2.4 Port related facilities and its conditions

2.4.1 Structure

The general layout plan of the port facilities and its surroundings is shown in next page. The main port facilities are summarized as shown in Table 2.4.1.1.

Table 2.4.1.1 Port Facilities at Anzali Port as of 1993

Name of facility	Description
1. General Cargo Wharf	
1-1 Berth No.1 (Q1)	L: 70 m, D: -3.1 m to -6.3 m bellow CD, EL at apron front: +1.1 m use for oil/gas tanker or passenger boat
1-2 Berth No. 2 (Q2)	L: 152.5 m, D: -6.3 m, EL: +1.0 m with 10 t quay crane
1-3 Berth No. 3 (Q3)	L: 152.5 m, D: -5.0 m, EL: +1.0 m with 16 t quay crane
1-4 Berth No. 4 (Q4)	L: 180 m, D: -5.3 m, EL: +1.0 m with 16 t quay crane
	Total length of berths: 555.0 m
[Note] These berths (Q1 to Q4) are used for general cargo ships including container cargo.	
1-5 Berth No. 5 (Q5)	L: 90.0 m, D: -4.7 m, EL: +1.8 to 2.5 m for small crafts/service vessels
2. Slipway	L: 60.0 m, Ship repair capacity: 2,000 t (designed), 1,600t (actual)
3. Seawall	
3-1 Seawall (SW1)	L: 152.0 m
3-2 Seawall (SW2)	L: 300.0 m
3-3 Seawall (SW3)	L: 310.0 m
	Total length of east seawall: 762.0 m
4. Breakwater	
4-1 East breakwater (Be)	L: 420.0 m, D: -4.0 m at top-end
4-2 West breakwater (Bw)	L: 490.0 m, D: -4.0 m at top-end
	Total length of breakwaters: 910.0 m

Note 1) L: Length, D: Depth, EL: Elevation, CD: Chart Datum
2) Refer to Fig. 2.5.1.1

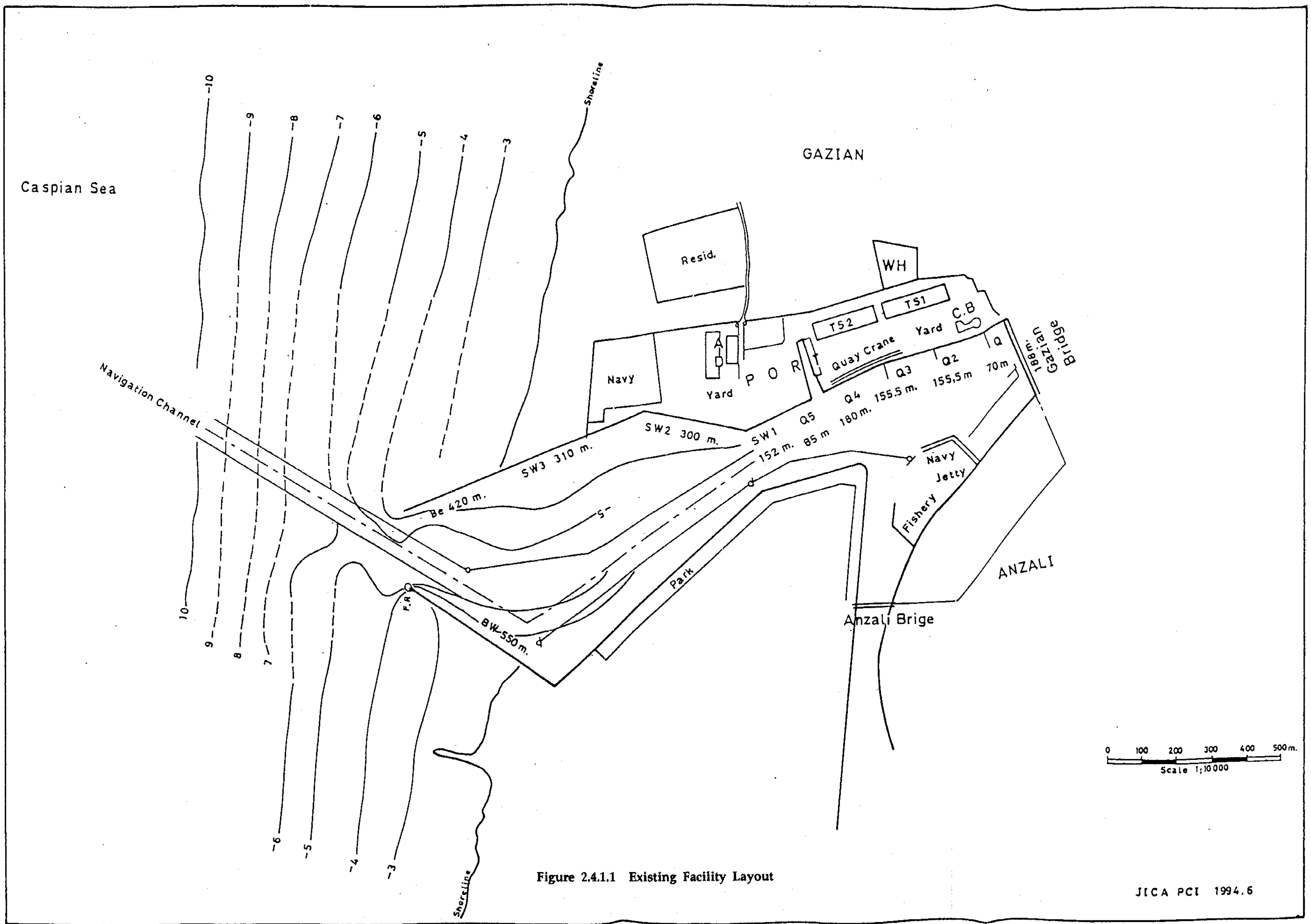


Figure 2.4.1.1 Existing Facility Layout

5. Channel/Basin

5-1 Channel — Width: 90m~110m~130m
Min.: 70m, Max.: 130m
D: -4.9m to -7.5m.
Maintenance dredging depth: -5.0m bellow CD

