(5) The share of four ports at the Persian Gulf

Vessels calling to the Persian Gulf ports come from all over the world. Main sea routes are though the Suez Channel for vessels from Europe and America and through the Indian Sea via Singapore for vessels from Asia.

Imam Khomeini port is located in the bottom of the Persian Gulf, has disadvantages in terms of ship cost and transport time, however, Imam Khomeini port is near to Teheran comparing with other major ports along the Persian Gulf coast. The two gateway ports, Imam Khomeini and Abbas, will compete with one another once the railway is completed at Abbas port. The share is estimated by cost analysis.
For the hinterland of each port in the Persian Gulf, the surrounding land is separated into eight areas considering transportation infrastructure, road and railway.

The area of consumption and production in Iran is closely related to the population distribution. The volume of cargo that flows to/from ports is related to the regional population.

Considering actual port activities, Imam Khomeini port should be the center of foreign trade. Future cargo share of each port in the Persian Gulf is forecasted based on micro forecast and checked by transportation cost analysis as shown in Table 3.1.1.1.

Table 2.3.3.2 Share of Cargo Volume among Four Ports (2010/11)

Port	1993	2010 By Micro Forecast	Case 1 By Cost Analysis	Case 2 By Cost Analysis	Case 3 By Cost Analysis
Khomeini	53%	50%	45%	48%	61%
Abbas	41%	44%	45%	42%	30%
Bushehr	3%	4%	4%	4%	4%
Chabahar	3%	2%	6%	6%	6%

Note: Import/Export cargo volume is equal to 100% with four ports at The Persian gulf ports in Iran. In this report, share is set by the "Micro Forecast".
Case 1; Cost is $5.0 per ton between Abbas and Imam Khomeini with sea lane.
Case 2; Cost is $2.5 per ton between Abbas and Imam Khomeini with sea lane.
Case 3; Cost is $5.0, railway will not connect from Abbas to existing railway.

2.3.4 Future Status of Cargo Flow

(1) General

The following are possible changes in cargo flow pattern in and around the country qualitatively predicted on the basis of perspective on future state of the various relevant factors.

1) International transit cargoes, including land bridge cargo, may increase depending on the relevant factors including availability of services to be provided by the competing foreign transportation system
2) The scale of sea-borne cargo flow through the Caspian Sea ports will increase steadily in the long term basis according to the economic development of CIS Republics.
3) Export cargo volume will increase steadily in line with the governments policy to seek a balanced trade that is not dependent on oil.
4) Substantial increase in cargo traffic through Bandar Abbas area can be expected due to active improvement of port facilities and its accessibility together with development of free trade area.
5) Composition of cargo commodities will be diversified according to growth of economic activities and close relations with neighboring countries.
6) Domestic sea-borne cargo flow will considerably increase according to progress of local port and coastal area development.
7) Total in/out flow of international trading cargoes through road or rail directly to/from the neighboring countries (overland cargo flow) will increase its share of the cargo traffic through the ports (sea-borne cargo flow).

(2) Forecast of Regional Cargo Traffic Distribution

The data of actual situation is available, on which the target proportion of the cargo volume in future foreign trade is assumed. Before the calculation some conditions are presumed as follows to decide the basic share of the cargo volume by region.

- Basically the regional cargo volume is estimated by the time series analysis.
- In the case of unavailable or shortage of cargo data, the acceptable proportion of the cargo volume by region will be selected considering the maximum share of the region in the past five years.
- The trial of the regional share calculation is for the Case-2 only.
- Land bridge cargo, the world transhipment cargo,oil-product and oil are excluded.

Resulting cargo volumes and proportions are shown in Table 2.3.4.1 and Figure 2.3.4.1.

Table 2.3.4.1 Estimated World Cargo Volume by Region in 2000/01, 2010/11

(In Case 2) [Unit; 1,000 tons]

	IMPORT FROM			EXPORT TO		
	1992	2000	2010	1992	2000	2010
FREETRAD	4	774	1,361	0	568	1,027
AFG, PAKI	167	194	342	103	184	441
TURKEY	596	836	1,218	219	387	926
CIS	750	873	1,535	33	641	1,158
ARAB	359	619	650	9	454	490
PER-GULF	1,032	1,026	1,394	982	993	1,784
OCEANIA	952	1,742	2,031	2	246	588
N-AMERIC	2,527	4,205	7,524	10	307	735
FE-ASIA	1,690	2,759	4,730	964	1,714	4,101
SE-ASIA	2,028	3,143	5,538	197	1,536	3,675
MEDITERR	702	1,634	2,830	119	578	1,382
W-EUROPE	5,624	8,467	14,503	617	1,094	2,617
E-EUROPE	1,417	1,503	2,644	70	879	2,102
S-AMERIC	2,891	3,980	5,862	2	246	588
AFRICA	374	610	1,040	111	989	2,367
TOTAL	21,113	32,366	53,203	3,438	10,816	23,982

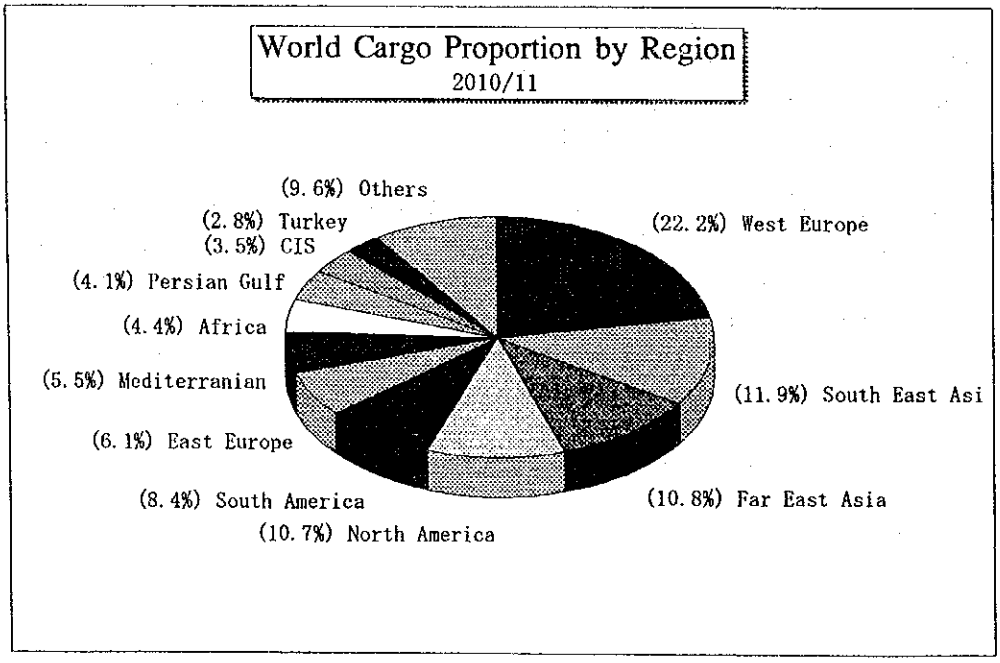


Figure 2.3.4.1 Estimated World Cargo Proportion by Region in 2010/11

(In Case-2)

(3) Forecast of cargo flow by transport mode

In the Table 2.3.4.1 the import and export cargo volume share from Afghanistan and Pakistan is 0.9% in 2010/11 and this cargo will be transported on land presumably. Turkey's share is 2.8% and this cargo will be also transported on land presumably.

The cargo volume share to/from Western Europe to Iran is 22.2% and this cargo will be transported on two routes and by different transport modes. One route is on land and the other is by ship through the Suez Canal. The cost of each transport mode was estimated.

Estimated cargo volume by transport mode in 2010/11 is summarized as shown in Table 2.3.4.2, which will keep almost same as present pattern.

Table 2.3.4.2 Cargo Volume by Transport Mode

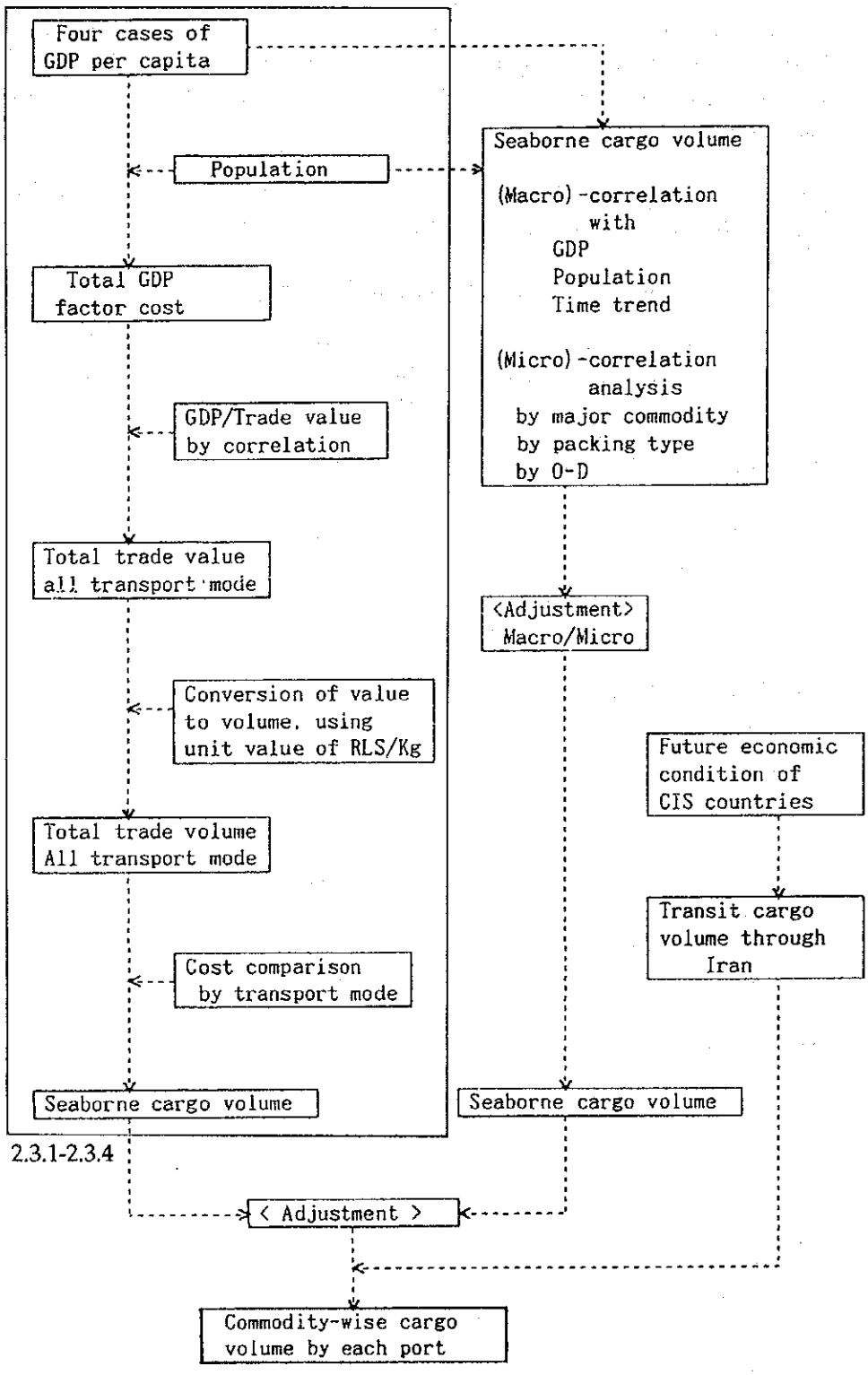
(Unit; 1,000 tons)

Mode	Region, Country	Import (2010/11)	Export (2010/11)	Total (2010/11)
On land	Afg, Pks, CIS	1,109	1,020	
	Turkey	1,218	926	
	W-Euro	4,718	851	
	E-Euro	881	701	
	Total	7,927	3,498	11,426
				(14.8%)
By Ship	E-Euro	881	701	
Caspian	CIS	768	579	
Sea	W-Euro	2,214	400	
	Total	3,863	1,679	5,543
				(7.2%)
By Ship	W-Euro	7,570	1,366	
Per-Gulf	E-Euro	881	701	
	Other	32,961	16,738	
	Total	41,412	18,804	60,217
				(78.0%)

2.3.5 Summary of Seaborne Cargo Demand Forecast for Major Iranian Ports

(1) Methodology for cargo demand forecast

Future demand is forecasted as shown in the flow-chart.



(2) Demand forecast for sea borne cargo

1) Macro forecast

The result of macro forecast in target years is shown in Table 2.3.5.1.

Table 2.3.5.1 Macro Forecast

Unit: 1,000 tons

		2000/01	2010/11
Handling Cargo Volume	Import	36,969 - 38,035	57,655 - 65,572
	Export	8,247 - 8,433	14,874 - 17,665
	Total	45,216 - 46,468	72,529 - 83,237

2) Micro forecast

The result of micro forecast in target years is shown in Table 2.3.5.2.

Table 2.3.5.2 Micro Forecast

Unit: 1,000 tons

		2000/01	2010/11
Handling Cargo Volume	Import	32,455	53,315
	Export	8,936	23,768
	Total	41,391	77,083

3) Cross check with the results of macro/micro forecast

Future trade of import and export cargo will be expected the continuance to be controlled by the government policy. Therefore, import cargo volume will not increase at the same rate as that of 1988/89 to 1992/93, while export cargo volume will increase at a greater pace than past records would suggest. Accordingly, macro forecast results will not be adopted in this study.

In conclusion, results obtained by the micro forecast method are adopted as the final estimation of cargo volume in target years.

Figure 2.3.5.1 shows a comparison of cargo volumes obtained by the macro and micro forecast methods.

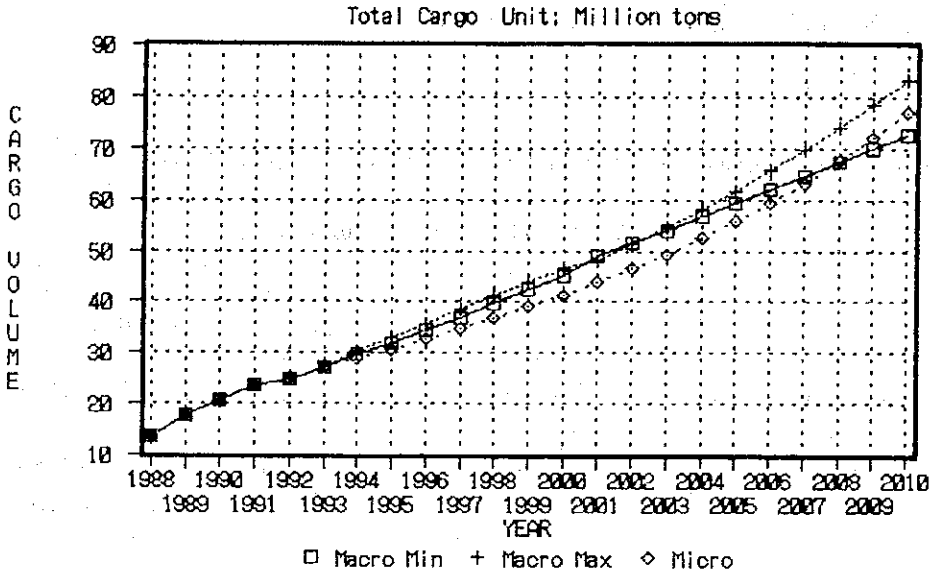


Figure 2.3.5.1 Comparison of Forecasted Cargo Volume

4) Cargo demand forecast for land bridge cargo

Future trade of four CIS countries (Kazakhstan, Uzbekistan, Kirghistan and Turkmenistan) with Asian & African countries through Iranian ports as land bridge cargo is forecasted as follows.

Target Year	Total Value (Bn.$)	Total Volume (1,000.tons)	Except former Soviet Union (1,000.tons)	Land bridge cargo of four CIS countries (1,000.tons)	
				From	To
2000/01	26.21	34,172	5,126	620	470
2010/11	35.22	45,919	12,857	1,540	1,180

5) Cargo demand forecast for Major Iranian Ports

i) Cargo volume by port

Forecasted cargo volume which was obtained in the aforesaid item 2) and 4), is distributed to twelve ports (Seven ports located Persian Gulf and five ports located in the Caspian Sea) considering;

(1) Post records of cargo volume in each ports
(2) Importance and roll of each ports

The results of cargo distribution are shown in table 2.3.5.3

Table 2.3.5.3 Forecasted Cargo Volume by Port

Unit:1,000 tons

Port Name	1993/94			2000/01			2010/11		
	Import	Export	Total	Import	Export	Total	Import	Export	Total
Persian Gulf									
Imam Khomeini	7,259	2,788	10,047	11,051	5,182	16,233	19,663	11,512	31,175
Rajaee	8,410	931	9,341	11,901	2,721	14,622	19,158	10,088	29,246
Bahonar	3,330	553	3,883	3,552	867	4,419	3,896	1,651	5,547
Bushehr	1,412	174	1,586	1,815	300	2,115	2,599	654	3,253
Behesti	816	2	818	1,158	9	1,167	2,008	226	2,234
* Khorramshahr	-	-	-	732	268	1,000	671	329	1,000
* Abadan	-	-	-	146	54	200	134	66	200
Sub-Total	21,227	4,448	25,675	30,355	9,401	39,756	48,129	24,526	72,655
Caspian Sea									
Anzali	1,036	42	1,078	1,594	218	1,812	4,240	842	5,082
Nowshahr	388	8	396	692	137	829	1,826	399	2,225
**Amir Abad	-	-	-	485	175	660	956	444	1,400
**Fereydunkener	-	-	-	349	21	370	713	87	800
**Torkaman	-	-	-	70	75	145	170	190	360
Sub-Total	1,424	50	1,474	3,190	626	3,816	7,905	1,962	9,867
TOTAL	22,651	4,498	27,149	33,545	10,027	43,572	56,034	26,488	82,522

Note: Including land bridge cargo

* ports were under re-construction in 1993/94

** ports were under construction in 1993/94

ii) Cargo volume by Commodity

On the Chapter 3.5.3 (Micro forecast) in Volume 1, forecasted handling cargo volume by commodity in major Iranian ports (twelve ports) is shown in Table 2.3.5.4.

Table 2.3.5.4 Forecasted Cargo Volume by Commodity

Unloaded & Loaded (Import & Export) Unit: 1,000 tons

COMMODITY	1993/94		2000/01		2010/11	
	tons	ratio	tons	ratio	tons	ratio
DRY BULK	3,940	14.5%	7,223	17.5%	9,188	11.9%
Barley	264	1.0%	229	0.6%	222	0.3%
Wheat	2,691	9.9%	3,260	7.9%	3,497	4.5%
Corn	812	3.0%	1,030	2.5%	1,113	1.4%
Sulphur	4	0.0%	300	0.7%	300	0.4%
Const. Material	164	0.6%	239	0.6%	408	0.5%
Salt	5	0.0%	63	0.2%	137	0.2%
Fertilizers	0	0.0%	2,102	5.1%	3,511	4.6%
LIQUID BULK	7,605	28.0%	9,091	22.0%	11,359	14.7%
Molasses	69	0.3%	118	0.3%	255	0.3%
Petroleum Products	6,923	25.5%	7,985	19.3%	9,454	12.3%
Vegetable Oil	613	2.3%	893	2.2%	1,491	1.9%
Liquid Gas	0	0.0%	95	0.2%	159	0.2%
BAGGED CARGO	4,059	15.0%	5,376	13.0%	8,803	11.4%
Fertilizers	590	2.2%	0	0.0%	0	0.0%
Chemical Material	1,806	6.7%	3,381	8.2%	6,790	8.8%
Sugar	344	1.3%	740	1.8%	848	1.1%
Rice	786	2.9%	620	1.5%	374	0.5%
Soy Bean	533	2.0%	635	1.5%	791	1.0%
CONTAINER						
Others	648	2.4%	2,157	5.2%	18,461	23.9%
REFRIGERATED GOODS						
Meat	83	0.3%	268	0.6%	497	0.6%
STEEL MATERIAL						
Metallic Product	4,576	16.9%	6,679	16.1%	11,155	14.5%
MINERAL	837	3.1%	1,053	2.5%	1,265	1.6%
Coal	830	3.1%	1,008	2.4%	1,158	1.5%
Copper	7	0.0%	45	0.1%	107	0.1%
GENERAL CARGO	5,401	19.9%	9,543	23.1%	16,355	21.2%
Dried Fruits & Nuts	207	0.8%	302	0.7%	503	0.7%
Others	5,194	19.1%	9,241	22.3%	15,852	20.6%
T O T A L	27,149	100.0%	41,391	100.0%	77,083	100.0%

Source: 1993/94 data, Ports & Shipping Organization
2000/01 & 2010/11, Forecasted by Study Team

Note : Classification of commodity-wise cargo is based on PSO data.
2000/01 & 2010/11, excluding land bridge cargo

2.3.6 Functional Allotment among Major Iranian Ports

Abbas port and Imam Khomeini port are the two major ports in Iran and each is expected to handle more than ten million tons of foreign trade cargo. In particular, Imam Khomeini port will handle many commodities in Iran because of its advantageous location near the high population density area. Raw materials, aluminum powder, rice, wheat, general cargo and so on will also be handled at this port.

These two ports are the main ports of Iran, while then ports of Bushehr and Chabahar are sub ports in the Persian Gulf of which roles are to serve mainly their respective districts.

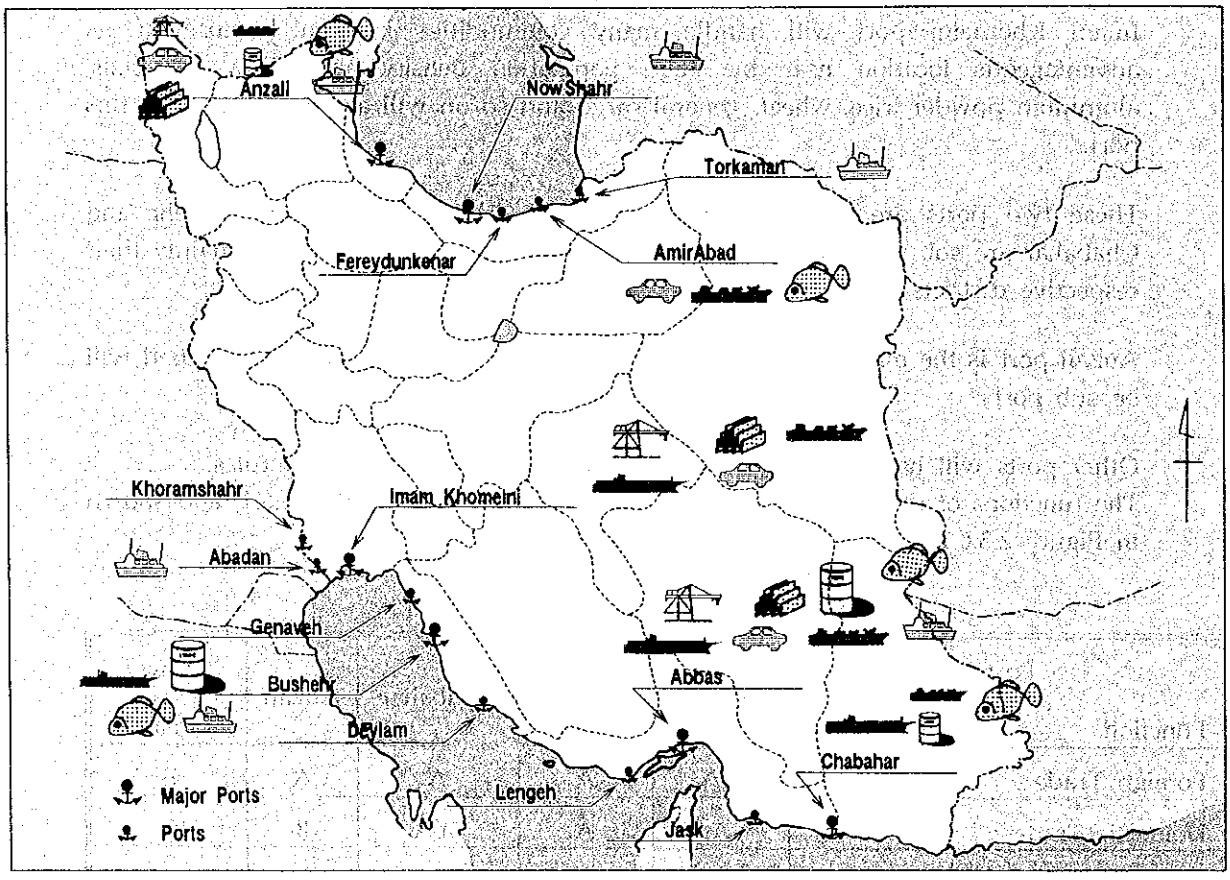
Anzali port is the main port in the Caspian Sea and NowShahr and Amir Abad will be sub ports.

Other ports will have relatively minor though nonetheless important roles.
The functions of major ports in 2010/11 are summarized as Table 2.3.6.1, and shown in Figure 2.3.6.1.

Table 2.3.6.1 Functions of Major Ports

Ports / Function	Imam Khomeini	Abbas	Bushehr	Chabahar	Anzali	Now Shahr
Foreign Trade	AA	AA	A	A	A	B
Domestic Trade	A	A	A	C	B	C
Commercial	AA	AA	A	A	A	B
Industrial	AA	AA	B	B	B	B
Container Cargo	AA	AA	A	B	A	B
Bulk Cargo	A	A	B	A	B	C
Heavy Cargo	A	A	B	B	A	B
Ro-Ro Cargo	A	A	-	-	A	-
Transit Cargo	A	AA	-	A	A	-
Liquid Cargo	C	AA	AA	A	A	B
Fishery	C	A	A	A	A	C
Passenger	B	A	A	-	A	A
Refuge	-	-	-	B	A	A

Allotment Degree
AA: High
A: Medium High
B: Medium Low
C: Low
-: Not Handled



Container Cargo
Bulky Cargo
Heavy Cargo
Ro-Ro Cargo
Transit Cargo
Liquid Cargo
Fishery
Passenger

Figure 2.3.6.1 Functional Allotment Among Iranian Ports

2.3.7 General Development Strategy of Major Iranian Ports

The Iranian Ports should be prepared by each port to the requirements as follows.

(1) Bulk cargo

The ships larger than Panamax type normally light their draft at Abbas port. Since actual cargo handling capacity is very low level in the Persian Gulf, adequate improving should be necessary.

The liquid bulk, chemical product, oil product also are handled at Abbas port, Bushehr port and Chabahar port. But the facilities are inadequate and will need to be improved as soon as possible.

