12-2 Haldia Dock System

12-2-1 Planning premises

The major planning premises adopted here for the formulation of the Short Term Development Plan for Haldia Dock System are as follows.

(1) The major planning target is to efficiently accommodate the projected demand in 1995.
As for the future traffic, the estimations presented in other sections, i.e. demand forecast and shipping forecast will be adopted as the basic assumptions.

(2) Existing port facilities will be examined for possible improvement and full utilization before recommending construction of new port facilities.
Priority will be placed upon the improvement or expansion of handling equipment as against the construction of additional terminals.

(3) The possibility of improving productivity for vessel/cargo handling will be explored.
Improved productivity will be adopted for planning instead of the actual historical figures as necessary. A more detailed analysis in this connection is presented in other section of this Report.

(4) The accessible draft at Haldia is assumed based on the figures presented by the CPT, ie. 9.3m in 1995 as against 8.6m at present.

(5) Comments of the counterparts on the preceding Reports are taken into consideration as appropriate.

(6) Most importantly, the Short Term Development Plan is formulated within the framework of the proposed Master Plan.

12-2-2 Required Scale of the Port Facilities (Haldia)

In this section, the required scale of the basic port facilities, i.e. the number of the berthing facilities and lock entrances as well as the required enlargement of the basin within the dock system so as to efficiently accommodate the estimated future throughput is analysed. Equipment and port traffic facilities are considered in other sections. Two different approaches are adopted in this analysis to examine the required berthing facilities, viz. conventional estimation baced upon berth occupancy criteria etc. and a computer simulation based upon queuing theory.

The target year of the analysis are 1995 for the Short-Term Development Plan.

(1) Berth Determination

Following is an analysis of the required number of berthing facilities by commodity.

1) POL/Other Liquid Bulk

a) Ship Size/Parcel Size/Productivity of Cargo Handling

Ship size, parcel size per vessel and handling productivity are set as below by reffering to the report prepared by Engineers India Ltd. as well as the information provided by OCC for the project.

Commodity	Year	Ship Size	Parcel Size	Productivity	Non-/ working Time at Berth
Crude	1995	87,000 DWT 144,000 DWT	50,000 Te 63,000 Te	3,500 THP 5,000 THP	15 hrs
Product	1995	35,000 DWT	28,000 Te	1,500 THP	15 hrs
Other Liquid Bulk	1995	12,000 ~ 25,000 DWT	11,000 ~ 23,000 Te (17,000 Te)	800 THP	15 hrs

1) Here, it is assumed that crude tankers visit Haldia after offloading part of their cargo at Madras/Visag.

2) Productivity is provided by OCC.

b) Projected Traffic

Projected traffic is estimated as follows based upon the demand forecast and average parcel size.

Year	Commodity	Cargo Volume ('000 tons)	Parcel Size	NOs of Calling Ships	Remarks
1995	Crude	2,610	50,000 Te 63,000 Te	26 21	50% of Cargo Vol. 50% of Cargo Vol.
	Product	5,420	28,000 Te	194	
	Other Liquid	280	17,000 Te	17	

Here, it is assumed that tankers will increase their parcel size up to 1995 taking advantage of the full permissible draft (9.3m).

c) Required Number of Berthing Facilities

At present, some POL cargo is handled at the Ore Berth within the Dock Complex (44% of the total POL product traffic was handled at the Ore Berth in 1986/87). However, it is envisaged that the Ore Berth will be used for coal traffic in the future. Therefore, it is assumed here that all POL product traffic will be handled at the oil jetties in the future.

The required number of berthing facilities for POL etc., can be calculated as follows.

① Berth Occupancy Rate

When the available jetties are only the existing jetty and the 2nd oil jetty;

Total time at berth per vessel:

(87,000 DWT Tanker) 50,000 Te/ 3,500 TPH + 15 hrs = 29.3 hrs

(150,000 DWT Tanker) 63,000 Te/ 5,000 TPH + 15 hrs = 27.6 hrs

(Product Tanker) 28,000 Te/ 1,500 TPH + 15 hrs = 33.7 hrs

(Other Liquid Bulk) 17,000 Te/ 800 TPH + 15 hrs = 36.3 hrs

Total berth occupying hours:

29.3 hrs x 26 ships + 27.6 hrs x 21 ships + 33.7 hrs x 194 ships + 36.3 hrs x 17 ships = 8,497 hrs

Berth occupancy rate per berth:

$$\frac{8,497 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs} \times 2 \text{ berths}} = 0.54$$

Then, the calculated berth occupancy rate is within the permissible limit.

② Computer Simulation Based on Queuing Theory

A computer simulation was carried out based on queuing theory. Major assumptions are as follows.

Port Entry : once a day (2 hrs) available

Distribution of ship arrival time : Erlung Distribution (phase K = 2)

The major outputs are as follows.

Avg. berth occupancy	Avg. pre-berthing detention (tw)	Avg. berth service time (tb)	tw/tb
0.53	6.4	32.9	0.19

Note: tw/tb = ratio of waiting to berth service time

Considering tw/tb is normally 0.2 - 0.3 and the ship waiting time per vessel would be remarkably improved from the present level of 26 hrs (86/87), two berths will be sufficient.

③ Conclusions

In 1995, two berths, i.e. the existing jetty and the 2nd oil jetty are likely sufficient provided that the increase of the pumping rate as assumed is carried out in accordance with the information provided by OCC.

2) Coal

a) Ship size / parcel size

At present, the maximum ship size calling at Haldia is 47,721 DWT with maximum and average parcel size of 32,792 Te and 24,054 Te respectively. This implies vessels cannot be fully loaded due to the permissible draft limits in the River Hooghly. According to the RITES Report on Coal Transportation (Least Cost Solution for Coal Transportation to Coastal Thermal Power Stations, Feasibility Report, RITES, April 1988), the following dimensions for the vessels to be used in coastal coal transportation are economically optimal.

for Tuticurin (due to draft limits):

28,000 DWT, L = 164.77m

B = 31.38m

d = 8.97m

25,900 Te

On the other hand, 35,000 DWT carriers were assumed in the master plan study for Tuticorin by Indian Ports Association. In the same study, other alternatives of 25,000 DWT and 30,000 DWT were also examined.

Making necessary modification according to the available draft at Haldia, the following figures for ship size/parcel size are adopted here.

Year	Ship size	Parcel size	Remarks
1995	35,000 DWT 30,000 DWT 25,000 DWT	29,000 Te 26,000 Te 23,000 Te	d = 9.3 m

b) Productivity of Handling

As analysed in another section, the productivity of handling coal is assumed as follows.

Berth	Hanlding rate	Remarks
Coal Berth	610 t/hr	x 2 loaders
Converted Berth	480 t/hr	x 2 loaders

c) Projected Traffic

Year	Ship sizwe	Berths	Cargo volume ('000 tons)	No. of calling ships
1995	35,000 DWT	Coal Berth Converted Berth	2,182 1,968	74 67
	20,000 DWT	Coal Berth Converted Berth	2,182 1,968	84 72
	25,000 DWT	Coal Berth Converted Berth	2,182 1,968	95 86

Note : Allocation of cargo volume to berth is determined in such a way as to equalize berth occupancy rates of 2 berths.

d) Required Number of Berthing Facilities

① Berth Occupancy Rate

Total time at berth per vessel:

According to section 11-2-3, the productivity is;

for coal berth : 610 TPH x 2

for ore berth : 480 TPH x 2

The average non-working time per vessel is assumed as 1 day including the required time for berthing/deberthing, preparation for loading, documentation, waiting time for lock opening etc.

<u>For 35,000 DWT vessels</u>

Total time at berth per vessel:

(Coal berth) $\dfrac{29{,}500 \text{ Te}}{680 \text{ TPH} \times 2} + 24 \text{ hrs} = 48.2 \text{ hrs}$

(Converted berth) $\dfrac{29{,}500 \text{ Te}}{480 \text{ TPH} \times 2} + 24 \text{ hrs} = 54.7 \text{ hrs}$

Total berth occupying hours:

(Coal berth) 48.2 hrs x 74 ships = 3,567

(Converted berth) 54.7 hrs x 67 ships = 3,665

Berth occpncy rate per berth:

(Coal berth) $\dfrac{3{,}567 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs}} = 0.45$

(Converted berth) $\dfrac{3{,}665 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs}} = 0.46$

<u>For 30,000 DWT vessels</u>

Total time at berth per vessel:

(Coal berth) $\dfrac{26{,}000 \text{ Te}}{610 \text{ TPH} \times 2} + 24 \text{ hrs} = 45.3 \text{ hrs}$

(Converted berth) $\dfrac{26{,}000 \text{ Te}}{480 \text{ TPH} \times 2} + 24 \text{ hrs} = 51.1 \text{ hrs}$

Total berth occupying hours:

(Coal berth) 45.3 hrs x 84 ships = 3,805

(Converted berth) 51.1 hrs x 76 ships = 3,884

Berth occpncy rate per berth:

(Coal berth) $\dfrac{3,805 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs}} = 0.48$

(Converted berth) $\dfrac{3,884 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs}} = 0.46$

<u>For 25,000 DWT vessels</u>

Total time at berth per vessel:

(Coal berth) $\dfrac{23,000 \text{ Te}}{610 \text{ TPH} \times 2} + 24 \text{ hrs} = 42.9 \text{ hrs}$

(Converted berth) $\dfrac{23,000 \text{ Te}}{480 \text{ TPH} \times 2} + 24 \text{ hrs} = 48.0 \text{ hrs}$

Total berth occupying hours:

(Coal berth) 42.9 hrs x 95 ships = 4,076 hrs

(Converted berth) 48.0 hrs x 86 ships = 4,128 hrs

Berth occpncy rate per berth:

(Coal berth) $\dfrac{4,076 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs}} = 0.51$

(Converted berth) $\dfrac{4,128 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs}} = 0.52$

Thus, berth occupancy rate are within the permissible limit, i.e. 0.5 ~ 0.6 for two berths, as follows;

(Coal berth) 0.45 - 0.51

(Converted berth) 0.46 - 0.52

② Computer Simulation Results

Refer to Table 12-2-1.

③ Conclusion

Assuming the improvement of the handling capacity as analyzed in Section 11-2-3, the coal berth and the converted coal berth would be sufficient for handling the projected traffic in 1995.

3) Fertiliser/Fertiliser Raw Material

a) Ship size/parcel size

At present, 20,000 - 30,000 DWT vessels are calling at Haldia with the maximum and average parcel size being respectively;

maximum parcel size:	fertiliser	10,917	Te
	raw material	14,852	Te
average parcel size:	fertiliser	9,976	Te
	raw material	9,461	Te

These figures will be adopted here for the year of 1995 based upon the results of the interview with the user ministry.

Yeay	Ship size	Parcel size	Remarks
1995	20,000 - 30,000 DWT	10,000 Te	

b) Handling Productivity

Handling of fertilizer raw material and bulky fertilizer is carried out by 2 cram shell unloaders (rated capacity = 700 TPH per each). Therefore effective handling rate is assumed as follows.

$$700 \text{ TPH} \times 2 \times \overset{\eta_1}{0.6} \times \overset{\eta_2}{0.8} = 672 \text{ TPH}$$

η_1 : working time efficiency

η_2 : cram shell efficiency

Average loss time at berth per vessel is assumed as 1 day including required time for berthing/deberthing, preparation for unloading, documentation, waiting time for lock opening, etc.

c) Projected Traffic

Year	Commodity	Cargo Volume ('000 tons)	Parcel Size	No. of Calling Ships	
1995	Fertiliser	12*	10,000 Te	1.2	25,000 tons x 0.5 (for bulk type)*
	Raw Material	530		53	

(*) Actual ratio of bulky type to bagged type were 0.27, 0.32, 0.54, 0.42 from 83/84 to 87/88.

d) Required Number of Berthing Facilities

① Berth Occupancy Rate

Total time at berth per vessel:

10,000 Te / 672 TPH + 24 hrs = 38.9 hrs

Total berth occupying hours:

38.9 hrs x 54.2 ships = 2,108 hrs

Berth occupancy rate:

In the case of 1 shift for handling

$$\frac{2{,}108 \text{ hrs}}{350 \text{ days} \times 7.5 \text{ hrs}} = 0.80$$

In the case of 2 shifts for handling

$$\frac{2{,}108 \text{ hrs}}{350 \text{ days} \times 15 \text{ hrs}} = 0.40$$

Therefore, the increase of the number of shifts to 2 shifts is imperative.

② Computer Simulation Results

Refer to Table 12-2-1.

e) Conclusions

In 1995, the increase up to 2 shifts will be required.

4) Coking Coal

a) Ship Size/Parcel Size

At present, 30,000 - 40,000 DWT vessels are calling at Haldia with the maximum and average parcel size being respectively;

$$\left.\begin{array}{ll}\text{maximum parcel size:} & 23{,}729 \text{ Te} \\ \text{average parcel size:} & 20{,}542 \text{ Te}\end{array}\right\} \text{ in 1987/88}$$

Taking into account these as well as the draft improvement in the future, 29,500 Te in 1995 will be adopted here.

b) Handling Productivity/Loss Time at Berth per Vessel

According to Section 11-2-3, handling productivity is assumed as follows.

$$700 \text{ TPH} \times 2 \times \overset{\eta_1}{0.6} \times \overset{\eta_2}{0.8} = 672 \text{ TPH per berth for 2 circuits}$$

η_1: woking time efficiency

η_2: grab bucket efficiency

1 day is assumed for non-working time per vessel.

c) Projected traffic

Year	Cargo Volume ('000 tons)	Parcel Size	No. of Calling Ships	Remarks
1995	1,800	29,500 Te	61	

d) Required Number of Berthing Facilities

① Berth Occupancy Rate

When 2 circuits are installed,

Total time at berth per vessel:

29,500 Te/672 TPH + 24 hrs = 67.9 hrs

Total berth occupying hours:

67.9 hrs x 61 ship = 4,142 hrs

Berth occupancy rate:

$$\frac{4,142 \text{ hrs}}{330 \text{ days} \times 24 \text{ hrs} \times 1 \text{ berth}} = 0.52$$

② *Necessity of Mechanization of Handling*

As against the productivity of the mechanized system as described above, when the present handling system is continued up to 1995;

Average net handling per ship berth day (1986/87):

16,880 Te / 3.89 days = 4,339 Te per ship-day

Total time at berth per vessel:

29,500 Te / 4,339 + 1 day = 7.8 days

Berth occupancy rate:

7.8 days x 61 ships / 330 days = 1.44 (1995)

Therefore, installation of a mechanized system by the year 1995 is imperative.

③ Computer Simulation Results

Refer to table 12-2-1.

e) Conclusions

Upto 1995, 1 mechanized berth with 2 circuits of 700 TPH rated capacity is required.

5) **Break-bulk general cargo/fertiliser (bagged)**

a) Projected Traffic

Year	Commodity	Cargo Volume ('000 tons)	Parcel Size	No. of Calling Ships	Remarks
1986/87	B/Bulk	115	3,837 Te	27	Actual
	Fertiliser	44	9,976 Te	4	
1995	B/Bulk	300	5,000 Te	60	Max. fertilizer in 87/88: 10,912 Te
	Fertiliser	13	11,000 Te	1.2	

(Note) i) Cargo Volume
1995: bagged fetilser : 25 x 0.5 = 13 ('000 tons)

b) Productivity

As of 1986/87, the handling rate of break-bulk cargoes at Haldia is 1,027 tons/day (Avg. parcel size/ Avg. working days per vessel = 4,259 Te/4.14 days). The gross handling productivity (including loss time for clearance and berthing-deberthing purposes) is assumed as 1,000 tons/day.

Thus,

Total time at berth per vessel:

$$\text{(B/Bulk)} \quad \frac{5{,}000 \text{ Te}}{1{,}000 \text{ tons/day}} = 5 \text{ days}$$

$$\text{(Fertiliser)} \frac{11{,}000 \text{ Te}}{1{,}000 \text{ tons/day}} = 11 \text{ days}$$

c) Required Number of Berthing Facilities

① Berth Occupancy Rate

Total occupying days p.a.:

5 days x 60 ships + 11 days x 1.2 ships = 313 days

Berth Occupancy Rate

$$\frac{313 \text{ ship days}}{330 \text{ days x 2 berths}} = 0.95 \text{ (in case 1 berth is available)}$$

$$\frac{313 \text{ ship days}}{330 \text{ days x 2 berths}} = 0.47 \text{ (in case 2 berths are available)}$$

Therefore, two general-cargo berths would be required.

Assuming 1 exclusively G/C berth and 1 multi-purpose berth be provided, and assuming 60% for G/C berth as well as 50% for multi-purpose berth as the permissible berth occupancy rate, the remaining ship days at the multi-purpose berth which can be provided for catering to container vessels is:

330 ships days x 0.6 + 330 ship days x 0.5 - 313 ship days

= 50 ship days.

② Conputer Simulation Results

Refer to Table 12-2-1.

d) Conclusions

Conclusions will be formulated in the following container section through articulating the container berth requirement.

6) **Containers**

a) Average container exchange / Handling productivity

At present, the average container exchange per vessel at Haldia is 244 TEUs (loading/unloading).

On the other hand, Engineers India Ltd. carried out the detailed analysis on augumentation of container facilities at Haldia. According to this, the average container exchange per vessel was proposed as 250 TEUs in the EIL Report.

Following this, 250 TEUs / vessel is assumed here in 1995.

In the same report be EIL, the handling rate of shoreside cranes was assumed 25 lifts on average as follows.

	Peak	Average
New gantry	30 lifts	15 lifts
Existing gantry	20	10
Total	50	25

The same figures will be adopted here for the multi-purpose berth using 1 existing crane and 1 new crane. As for the new berths, the handling rate at full-fledged container berths is normally 20 - 30 boxes/crane hr; however, taking the local conditions into account, 15 boxes/crane • hr will be adopted here.

b) Projected Traffic

Year	Cargo Volume	Avg. Exchange per Vessel	No. of Calling Ships	Remarks
1995	TEUs 56,000	TEUs 250	224	

c) Required Number of Berthing Facilities

① Berth occupancy rate

The following premises are adopted for the estimation.

TEU/Box : 1.1 in 1995 (based on the actual ratio of 40 ft/20 ft : 15/85)

Handling productivity : 25 boxes/hr for the berth using existing crane

30 boxes/hr for the berth using new cranes

Operation hours per day : 20 hrs (3 shifts)

Non-working time at berth per vessel : 12 hrs

Working days per year : 330 days

Total time at berth per vessel:

$$\text{(using existing crane):}\ \frac{250\ \text{TEUs}}{1.1\ \text{TEUs/Box} \times 25\ \text{Box/hr}} + 12\ \text{hrs} = 21.1\ \text{hrs} = 0.88\ \text{day}$$

$$\text{(using new crane):}\ \frac{250\ \text{TEUs}}{1.1\ \text{TEUs/Box} \times 30\ \text{Box/hr}} + 12\ \text{hrs} = 19.6\ \text{hrs} = 0.82\ \text{day}$$

Required ship days :

0.88 days x 224 ships = 197 ship days

On the other hand, available ship days at a container berth or the multipurpose is :

(at a container berth): 330 ship days x 0.5 = 165 ship days

(at the multi-purpose berth): 50 ship days (remaining)

(total): 215 shipdays

Comparing the above required ship days with available ship days, 1 container berth is required in addition to the multi-purpose berth. In this case, berth occupancy rate :

multipurpose berth : 0.5

container berth : 224 ships - $\dfrac{50 \text{ ship days}}{0.88 \text{ day}}$ = 167 ships

$$\frac{0.82 \text{ days} \times 167 \text{ ships}}{330 \text{ days}} = 0.41 < 0.5$$

d) Conclusion (handling containers as well as break-bulk general cargoes/bagged fertilizer)

The required berths are sumarrized as follows.

1 exclusively general cargo berth

1 multi-purpose berth

1 exclusively container berth

(2) Berth Determination for IWT Container Transport

IWT container transport demand is estimated as follows:

Year	Alternative	Estimate	Dutch Estimate
1995	—	18,400 TEUs	22,440 TEUs

In 1995, IWT containers can be handled at the ocean-going terminal, i.e. at the container berth, due to the small scale of demand.

Table 12-2-1 Computer Simulation Results

Name of Berths	Berth Occupancy Rate	Vessels Berthed	Average Waiting Time for Berthing (tw)	Average Berth Service Time(tb)	tw/tb
Coal Berth (converted)	% 50.9	Coal	hr/vessel 6.8	hr/vessel 52.0	0.17
Coal Berth	51.6	Coal	8.7	47.9	0.18
Phosphate Berth	37.1	Fertilizer/ F.Raw Material	2.6	38.6	0.07
C/coal Berth	52.1	C/Coal	10.8	73.4	0.15
Conventional Berth (Esisting)	62.7	Fertilizer/ B/Bulk	5.2 5.3	181.4 133.1	0.03 0.04
Multiopurpose Berth (New)	40.8	Fertiliser/ B/Bulk container	-ditto- -ditto- 3.2	-ditto- -ditto- 22.7	-ditto- -ditto- 0.14
New container Berth	48.7	Container	3.2	22.7	0.14

(3) Determination of the Required Number of Lock Entrances

The required number of lock entrances at Haldia can be analyzed based upon queuing theory as follows.

Assuming that ship arrival follows a Poisson distribution and service time at lock entrances follows exponential distribution, using M/M/S analysis;

1) In 1986/87

Average ship arrival

$$\lambda = \frac{577 \text{ ships} - 322 \text{ ships} + 104 \text{ ships}}{365 \text{ days}} = 0.98 \text{ ship/day}$$

Here, 577 : total ship arraival to Haldia

322 : ship arrival to the oil jetty

104 : ship arrival (POL products) to the ore berth

Average ship service $\mu = 2.5 - 5$ ships/day

2.5 for one tide available per day

5 for two tides available per day (assuming night navigation)

(2 - 3 ships per tide is the capacity of the lock entrance per tide at present based upon the interview with CPT)

Thus,

		Night navigation (with) (without)
Average waiting ships	Lq	= 0.047 - 0.158 ships
Average waiting time per vessel	Wq	= 0.048 - 0.161 day/vessel
Total waiting time p.a.	TWq	= 17.2 - 57.8 days p.a.

2) In 1995

a) When the number of lock entrances remains unchanged,

λ = 818 ships/365 days = 2.24 ships/day

μ = 2.5 - 5

S = 1

Thus,

Lq = 0.3636 - 7.7194 ships

Wq = 0.1623 - 3.4462 day/vessel

TWq = 133 - 282 days p.a.

Taking into consideration that the present situation (86/87) is near the lock capacity, the above Wq and Twg seem beyond the permissible limit.

b) When the number of lock entrances is increased to 2,

λ = 2.24 ships/day

μ = 2.5 - 5 ships/day

S = 2

Thus,

Lq = 0.024 - 0.225 ships

Wq = 0.011 - 0.100 day/vessel

TWq = 87 - 82 days p.a.

The situation will be remarkably improved to the level similar to the present through increasing the number of lock entrances from 1 to 2.

c) Otherwise, productivity improvement by up-grading tug fleet and berthing master number will be required.

If, μ = 4 - 8 ships/day, then, Wq = 0.049 - 0.318 day per vessel

TWq = 40 - 260 days p.a.

This also implies night navigation enabling the calling/dispatch of vessels is imperative.

Year	λ	μ	S	Lq	Wq	TWq	Remarks
	ships /day	ships /day		ships	day/ship	days p.a.	
1986/87	0.98	2.5 - 5	1	0.047 - 0.158	0.048 - 0.161	17.2 - 57.8	Present
			2	0.001 - 0.008	0.001 - 0.009	0.4 - 3.2	
1995	2.24	2.5 -5	1	0.3636- 7.719	0.1623- 3.446	133 - 282	×
			2	0.024 - 0.225	0.011 - 0.100	8.7 - 82	O
		4 - 8	1	0.109 - 0.713	0.049 - 0.318	40.0 - 260	O(with night navigation) ×(without ")
			2	0.006 - 0.048	0.0025- 0.0123	2.0 - 17	O

Note: The remarks show the evaluation of the calculation results based upon the comparison with the present condition in terms of waiting time for lock entrances (wq and TWg).

3) Conclusions

Up to 1995, the need for a 2nd lock entrance would emerge.

Otherwise, productivity improvement by upgrading tug fleet and berthing master number etc. as well as night navigation enabling calling/dispatch of vessels is imperative.

12-2-3 Required Scale of Cargo Handling Equipment

Refer to 11-2-3.

12-2-4 Port traffic facilities-Haldia port railway system

1) Container terminal

The required number of reception tracks, departure tracks and loading/unloading tracks in 1995 are calculated in the same way as for the Calcutta container terminal and presented in Table 12-2-2.

In 1995, the rakes have to be split up into two part at the terminal.

Table 12-2-2

	Handling Volume A (TEUs)	λ	μ	Required Number of Tracks		
				Reception	Loading/Unloading	Departure
1995	11,200	0.240	8 (Reception)	1	-	-
			1.33 (Loading/Unloading)	1	1	-
			2.67 (Departure)	-	-	1

2) Coal rake terminal

The number of reception and departure tracks in BH yard shall be examined considering the tippler efficiency and the locomotive availability.

The average number of arrival rakes (λ) at present is 4.2 rakes/day and the figures in 1995 are calculated as follows.

	(rakes/day)	λ (tonnes)
1987/88	4.21	2,540,000
1994/95	5.685	4,150,000

The average staying period of coal rakes at each of the tracks at Haldia are as follows as shown in Chapter 4.

Reception Tracks : 4.5 hrs (5.33 rakes/day)
Tippler, forming tracks, other : 19 hrs (1.26 rakes/day)
Departure Tracks : 12 hrs (2 rakes/day)

The required number of reception tracks shall be examined considering that waiting of incoming rakes at the trunk line should be strictly avoided and the required number of reception tracks depends on the tippling efficiency. Present tippling efficiency is 3.345 rakes/day.

Using the present operational efficiency at the reception tracks, tippler and departure tracks, the required number of reception tracks, tippler and departure tracks are calculated as shown in Table 12-2-3.

Table 12-2-3

	1987/88	1994/95
Reception Tracks	3	4
No. of Tipplers	3	4
Departure Tracks Departure (improved)	6 (5)	7 (5)

According to the above results, it is clear that tippling efficiency and examination/clearance efficiency at the departure tracks should be improved.

