社会開発調査部報告書

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF SURFACE TRANSPORT (MOST)

MUMBAI PORT TRUST (MBPT)

NO. 52

FINAL REPORT

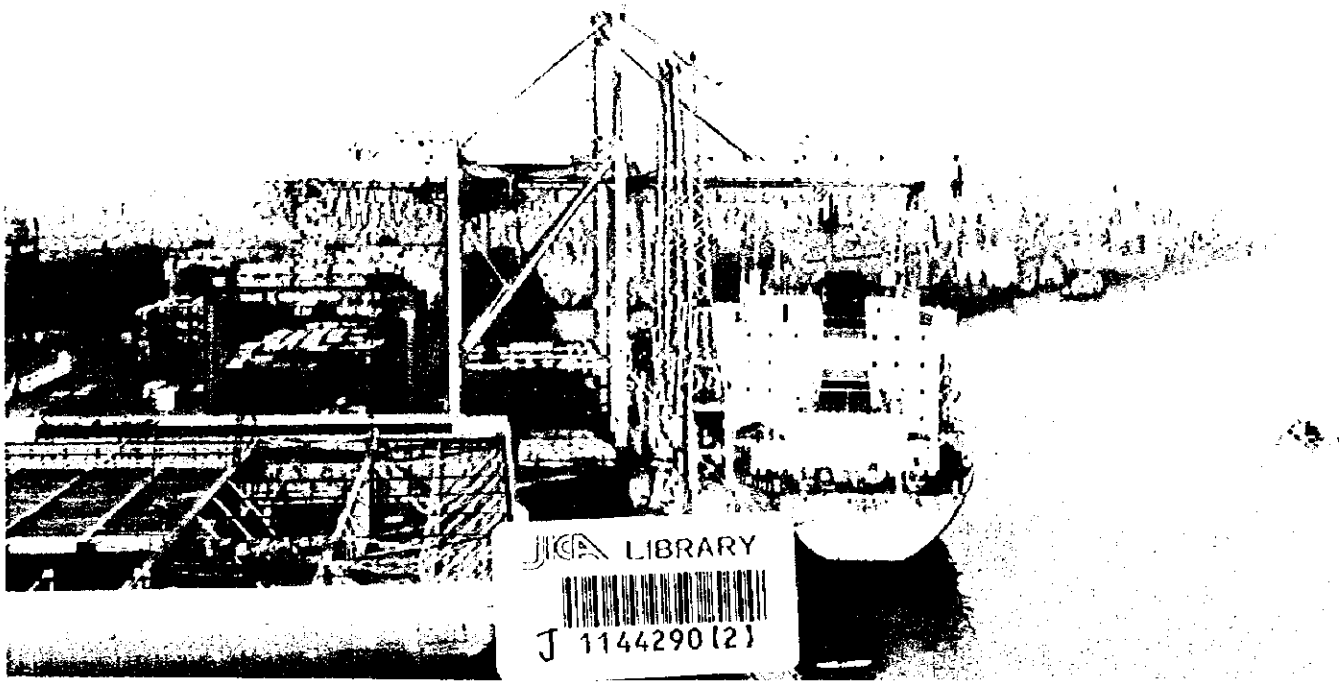
THE STUDY ON DEVELOPMENT OF THE PORT OF MUMBAI IN INDIA

(SUMMARY)

PART 1 PRESENT CONDITIONS

PART 2 MASTER PLAN

PART 3 SHORT-TERM PLAN



MARCH 1998

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)

JAPAN PORT CONSULTANTS, LTD. (JPC)

FINAL REPORT THE STUDY ON DEVELOPMENT OF (SUMMARY)
PART 1 PRESENT CONDITIONS
PART 2 MASTER PLAN

The following foreign exchange rates are applied in this study:

US$ 1.00 = Indian Rs. 35.10 = ¥113.8 (as of May, 1997)

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PREFACE

In response to a request from the Government of India , the Government of Japan decided to conduct a study on development of the Port of Mumbai in India and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team to India three times between February 1997 and February 1998, which was headed by Mr. Yugo Otsuki and was composed of members from the Overseas Coastal Area Development Institute of Japan (OCDI) and Japan Port Consultants, Ltd. (JPC).

The team held discussions with the officials concerned of the Government of India and conducted field surveys at the port. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of India for their close cooperation they extended of the team.

March, 1998

Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

March, 1998

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Mr. Fujita:

It is my great pleasure to submit herewith the Report for the Study on Development of the Port of Mumbai in India.

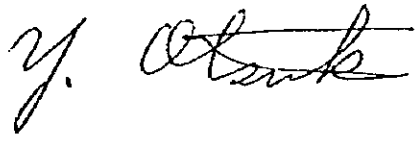
The study team which consists of the Overseas Coastal Area Development Institute of Japan (OCDI) and Japan Port Consultants, Ltd. (JPC), headed by myself, conducted a survey in India from February 1997 to February 1998 as per the contract with the Japan International Cooperation Agency.

The findings of this survey were fully discussed with the officials of the Mumbai Port Trust and other authorities concerned to formulate the Master Plan for the period up to the year 2017 and to formulate and examine the feasibility of the Short-term Plan for the period up to the year 2007, and were then compiled into this report.

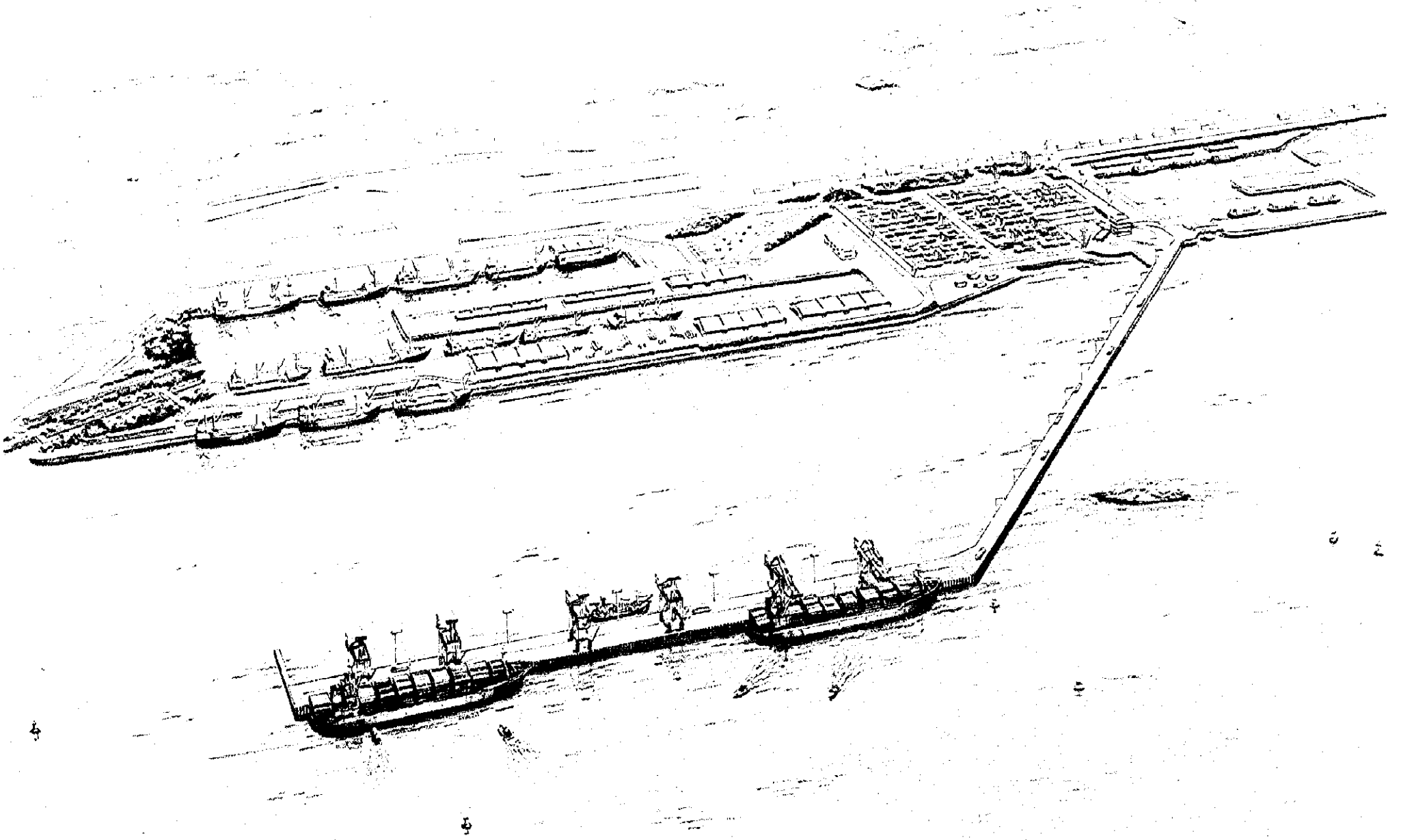
On behalf of the study team, I would like to express my deepest appreciation to the Government of India, Mumbai Port Trust and other authorities concerned for their brilliant cooperation and assistance and for the heartfelt hospitality which they extended to the study team during our stay in India.

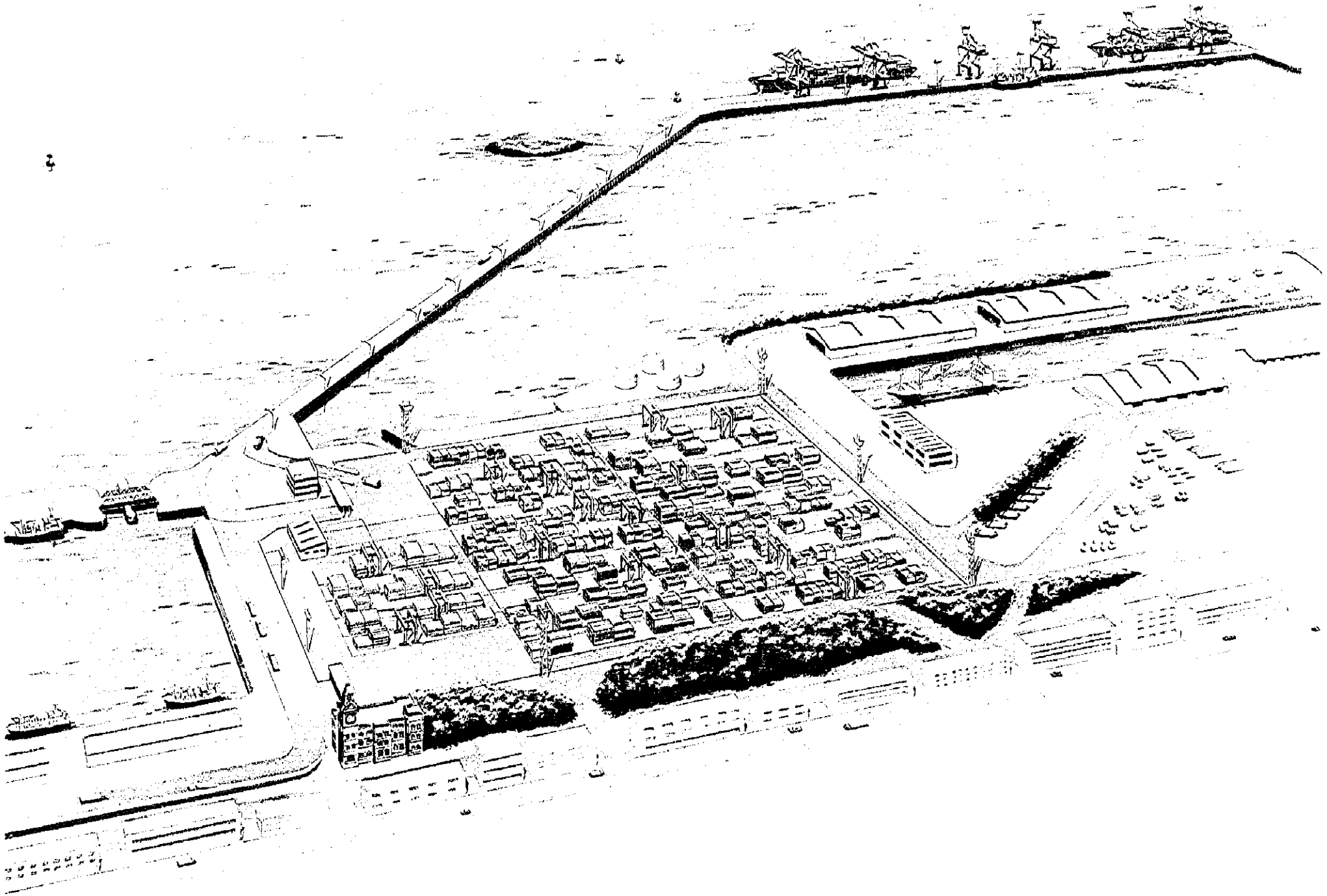
I am also greatly indebted to the Japan International Cooperation agency, the Ministry of Foreign Affairs, the Ministry of Transport and the Embassy of Japan in India for giving us valuable suggestions and assistance during the preparation of this report.

Respectfully,



Yugo Otsuki
Leader of the Study Team for the Study on Development of the Port of Mumbai in India





ABBREVIATIONS

ACR	Annual Confidential Report
A/N	Arrival Notice
1A	20 Foot Container
BARC	Bhabha Atomic Research Center
B/C	Benefit/Cost
BI	Butcher Island
BIS	Bureau of Indian Standard
B/L	Bill of Lading
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantity
BOT	Build-Operate-Transfer
B&P	Bertlin and Partners
BPCL	Bharat Petroleum Corporation Limited
BPS	Ballard Pier Station, Ballard Pier South
BPX	Ballard Pier Extension
CARMINS	Cargo Management and Information System
CD	Chart Datum
CDW	Cotton Depot West
CFS	Container Freight Station
CIF	Cost, Insurance and Freight
CLP	Container Load Plan
COD	Cotton Depot, Chemical Oxygen Demand
CONCOR	Container Corporation of India
CPA	Closest Position of Approach
CPCB	Central Pollution Control Board
CRS	Central Railway Stores
CRZ	Coastal Regulation Zone
CTCS	Container Traffic and Control System
CUM	Cubic Metre

CWC	Central Warehousing Corporation
CWPC	Central Water and Power Commission
CWPRS	Central Water & Power Research Station
1C	40 Foot Container
dB	Decibel
DCI	Dredging Corporation of India
DD	Designed Depth
DF	Dual Frequency
DGPS	Differential Global Positioning System
Dk	Dock
DO	Dissolved Oxygen
D/O	Delivery Order
DRCM	Direct Reading Current Meter
DWT	Dead Weight Tonnage
E	East
EIA	Environmental Impact Assessment
EIR	Equipment Interchange Receipt
EIRR	Economic Internal Rate of Return
EIS	Executive Information System, Environmental Impact Statement
EL	Entrance Lock
EMPA	Europe Maritime Pilot Association
E/P	Export Permission
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETP	Efficient Treatment Plant
FA & CAO	Financial Adviser & Chief Accounting Officer
FB	Frere Basin
FCL	Full Container Load
FMS	Financial Management System
FOB	Free on Board
FW	New Ferry Wharf

G	Green
GAP	Ganga Action Plan
GDP	Growth Domestic Products
GLD	General Landing Date
Gp.Fl.	Group Flashing
GPS	Global Positioning System
GRT	Gross Registered Tonnage
HC	Harbor Channel
HJ	Haji Bunder
HP	Horse Power
HPCL	Hindustan Petroleum Corporation Limited
HTL	High Tide Line
HY	Hay Bunder
Hz	Hertz
IALA	The International Association of Lighthouse Authority
ICD	Inland Container Depot
ID	Indira Dock
IDB	Indira Dock Berth
IDH	Indira Dock Harbor Wall
ID-HW	Indira Dock Harbor Wall
IEE	Initial Environmental Examination
IGM	Import General Manifest
ILAC	Ilac Limited
IMD	Indian Meteorological Department
IMO	International Maritime Organization
IS	Indian Standard
ISO	International Standardization Organization
JD	Jawahar Dweep
J/E	Jetty End
JICA	Japan International Cooperation Agency
JNP	Jawaharlal Nehru Port

JNPT	Jawaharlal Nehru Port Trust
JVC	Joint Venture Companies
KPT	Kandla Port Trust
kt	Knot
L	Length
LCL	Less than Container Load
LOA	Length Overall
LPG	Liquid Petroleum Gas
LTL	Low Tide Line
M	Mile, Million
m	metre
MBP	Mumbai Port
MBPT	Mumbai Port Trust
MCGB	Municipal Corporation of Greater Bombay
MD	Maintained Depth, Manganese Depot
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLD	Million Litre per Day
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
MMRDA	Mumbai Metropolitan Region Development Authority
MOD	Manganese Ore Depot
MOEF	Ministry of Environment and Forest
MOST	Ministry of Surface Transport
MOT	Marine Oil Terminal
M/P	Master Plan
MPCB	Maharashtra Pollution Control Board
MPN	Most Probable Number
MSR	Mazagaon Sewri Reclamation
M/R	Mate's Receipt
MT	Motor Tanker, Metric Ton

MV	Motor Vessel
MWL	Maintained Water Level
N	North
ND	Not Detected
NE	Northeast
NGO	Non Governmental Organization
NIO	National Institute of Oceanography
NM	Nautical Mile
NNE	North Northeast
NOI	Net Operating Income
N.O.S.	Not Otherwise Specified
NRT	Net Registered Tonnage
NW	Northwest
NWDB	National Wasteland Development Board
Occ	Occulting
OIL	Oil India Limited
ONGC	Oil and National Gas Corporation Limited, Oil&Natural Gas Commission
ORZ	Ocean Regulation Zone
PC Slab	Prestressed Concrete Slab
PD	Prince's Dock
pH	Potential Hydrogen
POL	Petroleum,Oil and Lubricant
PP	Pir Pau Oil Terminal
PPT	Parts per Trillion
PS	Horse Power
Q	Quick
QGC	Quay side Gantry Crane
R	Red
RCD	Railway Container Depot
RCF	Rashtriya Chemical & Fetilizers
RS	Reach Stacker

Rs.	Rupee
RTG	Rubber Tired Gantry Crane
S	South
S/A	Shipping Application
SE	Southeast
S/O	Shipping Order
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SSW	South Southwest
SW	Southwest
T&L	Tug & Launch
TC	Turning Circle
TEU	Twenty Foot Equivalent Unit
TP	Timber Pond Depot
TPM	Total Particulate Matter
TPS	Timber Pond South
TV	Television
UKC	Under Keel Clearance
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program
VD	Victoria Dock
VHF	Very High Frequency
VTMS	Vessel Traffic Management System
VTS	Vessel Traffic Service
W	West, White
WA	Wadala Area Depot
WHO	World Health Organization
YAP	Yamuna Action Plan

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EXECUTIVE SUMMARY

Executive Summary

1. Background of the study

Maritime transport has played a vital role in international and domestic trades in India. Indian ports have actively contributed to the national economy. Recently Indian ports have experienced a rapid growth in cargo volume owing to the liberalization policy of the national economy and consequent increase in foreign investments to India. The cargo volume is expected to further increase by attracting more foreign investments due to advantages of large population and relatively low level of wages. Many of the ports, however, are suffering from port congestion caused by insufficient port capacity.

