CHAPTER 3
PRESENT SITUATION OF THE PORT OF HODEIDAH

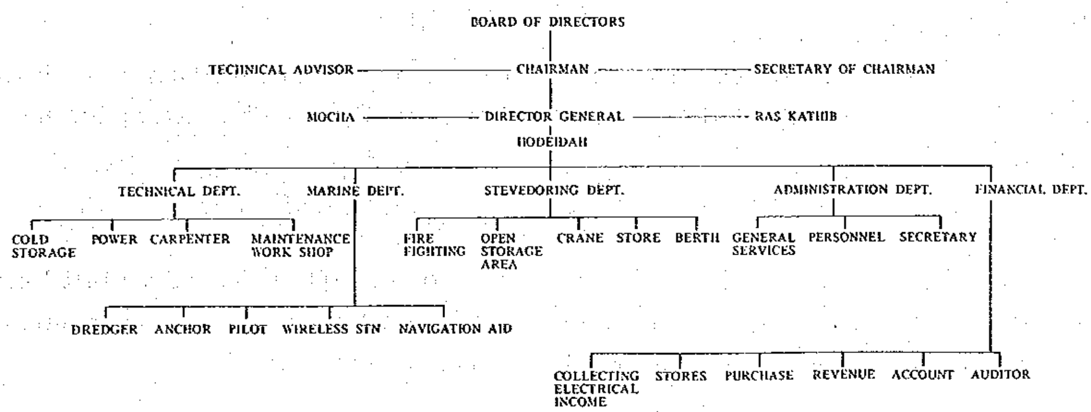
CHAPTER 3. PRESENT SITUATION OF THE PORT OF HODEIDAH

3-1 Port Management

3-1-1 Port Organization

An executive directive has been issued in Yemen to centralize the administration of the ports. To date, three of the ports are under the organization of the Ports and Marine Affairs Corporation (PMAC), which is under the command of the Minister of Public Works. PMAC, headed by the Board of Directors, manages planning, construction, management, and operation for the three ports. The Board of Directors consists of five members: the chairman of PMAC, the Director General of PMAC, the Director of the Stevedoring Dept. of PMAC, the Vice Governor of Hodeidah City, and the Director of the Port of Ras Kathib, Structure of organization of PMAC is shown on Table 3-1-1.

Table 3-1-1 Organization of PMAC



3-1-2 Port Service

(1) Pilotage

Pilotage is compulsory. Navigation is in force only during daylight time.

(2) Bunkers

Bunker facilities are not available.

(3) Fresh water

Fresh water supply is available alongside berths.

(4) Ship repair

In terms of ship repair, there is only a shipway for small vessels. It has just completed in February, 1982.

3-2 Land Use in the Port Area

3-2-1 Open Storage Yard

The open storage yeard in use at present is approximately 410,000 m^2 in area, of which 110,000 m^2 are used for general cargo, 170,000 m^2 for timbers, and 130,000 m^2 for containers. These lots, though unpaved, are levelled and sufficiently compacted. An additional 230,000 m^2 is in reserve and vacant.

3-2-2 Covered Storage Yard

Customs warehouses provide enclosed facilities for export and import goods. They consist 12, of which 4 have quayside locations. Their areas are as follows:

1,500 m^2 x 1 unit
3,000 m^2 x 8 units
3,045 m^2 x 2 units
6,000 m^2 x 1 unit

3-2-3 Container Marshalling Yard

A 135 meter-wide concrete-paved yard has been constructed behind the quay of 6th berth for marshalling containers. Behind this area, an additional 70,000 m^2 is reserved for the same purpose.

3-2-4 Grain Silo

The existing grain silo facility in the port consists of a 20,000 t silo and a 14-stall bagging plant with a bagging capacity of 200 t per hour. An additional silo of 11,000 t is presently under construction. The total area of the facility is approximately 33,000 m^2.

3-2-5 Road

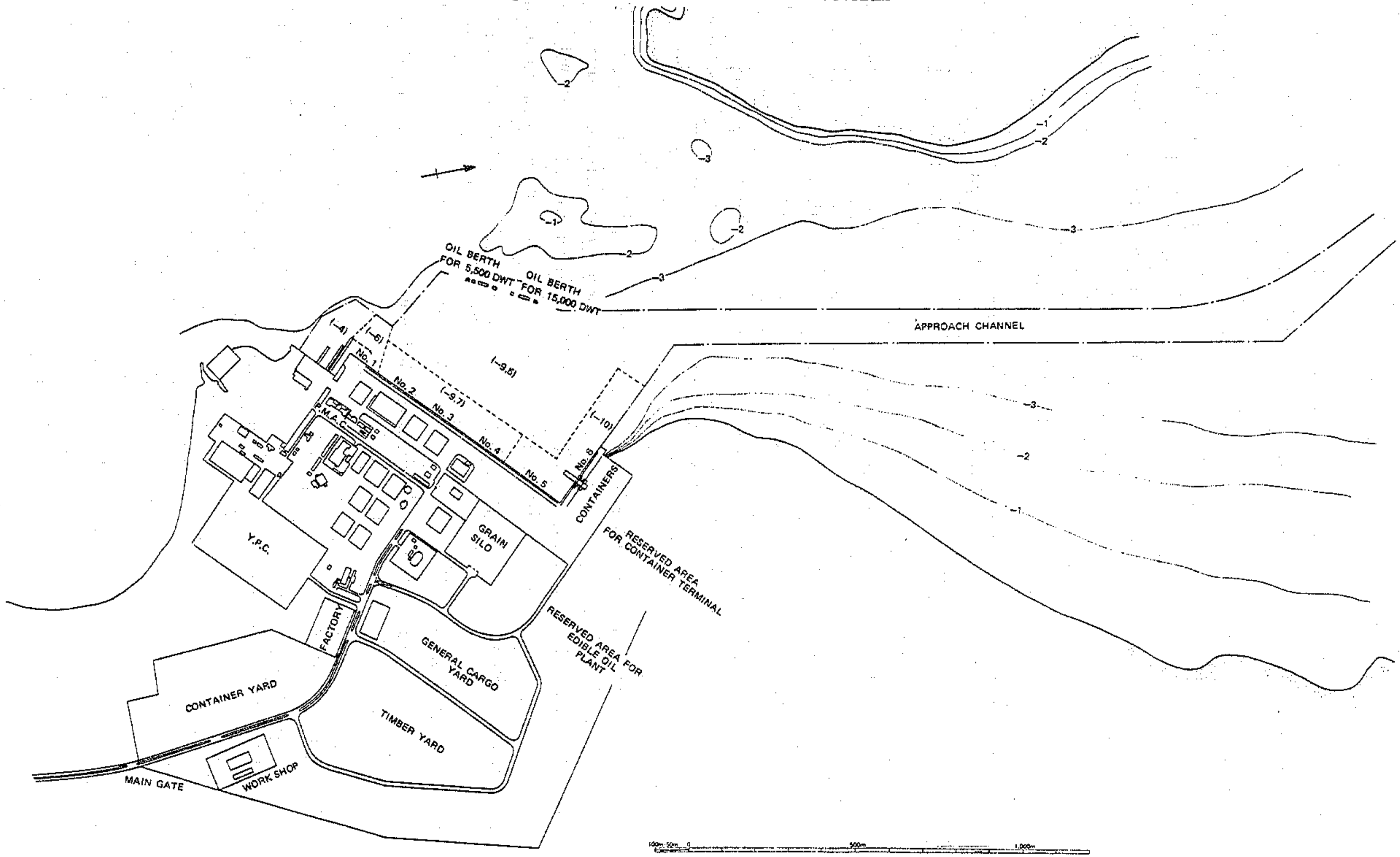
A main road runs from east to west in the port. It has two 6 meter-wide lanes and a median strip. Several 11 meter-wide feeder roads run from the main road. Some of them are concrete-paved.

3-2-6 Other

A Yemen Petroleum Company plant is located in the port area. Oil tanks in the facility are connected to the oil berth by submarine pipelines.

The outline of the existing the Port of Hodeidah is shown in Fig. 3-2-1.

Fig. 3-2-1 Outline of the Port of Hodeidah



3-3 Port Facilities

The Port of Hodeidah had the following berths and facilities as of the end of 1981.

3-3-1 Berths

Detail of the berths are given in Table 3-3-1. The quay walls of 1st berth to 5th berth consist of steel sheet piles and 6th berth consist of Steel sheet pile cellular Cofferdam. The steel sheet piles and Steel sheetpile Cellular Cofferdam, are topped with a reinforced concrete wall with fenders. The oil berths consist of steel-pipe-piled dolphines.

Table 3-3-1 Berth Dimensions

Berth No.	Length	Water depth
Berth 1	90 m	–3.0 – –9.7 m
Berth 2	160 m	–9.7 m
Berth 3	160 m	–9.7 m
Berth 4	166 m	–9.7 m
Berth 5	195 m	–10.0 m
Berth 6	195 m	–10.0 m
Oil Berth for Ships of 5,000 DWT		–7.0 m
Oil Berth for Ships of 15,000 DWT		–10.0 m

1st berth is used by the Navy. 2nd berth to 4th berth are used by cargo ships and dhows. Grain is unloaded at 4th berth. 5th berth and 6th berth were constructed in December 1981. 6th berth will be used for container unloading. An oil berth for ships of 15,000 DWT was constructed in 1981, but the pipeline to be connected with the Yemen Petroleum Company oil tanks is not yet completed.

3-3-2 Inner Harbor Basin

The inner harbor basin is about 400 meters wide surrounded by 1st berth to 6th berth and the oil berths. The water depth is –9.5 meters.

3-3-3 Approach Channel

The approach channel was dredged to –9.5 meters. Ships navigate through a channel 22 kilometers long with a width of 100 meters. The channel is marked by buoys.

3-3-4 Equipment

PMAC has the following cranes and forklifts:

Table 3-3-2 Cranes and Forklifts

Quay crane (10 t)	1 unit
Quay crane (5 t)	7 units
Mobile crane (15 t)	1 unit
Mobile crane (20 t)	3 units
Forklift (3–5 t)	6 units
Floating crane (75 t)	1 unit

PMAC is constructing a container crane alongside the quay of 6th berth. Shipping agents have other handling equipment in addition to the above.

3-3-5 Tugboats

PMAC has 6 tugboats, of which two have capacities of 1,200 to 1,800 hp, one has 800 hp, one has 600 hp and the remaining two having 250 hp. Shipping agents have barges up to 600 ton capacity.

3-4 Port Activities

During the calendar year of 1981, 880 ships called at the Port of Hodeidah. The cargo volume handled was about 1.60 millions tons. The total number of ships to call at the three ports (Hodeidah, Las Cathib and Mocha) during the same year was 1254; the cargo handled was about 2.22 millions tons. The percentages occupied by Hodeidah among the three ports was 71% of calling ships and 65% of cargo handled. These figures show the importance of the Port of Hodeidah to the YAR. Port statistics on calling ships and cargo handled are shown in Table 3-4-1 and 3-4-2.

Table 3-4-1 Number of Calling Ships

Port \ Year	1979	1980	1981
Hodeidah	982	847	880
Ras Kathib	160	176	259
Mocha	85	147	105
Salif	(unknown)	68	(unknown)
Total	1,227	1,238	1,244

Table 3-4-2 Cargo Handled (1,000 tons)

Port \ Year	1979	1980	1981
Hodeidah, Ras Kathib and Mocha	2,513	2,485	2,448
Salif	308	551	466
Total	2,821	3,036	2,914

Classification of the 847 ships that called at Hodeidah in 1979, 1980 and 1981 is shown on Table 3-4-3.

Classification of the Cargo traffic handled at Hodeidah, Ras Kathib and Mocha in 1979, 1980 and 1981 are shown on Table 3-4-4.

Table 3-4-3 Classification of Ships Calling at Hodeidah

Ships type \ Year	1979	1980	1981
Conventional	518	473	398
Refer	114	90	175
Container	137	74	98
RO/RO	3	9	40
Oil Tanker	133	157	138
Lash	70	35	21
Passenger Boat	7	9	10
Total	982	847	880

Table 3-4-4 Cargo Traffic Handled at Hodeidah, Ras Kathib and Mocha

Unit 1,000 tons

Commodities	1979	1980	1981
Cement	643	408	412
Sugar	128	120	75
Flour	113	62	81
Rice	16	16	23
Other bags	15	38	36
Wood	187	270	173
Steel	130	155	137
Barrels	42	45	33
Frozens	112	124	185
General and mixed	335	357	330
General goods inside containers	156	155	185
Fertilizers	14	9	17
Others	4	10	13
Passengers luggage	31	15	6
Wheat	–	82	192
Petroleum	587	619	550
Total	2,513	2,485	2,448

3-5 Cargo Handling

3-5-1 Cargo handling efficiency of Hodeidah port

As no suitable records for cargo handling efficiency were available from PMAC and private stevedoring companies, we analyzed ship movement records compiled by the PMAC Marine Dept. and received the following results.

Average cargo handling efficiency

(1) General cargo ship

General cargo: 660 tons/day/ship

Bagged flour: 1,030 tons/day/ship

Bagged cement: 1,140 tons/day/ship

(2) Reefer carrier

Reefer cargo: 460 tons/day/ship

(3) Bulk carrier

Bulk wheat: 1,720 tons/day/ship

Inasmuch as the analyzed duration of ship movement records was relatively short, the above figures may be insufficient in forming conclusions on cargo handling efficiency, but they are still some extent valid in indicating the port's efficiency.

As liner shipping companies generally expect a port to achieve minimum handling efficiency for general cargo of 800 to 1,000 tons/day, the Port of Hodeidah does not fulfill the requirements of shipping companies which could be among the biggest users of the port, and can not, therefore, be classified as an efficient port.

Despite this low efficiency, the 1,264,000 ton figure for dry cargo handled at the Port of Hodeidah through 4 berths in 1980 was satisfactorily high, but this was attained due to the extremely high rate of berth occupancy of nearly 100% which resulted in almost every ship having to wait undesirably long for berth space.

3-5-2 Present Situation of Cargo handling

According to our observation on cargo handling operations and through information received from PMAC and stevedoring agencies, the present cargo handling system is as follows;

(1) General cargo import

Cargo traffic at the Port of Hodeidah consists mostly of import cargo. Export cargo handling is very rare.

Cargo is unloaded from ship directly onto stevedores trucks hired from private trucking companies. It is then transferred to transit sheds or open shed areas located behind the berths, which the stevedores rent from PMAC. The cargo is then sorted by cargo mark and consignee, run through customs inspection, and stored until delivery.

(2) Container

Containers are unloaded from the ship directly onto the stevedore's trucks, then transferred to an open container storage yard of approx 13 hectares (shared by the stevedores) located near the port entrance area. The containers are then unloaded from the trucks by forklift or mobile crane, and piled in two tiers of two twenty-foot containers (or one forty-footer) long by four containers wide, each container being placed with the door facing towards the outside to enable unpacking of cargo.

Since there are various problems concerning container inland transportation and custom inspection, (ie one way full container transport, high inland carriage rate, severe custom inspection where all cargo must be unpacked, etc), most container cargoes are unpacked in the open container storage yard and delivered to the consignee. Consequently, most empty containers remain in the same position where they placed at first and they are seldom to shift until loaded back on ship. The loading of empty containers back on ship follows the reverse order of their unloading.

Since there is no container portal crane in the Port of Hodeidah (as of Dec. 1981), containers are handled by conventional handling methods.

The movement of containers between the ship and the wharf apron is performed by ship derricks or jib cranes with simple container lifting beams. Such methods seem fairly efficient with an average handling volume of about 10 container units per hour per derrick.

Accordingly, if two ship derricks engage in handling operations, their combined efficiency equals that of one container crane.

Transportation between wharf apron and open storage area is performed by ordinary type truck.

However, compared with exclusive container trailers (chassis + tractor) equipped with loading guide devices, current container-to-truck loading methods are quite time-consuming. The resulting time wasted while containers sit inactive causes congestion around the wharf apron, and a drop in the efficiency of the whole container handling process.

The use of exclusive container trailers should be introduced to eliminate the extra time required to set the container on the truck, enhancing the efficiency of the entire operation.

3-5-3 Administration

PMAC has not been fully involved in cargo operation. Currently, PMAC limits its business to berthing, pilotage and tug service, maintenance of equipment and navigation aids, and cargo placement area allocations.

The shipping agents, who also act as stevedores, are fully responsible for cargo handling operation.

The stevedores must also furnish their own foremen, crane operators, and forklift drivers as well as providing cargo handling equipment such as forklifts and mobile cranes.

All manpower, other than the above, required for stevedoring and cargo handling in the port area and direct truck movement is furnished by the central labor office.

Standard gang composition is as follows:

	Ship Gang	Shore Gang
Gang boss	1	1
Winchmen	3	0
Labor	8	11
Total	12 men	12 men

Ship labor hands performed all stevedoring and cargo handling aboard ship and lighters; shore labor hands performed all cargo handling on the apron and transit sheds.

The current total ship labor force is 983; the shore labor force is 930 regular laborers.

Work assignments are distributed by gangs, which are rotated to equalize yearly incomes in the force.

The working hours of labors are from 07:00 hrs to 12:00 hrs, then from 14:00 hrs to 02:00 hrs, and labor have worked 17 hours per day without changing the gangs by shift.

3-6 Port Charge

The tariff of the Port is shown in Table A3-6-1.

CHAPTER 4
CARGO TRAFFIC FORECAST

CHAPTER 4. CARGO TRAFFIC FORECAST

4-1 Basic Principle

4-1-1 General

The cargo traffic forecasts made in this Feasibility Study are for 1986, target year of the Urgent Plan and for the year 2000, target year of the Master Plan, as well as for 1993 when another new berth will be required for the Port of Hodeidah, following completion of the 7th berth under the Stage Construction Plan.

4-1-2 The Division of Functions between the Ports of YAR

Hodeidah, Ras Kathib, Mocha and Salif, the YAR's four ports all facing the Red Sea, will distribute the forecasted cargo, according to the outline of port functions given below:

1) The Port of Hodeidah

The Port of Hodeidah, to be operated in tandem with the Port of Ras Kathib, will play the most important role in seaport transportation in the YAR, being the center of commercial port facilities for the entire Republic, with the exception of the governorates of Taiz and Ibb, which are served by the Port of Mocha.

General cargo and containers, as well as wheat and petroleum – handling and storing facilities for which have been already provided – will be unloaded at the Port of Hodeidah.

2) The Port of Ras Kathib

The Port of Ras Kathib, located on the tip of the sand spit extending northwards from the Port of Hodeidah, will continue to complement Hodeidah Port.

Since Ras Kathib Port has limited cargo storage space, it will handle cargoes to be transported directly to the cities of Hodeidah and Sanaa. These cargoes are flour, sugar, cement and frozen cargo.

3) The Port of Mocha

The Port of Mocha will serve as the center of commercial port activities for the governorates of Taiz and Ibb. A wide range of general goods and construction materials supplied to the area above will be unloaded through Mocha, with the exception of containers and wheat, which will be handled by the specialized facilities of Hodeidah.

4) The Port of Salif

The Port of Salif is blessed with natural conditions which enable it to cater to large-sized vessels, such as bulk carriers, cement carriers, and tankers. Since the Port of Hodeidah is unable to accommodate such vessels because of its long approach channel, Salif will act as a complementary port to receive bulk cargo from large bulk carriers. This assumes, however, the construction of adequate roads between Salif and Bajil.

4-2 Economic Frame

In April 1982, the Central Planning Organization of the YAR submitted to the First Plenary Meeting of the Second Yemen International Development Conference the Second Five-Year Plan (1981–1986), drafted with the assistance of the World Bank and UNDP.

The Second Five-Year Plan emphasizes development of agriculture, manufacturing, mining and the power and water supply industries, while at the same time it recommends strong import restrictions to encourage growth of local industries. However, in light of the accomplishments of the First Five-Year Plan and the actual conditions present in the country, these import restriction seem to be excessive. Thus the cargo forecast in this report is based on revised Second Five Year Plan economic indices.

Table 4-2-1 Economic Indices

	1981–1986		1986–2000
	II Five Year Plan	This Study	
Growth rate of GDP	% 7.0 (5.9)	% 6.0	% 5.0
Import value	1.0 (18.4)	2.6	
Growth rate of sectors			
Agriculture, Forestry & Fisheries	4.8 (1.0)	2.0	
Mining and Quarries	12.0 (18.2)	12.0	
Manufac. Industries	14.5 (11.7)	14.5	
Electricity and Water	25.0 (20.4)	25.0	
Construction & Building	2.0 (10.6)	2.0	
Wholesale and Retial Trade	6.0 (2.2)	4.0	
Catering Services & Hotels	7.5 (5.3)	7.5	
Transport & Communications	6.0 (7.7)	6.0	
Financial Institutions	8.1 (25.9)	8.1	
Housing & Real Estate Serv.	6.5 (5.1)	6.5	
Personal & Social Services	8.1 (6.3)	8.1	
Growth rate of Resident Population	2.8 (3.0)	2.8	2.0

( ): Real Growth Rate during the I Five-Year Plan (1975/1976–1980/1981)

GDP and population value for 1986, 1993 and 2000 are projected in Table 4-2-2.

Table 4-2-2 Projection of GDP and Population

	1981	1986	1993	2000
	mil YR	mil YR	mil YR	mil YR
GDP	12,949	17,329	24,384	34,310
(Per capita)	(1,516 YR)	(1,805 YR)	(2,253 YR)	(2,812 YR)
Population (1,000)	8,540	9,603	10,823	12,200
Resident Population	7,145	8,203	9,423	10,800
Migrants	1,395	1,400	1,400	1,400

4-3 Cargo Forecast for the Year 1986

4-3-1 Macroscopic Cargo Forecast

Prior to the calculation of projections by commodity, a macroscopic forecast was drawn up of total cargo volume expected to be unloaded through the YAR in 1986. For this forecast, an equation is used to express the relation of total cargo to import values over the past 5 years (1975/1976 – 1979/1980) as indicated below.

$$Y = 0.95235 \cdot X - 883.221 \quad (\gamma = 0.9850)$$

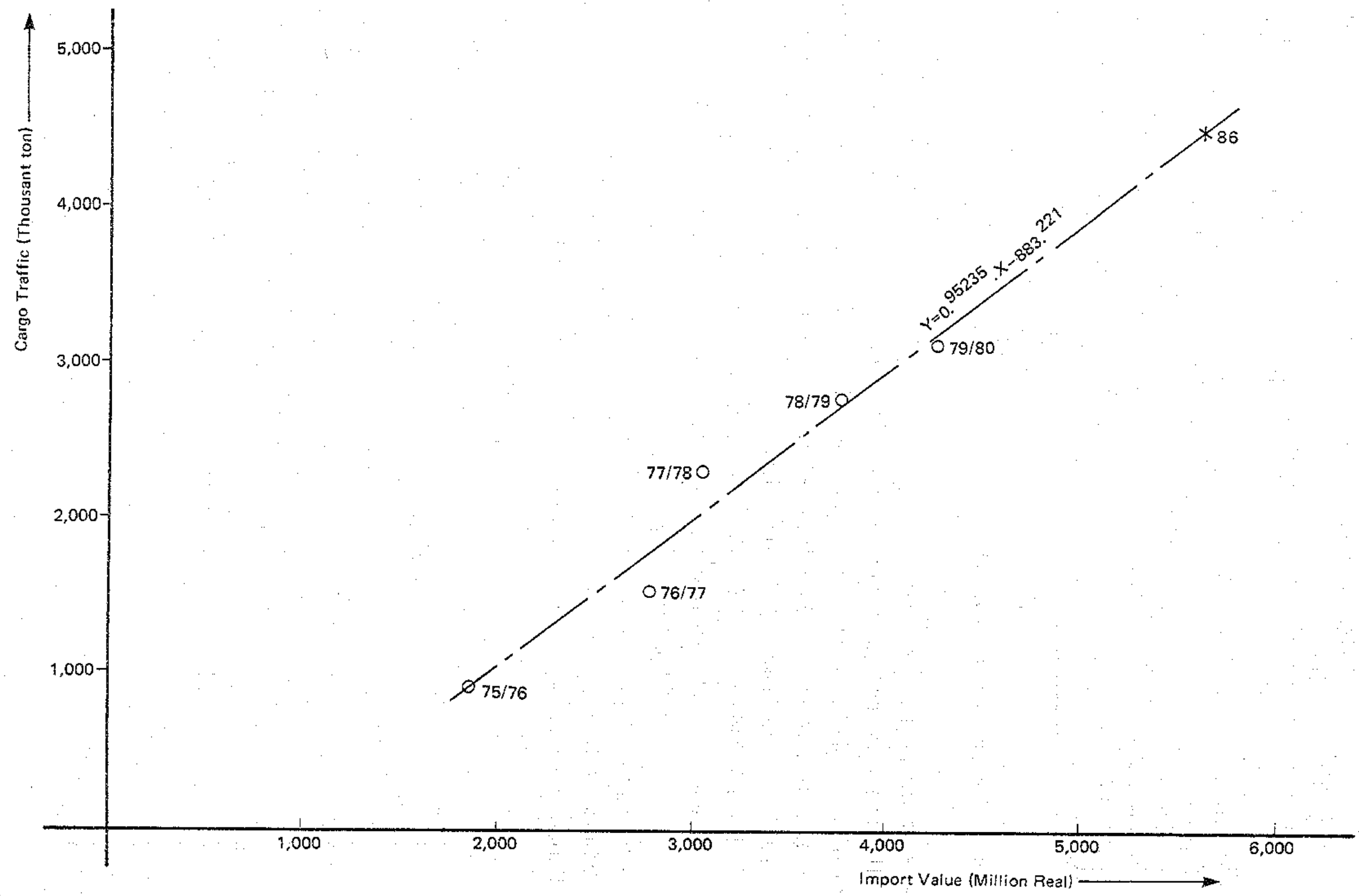
where Y: Volume of cargo unloaded (mil. tons)

X: Import value (bil. YR)

Port cargo traffic in the YAR in 1986 based on the above equation is predicted to be about 4,500 thousand tons.

Exports have not been treated in this study because the present volume is negligible.

Fig. 4-3-1 Cargo Traffic and Import Value



4-3-2 Projection by Commodity

(1) Wheat and Flour

The recorded imports of wheat and flour were 289,000 tons in 1980 and 359,000 tons in 1981.

Figures for wheat and flour consumption are shown below:

Table 4-3-1 Wheat and Flour Consumption and Production

Year	77	78	79	80	81
Consumption ('000 tons)		369	428	347	442
Per capita consumption (kg)		(56)	(63)	(49)	(58)
Production ('000 tons)		44.3	52.9	52.6	63
Import ('000 tons)		320	375	289	359

The import of wheat and flour for 1986 was estimated from the projected growth rate of per capita consumption under the First Five-Year Plan and the projected growth rate of personal consumption and population under the Second Five-Year Plan.

The projection for wheat and flour imports in 1986 is as follows.

Table 4-3-2 Wheat and Flour Import (1986)

Target Year	1986
Consumption ('000 tons)	600
Per Capita Consumption (kg)	(71.8)
Production ('000 tons)	91
Import ('000 tons)	510

(2) Rice

Recorded rice imports were 16,400 tons in 1979, 15,600 tons in 1980 and 22,500 tons in 1981.

The rice consumed in the YAR is entirely imported from abroad. Consumption levels since 1976 have not increased much as anticipated in the First Five-Year Plan.

The import of rice for 1986 was estimated from the projected growth rate of per capita consumption under the First Five-Year Plan, the projected growth rate of personal consumption under the Second Five-Year Plan and from the estimated population in 1986.