It seems that it will be possible to reduce examination and clearance time through coordination between CPT and S.E.

Tippler efficiency will also be improved by increasing the number of tipplers and/or reinforcing the capacity (ref. Chapter. 3.3).

Assuming the examination/clearance time will be reduced by half, the required numbers of departure tracks will be reduced to the numbers in Parenthese in Table 12-2-3.

3) P.O.L

At present, the average staying periods of P.O.L rakes at Haldia rail system are as follows, as mentioned in Chapter 4.

Reception tracks : 10 hrs (2.4 rakes/day)

Departure tracks : 15 hrs (1.6 rakes/day)

Using the above operational efficiency, the required numbers of reception tracks and departure tracks are calculated in the same way as for the other cases.

The arrival rate is calculated as follows.

Table 12-2-4

	Handling volume (tonnes)	λ	μ	Required number of Tracks		
				Reception	IOC	Departure
1995	1,280,000	2.612	2.4 (4.8) :Reception	4 (2)	-	-
			1.6 (3.2) :Departure	-	*	5 (3)

* Depend upon IOC's siding efficiency

According to the above results, it is clear that the operational efficiency at the reception tracks and departure tracks should be improved.

Assuming the operational efficiency will be doubled, the required numbers of departure tracks will be reduced to the numbers in Parentheses in Table 12-2-4.

4) Coking coal

At present, the average staying periods of coking coal rakes at the loading tracks and the departure tracks at G.M yard are as follows.

Reception tracks : 9 hrs (2.67 rakes/day)

Departure tracks : 15 hrs (1.60 rakes/day)

If a mechanical loading facility of coking/coal to wagons is developed by the target year 1995, the loading efficiency will improved as shown below (ref. chapter 4).

Loading efficiency : 4.930 rakes/day/line.

Using this improved efficiency, the required number of tracks (2 tracks/line) is calculated as shown in Table 12-2-5.

Table 12-2-5

	Handling volume (tonnes)	λ	μ	Required number of Tracks		
				Loading	Departure at G.M	
1995	1,800,000	2.612	4.930 :Loading	1	-	
2005			1.6 (3.2) :Departure	-	4	(2)

If the operational efficiency at the departure tracks, namely, examination of tracks and clearance, is doubled, the required numbers of tracks will be reduced to the numbers in parentheses in Table 12-2-5.

A direct link line shall be developed between the coal departure trucks and the coking coal loading terminal as shown in Fig. 12-2-1.

5) *Required number of tracks at Haldia*

The required number of reception tracks and departure tracks at G.M yard and BH yard are summarized in Table 12-2- 6 below. The required number of sorting yards will be eight in 1995.

Table 12-2-6

		Reception tracks		Departure tracks	
GM yard	1995	1 for containers 4 (2) for POL 1 for General cargo	6 (2)	1 for containers 5 (3) for POL 4 (2) for coking coal 1 for General cargo no truck for general cargo	11 (5)
BM yard	1995	4 for coal	4	7 (5) for coal	7 (5)

( ) : assuming a 100 % improvement of operational efficiency (examination/clearance)

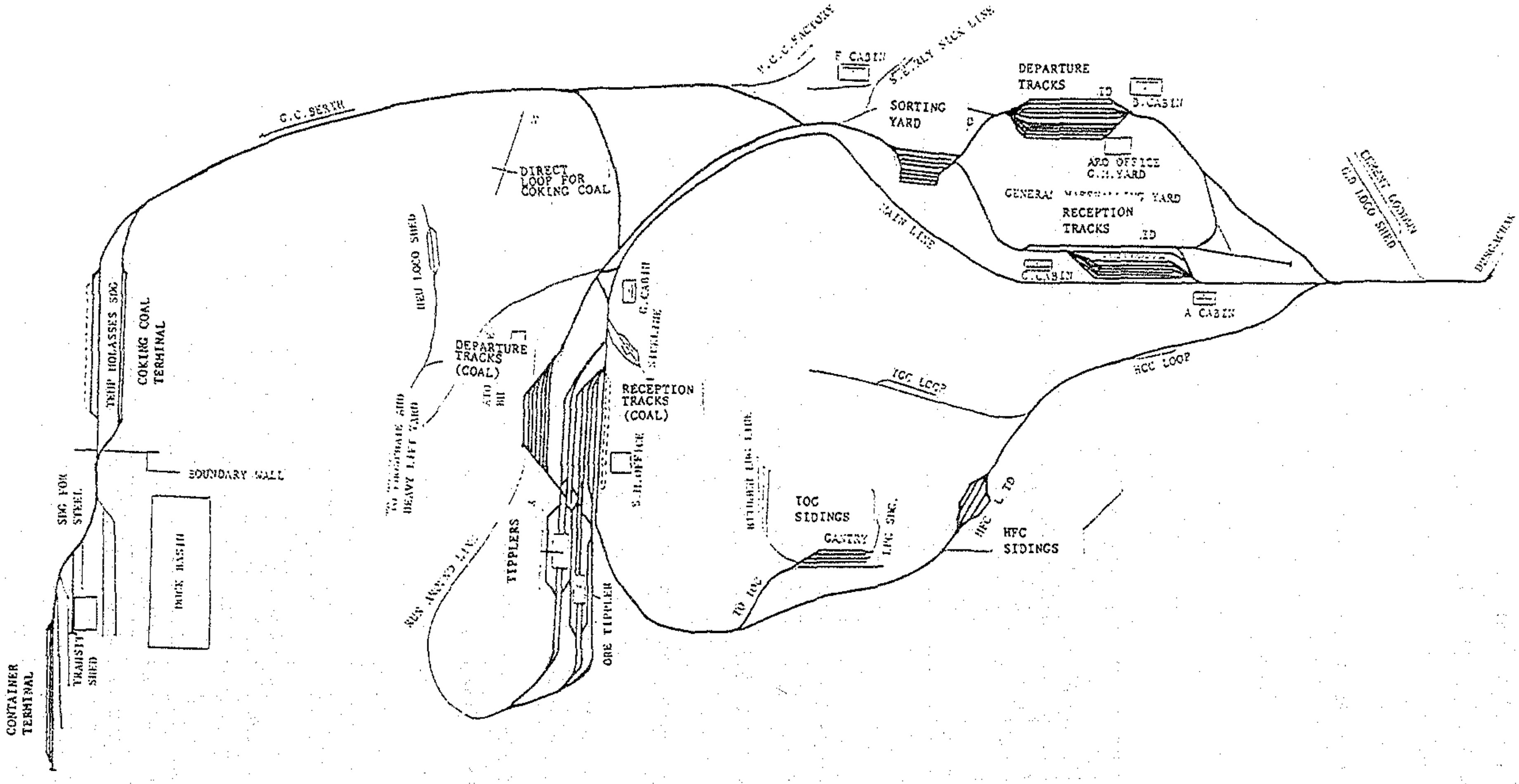


Fig. 12-2-1 General Plan of Haldia Railway System (1995)

6) Required number of locomotives

In 1995, at least seven locomotives will be necessary and two of them should have enough hauling capacity for coal rakes and one for container rakes. Their hauling capacity shall be over 4,000 tonnes for coal rakes and 3,000 tonnes for container rakes.

7) General improvement plan of Haldia railway system

Fig. 12-2-1 shows the general plan of Haldia railway system in 1995.

As noted in Chapter-4, Haldia railway system has many serious problems including lack of locomotives, frequent derailment, shortage of staff, and inefficient operations for the commercial/industrial sidings. Especially, the following problems need to be improved urgently.

a) Reducing the examination period through coordination between CPT and SE.
b) Through maintenance of the tracks in order to avoid derailment and to improve efficiency.
c) Increasing the number of locomotives.
d) Installing speed arresters (Car Reterder) at the post tippling zone to avoid damage to wagons.

Concerning the operation for the industrial sidings, it seems reasonable to entrust this operation to the Indian Railway.

It would be much better to transfer rakes directly from Indian Railway especially for HFC sidings and IOC sidings without passing through port railway yards considering the sufficient traffic volume to form rakes.

12-2-5 Proposed Layout Plan

Based on the required scale of the port facilities as analyzed in the foregoing sections, a layout for the Short-term Development Plan is prepared as shown in Fig. 12-2-3.

(1) The dimensions of newly constructed berths are assumed as follows

Taking into consideration that :

i) the berth of the existing berth is 220 m

ii) the study by EIL on the augmentation of container handling facilities at Haldia assumed the length of 220 m

iii) as regards container vessels in future upto 2005 :

			LOA
300-400	TEU vessel	presently most of the calling vessels	125 m
500	TEU vessel	increase the share	160 m
1000	TEU vessel	Black Sea Shipping, etc	190 m
7/800	TEU vessel	SCI etc may deploy in future	210 m

Thus, adding berthing gap (15-30), 200 m of berth length will be sufficient for 500 TEU loaders.

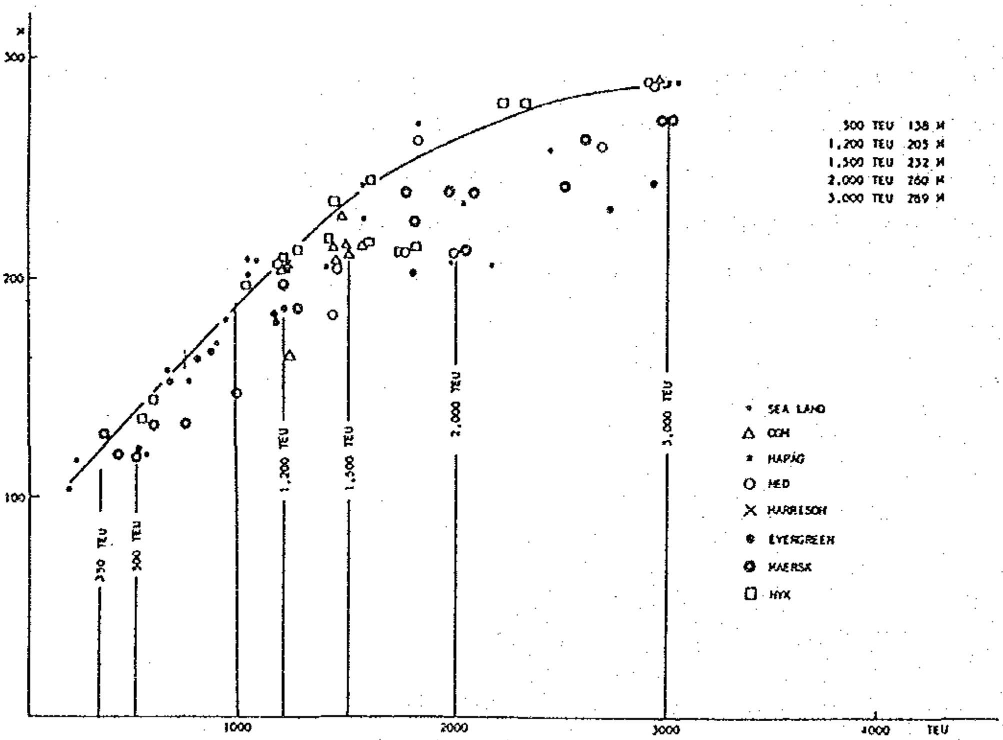


Fig. 12-2-2 Relationship Between LCA and TEU

vi) as regards conventional vessels :

Present calling vessels are less than 20,000 DWT (1986) and the appreciable increase of ship size of the conventional vessel is not expected.

Also, 15,000 DWT 20,000 DWT conventional vessels calling at Haldia/Calcutta occupies 12 % in 1986. Respective berth length = 180 m - 210 m.

v) all berth are continues, therefore the contiguous berth can be utilized when required.

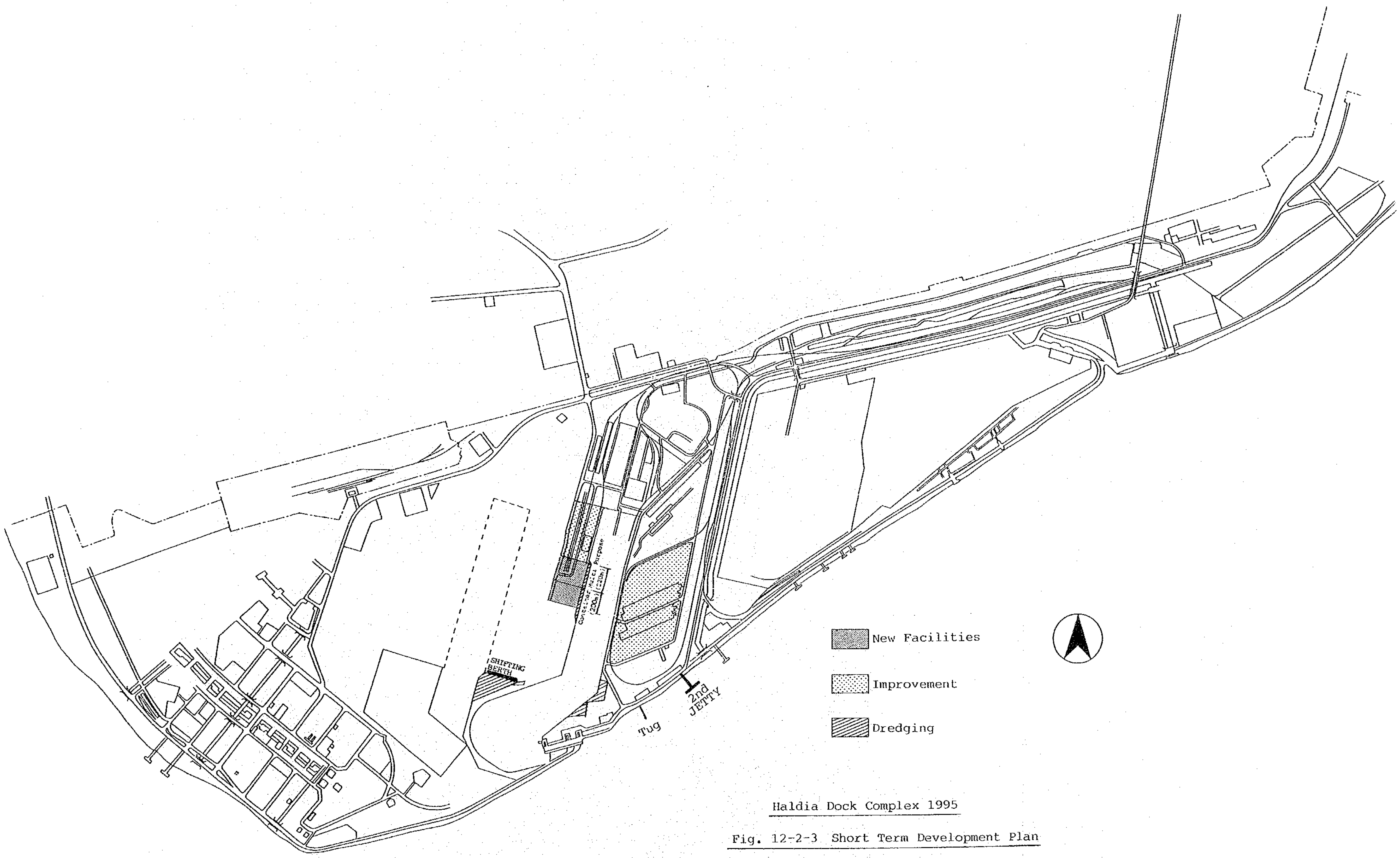
Thus, the following berth length will be adopted here,

Multi purpose berths : 1 = 220 m /berth

Container berths : 1 = 200 m /berth

(2) Detailed Layout Plan of the Coking Coal Berth and Container Terminals

The detailed layouts for the Short Term Development of the Coking Coal Berth and the Container Terminal are formulated as presented in the Fig. 11-2-6 and 11-2-11.



Haldia Dock Complex 1995

Fig. 12-2-3 Short Term Development Plan

12-3 Short-term Development Plan of Craft/Vessels

Refer to 11-3.

The procurement list of Craft/vessels within the Short-term Plan period is presented in Table 12-3-1.

Table 12-3-1 Procurement List of Port Service Vessels (Short-term Plan)

Port	Type of Vessel	Main Dimensions			Performance	Remarks
		L	B	D		
H	Hopper Dredger	84.0	16.0	7.2	1,700 ㎥	
C	Grab Dredger	60.0	12.0	5.0	750 ㎥	with hopper
H	〃	〃	〃	〃	〃	
C	Tug-Boat	39.5	9.7	4.9	1,250ps×2	
C	〃	〃	〃	〃	〃	
H	Tug-Boat	〃	〃	〃	〃	
H	〃	〃	〃	〃	〃	
H	〃	〃	〃	〃	〃	
C	River Survey Launch	20.4	4.6	2.2		
C	〃	〃	〃	〃		
C	Pilot/Harb./Dock Launch	20.8	5.0	2.6		
C	〃	〃	〃	〃		
C	〃	〃	〃	〃		
C	Floating Crane	45.0	24.0	3.5	60t	Self-propulsion
H	〃	40.0	18.0	3.5	60t	Non-propulsion
C	Multi-Purpose	45.0	12.0	5.5	1,000ps×2	
C	〃	〃	〃	〃	〃	
H	〃	〃	〃	〃	〃	

Chapter 13 Preliminary Design & Cost Estimate

In this chapter, we will study the preliminary design & cost estimate based on the Master Plan to 2005 and the Short-term Plan to 1995 described in Chapters 11 & 12 (refer to Fig. 13-1-1 to 13-1-4).

13-1 Design Condition

The design conditions of structures for the Master/Short Term Plans in 2005/1995 are considered in this section.

13-1-1 Design Conditions of Berths

Vessels to be accommodated and the design conditions of each berth, such as length, depth, apron elevation, surcharge, berthing velocity, seismic coefficient, and lifetime are shown in Table 13-1-1.

Table 13-1-1 Design Conditions of Berths

No.	Name of berth	Length (m)	Ship size (DWT)	Depth (m)	Elev. (m)	Surcharge (t/sq. m)	Remarks
1	1 CTN berth	200	30,000	- 7.5	+7.2	3.0	with cranes
	3 -do-	600	30,000	- 7.5	+7.2	3.0	with cranes
2	Multi berth	220	20,000	-10.4	+7.2	3.0	with cranes
3	Shifting berth		30,000	- 7.5		0	dolphins
4	Oil shifting berth		150,000	-12.2		ballast	dolphins
5	Lock System	330	70,000	-10.7	+7.2	2.0	with 350 m jetty
6	Barge berth	80	3,000	- 7.5	+7.2	3.0	with cranes
7	General Cargo berth	200	20,000	- 7.5	+7.2	1.0	
8	Pilot base	30	200	- 4.0	+6.5	1.0	with jetty

(Note) * Berthing velocity : 0.15 m/sec
* Seismic coefficient : 0.05
* Lifetime : 30 years
* The water surface elevation in Haldia Dock is + 4.5 m. Accordingly, the water depth in front of the berths is 12 m deep in average.

13-1-2 Tidal Range

a) Calcutta port : H.W.L. = KODS + 4.88m (MHWL)

M.W.L. = KODS + 3.19m

L.W.L. = KODS + 1.68m (MLWL)

KODS : Khidirpur old Dock Sill

b) Haldia port : H.W.L. = H.D. + 5.01m

M.W.L. = H.D. + 3.23m

L.W.L. = H.D. + 1.34m

*H.D. = KODS - 0.46m

13-1-3 Wave Force

The wave force is not considered except on the Hooghly river side at Haldia & Sagar navigation base because structures in the docks are sheltered. The wave force at the Hooghly river side & Sagar are as follows.

H 1/3 = 2.0m at Sagar island,

1.8m at Hooghly river side, Haldia

T = 6.0 sec.

13-1-4 Soil Conditions

The following sketche roughly show the sub-soil conditions based on the borings.

Haldia Dock

+ 7.0m
very soft to soft clayey SILT
$C = 2\ t/m^2,\ \gamma = 1.7\ t/m^3$

- 2.0m
loose silty SAND
$\phi = 26°,\ \gamma = 1.8\ t/m^3$

- 7.0m
moderately stiff to stiff clayey SILT
$C = 6\ t/m^2,\ \gamma = 1.7\ t/m^3$

-15.0m
dense to very dense silty SAND
$\phi = 35°,\ \gamma = 1.8\ t/m^3$

Sagar Island (Chemagari)

+ 7.0m
very soft silty CLAY
$C = 1\ t/m^2,\ \gamma = 1.7\ t/m^3$

- 8.0m
moderately stiff to stiff silty CLAY
$C = 4\ t/m^2,\ \gamma = 1.7\ t/m^3$

-12.0m
medium to dense silty SAND
$\phi = 30°,\ \gamma = 1.8\ t/m^3$

-18.0m
stiff to very stiff silty CLAY
$C = 7\ t/m^2,\ \gamma = 1.7\ t/m^3$

-22.0m
very dense fine SAND
$\phi = 35°,\ \gamma = 1.8\ t/m^3$

* The soil profiles at Calcutta/Haldia dock & Sagar island are shown in Fig. 3-2-1, 3-2-2, 3-2-3.

13-1-5 Allowable Stress

Allowable compression stress of reinforced concrete : 60 to 80 kg/sq.cm

Allowable tensile stress of steel : 1,400 kg/sq.cm

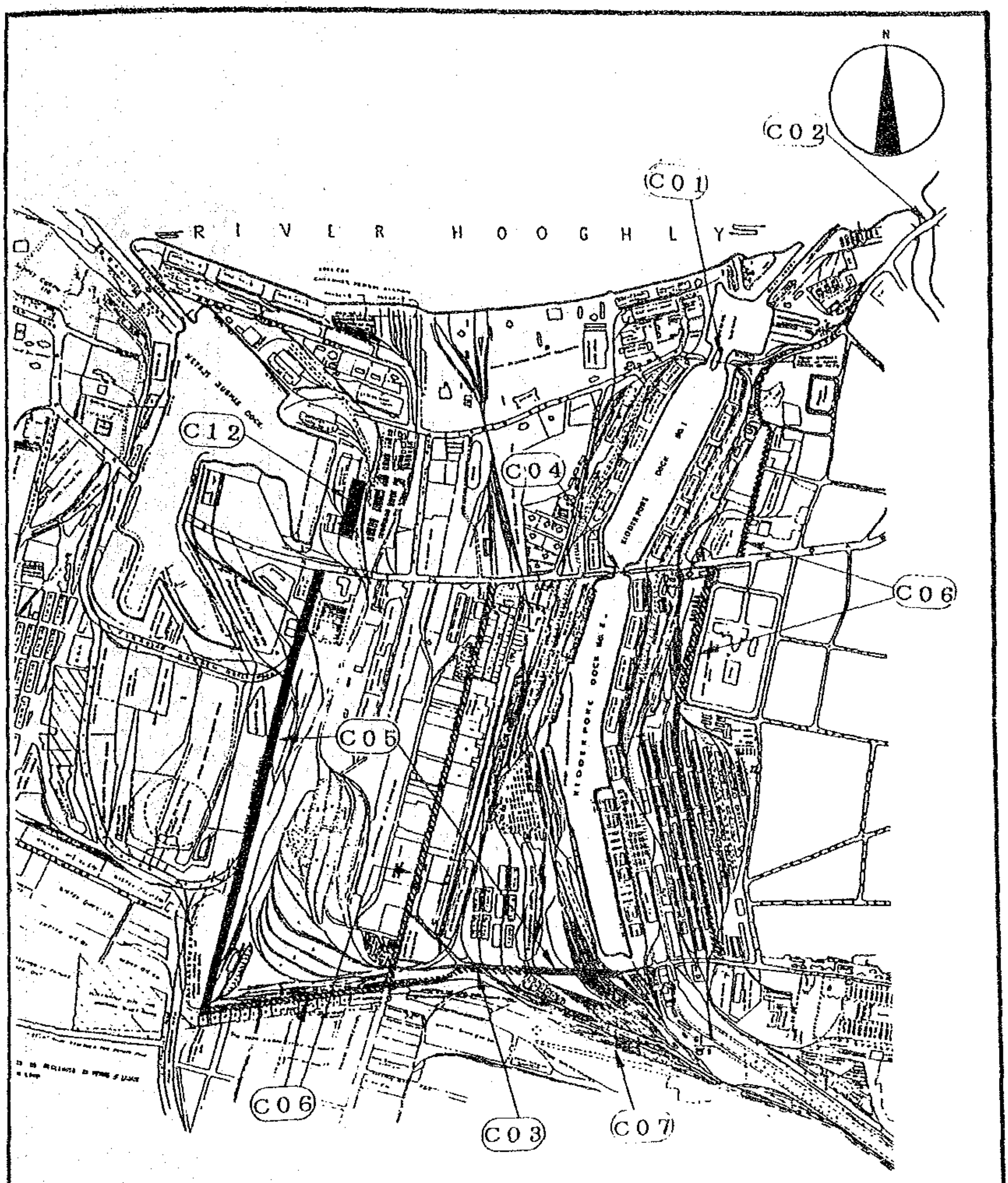
13-1-6 Safety Factors

Safety factors are shown in following table:

Table 13-1-2 Safety Factors

	Ordinary	Particular
Slope-sliding	1.3	1.0
Sliding of Wall	1.2	1.0
Over-turning of Wall	1.2	1.0
Axial bearing capacity of piles	2.5	2.0
Embedded length of Sheet piles	1.5	1.2

Fig. 13-1-1 Short Term Plan of Calcutta Dock System



C01 Replacement of Swing Bridge
C02 Hasting Bridge
C03 Flyover Bridge
C04 Replacement of Bascule Bridge
C05 New Road
C06 Widening Road
C07 Block Rake Terminal
C12 Container Freight Station