Taking the facts into account, Government of India has launched a new port policy which includes deregulation and privatization. Based on these basic policies, the port sector is trying to enforce various measures such as port modernization, introduction of special technology, diversification of financial resources to achieve high efficiency.

The Port of Mumbai, administrated and managed by MBPT is the largest port in India in terms of cargo volume handled. The port handled cargo of 34 million tons (16% of the total volume handled by Indian ports) and containers of 518,000 TEUs (40% of the total) contributing to the regional economy in its hinterland. The port is situated in the proximity of the densely-populated old Mumbai and has a constraint of space limitation for expansion. To complement the shortage of the capacity of the port under the space limitation, the Port of Jawaharlal Nehru and started its operation in 1989 to handle container and dry bulk cargoes.

Some of those cargoes still continue to come to the Port of Mumbai even after the Port of Jawaharlal Nehru becoming fully operated, because the commercial functions stay behind the Port of Mumbai are conveniently discharged or shipped at the port.

Therefore, the Port of Mumbai needs a master plan on the basis of reasonable allocation of their functions, satisfying social and commercial requirements of the port.

2. Objectives of the study

The objectives of the study are:

i) to formulate a master plan for the development of the Port of Mumbai for the period up to the year 2017, and

ii) to conduct a feasibility study on the short-term development and improvement plan of the Port of Mumbai for the period up to the year 2007.

3. Outline of the Master Plan and the Short-term Plan

3.1 Port facility plan

The plans of volumes of cargo, port facilities and construction costs proposed in this study are outlined in the table below.

Item	Short-term Plan	Master Plan
1. Target Year	2007	2017
2. Volume of Cargo		
Container (TEUs)	1,000,000	1,000,000
3. A New Full-scale Container Terminal		
3.1 Construction of infra-structure		
(1) Off-shore jetties with berth length of 900m and water depth of 13.5m below CD	*	---
(2) Connection bridge with 4 lanes and length of 1,180m	*	---
(3) Marshaling yard with area of 19.0ha and total storage capacity of 11,196 TEUs (3,732 ground slots)	*	---
(4) Dedicated container road with fly-over brigde: length of 700m	*	---
(5) Off-dock container depots with area of 15.5ha and total storage capacity of 6,336 TEUs (2,112 ground slots)	*	---
(6) Supplementary jetty to prevent waves for port service crafts: length of 100m	*	---
3.2 Construction of super-structure		
(1) Two CFSs (Container Freight Station) with floor apace of 19,200 sq.m	*	---
(2) Terminal control office	*	---
(3) Gate house	*	---
(4) Repair shop	*	---
3.3 Preparation of water facilities		
(1) Deepening the existing approach channel with water depth of 11.0m below CD	*	---
(2) Creation of turning basin with diameter of 520m and water depth of 11.0m below CD	*	---

(3) Navigational aids	*	---
3.4 Procurement of container-handling equipment		
(1) Six quay-side container gantry cranes	*	---
(2) 18 RTGs (Rubber Tyred Gantry Crane) (6 rows+1lane)	*	---
(3) Four Reach stackers	*	---
(1) 97 Yard tractor-trailer units	*	---
(2) 55 Road tractor trailer units	*	---
4. Improvement of the Main Channel		
(1) Deepening the present water depth to 12.0m deep below CD in terms of controlled depth	---	*
(2) Widening of the channel at the narrow places to 500m wide	---	*
4. Construction Costs (Billion Rs.)		
(1) A New Full-scale Container Terminal	20.0	---
(2) Improvement of the Main Channel	---	3.9

3.2 Improvement of the Main Channel

1) It should be noted that the main beneficiary of the project is JNP.
2) It is recommended that the commencement timing of the project be periodically reviewed in the future due to the actual increasing trend of future container traffic.

3.3 Management / Operations and Institutional Matters

1) Introduction of a closed terminal operation system
2) Comprehensive management by a terminal operator at the new container terminal
3) Transfer of some personnel from MBPT
4) Development of human resources through on-the-job training by foreign experts

4. Evaluation of Feasibility of the Short-term Plan

4.1 Economic Feasibility

A comparison between the "without-the-project" case and the "with-project" case was carried out to evaluate the feasibility of the project for construction of a new container terminal including

deepening the access channel, preparation of off-dock container depots and construction of a new dedicated container road with a fly-over bridge at MBP proposed in the Short-term Plan from the viewpoint of the national economy of India. The main economic benefits of the project are saving on sea transport costs for containers through MBP, port staying and off-shore waiting costs of container vessels calling at the port. The resulting economic internal rate of return (EIRR) of the project is estimated as 16.9%, exceeding the general criterion to assess the economic feasibility.

4.2 Financial Viability

The financial revenues are generated from port charges based on the tariff proposed to cover capital investment and operational costs by referring to the current tariff level and that of the neighboring port. The resulting financial internal rate of return (FIRR) of the project is estimated as 10.2% which exceeds the weighted average interest rates of assumed fund raising plans and hence the project is considered to be financially feasible.

5. Outline of Recommendations

1) It is proposed that the new container terminal should be wholly controlled by a terminal operator. The terminal operator should take the full responsibility of receipt, storage and delivery of the containers at the terminal. The terminal operator should supervise the overall container handling operation at the terminal by conducting yard planning and inventory control of containers. As for the organization of the terminal operator, the followings are considered.
   - one department of MBPT
   - establishing a new organization that is financially independent of MBPT
   - private sector as a lessee of the terminal facility and cargo handling equipment

2) The terminal operator needs to have the necessary number of personnel to handle containers efficiently and to manage the organization efficiently. It is necessary to select and transfer highly motivated workers or staff of MBPT on condition that trade unions of MBP agree. The terminal operator needs to invite foreign experts to assist in on-the-job training for terminal

employees.

3) It is necessary to raise the wage rate or allowance as incentives if workers gain skill and expertise through the training and consequently improve the efficiency of container handling. In the long run, it is necessary to consider the establishment of joint ventures with foreign companies for further improvement of the operation and management if private sector involvement develops in the port.

ORGANIZATION OF THE STUDY TEAM

ORGANIZATION OF THE STUDY TEAM

The study team is comprised of 11 specialists. This names and responsibilities are listed below;

Name	Responsibilities
Yugo Otsuki	Team Leader, Overall Management (OCDI)
Masahiko Furuichi	Port Planning, Environmental Impact Assessment (OCDI)
Nobuaki Kojima	Navigation Safety (OCDI)
Tadahiko Kawada	Demand Forecast, Economic Analysis (OCDI)
Shinichi Tezuka	Cargo Handling System (OCDI)
Shinobu Yamamoto	Port Management and Operation, Financial Analysis (OCDI)
Kenichi Sasaki	Design, Cost Estimation (JPC)
Tadasu Okude	Machinery, Equipment (JPC)
Anil Kumar Bhakta	Natural Survey, Dredging (JPC)
Sukriti Mandal	Environmental Survey (1) (JPC)
Tarun Kumar Acharya	Environmental Survey (2) (JPC)
Harutoshi Usui	Coordinator (OCDI)
Hideki Kobayashi	Coordinator (OCDI)
Toshihiro Okura	Coordinator (OCDI)

SUMMARY

Part I PRESENT CONDITIONS

1.1 Socio-Economic Condition of Mumbai Metropolis, Maharashtra State and India

1.1.1 Population

(1) Population of India

India has the second-largest population in the world, exceeded only by that of China. It had 439 million people in 1961, 548 million in 1971, 683 million in 1981, and 846 million in 1991. Estimates for 1996 put the figure at 932 million. (see Table 1.1.1-1).

Table 1.1.1-1 Growth of Population

	Item	unit	1931	1941	1951	1961	1971	1981	1991
India	Population	million	279.0	318.7	361.1	439.2	548.2	683.3	846.3
	Decennial growth	%	11.0	14.2	13.3	21.6	24.8	24.7	23.8
	average annual growth rate	%	1.0	1.3	1.3	2.0	2.2	2.2	2.2
Maharashtra State									
	Population	million	NA	NA	32.0	39.6	50.4	62.8	78.9
	Decennial growth	%	NA	NA	19.3	23.6	27.5	24.5	25.7
	average annual growth rate	%	NA	NA	1.8	2.2	2.4	2.2	2.3
Mumbai Metropolitan									
	Population	million	NA	NA	3.0	4.2	6.0	8.2	9.9
	Decennial growth	%	NA	NA	64.4	38.7	43.8	38.1	20.4
	average annual growth rate	%	NA	NA	5.1	3.3	3.7	3.3	1.9

(Source: Statistical Outline of India 1996-97, Registrar General and Census Commissioner, Administrative Reports of Municipal Corporation of Greater Mumbai)

Note : Estimates are as on 1st March of the year as per Census of India

(2) Population of Maharashtra State

Maharashtra is the third largest State in India both in terms of population and area. Its booming capital, Mumbai, makes it one of the most important states economically in India. The population of Maharashtra according to the 1991 Census was 78.9 million.

(3) Population of Mumbai Metropolis

Mumbai is the capital of Maharashtra State and the economic powerhouse of India. The population in the Mumbai Metropolitan Region as per the 1991 Census was 9.9 million. (see Table 1.1.1-1).

1.1.2 Gross Domestic Product (GDP)

(1) GDP

The Indian GDP amounted to around 2.742 billion Rupees (Rs) in the fiscal year of 1995-

96 at constant price of the year 1980-81 (see Table 1.1.2-1).

The income of Maharashtra State in 1995-96 is estimated to be 388,430 million Rupees (Rs) at constant (1980-81) price. (see Table 1.1.2-2)

Table 1.1.2-1 Trend of Indian GDP at Factor Cost (At 1980-81 prices)

(Unit: Rs.million)

Item Year	1970-71	1980-81	1986-87	1987-88	1988-89	1989-90	1990-91
GDP	904,260	1,224,270	1,632,710	1,703,220	1,884,610	2,014,530	2,122,530
Growth rate	#3.7	#3.1	4	4	11	7	5

Item Year	1991-92	1992-93	1993-94	1994-95	1995-96$
GDP	2,139,830	2,252,680	2,388,640	2,560,950	2,742,090
Growth rate	1	5	6	7	7

(Source: Economic Survey 1996-97)

Note #: average annual growth rate, $: quick estimates

Table 1.1.2-2 Net State Domestic Products & Capital Income of Maharashtra State

(at 1980-81 price)

	Unit	1980-81	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Primary	Rs.million	42,610	61,810	47,610	63,490	67,770	65,480	71,610
Growth rate	%		-5.9%	-23.0%	33.4%	6.7%	-3.4%	9.4%
Secondary	Rs.million	53,210	195,090	94,690	102,040	112,870	125,700	136,650
Growth rate	%		13.6%	-51.5%	7.8%	10.6%	11.4%	8.7%
Tertiary	Rs.million	55,810	115,440	126,390	138,660	156,280	166,700	180,170
Growth rate	%		8.7%	9.5%	9.7%	12.7%	6.7%	8.1%
N.S.D.P	Rs.million	151,630	272,450	268,690	304,190	336,920	357,880	388,430
Growth Rate	%		4.6%	-1.4%	13.2%	10.8%	6.2%	8.5%
Per Capita Income	Rs	2,435	3,486	3,365	3,736	4,057	4,227	4,500
Growth Rate	%		2.1%	-3.5%	11.0%	8.6%	4.2%	6.5%

(Source: Directorate of Economics and Statistics, Government of Maharashtra)

(2) GDP by Sector

The agriculture sector in 1995-96 is 684,800 million Rs, followed by the manufacturing sector (585,050 million Rs) , transport sector (386,120 million Rs) and banking sector (239,720) .

In Maharashtra State, the tertiary sector in 1995-96 is 584,990 million Rs, followed by the secondary sector (452,800 million Rs) and primary sector(277,990 million Rs) at 1980-81 price.

(3) GDP per Capita

Tables 1.1.2-3 show GDP per capita in India expressed at constant price (1980-81 price). Per capita income in Maharashtra state is shown in Table 1.1.2-2.

Table 1.1.2-3 Trend of Per capita at 1980-81 Prics

(Unit: Rs)

Item	1986-87	1987-88	1988-87	1989-90	1990-91	1991-92
Per Capita	2,373	2,434	2,619	2,732	2,839	2,800
Growth Rate (%)	2.6	2.6	7.6	4.3	3.9	-1.4

Item	1992-93	1993-94	1994-95
Per Capita	2,896	2,957	3,090
Growth Rate (%)	3.4	2.1	4.5

(Source: Central Statistical Organization)

1.1.3 Foreign Trades

(1) Trade of Export / Import Value

The foreign trade value of export in 1995-96 was about 1,063 billion Rupee (Rs) while that of imports was about 1,227 billion Rs..

As to commodity-wise share in trade value , in export, textile fabrics & manufactured take the largest share accounting for 23% of the total export in 1995-96, followed by handicrafts, gems and jewelry, machinery including transport and metal manufactures. On the other hand, in import, the major commodities are petroleum including lubricant, non-electrical machinery apparatus and appliances including machine tools and chemical element and compounds.

(2) Trend of Export / Import Value by Main Countries

Table 1.3.2 shows the major trade partners of India. Asia, USA, Japan, Germany, Saudi Arabia and Africa have historically been the major trade partners in both export and import

1.1.4Industry

(1) Agriculture

The production value of agriculture, a major industry in India for a long time, increased by

32% at 1980-81 constant price in the last decade.

As to the yield of major crops in 1995-96, sugarcane registered the largest volume of 282.9 million tons, followed by rice (79.6 million tons), wheat (62.6 million tons), potato(19.2 million tons), oilseeds(22.4 million tons), pulses(13.2 million tons), tea(0.8 million tons), rubber(0.5 million tons), coffee(0.2 million tons) and cotton(13.1 million bales)

(2) Manufacturing

a) Food

The production of sugar amounted to 16.5 million tons in 1995-96, an increase of 1.9 million tons from the previous year. Two years of record output of sugar resulted in accumulation of a large stock. In the sugar season in 1995-96, 0.9 million tons of sugar was exported.

b) Textiles

The textile industry is the largest industry in India accounting for about one-fifth of the total industrial output and around one-third of total export earnings, and provides employment for over 20 million people. The production of cotton yarn showed an increase of 5.1% in 1995-96 over the preceding year.

c) Fertilizer

Fertilizer consumption of nutrient terms rose from 0.3 million tons to 5.5 million tons in the period from 1960-61 ~ 1980-81 and further increased the following decade to 12.5 million tons; in 1995-96 it is estimated at 13.9 million tons.

d) Steel

Production of finished steel is estimated as 21.4 million tons in 1995-96 showing a growth rate of 20% over the preceding year. The volume of exported steel was 2 million tons in 1995-96.

(2) Mines

a) Iron Ore

The production of iron ore peaked in 1995-96 at 64.1 million tons. In the period of 1990-91~1994-95, the average volume of iron ore production was over 53 million tons. Annual growth rate increased by 16.7% over the previous year. The volume of export amounted to 31.7% in 1995-96.

1.1.5 Energy

(1) Electric Power

In 1995-96, power generation of India in utility amounted to 380.1 billion kwh, comprising hydro (17.5% of the total in utilities), thermal (72.2%)and nuclear(1.9%).

The main consumers of power are industry, agriculture, transport and household. Among them, the industrial sector is the largest consumer, using 120.9 billion kwh in 1993-94, 2.2 times as much as that in 1980-81.

Energy requirement in 1994-95 was 352.3 billion kwh against the supply of 327.3 kwh.

Central Government has launched a renovation and modernization plan of the thermal and hydro plants to meet the increasing demand.

In Maharashtra State, the installed capacity of electricity generation was 10,039MW in 1995-96. The thermal capacity accounted for 71.3% of the total, followed by hydro (15.9%), natural gas (10.9%) and nuclear (1.9%). The total consumption of electricity in 1995-96 was 45,924 million kwh.

(2) Coal

Coal is one of the primary sources of energy accounting for about 67% of the total energy consumption in India. Coal production amounted to around 272.5 million tons in 1994-95 and was estimated as 292 million tons in 1995-96.

(3) POL

a) Crude Oil

The production of crude oil amounted to 35.1 million tons in 1995-96, comprising 11.9 million tons in on-shore and 22.7 million tons in off shore. Domestic production in 1995-96 increased over the preceding year. On the other hand, import of crude increased from 20.7 to

30.8 million tons in the period of 1990-91~ 1993-94 and it decreased by 3.5 million tons up to1995-96.

b) Oil Products

The total refined crude oil throughput in 1995-96 is 58.6 million tons with a growth of 4.1% over the preceding year, supplied by domestic production and import of crude oil. The domestic consumption of oil products (72.6 million tons in 1995-96) exceeded domestic production, and the balance was imported. The grades of oil domestic products are categorized as Naphtha, Kerosene, High speed diesel oil, Fuel oil etc.

1.1.6 Government Budget

The Indian Budget amounted to 3,395 billion Rupees (Rs) in the fiscal year of 1995-96. Budget for investment for development of infrastructure such as enlargement of power supply, expansion of roads, railways and ports accounted for over 60% of the total budget until 1990-91. Since then ,the proportion of the budget allocated to infrastructure development has gradually decrease, registering 56.1% in 1995-96.

The budget of Maharashtra State was 256 billion Rupee (Rs) in 1996-97. Development share accounted for 60.8% of the total budget in 1996-97. In the last three fiscal years from 1994-95 to 1996-97, the development share decreased from 70.4% to 60.8% .

1.1.7 Eighth Five Year Plan (1992-1997)

(1) Objective

The Eighth Five Year Plan (1992-1997) focuses on the following :

(i) Clear prioritization of sector / projects for investment in order to facilitate operation-alisation and implementation of the policy initiatives taken in the areas of fiscal, trade and industrial sectors and human development;

(ii) Making resources for these priority sectors available and ensuring their effective utilisation; and completion of project on schedule avoiding cost and time overruns;

(iii) Creation of a social security net through employment generation, improved health care and provision of extensive education facility throughout the country; and

(iv) Creation of appropriate organization and delivery systems to ensure that the

benefits of investment in the social sectors reach the intended beneficiaries.

(2) Based on this approach , the following objectives are given priority :

(i) Generation of adequate employment to achieve near full employment level by the turn of the century;

(ii) Containment of population growth through people's cooperation and an effective scheme of incentive and disincentives;

(iii) Universalisation of elementary education and complete eradication of illiteracy among the people in the age group of 15 to 35 years;

(iv) Provision of safe drinking water and primary health care facilities, including immunisation, accessible to all the villages and the entire population, and complete elimination of scavanging;

(v) Growth and diversification of agriculture to achieve self - sufficiency in food and generate surpluses for export;

(vi) Strengthening the infrastructure(energy, transport, communication, irrigation) in order to support the growth process on a sustainable basis;

1.1.8 Ninth Five Year Plan (1997-2002)

The Planning Commission of the Indian Government has released the Approach Paper for the Ninth Five Year plan (hereinafter referred to as "the Ninth Plan") spelling out its approach, objectives and emerging issues, macro economic dimensions, development strategy and policy priority, sectoral strategy, cooperative federalism, implementation and delivery systems as a prelude to the formation of the Ninth Plan.

(1) Approach, objectives and emerging issues

The principal function of the Ninth Plan is to develop a shared vision in which each component of the economy plays its role towards a common purpose.