5-2 Basin — 150m dia. circle in front of Q3

6. Navigation Aids — Refer to Figure 2.4.1.2.

6-1 Harbour entrance lights (leading lights) 2 sets on the breakwaters

6-2 Channel markers: 6 light buoys

6-3 Beacons: 1 set at the west seawall

7. AD building — 1st floor: car parking 1,850 sq.m
2nd & 3rd floors: office 3,710 sq.m
Total floor area: 5,560 sq.m

8. Transit Shed

8-1 Transit shed-1 — L: 196m, W: 50.15m, H: 7.28m, Area: 9,830 sq.m

8-2 Transit shed-2 — L: 196.2m, W: 51.5m, H: 7.2m, Area: 10,104 sq.m

8-3 Warehouses — 3 warehouses for export materials

9. Customs building — Area: 1,080 sq.m

10. Utilities

10-1 Electricity — 2 transformers station connected to Manjil dam with 11kv
1,650 & 500 KVA
2 emergency generators with 500 & 250 KVA

10-2 Fresh water

Facilities:
2 lines @4" dia.t o Transit shed
1 line 4" dia. to residential area
1 line 4" dia. to residential area
1 line 0.75" dia. to resident area
1 line 0.5" dia. to resident area
City distribution pipe:
Pressure: 3.0m water column
= 0.3 atmospher
= 0.3 HP (Heat Pascal)
8 water hydrants at berth apron front for ships

Consumption:
3,000 cub.m/month for transit shed
800 cub.m/month for residential area
200 to 250 dub.m/month for gate area
2,500 to 3,000 cub.m/month for 100 houses

10-3 Sewage — Sewage treatment plant for residential area
No facility in the port area

10-5 Lighting System	9 towers of 16m height with 30 units Sodium steam system each unit: 170,000 lux, 2,080 W, 10.3 Amp, 920 cd/sq.cm, 380 v for cranes/yard area
Future demand:	48,000 lux, 400W
10-6 Fire Alarm System	2 system totaled 1 system of city 1 system: under ground container tank of 72 cub.m, pumping system pressure: 10 atmospheres 3 trucks of 7t with 1t mechanical phone 2 trucks with 250 kg powder gas 1 ambulance 1 fire pick-up truck 20 persons 24 hours shift 24 smoke detectors for transit shed 2 sensors for each transit shed 110 temperature (heat) detectors for transit shed 36 detectors for export warehouses 290 small sensors for administration bdg cost: 30,000,000 Rls.
10-7 Drainage	2 drainage lines, pavement surface slope of 2 % in yard area
10-8 Communication system	Micro-wave phone system to main cities in Iran are available 200 nos of Walkie/Talkie available
10-9 Other	
11. Residential Housing	280 × 200 = 56,000 sq.m
12. Equipment	
12-1 Quay Crane:	2 numbers of quay crane of 16 t lifting capacity 1 quay crane of 10 t lifting capacity
12-2 Yard Crane:	2 numbers of yard crane of 10 t lifting capacity
13. Service Vessels	
13-1 Hopper-suction Dredger:	Hopper capacity 1,000 cub.m
13-2 Cutter-suction Dredger:	750 ps
13-3 Service boat:	Tug boats, Floating crane 60 t 2 Barges of 1,000 m^3 , 1 barge of 400 m^3