Fig. 13-1-2 Master plan of Calcutta Dock System

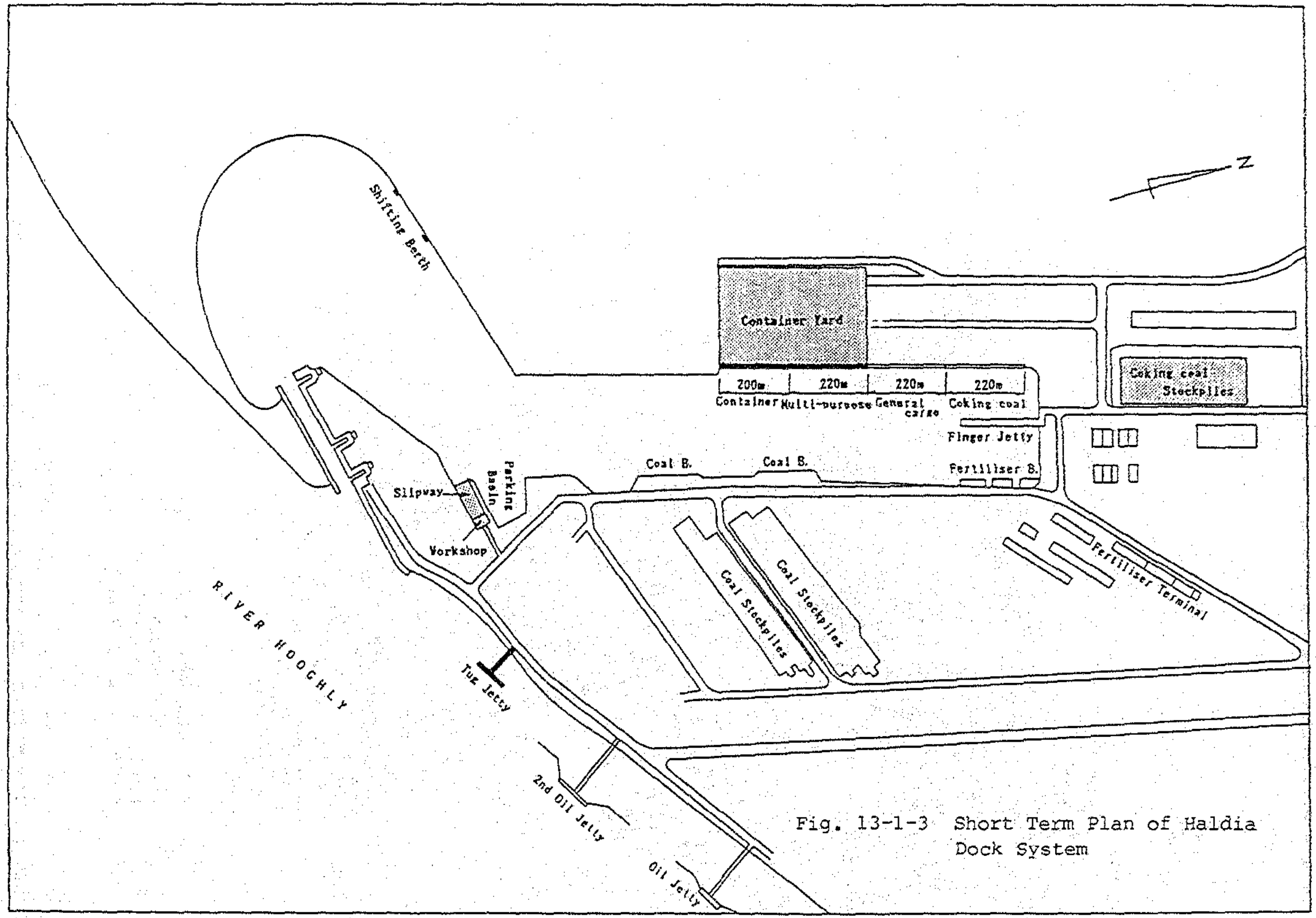


Fig. 13-1-3 Short Term Plan of Haldia Dock System

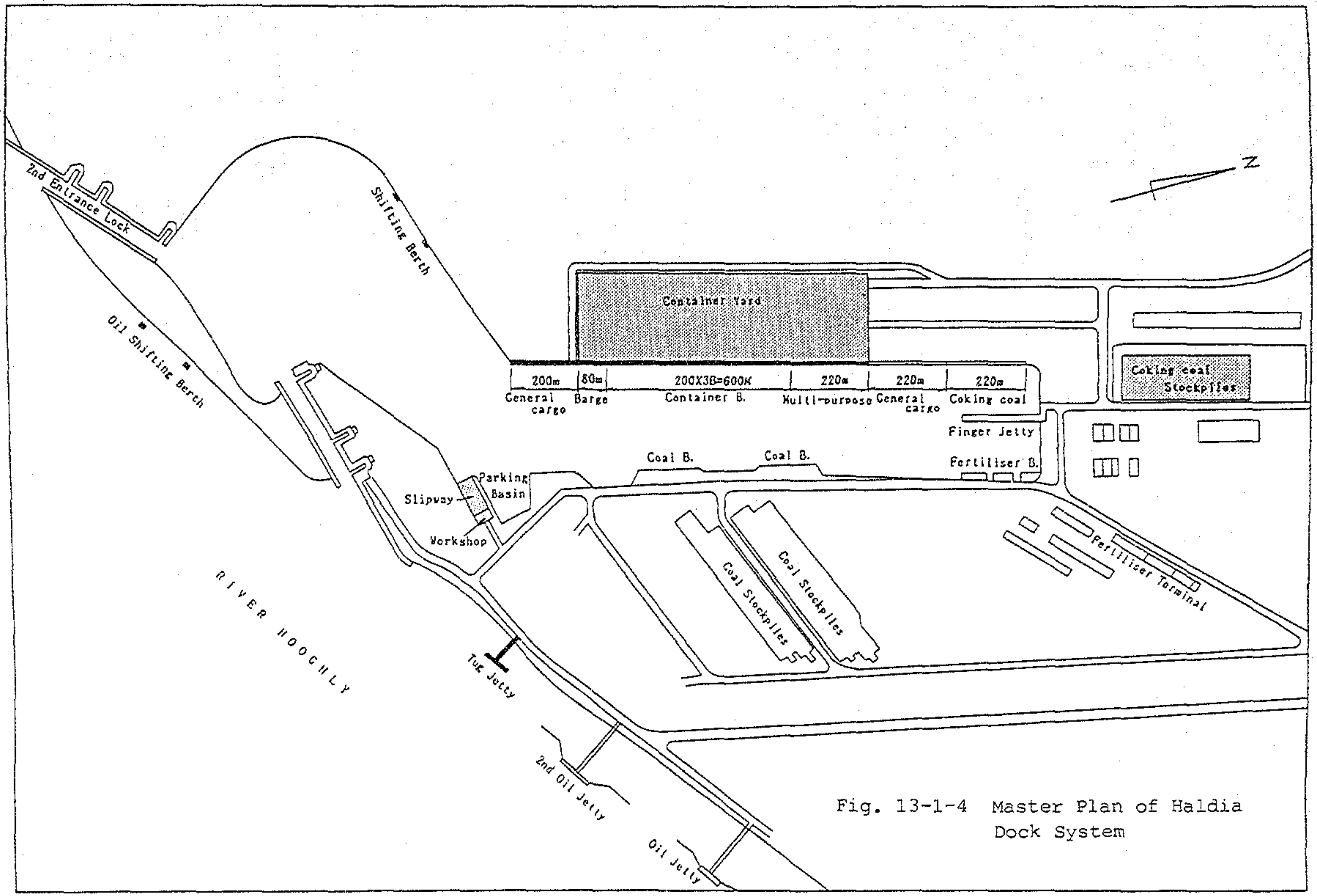


Fig. 13-1-4 Master Plan of Haldia Dock System

13-2 Design of Main Structures in Calcutta

13-2-1 Replacement of Existing Swing Bridge

There are 2 alternatives for the structural design of this bridge. One is a Lifted/Retractable type and the other is a Bascule type. The team has compared these 2 types as summarized in the following table.

Table 13-2-1 Comparison of 2 Alternative Bridges

Description	Bascule bridge	Retractable bridge
Navigation channel	middle island not necessary Width of channel : 67m * shall be removed exiting island	Need the island Width : 24m & 18m * same as existing
Navigation clearance height for small craft	higher i.e. able to pass during closed channel	low
Land use area	Small :	Large : * Compulsory land purchase is required
Technical aspect	Behind (cantilever type)	Excellent(simple beam)
Beauty	Beautiful sight	Behind
Cost/construct. period	104 M.Rs/2 years	85 M.Rs/2 years

[Remarks]

* Cost include mechanical & civil items and excludes compulsory land purchase fee & import duty.

** Mechanical materials (hydraulic) shall be imported for both types.

Synopsis:

Load : Tractor/Trailers loaded with 40 ft containers

Span : 67 400mm (same as existing bridge)

Width : 18,000mm (4 lanes)

Steel structure with counter weight

Total weight : 850t

*** Refer to Fig. 13-2-1.

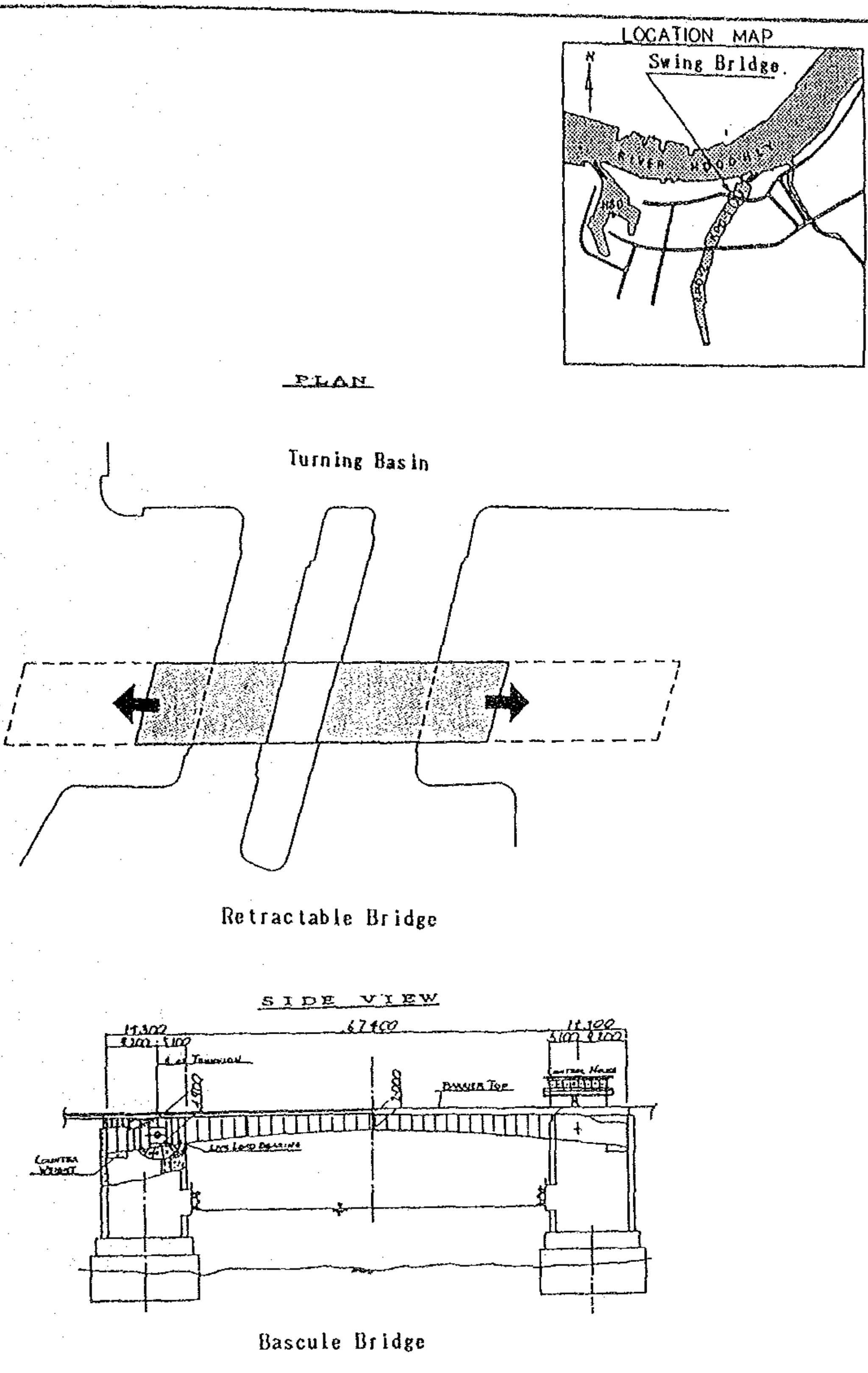


Fig. 13-2-1 Replacement of Swing Bridge

Based upon the analysis on the comparison of both alternatives, the bascule type is recommendable.

13-2-2 Additional Hasting Bridge

The prestressed concrete type is recommendable.

Synopsis :

Load : Tractor/Trailers loaded with 40 ft containers

Span : 80 000mm

Width :10 200mm (2 lanes)

PC structure made in India

13-2-3 Flyover Bridge at the Block Rake Terminal

The prestressed concrete type is recommendable.

Synopsis :

Load : Tractor/Trailers loaded with 40 ft containers

Span : 50 000mm

Width : 18 000mm (4 lanes)

PC structure made in India

13-2-4 Replacement of Existing Bascule Bride

Also, the existing Bascule Bridge between KPD 1 & 2 was timeworn, and it will be necessary to replace the Bridge in the Master Plan stage.

The structural type of this Bridge will be the same as that of the Bascule Bridge described in 13-2-1.

Synopsis :

Load : Tractor/Trailers loaded with 40 ft containers

Span : 50 000mm

Width : 18 000mm (4 lanes)

Steel structure with counter weight

Total weight : 650 t

13-2-5 Container Yard

The container yard plan is 1995 & 2005 at Calcutta is shown as Fig. 13-2-2. Main facilities in this yard are as follows:

C.F.S. 201 m by 45 m	9,040 sq.m
Yard	about 60,000 sq.m including refrigerated container
Transfer Cranes (rubber mounted)	12 units including 3 nos by ADB

[note] The cost for this container yard include in item 1) Pavement Grade-2 of Rehabilitation Works (C08).

13-2-6 Replacement of Hide Bridge

This bridge located at the south end of Hide road is also timeworn and shall be replaced as soon as possible. The several prestresses concrete beams corroded severely and fell down. The main steel truss was designed originally based upon old standard on the traffic design loads, and there fore it is necessary to modernize the design itself. We will recommend followings for the replacement of this bridge.

Synopsis:

Load : Tractor/Trailers loaded with 40 ft containers

Span : 50,000 mm

Width : 18,000 mm (4 lanes)

Structural type : Prestress concrete

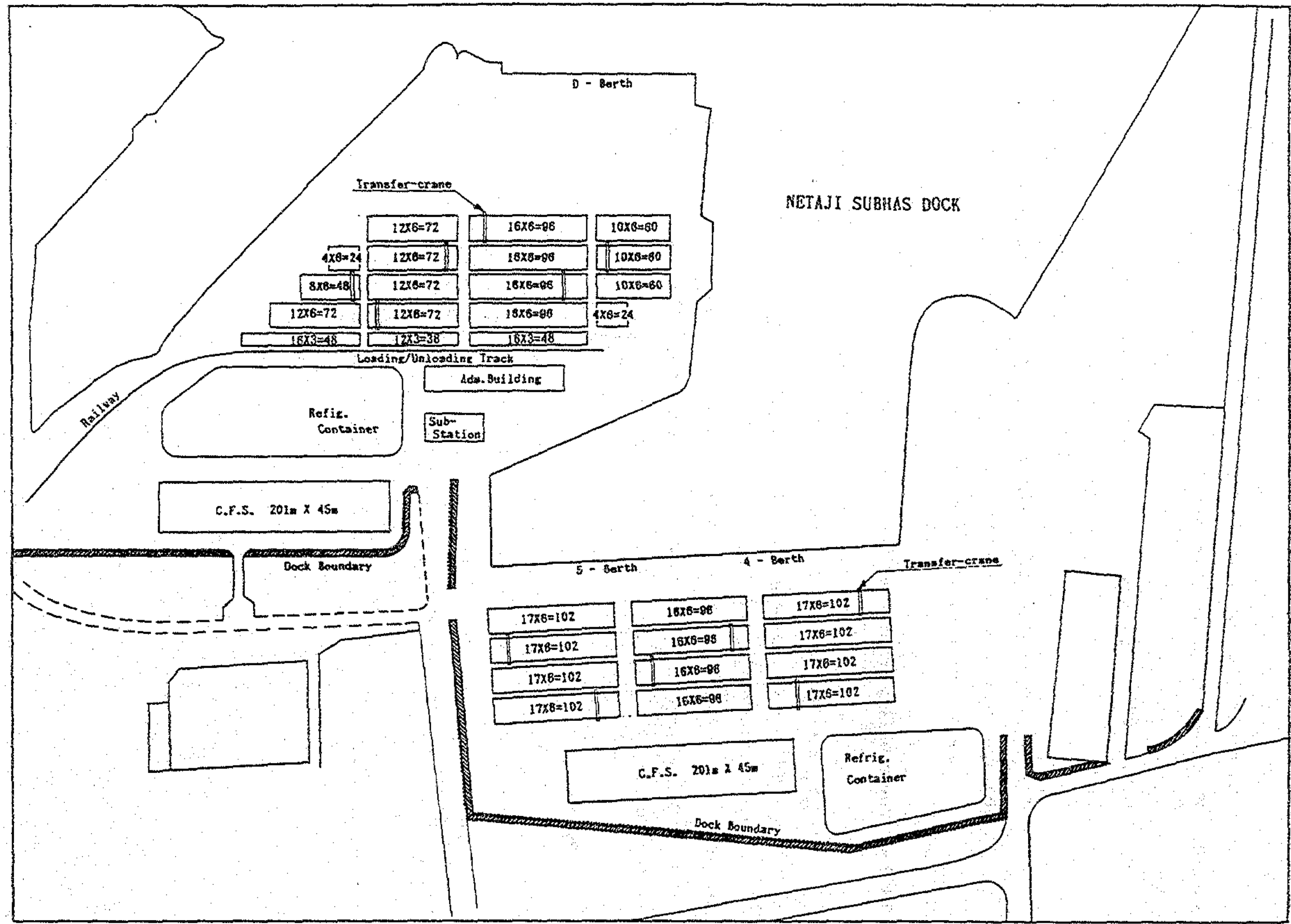


Fig. 13-2-2 Layout Plan of Container Yard at Calcutta

13-3 Design of Main Strucutres in Haldia

13-3-1 Container berth (Haldia)

The proposed layout plan of a container berth at Haldia is shown as Fig.13-3-1.

First of all, the study team compares various structual designs for the quaywall for the container berth at Haldia.

The following 3 structual types are considered.

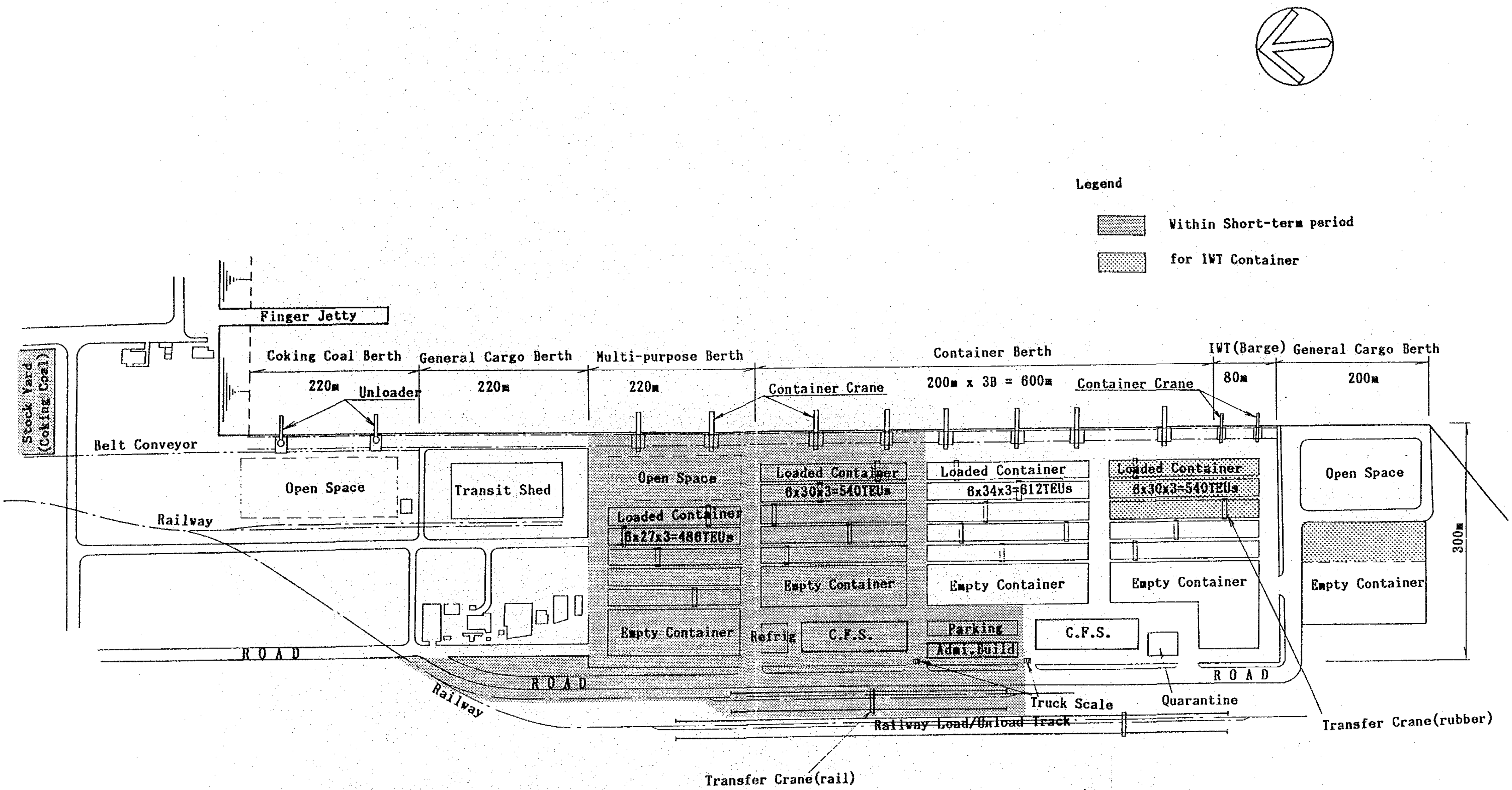
Type A Steel Sheet Pipe Pile
Type B Steel Pipe Pile
Type C Monolith Concrete

Table 13-3-1 Technical Comparison of 3 Alernative Quaywalls

	Type A	Type B	Type C
Main materials	Imported	Imported	Local supply
Main construction craft	Piling pontoon Deck barge	Piling pontoon Deck barge	Grab excavator
Labour force	small	usual	big
Workability	Not so easy	very easy	usual
Construction control	Not so easy	very easy	Not so easy
Construction period	Long	Usual	Long
Corrosion protection	Required	Required	Not required
Construction cost ratio (Type C=1)	1.10	1.05	1.0

[Remarks] * Soil improvement in the case of types A & B will be considered based on the sub-soil conditions.

* Construction cost includes import duty for the imported materials.



Admi.Building
1F; Maintenance shop & Cleaning
2F; Canteen
3F,4F; Office
5F; Operation control

Fig. 13-3-1 Layout plan of Container Yard at Haldia

Based on the above comparison table, alternative C i.e. Monolith concrete with some modification, is the recommendable structural type for the container berth. This type of construction is very popular in India and also a quite stable structure to be used permanently for the port.

Refer to Fig. 13-3-2.

13-3-2 Shifting berths

It is necessary to provide a waiting berth for container and other ships. The berth will be designed with 2 dolphins with 3 piles each in the Haldia Dock due to the economic reasons.

13-3-3 Shifting berth for oil tankers

This berth is required in the Master Plan. The structure of the berth required is formed for temporary use, and therefore the dolphin type is the most suitable and economic for this berth.

The design parameters of this berth are summarized below.

(1) Tanker size to be accommodated : 150,000 DWT

(2) Wave height : 3m (Max.)

(3) Current velocity : 4 kt

(4) Wind velocity : 20 m/sec (Max.)

(5) Sea bottom soil : Mud

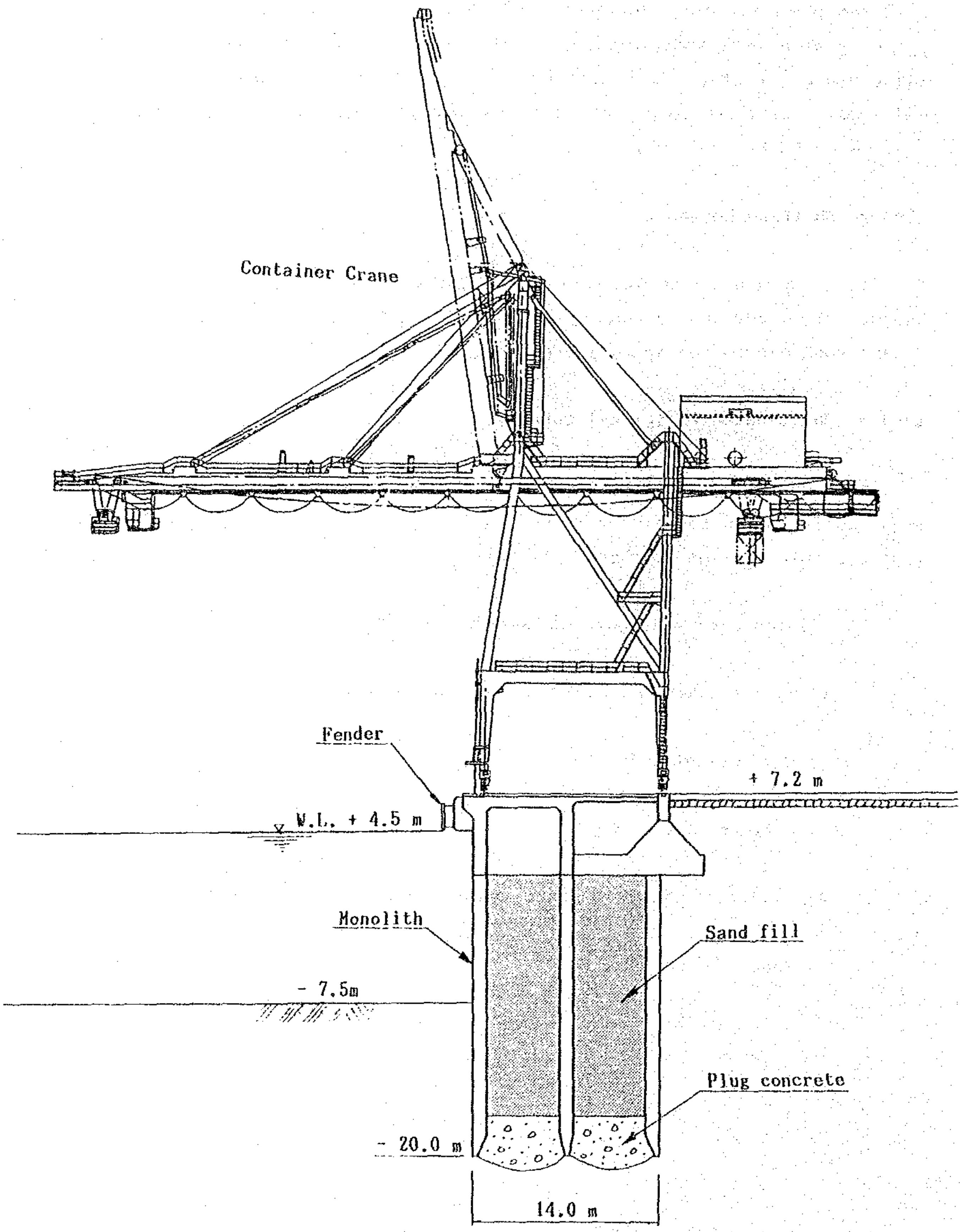


Fig. 13-3-2 Typical Section of Container Berth

13-3-4 Muti-purpose Berth

This berth shall be designed with the same structure as the container berth.