(2) Macro dimension of the plan

The macro-economic performance of the economy that is likely during the Ninth Plan has been worked out on the basis of a model that has been developed specifically for this purpose. The detailed quantitative projection of the base-line growth scenario for the Ninth Plan is

presented in Table 1.1.8-1.

Table 1.1.8-1 Macro Parameters of Base-Line Scenario

Growth Rate (% per annum)	IX Plan	Post Plan
GDP	6.2	6.5
GDP Agriculture sector	4.5	NA
Population	1.7	NA

Note: NA Not available

(3) Development Strategy and Policy Priorities

Allocation of resources to economic sectors is governed by the need for consistency in the role of these sectors to achieve the desired growth and demand pattern. However, allocation to social sectors i.e., health, education needs, poverty alleviation etc., is on the basis of perception of policy makers and planners concerning the of needs of these sectors, within overall constraints of available resources. There is no standard set of criteria for allocation within the sector.

(4) Sectorial Strategies

Economic development of regions such as North East where adequate growth has not been observed is essential.

(5) Implementation and delivery system

The Ninth Plan will give priority to improving project implementation and delivery mechanism to ensure intended benefits reach the people.

Strategy for the Ninth Plan.

i) Correctives to reverse many unsustainable trends in formulation and implementation of projects/schemes will be introduced.

ii) For infrastructure sector, better utilization of assets, early completion of ongoing projects will be emphasized and priority programs will be identified for formulation and implementation. The general guidelines are mentioned as follows.

a) Projects due for completion in the 8th plan, and in which less then 10% of approved outlay has been spent should be shelved considered for shelving.

b) Projects nearing completion should be accelerated with revised time - cost estimate.

c) Projects for completion in the Ninth Plan and beyond can be plan projects. No details will be needed for them.

d) For other projects justification is needed for continuation.

1.2 Natural Conditions in and around MBPT

1.2.1 General

The general information with respect to the natural condition for the study of technical aspects on the project was obtained through the previous study reports, structural drawings, survey results and various information supplied from MBPT and relevant authorities.

On the other hand, in order to assist in planning / designing of port facilities, certain detailed field investigations related to local conditions were made during this study. These investigations were made in two phases. Although the nature of investigation was quite similar in both phases, the first phase investigations emphasised to a large extent on siltation aspects and the second phase concentrated more on subsoil information to help in deciding the proposed berth location and dredging requirements.

Field investigations in the first phase conducted in April and May, 1997 were aimed to obtain information on the following natural conditions :-

(1) Observation of tidal current at five locations distributed within the harbour area.

(2) Bathymetric survey in navigable channels of Mumbai harbour and the water front of outer harbour wall of Indira dock.

(3) Sediment sampling of seabed at twenty locations distributed along the channels and analysis of samples collected.

(4) Sub-soil investigation on land along Indira dock outer harbour quay.

The field investigations in the second phase carried out in October and November, 1997 were planned to obtain information on the sub-soil condition at the location of proposed container berths and dredging areas. In addition, to assist in estimating the siltation in the harbour, certain surveys were also carried out .

The following field investigations were made in the second phase :-

(5) Shallow seismic survey of sea bed to acquire sufficient knowledge on the distribution and depth of rock ground at the location of proposed berths and areas to be dredged.

(6) Three in number marine bore holes along the proposed berths to identify the depth of bed rock.

(7) Observation of direction and velocity of tidal current at two locations .

(8) Sediment sampling of seabed at four locations to analyse the grain size distribution, specific gravity and settling velocity of sediments.

(9) Suspended sediment sampling, in order to obtain the vertical distribution of suspended sediment density.

1.2.2 Natural Condition

The natural condition of MBP and neighboring areas which should be applied in the engineering designs of the planned port facilities are as given in Table 1.2.2-1. The design condition will be determined in a realistic way so as to meet the actual service and other pertinent of the individual components of the port facilities and equipment planned when these become definable in more special terms.

1.2.3 Geological Characteristics at Project Area

The results of investigation mentioned in Item (5) above of Section 1.2.1 are compiled in Figure 1.2.3-1 and 1.2.3-2. According to the onshore and offshore soil boring, it is confirmed that the type of rock is mainly basalt and showing different grades of weathering. There is also the presence of murrum, with it properties varying in hardness and thickness depend on the degree of disintegration. The layer of weathered rock is overlain by residual soil which in turn is overlain by silty marine clay.

Table 1.2.2-1
General Information on Natural Conditions at Mumbai Port

No.	Item	Design Condition	Operational Condition	Remarks
1	Meteorological Conditions			
1-1	Wind speed	150 km per hour	70 km per hour	Source -1
1-2	Rainfall intensity	50 mm/hr.		
1-3	Temperature	min.10 deg., max.50 deg.		
1-4	Humidity	min.50 %, max.100%		
2	Sea Conditions			
2-1	Wave (max.)	H=3.0m, T=10sec, South		Source -1
2-2	Wave (significant)	H=1.5m, T=10sec, South		
2-3	Current	4 knots	3 knots	Source -1
3	Tied level			Source -2
3-1	HW (Highest Record)	+5.38 m		June 1924
3-2	MHWS	+4.42 m		
3-3	MHWN	+3.30 m		
3-4	Highest LW	+2.74 m		
3-5	Local mean sea level	+2.51 m		Survey Datum of India
3-6	Lowest HW	+2.48 m		
3-7	MLWN	+1.85 m		
3-8	MLWS	+0.76 m		
3-9	Chart Datum	±0.00 m		
3-10	LW (Lowest Recorded)	-0.44 m		October 1879
4	Soil Condition	(Composition of typical soil strata and properties are given below.)		
4-1	Surface Layer	Soft dark gray mud		
4-2	Upper Layer	Clayey or sandy stratum with stones and boulders		
4-3	Decomposed Rock	Basalt and Tuff		
4-4	Base Rock	Basalt and Tuff		
5	Seismic load	5% of dead load acting either in the longitudinal or transverse direction shall be considered.		

Source -1 Replacement of Submarine Pipelines and Modernization of MOT Berths
Detail Project Report Part II Modernization of MOT Berths, Bombay Port Trust, Oct.1994

-2 Bombay Port Trust Master Plan Volume I Main Report Bertlin and Pertners(India)1970

Note : These information will be used for the purpose of preliminary design of structure and data are subject to change through further investigation.

Figure 1.2.3-1 Recorded Level of Seabed

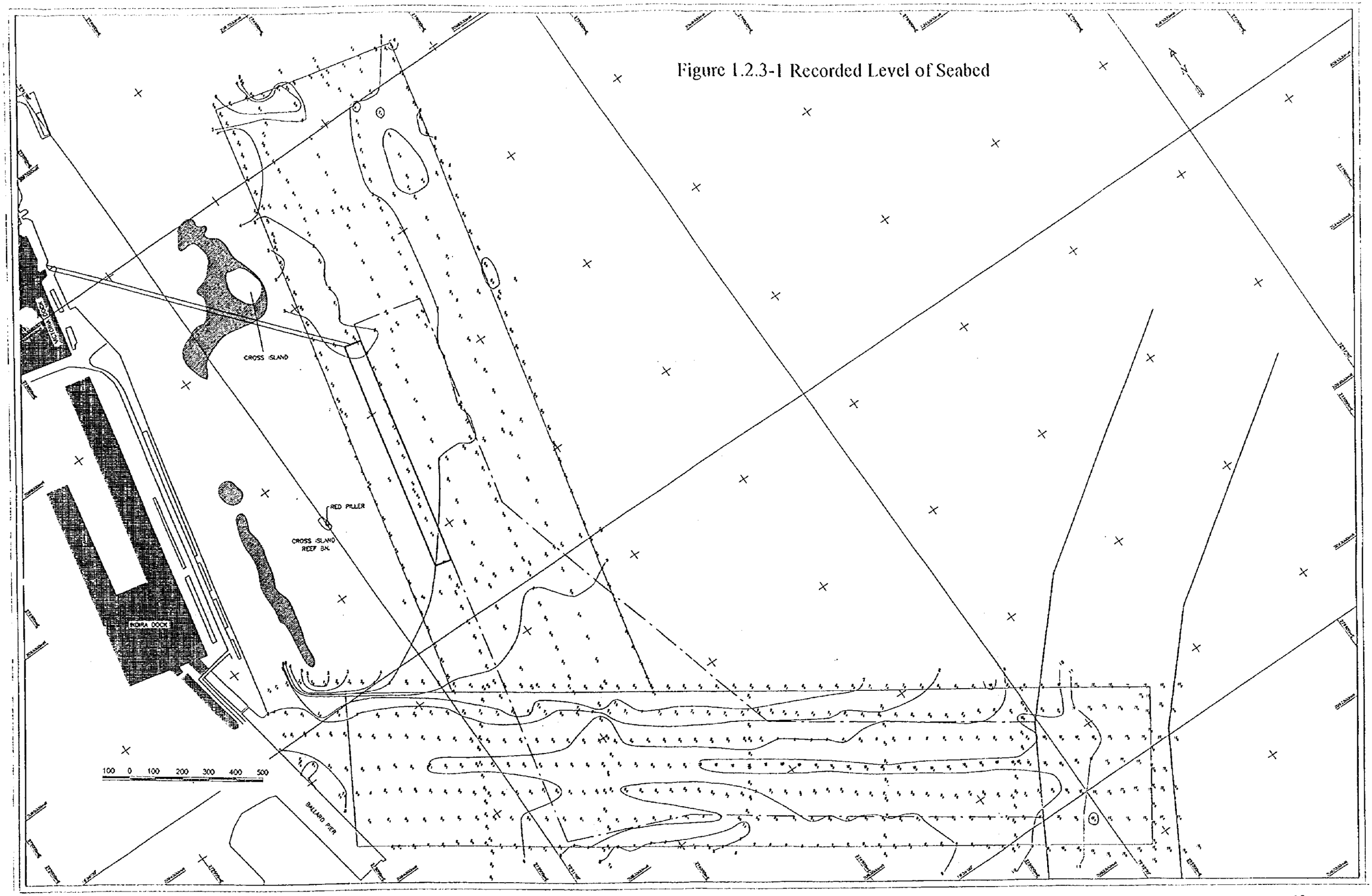
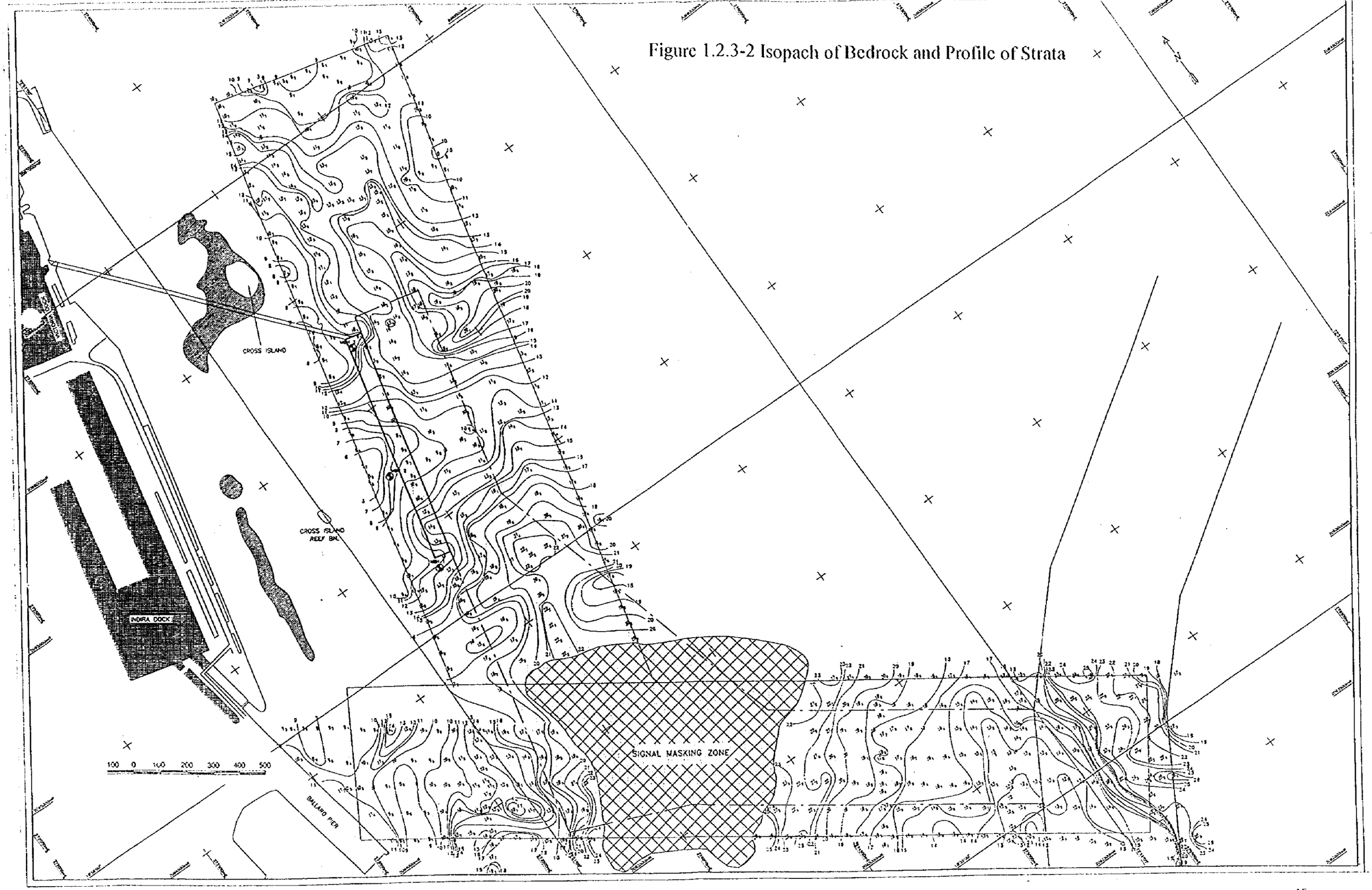


Figure 1.2.3-2 Isopach of Bedrock and Profile of Strata



1.3 Transport System of India

1.3.1 Ports in India

(1) Major Ports of India

There are 11 major ports in the country viz. Calcutta (including Haldia), Paradip, Visakhapatnam, Madras and Tuticorin on the East Coast and Cochin, New Mangalore, Mormugao, Jawaharlal Nehru, Mumbai and Kandla on the West Coast, which are under the control and supervision of the Ministry of Surface Transport. Development of major ports is constitutionally the responsibility of the Government of India. Import and export cargo handled by major ports are shown in Table 1.3.1-1 and Figure 1.3.1-1.

Table 1.3.1-1 Major Port Cargo Volume Handled in 1995-96

(Unit: thousand tons)

Name of Port	Import	Export	Transhipment	Total
Calcutta	4,250	1,874	-	6,124
Haldia	10,865	4,526	-	15,391
Paradip	4,196	7,059	4	11,259
Visakhapatnam	14,738	13,046	5,033	32,817
Madras	19,571	9,430	1,719	30,720
Tuticorin	7,955	1,331	-	9,286
Cochin	9,111	2,380	-	11,491
New Mangalore	1,883	7,001	-	8,884
Mormugao	1,948	15,276	871	18,095
Mumbai	17,064	16,617	367	34,048
JNP	4,139	2,558	176	6,873
Kandla	24,658	4,466	1,214	30,338
Total	120,378	85,564	9,384	215,326

Source) "Major Ports of India, A Profile:1995-96", Indian Ports Association

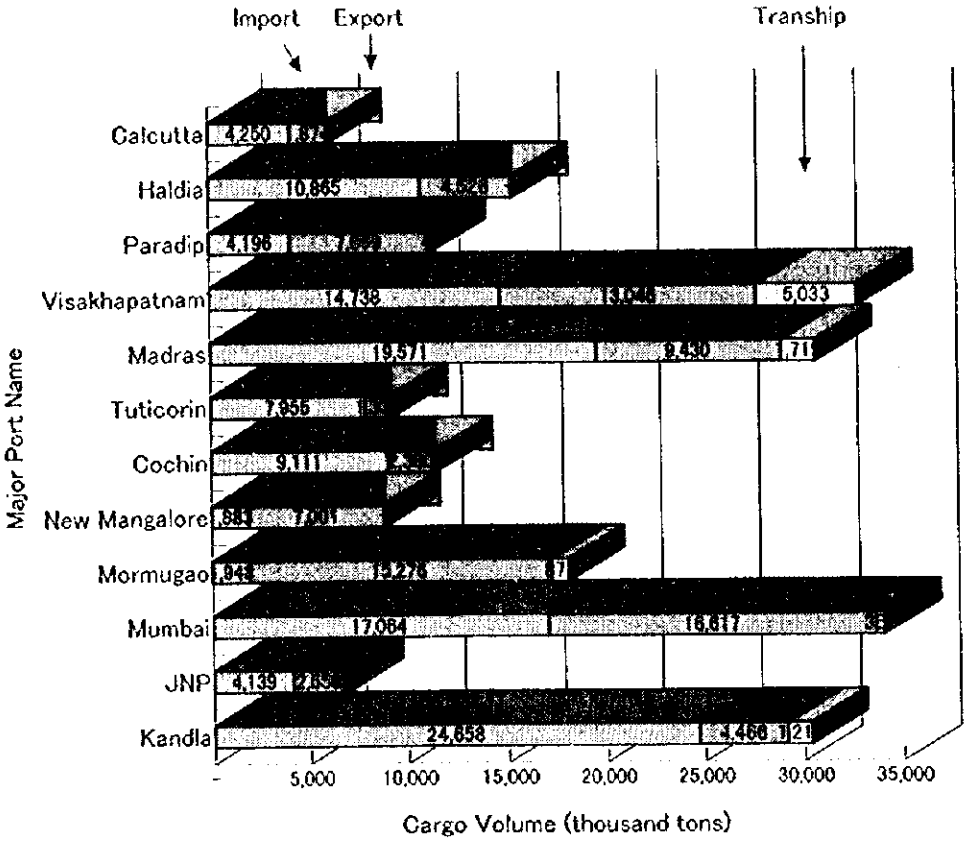


Figure 1.3.1-1 Major Port Cargo Volume Handled in 1995-96

(2) Minor Ports in Maharashtra State

There are 48 minor ports in Maharaashtra State along the coastline of 720 km running in the north-south direction from the State of Gujarat to Goa. The cargo volume handled by 48 minor ports in 1994-95 is 2.6 million ton.