Raw material cargo, including iron ore, aluminum powder and so on, are handled at Imam Khomeini port. Iron ore comes from the steel company jetty near Bandar Abbas. Cargo handling equipment should be introduced to Imam Khomeini port.

Grain is handled at Bushehr, Chabahar port to the inland silos for the district and this role will be retained in future but the quantity is not very large. Cargo handling equipment should be introduced.

Grain and liquid bulk cargoes are handled at Anzali, and Now shar port. The cargo volume will increase in future from CIS countries and so on. Port facilities should be secured as soon as possible at two ports and Amir Abad port.

Amir Abad port is under construction, however, it is near the CIS countries and the railway sidings. Since bulky cargo from Central Asia will increase, this port needs to have adequate capacity for them.

(2) Heavy cargo

Heavy cargo such as materials for the project will be handled at the two major ports, as well as at Chabahar and Anzali port, which handle heavy cargo. The capacity of equipment for heavy cargo handling at their ports, however, needs to be improved accordingly. Busher port handles the material for the oil project and Chabahar port handle the material for the development projects on going in the hinterland.

(3) Ro-Ro cargo

Ro-Ro ships will increase both in the Caspian Sea and the Persian Gulf. In the Caspian Sea, there is a ferry line between Baku and Krasnovotuk. Ro-Ro ships are useful for ports which do not have sufficient port facilities. Since CIS countries need to transport cargo to/from Europe through the Caspian Sea by road and rail and also cargo to/from Asia through the land. It is recommended in this case that containerization be introduced extensively, since the container is suitable style of transportation for transit operation in particular.

The port facility for the Ro-Ro ship needs to be prepared by Imam Khomeini port and Anzali port.

In the Persian Gulf, trade between the Arab coastal countries and Iran will increase with variety of ship types including Ro-Ro ship, lighter, rush ship.

(4) Transit Cargo

Cargo to/from the CIS countries going through Iran by rail and truck will use mainly Anzali port , Amir Abad port, Nowshahr port (the Caspian Sea side) Imam Khomeini port and Abbas port (the Persian Gulf side).

The transit cargo volume cannot be estimated precisely because of the limited data; however, the port facility shall be prepared for handling a cargo volume of about 2.5 million tons.

The cargo to/from Kish Island and Qeshm Island will be handled by near port for a while because of shortage of port facilities in their Island Lengeh port should respond for this requirement.

(5) Container cargo

Imam Khomeini and Abbas port will handle mainly container cargo with target volume in 2010/11 is 18.3 million tons. Considering the prevailing cargo style at the Caspian Sea, container cargo will increase. Anzali port will handle the container cargo regularly. Busher and Chabahar port will handle the container as the sub port and for the district.

(6) Industrial and Commercial Activities

Traffic demand for industrial and commercial oriented cargo will be increased in each major port. From the view point of regional development, the port should support the manufacturing activity more than now, through timely provision of convenient space for local industrial or commercial enterprises with various related port services.

Imam Khomeini and Abbas port should prepare the land for that purpose and the facilities should be improve to support new industrial/commercial complex.

(7) Storage

The port is required to prepare storage facilities in its area for the transhipment cargo, container cargo, general cargo, bulk cargo, liquid bulk cargo, heavy cargo, frozen cargo, bagged cargo. The current shortage of warehouses seems to hamper the Iranian transport system. It often happens that shippers don't act in moving their cargo from the port area, therefore the shed becomes filled soon to capacity. Adequate storage facilities should be secured in the port area, in the case that there is shortage in storage capacity of hinterland.

(8) Passengers and domestic cargo

Passenger ships will call at Abbas, Bushehr, Khoram shahr and Abadan port in the Persian Gulf and call at Anzali and Nowshahr port in the Caspian Sea.

Abadan and Khoram shar port will be reconstructed urgently and handle the cargo, passengers between Kuwait and so on.

Domestic cargo will increase for the reason that the port network will be constructed sufficiently and the cargo will be loaded and unloaded at main port. The cargo will be transported to other ports by coastal ship, in particular at Abadan, Khoram shar and Lengeh port.

(9) Fishery

Requirements of total capacity of fishery port function will increase at all PSO ports. Fereydunkenar (the Caspion Sea), Jask and Deylam port (the Persian Gulf) should respond for the requirement in 2010/11.

(10) Refuge

Requirements of total capacity of refuge port function will increase. Anzali, Nowshahr, Fereydunkenar and Amir Abad (the Caspian Sea), Chabahar port (the Persian Gulf) should respond for the requirement.

2.3.8 Investment for Port Development

(1) Maximum handling capacity at Iranian Ports

Maximum handling capacity after improving existing facilities and operation system is estimated for 15 ports by berth.

The results are shown in Table 2.3.8.1.

Table 2.3.8.1 Maximum Handling Capacity and Required Number of Berths

South Port (Imam Khomeini, Abbas, Bushehr, Chabahar, Khoramshahr, Abadan)

Berth (South Ports)	Number	Total Length (m)	Capacity (1,000 ton/Year)
Conventional	71	12,152	36,710
Container	10	2,081	11,564
Sub Total	81	14,233	48,274
Under Construction	5	932	2,300
Total	86	15,165	50,754
Cargo Volume			Forecast 2010/11 64,024
Over Cargo			13,450

North Port (Anzali, Nowshahr, Amir Abad, Torkaman)

Berth (North Ports)	Number	Total Length (m)	Capacity (1,000 ton/Year)
Conventional	6	1,324	1,720
Container	2	200	680
Sub Total	8	1,524	2,400
Under Construction	9	1,970	1,865
Total	17	3,494	4,265
Cargo Volume			Forecast 2010/11 7,141
Over Cargo			2,876

Note: Excluding Oil, Oil Products, Including transit cargo

(2) Required number of berth

In the Persian Gulf, total required number of berth in 2010/11 is 19, while the same is 14 in the Caspian Sea.

(3) Estimated cost of required port development

The cost, improving the existing facilities and to construct the new facilities, is estimated as follows.

Table 2.3.8.2 Cost of Port Development (Mn.US$)

Total Construction Cost	1,854
Available Funds	1,800
Lack of Funds	54

2.4 Improvement Strategy for Administrative and Institutional Regime for Effective Port Development and Management

2.4.1 General Roles of Major Lranian Ports

On the basis of the basic requirements for the country, the core roles expected from the port sector may be summarized as follows.

1) To be logistics centers to provide necessities of life
2) To support development of the national economy
3) To play the central role in the international transport network
4) Encouragement of various port functions

(1) General Requirements for the Iranian Port Sector

Considering the above expected roles of Iranian port sector, the following requirements for improving the port function need to be examined.

1) Quality improvement and modernization of ports and maritime transport to attract more ship calls
2) Improvement of the port facilities for cargo and passenger traffic demand
3) Encouragement of international transit through Iran
4) Promotion of regional development through provision of better business environment for port related industries
5) Supporting of the free trade zone activity
6) Encouragement of other various port functions such as fishery, refuge and recreation
7) Enhancement of environment protection

(2) Policy Guidelines for Iranian Ports development

Although bulky cargo still represents a large share of the Iranian international freight, Iran is facing diversifying international cargo transport in general cargo. Iranian ports will need to prepare and improve the general cargo transport system, for the container cargo handling which requires quick, flexible and reliable transport services.

Also, a comprehensive transport system utilizing different transport modes should be developed in consideration of not only Iranian international transport but also international transit transport through Iran.

However, Iranian ports do not rank high in terms of annual cargo handling volume in the Persian Gulf and the Caspian Sea and have less accumulation of port functions and shipping routes compared with other countries' ports in the region. If Iran wants to have major international ports, the following measures need to be considered.

1) Development of container handling facilities
2) Application of strategic tariff policy for inviting more liner calls to the Iranian ports
3) Provision of available areas or lots, utilities and services specially prepared for various port related industries
4) Rationalization of custom clearance procedures and bonded transport/storage systems for international transit cargoes through Iran
5) Total improvement in variety of option and quality of required port services
6) Provision of easy access to/from truck roads and rail

2.4.2 Basic Policy for Management and Operation of PSO Ports

Taking the following issues into consideration, smooth and efficient operation and management systems should be introduced to Iranian ports.

(1) Required Functions for Iranian Commercial Ports

To be logistics centers for the national citizens, to support development of the national economy and to function as strategic centers in the international transportation network, the Iranian ports should be "attractive and profitable ports for users".

It is thought that (1) highly efficient, (2) cost saving, (3) safe and reliable services are priority requirements in becoming an attractive port for users.

(2) PSO (Head office) and Individual Port Authorities

Port Authorities currently conduct port related activities according to direction of PSO. PSO strictly controls most of the affairs of Port Authorities. To provide the port users with higher quality services in the future, it is desirable that each port competes with each other and devises the contents of the port service.
It is desirable to transfer some of the power which PSO has currently, to the Port Authorities under a certain control of PSO. considering the following requirements.

1) Safeguarding the national interest and open use of port facilities to the public should be the first priority issue concerning port management and operation.
2) Efficient cargo handling is strongly required.
3) PSO should establish a basic policy and plan for proper development and conservation of port area which should be controlled under a policy to realize proper port activity.

In order to achieve the above objectives, PSO should establish new divisions and

modernize the functions of existing divisions and departments.

2.4.3 Application of Privatization

In Iran, public institution (PSO) owns the terminals and provides cargo handling services (though they are partly provided by private companies). However the cargo handling efficiency isn't high.
For more efficient provision of cargo handling and other port service activities, increased participation of the private sector is required. At the same time, the following issues should be borne in mind.

(1) Public port should be managed and operated not for limited or specified users but for open public use.

(2) Benefits derived from operation of ports should be returned directly to the Iranian economy.

(3) The Iranian ports are required to provide quick, reliable and economical service to users.

(4) Efficient service is often obtained by establishing a competitive environment.

Present operation of monopolistic cargo handling service by PSO should be modernized. PSO should encourage private sector to enter into the field of cargo handling service by providing an attractive environment for competition.

2.4.4 Financial System and Tariff Policy for Sound Financial Position

(1) Financial System

PSO has its own special account, to which the income from the ports is transferred. PSO has been able to make a profit in this account, but the financial condition of the account is not sound enough to allow for large scale port development. PSO has a modern financial system as it uses normal financial statements of PSO special account.

However, PSO finance is not fully independent from the National Government because its investment budget comes from the national general account.

The intervention of Government should be reduced especially in the field of port operation and investment for efficient port management and operation as much as possible. Financial system based on economic principles should be established to realize financially sound port management and operation.

With the advance of privatization in the future, it is considered that the income and expenditure sturucture will change. To keep soundness of financial condition, it is necessary to make future financial plans previous to the introduction of privatization.

(2) Tariff Policy

All Iranian commercial ports which are managed and operated by PSO use the same PSO tariff. The Supreme Council has authority to revise and fix it. However, seven items (excluding port entry charge) require permission of the parliament when the level is changed by more than 30%.

As mentioned above (1), financial system based on economic principles should be established to realize financially sound port management and operation. For efficient and smooth port management and operation, financial independence is necessary. Therefore, in future, PSO should have authority to revise tariff by himself.

The tariff should be set based on the policy explained below.

1) The tariff should be set at a proper level so that the ports can maintain a sound financial condition and make necessary investments. At least, it should be set at a level which income can cover management and operation cost and repayment for interest and principal of loans.
2) Even a port which has high efficiency with port service, cannot attract users if its tariff is at too high level. The tariff should be set at a competitive level taking neighboring ports' tariff into consideration.

2.4.5 Control of Port Area (Infrastructure and Facilities)

Port should be properly controlled to provide efficient and reliable operation. To this end, PSO should formulate basic policy for national ports and prepare plan concerning development and conservation of port area. In this policy and plan, basic roles and functions of ports, policy for usage of port area, location and scale of port infrastructure and facilities should be defined. Construction work for port development, permission for usage of port infrastructure, facility and area should conform to the port policy and plan.

2.4.6 Employment and Training Policy

For efficient port management and operation, it is necessary to improve staff's ability and to increase the number of educated staff. To provide proper training courses which deal with the various port functions, special training organs should be established, and the organs should raise funds for training so that PSO's financial condition is not burdened with it.

(1) Training Policy

1) Training System for Administrative Staff

Since PSO does not have its own training course for administrative staff, its own training courses need to be developed with the purpose to change the mentality of PSO administrative staffs to cope with promoting efficiency of port management and

operation.

2) Training system for Operational Employees

PSO should examine the training system for operational employees to develop their ability to cope with more quick and reliable cargo handling. To cope with privatization and increasing capacity of port facility in the future, PSO should study the training methods for efficient and precise cargo handling.

(2) Personnel Evaluation System, Personnel Movement and Working Condition

In order to raise morale of port authorities' staff and to promote their ability, a modern personnel evaluation system, by which PSO staff can be objectively evaluated, needs to be introduced. PSO should judge personnel transfer and working condition considering the report by this personnel evaluation system.

2.4.7 Port Promotion

The Iranian ports should contribute to development of the Iranian national economy by attracting more customers, competing successfully with other ports.
Therefore, PSO staff should approach the port users (all shipping companies and cargo owners) for stable cargo collection activities.

It is also important for the national citizens to recognize the importance of port activities. Therefore promotional activities should target not only shipping companies and cargo owners but the people of the country as well.

2.5 Improvement of Port Engineering Aspects

PSO has already established its own engineering system that combined system between the private consultants and POS's own engineer groups. They are well coordinated by various communication channels including the technical seminar and open discussions.

However, the present system should be improved for better technical management on the facility construction including the future large project as proposed in the Master Plan.

Thus, this subsection will provide several ideas in respect of the existing conditions of major ports with regard to the engineering aspects. As mentioned above, two ports, Imam khomeini and Anzali port are the main data sources.

2.5.1 Overall Upgrading of PSO Engineering System

In order to carry out an appropriate future development of major ports, PSO's organization with respect to engineering aspects can be improved further. The

following suggestions on such improvement are based on the experience of the Study Team working with PSO.

(1) It is recommended to continue the PSO technical sessions. However it might be better to be classified by technical fields and length of experience of participants.

(2) Technology of other countries should be introduced especially through technical analysis by computers. Wave calmness, siltation and ship navigation are most useful programs.

(3) It is recommended that PSO provide opportunities for young engineers to visit other countries and observe the modern port technology.

(4) Use of consultants should be continued. However PSO head office should have its own technical standards and common design criteria for planning of safe and economical ports.

(5) If communication between the departments is enhanced, technical knowledge of PSO personnel will be improved.

(6) If communications between the young engineers and senior engineers are maintained more than present situation, valuable experience can be transferred to the next generation.

Another point which should be noted is that average age of PSO employees is rather high. It is an essential matter to open the employment chance to the young engineers. In order to ensure a continuity of PSO engineering it is strongly recommended to add training for young generation.

2.5.2 Establishment of Technical Standards for Port Facility Design

PSO recognized the importance of keeping its own technical standards and tried to prepare them before. However the preparation of them was not completed yet. The consultants employed by PSO usually select the standards by themselves based on characteristics of each project.

Technical standards aim to provide the engineer and the consultant with the minimum requirements in both quality and capacity of facilities and basic design method to be followed.

If there are no technical standards, the engineer should start his works to select the design method for every detail. Of course, the standards can not specify all design methods, however the engineer can save time. In addition, the standards will contribute in designing safe facilities by means of minimum requirement verification.

Another advantage is the uniformity of quality to ensure that the project does not suffer from either over investment not under investment. This is very important in

public port development where it necessary to make the maximum use of a limited budget. Another advantage may be found out during auditing the project performance.

In the training of PSO technical personnel, the standards will be one of the useful materials.

2.5.3 Improvement of Engineering Statistics and Recording System

The engineering records of PSO project in the past contain a variety of useful information. The port planners and engineers who participate in future technical studies can obtain many indications from them as follows.

(1) Improvement and modification of the existing facilities

(2) Routine maintenance and rehabilitation of the existing facilities

(3) Preparation of design and tender documents for new project

(4) Preparation of common design criteria

(5) Preparation of technical standards

(6) Training PSO's young engineers and architects

(7) Improvement of technical capability of PSO in general

However, if any information about records is not given to them, utilization of such record will be limited to those who knows the existence of records. Thus, they should be given well-informed easy access to touch the records.

For this purpose, necessary actions should be taken into account as follows.

(1) Name of the section or department, to which the researchers will contact for obtaining the records, should be in formed openly.

(2) All available records should be filled in accordance with the specified system.

(3) List of records should be prepared by the responsible section and major contents should periodically be distributed to the engineering sections.

(4) When the implementation of new project is completed, an introductive note of the project should be prepared by the consultant and circulated to the engineering related sections.

(5) It is also recommended to record major topics during the implementation stage and conduct a special technical section about such topics by the consultants employed. To compile these discussions, an annual technical report can be prepared for further

review.

(6) Special attention should be paid to the records of site investigation carried out in past. In many cases, these records are still active and can be applicable to the present and future engineering study. Thus, they should be properly filed in order to mitigate the required cost of a new investigation.

2.5.4 Monitoring and Review for Flexible Project Implementation

Investment according to the long-term plan (or master plan) is a must for both economical construction and smooth operation of port. PSO recognizes meaning of the master plan since the completion of previous master plans for the major ports prepared by ADIBI-HARRIS in 1974.

All the facilities specified in the master plan were reflected on the forecast data of cargo demand together with type of cargo. However actual figures may deviate from the forecasts due to changes in various social and economic factors. Although a detailed study to cope with this situation is required, following countermeasures may be useful.

(1) Review of cargo forecast based on the latest data

(2) Review of the master plan

(3) Review of the implementation schedule

In order to modify and transfer the facilities to meet the new requirements, several important points should be taken into account during the master plan preparation, one of which is flexibility.

"The flexibility" in port development can be generally achieved by taking the following planning concepts into consideration, although these might be selected carefully by the port planners.

(1) Fixed facilities including buildings should not be installed until it is absolutely necessary.

(2) Open space should be kept as wide as possible.

(3) Future cargo handling system should be forecasted and taken into design criteria.

(4) Water depth around waterfront structures should be able to be increased to accommodate large vessels in the future.

2.5.5 Establishment of Effective Maintenance System

PSO has conducted its efforts to provide the existing facilities with the required maintenance services. However there are several damaged structures which require

both periodical maintenance works and urgent rehabilitation.

Maintenance works are required for not only ensuring port users of safety but also extending the life of existing facilities. It is recommended that the required maintenance works should be evaluated during the design stage by totaling the initial cost and maintenance cost. More economical maintenance works can be conducted if proper preparation works on objective structures are carried out. Findings and recommendations on this aspect are shown below.

(1) Inadequate identification of required maintenance works is observed. It is recommended to prepare a list of facilities together with possible damage.

(2) Insufficient inspection works is also observed. Monitoring the present usage and damage inspection should be conducted periodically. Inspection survey should be extended to underwater structures, under surface of deck structure and embedded facilities in the berth.

Maintenance work on the structures can be divided into two categories, namely the routine maintenance and the urgent rehabilitation. The former consists of preventive measures and required cost of which is minor, however the latter consists of corrective measures against large scale damage and required cost of which is large. According to past experience, if preventive maintenance is appropriately performed, the required cost for corrective maintenance works will be minimum.

2.5.6 Cargo Handling Equipment

The improvement plan to get higher productivity for each berth are made considering the following basic policies.

1) The most suitable handling system shall be introduced
2) The required equipment for system shall be prepared
3) All equipment to be used shall be maintained in good condition with enough preventive measures

The main items for cargo handling system which are improved are as follows.
1) The most of unloaded cargo will be stored temporally in the port area.
2) The unit load handling system by fork-lift truck is introduced.

2.5.7 Computer System of Terminal Operation

Introduction of information system is an effective means to improve port terminal operation. With the increasing container cargo, the computer controlled systems for container terminal operation will be indispensable, so that;

1) An optimum yard operation plan can be developed. Yard operation can be conducted more quickly and more accurately.
2) Utilization of container yard can be rationalized

3) Various kinds of information including container location for safe container storage can be obtained more easily.

2.5.8 Statistic and Recording System for Port Planning and Administration

In the port policy and plan, capacity of ports in the target year is an important issue. To estimate the capacity, present cargo turnover needs to be analyzed. To formulate physical plan and management plan of port infrastructure and facilities of each port, it is important to examine present situation concerning usage of port infrastructure and facilities. Present database, however, is not sufficient for above mentioned issues. Recording of new and more database is necessary.

2.6 Environmental Administration

2.6.1 Organization of Environmental Administration

The Department of the Environment (DOE), the Marine Conservation Office of Marine Operation Department in PSO, and Port Authorities at Major Ports are responsible for overseeing the environmental conditions in ports in Iran. Their functions for environmental conservation are as follows.

(1) The Department of the Environment

DOE, by law, is empowered to practice and supervise the protection and conservation of the country's environment. The functions of DOE are as follows:
- Conducting survey and research for environmental affairs
- Establishment of regulations and environmental standards
- Promoting environmental education
- Supervising, controlling and enforcement of environmental laws (submitting data, orders for disposal/improvement of problems, and guidance)
- Collecting information on environmental issues

To fulfill the above task, besides its basic organizational structure, it is furnished with the Environmental High Council and three coordinating councils:
- The Environmental High Council for determination of environmental policies and strategies of the country,
- The Council for coordination of environmental programs,
- The Council for coordination of environmental research, supply of data, and documents,
- The Council for coordination of environmental education and awareness.

(2) PSO (Head Office)

The major function of PSO concerning environmental matters is as follows:
- Instructing the Port Authority Offices at Major Ports regarding sample collections at problem water areas or from drainage nozzles from calling vessels at Major Ports

- Analyzing the samples
- Studying the water pollution sources in Iranian ports
- Reporting to DOE all types of contamination and pollution except contamination by oil
- Removing oil contamination in all Iranian water areas (including lakes)

3) Port Authority Office

Each Port Authority office has the following functions for environment.
- Removing sea contamination in Iranian ports
- Inspecting waste oil and water of calling vessels in Iranian ports
- Collecting samples at problem water areas or from drainage nozzles of calling vessels in Iranian ports

2.6.2 Environmental Strategies of the Iranian Government

According to the result of interviews at DOE, the environmental strategies of the government of Iran are as follows:
1. Protection of environmental resources through public education and participation.
2. Protection and rehabilitation of natural resources through research, education, resource control, and law enforcement.
3. Prevention of urban and rural environmental pollution through research, control, and supervision to ensure compliance with regulations of government and the general public.

The action project plan for supervision and control was proposed for fulfillment of the above strategies by DOE. The content of the action plan is as follows:
- To prevent environmental pollution via law enforcement.
- To prevent the seating of inappropriate industries, or workshops via law enforcement.
- To prevent the degradation of natural systems and wildlife habitats.

At present, the most interesting matter of DOE is water pollution in Persian Gulf caused by the outflow of the oil from Kuwait during the Persian Gulf War.

General standards for air pollution and water pollution (for industrial drainage, living drainage, discharging water to a river and water quality for supply) were established by DOE. However, there are no standards for port and marine areas. In addition, guidelines for an environmental impact assessment have not been established.

2.6.3 Environmental Study for development project

Due to the provisions set forth in Articles, environmental impact assessment has become mandatory. Environmental Impact Assessment Bureau is responsible for the environmental impact assessment, but to date such a study has not been conducted for a port project.

According to interviews at DOE, DOE shall indicate the required items and guideline of environmental impact assessment for this project based on the result of this study and the concrete construction plan of this project. The environmental impact assessment shall be processed after concrete construction plan with method is presented.

PSO is drafting regulations to prevent oil pollution. The regulations are being prepared by concerned authorities such as DOE, PSO and Navy, and include measures for prevention of oil spills and provision of waste oil disposal plant and data regarding waste oil diffusion.

A special committee consisting of government organizations concerned with environmental conservation such as DOE, Navy and PSO and environmental specialists has been established to exchange information. The procedure of environmental impact assessment in Iran is shown Figure 2.6.1.

2.6.4 Establishment of Port Environmental Regulations and Standards

The environment is a very important matter in Iran, which is a signatory country of several environment related treaties. However, the environmental conservation system for ports is not sufficient. In particular, routine inspection system for water and seabed material quality, standards of sea water quality test and geological test of seabed are lacking in the present regulations.

In this study, site survey which involved taking of samples for sea water and seabed material at Imam Khomeini Port and taking of samples for sea water and site observation at Anzali Port was conducted to ascertain the environmental conditions (Refer to Progress Report, Vol.II). According to the result of the survey at Imam Khomeini Port, the quality of sea-water and seabed material is not very good. Concerning Anzali Port, the floating waste and water plants observed at the basin in the port suggest that the environmental condition has been deteriorating. In addition, waste water from Anzali city flows out to Anzali lagoon which has a passage that leads through Anzali Port.

2.6.5 Recommendation for Environmental Administration

Based on the above, the study team makes the following recommendations:

1) Standards of sea water and seabed material quality in the port area should be set in consultation with DOE.
2) Routine inspection system for water and seabed quality should be established.
3) A laboratory for minimum requirement analysis of the samples of sea water and seabed material should be established.
4) Engineers to sample environmental quality and analyses data should be trained and assigned to all major ports.
5) Treatment plants for waste oil from ships and waste water from the port should be established at each major port.