13-3-5 Barge berth for Containers

This 80m long berth shall be equipped with quay cranes for containers, and will be designed with the same structure as container berths.

13-3-6 Lock System

This additional Lock Entrance with an approach jetty is required in the Master Plan. The proposed location of the lock entrance is indicated on Fig. 13-1-4.

The strucure of the new lock entrance will be similar to the existing one, but will be little larger. The synopsis is given as follows:

System : Sliding/floating caisson type electric gate

Length : 330m, sub-divided into 2 chambers of 225m & 95m depending on the length of the ship.

Width : 42 m

Depth : -10.7m below the lowest low water level

Ship size to be accommodated : L 270m, W 39m (upto 100,000 DWT)

Lead-in jetty : L 350m

Time for a ship to go in/out of the dock : 0.5 hour

The structure of the lock entrance will be concrete monolith type which is the same as the existing structure and local contractors have experience with this type of structure.

13-3-7 General Cargo Berth

The berth shall be designed with the same structure as the container berth.

13-4 Design of other facilities in Calcutta

13-4-1 Rehabilitation Works

1) Pavement :

To cope with the increasing cargo volume in the port, it is necessary to develop and rehabilitate the storage area required for cargo handling. And also, in order to increase the productivity of the port, the surface condition of the port area shall be developped and maintained for smooth traffic movement.

The area to be improved shall be divided into the following 5 grades of pavement based upon the load condition of each cargo (refer to Table 13-4-1 & Fig. 13-4-1 to 3)

Table 13-4-1 Design Load and Quantity of Pavement

Required area for	Grade	Design Load (t/sq.m)	In Short-term Plan	In Master Plan
heavy cargo	1	5.0	4,000	20,000
container	2	3.0	80,000	100,000
break bulk cargo	3	1.5	390,000	540,000
car park	4	1.0	30,000	50,000
undisposed materials	5	2.0	9,000	9,000
Total			513,000	719,000

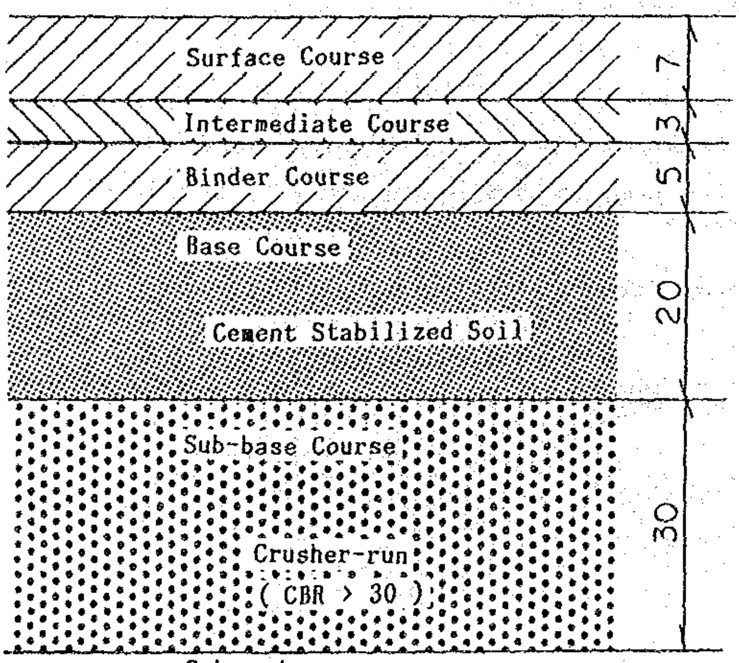


Fig. 13-4-1 Standard Section of Pavement for Normal Cargo and Mobile Equipment

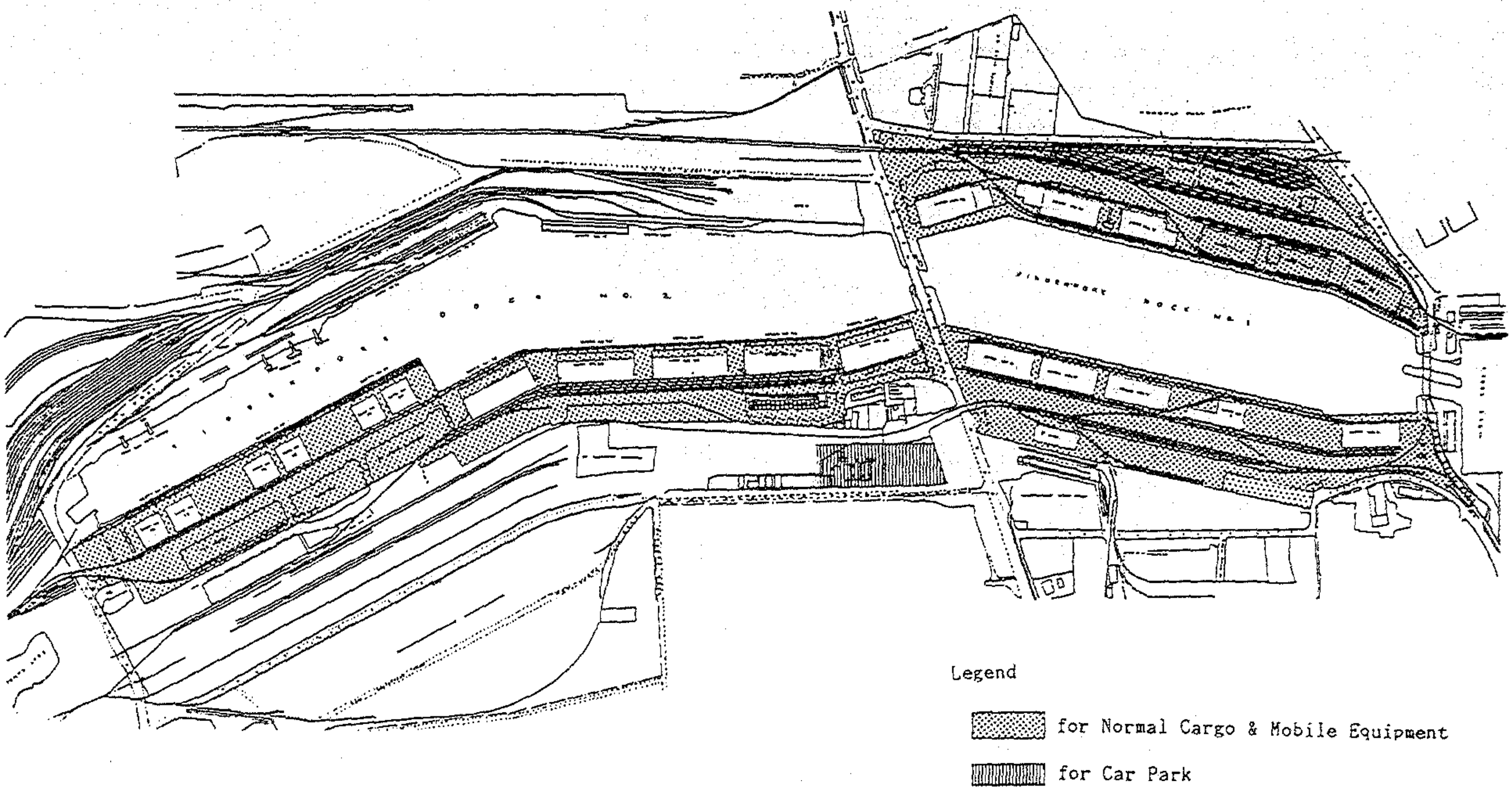


Fig. 13-4-2 Pavement at K.P. Dock in 2005

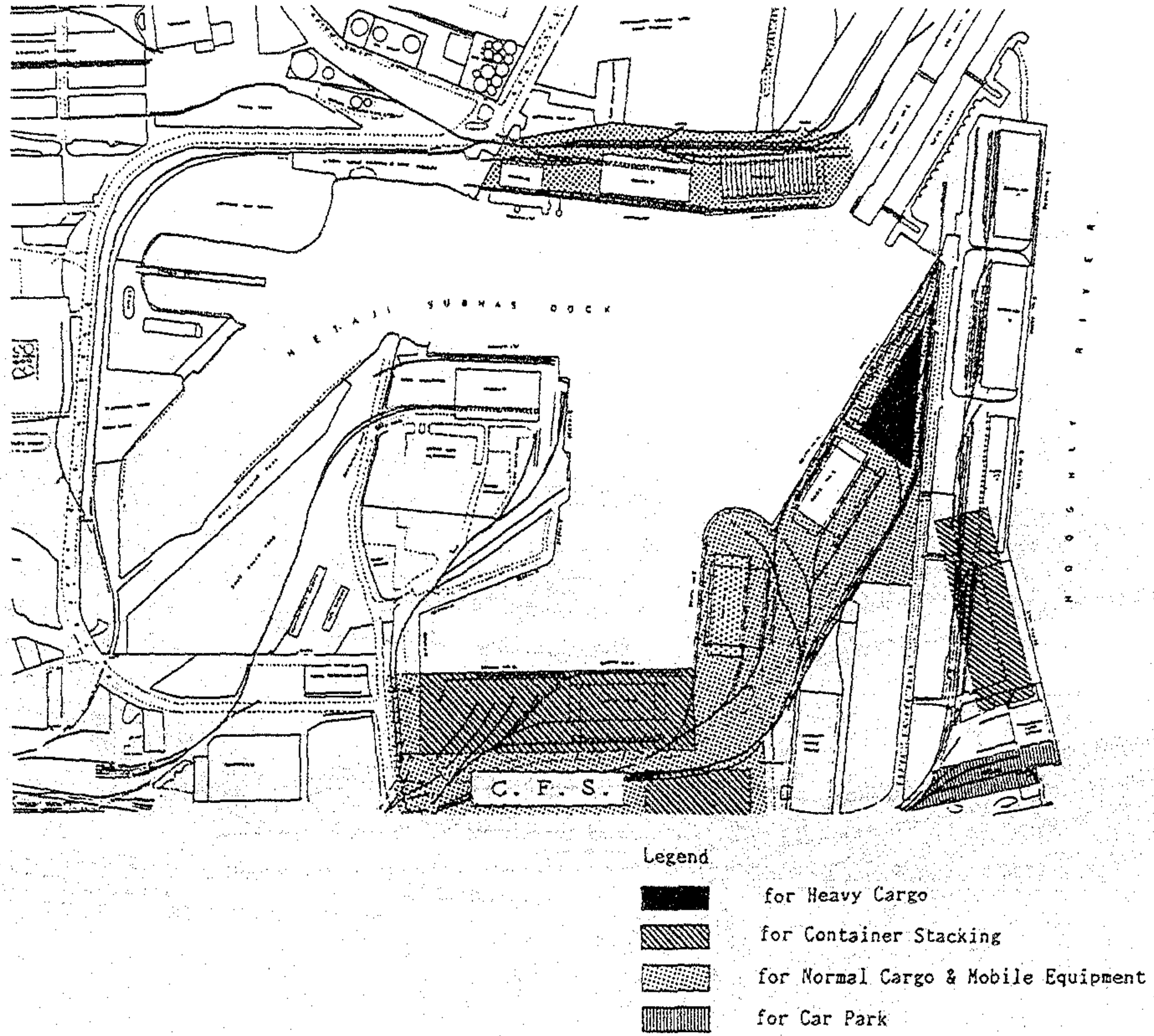


Fig. 13-4-3 Pavement at N.S. Dock in 2005

At present, the total port area of Calcutta is about 5 million sq.m (2 km by 2.5 km). The improved area will be 12 & 16 percent of the total port area in the Short-Term and Master Plan, respectively.

2) Fender System

(1) Corner fender

At all corners inside of KPD and NSD rubber fenders as shown in Fig. 12-4-4, should be provided to prevent damage of ships' hulls and of the wharves.

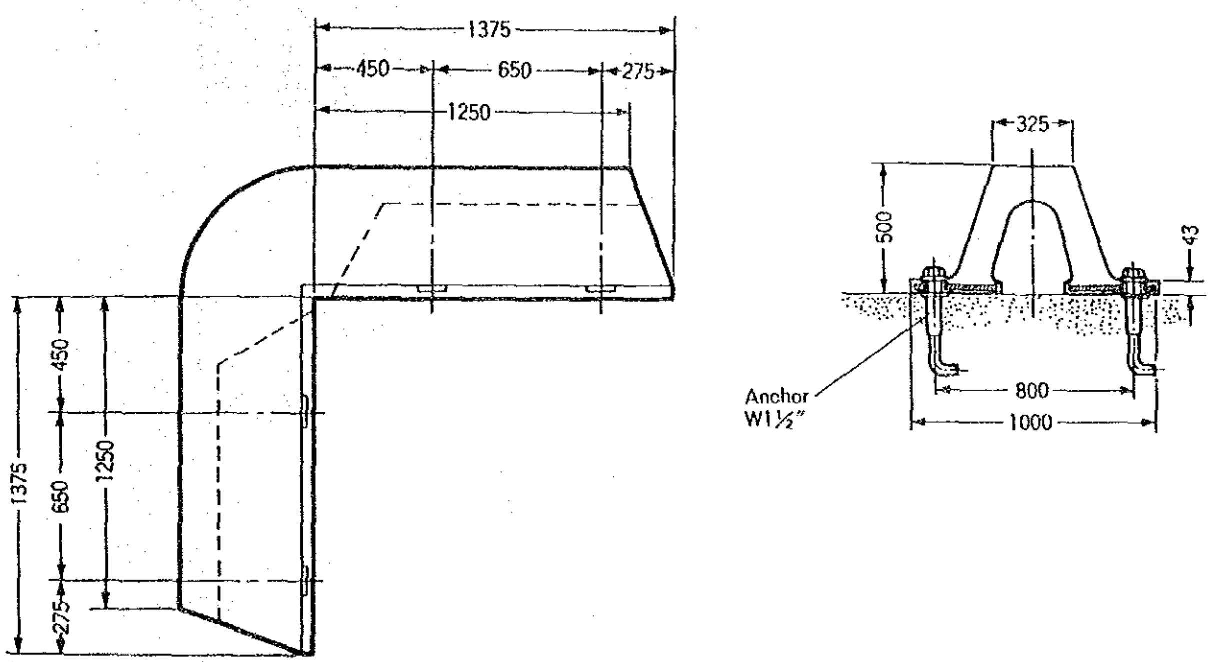


Fig. 13-4-4 Corner Fenders

Nos of Corner fenders

KPD : 16 nos.

NSD : 8 nos.

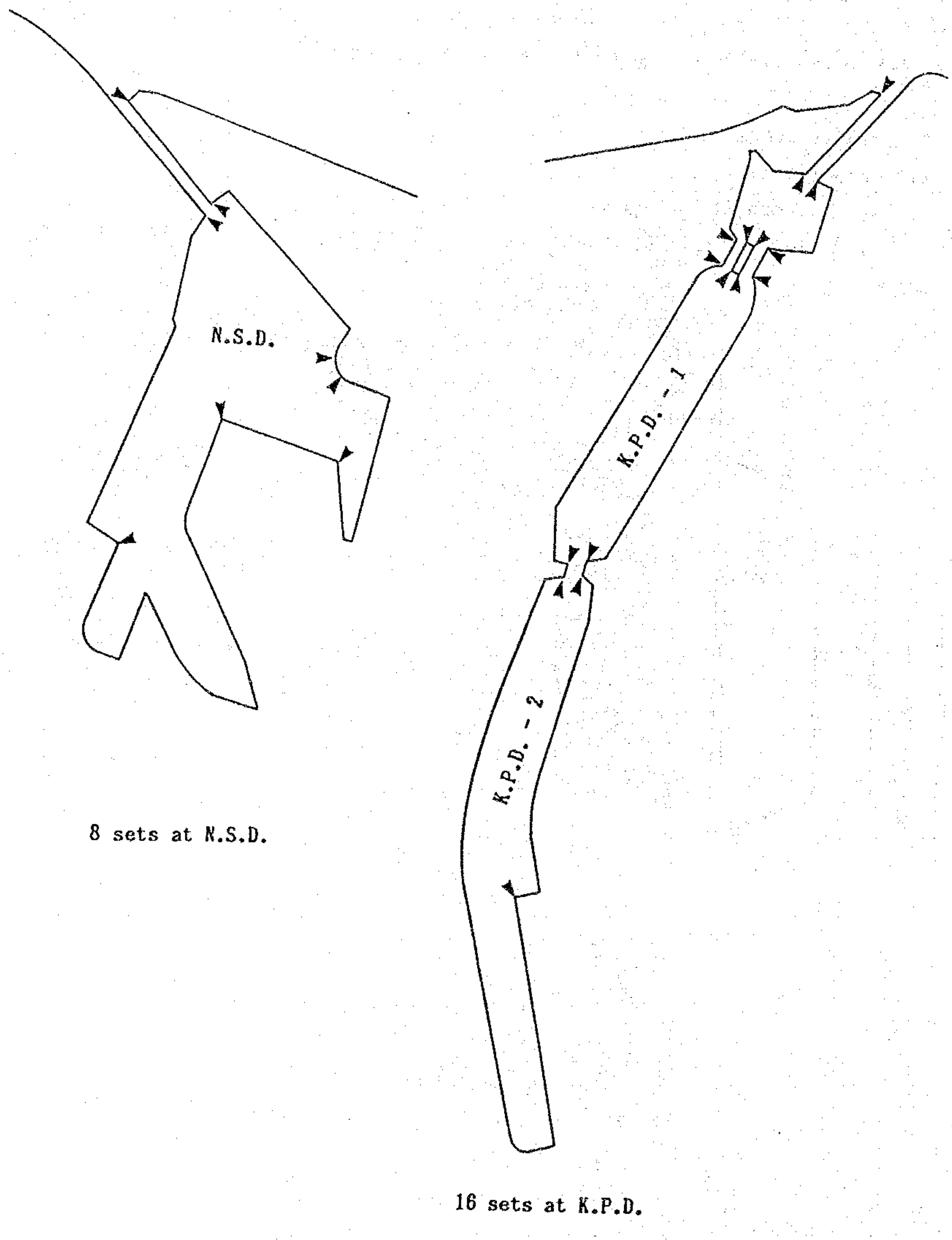
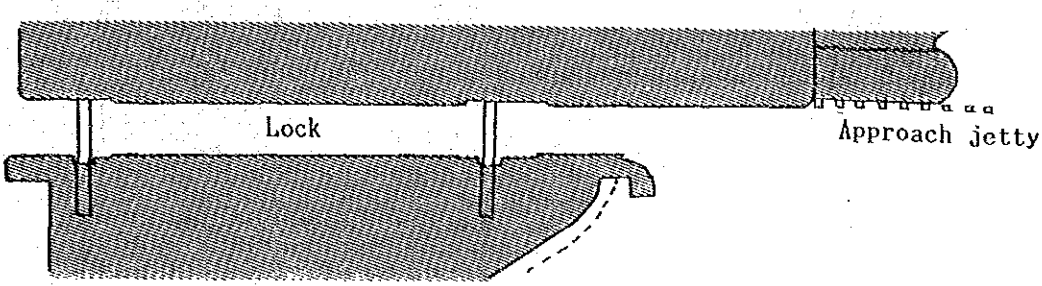


Fig. 13-4-5 Location of Corner Fender

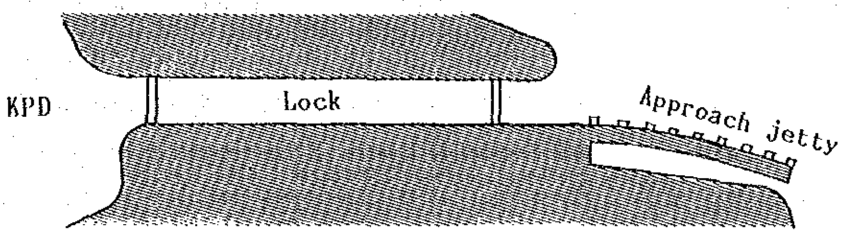
3) Approach Jetty to KPD & NSD

The existing approach jetty to the K.P.D and N.S. Dock are in a dilapidated condition.

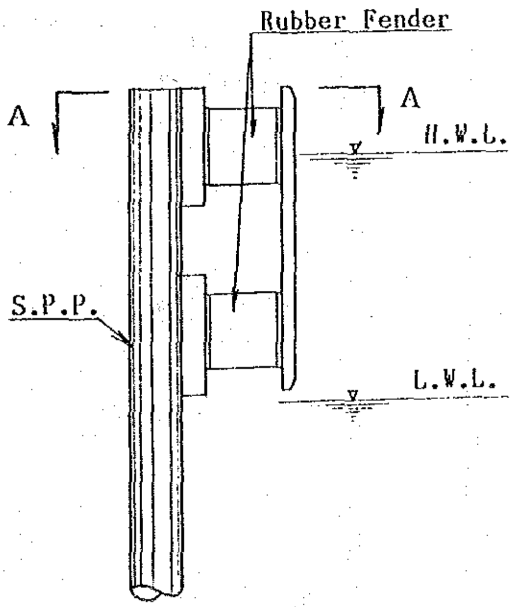
A new arrangement is to be made for allowing the ships to have a smooth passage alongside it.



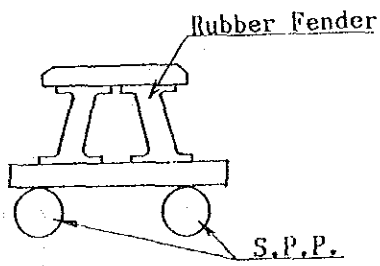
Location at N.S. Dock



Location at K.P. Dock



Detail of Jetty



Section A-A

Fig. 13-4-6 Approach Jetty

4) Modernisation of railway system (Calcutta)

The railway system at Calcutta Dock System is considerably old and worn.

The length of track to be renewed would be about 52 km.

EJC Yard	720 m	x 25 lines	=	18,000 m
GCD Yard	720	x 21	=	15,120
EJC - GCD	2,000	x 2	=	4,000
GCD - CESC	3,000	x 2	=	6,000
To Hindustan steel	500	x 14	=	7,000
To FCI	1,000	x 2	=	2,000
Total				52,120 m

5) Reinforcement of NSD No. 5 Berth

The Berth of NSD No. 5 is constructed in the type of the Steel Sheet Pile. The Structure of this Berth was time-worn and the front area of this Berth is restrained in the traffic movements. When new handling equipment introduce, it is necessary to reinforce this area. We will recommend the additional slabs with bore-piles shown as the following Fig. 13-4-7.

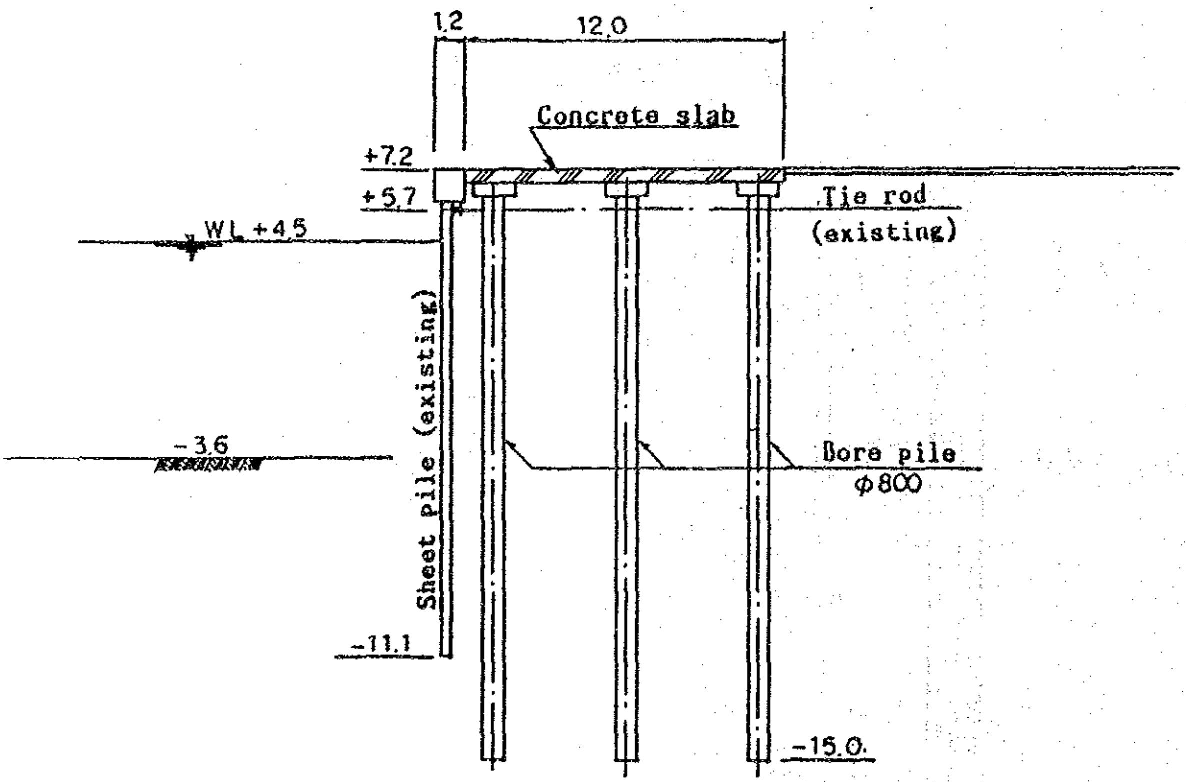


Fig. 13-4-7 Strengthening of N.S.D. No. 5 Berth

13-4-2 Road Works

New roads and widened roads will be designed as shown in Fig. 13-4-8 & 9.