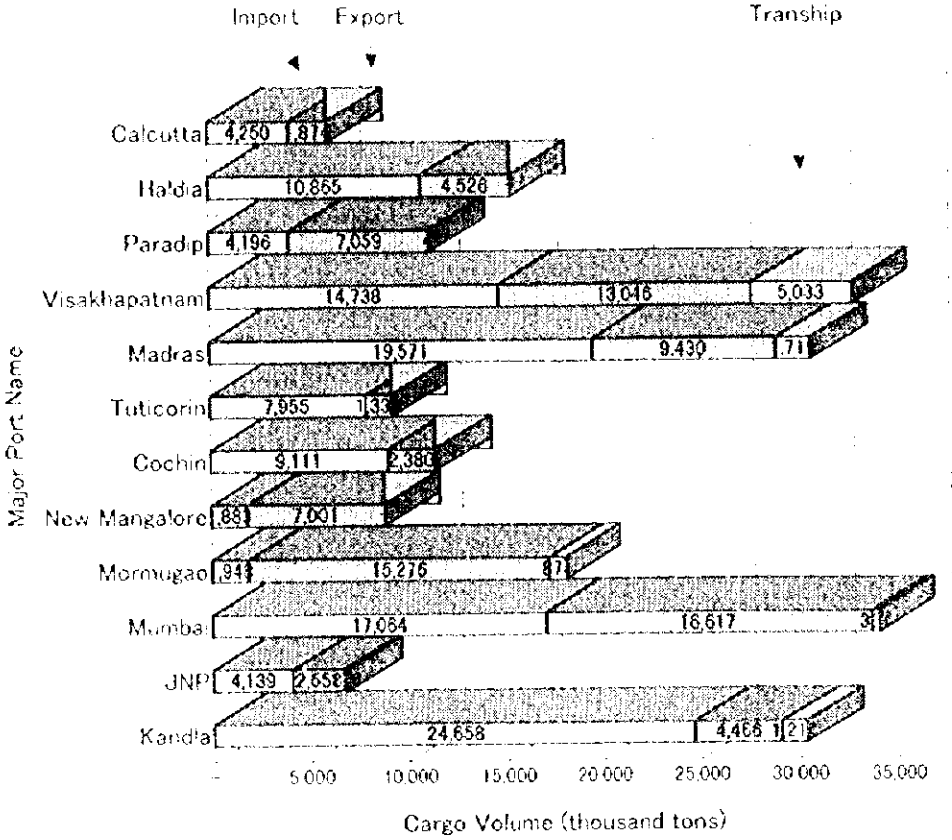
However, the State government has decided to develop all the 48 minor ports in the State through private participation. It has been decided to invite competitive bids from Indian companies for the development of the following seven minor ports;

1) Alewadi, 2) Dighi, 3) Dabhol, 4) Jaigad, 5) Ratnagiri, 6) Vijaydurg, 7) Redi

1.3.2 Port Administration System in India

(1) General

The Government of India owns all port properties. In India there are 11 major ports and some 139 intermediate and minor ports. The Indian Port Act 1908 applies to all ports in India regardless of the category of port. Major ports are Calcutta, Pradeep, Visakhapatnam, Chennai, Tuticorin,



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Minor and Intermediate Ports fall under the jurisdiction of the maritime states in which these ports are located and are administered through a department of state government headed by a Director of Ports or other Port Officer. In Gujarat and Maharashtra state, the Maritime Boards administer ports of respective state.

Port Trusts are administrated by the Boards of Trustees appointed for two year terms by the Government of India. Board members are selected from government departments, port labor and industry. In addition to infrastructure planning and construction, Port Trusts have the power to operate ship and cargo handling facilities and services and to make port regulations and to establish the level of port charges. They are required to submit to the Central Government, each year, budget estimates of revenue and expense but may not implement regulations or charges without the approval of the Government.

(2) Private Participation in the Port Sector

MOST recognizes that it is necessary to construct new facilities, modernize existing facilities, and expand cargo handling capacity to meet increasing amount of trade, especially exports. It also recognizes that it is imperative to secure private sector participation in the port sector without relying on financial resources of the Government. New guidelines have been published for private participation in ports for both leasing out of existing assets and construction and operation of new assets such as container terminals, cargo berths, warehousing, dry docking and ship repair. Private investment in ports will be on a BOT (Build-Operate-Transfer) basis.

(3) Development Plan of Container Terminal in JNP

JNP has planned to develop a new container terminal as an extension to the existing facilities through private investment on BOT basis. This is the first large project in the port sector to be implemented through private investment in India. The proposal is to construct a 600 meter long quay and reclaim an area of about 20 hectares for container yard. The terminal will have six quay gantry cranes, two of which will be of post panamax size, 15 yard cranes and three cranes for the

railway siding. Total investment of this project is estimated at about Rs. 700 crores.

1.3.3 Road Network in India

India has a total road network of around 2.9 million km which makes it the third largest road network in the world. However, this network is not adequate for speedy and efficient transportation. The national highway which is comprised of arterial routes currently has a network of 34,100 km. The table 1.3.3-1 shows the historical trend of length of roads in India

Road transport is the major transport mode for people and goods in India. Over 80% of passengers and over 60% of freight move by roads. It is estimated that by the year 2000 road traffic will account for 87% and 65% of passenger and goods traffic, respectively.

In Maharashtra State, as of 1994-95, the road length maintained by the PWD (Public Works Development) and ZPs (Zilla Parishads) together was about 185,000 km, consisting of the national highway (2,900 km), state highway(32,900 km),major district roads(41,600km), other district roads(41,200 km) and village roads(66,100 km).

Table 1.3.3-1 Length of Roads in India

Items	Unit	1970-71	1980-81	1990-91	1991-92	1992-93	1993-94	1994-95
Length of roads	thousand km							
Total		918.0	1,491.0	2,037.0	2,041.0	2,633.3	2,779.2	2,884.0
Surfaced		398.0	684.0	1,001.0	1,071.0	NA	NA	NA
Length of national highwaya	thousand km							
Total		24.0	32.0	33.7	33.7	34.1	34.1	34.1
Surfaced		23.0	32.0	33.7	33.7	34.1	34.1	34.1
Length of state highways	thousand km							
Total		57.0	94.0	127.0	128.6	130.8	133.0	135.3
Surfacsd		52.0	90.0	122.0	126.2	NA	NA	NA

(Source: Ministry of Surface Transport)

Table 1.3.3-2 Road Length and Type in Maharashtra State

(Unit: km)

Year	National highway	State highway	Major district roads	Other distr roads	Village roads	All roads
1965-66	2,364	10,528	12,628	8,744	17,524	51,788
1970-71	2,445	14,203	17,684	11,012	20,020	65,364
1975-76	2,860	15,032	19,925	14,506	36,434	88,757
1980-81	2,945	18,949	25,233	25,404	68,600	141,131
1985-86	2,937	19,260	26,157	28,478	76,839	153,671
1990-91	2,959	30,975	38,936	38,573	61,522	172,965
1991-92	2,959	31,076	38,984	39,316	62,159	174,494
1992-93	2,949	31,772	39,349	38,819	63,123	177,012
1993-94	2,953	31,947	40,142	40,440	65,379	180,861
1994-95(p)	2,953	32,947	41,642	41,240	66,079	184,861

Source: Public Work Department,Government of Maharashtra,Mumbai.

1.3.4 Railway Network in India

The Indian Railway is one of the important means of transport in the country, and consists of an extensive network spread over 62.9 thousand km comprising Broad Gauge (40.6 thousand km), Metro Gauge (18.5 thousand km) and Narrow Gauge(3.8 thousand km).During the last four decade the annual growth in the railway network has been negligible. However, the Indian railway has made substantial progress in electrifying routes from 3.7 thousand km in 1950-51 to 12.3 thousand km in 1995-96(see Table 1.3.4-1).

The present railway network is totally inadequate to handle the volume of passenger and freight traffic, which has been increasing continuously due to a rise in population and the rapid growth of trade and industry in the country. In order to meet these requirements, the Indian railways will have to put more emphasis on construction of new railway lines, doubling of existing lines, and electrification of railway routes.

In Maharashtra State, the railway has been the life line of Maharashtra's economy. The total length of railway routes in the State has increased marginally by 0.8% from 5.4 thousand km as of the end of March, 1985 to 5.5 thousand km at the end of March 1995.The total length of the railway line in Maharashtra was just 8.7% of the total railway length in the country(62.7 thousand km).

Table 1.3.4-1 Length of Railway in India

Items	Unit	1970-71	1980-81	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Route kilometers	(thousand km)								
Electrified		3.7	5.4	10	10.7	11.3	11.8	11.8	12.3
Total		58.8	61.2	62.4	62.5	62.5	62.5	62.7	62.9
Originating traffic	(million tons)								
Revenue- earning		167.9	195.9	318.4	338	350.1	358.7	365	390.6
Total trafic		196.5	220	341.4	360	370.9	377.5	381.6	404.9
Good carried	(billion tons-km)								
Revenue- earning		110.7	147.7	235.8	250.2	252.4	252.4	249.6	271.1
Total trafic		127.4	158.5	242.7	256.9	258.1	257.1	253	273.7

(Source: Ministry of Railways)

1.4 Maritime Transport to/ from India

1.4.1 Shipping Routes to/from MBP and JNP

Singapore, Colombo and Dubai are three predominant international hub ports on major routes to/from MBP and JNP. Loading capacity of feeder service routes of each sectors such as Singapore, Colombo and Dubai are approximately 700 TEUs per vessel, 400 TEUs and 600 TEUs respectively. This characteristics reflect the service route distances for each sectors.

Table 1.4.1-1 Feeder service to / from MBP and JNP

(Singapore Sector)

Shipping Line	Name of Vessel	Capacity (TEUs)	Route	Service Interval
MOL	Ocean Security Ocean Lemon Ocean Strength Easter Oasis	850 1,000 850 1,000	MBP-Port Kelang-Singapore-Dubai-Karachi-MBP	Weekly
NOL NYK P&O	Mumbai Bay Cocoplmise Anro Gowa	1,000 600 1,152	JNP-Colombo-Singapore-Karachi-JNP	Weekly
Nedlloyd K. Line MISC	Orient Freedom Meghna Vega	750 600	MBP-Penang-Singapore-MBP	Weekly
XCL (Common Services)	Kota Chaya	784	MBP-Penang-Singapore-MBP	Weekly
ACL (Common Services)	Trade East M. Kurako	784 784	MBP-Cochin-Singapore-MBP	Weekly
Bombay Express (Common Services)	Sea Success M. Kurako	784 784	MBP-Cochin-Singapore-MBP	Weekly
Sumudera (Common Services)	Sinar Toba Leeport Nordkap	684 558 846	MBP-Singapore-MBP	Weekly

(Colombo Sector)

Shipping Line	Name of Vessel	Capacity (TEUs)	Route	Service Interval
XCL (Common Services)	Susak X-Press Trisui Lamphum Navee	336 350	MBP-Colombo-MBP	Weekly
Sea Service (Common Services)	StarLight	440	MBP-Cochin-Colombo-MBP	10 days
OEL (Common Services)	Orient Challenge Trade Bliss	440 458	MBP-Colombo-MBP	4/5 days
OCT (Common Services)	Ultraflex Feeder Ultraflex Orient	320 320	MBP-Colombo-MBP	Weekly

(Gulf Sector)

Shipping Line	Name of Vessel	Capacity (TEUs)	Route	Service Interval
APL	Eagle Confidence Eagle Sky	460 460	MBP-Fujairah- MBP	Weekly
ICS SCI Forbes (Common Services)	Socol-2 Jaya Maps Putnl	564 577 360	MBP-Khorfakkan- Sharjah-Dubai- -Jebel Ali- -Adu Dhabi-MBP	Weekly
OEL XCL (Common Services)	Orient Shreyas Walma Marina-S	650 650 850	MBP-Khorfakkan- -Dubai-Jebel Ali- -Adu Dhabi-MBP	4 days
IAL (Common Services)	IAL President	180	MBP-Dubai- MBP	10 days

Source) "EXIM" during March 1stTo 31st, 1997

1.4.2 Maritime Traffic to/from India and MBP

As for international trade of India, India accounted for 1.8% in 1950 of the total world trades, and then decreased to 0.61% in 1994. Major export commodities of India have historically been coffee, tea, leather and spices in the world market. On the other hand, major import commodities of India have been edible oil, cashew nut, pulses, fertilizer and machinery.

As to export commodities through MBP, rice, oil cakes, foodstuff, chemicals, metal products and textile are major commodities in 1995. Steel products, paper goods, edible oil, food stuff, fertilizer, sulfur and chemicals are major commodities in import in 1995.

The major trading partners of MBP in export are East Asia, West Asia, East Africa, West Europe and U.S.A. and Canada. As to major trading partners of MBP in import, East Asia, West Asia, other African countries, U.S.A. and Canada, and West Europe.

1.5 Present Conditions of the Port of Mumbai (MBPT)

1.5.1 Port facilities

(1) General

The port of Mumbai is a naturally blessed port with a spacious expanse of calm waters of Mumbai Bay protected on the east by mainland India and sheltered on the west by Mumbai Peninsula. The bay, nearly rectangular in shape, measures about 20 km north to south and about 9 km east to west and covers a total surface area of 180 km2. Figure 1.5.1-1 shows the location of facilities in the port.

The central port of Mumbai, where general cargo is handled, is situated on Mumbai Peninsula and consists of three enclosed wet docks and several open wharves abutting on tidal waters. Crude oil, oil products, LPG and chemical products are handled at Marine Oil Terminal of the Jawahar Dweep, which is located in front of Butcher Island in the middle of Mumbai Bay, and Pir Pau Terminal in the innermost part of the bay.

In the Nhava Sheva area at the eastern end of Mumbai Bay is located Jawaharlal Nehru Port (JNPT) which came into cargo service in 1989 as a new port.

(2) Central Mumbai Port

1) Berthing Facilities

a. Wet Docks

Indira Dock has 21 berths measuring 3500 m long in total where the water depth alongside is maintained between 9.2 m and 10.0 m. Indira Dock has an entrance lock measuring 229 m long and 30.5 m wide which is accessible to ships at any tide level. Victoria Dock has 15 berths with a combined length of 1,700 m where the depth alongside is maintained at 7.0 m or more. Prince's Dock has 14 berths with a total length of 1,700 m where the depth alongside is maintained at 6.4 m or more.

In Mumbai Port, where MHWS is +4.42 m and MHWN is +3.30 m, the approach channels and the locks are so designed as to provide water levels +3.10 m above Chart Datum to enable ships to enter and leave the port taking advantage of these relatively high water levels. Figure 1.5.1-2 is the plan view of the three wet docks. Detailed berth data are given in Tables 1.5.1-1 (1) and 1.5.1-1(2) and similar data on the locks and approach channels in Table 1.5.1-2.

b. Open Berth

Two large berths, each measuring 244 m long, are provided at Ballard Pier located at the southern end of Central Mumbai Port. One of the two berths, the one on the north side, -9.1 m deep alongside, serves container ships and is equipped with two container cranes and backed by a 33,000 m2 container yard. On the east of Indira Dock is located an open wharf structure where a general cargo berth, measuring 700 m long and ranging in depth alongside from -6.0 to -7.0 m. Table 1.5.1-1 (1) and 1.5.1-1 (2) present relevant berth data.

2) Container Yard and Storage Yard

Cargo handling yards and warehouses are provided on the large berths located in the south of the Central Mumbai Port Area. It is difficult , however, to secure wide spaces immediately behind the large berths for storage of general cargo and containers. Major container freight stations, container depots, warehouses and customs yard are located 3 to 10 km north of the large berths. Tables 1.5.1-3 (1), 1.5.1-3 (2) and Table 1.5.1-4 summarize the data on the storage and warehousing facilities of MBPT.

3) Approach Channels

The Main Approach Channel giving access to MBPT extend nearly 20 km from the southwest end of Mumbai Peninsula to MOT and JNPT located in the innermost part of the Mumbai Harbour. The channel data are summarized in Table 1.5.1-2.

(3) Oil Terminal

1) Marine Oil Terminal (MOT)

On the east of Butcher Island is found a natural depth where four dolphin berths are built to form an oil terminal. These dolphin berths lie at depths ranging from -10.0 to -14.0 m to permit the mooring of tankers in the classes ranging from 40,000 to 80,000 DWT. Table 1.5.1-1 (2) summarizes the berth data of the Marine Oil Terminal.

2) Pir Pau Terminal

The Pir Pau area has a dolphin type oil berth -5.9 m alongside which was constructed in prewar days of year 1920. This oil berth has been used primarily for handling LPG and chemical products since the completion of Jawahar Dweep in 1955. In addition, a large dolphin berth with a depth alongside of -12.0 m was completed in 1996. With these berthing facilities Pir Pau Terminal has now been turned into a modern oil terminal.

Table 1.5.1-1 (1) Existing Berthing Facility of Indira Dock and Ballard Pier

Unit : Meter

No.	Name of Berth	Berth Length	Crown Height	Elevation of Berth Bottom (Below Chart Datum)		Water Level	Water Depth
				Designed	Maintained	Lowest	Quay Front
			(1)	(2)	(3)	(4)	(3)+(4)
BP	Ballard Pier	726					
BP-01	Passenger Terminal	232	+ 6.71	-10.66	- 9.70	+0.76	10.46
BP-02	Container Berth	244	+ 6.71	-9.75	- 9.10	+0.76	9.86
BP-03	East Mole	250	+ 6.71	-8.53	- 7.60	+0.76	8.36
IDB	Indira Dock Basin Berth	3,522					
IDB-01	No.1	180	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-02	No.2	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-03	No.3	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-04	No.4	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-05	No.5	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-06	No.6	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-07	No.7	152	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-08	No.8	152	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-09	No.9	152	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-E	Jetty End	130	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-10	No.10	152	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-11	No.11	152	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-12	No.12	152	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-13	No.12A	180	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-14	No.12B	180	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-15	No.13B	180	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-16	No.13A	180	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-17	No.13	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-18	No.14	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-19	No.15	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-20	No.16	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDB-21	No.17	158	+ 6.71	- 7.62	-6.71	+ 3.10	9.81
IDH	Indira Dock Harbour Wall	1,007					
IDH-01	No.18	183	+ 6.71	- 8.53	- 7.01	+0.76	7.77
IDH-02	No.19	168	+ 6.71	- 8.53	- 7.01	+0.76	7.77
IDH-03	No.20	168	+ 6.71	- 8.53	- 7.01	+0.76	7.77
IDH-04	No.21	168	+ 6.71	- 8.53	- 5.80	+0.76	6.56
IDH-05	No.22 (Ship Repair)	168	+ 6.71	- 8.53	- 4.50	+0.76	5.26
IDH-06	No.23 (Tug Berth)	122	+ 6.71	- 3.96	- 3.35	+0.76	4.11
IDH-07	MBPT Launches	30	+ 6.71	- 3.96	- 3.35	+0.76	4.11

Table 1.5.1-1 (2) Existing Berthing Facility of Victoria Dock and Others

Unit : Meter

No.	Name of Berth	Berth Length	Crown Height	Elevation of Berth Bottom (Below Chart Datum)		Water Level	Water Depth
				Designed	Maintained	Lowest	Quay Front
			(1)	(2)	(3)	(4)	(3)+(4)
VD	Victoria Dock	2,014					
VD-1	No.1	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-2	No.2	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-3	No.3	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-4	No.4	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-5	No.5	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-6	No.6	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-7	No.7	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-8	No.8	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-9	No.9	122	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-10	No.10 / 11	183	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-11	No.12	100	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-12	No.13	100	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-13	No.14	100	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-14	No.15	130	+ 5.79	- 5.79	- 4.87	+ 2.13	7.00
VD-15	Dredger Berth	203	+ 5.79	- 5.18	- 4.26	+0.76	5.02
VD-16	Barge Berth	100	+ 5.79	- 5.18	- 4.26	+0.76	5.02
PD	Prince's Dock	1,767					
PD-01	No.A	138	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-02	No.B	138	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-03	No.C	140	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-04	No.D	140	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-05	No.E	140	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-06	No.G	100	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-07	No.N / O	212	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-08	No.P / Q	212	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-09	No.H	116	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
PD-10	No.K / L / M	421	+ 5.79	- 5.18	- 4.26	+ 2.13	6.39
FW	New Ferry Wharf						
FW-01	Ferry Jetty	312	+ 6.00	- 5.18	- 4.26	+0.76	5.02
FW-02	Berth for Ferry	249	+ 5.79	- 5.20	- 3.10	+0.76	3.86
BI	Butcher Island Oil Terminal						
BI-01	Jawahar deep -1	229*	+7.62	- 11.6	- 11.0	+0.76	11.76
BI-02	Jawahar deep -2	213*	+7.62	- 11.0	- 10.2	+0.76	10.96
BI-03	Jawahar deep -3	229*	+7.62	- 11.6	- 11.2	+0.76	11.96
BI-04	Jawahar deep -4	280*	+8.00	- 14.3	- 14.3	+0.76	15.06
PP	Pir Pau Oil Terminal						
PP-01	Pir Pau Jetty	171*	+5.70	- 9.7	- 5.9	+0.76	6.66
PP-02	New Pir Pau Jetty	198*	+8.62	-12.0	-11.7	+0.76	12.46

Note : Figure with * indicates maximum ship length.

