KOLKATA PORT TRUST

HALDIA DOCK COMPLEX

Tender No.: RFQ/Tender No. GM(Engg.)/T/ 47/2019-2020

MECHANIZATION OF BERTH NO. 3 ON DESIGN, BUILD, FINANCE, OPERATE, TRANSFER ("DBFOT") BASIS AT HALDIA DOCK COMPLEX

♠ ***ADDENDUM-II*** ♠

CORRECTIONS / ADDITIONS / DELETIONS, ETC.

[Total Number of Pages:4]

NOTE:

1. This "Addendum-II" should be read in conjunction with this office above Tender Document.
2. Consequential changes, arising out of this Addendum-II, will be deemed to have been effected, even if the same were not incorporated specifically in the Tender Document.
3. One set of this "Addendum-II", shall have to be submitted along with the Offer (in with each page of it, duly signed and stamped, as token of acceptance.
4. All other terms and conditions of this office above Tender Document will remain unchanged

HALDIA DOCK COMPLEX

♠ ADDENDUM-II ♠

RFQ/Tender No. GM(Engg.)/T/ 47/2019-2020

Terms and conditions:

Sl. No.	Clause No./Ref. No.		Para/Line No./Page No.	As specified in the Tender Document.	To be Read as
1.	**Sl. 1 of Addendum-I** **Last date submission of RFQ Applications**		Page 2 of Addendum-I	Upto 15:00 hrs on 27.08.2019	Upto 15:00 hrs on 12.09.2019
2.	**Sl. 2 of Addendum-I** **Date of opening of RFQ application**		Page 2 of Addendum-I	After 15:30 hrs on 27.08.2019	After 15:30 hrs on 12.09.2019
3.	**Sl. 3 of Addendum-I** **Application due date**		Page- 2 Addendum-I	Upto 15:00 hrs on 27.08.2019	Upto 15:00 hrs on 12.09.2019
4.	**Sl. 4 of Addendum-I** **Date and time opening**		Page- 2 Addendum-I	After 15:30 hrs on 27.08.2019	After 15:30 hrs on 12.09.2019
5.	**(i)**	**----------------**	---------------	Techno-Economic feasibility study report (TEFR)	Techno-Economic feasibility study report (TEFR) is available as Annexure-I.
	(ii)	**----------------**	---------------	DPR	DPR is enclosed as **Annexure-II.**

Sl. No.	Clause No./Ref. No.		Para/Line No./Page No.	As specified in the Tender Document.	To be Read as
	(iii)	**----------------**	---------------	Tamp order	TAMP order enclosed as **Annexure-III.**
	(iv)	**----------------**	---------------	----------	The condition assessment report of IIT Madras with estimate for berth repairing is enclosed as **Annexure-IV.**
	(v)	**----------------**	---------------	------------	Soil data of back-up area of berth no.3 is enclosed as **Annexure-V.**
6.	**3.2.3(C)**		Page 38	The capital cost of the project should be more than Rs.331.94 Crores (Rupees Three thirty one point nine four crores); and	The capital cost of the project should be more than Rs.66.388 Crores (Rupees Sixty Six Point three eight eight Crores) and .
7.	**3.2.4**		Page 38	However, payments / receipts of less than Rs. 331.94 Crores (Rupees Three thirty one point nine Four crores);shall not be reckoned as payments / receipts for Eligible Projects.	However, payments / receipts of less than Rs.66.388 Crores (Rupees Sixty Six Point three eight eight Crores);shall not be reckoned as payments / receipts for Eligible Projects.
8.	**Clause 1.2.8** **Brief description of Bidding Process**		Page-17	Bids will be invited for the Project on the basis of highest premium ("**the Premium"**) in the form of revenue share quoted by a bidder for implementing the project. The concession period shall be pre-determined and will be indicated in the draft Concession Agreement forming part of the Bidding Documents. The Premium amount shall constitute the sole criteria for evaluation of Bids. The Project shall be awarded to the Bidder quoting the highest Premium. In this RFQ, the term "**Highest**	Bids are invited for the Project on the basis of Highest Royalty per MT of cargo handled at the Project Facilities (the "Royalty")]. The rate of Royalty will be indexed to as per the variations in the Wholesale Price Index (WPI) for all commodities announced by the Government of India annually as specified in the draft Concession Agreement. In this RFQ, the term "Highest Bidder" shall mean the Bidder who is [offering the highest royalty per MT of cargo handled at the Project Facilities (the "Royalty").

Sl. No.	Clause No./Ref. No.	Para/Line No./Page No.	As specified in the Tender Document.	To be Read as
			Bidder" shall mean the Bidder who is offering the highest Premium.	
9.	Appendix-I, Annexure-III Footnotes	Page-52 5^{th} Para, 1^{st} line	For conversion of US Dollars to Rupees, the rate of conversion shall be Rs.65.2652 (Rupees sixty five point two six five two) to a US Dollar.	For conversion of US Dollars to Rupees, the rate of conversion shall be Rs.69.4598 (Rupees sixty nine point four five nine eight) to a US Dollar as on 10.06.2019.

Annexure-I

FEASIBILITY STUDY

FOR

"MECHANISATION OF BERTH NO 3 AT HALDIA DOCK COMPLEX"

FINAL REPORT

MARCH 2018

INDIAN PORTS ASSOCIATION

NEW DELHI

CONTENTS

1.

Executive Summary:

1. The proposal relates to Feasibility Study of Mechanisation of Berth No. 3 at Haldia Dock Complex for up-gradation of berth to handle only dry bulk.

2. As per the traffic projections, the port is required to equip itself to handle 24.4 million tonnes of dry bulk cargo by 2020-21 and 29.9 million tonnes by 2025-26.

3. As per planning principles, cargo handling capacity should be at least 20 percent above the projected demand to avoid detention of vessels. The underlying principle is that berth should wait for the ship not vice versa. Since vessels arrive at Random, this spare capacity will address peak seasons also. Accordingly, the supply and demand position is as below:

Particulars	**Capacity (MTPA)**
Dry cargo Handling Capacity as on 31-3-2017	25.0
Capacity addition expected by 2025-26 (OT-1)	5.0
Total Capacity by 2025-26	31.0
Capacity required to handle projected cargo by 2025-26	29.9
Capacity required at 20% more than the traffic	6.0
Total required capacity	35.9
Balance required capacity to be added	4.9

Thus, HDC is required to enhance the capacity to handle dry cargoes present and projected with the capacity addition.

4. According to the lock gate perspective, ship scheduling and the no of vessels that can be handled through the lock gate system becomes a deciding factor in enhancing the capacity of berths in the impounded dock. After taking appropriate measures as being contemplated by port the lock gate system can handle an additional 2 to 3 movements per day thus making it possible to additional vessels due to enhanced capacity of berths in the impounded dock system. Thus, mechanization of berth No 3 is considered viable from this aspect as well.

5. The physical life of berth structure can be enhanced by taking required short and long term maintenance measures systematically. After undertaking repairs as would be recommended in a 'Condition Survey', the berth can be used for another 35 to 40 years. In view of the foregoing, mechanisation of berth 3 is technically feasible to invite prospective developers for investment.

6. For a coal terminal, TAMP guidelines stipulates that the optimum yard capacity is 70% of maximum coal that could pass through the yard. The optimal capacity of the yard is 2.4 Lakh tonnes. The average unloading rate from vessels is 20,000 tonnes per day based on equipment proposed and the vessel parcel size.

Following TAMP Guidelines, the optimal capacity of the berth terminal is calculated as 3.276 million tonnes per annum.

7. The backup area is trapezoidal in shape with a bell mouth like shape at one end. The back-up area considered has a width of 150 m for most part of the length and has a total area of about 1,13,000 Sq. m. Based on conceptual layout of stack yard it will have 2 rows of stockpiles with each having 4 stock piles of 100 m x 50 m and one stock pile of 50m x 50 m. Thus each row of stack yard consists of 5 stock piles. There will be two tracks for the two stacker cum reclaimers and they will operate in between the two rows of stock piles parallel to each other and side by side.

8. It has been proposed to locate the stockyard in the back up area of berth No 3 as earmarked. The coal from stockyard will be evacuated through rail. No lorry loading is permitted to avoid pollution of environment.

9. The proposed mechanization envisages following equipment to enable full scale mechanized system of ship unloading, conveying, stock piling and evacuation by rail.

Equipment	**Quantity**
Gantry Grab unloaders	2 Nos
Elevated Conveyors	780 m
Ground level conveyors	1250 m
Stacker cum Reclaimers	2 Nos
Rapid Wagon Loading System including Silo	1 No
Shunting Loco	1 No
Front end loaders	4 Nos
In-motion Rail weigh bridge	1 No
Workshop Facilities	1 Lot
Elec. Power supply and distribution system	1 Lot
Dust suppression and Firefighting facilities	1 Lot

10. The total capital cost of the project is estimated at Rs. 323.44 Crores. The detailed estimate is attached as Annexure 10.1. The summary break-up of the estimate is given as under:

S.No	**Particulars**	**Cost (Rs. Cr)**
1	Civil works	52.28
2	Mechanical works	218.78
3	Electrical works	12.90
	Sub Total	**283.96**
4 a	Detailed Engineering & Project Supervision @2%	5.68
4 b	Contingencies @ 3%	8.52
4 c	GST @ 18% on Civil works	9.88
4 d	GST on mechanical works (considered as ITC)	
	Total Capital Cost	**308.04**

5	Miscellaneous cost @ 5% of Total Capital cost as per TAMP	15.40
6	**GRAND TOTAL OF CAP-EX**	**323.44**

11. The annual operation and maintenance cost of the proposal is estimated at Rs. 66.28 Crores based on TAMP Guidelines for fixation of up-front tariff.

12. The estimated annual revenue based on tariff assessed as per the upfront tariff guidelines 2008 / Tariff orders is given below:

S.No	**Particulars**	**Unit**	**As per TAMP guidelines**
1	Estimated Throughput	MTPA	3.276
2	Avg Cargo Handling Rate	Rs. Per ton	360.28
3	Estimated Revenue Requirement on Cargo Handling	Rs. Cr	118.03

13. Sensitivity analysis has also been carried out to gauge the impact of increase in cost and reduction of revenue earnings on the viability of the proposal. The results of the analysis are presented below. The detailed Cash flow statement is given at Appendix-13.01.

Table 13.1 (Not considering IDC)

S.No	**Pre-Tax Project IRR**	**IRR (%)**	**NPV @ 12% (Rs. In cr)**
1	Base Case	15.37%	96.48
2	Capital Cost up by 10%	14.16%	65.48
3	Revenue down by 10%	12.87%	23.47
4	Annual O&M Cost up by 10%	14.27%	64.11
5	Combined effect of S.No. 2, 3 & 4	10.57%	(-) 39.90

From the above, it is evident that the FIRR of the Project at base case is 15.37% and in the least case of sensitivity gives 10.57% and hence the project is financially viable for taking up through PPP.

14. The Financial viability and Sensitivity analysis considering IDC is as under. The detailed Cash flow statement is given at Appendix-13.02.

Table 13.2 (Considering IDC)

S.No	**Pre-Tax Project IRR**	**IRR (%)**	**NPV @ 12% (Rs. In cr)**
1	Base Case	14.15%	65.97
2	Capital Cost up by 10%	12.98%	31.92
3	Revenue down by 10%	11.76%	(-) 7.05
4	Annual O&M Cost up by 10%	13.11%	33.60

5	Combined effect of S.No. 2, 3 & 4	9.56%	(-) 73.47

From the above, it is evident that the FIRR of the project at base case is 14.15% and in the least case of sensitivity gives 9.56% and hence the project is financially viable for taking up through PPP even when considering IDC.

15. Although the FIRR is attractive, the Reference Tariff works out to be higher than the Tariff in other berths and terminals in view of availability of less stockyard.

SECTION 1
INTRODUCTION

1.1 Preamble

Government of India, with its stated objective of transforming the existing ports into modern world-class ports, and develop new ports based on the trade requirement has taken up the SAGARMALA PROJECT. Towards this endeavour, a consortium of McKinsey and AECOM were appointed as Consultants to carryout origin destination study as well as prepare a National Perspective Plan by way of preparing a Master plan for all the major ports and further suggest new ports to be developed as required.

The Consultants as part of deliverables of this study developed a Draft Master Plan for Kolkata Port Trust (including Haldia Dock System) in December 2015. In this report the Consultants considered the complexity of lock gate operation for berthing/ un-berthing of vessels and need for segregation of cargo mix to be handled at various berths and optimisation of port facilities. In line with this, they have suggested shifting some of the selected liquid cargoes (cargoes to be identified by the Port) to a new berth to be developed outside the dock basin and utilise dry cargo berths inside the dock for handling dry bulk cargo (cargoes to be identified by the Port) to the extent possible. As part of this strategy they have further recommended mechanization of existing old berth No 3 inside the dock basin.

The recommendation of M/s AECOM is reproduced below-

Quote:

> ***"7.3.1. Mechanising Eastern Berths 2 and 3***: *To start with, the eastern berth 2 & 3 could be mechanised for up-gradation and these berths shall be developed only for handling of dry bulk cargo and all the liquid cargo shall be taken away to berths outside the basin. It is proposed that the initial mechanisation be taken up at berth No.3 which was earlier used for handling iron ore exports. Berth No.2 could continue to handle the cargo using MHC, dumpers and front end loaders."*

Unquote:

In the government's publication "Advantage Maritime India" the project was further defined as depicted below.

15. Project Name: Mechanisation of Berth 3 at Kolkata Port

S.No	Parameters	MIS 2016/ Cat4/ KoPT (Haldia)/4
1	Project Category-	Sagarmala - Port Modernisation
2	Project Proponent	Kolkata Port Trust- Haldia Dock
3	Project Objectives	Presently, Berth 3 is under utilised by handling small parcels of POL along with mix of other cargo, while the land and other infrastructure for handling coal is available.
4	Project Type	PPP
5	Tentative Cost Estimates	INR 150 Crore (USD 23.1 million)
6	Project Details	Berth 3 will be mechanised with two mobile harbour cranes with integrated hoppers, a conveyor system and at stack yard with stacker-reclaimers and wagon loader. With these, the berth may handle 3 MMTPA. It could be further enhanced to 4 to 4.5 MMTPA by reducing the dwell time. Capacity: 4 – 4.5 MMTPA
7	Project Status	KoPT will undertake Feasibility Study shortly.
8	Total Land Requirement	Land is available.

From the above it can be understood that the Sagaramala proposal is mechanize berth 3 with two mobile harbour cranes with integral hoppers, a conveyor system and stack yard with stacker reclaimer and wagon loader to handle 3 MTPA which could be enhanced 4 to 4.5 MTPA later.

In order to *crystallise* this proposal the Port authority has entrusted the work of "Preparation of Techno Economic Feasibility report for MECHANISATION OF BERTH NO 3" of Haldia Dock Complex to The Indian Ports Association.

1.2 Scope of Work

The port authority has defined the scope of work for the study as follows.

1. Identify possible cargoes that can be handled after mechanisation of the berth
2. Assessment of the traffic projections of the identified cargoes at the berth
3. Assessment of total capacity of the project with likely commodity wise distribution of cargo along with number of vessels likely to be handled and parcel size
4. Assessment of land area required for creation of storage facilities, arterial road, aggregation and evacuation facilities and other infrastructure for creation of assessed handling capacity.
5. Preliminary design of the proposed port mechanised facility
6. Estimated cost of the project with break up
7. Economic and financial benefits of the project.

1.3 Meetings and site visits

The IPA has entrusted the work to a team of resource persons and the team has made a preliminary visit to Haldia dock complex on 2nd to 4th May of 2017. During this visit the team has collected the available data relevant to the project and held detailed discussions with the HDC officials. Based on the discussions and analysis of the data collected, a draft report was prepared and submitted in Sept '17. Subsequent to this there were further developments' leading to some rethinking on OT1, and the matter is under review by port. The team made another visit to Haldia from 6th to 10th Jan 2018 and a revised draft was submitted during Feb '18. The draft report was comprehensively reviewed by port and based on their observations this final report is submitted.

1.4 Acknowledgement

IPA wishes to place on record the excellent support rendered by the Dy. Chairman, Heads of departments and other officials of Haldia Dock complex.

SECTION 2

PRESENT SETTING

2.1 Introduction

Kolkata Port, the oldest in India, is located on the east coast on the river Hooghly in the state of West Bengal. It became operational in the year 1870. It was declared as a Major Port under the Major Port Trust Act 1963. Subsequently in 1977, Haldia Dock Complex (HDC) was constructed as a satellite extension to Kolkata Port. The shipping activity at Haldia started with an oil jetty in the year 1968.

Haldia Dock Complex (HDC), an integral part of Kolkata Port Trust is located on the western bank of river Hooghly at Latitude: 22^0 02’ N and Longitude: 88^0 06’ E. It is about 104 km downstream of Kolkata and 130 km upstream from Sand heads. It handles a major share of Kolkata Port traffic. The layout of the HDC is given in the Picture. The details of berthing facilities available at HDC are presented in Table 2.1.

The pilotage distance to Haldia is about 130 km of which 75 km is sea pilotage. Remote pilotage assistance is provided through VTMS during the sea passage and in the channels. For vessels calling at Haldia, the pilot launching is undertaken south of Eden in fair weather and north of Eden during foul weather. For outward passage the same process is used in reverse order.

2.2 Hinterland

The hinterland of Kolkata/Haldia comprises of the entire Eastern India including West Bengal, Bihar, Jharkhand, eastern part of Uttar Pradesh, north east of Madhya Pradesh, Chattisgarh, Assam and other North Eastern States and the two landlocked neighboring countries viz. Nepal and Bhutan. But the primary hinterland consists of West Bengal, Jharkhand and Bihar which have major industries consuming fuel/ raw materials imported through this port. The industrial development, commerce and trade of this vast hinterland is inseparably linked to the life and development of Kolkata/ Haldia Port and vice-versa.

2.3 Connectivity

Haldia dock complex is well connected to the hinterland by road, rail and inland water ways. Haldia is accessible through NH 41 to Kolaghat where it meets NH 16 (old NH5) the Chennai - Kolkata Grand Northern trunk road. The HDC is well connected to South-Eastern railway network.

2.4 Berthing facilities

Haldia is an all-weather port having a 300.2 m long and 39.6 m wide lock gate and a 450 m dia turning basin. The Haldia dock Complex (HDC) consists of 17 berths of with 14 berths are inside the dock and the remaining 3 outside the dock which are all riverine jetties designed for handling liquid cargoes. Presently all dry bulk cargo is handled in berths inside the dock. There are two berths exclusively handling Containers and some berths handle only bulk liquids like edible oils and Paraxylene. The depth inside the impounded dock system at all the berths on an average is 9.5 m. The details of berths such as designed draft, LOA and permissible DWT are presented in the table below:

Table 2.1

Berthing Facilities

Sl. No	Berth No.	Type of Berth/Cargoes normally handled	Design Draft (Mtrs.)	Quay length (Mtrs.)	Maximum Vessel size	
					LOA (Mtrs)	DWT Designed
1	HOJ-I	Liquid Bulk Berth - Handling POL, Liq. Ammonia, LPG & Chemicals	12.2	290	236	90000
2	HOJ-II	Liquid Bulk Berth - Handling POL Crude, POL Product & LPG	12.2	330	277	150000
3	HOJ-III	Liquid Bulk berth - Handling POL Crude and POL Product	12.5	345	275	150000
4	2	Multipurpose Berth for handling Dry Bulk mainly Coke, Coal, Ore & Limestone	10	260	238	75000
5	3	Multipurpose Berth for handling Dry Bulk like coke, Coal, Ore & Limestone along with POL (Product), and Chemicals, mainly Paraxylene	12.2	337	239	75000
6	4	Mechanized Berth for handling Thermal Coal (Loading)	12.2	284	239	75000
7	4A	Mechanized Berth for handling Coking Coal (Unloading) Operated by ISPL	12.2	245	230	75000
8	4B	Multipurpose Berth for handling Dry Bulk & Break Bulk Cargo.	12.2	181	180	75000

9	5	Multipurpose Berth for handling Dry Bulk, Break Bulk & Liquid Bulk Cargo.	12.2	195	183	75000
10	6	Multipurpose Berth for handling Dry Bulk, Break Bulk & Liquid Bulk Cargo.	12.2	234	212	75000
11	7	Multipurpose Berth for handling Dry Bulk, Break Bulk & Liquid Bulk Cargo.	12.2	234	212	75000
12	8	Multipurpose Berth for handling Dry Bulk & Break Bulk Cargo.	12.2	218	220	75000
13	9	Multipurpose Berth for handling General &Dry Bulk cargo	12.2	218	210	75000
14	10	Container Handling	12.2	220	210	75000
15	11		12.2	220	210	75000
16	12	Multipurpose Berth for handling Dry Bulk& general cargo (only clean cargoes)	12.2	220	210	75000
17	13	Multipurpose Berth for handling Dry Bulk, general cargo	10	220	210	75000
Note: Vessels with a maximum beam of 32.3 meters can enter impounded dock						
Source: Administrative Reports of HDC						

2.5 Handling Capacity of HDC:

The handling capacity of a port/berth depends upon the length of berth, the draft, the type of cargo handled, the vessel parcel size etc. Apart from these, the single most important factor that decides the capacity calculations is the type of onshore handling facilities. The usable capacity of Haldia dock complex is assessed as 42.7 million tonnes. Based on the facilities available at various berths inside the Haldia dock complex, the dry cargo handling capacity is presented in the following statement. The assessment appears to be based on available onshore handling facilities and many assumptions.

Table 2.2

Assessed Capacity of Dry bulk cargo handling berths

Berth No	Predominant Cargoes handled	On-shore handling Facilities available	Assessed capacity based on facilities

HOJ I, HOJ II HOJ III	Crude , POL, LPG, Chemicals, and other liquids	Marine unloading arms & pipelines	
2	Coal ,limestone and other bulk	Two MHCs of 100 T capacity	4
3	Formerly an iron ore handling berth. Now caters to paraxylene, SKO, furnace oil, HSD etc.	Pipelines for liquid cargo	
4	Thermal coal (Export through mechanized handling system)	2 - 1500 TPH Wagon Tipplers, 2 Stacker-cum-Reclaimers, 2 -1500 TPH Shuttle Boom type Ship Loaders, 2 - Wagon Feeding Systems 20,000 MT per day.	3.5
4A	Coal (Import through mechanized handling system)- By ISPL	2 - Stacker-cum- Reclaimers, 2 Wagon Loaders, 2 - Mechanized Grab un-loaders	3.5
4B	Dry Bulk Cargo	2 MHC's at 20,000 TPD	4
5	Liquid bulk cargo	Pipelines	
6&7	Phosphoric acid Sulphuric acid etc.	Pipeline and floating oil jetty	
8	primarily dry bulk cargo	2 No MHC's @20,000 TPD	4
9	Dry and break bulk cargo	two MHC's@20,000 MTPD	
10&11	Container cargo	2 No RMQC and other associated equipment	
12	Dry bulk as well as break bulk - Operated by TMIL	Ship cranes and one MHC	2
13	Clean dry bulk and break bulk	TWO MHC capacity 100 tonne (recently commissioned)	4
	Total dry bulk handling capacity (For all dry bulk cargoes put together such as coal, Limestone, Manganese ore, Sugar, Iron ore, Fertilizer, Fertilizer raw material etc.		25
Compiled from data given by Port.			

A Picture of Haldia dock complex along with riverine jetties

SECTION 3

PRESENT TRAFFIC & PERFORMANCE

3.1 Traffic handled by Haldia Dock Complex vis-a-vis other major ports:

Haldia Dock Complex handled about 34.14 million tonnes of cargo during 2016-17 and registered a CAGR of 5 percent compared to 2014-15 in which the traffic handled was 31.01 million tonnes. The share of traffic handled by HDC constitutes 5.3 percent in the total traffic handled by all major ports put together. The table below shows the comparative total traffic of all the major ports during the last three years

Table 3.1

Traffic Handled by the Major Ports during last 3 years in Million tonnes

S.No	Port	2014-15	2015-16	2016-17
1	Kolkata	15.28	16.782	16.173
1a	Haldia Dock Complex	31.01	33.507	34.141
2	Paradip	71.011	76.386	88.955
3	Visakhapatnam	58.004	57.033	61.02
4	Kamarajar (Ennore)	30.251	32.206	30.02
5	Chennai	52.541	50.058	50.214
6	VOC (Tuticorin)	32.414	36.849	38.463
7	Cochin	21.595	22.098	25.007
8	New Mangalore	36.566	35.582	39.945
9	Mormugao	14.711	20.776	33.179
10	Mumbai	61.66	61.11	63.049
11	JNPT	63.802	64.027	62.025
12	Kandla	92.497	100.051	105.442
	Total	581.344	606.465	647.633

Source:IPA

3.2 Composition of traffic.

Haldia Dock is a predominantly dry bulk handling port. During 2015-16 dry bulk constituted 57 percent of the total traffic followed by liquid cargo with 37 percent. The share of break bulk cargo including containers was 6 percent. Coal is the predominant dry bulk cargo constituting 71 percent of total dry bulk cargo.

Similarly during 2016-17 dry bulk cargo constituted 58% of total traffic and liquid bulk 32%.

Import traffic constituted 86 percent of the total traffic in 2015-16. The major commodity wise traffic handled in Haldia during the last 5 years with breakup of Imports and Exports is presented in the table below.

Table 3.2

Major Commodity-wise Traffic handled during last 5 years- In Million tons

S.No	Cargo	2012-13	2013-14	2014-15	2015-16	2016-17
A	IMPORTS					
a	LIQUID CARGO					
1	POL crude and products	2.94	2.73	2.31	3.73	3.47
2	LPG	1.4	1.53	1.91	2.01	2.02
3	Palmoleon oil	1.04	0.99	1.19	1.45	1.39
4	Paraxylene, Liquid ammonia, Sulphuric acid, soya oil etc	1.86	2.14	2.54	2.64	2.73
Total Liquid Cargo		7.24	7.39	7.95	9.83	9.61
b	DRY BULK CARGO					
1	Manganese ore and slag	1.25	0.95	1.58	1.24	0.95
2	Fert.andFert.raw materials	0.35	0.53	0.69	0.48	0.38
3	Coking Coal	4.5	5.35	6	5.72	5.52
4	Non coking coal	2.25	2.65	3.87	4.61	3.99
5	Non coking coal(Trans loading)	-	0.2	0.51	1.82	0.59
6	Pet coke and m.coke	0.92	0.57	0.62	0.81	0.49
7	Cement clinker	0.16	0.05	-	0.2	0.72
8	Lime stone	1.23	1.29	1.4	1.51	1.97

9	Iron ore	0.08		1.9	0.82	-
10	sugar	0.36	0.3	0.05		0.46
11	Others	0.08	0.22	0.27	0.24	1.36
Total dry bulk cargo		11.18	12.11	16.9	17.47	15.71
c	BREAK BULK CARGO					
1	Steel	0.25	0.13	0.42	0.59	0.19
2	Fert. -bagged	0.05	0.03	0.11	0.15	0.12
3	Machinery	0.16	0.07			0.01
4	Others	0.01		0.03		0.02
Total break bulk		0.47	0.23	0.56	0.77	0.34
Container cargo including tare weight		1.66	0.98	1.02	0.78	1.23
TOTAL IMPORTS		20.55	20.71	26.43	28.84	26.89
EXPORTS						
a	LIQUID CARGO					
1	POL Products	1.86	1.84	1.31	1.34	1.30
2	Other liquids	0.24	0.25	0.16	0.35	0.23
Total liquid cargo		2.1	2.09	1.47	1.69	1.53
b	DRY BULK CARGO					
1	Iron ore	1.63	2.17	0.43	0.05	1.16
2	Thermal coal	1.98	1.6	1.19	1.55	1.82
3	Pig iron ,Fly Ash and sugar,	0.1	0.11	0.03	0.05	0.14
	TOTAL DRY BULK CARGO	3.71	3.88	1.65	1.65	3.12
c	General Cargo					
1	Steel	0.17	0.14	0.03	0.09	0.52
Total break bulk		0.17	0.14	0.03	0.09	0.55
d	Container cargo incl. tare weight	1.21	1.25	0.94	0.6	1.23
TOTAL EXPORTS		7.19	7.36	4.09	4.03	7.25
IWAI TRAFFIC		0.34	0.44	0.49	0.64	0.81
GRAND TOTAL		**28.08**	**28.51**	**31.01**	**33.51**	**34.14**

Source: Administrative Reports of HDC

3.3 Export/Import - Overseas / Coastal traffic

The share of imports in the overall traffic which was about 86 percent in 2015-16 has changed to 79% in 2016-17 shown in the table below

Table 3.3

Overseas and Coastal Traffic Distribution in Million tonnes and Percentage

	2016-17			2015-16		
	Overseas	**Coastal**	**Total**	**Overseas**	**Coastal**	**Total**
Exports	4.25	3.01	7.26 21%	2.19	2.48	4.67 (14%)
Imports	23.69	3.19	26.88 79%	25.29	3.55	28.84 86%
Total	27.94	6.20	34.14	27.48	6.03	33.51

The share of coastal traffic was 18% in 2015-16 whereas in 2016-17 it was 18.16% which shows that the trend remains the same. The coastal export traffic from Haldia is mainly thermal coal for power plants of Tamilnadu electricity board and the overseas exports is mainly container cargo.

3.4 Performance Indicators

The performance of vessels sailed from HDC in terms of OSBD (output per ship berth day), TRT (turn round time) and PBD (Pre berthing detention) for different commodity groups for the year 2015-16 compared to 2012-13 is presented in the table below. It is seen from the table that the average output per ship berth day increased from**6078** tonnes in 2012-13to **7806** tonnes in 2015-16, registering a CAGR of 8.7 percent over 2012-13.

Table 3.4

Efficiency Parameters Of Vessels calling at Haldia Port

indicator	Dry bulk (mech)		Dry bulk(conv)		Break bulk		Container		Liquid bulk	
	15-16	12-13	15-16	12-13	15-16	12-13	15-16	12-13	15-16	12-13
No.vessels sailed	170	220	544	443	70	89	223	333	1019	858
Average parcel size(t)	25908	24188	22900	20857	11201	7295	6092	8650	11080.00	10620
Average pre berthing detention	2.22	1.2	0.74	2.85	0..60	3.51	0.28	0.69	0.44	2.78
Average TRT(days)	3.21	3.79	5.1	5.88	7.66	7.44	1.51	2.2	2.38	3.3
Output per	13458	9355	7261	5459	2072	1447	8996	5932	8626	7118

berth day(t)										
Percentage of NWT to the total working time	16.32	47.6	13.64	35.5	14.22	30.09	24.8	40.84	13.98	47.45
Percentage of idle time at stay at berth	37.64	39.08	34.39	35.17	33.44	35.27	47.8	33.6	38.81	40.61

3.5. Berth Occupancy:

Table 3.5

Berth Occupancy During the Last Three Years

Berth No	Berth occupancy in percentage			Berth-wise Traffic in Million Tonnes		
	2012-13	2014-15	2015-16	2012-13	2014-15	2015-16
HOJ-I	78.87	78.27	81.9	1.90	2.12	1.94
HOJ- II	71.00	67.28	69.4	2.56	2.70	2.84
HOJ-III	17.44	8.61	31.6	1.46	0.69	2.33
2	46.45	85.98	86.4	1.58	1.68	1.82
3	65.58	49.02	83.6	1.4	1.11	1.62
4	65.32	33.75	59.6	1.95	1.19	1.77
4A	62.23	65.99	70.71	2.75	3.13	2.84
4B	85.75	76.69	83.74	1.84	4.33	4.49
5	95.35	89.88	94.24	1.68	1.43	1.32
6	79.22	84.06	85.01	1.31	1.6	1.38
7	77.18	82.32	80.08	1.19	1.3	1.12
8	37.72	83.78	88.02	1.19	1.59	1.73
9	96.02	98.16	90.49	1.95	2.47	1.35
10	61.41	18.9	19.7	1.3	0.46	0.35
11	71.3	45.55	41.21	1.5	1.54	1.04
12	70.65	62.07	80.52	0.73	0.87	1.33
13	75.11	83.75	92.6	1.21	1.58	1.53
Barge jetty IWAI jetty	etc.,			0.58	1.22	2.71
Total				**28.08**	**31.01**	**33.51**

Source: Appendix 1 and Appendix 8 of Administration reports for respective years

As can be seen from the above, the volume of traffic handled at the berths is showing an increasing trend YOY. The occupancy of berths is more than the prescribed norms, particularly in case of dry cargo handling berths. Higher berth occupancies, however cannot be taken as yard stick for justifying additional berths and there is a need to further analyse the performance in terms of productivity, idle time and effective working time etc.

3.6 Efficiency parameters for dry cargo

Since the present proposal is aimed at analysing the need for additional infrastructural facilities for dry cargo by way of mechanization of berth no 3, the performance analysis in the succeeding paras will be limited to dry bulk cargoes.

The table given below presents the details:

Table 3.6

Efficiency Parameters for Dry Bulk Cargo

commodity	Output per ship berthday(tonnes)			Av.PBD(days)			Av.TRT(days)		
	15-16	14-15	13-14	15-16	14-15	13-14	15-16	14-15	13-14
Coking coal	12207	10924	10129	1.98	1.38	1.4	3.71	3.61	4.03
Non-coking coal	8312	6961	6167	0.8	1.48	1.87	4.72	4.75	4.83
Thermal coal	13930	9495	8249	0.33	0.55	0.81	2.91	3.03	3.33
Iron ore	7468	6709	6090	0.72	2.07	3.79	5.1	5.45	5.71
Coke	5633	5074	4458	0.51	2.11	3.29	5.38	5.05	6.3
Rock phosphate and sulphur	2723	3071	2667	0.83	2	3.6	7.72	7.34	7.4
Fertilisers	1234	2190	1599	1	1.14	10.8	19.8	10.5	14.7
Lime stone	5522	5449	5642	0.7	2.02	2.38	6.21	5.93	6.1
Manganese ore and slag	6156	4954	4096	0.74	2.05	3.07	5.24	5.79	6.4
Steel	4037	3027	2883	0.5	1.48	2.44	4.21	4.4	5.8

It may be seen from the table that the output per ship berth day and Av. Turn round time registered significant improvement in case of Coal and steel. This is mainly on account of deployment of Harbour mobile cranes. The turn round time would have been much better, had there been no or minimum post completion delays after completion of work. Further analysis reveals that about 40 to 50 percent of the total stay in the port is either on account of pre berthing delays or on account of post completion delays**. In fact the post completion delay, due to limitations in the navigational channel is the main reason for congestion and has a cascading effect on the vessels at anchorage.**

3.7 Idle time/eff working time for dry cargoes

Table below presents such details.

Table 3.7									
Commodity wise Ave. Idle time and Ave. Effective working time per Vessel									
Commodity	**Avg. Idle time(days)**			**Avg. Eff working time(days)**			**Percentage of eff working time to the total TRT**		
	15-16	14-15	13-14	15-16	14-15	13-14	15-16	14-15	13-14
Coking coal	1.05	0.9	1.04	1.88	1.73	1.82	50.7	48	45.2
Non-coking coal	1.5	1.1	1.12	2.33	2.33	2.4	49.4	49	49.6
Thermal coal	1	1.06	1.01	1.24	1.35	1.62	42.7	44.6	48.6
Iron ore	1.2	1.22	2.31	2.97	2.24	2.03	58.7	41.1	35.6
Coke	1.67	1.1	1.47	2.87	2.61	3.18	53.3	51.7	50.5
Rock phosphate and sulphur	2.1	1.77	1.88	4.72	3.58	3.72	61.1	48.8	50.3
Fertilisers	5.2	2.95	3.2	13.69	6.61	8	69.3	62.9	54.4
Lime stone	1.5	1.1	1.45	3.74	3.22	3.1	60.2	54.3	50.8
Manganese ore and slag	1.22	1.3	1.5	2.98	2.88	3.32	56.9	49.7	51.5
Steel	1.4	1.25	2.2	2.26	2.72	2.36	53.75	61.4	40.6

3.8 Traffic handled during the first 9 months of 2017-18

During the first nine months of the current financial year i.e. from April to December 2017-18 the port has registered a throughput of 29.234 Million tons which is an impressive 17.67% increase over the corresponding period the previous year. The following statement illustrates the breakup of traffic handled during Apr-Dec 2017-18 with comparative figures during Apr-Dec 2016-17.

Table 3.8												
Traffic handled in HDC in April - Dec 2017-18 vis a vis same period Previous Year (in ,000)												
Period	Liquid Cargo		Iron Ore	Fertilizers		Coal		Containers		Misc.Cargo	TOTAL	% Variation
	POL(Crude ,Products, LPG,LNG)	Other Liquids	Pellets	Finish	Raw	**Thermal &Steam**	**Coking & Others)**	Tons	TEUs			Against 2016-17
Apr-Dec 2017	6011	3777	1295	316	228	**1515**	**8704**	2016	117	5372	29234	**17.67**
Apr-Dec 2016	4758	3302	569	138	211	**1210**	**8692**	1242	89	4722	24844	

From the statement it can be seen that the impressive increase in throughput is contributed by all the cargoes across the board and more importantly by containers, POL and in a lesser way by dry bulk and other cargoes.

SECTION 4

DRY BULK -TRAFFIC FORECAST

4.1 Past Traffic:

The Haldia Dock Complex handled 34.14 million metric tonnes of cargo during the last financial year 2016-17. Earlier the traffic at HDC was declining gradually from a maximum 42.34 million tonnes in 2005-06 to a minimum of 28.08 million tonnes in 2012-13. Thereafter the trend is one of raising traffic gradually year by year from 2013-14 to 2016-17. During the current year i.e. 2017-18 the same trend continues. As was seen in the previous section, the traffic during the first nine months of 2017-18 is an impressive 16% plus over the corresponding period the previous year. The traffic handled at Haldia Port during last 12 years under three broad categories namely coal, POL and other cargo is depicted in Figure 4.1 hereunder.

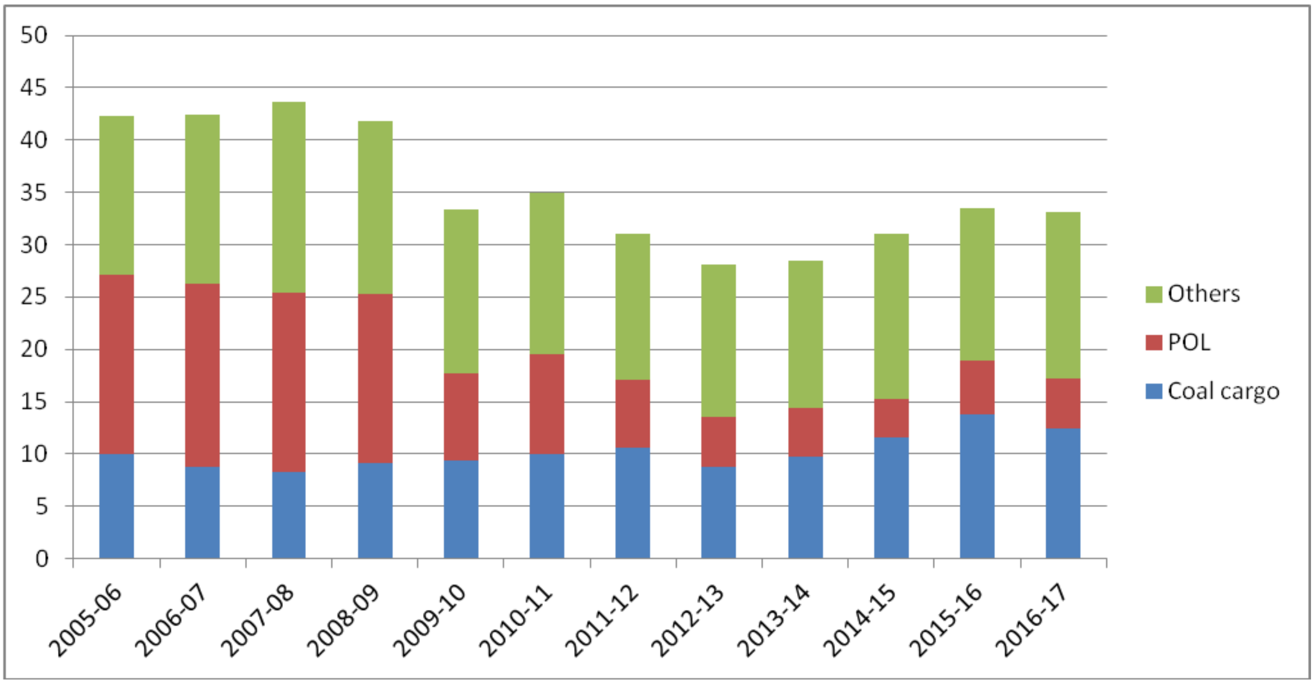


Figure 4.1: Traffic handled at HDC for past 12 years

The decline in traffic till 2012-13 was due to the reduction in handling of POL (due to diversion of crude to SBM in Paradeep) and due to ban on export of iron ore on account of environmental/ mining issues). This apart the reduction of draft in the river resulting in smaller vessels/ vessel with smaller parcel size calling at Haldia Port was also a factor.

The reduction of traffic is also attributable to the two competing ports namely Paradip and Dhamra taking away Haldia Dock traffic as they have deeper drafts.

Coal traffic is the single largest commodity for Haldia Port due to its geographical location where there is a large and well established manufacturing industrial base. From the chart above it can be seen that coal traffic (Thermal/ Coking Coal, Non Coking Coal and Cokes) constitutes about 25% to 30% of total traffic handled at Haldia Port in the last 12 years.

4.2 Hinterland of Kolkata/Haldia

Kolkata/ Haldia have a vast hinterland, comprising the entire Eastern India including West Bengal, Bihar, Jharkhand, eastern part of Uttar Pradesh, north east of Madhya Pradesh, Chattisgarh, Assam and other North Eastern States and the two landlocked neighboring countries viz. Nepal and Bhutan. But the primary hinterland consists of West Bengal, Jharkhand and Bihar which have major industries consuming fuel/ raw materials imported through this port. The industrial development, commerce and trade of this vast hinterland are inseparably linked to the life and development of Kolkata/ Haldia Port and vice-versa. The hinterland of Kolkata / Haldia is marked in the Figure 4.2 given hereunder.

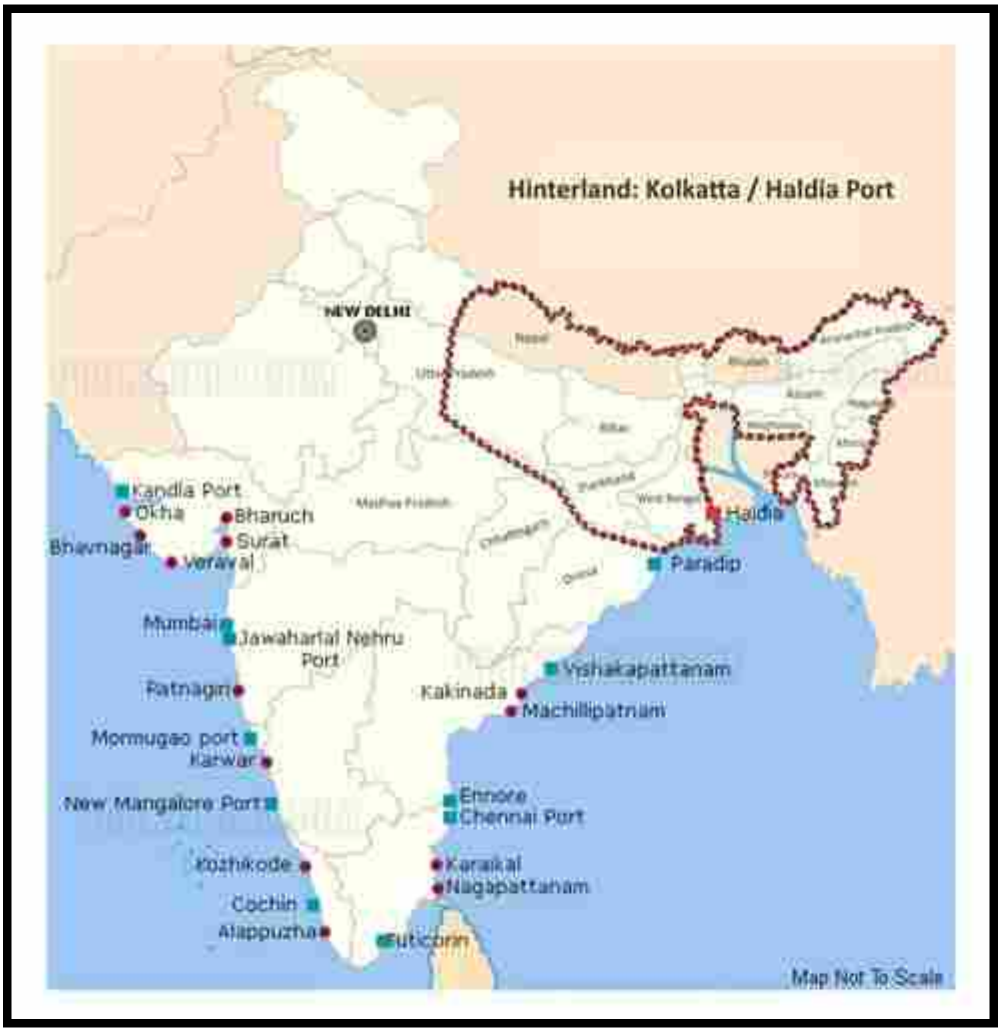


Figure 4.2 : Hinterland of Kolkata/Haldia

4.3 Traffic Study limited to Dry Bulk Cargoes

Since the present study relates to mechanisation of dry bulk cargo, the projections for traffic was limited to dry cargoes.

The dry cargo traffic handled by Haldia port during 2015-16 was 19.98 million tonnes constituting about 60 percent of the total traffic. Of this import dry cargo is 18.24 million tonnes. Import of coking coal and non-coking coal (12.2mt) constituted about 67 percent of import dry cargo. Before arriving at projections, it is relevant to discuss the profile of related industries.

4.4 Power Plants & Steel Industries around Haldia:

Thermal coal/ Steam Coal is mainly used in power generation. The other use of thermal coal is in the steel industry where it is used as a fuel for the blast furnace, either for production of metallurgical coke or for injection with the hot blast. As thermal coal has higher ash content, it is also used in cement, fertilizer, glass, ceramic, paper, and chemical industries. Steam coals are mainly used like brick making industry,coke oven, domestic use etc.

The requirement of coal for thermal power plants in India is met by two sources- domestic coal mining within India and import mainly from Indonesia, South Africa and Australia. Despite the hue and cry of environmental concerns, which course have some strength, various other parameters that have still kept coal as one of the most important sources of energy for power generation in thermal power plants is the huge demand for from the country's needs for the bludgeoning population and the its availability in abundance.

Like any part of India, Eastern Region (West Bengal, Jharkhand, Bihar, and Orissa) and north Eastern Region too are facing power shortage and will need more power plants to meet the power requirements. These are located around the Port of Kolkata/ Haldia Docks. Based on logistics they can be met either from Haldia Docks or neighboring Ports such as Paradip and Dhamra. In-spite of the advantage of deep drafts in Paradip and Dhamra Ports, Haldia still commands a sizeable customer base due to its strategic location of being close to the industries. Therefore, port facilities for coal handling at Haldia docks will always attract sizeable amount of imported coal traffic.

The following major steel industries, power plants and cement industries located in the region around Kolkata/ Haldia which need coal for the functioning of the plants-

- Tata Iron & Steel Manufacturing Co, Jamshedpur, Jharkhand
- SAIL's Bokaro Steel Plant, Bokaro, Jharkhand
- SAIL's Durgapur Steel Plant, West Bengal
- IISCO Steel Plant, Burnpur, West Bengal
- Electro steel Steel Plant, Bokaro, Jharkhand
- SAIL's Rourkela Steel Plant, North Orissa
- Electro steel Casting Ltd, Haldia, West Bengal
- Usha Martin Wire Ropes, Jamshedpur, Jharkhand
- Usha Martin Wire Ropes, Ranchi, Jharkhand
- Tata Metallic Limited (pig iron), Kharagpur, West Bengal
- Bengal Energy Ltd (Power plant & iron), Midnapur, West Bengal
- Jay Balaji Industries Ltd, Kolkata, West Bengal
- Jindal Steel, Howrah, West Bengal
- Super Smelters Ltd
- SPS Steel, Kolkata, West Bengal
- Hooghly Steel, Kolkata, West Bengal
- Suryam Steel, Kolkata,West Bengal
- Burnpur Cement, Asangaon, West Bengal

- Bansal Cement, Kharagpur, West Bengal
- Cement Manufacturing Co Ltd, Alipore, West Bengal
- Atibir Industries Co. Ltd
- Haldia Energy Limited-CESC Group (2 x 300 MW), Haldia West Bengal
- NTPC Farakka Super Thermal Power Plant (2100 MW),West Bengal
- KolaghatThermal Power Plant (1260 MW), East Midnapur, West Bengal
- Bakreshwar Thermal power Plant (1050 MW), Birbhum, West Bengal
- Durgapur Thermal Power Station (1000 MW), Durgapur, West Bengal
- Sagardighi Thermal power Plant (600 MW), Murshidabad, West Bengal
- Titagarh Thermal power Station (240 MW), Titagarh, West Bengal
- CESC Southern Generating station (135 MW), Kolkata, West Bengal

Some of the above power plants presently use domestic coal as fuel and others use imported coal for power generation based on total cost of operation (TCO), Gross Caloric Value (GCV), preferred ash contents, moisture contents as dictated by the design of these plants.

Though imported coal has cost advantage over domestic coal, resulting in use of imported coals by the power plants, the recent decision/ policy (Make in India) by Govt. of India is for encouraging use of domestic coal. But this will have to be tested in coming years based on volume of domestic coal production, cost of production and logistics cost to power plant operators. As on date, imported coal with 5500 GCV (Ex Indonesia) cost USD 36/ ton and freight USD 8/ ton. The cargo related charges at East Coast of India is about Rs 480/- per ton.

The total capacity of thermal power plants in West Bengal is approx. 14,540 MW as given hereunder:

Name of Power Plant	**Operator**	**Location/ Dist.**	**Capacity**
Kolaghat Thermal Power Station	WBPDCL	Mecheda, East Madinapur	1260 MW
Bakreshwar Thermal Power Station	WBPDCL	Suri, Birbhum	1050 MW
Bandel Thermal Power Station	WBPDCL	Hooghly	450 MW
Santaldih Thermal Power Station	WBPDCL	Purulia	500 MW
Sagardigi Thermal Power Station	WBPDCL	Murshidabad	1100 MW
Durgapur Thermal Power Plant	DVC	Durgapur (Burdwan)	350 MW
Farakka Super Thermal Power Station(Coal from ECL)	NTPC	Nagarun, Murshidabad	2100 MW

Name of Power Plant	**Operator**	**Location/ Dist.**	**Capacity**
Mejia Thermal Power Station	DVC	Durlabhpur, Bankura	2340 MW
Budge Budge Thermal Power Plant	CESC	Achipur, South 24 Paraganas	1225 MW
Titagarh Thermal Power Station	CESC	North 24 Paraganas	240 MW
CESC Southern Generating Station	CESC	Garden Reach, Kolkata	135 MW
Haldia Energy Ltd Power Plant	CESC	BaneshwarHaldia	600 MW
NSPCL Durgapur Plant	NTPC-SAIL JV	Durgapur	120 MW
Katwa Super Thermal Power Station (Under Construction)	NTPC	Katwa, PurbaBardhman	1320MW
New Cossipore Thermal Power Station	CESC	Kolkata	100 MW
Raghunathpur Thermal Power Station (Not fully Operation)	DVC/ Nayveli	Raghunathpur, Purulia	1200MW
India Power Corporation (Haldia) Ltd (Operation by end of 2017	IPCL	Haldia	450 MW
Total			14,540MW

Source:WBPDCL: West Bengal Power Distribution Co. Ltd, DVC: Damodar Valley Corporation, CESC: Calcutta Electric Supply Corporation (RP-Sanjiv Goenka Group), IPCL: India Power Corporation Limited

In addition to above mentioned major industries, there are many small industries/ foundries which need non coking coal. The requirement of coal for these small industries are met by the coal traders like Agarwal Coal Corporation, Coastal Energy Ltd, Saraogi Udyog P Ltd etc. These traders work on very thin margins, hence choose to use ports with least TCO (total cost overall) which includes demurrage on vessels arising out of port congestion. There are other coal traders like Bhatia Coal, Gupta Coal., who are also keen to develop customer base in West Bengal/ Jharkhand but are unable to take final call due to long vessel waiting time at Haldia Docks.

4.5: Methodology Adopted:

The traffic is analyzed on the basis of traffic growth in past (CAGR ranging from 6 years to 12 years based on cargo statistics available) up to FY 2016-17 and drawing the trend in future with application of correction based on the inputs provided by the major Customers using Haldia Port. In this connection the decision taken by government of India on encouragement to use of domestic coal over imported coal are duly taken note of. The coal cargoes have been divided in following five broad categories based on their suitability to be handled at Haldia.

1. Thermal Coal (loading) - TNEB cargo from domestic mines
2. Non coking coal/ Thermal coal import through trans-loader facility at Sagar
3. Other Non- coking coal import discharge at Haldia Port's berths (Excl trans-loading cargo at Sagar and coal loading)
4. Coking coal discharge at Haldia Port's berths
5. Cokes discharge at Haldia Port's berths

The volume of coal handled during last six years for above mentioned five categories of coal is given in Table 4.1 hereunder

Table 4.1

VOLUME OF COAL HANDLED DURING PAST SIX YEARS - in Million Tonnes

Financial Year	Thermal Coal (coastal export)	Non - coking coal (Trans-loading)	Non - coking coal (Others)	Coking Coal	Coke	Total
2011 - 12	2.35	0.00	3.27	4.94	0.27	10.83
2012 - 13	1.98	0.00	2.25	4.50	0.93	9.66
2013 - 14	1.60	0.20	2.64	5.35	0.58	10.37
2014 - 15	1.24	0.51	3.87	6.00	0.62	12.24
2015 - 16	1.55	1.82	4.61	5.72	0.81	14.51
2016 - 17	1.82	0.60	4.02	5.49	0.49	12.42

4.6 Traffic Forecast for Coal and Coke – Based on Past trends

4.6.1 Thermal Coal (Loading Cargo):

Thermal coal being brought from domestic coal mines (Raniganj) by rail for loading into ship at Berth No. 4 for shipment to Tuticorin Port as coastal cargo for use by Tamil Nadu Electricity Board Power Plant at Tuticorin.

The volume is low but is picking up slowly. In view of Govt. of India initiative to use domestic coal instead of imported coal, coastal volume will rise in coming years and will gradually rise to 3 million tones which can be handled at Berth No. 4 itself. However this volume will be shown separately to know total coal volume at Haldia Port.

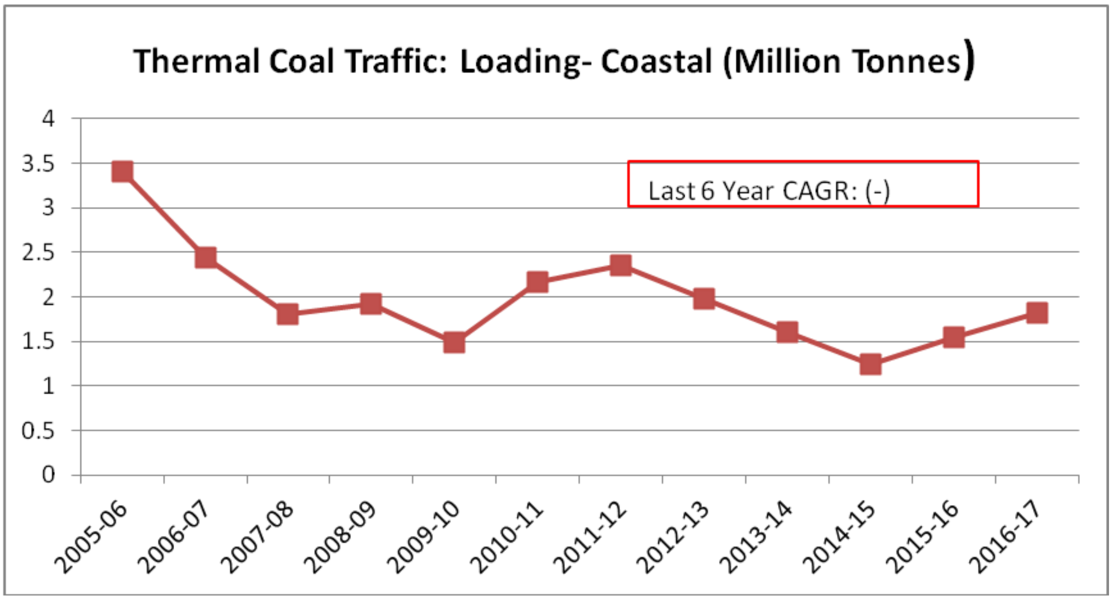


Figure 4.3

4.6.2 Non Coking Coal (Trans-loading Cargo):

Non coking coal/Thermal coal (import) handled from Sagar area by NTPC for its Farakka Thermal Power Plant does not come to HDC at any berth. This traffic shall not be taken into account for arriving at traffic to be handled at Haldia as this cargo moves through barges to Farakka after discharge in mid-stream. However this volume will be shown separately.

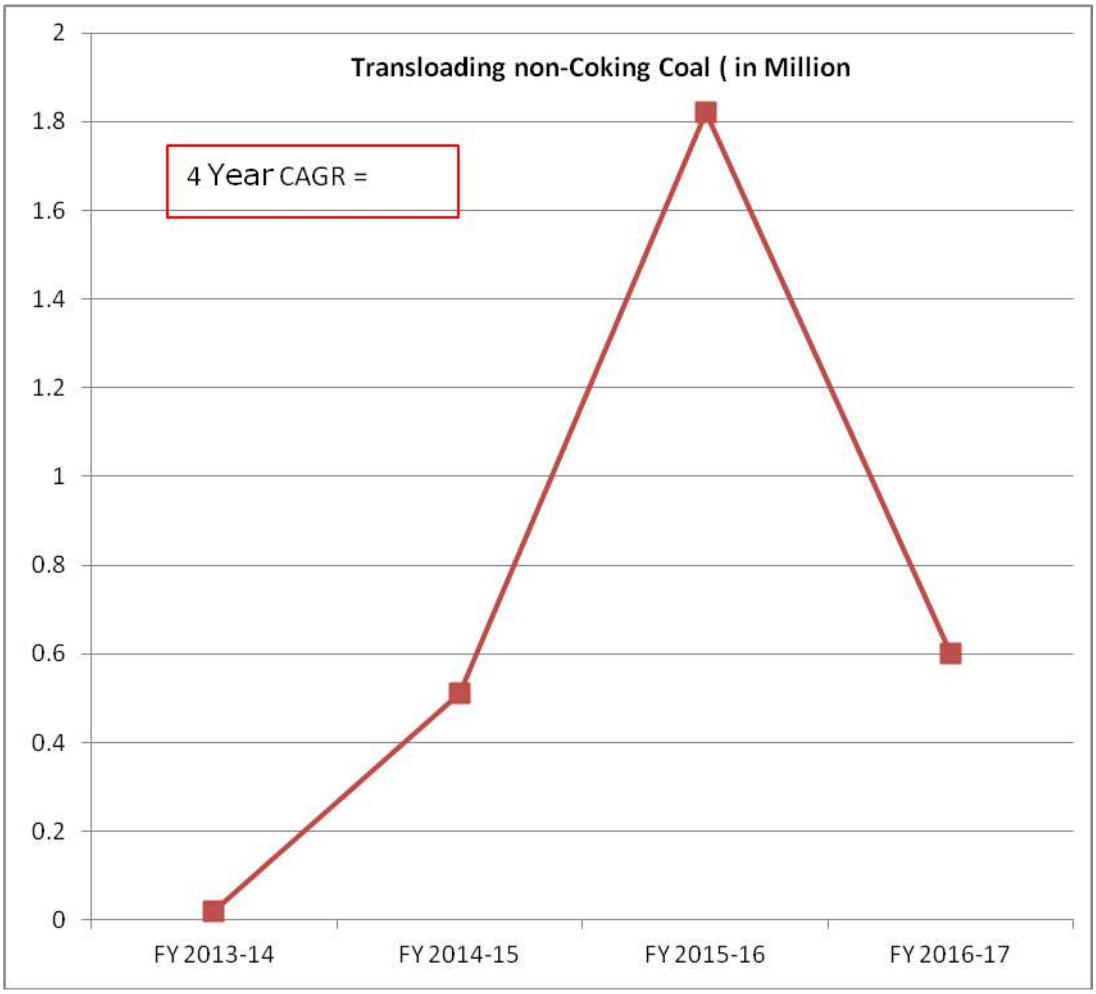


Figure 4.4

4.6.3 Other Non-Coking Coal (Import Cargo):

The growth trend of other non-coking coal handled in HDC for the last 6 years is depicted below.

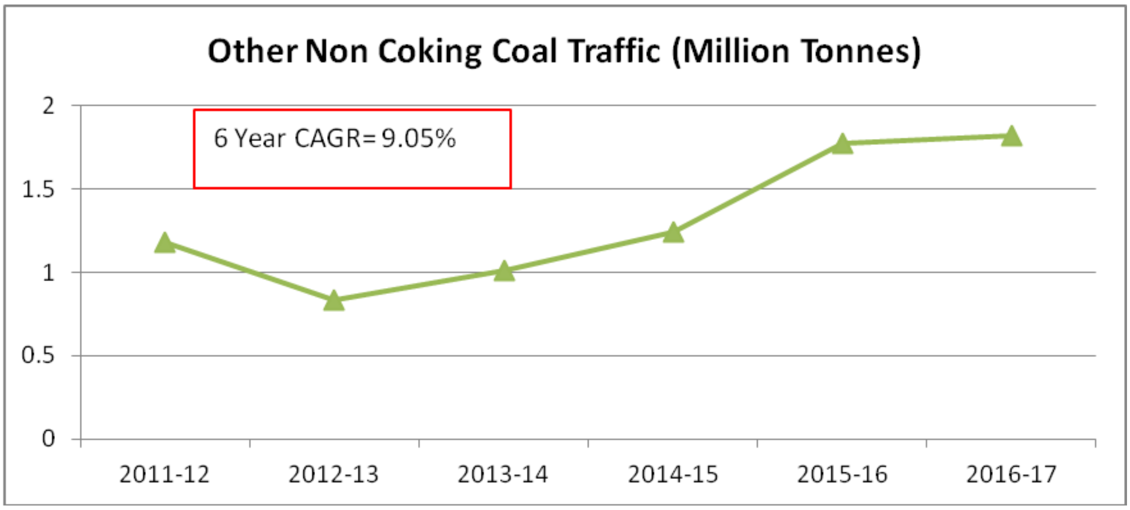


Figure 4.5

4.6.4. Coking Coal (Import Cargo):

Coking coal is primarily used in steel industry. In 2016, the world crude steel production reached 1628 million tonnes (mt) and showed a growth of 0.8% over 2015. China remained world's largest crude steel producer in 2016 (808 mt) followed by Japan (105 mt), India (96 mt) and the USA (79 mt). The per capita consumption of finished steel in 2015 is placed at 208 kg for world and 489 kg for China by World Steel Association.

World Steel Association has projected Indian steel demand to grow by 5.4% in 2016 and by 5.7% in 2017 while globally, steel demand has been projected to grow by 0.2% in 2016 and by 0.5% in 2017. Chinese steel use is projected to decline in both these years.

Crude steel capacity was 121.97 mt in 2015-16, up by 11% over 2014-15 and India, which emerged as the 3rd largest producer of crude steel in the world in 2015 as per ranking released by the World Steel Association, has to its credit, the capability to produce a variety of grades and that too, of international quality standards. The country is expected to become the 2nd largest producer of crude steel in the world soon. As per the New Steel Policy 2017 India aspires to achieve 300MT of steel-making capacity by 2030. This would translate into additional investment of Rs.10 lakh Crore by 2030-31. New Steel Policy seeks to increase per capita steel consumption to the level of 160 Kgs by 2030 from existing level of around 60 Kg.

The crude steel capacity may reach 150 MT by 2020 requiring 110MT of Coking coal. Thus the total coking coal imports by 2020 are expected to be of the order of 70 MT.

Coking Coal or Metallurgical coal to be used in manufacturing steel should have carbon to be as volatile-free and as ash-free as possible. Coking coal is also heated to produce coke, a hard porous material which is then used to blast in furnaces in steel plants for the extraction of iron from the iron ore.

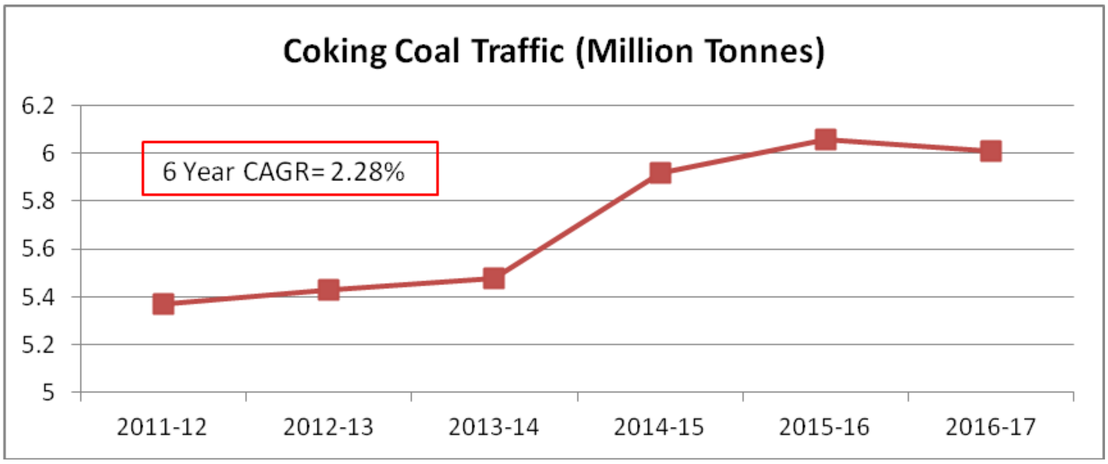


Figure 4.6

The figure above shows the trend in coking coal imports.

4.6.5 Cokes (Import Cargo):

Various types of cokes (RP Coke, Nut Coke, and Met Coke) handled at various berths inside HDC or to be handled at floating barge jetty will be taken into account for arriving at traffic to be handled. These cokes are used in iron & steel industries. Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace. As seen from traffic trend from FY 2011-12 to 2015-16, the coke traffic has risen considerably in last six years showing CAGR of 11.84%.

The trend in coke traffic for last 6 years at HDC is shown in Figure 4.7 hereunder.

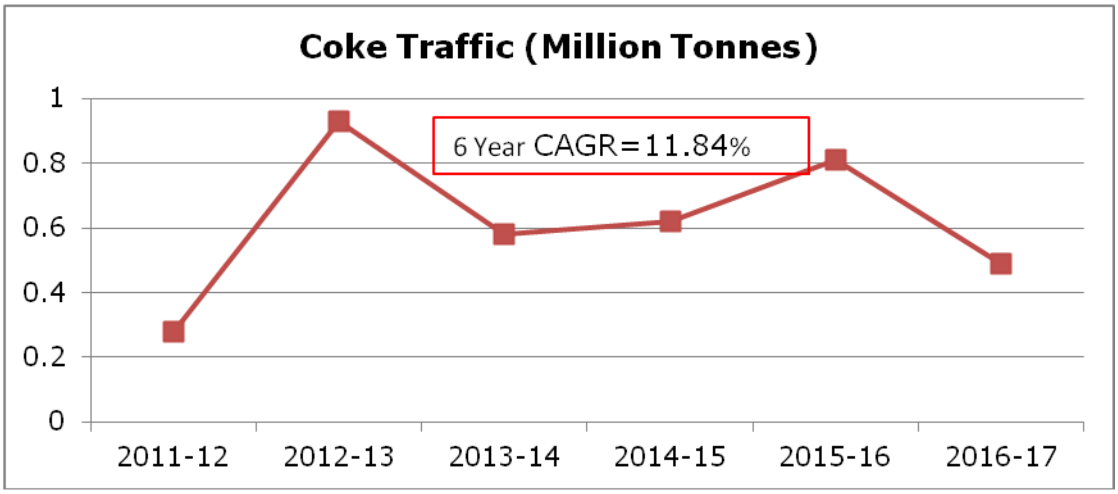


Figure 4.7

4.6.6 Coal Traffic Projection Based on Trend (CAGR Based):

The traffic projection for coal imported coal traffic at HDC based on CAGR trend is presented in the following Table 4.2.

Table 4.2

Traffic Projectionsfor Coal based on CAGR Trend

Financial Year	Thermal Coal	Trans-loading coal	Non-coking coal	Coking coal	Coke	Total coal Traffic	Projected# coal traffic
	(Coastal Exports)		(Imports)	(Imports)	(Imports)	(Imports& Exports)	(Imports)
2016-17	1.82	0.60	4.02	5.50	0.49	12.44	10.02
2017-18	1.73	0.87	4.39	5.63	0.55	13.17	10.60
2018-19	1.64	1.25	4.79	5.75	0.61	13.99	11.20
2019-20	1.56	1.80	5.23	5.88	0.69	15.16	11.80

2020-21	1.56	2.60	5.70	6.02	0.77	16.65	12.50
2021-22	1.56	2.60	6.21	6.16	0.86	17.36	13.20
2022-23	1.56	2.60	6.78	6.30	0.96	18.16	14.00
2023-24	1.56	2.60	7.39	6.44	1.07	19.06	14.90
2024-25	1.56	2.60	8.06	6.59	1.20	20.06	15.90
2025-26	1.56	2.60	8.79	6.74	1.34	21.06	16.90
2026-27	1.56	2.60	9.58	6.89	1.50	22.16	18.00
2027-28	1.56	2.60	10.45	7.05	1.68	23.36	19.20
CAGR	(- 4.98%)	44.24%	9.05%	2.28%	11.84%		
# Excluding Coastal exports and Trans-loading traffic							
Thermal coal exports and Trans-loading traffic purposely stagnated after 5th Year							

4.7 Traffic forecast based the Govt. Policy on use of domestic coal as Substitute to imported coal:

Government is gradually trying to reduce coal import in a bid to increase domestic production and stick to 1.5 billion tonne production target by the year 2020 set by the Coal Ministry. Out of this 1 billion tonne will by Govt companies and remaining 500 million tonne by private entities.

The statement made by the Coal Secretary, Ministry of Coal, Government of India while addressing MCC Chamber of Commerce and Industry in Kolkata in Feb 2016 re-affirms the same which is re-produced below-

Quote:

"We have done a detailed analysis on how to handle import. As we increase production, we must bring down imports, it is already coming down but should be at much faster rate. In power sector, we have engaged each of PSU power companies. We had meeting with state owned power companies on coal import. This fiscal (2015-16) import will reduce by 15 million tonne. From April next year (2016-17), they will stop placing fresh import orders. State owned power entities import about 35 to 40 million tones. The efforts are to encourage private companies to buy coal for long term from auction".

Unquote:

The above statement has turned into reality as can be seen in reduction in coal import in India during last two years as presented in the following Table 4.3.

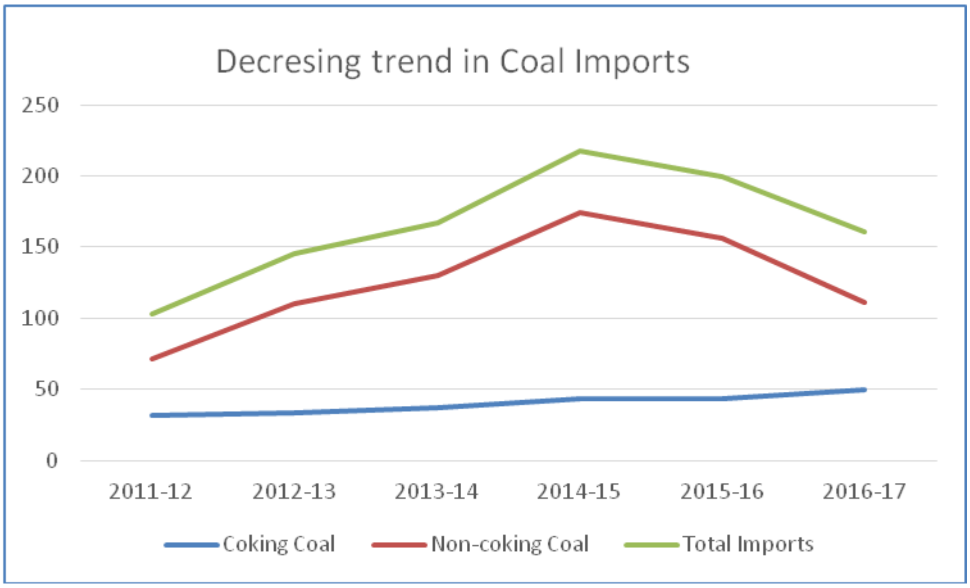
Table 4.3

Trend in Coal Imports (In Million tonnes) for the country

Type of Coal (Excluding Coke)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Coking Coal	31.8	33.56	36.87	43.72	43.50	50.00†
Non-coking Coal	71.05	110.23	129.99	174.07	156.38	111.00†
Total Imports	102.85	145.79	166.86	217.78	199.88	161.00†

† These Figures are provisional.

The same is presented graphically which clearly depicts the drastic decreasing trend in line with government policy.



Similarly coal traffic at Haldia Port declined from 14.51 million tones in 2015-16 to 14.42 miilion tones in 2016-17 and coal traffic at all major ports put together declined from 155.17 million tones in 2015-16 to 139.85 million tones in 2016-17.

The Govt. further stated on 1st May 2017 that it is aiming to bring down thermal coal import of power PSUs like NTPC to zero, in the current financial year, a move that would reduce the country's import bill by Rs 17,000 crores. The Govt. would also convince private companies operating in the power sector to totally stop import of fossil fuel. (PTI 1st May 2017).

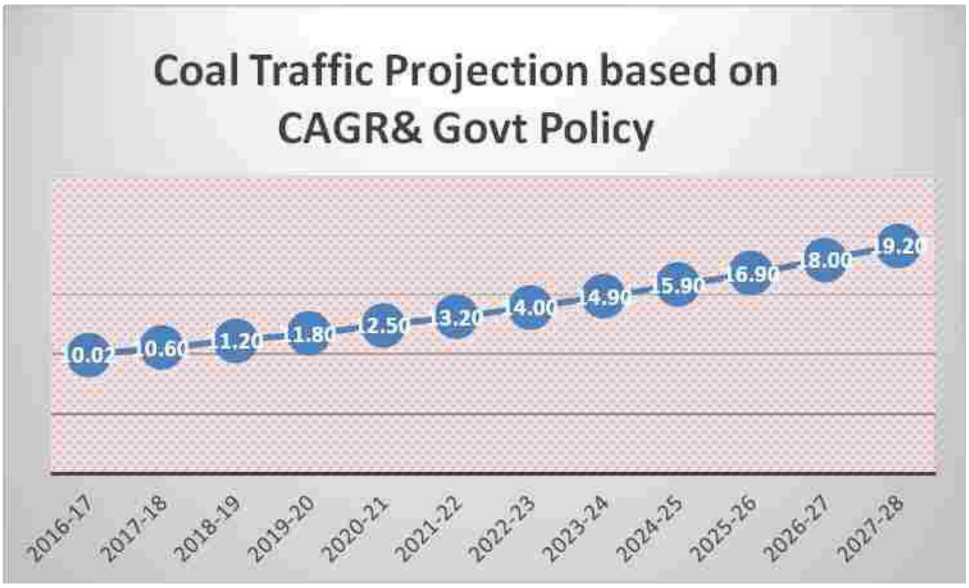
Keeping in view the announcement of the above policy, the import of trans-loading coal through Sagar Island by M/s NTPC for its Farakka Power Plant will become nil. Hence traffic projection gets corrected. In line with discussion with NTPC officials, it is understood that only old orders placed with traders will be honored which is to the tune of 3 lakh tones. No fresh orders will be placed for coal import. (NTPC handled one vessel namely MV Mary Gorgias carrying 71,760 MT steam coal (transloading cargo) at Kanika Sands (within the limits of Dhamra Port) during the period from 19.05.2017 to 28.05.2017).

Accordingly, the summary of traffic forecast for coal based the Govt Policy on use of domestic coal, superimposed on past traffic trend is given in the Table 4.4 hereunder.

Table 4.4

Traffic Projections based on CAGR Trend & Govt Policy on use of Domestic Coal

Financial Year	Thermal Coal	Trans-loading coal	Non-coking coal	Coking coal	Coke	Total coal Traffic	Projected coal traffic
	Coastal exports		Imports	Imports	Imports	Imports&Exports	Imports
2016-17	1.82	0.60	4.02	5.50	0.49	12.44	10.02
2017-18	1.73	0.87	4.39	5.63	0.55	13.17	10.60
2018-19	1.64	1.25	4.79	5.75	0.61	13.99	11.20
2019-20	1.56	1.80	5.23	5.88	0.69	15.16	11.80
2020-21	1.56	2.60	5.70	6.02	0.77	16.65	12.50
2021-22	1.56	2.60	6.21	6.16	0.86	17.36	13.20
2022-23	1.56	2.60	6.78	6.30	0.96	18.16	14.00
2023-24	1.56	2.60	7.39	6.44	1.07	19.06	14.90
2024-25	1.56	2.60	8.06	6.59	1.20	20.06	15.90
2025-26	1.56	2.60	8.79	6.74	1.34	21.06	16.90
2026-27	1.56	2.60	9.58	6.89	1.50	22.16	18.00
2027-28	1.56	2.60	10.45	7.05	1.68	23.36	19.20
CAGR	(-4.98%)	44.24%	9.05%	2.28%	11.84 %		



4.8 Traffic forecast based on interaction with Users:

The traffic forecast based on major coal importing customers through Haldia is presented in the table below.

Table 4.5

Coking Coal traffic projections Based on Interaction with Major Customers of Haldia

Customers for Coking Coal	2016-17 (Actuals)	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27
SAIL	3.55	3.70	3.70	4.00	4.00	4.25	4.25	4.25	4.25	4.25	4.25
Tata Steel	1.19	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Jai Bajaj Industries	0.28	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Electro steel Casting	0.36	0.36	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Usha Martin	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Tata Metallik	0.06	0.06	0.06	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

Raw Met Comm	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.01	0.005
ShyamSel Ferro Alloys	0.00	0.09	0.20	0.20	0.25	0.25	0.30	0.30	0.30	0.30	0.30
Total	5.53	6.15	6.30	6.66	6.72	6.97	7.02	7.02	7.02	7.02	7.02

4.8.1 Interaction with Non Coking Coal Customers:

Table 4.6

Non-Coking Coal Traffic Projection Based on Customer interaction

Customer Name	2016-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27
Tata Steel	0.42	0.50	0.50	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Agarwal Coal Corp	0.31	0.35	0.35	0.35	0.35	0.35	0.35	0.40	0.40	0.40	0.40
SAIL	0.28	0.3	0.50	0.50	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Super Smelters	0.25	0.25	0.25	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Sarogiudyog	0.16	0.18	0.20	0.23	0.25	0.27	0.30	0.32	0.35	0.35	0.4
Anand Carbo/Godawari	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Jai Balaji Industries	0.12	0.12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
HaldiaEnery Ltd	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Raw Met Commodities	0.10	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Electro steel castings	0.16	0.16	0.18	0.18	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Usha Martin	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
CESC Ltd	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian Power Corporp	0.00	0.60	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Sub-Total	2.23	2.93	3.61	4.39	6.33	6.35	6.38	6.45	6.48	6.48	6.53
Others @ .1026 CAGR	1.79	1.97	2.18	2.40	2.65	2.92	3.22	3.55	3.91	4.31	4.75
Grand Total	4.02	4.90	5.79	6.79	8.98	9.27	9.60	10.00	10.39	10.79	11.28

Note: CAGR is derived from Sub-total column for 12 years

4.8.2 Interaction with Coke Customers:

Table 4.7

Coke Traffic Projection Based on Customer Interaction

Customer -Coke	2016-17. Actual	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27
Neo-Metaliks	0.084	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Athir Industries	0.075	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
ReshmiMetaliks	0.037	0.037	0.038	0.040	0.050	0.050	0.050	0.050	0.050	0.050	0.050
ShyamSel/Ferro alloys	0.036	0.036	0.036	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Tata Metalliks	0.02	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Sub-Total	0.251	0.250	0.241	0.247	0.257	0.257	0.257	0.257	0.257	0.257	0.257
Other @ 0.0021 CAGR	0.240	0.241	0.241	0.242	0.242	0.243	0.243	0.244	0.244	0.245	0.245
Total	0.491	0.490	0.482	0.489	0.499	0.500	0.500	0.501	0.501	0.502	0.502

4.8.3 Interaction with Thermal coal (Loading) Customer:

Table 4.8

Thermal Coal (Coastal Loading) Traffic Projections based on Customer interaction

Customer	2016-16 Actual	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	28-27	27-28
TNEB (SICAL)	1.82	1.94	2.06	2.18	2.30	2.42	2.54	2.66	2.78	2.90	3.00	3.00

4.8.4 Interaction with Customer using Trans-loading Facility for NCC Import (NTPC):

Customer indicated that no further coal import through trans-loading facility as per GoI directive to use domestic coal. Hence this volume has been considered as Nil for future projection.

