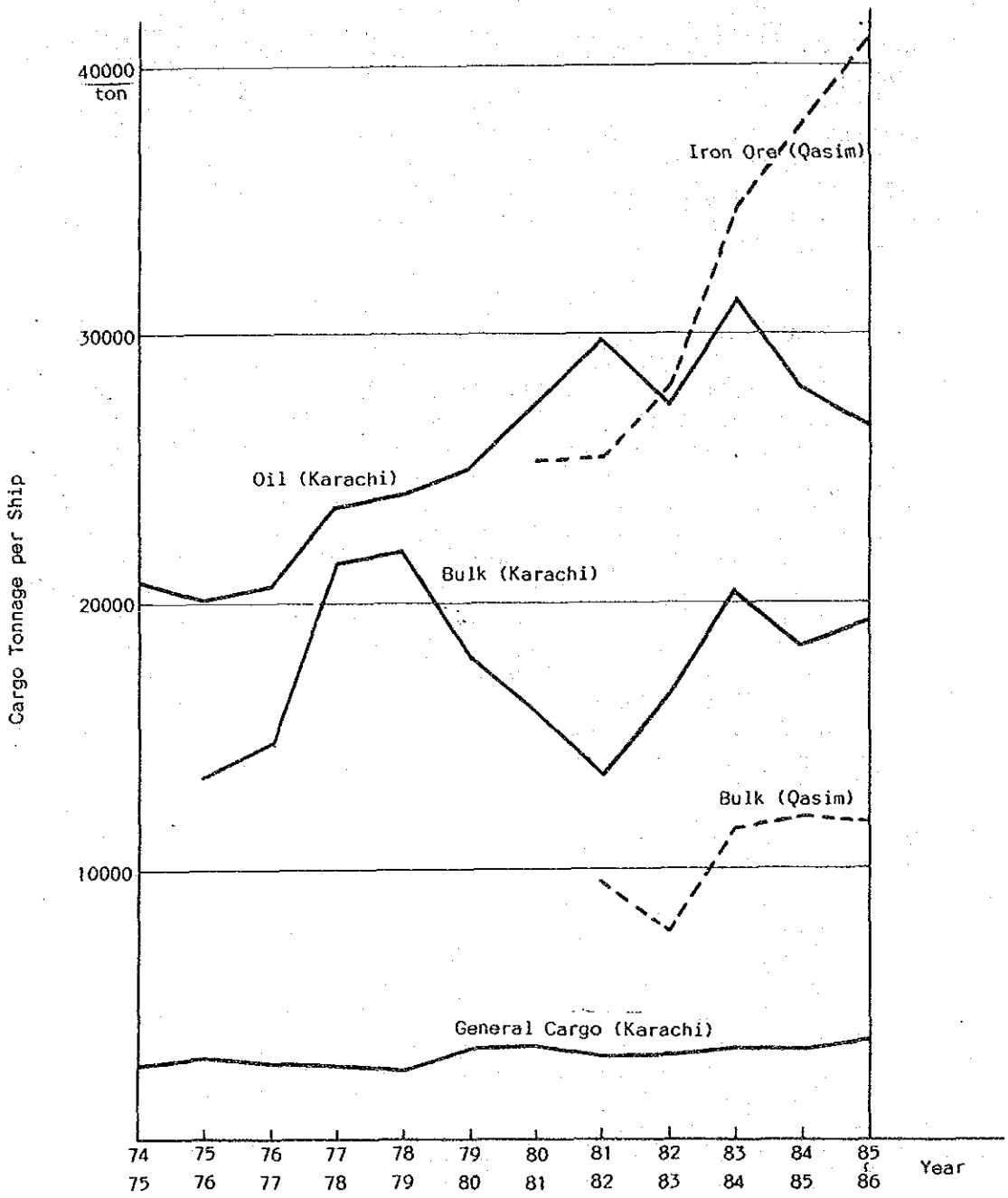
The past record of waiting time of ships for berthing, which is denoted by Wq hereinafter, is illustrated in Fig. 1.8.2 and tabulated in App. Table 1-8-2 for Port Karachi.

In the past, the longest waiting time of general cargo ship was recorded in 1978/79, i.e. about 10 days per ship. After that year, the conditions improved up to 1985/86, i.e. to about one day per ship on the average.

The following two points may be the major reasons for this sharp reduction in the waiting time.

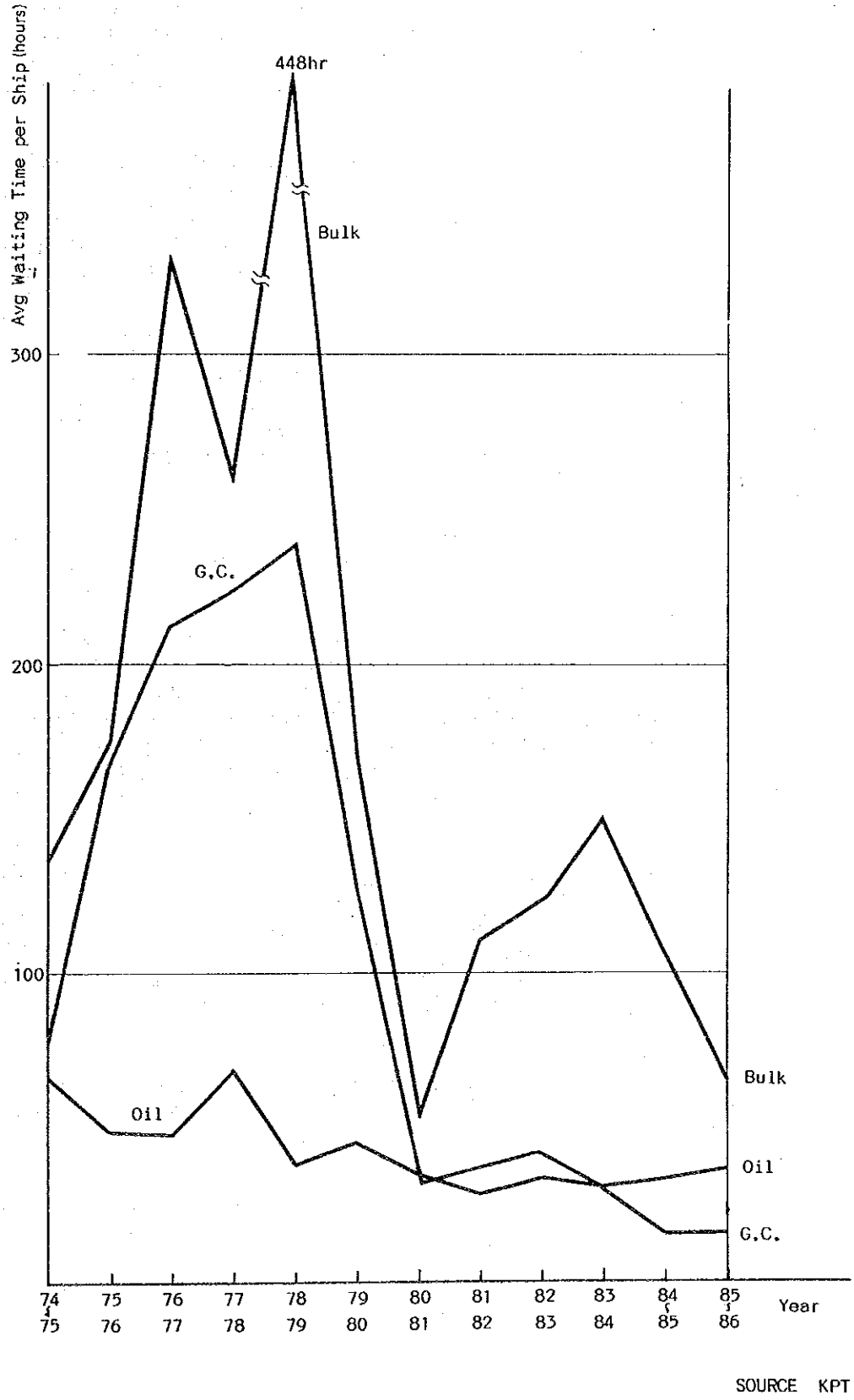
First is the establishment of NLC within the Army in 1978. NLC efficiently handled the crisis situation and succeeded in eliminating the extreme port congestion. Second is the opening of Port Qasim in 1980/81, providing additional berthing facilities.

Fig. 1.8.1 Cargo Tonnage Handled per Ship



Source: KPT

Fig. 1.8.2 Ship Waiting Time per Ship, Wq



SOURCE KPT

1.8.3 Berth Utilization and Cargo Handling Efficiency

Fig. 1.8.3 and App. Table 1-8-3 show the average operation time per ship or the average berthing time Tb. There are two factors which influence this value, that is cargo volume handled per ship (Fig. 1.8.1) and cargo handling speed or efficiency during berthing time which is denoted by Eb and is shown in Fig. 1.8.4 and App. Table 1-8-4.

With regards to Eb, the high value for oil cargo compared with other cargoes is due to the use of pumping facilities for loading and unloading. The higher productivity for iron ore and coal compared with other cargo is due to the special unloading machines at the exclusive use terminal at Port Qasim. Although the value for general cargo is relatively low, it has been increasing steadily.

Going back to the average berthing time in both ports, the staying time of bulk ships is rather longer than the staying time of other types of ships. The staying time of general cargo ships shows a steady improvement despite the increasing cargo tonnage handled per ship shown in Fig. 1.8.1.

Apparently, this is mostly due to the development of containerization and the improvement of container handling efficiency.

One of the main reasons for the excellent performance at the iron ore and coal terminal at Port Qasim is surely the efficient unloading system installed by Pakistan Steel Mill. The trend of oil cargo handling using pumping facilities at Port Karachi also indicates increasing efficiency and decreasing berthing time. Accordingly, it can be said that in order to improve bulk cargo handling productivity, the introduction of an efficient bulk cargo handling system might be one useful method.