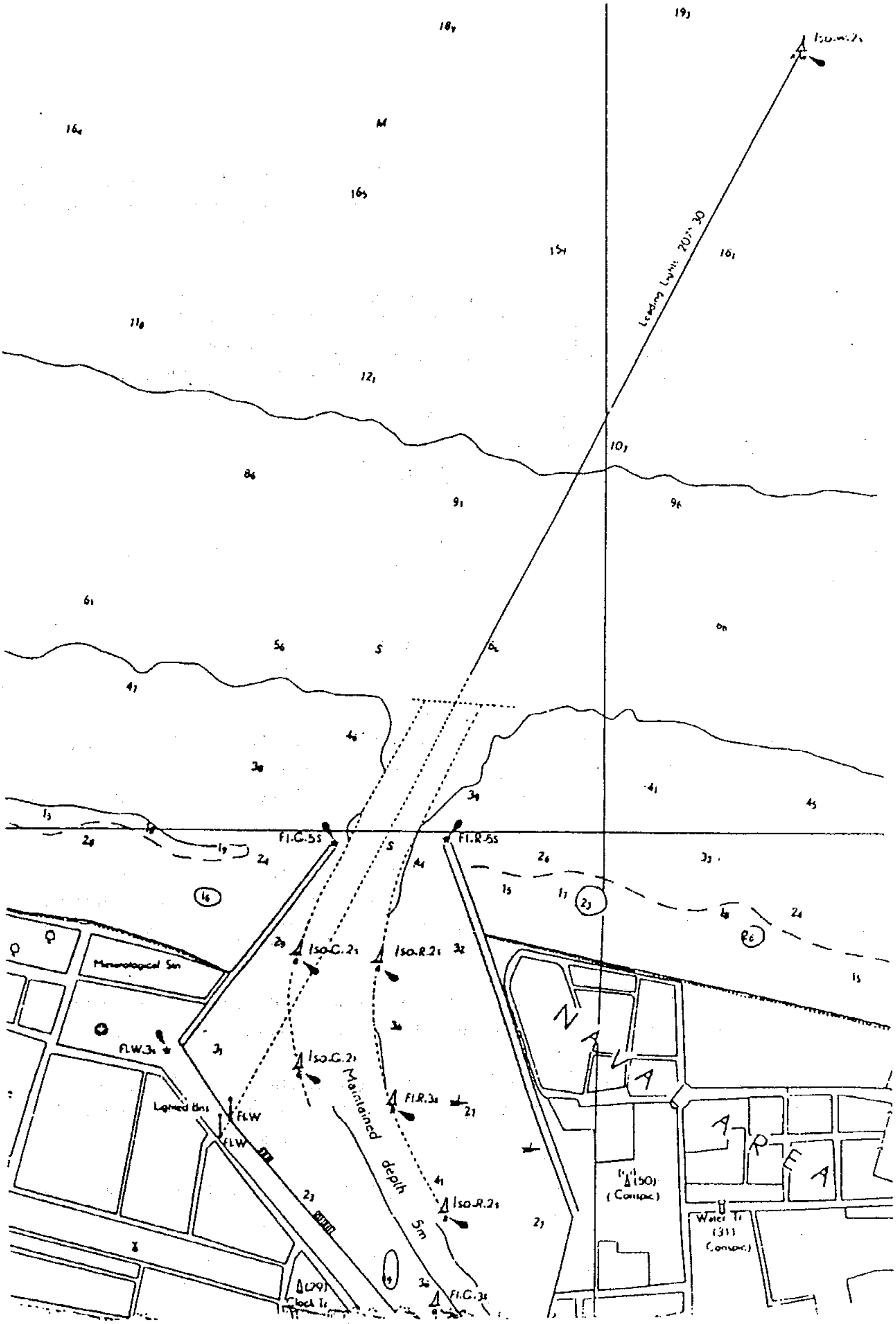
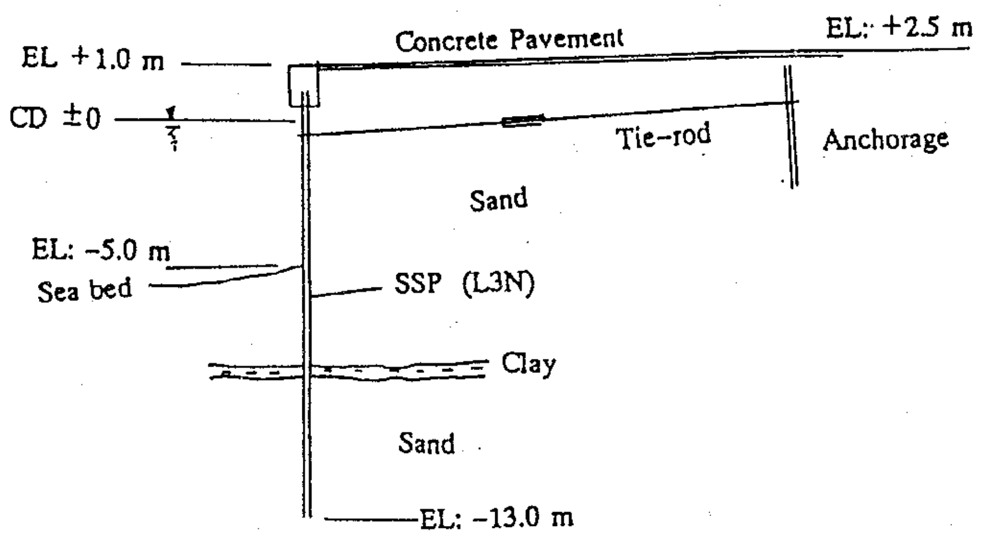


Figure 2.4.1.2 Navigation Aids

2.5 Basic Facilities and Structural Analysis

2.5.1 Wharves

The structural type of all existing five (5) wharves are same type of quaywall using steel sheet piles Steel Sheet Pile (SSP) foundation with the anchorage wall connected by the tie-rods. (refer to sketch below)



The wharves are constructed in 1970's, and aged about 20 years old, However, the quality of the steel piles are quite well maintained according to the test results for its thickness and length conducted by Study Team mainly due to low salt contents in Caspian sea water.

It is estimated that the durability of the material Steel Sheet Pile (SSP) itself against rusting of steel will be maintained in future. The other parts of the quaywall structure are generally well maintained except some parts of the surface of concrete pavement and the fender system.

There is a check-point on the stability of the quaywall structure. A remarkable earthquake was happened at Rudbar, Gilan province, about 70 km far from Anzali city in 1990's. It is recorded in magnitude of 7.7.
The sub-soil of the port consists mainly sand sedimentation caused by the river and the sand drift on seashore including some of silt/clay strata in thin thickness. As usual the sand layer has enough stability to support the structure.