4.9 Projection based on average of "trend" and "customer indication" for coking coal, non-coking coal and cokes but Thermal Coal (loading) considered purely as per "customer indication".

4.9.1 Total Coal Traffic Projection (Imported+ Loading + Transloading):

Table 4.9

FINAL PROJECTION BASED ON AVERAGE OF TREND AND CUSTOMER INTERACTION (EXCEPT TNEB & NTPC COAL) IN MMT

CUSTOMERS	2016-17 .Actual	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28
Coastal Coal (Loading):TNEB	1.82	1.94	2.06	2.18	2.30	2.42	2.54	2.66	2.78	2.90	3.00	3.00
Transloading Coal: NTPC	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Coking Coal (Import)	4.02	4.65	5.29	6.01	7.34	7.74	8.19	8.69	9.22	9.79	10.43	11.11
Coking Coal (Import)	5.50	5.89	6.03	6.27	6.37	6.56	6.66	6.73	6.80	6.88	6.95	7.03
Coke (Import)	0.49	0.52	0.55	0.59	0.63	0.68	0.73	0.79	0.85	0.92	1.00	1.09
All Cargo	12.43	13.00	13.93	15.05	16.64	17.40	18.12	18.87	19.65	20.49	21.38	22.23
All Import (All Cargo less TNEB and Transloading)	10.01	11.06	11.87	12.87	14.34	14.98	15.58	16.21	16.87	17.59	18.38	19.23

The final projections as given in the table above is line with government's present thinking.

In case of non-coking coal import it is proposed to reckon the projection of 7.3 million tones for 2025-26 also keeping in view the government‛s policy of reducing imports.

4.10 Iron ore

India which was formerly the world's No.3 supplier of iron ore has been closing down on imports over the last two years due to court-imposed restrictions aimed at curbing illegal mining in the key producing states of Karnataka and Goa. In FY 2015, India produced 129 million tonnes of iron ore and imported 15 million tonnes of iron ore.

4.10.1 Export Policy for Iron Ore - 2016

Exports of iron ore up to 64% Fe content is freely allowed. The export of iron ore with Fe content above 64% is canalized through MMTC. High-grade iron ore (Fe content above 64%) from Bailadila in Chhattisgarh is allowed to be exported with restrictions on quantity imposed primarily, with a view to meet domestic demand on priority. About 3 million tonnes is allowed for exports through vizag and paradeep. Though iron ore exports do take place in Haldia, the chances of increase in a big way are therefore remote.

The industries located in west Bengal source their iron ore requirements from mines in Jharkhand, Madhya Pradesh and as such iron ore exports are fluctuating through the port. In 2015-16, and 2016-17 the port handled about 0.8 miliion tonnes and 1.16 million tonnes of iron ore respectively as against 1.90 mt in 2014-15. As such, a moderate forecast of 1.3 mt to 2.3 mt is projected by 2020 and 2025 respectively

As such for iron ore Haldia will remain as an export cargo and in moderate quantities for a long time to come.

4.11 Manganese Ore (Import)

India is the second largest importer of Manganese ore in the world.India's dependence on Manganese Ore imports has increased as the Manganese Ore produced in India (apart from MOIL) is of low grade and high Iron content, and these are not suitable to produce the best quality Manganese alloys. These inferior quality of Manganese Ores produced domestically have to be blended with better variety imported ores. In view of the shortage in availability of high grade ore and imports becoming cheaper with demand from China diminishing, this trend is likely to continue.

The traffic on account of this cargo through Haldia was varying between 1.3 mt and 1.5 mt. Keeping this trend in view, 1.8 mt by 2020 and 2.3 mt by 2025 has been reckoned for this cargo.

4.12 Fertilisers and Raw materials (Imports)

The consumption of fertilizers in the country has increased by around 2.5 percent and is expected to rise at approximately 4 percent in the future. Growing agri-produce and an increase in the overall sown area will prompt greater demand for fertilizer end products—around 70 MMTPA by 2020 and around 120 MMTPA by 2035. Urea consumption in India is around 29 MMTPA, of which around 22.5 MMTPA is produced domestically and around 7 MMTPA is imported. While domestic plants are increasing capacity by around 5 MMTPA in 2020, the rising demand for urea (expected to be 35 MMTPA in 2020) will ensure that India continues to import around 7 MMTPA of urea. The volume of imports of fertilizer raw materials and finished products will grow at around 4 percent.

About 3 lakh tonnes of fertilisers and 3.4 lakh tonnes of fert. Raw materials is handled by the port in 2015-16.The traffic is estimated to grow at 5 percent per annum to reach 0.8 mtpa by 2020 and 1.2 mtpa by 2025.

4.13 Limestone

Limestone is the primary and major constituent for manufacture of cement. It is also used by the steel industry. With nearly 390 million tonnes (MT) of cement production capacity, India is the second largest cement producer in the world and accounts for 6.7 per cent of world's cement output. The cement production capacity is estimated to touch 550 MT by FY 20. Of the total capacity, 98 per cent lies with the private sector and the rest with the public sector. The top 20 companies account for around 70 per cent of the total production.

Haldia port handled 1.5 million tonnes of lime stone in 2015-16 compared to 1.23 mill tonnes in 2012-13(CAGR 7%). Keeping in view the demand for this commodity by cement and steel industry, the traffic is estimated at 2.1 mtpa by 2020 and 2.8 mtpa by 2025.

4.14 Other commodities

These include steel, soda ash, pig iron gypsum, pet coke, m coke cement etc. The traffic on account of these cargoes was around1.2 million tonnes in 2015-16.

4.15 Summary of Traffic projections

Table 4.10

Projections for Dry Cargo (million tonnes)

Commodity	Actual in 2015-16	Projections by IPA		AECOM projections	
		2020-21	2025-26	2020-21	2025-26
Coking coal	5.72	6.4	6.9	8.0	11.2
Non -coking coal	6.43	7.3	7.3	3.3	3.3
Thermal coal	1.55	2.3	2.9	1.6	2.1
Iron ore	0.87	1.3	2.3	1.0	1.3
Manganese ore and slag	1.24	1.8	2.3	2.0	2.5
Fertilisers and fert.rawmatls.	0.64	0.8	1.2	1.0	1.5
Cokes	0.81	0.6	0.9	@	@
Limestone	1.52	2.1	2.8	2.0	2.8
Others Excl steel	1.20	1.8	2.6	4.0	5.2
Total Dry Cargo	**19.98**	**24.4**	**29.2**	**22.9**	**29.9**

4.16 Traffic Forecast & Matching Handling Facilities

As per the above tabulated traffic projections, the port is required to equip itself to handle 24.4 Million tons of dry bulk cargo by 2020-21 and 29.2 Million tons by 2025-26.

Of 29.2 million tons for Dry bulk, 17.1 million tons is coal (coking coal, non-coking coal and thermal coal.

Of the projection of 17.1 million tons in 2025-26 thermal coal is 2.9 million tons which basically is an export cargo mostly meant for Tangedco handled through Tamilnadu ports. For this purpose there already exists a fully mechanized coal export handling facility in operation in berth No 4.

After accounting for this, the remaining coal amounting to 14.2 million is an import cargo. Berth No 4A already has a captive mechanized coking coal unloading system with a capacity of 3 MTPA installed by M/s ISPL on BOT basis. This quantity of 11.2 (14.2 MTPA- 3 MTPA) in 2025-26 means a substantial incremental increase of coal, thus meriting a fully mechanized coal unloading, stacking, reclaiming and wagon loading system.

4.17 Identification of Cargoes Mechanization and its traffic projection:

The scope of work for this assignment as defined by the port authority includes

- Identification of possible cargoes that can be handled after mechanisation of berth No 3 and
- Assessment of the traffic projections of the identified cargoes at the berth

4.17.1 Cargoes for Mechanization through Berth No 3

The main bulk cargoes handled in Haldia port are

Coking coal – Import

Non coking coal – Import

Limestone - Import

Thermal Coal – Export

Iron ore – Export

For any bulk cargo to merit mechanization, it need to be in substantial quantity and is handled all through the year and is not a seasonal cargo. If evacuation of such cargo is by rail, then it is an added advantage as their parcels will be large viz., in rake loads rather than in Lorry loads. Also they would be consigned to fewer users in larger parcels.

As seen in para 4.16, since coal is the predominant bulk cargo and bulk of it being imports it is proposed that Coal imports be mechanized through berth no 3.

4.17.2 Assessment of Traffic Projection for identified cargoes

As already indicated earlier, the port already has a fully mechanized bulk coking coal importing system in Berth No 4A which is a BOT facility of M/s ISPL. It has a capacity of 3.5 million tons per annum and is meant as a captive facility.

Thus as seen in the previous paragraph coal imports through Haldia will be of the order of 14.2 million tons in 2025-26. After accounting for handling through Berth No 4A, the coal traffic projection is 11.2 million tons some of which can be attracted to berth No 3.

SECTION 5

ONGOING PROJECTS

5.0 Preamble:

The port has been constantly striving to increase the handling capacity by way of increasing the berthing and handling facilities. While some have been recently commissioned many are in various stages of implementation and some are in advanced stage of planning.

5.1 Projects recently commissioned

5.1.1 Integrated Container Handling at Berth 10 & 11

LOA has been awarded on 23.12.2014 for Integrated Container Handling at addition of 0.20 MMTPA. Project was commissioned on 15.4.2015.

5.1.2Setting up of Floating pipeline Handling Facility for unloading Edible Oil from Vessels berthed at Berth Nos. 5/off 5/6/off 6 at HDC

(Estimated Cost: Rs. 44 crores, Capacity addition: 0.44 MMTPA)

LOI has been issued on 27.2.2015 for setting up of Floating pipeline Handling Facility for unloading Edible Oil from Vessels berthed at Berth Nos. 5/off 5/6/off 6 at HDC. The project has been commissioned on 09.06.2015.

5.1.3 Supply, Operation & Maintenance of different cargo handling equipment at berth Nos.2 & 8 of HDC under PPP/ allied mode

(*Estimated Cost* Rs. 150 crore / *Capacity addition:* 6.00 MTPA)

For Ship to Shore handling with MHC:

• Berth No2: LOA placed on 31.07.15 on M/s Bothra Shipping

• Berth no 8: LOA on 31/07/2015 on M/s Orissa Stevedores Ltd.

• Both the ship-to-shore and shore handling operation of the two berths (on split mode basis) and were commissioned.

• For shore handling operations, LOA issued on 9.10.15 to EC Bose & Co after due approval of BOT. Commissioning: Jan'2016.

5.1.4 Setting up of Riverine Barge Jetty for handling Fly Ash

(Estimated Cost: Rs. 2 crores, Capacity addition: 0.5 MMTPA)

This jetty is meant for shipment of fly ash from local upcoming power plants. Order has been placed on IRC Commercial Pvt Ltd. on 31.03.2015. The facility was commissioned on 05.11.2015

5.1.5 Floating crane handling facilities at Sagar/other deep draft locations.

(Estimated Cost: Rs. 84 crores, Capacity addition: 2.00 MMTPA for each arrangement)

Importing dry bulk cargo like Coal etc. has serious draft constraints as about 60% of their cargo brought in each shipload are unloaded at other ports leading to higher logistics cost. A floating crane handling system was therefore proposed in the open sea into which dry bulk cargo from mother vessels is lighteraged to be later transported to HDC by mini-bulk carriers (MBCs)/barges. The facilities have been commissioned in Dec 2017/Jan 2018.

1.6 Floating Riverine Barge Jetty with connecting road to the storage area

(Estimated Cost: Rs. 73 crores, Capacity addition: 2.55 MMTPA)

LOA has been issued to Bothra Shipping Services Pvt. Ltd. on 9.9.15 for Setting up of Floating Riverine Barge Jetty with connecting road to the storage area to mainly cater to the dry bulk transhipment traffic to be generated at HDC, once the transhipment operations are in place. The facility is expected to be commissioned in march/April 2018.

5.2 Projects Planned but and not taken off

5.2.1Berthing Facilities at Shalukhali for Bulk Cargoes

The port had earlier planned total four riverine berths at Shalukhali, which is about 15 km north of the existing Dock Complex. It was proposed to develop two fully mechanized berths for handling imported coal and two multi-purpose berths with HMC for handling other bulk cargoes like imported coal and iron ore. The bulk and breakbulk terminal planned at Shalukhali could not be taken up due to weak response from the prospective bidders.

5.2.2Berthing Facilities at Shalukhali for handling bulk Liquids

Subsequently KoPT planned to set up a liquid jetty at the same location in Shalukhali. The proposed facility was mainly meant for handling Paraxylene and some other chemicals with an expectation that Paraxylene will be shifted to the new jetty at Shalukhali along with proposed LPG imports as the capacity of the existing three oil jetties is nearly saturated.

The port has pursued this project through a bidding process and recently finalised on a prospective developer and entered into a concession agreement.

5.3 Projects under advanced stage of Planning:

5.3.1 Berthing facilities in OT1 for handling bulk coal

Due to depth limitations at the HDC, it was planned to ramp up transloading operations at the Sand heads during dry season and at Kanika Sands, an island off the Orissa coast, during monsoon. For this, a 270 m multipurpose jetty is planned to be constructed upstream of Oil Jetty III to be known as Outer Terminal 1 (OT1). The planned capacity for the jetty is about 5.0 MTPA and it will require a capital investment of over 413 Crores. The TEFR for this project was recently restructured by IPA. However due to some rethinking on this project by government of India, the port is yet to take a final view on this project.

5.3.2 Berthing facilities in OT2 for handling Liquid bulk

The area available between the 2nd Oil Jetty and lead-in Jetty has been proposed for development of a jetty for handling vessels of maximum 185 m LOA. The new riverine jetty shall be designed to handle vessels/barges up to 22,500 DWT/10,000 GT with parcel load of 15,000 T. It is estimated that this jetty will handle about 2.0 MTPA of liquid cargo. The price bids of four techno commercially qualified tenderers opened and the port has awarded LOA to the successful bidder. However the environmental clearance for this project is awaited and once this is received the project is expected to take off to construction phase.

5.4 Impact of projects on the present study:

Among the on-going projects and those under advanced stage of planning the proposal for construction of OT1 has a significant bearing on the proposal for mechanization of berth No 3 as follows

The proposed OT1 project has received significant expression of interest when invited through public private partnership and the project report has recently been restructured by IPA. It will be a fully mechanized coal unloading facility with two Harbour mobile cranes unloading coal from ships and the coal transferred to the stack yard through conveyors. The evacuation will be through a rapid in-motion wagon loading system and up to about 20% may be by flood loading of dumper Lorries through a lorry loading silo.

The project has an optimal capacity of 5 MPTA and more importantly being a riverine jetty these vessels will not have to go through the lock gate thus will have enormous savings to the ship standing cost and hence will be preferred for coal unloading.

However more recently there appears to be a rethinking on this project by Port and government of India. As such there is no clarity on the future of this project as for now.

With the development of Liquid jetty at Shalukhali, the major liquid cargo that is presently being handled in Berth No 3 viz. Paraxylene may get shifted out, thus releasing capacity for handling dry bulk cargo after mechanization. As such there would be no hindrance for mechanization of berth no 3 from the traffic perspective.

SECTION 6

PRESENT LOCK GATE SYSTEM-LIMITATIONS

6.0 Impounded Dock System:

Haldia Dock Complex (HDC) is the only riverine port in India having an impounded dock with a lock gate system to accommodate vessels up to Panamax size. The layout of HDC with lock gate system as seen from the satellite is presented hereunder.

6.1 Lock Gate System

The unique feature of HDC is its impounded dock and the lock gate operations. HDC lock is sized to handle a Panamax size ships having 986 feet (301 m approx.) in length, 130 feet (36.9 m approx.) in width and floor level of 10 m (33 ft.) w.r.t. CD. The lock is aligned west – southwest to facilitate entry during flood time. Three caisson gates have been provided at the lock, each with a camber for recess to allow ship passage. The central one is utilised as dry dock for repair of damaged gate. The lock gate system, along with its ancillaries, was designed by M/s Rendel, Palmer &Tritton, U.K and was commissioned in the year 1977.

The lock barrel of lock entrance connects the impounded dock with the river. The two caisson gates, viz. Outer Caisson Gate and the Inner Caisson Gate are always in operation. These two caisson gates move across the lock barrel over two separate sliding ways on two sides and rest against either side of the vertical wall of camber depending upon the water levels inside Lock and those at river and dock basin. The sliding and vertical contact surfaces between caisson gates and sliding way along with vertical walls of the camber is provided with Meehanite Casting Blocks fixed one after another.

Satellite images and pictures of the lock gate system are presented below for ready appreciation of this system which is not only a unique feature of HDC but also a lifeline.

An overview of lock gate system

Lock Gate System with Three Caisson Gates & Guiding Berth

Lock Gate with a Single Large Vessel in Transit

A Majestic view of Haldia Lock in its entirety

Lock gate in open position (on the dock side)

6.2 Present condition of the lock gates

As already discussed above, the caisson gates move across the lock barrel over two separate sliding ways provided with Meehanite Casting Blocks. The Meehanite Casting Blocks are bolted with seating plate (made of steel) and the seating plate is fixed in concrete structure by means of bolting. It is understood that some time ago during underwater inspection, some of the casting blocks of outer sliding ways were found dislodged. They were refitted into their respective positions by engaging a local firm. Moreover, a few damaged bolts of the seating plates (the plates which are placed in the concrete for holding the sliding way plate) have also been replaced as a short term measure to tide over the situation.

Effective functioning of caisson gates is the lifeline of the performance of HDC. It is, therefore, necessary that the port may look for long term solutions to ensure smooth and speedy caisson gate operations, if not already done.

6.3. Navigation in Hoogly River:

The shipping channel to Haldia Dock Complex, has to negotiate a number of shallow patches. The bars are located in variable situation, such as accretion and/or erosion in the region, growth and decay of submerged sand flats and several unstable islands. In view of the shallow depths at the bars, advantage is taken of the rise of tide so as to obtain the maximum draught for shipping. Forecast of the draught for inbound and outbound ships are published by Kolkata Port in advance. Normally, the vessels proceed in a convoy.

The Port maintains a pilot vessel at Sagar Roads. The river pilot embarks inbound vessels at Middleton Points and proceeds up the river. There is a pilot vessel at Gasper which puts pilots on-board inbound vessels or take them off from outbound vessels after pilotage down the river Hooghly. All vessels approaching Sand heads are to contact SandHead Pilot for instructions. On receipt of information about the vessel arrival, the pilot station intimates the vessel’s entry timings and allocates a position in the convoy. The information given to the vessel consists of Convoy number; number of ships in the convoy; names of preceding and succeeding vessels; Lower Gasper reporting time and Upper Gasper reporting time. The average convoy speed to be maintained is 12 knots and minimum separation of 1.5 nautical miles form up in their designated position in convoy. No overtaking is permitted.

6.4 Movement through lock entrance:

During construction of Lock it was found that there had been artesian condition prevailing at the sub-soil strata for which series of deep tube wells were operated round the clock to draw down the water level to facilitate deep excavation and construction. Because of this RPT, the then Resident Consultant of Haldia Docks, advised KoPT that water level inside lock should not be draw down below 1.22 m (+4.0 ft.) above CD. Further, some ancillary machinery of caisson gate were installed at 6.70m (+22.0 ft.) above CD. As such, operation of caisson gate cannot be performed at water level above 6.40m (21 ft.) above CD. Within the above limitations of water levels for operating caisson gates, HDC could achieve 10 movements of vessels (in and out) on an average per day during April to December 2017 as emerged from the discussion held with HDC officials on 8th January, 2018.

Considering the fact that lock has been constructed with heavy duty gravity type structures like Monoliths (‘well foundation’ type) and also over 40 years have passed since commissioning of the lock, IPA team is of the opinion that HDC may endeavour to operate caisson at water level up to 0.5m above CD. With this it is envisaged that about two additional movements over and above 10 movements per day may be achieved.

SECTION 7

BERTHING FACILITES

7.1 Berth No 3:

Earlier during 1970's the Berth No 3 was originally installed with a fully mechanized iron ore loading system. It consisted of two Wagon Tipplers with wagon feeding systems, conveyor system, four Stacker cum Reclaimers and two Ship Loaders.

With decline of iron ore traffic, the berth along with the same iron ore loading plant was used for loading thermal coal for some time. The following image depicts berth no 3 with stack yard as it used to be till in 2012 when the berth was equipped with ship loaders and the stack yard with stacker cum reclaimers.

Berth No 3 with back up area for Mechanized iron ore loading plant
(Image as during 2012)

Consequent to ban on iron ore exports imposed by GOI in 2012, the entire mechanized iron ore loading system including crane rails laid on the berth having also outlived its economic life, was decommissioned and dismantled.

The berth 3 is also having the facilities for handling Class B Petroleum Products since early eighties and tankers used to call at this berth since then and is being continued. Presently paraxylene is being handled through this berth through pipelines laid on the rear side of the berth. The back-up area is now used for stacking of bulk cargoes like coal with stacking and evacuation of such bulk cargoes done by semi-mechanized methods viz., by dumpers and pay loaders.

The satellite image presented below depicts berth No 3 and the back-up area as it now stands.

Berth No 3 as at present with Back-up area

7.2 Present Setting of Berth

The berth no 3 is an island type berth having 193 M (337 ft.) long berthing face for a width of about 14 M plus connected to the shore with approach ways on both ends. The overall length of the berth is about 337 M.

The berth is designed to handle 75,000 DWT Panamax vessels partly laden to 12.2 M draft up to 239 M LOA. Double cone fenders with frontal pads are provided to facilitate berthing of vessels and 60T capacity bollards are provided on the quay above the fenders for holding breast lines from the ship. Extreme bollards for moorings are about 335 M apart. The berth is also designed for operation of rail mounted shore cranes for a rail span (in transverse direction) of 13.72 M (45 ft.).

The latest image of the berth structure is presented below

Berth No 3 – Berth structure as of now

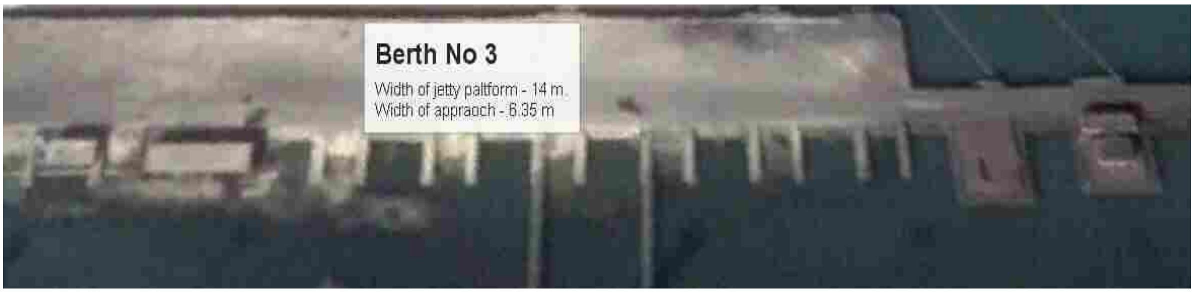
7.3 Limitations due to shorter span of crane rail gauge :

As has been noted above, the span of crane rail gauge in transverse direction was only 13.72M. As per present trend such cranes are manufactured for a much larger gauge.

7.4 Berth Structure

The berth structure comprises of RCC slab, long and cross beams supported on RCC monolith type gravity structures sunk apart. The fenders are installed on monolith walls. The crane rail beams are along the vertical walls of the monoliths with deep beams bridging the gaps. There are three rows of RCC piles at the rear side of the quay driven at regular intervals along the length of the berth to support the ship unloading conveyor system.

The image shown below depicts structure that used to support the conveyor system.



7.5 Condition of The existing Berth Structure

No significant damage of the quay is noticed. However, damages of the conveyor support structure at the rear side, to the extent of spalling of concrete thereby exposing the reinforcements are noticed at several locations.

In view of the above and also considering that the berth structure is 40 years old, it would prima facie require to carry out 'Condition Survey' by experts for ascertaining the stability of the berth structure, the conveyor support structure in particular, for withstanding design load criteria.

In view of the design characteristics, limited width and limited approaches from land side as noted in earlier paragraphs, it is not recommended for handling cargo using Harbour Mobile Cranes on berth no 3.

7.6 Drawings made available

With regard to the existing berth structure, the port has made available the following drawings for this study.

1. Drag. No H – ORE/COAL -8:Layout of ore and coal berths showing conveyor details

2. Drag. No. H-ORE/COAL-20: Details of deck slab, service slab &beams for race. roadway access to ore & coal berths from land
3. Drag. No H-ORE/COAL -21: Plan showing pile-caps for roadway access to ore and coal berths from land.

The above drawings are in the form of old Ammonia prints, hence not very legible. Further the drawings are also not useful for any technical study and investigation on the berth structure as they lack required details.

7.7 Observations on Berth Structure:

The berth structure in its present state, is suitable for installation of Gantry grab type ship unloaders. In fact the berth was earlier having ship loaders with tripper car and conveyor on the rear side. As such it is considered that there will be no major technical problem to install ship unloaders (as against ship loaders previously). Since these are tailor made equipment the ship unloaders can be designed to have wheel loads similar to erstwhile loaders commensurate with the wheel span subject to undertaking repairs on civil structure as per 'Condition Survey' to be carried out. It appears the main berth structure being monoliths may not require any major strengthening. However, the RCC structure to support the Conveyor System on the rear needs to be thoroughly repaired to revive them to original state before being used for the purpose.

7.8 Images of Present Berth No 3 Structure:

A few images of the present No 3 structure are provided below for immediate appreciation of its visual condition.

SECTION 8

PLANNING PARAMETERS

8.0 Foreword

The Planning for mechanization of berth no 3 has to be viewed from the following three perspectives.

- From Traffic perspective
- From the perspective of Lock gate system
- From the perspective of berth structure

They are further elaborated below.

8.1 Traffic Perspective:

The proposed mechanization of berth no 3 is for handling dry bulk cargoes and the cargoes suitable for such mechanization are coking coal, non-coking coal, thermal coal and Limestone. Of them the thermal coal meant for export is to be excluded as there already exists a mechanized coal loading facility at berth no 4 which is adequate to take care of present and projected export traffic of thermal coal which basically is for coastal exports to ports in Tamilnadu (for Tangedco power plants.)

As regards coking coal imports, there is already a mechanized unloading facility in berth no 4A installed by ISPL with a capacity of about 3.5 MTPA and is meant for captive needs of SAIL. Through this captive facility about less than 3 Million tons is presently being imported.

Thus the only remaining cargoes amenable for mechanization are import cargoes of coking coal, merchant coal and Limestone .

The traffic forecast projects 24.4 Million tons and 29.2 Million tons of dry bulk cargo, by 2020-21 and 2025-26 respectively.

During the first nine months of the current financial year i.e. in 2017-18 Haldia dock complex has registered a robust increase in traffic viz., 19.63% as compared to corresponding period the previous year as can be seen from the table below.

Period	Traffic handled in Lakh tons	Percentage increase in traffic
April – Dec 2016	27679	
April – Dec 2017	33113	19.63%

This overall increase is driven by all commodities and more importantly by containers followed by bulk cargoes. It is noted that this growth trend continues in Jan and Feb '18 as well and the total traffic could be 40 Million tons plus during the current financial year i.e. 2017-18 of which more than 20 million tons could be bulk cargoes.

The port presently is assessed to have capacity to handle 25 million tons of bulk cargoes. Of the various projects that are under planning, the project OT1 is planned to add a further capacity of 5 Million tons. Since the port authority has not taken a decision on pursuing OT1 and it is now decided by the port to prioritize mechanization of berth no 3 over OT1, there is adequate justification for installation of a fully mechanized bulk handling system for speedy unloading and evacuation of coal through berth No 3.

8.2 From the Perceptive of Lock Gate System:

This basically is a problem interconnected with ship scheduling in HDC. The problems in ship scheduling in HDC are on accounting of:

1) It being a riverine and tidal port, has to wait for tides for ship to navigate.
2) The impounded dock system with its lock gates can be operated for a limited window period twice a day and for specific frequency only.

The lock gates along with their sliding ways are now over 40 years old and some of the Meehanite casting blocks are refitted after their dislodgement and as lock gate movement has slowed down, the port need to look for long term solutions to ensure smooth and speedy lock gate operations.

Currently ships can enter the dock basin through lock basin in about 80 to 90 minutes. Similarly, departure of the ship from turning circle to outside lock takes about 90 to 100 minutes. The original design allowed for passage of 10 ships (5 in + 5 out) per high tide but with the passage of time the operating system of the lock has slowed down and currently on an average of 5 to 6 ships per tide could be taken in / out, which limits the number of ships that could be handled at the dock annually.

Thus ship scheduling and the no of vessels that can be handled through the lock gate system becomes a deciding factor in enhancing the capacity of berths in the impounded dock. After taking appropriate measures to revamp/refurbish the existing lock gate system as suggested in section 6 to accommodate additional 2 or 3 movements per day, the projected additional vessels can be handled in the impounded dock system. Thus mechanization of berth no3 is considered viable from this aspect as well.

8.3 From the Perspective of Existing Berth Structure

This aspect was already discussed in Section 7. The physical life of berth structure can be enhanced by taking proper short and long term maintenance measures systematically. After undertaking repairs as would be recommended in the 'Condition Survey' Report, the berth can be used for another 35 to 40 years. In view of the foregoing, mechanisation of Berth 3 is technically feasible to invite prospective developers for investment.

8.4 Other Factors

Presently there are about **9** harbour mobile cranes of 100 TPH capacity in operation under HDC. This apart, there is a fully mechanised coking coal unloading facility in berth no 4A (Concessionaire-ISPL) and a mechanized thermal coal loading system (owned and operated by HDC) in berth no 4.

As indicated in the section on "Traffic Forecast" the bulk export cargoes available for loading is very small and there is already a mechanized thermal coal loading facility in berth 4 catering to such needs (which are mainly coastal thermal coal exports to Tamil Nadu electricity board), hence there is no scope for any further mechanization for export cargoes.

Therefore, any further mechanization has to be for bulk import cargoes. The commodities which have sufficient volumes are coking coal, thermal coal and limestone. The rest are highly fragmented cargoes.

8.5 Basis of Planning for Mechanization of Berth 3

Based on favourably considering points raised in para 8.1, 8.2 and 8.3 above it is proposed to plan for mechanization of berth 3 for bulk coal imports.

8.6 Traffic to be handled

As indicated above the commodities to he handled are import cargoes of non-coking coal and coking coal.The quantity to be handled is 2 Million tons per annum initially increasing to 3.2 million tons plus.

8.7 Vessel parcel sizes

The planning parameters in respect of vessel size and parcel size of vessel for which the mechanized handling facilities are planned is presented in table 8.1.

Table 8.1			
Details of vessels carrying coal Handled in Haldia - During 2016-17			
Type of coal		Coking coal	Non-coking coal
Total Volume Handled in Million Tonnes		5.47	4.04
No of Ship calls		196	167
Deadweight Tonnage	Maximum	90.625	84,488
	Minimum	34402	28,437
	Average	79226	68,847
Length Overall in Meters	Maximum	229	237
	Minimum	180	170
	Average	226	213
Parcel size in Tonnes	Maximum	36,672	33,000
	Minimum	15,385	5,500
	Average	27,929	24,195
Productivity in Tonnes per day	Maximum	30,386	35,054
	Minimum	10,696	3,171
	Average	18,084	20,834

It is noticed that about 10% of total vessel calls have brought in parcels of more than 30,000 Tons. The variation of parcel size with the sailing draft is brought out in the following table 8.2.

Table 8.2 – Variation of Parcel Sizes Vs DWT

NAME OF VESSEL	DWT	Parcel size	Full Draft	Sailing Draft	
				Aft	Fwd
LUMINOUS HALO (HAL11301937)	**56,018**	42,924	**12.58**	7.40	7.40
KM SYDNEY (HAL11400180)	**80,638**	30,634	**14.41**	7.48	7.48
MYRTO (HAL11400214)	**82,131**	30,834	**14.43**	7.53	7.53
SUNRISE SERENITY (HAL11400277)	**76,544**	30,351	**14.10**	7.52	7.52
VISHVA CHETNA (HAL11400349)	**81,734**	31,899	**14.50**	7.90	7.85
VISHVA UDAY (HAL11400358)	**82,000**	31,790	**14.20**	7.90	7.90
STELLA DAWN (HAL11400373)	**81,700**	30,807	**14.40**	7.80	7.80
SAITA I (HAL11400593)	**81,922**	30,738		7.50	7.50
AENEAS (HAL11400610)	**81,586**	30,455		7.60	7.60
VISHVA ANAND (HAL11400725)	**80,655**	30,050	**14.50**	7.70	7.70
YASA FORTUNE (HAL11400680)	**82,849**	32,128	**14.43**	7.50	7.50
MARIA (HAL11400722)	**76,015**	32,846		8.00	8.00
IRON FUZEYYA (HAL11400776)	**82,209**	30,097		7.40	7.40
MAIA (HAL11400804)	**82,193**	31,925		7.50	7.50
BRIGHT WIND (HAL11400812)	**82,119**	34,123		8.10	8.10
OMIROS L (HAL11400863)	**81,450**	31,283		7.68	7.68
CAPTAIN ANTONIS (HAL11400864)	**82,177**	30,285		7.37	7.33
KONSTANTINOS II (HAL11400906)	**81,697**	30,959		7.80	7.80
PRABHU MOHINI (HAL11400927)	**81,168**	31,515	**14.52**	7.85	7.80
AGIA VALENTINI (HAL11400995)	**80,388**	31,721		7.75	7.64
GOLDEN KIJI (HAL11401115)	**76,596**	30,600		7.50	7.50
ASIA GRAECA (HAL11401123)	**73,902**	30,273	**13.94**	7.70	7.70
SRI PREM VEENA (HAL11401276)	**82,792**	30,752	**14.40**	7.40	7.30
LADY GIOVI (HAL11401553)	**81,791**	30,801	**14.38**	7.59	7.42
DA TONG (HAL11401554)	**81,104**	30,094	**14.00**	7.80	7.80
TIANJIN PIONEER (HAL11401677)	**75,744**	30,354	**13.99**	7.50	7.53
DONGHAE STAR (HAL11401696)	**82,861**	31,244	**14.80**	7.60	7.60
TRANS OCEANIC (HAL11301955)	**58,186**	40,650	12.83	6.60	6.60
ANNI SELMER (HAL11400003)	**56,000**	38,765	12.55	6.20	6.20
AZUR (HAL11401307)	**76,500**	32,000		7.53	7.48
MARIELENA (HAL11401349)	**81,354**	30,092		7.40	7.40
CHENNAI SELVAM (HAL11401486)	**52,489**	46,304	12.02	7.18	7.18
ULTRA LION (HAL11401772)	**81,588**	31,453		7.60	7.60

Taking all these into considerations, the design vessel size is taken as Panamax bulk carrier of the following dimensions:

DWT 83,000; LOA 240 M; Beam 32 M; Design full Load draft: 14.5 M; Parcel size 35,000 Te for 7.5 M draft (for berth structural design). However, taking into consideration the average parcel sizes over the past couple of years, the capacity of the berth as well as the stockyard will be worked out taking a parcel size of 24,000 tons only.

8.8 Planning Parameters for Mechanization of Berth No 3:

The planning parameters for mechanization of existing berth no 3 with modifications/additions proposed is indicated below.

- The berth no 3 has a length of about 337 m across extreme moorings. The loading platform has a length of about 193 M and a width of 15.75 m. The berth can handle panamax vessels with LOA up to 230 m and an average parcel size of 24,000 tonnes.
- The berth will be equipped with 2 no rail mounted gantry grab type unloaders with a capacity of 2000 TPH each. For this purpose the existing berth no 3 structure has to be provided with rails over which the unloaders will travel on the quay. The rail span of the proposed gantry grab unloaders have to be tailor made to suit its width.
- The coal/coking coal unloaded by the two unloaders will discharge into a single dock conveyor to be located on the rear side of the main berth structure on the piles and interconnecting beams. This conveyor will be an elevated one with a rated capacity of 4000 TPH commensurate with the capacity two unloaders.
- The coal from the dock conveyor will be conveyed through an elevated conveyor system to cross over the main road behind berth no to the backup area of berth No 3 for stacking.
- The coal from the stack yard reclaimed by stacker cum reclaimer (operating in reclaiming mode) will be conveyed to a stationary silo.
- Two no Stacker cum Reclaimers each having a rate capacity of 4000 TPH for stacking 3000 TPH capacity for reclaiming are planned for stock piling coal into the stack yard and then for evacuation through wagon loading.
- The coal from the stationary silo will be loaded into railway wagons through a rapid wagon loading system in which the wagons will be moving.
- The system will have a substation for receipt and distribution of HT and LT power for operating the mechanized system consisting of two no gantry grab unloaders, the belt conveyor system, two no stacker cum reclaimers, rapid wagon loading system, supporting utilities etc.,
- The estimated power requirement of about 1.8 MVA will be available from the port's main substation where adequate spare capacity is available. As such the prospective BOT operator has to lay HT power supply cables from the port's substation to the substation of the berth 3.

8.9 Stack Yard:

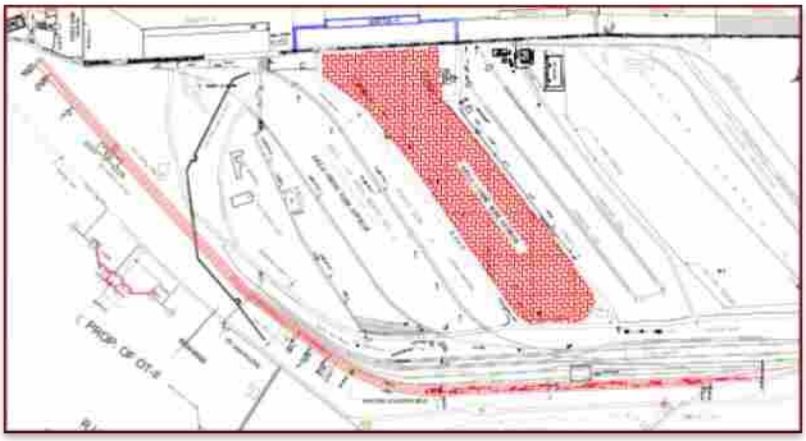
The stack yard for transit storage of coking coal, non-coking coal will be located in the designated stack yard to be situated in the back-up area of berth no 3. This area is same as the area in which the iron ore used to be stacked when berth no 3 was an iron ore loading facility. The backup area earmarked for berth no 3 is presented in the following figure.

Backup area earmarked for berth no 3 (shown in hatching)

The land earmarked for the purpose will have an area of about 1,13,000 sq.m. The same in the google image is depicted below.

8.10 Railway Yard

The railway yard for evacuating the material from the transit stack yard will be located in the existing railway yard where an old iron ore tippler was located (now defunct). The evacuation of coal will be through a rapid in-motion wagon loading system with a silo. The proposed railway yard for berth 3 will have two railway lines with a length go about of 1900 m for each line. One line is meant for rapid wagon loading and the line is planned to accommodate two rake lengths and the second line is planned for engine escape. The two lines proposed are planned adjacent to the existing lines in a green field area. A clearly demarcated railway corridor is depicted below.



Conceptual Layout of the proposed rail lines for Berth 3

Figure: Layout of Existing Railway yard

8.11 Handling System

The material handling system has been designed as ship-shore transfer through Rail Mounted gantry Grab unloaders, a conveyor system for transfer from berth to stack yard and handling at yard through two stacker cum reclaimer for stacking and a conveyor to carry the material from the stack yard to rapid loading silo and finally loading of coal from silo into wagons in-motion. The system will incorporate necessary pollution control measures

8.12 Handling Rates

8.12.1 Ship - Shore Transfer

Considering the capital cost, operational flexibility and proven performance, it is proposed to equip the berths with two gantry grab unloaders each having a rated capacity of 2000 TPH.

It is to be noted that due to draft limitations in Haldia vessels come with part load, having discharged the top portion of the hatches at another deep draught port. Hence the quantity of coal available for the cream bite of the grab will be limited. As the hatch gets emptied, the remaining coal is to be heaped at one place by a baby dozer to be lowered into the hatch. The baby dozer moves around shifting the scattered coal into a heap sufficient for the grab to bite into and lift. This process will involve some operational time as the grab content will largely get reduced as compared to a cream bite.

Such a sequence of operations are presented in the following Figures.

FIGURE – BABY DOZER HEAPING THE SCATTERED COAL

FIGURE – BABY DOZER FACILITATING GRAB BITE

FIGURE – BABY DOZER & GRAB WORKING IN TANDEM

When a fully loaded ship is discharged, the productivity will be higher as the grabs can take bite at the top of hatch with full grab content and less lifting height as compared to part discharged vessel. Thus its average discharge rate will be high. But in a partially loaded ship, the initial lift height itself will be more as he hatch content is already reduced. For clearing the last portion, the lifting height is more and the grab content is also less. All these cumulatively reduce the average productivity.

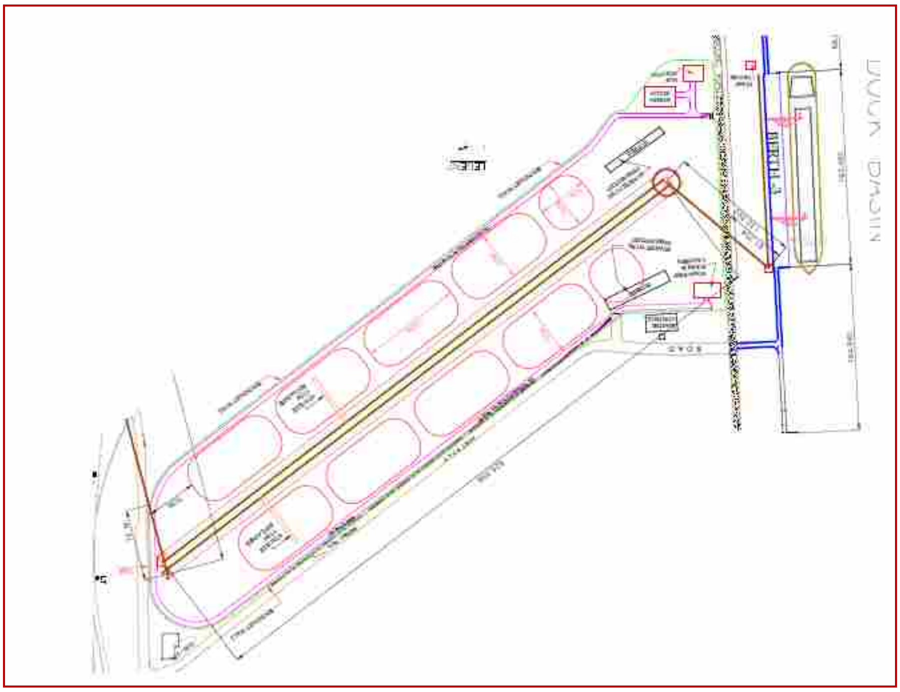
As can be seen from Table 8.1 the average productivity for coking coal and non-coking coal has been 18,084 TPD & 20,834 TPD for 2016-17. For 2015-16 the correspondingf figures are 16,981 TPD & 17,116 TPD.

Hence, taking the aforesaid issues into consideration, it is proposed that an average productivity of 20,000 TPD could be considered.

8.12.2 Berth - Stackyard Transfer

Keeping in mind the level of pollution that could be created due to handling by dumper and payloader system, it is planned to have a conveyor system. The unloaders planned will have integral hoppers, the coal unloaded will conveyed through hopper and shuttle conveyor to an elevated jetty conveyor located on the rear side of unloaders. The jetty conveyor will transfer the material into another conveyor through which the coal will be transferred to the yard stacking conveyors and finally transferred through stacker cum reclaimers into the stack yard. The conveyor system will have a matching rated capacity of 4000 TPH.

8.12.3 Layout of Stackyard:



Conceptual Layout of Stackyard

The material received through the conveyors and the stacker cum reclaimer into the stack yard will be stacked in a geometric shaped stockpiles. The stack yard is proposed to be equipped with two no stacker cum reclaimers. The conceptual layout of stack yard as proposed in this report will have a capacity of about 2.34 Lakh tons

8.12.3 Evacuation

It is proposed that all the cargo will be evacuated by rail. Thus about 2 to 3 rakes per day will be required for evacuation of planned annual throughput.

8.13 Optimum Capacity of Stockyard (*as per TAMP Guidelines)*

For a coal terminal TAMP guide line stipulates that the optimum yard capacity is 70% of maximum coal that could pass through the yard and is derived from the following formula.

Optimum Yard Capacity = 0.7 X A X Q X T tons

where A = is the stockpile area in sq. m

Q = Quantity that could be stacked per sq. m

T = Turnover ratio of the plot in a year

Total area of stockpiles = 8 x 100 x 50 + 2 x 50 x 50 = 45,000 m^2

Quantity that could be stacked per m^2 = 5.2 Te

Considering an evacuation rate of 2.4 rakes per day with each rake carrying 3800

Tons, the rate of evacuation per day is taken as 9120

Dwell time = 0.7 x 45,000 x 5.2/ 9,120 = 18 days

The average Plot turnover ratio in a year would therefore be 360/18 = 20

Yard capacity (0.7 x 45,000 x 5.2x20) = **3.276 MTPA**

8.14 Optimum Capacity of Berth (*as per TAMP Guidelines)*

It has been observed earlier in this section that the average handling rate is 20,000 tonnes per day.

Following TAMP Guidelines, the optimal capacity of the terminal is calculated using the following formula:

Optimal capacity

$$= 0.7 \times \frac{S1}{100} X\ P1 + \frac{S2}{100} X\ P2 + \frac{S3}{100} X\ P3 + \ldots X\ 365$$

S1 - Percentage share of capacity of Cargo type 1

P1 - Handling rate of the vessel carrying Cargo type 1

S2 - Percentage share of capacity of Cargo type 2

P2 - Handling rate of the vessel carrying Cargo type 2

S1, P1, S2, P2 and so on depending on the number of different types of Cargo to be handled at the berth of the particular port.

In the present proposal, the share of Panamax vessels and Handymax vessels are considered as 80% and 20% respectively based on the current trend.

According to the formula, the optimum capacity of the new berth (where only coal will be handled), works out to

$365 \times 0.7 \times 20{,}000 \approx 5.11$ MTPA say 5.00 MTPA

Therefore, the Optimum capacity of the TERMINAL:3.276 **MTPA** (*Lower of the two*)

SECTION 9
STOCK YARD, STACKING & EVACUATION

9.1 General:

The stockyard in a bulk unloading port is required for transit storage of bulk materials before evacuation for end user. The proposed mechanization of Berth No3 is planned for importing, transit storage and evacuation of coal. The volume and the number of stock piles should be commensurate with the grades of these materials handled, the throughput requirements for each grade and type of material, the rate of stacking, the rate of evacuation, vessel parcel size etc.

The required volumetric capacity of stack yard will depend on the bulk density and the angle of repose, the length, width and height of stock pile. If the height and width of stock pile are restricted, then the length has to be increased to maintain the same capacity. However, it is not always prudent to have a lengthy stack yard as that will entail too frequent travel over long distances for the yard machines. The width of stockyard has to be limited as too wide a stack will demand a long boom length for the yard machines which will increase their size and hence the cost much more than such arithmetic increase. The best way to optimise the capacity of a stack yard, therefore, is to optimise the height and width. The three aspects that impose limitation in stack height are:

1. Load bearing capacity of the soil: The proposed stack yard had been used for iron ore whose density is significantly more than coal for a number of years. As such no soil improvement wok is required except dozing to make level ground.
2. Limitation due to angle of Surcharge: With increase in height of stockpile, the surcharge angle will increase and if increased beyond specified angle, it will cause sliding of material while negotiating an incline such as the boom conveyor of stacker/reclaimer, inclined conveyor etc., thus making it technically not feasible. Further due to the limitation imposed by the angle of repose, the capacity increase of a stockpile will not be directly proportional to increase in height. To prevent spillage of coal on to the stacker/re-claimer track, 1.2m high RCC retaining wall is proposed along both sides of each track.
3. Pollution and Combustion due to Auto ignition: The coal has the property of combustion due to auto ignition on account of burden of coal in high stock piles. This is more pronounced if the coal stays in the stockyard for too long. Also too

much increase in stock pile height in an open stack yard may cause pollution due to windage.

The problems on account of points 2 and 3 above can be pronounced during hot and dry summer months. To limit the problem of auto ignition in case of coal and to contain pollution due to windage and optimise on the cost of improving soil for increasing the load bearing capacity of stockyard area, it is proposed to limit the height of coal stack yard to an optimal height of 10 meters. On a similar analysis the width of stock pile is planned is optimised to be 50 m.

It is proposed to plan for layout of stockyard with two parallel rows of stacks with a stacking capacity of 2.34 Lakh tonnes.

9.2 Stockyard Capacity Assessment

The capacity of stack yard planned depends on the annual throughput requirements, number of grades of materials, number of users, maximum vessel parcel size and rate of evacuation. In the section on Planning Parameters, the turnover ratio of stack yard per annum is taken as 20, with an average dwell time of about 18 days. Thus the stockyard capacity will be 7.14 % of annual throughput.

9.3 Stackyard planning:

Based on the capacity considerations as detailed above, the planning of stockyard is tabulated as below in Table 10.1

Table 10.1 - Stackyard Planning

Sl No	Description	
1	Annual Traffic	3.276 million tonnes
2	Norm for storage proposed as a Percentage of Annual Throughput	7.14 %
3	Capacity of stock pile required as per norm	2,34,000 Te
4	Density of coal	0.8
5	Angle of Repose	37^{0}
6	Height of stock pile	10 m for coal

7	Width of stock pile at the bottom	50 m
8	Width of stock pile at the top for coal	23.50 m
9	Length of stack proposed	100 m/50m
9	Length of the same stockpile at the top for coal	73.50 m (for 100 m long stock pile)
10	Volume of prismoid of each pile	32,442 m^3
11	Quantity stacked per pile having a length of 100 m at the bottom, a width of 50 m, a height of 10m for coal and with an angle of repose of 37°	25,954 Te ≈ 26,000 Te
12	Number of piles proposed	8 no of 100 m length and 2 no of 50 m length.
13	Total Length of stock pile proposed	900 m
14	No of Rows of stock piles proposed	2
15	No of stock piles proposed in each row	4 no of 100 m and 1 no of 50 m
16	Total No of stock piles proposed (as shown in the drawing)	10
18	Capacity of stock pile planned	2,34,000 Te

9.4 Locating the Stockyard

It has been proposed to locate the stockyard in the back up area of berth No 3 which is earmarked for the purpose and as per conceptual drawing enclosed.

9.5 Stack Yard Layout:

The stockyard area will be rectangular with 2 rows of stockpiles. There will be two tracks for the two Stacker cum reclaimers to operating independently. During ship unloading one Stacker cum Reclaimer will be deployed for stacking and the second one will be available for wagon loading. Whenever there is no vessel both the stacker cum recalimers will be available for stacking and depending upon operational exigencies any one of the two units can be used for reclaiming the coal from the stack yard for wagon loading. Both the Stacker and the reclaimers will run in between the two rows of stock piles parallel to each other independently, side by side and all the stock piles on either side can be accessed by both the stacker cum reclaimers.

9.6 Total Area of Stack yard vis a vis Area used for actual stacking:

The layout of stack yard planned is depicted in the drawing enclosed. The stock piles are laid out in two rows with one stacker cum reclaimer with a dedicated yard conveyor. Each row of stack yard consists of 5 stock piles with four stock piles having a length of 100 m and a width of 50 m (at the bottom) and a fifth stock pile having a length of 50 m. Each stock pile is separated from next by a gap of 10 m to avoid admixture. Thus after accounting for 490 m of length for actual stacking the remaining will be used for installing yard conveyors, two stacker cum reclaimers, for the purpose of accommodating the sloping conveyors, installing supporting facilities like dust suppression system, firefighting system, service road, workshop facilities, admin building, workers amenities building, substation etc. In view of these operational requirements the area that can be used for actual stacking will be about 45,000 sq.m (as per concept plan in this report). The existing RCC bunkers which are defunct need may dismantled and the area thus created may be used for locating additional stock pile and other operational requirements.

9.7 Evacuation:

The coal from stockyard will be evacuated through rail. The mechanized evacuation facilities will be in the form of a rapid in-motion wagon loading system. As the throughput the requirement is only 3.3 MTPA the rapid in-motion wagon loading system will have to cater to about three rakes per day at the most for the given throughput.

9.8 Railway Yard:

For evacuating the planned annual throughput of about 3.3 MTPA through in-motion wagon loading system, the existing railway yard located abutting the stack yard is proposed to be used. A rapid wagon loading silo of about 1000 tons capacity is proposed to be installed and the railway lines proposed for the exclusive purpose of berth 3 mechanization have been conceptualised as per the drawing enclosed.

9.8.1 Railway operations

The empty rake received in the port’s railway yard and earmarked for loading through the rapid wagon loading system berth No 3 will be hauled by port railways and handed over to the berth operator in the operator's yard. Thereafter the BOT operator will take over the rake and will haul the rake using their own locomotive. The empty wagon rake will be then moved at controlled speed to pass in the loading line under the silo. The loading will take place under controlled and specified speed to enable loading the full rake in about an hour. Once the loading is completed the locomotive will traverse through the BOT perator's second line for engine reversal. Thereafter the loaded rake will be kept ready for hauling by port's loco back into the port's railway yard for eventual handing over of loaded rake to the Indian railways.

The purpose of port handing over the empty rake to the operator in his yard and then takng over loaded rake from the same private operators yard is to ensure that the BOT operator's loco will not have to transgress into the port railway yard where a number of other movements will be taking place as per port operational planning and to avoid conflict or safety issues.

No lorry loading is permitted to avoid pollution of environment.

9.9 Assessment of Land area / other infrastructure required.

Since the entire facility is proposed to be developed on BOT basis, it is necessary to identify and earmark the facilities/infrastructure to be handed over to the prospective BOT operator which will be as follows.

a. The existing berth 3 structure will be made available for the prospective BOT operator to install gantry grab unloaders by the operator. However berth 3 per se as an asset will continue to be owned by the port and the port therefore will collect the berth hire charges. Hence the operator will not be required to pay towards the present assessed value of the berth nor any lease rentals for the water area in which the berth is located.

b. An area of 1,13,000 sq.m will be handed over to the BOT operator for their stack yard operations and supporting facilities.

c. The conveyor system to be installed have been conceptually worked out as shown in the enclosed drawing. As per this concept the system will have the following conveyor lines.

   1. Conveyor C1 in the berth area behind the gantry grab unloaders – 190 m
   2. Conveyor C2 from berth to stack yard – 130 m.

3. Conveyor C3 A and C3 B – Yard stacking/reclaiming conveyors – 2 x 625 m = 1250 m
4. Conveyor C4 – from stack yard to the wagon loading silo- 460 m

Of the above, the conveyors C1, C2 and C4 will be elevated conveyors and the remaining two viz., C3 A and C3 B will be ground level conveyors. Thus the total length of elevated conveyors will be about 780 m and the length of ground level conveyors will be about 1250 m.

d. The yard conveyors C3 A and C3 B will be fully within the area earmarked for the BOT operator. But the conveyor C1 will be fully outside the area allotted to the BOT operator. The remaining two conveyors C2 and C4 will be partly inside the area of the BOT operator and partly outside.
   For the conveyors that will be outside the leased area of the BOT operator a conveyor corridor of 6 m width is earmarked. Such area outside the BOT operator's leased area will be about 3834 sq.m
e. The area for installing two railway lines through a railway corridor is planned to be exclusively carved out as per conceptual plan enclosed and such area will be 30,150 sq.m.

SECTION 10

CAPITAL COAST ESTIMATE AND IMPLEMENTATIONCHEDULE

10.1 Capital Cost

The total capital cost of the project is estimated at Rs. 323.44 Crores. The detailed estimate is attached as ***Annexure 10.1.*** The summary break-up of the estimate is given as under:

(Rs. in crores)

	Particulars	**Costs**
I.	Civil Works	52.28
II.	Mechanical Works	218.78
III.	Electrical Works	12.90
	TOTAL	**283.96**
A	Detailed Engineering & Project Supervision @ 2%	5.68
b.	Contingencies @ 3%	8.52
C	GST @ 18% on civil works	9.88
D	GST @ 18% on mechanical &electrical works (ITC)	
	TOTAL CAPITAL COST	**308.04**
E	Miscellaneous Cost @ 5% of project cost as per TAMP	15.40
	GRAND TOTAL	**323.44**

Note: Input Tax Credit can be availed on GST paid on Mechanical / Electrical costs.
Hence not considered as Cap-ex and consequent Fixed assets.

10.2 Implementation Schedule

The project implementation period including detailed engineering for the above from the date of grant of concession is estimated at 27 months. The phasing of expenditure is given as under:

(Rs. In Crores)

Year	**Percent of Expenditure**	**Amount**
2018-19	25 %	80.86
2019-20	65 %	210.24
2020-21	10 %	32.34
TOTAL	**100 %**	**323.44**

Annexure 10.1

Detailed Capital Expenditure of the Project

S.No	Description	Amount (Rs. Crore)
A. Civil Works		
1	Construction of 4 transfer towers/ drive houses @ 0.25 Cr per drive house	1.00
2	Construction of Fixed Silo Structure Foundations	2.00
3	2 Stacker cum reclaimer tracks (each of 627 m length) @ Rs 6.0 Cr per KM	3.76
4	Service Road around the periphery of the yard (1620m x 5m) @ 12,000 per sq. m	9.72
5	Buildings consisting of Admin building, sub-station, control room, workshop ,stores, employees rest room, canteen etc.,	6.50
8	Laying of new railway lines for rapid wagon loading totalling to about 3,900 m (2 x 1950 m) at Rs 6 cr. Per km including land development for an average depth of 2.5 m and the tracks to withstand axle loads as per railway norms	23.40
9	Compound wall 1620 m long @ Rs. 10,000 per RM	1.62
10	1.2 m high RCC Concrete retaining Walls along the edge of Stacker-Re-claimer Track to prevent spillages – 1250 m long @10,000 per RM	1.25
11.	RCC Drain – 1 m wide x 1 m depth – 3200 m @Rs 9,000 per m	2.88
12	RCC settling tank 2 m depth and an area of 50 sq.m at Rs 30,000/- per sq.m	0.15
	Civil Works Cost (Total A)	**52.28**

B. Mechanical Works		
1	Gantry Grab unloaders - 2 Nos @ Rs 40 Crores each	80.00
2	Elevated Conveyors C1(190 m) and C2 (130) m @ Rs 1.9 Lakhs /m	6.08
3	Ground level conveyors C3 A and C3 B (each 625 m) 1250 m@Rs 1.2 Lakh/m	15.00
4	Stacker cum Reclaimers - 2 nos @ Rs 25 Crore each	50.00
5	Elevated conveyor C4 -460 m @Rs 2.5 lakh/m	11.50
5	Rapid Wagon Loading System including Silo structure	16.00
7	Shunting Loco – 1No	20.00
7	Front end loaders 4 No	1.20
8	In-motion Rail weigh bridge – 1 No	1.00
9	Workshop Facilities (LS)	6.00
10	Water supply and distribution system (LS)	2.00
11	Dust suppression and Firefighting facilities (LS)	10.00
	Mechanical Works Cost (Total B)	**218.78**
C. Electrical Works		
1	Electrical Power supply and distribution System including 33 KV/11KV substation	12.00

2	Illumination including High mast lighting	0.90
	Electrical Works Cost (Total C)	**12.90**
	Total Capital Cost (A + B + C)	**283.96**

SECTION 11
OPERATION AND MAINTENANCE COST

11.1 Capital Cost Estimate of the Project given in Section-10 (without GST on Mechanical and Electrical portion in view of Input Tax Credit available to the operator) is considered as the basis for calculating the annual operation and maintenance cost.

11.2 The annual operation and maintenance cost of the proposal is estimated at Rs. 66.28 Crores based on TAMP Guidelines for fixation of up-front tariff. The broad break-up of estimate is given in the table below.

Sl. No.	Particulars	Amount (Rs. in lakhs)
1.	**Repairs & Maintenance Cost**	**1856.00**
a)	Civil Works (1% of capital cost – Rs 6801.37 lakhs)	68.01
b)	Mechanical Works (7% of capital cost – Rs.24120.50 lakhs)	1688.43
c)	Electrical Works (7% of capital cost – Rs. 1422.23 lakhs)	99.56
2.	**Power and Fuel cost**	**471.23**
a)	Power for Operation of terminal (1.4 units per ton x 32.76 lakh tons x Rs. 8.47 per unit)	388.47
b)	Fuel cost for operation of Front End Loaders/Baby dozers – 4 Nos (3 dozers working and one standby) (12 ltrs ph x 3 dozers x Rs. 62.249 per litre x 8 hrs of operation per vessel and idle time/mobilisation)	24.74
c)	Fuel cost for operation of Loco – 1 No (30 litres x Rs. 62.249 per litre x 3 hrs of operation +20% towards positioning	58.02
3.	**Other Expenses** (Towards salaries and overheads @ 5% of Gross value of assets of Cargo handling Activity – Rs.32344.09 lakhs)	**1617.20**
4.	**Insurance** (@ 1% of Gross value of assets – Rs.32344.09 lakhs)	**323.44**
5.	**Lease rentals**	**482.33**
	Land area of 1,46,984 Sq .m (1,13,000 m2 + 3834 m2 + 30,150 m2) x Rs. 27.346 per sq.mtr p.m x 12 months	
6.	**Depreciation**	**1877.54**
a)	Civil structures - (3.17% of capital cost – Rs.6801.37 lakhs)	215.60
b)	Mechanical Works (6.33% of capital cost –Rs.24120.50 lakhs)	1526.83
c)	Electrical Works (9.50% of capital cost – Rs. 1422.23 lakhs)	135.11
7	**Total Operating Cost**	**6627.76**

11.3 The key assumptions for estimation of annual Operation and Maintenance expenditure are as follows.

11.3.1 Optimal Capacity Terminal:

The Optimal Capacity of the proposed Mechanised berth -3 is determined at 3.276 MTPA based on the norms prescribed in Upfront Tariff Guidelines 2008 / Tariff Orders considering the circumstances at Haldia Dock complex and the Lock gate constraints. The optimal quay capacity is working out to 5.11 MTPA at ship day output of 20000 tons for Panamax and Handymax vessels respectively considering 80% and 20% share. The Optimal Yard capacity is considered at 3.276 MTPA as explained in para 8.13. Hence the least of the two i.e. 3.276 MTPA is considered to be the optimal capacity of the terminal. Although the Capacity for all practical purposes shall be 3.3 MTPA it is taken as 3.276 MTPA for the purpose of TAMP calculations.

11.3.2 Repairs & Maintenance Cost:

As per norms specified in Upfront Tariff guidelines 2008, the Repairs & Maintenance cost is estimated at 1% of Civil assets and 7% of all Mechanical and Electrical equipment.

11.3.3 Power cost for Operation and Illumination:

a) Power Cost:

As per norms specified in Upfront Tariff guidelines, the power consumption for operation and illumination is taken at 1.4 units per tonne of cargo handled for the optimal capacity of 3.276 MTPA. The unit rate of power is considered at Rs. 8.47 by considering the rate paid for Jan 18 by Haldia as per the copy of the bill provided.

b) Fuel Cost:

i. Baby dozers:

The fuel cost for front end loaders is calculated at 12 litres per hour per loader with the prevailing cost per litre of Rs. 62.249 at Haldia as on 16th Feb 2018 as per the paid bill by HDC. Baby dozers shall work at an average of 6 hours per ship for pooling the cargo for Grab bite. Allowing 2 hours more for idle operations and mobilization, the actual hours of work are considered to be 8 hours per loader/dozer. At a given time only 3 loaders / dozers shall work in 3 hatches. Considering the average parcel size of 24000 MTs, the number of ships for handling the cargo of optimal capacity, works out to 138 p.a. which has been considered for calculating fuel consumption of front end loaders.

ii. Loco :

The fuel cost for Loco is calculated at 30 litres per hour with the prevailing cost per litre of Rs. 62.249 at Haldia as on 16th Feb 2018. For handling 100% of the 3.276 MTPA by rail, at the average rake capacity of 3800 tons with the time of 3 hrs taken for handling each rake and adding 20% for positioning of the rake, the number of hours required for loco to be used works out to 3107 hours which has been considered for calculating fuel consumption of Loco.

11.3.4 Other Expenses

As per norms specified in Upfront Tariff guidelines, other expenses are estimated at the rate of 5% of original capital cost of assets of Cargo Handling activity which include the following:

a) Salaries and wages of operating and maintenance staff including welfare and other expenses towards them.
b) Management and general overheads and other miscellaneous cost.

11.3.5. Insurance

As per Upfront Tariff guidelines, Insurance cost is estimated @ 1% of the total gross capital cost.

11.3.6. License Fee

License Fee payable for the land area of the project is estimated as per applicable lease rental rates of HDC @ Rs.26.81 per sqm per month as on 7/4/2017 escalated at 2% p.a. The area of land is taken from para 9.9 of technical section for the Stock yard, Railway yard and the area required for the conveyor trestle, service roads, Wagon loading area etc.

11.3.7 Depreciation

As per Upfront Tariff guidelines, Depreciation is estimated at 3.17% on Civil Assets, 6.33% of the capital cost of the Mechanical equipment and at 9.50% of Electrical and Communication systems on Straight line method as per the Companies Act 2013. However, the same is not considered in the cash flows being non cash expenditure for calculating IRR.

SECTION 12
ANNUAL REVENUE ESTIMATES

12.1. The Project is planned to be taken up through DBFOT. Since the Berth is constructed by the Port and is going to be maintained by the port, the Berth hire also accrues to the port besides the other Vessel related charges. Hence the BOT operator shall get the revenue earnings from the project from Cargo Handling charges only. The tariff shall be determined under Revised Reference Tariff guidelines 2013 or under Upfront Tariff guidelines 2008 in case no reference tariff is available for the given cargo profile in the port concerned or in any other Major Port. The said guidelines will also apply to Port's own Project. As such, the financial analysis has been carried out considering the entire project is taken up through DBFOT and no Reference Tariff for the similar operations is notified in HDC. Accordingly, the revenue from Cargo handling charges during a period of 30 years will accrue to Private operator and the Port will be entitled to a revenue share offered by the operator.

12.2 The estimated annual revenue based on Preliminary tariff assessed as per the upfront tariff guidelines 2008 / Tariff orders is given below:

S. No	Particulars	As Per TAMP
1.	Estimated Throughput (MTPA)	3.276
2.	Avg Cargo Handling Rate (Rs. per Ton)	360.28
3.	Revenue on Cargo Handling (Rs. In crore)	118.03
4	Berth Hire (Not to the Opearor)	
	Total Estimated Income (Rs. Cr)	**118.03**

12.3 The broad assumptions for the estimating the revenue are as follows.

12.3.1. The anticipated Handling charges are worked out based on the preliminary calculations of annual revenue requirement and capacity as per the TAMP Guidelines for determination of upfront tariff (2008.) / Tariff orders.

12.3.2. The port will also earn revenue from Vessel related charges as per the General scale of rates besides the revenue share offered by the Operator.

SECTION 13

FINANCIAL VIABILITY AND SENSITIVITY ANALYSIS

13.1 The Financial viability of the project, considering the 30 years' life period from the date of award of the construction of the project and considering the Tariff worked out in accordance with TAMP guidelines, works out to 15.37%. For arriving at FIRR, the Tariff is increased by 2% every year and all the O&M expenses are also escalated at 2% except Fuel which is escalated at 3%. The Operating income and the variable O&M expenditure are calculated based on the Cargo handled in the respective years ranging from 2.0 MTPA during the first year of operation i.e 2021-22 and with growth of 10% per annum till it reaches the optimal capacity of 3.276 MTPA. Replacement of major portion of Electrical assets is considered at the end of every 10 years and that of Mechanical equipment at the end of 15 years. The present day costs are escalated at 3% to arrive at the replacement cost of asset at that period.

13.2 Sensitivity analysis has also been carried out to gauge the impact of increase in cost and reduction of revenue earnings on the viability of the proposal. The results of the analysis are presented below. The detailed Cash flow statement is given at Annexure***-13.01.***

Table 13.01 (Not considering IDC)

S. No.	**Pre-Tax Project IRR at Constant prices**	**IRR (%)**	**NPV @ 12% (in Rs. cr)**
1	Base case	15.37%	96.48
2	Capital Cost up by 10%	14.16%	65.48
3	Revenue down by 10%	12.87%	23.47
4	Annual O&M Cost up by 10%	14.27%	64.11
5	Combined effect of Sl. no. 2, 3 & 4	10.57%	(-) 39.90

From the above, it is evident that the FIRR of the Project at Base case is 15.37% and even in the least case of sensitivity gives 10.57% and hence the Project is Financially viable for taking up through PPP. The Payback in absolute net revenues works out to be between 9 to 10 years and at NPV of 12% is between 14 to 15 years.

13.3. Although the FIRR is attractive, the Reference tariff works out to be higher than the tariff in other berths and terminals in view of availability of less stackyard and the lock gate constraints.

13.4. TAMP recognizes IDC by permitting 5% as Miscellaneous cost irrespective of the implementation schedule and the market rate of interest. The above IRR calculations are accordingly worked out. However, Ministry of Shipping vide their letter dated 1st Feb 2017 issued directions to provide second set of numbers calculating the IDC as per prevalent interest rate, implementation schedule etc while arriving at the cost of project along with IRR and project cost in case of PPP projects. Accordingly, the IDC calculated at 10% (prevailing market rate including processing charges etc) works out to Rs. 39.56 crores based on the implementation schedule given in section 10.2. Hence the total project cost including IDC works out to Rs. 363 crores (excluding GST on Mech / Elect assets as is stated in para 10.1. With the same assumptions given at para 13.1 above, the Financial viability and Sensitivity analysis is as under. The detailed Cash flow statement is given at ***Annexure-13.02.***

Table 13.2 (Considering IDC)

Sl. No	**Pre-Tax Project IRR at Constant prices**	**IRR (%)**	**NPV @ 12% (in Rs cr)**
1	Base case	14.15%	65.97
2	Capital Cost up by 10%	12.98%	31.92
3	Revenue down by 10%	11.76%	(-) 7.05
4	Annual O&M Cost up by 10%	13.11%	33.60
5	Combined effect of Sl. no. 2, 3 & 4	9.56%	(-) 73.47

13.5. From the above, it is evident that the FIRR of the Project at Base case is 14.15% and in the least case of sensitivity gives 9.56% and hence the Project is Financially viable for taking up through PPP. The Payback in absolute net revenues works out to be between 9 to 10 years and at NPV of 12% is between 17 to 18 years.

13.6. The viability of the project will be further prospective, in the event the operator achieves the productivity norms and eligible for 15% productivity increase in tariff over the notified tariff.

Annexure- 13.01

Mechanisation of B-3 at HDC

FINANCIAL FEASIBILITY - PROJECT IRR (not considering IDC)

				Rs Lakhs	15.37%	14.16%	12.87%	14.27%	10.57%
Year of Opn	**F Y**	**Cap-ex**	**Total Revenue**	**O&M Exps Excl depn**	**Net Operation Cashflows**	**Sensitivity Analysis**			
						Cap-ex +10%	**Revenue** -10%	**O&M** +10%	**Combined Effect**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	2018 - 19	8,086.02		482.33	-8,568.36	-9,376.96	-8,568.36	-8,616.59	-9,425.19
2	2019 - 20	21,023.66		491.98	-21,515.64	-23,618.00	-21,515.64	-21,564.84	-23,667.20
3	2020 - 21	3,234.41	-	501.82	-3,736.23	-4,059.67	-3,736.23	-3,786.41	-4,109.85
4	2021 - 22		7,646.66	4,615.39	3,031.27	3,031.27	2,266.60	2,569.73	1,805.06
5	2022 - 23		8,579.56	4,739.61	3,839.95	3,839.95	2,981.99	3,365.98	2,508.03
6	2023 - 24		9,626.26	4,870.28	4,755.99	4,755.99	3,793.36	4,268.96	3,306.33
7	2024 - 25		10,800.67	5,008.01	5,792.66	5,792.66	4,712.59	5,291.86	4,211.79
8	2025 - 26		12,118.35	5,153.50	6,964.85	6,964.85	5,753.01	6,449.50	5,237.66
9	2026 - 27		13,596.79	5,307.53	8,289.25	8,289.25	6,929.57	7,758.50	6,398.82
10	2027 - 28		14,105.45	5,424.32	8,681.13	8,681.13	7,270.59	8,138.70	6,728.15
11	2028 - 29		14,387.56	5,533.89	8,853.67	8,853.67	7,414.92	8,300.29	6,861.53
12	2029 - 30		14,675.31	5,645.68	9,029.64	9,029.64	7,562.10	8,465.07	6,997.54
13	2030 - 31	866.83	14,968.82	5,759.74	8,342.26	8,255.57	6,845.37	7,766.28	6,182.72
14	2031 - 32		15,268.19	5,876.11	9,392.08	9,392.08	7,865.26	8,804.47	7,277.65
15	2032 - 33		15,573.56	5,994.85	9,578.71	9,578.71	8,021.35	8,979.23	7,421.87
16	2033 - 34		15,885.03	6,116.00	9,769.03	9,769.03	8,180.53	9,157.43	7,568.93
17	2034 - 35		16,202.73	6,239.61	9,963.12	9,963.12	8,342.85	9,339.16	7,718.89
18	2035 - 36	34,085.21	16,526.78	6,365.73	-23,924.15	-27,332.67	-25,576.83	-24,560.73	-29,621.93
19	2036 - 37		16,857.32	6,494.41	10,362.91	10,362.91	8,677.18	9,713.47	8,027.74
20	2037 - 38		17,194.47	6,625.71	10,568.76	10,568.76	8,849.31	9,906.19	8,186.74
21	2038 - 39		17,538.36	6,759.67	10,778.68	10,778.68	9,024.85	10,102.72	8,348.88
22	2039 - 40		17,889.12	6,896.36	10,992.76	10,992.76	9,203.85	10,303.13	8,514.22
23	2040 - 41	1,164.94	18,246.90	7,035.83	10,046.14	9,929.64	8,221.45	9,342.55	7,401.37
24	2041 - 42		18,611.84	7,178.13	11,433.71	11,433.71	9,572.53	10,715.90	8,854.72
25	2042 - 43		18,984.08	7,323.32	11,660.76	11,660.76	9,762.35	10,928.42	9,030.02
26	2043 - 44		19,363.76	7,471.47	11,892.29	11,892.29	9,955.91	11,145.14	9,208.76
27	2044 - 45		19,751.04	7,622.64	12,128.40	12,128.40	10,153.30	11,366.14	9,391.03
28	2045 - 46		20,146.06	7,776.87	12,369.18	12,369.18	10,354.58	11,591.50	9,576.89
29	2046 - 47		20,548.98	7,934.25	12,614.73	12,614.73	10,559.83	11,821.30	9,766.41
30	2047 - 48		20,959.96	8,094.83	12,865.13	12,865.13	10,769.14	12,055.65	9,959.65
	Total	**68,461.07**	**4,26,053.60**	**1,71,339.84**	**1,86,252.70**	**1,79,406.59**	**1,43,647.34**	**1,69,118.72**	**1,19,667.25**
				FIRR	15.37%	14.16%	12.87%	14.27%	10.57%
				NPV@12%	₹ 9,648.33	₹ 6,548.44	₹ 2,346.55	₹ 6,411.26	₹ -3,990.40

Annexure- 13.02

Mechanisation of B-3 at HDC

FINANCIAL FEASIBILITY - PROJECT IRR considering IDC

				Rs Lakhs	14.15%	12.98%	11.76%	13.11%	9.56%
Year of Opn	**F Y**	**Cap-ex**	**Total Revenue**	**O&M Exps Excl depn**	**Net Operation Cashflows**	**Sensitivity Analysis** Cap-ex +10%	Revenue -10%	O&M +10%	Combined Effect
1	2	3	4	5	6	7	8	9	10
1	2018 - 19	8,490.32		482.33	-8,972.66	-9,821.69	-8,972.66	-9,020.89	-9,869.92
2	2019 - 20	22,923.87		491.98	-23,415.85	-25,708.24	-23,415.85	-23,465.05	-25,757.44
3	2020 - 21	4,885.98	-	501.82	-5,387.80	-5,876.40	-5,387.80	-5,437.98	-5,926.58
4	2021 - 22		7,646.66	4,615.39	3,031.27	3,031.27	2,266.60	2,569.73	1,805.06
5	2022 - 23		8,579.56	4,739.61	3,839.95	3,839.95	2,981.99	3,365.98	2,508.03
6	2023 - 24		9,626.26	4,870.28	4,755.99	4,755.99	3,793.36	4,268.96	3,306.33
7	2024 - 25		10,800.67	5,008.01	5,792.66	5,792.66	4,712.59	5,291.86	4,211.79
8	2025 - 26		12,118.35	5,153.50	6,964.85	6,964.85	5,753.01	6,449.50	5,237.66
9	2026 - 27		13,596.79	5,307.53	8,289.25	8,289.25	6,929.57	7,758.50	6,398.82
10	2027 - 28		14,105.45	5,424.32	8,681.13	8,681.13	7,270.59	8,138.70	6,728.15
11	2028 - 29		14,387.56	5,533.89	8,853.67	8,853.67	7,414.92	8,300.29	6,861.53
12	2029 - 30		14,675.31	5,645.68	9,029.64	9,029.64	7,562.10	8,465.07	6,997.54
13	2030 - 31	866.83	14,968.82	5,759.74	8,342.26	8,255.57	6,845.37	7,766.28	6,182.72
14	2031 - 32		15,268.19	5,876.11	9,392.08	9,392.08	7,865.26	8,804.47	7,277.65
15	2032 - 33		15,573.56	5,994.85	9,578.71	9,578.71	8,021.35	8,979.23	7,421.87
16	2033 - 34		15,885.03	6,116.00	9,769.03	9,769.03	8,180.53	9,157.43	7,568.93
17	2034 - 35		16,202.73	6,239.61	9,963.12	9,963.12	8,342.85	9,339.16	7,718.89
18	2035 - 36	34,085.21	16,526.78	6,365.73	-23,924.15	-27,332.67	-25,576.83	-24,560.73	-29,621.93
19	2036 - 37		16,857.32	6,494.41	10,362.91	10,362.91	8,677.18	9,713.47	8,027.74
20	2037 - 38		17,194.47	6,625.71	10,568.76	10,568.76	8,849.31	9,906.19	8,186.74
21	2038 - 39		17,538.36	6,759.67	10,778.68	10,778.68	9,024.85	10,102.72	8,348.88
22	2039 - 40		17,889.12	6,896.36	10,992.76	10,992.76	9,203.85	10,303.13	8,514.22
23	2040 - 41	1,164.94	18,246.90	7,035.83	10,046.14	9,929.64	8,221.45	9,342.55	7,401.37
24	2041 - 42		18,611.84	7,178.13	11,433.71	11,433.71	9,572.53	10,715.90	8,854.72
25	2042 - 43		18,984.08	7,323.32	11,660.76	11,660.76	9,762.35	10,928.42	9,030.02
26	2043 - 44		19,363.76	7,471.47	11,892.29	11,892.29	9,955.91	11,145.14	9,208.76
27	2044 - 45		19,751.04	7,622.64	12,128.40	12,128.40	10,153.30	11,366.14	9,391.03
28	2045 - 46		20,146.06	7,776.87	12,369.18	12,369.18	10,354.58	11,591.50	9,576.89
29	2046 - 47		20,548.98	7,934.25	12,614.73	12,614.73	10,559.83	11,821.30	9,766.41
30	2047 - 48		20,959.96	8,094.83	12,865.13	12,865.13	10,769.14	12,055.65	9,959.65
	Total	**72,417.15**	**4,26,053.60**	**1,71,339.84**	**1,82,296.61**	**1,75,054.90**	**1,39,691.25**	**1,65,162.63**	**1,15,315.55**
				FIRR	14.15%	12.98%	11.76%	13.11%	9.56%
				NPV@12%	₹ 6,596.95	₹ 3,191.93	₹ -704.83	₹ 3,359.88	₹ -7,346.91

Annexure-II

Project Report

FOR

“MECHANISATION OF BERTH NO 3 ON PPP MODE’’

DECEMBER, 2018

HALDIA, WEST-BENGAL-721 607

Contents

1. Executive Summary:

1. The proposal relates to Mechanisation of Berth No. 3 on PPP mode at Haldia Dock Complex to handle dry bulk cargo and proposed work on TEFR submitted by IPA.