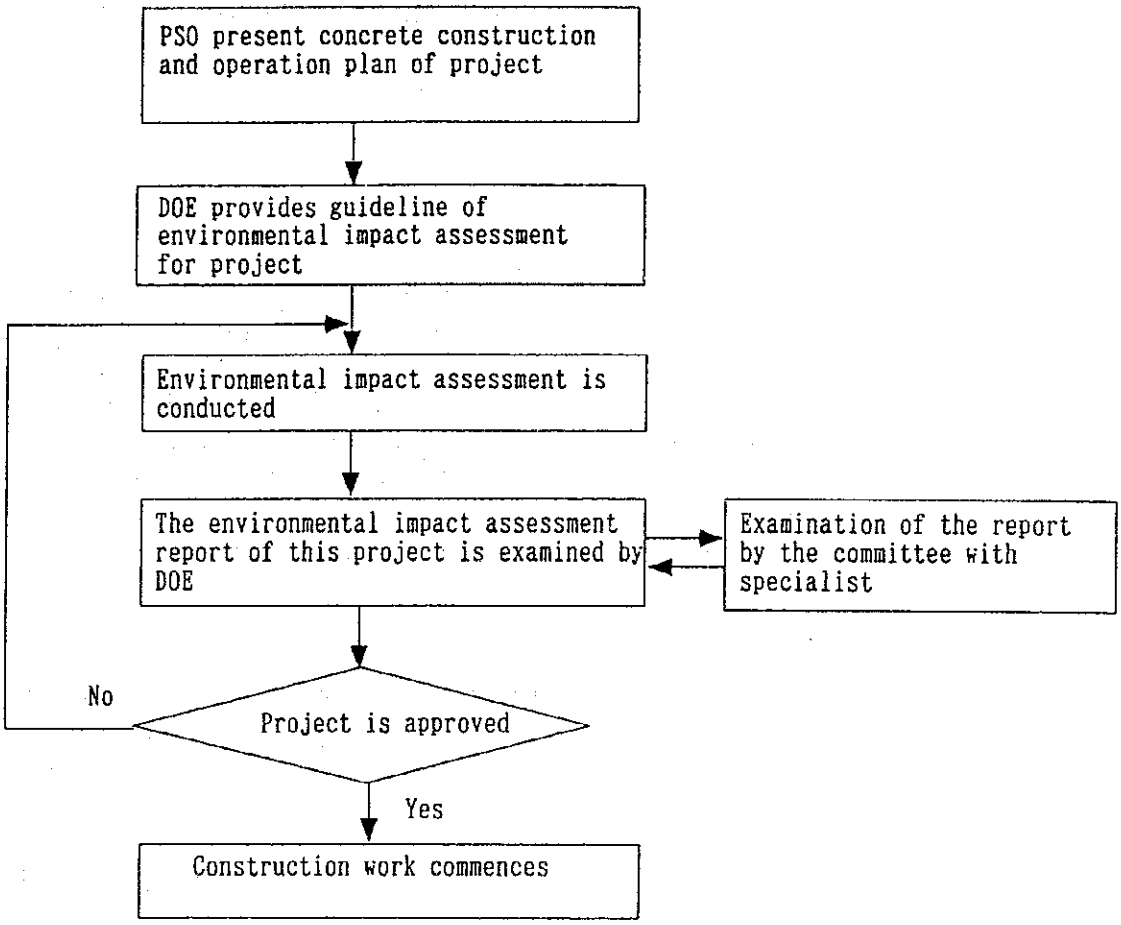


Figure 2.6.4.1 Procedure of Environmental Impact Assessment

3. Development Plan for the Imam Khomeini Port (Target Year 2010/11 and 2000/01)

3.1 Development Concept of The Port

3.1.1 Major Roles of Imam Khomeini Port

(1) Imam Khomeini port and Abbas port

The share of total cargo volume handled at the two major ports (Imam Khomeini and Abbas) in the Persian Gulf increased from 88% to 94% during the last 5 years. The share will exceed 89% in 2000, and 92% in 2010 according to the forecast of the Study. The average annual growth rate of cargo throughput from 1989 to 1993 at Imam Khomeini port is 15.5% while it is 20.0% at Abbas port. These two ports are collecting sea born cargo flow at high rate. In particular, the cargo volume significantly increased at Abbas port.
Figure 3.1.1.1 Shows past trend of cargo handling shares at each port.

(2) Major Roles of Imam Khomeini port

As above mentioned, Imam Khomeini port is the most important international port of Iran. The roles of Imam Khomeini port are identified, as the sea-borne cargo traffic center in total foreign trade, as the cargo distribution center, as the transition point of transport mode and as the industrial and commercial service center.

Figure 3.1.1.1 show past and future shares of the total cargo volume at each port in the Persian Gulf.

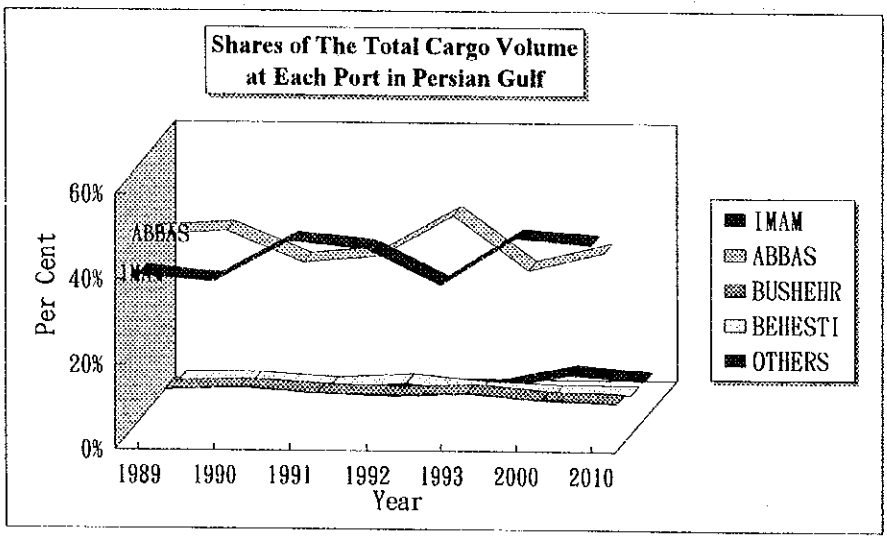


Figure 3.1.1.1 Shares of Total Cargo Volume at Each Port

3.1.2 Basic Policy of Port Development

(1) Major development goals

Major development goals should be based on the following seven subjects.

1) To assist smooth trading in Iran, especially for the land bridge cargo and increasing export cargo
2) To cope with the growing trend of containerization
3) To cope with the large vessels
4) To improve function of old facilities
5) To support industrial/commercial development and free trade area activities
6) To maintain efficiency with regards to port
7) To offer good service to port users

The conceptual subjects are set as follows;

1) Improvement of the wharf, channel, basin, yard and cargo equipment
2) Construction of the new port facilities
3) Keeping sufficient land for long term development
4) Promoting privatization with regards to port operation and management
5) Enhancement of cargo handling system in the port area for better future cargo flow

(2) The Direction of the Port Development

Considering the increasing cargo volume and enlarging vessel size, the basic concepts of port function at Imam Khomeini port are proposed as follows.

1) Foreign trade

a) To increase the port capacity, existing port facilities should be improved. In particular, grain bulk jetty, container berth and general cargo beth should be improved with adequate the berth length and depth.
b) To handle the increasing import/export cargo volume, West harbor should be expanded. In particular, steel and general export cargo beth should be expanded.
c) To facilitate cargo handling of land bridge cargo, cargo handling efficiency time should be improved as for as possible.

2) Cargo handling efficiency

a) For frozen cargo, some facilities should be improved.
b) A part of bagged cargo commodity should change to bulk cargo for example fertilizer.
c) Iron ore cargo should be handled at steel company's private berth. However, unloading of alumina powder will continue to be done at existing site.
d) A part of chemical fertilizer of bagged cargo should be handled at chemical

company's berth.

3.2 Current Situation of the Port

3.2.1 Location

The existing PSO port facilities are located on an artificial land reclaimed on the original low land (Physical situation of this port is as follows. Growth of the plant is difficult and elevation is 0.5 m from the high tide level).

Eastern Face; Face line and existing main access to Sar Bandar is about 4.5 km.

Northern Face; Zangi channel which was considered as a futurequay front in the new general layout in March 1991 (length approximately 5.0 m).

Western Face; Dorág channel along which 24 berths out of 34 public berths are located.(length approximately 3.7 km). There is another future quayfront namely "Far Future Quayfront" on the opposite channel bank of the existing wharf.

Southern Face; Musa channel approximately 2.8 km long was developed initially as a public port about 60 years ago. There are various port facilities of not only two marginal wharves but also two jetties together with a floating crane. The grain terminal (a jetty) is located at the eastern end of PSO area, beyond which there are two petrochemical factories.

3.2.2 Particulars in Natural Conditions

The Imam Khomeini Port climate is subtropical, hot and dry , with few clouds for most of the year.

Temperatures: A daily average of about 12 C(Jan.) to 35 C(Jun)

Rainfall: Total annual rainfall 100mm to 300mm. Rain occurs mainly in the months of November to February.

Wind: The most common wind direction is between W.N.W. and N.N.W.. Wind speed reaches up to 20 m/sec. Dust storm occurs in the project site usually during August and September. The salt content of the air is high.

Wave: The project site is protected well by the channel banks against waves. Wave height reaches 1.5 m when a wind of 25 m/sec intensity occurs.

Channel:	The port faces to Musa Channel which is a deep enough water way 60 km long providing vessels with access to the port. This favorable depth also is extended into two branch channel, Dorag and Zangi.
Tidal Range:	About 2.5 m (At the channel entrance), About 5.0 m (At the project site)
Tidal Speed:	1.5 knot (In February, at the entrance Channel)

3.2.3 Port Administration System

(1) Port Management

At Imam Khomeini port, the port activities are managed and operated by Imam Khomeini Port Authority. As shown in Figure 3.2.3.1, Port Director holds the highest position. Under the Port Director, some offices are established such as Public Relations Office, Program and Planning Center, Port Guard Office, Security and Legal Advisor.
In addition, four main departments, namely Finance and Administration Department, Technical Department, Civil Engineering Department and Operation Department, are established and they are headed by the four Deputy port directors.
Under these department, two port administration offices are established, which are in charge of administration of minor ports.

Berth allotment is generally on a first come first serve basis. Marine Operation Division is in charge of berth allotment.

Private entities provide cargo handling service on ships in principal, and Port Authority conducts cargo handling, stowage and cargo transport in the port area. Port Operation Division is in charge of cargo handling.

Port Authority provides mooring and water supply services, while bunkering service is carried out by private companies.

(2) Financial Condition and Port Tariff

At Imam Khomeini port, the balance of income and expenses has been in the black from 1991/92. With the revision of the tariff in 1993/94, income has increased drastically. However, due to changing exchange rate, balance has become red. Because the tariff for shipping company was revised in 1993/94 from Rls. base to dollars base. However, at first the tariff in dollars was calculated by using the rate (one dollar = 70 Rls), after that by wing rate one dollar = 1,750 Rls. Therefore, the tariff is still not reasonable.

On the basis of conference with PSO, net income is returned to PSO. Therefore, Port Authority can not retain earnings for investment, has little competence of financial

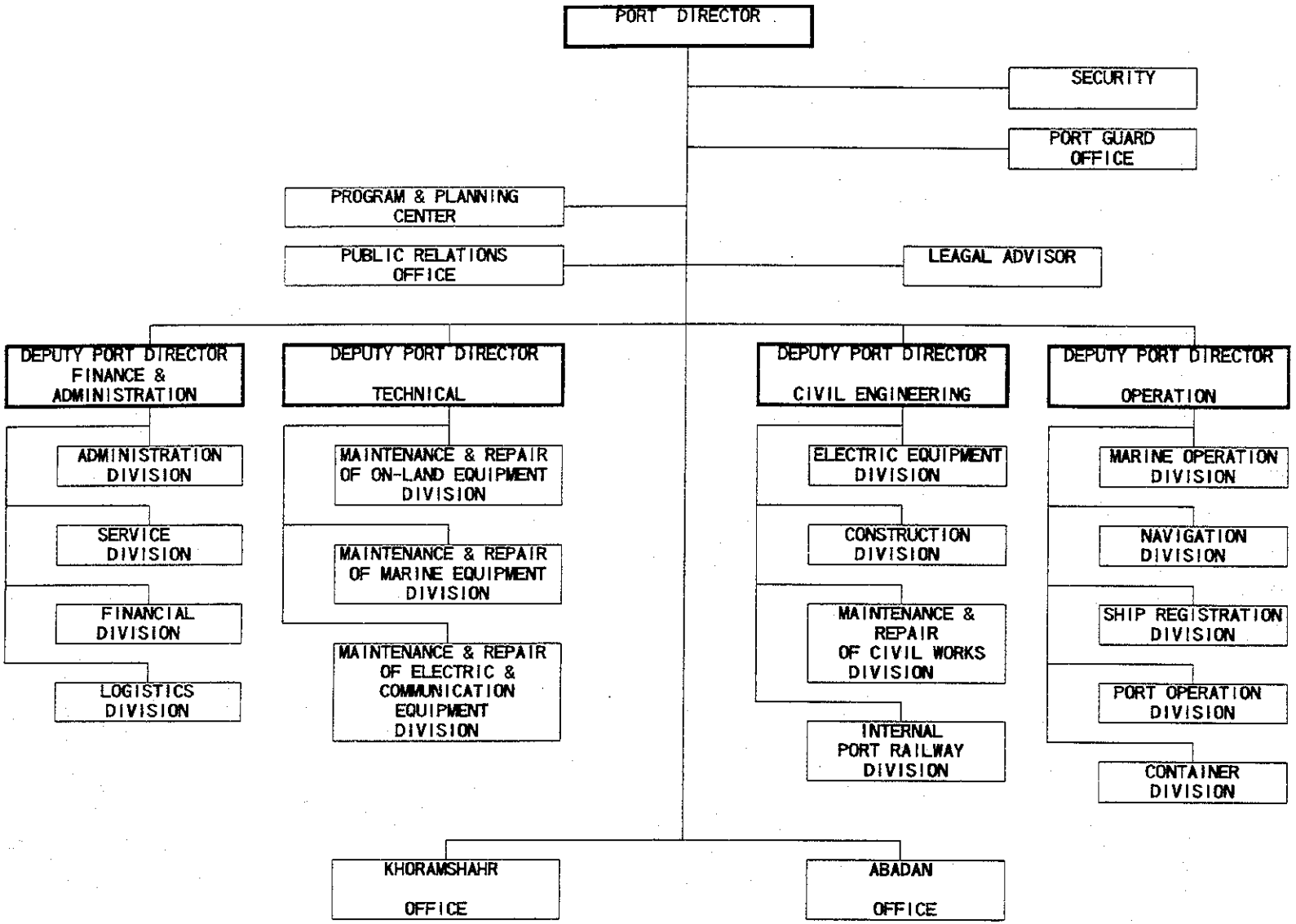


Figure 3.2.3.1 Organization Chart of Imam Khomeini Port Authority

decision.

3.2.4 Cargo Handling Equipment

The existing cargo handling equipment at the port are as follows.

Container crane	: 2 units
Transfer crane	: 2 units
Top lifter	: 5 units
Portal Jib Crane	: 6 units
Tire mounted mechanical unloader	: 1 units
Floating unloader	: 2 units
Mechanical & pneumatic unloader	: 2 units
Grain loader	: 1 units
Tire-mounted pneumatic unloader	: 2 units
Mobile Crane	: 17 units
Fork-lift truck	: 39 units
Others	: 55 units

There are many kinds of crane and most of them are tire mounted equipment except container crane, portal jib crane and mechanical unloader. There are two unique handling system which are floating unloader for ore and shiftable hopper for aluminum powder. There are no procurement and disposal plan for cargo handling equipment. So, there is the possibility that equipment trouble obstruct smooth port operation.

3.3 Demand Forecast and Port Capacity Evaluation

3.3.1 Commodity-wise Cargo Traffic Demand for the Port

(1) Present condition of handling cargo volume

Present economic activities in connection with port activities in a recent six-year period are shown in Figure 3.3.1.1, Figure 3.3.1.2 and Figure 3.3.1.3 show cargo handling volume by commodity type.

From 1988/1989 to 1989/1990, the cargo handling volume surged due to the end of the war. Then from 1989/90 to 1993/94(with the exception of 1992/93, have been stagnant due to import controll of the government), the handling cargo volume grew steadily every year. This trend toward steady growth is seen not only at Imam Khomeini port but at all Iranian ports.

In particular, the rapid increase in export cargo from 1991/92 to 1992/93 reflects the policy of the government. In concretely, these cargoes (bag and steel material) is as shown in the Figure 3.3.1.3.

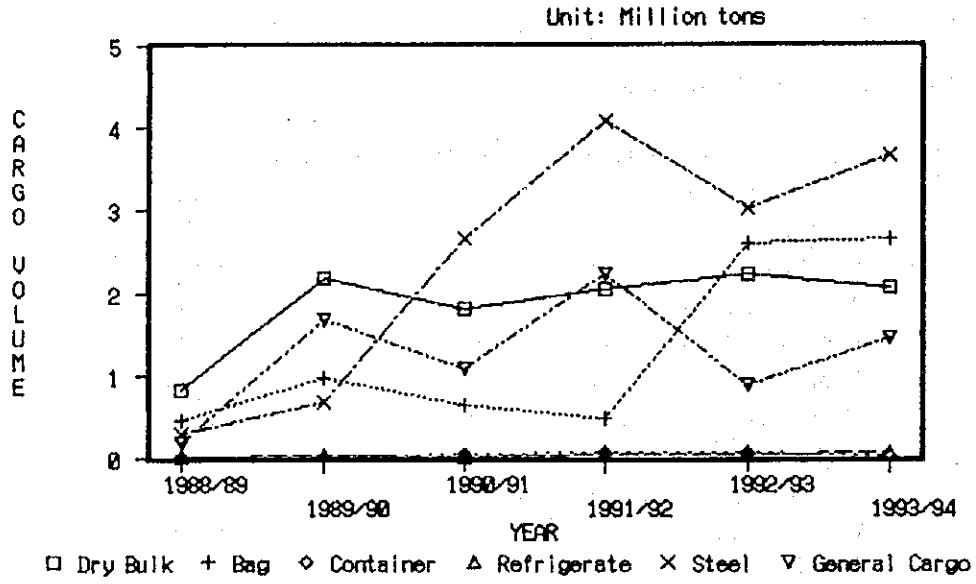


Figure 3.3.1.1 Total Cargo Traffic Movement at Imam Khomeini Port

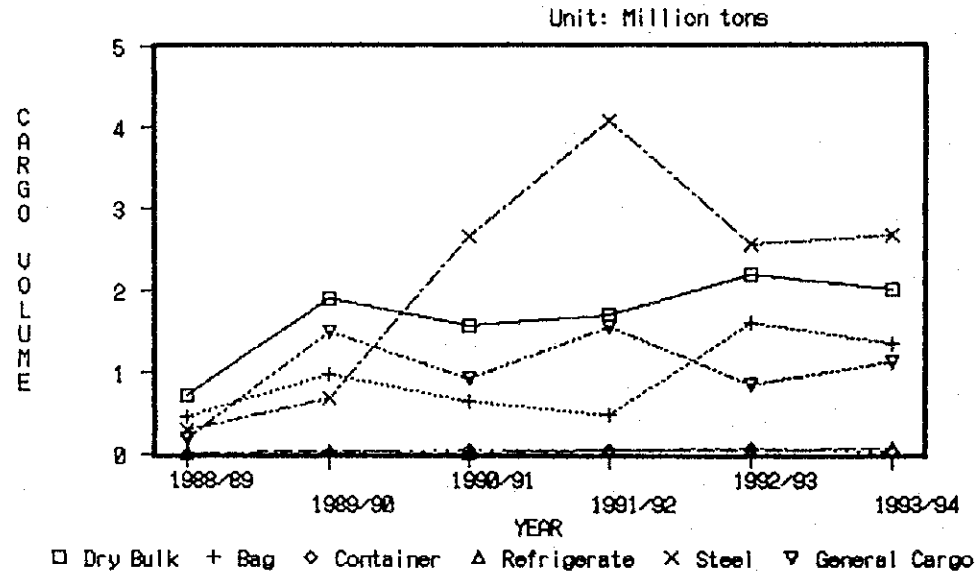


Figure 3.3.1.2 Import Cargo Traffic Movement at Imam Khomeini Port

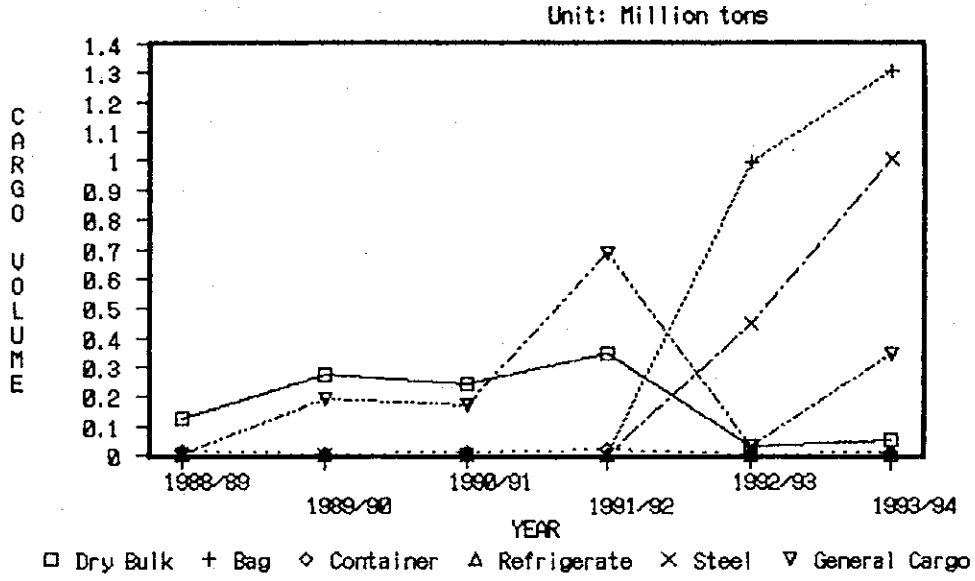


Figure 3.3.1.3 Export Cargo Traffic Movement at Imam Khomeini Port

(2) Demand forecast for handling cargo volume

The method of forecast is shown in Chapter 2.3.5 (the flow-chart).
Forecasted commodity-wise cargo handling volume in target years 2000/01 and 2010/11 is as shown in the Table 3.3.1.4.

The cargo handling volume including all commodities is forecasted to show the increasing tendency up to target year 2010/11. In particular container cargo is expected to increase rapidly in line with the trend towards containerization observed throughout the world.

Table 3.3.1.4 Forecasted Import & Export Cargo Handling Volume

Unit: 1,000 tons

COMMODITY	*1993/94 (Actual Data)			**2000/01			**2010/11		
	Imp.	Exp.	Total	Imp.	Exp.	Total	Imp.	Exp.	Total
Dry Bulk	2,017	54	2,071	3,531	180	3,711	4,342	163	4,505
Liquid Bulk	0	69	69	47	127	174	55	142	197
Bagged Cargo	1,356	1,305	2,661	1,501	1,874	3,375	1,780	3,625	5,405
Container	29	9	38	793	121	914	4,786	3,381	8,167
Refrigerated Cargo	66	0	66	219	0	219	410	0	410
Steel Product	2,674	1,005	3,679	2,986	1,448	4,434	4,810	1,840	6,650
Mineral	0	0	0	99	0	99	133	0	133
General Cargo	1,117	346	1,463	1,640	1,122	2,762	2,807	1,666	4,473
Sub Total	7,259	2,788	10,047	10,816	4,872	15,688	19,123	10,817	29,940
Land Bridge Cargo	0	0	0	235	310	545	540	695	1,235
Total	7,259	2,788	10,047	11,051	5,182	16,233	19,663	11,512	31,175
Ratio of Imp/Exp	72.3%	27.7%		68.1%	31.9%		63.1%	36.9%	

Note: *1993/94 (Actual Data) ----- PSO Data
**2000/01 & 2010/11 ------ Forecasted by the Study Team

3.3.2 Capacity Evaluation

(1) Dry Bulk Cargo (Grain)

1) Present handling capacity of silo jetty
Present handling capacity of existing berth is calculated by using actual data from 1990 to 1992. Wheat, barley and corn are unloaded at his jetty. Average value of the berth occupancy ratio of each cargo from 1990 to 1992 is used for capacity evaluation.

2) Potential cargo handling capacity
At silo jetty and at general cargo berth, forecast cargo handling capacity after improving existing facilities and operation system is calculated.

Until 2000, there will be two pneumatic unloaders at general berth, 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.

(2) Conventional Cargo

1) Present capacity
Conventional cargo includes bagged cargo, steel cargo, refrigerated cargo and general cargo.

Table 3.3.2.1 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

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.

(3) Container Cargo

The cargo handling capacity for one berth is 55 TEUs/hour using two container cranes, and of that for three berths is 38 TEUs/hour using four ship gears per berths.

(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 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.

(5) Total Evaluation of Cargo Handling Capacity

Based on the above, the cargo handling capacity is calculated as shown in Table 3.3.2.2.

Table 3.3.2.2 Cargo Handling Capacity in Imam Khomeini Port

unit : 1,000 tons

Commodity-wise	Present(1993) with existing	Maximum(2000) with improving	Future(2010) with developing[1]
Grain Berth	2,647	4,135	5,047
Conven. Berth	7,382	9,269	12,374
Contain. Berth	5,984	5,984	9,600
Ore Berth	1,910	3,255	3,255
Total	17,923	22,643	30,276

(1) Details are described in section 6.1.

3.4 Shipload and Number of Ship Calls

3.4.1 Present Condition of Ship Calls

(1) Actual results of ship calls

The number of calling vessels at Imam Khomeini port from 1990/91 to 1992/93 is as follows.