The projection for rice import in 1986 is as follows.

Table 4-3-3 Rice Import (1986)

Target Year	1986
Consumption ('000 tons)	100
Per Capita Consumption (kg)	(12)
Import ('000 tons)	100

(3) Sugar

Recorded sugar imports were 128,000 tons in 1979 and 120,000 tons in 1980, but dropping to 75,000 tons in 1981.

The import of sugar in 1986 shown in the following table was estimated from the projected growth rate of per capita consumption under the First Five-Year Plan, the growth rate of personal consumption expenditure under the Second Five-Year Plan and the projected population in 1986.

Table 4-3-4 Sugar Import (1986)

Target Year	1986
Consumption ('000 tons) Per Capita Consumption (kg)	200 (24)
Import ('000 tons)	200

(4) Cement

Recorded cement imports were 643,000 tons in 1979, 664,000 tons in 1980, 764,000 tons in 1981.

Cement consumption and production are shown below:

Table 4-3-5 Cement Consumption and Production

Year	75/76	76/77	77/78	79	80	81
Consumption ('000 tons)	116	327	639	711	745	unknown
Per Capita Consumption (kg)	(19)	(51)	(98)	(104)	(106)	
Production ('000 tons)	60	60	50	68	81	
Import ('000 tons)	56	267	589	643	664	764

To obtain the import volume of cement for 1986, the projected production volume of cement was subtracted from the projected consumption volume. 1986 cement consumption was calculated from the actual growth rate of the construction sector under the First Five-Year Plan, the projected growth rate under the Second Five-Year Plan and the estimated population in 1986. To domestically produce cement, the Second Five-Year Plan has set 1984 as the year for commencement of full operation at the Bajil Cement Factory, and 1982 has been set for full operation of the Amran Cement Factory.

An additional cement factory, with a capacity of over 500,000 t/y is planned for Mafruk. The second Five-Year Plan has not set any target date for full operation of this factory, as there is no exact estimated date of completion.

The estimated cement import volume for 1986 is as follows:

Table 4-3-6 Cement Import (1986)

Target Year	1986
Consumption ('000 tons)	1,330
Per Capita Consumption (kg)	(159)
Production ('000 tons)	830
Import ('000 tons)	500

(5) Liquid Petroleum Products (transported in metale drums)

Imports of liquid petroleum products (transported in metale drums) have not increased since 1976 although bulk petroleum products have shown a gradual increase. This seems to be due to the fact that the import of liquid petroleum products depends partially upon land transportation from Saudi Arabia.

Therefore, liquid petroleum imports in 1986 are estimated at 80,000 tons.

Liquid petroleum imports are not expected to increase greatly in the future, though a complete cessation of such imports is not likely either.

So, liquid petroleum imports through the year 2000 are estimated to be approximately the same as for 1986.

(6) Fertilizer

Recorded fertilizer imports were 14,000 tons in 1979, 9,000 tons in 1980, and 17,000 tons in 1981.

As no useful data has been available for estimating 1986 fertilizer imports, the ratio of the growth rate of fertilizer consumption to the growth rate of agricultural production in the Asian and African area was first obtained and from this ratio and the annual growth rate of agriculture, forestry & fisheries under the Second Five-Year Plan, the consumption of fertilizer in 1986 was estimated and applied an import figure.

The estimate for 1986 fertilizer imports is 20,000 tons.

(7) Other Cargo

Other cargo includes wood, steel, frozen goods, general cargoes, containers, and others, excludes petroleum. Recorded imports of these cargoes totalled 1,057,000 tons in 1979, 1,319,000 tons in 1980, and 1,126,000 tons in 1981 accounting for respectable volume of total cargo imports.

The growth rate of other cargo and total cargo import from 1976 to 1981 bringed an elastic value of 1.6 (increase rate of other cargo/increase rate of total cargo).

In the macroscopic projection using the above elastic value with the growth rate of total cargo imports, the 1986 import volume for other cargoes is estimated at 1,450,000 tons.

1) Steel

Recorded steel imports were 130,000 tons in 1979, 155,000 tons in 1980 and 137,000 tons in 1981.

According to a UNIDO projection, the annual production growth rate per capita in the developing nations is estimated to be 74.9% for the period from 1976 to 1985. (See Table 4-3-7)

From this figure, production per capita in the developing nations in 1979, 1980, 1981 and 1986 was obtained. Then the ratio of steel production per capita in developing countries to steel per capita consumption in the YAR was calculated for these same years. Based on the assumption that this ratio will remain constant through 1986, per capita consumption in the YAR for 1986 was first obtained and then the figure for total YAR steel consumption was obtained and applied as the steel import figure.

Thus, total steel imports in 1986 are estimated at 260,000 tons.

Table 4-3-7 Projection for Production of Crude Steel by UNIDO

(Unit: million tons)

	1975	1976	1985	2000
Scale of Production	646.3	683.5	1,050	1,750
Prospects of Developing Nations				
Scale of Production	62.5	66.5	151	530
Share in the World (%)	9.7	9.7	14	30
Products per Capita (kg per capita)	22.5	23.5	45	115
Rate of Domestic Production on National Consumption (%)	57.8	*58.8	72	100

Note: *Appearance consumption is supposed.
Source: UNIDO "Basic Projection 1985–2000"

2) Wood

Recorded wood imports totalled 187,000 tons in 1979, 270,000 tons in 1980 and 173,000 tons in 1981.

As most buildings in the YAR are built with non-wood materials, the sector of the economy consuming the largest proportion of wood is considered to be the manufacturing sector.

For this reason, the manufacturing sector's annual growth rate under the Second Five-Year Plan (from 1981 to 1986) was used to calculate the wood consumption growth rate.

Assuming that the figures for consumption and imports are equal, then 1986 wood imports are estimated at 340,000 tons.

3) General Cargo, Containers, Frozen Goods and Others

The rest of "other cargo" has been distributed to general cargo (including containers), frozen goods, and others, based on the present import levels of each commodity.

(8) Petroleum

Recorded petroleum imports totalled 250,000 tons in 1976, 588,000 tons in 1979, and 619,000 tons in 1980, showing a gradual increase since 1976. The growth from 1976 to 1980 was 25.4% per annum, nearly equalling that of the power generation sector over the same period.

An additional oil berth was completed which can accomodate 15,000 DWT tankers. It is believed that the capacity of this berth will be sufficient to handle petroleum imports through 1986. Therefore, petroleum imports have in this study been estimated at 1,400,000 tons for 1986, assuming a rate increase of 12.5% per annum. This is half the growth rate assumed for the power generation sector through 1986.

(9) Summary

Cargo projection results are presented in Table 4-3-8.

Table 4-3-8 Cargo Traffic Projection (1986)

(Unit: 1,000 tons)

Commodity	Actual Record			1986
	1979	1980	1981	
Cereal	391	305	382	610
Wheat and Flour	375	289	359	510
Rice	16	16	23	100
Sugar	128	120	75	200
Cement	643	664	764	500
Liquid Petroleum (packed in metal drums)	(42)	(46)	included in other cargo	80
Fertilizer	14	9	17	20
Other Cargo	1,057	1,319	1,126	1,450
Wood	187	270	173	340
Steel	130	155	137	260
Frozenes				200
General	740	894	816	650
Others				
Petroleum	588	619	550	1,400
Total	2,821	3,036	2,914	4,260

Note: 1) Liquid Petroleum (packed in metal drums) in 1979 and in 1980 are in the estimation.
2) General in 1979, in 1980 and in 1981 include all container cargoes.

4-3-3 Container Cargo Projection

(1) Present Containerization

Containerization has been progressing in the YAR and the volume of container cargoes was recorded at 156,000 tons in 1979, 155,000 tons in 1980, and 185,000 tons in 1981.

(2) Container Projection

Container cargo projection procedures are as follows.

a) To classify each commodity as either containerizable or not

b) To estimate by area the potential demand for containerizable cargo in the area

c) To estimate the rate of containerization

The rate of containerization mentioned above means the ratio of actual containerized cargo to the containerizable cargo.

A flow chart for the above procedure is shown in Fig. 4-3-2.

1) Volume of containerizable cargoes by commodity

The rate of containerizable cargo out of total cargo was determined for each commodity with consideration of country of origin, destination, configuration and cargo packing style. (See Table 4-3-9)

2) Volume of container cargoes in target year

To estimate the container cargo volume for the target year, the rate of containerization for every commodity of the total cargo volume was determined. This was done first using container cargo statistics from shipping routes in the Red Sea and the Perusian Gulf, both of which are relatively highly containerized, as well as taking into account the condition of ports and harbours in the origin and destination countries, and the progress of containerization in the YAR. The rate thus derived was then multiplied by the volume of containerizable cargo in the target year, thus yielding an estimated container cargo volume. (See Table 4-3-9)

3) Number of container vans

From the container cargo volume, the number of stuffed container was calculated for each commodity. Each 20 ft container was assumed to hold 12 tons when stuffed.

Since container cargo for export will not be generated until the year 2000, the number of container vans (counted as 20 ft containers) was calculated assuming empty containers and the stuffed containers are of equal number. (See Table 4-3-10)

Fig. 4-3-2 Flow Chart of Container Cargo Forecast

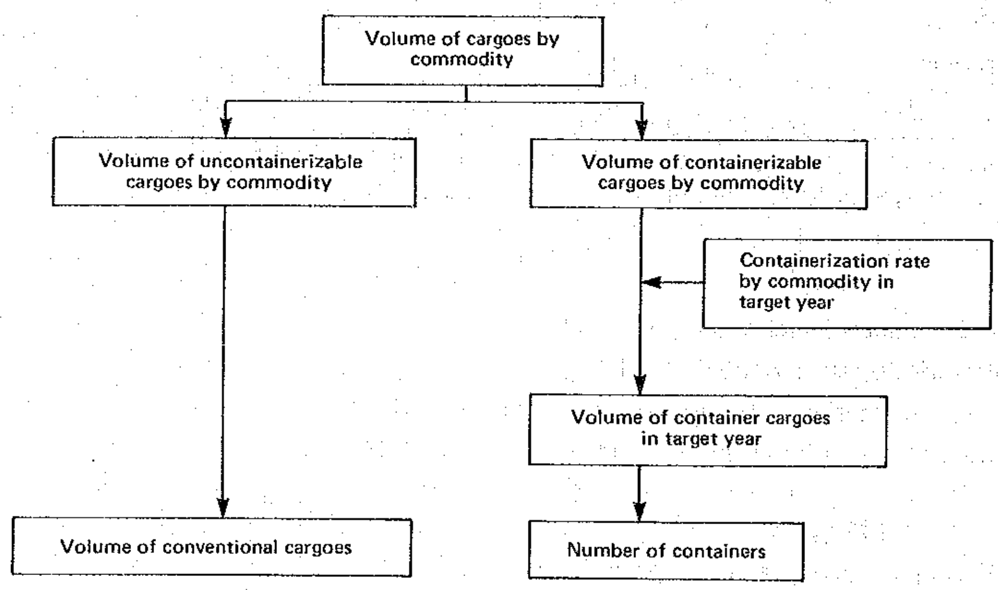


Table 4-3-9 Volume of Containerizable Cargoes and Container Cargoes for 1986

(Unit: 1,000 tons)

	Containerizable Cargoes	Container Cargoes
Wheat and Flour	50	40
Rice	50	40
Sugar	180	90
Fertilizer	20	10
Wood	136	50
Frozen Goods	160	120
General Cargoes and Others	520	240
Total	1,116	590

Table 4-3-10 Number of Container Vans (1986)

(Unit: TEU)

	Number of Container Vans
Wheat and Flour	3,334
Rice	3,334
Sugar	7,500
Fertilizer	834
Wood	4,167
Flozen Goods	10,000
General Cargoes and Others	20,000
Stuffed Container Vans	49,169
Empty Container Vans	49,169
Total Container Vans	98,338÷98,000

Table 4-3-11 Cargo Traffic Projection Finalized (1986)

(Unit: 1,000 tons)

Commodities \ Year	1986
Cereal	530
Wheat and Flour	470
Rice	60
Sugar	110
Cement	500
Liquid Petroleum (Packed in metal drums)	80
Fertilizer	10
Other Cargo	1,630
Wood	290
Steel	260
Frozenes	80
Containers	590
General Cargo and Others	410
Petroleum	1,400
Total	4,260

4-3-4 Apportioning of Cargoes to Each Port

The cargo estimated in Table 4-3-11 shall be apportioned to each of the four ports: Hodeidah, Ras Kathib, Mocha, and Salif. Apportioning is planned both in accordance with the "4-1-2 The Division of Functions between the Ports of the YAR" and with consideration toward the handling records and capacities of existing port facilities.

The basic approach in total cargo distribution is as follows:

a. Total cargoes have been apportioned to the Port of Mocha and other ports (Hodeidah, Ras Kathib, and Salif) based on distribution rates shown in Table 4-3-12. This table was made with reference to hinterland population distributions of Mocha Port and other ports, as shown in Table 4-3-13.

b. The cargoes of the other ports have been reapportioned to Hodeidah, Ras Kathib, and Salif. In this case, it is presumed that the handling capacities of the existing ports of Ras Kathib and Salif are respectively around 500,000 – 550,000 tons and 450,000 – 500,000 tons.

Distributed cargo traffic is presented in Table 4-3-14 and Fig. 4-3-3.

The Ports of Hodeidah and Ras Kathib are to handle 3,100,000 tons in 1986, increasing by 1,244,000 tons comparing with 1980 cargo.

4-3-5 Passenger Movement Forecast

Traffic between the port of Hodeidah and Saudi Arabia of passengers making pilgrimages to

Mecca increased until 1975, but by 1980 had declined rapidly to one-fifteenth the 1975 level, reflecting the shift to air transportation. It is expected that this yearly decrease will continue, so passenger movement is expected to drop to 2,000 by 1986.

Fig. 4-3-4 shows passenger movement, past and future.

Passenger movement is likely to dwindle to a negligible level by the year 2000.

Table 4-3-12 Cargo Distribution Rate

Commodity	Hodeidah Ras Kathib Salif	Mocha	Remarks
Wheat	100%	0%	
Flour	80	20	
Rice	100	0	
Sugar	80	20	
Cement	75	25	
Packed Petroleum Products	100	0	
Fertilizer	100	0	
Wood	80	20	
Steel	80	20	
Frozenes	80	20	
General and Mixed	80	20	
Containers	100	0	
Others	80	20	
Petroleum	80	20	

Table 4-3-13 Population of Port Hinterland in 1981

	Hodeidah, Ras Kathib and Salif Zone		Mocha Zone	
		%		%
Population (1000)	4,715	66.0	2,430	34.0
Population of Governorate Capital (1000)	387	77.3	114	22.7
Population of Manufacturing Sector (1000)	26	77.6	8	22.4
Population of Construction Sector (1000)	30	56.6	23	44.4

Source: Statistical Year Book, CPO.

Note: Mocha Zone consists of the governorate of Taiz and Ibb, while the Hodeidah, Ras Kathib and Salif Zone cover all the Governorates other than Taiz and Ibb.

Table 4-3-14 Cargo Traffic Projection by Port (1986)

Unit: 1000 tons

Commodity	Total	Hodeidah	Ras Kathib	Mocha	Salif
Wheat and Flour	470	310	–	20	130
Rice	60	–	60	–	–
Sugar	110	–	90	20	–
Cement	500	–	55	125	320
Liquid Petroleum (packed in metal drums)	80	–	80	–	–
Fertilizer	10	–	10	–	–
Other Cargo	1,630	1,140	235	205	50
Wood	(290)	(230)	(–)	(60)	(–)
Steel	(260)	(210)	(–)	(50)	(–)
Frozenes	(80)	(–)	(65)	(15)	(–)
Containers	(590)	(590)	(–)	(–)	(–)
General cargoes and others	(410)	(110)	(170)	(80)	(50)
Petroleum	1,400	1,120	–	280	–
Total	4,260	2,570	530	650	500

Fig. 4-3-3 Cargo Traffic by Port

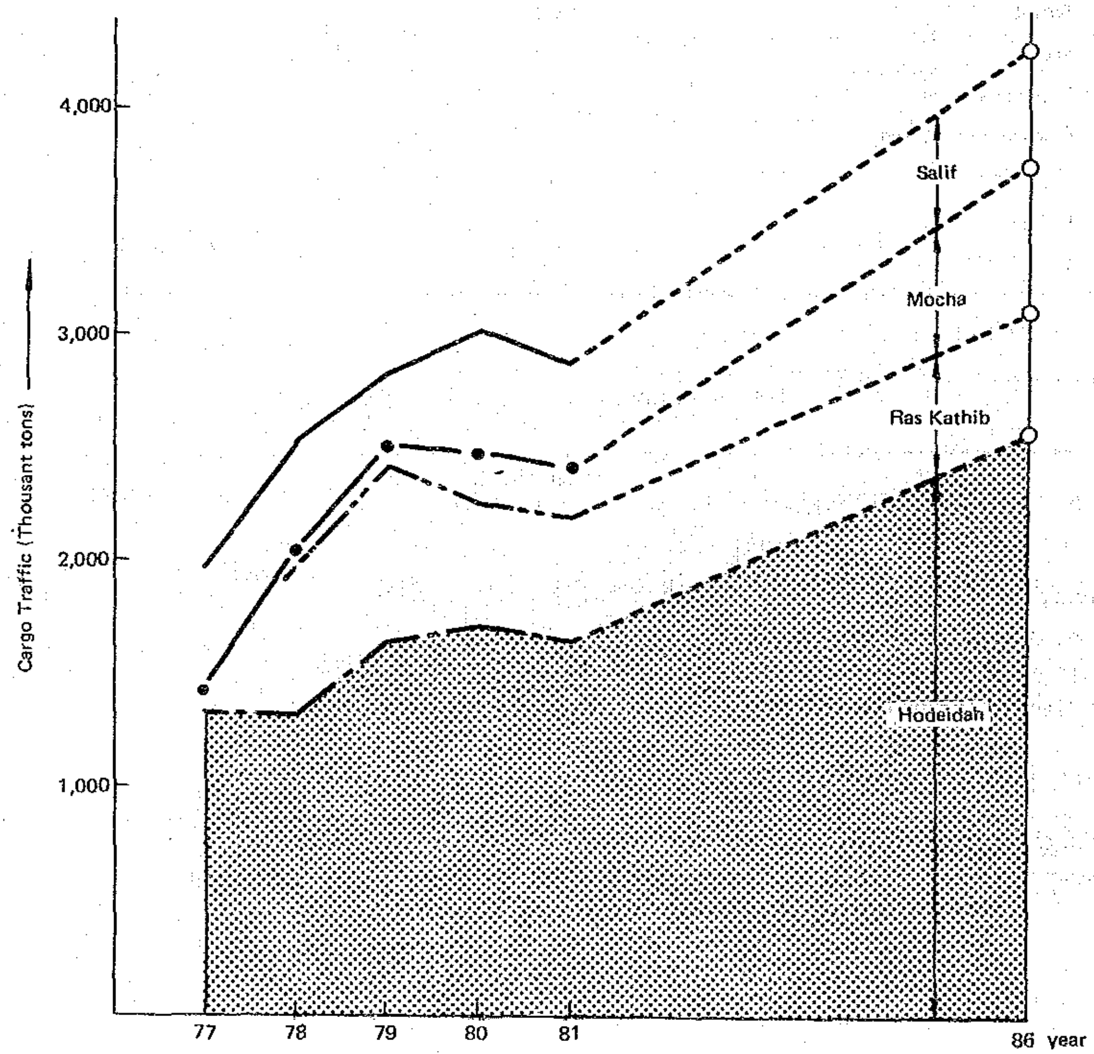
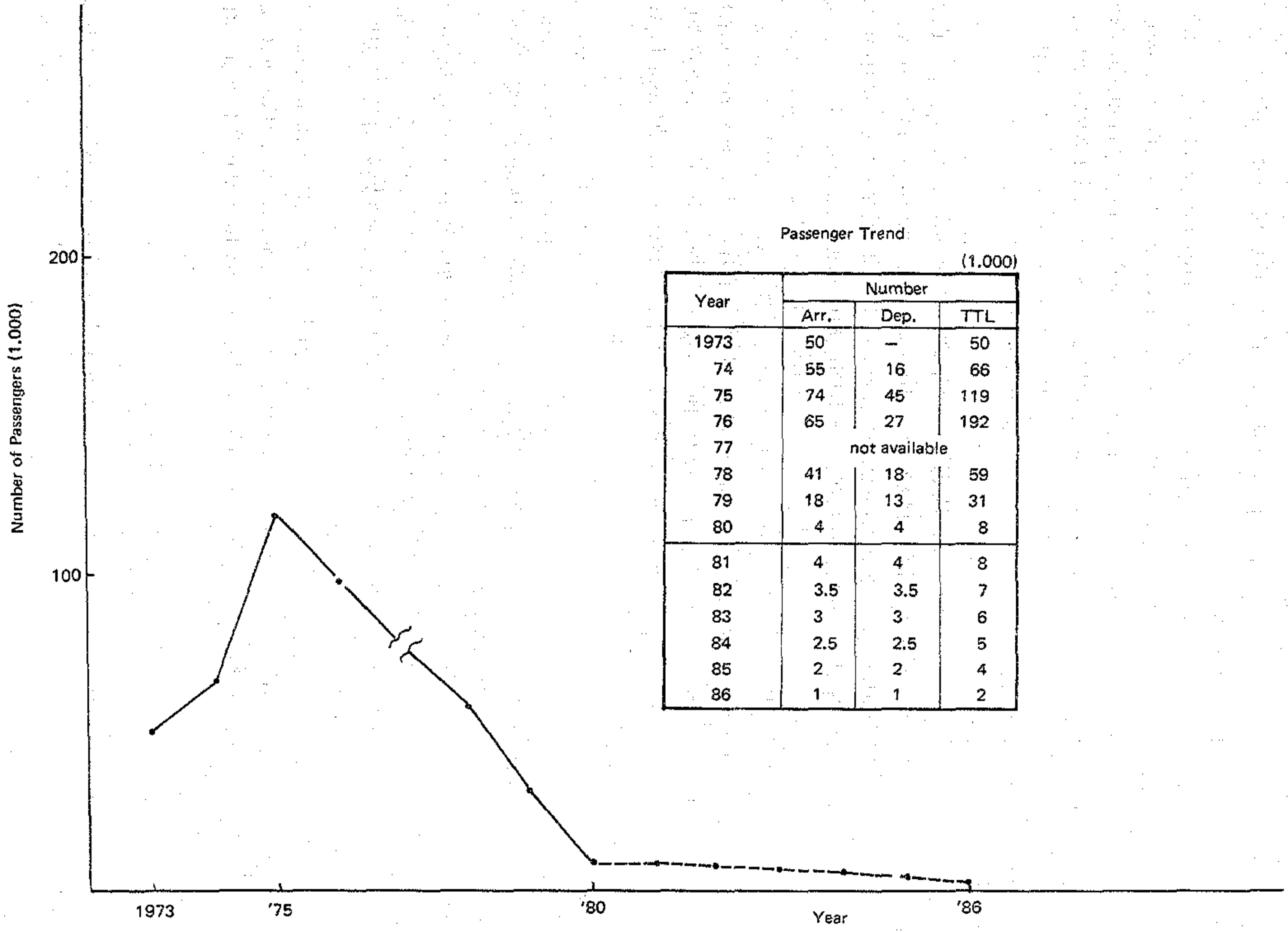


Fig. 4-3-4 Passenger Movement



Passenger Trend

(1.000)

Year	Number		
	Arr.	Dep.	TTL
1973	50	—	50
74	55	16	66
75	74	45	119
76	65	27	192
77	not available		
78	41	18	59
79	18	13	31
80	4	4	8
81	4	4	8
82	3.5	3.5	7
83	3	3	6
84	2.5	2.5	5
85	2	2	4
86	1	1	2

4-4 Cargo Forecast for the Years 1993 and 2000

Completion of the 7th berth (with its two gantry cranes), combined with operation of the 6th berth (one gantry crane) and the Ro/Ro berth (one rampway), will provide sufficient container cargo handling capacity only up to the year 1993. Therefore it is necessary to begin formulating a plan for an additional berth.

In order to draft step by step construction plans for the target years 1993 and 2000, cargo traffic projections for these same years are required.

These traffic projections have thus been calculated based mainly on the GDP and the population growth rates for the period from 1986 to 2000, as determined in Section 4-2.

4-4-1 Projections by Commodity

(1) Wheat and Flour

Assuming that the consumption growth rate for wheat and flour during the period from 1986 to 2000 is 5% (same as that of GDP) and that the production growth rate during this period is 7.6% (same as the projected growth rate under the Second Five-Year Plan) then imports of wheat and flour are estimated at 692,000 tons in 1993 and 930,000 tons in the year 2000.

(2) Rice and Sugar

There is no domestic production of rice or sugar. Since consumption equals imports in this case, and calculating from the GDP growth rate, rice imports are estimated at 141,000 tons in 1993 and 200,000 tons in 2000, while sugar imports are estimated at 281,000 tons in 1993 and 400,000 tons in 2000.

(3) Cement

Annual domestic cement production is estimated at 830,000 tons, at the Bajil and Amran cement factories, under the Second Five-Year Plan.

Production is expected to increase gradually, reaching 2,000,000 tons yearly between 1991 and 2001 (final year of the Fifth Five-Year Plan).

It is assumed that the Mafraf cement factory (500,000 ton production capacity) will be operating at full capacity.

Assuming that the consumption growth rate is equal to the GDP growth rate (5%), and calculating import volume by deducting production volume from consumption volume, then concrete imports are estimated at 141,000 tons in 1993, shifting to 500,000 tons of exports by the year 2000.

(4) Liquid Petroleum Products (transported in metal drums)

As previously mentioned in Section 4-3-2 (5), liquid petroleum imports are estimated at 80,000 tons in the year 2000.

(5) Fertilizer

Using the same method as explained in Section 4-3-2 (6). Consumption of fertilizer was calculated from the ratio of the annual fertilizer consumption growth rate in the Asian-African region as compared to the some regions' annual agricultural growth rate. This ratio was then multiplied by the annual agricultural growth rate in the YAR (as annual growth rate of 2% was assumed for the period 1981 – 1986).

Assuming that consumption is equal to imports, then fertilizer imports are estimated at 26,000 tons for 1993, and 35,000 tons for the year 2000.

(6) Steel, Wood and Petroleum

Assuming that the steel, wood and petroleum consumption growth rate is at 5% equal to that of the GDP, assuming that there is no domestic production of there items, and assuming that imports are equal to consumption the a steel, wood and petroleum imports in 1993 are respectively estimated at 366,000 tons, 670,000 tons and 1,970,000 tons and in the year 2000 are respectively estimated at 510,000 tons, 670 tons and 270,000 tons.

(7) Frozen Goods, General Cargo and Miscellaneous Items

To determine the figures for consumption of frozen goods, general cargo and miscellaneous items, first, total consumption for these three categories was calculated from the 1986 projected total consumption of all cargoes and from the projected GDP growth rate. Then, consumption for each of these three commodities was calculated from their respective 1981 consumption figures. The result of these computations was taken as the volume of import.

Therefore, imports of frozen goods, general cargo and miscellaneous items in 1993 are respectively estimated at 210,000 tons, 610,000 tons and 299,000 tons and imports in 2000 are respectively estimated at 400,000 tons, 860,000 tons and 420,000 tons.

4-4-2 Container Cargo Projection

The projection for container cargo and the number of container vans was made according to the process described in the flow chart of Fig. 4-3-2, which is the same method as mentioned in Section 4-3-3.

