Table 2-4-1 Progress of Railways

Year	Route length (Kilometers)			Running track (km)	Passengers originating (lakh)	Goods originating (lakh tonnes
	Electrified	Non-Electrified	Total			
1950-51	388	53,208	53,596	59,315	12,840	930
1960-61	748	55,499	56,247	63,602	15,940	1,562
1970-71	3,706	56,084	59,790	71,669	24,311	1,965
1980-81	5,345	55,895	61,240	75,860	36,125	2,200
1984-85	6,325	55,525	61,850	76,963	33,332	2,648

Table 2-4-2 Rolling Stock

Year	Number of locomotives				Number of coaching vehicles	Number of wagons
	Steam	Diesel	Electric	Total		
1950-51	8,120	17	72	8,209	19,628	2,05,596
1960-61	10,312	181	131	10,624	28,439	3,07,907
1970-71	9,387	1,169	602	11,158	35,145	3,83,990
1980-81	7,469	2,403	1,036	10,908	38,327	4,00,946
1984-85	5,970	2,905	1,253	10,128	38,583	3,65,390

2-4-2 Roads

Indian roads have a total length of about 1.7 million kilometers (1983-84). Roads are generally classified into the following categories:

i) National highways: These roads are the primary roads of the country and connect large cities and big industrial centers. Their development and maintenance is the responsibility of the Central Government. The total length of national highways was about 32 thousand kilometers as of March 1983, which was only 2 per cent of the total road length, but they carry nearly one-third of the road traffic.

ii) State highways: These roads link all the important centers of industry, trade and commerce of the State and national highways. State and the following district and rural roads are the responsibility of state governments and are maintained by various

agencies in the states and union territories. The Central Government also assists in the development of certain selected roads in the states.

iii) District roads: These roads connect different parts of the districts, important industrial centers and market centers, and usually lead to local railway stations.

iv) Rural roads: These roads are found in villages and are usually of two types - metalled and non-metalled.
paved and unpaved.

The surfaced length of road as of March 1983 was 731 thousand kilometers comprising 47 per cent of the total length of roads in India and the unsurfaced road totaled 823 thousand kilometers, comprising 53 per cent.

The number of motor vehicles is 8.6 million in 1984/85. The states with the largest number of registered motor vehicles (1982-83) are:

Maharashtra	1,085	thousand vehicles
Delhi	668	
Uttar Pradesh	597	
Gujarat	515	
Karnataka	504	
Punjab	439	
West Bengal	419	
Tamil Nadu	409	

Most of the states/union territories have nationalized passenger transport. In the country as a whole, about 40 per cent of the buses were being run by the public sector as of 31 March 1985. The nationalized services are operated by departments, municipal corporations or registered companies. In most of the cities, bus services are state owned. Goods transport is almost exclusively in the private sector.

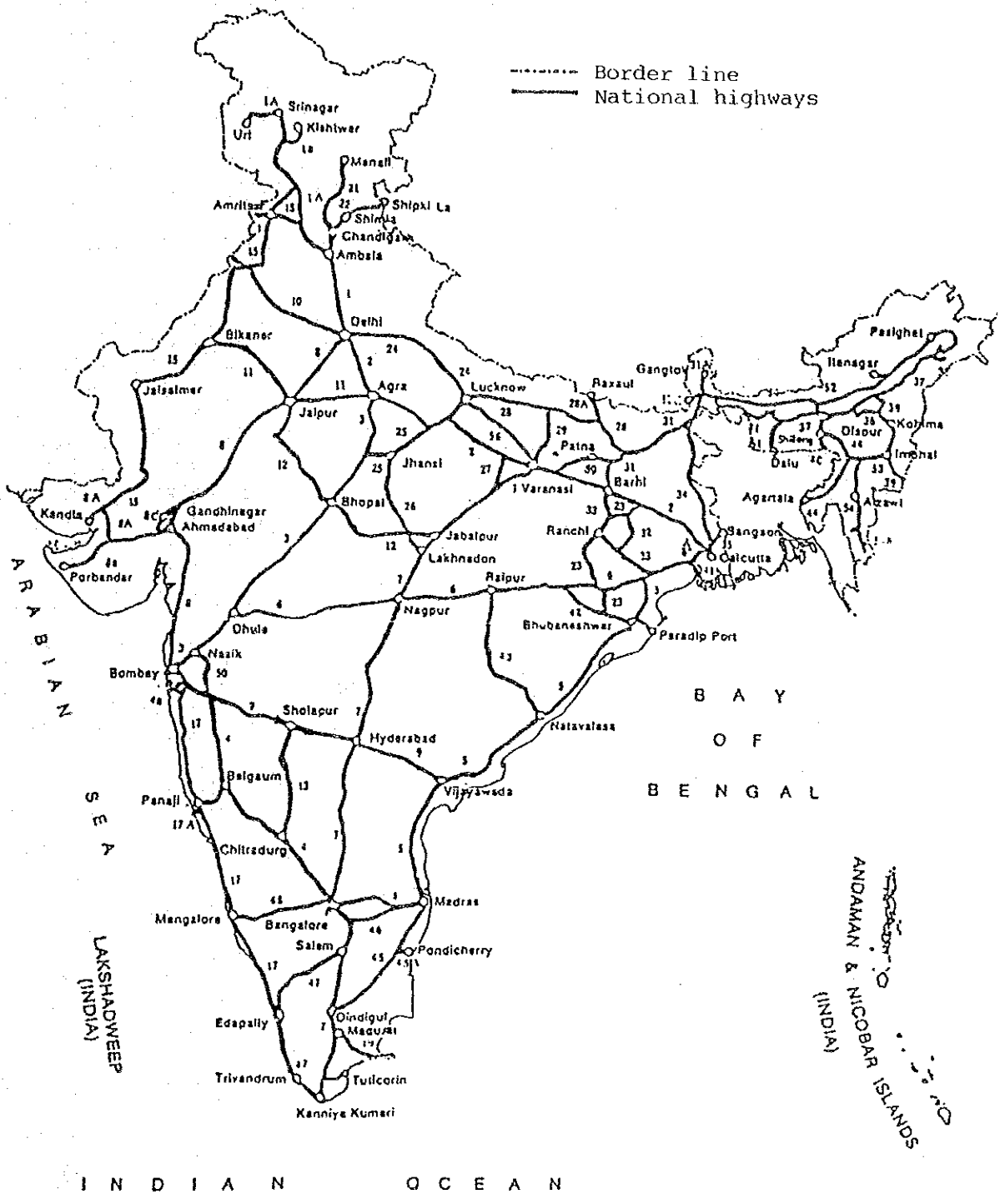


Fig. 2-4-2 National Highways

Table 2-4-3 Road Length in India
(As of 31 March 1983)

(in km)

	Surfaced Roads	Unsurfaced Roads	Total
All India	7,31,312	8,23,072	15,54,000
States			
Andhra Pradesh	67,087	66,908	1,33,995
Assam	7,924	24,908	32,466
Bihar	29,215	54,970	84,185
Gujarat	48,780	14,612	63,392
Haryana	21,281	3,160	24,441
Himachal Pradesh	4,704	16,142	20,846
Jammu & Kashmir	7,494	4,369	11,863
Karnataka	68,136	46,073	1,14,209
Kerala	24,461	80,389	1,04,850
Madhya Pradesh	58,230	54,946	1,13,176
Maharashtra	92,145	91,029	1,83,174
Manipur	1,973	3,491	5,464
Meghalaya	2,762	2,483	5,245
Nagaland	878	5,453	6,331
Orissa	16,784	1,02,702	1,19,486
Punjab	37,033	10,711	47,744
Rajasthan	42,422	33,350	75,772
Sikkim	1,118	59	1,177
Tamil Nadu	81,878	63,646	1,45,524
Tripura	1,294	7,098	8,392
Uttar Pradesh	72,811	81,962	1,54,773
West Bengal	25,336	31,665	57,001
Union Trritories			
Andaman & Nicobar	583	81	664
Arunachal Pradesh	2,051	10,693	12,744
Chandigarh	18	-	182
Dadra & Nagar Haveli	217	43	260
Delhi	8,844	7,052	15,896
Goa, Daman & Diu	3,287	2,796	6,083
Lakshadweep	-	-	-
Mizoram	1,168	1,494	2,662
Pondicherry	1,218	1,153	2,371

1. The Union territories of Arunachal Pradesh and Mizoram attamed statehood on 20 Feburuay 1987 according to the notifications in the Gazette extraodinary issued on 11 February 1987.
2. National Highways and Railways Roads only.

2-4-3 Sea transport (Ports and Shipping)

There are 11 major ports except Nhava Sheva and 137 intermediate/minor ports. The management and administration of the major port is governed by the Major Port Trusts Act of 1963 and carried out by the respective Port Trusts under the overall responsibility of MOST and that of intermediate/minor ports by the respective State Governments. The administration and development of shipping services is also the responsibility of MOST. The overall planning is, however, the responsibility of the Planning Commission.

India's coastline is about 6,000 kms. During 1987-88 a total of 139 million tonnes of cargo was handled by all the ports: the share of major ports was about 96 percent. The main commodities handled at the major ports were POL (47%), Iron ore (22%) and coal (10%).

India has one of the largest merchant fleets among the developing countries. The country's operative tonnage was 5.58 million GRT (Gross Registered Tonnage) as of 30 June 1986. There are 55 shipping companies in the country of which 19 are engaged exclusively in coastal trade, 29 in overseas trade and 7 in both coastal and overseas trade. The only government shipping company, viz. Shipping Corporation of India (SCI), carries on both coastal and overseas trade. SCI had a merchant fleet of 137 vessels 3.13 million GRT in June 1986 which is about 56 per cent of the total Indian tonnage. The major private sector shipping companies are the Scindia Steam Navigation Company Ltd., Great Eastern Shipping Company Ltd., India Steamship Company Ltd., Chowgule Steamship Ltd., and Damodar Bulk Carries Ltd.

There are four major and four medium size shipyards and about 32 small shipyards in India. Major and medium size shipyards are either in the public sector or state government undertakings while small size shipyards are in the private sector. There are also 15 major dry docks - five at Bombay, six at Calcutta, two at Cochin and two at Visakhapatnam.

The Government looks after the general navigational aids, while the states, port trusts and other agencies are responsible for the local aids. Under the Lighthouse Act, 1927 the Government exercises general control over all aids through the Department of Lighthouses and Lightships.

India has navigable waterways of 5,200 km along major rivers but only 1,700 km are actually utilized. The available length of canals is 4,300 km of which only 331 km are actually utilized. In land water transport is a

state subject. The Central Inland Water Transport Board (New Delhi) formulates policy for the development of inland water transport in the country. The Inland Water Transport Directorate of the Ministry of Surface Transport is responsible for the development of inland waterways and gives technical advice to the states.

Table 2-4-4 Traffic Handled by The Major Ports

(In million tonnes)

Port	1956-66		1970-71		1975-76		1980-81		1985-86		1986-87	
	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%
Calcutta & Haldia	9.7	19.2	6.0	10.8	7.7	11.7	9.3	11.6	12.1	10.1	12.0	9.7
Bombay	17.9	35.8	14.4	25.9	16.6	25.8	17.0	21.2	24.9	20.8	25.1	20.2
Madras	4.9	9.7	6.9	12.4	7.9	12.6	10.4	13.0	18.2	15.1	19.8	15.9
Cochin	2.9	5.8	4.8	8.6	4.3	6.5	5.2	6.5	5.1	4.3	6.8	5.5
Visakhapatnam	4.4	8.7	8.7	15.6	8.5	12.9	10.1	12.6	15.9	15.3	15.0	12.2
Kandla	2.5	5.0	1.6	3.0	3.2	5.0	8.8	11.0	16.5	13.7	16.2	13.0
Mormugao	7.9	15.8	11.0	19.8	12.7	19.5	13.8	17.2	16.1	13.4	14.9	12.0
Paradip	-	-	2.2	3.9	3.3	5.0	2.2	2.7	3.3	2.8	4.9	3.9
New Mangalore	-	-	-	-	0.5	0.5	1.0	1.2	3.7	3.1	5.4	4.3
Tuticorin	-	-	-	-	0.3	0.5	2.5	3.1	4.2	3.5	4.1	3.3
Total	50.2	100.0	55.6	100.0	65.0	100.0	80.3	100.0	120.0	100.0	124.2	100.0

Source: "VISAKHAPATNAM PORT MASTER PLAN STUDY" Volume II, June 1988

Table 2-4-5 Commodities Handled by The Major Ports

(In million tonnes)

Port	1956-66		1970-71		1975-76		1980-81		1985-86		1986-87	
	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%	Volume	%
Crude and POL	15.7	31.27	18.8	33.81	21.3	32.67	32.2	40.10	54.6	45.51	55.5	44.69
Iron Ore	11.0	21.91	19.2	34.53	21.1	32.36	22.9	28.52	28.8	24.02	30.6	24.64
Coal	2.0	3.98	0.7	1.26	1.1	1.69	2.2	2.74	7.5	6.25	9.4	7.58
Fertiliser (Raw & Finished)	1.8	3.59	2.9	5.22	2.7	4.14	6.0	7.47	6.01	5.06	4.9	4.07
Foodgrains	7.2	14.34	3.3	5.93	6.7	10.43	0.9	1.12	0.6	0.46	0.5	0.48
Iron/Steel/Machinery	2.1	4.18	1.8	3.24	1.1	1.84	2.0	2.49	2.7	2.23	3.3	2.62
Allother	10.4	20.73	8.9	16.01	11.0	16.87	14.1	17.56	19.7	16.47	19.7	15.92
Total	50.2	100.00	55.6	100.00	65.0	100.00	80.3	100.00	120.0	120.00	124.2	100.00

Source: "VISAKHAPATNAM PORT MASTER PLAN STUDY" Volume II, June 1988

2-4-4 Air Transport

Inland has two independent airline corporations, Air India for international routes, and Indian Airlines for all major internal and a few external flights to neighboring countries. These two corporations in 1981 launched, on a 50:50 basis, an internal feeder service called vayudoot.

As of 31 December 1985, there were 739 civil air craft in the country (including 110 gliders). During 1985 Indian registered aircraft carried 10.8 million passengers. There were 91 civil aerodromes and 26 civil enclaves maintained by the Ministry as of 1 June 1986. In addition there are many aerodromes controlled/owned/maintained by the Ministry of Defense, state governments, public undertakings, private individuals and bodies like flying clubs.

International Airports Authority of India (IAAI) was set up in 1972 for operation, management, planning and development of international air ports at Bombay, Calcutta, Delhi and Madras. The Authority provides consultancy services in relation to planning and development of airports in India and abroad.

The fleet of Air-India as of 31 December 1986 was 9 Boeing 747s, 5 Boeing 707s, and 3 Airbuses, and one more Boeing 747 and an additional 707 were delivered in 1987. Indian Airlines has in its fleet 26 Boeing 737s, 10 Airbuses and other smelled air craft.

Chapter 3 Present Situation of the Port

3-1 Locational Condition

3-1-1 Calcutta Dock System

Calcutta harbour is located on the left bank of the river Hooghly, which is a tributary of the river Ganges. Accordingly, the harbour is a river harbour. The river Hooghly flows into Bengal bay. Calcutta harbour in about 129km upstream from the estuary, and has a lock system. The harbour is located within the city of Calcutta which has a population of about 9,000,000 people. Calcutta is one of the 11 main ports in India. The location of the harbour is as follows:

latitude : 22 degrees 33 minutes north
longitude: 88 degrees 18 minutes east

The waterway to Calcutta harbor is the Hooghly river, which has many curves and many shoals and sandbanks formed by sedimentation. Accordingly, the navigation of vessels is difficult. For ships of over 200 tons, pilotage is required. The pilotage area stretches from Sandheads (72 km downstream from the estuary of the river) to Calcutta harbour. The Hooghly river is a tidal river. Accordingly, the size of ships which can enter the port depends on the tide level and he ship's velocity (refer to River Harbour Master's information).

The cargo handling volume at Calcutta Dock System is 4.4 million tons in 1987/88. This volume is about one third of the total volume of Calcutta port including both Calcutta and Haldia. Major import/inward items are fertilizer, petroleum products, iron and steel products, and machines and major export/outward items are jute, jute products, and tea. The container cargo volume in Calcutta Dock System is about 50,000 TEU in 1986/87. This volume is about three-fourths of the total volume at Calcutta port including both Calcutta and Hardia. Containerization of general cargo is progressing at Calcutta. The rehabilitation construction work financed by ADB is designed to help respond to this demand.

The hinterland area of Calcutta Dock System is Calcutta city, West Bengal state, Assam state, and Nepal. The number of laborers working in

the port is over 20,000 persons.

Calcutta Dock System must compete with other nearby ports for certain cargoes. For this purpose, the functions of the port need to be rationalized. It is important that the following themes be studied concretely:

1) Logical response to the supply and demand of cargo in the hinterland.
2) Handling equipment/facility plan
3) Development plan of road networks located inside and accesses to the port.

As mentioned above, the navigation channel for Calcutta Dock System is the Hooghly River which is a tidal river. The river is constantly being dredged and maintained. However, it is impossible to secure the sufficient depth. Accordingly, larger vessels must wait for the tide. Also, the ships which can call at the port are clearly limited by the draft restrictions.

Because of the siltation of the Hooghly River, the situation of the navigation channel is always changing. Hydrographical surveys are frequently executed by CPT. The masters of vessels are informed of the results. At present, mandatory pilotage for every ship over 200 tons is required by law. Pilots board at Sandhead at the beginning of a series of sandbars in the estuary. The distance between Sandhead and Calcutta is over 200km. At present, the pilots use 2 fleets by shifts. Each pilot ship has 80 crew members. It is a very inefficient system because the operation distance of the pilot ships is too long.