Table 1.5.1-2 Information of Harbor Channels and Entrance Locks

HARBOUR CHANNEL

Unit : Meter

No.	Name of Channel	Length	Width	Depth below Chart Datum		Remarks
				Designed	Maintained	
HC-1-1	Main Harbour Channel	16,400	460~450	-11.50	-10.90	Section 1 to Section 4
HC-1-2	Main Harbour Channel	6,730	450~600	-11.40	-10.80	Section 5 and Jawahar Dweep
HC-1-3	Main Harbour Channel (Total)	23,130				
HC-2	Indira Dock Approach Channel	2,700	360	-8.53	-7.62	Rock was removed during the capital dredging
HC-3	Indira Dock Entrance Channel	500	400	-8.23	-7.62	
HC-4	Indira Dock Harbour wall Channel	853	76	-7.31	-6.09	
HC-5	Prince's and Victoria Docks Channel	900	180	-5.18	-4.26	Dredging of2.7 m depth of silt annually
HC-6	Pir Pau Channel	2,000	180	-6.09	-5.50	
HC-7	JNPT Approach Channel	7,000	300	-11.00	-11.00	

ENTRANCE LOCK

Unit : Meter

No.	Name of Lock	Length	Width	Depth below Chart Datum		Operational Water Level	Operational Water Depth
				Designed	Maintained		
EL-1	Indira Entrance Lock	229.0	30.5	-8.23	-7.62	+3.10	-10.72
	(Outer sill is at a level of - 8.2 m)						
EL-2	Victoria Entrance Lock	-	24.4	-4.85	-4.30	+2.10	-6.40
EL-3	Prince's Entrance Lock	-	20.1	-4.25	-4.26	+2.10	-6.36

Table 1.5.1-3(1)
Existing Storage and Warehouse of Indira Dock and Ballard Pier

Storage

No.	Berth Number	Covered Area	Open Area		
			Yard Area	Container Slots	
		(sq. meter)	(sq. meter)	Slots (TEU's)	Area (sq.m)
BP	Ballard Pier				
BP-01	Ballard Pier Extension	6,117	3,200	-	
BP-02	Container Berth	-	32,800	516	17,500
IB	Indira Dock Basin Berth				
IDB-01	No.1	-	9,000	1,710	5,400
IDB-02	No.2	-	12,640	From No.1 to No.5	10,270
IDB-03	No.3	-	21,330	Including West	18,900
IDB-04	No.4	-	21,330	Yard	21,330
IDB-05	No.5	-	8,800		6,500
IDB-06	No.6	9,144	3,340	-	
IDB-07	No.7	-	6,240	-	
IDB-08	No.8	-	6,240	-	
IDB-09	No.9	-	5,600	-	
IDB-10	Jetty End	-	2,240	-	
IDB-11	No.11	4,876	2,690	-	
IDB-12	No.12	4,876	650	145 (No.12 North)	
IDB-13	No.12A	7,665	590	-	
IDB-14	No.12B	3,109	19,500	230	19,500
IDB-15	No.13B	8,361	-	-	
IDB-16	No.13A	9,290	15,200	-	
IDB-17	No.13	-	2,445	-	
IDB-18	No.14	-	1,460	-	
IDB-19	No.15	8,990	-	-	
IDB-20	No.16	6,196	1,530	-	
IDB-21	No.17	5,400	1,250	-	
IH	Indira Dock Harbour Wall				
IDH-01	No.18	2,542	690	-	
IDH-02	No.19	2,259	600	-	
IDH-03	No.20	5,946	440	-	
IDH-04	No.21	5,946	1,560	-	

Warehouse

No.	Area	Covered Area	Open Area	
			Yard Area	Container Slots
		(sq. meter)	(sq. meter)	(TEU's)
ID	Indira Dock Zone			
ID-01	No.1 Uncleared Warehouse	17,983	-	-
ID-02	No.7 ID Warehouse	7,376	-	-
ID-03	No.21 ID Warehouse	2,973	-	-

Table 1.5.1-3 (2)
Existing Storage and Warehouse of Victoria and Prince's Dock

Storage

No.	Berth Number	Covered Area	Open Area	
			Yard Area	Container Slots
		(sq. meter)	(sq. meter)	(TEU's)
VD	Victoria Dock			
VD-01	No.1	-	298	-
VD-02	No.2	8,919	298	-
VD-03	No. 3/4	7,804	2,832	-
VD-04	No. 5/6	7,804	586	-
VD-05	No. 7/8	7,804	1,932	-
VD-06	No. 9/10/11	-	3,689	-
VD-07	No.12	2,581	279	-
VD-08	No.13	-	279	-
VD-09	No.14	5,203	1,022	-
VD-CY	Container Park	-	8,000	390
Total		40,115	19,215	390
PD	Prince's Dock			
PD-01	No.A	-	1,881	-
PD-02	No.B	8,919	1,881	-
PD-03	No.C	7,804	323	-
PD-04	No.D	7,804	298	-
PD-05	No.F	2,397	-	-
PD-06	No.G	2,434	91	-
PD-07	No.N/O & No.P/Q	12,821	1,815	-
PD-CY	Container Park	-	2,100	-
Total		42,179	8,389	

Warehouse

No.	Area	Covered Area	Open Area	
			Yard Area	Container Slots
		(sq. meter)	(sq. meter)	(TEU's)
VC	Victoria Zone			
VC-01	No.5/6	2,759	-	-
VC-02	No.14	2,602	-	-
VC-03	No.15	1,558	-	-
PR	Prince's Zone			
PR-01	No.B	4,459	-	-
PR-02	No.D	3,902	-	-
PR-03	No.3	719	-	-
PR-04	No.4	1,003	-	-
PR-05	No.5	6,689	-	-
PR-06	No.6/7	3,398	-	-

Table 1.5.1-4 Existing Container Freight Station and Warehouse around Mumbai Port

Container Freight Station

No.	Name of Area	Covered Area	Open Area	
			Yard Area	Container Slots
		(sq. meter)	(sq. meter)	(TEU's)
FB-CFS	Frere Basin	10,336	32,180	676
FB-01C	Shad No.1	2,414	-	-
FB-02C	Shad No.2	2,414	-	-
FB-03C	Shad No.3	3,004	-	-
FB-04C	Shad No.5	1,815	-	-
FB-05C	Shad No.6	689	-	-
MD-CFS	Manganese Ore Depot	10,238	125,200	1,200
MD-01C	Shed No.1	2,170	-	-
MD-02C	Shed No.2	2,709	-	-
MD-03C	Shed No.3	2,709	-	-
MD-04C	Shed No.4	2,650	-	-
CD-CFS	Cotton Depot	11,003	28,850	200
CD-01C	Cotton Depot R.L.Y. Platform (J,G,H)	1,968	7,600	90
CD-02C	M Jetha (Open Plinth)	-	9,000	-
CD-03C	M 178/180	1,120	-	-
CD-04C	M 170/173	1,515	-	-
CD-05C	E Shed (Grain Depot)	6,400	12,250	110
TP-CFS	Timber Pond	14,020	185,990	2,565
TP-01C	Shed No.1	3,875	-	-
TP-02C	Shed No.3	3,410	-	-
TP-03C	Shed No.4	3,410	-	-
TP-04C	Shed No.5	3,325	-	-
WD-CFS	Wadala Area			
WD-01C	Wadala Incinerator R. Plot	2,890	57,960	820
Total			430,180	

Warehouse

No.	Area	Covered Area	Open Area	
			Yard Area	Container Slots
		(sq. meter)	(sq. meter)	(TEU's)
FB-WH	Frere Area			
FB-01C	New Frere Basin	8,387	-	-
FB-02C	Frere basin No.4	1,815	-	-
FB-03C	Disposal Yard of COS	-	12,400	360
FB-04C	Wadi Bunder No 2 Warehouse	608	-	-
FB-05C	Wadi Bunder No 3 Warehouse	2,408	-	-
MD-WH	Manganese Ore Depot			
MD-01C	South of CFS Sewree	-	37,635	-
CD-WH	Cotton Depot Area		59,325	
CD-01C	K Block	-	4,000	-
CD-02C	RCD Extension	-	47,150	490
CD-03C	A Shad (Grain Depot)	2,090	375	-
CD-04C	B Plot	-	7,800	-
CD-05C	H124, H126	834	-	-
TP-WH	Timber Pond			
TP-01C	New Sewree Warehouse	34,000	26,940	-
HY-WH	Hay Bunder Warehouse	6,375	14,300	220
HJ-WH	Haji Bunder Rail Way Yard (hazardous Cargo)	-	18,100	280
WD-WH	Wadala Area		95,670	1,360
WD-01C	Domestic Container Terminal (Triangular Plot)	-	13,000	-
WD-02C	Wadala Up Departure Yard (Golden Yard)	-	30,650	-
WD-03C	Wadala Bond	-	27,300	-
WD-04C	Other Area	-	24,720	-
Total			264,370	

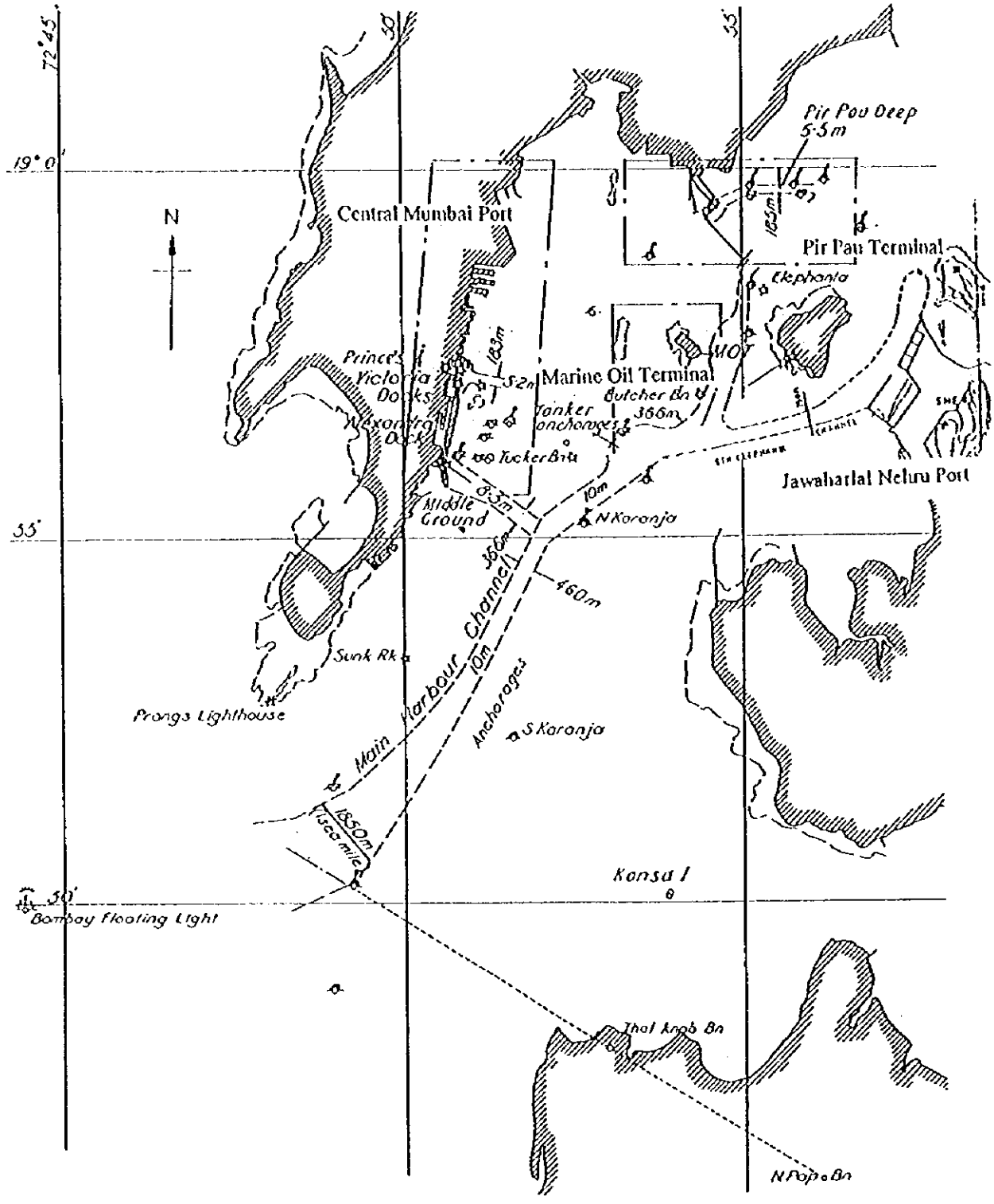

Figure 1.5.1-1 Location Map of Mumbai Port

Scale ; 1:110,000

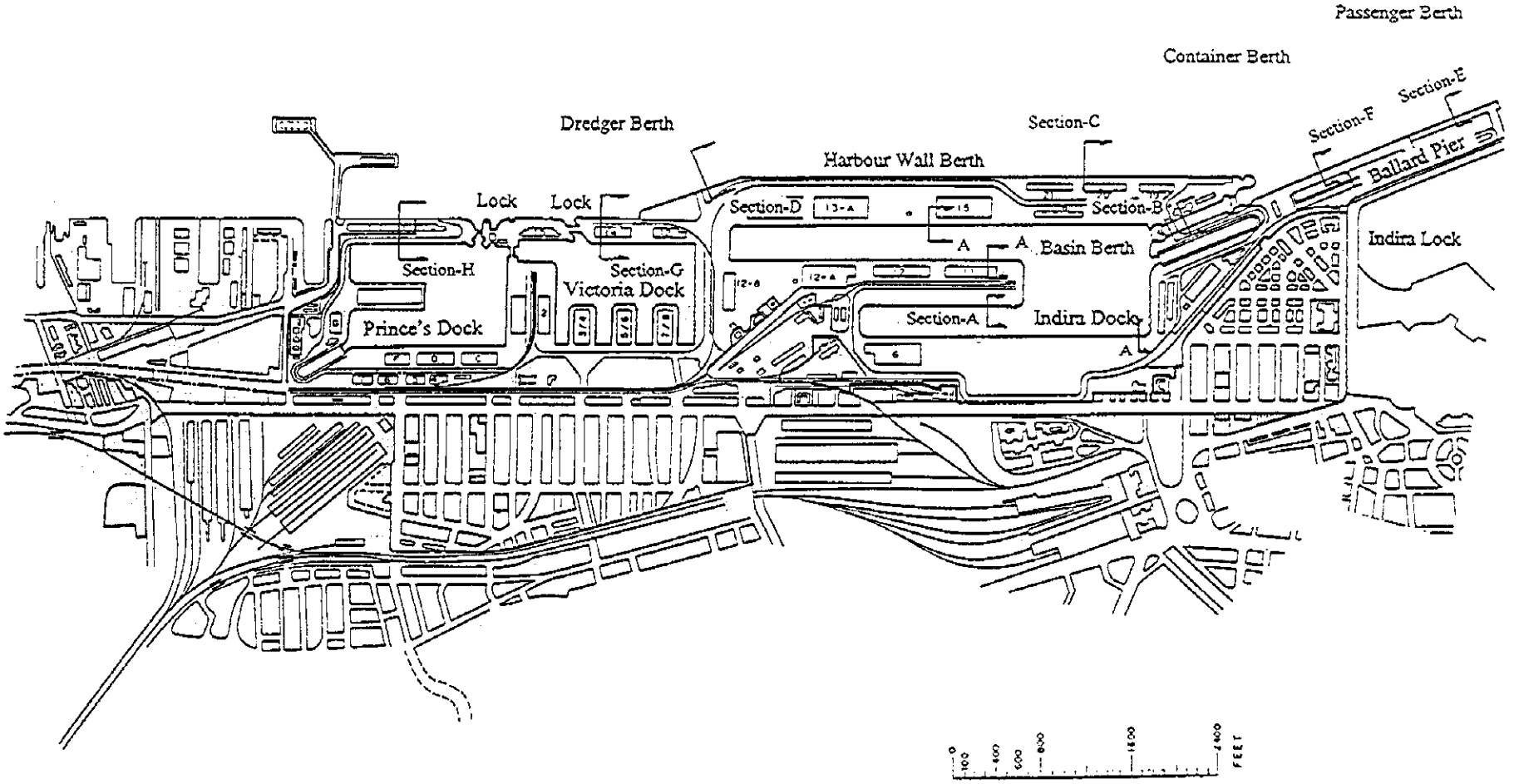

Figure 1.5.1-2 Plan of Dock Area in Central Mumbai Port

1.5.2 Port Traffic

(1) Cargo Traffic

The volume of cargo handled in Port of Mumbai dropped 27 million tons from 30 million tons in 1991-92 soon after Jawaharlal Nehru Port had started its operation in 1989. Since then the volume of cargo has increased steadily for five years reaching 34 million tons in 1995-96. As to the balance between import and export, volume of import cargo had been greater than that of export cargo until 1991-92. As the total cargo volume started increasing since 1991-92, the import cargo volume became greater than the export volume.

Container cargo accounts for 6.75 million tons (19.8%), Non-container cargo excluding Liquid Bulk accounts for 5.68 million tons (16.6%) and Liquid Bulk cargo accounts for 21.64 million tons (63.6%) in 1995-96. Commodity-wise cargo volume is available only for Non-container cargo excluding Liquid Bulk.

Major cargoes among import commodities are "POL" (8.7 million tons in 1995-96) and "Vegetable Oil" (0.5 million tons) as Liquid Bulk, "Iron and Steel" (1.7 million tons) and "Chickpeas-Pulses" (0.4 million tons) as Break Bulk, and "Rock Phosphate" (0.3 million tons) and "Sulfur" (0.4 million tons) as Dry Bulk. Major cargoes among export commodities are "POL" (11.5 million tons in 1995-96) as Liquid Bulk, and "Oil Cakes" (0.4 million tons) as Break Bulk.

(2) Container Cargo Traffic

The container cargo volume and TEUs handled in Port of Mumbai dropped 2.55 million tons and 280 thousand TEUs respectively in 1991-92 soon after Jawaharlal Nehru Port had started its operation in 1989. Since then the container cargo volume and TEUs have been increasing rapidly reaching 6.56 million tons and 518 thousand TEUs respectively.

