Chapter 5

Potential Cargo Handling Capacity Expected by Improving Existing Facilities and Operation System

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5.1 Basic Concept of Physical Possible Improvement

This section deals with the basic ideas for upgrading the existing facilities in order to minimize the cost required for the new development.

5.1.1 Marine Structures

Existing marine facility consists of two type of structures namely, the aged piers made of steel framed opens structures and rather new marginal wharfs made of reinforced concrete open structures.

The existing two jetties are typical ones of the former while the barge harbor, grain jetty, the four berth extension and wharfs of 4,500 m long are typical samples of the latter. Other than these are two trestles to land by two jetties.

(1) Aged open structures

Two jetties, the Eastern and the Western, are rather old even after several rehabilitation works made in the past. The most decisive structural elements of them are the existing H-shaped steel piles.

It is recommended to strengthen them by another rehabilitation until the end of their lives. However it is also recommended to abandon them and replace by new facility before large incident including structural failures by loading and vessel impact.

In the Short Term Plan, those jetties will partly be utilized after the required rehabilitation including,

1) Rehabilitation of superstructures like PSO currently is conducting.

2) Provision of supplemental jetty along the existing faceline.

3) Periodical monitoring on the deformation of structures and introduction of loading limit.

Thus it is assumed that these jetties will be the stand-by berths for supplemental use and will not be the main structures for the port operation.

(2) Concrete made wharfs, previous Ten and Fourteen Berth Extensions.

All these wharfs are rather healthy condition except the present partial damages. These marginal wharfs will provide the port users with the required services if the preventive repair works and urgent rehabilitation are given to them.

Open structures generally have various advantages than those of the gravity wall.

Their design water depth can be modified to deep water by addition structures although it is not easy work. Present DL-11.0m wharf below Cesco DL can be however deepened to DL-14.0m wharf if an additional front deck of 10m wide is provided.

Crane beam will be also can be added by additional piling through temporary opens at the existing precast deck element. These ideas mean that the existing wharf can change its depth capacity to meet calling of large size vessels in the future.

(3) Previous Four Berth Extension Area

In the original plan prepared in 1974, four berths of each 180 m long should have been constructed. Unfortunately only two berths at its eastern area were constructed. For the western two berths, no work is carried out except driving the concrete piles in 600 numbers.

These existing two berths in 400 m long are the typical jetty wharfs which consist of a detached pier structure with three access trestles to the main land. They are unfortunately located at the old port area where the most active operation in respect of cargo handling services takes place. This area should be given of more significant duties in respect of port productivity.

It is wall known that this type of structure is lower cost than those of marginal wharf. However, the throughout of it is less than those of the marginal wharf, since the required cycle time of cargo handling is longer than the marginal wharf. This can attribute to long circulating distance due to the limited access through the trestles.

In the short term plan, the existing structures will remain without any improvement, however the required upgrading of them should be carried out during the long term development. Upgrading method will be as follows.

1) A new deck will be provided between the existing pier and seawall being a marginal wharf. Provision of a parallel jetty along the existing faceline will be undertaken in order to make the depth of water deep enough to meet the large vessels.

2) Further upgrading than above can be performed by construction of new marginal wharfs faceline of which will advance seaward to obtain deep water for large vessels, after demolishing the existing structures. The remaining basin behind the wharf will be reclaimed in order to generate a wide space.

The former is minimum development to meet the general cargo berth while the latter is a large scale upgrading to meet the cargos which require a wide space like a container terminal.

(4) Existing Barge Harbor

There is very few damage at the marginal wharfs of existing Barge Harbor. Although the basin of this harbor is limited, it will serve the port with supplemental factors including not only barge berths but also berthing areas for the port service boats.

However special cautions should be considered for use of the small boats, since the crown height of present deck is DL +7.35 m.
One of issues of this harbor is a high sedimentation since it shapes a closed basin. There is a high current at the main stream of channel, however this basin has a dead water with no water circulation. Maintenance dredging should be carried out.

5.1.2 Transit Sheds and Warehouses

(1) Size and structure

Present transit shed and warehouse at the marginal wharfs are all standardized in size, 60m by 150m then 9,000m^2. They consist of steel frames and precast concrete walls supported by concrete piles. All these facilities are typical design and meet with the cargo sorting and storage operation.

Transit sheds have flat entrance gates toward the seaward apron and elevated platforms at their landward gates. The wall consisting of precast concrete elements rest on the piles at landward while those of seaward are supported by the concrete deck of marginal wharf.

There are three transit sheds behind the previous Four Berth Extension area. Size of these sheds is 40 m by 90 m then unit area is 3,600 m^2.

Other transit sheds and warehouses which are located in the old port area are so aged and seriously damaged.

(2) Existing transit sheds and warehouses in future use

It is recommended to use the existing storage facilities in the future as much as possible. In the general layout of the Master Plan, they should be given of the proper duties for the future. When necessary part of them will be removed to other site for new duties.

Thus some of them may be required to remove by the change of function after the rearrangement of facility function allocation. Since they are all prefabricated structures, they can be removed to other locations for new duties except the pile foundation.

(3) Upgrading of existing facilities

When necessary the existing storages will be improved to meet the new function allocated. For example, several transit sheds will be modified into the refrigerated transit sheds or warehouses. In this case the existing sheds can be utilized as the shelters for refrigerating facilities from the high temperature during the summer time.

5.1.3 Access Transport

(1) Road

An expressway between Imam Khomeini port and Esfahan needs to be constructed. Then Imam Khomeini port will be connected to Tehran by an expressway.

(2) Railway

There is a double track railway between Imam Khomeini port and Ahvaz.

5.2 Improvement Plans for Cargo Handling System and Cargo Handling Equipment

5.2.1 Basic Policy for Upgrading

The purpose of improvement of the cargo handling equipment is to get higher productivity of the existing berth thus the basic policy for the improvement is as follows;

(1) The fixed handling equipment at the quay of the exclusive berth will be used without replacement and modifications and/or repairs will be done as required to regain the original capacity.

(2) Very old handling equipment (except the above mentioned equipment) will be replaced.

(3) Equipment damaged due to poor maintenance will be repaired to recover the original capacity.

(4) Equipment required for handling cargoes will be fully supplied.

(5) Equipment required due to change of the cargo handling system will be also supplied.

(6) All equipment will work fully with good preventive maintenance.

(7) Time wasted due to shortage of spare parts will be avoided by good supply and management of spare parts.

The proposed measures are as follows;

5.2.2 Dry Bulk (Ore) at the Exclusive Berth

(1) Unloaders

Two sets of unloaders are installed at the quay side.
However one unloader has been out of order for a long time and the handling system by using ship gears has been adopted more frequently than that by unloaders.
The unloader which is out of order should be repaired promptly and both sets will maintain of the original capacity by good maintenance.
After recovery of the original capacity ,they should be used to the full extent.
Furthermore, it is recommended that the hopper on the unloaders are improved to prevent air pollution by ore powder.

(2) Belt conveyors and other equipment at the terminal

All equipment retains the original capacity by good maintenance and, besides, it is considered to prevent air pollution through improvement of the related equipment.

5.2.3 Dry Bulk (Grain) at the Exclusive Berth

(1) Improvement of the cargo flow at the terminal

a. For receiving line
All unloaded cargoes at the existing terminal are to be stored in the silo and there should be no by-pass (direct discharge) lines from unloaders to trucks or wagons.
Considering handling system at the marginal wharf, it is recommended however to install a direct discharge line.
b. For discharge line
A discharge chute is furnished at the middle of the silo. Furthermore, the discharge line which is not in good condition from the silo bottom can be used only for a recycle line.
The space under half bins cannot be used effectively.
The silo capacity is small compared with that of the unloaders and furthermore it has problems as mentioned.
It is recommended that the discharge line from the silo bottom is modified to be used properly.
Needless to say, the line should be kept in good condition.

(2) Improvement of the related equipment

Most of equipment (dust collection equipment, weighing equipment, etc,), except direct handling equipment at the terminal, are not in good condition and are out of use.
All equipment including both direct and indirect handling equipment are required to be in good condition to work effectively and smoothly.
All equipment at the terminal should be kept in good condition.

5.2.4 Dry Bulk (Grain) at the General Cargo Berth, Marginal Wharf

The existing cargo handling system will be changed to get large berth productivity. Most of cargoes unloaded by pneumatic unloaders will be stored provisionally at the transit shed behind the berth to be discharged later.

(1) Pneumatic unloaders

Two pneumatic unloaders are installed at present.
Additional two pneumatic unloaders should be provided.

(2) Belt conveyors

Belt conveyors should be used to transport unloaded grain from the apron to transit shed.
Belt conveyors consist of fixed conveyors and movable conveyors.
Fixed conveyors should be installed at the position not to be obstructive handling other cargoes.

(3) Shovel loaders

Shovel loaders are used for loading trucks in the transit shed.

5.2.5 Bagged Cargo (Rice, Sugar, Fertilizer, etc)

Pallet system should be introduced instead of net sling system at present because cargoes on the pallets at the apron can be handled easily by fork-lift trucks

(1) Mobiles crane for handling cargoes from/to ship

Mobile cranes should be used for handling cargoes of ship smaller than 30,000 dwt and the cargoes of ship larger than 30,000 dwt should be by the own ship gears.

(2) Fork-lift trucks

Fork-lift trucks should be used for handling cargoes on pallet at the apron and in the shed and also for transportation between them.

5.2.6 Metallic Products

Comparatively heavy cargoes should be handled with suitable sling by jib cranes installed at the berth. However pallet system should be introduced as much as possible.

(1) Jib cranes for handling cargoes from/to ships

The existing six (6) cranes will be used however the required number shall be reviewed.

In this case, the most suitable sling needs to be used for easier lifting.

(2) Mobile cranes for handling cargoes from/to ships

Mobile cranes should be used for handling cargoes of ships smaller than 30,000 DWT (depending on the lifting weight) at the berth where jib cranes are not installed.

(3) Mobile cranes for handling cargoes at the open storage yard

Mobile cranes should be used only for cargoes which cannot be handled by fork-lift trucks.

(4) Fork-lift trucks

Fork-lift trucks should be used for handling cargoes on pallets at the apron and storage place and also for transportation between them.

5.2.7 Miscellaneous

Package styles or boxed styles are various at present.
However, most of them can be divided into the two groups in way of handling.
One group can be handled in the same way as bagged cargoes and another group as metallic products.

5.2.8 Refrigerated Cargo

Cold storage facilities should be installed behind apron like transit shed and warehouse. Basically, refrigerated cargo should be stored in cold storage facilities after unloading from ship.

5.2.9 General Cargo

General cargo should be handled by same method for bagged cargo or metallic products.

5.2.10 Container

For the Container handling system at the container yard, the tire-mounted transfer crane system which is one of the already introduced systems at the terminal should be selected.

(1) Container wharf cranes

All containers from/to ships should be handled by container cranes installed at the quay side. Two container cranes should be installed basically at each berth respectively and size of cranes should depend on ship sizes to call.

(2) Transfer cranes, Container yard cranes

Transfer cranes should be used for loaded containers at the container yard and a standard type of six lanes shall be introduced.

There are several systems of container handling at container yard (marshalling yard) such as transfer crane system, straddle carrier system, chassis system. Imam khomeini port has been using the transfer crane system. Table 5.2.10.1 shows comparison of handling systems. Figure 5.2.10.1 to 5.2.10.3 shows typical layouts by cargo handling systems with same storage capacity. Many large container ports in the world use the transfer crane system. Transfer crane system is selected as the most suitable system considering cost, ease of operation, safety and PSO's experience.

Table 5.2.10.1 Comparison of Handling Systems

Item	Chassis system	Straddle carrier system	Transfer crane system	Folk lift system (Top-loader)
Land utilization	large	medium	small	large
Height of stack	low	medium	high	medium
Efficiency of container crane	low	high	long	high
Working hour for taking in/out container	short	medium	long	medium
Damege ratio of container	low	high	medium	high
Required skill of driver	low	high	medium	high
Term for training of driver	none	long	medium	short
Maintenance cost	small	large	medium	large
Running cost	low	high	medium	high
Required skill for repair	low	high	medium	high
Amount of investment (machinery)	medium	small	large	small
Amount of investment (container yard)	medium	large	medium	small
Scale of repair shop	small	large	-	medium
Experience of handling	none	none	yes	yes
Automation of operation	low	medium	high	medium

(3) Top lifter

Top lifter should be used only for reefer containers and for general service to loaded containers. One top lifter at a terminal should be enough.

(4) Fork-lift trucks

Middle-sized fork-lift trucks should be used for handling empty container and small-sized ones should be used for stuffing and un-stuffing containers at the CFS.

(5) Chassis

Chassis should be used for transportation mainly between the apron and the container yard.

(6) Tractor heads

Tractor heads should be used for pulling a chassis.

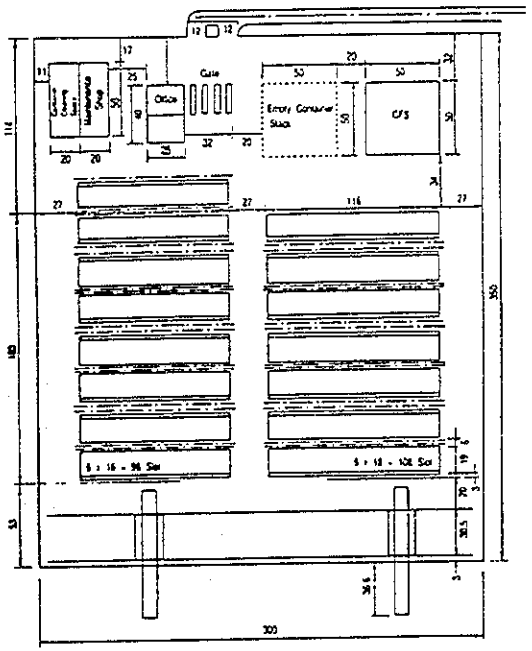


Figure 5.2.10.1 Transfer Crane System
Recommended System

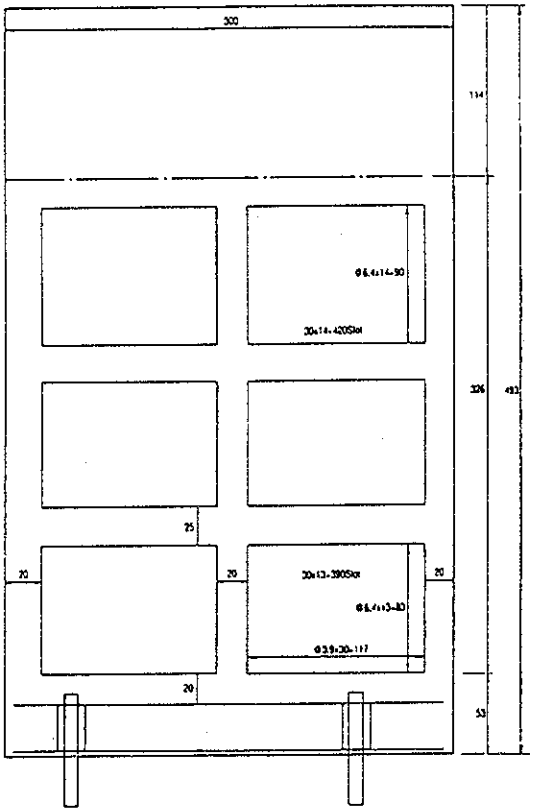


Figure 5.2.10.2 Straddle Carrier System

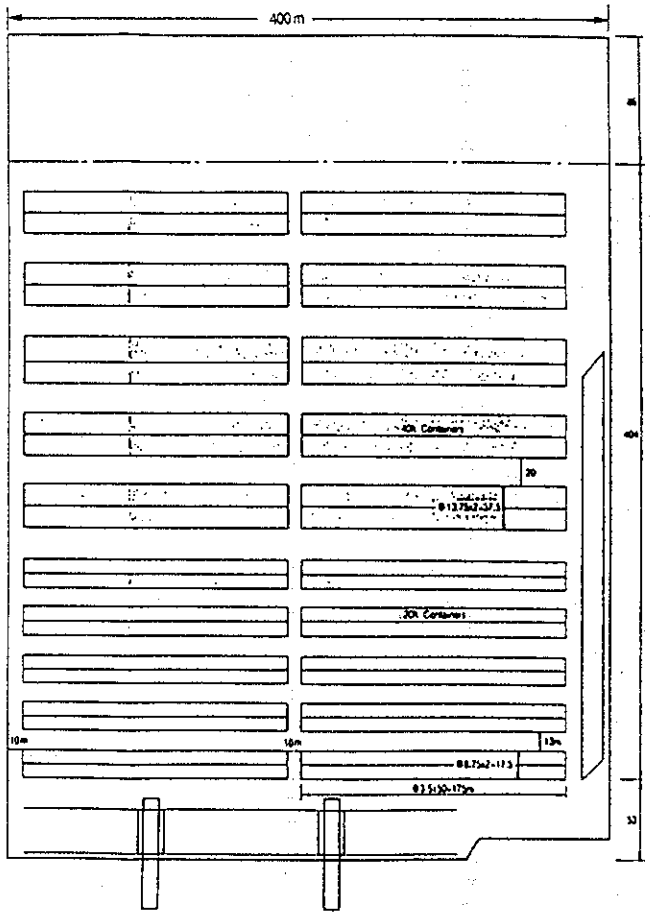


Figure 5.2.10.3 Chassis System

5.3 Commodity-wise Capacity Evaluation

5.3.1 Dry Bulk Cargo (Grain)

Target, 3,711,000 (2000) 4,505,000 (2010)

(1) Present handling capacity at silo jetty

Present handling capacity at existing berth is calculated as follows by using actual data from 1990 to 1992. Wheat, barley and corn are unloaded at this jetty. The berth occupancy ratio of each cargo is average value from 1990 to 1992.

