CHAPTER 2. NATURAL CONDITIONS

2-1 General Description

Fig. III-2-1 shows Karachi Port area. Karachi Port is located between Western and Eastern Backwaters. Arabian Sea is beyond the harhour entrance between Manora Breakwater (480 m long) and Keamari Groyne. Western Backwater is an area of approximately 35 Km^2. The surface is mostly covered with mud and many creeks are running through a shallow zone. Lyari River is flowing into the North Eastern Part of Western Backwater.

Eastern Backwater is an area of about 6 Km^2 and some of the area is covered with mangroves. Between mangroves are running stream channels. There are Lower and Upper Harbours in the port basins. The Upper Harbour is between East and West Wharfs and approximately 400 m wide. The Lower Harbour, about 600 m wide, is to the South of the Upper Harbour and near the harbour entrance.

2-2 Tides

Tide levels in Karachi are shown in Table III-2-1. Difference between M.H.H.W. and M.L.L.W. is 2.25 m. Tide volume which determines the naturml water depth at the harbour entrance is 68 million cubic meters for 3.0 m tide range.

2-3 Currents

Fig. III-2-2 shows the maximum current velocities and directions observed by the Danish Institute of Applied Hydraulics (DIAH)[1] in July and August, 1971. The observation was done at K and L points.

Values of velocities and directions shown are means of several data. The direction of the flood currents are eastward at both K and L. The velocity of the flood currents is approximately 0.3 m/s. The direction of the ebb currents is South-Westward and their velocity is between 1 and 1.25 m/s. No observation of ebb currents was done at L, but according to the observation done by the Hydraulics Research Station (HRS), velocity is about 0.30 m/s.

Figs. III-2-3 (1), (2) shows flood and ebb current patterns at the water surface inside the port which were obtained in the KPT hydraulic model. The direction of arrows shows current direction and their length means current velocity. Main flows having high velocities go through the Lower Harbour and Western Backwater. Ebb current velocity at the Lower Harbour is higher than 1 m/s. Velocity is low (0.2 – 0.3 m/s) and eddies are formed at the Upper Harbour.

2-4 Waves

High waves approach Karachi Port during monsoon season between May and September. They are a combination of swell and locally generated wind waves. Waves are observed using OSPOS type wave height meter off Manora Point (See Fig. III-2-1) of 9 m deep.

1) Port of Karachi Expansion Feasibility Study, Appendix Ea. 1973 August

Fig.s III-2-4 (1), (2) show monthly distribution of wave heights and periods and Fig. III-2-4 (3) shows a distribution of wave direction visually observed from Himalaya Point on the "Sand Spit" (See Fig. III-2-1). The maximum significant wave height in 1971 was 3 m. Wave period during monsoon season is 9 – 10 seconds. Mean wave direction is 237° clockwise from true North.

2-5 Wind

Wind is observed at both Manora Observatory and Karachi Airport. NE is the predominant wind direction in winter between November and February and wind velocity is lower than 8 m/s. In other seasons, 55 – 58 percent of total wind directions are W or WSW and wind velocity is lower than 10 m/s. Strong winds (velocity: 10.5 – 13.5 m/s) were recorded five times during the period between 1960 – 1970.

2-6 Precipitation

Fig. III-2-5 shows 10 years record of annual precipitation volumes observed at Karachi Airport. Main features are:

1) Annual precipitation volumes vary quite considerably. For example they vary in the range of between less than 50 mm and 750 mm.
2) A large portion of the precipitation occurs within a short period of time.

According to the Port Qasim Authority (PQA), dew occurs during 60 percent of a year.

2-7 Visibility

Visibility becomes worse due to haze, dust, and rainfall. According to the statistics, visibility becomes less than 1 Km especially during the period between September and November. Total days of restriction for navigation due to the poor visibility less than 1 Km are about 2 days in a year.

2-8 Bottom Sediments

Fig. III-2-6 shows distribution of median diameter (d_{50}) of bottom sediments. The followings can be pointed out:

1) d_{50} is smaller than 0.10 mm at the outer Arabian Sea area except near harbour entrance.
2) d_{50} is fairly large at the Lower Harbour between 0.10 – 0.28 mm.
3) Bottom sediments are silt and clay at the Upper Harbour and d_{50} there is about 0.005 mm.
4) At the channel approaching Fish Harbour, West side of West Wharf, bottom sediments are silt and d_{50} is approximately 0.01 mm.
5) Fine sand is existing around Baba Island and d_{50} is about 0.15 mm. At the area near West Wharf of Western Backwater, bottom sediments are silt and d_{50} is 0.008 – 0.052 mm.

6) At the Eastern side of Keamari Groyne, bottom sediments are fine sand and d_{50} is 0.075 – 0.12 mm.

2-9 Sedimentation

2-9-1 Present situation of sedimentation at the port area

Fig. III-2-7 shows present annual maintenance dredging volume (nearly equal to the average sedimentation volume) inside the port. At the entrance region, East of the Manora Breakwater, fairly coarse sand which has been transported from Sand Spit (from West to East, See Fig. III-2-1) as littoral drift is deposited. Sedimentation volume is, on an average, 0.115 million cubic meters per year. Current velocities are low at the Upper Harbour, so it works just like a settling basin and fine silt which has been transported from Arabian Sea or Western Backwater is deposited. Sedimentation volume is, on an average, 0.33 million cubic meters per year. At the Lower Harbour, about 50 thousand cubic meters of sand is deposited within a year. Negligible volume of sediments is deposited at Fish Harbour.

2-9-2 Sedimentation of the new approach channel

Water depths of the approach channel in Arabian Sea used to be, at the minimum, 9.1 meters without maintenance dredging. However, dredging of a new approach channel was completed on December 31, 1980 (See Fig. III-2-8). It is 183 m wide except turning area, 12.2 m deep, and about 3 Km long. Water depth of the protected channel inside the harbour is 11.3 m. Volume of the capital dredging was about 3.8 million cubic meters. It is predicted that sedimentation will occur in the new approach channel.

Fig. III-2-9 shows infill volumes of an approach channel having various water depths. They were calculated by DIAH. The new approach channel lies in the direction of 220° clockwise from true North. Therefore, expected infill volume is 0.60 million tons per year (0.48 million cubic meters) for water depth of 12.2 m (40 feet) according to Fig. III-2-9. However, this infill volume is due just to sediment transport by waves and currents (long term effect) and contribution of slumping (short term effect) is not included. The short term effect has been evaluated as the following (See Fig. III-2-10):

In the case of Qasim Port, the channel is about 12 m deep and 8 Km long part of the channel suffers sedimentation. Water depth of the bar around the channel was originally about 6 m. So, the difference between the water depth of the channel and the original water depth of the bar is 6 m. In the case of Karachi Port, water depth of the approach channel is about 12 m and about 3 Km long part will suffer sedimentation. Water depth of the area around the channel is approximately 9 m. Therefore, difference between the channel water depth and the water depth of the surrounding area is 3 m. Since wave heights, diameters of the bottom sediments, and design gradient of the channel slope are almost same between in Karachi Port and in Qasim Port, final gradient of the slope after the completion of slumping will be almost identical.

Accordingly, ratio between the slumping volumes of Karachi Port and of Qasim Port will be as follows:

Slumping volume of Karachi Port:
Slumping volume of Qasim Port

$= (3\ m)^2 \times (3\ Km) : (6\ m)^2 \times (8\ Km)$
$= 1 : 10.7$

Table III-2-2 shows expected infill volumes of the approach channel which are the sum of the long term effect infill volumes calculated by DIAH and the short term effect infill volumes calculated in the above.

2-10 Soil conditions

The soils to be studied in this project are recent (quaternary) alluvial deposits overlying unconformity sediments of the upper tertiary age. The general area of the project is located on a broad gentle syncline in which the tertiary deposits are horizontal or gently dipping. The tertiary deposits directly underneath the recent alluvia belong to the Manchar pliocene series and are followed by the Gaj miocene series.

The soil conditions of eastern part of Western Backwater area were described in the PORT OF KARACHI EXPANSION FEASIBILITY STUDY in 1973 FINAL REPORT VOLUME E AND APPENDIX Eb by VAN HOUTEN ASSOCIATES INC., on the basis of the soil investigations which were conducted in 1971.

Therefore, in this study, new soil investigations were not carried out, however, it is recommended to perform further investigation to derive more detailed soil data at the decided project area in the stage of detailed design.

The following data were quoted from the above reports and reviewed.

The location of borings is indicated in Fig. III-2-11.

The LAYER DIFFERENTIATION PROFILES are shown in Figs. III-2-13 to III-2-18.

The soil mass has been differentiated into four layers, L1, L2, L3, L4 described subsequently.

Layer L1 comprises peat, decayed organic matter, very organic clays and mixtures thereof. It is either exposed or covered with soil upto 0.5 m (2 ft) thick. The thickness of layer L1 varies between 1.2 m (4 ft) and 3.6 m (12 ft).

What characterises L1 is its storng organic odor, its high water content and its high organic content. It consists of very soft and compressible material, showing no resistance to any type of penetration.

Layer L2 either underlies L1, or is found at the surface. It has a thickness of 1.2 m (4 ft) to 4.8 m (16 ft) varying at random with location. It occupies most of the western backwater.

Layer L2 contains all surface soils (except material L1) with a low resistance to penetration, i.e., with standard penetration resistance (SPT) between 0 and 4 belows per foot, with a penetration resistance of 0 to 4 blows per six inches when tested with the dynamic probing, and close to nil resistance to the static probing. This layer contains very soft to soft superficial clays or very loose superficial sands.

Soils contained in this layer are either non organic or slightly organic. Only in the immediate vicinity of layer L1, an encromachment of organic lenses is observed.

Layer L3 underlies L1 and L2 and extends over the entire investigated area. It contains medium stiff to hard clays and medium dense to very dense sands. The resistance to standard penetration is between 4 blows per foot (in extreme cases) and refusal (more than 60 blows per foot).

The thickness of this layer varies between the extreme values of 1.5 m (5 ft) and more than 21 m (70 ft) (borings B4 and B47).

Layer L4 underlies L3 and extends to the maximum investigated depth. It contains all soils showing refusal to standard penetration (more than 60 blows per foot) and rock. It extends over the entire investigated area.

Layer L4 is first encountered as high as elevation -10 ft and as low as elevation about -65 ft (borings B4 and B47). It has been penetrated as deep as 75 ft (boring B16). Presumably it extends to a great depth, as inferred from the borings made by DEVCON in 1965 ((Development Construction Corporation Ltd.) and from the geology of the area.

Pliocene rock underlies the whole region at various depths. It appears principally as sandstone and conglomerate and less frequently as siltstone and shale. Rock has been found either as a continuous mass with soil intercalations or in the form of pockets inside the soil.

Soil and rock differentiation profiles are shown in Figs. III-2-19 to III-2-24. As mentioned above, hard material (S.P.T. Refusal) is encountered above the depth to be dredged over the project area. The contour lines of the hard material are shown in Fig. III-2-25.

2-11 Seismicity

Pakistan lies in the active seismic regions which runs through Indonesia to Mimalayas with its off-shoots in Baluchistan towards Mediterranean upto the Azores.

According to the report "TECTONICS AND EARTHQUAKE OCCURRENCE IN KARACHI REGION" by MASTER PLAN DEPARTMENT K.D.A., the zones of greater seismic activity are the Quetta region, the Mekran coast and the Northernmost part of the Frontier province. In the Karachi region, severe earthquake of any considerable damage has not been reported so far.

The Fig. III-2-26 shows the seismic zones with seismic factor to be considered in Pakistan.

The seismicity in the port area is moderate though the region west of Karachi lies in a zone of tectonic activity.

According to the above figure, seismic factor in Karachi region is ranging from 1/10 g to 1/20 g.

On the other hand, according to "SOIL INVESTIGATION REPORT for MARGINAL WHARF PROJECT IN PORT QASIM by NESPAK in 1976" the port area lies in a minor seismic zone, with acceleration ranging from g/20 to g/15, on the basis of the published data available from the Geophysical Centre Quetta.

In this region, seismic factor of 1/15 g has been taken in the designing of principal berthing facilities so far, such as East, West Wharves in Karachi Port and Marginal Wharf, I O C berth in Port Qasim.

In this study, 1/15 g is considered to be adequate as a seismic factor.

Table III-2-1 Tide Levels

(Unit: m)

Highest Astronomic Tide	(H.A.T.)	3.20
Mean Higher High Water	(M.H.H.W.)	2.68
Mean Lower High Water	(M.L.H.W.)	2.19
Mean Sea Level	(M.S.L.)	1.65
Mean Higher Low Water	(M.H.L.W.)	1.10
Mean Lower Low Water	(M.L.L.W.)	0.43
Chart Datum		0
Lowest Astronomic Tide	(L.A.T.)	–0.43

Table III-2-2 Expected Infill Volume

(Unit: 10000 m^3)

Year	Long Term Effect	Short Term Effect	Approach Channel Total	Entrance, Lower & Upper Harbours, Container Wharf	Total
1981	48	36	84	51.1	135.1
1982	48	16	64	51.1	115.1
1983	48	7	55	51.1	106.1
1984	48	3	51	51.1	102.1
1985	48	1	49	51.1	100.1
1986	48	0.7	48.7	51.1	99.8
1987	48	0.3	48.3	51.1	99.4
1988	48	0.1	48.1	51.1	99.2
1989	48	0.1	48.1	51.1	99.2
1990	48	0	48.0	51.1	99.1

Fig. III-2-1 Karachi Port

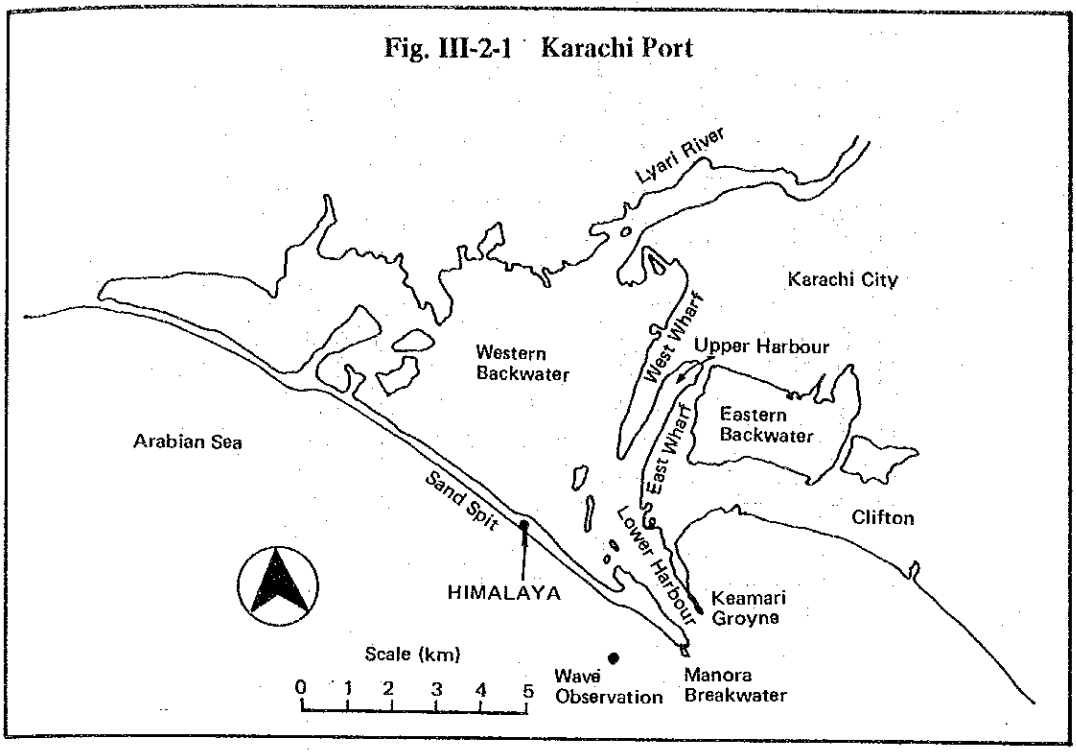


Fig. III-2-2 Maximum velocity and direction of the currents

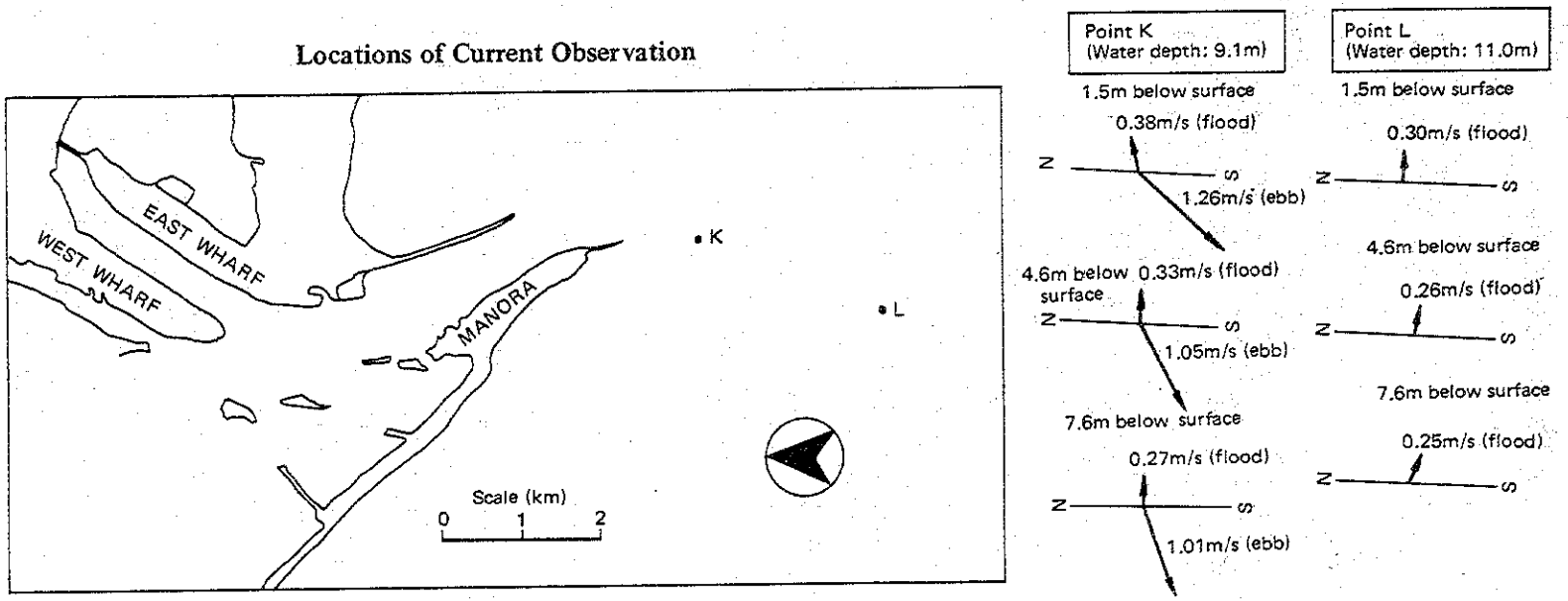
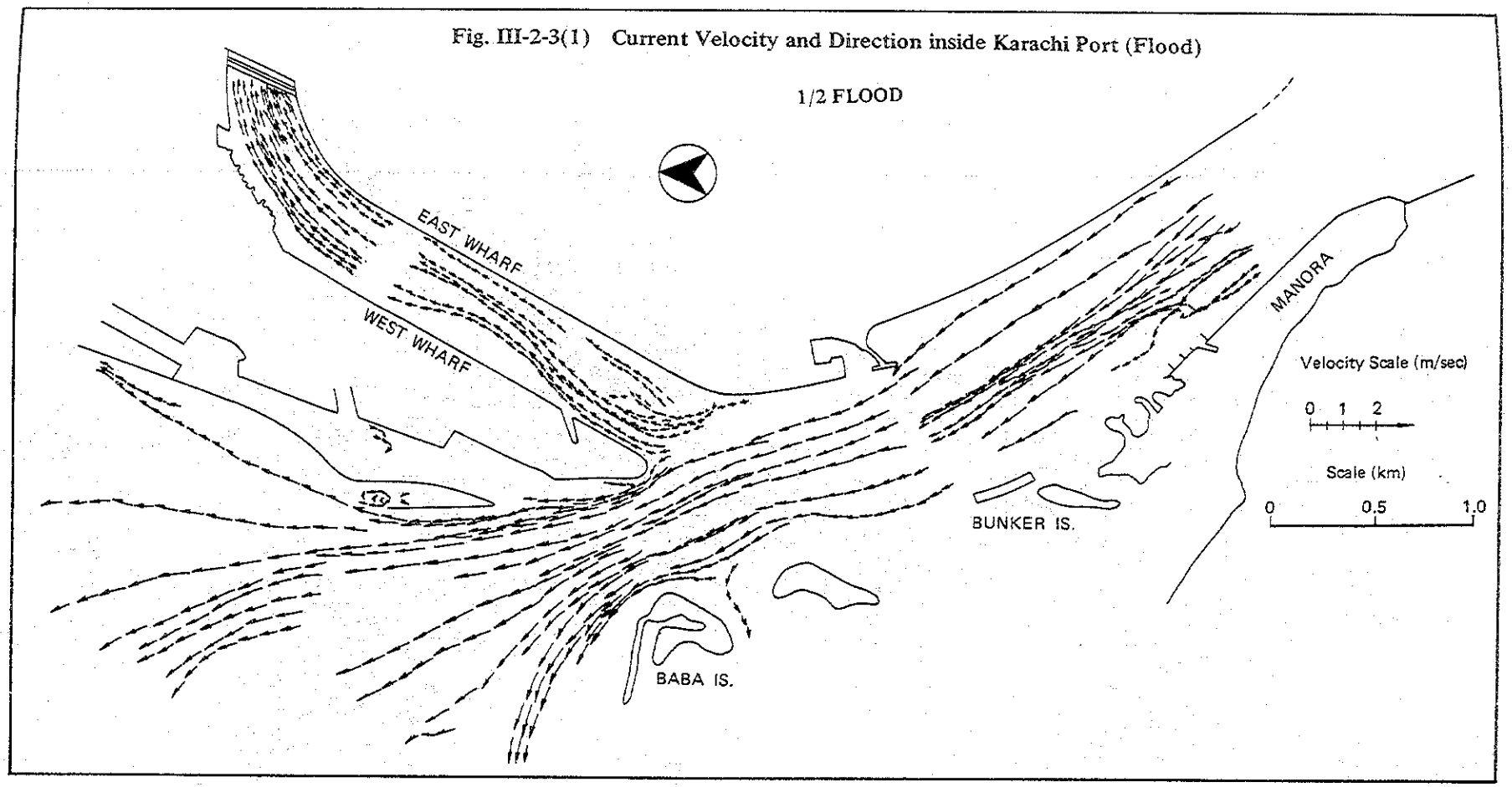


Fig. III-2-3(1) Current Velocity and Direction inside Karachi Port (Flood)



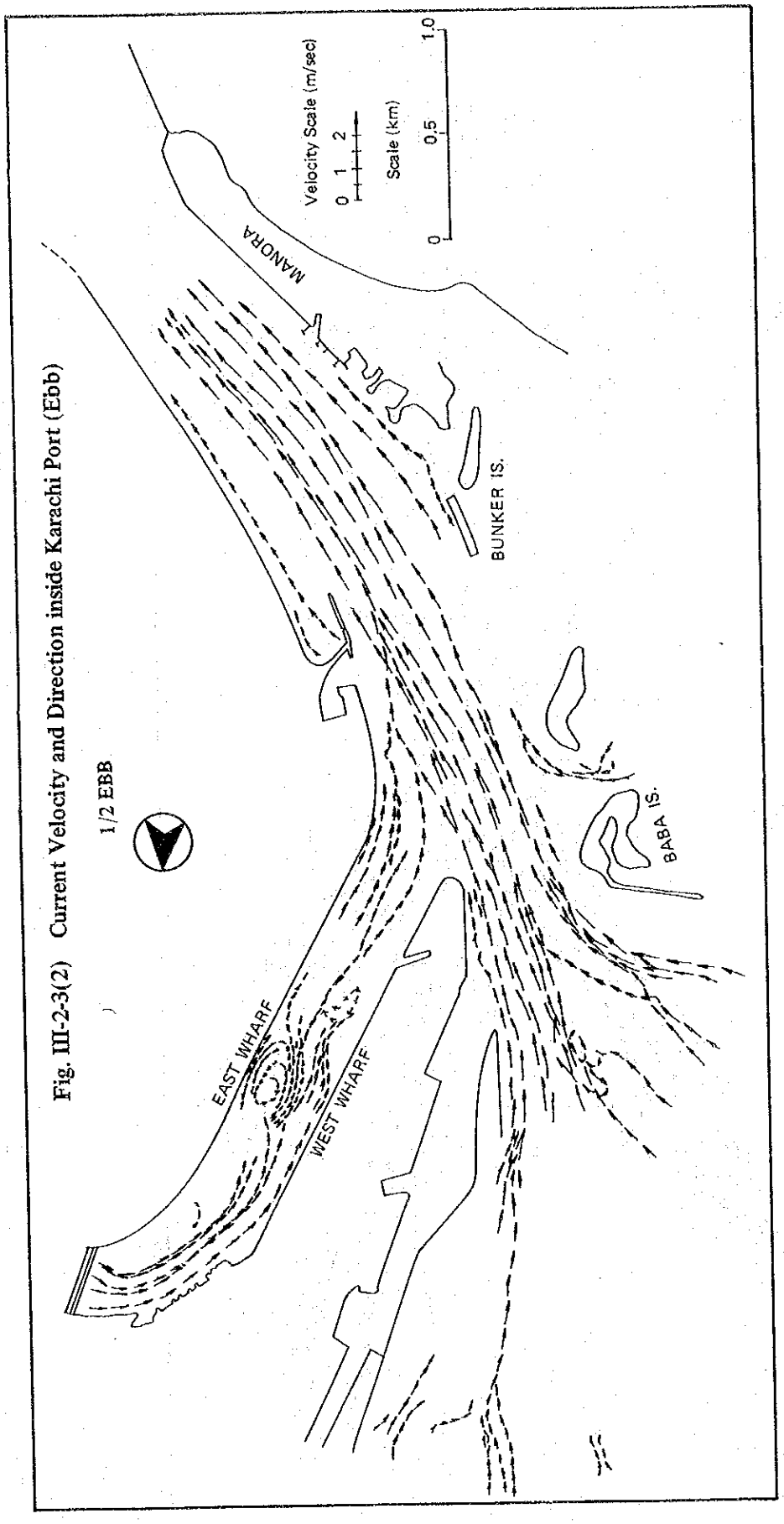
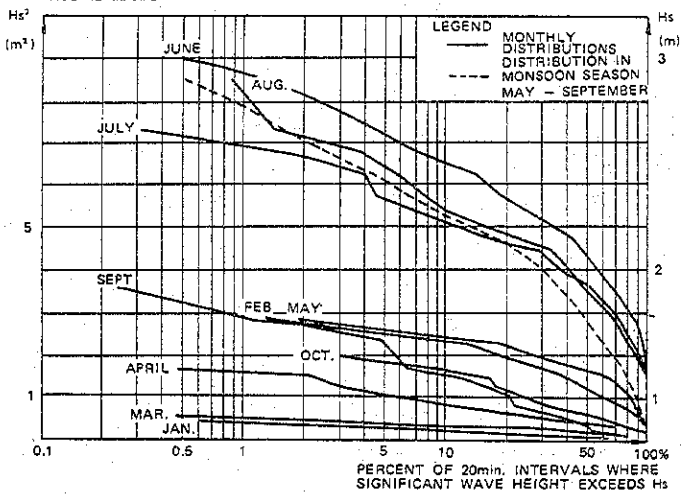


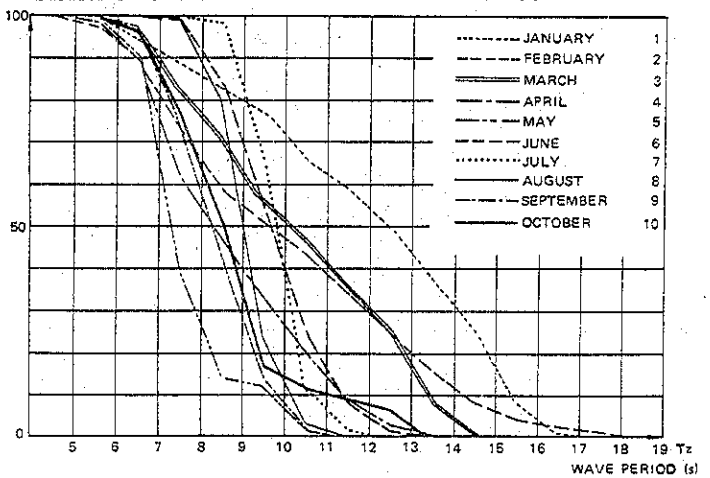
Fig. III-2-3(2) Current Velocity and Direction inside Karachi Port (Ebb)

Fig. III-2-4 Distributions of wave heights, periods, and directions

(a)



(b)



(c)

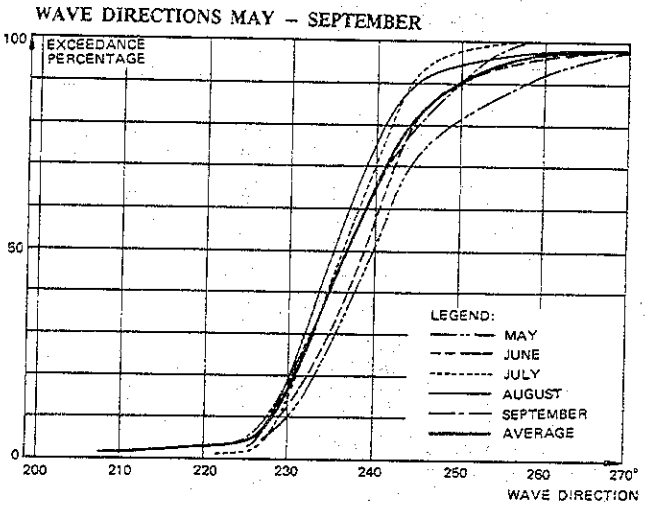
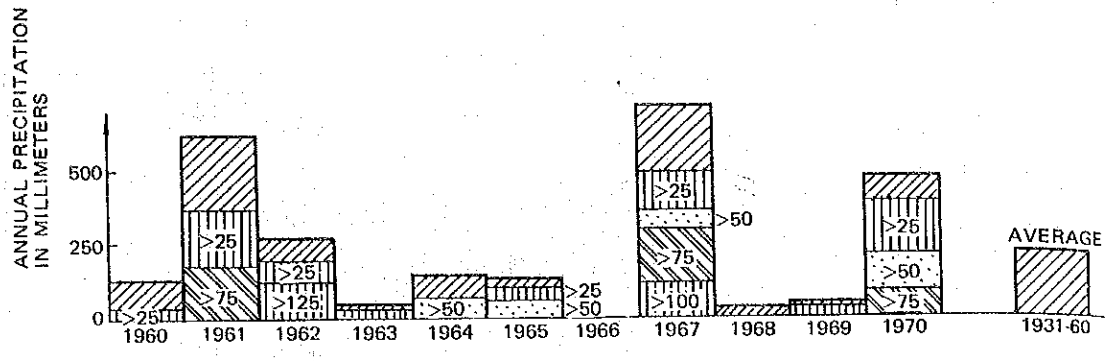


Fig. III-2-5 Precipitation Record



THE COLOMNS MARKED, 25, 50, ETC. INDICATE TOTAL AMOUNT OF PRECIPITATION ON DAYS WITH RAINFALL GREATER THAN 25, 50 mm ETC.