2. As per the traffic projections proposed by IPA in their TEFR, Haldia Dock Complex is required to equip itself to handle 24.4 million tonnes of dry bulk cargo by 2020-21 and 29.9 million tonnes by 2025-26.

3. As per planning principles, cargo handling capacity should be at least 20 percent above the projected demand to avoid detention of vessels. The underlying principle is that berth should wait for the ship not vice versa. Since vessels arrive at Random, this spare capacity will address peak seasons also. Accordingly, the supply and demand position is as below:

Particulars	Capacity (MTPA)
Dry cargo Handling Capacity as on 31-3-2017	25.0
Capacity addition expected by 2025-26 (OT-1)	5.0
Total Capacity by 2025-26	30.0
Capacity required to handle projected cargo by 2025-26	29.9
Capacity required at 20% more than the traffic	6.0
Total required capacity	35.9
Balance required capacity to be added	5.9

Thus, HDC is required to enhance the capacity to handle dry cargoes present and projected with the capacity addition.

4. According to the lock gate perspective, ship scheduling and the no of vessels that can be handled through the lock gate system becomes a deciding factor in enhancing the capacity of berths in the impounded dock. After taking appropriate measures as being contemplated by port the lock gate system can handle an additional 2 to 3 movements per day thus making it possible to handle additional vessels due to enhanced capacity of berths in the impounded dock system. Thus, IPA considered mechanization of berth No 3 is viable from this aspect as well.

5. IPA had also recommended that the physical life of berth structure can be enhanced by taking required short and long term maintenance measures systematically. After undertaking repairs as would be recommended in a 'Condition Survey', the berth can be used for another 35 to 40 years. In view of the foregoing, mechanisation of berth 3 is technically feasible for investment. Inline with the above, HDC had engaged IIT(M) for condition survey of the Berth no-3 and their recommendation in this regard. IIT(M) has already submitted their report along with repairing activity involved. They have submitted a estimate of 2.54 Crores for repairing of the Jetty.

6. For a coal terminal, TAMP guidelines stipulates that the optimum yard capacity is 70% of maximum coal that could pass through the yard. The optimal capacity of the yard is 3.5 MTPA. The average unloading rate from vessels is 20,000 tonnes per day based on equipment proposed and the vessel parcel size.
Following TAMP Guidelines, the optimal capacity of the berth terminal is calculated as 3.5 million tonnes per annum.

7. The backup area is trapezoidal in shape with a bell mouth like shape at one end. The back-up area considered has a width of 150 m for most part of the length and has a total area of about 1,13,000 Sq. m. excluding the land for SILO, Loading Conveyor and Rail line. Based on conceptual layout of stack yard it will have three rows of stockpiles. Thus each row of stack yard consists of 5 stock piles. There will be two seperate tracks for two yard Conveyor each having one stacker cum reclaimers and they will operate in between the three rows of stock piles parallel to each other.

8. It has been proposed to locate the stockyard in the back up area of berth No 3 as earmarked. The coal from stockyard will be evacuated through rail. 20% evacuation through road is considered keeping in the view of customer demand.

9. The proposed mechanization envisages following equipment & major work to enable full scale mechanized system of ship unloading, conveying, stock piling and evacuation by rail.

Sl.No	Description	Qty.
1.	1500 TPH Rail Mounted Gantry Grab Unloader including 35 CBM Grab with rail span of 13.687 M.	2 Nos
2.	Conveyor 3000 TPH capacity (Approx 2200 m) including transfer points and foundation etc.	1 Lot
3.	Stacker cum Reclaimer–Stacking-3000 TPH, Reclaiming - 2000 TPH, with Boom Length-30 m, Long travel rail gauge- 6m,	2 Nos.
4.	SILO- for rapid Wagon Loading site 2000 MT including construction foundation.	1 Lot
5.	Supply and laying of new railway lines for rapid wagon loading totaling to about 3900 m (2x1950m) including land development.	1 Lot
6.	Electrical power supply and distribution system including 3.3 kv substation.	1 Lot
7.	Dust suppression system and Fire Fighting facilities including water supply and distribution.	1 Lot
8.	Extension of existing track line of Stacker Cum Reclaimer (150 M) & replacement of old CR 80 rail.	1 Lot
9.	Illumination including high mast lighting	1 Lot
10.	In motion Rail weigh Bridge	2 No
14.	Bulldozer	1 No

List of hiring equipment (by HDC):

Sl. No.	Description of the equipment	Qty
01.	Shunting Loco, 5500 MT haulage capacity	01 No.
02.	Front end loader (3 cu m capacity)	04 Nos.
03	Front end Loader, 10 MT capacity	02 Nos
04.	Excavator, Capacity 3 Ton	01 No.
04.	Hydra (15T)	01 No.

10. The total capital cost of the project is estimated at Rs. 331.94 Crores including GST. The summary of break-up of the estimate is given as under:

BLOCK COST ESTIMATE

Capital Cost	-	[Rs in Crore]
Cargo Handling Activity	-	
(i). Civil Cost		
Revamping of the Existing Berth to accommodate the Loaders and other Machineries		2.54
Civil Foundation for Conveyer Structure		5.00
Civil Works for Silo System		5.00
Construction of New Railway Lines for Rapid Wagon Loading System		24.25
Extension of existing Track Line of Stacker cum Reclaimer		3.28
Service Road		4.65
RCC Drain		2.66
Compund Wall		3.65
Laterite Hard Stading of the Yard		8.10
Detailed Designs & Project Supervision costs @ 2%		1.18
Contingencies @ 3%		1.77
GST on Civil works @ 18%		11.18
Civil Cost including GST		**73.26**
(ii). Mechanical Equipment Cost		
1500 TPH Rail Mounted Gantry Grab Unloader including 25 CBM Grab with rail span of 13.687 M.		90.00
Conveyor 3000 TPH capacity (Approx 2200 m) including transfer points		38.00

Stacker cum Reclaimer– Stacking-3000 TPH, Reclaiming - 2000 TPH, with Boom Length-30 m, Long travel rail gauge- 6m,		35.10
SILO- for rapid Wagon Loading site 2000 MT		19.25
Dust suppression system and Fire Fighting facilities including water supply and distribution.		6.90
In motion Weigh Bridge		0.86
Bull Dozer		4.00
Detailed Designs & Project Supervision costs @ 2%		3.88
Contingencies @ 3%		5.82
GST on Mechanical Works @ 18% [Assumed Full ITC]		0.00
Mechanical Cost		**203.81**
(iii) Electrical Works		
Electrical Power Supply and Distribution System including Substation		36.20
Illumination with High Mast Lighting System		1.00
Detailed Designs & Project Supervision costs @ 2%		0.74
Contingencies @ 3%		1.12
GST on Mechanical Works @ 18% [Assumed Full ITC]		0.00
Electrical Cost		**39.06**
Total		**316.13**
(iv). Miscellaneous		
5% on Civil Cost and Equipment Cost		**15.81**
Total Capital Cost for Handling Activity (i + ii + iii+iv)		**331.94**

11. The estimated annual revenue based on tariff assessed as per the tariff guidelines 2008 / Tariff orders is given below:

S.No	Particulars	Unit	As per TAMP guidelines
1	Estimated Throughput	MTPA	3.5
2	Avg Cargo Handling Rate for Foreign Cargo	Rs. Per ton	376.65
3	Estimated Revenue Requirement on Cargo Handling	Rs. Cr	130.52

13. Sensitivity analysis has also been carried out to gauge the impact of increase in cost and reduction of revenue earnings on the viability of the proposal (copy enclosed **at Annexure-A**). The results of the analysis are presented below.

Table 13.01 (Not considering IDC)

S.No	Project IRR	IRR	NPV@10% (in Cr.)
1.	Base Case	18.78%	132.42
2.	Revenue decreased by 10%	14.77%	52.21
3.	Cost increased by 10%	16.98%	106.42
4.	Both cargo decrease & cost increase by 10%	13.25%	25.66

From the above, it is evident that the FIRR of the Project at base case is 18.78% and in the least case of sensitivity gives 13.25% and hence the project is financially viable for taking up through PPP mode.

SECTION 1

INTRODUCTION

1.1 Preamble

Government of India, with its stated objective of transforming the existing ports into modern world-class ports, and develop new ports based on the trade requirement has taken up the SAGARMALA PROJECT. Towards this endeavour, a consortium of McKinsey and AECOM were appointed as Consultants to carryout origin destination study as well as prepare a National Perspective Plan by way of preparing a Master plan for all the major ports and further suggest new ports to be developed as required.

The Consultants as part of deliverables of this study developed a Draft Master Plan for Kolkata Port Trust (including Haldia Dock System) in December 2015. In this report the Consultants considered the complexity of lock gate operation for berthing/ un-berthing of vessels and need for segregation of cargo mix to be handled at various berths and optimisation of port facilities. In line with this, they have suggested shifting some of the selected liquid cargoes (cargoes to be identified by the Port) to a new berth to be developed outside the dock basin and utilise dry cargo berths inside the dock for handling dry bulk cargo (cargoes to be identified by the Port) to the extent possible. As part of this strategy they have further recommended mechanization of existing old berth No 3 inside the dock basin.

The recommendation of M/s AECOM is reproduced below-

Quote:

"7.3.1. Mechanising Eastern Berths 2 and 3*: To start with, the eastern berth 2 & 3 could be mechanised for up-gradation and these berths shall be developed only for handling of dry bulk cargo and all the liquid cargo shall be taken away to berths outside the basin. It is proposed that the initial mechanisation be taken up at berth No.3 which was earlier used for handling iron ore exports. Berth No.2 could continue to handle the cargo using MHC, dumpers and front end loaders.*"

Unquote:

In the government's publication "Advantage Maritime India" the project was further defined as depicted below.

15. Project Name: Mechanisation of Berth 3 at Kolkata Port

S.No	Parameters	MIS 2016/ Cat4/ KoPT (Haldia)/4
1	Project Category-	Sagarmala - Port Modernisation
2	Project Proponent	Kolkata Port Trust- Haldia Dock
3	Project Objectives	Presently, Berth 3 is under utilised by handling small parcels of POL along with mix of other cargo, while the land and other infrastructure for handling coal is available.
4	Project Type	PPP
5	Tentative Cost Estimates	INR 150 Crore (USD 23.1 million)
6	Project Details	Berth 3 will be mechanised with two mobile harbour cranes with integrated hoppers, a conveyor system and at stack yard with stacker-reclaimers and wagon loader. With these, the berth may handle 3 MMTPA. It could be further enhanced to 4 to 4.5 MMTPA by reducing the dwell time. Capacity: 4 – 4.5 MMTPA
7	Project Status	KoPT will undertake Feasibility Study shortly.
8	Total Land Requirement	Land is available.

From the above it can be understood that the Sagaramala proposal is mechanization of berth 3 with two mobile harbour cranes with integral hoppers, a conveyor system and stack yard with stacker reclaimer and wagon loader to handle 3 MTPA which could be enhanced 4 to 4.5 MTPA later.

In order to *crystallise* this proposal the Port authority entrusted the work of "Preparation of Techno Economic Feasibility report for MECHANISATION OF BERTH NO 3" of Haldia Dock Complex to The 'Indian Ports Association' (IPA).

After detailed study, IPA submitted their TEFR considering viability of the project on PPP mode and recommended 2 nos Gantry Grab Unloader, Two nos Stacker Cum Reclaimer, Conveyor system and One SILO of 2000 Ton Capacity.

Inline with the meeting of Hony Minister of Shipping of Road Transport & Highways at Vishakhapatnam on 12.07.2018, it was decided to take up the project of mechanisation of berth No. 3 on EPC basis by Haldia Dock Complex including yard development of back up area and rail connectivity.

Accordingly, DIB proposal was sent to Ministry of Shipping and in the DIB meeting held on 14.12.2018 at New-Delhi chaired by Secretary (Shipping), it was decided that the Project will be taken up on PPP mode.

SECTION 2

PRESENT SETTING

2.1. Introduction

Kolkata Port, the oldest in India, is located on the east coast on the river Hooghly in the state of West Bengal. It became operational in the year 1870. It was declared as a Major Port under the Major Port Trust Act 1963. Subsequently in 1977, Haldia Dock Complex (HDC) was constructed as a satellite extension to Kolkata Port. The shipping activity at Haldia started with an oil jetty in the year 1968.

Haldia Dock Complex (HDC), an integral part of Kolkata Port Trust is located on the western bank of river Hooghly at Latitude: 22^0 02’ N and Longitude: 88^0 06’ E. It is about 104 km downstream of Kolkata and 130 km upstream from Sand heads. It handles a major share of Kolkata Port traffic. The layout of the HDC is given in the Picture. The details of berthing facilities available at HDC are presented in Table 2.1.

The pilotage distance to Haldia is about 130 km of which 75 km is sea pilotage. Remote pilotage assistance is provided through VTMS during the sea passage and in the channels. For vessels calling at Haldia, the pilot launching is undertaken south of Eden in fair weather and north of Eden during foul weather. For outward passage the same process is used in reverse order.

2.2. Hinterland

The hinterland of Kolkata/Haldia comprises of the entire Eastern India including West Bengal, Bihar, Jharkhand, eastern part of Uttar Pradesh, north east of Madhya Pradesh, Chattisgarh, Assam and other North Eastern States and the two landlocked neighboring countries viz. Nepal and Bhutan. But the primary hinterland consists of West Bengal, Jharkhand and Bihar which have major industries consuming fuel/ raw materials imported through this port. The industrial development, commerce and trade of this vast hinterland is inseparably linked to the life and development of Kolkata/ Haldia Port and vice-versa.

2.3. Connectivity

Haldia dock complex is well connected to the hinterland by road, rail and inland water ways. Haldia is accessible through NH 41 to Kolaghat where it meets NH 6. The HDC is well connected to South-Eastern railway network.

2.4. Berthing facilities

Haldia is an all-weather port having a 300.2 m long and 39.6 m wide lock gate and a 450 m dia turning basin. The Haldia dock Complex (HDC) consists of 17 berths of with 14 berths are inside the dock and the remaining 3 outside the dock which are all riverine jetties designed for handling liquid cargoes. Presently all dry bulk cargo is handled in berths inside the dock. There are two berths exclusively handling Containers and some berths handle only bulk liquids like edible oils and Paraxylene. The depth inside the impounded dock system at all the berths on an average is 9.5 m. The details of berths such as designed draft, LOA and permissible DWT are presented in the table below:

Table 2.1

Berthing Facilities

Sl. No	Berth No.	Type of Berth/Cargoes normally handled	Design Draft (Mtrs.)	Quay length (Mtrs.)	Maximum Vessel size	
					LOA (Mtrs)	DWT Designed
1	HOJ-I	Liquid Bulk Berth - Handling POL, Liq. Ammonia, LPG & Chemicals	12.2	290	236	90000
2	HOJ-II	Liquid Bulk Berth - Handling POL Crude, POL Product & LPG	12.2	330	277	150000
3	HOJ-III	Liquid Bulk berth - Handling POL Crude and POL Product	12.5	345	275	150000
4	2	Multipurpose Berth for handling Dry Bulk mainly Coke, Coal, Ore & Limestone	10	260	238	75000
5	3	Multipurpose Berth for handling Dry Bulk like coke, Coal, Ore & Limeston e along with POL (Product), and Chemicals, mainly Paraxylene	12.2	337	239	75000
6	4	Mechanized Berth for handling Thermal Coal (Loading)	12.2	284	239	75000
7	4A	Mechanized Berth for handling Coking Coal (Unloading) Operated by ISPL	12.2	245	230	75000
8	4B	Multipurpose Berth for handling Dry Bulk & Break Bulk Cargo.	12.2	181	180	75000
9	5	Multipurpose Berth for handling Dry Bulk, Break Bulk & Liquid Bulk Cargo.	12.2	195	183	75000

10	6	Multipurpose Berth for handling Dry Bulk, Break Bulk & Liquid Bulk Cargo.	12.2	234	212	75000
11	7	Multipurpose Berth for handling Dry Bulk, Break Bulk & Liquid Bulk Cargo.	12.2	234	212	75000
12	8	Multipurpose Berth for handling Dry Bulk & Break Bulk Cargo.	12.2	218	220	75000
13	9	Multipurpose Berth for handling General &Dry Bulk cargo	12.2	218	210	75000
14	10	Container Handling	12.2	220	210	75000
15	11		12.2	220	210	75000
16	12	Multipurpose Berth for handling Dry Bulk& general cargo (only clean cargoes)	12.2	220	210	75000
17	13	Multipurpose Berth for handling Dry Bulk, general cargo	10	220	210	75000
18	Floating Jetty	Coal, Jipsam		150		
Note: Vessels with a maximum beam of 32.3 meters can enter impounded dock						
Source: Administrative Reports of HDC						

2.5. Handling Capacity of HDC:

The handling capacity of a port/berth depends upon the length of berth, the draft, the type of cargo handled, the vessel parcel size etc. Apart from these, the single most important factor that decides the capacity calculations is the type of onshore handling facilities. The usable capacity of Haldia dock complex is assessed as 42.7 million tonnes. Based on the facilities available at various berths inside the Haldia dock complex, the dry cargo handling capacity is presented in the following statement. The assessment appears to be based on available onshore handling facilities and many assumptions.

Table 2.2
Assessed Capacity of Dry bulk cargo handling berths

Berth No	Predominant Cargoes handled	On-shore handling Facilities available	Assessed capacity based on facilities
HOJ I, HOJ II HOJ III	Crude , POL, LPG, Chemicals, and other liquids	Marine unloading arms & pipelines	

2	Coal ,limestone and other bulk	Two MHCs of 100 T capacity	4
3	Formerly an iron ore handling berth. Now caters to paraxylene, SKO, furnace oil, HSD etc.	Pipelines for liquid cargo	
4	Thermal coal (Export through mechanized handling system)	2 - 1500 TPH Wagon Tipplers, 2 Stacker-cum-Reclaimers, 2 -1500 TPH Shuttle Boom type Ship Loaders, 2 - Wagon Feeding Systems 20,000 MT per day.	3.7
4A	Coal (Import through mechanized handling system)- By ISPL	2 - Stacker-cum- Reclaimers, 2 Wagon Loaders, 2 - Mechanized Grab un-loaders	3.5
4B	Dry Bulk Cargo	2 MHC's at 20,000 TPD	4
5	Liquid bulk cargo	Pipelines	
6&7	Phosphoric acid Sulphuric acid etc.	Pipeline and floating oil jetty	2.0
8	Primarily dry bulk cargo	2 No MHC's @20,000 TPD	4
9	Dry and break bulk cargo	two MHC's@20,000 MTPD	
10&11	Container cargo	2 No RMQC and other associated equipment	
12	Dry bulk as well as break bulk - Operated by TMIL	Ship cranes and one MHC	2
13	Clean dry bulk and break bulk	TWO MHC capacity 100 tonne (recently commissioned)	4
	Total dry bulk handling capacity (For all dry bulk cargoes put together such as coal, Limestone, Manganese ore, Sugar, Iron ore, Fertilizer, Fertilizer raw material etc.		25
Compiled from data available at Port.			

SECTION 3
Traffic & Performance

3.1 Thermal Coal (Loading Cargo):

Thermal coal being brought from domestic coal mines (Raniganj) by rail for loading into ship at Berth No. 4 for shipment to Tuticorin Port as coastal cargo for use by Tamil Nadu Electricity Board Power Plant at Tuticorin.

The volume is low but is picking up slowly. In view of Govt. of India initiative to use domestic coal instead of imported coal, coastal volume will rise in coming years and will gradually rise to 3 million tones which can be handled at Berth No. 4 itself. However this volume will be shown separately to know total coal volume at Haldia Port.

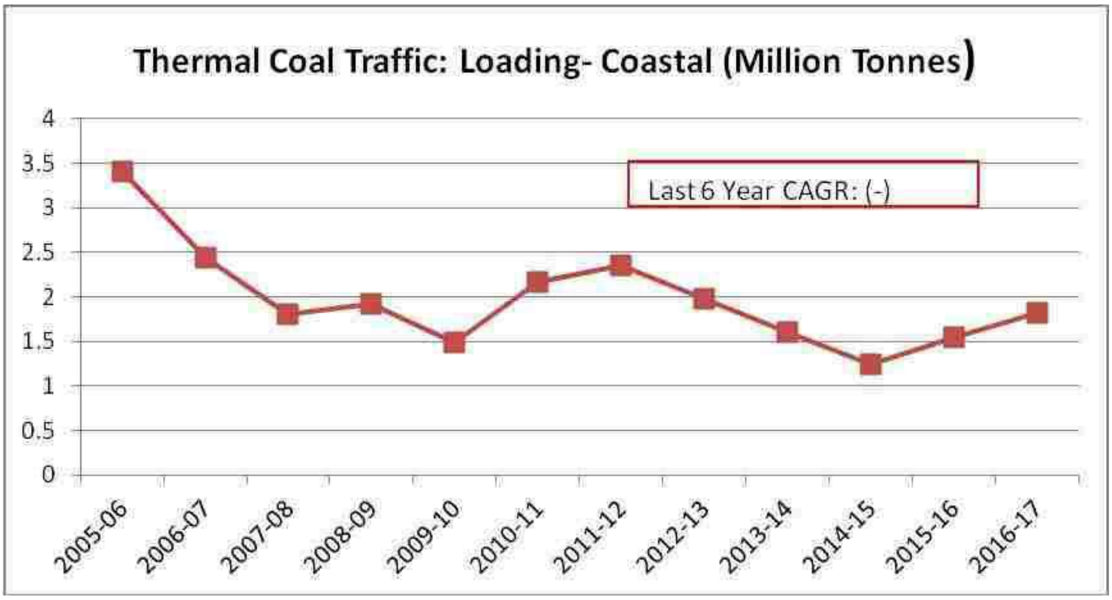


Figure 3.1

3.2 Non Coking Coal (Trans-loading Cargo):

Non coking coal/Thermal coal (import) handled from Sagar area by NTPC for its Farakka Thermal Power Plant does not come to HDC at any berth. This traffic shall not be taken into account for arriving at traffic to be handled at Haldia as this cargo moves through barges to Farakka after discharge in mid-stream. However this volume will be shown separately.

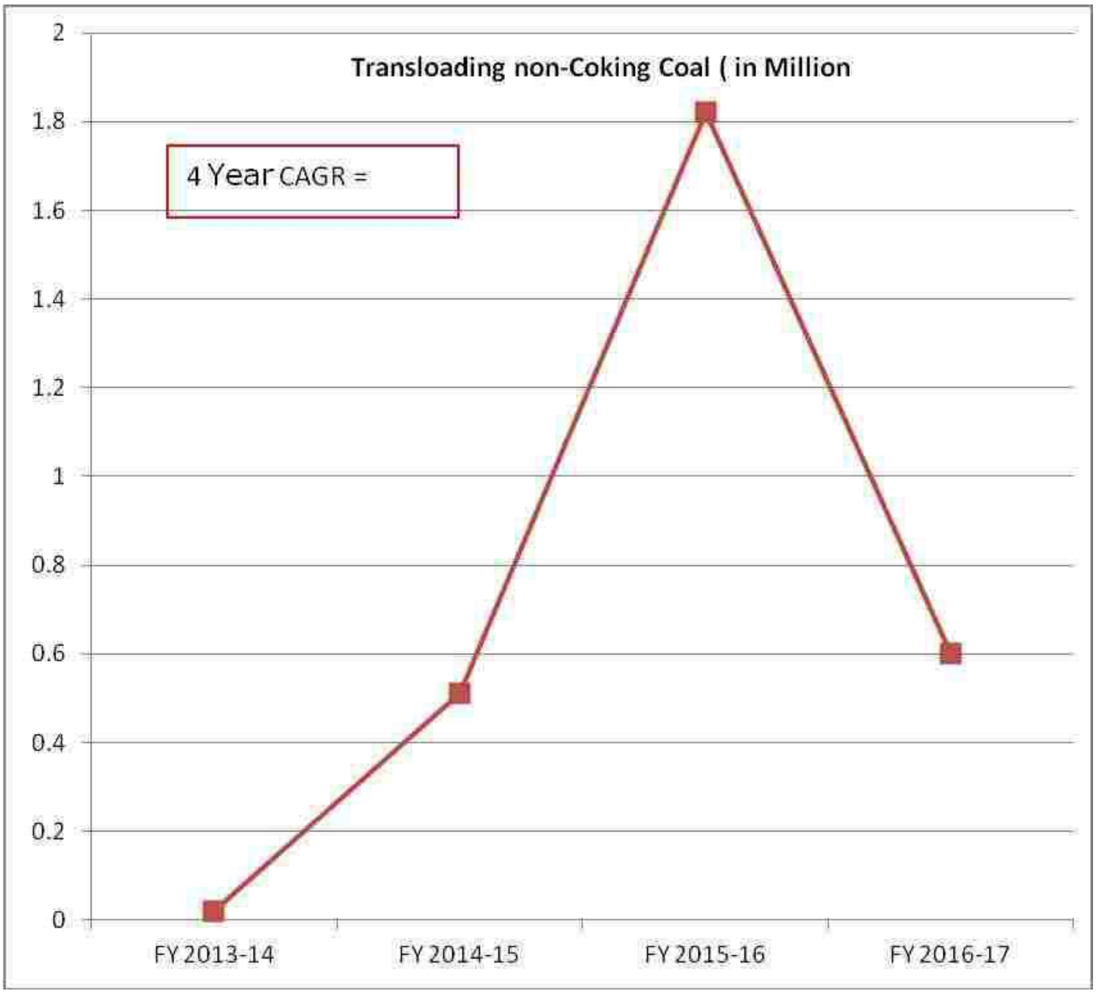


Figure 3.2

3.3 Other Non-Coking Coal (Import Cargo):

The growth trend of other non-coking coal handled in HDC for the last 6 years is depicted below.

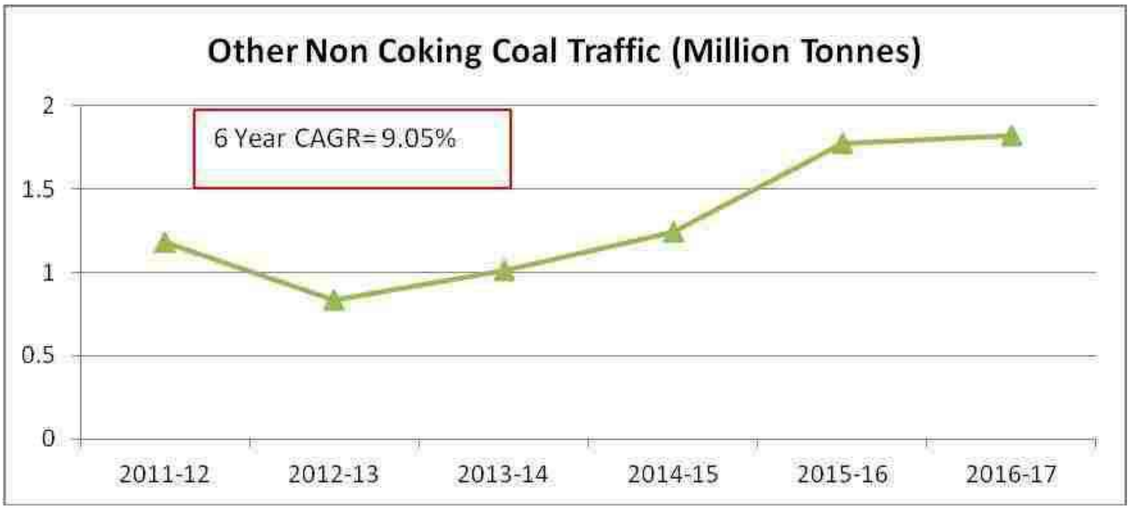


Figure 3.3

3.4. Coking Coal (Import Cargo):

Coking coal is primarily used in steel industry. In 2016, the world crude steel production reached 1628 million tonnes (mt) and showed a growth of 0.8% over 2015. China remained world's largest crude steel producer in 2016 (808 mt) followed by Japan (105 mt), India (96 mt) and the USA (79 mt). The per capita consumption of finished steel in 2015 is placed at 208 kg for world and 489 kg for China by World Steel Association.

World Steel Association has projected Indian steel demand to grow by 5.4% in 2016 and by 5.7% in 2017 while globally, steel demand has been projected to grow by 0.2% in 2016 and by 0.5% in 2017. Chinese steel use is projected to decline in both these years.

Crude steel capacity was 121.97 mt in 2015-16, up by 11% over 2014-15 and India, which emerged as the 3rd largest producer of crude steel in the world in 2015 as per ranking released by the World Steel Association, has to its credit, the capability to produce a variety of grades and that too, of international quality standards. The country is expected to become the 2nd largest producer of crude steel in the world soon. As per the New Steel Policy 2017 India aspires to achieve 300 MMT of steel-making capacity by 2030. This would translate into additional investment of Rs.10 lakh Crore by 2030-31. New Steel Policy seeks to increase per capita steel consumption to the level of 160 Kgs by 2030 from existing level of around 60 Kg.

The crude steel capacity may reach 150 MMT by 2020 requiring 110 MMT of Coking coal. Thus the total coking coal imports by 2020 are expected to be of the order of 70 MMT.

Coking Coal or Metallurgical coal to be used in manufacturing steel should have carbon to be as volatile-free and as ash-free as possible. Coking coal is also heated to produce coke, a hard porous material which is then used to blast in furnaces in steel plants for the extraction of iron from the iron ore.

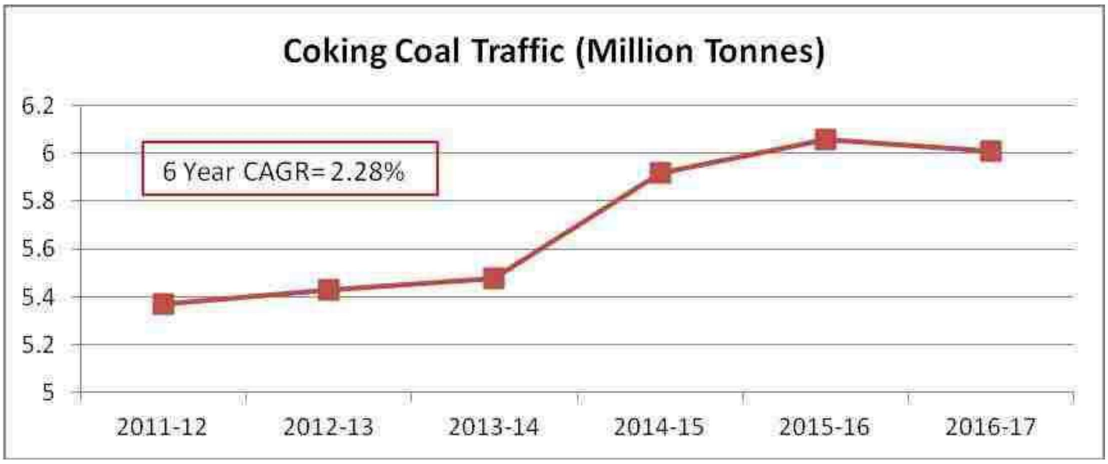


Figure 3.4

The figure above shows the trend in coking coal imports.

3.5. Cokes (Import Cargo):

Various types of cokes (RP Coke, Nut Coke, and Met Coke) handled at various berths inside HDC or to be handled at floating barge jetty will be taken into account for arriving at traffic to be handled. These cokes are used in iron & steel industries. Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace. As seen from traffic trend from FY 2011-12 to 2015-16, the coke traffic has risen considerably in last six years showing CAGR of 11.84%.

The trend in coke traffic for last 6 years at HDC is shown in Figure 4.7 hereunder.

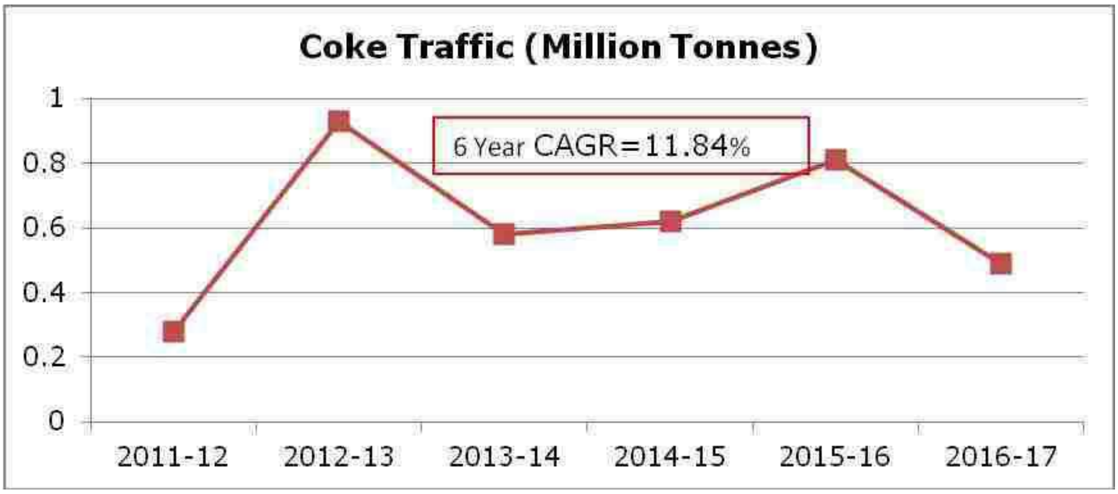


Figure 3.5

3.6 Coal Traffic Projection Based on Trend (CAGR Based):

The traffic projection for coal imported coal traffic at HDC based on CAGR trend is presented in the following Table 3.1.

Table 3.1

Traffic Projectionsfor Coal based on CAGR Trend

Financial Year	Thermal Coal (Coastal Exports)	Trans-loading coal	Non-coking coal (Imports)	Coking coal (Imports)	Coke (Imports)	Total coal Traffic (Imports& Exports)	Projected# coal traffic (Imports)
2016-17	1.82	0.60	4.02	5.50	0.49	12.44	10.02
2017-18	1.73	0.87	4.39	5.63	0.55	13.17	10.60
2018-19	1.64	1.25	4.79	5.75	0.61	13.99	11.20
2019-20	1.56	1.80	5.23	5.88	0.69	15.16	11.80
2020-21	1.56	2.60	5.70	6.02	0.77	16.65	12.50
2022-23	1.56	2.60	6.78	6.30	0.96	18.16	14.00
2023-24	1.56	2.60	7.39	6.44	1.07	19.06	14.90
2024-25	1.56	2.60	8.06	6.59	1.20	20.06	15.90
2025-26	1.56	2.60	8.79	6.74	1.34	21.06	16.90
2026-27	1.56	2.60	9.58	6.89	1.50	22.16	18.00
2027-28	1.56	2.60	10.45	7.05	1.68	23.36	19.20
CAGR	(- 4.98%)	44.24%	9.05%	2.28%	11.84%		
2021-22	1.56	2.60	6.21	6.16	0.86	17.36	13.20

Excluding Coastal exports and Trans-loading traffic

Thermal coal exports and Trans-loading traffic purposely stagnated after 5th Year

3.7 Traffic forecast based the Govt. Policy on use of domestic coal as Substitute to imported coal:

Government is gradually trying to reduce coal import in a bid to increase domestic production and stick to 1.5 billion tonne production target by the year 2020 set by the Coal Ministry. Out of this 1 billion tonne will by Govt companies and remaining 500 million tonne by private entities.

The statement made by the Coal Secretary, Ministry of Coal, Government of India while addressing MCC Chamber of Commerce and Industry in Kolkata in Feb 2016 re-affirms the same which is re-produced below-

Quote:

“We have done a detailed analysis on how to handle import. As we increase production, we must bring down imports, it is already coming down but should be at much faster rate. In power sector, we have engaged each of PSU power companies. We had meeting with state owned power companies on coal import. This fiscal (2015-16) import will reduce by 15 million tonne. From April next year (2016-17), they will stop placing fresh import orders. State owned power entities import about 35 to 40 million tones. The efforts are to encourage private companies to buy coal for long term from auction”.

Unquote:

The above statement has turned into reality as can be seen in reduction in coal import in India during last two years as presented in the following Table 3.2.

Table 3.2

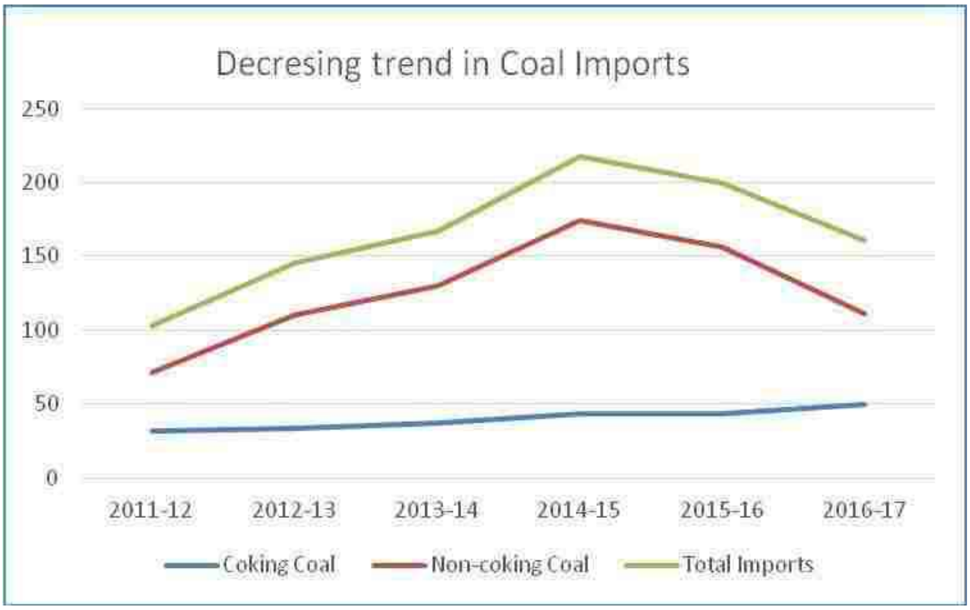
Trend in Coal Imports (In Million tonnes) for the country

Type of Coal (Excluding Coke)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Coking Coal	31.8	33.56	36.87	43.72	43.50	50.00†
Non-coking Coal	71.05	110.23	129.99	174.07	156.38	111.00†
Total Imports	102.85	145.79	166.86	217.78	199.88	161.00†

† These Figures are provisional.

The same is presented graphically which clearly depicts the drastic decreasing trend inline with government policy.

Figure-3.6.



Similarly coal traffic at Haldia Port declined from 14.51 million tones in 2015-16 to 14.42 miilion tones in 2016-17 and coal traffic at all major ports put together declined from 155.17 million tones in 2015-16 to 139.85 million tones in 2016-17.

The Govt. further stated on 1st May 2017 that it is aiming to bring down thermal coal import of power PSUs like NTPC to zero, in the current financial year, a move that would reduce the country's import bill by Rs 17,000 crores. The Govt. would also convince private companies operating in the power sector to totally stop import of fossil fuel. (PTI 1st May 2017).

Keeping in view the announcement of the above policy, the import of trans-loading coal through Sagar Island by M/s NTPC for its Farakka Power Plant will become nil. Hence traffic projection gets corrected. In line with discussion with NTPC officials, it is understood that only old orders placed with traders will be honored which is to the tune of 3 lakh tones. No fresh orders will be placed for coal import. (NTPC handled one vessel namely MV Mary Gorgias carrying 71,760 MT steam coal (transloading cargo) at Kanika Sands (within the limits of Dhamra Port) during the period from 19.05.2017 to 28.05.2017).

Accordingly, the summary of traffic forecast for coal based the Govt Policy on use of domestic coal, superimposed on past traffic trend is given in the Table 3.3 hereunder.

Table 3.3

Traffic Projections based on CAGR Trend & Govt Policy on use of Domestic Coal

Financial Year	Thermal Coal	Trans-loading coal	Non-coking coal	Coking coal	Coke	Total coal Traffic	Projected coal traffic
	Coastal exports		Imports	Imports	Imports	Imports & Exports	Imports
2016-17	1.82	0.60	4.02	5.50	0.49	12.44	10.02
2017-18	1.73	0.87	4.39	5.63	0.55	13.17	10.60
2018-19	1.64	1.25	4.79	5.75	0.61	13.99	11.20
2019-20	1.56	1.80	5.23	5.88	0.69	15.16	11.80
2020-21	1.56	2.60	5.70	6.02	0.77	16.65	12.50
2021-22	1.56	2.60	6.21	6.16	0.86	17.36	13.20
2022-23	1.56	2.60	6.78	6.30	0.96	18.16	14.00

2023-24	1.56	2.60	7.39	6.44	1.07	19.06	14.90
2024-25	1.56	2.60	8.06	6.59	1.20	20.06	15.90
2025-26	1.56	2.60	8.79	6.74	1.34	21.06	16.90
2026-27	1.56	2.60	9.58	6.89	1.50	22.16	18.00
2027-28	1.56	2.60	10.45	7.05	1.68	23.36	19.20
CAGR	(-4.98%)	44.24%	9.05%	2.28%	11.84%		

3.8 Traffic forecasted by IPA based on interaction with Users:

The traffic forecast based on major coal importing customers through Haldia is presented in the table below.

Table 3.4
Coking Coal traffic projections Based on Interaction with Major Customers of Haldia

Customers for Coking Coal	2016-17 (Actuals)	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27
SAIL	3.55	3.70	3.70	4.00	4.00	4.25	4.25	4.25	4.25	4.25	4.25
Tata Steel	1.19	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Jai Bajaj Industries	0.28	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Electro steel Casting	0.36	0.36	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Usha Martin	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Tata Metallik	0.06	0.06	0.06	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Raw Met Comm	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.01	0.005
Shyam Sel Ferro Alloys	0.00	0.09	0.20	0.20	0.25	0.25	0.30	0.30	0.30	0.30	0.30
Total	5.53	6.15	6.30	6.66	6.72	6.97	7.02	7.02	7.02	7.02	7.02

4.9. Interaction with Non Coking Coal Customers:

Table 3.5

Non-Coking Coal Traffic Projection Based on Customer interaction

Customer Name	2016-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27
Tata Steel	0.42	0.50	0.50	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Agarwal Coal Corp	0.31	0.35	0.35	0.35	0.35	0.35	0.35	0.40	0.40	0.40	0.40
SAIL	0.28	0.3	0.50	0.50	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Super Smelters	0.25	0.25	0.25	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Sarogiudyog	0.16	0.18	0.20	0.23	0.25	0.27	0.30	0.32	0.35	0.35	0.4
Anand Carbo/Godawari	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Jai Balaji Industries	0.12	0.12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
HaldiaEnery Ltd	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Raw Met Commodities	0.10	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Electro steel castings	0.16	0.16	0.18	0.18	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Usha Martin	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
CESC Ltd	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian Power Corporp	0.00	0.60	1.00	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Sub-Total	2.23	2.93	3.61	4.39	6.33	6.35	6.38	6.45	6.48	6.48	6.53
Others @ .1026 CAGR	1.79	1.97	2.18	2.40	2.65	2.92	3.22	3.55	3.91	4.31	4.75
Grand Total	4.02	4.90	5.79	6.79	8.98	9.27	9.60	10.00	10.39	10.79	11.28

Note: CAGR is derived from Sub-total column for 12 years

3.10. Interaction with Coke Customers:

Table 3.6

Coke Traffic Projection Based on Customer Interaction

Customer - Coke	2016-17. Actual	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27
Neo-Metaliks	0.084	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Athir Industries	0.075	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
ReshmiMetaliks	0.037	0.037	0.038	0.040	0.050	0.050	0.050	0.050	0.050	0.050	0.050
ShyamSel/Ferro alloys	0.036	0.036	0.036	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Tata Metalliks	0.02	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sub-Total	0.251	0.250	0.241	0.247	0.257	0.257	0.257	0.257	0.257	0.257	0.257
Other @ 0.0021 CAGR	0.240	0.241	0.241	0.242	0.242	0.243	0.243	0.244	0.244	0.245	0.245
Total	0.491	0.490	0.482	0.489	0.499	0.500	0.500	0.501	0.501	0.502	0.502

3.11. Interaction with Thermal coal (Loading) Customer:

Table 3.7											
Thermal Coal (Coastal Loading) Traffic Projections based on Customer interaction											
Customer	2016-16 Actual	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	28-27	27-28
TNEB (SICAL)	1.82	1.94	2.06	2.18	2.30	2.42	2.54	2.66	2.78	2.90	3.00	3.00

3.12. Interaction with Customer using Trans-loading Facility for NCC Import (NTPC):

Customer indicated that no further coal import through trans-loading facility as per GoI directive to use domestic coal. Hence this volume has been considered as Nil for future projection.

3.13. Projection based on average of "trend" and "customer indication" for coking coal, non-coking coal and cokes but Thermal Coal (loading) considered purely as per "customer indication".

3.14. Total Coal Traffic Projection (Imported+ Loading + Transloading):

Table 3.8												
FINAL PROJECTION BASED ON AVERAGE OF TREND AND CUSTOMER INTERACTION (EXCEPT TNEB & NTPC COAL) IN MMT												
CUSTOMERS	2016-17 .Actual	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28
Coastal Coal (Loading):TNEB	1.82	1.94	2.06	2.18	2.30	2.42	2.54	2.66	2.78	2.90	3.00	3.00
Transloading Coal: NTPC	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non Coking Coal (Import)	4.02	4.65	5.29	6.01	7.34	7.74	8.19	8.69	9.22	9.79	10.43	11.11
Coking Coal (Import)	5.50	5.89	6.03	6.27	6.37	6.56	6.66	6.73	6.80	6.88	6.95	7.03
Coke (Import)	0.49	0.52	0.55	0.59	0.63	0.68	0.73	0.79	0.85	0.92	1.00	1.09
All Cargo	12.43	13.00	13.93	15.05	16.64	17.40	18.12	18.87	19.65	20.49	21.38	22.23
All Import (All Cargo less TNEB and Transloading)	10.01	11.06	11.87	12.87	14.34	14.98	15.58	16.21	16.87	17.59	18.38	19.23

The final projections as given in the table above is line with government's present thinking.

In case of non-coking coal import it is proposed to reckon the projection of 7.3 million tones for 2025-26 also keeping in view the government's policy of reducing imports.

3.15 Iron ore

India which was formerly the world's No.3 supplier of iron ore has been closing down on imports over the last two years due to court-imposed restrictions aimed at curbing illegal mining in the key producing states of Karnataka and Goa. In FY 2015, India produced 129 million tonnes of iron ore and imported 15 million tonnes of iron ore.

3.15.1 Export Policy for Iron Ore - 2016

Exports of iron ore up to 64% Fe content is freely allowed. The export of iron ore with Fe content above 64% is canalized through MMTC. High-grade iron ore (Fe content above 64%) from Bailadila in Chhattisgarh is allowed to be exported with restrictions on quantity imposed primarily, with a view to meet domestic demand on priority. About 3 million tonnes is allowed for exports through vizag and paradeep. Though iron ore exports do take place in Haldia, the chances of increase in a big way are therefore remote.

The industries located in west Bengal source their iron ore requirements from mines in Jharkhand, Madhya Pradesh and as such iron ore exports are fluctuating through the port. In 2015-16, and 2016-17 the port handled about 0.8 miliion tonnes and 1.16 million tonnes of iron ore respectively as against 1.90 mt in 2014-15. As such, a moderate forecast of 1.3 mt to 2.3 mt is projected by 2020 and 2025 respectively
As such for iron ore Haldia will remain as an export cargo and in moderate quantities for a long time to come.

3.16. Manganese Ore (Import)

India is the second largest importer of Manganese ore in the world.India's dependence on Manganese Ore imports has increased as the Manganese Ore produced in India (apart from MOIL) is of low grade and high Iron content, and these are not suitable to produce the best quality Manganese alloys. These inferior quality of Manganese Ores produced domestically have to be blended with better variety imported ores. In view of the shortage in availability of high grade ore and imports becoming cheaper with demand from China diminishing, this trend is likely to continue.

The traffic on account of this cargo through Haldia was varying between 1.3 mt and 1.5 mt. Keeping this trend in view, 1.8 mt by 2020 and 2.3 mt by 2025 has been reckoned for this cargo.

3.17. Fertilisers and Raw materials (Imports)

The consumption of fertilizers in the country has increased by around 2.5 percent and is expected to rise at approximately 4 percent in the future. Growing agri-produce and an increase in the overall sown area will prompt greater demand for fertilizer end products—around 70 MMTPA by 2020 and around 120 MMTPA by 2035. Urea consumption in India is around 29 MMTPA, of which around 22.5 MMTPA is produced domestically and around 7 MMTPA is imported. While domestic plants are increasing capacity by around 5 MMTPA in 2020, the rising demand for urea (expected to be 35 MMTPA in 2020) will ensure that India continues to import around 7 MMTPA of urea. The volume of imports of fertilizer raw materials and finished products will grow at around 4 percent.

About 3 lakh tonnes of fertilisers and 3.4 lakh tonnes of fert. Raw materials is handled by the port in 2015-16.The traffic is estimated to grow at 5 percent per annum to reach 0.8 mtpa by 2020 and 1.2 mtpa by 2025.

3.18. Limestone

Limestone is the primary and major constituent for manufacture of cement. It is also used by the steel industry. With nearly 390 million tonnes (MT) of cement production capacity, India is the second largest cement producer in the world and accounts for 6.7 per cent of world's cement output. The cement production capacity is estimated to touch 550 MT by FY 20. Of the total capacity, 98 per cent lies with the private sector and the rest with the public sector. The top 20 companies account for around 70 per cent of the total production.

Haldia port handled 1.5 million tonnes of lime stone in 2015-16 compared to 1.23 mill tonnes in 2012-13(CAGR 7%). Keeping in view the demand for this commodity by cement and steel industry, the traffic is estimated at 2.1 mtpa by 2020 and 2.8 mtpa by 2025.

3.19. Other commodities

These include steel, soda ash, pig iron gypsum, pet coke, m coke cement etc. The traffic on account of these cargoes was around1.2 million tonnes in 2015-16.

3.20. Summary of Traffic projections

Table 3.9
Projections for Dry Cargo (million tonnes)

Commodity	Actual in 2015-16	Projections by IPA		AECOM projections	
		2020-21	2025-26	2020-21	2025-26
Coking coal	5.72	6.4	6.9	8.0	11.2
Non -coking coal	6.43	7.3	7.3	3.3	3.3
Thermal coal	1.55	2.3	2.9	1.6	2.1
Iron ore	0.87	1.3	2.3	1.0	1.3

Manganese ore and slag	1.24	1.8	2.3	2.0	2.5
Fertilisers and fert.rawmatls.	0.64	0.8	1.2	1.0	1.5
Cokes	0.81	0.6	0.9	-	-
Limestone	1.52	2.1	2.8	2.0	2.8
Others Excl steel	1.20	1.8	2.6	4.0	5.2
Total Dry Cargo	**19.98**	**24.4**	**29.2**	**22.9**	**29.9**

3.21. Traffic Forecast & Matching Handling Facilities

As per the above tabulated traffic projections, the port is required to equip itself to handle 24.4 Million tons of dry bulk cargo by 2020-21 and 29.2 Million tons by 2025-26. Out of 29.2 million tons for Dry bulk, 17.1 million tons is coal (coking coal, non-coking coal and thermal coal.

Of the projection of 17.1 million tons in 2025-26 thermal coal is 2.9 million tons which basically is an export cargo mostly meant for TANGEDCO handled through Tamilnadu ports. For this purpose there already exists a fully mechanized coal export handling facility in operation in berth No 4.

After accounting for this, the remaining coal amounting to 14.2 million is an import cargo. Berth No 4A already has a captive mechanized coking coal unloading system with a capacity of 3 MTPA installed by M/s ISPL on BOT basis. This quantity of 11.2 (14.2 MTPA- 3 MTPA) in 2025-26 means a substantial incremental increase of coal, thus meriting a fully mechanized coal unloading, stacking, reclaiming and wagon loading system.

3.22. Identification of Cargoes Mechanization and its traffic projection:

3.22.1 Cargoes for Mechanization through Berth No 3

The main bulk cargoes handled in Haldia port are

Coking coal – Import

Non coking coal – Import

For any bulk cargo to merit mechanization, it need to be in substantial quantity and is handled all through the year and is not a seasonal cargo. If evacuation of such cargo is predominately by rail, then it is an added advantage as their parcels will be large viz., in rake loads rather than in Lorry loads. Also they would be consigned to fewer users in larger parcels.

Since coal is the predominant bulk cargo and bulk of it being imports it is proposed that Coal imports be mechanized through berth no 3.

3.22.2 Assessment of Traffic Projection for identified cargoes

As already indicated earlier, the port already has a fully mechanized bulk coking coal importing system in Berth No 4A which is a BOT facility of M/s ISPL. It has a capacity of 3.5 million tons per annum and is meant as a captive facility.

Thus as seen in the previous paragraph coal imports through Haldia will be of the order of 14.2 million tons in 2025-26. After accounting for handling through Berth No 4A, the coal traffic projection is 10.7 million tons some of which can be attracted to berth No 3.

3.23. Requirement of Mechanization:

(i) Mechanization of Berth No.3 proposed will enable it to handle imported coal only. The said berth is expected to be commissioned in July2020 and thus, this berth will be available for handling coal for a period of 9months during the Financial year 2020-21.As per internal projections, 17MMT of imported coal is likely to be handled during 2020-21 while around 9.2MMT of other imported Dry Bulk Cargo is expected to be handled during the same fiscal. While imported Coking Coal will be handled at Berth No.2, 4A,4B & 8 , other Dry Bulk Cargo will be primarily handled at Berth No.2, 4B &8 as well as Berth No.13. Now, the capacity of each of the Berth Nos.2,4B,8 &13 is 4.5MMT per annum and Berth No.4A has a capacity of 3.5MMT. If 4.5 MMT of other Dry Bulk Cargo is handled at Berth No.2, 4B & 8. Therefore, Berth No.2, 4B &8 will be available for handling 8.8 MMT of coal after handling 3.5MMT of coal at Berth N0.4A.

(ii) During 2020-21,12.3MMT of coal is expected to be handled at Berth Nos.2,4A,4B & 8 . Out of the remaining 4.7MMT of imported coal required to be handled, 2.5MMT is expected to be handled at Floating Barge jetty and other barge handling facilities inside the impounded Dock and balance 2.2 MMT of coal will be handled at Berth No.3 during the 9 months period of the Financial Year 2020-21. However, from 2021-22 minimum 3.5 MMT coal will be available for handling at Berth No.3 which is evident from the above projection.

(iii) After handling of 3.5 MMT of coal at the berth , spare capacity at the jetty will be available for handling other liquid cargo and thus, facilities for handling other liquid cargo like Paraxylene, Edible oil, POL products etc. may be continued subject to clearance from the other statutory authorities.

SECTION 4

BERTHING FACILITES

4.1. Berth No 3:

Earlier during 1970's the Berth No 3 was originally installed with a fully mechanized iron ore loading system. It consisted of two Wagon Tipplers with wagon feeding systems, conveyor system, four Stacker cum Reclaimers and two Ship Loaders.

With decline of iron ore traffic, the berth along with the same iron ore loading plant was used for loading thermal coal for some time. The following image depicts berth no 3 with stack yard as it used to be till in 2012 when the berth was equipped with ship loaders and the stack yard with stacker cum reclaimers.

Berth No 3 with back up area for Mechanized iron ore loading plant
(Image as during 2012)

Consequent to ban on iron ore exports imposed by GOI in 2012, the entire mechanized iron ore loading system including crane rails laid on the berth having also outlived its economic life, was decommissioned and dismantled.

The berth 3 is also having the facilities for handling Class B Petroleum Products since early eighties and tankers used to call at this berth since then and is being continued. Presently paraxylene is being handled through this berth through pipelines laid on the rear side of the berth. The back-up area is now used for stacking of bulk cargoes like coal with stacking and evacuation of such bulk cargoes done by semi-mechanized methods viz., by dumpers and pay loaders.

The satellite image presented below depicts berth No 3 and the back-up area as it now stands.

Berth No 3 as at present with Back-up area

4.2. Present Setting of Berth

The berth no 3 is an island type berth having 193 M (337 ft.) long berthing face for a width of about 14 M plus connected to the shore with approach ways on both ends. The overall length of the berth is about 337 M.

The berth is designed to handle 75,000 DWT Panamax vessels partly laden to 12.2 M draft up to 239 M LOA. Double cone fenders with frontal pads are provided to facilitate berthing of vessels and 60T capacity bollards are provided on the quay above the fenders for holding breast lines from the ship. Extreme bollards for moorings are about 335 M apart. The berth is also designed for operation of rail mounted shore cranes for a rail span (in transverse direction) of 13.72 M (45 ft.).

The latest image of the berth structure is presented below

Berth No 3 – Berth structure as of now

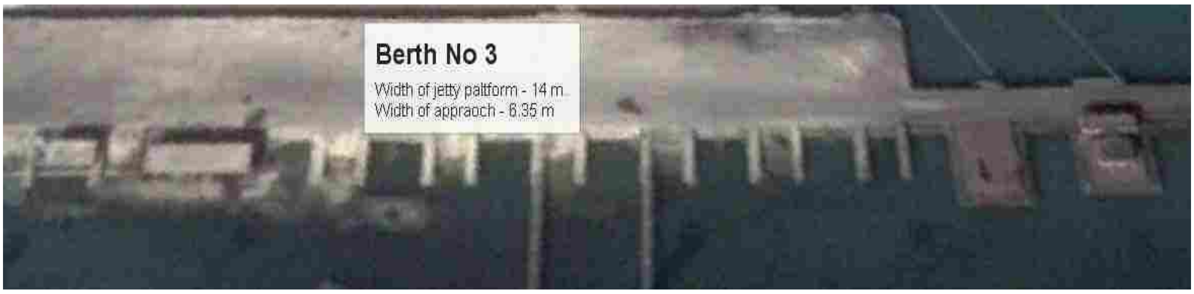
4.3. Limitations due to shorter span of crane rail gauge :

As has been noted above, the span of crane rail gauge in transverse direction was only 13.72M. As per present trend such cranes are manufactured for a much larger gauge.

4.4. Berth Structure

The berth structure comprises of RCC slab, long and cross beams supported on RCC monolith type gravity structures sunk apart. The fenders are installed on monolith walls. The crane rail beams are along the vertical walls of the monoliths with deep beams bridging the gaps. There are three rows of RCC piles at the rear side of the quay driven at regular intervals along the length of the berth to support the ship unloading conveyor system.

The image shown below depicts structure that used to support the conveyor system.



4.5. Condition of The existing Berth Structure

No significant damage of the quay is noticed. However, damages of the conveyor support structure at the rear side, to the extent of spalling of concrete thereby exposing the reinforcements are noticed at several locations.

In view of the above and also considering that the berth structure is 40 years old, it would prima facie require to carry out ‘Condition Survey’ by experts for ascertaining the stability of the berth structure, the conveyor support structure in particular, for withstanding design load criteria.

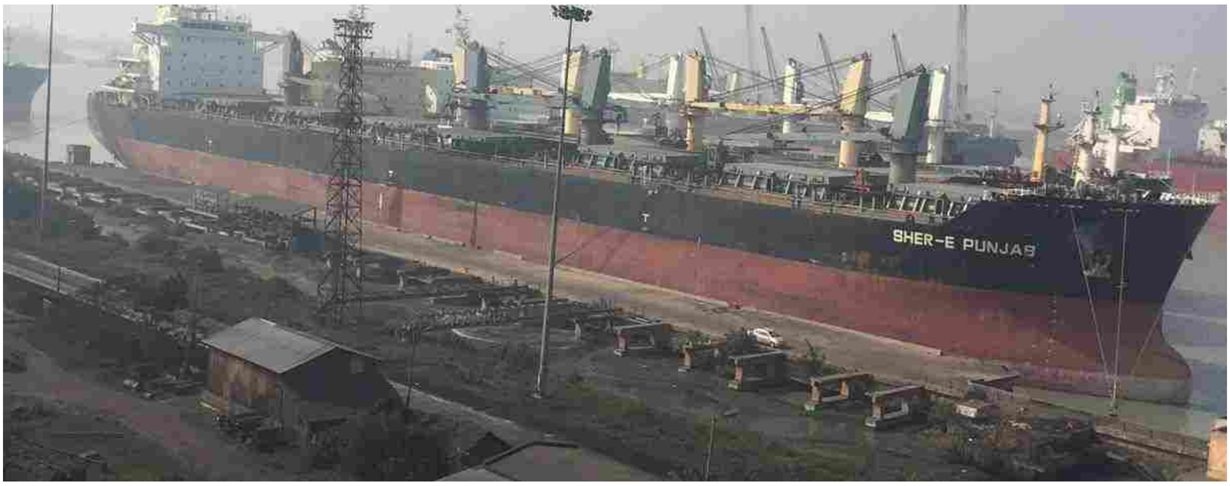
In view of the design characteristics, limited width and limited approaches from land side as noted in earlier paragraphs, it is not recommended for handling cargo using Harbour Mobile Cranes on berth no 3.

4.6. Observations of IPA on Berth Structure:

The berth structure in its present state, is suitable for installation of Gantry grab type ship unloaders. In fact the berth was earlier having ship loaders with tripper car and conveyor on the rear side. As such it is considered that there will be no major technical problem to install ship unloaders (as against ship loaders previously). Since these are tailor made equipment the ship unloaders can be designed to have wheel loads similar to erstwhile loaders commensurate with the wheel span subject to undertaking repairs on civil structure as per ‘Condition Survey’ to be carried out. It appears the main berth structure to support the Conveyor System on the rear needs to be thoroughly repaired to revive them to original state before being used for the purpose.

4.7. Images of Present Berth No 3 Structure:

A few images of the present No 3 structure are provided below for immediate appreciation of its visual condition.



SECTION 5
Planning Parameters

5.1. From the Perspective of Existing Berth Structure

This aspect was already discussed in Section 4. The physical life of berth structure can be enhanced by taking proper short and long term maintenance measures systematically. After undertaking repairs as would be recommended in the 'Condition Survey' Report, the berth can be used for another 35 to 40 years. In view of the foregoing, mechanisation of Berth 3 is technically feasible.

5.2. Other Factors

Presently there are about **9** harbour mobile cranes of 100 TPH capacity in operation under HDC. This apart, there is a fully mechanised coking coal unloading facility in berth no 4A (Concessionaire-ISPL) and a mechanized thermal coal loading system (owned and operated by HDC) in berth no 4.

As indicated in the section on "Traffic Forecast" the bulk export cargoes available for loading is very small and there is already a mechanized thermal coal loading facility in berth 4 catering to such needs (which are mainly coastal thermal coal exports to Tamil Nadu electricity board), hence there is no scope for any further mechanization for export cargoes.

Therefore, any further mechanization has to be for bulk import cargoes. The commodities which have sufficient volumes are coking coal, thermal coal and limestone. The rest are highly fragmented cargoes.

5.3. Basis of Planning for Mechanization of Berth 3

Based on favourably considering factors, it is proposed to plan for mechanization of berth 3 for bulk coal imports.

5.4. Traffic to be handled

As indicated above the commodities to be handled are import cargoes of non-coking coal and coking coal. The quantity to be handled is 2 Million tons per annum initially increasing to 3.5 million tons plus.

5.5. Vessel parcel sizes

The planning parameters in respect of vessel size and parcel size of vessel for which the mechanized handling facilities are planned is presented in table 5.1 & 5.2.

Table 5.1

Details of vessels carrying coal Handled in Haldia - During 2016-17

Type of coal Total Volume Handled in Million	Handled	Coking coal	Non-coking coal
Tonnes		5.47	4.04
No of Ship calls		196	167
	Maximum	90.625	84,488
Deadweight Tonnage	Minimum	34402	28,437
	Average	79226	68,847
	Maximum	229	237
Length Overall in Meters	Minimum	180	170
	Average	226	213
	Maximum	36,672	33,000
Parcel size in Tonnes	Minimum	15,385	5,500
	Average	27,929	24,195
	Maximum	30,386	35,054
Productivity in Tonnes per day	Minimum	10,696	3,171
	Average	18,084	20,834

It is noticed that about 10% of total vessel calls have brought in parcels of more than 30,000 Tons. The variation of parcel size with the sailing draft is brought out in the following table 5.2.

Table-5.2

NAME OF VESSEL	DWT	Parcel size	Full Draft	Sailing Draft	
				Aft	Fwd
LUMINOUS HALO (HAL11301937)	**56,018**	42,924	**12.58**	7.40	7.40
KM SYDNEY (HAL11400180)	**80,638**	30,634	**14.41**	7.48	7.48
MYRTO (HAL11400214)	**82,131**	30,834	**14.43**	7.53	7.53
SUNRISE SERENITY (HAL11400277)	**76,544**	30,351	**14.10**	7.52	7.52
VISHVA CHETNA (HAL11400349)	**81,734**	31,899	**14.50**	7.90	7.85
VISHVA UDAY (HAL11400358)	**82,000**	31,790	**14.20**	7.90	7.90
STELLA DAWN (HAL11400373)	**81,700**	30,807	**14.40**	7.80	7.80
SAITA I (HAL11400593)	**81,922**	30,738		7.50	7.50
AENEAS (HAL11400610)	**81,586**	30,455		7.60	7.60
VISHVA ANAND (HAL11400725)	**80,655**	30,050	**14.50**	7.70	7.70
YASA FORTUNE (HAL11400680)	**82,849**	32,128	**14.43**	7.50	7.50
MARIA (HAL11400722)	**76,015**	32,846		8.00	8.00
IRON FUZEYYA (HAL11400776)	**82,209**	30,097		7.40	7.40
MAIA (HAL11400804)	**82,193**	31,925		7.50	7.50
BRIGHT WIND (HAL11400812)	**82,119**	34,123		8.10	8.10
OMIROS L (HAL11400863)	**81,450**	31,283		7.68	7.68
CAPTAIN ANTONIS (HAL11400864)	**82,177**	30,285		7.37	7.33
KONSTANTINOS II (HAL11400906)	**81,697**	30,959		7.80	7.80
PRABHU MOHINI (HAL11400927)	**81,168**	31,515	**14.52**	7.85	7.80
AGIA VALENTINI (HAL11400995)	**80,388**	31,721		7.75	7.64
GOLDEN KIJI (HAL11401115)	**76,596**	30,600		7.50	7.50
ASIA GRAECA (HAL11401123)	**73,902**	30,273	**13.94**	7.70	7.70
SRI PREM VEENA (HAL11401276)	**82,792**	30,752	**14.40**	7.40	7.30
LADY GIOVI (HAL11401553)	**81,791**	30,801	**14.38**	7.59	7.42
DA TONG (HAL11401554)	**81,104**	30,094	**14.00**	7.80	7.80
TIANJIN PIONEER (HAL11401677)	**75,744**	30,354	**13.99**	7.50	7.53
DONGHAE STAR (HAL11401696)	**82,861**	31,244	**14.80**	7.60	7.60
TRANS OCEANIC (HAL11301955)	**58,186**	40,650	12.83	6.60	6.60
ANNI SELMER (HAL11400003)	**56,000**	38,765	12.55	6.20	6.20
AZUR (HAL11401307)	**76,500**	32,000		7.53	7.48
MARIELENA (HAL11401349)	**81,354**	30,092		7.40	7.40
CHENNAI SELVAM (HAL11401486)	**52,489**	46,304	12.02	7.18	7.18
ULTRA LION (HAL11401772)	**81,588**	31,453		7.60	7.60

Taking all these into considerations, the design vessel size is taken as Panamax bulk carrier of the following dimensions:

DWT 80,000; LOA 240 M; Beam 32 M; Design full Load draft: 14.5 M; Parcel size 35,000 Te for 7.5 M draft (for berth structural design). However, taking into consideration the average parcel sizes over the past couple of years, the capacity of the berth as well as the stockyard will be worked out taking a parcel size of 24,000 tons only.

5.6. Planning Parameters for Mechanization of Berth No 3:

The planning parameters for mechanization of existing berth no 3 with modifications/additions proposed is indicated below.

The berth no 3 has a length of about 337 m across extreme moorings. The loading platform has a length of about 193 M and a width of 15.75 m. The berth can handle panamax vessels with LOA up to 230 m and an average parcel size of 24,000 tonnes.

The berth will be equipped with 2 no rail mounted gantry grab type unloaders with a capacity of 1500 TPH each. For this purpose the existing berth no 3 structure has to be provided with rails over which the unloaders will travel on the quay. The rail span of the proposed gantry grab unloaders have to be tailor made to suit its width.

The coal/coking coal unloaded by the two unloaders will discharge into a single dock conveyor to be located on the rear side of the main berth structure on the piles and interconnecting beams. This conveyor will be an elevated one with a rated capacity of 3000 TPH commensurate with the capacity two unloaders.

The coal from the dock conveyor will be conveyed through an elevated conveyor system to cross over the main road behind berth no to the backup area of berth No 3 for stacking.

The coal from the stack yard reclaimed by stacker cum reclaimer (operating in reclaiming mode) will be conveyed to a stationary silo.

Two no Stacker cum Reclaimers each having a rate capacity of 3000 TPH for stacking 2000 TPH capacity for reclaiming are planned for stock piling coal into the stack yard and then for evacuation through wagon loading.

The coal from the stationary silo will be loaded into railway wagons through a rapid wagon loading system in which the wagons will be moving.

The system will have a substation for receipt and distribution of HT and LT power for operating the mechanized system consisting of two no gantry grab unloaders, the belt conveyor system, two no stacker cum reclaimers, rapid wagon loading system, supporting utilities etc.,

The estimated power requirement of about 1.8 MVA will be available from the port’s main substation where adequate spare capacity is available.

5.7. Stack Yard:

The stack yard for transit storage of coking coal, non-coking coal will be located in the designated stack yard to be situated in the back-up area of berth no 3. This area is same as the area in which the iron ore used to be stacked when berth no 3 was an iron ore loading facility. The backup area earmarked for berth no 3 is presented in the following figure 5.1.

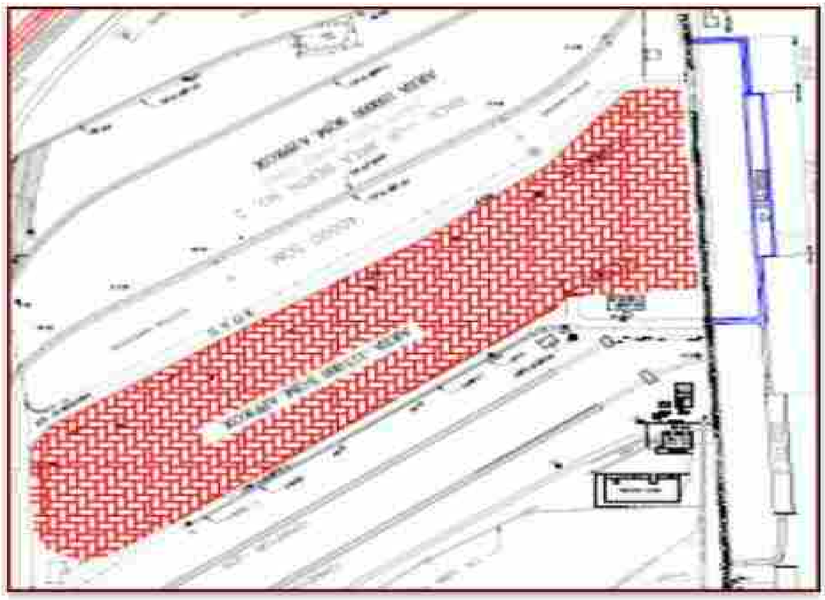


Fig-5.1. Backup area earmarked for berth no 3 (shown in hatching)

The land earmarked for the purpose will have an area of about 1,13,000 sq.m. The same in the google image is depicted below.

5.8. Railway Yard

The railway yard for evacuating the material from the transit stack yard will be located in the existing railway yard where an old iron ore tippler was located (now defunct). The evacuation of coal will be through a rapid in-motion wagon loading system with a silo. The proposed railway yard for berth 3 will have two railway lines with a length go about of 1900 m for each line. One line is meant for rapid wagon loading and the line is planned to accommodate two rake lengths and the second line is planned for engine escape. The two lines proposed are planned adjacent to the existing lines in a green field area. A clearly demarcated railway corridor is depicted below.

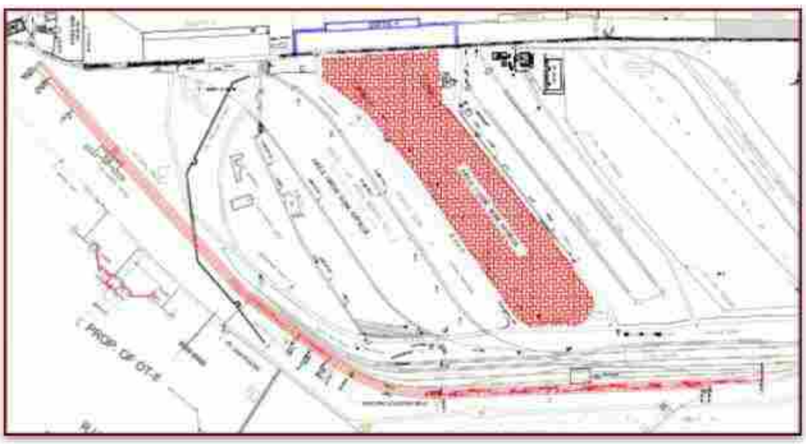


Fig-5.2.Conceptual Layout of the proposed rail lines for Berth 3

Fig-5.4. Layout of Existing Railway yard

5.9. Handling System

The material handling system has been designed as ship-shore transfer through Rail Mounted gantry Grab unloaders, a conveyor system for transfer from berth to stack yard and handling at yard through two stacker cum reclaimer for stacking and a conveyor to carry the material from the stack yard to rapid loading silo and finally loading of coal from silo into wagons in-motion. The system will incorporate necessary pollution control measures

5.10. Handling Rates

5.10.1 Ship - Shore Transfer

Considering the capital cost, operational flexibility and proven performance, it is with proposed to equip the berths two gantry grab unloaders each having a rated capacity of 1500 TPH.

It is to be noted that due to draft limitations in Haldia vessels come with part load, having discharged the top portion of the hatches at another deep draught port. Hence the quantity of coal available for the cream bite of the grab will be limited. As the hatch gets emptied, the remaining coal is to be heaped at one place by a baby dozer to be lowered into the hatch. The baby dozer moves around shifting the scattered coal into a heap sufficient for the grab to bite into and lift. This process will involve some operational time as the grab content will largely get reduced as compared to a cream bite.

Such a sequence of operations are presented in the following Figures.

Fig-5.4. – BABY DOZER HEAPING THE SCATTERED COAL

Fig-5.5. BABY DOZER FACILITATING GRAB BITE

Fig-5.6. BABY DOZER & GRAB WORKING IN TANDEM

When a fully loaded ship is discharged, the productivity will be higher as the grabs can take bite at the top of hatch with full grab content and less lifting height as compared to part discharged vessel. Thus its average discharge rate will be high. But in a partially loaded ship, the initial lift height itself will be more as he hatch content is already reduced. For clearing the last portion, the lifting height is more and the grab content is also less. All these cumulatively reduce the average productivity.

As can be seen the average productivity for coking coal and non-coking coal has been 18,084 TPD & 20,834 TPD for 2016-17. For 2015-16 the corresponding figures are 16,981 TPD & 17,116 TPD. Hence, taking the aforesaid issues into consideration, it is proposed that an average productivity of 20,000 TPD could be considered.

5.10.2 Berth - Stackyard Transfer

Keeping in mind the level of pollution that could be created due to handling by dumper and payloader system, it is planned to have a conveyor system. The unloaders planned will have integral hoppers, the coal unloaded will be conveyed through hopper and shuttle conveyor to an elevated jetty conveyor located on the rear side of unloaders. The jetty conveyor will transfer the material into another conveyor through which the coal will be transferred to the yard stacking conveyors and finally transferred through stacker cum reclaimers into the stack yard. The conveyor system will have a matching rated capacity of 3000 TPH.

5.10.3. Layout of Stackyard:

The material received through the conveyors and the stacker cum reclaimer into the stack yard will be stacked in a geometric shaped stockpiles. The stack yard is proposed to be equipped with two no stacker cum reclaimers. The conceptual layout of stack yard as proposed in this report will have a optimal capacity of about 2.00 Lakh tons

5.10.4. Evacuation

It is proposed that 80% cargo will be evacuated by rail and 20% road evacuation has been envisaged. Thus about 2 to 3 rakes per day will be required for evacuation of planned annual throughput.

5.10.5. Optimum Capacity of Stockyard (*as per TAMP Guidelines)*

For a coal terminal TAMP guide line stipulates that the optimum yard capacity is 70% of maximum coal that could pass through the yard and is derived from the following formula.

Optimum Yard Capacity = 0.7 X A X Q X T tons

where A = is the stockpile area in sq. m

Q = Quantity that could be stacked per sq. m

T = Turnover ratio of the plot in a year

Total area of stockpiles = 4 x 100 x 27 + 1 x 75 x 27+1x50x27+ 4x100x40+ 1x75x40+ 4x100x44+ 1x75x44 = 54,075 m2 ,

say **54000 sq.m**,

Quantity that could be stacked per m2 = 5.2 Te

Considering an evacuation rate of 2.6 rakes per day with each rake carrying 3800 Tons, the rate of evacuation per day is taken as 9880

Dwell time = 0.7 x 54,000 x 5.2/ 9,880 = 20 days

The average Plot turnover ratio in a year would therefore be 360/20 = 18

Yard capacity (0.7 x 54,000 x 5.2x18) = **3.538 MTPA, say 3.5 MTPA**

5.10.6. Optimum Capacity of Berth (*as per TAMP Guidelines)*

It has been observed earlier in this section that the average handling rate is 20,000 tonnes per day.

Following TAMP Guidelines, the optimal capacity of the terminal is calculated using the following formula:

Optimal capacity

$$= 0.7 \times \frac{S1}{100} \times P1 + \frac{S2}{100} \times P2 + \frac{S3}{100} \times P3 + ... \times 365$$

S1 - Percentage share of capacity of Cargo type 1

P1 - Handling rate of the vessel carrying Cargo type 1

S2 - Percentage share of capacity of Cargo type 2

P2 - Handling rate of the vessel carrying Cargo type 2

S1, P1, S2, P2 and so on depending on the number of different types of Cargo to be handled at the berth of the particular port.

In the present proposal, the share of Panamax vessels and Handymax vessels are considered as 80% and 20% respectively based on the current trend.