Table 3.4.1.1 Total Calling Vessel at Imam Khomeini Port

(unit: number of ship)

Year	1990/91	1991/92	1992/93
Vessel	332	452	507

Source: PSO

(2) Average ship type and average loaded cargo volume

Table 3.4.1.2 indicates number of calling vessels, average dead weight ton (DWT),

Table 3.4.1.2 Average Vessel Size & Unloading Cargo at Imam Khomeini Port

Unit:tons

	1990/91				1991/92				1992/93				1990-91-92		
	Ship	Av.DWT	Av.Cargo	L.R	Ship	Av.DWT	Av.Cargo	L.R	Ship	Av.DWT	Av.Cargo	L.R	Av.DWT	Av.Cargo	L.R
Dry Bulk															
Barley	4	39,286	25,968	66.1%	6	40,701	32,954	81.0%	0	-	-	-	40,135	30,160	75.1%
Corn	10	40,755	31,300	76.8%	12	34,555	31,417	90.9%	15	37,672	34,259	90.9%	37,494	32,538	86.8%
Fertilizer	9	35,349	30,772	87.1%	5	31,304	26,908	86.0%	5	34,253	32,442	94.7%	33,996	30,195	88.8%
Wheat	28	42,079	38,695	92.0%	31	42,236	40,042	94.8%	33	45,336	40,637	89.6%	43,300	39,845	92.0%
Total	51				54				53						
Average		40,413	34,849	86.2%		39,346	36,122	91.8%		42,121	38,059	90.4%	40,621	36,361	89.5%
Bag Cargo															
Rice	11	30,668	21,253	69.3%	8	29,676	23,747	80.0%	14	22,809	15,747	69.0%	27,093	19,522	72.1%
Soya Bean	2	35,839	26,249	73.2%	4	27,996	23,715	84.7%	10	26,085	19,725	75.6%	27,782	21,538	77.5%
Sugar	9	25,139	14,224	56.6%	9	17,721	14,062	79.4%	15	16,043	14,706	91.7%	18,981	14,399	75.9%
Chemical Material	17	22,024	18,392	83.5%	14	22,581	5,643	25.0%	27	17,283	13,721	79.4%	19,951	13,140	65.9%
Cement	0	-	-	-	8	***	***	***	18	***	***	***	***	***	***
Total	39				43				84						
Average		25,889	18,640	72.0%		23,572	14,011	59.4%		19,507	15,284	78.4%	22,059	15,743	71.4%
Container	7	17,694	5,487	31.0%	4	23,720	9,582	40.4%	10	18,474	3,641	19.7%	19,213	5,388	28.0%
Refrigerated															
Meat	2	15,216	4,478	29.4%	16	20,679	6,314	30.5%	15	15,216	4,839	31.8%	17,865	5,532	31.0%
Cheese	6	49,547	9,612	19.4%	4	12,142	8,289	68.3%	5	***	9,985	***	34,585	9,383	27.1%
Butter	4	26,659	5,553	20.8%	0	-	-	-	0	-	-	-	26,659	5,553	20.8%
Total	12				20				20						
Average		36,196	7,403	20.5%		18,972	6,709	35.4%		15,216	4,839	31.8%	22,171	6,289	28.4%
Steel															
Iron Product	78	28,653	18,346	64.0%	113	24,580	17,073	69.5%	88	27,386	16,730	61.1%	26,604	17,321	65.1%
Iron Ingot	6	17,715	9,999	56.4%	4	32,361	20,510	63.4%	4	31,189	20,882	67.0%	25,749	16,112	62.6%
Cast Iron	0	-	-	-	3	***	***	***	4	***	***	***	***	***	***
Total	84				120				96						
Average		27,872	17,750	63.7%		24,846	17,191	69.2%		27,551	16,911	61.4%	26,563	17,263	65.0%
Mineral															
Alminium Powder	4	48,062	34,000	70.7%	4	***	33,872	***	6	23,272	18,626	80.0%	33,188	24,776	74.7%
Iron Ore	11	58,630	39,433	67.3%	0	-	-	-	0	-	-	-	58,630	39,433	67.3%
Iron Powder	0	-	-	-	33	37,532	35,840	95.5%	25	42,487	41,573	97.8%	39,668	38,311	96.6%
Ore Powder	2	38,450	35,518	92.4%	2	36,909	35,797	97.0%	2	40,422	40,090	99.2%	38,594	37,135	96.2%
Phosphat	5	35,790	33,525	93.7%	8	46,165	38,925	84.3%	11	43,254	39,193	90.6%	42,669	37,923	88.9%
Powder Total	22				47				44						
Average		49,683	36,747	74.0%		39,109	36,412	93.1%		39,965	37,781	94.5%	41,589	37,032	89.0%
General Cargo															
Miscellane.	89	17,178	8,022	46.7%	115	16,654	4,727	28.4%	149	17,487	4,015	23.0%	17,138	5,257	30.7%

Source: PSO
Note : All data are based on imported cargo record
*** : Lack of sufficient information

average import cargo volume and loading rate (L.R) by commodity-wise cargo from 1990/91 to 1992/93 at Imam Khomeini port.

(3) Correlation between ship length and DWT

Figure 3.4.1.1 shows the correlation with vessel length and DWT of calling vessels at Imam Khomeini port from 1990/91 to 1992/93. The average length of calling vessels is as shown in Table 3.4.1.3.

Table 3.4.1.3 DWT and Vessel Length

DWT (tons)	Length (m)
10,000	133
15,000	152
20,000	164
30,000	180
40,000	195
50,000	215
60,000	221
70,000	235

3.4.2 Ship Type and Number of Ship Call in Future

The method of forecast for ship type and number of ship call in future at Imam Khomeini port is shown in Figure 3.4.2.1.

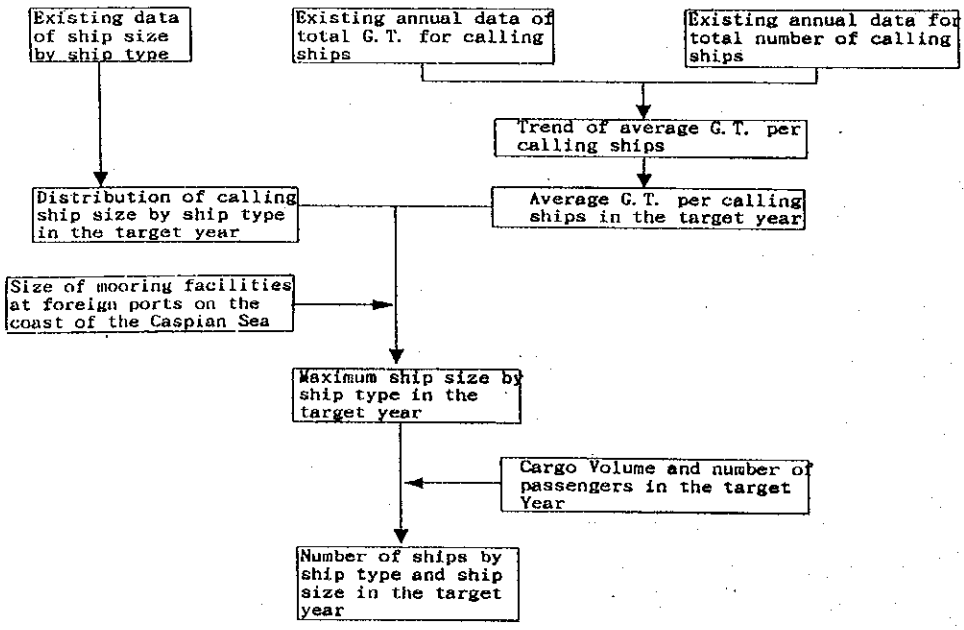


Figure 3.4.2.1 Flow Chart of Forecast for Ship Type and Number of Ship Call in Future

(1) Forecast for ship type in target year

Future average vessel-size in the target years is given in Table 3.4.2.1.

Table 3.4.2.1 Future Average Vessel-size (unit: DWT)

Ship Type	2000/01	2010/11
Bulk ship	45,000	50,000
(Bulk Cargo & Mineral)		
Container ship	24,000	30,000
Mix type ship		
Bagged & Refrigerated cargo	26,000	30,000
Steel product	28,000	30,000
General cargo	23,000	30,000

Note: Vessel-size in 2010/11 is forecasted by the Study Team.
It is assumed that vessel-size will increase with a fixed rate from present vessel-size (Table 3.4.1.2) to forecasted vessel-size in 2010/11.

(2) Forecast for number of ship calls

Total calling vessels by each vessel-size in target years is forecasted as in following Table 3.4.2.2 and Figure 3.4.2.2.

Table 3.4.2.2 Distribution of Calling Vessel

Ship Size DWT(tons)	1992/93 (No.)	2000/01 (No.)	2010/11 (No.)
0 - 700	13	0	0
700 - 1,000	10	0	0
1,000 - 2,000	33	0	0
2,000 - 3,000	0	0	0
3,000 - 5,000	4	10	0
5,000 - 8,000	13	35	7
8,000 - 10,000	8	17	34
10,000 - 15,000	41	42	103
15,000 - 30,000	195	609	801
30,000 - 40,000	62	135	864
40,000 - 50,000	118	123	137
50,000 - 70,000	10	24	123
70,000 - 90,000	0	5	0
90,000 - 100,000	0	0	0
100,000 - 150,000	0	0	0
Total	57	1,001	2,080

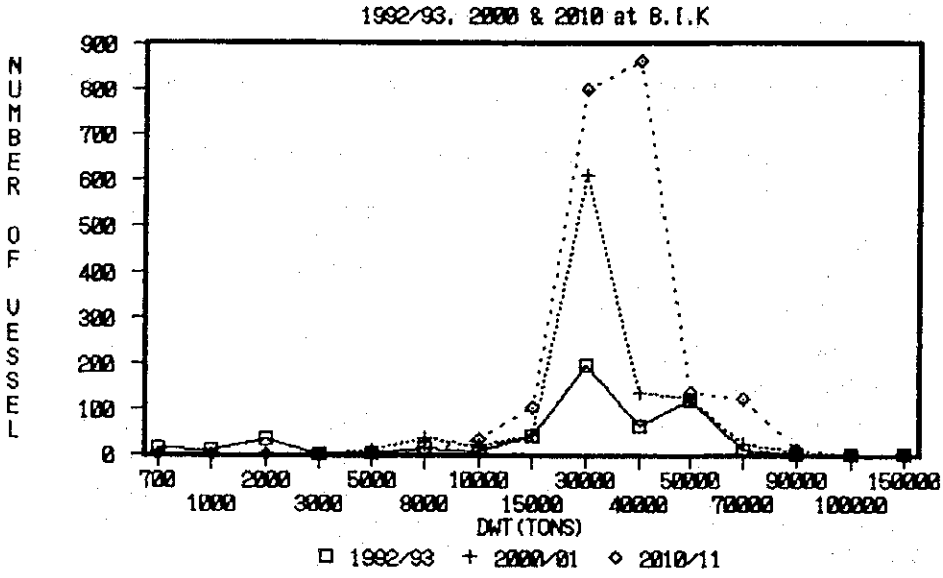


Figure 3.4.2.2 Transition of Calling Vessel

3.5 Physical Requirements for Future Port Development

3.5.1 Mooring Facility

Required number of conventional berth is calculated based on cargo demand forecast and ship type forecast. Calculation method is shown in Figure 3.5.1.1 as follows. The calculation is carried out by each ship type and the result is shown in Table 3.5.1.1.

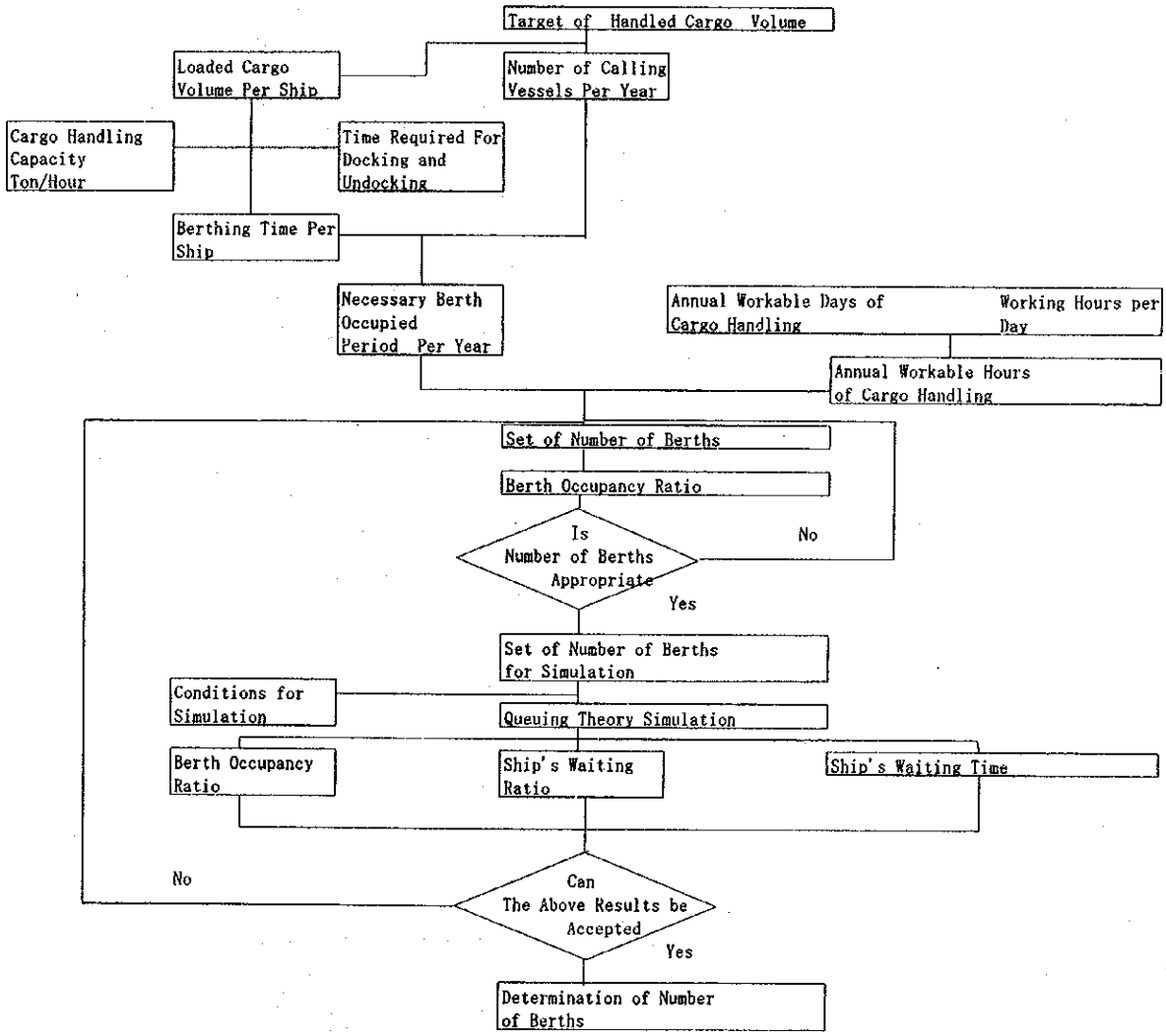


Figure 3.5.1.1 Flow Chart for Determining Number of Berths

Table 3.5.1.1 Required Berth Number and Length

	1993	No.(1)	2000	No.	2010	No.
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(2)	840	4	260	1	1,420	5
Total	5,602	29	4,551	21	7,857	33

(1) Existing berth number and length.

(2) Details are described in the section of "container terminal"

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 3.5.1.2.

Table 3.5.1.2 Future Port Facilities

Name of Berths	2000/01		2010/11	
Grain Jetty	240 x 1	-13 m Grain	240 x 1	-13 m Grain
Eastern Jetty	200 x 1	- 9 m Bagged	250 x 1	-13 m Bagged, General
Ore Pontoon	180 x 1	-13 m Mineral	250 x 1	-13 m Bagged, General
Western Jetty	260 x 1	-13 m Mineral	260 x 1 260 x 1	-13 m Bagged, General -14 m Mineral
No.7 - No.10	192.7x2	-10 m General	320 x 2	-14 m Container
Container	260 x 1 260 x 2 260 x 1	-12.5 m Container -12.5mSteel,Bagged -12.5 m Grain	280 x 3 260 x 1	-12.5 m Container -12.5 m Grain
No.16 - No.20	220 x 4	-11 m Steel,Bagged	220 x 4	-11 m Steel
No.21 - No.26	220 x 2 220 x 2 180 x 1	-11 m Ref.Liquid -11 m Gen.Bagged -11 m General	220 x 2 220 x 2 180 x 1	-11 m Ref.Liquid -11 m General -11 m General
No.27 - No.34	180 x 1 220 x 4	-11 m General -11 m General Ro-Ro	180 x 1 220 x 1 220 x 4	-11 m Bagged -11 m Bagged -11 m Gen.Ro-ro
New Berth			260 x 1 250 x 3 250 x 4	-14 m Steel -13 m Steel -13 m General
Total	24 Berths, 5,305 m		34 Berths, 8,230 m	

(2) Container Terminal

Required length and depth and number of container berth is decided on the basis of object vessel, cargo volume and handling capacity in target year.

Table 3.5.1.3 shows required length, depth and number of container berth.
Table 3.5.1.4 shows required area of facilities in container terminal.

Table 3.5.1.3 Container Berth

	Berth Length (m)	Depth (m)	Number	Vessel (DWT)
2000/01	280	-12.5	1	30,000
2010/11	280	-12.5	3	30,000
	320	-14.0	2	50,000

Table 3.5.1.4 Facilities in Container Terminal

Facilities	2000/01	2010/11
Container yard (Required number of ground slots, TEUs)	1,619	7,771
Container Freight Station (m^2)		
Number of truck lane	3,543	31,667
Maintenance Shop (m^2)	3	12
Container cleaning space (m^2)	--	4,000
Terminal office (m^2)	--	2,000
	--	2,500

3.5.2 Cargo Handling Equipment

The improvement plan to get higher productivity for each berth are made considering the following basic policies.

1) The most suitable handling system shall be introduced
2) The required equipment for system shall be prepared
3) All equipment to be used shall be maintained in good condition with enough preventive maintenance and sufficient spare parts.

The main items to be improved for cargo handling system are as follows.
1) The most of unloaded cargo will be stored temporarily in the port area.
2) The unit load handling system by fork-lift truck is introduced.

3.5.3 Transit Shed and Storage Facility

Table 3.5.3.1 shows the breakdown percentage of cargo using storage facilities and for direct delivery.

Table 3.5.3.1 Share of Cargo (%)

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

Table 3.5.3.2 Cargo in Storage Facilities (%)

Commodities	Short term storage		Long Term storage	
	Transit shed	sorting yard	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 are shown in the following Table 3.5.3.3 and 3.5.3.4.

Table 3.5.3.3 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	292,500	6,266	0	405,000	19,286	0
Metallic	-11x220x4nos	836,800	(30%) 8,235	(70%) 19,214	1,773,000	(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 3.5.3.4 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

3.5.4 Others

(1) Apron width

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.

(2) 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 existing entrance channel with more than 500 meters at Imam khomeini port is sufficient.

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

Maximum water depth of basin and channel in Imam Khomeini port is 14 meter.

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 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 of the overall length of the ship.

(3) Service Area and Parking Lot

Gas station and maintenance shop for the trucks is necessary. Two parking lots for the port, each about 20,000 m^2, are planned. Gas station and maintenance shop each about 10,000 m^2 are planned.

(4) Service Boat and Dredger

There are nine tug boats at present. Based on the number of future calling vessels, 17 tug boats will be needed. One more dredger will need for maintenance dredging.

3.6 Alternative Layout Plans of Port Facilities

3.6.1 Basic Policy for Development of Alternative Layout Plans

(1) Economy

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

1) Total cost should not exceed the sound financial position and government budget.
2) Cost efficiency should be secured.
3) 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.
4) From the viewpoint of urgent requirements of the port, the short term plan will focus on increasing productivity by rehabilitation of the existing facilities.

(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 case that construction will not be completed on schedule.
3) Technical support should be prepared in all development stages.

(3) Post Master Plan

Since the direction of further expansion for the port after completion of the development plan projects should be considered the well within the development plan stage, following points need to accounted.

1) Positional correlation between existing harbor and new developed harbor areas is necessary.
2) Access road and railway connection should be provided.
3) Information system should be introduced.
4) West harbor should have its own administrative system for efficient port activities.
5) Land for port activities should be kept adequately.

3.6.2 Alternative Layout Plans

For the improvement and expansion of the port up to the year 2010, three alternative layout plans are formulated and evaluated as shown in Figure 3.6.2.

(1) Alternative 1

1) Location and outline
At the old port located along Khor Musa, the existing berth will be improved to increase cargo handling efficiency.

The port development will be conducted along the west side of Khor Dorag (Hereinafter the development site is referred to as "West harbor") as shown in Figure 3.6.2.1.

2) Harbor layout
The eastern and western jetties should be demolished. Bagged, general and ore bulk cargo berths will be constructed here with reclamation.

Container terminal should be continuation of the container berths.

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

(2) Alternative 2

1) Location and outline
At the old port located along khor Musa, the existing berth will be improved to increase cargo handling efficiency.

The port development will be located along the left side of khor Zangi (Hereinafter the development site is referred to as "North harbor") as shown in Figure 3.6.2.2.

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

Other berth layout is as same as Alternative-1.

(3) Alternative 3

1) Location and outline
At the old port located along Khor Musa, the improvement works of ore berth for increasing cargo handling efficiency will be conducted.

The port development will be conducted along the West harbor as shown in Figure 3.6.2.3.

Note; (1) Existing harbor area is one the east side of Khor Dorag. Expansion area is on the west side of Khor Dorag. The expansion is referred to us the "West Harbor"

2) Harbor layout

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.

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.

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

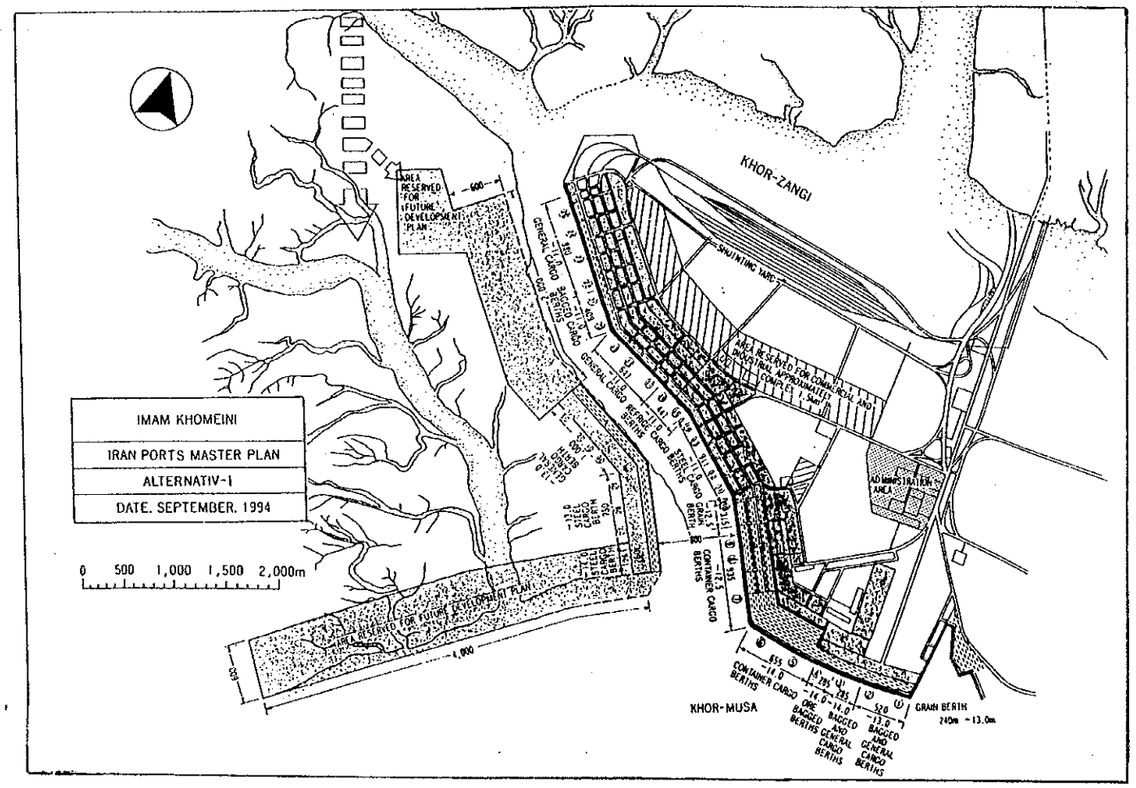


Figure 3.6.2.1 Alternative 1

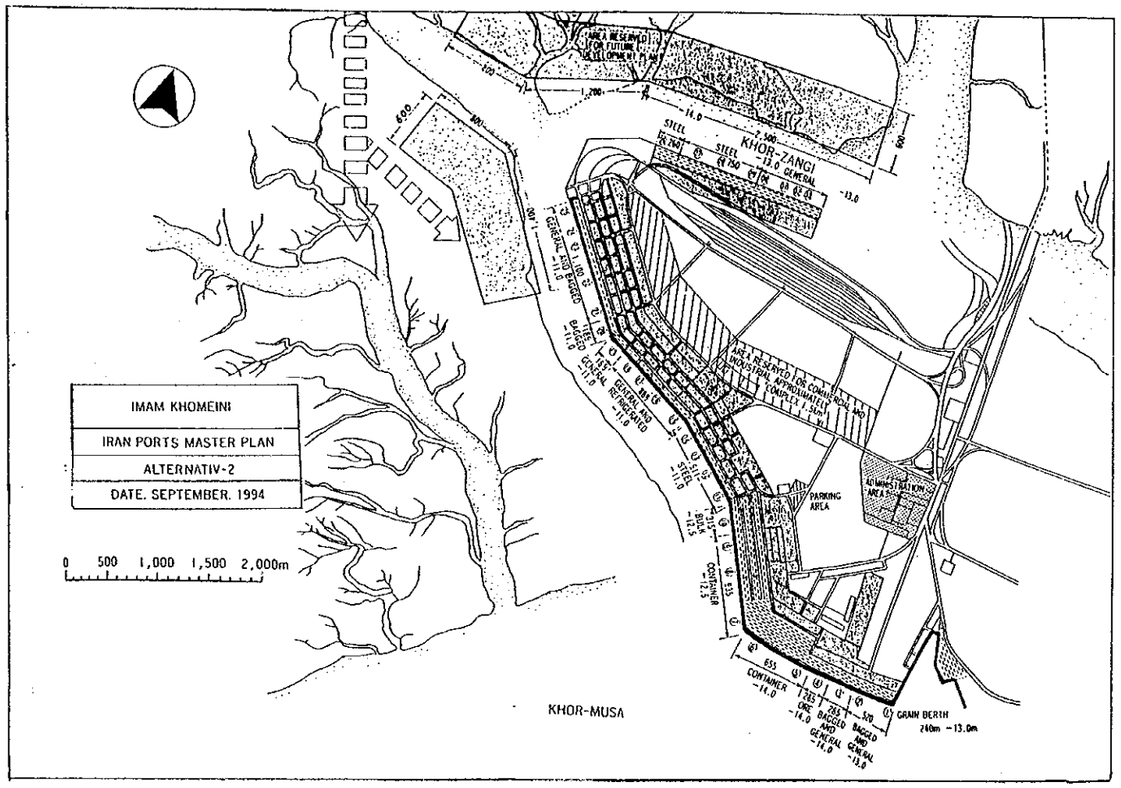


Figure 3.6.2.2 Alternative 2

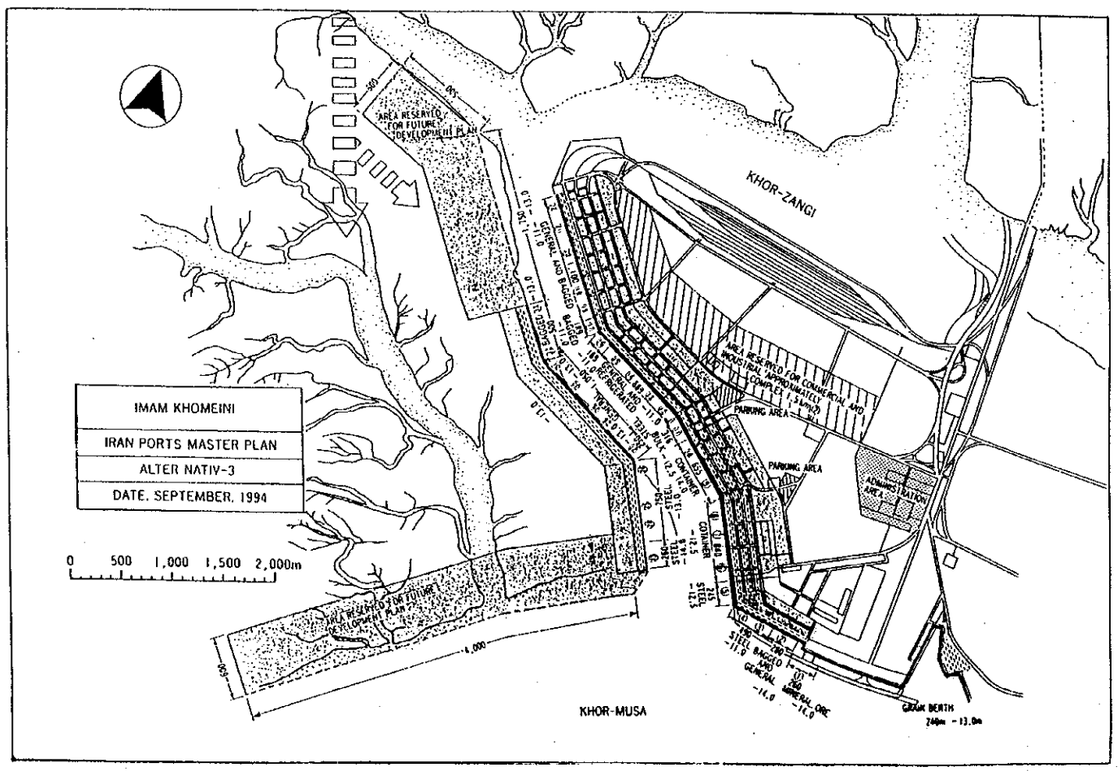


Figure 3.6.2.3 Alternative 3

Figure 3.6.2 Alternative Plans

3.6.3 Access to/from Port

(1) Road

Express route that connect Imam Khomeini port with Tehran is important. An expressway between Imam Khomeini port and Esfahan needs to be constructed. Imam Khomeini port will be connected to Tehran by expressway.