Fig. III-2-6 Distribution of Median Diameters

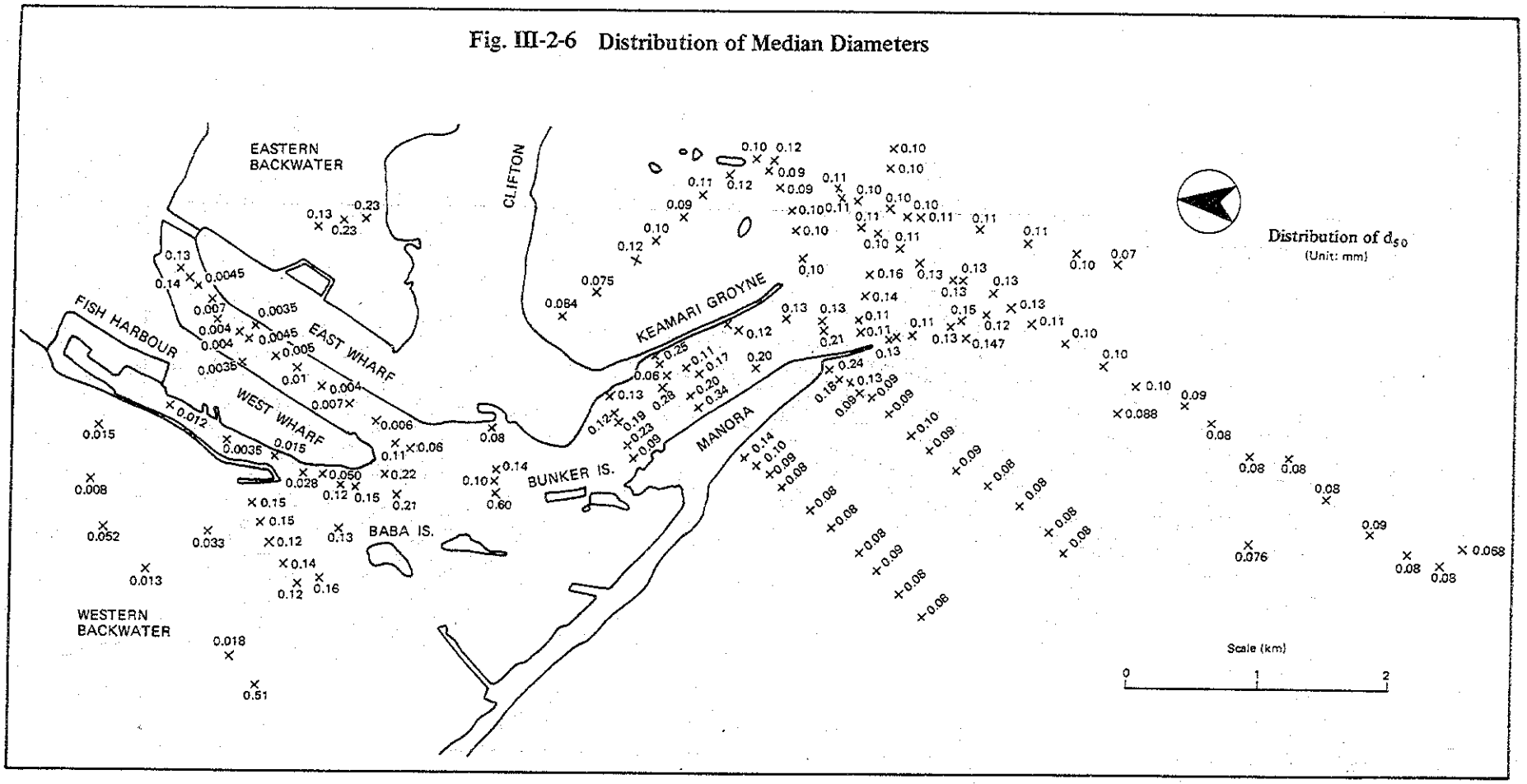


Fig. III-2-7 Average Maintenance Dredging Volume

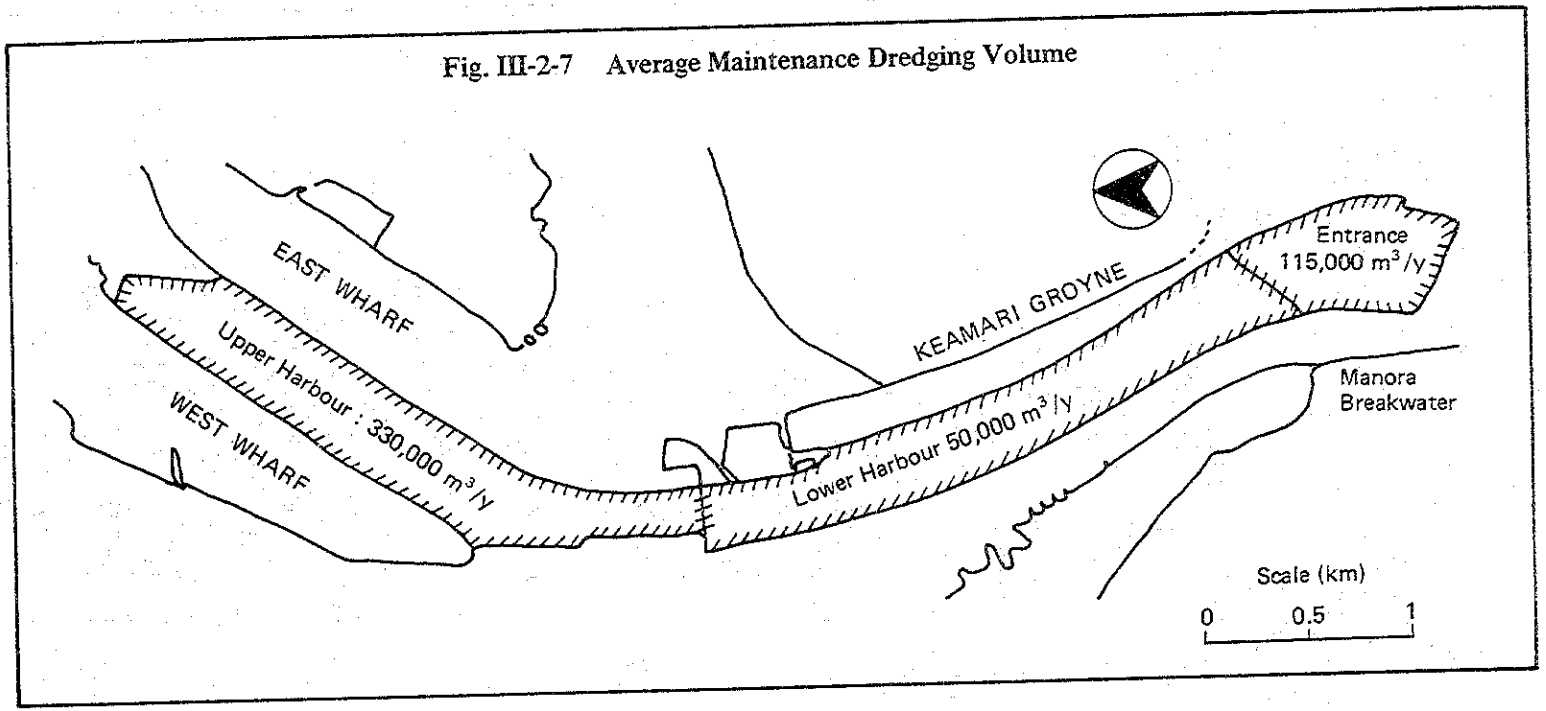


Fig. III-2-8 Layout of the Approach Channel

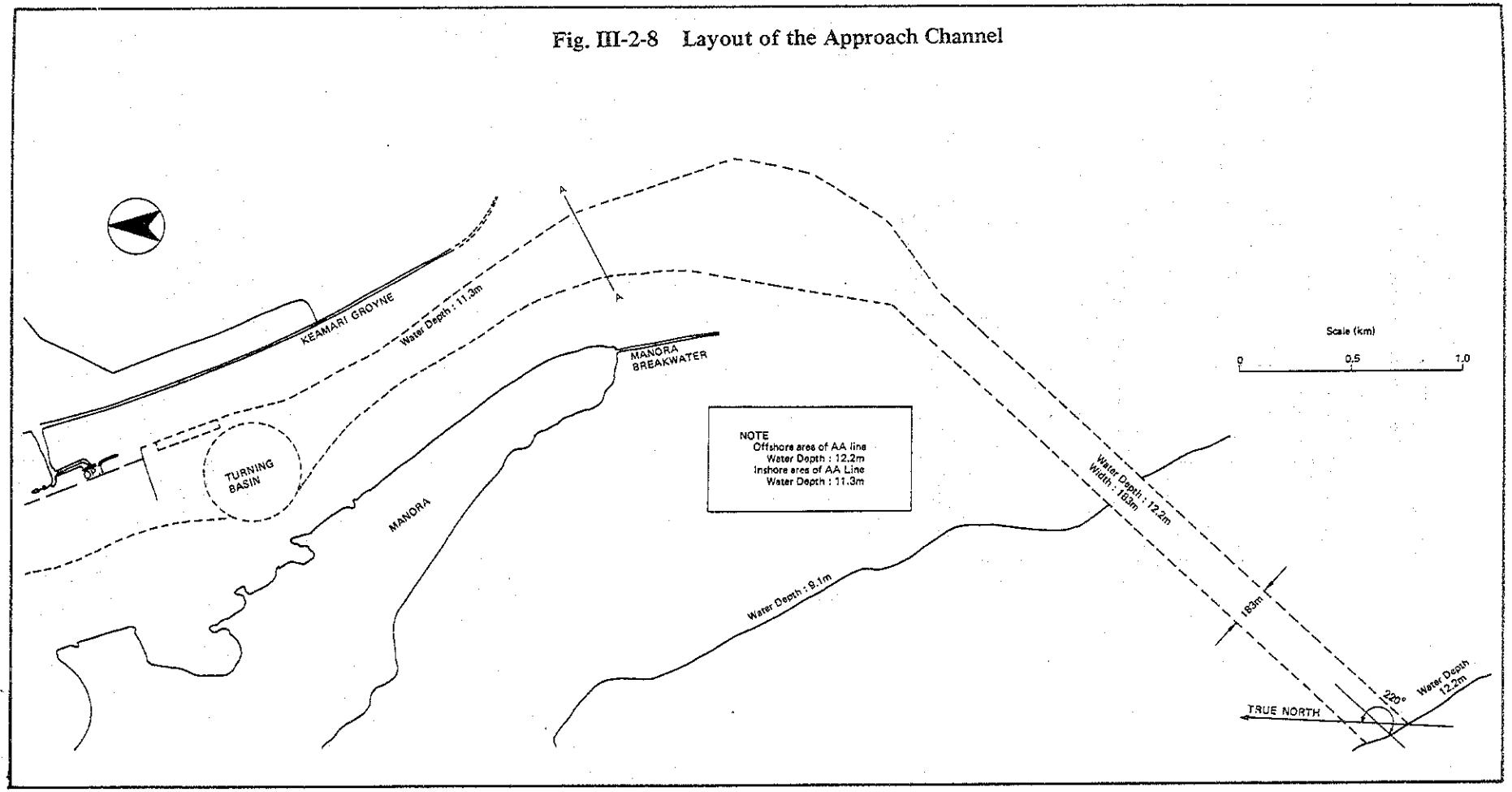


Fig. III-2-9 Infill Volumes due to Long Term Effects (after DIAH)

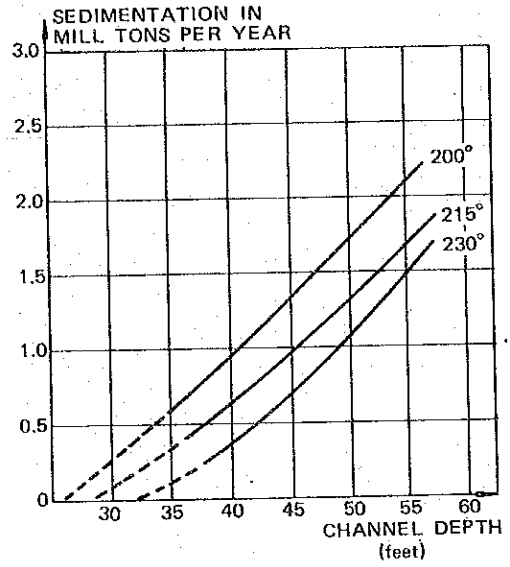
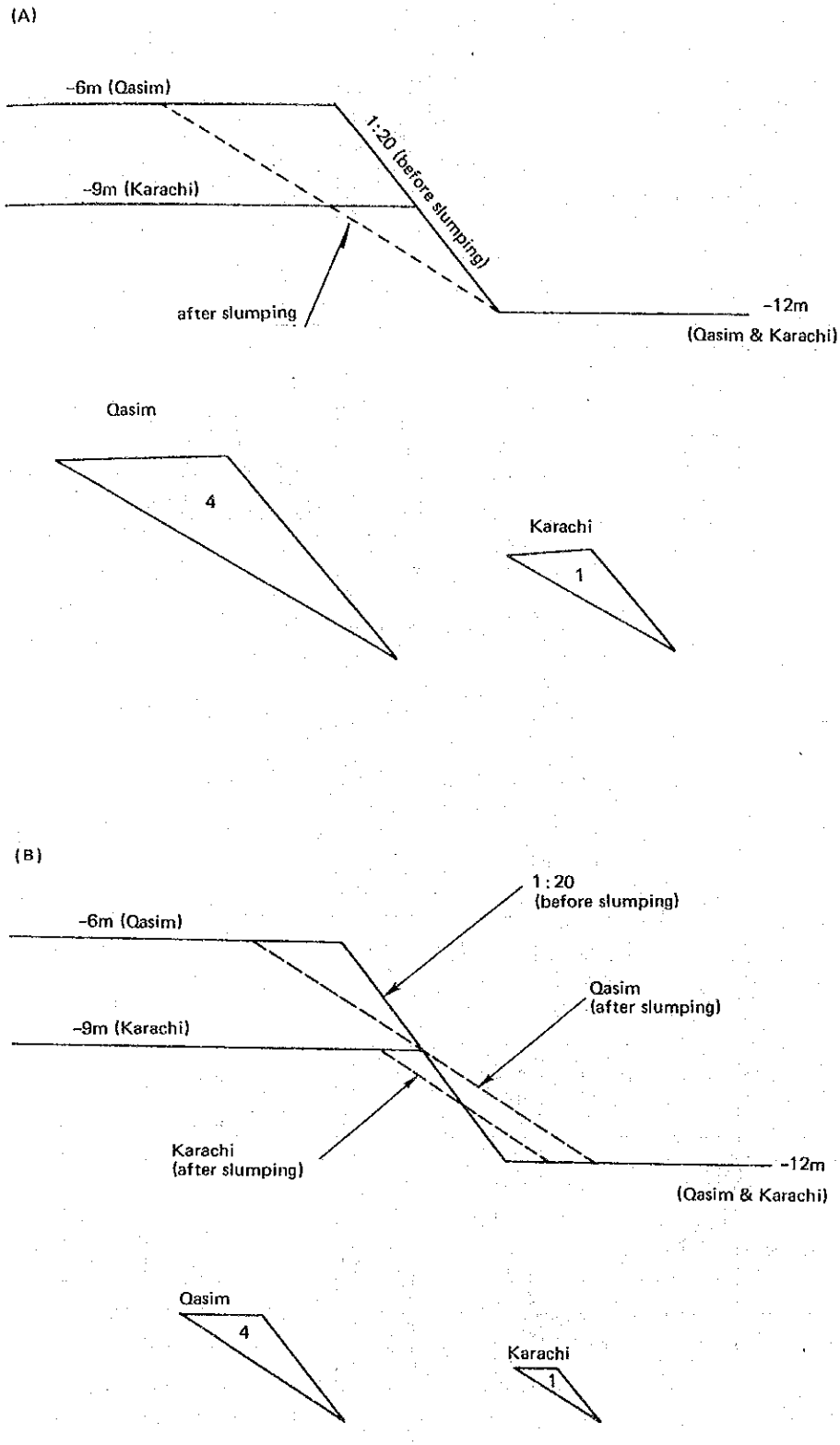


Fig. III-2-10 Volume of Slumping



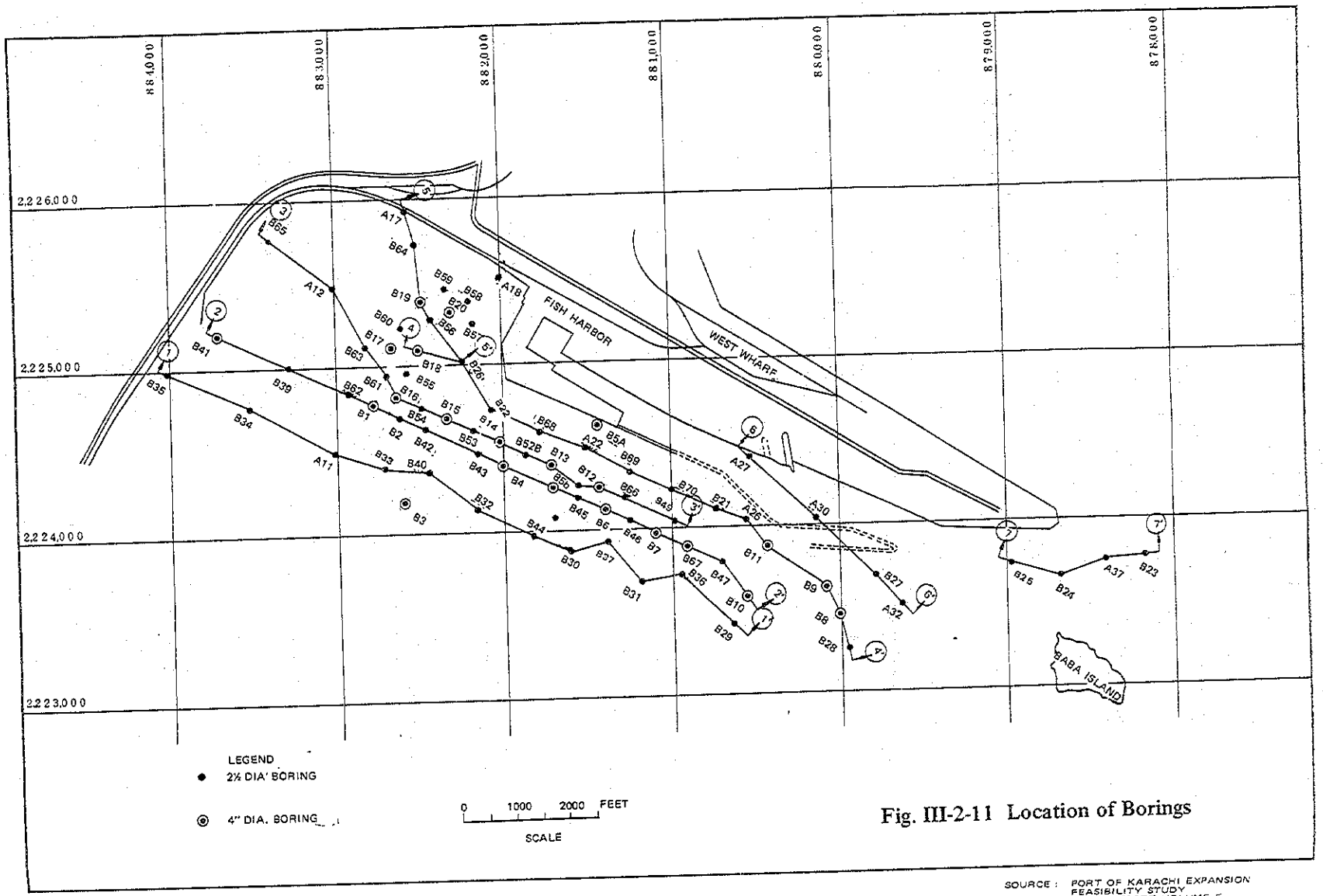


Fig. III-2-11 Location of Borings

SOURCE : PORT OF KARACHI EXPANSION FEASIBILITY STUDY FINAL REPORT VOLUME E AUGUST 1979

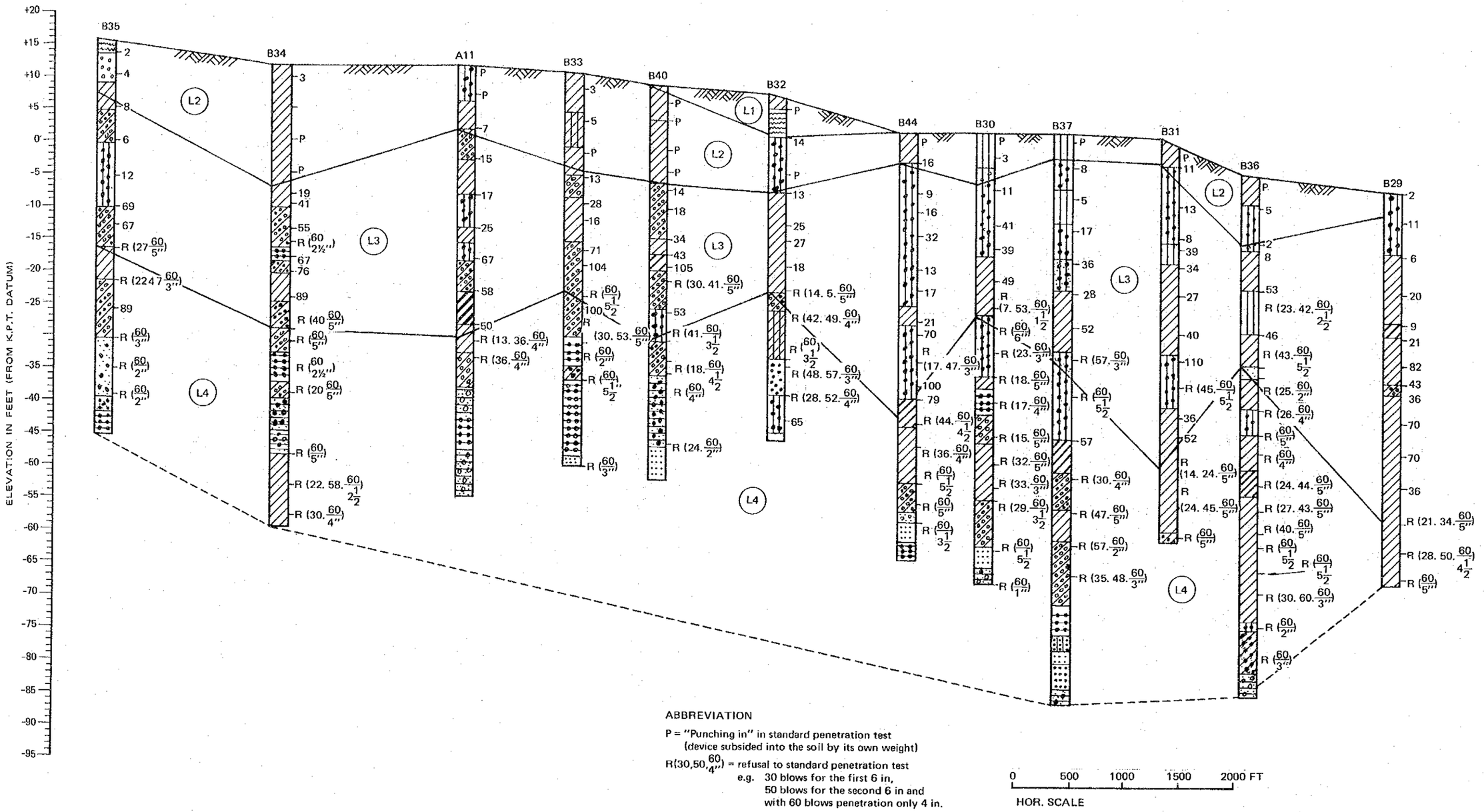
Fig. III-2-12 Soil Classification Chart

Major Divisions			Graph Symbol	Letter Symbol	Typical Descriptions
Coarse Grained Soils	Gravel and Gravelly Soils more than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels (Little or No Fines)		GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines.
				GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Littel or No Fines.
		Gravels with Fines (Appreciable Amount of Fines)		GM	Silty Gravels, Gravel-Sand Silt Mixtures.
				GC	Clayey Gravels, Gravel-Sand-Clay Mixtures.
More Than 50% of Material is Larger Than No. 200 Sieve Size	Sand and Sandy Soils more than 50% of Coarse Fraction Passing No. 4 Sieve	Clean Sand (Little or No Fines)		SW	Well-Graded Sands, Gravelly Sand, Little or No Fines.
				SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines.
		Sands with Fines (Appreciable Amount of Fines)		SM	Silty Sands, Sand-Silt Mixtures.
				SC	Clayey Sands, Sand-Clay Mixtures.
Fine Grained Soils More Than 50% of Material is Smaller Than No. 200 Sieve Size	Silts and Clays	Liquid Limit Less than 50%		ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity.
				CL	Inorganic Clays of Low to Medium Plasticity. Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
				OL	Organic Silts and Organic Silty Clays of Low Plasticity.
	Silts and Clats	Liquid Limit Greater than 50%		MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils.
				CH	Inogranic Clays of High Plasticity, Fat Clays.
				OM	Organic Clays of Medium to High Plasticity, Organic Silts.
Highly Organic Soils				Pt	Peat, Humus, Swamp Soils with High Organic Contents.

Note: Dual Symbols are used to indicate borderline soil classifications.

Note: Laboratory plasticity chart used in connection with above chart not shown.

Fig. III-2-13 Layer Differentiation Profile 1-1′



ABBREVIATION

P = "Punching in" in standard penetration test (device subsided into the soil by its own weight)

R(30,50,60/4″) = refusal to standard penetration test
e.g. 30 blows for the first 6 in,
50 blows for the second 6 in and
with 60 blows penetration only 4 in.