According to the formula, the optimum capacity of the new berth (where only coal will be handled), works out to

365 x 0.7 x 20,000 ≈ 5.11 MTPA say 5.00 MTPA

Therefore, the Optimum capacity of the TERMINAL: **3.5 MTPA** (*Lower of the two*)

TCHNOLOGY

6.1 SYSTEM DESCRIPTION

Berth no-3 at Haldia Dock has a length of 337 m across extreme mooring. The loading platform has a length of 193 m and width of 15.75 m. The berth can handle Panamax vessel up to LOA 230 m and an average parcel size 24000 MT. The existing rail span is 13.687 M and wheel load 32+/-2 MT to be used for designing the rail mounted gantry type grab unloaders.

The coal/coking coal unloaded by the two ship unloaders of capacity 1500 TPH each and will be discharged into a single dock conveyor (C1) of capacity 3000 TPH to be installed on the rear side of the main berth or existing foundation of demolished tripper conveyor. Stability of the existing berth and foundation shall be checked by the Haldia Port Authorities through IIT(M) and same shall be installed by EPC Contractor for installation of Ship Unloader, Conveyor etc.

The coal from the Dock Conveyor will be conveyed through an elevated conveyor (C2) behind berth no-3 and to be fed either to yard conveyors (C4A) or to conveyor C3, which in turn will feed to yard conveyor (C4B). All the conveyors shall have capacity 3000 TPH. The yard conveyors (C4A & C4B) shall have two Stacker cum Reclaimer (SCR) with bypass arrangement having capacity 3000TPH stacking and reclaiming.

The bulk material handling facility at berth no.3 involves unloading from ships via ship- unloaders, stacking and reclaiming by stackers and reclaimer and loading into wagons by rapid wagon loading system including Electrical work. The material is conveyed from berth up to wagon loading system by belt conveyors and via miscellaneous safety, health and environmental accessories etc.

The ship unloaders will be mounted on the berth-3 for handling bulk cargo mainly coal from ships ranging up to 80.000 DWT.

The grab will pick-up the cargo from the ship's hold and will discharge onto on-board hopper of the unloader. Material from the hopper will be fed to the on-board cross conveyor by a vibrating feeder for discharging to the berth conveyor. Unloader will be provided with features to have effective control of fugitive dust emissions particularly due to sea blowing winds. On board hopper will be covered on the three sides with sheeting and at the grab entry point minimum opening size necessary for grab entry will be provided with air curtains. At belt feeder discharge point enclosure supported on rails for dust containment will be provided. Material from the elevated berth conveyor will be transported to the plant by a system of belt conveyors.

The receipt of coal to wagon loading system shall be by either of the following paths:

- Coal evacuated by unloaders from ship shall be directly conveyed to storage silo of wagon loading system through series of conveyor (C1, C2, C3, C4A/ C4B, and C5) bypassing stacking.

- Stacked material at yard shall be reclaimed by reclaimer mounted on C4B conveyor or stacker cum reclaimer machine mounted on C4A conveyor for conveying it to the wagon loading storage silo via conveyors C4 and C5.

The feed to the storage silo of the system shall be by a single stream of conveyor (by others) with dual drive of 100% rating conveying at a peak rated capacity of 3000tph and average capacity of 1800tph.

The rapid wagon loading system shall be a computer controlled-automatic and operator attended-semi-automatic, weighing and loading system capable of loading each rake at loading rates up to 4000 TPH. The loading station shall be located over rail track for loading of coal in rakes. System shall consist of a 2000 ton capacity SILO having four openings with gates for loading into one pre weigh bin. Hydraulic system shall be provided for the operation of loading, discharge gates and telescopic chutes. The entire telescopic chute arrangement shall be made compatible for the handling of rake by electric engine. The rapid load out system shall have arrangement such that pre-weighed quantity of coal is discharged into each wagon and the individual weighment is recorded automatically.

The system shall be capable of loading all types of BOB and BOX wagons. The rake shall be hauled at a creep speed of 0.6 – 0.8km/hr. Each rake consists of 58-60 wagons each of maximum 71 T capacity including heap(max). The rake shall be hauled by diesel locomotive/ electric locomotive. Each wagon shall be loaded in one minute. The vertical and horizontal railway clearances shall be as per the requirement of Indian Railways.

Unidirectional shuttle / belt feeder shall be provided below the pre-weigh hopper for evacuating the residual cargo from silo to ground. Further coal dumped over ground shall be loaded into trucks by pay loaders

Dust extraction system shall be provided for suction of dust at the discharge hood of feeding conveyor and between the pre-weigh hopper and silo to allow displaced air from the weigh bin to be captured and prevent dust escaping from the system.

Air blasters shall be provided on the sloping surface of silo for trouble free flow of material from silo.

Adequate no. of heat sensors shall be provided in the silo for detecting any local heating and to give a warning in the loading control room and at the main control room

Minimum clearance of 1000mm shall always be provided from any equipment / structure / pedestal inside the building. The clear distance between the floors shall be minimum 3200mm (bottom of beam) and the headroom shall be suitable for handling / removing the equipment.

Auxiliary equipment like, air compressor with dryer & receiver, in-motion weigh-bridge, spray nozzles at telescopic chute and shuttle belt feeder discharge chute, air conditioning and ventilation in the switchgear cum control room located within the system, etc. shall be provided.

Adequate number of hoists (manual / electrical) with trolleys and monorails shall be provided for handling the equipment / components, etc.

Fire detection, alarm and firefighting system, service water, potable water, service air shall be provided by others, however provision shall be made in the rapid wagon loading system(like structural supports, inserts etc.) as per requirement for the same.

The coal from the Stack yard reclaimed by either SCR-1 or SCR-2 (in reclaiming mode) will be conveyed to conveyor C5 through the respective yard conveyors. The conveyor C5 shall feed to a stationery SILO of 2000 MT for subsequent loading in Wagon Pushed by a Locomotive (by others) in Rapid Wagon Loading system. The entire loading will be done by 1.25 Hr.

To meet the safety requirements necessary hydrant type firefighting system for entire battery limit, MVWS in the conveyor galleries, dust suppression system at stock yard and conveyor feed points, ventilation & air-conditioning systems in electrical substation and other buildings, service water & potable water system shall be provided.

The electrical, instrumentation & automation along with the substation for the entire Material Handling System shall be provided to suit the requirement.

Necessary rail line for the rapid loading system shall be quoted separately as per requirement.

Operation & Maintenance for smooth running of system along with spares and consumables for initial two years has been quoted separately.

Note: Refer material flow diagram attached elsewhere in the document.

6.2 MECHANICAL SUPPLY

6.2.1 SHIP UNLOADER

The grab type unloader of suitable capacity will transfer coal / coke from the ship to the material handling on the jetty or wharf. The cargo is unloaded with a mechanical grab. A clamshell bucket, typically controlled by winches and wire rope, digs and hoists materials from the transport vessel, lifting and discharging it into an on-board hopper. As this process is repeated, feeders at the hopper discharge will load the material onto a dock conveyor C1 for transporting to subsequent conveyor system.

6.2.1.1 SPECIFIED DESIGN DATA – SHIP UNLOADER

Sl.No	Description	Technical specification
1	Equipment Quantity	2 No's ship Gantry Grab unloader (suitable to cater to the existing rail centre 13.687m)
2	Cargo / Material handled	Coal (as specified)
3	Rated unloading capacity	1500 TPH [for each M/C]
4	Cream digging rate [approx.]	1500TPH [for each M/C]
5	Cycles per hour	Minimum 40 cycles / hour. (Bidder to submit the calculation along with the bid to substantiate cycle time and unloading capacity)
6	Grab capacity	35 cum. (maximum)
7	Ship size / Vessel	80,000 DWT / PANAMAX. LOA 230 m and Handymax with average parcel size 24000MT
8	Belt Feeder	• Belt width – suitable to handle • The rated capacity . • Minimum 30º trough x 3 roll with long center roll • Return side – Two roll flat type
9	No x Berth Rail size x Rail centers	2 x CR 80 /100 and 13.687 m centers (for the Grab Unloader).
10	Outreach from center of Jetty side rail	Suitable to handle Panamax Vessel upto 32.3 m beam.
11	**Operating Speeds (approx.)** i. Hoisting Speed ii. Lowering Speed iii. Closing iv. Trolley travel	To suit the number of cycle per hour on rated capacity of 1500 TPH. 140 to 160 m/min 180 to 200 m/min 150m/min 200 to 240 m/min

12	Boom Hoisting Speed	To suit the number of cycle per hour on rated capacity of 1500 TPH.
13	Bridge long travel speed	0 –40 m/min infinitely variable in both directions (AC sq. cage – VVFC). Higher speed shall generally be used for hatch change and travelling to the anchorage under operating condition.
14	Max. Wheel Load	32 +/- 2 Tonnes (operating/storm)
15	Design criteria for wind speed a) Normal unloading operation b) Long travel to storm anchoring c) Rail Clamp in position d) Storm anchoring in position	 20 m/s 24 m/s 36 m/s Max 63 m/s
16	Stability Factor (min.)	Based on FEM Standard
17	Long travel track gauge	13.687 M
18	Elevator	One for each machine of minimum 400Kgs payload capacity.
19	Anti-collision switch	To be provided for both machines

6.2.1.2 CODES AND SPECIFICATIONS

The specific codes / standards followed for the design of the system are as below:

IS 13082 – 1991 (part-1)	Ship unloader gantry mounted grab type- Code of practice for design manufacture and erection
IS 13082 – 1991 (part-2)	Ship unloader gantry mounted grab type- Code of practice for design manufacture and erection
IS 13082 – 1991 (part-3)	Ship unloader gantry mounted grab type- Code of practice for design manufacture and erection
CEMA	Belt conveyors for bulk materials
IS: 1891 - 1994	Conveyor and Elevator Textile Belting – Specification - Part 1 General Purpose Belting
IS 1891 : Part 5 : 1993	Conveyor and elevator textile belting - Specification: Part 5 Fire resistant belting for surface application
IS:8531-1986	Specification for Pulleys for Belt conveyors

IS:8598 - 1987	Specification for Idlers and idlers set for belt conveyors
IS 9295 - 1983	Steel tubes for Idlers for Belt conveyors
IS 13148-1991	Code of construction of structural works.
IS 3938 : 1983	Specification for Electric Wire Rope Hoists
IS:2062 - 2011	Steel for general structural purposes.
IS 7155 (part 3): 1990	Code of Recommended Practice for Conveyor Safety
IS 807	Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.
IS 816	Code of practice for use of metal arc welding for general construction in mild steel.
IS 2266	Steel wire ropes for general engineering purposes.
IS 2327	Straight sided splines for cylindrical shafts with internal centering-dimensions, tolerances and verification.
IS 2610	Power transmission straight-sided splines for machine tools-dimensions.
IS 1835	Specification for Round steel wire for ropes
IS 7847	General Characteristic of Lifting hook.
IS 3815	Specification for point hook with shank
IS : 15560-2005	Specification for point Hook with Shank up to 160 tons
IS:1940-1-1986	Mechanical vibration – Balance quality requirements of rigid Rotors-Part-1-Determination of permissible residual unbalance
VDI 2056:1964	Standards Of Evaluation For Mechanical Vibrations Of Machines
OSHA	Occupational Safety & Health Administration
ASHRAE: 2007	HVAC applications
IS 3177-1999	Code of practice for electric overhead travelling cranes and gantry cranes
IS 1136-2008	Preferred sizes for wrought metal products
IS 3443-1980	Crane rail sections

Any other Regulation and safety codes related to design, construction & operation of the ship unloader machine.

6.2.1.3 FEM Standard for unloader:

Operation	Class of Mechanism	State of Loading
Long travel	M8	L4
Load hoisting and grabbing	M8	L4
Trolley travel/boom luffing	M8	L4

GANTRY GRAB UNLOADER

6.2.2 BELT CONVEYOR SYSTEM

SL No	ITEM PARTICULARS	Capacity (TPH) (RATED / DESIGN)	Appx. length (horizontal) for each Conv (m)
1	Dock belt Conveyor C1	3000/3300	220
2	Elevated conveyor C2	3000/3300	120
2	Elevated conveyor C3	3000/3300	60
3	Yard conveyor (C4A & C4B)	3000/3300	660 each
4	Conveyor from yard Conveyor to SILO (C5)	3000/3300	490

NOTES:

1. All above conveyors are complete with belting (NN / EP / Steel cord type , as required), idlers, pulleys, gearboxes, high speed couplings, low speed couplings, brakes (Electro Hydraulic Thruster brakes),external scrapers (Pre scraper + main scraper), internal scrapers, all technological structures & deck plates (min. 3 mm thick plate for all conveyors throughout the conveyor length), pulley guards, coupling guards, take up arrangement (VGTU/HGTU/Screw take up as required) complete with TU frame, TU guides, counter-weights, TU guards etc.

2. The data of various conveyors as listed above are tentative and shall be finalized during detail engineering.

6.2.3 CONVEYOR ACCESSORIES:

SL No	ITEM PARTICULARS	Location	Brief Technical Description
1	Belt Scale	On Conveyor	Suitable to measure the capacity of the conveyor and shall be strain gauge load cell type
2	Metal Detector	On Conveyor	Suitable to locate/identify the presence of non-ferrous item
2	Flap Gate	At Discharge Chute	Suitable for discharging material to either of the two conveyors
3	ILMS	At Discharge Chute	To detect and remove tramp iron pieces for protecting the belt
4	Level Gauge at Loading Silo	At Silo	Suitable to measure the high and low material level of the silo
5	Manual Hoist	All TPs & Bldgs	For weight up to 3 Ton and Lift of 5 M
6	Electric Hoist	All TPs & Bldgs	For weight more than 3 Ton and Lift greater than 5 M
7	Belt Vulcanizing Machine	For conveyor belt	Suitable for 1800mm belt width
8	Lift	Silo complex	1 Ton capacity suitable for maintenance
9	Tools & tackles	For Maintenance	Suitable for maintenance of conveyor system
10	Commissioning spares	For Maintenance	Suitable for maintenance of conveyor system
11	Mandatory Spares	For Maintenance	Suitable for maintenance of conveyor system
12	First fill of lubricant	For Maintenance	Suitable for maintenance of conveyor system

6.2.4 RAPID WAGON LOADING SILO

6.2.4.1 TECHNICAL DATA

Rapid Wagon Loading type of loading system consists of RCC storage silo of 2000 MT, a bin below the silo and the loading chute. This silo will be constructed directly over the rail track. The rake will be moving below the loading chute at a constant speed while material will be discharged into the wagons.

SL.NO	DESCRIPTION	UNITS	DATA
A)	**Rapid Wagon Loading System**	Please refer attached scheme.	
1	Wagon loading rate	TPH	4000
2	Upstream conveyor feeding rate	TPH	3000
3	**Silo**		
a	Storage capacity	Ton	2000
b	No. of outlets of silo	No.	Four (4)
c	Silo slope angle	Deg	70^0 to horizontal (minimum)

d	Diameter of silo	m	To be provided by the bidder.
e	MOC of silo		M.S main plate and SS409 liner plate on sloping surface. Liner plate to be plug welded to mother plate.
4	**Maintenance gates**		
a	Purpose	-	Isolation and maintenance of downstream system/equipment
b	No. of gates	No.	Four (4)
c	Location	-	Bottom of silo
d	MOC of gate	-	Gate frame shall be structural channel of suitable size. Slide doors shall be MS plates with abrasion resistance steel liner of 360BHN. Liner plate to be plug welded to mother plate.
e	Operation	-	Portable hydraulic system

SL.NO	DESCRIPTION	UNITS	DATA
5	**Silo discharge gates**		
a	Purpose	-	Control the flow of material to pre weigh hopper
b	No. of gates	No.	Four (4)
c	Location	-	Below maintenance gate
d	MOC of gate	-	Gate frame shall be structural channel of suitable size. Slide doors shall be MS plates with abrasion resistance steel liner of 360BHN. Liner plate to be plug welded to mother plate.
e	Operation	-	By Hydraulic Cylinder per gate.
f	Non contacting proximity sensors	-	sensors per gate to indicate gate full open and close.
6	**Pre-weigh hopper**		
a	No. of pre-weigh hoppers	-	One (1)
b	Capacity	Ton	71(Minimum)
c	Hopper slope angle	Deg	70^0 to horizontal (minimum)
d	Location	-	Below the silo discharge gates and supported on high quality strain gauge dual ended shear bridge load cell and mounting assemblies.
e	MOC of hopper	-	M.S main plate and SS409 liner plate on sloping surface. Liner plate to be plug welded to mother plate.
f	Calibration of hopper	-	By set of certified cast iron test weights suspended by hydraulic cylinders and shackle assemblies
g	No. of load cell assemblies	No	To be designed by the Bidder
h	Each load cell rating	-	Rated at 150% safe overload with an ultimate overload rating of 300% of rated capacity.

SL.NO	DESCRIPTION	UNITS	DATA
7	**Discharge /Flow control gate**		
a	Purpose	-	Emptying the pre weigh hopper
b	No. of gates	No.	One (1)
c	Location	-	Below pre-weigh hopper
d	MOC of gate	-	Gate frame shall be structural channel of suitable size.
e	Operation	-	By Hydraulic Cylinder
f	Non contacting proximity sensors	-	Sensors per gate ti indiacte gate full open and close.
8	**Telescopic/swing chute**		
a	No. of chute	No.	One (1)
b	MOC of chute	-	MS main plate & Chromium carbide abrasion resistant wear liner plate
f	Traverse & telescopic functions	-	By heavy duty hydraulic cylinders
g	Mounting of chute	-	Shall be supported from steel trolley attached to bottom floor steel of load out structure.
9	**Hydraulic System**		
a	Purpose	-	Operation of each of the silo outlet gates, flood loading gates and telescopic chute system
b	Quantity	-	Two (2) – 1Working+ 1Standby. Each hydraulic system shall have its own power pack & each power pack shall include dual hydraulic pump(for immediate backup)
c	Hydraulic accumulator	-	Each hydraulic system shall be provided with hydraulic accumulator

SL.NO	DESCRIPTION	UNITS	DATA
			as back up protection for closing of gates in case of power or pressure failure.
B)	**Air blaster/Air cannon**		
a	Purpose	-	Ensure trouble free material flow from silo.
B	Suitability	-	Sustained temperature of minimum 150 deg C
c	Location	-	Sloping surface of silo
d	Capacity	-	Minimum of 625ltrs
C)	**Temperature sensors**	-	To be provided to detect any local heating within silo and provide warning (audio and visual) in local & main control room.
D)	**Level indicators**		
a	Type	-	Ultrasonic type complete with sensors, transmitters and limit controllers with audio visual signaling system for different levels.
B	Purpose	-	Monitor continuously level of material in silo and trip the silo feed conveyor at predetermined high coal level in silo.
E)	**Compressed air system**		
a	Purpose	-	For purging dust extraction system bag filters and purging air blasters. The capacity shall be based on the requirements of air blaster and DE system purging.
b	Compressor	-	One (1) no. oil free screw compressor including drives, intercoolers, after coolers, gearbox, silencer & other accessories.
c	Dryer	-	One (1) no. refrigerant type dryer of compressor capacity. Dew point at outlet of the air drying plant shall be (-) 20 deg C at atmospheric pressure. Dust particle size in instrument air shall be in accordance to ISO 8573- class-I.

SL.NO	DESCRIPTION	UNITS	DATA
d	Receiver	-	Two (2) no. of 1 cub.m capacity each (one for instrument air bag filter purging and the other for air blaster) shall be provided with nozzles, air release vents, safety valve, pressure gauge, temperature gauge, minimum 500 mm dia. manhole for inspection.
E	Type of Cooling	-	Air cooling.
f	Delivery pressure from dryer	-	8kg/cm2
F)	**Dust extraction system**		
a	Type of D.E. System	-	Bag Filter
b	Service	-	Continuous
c	No. of D.E. Systems required	-	One (1) no.
d	Maximum Emission Level in the Air Exhausted to the Atmosphere	mg/nm^3	30
n	Explosion vent		To be provided

SL.NO	DESCRIPTION	UNITS	DATA
G)	**Shuttle belt feeder**		
1	**Basic parameters**	-	
a	Capacity (Rated / Design)	TPH	Suitable to handle the rated through put.
b	Belt width	mm	To be designed by bidder
c	Belt speed	m/s	Suitable to achieve rated capacity
2	**Belting**	-	
i	Type	-	Heavy duty Synthetic fabric of N- N with rubber covers of adequate flexibility.
ii	Cover grade	-	Fire resistant (Canadian standard CAN/CSA M-422-M87 Grade-C). Flame retardation test conforming to ISO-340.
iii	Minimum cover thickness (with no negative tolerances)	-	Shall be selected based on loading cycle, lump size and as per manufacturers recommendation
iv	Top rubber thickness	mm	8
v	Bottom rubber thickness	mm	4
vi	No. of plies	No	Minimum 4
vi	Angle	Deg	Suitable to handle the rated capacity without spillage.
vii	Factor of safety	-	Minimum 10.
viii	Normal Working tension at design capacity	-	The belt shall be selected such that operating tension (T1) does not exceed 80% of max. Allowable working tension of belt.
ix	Maximum belt sag between idlers	-	2%
3	**Feeder drive assembly**		
i	Motor rating	-	1.1 x Calculated motor rating at design capacity considering efficiency and derating factors of transmission units
ii	**Gearbox**		
SL.NO	**DESCRIPTION**	**UNITS**	**DATA**
a	Type	-	Helical in general and bevel helical wherever applicable.
B	Mechanical rating	-	1.5 x absorbed power rating at the drive pulley.

C	Thermal rating	-	At least equal to absorbed power considering thermal service factors as per manufacturer.
D	Bearing	-	Antifriction ball/roller
e	Lubrication	-	splash
f	Holdback	-	For all inclined conveyors except for reversible Holdback shall be integral.
g	MOC		
1	Casing	-	Grade FG-260 of IS-210
2	Worm, gear and pinion	-	Alloy steel
3	Shaft	-	Forged / Alloy steel
4	Type of cooling	-	Natural / fan cooled
iii	**High speed coupling**		
a	Location	-	Between gearbox and motor
b	Type	-	Fluid couplings with extended delay chamber for conveyors with motor power 30 kW and above but less than or equal to 200kW. Flexible resilient couplings for conveyors with motor power less than 30 kW.
C	Coupling rating	-	For fluid couplings – service factor of 1 over installed motor rating. For flexible resilient coupling- service factor of 2 over installed motor rating.
iv	**Low speed coupling**		
a	Location	-	Between drive pulley and gearbox
b	Type	-	Geared couplings for conveyors with motor power less than 30 kW.
C	Coupling rating	-	Service factor of 1.5 over installed motor rating
v	**Brake**		
a	Purpose	-	For controlled stropping of the shuttle feeder travel drive.
b	Type	-	Electro hydraulic thrustor type

SL.NO	DESCRIPTION	UNITS	DATA
c	Service factor	-	1.5 minimum
4	**Idlers**		
i	**General for all idlers**		
a	Services	-	Heavy duty, continuous
b	Bearings	-	Heavy duty deep groove ball bearings lubricated for life
c	L10 life of idler bearing	hrs	25000
d	MOC	-	Roller – ERW steel tube (minimum 5.4 mm thick) as per IS 9295. Spindle – EN8.
e	Lubrication	-	Factory lubricated and Sealed for life, with double / triple labyrinth seals.
g	Testing of rolls	-	Dust , water penetration tests, friction test, free rotation tests or as applicable as per relevant standard.
ii	**Carrying idler**		
a	Type	-	Carrying idlers shall be of 3 roll. Roller diameter shall be minimum 152.4mm
b	Spacing	-	1000mm (Maximum) throughout the length. Suitable number of Transition idlers at head and tail end shall be provided.
Iii	**Return idler**		
a	Type	-	Two roll with 10° trough shall be provided. Roller diameter shall be minimum 152.4mm.
b	Spacing	-	3000 mm (Maximum) throughout the length
iv	**Impact idler**		
a	Type		Impact idlers shall be of 3 roll type of 190 mm roll dia (Min) with 127 mm steel tube dia.
B	Spacing		500 mm (minimum six (6) Nos.)
v	**Self-aligning troughing idler**		
a	Type & bearing diameter		Same as carrying idler

SL.NO	DESCRIPTION	UNITS	DATA
5	**Pulleys**		
i	**General**		
a	Face width	mm	Belt width + 200mm
b	Minimum shell thickness	mm	Suitable to handle the rated capacity.
c	End disc thickness	mm	Suitable to handle the rated capacity.
d	Shaft deflection	min	Shaft deflection limited to 1/2000 of distance between bearings and slope at bearings not more than 5 minutes (In the worst loading condition).
e	Lagging thickness	mm	12 mm thick herringbone rubber lagging for drive / head pulley. 10mm thick plain rubber lagging for non-drive pulley.
f	Lagging	-	Hot Galvanized
g	Shell material	-	MS (IS:2062)
h	Shaft material	-	C-45 or EN-8 - forged steel
i	L10 life of bearing	hrs	25,000
6	**Conveyor safety switches**		
a	Pull chord switch (emergency stop)	-	At 10 m from head and tail pulley on both the sides of conveyor. Adequate length of PVC coated wire rope and all accessories shall be provided. Minimum one pair per conveyor.
B	Belt sway switch (auto reset type)	-	Minimum one pairs
c	Zero speed switches	-	Proximity type zero speed switch shall be provided on tail pulley.
7	**Chutes**		
a	All surfaces	-	20mm thick TISCRAL/ SAILMA
b	Minimum size of chutes	-	Minimum C/S area shall be 5 times the area of cross load of preceding conveyor.

SL.NO	DESCRIPTION	UNITS	DATA
8	**Skirt boards**		
a	Minimum length	-	As per standard.
b	Height	-	As per standard.
c	Width	-	2/3 of belt width
d	Side & back plate	-	Min.10mmthk TISCRAL/SAILMA with 6mm thick SS409 liner
9	**Technological structures**		
a	Stringers	-	Min. stringer size – ISMC 150
b	Deck plate	-	Formed plate corrugated at every 1m of minimum 3.15 mm thickness shall be provided throughout the length of feeder.
c	Seal plate	-	Seal plates of minimum 3.15mm thick with suitable stiffners shall be provided throughout the length of feeder.
d	**Belt cleaners**		
i	Discharge end	-	**Pre-cleaner:** Pre Cleaner with modular 40 mm thick PU blades. The cleaner assembly should be mounted on elastomount type mounting arrangement. **Main cleaner:** Multi- blade sprung type, blade with tungsten carbide tip with SS base. With Spring action at individual blade holder as well as at elastomount type mounting arrangement.
ii	Tail / Take-up	-	'V' Type cleaner assembly to clean the inside of the blade, MS plate with 20mm thick PU blade and elastomount arrangement.
e	**Shuttle travel drive**		
i	Parking brake		Electric /hydraulic operated rail clamp with provision of manual operation to be provided
ii	Wheel		The wheels shall be double flanged with straight tread, and shall be
			forged. Wheels shall be heat treated to have a hardness of BHN 300 to 350 on the rolling surface
iii	Operation	-	Travel operation of telescopic chute and shuttle belt feeder shall be provided
10	**Belt weigher**		

a	Quantity		One (1)
b	Range	-	20% to 120% of rated capacity requirement with 100% overload protection
c	Accuracy	-	± 0.5%
d	Measurement provisions	-	Flow rate indicator & totaliser
e	Type of totaliser	-	Digital, six digits
f	Local & Remote rate indicator	-	Required
g	Type of belt scale	-	Electronic/Microprocessor based
h	Type of load cell	-	Temperature compensated hermetically sealed and protected against shock and vibration.
i	No of weigh idlers	-	Min 2 nos.
j	Test weight for calibration	-	Required
H)	**DUST SUPPRESSION SYSTEM**		
a.	Type	-	Plain water dust suppression system
b.	Location of spray	-	At discharge of telescopic chute & at discharge of shuttle belt feeder
c.	Nozzle capacity	-	10lpm / nozzle
d.	Pressure at inlet of spray head	-	To be designed by bidder.
e.	Minimum no. of nozzles	-	Minimum 2 no of nozzles for discharge side of conveyor and 4 no of nozzles for receipt side of conveyor shall be provided
I)	**Rail weigh in-motion system**		
a	Weigh sensors	-	Embedded rail mounted strain gauge sensors.
	Design	-	Pitless type
c	Accuracy	-	±0.5% for each wagon and better than ±0.25% for complete rake
d	Weighing speed	-	Upto 15km/hr
e	Wagon ID	-	All types of 2 axle and 4 axle
f	Direction of weighment	-	Bidirectional
g	Track switches	-	Optical proximity
h	Weigh bridge	-	Suitable for CR 80 track guage.
I	Weigh rail with all necessary fixtures	-	To be provided
j	Calibration	-	Digital Auto correction

J)	**ELECTRIC WIRE ROPE HOIST**		
1	For handling maintenance part	-	>/= 2000 Kg or with a lift of more than 10m
2	Capacity	-	Minimum margin of 25% over the maximum weight of the heaviest equipment / component to be handled.
3	Location (Indoor/ Outdoor)	-	Based on the location
4	Type of control	-	Pendant
K)	**MANUAL HOIST**		
1	For handling maintenance part	-	>300kg to <2000 Kg or with a lift of less than or equal to10m Hook to be provided at all required locations of maintenance for handling maintenance part of weight <300kg.
2	Capacity	-	Minimum margin of 25% over the maximum weight of the heaviest equipment / component to be handled
3	Application	-	Based on location
4	Trolley and hoist operation	-	Hand operated

2.0 CODES AND SPECIFICATIONS

The specific codes / standards followed for the design of the system are as below:

RDSO	Research Designs and Standards Organization, Indian Weights and Measures Department
CEMA	Belt conveyors for bulk materials
IS: 1891 - 1994	Conveyor and Elevator Textile Belting - Specification - Part 1 General Purpose Belting
IS 1891 : Part 5 : 1993	Conveyor and elevator textile belting - Specification: Part 5 Fire resistant belting for surface application

IS:8531-1986	Specification for Pulleys for Belt conveyors
IS:8598 - 1987	Specification for Idlers and idlers set for belt conveyors
IS 9295 - 1983	Steel tubes for Idlers for Belt conveyors
IS 800-2007	Code of construction of structural works.
IS:2062 - 2011	Steel for general structural purposes.
IS:1239 2004 part 1	Spec for mild steel tubes tubular and other wrought steel
IS:3589 : 2001	Steel pipes for water and sewage (168.3 to 2540mm outside diameter)
IS 3832 : 2005	Manual Hoist / Chain Pulley Block
IS 3938 : 1983	Specification for Electric Wire Rope Hoists
IS 4894 : 1987	Specification for centrifugal fan
IS 7155 (part 3): 1990	Code of Recommended Practice for Conveyor Safety
IS: 4682	Code of practice for lining of vessels and equipment chemical processes.
"American Conference of Governmental Industrial Hygienists"(ACGIH)	Calculation of dust extraction capacity
IS 807	Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.
IS 325	Three phase induction motors.
IS 816	Code of practice for use of metal arc welding for general construction in mild steel.
IS 2266	Steel wire ropes for general engineering purposes.
ISO 8573.1	Code for Compressed air quality.
ANSI B31.3	Code for Process piping
BS- 487	Fusion Weld Steel Air Receiver
ANSI -B16.5	Code of Steel Flanges and Pipe fittings
TEMA	Standards of the Tubular Exchanger Manufacturer's Association
ASME sec VIII Div 1 : ASME	Code for Boiler & Pressure Vessel
IS 4029	Guide for testing three phase induction motors
IS 1835	Specification for Round steel wire for ropes

IS 7847	General Characteristic of Lifting hook.
IS 3815	Specification for point hook with shank
IS : 15560-2005	Specification for point Hook with Shank up to 160 tons
IS:655	Specification of metal air duct
IS:4894	Specification of centrifugal fan
IS:1940-1-1986	Mechanical vibration – Balance quality requirements of rigid Rotors-Part-1-Determination of permissible residual unbalance
OSHA	Occupational Safety & Health Administration
ASHRAE: 2007	HVAC applications

Any other Regulation and safety codes related to design, construction & operation of the rapid wagon loading system.

6.2.5 In motion rail weigh bridge

Weigh-in-motion or weighing-in-motion (WIM) bridge is designed to capture and record the gross vehicle weights as wagons drive over a measurement site. Unlike static scales, WIM systems are capable of measuring vehicles traveling at a reduced or normal traffic speed and do not require the rake to come to a stop.

Two numbers rail weigh bridge have been considered; one at the in-haul side to measure the tare weight and another at the out-haul side to measure the gross weight.

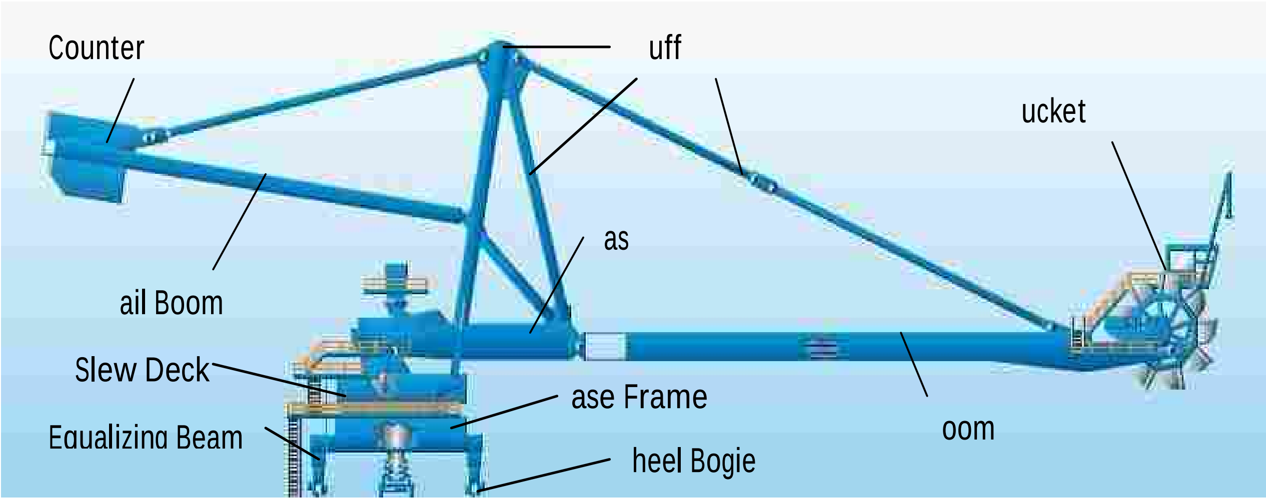
6.2.6 STACKER RECLAIMER

In Bulk Material Handling industry equipment such as Stacker, Reclaimer, Stacker cum Reclaimer etc. are essential for efficient stockpile management. L&T's Reclaimers and Stacker-reclaimers are custom designed and it incorporates the latest technological advancement in material handling sector. The design & analysis is done with complete in-house capability using state-of-art finite element analysis to build tailor made system suitable for specific customer requirement. These value added, cost-effective & world class machines are constantly ensuring efficient operation, long service life, and minimum running cost, optimum civil foundation cost & substantial power savings to our customers.

MACHINE DESCRIPTION

Stacker Reclaimer is a machine that stakes or stores materials in the stockyard and reclaim the same as and when required by means of a Bucket Wheel. The machine comprises of the following major components: Wheel Bogie system, Compensating Beam, Base Frame, Slew Deck, Mast, Boom, Bucket Wheel, Tail Boom & Tripper Structure. The total weight of the machine varies from 400 to 1000 MT depending on size & capacity.

SCHEMATIC ARRANGEMENT OF STACKER RECLAIMER



ASSUMPTIONS

1. All the machine mounted Electrics & Instruments including travel mid-point electrical Equipment are suitable for non-hazardous classified area only.
2. No additional system is considered in L&T scope on machine which is not mentioned in the Technical offer or not mandatory for complete operation of the machine.
3. No CCTV system is considered on machine.

‘**Technical Specification**’

1. **Technical parameters of Stacker-cum-reclaimer**:

Rail-mounted, self-propelled, luffable, slewable, Boom-type Stacker-cum-Bucket Wheel Reclaimer, complete with Electrical, etc., for operating with a unidirectional Yard Conveyor, with provision for by-pass feeding, shall be supplied as per the given specification. The main characteristics of the machine shall be as follows:

1	Type	:	Rail-mounted, self-propelled, luffable, slewable, Boom-type Stacker-cum-Bucket Wheel Reclaimer, complete with Electrical, etc., for operating with a unidirectional Yard Conveyor, with provision for by-pass feeding.
2	Quantity	:	2 (one) no.
3	Material to be handled	:	Coal Lump size: (-) 300 mm Bulk Density: 800 kg/m^3 Angle of Repose: 37°
4	Capacity (MTPH)	:	Stacking – Rated: 3000 MTPH Reclaiming – Rated: 2000 MTPH
5	Boom length (m)	:	30 m [Slew Centre to Axis of Rotation of Bucket Wheel]
6	Track Guage	:	6 m
7	Track Rail type & size	:	CR 80
8	Duty	:	Continuous, 20 hours a day, 350 days a year. For design criteria, please refer table below.
9	Power Supply	:	3.3 kV, 3 Phase, 50 Hz, through Flexible Cables and Cable Reeling Drums.
10	Cable length on cable reel	:	350 m + 4 Coils
11	Power Cable Reeling Drum (PCRD)	:	Motor-operated, Barrel type.
12	Travel speed	:	Step less: 3 – 20 m/min
13	Slew speed/range	:	0.09 to 0.20 rpm (approx.) 105° on either side, from centre line of track. **Slew Bearing** shall be of **Rothe Erde**, **Germany** make.
14	Luffing mechanism	:	
	a) Range	:	Should be capable of reclaiming **1 m below the Rail level** and **10 m above the Rail Level**. Reclaiming level should be considered as the bottom of the Bucket Wheel. Range shall be suitable for making the specified pile cross section. However, inclination of more than $\pm 14^0$ is not acceptable.
	b) Drive	:	Electro-Hydraulic.
	c) Boom luff Cylinder type/Designation	:	Clevis-mounted heavy duty repairable construction type.
	d) No. of Cylinder	:	2 (Two)
	e) Power pack pump type	:	Variable displacement pump shall be of axial piston type.
15	Length of the stock pile	:	650 m
16	Cross section of the stock pile	:	Trapezoidal

17	Bottom width of the stock pile	:	27 m, 40m, 44 m
18	a) Height of the stock pile	:	10.0 m above Rail level ~ 11.0 m above Yard level
19	Bucket Wheel	:	
	1. Type	:	Cell less
	2. Diameter	:	To suit height of the stockpile, capacity of the machine, luffing range and all other relevant parameters.
	3. Type of drive/motion	:	The Bucket Wheel drive shall be **Direct Hydraulic Drive**, **without any Gear Box**. The Bucket Wheel drive shall be of **reversible** type to facilitate withdrawal of Wheels in the event of excessive under cutting.

4. The speed range of the Bucket Wheel should be selected such that the reclaimed material is discharged onto the slope chute efficiently, at all speeds of the selected speed range.
5. The Cutting Edge/Lip shall be made of highly wear resistant Steel having hard faced surface. The minimum hardness of replaceable Liner shall be 350 BHN.
6. **Push-back type Trailing Tripper**, with suitable arrangement for changing from stacking mode to reclaiming mode and vice versa, to be considered.

This would mean suitable provision for feeding of cargo directly from the Trailing Tripper to the Yard Conveyor as well as from the Trailing Tripper to the Boom Conveyor (during stacking operation). Moreover, suitable provision should be kept for feeding the reclaimed cargo from the Boom Conveyor to the Yard Conveyor.

20	Travel mechanism	:	
	a) Type of support	:	3 (Three) Point, 4 (Four) Corner
	b) Wheel spacing	:	Not less than 1.5 times Wheel diameter.
	c) Drive	:	The Gantry Drives should be designed for **near-continuous** and **intermittent** operation. **Electro-Mechanical** type Gantry Drive with **VVVF** (**Flux & Vector Control**) type Speed Control should be used. Number of drives for long travel mechanism shall be decided by the Contractor, taking into account the speed indicated above. The long travel mechanism drive shall be provided with multiple drives on each side. In the event of failure of any drive Motor, the corresponding Motor on the other side shall be automatically disconnected. However, the machine shall be operational with the remaining drives. Minimum 50% of the long travel wheels shall be positively driven.
	d) Rail Clamp	:	2 (two) nos. Electrical + 2 (two) nos. Mechanical Hydraulic release type.
	e) Buffer type	:	Spring-operated.
	f) Wind load	:	Wind pressure and loads to be calculated using the following values: a) Wind speed at **normal operating condition – 20 m/sec**. b) Wind speed at **non-operating condition – 56 m/sec**.

g) **Wheel load** for the proposed Stacker-cum-reclaimer shall be restricted to **20.32 MT ± 10% per Wheel** (**vertically downward**).

h) Jacking point shall be provided at suitable point for replacement of long travel wheel of Stacker-cum-reclaimer.

i) **1** (**one**) **no. Lifting Jack** of suitable capacity, complete with **Pumps**, **Pressure Gauge** and all accessories, to be provided with the Stacker-cum-reclaimer for replacement of long travel wheel.

21 Boom Conveyor drive of Electro-mechanical type, with **Hydraulic Jack operated Screw take-up**, shall be considered. Gear Reducer for Boom Conveyor drive shall be Bevel Helical/Helical type.

22 The belting and type of Idlers to be provided in the machine shall be as follows:

23	Control Cable Reeling Drum (CCRD)	:	Motor – operated, Barrel-type.

24 **Stall Torque Motor** for **PCRD** and **CCRD** may either be of **Demag**, **Germany** make or **MARK ELEKTRIKS** make. However, for any other make of Stall Torque Motor to be used for PCRD and CCRD, the Contractor shall obtain prior approval from the Engineer, after the said make has duly been recommended by the 3rd Party Inspection Agency.

Minimum 4 (four) dead turns extra Cable length shall be considered, over and above the travel requirement for the formation/reclamation of stock piles.

25	Power Supply available	:	3 Phase, 3.3 kV ± 10%, 50 Hz ± 5%.

26 Walkway of minimum 800 mm width, Grating Floor and Hand Railing shall be provided on both the sides of the Boom Conveyor for maintenance purpose.

27 The Boom's hoisting movement upwards shall be restricted to maximum limit to prevent it from damaging the Reclaimer structure. However, provision shall be made to enable the Boom end to be brought to the ground for repair and maintenance by bypassing the Operational Limit Switch that restricts its downward movement.

The height of the Boom end shall be automatically adjusted to limit the height of the free fall of the discharged materials. The Boom Hoist shall get automatically adjusted so that the height of free fall of material shall not exceed 2 m and shall not be less than 1 m. However, at the start of formation of pile on the ground, the initial height of free fall may be up to 4 m. Central stockpiling shall be possible with all Boom positions.

28 Before the stack of material reaches to its topmost height in a particular position, an Audio Visual Signal shall be provided in the Cabin to warn the Operator to plan for shifting of the machine to the next location.

29 The machine shall be suitable for reclaiming material from the stock pile of the given cross section by operating from one side of the stock pile.

30 Electrical equipment, Electronic equipment (including PLC) and accessories, wherever installed in the machine, shall be provided with Air-conditioning, as per requirement.

31 Press To Talk (PTT) system shall be provided.

32 Over Travel Device (Non-contact type) shall be provided.

33	**Protection Equipment**: All machineries shall be provided with fire protection equipment including, but not limited to, the following: Smoke and Thermal-type Fire Detectors shall be installed in all the Switch Room. A Xenon Flash Lamp or equivalent and Siren warning system shall be installed above the Operator's Cabin. A fire water pipe work system which shall be installed on the machine and include hydrants hoses and hose reels located to provide coverage of all operating areas. The system shall also include suitable length of hose reel connection for each machines that can be accessed at ground level to manually couple to the nearest 65 NB hydrant connection. The hydrant connection shall be compatible with Indian

	Standards. The pipe work system shall be galvanized and painted in accordance with this Specification. Suitable **CO_2 type Fire Extinguishers** are to be provided at the following installations of each machineries: a) **Electrical Control Room – 2** (**Two**) **Nos.** b) **Operator's Cabin – 1** (**One**) **No.**

2. **Design Criteria**:

Stacker cum Reclaimer **Table No. A**

The various machineries, structures, etc. shall be designed as per FEM.1.001 – 3rd edition as detailed below:

Sl. No.	Nature of work	Class of Utilisation	Load Spectrum	Appliance/ Mechanism Class
1.	Steel structures	U8	Q4	A8
2.	Boom Conveyor drive mechanism	T9	L4	M8
3.	Bucket Wheel drive mechanism	T9	L4	M8
4.	Slew mechanism	T8	L4	M8
5.	Long travel mechanism	T7	L4	M8
6.	Luffing mechanism	T7	L4	M8

6.2.7 UTILITY SCOPE

The scope of work of utilities generally comprising of dust suppression system, ventilation system, firefighting protection, air conditioning system and the like are proposed. The types of utilities system considered are as follows:

Sl. No	Type of System	System	Description
1	Stockpile Dust Suppression	DS	Sprinkler type dust suppression system for coal/coke stockpile to arrest the airborne particles
2	Plain Water Dust Suppression System	PWDS	Dust suppression at conveyor feed and discharge points.
3	Ventilation System	VS	Dry type Pressurized Ventilation System at Electrical substation buildings for the MCC and cable vault area. Only wall mounted exhaust fan ventilation for staff rest rooms, canteens, admin building.
4	Air Conditioning System	AC	Air cooled package AC at the control room of Electrical substation building.
5	Fire Fighting System	FFP	Hydrant type firefighting system shall be provided across the battery limit of the plant and in the buildings and transfer points under scope. Medium velocity water system (MVWS) at conveyor galleries Extinguisher at the buildings only.
6	Fire Protection System	FPS	FPS shall be provided only at the substation building along with dry type portable extinguisher.
7	Potable Water	PW	PW to be provided at specified points in the admin & canteen buildings.
8	Service Water	SW	SW to be provided at strategic location to suit the requirement.

6.2.8 ELECTRICAL SYSTEM

The electrical scope shall include inter-alia the following:

SL. NO.	EQUIPMEN T	QTY	UOM
1.	OUTDOOR TYPE POWER TRANSFORMERS	1	Lot
2.	NEUTRAL GROUNDING RESISTOR	1	Lot
3.	HT SWITCHBOARD	1	Lot
4.	OUTDOOR TYPE DISTRIBUTION TRANSFORMERS	1	Lot
5.	415V LT BUSDUCT	1	Lot
6.	415V LT PMCC	1	Lot
7.	415V LT MCC(UTILITY)	1	Lot
8.	415V VFD Drive (if applicable)	1	Lot
9.	415V ASPB	1	Lot
10.	415/240V ACDB	1	Lot
11.	HT APFC CAPACITOR PANEL (as required)	1	Lot
12.	LT APFC CAPACITOR PANEL	1	Lot
13.	415V LOCAL STARTER PANEL	1	Lot
14.	HT MOTOR	1	Lot
15.	LT MOTORS	1	Lot
16.	DC BATTERY & BATTERY CHARGER WITH DCDB	1	Lot
17.	MAIN LIGHTING DISTRIBUTION BOARD	1	Lot
18.	ILLUMINATION SYSTEM (excluding high mast)	1	Lot
19.	WELDING RECEPTACLES	1	Lot
20.	EARTHING SYSTEM	1	Lot
21.	LIGHTNING PROTECTION SYSTEM	1	Lot
22.	FIELD DEVICES	1	Lot
23.	LOCAL PUSH BUTTON STATION	1	Lot
24.	POWER & CONTROL JUNCTION BOXES	1	Lot
25.	HT POWER CABLE	1	Lot
26.	LT POWER CABLE	1	Lot
27.	CONTROL & INSTRUMENTATION CABLES	1	Lot
28.	CABLE TRAYS & ACCESSORIES	1	Lot

6.2.9 CIVIL & STRUCTURAL SCOPE OF WORK

The major buildings /structures of coal/coke handling system as envisaged to be included in the scope of work shall be as follows subject to process requirement as finalized during detail engineering.

I.	**CIVIL WORKS**
1	SURVEY & SOIL INVESTIGATION
2	SUPPLY AND FIXING OF RAIL ON BERTH NO3
3	ALL BUILDING AND CONVEYOR TRESTLES/BENT FOUNDATION
4	RCC TANKS AS REQUIRED.
5	PUMP HOUSE
6	ADMINISTRATION BUILDING
7	SUB-STATION BUILDING
8	STAFF REST ROOMS & CANTEEN
9	INTERNAL ROADS & DRAINS UP TO THE NEARBY MAIN ROADS
10	ROADS & DRAINS AROUND BUILDING & TPs (AS REQUIRED) TO CONNECT PLANT MAIN ROAD & DRAIN WITHIN THE BATTERY LIMIT
11	MICRO GRADING AND PAVING WITHIN THE BATTERY LIMIT
12	STOCK-PILE BED PREPARATION
II.	**STRUCTURAL WORKS**
1	COVNEYOR TRANSFER POINTS
2	CONVEYOR GALLERIES, TRESTLES AND BENTS.
3	PIPE RACK, CABLE RACK ETC. (as required)
4	SHEETING WORKS (as required)
5	ANY OTHER PLATFORM/BUILDINGS/STRUCTURES REQUIRED FOR COMPLETION OF MATERIAL HADNLING SYSTEM

Mechanical Engineering Codes

Sr. No.	Codes	Descriptions
1	Federation Europeenne de la Manutention (FEM)	Rules for the design of Hoisting Appliances
2	BS-2573	Specifications for Permissible Stresses in Cranes and Design Rules
3	Conveyor Equipment Manufacturer Association	Belt Conveyors for Bulk Materials
4	(CEMA) IS 11592	Selection & Design of Belt Conveyors
5	ASTM-D-2234 & ASTM-D-	Sampling
6	2013 and ISO & JIS Fire Protection Manual	Fire Fighting system
7	(Tariff Advisory Committee) IS 8598	Specifications for Idlers & Idler Sets for Belt Conveyors
8	IS 9295	Steel Tubes for Idlers
9	IS 2266	Steel Wire Ropes for General Engineering Purposes Specifications.
10	IS 3177	Code of Practice for Electric Overhead Traveling Cranes and Gantry Cranes other than Steel Work Cranes.
11	IS 1136	Preferred Sizes for Wrought Metal Products
12	IS 3443	Crane Rail Sections
13	IS 9295	Steel Tubes for Idlers for Belt Conveyors
14	IS 8598	Specification for Idlers and Idler Sets for Belt Conveyors.
15	IS 1891	Conveyor and Elevator Textile Belting
16	ISO / Metric	Screw Threads & Gearing Profiles

17	IS 210 Grade 20 excepting counter weights	Grey Iron Castings – Specification
18	IS 2644 Grade 1	High Tensile Steel Castings
19	IS 2664 Grade 4	Specification for Quenching Oil
20	IS 1030	Carbon Steel Castings for General Engineering Purpose
21	IS 2707 Grade 23-45	Carbon Steel Castings for Surface Hardening
22	IS 1570, C40, Cold Drawn Specified	Schedules for Wrought Steel
23	IS 1875	Carbon Steel Billets, Blooms, Slabs and Bars for Forgings
24	IS 276	Austenitic – Manganese Steel Castings
25	IS 2062 (Fusion Welding Quality)	Hot rolled Low, Medium and High Tensile Structural Steel
26	IS 961 (Fusion Welding Quality)	Structural Steel (High Tensile)
27	IS 1570, C14	Schedules for Wrought Steels
28	IS 1895 Grade 1	Specification for Cotton New AR
29	IS 1239	Steel Tubes, Tubulars and Other Wrought Steel Fittings
30	IS 1161	Steel Tubes for Structural Purposes
31	IS 306 Grade 2	Tin Bronze Ingots and Castings
32	IS 28	Phosphor Bronze Ingots and Castings
33	IS 305 Grade 2	Specification for Aluminum Bronze Ingots and Castings
34	IS 6911	Stainless Steel Plate, Sheet and Strip
35	IS 807	Design, Erection and Testing (Structural Portion) of Cranes & Hoists.
36	IS 875	Code of Practice for Design Loads for Buildings and Structures.

Civil Codes

Sr. No	Codes	Descriptions " Code of Practice"
1.	IS:456	for plain and reinforced concrete
2.	IS:875	of practice for design load (Part 1 to Part 5)
3.	IS:1893	criteria for earthquake resistant design of structures (Part 1 to 3)
4.	IS:4651	for planning & design of ports & harbours (Part 1 to 5)
5.	IS:1343	for pre stressed concrete
6.	IS:800-1984	for general construction in steel
7.	IS:806-1968	for use of steel tubes in general building construction
8.	IS:2911	for design & construction of pile foundation
9.	IS:2974	for design & construction of machine fdn.
10.	IS:4000-1967	for assembly of structural joints using high tensile friction grip fasteners
11.	IS:7205-1974	Safety code for erection of structural steel works
12.	IS:7215-1974	Tolerance for fabrication of steel structures

Geotechnical Codes

Sr. NO	Codes	Descriptions " Code of Practice"
1	IS:1080	For design and construction of shallow foundations in soils (other than raft, ring and shell).
2	IS:1498	Classification and identification of soils for general engineering purposes.
3	IS:1888	Method of load test on soils
4	IS:1892	for sub-surface investigation for foundation
5	IS:1904	for design and construction of foundations in soils: General Requirements
6	IS:2720	Method of test of soils
7	IS:2911	for design and construction of pile foundation
8	IS:2950	for design and construction of raft foundation
9	IS:2974	for design and construction of machine foundation
10	IS:5121	Safety code of piling and other deep foundation
11	IS:6403	for determination of breaking capacity of shallow foundation
12	IS:8009	for calculation of settlements of foundations
13	--	Guidelines on soft soils stage construction method – RDSO (Ministry of Railways).

SECTION 7
STOCK YARD, STACKING & EVACUATION

7.1 General:

The stockyard in a bulk unloading port is required for transit storage of bulk materials before evacuation for end user. The proposed mechanization of Berth No3 is planned for importing, transit storage and evacuation of coal. The volume and the number of stock piles should be commensurate with the grades of these materials handled, the throughput requirements for each grade and type of material, the rate of stacking, the rate of evacuation, vessel parcel size etc.

The required volumetric capacity of stack yard will depend on the bulk density and the angle of repose, the length, width and height of stock pile. If the height and width of stock pile are restricted, then the length has to be increased to maintain the same capacity. However, it is not always prudent to have a lengthy stack yard as that will entail too frequent travel over long distances for the yard machines. The width of stockyard has to be limited as too wide a stack will demand a long boom length for the yard machines which will increase their size and hence the cost much more than such arithmetic increase. The best way to optimise the capacity of a stack yard, therefore, is to optimise the height and width. The three aspects that impose limitation in stack height are:

1. **Load bearing capacity of the soil**: The proposed stack yard had been used for iron ore whose density is significantly more than coal for a number of years. As such no major soil improvement wok is required except dozing to make level ground. However laterite bouldering has been considered for development of the yard.
2. **Limitation due to angle of Surcharge:** With increase in height of stockpile, the surcharge angle will increase and if increased beyond specified angle, it will cause sliding of material while negotiating an incline such as the boom conveyor of stacker/reclaimer, inclined conveyor etc., thus making it technically not feasible. Further due to the limitation imposed by the angle of repose, the capacity increase of a stockpile will not be directly proportional to increase in height. To prevent spillage of coal on to the stacker/re-claimer track, 1.25m high RCC retaining wall is proposed along both sides of each track.
3. **Pollution and Combustion due to Auto ignition:** The coal has the property of combustion due to auto ignition on account of burden of coal in high stock piles. This is more pronounced if the coal stays in the stockyard for too long. Also too much increase in stock pile height in an open stack yard may cause pollution due to windage.

The problems on account of points 2 and 3 above can be pronounced during hot and dry summer months. To limit the problem of auto ignition in case of coal and to contain pollution due to windage and optimise on the cost of improving soil for increasing the load bearing capacity of stockyard area, it is proposed to limit the height of coal stack yard to an optimal height of 10 meters. On a similar analysis the width of stock pile is planned is optimised to be 27 m, 40 m & 44 m.

It is proposed to plan for layout of stockyard with three parallel rows of stacks with a stacking capacity of 2.00 Lakh tonnes.

7.2 Stockyard Capacity Assessment

The capacity of stack yard planned depends on the annual throughput requirements, number of grades of materials, number of users, maximum vessel parcel size and rate of evacuation. In the section on Planning Parameters, the turnover ratio of stack yard per annum is taken as 18, with an average dwell time of about 20 days. Thus the stockyard capacity will be 5.71 % of annual throughput.

7.3 Stackyard planning:

Based on the capacity considerations as detailed above, the planning of stockyard is tabulated as below in Table 7.1

Table 7.1 - Stackyard Planning

Sl No	Description	
1	Annual Traffic	3.50 million tonnes
2	Norm for storage proposed as a Percentage of Annual Throughput	5.71 %
3	Capacity of stock pile required as per norm	1,99,850 Te
4	Density of coal	0.8
5	Angle of Repose	37☐
6	Height of stock pile	10 m for coal

No	Description	
7	Width of stock pile at the bottom	27M,40M,44M m in three plots
8	Width of stock pile at the top for coal	11m,24m,28m m
9	Length of stack proposed	100 m/ 75m/50m
9	Length of the same stockpile at the top for coal	73.50 m (for 100 m long stock pile)
10	Quantity stacked per pile having a length of 100 m at the bottom, a width of 40 m, a height of 10m for coal and with an angle of repose of 37☐	27680 Te
12	Number of piles proposed	12 no of 100 m Length, 3 nos 75m length and 1 no of 50 m length.
13	Total Length of stock pile proposed	1475 m divided in three piles of27m, 40 m & 44m
14	No of Rows of stock piles proposed	3
15	No of stock piles proposed in each row	6 no on plot I and 5 no on plot-II & III
16	Total No of stock piles proposed (as shown in the drawing)	16
18	Capacity of stock pile planned	2,00,000 Te

7.4 Locating the Stockyard

It has been proposed to locate the stockyard in the back up area of berth No 3 which is earmarked for the purpose and as per conceptual drawing enclosed.

7.5 Stack Yard Layout

The stockyard area will be rectangular with 3 rows of stockpiles. There will be two separate tracks for the two Stacker cum reclaimers on two yard conveyor to operating independently. During ship unloading one Stacker cum Reclaimer will be deployed for stacking and the second one will be available for wagon SILO loading. Whenever there is no vessel both the stacker cum recalimers will be available for reclaiming and depending upon operational exigencies any one of the two units can be used for reclaiming or both the reclaimer can be useed for reclaiming the coal from the stack yard for wagon loading. Both the Stacker cum reclaimers will run in between the three rows of stock piles parallel to each other independently, side by side and two stock piles on either side of conveyor can be accessed by either of the stacker cum reclaimers.

7.6 Total Area of Stack yard vis a vis Area used for actual stacking:

The layout of stack yard planned is depicted in the drawing enclosed. The stock piles are laid out in three rows with two stacker cum reclaimer with two dedicated yard conveyor. Plot no-I consists of 6 stock piles and Plot- no-II & III have 5 stock piles. Each stock pile is separated from next by a gap of 10 m to avoid admixture. Thus after accounting for 525 m of length for actual stacking the remaining will be used for installing yard conveyors, two stacker cum reclaimers, for the purpose of accommodating the sloping conveyors, installing supporting facilities like dust suppression system, fire fighting system, service road, workshop facilities, admin building, workers amenities building, substation etc. In view of these operational requirements the area that can be used for actual stacking will be about 54,000 sq.m (as per concept plan in this report). The existing RCC bunkers which are defunct need may dismantle and the area thus created may be used for locating additional stock pile and other operational requirements.

7.7 Evacuation:

The coal from stockyard will be evacuated through rail. The mechanized evacuation facilities will be in the form of a rapid in-motion wagon loading system. As the throughput the requirement is only 3.5 MTPA the rapid in-motion wagon loading system will have to cater to about three rakes per day at the most for the given throughput.

7.8 Railway Yard:

For evacuating the planned annual throughput of maximum 3.5 MTPA through in-motion wagon loading system, the existing railway yard located abutting the stack yard is proposed to be used. A rapid wagon loading silo of about 2000 tons capacity is proposed to be installed and the railway lines proposed for the exclusive purpose of berth 3 mechanization have been conceptualised as per the drawing enclosed.

9.8.1 Railway operations

The empty rake received in the port's railway yard and earmarked for loading through the rapid wagon loading system berth No 3 will be hauled by port railways and handed over to the berth operator in the Operator's yard. The empty wagon rake will be then moved at controlled speed to pass in the loading line under the silo. The loading will take place under controlled and specified speed to enable loading the full rake in about an hour & 10 minute. Once the loading is completed the locomotive will traverse through second line for engine reversal. Thereafter the loaded rake will be kept ready for hauling by port's loco back into the port's railway yard for eventual handing over of loaded rake to the Indian railways.

The purpose of port handing over the empty rake to the operator in his yard and then taking over loaded rake from the same private operators yard is to ensure that the BOT operator's LOCO will not have to transgress into the port railway yard unnecessarily where a number of other movements will be taking place as per port operational planning and to avoid conflict or safety issues.

SECTION 8
CAPITAL COST ESTIMATE AND IMPLEMENTATIONCHEDULE

8.1 Capital Cost

The total capital cost of the project is estimated at Rs. 331.94 Crores. The summary break-up of the estimate is given as under:

BLOCK COST ESTIMATE

II	**Capital Cost**	-	[Rs in Crore]
A.		-	
	(i). Civil Cost		
	Revamping of the Existing Berth to accommodate the Loaders and other Machineries		2.54
	Civil Foundation for Conveyer Structure		5.00
	Civil Works for Silo System		5.00
	Construction of New Railway Lines for Rapid Wagon Loading System		24.25
	Extension of existing Track Line of Stacker cum Reclaimer		3.28
	Service Road		4.65
	RCC Drain		2.66
	Compund Wall		3.65
	Laterite Hard Stading of the Yard		8.10
	Detailed Designs & Project Supervision costs @ 2%		1.18
	Contingencies @ 3%		1.77
	GST on Civil works @ 18%		11.18
	Civil Cost including GST		**73.26**
	(ii). Mechanical Equipment Cost		
	1500 TPH Rail Mounted Gantry Grab Unloader including 25 CBM Grab with rail span of 13.687 M.		90.00
	Conveyor 3000 TPH capacity (Approx 2200 m) including transfer points		38.00
	Stacker cum Reclaimer– Stacking-3000 TPH, Reclaiming - 2000 TPH, with Boom Length-30 m, Long travel rail gauge- 6m,		35.10
	SILO- for rapid Wagon Loading site 2000 MT		19.25
	Dust suppression system and Fire Fighting facilities including water supply and distribution.		6.90
	In motion Weigh Bridge		0.86
	Bull Dozer		4.00
	Detailed Designs & Project Supervision costs @ 2%		3.88
	Contingencies @ 3%		5.82
	GST on Mechanical Works @ 18% [Assumed Full ITC]		0.00
	Mechanical Cost		**203.82**

	(iii) Electrical Works		
	Electrical Power Supply and Distribution System including Substation		36.20
	Illumination with High Mast Lighting System		1.00
	Detailed Designs & Project Supervision costs @ 2%		0.74
	Contingencies @ 3%		1.12
	GST on Mechanical Works @ 18% [Assumed Full ITC]		0.00
	Electrical Cost		**39.06**
	Total		**316.13**
	(iv). Miscellaneous		
	5% on Civil Cost and Equipment Cost		**15.81**
	Total Capital Cost for Handling Activity (i + ii + iii+iv)		**331.94**
B.	**Berth Hire Activity**		**0.00**
	Total Capital Cost (A + B)		**331.94**

Note: Input Tax Credit can be availed on GST paid on Mechanical / Electrical costs. Hence not considered as Cap-ex and consequent Fixed assets

8.2 Implementation Schedule:

The project implementation period including detailed engineering for the above from the date of grant of concession is estimated at 18months. The phasing of expenditure is given as under:

(Rs. In Crores)

Year	Percent of Expenditure	Amount
2019-20	25 %	82.99
2020-21	50 %	165.97
2021-22	25%	82.98
TOTAL	**100 %**	**331.94**

8.3 Grant Chart

Sl. no	Activity	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20	Sep 20	Oct 20	Nov 20	Dec 20	Jan 21	Feb 21	Mar 21
1	Preparation of Engineering Drawing and Approval																		
2	Yard Development and Jetty Repairing																		
3	Civil Work and Structural Foundation																		
4	Undercarriage of Rapid Wagon Loading System with Accessories, Unloader and Stacker cum reclaimer erection																		
5	Installation of Super Structure of SILO , Unloader and Stacker cum reclaimer																		
6	Testing and Commissioning																		
7	Trial Run and Taken Over																		

SECTION 9
OPERATION AND MAINTENANCE COST

9.1 Capital Cost Estimate of the Project given in Section-8 (without GST on Mechanical and Electrical portion in view of Input Tax Credit available to the operator) is considered as the basis for calculating the annual operation and maintenance cost.

9.2 The annual operation and maintenance cost of the proposal is estimated at Rs. 77.41 Crores as per TAMP guidelines for fixation of up-front tariff. The O&M cost as per TAMP Guidelines for fixation tariff estimated is given in the table below.

	Operating Cost for Cargo Handling Activity -	In Crores
	-	
	(a) Hire Charge	
	i) One High Power Locomotive (without Fuel)	2.0943
	ii) Four Baby Dozers (All inclusive rate)	1.94481
	iii) One Excavator (All Inclusive Rate)	0.33293
	iv) One Hydra (All inclusive rate)	0.17856
	v) Two 10 MT Pay Loaders for road evacuation (All inclusive)	2.96352
	(b). Power Cost -	5.90
	1.4 units/ tonne, Effective Levy-Rs 11.91 per KWH (Energy Charge- Rs 7.15 per KWH, Demand Charge-Rs 384.00 per KVA for 1600 KVA, Govt Duty- 17.5%, Line Loss-2.6% , KOPT's Overhead Charge-19.25%]	
	(c). Fuel Cost	
	Locomotive	0.38
	32 ltrs per hour * Rs.66.00 per litre *1788 hours p.a	
	Bull Dozer	0.38
	(12 ltrs per Hour @ Rs 66.00 per ltrs for 2 shifts per day for 300 days)	
	(d). Repair & Maintenance	
	- Civil Assets (1% on civil work)	0.77

	- Mechanical & Electrical Equipment including spares (7% on equipment cost)	17.85
	(e). Insurance (1% on Gross fixed assets)	3.32
	(f). Depreciation	
	- Civil Work @ 3.17%	2.44
	- Mechanical Work @ 6.33%	13.55
	- Electrical Assets @ 9.5%	3.90
	(g). License Fee [146984 sqm @ 27.346 per sqm per month)	4.82
	(h). Other Expenses towards salaries and overheads (5% on gross value of assets)	16.60
	Total Operating Cost	**77.41**

9.3 The key assumptions for estimation of annual Operation and Maintenance expenditure are as follows.

9.3.1 Optimal Capacity Terminal:

The Optimal Capacity of the proposed Mechanised berth -3 is determined at 3.50 MTPA based on the norms prescribed in Upfront Tariff Guidelines 2008 / Tariff Orders considering the circumstances at Haldia Dock complex and the Lock gate constraints. The optimal quay capacity is working out to 5.11 MTPA at ship day output of 20000 tons for Panamax and Handymax vessels respectively considering 80% and 20% share. The Optimal Yard capacity is considered at 3.50 MTPA. Hence the least of the two i.e. 3.5 MTPA is considered to be the optimal capacity of the terminal.

9.3.2 Repairs & Maintenance Cost:

As per norms specified in Upfront Tariff guidelines 2008, the Repairs & Maintenance cost is estimated at 1% of Civil assets and 7% of all Mechanical and Electrical equipment.

9.3.3 Power cost for Operation and Illumination:

a) Power Cost:

As per norms specified in Upfront Tariff guidelines, the power consumption for operation and illumination is taken at 1.4 units per tonne of cargo handled for the optimal capacity of 3.5 MTPA. The unit rate of power is considered at 1.4 units/ tonne, Effective Levy-Rs 11.91 per KWH (Energy

Charge- Rs 7.15 per KWH, Demand Charge-Rs 384.00 per KVA for 1600 KVA, Govt Duty- 17.5%, Line Loss-2.6% , KOPT's Overhead Charge-19.25%].

b) Fuel Cost:

1) Dozers:

The fuel cost for Buldozer is calculated at 12 litres per hour with the prevailing cost per litre of Rs. 66.00 at Haldia as on 19th December. Dozers shall work at an average of two shifts per day for dozing of cargo.

2) Loco:

The fuel cost for Loco is calculated at 32 litres per hour (as per VIZAG Port Trust Order dated 29.11.2017 with the prevailing cost per litre of Rs. 66.00 at Haldia as on 19th Dec 18. For handling 80% of the 3.5 MTPA by rail, at the rake capacity of 3800 tons with the time of 2 hrs taken for handling each rake and adding 20% for positioning of the rake, the number of hours required for loco to be used works out to 1788 hours per annum which has been considered for calculating fuel consumption of Loco.

c) Loading of cargo for road evacuation:

It has been considered that 20% cargo will be evacuated through road. The cost of road evacuation as per two high capacity front end loader@ Es 24696 per shift per Loader has been considered as per the ongoing TAMP approved rate for stevedoring and Shore Handling **.**

d) Hiring of Equipments:

Frontend loader, Excavator , Locomotive and Hydra have been considered as taking on hiring basis as mentioned below:

i) **Locomotive:** Hiring of Locomotive of High Power Locomotive for hauling of 5500 MT @ Rs 17,45,288 per month has been considered and the hiring rate of Vizag Port Trust order dated 29.11.2017 has been considered.

ii) **Frontend loader**: Hiring of Front end loader of 3 cu meter capacity has been considered for working in hatches. The rate of Rs 13230 per shift as per TAMP approved rate fopr Stevedoring and Shore handling of HDC has been considered.

iii) **Excavator:** Hiring of excavator has been considered as per the rate of Rs 1156/- per hour as per existing order of HDC.

iv) **Hydra:** Hiring of Hydra of 15 MT capacity has been considered and the hiring rate of HDC's existing order rate of Rs 520 per hour has been considered for 360 days.

e) Other expenses:

As per norms specified in Upfront Tariff guidelines, other expenses are estimated at the rate of 5% of original capital cost of assets of Cargo Handling activity which include the following:

(i) Salaries and wages of operating and maintenance staff including welfare and other expenses towards them.

(ii) Management and general overheads and other miscellaneous cost.

f) Insurance:

As per Upfront Tariff guidelines, Insurance cost is estimated @ 1% of the total gross capital cost.

g) License Fee:

License Fee payable for the land area of the project is estimated as per applicable lease rental rates of HDC @ Rs.27.346 per sqm per month as on Nov,18. The area of land is taken from the technical sections of the Feasibility report of IPA for the Stock yard, Railway yard and the area required for the conveyor trestle, service roads, truck loading area etc.

h) Depreciation:

As per Upfront Tariff guidelines, Depreciation is estimated at 3.17% on Civil Assets, 6.33% of the capital cost of the Mechanical equipment and at 9.50% of Electrical and Communication systems on Straight line method as per the Companies Act 2013.

9.3.6 Depreciation

As per Upfront Tariff guidelines, Depreciation is estimated at 3.17% on Civil Assets, 6.33% of the capital cost of the Mechanical equipment and at 9.50% of Electrical and Communication systems on Straight line method as per the Companies Act 2013. However, the same is not considered in the cash flows being non cash expenditure for calculating IRR.

SECTION 10
ANNUAL REVENUE ESTIMATES

10.1. The Project is planned to be taken up through EPC Basis. Since the Berth is constructed by the Port and is going to be maintained by the port, the Berth hire also accrues to the port besides the other Vessel related charges. The tariff shall be determined under Revised Reference Tariff guidelines 2013 or under Upfront Tariff guidelines 2008 in case no reference tariff is available for the given cargo profile in the port concerned or in any other Major Port. The said guidelines will also apply to Port's own Project. As such, the financial analysis has been carried out considering the entire project is taken up through EPC and no Reference Tariff for the similar operations is notified in HDC.

10.2 The estimated annual revenue based on Preliminary tariff assessed as per the upfront tariff guidelines 2008 / Tariff orders is given below:

Activity		**Amount**
a) Cargo Handling Charges	98%	127.90
b) Storage Charges	1%	1.31
c) Miscellaneous Charges	1%	1.31
d) Total Revenue Requirement	**100%**	**130.52**

10.3 The broad assumptions for the estimating the revenue are as follows.

10.3.1. The anticipated Handling charges are worked out based on the preliminary calculations of annual revenue requirement and capacity as per the TAMP Guidelines for determination of upfront tariff (2008.) / Tariff orders.

10.3.2 : The cargo handling charges are proposed to be as under:

S. No.	Commodity	Unit Rate in Rs. per Metric Tonne	
		Foreign	Coastal
1.	All Types of Coal & Coke, Limestone and other Dry Bulk Cargoes (Other than Thermal Coal, Iron Ore & Iron Ore Pellets)	376.65	225.99
2.	Thermal Coal, Iron Ore & Iron Ore Pellets	376.65	376.65

SECTION 11

FINANCIAL VIABILITY AND SENSITIVITY ANALYSIS

11.1 The Financial viability of the project, considering the 20 years' life period from the date of award of the construction of the project and considering the Tariff worked out in accordance with TAMP guidelines, works out to 18.78%. For arriving at FIRR, the Tariff is kept fixed and all the O&M expenses are also escalated at 3%. The Operating income and the variable O&M expenditure are calculated based on the Cargo handled in the respective years ranging from 1.5 MTPA during the first year of operation i.e 2020-21. Overhauling of major portion of Mechanical & Electrical assets is considered at the end of every 10 years and then of at the end of 15 years.

11.2 Sensitivity analysis has also been carried out to gauge the impact of increase in cost and reduction of revenue earnings on the viability of the proposal. The results of the analysis are presented below. The detailed Cash flow statement is given below:

Table 11.1 (Not considering IDC)

S.No	**Project IRR**	**IRR**	**NPV@10%** (in Cr.)
1.	Base Case	18.78%	132.42
2.	Revenue decreased by 10%	14.77%	52.21
3.	Cost increased by 10%	16.98%	106.42
4.	Both cargo decrease & cost increase by 10%	13.25%	25.66

From the above, it is evident that the FIRR of the Project at base case is 18.78% and in the least case of sensitivity gives 13.25% and hence the project is financially viable.

CALCULATION OF PROJECT IRR OF THE PROJECT UNDER PPP MODE

Period	Cash Outflow [Without considering Revenue Sharing]				Income from the Project	Net Cash Inflow [Before Tax]	Net Cash Flow		
	Capital Cost of the Project	O&M [Without Depreciation]	Replacement Cost of Mechanical & Electrical Equipment	Total Cash Outflow			If Capital Cost increases by 10%	If Income decreases by 10%	If Capital cost increases by 10% as well as Income decreases by 10%
2019-20	**82.99**			82.99	0	-82.99	-91.28	-82.99	-91.28
2020-21	**165.97**			165.97	0	-165.97	-182.57	-165.97	-182.57
2021-22	**82.99**	57.53		140.52	97.89	-42.62	-50.92	-52.41	-60.71
2022-23		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2023-24		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2024-25		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2025-26		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2026-27		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2027-28		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2028-29		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2029-30		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2030-31		57.53	39.06	96.59	130.52	33.93	33.93	20.88	20.88
2031-32		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2032-33		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2033-34		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2033-35		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2035-36		57.53	203.82	261.35	130.52	-130.82	-130.82	-143.88	-143.88
2036-37		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2037-38		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2038-39		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2039-40		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2040-41		57.53	39.06	96.59	130.52	33.93	33.93	20.88	20.88
2041-42		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2042-43		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2043-44		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2044-45		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2045-46		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2046-47		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2047-48		57.53		57.53	130.52	72.99	72.99	59.94	59.94
2049-50		57.53		57.53	130.52	72.99	72.99	59.94	59.94
					IRR	**18.78 %**	**16.98%**	**14.77%**	**13.25%**
					NPV (12%)	**₹ 132.97**	**₹ 106.42**	**₹ 52.21**	**₹ 25.66**
Notes:									

1. The increase in operating cost has not been factored as operator would get protection against the same by increase in tariff to the extent of 60% of WPI increase.and expected to bridge the gap of 40% by effeciency. On the same analogy, increase in rate for income calculation has also not been considered.

2. The Electrical equipmemts are estimated to be replaced after 10 years and mechanical equipments after 15 years both at original cost

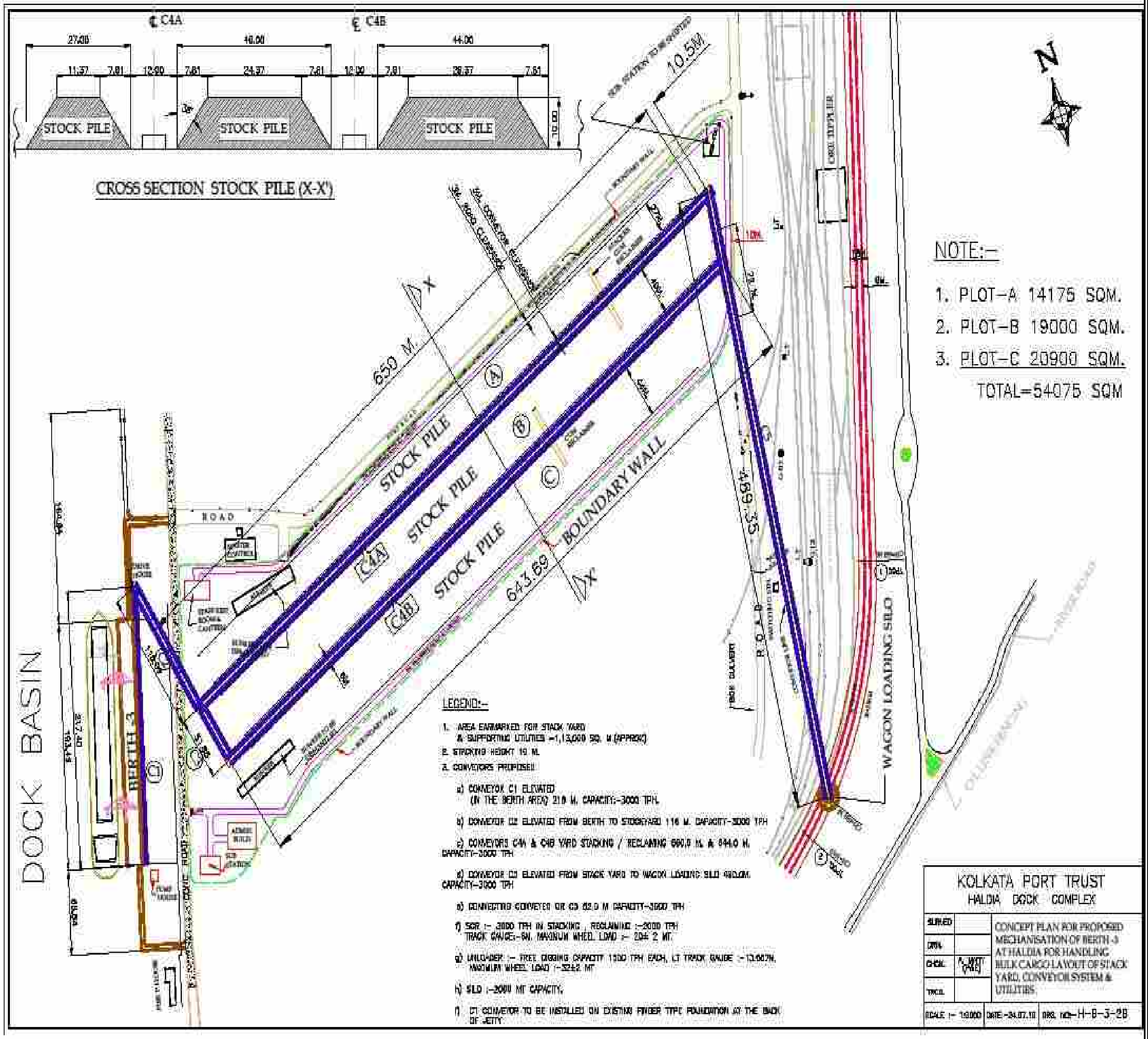
4. The payment towards Project Cost has been considered at 25% in 2019-20, 50% in 2020-21 and balance 25% in 2021-22.