Imam Khomeini port--Esfahan–Tehran route

Imam Khomeini port--Ahvaz	:156km Two-Lane Main Road (Under construction)
Ahvaz--Esfahan	:Under-Study Expressway
Esfahan–Tehran	:Four-Lane Expressway (Completed 280 Km out of total 440 km)

There are two different road network plans for the Imam Khomeini port area in one plan. The west port is connected by expressway near Sar Bandar. The other plan is that the west port is connected with the east port (existing port) by bridge or tunnel. Road network plans of Khomeini port are shown in Figure 3.6.3.1.

(2) Railway

Double-tracking project is ongoing between Khomeini port and Ahvaz.

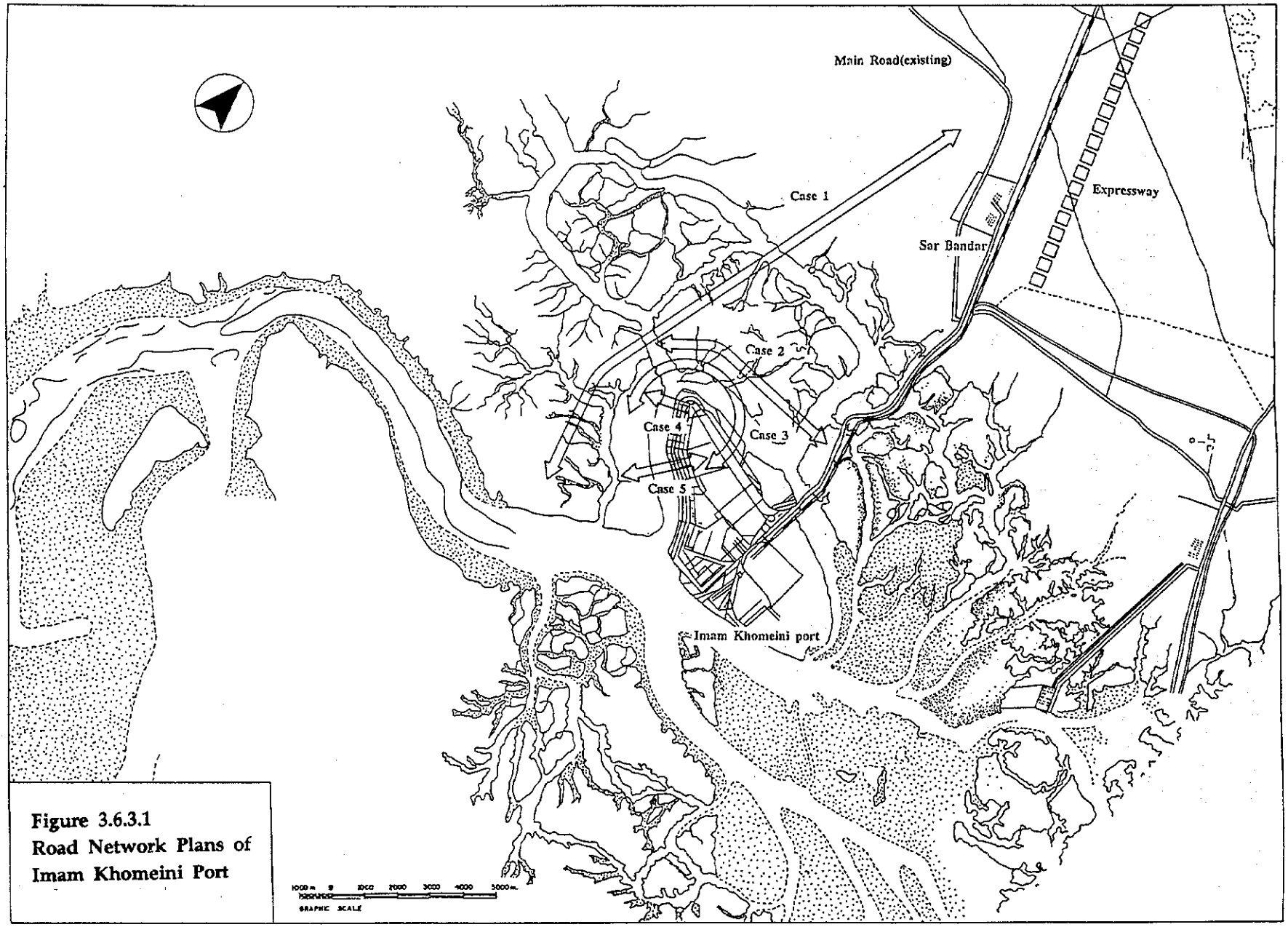


Figure 3.6.3.1
Road Network Plans of Imam Khomeini Port

3.6.4 Evaluation of Proposed Alternative Plans

According to the basic policy for development layout plan, the evaluation indexes for proposed alternative plans are developed as follows, and the result of evaluation is shown in Table 3.6.4.1. In Table 3.6.4.1, evaluation is indicated through 13 concrete indexes.

1) Cost performance
2) Productivity (Efficiency)
3) Practicability
4) Cargo handling capacity
5) Flexibility
6) Fitness for post master plan
7) Technical aspect
8) Environmental impact
9) Inland transportation
10) Navigation

(1) Recommended Alternative

Alternative 1 is selected for Master Plan and road plan of Case -2 is selected for Master Plan as shown in Figure 3.6.4.1.

1) Mooring facilities
General cargo berths should be constructed four berths at the West Harbor of which depth is -13 meters and 250 meters long. It will be able to accommodate up to 50,000 DWT -70,000 DWT vessels. This construction should be undertaken in the long term stage development before the steel expansion berth will start to construct.

Grain terminal should be improved as soon as possible. It should be able to accommodate vessels up to 50,000 DWT at the berth with water depth of -14 meters.

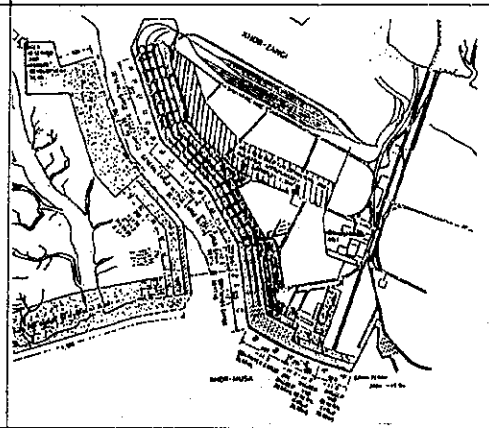
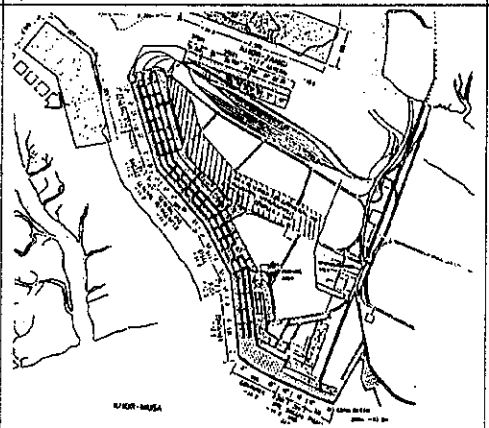
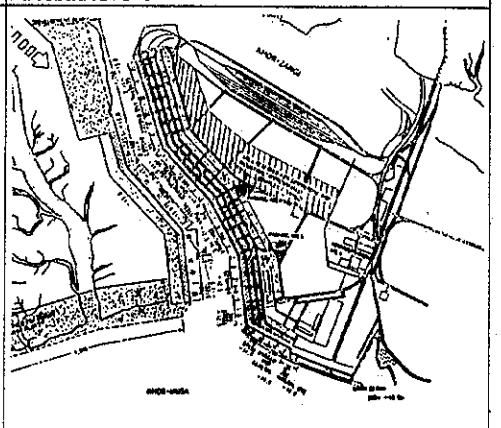
Before 2000/01, cargo handling equipment at the container terminals should be repaired and the basin in front of the existing berth should be dredged. The extension of the berth should be undertaken immediately with the demolish of existing berth for container cargo. Existing container berth should be renewed for increasing cargo volume, just after the above expansion.

Existing ore dolphin should be demolished. Then the multi purpose bulk berth for ore and aluminum powder should be constructed at the same place of the demolished jetties. Coal and coke cargo should be removed to the Steel company berth.

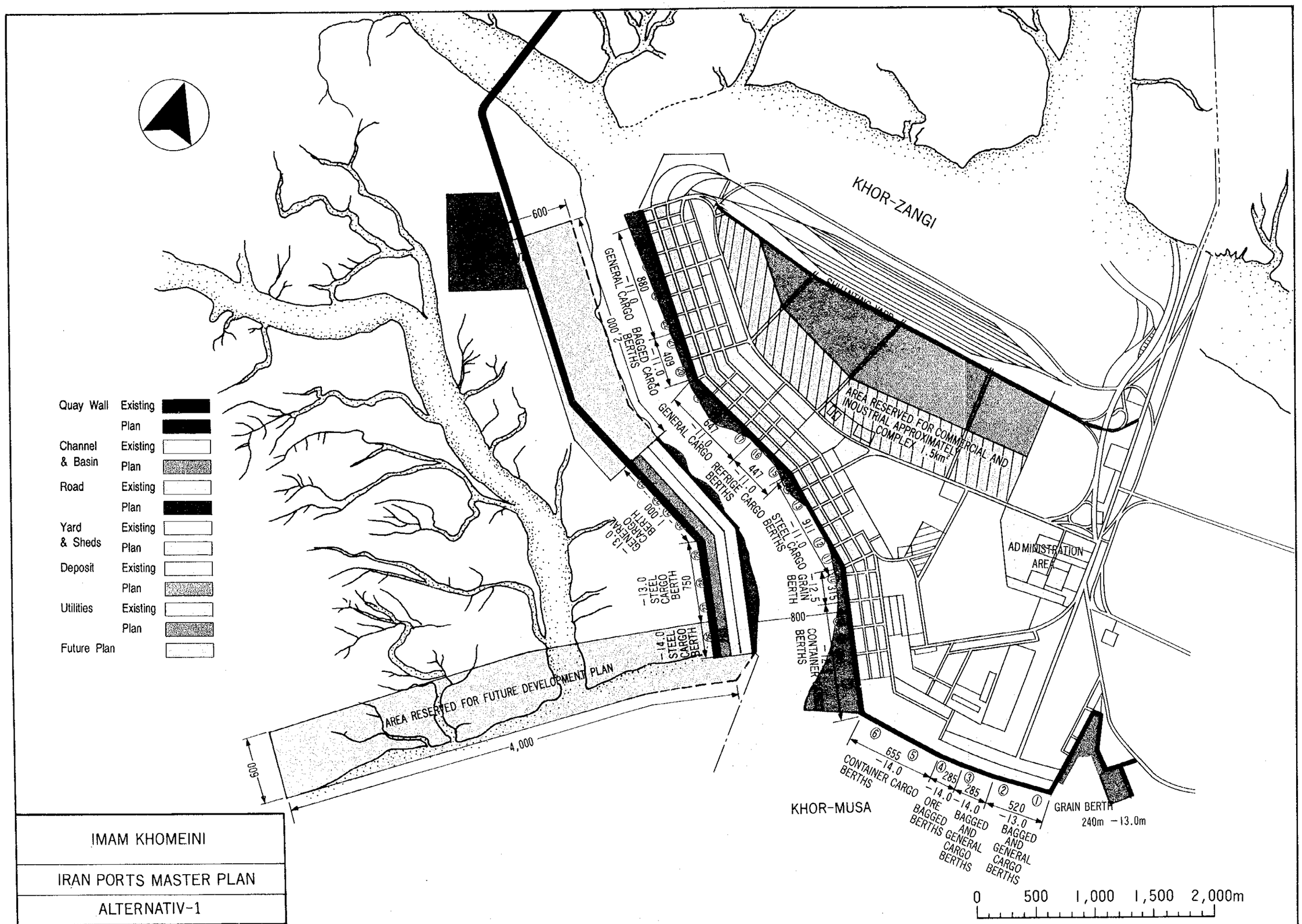
Existing western and eastern jetty should be demolished and new multi-purpose berths should be constructed with reclamation for bagged cargo and general cargo of large vessels.

Steel cargo handling berths should be separated in existing harbor and west harbor.

Table 3.6.4.1 Evaluation of Alternatives for Master Plan at Imam Khomeini Port

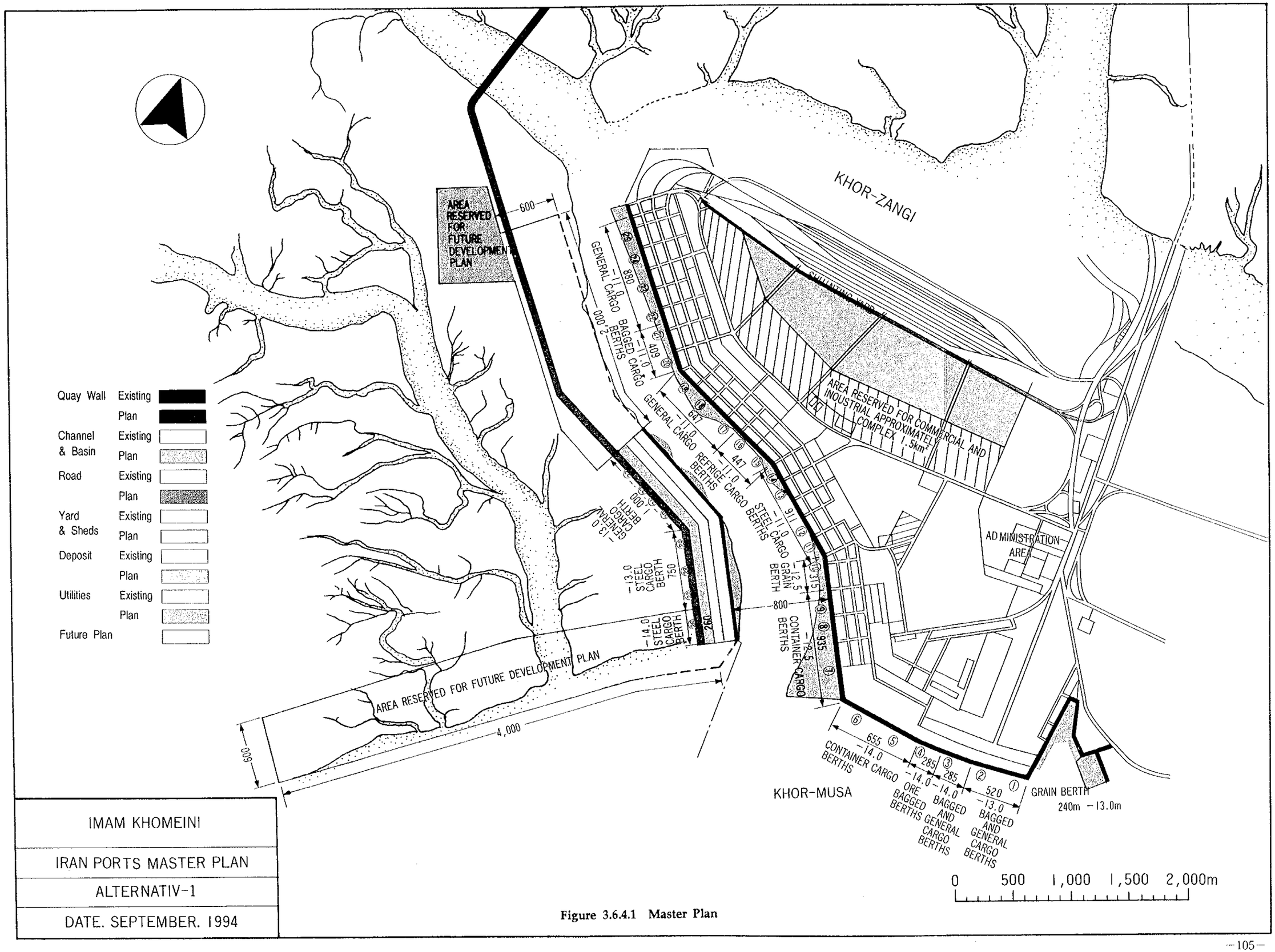
	Alternatives		
	Alternative-1	Alternative-2	Alternative-3
Location			
Reliability	3	2	3
Practicability	2	2	2
Flexibility	3	1	2
Accessbility	2	3	2
Construction Cost	2	3	2
Post Master Plan	3	2	2
Effect on Existing Facility	2	2	1
Navigation	3	1	3
Environment (Natural)	2	1	2
Environment (Social)	2	2	2
Disturbance 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)



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

Figure 3.6.4.1 Master Plan



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

Figure 3.6.4.1 Master Plan

More available area for handling large items such as machinery should be secured by new four berths at the West harbor.

2) Transit sheds and sorting yard
A total transit sheds and sorting yards with an area 202,000 m^2 will be available on completion of the Master Plan.

3) Warehouse and storage yard
The total area of open storage and warehouse available is approximately 253,000 m^2 except the container berths' yard. And cold storage should be secured as soon as possible.

3.7 Short Term Plan and Rehabilitation Plan

(1) Short Term Plan (Target year 2000/01)

1) Improvement schemes of Silo terminal
-Improvement of jetty by dolphin
-Dredging of basin, -13.0 m (below Cesco C.D.)[1)]
-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.)
-Paiement

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

5) Improvement schemes of container terminal (No.11 - No.15)
-container berth; 1 berth
Berth length, 260 m
Dredging of basin, -12.5 m (below Cesco C.D.)
Repairing the gantry crane
Pavement of yard

-Steel cargo berth; 2 berths
Berth length, 260 m x 2

NOTE 1); Cesco is consultant company. The chart datume is Cesco's data at Imam Khomeini port.

Dredging of basin, -12.5 m (below Cesco C.D.)
Pavement of yard

-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 (No.21 - No.22)
-Refrigerated cargo berth; 2 berths
Berth length, 220 m x 2
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
-Dredging of basin, -11.0 m (below Cesco C.D.)

(2) Subjects of urgent Rehabilitation (Target year 1997/98)

1) Repairing of structure (Berth No.11 to No.34)
2) Improvement navigation aids
3) Improvement of cargo handling equipment for increasing the cargo handling efficiency

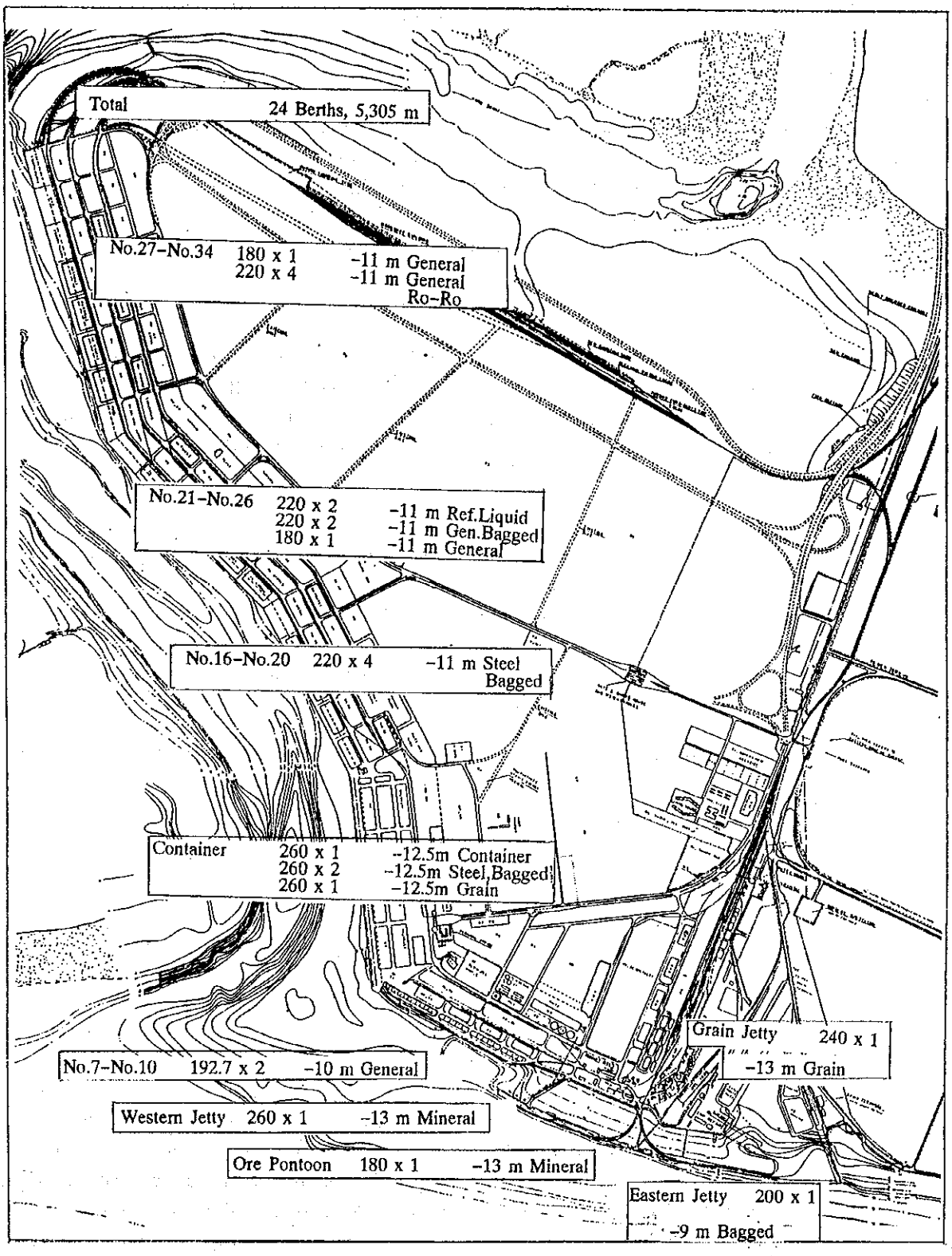


Figure 3.7.1 Short Term Plan

3.8 Design and Estimation of Required Port Facilities

3.8.1 Structures

Table 3.8.2.1 indicates the major work components to be included in the project, namely those for the Short Term Development (STD) and the Long Term Development (LTD). (Refer to Table 3.9.1.1 for the project implementation).
As seen in the table, the project consists of various works from the structural repair to the proposed development of completely new facilities.

Cost estimation is carried out based on the costing criteria as follows:

(1) Construction efforts for the Short Term Plan is tentatively scheduled to start at the beginning of 1997 and will be completed by the end of 2000. It is also assumed that the construction efforts for the Long Term Plan will start at the beginning of 2001 and will be completed by the end of 2010.

(2) Estimation is based on the market price as of January 1994.

(3) Customs duty of 40 % on imported construction materials for permanent works are included. However those on imported equipment and materials to be imported merely to the project are excluded.

(4) Various charges to be born by the contractors included social charges, mine tax and business tax are considered.

(5) Exchange rate for cost estimation is average value between government rate and city market bank rate at the beginning of 1994.
One US dollar = 2,000 Rials

(6) Any compensation for other industries including fishing rights none or a small sum is excluded.

(7) Engineering fee is 10.0% of the initial investment cost.

(8) Physical contingency is 10.0% of the initial investment cost.

(9) Price escalation is not considered.

Any cost for land purchase or rental otherwise for both permanent works and temporary works are excluded as far as their location is within the PSO premises. It is proposed that a part of existing wharf and reclaimed land can be utilized for free of charge by the contractor as a temporary construction site. The typical unit price and major construction plants especially for floating equipment are based on the both information provided by PSO and similar projects in the past..

3.8.2 Cargo Handling Equipment

The required cargo handling equipment and cost of them is shown in the following.