(3) Container Cargo Flow in and around MBP

A very limited space is available for container handling in Port of Mumbai so that CFS and RCD are located 10 to 15 km away from the container berths. As to Import cargo, approximately 85% of laden containers directly go to CFS and get customs clearance, the remaining 15% go to ICD (through RCD). Sixty-five percent of CFS containers are de-stuffed at CFS then transported to final destination as a loose cargo. The remaining 35% is transported to final destination by laden container

and de-stuffed at factory / house. As to export container, 83% of laden container cargo come from CFS to quay side after completing customs clearance. The remaining 17% directly comes from ICD (through RCD). Approximately half of CFS containers are stuffed at factory / house and the other half come to CFS as loose cargo.

1.5.3 Port Activities

(1) Vessel Calls

The number of cargo vessels which called Port of Mumbai (MBP) has stayed around two thousand until 1993-94, revealing less effect of newly started operation of Jawaharlal Nehru Port (JNP) in 1989.

Table 1.5.3-1 Trends of Number of Vessels called to MBP

Year	1987-88	1988-99	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
No. of Vessels	2,041	2,086	2,010	1,973	1,928	2,069	2,094	2,330	2,276	2,380

MBP is known as one of the busiest ports in the world. Average pre-berthing time is about 4.51 days. Vessel type-wise average pre-berthing times are shown in Table 1.5.3-2. Not only bulk cargo vessels but also container vessels are required to wait for a couple of days before entering the port. A long pre-berthing time is expected due to higher level of berth occupancy rate.

Table 1.5.3-2 Average Pre-berthing Time by Vessel Type called to MBP in 1995-96

Vessel Type	Break Bulk	Dry Bulk	Liquid Bulk			Container
			Crude Oil	POL	Chemical	
Pre-berthing Time	5.35 (days)	12.64 (days)	5.57 (days)	4.91 (days)	5.11 (days)	2.52 (days)

(2) Berth Occupancy Conditions

According to the individual vessel calling records provided by MBPT, 2,301 cargo vessels called the port in 1995-96.

1) Container Cargo

73.5% of all container cargo handled in MBP is handled at 1-ID to 5-ID, BPS and BPX in Indira

Dock, while 15.3% is handled in other berths in Indira Dock. This means that 88.8% of container cargo is handled in Indira Dock. Remaining 11.1% is handled in Victoria Dock. 1-ID to 5-ID and BPS are container berths which only handle containers. BPX is a passenger berth ,however, mainly used by container vessels unless occupied by cruise vessels. In other words, 26.4% of containers is handled at multi-purpose berths in both Indira and Victoria Dock.

2) Break Bulk Cargo

85.6% of break bulk cargo is handled at multi-purpose berths (non-container berths) in Indira Dock. "Iron and Steel" which is one of the major commodities of break bulk cargo is handled mainly at 9, J/E, 10, 11, 12A, 13, 13A, 13B, 14, 15, 16, 17, 18 and BPX-ID. Bag cargoes such as "Pulses" (6, 10, 11, 13B, 14, 16 and 17-ID), "Rice" (12, 13A, 14, 15, 18, 20 and 21-ID), and "Oil cakes" (6, 12 and 13B-ID) are handled widely handled in Indira Dock. 12.3% is handled in Victoria Dock.

3) Dry Bulk Cargo

83.3% of dry bulk cargo is handled in Indira Dock. One major commodity, "Sulphur" is handled mainly at 6, 7, 8, J/E, 10, 11, 20 and 21-ID, and at 1, 4 and 8-VD. The other major commodity, "Rock Phosphate" is handled mainly at 7, J/E and 12B-ID. 14.7% is handled in Victoria Dock.

4) Liquid Bulk Cargo

68.5% of Crude Oil is handled at the deepest new berth, 4-JD. The remaining 31.5% is handled at 1-JD to 3-JD. 4-JD is a berth for exclusive use of Crude Oil. POL is handled at 1-JD, 3-JD and old Pir Pau in almost equal proportions.

All Chemical is handled at old Pir Pau. New Pir Pau which is designed for both POL and Chemical started its operation in December, 1996. These statistics do not include operation at new Pir Pau.

Edible Oil is mainly handled at 9, J/E, 10, 11, 13, 13B, 18, 20 and 21-ID in Indira Dock.

(3) Cargo Handling Productivity

Cargo handling productivity for each commodity are calculated in the following equation.

Productivity (ton/hour/vessel) = Total Cargo Volume handled (tons) / Total Berth Time (hours)

Productivity calculated for each commodity using berthing records in 1995-96 are shown in Table 1.5.3-3.

Table 1.5.3-3 Cargo Handling Productivity by Major Commodities in MBP

Commodity	Total Cargo Volume (tons or boxes)	Total Berth Time (hours)	Productivity (ton/ hour/vessel)
Break Bulk Cargo	3,697,450	136,495	27.1
Pulses (Bag)	373,687	13,741	27.2
Rice (Bag)	486,795	15,552	31.3
Wheat (Bag)	82,974	3,360	24.7
Sugar (Bag)	65,622	2,341	28.0
Oil Cakes (Bag)	244,950	8,800	27.8
Wood Pulp	81,687	1,730	47.2
Wood Logs	4,629	1,488	3.1
News Print	139,087	4,518	30.8
Iron and Steel	1,189,957	12,911	92.2
Miscellaneous	989,643	70,612	14.0
Dry Bulk Cargo	923,543	33,046	28.0
Borax	13,205	506	26.1
Fertilizer	69,467	3,161	22.0
Lead	11,580	772	15.0
Rock Phosphate	292,272	7,660	38.2
Salt	31,127	1,299	24.0
Scrap	118,946	3,033	39.2
Sulfur	386,946	16,615	23.3
Liquid Bulk Cargo	12,166,196	35,895	169.4
Crude Oil (discharge)	2,017,302	5,019	401.9
Crude Oil (charge)	5,552,930	4,404	1260.9
POL (discharge)	2,630,478	12,691	207.3
POL (charge)	868,416	3,152	275.5
Chemical (discharge)	191,813	1,179	162.7
Chemical (charge)	3,593	93	38.6
Container	442,340	73,843	6.0
Container(Ship Crane)	167,547	66,445	5.4
Container(Quay Crane)	33,408	7,398	11.2

Source) "Individual Calling Vessel Records 1995-96", MBPT

1.5.4 Present Container Handling System

1) Export container handling procedure

Procedures necessary for handling export containers by Shipping Agent, Transportor, MBPT, and Stevedore/Tally are summarized in accordance with the basic job flow.

2) Import container handling procedure

Procedures necessary for handling import containers by Shipping Agent, Transportor, MBPT, and Stevedore/Tally are summarized in accordance with the basic job flow.

3) Present export container documentation

Documents necessary for handling export containers are summarized in accordance with the present container handling jobs.

4) Present import container documentation

Documents necessary for handling import containers are summarized in accordance with the present container handling jobs.

1.5.5 Maintenance System of Port Equipment

(1)Present States of Cargo Handling Equipment

1) Container handling equipment

Two units of quay side gantry crane with the rated load of 35.5 MT and the rail span of 20 meters have been in service at the Ballard Pier Station Berth. Three units of rubber tired gantry crane with the rated load of 35.5 MT and the span of 23.47 meters have been in service at the Ballard Pier Station Stacking Yard. Two units of reach stacker with the rated load of 42MT are available at the Rail Container Depot.

2) Electric wharf cranes for handling general cargoes

Total number of 68 electric level luffing wharf cranes have been used for handling general cargoes at the wharves of Indira Dock, excepting 4 units installed at the Ballard Pier Extension. Their hoisting capacity is 3 ton (44 nos.), 6 ton (20 nos.), and 13 ton (4 nos.), respectively. Those cranes of 3-ton and 6-ton capacity are rather aged. Fifty-five units of them were manufactured in 1961 to 1963.

3) Mobile type cargo handling equipment

MBPT has 2 units of 30-ton capacity crawler crane, 2 units of 20-ton capacity port tower crane and 25 units of 14-ton capacity mobile crane. As for forklift trucks, MBPT is provided with 43 units of 3-ton capacity Diesel driven forklift truck, 10 units of 1.5-ton and 1-ton capacity battery operated electric motor driven forklift truck, and 4 units of 16-ton heavy duty Diesel driven forklift truck. In addition, MBPT has 32 units of tractor used for pulling trolleys and water tankers.

(2)Present States of Oil Loading/Unloading Facilities

Oil loading/unloading is carried out at Marine Oil Terminal, Jawahar Dweep. Liquid chemicals, LPG, LSHS, and other products are handled at New Pir Pau Pier.

1) Marine Oil Terminal

There are four berthing jetties, or Jetty Nos. 1, 2 and 3 for 55,000DWT, and No.4 for 120,000DWT. Method of ship to shore connection at Jetty Nos. 1,2 and 3 is by flexible hoses and number of pipeline is seven, i.e. 24"×4 (BH, C-1, C-2, B-1), 16"×2 (W-1, W-2), and 12"×1 (W-3), of which length up to Pir Pau Manifold is 4.7 km. Mode of ship to shore connection at Jetty No. 4 is through 5 units of marine loading arm. Bombay High (BH) line is 36" in diameter and 7.2 km long.

2) New Pir Pau Pier

One jetty can accommodate a ship of 35,000DWT. Method of ship to shore connection is by marine loading arms and method of product evacuation is through 10 nos. of pipeline, of which length is average 6 km to 7 km.

3) Present states of fire-fighting equipment

Fire-fighting facilities are provided at Marine Oil Terminal, New Pir Pau Pier, Pir Pau Manifold, and Old Pier.

(3)Availability and Utilization of Cargo Handling Equipment

1) Container handling equipment

The percentage of availability and that of utilization of container cranes for the latest three years are 83% and 36%, respectively. MBPT has norms with respect to these indexes, which shall be 85% and 35%, respectively. As for transfer cranes, their indexes are almost of same values as those of container cranes. MBPT's norms for transfer cranes shall also be 85% and

35%, respectively. Reach stackers are operated with availability of 87% and utilization of 33%, respectively.

2) Electric wharf cranes

As for 3-ton and 6-ton capacity electric wharf cranes, the percentage of availability on the basis of Gross is 84%-90% and that of utilization (Gross) is 24%-32%, respectively. MBPT has norms for these cranes, which shall be 85% and 35%, respectively. As for 13-ton capacity electric wharf cranes, the percentage of availability on the basis of Gross is 74%-94% and that of utilization (Gross) is 16% - 19%, respectively.

3) Mobile type cargo handling equipment

Crawler cranes	:	Availability = 84% - 94% and Utilization = 2% - 6%
Tower cranes	:	Availability = 66% - 85% and Utilization = 15% - 22%
Mobile cranes	:	Availability = 83% - 88% and Utilization = 19% - 23%
Forklift trucks	:	Availability = 87% - 90% and Utilization = 19% - 26%
Tractors	:	Availability = 82% - 91% and Utilization = 23% - 25%

(4)Maintenance System of Cargo Handling Equipment

1) Container handling equipment

Periodic maintenance, i.e. daily/weekly/monthly/quarterly/annual maintenance, is carried out for the container handling equipment. Although MBPT is trying to carry out the periodic maintenance on schedule, it is said to be rather difficult to follow the pre-determined maintenance schedules due to acute work requirements, and actual maintenance is carried out whenever there is availability of cranes for maintenance purpose. Maintenance system including technical check-up lists is summarized according to each maintenance schedule.

2) Electric wharf cranes

Periodical inspection and maintenance of 68 nos. of electric level luffing wharf crane have been performed by the Cranes and Dock Machinery Section, Indira Dock. General checking (Monthly), Annual thorough examination, Checking and greasing wire ropes (Monthly, Quarterly, as per condition of wire rope), Load test (Biennially), Lubrication (Quarterly), Changing lifting tackles (Annually), Painting, Annual overhauling of hoist motor, and General maintenance (Annually) are summarized briefly.

3) Mobile type cargo handling equipment

Periodic inspection and maintenance of mobile type cargo handling equipment are summarized briefly.

1.5.6 Port Services

(1) Pilotage and Towage

4 hours operation (no shift concept staff fixed for 24 hours basis) Number of closing days 12 days (Jan.26, Mar.24, Apr.14,18, May 1,8,18, Aug.15, Sep.6, Oct.11, Nov.1, Dec.25 in 1997)

(2) Container and Break Bulk Cargo Handling

The Mumbai Port Trust adopts a three working shift system and operates 20 hours a day and 352 days per year.

Operation Time	Meal Time
08:00-17:00	13:00-14:00
17:00-23:30	20:00-20:30
23:30-06:00	03:00-03:30

Net working hours per day 20 hours

Number of closing days 13 days (Jan.26, Feb.10, Mar.24, Apr.14,18, May 1,8,18, Aug. 15, Sep.6, Oct.11, Nov.1, Dec.25 in 1997)

(3) Stuffing/destuffing containers and delivering/receiving cargoes

Operation time	Meal Time
08:00-17:00	13:00-14:00
17:00-23:30	20:00-20:30

Net working hours per day 14 hours

Number of closing days 13 days (Jan.26, Feb.10, Mar.24, Apr.14,18, May 1,8,18, Aug.15, Sep.6, Oct.11, Nov.1, Dec.25 in 1997)

1.6 Present Conditions of Jawaharlal Nehru Port (JNPT)

1.6.1 Port Facilities

(1) General

JNPT, which came into cargo services in 1989 as a new port, is situated in the Nhava-Sheva area at the eastern end of Mumbai Bay. Vessel bound for JNPT sail through the -11.0 m deep Approach Channel of Mumbai Port and switch to the JNPT Channel to reach its berthing facilities. The depth alongside the JNPT berths are maintained at -13.5 m. The port was planned in such a way that large vessel can use the JNPT channel at high water level. JNPT consists of the Container Terminal and Dry Bulk Terminal. The basin area called Elephanta Dweep has a natural depth of varying from 12 to 17 meters below CD and requires almost no maintenance dredging.

(2) Container Terminal

The berth is a pier type structure supported on cast in situ concrete piles and having a concrete deck measuring 680 m long and about 35 m wide. The pier is connected to the Container Yard by a four crossover bridge. Table 1.6.1-1 gives basic data of the pier and summarized data of six (6) cranes operating on the pier. The Container Yard, 350,000 m2 in total area, has a stacking area equipped with ground slots for 4,120 TEU's, a 1,000 m long railway transhipment yard, an administration building, and other facilities. The transfer crane system is used for container handling in the stacking area where 14 tire mounted container cranes capable of 3-tier stacking and 4-tier clearance are in operation. A Container Freight Station is located 6 km away from the Container Yard and is connected to it by road and railway.

(3) Dry Bulk Terminal

The berth is a Pier type structure supported on cast in situ concrete piles and have a concrete deck of 712 m in length and about 30 m in width. The pier is connected to storage and bagging facilities by a crossover bridge and a causeway. Table 1.6.1-1 gives its berth data.
In the yard, four transit sheds with capacities ranging from 40,000 to 140,000 tons provide temporary storage of imported fertilizers and feedstuff.

Table 1.6.1-1 Berth and Cargo Handling Facilities at Jawaharlal Nehru Port

1. Container Terminal

1-1. Container Berth

No.	Type of Structure	Depth	Length	Remarks
CB-1	Deck type jetty supported by in situe concrete pipe pile	13.5 m	680 m	Concrete deck slab type

1-2. Quay Container Crane

No.	Type of Crane	Lifting Capacity	Out Leach	Commission	Maker
		(tons)	(meter)		
QC-1	Rail Mounted Gantry Crane	35.5	39.0	1989	KHIC
QC-2	Rail Mounted Gantry Crane	40.0	39.0	1997	BM,TITAN
QC-3	Rail Mounted Gantry Crane	35.5	39.0	1989	KHIC
QC-4	Rail Mounted Gantry Crane	35.5	39.0	1989	KHIC
QC-5	Rail Mounted Gantry Crane	40.0	39.0	1995	Hanjung
QC-6	Rail Mounted Gantry Crane	40.0	39.0	1997	Hanjung

1-3. Yard Container Crane

No.	Type of Crane	Number	Remarks
YC-1	Rubber Tyred Transfer Crane	8	JNPT's own crane
YC-2	Rubber Tyred Transfer Crane	6	Hired on a 10 year lease
YC-3	Rail Mounted Transfer Crane	3	JNPT's own crane
YC-4	Reach stacker	3	JNPT's own crane

1-4. Container Yard

No.	Item	Description
GS-1	Ordinary Container	4 Tiers and 30,000TEU's Capacity
GS-2	Reefer Container	240 slots

2. Dry Bulk Terminal

2-1. Dry Bulk Berth

No.	Type of Structure	Depth	Length	Remarks
DB-1	Deck type jetty supported by in situe concrete pipe pile	13.5 m	712 m	Concrete deck slab type

2-2. Quay Unloader Crane

No.	Type of Crane	Number	Capacity	Commission	Remarks
			(ton/hr)		
QC-1	Grab type unloader	2	400	1989	
QC-2	Continuous unloader	2	450	1989	

2-3. Storage Shed

No.	Description	Number	Storage Capacity	Remarks
SS-1	Fertiliser shed	2	80,000 - 115,000 tons	
SS-2	Sulphur shed	1	140,000 tons	
SS-3	Foodgrains shed	1	42,000 tons	
SS-4	Bag storage shed	1	30,000 tons	

1.6.2 Port Traffic

(1) Cargo Traffic

The volume (excluding transhipment cargo) of cargo handled in Jawaharlal Nahru Port has been steadily increasing since Jawaharlal Nehru Port started its operation in 1989, and reached 7.8 million tons in 1996-97. As to the balance between import and export, volume of import cargo had been far greater than that of export cargo. However, volume of export cargo started increasing at higher rate than import cargo since 1993-94.

Container cargo accounts for 4.81 million tons (61.6%), Non-container cargo (Bulk Cargo) accounts for 2.99 million tons (38.4%) in 1996-97. Jawaharlal Nehru Port is planned especially for handling container and dry bulk. Major commodities for dry bulk cargo handled (imported) in the port are "Fertilizer" (1.29 million tons / 43.0% of Bulk) and "HBI/Iron" (0.69 million tons / 23.0% of Bulk) in 1996-97.

Only a small amount of bulk cargoes is exported; "Food Grain" (0.38 million tons) and "Vehicle" (0.05 million tons) in 1996-97.

(2) Container Cargo Traffic

The container cargo volume and TEUs handled in Jawaharlal Nehru Port continue to increase at high rate reaching 4.81 million tons and 400 thousand TEUs respectively in 1996-97. Container cargo volume has almost grown by a factor of 12 in seven years. Empty Ratios for import and export container cargoes in 1996-97 are 41.9% and 4.3% respectively. 20 foot Container Ratio to total TEUs has been slightly decreasing for the last 5 years reaching 52%. However, the number of 20 foot containers is still greater than that of the 40 foot containers.

(3) Container Cargo Flow in and around JNP

As to Import cargo, approximately 54% of laden containers directly go to CFS and complete customs clearance, and the remaining 46% go to ICD (through RCD). As to export container, 76% of laden containers cargo come from CFS to quay side after completing customs clearance. The remaining 24% directly come from ICD (through RCD).