- **Wheat**

Average operation days per vessel is 8.63[1] days.
Average DWT of calling vessels is 39,791[1] tons.
Average unloading rate to vessel size in DWT is 0.921[1].

Qd = 39,791 x 0.921 / 8.63
= 4,247 (ton/day/Berth)

Present handling capacity of berth = 365 x 0.584[1] x 4,247
= 905 thousand tons per year
(0.584 is berth occupancy ratio)

- **Barley**

Average operating days per vessel is 4.5 days.
Average DWT of calling vessels is 29,461 tons.
Average unloading rate to vessel size in DWT is 0.737.

Qd = 29,461 x 0.737 / 4.5
= 4,825 (ton/day/Berth)

Present handling capacity of berth = 365 x 0.21 x 4,825
= 370 thousand tons per year
(0.21 is berth occupancy ratio)

- **Corn**

Average operating days per vessel is 14.87 days.
Average DWT of calling vessel is 32,325 tons.
Average unloading cargo volume to DWT is 0.858.

Qd = 32,325 x 0.858 / 14.87
= 1,865 (ton /day/berth)

Note: (1) Details are shown in Appendix III-1.2, same to barley and corn

Present handling capacity of berth = 365 x 0.018 x 1,865
= 12.3 thousand tons per year
(0.018 is berth occupancy ratio)

Total handling capacity, to sum up, is 1,287 thousand tons per year.

(2) Potential cargo handling capacity

1) At silo jetty, Exclusive terminal
Forecast cargo handling capacity after upgrading existing facilities and operation system is calculated by the formula in the section 4.4.

$Qd = Qu \times Nu \times \eta_1 \times h \times \eta_2$

Qd ; Handling volume (ton/day/berth)
Qu ; Handling volume per unit (ton/hour/unit,gang)
Nu ; Number of unit (gang)
η_1 ; Unloading efficiency
η_2 ; Working time efficiency
h ; Working hours per day

Before 2000, unloading equipment should be repaired. Berth length and depth should be also increased.

Qd = 1,000 x 2 x 0.7 x 17 x 0.8 = 19,040 (ton/day/berth)

Max handling capacity is calculated as follows.

Assuming day off per week (52 days per year) and 50 days per year for maintenance work, the annual number of operating days is 263.

Berth occupancy rate is 0.7, which means that vessels do not have to wait for berthing.
Average carrying cargo volume by vessel is 44,750 tons by 50,000 DWT vessels. Berthing days are operating days and docking / undocking days.

Berthing days = operating days + docking / undocking days
= 44,750 / 19,040 + 0.56
= 2.91 days per vessel

Operating vessels in year = 263 x 0.7 / 2.91
= 63 vessels / year

Max handling capacity per year = 63 x 44,750
= 2,834 thousand tons

2) At a general cargo berth

Since unloading capacity by exclusive berth at silo is inadequate for grain cargo, the excess grain cargo 877,000 ton (2000) and 1,671,000 ton (2010) should supplementary be handled at the general cargo berth with pneumatic unloading machine.

Until 2000, there will be two pneumatic unloaders, so cargo distribution will be performed with two unloaders and trucks by direct delivery. Before 2010, four unloaders should be prepared according to the increasing cargo volume.

- For the year of 2000

Qd (at 2000)	= 280 x 2 x 0.75 x 17 x 0.8
	= 5,712 ton / day
Berthing days	= 44,750 / 5,712 + 0.51
	= 8.34 days
Operating vessels in year	= 362 x 0.7 / 8.34
	= 30.4 vessels

It is necessary to unload cargo as fast as possible. However, since handling equipment is inadequate, a large numbers of employees and year round service should be provided.

Max handling capacity per year	= 30.4 x 44,750
	= 1,360 thousand tons

- For the year of 2010

Qd (at 2010)	= 280 x 4 x 0.75 x 17 x 0.8
	= 11,424 ton / day
Berthing days	= 44,750 / 11,424 + 0.51
	= 4.43 days
Operating vessels in year	= 313 x 0.7 / 4.43
	= 49.5 vessels
Max handling capacity per year	= 49.5 x 44,750
	= 2,213 thousand tons

(3) Result

Table 5.3.1.1 and Figure 5.3.1.1 show the forecast of bulk cargo volume and the cargo handling capacity of two facilities in Imam Khomeini port.

Table 5.3.1.1 Cargo Handling Capacity of Two Facilities

Year	1993	2000	2010	
Exclusive Berth	1,287	2,775	2,834	-
General Berth	1,360	1,360	2,213	-
Total Capacity	2,647	4,135	5,047	X 1,000 tons

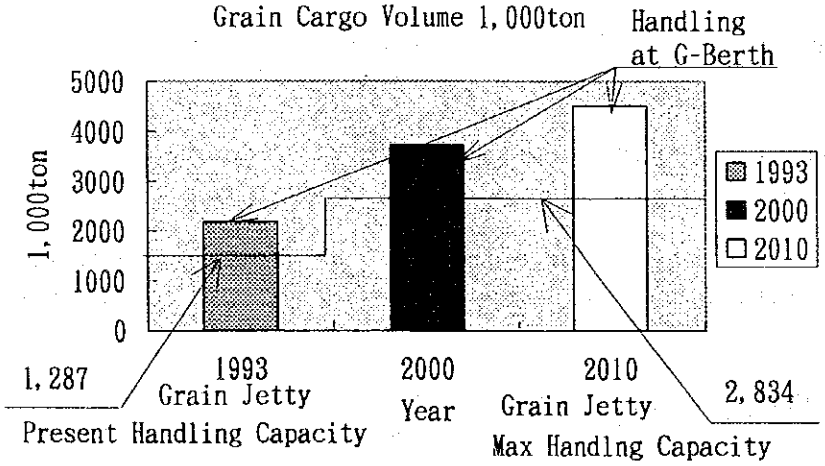


Figure 5.3.1.1 Cargo Volume and Cargo Handling Capacity

5.3.2 Conventional Cargo

(1) Present capacity

					Total
1993	2,661	3,679	66	1,463	7,869
2000	3,375	4,434	219	2,762	10,790
2010	5,405	6,650	410	4,473	16,938

Conventional cargo includes bagged cargo, steel cargo, refrigerated cargo and general cargo. Table 5.3.2.1 shows the cargo volume and number of vessels. Table 5.3.2.2 shows the berth numbers which is used by conventional cargo.

Table 5.3.2.1 Cargo Volume and Numbers of Vessels (1992)

Commodity wise	Bagged Cargo	Refrige-rated	Steel	General	Total
Cargo volume	455 -	109 -	2,233 -	722 -	3,519 -
Number of Vessels	27	20	96	149	292

Table 5.3.2.2 Existing Numbers of Conventional Cargo Berths (1993)

Berth	Eastern Jetty	No.7-No.10	No.11-No.15	No.16-No.34	Total
Number of Berth	3	2	0	16	21

Using the data shown in the Table 5.3.2.1, the carrying cargo volume per vessel is calculated. Service days per vessel, operating vessels per year and handling capacity are calculated on the basis of values of following items.

Carrying cargo per vessel	= 3,519 x 1,000 / 292 = 12,051 tons
Qu	= 26.5 ton / unit
Nu	= 4 units
h	= 17 hours / day
Mooring days	= 0.4
Berth numbers	= 21
Berth occupied ratio	= 0.7
Service days	= 12,051 / (26.5 x 4 x 17 x 0.8) + 0.4 = 8.76 days
Operating vessels	= 21 berths x 365 days x 0.7 / 8.76 days = 612.5 vessels
Max handling capacity	= 612.5 x 12,051 = 7,382 thousand tons / year

(2) Potential cargo handling capacity

Potential cargo handling capacity after improving existing facilities is calculated based on present infrastructure plus various improvement works including dredging, pavement, repairing, installing cargo equipment and berth extension, but not including construction of a new berth.

Carrying cargo per vessel	= 7,348 x 1,000 / 564 = 13,028 tons
Qu	= 26.5 ton / unit
Nu	= 4 units
h	= 17 hours / day

Berth numbers	= 27 (No.8, No.9, No.10 and No.32-No.34 are fulfilled)
Berth occupancy ratio	= 0.7
Service days per vessel	= 13,028 / (26.5 x 4 x 17 x 0.8) + 0.3 = 9.34 days
Operating vessels	= 26 berths x 365 days x 0.7 / 9.34 = 711 vessels
Max handling capacity	= 711 x 13,028 = 9,269 thousand tons

(3) Handling capacity in 2010

Using the same method, the future cargo handling capacity is calculated as follows. In the case, the new port facilities are constructed.

Carrying cargo per vessel	= 12,118 X 1,000 / 778 = 15,575 tons
Qu	= 33.75 ton / unit
Nu	= 4 units
h	= 17 hours /day
Berth numbers	= 27
Berth occupied ratio	= 0.7
Service days per vessel	= 15,575 / (33.75 x 4 x 17 x 0.8) + 0.2 = 8.68 days
Operating vessels	= 27 berths x 365 days x 0.7 / 8.68 = 795 vessels
Max handling capacity	= 795 x 15,575 = 12,374 thousand tons

(4) Results

Cargo volume and cargo handling capacity in 2000, in 2010 are shown in Figure 5.3.2.1.

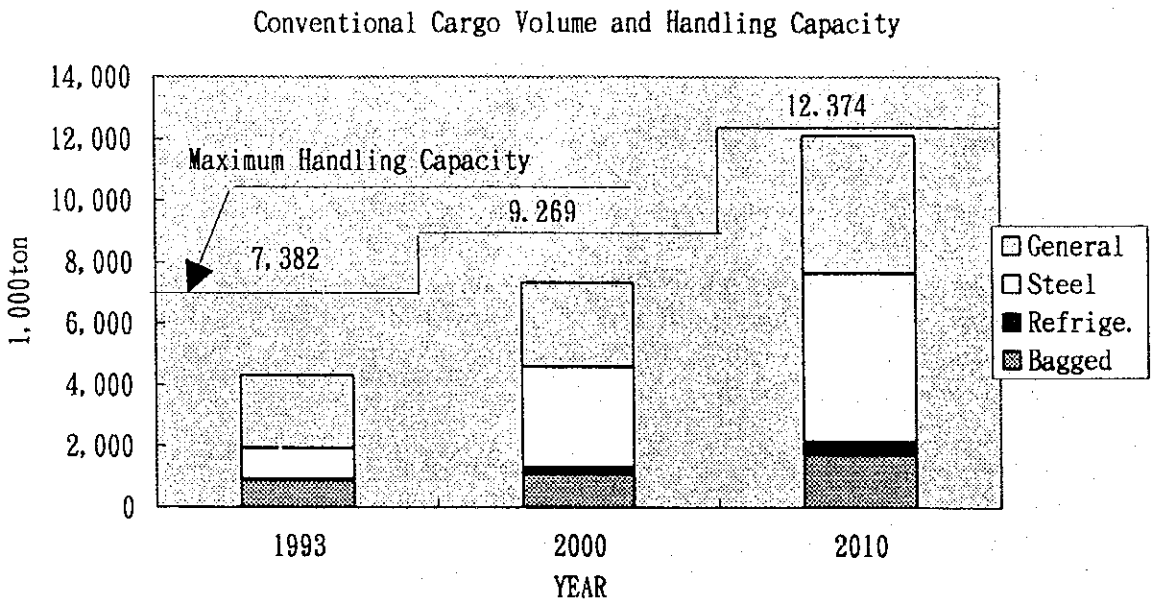


Figure 5.3.2.1 Conventional Cargo Volume and Handling Capacity

5.3.3 Container Cargo

(1) Present cargo handling capacity for present four berths

The cargo handling capacity is 55 TEUs/hour using two container cranes or the capacity is 38 TEUs/ hour using four ship gears per berth.

There are one berth with two cranes and three berths without cranes. The cargo handling capacity is calculated on the following assumptions.

Working hours	= 17 hours /day
Working days	= 313 days
Working time efficiency	= 0.8
Berth occupancy ratio	= 0.8
Handling capacity(Crane x 2)	= 65 x 17 x 0.8 x 313 x 0.8 = 187,299 TEUs
Handling capacity(Ship Gear x 4)	= 38 x 17 x 0.7 x 313 x 0.8 = 113,231 TEUs
Total (TEU)	= 187,299 + 3 (Berths) x 113,231 = 526,992 TEUs
Total (ton)	= 526,992 TEU x 11 ton/TEU = 5,797 thousand tons

5.3.4 Bulk Cargo (Ore)

The volume of iron ore powder unloaded at the Eastern Jetty in 1993 was 1.9 million tons. The volume of alumina powder unloaded at the exclusive berth was 233 thousand tons in 1993.

If unloader is repaired or improved, quantity of cargo handled per day at exclusive berth will be 17,680 tons /day/berth. (see the section 4.2.2) The cargo handling capacity is calculated as follows.

Max cargo handling capacity = 17,680 x 263 x 0.7 = 3,255 thousand tons

5.4 Total Evaluation of Cargo Handling Capacity

5.4.1 Conclusion of Available Cargo Handling Capacity

Based on the above, the cargo handling capacity is calculated as shown in Table 5.4.1.1.