The volume of containerizable cargo by commodity and the volume of container cargoes by commodity for 1993 and 2000 are as shown in Table 4-4-1, while the number of container vans in 1993 and 2000 are as shown in Table 4-4-2.

Table 4-4-1 Volume of Containerizable Cargoes and Container Cargoes for 1993 and 2000

(Unit: 1,000 tons)

	1993		2000	
	Containerizable Cargo	Container Cargo	Containerizable Cargo	Container Cargo
Wheat and Flour	69	60	93	90
Rice	71	62	100	95
Sugar	253	214	360	330
Fertilizer	26	23	40	35
Wood	191	143	268	250
Flozen Goods	230	201	328	300
General Cargoes and Others	727	593	1,040	930
Total	1,567	1,296	2,229	2,030

Table 4-4-2 Number of Container Vans (1993, 2000)

(Unit: TEU)

	Number of Container Vans	
	1993	2000
Wheat and Flour	5,000	7,500
Rice	5,167	7,917
Sugar	17,834	27,500
Fertilizer	1,917	2,917
Wood	11,917	20,834
Frozen Goods	16,750	25,000
General Cargoes and Others	49,417	77,500
Stuffed Container Vans	108,002	169,168
Empty Container Vans	108,002	169,168
Total Container Vans	216,004÷216,000	338,336÷338,000

4-4-3 Apportioning of Cargoes to Each Port

The estimated cargo volume of 2000 is to be apportioned to Hodeidah, Ras Kathib, and Salif. The apportioning is based on the same ideas employed in 4-3-4, in the distribution of cargoes through 1986.

Table 4-4-3 Cargo Traffic Projection (2000)

(Unit: 1,000 tons)

	1986	2000		Forecast Methodology (2000)
Wheat and Flour	510		930	Consumption: $600 \times (1.05)^{14} \doteqdot 1,188$ Production: $91 \times (1.05)^{14} \doteqdot 254$ Import: $1,188 - 254 \doteqdot 930$
Rice	100		200	Consumption: $100 \times (1.05)^{14} \doteqdot 200$ Import: 200
Sugar	200		400	Consumption: $200 \times (1.05)^{14} \doteqdot 400$ Import: 400
Cement	500	Ex	500	Production: $830 + 500 + 200 \times 9 = 3,130$ Consumption: $1,330 \times (1.05)^{14} = 2,633$ Export: $3,130 - 2,633 \doteqdot 500$
Liquid Petroleum (packed in metal drums)	70		80	Shown 4–3–2–(5)
Fertilizer	20		40	(*Growth rate of consumption of Fertilizer)/(*Growth rate of Agriculture) = *2.41 Annual Growth rate of Agriculture from 1981 to 1986: 2.0% Annual Growth rate of Fertilizer from 1987 to 2000: $2.41 \times 2.0 \doteqdot 5.0\%$ Consumption of Fertilizer for 2000: $20.0 \times (1.05)^{14} \doteqdot 40$ Import: 40
Wood	340		670	Consumption: $340 \times (1.05)^{14} \doteqdot 670$, Import: 670
Steel	260		510	Consumption: $260 \times (1.05)^{14} \doteqdot 510$ Import: 510
Flozenes, General Cargoes and Others	850		1,680	Consumption: $850 \times (1.05)^{14} \doteqdot 1,680$ Import: 1,680
Petroleum	1,400		2,770	Consumption: $1,400 \times (1.05)^{14} \doteqdot 2,770$ Import: 2,770
Total	4,260	Im	7,280	
		Ex	500	
		Total	7,780	

Note: 1) This figure include container cargoes.
2) *Average of Asia and Africa.

Table 4-4-4 Cargo Traffic Projection by Port (1993, 2000)

(Unit: 1,000 tons)

	1993					2000				
	Total	Hodeidah	Ras Kathib	Mocha	Salif	Total	Hodeidah	Ras Kathib	Mocha	Salif
Wheat and Flour	632	350	–	25	257	840	350	310	30	150
Rice	79	–	79	–	–	105	105	–	–	–
Sugar	67	–	54	13	–	70	–	55	15	–
Cement	141	–	–	35	106	Ex 500	–	Ex 60	Ex 120	Ex 320
Liquid Petroleum (packed in metal drums)	80	–	80	–	–	80	–	80	–	–
Fertilizer	3	–	3	–	–	5	5	–	–	–
Other Cargo	2,399	1,857	245	220	77	3,410	3,140	–	270	–
Wood	(335)	(268)	(–)	(67)	(–)	(420)	(340)	(–)	(80)	(–)
Steel	(366)	(293)	(–)	(73)	(–)	(510)	(410)	(–)	(100)	(–)
Frozenes	(86)	(–)	(69)	(17)	(–)	(100)	(80)	(–)	(20)	(–)
Containers	(1,296)	(1,296)	(–)	(–)	(–)	(2,030)	(2,030)	(–)	(–)	(–)
General Cargoes and Others	(316)	(–)	(176)	(63)	(77)	(350)	(280)	(–)	(70)	(–)
Petroleum	1,970	1,576	–	394	–	2,770	2,220	(–)	550	–
Total	5,371	3,783	461	687	440	Im 7,280 Ex 500	Im 5,820	Im 445 Ex 60	Im 865 Ex 120	Im 150 Ex 320

CHAPTER 5
MASTER PLAN AND SHORT TERM PLAN

CHAPTER 5. MASTER PLAN AND SHORT TERM PLAN

5-1 General

5-1-1 Ports in Yemen Arab Republic

There are four major ports in the Yemen Arab Republic: Salif, Hodeidah, Ras Kathib, and Mocha. The ports are interdependent in both port function and in the hinterlands they support.

The interdependency of the country's ports is revealed by knowing changes in cargo handling functions among the ports. For example, a new bulk cement terminal which was built in the last quarter of 1979 at Salif resulted in a decrease in throughput of bagged cement at Ras Kathib in 1980. During the reconstruction of the Port of Mocha (through November 1978), traffic cargo was transferred to Hodeidah Port.

During periods of tremendous congestion at the Port of Hodeidah, some functions have been observed to be transferred to other ports. Specifically, bulk goods such as cement, wheat, and oil were sent to Salif: construction materials, such as cement and wood, as well as some frozen goods were unloaded at Mocha; and motor vehicles carried by RO/RO vessels were unloaded at Salif.

This cooperation between ports of the YAR eased congestion to a large extent at the Port of Hodeidah in 1980 and 1981.

Port interdependency is an important theme in any discussion of port developments in the YAR, and future directions of port interdependency should be given prime consideration in port planning.

5-1-2 Shipping Service

Sea transport can be classified roughly into two types of shipping operation: liner service and tramp service. Liner service vessels call periodically at Hodeidah, the main port of the country, while the other ports are serviced mainly by tramp vessels carrying bulk or specialized cargoes. One exception to this is the confinuing but small scale salt exports from Salif, where liner ships load bulk rock salt as base cargo.

From the view point of shipping operations, the number of calling ports must be minimized on voyages in order to economically operate a fleet. Consequently, it is clearly best for liner vessels to limit their calls at Hodeidah, leaving tramp vessels to alternately visit other ports in the country. In addition to maintaining first class handling and port service facilities, a liner port must also have a fixed market and necessary accessories to sea trade operations such as shipping agents, custom brokers, merchants and warehouses. In this sense, no ports other than Hodeidah can yet be classified as liner ports. Even assuming these ports undergo development in near future, it is still expected that liner cargoes will be directed mainly to the Port of Hodeidah where congestion is being alleviated due to the upgrading of mooring facilities.

Liner vessels calling on ports along the Red Sea coast are gradually being upgraded, being converted into multi-purpose type vessels or container ships with on-board handling machines. As ship costs (building and operation) rise, the need becomes greater for quicker dispatching. Full container vessels of 2,000 – 2,800 TEU and calling on ports in Saudi Arabia. However, as their operating cost is approximately 40 – 45,000 US$ per day, additional calls are prohibitively expensive without sufficient amounts of cargo.

Container linears operating in the Red Sea area can be classified into two groups, as middle class carriers and third generation container carriers. Middle class carriers are more numerous, with a loading capacity from 500 TEU to 750 TEU; ship length less than 200 m; and draft less than 10 m. The third generation container carriers are very large intercontinental traders. Recent ship building trends indicate that a relatively large number of middle class container vessels will be launched in 1981 – 82, where as there will be a decrease among the largest size container carriers. Some of these middle class container ships will be equipped with about 30 ton capacity deck cranes. The worldwide trend can be observed where by non-international lines have begun employing these middle class container carriers.

A characteristic of the middle east trade in that it is import oriented. When a line is containerized, empty vans have to brought back to the exporting countries. Compared with intercontinental trade, the throughput of a berth will, in theory, be reduced by nearly half. This should be kept in mind when planning a container berth for Hodeidah. Frozen goods, steel and rubber tires, wood, bagged cement, etc., are cargo that can be economically transported by conventional cargo vessels.

5-1-3 Direction of Port Development

(1) Salif Port

The Port of Salif is located about 70 km north of Hodeidah and is operated through a Yemen Salt Mining Corporation. The port has three deep sea berths which handle specialized cargo such as bulk rock salt, using a pier equipped with a modern ship loader. Imported cars and trucks are also unloaded, bulk cement is handled at the north pier which is equipped with cement silos and a bagging plant. Wheat is handled on a simple unloading floating pier. An oil company is expected to build a pier at the port in the near future. The Kamaran Passage maintains a deep draft right up to these mooring facilities. Fig. 5-1-1 shows the location of the Port of Salif. It is sheltered from the Red Sea by Kamaran Island, a natural breakwater.

There is, however, no proper liner port function at present. Shipping agents and stevedoring companies are sent from Hodeidah when a ship makes a call. Salif town is lightly populated and can hardly supply the labour demanded by existing port handling volumes. Civil infrastructures are not yet sufficiently developed. The road connection to the main highway which runs between Sana'a and Hodeidah is not paved yet. These deficient road conditions hinder smooth cargo distribution to the hinterland. Furthermore location of the port seems too close to the Port of Hodeidah, perhaps discouraging liner vessels from calling at both ports in one vogage, even though the port is favored with excellent natural conditions.

A development plan has been proposed by PMAC for the port as shown in Fig. 5-1-2. An oil unloading berth is planned to accomodate a 100,000 DWT crude oil tanker. Also, a wharf for general cargo handling berths will be constructed through reclamation. Large draft tramp vessels can be accomodated by building some simple mooring facilities. Oil, cement, wheat and other bulk or specialized cargo as vehicles will be handled there in the future as well.

Fig. 5-1-1 Port of Salif

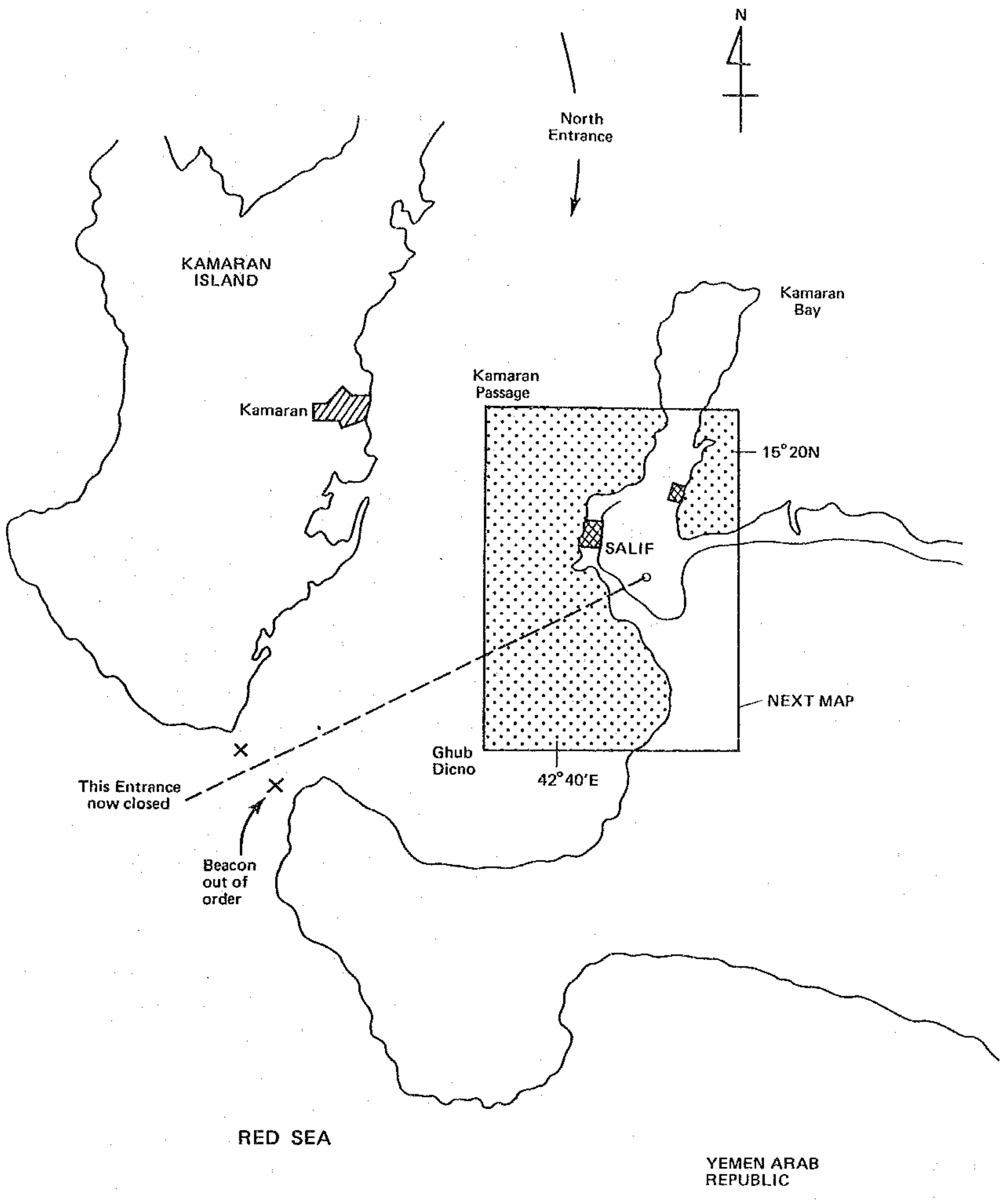
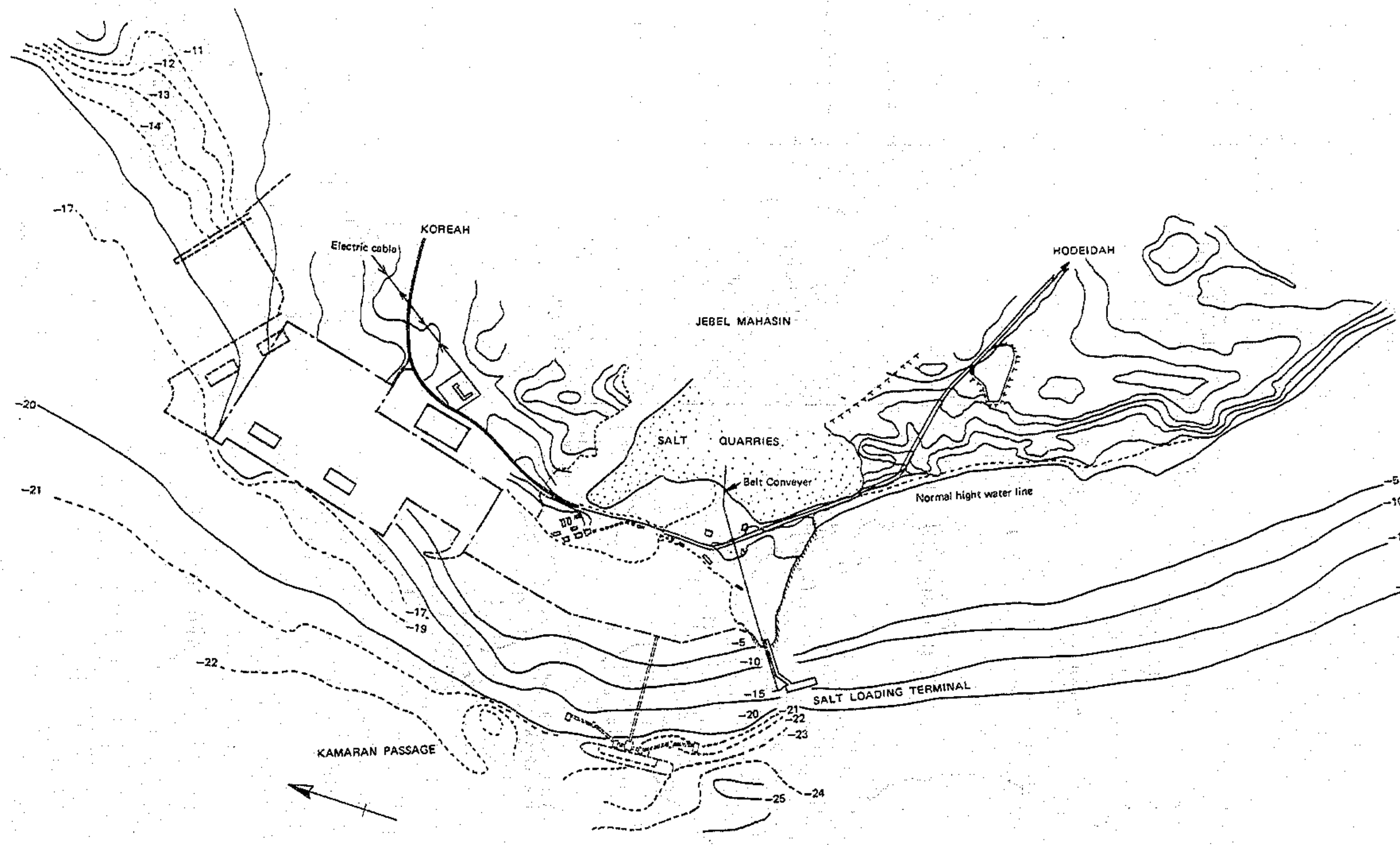


Fig. 5-1-2 Master Plan of Solif Port



(2) Ras Kathib Port

Ras Kathib Port is operated by PMAC, as an adjunct to the Port of Hodeidah. The port is located about 15 km from the town of Hodeidah and at the entrance to the Hodeidah approach channel, with four approximately 8 m deep berths available. It is considered advantageous to expand the port by dredging work, since the total dredging would amount to far less work than to build the deep sea berth at Hodeidah. Though construction might be more economically executed there, transport of cargoes and labourers between the port and the town might be problematic. At present, the port supporting functions are underdeveloped, so main cargo handled there is mainly bulk, bagged or specialized. Frozen cargo and cement bags may be unloaded in the future as at present. Such cargo is shipped by non-containerized tramp vessel, taking fully unload.

(3) Hodeidah Port

The Port of Hodeidah is the largest port in the country, staffed by well trained labourers and experienced traders. Extreme congestion was overcome in 1982, and port capacity increased with the recent addition of the 5th and 6th berths. An agglomeration of commercial activities can be found in the town of Hodeidah, creating demand for more cargoes, especially liner cargoes coming into port.

Handling efficiency has been improved since the period of severe congestion, and the increase of containerized vessels calling at port has contributed greatly to increases in the port's throughput. Port operations are now in excellent condition, with the apron being kept clean transit sheds being used properly, and the container yard (about 13 ha) and other wide open storage areas being used efficiently. This is perhaps due to the high port storage charges, designed to more cargo quickly out of port.

As mentioned in Chapter 4, the Port of Hodeidah is expected to grow in the future as a liner port, thereby accomodating a large number of container vessels. According to our estimations of future cargo traffic, an additional container berth is necessary at the 7th berth location by the year 1986, and by the year 2,000 three general cargo berths and two container berths will be further required at the new site.

Container services governing liner shipping should will concentrate at the Hodeidah berths, where liner port function are already developed. Liner vessels are operated at full draft, unlike trampers, since some of their vans on board are empty when they call on ports. From 1979 to 1981, 50 to 100 TEU vans were recorded in Hodeidah as being unloaded from one vessel. It is estimated that this will increase to an average of 150 TEU by the year 1986. 150 TEU containers can be carried by middle size (500 – 750 TEU loading capacity) container vessels, which will need a –9 to –10 meter water depth.

Larger container carriers with less draft can also enter the port while voyaging to Red Sea ports, but in some cases they may need to adjust draft or wait for high tides. To eliminate these incoveniences, further minor dredging of approach channel shall be undertaken, so as to reach a depth of –10 m, from –9.2 m at present. In consideration of the fact that larger container carriers will call on the port at relatively small drafts, it is recommended that the 7th berth be 250 m long, to allow the berthing of 180 – 200 m long container vessels.

Two more container berths with depth of –12 m are proposed in the Master Plan, though depths for these berths have to be examined though analyses of port shipping records before the decision is made to go a head with construction.

RO/RO berth will be required of at least one berth in Hodeidah, thus a site has been chosen at the core of the 7th berth. This berth will also be utilized as a passenger terminal during pilgrimage season.

(4) Mocha Port

The port of Mocha, once famous for the export of Mocha coffee, is located about 250 km south of Hodeidah. Port traffic is now increasing with completion of two −7.8 m berths at the end of 1978. The port also has a 200 meter wharf for small vessels (known as show) and buoys for unloading oil. Dhows travel between Djibouti & Mocha. Their number is gradually decreasing, and they are not considered to be of major importance.

Due to its physical location, the southern part of the country is deemed to be the hinterland of this port, including the towns of Taiz, Dhamar, Ibb, etc. At present however, cargoes to these towns are transported mainly through the Port of Hodeidah, since the port operation and related trading functions of Mocha are not yet sufficient to attract liner vessels, and also because the small size of the town of Mocha itself. The major cargo handled at the port are frozen goods, oil, and some construction materials by tramp vessels.

A Master Plan for port development has been prepared as shown in Fig. 5-1-3. However, the plan faces two major obstacles: first, the above mentioned lack of efficient trading and port operation activities at the port; second, the presence of sand drift accross the port entrance. It is too early to predict whether the approach channel can be maintained at a depth of −10 m.

(5) Ship Calls on the Port of Yemen Arab Republic from 1979 to 1981

Calling vessels by type from 1979 to 1981 are indicated in Fig. 5-1-4 for the three ports among the ports described above. Comparing the ship calls, container vessels increased markedly during these three years, from 10 to 63 calls at Hodeidah.

Fig. 5-1-3 Possible Mocha Port Expansion Plan

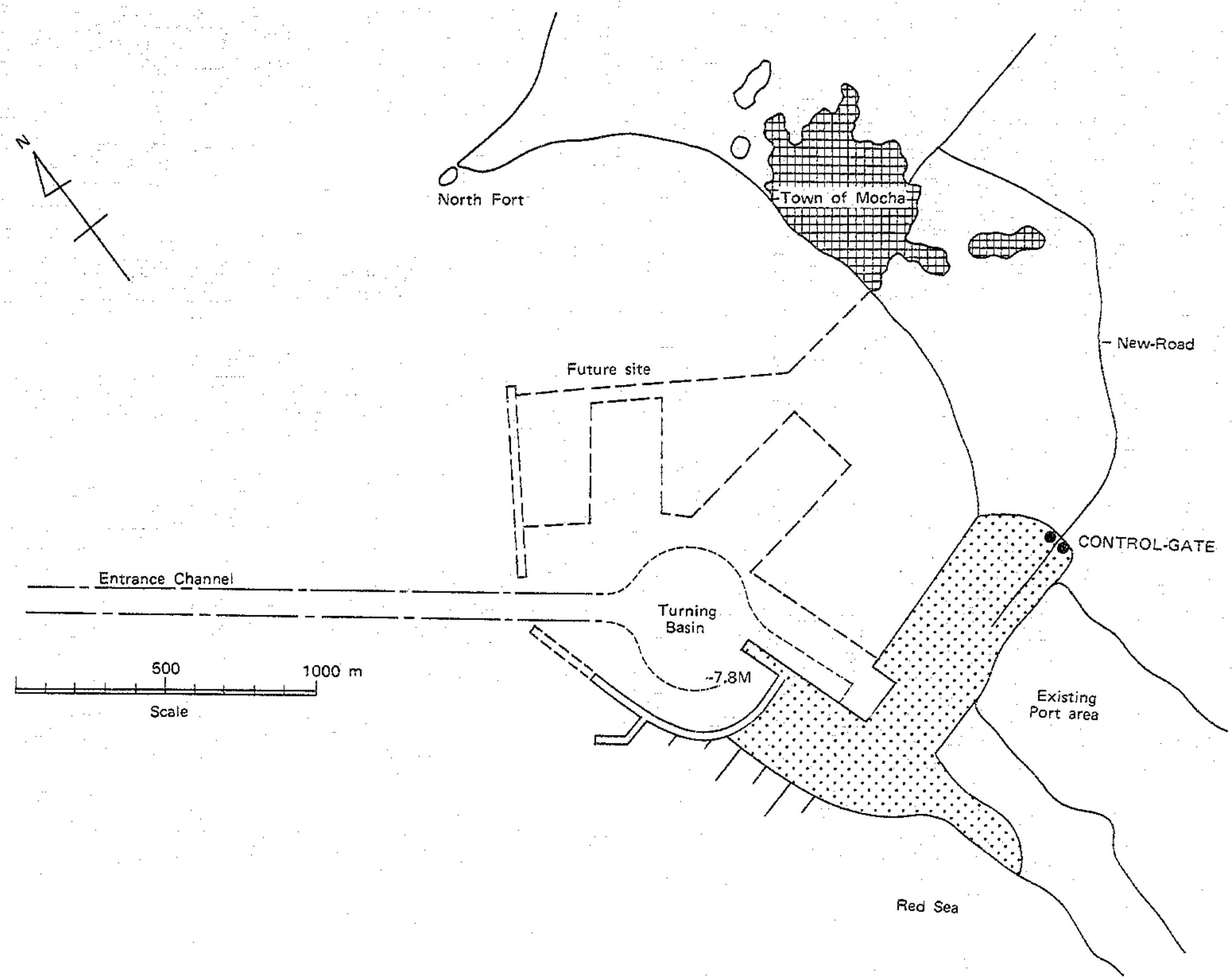
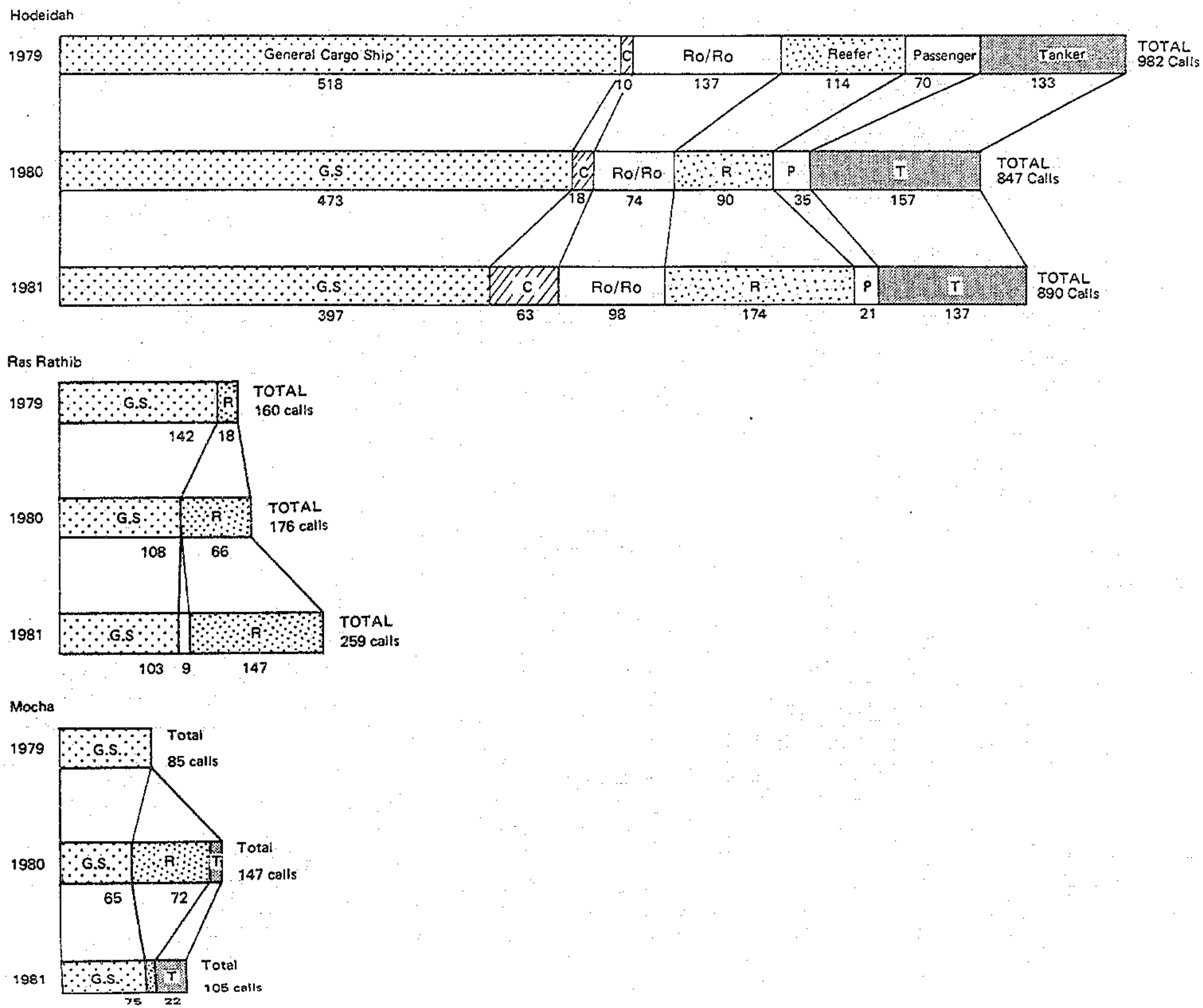


Fig. 5-1-4 Number of Calling Vessels by Type



5-2 Master Plan

5-2-1 General

In accordance with the cargo volume forecast for the year 2000 (refer to 4-4), cargo handling volume in Hodeidah is estimated at 1.57 million tons, excluding oil and container cargo. On the other hand, container cargo is estimated at 2.03 million tons.