1.6.3 Port Activities

(1) Vessels Calls

The number of vessels which called Jawaharlal Nehru Port was 99 when the port started its operation in 1989. Since then the number of vessels calling the port has been rapidly increasing and reached 640 in 1996-97.

Table 1.6.3-1 Trends of Number of Vessels Calling JNP

Year	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97
No. of Vessels	99	170	416	418	422	540	546	640

Source) "Administration Report from 1990-91 to 1996-97", JNPT

Average pre-berthing time is about 2.09 days. Vessel type-wise average pre-berthing times are shown in Table 1.6.3-2. Not only dry bulk cargo vessels but also container vessels are required to wait for a couple of days but less than that of Port of Mumbai before entering the port. A long detention time is expected due to higher level of berth occupancy rate.

Table 1.6.3-2 Average Pre-berthing Time by Vessel Type called to JNP in 1996-97

Vessel Type	Others	Dry Bulk	Car Carrier	Container
Average Pre-berthing Time	3.96 (days)	0.34 (days)	0.19 (days)	1.45 (days)

Source) "Administration Report 1996-97", JNPT

(2) Berth Occupancy Conditions

According to berthing records of vessels calling Jawaharlal Nehru Port in 1996-97, 640 cargo vessels called the port. Berth type-wise occupancy rate by calling cargo vessels in 1996-97 is shown in Table 1.6.3-3.

Table 1.6.3-3 Berth-wise Occupancy Rate by Vessels Type in 1995-96

Berth Type	Container Berth	Bulk Berth	Service Berth
Berth Occupancy Rate	81.6%	74.0%	44.5%

Source) "Administration Report 1996-97", JNPT

1.6.4 Present Container Handling System

1) Export container handling procedures

Procedures necessary for handling export containers by Shipping Agent, Transportor, JNPT and Stevedore/Tally are summarized in accordance with the basic job flow.

2) Import container handling procedures

Procedures necessary for handling import containers by Shipping Agent, Transportor, JNPT and Stevedore/Tally are summarized in accordance with the basic job flow.

1.6.5 Maintenance System of Port Equipment

1) Container handling equipment

JNPT has six units of container crane at JNP Container Berths, three of which have the rated load of 35.5 MT and the remaining three 40.0 MT, respectively. Their rail span is 20 meters. Fourteen rubber tired transfer cranes with the rated load of 35.5 MT (8 nos.) and 40.0 MT (6 nos.) are available at the JNP Container Yard. Three rail-mounted transfer cranes with the rated load of 35.5 MT are available at the JNP train terminal, and three reach stackers with the rated load of 35.5 MT at the container terminal. 38 units of tractor and 136 units of trailer are in service in the terminal.

2) Dry bulk cargo handling equipment

JNPT has two types of dry bulk cargo handling unloader at the JNP Bulk Berth, i.e. two units of grab-bucket type with the capacity of 400 m^3/h and two units of continuous type with the capacity of 450 m^3/h. They handle mainly fertilizers, raw material for fertilizer, and food grains.

3) Other equipment

In addition to the above cargo handling equipment, JNP has three scrap reclaimers, thirty bagging machines, two bag stackers/reclaimers, etc.

4) Flotilla

JNP owns the following port service vessels; Pilot launch(3 nos.), Tug boat(4 nos.), Mooring boat(2 nos.), Survey launch(1 no.), and Bilge barge(1 no.).

5) Availability and utilization of cargo handling equipment

The percentage of availability and that of utilization of the port equipment will be summarized on the basis of Gross as follows:

Container cranes	:	Availability = 83%-90% and Utilization = 36%-63%
Transfer cranes (Rubber tired)	:	Availability = 63%-81% and Utilization = 43%-60%
Transfer cranes (Rail-mounted)	:	Availability = 89%-93% and Utilization = 36%-64%
Tractor and trailers	:	Availability = 67%-79% and Utilization = 19%-50%
Grab-bucket type unloaders	:	Availability = 50%-71% and Utilization = 14%-24%
Continuous type unloaders	:	Availability = 67%-76% and Utilization = 14%-25%

1.6.6 Port services

(1) Pilotage and towage

24 hours operation and no closing day

(2) Container and bulk cargo handling

24 hours operation (3 shifts)

Working Time

07:00-15:00

15:00-23:00

23:00-07:00

no closing day

(3) Stuffing/destuffing containers

16 hours a day (2 shifts)

Working Time

07:00-15:00

15:00-23:00

De-stuffing closing days Sundays and holidays

Stuffing closing days No closing days

(4) Delivering/receiving cargoes

24 hours operation and no closing day

1.7 Access Channels

1.7.1 Alignment and Dimensions of the Channels

The outline of the channel dimensions and locations is given in Table 1.7.1-1 and Figure 1.7.1-1.

Table 1.7.1-1 Outline of the Channel Dimensions

Main Channel (Entrance - Oil Terminal)

Location	Alignment(°)	Leg(km)	Depth(m)	Width(m)
Entrance (18-50.6N, 72-47.5E)	063	5.5	-11.0 to -10.9	420 to 440
S off Sunk R. Light Beacon	030	6.8	-12.0 to -10.5	450 to 325
E off South Break Water	055	4.6	-11.5 to -9.4	470 to 500
S off Butcher Beacon	042	2.4	-15.0 to -9.1	600 to 700
E off Butcher Oil Terminal	-	-	-	-

Approach Channel (Main Channel - Ballard Pier/Indira Dock)

Location	Alignment(°)	Leg(km)	Depth(m)	Width(m)
Main Channel Branch	305	3.1	-8.5 to -5.5	390
Off Ballard Pier/Indira Dock	-	-	-	-

North Channel (Cross Is. NE - Victoria Prince's Dock)

Location	Alignment(°)	Leg(km)	Depth(m)	Width(m)
7 c. E of N Channel Beacon	256/276	1.0	-4.7 to -3.2	185
Victoria/Prince's Dock	-	-	-	-

Trombay Channel / Pir Pau Dweep (Oil Terminal - New Oil Terminal)

Location	Alignment(°)	Leg(km)	Depth(m)	Width(m)
E of Oil Terminal	010	1.8	-10.9 to -5.6	700 to 950
W off Elephanta Patch	042/var.	5.0	-5.5	200
Pir Pau Jetty	-	-	-	-

Jawahar Lal Nehru Channel (Main Channel - JNP)

Location	Alignment(°)	Leg(km)	Depth(m)	Width(m)
S of Butcher Beacon	085	2.9	-11.0	230 to 330
S off Elephanta Island	045/023/var.	2.3	-11.0	430 to 500
JNP Container Terminal	-	-	-	-

(Source: Combined UK Chart, 2621, 2627 with survey results by MBPT, 1996.)

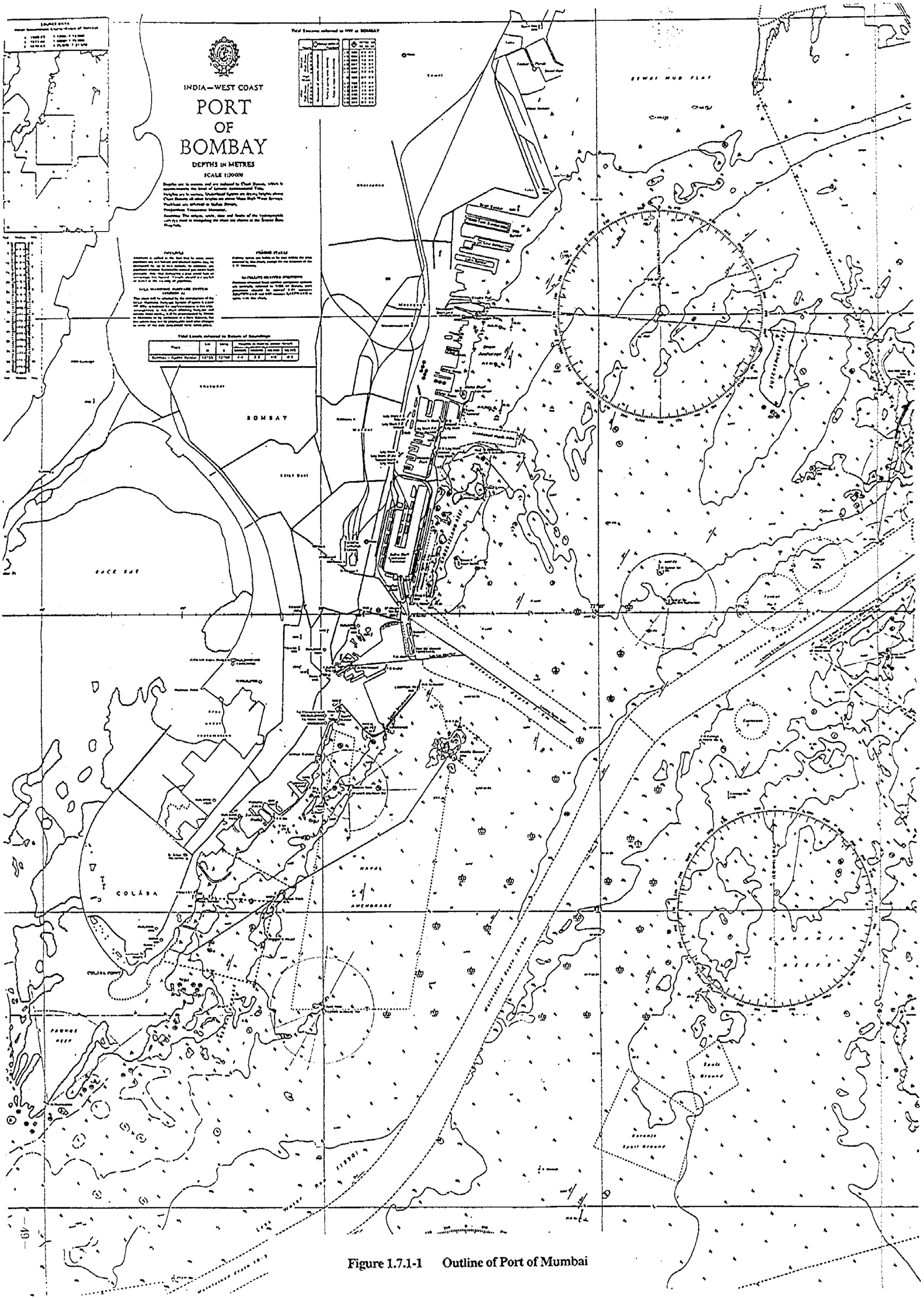

Figure 1.7.1-1 Outline of Port of Mumbai

1.7.2 Navigational Aids

1) Landmarks in the approaches to Mumbai

There exist six landmarks in the approaches to Mumbai, i.e. Kankeshwar, Ashuera Hill, North Pap Beacon, Thal Knob, Trombay Peak and Kanhoji Angre Is.

2) Lights, beacons and buoys

All navigational aids are under control of The Deputy Conservator, MBPT. The Maritime Buoyage System of The International Association of Lighthouse Authority (IALA) is being introduced throughout Indian Ocean, and hence existing marks at the Port are in conformity with IALA region "A" system in terms of classification by clour.

1.7.3 Navigation Control

1) Administration

The Deputy Conservator's office of MBPT is the sole executive body on maritime affairs, and controls over following matters: maintenance of the harbour; regulations of navigation; harbour communication; pilotage; and dredging.

2) Sailing rules

The Port Rules and Docks By-laws are stipulated in The Indian Port Act, 1908 (Act No. 15 of 1908) and Bombay Port Rules, 1966.

3) Pilots

Twenty-nine licensed pilots (including one on deputation to JNPT and two under training) are in service at the Port of Mumbai. In addition to the pilots, the port provides nine Dock Masters and five Master Pilots, who are senior than the above mentioned pilots, serving in berthing/unberthing maneuvers mainly.

4) Floating equipment

The Port provides abundant floating equipment under control of The Deputy Conservator, which consists of 26 tug boats, one survey launch, six pilot launches, three inspection launches, 12 mooring launches, four dredgers, two floating cranes, two water barges, and eight barges. With the exception of 13 fairly new tugs, others are rather aged boats over 25 to 31 years as of 1997.

5) Accidents in the last five years

There have been nine accidents within the harbour area in the last five years. Seven cases involved vessels crashing into the port facilities, and the other two were groundings. The distinctive feature of those accidents is that they all occurred at the quay or dock gate side at the stage of berthing/unberthing vessels.

6) Traffic control of the vessel in the port

MBPT has been planning to replace the traditional vessel traffic service system since early 1990's with a most advanced system known as Vessel Traffic Management System (VTMS). The plan has been supported by the Second Port Project of ADB both financially and technically. The new system is to be in full operation in April 1997.

1.7.4 Dredging and Dumping Areas and Volume

1) General

The problem of siltation does exist which can be attributed to various factors, i.e. tidal action, alteration of currents, nature of bed material, and the inflow from various creeks joining the harbour. The tidal deposits of suspended material and river sediments within the harbour necessitate considerable maintenance dredging. The alluvium deposits in the harbour consist of mainly silty marine clay with the density of the material of 1.2 to 1.35 ton/m^3. MBPT establishes not only the depth to which the areas in the harbour have been deepened but also the minimum maintained depths in the channels and alongside berths during the year.

Until 1986, maintenance dredging was being carried out exclusively by MBPT's own dredgers. Between 1986 to 1993 Dredging Corporation of India (DCI) was directly authorized by MBPT to carry out the major part of maintenance dredging, especially in the channels. From 1994 MBPT adopted the procedure of selecting contractors based on open tenders for supplementing the dredging.

2) Siltation problems (An overview)

The major amount of siltation seems to occur during the monsoon months, i.e. June to September every year. Based on their experience over the years, MBPT formulated a dredging guide in 1984, which indicates the probable average rate of siltation for different areas and the periodicity of surveys to be carried out so as to keep a check on the availability of minimum

navigable depths in the port. Based on these survey results, dredging is carried out in the respective areas which reveal siltation beyond permissible limits.

3) Maintenance dredging

The main channel needs to be dredged about once every 3 years so far and the remaining areas normally need to be dredged once a year, just after the south west monsoon period is over. For areas within the docks and at shallow berths in the harbour, dredging is carried out on an "as and when required" basis all round the year, depending on the results of periodic hydrographic surveys.

The annual volume dredged by DCI and private contractor during the period 1994/95 was 6.5 million m^3 and during 1995/96 1.14 million m^3. Since 1986, MBPT's own dredgers have been catering to the requirement of dredging in the docks and to limited areas beyond the docks.

4) Capital dredging

There had been no capital dredging carried out since 1982 after deepening the main channel to -11m CD until recently in 1994, i.e. during construction of New Pir Pau oil and chemical berth, when the approach channel including turning circle and area in front of the proposed berth was dredged to -9m CD.

5) Dumping grounds

There are three dumping grounds identified by MBPT where the dredge spoil is presently being discharged. With the ebb and flood tide being quite active in the Mumbai harbour, two dumping grounds at a distance of about 18.7 km from the Indira dock channel have been earmarked. The major quantities dredged from the harbour are dumped either at the ebb or flood dumping grounds depending on the prevailing tide condition.

1.7.5 Dredging Vessels

MBPT owns four dredgers at present, i.e. 3 Nos. of grab-bucket dredger and 1 No. of backhoe dredger.

1.7.6 Dredging Implementation

Based on the dredging guide formulated by MBPT in 1984, maintenance dredging has been carried out in the respective areas which reveal siltation beyond permissible limits. Presently

dredging is carried out in access channels by the selected contractor for some of the areas in the harbour, in addition to ongoing dredging activities by DCI.

There are strict restrictions on dredging, including possible days to facilitate dredging of the areas and securing least influence to movement of the vessels. The tender specifications provided by MBPT define the frequency of dredging, considering siltation during the contract period.

1.8 Present Management and Administration of the Port of Mumbai (MBP) and Jawaharlal Nehru Port (JNP)

1.8.1 Outline of the Mumbai Port Trust (MBPT)

The Bombay Port Trust was constituted in 1873 under the Bombay Port Trust Act of 1873 with power to levy wharfage, port dues, pilotage fees, etc. The activities of the port are regulated by the Major Port Trust Act, 1963 with effect from 1st February 1975.

On 8th January 1996 the name of Bombay Port Trust was changed to Mumbai Port Trust in accordance with renaming the surrounding city Mumbai in 1995.

The Trust is administrated by the Board of 21 Trustees. The Chairman of the Board of Trustees is the Chief Executive of the Port. He exercises supervision and control over the day-to-day activities of the Port. He functions as the administrative head for all the Port employees. Other Trustees are officials and non-officials representing the principal chambers of commerce, customs, railways, civic body, labor employed in the Port etc. Figure 1.8.1-1 shows the organization structure of the MBPT.

1.8.2 Present Port Tariff, Charges and Dues (MBPT)

(1) Port Dues

Table 1.8.2-1 Port Dues

	Rate per GRT		
Size of vessel (GRT)	Foreign-going	Coasting	How often Payable
3,000t and upwards	US$ 0.17	Rs. 1.6	Once in the same month
Under 3,000t	US$ 0.12	Rs. 1.1	Once in the same month

(2) Berth hire

Table 1.8.2-2 Berth Hire

	Rate for GRT per day or part thereof	
Vessels berthed at	Coasting	Foreign going
Indira Dock, its harbor wall, Ballard Pier, Ballard Pier Extension, Prince's Dock, Victoria Docks and its harbor wall	Rs. 2.2	US$ 0.14

Minimum chargeable 1,000 GRT

(3) Pilotage, Tug assistance, Towage

Vessels maneuvering with main engines

Table 1.8.2-3 Pilotage, Tug assistance and Towage

	Rate per GRT per day	
Nature of Movement	Coasting (Rs.)	Foreign Going(US$)
Sea to Dock & Dock to Sea with tug assistance	3.5	0.24
Sea to Stream & Stream to Sea without tug assistance	0.55	0.04
Stream to Dock & Dock to Stream		
(1) Vessels not requiring tug assistance	0.55	0.04
(2) Vessels requiring tug assistance	3.35	0.23
One Dock to another Dock with tug assistance	1.6	0.11
Stream to Stream without tug assistance	0.2	0.02
Dock to Jawahar Dweep / Pir Pau or vice versa with tug assistance	2.3	0.16

(4) Charges on cargo containers, containerized cargo and container equipment

1)Charges on cargo containers

Wharfage on cargo containers unloaded from/loaded into container vessels/other vessels

cargo container having a length up to 20 feet Rs.200 per unit

cargo container having over 20 feet and up to 40 feet Rs.300 per unit

2) Charges on cargo containers and containerized cargo destined to / received from ICD payable by combined transport operators / agents of vessels

(a) Charges on cargo containers railed to the Docks/dispatched by rail to ICD

Loaded/empty containers having a length up to 20 feet Rs.1300 per unit

Loaded/empty containers having over 20 feet and up to 40 feet Rs.1950 per unit

(b) Charges on cargo containers received from/removed to ICD by road

Loaded/empty containers having a length up to 20 feet Rs.1300 per unit

Loaded/empty containers having over 20 feet and up to 40 feet Rs.1950 per unit

(c) Consolidated wharfage on cargo containers stuffed at factories

Containers having a length up to 20 feet	Rs.1000 per unit
Containers having over 20 feet and up to 40 feet	Rs.2000 per unit

(d) Consolidated wharfage on transhipment cargo in containers

Containers having a length up to 20 feet	Rs.1200 per unit
Containers having over 20 feet and up to 40 feet	Rs.2400 per unit

(5) Charges for Port Trust labor for stuffing or destuffing of cargo

Table 1.8.2-4 Stuffing/destuffing Charge

	Per container
Container up to 20 feet	Rs.600
Container over 20 feet up to 40 feet	Rs.1200

1.8.3 Present Port Tariff, Charges and Dues (JNPT)

(1) Port dues

Rate per GRT	Foreign vessels (US$)	Coasting vessels (Rs.)
Bulk vessels	0.22	3.65
Container vessels	0.17	2.90
Car carrier vessels (RO-RO)	0.11	1.75
Vessels of 10 tons and upwards other than those covered above (except fishing boat)	0.17	2.90

(2) Fees for pilotage-cum-towage

Rate per GRT	Foreign vessels (US$)	Coasting vessels(Rs.)
Up to 60,000 GRT	0.42	7.20
60,001-100,000 GRT	0.44	7.50
100,001 and above GRT	0.49	8.20
Pilotage fee for vessels not requiring tug assistance	0.14	2.90

Minimum charge per vessel		
a) Requiring tug assistance	300	7,200
b) Not requiring tug assistance	200	5,000

(3) Berth hire charge

Rate for GRT per day or part thereof	Foreign vessels (US$)	Coasting vessels (Rs.)
Container Berth	0.14	2.35
Bulk Berth	0.14	2.35
Multipurpose Berth	0.14	2.35
Landing Jetty	0.14	2.35
Anchorage Berth	0.07	1.18

(4) Charges for handling and movement of containers

Normal containers		
Rate for TEU (Rs.)	Loaded	Empty
From ship to CY or vice versa	2,600	2,100
From CY to CFS or vice versa	925	925
From CY to Railway flat or vice versa	1,300	1,300
From CY to Truck or vice versa	400	400

(5) Storage fees

1) Loaded import container lying in the port premises

Rate per day	Up to 20' (US$)	Over 20' (US$)
First three days	Free	Free
4-15 days	3.25	6.50
16-30 days	6.50	13.00
Thereafter	13.00	26.00

2) Loaded export container stored in the port premises

Rate per day	Up to 20' (US$)	Over 20' (US$)
First seven days	Free	Free
8-15 days	2.86	5.72
16-30 days	5.72	11.44
Thereafter	11.44	22.88

1.8.4 Present Port Finance

(1) MBPT

1) Income statement

Table 1.8.4-1 shows the income statements of MBPT between 1992-93 and 1996-97. (Fiscal year in India begins on 1st April and ends on 31st March.) Port Trusts do not pay income tax on their commercial activities. About 74% of total revenue is derived from cargo handling and storage in 1996-97. Contributions of railway and real estate revenue are very low.