Table 5.4.1.1 **Potential Cargo Handling Capacity of Existing Port Facility Improvement in Imam Khomeini Port**

unit : 1,000 tons

Commodity-wise	Present (1993) with existing	Maximum (2000) with improving	Future (2010)[1] with developing
Grain Berth	2,647	4,135	5,047
Conven. Berth	7,382	9,269	12,374
Contain. Berth	5,797	5,797	9,600
Ore Berth	1,910	3,255	3,255
Total	17,736	22,456	30,276

(1) Details are described in section 6.1.

5.4.2 Backup Measures Required for Securing the Forecast Capacity

Improvement and repairs should be conducted immediately, in particular, the depth and length of the berth should be maintained adequately to cope with enlarging the vessel's size. Behind the apron, it is necessary to improve the transportation system, which is one of the most important factor in securing adequate cargo handling capacity.

Chapter 6

Physical Requirements for Future Port Development

Chapter 6 Physical Requirements for Future Port Development

6.1 Capacity and Functional Requirements for Future Port Related Facilities

6.1.1 Wharf and Jetty

Required number of conventional berth is calculated based on cargo demand forecast and ship type forecast. Calculation method is shown in Figure 6.1.1.1 as follows. The calculation is carried out by each ship type.

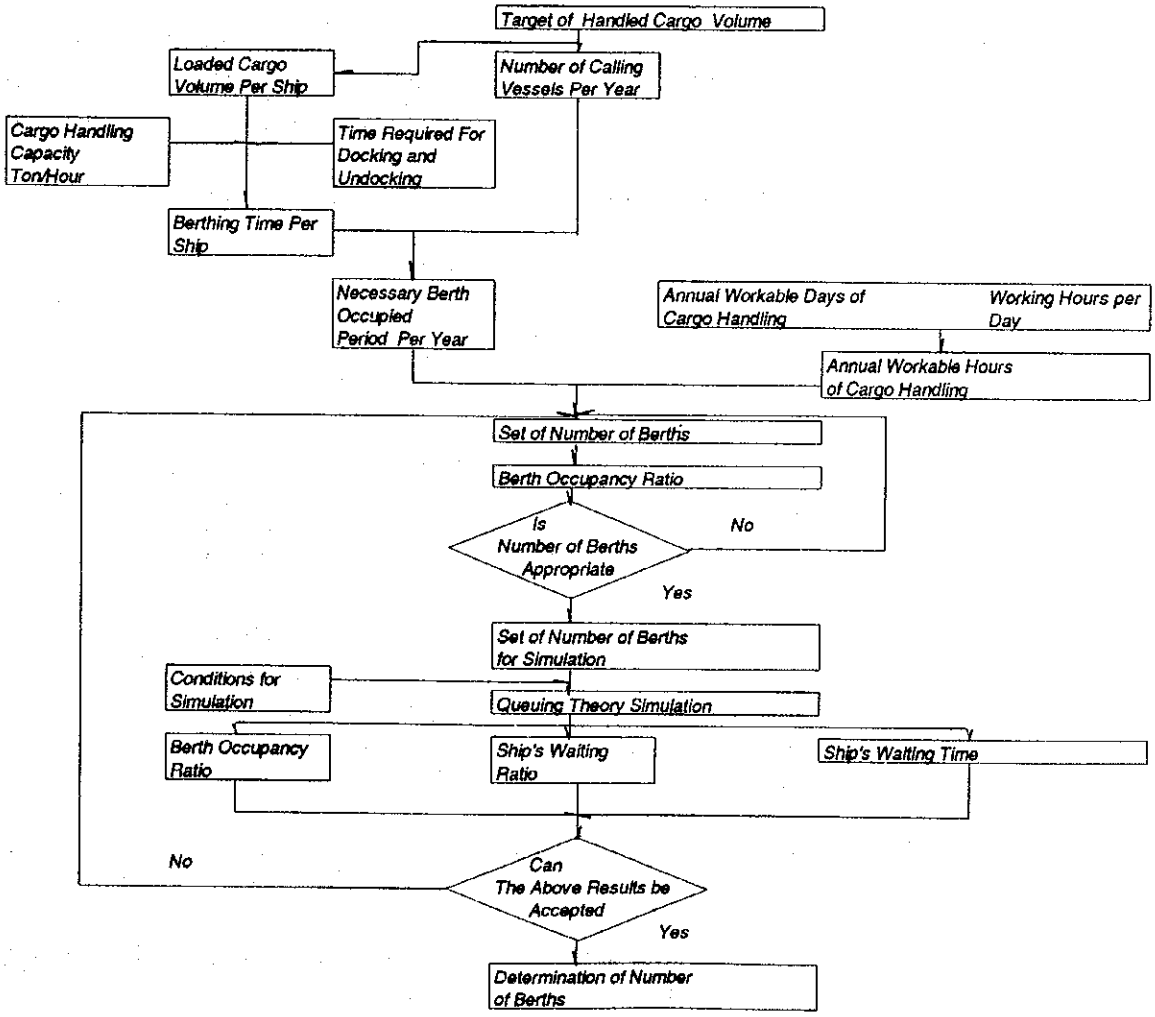


Figure 6.1.1.1 Flow Chart for Determining Number of Berths

(1) Bagged cargo

Cargo volume forecast is as follows.

	1993/94	2000/01	2010/11	
Import	1,356	1,501	1,780	
Export	1,326	1,874	3,625	x 1,000tons
	2,682	2,375	5,405	

67.9 percent of total cargo volume, which consists of chemical material, ammonium, fertilizer, phosphate and sulphur, is handled by exclusive berth of Razi Chemical and Petroleum company, and rest of cargo (32.1 percent of total cargo volume) is handled by conventional berth.
Required number of berths is calculated using the following formula.

$$\text{Number of berths} = \frac{\text{Total number of service days}}{\text{Annual number of workable days per berth} \times \text{Berth occupancy ratio}}$$

Terms	2000/01	2010/11
Annual workable days	313 days	313 days
Average cargo handling capacity with four gangs	36 ton/hr	36 ton/hr
Average carrying volume per ship	19,500 ton	22,500 ton
Average berthing days	10.48 days	12.02 days
Number of calling vessels	56 vessels	77 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	2.7	4.2
Total berth length (x 250 m)	665 m	1,057 m

Using the same approach, required number of berths by each vessel type is calculated and the result is shown in Table 6.1.1-1.

Table 6.1.1.1 Required Number of Berth in 2000 and 2010 by Berth Length

B.LENGTH	180 m	220 m	250 m	260 m	Total
2000/01	0.3	0.8	1.4	0.2	2.7
2010/11	0.3	1.0	2.1	0.5	3.9

(2) Refrigerated Cargo

Cargo volume forecast is as follows.

	1993/94	2000/01	2010/11	
Import	117	219	410	
Export	0	0	0	x 1,000tons

Terms	2000/01	2010/11
Annual workable days	313 days	313 days
Average cargo handling capacity	1,571 ton/hr	1,571 ton/hr
Average carrying volume per ship	7,800 ton	9,000 ton
Average berthing days	5.26 days	6.02 days
Number of calling vessels	28 vessels	46 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	2.67	1.25
Total berth length (x 220 m)	148 m	275 m

Required number of berth is 2 (220m).

(3) Steel material cargo

Cargo demand forecast is as follows. Alumina and iron powder are handled at the exclusive berth, so both volumes are subtracted from the total cargo volume.

	1993/94	2000/01	2010/11	Remark
Import	759	2,986	4,810	Including alumina/iron powder.
Export	1,004	1,448	1,840	
Al.Podwer		-250	-250	
I R.Powder		-900	-900	

x 1,000 tons

Terms	2000/01	2010/11
Annual workable days	313 days	313 days
Average cargo handling capacity	3,548 ton/hr	3,548 ton/hr
Average carrying volume per ship	18,200 ton	19,500 ton
Average berthing days	5.75 days	6.12 days
Number of calling vessels	180 vessels	282 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	4.73	7,87
Total berth length (x 250 m)	1,184 m	1,968 m

Note; Details of required number of berth are described in Appendix III-1.3,1.6

Table 6.1.1.2 Required Number of Berths in 2000 and 2010 by Berth Length

B.LENGTH	180 m	220 m	250 m	260 m	Total
2000/01	0.3	1.7	1.9	0.4	4.3
2010/11	0.2	2.7	3.5	0.9	7.3

(4) Mineral (Bulk cargo)

Cargo demand forecast is as follows.

	1993/94	2000/01	2010/11	
Import	0	99	133	
Export	0	0	0	
Al.Powder		250	250	
Ir.Powder		900	900	x 1,000tons

Terms	2000/01	2010/11
Annual workable days	263 days	263 days
Average cargo handling capacity	17,680 ton/hr	17,680 ton/hr
Average carrying volume per ship	40,050 ton	44,500 ton
Average berthing days	2.65 days	2.90 days
Number of calling vessels	31 vessels	29 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	0.44	0.45
Total berth length (x 250 m)	112 m	114 m

Required number of berth is 1 (2000/01, 2010/11).

(5) General cargo

Cargo volume forecast is as follows.

	1993/94	2000/01	2010/11	
Import	757	1,640	2,807	
Export	13	1,122	1,666	x 1,000tons

Terms	2000/01	2010/11
Annual workable days	313 days	313 days
Average cargo handling capacity	1,690 ton/hr	1,843 ton/hr
Average carrying volume per ship	9,200 ton	12,000 ton
Average berthing days	5.85 days	6.91 days
Number of calling vessels	300 vessels	373 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	7.9	11.8
Total berth length (x 250 m)	1,762 m	2,586 m

Table 6.1.1.3 Required Number of Berth in 2000 and 2010 by Berth Length

B.LENGTH	180 m	220 m	250 m	260 m	Total
2000/01	0.0	6.3	0.9	0.2	7.4
2010/11	0.3	4.5	5.7	0.6	11.3

(6) Results

Required berth number and length based on frequency of ship entry and handling capacity is shown in Table 6.1.1.4.

Table 6.1.1.4 Required Berth Number and Length

	1993	No.(1)	2000	No.(2)	2010	No.(2)
Bulk(silo)	240	1	240	1	240	1
Bulk(G.B.)	210	1	180	1	196	1
Bagged.	366	2	665	3	1,057	4
Refrige.	183	1	148	1	275	2
Steel	1,171	6	1,184	5	1,968	8
Mineral	520	3	112	1	114	1
General	2,072	11	1,762	8	2,586	11
Container(3)	840	4	260	1	1,420	5
Total	5,602	29	4,551	21	7,857	33

(1) Existing berth number and length. See in Appendix III-1.4 (Unit length 180m/berth)
(2) Unit berth length 220m/berth
(3) Details are described in the section 6.1.2

The queuing theory for 2010 is employed to refine the method using frequency of ship entry and handling capacity. As a results, 34 berths are required in 2010. Final results are shown in Table 6.1.1.5 (See Appendix III-1.5).

Note; Relation between berth length and ship size is described in Appendixe III-1.7.

Table 6.1.1.5 Future Port Facilities

Name	2000	2010
Grain Jetty	240 x 1 -13 m Grain	240 x 1 -13 m Grain
Eastern Jetty	250 x 1 -9 m Bagged	250 x 2 -13 m Bagged and General
Ore Dolphin	180 x 1 -13 m Mineral	250 x 1 -13 m Bagged and General
Western Jetty	240 x 1 -13 m Mineral	260 x 1 -14 m Mineral
No.7-No.10	192.7 x 2 -10 m General	320 x 2 -14 m Container
Container	260 x 1 -12.5 m Container 260 x 2 -12.5 m Steel, Bagged 260 x 1 -12.5 m Grain	280 x 3 -12.5 m Container 260 x 1 -12.5 m Grain
No.16-No.20	220 x 4 -11 m Steel and Bagged	220 x 4 -11 m Steel
No.21-No.26	220 x 2 -11 m Refrige.Liquid 220 x 2 -11 m General and Bagged 180 x 1 -11 m General	220 x 2 -11 m Refreige.Liquid 220 x 2 -11 m General 180 x 1 -11 m General
No.27-No.34	180 x 1 -11 m General 220 x 4 -11 m General Ro-Ro	180 x 1 -10 m Bagged 220 x 1 -11 m Bagged 220 x 4 -11 m General,Ro-Ro
New Berth	- -	260 x 1 -14 m Steel 250 x 3 -13 m Steel 250 x 4 -13 m General
Total	24 Berth, 4,935 m	34 Berths, 8,230 m

(7) Calculation of apron width

The apron is the quay surface between the front line of the berth and the transit shed or open storage area where cargoes and vehicles used for cargo handling are placed temporarily.

The width of the apron must be adequate to ensure safe and smooth cargo handling. It is determined considering the way the berth is utilized, the types of transit sheds and warehouse, the cargo handling equipment and the type of connecting land transportation. Aprons located in front of sheds and on which forklifts are used should not be less than 15-20 meters wide. Aprons adjacent to open storage areas where trucks are used for direct loading/unloading should be 10-15 meters wide. In Iran, a width of 25 meters has been adopted.

6.1.2 Container Terminal

Container terminal should be provided with the following main facilities.

Container berth
Container yard (Marshalling yard)
Container freight station (CFS)
Maintenance shop
Container cleaning space
Terminal gate
Terminal office

(1) Container Berth

1) Berth Dimension

Required length of container berth is decided on the basis of object vessel in target year. According to the forecast of calling vessels in Chapter 3, average size of calling size of vessels is 24,000 DWT in 2000/01, 30,000 DWT in 2010/11 and maximum size is 30,000 DWT in 2000/01, 40,000 DWT in 2010/11. Berths for both of 30,000 DWT and 40,000 DWT is planed in the Master Plan. Dimensions of 30,000 DWT and 40,000 DWT are as follows.

Table 6.1.2.1 Vessel size

Vessel	Length (m)	Breadth (m)	Draft (m)
30,000 DWT	242	32.3	11.6
40,000 DWT	280	32.3	13.0

Required berth length and depth are estimated as follow.

Berth length > (Length of vessel) + (Breadth of vessel)

Berth depth > (Draft of vessel) + (0.5 m to 1.5 m)

Therefor, the following berth lengths and depths are required.
280 m length, -12.5 m depth for 30,000 DWT
320 m length, -14.0 m depth for 40,000 DWT

2) Number of berths

Required number of berths is determined based on cargo volume and cargo handling capacity. Two (2) container cranes should be installed at each berth. Cargo handling capacity per berth per year is calculated by the following formula.

$$Qy = n \times Nh \times Kc \times Hd \times Dy \times Ew$$

where Qy : Cargo handling capacity (TEUs/berth/year)
n : Number of container cranes (unit)
Nh : Number of container boxes to be handled per crane per hour (boxes/unit/h)
Kc : Conversion ratio from boxes to TEUs
Hd : Working hours per day (h/day)
Dy : Annual operation days (days/year)
Ew : working time efficiency

$$Qy = 2 \times 25 \times 1.1 \times 17 \times 313 \times 0.7$$
$$= 204{,}858 \text{ (TEUs/berth/year)}$$

According to the demand forecast in Chapter 3, volume of container cargo in target years is shown in the following Table 6.1.2-2.

Table 6.1.2.2 Volume of Container Cargo

2010/11	Import	Export	Refrigerat (Import)	Empty	Transit	Total
Container cargo Volume (ton)	4,176,000	3,381,000	610,000	-	1,235,000	9,402,000
Unit Weight(ton/TEU)	12.06	12.06	12.06	-	12.06	-
Annual Container Throughput (TEUs)	346,211	280,299	50,569	128,130	102,388	907,597
2000/01	Import	Export	Refrigerat	Empty	Tranship	Total
Container cargo Volume (ton)	699,580	121,000	93,420	-	545,000	1,459,000
Unit Weight(ton/TEU)	12.06	12.06	12.06	-	12.06	-
Annual Container Throughput (TEUs)	57,998	10,031	7,745	61,283	45,183	182,240

Required number of container berths is calculated by the following formula.

$$N > My / Qy$$

where N : Required number of container berth
My : Annual container throughput (TEUs/year)

Required number of container berths (N) is estimated as follows.