Table 3.8.2.1 List of Equipment

Units: 1,000 US$ (KHOMEINI)

	Capacity	Existing	Unit Price	Master Plan			Short Term		
				Required	Procurement	Cost	Required	Procurement	Cost
Unloader for Grain	1,000 t/h	2	—	2	0	0	2	0	0
Related facilities	—	1 set	—	1 set	0	7,000	1 set	0	7,000
Unloader for Mineral	1,000 t/h	2	—	2	0	0	2	0	0
Related facilities	—	1 set	—	1 set	0	0	1 set	0	0
Container Crane	30.5	2	9,000	4	2	18,000	2	0	
〃	30.5	0	7,000	6	6	42,000	0	0	
Jib Crane	6t × 25	6	—	6	0		6	0	
Loader for Grain	1,000 t/h	1	—	0	0		0	0	
Pneumatic Unloader	280 t/h	2	4,000	4	2	8,000	2	0	
Conveyor (Movable)	300 〃	0	100	4	4	400	0	0	
〃 (Fixed)	500 〃	0	500	3	3	1,500	0	0	
Transfer Crane	30.5 t	2	2,500	27	25	62,500	5	3	7,500
Mobile Crane	550 t	1	—		0			0	
	90 〃	1	—		0			0	
	60 〃	2	—	3	0		1	0	
	50 〃	0	800	12	11	8,800	7	5	4,000
	47.5 〃	1	—						
	40 〃	2	600	17	15	9,000	11	9	5,400
	35 〃	1	520	6	5	2,600	22	19	9,880
	27.5 〃	2	—						
	25 〃	4	350	14	6	2,100	12	4	1,400
	20 〃	0	—						
	10 〃	1	—						
	8 〃	2	—						
Rail Road Crane	20 t	1	—		0	0		0	0
	10 〃	3	—		0	0		0	0
Fork-lift Truck	40 t	5	—	2	0		0	0	
	20 〃	0	—	3	0		1	0	
	15 〃	3	—	0	0		0	0	
	13.5 〃	1	—	0	0		0	0	
	10 〃	10	—	0	0		0	0	
	7.5 〃	0	—	5	0		1	0	
	7 〃	6	—	0	0		0	0	
	5 〃	9	82	39	10	820	23	13	1,066
	4.5 〃	9	—	0			0	0	
	3 〃	0	35	150	141	4,935	127	118	4,130
	2.5 〃	1	—	0	0		0	0	
	2 〃	0	25	8	7	175	2	1	25
Shovel Loader	1 m³	0	90	4	4	360	0	0	
Tractor Head			150	62	40	6,000	13	0	
Trailer		49		27	0		24	0	
Chassis			50	71	49	2,450	14	0	
Truck Scale		0	150	5	5	750	1	1	150
						177,390			40,551

3.8.3 Navigation Aids

(1) The following factors should be kept in mind ;

1) Removal of wrecks

Near the way from No.1/No.6 to No.9/No.14 buoy

2) The relocation of No.4 Khor Musa approach buoy to a position approximately 3 km to the west

3) Relocation of the Pilot boarding point

(Definition of waiting anchorage)
to a point near the above No.4 Khor Musa approach buoy

4) Relocation of the Pilot boarding point

(After removal of wrecks)
to a point near No.9/14 buoys

5) Maintenance and accurate positioning of light buoys and beacons

(Periodical maintenance dredging and sounding of the channel)

6) The end of wharves and jetties should be marked by lights.

3.9 Project Implementation and Stage Investments

3.9.1 Stage Investments

The required works of project will be implemented through two basic stages, namely, the Short Term Plan and the Long Term Plan. The former will be carried out for both the rehabilitation and upgrading of existing facilities, while the latter will be performed to develop new port facilities at Dorag west bank.

Table 3.9.1.1 Outline Schedule

Project Components	Financial and Design	Construction and Procurement	Commencement of Services
A. Existing Port Facility			
Short Term Development			
Scope 1, (STD-EF1, RH)	1995-1996	1997	1998
Scope 2, (STD-EF2)	1995-1997	1998-2000	(2000)2001
Long Term Development			
Scope 1, (LTD-EF1)	1997-2000	2001-2007	(2003)2008
Scope 2, (LTD-EF2)	1997-2000	2001-2008	(2003)2009
B. New Development			
Short Term Development			
None	-	-	-
Long Term Development			
Scope 1, (LTD-ND1)	1997-2000	2001-2008	(2996)2009
Scope 2, (LTD-ND2)	2002-2005	2006-2010	(2008)2011

Note: Figure in parenthesis indicates the year for the partial completion of works.

3.9.2 Implementation Plan

Major Work components and quantity of works at each stage are shown in Table 3.9.2.1.

Table 3.9.2.1 Major Work Components by Project Groups

Stages and Works	Present Berth No.	Future Berth No.	Quantity of Works
STD-EF1			
Structural Repair	B1-B34	NB1 to NB25	30,000m²
Dredging (Grain J. Container Berth)	Grain J.-B20	Grain J. -	2,070,000m²
On-land Facilities		NB10	LS
CH Equipment Repair			LS
Navigation Aids			
Others			
STD-EF2			
Dredging	B21-B34	NB11-NB25	880,000m³
Grain Jetty (Dolphin, contracted)	Grain J.	Grain J.	One dolphin*
Bagged Cargo Berth		NB1	200m × -9.0m
Tentative Ore Berth (C.H. Repair)		NB2	Set
Mineral Berth		NB4	260m x-13.0m
C.H. Equipment			Set
Buildings, Refrigerated Warehouses etc.	B21, 22		18,000m²
LTD-EF1			
(Old Port Areas)			
Cargo Review			
Demolition and Removal	B1-B10		Old structures
Container Berth		NB5 to NB6	640m
Mineral Berth		NB4	260m
Bagged Cargo Berths		NB1 to NB3	760m
Dredging			1,090,000m³
Land Reclamation			27.9 ha
On-land Facilities		NB1 to NB6	Set
Utilities		NB1 to NB6	Set
Buildings			44,700m²
C.H. Equipment			Set
LTD-EF2			
(Former Ten Berth Extension Area)			
Berth Extension		NB7	200m
CH Equipment			Set
On-land Facilities/Utilities	B11-B20	NB7-NB14	LS
Buildings			47,500m²
(Former Fourteen Berth Extension)			
CH Equipment			
On-land Facilities/Utilities			Set
Building, Refrigerated Warehouses,	B21-B34	NB15-NB25	Set
	B21-B23	NB15, 16	2x9,000m²
LTD-ND1			
Cargo Review			
Main Access (Route 5)			5,350m,2bridges
Dredging			13,930,000m³
Reclamation			87.5 ha
Steel Berths	None	WB1 to WB4	
C.H. Equipment			Set
Navigation Aids			Set
On-land Facilities			Set
Utilities			LS
Buildings			43,200m²
LTD-ND2			
General Cargo Berth	None	WB5 to WB8	
CH Equipment			Set
On-land Facilities			Set
Utilities			Set
Building			66,100 m²

3.10 Project Cost Estimation

3.10.1 Initial Cost by Alternative Plan

Table 3.10.1.1 shows the cost summary to be required for the initial investment estimated on the best plans among each alternative. It is clear that Alterative Plan-2 has similar characteristics with Plan-1 in respect of the initial investment cost. However, considering the result of evaluation mentioned in 3.6.4, Plan-1 was finally selected as the plan to be implemented.

Table 3.10.1.1 Initial Investment Cost Summary of Master Plan Alternatives

Unit: million US$

Cost Elements	Plan-1		Plan-2	Plan-3
1. Construction Works	770.54	(66.9%)	719.92	771.77
2. CH Equipment and Navigation Aids	189.39	(16.5%)	189.39	189.39
Subtotal (1+2)	959.93	(83.4%)	909.31	961.16
3. Physical Contingency	95.99	(8.3%)	90.93	96.12
4. Engineering Fees	95.99	(8.3%)	90.93	96.12
Total (1 to 4)	1,151.91	(100.0%)	1,091.17	1,153.40

3.10.2 Stage Development Plan

(1) Table 3.10.2.1 indicates the required initial cost by each development stage, namely the Short Term Plan and Long Term Plan, Required cost for the former will amount to 124 million US$ sharing 10.8 % and the latter will amount to 1,028 million US$.

Table 3.10.2.1 Cost Summary of Master Plan by Development Stage (Plan 1)

Unit: Million US$

	Alternatives	Short Term Development, STD	Long Term Development, LTD	Total Master Plan
Plan 1				
1.	Rehabilitation	15.87	0	15.87
2.	Upgrading Existing Facilities	45.13	260.54	305.67
3.	New Development	0	317.89	317.89
4.	Main Access and Utilities	0	131.11	131.11
5.	Subtotal (1 to 4)	61.00	709.54	770.54
6.	Cargo Handling Equipment	40.55	136.84	177.39
7.	Navigation Aids	2.00	10.00	12.00
8.	Subtotal (6 to 7)	42.55	146.84	189.39
9.	Total (5 and 8)	103.55	856.38	959.93
10.	Physical Contingency	10.36	85.64	95.99
11.	Engineering Fees	10.36	85.64	95.99
12.	Subtotal (10 and 11)	20.72	171.28	191.98
13.	Grand Total (9 and 12)	124.27	1,027.66	1,151.91
	Index (%)	(10.8%)	(89.2%)	(100.0%)

(2) The total costs of 124.27 million US$ consists of the local currency portion of 28.78 million US$ sharing 23.2% of the total and the foreign currency portion of 95.49 million US$ sharing 76.8% of the total. (See Table 3.10.2.2)

Table 3.10.2.2 Short Term Development by Currency Portion for Alternative Plan 1

Unit: Mn US$

	Works	Local Currency Portion (%)	Foreign Currency Portion (%)	Total
A.	Construction Works			
1.	Rehabilitation,STD-EF1	5.00 (31.5%)	10.87 (68.5%)	15.87
2.	Upgrading Existing Facilities, STD-EF2	14.77 (32.7%)	30.36 (67.3%)	45.13
	Subtotal (1+2)	19.77 (32.4%)	41.23 (67.6%)	61.00
B.	Procurement			
3.	Cargo Handling Equipment	3.85 (9.5%)	36.70 (90.5%)	40.55
4.	Navigation Aids	0.19 (9.5%)	1.81 (90.5%)	2.00
	Subtotal (3+4)	4.04 (9.5%)	38.51 (90.5%)	42.55
C.	Total Works (A+B)	23.81 (23.0%)	79.74 (77.0%)	103.55
D.	Allowance			
5.	Physical Contingency	2.38 (23.0%)	7.98 (77.0%)	10.36
6.	Engineering Fees	2.59 (25.0%)	7.77 (75.0%)	10.36
	Subtotal (5+6)	4.97 (24.0%)	15.75 (76.0%)	20.72
E.	Total Cost (C+D)	28.78	95.49	124.27
	Index (%)	(23.2%)	(76.8%)	(100.0%)

3.11 Economic Analysis

3.11.1 Purpose and Methodology of Economic Analysis

The purpose of the economic analysis is to appraise the economic feasibility of the Short Term Plan for the new port facilities of the port from the viewpoint of the national economy. Therefore, the purpose of this chapter is to investigate the economic benefits as well as the economic costs which will arise from the project and to evaluate whether the net benefit of the project exceed those which could be obtained from other investment opportunities in Iran.

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used in order to appraise the feasibility of the project.

The EIRR value is obtained from the annual economic benefit-cost value. The economic benefits are obtained from the difference between the "With the project" case (hereinafter referred to as "With" case) and "Without the project case (hereinafter referred to as "Without" case).

In estimating the costs and benefits of the project, "economic pricing" is applied.

3.11.2 "Without" Case and "With" Case

(1) "Without" Case

The berth conditions of "Without" case are assumed as shown in Table 3.10.2.1.

Table 3.11.2.1 Berth Condition of "Without" Case

New Berth Number	Depth (m)	Number of Berth
NB-1	-13	1
NB-5,6	-10	2
NB-8~10	-10	3
NB-11~14	-11	4
NB-15~25	-10	8

(2) "With" Case

The berth conditions of "With" case are assumed as follows.

Table 3.11.2.2 Berth Condition of "With" Case

New Berth Number	Depth (m)	Number of Berth
NB-1	-13	1
NB-5,6	-10	2
NB-8~10	-13	3
NB-11~14	-11	4
NB-15~25	-11	8

3.11.3 Prerequisites of Economic Analysis

(1) Base Year

In this Study, 1994 is set as the base year.

(2) Project Life

The target term of economic analysis is 30 years.

3.11.4 Economic Prices

In general, all costs and benefits are divided into traded goods, non-traded goods labor and transfer items. Labor is further divided into skilled and unskilled labor.

Traded goods are expressed at CIF(cost, insurance and freight)prices for imports and at FOB(free on board)prices for exports, which are border prices themselves.

The Standard Conversion Factor (SCF) is used to determine the economic prices of certain non-traded goods and services that cannot be directly valued at border prices.

The economic cost of skilled labor is obtained by multiplying its market prices by the Conversion Factor for Consumption (CFC).

For the economic analysis, cost of unskilled labor should be measured in terms of their opportunity costs.

In this Study, the SCF of 0.862 and CFC of 0.791 are adopted according to the past records of trade and customs. The conversion factor for skilled labor of 0.640 is adopted.

3.11.5 Costs and Benefits of the Project

Considering the "With" and "Without" scenarios above, the following items are identified as the benefits of the Short Term Plan for Imam Khomeini port.

1) Saving in ships' staying costs.

2) Saving in interest of cargo costs.
3) Development of port related industries.
4) Increase in employment opportunities.
5) Improvement of cargo handling safety and reduction of cargo damage.
6) Promotion of national economic development through the formulation of an efficient transportation system.

(1) Calculation of Benefits

1) Saving in ships' staying costs

In accordance with implementation of project, the total ships' staying time will be greatly decreased. The reduction of the ships' staying time under the "With" case is one of the main benefits of the project.

This benefits of the project are calculated in Table 3.10.5.1.

Table 3.11.5.1 Saving in Ships' Staying Costs

(Mn. US$)

	2000/01	2010/11
Accruing to Khomeini Port	22,504	27,585

(2) Saving in Interest of Cargo Costs

According to the above benefits derived from savings of interest of cargo costs due to the implementation of this project are calculated in Table 3.10.5.2.

Table 3.11.5.2 Saving in Interest of Cargo Costs

(Mn. US$)

	2000/01	2010/11
Accruing to Khomeini Port	4,094	5,322

3.11.6 Evaluation and Conclusion

(1) Calculation of EIRR

The economic internal rate of return(EIRR) based upon a cost-benefit analysis is used to appraise the economic feasibility of project.
The calculation for the EIRR is as follows : EIRR = 19.67%

(2) Sensitivity Analysis

In order to estimate the EIRR, when certain conditions change, a sensitivity analysis is conducted. The changing range is based on cargo forecasts difference between macro and micro forecast.

Base Case :	EIRR=19.67%
Case A : The costs increase by 10%	EIRR=17.81%
Case B : The benefits decrease by 10%	EIRR=17.62%
Case C : Combination of the above A and B	EIRR=15.85%

(3) Conclusion

There are various views concerning the appropriate EIRR level used to guide the judgement as to whether a project is feasible or not. The leading view is that the project is feasible if the EIRR exceeds the opportunity cost of capital. Generally it is standard that the opportunity cost of capital in development countries is more than 10%. Therefore, this Short-term Development project is feasible from the viewpoint of the national economy.

3.12 Financial Analysis

3.12.1 Purpose and Methodology of the Financial Analysis

(1) Purpose

The purpose of the financial analysis is to appraise the financial feasibility of the proposed port facility development scheme. The analysis focuses on the financial viability of the project itself and to check the influence on the soundness of the port management body during the project life. The project in this study is defined as construction and repair in the short term plan.

(2) Methodology

The viability of the project is analyzed using the Discount Cash Flow Method and appraised by the FIRR (financial internal rate of return). The influence on the financial soundness of the port management body is appraised based on projected financial statements regarding the project.

3.12.2 Prerequisites of the Financial Analysis

(1) Fund raising

Funds for both construction and repair are all raised by foreign loans. Funds for renewal investment are all raised by internal funds of the port management body.

The following conditions apply to the above funds.

1) Foreign funds

Loan period: 30 years, including a grace period of 3 years
Interest rate: 3% per annum
Repayment: fixed amount repayment of principal and interest

2) Internal funds of the port management body
Internal funds are allocated from retained earnings of the port management body.

(2) Others

Project life: 30 years
Base year: 1994
Cargo handling volume: Based on the demand forecast

3.12.3 Income and Expense

(1) Income

Marine and terminal operations income, Port operations income, Loading/Unloading operations income, Equipment service income, Miscellaneous income

(2) Expense

Cost for initial investments, Operating expense (Personnel, Maintenance and repair, other expense, Depreciation costs), Reinvestment

3.12.4 Financial Analysis

(1) Appraisal by FIRR

The results of FIRR calculation including sensitivity analysis are shown in Table 3.12.4.1

Sensitivity analysis

Case A : The income decreases by 10%
Case B : The project cost increases by 10%
Case C : The income decreases by 10% and the project cost increases by 10%

Table 3.12.4.1 Result of Calculation

Original Case	22.5%	
Sensitivity Analysis A	19.9%	Revenue 10%Down
Sensitivity Analysis B	20.2%	Cost 10%Up
Sensitivity Analysis C	17.5%	Revenue 10%Down, Cost 10%UP

Interest rate of the funds is 3 % in this study. FIRR exceeds this rate, even in case C of the sensitivity analysis, therefore this project can be judged financially feasible.

(2) Financial soundness of the port management body

The financial indicators based on the projected financial statement, show excellent levels. Therefore, the port management body will be financially sound.

(3) Others

As mentioned above, the financial analysis of the short term plan yields high levels both in terms of viability of the project and financial soundness of the port management body. However, considering the huge investment required for the Master Plan, it is necessary of the port management body to retain as much of its earnings as possible, at the same time, the project of the short-term plan must be advanced. Therefore, FIRR at the above level is necessary. In addition, Government should use contribution income for port development, granting the subsidies or loans to the ports which have unsound financial conditions.

3.13 Management and Operation for the Proposed Port Activities

3.13.1 Privatization of Cargo Handling Operation

(1) Administration System

As is commonly understood, public sector is normally not flexible in providing personnel or investment in response to the actual fluctuation of demand. In this sense, full involvement of port authority in cargo handling services is not always suitable for improvement of efficiency of such services under a competitive market, and increased situation of cargo flow in particular.

Therefore, for early introduction of privatization, Alternative(A) and Alternative(B) in the Table 3.13.1.1 are considered the appropriate selections for PSO.

(2) Port Authority

If cargo handling service is privatized, the sections for cargo verification, cargo handling, warehouse will be separated from Imam Khomeini port authority.

Table 3.13.1.1 Alternatives of Terminal Operation

Alternative		Present		Short Term Plan (- 2000)		Long Term Plan (- 2010)	
		Major ports on Persian Gulf	Major ports on Caspian Sea	Major ports on Persian Gulf	Major ports on Caspian Sea	Major ports on Persian Gulf	Major ports on Caspian Sea
(A)	Owned by	Public	Public	Public	Public	Public	Public
	Provide service for	Open	Open	Open	Open	Open & Exclusive	Open
	Cargo handled by	Public & Private	Public & Private	Private	Private	Private	Private
(B)	Owned by	Public	Public	Public	Public	Public	Public
	Provide service for	Open	Open	Open & Exclusive	Open	Open & Exclusive	Open
	Cargo handled by	Public & Private	Public & Private	Private	Private	Private	Private

Note: Exclusive; The type of operation which allows only limited companies to use berths.

Open & Exclusive; In principle the berths are open to public use, but exclusive use berths will be partly introduced.

Eventually the organization for mooring, water supply, repair work of cargo handling equipment, should also be separated. Towage and pilotage can be separated if there is enough demand.

However, the organization which conducts management of port infrastructure and facilities should be left under their administration.

3.13.2 Major Proposals for Effective Port Management

(1) Financial System and Port Tariff

In future, port income is expected to greatly increase at Imam Khomeini port. Therefore, it is desired that Imam Khomeini Port Authority has a self-supporting accounting system. To put it concretely, in future, Port Authority should begin to allocate income for maintenance and repair expenditures. And gradually, investment funds should also begin to be raised from income. The contributions to PSO should be abolished gradually.

If investment funds can not be raised only from income, Port Authority should consider regular loans.

To support above financial system, PSO should set its tariff at a proper level to obtain sufficient income to maintain sound financial condition and to make the necessary investments. On the other hand, tariff should be set taking levels of neighboring ports into consideration to attract more port users. To set tariff at a proper level, PSO and Port Authority should have power to revise and fix tariff.

(2) Training System for Staff

For efficient port management and operation, it is necessary to improve staff's ability and to increase the number of educated staff. To provide proper training courses which deal with the various port functions, special training organs should be established, and the organs should raise funds for training so that PSO's financial condition is not burdened with it.

3.14 Environmental Considerations

An environmental study is comprised of three steps: Preliminary Environmental Survey (PES), Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA). The procedure of the environmental study in this study is shown in Figure 3.14.2.1.

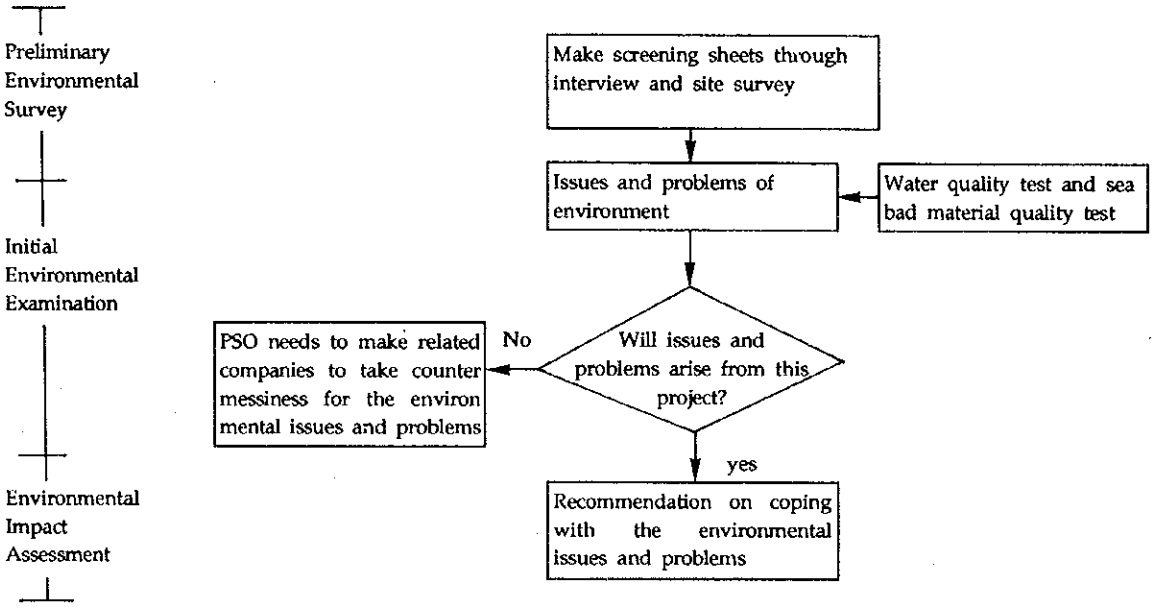


Figure 3.14.2.1 Procedure of Environmental Consideration

3.14.1 Present Condition

Imam Khomeini Port has many environmental problems such as water pollution by waste oil from vessels, air pollution by aluminum and iron powders at handling time or from storage in the open area, air pollution and foul smells of sulfur containing waste gas discharged from neighboring plants and waste by calling ships, port workers and handling cargoes.

3.14.2 Proposed Measures for Environmental Consideration

According to the result of the environmental impact assessment (EIA) of which items are selected by the initial environmental examination, it is recommended to monitor bilge generated from vessels and give guidance to prevent it, implement dust prevention measures during the cargo handling operations and at the open storage spaces and study the construction of a waste treatment plant. Above items should be implemented in the Short Term Plan.

To cope with urban population increase in the port vicinity and the expansion of activities in Imam Khomeini Port in the post Master Plan we recommend construction

of a waste oil treatment plant and a sewage treat-ment plant utilizing the vast area surrounding Imam Khomeini Port.

According to the result of this study, routine inspection system for air, water and sea bed qualities in each port area should be established, in addition, a simple test laboratory at each of the major ports is required.

4. Master Plan for the Anzali Port (Target Year 2010/11 and 2000/01)

4.1 Development Concept of the Port

4.1.1 Major Roles of Anzali Port

Anzali Port is a gateway port for international trade in Iran on the coast of the Caspian Sea. This port supplies Teheran and its vicinity with goods imported from northern countries and Europe.
The port will serve as a hub for container cargoes of the land-bridge cargoes between Russia, CIS countries, Azarbaijan and Arabic countries which are expected to increase rapidly in the near future.

4.1.2 Basic Policy of Port Development

The cargo volume including the land-bridge cargo in the target year will be about 4.6 times (about 5 million tons) the current volume (1993/94), and the calling ships will increase in their size. Therefore, it is required to extend the existing berths by constructing new ones. The cargo which is on the increase must be handled efficiently because Anzali Port, surrounded by an urban area, has no room for expansion. For container cargo and liquid bulk cargo in particular, exclusive berths should be prepared in the Master Plan because the volume of these cargoes will largely increase in the target year. In order to cope with the large increase in dry bulk cargo import (mainly wheat), and the increase in iron products and conventional break bulk cargo, a cargo handling system for dry bulk cargo consisting of a large portable unloader and silo should be introduced. In addition, jib cranes should be installed for heavy cargo. A shed for break bulk cargoes should be built and the open yard should be expanded.

In the Master Plan and the Short Term Development Plan, the mooring facilities and the sorting facilities should be provided in the northeastern area. In the Master Plan, the port administration facilities should be moved to the east just behind the southern part of the present port facilities. The housing for PSO personnel and custom's officers will remain immediately behind the southern part of the present port area. Just behind the north part of the port area, a back up area for port activities and future expansion area should be allocated.

Container cargo handling at Anzali Port is mainly conducted using mobile cranes alongside the ship in the Short Term Development Plan. In the Master Plan, gantry cranes for container handling should be equipped at the quay. For handling at the container yard, transfer cranes and container trailers should be prepared in the Master Plan and the Short Term Development Plan.

The Master Plan adopts the system in which discharged cargo of break bulk cargo (including bagged cargo and heavy cargo) and dry bulk cargo are tentatively placed in the sorting facilities.

From Q1 to Q4,the quays will probably be submerged in the near future. However, cargo handling at Anzali Port is mostly carried out from Q1 to Q4 in the old port area at present. To raise the crown height, it is necessary to construct substitute facilities for these berths immediately. They should be built on the north of the shipway according to the Master Plan layout, and should be used as prescribed in the Master Plan after the raising work is done.

4.2 Current Situation of the Port

4.2.1 Location

Anzali Port which is located on the north side of Rasht in Gillan province is a major international trade port on the coast of the Caspian Sea.

The hinterland of this port is mainly Tehran and Gilan province but part of the cargo is distributed (or collected) throughout the north-west area in Iran.

4.2.2 Natural Condition

(1) Meteorography and Oceanography

Anzali port is located in the south coast of the Caspian Sea and its meterography and oceanography are similar to the south coast of Japan sea. (Latitude of these two area: N 37.5 at Anzali, N 37.9 at Niigata) It is calm and warm from April to September, and stormy and cold with many clouds and rainy from October to March. The meteorography and oceanography at Anzali is summarized below.