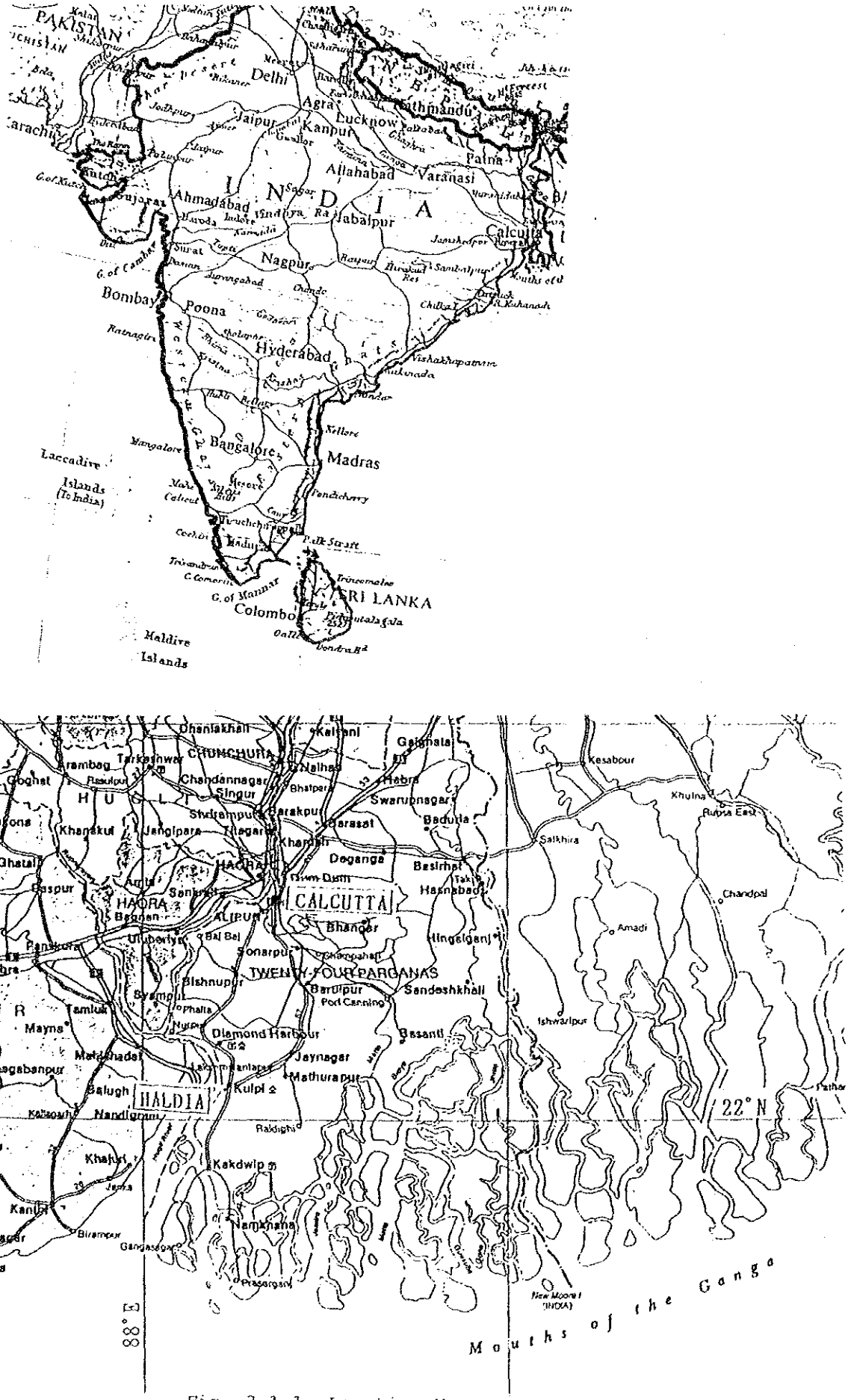


Fig. 3-1-1 Location Map

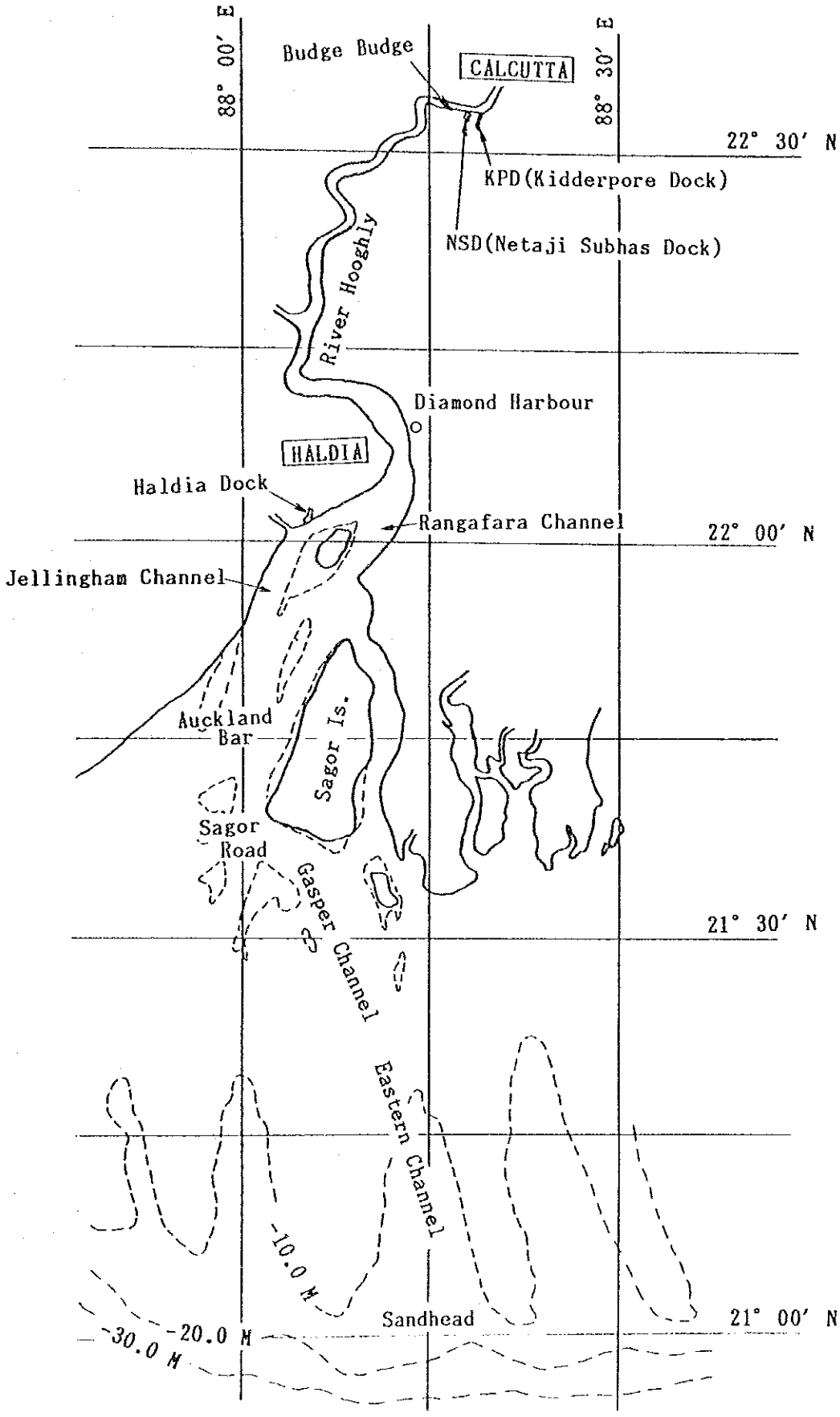


Fig. 3-1-2 Approach Cannel

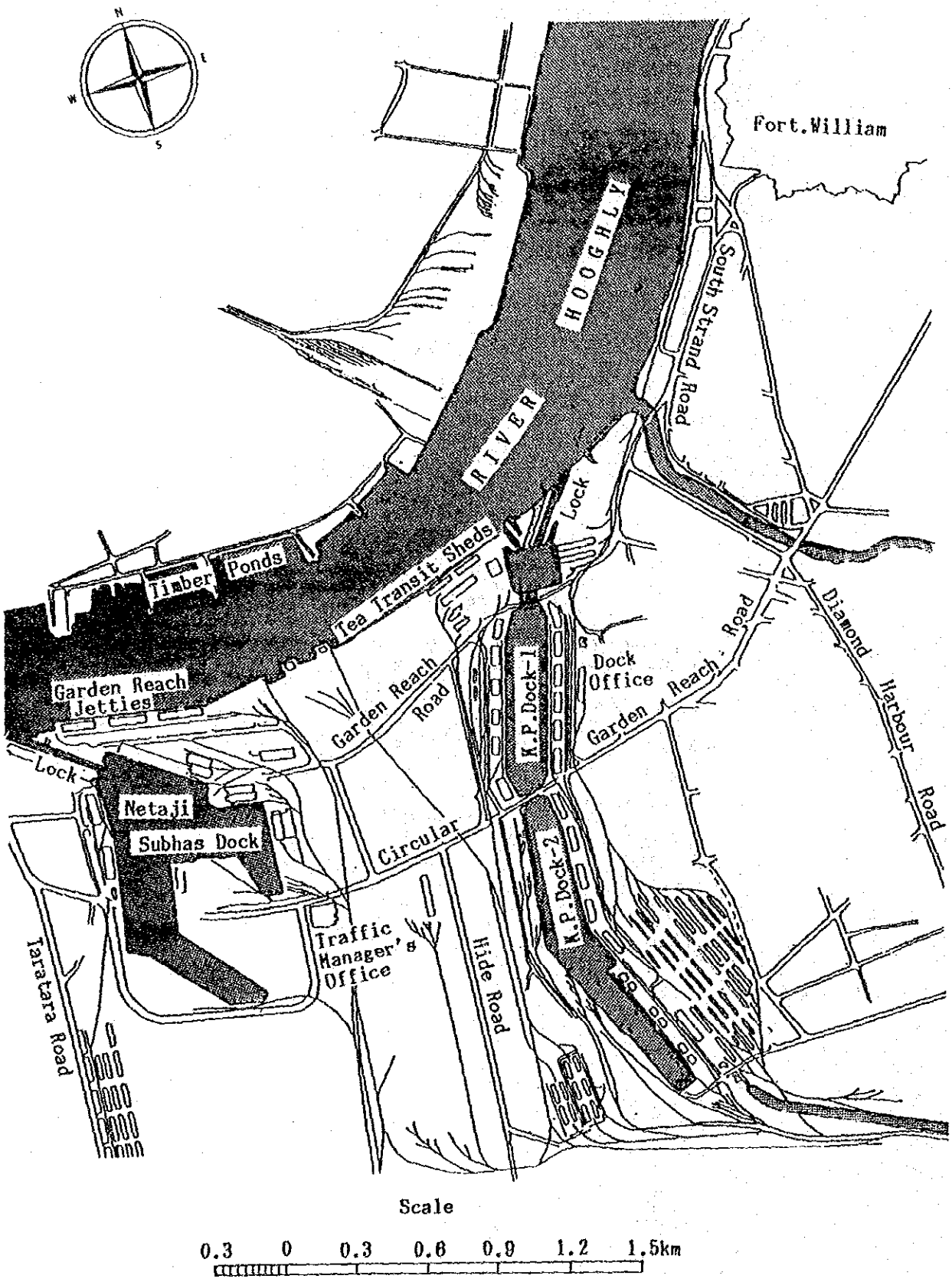


Fig. 3-1-3 Plan of Calcutta Dock System

3-1-2 Haldia Dock System

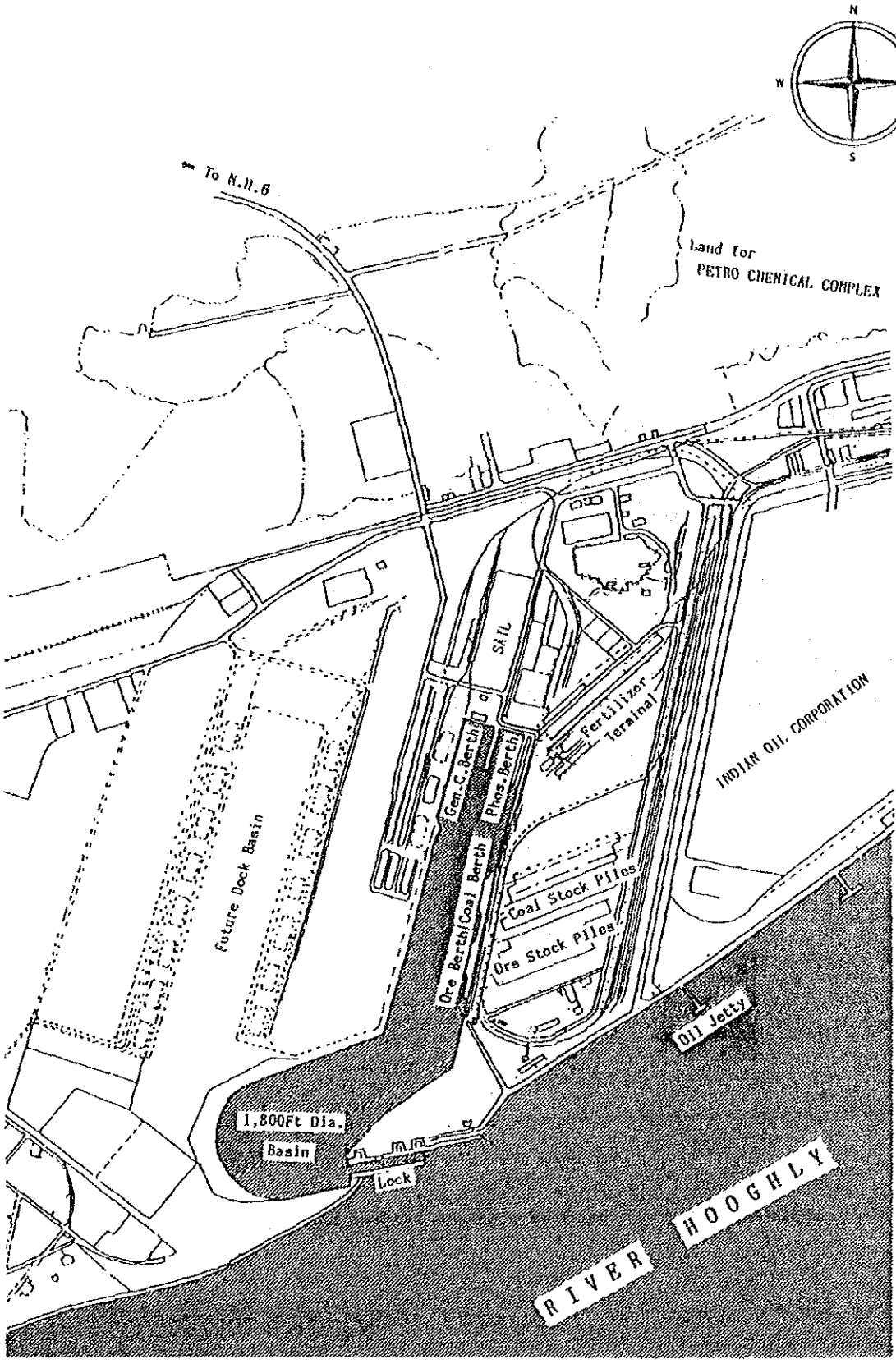
Haldia Dock System is located on the right bank of the Hooghly river 104km downstream from Calcutta. The structural system of the port is a lock system just like Calcutta. Haldia Dock System is planned as a complementary port to Calcutta Dock System. Development began from 1964 and the port was opened in 1977. The purpose of the development plan is as follows.

1) to respond to the enlargement of ship size

2) to develop coastal industry such as petrochemical and fertilizer production.

The cargo handling volume at Haldia is 8.7 million tons in 1987/88. This throughput has grown about 3 times within 10 years, and is equivalent to about two-thirds of the total volume at Calcutta port. The main items inwards are crude oil, petroleum products and coke, and the main items outwards are coal and petroleum products. The annual container cargo volume is presently 15,000 TEU, which represents an increase of about 2.3 times within 5 recent years and is about one-fourth of the total container cargo volume at Calcutta port including both Calcutta and Haldia.

Haldia Dock System is more rational in comparison to Calcutta Dock System in terms of facility arrangement and land use because the port is much newer. However, it has become necessary to review the original master plan because 20 years have already passed since the port was opened. Especially, the increase of bulk cargo volume and container cargo volume are urgent themes. Also, it is important to develop access traffic networks.



Scale

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 Ft

Fig. 3-1-4 Plan of Haldia Dock System

3-2 Natural Conditions

3-2-1 Calcutta

(1) Geology

Calcutta, located on the south-eastern edge of the Gangetic delta, is comprised mainly of alluvium in the lithological aspect, and of upper carboniferous-lower cretaceous gondwana covered sediments of Indian Platform in the tectonic aspect.

Calcutta exists literally at the water level and the land is flat with the decline of the plain measured in inches per mile. This continues to the plain up and down stream the River Hooghly north and south to the border of Bangladesh and about 100km west.

Therefore, there are no slopes and flats defined at 10 - 20 meters per kilometer within 100 kilometers from Calcutta.

As for earthquake considerations, the Calcutta area is in the border of Zone III and Zone IV - in I.S. 1983 - 1984, but Calcutta is often clasified as Zone III with a basic horizontal seismic coefficient of 0.04. No epicenters of earthquakes have been located around Calcutta for the past 190 years.

The geological study of the Bengal basin (as reported) has not yet been able to demarcate precisely the boundaries between the Pleistocene and the Recent series of sediments in the vertical sequence. However, the tentative construction of the stratigraphic column suggests that the deposit down to a depth of more than 100 metres constitutes the Recent series. The Recent series is characterised by its higher water content and variable, but appreciable, quantity of organic matter. It has been suggested that the Pleistocene sediments in the Bengal basin directly rest on the Tertiary sediments and gradually pass upwards through a cyclothemic succession of gravel, sand, silt and clay to the Recent sediments.

It has been recognised that the Recent sediments comprise sand, silt and clay with the latter two being dominant. In an alluvium deposit, three major environments of deposition are normally at play. The observation of the Bengal basin, however, suggests evidence of only two environments, i.e. the Flood plain or Backswamp environment and the Meander Belt environment. Overlapping of deposits of different environmental conditions as expected in an alluvium plain has been recognised within the Calcutta Metropolitan

District. Further, the most recent deposits with which the civil engineering profession is normally interested are said to have been deposited under Backswamp environment.

(2) Climate Conditions

1) Temperature

Calcutta is located near the Tropic of Cancer. Therefore, there is a seasonal variation in the temperature which is specially reflected in the mean daily minimum temperature and the mean lowest temperature by month. May to September are the hotter months whereas December and January are the colder months. The southwest monsoon usually begins in late May and lasts through August. The monsoon helps reduce the temperature, so April and May are the hottest months in the year. In Alipure the highest temperature so far recorded was 43.9 °C on June 1, 1924 and the lowest temperature was 6.7 °C on January 20, 1899. In Dum Dum the highest temperature recorded was 42.9 °C on May 28, 1958 and the lowest was 5.0 °C on January 15, 1947. Half of the days in June to September are rainy days with thunder. On the other hand, the mean total monthly rainfall during the northwest monsoon period from November to February is less than 35mm. The average number of rainy days in this season is less than 2 days. December is the driest month having a monthly rainfall of less than 5mm and an average of less than 1 rainy day. The average annual rainfall is around 1,500mm. The heaviest rainfall in 24 hours since the observatory was established is 369.1mm on August 20, 1900 at Alipure and 288mm on August 21, 1900 at Dum Dum.

2) Humidity

In Calcutta there is little monthly variation in the relative humidity, but the variation is greater than at Haldia.

During June to October, the average relative humidity is 80 to 85% with little variation between the morning and the afternoon. March and April have the lowest relative humidity of around 70%.

3) Visibility

At the Alipure Observatory which is located at the center of Calcutta, there are 15 days per year with a visibility of less than 1km, and most of them are concentrated in December to February. Bad visibility is caused by

fog in the early morning and lasts a few hours or less. The number of days per year with visibility of less than 4km is around 130 days. The poor visibility is caused by fog and precipitation. At Dum Dum the number of days per year with visibility of less than 1km and less than 4km is one-third and two-thirds respectively of the number at Alipure. The climate statistics at Alipure and Dum Dum are shown in Appendix 3-2-1.

(3) Wind Condition

The monthly variation of wind statistics at Calcutta is presented in Table 3-2-1. The monthly mean wind distribution with May representative of the southwest monsoon and November of the northwest monsoon, is shown in Appendix 3-2-1.

(4) Sub-Soil Conditions

Detailed soil investigations were conducted by boring and soil sampling at the Kidderpore Dock and laboratory tests were carried out during the first field survey of the study in June-August 1988.

The soil strata and N-values of the borings are presented in Fig.3-2-1.

A detailed study of the vast amount of information currently available reveals a typically uniform subsoil feature over a very large area in and around Calcutta.

The subsoil with uniform features as stated above is more commonly known as Normal Calcutta Deposit whereas the other deposits in the channels are normally termed as Rive Channel Deposits. It may be noted that below the River Channel Deposits Normal Calcutta Deposits of lower horizon have been encountered. This signifies that the River Channel Deposits are subsequent features imposed over the deltaic terrain of Southern Bengal.

The Normal Calcutta Deposit may be broadly designated in two horizons- the first horizon and the second horizon. The first horizon represents the upper zone covering the softer components of subsoil, which in this region extends approximately about 15 metres below ground level. A majority of the components of this horizon have been found to be normally consolidated. The upper crust of the horizon is recognized to be desiccated. The second horizon comprises the stiffer or denser components occurring just beneath the first horizon and extends down to about 50 metres or more below ground level. The cohesive components of the second horizon have been found to be generally over consolidated. The stiff clay of this horizon exhibits very

interesting texture and colour.

Detailed soil stratification and characteristics in and around Calcutta are presented in Appendix 3-2-3.

(5) Natural Conditions in Calcutta Dock System

1) Topography and Sub-soil Conditions

Calcutta Port, which is located on the left bank of the River Hooghly and near the center of Calcutta city, exists literally on the water level. Calcutta Port has two dock systems which consist of two gate locks, Netaji Subhas Dock, and Kidderpore Dock No. 1 & No. 2 Tidal Basin. The crown height of the wharves is 7.2m above Chart Datum. The land level in the port area is about 7.5m above C.D. and the variation of ground levels may be within two feet from C.D. + 7.5m.

Only the embankment of the River Hooghly and the crown height of the lock sidewalls & river side quaywalls are higher than the inside port area. Detailed soil investigations of Calcutta Dock and laboratory tests were executed during the first field survey of the study in June-August 1988.

The soil strata and N-values of the borings are presented in Fig. 3-2-1, and the results of the laboratory tests are shown in Appendix 3-2-3. Numerous soil investigations by means of borings have been carried out in Calcutta Dock System by C.P.T. Their borehole logs show that stratification and characteristics of soils seem to be nearly similar in general. However, as partial differences such as of the bearing layer in depth do exist, careful detailed investigations in the areas where important structures are proposed will be necessary.

2) Water depth in the Docks

Nataji Subhas Dock

The average dock level of Nataji Subhas Dock basin is 4.72m above K.O.D.S. The water depth of the turning basin has been maintained at a minimum depth of 8m. The depth of the mooring basins is varied. According to soundings surveyed under the superintendence of the commander port dredging surveys during 1986, the minimum depth of each mooring basins is as follows.

Water Depth of Mooring Basins in N.S. Dock

Name of Berth	Location		Water Depth
Berth No. 1	North of Dock	Lock side	8.7m
Berth No. 2	North of Dock	Center	8.2m
Berth No. 3	North of Dock	East	7.9m
Berth No. 4 & 5	East of Dock		8.4m
Berth D	Finger Jetty	West	7.8m
Berth A	West of Dock	Lock side	7.7m
Berth B	West of Dock	Center	7.2m
Berth C	West of Dock	South	6.9m

The water depths indicated above show the points of the shallowest projection and therefore it is possible to easily obtain the necessary depths by means of dredging.

The level of sill in N.S.D. Lock is 6.71m below K.O.D.S. A minimum depth of 4.8m below K.O.D.S. is reported according to soundings surveyed under the superintendence of the Commander in May 1988. The difference of the sill level and bottom depth represents the thickness of siltation. At N.S.D. entrance, the minimum depth reported by the commander is 3.4m below K.O.D.S.

Kidderpore Dock

Kidderpore Dock entrance is located about 3 km upstream of N.S.D. entrance. The average water level of the Kidderpore Dock is 6.4m above K.O.D.S.

The latest soundings surveyed under the Commander show the following order.

Water Depth of Basins in Kidderpore Dock

Name of Dock	Name of Berth	Surveyed on	Min. Depth from the Average Water Level
Tidal Basin	Berth No. 13	March, 1988	7.0 m
	Berth No. 14	April, 1988	5.6 m
	Approach to KPDI	May, 1988	10.0 m
KPD No. 1 Dock	Entrance(east)	April, 1988	4.8 m
	Entrance(west)	April, 1988	10.0 m
	Berth No. 1	Dec., 1987	8.9 m
	Berth No. 3	Dec., 1987	8.2 m
	Berth No. 5	Aug., 1987	9.0 m
	Berth No. 7	Aug., 1987	9.0 m
	Berth No. 9	Aug., 1987	8.8 m
	Berth No. 11	July, 1987	8.8 m
	Berth No. 4	Feb., 1987	8.1 m
	Berth No. 6	Aug., 1987	8.6 m
	Berth No. 8	Aug., 1987	9.0 m
	Berth No. 10	July, 1987	8.8 m
	Berth No. 12	Aug., 1987	8.0 m
KPD No. 2 Dock	Entrance	June, 1986	9.6 m
	Berth No. 23	Dec., 1986	8.4 m
	Berth No. 24	Oct., 1986	8.8 m
	Berth No. 25	July, 1986	8.5 m
	Berth No. 26	Aug., 1986	8.1 m
	Berth No. 27	Aug., 1986	8.0 m
	Berth No. 28	Nov., 1986	8.0 m
	Berth No. 29	Nov., 1986	8.0 m
	Berth No. 19	Oct., 1986	8.2 m
	Berth No. 20	Dec., 1986	8.7 m
	Berth No. 21	Sep., 1986	7.7 m
	Vacant Land Off Berths No. 28 - 29	Nov., 1986	6.0 m

The water-front of 420m in length from Berth No. 15 to Berth No. 17 is a natural slope with a grade of about 1 by 2.

The average water depth of turning basins in the Tidal Basin, KPD Dock No. 1 and KPD Dock No. 2 is 10m, 10.5m and 10m respectively.

The minimum depth of KPD lock and KPD entrance is 4.4m and 3.7m below KODS.

Table 3-2-1 Wind Statistics at Calcutta

Place	Alipure 22° 32'-N, 88° 20'-E														Dum Dum 22° 39'-N, 88° 27'-E											
Month	Mean Wind Speed	No. of days with Wind Speed km/hr				Percentage of Wind from									Mean Wind Speed	No. of days with Wind Speed km/hr				Percentage of Wind from								
		62, more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	CALM		62, more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	CALM
JAN.	2.8	0	0	16	15	18	13	4	2	1	2	2	11	47	4.1	0	0	22	9	32	9	4	2	3	1	2	18	29
FEB.	3.7	0	0	17	11	12	9	3	3	4	12	6	12	39	5.1	0	0	19	9	18	12	4	4	7	3	5	15	29
MAR.	5.2	0	0	25	6	5	4	2	3	12	36	9	10	19	8.4	0	1	25	5	9	4	3	6	21	22	11	10	14
APR.	7.4	0	1	26	3	1	1	1	6	21	51	6	3	10	13.0	0	6	22	2	2	2	5	8	37	32	5	3	6
MAY	8.7	0	2	27	2	1	3	6	10	33	36	3	1	7	16.2	0	10	19	2	1	3	6	12	45	26	2	1	4
JUN.	6.7	0	1	25	4	1	4	11	16	24	26	4	1	13	12.4	0	4	23	3	1	3	12	19	33	17	4	2	9
JUL.	6.0	0	0	27	4	1	5	14	16	19	29	4	1	11	11.5	0	5	24	2	1	6	15	20	26	21	4	1	6
AUG.	5.3	0	0	26	5	1	5	17	14	17	25	4	2	15	10.0	0	3	24	4	2	5	16	22	20	17	5	2	11
SEP.	4.3	0	0	24	6	2	7	14	17	13	17	5	4	21	8.4	0	2	24	4	6	8	16	19	17	10	5	5	14
OCT	3.1	0	0	21	10	11	15	8	5	1	10	4	10	33	5.0	0	1	22	8	18	14	11	6	7	6	4	11	23
NOV.	2.6	0	0	16	14	21	11	3	1	0	2	3	14	45	3.9	0	0	22	8	32	14	4	1	1	3	3	18	26
DEC.	2.5	0	0	17	14	27	8	2	1	0	1	1	16	44	3.5	0	0	22	9	35	9	3	1	1	1	2	21	27
Annual Mean	4.9	0	4	267	94	9	7	7	8	12	21	4	7	25	8.5	0	32	268	65	13	7	9	10	18	13	4	9	17

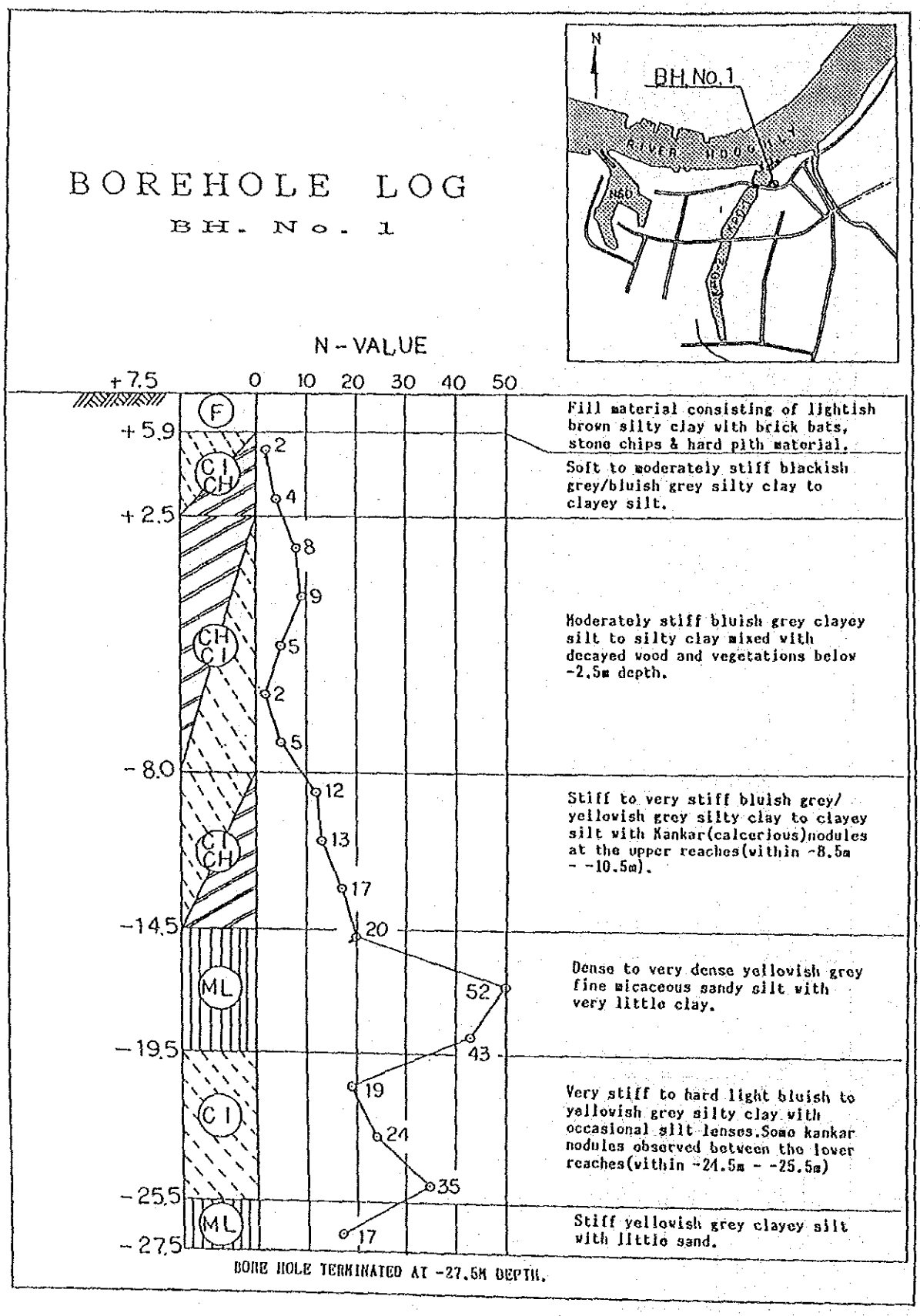


Fig. 3-2-1 Borehole Log at Calcutta Dock System

3-2-2 Haldia and Sagar Island

(1) Geology

The Haldia area, located on the southeastern edge of the Gangetic delta, is comprised mainly of ancient to recent deltaic sediments of vast thicknesses. These alluvial deposits are overlying marine formations probably of Mid-pliocene age and older precambrian shales, schists and phyllites.

The topmost sediments, belonging to the recent alluvium, consist of clay, kankar and at some places laterite gravel. Underlying these sediments are older alluvial deposits which consist of coarse sand and laterite. The actual thicknesses of these formations have not yet been ascertained. This area as part of the Ganga-Brahmaputra delta has undergone subsidence in the geologic past. For earthquake considerations this area is classified as Zone IV - in I.S. 1983-1984, with a basic horizontal seismic coefficient of 0.05.

The epicenter of only one earthquake with an approximate magnitude of 5.0 to 6.0 was located near Haldia in the past 100 years.

(2) Climate Conditions

1) Temperature

There is a seasonal variation in the temperature at Haldia. April and May are hotter months whereas December and January are colder. The highest temperature so far recorded is 44.90 °C in May 1975 and the lowest temperature is 6.90 °C in December 1975.

The mean annual daily maximum temperature at Sagar Island is 29 °C and 32 °C in May and June (the hottest months), and 25 °C in December and January (the coldest months), which is approximately 3 °C lower than at Calcutta.