Fig. III-2-14 Layer Differentiation Profile 2-2'

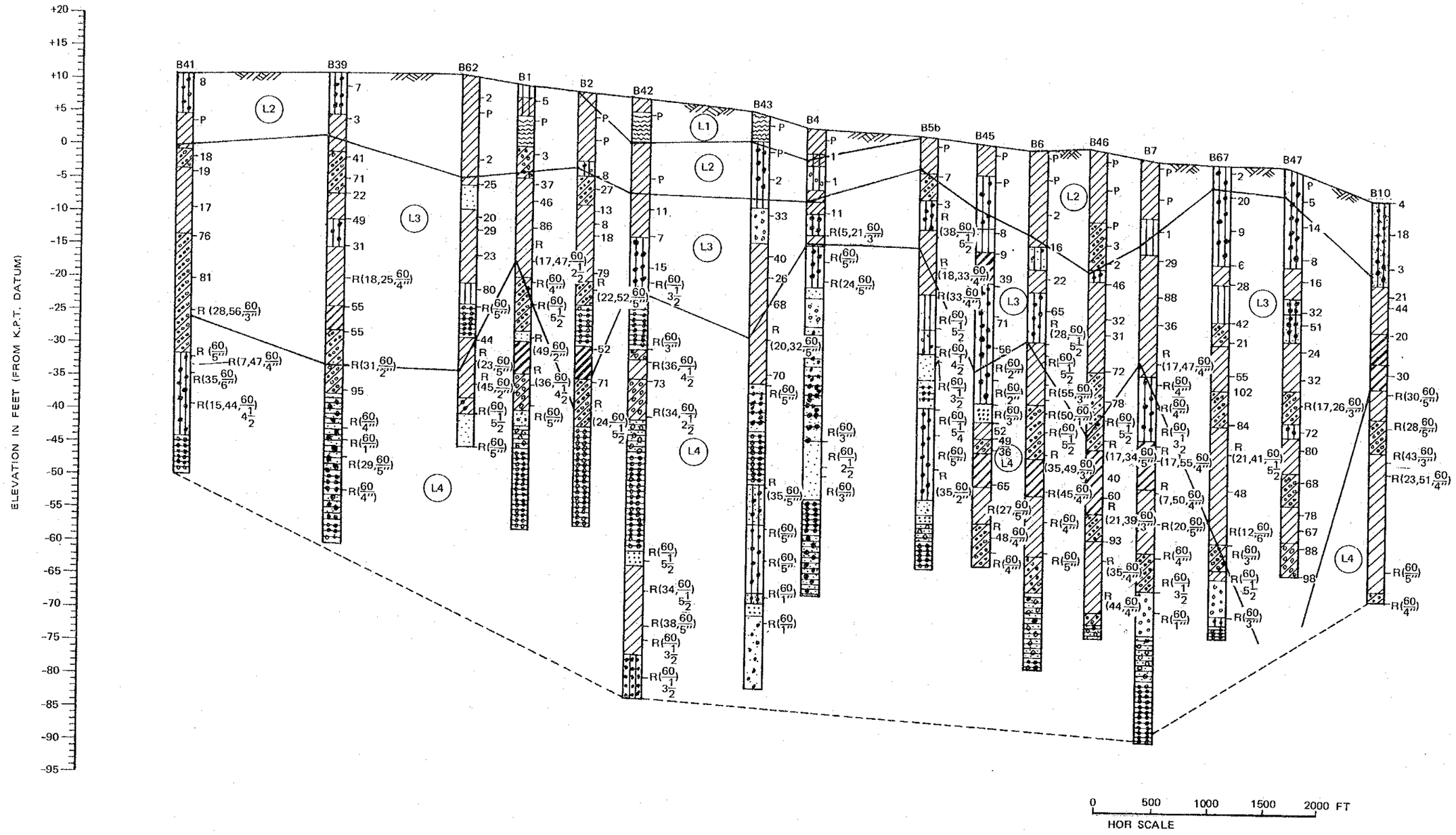


Fig. III-2-15 Layer Differentiation Profile 3-3'

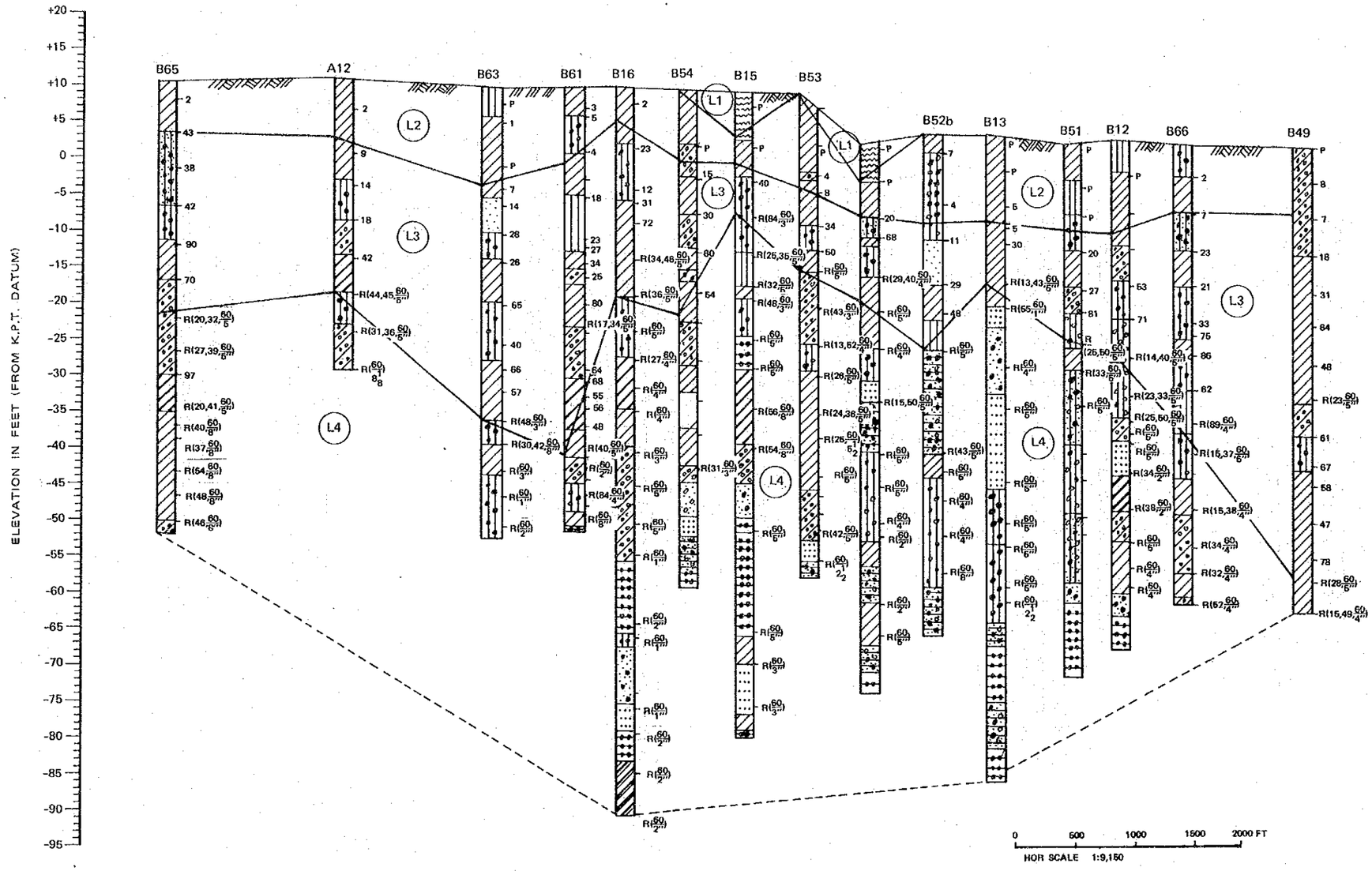


Fig. III-2-16 Layer Differentiation Profile 4-4′

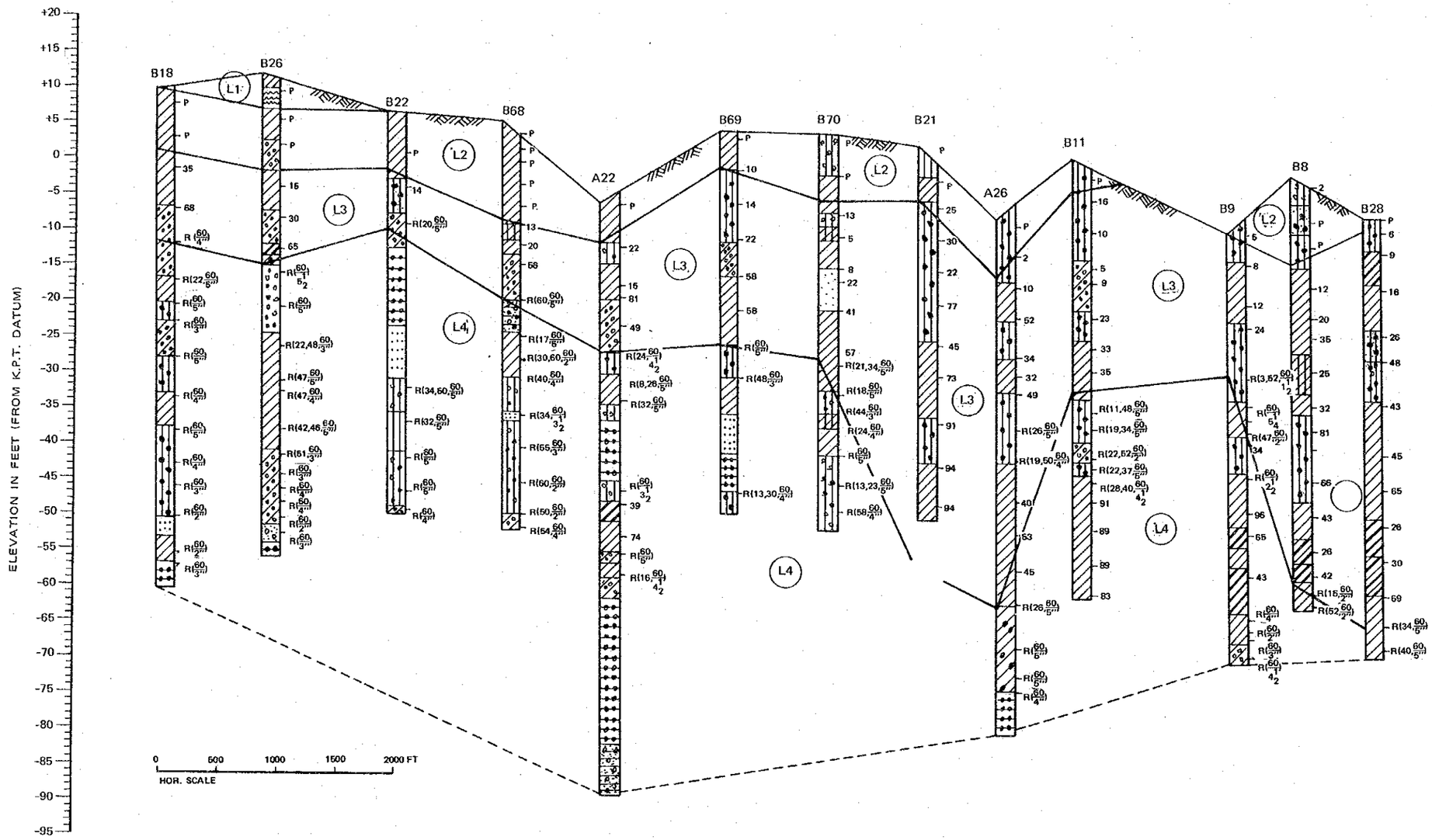


Fig. III-2-17 Layer Differentiation Profile 5 - 5'

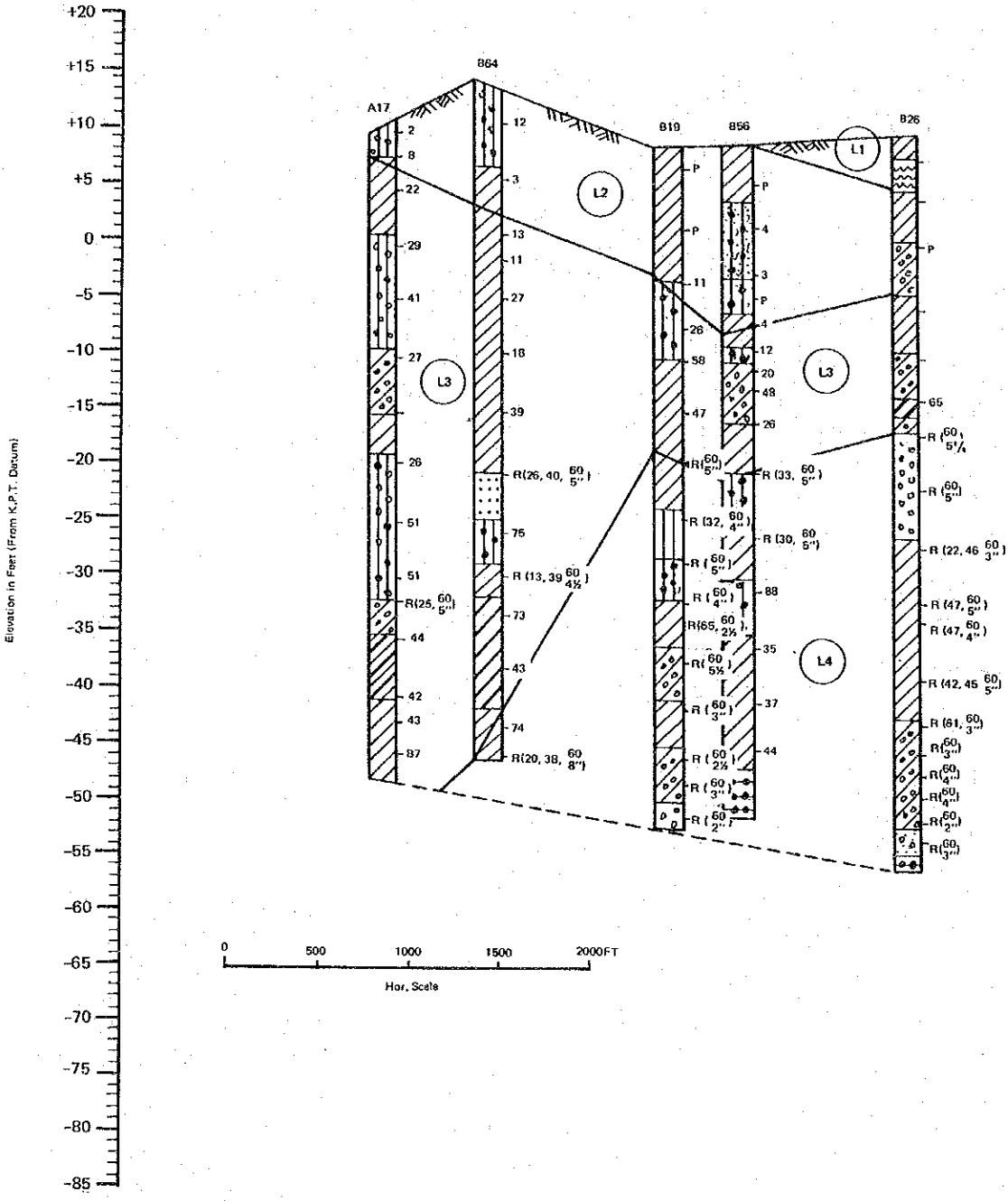
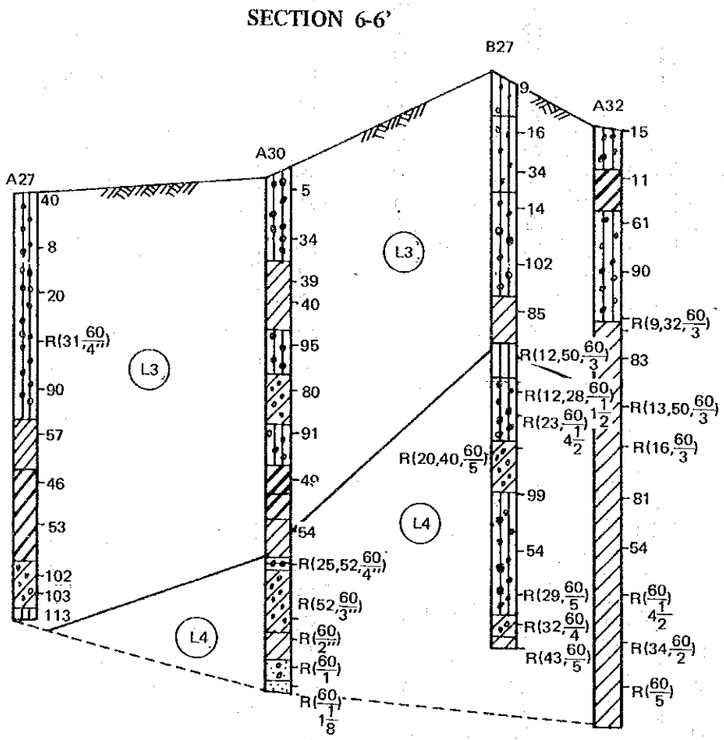
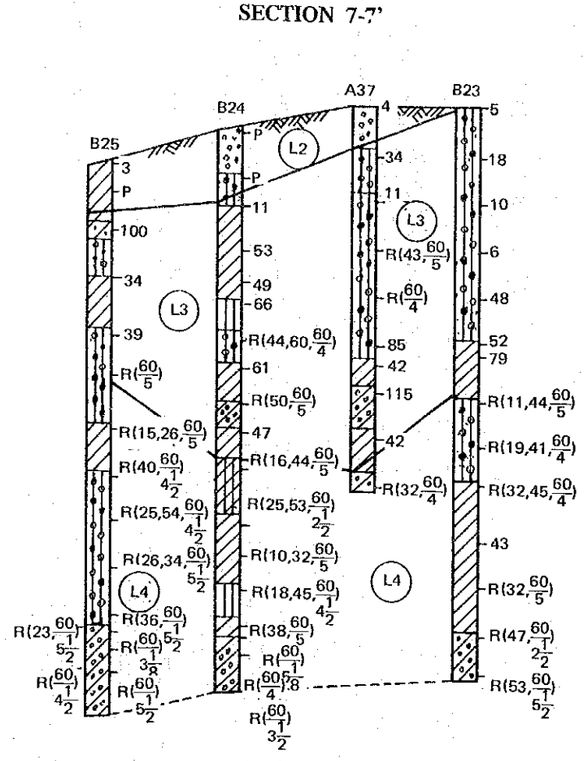
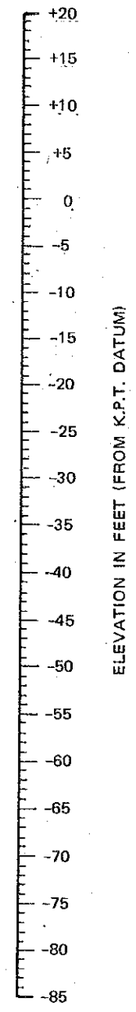


Fig. III-2-18 Layer Differentiation Profiles 6-6'/7-7'