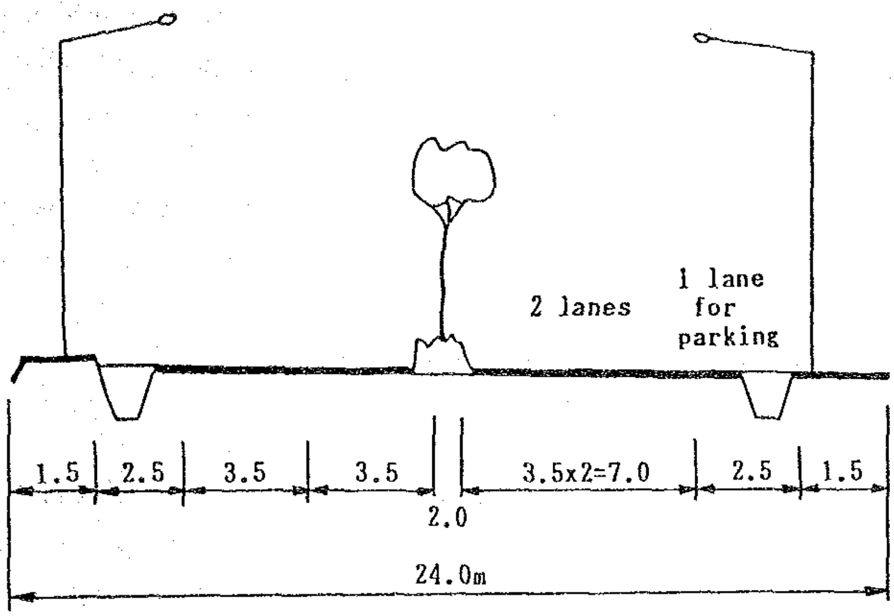


Fig. 13-4-8 New Road Section

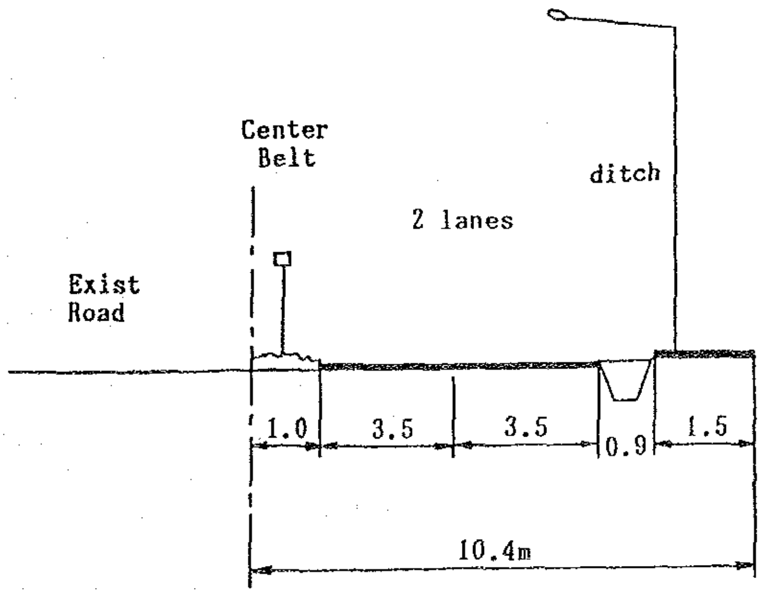


Fig. 13-4-9 Widening Road Section

13-5 Design of Other Facilities in Haldia

13-5-1 Capital Dredging

Capital dredging shall be required inside and outside of the dock at Haldia. The dredging areas will cover the front of the new berths, the turning basin inside of the docks and the front area of the new lock entrance and its crossing areas.

Fig. 13-5-1 & 2 show the above dredging areas.

The dumping area of the dredged materials shall be selected appropriately.

13-5-2 Parking Basin & Jetty for Small Crafts

1) Parking Basin

These facilities will be used as a parking place for small craft of port service vessels. In order to prevent the ship's smooth pilotage in the dock, the proposed location of the site and layout plan will be recommended as shown in Fig. 13-5-3. The site is ajoined to slipway, workshop & the space for the expecting dry dock in future near the existing lock entrance.

The facilities are consisted of:

Basin -5.0 m deep, 15,000 sq.m

Mooring wall 300 m, Diaphragm wall type

The craft to be accommodated in 1995:

Type of craft	Size	Q'ty	Remarks
Tug-boat	39.5 x 9.9 x 4.9	8	Existing: 5 nos
Multi-purpose ship	45.0 x 12.0 x 5.5	1	
Grab-dredger	68.3 x 13.7 x 5.4	1	Existing
-do-	40.0 x 10.0 x 3.6	1	
Floating Crane	40.0 x 18.0 x 3.5	1	
Total		12	

2) Jetty in River

This jetty will be used as a mooring facility of Tug-boats for oil tankers. The proposed jetty will be located between the 2nd oil jetty and the existing lock entrance in the river. (refer to Fig. 13-1-3 & 13-5-4)

Synopsis of the jetty:

Length	90 m
Breadth	12 m
Depth	5 m
Structure	P C piles & concrete decks

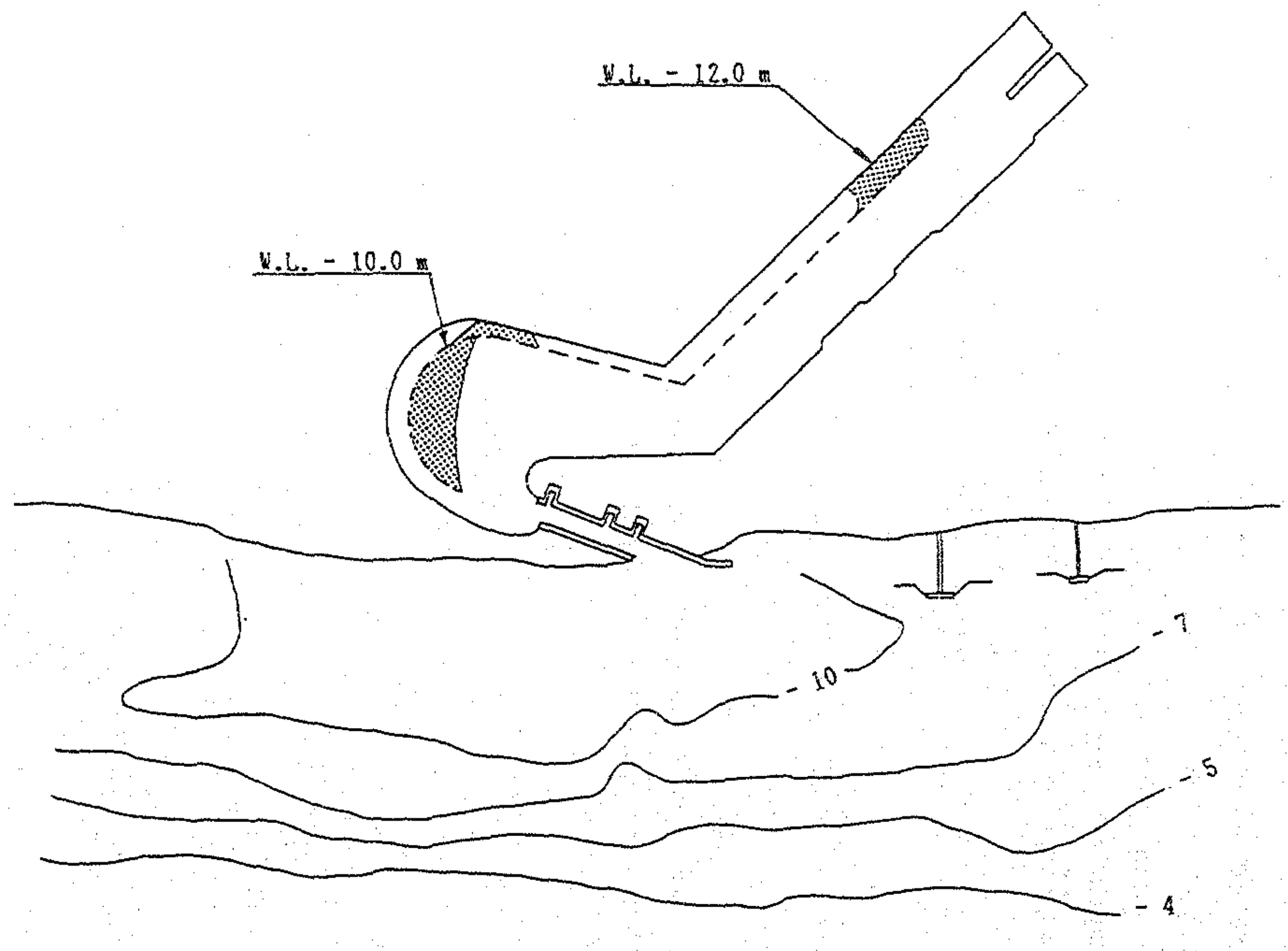


Fig. 13-5-1 Capital Dredging at 1995

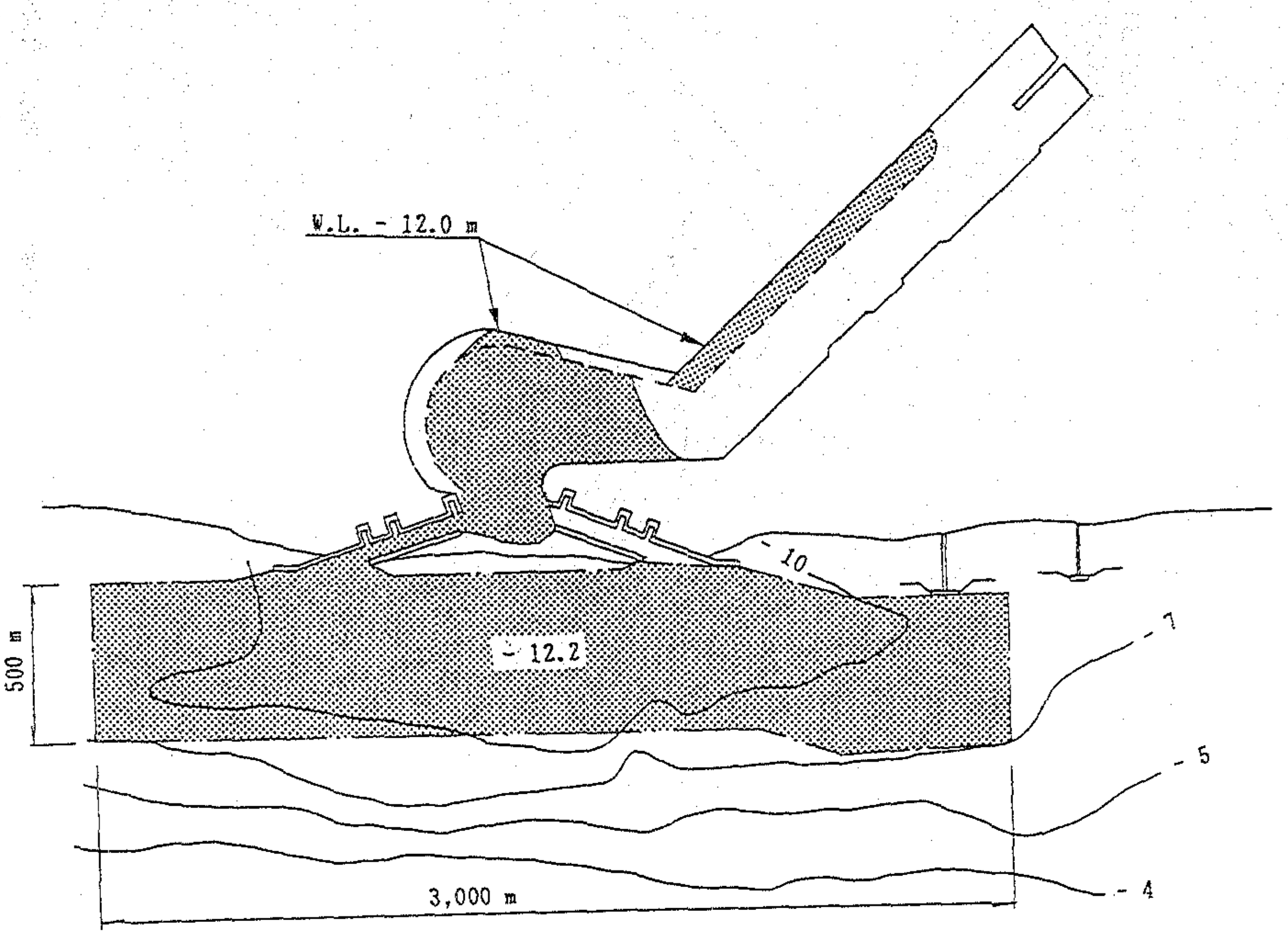
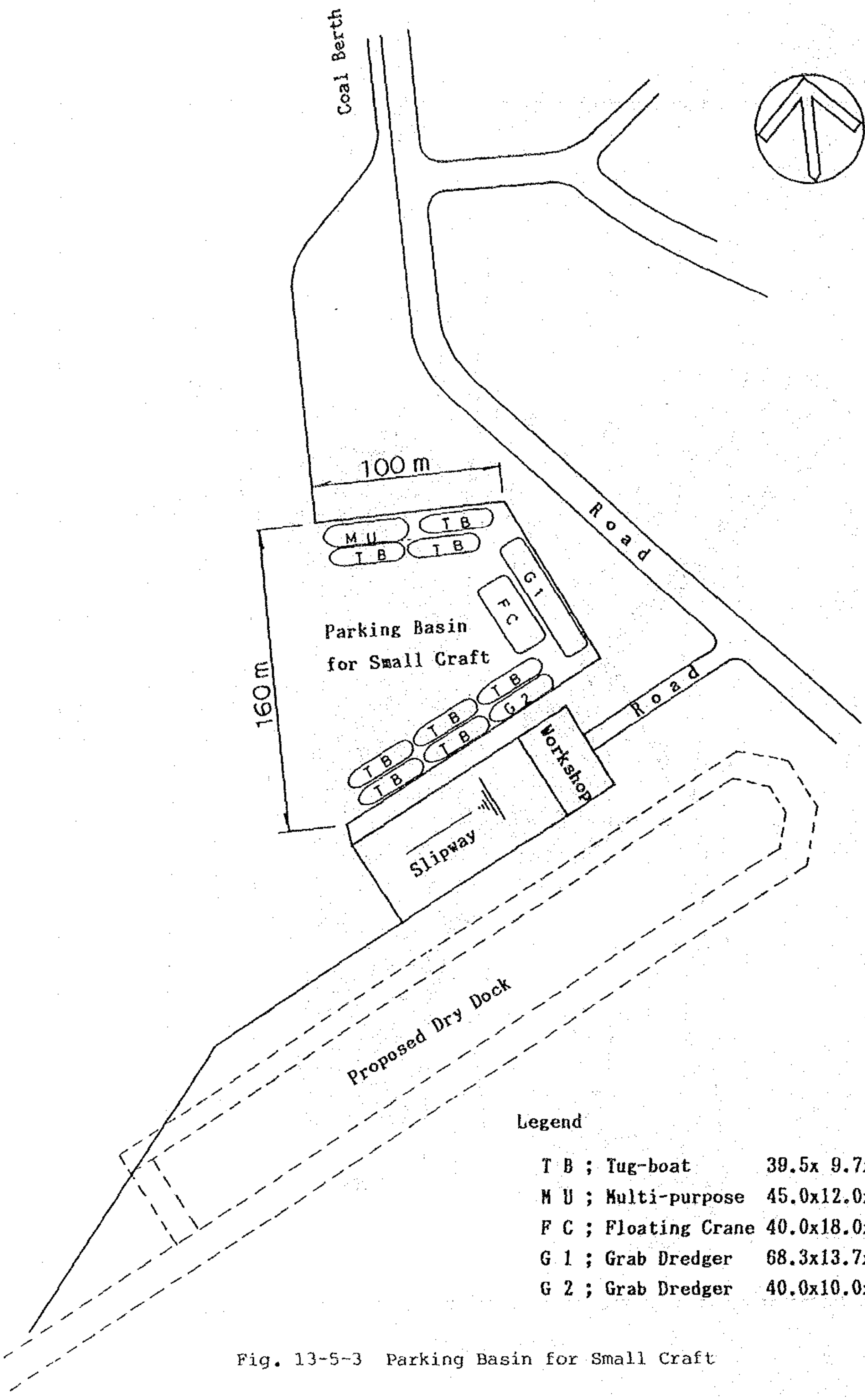


Fig. 13-5-2 Capital Dredging at 2005



Legend

T B	;	Tug-boat	39.5x 9.7x4.9
M U	;	Multi-purpose	45.0x12.0x5.5
F C	;	Floating Crane	40.0x18.0x3.5
G 1	;	Grab Dredger	68.3x13.7x5.4
G 2	;	Grab Dredger	40.0x10.0x3.6

Fig. 13-5-3 Parking Basin for Small Craft

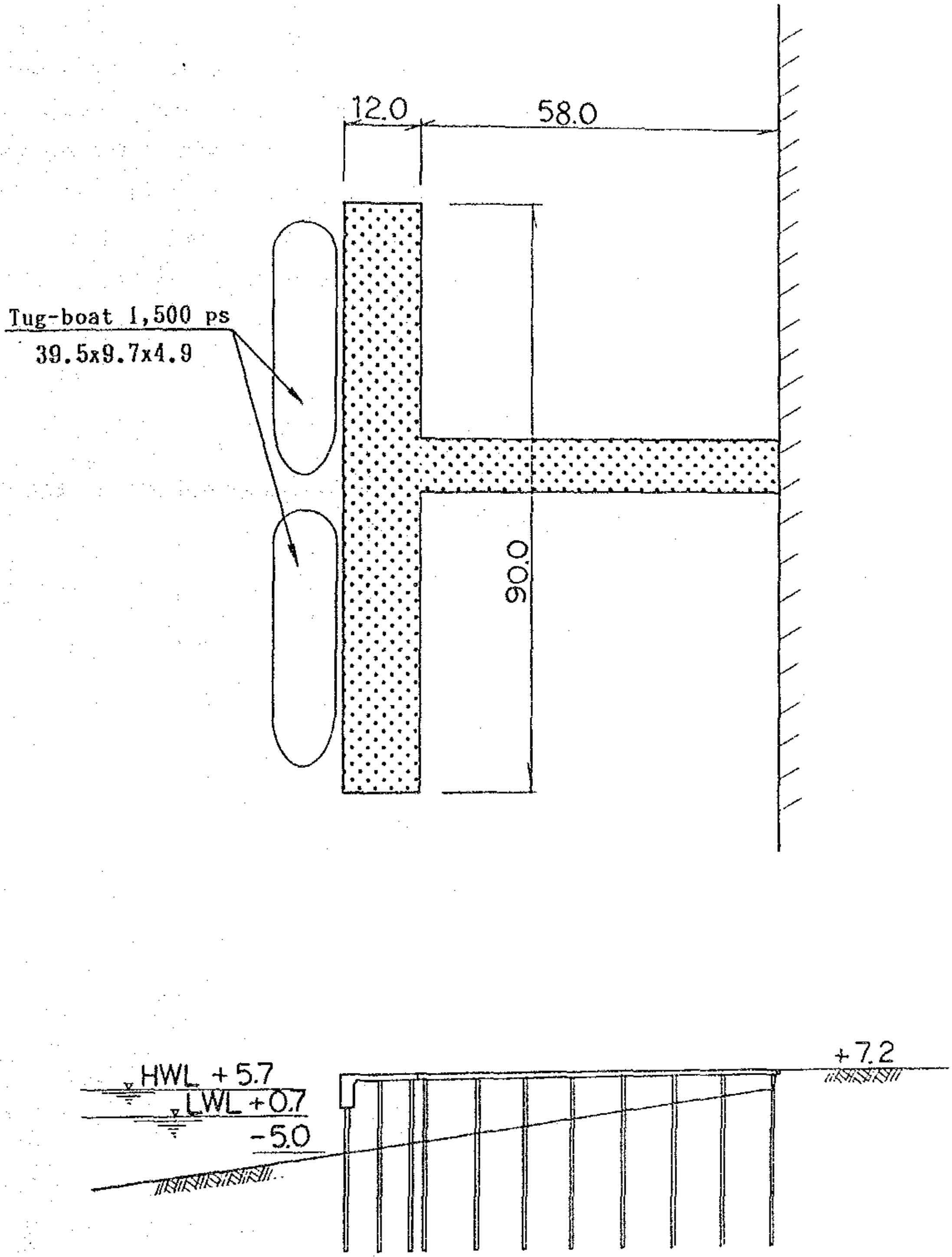


Fig. 13-5-4 Tug Jetty in River

13-5-3 Slipway

The slipway is designed for underwater inspection and repair of small craft.

Larger craft like dredgers shall be sent to Calcutta for inspection and repair.

Length : 95 m

Width : 50 m (2 lanes)

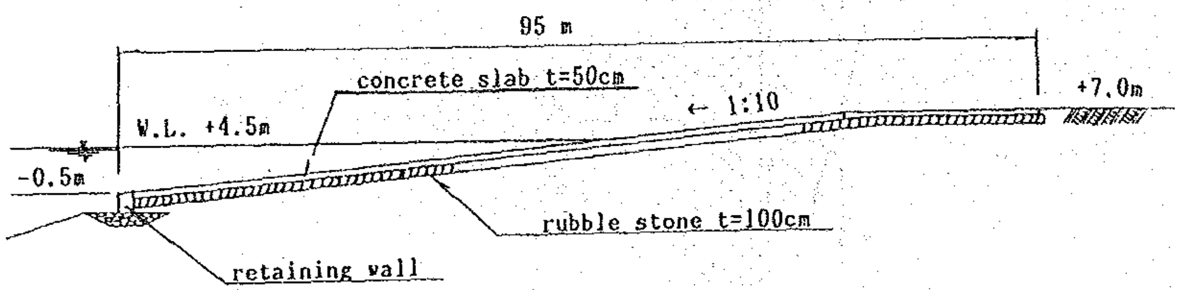


Fig. 13-5-5 Slipway

13-5-4 Lighting for Night Navigation and Fenders

In order to improve ship's movement at night in the Dock, the following lighting facilities shall be installed as shown in Fig. 13-5-6.

Lighting Tower	5 sets
Lighting at Berth's front lines	7 sets

And, rubber fenders at the north side of the south-west inside corner of the existing Lock Entrance shall be installed as shown in the same Fig. for the safety of ship maneuvering at night during the monsoon season.

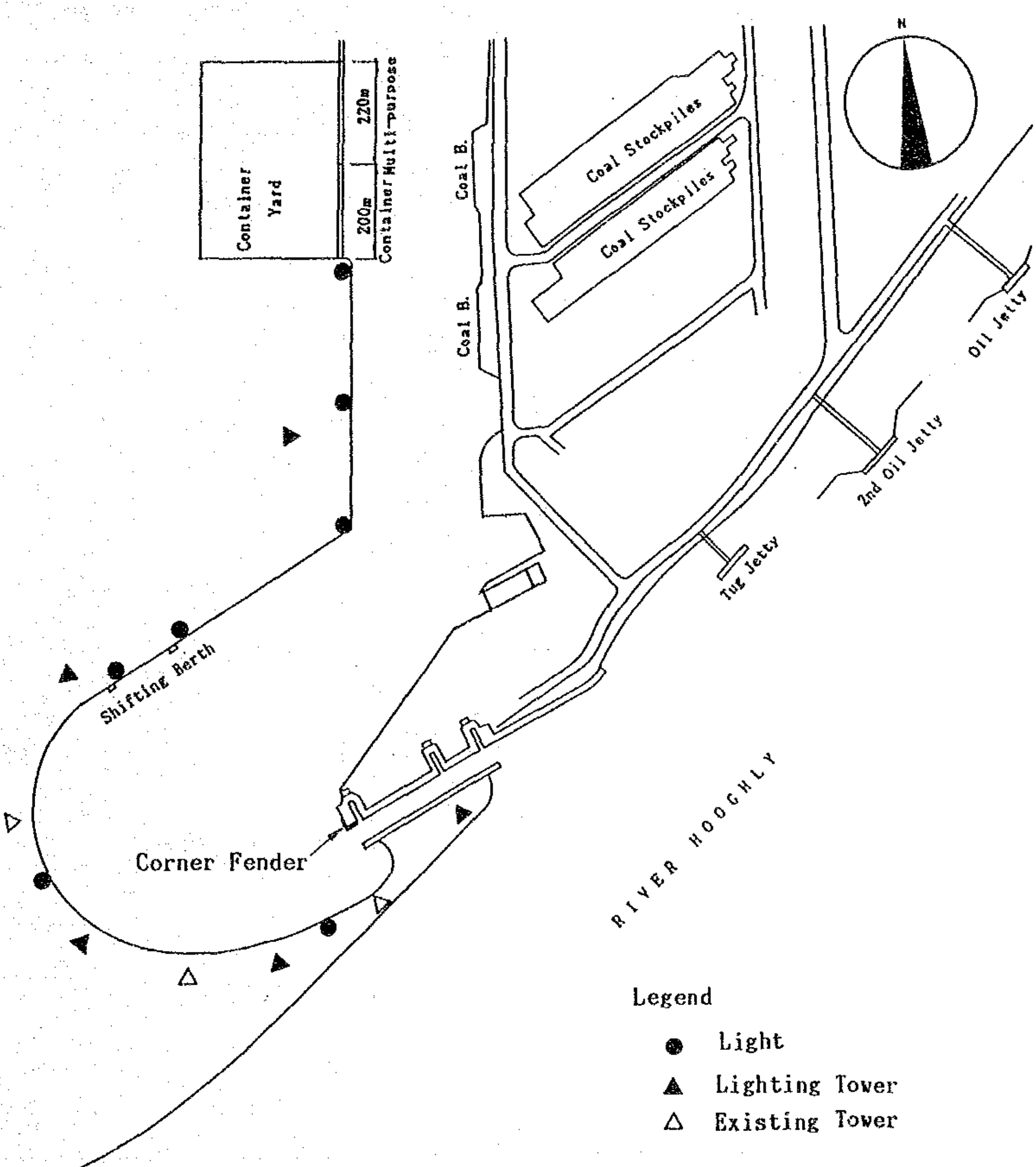


Fig. 13-5-6 Short Term Plan of Haldia Dock System (Lighting for night navigation)

13-5-5 Coking Coal Plant

The layout of the Coking Coal Plant will be planned as shown Fig. 13-5-7. The main facilities of the plant are as follows.