The mean annual daily minimum temperature at Sagar Island is 23 °C and 27 °C in May to September (the highest months), and 16 °C in December and January (the lowest months), which is similar to Calcutta.

The monthly variation of the mean daily maximum temperature is as small as 5 °C. The greatest difference between the highest and lowest temperatures in one month is 22 °C.

Based on the mean temperature records of the past 35 years, the mean daily maximum and minimum temperatures at Haldia are presented in Table 3-2-2.

Table 3-2-2 Monthly Air Temperature at Haldia

Sl. No.	Month	Mean Daily Temp. °C	
		Max.	Min.
1.	January	26	15
2.	February	29	17
3.	March	34	22
4.	April	36	25
5.	May	37	27
6.	June	34	26
7.	July	32	26
8.	August	32	26
9.	September	32	26
10.	October	30	24
11.	November	29	18
12.	December	26	13

Source : Midnapore weather report - prepared by India Meteorological Department.

2) Rainfall

This region (Sagar Island) is mainly exposed to the southwest monsoon from June to September, and the average monthly rainfall is approximately 350mm. July and August are the wettest months having a monthly rainfall of over 400mm. During the northwest monsoon period from November to February, the monthly average rainfall is less than 35mm.

The average annual rainfall is around 1,900mm and the average number of rainy days in a year is about 88. Rainfall from June to October is over 1,600mm and that from November to May is about 270mm. In Haldia, rainfall is less than at Sagar Island and the average monthly rainfall from June to September is over 225mm. July and August are the wettest months with a monthly rainfall as high as 300mm. During the northwest monsoon period from November to February, the monthly average rainfall is less than 50mm. The average annual rainfall is around 1,500mm and the average number of rainy days in a year with rainfall of 26mm or more is about 20.

3) Humidity

The monthly variation 05 relative humidity at Haldia is presented in Table 3-2-3.

Table 3-2-3 Monthly Variation of Relative Humidity at Haldia

Sl. No.	Month	Relative Humidity (%)	
		0800 hrs.	1700 hrs.
1.	January	82	54
2.	February	80	45
3.	March	76	43
4.	April	76	54
5.	May	78	66
6.	June	84	77
7.	July	87	82
8.	August	88	82
9.	September	88	81
10.	October	84	75
11.	November	79	64
12.	December	81	59

Source : Bay of Bengal Pilot

From the table, the mean relative humidity is highest in August and lowest in March. During the northeast monsoon (November - February) the relative humidity is low, but it is high during the southwest monsoon (June - Sept.). The relative humidity at Sagar Island is similar to that at Haldia.

4) Visibility

No visibility statistics are available for the River Hooghly Estuary. According to information from the bay of Bengal pilots, the visibility is never bad enough to prevents vessels passing through the waterways in the Estuary and the River Hooghly from navigating.

However, the number of days with visibility of less than 1km and of less than 4km at the site may be greater than at Calcutta.

(3) Wind Conditions

The wind pattern in the estuary is more or less in line with the general wind system of the Indian subcontinent. The southwest wind prevails from the end of April to October. A lighter northeast wind blows over the other months with rather unsettled conditions in March - April and in October - November. The average velocity of fully - formed storms appears to be 16km/h to 20km/h. All large storms in the bay are cyclonic.

These occur from April to November, when the southwest trade winds in the Pacific ocean go through a series of pulsations.

These variations in strength and alternations of advances and withdrawal form one of the important features of the southwest monsoons, and provide the disturbed wind conditions for the formation of cyclonic storms. The largest and fiecest cyclones occur in October. A total of 212 cyclonic storms have occurred in the bay during a period of 45 years, and the number of monthly storms is presented in Appendix A-3-1-3.

During the first field survey of the JICA study, sequence recording papers for wind direction and wind velocity at Sagar Observatory were traced and the data were analyzed. The result of the analysis is presented in Appendix A-3-1-4.

During this period cyclones attacked the Estuary twice.

The first cyclone reached the Estuary on 9th June, and the embankment southwest of Sagar Island was damaged by something like jab from swell generated by strong winds from the south southwest.

The cyclone wind speed recorded 34m/sec for an instant (gust) at AM 4:45 and the wind direction, which was previously from the north, changed to S.S.W.

The barometer shows 984.5 mb as the lowest atmospheric pressure during the day and rainfall totaled 75.8mm.

(4) Sub-soil Conditions

Detailed soil investigations were conducted in Haldia Dock System by two boreholes to a depth of 30m below surface.

These investigations were carried out by Casa Engineers International PVT, LTD through the JICA study team during July 1988. Based on the above study and analysis, the subsoil has been primarily divided into four strata as described below:

Stratum 1 ... Between ground surface (+6 - +7m) and (-)2m - very soft to soft clayey silt with N-values ranging from 0 to 10.

Stratum 2 ... Between (-)2m and (-)9m - Loose sandy silt with N-values from 2 to 10.

Stratum 3 ... Between - (-)9m and (-)16m - moderately stiff to stiff clayey silt with N-values from 5 to 20.

Stratum 4 ... Below (-)16m up to the final set (-)24m - an upper part

of medium dense silty sand, and a lower part of dense to very dense silty sand with N-values of 15 to 30 for the upper part and 30 to 70 for the lower part.

Sagar Island

Detailed soil investigations by means of borings and samplings were not available at Sagar Island.

The study team carried out one boring for soil investigation at Chemagari point on Sagar Island in order to examine the Soil for the preliminary design of the facilities for the pilot basin.

Based on the above investigations, the subsoil strata of Sagar Island is similar to that at Haldia. The difference is only the thickness of the surface layer - very soft to soft clayey silt or silty clay - which is about 20m at Sagar Island, that is roughly 2 times thicker than at Haldia.

The borehole logs at Haldia and Sagar Island are shown in Fig. 3-2-2 and Fig. 3-2-3.

(5) Natural Conditions in Haldia Dock System

1) topography

The elevation level at Haldia is based on KODS (Kidderpore Old Dock Sill). The River Datum at the Haldia area (from Sagar to Diamond harbour) is 0.46m below KODS. Thus, the relationship is as follows

$$EL = RD - 0.46m$$

The ground level at Haldia Dock System including the area for future extension varies little, but various heights in facilities may be defined with the following range.

Embankment	RD + 8.5m -- +10.0m
Helical roads	RD + 8.5m -- ± 0.5m
Forest	RD + 7.0m -- + 8.0m
Rice field	RD + 5.0m -- + 6.0m
Container yard	RD + 6.6m
Wharves	RD + 7.2m
Reclaimed ground	RD + 6.5m -- + 7.0m
Other vacant area	RD + 5.2m -- + 5.7m

2) Haldia Dock System

The average impounded level of Haldia Dock is 4.5m above River Datum. The water depth of the turning basin is over 10m within an area 350m in diameter, and over 7m within an area 600m in diameter. The water depth from the turning basin to the coal berth, and from the general berth to the finger jetty is 13.5m and 12.5 on average, respectively. The minimum depths of mooring basins for the container berth, general cargo berths, finger jetty, phosphate berth, and coal & ore berths are 11.0m, 9.5m, 10.5m, 11.0m and 11.5m respectively.

No revetment is available at the circumferences of the turning basin and from it to the coal berth. At some parts, concrete blocks are arranged at the shore line to protect the shore slopes with a grade of about 1 by 4. At Haldia Dock Lock, a minimum depth of 5.2m below RD is reported by superintendence of Commander HPSU at present.

However, since the Lock has siltation problems, maintenance by means of a grab dredger is often carried out. Haldia Dock entrance is located at an area of accertion against Haldia Oil Jetty Located one mile upstream from Haldia Lock. Thus, the necessary depth for vessels at Haldia Dock entrance is maintained by maintenance dredging.

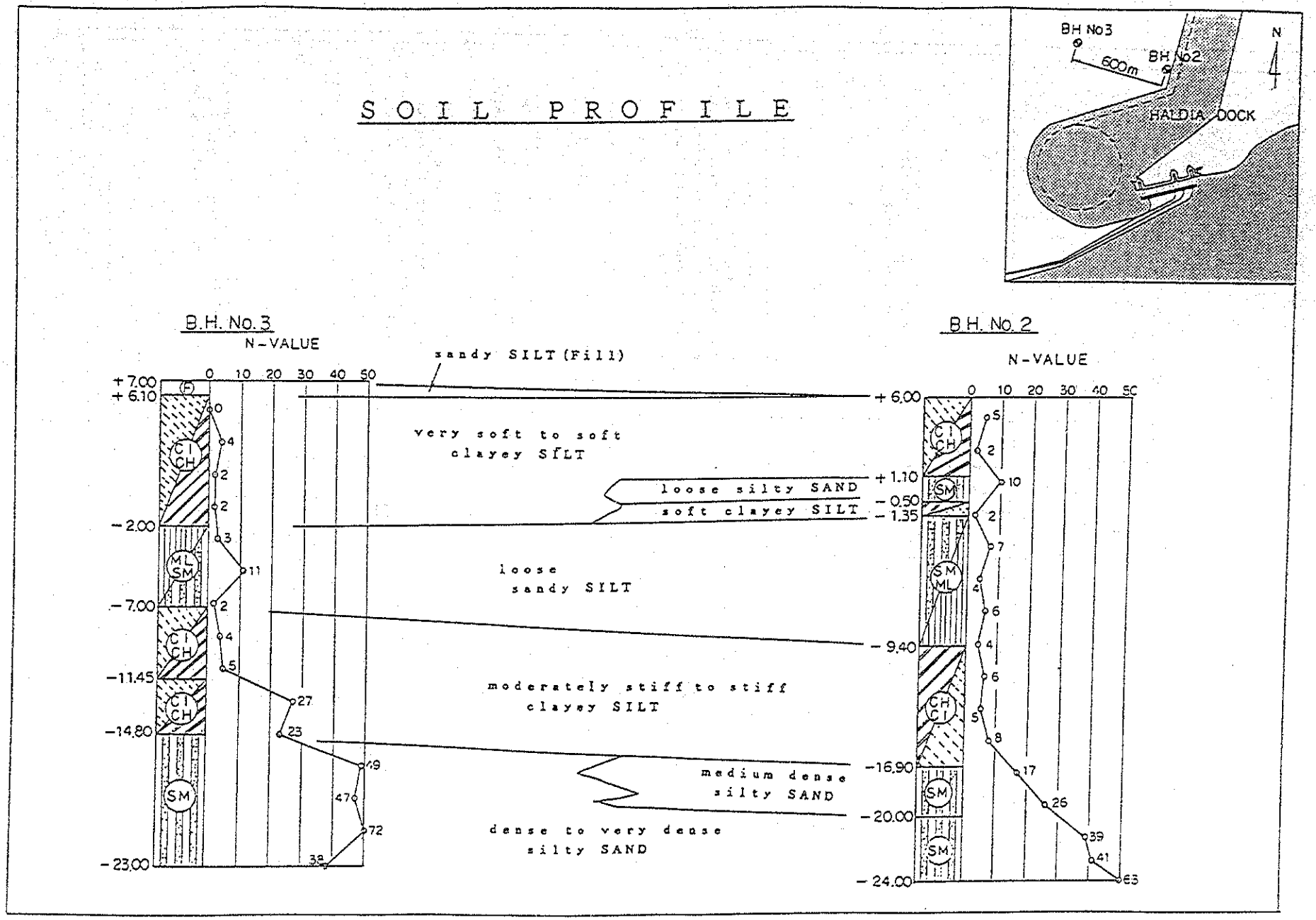


Fig. 3-2-2 Borehole Log at Haldia Dock System

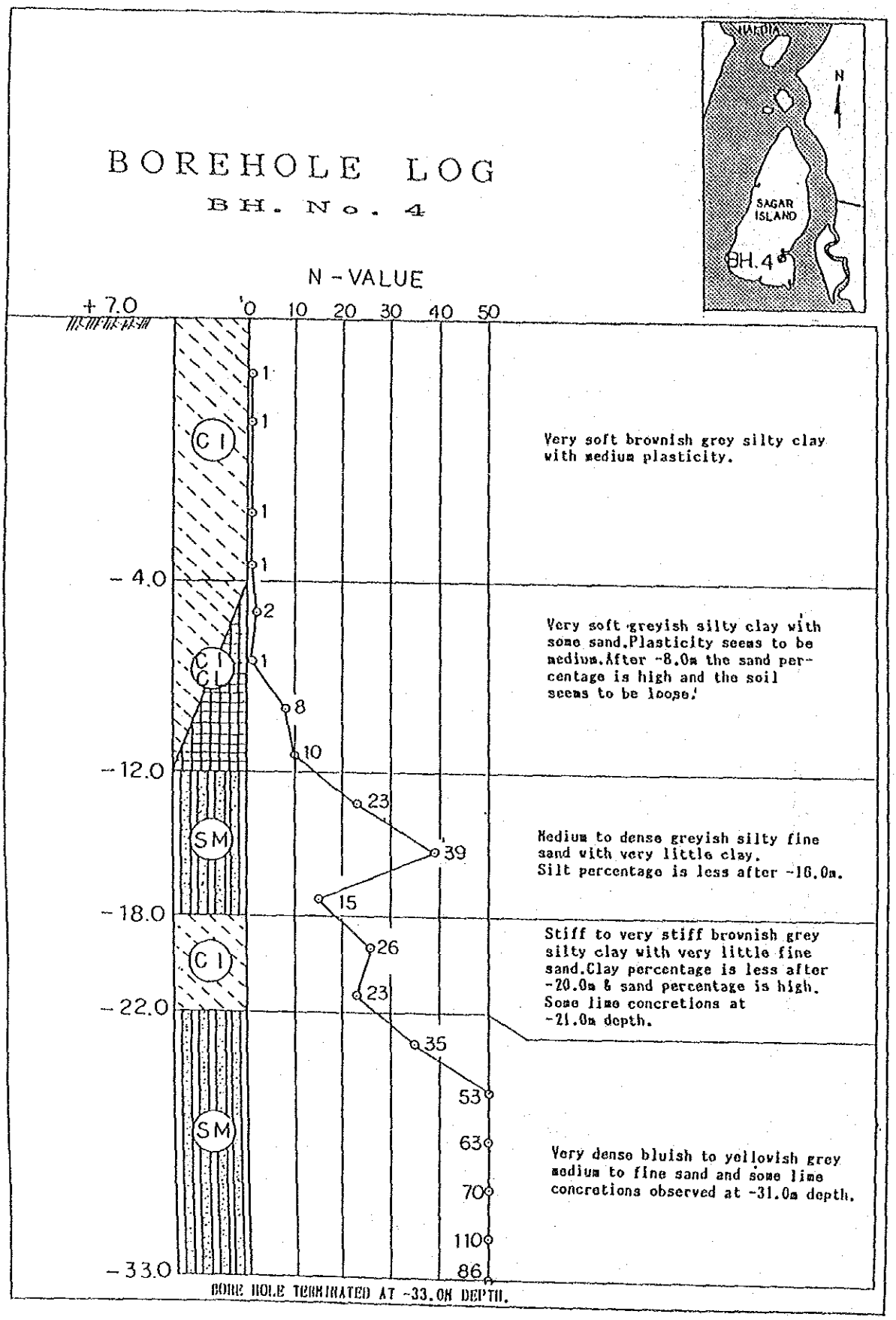


Fig. 3-2-3 Borehole Log at Sagar Island

3-2-3 River Hooghly and the Estuary

(1) Waves

A frequency analysis of the wave directions at the mouth of the estuary is given in Appendix A-3-2-1. The waves mostly approach the estuary from between SSW and SW from February to September. In October, the waves appear to arrive from various directions. From November to the end of January, the incidence of waves is from the north to northeast.

According to the information from the captains of C.P.T., the maximum wave height in the mouth of the Estuary is about 3 to 4m during the southwest monsoon. When the waves arrive at estuary bars (Mizen sand, Upper long sand, Lower long sand), the waves break and lose much of their energy, and approach the down stream of Sagar Island surcharging on the bars. When the waves arrive downstream of Sagar Island, the maximum wave height is limited to about 1.8m with a period of 8 - 10sec. These data were recorded by a wave recorder installed downstream of Sagar and operated for an hour twice each day.

Wave observation at the Sagar Semaphore was conducted by the study team from 12th July to 4th August, 1988 during the first field survey in India. The wave observation data at Haldia Oil Jetty from March to July 1982 gives the wind direction and the maximum wave height in daytime (8:00 AM - 17:00 PM).

Based on the above data and survey records, wave conditions at the sites were analyzed. However, the wave data of both Sagar and Haldia are insufficient to analyze statistics and provability aspects because of the short observation period at Sagar and the lack of observation data during daytime at Haldia. Thus the tables and figures presented in Appendix A-3-2 refer to the study for navigation aids and a navigation safety control system. However, in order to obtain accurate statistics and probability, more careful long-term observations should be carried out.

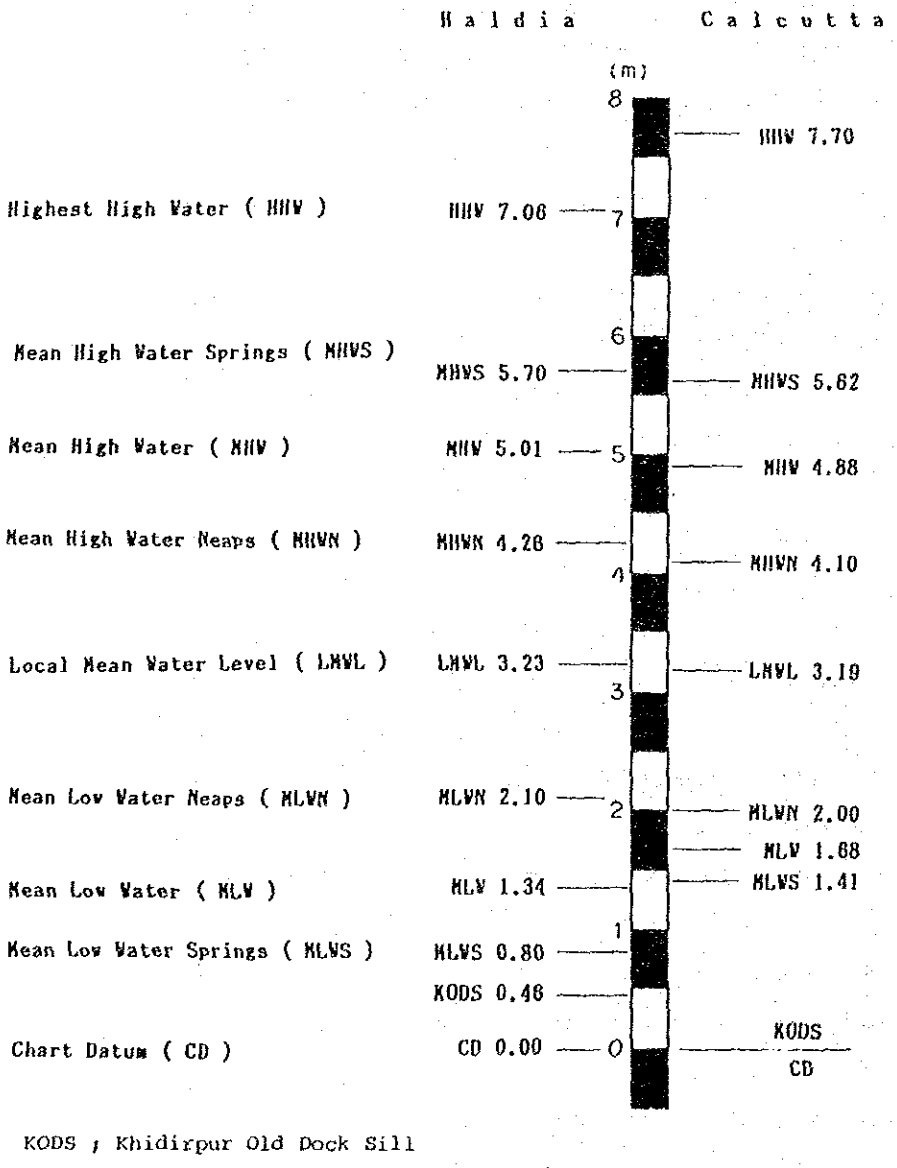
(2) Tide

The tide level from Calcutta to the estuary of Hooghly river is based on the level of Khidirpur Old Dock sill (K.O.D.S.). Between Calcutta to Mayapur including the entrance of Khidirpur and Nataji Subhas docks, the chart datum (CD) is the same level as at K.O.D.S, equal to zero. Between Diamond harbour to Sagar the chart datum (CD) is 0.46 meters below K.O.D.S.

The Hooghly River tide tables are based on the chart datum which is approximately the lowest low water (LLW). Tide table at Haldia and Calcutta are shown in Fig. 3-2-4.

There are seasonal variations in the tide levels because of freshets in the Hooghly river. The range between freshets and the dry season in high water spring is about 0.4 meters at Haldia and 0.9 meters at Calcutta. The tidal range at Haldia is 4.9m in springs and 2.16 m in neaps and at Calcutta it is 4.21m in springs and 2.10m in neaps.

Mean Sea-Level at Calcutta and Haldia is 2.36m and 2.82m above each River Datum respectively.



KODS ; Khidirpur Old Dock Sill

Fig. 3-2-4 Tide Table at Haldia and Calcutta

(3) Tidal Streams

The relative strengths of the ingoing and outgoing tidal streams vary at different seasons of the year. During the NW monsoon from November to February, their rates are approximately equal, 3 to 3.5 knots at springs and 1.5 to 2 knots at neaps. Velocities are max. during March to June, principally due to the rising tides culminating into the equinoctial tide, and also increases its rate t from 4 to 6 Knots at springs.

From July to October, the freshets cause the outgoing stream to predominate; it attains a maximum rate of 7 knots at springs. Bores sometimes occur in the Hooghly river in the stretch between Hugli point and 30 miles up-stream of Calcutta. Bores only occur with greater than average spring tides, and then usually when the seawork flow is augmented by fresets. There is a considerable diurnal inequality in the tides of the Hooghly, the higher water of spring tides occurring at night between October and March, and in daylight between May and September.

The bore reaches a maximum at Chinsura, about 23 miles above Howrah Bridge, and disappears above Naya Serai. The bore on 30 March, 1986, had a height of nearly 1.2m at Buj Buj and Calcutta, increasing to 1.6m at Chinsura.

(4) Sea-bottom Conditions in the Navigation Channels

The navigable channel is subject to annual variations caused by the difference in direction of the scour of the freshets and flood stream during the rainy and dry seasons. The channel through the estuary is subject to changes across the whole of its width, from time to time, such as occur in all wide, sandy and tidal estuaries in their normal state.

In some parts of the river the changes in depths and in the directions of the channels are very rapid, so frequent soundings are carried out by the Marine Department of C.P.T. After the analysis of the soundings, suitable tracks in the channel are quickly decided and the river pilots are informed.

Presently, droughts of 6.8m for Calcutta and 8.6m for Haldia are available in the shipping channels. There are some bars, crossings, reaches and fairway in the navigation channels. The activities of accretion and erosion are small in the reaches and fairway, so that changes of the navigation channels and maintenance dredging have seldom been carried out in these areas. The locations, general information and bottom

profiles of the present navigation channels are presented in Appendix A-3-4-1. However the bottom profile shown in Appendix A-3-4-2 is not useful to apply at present because of the continuous bottom changes day by day in the channels.

A sounding at Gasper channel and Sagar Roads was carried out during the second field survey by the JICA study team in order to examine the proposed channel & anchorage depth and width for the study on the navigation safety control and the improvement of the improvement of the navigation aids system. The bottom changes of the representative section and the border in the Upper and Lower Bars is shown in Fig. 3-2-6 and 3-2-7.

The water depth of Sagar Roads between Lower Auckland Bar and Middleton Bar is over 10m below CD, and the area is about 60 square km, 6km in length and 10km in width. The sea bottom at Sagar Roads seems not to have changed since a few decades ago. Therefore, Sagar Roads may provide a suitable ship-waiting area and/or anchorage.

There are two bars (Upper & Lower) at Middleton Bar in the Gasper channel. The upper bar is situated at the eastern edge of Lower Long Sand Which is one of the biggest sand bars in the River Hooghly Estuary, and the bar lies at the foot of the western side of the existing navigation channel. The lower bar lies eastward of the channel.

In order to enable the navigation of ingoing and outgoing vessels in the river and the estuary, maintenance dredging, with an annual dredged volume of more than 10 million cubic meters over the past ten years except in the last fiscal year (1987 - 1988), was continually carried out by C.P.T.

Balari channel (crossing) was closed in 1987 and Rangafala channel was opened in place of Balari channel. Balari Bar together with Agninari Char (new sand bar island) is rapidly growing year by year. As the bar of the above area grows bigger, the dredging volume to maintain Balari channel increases. Dredging volume in 1987 increased to about 1.5 times the average annual dredging volume in the previous 7 years.

In spite of the endless change of the tidal streams, water in the river as a whole flows to the Bay of Bengal due to the freshets. According to the information of the Hydraulic Study Department, a sandy and silty drift of 12 million cubic meters goes into Garden Reach from upstream, and a similar volume goes out to the Bay of Bengal.

Dredged material are dumped in deep ebb channels. The ebb channels remain deep as their transport capacity may be much than the dumped

volume. Radio Active Tracer Studies by Hydraulic Study Department at dumping places tend to indicate that there is no immediate return of the material over the bars.

The dredged volume of the past twelve years (1976-1987) in Middleton Bar was 13.3 million cu.m, average 1.1 M cu.m per year. But there are annual variations, for example, the dredged volumes in 1977 and 1981 were over 3 million cu.m, and the dredged volume of the latest five years per year was 0.7 million cu.m.

As the Middleton channel is located at a narrow middle channel among growing sand bars, the bottom changes from time to time with variations of intensity caused by the freshets and flood stream.

Sieve analysis of the sea bottom deposits in the Estuary are presented below.