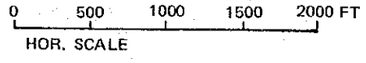


Fig. III-2-19 Soil & Rock Differentiation Profile 1-1′

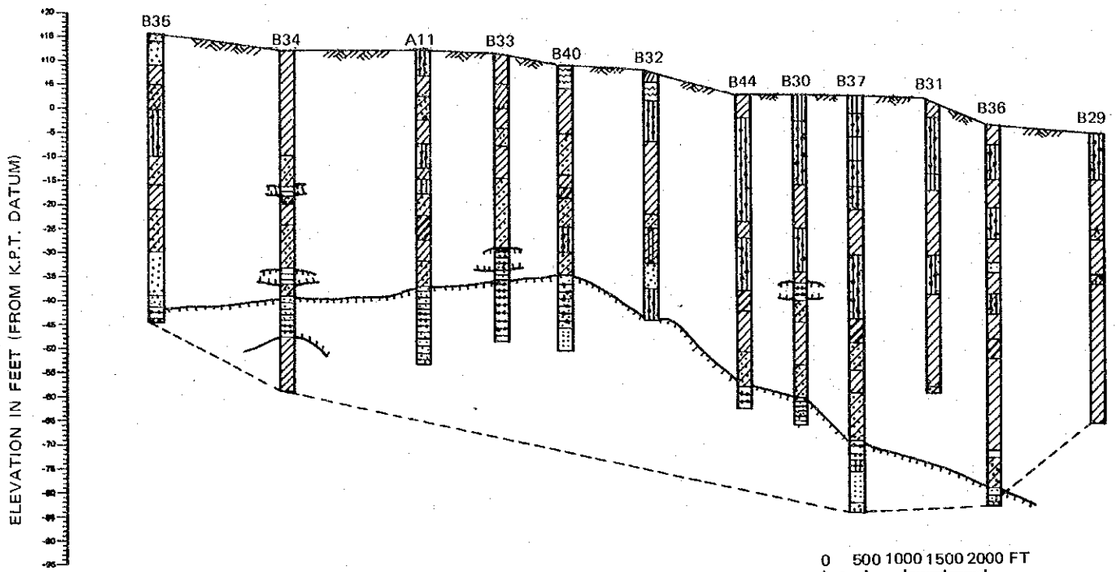


Fig. III-2-20 Soil & Rock Differentiation Profile 2-2′

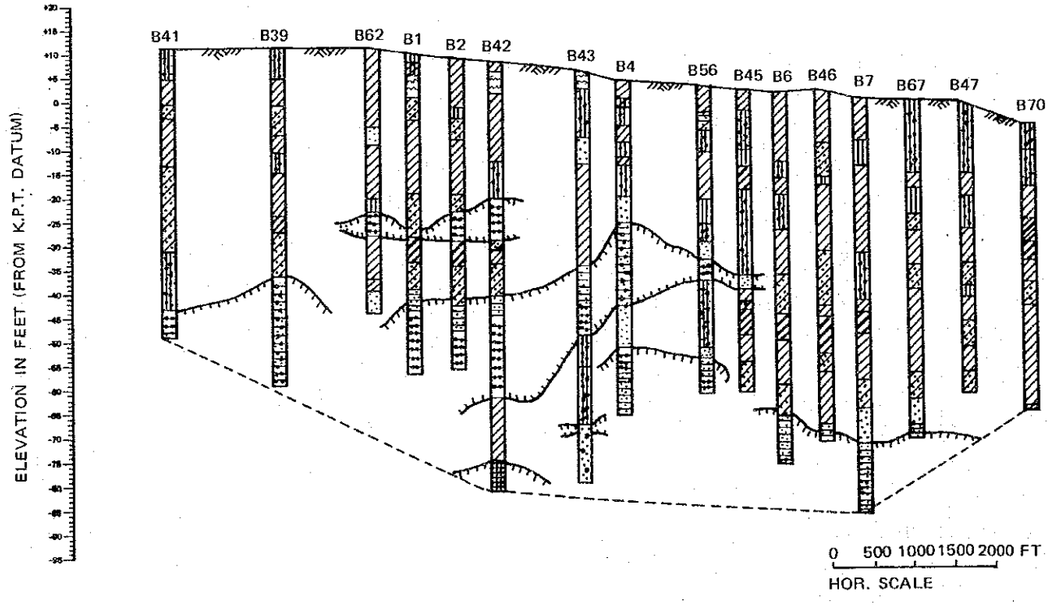


Fig. III-2-21 Soil & Rock Differentiation Profile 3-3′

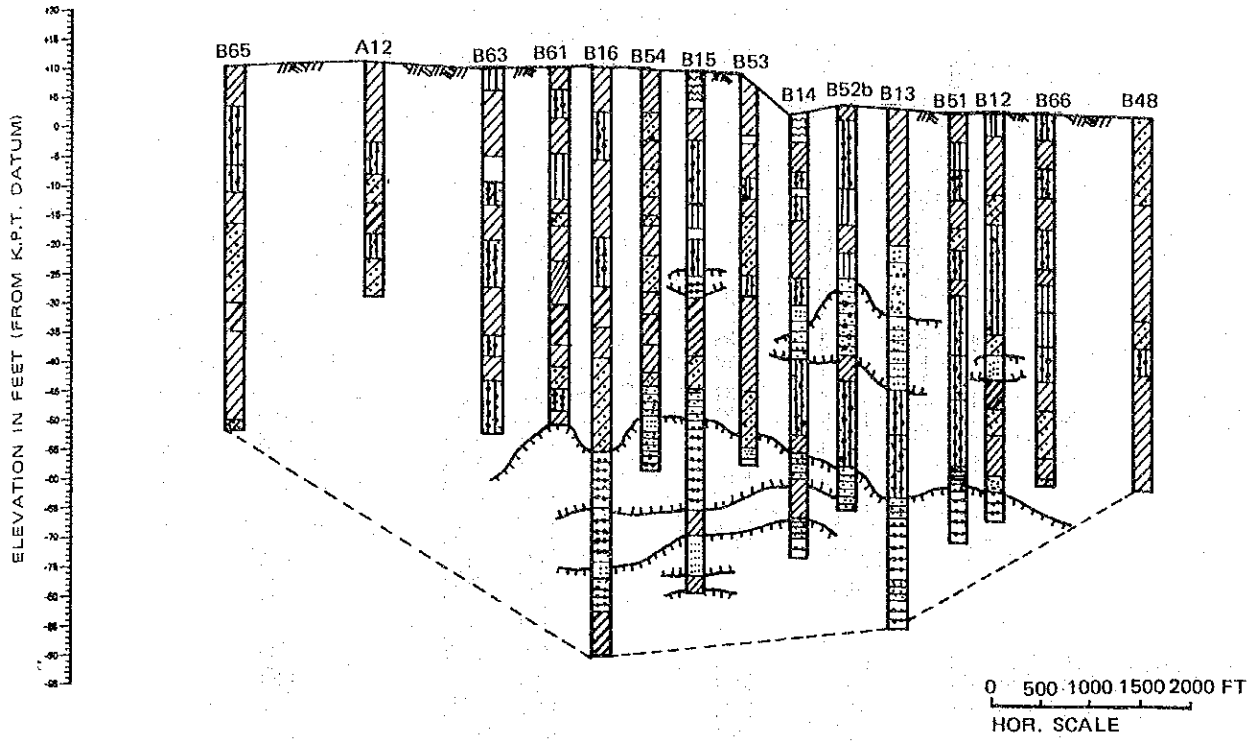


Fig. III-2-22 Soil & Rock Differentiation Profile 4-4′

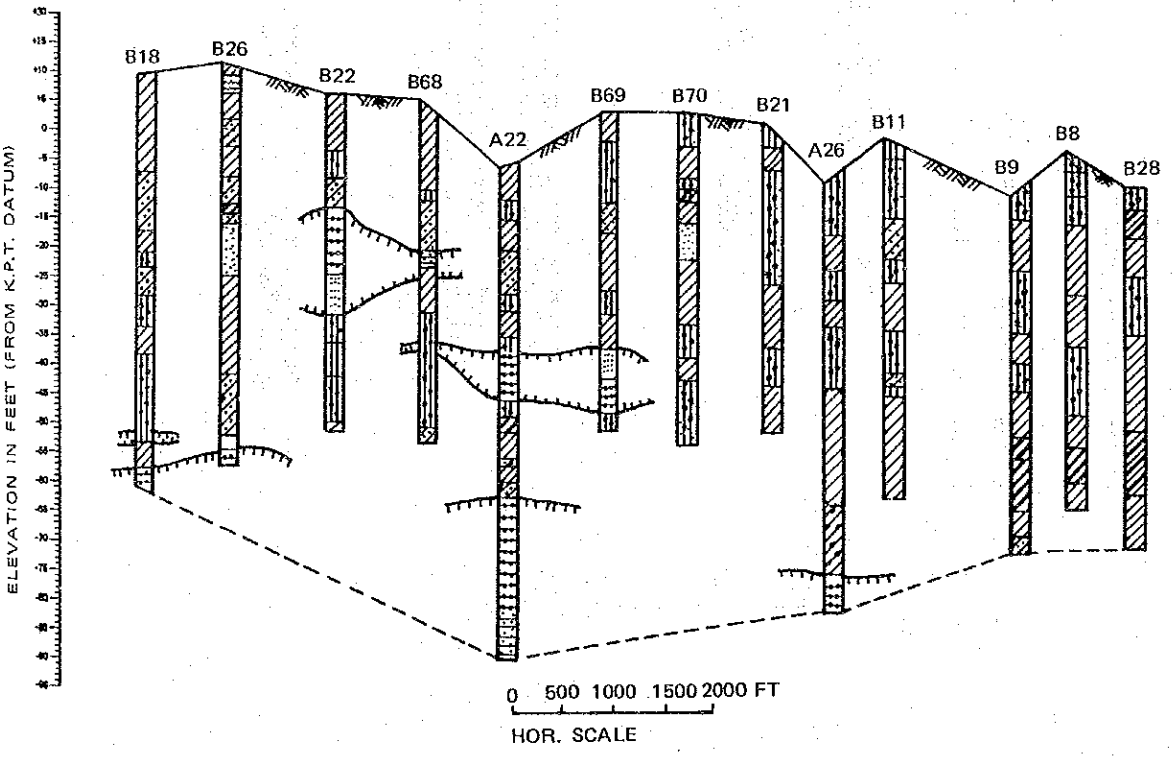


Fig. III-2-23 Soil & Rock Differentiation Profile 5-5′

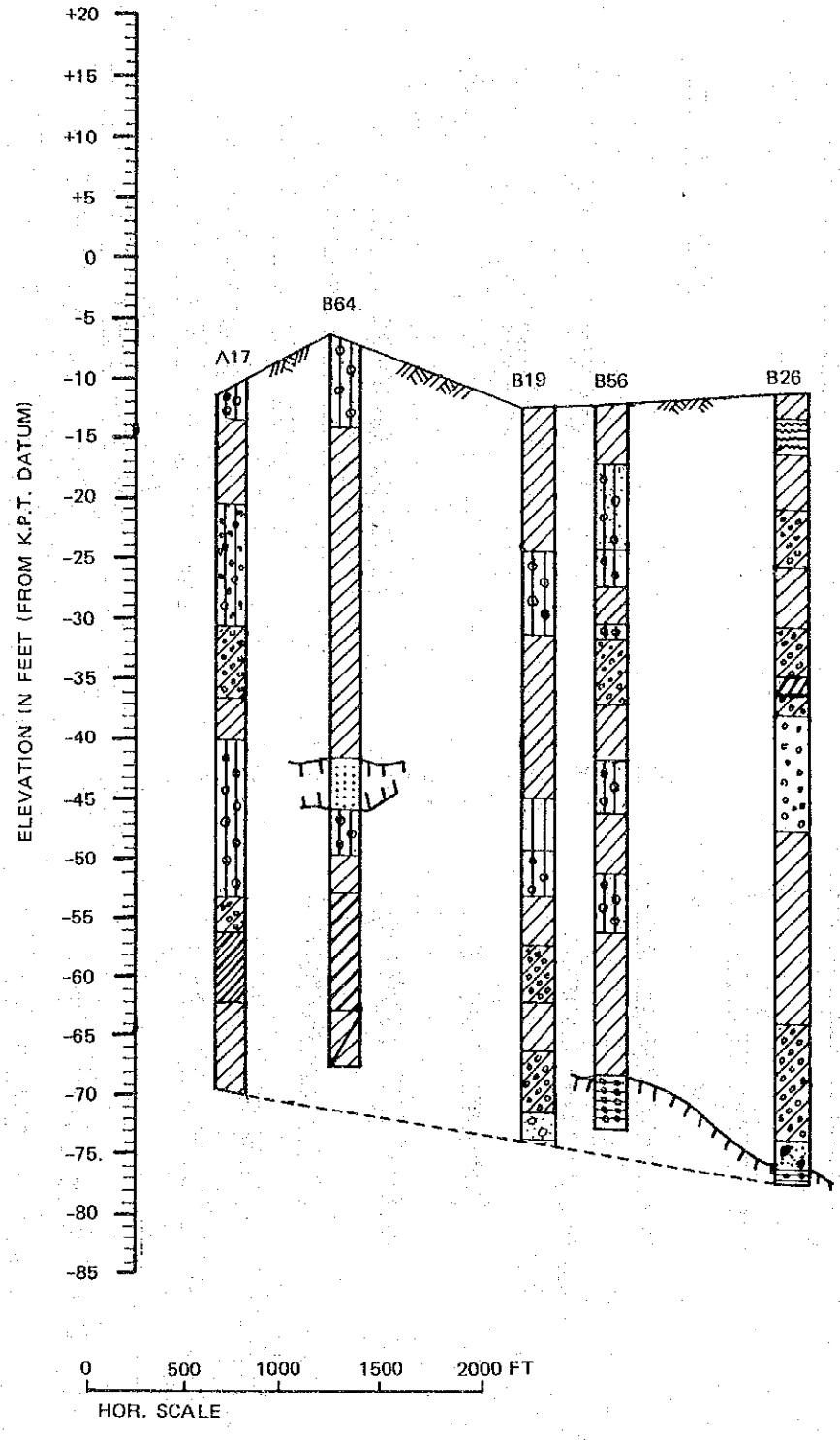
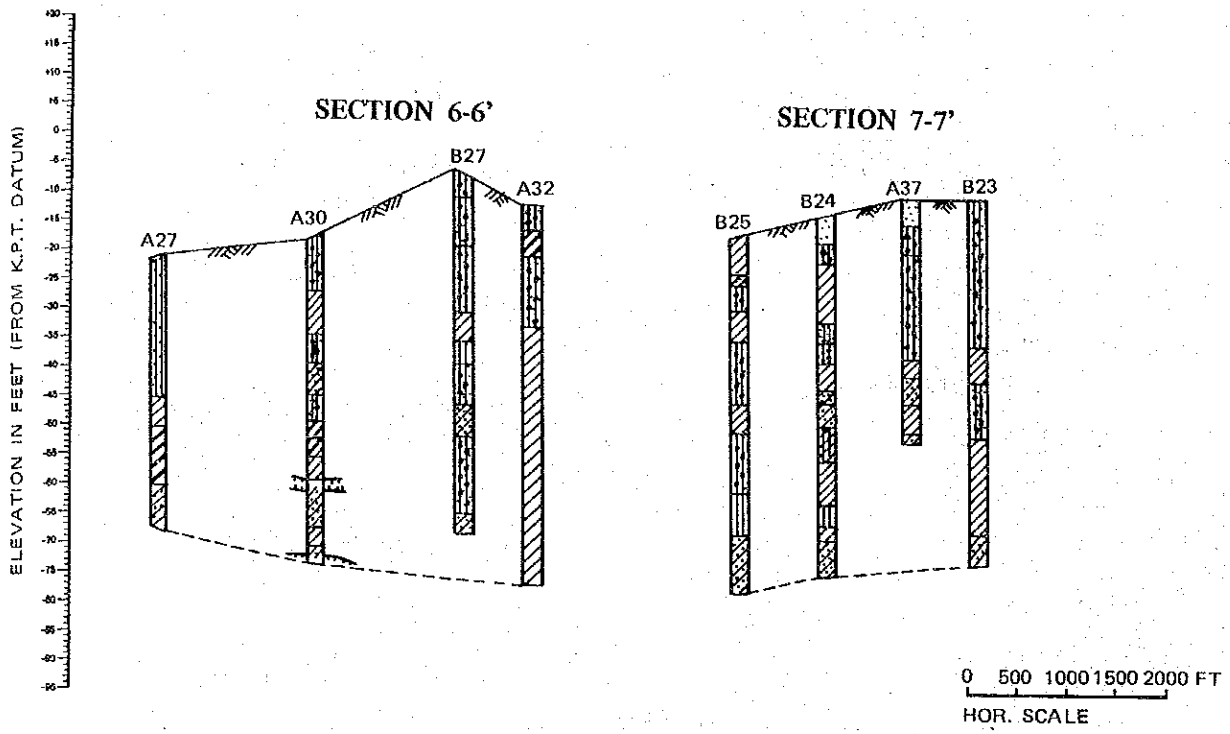


Fig. III-2-24 Soil & Rock Differentiation Profiles 6-6'/7-7'



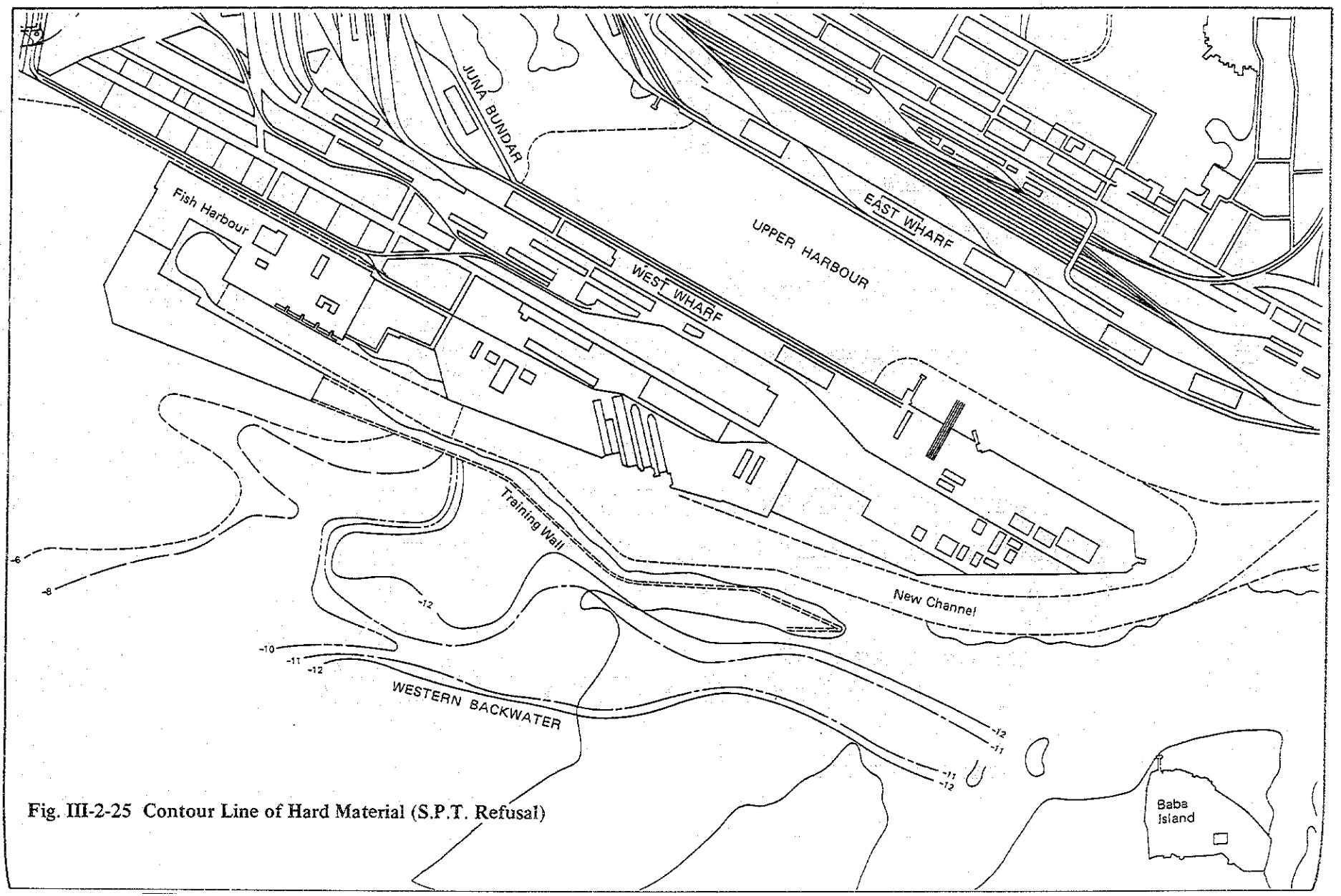
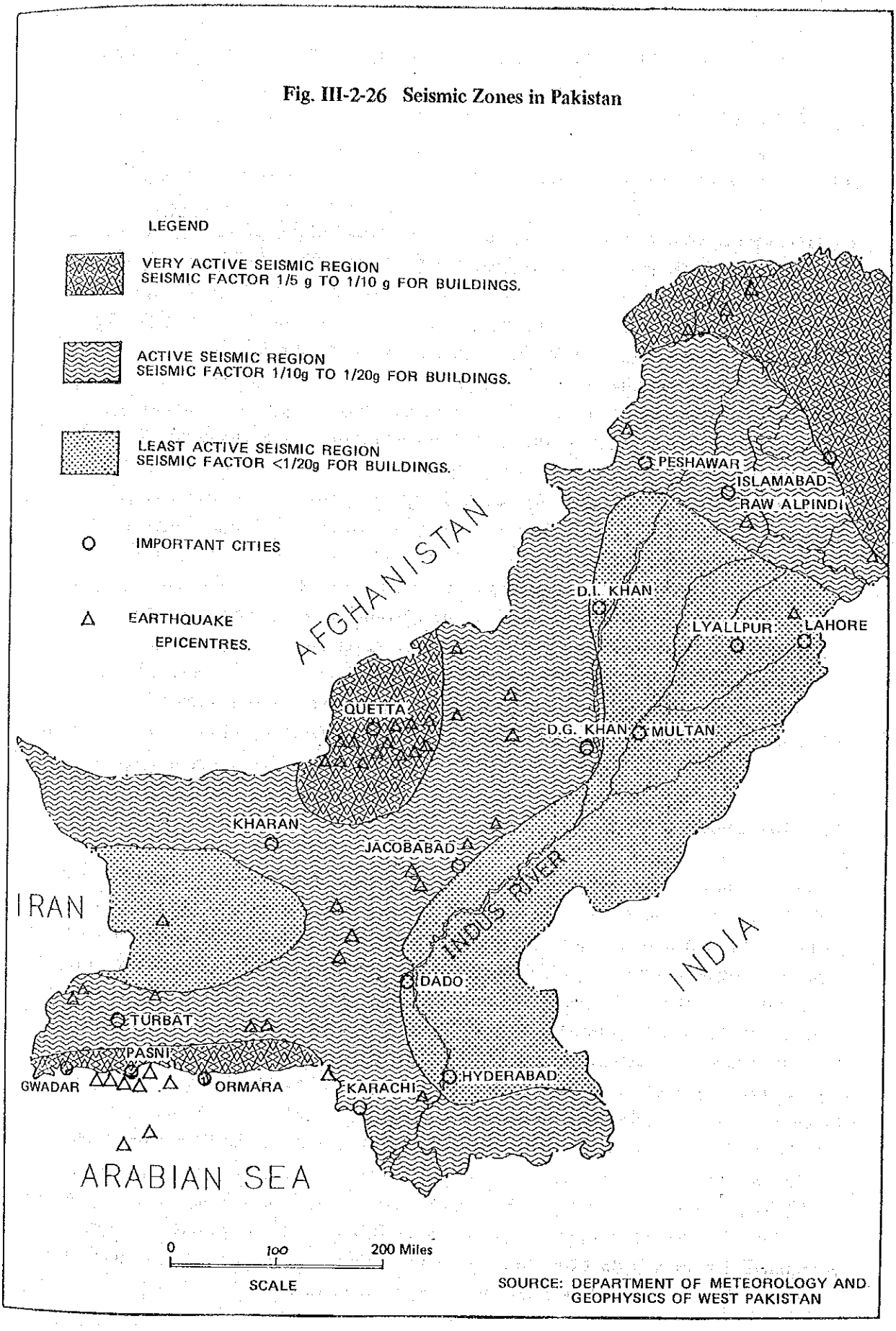


Fig. III-2-25 Contour Line of Hard Material (S.P.T. Refusal)

Fig. III-2-26 Seismic Zones in Pakistan



CHAPTER 3. PRESENT SITUATION OF KARACHI PORT

3-1 Port Management

3-1-1 Port and Shipping Administrative Organization

Ministry of Communications (MOC) controls the administration of the roads, ports, shipping, telegram & telephone and post office, and Ports & Shipping Wing (P S W), an internal bureau, is in charge of overall consolidation of various organizations related to ports and shipping. All practical works such as planning, construction and management, etc. are conducted by national organizations, which are autonomous bodies under the control of P S W.

As organizations in charge of ports, there are Karachi Port Trust (K P T) and Port Qasim Authority (P Q A) for which the wharf is being constructed.

There are two organizations dealing with shipping; Pakistan National Shipping Corporation (P N S C) operates vessels while Karachi Shipyard & Engineering Works, Ltd. manages a shipyard.

National Logistic Cell (N L C), the commissariat of the army, controls related organizations in respect of the handling of the cargo/freight at Karachi Port Wharf, and engages in the truck transportation to Up-country.

Pakistan Railways, a national organization under the control of the Ministry of Railways, transports the cargo/freight from Karachi Port and Qasim Port to inland Up-country by rail.

Overall consolidation of the nation's transportation system as a whole is virtually in the hand of Planning and Development Division (P D D) of the Ministry of Finance and Planning at the stage when investment plans are submitted by respective ministries for approval. The relationship between M O C, P S W and respective ports and shipping-related organizations are shown in Fig. III-3-1.

3-1-2 Management of K P T

(1) The management of K P T is based on the Karachi Port Trust Act enacted in 1986. The highest decision-making organ is the Board of Trustees which consists of 11 members including Chairman. Chairman is appointed by the Federal Government and the Trustees are representatives of shipowners, shippers, port labourers and the Government. K P T controls the land, waters and various facilities in the prescribed port area. Important policy-making matters such as the lease, sale and transfer of property, the general budget, the investment budget, therevision of port fees, the issurance of debentures and loans require prior approvals of the Federal Government. The financial statement must be submitted twice a year to the Federal Government for audit by the duly appointed auditor.

The organization chart and personnel of K P T are shown in Fig. III-3-2 and Table III-3-1 respectively.

(2) Transitions in K P T's financial statement are shown in Table III-3-2.

K P T's accounting system was improved on July 1, 1975 and converted it to be based on a commercial basis, and the expenditure items broken down in further details enabled an easier and more efficient control of the accounts for respective divisions.

(3) K P T revised its tariff from time to time on an ad-hoc basis since the revision made in 1964. However, it was felt that a full scale revision was required in order to cope with increased operational expenses such as personnel expenses, material costs, maintenance and repair fees for machineries, equipments and facilities as well as with the investment in the development project. After investigations and researches were conducted for several years, the revision to the Tariff was made in August, 1979. Current tariff is shown in Table III-3-3.

(4) K P T's financial resources are divided into two; for operating expenses 100% owned capital, and for development investment 100% owned capital for local currency and the foreign loans for foreign currency.

There are two procedures followed for foreign loans; entering contracts directly with the lender, and sub-contracting with the Federal Government which has entered the contract with the lender. Table III-3-4 shows K P T's foreign loans. When K P T contracted the loan with International Development Association (IDA) in respect of the 4th Project, they were obliged to keep the return on net fixed assets at 4% until 1981, and at 7% after 1982 at lowest respectively.

(5) K P T needs not pay dividends nor income taxes on its earnings.

(6) All the land is owned by K P T, but a portion of it is being leased to private enterprises. The average lease for 1980 is 32.50Rs per square feet for the period of 25 years.

(7) Port railways were constructed by K P T and are operated by the Pakistan Railways. Neighbouring roads outside the port are planned, designed, estimated and constructed by K P T, and will be delivered to the Sind State Government after completion. 80% of the total investment is financed by the Federal Government and the remaining 20% by the Sind State Government.

(8) There has been no labor dispute in the last 3 years.

(Reference materials: KPT Administration Report 1978 – 79, K P T Year Book 1979 – 80, "Preliminary Investigation for Transportation and Economy in Western Asia" consigned by the Ministry of Transport, Japan.)

3-2 Port facilities

3-2-1 Port facilities

The present Karachi Port consists mainly of the Entrance Channel (12,830 feet 3.9 Km), the Lower Harbour Channel (approx. 10,700 feet 3.3 Km), the Upper Harbour Channel (approx. 11,400 feet 3.5 Km) and the berthing facilities known as the East and West Warves as well as Juna Bunder Berth, which has transit sheds or plinth and four oil piers. The entrance of the port is protected from open sea wave by Keamari Groyne and Manora Breakwaeter.

These facilities are indicated in Tables III-3-5 and III-3-6.

Port layout and the section of the main structure are shown in Fig. III-1-1 and Figs. III-3-3 to III-3-8.

Besides above facilities, there are two ship repair berths, 660 and 450 ft long, 24 ft deep at East Wharf and two dry docks of 620 ft x 90 ft x 18 ft and 560 ft x 80 ft x 16 ft respectively.

3-2-2 Cargo handling equipment

KPT's existing cargo handling equipment are shown in Table III-3-7.

In each main berth are installed approx. 4 quay cranes which are used for on-quay handling of the cargo together with the ship's derrick crane. Most handling of the cargo is executed on the quay side, but some goods are loaded or discharged to a barge lying on the opposite side or alongside a ship which stays abreast of the main ship. The cargo on the barge is managed by the quay crane or the mobile crane installed on the lighterage wharf. The towing units and the trailers are used for transporting the cargo between the ship's side, the open plinth, the transit shed and the warehouse. The fork lift and the mobile crane are used for stacking the cargo respectively on the transit shed and on the open plinth.

KPT has its own repair shop for those cargo handling equipments in the port area and executes maintenance and repair there. The out-of-action rate of main cargo handling vehicles is shown in Table III-3-8. At the time of KPT survey (September 1980), the ratio of the equipments under repair to total units was 50% for the fork lift, 51.2% for the trailer (3 tons) and 66.7% for the trailer (10 tons), which has exacerbated shortage of cargo handling equipments. The primary reason is that KPT's equipment replacement plan (service life is 8 years for the fork lift and 10 years for others) is not progressing as scheduled and deterioration of the equipment is obvious. On the other hand, KPT is introducing the planned maintenance with organization improvement and personnel replacement for a target date of one of one and half years ahead, in view of problems in the maintenance system.

Then, the container handling equipments provided by the shipping lines and agents are shown in Table III-3-9. Big fork lifts are used for handling of full containers in the heavily-paved container parks and smaller ones are used to stuff and unstuff the container with cargoes. The trucks, chassis and hustlers assure long-distance transportation of the container. The generator sets are used to cool and keep cool the refrigerator containers. KPT's quick improvisation plan for handling containers stipulates that all necessary container handling equipments shall be provided by the shipping lines.

Customs duties ranging from 40% to 85% and sales tax at the rates of 10% to 20% had been collected from shipping lines using imported container handling equipment within the port area. So, the shipping companies had refrained from purchasing new equipment and got over the actual inconvenience by accommodating each other with their equipment, or hiring mobile cranes and trucks from the local market. But in order to encourage the present trend towards containerization it has been decided to reduce the customs duties on the equipment used for handling the containers in the port area to 20%, where as the sales tax is being withdrawn altogether, effective July 1981. Therefore, many units of container handling equipment are expected to be imported from October 1981.

It is recommended that, if there is the fear that container congestion in the port area may arise due to the failure to supplement sufficient equipment for the rapid increase of containers, advance investment be made for the purchase of some of the equipment scheduled to be introduced under the Urgent Plan.

3-2-3 Railways in the port area

The railway line as the important transportation system to inland area is led into the port area from the following three entrances.

The line from MAURIPUR SIDING YARD located north shore of Western Backwater enters from the north end of West Wharf and goes through behind the transit sheds or plinths of the wharf and extends upto Berth No. 24.

The line from KARACHI CITY YARD enters from the north side of NAPIER MOLE BRIDGE and is divided into two lines. One line goes through M. I. YARD behind the JUNA BUNDER BERTH and extends to West Wharf, and other line crosses Chinna creek and extends to EAST WHARF RAILWAY YARD.

Another one is the line which enters from the south end of EAST WHARF via Keamari.

Presently MANSFIELD IMPORT RAILWAY YARD is being remodelled and will be adequate for handling 1,000 wagons per day. Moreover the new railway line is scheduled to extend to the container and overflow cargo transit storage park at Keamari Groyne from KARACHI CANTT. YARD via STOWELL YARD.

The railway line around Karachi Port is shown in Fig. II-2-5.

3-2-4 Access road

To EAST WHARF, the main access of BUNDER ROAD is an undivided four-lane road which crosses the bridge over Chinna creek from K. P. T. building and goes behind EAST WHARF.

Presently new NAPIER MOLE BRIDGE over Chinna creek is almost completed so the bottle neck to the urban area will be dissolved. To WEST WHARF, the access is WEST WHARF ROAD which goes behind M. I. YARD and enters from the north end of WEST WHARF.

No road connects EAST WHARF and WEST WHARF presently. 80 feet wide road along the seashore from Clifton will be constructed as the access to the container and overflow cargo transit storage park at Keamari Groyne which is under construction.

The road which connects EAST WHARF and KEAMARI GROYNE has been widened to 4 lanes.

3-3 Port activities

3-3-1 Volume of cargo handled

Volume of cargo handled at Karachi Port is shown in Table III-3-10 to III-3-12 and Fig. III-3-9. As shown, the total port cargo throughput started to make a sharp increase in 1977 – 78 from a level of 10 million tons per year and reached to 1.5 million tons in 1978 – 79.

This remarkable increase is explained to be due mainly to a dry bulk import of wheat and fertilizer which were imported at about two times more than the previous year (from 1.5 million tons in 1977 – 78 to 3.6 million tons in 1978 – 79.). In 1979 – 80, though the volume of dry bulk cargo decreased by about 1.5 million tons, that of general and liquid bulk cargo increased by about 1.0 million tons to make a decreased throughput of about 14.5 million tons. Classified into

six categories as shown in Fig. III-3-9, only a general cargo export shows a slight decrease during the period of 1974 – 79, but this is compensated by the increase of general cargo import to keep a total volume of general cargo at the same level. All other export/import cargoes show an increase, and among others a liquid bulk cargo shows a constant increase of about 0.5 million tons per year.

3-3-2 Number of ship's call

Number of vessels called Karachi Port is shown in Table III-3-13 and Fig. III-3-10. Ships are categorized in the same way as in the previous section and their berthing positions are given by month. A sharp increase of ship's call comes out in 1975 and continues upto 1978 at an average annual increase rate one hundred vessels to reach the total ship's call of about 1750 in 1978. Then in 1979 it decreases by about one hundred ships, eighty freighters and twenty bulkers. This is clearly explained by figures in Table III-3-14. As shown in the table, tonnages of cargoes per freighter increase from 2,393 tons in 1978 – 79 to 3,036 tons in 1979 – 80. Number of freighters called in 1979 decreases despite the increase of tonnage hundled due to an increased tonnage per ship, and samething applies for tanker.

The characteristics of ship size are illustrated in Fig. III-3-11 and it is shown that a majority of ships calling Karachi is of LOA less than 500' except for crude oil, fertilizer and container carriers.

3-3-3 Container traffic

Statistics of container traffic are given in Table III-3-15 and Fig. III-3-12. As shown, the volume of cargo increases in geometrical progression, and in terms of TEU, it is reported that a total of 40,000 containers were handled in 1979 – 80. It should be noted that the numbers of export and import containers are almost balanced, the fact which is an advantageous condition for an introduction of containerization. According to the statistics in 1979 – 80, the containers are composed as follows:

	20'	40'	Total
Loaded	17820	14376	32196 (TEU)
Empty	6555	1384	7939 (TEU)
Total	24375	15760	40135

The ship berthed alongside East Wharf can handle containers and break bulk cargo at the same time. However, the ship at the West Wharf Nos. 22, 23 and 24, allocated as the priority berth for container ship, is permitted to handle container only. Container crane is not provided at any berth, therefore, all containers have to be loaded/discharged to/from vessels by using ship's cranes.

About 10 shipping lines are allocated space at berth No. 6, M.I. Yard and berth No. 24 where export cargo is stuffed and empty containers are stored. Import containers are carried by trailers to the adjacent shed allocated by KPT. Then the contents are unstuffed and stored in the shed.

Two shipping lines are handling containers on their own barges which are just like their CFS and vanpool.

3-3-4 Port congestion

A remarkable change of port congestion is illustrated in Fig. III-3-13 and detailed in Table III-3-16. Early in 1980, a waiting time of ship decreases for both bulker and liner.

This sharp decrease of waiting time is explained to be due to various reasons such as an incentive scheme, a reinforcement of capacity of road transportation, an improvement of cargo flow in warehouse, etc. A heavy port congestion experienced till 1980 has been suddenly removed. It is shown that an average waiting time is reduced from about 10 days in 1977 – 79 to about one day in 1980. The port condition after March in 1980 become quite reasonable.

Interesting and significant characteristics can be extracted from Table III-3-16 by comparing port conditions after March 1980 with conditions during other period. The comparison is given below,

	No. of Ship's Call at Clear Berth	Average Waiting Time	Average Operation Time	Average Cargo Handled/ Ship/Hour
1977–78	1026	203 hrs.	190.0 hrs.	39.6 t/ship/hr
1978–79	1262	233	173.1	49.8
1979–80	1614	22	118.25	67.9*

(* proportionated from data in Mar.–June 1980)

It is clearly shown that an increased cargo handling productivity gives a rise to a sharp reduction of ship waiting time though accompanied by an increased number of ships handled at the clear berths.

3-4 Cargo handling

3-4-1 Cargo handling method

Present conventional cargo handling methods are shown as follows:

(1) Import general cargo

The cargo unloaded from the ship is transported to the transit shed or the open plinth allocated by KPT and is kept there for delivery. Some goods are directly delivered to the consignee's truck or railway wagon. The goods, unloaded to the barge, land on the lighterage wharf and are carried and stored in the shed until time for delivery.

(2) Import wheat and fertilizer

The wheat is unloaded in bulk from the ship onto the wharf through the vacuators and then packed in bags for transportation to MINFA warehouse.

The fertilizer is unloaded after being bagged in the ship's hold, and is directly delivered to the railway wagon or the truck.

(3) Export general cargo and rice

Usually general cargo is directly transported alongside the ship by the shipper's truck for loading on board.

The rice is also directly transported alongside the ship from RECP godown warehouse for loading on board.

The workers registered by the KDLB are in charge of unloading to the wharf or the barge from the ship's hold and loading in the reverse order, or stacking import cargo in KPT's shed.

KPT's workers are responsible for operation of the quay crane to be used for loading/unloading cargo to/from the ship, transfer of import general cargo from the ship's side to the transit shed or the open plinth, transfer of longer retained import general cargo from the transit shed to the central warehouse, and care of import general cargo until its delivery to the consignee.

Other work is carried out by the workers arranged by the contractor of the shipping lines, the shippers or the consignees.

Then, the actual container handling method is as follows:

1) Operation at the container park in the port area.

Some 10 shipping lines rent from KPT the container park of approx. 20 acres in the M.I. yard north side, in the hinterland of the berth No. 6 and the berth No. 24.

The export cargo is received from the shipper in the container park and stuffed into the container, and then is transfered by the trailers or the hustlers to the ship's side to be loaded by the ship's crane. Some export cargoes on the shipper's premises are stuffed into the container, which is carried into the container park for loading.

After temporary storage in the container park, the import container is transported to the proximity of the shed allocated by KPT and is unstuffed there for delivery to the consignee via the shed. Some import containers are directly taken out with goods stuffed in from the container park to the consignee's premises.

The empty containers unloaded from the ship, or those empty after unstuffing import cargo, are stored in the container parks.

As a site for future container handling, KPT has created a reclaimed land in Keamari Groyne and remodelled a part of the hinterland of the berth No. 5 to heavy pavement for use of container handling equipments. After completion of the above construction scheduled for end of March in 1982, container operation is planned in the general cargo plinth (5.2 acres), the shed (4.6 acres) and the container park (32.7 acres) in the reclaimed land of Keamari groyne, the

hinterland of the berth No. 5 and the MI yard, north and south side.

The spaces can provide a container handling capacity of about 100,000 units (150,000 TEU) per year, which will be sufficient until the completion of the Urgent Plan.

The allocation of space at the KPT container park is proposed as follow; The space of the M.I. yard be divided into seven parts, six of them leased for management by bonafide shipping lines or agents who must be regular callers at the port, and the remaining one lot allocated as a common user area where containers of random caller vessels be handled there by paying the rate of the comprehensive fee per slot; the space at the Keamari Groyne be divided into six parts and all be leased to aspiring shipping lines or agents, in the hinterland of Berth No. 5, containers of random caller vessels be handled under the direct management of the KPT.

According to the hearings with the shipping lines and agents, they are under obligation to employ 24 workers registered by KDLB per hook for container loading/unloading to/form the ship and 8.5 KDLB workers per container for cargo stuffing/unstuffing into/from the container.