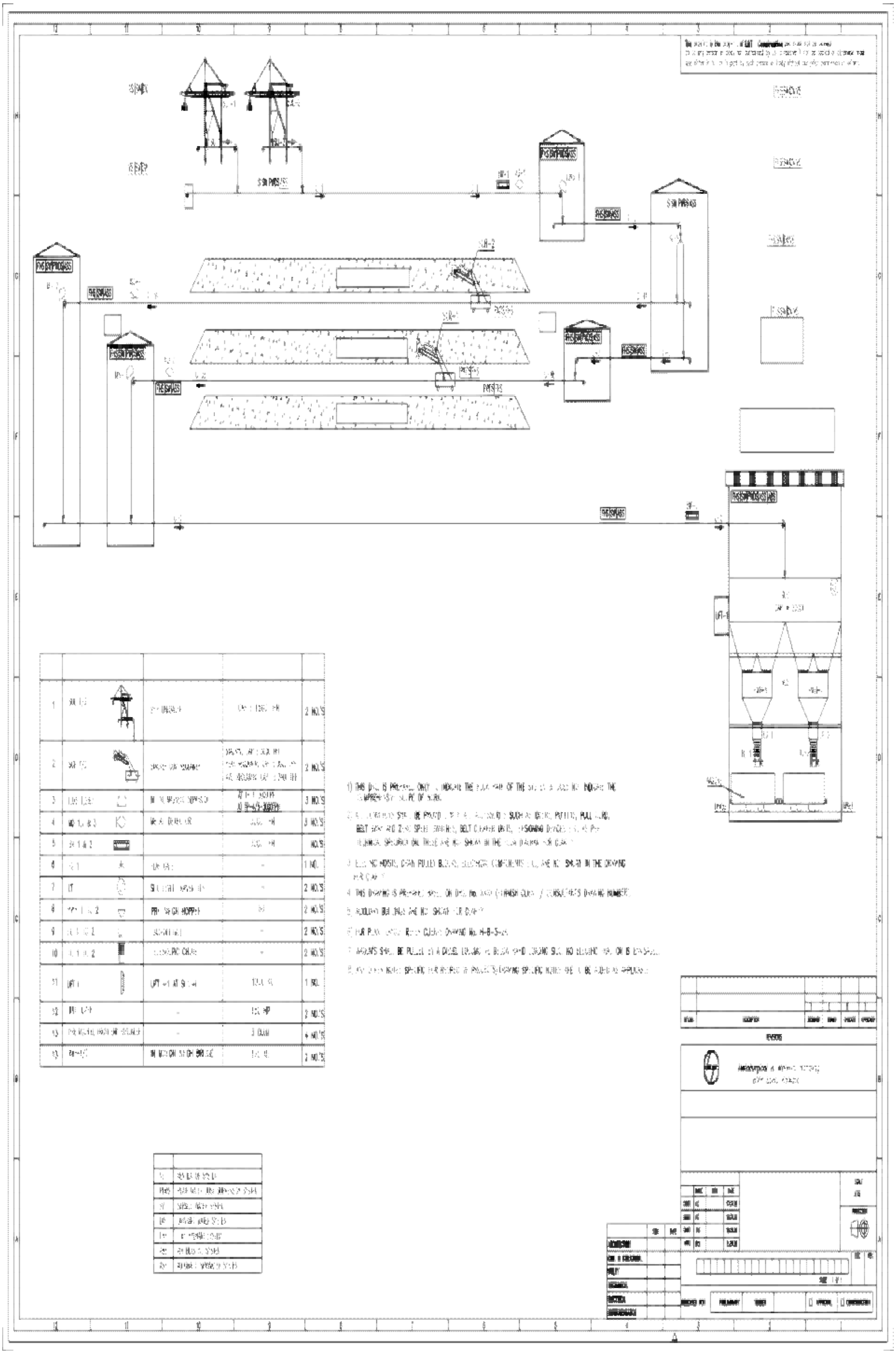
5. Capacity utilisation in the first year of operation i.e in 2021-22 has been assumed at 75%.

6. The Calculation of NPV (12% discounting) and IRR has been made without considering Income Tax element as Tax incidence would depend on Revenue Share which is an admissible cost.

CALCULATION OF PROJECT EIRR

Period	Cash Outflow [Without considering Revenue Sharing]				Economic Benefit of the Project			Net Economic Benefit [Before Tax]
	Payment towards Project Cost to be made by BOT Operator from own resources	O&M [Without Deprecia tion]	Replacement Cost of Mechanical & Electrical Equipment	Total Cash Outflow	Cargo Handling Income	Avoidance of dead freight loss due to optimum loading	Gross Economic Benefit	
2019-20	82.99			82.99				-82.99
2020-21	165.97			165.97				-165.97
2021-22	82.99	57.53		140.52	97.89	13.53	111.42	-29.09
2022-23		57.53		57.53	130.52	18.04	148.57	91.03
2023-24		57.53		57.53	130.52	18.04	148.57	91.03
2024-25		57.53		57.53	130.52	18.04	148.57	91.03
2025-26		57.53		57.53	130.52	18.04	148.57	91.03
2026-27		57.53		57.53	130.52	18.04	148.57	91.03
2027-28		57.53		57.53	130.52	18.04	148.57	91.03
2028-29		57.53		57.53	130.52	18.04	148.57	91.03
2029-30		57.53		57.53	130.52	18.04	148.57	91.03
2030-31		57.53	39.06	96.59	130.52	18.04	148.57	51.97
2031-32		57.53		57.53	130.52	18.04	148.57	91.03
2032-33		57.53		57.53	130.52	18.04	148.57	91.03
2033-34		57.53		57.53	130.52	18.04	148.57	91.03
2033-35		57.53		57.53	130.52	18.04	148.57	91.03
2035-36		57.53	203.82	261.35	130.52	18.04	148.57	-112.78
2036-37		57.53		57.53	130.52	18.04	148.57	91.03
2037-38		57.53		57.53	130.52	18.04	148.57	91.03
2038-39		57.53		57.53	130.52	18.04	148.57	91.03
2039-40		57.53		57.53	130.52	18.04	148.57	91.03
2040-41		57.53	39.06	96.59	130.52	18.04	148.57	51.97
2041-42		57.53		57.53	130.52	18.04	148.57	91.03
2042-43		57.53		57.53	130.52	18.04	148.57	91.03
2043-44		57.53		57.53	130.52	18.04	148.57	91.03
2044-45		57.53		57.53	130.52	18.04	148.57	91.03
2045-46		57.53		57.53	130.52	18.04	148.57	91.03
2046-47		57.53		57.53	130.52	18.04	148.57	91.03
2047-48		57.53		57.53	130.52	18.04	148.57	91.03
2049-50		57.53		57.53	130.52	18.04	148.57	91.03
						EIRR		23.96%


CROSS SECTION STOCK PILE (X-X')
STOCK PILE
DOCK BASIN
BERTH-3
WAGON LOADING SILO
BOUNDARY WALL
643.69
650 M.
489.35
10.5M
NOTE:-
1. PLOT-A 14175 SQM.
2. PLOT-B 19000 SQM.
3. PLOT-C 20900 SQM.
TOTAL=54075 SQM
LEGEND:-
KOLKATA PORT TRUST
HALDIA DOCK COMPLEX
CONCEPT PLAN FOR PROPOSED MECHANISATION OF BERTH-3 AT HALDIA FOR HANDLING BULK CARGO LAYOUT OF STACK YARD, CONVEYOR SYSTEM & UTILITIES



Annexure-III

(Published in Part - III Section 4 of the Gazette of India, Extraordinary)

Tariff Authority for Major Ports

G.No. 200 **New Delhi,** **7 June 2019**

NOTIFICATION

In exercise of the powers conferred by Section 48 of the Major Port Trusts Act, 1963 (38 of 1963), the Tariff Authority for Major Ports hereby disposes of the proposal received from Kolkata Port Trust (KOPT) for fixation of reference tariff for the project “Mechanization of Berth No. 3 at Haldia Dock Complex (HDC) of KOPT on Design, Build, Finance, Operate, and Transfer (“DBFOT”) basis” for the period of thirty years, as in the Order appended hereto.

(T.S. Balasubramanian)
Member (Finance)

Tariff Authority for Major Ports

Case No. TAMP/41/2018-KOPT

Kolkata Port Trust … **Applicant**

QUORUM

(i). Shri. T.S. Balasubramanian, Member (Finance)
(ii). Shri. Rajat Sachar, Member (Economic)

O R D E R

(Passed on this 29th day of March 2019)

This case relates to the proposal received from Kolkata Port Trust (KOPT) for fixation of reference tariff for the project "Mechanization of Berth No. 3 at Haldia Dock complex (HDC) of KOPT on Design, Build, Finance, Operate, and Transfer ("DBFOT") basis", for the period of thirty years.

2.1. The KOPT had initially filed a proposal dated 11 May 2018 for fixation of reference tariff for the project "Mechanization of Berth No. 3". The said proposal was taken up on consultation with the concerned users/ user organisations, Major Coal importers/ Iron ore exporters and the prospective bidders as suggested by the KOPT. Some of the users/ user organisations had furnished their comments. These comments were forwarded to the KOPT as feedback information. The KOPT has responded vide its letter dated 26 February 2019.

2.2. The Joint hearing on the proposal was held on 07 June 2018 at the KOPT premises. At the joint hearing, the KOPT and the users/ user organisations, prospective bidders made their submissions. Accordingly, the KOPT was requested to review its proposal with regard to proposed storage schedule in light of the feedback of bidders and other user organisations received during the joint hearing.

2.3. We have vide our letter dated 5 June 2018 sought certain additional information/ clarification on the proposal from KOPT.

2.4 After several reminders dated 5 July 2018, 1 August 2018, 27 August 2018, 21 September 2018 and 04 December 2018 to furnish all the requisite information to us to enable us to pass Orders, the KOPT vide its letter dated 15 January 2019 has forwarded a revised proposal for fixation of Upfront tariff for Mechanization of Berth No.3 at Haldia Dock Complex on DBFOT basis on PPP mode for a concession of 30 years.

3.1 The main submissions of the KOPT in its revised proposal are as follows:

(i). A proposal for approval of up-front Tariff on PPP mode related to Mechanization of Berth no. 3 of Haldia Dock Complex was sent to TAMP vide letter no.(Engg)/1037/67 dated 11/05/2018.

(ii). The pre-bid conference w.r.t the RFQ of the aforesaid project was held on 28/03/2018. The hearing of TAMP was also held on 07.06.2018.

(iii). In the meeting taken by Hon'ble Minister of Shipping on 12.07.2018 at Visakhapatnam, it was decided that the proposed project would be taken up on EPC mode from KOPT's internal resources. Accordingly, DIB proposal was sent to Ministry of Shipping.

(iv). In the DIB meeting held on 14.12.2018 at New Delhi chaired by Secretary (Shipping), it was decided that the Project will be implemented through PPP mode. Accordingly, the KOPT was asked to submit a fresh proposal for appraisal by the SFC at the earliest. [The KOPT has furnished the Minutes of the DIB meeting along with its revised proposal.]

(v). Hence, revised proposal for fixation of tariff on PPP mode has been prepared.

3.2. The backdrop of the project as furnished by KOPT along with its proposal dated 15 January 2019 are as follows:

(i). The assessed capacity of the Haldia Dock Complex (HDC) is 50.9 million tonnes. The traffic at HDC has increased during the financial year 2017-18 at 40.5 million tonnes as compared to the last year at 34.14 million tonnes. The traffic at HDC had declined during the last few years from 42.3 million tonnes in 2005-06 to minimum of 28.08 million tonnes in 2012-13 and picked up gradually. The traffic handled at HDC during last eight years is as follows:

(in Million Tonnes)

Year	**POL**	**Iron Ore**	**Fertilizers & Fert. Raw Materials**	**Coal**	**Containers**	**Other/ Misc. Cargo**	**Total**
2010-11	9.65	5.95	0.46	8.18	2.84	7.92	35.00
2011-12	7.91	3.94	0.52	7.29	2.62	8.74	31.02
2012-13	6.19	1.71	0.39	6.48	2.87	10.44	28.08
2013-14	6.10	2.17	0.56	6.95	2.23	10.50	28.51
2014-15	5.52	2.34	0.80	7.24	1.96	13.15	31.01
2015-16	7.09	0.87	0.64	7.27	1.37	16.27	33.51
2016-17	6.78	1.16	0.47	7.34	2.47	15.92	34.14
2017-18	8.14	1.58	0.70	9.50	2.67	17.91	40.50

(ii). Kolkata/ Haldia have a vast hinterland, comprising the entire Eastern India including West Bengal, Bihar, Jharkhand, eastern part of Uttar Pradesh, north east of Madhya Pradesh, Chhattisgarh, Assam and other North Eastern States and the two landlocked neighboring countries viz. Nepal and Bhutan. But the primary hinterland consists of West Bengal, Jharkhand and Bihar which have major industries consuming fuel/ raw materials imported through this port. The industrial development, commerce and trade of this vast hinterland are inseparably linked to the life and development of Kolkata Port and vice-versa.

(iii). The existing facilities for handling dry bulk at Port is as follows:

Berth	**Length in m**	**Cargo Handled**	**Capacity * (million tonnes)**	**Remarks**
Inside Dock Basin				
Berth 2	260	Coal, Coke, Limestone, Iron ore	4.00	2 MHC's for loading / unloading of coal
Berth 3	337	POL products, Paraxylene, Chemicals	1.75	Bare berth
Berth 4	284	Coal, Coke, Ore	3.70	Mechanized berth for loading Thermal coal
Berth 4 A	245	Coal	3.50	Mechanized berth for unloading Coal
Berth 4 B	181	Coal, coke, iron ore	4.00	2 MHC's for loading / unloading of coal
Berth 6 & 7	234	Vegetable oil, chemicals, iron ore	2.00	Berth no.6 & 7 is presently used for unloading of Liquid cargo
Berth 8	218	Coal, coke	4.00	2 MHC's for loading / unloading of coal
Floating Jetty	150	Coal, Gypsum	2.50	One Floating & one crane for grab unloading
Total:			**25.45**	

(*) Capacity as re-assessed by HDC.

(iv). The existing Coal Berths Occupancy (BO) at Port is as follows:

Berth No	Cargo	2013-14	2014-15	2015-16	2016-17	2017-18
2	Coal	81.10%	85.98%	86.43%	78.11%	**86.80%**
8	Coal	79.88%	83.78%	88.02%	78.62%	83.99%
4A	Coking coal	73.71%	65.99%	70.71%	71.99%	78.02%
4B	Mix coal	64.82%	76.69%	83.74%	78.90%	86.31%
All	All coals	62.12%	58.80%	71.35%	66.59%	72.83%
Total	All 13 berths	*69.53%	*66.92%	73.98%	69.38%	72.83%

*Excluding Berth No. 5
** Berth No. 2, 4, 4A, 4B & 8.

(v). Due to growing need for handling dry bulk and other developments in the hinterland, HDC has decided to review the proposal of Mechanisation of Berth 3 with reference to the traffic demands. Accordingly, HDC engaged IPA to prepare a Feasibility Report of the proposed investment. [The Feasibility Report for Mechanisation of Berth No 3 at Haldia Dock Complex has been submitted by IPA.]

(vi). However, HDC saw that capacity of some of the equipment recommended by IPA is on higher side. Accordingly, HDC has prepared a Detailed Project Report (DPR) and concept layout of the Plant. Estimate of ₹ 331.94 Crores plus GST of the project have been prepared based on budgetary offer from the EPC Contractors and on the basis of existing order rate of HDC.

3.3. The salient features of the project as furnished by the KOPT are as follows:

(i). The project envisages a fully mechanized berth with a dedicated stockyard with equipment for dispatch by Rail. Such a system can handle only import of Coal. However, considering the uncertainties in the coal traffic, it is recommended that the facility could have a flexibility to handle suitable other dry bulk cargo, which, could be handled with certain provisions for cleaning the conveyors and the stockpiles. One of such commodity could be limestone whose traffic has been generally on the rise.

(ii). The berth is located inside the impounded Dock basin of Haldia Dock Complex. The berth no. 3 has a length of about 337 M and a width of 15.75 m. The berth can handle panamax vessels upto 90,000 DWT with LOA up to 230 m and an average parcel size of 24,000 tonnes.

(iii). The berth will be equipped with 2 no rail mounted gantry grab type unloaders with a capacity of 1500 TPH each. For this purpose, the existing berth no 3 structure has to be provided with rails over which the unloaders will travel on the quay. The rail span of the proposed gantry grab unloaders have to be tailor made (13.687) to suit its width.

(iv). The coal/ coking coal unloaded by the two unloaders will be discharged into a single dock conveyor to be located on the rear side of the main berth structure on the piles and interconnecting beams. This conveyor will be an elevated one with a rated capacity of 3000 TPH commensurate with the capacity of two unloaders. The coal from the dock conveyor will be conveyed through an elevated conveyor system to cross over the main road behind berth and then to the yard conveyor for stacking.

(v). The coal from the stack yard reclaimed by stacker cum reclaimer (operating in reclaiming mode) will be conveyed to a stationary silo. Two no Stacker cum Reclaimers each having a rated capacity of 3000 TPH for stacking 2000 TPH capacity for reclaiming are planned for stock piling coal into the stack yard and then for evacuation through wagon loading.

(vi). The coal from the stationary silo will be loaded into railway wagons through a rapid wagon loading system in which the wagons will be moving.

(vii). The system will have a substation for receipt and distribution of HT and LT power for operating the mechanized system consisting of two no gantry grab unloaders, the belt conveyor system, two no stacker cum reclaimers, rapid wagon loading system, supporting utilities etc. The estimated power requirement of about 1.8 MVA will be available from the port's main substation where adequate spare capacity is available. As such the prospective BOT operator has to lay HT power supply cables from the port's substation to the proposed substation of the Berth 3.

(viii). The stack yard for transit storage of coking coal, non-coking coal will be located in the designated stack yard to be situated in the back-up area of berth no 3. This area is same as the area in which the iron ore used to be stacked when berth no 3 was an iron ore loading facility. The land earmarked for the purpose will have an area of about 1,13,000 sq.m. excluding silo. However, total area earmarked for complete project is 1,46,984 sq.m except Berth no. 3.

(ix). The railway yard for evacuating the material from the transit stack yard will be located in the existing railway yard where an old iron ore tippler was located (now defunct). The evacuation of coal will be through a rapid in-motion wagon loading system with a SILO. The proposed railway yard for Berth 3 will have two railway lines with a length go about of 1900 m for each line. One line is meant for rapid wagon loading and the line is planned to accommodate two rake lengths and the second line is planned for engine escape. The two lines proposed are planned adjacent to the existing lines in a green field area.

(x). The material handling system has been designed as ship-shore transfer through Rail Mounted Gantry Grab Unloaders, a conveyor system for transfer from berth to stack yard and handling at yard through two Stacker cum Reclaimer for stacking and a conveyor to carry the material from the stack yard to rapid loading SILO and finally loading of coal from SILO into wagons in-motion. The system will incorporate necessary pollution control measures.

(xi). Ship - Shore Transfer:

(a). Considering the capital cost, operational flexibility and proven performance, it is proposed to equip the berths with two Gantry Grab Unloaders each having a rated capacity of 1500 TPH.

(b). Due to draft limitations in Haldia, vessels come with part load, having discharged the top portion of the hatches at another deep draught port.

(c). When a fully loaded ship is discharged, the productivity will be higher as the grabs can take bite at the top of hatch with full grab content and less lifting height as compared to part discharged vessel. Thus, its average discharge rate will be high. But in a partially loaded ship, the initial lift height itself will be more as the hatch content is already reduced. For clearing the last portion, the lifting height is more and the grab content is also less. All these cumulatively reduce the average productivity. Hence the quantity of coal available for the cream bite of the grab will be limited.

(d). As the hatch gets emptied, the remaining coal is to be heaped at one place by a baby dozer to be lowered into the hatch. The baby dozer moves around shifting the scattered coal into a heap sufficient for the grab to bite into and lift. This process will involve some operational time as the grab content will largely get reduced as compared to a cream bite.

(e). The average productivity for coking coal and non-coking coal has been 18,084 TPD and 20,834 TPD for 2016-17. For 2015-16 the corresponding figures are 16,981 TPD & 17,116 TPD. Hence, taking the aforesaid issues into consideration, it is proposed that an average productivity of 20,000 TPD could be considered.

(xii). Berth - Stockyard Transfer:

Keeping in mind the level of pollution that could be created due to handling by Dumper and Payloader system, it is planned to have a conveyor system. The Unloaders planned will have integral hoppers, the coal unloaded will be conveyed through hopper and shuttle conveyor to an elevated jetty conveyor located on the rear side of Unloaders. The jetty conveyor will transfer the material into another conveyor through which the coal will be transferred to the yard stacking conveyors and finally transferred through stacker cum reclaimers into the stack yard. The conveyor system will have a matching rated capacity of 3000 TPH.

(xiii). Layout of Stackyard:

The material received through the conveyors and the stacker cum reclaimer into the stack yard will be stacked in a geometric shaped stockpiles. The stack yard is proposed to be equipped with two no Stacker cum reclaimers. The conceptual layout of stack yard as proposed will have a capacity of about 2.00 Lakh tonnes.

(xiv). Evacuation

It is proposed that 80% the cargo will be evacuated by rail and 20% of the cargo will be evacuated through Road. Thus about 2 to 3 rakes per day will be required for evacuation of planned annual throughput.

(xv). Mainly Coal, Coke, Limestone and other compatible dry bulk cargoes are proposed to be handled at this facility.

(xvi). **Calculation of Optimal Capacity**

The optimal capacity of the terminal is reckoned as 70% of the maximum capacity. The optimal capacity is the lower value of the optimal quay capacity and optimal stack yard capacity.

(a). Optimal Capacity of Stockyard (As per TAMP guidelines)

For a coal terminal TAMP guide line stipulates that the optimum yard capacity is 70% of maximum coal that could pass through the yard and is derived from the following formula.

$$\text{Optimal Yard capacity} = \frac{0.7 \times A \times U \times Q \times T \text{ tons.}}{100}$$

Where

A - Area of the yard made available by the port for development in sq.m.

Q - Quantity that could be stacked per sq.m. of area

T - Turnover ratio of the plot in a year

U – Percentage of total yard area that could be used for stacking

Total area of stockpiles = 54,000 m2

Quantity that could be stacked per m2 = 5.2 Tonne

Considering an evacuation rate of 2.6 rakes per day with each rake carrying 3800 Tons, the rate of evacuation per day is taken as 9880

Dwell time = 0.7 x 54,000 x 5.2/ 9,880 = 20 days

The average Plot turnover ratio in a year would therefore be 360/20 = 18

Yard capacity (0.7 x 54,000 x 5.2 x 20) = 3.538 MTPA, Say 3.5 MMTPA

(b). Optimal Quay capacity

Average handling rate is 20,000 tonnes per day. Following TAMP Guidelines, the optimal capacity of the terminal is calculated using the following formula.

Optimal capacity

$$= 0.7 \times \frac{S1 \times P1}{100} + \frac{S2 \times P2}{100} + \frac{S3 \times P3}{100} + \ldots \times 365$$

Where, S1 - Percentage share of capacity of Cargo type 1
P1 - Handling rate of the vessel carrying Cargo type 1
S2 - Percentage share of capacity of Cargo type 2
P2 - Handling rate of the vessel carrying Cargo type 2

S1, P1, S2, P2 and so on depending on the number of different types of Cargo to be handled at the berth of the particular port.

In the present proposal, the share of Panamax vessels and Handymax vessels are considered as 80% and 20% respectively based on the current trend.

According to the formula, the optimum capacity of the new berth (where only coal will be handled), works out to

365 x 0.7 x 20,000 ≈ 5.11 MTPA say 5.00 MTPA

Therefore, the Optimum capacity of the TERMINAL: **3.5 MTPA** (Lower of the two)

Hence the optimal capacity of the terminal is considered as 3.5 MTPA.

(xvii). Capital Cost

The total capital cost of the project is estimated at ₹. 331.94 Crores. The summary break-up is as follows:

No	Description	Amount (₹ in Crore)
A. Civil Cost		
1	Revamping of the Existing Berth to accommodate the Loaders and other Machineries	2.54
2	Civil Foundation for Conveyer Structure	5.00
3	Civil Works for Silo System	5.00
4	Construction of New Railway Lines for Rapid Wagon Loading System	24.25
5	Extension of existing Track Line of Stacker cum Reclaimer	3.28
6	Service Road	4.65
7	RCC Drain	2.66
8	Compound Wall	3.65
9	Laterite Hard Standing of the Yard	8.10
10	Detailed Designs & Project Supervision costs @ 2%	1.18
11	Contingencies @ 3%	1.77
12	GST on Civil works @ 18%	11.18
	Civil Cost including GST (Total A)	**73.26**
B. Mechanical Equipment Cost		
1	1500 TPH Rail Mounted Gantry Grab Unloader including 25 CBM Grab with rail span of 13.687 M.	90.00
2	Conveyor 3000 TPH capacity (Approx 2200 m) including transfer points	38.00
3	Stacker cum Reclaimer– Stacking-3000 TPH, Reclaiming - 2000 TPH, with Boom Length-30 m, Long travel rail gauge- 6m	35.10
4	SILO- for rapid Wagon Loading site 2000 MT	19.25

5	Dust suppression system and Fire Fighting facilities including water supply and distribution.	6.90
6	In motion Weigh Bridge	0.86
7	Bull Dozer	4.00
8	Detailed Designs & Project Supervision costs @ 2%	3.88
9	Contingencies @ 3%	5.82
10	GST on Mechanical Works @ 18% [Assumed Full ITC] *	0.00
	Mechanical Cost (Total B)	**203.82**
C. Electrical Works		
1	Electrical Power supply and distribution System including substation	36.20
2	Illumination including High mast lighting	1.00
3	Detailed Designs & Project Supervision costs @ 2%	0.74
4	Contingencies @ 3%	1.12
5	GST on Mechanical Works @ 18% [Assumed Full ITC] *	0.00
	Electrical Works Cost (Total C)	**39.06**
	Total (A + B + C)	**316.13**
D. Miscellaneous Costs		
	5% of civil & equipment cost	**15.81**
	TOTAL CAPITAL COST (A+B+C+D)	**331.94**
E. Berth Hire Activity		0.00
	GRAND TOTAL OF CAPITAL COST	**331.94**

* **Note:** Input Tax Credit can be availed on GST paid on Mechanical/ Electrical costs. Hence not considered as Cap-ex and consequent Fixed assets.

(xviii). **Calculation of Total Operating Cost**

₹. Crores

Sl. No	**Particulars**	**Amount**
1.	**Hire Charge**	
	One High Power Locomotive (without Fuel)	2.09430
	Four Baby Dozers (All inclusive rate)	1.94481
	One Excavator (All Inclusive Rate)	0.33293
	One Hydra (All inclusive rate)	0.17856
	Two 10 MT Pay Loaders for road evacuation (All inclusive)	2.96352
2.	**Power Cost** 1.4 units/ tonne, Effective Levy-Rs 11.91 per KWH Energy Charge- Rs 7.15 per KWH, Demand Charge-₹ 384.00 per KVA for 1600 KVA, Govt Duty- 17.5%, Line Loss-2.6%, KOPT's Overhead Charge-19.25%]	5.90
3.	**Fuel Cost**	
	Locomotive 32 ltrs per hour * Rs.66.00 per litre *1788 hours p.a.	0.38
	Bull Dozer (12 ltrs per Hour @ Rs 66.00 per ltrs for 2 shifts per day for 300 days)	0.38
4.	**Repair & Maintenance**	
	Civil Assets (1% on civil work)	0.77

	Mechanical & Electrical Equipment including spares (7% on equipment cost)	17.85
5.	**Insurance** (1% on Gross fixed assets)	3.32
6.	**Depreciation**	
	Civil Work @ 3.17%	2.44
	Mechanical Work @ 6.33%	13.55
	Electrical Assets @ 9.5%	3.90
7.	**License Fee** [146984 sqm @ 27.346 per sqm per month)	4.82
8.	**Other Expenses** towards salaries and overheads (5% on gross value of assets)	16.60
	Total Operating Cost	**77.41**

(xix). **Calculation of Annual Revenue Requirement**

As per TAMP guidelines, the Annual Revenue Requirement is the aggregate of operating cost and Return on Capital @ 16% on capital employed. The following table provides the calculations.

(a) **Revenue Requirement for Cargo Handling Activity**

(₹. in Crores)

Estimated Revenue Requirement	**Amount**
(a) Operating Cost	77.41
(b) Return of Capital Employed @ 16%	53.11
Total Revenue Requirement (a) + (b)	**130.52**

(b) **Apportionment of Annual Revenue Requirement (Cargo Handling Activity):**

The TAMP guidelines, prescribed that the Annual Revenue Requirement (ARR) of Cargo handling activity be divided into three categories i.e. Cargo handling charges, Storage Charges and Miscellaneous charges at @ 98%, 1% and 1% respectively. Accordingly, the ARR is further apportioned as under:

(₹.in crores)

Activity		**Amount**
a) Cargo Handling Charges	98%	127.90
b) Storage Charges	1%	1.31
c) Miscellaneous Charges	1%	1.32
Total Revenue Requirement (a) + (b) +(c)	**100%**	130.52

(xx). The share of Overseas and Coastal movements for Dry Bulk Cargo (Coal, Limestone etc.) is considered to be around 90% and 10% respectively. Accordingly, based on the Optimum capacity of the cargo to be handled at the proposed project facilities and the annual revenue requirement, the KOPT has calculated proposed tariff.

3.4. The KOPT has sought approval for the following:

(i). **Cargo Handling Charges**

Sl. No	**Commodity**	**Unit Rate in ₹. per Metric Tonne or part thereof**	
		Foreign	**Coastal**

1	All types of Coal / Coke, Limestone and other Dry Bulk Cargoes (Other than Thermal Coal, Iron Ore & Iron Ore Pellets).	376.65	225.99
2	Thermal Coal, Iron Ore & Iron Ore Pellets.	376.65	376.65

(ii). **Storage Charges**

The Annual Requirement towards storage charges is ₹ 1.31 crores. It is expected that only 35% of the cargo may be stored beyond the free days of 10. Accordingly, the working of Storage charges for the cargo stored in the stack yard beyond the free period is as under:

	Working for calculation of storage charges (Berth No.3)					
Sr. No	**Particulars**	**Free days**	**1st slab**	**2nd slab**	**3rd slab**	**Total**
1	Optimum Capacity	35,38,080				
2	Days in each slab	10	5	5	0	
3	%age of cargo in each slab	40%	40%	20%	0%	**100%**
4	Qty in each slab	1415232	1415232	707616	0	**3838080**
5	Weights assigned		1.00	1.50	2.00	
6	50% time is taken in each slab on an average		3538080	8845200	0	**12383280**
7	Weighted Qty in each slab (50% time taken in each slab on an average)		3538080	13267800	0	**16805880**
8	Revenue requirement					**13051143**
9	Tariff for each slab		**0.78**	**1.17**	**1.56**	

Hence, the proposed storage charges for the cargo stored in the stack yard beyond the free period are as follows**:**

Description	**Rate in ₹. per MT per Day or part thereof**
Free period	10 days
First five days after expiry of free period	0.78
6th day to 10th day after expiry of free period	1.17
From 11th day onwards	1.56

(iii). **Miscellaneous Charges**

The Annual Requirement towards Miscellaneous charges is ₹.1.31 crores. Accordingly, composite charge for all the miscellaneous services is proposed by KOPT at ₹. 3.69 per tonne.

Sr. no.	**Particulars**	**₹. in crores**
i.	Revenue Requirement **(a)**	1.31
ii.	Capacity of the Terminal (MMTPA) **(b)**	3.50
	Misc charges per tonne (a) / (b)	**3.69**

3.5. The Performance Standards as proposed by the KOPT is as follows:

(i). The parameter deals with the productivity of the terminal (Gross Berth Output) for different types of cargo.

(ii). In case of coal/coke/limestone/other dry bulk cargo, the capability of the terminal (mechanization, method of handling) and parcel size will determine the Gross Berth Output. Higher terminal capability and greater parcel size will lead to high productivity.

(iii). The Gross Berth Output shall be calculated by taking the total cargo unloaded from the ships during a month in the terminal divided by the total number of working days of the ships in that month at that terminal.

(iv). The number of working days of the ships shall be determined by subtracting 4 hours per ship from the total hours spent by all the ships at that terminal in the month in question and dividing it by 24.

(v). The norms of Gross Berth Output for Coal/ Coke/Limestone/Other Dry Bulk Cargoes are as follows:

- Gross Berth Output for the Panamax Vessels – 20,000/ Day /Berth.
- Gross Berth Output for the Handymax Vessels – 20,000/ Day /Berth.

3.6. The KOPT vide its letter no. GM/(Engg)/1017/TAMP/264 dated 08 February 2019, has forwarded a copy of the Board Resolution approving the revised proposal of KOPT.

4.1. The salient differences between the earlier proposal of KOPT filed in May 2018 and the proposal of January 2019 are tabulated below:

Sl. No.	Salient features	May 2018 proposal	January 2019 Proposal
1	Capital Cost (₹. in crores)	323.44	331.94
2	Storage area (in Sq.m)	45000	54000
3	Optimal Terminal Capacity (in MTPA)	3.276	3.530
4	Evacuation	100% through rail	80% through rail & 20% through road
5	Total operating cost (₹.in crores)	66.36	77.41
6	Total revenue Requirement (₹. in crores)	118.11	130.52
7	Foreign Cargo Handling Charges per MT in ₹	368.05	376.65
8	Coastal Cargo Handling Charges per MT in ₹	220.83	225.99

4.2. As per KOPT, the changes have arisen in the KOPT proposal of January 2019 vis-à-vis May 2018 proposal on account of the following:

(i). In the revised proposal, the capital cost estimate has been changed on account of the following:

(a). The capacity of some of the equipments have been changed.

(b). The cost of Jetty revamping and yard development has been taken into consideration in the estimate.

(c). Some of the Equipments like Locomotive and Front End Loader have been considered on Hiring basis rather than owning as the equipment will be used as per the operational and maintenance requirements only. Normally Ports own Locomotive for operation. However, nowadays Ports are Hiring Locomotive for avoiding owning of equipment and manpower. If the PPP operator owns the above equipment, the idling cost of equipments and manpower will be loaded in the estimate. So the estimate by considering hired equipment will make it more realistic.

(ii). IPA did not consider the equipment like high capacity Front End Loader as the evacuation was proposed 100% through rail. However, two nos. High Capacity Front end loader has been considered for road evacuation. These equipments have been considered on hiring basis as those equipment may not be required every day and 24 hours. Hence, the hiring will reduce the idling cost of the equipments. However, for operational requirement like road evacuation and maintenance those equipment's are essential which has not been considered by IPA.

4.3. A comparative statement of the charges proposed in the revised proposal dated 15 January 2019 vis-à-vis the earlier proposal of KOPT dated 11 May 2018 for the proposal in reference is given below:

Sr. No.	Particulars	As Per Revised Proposal dated 15.01.2019	As Per Earlier Proposal dated 11.05.2018
I	**Optimal capacity**		
(a)	**Optimal Quay Capacity**		
	Percentage Share of capacity of Vessels		
	- Panamax Vessels (S1)	70%	70%
	- Handymax Vessels (S2)	30%	30%
	Shipday Output		
	- Panamax vessels (P1)	20000	20000
	- Handymax vessels (P2)	20000	20000
	Optimal Quay Capacity = 0.7*((S1*P1)+(S2*P2))*365 (in tonnes)	**5110000**	**5110000**
(b)	**Optimal Yard Capacity**		
	- Area of the yard made available by the port as usable storage (in m2) (A)	54000	45000
	- Percentage of total yard area that could be used for stacking (U)	100%	100%
	- Quantity that could be stacked per m2 of area (Q)	5.2	5.2
	- Turnover ratio of the plot in an year (T)	18	20
	Optimal yard capacity (0.7 x (A x U% x Q x T tons) (in tonnes)	**3538080**	**3276000**
	Optimal Capacity of the terminal (lower of (a) and (b)) (in tonnes)	**3538080**	**3276000**
	Optimal Capacity of the terminal (in million metric tonnes per annum)	**3.538**	**3.276**
II	**Capital Cost**		
A.	**Cargo Handling Activity**	₹ in crores	₹ in crores
	(i). Civil Cost		
	Revamping of the Existing Berth to accommodate the Loaders and Other Machineries	2.54	0.00
	Civil Foundation for Conveyor Structure	5.00	0.00
	Civil works for Silo System	5.00	2.00
	Construction of New Railway Lines for Rapid Wagon Loading System	24.25	23.40
	Extension of railway tracks upto wagon loading yard & provision of sidings	3.28	0.00

Sr. No.	Particulars	As Per Revised Proposal dated 15.01.2019	As Per Earlier Proposal dated 11.05.2018
	Service Roads	4.65	9.72
	RCC Drain	2.66	2.88
	Compound wall	3.65	1.62
	Laterite Hard Stading of the Yard	8.10	
	Construction of 4 transfer towers/ drive houses @ 0.25 Cr per drive house	0.00	1.00
	2 Stacker cum reclaimer tracks	0.00	3.76
	Buildings consisting of Admin building, sub-station, control room, workshop, stores, employees rest room, canteen etc.,	0.00	6.50
	1.2 m high RCC Concrete retaining Walls along the edge of Stacker-Re-claimer Track to prevent spillages	0.00	1.25
	RCC settling tank 2 m depth and an area of 50 sq.m	0.00	0.15
	Detailed Designs & Project Supervision costs @ 2%	1.18	1.05
	Contingencies @ 3%	1.77	1.57
	GST on Civil works @ 18%	11.18	9.88
		73.26	**64.77**
	(ii). Equipment Cost		
	1500 TPH Rail Mounted Grantry Grab Unloader including 25 CBM with rail span of 13.687 M.	90.00	80.00
	Conveyor 3000 TPH capacity (Approx 2200 m) including transfer points	38.00	32.58
	Stacker cum Reclaimer - Stacking - 3000 TPH, Reclaiming - 2000 TPH, with Boom length - 30 m. Loan travel Guage - 6m	35.10	50.00
	Silo - For rapid Wagon Loading Site 2000 MT	19.25	16.00
	Dust Suppression System and Fire Fighting facilities including Water Supply and distribution	6.90	12.00
	Baby dozers (FELs)	0.86	1.20
	Other Equipment, Weigh Bridge, Work Shop facilities etc.	4.00	7.00
	Electrical Power Supply and Distribution System including Substation	36.20	12.00
	Illumination with High Mast Lighting System	1.00	0.90
	Shunting Loco		20.00
	Detailed Designs & Project Supervision costs @ 2%	4.63	4.63
	Contingencies @ 3%	6.94	6.95
	Total	**242.88**	**243.26**
	(iii). Miscellaneous		
	5% on Civil Cost and Equipment Cost	15.81	15.40
	Total Capital Cost for Handling Activity (i + ii + iii)	**331.94**	**323.44**
III	**<u>Operating Cost for Cargo Handling Activity</u>**	₹ in crores	₹ in crores
	(a). Hire Charges	**7.51**	**0.00**
	- 1 no. High Power Locomotive (without Fuel) Revised Proposal- (₹ 17.45 Lakhs per month x 12 months)	2.09	0.00
	- 4 nos. Four Baby Dozers Revised Proposal - (4 nos. x ₹. 13230 per Shift x 368 shifts)	1.95	0.00
	- 1 no. Excavator Revised Proposal - (₹.1156 per Hr.x 8 Hrs. per shift x 360 shifts)	0.33	0.00
	- 1 no. Hydra Revised Proposal – (₹..520 per Hr. x 360 days x9.54 hrs per day)	0.18	0.00
	- 2 nos. 10 MT Pay Loaders for road evacuation	2.96	0.00

Sr. No.	Particulars	As Per Revised Proposal dated 15.01.2019	As Per Earlier Proposal dated 11.05.2018
	Revised Proposal - (2 nos.x ₹. 1715 per Hr. x 24 Hrs x 360 days)		
	(b). Power Cost	**5.90**	**3.88**
	Revised proposal (1.4 units/ tonne * ₹. 11.91 unit * 3.538 MTPA) Earlier proposal (1.4 units/ tonne * ₹. 8.47 unit * 3.28 MTPA)		
	(c). Fuel Cost	**0.76**	**0.91**
	- Locomotive Revised Proposal (32 ltrs per hour x ₹.66 per litre x 3.5 MTPA * 0.80 / 3800 Tons x 3 hrs x 1.20) Earlier Proposal (30 ltrs per hour x ₹..68.63 per litre x 3.276 MTPA /3800 tonnes x 2 hrs x 1.20)	0.38	0.64
	- Bull Dozer Revised Proposal (12 ltrs per hour x ₹. 66 per litre x 2 shifts per day x 8 hrs per shift x 300 days)	0.38	
	- Baby Dozers Earlier Proposal (12 ltrs per hr. * 3 dozers x 68.63 per ltr * 8 hrs per vessel x 138 vessels.)		0.27
	(d). Repair & Maintenance	**18.62**	**18.56**
	- Civil Assets (1% on civil work)	0.77	0.68
	- Mechanical & Electrical Equipment including spares (7% on equipment cost)	17.85	17.88
	(e). Insurance (1% on Gross fixed assets)	**3.32**	**3.23**
	(f). Depreciation	**19.88**	**18.78**
	- Civil Work @ 3.17%	2.44	2.16
	- Mechanical Work @ 6.33%	13.55	15.27
	- Electrical Assets @ 9.5%	3.90	1.35
	(g). License Fee (146984 sqm @ 27.346 per sqm per month)	**4.82**	**4.82**
		16.60	**16.17**
	Total Operating Cost	**77.41**	**66.36**
IV	**<u>Estimated Revenue Requirement & upfront tariff for Cargo Handling Activity</u>**		
(i).	**<u>Estimated Revenue Requirement</u>**		
	(a). Total Operating Cost	77.41	66.36
	(b). Return on capital Employed @ 16%	53.11	51.75
	(c). Total Revenue requirement from cargo handling activity	**130.52**	**118.11**
(ii).	**Apportionment of Revenue Requirement**		
	(a). Cargo Handling Charges (98% of ARR)	127.91	115.75
	(b). Storage Charges (1% of ARR)	1.31	1.18
	(c). Miscelleneous Charge (1% of ARR)	1.31	1.18
	(d).Total Revenue requirement from cargo handling activity	**130.52**	**118.11**
(iii).	**<u>Cargo Handling charge</u>**		
	(a). Cargo Handling Charge		
	- Revenue Requirement (₹. in lakhs)	12791.20	11575.09
	- Capacity (Lakh Tonnes per annum)	35.38	32.76
	- Per Tonne rate for handling of cargo (foreign)	**361.53**	**353.33**
	- Per Tonne rate for handling of cargo (foreign)	**376.65**	**368.05**
	- Per Tonne rate for handling of cargo (foreign)	**225.99**	**220.83**

Sr. No.	Particulars	As Per Revised Proposal dated 15.01.2019	As Per Earlier Proposal dated 11.05.2018
	(b). Storage Charge		
	- Revenue Requirement (₹. in lakhs)	130.52	118.11
	- % of Cargo to attract storage charge	35%	25%
	- Capacity of cargo to attract storage charge (tonnes)	1238328	819000
	Storage Charge (beyond the free period)	**Rate Per tonne per day or part thereof**	**Rate Per tonne per day or part thereof**
	-Free period	10 days	10 days
	-First five days (after free period)	**0.78**	**1.59**
	-6th day to 10th day (after free period)	**1.17**	**2.38**
	-11th day onwards (after free period)	**1.56**	**3.56**
	(c). Miscelleneous Charge		
	- Revenue Requirement (₹ in lakhs)	130.52	118.11
	- Capacity (Lakh Tonnes per annum)	35.38	32.76
	- Miscellenous Charge (₹ per tonne)	**3.69**	**3.61**

5. In view of the changes in the revised proposal dated 15 January 2019 with that of earlier proposal of KOPT dated 11 May 2018, a copy of the revised proposal dated 15 January 2019 of KOPT was forwarded to the concerned users/ user organizations/ prospective bidders vide our letter dated 13 February 2019 seeking their comments. None of the users/ user organisations/ prospective bidders have furnished their comments on the revised proposal of KOPT, except Steel Authority of India Limited (SAIL). The comments of SAIL were forwarded to KOPT as feedback information. The KOPT has furnished its comments vide its e-mail dated 6 March 2019.

6. As stated earlier, we have vide our letter dated 5 June 2018 sought some additional information/ clarification from KOPT on its May 2018 proposal. The KOPT vide letter no. GM/(Engg)/1017/TAMP/264 dated 08 February 2019 has furnished additional information/ clarification as sought by us vide our letter dated 5 June 2018. The KOPT has furnished the information/ clarification keeping in view its revised proposal dated 15 January 2019. The information sought by us vide our letter dated 5 June 2018 and the reply of KOPT thereon vide its letter dated 08 February 2019 are tabulated below:

Sl No.	Information/ Clarification sought by TAMP	Reply furnished by KOPT
1	**GENERAL:**	
(i)	The KOPT to furnish the resolution of the Board of Trustees of KOPT, approving the proposal under reference.	The revised proposal has been submitted with the approval of Chairman, KOPT. However, the same has been ratified by Board of Trustees in their meeting dated 31.01.2019. (The KOPT has furnished a copy of the Board Resolution).
(ii)	The proposed facility is envisaged to handle coal/ coke, thermal coal, iron ore, iron ore pellets, limestone and other compatible dry bulk cargo. In this regard, the KOPT to clarify/ furnish the following: (a). The percentage share of each of the cargo item envisaged to be handled at the facility may be furnished.	 a) 80% cargo will be Coking Coal / Non-Coking Coal, 10% Limestone and other Flux, balance 10% other dry bulk cargo.

Sl No.	Information/ Clarification sought by TAMP	Reply furnished by KOPT
	(b). Reason for adopting the Guidelines as applicable for a coal terminal rather than adopting the guidelines prescribed for a multipurpose berth, may be explained.	b) Since this berth will handle primarily coal, guideline for coal terminal has been adopted. Further the method and rate of handling of Limestone & other dry bulk cargo is almost similar to coking coal.
(iii)	On the ground of uncertainty on import of coal cargo, the KOPT has rightly sought to propose handling of other dry bulk cargo like limestone, iron ore, iron ore pellets etc. While this is a welcome step, the KOPT to consider handling of any other compatible cargo that can be handled at the facility at the time of fixation of Reference tariff on upfront basis and before invitation of bids. The KOPT to also note that the 2008/ 2013 Guidelines do not provide for fixation of tariff for additional cargo/ service or review of reference tariff and intervention by TAMP in a post bid scenario except for the Wholesale Price Index (WPI) indexation.	Although this berth will primarily handle coal, yet provision has been made for handling other dry bulk cargo and the indicative share of the cargo to be handled has been provided above. No cargo other than those already mentioned is envisaged as compatible cargo for handling at the proposed facility due to probable contamination.
(iv)	It may be recalled that the KOPT has come up with a proposal for fixation of reference tariff for the project of "Setting up of Outer Terminal-I. The said project also envisages handling of coal/ coke, thermal coal, iron ore, iron ore pellets, limestone and other compatible dry bulk cargo. The reason for envisaging and going ahead with two identical projects with the same cargo profile and with almost the same quay capacity to be explained.	The project for OT-I has been kept in abeyance at the moment and the Berth no.3 Mechanization will be taken up first.
(v)	Further, KOPT to note that the information/ clarification furnished by KOPT under cover of its letter no. Ad/0038/PPP/OT-I/VIII/1500 dated 31 May 2018 relating to the proposal received from KOPT for fixation of reference tariff for the project of "Setting up of Outer Terminal-I", is being construed as the response of KOPT in the subject proposal of KOPT also on similar issues and hence is not being sought from KOPT again.	The information/clarifications furnished by KOPT dated 31.05.2018 are similar except the following salient points: a. Berth No 3 with its backup area and railway yard are already available. b. As such the capital investment gets limited to that extent c. OT1 is a green field project requiring construction of a berth whereas berth no 3 is an existing berth with low utilization. d. The existing railway yard has spare capacity.
2	Optimal capacity:	
(i)	Quay capacity: (a). The basis to consider the percentage share of Panamax vessels and Handymax vessels at 80:20 to be explained, considering that the KOPT in its proposal for fixation of reference tariff for the project of "Setting up of Outer Terminal-1 has considered the percentage share of Panamax vessels and Handymax vessels at 70:30, based on the ratio of past 5 years.	During 2017-18 in respect of import coal, 80% cargo was carried by Panamax vessels (320 nos.) while 20% cargo was carried by Handymax vessels (80 nos). The percentage share has been considered as per the above.

Sl No.	Information/ Clarification sought by TAMP	Reply furnished by KOPT
	(b) KOPT to confirm that the operator of the proposed facility would not be allowed to deploy higher capacity Rail mounted gantry grab type unloaders at the facility other than the 2000 TPH capacity Rail mounted gantry grab type unloaders proposed to be deployed at the facility.	In the revised proposal, the capacity of the Gantry Grab Unloader has been downsized to 1500 TPH. It is confirmed that the operator of the proposed facility would not be allowed to deploy higher capacity Rail mounted gantry grab type un-loaders as the same will be installed on the existing berth where the wheel load to be restricted within 32 MT.
	(c). KOPT to also confirm that all the dry bulk cargoes viz., coal/ coke, limestone and other dry bulk cargo, (thermal coal, iron ore & iron ore pellet envisaged to be handled at the facility would have the same productivity level of 20,000 tonnes per day.	It is confirmed that the coal and its variants like coke, thermal coal, Limestone and Iron Ore Fines which are envisaged for handling through the proposed facility in berth no 3 will have the same productivity level of 20,000 TPD
	(d). The actual productivity in respect of Coking coal and non-coking coal achieved at HDC during the year 2016-17 based on which the HDC has considered the productivity at 20000 tonnes in the subject proposal under reference appears to be based on the productivity achieved by Harbour Mobile Crane (HMC) at the berths of HDC. In this backdrop, the KOPT to confirm whether the productivity of 20000 tonnes based on the deployment of HMC's will be valid when grab unloaders are proposed to be deployed at the proposed facility.	At MHCs Berth at HDC, the productivity level for dry bulk cargo has been fixed at 20,000 MT per day considering the restrictions in evacuation by conventional method (dumper, payloader combination) and the average parcel size of vessels as 26000 MT. At Berth no-3 although no problem is envisaged for transfer of cargo from hook point to stack yard, yet due to the limitations in average parcel load of vessels, which is similar to the vessels handled at MHC berth, the effective unloading capacity of grab unloader will be 50% of the rated capacity. Thus each grab unloader can effectively discharge 10,000 MT per day and with 2 grab unloader the productivity has been proposed at 20,000 MT per day which is similar to MHC Berth.
	(i). The rated capacity of the Grab unloaders are reported to be at 2000 TPH. Considering 24 working hours and a 70% utilization, the productivity of one grab unloader works out to 33600 tonnes per day. In this backdrop, considering the productivity at 20000 tonnes per day to be justified keeping in view the rated capacity of Grab unloader.	The rated capacity of the Gantry Grab Un-loader has been revised downwards to 1500 TPH. 20,000 Tons per day productivity is the target set by Ministry of Shipping.
	(ii). Since the yard capacity is a constraint, even the one grab un-loader may not be fully utilized. That being so, deployment of 2nd grab unloader to be justified.	Two nos. Gantry Grab Un-loader have been considered in the estimate and also the capacity from 2000 TPH to 1500 TPH have been revised downwards. Considering 24 working hours and 70% utilization, the productivity of one Grab unloader works out to 25200 tones per day. Haldia Dock Complex handles partially unloaded import cargo from vessel and the productivity is lower than other ports who handles full vessel cargo. It is seen that the productivity achieved by Berth no-4A of HDC with two nos. 750 TPH Gantry Grab Unloader during 2018-19 was 10301 MT. So, with revised capacity of 1500 TPH, the

Sl No.	Information/ Clarification sought by TAMP	Reply furnished by KOPT
		2nd Unloader is justified for achieving 20000 Tons per day.
(ii)	Yard Capacity (a) From the proposal furnished by KOPT, it is seen that an area of 146984 square meters of land has been proposed to be earmarked for the proposed facility. The norms for estimation of yard capacity prescribed for mechanized coal terminals provides for a cushion of around 50%, to meet the requirement of area for ancillary facilities. That being so, the balance 50% is required to be considered for stacking purpose. Against this position, the KOPT has considered only about 30% of the total area of land i.e. 45000 square metres for the purpose of stacking of cargo, in the yard capacity calculation. The KOPT to justify consideration of only 30% of the total area proposed to be allotted for the facility for stacking and balance 70% for ancillary purposes.	Out of the total land area of 1,46,984 sq.m, only an area of 1,13,000 sq.m is meant for stack yard. Balance area has been earmarked for SILO, Rail line and Loading Conveyors. The actual area considered for Stock pile as per revised plot diagram is 54,000 sq.m which is about 47% of 1,13,000 sq mt. This is on account of the fact the area earmarked for stack yard is trapezoidal in shape with a bell mouth like shape at one end
	(b) From the workings furnished by KOPT, it is seen that there is a wide gap between the yard capacity and the quay capacity. The plant capacity is almost 56% more than the yard capacity. Since yard capacity is reported to be a constraint, the KOPT to look into the profile of the equipment and the Conveyor system and explore deploying a lower capacity handling equipment and Conveyor system, if yard capacity cannot be improved so as to narrow down the gap between the yard and the quay capacity.	The limitation in terminal capacity is definitely on account of limitation in yard capacity which is on account of limitation in yard area available. However, the yard capacity has been revised considering the space available in Sothern plot. The equipment capacities as planned are proposed to assure a guaranteed minimum unloading rate of 20,000 TPD at the minimum and any downsizing of equipment will seriously impair the speedy handling of vessel which is one of the objectives of mechanization.
3	Capital cost:	
	(i). The basis for considering contingencies @ 3%, project supervision @ 2%, GST on civil works @ 18% of the civil cost and mechanical cost in the capital cost estimates of cargo handling activity to be furnished.	It is the normal practice for estimation to consider 3% and 2% for Contingencies and Project supervision respectively to accommodate preliminary expenses, tendering, Miscellaneous works and Project Management Consultancy etc. As has been stated in the note below the estimation of Capital costs, Input Tax Credit can be availed on GST paid on Mechanical / Electrical costs. Hence not considered as Capex and consequent Fixed assets. However, GST input tax credit is not available for Civil assets and hence the same is considered as Cap-ex.
	(ii). The KOPT to furnish the basis for the quantum of each item of civil work and the document substantiating the base rate considered by it to estimate the civil capital costs.	The estimate of Civil work have been prepared based on budgetary offer from manufacturer and the existing contract rate of HDC.

Sl No.	Information/ Clarification sought by TAMP	Reply furnished by KOPT
	(iii). The KOPT to furnish documentary evidence in support of the cost of each of the Equipment viz., Rail mounted gantry grab unloaders, Elevated conveyor system (C1, C2 & C4), Ground level conveyor system, Stacker cum Reclaimer, Shunting Loco, Wagon Loading Silo, Front end loaders (Baby dozers) and In-motion rail weigh bridge. The workings to arrive at the cost of each of the Equipment as considered in the estimates also to be furnished.	The cost estimate of equipment has been prepared based on budgetary offer from the manufacturer. The documentary evidence is furnished by KOPT.
	(iv). The basis for the lump sum considered for Workshop facilities, dust suppression, water supply and Electrical works to be furnished justifying the cost considered in the estimates.	The cost estimate of equipment has been prepared based on budgetary offer from the manufacturer. The documentary evidence is furnished by KOPT.
	(v). The KOPT to confirm that the base rate considered by it to estimate the civil capital costs as well as cost of each of the equipment considered, reflect the prevailing/ current market rates.	The base rate considered in the revised estimate are as per the current market rate available in HDC.
	(vi). The Upfront Guidelines for the Coal terminal lists down among other things under Capital cost estimation, the cost towards conveyor gallery and marshalling yard. The reason for not considering the cost of these civil works may be explained.	The cost estimate of conveyor gallery and marshalling yard are included in the revised estimate already submitted with our revised proposal. The capital cost of conveyor system is considered in the mechanical works in Tariff proposal. Also a rapid wagon loading system with shunting loco (on hire) is considered in the mechanical works.
4	Operating Costs:	
	(i). The basis for considering cost of fuel in respect of baby dozers for 8 hours of operation per dozer per vessel to be explained.	Baby dozers shall work at an average of 6 hours per ship for pooling the cargo for Grab bite. Allowing 2 hours more for idle operations and mobilization, the actual hours of work are considered to be 8 hours per loader/ dozer.
	(ii). With regard to the calculation of fuel cost in respect of loco, the KOPT to clarify/ furnish the following:	
	(a) Basis for considering fuel consumption of 30 litres per hour.	Consumption of fuel has been considered as 40 ltr per hour as per present consumption of fuel in the hired loco at HDC. (In the proposal, KOPT has considered fuel consumption of 30 Liters per hour.
	(b) Basis to considering the carrying capacity of 1 rake at 3800 tonnes.	One standard railway rake will have 58 or 60 wagons with a carrying capacity of 64 tons per rake. Thus 58 wagon rake can carry 3712 tons and 60 wagon rake can carry 3840 tons. Due to mix of railway rakes that may come to the port, per rake capacity is considered as 3800 tons.
	(iii). The entire 100% of cargo is proposed to be evacuated through rails. The proposal states that no lorry loading will be permitted	80% cargo has been considered to be evacuated through rail and 20% through

Sl No.	Information/ Clarification sought by TAMP	Reply furnished by KOPT
	to avoid pollution of environment. However, the calculation furnished by port for estimation of fuel cost for loco considers only 80% of cargo to be moved by rail. If entire 100% of cargo is to be moved by rail, the fuel cost of operating the loco needs review	road in the revised estimate. The fuel cost have been considered accordingly.
5	Annual Revenue Requirement and Handling rates:	
	As regards the proposed storage charges, free dwell time and chargeable slab period, it is brought to the notice of the KOPT that some projects whose tariff was fixed under 2008 Guidelines at Major Port Trusts are facing the issues in relation to reported high storage charges which is reported to have impact on the viability of the projects. It is reported by some operators that because of high storage charges they are not in a position to attract traffic to their terminals and the cargo gets directed to nearby non-major ports and private ports who offer more free dwell time and charge lower storage charges. As stated above, the 2008 Guidelines do not provide for modification of any tariff including free period and storage charges in a post bid scenario. The KOPT to keep in view the above position while firming up the storage charges and free dwell time.	Storage charges have been calculated as per 2008 Guideline. The storage charges as arrived ₹.0.78 /MT for 1st slab after free time of 10 days, ₹.1.16 / MT for 2nd slab after 15 days and ₹.1.55 / MT after 3rd slab (20 days) is over. In the earlier proposal, the same was ₹.1.59 / MT for 1st slab, ₹.2.38 / MT for 2nd slab and ₹.3.57 / MT after 3rd slab (20 days) is over. So the storage charges have been revised after considering the remarks of the TAMP in this regard.
6	Scale of Rates:	
	Considering that the berth hire charges at the proposed facility will be levied by KOPT, the relevance of prescribing "Notes relating to Berth hire" under "Notes to 1.3" in the proposed Scale of Rates to be examined.	The equipment will be installed on existing Berth constructed by HDC, KOPT. Dredging in front of Berth will be done by HDC. However, a minor repairing cost (₹. 2.54 cr Plus GST) of the existing jetty has been considered by the operator as the repairing is essential for the equipments to be installed by the operator. Dredging in front of the Berth will be done by HDC. Accordingly HDC, KOPT shall realize the Berth Hire Charge. [The reply furnished by KOPT is not relevant to the clarification sought by us.]

7.1. In view of the changes in the revised proposal dated 15 January 2019 with that of earlier proposal of KOPT dated 11 May 2018, a Joint hearing on the revised proposal dated 15 January 2019 was held on 19 February 2019 at KOPT premises. At the joint hearing, the KOPT made a brief power point presentation of its proposal. The KOPT and the concerned users/ user organizations have made their submissions at the joint hearing.

7.2. At the joint hearing, the TMILL was requested to furnish its written arguments on the revised proposal to us with a copy to KOPT, within a period of 10 days. However, inspite of a reminder dated 07 March 2019, the TMILL has not responded, till the case was finalised.

8. The proceedings relating to consultation in this case are available on records at the office of this Authority. An excerpt of the comments received and arguments made by the concerned parties will be sent separately to the relevant parties. These details will also be made available at our website http://tariffauthority.gov.in

9. With reference to the totality of information furnished by the KOPT the following position emerges:

(i). Owing to the industrial, commerce and trade developments in the vast hinterland of Kolkata Port Trust (KOPT) and the resultant growing need for fuel/ raw materials, the KOPT has envisaged Mechanisation of Berth 3 of Haldia Dock Complex (HDC) of KOPT, to meet the growing traffic demands. Accordingly, the KOPT has come up with a proposal for fixing Reference tariff for the Mechanization of Berth No. 3 on Design, Build, Finance, Operate, and Transfer ("DBFOT") basis" for the period of thirty years at HDC, by following the principles of the Upfront Tariff Guidelines of 2008. The proposal of the port has approval of its Board of Trustees.

(ii). The proposed mechanized berth is envisaged to primarily handle all types of import Coal/ Coke including thermal coal. However, considering the uncertainties with respect of Coal imports and to ensure optimum utilization of the facility and to provide flexibility to the terminal operator, the KOPT has proposed handling of limestone, iron ore, iron ore pellets and other dry bulk cargo also at the facility. The KOPT has indicated that about 80% cargo envisaged to be handled at the proposed berth would be Coking Coal/ Non-Coking Coal, 10% of the cargo would be Limestone and other Flux and the balance 10% cargo would be other dry bulk cargo. The KOPT has confirmed that the method and rate of handling of Limestone and other dry bulk cargo is almost similar to coking coal.

In this regard, it is relevant to mention here that once an upfront/ reference tariff is fixed by this Authority for a set of cargo items following the Upfront Tariff Guidelines of 2008 or the Reference Tariff Guidelines of 2013, the said Guidelines do not provide for fixation of tariff for additional cargo/ service or review of reference tariff in a post bid scenario except for the annual indexation of tariff with reference to the variation in Wholesale Price Index (WPI). In such a scenario, the proposal of the port for envisaging handling of limestone, iron ore, iron ore pellets and other dry bulk cargo also in addition to the coal/ coke, on the ground of uncertainty on import of coal cargo is a welcome step. Also, precedence is available at the Paradip Port Trust (PPT), where the PPT, to bring in efficiency and to ensure optimum utilisation of its facilities, at times, handles thermal coal at its Iron Ore Handling Plant (IOHP) and also handles Iron Ore Pellets/ Iron Ore Fines/ Other Dry Bulk Cargo at its Mechanized Coal Handling Plant (MCHP).

Thus, the judgment of the KOPT to consider handling of any other compatible cargo at the proposed facility in addition to the handling of coal/ coke, at this stage itself of fixing of Reference tariff and before invitation of bids, is taken into account.

(iii). The KOPT had initially submitted its proposal in May 2018. The said proposal was taken up on consultation with the relevant stakeholders. A Joint hearing on the proposal was held on 07 June 2018. The KOPT was requested to review its proposal with regard to proposed storage schedule in light of the feedback of bidders and other user organisations received during the joint hearing. After several reminders and for the reasons as brought out in the earlier part of the Order, the KOPT filed its revised proposal only in January 2019. The information/ clarification sought by us has been furnished by KOPT on 08 February 2019. The proposal of KOPT alongwith information/ clarification furnished by KOPT is considered in the analysis.

(iv). As stated earlier, the proposed facility will predominantly handle coal/ coke (80%) and the other dry bulk cargo proposed to be handled at the facility would be 20%. Hence, for determination of tariff for the cargo to be handled at the proposed facility, the KOPT has adopted the Upfront tariff Guidelines as applicable for a coal terminal. A multipurpose cargo berth envisages handling of both dry bulk cargo and break bulk cargo whereas the proposed mechanized berth is envisaged to handle only dry bulk cargo. Therefore, the approach of the port in adoption of the Upfront tariff Guidelines as applicable for a coal terminal, instead of the Upfront tariff Guidelines for a Multipurpose berth, for fixation of Reference tariff for the proposed facility, is seen to be apt.

(v). Optimal Capacity:

(a). Optimal Quay Capacity:

(i). The KOPT proposal envisages handling of Panamax vessels and Handymax vessels at the proposed facility with the deployment of two Rail Mounted Gantry Grab Unloader. Based on the average productivity achieved during the past years with HMCs at other berths, the KOPT has considered similar productivity of 20000 tonnes per day in respect of the Panamax Vessels and Handymax Vessels.

The Upfront tariff fixation guidelines of 2008 for the Coal Terminal prescribes unloading norms of 35000 tonnes per day in respect of Panamax vessel and 15000 tonnes per day in respect of Handymax Vessels. Though the Guidelines prescribe different productivity levels for Panamax vessels and Handymax vessels, the KOPT has considered a uniform handling rate of 20000 tonnes per day for the Panamax Vessels and Handymax Vessels. In view of the lock gate and draft constraints at HDC, the HDC is mostly the second port of call with partially loaded vessels and hence the Panamax/ Handymax vessels arriving at HDC generally bring bottom cargo. In view of this position, the average actual productivity achieved at the MHC berths of HDC for coal for both Handymax and Panamax Vessels is reported to be similar.

The KOPT has also confirmed that the coal and its variants and all other dry bulk cargo envisaged for handling through the proposed facility in berth no 3 will have the same productivity level of 20000 tonnes per day.

Considering that the productivity of 20000 tonnes per day for both Handymax and Panamax Vessels as considered by KOPT is based on the past actuals, this Authority is inclined to consider a productivity of 20000 tonnes per day for both Handymax and Panamax Vessels.

It is noteworthy that recognizing the peculiarity of the situation at KOPT (of low draft), this Authority has in the past, while determining the upfront/ reference tariff at KOPT, has considered the productivity level of a MHC at 10000 MT per day. Considering the deployment of 2 no. of Rail Mounted Gantry Grab Unloader at the proposed facility, consideration of productivity of 20000 MT per day appears to be in order.

(ii). The ratio of Panamax and Handymax Vessels has been considered by KOPT at 80:20, based on the actual ratio of Panamax and Handymax Vessels during the year 2017-18.

(iii). Considering the ship day output at 20000 tonnes per day for both Panamax vessels and Handymax vessels at 70% utilisation, the optimal quay capacity of the proposed facility works out to 5.11 million tonnes per annum as estimated by the port.

(b). Optimal Yard Capacity:

(i). The upfront tariff guidelines stipulate that the yard capacity is to be assessed for the area of the yard made available by the port for development. In its proposal, the port envisages allotment of an area of 146984 sq.m of land to the proposed BOT operator. Out of the said area, 54000 sq.m of land has been earmarked for storage and the balance area has been earmarked for SILO, Rail line and Loading Conveyors. Further, the KOPT has also stated that the area earmarked for stack yard is trapezoidal in shape with a bell mouth like shape at one end.

The norm for estimation of yard capacity prescribed for mechanized coal terminals provides for a cushion of around 50%, to meet the requirement of area for ancillary facilities. That being so, the balance 50% is required to be considered for stacking purpose. Against this position, the KOPT has considered only about 38% of the total area of land i.e. 54000 square metres for the purpose of stacking of cargo, in the yard capacity calculation.

None of the users/ prospective bidders have objected to the proposed arrangement. Further, the peculiar shape of the stack yard, is presumed to impact the stacking of the cargo at the stack yard. It is also not unreasonable to assume that the port would have done due diligence on this aspect. The judgment of the port in this regard is, therefore, relied upon.

(ii). The guidelines for upfront tariff setting prescribe the stacking factor norm at 3 tonnes per square metre for stacking coal. The KOPT has considered the stacking factor at 5.2 tonnes per square metre. The Adani Ports and Special Economic Zone Limited (APSEZL) is of view that about 4.5 tonne per sq. mtr can be stacked. However, the KOPT has not considered the view of APSEZL. Since the proposed stack height is as per the Feasibility Report, this Authority relies upon the quantity that could be stacked per sq.m of area at 5.2 tonnes, as proposed by the KOPT.

(iii). The norm for plot turnover for a coal terminal prescribed in the guidelines is 12, based on the dwell time of 30 days. Considering an evacuation rate of 2.6 rakes per day with each rake carrying 3800 tonnes, the rate of evacuation per day has been considered at 9880 tonnes. Accordingly, the KOPT has arrived at a dwell time of 20 days (0.7 x 54,000 x 5.2/ 9,880 = 20 days), which results into the plot turnover ratio of 18.

(iv). Based on the parameters as considered by KOPT as discussed above, the optimal yard capacity of the facility works out to 3.538 million tonnes per annum at 70% utilization, as estimated by the Port.

(c). As per the Guidelines, the lower amongst the optimal quay capacity and yard capacity is to be considered as the optimal capacity of the facility. In the case in reference, the quay capacity has been assessed at 5.11 million tonnes per annum and the yard capacity has been assessed at 3.538 million tonnes per annum. Accordingly, the optimal capacity of the proposed facility would be 3.538 million tonnes per annum, being the lower amongst the optimal quay capacity and yard capacity.

In this connection, it is noticed that there is a wide gap between the yard capacity and the quay capacity. Thus, the KOPT was specifically requested to look into the profile of the equipment and the Conveyor system and explore deploying a lower capacity handling equipment and Conveyor system, if yard capacity cannot be improved so as to narrow down the gap between the yard and the quay capacity. In this regard, the KOPT has stated that there is limitation in the yard area available. Also, the port has reported to have planned the equipment capacities to assure a guaranteed minimum unloading rate of 20000 tonnes per day and that any downsizing of equipment will seriously impair the speedy handling of vessel which is one of the objectives of mechanization.

Based on the justification furnished by the port, this Authority relies upon the optimal capacity of the proposed facility at 3.538 million tonnes per annum, being the lower amongst the optimal quay capacity and yard capacity.

(vi). Capital Cost:

(a). The project envisages unloading of Coal/ Coke, limestone, iron ore, iron ore pellets and other dry bulk cargo in the import cycle, in a fully mechanized manner from the ship to the yard, without any manual intervention. Thus, the civil works and the profile of equipment has been estimated by the KOPT to enable mechanized handling of cargo.

(b). The capital cost as estimated by the KOPT in its proposal for the handling activity is ₹331.94 crores of which ₹ 73.26 crores is towards civil capital costs, ₹ 203.81 crores is towards mechanical and equipment capital costs, ₹ 39.06 crores is towards electrical works and ₹ 15.81 crores is towards Miscellaneous capital costs.

(c). Civil Cost:
The capital civil costs has been estimated by the KOPT to the tune of ₹ 73.26 crores. The upfront tariff guidelines broadly indicate the civil works involved for a coal terminal and require the port to estimate civil cost. The items of civil works as considered by KOPT generally adhere to normative list of civil works as stipulated in the guidelines for the coal terminal. The KOPT has confirmed that the estimate of Civil works have been prepared based on budgetary offer from manufacturer and the existing/ prevailing market/ contract rate of HDC. In view of the above said confirmation given by the KOPT, the civil cost estimates as furnished by the KOPT are relied upon.

(d). Equipment Cost:

(i). The Equipment cost of ₹ 242.88 crores as estimated by the Port is towards 1500 TPH Rail Mounted Gantry Grab Unloader, Conveyor 3000 TPH capacity (Approx 2200 m), Stacker cum Reclaimer, Silo, Dust suppression system and Fire Fighting facilities, In motion Weigh Bridge, Bull Dozer, Detailed Designs & Project Supervision costs @ 2% and Contingencies @ 3%. Further, since Input Tax Credit can be availed on GST paid on Mechanical/ Electrical costs, the GST component has not been considered by the KOPT as part of capital costs.

(ii). In addition to the above, the KOPT has envisaged to deploy some equipment on hire basis viz., 1 no. of High Power Locomotive, 4 nos. of Baby Dozers, 1 no. of Excavator, 1 no. of Hydra and 2 nos. of 10 MT Pay Loaders for road evacuation.

(iii). The coal/ coking coal unloaded by 2 nos. of rail mounted gantry grab type unloaders will be discharged into a single dock elevated conveyor. The coal from the dock conveyor will be conveyed to the yard conveyor for stacking. The coal from the stack yard reclaimed by stacker cum reclaimer will be conveyed to a stationary silo. The coal from the stationary silo will be loaded into railway wagons through a rapid wagon loading system in which the wagons will be moving. 80% the cargo is envisaged to be evacuated by rail and 20% of the cargo will be evacuated through Road. The port has stated that 1 no. of payloader will not be sufficient to evacuate 20% of the optimal capacity envisaged to be moved by rail and has, therefore, considered deployment of 2 nos. of pay loaders on hire basis. Further, during final stage of ship unloading operation, as the hatch gets emptied, the remaining coal is to be heaped at one place by baby dozers to be lowered into the hatch. The equipment proposed to be deployed by the KOPT is seen to be in sync with the methodology of handling of cargo as envisaged by KOPT.

(iv). With regard to deploying of equipment on hire basis, it is relevant here to mention that in the initial proposal of KOPT of May 2018, the port had envisaged the capital cost of all equipment on purchase basis. At that time, it was the suggestion of some stakeholders to consider deployment of equipment on hire basis. Accordingly, the KOPT in its revised proposal of January 2019 has proposed deployment of above referred equipment of hire basis. The port is of the view that if the BOT operator owns the above equipment, the idling cost of equipment and manpower will be loaded in the estimates of the capital cost and that considering hiring of the equipment will make the estimates more realistic. The judgment of the port in this regard is relied upon.

(v). Given that none of the prospective bidders nor the users have raised any other pointed objection to the proposed equipping plan, this Authority is inclined to consider the equipping plan as proposed by the port, which is based on the Feasibility Report.

(e). Electrical works:
The capital cost towards Electrical Power supply and distribution System including substation, Illumination including High mast lighting, Detailed Designs & Project Supervision costs @ 2% and Contingencies @ 3%, has been considered by KOPT.

(f). The estimates of various equipment and electrical works is generally seen to be as per the documentary evidence furnished by the KOPT. Thus, the capital cost estimates as furnished by the KOPT is relied upon.

(g). With regard to considering contingencies @ 3% and project supervision @ 2%, the KOPT is of the view that it is the normal practice for estimation to accommodate preliminary expenses, tendering, Miscellaneous works and Project Management Consultancy etc.

(h). The miscellaneous capital cost is estimated at 5% on civil and equipment cost which is as per the norm prescribed in the guidelines for coal terminal.

(i). The APSEZL has stated that the proposal of KOPT specifies detailed technical specifications of the project facilities to be developed. The APSEZL is of the view that specifying so much of detailed specifications will not allow the design flexibility to the Concessionaire, given that the Model Concession Agreement which will be base for the Concession Agreement to be issued for the Project specifies that Design Risk will be borne by the Concessionaire. Thus, the APSEZL has suggested that equipment, design and rated capacity should be left to the Concessionaire to determine and achieve terminal capacity and performance standards to be specified in the Concession Agreement for the Project. In this regard, the KOPT has stated that only some basic parameters have been mentioned and that the Operator can design other aspects considering Terminal Capacity and Performance Standard.

(vii). Return on capital employed is calculated at 16% of the estimated capital cost as per the norm prescribed in the guidelines.

(viii). Operating Cost:

(a). Hire Cost:

(i). As stated earlier, some equipment has been proposed to be deployed on hire at the proposed facility. Accordingly, the hire cost in respect of 1 no. of Locomotive, 4 nos. of Baby dozers, 1 no. of Excavator, 1 no. of Hydra and 2 nos. of 10 MT Pay loaders has been considered by KOPT, as part of the operating cost.

(ii). The hire cost of the locomotive has been considered by KOPT at ₹ 17.45 lakhs per month, based on the Work Order no. IM&EE/MOF/M-II/Rites/Extension/2017-19/9008 dated 29 November 2017, issued by the Visakhapatnam Port Trust (VPT) to RITES Limited. The Work Order is valid till November 2019. The hire charges is exclusive of fuel cost. Hence, the fuel cost has been estimated separately, as discussed in the following paragraph. The hire cost estimated by KOPT for a period of 12 months is relied upon.

(iii). The hire cost of the Baby Dozers have been considered at an all-inclusive cost of ₹ 13230/- per shift. This rate is reported to be as per the hire charge worked out and considered in the proposal relating to fixing of stevedoring and shore handling charges at HDC vide Order no. TAMP/79/2016-KOPT dated 19 January 2018.

Considering the optimal capacity at 3.538 million metric tonnes per annum and the average parcel size of the vessel at 24000 tonnes, the KOPT has determined that 147 vessels will be handled at the facility. Since the baby dozers would be required to aggregate the cargo, the port has considered that 4 nos. of baby dozers would be aggregately deployed for 10 shifts per vessel. The judgment of the port in this regard, is relied upon.

(iv). The hire cost of the Excavator has been considered by KOPT at ₹ 1156/- per hour, based on the Work Order no. I&CF/SDM/DOCK/T/847/1248 dated 04 January 2018 as issued by the KOPT to T.R Logictics Private Limited. The hire charges is an all-inclusive cost. The number of hours of deployment of Excavator has been considered for 8 hours per day for 360 days. The judgment of the port in this regard, is relied upon.

(v). The hire cost of the Hydra has been considered by KOPT at ₹ 1156/- per hour, based on the Work Order no. I&CF/SDM/DOCK/T/847/1247 dated 04 January 2018 as issued by the KOPT to Anil Infracom. The hire charges is an all-inclusive cost. The number of hours of deployment of Hydra has been considered for 8 hours per day for 360 days. The judgment of the port in this regard, is relied upon.

(vi). The hire cost of the 10 MT Pay loaders to be deployed for road evacuation have been considered at an all-inclusive cost of ₹ 24696/- per shift per loader This rate is reported to be as per the hire charge worked out and considered in the proposal relating to fixing of stevedoring and shore handling charges at HDC vide Order no. TAMP/79/2016-KOPT dated 19 January 2018.

The hire cost has been worked out by the port by considering deployment of 2 number of pay loaders for 2 shifts per day (road evacuation is not envisaged at night) for 300 days per annum. The judgment of the port in this regard, is relied upon.

(b). Power Cost.
The consumption of power to the tune of 1.4 units per tonne is seen to be as per the norm prescribed in the Upfront Guidelines. The per unit cost of power at ₹ 11.91 per unit as considered by KOPT is supported by documentary evidence.

(c). Fuel Cost:

(i). Locomotive:

The KOPT has considered the fuel consumption in respect of Locomotive at 32 litres per hour. This is reported to be as per the Work Order dated 29 November 2017, issued by the VPT to RITES Limited, as brought out above.

Given that each rake has a capacity of carrying 3800 tonnes of cargo and with the time of 2 hours taken for handling each rake and an additional time of 20% for positioning, the KOPT has calculated the fuel consumption for 1788 hours per annum to handle 80% of the optimal capacity, which is estimated to be handled by rail. The workings furnished by KOPT in this regard is considered.

(ii). Bull Dozers:

The KOPT has considered the fuel consumption in respect of Bull dozer at 12 litres per hour. No documentary evidence has been furnished in support of the fuel consumption of Bull Dozer. Considering that the fuel consumption is as per the Feasibility Report, the same is relied upon in the analysis. Incidentally, the upfront guidelines prescribe a fuel consumption norm of 12 litres per hour in respect of a 10T Payloader.

The cost of fuel in respect of Bull dozers has been considered for 16 hours of operation per dozer on the ground that Dozer shall work at an average of two shifts per day for dozing of cargo.

(iii). The cost of fuel of ₹ 66 per litre as considered by KOPT has been updated with reference to the prevailing cost of fuel at ₹ 69.16 per litre.

(iv). With regard to evacuation of the remaining 20% of cargo, the KOPT has stated that the said cargo would be evacuated by the front end loaders which would be deployed on hire, the cost of which has already been taken into account, as discussed earlier.

(c). As per the norms prescribed in the guidelines for a coal terminal, the repairs and maintenance cost on civil work is estimated by KOPT at 1% on the civil cost and 7% on mechanical equipment and electrical equipment cost. The said estimation is also considered at 1% on the component of civil assets and 7% on the component of equipment cost forming part of the miscellaneous assets.