Analysis of soil sample by sieve

D	Diameter in mm		remarks
D--10	0.055	silt	D16 = 0.018
D--20	0.077	fine sand	D84 = 0.117
D--30	0.093		Median diameter = D50 = 0.117
D--40	0.106		Mean diameter = 0.117
D--50	0.117		Uniformity Coefficient = 2.33
D--60	0.128		
D--70	0.140		
D--80	0.154		
D--90	0.181		

* sampling place ---- Balari Bar, Jelligham, Lower Auckland, Lower Middleton, Gasper
* number of samples - 22 points
* sampling period --- 1982 -- 1987
* Data source ------- Hydrulic Study Department of C.P.T.

The average salinity in P.P.T (1982 -- 1987) is as follows.

Calcutta Dock	0.037 ppt
Calcutta freshet	0.028 ppt
Haldia Dock	15.21 ppt
Haldia freshet	3.66 ppt

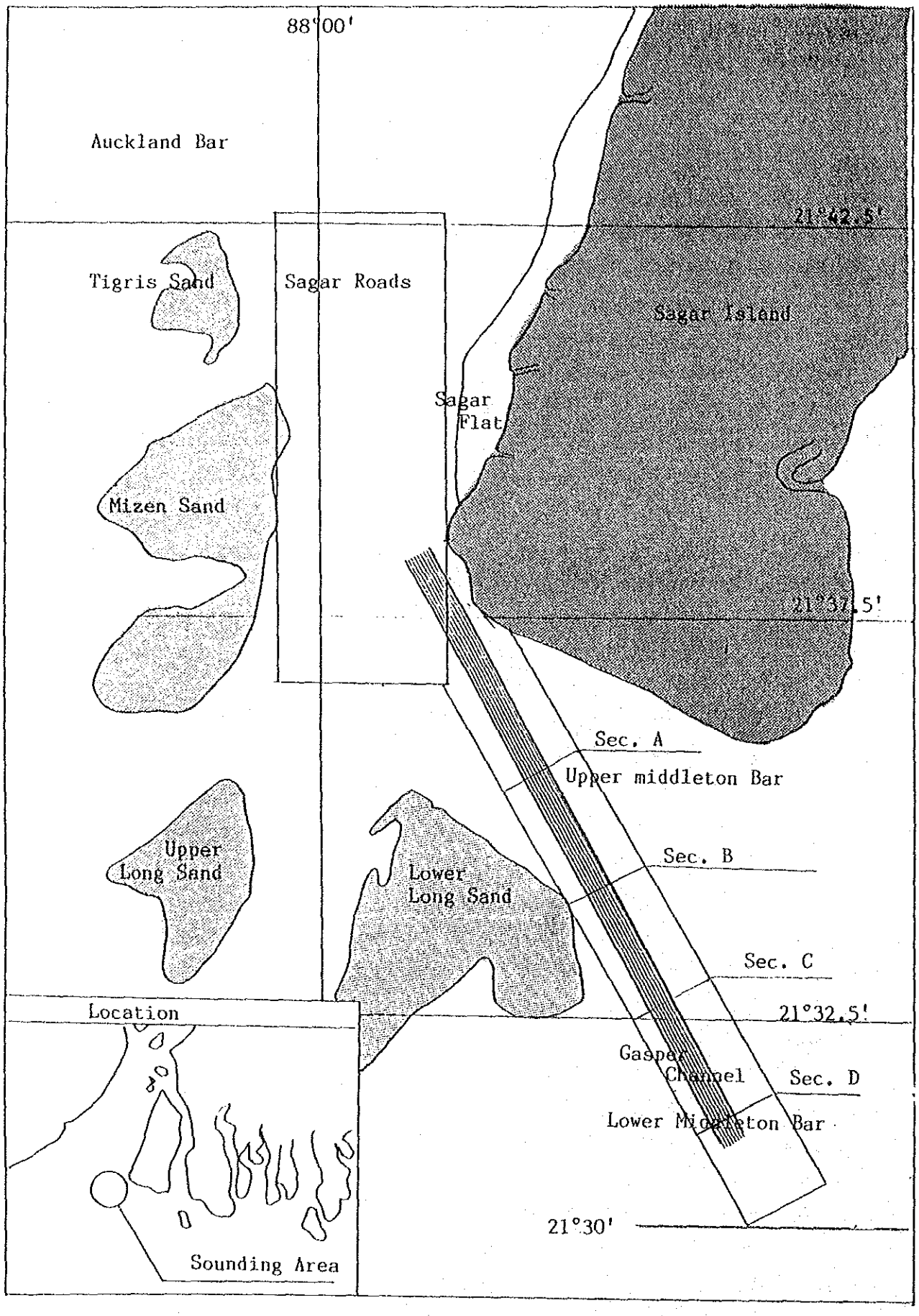


Fig. 3-2-5 Location of Sagar Roads & Gasper channel

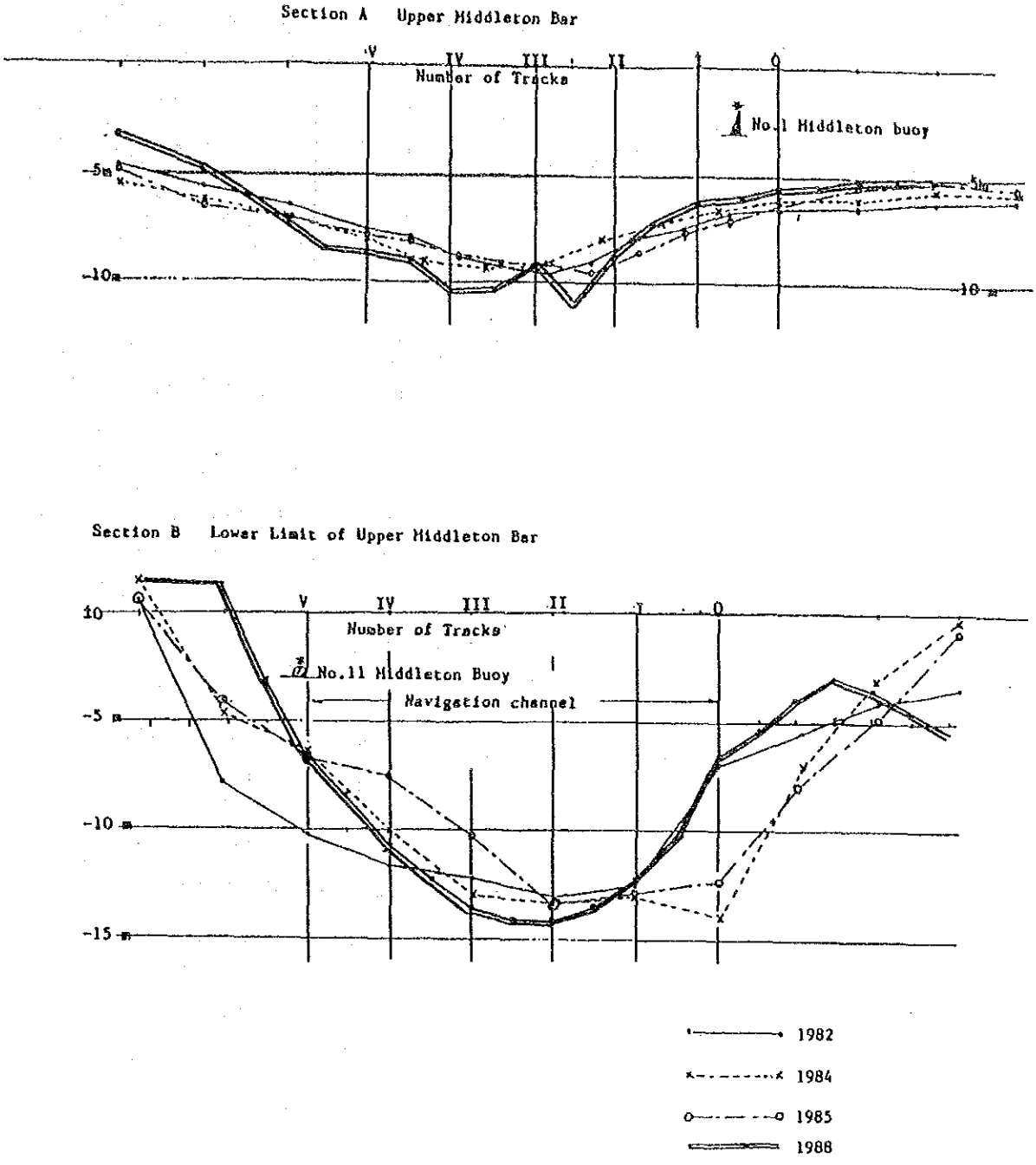


Fig. 3-2-6 Bottom Changes at Upper Middleton Bar

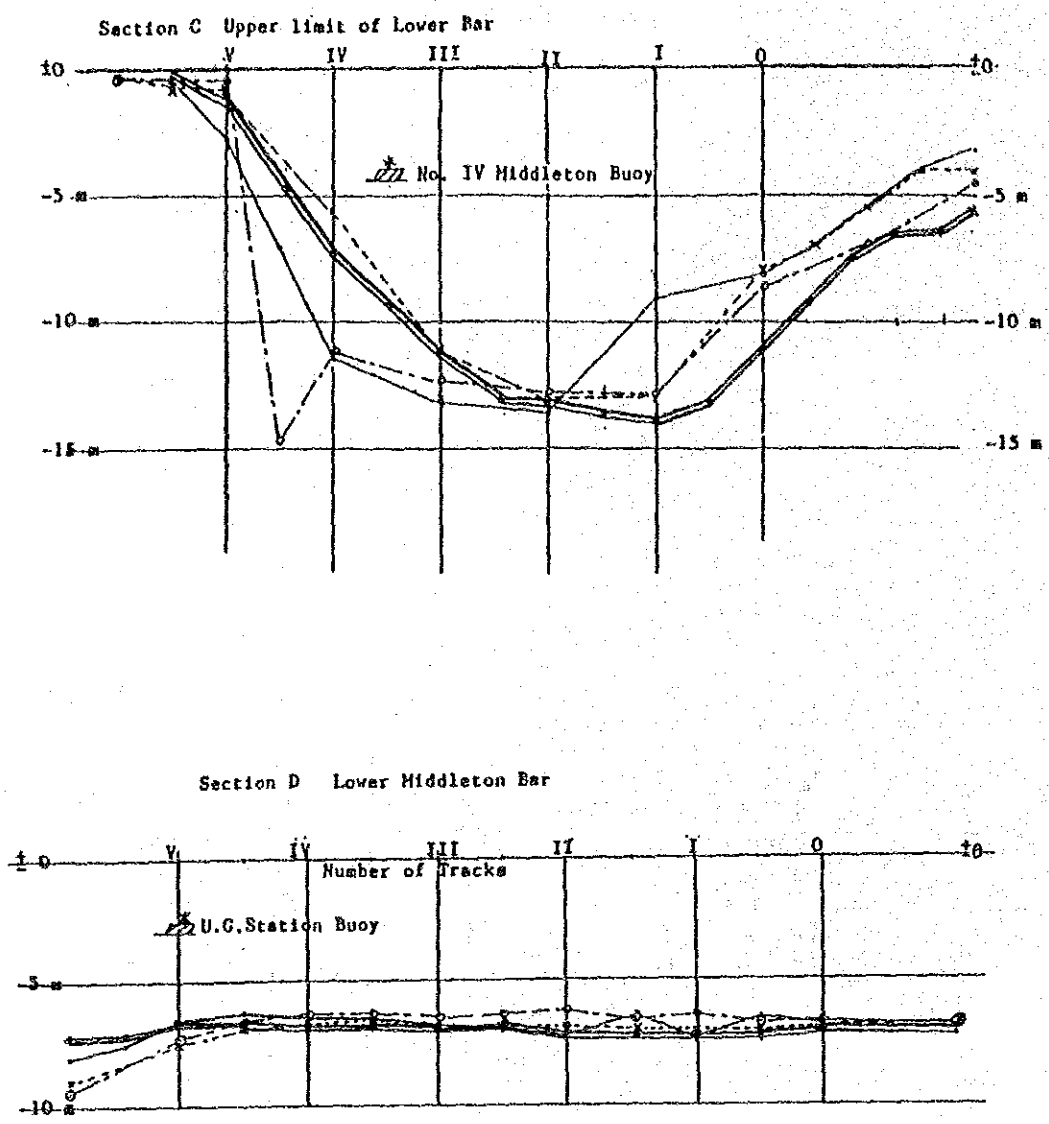


Fig. 3-2-7 Bottom Changes at Lower Middleton Bar

3-3 Existing Port Facilities and Equipment

The present condition of the existing port facilities at Calcutta port is described below.

3-3-1 Calcutta Dock System

The existing port facilities at Calcutta Dock System are shown in Table 3-3-1.

The conclusions from the field survey are summarized as follows.

1) Port facilities are arranged in two water areas which were separately excavated.
2) The maximum ship size which can enter the port at both docks is restricted by the size of the chamber of the lock at the mouth of the dock.
   maximum ship length : in KPD 157 meters
   in NSD 172 meters
3) The depth of water inside the dock is designed as 30 feet, but the actual depth of water is from 7 meters to 9 meters.
4) The numbers of berths are:

KPD	19
NSD	9
GARDEN REACH	2
BUDGE BUDGE	5
total	35

5) The numbers of berths which are actually being used are:

KPD	18
NSD	9
BUDGE BUDGE	5
total	32

6) The main handling commodities are general cargo and containers/heavy cargo, etc.
7) The main handling equipment is:

Coal loading facility:	300 t/h	1 berth
Grain loading facility:	200 t/h	1 berth
Heavy cargo berth:	200 t wharf crane	1 berth

8) Although there are numerous handling machines such as quay/yard cranes, mobile cranes, fork-lifts, and tractors/trailers, almost all of them are deteriorated.
9) The NSD D berth is used exclusively for containers. The development project of the container yard located behind the NSD D berth is being executed with financing from the Asian Development Bank.
10) The roads inside the port and the accesses to the port are all crowded.
11) There are many areas which are not properly maintained or developed for use in the monsoon season.

3-3-2 Haldia Dock System

The harbour facilities at Haldia Dock System are listed in Table 3-3-2.

The results of the field survey at Haldia port are summarized as follows.

1) Harbour facilities are arranged in one water area and the structures are similar to those at the Calcutta lock system.
2) Outline of the lock system in Haldia port:
   Lock entrance: Sliding/floating caisson type electric gate
   Length: 296 m, sub-divided into chambers 305ft & 655ft depending on the length of the ship.
   Width : 39 m; depth: 10.2m below the lowest low water; ship size to be accommodated: L 279m, W 36.6m.
   Lead-in-jetty: L 330 m
   Time for a ship to go in or out of dock: 0.5 hour
3) The turning basin inside the dock has a diameter of 540 meters.
4) The water area in the dock is about 70,000 square meters.
5) There are 1 berth each for iron ore, coal, fertilizer and other bulk cargoes in the water area inside the dock. And there is also a berth for general cargo and container cargo.
6) Petrochemical/fertilizer factories are located at the periphery of the port. There is also a lot of open land.
7) There is a residence area for the harbour workers.
8) The facility for iron ore has been shifted to handling coal because the export of iron ore ceased from 1985.

9) Coal outward volume is not increasing as originally forecast. The actual volume in 1987/88 was 2,600,000 tons against an estimated annual output of 3,500,000 tons.

Table 3-3-1 Existing Port Facilities & Handling Equipment

Calcutta

As of 1988, 2nd Revision/19880414

Location	Berth					Shed			Major Commodity	Handling Equipment					
	No.	L (m)	Width (m)	Depth *(m)	Occupancy(%)	No.	Covered (sq.m)	Open (sq.m)		Type	Capacity (t)	No.	Manu. year	Age (y)	Name
K P D (1)	1	133	18.29	9.15	66.5	1	3,345	1,830	G/C	Jib	5.0	4	1963	25	K1/J1～J4
	3	128	18.29	9.15	53.1	3		4,255	G/C,CTN	Jib	5.0	5	1963	25	K3/J5～J8
-Max.Vessel	4	136	15.24	9.15	62.2	4	3,344	892	G/C	Jib	5.0	5	1963	25	K4/16～20
size to be	5/7	229	18.29	9.15	86.5	5/7	6,688	1,561	G/C	Jib	5.0	4	1963	25	K5/J11～J14
accommodated	6	118	15.24	9.15	85.4	6	3,345	780	G/C	Jib	5.0	4	1963	25	K6/12～15
	8	128	15.24	9.15	71.2	8	3,344	1,450	G/C	Jib	5.0	3	1963	25	K8/9～11
OAL: 157 m	9	108	18.29	9.15	70.4	9	3,345	650	G/C,Ferti.	Jib	5.0	5	1963	25	K9/J15～18
Beam: 21.8m	10	181	15.24	9.15	84.1	10	3,345		G/C	Jib	5.0	4	1963	25	K10/5～8
	11	151	18.29	9.15	80.0	11	3,344	892	G/C	Jib	5.0	5	1963	25	K11/20～24
	12	143	15.24	9.15	62.8	12	3,344		G/C	Jib	5.0	4	1963	25	K12/1～4
Sub-total	10	1,435					33,445	12,310				43			
K P D (2)	20	147		9.15	52.0	20			Coal						
	22	151	12.2	9.15	53.8	22	8,918	1,412	G/C,(Pas.)						
	23	147	12.2	9.15	60.5	23	8,918	1,394	G/C,Grain						
	24	152	12.2	9.15	68.8	24	8,918	1,393	G/C						
	25	189	12.2	9.15	65.4	25	8,918	1,394	G/C						
	26	185	12.2	9.15	71.2	26	9,033	3,783	G/C						
	27	195	21.3	9.15	87.9	27	3,623	3,512	G/C,Log,Heavy	Jib	3.0	2	1985	3	K27/1A,2A
	28	195	21.3	9.15	63.8	28	3,523	4,168	G/C,Log,Heavy	Jib	2.0	2	1985	3	K28/1A,2A
	29	183	21.3	9.15	86.5	29	3,623	3,513	G/C,Heavy	Jib	2.0	2	1985	3	K29/1A,2A
Sub-total	9	1,567					51,478	20,549				8			
Total(KPD)	19	2,982					84,923	32,858				49			
N S D	1	200	13.7	9.15	81.0	1		4,200	G/C,CTN,Heavy		200.0	1	1957	31	
	2	187	15.2	9.15	83.0	2	11,757	3,831	G/C	Jib	2.0	2	1983	25	Q/C8,11,13
-Max.Vessel	3	183	15.2	9.15	86.5	3	11,758	1,487	G/C,Cement	Jib	2.0	2	1983	25	Q/C18
size to be	4	181	15.2	9.15	85.2	4	11,758	1,487	G/C,CTN	Jib	5.0	1	1983	25	Q/C17
accommodated	5	182	12.2	9.15	70.6	5		6,050	G/C,CTN	Jib	5.0	2	1963	25	Q/C43～48
	A	174	15.2	9.15	66.3	A	15,235	2,555	G/C						
OAL: 172 m	B	174	15.2	9.15	70.6	B	10,093	1,278	G/C		3.0	3	1959	29	Q/C38～42
Beam: 24.4m	C	152		9.15	35.8	C	1,872		POL, Dolphin berth for oil tankers						
	D	192	21.3	9.15	75.8	D	12,263	2,322	G/C,CTN		3.0	5	1959	29	Q/C32～36
Total(NSD)	9	1,625					74,736	23,210				16			
Budge Budge	1	189			69.8				POL,Veg.oil						
	2	102			43.2				POL,Veg.oil						
	3	183			34.2				Bunk Veg.o						
	5	189			58.9				POL,Veg.oil						
	8	189			30.8				POL,Veg.oil						
Sub-Tota	5	832													
Total(Calcut)	33	5,439					159,659	56,069				65			

Note

* The average water depth at berths in KPD & NSD varies between 8.5m to 8.15m.

Mobile Crane

Capa	No.	M/Y	Age
30t	2	1984	24
30	1	1982	6
30	1	1985	3
10	1	1964	24
10	3	1967	21
10	2	1981	7
10	3	1984	4
10	1	1986	2
10	2	1987	1
8	4	1974	14
8	5	1980	8
8	1	1981	7
8	10	1982	6
8	1	1983	5
8	8	1988	2

Rep.15t by 20 Yard Crane

Rep.8t/2nos. by 10t/2nos

Yard Crane

Capa	No.	M/Y	Age
15	1	1943	45
8	2	1943	45
6	1	1943	45
30	1	1943	45
8	2	1943	45
2	1	1930	58
3	3	1958	30
200	1	1957	31
4	1	1943	45
3	1	1963	25
3	1	1963	25

Forklift

Capa	No.	M/Y	Age
3t	3	1980	8
3	5	1981	7
3	22	1982	6
3	5	198	
2	12	1985	3

Table 3-3-2 Existing Port Facilities & Handling Equipment

HALDIA

as of 1988

Description	Berth					Shed			Major Commodity	Handling Equipment						Note
	No.	L (m)	Width (m)	Depth *(m)	Occupancy(%)	No.	Covered (sq.m)	Open (sq.m)		Type	Capacity (t)	No.	Manu. year	Age (y)	Name	
Lock Entrance Lead-in-jetty		295 (985') 330(1,100')	39.0 (130')	-10.2 below LLW (34')						For Multi & G/C Berths Mobile Crane Forklift Shunter Tractor Trailer		5 8 2 4 5				2 chambers: 91.5m(305') 196.4m(654')
-Max.ship side to be accommodated : L 279m (930'),W 36.6m(122')																
Turning Basin	Dia. 540m(1800')			-13.5(45')												
Ore Berth		332(OAL) (1108') 194 (646')	16.8(Berth face) (56')				Stockpile:	300,000 ×2 = 600,000	Ore (formerly) Coal	Loader Tippler Conveyor Sta/Rec	3,000T/H 1,500T/H 3000T/H 1500t/h	2 2 2 2			Rota	Stacker/Reclaimer Stacker 1,500 t/h Reclaimer min. 750 t/h avg.1,250 t/h max.1,400 t/h
-Ship size to be accommodated : 258m(860') -Initial annual programme output : 4,000,000 t/y with modification : 7,000,000 t/y																
Coal Berth		280(OAL) (932') 148 (493')	16.8(Berth face) (56')				Stockpile:	100,000 ×2 = 200,000	Coal	Loader Tippler Conveyor Sta/Rec	1500t/h 1500t/h 1500t/h 1500t/h	2 2 2 2				Stacker/Reclaimer Stacker 1,500 t/h Reclaimer min. 750 t/h avg.1,000 t/h max.1,250 t/h
-Ship size to be accommodated : 228m(760') -Estimated output : 3,500,000 t/y - with modification : 5,000,000 t/y																
Phosphate Berth		239(OAL) (787') 176 (586')	18.8(Berth face) (66')						Phosphate	Grab-Bucket Unloader Conveyor Bagging plant	700t/h 1300t/h 30t/h	2 1 12				800 bags/h, 50 kg/bag
-Estimated output : 1,600,000 to 1,900,000 t/y -Divert to Hindusthan Lever or F.C.I.directly																
Finger Jetty		231 (770')	18.9 (63')						Salt Sulpher Fertilizer	Grab-Bucket Unloader	15t	1				with 2 conveyors of 500 t/h & hopper
-Estimated output : 800,000 t/y																
Multi-Berth		432 (1440') 507(1690',OAL)	36.0(Berth face) (120')				9,000 (100,000 sq.ft)	800 CTN	G/C,CTN Heavy	Quay Crane Transtainer	30.5t 30t	1 1			Paceco Paceco	40' container 2/3 high
General Cargo									G/C,Coking Coal							by ship gears & mobile equipment
Oil Jetty -Small jetties at river side	90(Hoogly river side, feed Haldia Refinary								C/Oil							L:234m Tanker 87,500 t

2nd Revision/19890707

3.4 Structual Survey

3.4.1 Calcutta Dock System

(1) Port facilities

Calcutta was the first major port in modern India. The first jetties of Calcutta were constructed in 1869, followed by an oil wharf at Budge Budge in 1886 and a tea warehouse at Armenian Ghat in 1887. Wet docks followed at Kidderpore, 3.2km downstream of the first jetties, and were opened in 1893. Netaji Subhas Dock (formerly King George's Dock) was constructed in 1928.

The Port of Calcutta is plagued with bars, bends and bores. As a riverine port like Klong Toei Port in Bangkok, Phnom Penh Port in Kampuchea, Rangoon port in Burma and many ports in Indonesia, Calcutta faces many problems, mostly from siltation. In 1962, Haldia port was selected and was commissioned in 1977 as an outer-port of Calcutta. A Jetty for P.O.L. and a new dock were opened in that year. Since the commencement of operations at Haldia Port, the port has been growing in an orderly fashion. However, Haldia is still a riverine port, and thus faces many of the same problems as Calcutta Port.

Almost all the facilities and handling equipment at Calcutta are time-worn. Therefore, the improvement and/or rehabilitation works of existing port facilities shall be taken into consideration.

However, almost all of the harbour structures in Calcutta port are highly durable because they were designed as gravity style structures even though they were constructed long ago.

Accordingly, the quay walls themselves are in a sufficient condition for use even at present. Weathering has progressed however, and some damages are observed. Handling equipment, warehouses and transit sheds are remarkably deteriorated and some of them are useless at present.

There are 4 categories of structual design of the existing quaywalls at Calcutta port. (refer to Fig. 3-4-1)

1) Traditional gravity type: Mass concrete or brick masonry on hard bed materials in dock is used to maintain the stability of the quaywall. This is used for KPD 1 To 13, 22 To 26, NSD 1 To 4, and NSD A & B

2) Steel sheet pile style: This type is very popular in Japan and other countries. But, there is only one such berth, NSD 5, in Calcutta port.

3) R/C (Reinforced Concrete) pile pier type: This type is also very popular and used for KPD 27 to 29, and NSD D berth.

4) Dolphin type: This type is often used for bulk or liquid materials handling.

There is no serious problem in the quay structures.

There is reportedly some problem with the mechanical operation of the lock gate system.