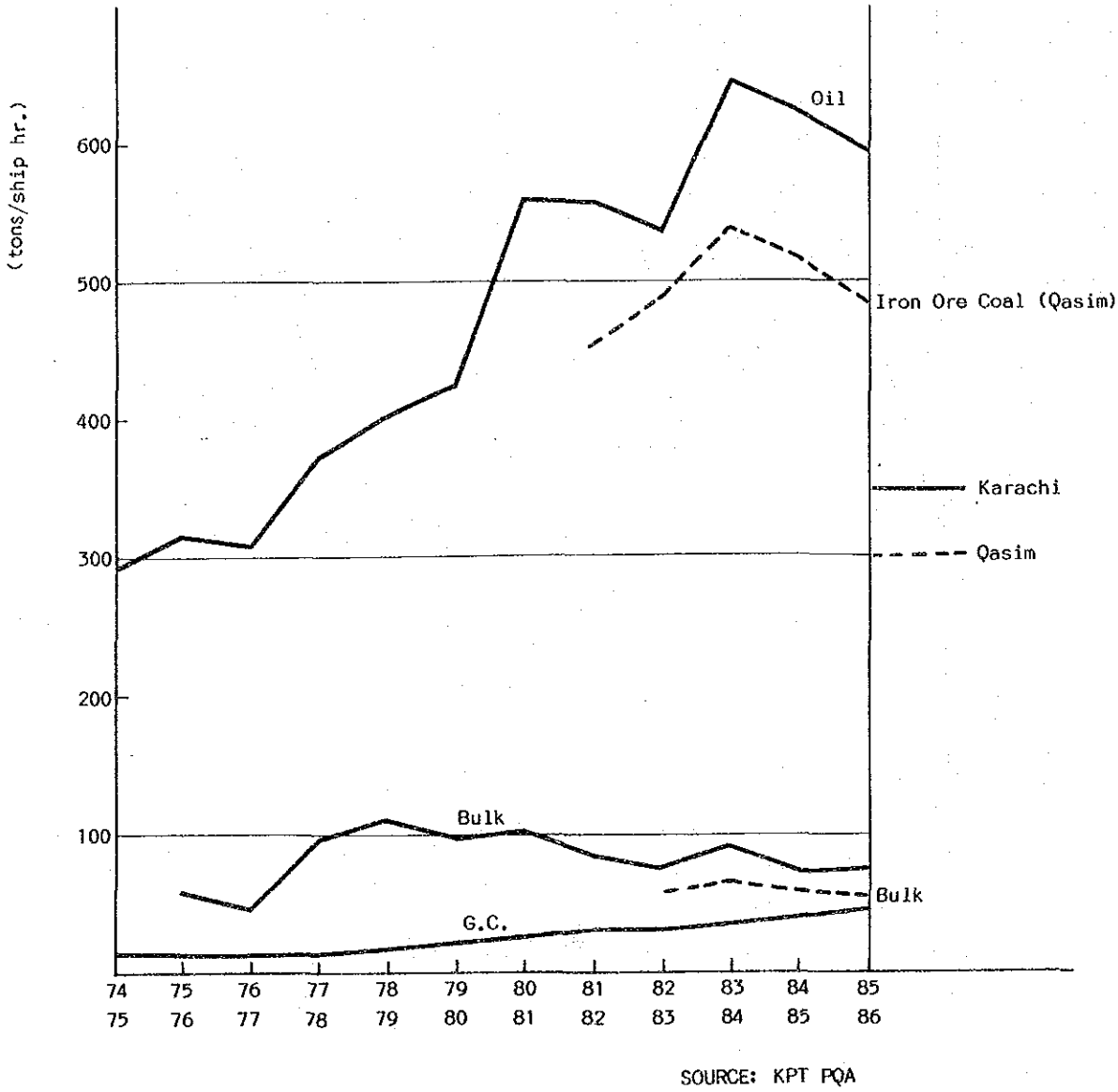
The berth occupancy is summarized in Tables 1.8.4 (1) and (2).

At Port Karachi over the last three years, the berth occupancy rates have been approximately 70% at the East and West Wharves and 40% at the Oil Piers. The occupancy at the East and West Wharves is quite high, and this is reflected in the long waiting time discussed above.

At Port Qasim, high berth occupancy rates of approximately 70% at the Multipurpose Terminal (MPT) and 50% at the Iron Ore and Coal Berth (IOCB) were recorded in 1985/86.

Fig. 1.8.3 Average Berthing/Operation Time per Ship, Tb

Fig. 1.8.4 Cargo Handling Efficiency (Cargo Tonnage per Ship per Hour), Eb



SOURCE: KPT PQA

Table 1.8.4(1) Berth Occupancy at Port Karachi from 1981 to 1986

(Unit: percent)

Year	Dry Cargo			Liquid Cargo
	East Wharves	West Wharves	Weighted Average*	B.O.P. (Oil Piers)
1981/82	80.7	77.9	79.8 (79.7)	44.4
1982/83	84.3	81.8	83.4 (82.1)	44.2
1983/84	71.9	78.5	73.7 (76.0)	37.5
1984/85	72.2	70.6	71.7 (67.2)	36.4
1985/86	71.3	69.5	70.8 (68.7)	39.8

Source: KPT except * which is estimated by the JICA Team for all berths including East and West Wharves. Numbers in parentheses are those derived from App. Table 1-8-1, assuming the number of berths is 24.

Table 1.8.4(2) Berth Occupancy at Port Qasim from 1980 to 1986

(Unit: percent)

Year	Multipurpose Terminal (MPT)	Iron, Oil and Coal Berth (IOCB)
1980/81	NA	23.5
1981/82	NA	30.7
1982/83	36.1	30.2
1983/84	42.4	28.8
1984/85	33.0	NA
1985/86	71.7	51.2

Source: PQA

1.9 Analysis of Port Activities

1.9.1 Cargo Handling Efficiency by Type of Cargo

One important measure of port activities is the cargo handling efficiency by type of cargo. It is necessary to determine the handling efficiency of each cargo type in order to determine which handling systems should be improved as part of the overall port planning.

At Port Karachi, most of the berths are used on a non-exclusive basis for the handling of various types of cargo, and detailed by type and by berth statistics are not available. Thus, it is difficult to discern the actual handling efficiencies. Nevertheless, a reasonable estimation can be made based on the available data. The cargo types can be classified as follows:

General cargo	Break-bulk	Dry cargo		Handled at East and West Wharves
	Container			
Bulk cargo	Dry-bulk			
	Liquid-bulk	Mineral oil	...	Oil Piers and Berth 20
		Vegetable oil		

We know the cargo handling efficiencies of general, bulk and liquid cargo ships as shown in Fig. 1.9.1. The question is what are the efficiencies of break-bulk and container ships, and of ships carrying mineral oil and vegetable oil.

The relationship between the cargo handling efficiency of break-bulk cargo ships and container ships can be expressed as:

$$EbG = \frac{V_G}{Tbt - \frac{V_C}{Eb_C}}$$

where, Eb: Average cargo handling efficiency during berthing time,

V : Annual throughput,

Tb: Total berthing time for a year, and

suffixes t, G and C refer to both types of ships, non-container (break-bulk) ships, and container ships, respectively.

Knowing V and Tb, the equation is as shown in Fig. 1.9.2.

Fig. 1.9.1 Cargo Handling Efficiency During Berthing Time at Port Karachi

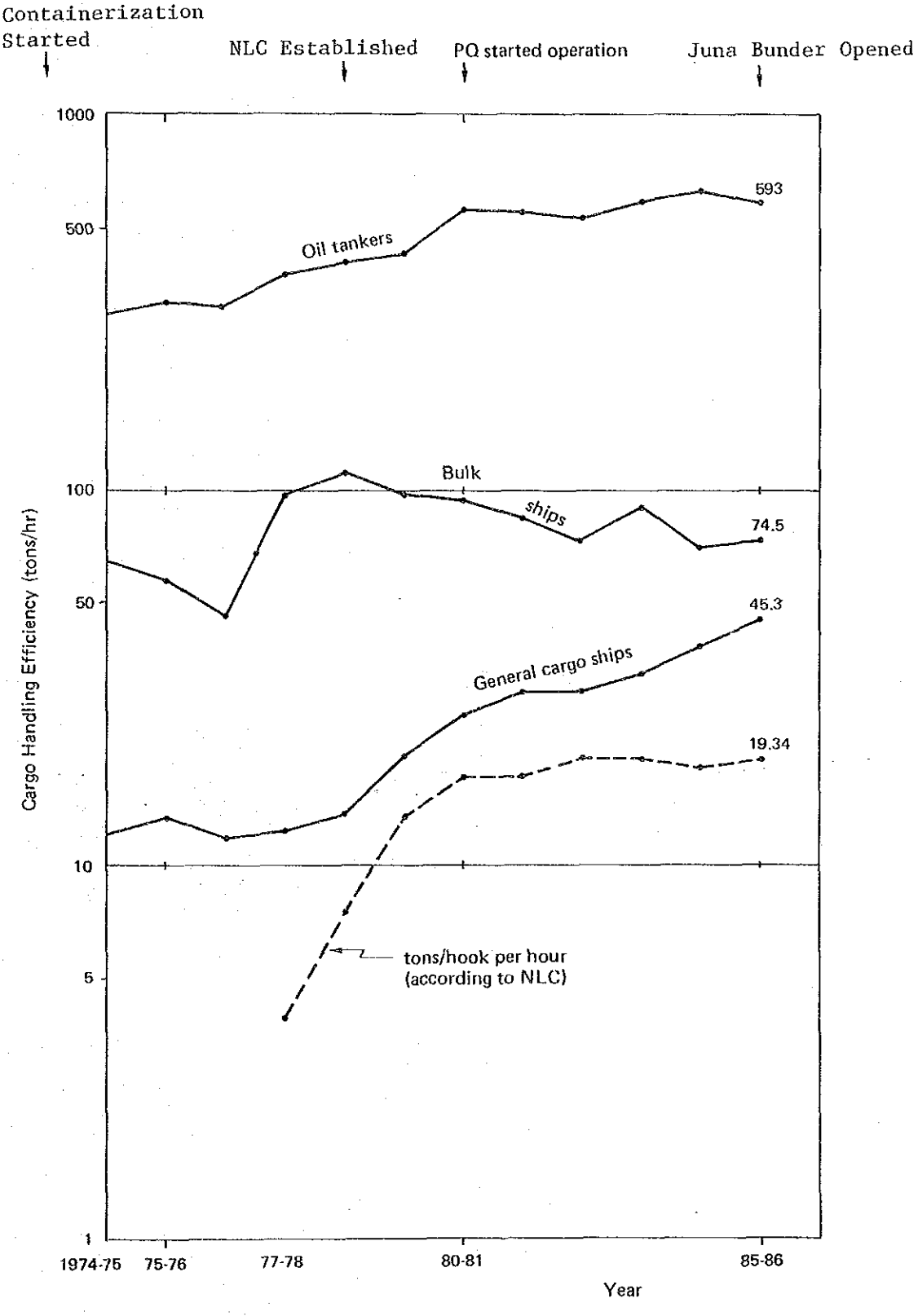
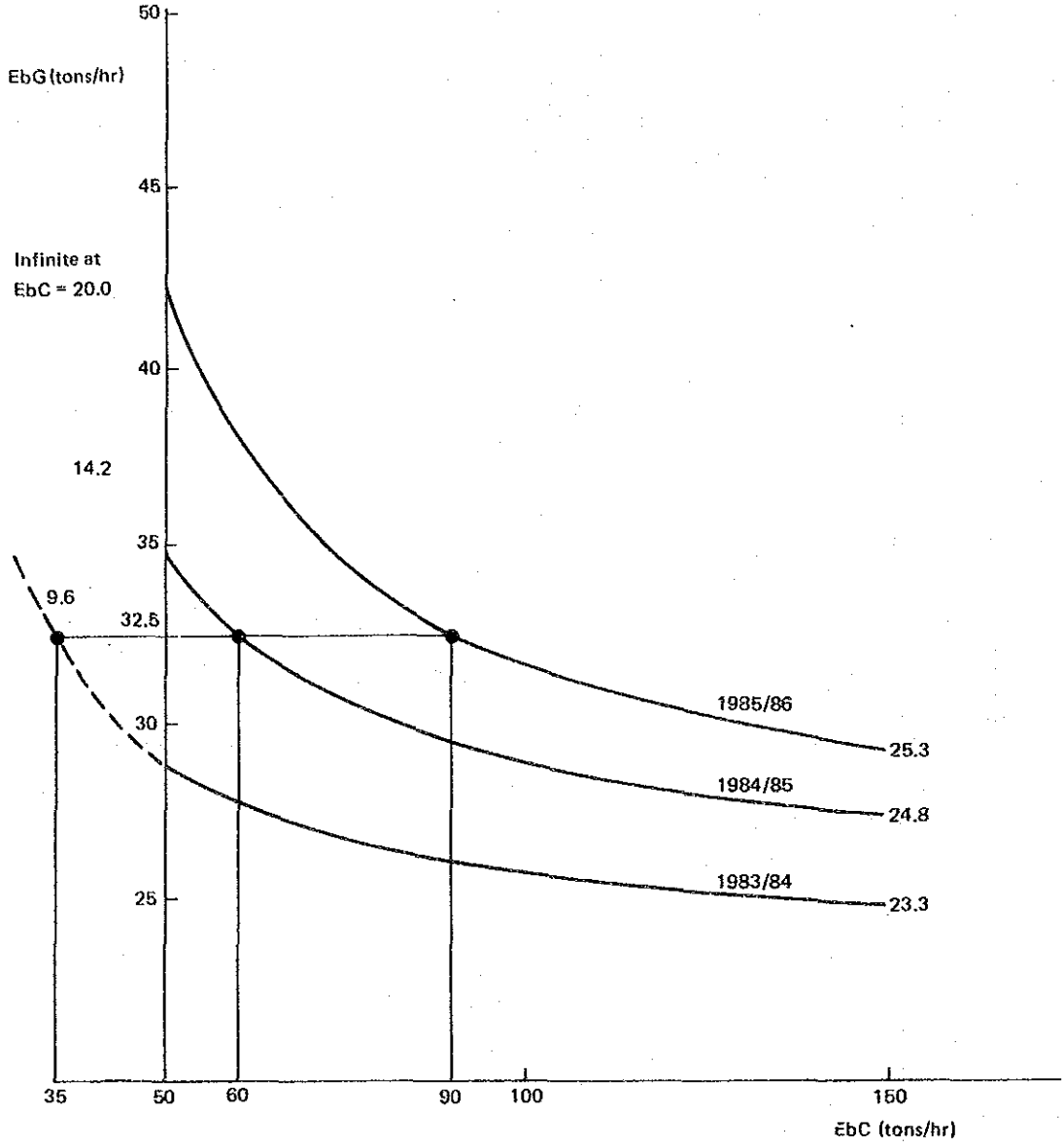