Personnel cost (salaries and wages) is a major component of operating expenditures. Its proportion to operating expenses has been more than 63% since 1992-93. The ratio of depreciation to the total expenses is 5% in 1996-97. It is very low. This implies that MBPT continues to use very old fixed assets exceeding their useful lives.

Judging from the net surplus, the income statement seems to indicate good performance. MBPT reserves substantial amount of funds for future capital investment from its surplus.

Working ratio, the proportion of operating expenses excluding depreciation to operating income, is 60% in 1996-97. Working ratio is required to be lower than 50-60% to keep sound operational efficiency.

2) Balance sheet

Table 1.8.4-2 shows the balance sheets of MBPT between 1993 and 1997. The amount of financial investment (securities and fixed deposit) is almost the same as net worth. The percentage of financial investment to total assets is 70%. MBPT invests in securities instead of having its own capital assets. The rate of return on fixed assets is 72%. This is extremely high. This implies an inadequate level of capital investment on the part of the MBPT.

(2) JNPT

1) Income statement

Table 1.8.4-3 shows the income statements of JNPT between 1992-93 and 1996-97. Net surplus increased considerably in 1995-96. It is attributable to the increase of operating revenue, especially container handling charge. Since 1992-93 working ratio has indicated favorable level, which is less than 60%. The ratio of personnel cost (salaries, wages and benefits) to operating expenses is about 10% in fiscal year 1996-97. This is much lower than that of MBPT.

2) Balance sheet

Table 1.8.4-4 shows the balance sheets of JNPT between 1993 and 1997. The percentage of long term debt to total liabilities has been more than 90% since 1993. Capital debt was much larger than net worth. But a debt to equity ratio was improved to 59/41 in 1997 from 86/14 in 1993. Until 1995 rate of return on net fixed assets was below 7%, the minimum requirement. But it exceeded in 1996.

1.8.5 Computerization in MBPT

MBPT is introducing a Management Information System, consisting of Vessel Traffic Management System (VTMS), Cargo Management and Information System (CARMINS), Container Traffic and Control System (CTCS), Financial Management System (FMS) and Executive Information System (EIS). All systems mentioned above will be connected in a broadband data communication network consisting of optical fiber cable. These systems are currently being implemented and some are already in operation.

1.8.6 Port Workers, Trade Unions and Labor Practices in MBP

(1) Port Workers

Port workers in the port of Mumbai are divided into two categories, on-board workers and

on-shore workers. On-shore workers belong to MBPT, while on-board workers primarily once belonged to Bombay Dock Labour Board (BDLB). In 1994 BDLB was merged into Bombay Port Trust because of financial problems. After the merger, on-board workers gained the status of MBPT monthly rated employees. Although stevedore companies have to hire cargo handling workers from MBPT for on-shore and on-board work, they also have approximately 1,200 employees of their own (supervisors, assistant supervisors, chargemen, foremen and dock clerks). Transporters too have their own employees to operate cargo handling equipment such as fork lift trucks, top lifters, reach stackers and truck trailers.

(2) Trade Unions

At MBPT there are four trade unions of the port workers. Among them, Transport and Dock Workers Union and MBPT Dock and General Employees Union are the major unions. Presidents of both unions are members of the Board of Trustees. Transport and Dock Workers Union, which was established in 1954, has around 80 percent of the dock workers as union members. On the other hand, MBPT Dock and General Employees Union has only about 15-20 percent of dock workers as union members. However 80 percent of the technically skilled workers in the engineering department or working on tugs and launches are members.

Both these unions are very strong because their workers' membership are large and their presidents as trustees of the Board can get up-to-date knowledge on the Indian port sector. These unions are well aware of the Port and their workers and open to support the various policies of the management to make the Port competitive, but not at the cost of job losses. They also strongly believe in sharing the gains from the productivity increases with workers.

(3) Wage System

Wages of all the dock workers are based on a combination of time rate and piece rate. Dock workers can get piece rate earning if their gang achieves a 'datum' (a sort of minimum productivity norm). One can earn one's normal wages including various perquisites without touching the datum line. Besides time rate and piece rate earnings, dock workers get the following benefits.

1) On-Board Worker

a) All dearness allowance (including variable dearness allowance)
b) House rent allowance
c) Weekly off wages
d) Holiday work wages
f) Washing allowance
g) Transport Allowance
h) Children's education allowance
i) Miscellaneous allowance

2) On-Shore Worker

a) Personal pay
b) House rent allowance
c) Dearness allowance
d) Special dearness allowance
e) City compensatory allowance
f) Transport allowance
g) Washing allowance
h) Equation allowance

(4) Labor Practices

1) Speed Money

Speed money refers to an informal and illegal incentive employers of stevedore companies give the dock workers to increase the productivity of cargo handling and complete the expected official work.

2) Ghost Money

Although only registered workers can perform dock works legally, employers engage unregistered underprivileged cheap labour unofficially at the dock. The employer hires unregistered casual workers on piece rate only (no time rate) and pays directly these unregistered workers. The work performed by the unregistered workers is added to the registered workers' performance. If the datum line is crossed, registered workers can get piece rate earnings.

At times the full gang strength is not allotted to an employer due to shortage of labor. Under this situation, the less-strength gang gives output equivalent to the full gang and gets paid for the absentees' unofficially directly by the employers.

3) Job Selling

The job of hatchmen in handling sulphur is hard, dirty, unpleasant and dangerous. Most workers try to skip the work when they come to know that the day's work is handling sulphur.

Since they want to be absent without losing their pay, they pass this job to an outside person (unregistered casual worker) and pay the outside person about Rs. 100 in cash for the work per shift and get paid from the work done by the outside person.

4) Others

Workers have developed informal work practices to achieve 'datum line' very fast. For example, in case of container stuffing and destuffing, a total of 24 workers are required in a shift, but there is no place for all of them to work together in a container. Therefore the gang strength is divided into two and work is done on two containers simultaneously. In case of bulk cargo, the use of extra slings by the gangs also increases the speed of the work to overtake the 'datum line' fast.

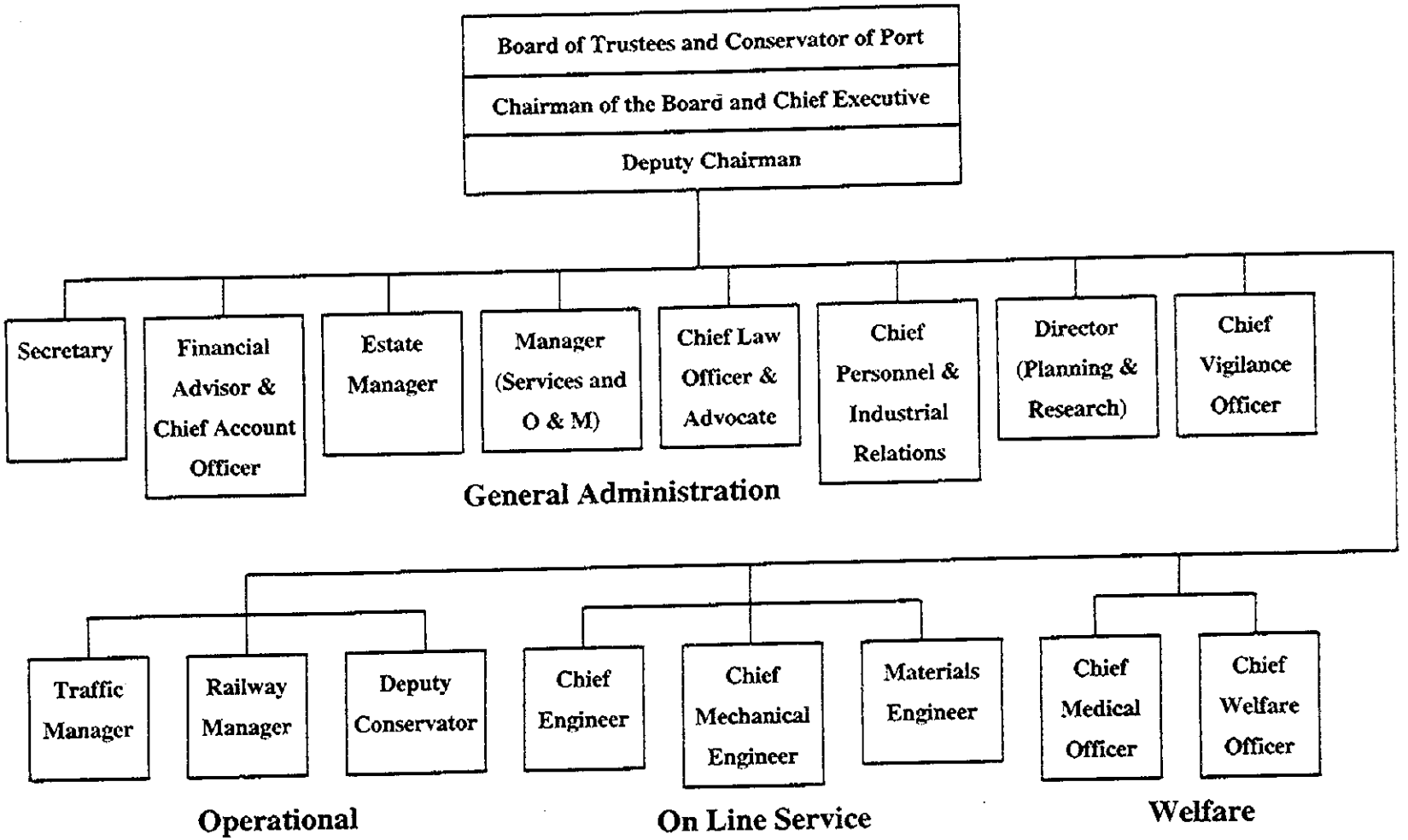

Figure 1.8.1-1 Organization Structure of MBPT

Source : MBPT Brochure

Table 1.8.4-1 MBPT Income Statement

(Rs. in crores)

	1992/93	1993/94	1994/95	1995/96	1996/97
Operating Revenues	364.52	416.68	475.14	581.88	592.58
Cargo Handling and Storage Charges	261.24	296.10	349.68	423.18	435.70
Port and Dock Charges	83.94	101.15	105.74	136.20	133.62
Railway Earnings	3.27	3.39	4.48	6.10	4.91
Estate Rentals	16.07	16.04	15.24	16.40	18.35
Operating Expenses	219.16	239.94	300.62	313.58	374.43
Salaries and Wage	142.59	153.49	199.71	215.62	238.89
Stores	16.52	20.72	18.85	20.33	21.34
General Expenses	2.25	2.79	2.52	3.49	3.50
New Minor Works	1.13	0.85	0.68	0.57	1.10
Sundry Expenses	44.65	48.98	64.81	59.51	89.98
Inter-departmental charges and transfers	0.13	0.09	0.13	0.01	0.57
Depreciation of Fixed Assets	11.89	13.02	13.92	14.05	19.05
Net Operating Income (NOI)	145.36	176.74	174.52	268.30	218.15
NOI before Depreciation	157.25	189.76	188.44	282.35	237.20
Other Income & Expenses					
Finance & Other Income	72.71	68.14	83.37	100.55	95.94
Fund Management Income	52.49	54.07	68.45	85.31	79.08
Others	20.22	14.07	14.92	15.24	16.86
Finance & Other Expense	86.10	66.63	114.52	114.50	122.17
Interest on loans from ADB				1.48	1.51
Others	86.10	66.63	114.52	113.02	120.66
Net Surplus	131.97	178.25	143.37	254.35	191.92
Operating ratio	60%	58%	63%	54%	63%
Working ratio	57%	54%	60%	51%	60%

(Source : MBPT Annual Account)

Table 1.8.4-2 MBPT Balance Sheet

(Rs. in crores)

As of 31st March	1993	1994	1995	1996	1997
Assets					
Fixed Assets	194.46	231.38	269.83	304.84	373.76
Investment	1,387.89	1,717.65	2,045.59	2,534.17	3063.04
Current Assets	417.47	485.50	640.66	775.78	915.82
Cash & Deposit	10.38	9.72	58.63	63.09	70.70
Others	407.09	475.78	582.03	712.69	845.12
Total Assets	1,999.82	2,434.53	2,956.08	3,614.79	4,352.62
Liabilities					
Current Liabilities	129.22	164.13	230.35	276.80	337.31
Loan from Government	5.63	16.81	31.10	35.77	53.47
Provision for Unrecovered Estate Rental	219.69	265.21	320.54	370.18	433.61
Pension Fund	66.65	87.90	126.81	180.21	243.48
Provident Fund	181.70	198.76	246.49	293.75	356.00
Total Liabilities	602.89	732.81	955.29	1,156.71	1,423.87
Net Worth					
Capital Reserve	194.46	214.57	238.73	269.07	320.29
Revenue Reserves	533.39	546.97	545.37	549.90	560.87
Fund for Replacement, Rehabilitation and Modernisation of Capital Assets	544.52	731.57	936.40	1,177.86	1432.37
Fund for Development, Repayment of loans and Contingencies	123.56	207.61	279.29	460.25	614.22
MBPT Centenary Commemoration Fund	1.00	1.00	1.00	1.00	1.00
Total Net Worth	1,396.93	1,701.72	2,000.79	2,458.08	2,928.75
Liabilities & Net Worth	1,999.82	2,434.53	2,956.08	3,614.79	4,352.62

(Source : MBPT Annual Account)

Rate of return on net fixed assets	75%	76%	65%	88%	72%

Table 1.8.4-3 JNPT Income Statement

(Rs. in crores)

	1992/93	1993/94	1994/95	1995/96	1996/97
Operating Revenues	85.52	102.68	153.26	233.67	246.08
Cargo Handling and Storage Charges	27.32	24.63	33.13	52.26	40.68
Container Handling Charges	39.29	51.62	82.78	131.64	144.51
Port and Dock Charges	14.93	22.01	30.08	35.79	42.52
Estate Rentals	3.98	4.42	7.27	13.99	18.36
Operating Expenses	62.11	78.09	87.18	115.63	139.83
Salaries & Wages excluding bonus	6.58	8.71	10.15	12.93	14.40
Other Employee Related Benefit	1.39	2.07	2.52	3.12	3.67
Port Operations Related Expenses	16.76	22.86	34.07	55.49	70.50
Dredging Expenditure	1.69	7.02	1.43	5.34	9.90
Management of Port Computer Facilities	0.54	0.40	0.41	0.53	0.48
Depreciation	31.27	32.15	32.57	32.61	33.74
Administration & General Expenses	3.88	4.88	6.03	5.61	7.14
Net Operating Income (NOI)	23.41	24.59	66.08	118.04	106.25
NOI before Depreciation	54.68	56.74	98.65	150.65	139.99
Other Income & Expenses					
Finance & Other Income	17.97	21.59	25.81	45.16	71.42
Finance & Other Expense	25.32	34.89	29.70	37.77	35.14
Interest on Loans	21.04	28.94	26.82	33.51	30.65
Others	4.28	5.95	2.88	4.26	4.49
Net Surplus	16.06	11.29	62.19	125.43	142.53
Operating ratio	73%	76%	57%	49%	57%
Working ratio	36%	45%	36%	36%	43%

(Source : JNPT Annual Accounts)

Table 1.8.4-4 JNPT Balance Sheet

(Rs. in crores)

As of 31st March	1993	1994	1995	1996	1997
Assets					
Fixed Assets	990.16	1,006.22	1,034.20	1,076.55	1134.61
Investment	126.46	153.90	206.39	327.08	444.12
Current Assets	63.16	68.98	73.69	104.89	92.60
Total Assets	1,179.78	1,229.10	1,314.28	1,508.52	1,671.33
Liabilities					
Current Liabilities	26.11	35.24	40.19	63.56	68.23
Capital Debt	992.08	987.52	968.85	973.15	944.89
Loan from Government	554.83	567.83	572.17	581.79	581.37
Loan from Mumbai Port Trus	384.76	367.20	344.18	318.87	291.02
Loan from Kandra Port Trust	52.49	52.49	52.49	52.49	52.49
Loan from Chennai Port Trust				20.00	20.00
Pension and Provident Funds	1.81	2.93	5.03	7.11	10.40
Total Liabilities	1,020.00	1,025.69	1,014.07	1,043.82	1,023.52
Net Worth					
Reserves	50.95	62.43	125.91	257.48	406.85
Provisions	108.83	140.98	174.30	207.22	240.96
Total Net Worth	159.78	203.41	300.21	464.70	647.81
Liabilities & Net Worth	1,179.78	1,229.10	1,314.28	1,508.52	1,671.33
Rate of Return Net Fixed Assets	2.36%	2.44%	6.39%	10.97%	9.36%

(Source : JNPT Annual Account)