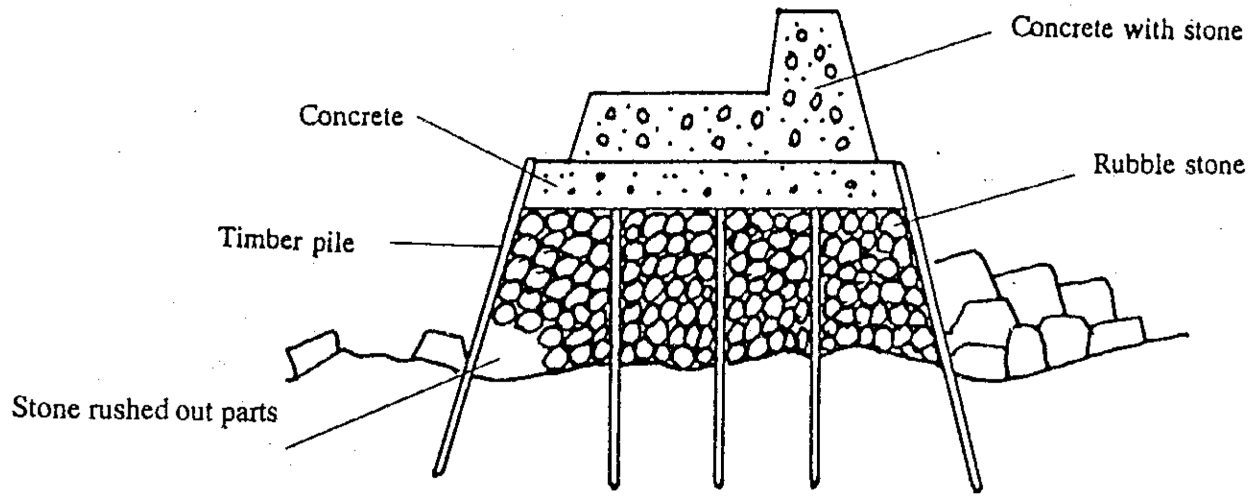
When the earthquake is coming, the sand layer will become such as a liquid due to the liquefaction and not stable.

Therefore, when new structure is proposed on the same ground site, the checking calculation against the liquifaction shall be required.

Another important point is the top elevation of the berth apron front. The elevation of the existing quaywall is about +1.00 m above CD (Chart Datum) in Anzali port. The water level in the Caspian sea has been rising up recently about 2.0 m since 1977. It will be estimated to reach +2.0 m in 2010. It is necessary to make adequate solution on the matter. (refer to Design Criteria)

2.5.2 Breakwater

There are two (2) breakwaters located at the entrance of the port. The structure of the breakwater consists of the stone mounted bank covered partially by concrete blocks (tetra-pods). The sketch shows the typical cross section (at middle part).

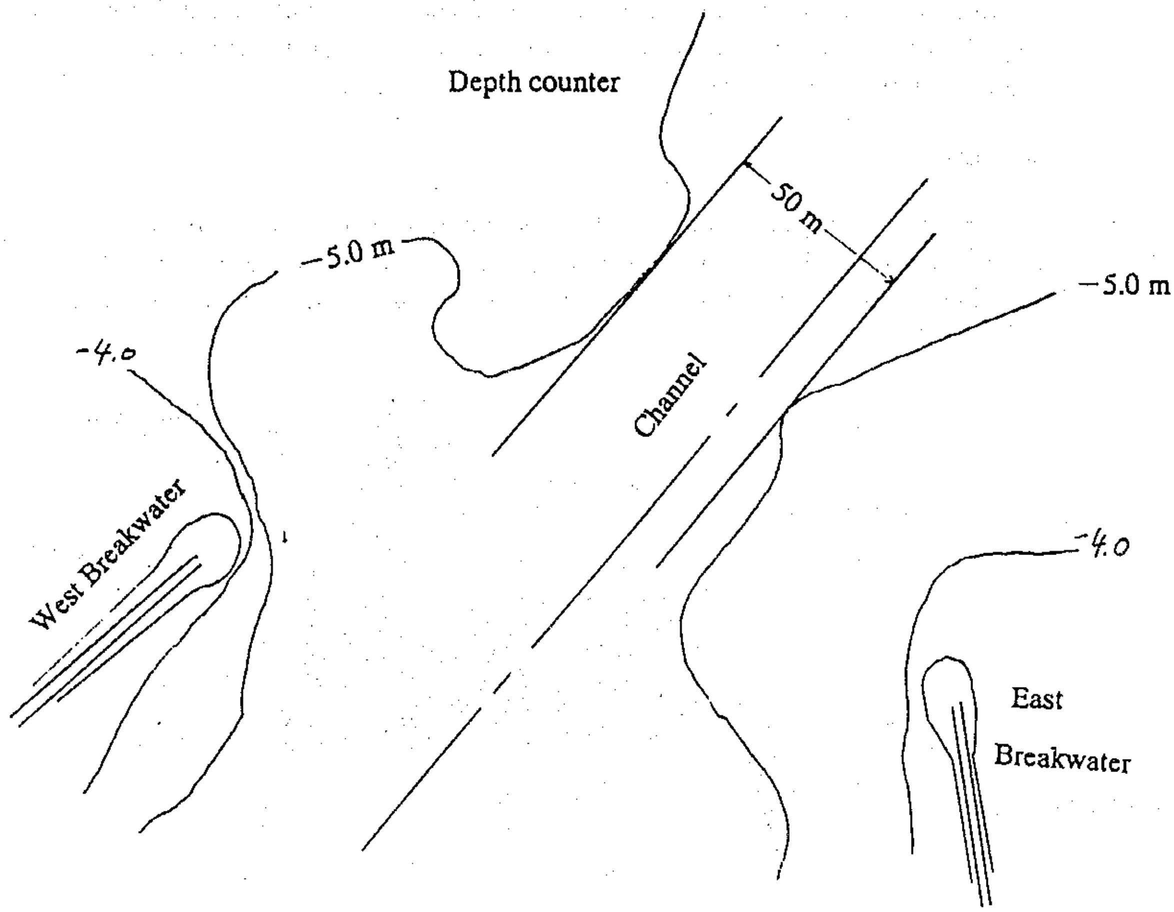


Some parts of the breakwater foundation are rushed out caused by rough waves and the effort of the maintenance works have been made on time.