Fig. 1.9.2 Assessment of the Cargo Handling Efficiency



According to NLC, the value of handled tons per hook per hour has not changed at Karachi (See Fig. 1.9.1), and has remained at around 19 tons/hook·hour during the past few years. Hence the improvement of cargo handling efficiency year by year, which is demonstrated in Fig. 1.9.2, could be attributed to the improvement of container handling efficiency and not to an improvement of the handling of break-bulk cargo. On the other hand, it is reported that container handling speed on the quay is 3.5 minutes per box. If we consider the idle time ratio of cargo handling during ship berthing time to be 0.6, container handling efficiency turns out to be Eb_C = 90 tons/hr, which corresponds to Eb_G = 32.5 tons/hr in 1985/86 from Fig. 1.9.2. If we assume the handling efficiency of break-bulk cargo to be 32.5 tons/hr for the past three years, container handling efficiency increased sharply from 35 tons/hr to 60-90 tons/hr over these years.

In conclusion, possible present efficiency could be:

Eb_C = app. 90 tons/hr or 10 TEU/hr
Eb_G = app. 30 tons/hr

The handling efficiency of dry bulk cargo is presently

Eb_B = 74.5 = app. 75 tons/hr.

And the highest efficiency was Eb_B = 110.9 tons/hr in 1978/79.

These values of Eb seems reasonable when we take into consideration presently employed cargo handling methods and equipment.

Lastly, division of the efficiency between mineral oil and vegetable oil cannot be made straightforwardly. According to KPT, the handling rates of edible oil and molasses vary between 100 tons to 300 tons per hour per pipeline, and oil vessels may use up to four pipelines for loading and/or unloading. In addition, we know the overall berth occupancy of Oil Piers OP-1 to OP-4, i.e. 39.8% in 1985/86, and the berthing time of each type of ship. Then trial and error computations of the efficiency of mineral oil, Eb_M, and that of vegetable oil, Eb_V, were made until the result conforms to the above information, and the best combination was found to be

Eb_M = 900 tons/hr, and
Eb_V = 250 tons/hr.

1.9.2 Assessment of Berth Utilization by Type of Ship

As already shown in Table 1.8.4(1), statistics of berth occupancy at East Wharf and West Wharf at Port Karachi are meaningful if we consider the total number of berths to be 24.

Here again, an assessment is performed to clarify the utilization of these 24 berths by different types of ships, i.e. general cargo ship, container ship and bulk ships. From the information on the number and average berthing time of each type of ship, the total berthing time of each type of ship is firstly obtained, and then proportional allotment is made to the 24 berths, taking account of the above berth occupancy.

The result of the assessment on the effective number of berths utilized by each type of ship in 1985/86 is as follows:

Container ships: 4.1 berths
General cargo ships: 14.3 berths
Dry bulk ships: 5.6 berths

1.9.3 Unit Cargo Throughput

Knowing the above effective number of berths utilized by each type of ship at Port Karachi, it is easy to calculate the unit cargo throughput over the wharves, and the results are:

Container cargo: 540 thousand tons/berth or 2,800 tons/m,
General cargo: 200 thousand tons/berth or 1,000 tons/m,
Dry bulk: 450 thousand tons/berth or 2,400 tons/m.

These values could be considered rather realistic and conceivable.

For oil tankers, the unit cargo throughputs are roughly estimated to be:

Mineral oil: 6,000 thousand tons/berth (Berths OP-1 and 4)

Vegetable oil: 430 thousand tons/berth (Berths OP-1 to 3 and No. 20)

1.9.4 Investigation on Waiting Time

Table 1.9.1 summarizes the number of berths, S, berth occupancy, ρ, waiting time, Wq, and service level, μWg, at Port Karachi, where $1/\mu$ is the average berthing time per ship. The service level means the ratio of waiting time over berthing time, which, if smaller, would be better for ships. It is understood that the service levels for container ships, non-container general cargo ships and dry bulk ships are all above 20%. For oil tankers the level exceeds 80%.

Table 1.9.1 Service Level of Port Karachi

Type of Ship	S (Berths)	ρ (%)	Wq (hr/ship)	W/μ (%)
Container ship	24	70.8	16.1	20.2
Non-container ship				
Dry bulk ship			63.6	24.7
Oil tanker	4	39.8	37.0	82.8
Petroleum, Edible oil, etc.				

Source: JICA Study Team

Taking into consideration standard ports where the level is kept below 5%, these values at Port Karachi are considered to be extraordinarily high. Special attention should be given to container ships, which require quick operation and for which the usual service level is almost zero.

It might be reasonable to conclude that improvement of berthing facilities and cargo handling efficiency at Port Karachi is now an important subject for oil tankers, container ships and the other cargo ships.

1.9.5 Railway and Road Transport of Port Cargoes

Demarcation of railway and road transport is an important issue in view of the efficient collection and/or release of port cargoes.

Table 1.9.2 shows the statistics of railway/road transport to/from Port Karachi.

As clearly seen in the Table, more than 80% of the seaborne cargo at Karachi Port has been transported by trucks. Although a large railyard is located within Port Karachi area, it can be understood that the railway is not utilized efficiently. Considering the congested road traffic in Karachi City, especially on the roads connecting the port and the superhighway, if a certain portion of the cargo presently transported by trucks could be shifted to rail transport, it would result in the improvement of present road conditions and more effective utilization of rail facilities.

Table 1.9.2 Ratio of Cargo Tonnage Transported by Rail and Road at Port Karachi

(Unit: Ton)

Categories	1983-84			1984-85			1985-86		
	By Rail	By Road	Total	By Rail	By Road	Total	By Rail	By Road	Total
Dry General Cargo	377,877 (9%)	3,802,724 (91%)	4,180,601 (100%)	367,230 (9)	3,526,619 (91)	3,893,849 (100)	517,125 (10)	4,476,445 (90)	4,993 (100)
Dry Bulk Cargo	28,989 (29)	1,792,090 (71)	2,521,079 (100)	718,555 (26)	2,050,263 (74)	2,768,818 (100)	719,035 (28)	1,810,694 (72)	2,529,729 (100)
Total:	1,106,866 (17)	5,594,914 (83)	6,701,680 (100)	1,085,785 (16)	5,576,882 (84)	6,662,667 (100)	1,236,160 (16)	6,287,139 (84)	7,523,299 (100)

Source: KPT
Note: Figures in parentheses show share by rail and road.

1.10 Review of the Sixth Five Year Plan

1.10.1 Summary of the Sixth Five Year Plan

Project names, costs and planned allocations under the Sixth Five Year Plan are shown in Table 1.10.1.

The major elements of the Plan are as follows:

Public Sector

(1) Port Qasim to be commissioned as a bulk cargo handling port by:

   a) Completion of the ongoing programme, acquisition of mechanical cargo handling equipment, and construction of transit silos.

   b) Acquisition of a dredger to avoid the excessive costs of contract dredging.

   c) Developing a 3 million ton capacity oil terminal.

(2) Execution of the second phase of the Jinnah Bridge.

(3) Construction of a mini-port at Gwadar.

The estimated cost of the public sector programme is Rs. 1,884 million.

Semipublic Sector

(1) Construction of a 1.7 million ton container terminal

(2) Construction of an oil products berth

(3) Acquisition of cargo handling equipment/tugs for Karachi Port

The estimated cost of the programme in the semipublic sector is Rs. 1,570 million. The cargo traffic during the Sixth Five Year Plan was estimated to increase at an annual rate of 7%. Considering the actual growth rate from 82/83 to 85/86 for all cargoes of 6.9%, the projection was quite accurate. In the Plan, establishment of a "National Port Authority" to manage both the ports by one organization was proposed. However, this has not yet been realized.

Table 1.10.1 Sixth Five Year Plan Projects and Budgetary Allocation

(Rs. Million)

Name and Status of Project	Total Cost	F.E.C.	Plan Allocation
Public Sector			
Port Qasim (ongoing)	4700	1913.12	
Acquisition of Dredger for Port Qasim (ongoing)	407	301.00	
Oil Terminal at Port Qasim (PC-II approved)	412	405.00	
Jinnah Bridge (Second Phase) (not approved)	200	40.00	
Construction of Fish Harbour-cum-Mini Port at Gwadar (ongoing)	758.7	269.6	
Permanent Campus for Pakistan Marine Academy (ongoing)	98.483	-	
Navigational Aids on the Coast of Pakistan	6.5	1.4	
Light House at Ketty Bunder	2.152	1.0	1884
Semipublic Sector			
Construction of Container Terminal, Oil Products Berth and Acquisition of Cargo Handling Equipment for KPT	-	-	1570
Total	6584.835	2931.12	3454

1.10.2 Actual Expenditures under the Sixth Five Year Plan

Actual expenditures under the Sixth Five Year Plan are shown in Table 1.10.2.