Annual cargo handling capacity per berth varies with handling efficiency. Based upon cargo handling data from developing countries, annual cargo handling capacity for general cargo can be assumed to be 200 thousand tons per berth, therefore approximately 8 general cargo berths will be required in the year 2000 in Hodeidah. If annual handling capacity of container cargo is assumed to be 500 thousand tons per berth, 4 container berths will be needed.

Table 5-2-1 shows type and volume of cargo to be handled at each berth in service in the year 2000. Total cargo volume by commodity is tabulated in Table 4-4-1. According to Table 5-2-1, which shows berth occupancy rate for each berth, the average rate is calculated at 63%. This value means that the berth operations are expected to be very efficient.

Table 5-2-1 Allotment of Cargo to Each Berth and Occupancy Rate (2000)

(Unit. 1,000 tons)

Berth	Cargo Volume	Berth Occupancy Rate (%)	Break Down of Cargo
Hodeidah Port			
No. 1B–3B and No. 5B	620	47%	General and others 280, Rice 105, Frozenes 80, Fertilizer 5, Steel 150
No. 4B	350	59%	Wheat 350
No. 6B and 7B	900	68%	Container 900
No. 8B–10B	600	61%	Steel 260, Wood 340
No. 11B and 12B	990	75%	Container 990
RO/RO Berth	140	64%	Container 140
Oil Berths (2)	2,220		Petroleum 2,220
Total	5,820	Average 63%	
Ras Kathib Port			
No. 1B–4B	505		Wheat 66, Flour 244, Sugar 55, Packed Petroleum 80, Cement 60 (export)
Total	505		
Grand Total	6,325		

As mentioned in 5-1-2, large size container ships (2,000 – 2,800 TEU) sailing in the Red Sea area may enter the port of Hodeidah in the year 2000. A water depth of –12 m has been decided on for the container berth. However, the possibility that large container vessels may in the future call at Hodeidah Port is highly dependant upon such factors as future cargo volumes, etc. In any case, water depth for the container berth should be reexamined before implementation.

Facilities included in the Master Plan for Hodeidah Port with a target year of 2000 are as follows;

1) General Cargo Berth:	Water depth 10 m,	Length 200 m	
	Number of berths: 3		
2) Container Berth :	Water depth 10 m,	Length 250 m	
	Number of berths: 1		
:	Water depth 12 m,	Length 250 m	
	Number of berths: 2		
3) RO/RO Berth :	Number of berths: 1		
4) Basin for small craft:	(In order to utilize the 1st berth more efficiency)		

Shipping agents and stevedoring companies are well developed and supporting liner ships call on Hodeidah Port. Futhermore there is a room for future expansion of port facilities in Hodeidah Port. It would be desirable to plan new port facilities adjacent to the existing port.

5-2-2 Site for New Wharves

A site for the new wharves should be determined not only in consideration of space for facilities included in the Master Plan, but also in consideration of room for future expansion.

Figure 3-2-1 shows a layout of the area around the port of Hodeidah at present. It can clearly be seen that the site proposed for the Master Plan should be located on the west or east side of the port channel. The recently completed container berth (6th berth) is located on the east side of the channel. The new wharves are recommend for the same side of the channel as the 6th berth, so that the new wharves can be operated together with the existing berths. Futhermore, the west side of the channel is not considered a suitable site for the Master Plan because Navy facilities are located there.

Approximately soon east of the channel is a sand bank composed of material dredged from the channel. The ground in the area of the bank may have to be stabilized due to pressures caused by the bank's weight. Dredging of this sand bank area to create a mooring area or turning basin world require great costs. These above mentioned factors should be prudently studied before determining the site for the Master Plan. Three alternatives for the Master Plan called from nearly a dozen under review, are explained below.

(1) Plan I

In this plan, the new container wharf (7th berth) is planned on the same alignment as the 6th berth. In addition to the above berth, 3 general cargo wharves and 2 container wharves are planned for the north-east side of 7th berth. These berths face towards the turning basin, located on the east side of the channel.

The drawbacks to this plan are as follows;

1) The 400 m waterfront on the 7th berths north-west side can not be efficiently utilized.
2) Using the 400 m waterfront for mooring would hinder effective operation of the 7th berth.
3) The sand bank would have to be dredged in order to construct the turning basin.

Fig. 5-2-1 Plan (I)

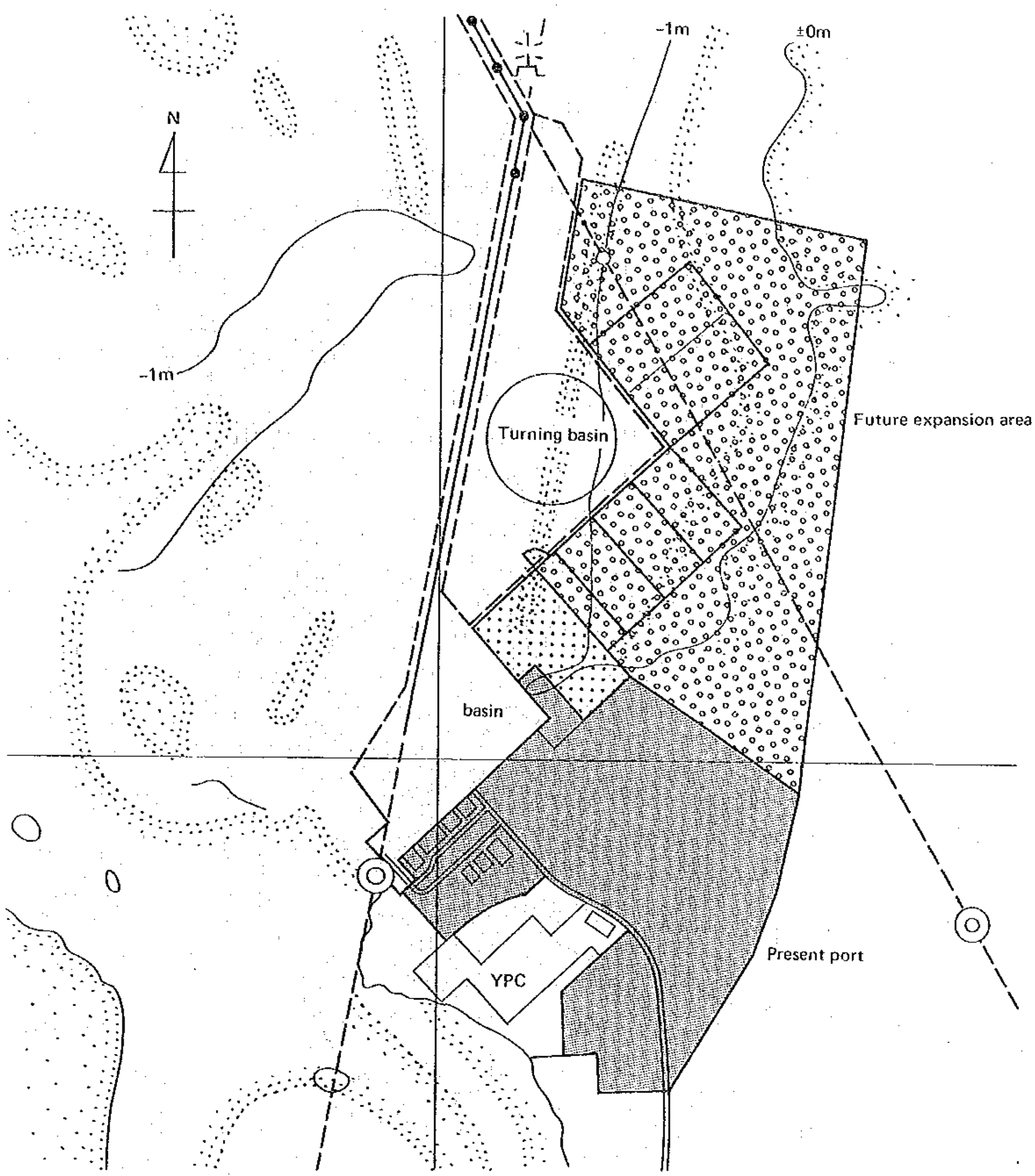


Fig. 5-2-2 Plan (II)

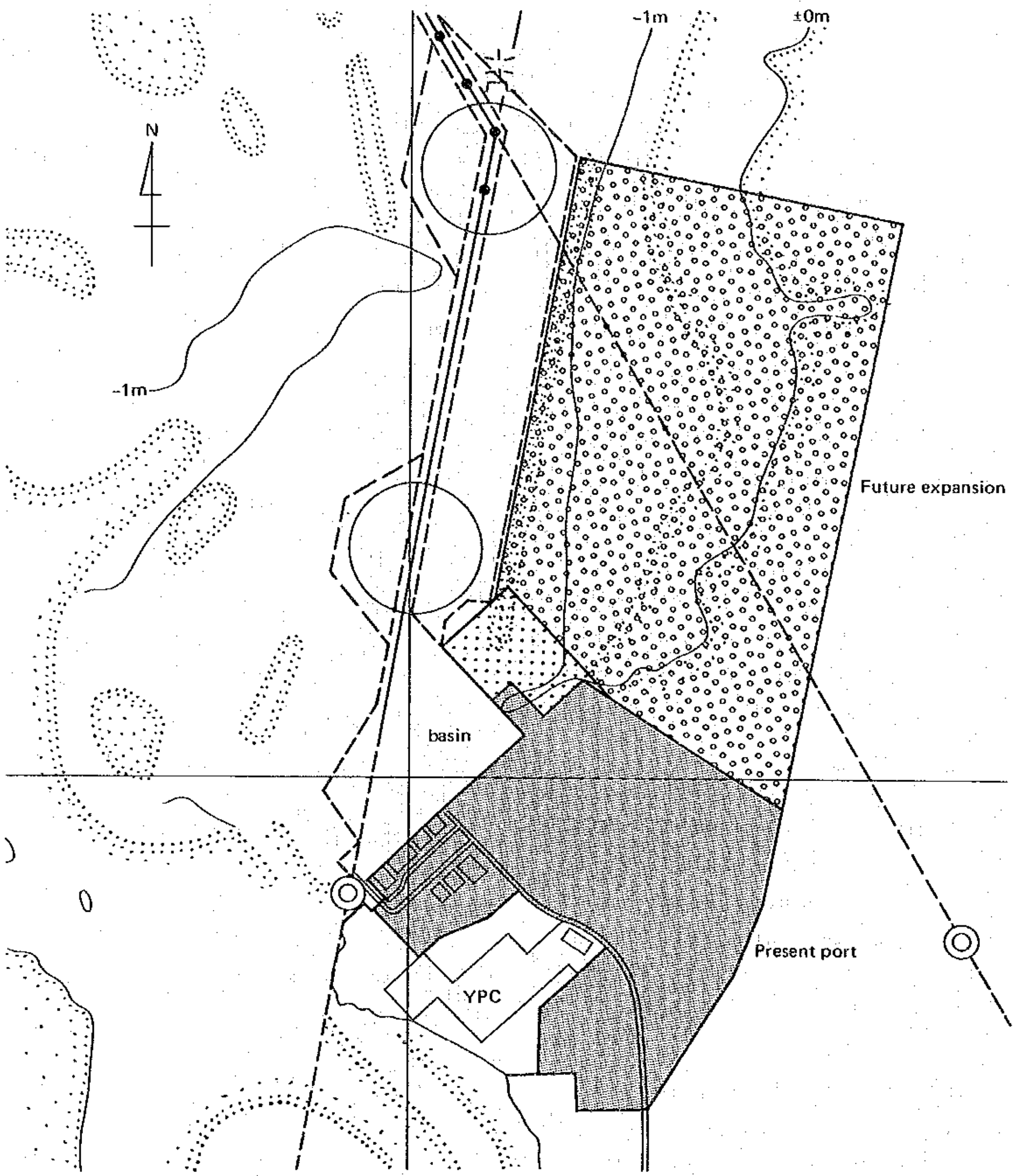


Fig. 5-2-3 Plan (III)

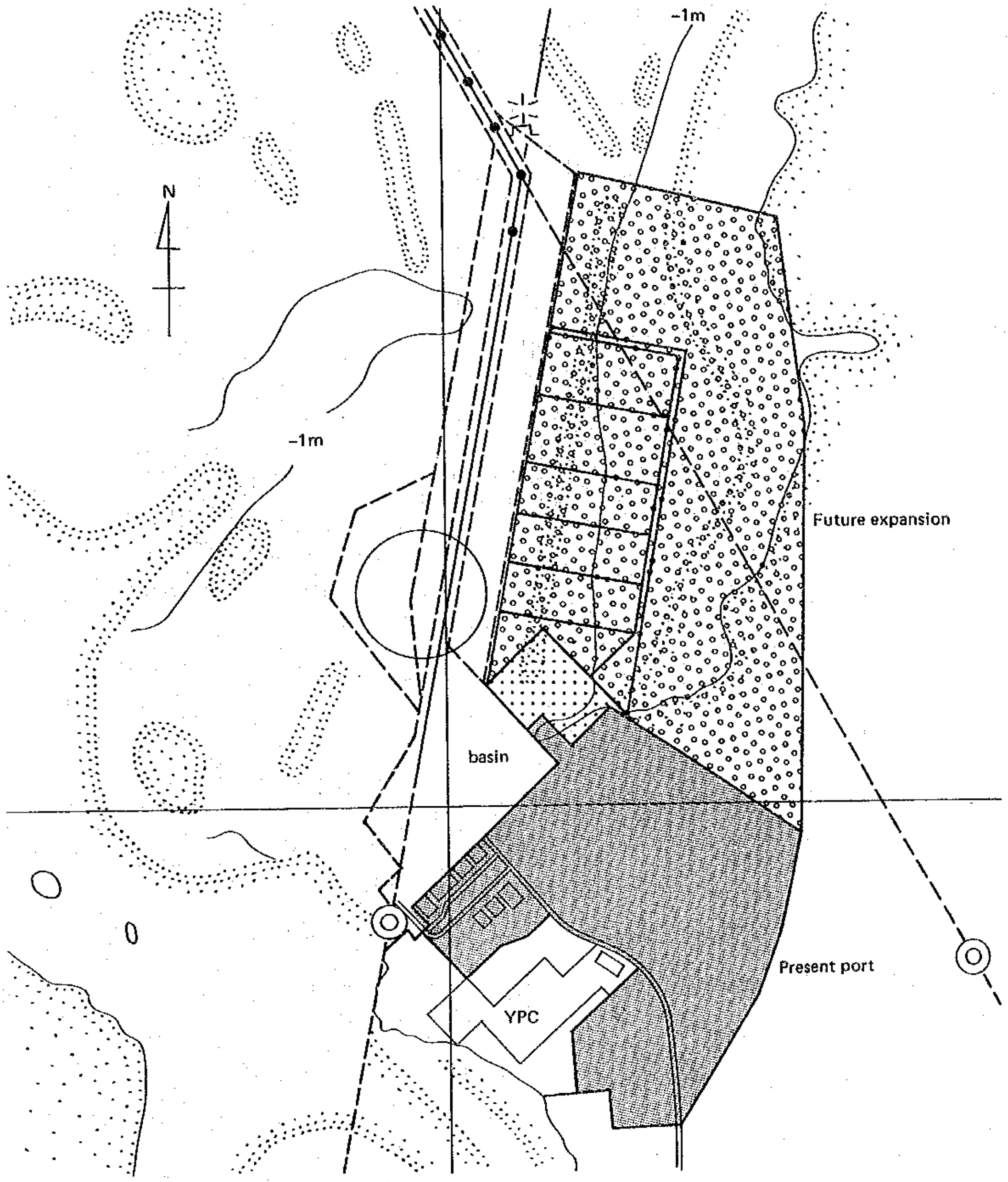
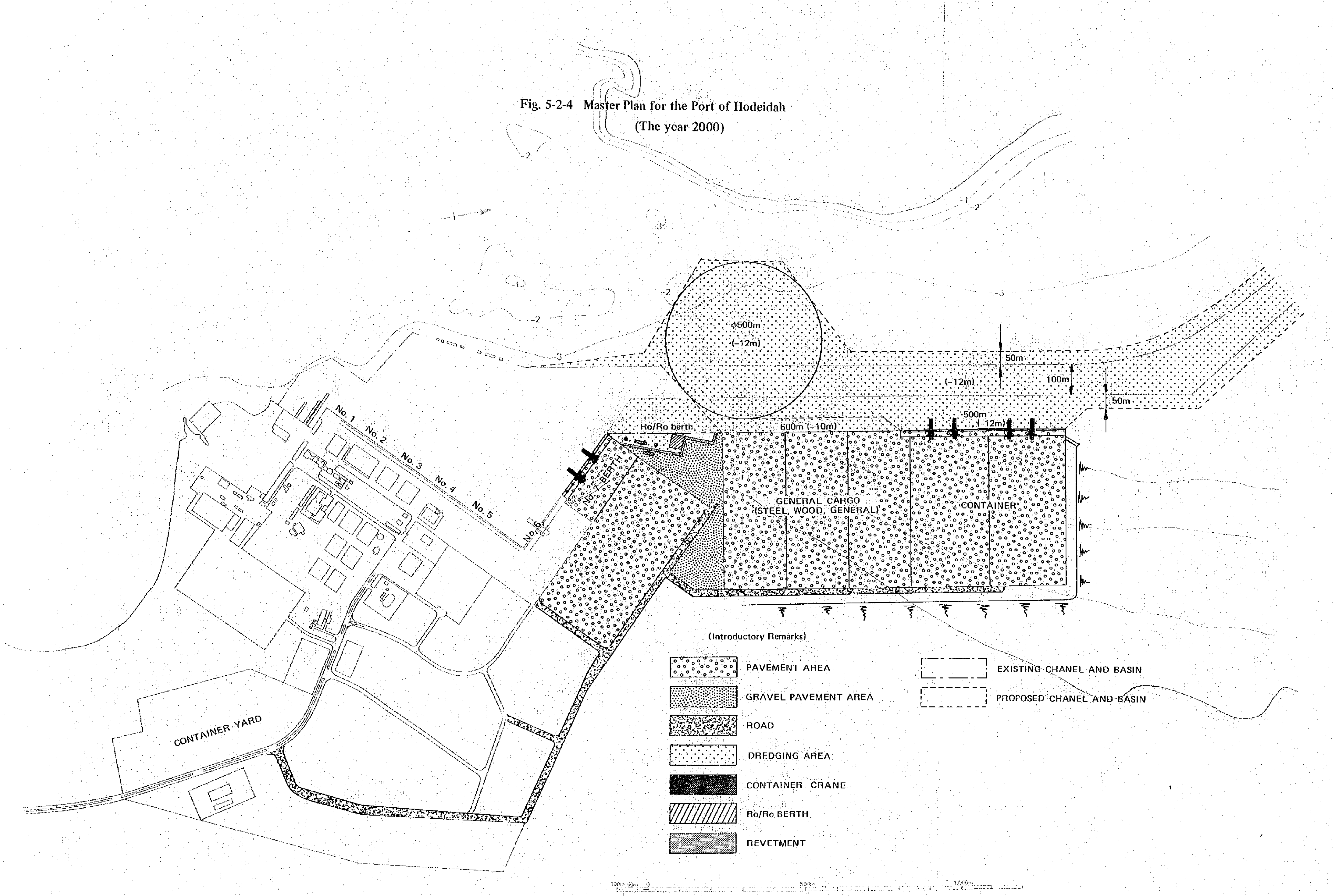


Fig. 5-2-4 Master Plan for the Port of Hodeidah
(The year 2000)



(2) Plan II

The new wharf's alignment is the same as that of the sand bank, with the turning basin located across the channel. A RO/RO berth is planed on the east side of the 7th berth. This plan doesn't contain the drawbacks of plan I. The soil condition of the sand bank is at present unknown. Futher study is required to determine whether the alignment is suitable for the final plan or whether a different site must be considered. If soil stabilization work is necessary for construction of the new wharves, the alignment should be shifted west ward. RO/RO ships may interfere with other ships pilots' line of vision, as the RO/RO ship berths are at an oblique angle to the alignment of the channel. This phenomenon could causes psychological difficulties in a pilot's maneuvering of his ship.

(3) Plan III

Alignment of the new wharves is extended parallel to the center line of the channel, from the edge of the 7th berth. In this plan the RO/RO berth would be constructed in a triangular area. This plan doesn't have the drawbacks of plans I and II, and the construction work involved is rather simple.

(4) Proposed Master Plan

After examining the three alternatives, Plan III is recommended for the port of Hodeidah Master Plan. (See Fig. 5-2-4)

A turning basin with a diameter of 500 m is planned at the south end of the channel. This basin should be completed before commencement of operation in 1993 of an additional container berth and general cargo berth. The channel which is 100 m wide at present should be widened to 200 m, though for the time being the present depth of 10 m is sufficient.

5-2-3 Facilities for the Master Plan

(1) Conventional Berth

Three conventional berths are necessary for handling cargo such as steel and wood. This cargo is generally not containerized except when empty vans are to be staffed later with export cargoes. As the wharf for handling steel and wood requires a wide area behind it, an open storage area up to 500 m wide has been planned behind the quaywall. In consideration of the size of vessels that will enter the port, the quaywalls have been designed with a depth of −10 m and a length of 200 m. The quaywalls' total length will then be 600 m.

Three conventional berths should be constructed in phases, as cargo volume increases. However, only one berth will be needed in the year 1993.

(2) Container Berth

Three container berths, including the 7th berth, should be completed by the year 2000. The length of container berths has been set at 250 m in consideration of the size of ships that will call at port. Large full-container ship may make calls in the year 2000. Water depth for the 7th berth has been set at 10 m. However, the 7th berth quaywall structure should be designed with a depth of 11 m to meet possible future requirements. The water depth for the other 2 berths has been tentatively set at −12 m, but this may have to be reexamined when construction plans are finalized. Each container berth should be equipped with two container portal cranes.

As mentioned in 6-3, an area up to 350 m wide bordering on the waterfront is required to effectively operate a container terminal. In the plan under consideration, a 50 – 150 m wide strip to be used for a road and devanning has also been added to the abovementioned area.

Total width of the reclamation area for the 7th berth and two additional berths then becomes 400 m and 500 m respectively.

(3) RO/RO Berth

Demand for RO/RO vessels will not decrease in the future because these vessels can efficiently transport passengers and limited numbers of containers. Therefore, there will still be need for a RO/RO berth. According to the records of RO/RO ships calling on Hodeidah Port, the average overall length of these ships is 140 m. In accordance with these ships' sizes, specifications for a new RO/RO berth have been set at –7.5 m depth and 160 m long. The RO/RO berth consists of 3 mooring dolphines, one pontoon for vehicles and one for passengers, and a building to accomodate waiting passengers (15 m x 30 m). The triangular area at the end of the 7th berth is considered suitable as a site for the RO/RO berth. There is room there in the future for an additional berth if necessary.

(4) Turning Basin and Channel

The channel depth is 9.5 m except for same areas with a depth of 9.2 m and channel width is 100 m. In general, required channel depth and width are a function of the size of prospection ships, and sea and weather conditions. Prospective ships for a 12 m deep berth include the following:

general cargo ships: 30,000 GWT
overall length; approximately 200 m
container ships : overall length; approximately 250 m

Required channel width is about 200 m for the abovementioned prospective ships. Required turning basin diameter is 500 m. If the berth water depth is assumed to remark 10 m in the future, then the required channel width would be 150 m and the basin diameter would be 450 meters. The existing 100 m wide channel is adequate for the being.

Materials dredged from the basin and the channel will be used as a filling for reclamation of the new wharf site. The volume of dredged material is expected to exceed the volume required for the reclamation.

Therefore some of the dredged material will have to be disposed of elsewhere. Though it is most economical to dispose of dredged materials near the site of dredging, in this case it will be necessary to carry out disposal at a site where it is highly unlikely that the material will flow back into the dredged area. Particularly, carefull study is required concerning this problem before dredging to –12 m is commenced, as the channel extends approximately 20 km, and severe siltation problems could ensure.

(5) Road

It is planned for the new wharf area to be connected with the existing port area by the existing road. However, the 15 m wide existing road should be expanded to 20 m. Furthermore, a new main road with a width of 20 m is planned at the fringe of the new wharf area, as well as a 15 m wide road on the south-east side of the 6th berth. Another 20 m wide road is planned behind the 7th berth extending to the RO/RO berth area.

As port traffic increases, a second traffic control gate should be considered.

(6) Layout

Layout of Master Plan for the Port of Hodeidah is shown in Fig. 5-2-4.

5-3 Short Term Plan

5-3-1 General

As mentioned in 5-2, the Port of Hodeidah Master Plan requires that by the target year 2000 3 conventional berths, 3 container berths and one RO/RO berth be built.

Before reaching this target year, port development projects must be executed in phases to cope with continuing increases in cargo volume. The cargo volume forecast for Hodeidah Port is shown in Chapter 4. In accordance with this forecast, one container berth will be required in the year 1986. In addition to this berth, an additional container berth and one conventional berth will be required around the year 1993.