The alignment of the existing 2 breakwaters is not so effective to the wave directions during rough weather season. The study on the matter is required.

2.5.3 Channel/Basin and Maintenance Dredging

According to the study described in the sub-section 2.1.5, it is observed that the channel and basin in the port have been well maintained by the PSO. However, it is not successful to keep the width and depth of the channel/basin. Especially, the estuary area of the channel at the both breakwaters to-ends, there are some difficulties to maintain the area, because the various wave actions and water flows are concentrated at this area. According to the sounding results, it is estimated that the width of the channel at this point is 50 m minimum. (refer to the figure below.)



In order to maintain the width of the channel, it is necessary to consider the items blow.

a) To keep the stable slope end of the breakwater during the maintenance dredging operations.
b) To repair or rehabilitate the slopes of the breakwaters to be maintained.

2.5.4 Elevation of Port Area and Water Level

According to the studies of the current situations described in the sub-section 2.1.3 (1) and 2.1.4 (4), the risining up works of the existing port facilities areas including the quaywalls, yards, buildings, etc. are required to cope with the increasing of the water the water level in the Caspian sea.

The existing situation of the elevations in the port area is shown in Figure 2.5.4.1 based on the topographic survey.

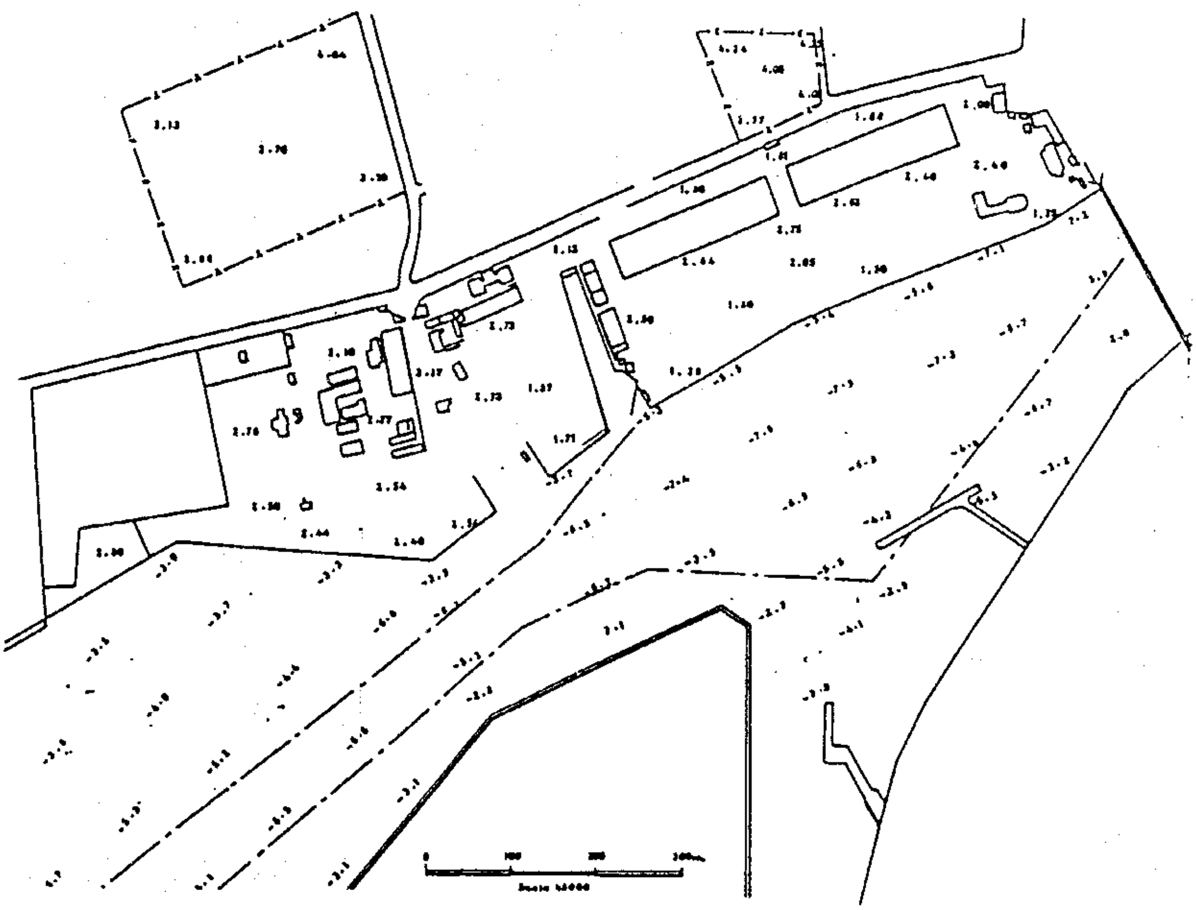


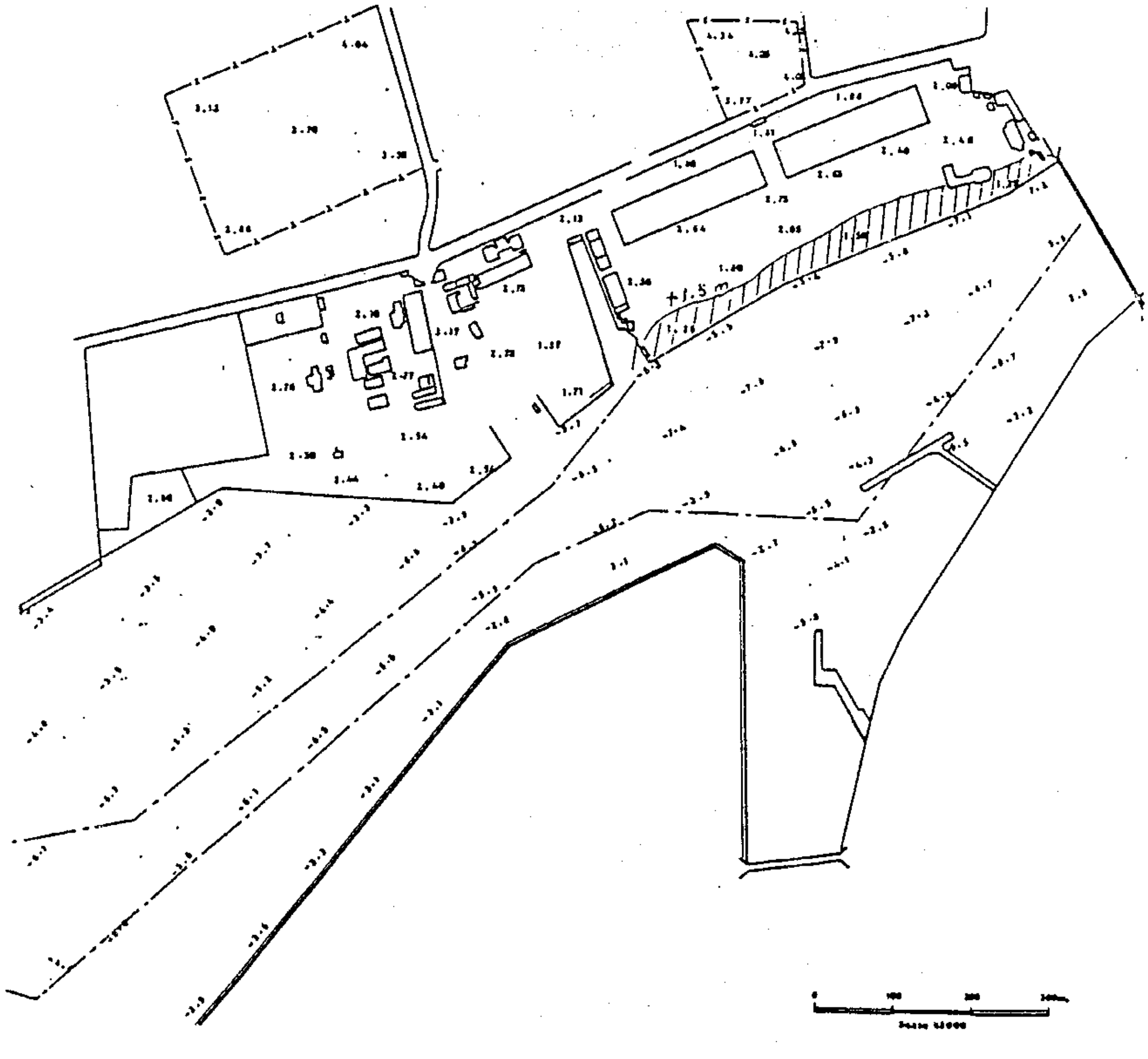
Figure 2.5.4.1 Elevation of Port Area and Water Level

According to the figure, the following items are observed.