Among facilities related to the port, some bridges at the intersections between roads and docks are deteriorating structually and there are problems of traffic congestion. Furthermore, reconstruction and development of fundamental facilities such as railroads/roads/sewerage/electricity/water supply/lighting/communication, etc. is sorely needed.

(2) Cargo Handling Equipment

The existing cargo handling equipment at Calcutta port is shown in Table 3-4-3. The port is designed like a typical European Port with many quay-side cranes for cargo handling crowded together. Based on the available documents and the site investigation, there are many problems at the port.

1) Age

Table 3-4-2 shows the age of cranes at Calcutta Port.

Table 3-4-2 The Age of Cranes at Calcutta

Items	Number	Average age (years)	Number over working lifetime	Percent over working over lifetime
Quay-side cranes	63	23.5	57	90
Mobile & Yard cranes	61	16.3	24	40
Forklift trucks	47	4.94	30	64

Remarks

1. Estimated working lifetime

Quay-side crane 25 Years

Yard crane	25 Years
Mobile crane	15 Years
Forklift truck	5 Years

From the table it can be seem that:

a) Most of the quay side cranes and Forklift trucks are very old and 90 percent of the quay-side cranes and 64 percent of the forklift trucks are beyond their regular working lifetimes.

b) It is assumed that this equipment is inefficient because machinery performance depends on age, worked hours and maintenance level.

c) There is presently no schedule for replacement of this equipment.

2) Effective use of the existing handling equipment

a) Quay-side cranes

There are 63 quay-side cranes at the port. Based on the site investigation, many of these cranes are not necessary.

Many of the quay-side cranes are not being used effectively because they are not at the most suitable position to access the cargo onboard and they are fixed on a rail. The cranes have to be moved to the most suitable position to increase productivity and improve safety.

b) Yard cranes

There are 18 yard cranes at the open storage yard. Most of them can travel on a rail. However, most of them are actually being used as fixed cranes.

Thus, their service area is limited and very narrow.

c) Minor handling equipment (Forklifts, Trailers, etc.)

The throughput capacity at berth depends on the capacity of the smallest handling equipment at each cargo handling stage.

The handling capacities of minor handling equipment are as important as those of quay-side cranes or ship gear.

Most general cargo (except bulk cargo and timber) is handled manually with the help of hand trucks at present.

d) Floating Cranes

The existing floating cranes at Calcutta Dock system are listed in Table 3-4-3.

Table 3-4-3 Existing Floating Cranes

Name	Year Built	Capacity			Hull Dimensions			Gross Tonnage	Max Speed
		Lifting	Max Radius	Height of hook above W.L	Length	Breadth	Mean Draft		
		(t)	(m)	(m)	(m)	(m)	(m)	(t)	(kt)
ATLAS	1923	60	18.3	23.5	54.6	17.4	2.3	980.0	10
BAHABAHU	1963	60	24.4	26.5	54.9	17.4	2.8	1,000.6	9.5
VIR. BAHU	1963	30	18.3	26.5	48.2	15.2	2.5	758.0	10

There are three floating cranes at the port. One of them is very old, and the other two are old.

The existing handling equipment (ship gear, quay-side cranes and mobile cranes) can not handle very heavy cargo and larger mobile cranes can not be used because of the shortage of bearing strength at the apron.

In these cases, floating cranes are used.

3-4-2 Haldia Dock System

(1) Port Facilities

Haldia Dock System was developed from about 1964 and opened in 1977. The Dock System is new in comparison to Calcutta Dock System. Accordingly, the deterioration of facilities is not yet significant. However, there is some problem with the handling system for iron ore and coal.

First of all, the quay wall is designed as a concrete monolith type structure. Accordingly, this structure is strong enough in terms of durability and resistance to rust (refer to Fig. 3-4-2)

The oil jetty located along the Hooghly River is a steel pipe pile structure. This pier has structure itself shows no damage. Also, there are problems with siltation at the front area of the entrance lock of Haldia dock.

Sooner or later it will be necessary to study comprehensively systematic maintenance dredging including the dredging of navigation cannels because this is a serious problem for both Calcutta and Haldia Dock System.

(2) Cargo Handling Equipment

The existing cargo handling equipment at Haldia Dock System is shown

in Table 3-4-4. The equipment is not so old as at Calcutta Dock System because Haldia Dock System opened only eleven (11) years ago. However, the maintenance level is not high.

At present the most important item concerning the existing handling equipment is the need for sufficient maintenance to increase productivity and maintain safety.

3-4-3 Craft/Vesscls

These are described in Section 11-3-1.

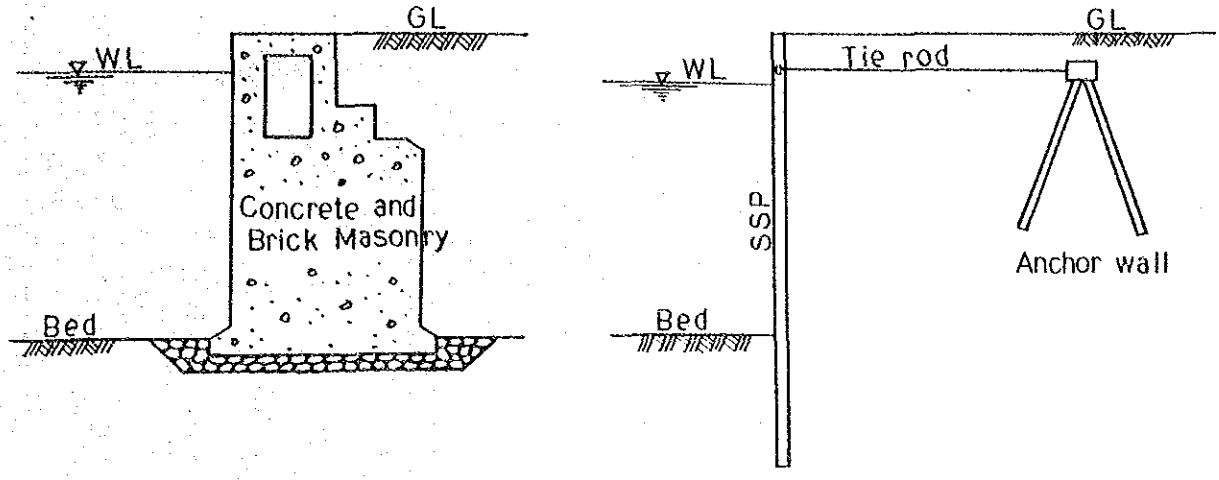
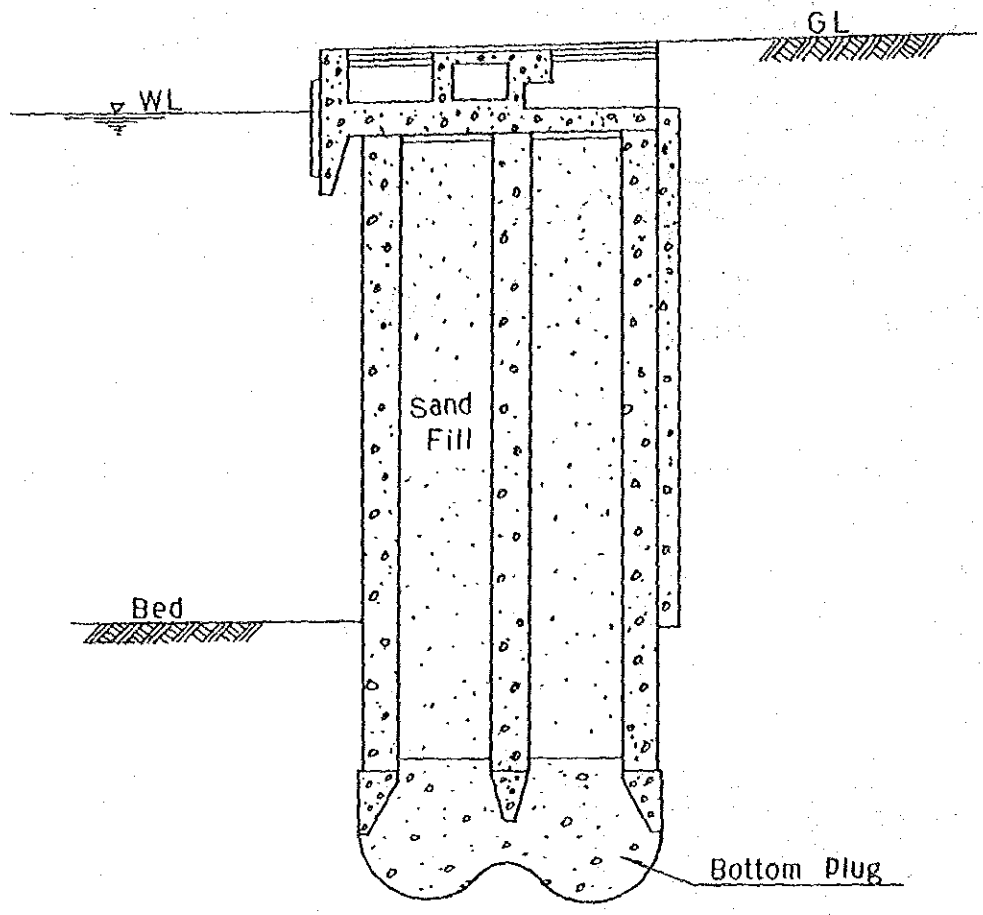


Fig. 3-4-1 Existing Quaywalls at Calcutta Dock System



Concrete monolith type

Fig. 3-4-2 Existing Quaywall at Haldia Dock System

Table 3-4-1 Existing Port Facilities & Handling Equipment
Structural Survey List

CALCUTTA

As of 1988

Location	Berth No.	Berth Structual Type	Activity (Cargo) Occupancy (%)	Volume (1,000 t) 85/86	86/87	87/88	Average	Major Commodity	Handling Equipment Type	Capacity (t)	No.	Manu. year	Age (y)	Name
K P D (1)	1	Gravity	86.5	104	61	70	78.3	G/C	Jib	5.0	4	1963	25	K1/J1～J4
	3	-do-	53.1	97	100	117	104.7	G/C,CTN	Jib	5.0	5	1963	25	K3/J5～J9
	4	-do-	62.2	34	60	85	59.7	G/C	Jib	5.0	5	1963	25	K4/16～20
	5/7	-do-	86.5	110	103	128	113.7	G/C	Jib	5.0	4	1963	25	K5/J11～J14
	6	-do-	85.4	47	53	56	52.0	G/C	Jib	5.0	4	1963	25	K6/12～15
	8	-do-	71.2	90	74	93	85.7	G/C	Jib	5.0	3	1963	25	K8/9～11
	9	-do-	70.4	118	105	114	112.3	G/C,Ferti.	Jib	5.0	5	1963	25	K9/J15～19
	10	-do-	84.1	81	93	97	90.3	G/C	Jib	5.0	4	1963	25	K10/5～8
	11	-do-	80.0	77	100	82	86.3	G/C	Jib	5.0	5	1963	25	K11/20～24
	12	-do-	62.9	110	79	103	97.3	G/C	Jib	5.0	4	1963	25	K12/1～4
K P D (2)	20	Dolphin	52.0	63	59	9	43.7	Coal						
	22	Gravity	53.6	43	37	32	37.3	G/C,(Pas.)						
	23	-do-	60.5	124	100	80	101.3	G/C,Grain						
	24	-do-	66.8	115	86	103	101.3	G/C						
	25	-do-	65.4	112	108	111	110.3	G/C						
	26	-do-	71.2	114	106	83	104.3	G/C						
	27	R C Pile	87.9	112	112	137	120.3	G/C,Log,Heavy	Jib	3.0	2	1985	3	K27/1A,2A
	28	-do-	63.8	92	87	140	106.3	G/C,Log,Heavy	Jib	2.0	2	1985	3	K28/1A,2A
	29	-do-	86.5	117	114	135	122.0	G/C,Heavy	Jib	2.0	2	1985	3	K29/1A,2A
Total(KPD)	19										49			
N S D	1	Gravity	81.0	89	107	119	105.0	G/C,CTN,Heavy		200.0	1	1957	31	
	2	-do-	83.0	116	125	163	134.7	G/C	Jib	2.0	2	1963	25	Q/C8,11,13
	3	-do-	86.5	108	122	153	128.0	G/C,Cement	Jib	2.0	2	1963	25	Q/C16
	4	-do-	85.2	118	108	149	125.7	G/C,CTN	Jib	5.0	1	1963	25	Q/C17
	5	Steel Sheet	70.6	143	180	179	167.3	G/C,CTN	Jib	5.0	2	1963	25	Q/C43～48
	A	Gravity	66.3	135	135	122	130.7	G/C						
	B	-do-	70.6	120	137	123	128.7	G/C		3.0	3	1959	29	Q/C38～42
	C	Dolphin	35.6	131	120	112	121.0	POL, Dolphin berth for oil tankers						
	D	R C Pile	75.8	207	191	200	199.8	G/C,CTN		3.0	5	1959	29	Q/C32～36
Total(NSD)	9										16			
Budge Budge	1		69.8					POL,Veg.oil						
	2		43.2					POL,Veg.oil						
	3		34.2					Bunk Veg.o						
	5		58.9					POL,Veg.oil						
	8		30.6					POL,Veg.oil						
Total(Calcut)	33										65			

Note

* The average water depth at berths in KPD & NSD varies between 8.5m & 9.15

Mobile Crane

Capa	No.	M/Y	Age
30t	2	1964	24
30	1	1982	6
30	1	1985	3
10	1	1964	24
10	3	1967	21
10	2	1981	7
10	3	1984	4
10	1	1986	2
10	2	1987	1
6	4	1974	14
6	5	1980	8
6	1	1981	7
6	10	1982	6
6	1	1983	5
6	6	1986	2

Rep.15t by 20 Yard Crane

Rep.6t/2nos. by 10t/2nos

Yard Crane

Capa	No.	M/Y	Age
15	1	1943	45
6	2	1943	45
6	1	1943	45
30	1	1943	45
6	2	1943	45
2	1	1930	58
3	3	1958	30
200	1	1957	31
4	1	1943	45
3	1	1963	25
3	1	1963	25

Forklift

Capa	No.	M/Y	Age
3t	3	1980	8
3	5	1981	7
3	22	1982	6
3	5	198	
2	12	1985	3

[Remarks] 1) The average length of all berths in Calcutta port is 165 m. This figure is slightly shorter than the standard length(i.e.180 m) of -9.0 m deep berths for oceangoing ships. However, because the berths are continuous,this presents no problem. 2) The average apron width of the berths is also narrow for the cargo handling operation. 3) The water depth at Docks is sufficient.

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Table 3-4-4 Existing Port Facilities & Handling Equipment
Structural Survey List

HALDIA

As of 1988

Description	Berth	Activity (Cargo)						Handling Equipment						Note
	Structual Type	Occupancy (%)	Volume (1,000 t)				Major Commodity	Type	Capacity (t)	No.	Manu. year	Age (y)	Name	
			85/86	86/87	87/88	Average								
Lock Entrance Lead-in-jetty	Concrete Monoliths													2 chambers: 81.5m(305') 198.4m(654')
Turning Basin Dia. 540m(1800')														
Ore Berth	Concrete Monoliths						*(Ore) Coal	Loader Tippler Conveyor Sta./Rec.	3,000 t/h 1,500 t/h 3,000 t/h 1,500 t/h	2 2 2 2			Rota	* Shifting to Coal Berth Stacker/Reclaimer Stacker 1,500 t/h Reclaimer min. 750 t/h avg.1,250 t/h max.1,400 t/h
Coal Berth	Concrete Monoliths		1,784	2,059	2,824		Coal	Loader Tippler Conveyor Sta./Rec.	1,500 t/h 1,500 t/h 1,500 t/h 1,500 t/h	2 2 2 2				Stacker/Reclaimer Stacker 1,500 t/h Reclaimer min. 750 t/h avg.1,000 t/h max.1,250 t/h
Phosphate Berth	Concrete Monoliths						Phosphate	Grab-Bucket Unloader Conveyor Bagging plant	700 t/h 1,300 t/h 30 t/h	2 1 12				 600 bags/h, 50 kg/bag
Finger Jetty	Concrete Monoliths		38 166	7 181	144	14 164	Salt Sulpher Fertilizer	Grab-Backet Unloader	15 t	1				with 2 conveyors of 500 t/h & hopper
Multi-Berth	Concrete Monoliths						G/C,CTN Heavy cargo	Quay Crane Transtainer	30.5 t 30 t	1 1			Paceco Paceco	 40' container 2/3 high
General Cargo	Concrete Monoliths						G/C Coking Coal							by ship gears & mobile equipment
Oil Jetty -Small jetties	Steel Pipe Pile		1,653 789	1,604 686	1,665 622	1,641 699	Crude Oil Edible Oil							L:234m Tanker 87,500 t

2nd Revision/19890707

Chapter 4 Present Port Traffic Facilities

4-1 General

Calcutta port has good accessibility with respect to the Calcutta metropolitan area. However, the accessibility to its major hinterland, which is mostly outside of Calcutta, is reduced by the traffic congestion in the city and port area. The major roads which either by-pass or go through Calcutta port area are: Circular Garden Reach Road, Garden Reach Road, Hide Road, Taratala Road, and Diamond Harbour Road (Fig. 4-1-1). These roads are not narrow in comparison to the other roads in Calcutta city. The average width of each road is 15m - 30m. The major vehicles running on these roads are trucks, cars and buses. Due to the lack of adequate parking space, many trucks park on these roads and cause traffic jams. The trucks queuing around exit gates and parking on the roads in the Docks hold up traffic and reduce the efficiency of cargo handling.

The CPT Railway network at Calcutta has fallen into disuse in many areas with the increase of road transportation, and some railway tracks have been removed. CPT Railway has two major yards now, viz East Dock Junction interchange yard (EJC) and the subsidiary yard (GCD) (Fig. 4-1-1) with a holding capacity of 1900 and 500 wagons respectively. The handling capacity is estimated at 3.5 million tonnes per year. However, CPT Railway traffic in 1987/88 is estimated at about 1.1 million tonnes. At present, most CPT railway cargoes are to/from industrial and commercial sidings located around the dock system. Port related cargo volume is very small. Railway users have been complaining about inefficient railway operation and insufficient railway facilities, that is deterioration in track maintenance leading to frequent derailments, delay in restoration of movement, and shortage of motive power which hinders the smooth movement of imported cargo, especially bulk cargoes and project cargoes. At present, a minimum of six placements and withdrawals have to be made for loading a rake at the transit sheds. This situation has forced the importers to switch over to road or carry their cargoes to the rail terminal around Calcutta for onward dispatch by rail. This movement has become one of the causes of traffic congestion in the city area.

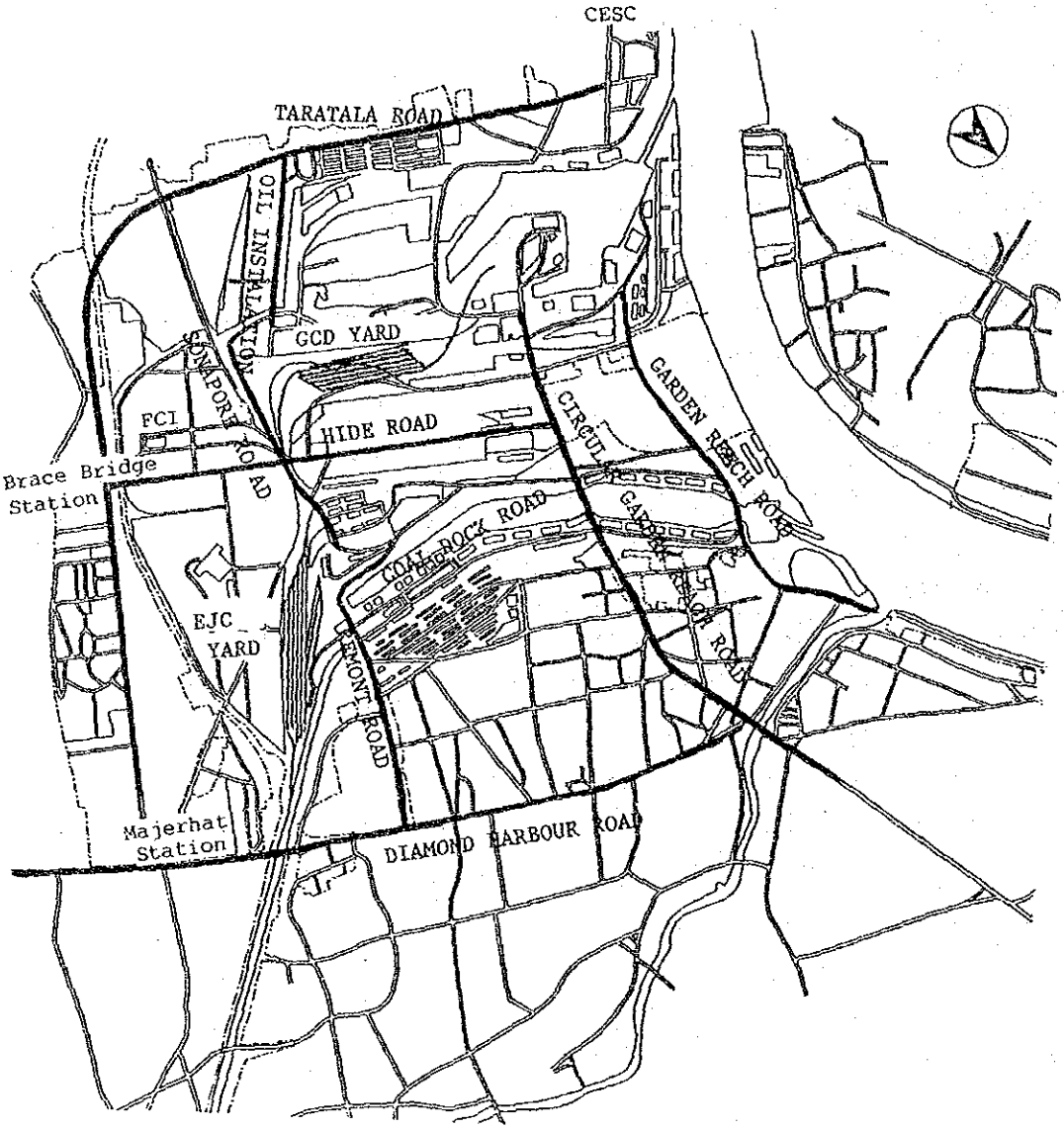


Fig. 4-1-1 Road Network in Calcutta Port

The modal share of the transportation of imported cargoes at Calcutta is presented in Table 4-1-1. Most export cargoes are delivered by road and waterway. In 1986/87, the export cargo delivered by rail was only 2 thousand tonnes.

Haldia port serves as a terminal of the South Eastern Railway and as an exchange area (GM: General Marshaling Yard) where trains are taken over/made over to the trunk railway.

The movement of railway traffic is in the form of rakes. The speed permitted within the port railway systems is 8km per hour. The size of the

rakes varies from 88 to 145 in terms of 4 wheeler wagons. The average yard holding capacity with operational mobility is 1500 wagons.

The total railborne traffic handled in 1987/88 was 4.03 million tonnes which included 2.54 million tonnes of coal, 0.69 million tonnes of P.O.L., and 0.51 million tonnes of coking coal. But there has been no corresponding development of infrastructure and workforce. Therefore, Haldia port is presently under heavy pressure. The existing facilities, especially locomotives and tracks, are not sufficient to handle the expected increase in the handling volume of coal, P.O.L. and containers.

Table 4-1-1 Import Cargo at Calcutta Dock System (Figures in Tonnes)

	1984-85	1985-86	1986-87	1987-88
Total Discharge:	2,821,000	3,162,000	2,980,000	3,764,389
Mode of delivery:				
(A) Road:	1,758,868(62.3%)	1,971,551(60.4%)	2,204,530(73.9%)	2,194,787(58.3%)
(B) Rail:	114,823(4.0%)	115,517(3.7%)	85,061(2.8%)	115,415(3.0%)
(C) River:	35,622(1.3%)	55,018(0.2%)	27,742(0.9%)	19,994(0.5%)
(D) Pipeline:	729,000(25.9%)	733,116(23.1%)	652,965(21.9%)	821,603(21.8%)

Source: CPT

4-2 Railway Transportation System in Calcutta/Haldia

4-2-1 Railway System in Calcutta

1) Facilities

a) Tracks

The present CPT Railway network was developed around 1920, and certain modifications were carried out in 1963/64 (Fig. 4-2-1).