The planned stages are as follows:

Short Term Plan (Phase I) : Targer year, 1986 (See Fig. 5-3-1)
Short Term Plan (Phase II): Target year, 1990 (See Fig. 5-3-2)
Middle Term Plan : Target year, 1993 (See Fig. 5-3-3)

Short Term Plan (Phase I) is the same as the Urgent Plan mentioned in Chapter 6.

5-3-2 Container Berth

As mentioned in Chapter 6, The 7th berth (a container berth) should be completed by the year 1986, and in full operation together with the 6th berth by the year 1990.

Dimensions for the container terminal are as follows:

1) Quay wall : Length 250 m
Depth 10 m
2) Terminal Area : 250 m x 350 m (87,500 m^2)
3) Container Portal Crane: Lifting capacity 30.5 tons
Rail gauge 18 m
4) Utilities : Water supply facilities
Electric supply facilities
(for illumination and reefer)

It is expected that cargo handling equipment other than container portal cranes will be provided by stevedoring companies. Although, in the final stage a width of 350 m has been planned for the container terminal area, the width in 1986 will not necessary extended to 350 m, because the terminal is not expected to be in full operation in that year. In the year 1986, the container terminal shall be paved to a width of 135 m. A gravel surface, similar to that which covers the area near the port gate is also sufficient for the area behind the paved yard as shown in Fig. 6-3-2.

5-3-3 RO/RO Berth

RO/RO berth should be constructed adjust to the 7th berth. Then, alignment of the RO/RO berth has been planned taking into account alignment of new wharves in the Master Plan, so as to allow safe maneuvering of vessels in the channel.

Passengers will also embark and disembark at the berth. Therefore, a building to accomodate waiting passengers and a pontoon for the passengers are required at this berth.

Design depth and length for the berth are 7.5 m and 160 m respectively. A plan for the RO/RO berth is shown in Fig. 5-4-5 in Chapter 5. It is expected that dredging work needed for construction of the RO/RO berth will be performed by the PMAC.

Fig. 5-3-1 Urgent Plan for the Port of Hodeidah
(The year 1986)

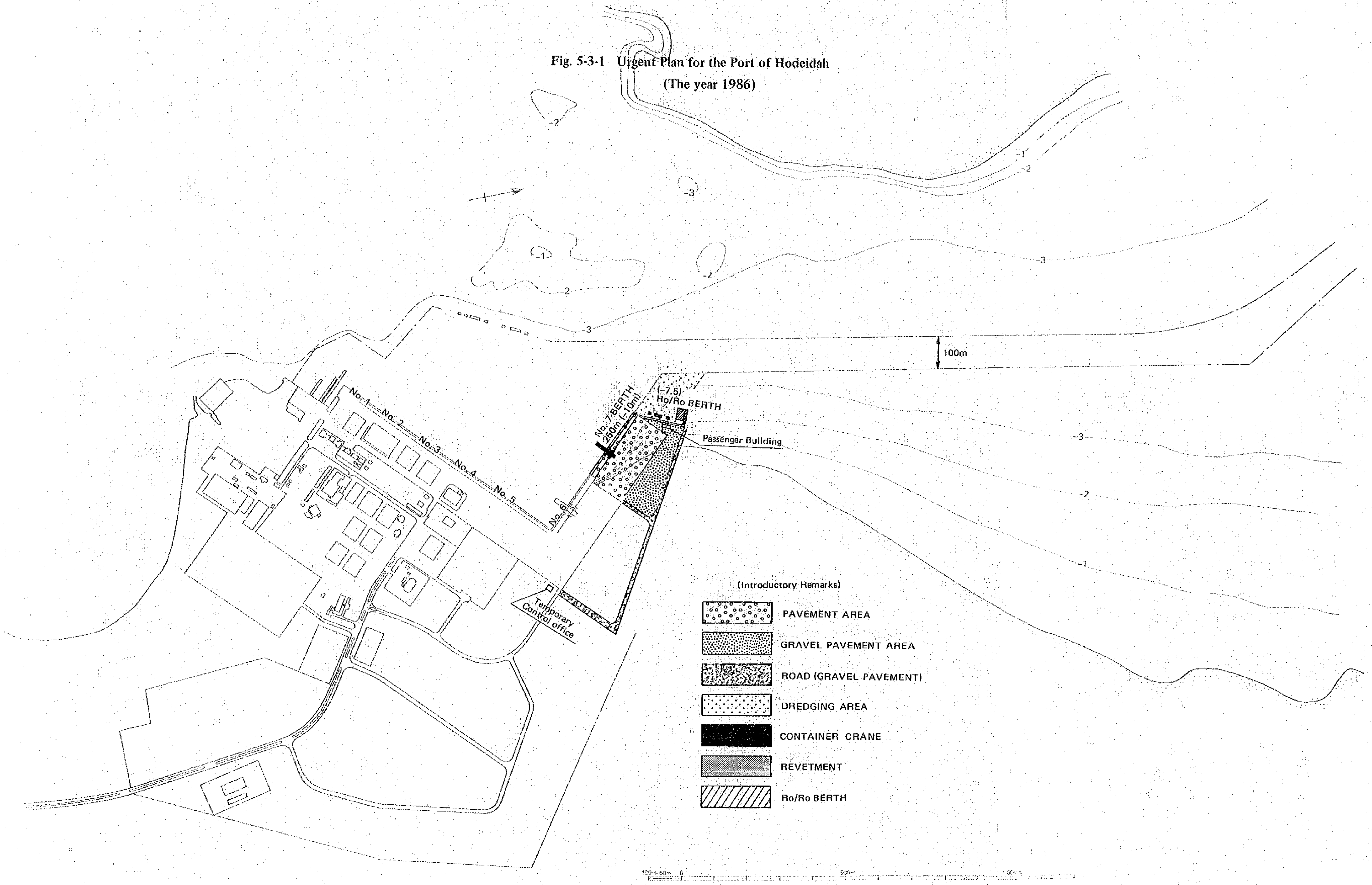


Fig. 5-3-2 Short Term Plan Phase II for the Port of Hodeidah
(The year 1990)

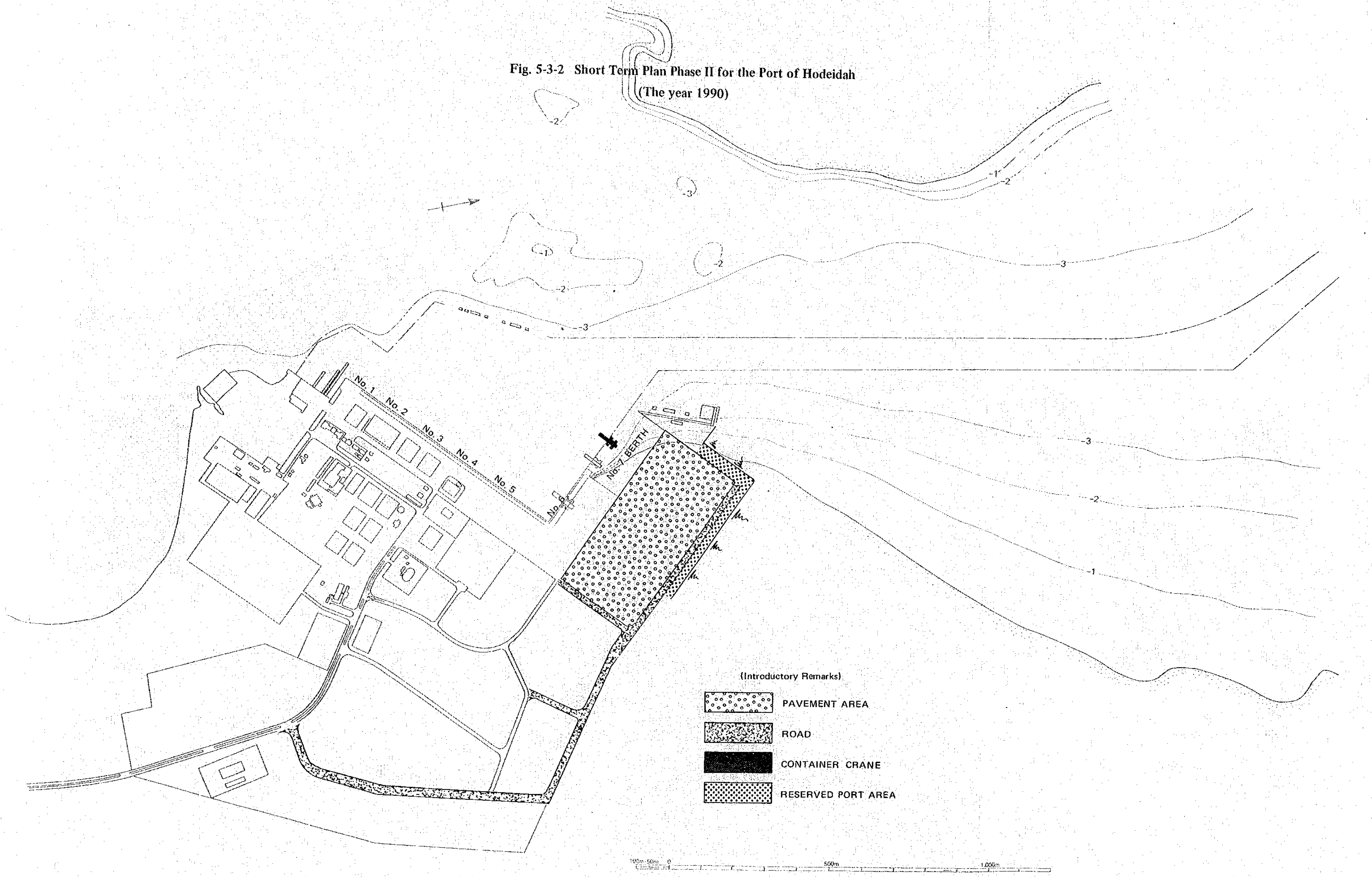
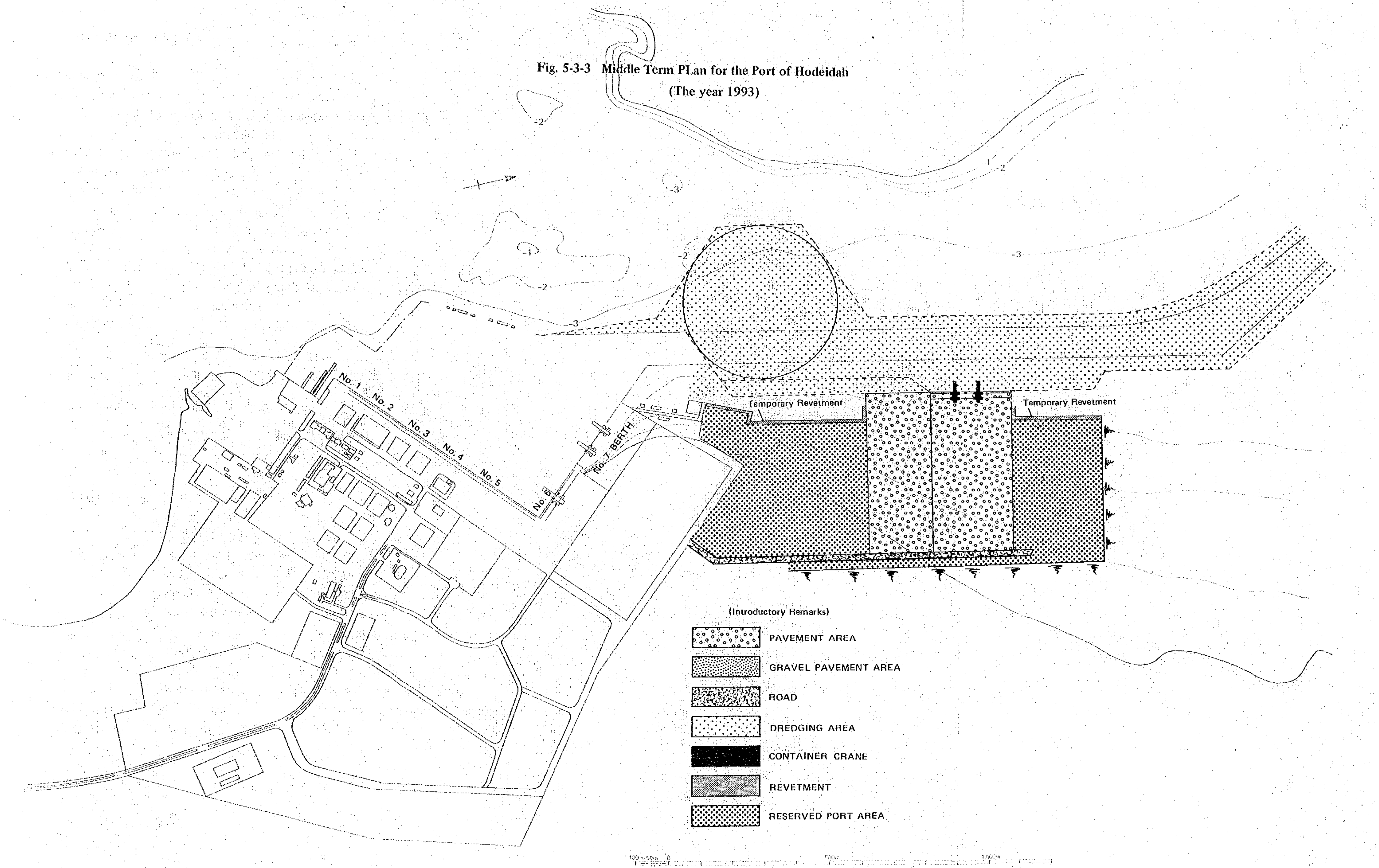


Fig. 5-3-3 Middle Term PLan for the Port of Hodeidah
(The year 1993)



5-4 Standard Design of Structures

5-4-1 Short Term Plan

(1) Design Condition

Design conditions for major port structures under the Short Term Plan, are as follows.

Object vessel	25,000 DWT
Ship's berthing velocity	0.15 m/sec
Length of quay wall	250 m
Water depth	–11.0 m
Top elevation	+2.47 m
Tidal level	H.W.L. + 0.88 m
	L.W.L. ± 0.00
Surcharge	3.0 t/m² (under normal circum fances)
	1.5 t/m² (in the case of on earthquake)
Seismic coefficient	Kh = 0.1

Soil condition

Elevation	Soil	N. Value	Angle of Internal Friction	Unit Weight (t/m³)
+2.47 to Seabed	Sand	0–5	$\phi = 30°$	Above R.W.L. = 1.8 Below R.W.L. = 1.0
Seabed to –19 m	Sand	20	$\phi = 35°$	1.0
Below –19 m	Silt	30	C = 10 t/m²	0.8

Safety factor	Sliding	:	1.2
	Overturning	:	1.2
	Bearing of pile	:	2.5
Allowable stress	Reinforce concrete	:	80 kg/cm²
	Plain concrete	:	55 kg/cm²
	Steel structure	:	1,400 kg/cm²
	Steel sheet pile	:	1,800 kg/cm²
Corrosion rate	Above HWL	:	0.30 mm/years (in sea water)
	HWL to seabed	:	0.10 mm/years (〃)
	Above RWL	:	0.03 mm/years (in soil)
	Below RWL	:	0.02 mm/years (〃)
Wheel load of Container Crane	Wheel load	:	25 t/wheel (as same as 6th berth)
	Rail gauge	:	18.0 m

(2) Comparative Design and Other facilities

1) Container Berth

Existing cross section of 6th berth is shown in Fig. 5-4-1.

For the container berth, two alternative plans (A and B) were compared.

Plan A: Steel sheet pile cellular cofferdam type quaywall (Fig. 5-4-2, 5-4-3)

Plan B: Steel pipe type sheet pile quaywall (Fig. 5-4-4)

The above plans have the following characteristics.

A) Steel sheet pile cellular cofferdam type quaywall (Plan A)

a. If the seabed in the selected area is composed of soft ground so that it becomes difficult to drive sheet piles to a depth for sufficient passive earth pressure to be expected on the embedded point, then the sheet pile quaywall type is unfeasible. However, if sheet piles are driven in past the soft layer into more secure ground then this type can be expected to provide sufficient vertical bearing capacity.

b. This type is not stable before the cell is filled with sand or gravel. Prompt and scheduled execution is required.

c. Connection between sheet piles are relatively weak so caution should be exercised in handling and driving of sheet piles.

B) Steel pipe type sheet pile quaywall (Plan B)

a. This type can be applied to deep quaywalls, since a wide range of diameter and wall thicknesses with welded special joints of steel piles are available.

b. This type in capable of bearing vertical loads, therefore it is suitable for application to the structures on which both horizontal and vertical loads act.

c. Tie-rods are necessary for this type.