(1) Apron elevation at the quaywall Q_1 to Q_4 : +1.0 ~ +1.2 m above C.D.
(2) Apron elevation at the quaywall Q_5 : +2.1 ~ +2.5 m above C.D.

Elevation at Transit Shed: +2.5 m above C.D.
Elevation at Administration building: +3.7 m above C.D.

Based on the survey map, it is estimated that the area covered by the water at the elevation of +1.5 m water level above C.D. (estimated year: 2005)



Covered Area by Water

It is necessary to set up the designed height of the port areas to cope with the water level in future development plans.

Chapter 3

Demand Forecast

Chapter 3 Demand Forecast

3.1 Commodity-wise Cargo Traffic Demand for the Port

In Chapter 3 of Interim Report(1), cargo traffic demand at each study port was forecasted. Based on these results, commodity-wise cargo traffic demand at each study port was then forecasted.
Hereinafter, cargo traffic demand at Anzali port will be studied for the Master Plan Study.

3.1.1 Past and Current Cargo Handling Volume in Anzali Port

Present economic activities in connection with port activities in a recent six-year period are shown in Table 3.1.1.1, Table 3.1.1.2 and Table 3.1.1.3. Figure 3.1.1.1, Figure 3.1.1.2 and Figure 3.1.1.3 show cargo handling volume by commodity type.
From 1988 to 1989, imports of petroleum product increased explosively due to the end of war. This trend continued till 1991, 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 due to the social-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, 1993, at which the import of container cargo and export of bagged cargo increased significantly, can be regarded as a transition year.
The socio-economic structure of Iran seems to have clearly undergone changes since 1992 as a result of the economic policy.