(d). Insurance cost is estimated at 1% of the gross fixed assets and other expenses are estimated at 5% of the gross value of fixed assets by KOPT, which is in line with the norms prescribed in the guidelines.

(e). Depreciation has been computed by KOPT @ 3.17% on civil assets, 6.33% on Mechanical assets and 9.5% on Electrical assets. The KOPT has confirmed that the depreciation rates are as per the Straight line method as per the Companies Act, 2013.

(f). The guidelines for upfront tariff fixation stipulate that lease rent for port land is to be estimated based on the rates prescribed in the Scale of Rates of the respective Major Port Trusts. Lease rental has been estimated by the port for a land area of 146984 square metres. The licence fee for the Dock Interior (inside Custom bounded area) (Bare Land) has been fixed at ₹ 26.28 per sq.m per month vide the Order no. TAMP/62/2016-KOPT dated 29 March 2017. As per the said Order, the said licence fee has come into effect from 07 April 2016. Therefore, in April 2018, the said licence fee would have got escalated twice by 2% and the licence fee as applicable as on date would be ₹ 27.346 per sq.m per month, which has been considered by KOPT in its workings.

(ix). The statement for fixing upfront tariff submitted by the KOPT has been modified in line with the above analysis. A copy of the modified statement is attached as **Annex - I**.

(x). (a). The Annual Revenue Requirement (ARR) for the Cargo handling activity which is the sum of the operating cost and return on capital employed is estimated at ₹130.56 crores as against ₹130.52 crores estimated by the port.

(b). As prescribed in the guidelines for a coal terminal, the KOPT has apportioned 98% of the total revenue requirement towards handling charges and 1% each towards storage charge and miscellaneous charge.

(xi). (a). The tariff caps are determined so as to meet the estimated revenue requirement to operate the terminal at the optimal capacity. Since the handling rate for all the three cargo groups proposed to be handled at the envisaged facility is reported to be the same, the KOPT has sought to prescribe uniform rate for all the cargo items, by considering the ratio of foreign and coastal cargo at 90:10 on the basis of the average of the actual ratio of foreign and coastal cargo (dry bulk [excluding thermal coal shipment]) handled at HDC in the last 3 years. The ratio of foreign and coastal cargo was given by the KOPT based on the past actual data, during the proceedings relating to the proposal received from KOPT for fixation of Reference tariff for the project of Setting up of Outer Terminal-I at HDC vide Order no. TAMP/76/2017-KOPT dated 31 July 2018.

(b). As per policy direction of the Government, concessional tariff are to be prescribed for coastal cargo (other than thermal coal and POL including crude oil, iron ore and iron ore pellets). Accordingly, concessional tariff has not been prescribed for coastal thermal coal, iron ore and iron ore pellets

(xii). (a). In the proposed Scale of Rates, the KOPT has proposed a free period of 10 days for coal/ coke and all the other dry bulk cargo envisaged to be handled at the facility, as against the free period of 25 days prescribed in the upfront guidelines.

(b). In the calculation of storage charges, the KOPT has considered that 40% of the cargo will be evacuated within the free period of 10 days and the balance 60% of the cargo is assumed to be evacuated in a gradual manner over 3 slab periods each comprising of 5 days. Thereafter, the KOPT has assigned weight to each of the slab and has thus worked out the storage charges to be applicable in each of the slabs to meet the ARR pertaining to the Storage activity. The rate for the 2nd slab and 3rd slab is prescribed at 1.5 times and 2 times the rate of the 1st slab. The working for storage charges as furnished by KOPT is attached as **Annex – II.**

(c). The APSEZL has stated that such fast evacuation of cargo is not a current trade practice and that importers of the cargo at most of the ports get a free storage period of at least one month. Thus, the APSEZL has requested the port to review the calculation of storage charges by considering a free period of 25 days as prescribed in the Guidelines. Request for increase in the free days has been made by other stakeholders also.

(d). Some projects whose tariff was fixed under 2008 Guidelines at Major Port Trusts are facing the issues in relation to reported high storage charges which appear to have impact on the viability of the projects. It is reported by some operators that because of high storage charges they are not in a position to attract traffic to their terminals and the cargo gets diverted to nearby non-major ports and private ports who offer more free dwell time and charge lower storage charges. The 2013 Reference tariff Guidelines do not provide for modification of any tariff including free period and storage charges in a post bid scenario. Even the APSEZL has highlighted this aspect. Based on this position, the KOPT was requested to firm up the storage charges and free dwell time.

(e). The KOPT has stated that the plot turnover ratio for a coal terminal prescribed in the guidelines is 12 based on the dwell time of 30 days. However, considering that the cargo at the proposed facility would be evacuated from the stackyard through mechanized wagon loading system, it has adopted a plot turnover ratio of 18 based on a dwell time of 20 days. In view of this position, the KOPT has reported to have considered a free period of 10 days.

(f). The KOPT has analysed the request made by the prospective bidders to increase the free days by stating that if the free period is increased, there will be a tendency to store the cargo for a longer period of time, thereby impacting the utilization of the berth and the other parameters. The port has also stated that latest machineries with SILO loading will result in faster evacuation of cargo and reduction of dwell time. Thus, the KOPT is of the view that 10 days free time is enough.

(g). Based on the detailed justification furnished by the Port, this Authority is inclined to approve the storage charges based on the methodology adopted by the Port, with free storage period of 10 days.

(xiii). Based on the annual revenue requirement, the upfront tariff cap for miscellaneous charge is prescribed at ₹ 3.69 per tonne. The miscellaneous charge covers miscellaneous services such as sweeping, weighment of wagons, trucks, receiving/ delivery of cargo etc.

(xiv). In the proposed Reference tariff schedule, the KOPT has proposed definitions for common terms like coastal vessel, foreign vessel, day, free period and per day. The definitions are found to be in line with the definitions prescribed for the respective terms in the various Upfront/ Reference tariff Schedules for the various project at various Major Port Trusts.

(xv). In the proposed Reference tariff schedule, the KOPT has proposed some general conditionalities like conditionalities governing classification of vessels into foreign and coastal, levy of interest on delayed payments/ refunds, rounding off bills, non-levy of charges for delay beyond a reasonable level attributable to the terminal operator, conditionalities governing the flexibility provided to the terminal operator to levy charges lower than ceiling rates/ rationalize the condiitonalities, which are found to be in line with the general conditionalities prescribed in the Upfront/ Reference tariff schedule of various major port trusts.

(xvi). In the proposed Scale of Rates, the KOPT has proposed “Notes relating to Berth hire”. Considering that the berth hire charges at the proposed facility will be levied by KOPT, the levy of berth hire by the KOPT would be governed by the KOPT Scale of Rates. Hence, prescription of the notes in the Scale of BOT operator is not essential and hence, it is deleted.

(xvii). The KOPT has proposed a provision to state that the Cargo handling charges is a composite charge for unloading of the coal/ coke, Limestone and other Dry Bulk Cargo from the vessel and transfer of the same up to the point of storage, storage at stack yard upto a free period of 10 days after completion of unloading, reclaiming from stack yard and loading on the wagons/ trucks and is inclusive of wharfage and supply of labour and/ or equipment wherever necessary and all other charges not specifically prescribed in the Scale of Rates.

(xviii). Under the schedule of storage charges, the KOPT has proposed conditionalities stating that commencement of free period from the day following the day of complete discharge of cargo, non-exclusion of terminal's non-working days and custom notified holidays for the purpose of free period, storage charges to be payable for all days including terminal's non-working days and custom notified holidays for stay of cargo beyond free days and storage charge on cargo are not accrue for the period when the terminal operator is not in a position to deliver/ ship the cargo when requested by the user due to reasons attributable to the operator, are seen to be in line with the prescription at the other major ports/ private terminals.

(xix). As per clause 2.8 of the upfront tariff Guidelines of 2008, the tariff caps will be indexed to inflation but only to an extent of 60% of the variation in Wholesale Price Index (WPI) occurring between 1 January 2008 and 1 January of the relevant year. Such automatic adjustment of tariff caps will be made every year and the adjusted tariff caps will come into force from 1 April of the relevant year to 31 March of the following year. In the instant case, since the estimation of capital cost and unit rate of operating cost considered in the upfront tariff calculation are as of the year 2018, it is found appropriate and relevant to prescribe the base WPI to be considered for automatic adjustment every year as on 1 January 2018, as proposed by KOPT.

(xx). Clause 2.2 of the revised tariff guidelines of 2013 requires this Authority to prescribe the Reference Tariff along with the Performance Standards. Though the revised guidelines of 2013 do not require this Authority to go into the Performance Standards proposed by the port it is not unreasonable to assume that the ports would propose reasonable and achievable Performance Standard.

The KOPT has proposed the Performance Standards in respect of Gross Berth Output for Coal/ Coke, Limestone and other Dry Bulk Cargoes to be handled by the Panamax Vessels and Handymax Vessels each at 20000 tonnes per Day per Berth, as considered in the optimal quay capacity calculation.

Recognizing that clause 2.2. of the revised guidelines of 2013 requires this Authority to notify the Performance Standards, the Performance Standards as proposed by the KOPT, are notified along with the Reference Tariff Schedule.

10.1. Subject to above, the Reference Tariff Schedule along with conditionalities governing the Reference Tariff has been modified.

10.2. The Reference Tariff Schedule is attached as **Annex - III** and the Performance Standards for the Mechanisation of Berth no. 3 at HDC of KOPT is attached as **Annex - IV**.

10.3. In the result, and for the reasons given above and based on collective application of mind, this Authority approves the Reference Tariff Schedule for the Mechanisation of Berth no. 3 at HDC and notify alongwith the Performance Standards.

10.4. If there is any error apparent on the face of records considered or for any other justifiable reasons, the port may approach this Authority for review of the reference tariff fixed, prior to completion of bidding process of the project giving adequate justification/ reasoning within 30 days from the date of notification of the Order in the Gazette of India.

10.5. As per clause 2.5 of the Revised Tariff Guidelines 2013, the Reference Tariff and Performance Standards notified by this Authority shall be mentioned in the bid document and subsequently in the Concession Agreement in respect of PPP Projects. Accordingly, the KOPT is advised to incorporate the Reference Tariff and Performance Standards, in the bid document and subsequently in the Concession Agreement in respect of PPP Projects.

11.1. From the date of Commercial Operation (CoD) till 31st March of the same financial year, the tariff would be limited to the indexed Reference Tariff relevant to that year, which would be the ceiling. The aforesaid Reference Tariff is automatically revised every year based on an indexation as provided in para 2.2 of the tariff guidelines of 2013 which will be applicable for the entire concession period.

However, the PPP operator would be free to propose a tariff along with Performance Standards (the "Performance Linked Tariff") from the second year of operation onwards, over and above the indexed Reference Tariff for the relevant financial year, at least 90 days before the 1st April of the ensuing financial year. Such Performance Linked Tariff shall not be higher than 15% over and above the indexed Reference Tariff for that relevant financial year (and this will be the Tariff Cap). The Performance Linked Tariff would come into force from the first day of the following financial year and would be applicable for the entire financial year.

11.2. The proposal shall be submitted to this Authority along with a certificate from the independent engineer appointed under the Concession Agreement of the Project indicating the achievement of Performance Standards in the previous 12 months as incorporated in the Concession Agreement or for the actual number of months of operation, in the first year of operation as the case may be.

11.3. On receipt of the proposal, this Authority will seek the views of the KOPT on the achievement of Performance Standards as outlined in para 5 of the tariff guidelines of 2013, within 7 days of receipt.

11.4. In the event of Operator not achieving the Performance Standards as incorporated in the Concession Agreement in previous 12 months, this Authority will not consider the proposal for notifying the Performance Linked Tariff for the ensuing financial year and the Operator shall be entitled to only the indexed Reference Tariff applicable for the ensuing financial year.

11.5. After considering the views of the KOPT, if this Authority is satisfied that the Performance Standards as incorporated in the Concession Agreement have been achieved, it shall notify the performance linked tariff by 15th of March to be effective from 1st of April of the ensuing financial year.

11.6. While considering the proposal for Performance Linked Tariff, this Authority will look into the Performance Standards and its adherence by the Operator. This Authority will decide on the acceptance or rejection of the Performance Linked Tariff proposal based on the achievement or otherwise of the Performance Standards by the operator. Determination of indexed Reference Tariff and Performance Linked Tariff will follow the illustration shown in the Appendix attached to the tariff guidelines of 2013.

11.7. From the third year of operation, the Performance Linked Tariff proposal from the PPP operator shall be automatically notified by this Authority subject to the achievement of Performance Standards in the previous 12 months period as certified by the Independent Engineer. The PPP operator, for the Performance Linked Tariff from the third year onwards, will submit the Performance Linked Tariff proposal along with the achievement certificate from the independent engineer by 1st March and this Authority shall notify by 20th March, the Performance Linked Tariff to be effective from the ensuing financial year.

11.8. In the event any user has any grievance regarding non-achievement by the PPP operator of the Performance Standards as notified by this Authority, he may prefer a representation to this Authority which, thereafter, shall conduct an inquiry into the representation and give its finding KOPT. The KOPT will be bound to take necessary action on the findings as per the provisions of the respective Concession Agreement.

11.9. Within 15 (fifteen) days of the signing of the Concession Agreement, the concerned operator will forward the Concession Agreement to this Authority which will host it on its website.

11.10. The PPP operator shall furnish to this Authority quarterly reports on cargo traffic, ship berth day output, average turnaround time of ships, average pre-berthing waiting time as well as the tariff realized for each berth. The quarterly reports shall be submitted by the PPP operator within a month following the end of each quarter. Any other information which is required by this Authority shall also be furnished to them from time to time.

11.11. This Authority shall publish on its website all such information received from PPP operator. However, this Authority shall consider a request from any PPP operator about not publishing certain data/ information furnished which is commercially sensitive. Such requests should be accompanied by detailed justification regarding the commercial sensitiveness of the data/information in question and the likely adverse impact on their revenue/ operation of upon publication. This Authority's decision in this regard would be final.

(T.S. Balasubramanian)
Member (Finance)

				ANNEX - I
	REFERENCE TARIFF CALCULATION FOR THE MECHANISATION OF BERTH NO. 3 AT HALDIA DOCK COMPLEX OF KOLKATA PORT TRUST.			
			₹	**in crores**
Sr. No.	**Particulars**		**Estimates furnished by KOPT**	**Estimates modified by TAMP**
I	**Optimal capacity**			
(a)	**Optimal Quay Capacity**			
	Percentage Share of capacity of Vessels			
	- Panamax Vessels (S1)		80%	80%
	- Handymax Vessels (S2)		20%	20%
	Shipday Output			
	- Panamax vessels (P1)		20000	20000
	- Handymax vessels (P2)		20000	20000
	Optimal Quay Capacity = 0.7*((S1*P1)+(S2*P2))*365 (in tonnes)		**5110000**	**5110000**
(b)	**Optimal Yard Capacity**			
	- Area of the yard made available by the port as usable storage (in m2) (A)		54000	54000
	- Percentage of total yard area that could be used for stacking (U)		100%	100%
	- Quantity that could be stacked per m2 of area (Q)		5.2	5.2
	- Turnover ratio of the plot in an year (T)		18	18
	Optimal yard capacity (0.7 x (A x U% x Q x T tons) (in tonnes)		**3538080**	**3538080**
	Optimal Capacity of the terminal (lower of (a) and (b)) (in tonnes)		**3538080**	**3538080**
	Optimal Capacity of the terminal (in million metric tonnes per annum)		**3.53808**	**3.53808**
II	**Capital Cost**			
A.	**Cargo Handling Activity**		₹	**in crores**
	(i). Civil Cost			
	Revamping of the Existing Berth to accommodate the Loaders and Other Machineries		2.54	2.54
	Civil Foundation for Conveyor Structure		5.00	5.00
	Civil works for Silo System		5.00	5.00
	Construction of New Railway Lines for Rapid Wagon Loading System		24.25	24.25
	Extension of railway tracks upto wagon loading yard & provision of sidings		3.28	3.28
	Service Roads		4.65	4.65
	RCC Drain		2.66	2.66
	Compound wall		3.65	3.65
	Laterite Hard Stading of the Yard		8.10	8.10
	Detailed Designs & Project Supervision costs @ 2%		1.18	1.18
	Contingencies @ 3%		1.77	1.77
	GST on Civil works @ 18%		11.18	11.18
			73.26	**73.26**
	(ii). Equipment Cost			
	1500 TPH Rail Mounted Gantry Grab Unloader including 25 CBM Grab with rail span of 13.687 M		90.00	90.00
	Conveyor 3000 TPH capacity (Approx 2200 m) including transfer points		38.00	38.00
	Stacker cum Reclaimer– Stacking-3000 TPH, Reclaiming - 2000 TPH, with Boom Length-30 m, Long travel rail gauge- 6m		35.10	35.10
	SILO- for rapid Wagon Loading site 2000 MT		19.25	19.25
	Dust suppression system and Fire Fighting facilities including water supply and distribution.		6.90	6.90
	In motion Weigh Bridge		0.86	0.86
	Bull Dozer		4.00	4.00
	Detailed Designs & Project Supervision costs @ 2%		3.88	3.88
	Contingencies @ 3%		5.82	5.82
			203.81	**203.81**
	(iii). Electrical Works			
	Electrical Power supply and distribution System including substation		36.20	36.20
	Illumination including High mast lighting		1.00	1.00
	Detailed Designs & Project Supervision costs @ 2%		0.74	0.74
	Contingencies @ 3%		1.12	1.12
			39.06	**39.06**
	(iv). Miscellaneous			
	5% on Civil Cost, Equipment & Electrical Cost		15.81	15.81
	Total Capital Cost for Handling Activity (i + ii + iii)		**331.94**	**331.94**

Sr. No.	Particulars		Estimates furnished by KOPT	Estimates modified by TAMP
III	**Operating Cost for Cargo Handling Activity**		₹	**in crores**
	(a). Hire Cost			
	- Locomotive		2.09	2.09
	(KOPT - Rs.17.45 lakhs per month * 12 months) (TAMP - Rs.17.45 lakhs per month * 12 months)			
	- Baby Dozers		1.94	1.94
	(KOPT - Rs.13230/- per shift * 10 shifts per vessel * 147 vessels) (TAMP - Rs.13230/- per shift * 10 shifts per vessel * 147 vessels)			
	- Excavator		0.33	0.33
	(KOPT - Rs.1156/- per hour * 8 hours * 360 days per annum) (TAMP - Rs.1156/- per hour * 8 hours * 360 days per annum)			
	- Hydra		0.18	0.18
	(KOPT - Rs.620/- per hour * 8 hours * 360 days per annum) (TAMP - Rs.620/- per hour * 8 hours * 360 days per annum)			
	- 10 MT Pay loaders		2.96	2.96
	(KOPT - Rs.24696/- per shift * 2 shifts * 2 payloaders * 300 days) (TAMP - Rs.24696/- per shift * 2 shifts * 2 payloaders * 300 days)			
	(b). Power Cost		5.90	5.90
	(KOPT - 1.4 units/ tonne * Rs. 11.91 per unit * 3.538 MMTPA) (TAMP - 1.4 units/ tonne * Rs. 11.91 per unit * 3.538 MMTPA)			
	(b). Fuel Cost			
	- Bull Dozers		0.38	0.40
	(KOPT - 12 ltrs/ hour * Rs.66 per litre * 16 hours per day * 300 days) (TAMP - 12 ltrs/ hour * Rs.69.16 per litre * 16 hours per day * 300 days)			
	- Locomotive		0.38	0.40
	(KOPT - 32 ltrs per hour * Rs.66 per litre * 1788 hours p.a) (TAMP - 32 ltrs per hour * Rs.69.16 per litre * 1788 hours p.a)			
	(c). Repair & Maintenance			
	- Civil Assets (1% on civil work)		0.77	0.77
	- Mechanical & Electrical Equipment including spares (7% on equipment cost)		17.85	17.85
	(d). Insurance (1% on Gross fixed assets)		3.32	3.32
	(e). Depreciation			
	- Civil Work @ 3.17%		2.44	2.44
	- Mechanical Work @ 6.33%		13.55	13.55
	- Electrical Assets @ 9.5%		3.90	3.90
	(f). License Fee (146984 sq.m * Rs.27.346 per month * 12 months)		4.82	4.82
	(g). Other Expenses towards salaries and overheads (5% on gross value of assets)		16.60	16.60
	Total Operating Cost		**77.41**	**77.45**
IV	**Estimated Revenue Requirement & upfront tariff for Cargo Handling Activity**			
A.				
(i).	**Estimated Revenue Requirement**			
	(a). Total Operating Cost		77.41	77.45
	(b). Return on capital Employed @ 16%		53.11	53.11
	(c). Total Revenue requirement from cargo handling activity		**130.52**	**130.56**
(ii).	**Apportionment of Revenue Requirement**			
	(a). Cargo Handling Charges (98% of ARR)		127.91	127.95
	(b). Storage Charges (1% of ARR)		1.31	1.31
	(c). Miscelleneous Charge (1% of ARR)		1.31	1.31
	(d).Total Revenue requirement from cargo handling activity		**130.52**	**130.56**
(iii).	**Cargo Handling charge**			
	(a). Cargo Handling Charge			
	- Revenue Requirement (₹ in lakhs)		127.91	127.95
	- Capacity (Lakh Tonnes per annum)		35.38	35.38
	- Per Tonne rate for handling of cargo (foreign)		**376.65**	**376.69**
	(b). Storage Charge			
	- Revenue Requirement (₹ in lakhs)		130.52	130.56
	- % of Cargo to attract storage charge		60%	60%
	- Capacity of cargo to attract storage charge (tonnes)		2122848	2122848
	Storage Charge (beyond the free period)		**Rate Per tonne per day or part thereof**	**Rate Per tonne per day or part thereof**
	-Free period		10 days	10 days
	-First five days (after free period)		**0.78**	**0.78**
	-6th day to 10th day (after free period)		**1.17**	**1.17**
	-11th day onwards (after free period)		**1.56**	**1.56**
	(c). Miscelleneous Charge			
	- Revenue Requirement (₹ in lakhs)		130.52	130.56
	- Capacity (Lakh Tonnes per annum)		35.38	35.38
	- Miscellenous Charge (₹ per tonne)		**3.69**	**3.69**

Annex - II

Working for calculation of Storage Charges						
S.No	**Particulars**	**Free days**	**1st slab**	**2nd slab**	**3rd slab**	**Total**
1	Optimum Capacity	35,38,080				
2	Days in each slab	10	5	5	0	
3	%age of cargo in each slab	40%	40%	20%	0%	**100%**
4	Qty in each slab	1415232	1415232	707616	0	**3838080**
5	Weights assigned		1.00	1.50	2.00	
6	50% time taken in each slab on an average)		3538080	8845200	0	**12383280**
7	Weighted Qty in each slab		3538080	13267800	0	**16805880**
8	Revenue requirement					**13051143.83**
9	AvgTariff per ton per day					**0.78**
10	Tariff for each slab		**0.78**	**1.17**	**1.56**	

Annex-III

KOLKATA PORT TRUST

REFERENCE TARIFF SCHEDULE FOR MECHANISATION OF BERTH NO 3 AT HALDIA DOCK COMPLEX, KOLKATA PORT TRUST

1. Definitions:

In this Scale of Rates, unless the context otherwise requires, the following definitions shall apply:

(i). 'Coastal Vessel' means any vessel exclusively employed in trading between any Port or place in India to any other Port or place in India having a valid coastal license issued by the Director General of Shipping / Competent Authority.

(ii). 'Foreign Vessel' means any vessel other than Coastal vessel.

(iii). 'Day' shall mean the period starting from 6 am of a day and ending at 6 am on the next day.

(iv). 'Free period' shall mean the period during which cargo is allowed storage free of demurrage and this period shall exclude Customs notified holidays and Terminal's non-operating days.

(v). 'Per Day' shall mean a calendar day or part thereof.

2. General Principles of Assessment:

(i). Criteria for levy of Cargo Related Charges (CRC) at Concessional Coastal rate

(a) Foreign going Indian Vessel having General Trading License issued for 'worldwide and coastal' operation should be accorded applicable coastal rates with respect to Handling Charges (HC) i.e. ship to shore transfer and transfer from/ to quay to/ from storage yard including wharfage in the following scenario:

(i) Converted to coastal run and carrying coastal cargo from any Indian Port and destined for any other Indian Port.

(ii) Not converted* to coastal run but carrying coastal cargo from any Indian Port and destined for any other Indian Port.

* The Central Board of Excise and Customs Circular no.15/2002-Cus. dated 25 February 2002 allows carriage of coastal cargo from one Indian port to another port in India, in Indian flag foreign going vessels without any custom conversion.

(b) In case of a Foreign flag vessel converted to coastal run on the basis of a license for specified period or voyage issued by the Director General of Shipping, and a Custom Conversion Order, the coastal cargo/container loaded from any Indian Port and destined for any other Indian Port should be levied at the rate applicable for coastal cargo / container.

The charges for coastal cargo/containers/vessels shall be denominated and collected in Indian Rupee.

(ii). System of classification of vessel for levy of Vessel Related Charges (VRC)

(a). A foreign going vessel of Indian flag having a General Trading Licence can convert to coastal run on the basis of a Customs Conversion Order. Such vessel that converts into coastal run based on the Customs Conversion Order at her first port of call in Indian Port, no further custom conversion is required, so long as it moves on the Indian Coast.

(b). Foreign going vessel of foreign flag can convert to coastal run on the basis of a license for specified period or voyage issued by the Director General of Shipping and a custom conversion order.

(c). Criteria for levy of Vessel Related Charges (VRC) at Concessional Coastal rate and foreign rate

- In cases of such conversion, coastal rates shall be chargeable by the load port from the time the vessel starts loading coastal goods.

- In cases of such conversion coastal rates shall be chargeable till the vessel completes discharging operations at the last call of Indian Port; immediately thereafter, foreign going rates shall be chargeable by the discharge ports.

- For dedicated Indian coastal vessels having a Coastal licence from the Director General of Shipping, no other document will be required to be entitled to coastal rates.

(iii) Interest on delayed payments / refunds:

a) The user shall pay penal interest on delayed payments under this Scale of Rates. Likewise, the Terminal Operator shall pay penal interest on delayed refunds.

b) The rate of penal interest will be 2 % above the Base Rate declared by the State Bank of India. The penal interest rate will apply to both the Terminal Operator and the user equally.

c) The delay in refunds will be counted only 20 days from the date of completion of services or on production of all the documents required from the users, whichever is later.

d) The delay in payments by the users will be counted only 10 days after the date of raising the bills by the Terminal Operator. The provision shall, however, not apply to the cases where payment is to be made before availing the services as stipulated in the Major Port Trusts Act, 1963 and/or where payment of charges in advance is prescribed in this Scale of Rates.

(iv). All charges worked out shall be rounded off to the next higher rupee on the grand total of each bill.

(v). No claims for refund shall be entertained unless the amount refundable is Rs. 100/-or more. Likewise, terminal operator shall not raise any supplementary or undercharge bills, if the amount due to the terminal is ₹ 100/- or less.

(vi). Users will not be required to pay charges for delays beyond a reasonable level attributable to the Terminal Operator.

(vii). The berth hire charges for all Coastal vessels should not exceed 60% of the corresponding charges for other vessels.

(viii). (a). The reference rates prescribed in this Scale of Rates are ceiling levels; likewise, rebates and discounts are floor levels. The Terminal Operator may, if it so desires, charge lower rates and/ or allow higher rebates and discounts.

(b). The Terminal Operator may also, if he so desires, rationalize the prescribed conditionality governing the application of rates prescribed in the Scale of Rates, if such rationalization gives relief to the user in rate per unit and the unit rates prescribed in the Scale of Rates do not exceed the ceiling levels.

(c). Provided that the Terminal Operator should notify the public such lower rates and / or rationalization of the conditionality governing the application of such rates and continue to notify the public any further changes in such lower rates and / or in the conditionality governing the application of such rates, provided the new rates fixed shall not exceed the rates notified by the TAMP.

(ix). In calculating the gross weight/ measurement by volume or capacity of any individual item, fractions upto and inclusive 0.5 shall be taken as 0.5, unit fractions of above 0.5 shall be treated as one unit, except where otherwise specified.

3. Cargo Handling Charges:

Sl. No.	Commodity	Unit Rate in ₹ per Metric Tonne	
		Foreign	Coastal
1.	All Types of Coal & Coke, Limestone and other Dry Bulk Cargoes (Other than Thermal Coal, Iron Ore & Iron Ore Pellets)	376.69	226.01
2.	Thermal Coal, Iron Ore & Iron Ore Pellets	376.69	376.69

Note:
The Cargo handling charges prescribed above is a composite charge for unloading of the coal/ coke, Limestone and other Dry Bulk Cargo from the vessel and transfer of the same up to the point of storage, storage at stack yard upto a free period of 10 days after completion of unloading, reclaiming from stack yard and loading on the wagons / trucks. This composite charge includes wharfage and supply of labour and/ or equipment wherever necessary and all other charges not specifically prescribed in the Scale of Rates.

4. Storage Charges

The Storage charges for the cargo stored in the stack yard beyond the free period allowed shall be as follows:

Description	Rate in ₹ per MT per Day or part thereof
Free period	10 days
First five days after expiry of free period	0.78
6th day to 10th day after expiry of free period	1.17
From 11th day onwards	1.56

Notes :

(i). Free period shall commence from the day following the day of complete discharge of cargo.

(ii). For the purpose of free time, terminal's non-working days and Custom's notified holidays shall be excluded.

(iii). Storage charge shall be payable for all days including terminal's non-working days and Custom's notified holidays for stay of cargo beyond the prescribed free days.

(iv). Storage charge on cargo shall not accrue for the period when the terminal operator is not in a position to deliver/ ship the cargo when requested by the user due to reasons attributable to the operator.

5. Miscellaneous Charges:

Composite charge for all the miscellaneous services such as sweeping, weighment of wagons/ trucks, receiving/ delivery of cargo etc., shall be levied at ₹ 3.69 per metric tonne.

6. General Note to Section-3 to Section-6 Above:

i. The Reference Tariffs will be indexed to inflation but only to an extent of 60% of the variation in Wholesale Price Index (WPI) occurring between 1st January 2018 and 1st January of the relevant year. Such automatic adjustment of Reference Tariffs will be made every year and the adjusted tariff caps will come into force from 1 April of the relevant year to 31 March of the following year.

ii. From the date of Commercial Operation (CoD) till 31st March of the same financial year, the tariff would be limited to the indexed Reference Tariff relevant to that year, which would be the ceiling. The aforesaid Reference Tariff shall be automatically revised every year based on an indexation as provided in para 2.2 of the tariff guidelines of 2013 which will be applicable for the entire licence period. However, the Licensee would be free to propose a tariff along with Performance Standards (the "Performance Linked Tariff") from the second year of operation onwards, over and above the indexed Reference Tariff for the relevant financial year, at least 90days before the 1st April of the ensuing financial year. Such Performance Linked Tariff shall not be higher than 15% over and above the indexed Reference Tariff for that relevant financial year (and this will be the Tariff Cap). The Performance Linked Tariff would come into force from the first day of the following financial year and would be applicable for the entire financial year.

iii. The proposal shall be submitted to TAMP along with a certificate from the independent engineer appointed under the Concession Agreement of the Project indicating the achievement of Performance Standards in the previous 12 months as incorporated in the Licence Agreement or for the actual number of months of operation in the first year of operation as the case may be.

iv. On receipt of the proposal, TAMP will seek the views of the Major Port Trust on the achievement of Performance Standards as outlined in para 5 of the tariff guidelines of 2013, within 7 days of receipt.

v. In the event of Licensee not achieving the Performance Standards as incorporated in the Licence Agreement in previous 12 months, TAMP will not consider the proposal for notifying the Performance Linked Tariff for the ensuing financial year and the Licensee shall be entitled to only the indexed Reference Tariff applicable or the ensuing financial year.

vi. After considering the views of the Major Port Trust, if TAMP is satisfied that the Performance Standards as incorporated in the Concession Agreement have been achieved, it shall notify the performance linked tariff by 15th of March to be effective from 1st of April of the ensuing financial year.

vii. While considering the proposal for Performance Linked Tariff, TAMP will look into the Performance Standards and its adherence by the Licensee. TAMP will decide on the acceptance or rejection of the Performance Linked Tariff proposal based on the achievement or otherwise of the Performance Standards by the Licensee. Determination of indexed Reference Tariff and Performance Linked Tariff will follow the illustration shown in the Appendix attached to the tariff guidelines of 2013.

viii. From the third year of operation, the Performance Linked Tariff proposal from the Licensee shall be automatically notified by TAMP subject to the achievement of Performance Standards in the previous 12 months' period as certified by the Independent Engineer. The Licensee, for the Performance Linked Tariff from the third year onwards, will submit the Performance Linked Tariff proposal along with the achievement certificate from the independent engineer by 1st March and TAMP shall notify by 20th March, the Performance Linked Tariff to be effective from the ensuing financial year.

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Annex-IV

PERFORMANCE STANDARDS

Schedule of Performance Standards for "Mechanisation of Berth no. 3" at Haldia Dock Complex, Kolkata Port Trust"

Gross Berth Output:

The parameter deals with the productivity of the terminal (Gross Berth Output) for different types of cargo. In case of coal/ coke/ limestone/ other dry bulk cargo, the capability of the terminal (mechanization, method of handling) and parcel size will determine the Gross Berth Output. Higher terminal capability and greater parcel size will lead to high productivity. The Gross Berth Output shall be calculated by taking the total cargo unloaded from the ships during a month in the terminal divided by the total number of working days of ships in that month at that terminal. The number of working days of the ships shall be determined by subtracting 4 hours per ship from the total hours spent by all the ships at that terminal in the month in question and dividing it by 24.

The norms of Gross Berth Output for Coal/ Coke, Limestone and other Dry Bulk Cargoes are as follows;

- Gross Berth Output for the Panamax Vessels – 20,000/ Day /Berth.
- Gross Berth Output for the Handymax Vessels – 20,000/ Day /Berth.

SUMMARY OF THE COMMENTS RECEIVED FROM THE PORT USERS / DIFFERENT USER ORGANISATIONS AND ARGUMENTS MADE IN THIS CASE DURING THE JOINT HEARING BEFORE THE AUTHORITY.

F. No. TAMP/41/2018-KOPT		**Proposal received from Kolkata Port Trust (KOPT) for fixation of reference tariff for the project "Mechanization of Berth No. 3 on Design, Build, Finance, Operate, and Transfer ("DBFOT") basis" for the period of thirty years at Haldia Dock complex (HDC).**

A summary of the comments received from SAIL on the revised proposal of KOPT dated 15 January 2019 and reply of KOPT thereon is tabulated below:

Sr. no.	Comments received from Users / Prospective bidders	Reply of KOPT
I.	**Steel Authority of India Ltd (SAIL)**	
(a).	In the revised proposal, Cargo Handling Charges has been revised upwards from ₹.368.05/-pmt to ₹.376.65 /-pmt. Further, new proposal indicates higher terminal handling capacity up from 3.276 MTPA to 3.53 MTPA. Accordingly, the handling rate should be lower considering higher throughput. We would request for lowering of tariff due to increase in handling capacity.	The revised cost estimate is prepared based on the budgetary offer. The same has increased due to market escalation. Further the Terminal handling capacity increased to 3.5 MTPA due to increase in storage area around 54000 sq.m. Accordingly handling rate is prepared as per TAMP 2008 guidelines.
(b).	The proposal indicates storage area of around 54000 sq.m which appears to be less in comparison with overall handling capacity of 3.5 MMTPA. This aspect may be reviewed.	Average unloading is around 20,000 MT per day and evacuation shall be carried out through wagon loading SILO system approximately per rake per 2 hrs ie. around 20,000 MT per day. Hence 54000 sq.m is sufficient for handling 3.5 MMTPA
(c).	HDC finalized other handling schemes at different berths wherein they are charging a composite rate from the users against a set of work of handling dry bulk cargo. It has been observed that the scope of work indicated by HDC for undertaking such handling jobs of dry bulk cargo in a comprehensive manner does not cover certain essential elements of dry bulk handling which is narrated here under:	
	i) Stock accounting of receipt and despatch of cargo and compensation towards loss of cargo beyond permissible handling loss as per industry norms.	One Mechanized dry bulk cargo handling berth is already operational under PPP mode at Berth no-4A where ISPHL is the PPP operator and the cargo of SAIL is being handled. Similarly, the scope applicable in the instant project for basic parameter like unloading from vessel, stacking and conveying, reclaiming and loading into the wagons through SILO based loading system have been considered under this tariff proposal.
	ii) Loading of wagons as per carrying capacity of wagons in line with railway guidelines.	As the loading of Wagons will be through SILO system, then the loading will be upto the carrying capacity of wagons.
	iii) Covering of wagons by tarpaulin as per railway/RPF guideline.	Covering of wagons by tarpaulin is under the scope of the importer.
	iv) Storage of cargo grade wise to avoid contamination at the stacks.	The stock piles has been designed in a Segregated manner and giving sufficient gap between the cargo heaps to avoid contamination.

	v) Although the cargo is stored in the license plot of the user, the actual work of shore clearance, stacking and wagon loading including despatch related services are within the ambit of HDC which are executed by the contractor appointed by HDC. Accordingly, the stockyard management services, stock accounting, protection towards loss of cargo due to either handling loss or security related matter should be logically within the scope of HDC. However, these are not specifically incorporated in the scope of HDC and are not being carried out by the HDC contractor. In turn, the users are advised to make alternative arrangement for getting these jobs done as part of bulk cargo handling requirement at an additional cost.	Dust suppression system has been considered in the estimate and it will be under the scope of Concessionaire.
	vi) There are certain minor but common requirement like placing of railway indents on port railways, pasting labels on wagons indicating description of cargo loaded and other associated jobs which are essential for dry bulk cargo handling but are not being carried out by HDC under their comprehensive arrangement. These jobs are necessarily carried out by the importers like SAIL through HDC appointed contractor at an additional cost.	The existing system will prevail.
(d).	In view of general requirements of any user to handle dry bulk cargo at the Ports and for onward despatch, HDC may be advised to frame schemes covering all elements of operation and not restricting their offer to a truncated service. In other words, the users have to any way make arrangement with HDC appointed contractor through a negotiation process by incurring additional expenses. It is, therefore, requested that TAMP may direct HDC to design a comprehensive scheme taking care of general requirement of dry bulk cargo handling at the Port.	The tariff has been proposed considering the composite rate of Unloading from vessel, conveying & stacking at the stackyard, reclaiming from yard/direct shipment from unloader, conveying and loading into wagons through SILO loading system. Therefore, all the basic elements of dry bulk cargo handling have been considered under the scope of work.
(e).	In the instant case of fixing tariff, the scope of work covers despatch of cargo, shore clearance and despatch related services without taking care of the associated jobs as mentioned above. HDC may be requested to work out there tariff to include all the associated jobs as enumerated above. If required, a consultation process can also be initiated by HDC to get feedback from importers of dry bulk cargo through Haldia Port. Since, the charges in Haldia Port is higher compared to neighbouring major Ports, TAMP may consider more competitive rates for comprehensive service at all locations of HDC.	The rate has been proposed based on the tariff guidelines of 2008. Considering the composite work from unloading from vessel and loading into wagons through the faster loading than other mode of operation at Haldia Port, the proposed rate is competitive and justified.

1.2. The comments received from users/ prospective bidders on the earlier proposal of KOPT dated 11 May 2018 and the response of KOPT thereon are tabulated below:

Sr. no.	Comments received from Users / Prospective bidders	Reply of KOPT
I.	**Steel Authority of India Ltd (SAIL)**	
(i).	The proposed Tariff is divided into three parts i.e. cargo related charges, storage charges and Miscellaneous charges. The tariff is working out to be ₹.375.18 (max) depending on time of storage. This is higher in comparison to all other mechanised berths (B2&8).	The storage charges have been revised downwards in the instant proposal as requested.
(ii).	As per proposal, cargo storage charges are free for first 10 and thereafter, incremental charges have been proposed for storage beyond free period. Since the stock turnover ratio is estimated as 20 days in the proposal, the free period may also be increased commensurately, particularly considering railway rake availability constraints in mind which is beyond control of importers.	In the revised estimate, it has been considered that 40% cargo will be evacuated during free period of 10 days and 40% within 15 days and 20 % within 20 days. This is possible considering the capacity of the machineries selected for the instant project. In case of SILO loading and 20% option for road evacuation, the free period of 10 days is justified. Increasing the free time to 25 days and three slab each of 5 days will tantamount to dwell time to 40 days which is not at all the intention of this huge project. Latest machineries with SILO loading will result in faster evacuation of cargo and reduction of dwell time
(iii).	The proposal indicates performance parameter like guaranteed gross berth output upto 20000 tonne per day. As regards terms for wagon loading, no such indicator has been mentioned. KOPT should be in a position to guarantee minimum loadability of wagons (the carrying capacity/chargeable weight of the wagons) so that the users are not penalized for not achieving the full loading potential of the wagons. Similarly, the railway rakes also have to be loaded within the permissible time of railways to avoid any demurrage liability on the users.	The wagon loading time has been considered as 2 hrs. with high loading rate through SILO based loading system. Also the Capacity of each rake has been considered as 3800 MT i.e. 64.4 MT per wagon in a 59 box rake.
(iv).	Since, the charges in Haldia Port is higher compared to neighbouring major Ports, KOPT may consider offering reduction in rate with quantity linked incentive. This will encourage large importers like SAIL to handle more volume through Haldia Dock Complex. Since Steel industry is mainly located in eastern region and heavily dependent on Haldia Port, TAMP may consider more competitive operational rates at HDC.	Considering Capital Cost and O&M cost, the rate of unloading from vessel and loading into the wagons with fully mechanized system, the rate seems to be reasonable with respect to other berths of HDC.
2.	**Chettinad Builders Private Ltd.**	
	Storage Charges as per 10.2.5 in Tariff Proposal: It is observed that the free period for storage of cargo is taken as 10 days and followed by a rate per ton per day basis.	

	(i). It is suggested that there should not be a head of tariff on storage charges since the port i.e. HDC is collecting lease rental for the entire land provided from the concessionaire. The option should be on the concessionaire whether and how to charge the storage charges from different clients in order to have flexibility and attracting cargo to the terminal. In the case any revenue is collected by the concessionaire then the agreed revenue share should be payable to the concessioning authority. (ii). The free days of 10 days is very less for accumulating any export cargo as the current trend is a minimum of 30days of free period for any export cargo.	As the importers are liable to pay the license fee, free storage of 10 days has been considered in the proposal. However, it has been considered that the storage charges will apply after free period of 10 days for faster evacuation. Storage charges have been calculated as per 2008 Guideline. The storage charges as arrived ₹.0.78 /MT for 1st slab after free time of 10 days, ₹.1.16 / MT for 2nd slab after 15 days and ₹.1.55 / MT after 3rd slab (20 days) is over.
3.	**Adani Ports and Special Economic Zone Limited**	
(i).	General	
	Reference to the Detailed Technical Parameters of Project Facilities The proposal specifies detailed technical specifications of the project facilities to be developed like detailed tech specs of Mobile Harbour Cranes, design and rated capacity of conveyors at jetty and stockyard, design and rated capacity of wagon loading system and truck loading system. Specifying so much of detailed specs will not allow the design flexibility of the Concessionaire which is and would be given to the Concessionaire in the proposed kind of PPP project i.e. on **Design**, Build, Finance, Operate and Transfer (DBFOT). Model Concession Agreement which will be base for the Concession Agreement to be issued for the Project also specifies that Design Risk will borne by the Concessionaire. APSEZL fully adhere to the obligation of creating a specified terminal capacity, obligation of meeting the specified performance standards and numbers of equipment's to be installed that are specified in the Concession Agreement. Hence, APSEZL suggests that detailed specs of equipment, design and rated capacity should be left to the Concessionaire to determine and achieve terminal capacity and performance standards to be specified in the Concession Agreement for the Project.	The instant project has been revised consisting of Gantry Grab Unloader, Stacker cum Reclaimer (SCR), Conveyor system and SILO loading system. Basic parameters like rated capacity and long travel rail gauge of Unloader & SCR have been mentioned in DPR as the Unloader will be installed on existing berth and SCR will be installed on existing Concrete track foundation. Other aspect specified in DPR will be designed by the operator considering Terminal Capacity and Performance Standard.
(ii).	10.2.1 (a)	
	Project Capacity	
	The optimal capacity of the stockyard is about 3.276 MTPA. After considering the yard plan, the remaining length after deducting the yard machine end positing and yard conveyor head end inclination about 8	Three rows of stockpiles have been considered in revised plan and stockpile area have been considered as 54000 sqm instead of 45000 sq m. earlier. Additional area has been added in plot no 3 as per layout plan [The

	number of stockpile of 100m x 50m are possible. This will result in the reduction of the storage capacity of stockyard and annual yard capacity. The stockyard capacity calculation has considered about 5.2 Ton per sqm of coal can be stacked. But as per our understanding about 4.5 Ton per sqm can be stacked. Based on the above, it is requested to provide additional area of 100m x 50m in continuity with the existing stockyard to achieve 3.2 MTPA of capacity with 10 numbers of stock piles of 100m x 50m.	HDC of KOPT has attached the layout plan for reference].
(iii).	10.2.2 (B)	
	Capital Cost – Gantry Grab Unloader	
	The mechanised system of the project consists of 2 nos of Gantry Grab Unloader with an estimated cost of ₹. 40 Crore for one unloader. As per industry estimate, the cost of one unloader is in the range of ₹. 45-50 Crore which is about 10-20% higher than the current estimated cost of unloader. We request TAMP/KOPT to reconsider the cost of unloader in the project CAPEX. Therefore, it is requested to consider 20m rail for GSU which is the industry standard for berth design since span less than 20m is not considered as an efficient design of unloader.	In the revised estimate, the cost of all equipment considered as per present market rate obtained from equipment manufacturer. The rail span of long travel of 13.687 m has been considered as the unloader will be installed on the existing berth. Equipment manufacturers have submitted the rate considering the same parameter.
(iv).	10.2.2 (B)	
	Capital Cost Mechanical Works	
	4 no. of front end loaders are proposed to be used for shifting of the scattered coal into a heap sufficient for the grab of crane to bite into and lift from the hatch of the vessel. These equipment are being proposed to be procured by the Concessionaire. However, as a widely observed market practice and also from the viability point of view, these types of equipment's are not generally procured but they are used on hire basis. This will reduce the project cost as well as improve the viability of the project and also rationalize the tariffs to be paid by the users. As far as the tariff calculation is concerned, capital cost of the baby dozers may be removed and appropriate hire charges for such dozers may be considered under the operating cost of the project considered at Para 10.2.2. Thus, it is suggested to allow the concessionaire to hire these equipment instead of purchasing the same.	The front end loaders for hatch operation as well as road evacuations have been considered on hiring basis in the revised estimate.
(v).	10.2.2 (B)	
	Capital Cost of project	
	The Project Cost considered for Tariff Fixation is on higher side. On reviewing the cost break up given in the proposal, it considers Detailed Engineering and Project Supervision @ 2% and Contingencies @ 3% of block estimates of Civil, Mechanical and	The revised estimate of ₹. 331.94 Cr prepared based on market rate and 2% supervision & 3% contingency as per norm. 5% miscellaneous charge added as per 2008 guideline.

	Electrical assets. However, APSEZL feel that both these components may get covered in the block estimates mentioned. Further, as per TAMP Guidelines 2008 also, these items are not considered in the capital cost for tariff fixation. Only Miscellaneous component of 5% specified in the Guidelines can be added to the block cost estimated which is already factored in. Hence, in line with TAMP Guideline 2008, APSEZL has suggested that to remove Detailed Engineering and Project Supervision @ 2% and Contingencies @ 3% from the block cost estimates. This will help to reduce the Project Cost as well as the tariffs to be paid by the users. Since the capital cost estimates will impact the fixation of tariffs, APSEZL would like to review and provide its suggestion on the same also. Hence, it is requested to share the detailed cost estimates prepared for the Project.	
(vi).	Para 10.2.2 (B)	
	Capital Cost of the Project - Loco	
	It is requested to allow the Concessionaire to use the Loco on hire basis. This will help to reduce the capex of the Project. As far as tariff fixation is concerned, the hire charges of Loco can be considered as a part of the operating cost of the cargo handling activities.	The locomotive has been considered on **hired basis** as per the rate of other ports in the revised proposal.
(vii).	Para 10.2.3 (e)	
	License Fee	
	Proposed license fee for land area is ₹.26.81 per sqm per month as per the Scale of Rate of HDC as on 7/4/2017. The license fees will be escalated @ 2% per annum. The license fees for land will be about ₹. 29.02 per sqm per month when the terminal will commence operation in 2021. It is suggested that the proposed rate of License fee is very high and it should be reduced appropriately so that it does not become undue burden over the tariffs to be paid by the users.	The license fee has been considered in the **revised estimate** as per the prevailing rate at KOPT.
(viii).	Para 10.2.5	
	Proposed Tariff on a higher Side	
	The mechanization of the terminal brings in many benefits including operational and cost efficiency. The mechanization will lead to overall reduction in the overall handling cost of the cargo which will benefit the cargo owner. The existing handling tariff of imported coal at many neighboring competing ports is in the range of ₹ 270 per ton to ₹ 290 per ton. The proposed tariff for the Project is ₹ 368.05 per ton which is very high as per the existing handling tariff. The high tariff is mainly attributed to the high project CAPEX of	The revised estimate of ₹. **331.94 Cr** is as per the present market rate. However, the proposed tariff is for unloading from the vessel, conveying to yard, reclaiming and loading to the rake through SILO loading system. The loading rate of each rake is proposed as 2 hrs. Hence, the evacuation of rake will be much faster. So, the instant project is not comparable and the rate is justified as the proposed system will add much more benefit to the user.

	₹.323.44 Crore for a capacity of 3.276 MTPA. The lower project CAPEX will lead to lower tariff which will increase the commercial attractiveness of the project and ultimately benefiting to the port users / cargo owners. It is requested to reconsider the project CAPEX and bring down the project CAPEX so that the tariff of the Project become competitive with the existing competing terminals.	
(ix).	Annexure I	
	Working for calculation of storage charges	
	While fixing the tariffs for storage charges, HDC has considered that 65% of the cargo will get evacuated in first 10 days and the rest of the cargo will be evacuated in the next 6 days. However, such a fast evacuation is not a current practice as per the trade prevailing in the market. Importers of the cargo at most of the ports including Haldia Dock Complex get the free storage period of at least one month. Among these, direct users generally evacuate the cargo within a month period while traders evacuate the cargo by 40-50 days. The Upfront Tariff Guidelines, 2008 allows 25 days of free storage in case of Coal Import terminal. Thus, in line with Upfront Tariff Guidelines 2008 as well as the prevailing dwell time of coal importers, free period for storage of cargo should be allowed for 25 days. This will help in fixation of competitive storage tariffs which will be beneficial to the terminal users. Calculation of Storage Tariffs in the Proposal a) HDC has proposed that all the cargo including direct users and traders will be evacuated in total 16 days only. However, we, based on our experience at HDC as well as other ports, suggest that direct user itself will be able to evacuate the cargo within minimum 30 days while traders' cargo may get evacuated by around 40-50 days. Hence, we suggest that calculation of storage tariff should consider the three slabs of 5 days each after the free period of 25 days. b) As far as the percentages of cargo evacuation is concerned, as per our suggestion in previous point above, 60% of cargo can be considered to be evacuated in 25 days of free period while next 10% of cargo may get evacuated in next 5 days. Remaining 30% cargo can be	In the revised estimate, it has been considered that 40% cargo will be evacuated during free period of 10 days and 40% within 15 days and 20 % within 20 days. This is possible considering the capacity of the machineries selected for the instant project. In case of SILO loading and 20% option for road evacuation, the free period of 10 days is justified. a) Increasing the free time to 25 days and three slab each of 5 days will tantamount to dwell time to 40 days which is not at all the intention of this huge project. Latest machineries with SILO loading will result in faster evacuation of cargo and reduction of dwell time. b) & c) In the revised estimate, it has been considered that 40% cargo will be evacuated during free period of 10 days and 40% within 15 days and 20 % within 20 days. This is possible considering the capacity of the machineries selected for the instant project. In case of SILO loading and 20% option for road

	considered to be evacuated during the next 10 days i.e. 15% in each of the slabs of 5 days. c) The storage tariff calculation in Page 25 assumes that 65% cargo is evacuated in first 10 days and the remaining 35% cargo be stored in the yard for next 5 days and all the cargo be evacuated in the 16th days. This assumption is not in confirmation with 18 days of dwell time assumed for calculation of turnover ratio. Also it is difficult to evacuate such a large quantity in a single day i.e. 16th day. It is requested to revise the storage tariff calculation as suggested in above points (a) and (b). Criticality of Storage Tariffs TAMP and Port Authority will be aware that presently a number of projects at Major Ports are facing the issues in relation to high storage charges which are hampering the viability of the various cargo terminals. The issue of high storage charges has become so much critical to the concessionaires that in many of the cases terminal operators are not able to attract traffic to their terminals and bleeding with heavy losses and the same is also resulting in revenue loss to the Port Authorities. However, Port Authorities are helpless and are not in position to do anything about it in a post bid scenario. Storage charges proposed by HDC in the present proposal are quite high and may jeopardize the commercial viability of this project which could otherwise be a good proposal from all other aspects. In view of this, it is requested to fix a competitive storage tariff for long term viability and success of the project. The storage charges should be fixed at a level which is reasonable, competitive and comparable to the charges which are prevailing for the storage facilities available at HDC and other competing ports/terminals. This will help in setting up a level playing field for the concessionaire and users will also be happy to pay comparable charges.	evacuation, the free period of 10 days is justified The storage charges have been revised downwards in the instant proposal as requested. In the revised estimate, it has been considered that 40% cargo will be evacuated during free period of 10 days and 40% within 15 days and 20 % within 20 days. This is possible considering the capacity of the machineries selected for the instant project. In case of SILO loading and 20% option for road evacuation, the free period of 10 days is justified
4.	**Gopalpur Ports**	
(i).	The project throughput should be based on 3 mmt or less which predominantly shall be coal.	In the revised proposal, the throughput of proposed project has been computed as **3.53 MMTPA.**

(ii).	Kindly clarify on 'Foreign' tariff of ₹.368.05/mt and 'Coastal' tariff of ₹.220.83 - These should be ₹.392.58/mt and ₹. 235.53/mt. (i) Revenue requirement ₹.11575.06 lakhs, (ii) Terminal capacity 32.76 lakhs <u>Handling charges</u> - • Foreign cargo 90% of Terminal Capacity => 29.484 MT • 98% ARR = > ₹.11,575.06 lakhs ***∴ Dry bulk handling charges per ton => ₹.392.58*** ***Similarly, for coastal cargo proportionately => ₹.235.53***	The tariff for imported cargo has been proposed as ₹.376.65 per MT and that for coastal cargo as **₹. 225.99** per MT in the current proposal. i) Revenue requirement has been calculated as **130.52 Cr**. ii) Optimum Terminal capacity of the project has been computed as **35.38 lakh** MT as per the revised estimate.
5.	**TM International Logistics Ltd (TMILL)**	
(i).	Clause no. 10.2.2 Capital Costs A 3 In the detailed capital expenditure of the project, cost of stacker cum reclaimer tracks (2 no) is mentioned as ₹. 3.76 Cr. However, as per calculation basis, it should be 7.52 Cr.	The stacker cum reclaimer will be installed on the existing concrete base foundation. The bidder will be required to replace the rails only and about 150 m track are required to be extended for the project. Accordingly, an estimated cost of ₹. 3.277 Cr. considered in the Block cost estimate for the project.
(ii).	Clause no. 10.2.2. Capital costs B 7 In the detailed capital expenditure of the project, cost Front end loaders of 4 No. is considered as ₹. 1.20 Cr. TMILL proposes to consider 7 No. of front end loaders (6 MT capacity), 2 No. of excavator (2 MT capacity) 2 No. of dumper (20-25 MT capacity). These additional equipment’s are required to not only to take care of the vessel hatch finishing operations nut to handle, shift and store residual cargo at stackyard and rake loading area, reclaim and stoppage in mechanized system due to breakdown and other factors. Total Capital cost for these proposed equipment’s is approx. ₹. 12-13 Cr and it may be considered in the tariff calculation suitably. Further, the associated operating costs for this increased number in equipment’s should be recalculated.	The front end loaders for hatch operation as well as road evacuations have been considered on **hiring basis** in the revised estimate.
(iii).	Clause no. 10.2.5 Proposed Tariff Tariff Calculation is done considering 90% imported cargo and 10% coastal cargo and accordingly two different rates have been derived for import and coastal cargo. However, due to Govt. of India’s drive towards inland waterway transport movement of goods, there are growth possibilities for coastal cargo. Hence, TAMILL has urged to relook the volume proportion of import vs. coastal cargo and propose that tariff calculation to be redone based on 80:20 proportion for import vs. coastal cargo.	The ratio of Imported to Coastal cargo has been considered as 90% to 10% as most of the cargo will be imported. The proportion of cargo have been considered as 80% Coking Coal / Non-Coking Coal, 10% Limestone and other Flux, balance 10% other dry bulk cargo.

2. A Joint hearing on the revised proposal dated 15 January 2019 was held on 19 February 2019 at KOPT premises. At the joint hearing, the KOPT made a brief power point presentation of its proposal. At the joint hearing, the KOPT and the concerned users/ user organizations have made the following submissions:

HDC of KOPT

(i). A Berth no. 3 mechanisation proposal under PPP mode was filed by HDC with TAMP in May 2018. TAMP held a joint hearing also. Subsequently, at the behest of MOS, it was decided to take up the project with the KOPT's resources. Thereafter, again at the behest of MOS, it has been decided to take up the project on PPP mode. Hence, a revised proposal is submitted.

(ii). Highlights the physical features, layout of the project.

(iii). The key changes in the revised proposal vis-à-vis the earlier proposal submitted to TAMP in May 2018 is that cost of jetty revamping and yard development is being considered now, some equipment are proposed to be considered on hire rather than owning etc.

(iv). Due to draft restriction, vessels come with bottom cargo in all hatches. We could consider productivity at 20,000 tonne per day. We have also frozen equipment. We are also proposing 2 nos. of unloaders, 2 nos. of stacker cum reclaimers and laying of rail lines.

(v). Total Capital Cost of the project is ₹. 331.94 crores.

(vi). We have proposed handling charge at ₹. 376.65 per tonne, storage charge at ₹. 1.41 per tonne and Miscellaneous charge at ₹. 3.69 per tonne for approval.

(vii). The point made by Ripley is a basic question on the need for the project. This is not additional berth. The project is for mechanization of existing berth. The hearing of TAMP is to discuss on the tariff issue. The point made by Ripley has no relevance to tariff proposed for the project.

(viii). In the proposed berth no. 3, the proposed rate is a composite rate for unloading of the cargo from vessel till loading onto the rakes. The operations at berth no. 3 is fully mechanized, while at berth no. 2 & 8, the cargo is handled through conventional means. The facility at berth no. 2 & 8 vis-à-vis berth no. 3 are very different. Therefore, the rates are different. The proposed rates for berth no. 3 are very much attractive.

(ix). The proposed facility is envisaged to be used by dedicated users viz., TATA, SAIL etc. In such an event, the cargo can be aggregated and more cargo can be staked due to mechanization. The Turnover time will also be lower. When there are many users, the cargo cannot be aggregated.

(x). For 2-3 user facility, the proposed area should be sufficient.

(xi). Further, considering that it takes 1.5 hours to load a rake, 6-7 rakes can be handled per day. The project is viable.

(xii). If the storage period is increased, there will be a tendency to store the cargo for a longer period of time. This will impact the utilization of the berth and impact the other parameters. 10 days free time is enough.

Ripley

(i). Considering that there are restrictions in the number of vessels visiting HDC owing to draft constraints and lock gate, why is a new berth conceptualized, which is only going to add to the congestion at the HDC?

Five Star Logistics

(i). Berth no. 2 & 8 at HDC, which are operated by the port carry out the same operation as is envisaged at proposed Berth no. 3. However, the rates proposed for the Berth no. 3 are higher than the rates of berth no. 2 & 8. In such a scenario, why would anyone come to Berth no. 3.

TMILL

(i). In the proposed facility with an area of 54000 sq.m, about 3.5 MMTPA is envisaged to be handled. This works out to handling of about 64 tonnes per sq.m. However, in the port, the handling is 22 tonnes per sq.m.

ISHPL

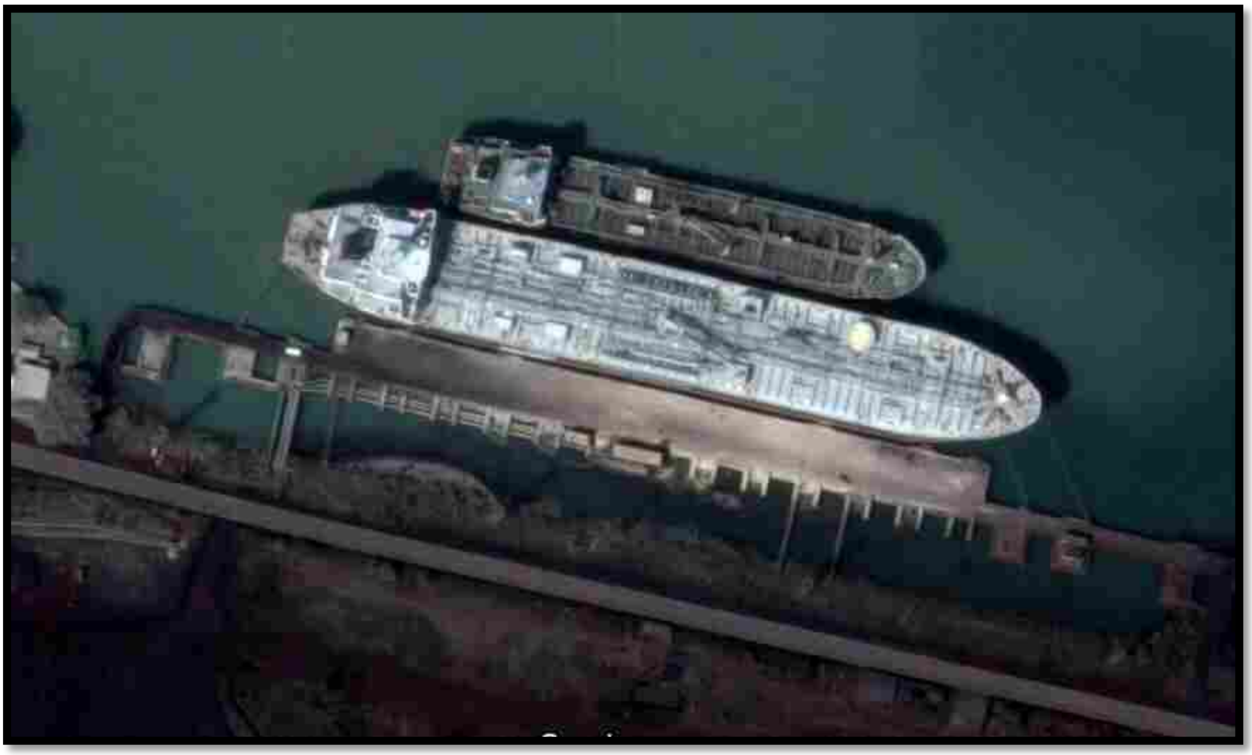
(i). A precedence is available to state that with the same area, even we are handling 3.5 MMTPA. The proposal of KOPT is not way off.

SAIL

(i). For a facility with single user, this will work. It is only when you have many users, this cannot be achieved. There will be issue of turnaround of cargo.

(ii). The port can consider giving a storage period of 20 days.

Condition Assessment of Concrete in the Reinforced Concrete Structural Elements of the Berth 3



DETAILED TEST REPORT (NON-DESTRUCTIVE TEST)

Doc No: IITM/DOE/HDC/MB-3/DTR/01

CLIENT:

Haldia Dock Complex

Kolkata Port Trust

Haldia.

CONSULTANT:

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01	For Approval	VP	R.K.S.H	RSUN/NS	12-09-2018
Rev.	**Description**	**Prepared**	**Verified**	**Approved**	**Date**

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1.0 PROJECT BACKGROUND :

Kolkata Port Trust (Authority) is a Riverine port with two Dock Systems viz. Kolkata Dock System (KDS) located in Kolkata and Haldia Dock Complex (HDC) located at Haldia. HDC is located on the western bank of river Hooghly at a Latitude: 220 02' N and Longitude: 880 06' East.

Haldia Dock Complex has a vast economic hinterland comprising major Steel Plants of SAIL and TATA Steel, Power Plants of NTPC, CESC, WBPDCL, high grade iron ore & Coal mines, Coke & Fertilizer manufacturing industries etc. In view of this, HDC has a potential to handle substantial volume of dry bulk cargo consisting of Coking Coal, Non Coking coal, Coke, Lime Stone, Manganese Ore, Iron ore, Fertilizer Raw Materials, etc.

2.0 INTRODUCTION

M/s HDC intended to assess the condition of concrete in the Reinforced Concrete (RC) Structural Elements and the Concrete Block Masonry of the Berth no -3 of M/s Haldia Dock Complex (HDC), Kolkata Port Trust (KoPT), West Bengal.

Accordingly, General Manager (Engineering), HDC, KoPT placed the work order no. GM(Engg)/1037/93 dated June 05th, 2018 for the consultancy services to Department of Ocean Engineering IIT Madras for Berth no -3, HDC, Haldia.

M/s IIT Madras confirmed the scope of work and entrusted the condition assessment work to M/s Hitech Concrete Solutions Chennai Pvt Ltd, Chennai. The site investigation to assess the condition of concrete in the RC structural elements and the Concrete Block Masonry of the Berth no -3was carried out by M/s Hitech Concrete Solutions Chennai Pvt Ltd, Chennai from ***20-06-2018 and 30-06-2018.***

This report outlines the details of the site investigation and the findings on the quality of structural elements including the Rehabilitation methodology for the distressed structural elements and the concrete block Masonry and the Bill of Quantity (BOQ).

3.0 SCOPE OF WORK

The following scope of consultancy works related to Mechanization of berth (Berth No -3) are:

1) To conduct reconnaissance Survey/Visual Inspection.
2) To conduct Non-destructive tests.
3) Processing test results for assessment.
4) Submission of detailed report.

5) Rehabilitation Methodology.
6) Bill of quantity for civil works.

4.0 TESTS CONDUCTED AT SITE

M/s Hitech carried out the site investigation to assess the condition of concrete in the RC Structural Elements. Visual inspection was conducted on RC elements of berth They located the structural elements on which the NDT tests are to be conducted.

5.0 VISUAL OBSERVATIONS

The following are the general observations noticed during the visual inspection of the structural elements investigated were the RC Columns, RC Beams, RC Deck slab and RC Caisson of the Berth 3 of M/s Haldia Dock Complex**. Fig.1** gives the layout of the Berth 3. **Photo 1** shows a general view of Berth 3 at M/s Haldia Dock Complex.

Photo 1A A view of the berthing side of the Berth 3 of M/s Haldia Dock Complex

Photo 1B A view of the rear side of the Berth 3 of M/s Haldia Dock Complex

The visual inspection was jointly conducted with the representative of M/s IIT, Madras. A fibre boat was used for the inspection of the various RC structural elements of the Berth 3. The following are typical distresses noticed in Berth 3.

- Distress was noticed in the RC barrier in the various locations of Berth 3 **(Photo 2)**.
- Vegetation growth as well as raw material wastage, viz., coal etc was noticed in the entire RC cantilever slab of the Pipeline Rack **(Photos 3 & 4)**.
- Distress was noticed in the RC cantilever slab of the Pipeline Rack in the North East corner at Berth 3 **(Photo 5)**.
- Cracking/distress was noticed in the RC Columns and RC Beams of the RC cantilever portion of the Pipeline Rack at East side of the Berth 3 **(Photos 6 & 7)**.
- Spalling of concrete and exposure of the rebars was noticed in some of the locations of the Caisson in the berthing face **(Photo 8)**.
- Spalling of concrete and exposure of the rebars was noticed in some of the locations of the RC Beams between the Caissons in the berthing face **(Photo 9)**.
- Distress was noticed in the expansion joints of the Approach slab and deck slab **(Photo 10)**.
- Spalling of concrete and exposure of rebars was noticed in some of the locations of the RC slab of the Security building and Site office room **(Photo 11)**.
- Distress was noticed in the RC deck slab due to wear.

Photo 2 A view of the distress noticed in the RC barrier on the south side approach way in Berth 3

Photo 3 A view of the vegetation growth and raw material wastage in the cantilever RC Slab of the Pipeline Rack

Photo 4 A view of the vegetation growth and raw material wastage in the cantilever RC Slab of the Pipeline Rack

Photo 5 A view of the distressed cantilever slab of Pipeline Rack in North East corner

Photo 6 A view of the cracking/distress in the RC column and RC beam of the cantilever portion of the Pipeline Rack at the East side

Photo 7 A view of the cracking/distress noticed in the RC column & RC beam and the deck slab of the cantilever portion of the Pipeline Rack at the East side

Photo 8 A view of the spalling of concrete and exposure of rebars noticed in the RC caisson on berthing face

Photo 9 A view of the spalling of concrete and exposure of the rebars noticed in the RC beam between the RC caissons on berthing face

Photo 10 A view of the distress noticed in the Expansions joint in the Approach deck slab

Photo 11 A view of the spalling of concrete and exposure of the rebars noticed in the RC slab of the Site office room

5.0 INVESTIGATION AT SITE

5.1 Choice of Test Method

The following test methods were employed to assess the quality of concrete in the RC Structural Elements of the Berth 3:

1. Ultrasonic Pulse Velocity (UPV) Test
2. Core Test
3. Carbonation Test
4. Half-Cell Potential Test
5. Determination of Chlorides and pH through extraction of concrete powder samples.

5.2 Ultrasonic Pulse Velocity Test

In-situ testing is a specialised job requiring reliable test methods and instruments. For assessment of quality of in-situ concrete, a few testing methods and instruments are available and they could be categorized as non-destructive test methods and partially destructive test methods. As the primary objective of the investigation was to assess the condition of the in-situ concrete, the ultrasonic pulse velocity test method, which is a non-destructive test method, was chosen and adopted. This technique, measures the velocity of the ultrasonic pulse of a particular frequency (54 kHz or 24 kHz for concrete) through the concrete medium.

This method consists, basically, of measuring the transit time of ultrasonic pulse transmitted through the concrete medium and calculating the pulse velocity by dividing the path length by time of transit **[1]**. The pulse velocity measurements can be used to establish the following characteristics of the concrete structure.

i. Homogeneity
ii. The presence of cracks, voids, and other imperfections
iii. Changes in the structure of the concrete which occur with time
iv. The quality of the concrete in relation to the standard requirements
v. The quality of one element of concrete in relation to another
vi. The values of elastic moduli of concrete.

There are three possible ways of measuring pulse velocity, namely, direct transmission (cross probing), semi-direct transmission and indirect or surface transmission.

The direct transmission method is generally preferred, since the maximum energy of the pulse is being directed at the receiving transducer and this gives maximum sensitivity. However, in many situations two opposite faces of the structural member may not be accessible for measurements or the path lengths may be too large. In such cases, the semi direct and indirect measurements are resorted. In the case of indirect method of measurement, the transmitting and receiving transducers are placed on the same face of the concrete member. In the case of semi direct measurement, the transducers are placed on the adjacent face of the concrete elements.

Grid lines were marked at a spacing of 300 mm in both the directions of the selected RC structural elements. The area around the grid points was smeared with grease, so that a smooth-plain concrete surface was available for holding the transducer against the surface. Grease applied at the grid point provided an acoustic coupling medium between the concrete surface and the transducer.
The transit time of ultrasonic pulse was read from the digital indicator of the PUNDIT (Portable Ultrasonic Non-destructive Digital Indicating Tester, manufactured by PROCEQ). When large voids/pores are present in the concrete member along the path of the ultrasonic pulse, the ultrasonic wave would get scattered and the pulse may not reach the receiving transducer. In such cases, readings on the PUNDIT would be unstable.

In the present investigation, direct method of measurement was adopted for the RC columns **(Photo 12)** and RC beams while indirect method of measurement was adopted for the RC Caisson **(Photo 13)** and RC Deck slab.

The indirect velocity is invariably lower than the direct velocity on the same concrete element. For good quality concrete, a difference of about 0.5 km/s may generally be encountered as per Indian Standards IS: 13311 – 1992- Part I **[2]**. Hence, in this investigation, a correction factor of 0.5 km/s has been applied to all the UPV values obtained through indirect method of measurement.

Photo 12 A view of UPV test in progress in a column by direct method of measurement

Photo 13 A view of UPV test in progress in the Caisson by indirect method of measurement

5.2.1 Guidelines for analysis of test results

The general guidelines for assessing the quality of concrete as per IS: 13311(Part I) – 1992 based on ultrasonic pulse velocity (UPV) values of concrete are as follows**:**

Sl.No.	Indicative quality	UPV readings in km/s
1	Excellent	Greater than 4.50 km/s
2	Good	Between 3.50 to 4.50 km/s
3	Medium	Between 3.00 to 3.50 km/s
4	Doubtful	Lesser than 3.00 km/s

Table 1 shows the summary of the UPV test results for the various RC structural elements of the Berth 3. Detailed UPV test results of the RC structural elements are given in **Tables A1-A30** in **Annexure III.**

Table 1 Summary of the UPV Test Results

S. No	Identification	No of Points	Maximum UPV in km/s	Minimum UPV in km/s	Average UPV in km/s
Approach Area					
1	**Approach Beam – C38-C39**	**15**	**3.81**	**2.69**	**3.19**
2	**Approach Beam – C4-C5**	**18**	**4.11**	**2.99**	**3.45**
3	**Approach Beam – C38-C39**	**15**	**4.21**	**3.71**	**3.99**
4	**Approach Beam – C39-C40**	**15**	**4.41**	**2.97**	**4.05**
5	**Approach Beam – C41-D41**	**15**	**4.44**	**3.80**	**4.13**
RC Columns & RC Beams of the Pipeline Rack					
6	**RC Column – D20**	**12**	**4.20**	**0.90**	**2.40**
7	**RC Column – D14**	**14**	**4.07**	**1.04**	**3.50**
8	**RC Column – C10**	**12**	**4.11**	**1.69**	**2.82**
9	**RC Beam – C31-D31**	**13**	**3.97**	**1.69**	**3.41**
10	**RC Beam – C13-D13**	**13**	**4.00**	**3.08**	**3.66**
11	**RC Beam – C10-D10**	**13**	**4.00**	**3.51**	**3.83**
RC Caissons					
12	**RC Caisson – C38-D38**	**16**	**4.18**	**2.90**	**3.69**
13	**RC Caisson – D36-D37**	**15**	**3.61**	**2.59**	**3.27**
14	**RC Caisson – C28-D29**	**20**	**3.97**	**2.54**	**3.36**

15	**RC Caisson – B7-B8**	**16**	**3.66**	**1.58**	**2.85**
16	**RC Caisson – C7-D7**	**15**	**3.91**	**2.40**	**3.10**
17	**RC Caisson – D5-D6**	**15**	**4.32**	**2.61**	**3.23**
18	**RC Caisson – C4-D4**	**10**	**4.47**	**3.51**	**3.84**
19	**RC Caisson – C35-C36**	**15**	**4.30**	**2.61**	**3.55**
20	**RC Caisson – A33-A34**	**12**	**4.37**	**3.59**	**3.90**
21	**RC Caisson – A9-A10**	**15**	**3.64**	**2.64**	**3.32**
22	**RC Caisson – A11-A12**	**15**	**3.78**	**2.61**	**3.24**
RC Deck Slab					
23	**RC Deck Slab – A9-B9/A10-B10**	**20**	**4.19**	**2.58**	**3.34**
24	**RC Deck Slab – B17-C17/B18-C18**	**20**	**4.20**	**2.64**	**3.50**
25	**RC Deck Slab – A25-B25/A26-B26**	**20**	**4.22**	**2.58**	**3.42**
26	**RC Deck Slab – B31-C31/B32-C32**	**20**	**4.21**	**2.59**	**3.39**
27	**RC Deck Slab – A12-B12/A13-B13**	**20**	**3.91**	**2.28**	**3.39**
28	**RC Deck Slab – B20-C20/B21-C21**	**20**	**4.19**	**2.64**	**3.47**
29	**RC Deck Slab – A26-B26/A27-B27**	**20**	**4.21**	**3.11**	**3.45**
30	**RC Deck Slab – B32-C32/B33-C33**	**20**	**4.22**	**2.59**	**3.55**

5.3 Core Sampling of Concrete

Concrete core samples were extracted from selected RC Structural elements of Berth 3. The diameter of the core samples that were extracted was 69 mm. In all, 30 concrete core samples viz., 2 from the Approach RC slab, 6 from the Approach RC beams, 2 from the RC columns, 2 from the RC beams, 10 from the RC Caissons & 8 from the RC Deck slab **(Photo 14)** were drilled from the Berth 3.

Photo 14 Core drilling test in progress in the RC deck slab

Immediately after the extraction of the concrete core samples, they were tested to check for carbonation. The cylindrical concrete core samples were sprayed with 1% solution of phenolphthalein in alcohol indicator. If the sprayed portion results in colourless surface, it indicates the extent of carbonation **(Photo 15)**. **Table 2** gives the results of the presence of carbonation in the core samples.

Photo 15 Phenolphthalein test in progress on a core sample

The ends of the concrete core samples were dressed by cutting the edges suitably in the laboratory and the cylindrical test specimens of size 69 mm diameter and of sufficient length were cut from the core samples for testing them to obtain the compressive strength of concrete. UPV tests were conducted in all the 30 core samples**.** The cylindrical test specimens were then capped with a high strength grout material and tested in a 1000 kN Universal Testing Machine (UTM) to obtain their compressive strength**.**

The equivalent cube compressive strength was calculated after applying the correction factor for l/d ratio, cylinder to cube conversion factor of 1.25, and an additional factor of 1.08, which is suggested by SP-24 to account for the size effect in case cores of diameter smaller than 95 mm are extracted. It should be noted that SP-24 was used in conjunction with IS 456:1978 and is not in use today because of the change in the concrete code to the new IS 456:2000. Nevertheless, the factor of 1.08 is legitimate from the point of view of accounting for the size effect. The equivalent cube compressive strength of concrete for the various core samples is given in **Table 2**.