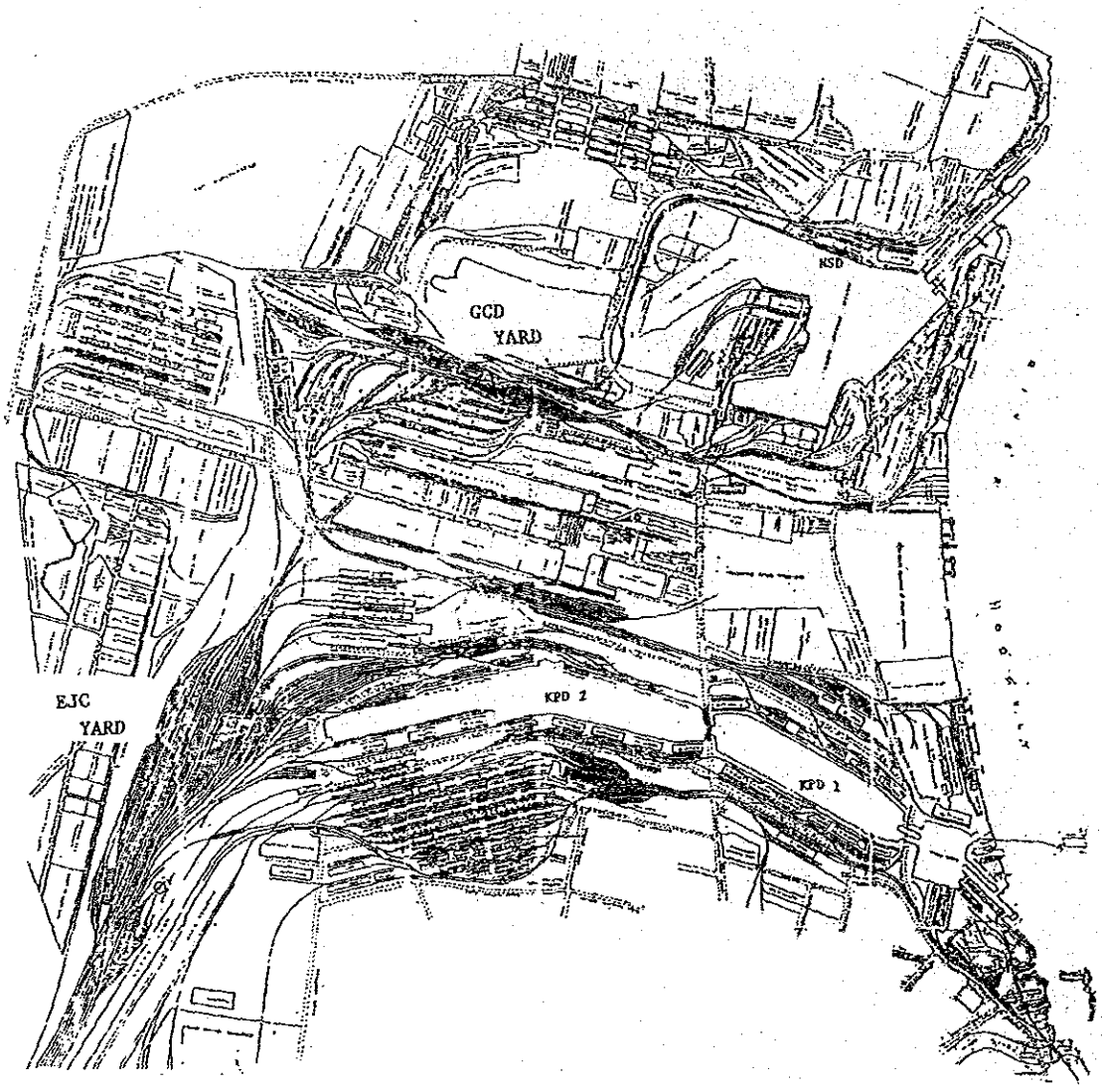


Fig. 4-2-1 Railway System in Calcutta Port

At present, CPT Railway has two major yards, viz the interchange yard (EJC) and the subsidiary yard (GCD). The EJC yard is located near the railway entrance to the dock.

At the EJC yard, incoming trains and outgoing trains transfer between the main line (East Railway) and the dock railways, and trains are held pending their being broken down, marshalled, and shunted into sorting siding order, governed by their berth sidings or other destination. At present there are 50 tracks. Some of them are fully electrified or top electrified, and these are used as arrival tracks, departure tracks, sorting tracks, and for loco movement. However, the number of tracks is too large considering the present cargo volume.

The GCD subsidiary yard is located near NSD dock and the private sidings.

The GCD subsidiary yard has 21 tracks, and they can be divided into those used for sorting, shunting and stabling of wagons mainly for NSD and those used for the sidings of TATA, F.C.I, etc. A reduction of the GCD yard tracks seems necessary because of the decline in cargo volume handled at quayside lines.

There are many loading tracks on the quays and at the rear of the transit sheds. However, most of them are no longer used.

At present, tracks on the quayside and/or tracks behind sheds are used at KPD 22-29 and at A,B, and 1,2,3,4 NSD. As mentioned above, at least six placements and withdrawals have to be made for loading a rake. Therefore, many importers have switched over to road transport or carry their cargoes to the nearby rail terminals. It is common sense that with the increase of road transportation or motorization, the required number of quayside tracks will be reduced gradually. However, in Calcutta, the condition of road transportation is also bad. Therefore, the possibility of increased utilization of the present railway system connected with the trunk line of the Indian Railway should be considered in order to minimize the road traffic congestion and pollution in the port area and along the access to the city.

b) Locomotives

CPT has a fleet of 23 diesel locomotives with H.P. varying between 320 and 1,250 which were purchased between 1959 and 1982. Some of the locomotives of the existing fleet have outlined their normal service life. The condition of the locomotives is summarized in Table A-4-1.

2) Traffic Volume

CPT Railway handles 1.1 million tonnes of cargo per year. However, most of those cargoes are carried to sidings in business establishments.

The cargo volume to/from sidings by rail includes 0.874 million tonnes of inward cargoes comprising food grain from the northern part of India (Punjab, Haryana) and steel from Bhalai, Bokaro, etc., which are consumed in and around Calcutta. Imported cargo transfered by railway is mostly bulk cargo, that is food grain, cement, fertilizer, sugar, etc. The major destination is Nepal.

The cargo volume handled on the Southern section by C.P.T. Railway from 1958/59 to 1986/87 is presented in Table 4-2-1. Major movement to sidings in 1987/88 is shown in Table 4-2-2.

Table 4-2-1 Cargo Volume on Southern Section (in Lakh Tonnes)

Year.	Inward	Outward	Total.
1958-59			59.77
1959-60			58.43
1960-61			52.41
1961-62			51.04
1962-63			58.50
1963-64	41.26	16.80	58.06
1964-65	41.19	19.16	60.35
1965-66	37.47	18.94	56.41
1966-67	39.39	23.07	62.46
1967-68	31.01	17.89	48.90
1968-69	34.88	15.11	49.99
1969-70	29.59	9.19	38.78
1970-71	23.95	9.29	33.24
1971-72	22.19	12.62	34.81
1972-73	26.95	9.52	36.48
1973-74	24.93	8.12	33.05
1974-75	19.73	10.01	29.77
1975-76	26.51	10.84	37.35
1976-77	25.73	10.59	36.32
1977-78	23.97	5.33	29.30
1978-79	18.19	6.20	25.11
1979-80	12.92	4.50	17.42
1980-81	10.31	4.27	14.58
1981-82	12.28	4.36	17.64
1982-83	18.21	3.61	21.82
1983-84	9.12	4.14	13.26
1984-85	7.37	1.41	8.78
1985-86	8.08	1.85	9.93
1986-87	8.08	1.82	9.90
1987-88	8.76	2.27	11.03

Source: CPT

Table 4-2-2 Major Movement to Sidings

Lessee	Commodity	Inward/Outward	Million tonnes 1987/88 (year)
C.E.S.C	Coal	Inward	-
F.C.I	Food	Inward	0.5
H.S.L	Steel	Inward	0.3
TATA	Steel	Inward	0.1
B.L	Steel	Inward	0.1

Source: CPT

The number of trains and wagons received and dispatched at Calcutta is shown in Table 4-2-3.

Table 4-2-3 Number of Trains/Wagons at Calcutta

(Calcutta)

	1985/86	1986/87	1987/88
Total No. of trains received	490	427	538
Total No. of trains despatched	461	407	519
Total No. of wagons received	35,110	32,026	39,117
Total No. of wagons despatched	35,138	32,093	39,336
Total food loaded	258	29	100
Total fertilizer loaded	1,061	59	648
Average turn around of wagons (days)	5.4	4.2	4.11
Total traffic *1000 tonnes	993	990	1,103
inward	808	808	876
outward	185	182	227

Source: CPT

The number of wagons despatched to Nepal in three recent years is shown in Table 4-2-4. The traffic volume of major imported bulk cargoes is shown in Table 4-2-5, and the volume of Nepal cargo is shown in Table 4-2-6.

Table 4-2-4 Outward cargoes via CPT Railway

	1985/86	1986/87	1987/88
No. of wagons to Nepal (in terms of 4 wheeler)	2,066	371	2,380
Total No. of despatched wagons of loaded import cargoes	8,315	9,142	8,379

Source: CPT

Table 4-2-5 Traffic Handled at Calcutta Port (In .000 Tonnes)

Commodity	1986 - 87				1987 - 88			
	Mode of delivery				Mode of delivery			
	Total Import	By Rail	By Road	From Rail heads	Total Import	By Rail	By Road	From Rail heads
Fertilizer	293	13	280		153	14	139	
Raw materials for Fertilizer	129	118	109	77	184	101	229	86
Machinery	98				146			
Cement	128	16	112		183	46	137	

Note: Figures shown include of Nepal traffic
Source: CPT

Table 4-2-6 Nepal Traffic (In .000 Tonnes)

	1986- 87			1987 - 88		
	Mode of delivery			Mode of delivery		
	Total Import	By Rail	By Road	Total Import	By Rail	By Road
Cement	73	15	58	150	46	104
Fertilizer & Raw materials for fertilizer	31	11	20	32	15	17

Note: Entire volume of Nepal traffic carried from the Docks by road is taken to Nepal by truck up to the final destination (verage distance - 850kms)
Source: CPT

Some bulky truck cargoes are transshipped to rail at a nearby station, Howrah/Sealdah, for final movement by rail. This cargo volume is presently around 0.1 million tonnes. Table 4-2-7 shows the destinations of those cargoes.

Table 4-2-7 Volume of Traffic transported by rail from Railheads after being carried by Road from the Docks

(in .000 Tonnes)

Year	Volume	Destination	Distance from Calcutta
1986-87	77	Patna (Bihar) -	533km
		Maldah (W. Bengal) -	390km
1987-88	86	Shaktinagar (Up) -	840km
		New Jalpaiguri -	633km
		(West Bengal)	

Source: CPT

The modal share of transportation for import cargo and total volume of traffic moved by rail are shown in Table 4-2-8, 4-2-9.

Table 4-2-8 Delivery of imported cargo from Calcutta Port by Rail & by Road

(in .000 Tonnes)

	1984-85	1985-86	1986-87	1987-88
By Rail (From Berths only)	114	115	85	115
By Road	1,758	1,971	2,204	2,194

Table 4-2-9 Total Volume of Traffic moved by Rail from Calcutta Port

(in .000 Tonnes)

	1984-85	1985-86	1986-87	1987-88
From Berths -	114	115	85	115
From Sidings -	27	70	97	112
Total:-	141	185	182	227

Source: CPT

Regarding container traffic, at present CPT Railway carries only empty containers. However, after the completion of the new container handling yard which is under construction now, CPT will carry container cargoes from Guwahati ICD.

Recent container movement in Calcutta port is shown in Table A-4-2.

3) Operation/Management

Traffic between C.P.T. and the Indian Railway is transferred at the EJC Yard which serves as both a terminal and a marshalling yard.

At the EJC yard, the following examinations are conducted.

a) Mechanical examination of the condition of wagons by neutral examining staff

b) Join seal checking by train guards and C.P.T. clerks

Trains arriving at the EJC yard from the truck line and outward trains prior to despatch to the truck line are examined for damage. Repair of damaged wagons is carried out at the maintenance lines at the EJC yard.

Loading and unloading points over the C.P.T. Railway system can be broadly divided into -

i) those in the transit area dealing with import and export cargo and the loading/unloading of wagons carried out by C.P.T. labour and

ii) sidings serving various industries, commercial warehouses, stock yards, depots, etc.

In accordance with a working agreement, wagons arriving from the Indian Railways are allowed to remain in the C.P.T. Rly. system free of detention charges for 60 hrs. in the case of inward loaded wagons and 36 hrs. in the case of inward empty wagons. 24 hrs. additional free-time is permitted on wagons which return loaded. For detention of wagons beyond the free-time hire charges are levied from times to time by the Director of Wagon Interchange. The present rate is Rs. 104 per 4-wheeled wagon per day.

The number of staff of the C.P.T. Railway (Operation branch) is presented in Table A-4-3. It is estimated that total number will decrease to under six hundred in 1990.

Table A-4-4 shows the financial condition of the C.P.T. Railway. In 1986/87, the deficit was over nine hundred Lakhs.

4) Bottlenecks/Problems

a)The volume of seaborne and railborne traffic handled at Calcutta port (Southern Section) since 1958/59 is given in Table 4-2-1. The reasons for the decrease in traffic volume are as follows:

1 Coal & ore traffic stopped.

2 Since 1975/76, importers have been obliged to pay for shed rent until the loading of wagons is completed, even if there is some delay in supply or loading of wagons over which they have no control. Therefore, in order to avoid uncertain expenses, the importers moved to road transport.

3 General tendency of motorization. For short distance transportation, a diversion of rail traffic to roads has occured throughout the country.

4 Deterioration in the turn-around time of wagons due to inefficient operations.

b) The cost of maintenance and repair of tracks is very high compared to other Port Railways.

c) The large number of derailments (Table 4-2-10) affects the operation and wagon turn-around time and raises the operating costs.

d) Detention charges on wagons which occur in the process of loading/unloading have to be absorbed as operational charges because the loading and unloading of wagons is executed by port labourers in Calcutta.

Table 4-2-10 Number of derailments on C.P.T. Railway

Year	Total No. of derailments (in terms of 4 wheel wagons)
1983-84	478
1984-85	349
1985-86	387
1986-87	374
1987-88	416

Source: CPT

4-2-2 Railway System in Haldia

1) Facilities

a) Tracks

Haldia railway has two major yards, the general marshaling yard (GM) and the bulk handling yard (BH) (Fig. 4-2-2). The general marshaling yard has five reception tracks and five departure tracks for general cargo and oil traffic. The bulk handling yard is directly connected with the South Eastern Railway main line and has five reception tracks and five departure tracks for coal and three stabling tracks for loaded and empty oil tank wagons for Indian Oil Corporation. The sorting yard of the GM yard is used for marshaling, grouping and segregation of damaged wagons from incoming rakes. Haldia port railway has three port-owned sidings viz. the general cargo berth and two construction sidings, and there are also three private sidings viz. The PCC, IOC, and HFC Sidings (Table A-4-5).

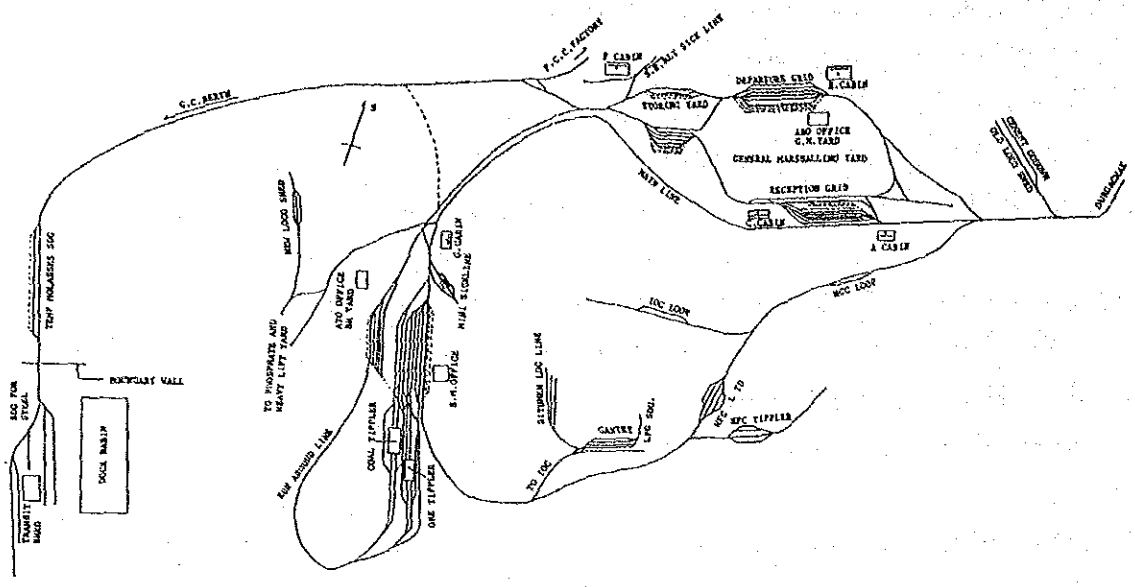


Fig. 4-2-2 Railway System in Haldia

b) Locomotives

Haldia Port has 3 types of diesel locomotives viz. Canadian type, SAN, and WDS-4. Their hauling capacity on straight level track is 1,600 MT, 3,200 MT and 2,400 MT, respectively. The total number of locomotives owned by C.P.T. is 15. However, only two locomotives are available for shunting work: one SAN and one WDS-4. Due to the shortage of locomotives, C.P.T. has hired one locomotive with a hauling capacity of 4,000 MT(WDS6-R) from the Indian Railway.

2) Traffic Volume

Cargoes handled at Haldia are mainly bulk cargoes. Therefore, most cargoes are transported by railway. The volume of railborne traffic handled at Haldia during 1985/86 to 1987/88 is presented in Table 4-2-11, and Table 4-2-12.

Table 4-2-11 Number of Trains/Wagons at Haldia

	1985/86	1986/87	1987/88
Total No. of trains received	1,782	1,799	1,921
Total No. of trains despatched	1,683	1,721	1,835
Tonnage (Outward) millions	1,274	1,240	1,336
Tonnage (Inward) millions	2,258	2,345	2,694
Total No. of wagons received	132,632	140,440	152,142
Total No. of wagons despatched	134,189	138,362	156,520
Total No. of Coal wagons received	81,017	86,225	109,683
Total No. of wagons loaded with P.O.L.	33,652	32,984	31,923
Total No. of wagons loaded with coking coal	19,652	18,200	22,045

Source: CPT

Table 4-2-12 Railborne Traffic Handled at Haldia from 1980-81 to 1987-88

(in million tonnes)

	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88
Sh. Coal	.67	1.06	1.52	1.62	1.57	1.87	2.00	2.54
P.O.L.	.69	.60	.56	.59	.54	.67	.67	.69
C/Coal	.016	.042	.25	.053	.065	.454	.42	.51
G.I & Others	.22	.40	.20	.38	.55	.54 (706 TEUs)	.49 (5,134 TEUs)	.29 (2,910 TEUs)
Total	1.59	2.10	2.53	2.64	2.72	3.53	3.58	4.03

Source: CPT

The average load by type of wagon and commodity are shown in Table A-4-6.

The average load per rake and number of wagons per rake are shown in Table 4-2-13.

Table 4-2-13 Average Load Per Rake

Type of rakes	Number of wagons	Average tonnage. (tons)
Covered wagons	72 (in terms of 4 wheelers)	2,000
POL tank wagons	50 - 70	1,000 - 1,400
BOX rakes	35	2,000
(Coal)	44	2,600
	56	3,250

Regarding container traffic, present container movement by railway at Haldia is 3,000 TEUs. Around 80% of these are from Guwahati ICD carrying tea, and 20% are imported project cargo. Tea in containers is seasonal traffic. Table A-4-7 shows the container movement through Haldia from 22.6.87 -15.12.87.

The present origin and destination of railborne cargo handled at Haldia is shown in Table 4-2-14.

Table 4-2-14 O/D of railborne cargo.

Cargo		Origin	Destination	Distance (km)	Freight cost (Rs/tonne)
Inward	Coal	Barakar	Haldia	355	102.9
	"	Andal	"	325	96.5
Outward	Raw Petroleum Coke	Haldia	Barauni	626	230.4
	"	"	New Bangaigaon	1,012	351.9
	Calcined Petroleum Coke	"	Renukut	721	261.2
		"	Mera	468	169.1
	Coking coal	"	Bokaro	475	134.2
		"	Burnpur	341	100.8
		"	Durgapur	368	105.2
	P.O.L.	"	Balosore	224	117.9
		"	TATA	244	126.8
		"	Raurkella	408	254.9
		"	Namkum	401	254.9

Source: CPT

3) Operation/Management

The operational efficiency of loading/unloading facilities is presented in Table 4-2-15.

Table 4-2-15 Operational Efficiency

	Efficiency
Coal Tippler	60 - 70 Box wagons/shift
I.O.C	40 Tank wagons/shift
G.C Berth	35 Box Wagons loading coking coal / 9 hours(average)
Covered rake	Average 10 hours
Container	Loading: 8 hours/rake Unloading: 8 hours/rake

Source: CPT

The present average turn around time of wagons is shown in Table A-4-8. In the future, in order to handle cargoes more efficiently, improvement of the turn around time shall be achieved with coordination between CPT, SE and IOC.

The examination periods by S.E occupy around 20 - 40 % of the total turn around time. At present S.E examination is carried out by one group/shift/yard. Their capacity is around 2.5 rakes/shift. The actual examination time is 3 hours. The percentage of damaged wagons is very high, that is, around 10% of incoming wagons. The waiting time for CPT locomotives which is included in operation time is significant due to the lack of available locomotives.

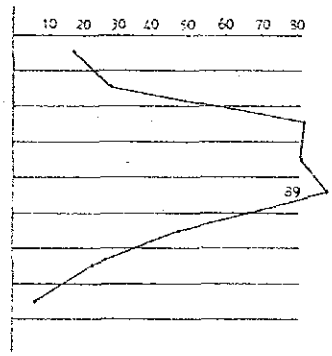
Regarding coal rakes, in 1987/88 arrival frequency in terms of the number of arrival rakes/day, is presented in Table 4-2-16.

Table 4-2-16 Arrival frequency of coal rakes

	1987/4	5	6	7	8	9	10	11	12	1	2	3	Total
No. of rakes	-	-	-	-	1	1	6	8	-	-	-	1	17
1	4	-	2	2	1	5	7	4	-	1	-	1	27
2	5	5	4	10	7	10	9	11	9	3	2	5	80
3	6	7	6	7	9	6	5	3	8	9	8	5	79
4	9	6	6	6	9	6	3	3	12	9	8	10	89
5	4	6	6	3	4	2	1	1	1	6	6	6	46
6	2	3	5	3	-	-	-	-	1	2	3	3	22
7	1	2	1	-	-	-	-	-	-	1	2	-	6
Total	30	31	30	31	31	30	31	30	31	31	29	31	366

Note: total rakes: 1,184 average arrival rakes : 3.23/day
wagons: 43,380 average arrival wagons: 118/day

Source: CPT



Tippler efficiency (excluding ore tipplers) is presented in Table A-4-9.

There are only three locomotives available at Haldia. Other locos are not available or have less hauling power. It seems another 2 - 3 locos are necessary for effective operation. In addition, at Haldia, bad track conditions also hinder inefficient operation.

Around 87% of the sleepers at Haldia Railway are wooden sleepers directly spiked with dog spikes (without bearing plates) which cause loosening and widening of tracks. 10% of them are steels and 3% are wooden sleepers with bearing plates. The major causes of derailment at Haldia seem to be insufficient compassion of soil, wooden sleepers without bearing

plates, and not enough balasting material.

However, not only track conditions, but also other equipment and operational conditions cause derailment. The frequency of derailment is the maximum in the monsoon season, especially in June. Table A-4-10 shows the cause and number of wagons derailed in June '88.

The working conditions of Haldia Railway are presented in Table 4-2-17. The deployment of staff per shift for operations is around 60.

Table 4-2-17 Working Condition of Haldia Railway

Assignment of locomotives	Average two locomotives/shift (plus one S.E Railway locomotive on hire) Marshalling, placement, withdrawal and outward formulation of trains
Personnel Assignment	4 sets of shunting per shift (staff and drivers) Total 22 workers 38 workers for supervision of work and clerical work, etc.

Source: CPT

4) Bottlenecks/Problems

(a) Convergence of rakes to port railway system from Indian railway in quick succession.

(b) Percentage of sick wagon both incoming and outgoing is too high which increases shunting operations and reduces operational efficiency.

(c) Sporadic performance of tipplers.

(d) Loading of 40 wagons per shift by IOC which is less than the rake composition increases the number of oil tank rakes.

(e) Non-availability of locomotives and non availability of locomotives with sufficient hauling power.

(f) Bad track condition including pathways.

(g) Frequent derailments and breach of lines and delay in rerailment and restoration of tracks.

(h) Excessive time taken by S.E. Railway train examining staff.

(i) Shortage of staff.

(j) No speed arrester (car retarder) at the post tippling zone, consequently causing damage to the wagons and delay in clearing empty boxes for forming trains as well as additional movement for handling the sick wagons. Additional track is required to stable these wagons.

(k) CPT is forced to use the main line as a turnout track for delivering wagons to the HCC Loop and the IOC Loop. This is an inefficient and dangerous operation, and a better afternative should be arranged.

(l) Considerable time is wasted at Tippler zone for sorting out of low chassis coal wagons which are un-suitable to be handled by beetles.

4-3 Road Transportation System in Calcutta

4-3-1 Road Conditions in Calcutta

1) Facilities

In Calcutta port, there are four major longitudinal corridors and three major transverse corridors, as follows.

Longitudinal corridors

① Circular Garden Reach Road

② Garden Reach Road

③ Remount Road - Sonapore Road - Oil installation Road

④ Taratala Road

Transverse corridors

① Taratala Road

② Hide Road - Nimak Mahal Road

③ Diamond Harbour Road

These main corridors constitute the road network together with secondary roads viz. Coal Dock Road, Dumayun Avenue, Satya Doctor Road, Eastern Boundary Road, Kantapurker Road, and Sonai Road.

Circular Garden Reach Road is the most important road of the port. This road acts as the main artery not only for the freight movement but also for passenger traffic, buses, and cars. Circular Garden Reach Road is 14m wide. The gateway of this road is the Kidderpore intersection which is generally congested all day. Therefore, during peak hours (morning and evening) this road is heavily jammed with buses, trucks and cars.

Swing Bridge is located at the gateway to the port on the Garden Reach Road. As heavy vehicles are restricted from using this bridge, Garden Reach Road is not so crowded compared with Circular Garden Reach Road.

Remount Road has the potential to become another main artery for the port. However, this road is not directly connected to Sonapore road and Oil Installation Road. There is a railyard (the EJC Yard) between Sonapore Road and Remount Road. Therefore, Remount Road has to be linked to Coal Dock Road.

Taratala Road goes around the port on its southern and western periphery. Taratala Road is 120' wide and has a big capacity. However, the traffic level on this road is not so high at present.

Hide Road is mainly used for cargo movement from the private

establishments located along the side of the road.

Diamond Harbour road runs along the eastern periphery of the port. At the intersection with Circular Garden Reach Road, the Kidderpore intersection is heavily congested. Tram cars also run along this road and contribute to the traffic congestion on the road and at the Kidderpore intersection.