Table 3.1.1.1 Total Cargo Volume in Anzali Port

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

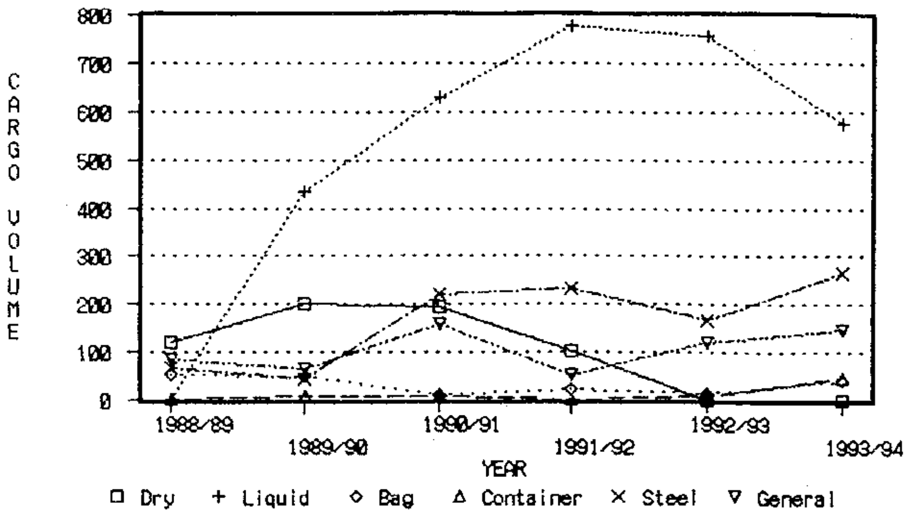


Figure 3.1.1.1 Total Cargo Traffic Movement in Anzali Port (unit: 1,000 tons)

Table 3.1.1.2 Import Cargo Volume at Anzali Port

Bander Anzali Unit: 1,000 tons

COMMODITY	1988/89		1989/90		1990/91		1991/92		1992/93		1993/94	
	tons	ratio	tons	ratio	tons	ratio	tons	ratio	tons	ratio	tons	ratio
DRY BULK	120		202		196		103		0		0	
Barley	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wheat	120	36.0%	202	25.2%	196	16.0%	103	8.6%	0	0.0%	0	0.0%
Corn	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
LIQUID BULK	4		433		629		775		756		577	
Petroleum Products	4	1.2%	433	54.1%	629	51.3%	775	65.0%	756	71.7%	577	55.7%
Vegetable Oil	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
BAGGED CARGO	53		49		11		25		12		10	
Fertilizers	53	15.9%	31	3.9%	2	0.2%	5	0.4%	12	1.1%	10	1.0%
Chemical Material	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sugar	0	0.0%	18	2.2%	9	0.7%	20	1.7%	0	0.0%	0	0.0%
Rice	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Soy Bean	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
CONTAINER												
Others	2	0.6%	10	1.2%	9	0.7%	4	0.3%	8	0.8%	43	4.2%
REFRIGERATED GOODS												
Meat	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
STEEL MATERIAL												
Metallic Product	69	20.7%	44	5.5%	222	18.1%	234	19.6%	168	15.9%	266	25.7%
MINERAL												
Coal	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
GENERAL CARGO												
Others	85	25.5%	63	7.9%	158	12.9%	51	4.3%	111	10.5%	140	13.5%
TOTAL	333	100.0%	801	100.0%	1,225	100.0%	1,192	100.0%	1,055	100.0%	1,036	100.0%

Source: Ports & Shipping Organization

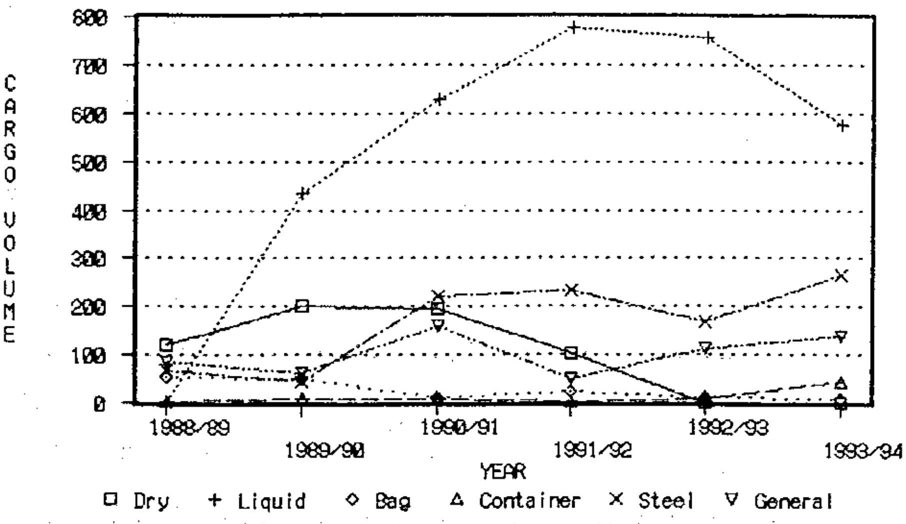


Figure 3.1.1.2 Import Cargo Traffic Movement in Anzali Port (unit: 1,000 tons)

Table 3.1.1.3 Export Cargo Volume in Anzali Port

Bander Anzali

Unit: 1.000 tons

COMMODITY	1988/89		1989/90		1990/91		1991/92		1992/93		1993/94	
	tons	ratio	tons	ratio	tons	ratio	tons	ratio	tons	ratio	tons	ratio
DRY BULK	0		0		0		0		0		0	
Sulphur	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Const. Material	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Salt	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
LIQUID BULK	0		0		0		0		0		0	
Molasses	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Petroleum Product	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Liquid Gas	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
BAGGED CARGO	0		0		0		0		3		31	
Chemical Material	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	31	73.8%
Rice	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	23.1%	0	0.0%
CONTAINER												
Others	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	7.7%	3	7.1%
REFRIGERATED GOODS												
Meat	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
STEEL MATERIAL												
Metallic Product	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
MINERAL												
Copper	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
GENERAL CARGO	1		2		1		1		9		8	
Dried Fruits & nuts	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Others	1	100.0%	2	100.0%	1	100.0%	1	100.0%	9	69.2%	8	19.0%
TOTAL	1	100.0%	2	100.0%	1	100.0%	1	100.0%	13	100.0%	42	100.0%