Temperature:	Normal: 4℃ to 30℃ (maximum 37℃, Minimum -11℃)
Moisture:	65% to 93%
Rainfall:	Annual average 1,850mm (Oct. to Dec. : 50%)
Vicinity:	No data; it is not so good for several days.
Wind:	Wind velocity: NW, N, NE
Wave:	Height 4m to 6m (off shore), 3m to 4m (at breakwater end), 1 to 1.5m (inside harbour) Direction: same as wind
River current:	1 knot from the lagoon. Recently decreasing due to water level raising up.
Littoral drift:	A little from West to East.
Tidal range:	20cm to 40cm/year.
Water quality:	Salt content 30% of normal sea water. Some polluted areas in the city river.
Water level:	Raising up.

(2) Topography and Geology

Anzali Port and its surroundings are located in the triangle delta formed by the river Sefid-Rud in the west zone of the Alborz mountain chains. The soil of the area is geologically consisted of the quaternary alluvium era. It contains mainly the sandy

materials with some silt and clay. Summary is shown as below.

a) Topography: It is formed in flat area due to the delta by the river.
   Elevation: +1 to 4m in the port area.
   Soil:Mainly sand with some silt and clay.
   N-value: 20 to 30 (depth: 20m)
   Stone quality: good at quarries.
   Earthquake: Notice zone due to the Alborz.

(3) Remarkable Items

1) Water level of the Caspian Sea

The water level of the Caspian Sea was dropping down from the late 19 century. In 1977, it changed to raise up. The average speed until 1992 was 13cm per year. The reason of this phenomena has been studied up to now, but the definite reason is not clear yet. As one of the assumptions, the current raise will be continued constantly, it will be reached to +1.0m in 2000 and +2.3m in 2010 above CD (Chart Datum). For reference, There was un-comfirmed recorded data shown +1.3m in 1869.

It is necessary to study and cope with the matter because of its relation to the future development planning and its design.

2) Stormy season

It is notified that the marine construction works during the stormy season in winter is seriously influenced by the heavy rains, and windy waves of NW, N and NE direction.

3) Earthquake

There was an earthquake of the magnitude of 7 class at Rud-bar located in the west zone of the Alborz mountain chains.
About 30,000 peoples were dead by this disaster. The town Rud-bar is located in the distance of 70km from Anzali. It is remarkable that Anzali port belongs to the high intensity zone in the seismic zoning map in Iran.

4) Liquifaction of ground

It is necessary to study the liquefaction of the existing sand layers at Anzali.

4.2.3 Port Administration System

(1) Port Management

At Anzali port, the port activities are managed and operated by Anzali Port Authority. The organization structure of Anzali Port Authority is comparatively smaller than Imam Khomeini Port Authority because of the difference of the scale of each port. But, in general, Anzali Port Authority has the same function as Imam Khomeini Port Authority.
As shown in Figure 4.2.3.1, Port Director holds the highest position. Under the Port Director, some offices are established such as Program and Planning Center, Port

Guard Office and Security.
In addition, three main departments, namely Finance and Administration Department, Civil Engineering & Technical Department and Operation Department, are established and they are headed by the three Deputy Port Directors.

Berth allotment is generally on a first come first serve basis. Marine Operation and Navigation Division is in cargo of berth allotment.

All cargo handling services used to be provided by Port Authority. Recently, however, the office has started to allow private entities to conduct cargo handling service in the ship hold. Port Authority conducts cargo handling, stowage and cargo transport in the port area.

Port Authority provides mooring and water supply services, while bunkering service is carried out by private companies.

(2) Financial Condition and Port Tariff

At Anzali port, the balance of income and expenses was in the red in 1991/92 and in 1992/93. But, with the revision of the tariff in 1993/94, income has increased drastically and the balance now shows a profit.

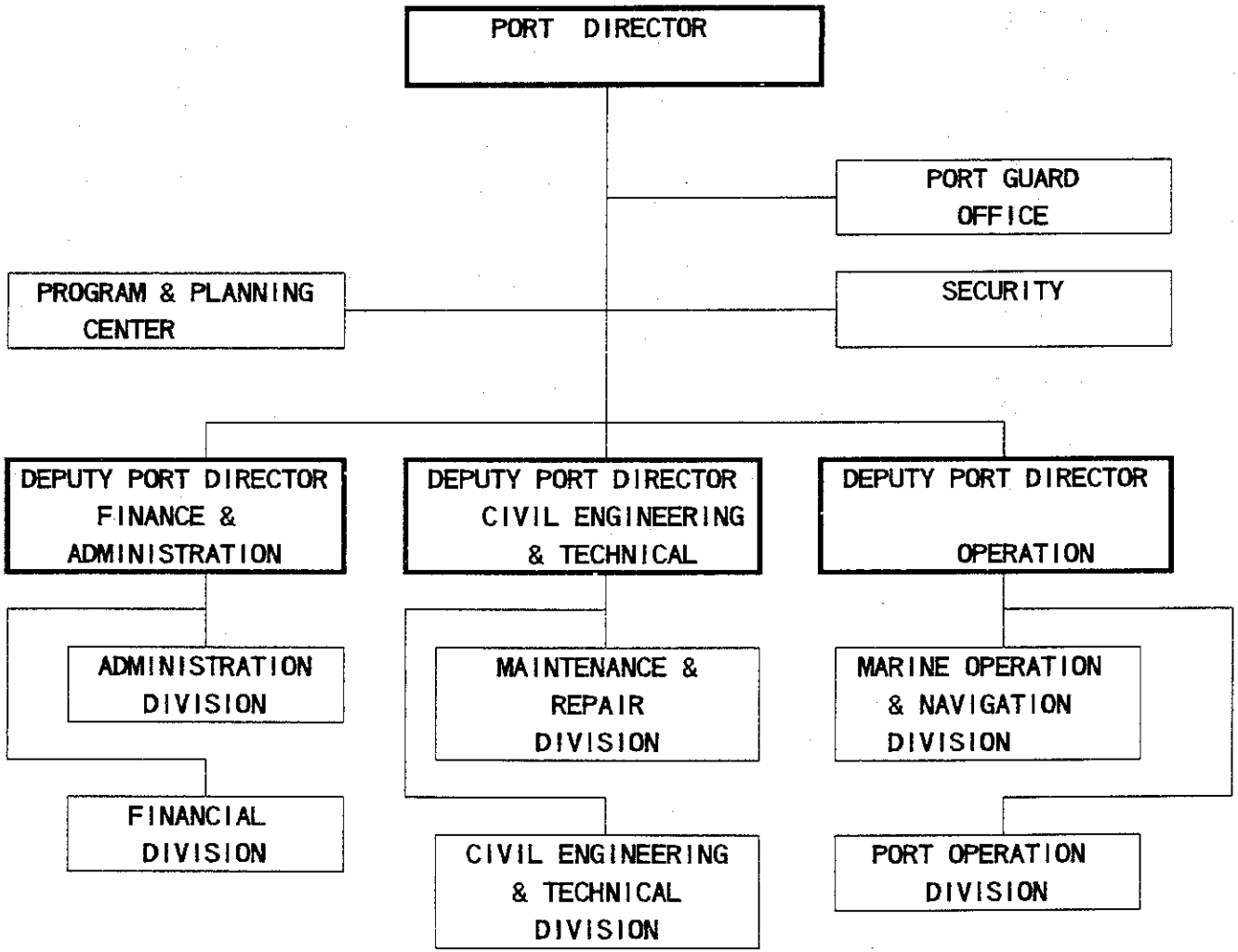


Figure 4.2.3.1 Organization Chart of Anzali Port Authority

4.2.4 Cargo Handling Equipment

The existing cargo handling equipment at the port are as follows.

Portal Jib Crane	:	5 units
Tire-mounted pneumatic unloader	:	2 units
Mobile Crane	:	17 units
Fork-lift truck	:	14 units
Others	:	28 units

It seems that all the existing equipment including very old equipment have worked fully in good condition. However, it is required to formulate the procurement and disposal plan for cargo handling equipment and the plan of them shall be carried out on schedule.

4.3 Demand Forecast and Port Capacity Evaluation

4.3.1 Commodity-wise Cargo Traffic Demand for the Port

(1) Present condition of handling cargo volume

Present economic activities in connection with port activities in a recent six-year period (1988/99 - 1993/94) are shown in Figure 4.3.1.1, Figure 4.3.1.2 and Figure 4.3.1.3 show cargo handling volume by commodity type.

From 1988/1989 to 1989/90, import of petroleum product increased explosively due to the end of war. This trend continued up to 1991/92, but since then, imports of petroleum product have been decreasing. However, present share of petroleum product in total handling cargo is still over 50%; this is a special feature of Anzali port.

Wheat imports stopped after 1991/92 due to the socio-economic condition of the producing countries. The handling volume of other cargo like metallic product and general cargo, the handling cargo grew slightly each year.

This trend toward steady growth is seen not only at Anzali port but at all Iranian ports. In particular, the rapid increase in exports of bag and general cargo from 1992/93 to 1993/94 reflects the new economic policy of the government.

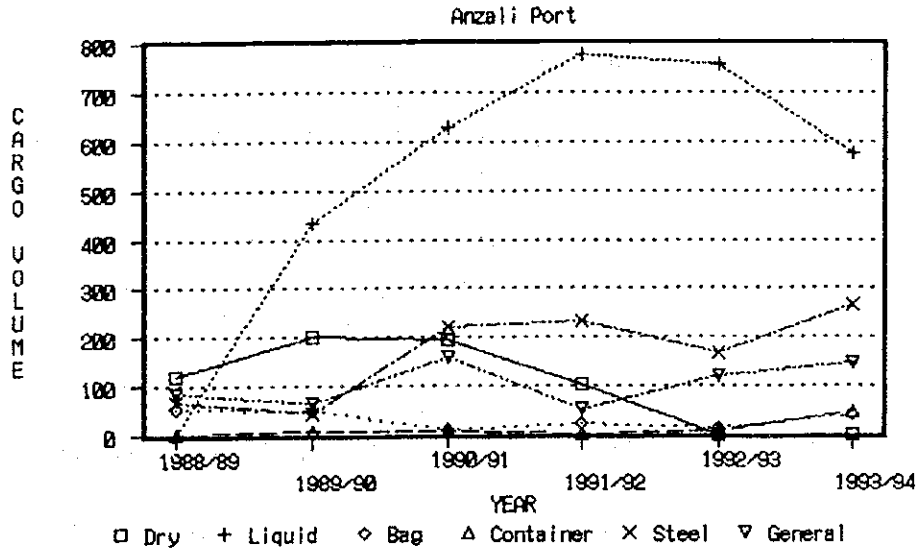


Figure 4.3.1.1 Total Cargo Traffic Movement at Anzali Port

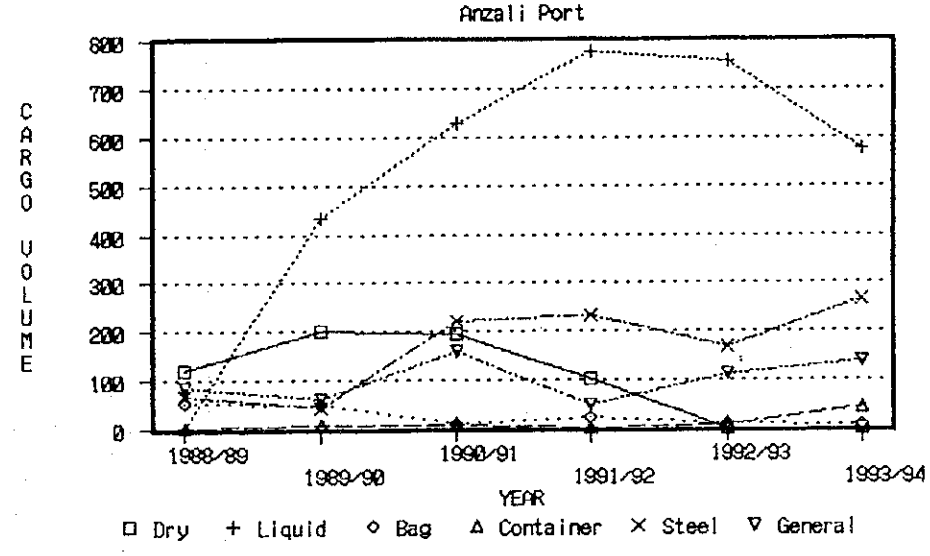


Figure 4.3.1.2 Import Cargo Traffic Movement at Anzali Port

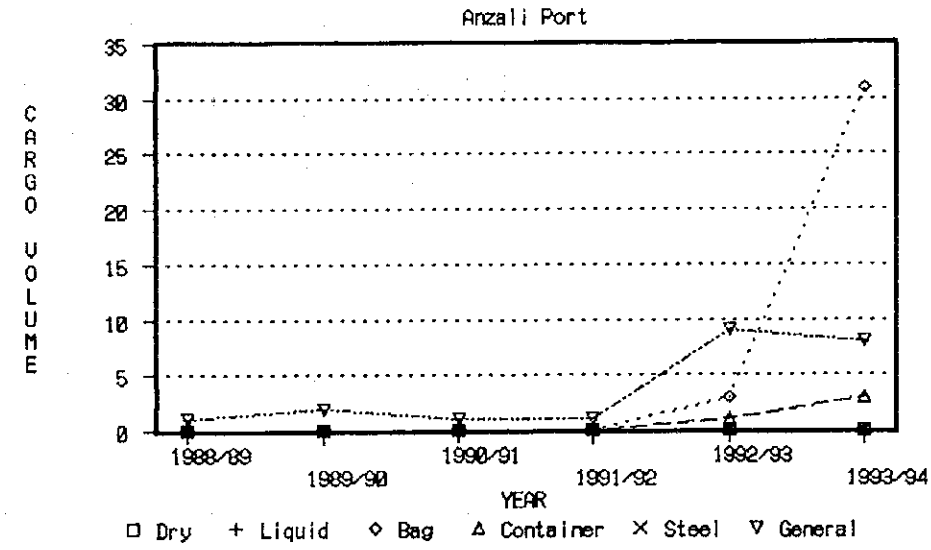


Figure 4.3.1.3 Export Cargo Traffic Movement at Anzali Port

(2) Demand forecast for handling cargo volume

Forecasted commodity-wise cargo handling volume in target years 2000/01 and 2010/11 is as shown in the Table 4.3.1.1.

The cargo handling volume forecasted on all commodity shows the increasing tendency up to target year 2010/11 from now on. Especially, import of container, import of petroleum product and export of general cargo (non-container) will be forecasted as rapid progress.

Table 4.3.1.1 Forecasted Import & Export Cargo Handling Volume

Unit: 1,000 tons

COMMODITY	*1993/94 (Actual Data)			**2000/01			**2010/11		
	Imp.	Exp.	Total	Imp.	Exp.	Total	Imp.	Exp.	Total
Dry Bulk	0	0	0	222	0	222	444	0	444
Liquid Bulk	577	0	577	798	4	802	1,518	12	1,530
Bagged Cargo	10	31	41	44	5	49	111	20	131
Container	43	3	46	84	2	86	1,120	39	1,159
Refrigerated Cargo	0	0	0	0	0	0	0	0	0
Steel Product	266	0	266	212	6	218	549	26	575
Mineral	0	0	0	0	0	0	0	0	0
General Cargo	140	8	148	79	83	162	113	450	563
Sub Total	1,036	42	1,078	1,439	100	1,539	3,855	547	4,402
Land Bridge Cargo	0	0	0	155	118	273	385	295	680
Total	1,036	42	1,078	1,594	218	1,812	4,240	842	5,082
Ratio of Imp/Exp	96.1%	3.9%		88.0%	12.0%		83.4%	16.6%	

Note: *1993/94 (Actual Data) ----- PSO Data
**2000/01 & 2010/11 ------ Forecasted by the Study Team

4.3.2 Capacity Evaluation

Now there are five berths at Anzali Port; Q1 (70 m, -5.5m), Q2 (153 m, -5.5 m), Q3 (152 m, -5.5 m), Q4 (170 m, -5.5 m) and Q5 (85 m, -5.5 m). As the berth length is short and the basin width narrow, Q5 is used as the idle berth for working crafts at present.

The total cargo handling capacity of the above berths to general cargo is about one million tons per year.

Future preparing the prerequisites such as the increased depth in the port (-6.5 m), expansion of Q5 and the increased number of cargo handling machines. The cargoes which can be handled at these berths including liquid bulk cargoes is about 1.5 million tons.

4.4 Ship Size and Number of Ship Call

The precondition of the estimate for vessel-size, type and number in Master Plan and Short Terma Plan is as follows.

1) Patterns of distribution for size of calling ships by ship type (dry cargo ship, liquid bulk tanker, passenger ship and tug boat) do not drastically change during the planning period.

2) Size of calling Passenger ships, tug boats and barges is fixed to existing size.

3) Length and depth of foreign port (non-Iranian ports) on the coast of the Caspian Sea do not drastically change during the planning period.

Based on the above precondition, the procedure of the estimate for size of calling ships at Anzali Port is explained by the flow chart in Figure 4.4.1.1.

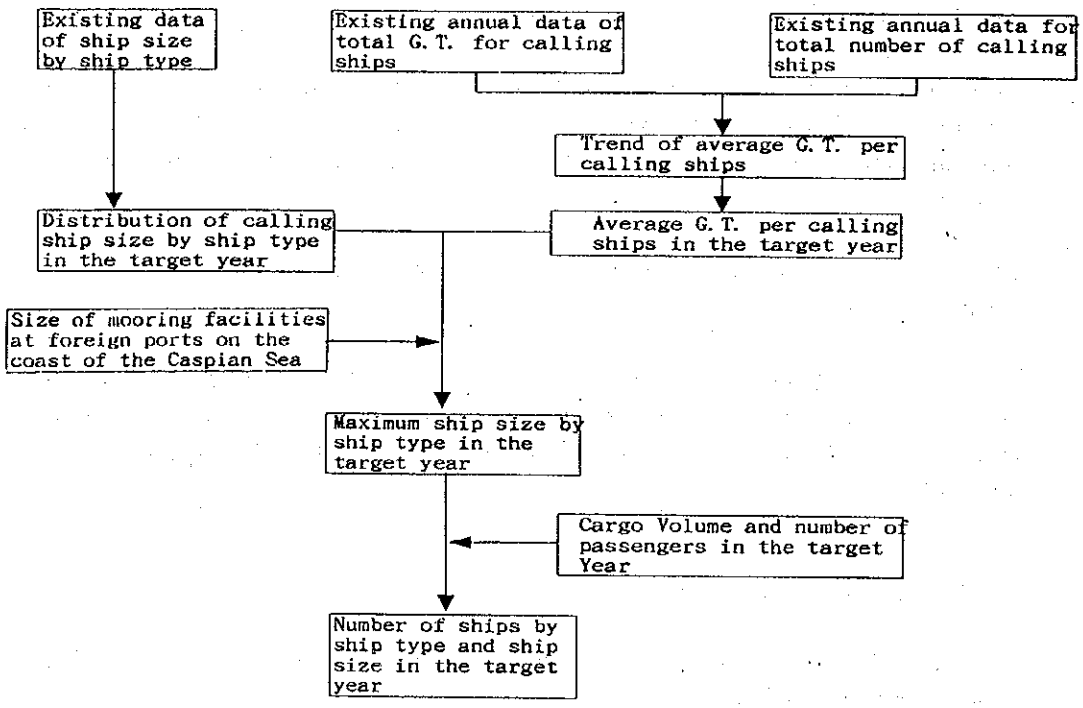


Figure 4.4.1.1 Flow Chart of to Estimation for Ship Size and Number of Calling Ships

The following tables show the maximum and average size of calling ships and number of calling ships at Anzali Port in 2010 and 2000.

Table 4.4.1.1 Calling Ship Size at Anzali Port in 2010/11

Target Year	Ship type	Maximum Ship Size		Maximum draft	Depth of Berth	Length of Berth
		(G.T)	(D.W.T)	(m)		
2010	Dry Cargo Ship	6,000 GT	9,000 DWT	5.8	6.5	170
	Passenger Ship	2,000 GT	-	5	6.6	100
	Tanker	6,500 GT	10,000 DWT	6.4	7.0	180
	Tug Boat (Barge)		(1,000 DWT)	3.5	3.5	100
2000	Dry Cargo Ship	5,000 GT	7,500 DWT	5.2	6	130
	Passenger Ship	2,000 GT	-	5	5.5	100
	Tanker	5,500 GT	8,500 DWT	5.7	6.5	140
	Tug Boat (Barge)		(1,000 DWT)	3.5	4	100

Table 4.4.1.2 Number of Calling Ships by Size and Type in 2000/01

Class (G.T.)	Number of Ships by Ship Type				Total
	D.C.Ship	Tanker	Passenger	Tug boat	
0- 500	0	0	0	14	14
500-1000	0	0	0	7	7
1000-1500	3	0	0	0	3
1500-2000	12	2	52	0	67
2000-2500	3	0	0	0	3
2500-3000	7	0	0	0	7
3000-3500	18	0	0	0	18
3500-4000	10	0	0	0	10
4000-4500	43	2	0	0	45
4500-5000	67	0	0	0	67
5000-5500	0	103	0	0	103
Total	164	108	52	21	345

Table 4.4.1.3 Number of Calling Ships by Size and Type in 2010/11

Class (G.T.)	Number of Ships by Ship Type				Total
	D.C.Ship	Tanker	Passenger	Tug boat	
0- 500	0	0	0	50	50
500-1000	0	0	0	25	25
1000-1500	0	0	0	0	0
1500-2000	0	0	87	0	87
2000-2500	14	0	0	0	14
2500-3000	99	5	0	0	103
3000-3500	15	0	0	0	15
3500-4000	38	0	0	0	38
4000-4500	127	0	0	0	127
4500-5000	25	0	0	0	25
5000-5500	139	4	0	0	143
5500-6000	239	0	0	0	239
6000-6500	0	197	0	0	197
6500-7000	0	0	0	0	0
Total	695	206	87	75	1063

Ships plying the Caspian Sea are relatively flat-bottomed compared to internationally standard ships. Ships of the Caspian Sea are also distinguished by their shallower drafts. Therefore, in estimating future size of calling ships, the relation between D.W.T. or G.T. and the dimension of internationally standard ships cannot be applied. Instead, dimensions of future calling ships at Anzali Port are estimate based on the actual dimensions of calling ships at Anzali Port.

4.5 Physical Requirements for Future Port Development

4.5.1 Terminal Facilities

(1) Mooring Facilities

The method of the estimation of number of berth on the Master Plan and Short Term Plan is mentioned below.

The required number of berths at Anzali Port in the Master Plan and the Short Term Plan is obtained using results of the cargo forecast, the average cargo handling efficiency, the annual average cargo handling time and the assumed berth occupancy ratio. Then, the berths are allocated according to ship type, tentatively. Forecasted cargo volume, forecasted average ship size and the number of calling ships by ship type, the cargo handling efficiency, and the assumed number of berths are input to simulation model for berth utilization using the queuing theory. In the simulations, the assumed number of berths is adjusted from the number of berths obtained preliminarily. The maximum per-missible average berth waiting time for all calling ships except container ships is assumed to be less than one day. For container ships, the maximum permissible average berth waiting time for all calling container ships is assumed to be less than six hours. The combination of ship types which uses each berth is assumed tentatively. In the Master Plan container ships and tankers will have to use exclusive berths.

As a result of the simulations, 11 berths are required for the Master Plan:two for handling mainly dry bulk cargos, three for containers, two for liquid bulk cargos, and the rest for general cargo (conventional break bulk cargo) and steel.

As a result of the simulation for the Short Term Plan, one berth should be used for handling liquid bulk berth and six as multi-purpose berths. Table 4.5.1.1 shows the mooring facilities for the Short Term Plan and the Master Plan.

Table 4.5.1.1 Mooring Facilities at Anzali Port on Master Plan and Short Term Plan

	Kind of berth	Number of berth	Length (m)	Depth (m)
Existing facilities	Multi purpose berth	5	640	5.5
Short term plan	Multi purpose berth	6	965	6.0
	Liquid bulk berth	1	170	6.5
Master plan	Multi purpose berth	6	965	6.5
	Container berth	3	510	6.5
	Liquid bulk berth	2	360	8.5

(2) Container Terminal

Table 4.5.1.2 shows required area of facilities in container terminal.

Table 4.5.1.2 Facilities in Container Terminal

Facilities	2000/01	2010/11
Container yard (Required number of ground slots, TEUs)	396	2,668
Container Freight Station (m^2)	476	6,418
Number of Truck Lane	1	4
Maintenance Shop (m^2)	--	1,000
Container Cleaning Space (m^2)	--	1,000
Terminal Office (m^2) Shop	--	1,000

4.5.2 Improvement Plan of Cargo Handling Equipment and Cargo Handling System

The improvement plan to get higher productivity for each berth are made under the following basic policies.

1) The most suitable handling system shall be introduces
2) The required equipment for the system shall be prepared
3) All equipments to be used shall be maintained in good conditions under enough preventive maintenance with sufficient spare parts.

The major inprovements for cargo handling system are as follows:

1) The most of unloaded cargo will be stored temporally at the port area
2) The unit load handling system by fork-lift truck is introduced

Table 4.5.2.1 Cargo Handling Efficiency

Commodity	Efficiency	Handling Equipment
Bulk Cargo (Grain) (Grain)	6,270 ton/day/2 gangs	Pneumatic Unloader
Bagged Cargo (Rice, Sugar, Fertilizer)	1,382 ton/day/2 gangs	Jib Crane, Mobil Crane
Metallic Products	1,920 ton/day/2 gangs	Jib Crane
Container	50 TEUs/hour/2 gangs	Container Crane

4.5.3 Transit Shed and Storage Facility

Table 4.5.3.1 shows the percentage of cargo using storage facilities and for direct delivery by commodity.

Table 4.5.3.1 Cargo and Storage Facilities

(%)

Commodities	Transit shed	Warehouse	Open yard	Direct delivery
Dry bulk	75	0	0	25
Bagged	40	40	0	20
Metallic	10	10	60	20
General	35	35	10	20

Required area of storage facilities are shown in following Table 4.5.3-2 and 3.