As the container is not included in the items covered by the incentive overtime scheme, and loading/unloading operation efficiency is quite low due to placement of crane drivers who are different each time under the roster system, they have the ship's crew or private workers under contract with the stevedore company operate the ship's crane. Regarding stuffing/unstuffing cargo into/from the container, it is badly reputed that the damage ratio is higher and the cargo stuffing factor is low despite high productivity for the items covered by the incentive overtime scheme.

2) Container operation by the barge

Two shipping lines handle container on their own barges as container freight stations or van pools. The container is unloaded to a hatch type barge of 500 – 600 ton capacity by the ship's crane, in two tiers, and in such a manner that a space can be secured to open a container door. Then, the import cargo is unstuffed from the container by use of a gap between the containers, and the export cargo is stuffed into the container which is loaded to the ship by the ship's crane.

3) Private container freight station (CFS)

In the reclaimed land of Chinna Creek, adjacent to the timber pond, a container freight station of 2.3 acres was constructed by a shipping agent and put in operation from June 1981.

In this CFS necessary customs clearance precedures are prosecuted all 24 hours of the day in parallel with unstuffing import cargo from the container or stuffing export cargo into the container for bonded transport between the CFS and the East or West Wharf of Karachi Port. Containers and containerized cargo meant for Afghanistan and transhipment goods for other ports or Dry Port Lahore, and dangerous cargo, shall not be allowed to be taken to this CFS.

When the team visited the CFS in August 1981, three shipping lines were using it as a place for container stuffing and unstuffing of loose cargo, and a container lease company engaged in the lease in and out of containers.

Many similar private CFSs must be established outside the port area to be able to enjoy the merits from the rationalization of transportation of trade goods through containerization, and increase the use efficiency of the container terminal in future.

Table III-3-1 Number of Officers & Employees of KPT
(As of 30 Dec. 1980)

Division	Officers	Employees	Total
DIVISION			
Operation	2	8	10
P. & D.	28	584	612
Engineering	2	8	10
Finance	2	8	10
Administration	2	8	10
DEPARTMENT			
Chief Engineer	25	1,400	1,425
Chief Mech. & Elect. Eng.	45	3,694 75 (Daily Wages)	3,814
Traffic Manager	32	2,790 1,037 (Daily Wages)	3,859
Deputy Conservator	35	1,213 2 (Daily Wages)	1,250
Chief Accounts Officer	25	336	361
Chief Accounts Officer (C)	4	68	72
Finance	3	14	17
Audit	3	58	61
Chief Medical Officer	20	656	676
Estate	5	108	113
Personnel	4	21	25
I. R. & W.	8	88	96
Stores	8	244 2 (Daily Wages)	254
Watch & Ward	6	1,150	1,156
O. & M.	7	27	34
Training & Education	9	204	213
M. S. & C.	9	27	36
Secretary	8	177	185
Port Civil Defence Office	1	5	6
Total	293	14,012	14,305

Source: KPT

Table III-3-2 Financial Statement

Income & Expenditure Account

(Unit: Million Rs)

	1975–76	1976–77	1977–78	1978–79	1979–80
Operating Incoem	277	295	325	332	623
Less Dept. Expenditure	167	167	198	323	328
Net Operating Income	110	128	127	9	295
Less Depreciation	32	36	37	39	42
Interest	22	26	33	42	48
Bad Debts	5	3	5	5	4
Net Operating Surplus	51	63	52	(77)	201
Add. Miscellaneous Income	37	33	46	43	33
Surplus	88	96	98	(34)	234

Balance Sheet

(Unit: Million Rs)

	1975–76	1976–77	1977–78	1978–79
Assets				
Fixed Assets	939	1,063	1,157	1,321
Land	15	15	15	15
Net Fixed Assets	793	820	796	793
Work in Progress	131	228	346	513
Investment	301	328	332	325
Net Current Assets	101	85	123	(5)
Capital Employed				
Capital Fund	5	10	16	30
Long-term Loan	284	315	353	398
Other Reserves	1,052	1,515	1,243	1,212
Total	1,341	1,476	1,612	1,640

Table III-3-3 Current Tariff

(Unit: Rs)

Cargo Handling		
Wharfage (per tonne)		Tariff
Wheat (imp)		4.0
Rice (exp)		3.2
Ferti & PhosRock (imp)		3.2
Cement (imp)		*14.5
General Cargo		33.0
Crude & Petroleum (imp)		7.2
" " (exp)		24.9
Residual Liquid (imp)		7.2
" " (exp)		4.1
CONTAINER Loaded		42.0
Empty		300.0 per unit
Hire of Equipment (per tonne)		
General Cargo		6.82
Bulk		3.82
Oil		0.08
(*CONTAINER–assumption for project)		(21.28)
Special Night Work, Holiday		
General Cargo		2.96
Bulk		1.66
Oil		0.04
(*CONTAINER–assumption for project)		0.80
Cargo Storage (per tonne)		
General Cargo (imp)		61.55
(*CONTAINER–assumption for project)		
(imp)		3.2 + 10 per day
(exp)		3.2 + 10 per day
Ship Movement & Services		
Pilotage		
Entering & Leaving	(NRT + on deck cargo MT) x Rs2	
Other	1,215.07/ship	
Use of Harbour Facilities		
Berthage	(NRT + on deck cargo MT) x Rs0.5	
Port Dues	(NRT + on deck cargo MT) x Rs3	
Others	1,130.01/ship	
Hire Services Supplied		
Ship Movement Tugs, etc.	9,113.00/ship	
Ship Services Supplied		
Water Supply	3,481.17/ship	

*Whafage for general cargo: The rate is shown as 16 Rs per tonne on the Gazette, but the wharfage includes surcharges in addition to the basic tariff.

Table III-3-4 Foreign Loans

(Currency in Million)

Particulars of Loans	Amount of Loan Sanctioned		Rate of Interest (%)	Withdraws		Principal Repayment		Term of Loan (Years)	Grace Period for Principal (Years)	Balance as on 30 Nov. 1980	
	Foreign Currency	Pak Rupees		Effected	Closed/ to Close	To Start/ Started	To Close			Foreign Currency	Pak Rupees
IBRD Loan No.376-Pak for 2nd Port Project	$15.778	152.301	5.50	15.9.1964	30.6.1977	1.4.1969	1.4.1989	24.5	4.5	$8.876	89.471
I.D.A. Credit No. 422-Pak for 3rd Port Project (Relent Loan)	$17.750	178.920	7.25	14.12.1973	30.6.1981	1.12.1983	1.6.2023	50	10	$17.400	175.393
I.D.A. Credit No. 492-Pak for 4th Port Project (Relent Loan)	$16.000	161.282	7.25	26.7.1976	31.12.1981	1.6.1979	1.12.1998	23	3	$11.968	120.639
French Credit 1976-77 for Over Run on 4th Port Project (Relent Loan)	F.F.57.500	132.914		5.7.1979	30.6.1981		2.004			F.F.38.637	89.309
State Credit	F.F.28.750	—	3.00	—	—		—	25	7	—	—
Bank Credit	F.F.28.750	—	8.80	—	—		—	10		—	—
French Credit 1977-78 for Over Run on 3rd Port Project (Relent Loan)	F.F.2.135	—	—	28.9.1980	—	—	—	—	—	F.F.0.079	—
15th N.I. Bank Loan 79-80 for 4th Port Project (Relent Loan)	D.FL.2.600	—	—	10.1980	—	13.12.1990	—	23	10	D.FL.2.600	—

(Source: K P T)

Table III-3-5 Channel

Name of the Channel	Length	Width	Sanctioned Depth	Remarks
Entrance Channel	12,830 ft. (3.9 km)	600 ft. (183 m)	40 ft. (12.2 m)	
Lower Harbour Channel	Approx. 10,700 ft. (3.3 km)	600 ft. (183 m)	37 ft. (11.3 m)	
Upper Harbour Channel	Approx. 11,400 ft. (3.5 km)	1,000 ft. (300 m)	34 ft. (10.4 m)	

Table III-3-6 Port Facility (KPT)

Berth No.	Length (ft.)	Sanctioned Draft (ft.)	Transit Shed Area (sq.ft.)	Transit Plinth Area (sq.ft.)	Remarks
EAST WHARVES					
No. 1	505 ft.	30 ft.	–	82,000	Berth designed for 34 ft. depth.
2	500 ft.	30 ft.	56,000	–	– do –
3	550 ft.	30 ft.	–	–	– do –
4	500 ft.	30 ft.	–	62,000	– do –
5	484 ft.	28 ft.	–	49,000	
6	550 ft.	28 ft.	100,000	–	
7	484 ft.	28 ft.	–	81,000	
8	550 ft.	31 ft.	100,000	–	
9	484 ft.	34 ft.	–	70,000	
10	484 ft.	34 ft.	–	45,000	
11	550 ft.	34 ft.	100,000	–	
12	484 ft.	34 ft.	–	84,000	
13	550 ft.	34 ft.	100,000	–	
14	484 ft.	34 ft.	–	66,000	
15	484 ft.	34 ft.	–	54,000	
16	550 ft.	34 ft.	100,000	–	
17	484 ft.	34 ft.	–	77,000	
WEST WHARVES					
No. 18	550 ft.	32 ft.	111,000	–	
19	550 ft.	34 ft.	105,000	–	
20	600 ft.	34 ft.	–	110,000	
21	625 ft.	34 ft.	116,000	–	
22	600 ft.	32 ft.	–	170,000	Berth designed for 38 ft. depth.
23	700 ft.	32 ft.	113,000	–	– do –
24	500 ft.	32 ft.	–	88,000	– do –
JUNA BUNDER					
No. 1	490 ft.	30 ft.	–	67,000	Under construction
2	537 ft.	30 ft.	67,000	–	– do –
3	537 ft.	30 ft.	67,000	–	– do –
4	532 ft.	30 ft.	–	64,000	– do –
OIL PIERS					
No. 1	403 ft.	32 ft.			22,000 tons Tanker
2	664 ft.	32 ft.			– do –
3	1,000 ft.	32 ft.			32,000 tons Tanker
4	1,000 ft.	32 ft.			Designed for 75,000 DWT Tanker

YEAR OF CONSTRUCTION

Berths No. 1 to 4 – 1975
Berths No. 5 to 17 – 1964
Berths No. 18 to 21 – 1930
Berths No. 22 to 24 – 1973
Juna Bunder Berths – 1981

Table III-3-7 List of Cargo Handling Equipments Owned by KPT

Type of Cargo Handling Equipment	Total Nos on Stock
Quay cranes (2 tons)	38 units
" (3 tons)	60 "
" (25 tons)	1 "
" (30 tons)	1 "
Floating cranes (125 tons)	1 "
" (60 tons)	1 "
Cargo barges (250 tons)	17 "
Dangerous good and explosive barges (50 tons)	2 "
(200 tons)	1 "
(From KPT year book 1979–1980)	
Shunting tractors	12 units
Motor trucks	28 "
Towing units	160 "
Fork lifts	74 "
Mobile cranes (3 tons)	84 "
" (10 tons)	2 "
Trailors (3 tons)	850 "
" (10 tons)	150 "

(From quarterly statement showing the state of cargo handling equipment of traffic department on September, 30, 1980)

Table III-3-8 Cargo Handling Vehicles out of Action

Type of Vehicle	Total Nos on Stock	Out of Action	
		Nos	Percentage
Shunting tractors	12	3	25.0%
Motor trucks	28	6	21.4
Towing units	160	71	44.4
Fork lifts	74	37	50.0
Mobile cranes (3 tons)	84		
(10 tons)	2	12	14.0
Trailors (3 tons)	850	435	51.2
(10 tons)	150	100	66.7

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(From quartery statement showing the state of cargo handling equipment of traffic department on September, 30, 1980)

Table III-3-9 Container Handling Equipment used by Shipping Lines

Type of Equipment	Total Nos on Stock	Nos of Equipment being Imported
Fork lifts (35 tons)	1 unit	
" (30 tons)	1	
" (15 tons)	1	
" (3 tons)	1	
" (2.5 tons)	3	2 units
40' spreader		1
Trucks (20')	2	
Prime movers	5	1
Chassis (20')	30	
(40')	65	2
Hustlers	2	
Generator sets		12

Others: All equipment i.e. mobile cranes and trailors are hired from local market.

Table III-3-10 Pakistan's Exports and Imports Handled at Karachi Port by Types of Cargoes during the Years 1974–75 to 1979–80

('000 M/T)

Types of Cargo	1974-75			1975-76			1976-77			1977-78			1978-79			1979-80		
	Exp.	Imp.	Total	Exp.	Imp.	Total	Exp.	Imp.	Total	Exp.	Imp.	Total	Exp.	Imp.	Total	Exp.	Imp.	Total
1. Bulk, Liquid	311	4,074	4,385	382	3,753	4,135	648	4,111	4,759	1,212	4,987	6,199	1,297	5,448	6,745	1,302	6,046	7,348
2. Bulk, Dry	941	2,005	2,946	894	2,107	3,001	924	987	1,911	806	1,661	2,467	1,008	4,384	5,392	1,202	2,852	4,054
3. General Cargo Dry	1,052	1,692	2,744	1,116	1,745	2,861	802	2,000	2,802	822	2,077	2,899	733	2,032	2,765	894	2,361	3,255
Total:	2,303	7,771	10,074	2,392	7,605	9,997	2,374	7,098	9,472	2,840	8,725	11,565	3,038	11,864	14,902	3,398	11,259	14,657

(Source: KPT)

Table III-3-11 Pakistan's Exports by Major Commodities Handled at Karachi Port during the Years 1971–72 to 1978–79

('000 M/T)

Commodities	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
Bones	20	17	20	21	11	8	9	7
Cement	535	528	710	491	99	13	—	—
Cotton	274	227	70	200	123	23	102	56
Cotton Yarn	—	50	94	56	82	11	7	9
Fish	27	35	37	10	20	11	7	5
Foodgrain (Other than Rice)	4	60	141	19	15	62	59	34
Leather	—	6	9	5	10	6	4	3
Hides & Skin	24	14	4	5	3	1	1	1
Marble Stone	7	7	4	7	16	9	6	9
Molasses	77	98	128	159	129	170	429	416
Oil Cakes	34	52	17	20	102	50	37	42
Petroleum Products	635	719	654	311	381	478	783	881
Ores	40	15	22	6	18	15	3	—
Rice	185	772	516	450	796	910	806	1,008
Rapeseed	13	26	52	35	15	56	82	62
Salt	33	8	1	2	1	1	2	—
Seeds (Other than Rapeseed)	6	19	14	19	24	30	4	4
Sports Goods	4	5	5	5	4	3	2	3
Textiles	231	245	103	63	61	35	23	30
Wool and Goat Hair	6	5	5	3	5	6	3	2
Other Cargoes	250	300	489	410	477	476	471	466
Total:	2,505	3,208	3,095	2,303	2,392	2,374	2,840	3,038

Table III-3-12 Pakistan's Imports by Major Commodities Handled at Karachi Port during the Years 1971–72 to 1978–79

('000 M/T)

Commodities	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
Coal and Coke	112	75	77	75	38	57	57	58
Chemical	—	18	21	24	36	61	52	84
Fertilizer	198	404	729	313	317	510	578	1,400
Iron and Steel	388	480	370	579	401	476	589	463
Jute	—	36	52	56	53	61	36	41
Phosphate	19	66	—	11	35	26	58	136
Oils Minerals	3,568	3,623	4,010	4,074	3,753	3,766	4,697	4,990
Oils Edible and Tallow	78	68	164	199	272	345	291	458
Paper	—	21	44	65	31	53	52	67
Sugar	63	200	62	—	30	11	20	10
Tea	—	25	41	45	47	54	53	58
Timber	—	16	9	17	16	22	12	10
Wheat	726	1,380	967	1,435	1,445	394	967	2,161
Other Cargoes	823	709	922	878	1,131	1,262	1,263	1,928
Total:	5,975	7,121	7,468	7,771	7,605	7,098	8,725	11,864

Table III-3-13 No. of Ship's Call

For the Month of	Type of Vessels						
	Bulk		Gen. Cargo			Oil Tanker	Total
	Along-Side	Ab-Reast	Along-Side	Ab-Reast	Moor-ings		
1972-73							
July, 1972	2	—	38	40	—	11	91
Aug., "	11	1	50	36	—	19	117
Sept., "	6	—	28	22	1	14	71
Oct., "	10	1	34	35	—	16	96
Nov., "	11	3	21	42	—	15	92
Dec., "	15	8	32	41	—	15	111
Jan., 1973	13	1	39	37	3	20	113
Feb., "	13	—	31	26	—	16	86
March, "	17	3	37	30	—	17	104
April, "	16	3	34	20	—	28	101
May, "	18	4	37	34	—	22	115
June, "	10	3	26	25	—	16	80
Total:	142	27	407	388	4	209	1,177
1973-74							
July, 1973	9	1	32	28	—	12	82
Aug., "	13	4	31	23	3	20	94
Sept., "	14	—	35	30	—	22	101
Oct., "	16	2	32	20	—	22	92
Nov., "	13	2	40	26	—	16	97
Dec., "	17	5	50	25	—	21	118
Jan., 1974	29	1	31	17	—	22	100
Feb., "	27	—	34	27	—	22	110
March, "	11	3	53	27	—	15	109
April, "	16	—	65	12	—	22	115
May, "	12	3	44	35	—	26	120
June, "	13	1	51	26	—	22	113
Total:	190	22	498	296	3	242	1,251
1974-75							
July, 1974	8	1	54	9	2	21	95
Aug., "	8	—	63	8	—	24	103
Sept., "	2	1	14	4	—	6	27
Oct., "	7	3	53	11	—	17	81
Nov., "	10	—	62	21	—	19	112
Dec., "	8	1	54	32	1	25	121
Jan., 1975	15	6	58	22	—	22	123
Feb., "	14	3	32	24	—	19	92
March, "	8	4	54	34	—	18	118
April, "	12	3	59	30	—	17	121
May, "	8	2	55	31	—	18	114
June, "	10	—	43	33	1	19	106
Total:	110	24	601	259	4	225	1,225

Table III-3-13 No. of Ship's Call (Cont'd)

For the Month of	Type of Vessels						
	Bulk		Gen. Cargo			Oil Tanker	Total
	Along-Side	Ab-Reast	Along-Side	Ab-Reast	Moor-ings		
1975-76							
July, 1975	15	—	46	31	—	15	107
Aug., "	4	1	37	31	4	19	96
Sept., "	6	4	33	39	—	16	98
Oct., "	14	5	44	37	—	19	119
Nov., "	10	8	47	20	—	20	105
Dec., "	8	4	38	41	—	22	113
Jan., 1976	16	2	41	37	—	15	111
Feb., "	8	3	48	40	—	22	121
March, "	10	3	43	42	—	20	118
April, "	9	2	49	33	—	20	113
May, "	11	1	38	29	—	18	107
June, "	9	1	54	18	—	20	102
Total:	120	34	518	398	4	226	1,300
1976-77							
July, 1976	7	3	40	24	—	17	91
Aug., "	8	—	48	41	1	19	117
Sept., "	10	2	21	40	—	19	92
Oct., "	11	—	51	49	—	22	133
Nov., "	10	1	38	52	—	22	123
Dec., "	7	4	46	48	—	21	126
Jan., 1977	5	1	39	56	16	16	133
Feb., "	4	—	51	57	7	23	142
March, "	4	1	49	47	4	22	127
April, "	6	1	28	60	5	20	120
May, "	7	1	37	58	6	16	125
June, "	2	1	27	68	2	19	119
Total:	81	15	475	600	41	236	1,448
1977-78							
July, 1977	10	1	40	34	1	20	106
Aug., "	7	2	47	36	4	18	114
Sept., "	5	1	37	32	3	16	94
Oct., "	10	3	48	41	2	24	128
Nov., "	9	—	47	43	1	20	120
Dec., "	9	—	61	44	4	25	143
Jan., 1978	11	1	55	37	3	22	129
Feb., "	19	1	56	36	4	24	140
March, "	19	4	62	37	6	22	150
April, "	18	4	56	35	4	20	137
May, "	19	3	59	40	8	22	151
June, "	14	2	52	43	11	23	145
Total:	150	22	620	458	51	256	1,557

Table III-3-13 No. of Ship's Call (Cont'd)

For the Month of	Type of Vessels						
	Bulk		Gen. Cargo			Oil Tanker	Total
	Along-Side	Ab-Reast	Along-Side	Ab-Reast	Moor-ings		
1978-79							
July, 1978	14	1	50	30	5	22	122
Aug., "	14	2	54	30	10	22	132
Sept., "	21	1	69	36	8	24	159
Oct., "	20	—	69	36	8	22	155
Nov., "	20	1	59	24	3	23	130
Dec., "	25	4	61	33	14	22	159
Jan., 1979	33	7	55	30	7	22	154
Feb., "	26	12	49	20	8	28	143
March, "	29	6	62	26	7	31	161
April, "	23	8	68	23	17	26	165
May, "	25	6	65	22	10	23	151
June, "	13	6	52	27	8	21	127
Total:	263	54	713	337	105	286	1,758
1979-80							
July, 1979	15	3	54	29	5	33	139
Aug., "	14	3	44	23	5	25	114
Sept., "	27	4	62	22	7	23	145
Oct., "	15	7	70	25	4	21	142
Nov., "	20	8	55	11	6	22	122
Dec., "	23	1	78	12	1	26	141
Jan., 1980	28	4	78	7	3	17	137
Feb., "	28	—	74	1	—	22	125
March, "	29	1	99	4	2	23	158
April, "	19	—	90	5	2	22	138
May, "	21	—	83	6	6	28	144
June, "	18	4	83	12	4	23	144
Total:	257	35	870	157	45	285	1,649

Table III-3-14 Average Tonnage Handled per Ship

Type of Cargo	1974-74	1975-76	1976-77	1977-78	1978-79	1979-80
Liquid Bulk	19,488	18,296	20,165	24,214	23,583	25,782
Dry Bulk	21,985	19,487		14,343	17,009	13,884
General Cargo	3,175	3,109		2,567	2,393	3,036

Table III-3-15 Container Traffic Statistics

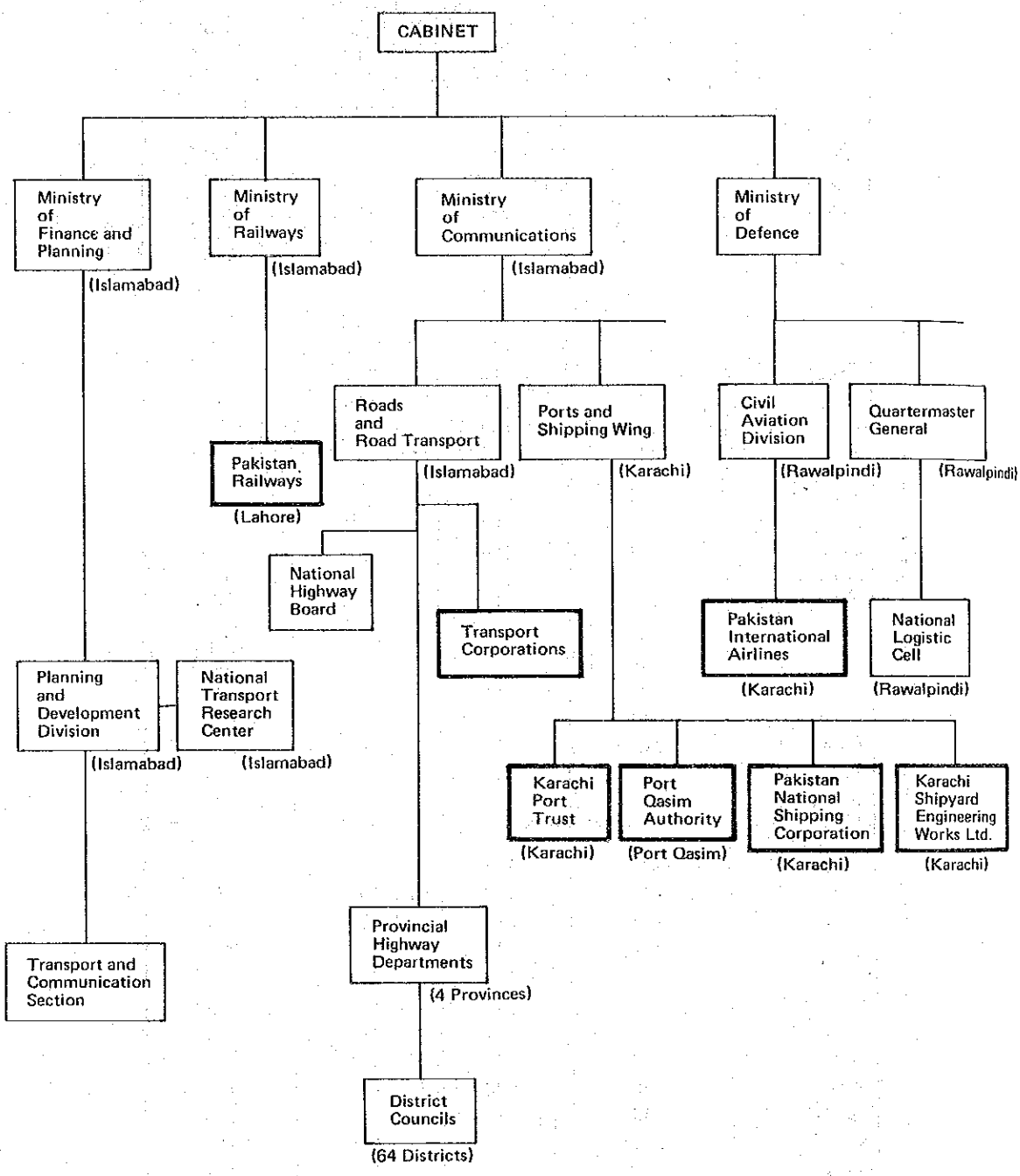
Year	No. of Ship Called	Export				Average Weight Ton/TEU	Import				Average Weight Ton/TEU	Total	
		20	40	TEU	Tonnage		20	40	TEU	Tonnage		TEU	Tonnage
1977	35	980 /	616 /	2,212 /	45,559	20.6	381 / 760	1,009 /	381 / 2,778	41,592	15.0	381 / 4,990	87,151
1978	61	2,391 /	1,288 /	4,967 /	101,542	20.4	419 / 1,582	1,624 /	419 / 4,830	73,107	15.1	419 / 9,797	174,649
1979	121	109 / 8,150	2,526 /	109 / 13,202	240,864	18.2	1,598 / 6,928	2,751 /	1,598 / 12,430	178,465	14.4	1,707 / 25,632	419,329
1979-80	—	1,753 / 9,597	467 / 3,486	2,687 / 16,569			4,802 / 8,223	225 / 3,702	5,252 / 15,627				
1980 (1-3)	21	2,361 /	57 /	2,475 /	35,013	14.1	555 / 1,478	37 /	555 / 1,552	19,081	12.3		

Note: Empty / Loaded

Table III-3-16 Average Waiting/Operation Time of Ship

For the Month of	Average Time Duration in Port			
	No. of Ship's Call	Waiting Time (Hours)	Operation Time (Hours)	Turn Round Time (Hours)
1977-78				
July, 1977	106	280	224	504
Aug., "	114	306	234	540
Sept. "	94	204	242	446
Oct., "	128	236	193	429
Nov., "	120	168	192	360
Dec., "	143	125	175	300
Jan., 1978	129	113	172	285
Feb., "	140	138	176	314
March, "	150	167	166	333
April, "	137	215	173	388
May, "	151	307	148	455
June, "	145	177	186	363
1978-79				
July, 1978	122	202	199	401
Aug., "	132	163	172	335
Sept., "	159	188	167	355
Oct., "	155	175	171	346
Nov., "	130	156	141	297
Dec., "	159	153	187	340
Jan., 1979	154	280	146	426
Feb., "	143	269	150	419
March, "	161	365	156	521
April, "	165	317	189	506
May, "	151	307	217	524
June, "	127	226	182	408
1979-80				
July, 1979	139	181	150	331
Aug., "	114	277	230	507
Sept., "	145	294	174	468
Oct., "	142	216	168	384
Nov., "	122	145	191	336
Dec., "	141	113	179	292
Jan., 1980	137	72	124	196
Feb., "	125	35	114	149
March, "	158	22	122	144
April, "	138	20	100	120
May, "	144	23	131	154
June, "	144	23	120	143

Fig. III-3-1 Administrative Organization Chart of Transport (As of 30 Dec. 1980)