Total expenditures in the public and semipublic sectors are Rs. 1,058,879 million and Rs. 1,243 million, respectively. Thus the achievement ratios of actual expenditures to budgeted expenditures under the Sixth Plan are 56.2% for the public sector are, 79.2% for the semipublic sector and 66.6% for the total expenditures.

According to Subworking Group Report, the basic reason for not completing the projects within the plan period was inadequate provision of funds and non-release of funds in the 4th quarter.

Table 1.10.2 Actual Expenditures and Achievement Ratios

(Rs. Million)

	Public Sector	Semipublic Sector (KPT)	Total
(A) Total Allocation during five years	1884	1570	3454
Expenditures			
1983/84	181.712	210	391.712
84/85	340.330	230	570.330
85/86	198.191	393	591.191
86/87	188.000	410	598.000
87/88	150.646*	NA	150.646
(B) Total Expenditures during five years	1058.879	1243	2301.879
(C) Achievement Ratio B/A (%)	56.2%	79.2%	66.6%

*: budget allocation

Source: Federal Government Public Sector Development Programme (1982-87)

1.11 Present Problems

There are various problems in the port sector. Major problems, however, can be summarized as follows:

Port Karachi lacks basic port facilities and is congested, and Port Qasim is not utilized sufficiently.

(1) Port Karachi

- Container yard and handling equipment to cope with increasing container cargo are insufficient, and there seems to be an urgent necessity to develop a full-scale container terminal.
- The level of ship waiting time is considered to be unacceptably high, and this suggests an overall lack of berthing facilities. The congestion of oil berths requires urgent countermeasures.
- When cargoes handled at Port Karachi are transported to or from upcountry by road, they have to pass through the congested Karachi city area. The Jinnah Bridge Phase II Project will improve access road transportation between the Port and the super highway. Another means might be to utilize existing railway transport more efficiently.
- Presently custom clearance procedures are carried out only within Karachi Port area and dry ports. Customs examination of container cargoes includes stuffing and unstuffing operations, and this requires considerable cost and time loss for consignees as well as for the port management body.

(2) Port Qasim

- The tariff of Port Qasim is higher than that of Port Karachi. Rationalization of the current tariffs between the two ports will be necessary in order to increase cargo volumes at Port Qasim and to improve the utilization of existing port facilities.
- As Port Qasim was opened rather recently, there seems to be room for the operating body to improve their service and operations. For example, there are more than 20 stevedoring companies in Port Karachi, and shipping companies can choose any of them freely. However, the number and choice of stevedoring companies at Port Qasim is restricted. At Qasim the assignment of stevedoring company is made by PQA, and not by shipping companies. It is clear that port users would prefer a free choice. Thus, unless the present port services are improved, Port Qasim will not be able to compete with the other port.
- The dredging volume at the entrance channel of Port Qasim reaches 2.4 million m^3 annually, and the cost of dredging works places a great burden on the financial condition of PQA.
- Port Qasim has 4,000 hectares of land reserved for industries and economic activities which are either port-based or port-related. Unfortunately current land utilization is insufficient. With the development of coastal industries in this area, Port Qasim could grow into a large and prosperous port.

CHAPTER 2 MASTER PLAN

2.1 General

After heavy congestion occurred at Port Karachi in 1978, Port Qasim was opened in 1980. Since then, owing to the endeavours of all the parties concerned with the ports, congestion at both Ports has been gradually reduced. On the other hand, the overall cargo throughput has been increasing rapidly due to the recent remarkable economic growth in Pakistan. There seem to be some signs that the ports might face difficulties again in the near future. Now is the time to formulate a Master Plan for the orderly development of the ports, taking into account future demands.

In this chapter, first, the basic concepts employed in making the Master Plan are introduced. Second, the forecast of seaborne cargo volume by the year 2005/06 is executed as a basis for the planning. Third, taking into consideration the recent rapid growth of containerization in Pakistan, an analysis is performed on the prospects of containerization and container cargo volume in the future, reflecting the past trend and the overall cargo volume forecast. Lastly, the development plan of port facilities is proposed as the Master Plan.

2.2 Basic Concept

In formulating the Master Plan, the following provisions have been taken into consideration:

(a) Based on the traffic demand forecast, which is partially based on discussions between the counterparts from the Government of Pakistan and the JICA Study Team, seaborne cargo throughput is estimated up to 2005/06.

(b) In the Master Plan, development of port facilities is planned to cope with the estimated cargo throughput.

(c) Only the ports of Karachi and Qasim are to be developed based on the above nation-wide demand forecast. Gwadar mini-port is discussed independently from the viewpoint of regional development.

(d) Long-term development programmes related to ports, such as coal power plant projects which involve the possibility of import of foreign coal, were not incorporated in the present Master Plan except for projects which have already been authorized by the Government of Pakistan.

(e) Not only the development of hardware, but also the development of software such as systems, procedures, etc. for port cargo handling was also taken into consideration, as it affects the overall development of the transport system in Pakistan.

2.3 Forecast of Seaborne Cargo Throughput

The demand forecast of seaborne cargoes is shown in Tables 2.3.1 and 2.3.2.

The rate of increase of the cargo tonnage is indicated by an index in parentheses with a base value of 100 for 1985/86. The figures are 128 for 1992/93, 159 for 1997/98 and 227 for 2005/06.

The shares of import and export cargo are considerably different at present, as shown in Table 2.3.2. Imports are expected to account for 76.9% of the total foreign trade cargo in 1985/86, 78.0 in 1992/93, 77.9% in 1997/98, and 75.4% in 2005/06.

The major commodity groups of dry cargo are composed of wheat, fertilizer, iron & steel, mining products, coal & coke, rice and others. The major commodities of liquid cargo are edible oil, molassses, crude oil and petroleum products.

Wheat, sugar, cement, fertilizer and rock phosphate, which are presently imported, are expected to become export commodities owing to expected increases in domestic production.

Table 2.3.1 Demand Forecast of Seaborne Trade

(1,000 tons)

Commodities	1985/86	1992/93	1997/98	2005/06
Dry Cargo	11,959	14,637	18,437	28,041
Wheat	1,909	832	958	1,128
Sugar	268	214	60	415
Cement	217	14	36	94
Fertilizer	834	1,178	970	654
Iron & Steel	522	64	564	1,249
Mining Products (ore)	1,343	2,240	3,160	6,656
Coal & Coke	872	2,763	4,337	6,409
Rock Phosphate	225	391	55	47
Rice	1,316	1,031	1,006	1,032
Cotton	639	608	539	425
Others	3,814	5,302	6,752	9,931
Liquid Cargo	8,048	10,885	13,293	17,421
Edible Oil	825	1,096	1,118	1,006
Crude Oil	3,726	4,285	4,305	4,360
Molasses	736	844	1,194	1,886
Petroleum Products	2,761	4,660	6,676	10,169
Grand Total	20,007	25,522	31,730	45,462
(Index)	(100)	(128)	(159)	(227)

Source: JICA Study Team

Table 2.3.2 Demand Forecast for Import/Export Cargo

(1,000 tons)

Commodity	1985/86	1992/93	1997/98	2005/06
Import	15,383	19,902	24,705	34,301
Dry	8,218	9,861	12,606	18,766
Wheat	1,909	-	-	-
Sugar	268	214	60	-
Cement	217	-	-	-
Fertilizer	456	1,178	970	-
Iron/Steel	430	64	564	1,249
Mining Products (Ore)	1,334	2,240	3,160	6,656
Coal/Coke	853	2,763	4,337	6,409
Rock Phosphate	225	391	55	-
Others	2,526	3,011	3,460	4,452
Liquid	7,165	10,041	12,099	15,535
Edible Oil	825	1,096	1,118	1,006
Crude Oil	3,726	4,285	4,305	4,360
Petroleum Products	2,614	4,660	6,676	10,169
Export	4,624	5,620	7,025	11,161
Dry	3,741	4,776	5,831	9,275
Wheat	-	832	958	1,128
Rice	1,316	1,031	1,006	1,032
Cotton	639	608	539	425
Sugar	-	-	-	416
Cement	-	14	36	94
Fertilizer	378	-	-	654
Iron/Steel	92	-	-	-
Minerals	9	-	-	-
Coal/Coke	19	-	-	-
Rock Phosphate	-	-	-	47
Others	1,288	2,291	3,292	5,479
Liquid	883	844	1,194	1,886
Molasses	736	844	1,194	1,886
Petroleum Products	147	-	-	-

Source: JICA Study Team

2.4 Prospects on Containerization and Container Cargo Volume

Containerization at Port Karachi has been steadily developing since 1978, with an average growth rate of 39% per year. The characteristics of containerization at the port might be summarized as follows:

(a) The throughput of both imports and exports of dry cargo has not increased remarkably over the past five years. Nevertheless, the container cargo volume has drastically increased during the same period of time. In other words, dry cargoes in the form of break-bulk have been gradually shifting into containerized cargo.

(b) If we count containerizable cargo as sugar, others, and half of iron & steel for imports, and sugar, cotton, others, and a quarter of rice for exports, the containerized rate was 42.0% in 1985/86 at both Karachi and Qasim Ports.

(c) Although the containerized rates for import and export were quite different, i.e. 33.0% and 53.9% respectively in 1985 for the two Ports, the volumes of export and import container cargoes, specifically in terms of TEUs (Twenty Foot Equivalent Units), have been almost the same in the past. This tendency is observed at several ports in the region, and is expected to continue in the future.

(d) The average weight per TEU has been rather constant at the level of 9 tons/TEU in the past, if we include not only loaded containers but also empty containers into the averaging procedure.

Based on the above factors and the forecast seaborne cargo throughput, containerization in the future is first assessed by applying the logistic curve and the least square method. It is assumed that the final containerization ratio will reach 90% in 2005/06. Then forecast container cargo volumes are calculated as shown in Table 2.4.1 and Fig. 2.4.1.

The forecast volumes of container cargoes in 1992/93 and 2005/06 are 4.5 million tons and 10.5 million tons, respectively.