Table 4.5.3.2 Required Area of Storage Facilities in 2000/01

Commodity	Total cargo volume (ton)		Transit shed	Warehouse	Open yard
Bagged	49,000	Share (%)	40	40	0
		Cargo volume (ton)	19,600	19,600	0
		Area (m^2)	1,416	1,089	0
Metallic	218,000	Share (%)	10	10	60
		Cargo volume (ton)	21,800	21,800	130,800
		Area (m^2)	1,968	1,514	9,083
General	162,000	Share (%)	35	35	10
		Cargo volume (ton)	56,700	56,700	16,200
		Area (m^2)	5,119	3,937	1,125
		Total area (m^2)	8,502	6,540	10,208

Table 4.5.3.3 Required Area of Storage Facilities in 2010/11

Commodity	Total cargo volume (ton)		Transit shed	Warehouse	Open yard
Bagged	131,000	Share (%)	40	40	0
		Cargo volume (ton)	52,400	52,400	0
		Area (m^2)	3,784	2,911	0
Metallic	575,000	Share (%)	10	10	60
		Cargo volume (ton)	57,500	57,500	345,000
		Area (m^2)	5,191	3,993	23,958
General	563,000	Share (%)	35	35	10
		Cargo volume (ton)	197,050	197,050	56,300
		Area (m^2)	17,789	13,684	3,910
		Total area (m^2)	26,765	20,588	27,868

4.6 Alternative Layout Plans of Port Facilities

4.6.1 Basic Policy for Development of Alternative Layout Plan

- The depth of the existing berths, basin and channel should be dredged to accomodate the draft of calling ships in the target years (2000/01 and 2010/11).

- Tankers should be berthed at an exclusive berth in the Short Term Development Plan. In the development plan, exclusive berths should be prepared for container ships and tankers.

- The draft of the present maximum tanker on the Caspian Sea is about 8 meter. Therefore, the draft of the available calling tanker at Anzali Port is assumed 8 meter in the development plan.

- The layout of the port facilities should be flexible enough to cope with any future deviation of cargo handling demand. In this connection, it is also essential to modify the Master Plan, if necessary, according to the review of cargo handling demand and/or potential size of calling ships at the final of Short Term Plan.

- The direction of the entrance channel should not be changed considering wave direction for entering ships and the effect of water flash to littoral drift at the mouth of the port.

- The port facilities should be expanded toward the north and the east.

- The present shape of the port should be kept as much as possible in future.

- Facilities requiring deep water should be located near the port mouth (the north side of the port) and facilities requiring shallow water should be located in the inner port (the south side of the port).

4.6.2 Layout Plans

(1) Required number of berths in the Master Plan (in 2010/11)

- Six multi-purpose berths: (Total length: about 970 m, depth: -6.5 m)
- Two berths for liquid bulk: (Total length: 360 m, depth: -8.5 m)
- Three berth for container ships: (Total length: 510m, depth: -6.5 m)

(2) Alternative 1 (See Figure 4.6.2.1)

1) Anzali Port should be extended first toward the entrance of the port in the north and then eastward along the Caspian coast.
2) Three multi-purpose berths should be provided at existing Q2 to Q4. The remaining multi-purpose berths and the container berth should be provided by extending the berth the north of the shipway about 1,000 m to the north.

(170 m x 5B + 150 m)
3) The berths for tanker which are dolphin structures should be located in front of the park on the opposite side (to the west of the passage) of the existing commercial port facilities.
4) In order to improve the calmness of the basin and the berths which are newly constructed to the north of the existing mooring facilities, the existing western breakwater should be extended by about 800 m.
5) In the Alternative layout 1, the dredging volume will much exceed the volume of the reclamation. Using the remaining dredged material, the area immediately behind the new container terminal should be raised in order to prevent submerging of the area in the north of the back up area of the port from the rising water.

(3) Alternative 2 (See Figure 4.6.2.2)

1) A dolphin type tanker berth will be constructed at about 400 m offshore from the north side of the west breakwater.
2) The lay out of the other mooring facilities should be the same as those for the Alternative 1.
3) In order to improve the calmness of the basin and the berths which are newly constructed north of the existing mooring facilities, the existing western breakwater should be extended by about 100 m.
4) In order to improve the calmness of the basin, the berths which are newly constructed north of the existing mooring facilities, and the new tanker dolphin to be constructed to the north of the western breakwater, the new breakwater of about 800 m should be constructed at the north of the existing western breakwater.
5) The remaining dredging volume should be used as in the case of the Alternative 1 to raise the area immediately behind the new container terminal.

(4) Alternative 3 (See Figure 4.6.2.3)

1) The port should be extended in the same direction as in the Alternative 1.
2) In order to improve the calmness of the basin and the new berths which are constructed to the north of the existing mooring facilities (including the tanker berth), the existing western breakwater should be extended by about 600 m, and a new breakwater of about 800 m which is located to the north of the existing east breakwater should be constructed.
3) The dolphin type berths for tanker should be constructed inside the new breakwater to the north of the existing eastern breakwater.
4) The lay out for the other mooring facilities should be the same as those for the Alternative 1.
5) The remaining dredging volume should be used to raise the area immediately behind the newly built container terminal as in the Alternative 1.

(5) Alternative 4 (See Figure 4.6.2.4)

1) The port should be extended in the same direction as in the Alternative 1.

2) The tanker berth should be located at the south end of the existing commercial port facilities.
3) The existing slipway for repairing small crafts should be removed.
4) In order to improve the calmness of the basin and the new berths which are constructed to the north of the existing mooring facilities, the existing western breakwater should be extended by about 500 m.
5) The remaining dredging volume should be used to raise the area immediately behind the new container terminal as in the Alternative 1.

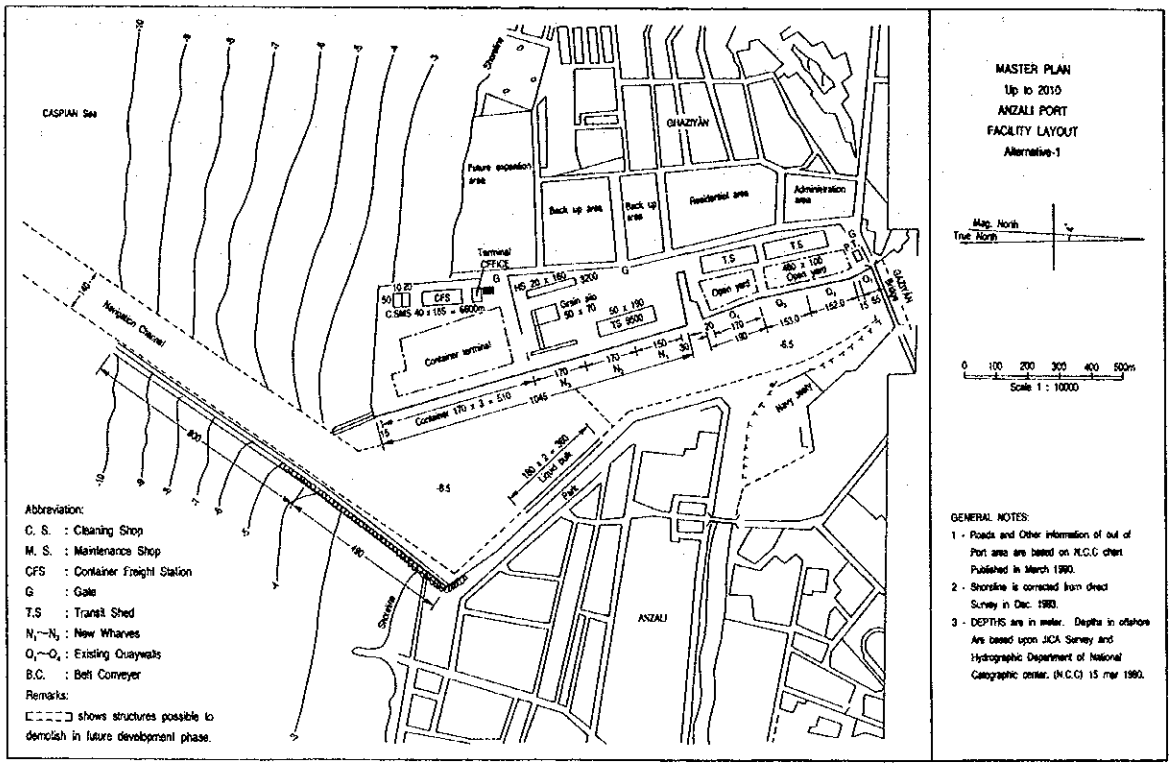


Figure 4.6.2.1 Alternative Plan (1)

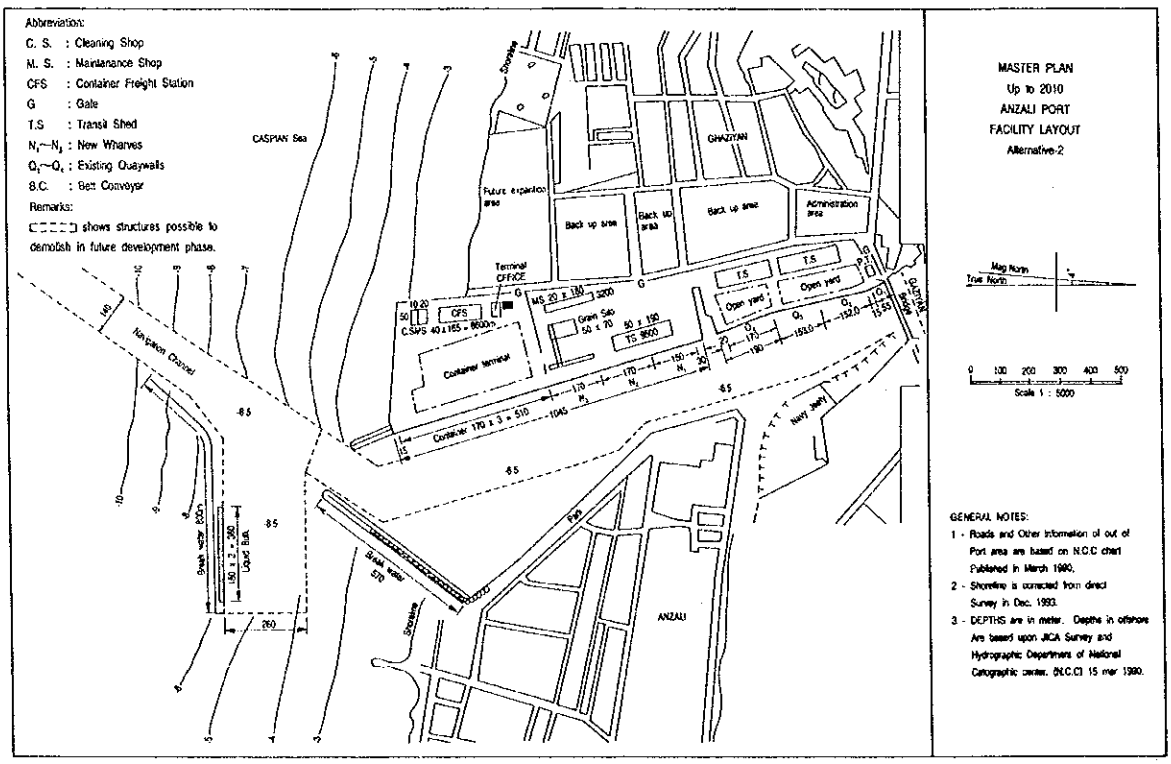


Figure 4.6.2.2 Alternative Plan (2)

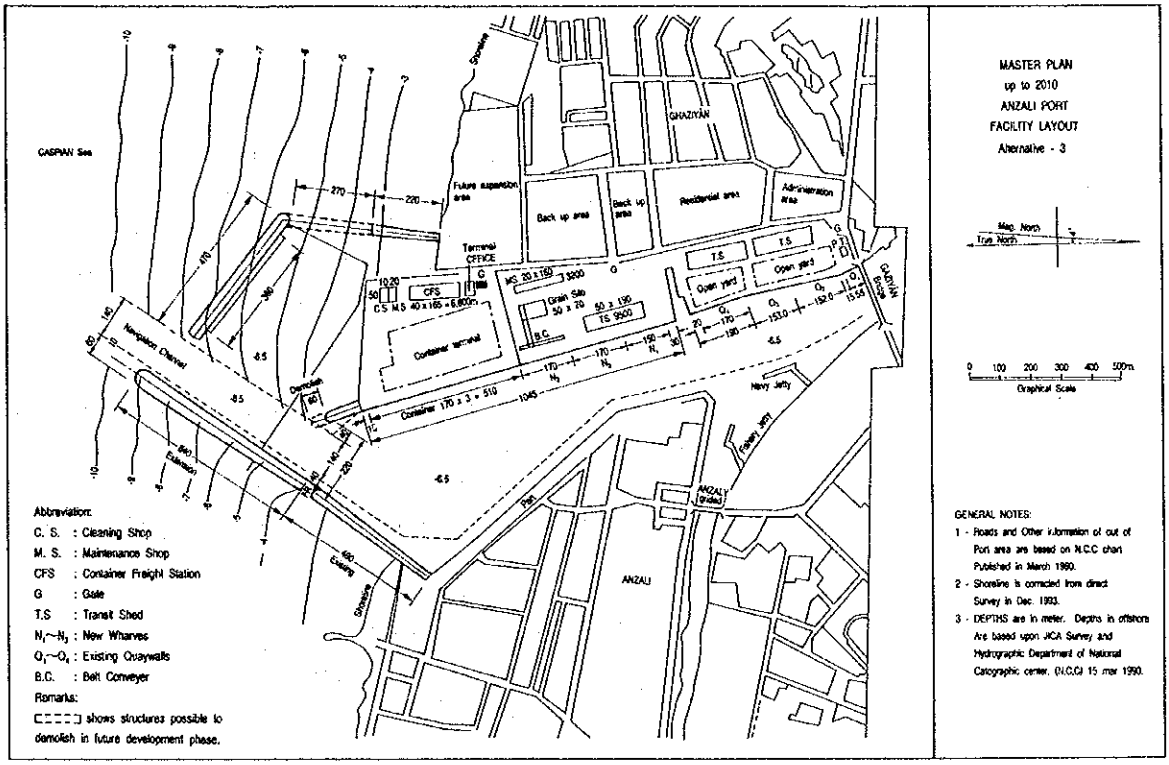


Figure 4.6.2.3 Alternative Plan (3)

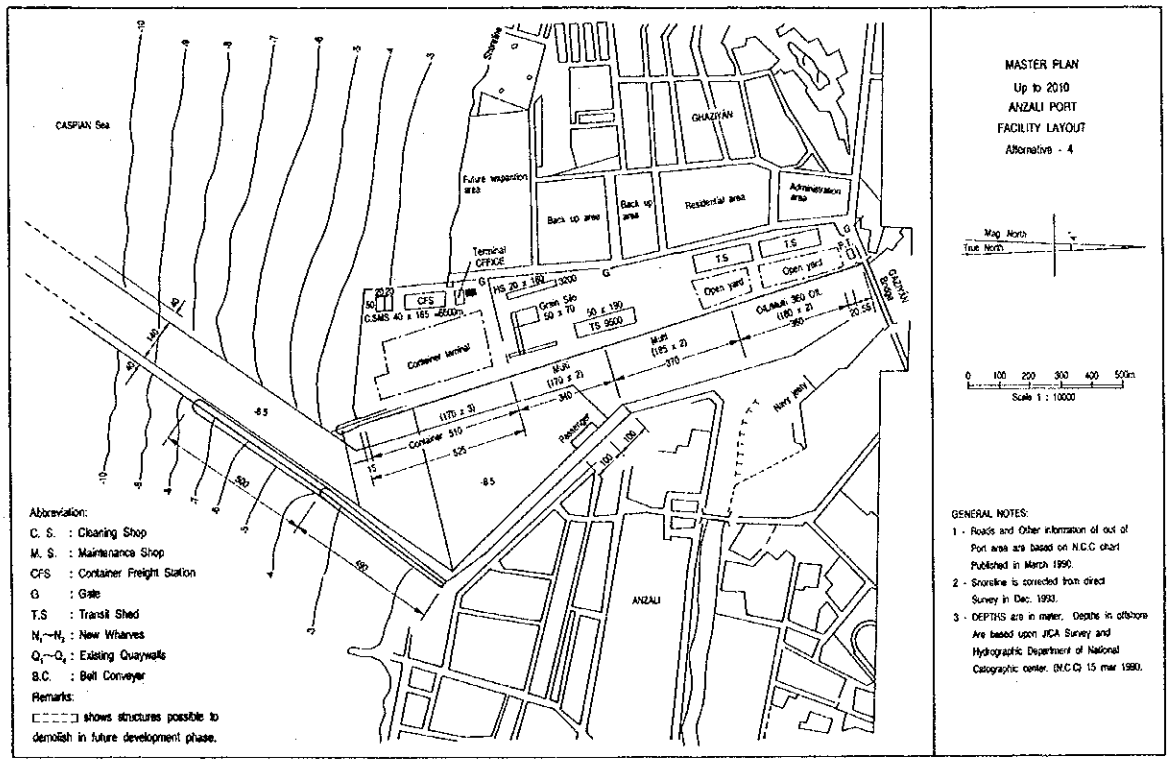


Figure 4.6.2.4 Alternative Plan (4)

4.6.3 Access to/from Port

(1) Road

Two-lane main road stretching 217km provides access between Anzali port and Qazvin while a six-lane freeway connects Qazvin with Tehran over a distance of 148km. Therefore, a freeway between Anzali port and Qazvin needs to be constructed while Tehran will be connected with Anzali port at the Caspian Sea by freeway.

4.6.4 Evaluation of Proposed Alternative Plans

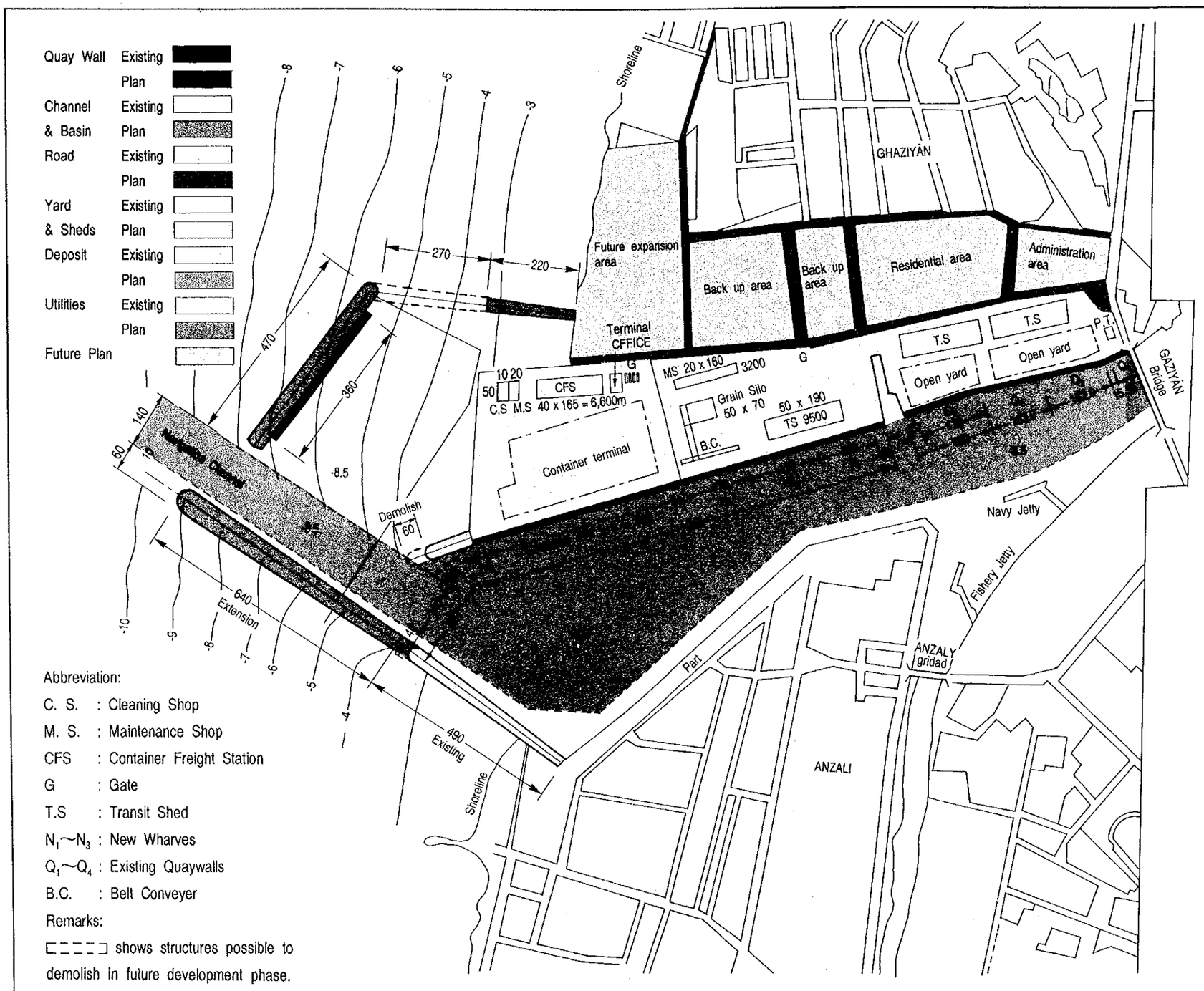
The evaluation items of the proposed alternative plans included construction cost, development potential, ship maneuverability, calmness of inner harbour and protection of environment and others. (Major content of others are difficulty in construction work and stage plan.) An evaluation of the alternative plans is shown in the following Table.

Table 4.6.4.1 Evaluation of Alternatives

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Construction cost	B	B	C	A
Development potential	A	A	B	A
Maneuvering of ship	B	A	A	C
Calmness	B	B	A	B
Protection of environment	C	A	A	C
Others	A	C	A	A
Total evluation	C	B	A	C

Note A: Preferable B: Normal C: Not Preferable

According to Table 4.6.4.1, alternative 3 is adopted for Master Plan.



Abbreviation:

C. S. : Cleaning Shop
M. S. : Maintenance Shop
CFS : Container Freight Station
G : Gate
T.S : Transit Shed
$N_1 \sim N_3$: New Wharves
$Q_1 \sim Q_4$: Existing Quaywalls
B.C. : Belt Conveyer

Remarks:

⊏⊐⊏⊐⊐ shows structures possible to demolish in future development phase.

MASTER PLAN
up to 2010
ANZALI PORT
FACILITY LAYOUT
Alternative - 3

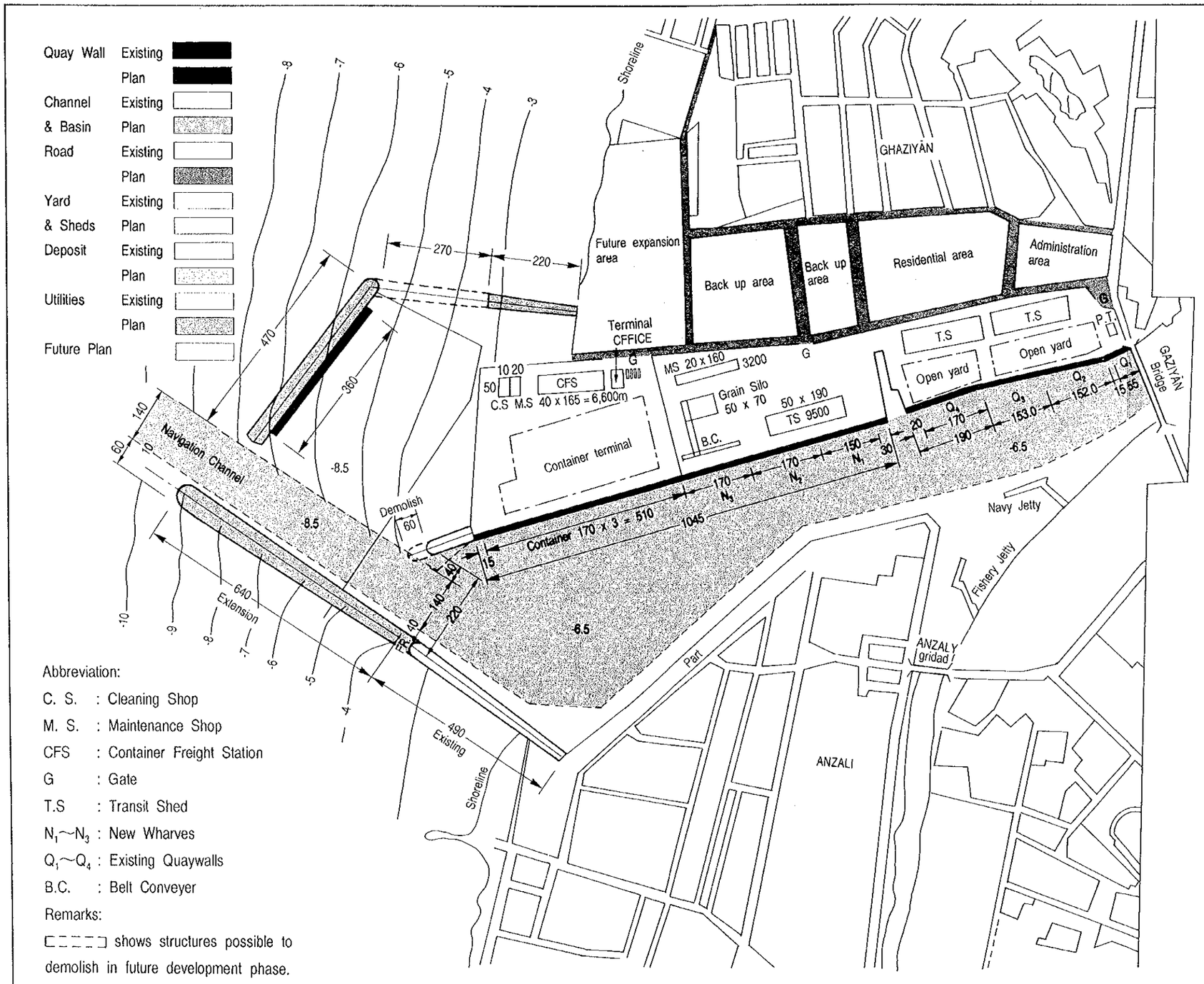
Mag. North
True North
4°

0 100 200 300 400 500m.
Graphical Scale

GENERAL NOTES:

1 - Roads and Other information of out of Port area are based on N.C.C chart Published in March 1990.
2 - Shoreline is corrected from direct Survey in Dec. 1993.
3 - DEPTHS are in meter. Depths in offshore Are based upon JICA Survey and Hydrographic Department of National Catographic center. (N.C.C) 15 mar 1990.

Figure 4.6.4.1 Master Plan of Anzali Port



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MASTER PLAN
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ANZALI PORT
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Figure 4.6.4.1 Master Plan of Anzali Port