Table 6.1.2.3 Required Number of Container Berths

Year	2000/01	2010/11
Number of berths	1	5

(2) Container Yard

Required storage counted by number of container is calculated by the following formula.

Ml = (My x Dw x p) / Dy

where, Ml : Required storage number of container (TEUs)
My : Annual container throughput (TEUs)
Dw : Average dwelling time (days)
Dy : Operating days par year (days)
p : Peak ratio

Required number of ground slots is calculated by the following formula.

Sl = Ml / L

where, Sl : Required number of ground slots (TEUs)
L : Stacking number of container (TEUs)

Sl is calculated as 1,619 slots for 2000/01 and 7,771 slots for 2010/11 as shown in following Table 6.1.2.4 and 6.1.2.5.

Table 6.1.2.4 Required Storage Capacity in Container Yard 2000/01

2000/01	Import	Export	Refrigerat	Empty	Transit	Total
Container cargo Volume (ton)	699,580	121,000	93,420	-	545,000	1,459,000
Unit Weight(ton/TEU)	12.06	12.06	12.06	-	12.06	-
Annual Container Throughput (TEUs)	57,998	10,031	7,745	61,283	45,183	182,240
Dwelling Days	7	5	5	7	5	-
Operating Days	313	313	313	313	313	-
Peak Ratio	1.3	1.3	1.3	1.3	1.3	-
Required Strage Number:Ml (TEUs)	1,686	208	161	1,782	938	4,775
Stacking Height	3.0	3.0	2.0	3.0	3.0	
Required Ground Slots (TEUs)	562	69	80	594	313	1,619

Table 6.1.2.5 Required Storage Capacity in Container Yard 2010/11

2010/11	Import	Export	Refrigerat (Import)	Empty	Transit	Total
Container cargo Volume (ton)	4,176,000	3,381,000	610,000	-	1,235,000	9,402,000
Unit Weight(ton/TEU)	12.06	12.06	12.06	-	12.06	-
Annual Container Throughput (TEUs)	346,211	280,299	50,569	128,130	102,388	907,597
Dwelling Days	7	5	5	7	5	-
Operating Days	313	313	313	313	313	-
Peak Ratio	1.3	1.3	1.3	1.3	1.3	-
Required Strage Number:Ml (TEUs)	10,066	5,821	1,050	3,725	2,126	22,788
Stacking Height	3.0	3.0	2.0	3.0	3.0	
Required Ground Slots (TEUs)	3,355	1,940	525	1,242	709	7,771

(3) Container Freight Station

Required area for CFS is calculated by the following formula.

$A = (Mc \times Dw \times p) / (w \times r \times Dy)$

where, A : Required area of CFS (m^2)
Mc : Annual handling volume of container cargo through CFS (ton)
Dw : Dwelling time at CFS (7 days)
p : Peak ratio (1.3)
w : Volume of cargo per unit area (1.5 ton/m^2)
r : Utilization ratio of CFS (0.5)
Dy : Operating days per year (313 days)

The ratio of LCL (less than container load cargo) cargo at Imam Khomeini port was 6.77 percent in 1991, 2.78 percent in 1992 and 12.1 percent in 1993, an average of 7.21 percent over the three year period. The ratio of LCL cargo is assumed 10 percent including allowance for 2000/01 and 2010/11.

Table 6.1.2.6 Required Area of Container Freight Station

	2000/01	2010/11
Annual container cargo volume (ton)	914,000	8,167,000
LCL cargo volume: Mc (ton)	91,400	816,700
Required area of CFS: A (M2)	3,543	31,660

The area of existing CFS is 16,800 m^2 (60 m x 280 m), thus three new CFS's of 6,000 m^2 (40 m x 150 m) are required in 2010/11. No additional CFS will be required in 2000/01.

(4) Maintenance Shop

Required area for maintenance shop depends on factors such as rate of damaged container, type and number of cargo handling vehicles and machines to be used in the terminal. Generally, size of maintenance shop is 800 to 1,000 m^2 per berth. Following dimensions are assumed;

Area : 4,000 m^2 (50 m x 80 m)
Height : 10 m
Width of space in front of maintenance shop : more than 10 m

(5) Container Cleaning Space

For washing and cleaning of empty containers, container cleaning space should be planned at the container terminal. Container cleaning space of 2,000 m^2 (40 m x 50 m) is planned in the Master Plan.

(6) Terminal Gate

Required number of truck lanes is calculated by the following formula.

$N = (Mc \times p \times s) / (Dy \times H \times 60)$

where, N : Required number of truck lanes
Mc : Annual containers throughput (TEUs)
p : Peak ratio (1.3)
s : Necessary procedure time per truck (3.0 min.)
Dy : Operating days per year (313 days)
H : Operating hours par day (17 hours)

Required number of truck lane is as follows.

Table 6.1.2.7 Required Number of Truck Lanes

	2000/01	2010/11
Annual containers	182,240	907,597
throughput (TEUs)	-	-
Truck lanes	3	12

(7) Terminal Office

Terminal office is planned next to the terminal gate for management and operation of container terminal. Generally, the area of a terminal office is 1,200 to 1,500 m^2 per berth. Following dimensions are planned in the target year 2010/11.

Area : Total 2,500 m^2 (30 m x 50 m and 20 m x 50 m)
Story : 2 stories

6.1.3 Wharf and Jetty for Bulk Cargo

Cargo volume forecast is as follows.

	1993/94	2000/01	2010/11	
Import	2,071	3,7111	4,505	
Export	0	0	0	x 1,000tons

Grain cargo should be handled by both exclusive berth and general cargo berth in future.

Exclusive berth (Grain terminal jetty)

Terms	2000/01	2010/11
Annual workable days	263 days	263 days
Average cargo handling capacity	19,046 ton/hr	19,046 ton/day
Average carrying volume per ship	40,275 ton	44,750 ton
Average berthing days	2.67 days	2.91 days
Number of calling vessels	69 vessels	63 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	1.0	1.0
Cargo handling capacity (x1,000 ton)	2,775	2,834

Genera berth

Terms	2000/01	2010/11
Annual workable days	362 days	313 days
Average cargo handling capacity	5,712 ton/hr	11,424 ton/day
Average carrying volume per ship	40,275 ton	44,750 ton
Average berthing days	7,56 days	4.42 days
Number of calling vessels	23 vessels	37 vessels
Berth occupancy ratio	0.7	0.7
Number of berth	0.7	0.8
Total berth length (x240 ton)	168 m	192 m

The grain cargo should be handled at exclusive jetty to the capacity and over cargo from exclusive berth should be handled with a general cargo berth. (Details are described in appendix 6.1.4.)

6.1.4 Transit Shed and Storage Facility

Transit shed, sorting yard, warehouse and open yard are planned at the general cargo

berth. Transit shed and sorting yard should be used for short term storage while warehouse and open yard should be used for long term storage. Especially in the case of dry bulk cargo, an exclusive transit shed should be installed. Exclusive transit shed for dry bulk cargoes should have a belt conveyor system and ventilator. Cold storage facilities for refrigerated cargo should be installed at the general cargo berth. Transit shed and sorting yard should be located behind the apron. Warehouse and open yard should be located behind transit shed and sorting yard. Required area of storage facilities is calculated by the following formula.

$$Ab = (Mb \times p) / (Rt \times w \times r)$$

where Ab : Required area of storage facility (m2)
Mb : Annual cargo volume (ton/year)
p : Peak ratio
Rt : Turnover ratio (times/year)
w : Volume of cargo per unit area (ton/m2)
r : Utilization ratio of storage facilities

Parameters mentioned above are assumed as follows.
- For transit shed and sorting yard
Peak ratio : 1.3
Turnover ratio : 24 times/year
Volume of cargo per unit area:
3.5 ton/m2 for dry bulk cargo
2.5 ton/m2 for bagged cargo
2.5 ton/m2 for metallic cargo
2.0 tom/m2 for general cargo
2.0 ton/m2 for refrigerated cargo
Utilization ratio : 0.7

- For warehouse and open yard
Peak ratio : 1.0
Turnover ratio : 12 times/year
Volume of cargo per unit area:
3.5 ton/m2 for dry bulk cargo
2.5 ton/m2 for bagged cargo
2.5 ton/m2 for metallic cargo
2.0 tom/m2 for general cargo
2.0 ton/m2 for refrigerated cargo
Utilization ratio : 0.7

Direct delivery is currently performed for approximately 50 percent of the total cargo volume. Table 6.1.4.1 shows the estimated breakdown indirect delivery and direct delivery.

Table 6.1.4.1 Share of Direct Delivery (%)

	1993/94	2000/01	2010/11
Direct delivery	50	30	20
Transit shed, Sorting yard	10	30	40
Warehouse, Open yard	40	40	40

Table 6.1.4.2 shows the percentage of cargo stored in storage facilities by commodity.

Table 6.1.4.2 Cargo in Storage Facilities (%)

Commodities	Short term storage - Transit shed	sorting yard	Long term storage - Warehouse	Open yard
Dry bulk	100	0	100	0
Bagged	100	0	100	0
Metallic	30	70	30	70
Refrigerated	100	0	100	0
General	60	40	60	40

Required area of storage facilities calculated by above formula and parameters are shown in the following Table 6.1.4.3 and 6.1.4.4.

Table 6.1.4.3 Required Area of Storage Facilities in 2000/01

Commodity	Berth Depth*Length *nos	Cargo volume (ton/year)	Storage area (m2) Transit shed	Sorting yard	Cargo volume (ton/year)	Storage area (m2) Warehouse	Open yard
Dry bulk	-12.5x260	180,800	3,997	0	0	0	0
Bagged	-11x220	202,500	6,268	0	405,000	19,286	0
Metallic	-11x220x4nos	886,800	(30%) 8,235	(70%) 19,214	1,773,600	(30%) 25,337	(70%) 59,120
Refrigerated	-11x220x2nos	43,800	1,695	0	87,600	5,214	0
General	-11x220x6nos	552,400	(60%) 12,824	(40%) 8,549	1,104,800	(60%) 39,457	(40%) 26,305

Table 6.1.4.4 Required Area of Storage Facilities in 2010/11

Commodity	Berth Depth*Length *nos	Cargo volume (ton/year)	Storage area (m2) Transit shed	Storage area (m2) Sorting yard	Cargo volume (ton/year)	Storage area (m2) Warehouse	Storage area (m2) Open yard
Dry bulk	-12.5x260	1,698,000	37,541	0	0	0	0
Bagged	-10x180	69,000	2,136	0	69,000	3,286	0
	-11x220	205,000	6,345	0	205,000	9,762	0
	-13x240x2nos	345,300	10,688	0	345,300	16,443	0
	-14x250	46,000	1,424	0	46,000	2,190	0
			(30%)	(70%)		(30%)	(70%)
Metallic	-11x220x4nos	887,000	8,236	19,218	887,000	12,671	29,567
	-13x250x3nos	1,040,900	9,666	22,553	1,040,900	14,870	34,697
	-14x260	276,500	2,568	5,991	276,500	3,950	9,217
Refrigerated	-11x220x2nos	164,000	6,345	0	164,000	9,762	0
			(60%)	(40%)		(60%)	(40%)
General	-10x180	39,200	910	607	39,200	1,400	933
	-11x220x6nos	729,900	16,944	11,296	729,900	26,068	17,379
	-13x250x4nos	915,600	21,255	14,170	915,600	32,700	21,800
	-14x260	102,000	2,368	1,579	102,000	3,643	2,429

6.1.5 Channel and Basin

The width of channels outside the harbor should have a larger clearance than channels inside the harbor in view of the natural conditions, traffic volume, navigating speed, mutual suction of vessels and psychological influence on ship operators.

From this perspective, the width of the entrance channel is at Imam Khomeini port, more than 500 meters, is sufficient.

The water depth of the channel is obtained by the following formula:

$d > D + D' + H / 2 + (0.3\text{-}0.5)$ m
$d > 12.7 + 0.75 + 0.75 + 0.4 = 14.6$ m

d : Water depth
D : Full draft of object ship 12.7 m
D' : Clearance for ship's squat and trim 0.75 m
H : Wave height outside the harbor 1.5 m

The required depth is approximately 15 meters, however, the actual channel depth is 12.2 meters in the shallowest area. Because large cost in necessary for dredging, entering and departing vessels should use the tidal range which is 2.5 meters on average.

Water depth of the, basin and channel in the harbor, is obtained according to the following formula.

$d > 1.1 \times D$

d : Water depth in the harbor area
D : Full draft of object ships

Maximum water depth in the Imam Khomeini port is d > 1.1 x 12.7 meters = 14 meters, below the Cescs datum, LAT.

The width of operational basin for docking/undocking and the channel which leads to the interior of the port should be decided taking the use of tug boats into account. The width in this port is more than 3 x L (L : Object ship length). This is sufficient for a vessel to turn by herself.

Though, the area of a basin for turning of the bow of ship with tug boats should exceed an area of circle with the radius of 1.5 times the overall length of the ship, another ship can enter or leave the port simultaneously.

6.1.6 Inter-port Access Road, Railway

Inter-port roads are composed of a 25m wide main road (four-lane) and a 10 m wide road (two-lane) in Imam Khomeini port. The main road runs parallel to the berth behind the cargo handling area. Main road plan is shown in Figure 6.1.6.1.
(See Appendix III-1.1, III-1.11)
Railway siding is provided for warehouse and direct delivery berth. In future, marshalling yard need for the wagon as same level as existing yard.

6.1.7 Utility Mains

This subsection deals with the direction of utility mains for upgrading the existing situation to meet the future requirement.

(1) Water Supply

Basic function of water supply system is four holds namely, general use in port operation, vessel supply, fire fighting and gardening water.
Water in general use should be enough to the daily water consumption of PSO employees and private port operators if they are. Vessel supply will depend on the size of water tank in the hold and number of supply a day. Fire fighting water will be provided to outlet hydrants by sufficient water pressure. It is proposed that parks will be provided each faceline block to maintain good working environment.

Existing port area
Another consideration should be made on the improvement of raw water intake and water reservoirs. Present water intake should be relocated to the western area of the existing railway tracks. Thus present 200mm pipe crossing the tracks can easily improved to larger size such as 300mm or larger to meet the future water consumption increase.

Supply to the Dorag West Bank West Harbor
If the Dorag west bank is selected as the new development site, an independent water supply system should be provided. The main lines will run along the new main access and a new pumping station should be constructed at the west bank.