Fig. 5-4-1 Typical Cross Section of Quaywall for 6th Berth

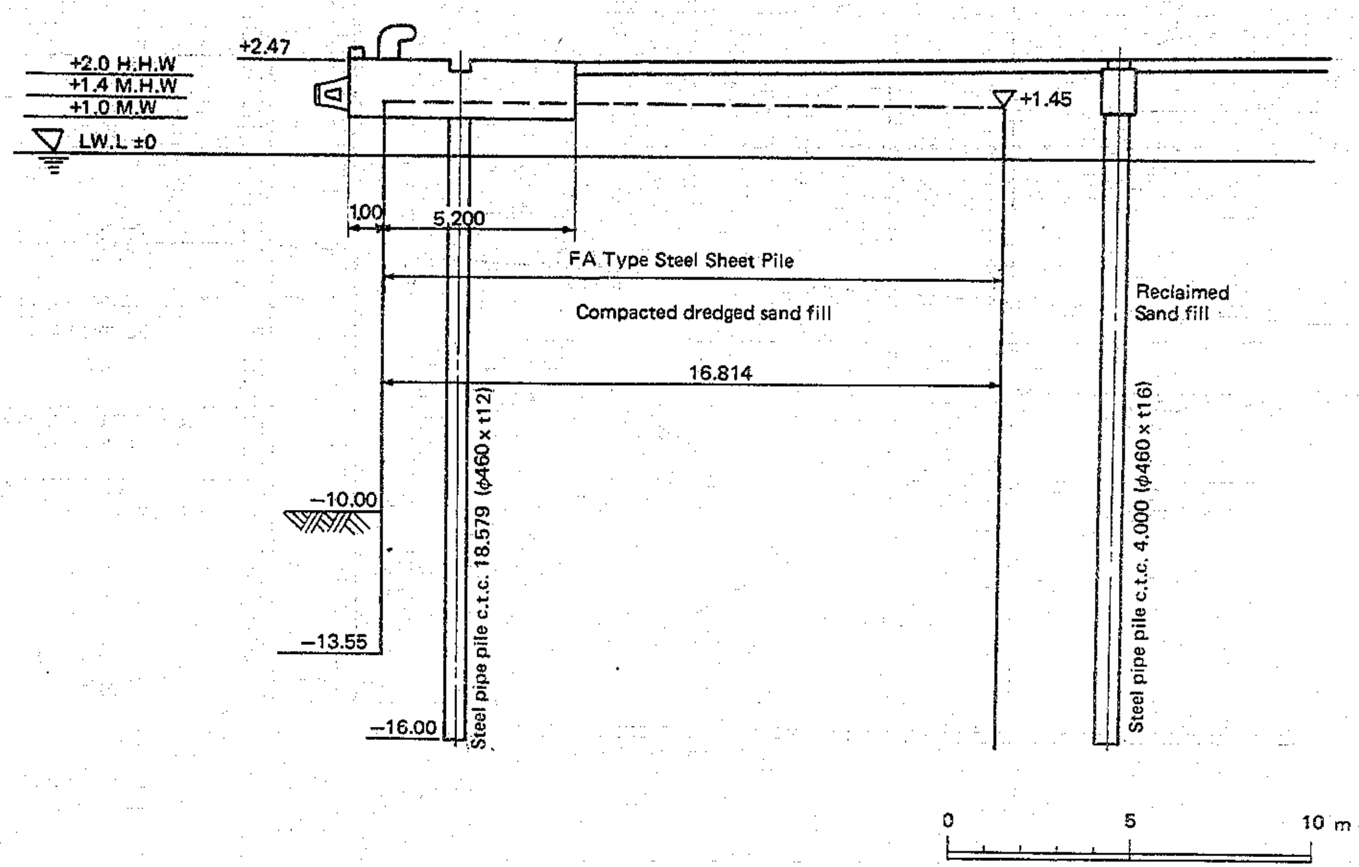


Fig. 5-4-2 Steel Sheet Pile Cellular Cofferdam Type Quaywall (Plan A) – I

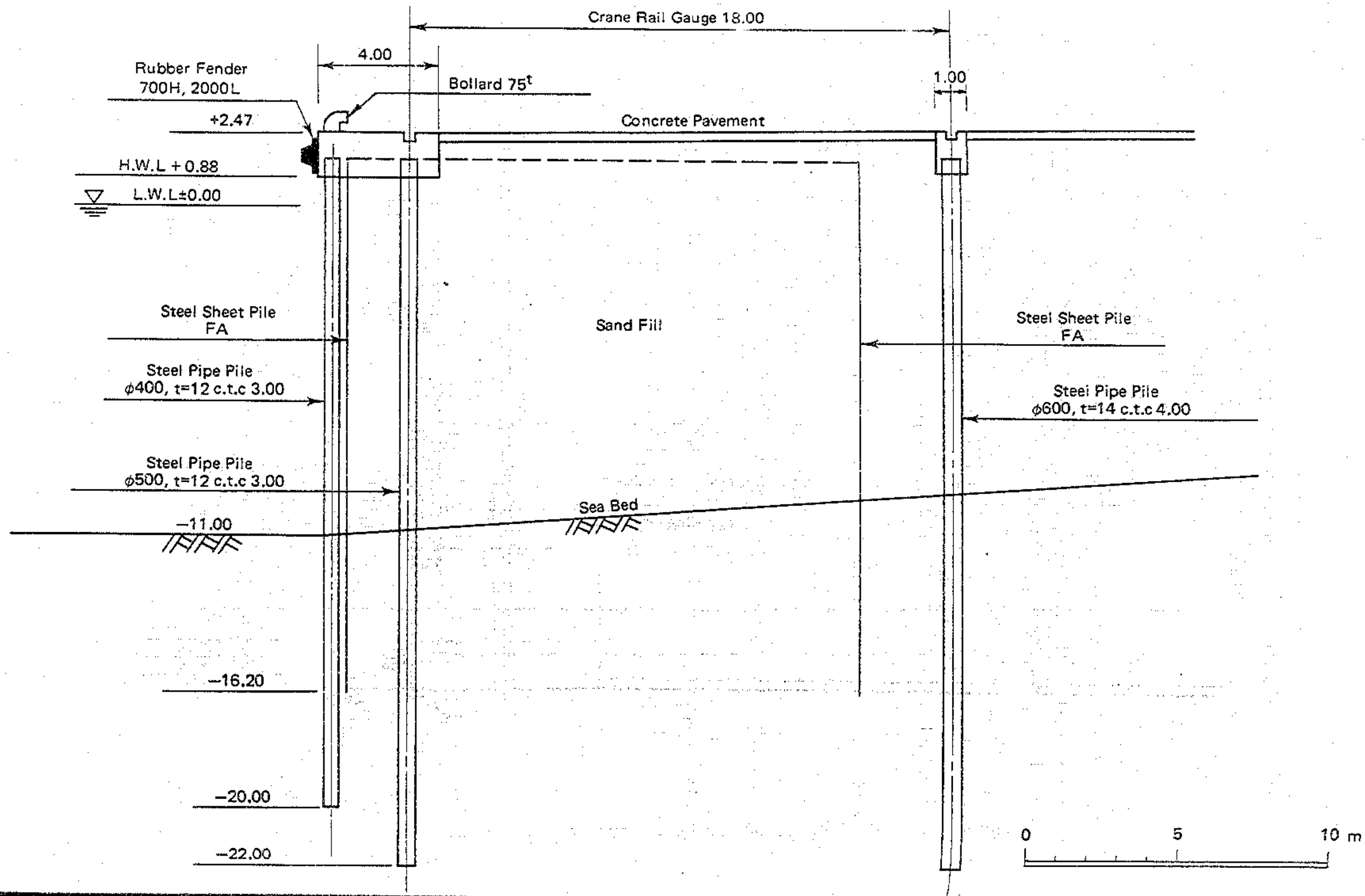


Fig. 5-4-3 Steel Sheet Pile Cellular Cofferdam Type Quaywall (Plan A)-II

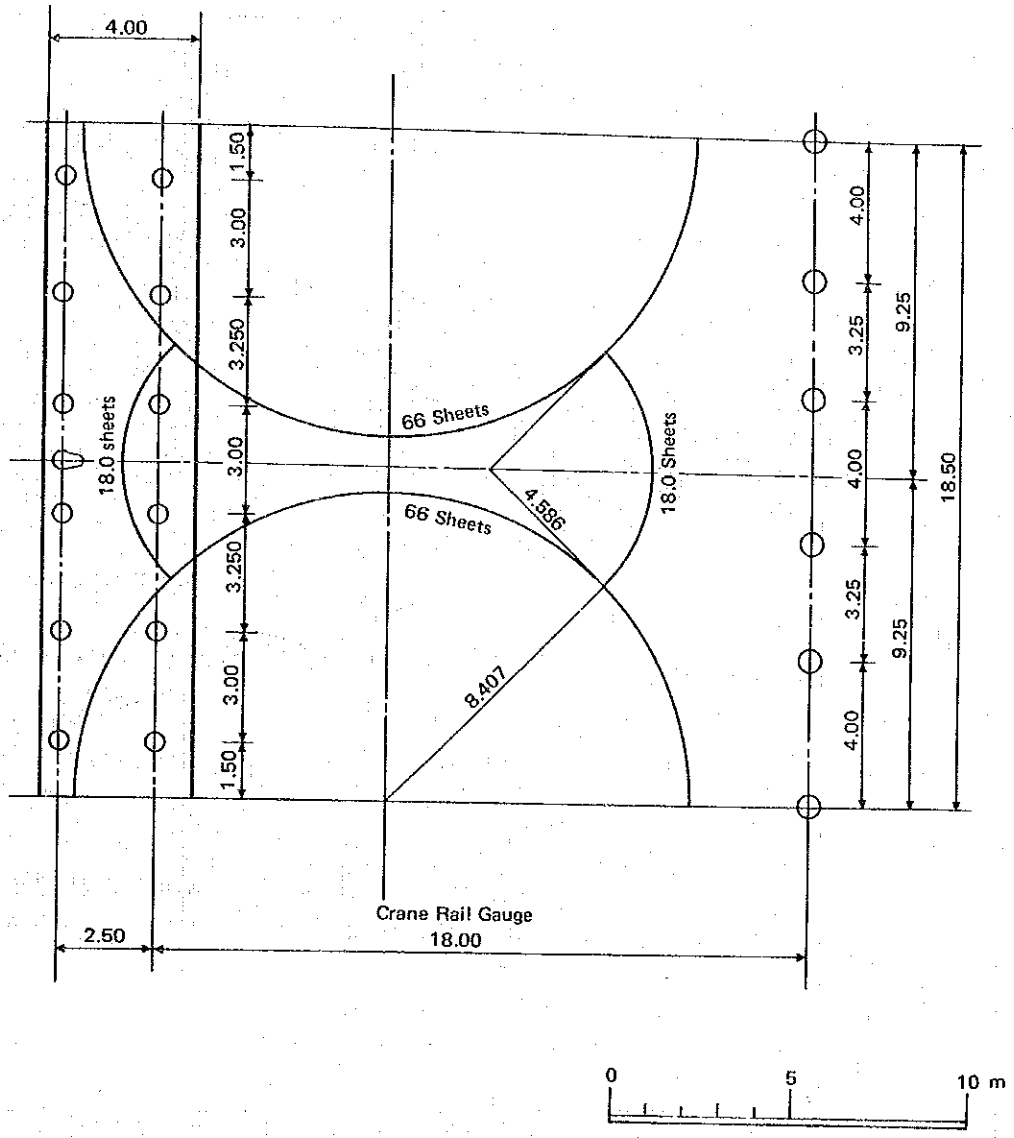
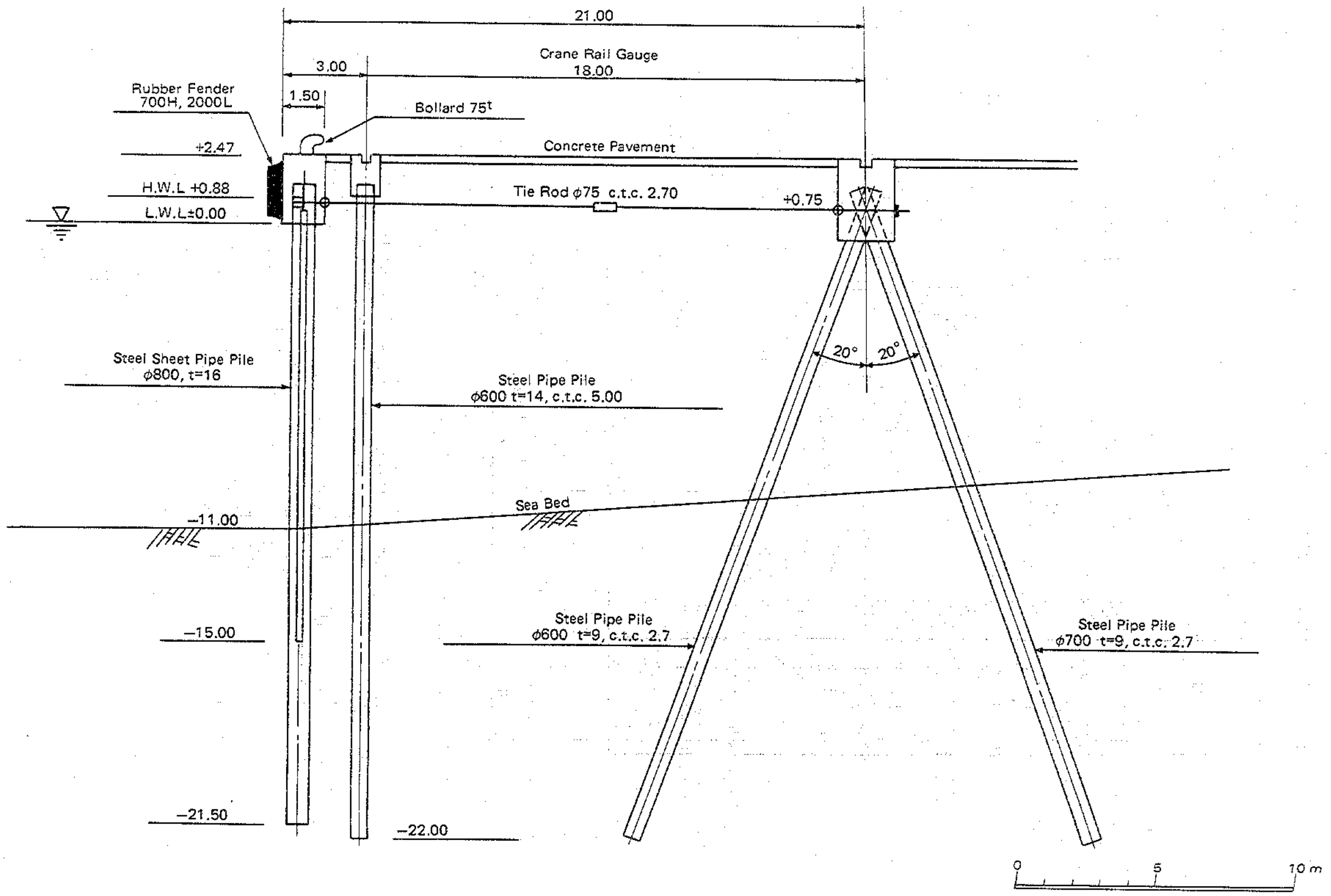


Fig. 5-4-4 Steel Pipe Type Sheet Pile Quaywall (Plan B)



Comparative economy and workability is shown in Table 5-4-1.

Table 5-4-1 Comparison Table

Item \ Type	Plan A Steel Sheet Pile Cellular Cofferdam Type Quaywall		Plan B Steel Pipe Type Sheet Pile Quaywall	
Large Construction Craft	Simple pile driving barge (with vibration hammer)	◎	Pile driving barge (with D-70 hammer)	○
Workability at the Port of Hodeidah	Very easy	◎	Very easy	◎
Construction Control	Very easy	◎	Easy	○
Workload	Small	◎	Small	◎
Construction Speed	Very fast	◎	Very fast	◎
Requirement of Corrosion Prevention	Required	△	Required	△
Construction Cost US$/m	51,700		57,870	
Construction Cost Ratio (Plan A = 1.0)	1.0		1.1	

Note: ◎ Excellent ○ Some problems △ Poor

Based on the above comparison of economy and workability, it has been decided to employ alternative plan A (Steel sheet pile cellular cofferdam type quaywall)

3) Ancillary Facilities

Ancillary facilities for the berth are shown in Table 5-4-2.

Table 5-4-2 Ancillary Facilities

Ancillary Facilities	Interval	Remarks
Bitt	15–20 m	
Rubber Fender	4 m	
Ladder		end of a berth
Curbing	Continuous	3.2 m + 0.3 m (interval)

4) Area connecting 7th berth and RO/RO berth.

A) Maintaining a Berth Depth

A retaining wall located at the berth end must be extended by more than 40 m from the planned berth end in order to maintain a standard depth in the area adjacent to the berth by preventing back fill from drifting down into the basin.

5) RO/RO Berth

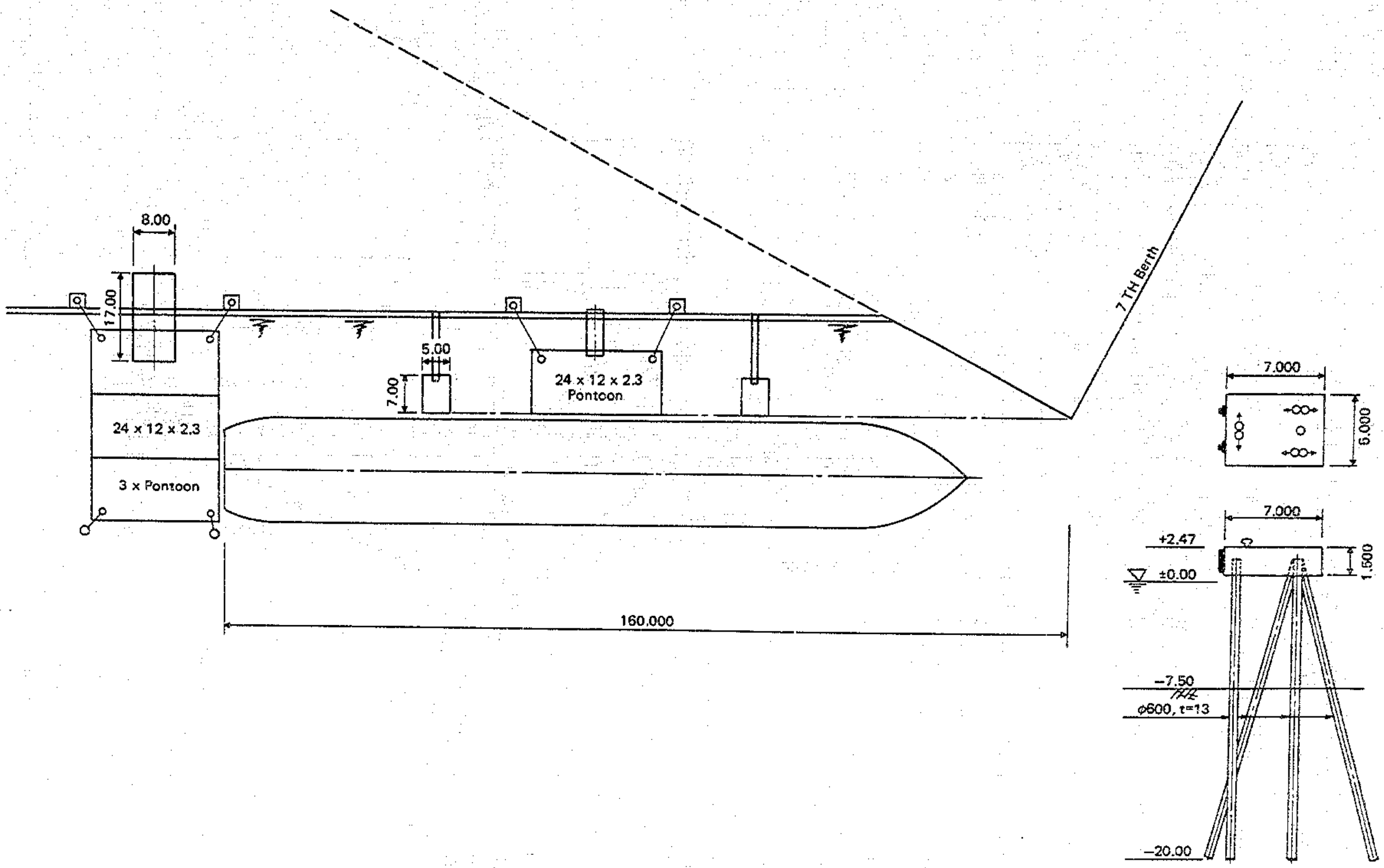
The structure for the RO/RO berth should be as simple and economical as possible. Its general plan is shown in Fig. 5-4-5.

6) Container Crane

The general layout for the container crane is shown in Fig. 5-4-6, with the following structural specifications.

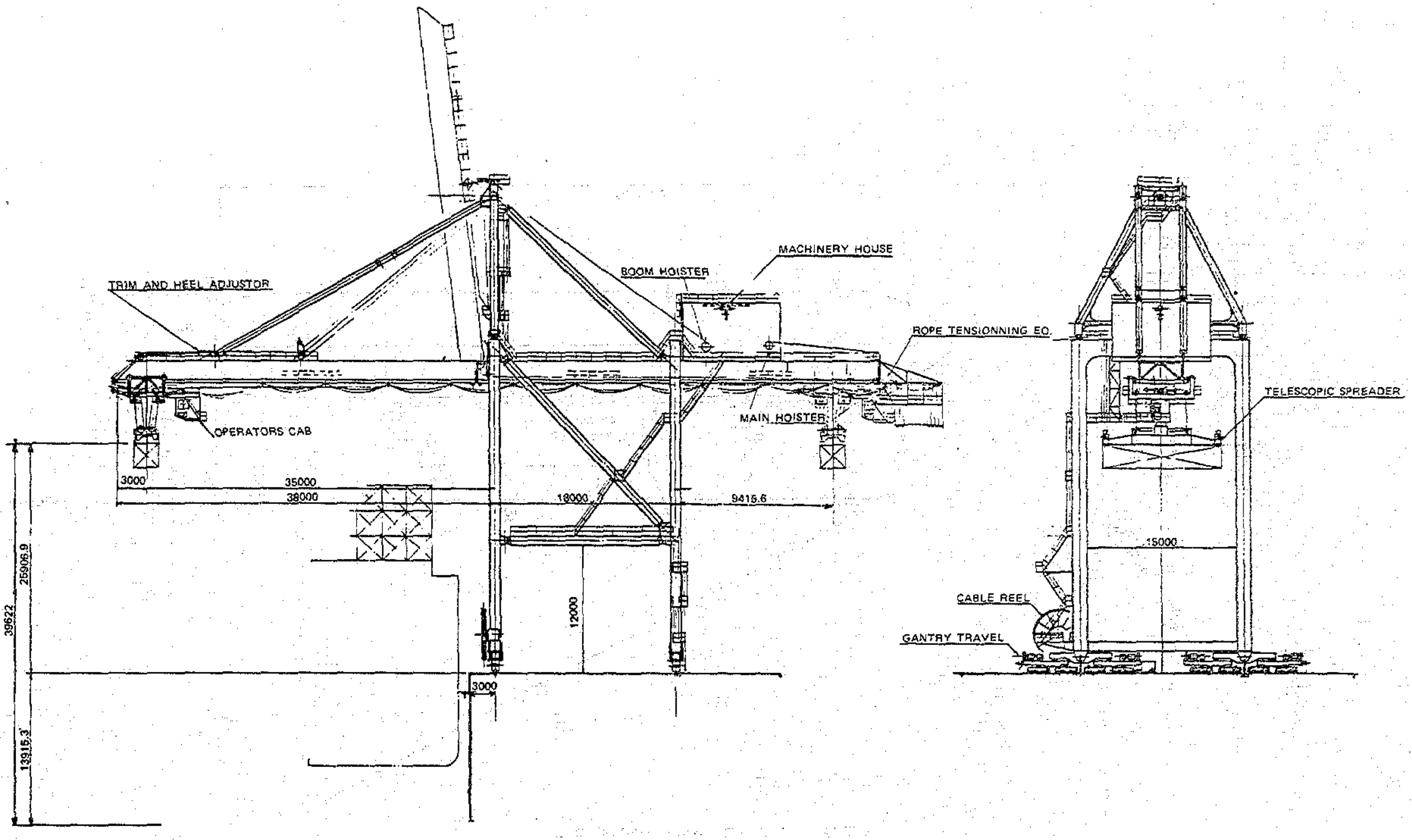
Lifing capacity	:	30.5 ton
Main hoisting speed	:	45 (load)/90 (no load) m/min
Trolley travel speed	:	150 m/min
Gantry travel speed	:	45 m/min
Boom hoist speed	:	5 min/one way
Power source	:	AC 3,300 V, 50 Hz, 3 phase

Fig. 5-4-5 Plan of RO/RO Berth



(Cross-Section of Dolphin)

Fig. 5-4-6 General Arrangement of Container Crane



5-4-2 Master Plan

(1) Design Conditions

Design conditions for the Master Plan are assumed to be the same as those for the Short Term Plan.

(2) Berth Structure

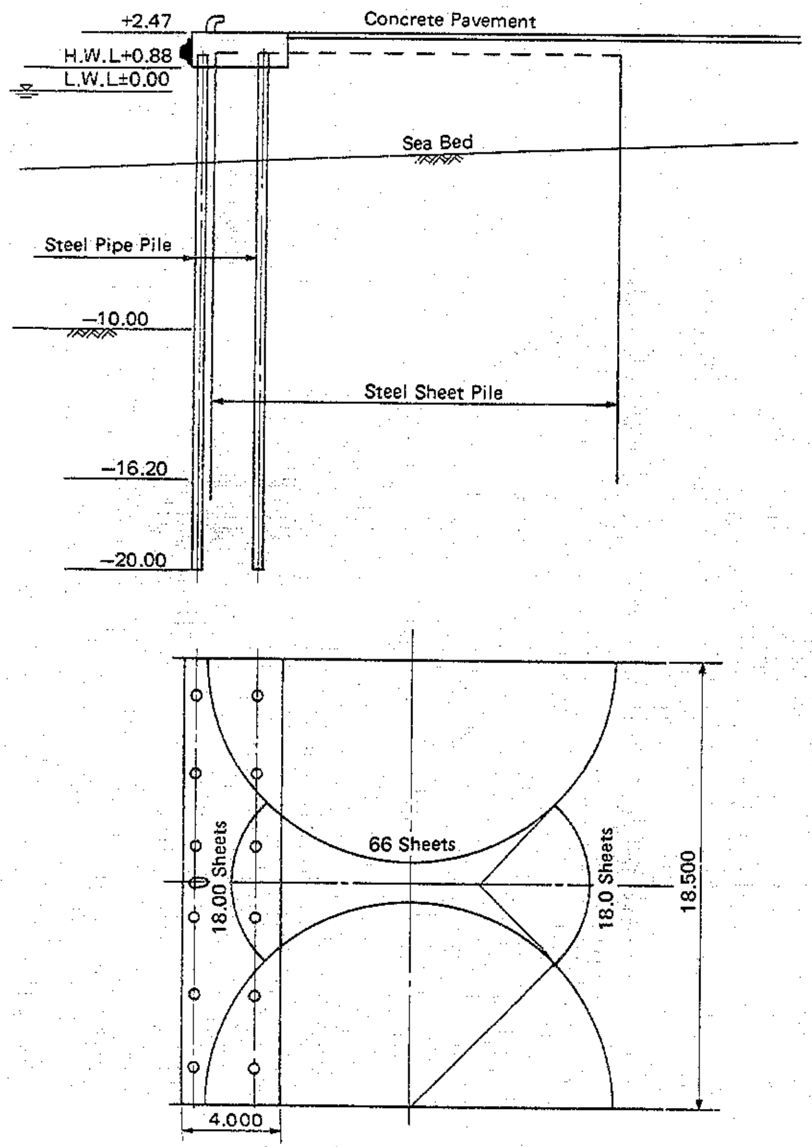
1) General Cargo Berth (−10 m)

Berth structure for the General Cargo Berth is shown in Fig. 5-4-7. After taking into account various alternatives, it has been decided to employ the Steel Pipe Type Sheet Pile Quaywall.

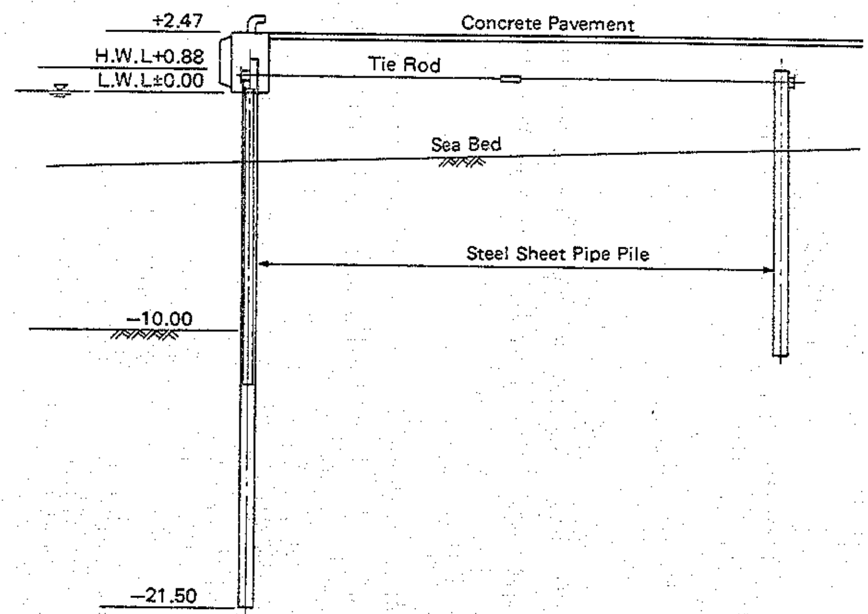
2) Container Berth (−12 m)

Berth structure for the Container Berth is shown in Fig. 5-4-8. After taking into account various alternatives, it has been decided to employ the Steel Sheet Pile Cellular Cofferdam Type Quaywall.

Fig. 5-4-7 Design Concept for General Cargo Berth (−10 m)

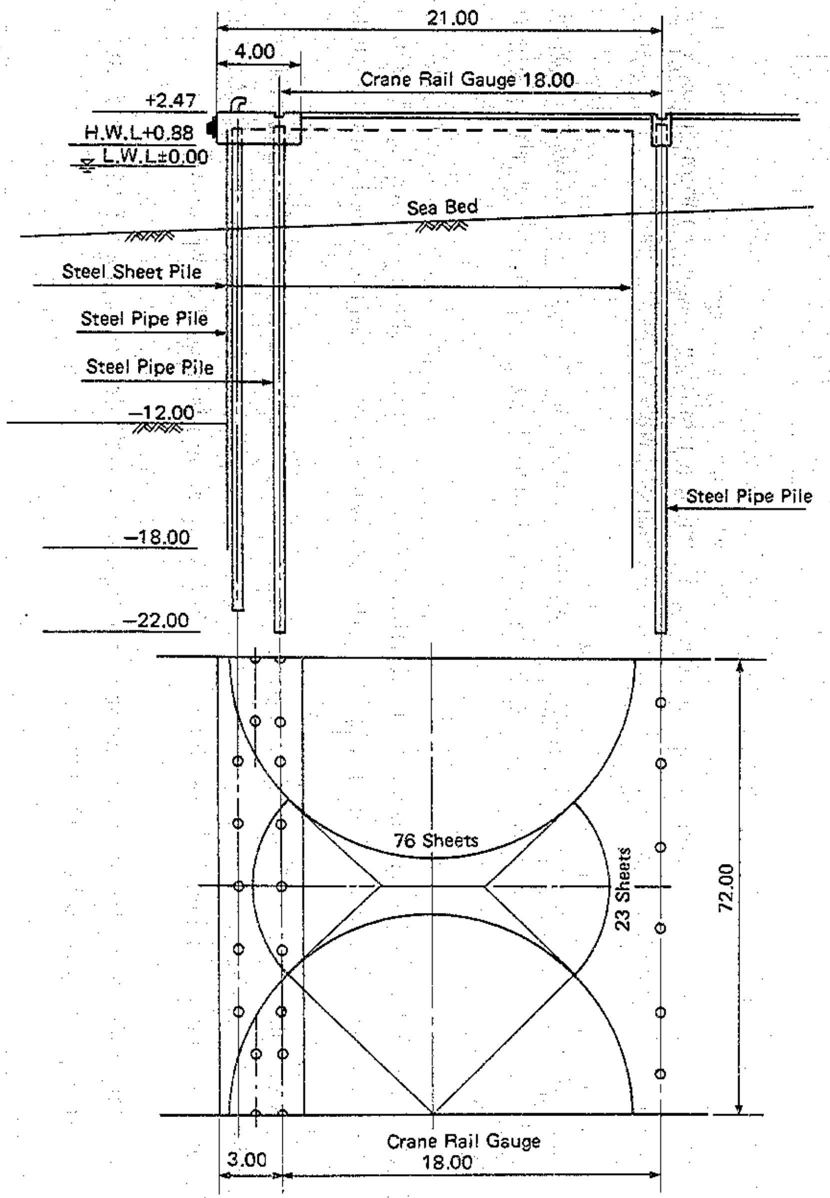


(Steel Sheet Pile Cellular Cofferdam Type Quaywall)

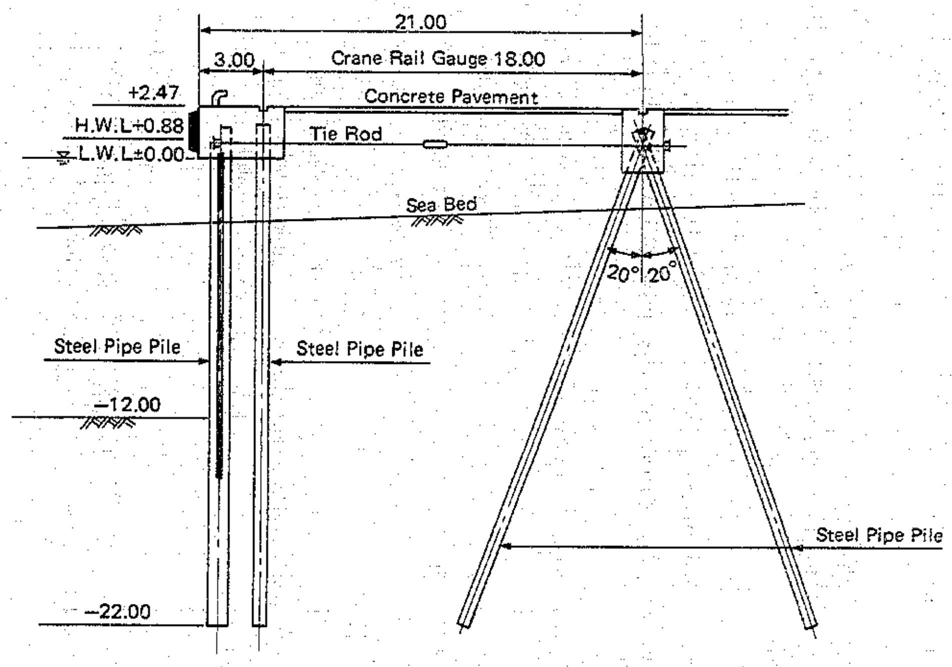


(Steel Pipe Type Sheet Pile Quaywall)

Fig. 5-4-8 Design Concept for Container Berth (−12 m)



(Steel Sheet Pile Cellular Cofferdam Type Quaywall)



(Steel Pipe Type Sheet Pile Quaywall)

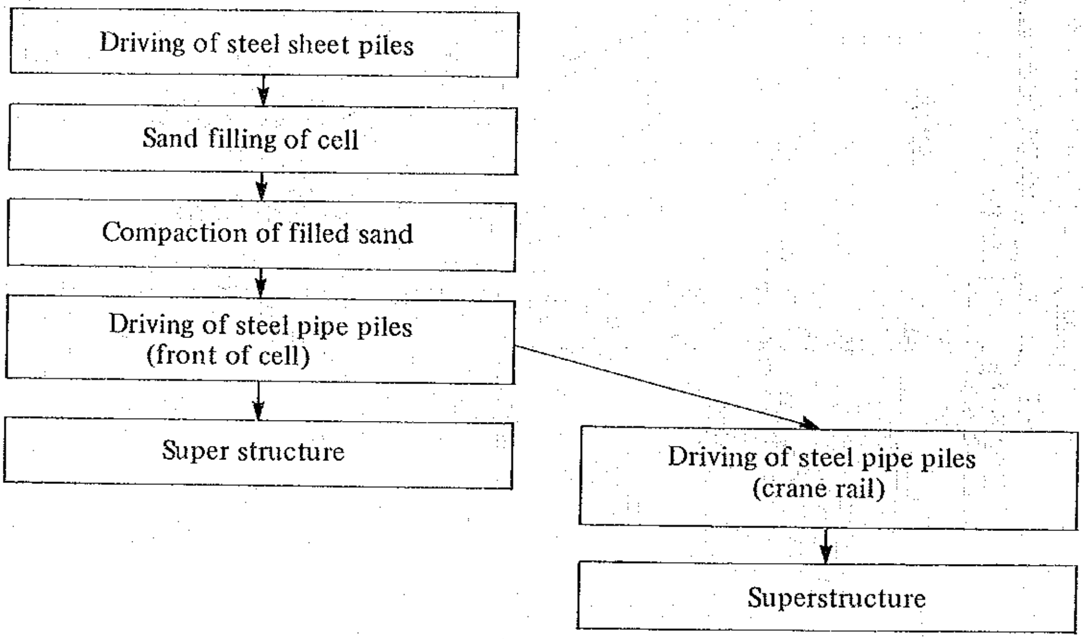
5-5 Construction Plan

5-5-1 Basic Concept

Based on structural designs mentioned in the previous section, the available construction plans for Hodeidah Port have been worked out.

5-5-2 Construction Method of Major Facilities of Short Term Plan

Working procedures for a steel sheet pile cellular cofferdam type quaywall for the short term plan are as follows.



(1) Steel sheet piles for cells are to be driven in using a vibrating hammer mounted on a pile driving barge. The barge shall be a 300 t flat barge equipped with a crawler crane.