Unloader	: capacity	700 t/h	1 set
Belt-conveyor	: - do -	1,400 t/h	1,700 m
Stacker/Reclaimer:	- do -	1,400 t/h	2 sets
Stock Yard	: 350 m by 128 m		45,000 sq.m

The berth handling the Coking Coal is also used for General Cargo. Therefore, the Unloader & Belt-conveyor line on the apron of the berth are designed with the necessary space and clearance to handle General cargo.

Clearance at the apron : 6 m

Clearance at other areas : 10 m

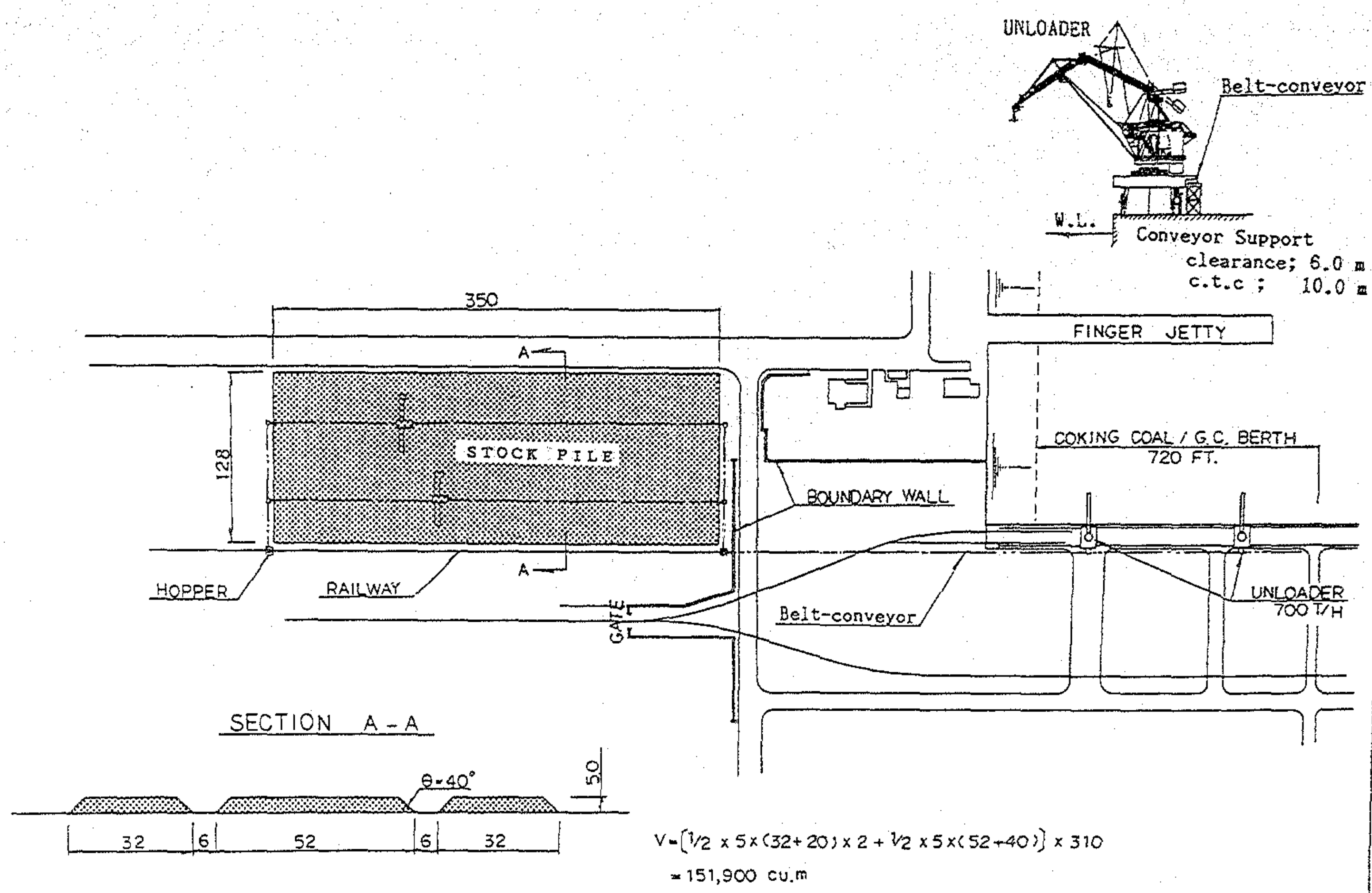


Fig. 13-5-7 Layout of Coking Coal Handling Plant

13-5-6 Sagar Pilot Base

The design criteria of the structure are shown as follows.

(1) Tide :

MHWS +5.22m ▽

MHWN +3.98m ▽

MSL +3.00m ▽

MLWN +2.23m ▽

MLWS +0.92m ▽

0.00

(2) Wave height : H1/3 = 1.0m , T1/3 = 6 sec

(3) Crown height : 0.6 H1/3 + MHWS = 5.55
say 6.0m

(4) Surcharge : w = 1.0 t/sq.m , w'= 0.5 t/sq.m

(5) Seismic coefficient : KH = 0.05

The alternative location at Johnson point is recommended for the base due to the calmness & economy (please refer to Fig. 13-5-8 & Table 13-5-1).

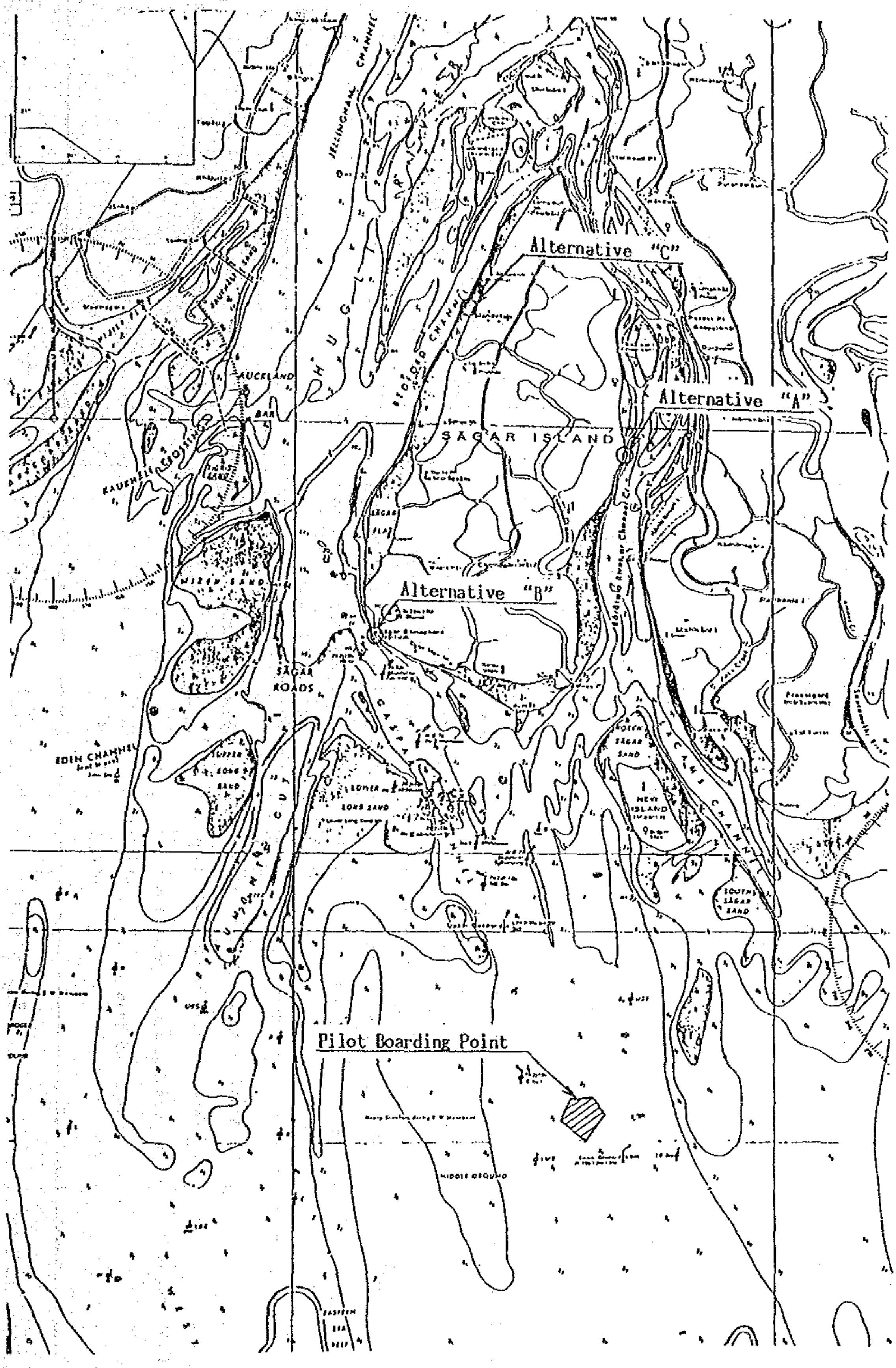
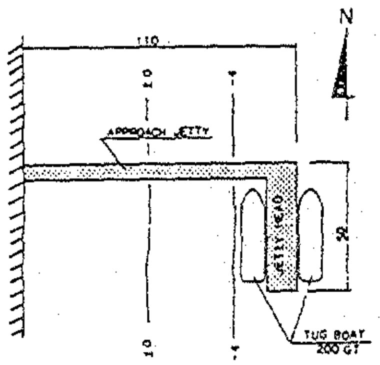
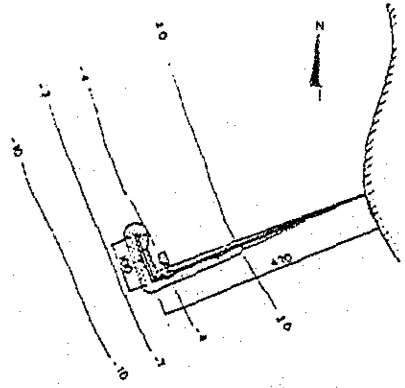
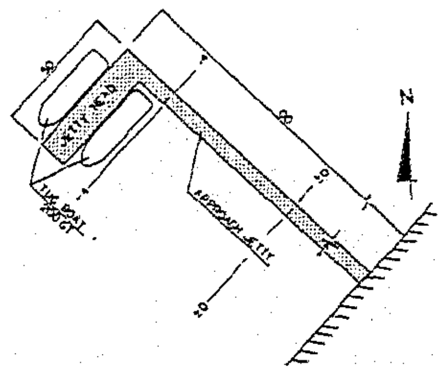


Fig. 13-5-8 Location of Sagar Pilot Base

Table 13-5-1 Comparison of 3 Alternative Pilot Base Site

	Alternative "A"	Alternative "B"	Alternative "C"
Location Plan			
Advantage	· Breakwater is not necessary because of sheltered area. · Distance from Pilot Boarding Point is not so long.(40km)	· Distance from Pilot Boarding Point is shortest.(30km) · Very close to the Station Building which will be built on the waterfront at south-west part of Sagar Is.	· Breakwater is not necessary because of sheltered area.
Disadvantage	· Access road is required.(10km) · Shallow water depth(-2m) is existing between Boarding Point and Base.	· Breakwater is necessary for pilots landing during monsoon season.	· Distance from Pilot Boarding Point is long.(0km)
Cost (M.Rs)	35	80	40

13-6 Construction Plan

13-6-1 Premises

1) Natural conditions for construction work

Zoning: The construction areas shall be divided into 2 zones as follows.

Sheltered zone: Inside of docks at Calcutta & Haldia

Non-sheltered zone: Alongside of Hooghly river at Haldia Onshore at Sagar island

Rainfall Annual rainfall in the tropical rainy zone varies from 0mm to 390mm/month at Calcutta and 330mm/month at Haldia, and the average rainfall is 160mm/month (1,900mm/year) at Calcutta and 125mm/month (1,500mm/month) at Haldia.

Dry season : Nov. to June

Rainy season (Southwest Monsoon) : June to Sep.

(Northwest Monsoon) : Nov. to Feb.

Mean daily temperature is max.37°C in May and 13°C in Dec., with a record high of 44.9°C and a record low of 6.9°C.

Wind velocity generally varies from 4.2m/sec to 22.0m/sec, with a maximum speed of 57 m/sec during cyclonic storms.

Significant Wave height is H1/3=2.0m at the southeast shore of Sagar Island, and 1.8m at the riverside in Hldia.

Workable days per year for construction are shown below.

Sheltered zone : 300 days

Non-sheltered zone : 250 days

2) Construction materials

Local & imported Cement is available, including sulphur-resisting cement (to use for marine concrete). Regarding the quality of cement, compression tests shall be carried out on the materials before the Detailed

Design.

Re-bar, form-work wooden materials and concrete aggregates are normally available. But, souces of stone materials including rocky & armour stone shall be studied carefully in case a large quatity is required.

Steel materials are normally available.

3) Construction equipment & machinery

Normal scale construction equipment & machinery (such as bulldozer, power shovel, mobile crane, dredger and piling pontoon) are available nearby. However, it is necessary to study the actual requirements further.

4) Labour force for construction works

Labourers are available at any time.

5) Unit costs to be applied for the cost estimate

The study team has studied the basic unit costs for port development projects. The unit costs for various construction items are summarized in Table 13-6-1 and 13-6-2.

Table 13-6-1 Unit Prices for Construction Material & Wages (1988 prices)

Description		Unit price	Remarks
Material			
1. Light oil (diesel)		3.5 Rs/ℓ	
2. Gasoline		8.75Rs/ℓ	
3. Re-bars		6,750 Rs/ton	IS 226
4. Deformed bars		7,250 Rs/ton	IS 1786
5. Steel	; angles	7,500 Rs/ton	IS 226
	channels	8,000 Rs/ton	IS 226
	joists	8,250 Rs/ton	IS 226
	plates	9,250 Rs/ton	IS 226
	sheet pile	9,250 Rs/ton	IS 226
6. Cement	; ordinary portland	1,500 Rs/ton	
	sulphur resistant	2,000 Rs/ton	
7. Sand		250 Rs/cu.m	
8. Gravel		400 Rs/cu.m	
9. Armour stone		600 Rs/cu.m	
10. Flat wood (t=12mm)		300 Rs/sq.m	
11. Asphalt	; straight	3,000 Rs/ton	
	hot mix	500 Rs/ton	
12. Fender	; corner 500Hx1250Lx1250L	214,000 Rs/no	excl.tax
	1000Hx1500L with frame	425,000 Rs/no	〃
Wage			
1. Foreman		2,800 Rs/month	
2. Skilled labourer		1,500 Rs/month	
3. Common labourer		900 Rs/month	
4. Welder		1,200 Rs/month	
5. Bar bender		1,200 Rs/month	
6. Carpenter		1,200 Rs/month	
7. Car driver		1,200 Rs/month	
8. Minimum wage		750 Rs/month	

Table 13-6-2 Unit Cost for Construction (1988 prices)

Description	Unit cost (Rupees)	Note
1. Concrete (1:2:4)	1,400 /cub.m	
2. Re-bar	10,000 /t	Deformed bar
3. Form work	450 /sq.m	
4. Reinforced Concrete	3,100 /cub.m	including form work
5. Excavation	25 /cub.m	
6. Back filling	10 /cub.m	
7. Dredging (by Grab dredger)	** 50 /cub.m	Distance to dumping area : within 10 km
8. Asphalt pavement	* 300 /sq.m	including base
9. Road : 2 lanes	5,500 /lin.m	including ditch etc.
4 lanes	10,000 /lin.m	including ditch etc.
10. Bridge (Concrete)	10,000 /sq.m	including foundation
11. Railway : Laying straight line	2,500 /lin.m	
exchange track	3,500 /lin.m	
Demolition	150 /lin.m	
12. Building : Office,house	5,000 /sq.m	including A/C etc.
Transit shed	3,000 /sq.m	including foundation
13. Container Berth	850,000 /lin.m	Monolith type
14. General Cargo Berth	600,000 /lin.m	-do-
15. Multi-purpose Berth	850,000 /lin.m	-do-
16. Barge Berth (-6.0m depth)	450,000 /lin.m	-do-
17. Entrnce Lock System	800 Million Rupees/set	
18. Container Berth (Madras,M/P,1986)	650,000 /lin.m	Length : 200m

[Remarks] 1.The mark * shows the price for the standard section of the general paved road. Therefore, prices of pavement are varied due to the required design load for the foundation.

2. The mark ** : This price is also varied due to the distance between dredging site & dumping area.

13-6-2 Construction Shedule

The development schedule is projected as follows:

1) Completion of Feasibility Study by JICA on the development of Calcutta/Haldia Dock system of CPT .... sept. 1989
2) Period of Engineering Study (Detailed Design & Documentation for Tender .... 12 months
   Apr. 1990 to Mar. 1991
3) Tender Call, Evaluation of Tender & Signing the Contract .... 6 months
   Apr. 1991 to Sep. 1991
4) Preparation Works for Construction of Various Projects .... 3 months to 6 months
5) Construction Period of Various Projets .... 30 months
   Oct. 1991 to Mar. 1995

The working schedule of various projects in the Master & Short-term Plans are shown as Table 13-6-3 & 13-6-4.

Table 13-6-3 Working Schedule

Item NO.	Description	Q'ty \ Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	F/S by JICA																		
2	E/S (D/D & Survey)																		
3	Tender for Const.																		
4 Calcutta	Replacement Swing B.	1 set																	
	Hasting Bridge	1 set																	
	Fly-over Bridge	1 set																	
	Replace. Bascule B.	1 set																	
	Road Works	L.S.																	
	Railway Works	L.S.																	
	Rehabili. Works	L.S.																	
	Cargo Handling Equip	L.S.																	
	Port Service Vessel	L.S.																	
5 Haldia	Container Berth	600 m																	
	Multi-purpose Berth	220 m																	
	General Cargo Berth	200 m																	
	Barge Berth	80 m																	
	Shifting Berth	1 set																	
	Tanker Shifting Buoy	1 set																	
	Yard Works	L.S.																	
	Parking Basin	L.S.																	
	Jetty in River	90 m																	
	Slipway, Workshop	L.S.																	
	Railway Works	L.S.																	
	Entrance Lock	L.S.																	
	Cargo Handling Equip	L.S.																	
	Port Service Vessel	L.S.																	
6	Navigation System	L.S.																	

Table 13-6-4 Working Schedule

Item NO.		Description	Q'ty \ Year	1988	1989	1990	1991	1992	1993	1994	1995
1		F/S by JICA									
2		E/S (D/D & Survey)									
3		Tender / Evaluation									
4	Calcutta	Replacement Swing Bridge	1 set								
		Hasting Bridge	1 set								
		New Roads	1,500 m								
		Widening Roads	650 m								
		Railway Works	L.S.								
		Pavement	580,000 m²								
		Fender System	L.S.								
		C.F.S.	9,040 m²								
		Cargo Handling Equipment	L.S.								
		Port Service Vessel	L.S.								
		Misc.Works	L.S.								
5	Haldia	Container Berth	200 m								
		Multi-purpose Berth	220 m								
		Yard Works	L.S.								
		Shifting Berth	L.S.								
		Parking Basin	L.S.								
		Slipway,Workshop	L.S.								
		Jetty in River	90 m								
		Railway Works	L.S.								
		Capital Dredging	350,000 m³								
		Cargo Handling Equipment	L.S.								
		Port Service Vessel	L.S.								
		Misc.Works	L.S.								
6		Navigation System	L.S.								

13-7 Cost Estimate

13-7-1 Cost Estimate Factors

The most basic factors involved in the cost estimate are described in sections 13-1 to 13-4.

Additional factors are presented as follows.

1) Prices are shown in Indian Rupees, based on 1988 prices.
2) The exchange rate is 1 Rupee = 10 Yen.
3) Customs duties on imported construction materials & equipment are not included in the attached tables. (Please refer Table 13A-7-1T 9,000 & 13A-7-2T in which 90% of the assumed duty except the floating equipment included.)
4) No import duty for the floating equipment.
5) Sales tax of 9 % in local currency is assumed.
6) A physical contingency of 10 % is assumed.
7) The project costs relating with the other organizations should be shared with them as following table.

<u>Projects cost to be shared</u>

Short term plan up to 1995 (without import duty)

Item	Description		CPT	State Govern-ment	Rail-way	SAIL	IWT	Total (M.Rs)
C01	Replacement of Swing Bridge		1/2	1/2				104.0
C02	Widening of Hasting Bridge			1				15.0
C05	New Roads			1				15.0
C06	Widening Roads			1				3.6
C10	Replacement of Hide Bridge		1/3	1/3	1/3			9.9
H12	Coking Coal Yard					1		13.5
H13-D	-do-	Tracks				1		5.7
H17-18h	-do-	Unloader				1		137.0
	-do-	Stacker/Reclaimer				1		98.0
	-do-	Belt Conveyor				1		62.0

13-7-2 Project cost Estimate in Master Plan up to 2005

The total project cast of the Master plan up to 2005 is estimated as

Rs. 7,881,200,000.

as shown on Table 13-7-1, of which the local & foreign portions are :

Local portion	Rs.	4,640,400,000	(58.9 %)
Foreign portion	Rs.	3,240,800,000	(41.1 %)

The cost breakdown of the Master plan is shown in Tables 13-7-1M to 6M.

13-7-3 Project Cost Estimate in Short-term Plan up to 1995

The total project cost of the Short-term Plan up to 1995 is estimated as

Rs. 3,292,300,000.

as shown in Table 13-7-1, of which the local & foreign portions are :

Local portion	Rs.	1,855,300,000	(56.4 %)
Foreign portion	Rs.	1,437,000,000	(43.6 %)

The cost breakdown of the Short-term plan is shown in Tables 13-7-1S to 6S.

[Note] * Project Cost for the Urgent Plan is attached separately in Appendix.

Table 13-7-1 Project Cost Estimate of MASTER Plan up to 2005

★ 1988 prices without Import Duty

☞ CALCUTTA 2005

No.	Description	Q'ty	Unit cost (M.Rs)	Amount (M.Rs)	Foreign portion %	Foreign portion (M.Rs)	Note
C01	Replacement of Swing Bridge S:70 m W:18 m		1.48	52.0 [52.0]	44	23.0 [23.0]	Cost sharing(CPT & State),Bascule type
C02	Widening of Hasting Bridge S:80 m W:10.2m		0.19	[15.0]	7	[1.0]	by State Government
C03	Flyover Bridge S:50m	50 m	0.2	[10.0]	10	[1.0]	-do- , at BRT
C04	Replacement of Bascule Bridge S:50 m W:18 m		1.46	36.5 [36.5]	47	17.0 [17.0]	Cost sharing(CPT & State),Bascule type
C05	New Roads	1.5 km W:24 m	10.0	[15.0]	10	[1.5]	by State Government with ditch,light etc
C06	Widening Roads	4.15 km W:10.2m	5.5	[22.8]	10	[2.3]	-do-
C07	Railway Works	LS		93.1	9	8.0	Refer Table 13-7-1M
C08	Rehabilitation Works	LS		572.9	17	95.7	Refer Table 13-7-2M
C09	Barge Berth	80 m	0.45	[36.0]	20	[7.2]	1 berth -6.0m by IWT
C10	Replacement of Hide Bridge S:50 m W:18 m		0.2	3.3 [6.6]	10	0.3 [0.6]	Cost sharing(CPT, State & Railway)
C11	Container Park & Equipment			[68.9]			by ADB
C12	CFS	9,040 sq.m	0.0032	29.6	17	5.0	at NSD No.4 & 5
C13	Cargo Handling Equipment	LS		776.6 (105.4)		0	Refer Table 13-7-5M
C14	Port Service Vessels	LS		499.8	80	400.3	Refer Table 13-7-6M
	Sub-total(Calcutta)			2,063.8 (108.4)	27	549.3	

-continuing

[Remarks] 1) All costs exclude import duty. 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in this total amount.

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☞ Haldia 2005

H01	Container Berth	600 m	0.85	510.0	19	96.0	3 berths, W:25m
H02	Waiting Berth	LS		2.2	50	1.0	2 dolphins w/h piles
H03	Multi-Berth	220 m	0.85	187.0	19	35.2	1 berth, W:25m
H04	Barge Berth	80 m	0.85	68.0	19	12.8	1 berth -10.4m
H05	Oil Waiting Berth	LS		30.0	70	21.0	Jetty at river
H06	2nd Oil Jetty	LS		[274.6]			by OECF
H07	Lighting System for navigation	LS	17.7	17.7	17	3.0	5 towers etc.
H08	Yard Works	LS		353.0	11	40.0	Refer Table 13-7-3M
H09	Lock Entrance	LS	800.0	800.0	30	240.0	includ. mecha.etc with 350m jetty
H10	Capital Dredging	5M.cu.m	63.7Rs	318.5	24	75.0	dump to deep sea
H11	General Cargo berth	200 m	0.6	120.0	20	24.0	1 berth
H12	Coking Coal yard	45,000 sq.m	300 Rs	[13.5]	10	1.4	Pavement, by SAIL
H13	Railway Works	LS		148.7	8	12.1	Refer Table 13-7-1M
H14	Parking Basin & Jetty for small Craft	LS		26.4	23	6.0	
H15	Slipway & Workshop for small Craft	LS		17.3	29	5.0	
H16	Jetty in River	LS		21.8	25	5.5	for Tug-boats
H17	Cargo Handling Equipment	LS		955.8 (51.7)	48	441.4	Refer Table 13-7-5M
H18	Port Service Vessels	LS		1,016.1	96	971.2	Refer Table 13-7-6M
	Sub-total (Haldia)			4,592.5 (51.7)	43	1,989.2	

-continuing

[Remarks] 1) All costs exclude import duty. 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in this total amount.