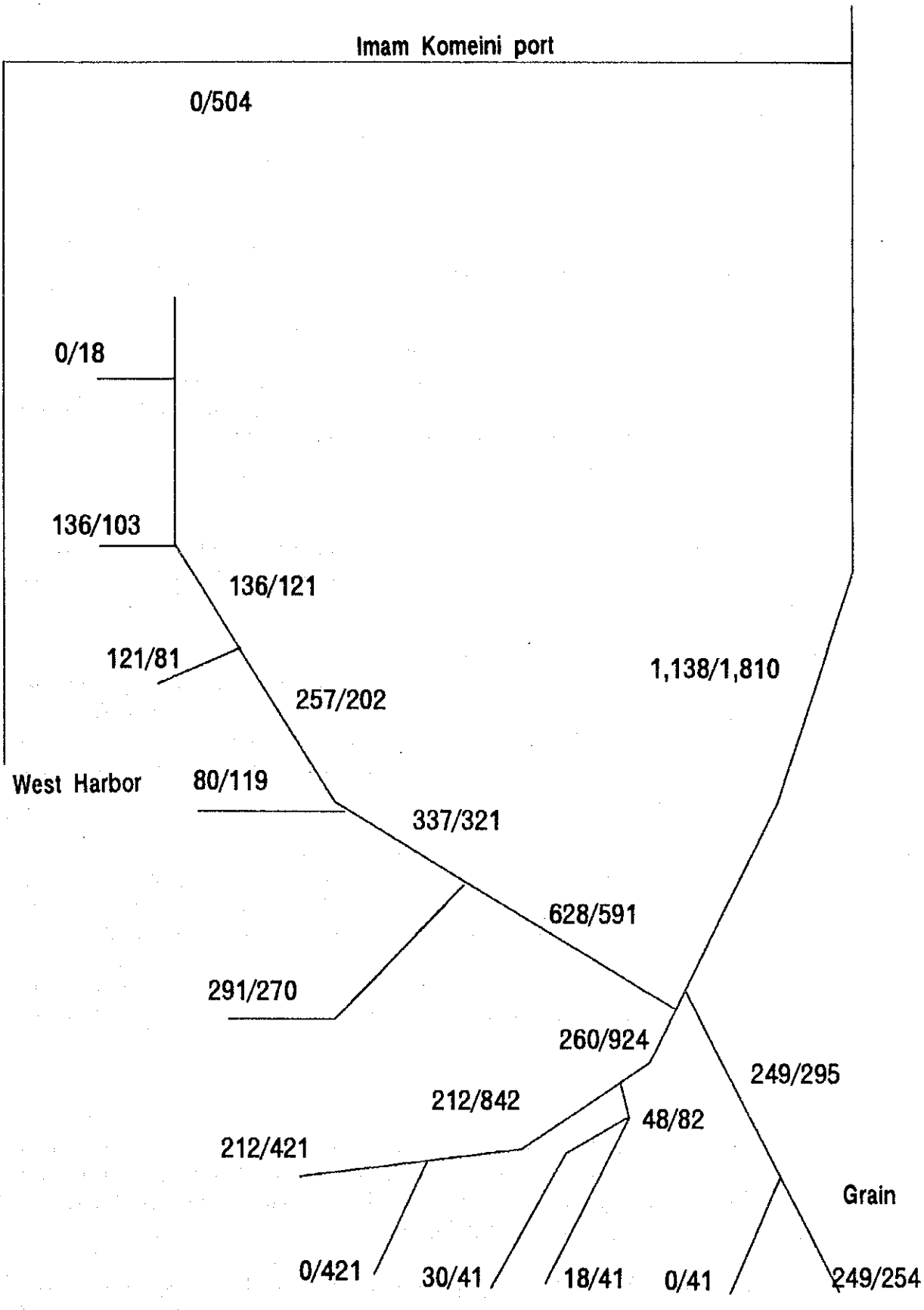


Figure 6.1.6.1 Traffic Volume (2000/2010)
(unit: Trucks/Hours)

- Underground water reservoirs
- Pressure tanks
- Pumps
- Others

(2) Power Supply System

Basic function of power supply system is four holds namely, general power supply for the various utilities, maintenance shops together with factories, lighting and power to the cargo handling equipment.

Present line connection is rather complicated. The main lines should be laid on simple arrangement. The existing main substation which is located in the eastward of the rail tracks. This facility will be removed to the western area of the tracks like the water intake station, since the large power consumers will be located at this side in the future.

Supply to the Dorag West Bank

Similar to the water supply system, an independent power supply lines should be provided. The main supply lines will be installed along the new main access to the new site and a new substation should be provided also.

Countermeasures for the power failures

It is reported by PSO that the port is provided with a enough power to operate. However stand-by generators will be required to maintain the minimum port operation during the hours of power failures. At present, there are five generators of 1,500 KVA in total. However, two of them are under repair and rest of them are completely damaged.

It is recommend to keep a supply capacity of an emergency power for the important facilities including lighting and power to the cargo handling equipment. Stand-by generators will be also required to provide container wharf cranes with back-up power in order to prevent the container cargo operation from the power failures.

It is recommend to equip a stand-by generator of 600 KVA for container wharf crane. For the time being, other equipment than gantry cranes are of engine driven according to the future plan in Chapter 9.

(3) Sewerage System

Present system should be improved by the advanced septic tank system and treated effluent should be discharged to underground though the seepage pipes. Size of the septic tank should meet with the volume of waste volume per PSO employees and others during the peak number of them.

Central treatment plan will neither effective nor economical since its operation and maintenance require skilled biochemical engineers. And long collection lines should

Central treatment plan will neither effective nor economical since its operation and maintenance require skilled biochemical engineers. And long collection lines should be laid together with expensive treatment plant.

When so required, oil separator will be installed to treat oil spill.

Existing port area

It is recommend to provide each large building and office with a septic tank and seepage pipes to be embedded underground.

Treatment and discharge at the Dorag West Bank

If the Dorag West Bank is selected as the new development site, the same system shown above can be used.

(4) Oil separators

PSO has a responsibility to make its premises out of oil spillage. One of the large oily water sources is the ballast water. It is recommend to make more discussion about the scope of facilities to be provided by PSO. However an oil separator of a minimum requirement should be provided to treat the oily water which may be collected from the open basin. Necessary discussion will be conducted in Chapter 16.

(5) Bunker Supply System

There is two basic concepts in the bunker supply system in respect of the method of loading fuels to vessels. The first one is through pipe lines laying along the wharf faceline like the present design at Imam Khomeini port. Another method is provision of fuels by the bunkering barges.

In the Master Plan preparation, the former one will be employed since the related facility including service tunnels are completed.

However, more detail alternative study should be carried out between these two methods during the detailed design stage of the new development area. The latter method will provide PSO with various advantages including lower risk of fire incidents to PSO. The size of service tunnel can be reduced. Initial investment cost of port facility will be also reduced.

6.1.8 Service Area and Parking Lot

Oil gas stand and maintenance shop for the trucks is necessary.
These should be a number of parking lots in the port area. For example, a parking lot is necessary for trucks that are waiting to be loaded.

Waiting time for customs, weighing and loading is usually long, thus adequate parking space should be provided for trucks.

At this time, two parking lots, each about 20,000 m^2, are planned. One is at the entrance of the container terminal and the other is beside the grain cargo berth.

6.1.9 Space for Port Related Industry and Commercial

Steel, fertilizer, chemical, automotive and light industry such as labeling and packing should be located in the port area. As there are many kinds of companies related to port activities, it is important to secure space for these companies.

In this plan, about 1,500,000 m^2 land is prepared for the activities of industry and commerce.

6.1.10 Space Reserved for Future Expansion

At Imam Khomeini port, it may seem that there is a vast area for future expansion and that port users can choose whatever piece of land they like. However, it is very difficult to decide the direction of the future expansion area in the post Master Plan.

A difficult issue is in deciding how the new development will interact with the existing one, that is, will they complement each other or be independent of each other. In the former scenario, securing access routes and provision of necessary infrastructure are key issues.

In this Master Plan, the existing facility and the new development have a complementary relationship. An expressway extending to the central area in Iran and a railway network are necessary for both sites.

However, after 2010, these two sites should be developed independently.

About 4,000,000 square meters space is prepared for the future expansion area.

6.1.11 Service Boat and Dredger

In the future three times as many vessels will call and thus, by calculation, 17 tug boats will be needed as shown in Table 6.1.11.1.

There are three dredgers in operation at the ports in the Persian Gulf. Considering the future maintenance dredging volume, the size and capacity of these dredgers are rather small. Though it is difficult to precisely determine the required dredging volume in future rough estimation was conducted or discussed in subsection 12.4. It is certain that the maintenance dredging volume will be increased accordingly.

Table 6.1.11.1 Planning of Service Craft Facilities

	1993/94	2000/01	2010/11	
Tug Boats	11	13	17	
Survey Boats	0	1	1	
Line Boats	1	2	4	
Pilot Boats	3	5	9	
Others	1	3	6	
Total	16	24	37	
Calling Ships	507	1,001	2,080	
Dredger				
Hopper	2	3	4	
Grab	1	2	2	
Maint. Volume	1,800	3,000	4,000	x1,000m3

Chapter 7

Alternative Layout Plans of Port Facilities

Chapter 7 Alternative Layout Plans of Port Facilities

As discussed subsection 5.4, The potential cargo handing capacity after passible upgrading of existing facility is not enough to cope with the cargo traffic in 2010/11 Thus excess cargo from the existing facility should be handled by newly developed facility. In order to select the best combination between the existing facility and new development, three alternative plans were studied.

In this chapter, thus the three alternative layout plans are illustrated for the selection of the best scheme.

7.1 Basic Policy for Development of Alternative Layout Plans

7.1.1 Economy

There are various viewpoints in evaluating the alternative plans. The economic viewpoint is the most important. Basic guidelines are set out as follows.

(1) Total cost should not exceed the port finance and government budget.

(2) Cost efficiency should be secured maximum use of existing facilities.

(3) Opportunity cost of capital should be favorable compared to investment in other projects.

(4) Maintenance cost should be kept at a reasonable level, in particular, dredging work which needs large cost should not exceed a level that port income can cover.

(5) From the viewpoint of productivity and practicability, the short term plan will focus on increasing productivity by dealing with urgent issues (rehabilitation, etc).

7.1.2 Flexibility

The Master Plan must be flexible enough to cope with any changes in the social environment or port activities.

The factors to be considered for securing the flexibility of the Master Plan may be identified as follows.

(1) Flexibility to the cargo volume change should be secured.

(2) The cargo handling capacity should be secured even in the case that construction will not be completed on schedule.

(3) Technical support should be prepared in all development stages.

7.1.3 Post Master Plan

The direction of further expansion for the port after completion of the Master Plan should be considered as the fare of the Master Plan layout.

(1) Correlation between existing harbor and new developed harbor area is necessary.

(2) Access road and railway connection should be provided.

(3) Each harbor should have its own administrative system for efficient port activities

(4) Land for port activities should be kept adequately.

7.2 Access to/from Port

7.2.1 Main Outer Access Road

Khomeini port--Esfahan--Tehran route

Khomeini port--Ahvaz	:156km Two-Lane Main Road
Ahvaz--Esfahan	:Under-Study Expressway
Esfahan--Tehran	:Four-Lane Expressway

(1) Khomeini port--Ahvaz (156km)

This route is now a two-lane main road and connects Imam Khomeini port with Ahvaz via Abadan. For this Master Plan, this route should be constructed as an expressway.

(2) Ahvaz--Esfahan

This route (Ahvaz-Esfahan-Tehran) which is under study is shorter than the existing route which connects Ahvaz with Tehran via Khorram Abad.

(3) Esfahan--Tehran (439km)

This route is composed of a 280km expressway with four-lane. An 160km expansion is now in progress.

(4) Imam Khomeini port

In the alternatives plans 1 and 3, there are two different road network plans. In one plan, The west Drag site is connected by expressway near Sar Bandar. The other plan is that the site is connected with the east Drag site (existing port) by bridge or tunnel. Road network plans of Imam Khomeini port are shown in Figure 7.2.1-1 and 7.2.1-2.