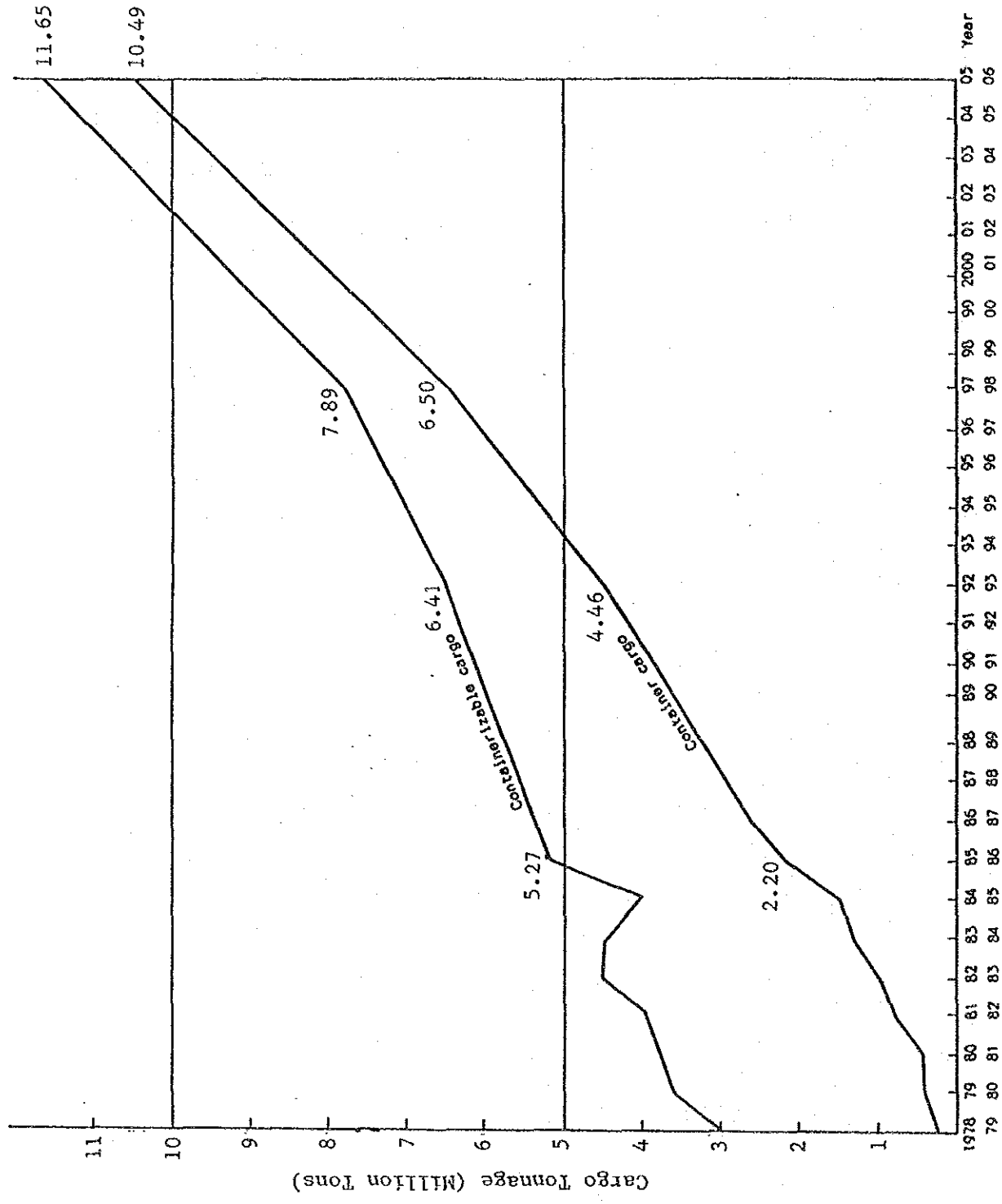
Table 2.4.1 Containerized Cargo Forecast

(1,000 tons)

Import	1985-86	1992-93	1997-98	2005-06	Export	1985-86	1992-93	1997-98	2005-06	Total	1985-86	1992-93	1997-98	2005-06
Total Dry Cargo	8,218	9,861	12,606	18,766	Total Dry Cargo	3,741	4,776	5,831	9,275		11,959	14,630	18,437	28,040
Wheat	1,909	-	-	-	Wheat	-	832	958	1,128					
Sugar	268	214	60	-	Rice	1,316	1,031	1,006	1,032					
Cement	217	-	-	-	Cotton	639	608	539	425					
Fertilizer	456	1,178	970	-	Sugar	-	-	-	416					
Iron/Steel	430	64	564	1,249	Cement	-	14	36	94					
Minerals (Ore)	1,334	2,240	3,160	6,656	Fertilizer	378	-	-	654					
Coal/Coke	853	2,763	4,337	6,409	Iron/Steel	92	-	-	-					
Rock Phosphate	225	391	55	-	Minerals (Ore)	9	-	-	-					
Others	2,526	3,011	3,460	4,452	Coal/Coke	19	-	-	-					
					Rock Phosphate	-	-	-	- 47					
					Others	1,288	2,291	3,292	5,479					
Total Containerizable Cargo	3,009	3,257	3,802	5,077	Total Containerizable Cargo	2,256	3,157	4,083	6,577	Total Containerizable Cargo	5,265	6,414	7,885	11,654
Sugar	268	214	60	0	Sugar	0	0	0	415					
Iron/Steel	215	32	282	625	Rice	329	258	252	258					
					Cotton	639	608	539	425					
Others	2,526	3,011	3,460	4,452	Others	1,288	2,291	2,292	5,479					
Total Containerized Cargo	993	2,230	3,250	4,950	Total Containerized Cargo	1,216	2,230	3,250	5,540	Total Containerized Cargo	2,209	4,460	6,500	10,490
Containerized Rate (%)	33.0	68.5	85.5	97.5	Containerized Rate (%)	53.9	70.6	79.6	84.2	- Containerized Rate (%)	42.0	69.5	82.4	90.0

Source: JICA Study Team

Fig. 2.4.1 Container Cargo Projection



2.5 Development Plan of Port Facilities

The projected cargoes in 2005/06 are first classified into general cargo, bulk cargo, iron ore and coal for Pakistan Steel Mills and liquid cargo, and then allocated to Port Qasim and Port Karachi, taking into consideration the best usage of existing facilities and their capacity. The results of the cargo classifications and berth assignment are shown in Table 2.5.1.

In order to calculate the necessary number of berths in 2005/06, cargo handling efficiency and berth occupancy are assumed based on the study and analysis of Chapter 1.

The formula for this calculation is:

$$S = \frac{V}{E_b} \times \frac{1}{365 \times 24 \times \rho}$$

where, S ; Required number of berths,

V ; Cargo throughput per year (ton/yr),

E_b; Cargo handling efficiency (tons/hr during berthing time), and

ρ; Berth occupancy.

Cargo handling efficiency by type of cargo E_b are presented in Appendix 2-5-1. Berth occupancy ρ can be obtained from App. Fig. 2-5-1. At the same time, it is to be noted that Sand ρ are a function of the service level at the berth which is defined by the ratio of berthing time, $1/\mu$, and waiting time for berthing, Wq, of a ship, and which should usually be less than about five percent as a planning criteria. As for the berth occupancy of the oil berth, a case study is executed and the result is presented in Appendix 2-5-3.

The results of the calculations of berth requirements are tabulated in Table 2.5.2. As shown in the table, the necessary number of container berths under the Master Plan will be 8 berths; 6 berths at Port Karachi and 2 berths at Port Qasim.

Two new oil berths will also be necessary, one at Port Karachi and one at Port Qasim.

There are several important projects other than berthing facilities to be incorporated under the Master Plan, including the following items.

(a) Karachi Port

1) Feasibility study of container terminal
2) Container handling equipment
3) Harbour craft and cargo handling equipment
4) Roads and warehouses
5) Jinnah Bridge

Table 2.5.1 Cargo Classification and Berth Assignment (Master Plan)

(1000 tons)

Classification		Berth Assignment	
1. General Cargo	12,278	Karachi	
		Conventional Berths	1,800
Sugar	415	Container Berths	7,860
Iron/Steel	1,249		
Rice (1/4)	258	Qasim	
Cotton	425	Container Berths	2,620
Others	9,931		
Subtotal	12,278		12,280
2. Bulk Cargo	8,762	Karachi	
		Conventional Berths	5,100
Wheat	1,128		
Cement	94	Qasim	
Fertilizer	654	Multipurpose Berths	3,660
Mining Products (Ore)	2,306		
Coal & Coke	3,759		
Rock Phosphate	47		
Rice (3/4)	774		
Subtotal	8,762		8,760
3. Iron Ore & Coal for PSM	7,000	Qasim	
		IOC Berths	7,000
Iron Ore and Coal	7,000		
4. Liquid Cargo	9,592	Karachi	
		Oil Berth	9,592
Edible Oil	1,006		
Molasses	1,886		
Petroleum Products	4,520		
Crude Oil	2,180		
Subtotal	9,592		9,592
5. Liquid Cargo		Qasim	
		Oil Berth	7,829
Petroleum Products	5,649		
Crude Oil	2,180		
Subtotal	7,829		7,829

Source: JICA Study Team

Table 2.5.2 Berthing Facilities (Master Plan)

Port/Berth	Cargoes	Cargo Tonnage (1,000 t/y)	Ship size/ Quay Depth (DWT/m)	Necessary No. of Berths			Cargo Handling Efficiency (tons/hr)	Designed Berth Occupancy Rate (%)
				Existing	New	Total		
Karachi								
. East and West	General Cargo	1,800	30,000/-10	10		15	30	70
	Bulk Cargo	5,100	45,000/-11.5	5			220	53
. Container	Container	7,860	30,000/-12		6	6	37.5 TEU/hr	40
. Oil	Mineral/ Vegetable Oil	9,592	70,000/-13.4	2	1	3	4,000(Mineral) 500(Vegetable)	40
Qasim								
. Multi-purpose	Bulk Cargo	3,660	30,000/-10	4	0	4	220	47
. I.O.C.	Iron Ore & Coal	7,000	50,000/-12	1	0	1	1,350	60
. Oil	Mineral Oil	7,829	50,000/-12	0	1	1	4,000	40
. Container	Container	2,620	30,000/-12	0	2	2	37.5 TEU/hr	40

Source: JICA Study Team

(b) Qasim Port

1) Harbour craft and cargo handling equipment
2) Dredger

(c) Others

1) Gwadar mini-port
2) Feasibility study on inland water transport (IWT)

The feasibility study on the container terminal is for planning and design of the container terminal at Port Karachi as explained below in Section 3.4. Container cargo handling equipment is to be used as a temporary measure at Port Karachi to cope with the increase in container cargo volume until the completion of the container terminal. This equipment is expected to be provided by the private sector.

Harbour craft and cargo handling equipment at Port Karachi and Port Qasim include those listed in App. Table 2-5-5. The plan is to introduce more efficient bulk handling equipment at a total cost of approximately Rs. 329 million.

Roads and warehouse project are ongoing works and are described in 3.6, below.

The dredger at Port Qasim is also an ongoing procurement project for the maintenance dredging of the channel and is explained in 3.6.

Two small projects categorized as others are also expected under the 7th Five Year Plan.

The overall projects for the Master Plan of the port sector are proposed as shown in Table 2.5.3.

It should be noted that the maintenance costs associated with the above port facilities and equipment are not included in this table. The total cost at Port Karachi is Rs. 6,662 million, the cost at Port Qasim is Rs. 2,156 million, the cost of other projects is Rs. 518 million, and the grand total cost at all the ports is Rs. 9,336 million.

Table 2.5.3 List of Port Projects (Master Plan)

(Rs. Million)

Name of Project (No. of Berths)	Project Cost	Remarks
Karachi Port		
• Container Terminal (6)	4,522	
• Feasibility Study on Container Terminal	16	
• Container Cargo Handling Equipment	-	private sector
• New Oil Berths (1)	230	
• Harbour Craft and Cargo Handling Equipment	1,394	
• Roads and Warehouses	250	
• Jinnah Bridge	250	
Sub total	6,662	
Qasim Port		
• Oil Terminals (1)	216	
• Container Terminal (2)	-	private sector
• Harbour Crafts and Cargo Handling Equipment	1,294	
• Dredger	646	
Sub total	2,156	
Others		
• Gwadar Mini-port	500	
• Feasibility Study on I.W.T.	18	
Sub total	518	
Grand Total	9,336	

Source: JICA Study Team

CHAPTER 3 SEVENTH FIVE YEAR PLAN

3.1 General

The urgency and importance of developing certain infrastructures at Ports Karachi and Qasim is very clear in view of the present port facilities and activities as well as the expected future cargo throughput.