(2) Out of a total life span of 50 years, the cathodic protection will last for a period of 20 years, and as protection for the remaining 30 years, the thickness of 1 – 3 mm will be added to steel structures.

(3) Cells will be filled with sand material procured from the area behind the 6th berth or from the pit located about 5 km from the 7th berth. Transportation of sand is done by dump trucks.

(4) Steel pipe piles in front of the cells are to be driven in using diesel hammer attached to simple driving barge. However steel pipe piles for the crane rail are to be driven in on land using a diesel hammer attached with crawler crane, after completion filled sand compaction.

(5) Materials for reclamation are to be procured from the pit located about 5 km from the 7th berth and transported by dump trucks.

(6) Pavement from the quay wall 135 m distance will be done by concrete.

(7) Dredging to a depth of −7.5 m in front of RO/RO berth will be carried out using the PMAC owed pump dredger. Dredged material will be discharged onto the land area of the RO/RO berth.

(8) Because it is considered likely that the phenomenon of sinking will be encountered due to the soft seabed, it is thought advisable to first reclaim the proposed concrete pavement area, before proceeding on to reclamation of the outer area.

5-5-3 Construction Materials, Equipment and Labor Force

(1) Construction Materials

The only construction materials available in Hodeidah are sand, stone, fuel oil, gasoline and timber. Other materials (such as cement, steel) are to be imported. Aggregates for concrete are crushed at the construction site.

(2) Construction Equipment

All of the offshore equipment will be mobilized from abroad, as well as all of onshore equipment. Only minor capacitied equipment are available at Hodeidah.

(3) Labor force

Unskilled workers, as well as a few of skilled workers can be procured domestically. However, most of the skilled workers for the construction have to be obtained from abroad.

5-5-4 Construction Schedule

(1) Urgent Plan

The construction schedule is shown in Table 5-5-1. According to this plan the engineering study is assumed to commenced in July 1982. The period of the engineering study is 12 months. In the first 6 months, detailed designs will be executed, for remaining 6 months, tender evaluations will be carried out. The actual construction work will be initiated in July 1983, and be completed by December 1985. The construction period will be 30 months. Supervision up through the maintenance period will be continued. From Janually in 1986, the port facilities shall be functioning effectively to cope with the cargo volume of the year.

(2) Short Term Plan Phase II and Master Plan

The construction schedule is shown in Table 5-5-2.

Table 5-5-1 Construction Schedule of Urgent Plan (1982 ~ 1986)

				'82						'83						'84						'85						'86					
No.	Description	Unit	Quantity	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
1	The 7th berth	m	250																														
2	Reclamation	m^3	271,000																														
3	Pavement	m^2	31,000																														
4	Container crane	sum	1																														
5	Controll office	sum	1																														
6	Ro/Ro berth	sum	1																														
7	Passenger building	sum	1																														
8	Dredging	m^3	85,000																														
9	Road (Temporary)	m	850																														
10	Mobilization & Demobilization	sum	1																														
11	Engineering study	sum	1																														
12	Supervision	sum	1																														

Table 5-5-2 Construction Schedule (1987 ~ 2000)

No.	Description	Unit	Quantity	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000
1	Container Berth	m	500														
2	General Cargo Berth	m	600														
3	Revetment	m	260														
4	Temporary Revetment	m	700														
5	Pavement	m^2	703,700														
6	Dredging	m^3	13,050,000														
7	Reclamation	m^3	2,591,000														
8	(1) by dump truck	m^3	132,000														
9	(2) by pump dredger	m^3	2,459,000														
10	Road	m	3,600														
11	Building	sum	1														
12	Utility	sum	1														
13	Container Crane	set	5														
14	Mobi/Demobilization	sum	1														
15	Engineering and Supervision	sum	1														

(1) Reclamation of behind area of 7th berth.
(2) Reclamation of container and general cargo berth area.

5-6 Estimation of Construction Costs

5-6-1 Conditions of Cost Estimation

Conditions of cost estimation for Urgent Plan are as follows.

1) All prices are expressed in December 1981 prices.
2) The exchange rate is 1 US$ = 4.5 YR
3) Import duties for imported materials and mobilized equipments are not included.
4) Taxes on the foreign currency in the cost estimation are not included.
5) Royalities on reclaiming material are not included.
6) Cost of utilities is included only for the 7th berth.
7) The pump dredger owned by PMAC will be used by free of charge which is expected to commence the work in good condition.
8) Contingency is 10% for physical unknown factors excluding the items mobilization and demobilization.
9) Escalation of prices is not allowed.

Conditions of cost estimation for Master Plan are as same as the conditions of Short Term Plan, excluding the items 6) and 7).

5-6-2 Construction Cost

The construction cost under above mentioned conditions of cost estimation for Urgent Plan is 42,695,000 US$. Details of construction cost are shown in Table 5-6-1. Table 5-6-2 shows the yearly investment program for Urgent Plan. Table 5-6-3 shows the construction cost of each phase and Total, Total construction cost is 351,009,000 US$.

Table 5-6-1 Construction Cost of Urgent Plan

Unit: 10^3 US$
( ) 10^3 YR

Item No.	Description	Unit	Quantity	Amount	Local Currency	Foreign Currency
1	The 7th berth	m	250	12,418	2,760 (12,423)	9,658
2	Reclamation	m^3	271,000	4,046	2,762 (12,429)	1,284
3	Pavement	m^2	31,000	5,141	3,521 (15,844)	1,620
4	Container crane	sum	1	4,505	0	4,505
5	Control office	sum	1	86	78 (352)	8
6	The Ro/Ro berth	sum	1	1,850	283 (1,274)	1,567
7	Passenger building	sum	1	201	155 (700)	46
8	Dredging	m^3	85,000	179	80 (360)	99
9	Temporary Road	m	850	78	66 (298)	12
10	Mobilization & Demobilization	sum	1	9,231	690 (3,105)	8,541
	Sub Total			37,735	10,395 (46,785)	27,340
11	Engineering study	sum	1	653	128 (576)	525
12	Supervision	sum	1	1,265	428 (1,926)	837
13	Physical contingency	sum	1	3,042	1,026 (4,618)	2,016
	Total			42,695	11,977 (53,905)	30,718

Table 5-6-2 Yearly Investment for Urgent Plan

Unit: 10^3 US$
( ) 10^3 YR

Year	'82		'83		'84		'85		'86		Grand Total	
	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C
	70 (317)	289	2,658 (11,965)	12,226	7,192 (32,362)	9,248	2,034 (9,156)	8,910	23 (105)	45	11,977 (53,905)	30,718
Amount	359		14,884		16,440		10,944		68		42,695	

Table 5-6-3 Construction Cost of Each Stage Plan

L/C Local currency Unit: 10^3 US\$
F/C Foreign currency ( ) 10^3 YR

Description	Total					1986				1990				1993				2000			
	Unit	Q'ty	Amount	L/C	F/C	Q'ty	Amount	L/C	F/C	Q'ty	Amount	L/C	F/C	Q'ty	Amount	L/C	F/C	Q'ty	Amount	L/C	F/C
Container Berth	m	750	40,875	9,085 (40,885)	31,790	250	12,418	2,760 (12,423)	9,658					250	14,228	3,162 (14,230)	11,066	250	14,229	3,163 (14,232)	11,066
General Cargo Berth	m	600	29,491	6,555 (29,498)	22,936									200	9,830	2,185 (9,832)	7,645	400	19,661	4,370 (19,666)	15,291
The Ro/Ro Berth	sum	1	1,850	283 (1,274)	1,567	1	1,850	283 (1,274)	1,567												
Reclamation	10^3m^3	2,862	7,009	4,451 (20,029)	2,558	271	4,046	2,762 (12,429)	1,284	132	1,980	1,320 (5,940)	660	2,459	983	369 (1,660)	614				
Dredging	10^3m^3	13,135	30,194	9,215 (41,467)	20,979	85	179	80 (360)	99					13,050	30,015	9,135 (41,107)	20,880				
Pavement	10^3m^2	734.7	121,251	83,039 (373,675)	38,212	31	5,141	3,521 (15,844)	1,620	153.7	25,360	17,368 (78,156)	7,992	225	37,125	25,425 (114,412)	11,700	325	53,625	36,725 (165,263)	16,900
Revetment	m	260	73	62 (279)	11									160	45	38 (171)	7	100	28	24 (108)	4
Temporary Revetment	m	700	199	169 (760)	30									700	199	169 (760)	30				
Road	m	3,600	11,467	7,852 (35,333)	3,615					2,500	7,837	5,367 (24,151)	2,470	1,100	3,630	2,485 (11,182)	1,145				
Temporary Road	m	850	78	66 (298)	12	850	78	66 (298)	12												
Container Crane	set	6	27,030	0	27,030	1	4,505	0	4,505	1	4,505	0	4,505	2	9,010	0	9,010	2	9,010	0	9,010
Building	sum	1	7,463	5,973 (26,882)	1,490	1	287	233 (1,052)	54	1	3,588	2,870 (12,915)	718	1	1,196	956 (4,303)	240	1	2,392	1,914 (8,612)	478
Utility	sum	1	2,920	438 (1,971)	2,482					1	1,040	156 (702)	884	1	626	94 (423)	532	1	1,254	188 (846)	1,066
Mobilization & Demobilization	sum	1	29,077	2,173 (9,780)	26,904	1	9,231	690 (3,105)	8,541	1	3,692	276 (1,242)	3,416	1	9,231	690 (3,105)	8,541	1	6,923	517 (2,328)	6,406
Sub-Total			308,977	129,361 (582,131)	179,616		37,735	10,395 (46,785)	27,340		48,002	27,357 (123,106)	20,645		116,118	44,708 (201,185)	71,410		107,122	46,901 (211,055)	60,221
Engineering & Supervision	sum	1	12,766	5,314 (23,913)	7,452	1	1,918	556 (2,502)	1,362	1	1,920	1,094 (4,923)	826	1	4,644	1,788 (8,046)	2,856	1	4,284	1,876 (8,442)	2,408
Physical Contingency	sum	1	29,266	13,249 (59,622)	16,017	1	3,042	1,026 (4,618)	2,016	1	4,623	2,817 (12,677)	1,806	1	11,153	4,580 (20,610)	6,573	1	10,448	4,826 (21,717)	5,622
Total			351,009	147,924 (665,666)	203,085		42,695	11,977 (53,905)	30,718		54,545	31,268 (140,706)	23,277		131,915	51,076 (229,841)	80,839		121,854	53,603 (241,214)	68,251

5-7 Container Terminal Operation

5-7-1 Facility and Equipment Plan for Full Scale Terminal

According to our cargo traffic forecast, there may be sufficient demand to operate the No. 6/7 berth container terminal as a full scale terminal (referred to hereafter as "phase II of No. 6/7 berth") by around the year 1990.

For future reference to aid in the construction of such a full scale container terminal, its facilities, equipment and operation systems are illustrated as follows:

(1) Layout of the main facilities

A facility layout should be designed which will enable all terminal function to fully operate, maintaining goal volumes for container and cargo movement.

The basic layout of facilities for the 6th and the 7th berth container terminal are shown in Fig. 5-7-1, 5-7-2, 5-7-3.

However, when construction actually to be materialize, further review of this layout will be required, with consideration to the following items.

(1) Container cargo volume to be handled.
(2) Number of ship calls.
(3) FCL (full container load)/LCL (Less than full container load) ratio.
(4) Storage durations of full and empty containers.
(5) Storage quantities of full and empty containers.
(6) Operating organization.
(7) Maintenance capability for machinery and containers.
(8) Skill level of workers operating the terminal.

The arrangement of major facilities in the basic layout, started with the container ship berth back and going toward the terminal, shall be as follows: Quay and apron, container yard, administration office, gate house, maintenance shop, container freight station (CFS), trailer park, port road.

Container storage capacity differs between the respective container operation systems, just as the overall efficiency and service level of the container terminal depend largely on the choice of operation system and the type and amount of equipment used.

Operation systems must therefore be carefully studied to determine the optimum type for the 6th and the 7th berth container terminal. (Refer to the following section "Selection of container handling methods").

The example of container handling equipment and land facilities required for the No. 6/7 berth container terminal are shown in Table 5-7-1.

Fig. 5-7-1 Basic Layout of Chassis System

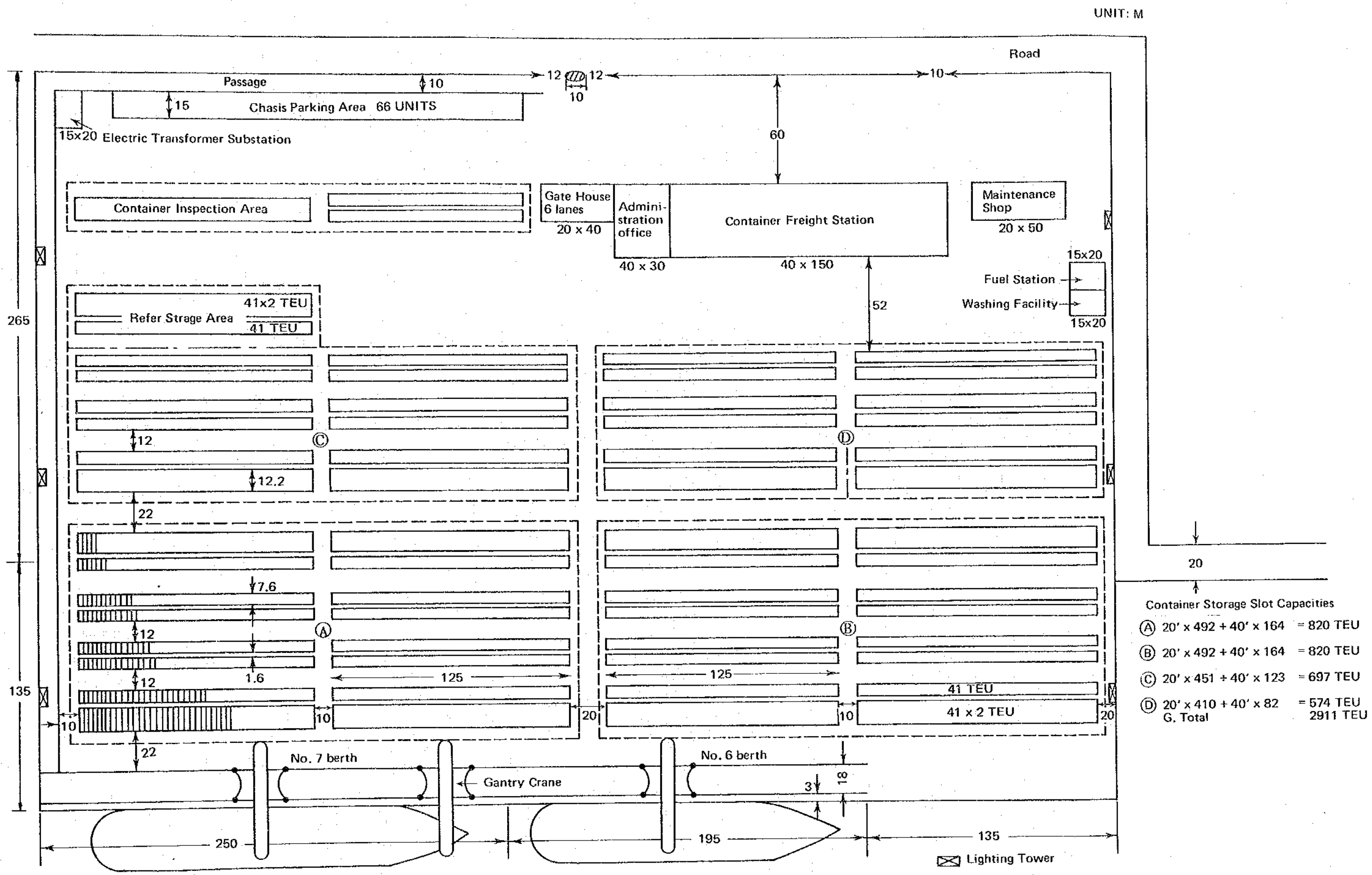


Fig. 5-7-2 Basic Layout of Straddle Carrier System

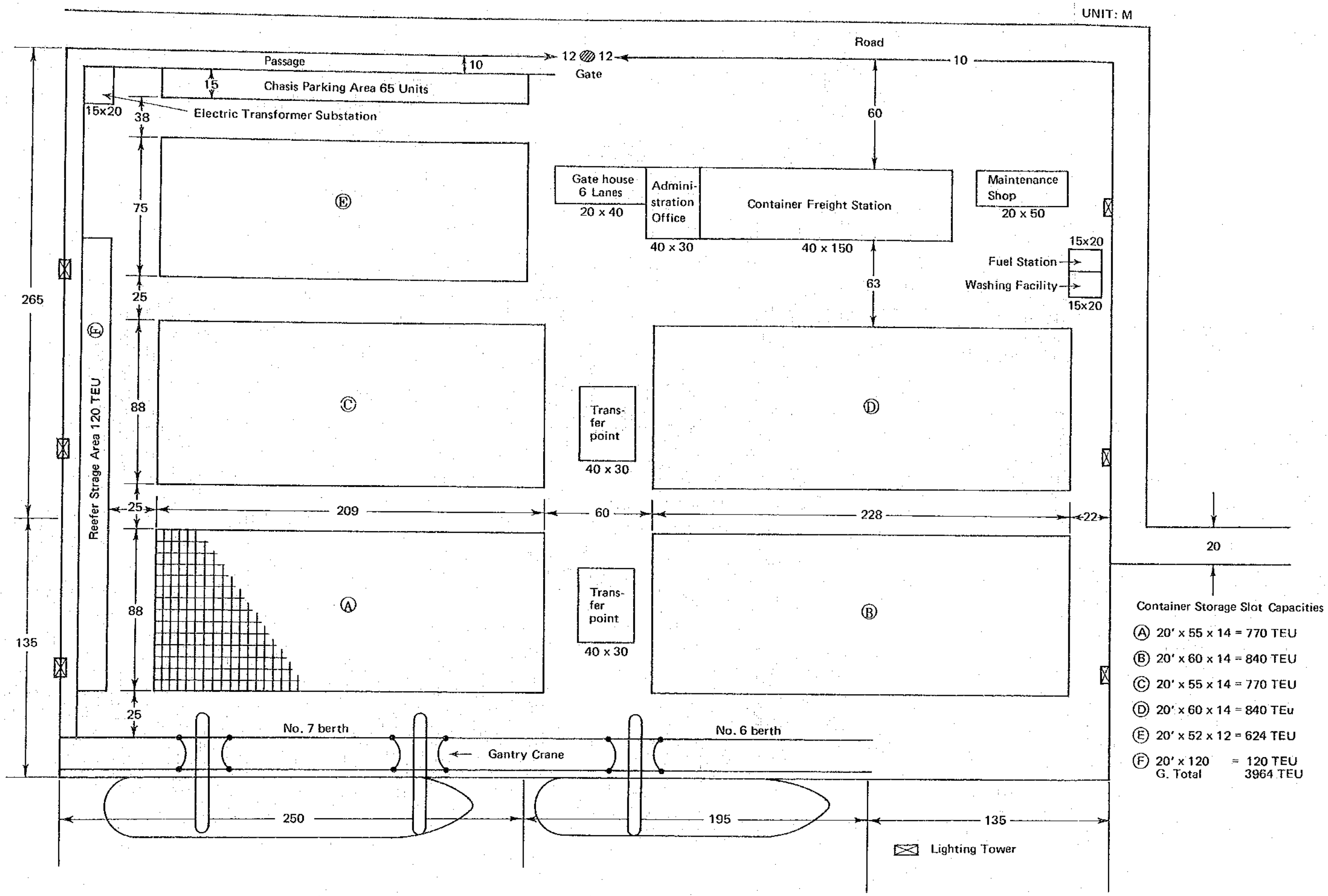


Fig. 5-7-3 Basic Layout of Transtainer System

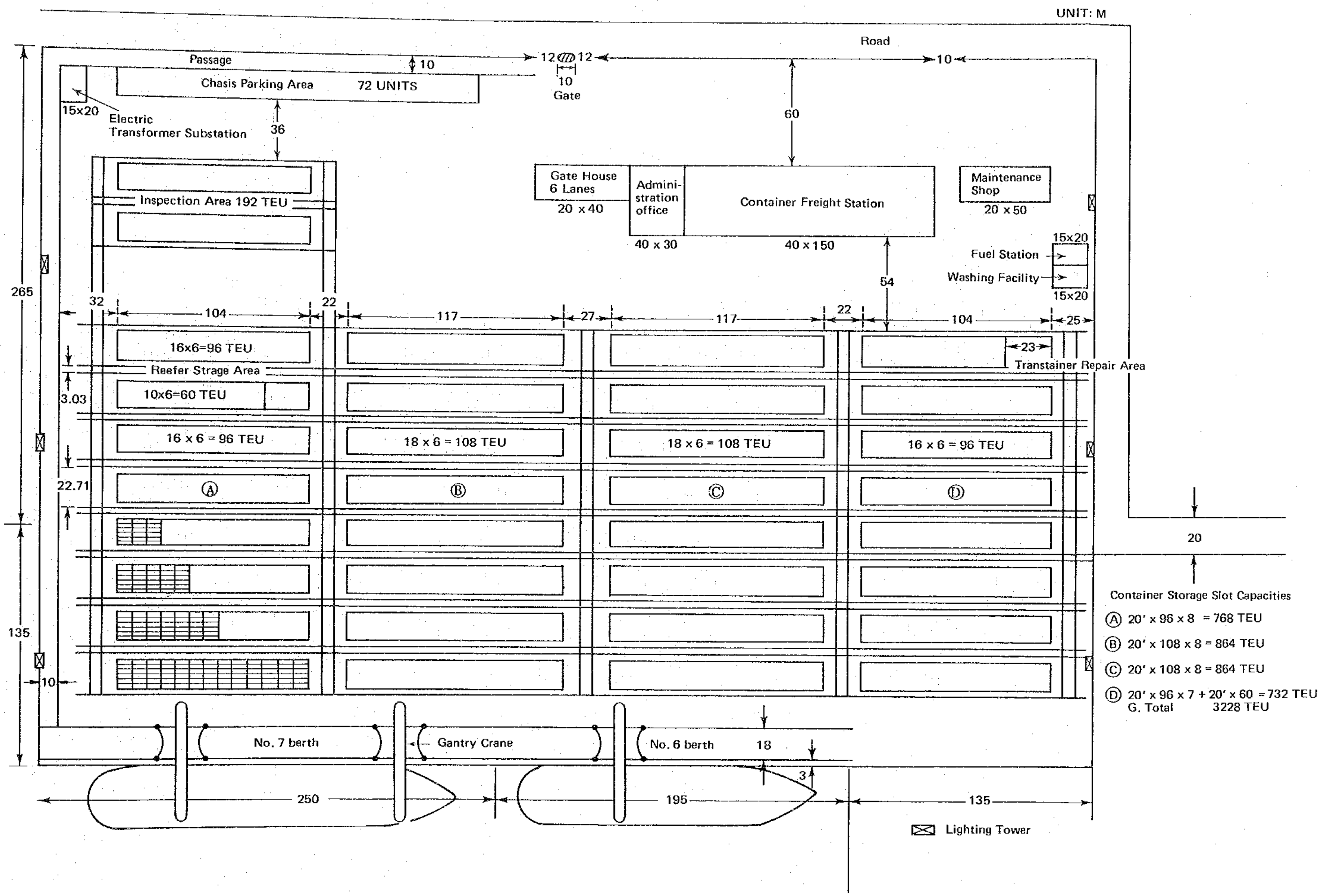


Table 5-7-1 Container Handling Equipment and Land Facilities Required for No. 6/7 Berth

Items	Specification	Straddle Carrier System	Tire Mounted Transfer Crane System
Wharf			
Length		195 m + 250 m = 445 m	195 m + 250 m = 445 m
Water Depth		–10 m ~ –11 m	–10 m ~ –11 m
Width of Apron		21 m	21 m
Handling Equipment			
Container Crane	Capacity 30.5 t	3	3
Straddle Carrier	3 high stacker	12 (cargo handling 10 + CFS & Reserve 2)	–
Transfer Crane	4 high stacker	–	8
Tractor		5	12
Chassis	20'	10	24
	40'	5	12
Fork Lift	Capacity 5 t	2	2
Weighing Scale	Capacity 50 t	2	2
Land Facilities			
Container Terminal Area		232,000 m^2 (580 m x 400 m)	232,000 m^2 (580 m x 400 m)
Container Storage Capacity		3964 TEU Slots	3228 TEU Slots
Administration Office		1,200 m^2 (40 m x 30 m)	1,200 m^2 (40 m x 30 m)
Gate House		800 m^2 (20 m x 40 m)	800 m^2 (20 m x 40 m)
Container Freight Station		6,000 m^2 (40 m x 150 m)	6,000 m^2 (40 m x 150 m)
Maintenance Shop		1,000 m^2 (20 m x 50 m)	1,000 m^2 (20 m x 50 m)
Fuel Station		300 m^2 (15 m x 20 m)	300 m^2 (15 m x 20 m)
Electric Facility		1 set	1 set
Water Facility		1 set	1 set
Lighting Towers		1 set	1 set
Cost of Handling Equipment (not include mobilization cost)		4,745,000 US$	6,231,000 US$

(2) Facilities

The following is a description of the role of the main facilities.

(a) Quay and Apron. (Refer to chapter 6-3-1(3))

The quay is the facility for mooring container ships, and its length depend upon the dimension of the container ship.

The apron is a paved area which extends from the sea side corner along the quay, and is the space required for movement of trucks and trailers, for temporary storage of containers, and for housing spare spreaders for the container crane.

The apron also has crane rail installed along its whole length in order to allow movement of the container crane.

(b) Container yard. (Refer to chapter 6-3-1(3))

The container yard is the place to be used for preparation of container ship operation, full and empty container storage, and receipt/delivery of containers from/to shipper/consignee.

The container yard is located next to the apron. It is specified that its pavement be strong enough to withstand the wheel load of cargo handling equipment, and it must also be furnished with illumination facilities for night cargo handling work.

The layout of the container yard depends upon the container handling system to be adopted. In general, the layout is divided into a container storage space with checkered lines painted on the surface of the pavement to facilitate an orderly disposition of the containers, and a passage way for transportation.

(c) Control center

The control center is the decision making center for the whole container terminal operation, concerning matters of instruction and supervision of ship cargo handling work, yard operations, arrangement in the yard of containers, etc.

The control center should be located in the highest floor of the administration building commanding a view of the entire terminal, and equipped with wireless telephone equipment for sending instructions to the crane, handling equipment etc.. It should also be furnished with an air chuter for sending documents between the gate and the control center.

(d) Gate house

The gate house is where containers and cargoes are delivered/received, and also where custodial responsibility for the containers can be transferred between the terminal acting as shipping lines agency and the shippers, consignees or inland carriers. Consequently, when containers pass through the gate house, various functions are performed such as inspection for container abnormalities and inspection of door seals, weighing of containers, check of documents, etc..

(e) Maintenance shop

The maintenance shop is designed to carry out inspection, maintenance, repair, etc., for containers, as well as to periodically inspect, maintain and repair cargo handling equipment, vehicles, etc., used inside the container terminal.

In most case, the maintenance shop is provided with a power supply for the refrigerated containers, overhead crane, air compressor, chargers and the respective power outlets, in addition to the machinery required for repair.

(f) Container Freight Station (CFS)

The container freight station is a sort of transit shed used for receipt/delivery, storage and stuffing/unstuffing of small cargo lots in transit to and from containers.