Case 1 : Expressway (near Sar Bandar) 2 Short span bridges

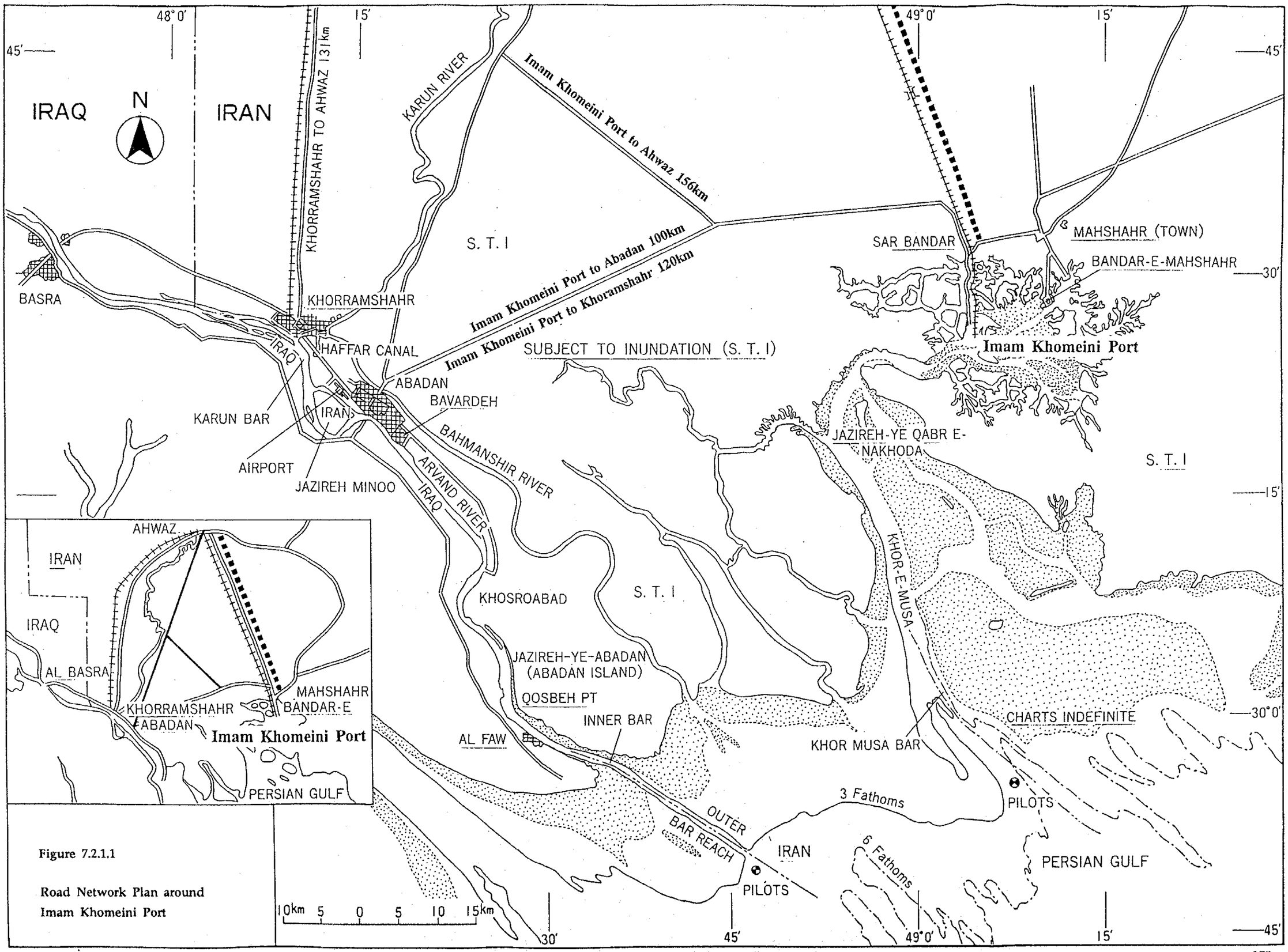


Figure 7.2.1.1

Road Network Plan around Imam Khomeini Port

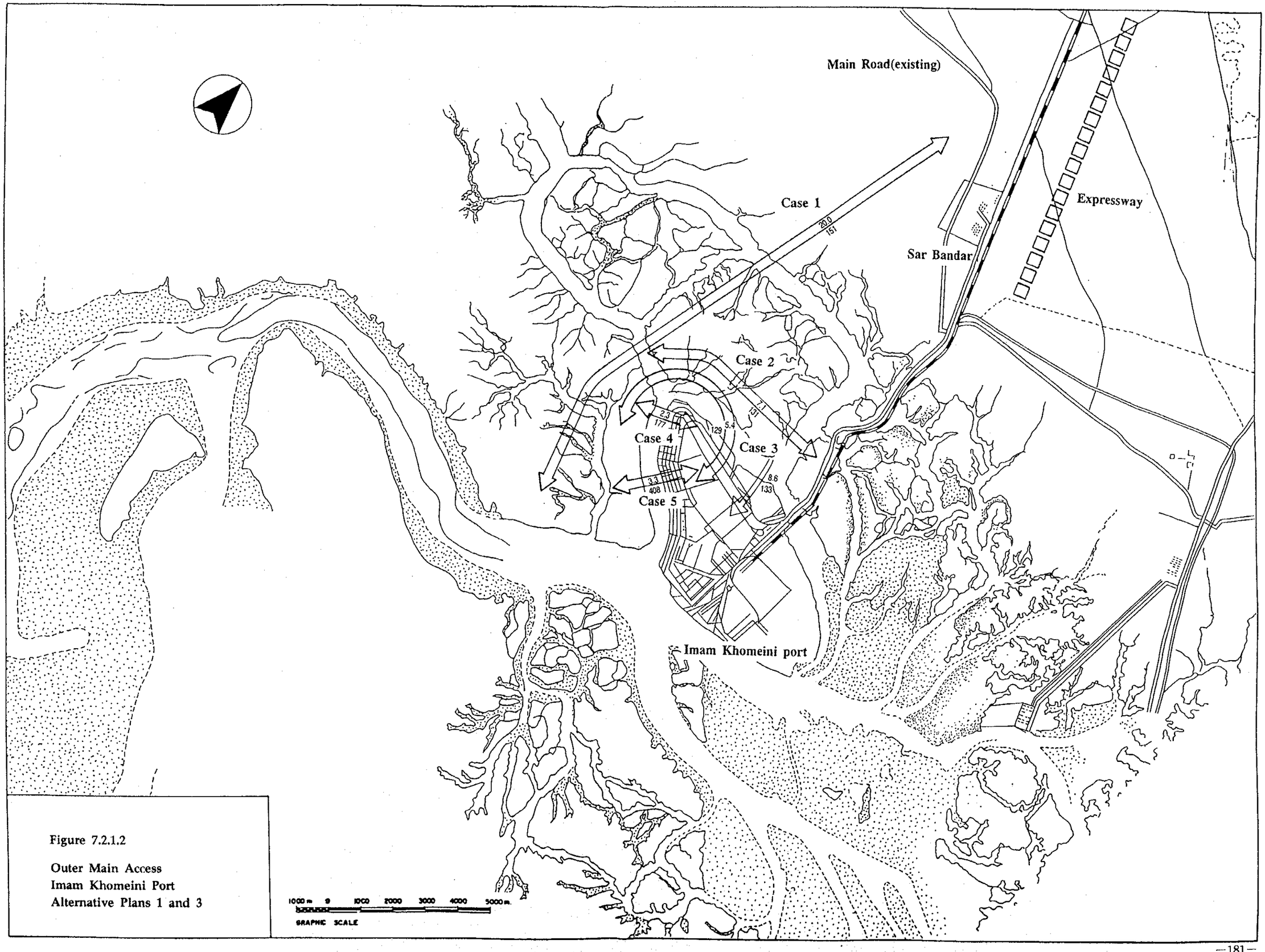


Figure 7.2.1.2

Outer Main Access
Imam Khomeini Port
Alternative Plans 1 and 3

Case 2 : Main road (near Khor Zangi)	2 Short span bridges
Case 3 : East port (near Khor Zangi)	2 Short span bridge
Case 4 : East port (near Khor Dowraq)	One long span bridge
Case 5 : East port (near Khor Musa)	tunnel under Drag channel

7.2.2 Railway Connection

Imam Khomeini port--Ahvaz
Double-track railway is founded in this route. This railway is used to transport iron ore from Imam Khomeini port to Ahvaz Steel Complex and steel products are exported from Imam Khomeini port.

7.3 Alternative Layout Plans

For the improvement and expansion of the port up to the year 2010, to meet excess cargo traffic over the existing facility alternative layout plans are studied. Of these layout plans, three basic alternative layout plans are formulated and evaluated. (See Appendixes 7.3) These plans contains not only upgrading of existing facility but also the new development.

7.3.1 Alternative 1

(1) Location and outline

At the old port located along Khor Musa, the existing berth should be upgraded to increase cargo handling efficiency.

The new port development should be conducted along the west side of Khor Dorag (Hereinafter the development site is referred to as "West harbor") as shown in Figure 7.3.1.1.

(2) Harbor access

There are five harbor access routes to/from the West harbor along Khor Dorag.
Two routes provide connections to/from the inland transport infrastructure.One consists of a road and railway that branches off the existing road and railway 15 kilo meters north from the port. The other is a road and railway that branches off from a point near the existing berth, 2 kilo meters north of the port.

Three routes are planned to provide connections between the existing harbor and West harbor. One route is via a bridge in the interior of Khor Dorag, and another is via two bridges. The third one uses a submerged tunnel at the center of the existing berth line.

(3) Harbor layout

The grain terminal should be improved to increase the cargo handling efficiency.

The Eastern and Western Jetties should be demolished. Bagged, general and ore bulk cargo berths will be constructed here with reclamation.

Additional Container terminal should be constructed in front of existing Berth No.7-No.10.

Steel berths are placed in continuation of the container berths.

The general, bagged and refrigerated cargo berths are placed as a continuation of steel berths with water depth of 11 meters.

Steel and general cargo berth with water depth of more than 13 meters, are placed at West harbor along Khor Musa.

The small boats harbor will remain at the existing site though an extension is planned.

7.3.2 Alternative 2

(1) Location and outline

At the old port located along Khor Musa, the existing berth will be upgraded to increase cargo handling efficiency.

The new port development will be located along the south bank of Khor Zangi (Hereinafter the development site is referred to as "North harbor") as shown in Figure 7.3.2.1.

(2) Harbor access

Harbor access to/from the North harbor along Khor Zangi will be via the existing road and railway.

(3) Harbor layout

The grain terminal should be improved to increase the cargo handling efficiency.

The Eastern and Western Jetties should be demolished. Bagged, general and ore bulk cargo berths will be constructed here with reclamation.

Additional Container terminal should be constructed in front of existing Berth No.7-No.10.

Steel berths are placed in continuation of the container berths.

The general, bagged and refrigerated cargo berths are placed as a continuation of steel berths with water depth of 11 meters in front of them.

Steel and general cargo berth with water depth of more than 13 meters, are placed at North harbor along Khor Zangi.

The small boats harbor will remain at the existing site though an extension is planned.

7.3.3 Alternative 3

(1) Location and outline

At the old port located along Khor Musa, the upgrading works of ore berth for increasing cargo handling efficiency will be conducted.

The new port development will be conducted along the West harbor as shown in Figure 7.3.3.1.

(2) Harbor access

Same as Alternative 1.

(3) Harbor layout

The grain terminal should be improved to increase the cargo handling efficiency.

The Eastern and Western Jetties will be retained in their present condition except for the demolition and reconstruction of the one berth. Some green belt and the land for road in harbor will be placed with reclamation behind the existing jetty.

Additional Container terminal should be constructed in front of existing Berth No.12-No.18 with improvement of back yard. Some warehouses will be demolished.

Steel berths are placed in continuation of the container berths.

The general, bagged and refrigerated cargo berths are placed as a continuation of steel berths with water depth of 11 meters in front of them.

Steel and general cargo berth with water depth of more than 13 meters, are placed at West harbor along Khor Dorag.

The small boats harbor will remain at the existing site though an extension is planned.