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☞ Calcutta/Haldia ☜								
CH1	Channel Navigation System	LS			318.2	74	236.5	Refer Table 13-7-4M
	Total (C+H+CH)				6,974.5 (157.1)	40	2,775.0	
Engineering & Contingency								
	Consulting Services	3 %			209.2	90	188.3	
	Physical Contingencies	10 %			697.5	40	277.5	
	Price Contingency	%						
	Grand Total				7,881.2 (157.1)	41	3,240.8	

[Remarks] 1) All costs exclude import duty. 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in this total amount. 12th Revision/890922

Table 13-7-1S Breakdown of RAILWAY WORKS

MASTER PLAN UP TO 2005

1988 prices without Import Duty

CALCUTTA(C07) 1995

No	Description	Q'ty	Unit	Unit Cost Rupees	Amount Mil.Rs.	Imp. Duty	For. C'cy	Note
A)	Block Rake Loading Terminal :							
1)	Track	2,160	m	2,500/m	5.4		0.54	new railway
2)	Pavement	50,400	sq.m	400/sq.m	20.16		1.70	for container
3)	Road W:7.5m	15,000	sq.m	400	6.0		0.60	traffic,L:1,200m,
4)	Reclaiming	15,000	sq.m	100	1.5		0.15	with compaction
	Sub-total				33.06	0	2.99	
B)	Container Loading Terminal							
C)	Locomotives :	2	units	25.0 M.Rs	50.0		5.0	high powered
		2	unit	5.0	10.0			low powered
	Sub-total				60.0	0	5.0	
	Total(Calcutta)				93.06	0	7.99	
					say 93.1		say 8.0	

[Remarks] 1) Regarding to modernization works of rail, please refer item 6 of Rehabilitation works in Table 13-7-2S.

10th Revision/19890922

Table 13-7-1S Breakdown of RAILWAY WORKS
SHORT-TERM PLAN UP TO 1995

HALDIA(H13) 1995 1988 prices

No	Description	Q'ty	Unit	Unit Cost Rupees	Amount Mil.Rs.	Imp. Duty	For. C'cy	Note
A)	General Marshaling Yard :							
1)	Tracks	6,480	m	2,500	16.2		1.32	as reception & departure lines
B)	Bulk Handling Yard :							
	Tracks	1,440	m	2,500	3.6		0.36	as departure lines
	Wagon Pusher	2	sets	5.0 M.Rs	10.0		0.5	
	Sub-total				13.6		0.86	
C)	Sorting Yard :							
	Tracks	3,600	m	2,500	9.0		0.90	
D)	Coking Coal Terminal :							
	Tracks	2,300	m	2,500	[5.7]			as loading & link lines,SAIL project
E)	Container Loading Termiial :							
1)	Tracks	3,740	m	2,500	9.35		0.94	as loading & escape lines
2)	Cranes :		set					
	Rail	2,160	m	3,500	7.56		0.76	
3)	Pavement :	32,400	sq.m	400	12.96		1.30	Grade-2
	Sub-total(E)				75.0		3.00	
F)	Locomotives :	3	units	25 M.Rs	75.0		6.0	high powered
	Workshop	1	unit		5.0			middle powered
	Sub-total(F)				80.0		6.0	
	Total(Haldia)				148.67	0	12.08	
				say	148.7		12.1	

[Remarks] 1) All facilities are procured by local. 5th Revision/19890922

Table 13-7-2M Breakdown of REHABILITATION WORKS

MASTER PLAN UP TO 2005 1988 prices

CALCUTTA(C08) 2005

No.	Description	Q'ty	Unit	Unit Cost (Rs.)	Amount Mil.Rs.	Imp. Duty	For. C'cy	Note
1)	Pavement: Grade-1	20,000	sq.m	500	10.0		1.0	for heavy cargoes
	Grade-2	100,000	sq.m	400	40.0		4.0	containers
	Grade-3	540,000	sq.m	250	135.0		13.5	normal cargo
	Grade-4	50,000	sq.m	200	10.0		1.0	car park & widening roads at gates
	Grade-5	9,000	sq.m	300	2.7		0.3	undisposed material
	Sub-total	719,000	sq.m		197.7		19.8	
2)	Quarters	50	nos					
	/Fence	1,300	m		15.0	0	1.5	
	/Demolish works		LS					
3)	Fender system	24	sets		20.2	9.5		Corners in Docks
	Approach Jetty	18	sets		30.0	10.3		KPD & NSD Lock entrance/with fenders
	Sub-total				50.2	19.8	28.0	
4)	Communication & Computer				25.0			
	& Marine Tower				25.0		0.4	
	Sub-total				50.0		0.4	
5)	Dock Gate							
	Oil Hydraulic system				30.0		12.5	Modernization
	Floating caisson etc				170.0		28	-do-
	Sub-total				200.0	12.0	40.5	
6)	Replacement of existing Rail				40.0		4.0	52 km
7)	Reinforcement of NSD No.5 Berth				15.0		1.5	At apron area for
8)	Modernization of Workshop				5.0		0	CTN handling
	Total without Import Duty				572.9	31.8	95.7	
	with Import Duty				604.7			

[Remarks] 1) Imported Rubber Fenders shall be applied for item 3).

9th Revision/19890922

Table 13-7-3M Breakdown of Y a r d W o r k s

MASTER PLAN UP TO 2005 1988 prices

HALDIA(H08) 2005

No	Item	Q'ty	Unit	Unit Cost (Rupees)	Amount Mil.Rs.	Duty M.Rs	For. C'cy	Note
A)	Container Yard :							
1	CFS : 2 units	11,200	sq.m	3,200	35.84	3.6		
	Misc.	LS			0.16			
	Sub-total				36.0	3.6	7.2	
2	Pavement	300,000	sq.m	330	99.0		9.9	CTN :350m/200m x 3 Multi:250m/220m x 1 Barge: 80m/200m x 1
3	Soil Improvement	300,000	sq.m		97.0	10.8	15.7	Sand piles
4	Lighting	7	berths	10 Mil.R	70.0	7.0	7.0	including existing 2 berths
5	A D Building	1,200	sq.m	5,000	6.0	0		5 floors including workshop,canteen etc.
6	Computer etc.		LS		10.0		0.2	
B)	Truck Terminal	20,000	sq.m	250	5.0			
C)	Quarters	226	nuits		30.0			
	Total ......without Import Duty.....				353.0	21.4	40.0	
	......with Import Duty.......				374.4			

[Remarks] 1) Regarding Coking Coal Yard, please refer to item H12 in Table 13-7-1.

5th Revision/19890922

Table 13-7-4M Breakdown of CHANNEL NAVIGATION SYSTEM

★ MASTER PLAN UP TO 2005 1988 prices

CALCUTTA/HALDIA(CH1) 2005

Description	Q'ty	Unit Cost (M.Rs)	Amount (M.Rs)	Imp. Duty (M.Rs)	For. Cu'cy (M.Rs)	Note
A) Replacement of Pilot Station Vessel 2,000 GT						Exist.: 1,000GT
B)						
C) Tug-Boat 200GT, 1,800ps	2 units	33.0	66.0	0	62.0	
D) Pilot Station	LS		39.1	4.5	10.5	at Sagar
E) Navigation Aids						
Lower Traffic Lanes	LS		20.6	14.9	18.5	
Upper -do-	LS		64	36	40.5	Light Buoy
Sub-total			84.6	50.9	59	
F) Buoys at anchorage	LS		5.4	3.6		
G) Traffic Control System	LS		110	90	105	
G) Wave Protection	LS		13.1	0		at exist. tower side
Sub-total: without Import Duty			318.2	149.0	236.5	
: with Import Duty			467.2	Million Rupees		

[Remarks] 1) These amounts are based upon the Plan-2 in the Step-3 during 2000 to 2005.

8th Revision/890901

Table 13-7-5M Breakdown of HANDLING EQUIPMENT

MASTER PLAN UP TO 2005 1988 prices

CALCUTTA(C13) 🖃 2005

No.	Description	Capacity	Q'ty	Unit Cost 000 Rs.	Amount M.Rs	Tax M.Rs	Note
01c	Forklift	2.0 t	26	400	(10.4)		by CPT for CTN
02c	-do-	3.0 t	190	500	(95)		by CPT
	(Initial 39 + Replace 123) for G/C + (Initial 14 + Replace 14) for CTN = 190						
03c	-do-	5.0 t	65	800	52.0		
	(Initial 26 + Replace 36) for G/C + (Initial 1 + 2 = 3) for CTN = 65						
04c	-do-	10.0 t	9	2,000	18.0		2 nos. by ADB
	(Initial 3 + Replace 6) for G/C = 9						
05c	-do-	45.0 t	3	14,000	42.0		
	Sub-total(Forklift)				112.0 (105.4)	0	
06c	Mobile Crane	6.0 t	14	3,000	42.0		
		10.0 t	19	4,000	76.0		
	(Initial 3 + Replace 16) for G/C = 19						
07c	-do-	16.0 t	10	4,500	45.0		Initial for GC
08c	-do-	30.0 t	12	6,000	72.0		
	(Initial 8 + Replace 6) for G/C = 12						
09c	-do-	45.0 t	3	10,000	30.0		Initial for GC
	Sub-total(Mobile Crane)				265.0	0	
10c	Chassis	20 ft	60	200	12.0		for CTN
11c	-do-	40 ft	53	400	21.2		for CTN
	Sub-total(Chassis)				33.2	0	
12c	Tractor		48	800	38.4		for CTN
13c	Truck-Scale	50 t	-		-		

-continuing

CALCUTTA(C13) 目 2005

No.	Description	Capacity	Q'ty	Unit Cost 000 Rs.	Amount M.Rs	Tax M.Rs	Note
14c	Yard Crane	30.0 t	2	22,000	44.0		
		20.0 t	2	18,000	36,0		
20c	Quay Crane for Barge		2	15,000	[30.0]		by IWT
21c	Transfer Crane		9	12,000	108.0	0	Rubber mounted
22c	Shore Crane		8	10,000	80.0		
23c	-do- (Fertilizer)		3	20,000	60.0		At NSD A & B
	Total(Calcutta)				776.6 (105.4)		

[Remarks] 1) The prices above are based upon local procurement.

11th Revision/19890922

Table 13-7-5M Breakdown of HANDLING EQUIPMENT

MASTER PLAN UP TO 2005 1988 prices

CALCUTTA/HALDIA(H17/1) 📼 2005

No.	Description	Capacity	Q'ty	Unit Cost 000 Rs	Amount 000 Rs	Imp. Duty M.Rs	For. Cu'cy M.Rs	Note
01h	Forklift	2.0 t	63	400	(25.2)			by CPT for CTN
02h	-do-	3.0 t	53	500	(26.5)			by CPT
	(Initial 8 + Replace 10) for G/C + (Initial 9 + Replace 26) for CTN = 53							
03h	-do-	5.0 t	7	800	5.6			
				(Initial 5 + Replace 2) for CTN = 7				
04h	-do-	10.0 t	0	2,000	0			
05h	-do-	45.0 t	3	14,000	42.0			
	Sub-total(Forklift)				47.6 (51.7)	0		
06h	Mobile Crane	10.0 t	3	4,000	12.0			Replace for GC
10h	Chassis	20 ft	88	200	17.6			
11h	-do-	40 ft	83	400	33.2			
				(Initial 80 + Replace 91) for CTN = 171				
	Sub-total(Chassis)				50.8	0		
12h	Tractor		77'	800	61.6			for CTN
			(Initial 33 + Replace 44)					for CTN = 77
13h	Truck-Scale	50 t	4	2.3 M.R	9.2	4.8	5.88	
14h	Boulder Removal Equipment		1		20.0		1.5	for Coal plant
15h	Stacker/Reclaimer		2	49 M.Rs	98.0	72.0	84.0	-do-
17h	Watering Facility		LS		10.0			-do-
18h	Unloader for Coking Coal		2 sets		[137.0]	[117]	[133]	by SAIL
	-do- Stacker/Reclaimer		2 sets	49 M.Rs	[98.0]	[72.0]	[84.0]	-do-
	-do- Belt-conveyor		1,800 m		[62.0]			-do-
	-do- Tripper				[2.2]			Loader for wagons

-continuing-

CALCUTTA/HALDIA(H17/2) 편 2005

No.	Description	Capacity	Q'ty	Unit Cost 000 Rs	Amount 000 Rs	Imp. Duty M.Rs	For. Cu'cy M.Rs	Note
20h	Quay Crane for Berths		7	52.6M.R	368.2	306.2	348.0	
	-do- for Barge		2	15 M.Rs	30.0		2.0	
21h	Transfer Crane		17	12 M.Rs	204.0	0		Rubber mounted
22h	-do-		1	10 M.Rs	10.0	0		Rail mounted
23h	Equipment for IWT CTN Berth							
	1) Transfer Crane		2	12 M.Rs	24.0	0	0	Rubber mounted
	2) Forklift	5.0 t	1	800	0.8			
	3) Chassis	40 ft	8	400	3.2			
	4) Tractor		8	800	6.4			
	Sub-total				34.4	0	0	
	Total(Haldia,2005) without Import Duty				955.8 (51.7)	383.0	441.4	
	-do- with Import Duty				1,338.8			

[Remarks] 1) Import duty : 90 %

12th Revision/19890922

Table 13-7-6M Breakdown of PORT SERVICE VESSELS

MASTER PLAN UP TO 2005 1988 prices

☞ Calcutta(C14) 2005

	Description	Capacity	Q'ty	Unit Cost 000 R	Amount M.Rs	Imp.D M.Rs	For. Cu'cy	Note
01h	Grab Dredger	750 cu.m	1	35,000	35.0		33.0	with hoppers
02c	Tug-Boat	2,500 ps	3	43,000	129.0		123.0	1,250 ps × 2
		1,500 ps	4	28,400	113.6		108.8	750 ps × 2
03c	River Servey Launch		4	6,000	24.0			
04c	Pilot/Harbour/ Dock Launch		4	6,000	24.0			
05c	Anchor Vessel		1	15,000	15.0			
06c	Floating Crane	150 t	1	29,000	29.0		26.0	Non-propellar fixed type
08c	-do-	60 t	1	37,000	37.0		35.5	Self-pro.swing
09c	Multi-Purpose Ship		2	40,100	80.2		74.0	
10c	General Service		1	8,000	8.0			
11c	Water Berge	200 t	1	5,000	5.0			
	Sub-total(Calcutta)				499.8		400.3	

Haldia(H18) 2005

	Description	Capacity	Q'ty	Unit Cost 000 R	Amount M.Rs	Imp.D M.Rs	For. Cu'cy	Note
01h	Hopper Dredger	3,000 cu.m	1	410,000	410.0		405.0	
02h	-do-	1,700 cu.m	1	307,200	307.2		305.0	
03h	Grab Dredger	750 cu.m	1	35,000	35.0		33.0	with hoppers
04h	Tug-Boat	2,500 ps	3	43,000	129.0		123.0	1,250 ps × 2
		1,500 ps	2	28,400	56.8		54.4	750 ps × 2
05h	Floating Crane	60 t	1	15,000	15.0		13.8	Non-propellar fixed type
06h	Multi-Purpose Ship		1	40,100	40.1		37.0	
07h	General Service		1	8,000	8.0			
08h	Mooring Vessels		2	5,000	10.0			
09h	Water Berge	200 t	1	5,000	5.0			
	Sub-total(Haldia)				1,016.1		971.2	

[Remarks] 1) No import duty for the floating equipment. 11th Revision/19890922

Table 13-7-2 PROJECT COST ESTIMATE

SHORT-TERM PLAN UP TO 1995

1988 prices without Import Duty

☞ CALCUTTA 1995

No.	Description	Q'ty	Unit cost (M.Rs)	Amount (M.Rs)	Foreign portion %	Foreign portion (M.Rs)	Note
C01	Replacement of Swing Bridge S:70 m W:18 m			52.0 [52.0]	44	23.0 [23.0]	Cost sharing (CPT & State), Bascule type
C02	Widening of Hasting Bridge S:80 m W:10.2m			[15.0]	7	[1.0]	by State government
C03	Flyover Bridge S:50 m						-do-, in M/P
C04	Replacement of Bascule Bridge						Schedule in M/P
C05	New Roads W:24 m	1,500m	0.01	[15.0]	10	[1.5]	by State government
C06	Widening Roads W:10.2m	650m	0.0055	[3.6]	10	[0.4]	-do-
C07	Railway Works	LS		80.9	9	7.1	Refer Table 13-7-1S
C08	Rehabilitation Works	LS		306.4	20	61.5	Refer Table 13-7-2S
C09	Barge berth	80 m		[48.0]			by IWT
C10	Replacement of Hide Bridge S:50 m W:18 m			3.3 [6.6]	10	0.3 [0.6]	Cost sharing (CPT, State & Railway)
C11	Container Park & Equipment			[68.9]			by ADB
C12	CFS	9,040 sq.m		29.6	17	5.0	at NSD No.4 & 5
C13	Handling Equipment	LS		331.7 (31.5)		0	Refer Table-13-7-5S
C14	Port Service Vessels	LS		270.0	83	224.5	Refer Table-13-7-6S
	Sub-total (C:Calcutta)			1,073.9 (31.5)	29	315.9	

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[Remarks] 1) All costs exclude import duty. 2) Figures in () show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in total amount.

21th Revision/890921

☞ HALDIA 1995

No.	Description	Q'ty	Unit cost (M.Rs)	Amount (M.Rs)	Foreign portion %	Foreign portion (M.Rs)	Note
H01	Container Berth	200 m	0.85	170.0	19	32.0	1 berth, w:25m Monolith type
H02	Waiting Berth	LS		2.2	45	1.0	2 dolphins with 3 piles each
H03	Multi-Berth	220 m	0.85	187.0	19	35.2	1 berth, w:25m Monolith type
H04	Barge Berth	80 m					Schedule in M/P
H05	Oil Waiting Berth	LS					Schedule in M/P
H06	2nd Oil Berth	LS		[274.6]			by OECF
H07	Lighting for night navigation	LS		17.7	17	3.0	5 towers etc.
H08	Yard Works	LS		197.2	11	22.6	Refer Table 13-7-3S
H09	Lock Entrance	LS					Schedule in M/P
H10	Capital Dredging	0.35 M.cu.m	63.7 Rs	22.3	24	5.3	Basin & Berth front dumping to deepsea
H11	General Cargo Berth	LS					Schedule in M/P
H12	Coking Coal Yard	45,000 sq.m	300 Rs	[13.5]	10	[1.4]	SAIL project
H13	Railway Works	LS		120.6	8	9.6	Refer Table 13-7-1S
H14	Parking Basin & Jetty for small craft	LS		26.4	23	6.0	Basin & Jetty
H15	Slipway & Workshop for small craft	LS		17.3	29	5.0	At the above site
H16	Jetty in River			21.8	25	5.5	for Tug-boats

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[Remarks] 1) All costs exclude import duty. 2) Figures in () show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in total amount.

19th Revision/890919

No.	Description	Q'ty	Unit cost (M.Rs)	Amount (M.Rs)	Foreign portion %	Foreign portion (M.Rs)	Note
H17	Cargo Handling Equipment	LS		358.3 (13.4)	43	153.4	Refer Table 13-7-5S
H18	Port Services Vessels	LS		526.3	97	511.8	Refer Table 13-7-6S
	Sub-total (Haldia)			1,667.1 (13.4)	47	790.4	
CALCUTTA/HALDIA							
CH1	Channel Navigation	LS		172.5	71	123	Refer Table 13-7-4S
	Total (C+H+CH)			2,913.5 (44.9)	42	1,234.8	
Engineering & Contingency							
	Consulting Services	3 %		87.4	90	78.7	
	Physical Contingencies	10 %		291.4	42	123.5	
	Price Contingency	%					
	Grand Total			3,292.3 (44.9)	44	1,437.0	

[Remarks] 1) All costs exclude import duty. 2) Figures in () show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in total amount.

20th Revision/19890920

Table 13-7-1S Breakdown of RAILWAY WORKS

SHORT-TERM PLAN UP TO 1995

1988 prices without Import Duty

CALCUTTA(C07) 1995

No	Description	Q'ty	Unit	Unit Cost Rupees	Amount Mil.Rs.	Imp. Duty	For. C'cy	Note
A)	Block Rake Loading Terminal :							
1)	Track	1,440	m	2,500/m	3.6		0.36	new railway
2)	Pavement	30,600	sq.m	400/sq.m	12.2		1.22	for container
3)	Road W:7.5m	9,000	sq.m	400	3.6		0.36	traffic,L:1,200m,
4)	Reclaiming	15,000	sq.m	100	1.5		0.15	with compaction
	Sub-total				20.9	0	2.09	
B)	Container Loading Terminal							
C)	Locomotives :	2	units	25.0 M.Rs	50.0		5.0	high powered
		2	unit	5.0	10.0			low powered
	Sub-total				60.0	0	5.0	
	Total(Calcutta)				80.9	0	7.09	
						say	7.1	

[Remarks] 1) Regarding to modernization works of rail, please refer item 6 of Rehabilitation works in Table 13-7-2S. 6th Revision/19890918

Table 13-7-1S Breakdown of RAILWAY WORKS
SHORT-TERM PLAN UP TO 1995

HALDIA(H13) 1995 1988 prices

No	Description	Q'ty	Unit	Unit Cost Rupees	Amount Mil.Rs.	Imp. Duty	For. C'cy	Note
A)	General Marshaling Yard :							
1)	Tracks	4,320	m	2,500	10.8		1.08	as reception & departure lines
B)	Bulk Handling Yard :							
	Tracks	1,440	m	2,500	3.6		0.36	as departure lines
	Wagon Pusher	2	sets	5.0 M.Rs	10.0		0.5	
	Sub-total				13.6		0.86	
C)	Sorting Yard :							
	Tracks	2,160	m	2,500	5.4		0.54	
D)	Coking Coal Terminal :							
	Tracks	2,300	m	2,500	[5.7]			as loading & link lines,SAIL project
E)	Container Loading Termiial :							
1)	Tracks	1,580	m	2,500	3.9		0.4	as loading & escape lines
2)	Cranes :		set					
	Rail	720	m	3,500	2.5		0.25	
3)	Pavement :	10,800	sq.m	400	4.3		0.43	Grade-2
	Sub-total(E)				10.7		1.08	
F)	Locomotives :	3	units	25 M.Rs	75.0		6.0	high powered
		0	unit	17.5 M.Rs				middle powered
	Sub-total(F)				75.0		6.0	
	Total(Haldia)				120.6	0	9.6	

[Remarks] 1) All facilities are procured by local. 6th Revision/19890918

Table 13-7-2S Breakdown of REHABILITATION WORKS

SHORT-TERM PLAN UP TO 1995 1988 prices

CALCUTTA(C08) 1995

No.	Description	Q'ty	Unit	Unit Cost (Rs)	Amount (Mil.Rs)	Imp. Duty (MR)	Fore. Cu'cy (M.R)	Note
1)	Pavement: Grade-1	4,000	sq.m	500	2.0		0.3	for heavy cargoes
	Grade-2	80,000	sq.m	400	32.0		3.0	containers
	Grade-3	390,000	sq.m	250	97.5		9.7	normal cargo
	Grade-4	30,000	sq.m	200	6.0		0.6	car park & widening roads at gates
	Grade-5	9,000	sq.m	300	2.7		0.4	undisposed material
	Sub-total	513,000	sq.m		140.2		14.0	
2)	Quarters	50	nos					
	/Fence	1,300	m		15.0	0	1.5	
	/Demolish works		LS					
3)	Fender system	24	sets		20.2			Corners in Docks
	Approach Jetty	18	sets		30.0			KPD & NSD Lock entrances/with fenders
	Sub-total				50.2	19.8	28.0	
4)	Communication & Computer				20.0			Walky-Talky etc.
	& Marine Tower				0.0			shedule in M/P
	Sub-total				20.0			
5)	Dock Gate							
	Oil Hydraulic system				21.0	9.0	12.5	Modernization
	Floating caisson etc				0.0			-do- shedule in M/P
	Sub-total				21.0	9.0		
6)	Replacement of existing Rail				40.0		4.0	52 km
7)	Reinforcement of NSD No.5 Berth				15.0		1.5	At apron area
8)	Modernization of Work-shop				5.0			
	Total	without Import Duty			306.4	28.8	61.5	
		with Import Duty			335.2			

[Remarks] 1) Imported Rubber Fenders shall be applied for item 3).

11th Revision/19890918

Table 13-7-3S Breakdown of Y a r d W o r k s

SHORT-TERM PLAN UP TO 1995 1988 prices

HALDIA(H08) 1995

No	Item	Q'ty	Unit	Unit Cost (Rupees)	Amount (Mil.R)	Duty (MR)	For. C'cy (MR)	Note
A)	Container Yard :							
1	CFS : 1 unit	5,600	sq.m	3,200	17.92	1.8	3.4	
	Misc.	LS			0.08			
	Sub-total				18.0	1.8		
2	Pavement	125,000	sq.m	330	41.2		3.8	CTN :350m/200m x 1 Multi:250m/220m x 1
3	Soil Improvement							
		125,000	sq.m	340	43.0	4.5	11.2	Sand piles
4	Lighting	4	berths	11 Mil.Rs	44.0		4.0	including existing 2 berths
5	A D Building	1,200	sq.m	5,000	6.0	0		5 floors including workshop,canteen etc.
6	Computer etc.		LS		10.0		0.2	
B)	Truck Terminal	20,000	sq.m	250	5.0			
C)	Quarters	226	nuits		30.0			

Total ......without Import Duty..... 197.2 | 6.3 | 22.6

......with Import Duty........ 203.5

[Remarks] 1) Regarding to Coking Coal Yard by SAIL, please refer to item H12 in Table 13-7-2.