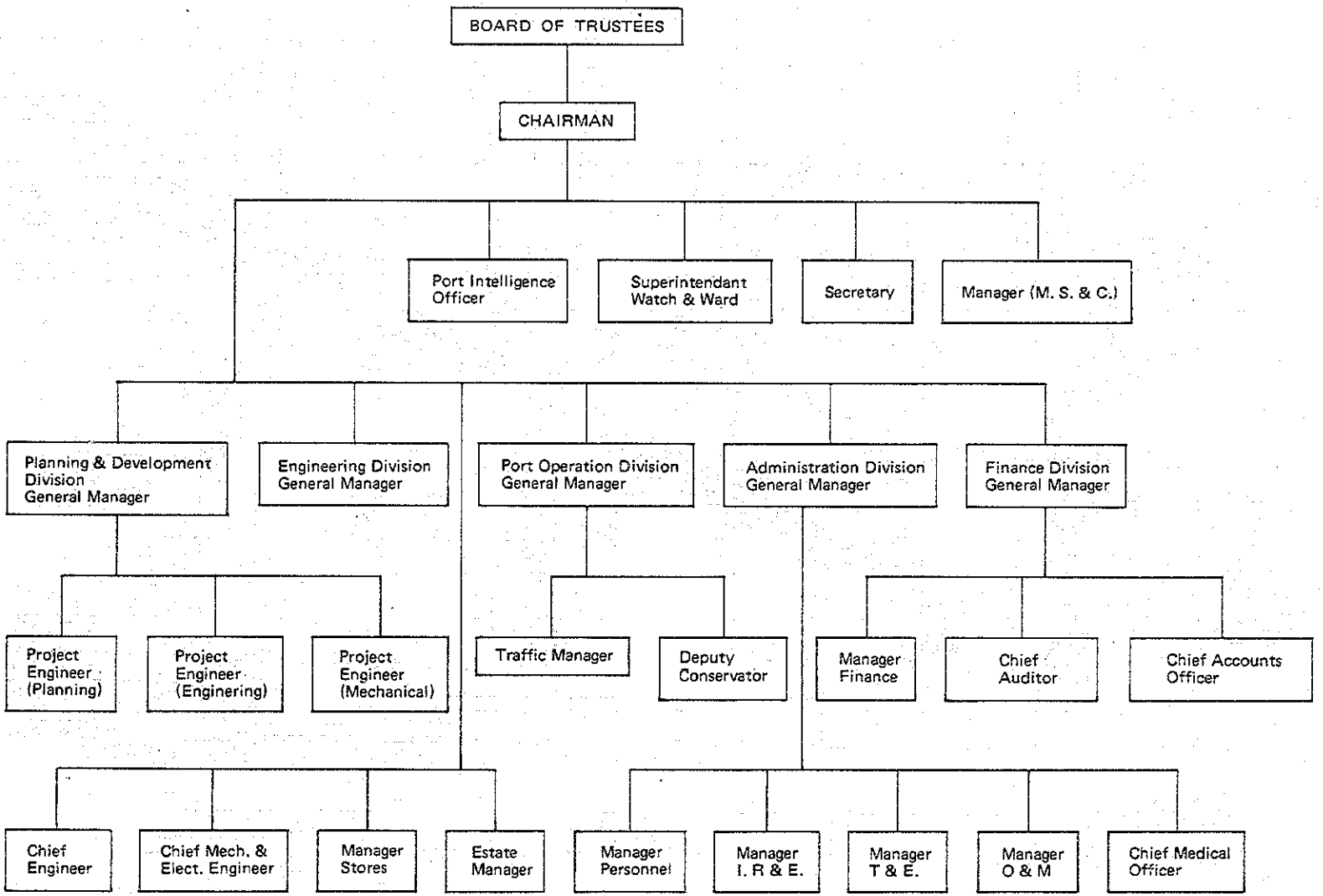
remarks:

Administrative organization and related organization

Public corporation

(Source: Ministry of Transport of the Japanese Government, Preliminary study for transport and economics in the region)

Fig. III-3-2 Organization Chart of KPT
(As of 30 Nov. 1980)



(Source : KPT)

Fig. III-3-3 Karachi Port East Wharf No. 1 ~ No. 4 Berth

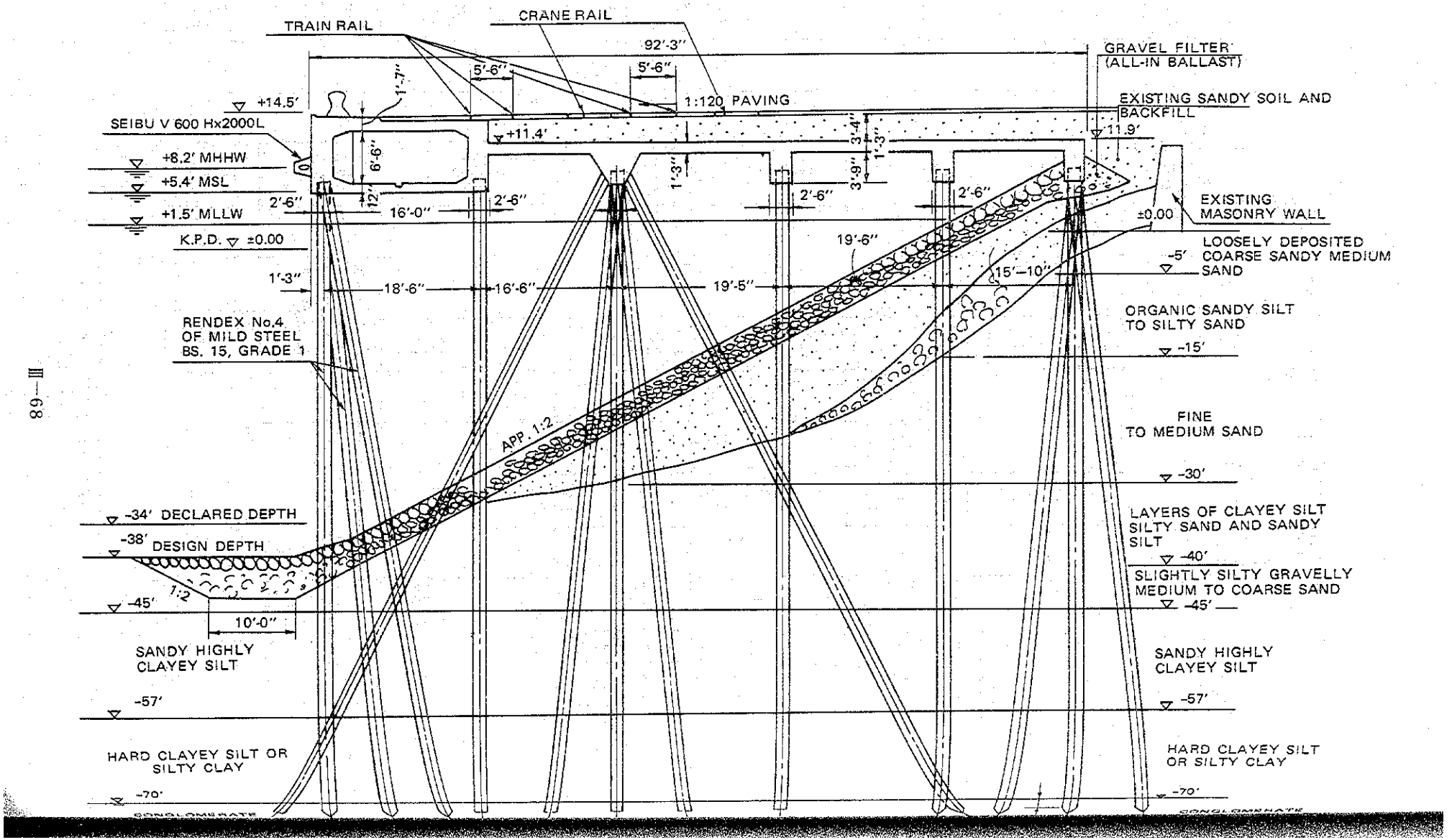


Fig. III-3-4 Karachi Port East Wharf – No.5 To No. 17. Quaywall Section

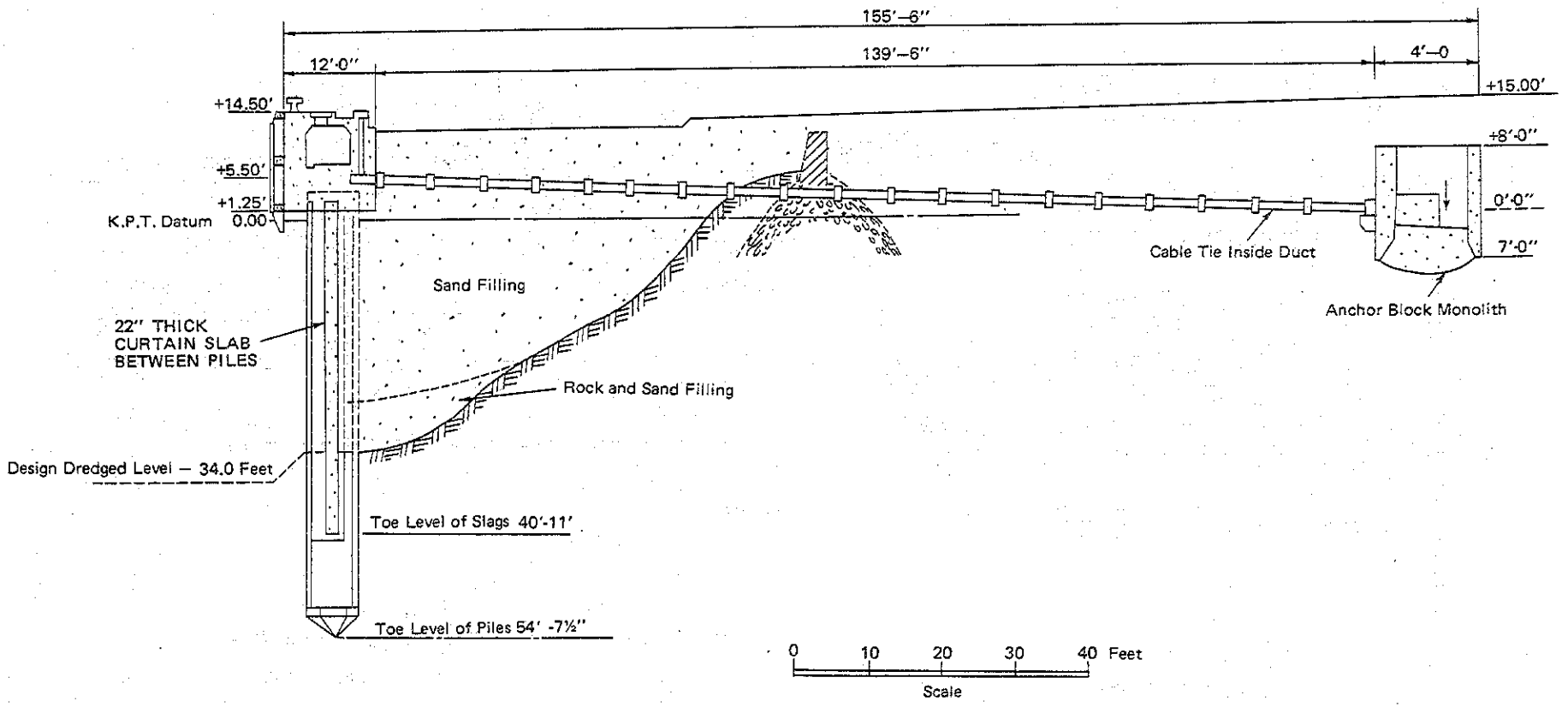


Fig. III-3-5 Karachi Port

Juna Bunder Berths Section (Standard Portion)

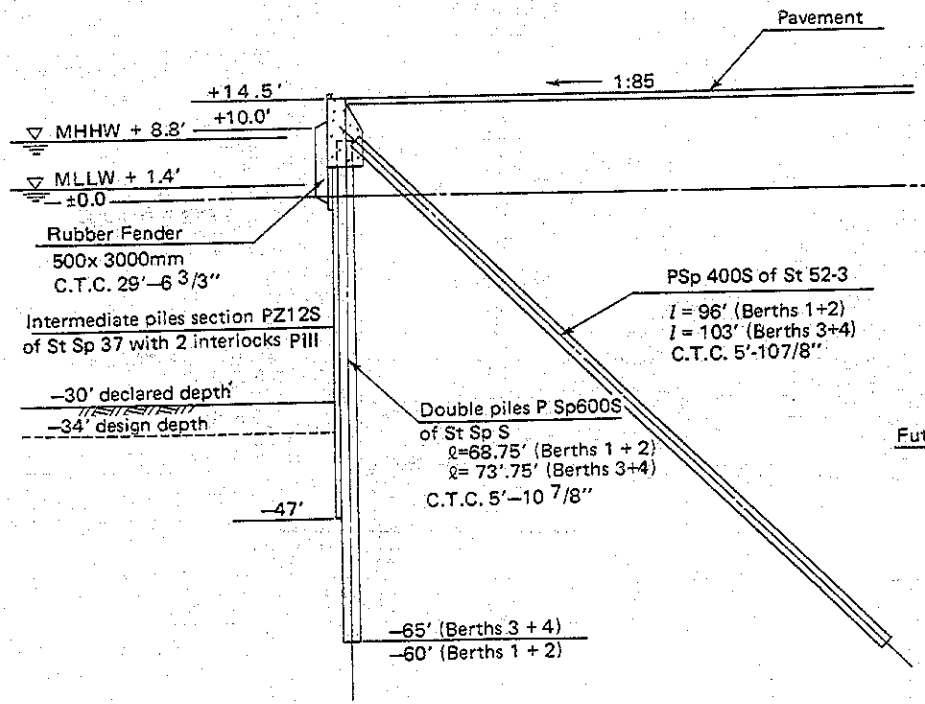
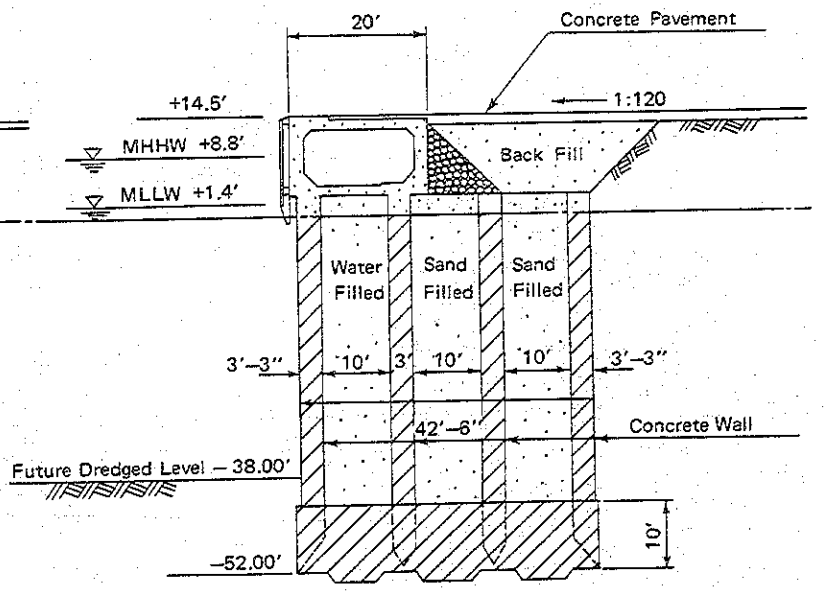


Fig. III-3-6 Karachi Port

West Wharf Quaywall Section



0 10 20 30 Feet

Scale

Fig. III-3-7 Karachi Port Keamari Groyne Embankment Protection

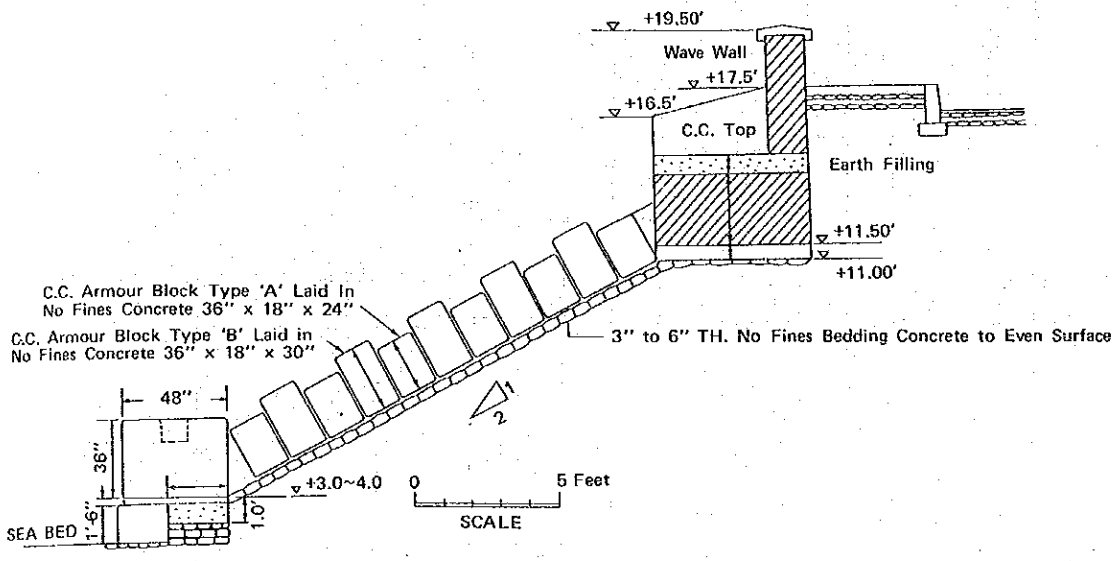


Fig. III-3-8 Manora Breakwater

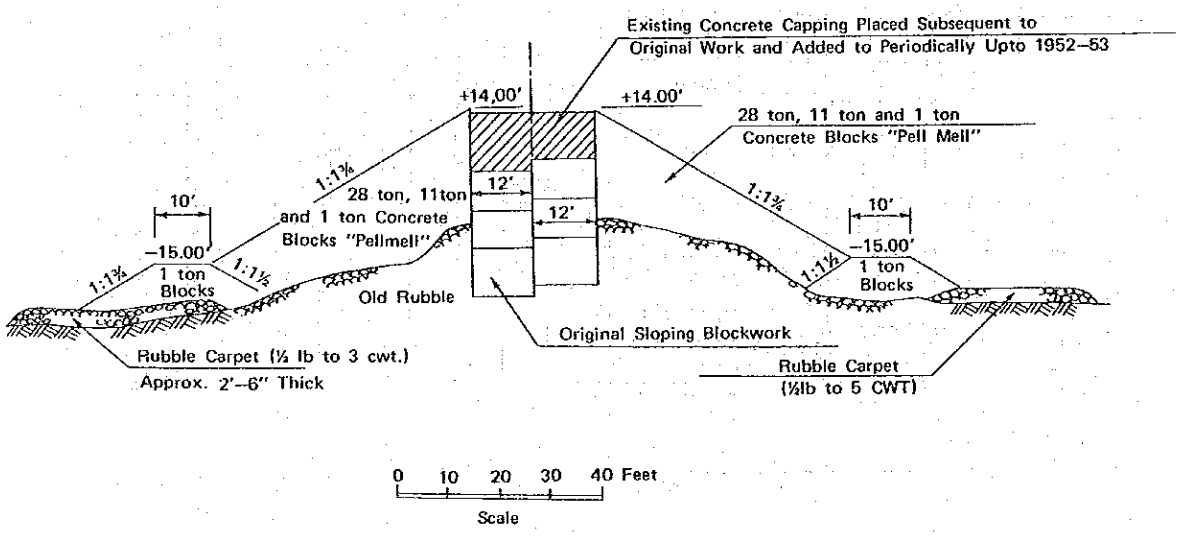


Fig. III-3-9 Exports and Imports Handled at Karachi Port

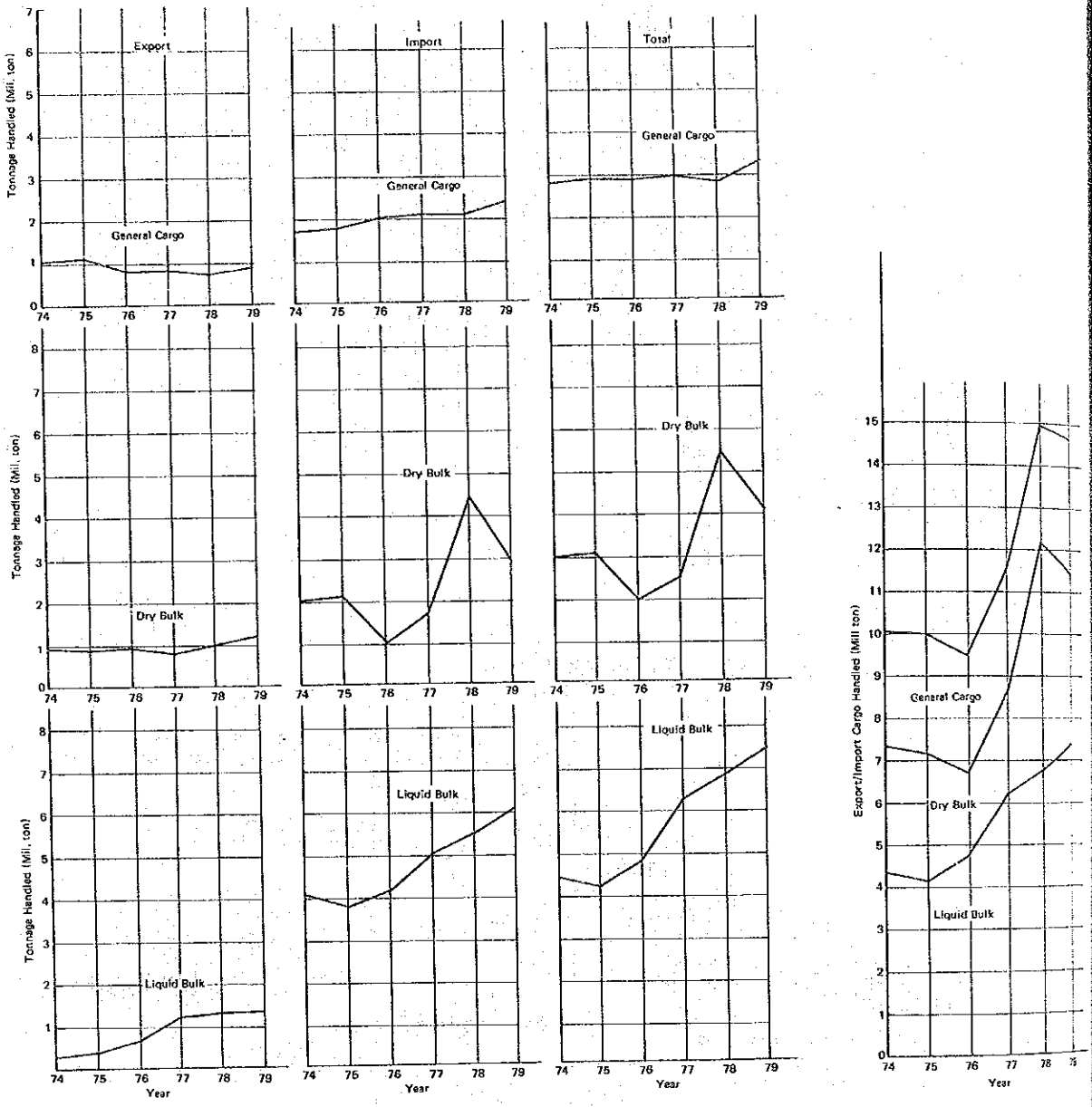


Fig. III-3-10 No. of Vessel Called

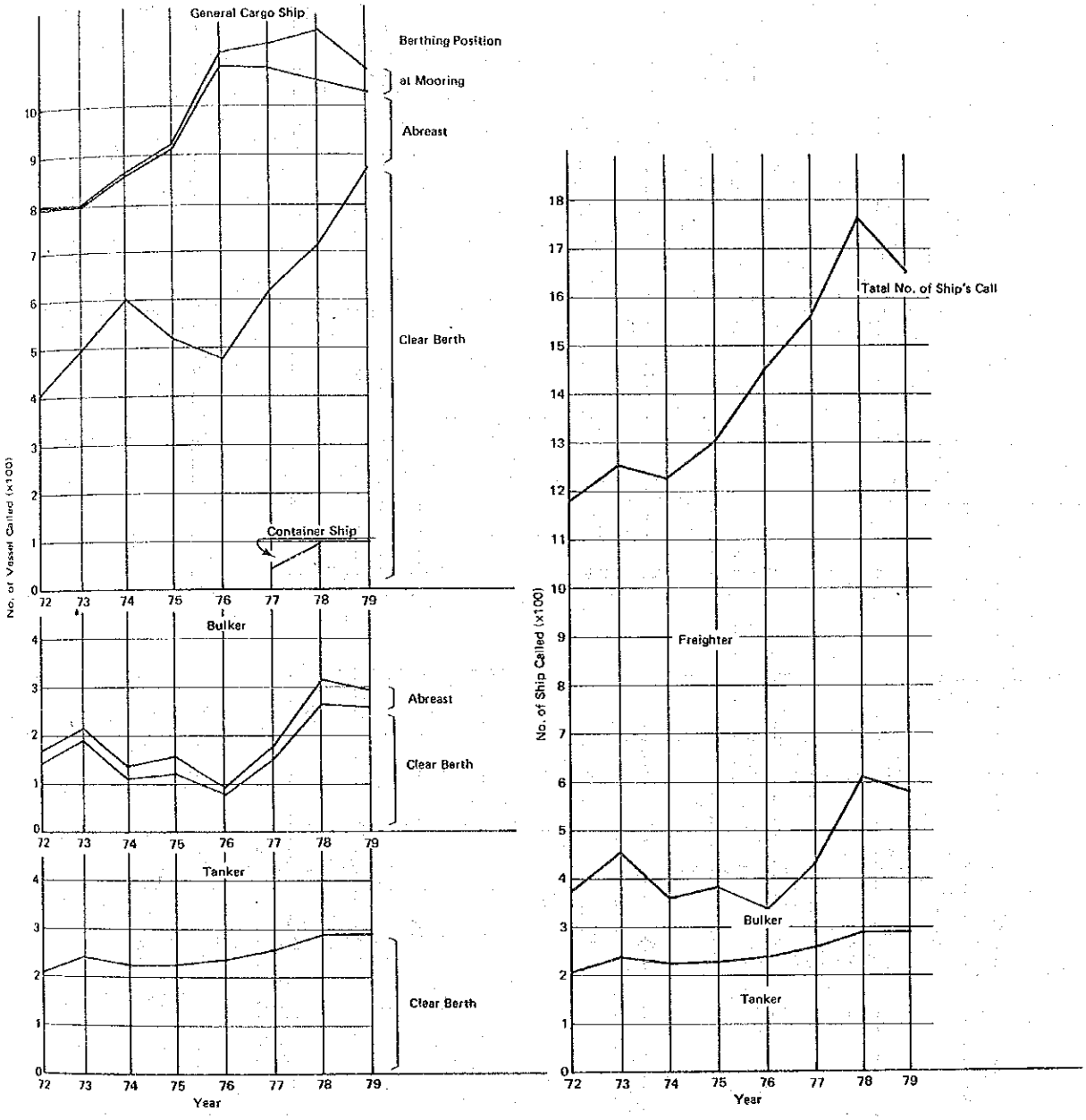


Fig. III-3-11 Ship Size Distribution by Commodity (compiled from ships called Karachi in 1980)