Among other items, the handling of container cargoes and oils are surely to come within the current focus under the Seventh Five Year Plan starting in 1988/89. It seems that the time is ripe to take strong and firm measures to avoid potential difficulties concerning these cargoes.

In this chapter, first, the basic policies and strategies are prepared for the port sector under the Seventh Five Year Plan. Second, candidate projects are reviewed and summarized for further discussions. Third, find ways to develop a container terminal at Port Karachi, which is a problem of great urgency, are analyzed. Fourth, evaluation of the candidate projects is made, and the projects for the Seventh Five Year Plan are identified.

Finally, some important policy options are proposed in order to supplement the plan.

3.2 Basic Policies/Strategies

In formulating the Seventh Five Year Plan of the Port Sector, the following basic policies/strategies are considered essential:

(a) Port facilities and equipment required by the demand forecast in harmony with the schedule of the Master Plan;

(b) Efficient utilization of the existing facilities and equipment at the Ports of Karachi and Qasim;

(c) Each port will play its respective role and should function to complement each other. That is, principally, Port Karachi to mainly deal with general cargo and traditional bulk cargoes. On the other hand, Port Qasim to mainly handle bulk cargo and cargoes associated with the local industries. However, exceptional assignment of some cargoes such as oil and container cargoes could take place beyond these guidelines as far as item (b) above is satisfied, as discussed in detail in Section 3.4;

(d) On-going projects are to be promoted unless a specific hindrance is anticipated; and

(e) Participation of the private sector in cargo handling is to be encouraged, if it is acceptable from the national economic and other public points of view.

3.3 Candidate Projects

The candidate projects discussed below are summarized in Table 3.3.1, taking into consideration the following projects in addition to those mentioned above in 3.2:

(a) Projects listed in the Sixth Five Year Plan;

(b) Projects recommended in the Sub-Working Group Report; and

(c) Projects identified to be necessary by the JICA Study Team through discussions with officials concerned in the Government and implementing agencies, and based on the studies and investigations carried out by the Team.

Table 3.3.1 List of Candidate Projects for Port Planning

Name of Project (No of berths)	6th F.Y.P (*On-going)	Sub-working group report	Addition by the JICA Study Team
Karachi			
Container Terminals (2)	0	0	
F.S on Container Terminal			0
Handling Equipment for Container Cargo			0
Oil Berth (1)	0	0	
Harbour Craft	0	0	
Roads & Warehouses	*	0	
Jinnah Bridge	0	0	
Qasim			
Container Terminals (2)	*	0	
Oil Berth (1)	0	0	
Dredger	0*	0	
Harbour Craft	0	0	
F.S on Channel Dredging			0
Multipurpose Berth		0	
Fertilizer Terminal	0		
Wheat Terminal	0		
Silo	0	0	
Rock Phosphate Berth		0	
Roads & Housing	*	0	
Coal Berth		0	
Channel Dredging		0	
Other			
Gwadar Mini-port	0*	0	
F.S on I.W.T.		0	
F.S. on Khor Kalmat		0	

Source: Study Team

3.4 Study on Container Terminal

3.4.1 General Overview

Presently containers are handled only at Port Karachi. The West and East Wharves are utilized not only by container ships, but also by general and bulk cargo ships. As discussed in 1.8 above, the present service level and waiting time of ships are not satisfactory, even though the wharves are almost fully utilized in terms of high berth occupancy and cargo handling efficiency using the present facilities and equipment.

On the other hand, it is clear that the containerization of general cargoes will advance further in the future. As explained in 2.4, the volume of container cargoes is expected to double in 1992/93 and to reach about 10 million tons in 2005/06, or about five times the present volume.

It is apparent that the present port cannot accommodate such a large cargo volume, and it is necessary to take measures for its improvement such as development of berths suitable for container ships and introduction of modern container handling equipment.

In order to cope with the progress of containerization, the Government and the port management bodies have been considering various measures since the Fifth Five Year Plan. The first and the most sweeping reform plan was prepared by the JICA Study Team in 1982 and taken up in the Sixth Five Year Plan. This was a development plan of the Western Backwater area for a new container terminal, constructing two new berths by 1987/88 and six berths by 1990/2000, based on an in-depth feasibility study. This project has not been undertaken yet, mainly due to financial limitations.

Secondly, according to the information given by the Government, the Government decided two years ago to convert the three existing berths of the Multipurpose Terminal (MPT) at Port Qasim into two container berths, inviting the private sector to invest in the container handling equipment. This project also has not been initiated at the time of this study (September 1987), although it is expected to start soon.

Lastly, the Government has also been considering the possibility of converting some of the existing berths at Port Karachi into container berths. This idea has not been studied in depth by any study team missions in the past. The Government is, however, very eager to examine the viability of this proposal.

This chapter focuses on a preliminary investigation on the conversion plan at Port Karachi, following the request of the Government. It should be noted here that the investigations and analyses are rather rough, based on certain important assumptions, and should be reviewed by a feasibility study at the earliest stage of the 7th Five Year Plan.

3.4.2 Fundamental Premises

First of all, we assume the following important premises as the basis of the discussions in this chapter:

(1) Container Ships and Scale of the Container Wharves

In order to plan the dimensions of new container wharves such as quay length and water depth, it is necessary to assume the size of container ships to be commissioned in the future. Presently the maximum multipurpose vessel owned by PNSC has a container capacity of 770 TEU (23,490 DWT), and the maximum container ship chartered by PNSC has a capacity of 1,019 TEU (26,320 DWT). As for liner container ships which called at Port Karachi in 1986, according to Statistics on World Container Ships, Fleet and Operation (NYK Research Chamber), the ship size varied from 343 TEU (6,500 DWT) to 1,879 TEU (31,205 DWT), depending on their routes, i.e. Far East, Middle East, Europe, Australia, East Africa and India. Among them 18% were 1,200 TEUs and the overall average size was about 840 TEU (16,000 DWT) for all the routes, which is in between the so-called first generation and second generation size. It is supposed here that, during the 7th Five Year Plan period, the ship size will remain in the so-called second generation category, i.e. not more than 2,500 TEU (40,000 DWT). Based on this assumption, a quay length of 300 m and a water depth of 12 m would be sufficient, taking into consideration the fact that the container vessels will not be fully loaded.

The increase of container ship size, however, is an ongoing worldwide tendency.

This is not a matter related only to Pakistani ports, but also concerns the other ports on route. In fact, many ports in the world including some leading Middle Eastern and Asian ports have container terminals with a water depth of more than 12 meters as shown in App. Fig. 3-4-1.

It seems, therefore, realistic that the wharves should be developed in such a way that the depth could be increased further in the future, possibly to a water depth deeper than 12 meters.

(2) Ports to Be Developed

The conversion of a part of MPT at Port Qasim is accepted as a precondition, because this could contribute to more efficient use of existing facilities, it is physically feasible, and for other reasons. At the same time, development of container facilities at Port Karachi is also considered.

In other words, it is assumed that there will be two separate ports where containers will be handled in the future.

This will likely involve many administrative issues such as whether the management body should be unified or kept separate; the management and operation of the yards exclusive or public; the evenness of government subsidies, tariffs and charges; etc. Such subjects must be considered in the planning. Here it is simply assumed, however, that both terminals will be utilized evenly or, in other words, that the container throughput per berth of both ports will be the same.

This policy or premise shall be confirmed in the feasibility study.

(3) Overall Arrangement and Utilization of Facilities

Policies with regard to the following facilities are also prerequisites for the planning:

a. Railway -- where to locate the marshalling area of wagons: in the terminal or outside? Whether or not to allow stuffing/ unstuffing of containers directly to and from wagons?

b. Container Freight Station (CFS) -- Where to locate the CFS: in the terminal or outside? If the CFS is located outside the terminal, could customs clearance be carried out even at a private CFS inside the town? This issue will affect the future FCL/LCL ratio and traffic congestion on roads.

In this report, the marshalling area of wagons and the railway CFS are assumed to be located outside the port because of the limited space in the container terminal and in order to avoid excessive disorder of cargo handling in the terminal. Therefore, trains in the terminal will be limited to the transport of FCL cargo.

On the other hand, the CFS for cargoes to be transported by roads is planned within the terminal, taking into consideration the considerable volume of LCL cargoes. The percentage of LCL cargoes will decrease in the future, following the development of door-to-door services, but will still remain at a high level for some time. These policies will also have to be discussed in more detail the regional economic and social viewpoints during the feasibility study.

(4) Fundamental Design Conditions

Certain fundamental design conditions, such as the strength of the present quay structures and soils, etc. are not known and not considered in this study. Therefore they will be investigated as part of the feasibility study.

(5) Cost Estimates

A rough cost estimate of the tentatively planned facilities and equipment is conducted in this chapter. It should be noted that this is only a rough, preliminary estimate and a more detailed estimate will have to be carried out as part of the feasibility study.

3.4.3 Possibility of Conversion of Wharves at Port Karachi

(1) Physical Condition of Existing Structures

Among the wharves at Port Karachi, Berths 1 to 4 have the same structure as shown in App. Fig. 3-4-2 and seem not to be suitable for use as container berths on which 600 dead weight ton gantry cranes are to be installed.

Berths 5 to 17, the structure of which is shown in Fig. 3.4.1, may also not be suitable for conversion as shown in App. Fig. 3-4-3(1) and(2) due to the lack of sufficient bearing strength against horizontal forces. There is a possibility, however, to convert these berths by moving the face line forward by about 30 meters as shown in Fig. 3.4.2, subject to confirmation of soil and other conditions.

Berths 22 to 24 have a structure as shown in App. Fig. 3-4-4. These berths could be transformed into container berths as shown in App. Fig. 3-4-5 assuming that the strength of the existing concrete wall and soil is sufficient.

(2) Appropriateness to Serve as a Container Terminal

Table 3.4.1 shows a comparison between Berths 6 to 17 at East Wharf and Berths 22 to 24 at West Wharf in terms of their possible use as a container terminal.

Generally speaking, as far as the impact to road traffic is concerned, West Wharf is more suitable than East Wharf. However, if we consider the large area required for the container yard, East Wharf will meet this indispensable condition better than the West Wharf. In terms of convertible quay length, East Wharf (Berths 6 to 17) allows six container berths. On the other hand, West Wharf (Berths 22 to 24) has room for only two container berths.

Therefore, East Wharf is selected as the appropriate site.