At present, four gates are used for Kidderpore Dock No.1 (KPD-I). Gate 1 and Gate 2 are for entry and Gates 3 and 4 are for exit. For KPD-II, three gates are used. Gate 5, Gate 11 and Gate 13 are used for both entry and exit. For NSD, 6 gates are used viz. 3 GRJ, 3 NSD, 4 NSD, 5 NSD, 7 NSD, and 9 NSD gates. The gate locations are shown in Fig. 4-3-1.

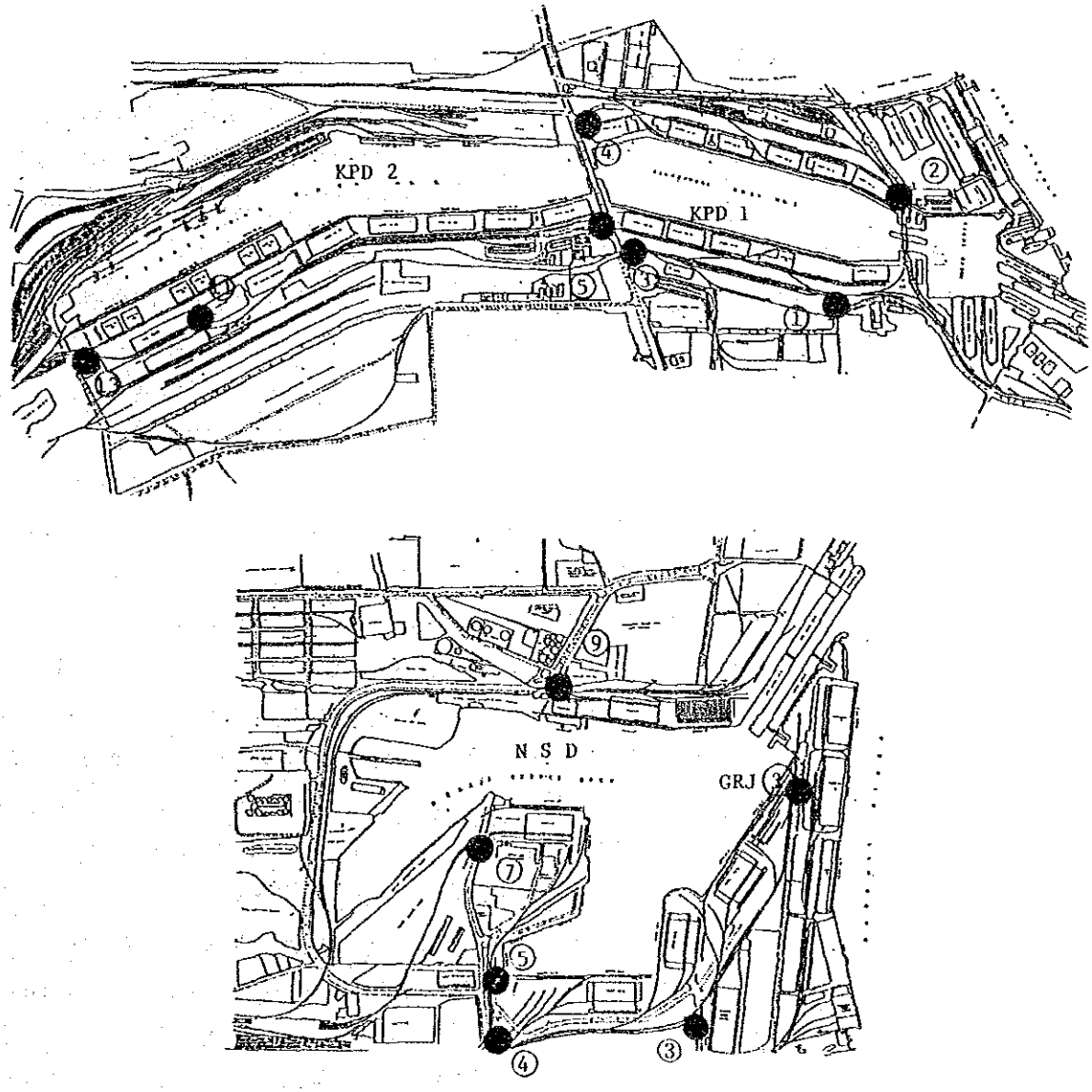


Fig. 4-3-1 Gates of Docks

2) Traffic Volume

Inbound and outbound traffic movement at the port are presented in Table 4-3-1, and gate statistics (1.1.88 - 30.6.88) are shown in Table A-4-11.

Table 4-3-1 Statistics on Inbound/Outbound Trucks

		84/85	85/86	86/87	87/88
Inbound Export					
	1) Trucks (Including Trailers)	68,100	76,639	56,136	51,693
	2) Carts	374	461	460	605
Outbound Import					
	1) Trucks (Including Trailers)	160,401	180,883	182,489	177,312
	2) Carts	1,435	1,663	1,469	882

According to the data in Table 4-3-1, traffic volume by truck in 1987/88 was around 2.2 million tonnes and the number of trucks was 229,000. Therefore, the average load per vehicle is around 9.6 tonnes. The average load by type of vehicle by commodity is shown in Table A-4-12.

In the dock area around KPD-I, II, and NSD, irregular parking of trucks causes congestion and consequently hinders port operations.

During rush hour, there are heavy traffic jams at the exit gates. One of the reasons for the traffic jams is the long staying time of trucks in the dock area due to the inefficient loading/unloading and examination of cargoes. Fig. 4-3-2 and Fig. 4-3-3 present the staying period of trucks in the KPD-I and NSD area on certain congested days.

Fig. 4-3-2 refers to the vehicles which enter at Gate 2 and exit at Gate 4 of KPD-I, and Fig. 4-3-3 is for vehicles from Gate 3 GRJ to Gate 3 NSD. The average staying period was 6 - 6.5 hours. This average may depend on the ratio of loading trucks for export and empty trucks for import. Fig. 4-3-4 shows the arrival density and departure density (number of vehicles per hour) at KPD-2 and-4 gates and the total number of trucks staying every hour from 22th July, 1988 to 23rd July, 1988.

The maximum number of arrivals Per/hour was 25 - 35 and the maximum number of departures was 25- 30. At the exit gates, around 5 - 15 vehicles were queuing for exit and waiting for examination and clearance.

As mentioned, Circular Garden Reach Road is the most important road,

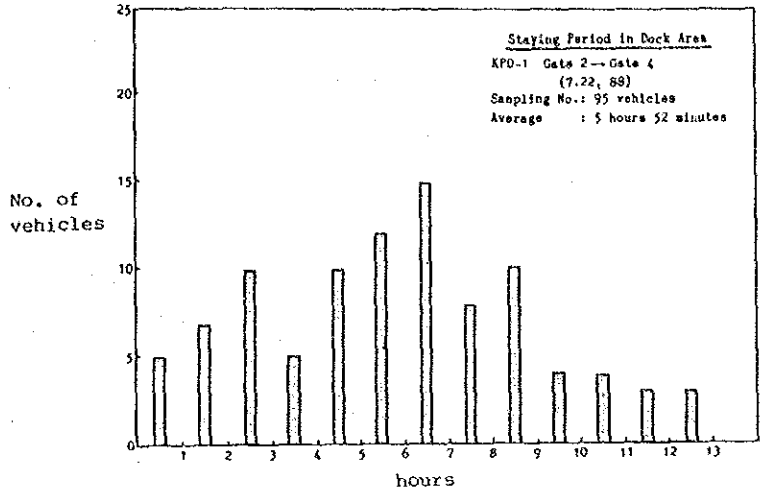


Fig. 4-3-2 Staying Period of Trucks in KPD-1

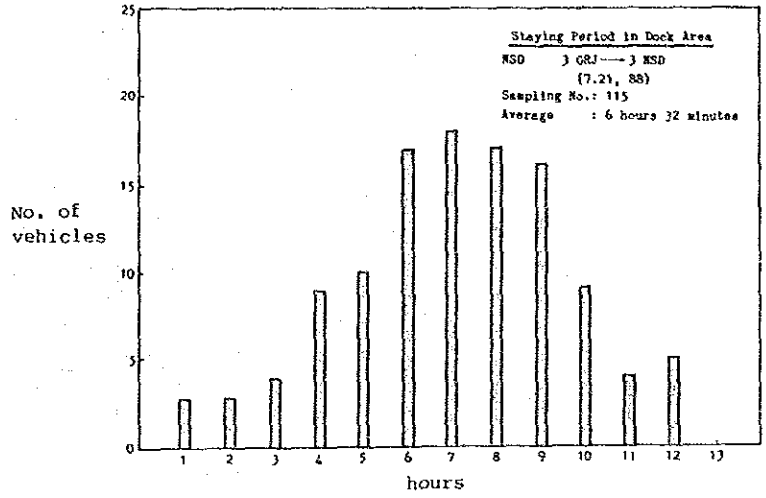


Fig. 4-3-3 Staying Period of Trucks in NSD

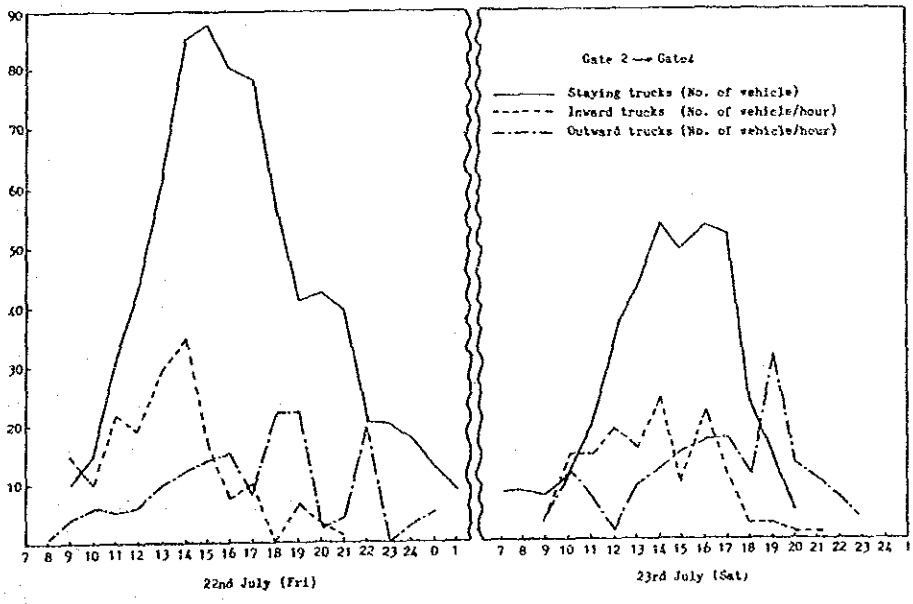


Fig. 4-3-4 Arrival/Departure Rate of Trucks

and is used not only by port oriented trucks but also by trucks from commercial and industrial areas in the port and buses and cars for port workers and commuters traveling between the western region of the NSD area and the city center.

According to the traffic survey conducted in the evening on 4th August, 1988, the number of buses, and cars is substantial. Fig. 4-3-5 presents the number of trucks, buses and cars passing through Bascle Bridge on Circular Garden Reach Road.

Around 45% of the total traffic at this period was trucks, 26% buses, and 29% cars.

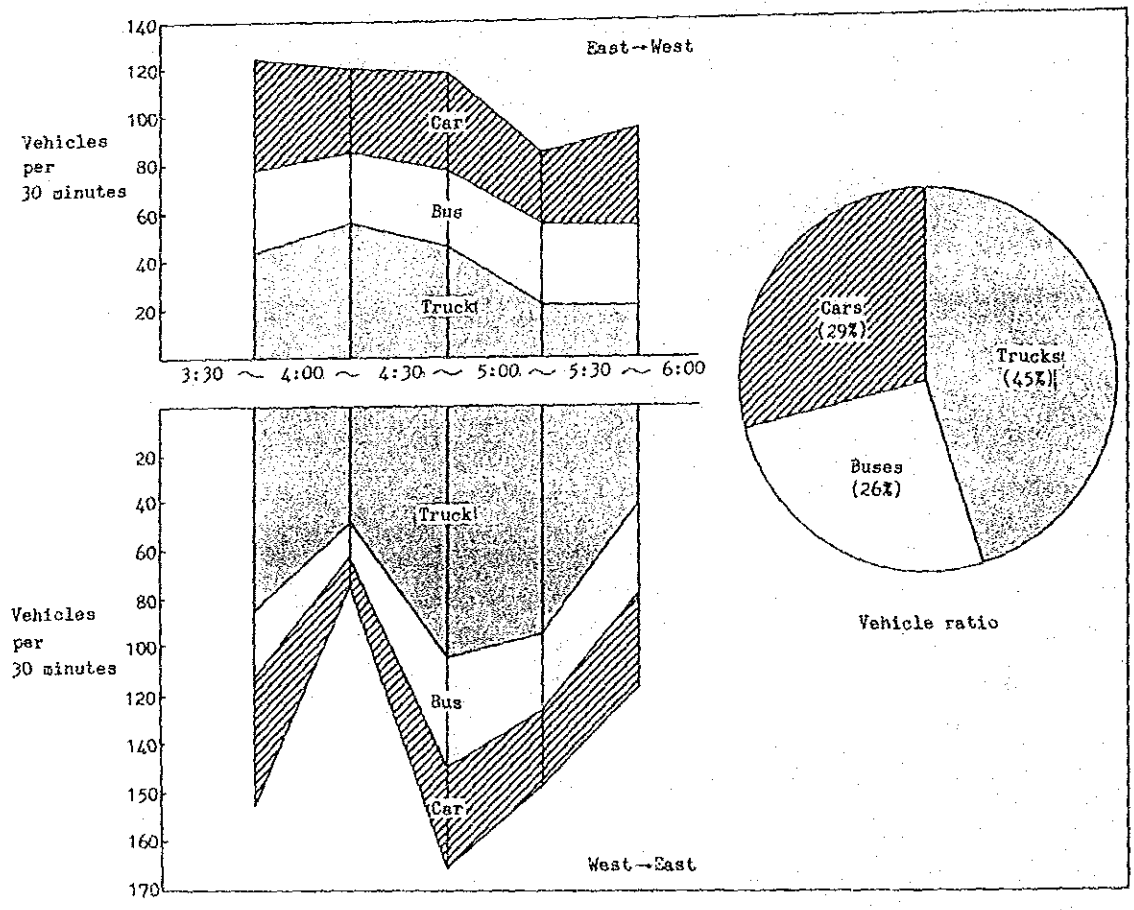


Fig. 4-3-5 Traffic Volume in Bascle Bridge

At present, the passage of heavy vehicles over Swing Bridge is resticted, and only cars are allowed to run on this bridge. In the morning rush hour, around five hundred cars pass the bridge per hour in

both directions.

4) Bottlenecks

On the Circular Garden Reach Road, at Kidderpore intersection and at Kidderpore bridge, the traffic condition is very bad. Many trucks, buses, and private cars pass through this intersection and bridge together, not only from Circular Garden Reach Road but also from Diamond Harbour Road, and many trucks come through this intersection and pass over the bridge. In addition, tram cars also pass through the intersection and contribute to the traffic jams. In fact, the peak hour volume of vehicles is not so heavy, but the cross sectional and geometrical features of the intersection and bridge affect the congestion. Some measures must be taken to avoid the passage of heavy vehicular port traffic through Kidderpore intersection and Kidderpore Bridge.

On Garden Reach Road, heavy vehicles are prohibited from using Swing Bridge. Therefore, all these vehicles have to move to Circular Garden Reach Road, and this worsens the congestion on that road.

In order to redirect some heavy vehicles from Bascle Bridge to Swing Bridge and to ease the present traffic jam on Circular Garden Reach Road and at the Kidderpore intersection, Swing Bridge must be strengthened.

In order to link Remount Road and Oil Installation Road more efficiently, Coal Dock Road and Hoboken Road have to be expanded and improved. In connection with this link, the intersection between Hide Road and Sonapore Road must be redesigned.

Inside and outside the gates, the parking of incoming and outgoing trucks on the road creates bottlenecks due to the absence of proper parking facilities.

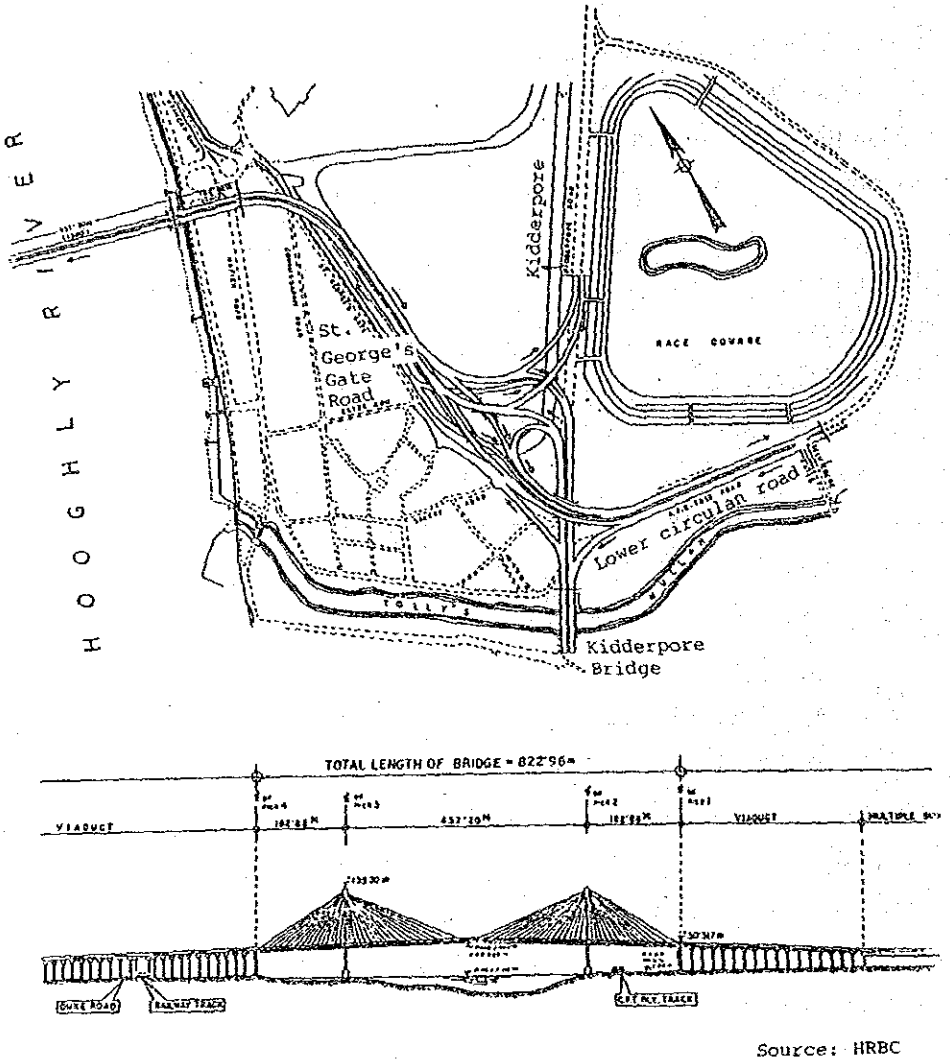
Street parking activity on Garden Reach Road, Circular Garden Reach Road and Hide Road badly affect road movement.

5) Related Development Plans

a) Second Hooghly River Bridge

With the increase of traffic on the present Howrah Bridge, the Government of West Bengal decided to construct a new bridge at Princeps Ghat. The structure of the interchange on the Calcutta side is shown in Fig. 4-3-6. This connects the bridge approaches to Lower Circular Road,

Kidderpore Road and St. George's Gate Road and extends to the northwest side of Calcutta Race Course.



Source: HRBC

Fig. 4-3-6 Second Hooghly River Bridge

The geometric design of the bridge is based on the future maximum projected traffic volume, that is 8,500 vehicles/hour/2 ways.

The traffic requirements of this interchange are enumerated below:

(1) Traffic originating from Howrah to Calcutta through the Crossing will be able to proceed to north Calcutta via Kidderpore Road, to Kidderpore Docks via Kidderpore Bridge, and to South Calcutta via lower Circular Road with grade separations.

(2) Traffic originating from South Calcutta through Lower Circular Road

will have grade separations while proceeding to Kidderpore Docks through Kidderpore Bridge, to Howrah via the Crossing and to north Calcutta via St. George's Gate Road.

(3) Similarly traffic originating from Kidderpore Docks to South Calcutta via Lower Circular Road, to north Calcutta via St. George's Gate Road and to Howrah via the Crossing and traffic originating from north Calcutta via St. George's Gate Road and proceeding to South Calcutta via lower Circular Road, to Howrah via the Crossing and to Kidderpore Docks via Kidderpore Bridge will also have grade separations.

As explained above, traffic passing through the Second Hooghly Bridge to/from KPD/NSD will have to go through the Kidderpore Bridge. However, the traffic on the bridge is heavily congested as mentioned above. Therefore, some improvement in the bridge will be necessary.

b) Circular Railway

The need for providing direct commuting facilities for the suburban railway passengers to and from the city of Calcutta has been recognized.

Therefore, many studies have been conducted and recommendations made that a circular railway be prepared around the city of Calcutta using the existing railway alignment. In the CPT area, they suggest an elevated and grade separated alignment between Hasting and Majhehat. This plan has been examined by Eastern Railway but has not been approved yet.

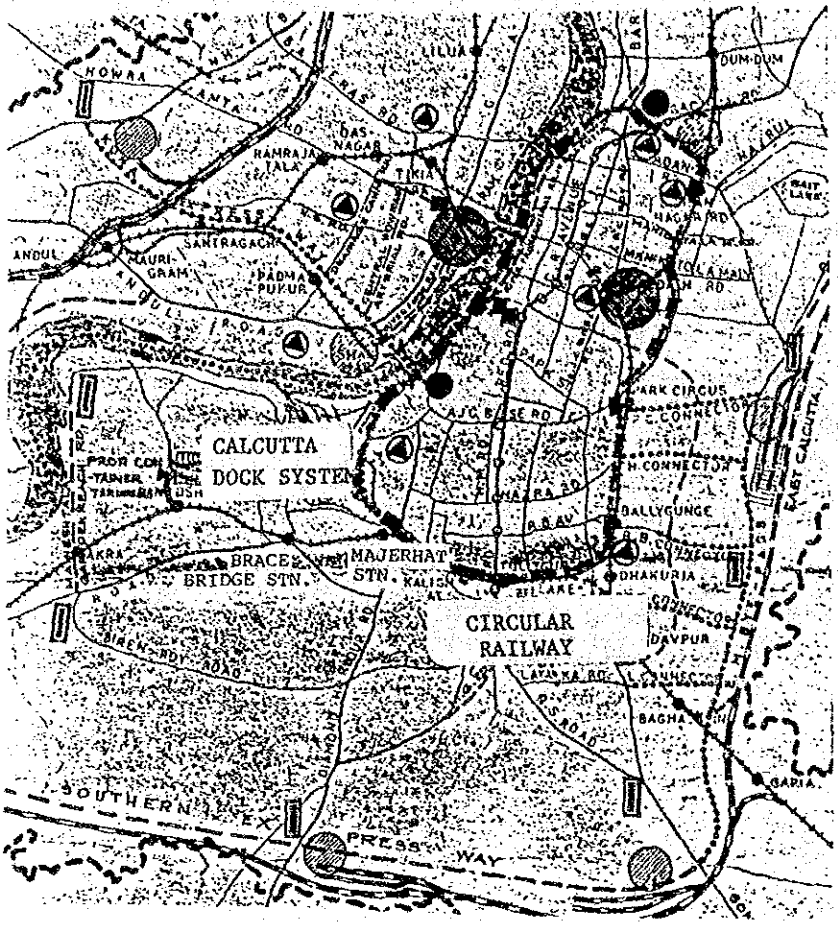


Fig. 4-3-7 Circular Railway

Chapter 5 Present Shipping and Cargo Traffic

5-1 General

Due to the draft restriction and the shortage of the cargo handling facilities, the size, type and cargo carrying capacity of the vessels calling at the ports of Calcutta and Haldia are limited to a great extent. In spite of this severe situation, there are many shiping lines actively carring trade to and from Calcutta and Haldia.

1) Calcutta

The majority of the shipping lines are still operating Break Bulk vessels for general cargo. As to the container service, Calcutta is not surved by main line container vessels due to the access restrictions and the present small quantity of container cargo. Instead, a number of shipping lines maintain feeder services to Calcutta from Singapore, Madras and Colombo and vice-versa, mainly on a slot charter basis. The major lines are APL, CSC, COBRA and SCI (SCI and CSC operate their own feeder vessels in addition to slot charters.)

2) Haldia

Haldia is served mainly by bulk carreis, although some container vessels and multi-purpose vessels also call at the port. BLASCO (USSR) and SCI are the main users of the port.

5-2 Present Shipping

5-2-1 No. of Vessels Calling at the Ports

1) Calcutta

During the year 1987-88, 933 vessels called at Calcutta (including Budge Budge) as against 894 vessels in the previous year. The total number of calling vessels has been increasing at an average annual rate of 5.9% over the last three years. Out of 933 vessels, 155 vessels (16.6%) are domestic trade vessels and 778 vessels (83.4%) are foreign trade vessels.

The number of domestic and foreign trade vessels is as follows.

	Domestic		Foreign	Total
1985-86	149	17.9%	683	832
1986-87	137	15.3	757	894
1987-88	155	16.6	778	933
		16.6		

2) Haldia

During the year 1987-88, 555 vessels called at Haldia as against 571 vessels in the previous year. The total number of calling vessels has decreased slightly for the last three years. About 30% are domestic trade vessels and 70% are foreign trade vessels.

5-2-2 Vessels Types and Sizes

Many types of vessels call at Calcutta/Haldia, but the size and cargo carrying capacity of the vessels are naturally limited due to the draft restrictions in the riverine ports.

1) Calcutta

Out of the total number of calling vessels, about 58% are Break Bulk vessels, 17% are Liquid Bulk vessels, 17% are Container feeder vessels and the rest are Dry Bulk vessels. Since there are no Gantry cranes available at the port, normally self-sustained container feeder vessels call at Calcutta. The number of vessels by vessel type is as follows.