The ideal form of container transportation is door to door transportation, where cargo is transported without unpacking or reloading from the point of origin to final destination. But, if there are cargo lots not large enough to fill a whole container, they are, in the case of export, collected at a given place and stuffed in the containers after being classified according to their destinations.

In the case of import, the consolidated cargo should be unstuffed from the container and delivered to the appropriate consignee, after being storted out by destination.

The container freight station is where the above activities are carried out.

(g) Other facilities

i) Washing facilities

Washing facilities will usually be constructed near the maintenance shop.

They will be used to wash the interior and exterior of containers and to wash cargo handling equipment.

ii) Fuel oil supply facilities

The fuel oil supply facilities will be constructed near the maintenance shop, in order to supply fuel oil to cargo handling equipment at the terminal.

iii) Electric power receiving and transforming substation

An electric power receiving and transforming substation is required to supply electricity to various facilities and equipment in the container terminal.

(3) Container Handling Equipment

The various types of container handling equipment in the terminal must be functionally combined in order to carry out most effectively the tasks of loading/unloading, receiving/delivering, and storing large numbers of containers.

Appropriate type and quantities of equipment must be selected in consideration of the specifications, working efficiency, and capacity of each unit. The following is a description of the each required type of container handling equipment.

(a) Container crane (Refer to Fig. 5-4-6)

A container crane is a special crane for loading/unloading containers to/from ships. The crane is moved along rails laid on the apron to a specified position.

Its trolley traverses the boom stretched out over a container ship.

The spreader suspended from the trolley grabs a container, then it is hoisted and lowered, so as to load/unload the container onto/from the container ship.

(b) Straddle carrier (Refer to Fig. 5-7-4).

A straddle carrier is specifically designed as a single machine that can lift and transport containers to any location in the terminal.

A straddle carrier travels straddling the containers, then its spreader suspended from the body frame grabs a container, lifts it, and stacks it in a pile of three containers.

(c) Tire mounted transfer crane (Refer to Fig. 5-7-5)

Tire mounted transfer cranes are box girder gantry structures mounted on rubber tire wheels.

They can generally stack containers four high and six wide, leaving a lane for tractor travelling.

Transfer cranes are designed to travel straddling the above stacks, its trolley traversing the crossing beam supported by two travelling legs.

The spreader suspended from the trolley grabs a container, rolls either up or down, then transferring the container between the trailer and a certain slot in the container yard.

(d) Rail mounted transfer crane (Refer to Fig. 5-7-6)

Rail mounted transfer cranes are similar to tire mounted transfer crane except that these cranes travel on the rail laid in the container yard.

Rail mounted transfer cranes are generally large in size, with a span stretching 9 or more rows of containers. They can stack container 5 high.

(e) Tractor and chassis

This is composed of a chassis specially designed for containers, and a tractor to haul it.

It transport containers the distance between the wharf apron, the container yard and the CFS.

(f) Weighing scale

A weighing scales are installed under the receiving lanes for export containers at the gate house.

The total weight of the vehicle and container is measured when it passes over the scale, and the measurement reading are indicated on an instrument in the gate booth.

Fig. 5-7-4 Straddle Carrier

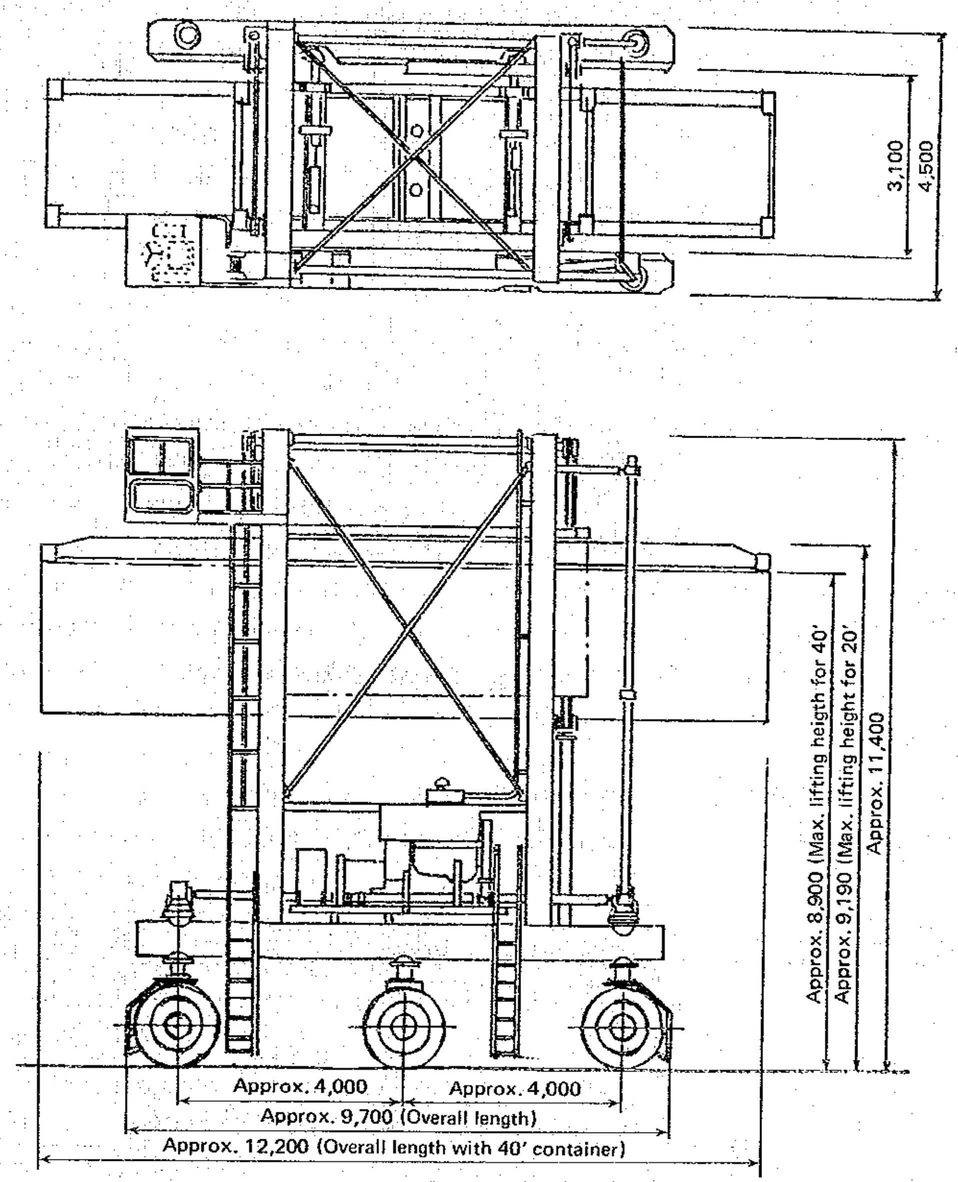
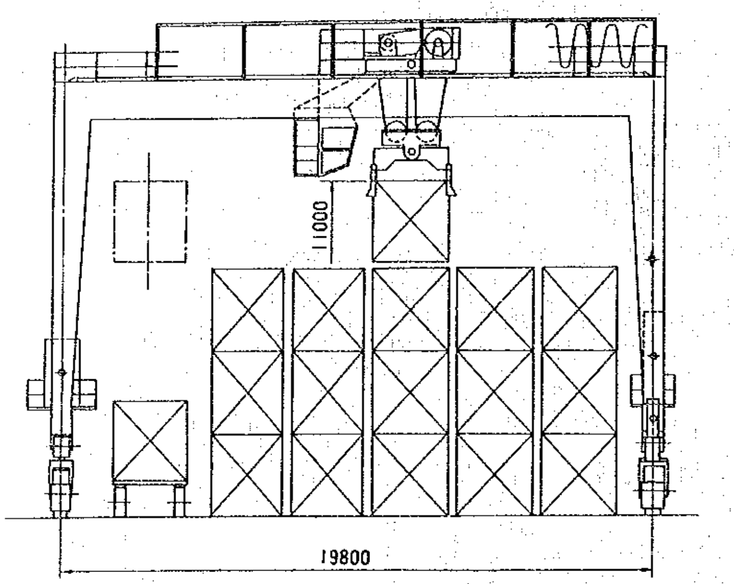


Fig. 5-7-5 Tire Mounted Transfer Crane



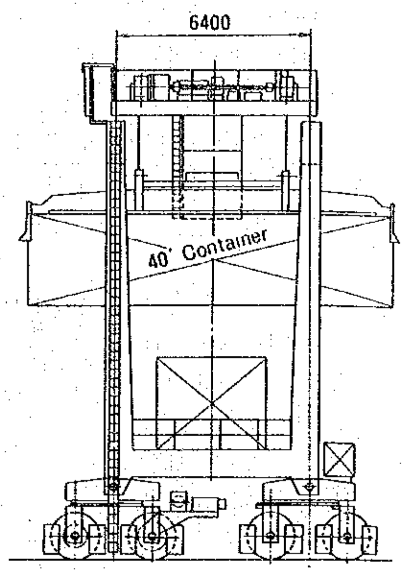
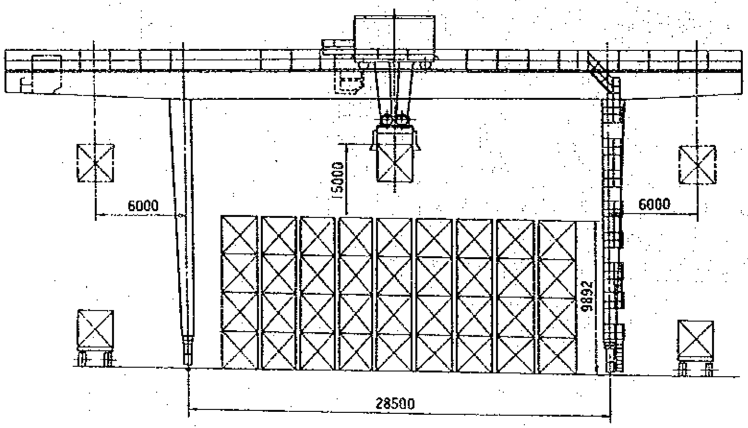
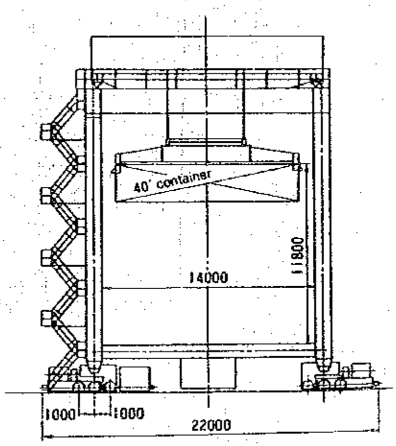


Fig. 5-7-6 Rail Mounted Transfer Crane





5-7-2 Selection of Container Handling System for Full-Scale Container Terminal

The operating efficiency, service level, and general quality of a container terminal is governed largely by the selection of its container handling systems, that is, the type and the quantity of equipment to be used at the terminal.

The most popular in current use are the chassis system, the straddle carrier system, and the transfer crane system.

Also used is the forklift system, adaptable for container handling in small areas such as van pools or berths for conventional ships. In a true container terminal, however, where special equipment is required to handle smoothly large quantities of 40-feet full containers, the forklift system would cause unwarranted decreases in the container storage rate and require a wide stretch of heavy pavement. Thus, the forklift system has rarely been adopted, and may therefore be excluded from the discussion of the candidate systems presented below.

(1) Chassis system

Containers unloaded from ship are placed directly on chassis, which are hauled by tractor to assigned positions in the storage area. Then the chassis are disconnected from the tractors and the containers are stored in the yard, remaining loaded on their chassis for later collection by tractor.

At the time of cargo delivery, the chassis are coupled to tractors provided by each consignee for inland transportation, and hauled from the yard.

In the opposite case, where containers for export are hauled on chassis to the terminal, they are conveyed directly to the yard, where they are uncoupled from their tractors and stored, as before, while still loaded on the chassis. Upon arrival of the ship in port, the chassis are coupled to the yard tractor in accordance with the cargo working sequent list of the ship in question, then moved into position under the crane for loading. Ultimately, of course, only the container is loaded onto the ship.

Emptied chassis are either hauled by tractor to the empty chassis yard, or loaded with containers taken from ship and stored in the full container storage yard. Containers must therefore be stored one high, requiring a relatively large transit storage area.

The advantages of this system are listed below.

a) Auxiliary container handling equipment is not required, with the exception of the yard tractor used for shipside cargo handling. This is the best-suited system for door-to-door cargo transport.

b) There is relatively little risk of cargo or container damage, as the handling of container by various equipment is minimized (except, as above, in shipside loading/unloading).

c) Containers can be handled more easily and quickly than by any other method, because every container is immediately available for removal by tractor, permitting an annual container turnover of about two or three times that of other systems.

d) Since there are no heavy vehicles employed except the chassis and the tractor, the surface of the container yard does not require the heavy-duty paving demanded by other systems.

e) When a crane is used to load and unload containers at the apron, it is easy to employ a dual-cycle operation, which not only ensures highly efficient handling, but also improves the efficiency of the container yard and chassis operations.

On the other hand, the system has the following disadvantages:

a) Since the containers are not stacked in multiple tiers, all chassis must be arranged in such a way as to be accessible to the tractor. The area efficiency of the container yard is thus extremely low as compared with the multiple tier stacking system, and a large land area is required.

b) As many chassis as the number of containers to be stored are demanded by this system, requiring an extremely large capital investment as compared with other systems.

c) There is no problem if each terminal is to be used exclusively by one shipping company, but if it is to be shared by several shipping companies, the chassis provided by the various companies will be mixed together, causing in possible confusion.

d) Since the chassis are able to travel ordinary roads without modification, a large number of them must be submitted for inspection in accordance with the regulation of the countries in which they are to be hauled.

(2) Straddle carrier system

Of the more than 400 container berths operating in the world, about 40% of them employ the straddle carrier system. Straddle carriers can stack containers two or three tiers high, move them between the quayside crane and the storage area, and load or unload them to or from road transport trailers.

Containers unloaded from ship are placed directly on the wharf apron, then lifted by the straddle carrier and transferred to prescribed slots in the yard, where they are stacked in tiers up to three high.

When the containers are delivered, they are moved by the straddle carrier to the transfer point and loaded onto waiting inland transportation trailers. This procedure is reversed in the case of export, or in the case of the receiving of empty containers.

This handling system presents the following advantages:

a) Since the straddle carrier has high flexibility and mobility, its disposition can be changed freely to cope with daily flucuations in the terminal work load (peak and bottom of shipside cargo handling, and peak and bottom of container receiving and delivering).

b) The straddle carrier can perform both the transfer and the conveyance of containers. It is suitable for random operations such as while engaging the ship loading/unloading operation, it can also engage the delivery of import containers to road trailers. It is easy to control the operation because each unit is allotted its task independently.

c) Since containers can be stacked in multiple layers, the container yard area can be used efficiently.

d) Compared with other systems, the initial cost of this system is relatively small.

On the other hand, this system presents the following disadvantages.

a) Since the straddle carrier is an industrial vehicle requiring precision operation, special operating skills are necessary, as well as considerable time and cost for maintenance.

b) Since the wheel load is very heavy, the container terminal must be thickly paved.

c) As consignees often arrive at the receiving point on short notice, containers cannot be dispatched to them as smoothly as in the case of the chassis system.

(3) Transfer crane system

The transfer crane system is a compound cargo handling system, composed of transfer cranes, tractors, and chassis.

The transfer cranes are used to handle containers within the container yard; the tractors and chassis are used for transfering containers between container ship and container yard at the time of loading/unloading.

There are two types of transfer cranes: those which travel on rails and those with rubber tired wheels.

Rail mounted transfer cranes are generally large in size, stretching over 9 or more rows of containers and able to stack containers up to 5 high, but these require an extremely large initial investment.

The rubber-tired transfer crane normally straddles 5 or 6 rows of containers within its portal, as well one lane for tractor travelling. It is able to stack containers up to three or four high.

Since transfer cranes are able to move only forward and backwards, however, horizontal transportation of containers between the ship and the container yard is effected by the yard tractor and chassis. In the delivering and receiving of containers to and from inland transportation trailer, road transportation tractors are directed to the tractor travelling lane of the transfer crane, where containers are directly loaded onto or unloaded from the chassis.

The transfer crane system presents the following advantages:

a) Since containers can be stacked in multiple layers, the storage of a large number of containers is possible.
b) The transfer crane, compared with the straddle carrier is a technically stable machine with low maintenance costs and long life.
c) Since the movement of the rail-mounted transfer crane is restricted to a predetermined location and direction, an automatic computer control system may easily be applied.

On the other hand, the transfer crane system presents the following disadvantages.

a) The transfer crane is well suited to full-time operation at a consistent rate, but it is quite difficult to increase its workload temporarily to cope with occasional fluctuations in workload. Thus, a high volume of container concentrated within a short time period will overburden the transfer crane, resulting in waiting time for the inland transport tractor.
b) Just as with the straddle carrier system, the movement of containers in the lower layers of a tier is problematic.
c) The wheel load of the transfer crane is exceedingly great and demands very heavy duty pavement. However, since the travelling route is limited, heavy-duty pavement is required only for specific areas.
d) The substitution of equipment is quite difficult in case of equipment failure, and there is a risk of considerable bad effects on the operation of the system.

(4) Analytic comparison of systems

The above-mentioned systems – the chassis system, the straddle carrier system, and the transfer crane system – are employed by most of the container terminals in the world.

However, each system has its advantages and disadvantages as detailed above, and as summarized in Table 5-7-2 ("Comparison of Systems"), which presents an analytic comparison of the systems from the viewpoints of economy and handling.

Table 5-7-2 Comparison of Systems

Item \ System	Chassis	Straddle Carrier	Tyre-Mounted Transfer Crane	Rail-Mounted Transfer Crane
Storage Capacity	△	○	◎	◎
Initial Cost	△	○	◎	◎
System Simplicity	◎	○	△	△
Handling Efficiency	◎	○	△	○
Wharf Efficiency	△	◎	△	△
Mobility of Operation	◎	○	△	△
Container Damage	◎	△	○	○
Maintenance Cost	○	△	◎	◎
Flexibility of Operation	◎	◎	△	△
Expandability	◎	○	△	△
Adaptability of Automation	△	△	○	◎
Loading to Railway	△	△	○	◎

◎: excellent, ○: good, △: questionable

It is considered, however, that the rail-mounted transfer crane system is the handling system of the future, as it is suited to a handling extremely high volume of containers as well as to automation by computer. The straddle carrier system has been the most popularly used, because of its mobility and flexibility, while the chassis system is popular for its operation simplicity and handling efficiency.

However, inasmuch as the Port of Hodeidah must serve several users, the chassis system is definitely not recommended, and has consequently been excluded from the object of following discussion.

In light of the above analysis, only the straddle carrier system and the transfer crane system will be taken into consideration as possible types for the container handling system to be installed in the combined 6th and 7th berth terminal.

5-7-3 Management

(1) Organization of full scale terminal

The number of employees required to effectively perform terminal operation depend on various factors, such as possible employer/employee agreements, and the ability and experience of each employee.

It is rather difficult at this stage to determine the appropriate number of employees required for operation of the full scale container terminal at Hodeidah port, because, the operation system for a full scale terminal differs from that of a conventional ship as now exist in the Hodeidah port.

Also the ability and experience of the workers has not been ascertained.

The appropriate number of employees required for operation should be determined after studying the operation system of developed terminals and after teaching and training the workers specifically for their jobs.

Accordingly, data concerning average organizations and functions prevailing in container terminals in Japan are described here for reference.

In order to systematize the entire operation of a container terminal, the terminal is divided into six departments:

General affairs dept, accounting dept. Business dept. Operation dept. Maintenance and Repair dept. and CFS dept. (Refer Table 5-7-3)

The following is an outline of the duties and functions of each department.

1) General affaires department:

Assets and cost control related to the container terminal. Receipt and disbursement of labour and general administration costs.

Also miscellaneous work.

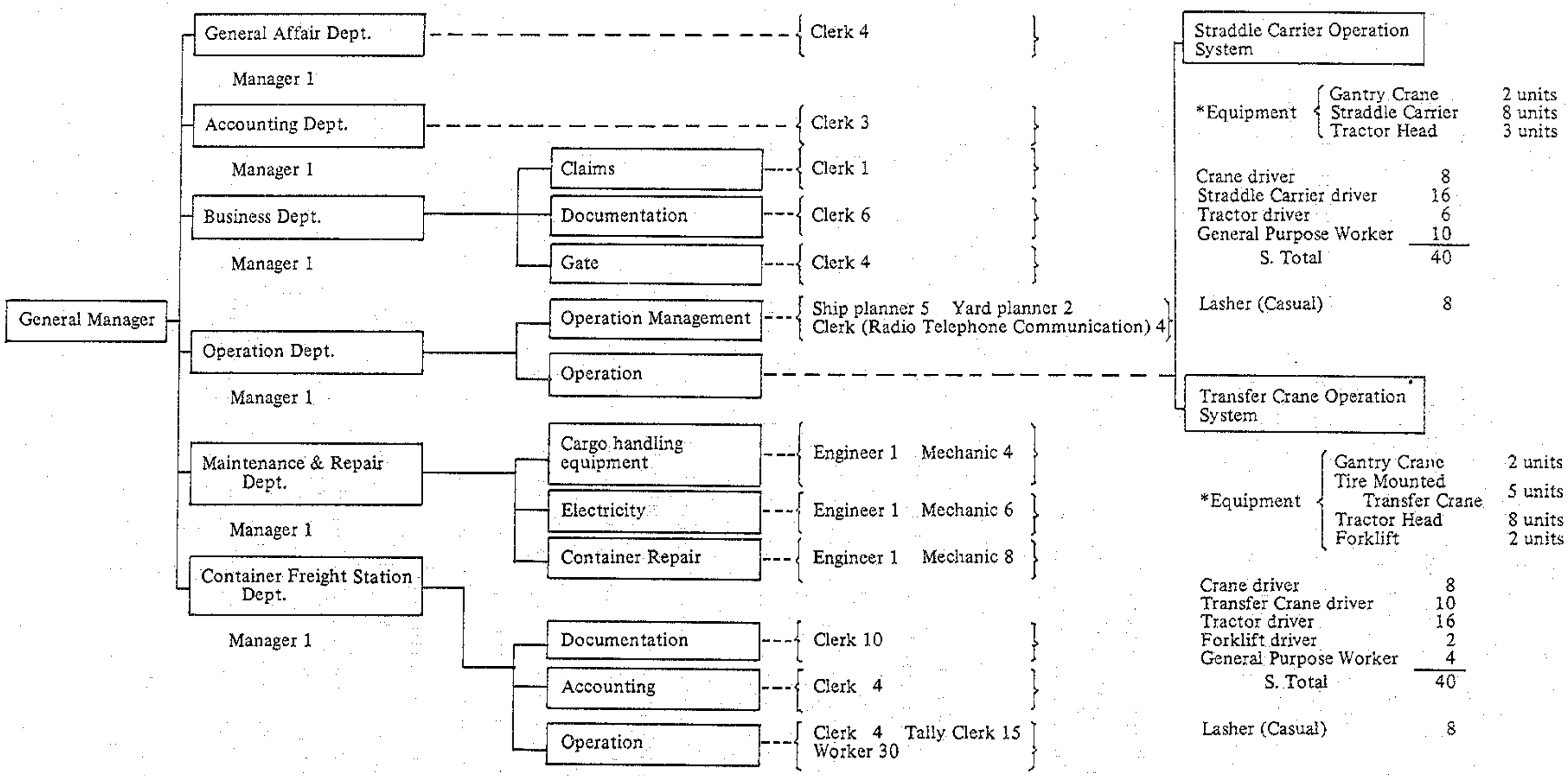
2) Accounting department:

Demand and receipt of fee for loading/unloading, storage, receipt/delivery and repair of containers.

3) Business department:

This department is composed of three section, namely, documentation, claim and gate clerks.

Table 5-7-3 Organization of Container Terminal



	General Manager	Manager	Ship planner, Clerk, Yard planner, Engineer	Tally Clerk	Mechanic	C.F.S. Worker	Terminal Worker	Total
Number of Person	1	6	50	15	18	30	40 + 8	160 + 8

Preparation and issuance of necessary documents concerning export and import containers.

Arranging various government inspections including zoological and botanical guarantine and custom inspection.

Paper work concerning the inventory control and the receipt/delivery of containers.

Taking appropriate action and making suitable arrangements after accidents and damages have occurred to people, container ships, terminal facilities, equipment, containers, road transport vehicles, etc..

Negotiations with shipping companies, shippers, forwarding agents, etc., and contact with related authorities in regard to the activities mentioned above.

4) Operation department:

This department is composed of two sections, namely, management section (including ship planner, yard planner and clerk) and operation section (including craneman, cargo handling equipment driver and miscellaneous workers).

a) Management section

Planning the ship's stowage in compliance with requests of the ship operator's stowage planner, loading/unloading ship operation, arrangement of containers in the container yard, and shifting of containers between the CFS and the container yard.

Arrangement of drivers for container handling equipment and other workers necessary to execute the above mentioned plans.

Control and supervision of road transport vehicle within the terminal. The management section is responsible for supervision and execution of the above mentioned plans as they relate to the yard and ship.

b) Operation section

Execution of operation related to the yard and ship under supervision of the management section.

5) Maintenance and Repair department:

This department is composed of cargo handling equipment, electricity and container repair section.

Maintenance and repair of cargo handling equipment such as the straddle carrier, transfer crane, yard tractor and chassis, forklifts and container cranes.

Maintenance and repair of the transformer sub-station, illumination, electrical parts of the container handling equipment and refrigerated containers.

Cleaning and repair of containers.

6) CFS department:

This department is composed of the CFS operation, documentation and accounting section.

Planning in relation to the delivery/receipt and the storage of cargoes at the CFS, and the stuffing/unstuffing of cargoes into/out of containers.

Arrangement of drivers for cargo handling equipment and other workers required for the above mentioned plans.

Execution of work in accordance to plans.

Direction and supervision of work.

Preparation and issuance of documents necessary for export and import cargoes.

Demand and receipt of fee for stuffing/unstuffing of loose cargoes into or out of containers, their storage, receipt and delivery.

Receipt and disbursement of labour and general administration costs of CFS.

(2) Management

Management and operation systems for the full scale container terminal should be designed to permit operation of the terminal under a single organizational body which directly employes a full force of well trained and experienced personnel.

Then, it should be arranged that the terminal users must be provided with through and complete service by above mentioned body, from the unloading of import containers from ship to final delivery to consignee; from the receipt of export containers from the shippers to their loading onto ships.

5-7-4 Training

Prior to the opening of a full scale container terminal at the port of Hodeidah, it is recommended that PMAC and/or the organizational body that plans to operate the container terminal should investigate the operational systems of container terminal in developed countries, so as to provide detailed training on container terminal operation procedures to the staff and workers who will be employed at the terminal.

The key staff member responsible for managing ship cargo handling, yard operation, documentation, and inventory control, should be trained by being directly in charge of an actual job at an already developed container terminal for at least six month, so as to obtain full and detailed knowledge of operation.

As for the engineers who will be responsible for maintenance and repair of highly complex cargo handling equipment and refrigerated containers, they should be trained by the manufacturers of such equipment and at maintenance shop at already developed terminal, for at least six month.

The workers who will drive container handling machinery should be trained in driving such machinery through actual experience.

Therefore, it is recommended that such machinery should be purchased well in advance of the terminal's opening (three months or so), for use in worker training.

At that time, it would be advisable to invite experienced drivers from developed terminals to serve as instructors.