Fig. 3.4.1 Karachi Port East Wharf Berths 5-17

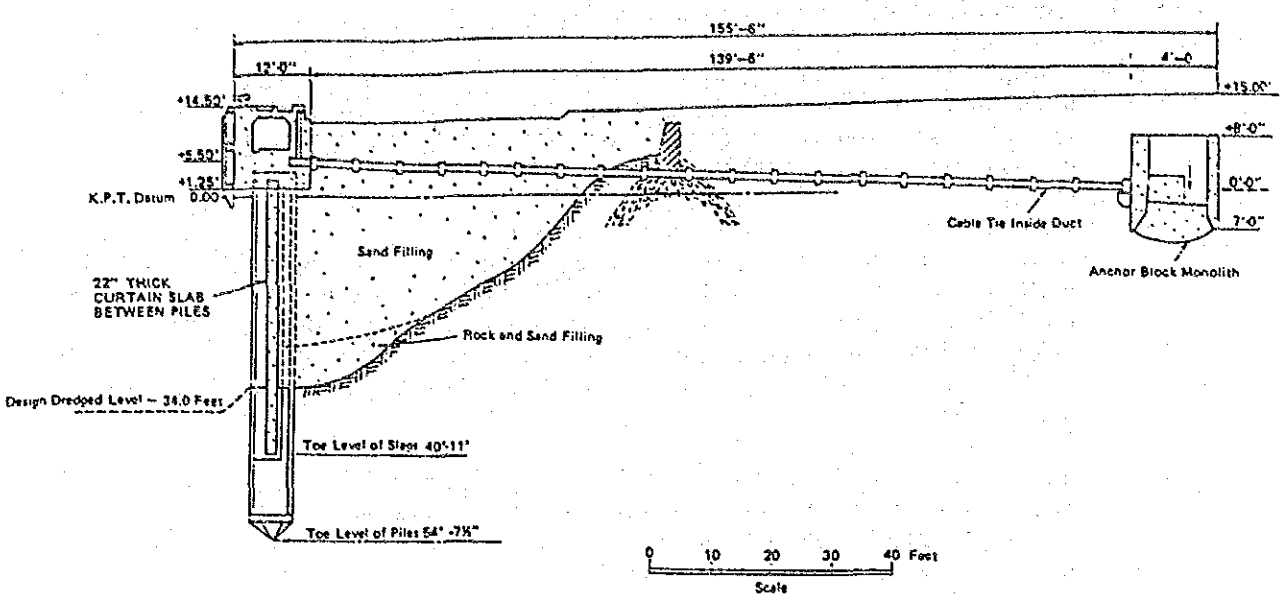


Fig. 3.4.2 A Possible Conversion Plan (East Wharf)

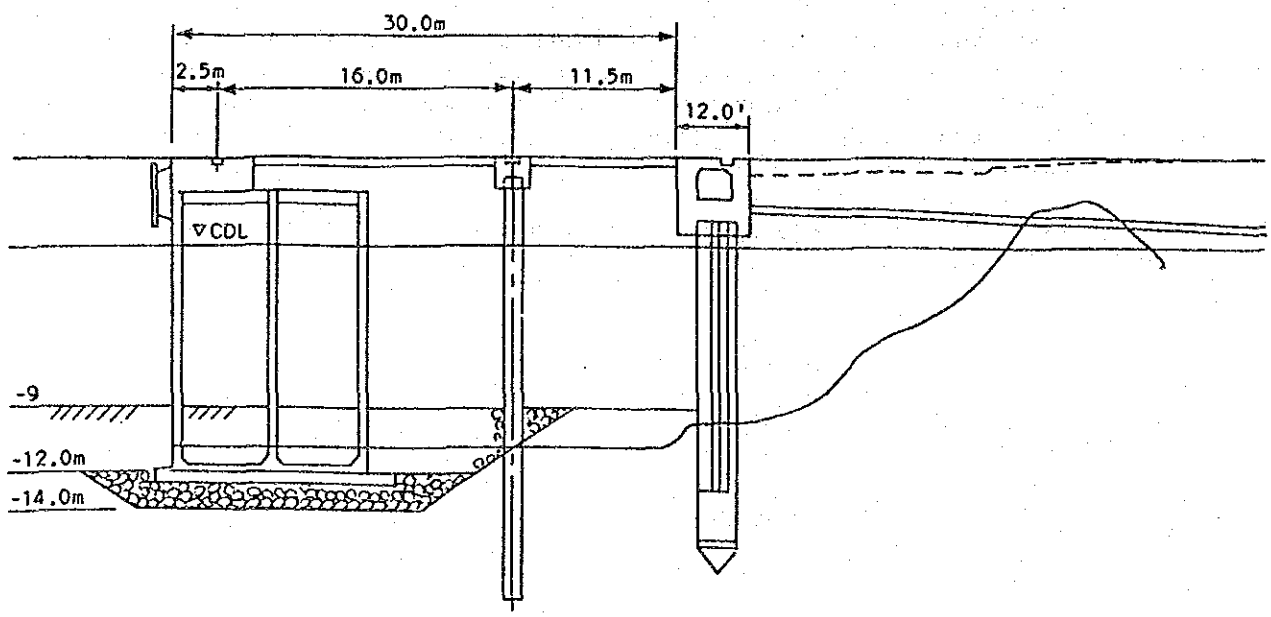


Table 3.4.1 Possible Use as Container Terminal

Item	East Wharf	West Wharf
Berth No.	6 - 17	22, 23, 24
Length	1,871m	549m
Width	400m up to outer road	280m up to outer road
		160m up to KESC Bldg
	210m up to rails	90m up to rails
Water depth	8.5m for No. 6, 7	9.8m
	9.4m for No. 8	
	10.4m for No. 9 - 17	
Design water depth	10.4m	11.6m
Year built	1964	1973
Quay structure	Concrete piles and walls	Concrete caissons
Transit shed area	9,290m^2 each at No. 6,8,11,13,16	10,500m^2 at No. 23

Source: JICA Study Team

3.4.4 Tentative Conversion Plan

(1) Estimate of Berth Utilization

The discussion is based on certain assumptions. First of all, the target years are 1992/93 as the final year of the Seventh Five Year Plan and 2005/06 as that of the Master Plan. The expected volumes of container cargo are, as forecasted in 2.4, 4.5 million and 10.5 million tons.

In 1992/93, it is assumed that the three MPT berths at Port Qasim will already be operational as two container berths equipped with gantry cranes and other port equipment.

The average number of containers to be loaded and unloaded, which is presently 350 TEU/ship, is extrapolated based on the past trend and forecast as 450 TEU/ship in 1992/93 and 750 TEU/ship, which is half the capacity of second generation container ships, in 2005/06.

The average volume per container, which is presently 9.0 tons/TEU, is assumed to increase linearly to 9.7 tons/TEU in 1992/93 and 11 tons/TEU in 2005/06.

In addition, the number of gantry cranes, handling speed, ratio of container size of 20'/40', crane handling efficiency, and overall berth operation efficiency are assumed as summarized in Table 3.4.2.

Then the expected berth occupancy, service level and waiting time of ships for berthing are calculated theoretically by means of queuing theory, and the results are presented in Table 3.4.2 assuming two operational berths in 1992/93 and six in 2005/06.

The service levels obtained are slightly higher than 5% in 1992/93 and less than 1% in 2005/06.

It should be noted that the above analysis is based on the important premise that all the container cargoes are to be handled at the ports of Karachi and Qasim, and the management or berth assignment is to be done so as to utilize both ports evenly by means of unified management. If we allow the use of conventional berths as well or if the berth assignment is done separately at each port, the results vary as shown in Table 3.4.3. The results suggest that:

1) Generally speaking, unified management can reduce waiting time.

2) If it is necessary to keep the service level below 5% in 1992, unified management and the shift of part of the container ships to conventional berths will be necessary.

3) If unified management is not possible, it might become necessary to employ a preferential container ship system, whereby only specific ships can berth at the container terminal.

Table 3.4.2 Computation of Berth Utilization and Yard Areas

Item	1992/93*	2005/06	Remarks
1. Container throughput Cargo Volume (tons)	4,500,000	10,490,000	
(tons/berth)	1,125,000	1,310,000	* Number of berths = 4 in 1992/93, 8 in 2005/06
(TEU/berth)	116,000	119,000	TEU = 9.7 tons in 1992/93, 11.0 tons in 2005/06
2. Average TEU to be handled per ship (TEU/ship)	450	750	incl. loading and unloading
3. Ratio of container size(in TEU) 20':40'	40 : 60	20 : 80	
4. Average number of boxes to be handled per ship (boxes/ship)	315	450	Number of gantry cranes = 2
5. Average berthing time (hr)	17.5	20.0	Handling speed = 20 boxes/hr/crane in 1992/93, 25 boxes/hr/crane in 2005/06
6. Average number of ships (ships/berth/year)	258	159	Handling efficiency = 0.75
7. Berth occupancy (%)	51.5	36.3	Overall efficiency = 0.60
8. Service level (%)	6.7	0.3	Ebt = 25.7 TEU/hr in 1992/93
9. Waiting time (hours/ship)	1.2	0.1	37.5 TEU/hr in 2005/06
10. Yard conditions			
Average stacking height	2.25	2.25	Reefer: one story
Acceptance of export containers	7 days before ship arrival		
Average dwell time of containers			
Import FCL (days)	5	4	
LCL (days)	6	6	
MT (days)	3	3	
Reefer (days)	3	3	
Ratio of FCL: LCL	60 : 40	80 : 20	
Ratio of MT: Loaded containers	25 : 75	15 : 85	
11. MT yard conditions			
Average stacking height	3	3	
Average dwell time of MT containers			
from FCL (days)	2	1.5	
from LCL (days)	7	5	
MT (days)	14	10	
12. Required yard slots			
Export	407	400	Unit: slots/berth
Import FCL	265	320	
LCL	212	120	
MT	88	106	Refrigerated cargo volume 20,000t in 1992, 100,000t in 2005
Reefer	33	165	
Export and import total	1,005	1,111	
MT total	717	268	

Table 3.4.3 Container Ship Waiting by Management System

(1) 1992/93

	Present	Confined to use Container Terminals		Allowed to use Conventional Berths*	
		Unified Management	Separate Management	Unified Management	Separate Management
Berth occupancy (%)	70.8	51.5	51.5	45.7	45.7
Service level (%)	20.2	6.7	25.0	4.8	18.3
Waiting time (hr/ship)	16.1	1.2	4.4	0.8	3.2

*) Assuming that 4 million tons of container cargoes are handled at container terminals at Karachi and Qasim Ports and that the remaining 500 thousand tons are handled at conventional berths at Karachi Port.

(2) 2005/06 (Containers are confined to use only container terminals)

	Unified Management	Separate Management	
		Karachi (6 Berths)	Qasim (2 Berths)
Berth occupancy (%)	36.3	36.3	36.3
Service level (%)	0.3	0.8	10.5
Waiting time (hr/ship)	0.1	0.2	2.1

(2) Tentative Layout of the Converted Container Terminal

Fundamentally, containers yards (C/Y), buildings, the CFS and railway yard except railway marshalling/shunting area and railway CFS are planned to be located at the East Wharf as shown in Fig. 3.4.3. All the existing facilities on the wharf are assumed to be demolished. The empty containers, which requires considerable open space, is assumed to be handled at the back side of Juna Bunder Wharf.

The computation of the necessary container yard area is shown in Table 3.4.2 based on several assumptions. In order to avoid the overflow of containers in the C/Y, the planned daily container volume assumes 80 percent coverage, not average coverage. Acceptance of export containers is assumed to begin seven days ahead of ship arrival as shown in App. Fig. 3-4-6.