6th Revision/19890704

Table 13-7-4S Breakdown of CHANNEL NAVIGATION SYSTEM

☆ SHORT-TERM PLAN UP TO 1995 1988 prices

CALCUTTA/HALDIA(CH1) 1995

Description	Q'ty	Unit Cost M.Rs	Amount M.Rs	Imp. Duty M.Rs	Foreign Cu'cy	Note
A) Replacement of Pilot Station Vessel 2,000 GT						Exist.:1,000GT
B)						
C) Tug-Boat 200GT, 1,800ps	2 units	33.0	66.0	0	62.0	
D) Pilot Station	LS		39.1	4.5	10.5	Sagor island
E) Navigation Aids	LS		20.6	14.9	18.5	
F) Buoys at anchorage	LS		5.4	3.6	4.5	
G) Traffic Control System	LS		28.3	21.7	26.3	
G) Wave Protection	LS		13.1	0	1.2	at exist.tower side, Sagor
Sub-total: without Import Duty			172.5	44.7	123	
: with Import Duty			217.2	Million Rupees		

[Remarks] 1) The above cost is based upon a alternative plan-4.

10th Revision/19880904

Table 13-7-5S Breakdown of HANDLING EQUIPMENT

SHORT-TERM PLAN UP TO 1995 1988 prices

☞ CALCUTTA(C13) 1995

No.	Description	Q'ty	Unit Cost (000Rs)	Amount (M.Rs)	Imp. Duty (M.R)	Note
01c	Forklift 2.0 t	(30)				by ADB for CTN
02c	-do- 3.0 t	63	500	(31.5)		by CPT
	(Initial 14 + Replace 35) for G/C + Initial 14 for CTN = 63					
03c	-do- 5.0 t	19	800	15.2		
	(Initial 18 + Replace 0) for G/C + Initial 1 for CTN = 19					
04c	-do- 10.0 t	1	2,000	2.0		2 nos. by ADB
	(Initial 1 + Replace 0) for G/C = 1					
05c	-do- 45.0 t	1	14,000	14.0		
	Sub-total(Forklift)			31.2 (31.5)	0	
06c	Mobile Crane 10.0 t	4	4,000	16.0		
	(Initial 0 + Replace 4) for G/C = 4					
07c	-do- 16.0 t	5	4,500	22.5		Initial for GC
08c	-do- 30.0 t	3	6,000	18.0		
	(Initial 1 + Replace 2) for G/C = 3					
09c	-do- 45.0 t	2	10,000	20.0		Initial for GC
	Sub-total(Mobile Crane)			76.5	0	
10c	Chassis 20 ft	18	200	3.6		Initial 33
11c	-do- 40 ft	15	400	6.0		for CTN
	Sub-total(Chassis)			9.6	0	
12c	Tractor	8	800	6.4		for CTN
13c	Truck-Scale 50 t	-		-		
14c	Yard Crane 30.0 t	1	22,000	22.0		Betw.KPD 28&29
	20.0 t	1	18,000	18.0		27&28
21c	Transfer Crane	9	12,000	108.0	0	Rubber mounted
22c	Shore Crane					in M/P
23c	-do- (Fertilizer)	3	20,000	60.0		At NSD A & B
	Total(Calcutta)			331.7 (31.5)	0	

[Remarks] 1) Prices above are based upon local procurement. 11th Revision/890920

Table 13-7-5S Breakdown of HANDLING EQUIPMENT

SHORT-TERM PLAN UP TO 1995 1988 prices

CALCUTTA/HALDIA 1995

	Description		Q'ty	Unit Cost '000 Rs	Amount M.Rs	Imp. Duty M.Rs	Fore-ign Cu'cy	Note
01h	Forklift	2.0 t	16	400	(6.4)			by CPT for CTN
02h	-do-	3.0 t	14	500	(7.0)			by CPT
	(Initial 5 + Replace 0) for G/C + (Initial 1 + Replace 16) for CTN = 22							
03h	-do-	5.0 t	1	800	0.8			
			(Initial 1 + Replace 0) for CTN = 1					
04h	-do-	10.0 t	0	2,000	0			
05h	-do-	45.0 t	1	14,000	14.0			
	Sub-total(Forklift)				14.8 (13.4)	0	0	
06h	Mobile Crane	10.0 t	1	4,000	4.0			Replace for GC
		16.0 t	1	4,500	4.5			
		30.0 t	1	6,000	6.0			
	Sub-total(Mobile Crane)				14.5	0	0	
10h	Chassis	20 ft	23	200	4.6			
11h	-do-	40 ft	20	400	8.0			
	Sub-total(Chassis)				12.6	0	0	
12h	Tractor		20	800	16.0			for CTN
			(Initial 16 + Replace 4) for CTN = 20					
13h	Truck-Scale	50 t	2	2.3M.Rs	4.6	2.4	2.94	
14h	Boulder Removal equipment		1		20.0		1.5	
17h	Watering Facility		LS		10.0			
18h	Unloader for Coking Coal		2 sets		[137.0]	[117]		by SAIL
	-do- Stacker/Reclaimer		2 sets		[98.0]	[72]		-do-
	-do- Belt-conveyor		1,700 m		[62.0]			-do- 1,400 t/h
	-do- Tripper				[2.2]			Wagons loader
20h	Quay Crane		3 sets	52.6M.R	157.8	131.2	149	for CTN Berth
21h	Transfer Crane		9	12 M.Rs	108.0	0		Rubber mounted
	Total(Haldia,1995) without Import Duty				358.3 (13.4)	133.6	153.4	
	Total(Haldia,1995) with Import Duty				491.9			14th Revision/19890918

Table 13-7-6S Breakdown of PORT SERVICE VESSELS

SHORT-TERM PLAN UP TO 1995　　1988 prices

CALCUTTA(C14) 1995

	Description	Capacity	Q'ty	Unit Cost 000 R	Amount M.Rs	Imp.D M.Rs	For. Cu'cy	Note
01c	Grab Dredger	750 cu.m	1	35,000	35.0	0	33	with hoppers
02c	Tug-Boat	2,500 ps	2	43,000	86.0	0	82.5	1,250 ps × 2
03c	River Survey Launch		2	6,000	12.0	0		
04c	Pilot/Harbour/ Dock Launch		3	6,000	18.0	0		
05c	Anchor Vessel							
06c	Floating Crane							Non-propellar fixed type
07c	-do-	150 t						-do- in M/P
08c	-do-	60 t	1	37,000	37.0	0	35.5	Self-pro.swing
09c	Multi-Purpose Ship		2	40,100	82.0	0	74	
10c	General Service							Schedule in MP
	Sub-total(Calcutta)				270.0	0	224.5	

Total (Calcutta) .... 270.0 Million Rupees

Haldia(H18) 1995

	Description	Capacity	Q'ty	Unit Cost 000 R	Amount M.Rs	Imp.D M.Rs	For. Cu'cy	Note
02h	Hopper Dredger	1,700 cu.m	1	307,200	307.2	0	305	
03h	Grab Dredger	750 cu.m	1	35,000	35.0	0	2	with hoppers
04h	Tug-Boat	2,500 ps	3	43,000	129.0	0	123.0	1,250 ps × 2
05h	Floating Crane	60 t	1	15,000	15.0	0	13.8	Non-propellar fixed type
06h	Multi-Purpose Ship		1	40,100	40.1	0	37	
07c	General Service							Schedule in MP
	Sub-total(Haldia)				526.3	0	511.8	

Total (Haldia) .... 526.3 Million Rupees

[Remarks] 1) No import duty for the floating equipment.　13th Revision/19890920

Table 13A-7-1T9000 Project Cost Estimate of MASTER Plan up to 2005

1988 prices with Import Duty

※

☞ CALCUTTA 2005

No.	Description	Q'ty	Unit cost (M.Rs)	Amount (M.Rs)	Foreign portion %	Foreign portion (M.Rs)	Note
C01	Replacement of Swing Bridge S:70 m W:18 m			70.0 [70.0]	33	23.0 [23.0]	Cost sharing(CPT & State),Bascule type
C02	Widening of Hasting Bridge S:80 m W:10.2m			[15.0]	7	[1.0]	by State Government
C03	Flyover Bridge S:50m		10.0	[10.0]	10	[1.0]	-do- , at BRT
C04	Replacement of Bascule Bridge S:50 m W:18 m			50.0 [50.0]	34	17.0 [17.0]	Cost sharing(CPT & State),Bascule type
C05	New Roads	1.5 km W:24 m	11.0	[16.4]	9	[1.5]	by State Government with ditch,light etc
C06	Widening Roads	4.15 km W:10.2m	6.0	[24.9]	9	[2.3]	-do-
C07	Railway Works	LS		93.1	9	8.0	Refer Table 13-7-1M
C08	Rehabilitation Works	LS		604.7	16	95.7	Refer Table 13-7-2M
C09	Barge Berth	80 m	0.53	[48.0]	17	[7.2]	1 berth -6.0m by IWT
C10	Replacement of Hide Bridge S:50 m W:18 m			3.3 [6.6]	10	0.3 [0.6]	Cost sharing(CPT, State & Railway)
C11	Container Park & Equipment			[68.9]			by ADB
C12	CFS	9,040 sq.m		32.0	16	5.0	at NSD No.4 & 5
C13	Cargo Handling Equipment	LS		776.6 (105.4)		0	Refer Table 13-7-5M
C14	Port Service Vessels	LS		499.8	80	400.3	Refer Table 13-7-6M
	Sub-total(Calcutta)			2,129.5 (105.4)	26	549.3	

-continuing

[Remarks] 1) All costs except the floating equipment include import duty(90%) except the floating crafts. 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in this total amont.

☞ Haldia 2005

H01	Container Berth	600 m	0.94	564.0	17	96.0	3 berths, W:25m
H02	Waiting Berth	LS		2.9	24	1.0	2 dolphins w/h piles
H03	Multi-Berth	220 m	0.94	206.8	17	35.2	1 berth, W:25m
H04	Barge Berth	80 m	0.94	75.2	17	12.8	1 berth -10.4m
H05	Oil Waiting Berth	LS	48.9	48.9	43	21.0	7 Buoys at river
H06	2nd Oil Jetty	LS		[274.6]			by OECF
H07	Lighting System for navigation	LS	17.7	17.7	17	3.0	5 towers etc.
H08	Yard Works	LS		374.4	11	40.0	Refer Table 13-7-3M
H09	Lock Entrance	LS		1,016.0	24	240.0	includ. mecha.etc with 350m jetty
H10	Capital Dredging	5M.cu.m	63.7Rs	318.5	24	75.0	dump to deep sea
H11	General Cargo berth	200 m	0.71	142.0	17	24.0	1 berth
H12	Coking Coal yard	45,000 sq.m	300 Rs	[14.8]	9	[1.4]	Pavement, by SAIL
H13	Railway Works	LS		148.7	9	12.1	Refer Table 13-7-1M
H14	Parking Basin & Jetty for Small Craft	LS		30.0	20	6.0	
H15	Slipway & Workshop for Small Craft	LS		20.0	25	5.0	
H16	Jetty in River	LS		25.0	22	5.5	for Tug-boats
H17	Cargo Handling Equipment	LS		1,338.8 (51.7)	31	441.4	Refer Table 13-7-5M
H18	Port Service Vessels	LS		1,016.1	95	971.2	Refer Table 13-7-6M
	Sub-total (Haldia)			5,345.0 (51.7)	37	1,989.2	

-continuing

[Remarks] 1) All costs except the floating equipment include import duty(90%) except the floating crafts. 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in this total amont.

9th Revision/19890922

☞ Calcutta/Haldia ☜							
CH1	Channel Navigation System	LS		467.2	51	238.5	Refer Table 13-7-4M
	Total (C+H+CH)			7,941.7 (157.1)	35	2,775.0	
Engineering & Contingency							
	Consulting Services	3 %		238.3	90	214.5	
	Phisical Contingencies	10 %		794.2	35	277.5	
	Price Contingency	%					
	Grand Total			8,972.2 (157.1)	36	3,267.0	

[Remarks] 1) All costs except the floating equipment include import duty(90%) except the floating crafts. 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations, and both costs are not included in this total amont.

9th Revision/19890922

Table 13A-7-2T

PROJECT COST ESTIMATE

14th Revision/19890914

Calcutta 1995 SHORT-TERM PLAN up to 1995 Unit: Million Rupees 1988 prices

No.	Description		Q'ty	Local currency (A)	Local currency Imp.D (B)	Local currency Total (C)	Foreign currency (D)	Total:E Amount (H+L+M) (C+D)	Labour fee Un-skilled (F)	Labour fee Skilled (G)	Labour fee -do- F.(G')	Labour fee Total:H F+G+G'	Material/Equipment Imported (J)	Material/Equipment Local (K)	Material/Equipment Total (J+K=L)	etc. (M)	Note
C01	Replacement of Swing Bridge	S:70m	1 set	29.0 [29]	18.0 [18]	47.0 [47]	23.0 [23]	70.0 [70.0]	10.0 [10]	2.0 [2]	3.0 [3]	15.0 [15]	38.0 [38]	10.0 [10]	48.0 [48]	7.0 [7]	Cost Sharing (CPT & State), Bascule
C02	Widening of Hasting Bridge	S:80m	1 set					[15.0]									State gvt.project 2 lanes, W:10.2m
C03	Flyover Bridge	S:50m	1 set					[ ]									-do- , in M/P
C04	Replacement of Bascule Bridge							[ ]									Schedule in M/P
C05	New Roads	W:24m	1,500m					[16.4]									State goverment
C06	Widening Roads	W:10.2	650m					[4.0]									-do-
C07	Railway Works		1 set	73.8		73.8	7.1	80.9	4.1	2.7	7.1	13.9		61.1	61.1	5.9	Refer Table S-1
C08	Rehabilitation Works		LS	244.9	28.8	273.7	61.5	335.2	25.1	18.7	29.5	73.3	60.8	165.2	226.0	35.9	Refer Table S-2
C09	Barge Berth	-6.0m	80m					[48.0]									With Q/C,by IWT
C10	Replacement of Hide Bridge	S:50m W:18m	LS	3.0 [8.0]		3.0 [8.0]	0.3 [0.6]	3.3 [8.6]	0.4 [0.8]	0.3 [0.6]	0.3 [0.6]	1.0 [1.0]		2.0 [2.0]	2.0 [2.0]	0.3 [0.3]	Cost Sharing(CPT, State & Railway)
C11	Container Park & Equipment							[68.8]									by ADB loan

[Remarks] 1) Figures in [ ] are not included in sub-total amount. 2) Import Dity: 90% for equipment & materials except the floating equipment.

No.	Description	Q'ty	Local currency			Foreign currency (D)	Total:E Amount (H+L+M) (C+D)	Labour fee				Material/Equipment			etc. (M)	Note
			(A)	Tax (B)	Total (C)			Un-skilled (F)	Skilled (G)	-do- F.(G')	Total:H F+G+G'	Imported (J)	Local (K)	Total (J+K=L)		
C12	CFS	8,040 sq.m	24.8	2.4	27.0	5.0	32.0	4.5	2.5	2.3	9.3	5.1	12.6	17.7	5.0	at NSD No.4 & 5
C13	Handling Equipment	LS	331.7 (31.5)		331.7 (31.5)		331.7 (31.5)						326.2 (31.5)	326.2 (31.5)	5.5	
C14	Service Vessels	LS	45.5		45.5	224.5	270.0	2.3	2.9	6.0	11.2	218.5	36.5	255.0	3.8	
	Total (Calcutta)		752.5 (31.5)	49.2	801.7 (31.5)	321.4	1,123.1 (31.5)	48.4	29.1	48.2	123.7	322.4	613.6 (31.5)	936.0 (31.5)	63.4	
Haldia 1995																
H01	Container Berth	200 m	138.0	18.0	156.0	32.0	188.0	26.0	10.0	12.0	48.0	38.0	80.0	118.0	22.0	1 berth, W:25m Monolith type
H02	Waiting Berth	1 set	1.2	0.7	1.9	1.0	2.9	0.4	0.2	0.2	0.8	1.5	0.3	1.8	0.3	2 dolphins
H03	Multi-Berth	220 m	151.8	19.8	171.6	35.2	206.8	29.0	10.8	13.2	53.0	41.8	84.2	126.0	27.8	1 berth, W:25m
H04	Barge Berth	80 m														Schedule in M/P
H05	Oil Waiting Berth	1 set														-do-
H06	2nd Oil Berth						*[274.6]									By OECF loan

[Remarks] 1) Mark * shows that this cost is including existing oil jetty reinforcement. 2) Unit: Million Rupees, 1988 prices 3) Figures in [ ] & ( ) are not included in sub-total amount. 3) Import Dity: 90% for equipment & materials except the floating equipment.

17th Revision/880819

Haldia (2) 1995

No.	Description	Q'ty	Local currency (A)	Local currency Tax (B)	Local currency Total (C)	Foreign currency (D)	Total Amount (E) (H+L+M) (C+D)	Labour fee Un-skilled (F)	Labour fee Skilled (G)	Labour fee -do- Foreign (G')	Labour fee Total (H) F+G+G'	Material/Equipment Imported (J)	Material/Equipment Local (K)	Material/Equipment Total (J+K=L)	etc. (M)	Note
H07	Lighting for night navigation	1 set	14.7		14.7	3.0	17.7	2.0	1.0	3.0	6.0		9.0	9.0	2.7	5 towers & berth corners in Dock
H08	Yard Works	1 set	174.6	6.3	180.9	22.8	203.5	25.9	16.0	15.6	57.5	13.3	87.8	101.1	44.9	Refer Table S-3
H09	Lock Entrance															Schdule in M/P
H10	Capital Dredging	0.35 M.cu.m	17.0		17.0	5.3	22.3	3.8	2.0	5.3	11.1		7.8	7.8	3.4	Basin & berth's front in Dock
H11	General Cargo Berth															Schedule in M/P
H12	Coking Coal Yard	44,000 sq.m					[14.8]									SAIL project
H13	Railway Works	1 set	111.0		111.0	9.6	120.6	6.5	5.5	9.6	21.6		86.3	86.3	12.7	Refer Table S-1 w/o crane
H14	Parking Basin & Jetty for small crafts	1 set	20.4	3.6	24.0	6.0	30.0	6.0	4.0	2.0	12.0	7.6	6.4	14.0	4.0	Basin & jetty
H15	Slipway & Workshop for small crafts	1 set	12.3	2.7	15.0	5.0	20.0	3.0	2.0	2.0	7.0	5.7	4.3	10.0	3.0	At the above site
H16	Jetty in River	90 m	16.3	3.2	18.5	5.5	25.0	4.0	3.0	2.0	9.0	6.7	5.3	12.0	4.0	for Tug-boats
H17	Handling Equipment	LS	204.9 (13.4)	133.6	338.5 (13.4)	153.4	491.9 (13.4)	4.1	2.4	5.0	11.5	282.0	194.9 (13.4)	476.9 (13.4)	3.5	
H18	Service Vessels	LS	14.5		14.5	511.8	526.3	1.9	3.4	8.3	13.6	503.5	4.6	508.1	4.6	
	Sub-total (Haldia)		876.7 (13.4)	187.9	1,064.6 (13.4)	790.4	1,855.0 (13.4)	112.6	60.3	78.2	251.1	800.1	570.9 (13.4)	1,471.0 (13.4)	132.9	

[Remarks] 1) Unit: Million Rupees, 1988 prices 2) Figures in ( ) show the cost borne by CPT & in [ ] by other organizations and both costs are not included in total amount. 3) Import duty : 90 % for materials & equipment except the floating equipment.

14th Revision/19890914

Calcutta/Haldia 1995

No.	Description	Q'ty	Local currency (A)	Local currency Tax (B)	Local currency Total (C)	Foreign currency (D)	Total Amount (E) (H+L+M) (C+D)	Labour fee Un-skilled (F)	Labour fee Skilled (G)	Labour fee -do- Foreign (G')	Labour fee Total (H) F+G+G'	Material/Equipment Imported (J)	Material/Equipment Local (K)	Material/Equipment Total (J+K=L)	etc. (M)	Note
CH1	Channel navigation system		49.5	44.7	94.2	123	217.2	10.5	5.7	13.4	29.6	154.3	22	176.3	11.3	Refer Table S-4
	Sub-total (CH)		49.5	44.7	94.2	123	217.2	10.5	5.7	13.4	29.6	154.3	22	176.3	11.3	
	Total (C+H+CH)		1,678.7 (44.9)	281.8	1,96050 (44.9)	1,234.8	3,195.3 (44.9)	169.5	95.1	139.8	404.4	1,376.8	1,206.5 (44.9)	2,583.3 (44.9)	207.6	
	Consultant Services	3 %	9.6		9.6	86.3	95.9									
	Physical Contingencies	10 %	167.9	28.2	196.1	122.9	319.0									
	Grand Total		1,856.2 (44.9)	310.0	2,166.2 (44.9)	1,444.0	3,610.2 (44.9)						(44.9)	(44.9)		

[Remarks] 1) Unit: Million Rupees, 1988 prices 2) 4/4 3) Import duty : 90 % for materials & equipment except the floating equipment. 19th Revision/890919

ON-GOING PROJECTS

No.	Description	Q'ty	Local currency (A)	Local currency Tax (B)	Local currency Total (C)	Foreign currency (D)	Total:E Amount (H+L+M) (C+D)	Labour fee Un-skilled (F)	Labour fee Skilled (G)	Labour fee -do- F.(G')	Labour fee Total:H F+G+G'	Material/Equipment Imported (J)	Material/Equipment Local (K)	Material/Equipment Total (J+K=L)	etc. (M)	Note
C11	Container Park & Equipment						68.9									by ADB loan
H05	Oil Berth (2nd)						274.6									by OECF loan
	Total						343.5									

Table S-1 Breakdown of Railway Works

Calcutta (C07) 1995 Short-term Plan up to 1995 Unit: Million Rupees 1988 prices

No.	Description	Q'ty	Local currency (A)	Tax (B)	Total (C)	Foreign currency (D)	Total: Amount (H+L+M) & (C+D)	Labour Fee: Un-skilled (F)	Skilled (G)	-do- F.(G')	Total:H F+G+G'	Material/Equipment: Imported (J)	Local (K)	Total (J+K=L)	etc.	Note
A	Block Rake Loading Terminal															
1)	Track (new railway)	1,440 m	3.24		3.24	0.36	3.6	0.6	0.24	0.36	1.2		1.2	1.2	1.2	
2)	Pavement	30,600 sq.m	11.02		11.02	1.22	12.24	1.7	1.08	1.22	4.0		7.34	7.34	0.8	
3)	Road	9,000 sq.m	3.24		3.24	0.36	3.6	0.6	0.24	0.36	1.2		1.8	1.8	0.6	
4)	Reclaiming	15,000 sq.m	1.35		1.35	0.15	1.5	0.2	0.15	0.15	0.5		0.75	0.75	0.25	
	Sub-total(A)		18.85		18.85	2.09	20.94	3.1	1.71	2.09	6.9		11.09	11.09	2.85	
B	Locomotive	2units	45.00		45.00	5.00	50.0	1.0	1.0	5.0	7.0		40.0	40.0	3.0	
		2 unit	10.0		10.0		10.0						10.0	10.0		
	Sub-total(B)	3units	50.0		50.0	5.0	55.0	1.0	1.0	5.0	7.0		45.0	45.0	3.0	
	Total(Calcutta)		73.85		73.85	7.09	80.94	4.1	2.71	7.09	13.9		61.09	61.09	5.95	
		say:	73.8		73.8	7.1	80.9		2.7	7.1			61.1	61.1	5.9	

[Remarks] 1) Other railway modernisation works (i.e.track rehabilitation) may be necessary in addition to those indicated above. This item is not included here.
Please refer item 8) of Rehabilitation orks in Table S-2.

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Table S-1 Breakdown of Railway Works

Haldia (H13) Short-term Plan up to 1995

Unit: Million Rupees 1988 prices

No.	Description	Q'ty	Local currency (A)	Local currency Tax (B)	Local currency Total (C)	Foreign currency (D)	Total: Amount (H+L+M) & (C+D)	Labour Fee Un-skilled (F)	Labour Fee Skilled (G)	Labour Fee -do- F.(G')	Labour Fee Total: H F+G+G'	Material/Equipment Imported (J)	Material/Equipment Local (K)	Material/Equipment Total (J+K=L)	etc.	Note
A	General Marshaling Yard															
1)	Track	4,320 m	8.72		8.72	1.08	10.8	1.10	1.02	1.08	3.2		5.4	5.4	2.2	
B	Bulk Handling Yard															
1)	Track	1,440 m	3.24		3.24	0.36	3.6	0.40	0.24	0.36	1.0		1.8	1.8	0.8	
2)	Wagon Pusher	2 line	9.5		9.5	0.5	10.0	0.5	0.5	0.5	1.5		8.0	8.0	0.5	
	Sub-total		12.74		12.74	0.86	13.6	0.9	0.74	0.88	2.5		9.8	9.8	1.3	
C	Sorting Yard															
1)	Track	2,160 m	4.86		4.86	0.54	5.4	0.7	0.36	0.54	1.6		2.7	2.7	1.1	
D	Coking Coal Terminal															
1)	Track	2,300 m					[5.76]									SAIL project
E	Container Loading Terminal															
1)	Track	1,580 m	3.55		3.55	0.4	3.95	0.5	0.3	0.4	1.2		2.0	2.0	0.75	
2)	Crane Rail	720 m	2.27		2.27	0.25	2.52	0.3	0.2	0.25	0.75		1.3	1.3	0.47	
3)	Pavement	10,800 sq.m	3.89		3.89	0.43	4.32	0.5	0.37	0.43	1.3		2.1	2.1	0.82	
	Sub-total		9.71		9.71	1.08	10.79	1.3	0.87	1.08	3.25		5.4	5.4	2.14	
F	Locomotive	3units	69.0		69.0	6.0	75.0	2.0	2.0	6.0	10.0		60.0	60.0	5.0	High powered
G	Work-shop	1 set	5.0		5.0		5.0	0.5	0.5		1.0		3.0	3.0	1.0	
	Total		111.03		111.03	9.58	120.59	6.5	5.49	9.58	21.55		86.3	86.3	12.74	
		say	111.0		111.0	9.6	120.6		5.5	9.6	21.6				12.7	

[Remarks]

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