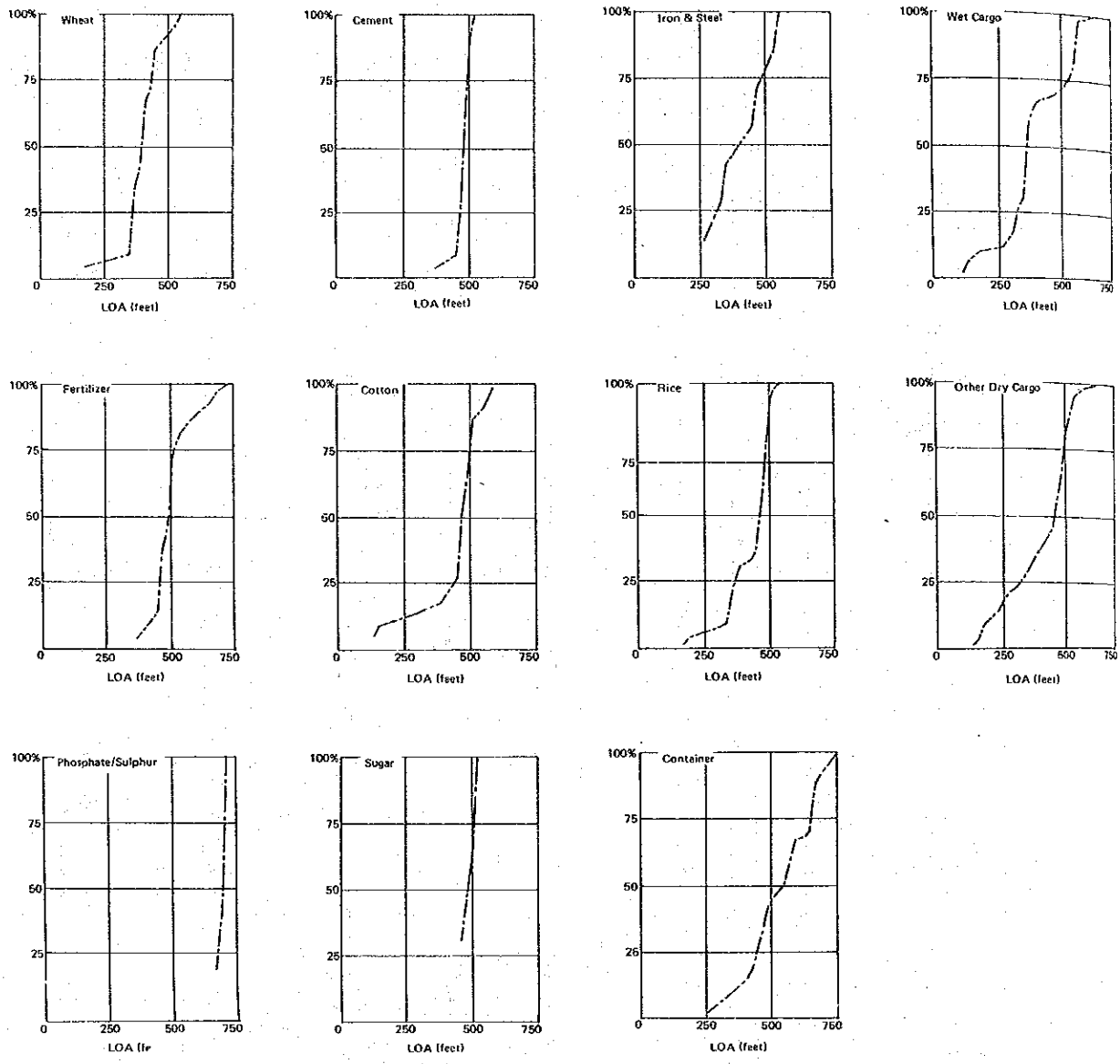


Fig. III-3-12 Container Traffic

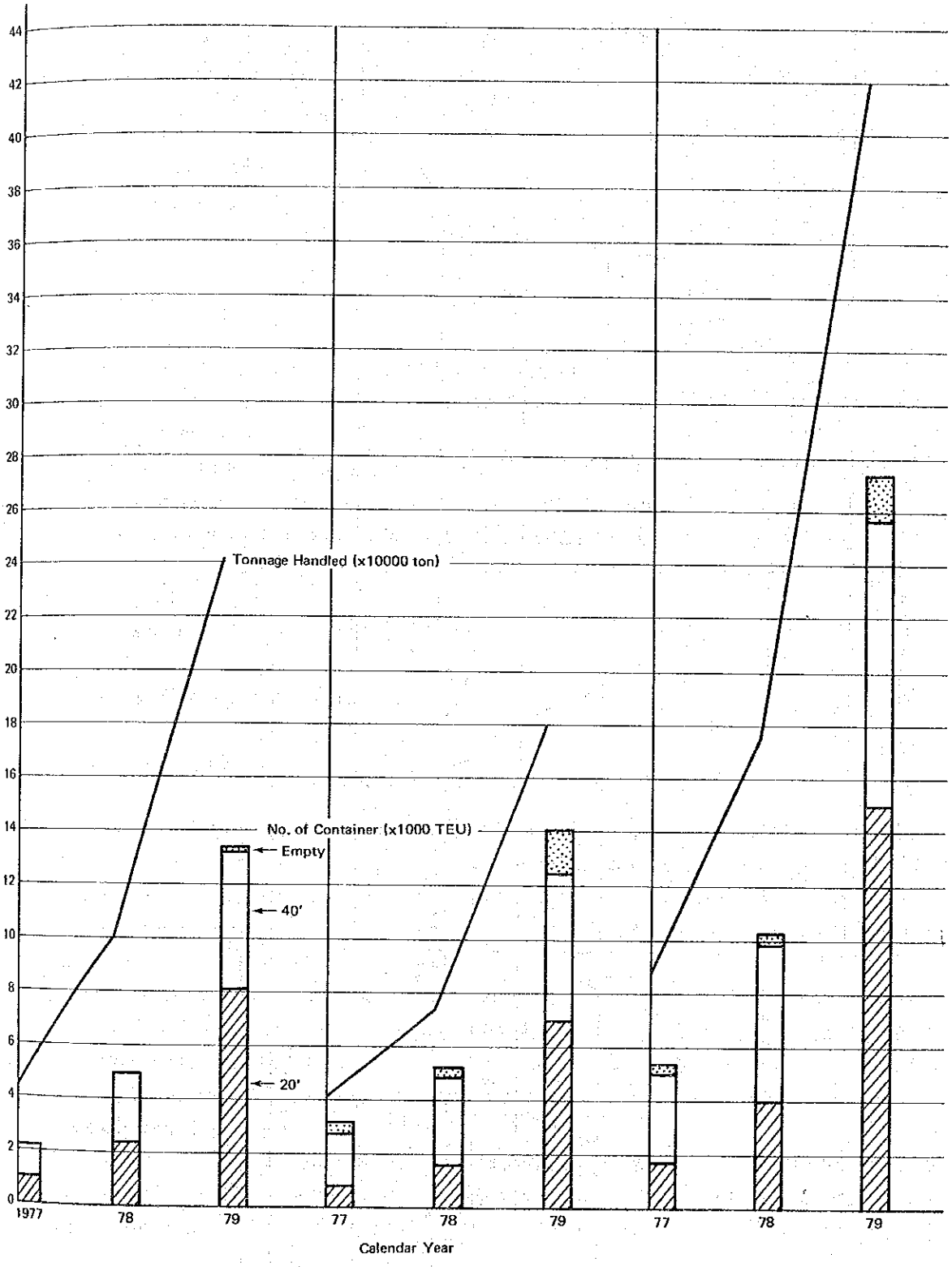
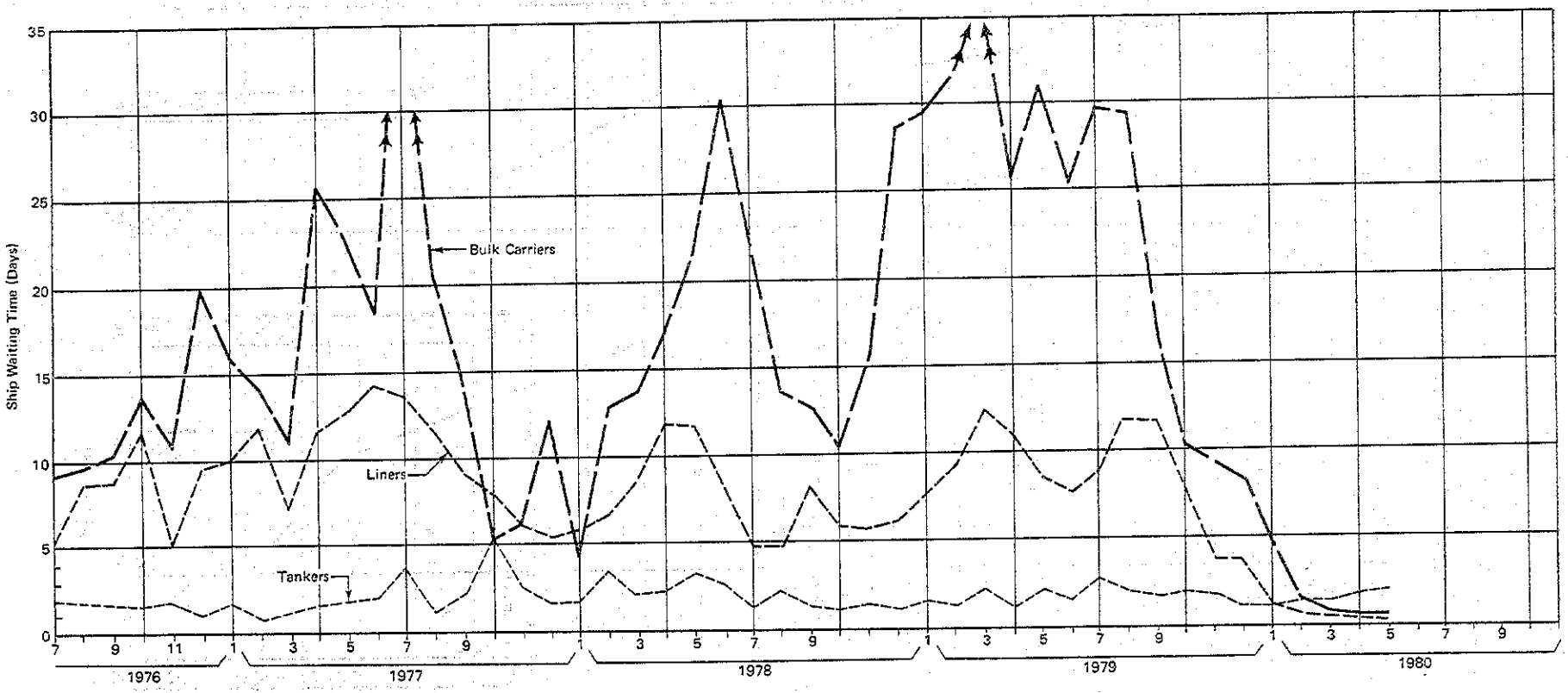


Fig. III-3-13 Ship Waiting Time-July 1976-May 1980



CHAPTER 4. DEVELOPMENT PLAN

4-1 Introduction

This chapter deals with the development plan for a full-fledged container berth to be constructed in Karachi Port. The future port expansion plan has already been examined in detail by KPT and the Western Backwater area was selected as an ideal site. The team reviewed the past studies from various aspects and found the Western Backwater area to be the most adequate among other alternate sites.

The layout and scale of container berth will be determined so as to cope with the future port traffic demand forecasted in PART I.

4-2 Basic courses

In formulating the development plan, followings are considered as basic courses:

1) The target year of the Master Plan is set as the year of 1999 – 2000, and 1987 – 1988 for the Urgent Plan.
2) A containerization, which is a world-wide prevailing trend of sea-borne transportation, shall be taken up as a imperative mean of expanding the port capacity.
3) The development plan in the present study is to deal mainly with the containerized cargo, container berths and related facilities. The other dry and liquid bulk cargos/berths are not to be studied in detail.
4) In designing port facilities, the Japanese standard of port engineering is adopted.

4-3 Required scale of container berth

4-3-1 Future port traffic

The volume of future port cargo is forecasted in PART I and is summarized in Table III-4-1 and Fig. III-4-1. As shown, the composition of commodities becomes different from that of the present one. This is due mainly to different growth rates of cargo as well as to the distorted composition of port cargo which was caused by a bad crop in 1977 – 78. Forecast of port cargo traffic is characterized as follows:

(1) The volume of export/import general cargo in 1999/2000 increases 2.43 times of that in 1979 – 80, this is remarkable if compared with the 1.93 increase ratio of total port cargo of.
(2) The share of general cargo over a total port cargo in 1999/2000 increase to 28% from 22% in 1979 – 80, on the contrary a dry bulk cargo decreases to 23% from 25%. The share of liquid bulk cargo remains constant at around 50%.

The volume of containerized cargo and the percentage of containerization are forecasted as summarized in Table III-3-2. Total export/import volume of containerized cargo is forecasted to increase rapidly from about 1.7 million tons in 1978 – 88 to 5.9 million tons in 1999 – 2000.

4-3-2 Required number of container berth

The required scale of new container terminal depends on various factors such as volume and unit weight of container cargo, 20'/40'container ratio, semi-/full-container ship ratio, cargo handling productivity, etc. These factors shall be determined in this section by referring to the past performance in Japan.

(1) Semi-/full-container ship ratio.

Table III-4-3 shows the share of container carrier by type recorded in Japanese container trade. Trade pattern in Pakistan is of course different from that in Japan, but as there are not enough shipping data, semi-/full-container ratio has been determined as below by referring the figures shown in Table III-4-3.

	1987/88	1999/2000
Semi-/Full-container Ship	20:80	15:85

The new container terminal is principally planned to be exclusively used by a full container ship, however a semicontainer ship may be accepted at the terminal so long as there is still extra room for a full-container ship.

(2) Composition of container cargo

The composition of container cargo of Japanese shipping company is indicated in Table III-4-3 and III-4-4. In this study, the container composition is determined as below by taking the actual records into consideration.

20'/40' (TEU) ratio	50 : 50
FCL/LCL ratio	60 : 40

The 20'/40' ratio is rounded from the actual figures. The FCL/LCL ratio of actual record is 68:32. Usually some of FCL cargo are sent to CFS and unstuffed in the same way as LCL cargo due mainly to lack of cargo handling equipment in consignee's premises. This procedure is taken into account to give the above figure of FCL/LCL ratio.

(3) Unit weight of container cargo

A handling capacity of gantry crane is determined by a number of container boxes rather than a weight of container cargo and therefore a unit weight of container cargo is a controlling factor for a cargo handling capacity of container berth. A unit weight of container depends on a density of each commodity and varies according to the cargo composition in each year. Table III-4-5 gives the unit weight of container for the target years of Urgent and Master Plans and import/export cargos respectively. Following figures are used as unit container weights by rounding off the results shown in the table.

	Unit Weight/TEU (in 1987/88 & 1999/2000)
Import	9 MT
Export	11 MT

Calculation is detailed in Appendix III-1.

(4) **Required number of container berth**

The number of container berths, which is required to handle the container cargo forecasted in PART I is calculated at six for the Master Plan by assuming the cargo handling productivity to be about one million tons/year/berth and is verified as below,

- Container cargo is to be handled by a full- & semi-container ship as below,

	by Full CTNR ship at New Terminal	by Semi CTNR ship at present port	Total
Export	2,256,750 tons	398,250 tons	2,655,000 tons
Import	2,737,850 tons	483,150 tons	3,221,000 tons

- Unit weight of container cargo is 11 tons/TEU for export and 9 tons/TEU for import.
- Thus, the total number of TEUs to be handled at the new container terminal is calculated as below,

Export	205,159	TEU/Year
Import	304,206	TEU/Year

- The above containers (TEU) are composed as below,

	Full	Transhipment Full & Empty	Empty Imbalance	Total
Export	205,159	304,206 ÷ 9	–	338,007
Import	304,206	304,206 ÷ 9	304,206–205,159	338,007
		Total:		676,014

- Number of containers discharged/loaded per ship is assumed to increase from about 300 TEU in 1979/80 to 600 TEU in 1999/2000. This is an average value at present in Japan, the composition of which is as follows:

Number of Containers/Ship (1999/2000)

	Loaded		Empty & Transhipment		Total
	20'	40'	20'	40'	
Export	96	47	56	27	226
Import	136	67	16	7	226
				Total :	452

- Ship operation time is calculated as below,

  Container handling time
  (2 gantry cranes/berth)
  Handling capacity 20 Nos./hr/crane
  Operation efficiency 75%
  452/ (20 x 2 x 0.75) = 15 hrs

  Total ship turnaround time is estimated at about one day including time for berthing/unberthing, quarantine, custom clearance, etc.
- Total number of ship's calls are calculated as
  676,014/600 = 1,127 ships/year
  1,127/6 = 188 ships/berth/year
- Berth occupancy is roughly calculated as below, assuming the working efficiency of berth at about 80%,

  188/(365 x 0.80) = 0.64
- For this figure of berth occupancy, ship waiting time is calculated by the queuing theory at about 1.5 – 3 hrs, and this is acceptable from the viewpoint of port service.

In the same way, two container berths are necessary to meet the traffic demand in the target year of 1987/88 for the Urgent Plan.

4-3-3 Container and cargo movement

Overall container and cargo movement is shown in Table III-4-6 and illustrated in Fig. III-4-2. The modal split on an inland transportation is based on the results described in PART II.

4-4 Facilities and equipment

4-4-1 Layout of the main facilities

The port container terminal, as the key station between sea and land transportation in the sea container transport system, must, of course, have various facilities spacious enough to handle large quantities of containers and cargoes efficiently and rapidly by the concerted operation of container ships, terminal cargo handling equipment, and road and rail transport vehicles. And

these facilities must be arranged so as to function as an organized whole.

A facility layout enabling all the functions of the terminal to be in full play, in keeping with the movement of containers and cargoes predicted for the target year, has been selected from among the different facility layouts that are generally used. (Fig. III-4-3, III-4-4 and III-4-5)

The required scale of the terminal for the Master Plan and the Urgent Plan is six berths (1800 x 570m) and two berths (600m x 570m) respectively, if the length of a berth for the mooring and container handling of a container ship is 300m and the depth of the terminal is 570m.

It is assumed that rubber-tired transfer cranes and rail-mounted transfer cranes shall be introduced respectively as the main container handling equipment for container yard operation and unit train operation. (See Chapter 4: 4-4-3 Selection of container operation system)

The arrangement of the main facilities from the container ship berth toward the depth direction of the terminal shall be: Quay and apron, container yard, administration and maintenance, trailer park, port road, truck park, container freight station (CFS), railway siding track for box wagons and railway siding track for unit trains. The administration and maintenance facilities shall be collectively installed at every two berths.

(Advantages)

a) The transfer of containers between the container ship and the container yard can be effected rapidly according to the operational plan without crossing on the same level with the railway siding track.

b) Trailers and trucks arranged for by shippers and consignees can have access to the container yard and the CFS without delay.

c) The utilization flexibility of facilities and equipment on continuous berths will be able to be enhanced.

d) The facilities, which load and unload the goods as packed in the containers to and from the railway, shall have a sufficient capacity to accomodate one unit train with all wagons coupled.

e) The depth of the entire terminal can be reduced by aligning the CFS where loose cargo, transported by road and rail, is handled.

The movement of containers between cargo transit areas, in which loose cargoes transported by both road and rail are stuffed, can be minimized.

Cargo transit areas, cargo handling equipment and workers at the CFS can be used effectively and as required.

f) Only tractors and chassis belonging to the terminal cross over the railway siding track for box wagons. Therefore, traffic control for tractors and railway wagons is easy.

(Disadvantages)

a) The container transfer distance between the container ship and the unit train is maximum. The direct load and discharge of containers between the container ship and the unit train by the container crane is impracticable.

b) This arrangement brings about a level crossing for every berth between railway wagons

transporting loose cargoes and trailers transporting containers to unit trains.

c) At the container freight station, the control of parking chassis and trucks in parallel, and the operation of handling of loose cargoes transported by road and rail at the same area, are complicated.

4-4-2 Facilities

The following is a description of the roles and scales of the main facilities:

(1) Quay

While import and export containers are exchanged by the container cranes between the container ship and the apron, the container ship is required to be moored in parallel to the quay wall. The characteristic of the container ship is as follows: She has a larger gross tonnage to the dead weight tonnage and a wider area receiving wind pressure, than the conventional cargo ship. The shape of her hull is streamlined for her high-speed navigation. Her mooring bitts are located only at her bow and stern because of stowaging containers on deck.

Therefore, many stronger bitts and fenders are required to be installed on the quay.

There must be pipe lines to supply fuel oil and fresh water to the container ship, telephone wiring and quay wall lighting.

(2) Apron

A clearance of 2m between the wharf edge and the crane seaside rail will be provided. This space will be secured for housing power cables of container cranes and stoppers for container trailers, and for descending the container ship's gangway ladder.

The distance between the seaside and landside rails of the container crane will be 16m. This space will be used for the travelling of tractors and chassis, the temporary storage of containers to be loaded onto the container ship and the housing of spare spreaders for the container cranes.

A 16-m space for the temporary keeping of the container ship's hatch covers will be secured between the landside rail of container cranes and container yards.

(3) Container yard

The container yard will be used for the preparation of the container ship and the unit train operation, for the storage of full and empty containers and for the receipt/delivery of containers from/to the container freight station and shippers/consignees.

At the containers stacking space of the container yard, the corner fittings of containers shall be supported by P.C. plates: Other parts will be dust-proofed.

The lane to be travelled by the rubber-tired transfer crane will be heavily paved with cement concrete while the passage to be travelled by the tractor and chassis will be paved with asphalt concrete. The entire container yard will be made at a down grade of about 1 in 100 toward the quay. The refrigerated container yard will be provided with electric power plugs for the

storage of full refrigerated containers and the precooling of empty refrigerated containers to be stuffed with frozen goods.

Stufficient lighting equipment will be provided for night container operation so that the entire container yard can be illuminated at 20 lx more.

The container terminal will be surrounded with fences of 2m or more because it is a bonded area.

At the container yard, containers will be disposed in parallel to the quay wall line. An interval between containers in the lateral direction will be 40cm. A block will be composed of six rows of containers. An interval between containers in the front/rear directon will be 40cm for dry containers and 1.5m for refrigerated containers.

Container blocks will be arranged in the lateral direction, in order that the trailer travelling lanes for adjoining the container blocks may be close together. This will enable a trailer undergoing the transfer of a container by a rubber-tired transfer crane to be passed by another trailer from the rear.

20m is secured as a interval between container blocks in the front/rear direction so that they may be available for the travelling of trailers and the movement of a transfer crane to another container block located in the lateral direction.

The required number of ground slots (number of floor spaces in 20 footer equivalent units at the container stowing place) for the Master Plan and the Urgent Plan were planned as follows:

	Annual through-out	Ground slots	
		Total	Refrigerated CNTR
Master Plan	676,014 TEU	10,124 TEU	415 TEU
Urgent Plan	169,284 TEU	2,732 TEU	117 TEU

Predicting the necessary number of ground slots is difficult because it is affected by various factors, including the calling intervals of container ships, the quantity of containers to be loaded/unloaded to and from each container ship, the type of containers, the pattern of receiving and delivering containers from shippers and to consignees, the transport capacity of the railway, the quantity of empty containers to be stowed and the dwelling period of import containers at the terminal, etc.

It is calculated by a simple formula usually used at the stage of the feasibility study. (Appendix III-2)

(Conditions)

- As for the period of keeping containers at the terminal and the ratio of the net stacking container slot, values are adopted which take into consideration the incorporate allowance for the actual circumstances of Pakistani port cargo handling and railway/road transport, in addition to what has been achieved at Far Eastern and Middle East terminals.
- 100% and 50% are used as ratios of empty containers kept at the port container terminal for stuffing, respectively, export LCL and FCL cargoes to all full export containers.

The size of the container yard required by the Urgent Plan is for 1.5 berths if the

above-mentioned proposed ground slot is applied as it is. But for the following reasons, a container yard for two berths will be constructed under the Urgent Plan.

- Coping, to an extent, with the increase of volume of containers handled, the bunching of container ships and the longer stay of import containers and cargoes.
- Preventing inefficiency in such operations as the transfer and the storage of containers.
- Avoiding the difficulty and the wastefulness of construction due to the conduct of civil work on two separate occasions.

(4) Maintenance facilities

These facilities are responsible for the inspection of containers, the cleaning of containers before and after use, the repair of damaged containers and the maintenance and repair of the container and cargo handling equipment.

a) Maintenance shop

The 600 m^2 ground floor will be paved with cement concrete. It will be used as the repair shop for container/cargo handling equipment and heavily damaged containers and as the store for keeping spare parts. It will be provided with such items of equipment as pit for repairng container handling equipment, overhead travelling crane (5 tons), electric hoist (2.5 tons), compressor (14 kg/cm^2), oil hydraulic jack (150 tons, 30 tons, 10 tons), electric generator (5 KVA), welder, hot-air drier, drilling machine, lathe, grinder, etc.

The 200 m^2 first floor will be used as the office of the engineering section.

b) Water treatment area

With a floor area of 400 m^2, the washing space will be paved with cement concrete and provided with such items as a washer, an oil/water separator and effluent treating equipment.

c) Space for repair and examination of containers

This 4,480 m^2 space will be paved with asphalt concrete. It will be provided with 20 electric power plugs for repairing refrigerated containers and stands for repairing containers.

d) Fuel oil supply facility

This 300 m^2 space will be surrounded with a gutter for preventing fuel oil leakage. It will be provided with oil supply towers and underground fuel oil tanks.

e) Electric power receiving and transforming substation

This facility will receive 11,000 V high-voltage power and supply electricity to different facilities and equipment in the container terminal after reducing the power to necessary voltages. It will be a two-storey building with a floor area of 150 m^2. Its ground floor will be provided with transformers with the following transforming capacities:

Container cranes	2,000 KVA
Rail-mounted transfer cranes	1,000 KVA
Terminal illumination	200 KVA
Container freight station	500 KVA
Maintenance facilities	800 KVA
Administration facilities	500 KVA
Refrigerated containers	1,600 KVA
Total	6,600 KVA

The first floor will be provided with switchboards and monitor panels.

A yard for keeping refrigerated containers will be provided with transformers for increasing or decreasing electric power to necessary voltages.

Underground wiring must be used for power supply to different facilities and equipment in the container terminal so as not to interfere with the travelling of container handling equipment.

f) Water supply equipment

Water supply tanks and piping will be provided to supply water to container ships, to wash containers and container handling equipment, and supply fire fighting water. Underground piping will be used in areas where container handling machines and vehicles are driven.

g) Fire station

A single-storied building with a floor space of 225 m^2 will be provided. It will have sufficient space to hold a fire engine and an ambulance and prepare for the early extinguishing of fire that may occur in the container terminal.

(5) Gate house

Check with containers leaving or entering the container yard for abnormarity, the weighing of containers, the delivery or receipt of necessary papers and the designation of container depositories will be made at the gate house.

The provision of six lanes for container trailers, two 50-ton weighing scales, three booths and a container inspection bridge over the booths are proposed under the Urgent Plan.

(6) Guard box

This will execute the watching and the conducting for vehicles and pedestrians entering from the port road or leaving the terminal. The floor space of each guard box will be 24 m^2.

(7) Administration facilities

a) Administration building

This building will house the administration divisions which will plan and supervise all work concerning the container terminal.

The construction of a 1,500 m^2 four-storied administration building with a basement is proposed under the Urgent Plan.

3rd floor: It will comprise the office for the Planning and the Yard control division of the Operational section, and the telex and computer rooms. Contact by computer/telephone circuit and air chuter will be maintained with the gate house, documentation personnel, etc. The operators of container handling equipment will be directed and supervised by the wireless telephones.

2nd floor:	Offices of the terminal users.
1st floor:	Offices of custom house, animal and plant inspection, port security, etc.
Ground floor:	Offices of the Administration section and the Documentation division of the Operational section.
Basement:	Will be provided with machines and motive power facilities necessary for the administration building.

b) CFS (container freight station) office

A 400 m^2 office will be provided adjacent to each closed shed and open plinth.

It will manage the planning and supervision of work concerning the reception/delivery /storage/stuffing/unstuffing of loose cargoes and related documentation.

c) Canteen

This will be used to feed terminal-related workers and provide for their standby.

For container yard workers:		Floor space 225 m^2 x 1
For CFS workers	:	Floor space 200 m^2 x 4

d) Mosque

A mosque with a floor space of 225 m^2 will be constructed.

e) Lavatory

For container yard workers:		Floor space 120 m^2 x 2
For CFS workers	:	Floor space 120 m^2 x 2

(8) Paking lot

The following parking lots will be provided under the Urgent Plan:

Road tractors and chassis	: 3,876 m^2
Terminal tractors and chassis	: 2,074 m^2
Passenger cars (related to container yard)	: 2,050 m^2
Passenger cars (related to container freight station)	: 1,200 m^2
Trucks (related to container freight station)	: 3,480 m^2
Total	: 12,680 m^2

(9) Multipurpose area

This area is used for many purpose including the storage of dangerous goods and containers, animal and plant inspection, customs inspection and fumigation.

(10) Container freight station

Most small-lot cargoes insufficient for a container (LCL-less than container load cargoes) and some large-lot cargoes (FCL-full container load cargoes) at the request of shippers, will be received from shippers, delivered to consignees, kept on storage spaces, and stuffed/unstuffed to and from containers. This station will also take steps for customs clearance, animal inspection and plant inspection.

The closed shed will have a roof and its floor will be paved with cement concrete at a height of about 1.3 m in keeping with the same level to the bed of a truck or a railway wagon and the floor of a container loaded on a chassis.

A ramp will be provided to facilitate forklift access to the floor of the closed shed.

An open plinth will be provided at the same level with the vehicle-used roadway as the place where containers will be unloaded, and lengthy/heavy cargoes will be stuffed/unstuffed to and from them.

The required floor space of loose cargo handling place for the Master Plan and the Urgent Plan were planned as follows:

	Annual through-out	Floor space
Master Plan	1,520,799 MT	79,200 m^2
Urgent Plan	440,060 MT	26,400 m^2

Predicting the necessary floor space of the loose cargo handling place is difficult because it is affected by various factors, including the arrival intervals of container ships, the number of containers loaded or unloaded from a container ship, the ratio of containers routed through the container freight station to all full containers handled at the terminal, the pattern of receipt and delivery of loose cargoes, the type of cargoes, the dwelling period of import cargoes, and the type and number of cargo handling equipment. It was calculated by a simple formula that is generally used. (Appendix III-3)

A seven-day period of loose cargo to be kept at the CFS is set for the total volume of export and import cargo. At the present Karachi Port, export cargoes are directly loaded onto a conventional ship from their shippers. Therefore, there are rather few problems for export cargoes since this will be changed to the receipt of cargoes with a receiving term of seven days prior to the arrival of a ship. But import cargoes are taken over by their consignees after a dwelling period averaging three weeks from their unloading. In order to enable them to be delivered by the consignees within the free time of seven days, it is required to initiate such actions as providing adequate storage charges and reducing the time of customs lien.

In determining the cargo volume to be kept per unit space (1 m^2) at the cargo storage space, reference was made to what was achieved at the closed shed of KPT and the CFS in the Far East.

The layout of the propsed closed shed is shown. (Fig. III-4-6)

A closed shed will have a length of 110m. This is sufficient for simultaneous cargo operation by bringing 22 chassis or trucks and 10 railway wagons alongisde it, and fully adequate for the peak hour cargo handling volume.

The depth of a closed shed will be 60m, which will not only eliminate the necessity to increase the number of forklifts used to shift loose cargoes in the shed, but also provide sufficient storage space for loose cargoes.

The size of a block of the cargo storage space is: 22m x 5.1m = 112.2m^2, thus providing sufficient floor space for 44 pallets of 1.8m in width and 1.2m in depth.

Space with a width of 6m is secured for cargo handling with chassis/truck/railway wagon. A passage with a width of 4m is secured for the shifting of palletized cargoes to the cargo storage space, and for the stacking/picking up of palletized cargoes by forklifts.

In order to store valuable cargoes and damaged cargoes, two strong rooms of 550m^2 will be provided on the CFS office side.

As a result, the ratio of the cargo storage space to the total floor space of the closed shed is 44.2%.

Under the Urgent Plan, the theoretically necessary space of the cargo handling place is 3.5 times the space of a 110 x 60m closed shed. However, since many unpredictable factors are involved in the design value, it is recommended that three closed sheds and one open plinth (110 x 60m) will be constructed.