The dwell time of import containers and the average stacking height in C/Y and MT/Y are assumed as shown in Table 3.4.2. The results of the computation is 1,005 slots per berth (one slot is a 20 foot equivalent space) in 1992/93 and 1,111 slots per berth in 2005/06 at the C/Y. At the MT/Y, the required space is 1,434 slots (717 slots x 2 berths) in 1992/93 and 1,608 slots (268 slots x 6 berths) in 2005/06.

A layout plan is drafted in Fig. 3.4.4 based on the above analysis.

(3) Rough Cost Estimate

The costs of the above conversion plan and of the original Western Backwater development plan are roughly estimated as shown in Tables 3.4.4 and App. Tables 3-4-1 and 3-4-2.

The cost comparison is summarized in Table 3.4.4. Costs for equipment and the total cost for the Master Plan are summarized in App. Tables 3-4-1 and 3-4-2.

As seen in the Table, the conversion plan could be less expensive than the original plan. However, it should be noted that the cost for the conversion plan does not include the cost of the MT/Y and railway marshalling yard.

(4) Effects of the Conversion on the Other Berths

In 1992/93, it is forecast that Port Karachi will have 2.25 million tons of container cargoes, 2.0 million tons of break-bulk cargoes and 3.7 million tons of dry-bulk cargoes, as well as oil cargoes.

The container cargoes could be handled at the two converted container berths and, if necessary, at Berth 24.

Fig. 3.4.3 Converted Container Terminal Plan at Port Karachi

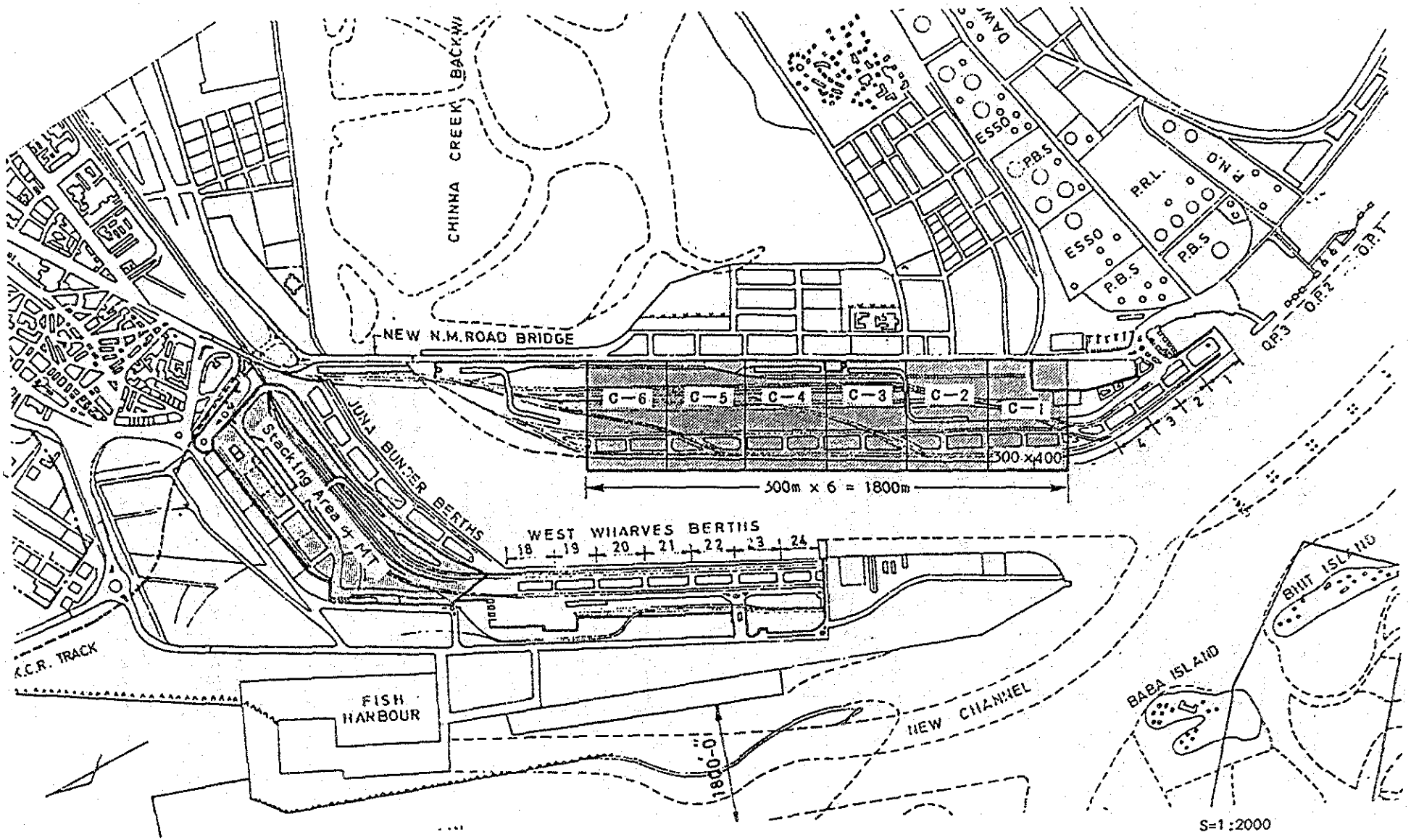
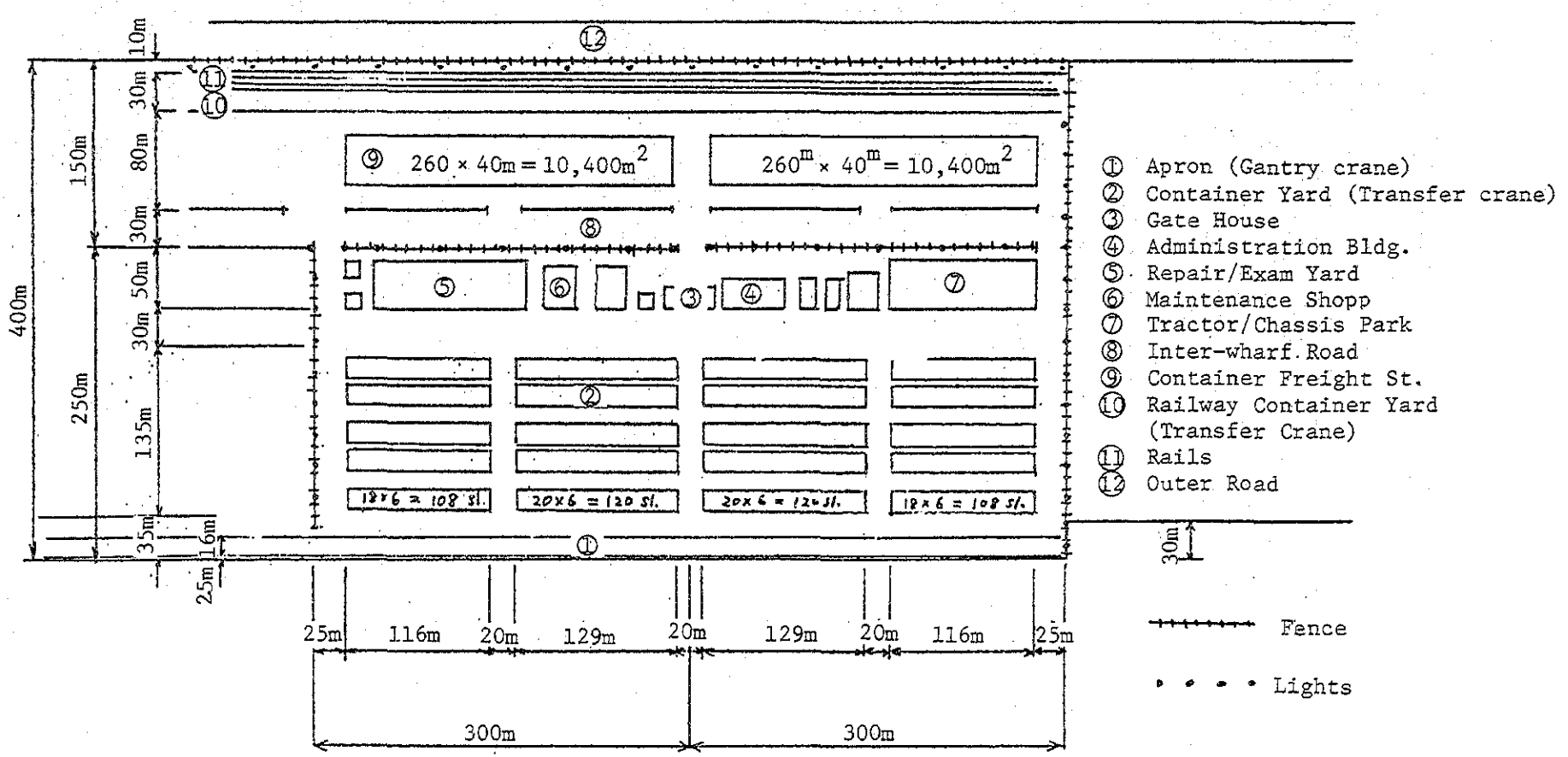


Fig. 3.4.4 Tentative Yard Layout for Two Berths (Conversion of East Wharf)

Scale: 1/5,000



Number of Slots per Berth: 1,140

Table 3.4.4 Rough Cost Estimate of Container Terminal

(Unit: Rs. Million)

Item	Western Backwater Plan			Conversion Plan		
	Quantity	Unit Cost	Amount	Quantity	Unit Cost	Amount
Preparation & Temporary Work	L.S.		11	L.S.		10
Container Berth Quay Wall	600m	0.3 Rs.million/m	180	600m	0.3 Rs.million/m	180
Dredging & Reclamation	4,700thm^3	50Rs/m^3	235	3,000thm^3	50Rs/m^3	150
Slope Protection & Retaining Wall						
Slope Protection	9,300m	3,710Rs/m	34	-		-
Retaining Wall	72m	123,500Rs/m	9	70m	123,500Rs/m	9
Access Railway and Road						
Railway	11,700m	2,300Rs/m	27	1,000m	1,800Rs/m	2
Road	4,100m	4,000Rs/m	16	300m	1,300Rs/m	0.4
Interchange or Flyover	1		22			
Container Terminal						
Pavement	282,400m^2	690Rs/m^2	195	192,900m^2	690Rs/m	133
C.F.S.	19,800m^2	3,000Rs/m^2	59	19,800	3,000Rs/m^2	59
Office & Other Building	9,881m^2	2,760Rs/m^2	27	9,881	2,760Rs/m^2	27
Railway	3,600m	1,800Rs/m	6	1,800	1,800Rs/m	3
Foundation of Rail Mounted Transfer Crane	600m	5,500Rs/m	33	600m	55,000Rs/m	33
Utilities	L.S.		37	L.S.		19
Mobilization & Demobilization	L.S.		25	L.S.		22
Equipment						
Cargo Handling Equipment	L.S.		567			567
Navigational Aids	L.S.		2	L.S.		2
Demolition and Removal	L.S.					27
Sub Total			1,485			1,243
Engineering Study & Supervision			152			44
Physical Contingency			165			130
Total			1,702			1,417

Note: Physical contingency for equipment is 5%, that for other is 15%.

Source: JICA Study Team