Table 2 Detailed Results of the Core Test

SI. No.	Location of the core sample	Diameter of the core sample in mm	Length of the core sample in mm	Carbonation depth in mm	UPV in km/s	Equivalent Cube Compressive Strength in (MPa)	Average Equivalent Cube Compressive Strength in (MPa)
Approach Area							29.8
1	RC Slab – B4-C4/B5-C5	69	138	30	4.49	26.9	
2	RC Slab – B36-C36/B37-C37	69	138	40	4.42	32.7	
3	RC Beam – C4-C5	69	138	40	4.33	31.3	28.0
4	RC Beam – B37-B39	69	130	30	4.56	26.1	
5	RC Beam – B39-B40	69	138	70	4.07	16.4	
6	RC Beam – B4-B5	69	138	25	4.54	32.3	
7	RC Beam – C38-C39	69	138	50	4.30	29.3	
8	RC Beam – C39-C40	69	138	30	4.48	32.7	
RC Columns & RC Beams of the Pipeline Rack							21.2

9	**RC Column – D20**	**69**	**130**	**40**	**4.16**	**19.9**	
10	**RC Column – C11**	**69**	**138**	**15**	**4.61**	**22.4**	
11	**RC Beam – C19-D19**	**69**	**138**	**70**	**4.22**	**17.3**	**16.7**
12	**RC Beam – C24-D24**	**69**	**125**	**30**	**4.51**	**16.0**	
RC Caissons							**28.4**
13	**RC Caisson – C5-D5**	**69**	**138**	**30**	**4.55**	**27.8**	
14	**RC Caisson – B7-B8**	**69**	**138**	**60**	**4.32**	**33.0**	
15	**RC Caisson – C7-D7**	**69**	**138**	**40**	**4.40**	**25.6**	
16	**RC Caisson B35-B36**	**69**	**138**	**40**	**4.39**	**34.4**	
17	**RC Caisson – C38-D38**	**69**	**138**	**35**	**4.27**	**22.6**	
18	**RC Caisson – A11-A12**	**69**	**138**	**25**	**4.41**	**16.1**	
19	**RC Caisson – B5-B6**	**69**	**138**	**10**	**4.10**	**28.2**	
20	**RC Caisson – A9-A10**	**69**	**138**	**10**	**4.20**	**34.8**	
21	**RC Caisson – C11-C12**	**69**	**138**	**20**	**4.38**	**27.6**	
22	**RC**	**69**	**138**	**25**	**4.50**	**33.7**	

	Caisson – A33-A34						
RC Deck Slab							
23	**RC deck slab – A9-B9/ A10-B10**	**69**	**138**	**30**	**4.28**	**31.8**	**27.4**
24	**RC deck slab – A10-B10/ A11-B11**	**69**	**138**	**20**	**4.55**	**33.9**	
25	**RC deck slab – A13-B13/ A14-B14**	**69**	**138**	**20**	**4.33**	**19.7**	
26	**RC deck slab – A14-B14/ A15-B15**	**69**	**138**	**30**	**4.52**	**18.0**	
27	**RC deck slab – B20-C20/ B21-C21**	**69**	**138**	**30**	**4.37**	**26.9**	
28	**RC deck slab – B22-C22/ B23-C23**	**69**	**138**	**20**	**4.42**	**30.3**	
29	**RC deck slab – B23-C23/ B24-C24**	**69**	**138**	**20**	**4.17**	**31.3**	
30	**RC deck slab – A32-B32/A33-B33**	**69**	**138**	**30**	**4.46**	**27.5**	

5.4 Half-cell Potential Test

This method covers the estimation of electrical half-cell potential of reinforcing steel in concrete for the purpose of determining the corrosion activity of the reinforcing steel. A Copper-copper sulphate (Cu-CuSo4) electrode (reference electrode) was used to measure the half-cell potential. It consists of a rigid tube that is non-reactive with copper or copper sulphate, a porous sponge placed at the conduct end that remains wet by capillary reaction and a copper rod that is immersed within the tube in a saturated solution of copper sulphate. The solution was prepared with reagent grade copper sulphate crystals dissolved in distilled water. The solution was considered super saturated when an excess of crystal (undissolved) lies at the bottom of the solution**.**

Half-cell potentiometer works on the principle of measuring voltage in the circuit of reinforcement and cover concrete using Copper Sulphate Half-Cell. This method essentially consists of measurement of the absolute potential of the concrete with reference to the reference electrode. The reference guidelines for the probability of corrosion ASTM C-876 **[3]** is presented in the **Table 3.**

The half-cell potential test measurements were conducted in 12 locations of the Berth 3. It is a pre-requisite that the RC structural elements that are to be subjected to half cell measurements have to be fully saturated during the measurements and hence the RC structural elements were pre-wetted before taking the readings **(Photo 16)**. Even though this method has limitations, it is still widely used and is being recognized to be a useful tool for assessing the probability of corrosion. **Table 4** gives the results of the half-cell potential test on the twelve locations.

Table 3 Reference guidelines for probability of corrosion (ASTM C-876)

Sl. No	Measured Potential Difference	Probability for Corrosion
1	More negative than (-) 350 mV	There is a greater than 90 % probability that reinforcing steel corrosion is occurring in that area at the time of measurement.
2	Between (-) 200 mV to (-) 350 mV	Corrosion activity of the reinforcing steel in the area is uncertain.
3	More positive than (-) 200 mV	Greater than 90 % probability that no reinforcing steel corrosion is occurring in that area at the time of measurement.

Photo 16 Half-cell Potential test in progress in a RC beam

Table 4 Half Cell Potential Test Results

Sl. No	Location	Half Cell Potential Readings in mV
1	**Approach Beam – B38-B39 - Unaffected**	**-234, -286, -313, -346, -328, -391, -321, -286, -271, -238**
2	**RC Column of Pipeline rack– C17 - affected**	**-404, -477, -469, -521, -508, -512, -411, -408, -426, -411**
3	**RC Column of Pipeline rack – D27- affected**	**-489, -429, -469, -484, -411, -429, -427, -484, -469, -471**
4	**RC Beam of Pipeline rack – C19-D19 - unaffected**	**-300, -298, -349, -330, -329, -289, -318, -320, -321, -340**
5	**RC Beam of Pipeline rack – C28-D28- affected**	**-299, -382, -378, -409, -429, -411, -421, -368, -382, -370**
6	**Caisson – C27-C28- affected**	**-389, -394, -424, -409, -429, -411, -484, -412, -379, -369**
7	**Caisson – B35-B36- unaffected**	**-188, -255, -260, -228, -270, -279, -284, -208, -269, -270**
8	**Caisson – A9-A10- unaffected**	**-289, -276, -286, -314, -326, -320, -274, -228, -271, -299**

9	**Caisson – A15-A16-affected**	**-389, -379, -409, -399, -378, -394, -391, -386, -374, -389**
10	**Caisson – A27-A28-affected**	**-474, -489, -464, -455, -468, -442, -489, -428, -482, -436**
11	**Caisson – A33-A34-affected**	**-394, -412, -486, -426, -434, -444, -438, -442, -486, -436**
12	**RC deck slab – B22-C22/B23-C23-unaffected**	**-203, -197, -270, -234, -284, -232, -264, -215, -209, -198**

5.5 Evaluation of Chlorides and pH

Concrete samples in powder form were drawn from 12 locations of the Berth 3 using a masonry drilling machine. These samples were collected for chemical analysis of concrete to check for the presence of aggressive chemical agents, such as, chlorides and pH. **Photo 17** shows the extraction of the powder samples using a masonry drilling machine. **Table 5** gives the results of chloride and pH levels in concrete in the various RC structural elements.

Photo 17 Powder sample being extracted from a RC column of Berth 3

Table 5 Results of Chloride Test & pH

Sl. No.	Member Identification	Chloride Content in (kg/m^3)	pH	Stipulation
1	Approach RC Slab – B36-C36/B37-C37 - Unaffected	0.59	11.40	Maximum Chloride content in concrete shall not exceed 0.6 kg/m^3 by weight of concrete at the time of placing as per IS: 456-2000.
2	Approach RC Beam C36-C37 – Unaffected	0.20	11.07	
3	RC Column of Pipeline rack – D20 – Unaffected	0.37	9.82	
4	RC Beam of Pipeline rack – C19-D19 -affected	0.69	10.90	
5	RC Caisson – C36-D36 - Unaffected	0.23	11.13	
6	RC Caisson – B35-B36- Unaffected	0.30	10.91	
7	RC Caisson – B5-B6 - Unaffected	0.90	11.55	
8	RC Caisson – A9-A10- Unaffected	0.24	11.93	
9	RC deck slab – A14-B14/A15-B15 - Unaffected	1.44	11.50	
10	RC deck slab – B23-C23/B24-C24 - Unaffected	1.06	11.27	
11	RC deck slab – B20-C20/B21-C21 - Unaffected	0.24	11.60	
12	RC deck slab – A32-B32/A33-B33- Unaffected	0.28	11.04	

6.0 EVALUATION OF THE TEST RESULTS

The results of the ultrasonic pulse velocity test, core drilling test, carbonation test, half-cell potential test and chemical analysis of the powder samples in the RC structural elements of the Berth 3 of M/s Haldia Dock Complex at Haldia, West Bengal are discussed in the following sections.

6.1 Ultrasonic Pulse Velocity Test

6.1.1 Approach Area

It is found from **Table 1** that the average UPV values for the Approach Beams C38-C39 and C4-C5 are between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as ‘Medium’ as per the guidelines of IS: 13311 (Part I)- 1992.

The average UPV values for the Approach Beams C38-C39, C39-C40 and C41-D41 are above 3.5 km/s and the integrity of concrete can be considered as ‘Good’ as per the guidelines of IS: 13311 (Part I)- 1992.

6.1.2 RC Columns and RC Beams of Pipeline Rack

The average UPV values for the RC Column D14 and RC Beams C13-D13 and C10-D10 are above 3.5 km/s and the integrity of concrete can be considered as ‘Good’ as per the guidelines of IS: 13311 (Part I)- 1992.

The average UPV value for the RC Beam C31-D31 is between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as ‘Medium’ as per the guidelines of IS: 13311 (Part I)- 1992.

The above RC structural elements were visually in a good condition and UPV tests were conducted to ensure that the core of the RC structural elements were also in good condition.

The average UPV values for the RC Columns D20 & C10 are below 3.00 km/s and the integrity of concrete can be considered as ‘Doubtful’ as per the guidelines of IS: 13311 (Part I)- 1992. The above 2 RC columns have already been shotcreted earlier in the bottom half.

6.1.3 RC Caissons

The average UPV values for the RC Caissons C38-D38, C4-D4, C35-C36 & A33-A34 are above 3.5 km/s and the integrity of concrete can be considered as ‘Good’ as per the guidelines of IS: 13311 (Part I)- 1992.

The average UPV values for the RC Caissons D36-D37, C28-D29, C7-D7, D5-D6, A9-A10 & A11-A12 are between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as 'Medium' as per the guidelines of IS: 13311 (Part I)- 1992.

The average UPV value in the RC Caisson B7-B8 is below 3.0 km/s and the integrity of concrete can be considered as 'Doubtful' as per the guidelines of IS: 13311 (Part I)- 1992. The surface of the above RC caisson was not in a good condition and exhibited distress.

6.1.4 RC Deck Slab

The average UPV values for the RC deck slab B17-C17/B18-C18 & B32-C32/B33-C33 are above 3.5 km/s and the integrity of concrete can be considered as 'Good' as per the guidelines of IS: 13311 (Part I)- 1992.

The average UPV values for the RC deck slab A9-B9/A10-B10, A25-B25/A26-B26, B31-C31/B32-C32, A12-B12/A13-B13, B20-C20/B21-C21 & A26-B26/A27-B27 are between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as 'Medium' as per the guidelines of IS: 13311 (Part I)- 1992.

6.2 Core Drilling Test

6.2.1 Assessment of carbonation

The concrete core samples, immediately after extraction were tested for carbonation. It is seen from **Table 2** that the concrete core samples extracted from the Approach area, RC columns & RC beams of the Pipeline Rack, RC Caissons & RC Deck Slab showed carbonation depths varying from 10 mm to 70 mm.

6.2.2 Equivalent cube compressive strength

The concrete core samples were subjected to compressive strength test in a Universal Testing Machine of 1000 kN capacity. The results of the compressive strength tests of core samples are given in **Table 2.**

The average equivalent cube compressive strengths of the core samples extracted from the Approach RC slab, Approach RC Beam, RC Columns, RC Beams, RC Caissons & RC deck slab are 29.8 MPa, 28.0 MPa, 21.2 MPa, 16.7 MPa, 28.4 MPa & 27.4 MPa respectively.

The UPV tests conducted on the core samples show that the integrity of the concrete can be considered as ‘Good’.

6.3 Half-cell Potential Test

It is seen from **Table 4** that the half-cell potentials in the RC Columns C17, D27, RC Beam C28-D28 of Pipeline Rack & RC Caissons C27-C28, A15-A16, A27-A28 & A33-A34 are more than -350 mV indicating that there is a greater than 90 % probability that reinforcing steel corrosion is occurring in that area at the time of measurement as per the reference guidelines of ASTM C-876.

The results of the half-cell potentials in the Approach Beam B38-B39, RC Beam C19-D19 of Pipeline Rack, RC Caissons B35-B36, A9-A10 and RC deck slab B22-C22/B23-C23 are between -200 mV to -350 mV indicating that the corrosion activity of the reinforcing steel in the area is uncertain at the time of measurement as per the reference guidelines of ASTM C-876.

6.4 Chemical Analysis of Concrete Powder Samples

It is found from **Table 5** that the chloride contents in 8 out of 12 samples drawn from the various locations of the RC structural elements of the Berth 3 are well within the permissible value of 0.6 kg/m^3 at the time of placing as specified in IS: 456-2000 **[4]**.

The chloride contents of the remaining 4 samples drawn from the various RC structural elements of the Berth 3 are between 0.69 kg/m^3 and 1.44 kg/m^3 compared to a permissible value of 0.6 kg/m^3 at the time of placing.

The pH of the concrete samples in the RC structural elements varies between 9.82 and 11.93 which indicates a reduction of alkalinity.

7.0 RECOMMENDATIONS

It is recommended to dismantle the damaged RC structural elements, viz., RC columns, RC beams and RC cantilever slab of the Pipeline Rack. The distressed RC barriers may be dismantled and recast.

The distressed locations of the RC Caissons and RC beams between the RC Caissons may be rehabilitated using Ready to use Polymer Modified Mortar - Renderoc SP40 manufactured by M/s Fosroc Chemicals or equivalent as per the **Methodology A** given in **Annexure I.**

The damaged expansions joints in the Deck slab and Approach slab of the Berth 3 may be rehabilitated as per the **Methodology B** given in **Annexure I**.

The distress noticed in some of the locations of the RC slab of the Security building and Site office room may be rehabilitated using Polymer Modified Mortar – Nitobond SBR manufactured by M/s Fosroc Chemicals or equivalent as per the **Methodology C** given in **Annexure I.**

Distress was noticed in the top portion of the RC deck slab in the Berth 3. Hence, it is recommended to rehabilitate the same with Floor hardener (Nitofloor Hard Top manufactured by M/s Fosroc Chemicals or equivalent) as per the **Methodology D** given in **Annexure I.**

The Bill of Quantity for the rehabilitation of the various structural elements of the Berth 3 is given in **Annexure II.**

8.0 CONCLUDING REMARKS

Based on the results of the Non-Destructive Tests carried out on the RC structural elements at M/s Haldia Dock Complex, West Bengal, the following conclusions are drawn:

- The average UPV values for the Approach Beams C38-C39 and C4-C5 are between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as ‘Medium’ as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the Approach Beams C38-C39, C39-C40 and C41-D41 are above 3.5 km/s and the integrity of concrete can be considered as ‘Good’ as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the RC Column D14 and RC Beams C13-D13 and C10-D10 are above 3.5 km/s and the integrity of concrete can be considered as ‘Good’ as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV value for the RC Beam C31-D31 is between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as 'Medium' as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the RC Columns D20 & C10 are below 3.00 km/s and the integrity of concrete can be considered as 'Doubtful' as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the RC Caissons C38-D38, C4-D4, C35-C36 & A33-A34 are above 3.5 km/s and the integrity of concrete can be considered as 'Good' as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the RC Caissons D36-D37, C28-D29, C7-D7, D5-D6, A9-A10 & A11-A12 are between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as 'Medium' as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV value in the RC Caisson B7-B8 is below 3.0 km/s and the integrity of concrete can be considered as 'Doubtful' as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the RC deck slab B17-C17/B18-C18 & B32-C32/B33-C33 are above 3.5 km/s and the integrity of concrete can be considered as 'Good' as per the guidelines of IS: 13311 (Part I)- 1992.

- The average UPV values for the RC deck slab A9-B9/A10-B10, A25-B25/A26-B26, B31-C31/B32-C32, A12-B12/A13-B13, B20-C20/B21-C21 & A26-B26/A27-B27 are between 3.00 km/s to 3.5 km/s and the integrity of concrete can be considered as 'Medium' as per the guidelines of IS: 13311 (Part I)- 1992.

- The concrete core samples extracted from the Approach area, RC columns & RC beams of the Pipeline Rack, RC Caissons & RC Deck Slab showed carbonation depths varying from 10 mm to 70 mm.

- The average equivalent cube compressive strengths of the core samples extracted from the Approach RC slab, Approach RC Beam, RC Columns, RC Beams, RC Caissons & RC deck slab are 29.8 MPa, 28.0 MPa, 21.2 MPa, 16.7 MPa, 28.4 MPa & 27.4 MPa respectively.

- The UPV test conducted on the core samples show that the integrity of the concrete can be considered as ‘Good’.

- The half-cell potentials in the RC Columns C17, D27, RC Beam C28-D28 of Pipeline Rack & RC Caissons C27-C28, A15-A16, A27-A28 & A33-A34 are more than -350 mV indicating that there is a greater than 90 % probability that reinforcing steel corrosion is occurring in that area at the time of measurement as per the reference guidelines of ASTM C-876.

- The half-cell potentials in the Approach Beam B38-B39, RC Beam C19-D19 of Pipeline Rack, RC Caissons B35-B36, A9-A10 and RC deck slab B22-C22/B23-C23 are between -200 mV to -350 mV indicating that the corrosion activity of the reinforcing steel in the area is uncertain at the time of measurement as per the reference guidelines of ASTM C-876.

- The chloride contents in 8 out of 12 samples drawn from the various locations of the RC structural elements of the Berth 3 are well within the permissible value of 0.6 kg/m^3 at the time of placing as specified in IS: 456-2000.

- The chloride contents of the remaining 4 samples drawn from the various RC structural elements of the Berth 3 are between 0.69 kg/m^3 and 1.44 kg/m^3 compared to a permissible value of 0.6 kg/m^3 at the time of placing.

- The pH of the concrete samples in the RC structural elements varies between 9.82 and 11.93 which indicates a reduction of alkalinity.

- It is recommended to dismantle the damaged RC structural elements, viz., RC columns, RC beams and RC cantilever slab of the Pipeline Rack. The distressed RC barriers may also be dismantled and recast.

- The distressed locations of the RC Caissons and RC beams between the RC Caissons may be rehabilitated using Ready to use Polymer Modified Mortar - Renderoc SP40 manufactured by M/s Fosroc Chemicals or equivalent as per the **Methodology A** given in **Annexure I.**
- The damaged expansions joints of the Berth 3 may be rehabilitated as per the **Methodology B** given in **Annexure I**.

- The distress noticed in some of the locations of the RC slab of the Security building and Site office room may be rehabilitated using Polymer Modified Mortar – Nitobond

SBR manufactured by M/s Fosroc Chemicals or equivalent as per the **Methodology C** given in **Annexure I.**

- Distress was noticed in the top portion of the RC deck slab in the Berth 3. Hence, it is recommended to rehabilitate the same with Floor hardener (Nitofloor Hard Top manufactured by M/s Fosroc Chemicals or equivalent) as per the **Methodology D** given in **Annexure I.**

- The Bill of Quantity for the rehabilitation of the various structural elements of the Berth 3 is given in **Annexure II.**

9.0 ACKNOWLEDGEMENT

M/s Indian Institute of Technology (IIT), Madras and M/s Hitech Concrete Solutions Chennai Pvt Ltd, Chennai acknowledges with thanks, the help and cooperation rendered by the Engineers/Personnel's of M/s Haldia Dock Complex during the site investigation.

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Annexure I
REHABILITATION METHODOLOGY

Methodology A

Rehabilitation Methodology for the distressed RC structural elements using Ready to use Polymer Modified Mortar

Stage 1

The working platform above the water level shall be erected using the hanging support from the top of the deck. The above fixing and erection work shall be carried out with the help of floating pontoon and boats etc.

Stage 2

The distressed concrete shall be chipped and removed without damaging the rebar and the rear side of the steel bar shall be exposed using the mechanical arrangements by hand chiselling. It is recommended to use water jet for the removal of all loose particles and corrosion stains.

Stage 3

Anchoring shear connectors into existing structural element

- Shear connectors in the form of 'L-shaped' bars have to be anchored into the existing concrete to ensure integral action of the reinforced concrete spray portion with the hardened core concrete of the existing column.
- Drill holes not less than 75 mm depth (long) into the members from the surface (Perpendicular to the surface) taking care not to damage the existing steel reinforcements in the structural element. The positioning of the holes has to be staggered along the perimeter and height of the structural element.
- Clean the holes with a jet of compressed air and remove the loose dust particles thoroughly.
- Use chemical resin type capsules (Lokfix S manufactured by M/s Fosroc Chemicals (I) Pvt. Ltd. or Equivalent) for anchoring/fixing dowel bars into the holes to serve as shear connectors.

- Adopt at least 10-mm dia. HSD bars as shear connectors for which 12-mm dia holes may be needed.
- The additional reinforcement may be connected to the shear connectors already provided.

Stage 4
Application of anti-corrosive coating

- Clean the reinforcement and apply the metallic based (preferably zinc based) anticorrosive coating like Nitozinc primer manufactured by M/s Fosroc Chemicals or equivalent.

Stage 5
Provision of Galvanic protection

- Provide Galvanic protection system like Galvashield XPI manufactured by M/s Vector Technolgy or equivalent as per the design spacing based on the percentage of reinforcement available in the RC element. Pockets may be made provided as per the steel density ratio and the connectivity between the reinforcements may be ensured prior to application of any repair product.

Stage 6
Provision of epoxy jointing compound

- Prepare the structural elements surface suitably using an epoxy based bond coat, so that the spray mortar may bond well with the existing/old concrete. Manufacturer's instructions/specifications are to be followed for the epoxy bond coat like Nitobond EP (manufactured by M/s Fosroc Chemicals or equivalent).

Stage 7

- Apply the Ready to use Polymer Modified Mortar (Rendroc SP40 or equivalent) as per the Manufacturers specification.

Methodology B

Expansion Joint Treatment

Horizontal Joints

Clean the joint and remove the pad to the required depth. At any given point of time, the depth should not be less than half width of the joint. If the joint is broken, rectify the same with either Micro concrete or with Polymer modified mortar. Allow the same to cure completely.

Provide the Packer rod and affix Masking tape on either side of the joint. Apply the Primer to both the faces of the joint and provide debonding tape. Mix the base and hardner of the PU Sealant Colpor 200 manufactured by M/s Fosroc Chemicals or equivalent and pour the same to the primed joint. Allow it to set completely.

Provide Alumnium sheet of width 100 mm in such a way that the sheet is fixed at one end and free at the other end. Refill the area with required brick jelly concrete and finish the same by taking the joint up to the top.

Methodology C

Isolated Repair of the RC Structural Elements using Polymer Modified Mortar

Stage 1

- Remove the damaged concrete portions in the RC structural elements wherever distress is noticed completely till the reinforcement is exposed from the member carefully with mechanical arrangements and hand chiselling. Clean the surface to remove loose dust/particles.

<u>Stage 2 - In case the existing rods have undergone 30% loss in diameter</u>

Anchoring shear connectors into existing element

1. Shear connectors in the form of ‘L-shaped’ bars have to be anchored into the existing concrete to ensure integral action of the reinforced concrete portion with the hardened core concrete of the existing element.

2. Drill holes not less than 75 mm depth (long) into the members from the surface (Perpendicular to the surface) taking care not to damage the existing steel reinforcements in the element. The positioning of the holes has to be staggered along the perimeter and length of the element.
3. Clean the holes with a jet of compressed air and remove the loose dust particles thoroughly.
4. Use chemical resin type capsules (Lokfix S manufactured by M/s Fosroc Chemicals (I) Pvt. Ltd or Equivalent) for anchoring/fixing dowel bars into the holes to serve as shear connectors.
5. Adopt at least 8-mm dia. HSD bars as shear connectors for which 12-mm dia holes may be needed.
6. Provide required additional reinforcement.
7. The additional reinforcement may be connected to the shear connectors already provided.

Stage 3

Application of anti-corrosive coating

- Clean the reinforcement and apply the anticorrosive coating like Nitozinc primer (manufactured by M/s Fosroc Chemicals or equivalent).

Stage 4
Provision of Galvanic protection

- Provide Galvanic protection system like Galvashield XPI manufactured by M/s Vector Technology or equivalent as per the design spacing based on the percentage of reinforcement available in the RC element. Pockets may be made provided as per the steel density ratio and the connectivity between the reinforcements may be ensured prior to application of any repair product.

Stage 5
Provision of epoxy jointing compound

- Prepare the surface suitably using an epoxy based bond coat like Nitobond EP (manufactured by M/s Fosroc Chemicals or equivalent), so that the repair material may bond well with existing/old concrete. Manufacturer's instructions/ specifications are to be followed for the epoxy bond coat.

Stage 6

After the application of the bond coat, Polymer Modified Mortar (Nitobond SBR manufactured by M/s Fosroc chemicals or equivalent) may be prepared as follows:

- Cement and sand (sieved) shall be mixed in the ratio of 1:3 and 3 litres of Nitobond SBR per bag of cement or any equivalent shall be added to the above mortar mix and applied to the primed concrete surface using a trowel. The dosage of SBR shall be 3 lit per bag of cement.

Stage 7

The surface shall be finished neatly to the required line and length. Membrane curing (Concure WB manufactured by M/s Fosroc Chemicals or equivalent) shall be used for curing the finished surface.

Methodology D

Deck Slab Flooring using Floor Hardener

The floor topping over the deck slab sequence is recommended in such a way that the floor be marked off into bays of known area. Sufficient material should then be laid out to meet the required spread rates.

Application of dry shake on floor hardener like Nitoflor Hard Top manufactured by M/s Fosroc Chemicals or equivalent can begin after the base concrete has stiffened to the point when light foot traffic leaves an imprint of about 3 mm. Any bleed water should by now have evaporated.

Stage 1

- The first application is made using 50% to 70% of the total material. Floor hardener is evenly broadcast onto the concrete surface. When the material becomes uniformly dark by the absorption of moisture from the concrete this first application can be floated. Wooden floats or, on large areas, the power trowel with disc may be used. It is important, however, that the surface is not over worked.

Stage 2

- Immediately after floating, the remaining Floor hardener is sprinkled evenly over the surface. Again, moisture is absorbed, and the surface can be floated in the same way as before.

Stage 3

- Final finishing of the floor using a power trowel can be carried out when the floor has stiffened sufficiently so that damage will not be caused. Cure the same as per the standard practice.

Stage 4

- Within 72 hours, cut the floor top with the cutting machine to a width of 6 mm and to a depth of 25 mm followed by filling the same with PU sealant like Colpor 200 manufactured by M/s Fosroc Chemicals or equivalent.

Methodology E

Rehabilitation Methodology for distressed RC structural elements in the splash zone using under water micro concrete jacketing

Stage 1

The working platform above the water level shall be erected using the friction support from adjacent Caisson and hanging support from the top of the deck. The above fixing and erection work shall be carried out with the help of floating pontoon and boats etc.

Stage 2

The crushed/ damaged concrete shall be chipped and removed without damaging the rebar and the rear side of the steel bar shall be exposed using the mechanical arrangements by hand chiselling. It is recommended to use water jet for the removal of all loose particles and corrosion stains, which might be present due to tidal difference/wave action.

Stage 3

Anchoring shear connectors into existing structural element

- Shear connectors in the form of 'L-shaped' bars has to be anchored into the existing concrete to ensure integral action of the reinforced concrete jacket portion with the hardened core concrete of the existing column.
- Drill holes not less than 75 mm depth (long) into the members from the surface (Perpendicular to the surface) taking care not to damage the existing steel reinforcements in the structural element. The positioning of the holes has to be staggered along the perimeter and height of the structural element.

- Clean the holes with a jet of compressed air and remove the loose dust particles thoroughly.
- Use chemical resin type capsules (Lokfix S manufactured by M/s Fosroc Chemicals (I) Pvt. Ltd. or Equivalent) for anchoring/fixing dowel bars into the holes to serve as shear connectors.
- Adopt at least 10-mm dia. HSD bars as shear connectors for which 12-mm dia holes may be needed.

Stage 4
Application of anti-corrosive coating

- Clean the reinforcement and apply the metallic based (preferably zinc based) anticorrosive coating like Nitozinc primer (manufactured by M/s Fosroc Chemicals or equivalent).

Stage 5
Provision of Galvanic protection

Provide Galvanic protection system like Galvashield XPI or equivalent as per the design spacing based on the percentage of reinforcement available in the RC elements.

Stage 6
Provision of water tight shuttering

- Suitable shuttering (leak proof) system has to be placed in position for the jacket portion of the members in stages and micro concrete after mixing with required 10 mm down grade chips where ever required as per specifications has to be placed into the form work of the jacket portion. Care has to be taken so that the micro-concrete used does not flow out of the shuttering and shuttering should not bulge due to the self-weight of the micro concrete.

Stage 7

- Under water Micro concrete (Rendroc UW or equivalent) used for jacketing shall be prepared using washed surface dry condition 12 mm down size aggregates in the ratio of 1:0.25 (for a 25 kg bag of micro concrete 6.25 kgs of 12 mm down size aggregate shall be added). The micro concrete should have a minimum characteristic compressive strength of 45 MPa at 28 days and shall be prepared and placed using the water cement ratio as per the manufacturers specifications. Proper hopper arrangement needs to be provided in such a way that the micro concrete should travel along the hopper and the shutter to avoid the entrapped air.

Stage 8

- After the concrete in the jacket portion of the structural elements in the particular stage has attained its strength, the props placed for supporting the corresponding beams are to be removed.

ANNEXURE II

Bill of Quantity (BOQ) – Abstract

SITE - Berth 3 of M/s Haldia Dock Complex, West Bengal					
S.NO	DESCRIPTION	UNIT	QTY	RATE in Rs	AMOUNT in Rs
A	**Special Repair Work**				
1	Surface Preparation	sq.m	5790.00	650.00	3763500.00
2	Anchoring the Main Reinforcement	Nos	681.00	660.00	449460.00
3	Anchoring the Distribution Reinforcement	Nos	969.00	660.00	639540.00
4	Additional Reinforcement	kg	54120.00	90.00	4870800.00
5	Shear connector	Nos	582.00	180.00	104760.00
6	Sacrificial anode	Nos	204.00	2250.00	459000.00
7	Anti-Corrosive coating	liters	21.00	2400.00	50400.00
8	Epoxy Jointing Compound	sq.m	204.00	1050.00	214200.00
9	Form work	sq.m	1330.00	600.00	798000.00
10	Ready to Use PMM	sq.m	156.00	6400.00	998400.00
11	Polymer modified mortar	sq.m	48.00	2400.00	115200.00
12	Microconcrete UW	Sq.m	23.00	32500.00	747500.00
13	Curing compound	sq.m	1103.00	225.00	248175.00
14	Demolishing RCC	cum	499.00	3900.00	1946100.00
15	Concrete	cum	550.00	9000.00	4950000.00
16	Floor Hardener with cutting and sealant	sq.m	4687.00	420.00	1968540.00
17	Expansions Joints	RM	644.00	3900.00	2511600.00
18	Debris Removing	cum	735.00	800.00	588000.00
				Total Amount	**2,54,23,175.00**

Note:

I) Total cost is exclusive of GST, Contingencies, PMC, Supervision charges, etc by HDC, KoPT Norms. The cost is arrived at using representative locations, actual quantities can vary.

II) The quantity and rates of the following items are not included in the BOQ

i) The General civil works are not included.

ii) Painting works are not included.

iii) Damaged portions of Handrails removal and re-fixing are not included.

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Detailed Measurements

Polymer Modified Mortar							
S.NO	**Description**	**Unit**	**No**	**L**	**B**	**D**	**QTY**
1	**Surface Preparation**	sqm					
	Security building RC Slab		1.00	3.25	3.00		9.75
	Site Office Room - RC Slab		1.00	8.00	2.00		16.00
			1.00	4.80	3.30		15.84
	Subtotal						**41.59**
	Round off with 15 % extra						**48.00**
2	**Anchoring the Main Reinforcement**						
	Security building RC Slab	Nos	22.00				**22.00**
	Site Office Room - RC Slab	Nos	86.00				**86.00**
	Subtotal						**108.00**
	Round off with 15 % extra						**124.00**
3	**Anchoring the Distribution Reinforcement**						
	Security building RC Slab	Nos	20.00				**20.00**
	Site Office Room - RC Slab	Nos	35.00				**35.00**
	Subtotal						**55.00**
	Round off with 15 % extra						**63.00**
4	**Additional Reinforcement**						
	Security building RC Slab 3.25m*3m						
a	Shorter span	kg	22	4.00	0.62		54.56
b	longer span	kg	15	4.25	0.40		25.18
	Site Office Room - RC Slab 8m*2m						
a	Shorter span	kg	54	3.00	0.62		100.44
b	longer span	kg	10	4.25	0.40		16.79
	Site Office Room - RC Slab 4.8m*3.3m						
a	Shorter span	kg	32	4.30	0.62		85.31
b	longer span	kg	7	4.25	0.40		11.75
						Total	**294.03**

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						qty	
	Round off with 15 % extra						**338.00**
5	**Shear connectors**						
	Security building RC Slab	Nos	20.00				**20.00**
	Site Office Room - RC Slab	Nos	57.00				**57.00**
	Subtotal						**77.00**
	Round off with 15 % extra						**89.00**
6	**Anti corrosive coating**						
	to the above mentioned area						
	subtotal						4.16
	Round off with 15 % extra						**5.00**
7	**Epoxy Jointing Compound**						
	to the above mentioned area						
	subtotal						41.59
	Round off with 15 % extra						**48.00**
8	**Polymer Modified Mortar**						
	to the above mentioned area						
	subtotal						41.59
	Round off with 15 % extra						**48.00**
9	**Curing Compound**						
	to the above mentioned area						
	subtotal						41.59
	Round off with 15 % extra						**48.00**
10	**Debris**						
	to the above mentioned area						
	subtotal						2.08
	Round off with 15 % extra						**2.00**
11	**Galavashiled XPI (Consider 1 per sqm)**						
	subtotal						41.59
	Round off with 15 % extra						**48.00**

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Ready to Use Polymer Modified Mortar							
S.NO	**Description**	**Unit**	**No**	**L**	**B**	**D**	**QTY**
1	**Surface Preparation**						
	RC Caissons						
	A9-A10, A11-A12, A15-A16, A27-A28, A31-A32, A33-A34 & A37-A38	Sq.m	7	6.50		2.00	91.00
	RC Beams 8 Nos (Consider 50% of area)						
		Sq.m	4	9.00		1.25	45.00
	sub total						**136.00**
	Round off with 15 % extra						**156.00**
2	**Anchoring the Main Reinforcement**						
	A9-A10, A11-A12, A15-A16, A27-A28, A31-A32, A33-A34 & A37-A38	Nos	420				420.00
	RC Beams 8 Nos of 50%	Nos	64				64.00
						sub total	**484.00**
	Round off with 15 % extra						**557.00**
3	**Anchoring the Distribution Reinforcement**						
	A9-A10, A11-A12, A15-A16, A27-A28, A31-A32, A33-A34 & A37-A38	Nos	420				420.00
	RC Beams 8 Nos of 50%	Nos	368				368.00
						sub total	**788.00**
	Round off with 15 % extra						**906.00**
4	**Additional Reinforcement**						
	RC Caissons						
	A9-A10, A11-A12, A15-A16, A27-A28, A31-A32, A33-A34 & A37-A38						
	Harizontal direction 12mm @ 200 c/c	kg	70	7.50	0.89		466.20
	Vertical direction 12mm @ 200 c/c	kg	210	3.00	0.89		559.44
	RC Beams						

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a	Main rod 4 nos of 16mm dia	kg	32	5.50	1.58		278.08
b	Stirrups 8mm @ 150mmc/c	kg	240	1.75	0.40		165.90
						Total Qty	**1469.62**
	Round off with 15 % extra						**1690.00**
5	**Shear connectors**						
	RC Caisson						
		Nos	189				189.00
	RC Beams	Nos	240				240.00
						Total Qty	**429.00**
	Round off with 15 % extra						**493.00**
6	**Anti Corrosive coating**						
	to the areas mentioned in item 1						
						Total	**136.00**
						Total	**13.60**
	Round off with 15 % extra						**16.00**
7	**Epoxy Jointing Compound**						
	to the above mentioned area						
	subtotal						**136.00**
	Round off with 15 % extra						**156.00**
8	**Ready to use PMM**						
	to the above mentioned area						
	subtotal						136.00
	Round off with 15 % extra						**156.00**
9	**Under Water Micro Concrete**						
	RC Caissons						
	A9-A10, A11-A12, A15-A16, A27-A28, A31-A32, A33-A34 & A37-A38	Sq. m	7	6.5		1	45.50
	RC Beams 8 Nos	Sq. m	8	9		1.25	90.00

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	to the areas mentioned in item 9 with 75 mm tk						10.16
	MICRO CONCRETING converting to Ton						20.33
	subtotal	Ton					23.00
10	**Galavashiled XPI (Consider 1 per sqm)**						
	subtotal					**Total Qty**	**136.00**
	Round off with 15 % extra						**156.00**
11	**CURING COMPOUND**						
	to the areas mentioned in item 1						
	subtotal						136.00
	Round off with 15 % extra						**156.00**

RC Deck Slab

Sl.No	Item	Units	No	L in m	B in m	D in m	Quantity
1	**Surface Preparation**	Sqm					
	Approach Slab North		1.00	95.50	5.50		525.25
	Approach Slab South		1.00	85.50	5.50		470.25
	RC Deck Slab (6.5m*16m)		13.00	16.00	6.50		1352.00
	RC Deck Slab (9m*16m)		12.00	16.00	9.00		1728.00
	subtotal						4075.50
	Round off with 15 % extra						**4687.00**
2	**Additional Reinforcement**						
	Approach Slab North	kg					
a	Span X		477.5	6.50	0.89		2759.23
b	Span Y		27.5	96.50	0.89		2359.18
	Approach Slab South						
a	Span X		427.5	6.50	0.89		2470.31
b	Span Y		27.5	86.50	0.89		2114.71
	RC Deck Slab (6.5m*16m)						
a	Span X		1040	7.50	0.89		6934.20

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b	Span Y		422.5	17.00	0.89		6385.24
	RC Deck Slab (9m*16m)						
a	Span X		960	10.00	0.89		8534.40
b	Span Y		585	17.00	0.89		8841.11
	subtotal						40398.38
	Round off with 15 % extra						**46458.00**
3	**Formwork**	Sqm					
	Approach Slab North		2.00	95.50	0.15		28.65
			14.00	5.50	0.15		11.55
	Approach Slab South		2.00	85.50	0.15		25.65
			14.00	5.50	0.15		11.55
	RC Deck Slab (6.5m*16m)		13.00	45.00	0.15		87.75
			26.00	16.00	0.15		62.40
	RC Deck Slab (9m*16m)		12.00	50.00	0.15		90.00
			24.00	16.00	0.15		57.60
	subtotal						375.15
	Round off with 15 % extra						**431.00**
5	**Concrete**	Cum					
	Approach Slab North		1.00	95.50	5.50	0.10	52.53
	Approach Slab South		1.00	85.50	5.50	0.10	47.03
	RC Deck Slab (6.5m*16m)		13.00	16.00	6.50	0.10	135.20
	RC Deck Slab (9m*16m)		12.00	16.00	9.00	0.10	172.80
	subtotal						407.55
	Round off with 15 % extra						**469.00**
6	**Expansions joints**						
	Approach area	RM	14.00	6.10			85.40
	RC Deck Slab	RM	25.00	19.00			475.00
	subtotal						560.40
	Round off with 15 % extra						**644.00**
6	**Debris**	Cum					
	Approach Slab North		1.00	95.50	5.50	0.05	26.26
	Approach Slab South		1.00	85.50	5.50	0.05	23.51
	RC Deck Slab (6.5m*16m)		13.00	16.00	6.50	0.05	67.60

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	RC Deck Slab (9m*16m)		12.00	16.00	9.00	0.05	86.40
	subtotal						203.78
	Round off with 15 % extra						**234.00**

RC Barriers & Pipeline Rack

Sl.No	**Item**	**Units**	**No**	**L in m**	**B in m**	**D in m**	**Quantity**
1	**Dismantling**						
	East Side - Pipeline Rack						
	Top Deck Portion	Cum	26.00	7.50	1.70	0.25	82.88
	RC Beams	Cum	26.00	7.50	0.30	0.50	29.25
	RC Columns	Cum	52.00	2.00	0.57	0.88	52.17
	Cantilever Slab	Cum	1.00	332.00	2.00	0.30	199.20
	RC Barriers						
	Approach area	Cum	2.00	181.50	0.25	0.35	31.76
	Berthing face	Cum	1.00	192.50	0.40	0.50	38.50
	subtotal						433.75
	Round off with 15 % extra						**499.00**
2	**Surface Preparation**						
	RC Barriers						
	Approach area	Cum	2.00	181.50	1.20		435.60
	Berthing face	Cum	1.00	192.50	1.80		346.50
	subtotal						782.10
	Round off with 15 % extra						**899.00**
3	**Additional Reinforcement**						
	RC Barriers Approach area						
a	Main rod 3 nos of 16 mm dia	kg	6	182.50	1.58		1730.10
b	Stirrups 8mm @ 200mmc/c	kg	1840	1.20	0.40		872.16
	RC Barriers Berthing face						
a	Main rod 3 nos of 16 mm dia	kg	3	193.50	1.58		917.19
b	Stirrups 8mm @ 200mmc/c	kg	1940	1.80	0.40		1379.34
	subtotal						4898.79
	Round off with 15 % extra						**5634.00**
4	**Formwork**						
	RC Barriers						
	Approach area	Cum	2.00	181.50	1.20		435.60
	Berthing face	Cum	1.00	192.50	1.80		346.50

	subtotal						782.10
	Round off with 15 % extra						**899.00**
5	**Concrete**						
	RC Barriers						
	Approach area	Cum	2.00	181.50	0.25	0.35	31.76
	Berthing face	Cum	1.00	192.50	0.40	0.50	38.50
	subtotal						70.26
	Round off with 15 % extra						**81.00**
6	**CURING COMPOUND**						
	to the areas mentioned in item 2						782.10
	subtotal						782.10
	Round off with 15 % extra						**899.00**
7	**Debris**						
	East Side - Pipeline Rack						
	Top Deck Portion	Cum	26.00	7.50	1.70	0.25	82.88
	RC Beams	Cum	26.00	7.50	0.30	0.50	29.25
	RC Columns	Cum	52.00	2.00	0.57	0.88	52.17
	Cantilever Slab	Cum	1.00	332.00	2.00	0.30	199.20
	RC Barriers						
	Approach area	Cum	2.00	181.50	0.25	0.35	31.76
	Berthing face	Cum	1.00	192.50	0.40	0.50	38.50
	subtotal						433.75
	Round off with 15 % extra						**499.00**

Detailed Specifications					
Sl.No	Items	Unit	Quantity	Rate	Amount in Rs
1	**Surface Preparation:** Labour charges for chipping the spalled and old concrete of the RC Structural elements viz, RC Slab, Caisson, Deck Slab eic., Check for the phenolphthalein test and if there is no change in colour, chip the same further down until, reaching the good or uncontaminated concrete. Clean the surface and make sure that surface is clean and free from loose particle. The rate shall include the cost of all the operations and etc., complete. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	Sqm	5790.00	650.00	3763500
2	**Anchoring Main Reinforcement:** Mark the position of holes to be drilled for anchoring the rebar into the Caisson or other RC elements. Drill 16mm dia holes in the marked places using rotary hammer drilling machine of reputed make to a depth of 75mm into the Caisson or other RC elements. Clean the holes neatly and wash the same with jet of water. Allow it do dry and make sure that no fine dust particles are present in the holes. Mix the base and hardener of the polyester resin using a spatula and push the same in to the holes with a proper tool so that the bottom most point of the hole receives the material. The filling is to be done for a minimum portion of 1/3rd of the hole depth. Now insert the rebar which need to be anchored for the provision of main reinforcement, gently and finish the surface of the around the	Nos.	681.00	660.00	449460

	rebar area using the same material which comes out of the hole excessively. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				
3	**Anchoring the Distribution Reinforcement:** Tie them to the prefixed shear connectors so that the additional rebar acts monolithic with the existing ones and core concrete. In case of the shear reinforcement also, if the diameter of the reabrs are reduced, provide 10mm dia stirrups in the form of 2 "U" shaped. Tie them properly so that it has a tight contact with the main bars. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	Nos.	969.00	660.00	639540
4	**Additional Reinforcement:** Check the diameter of the existing rebars and if the diameter is less than 30% of the original diameter, provide additional reinforcement. Cut the required bars as main reinforcement to the required length with proper development length. Tie them to the prefixed shear connectors so that the additional rebar acts monolithically with the existing ones and core concrete. In the case of the shear reinforcement also, if the diameter of the rebars are reduced, provide 8mm dia stirrups in the form of 2 "U" shaped bars. Tie them properly so that it has a tight contact with the main bars. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	kg	54120.00	90.00	4870800
5	**Shear Connectors:** Drilling 12mm dia holes up to a depth	Nos.	582.00	180.00	104760

	of 75mm maximum and fixing 8mm dia L shaped anchor rods as shear connectors at every 500mm c/c on the surfaces of the Pile or any other structural member as the case may be. Clean the same using water and make sure that there are no fine particles present in the hole. Mix the base and hardener of the polyester resin with the spatula thoroughly. Fill the drilled and cleaned holes to a minimum depth of 1/3rd of the hole with the prepared polyester resin. Make sure that the resin has reached till the end of the hole. At this stage push the shear connector gently in to the hole and finish the excess resin which comes out of the hole and allow the shear connectors not to be disturbed for minimum 20 minutes - complete. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				
6	**Provision of Galvanic Anode:** Prior to installation of the self-sacrificial anode Galvashield XPI units, check the continuity of the steel reinforcement. Any loss of continuity will require additional electrical connections or restoration of continuity by effective means. Select a location for the Galvashield XPI as close as practical to the edge of the repair zone. Galvashield XPI units should be positioned around/along the repair boundary. In addition to standard substrate preparation, the Galvashield XPI anode(s) shall be thoroughly pre-soaked in clean water for a minimum of 10 minutes and a maximum of 20 minutes, prior to the application of the repair mortar. Tighten tie wires using Galvashield Fixing Tool so that no free movement is possible, thus ensuring	Nos.	204.00	2250.00	459000

	good electrical continuity. To test electrical continuity between tie wires and reinforcement bar, a continuity meter like electrical multi meter should be used. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				
7	**Anti-corrosive Coating:** Clean the rebars using the rust remover if there exists any rust, otherwise clean the rebar free of foreign material. Mix the base and hardener of the anti-corrosive coating like Nitozinc Primer of Fosroc or equivalent mechanically using a slow speed heavy duty drilling machine fitted with mixing paddle. Apply the mixed materials to the cleaned rebar at 45 microns/coat and total dry film thickness (DFT 90) microns in 2 coats and allow it to dry complete. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	litters	21.00	2400.00	50400
8	**Epoxy Jointing Compound:** Clean the concrete surface, remove the loose particle, if any. Make sure that the form work is ready for positioning. Mix the base and hardener of the epoxy resin jointing compound and apply the same to the prepared surface. Care should be taken that the micro concrete need to be done within 5 hours maximum from the time of application of epoxy jointing compound Nitobond EP of Fosroc or equivalent. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	Sqm	204.00	1050.00	214200
9	**Formwork:** Cantering and shuttering including	Sqm	1330.00	600.00	

	strutting, propping, etc., as per the required line and length at all different elevations level as per the standard specification-complete. Form work should be rigid to prevent loss of grout or mortar concrete from concrete at all stages & appropriate to the methods of placing & compacting as per standard specification. It should be made of suitable material i.e., timber, plywood, plastic, Steel depending upon the type of finish specified. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				798000
10	**Ready to Use Polymer Modified Mortar:** Chip off the corrosion damaged areas on the Caisson/other structural members. Clean reinforcement using Reebaklens RR of Fosroc or equivalent and make sure that there are no traces of rust on the surface of existing rebars. Check for the depth of carbonation using the phenolphthalein indicator and make sure that the contaminated concrete is removed completely. Renderoc SP40 of Fosroc or equivalent is supplied as a single component, ready to use blend of dry powders and fibres which requires only the addition of clean water to produce a highly consistent, hand and spray grade, repair mortar suitable for most structural and load bearing repairs.	Cu.m	156.00	6400.00	998400
11	**Polymer Modified Mortar:** Chip off the corrosion damaged areas on the beam/ column/ slab/girder or any other structural members. Clean reinforcement using Reebaklens RR of Fosroc or equivalent and make sure that there are no traces of rust on the surface of existing rebars. Check for the depth of carbonation using the	Sqm	48.00	2400.00	115200

	phenolphthalein indicator and make sure that the contaminated concrete is removed completely. Wet the surface with potable water and make sure that the surface is kept moist so that the water cement ratio in the polymer modified mortar is maintained. Supply and application of Nitobond SBR or equivalent soon after the finishing is over, apply the curing compound complete. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				
12	**SUPPLY AND POURING ANTI-WASHOUT MICRO CONCRETE :** Sufficient quantity of RENDROC UW shall be stocked along with 12 mm downgraded chips at site to enable completion of pouring in a continuous operation. An approved grout concrete mixer of slow speed heavy duty drill shall be used for the mixing of themicro concrete. Exact quantity of water as recommendedby IIT - Madras should be poured in to mixing vessel along with the RENDROC UW and 12 mm cleaned chips (in the ratio of 1:0.5) slowly. The mix shall be mixed thoroughly in forced action. The mixed material should be placed immediately in the form work continuously without any gap through the PVC pipe fixed from the top of the deck. (Rates are inclusive of necessory scaffolding for the work). Payment will be made on the quantity of RENDROC UW or approved equivalent used in the work.	MT	23.00	32500.00	747500
13	**Curing Compound**: Immediately after striking the form work or after completion of the repair works, the surface should be sprayed water once and followed by application	Sqm	1103.00	225.00	248175

	f membrane based curing compound like Concure WB of Fosroc or equivalent diluted with water in the ratio of 1: 1 as a curing membrane - Complete. The rate shall include cost of equipment, plants, materials, sand, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				
14	**Demolishing RCC Structural Elements:** Mark the RC Elements and cutting the same to isolate. Chip off the all the portion part by part carefully including cutting the rebar. Bring down the cut portion either as full piece or as loose concrete. The rate shall include cost of equipment, plants, materials, instrumentation, hiring of boat, catamaran, pontoon, labour and fuel etc. complete.		499.00	3900.00	1946100
15	**Concreting:** Providing & laying of RC Deck Slab of M25 grade including necessary cantering, shuttering, compacting, curing & finishing all as directed by the banks engineer. Cantering and shuttering including strutting, propping, etc... including the concrete admixture conforming to IS: 9103 to improve workability without affecting the strength and durability as directed by the engineer-in-charge. The rate shall include cost of equipment, plants, materials, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	cum	550.00	9000.00	4950000
16	**Floor Hardener with cutting and sealant:** Application of dry shake on floor hardener like Nitoflor Hard Top of Fosroc or equivalent can begin when the base concrete has stiffened to the point when medium foot traffic leaves an imprint of about 3mm. Any bleed water should by now have evaporated.	sqm	4687.00	420.00	1968540

	The rate shall include cost of equipment, plants, materials, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.				
17	**Expansions Joints:** Provide the Packer rod and affix Masking tape on either side of the joint. Apply the Primer to both the faces of the joint and provide debonding tape. Mix the base and hardener of the PU Sealant Colpor 200 manufactured by M/s Fosroc Chemicals or equivalent and pour the same to the primed joint. Allow it to set completely. The rate shall include cost of equipment, plants, materials, instrumentation, hiring of boat, catamaran, pontoon, labour and survey, fuel etc. complete.	Sqm	644.00	3900.00	2511600
18	**Debris Removing**: Loading, transporting, dumping and levelling the debris etc., in the hollows of low lying area inside the harbour within a lead of 2 Km (Viz Between 1 Km to 2 Km) as directed, all details as per relevant specification and including all labour, transport, tools, equipment, fuel, etc., complete. (No deduction will be made for voids).	Cu.m	735	800	588000
Total					**2,54,23,175.00**

Annexure III

Detailed UPV Test Results for Berth 3

Table A1 UPV Values for Approach Beam C38-C39 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.14	2.69	3.28	3.36	2.96
B	3.17	3.78	3.81	3.26	2.71
C	3.40	3.06	3.16	3.10	3.01

Table A2 UPV Values for Approach Beam C4-C5 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6	6-7
A	4.11	2.99	3.12	3.64	3.60	3.89
B	3.83	3.40	3.18	3.78	3.16	3.85
C	3.54	3.06	3.24	3.14	3.39	3.18

Table A3 UPV Values for Approach Beam C38-C39 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.82	4.14	4.02	3.80	4.20
B	3.91	4.21	4.12	4.00	4.17
C	3.76	4.19	4.01	3.76	3.71

Table A4 UPV Values for Approach Beam C39-C40 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6

A	4.06	4.41	3.86	3.83	4.14
B	4.18	4.27	3.99	4.22	4.16
C	3.97	4.32	4.28	4.11	2.97

Table A5 UPV Values for Approach Beam C41-D41 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	4.27	4.17	4.11	3.83	3.80
B	4.36	4.44	3.98	3.96	4.18
C	4.35	4.01	4.09	4.42	3.99

Table A6 UPV Values for RC Column – D20 - (Direct Method)

	A	B
1	3.82	4.03
2	3.94	3.81
3	2.14	4.20
4	1.09	0.90
5	1.24	1.08
6	1.42	1.08

Table A7 UPV Values for RC Column – D14 - (Direct Method)

	A	B
1	3.67	3.93

2	3.82	3.97
3	4.01	3.89
4	4.02	4.07
5	4.01	4.05
6	1.67	3.67
7	1.04	3.31

Table A8 UPV Values for RC Column –C10 - (Direct Method)

	A	B
1	4.11	3.77
2	2.08	3.81
3	1.71	1.69
4	2.79	3.85
5	2.25	2.39
6	2.89	2.49

Table A9 UPV Values for RC Beam – C31-D31 - (Direct Method)

	1	2	3	4	5	6	7	8	9	10	11	12	13
A	3.21	1.69	3.06	3.81	3.31	3.80	3.97	3.66	3.10	3.95	3.87	3.77	3.08

Table A10 UPV Values for RC Beam – C13-D13 - (Direct Method)

	1	2	3	4	5	6	7	8	9	10	11	12	13
A	3.08	3.77	3.57	3.64	3.75	3.47	3.70	3.21	3.92	3.70	3.85	3.90	4.00

Table A11 UPV Values for RC Beam – C10-D10 - (Direct Method)

	1	2	3	4	5	6	7	8	9	10	11	12	13
A	3.80	3.90	3.70	3.90	3.66	3.77	3.90	3.87	3.92	3.87	3.51	4.00	3.95

Table A12 UPV Values for Caisson Side Face – C38-D38 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.74	3.95	4.01	4.18
B	4.14	3.61	3.58	2.90
C	4.01	3.91	3.64	3.53
D	3.56	3.56	3.61	3.16

Table A13 UPV Values for RC Caisson – D36-D37 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.18	2.59	3.39	3.39	2.66
B	3.22	2.68	3.51	3.61	3.41
C	3.41	3.44	3.55	3.58	3.36

Table A14 UPV Values for RC Caisson – C28-D29 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.65	3.43	3.24	3.10	2.54
B	3.72	3.89	3.19	2.84	3.36
C	3.97	3.58	3.07	2.86	3.95
D	3.53	3.05	3.10	3.36	3.76

Table A15 UPV Values for RC Caisson – B7-B8 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.66	3.40	3.10	2.62
B	3.34	3.34	3.18	2.33
C	3.20	3.40	1.58	2.41
D	2.80	2.24	2.11	2.82

Table A16 UPV Values for RC Caisson – C7-D7 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.10	3.36	2.63	3.07	3.33
B	2.56	2.40	3.34	3.33	3.91
C	3.04	2.91	3.10	3.32	3.14

Table A17 UPV Values for RC Caisson – D5-D6 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.11	2.81	2.74	2.72	3.36
B	3.64	3.22	3.21	2.61	3.14
C	3.05	4.32	3.40	3.11	3.97

Table A18 UPV Values for RC Caisson – C4-D4 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.59	3.56	3.62	4.11	3.83
B	3.83	3.51	3.84	4.47	4.01

Table A19 UPV Values for RC Caisson – C35-C39 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	2.81	3.33	3.61	4.09	3.95
B	2.78	2.61	3.56	4.14	3.71
C	3.40	2.86	3.98	4.30	4.07

Table A20 UPV Values for RC Caisson – A33-A34 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	4.36	3.59	3.93	3.81
B	3.87	3.91	3.83	4.37
C	3.59	4.21	3.70	3.61

Table A21 UPV Values for RC Caisson – A9-A10 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.51	3.29	3.21	3.19	3.21
B	3.39	3.30	3.64	2.64	3.36
C	3.53	3.41	3.58	3.19	3.41

Table A22 UPV Values for RC Caisson – A11-A12 - (Indirect Method)

	1-2	2-3	3-4	4-5	5-6
A	3.39	3.28	3.64	2.66	3.29
B	2.91	3.41	3.78	2.79	3.18
C	3.19	2.61	3.59	3.29	3.64

Table A23 UPV Values for RC Deck Slab – A9-B9/A10-B10 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.89	2.64	3.21	2.91
B	4.19	3.36	3.61	3.14
C	3.61	3.21	3.76	2.58
D	3.17	3.20	3.56	2.61
E	3.44	3.39	3.91	3.44

Table A24 UPV Values for RC Deck Slab – B17-C17/B18-C18 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	2.97	3.21	3.39	3.64
B	4.20	3.89	3.70	2.64
C	3.64	3.71	3.61	3.41
D	3.79	3.59	3.21	3.36
E	3.64	3.83	3.28	3.22

Table A25 UPV Values for RC Deck Slab – A25-B25/A26-B26 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.41	3.21	3.84	3.41
B	3.36	3.42	3.71	2.61
C	3.41	3.26	4.19	2.58
D	3.22	3.39	3.64	3.21
E	3.36	3.64	4.22	3.39

Table A26 UPV Values for RC Deck Slab – B31-C31/B32-C32 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.31	3.27	3.12	3.59
B	3.19	3.14	3.21	3.64
C	3.22	3.22	2.59	3.84
D	3.61	3.19	3.49	3.79
E	3.79	3.21	3.26	4.21

Table A27 UPV Values for RC Deck Slab – A12-B12/A13-B13 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.44	3.64	3.41	3.10
B	3.86	3.78	2.61	3.24
C	3.91	3.59	2.28	3.39
D	3.80	3.79	3.26	3.41
E	3.78	3.50	2.96	3.10

Table A28 UPV Values for RC Deck Slab – B20-C20/B21-C21 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	2.90	3.46	3.21	3.19
B	3.34	3.89	4.19	3.98
C	3.64	3.99	3.29	3.41
D	3.61	2.64	3.39	3.66
E	3.59	3.11	3.21	3.79

Table A29 UPV Values for RC Deck Slab – A26-B26/A27-B27 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.41	3.22	3.31	3.44
B	3.56	3.19	3.41	3.34
C	3.64	4.21	3.51	3.41
D	3.21	4.19	3.41	3.22
E	3.11	3.64	3.18	3.39

Table A30 UPV Values for RC Deck Slab – B32-C32/B33-C33 - (Indirect Method)

	1-2	2-3	3-4	4-5
A	3.31	3.39	3.71	3.21
B	3.59	3.92	4.22	3.39
C	3.61	2.59	3.64	3.51
D	4.22	2.61	3.58	3.79
E	3.61	3.39	3.41	4.22

1. INTRODUCTION:

This report deals with Geo-soil Investigation at the proposed site for construction of Hardstand/Road inside Dock Area Haldia Dock Complex, Haldia, West Bengal. Here it is proposed to construct hardstand and other roads for storage of coal and ore substances upto a height of 5.00 metres. The work has been awarded to us, wide work order No. M (I&CF) T/2091/31 dated 07/04/2015. The work of project promotion has been taken up by Kolkata Port Trust, Haldia Dock Complex Haldia.

2. SCOPE OF WORK:

For the proposed construction of Hardstand/Road inside Dock Area Haldia Dock Complex, Haldia, it is required to determine the safe allowable bearing capacity and modulus of sub grade reaction together with necessary engineering characteristics of underlying soil strata; hence the scope of work is as follows:

2.1 Boring one hundred five numbers of boreholes of 150 mm diameter up to a maximum depth of 15.00 metre, within the proposed area of construction.

2.2 Conducting the Standard Penetration Test (SPT) at every 1.50 metre interval or at change of strata in all the boreholes.

2.3 Collecting disturbed soil samples at every 1.50 metre interval or at change of strata from the boreholes.

2.4 Collecting undisturbed soil samples from the boreholes at 1.50 to 2.00 metre interval or change of strata.

2.5 Observing the ground water table.

2.6 Conducting plate load test and modulus of sub grade reaction at forty five locations within the proposed layout.

2.7 Collection of disturbed sample from the pits excavated for plate load test for testing them in laboratory for Proctor Compaction and CBR value.

2.8 Transporting all the disturbed and undisturbed soil samples collected during the field investigation to our soil mechanics laboratory at Kanpur.

2.9 Conducting the laboratory test on all the soil samples collected during field investigation for determination of their engineering characteristics.

2.10 Compilation of field and laboratory test results, working out the safe allowable bearing capacity and modulus of sub grade reaction preparing the report including detailed recommendations and necessary precautions.

3. PROJECT LOCATION:

The site for proposed Hardstand/Road is located inside Dock Area Haldia Dock Complex, Haldia, District Purba Medinipur West Bengal.

4. OBSERVATIONS AT SITE:

The following observations have been made at the site:

4.1 Effects of saltpetre and termite have not been observed at the site.

4.2 The site is levelled with the adjacent road.

4.3 No tree roots were found in any of the bore holes.

5. FIELD INVESTIGATION:

The field investigation work at this site was carried out from April 23rd; 2015 to July 15th; 2015. The following investigation work was done:

5.1. **One Hundred Five numbers** of boreholes of diameter 150 mm were made up to the depth of 15.00 metre within the layout. The locations of boreholes have been reported and marked as BH-1 to BH-105 in “BOREHOLES LOCATION PLAN” in Appendix **A**.

5.2. **Standard Penetration Tests** were conducted as per IS: 2131-1981 at 1.50 metre interval in all the boreholes. The results have been reported in Table 1 of Appendix B under the title “SUMMARY OF TEST RESULTS” and in chart 1 to 105 of Appendix C titled as “BORE LOG CHARTS”.

5.3. **Disturbed soil samples** were collected from the boreholes at an interval of 1.50 metre in all the bore holes. These have been reported in BORE LOG CHART No. 1 to 105 of Appendix C.

5.4. **Undisturbed soil samples** were attempted to collect from all the boreholes at an interval of 1.50 metre to 2.00 metre or at change of strata whereas applicable upto the required depth. Some of the samples were not retained in shellby tube . These have been reported in BORE LOG CHART No.1 to 105 of Appendix C

5.5. **Water table** has been observed as per IS 6935-1973 and reported in Appendix C “BORE LOG CHART”..

5.6. **Plate Load tests** were performed in accordance with IS 1888-1982 and results have been reported in table 3 “PLATE LOAD TEST RESULTS” of Appendix B.

5.7. **Modulus of sub grade reaction test** were performed in accordance with IS 9214-1979 and results have been reported in table 5 “MODULUS OF SUB GRADE TEST RESULT” of Appendix B.

5.8. **Soil** samples for performing California Bearing Ratio test have been collected at twenty five locations, in accordance with IS 2720 (part-16)-1987. The locations have been marked in Appendix-A Bore hole location plan.

6. LABORATORY TESTS:

The following laboratory tests were conducted to determine the engineering characteristics of sub-soils:

6.1. **Field moisture contents** were determined by oven drying method as per IS 2720 (part II)-1973. The results have been reported in table 1 "SUMMARY OF TEST RESULTS" of Appendix B.

6.2. **Field density** of soil strata were obtained using Shelby tubes in accordance with IS 2720 (part XXIX)-1975. The results have been reported in table 1**:** "SUMMARY OF TEST RESULTS**"** of Appendix B.

6.3. **Mechanical sieve analysis test** were performed in accordance with IS 2720 (Part IV) - 1985, for the purpose of identification by grain size analysis, on coarse part of the soil samples and the results have been reported in table 1 **"**SUMMARY OF TEST RESULTS" of appendix B.

6.4. **Particle size analysis** test by hydrometer method were performed in accordance with IS 2720 (Part IV) - 1965 on the part of soil samples obtained after the sieve analysis. The results have been reported in table 1 "SUMMARY OF TEST RESULTS" of appendix B.

6.5. **Atterbergs' limits** tests were performed in accordance with IS 2720 (part V)-1985 and results have been reported in table 1 **"**SUMMARY OF TEST RESULTS" of Appendix B.

6.6. **Specific gravity** tests were performed in accordance with IS 2720 (part III-sec. 1) - 1980 and the results have been reported in table 1 "SUMMARY OF TEST RESULTS" of Appendix B.

6.7. **Unconfined Compressive** Strength tests were performed in accordance with IS 2720 (part 10)-1991 and results have been reported in table 2 "SUMMARY OF SHEAR PROPERTIES TEST RESULTS" of Appendix B.

6.8. **Direct shear tests** were performed as per IS 2720 (part XI)-1971, on the undisturbed soil samples obtained during the field investigation. The results have been reported in table 2 "SUMMARY OF TEST RESULTS" of Appendix B.

6.9. **Triaxial Compression Test for two different test conditions namely Consolidated Drained (CD)** were performed as per IS 2720 (part X & XI)-1997, on the undisturbed soil samples obtained during the field investigation. The results have been reported in table 2 "SUMMARY SHEAR PROPERTIES TEST RESULTS" of Appendix B.

6.10. **Unconsolidated Undrained (UU)** were performed as per IS 2720 (part X & XI)-1997, on the undisturbed soil samples obtained during the field investigation. The results have been reported in table 1 "SUMMARY OF TEST RESULTS" of Appendix B.

6.11. **Permeability test** were performed in accordance with IS 2720 (part-17)-1986 on the undisturbed soil sample collected from the bore hole and results have been reported in table 2 “SUMMARY SHEAR PROPERTIES TEST RESULTS” of Appendix B.

6.12. **Modified proctor Compaction tests** were performed in accordance with IS 2720 (Part VII) – 1980 in order to determine the maximum dry density and the corresponding moisture content. The results have been reported in table 4: SUMMARY OF TEST RESULTS of Appendix B.

6.13. **California Bearing Ratio** tests were performed on soil samples collected from the field and prepared at the Maximum dry density obtained from Modified Proctor Test in accordance with IS 2720 (part-16)-1987 marked as CBR-1 to CBR-25 and results have been reported in table 4 “CBR TEST RESULTS” of Appendix B.

6.14. **Consolidation tests** were performed on cohesive soil samples in accordance with IS: 2720 (part XV)-1997. The results have been reported in table 1: SUMMARY OF TEST RESULTS of Appendix B..

7. WATER TABLE:

The water table at this site was encountered during the boring operation. The depth of water table was measured as per IS 6935-1973. These have been reported in BORE LOG CHART No.1 to 105 of Appendix C

8. DETAILS OF SOIL STRATA:

The classification of soil strata have been done with the help of soil characteristics obtained in laboratory tests as per IS 1498-1978. The detailed nature of the soil strata have been reported in table 1: “SUMMARY OF TEST RESULTS” of Appendix B and Bore Log Chart No. 1 to 105 of Appendix C. The soils found in general consist of inorganic silt and clays of intermediate to low plasticity. Entire soil strata in all the bore holes consist of non-expansive soils and no organic matter and harmful salts.

9. CALCULATIONS AND RESULTS:

The safe allowable bearing capacity of the foundation for the proposed pavement/hardstand has been calculated on the shear failure criteria suggested as per IS 6403-1981, IS: 1904-1978.

Since the size of hardstand is infinite in extent. The calculations have been done for raft foundation

9.1. SHEAR FAILURE CRITERIA

Type of shear failure = Mixed

Factor of safety (F.S.) = 2.50

Depth of critical water table = 0.00 m

Net allowable bearing capacity: = q_{na} (kN/m^2)

$$q_{na} = (1 / F.S.) [0.667c\, N_c\, S_c\, d_c + q\, (N_q - 1)\, S_q\, d_q + 0.5\, B\, \gamma\, N\gamma\, S\gamma\, d_\gamma W']$$

Where,

B = Width of foundation (metre)

D = Depth of foundation (metre)

ϕ = Angle of shearing resistance (degree)

c = Cohesion intercept (kN/m^2)

q = Effective overburden (kN/m^2)

N_c, N_q, N_γ = Bearing capacity coefficient

d_c, d_q, d_γ = depth factors

W' = Water table correction factor

Shape Factors:

S_c = 1.00

S_q = 1.00

S_γ = 1.00

Substituting the values, the value of q_{na} can be calculated as per table below:

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-1	10.00	0.00	7	26.0	0.750	18.500	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	48.61
BH-2	10.00	0.00	7	25.0	0.750	17.510	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	46.90
BH-3	10.00	0.00	7	26.0	0.750	17.900	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	48.61
BH-4	10.00	0.00	9	22.0	0.750	19.120	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40
BH-5	10.00	0.00	7	25.0	0.750	17.920	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	46.90
BH-6	10.00	0.00	7	25.0	0.821	18.570	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	46.90
BH-7	10.00	0.00	7	25.0	0.750	17.410	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	46.90
BH-8	10.00	0.00	4	26.0	0.808	18.700	10.000	0.00	5.86	1.30	0.24	1.00	1.00	1.00	0.50	43.04
BH-9	10.00	0.00	9	22.0	0.750	18.030	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40
BH-10	10.00	0.00	7	23.0	0.840	18.190	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	43.49
BH-11	10.00	0.00	9	22.0	0.750	16.970	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-12	10.00	0.00	8	23.0	0.772	18.680	10.000	0.00	6.62	1.63	0.50	1.00	1.00	1.00	0.50	45.66
BH-13	10.00	0.00	13	17.0	0.750	17.440	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-14	10.00	0.00	14	18.0	0.796	18.700	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	50.41
BH-15	10.00	0.00	13	19.0	0.750	17.720	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	50.23
BH-16	10.00	0.00	12	18.0	0.815	18.210	10.000	0.00	7.63	2.12	0.92	1.00	1.00	1.00	0.50	45.85
BH-17	10.00	0.00	13	19.0	0.750	17.240	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	50.23
BH-18	10.00	0.00	13	18.0	0.791	18.670	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-19	10.00	0.00	14	17.0	0.750	17.690	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-20	10.00	0.00	14	19.0	0.803	19.030	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	52.58
BH-21	10.00	0.00	9	22.0	0.750	18.040	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40
BH-22	10.00	0.00	10	22.0	0.809	19.170	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	48.92
BH-23	10.00	0.00	9	21.0	0.750	18.920	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-24	10.00	0.00	9	21.0	0.780	19.900	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-25	10.00	0.00	9	23.0	0.750	16.370	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	48.23

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-26	10.00	0.00	9	23.0	0.750	19.870	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	48.23
BH-27	10.00	0.00	9	21.0	0.750	17.190	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-28	10.00	0.00	10	22.0	0.721	19.820	10.000	0.00	7.30	1.96	0.79	1.00	1.00	1.00	0.50	50.70
BH-29	10.00	0.00	9	21.0	0.750	17.710	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-30	10.00	0.00	8	22.0	0.847	16.630	10.000	0.00	6.62	1.63	0.50	1.00	1.00	1.00	0.50	43.89
BH-31	10.00	0.00	9	21.0	0.750	16.990	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-32	10.00	0.00	11	21.0	0.853	17.950	10.000	0.00	7.38	2.00	0.82	1.00	1.00	1.00	0.50	49.48
BH-33	10.00	0.00	13	18.0	0.750	17.630	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-34	10.00	0.00	12	17.0	0.821	17.910	10.000	0.00	7.63	2.12	0.92	1.00	1.00	1.00	0.50	43.81
BH-35	10.00	0.00	6	29.0	0.750	17.450	10.000	0.00	6.22	1.46	0.36	1.00	1.00	1.00	0.50	51.73
BH-36	10.00	0.00	7	28.0	0.791	17.860	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	52.03
BH-37	10.00	0.00	13	18.0	0.750	17.410	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-38	10.00	0.00	7	25.0	0.847	17.290	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	46.90
BH-39	10.00	0.00	6	29.0	0.750	17.720	10.000	0.00	6.22	1.46	0.36	1.00	1.00	1.00	0.50	51.73

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{ns}
BH-40	10.00	0.00	7	28.0	0.762	18.460	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	52.03
BH-41	10.00	0.00	6	29.0	0.750	17.410	10.000	0.00	6.22	1.46	0.36	1.00	1.00	1.00	0.50	51.73
BH-42	10.00	0.00	7	28.0	0.803	18.390	10.000	0.00	6.40	1.53	0.42	1.00	1.00	1.00	0.50	52.03
BH-43	10.00	0.00	9	21.0	0.750	16.690	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-44	10.00	0.00	10	20.0	0.810	17.600	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	45.12
BH-45	10.00	0.00	8	22.0	0.750	16.630	10.000	0.00	6.62	1.63	0.50	1.00	1.00	1.00	0.50	43.89
BH-46	10.00	0.00	9	21.0	0.779	17.540	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-47	10.00	0.00	8	22.0	0.750	16.950	10.000	0.00	6.62	1.63	0.50	1.00	1.00	1.00	0.50	43.89
BH-48	10.00	0.00	9	21.0	0.791	17.920	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-49	10.00	0.00	9	21.0	0.750	17.360	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-50	10.00	0.00	10	20.0	0.762	17.860	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	45.12
BH-51	10.00	0.00	9	21.0	0.750	17.460	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-52	10.00	0.00	10	20.0	0.803	18.440	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	45.12
BH-53	10.00	0.00	13	18.0	0.750	16.310	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{ns}
BH-54	10.00	0.00	14	17.0	0.773	18.390	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-55	10.00	0.00	9	22.0	0.750	16.250	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40
BH-56	10.00	0.00	10	21.0	0.803	17.200	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	47.02
BH-57	10.00	0.00	13	18.0	0.750	16.190	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-58	10.00	0.00	14	17.0	0.803	17.150	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-59	10.00	0.00	13	17.0	0.750	17.490	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-60	10.00	0.00	14	16.0	0.801	18.470	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-61	**10.00**	**0.00**	**13**	**17.0**	**0.750**	**17.510**	**10.000**	**0.00**	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-62	10.00	0.00	14	16.0	0.816	18.480	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-63	10.00	0.00	13	17.0	0.750	16.220	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-64	10.00	0.00	13	17.0	0.834	17.210	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-65	10.00	0.00	13	17.0	0.750	17.650	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-66	**10.00**	**0.00**	**14**	**16.0**	**0.803**	**18.630**	**10.000**	**0.00**	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-67	10.00	0.00	13	17.0	0.750	17.150	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-68	10.00	0.00	14	16.0	0.773	18.580	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-69	10.00	0.00	14	17.0	0.750	17.300	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-70	10.00	0.00	14	16.0	0.791	18.280	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-71	10.00	0.00	9	21.0	0.750	17.800	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-72	10.00	0.00	10	20.0	0.762	18.220	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	45.12
BH-73	10.00	0.00	9	22.0	0.750	17.670	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40
BH-74	10.00	0.00	10	21.0	0.779	18.650	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	47.02
BH-75	10.00	0.00	13	17.0	0.750	17.890	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-76	10.00	0.00	14	16.0	0.750	18.600	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-77	10.00	0.00	9	22.0	0.750	17.650	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40
BH-78	10.00	0.00	10	21.0	0.803	18.630	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	47.02
BH-79	10.00	0.00	13	17.0	0.750	18.090	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-80	**10.00**	**0.00**	**14**	**16.0**	**0.810**	**19.080**	**10.000**	**0.00**	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-81	10.00	0.00	13	17.0	0.750	19.120	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{na}
BH-82	10.00	0.00	14	16.0	0.700	19.060	10.000	0.00	8.72	2.69	1.44	1.00	1.00	1.00	0.50	51.61
BH-83	10.00	0.00	19	15.0	0.750	17.470	10.000	0.00	9.89	3.33	2.06	1.00	1.00	1.00	0.50	60.14
BH-84	10.00	0.00	20	14.0	0.795	18.450	10.000	0.00	10.26	3.54	2.26	1.00	1.00	1.00	0.50	60.93
BH-85	10.00	0.00	13	17.0	0.750	17.210	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-86	10.00	0.00	14	16.0	0.765	18.400	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-87	10.00	0.00	8	22.0	0.750	17.620	10.000	0.00	6.62	1.63	0.50	1.00	1.00	1.00	0.50	43.89
BH-88	10.00	0.00	9	21.0	0.828	18.590	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	44.57
BH-89	10.00	0.00	13	17.0	0.750	17.530	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-90	10.00	0.00	14	16.0	0.797	18.560	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-91	10.00	0.00	13	17.0	0.750	17.590	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-92	10.00	0.00	14	16.0	0.801	18.570	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-93	10.00	0.00	13	17.0	0.750	17.260	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	46.02
BH-94	10.00	0.00	14	16.0	0.801	18.470	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	46.07
BH-95	10.00	0.00	9	22.0	0.750	17.490	10.000	0.00	6.87	1.75	0.61	1.00	1.00	1.00	0.50	46.40

Bore Hole No.	B	D	ϕ	c	e_o	γ	γ_1	q	N_c	N_q	N_γ	d_c	d_q	d_γ	W'	q_{ns}
BH-96	10.00	0.00	10	21.0	0.791	18.220	10.000	0.00	7.12	1.88	0.71	1.00	1.00	1.00	0.50	47.02
BH-97	10.00	0.00	13	18.0	0.750	17.240	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-98	10.00	0.00	14	17.0	0.816	18.130	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-99	10.00	0.00	13	18.0	0.750	17.160	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-100	10.00	0.00	13	18.0	0.847	16.050	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-101	10.00	0.00	14	18.0	0.750	17.550	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	50.41
BH-102	10.00	0.00	14	17.0	0.785	18.080	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-103	10.00	0.00	13	18.0	0.750	17.500	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12
BH-104	10.00	0.00	14	17.0	0.797	18.280	10.000	0.00	8.14	2.37	1.13	1.00	1.00	1.00	0.50	48.24
BH-105	10.00	0.00	13	18.0	0.750	17.140	10.000	0.00	7.88	2.24	1.03	1.00	1.00	1.00	0.50	48.12

10. RECOMMENDATIONS:

Keeping in mind, the field test results, laboratory test results and IS codes of practice; the following recommendations are hereby made:

10.1 Bearing capacity has been worked out by two methods namely Laborotary test and Plate Load Test. The safe allowable bearing capacity obtained as per Plate Load Test is the least and value of 3.00 T/m^2 shall be recommended at a depth of 1.00 metre from the existing ground level.

10.2 For the design of pavements the value of modulus of sub grade reaction shall be taken as 11475 kN/m^3

10.2 Since the bearing capacity seems to be low for construction of hardstands/roads inside the dock complex, Ground improvement may be required to achieve the desired bearing capacity and to improve the sub grade modulus as well.