(11) Railway siding track for box wagon

Three lines of siding track for box wagons to transport loose cargoes will be provided at intervals of 5m behind the container freight station. Mentioned in the order from the CFS side, these lines will be used as a cargo handling line, a line for standing by, and a line passing to the adjacent terminal.

(12) Unit train operation facilities

These facilities will transfer containers between the unit train and the trailer. A road width of 20m between the rail-mounted transfer crane seaside rail and the railway siding track for box wagon described in the preceding clause, will be provided for the travelling or turning of tractors and chassis. The rail span for the travelling of the rail-mounted transfer crane will be 30m. This span will have two lanes for trailer use, two rows for temporary container depository to make a certain extent of operation possible even when the container yard is congested, and three lines of railway siding track for a unit train.

4-4-3 Selection of container operation system

The efficiency and the service level of the container terminal largely depends on the selection of an operation system, type and amount of equipment to be used.

Currently adopted operation systems have the following advantages and disadvantages: (Table III-4-7, III-4-8, III-4-9, Fig. III-4-7 (1 – 6))

(1) Rail-mounted transfer crane and chassis feed

The rail-mounted transfer crane, running on the rail with external power source, transfers containers between the container yard and the trailer, and the trailer carries the containers.

From the fact that this system grants the greatest capacity of handling containers per unit area and the highest reliability of the equipment, various automated systems, in their advanced forms, have been introduced in Europe and U.S.A. where it has become difficult to make spacious land available in port areas and to get skilled port labourers. Ordinary container terminals often apply this system for loading and unloading of containers to and from the railway wagons. However, they do not prefer to use this system at the container yard because its service

area is limited within the defind container yard. Some super-cranes, or many smaller ones, should be equipped to deal with the partial peak work among certain container stacking blocks and a considerable amount of initial investment is required.

(2) Rubber-tired transfer crane and chassis feed

As compared with the rail-mounted transfer crane, this system is economical, because the rubber-tired transfer crane with a diesel engine on board can move through all container stacking blocks without any restriction on the service area and only the amount of equipment corresponding to the operation volume will have to be provided.

On the other hand, in comparison with other systems for transfer cranes, this system has the biggest storage capacity of containers per unit area and is suitable to transfer systematically a volume of containers. In other words, this system is convenient for storing numerous empty containers and full import containers retained for a long time in the container yard, and loading and discharging a volume of containers to and from the ship.

However, random operation is its weak point.

Operation productivity will easily be changed according to the ability of all the personnel who control the system.

(3) All straddle carrier

This is the most wide-spread operation system, samely as the above rubber-tired transfer crane. It consists of a single unit which possesses both functions of transfer and conveyance of the container. It is suitable for random operation such as delivery of the import container to the road trailer. It is easy to control the system because each unit is allotted its duty independently.

However, the highest level of skill is required for the driver of a unit and, moreover, trouble can occur quite frequently in an area which lacks an adequate maintenance system.

It is desirable to use, together with this system, the yard trailer in a large-scale terminal where the container must be conveyed over a fairly long distance.

(4) Combined system of transfer crane and straddle carrier

This system utilizes both the mass handling capacity of the transfer crane and the mobility of the straddle carrier. It takes a smaller yard space than the straddle carrier system. However, as the service areas of both units are limited, a larger amount of equipment must be placed in service than with the respective single system.

And the use of different type equipment is disadvantageous to the required number of operation personnel and to the maintenance work.

(5) All chassis and transfer crane

In the common user terminal, the container shall be transferred from the yard chassis to the street chassis at the terminal gate.

With this system, the container can be stored and picked up most easily at any place in the container yard, but it requires the most expensive capital investment because a vast land and numerous chassis are needed.

(6) Top lifter and chassis feed

The top lifter is developed from the fork lift truck and is used for the handling of the container in a small area such as a van pool or at berths for conventional ships.

In a genuine container terminal, where super-equipment is required to handle a quantity of 40-footer full containers smoothly, this system would badly increase the container storage rate and require a wide space of heavy pavement.

For the reason, this system has been rarely adopted.

(7) Other container handling equipment

Although the mobile crane and the side loader are conceivable, their capacities of container storage are lower and their duty cycles are longer than the systems mentioned in the above. In general, they are used as auxiliary equipment.

An operation system to be selected for the new container terminal should satisfy the following conditions as much as possible:

1) Estimate of cargo flow (Fig. III-4-2)

Mostly, the goods are to be transported as packed in the container by railway, or in break bulk by railway or road, via the terminal CFS. Numerous empty containers, due to an imbalance between full import and export containers, and full import containers retained for a long time, must be stored.

2) The equipment will be highly reliable with less trouble rate.
3) The container must be conveyed over a fairly long distance in the terminal.
4) The system shall permit the terminal to offer enough services to every common user.
5) The system shall not extend over a wide range, because new sites will be reclaimed and created.

(Conclusion)

The rubber-tired transfer crane system can be recommended for the container yard of the new container terminal. It is suitable to transfer systematically a volume of containers, has a big storage capacity of containers, has lower trouble occurrence rate and requires a reasonable amount of capital investment.

Moreover, it is considered advisable for the rail-mounted transfer crane capable of operating most safely and rapidly in a small space to be adopted as equipment for transferring containers between a unit train and a trailer. (Fig. III-4-8)

The other reasons are as follows:

- It is possible to accommodate one unit train with all wagons coupled for transferring containers to and from a unit train/trailer.

- o A necessary crane span for such operation exceeds the optimum value of the rubber-tired transfer crane.
- o The service area of the crane is restricted within the narrow place over the railway siding track for the unit train and there is no need to move the crane to another area in the lateral direction.

It must be noted that a final decision to select the optimum operation system be made taking into consideration again the following items when the project will be executed.

- o FCL/LCL ratio
- o Railway transport/road transport ratio
- o Quantity of empty containers and full import containers to be stored
- o Maintenance capability
- o Management organization

4-4-4 Equipment

The required amount of container and cargo handling equipment for the Master Plan and the Urgent Plan is calculated by a simple formula generally used at the stage of feasibility study. (Table III-4-8 and III-4-10, Appendix III-4 (1 – 2))

(Conditions)

a. First, the required amount of equipment per berth for the target year is determined for each operation. Then, what is obtained by multiplying this by the number of berths for the target year, is used as the total necessary amount of equipment for the terminal.
b. Two units per ship (berth) are used as the standard number of container cranes for container ship operation.
c. In determining the peak day factor and the productivity, reference is made to actual achievements in the Middle East and the Far East terminals.
d. Each working hour zone is set by referring to the realities of the KPT. With respect, particularly, to unit train operation, a system to start container handling immediately after the arrival of a unit train must be established to be able to make effective use of exclusively used wagons.

The following is a description of the role of each type of container and cargo handling equipment and its essential particulars:

(1) Container crane

A container crane travels to a directed position on the rail laid on the apron. Its trolley traverses the boom stretched out over a container ship. The spreader suspended from the trolley grabs a container, and it is hoisted and then lowered. This is how the crane is used for container handling.

Rated load (continuous operation for container under spreader) 30.5 MT

Max. hoisting load (including spreader)	50 MT
Rail span	16 m
Minimum outreach to center line of spreader from waterside crane rail	35 m
Back reach to center line of spreader from landside crane rail	11 m
Effective clearance for hatch cover between two legs	16 m
Minimum height above water side crane rail to highest position of spreader	25 m
Minimum depth below waterside crane rail to lowest position of spreader	12 m
Over all width of boom and trolley combination	7 m
Crane weight	600 MT
Hoisting speed with full rated load	50 m/min.
Hoisting speed without container	120 m/min.
Traversing speed with full rated load	150 m/min.
Travelling speed	45 m/min.
Boom raising and lowering motion	8 min./cycle
Horizontal width between wharf edge and seaside crane rail (excluding fender)	2 m
Thickness of fender	1 m
Depth below waterside crane rail to MHHW	1.82 m
Depth below waterside crane rail to MLHW	3.07 m
Electric power supply (trailing cable type)	AC 3,000 V
Spreader (20'/40' telescopic type)	2 units per crane
Wagon for spreader	1 unit per crane
40 ton heavy lift beam	1 unit per berth
Over height sling	1 set per crane

(2) **Rubber-tired transfer crane**

A rubber-tired transfer crane travels to a directed position on exclusive-use paved lanes running criss-cross on the container yard. Its trolley traverses on the crossbeam supported by two travelling legs. The spreader suspended from the trolley grabs a container, and is rolled up and then down. This is how the crane makes a container transfer between a trailer and a certain slot in the container yard.

Rated load	30.5 MT
Span of crane legs over 6 rows of container and one lane for trailer	22.71 m
Traversing distance of center line of spreader	18.31 m
Minimum height above container yard to highest position of spreader over 9½ container x 4 high	12.22 m
Crane weight	110 MT
Number of wheels	8 wheels

Maximum static wheel load	28 MT/wheel
Hoisting speed with full rated load	15 m/min.
Hoisting speed without container	35 m/min.
Traversing speed	70 m/min.
Travelling speed	90 m/min.
Engine	Diesel 260 PS/1,800 rpm.
Turning method	Simultaneous turning at right angle
Spreader (20'/40' telescopic type)	5 units every 4 cranes
Wagon for spreader	One unit every 4 cranes
Over height sling	2 sets per berth

(3) **Rail-mounted transfer crane**

A rail-mounted transfer crane in the direction of the train proceeding to a directed position on the rail laid astride the siding track for the unit train, the temporary container storage and the trailer traffic zone. Its trolley traverses on the cross beam supported by two travelling legs. The spreader suspended from the trolley grabs a container, and they are hoisted and then lowered. This is how the crane makes a container transfer between a unit train and a yard trailer.

Rated load	30.5 MT
Span of crane legs over three siding tracks of unit train, two rows of container and 2 lanes for trailer	30 m
Traversing distance of center line of spreader	25.6 m
Lifting height under spreader	12.22 m
Crane weight	150 MT
Hoisting speed with full rated load	15 m/min.
Hoisting speed without container	35 m/min.
Traversing speed	70 m/min.
Travelling speed	90 m/min.
Electric power supply (conductor and collector system)	3,000 V
Spreader (20'/40' telescopic type)	2 units per crane
Wagon for spreader	1 unit per crane
Over height sling	1 set per crane

(4) **Tractor and chassis**

This is composed of a chassis (semi-trailer) exclusively used for containers, and a tractor that hauls it. This transports containers for the distance between the container ship, the container yard, the CFS and the unit train.

a) Tractor

Max. load on fifth wheel	9 MT
Over all length	5.6 m

Width		2.5 m
Tractor weight		6 MT
Engine		Diesel 350 PS/2,500 rpm

b) Chassis

Max. pay load	40' CNTR x 1	30.5 MT
	20' CNTR x 2	40.6 MT
Length		12.8 m
Overall length of tractor and chassis combination		16.4 m
Chassis weight		6.5 MT
Width		2.65 m
Settling container on chassis		socket method

(5) Weighing scale

A weighing scale will be installed under the lane for receiving export FCL containers at the gate house. The total weight of the vehicle and container that passes, is indicated on the instrument in the booth. The date of measurement and the weight are printed out on the printer.

Maximum weighing capacity	50 MT
Dimensions of platform	18.0 m x 3.5 m

(6) 3 ton-forklift

This is used at the CFS to stuff/unstuff loose cargoes to and from containers, to shift cargoes between containers and cargo storage space, and to receive/deliver cargoes from shippers and to consignees.

It is necessary to select the type of forklift satisfying the following conditions:

a) Type with sufficient lifting capacity to cope with the latest tendency of increasing size of cargo packages.

b) Full free lift type suitable for work in a low-ceiling container, (The inside measure of an 8-foot-tall container is 2.15m).

c) Light weight type capable of carrying cargoes within the allowable limits of the floor strength (2,730 kg/wheel load for wheel ground contact area of 142 m^2) of a container.

d) Type with short length so as to be able to secure large cargo storage space in the closed shed.

Max. load		3 MT
Max. lifting height		3 m
Free lifting height		1.2 m
Travelling speed	High gear	300 m/min.
Travelling speed	Low gear	150 m/min.
Over all length with fork		3.7 m

Fork lift weight		4 MT
Engine	Diesel	45 PS/2,700 rpm

3 ton-forklifts are also used for many other purposes, inclusive of: Placing a container onto the repair stand for repair, changing power units for a refrigerated container, bringing a sling for an overheight container and attaching or detaching the same, and hauling a wagon for a spare crane spreader. It is desirable to use the same type as the CFS forklifts for convenience of use and interchangeability of spare parts.

As forklift accessories, there must be a steel plate to adjust the level difference between the closed shed floor and the container on chassis and enable the forklift to travel safely, and the fork extension sleeve for lifting up a damaged empty container on the repair stand.

(7) 6 ton-forklift

This is used for bulky or heavy cargoes that are handled at the CFS.

Max. load		6 MT
Max. lifting height		3 m
Travelling speed	high gear	300 m/min.
Travelling speed	low gear	150 m/min.
Over all length with fork		4.7 m
Forklift weight		8 MT
Engine	Diesel	60 PS/2,200 rpm

(8) 15-ton forklift truck with telescopic side spreader

This is used to hoist and shift a container by supporting the sidewall of the container by the front of the forklift, as the side spreader attached to the lift mast of the forklift grabs the container on two places of the longitudinal corner fittings of the container. It is mainly used to shift 40' empty refrigerated containers at the container repair area.

Rated load	40' empty container	6 MT
Max. lifting height for stacking 9' container x 3 high		8.5 m
Max. travelling speed		300 m/min.
Over all length with CNTR		8 m
Over all length with side spreader		5.7 m
Forklift weight		25 MT
Engine	Diesel	120 PS/2,400 rpm

(9) 35-ton forklift truck with telescopic spreader

This is used to transfer or shift a container, as the spreader attached to the lift mast of the forklift grabs the container from above and lifts it up or down. It will be used at the open plinth

of the CFS and the multipurpose area, for handing containers to be stuffed/unstuffed bulky and heavy cargoes, dangerous goods containers, and containers requiring customs inspection or animal/plant inspection.

Max. lifting capacity	fork operation	35 MT
Max. lifting capacity	spreader operation	30.5 MT
Max. lifting height for stacking 9' container x 3 high		8.5 m
Max. travelling speed		500 m/min.
Over all length		9.5 m
Forklift weight		65 MT
Engine	Diesel	210 PS/2,200 rpm

(10) 35-ton mobile crane

This is used to restore a container that has been toppled or moved due to strong wind or misoperation, or auxiliarily used for the handling of bulky cargoes and containers.

Max. lifting capacity with boom length 10.7m and operational radius	3.5m	35 MT
Length of boom	10.7 ~	34 m
Mobile crane weight		35 MT
Max. travelling speed		60 km/hour
Engine	Diesel	300 PS/2,500 rpm

(11) Pallet

The work efficiency and the storage capacity at the CFS is increased by using forklifts to rapidly shift loose cargoes and pile them high. In order to make this forklift operation possible, pallets for holding small lots of cargoes consolidated into large units are used.

Dimensions of pallet	1.8 m x 1.2 m

(12) Computer

Under the Urgent Plan, containers of 169,284 TEU (126,963 units) per year will be handled. It is recommended that a yard plan computer system be adopted with a view, mainly, to the rapid and accurate container inventory control at the terminal.

Its work consists, mainly, of the following:

- o Inventory control of containers in the terminal.
- o Determination or checking of yard stacking address for receiving and delivering containers.
- o Making of loading and unloading sequence lists of containers to and from ships.
- o Making of receiving and delivering sequence lists of containers to and from the unit train.
- o Making of various lists, reports and others.

Central processing unit	1 unit
Core memory capacity	16 bits 256 KB (kilobyte)
Cycle time	500 ns (nanosecond)
Magnetic tape unit	1 unit
Tape speed	45 ips (inch per second)
Data storage capacity	800–1600 bpi (bytes per inch)
Magnetic disc unit	2 units
Data storage capacity	67 MB (megabyte)
Average access time	38 ms (millisecond)
Line printer	1 unit
Characters per line	132
Printing speed	300 lines/minute
CRT (Cathode-Ray Tube) display	16 units
Number of characters displayable	1,920 (80 characters x 24 lines)
Data transmission speed	300 ~ 2,400 bits/second
Serial printer	3 units
Characters per line	132
Printing speed	180 characters/second

(13) Wireless telephone (VHF)

This will be used for the yard operator in the administration building to supervise the drivers of container handling equipment at the terminal, and to instruct them about container ship operation and container shift plans.

Frequency	150 MHz band
Number of channels	6
Antenna power	5 W
Electric power supply from container handling equipment	DC 24V, AC 100V, AC 220V

4-4-5 Management

(1) Operation

The following is the outline of the container terminal operation concerning export containers. As to import containers, the procedure is reverse.

1) When an export container arrives at the terminal by a trailer arranged for by a shipper, it is checked at the gate house for sealing, external damage, the height of over-height container cargo, the set temperature of a refrigerated container and other details, and their weight is measured. Details of an incoming container (container number, shipping comapny, name of ship, destination, size, weight, type of cargo and state of procedure with government offices, including customs house) are input into computer terminal equipment. After careful conduct

of necessary inspections, a receipt for the container is handed to the trailer driver from the gate clerk.

2) The computer outputs the storage position on the computer terminal units in the gate house and the control office by a program of determination of yard stacking address for receiving containers. The gate clerk indicates this to the trailer driver, and a yard operator does the same by VHF to a driver of the rubber-tired transfer crane. The trailer proceeds to the directed bay in the vehicle traffic zone in the container yard, to wait. The rubber-tired transfer crane travels to the bay and transfers the container from the trailer to the directed storage slot.

3) When a container ship arrives, a rubber-tired transfer crane transfers a container from its storage slot in the container yard to a yard trailer according to the loading work sequence list prepared by the ship planner. The yard tractor brings the container to the side of the container ship. The container is stowed at the designated slot on the container ship from the yard trailer by a container crane.

The operation efficiency of the terminal is high in proportion to the number of containers that, in the abovementioned method from the receipt of export containers to their shiploading, are directly loaded from their storage slots at the time of their receipt. It is, therefore, necessary for the decision to place container receiving slots in the container yard and to place container loading slots on board to be planned most carefully.

In order to load rapidly a large number of containers on a container ship, and enable the ship to leave according to her schedule, it is necessary to prepare a loading work plan in advance. Therefore, it is necessary to change from the current formula of export cargo direct load, to a formula whereby the receipt of all containers is completed by the previous day of the ship's arrival.

4) Small-lot export cargoes insufficient for a full container load, or some large-lot cargoes of shippers lacking the facilities for stuffing them, are brought to the container freight station by trucks or railway wagons arranged for by the shippers.

A CFS clerk issues a receipt after checking for the ship's name on which the receiving cargoes are to be loaded, the name of the shipping line that booked the cargoes, the destination, the cargo mark, the number of packages, the conditions of cargoes and whether customs formalities have been completed or not.

Under the direction of a CFS foreman, loose cargoes are unloaded onto CFS pallets separately by cargo marks – by shipper-provided truck drivers or workers, in the case of cargoes brought by trucks, and by CFS workers in the case of cargoes brought by railway wagons – and are shifted to the storage space by forklifts.

An empty container is shifted from the container yard to the CFS by a yard trailer according to the instruction from the shipping line who has booked loose cargoes, and the export cargoes are stuffed into the empty container.

The container having been stuffed with the export cargoes, is shifted from the CFS to the container yard by the yard trailer according to the shift plan. To ensure the accuracy of this work, the gate house checks the passage of containers.

5) Export containers brought from the Inland Container Freight Station by a unit train are also shifted to and arranged at the designated slots in the container yard so that they can be

loaded efficiently on a container ship.

The transfer of export containers from the unit train to the container yard is made according to a shift plan prepared on the base of the data reported in advance from the Inland Container Freight Station.

The gate house and the passages at both ends of the terminal will be used to bring containers from the unit train to the container yard.

(2) Organization and Personnel

It is recommended that reference be made to the appended example of the organization chart and personnel assignment necessary for a port terminal. (Fig. III-4-9)

This incorporates the present conditions of Karachi Port into the organization chart used for container terminals in general. The number of personnel assigned anticipates a day shift on the peak work day.

The following is an outline of the duties and functions of each division:

1) General affairs: Assets and cost control related to the container terminal. Receipt and disbursement of labour and general administration costs. Also, miscellaneous work.

2) Accounts: Demand and receipt of fees for the loading/unloading, storage, receipt/delivery and repair of containers.

3) Claims: Disposal of accidents occurring to people, container ships, terminal facilities and equipment, containrs, road and railway transport vehicles, etc.

4) Planning: Planning concerning such matters as the container ship and the unit train operation, the arrangement of containers in the container yard, and the shift of containers between unit trains and the container yard/and also between the CFS and the container yard.

5) Yard control: Preparation of drivers for container handling equipment and other workers necessary to execute plans mentioned in the preceding item. Direction and supervision of work. Control of road and railway vehicles provided for by shippers and consignees in the terminal. Receipt and delivery of containers and container appearance check at the gate house.

6) Documentation: Preparation and issuance of necessary papers concerning export and import containers. Arrangements for various government inspections. Paper work concerning the inventory control and the receipt/delivery of empty containers.

7) Equipment and facilities: Maintenance of equipment and facilities belonging to the container terminal.

8) Container repair: Detection of filth and defects of containers brought to the container year or unloaded from container ships. Cleaning and repair of containers. Materials control.

9) Electricity: Maintenance and repair of transformer substations, illumination, electrical parts of container handling equipment and refrigerated containers.

10) CFS operation: Planning relative to the delivery/receipt and the storage of cargoes at the CFS, and the stuffing/unstuffing of cargoes into or out of containers, and other matters. Provision of drivers for cargo handling equipment and other workers necessary for the above-mentioned plans. Direction and supervision of work. Control of shipper/consignee-provided road and railway vehicles relative to the CFS.

11) CFS documentation: Preparation and issuance of papers necessary for export and import cargoes. Arrangements for various government inspections.

12) CFS general affairs (accounts): Demand and receipt of fees for the stuffing/unstuffing of loose cargoes into or out of containers, their storage and their receipt/delivery. Receipt and disbursement of labourer and general control costs relative to the CFS. Also, miscellaneous work.

(3) Management

It would be the most desirable management and operational system at the container terminal that a single organization body employed directly the required number of experienced and well trained personnel, provide to the terminal users a through and complete service, from unloading import containers out of the ship to their delivery to the consignee, or from receiving export containers and cargoes from the shipper to their loading onto the ship.

Even if the realization of the above-mentioned system is impossible, it is recommended to establish at least a reliable corporate body or partnership who entrusts the part of his terminal duties to one contractor or, at the most, to two contractors recognized as specialists in their own duties, but is answerable to the terminal users for any damage done to people, containers, cargoes, ships or user's equipment through the whole terminal operation.

The management system for the first Pakistani common user container terminal (two berths) to be constructed at Karachi Port should be decided by the KPT board.

It is recommended that references be made to a plan advised by the team as a feasible management system, which is as follows:

1) The KPT, which has an established management foundation and performs important duties in the operation of the present Karachi Port, will be consistently responsible to terminal users for all work from the receipt of containers or loose cargoes to the loading of container ships, and from the unloading of container ships to the delivery of containers or cargoes.

2) The administration and engineering sections shall be staffed with the permanent personal of KPT.

3) The management of the Operational section, and of the Operation division and the Documentation division belonging to the CFS section, will be entrusted to contractors. A single contractor is desirable. At the most, there will be only one company each for the Operational section and the CFS section.

4) All container and cargo handling equipment will be operated by the KPT workers. Work under container cranes, work on the container yard and work under rail-mounted transfer cranes will also be performed by the KPT workers.

5) The work of talley clerks for container ships, the container yard and the CFS will be entrusted to a contractor.

6) The securing of containers on container ships and unit trains, and the handling of loose cargoes in the CFS will be assigned as follows:

The minimum number of workers necessary to handle the average volume of work will be provided from the KPT work force.

The number of extra workers necessary on peak days will be supplied with roster labourers dispatched from the Karachi Dock Labour Board.

7) Apart from the roster labourers of the KDLB, the management staff and the operation workers will be all steady men who will be attached to the terminal, receive necessary training and become familiarized with their duties.

8) Especially, a reliable maintenance and repair system must be established by retaining and training of equipment repair technicians, and supplementing and storing spare parts of equipment so that container and cargo handling equipment can always be operated in a satisfactory condition.

Competent personnel as drivers of container handling equipment and maintenance engineers will be secured by giving them the treatment that they deserve as special technicians. Unsuitable personnel will be promptly transferred to other jobs.

9) The service of receiving and delivering containers and loose cargoes transported by road vehicles will, in principle, consist of a daytime shift (eight hours) on weekdays and, if necessary, the personnel will work overtime.

The service of the container ship operation, the loading/unloading operation of containers and cargoes transported by the railway, and the stuffing/unstuffing work of loose cargoes to and from containers at the CFS will be conducted continuously, day and night.

To prevent accidents and maintain work efficiency, it is advisable to apply a three-shift system, at least, to the drivers of container handling equipment and not to have them work overtime.

10) Receiving and free time of about seven days will be set for export/import containers and loose cargoes, and parties concerned will be made to strictly adhere to it. Suitable demurrage charges will be set. The time of exercise of customs lien for import loose cargoes having exceeded free time will be shortened.

(Observation of regulations)

The following is adivce concerning the simplification of customs formalities and documentation, and the expansion of facilities for container handling outside the port area. These are necessary to be able to rapidly handle large quantities of containers and cargoes.

11) The domestic legislation and regulations concerning customs clearance will be improved in the spirit of the Customs Convention on Container, and the Customs Convention on the International Transport of Goods under cover of TIR Carnets, so that customs formalities will be simplified and standardized as much as possible.

Examples of what is usually done are as follows:

- The procedure for import containers themselves is performed by submitting an import declaration accompanied with a container number list upon completion of the unloading of all containers. A procedure similar to that for the import declaration is taken for export containers themselves.
- Customs formalities for the domestic transportation of containers themselves are as follows: The person responsible for the container handling facility makes a self-recording of all records conerning the shift of containers to and from his facility, so that he can

always respond to a follow-up survey by the customs house. Customs formalities concerning the shift of individual containers themselves are thereby omitted.

o If a manifest prepared by the shipping line carries all information required by the customs house, a copy of this manifest can be used in place of a customs form.

o In the case of the bonded transportation of a container holding bonded cargoes, the shipping company's seal may be substited for a customs seal.

o When cargoes held in the TIR container cross the Afghan border, customs formalities will be simplified.

o For cargoes constantly exported and imported by bonafide shippers and consignees, customs formalities are simplified.

12) The facilities where customs formalities are observed, will be expanded by the public sector outside the port area. At the same time, the construction of container handling facilities by the private sector will be encouraged, and cooperation will be extended to customs formalities there.

By carrying out the above items, the merits of container transportation will be fully enjoyed, and the use efficiency of the port terminal and other container handling facilities will be increased.

4-5 Location and layout of container berth

4-5-1. Site selection

For the development of future container terminal, various sites can be taken as alternatives and have been already examined by KPT. The team reviewed the past related studies and they are summarized as below.

1) At the back of the Keamari Groyne

This site is frequently affected by monsoon waves and therefore was dropped. The site is now being developed for providing a container yard and is planned for a future roll-on roll-off berth.

2) At the Bunker Island

This site, though to a lesser extent, also suffers the wave agitation as in the above case. Further, the construction cost of road connection is very high and therefore was dropped.

3) In the Chinna Creek Backwater

This site, though well protected, involves extensive dredging operations, and major modifications to long bridge structures, and was accordingly dropped from economic considerations.

4) **Improvement of the existing conventional berths**

None of the existing berths is designed for carrying a heavy container handling equipment. Further, even if the existing quay can be modified for a full scale container handling operation, the back-up land area is impossible to be rearranged for an efficient container handling.

5) **In the Western Backwater Area**

This area can be the optimum site for a future development of container terminal by the following reasons:

- The site is spacious for a modern container berth and permits future expansion without any substantial restriction.
- The site is easily connected to road and railway arteries as well as the existing navigation channel.
- The site provides easy and convenient connection to R.C.D. Highway.

Considering all the aspects mentioned above, the Western Backwater Area is selected as the location for the future container terminal and will be examined in detail in the following chapters.

4-5-2. Container terminal layout

The Western Backwater Area has been selected as the construction site for the future container terminal and the scale of terminal has been determined in a previous section. Then, the detailed layout of the terminal will be determined in this paragraph. On determining the terminal layout, various conditions such as a soil condition, navigational aspect, access road/rail, construction cost, etc. should be taken into consideration. Fig. III-4-10 illustrates the planned terminal layout for the Master Plan and Fig. III-4-11 for the Urgent Plan. This layout has been determined through due consideration of following conditions.

- This area is exclusively utilized for container transportation. The berths for other than container cargo handling is not included in this plan.
- The location of berths is so determined that the volumes of soil to be dredged and reclaimed may be balanced and this is required not only from the economical viewpoint but also from the viewpoint of siltation. The geometry of the berths proposed by KPT in the Western Backwater Scheme has been tested in a physical rigid boundary tidal model, and it has been established that this will not affect the tidal prism or siltation in the harbour. The Western Backwater Scheme proposed by KPT is shown in Fig. III-4-12.
  As the layout of terminal planned here is the first and small part of overall scheme, the result mentioned above is considered to be applicable to the present plan.
- The approach channel and turning basin is designed to assure a safe and efficient ship manoeuverability and will be discussed in detail in the following section.
- The soil condition in this area is very hard for the deep layers as detailed in the Chapter 2 "Natural Condition". The dredging cost of hard material N>150 for instance is, 10 times that of soil N>50. This is the main reason why the innermost berth proposed here is