Vessel type	1985-86	1986-87	1987-88
Liquid Bulk	130	151	157
Dry Bulk	81	61	69
Break Bulk	483	509	545
Container	138	173	162
Total	832	894	933

The number of calls by all types of vessels except containers vessels has been increasing, especially the increase of calls by Break Bulk vessels is remarkable.

The average and maximum G.R.T. of vessels are as follows.

	Average G.R.T.	Maximum G.R.T.
1985-86	7,302	15,098
1986-87	5,771	15,848
1987-88	6,968	18,542

The average G.R.T. of vessels by vessels type is as follows.

	1985-86	1986-87	1987-88
Liquid Bulk	7,457	6,717	9,353
Dry Bulk	10,446	6,919	8,011
Break Bulk	6,738	5,961	7,100
Container	5,505	3,786	3,869

The maximum G.R.T. of vessels by vessel type is as follows.

	1985-86	1986-87	1987-88
Liquid Bulk	15,098	15,848	18,542
Dry Bulk	14,054	10,458	9,851
Break Bulk	12,108	12,556	13,443
Container	7,285	4,556	5,608

* The average carrying capacity of container vessels is 390 TEUs (max. 570TEUs).

2) Haldia

Out of the total number of calling vessels, about 55% are Liquid Bulk vessels, 26% are Dry Bulk vessels, 14% are Container vessels and the rest are Break Bulk vessels. The number of vessels by vessel type is as follows.

Vessel type	1985-86	1986-87	1987-88
Liquid Bulk	349	323	307
Dry Bulk	144	133	146
Break Bulk	28	30	25
Container	50	85	77
Total	571	571	555

It is remarkable that the number of calls by Liquid Bulk vessels decreased to 307 vessels in 1987 - 88 as against 349 vessels in 1985-86.

The size of vessels that can call at Haldia is larger than at Calcutta, but since there are still draft restrictions, many vessels cannot call at Haldia with full loads. The maximum D.W.T. of vessels by vessel type and the average/maximum cargo tonnage per vessel in 1987-88 are as follows.

Vessel type (cargo)	Maximum D.W.T.	Maximum Cargo Tonnage	Average Cargo Tonnage
Liquied Bulk (POL-Crude)	89,490	42,267	29,505
Liquid Bulk (POL-Products)	67,225	25,565	10,784
Dry Bulk (Coal)	47,721	32,792	24,054
Dry Bulk (Fertilizer-Raw)	43,124	14,852	9,461
Dry Bulk (Coking Coal)	47,721	23,729	20,542
Break Bulk (Fertilizer)	-	10,912	9,976
Break Bulk (General Cargo)	30,413	14,010	4,264
Container (Containers)	8,000	244 TEUs	

- o POL - Crude : At present, vessels call at Haldia with a load of 30/35,000 tons after discharging more than half of their cargo at Madras due to the draft restriction at Haldia.
- o Coking Coal : At present, vessels call at Haldia after discharging part of the load at Paradip or Visakhapatnam.

5-3 Cargo and Passenger Traffic

5-3-1 Cargo Traffic

During the year 1987-88, Calcutta port handled about 4.4 million tons of cargo including about 1.2 million tons of domestic cargo as against 4 million tons including 1 million tons of domestic cargo in the previous year, which is a 10% increase over the previous year. Haldia port handled about 8.7 million tons of cargo which shows an 8.7% increase over the previous year's tonnage of 8 million tons.

Cargo traffic for the last three years is as follows.

Calcutta	1985-86	1986-87	1987-88 ('000 tons)
Import	3,040	2,894	3,356
Export	864	929	757
I.W.T.	259	224	280
Total	4,163	4,047	4,393

Haldia	1985-86	1986-87	1987-88 ('000 tons)
Import	5,358	5,212	5,321
Export	2,606	2,813	3,357
I.W.T.	-	-	-
Total	7,964	8,025	8,678

As to the container cargo, Calcutta port handled 36,332 TEUs of loaded containers (486,865 tons) and 11,303 TEUs of empty containers during the year 1987-88 as against 36,035 TEUs (466,712 tons) and 13,758 TEUs respectively in the previous year, which is only an 0.8% increase for loaded containers (a 4% increase for tonnage) and a 17.8% decrease for empty containers. In the meantime, Haldia port handled 11,336 TEUs of loaded containers (113,431 tons) and 7,516 TEUs of empty containers which show 10% (7%) and 46.7% increases respectively over the previous year. Container traffic for the last three years is as follows.

	1987 - 88			1986 - 87			1985 - 86		
	Calcutta	Haldia	Total	Calcutta	Haldia	Total	Calcutta	Haldia	Total
Import									
Loaded	16,444	3,699	20,143	13,868	6,215	20,083	12,800	3,673	16,473
Empty	7,558	5,122	12,680	11,094	1,238	12,332	10,616	363	10,979
Total	24,002	8,821	32,823	24,962	7,453	32,415	23,416	4,036	27,452
Tonnage	218,194	46,752	264,946	183,334	74,771	258,105	162,451	39,829	202,280
" /TEU	13.3	12.6	13.2	13.2	12.0	12.9	12.7	10.8	12.3
Export									
Loaded	19,888	7,627	27,515	22,167	4,054	26,221	19,128	1,918	21,046
Empty	3,745	2,394	6,139	2,664	3,886	6,550	3,248	2,081	5,329
Total	23,633	10,021	33,654	24,831	7,940	32,771	22,376	3,999	26,375
Tonnage	268,671	86,679	355,350	283,378	49,870	333,248	234,073	24,700	258,773
" /TEU	13.5	11.4	12.9	12.8	12.3	12.7	12.2	12.9	12.3
Total									
Loaded	36,332	11,326	47,658	36,035	10,269	46,304	31,928	5,591	37,519
Empty	11,303	7,516	18,819	13,758	5,124	18,882	13,864	2,444	16,308
Total	47,635	18,842	66,477	49,793	15,393	65,186	45,792	8,035	53,827
Tonnage	486,865	133,431	620,296	466,712	124,641	591,353	396,524	64,529	461,053
" /TEU	13.4	11.8	13.0	13.0	12.1	12.8			

At Calcutta, there was an increase of 18.5% in import loaded containers and decrease of 10.3% in exports over the previous year. In Haldia, there was an increase of 88% in export loaded containers and a decrease of 40.5% in imports over the previous year.

5-3-2 Passenger Traffic

During the year 1987-88, 48,375 passengers to and from Andaman embarked and disembarked at Calcutta port as against the 46,654 passengers which embarked and disembarked in the previous year. At present, the sailing frequency is 2 sailing per month and the average number of passengers is about 1,000 persons per vessel. Kidderpore Dock No.2, 22 berth is now allocated to passenger boats. Passenger traffic for the last three years is as follows.

1985 - 86 : 48,316 (persons)

1986 - 87 : 46,654

1987 - 88 : 48,375

5-3-3 Characteristics of Cargo Throughput at Calcutta/Haldia

(1) Historical Trend of Total Cargo Traffic

1) During the 12 years from 1976/77 to 1987/88 the total cargo traffic though Calcutta/Haldia gradually increased from 8.4 million tonnes to 13.1 million tonnes except for a decrease in 1977/78 (the annual growth rate of cargo traffic is approximately 4.1 percent during these 12 years). This is mainly due to the increase of import cargo.

2) The historical trend of cargo traffic by port shows the following characteristics.

① The total cargo handled at Haldia exceeded that at Calcutta in 1979/80 and share of Haldia is gradually increasing.

② While the total cargo handled at Haldia rapidly increased during these 12 years with the volume in 1987/88 3 times that in 1976/77, the total cargo volume handled at Calcutta remained stable in the rage from 3.8 million tonnes to 4.6 million tonnes except for the year 1976/77.

③ The ratio of import cargo to export cargo handled at Haldia is gradually decreasing, that is, although the import cargo volume is larger than the export cargo volume, the increase rate of import cargo is less than that of export cargo.

However in Calcutta the ratio of import cargo to export cargo is gradually increasing because of the shares decrease of export cargo.

④ The shares of import cargo are roughly 40 percent at Calcutta and 60 percent at Haldia after 1977/78.

⑤ The share of export cargo at Calcutta dropped sharply from 89 percent in 1976/77 to 28 percent in 1986/87.

The share of export cargo at Haldia, on the other hand, increased sharply.

(2) Historical Trend of Cargo Traffic by Commodity

1) Import cargo

1 P.O.L.(Crude)

P.O.L.(Crude) is handled at Haldia by the Indian Oil corporation, Haldia, with a refining capacity of 2,500 thousand tonnes per year. The cargo volume increased from 1,900 thousand tonnes in 1976/77 to 2,719 thousand tonnes in 1987/88 at an annual growth rate of 3.3 percent. P.O.L.

(Crude) is imported from Gulf Countries.

2 P.O.L.(Products)

P.O.L.(Products) is handled at Calcutta (Budge Budge) and Haldia. The shares of P.O.L.(Products) handled at Calcutta and Haldia are approximately 30 percent at Calcutta and 70 percent at Haldia after 1979/80.

3 Foodgrains

As Indian Government policy promotes self-sufficiency in foodgrains, there is no plan to import foodgrains except in years with poor harvests due to drought, etc. When it is necessary to import foodgrains, the nearest port to the area where there is a shortage is used. Thus, the cargo volume of foodgrains fluctuates year by year.

4 Fertilizer

Fertilizer is largely consumed on irrigated land. Though the Indian Government plans to increase domestic production under the Seventh Five Year Plan 1985-90, it is still necessary to import fertilizer. The volume of fertilizer handled at Calcutta and Haldia average 80 percent at Calcutta and 20 percent at Haldia after 1978/79.

5 Raw Materials for Fertilizer

The volume of raw materials for fertilizer handled at Calcutta/Haldia also fluctuates but has gradually increased sine 1976/77. As the demand for raw materials for fertilizer will increase in proportion with increases in fertilizer production, the cargo volume handled at Calcutta/Haldia will increase when the production of fertilizer in the hinterland increases. The shares of raw materials for fertilizer handled at Calcutta and Haldia are approximately 60 percent at Calcutta and 40 percent at Haldia after 1979/80.

6 Coking Coal

Coking coal is mainly used at steel plants. There are major steel plants in West Bengal, Bihar, Orissa and Madhya Pradesh. Haldia handled coking coal because there are three major steel plants (Bokaro, Durgapur and Burnpur) behind Haldia. As the production of high quality coking coal is insufficient in India, the cargo handled at Haldia will increase when

the production of iron and steel increases in the hinterland.

7 Iron, Steel and Machinery

Imports of iron, steel and machinery are mainly handled at Calcutta. The cargo volume of iron, steel and machinery fluctuates from 100 thousand tonnes to nearly 600 thousand tonnes after 1976/77. The cargo volume divided into 1)iron and steel and 2) machinery after 1983/84 is as follows:

Year	Iron and Steel		Machinery	
	Calcutta	Haldia	Calcutta	Haldia
1983/84	251	-	59	-
84/85	277	1	78	3
85/86	310	6	82	7
86/87	305	-	98	23
87/88	224	-	146	8

(Unit : '000 tonnes)

8 Cement

The volume of Cement handled at Calcutta/Haldia increased suddenly in 1978/79 and fluctuated in the rage from 120 thousand tonnes to 270 thousand tonnes after 1978/79. The shares of cement handled at Calcutta and Haldia fluctuate year by year. The average share of the cargo handled at Calcutta is 85 percent after 1978/79. The cargo is imported from Korea, Indonesia, Malaysia and Singapore and delivered to West Bengal, Uttar Pradesh, Bihar and Nepal.

9 Edible Oil

Edible Oil is mainly handled at Calcutta and the volume of edible oil fluctuates from 75 thousand tonnes to 125 thousand tonnes after 1978/79. The cargo is imported from European countries, the U.S.A. and Canada and is delivered to West Bengal and Nepal.

10 Salt

Salt handled at Calcutta is only coastal cargo and the volume is decreasing.

11 Sugar

The volume of Sugar handled at Calcutta/Haldia fluctuates year by

year. The cargo is imported from European countries, Cuba, Korea and China and delivered to Bihar, West Bengal and Nepal.

12 Other cargo

The volume of other cargo handled at Calcutta/Haldia gradually increased until 1982/83, suddenly decreased in 1983/84, and is rapidly increasing after 1983/84. The shares of other cargo handled at Calcutta and Haldia average 90 percent at Calcutta and 10 percent at Haldia during 1978/79 to 1987/88.

2) Export cargo

1 P.O.L.(Products)

Export of P.O.L.(Products) at Calcutta/Haldia fluctuates in the rage from 300 thousand tonnes to 800 thousand tonnes. The shares of the cargo handled at Calcutta and Haldia change year by year, with the share at Haldia gradually decreasing after 1977/78.

2 Coal

There are major coal mines in West Bengal, Bihar and Madhya Pradesh in the hinterland of Calcutta/Haldia. Coal is mainly used for electric power in India. Coal handled at Calcutta/Haldia is mainly coastal cargo for thermal power plants. The volume of Coal handled at Calcutta/Haldia rapidly increased after 1979/80. Coal will be handled only at Haldia in the near future.

3 Iron, Steel and Machinery

Export iron, steel and machinery is only handled at Calcutta.

The cargo volume of iron, steel and machinery rapidly decreased during 1976/77 to 1983/84 and after that remained in the range from 90 to 130 thousand tonnes. The cargo volume divided into 1) iron and steel, and 2) machinery after 1983/84 is as follows:

(Unit: '000 tonnes)

Year	Iron and Steel	Machinery
1983/84	69	6
84/85	117	10
85/86	105	13
86/87	79	12
87/88	109	11

4 Jute and Jute Products

The volume of jute and jute products handled at Calcutta/Haldia is decreasing. Jute products are mainly used as packing materials for cement, fertilizer, sugar and foodgrains. But the emergence of synthetic substitutes in the international market has limited the increase of Jute production.

5 Tea

The tea industry developed as export-oriented industry. But domestic consumption of tea has gradually increased in India. 80 percent of the Indian tea grows in North India. Calcutta/Haldia handle most of the tea exports of North India.

6 Iron ore

Iron ore was handled at Haldia until 1984/85 but has not been handled since that time.

7 Other cargo

The volume of other cargo handled at Calcutta/Haldia decreased during 1976/77 to 1980/81, increased until 1984/85, suddenly decreased in 1985/86 and is now gradually increasing after 1985/86. The shares of other cargo handled at Calcutta and Haldia are approximately 90 percent at Calcutta and 10 percent at Haldia.

Table 5-3-1 Cargo Traffic at Calcutta and Haldia

	Cargo volume ('000 tonnes)			Share (%)		
	Calcutta	Haldia	Total	Calcutta	Haldia	Total
1976/77	5,713	2,645	8,358	68.4	31.6	100
77/78	4,350	3,456	7,806	55.7	44.3	100
78/79	4,391	3,847	8,238	53.3	46.7	100
79/80	3,842	4,953	8,795	43.7	56.3	100
80/81	4,066	5,446	9,512	42.7	57.3	100
81/82	4,448	5,478	9,926	44.8	55.2	100
82/83	4,575	6,116	10,691	42.8	57.2	100
83/84	4,088	6,380	10,468	39.1	60.9	100
84/85	3,988	6,536	10,524	37.9	62.1	100
85/86	4,163	7,964	12,127	34.3	65.7	100
86/87	4,047	8,025	12,072	33.5	66.5	100
87/88	4,393	8,678	13,071	33.6	66.4	100

(Unit: '000 tonnes, %)

	Import						Export					
	Calcutta		Haldia		Total		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	2,768	55.0	2,263	45.0	5,031	100	2,945	88.5	382	11.5	3,327	100
77/78	1,694	41.4	2,399	58.6	4,093	100	2,656	71.5	1,057	28.5	3,713	100
78/79	2,397	44.4	2,998	55.6	5,395	100	1,994	70.1	849	29.9	2,843	100
79/80	2,232	36.5	3,891	63.5	6,123	100	1,611	60.3	1,061	39.7	2,672	100
80/81	2,653	37.4	4,445	62.6	7,098	100	1,413	58.5	1,001	41.5	2,414	100
81/82	2,876	42.2	3,940	57.8	6,816	100	1,572	50.5	1,538	49.5	3,110	100
82/83	3,145	44.4	3,939	55.6	7,084	100	1,430	39.6	2,177	60.4	3,607	100
83/84	2,946	42.5	3,992	57.5	6,938	100	1,142	32.4	2,388	67.6	3,530	100
84/85	2,821	39.9	4,247	60.1	7,068	100	1,167	33.8	2,289	66.2	3,456	100
85/86	3,162	37.1	5,358	62.9	8,520	100	1,001	30.3	2,306	69.7	3,307	100
86/87	2,978	36.4	5,212	63.6	8,190	100	1,069	27.5	2,813	72.5	3,882	100
87/88	N.A	-	5,321	-	N.A	-	N.A	-	3,357	-	N.A	-

Table 5-3-2 Import Cargo Traffic by Commodity

(Unit : '000 tonnes, %)

	P.O.L.(Crude)		P.O.L.(Product)					
	Haldia		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	1,900	100	357	49.6	363	50.4	720	100
77/78	1,899	100	395	44.1	500	55.9	895	100
78/79	2,187	100	569	46.4	657	53.6	1,226	100
79/80	2,528	100	420	29.2	1,019	70.8	1,439	100
80/81	2,335	100	676	26.9	1,839	73.1	2,515	100
81/82	2,313	100	482	27.5	1,272	72.5	1,754	100
82/83	2,495	100	474	32.9	965	67.1	1,439	100
83/84	2,583	100	412	28.8	1,020	71.2	1,432	100
84/85	2,401	100	597	30.1	1,385	69.9	1,982	100
85/86	2,845	100	737	30.8	1,653	69.2	2,390	100
86/87	2,700	100	655	29.0	1,604	71.0	2,259	100
87/88	2,719	100	831	33.3	1,665	66.7	2,496	100

	Foodgrains						Fertilizer					
	Calcutta		Haldia		Total		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	1,026	100	-	-	1,026	100	353	100	-	-	353	100
77/78	109	100	-	-	109	100	289	100	-	-	289	100
78/79	56	94.9	3	5.1	59	100	523	92.7	41	7.3	564	100
79/80	-	-	-	-	-	-	279	86.1	45	13.9	324	100
80/81	68	100	-	-	68	100	512	91.6	47	8.4	559	100
81/82	172	100	-	-	172	100	334	91.8	30	8.2	364	100
82/83	423	100	-	-	423	100	145	83.8	28	16.2	173	100
83/84	922	98.3	16	1.7	938	100	111	53.6	96	46.4	207	100
84/85	188	92.2	16	7.8	204	100	401	71.6	159	28.4	560	100
85/86	2	100	-	-	2	100	391	83.0	80	17.0	471	100
86/87	9	100	-	-	9	100	293	79.0	78	21.0	371	100
87/88	62	95.4	3	4.6	65	100	153	83.6	30	16.4	183	100

	Raw Materials for Fertilizer						Coking Coal	
	Calcutta		Haldia		Total		Haldia	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	80	100	-	-	80	100	-	
77/78	109	100	-	-	109	100	-	
78/79	122	100	-	-	122	100	40	100
79/80	90	77.6	26	22.4	116	100	212	100
80/81	77	66.4	39	33.6	116	100	17	100
81/82	129	68.3	60	31.7	189	100	42	100
82/83	107	61.8	66	38.2	173	100	245	100
83/84	79	40.7	115	59.3	194	100	62	100
84/85	124	52.1	114	47.9	238	100	46	100
85/86	214	71.3	86	28.7	300	100	470	100
86/87	129	55.6	103	44.4	232	100	422	100
87/88	184	61.7	114	38.3	298	100	500	100

	Iron Steel, Machinery						Cement					
	Calcutta		Haldia		Total		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	151	100	-	-	151	100	7	100	-	-	7	100
77/78	108	100	-	-	108	100	6	100	-	-	6	100
78/79	176	100	-	-	176	100	78	65.0	42	35.0	120	100
79/80	414	100	-	-	414	100	106	85.5	18	14.5	124	100
80/81	253	100	-	-	253	100	157	78.9	42	21.1	199	100
81/82	436	100	-	-	436	100	240	90.2	26	9.8	266	100
82/83	584	99.0	6	1.0	590	100	175	100	-	-	175	100
83/84	310	100	-	-	310	100	168	89.4	20	10.6	188	100
84/85	355	98.9	4	1.1	359	100	140	84.8	25	15.2	165	100
85/86	392	96.8	13	3.2	405	100	168	80.4	41	19.6	209	100
86/87	403	94.6	23	5.4	426	100	128	78.0	36	22.0	164	100
87/88	370	97.9	8	2.1	378	100	183	95.8	8	4.2	191	100

	Edible Oil		Salt		Sugar					
	Calcutta		Calcutta		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	29		241	100	-		-		-	
77/78	63		143	100	-		-		-	
78/79	100		217	100	-		-		-	
79/80	93		179	100	-		-		-	
80/81	108*	96.4	214	100	14	73.7	5	26.3	19	100
81/82	105	100	52	100	36	90.0	4	10.0	40	100
82/83	75	100	148	100	-		-		-	
83/84	87	100	102	100	-		-		-	
84/85	104*	95.4	36	100	35	67.3	17	32.7	52	100
85/86	80	100	30	100	159	81.5	36	18.5	195	100
86/87	122	100	18**	94.7	121	94.5	7	5.5	128	100
87/88	124*	92.5	15	100	68	100	-		68	100

*) Edible Oil : 4 thousand tonne of Edible Oil was handled at Haldia in 1980/81
5 thousand tonnes in 1984/85 and 10 thousand tonnes in 1987/88.

**) One thousand tonnes of Salt was handled at Haldia in 1986/87.

	Other Cargo					
	Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share
1976/77	524	100	-	-	524	100
77/78	472	99.9	0.3	0.1	472	100
78/79	556	95.2	28	4.8	584	100
79/80	651	93.8	43	6.2	694	100
80/81	574	83.1	117	16.9	691	100
81/82	840	81.3	193	18.7	1,033	100
82/83	1,014	88.3	134	11.7	1,148	100
83/84	755	90.4	80	9.6	835	100
84/85	841	91.8	75	8.2	916	100
85/86	989	88.1	134	11.9	1,123	100
86/87	*1,102	82.2	*238	17.8	1,340	100
87/88	N.A		**254		1,705	100

*) In 1986/87 other liquid cargo is included 34 thousand tonnes in Calcatta and 101 thousand tonnes in Haldia

**) In 1987/88 other liquid cargo is included 31 thousand tonnes in Calcutta

Table 5-3-3 Export Cargo Traffic by Commodity

(Unit: '000 tonnes, %)

	P.O.L.(Products)						Coal					
	Calcutta		Haldia		Total		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	82	18.4	364	81.6	446	100	790	97.8	18	2.2	808	100
77/78	43	7.0	573	93.0	616	100	686	66.2	350	33.8	1,036	100
78/79	37	7.3	467	92.7	504	100	525	66.0	271	34.0	796	100
79/80	33	5.4	582	94.6	615	100	164	26.4	457	73.6	621	100
80/81	18	5.9	286	94.1	304	100	219	25.3	648	74.7	867	100
81/82	34	7.1	444	92.9	478	100	339	24.5	1,042	75.5	1,381	100
82/83	43	6.5	618	93.5	661	100	378	20.1	1,506	79.9	1,884	100
83/84	63	8.5	676	91.5	739	100	262	13.9	1,623	86.1	1,885	100
84/85	67	9.4	642	90.6	709	100	94	5.7	1,568	94.3	1,662	100
85/86	35	4.2	789	95.8	824	100	65	3.5	1,784	96.5	1,849	100
86/87	77	10.1	686	89.9	763	100	62	2.9	2,059	97.1	2,121	100
87/88	75	10.8	622	89.2	697	100	8	0.3	2,624	99.7	2,632	100

	Iron, Steel Machinery		Jute & Jute Products					
	Calcutta		Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	730	100	490	100	-		490	100
77/78	582	100	626	100	-		626	100
78/79	380	100	383	100	-		383	100
79/80	202	100	612	100	-		612	100
80/81	128	100	571	100	-		571	100
81/82	86	100	556	100	-		556	100
82/83	84	100	357	100	-		357	100
83/84	75	100	202	98.5	3	1.5	205	100
84/85	*127	99.2	283	96.9	9	3.1	292	100
85/86	118	100	287	98.3	5	1.7	292	100
86/87	91	100	350	99.2	2	0.8	353	100
87/88	120	100	276	98.5	6	1.5	282	100

*) One thousand tonnes of in iron, steel and machinery was handled in Haldia in 1984/85

	Tea						Iron Ore	
	Calcutta		Haldia		Total		Haldia	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share
1976/77	196	100	-		196	100	-	
77/78	159	100	-		159	100	133	100
78/79	139	100	-		139	100	96	100
79/80	146	100	-		146	100	86	100
80/81	152	100	-		152	100	13	100
81/82	159	100	-		159	100	13	100
82/83	133	100	-		133	100	10	100
83/84	116	85.9	19	14.1	135	100	20	100
84/85	131	85.6	22	14.4	153	100	6	100
85/86	163	96.4	6	3.6	169	100	-	
86/87	126	81.8	28	18.2	154	100	-	
87/88	103	60.9	66	39.1	169	100	-	

	Other Cargo					
	Calcutta		Haldia		Total	
	Volume	Share	Volume	Share	Volume	Share
1976/77	657	100	-		657	100
77/78	560	99.8	1	0.2	561	100
78/79	530	97.2	15	2.8	545	100
79/80	454	92.7	36	7.3	490	100
80/81	325	85.8	54	14.2	379	100
81/82	398	91.1	39	8.9	437	100
82/83	435	91.0	43	9.0	478	100
83/84	424	90.0	47	10.0	471	100
84/85	466	91.9	41	8.1	507	100
85/86	333	93.8	22	6.2	355	100
86/87	363	90.5	38	9.5	401	100
87/88	380	90.7	39	9.3	419	100