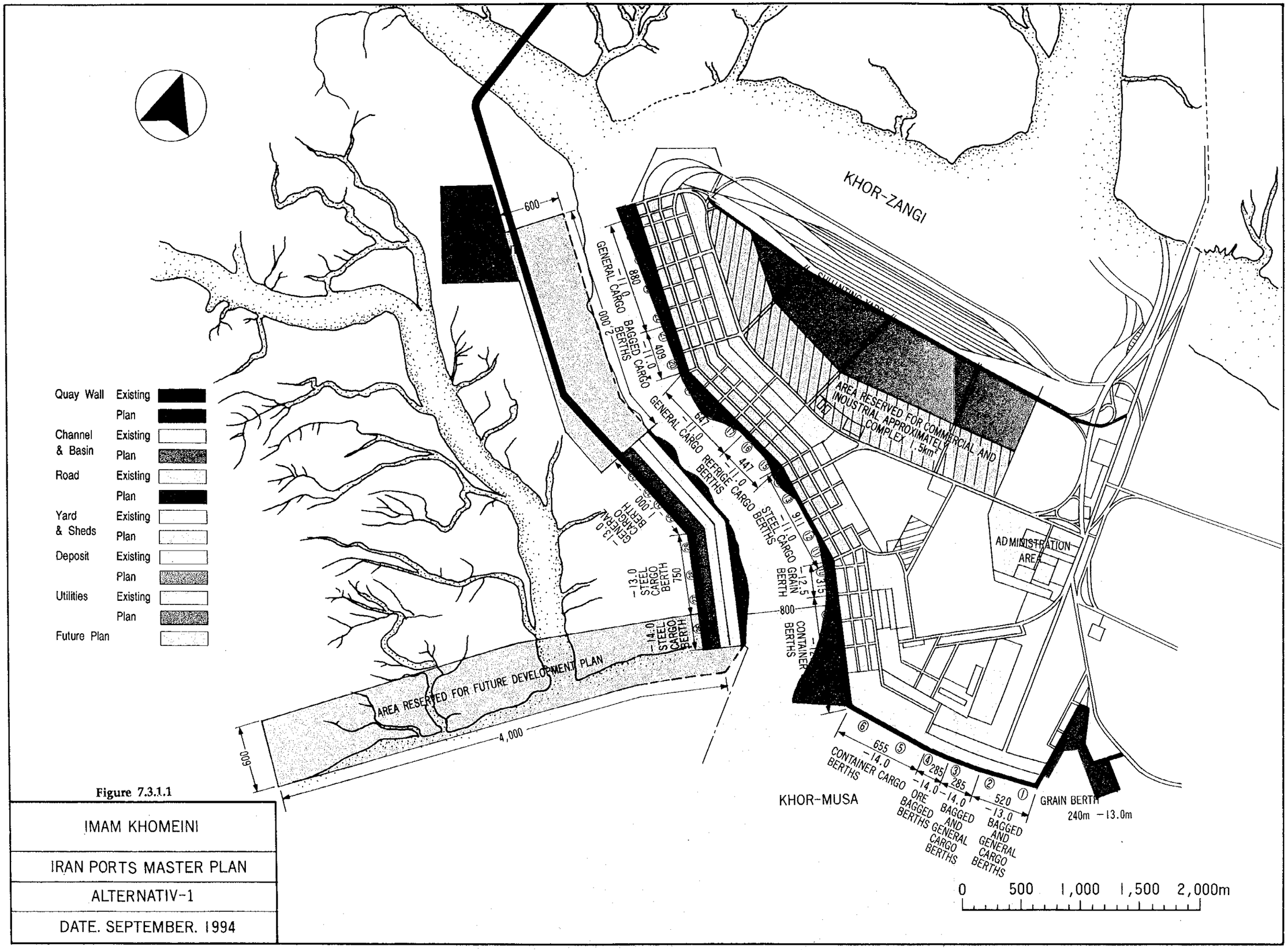


Figure 7.3.1.1

IMAM KHOMEINI
IRAN PORTS MASTER PLAN
ALTERNATIV-1
DATE. SEPTEMBER. 1994

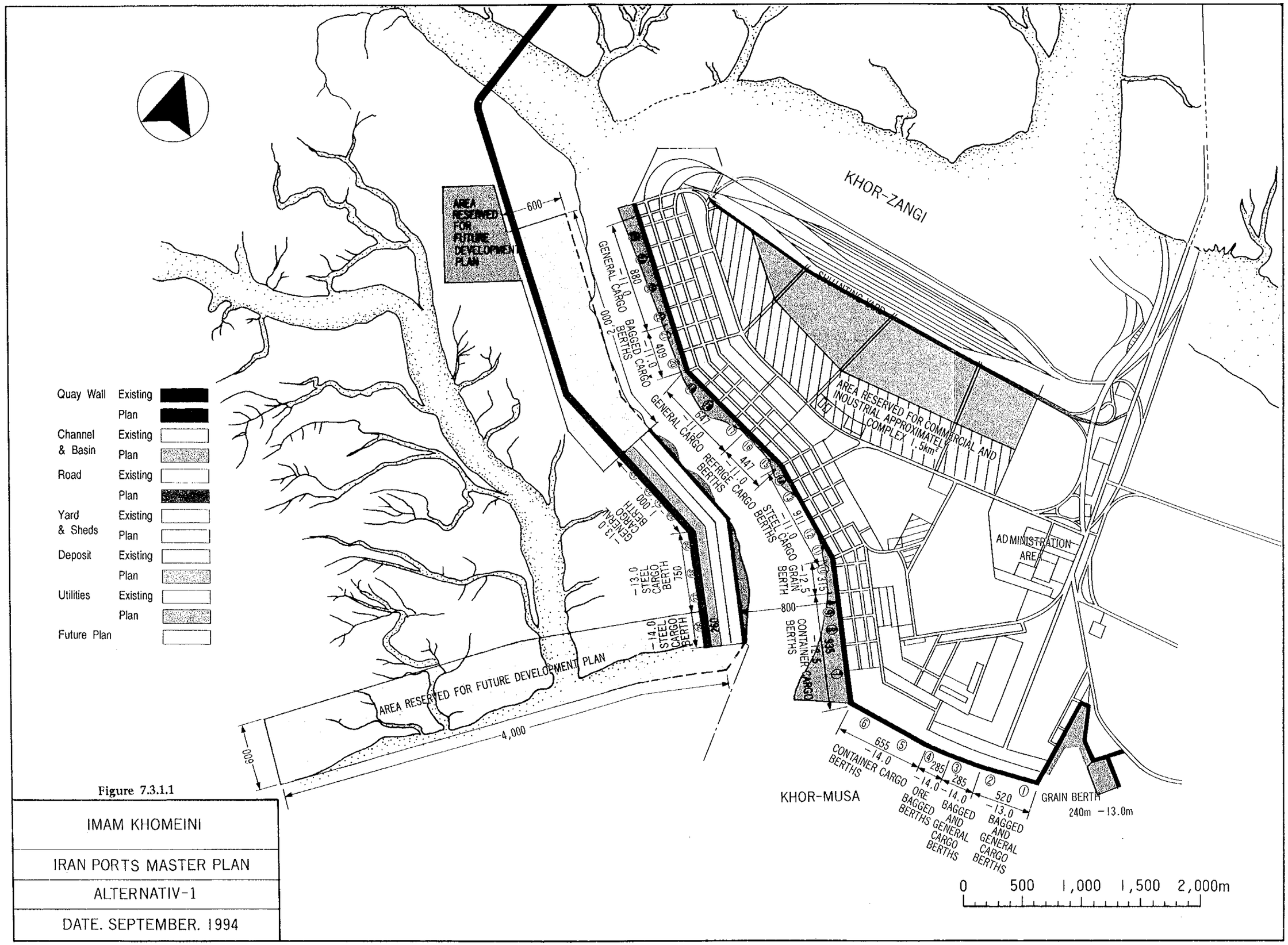


Figure 7.3.1.1

IMAM KHOMEINI
IRAN PORTS MASTER PLAN
ALTERNATIV-1
DATE. SEPTEMBER. 1994

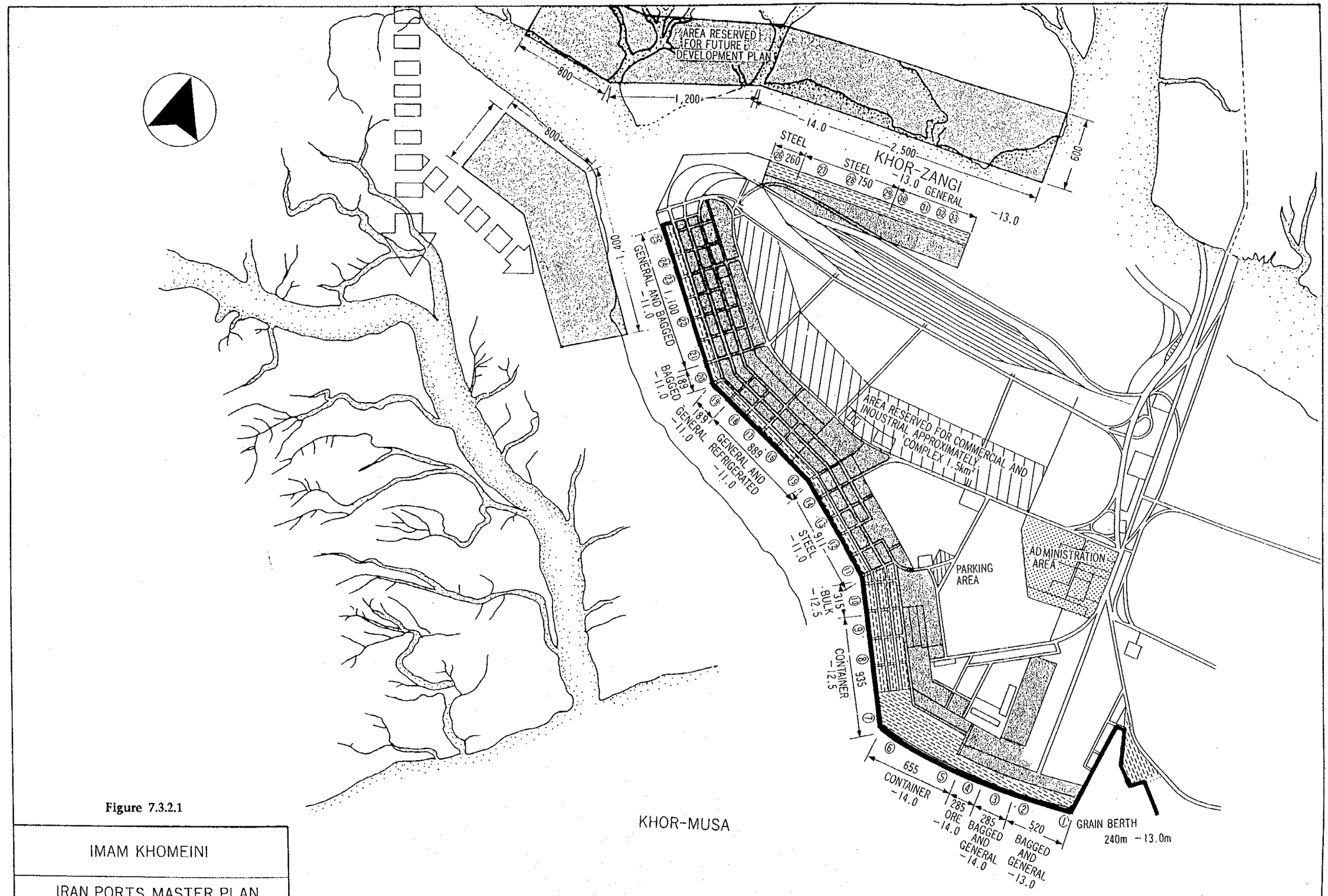


Figure 7.3.2.1

IMAM KHOMEINI
IRAN PORTS MASTER PLAN
ALTERNATIVE-2
DATE. SEPTEMBER. 1994

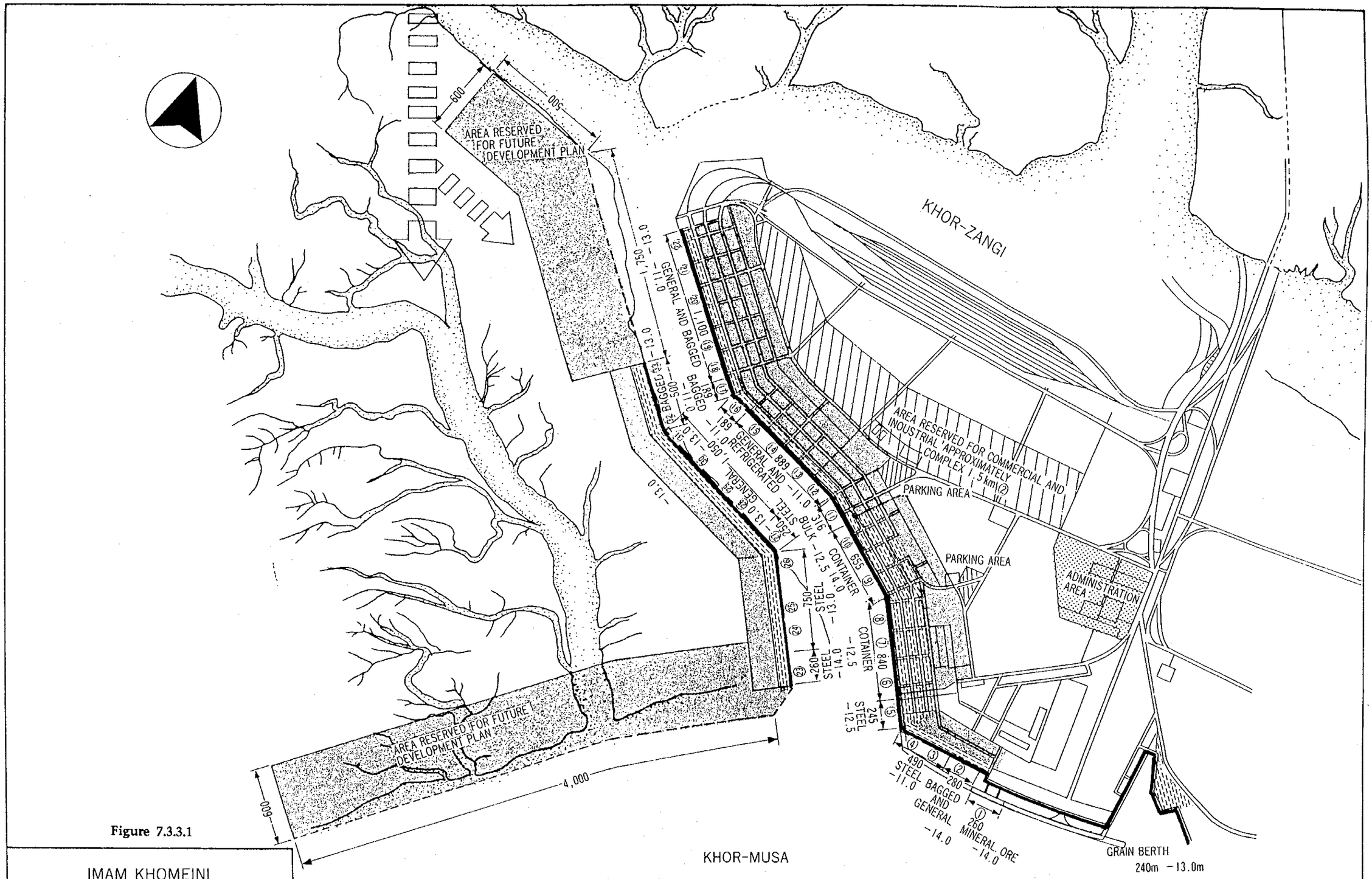


Figure 7.3.3.1

IMAM KHOMEINI
IRAN PORTS MASTER PLAN
ALTERNATIVE-3
DATE. SEPTEMBER. 1994

7.4 Container and Bulk Terminal

7.4.1 Container terminal

(1) Alternative Plan A

Alterative plan a is for alternative plans 1 and 2 of the master plan.
Location of container terminal in this plan is planned at existing Berth No.11 to No.14 and at the west side of the Western Jetty. Container terminal has a total of five berths; two of which are 320 m in length and the remaining three are 280 m in length. Figure 7.4.1.1 shows layout of major facilities in container terminal for target year 2010/11.

(2) Alternative Plan B

Alternative plan B is for alternative plans of the master plan.
Location of container terminal in this plan is planned at existing berth No.11 to No.18. Container terminal has a total of five berths; two of which are 320 m in length and remaining three are 280 m in length, the same as alternative plan A. The faciline of existing Berths No.16 to 20 will advance seaward by 10 meters in order to obtain deep water of OL - 14.0m. Figure 7.4.1.2 shows layout of major facilities in container terminal for target year 2010/11.

7.4.2 Bulk (Grain) Terminal

(1) Existing Exclusive berth for grain (Grain jetty) should be expanded by 60 m for 240 m berth. And a general cargo berth should be prepared for grain unloading as its peasant role that handles excess cargo from the exclusive berth.

The former will be able to accommodate vessels up to 50,000 DWT with water depth of -13.0 m. The berth length and depth for the latter will be 300 m and -12.5 m respectively.

7.5 Evaluation Indexes for Proposed Alternative Plans

According to the basic policy for development layout plan, the evaluation indexes for proposed alternative plans are should be as follows.

(1) Cost performance

(2) Effect on existing port facility

(3) Disturbance to preset port operation

(4) Ease of port management

(5) Flexibility

(6) Applicability to Post master plan

(7) Technical issues

(8) Environmental impact

(9) Inland transportation

7.6 Evaluation and Recommendation

7.6.1 Alternative 1

(1) Structure

In this alternative, There are modification / demolishing of existing berthing facilities except that it will be necessary to demolish the existing berth, between Berth No.10 and Eastern Jetty to construct the container terminal, bagged cargo berths and renewal of mineral berth along side of Khor Musa.

Ore powder and iron powder cargoes should be handled at the existing berth site at Berth No.6 of Western Jetty.

At Khor Dorag, channel depth should be deepened and it width should be expanded, thus the siltation will automatically increase in future. According to the preliminary study, an annual maintenance dredging volume for this plan will amount to 650,000 m^3. The problem of siltation at the channel entrance should be also important.

(2) Port activities

Dust pollution of the commercial port will be disadvantage but this applies to all alternatives because of the difficulty of relocation of existing grain jetty and proposed container terminal.

New development at the west bank of Khor Dorag which will handle the export metal cargo and general cargo should be accordingly located far from existing administrative center. Another administrative center should be constructed in the newly developed site.

Access road should be necessary for connection between the new site and the existing port area. In the stage of Master Plan, it should be better to use existing railway shunting yard.

7.6.2 Alternative 2

Alternative 2 has similar development characteristics to Alternative 1. South bank of Khor Zangi should be the newly developed site instead of the west bank of Dorag in Alternative 1.