For the purpose of ground improvement we suggest to excavate top soil strata up to a depth of 500 mm to 750 mm below the base of foundation and replace it with the granular soils and compact suitably. The existing soil may be used partially as a mix with the granular soil. The ratio of mix depends on the properties of the granular soils. The specific agency may be consulted for detailed improvement method.

for Techpro Engineers Pvt. Ltd

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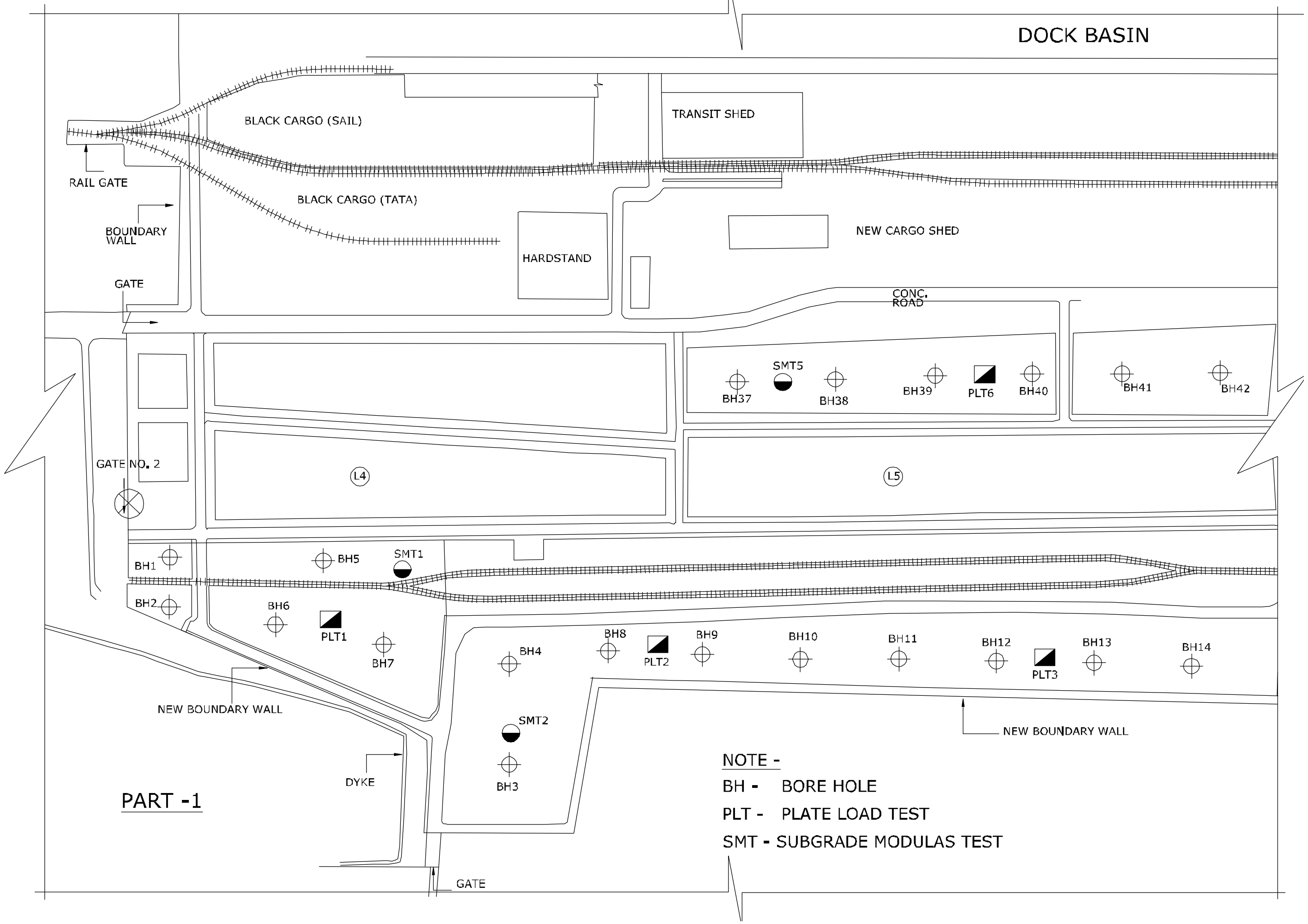
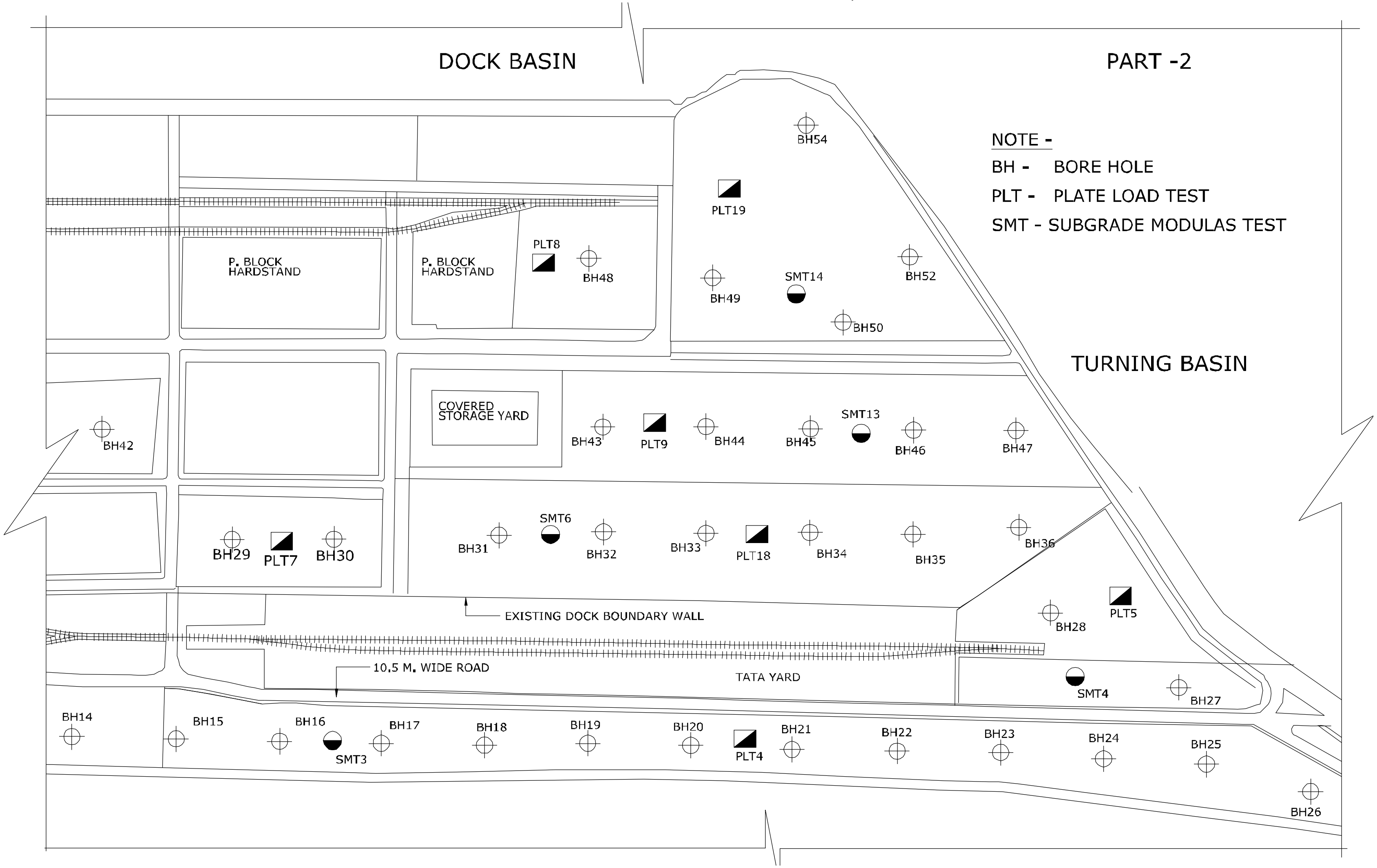
M.Tech (Geo Tech)
Consultant

APPENDIX – A
TEST LOCATION PLAN (PART-1)



APPENDIX – A
TEST LOCATION PLAN (PART-2)



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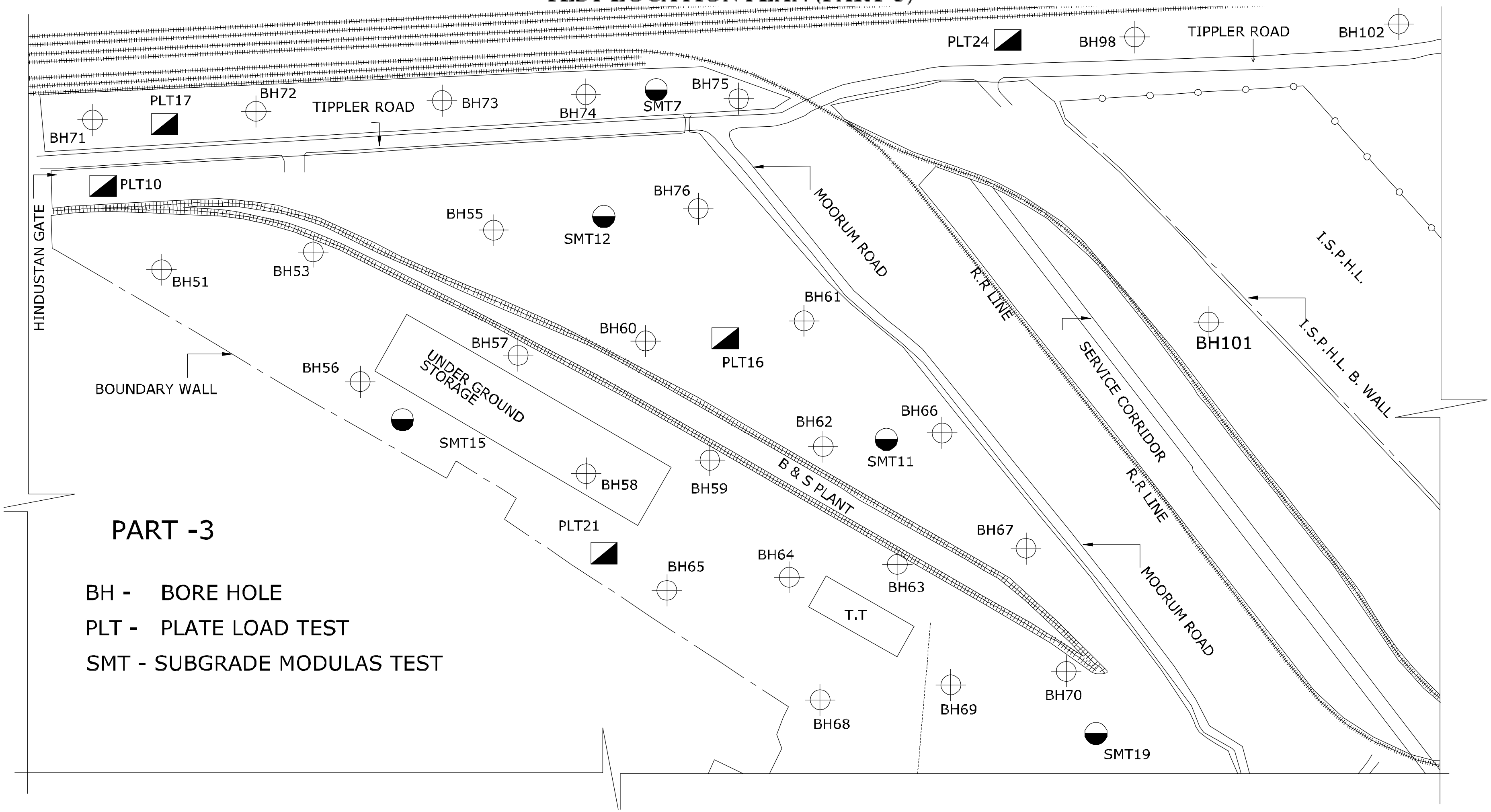
APPENDIX – A
TEST LOCATION PLAN (PART-3)



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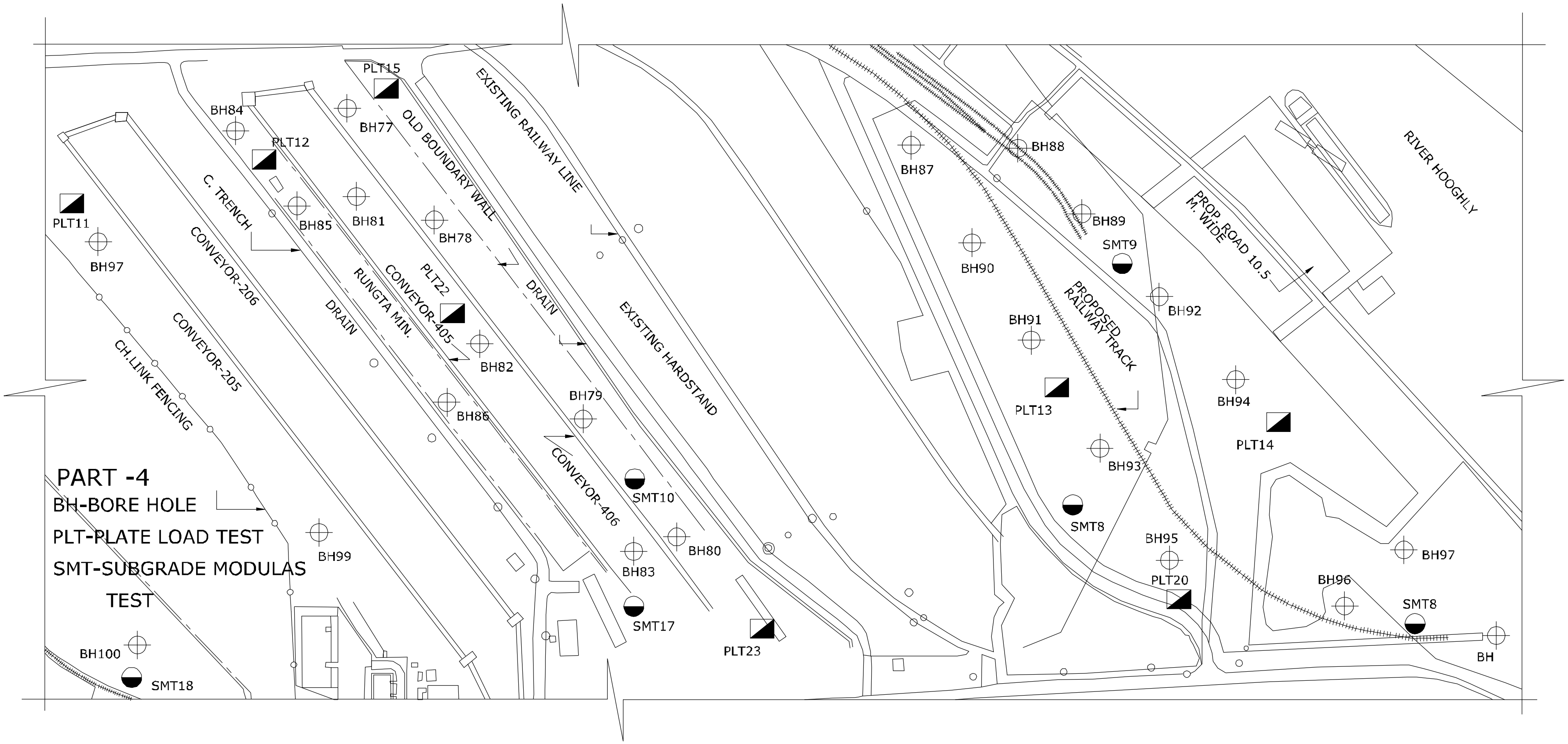
APPENDIX – A
TEST LOCATION PLAN (PART-4)



APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH-76)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	**Inorganic silt and clays of low plasticity**	CL-ML		-	1	4	1	6	78	10	22.36	1.860	1.520	31	24	7	UU	16	14	-	-	2.66	-	0.750
1.50		-	6	-	-	-	-	-	-	-	27.75	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50	**Inorganic silt of low plasticity**	ML		-	3	1	6	5	73	12	23.75	1.875	1.515	32	24	8	UU	17	14	-	-	2.66	-	0.756
3.00		-	5	-	-	-	-	-	-	-	31.40	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	4	-	-	-	-	-	-	-	22.92	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	**Inorganic clays of low plasticity**	CL		-	2	3	4	6	71	14	26.23	1.888	1.496	33	23	10	UU	21	10	-	-	2.66	-	0.778
6.00		-	3	-	-	-	-	-	-	-	26.52	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	**Inorganic clays of intermediate plasticity**	CI		-	1	2	1	9	74	13	27.23	1.903	1.496	38	23	15	UU	25	8	-	-	2.66	-	0.778
9.00		-	8	-	-	-	-	-	-	-	23.50	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	**Inorganic silt of intermediate plasticity**	MI		-	2	1	3	9	72	13	23.35	1.891	1.533	36	23	13	UU	24	9	-	-	2.66	-	0.735
12.00		-	6	-	-	-	-	-	-	-	28.20	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			4	-	-	-	-	-	-	-	23.15	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00		MI	5		1	1	3	6	79	10	28.33	-	-	33	23	10	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH- 77)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic silt of intermediate plasticity	MI	-	-	0	0	2	2	87	9	21.70	1.765	1.450	45	29	16	UU	22	9	-	-	2.66	0.100	0.834
1.50		-	6	-	-	-	-	-	-	-	22.18	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		MI	-	-	0	0	0	1	89	10	25.15	1.827	1.460	46	28	18	UU	26	7	-	-	2.66	0.105	0.822
3.00		-	5	-	-	-	-	-	-	-	26.18	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	4	-	-	-	-	-	-	-	23.70	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic clays of intermediate plasticity	CI	-	-	0	0	0	4	86	10	24.80	1.841	1.475	39	24	15	UU	27	6		-	2.66	0.107	0.803
6.00		-	5	-	-	-	-	-	-	-	25.15	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	Inorganic clays of low plasticity	CL	2	-	0	0	0	5	91	4	28.19	1.897	1.480	32	23	9	UU	21	8	-	-	2.66	0.096	0.797
9.00		-	2	-	-	-	-	-	-	-	27.90	-		-	-	-	-	-	-	-	-	-	-	-
9.50		CL	-	-	0	0	0	3	91	6	28.45	1.920	1.495	33	21	12	UU	22	9			2.66	0.100	0.779
12.00		-	4	-	-	-	-	-	-	-	28.70	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			5		-	-	-	-	-	-	29.40	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00	Inorganic silt of low plasticity	ML	5	-	0	0	0	7	87	6	29.45	-	-	31	25	6	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH-78)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic silt of intermediate plasticity	MI		-	3	1	3	3	79	11	26.29	1.863	1.475	43	27	16	UU	21	10	-	-	2.66	-	0.803
1.50		-	7	-	-	-	-	-	-	-	27.58	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		MI		-	2	1	1	2	82	12	30.35	1.929	1.480	44	26	18	UU	25	8	-	-	2.66	-	0.797
3.00		-	4	-	-	-	-	-	-	-	31.58	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	3	-	-	-	-	-	-	-	28.42	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic clays of intermediate plasticity	CI		-	4	1	1	5	77	12	31.00	1.956	1.493	37	22	15	UU	26	7	-	-	2.66	-	0.782
6.00		-	2	-	-	-	-	-	-	-	31.12	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	Inorganic clays of low plasticity	CL		-	2	1	1	6	84	6	33.39	2.005	1.503	30	21	9	UU	20	9	-	-	2.66	-	0.770
9.00		-	8	-	-	-	-	-	-	-	33.10	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50		CL		-	1	1	1	4	85	8	33.65	2.031	1.520	31	19	12	UU	21	10	-	-	2.66	-	0.750
12.00		-	6	-	-	-	-	-	-	-	33.90	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			4	-	-	-	-	-	-	-	34.60	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00	Inorganic silt of low plasticity	ML	3		4	1	1	8	78	8	34.65	-	-	29	23	6	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH- 79)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic clays of low plasticity	CL	-	-	1	0	4	10	79	6	25.18	1.809	1.445	33	25	8	UU	17	13	-	-	2.66	0.100	0.841
1.50		-	6	-	-	-	-	-	-	-	20.90	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL	-	-	0	0	0	3	92	5	22.70	1.790	1.459	33	23	10	UU	18	13	-	-	2.66	0.098	0.823
3.00		-	3	-	-	-	-	-	-	-	22.75	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	3	-	-	-	-	-	-	-	24.18	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic silt of intermediate plasticity	MI	-	-	0	0	0	6	87	7	25.15	1.840	1.470	38	26	12	UU	22	9		-	2.66	0.097	0.810
6.00		-	4	-	-	-	-	-	-	-	20.90	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00		MI		-	0	0	1	1	86	12	18.19	1.749	1.480	38	26	12	UU	26	7	-	-	2.66	0.098	0.797
9.00		-	6	-	-	-	-	-	-	-	27.15	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	Inorganic clays of low plasticity	CL	-	-	0	0	0	8	86	6	27.90	1.912	1.495	33	26	9	UU	25	8	-	-	2.66	0.095	0.779
12.00		-	4	-	-	-	-	-	-	-	24.70	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			4		-	-	-	-	-	-	25.45	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00		CL	3	-	0	2	2	5	86	5	22.18	-		33	26	9	-	-	-	-	-	-	-	-

APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH-80)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic clays of low plasticity	CL		-	0	1	5	11	75	8	29.77	1.908	1.470	31	21	10	UU	16	14	-	-	2.66	-	0.810
1.50		-	5	-	-	-	-	-	-	-	26.30	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL		-	2	1	1	4	85	7	27.90	1.892	1.479	31	21	10	UU	17	14	-	-	2.66	-	0.799
3.00		-	4	-	-	-	-	-	-	-	28.15	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	3	-	-	-	-	-	-	-	28.90	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic silt of intermediate plasticity	MI		-	3	1	1	7	79	9	31.35	1.954	1.488	36	24	12	UU	21	10	-	-	2.66	-	0.788
6.00		-	2	-	-	-	-	-	-	-	26.87	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00		MI		-	1	1	2	2	80	14	23.39	1.855	1.503	36	24	12	UU	25	8	-	-	2.66	-	0.770
9.00		-	7	-	-	-	-	-	-	-	32.35	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	Inorganic clays of low plasticity	CL		-	2	1	1	9	79	8	33.10	2.023	1.520	31	22	9	UU	24	9	-	-	2.66	-	0.750
12.00		-	6	-	-	-	-	-	-	-	29.90	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			4	-	-	-	-	-	-	-	30.65	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00		CL	3		1	3	3	6	80	7	27.38	-	-	31	22	9	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH- 81)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic clays of low plasticity	CL	-	-	0	0	0	9	85	6	24.18	1.912	1.540	30	22	8	UU	17	13	-	-	2.66	0.090	0.727
1.50		-	7	-	-	-	-	-	-	-	24.10	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL	-	-	0	0	0	8	87	5	25.18	1.828	1.460	30	22	8	UU	18	13	-	-	2.66	0.098	0.822
3.00		-	5	-	-	-	-	-	-	-	20.70	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	4	-	-	-	-	-	-	-	20.80	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic clays of intermediate plasticity	CI	-	-	0	0	0	7	83	10	24.70	1.832	1.469	40	25	15	UU	22	9		-	2.66	0.100	0.811
6.00		-	3	-	-	-	-	-	-	-	20.18	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	Inorganic silt of intermediate plasticity	MI		-	0	0	1	1	86	12	18.19	1.749	1.480	38	26	12	UU	26	7	-	-	2.66	0.098	0.797
9.00		-	6	-	-	-	-	-	-	-	27.15	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	Inorganic clays of intermediate plasticity	CI	-	-	0	0	8	6	76	10	22.90	1.837	1.495	45	30	15	UU	25	8	-	-	2.66	0.098	0.779
12.00		-	4	-	-	-	-	-	-	-	25.12	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			6		-	-	-	-	-	-	25.70	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00	Inorganic clays of low plasticity	CL	3	-	0	2	5	7	81	5	25.10	-		30	21	9	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH-82)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00		CL		-	2	1	1	10	78	8	21.77	1.906	1.565	28	20	8	UU	16	14	-	-	2.66	-	0.700
1.50		-	7	-	-	-	-	-	-	-	21.30	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50	**Inorganic clays of low plasticity**	CL		-	3	1	1	9	79	7	23.03	1.821	1.480	28	20	8	UU	17	14	-	-	2.66	-	0.797
3.00		-	5	-	-	-	-	-	-	-	18.55	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	4	-	-	-	-	-	-	-	18.30	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00		CI		-	2	1	1	8	76	12	22.55	1.822	1.487	38	23	15	UU	21	10	-	-	2.66	-	0.789
6.00		-	6	-	-	-	-	-	-	-	18.03	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	**Inorganic clays of intermediate plasticity**	CI		-	1	1	2	2	80	14	16.04	1.744	1.503	36	24	12	UU	25	8	-	-	2.66	-	0.770
9.00		-	6	-	-	-	-	-	-	-	25.00	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50		CI		-	1	1	9	7	70	12	20.75	1.835	1.520	43	28	15	UU	24	9	-	-	2.66	-	0.750
12.00		-	3	-	-	-	-	-	-	-	22.97	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			11	-	-	-	-	-	-	-	23.55	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00	**Inorganic clays of low plasticity**	CL	5		0	3	6	8	76	7	22.95	-	-	28	19	9	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH- 83)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00		CL	-	-	0	0	1	2	90	7	19.90	1.747	1.457	31	22	9	UU	15	19	-	-	2.66	0.095	0.826
1.50		-	3	-	-	-	-	-	-	-	21.98	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL	-	-	1	1	1	2	87	8	20.53	1.766	1.465	33	25	8	UU	20	17	-	-	2.66	0.103	0.816
3.00	Inorganic clays of low plasticity	-	4	-	-	-	-	-	-	-	20.30	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	5	-	-	-	-	-	-	-	19.20	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00		CL	-	-	2	3	1	3	80	11	19.86	1.763	1.471	35	28	7	UU	20	17	-	-	2.66	0.116	0.808
6.00		-	3	-	-	-	-	-	-	-	18.90	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00		MI	-	-	3	4	4	2	79	8	20.00	1.774	1.478	36	27	9	UU	16	20	-	-	2.66	0.110	0.800
9.00		-	7	-	-	-	-	-	-	-	20.98	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	Inorganic silt of intermediate plasticity	MI	-	-	4	6	7	4	70	9	21.30	1.795	1.480	38	28	10	UU	17	20	-	-	2.66	0.102	0.797
12.00		-	5	-	-	-	-	-	-	-	22.50	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			11		-	-	-	-	-	-	21.90	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00	Inorganic clays of low plasticity	CL	3	-	5	2	3	1	81	8	20.30	-	-	33	24	8	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH-84)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic clays of low plasticity	CL		-	3	1	2	3	82	9	24.49	1.845	1.482	29	20	9	UU	14	20	-	-	2.66	-	0.795
1.50		-	3	-	-	-	-	-	-	-	27.38	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL		-	0	2	2	3	83	10	25.73	1.867	1.485	31	23	8	UU	19	18	-	-	2.66	-	0.791
3.00		-	5	-	-	-	-	-	-	-	25.70	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	6	-	-	-	-	-	-	-	23.92	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00		CL		-	1	4	2	4	76	13	26.06	1.877	1.489	33	26	7	UU	19	18	-	-	2.66	-	0.786
6.00		-	3	-	-	-	-	-	-	-	24.87	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	Inorganic silt of intermediate plasticity	MI		-	2	5	5	3	75	10	25.20	1.879	1.501	35	26	9	UU	15	21	-	-	2.66	-	0.772
9.00		-	8	-	-	-	-	-	-	-	26.18	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50		MI		-	3	7	8	5	66	11	26.50	1.904	1.505	35	25	10	UU	16	21	-	-	2.66	-	0.767
12.00		-	5	-	-	-	-	-	-	-	27.70	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			4	-	-	-	-	-	-	-	27.10	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00	Inorganic clays of low plasticity	CL	6		4	3	4	2	77	10	25.50	-	-	31	23	8	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS (BH- 85)

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic clays of low plasticity	CL	-	-	1	4	2	3	84	6	18.70	1.721	1.450	32	24	8	UU	17	13	-	-	2.66	0.098	0.834
1.50		-	6	-	-	-	-	-	-	-	21.70	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL	-	-	1	5	5	5	78	6	22.15	1.783	1.460	32	24	8	UU	18	13	-	-	2.66	0.097	0.822
3.00		-	5	-	-	-	-	-	-	-	25.18	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	2	-	-	-	-	-	-	-	25.45	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic silt and clays of low plasticity	CL-ML	-	-	3	3	5	1	81	7	26.70	1.869	1.475	32	25	7	UU	22	9	-	-	2.66	0.097	0.803
6.00		-	4	-	-	-	-	-	-	-	22.10	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	Inorganic clays of low plasticity	CL	-	-	4	3	3	1	81	8	23.18	1.823	1.480	34	25	9	UU	26	7	-	-	2.66	0.098	0.797
9.00		-	7	-	-	-	-	-	-	-	24.90	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	Inorganic silt and clays of low plasticity	CL-ML	-	-	1	3	3	2	85	6	22.18	1.827	1.495	33	26	7	UU	25	8	-	-	2.66	0.099	0.779
12.00		-	5	-	-	-	-	-	-	-	23.10	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			3		-	-	-	-	-	-	25.79	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00		CL-ML	6	-	3	2	1	1	84	7	30.10	-	-	33	26	7	-	-	-	-	-	-	-	-

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APPENDIX 'B'
SUMMARY OF TEST RESULTS **(BH-86)**

Bore hole depth	Soil Description	Soil classification	SPT		Grain Size Analysis						Density and Moisture			Atterberg Limits			Shear Strength Parameters			Shrinkage Limit (%)	Free Swell Index (%)	Specific Gravity Gs	Consolidation Characteristic	
			Observed	Corrected	Gravel (%)	Course Sand (%)	Medium Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)	moisture Content (%)	Bulk Density (gm/cc)	Dry Density (gm/ cc)	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Type of test	C (KN/m^2)	Φ (Degrees)				C_c	Void Ratio, e_0
1.00	Inorganic clays of low plasticity	CL		-	0	5	3	4	80	8	22.08	1.840	1.507	30	22	8	UU	16	14	-	-	2.66	-	0.765
1.50		-	4	-	-	-	-	-	-	-	24.58	-	-	-	-	-	-	-	-	-	-	-	-	-
2.50		CL		-	0	6	6	6	74	8	23.58	1.860	1.505	30	22	8	UU	17	14	-	-	2.66	-	0.767
3.00		-	5	-	-	-	-	-	-	-	23.55	-	-	-	-	-	-	-	-	-	-	-	-	-
4.50		-	4	-	-	-	-	-	-	-	21.42	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	Inorganic silt and clays of low plasticity	CL-ML		-	2	4	6	2	77	9	23.91	1.867	1.507	30	23	7	UU	21	10	-	-	2.66	-	0.765
6.00		-	3	-	-	-	-	-	-	-	22.72	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	Inorganic clays of low plasticity	CL		-	3	4	4	2	77	10	23.05	1.875	1.524	32	23	9	UU	25	8	-	-	2.66	-	0.745
9.00		-	6	-	-	-	-	-	-	-	24.03	-	-	-	-	-	-	-	-	-	-	-	-	-
9.50	Inorganic silt and clays of low plasticity	CL-ML		-	0	4	4	3	81	8	24.35	1.903	1.530	31	24	7	UU	24	9	-	-	2.66	-	0.739
12.00		-	6	-	-	-	-	-	-	-	25.55	-	-	-	-	-	-	-	-	-	-	-	-	-
13.50			2	-	-	-	-	-	-	-	24.95	-	-	-	-	-	-	-	-	-	-	-	-	-
15.00		CL-ML	4		2	3	2	2	82	9	23.35	-	-	31	24	7	-	-	-	-	-	-	-	-

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Depth	Permeability (10^{-6} Cm/Sec)	Shear Strength Parameters							
		Type of test	C (KN/m^2)	Φ (Degrees)	Type of test	C (KN/m^2)	Φ (Degrees)	Type of Test	C (KN/m^2)
BH-75									
1.00	0.58	CD	14	11	DST	12	10	UC	17
2.50	0.45	CD	15	11	DST	13	10	UC	18
5.00	0.54	CD	19	7	DST	17	6	UC	22
7.00	0.32	CD	23	5	DST	21	4	UC	26
9.50	0.38	CD	22	6	DST	20	5	UC	25
BH-76									
1.00	0.44	CD	19	7	DST	17	6	UC	22
2.50	0.46	CD	23	5	DST	21	4	UC	26
5.00	0.45	CD	24	4	DST	22	3	UC	27
7.00	0.31	CD	18	6	DST	16	5	UC	21
9.50	0.46	CD	19	7	DST	17	6	UC	22
BH-77									
1.00	0.38	CD	19	7	DST	17	6	UC	22
2.50	0.46	CD	23	5	DST	21	4	UC	26
5.00	0.42	CD	24	4	DST	22	3	UC	27
7.00	0.41	CD	18	6	DST	16	5	UC	21
9.50	0.43	CD	19	7	DST	17	6	UC	22
BH-78									
1.00	0.44	CD	12	17	DST	10	16	UC	15
2.50	0.46	CD	17	15	DST	15	14	UC	20
5.00	0.45	CD	17	15	DST	15	14	UC	20
7.00	0.31	CD	13	18	DST	11	17	UC	16
9.50	0.46	CD	14	18	DST	12	17	UC	17
BH-79									
1.00	0.44	CD	14	11	DST	12	10	UC	17
2.50	0.46	CD	15	11	DST	13	10	UC	18

Depth	Permeability (10^{-6} Cm/Sec)	Shear Strength Parameters							
		Type of test	C (KN/m^2)	Φ (Degrees)	Type of test	C (KN/m^2)	Φ (Degrees)	Type of Test	C (KN/m^2)
5.00	0.45	CD	19	7	DST	17	6	UC	22
7.00	0.31	CD	23	5	DST	21	4	UC	26
9.50	0.46	CD	22	6	DST	20	5	UC	25
BH-80									
1.00	0.58	CD	14	11	DST	12	10	UC	17
2.50	0.45	CD	15	11	DST	13	10	UC	18
5.00	0.54	CD	19	7	DST	17	6	UC	22
7.00	0.32	CD	23	5	DST	21	4	UC	26
9.50	0.38	CD	22	6	DST	20	5	UC	25
BH-81									
1.00	0.54	CD	14	11	DST	12	10	UC	17
2.50	0.52	CD	15	11	DST	13	10	UC	18
5.00	0.55	CD	19	7	DST	17	6	UC	22
7.00	0.35	CD	23	5	DST	21	4	UC	26
9.50	0.38	CD	22	6	DST	20	5	UC	25
BH-82									
1.00	0.54	CD	14	11	DST	12	10	UC	17
2.50	0.52	CD	18	7	DST	16	6	UC	21
5.00	0.55	CD	19	7	DST	17	6	UC	22
7.00	0.35	CD	19	7	DST	17	6	UC	22
9.50	0.38	CD	18	7	DST	16	6	UC	21
BH-83									
1.00	0.44	CD	12	17	DST	10	16	UC	15
2.50	0.46	CD	17	15	DST	15	14	UC	20
5.00	0.45	CD	17	15	DST	15	14	UC	20
7.00	0.31	CD	13	18	DST	11	17	UC	16
9.50	0.46	CD	14	18	DST	12	17	UC	17

Depth	Permeability (10^{-6} Cm/Sec)	Shear Strength Parameters							
		Type of test	C (KN/m^2)	Φ (Degrees)	Type of test	C (KN/m^2)	Φ (Degrees)	Type of Test	C (KN/m^2)
BH-84									
1.00	0.53	CD	12	10	DST	14	11	UC	18
2.50	0.41	CD	14	12	DST	15	11	UC	17
5.00	0.52	CD	17	8	DST	19	7	UC	24
7.00	0.30	CD	20	4	DST	23	3	UC	25
9.50	0.41	CD	19	7	DST	22	6	UC	23
BH-85									
1.00	0.58	CD	14	11	DST	12	10	UC	17
2.50	0.45	CD	15	11	DST	13	10	UC	18
5.00	0.54	CD	19	7	DST	17	6	UC	22
7.00	0.32	CD	23	5	DST	21	4	UC	26
9.50	0.38	CD	22	6	DST	20	5	UC	25
BH-86									
1.00	0.39	CD	17	5	DST	19	6	UC	23
2.50	0.42	CD	19	8	DST	20	7	UC	22
5.00	0.43	CD	19	7	DST	21	6	UC	26
7.00	0.29	CD	19	4	DST	22	3	UC	24
9.50	0.49	CD	18	6	DST	21	5	UC	22
BH-87									
1.00	0.44	CD	19	6	DST	17	5	UC	22
2.50	0.46	CD	20	7	DST	18	6	UC	23
5.00	0.45	CD	21	6	DST	19	5	UC	24
7.00	0.31	CD	22	5	DST	20	4	UC	25
9.50	0.46	CD	21	5	DST	19	4	UC	24
BH-88									
1.00	0.53	CD	12	10	DST	14	11	UC	18
2.50	0.41	CD	14	12	DST	15	11	UC	17

APPENDIX 'B'

TABLE-3: PLATE LOAD TEST RESULTS (PLT-15)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	1.905	1.905
2.50	2.980	4.885
3.75	4.120	9.005
5.00	4.300	13.305
6.25	6.560	19.865
7.50	6.110	25.975
8.75	5.615	31.590

Calculations:

From Load Settlement curve:

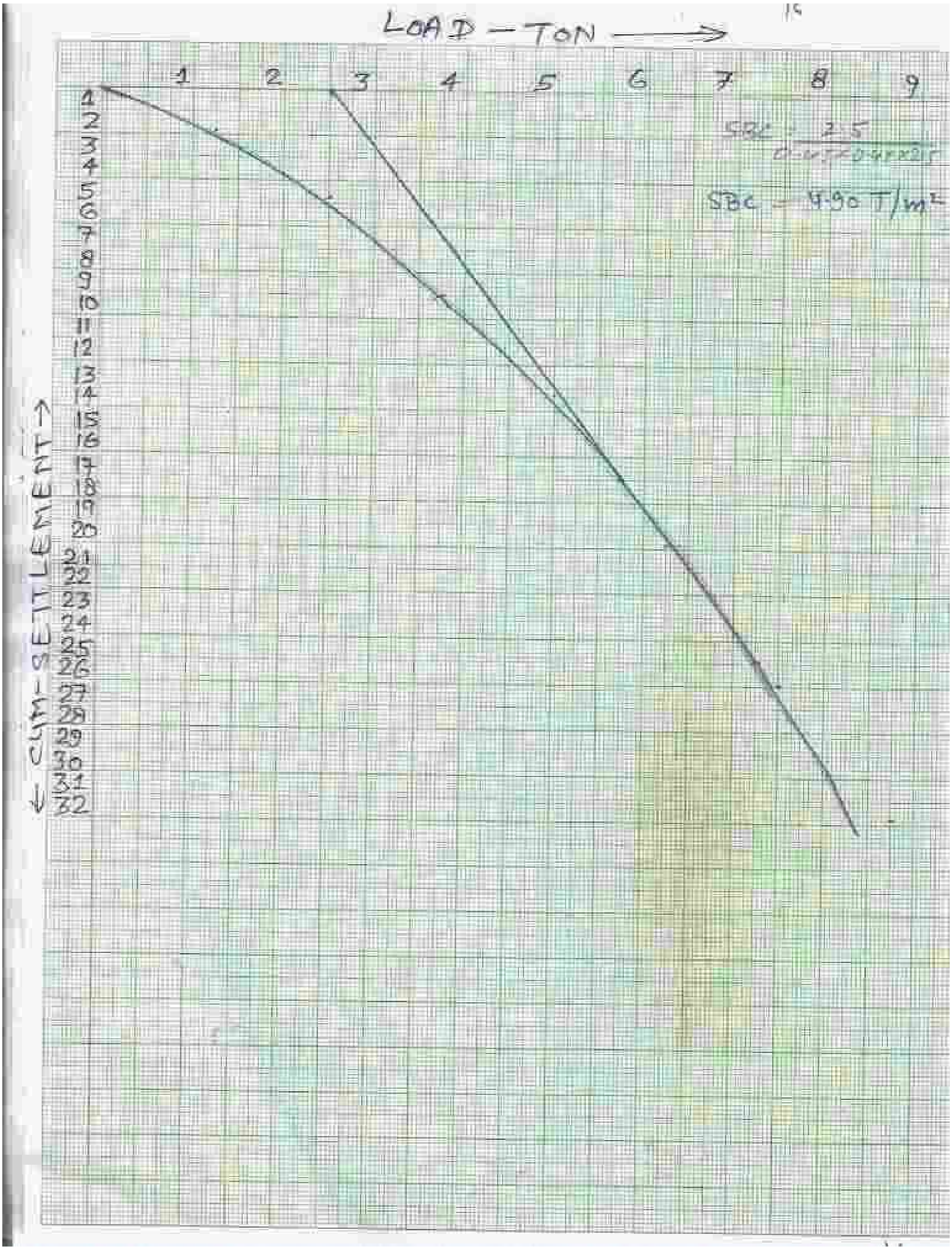
Ultimate Load: 2.50 T

Ultimate Bearing Capacity: 2.50/ (.45x.45) =12.34 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 12.34/2.5 = 4.90 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'
TABLE-3: PLATE LOAD TEST RESULTS (PLT-16)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	1.435	1.435
2.50	3.730	5.165
3.75	5.165	10.330
5.00	6.350	16.680
6.25	5.290	21.970
7.50	4.000	25.970

Calculations:

From Load Settlement curve:

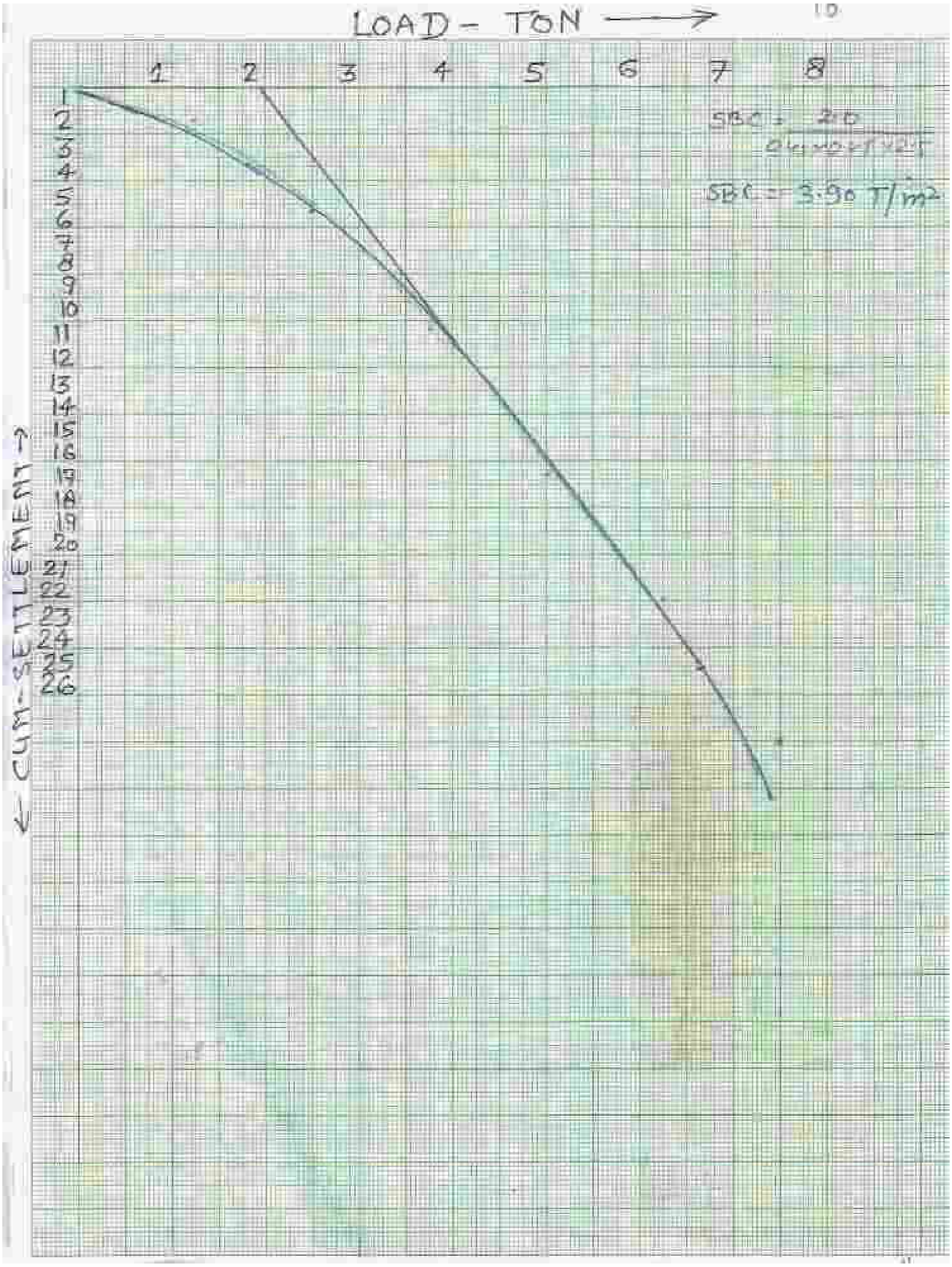
Ultimate Load: 2.00 T

Ultimate Bearing Capacity: 2.00/ (.45x.45) =9.87 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 9.87/2.5 = 3.90 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'

TABLE-3: PLATE LOAD TEST RESULTS (PLT-17)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	2.190	2.190
2.50	4.625	6.815
3.75	4.765	11.518
5.00	7.370	18.880
6.25	4.725	23.613
7.50	5.825	29.438

Calculations:

From Load Settlement curve:

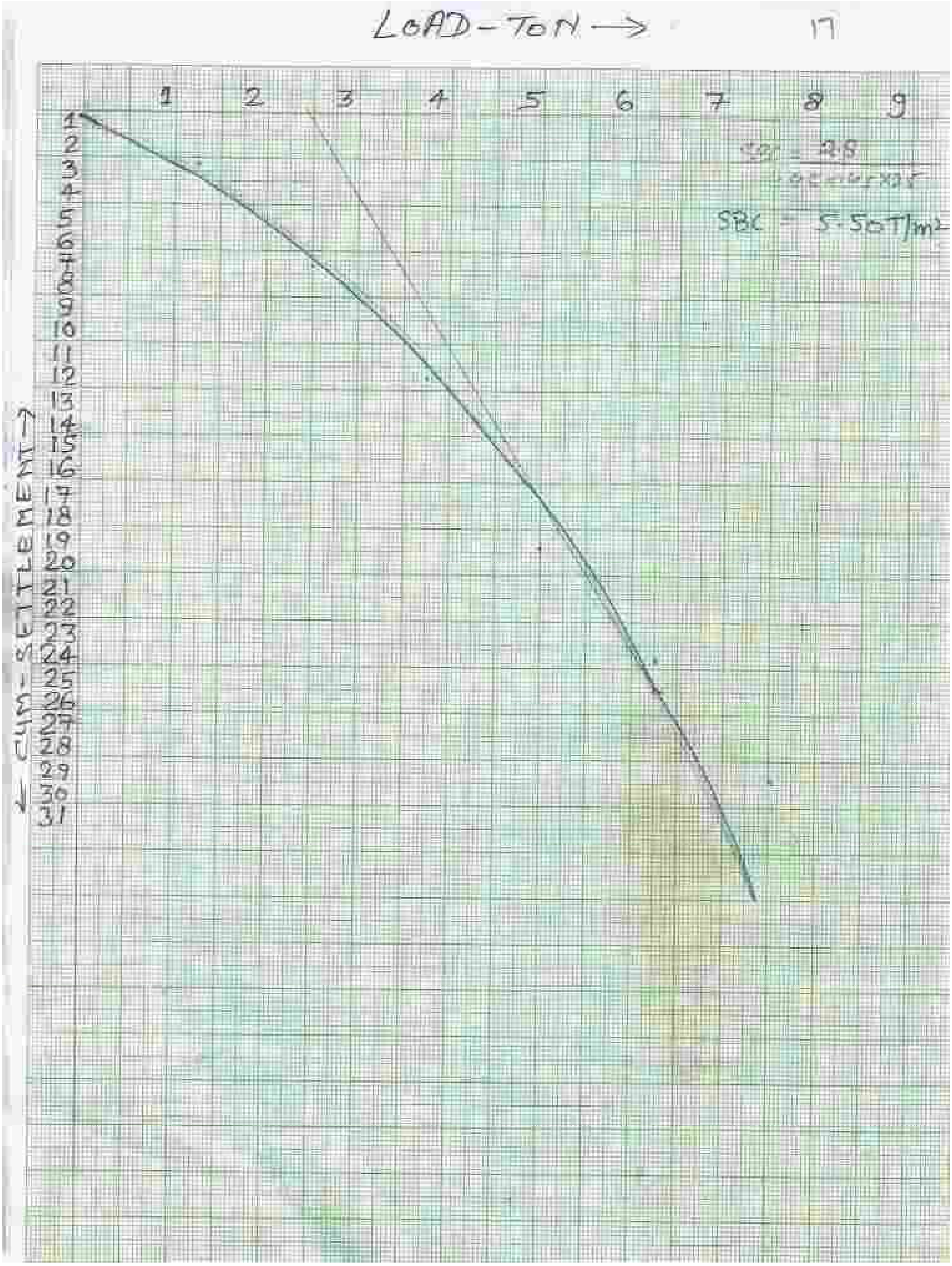
Ultimate Load: 2.80 T

Ultimate Bearing Capacity: 2.80/ (.45x.45) =13.83 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 13.83/2.5 = 5.53 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'

TABLE-3: PLATE LOAD TEST RESULTS (PLT-18)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	5.560	5.560
2.50	5.325	10.885
3.75	5.165	16.050
5.00	7.430	23.510
6.25	3.560	27.070

Calculations:

From Load Settlement curve:

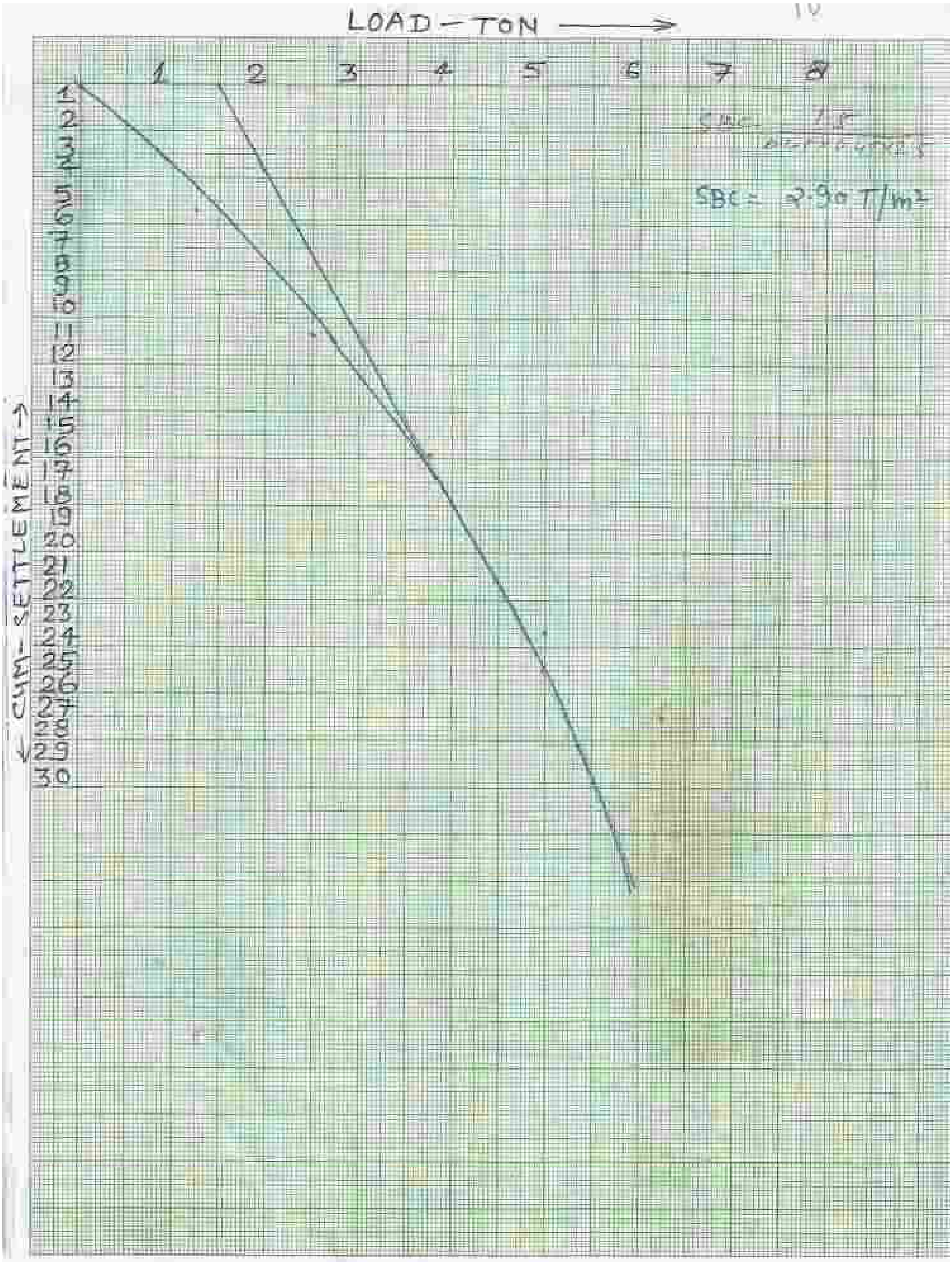
Ultimate Load: 1.50 T

Ultimate Bearing Capacity: 1.50/ (.45x.45) =7.40 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 7.40/2.5 = 2.90 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX ‘B’

TABLE-3: PLATE LOAD TEST RESULTS (PLT-19)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	1.520	1.520
2.50	7.555	9.075
3.75	14.910	23.990
5.00	11.360	35.350

Calculations:

From Load Settlement curve:

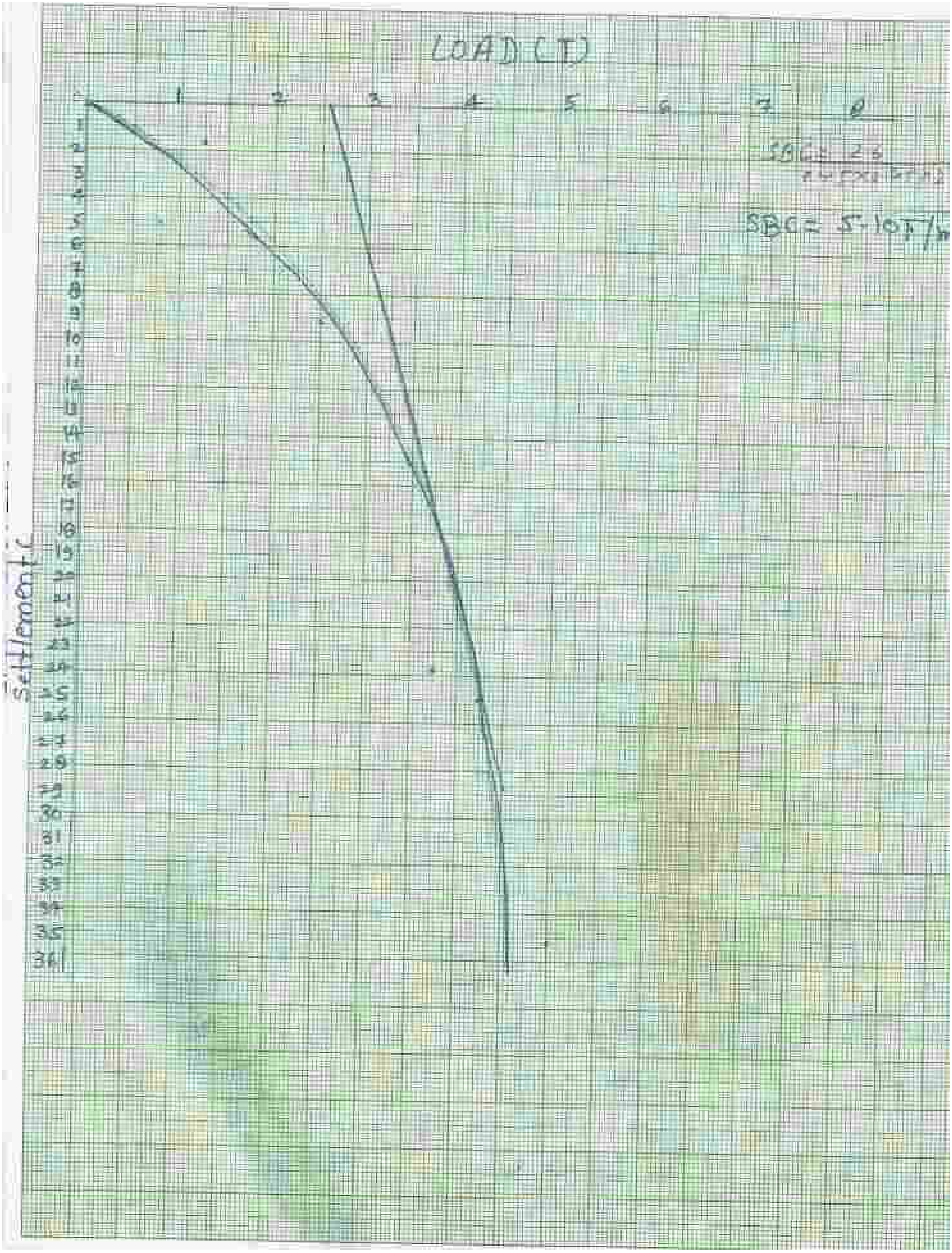
Ultimate Load: 2.60 T

Ultimate Bearing Capacity: 2.60/ (.45x.45) =12.84 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 12.84/2.5 = 5.10 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'

TABLE-3: PLATE LOAD TEST RESULTS (PLT-20)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	1.985	1.985
2.50	6.195	8.180
3.75	4.170	12.350
5.00	5.885	18.235
6.25	5.565	23.800
7.50	4.370	27.170

Calculations:

From Load Settlement curve:

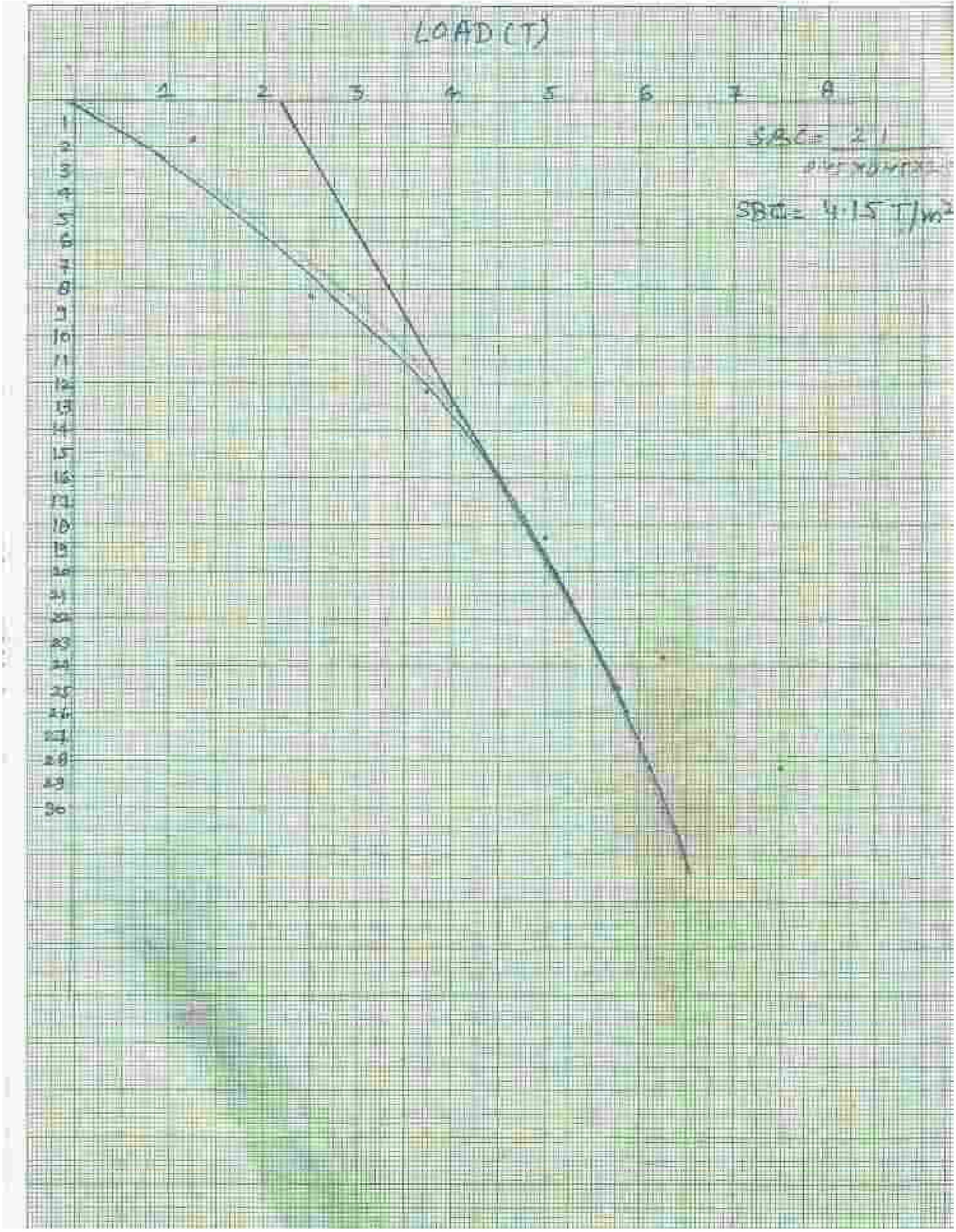
Ultimate Load: 2.10 T

Ultimate Bearing Capacity: 2.10/ (.45x.45) =10.37 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 10.37/2.5 = 4.15 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'

TABLE-3: PLATE LOAD TEST RESULTS (PLT-21)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	2.880	2.880
2.50	2.940	5.820
3.75	4.070	9.890
5.00	4.310	14.200
6.25	5.565	19.765
7.50	6.625	26.390

Calculations:

From Load Settlement curve:

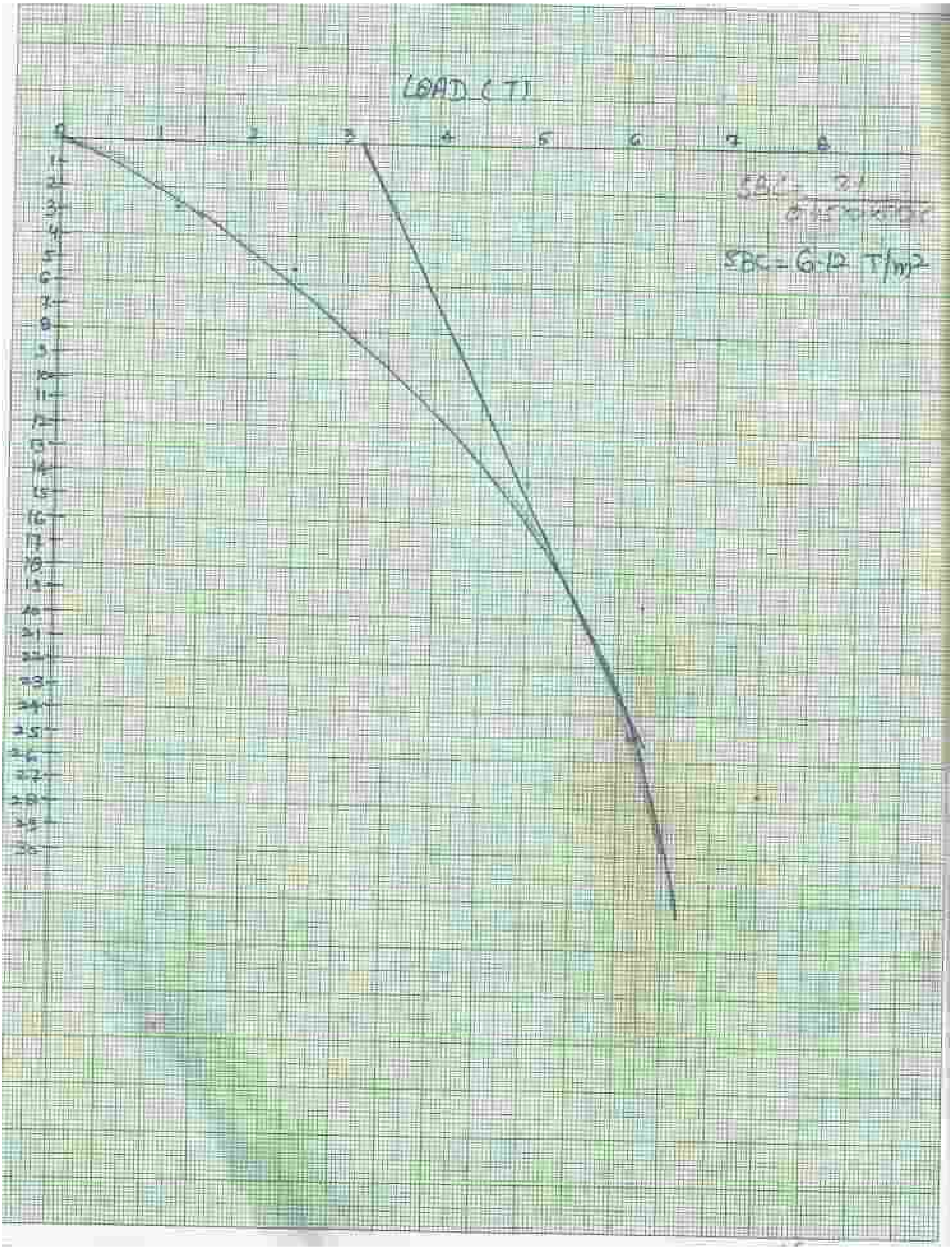
Ultimate Load: 3.10 T

Ultimate Bearing Capacity: 3.10/ (.45x.45) =15.30 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 15.30/2.5 = 6.12 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'

TABLE-3: PLATE LOAD TEST RESULTS (PLT-22)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	6.50	6.50
2.50	11.20	17.70
3.75	30.50	48.20

Calculations:

From Load Settlement curve:

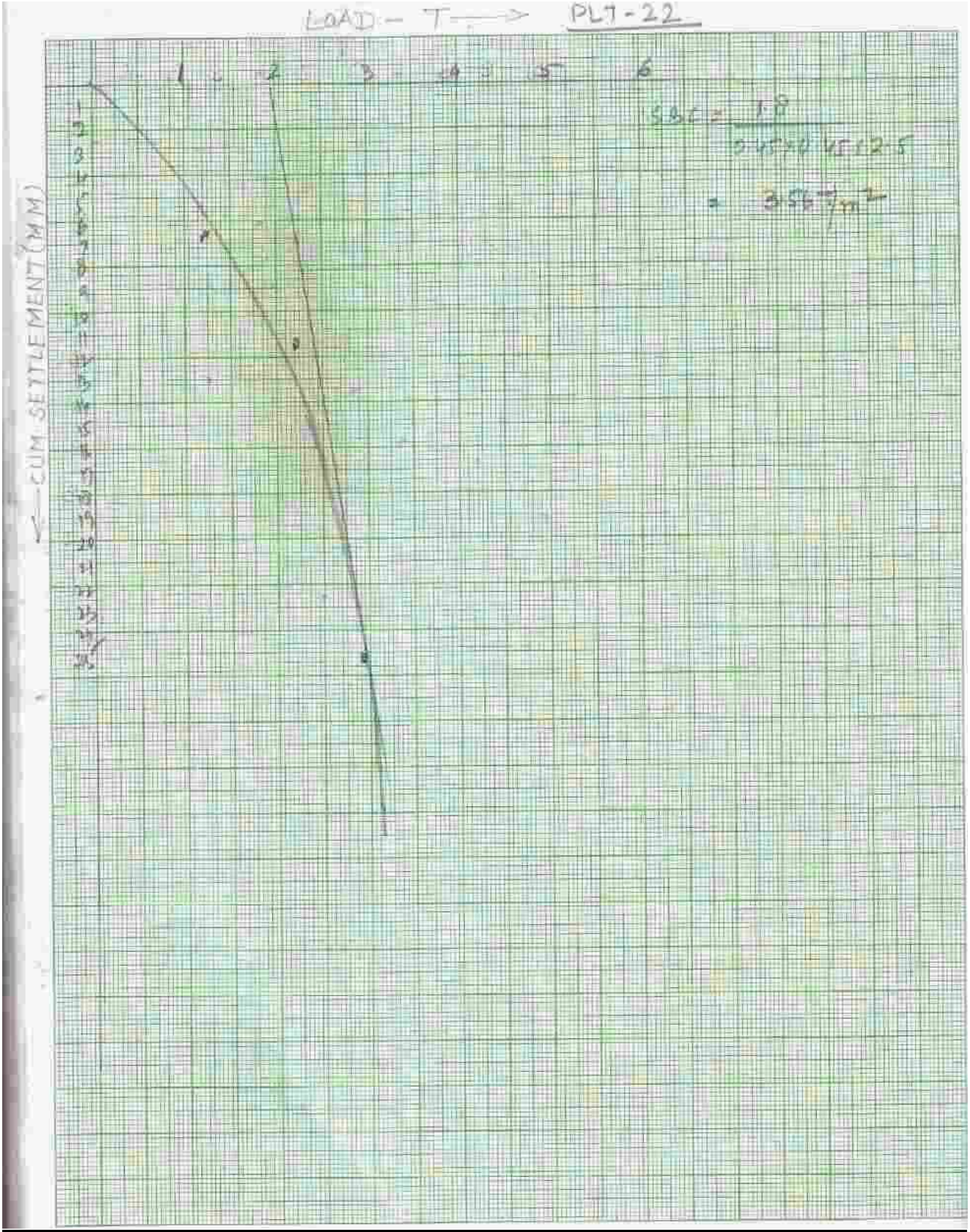
Ultimate Load: 1.80 T

Ultimate Bearing Capacity: 1.80/ (.45x.45) =8.88 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 8.88/2.5 = 3.56 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX 'B'
TABLE-3: PLATE LOAD TEST RESULTS (PLT-23)

Load (T)	Average Settlement (mm)	Cumulative Settlement (mm)
1.25	2.090	2.090
2.50	3.935	6.025
3.75	3.850	9.875
5.00	5.795	15.670
6.25	7.290	22.960
7.50	5.815	28.775

Calculations:

From Load Settlement curve:

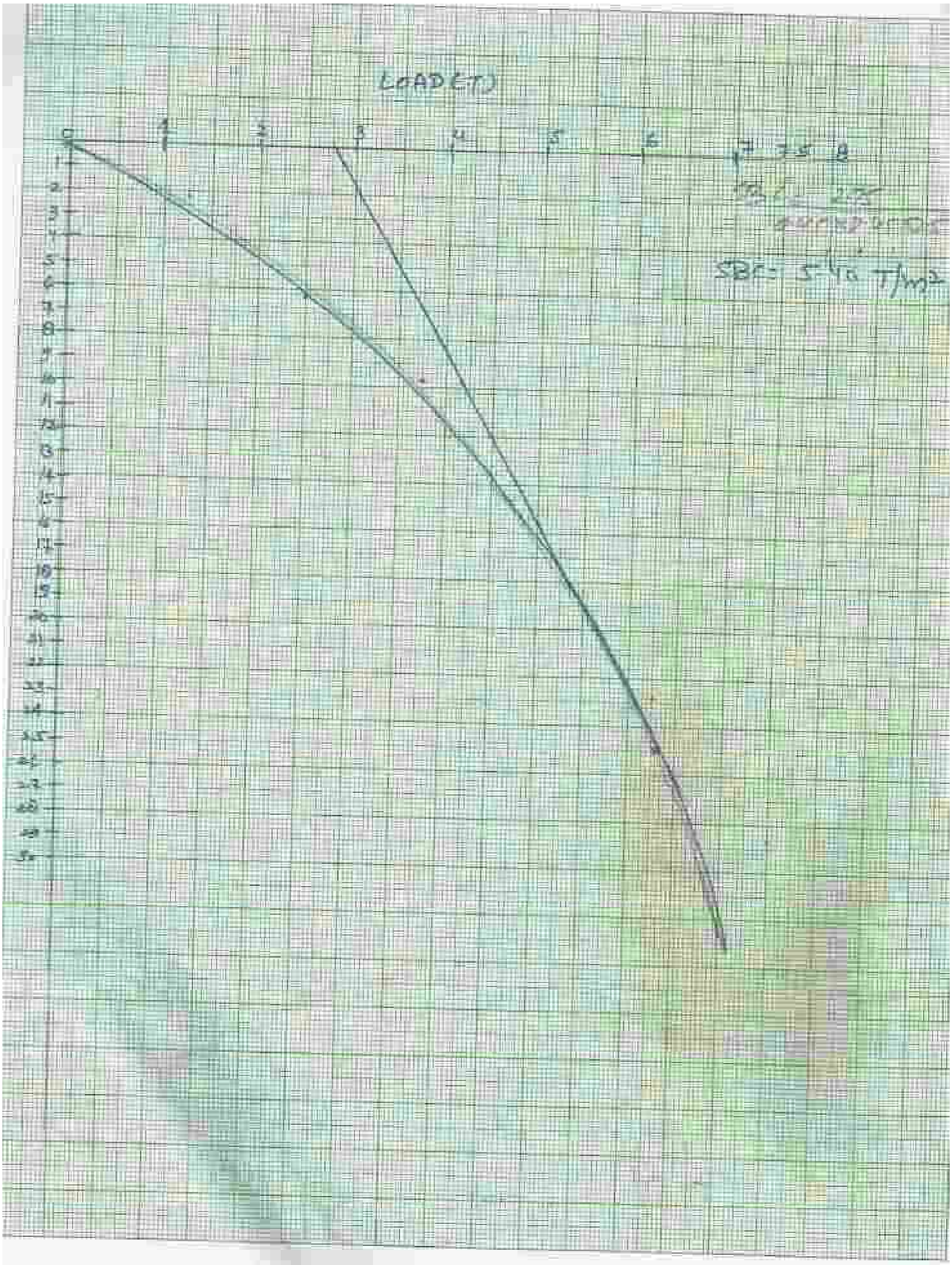
Ultimate Load: 2.75 T

Ultimate Bearing Capacity: 2.75/ (.45x.45) =13.58 T/m^2

Factor of Safety = 2.5

Safe bearing capacity: 13.58/2.5 = 5.40 T/m^2

LOAD VS CUMULATIVE SETTLEMENT CURVE



APPENDIX- C
CHART 76: - BORE LOG CHART (BH-76)

Techpro EngineersPvt. Ltd. **Bore/ Drill Log**

Project: – Geotech inves in Connection with The Construction Of Hard Stand
Bore Hole No.: – 76
Location: – Haldia Dock Complex
Ground Elevation:
Method of Boring/ Drilling: – Rotary & Percussion Drill
Water Level (Static): – 1.50 m
Boring/ Drilling Equipments: – Manual Winch M/c
Dia. Of Boring / Drilling : – 150 mm
Casing Lowered : – 15.00 m
Date: From 20-6-15 to 20-6-15

Date (dd/ mm)	Elevation (m)	Depth/ RUN (m) From	Depth/ RUN (m) To	Length (m)	Nature of Sampling	SPT: No. of blows 0-15 cm	15-30 cm	30-45 cm	N Value	Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		1.00	1.45	0.45	U									Silty clay
		1.50	1.95	"	D.P	2	3	3	6					"
		2.50	2.95	"	U									"
		3.00	3.45	"	D.P	1	2	3	5					"
		4.50	4.95	"	D.P	1	2	2	4					Silty Soil (Marshy Soil)
		5.00	5.45	"	U									"
		6.00	6.45	"	D.P	1	1	2	3					"
		7.00	7.45	"	U									"
		9.00	9.45	"	D.P	3	4	4	8					"
		9.50	9.95	"	U									"
		12.00	12.45	"	D.P	2	3	3	6					"
		13.50	13.95	"	D.P	1	2	2	4					"
		15.00	15.45	"	D.P	1	2	3	5					"

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Site Supervisor

Abbreviation Used: U - Undisturbed Sample C-Core Sample D- Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) >100)

APPENDIX- C
CHART 77: - BORE LOG CHART (BH-77)

Techpro EngineersPvt. Ltd. **Bore/ Drill Log**

Project: – Geotech inves in Connection with The Construction of Hard Stand

Bore Hole No.: – 77

Location: – Haldia Dock Complex

Ground Elevation:

Method of Boring/ Drilling: – Rotary & Percussion Drill

Water Level (Static): – 1.50 m

Boring/ Drilling Equipments: – Manual winch m/c

Dia. Of Boring / Drilling: – 150 mm

Casing Lowered: – 15.00 m

Date: From 21-6-15 **to** 21-6-15

Date (dd/ mm)	Elevation (m)	Depth/ RUN (m) From	Depth/ RUN (m) To	Length (m)	Nature of Sampling	SPT: No. of blows 0-15 cm	15-30 cm	30-45 cm	N Value	Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		1.00	1.45	0.45	U									silty clay
		1.50	1.95	"	D.P	2	3	3	6					"
		2.50	2.95	"	U									"
		3.00	3.45	"	D.P	2	2	3	5					"
		4.50	4.95	"	D.P	1	1	3	4					Silty Soil (Marshy soil)
		5.00	5.45	"	U									"
		6.00	6.45	"	D.P	1	2	3	5					"
		7.00	7.45	"	U									"
		9.00	9.45	"	D.P	1	1	1	2					"
		9.50	9.95	"	U									"
		12.00	12.45	"	D.P	1	2	2	4					"
		13.50	13.95	"	D.P	1	2	3	5					"
		15.00	15.45	"	D.P	2	3	4	5					"

For Techpro Engineers Pvt. Ltd

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Abbreviation Used: U - Undisturbed Sample C-Core Sample D- Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) >100)

APPENDIX- C
CHART 78: - BORE LOG CHART (BH-78)

Techpro EngineersPvt. Ltd. — **Bore/ Drill Log**

Project:- Geotech inves in Connection with The Construction Of Hard Stand — Bore Hole No.: – 78

Location:- – Haldia Dock Complex — Ground Elevation:

Method of Boring/ Drilling: – Rotary & Percussion Drill — Water Level (Static): – 1.80m

Boring/ Drilling Equipments: – Manual winch M/c — Dia. Of Boring / Drilling :– 150mm

Casing Lowered : – 15.00m — Date: From 21-6-15 to 21-6-15

Date (dd/ mm)	Elevation (m)	Depth/ RUN (m) From	To	Length (m)	Nature of Sampling	SPT: No. of blows 0-15 cm	15-30 cm	30-45 cm	N Value	Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		1.00	1.45	0.45	U									Silty clay
		1.50	1.95	"	D.P	2	3	4	7					"
		2.50	2.95	"	U									"
		3.00	3.45	"	D.P	2	2	2	4					"
		4.50	4.95	"	D.P	1	1	2	3					Silty Soil (Marshy Soil)
		5.00	5.45	"	U									"
		6.00	6.45	"	D.P	1	1	1	2					"
		7.00	7.45	"	U									"
		9.00	9.45	"	D.P	2	3	5	8					"
		9.50	9.95	"	U									"
		12.00	12.45	"	D.P	1	2	4	6					"
		13.50	13.95	"	D.P	1	2	2	4					"
		15.00	15.45	"	D.P	1	1	2	3					"

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Abbreviation Used: U - Undisturbed Sample C-Core Sample D- Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) >100)

APPENDIX- C
CHART 79: - BORE LOG CHART (BH-79)

Techpro EngineersPvt. Ltd. **Bore/ Drill Log**

Project:. – Geotech inves in Connection with The Construction of Hard Stand
Bore Hole No.: – 79
Location:. – Haldia Dock Complex
Ground Elevation:
Method of Boring/ Drilling: – Rotary & Percussion Drill
Water Level (Static): – 1.60 m
Boring/ Drilling Equipments: – Manual winch M/c
Dia. Of Boring / Drilling :. – 150 mm
Casing Lowered :
Date: From 21-6-15 to 21-6-15

Date (dd/ mm)	Elevation (m)	Depth/ RUN (m) From	To	Length (m)	Nature of Sampling	SPT: No. of blows 0-15 cm	15-30 cm	30-45 cm	N Value	Time Taken (min)	Total length of Core Pieces (m)	Core Recovery (%)	R. Q. D. (%)	Description
		1.00	1.45	0.45	U									Silty clay
		1.50	1.95	"	D.P	2	2	4	6					"
		2.50	2.95	"	U									"
		3.00	3.45	"	D.P	2	1	2	3					"
		4.50	4.95	"	D.P	1	1	2	3					Silty Soil (Marshy Soil)
		5.00	5.45	"	U									"
		6.00	6.45	"	D.P	2	2	2	4					"
		7.00	7.45	"	U									"
		9.00	9.45	"	D.P	2	3	3	6					"
		9.50	9.95	"	U									"
		12.00	12.45	"	D.P	1	2	2	4					"
		13.50	13.95	"	D.P	1	1	3	4					"
		15.00	15.45	"	D.P	1	1	2	3					"

For Techpro Engineers Pvt. Ltd.
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Abbreviation Used: U - Undisturbed Sample C-Core Sample D- Disturbed Sample P - Standard Penetration Test
R: Refusal (Standard Penetration Test (N) >100)