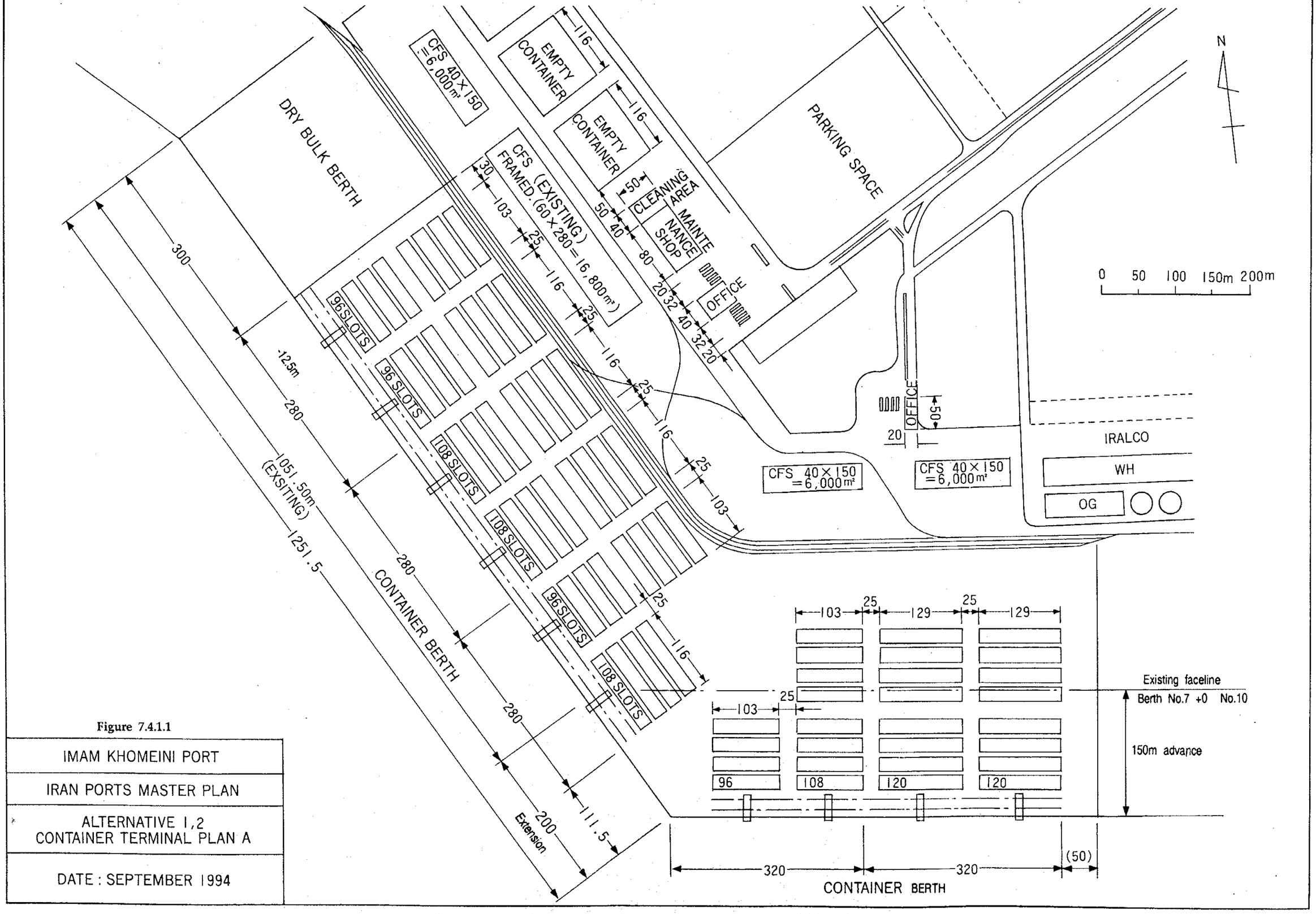


Figure 7.4.1.1

IMAM KHOMEINI PORT
IRAN PORTS MASTER PLAN
ALTERNATIVE 1,2 CONTAINER TERMINAL PLAN A
DATE : SEPTEMBER 1994

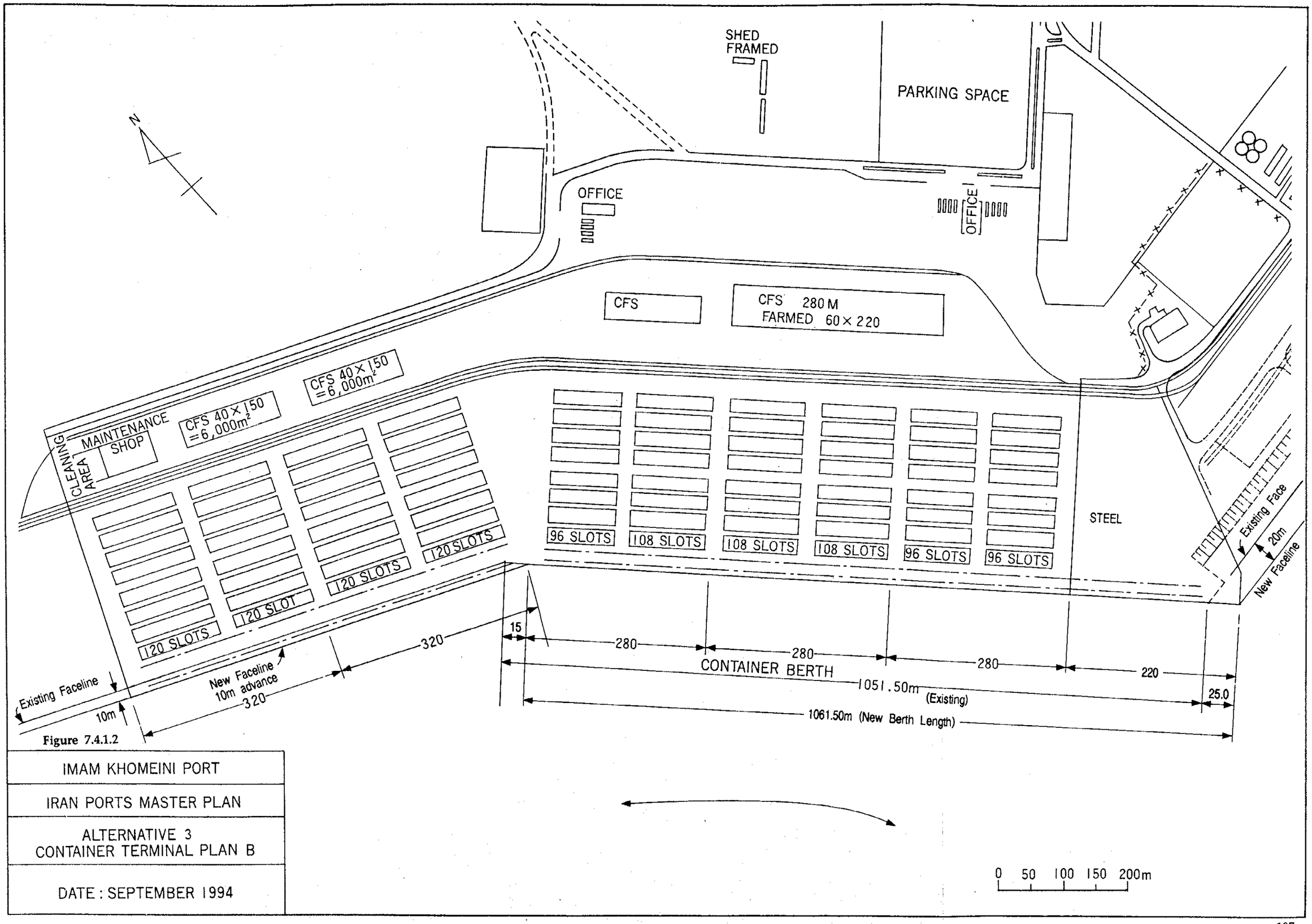


Figure 7.4.1.2

IMAM KHOMEINI PORT
IRAN PORTS MASTER PLAN
ALTERNATIVE 3 CONTAINER TERMINAL PLAN B
DATE : SEPTEMBER 1994

(1) Structure

There is no berthing facility except a small jetty at the Khor Zangi. Average water depth of this channel is about -4.9m (below Cesco Datum).
It is estimated that an annual maintenance dredging volume for this plan will amount to 1,000,000 m^3 according to the preliminary study.

This plan requires the large dredging area in Khor Zangi. Since precise evaluation of maintenance dredging volume in future is difficult, further examination based on the detailed surveys needs to be conducted by PSO while the implementation of the development plan.

(2) Port activities

It is one of advantages of this plan that this alternative permits the concentration in one area of all port activities.
Other advantage are both existing utility mains and main access can be utilized as for as demands for them are within the existing capacity.
However, extension of these mains should be conducted then necessary to prevent the existing facilities from ingestion. The port can be expanded in the post Master Plan stage to opposite side from existing harbor area cross the Khor Zangi, then further expansion can be made as alternative 1 is proposed.

7.6.3 Alternative 3

This plan has similar concept to Alternative 1 in respect of Dorag West bank development. However, this plan has larger development than plan 1, thus minor nonfiction will be provided to the existing facilities.

(1) Structure

Existing four Berths No.7 to No.10 of jetty type will be modified into marginal wharfs in order to upgrade the cargo handling capability. Ore powder and iron powder cargoes should be handled at the existing berth site at Berth No.6 of Western Jetty. Significant roles of remaining Berths No.1 to No.5 in respect of cargo handling capability will not be expected, since their structures are old ones and damaged ever after the repair works by PSO.

Existing Berths No.16 to No.20 will be upgraded regarding the depth of water by means of widening of existing deck by 10 meters, This improvement will provide two container berths and one grain berth of DL-14.0m.
Other three container berths will be located at the existing Berth No.12 to No.15 consisting a container terminal with other two new berths as discussed previously.
Present Berth No.11 will be a steel cargo berth of DL-12.5m
Accordingly existing four transit sheds and two ware houses behind existing Berths No.16 to No.19 will be removed to other sites for new duties.

The new berth development along the Dorag Western bank will be 2,500 meters long in the Master Plan stage, therefore, the utilities for port activities should be prepared before to start the cargo handling operation.

(2) Port activities

This alternative has similar problems to Alternative 1.

7.6.4 Recommended Alternative

Table 7.6.4.1 shows the total evaluation of three master plan alternatives. Each plan has been evaluated by marking system under thirteen points of view.
Alternative Plan 1 was given the highest marks among them.
Major contents of explained Alternative Plan 1 are follows.

(1) Waterfront facilities in the New Development

It is recommended to construct eight new berths at the Khor Dorag channel West Bank, the West Harbor, namely four general cargo berths and four steel berths.

Four general cargo berths which depth is -13 m and 250 m long each,should be constructed at the West Harbor. It will be able to accommodate up to 50,000 DWT vessels. This construction should be undertaken in the long term stage development before four new steel berths will start to construct.

Four steel berths will consist of -14.0 m berth of 260 m long and three -13.0 m berths of 250 m long each. This steel berths will be located at the entrance part to Dorag Channel. (See Appendix III-1.8, III-1.9)

(2) Upgrading of Existing Port Area

Grain terminal should be improved by means of 60 m extension as soon as possible. It should be able to accommodate vessels up to 50,000 DWT this existing water depth of -12.5 m should be changed to -13.0 meters.

Before 2000/10, existing container berth should be maintained, however improvement on cargo handling equipment and dredging of the basin in front of the existing berth should be made. And the extension of the container berth should be undertaken immediately after the demolish of existing Berth No.7 to No.10. Existing container berth should be renewal for increasing cargo volume, just after the above expansion.

Existing ore dolphin should be demolished, after the multi purpose bulk berth for ore and aluminum powder is constructed. Coal and coke cargo should be removed to the Steel Company berth which is scheduled to construct at the eastern basin of grain jetty.

Existing Western and Eastern Jetty is should be demolished and new three multi

purpose berth for bagged cargo and general cargo of large vessels should be constructed with reclamation.

Steel cargo handling berths should be separated in the existing port and West Harbor. Each section will have four berths, wide space for handling large items such as heavy machinery should be secured at the West Harbor. (See Appendix III-1.12)

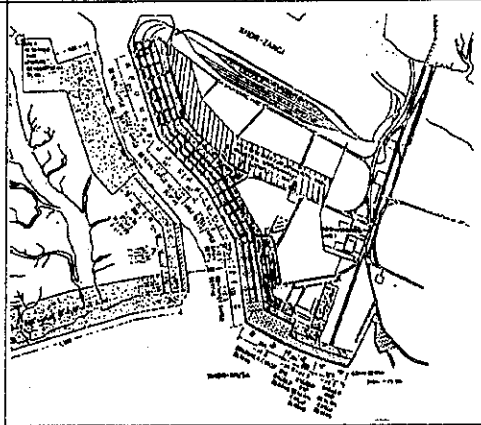
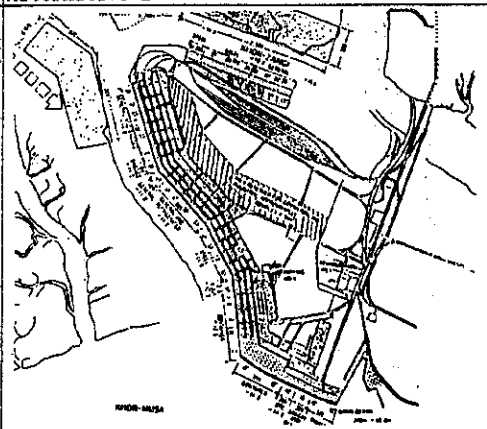
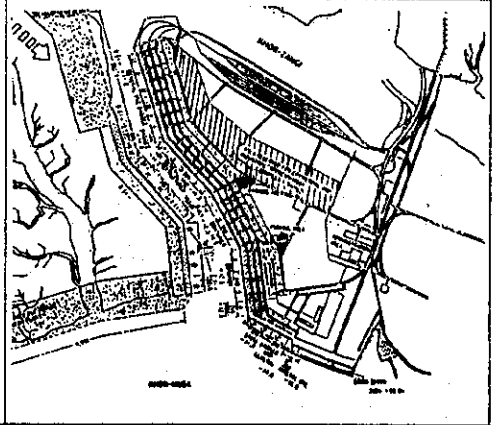
(3) Transit sheds and sorting yard

A total transit sheds and sorting yards area 202,000 m^2 should be available on completion of the Master Plan.

(4) Warehouse and storage yard

The total area of open storage and warehouse will be is approximately 253,000 m^2 except the container yard. And cold storage facilities should be secured as soon as possible at the existing Berths No.21 and No.22.

Table 7.6.4.1 Evaluation of Alternatives for the Master Plan of Imam Khomeini Port

	Alternatives		
	Alternative-1	Alternative-2	Alternative-3
Location			
Reliability	3	2	3
Practicability	2	2	2
Flexibility	3	1	2
Accessbility	2	3	2
Construction Cost	2	3	2
Post Master Plan	3	2	2
Effect on Existing Facility	2	2	1
Navigation	3	1	3
Environment (Natural)	2	1	2
Environment (Social)	2	2	2
Disturbance to port	2	2	1
Port Management	2	3	2
Maintenance Cost	3	1	3
Over All Evaluation	31	25	27
Priotrity	1	3	2

Note : Evaluation Point; 3 (Good), 2(Average) and 1 (Poor)

7.7 Short Term Development Plan and the Project

7.7.1 Stage Plan

Project proposed in the Master Plan container the required works to be conducted until 2011. Some project should be implemented by 2000 or earlier. Master Plan is divided into two basic stages, Short Term Development Plan and Long Term Development Plan. The program of practical improvements for the use existing facilities can go ahead independently of the long term plan. There will always be an urgent need for moderate structural cargo-handling equipment or the extension of available marshalling yard. Improvements of this kind should not be delayed until the main investment plan to start.

7.7.2 Basic Policy for Short Term Plan

While the management improvement and physical planning for the short term development plan, should be generally in according with the overall concept and scenario of the long term development and layout plan proposed in the Master Plan, the following policies are adopted for particular consideration in the short term development plan.

(1) Short term planning should be conducted on the basis that the present legal or juridical system for port administration will generally be maintained at least for the proposed planning term.

(2) On going and/or under planning development scheme for major ports in PSO will be mostly realized up to the target year.

(3) In order to secure the successful introduction of more efficient port management and operation system, a phased improvement scheme should be proposed.

(4) In determining the development site of a new container terminal, the maximum flexibility in selecting the sites for further development should be preserved so that possible future contingency can be allowed.

(5) The structural type of infrastructure of the wharf should be selected on the basis not only of cost and engineering applicability be also of local material availability and easy maintenance of the structure.

(6) With a view to minimize the initial investment cost of the project, only vital supporting facilities including access facility should be included.

(7) Short term development plan should be formulated considering the financial availability of the port, with a view to avoiding possible failure in securing the other port development.

(8) All project facilities should be planned under careful consideration of

environmental impact to minimize the marginal effect of the project.

7.7.3 Project Scope (Target year 2000/01)

The proposed Project includes the following main components;

(1) Improvement schemes of Silo terminal

Grain terminal should be improved by means of 60 m extension as soon as possible. It should be able to accommodate vessels up to 50,000 DWT this existing water depth of -12.5 m should be changed to -13.0 meters.

- Improvement of jetty by dolphin style
- Dredging of basin, -13.0 m (below Cesco C.D.)
- Repairing the unloading equipment

(2) Countermeasures for maintaining the cargo handling capacity of Eastern jetty

- Minimum investment to keep the berth length to 200 m for the large calling vessel
- Dredging of basin, -9.0 m (below Cesco C.D.)

(3) Countermeasures for maintaining the cargo handling capacity of Western jetty

- Improvement of the berth length, 240 m
- Dredging of basin, -13.0 m (below Cesco C.D.)
- Repairing the cargo handling equipment

(4) Floating unloader

- Minimum investment to be reactivated
- Demolishing in future (long term)

(5) Improvement schemes of container terminal (No.11 - No.15)

There are five existing berths with 180 m each. This length is short to moor the calling vessels. It is necessary to use existing facilities, therefore, container cargo, steel cargo and grain cargo are handled at these berths.

- Container berth; 1 berth
  Berth length, 260 m
  Dredging of basin, -12.5 m (below Cesco C.D.)
  Repairing the gantry crane
  Improvement of yard equipment

- Steel cargo berth; 2 berths
  Berth length, 260 m x 2
  Dredging of basin, -12.5 m (below Cesco C.D.)
  Improvement of yard equipment

- Grain cargo berth; 1 berth
  Berth length, 260 m
  Dredging of basin, -12.5 m (below Cesco C.D.)
  Repairing the pneumatic unloader

(6) Improvement schemes of refrigerated cargo berth

Refrigerated cargo need the special berths to handle.
- Refrigerated cargo berth; 2 berths
  Berth length, 2 berths
  Dredging of basin, -11.0 m (below Cesco C.D.)
  Improvement of transit sheds and warehouse

(7) Improvement schemes of berths, No.23 - No.34

It is necessary to dredge the basin to available depth.
- Dredging of basin, -11.0 m (below Cesco C.D.)

7.7.4 Urgent Rehabilitation Plan (Target year 1997/98)

The program of immediate practical improvements and repairing for the use of existing facilities can go ahead independently of the short term plan and long term. There will be an urgent need for moderate technical and operational repairing such as the repairing of structure, navigation aides and cargo-handling equipment. Repairing of this kind are independent of future capital investments and should not be delayed until the main investment plan is finalized

(1) Repairing of concrete structure (berth No.11 to No.34)

(2) Improvement and repairing navigation aids

(3) Repairing of cargo handling equipment for increasing the cargo handling efficiency
Details are described at each chapter.