Source: Ports & Shipping Organization

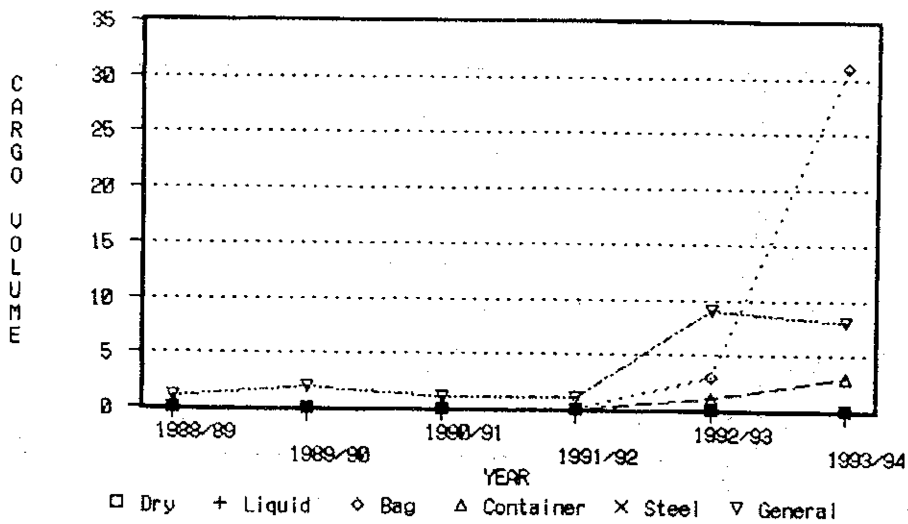


Figure 3.1.1.3 Export Cargo Traffic Movement in Anzali Port
(unit: 1,000 tons)

3.1.2 Forecast Cargo Handling Volume in Anzali Port

Forecasted Commodity-wise cargo handling volume in the target years 2000 and 2010 is shown in the Table 3.1.2.1.

Table 3.1.2.1 Forecasted Cargo Handling Volume

(Unit: 1,000 tons)

Commodity	1993/94	2000/01	2010/11
Dry Bulk Cargo	0	222	444
Liquid Bulk	577	802	1,530
Bagged Cargo	41	49	131
Container Cargo	46	86	1,159
Refrigerated Cargo	0	0	0
Steel Product	266	218	575
Mineral(bulk)	0	0	0
General Cargo	148	162	563
Sub-Total	1,078	1,538	4,402
Transit Cargo	0	273	680
TOTAL	1,078	1,811	5,082

Note: 2000/01 & 2010/11 forecasted by the Study Team

Annual growth rate of each commodity from 1993/94 to 2000/01 and from 2000/01 to 2010/11 is shown in the Table 3.1.2.2.

Table 3.1.2.2 Annual Growth Rate

Commodity	1993/94 to 2000/01	2000/01 to 2010/11
Dry Bulk Cargo	146.6%	7.2%
Liquid Bulk	4.8%	6.7%
Bagged Cargo	2.6%	10.3%
Container Cargo	9.4%	29.7%
Refrigerated Cargo	0%	0%
Steel Product	-2.8%	10.2%
Mineral(bulk)	0%	0%
General Cargo	1.3%	13.3%
TOTAL	5.2%	11.1%

Table 3.1.2.3 indicates the import, export and total cargo by commodity; the weight of export cargo in port activities shows a tendency to increase. The share of export cargo is 3.9%, 6.5% and 12.4% in 1993/94, 2000/01 and 2010/11 respectively.

Forecasted total cargo volume, import cargo volume and export cargo volume from present to the target years are shown in Figure 3.1.2.1, 3.1.2.2 and 3.1.2.3 respectively.

Table 3.1.2.3 Forecasted Import & Export Cargo Handling Volume

(unit: 1000 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
Total	1,036	42	1,078	1,439	100	1,539	3,855	547	4,402
Ratio of Imp/Exp	96.1%	3.9%		93.5%	6.5%		87.6%	12.4%	

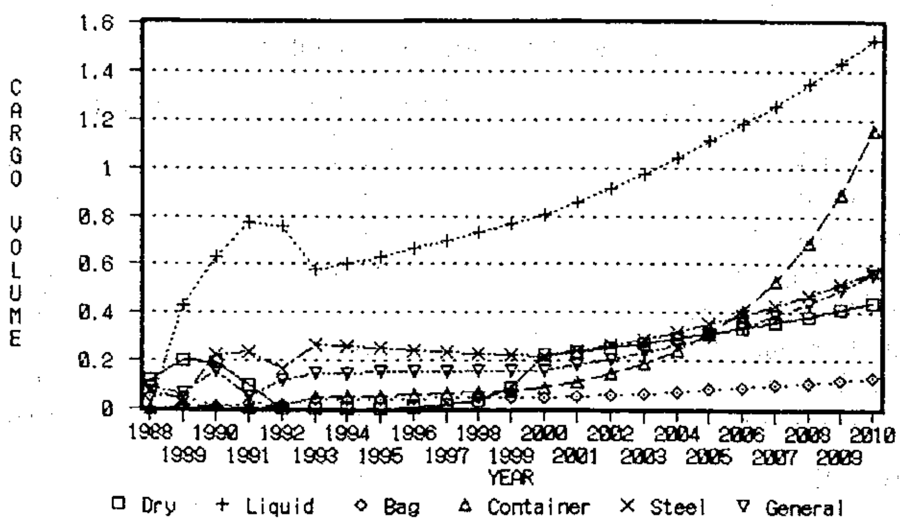


Figure 3.1.2.1 Forecast Total Cargo Traffic Movement
(unit: million tons)

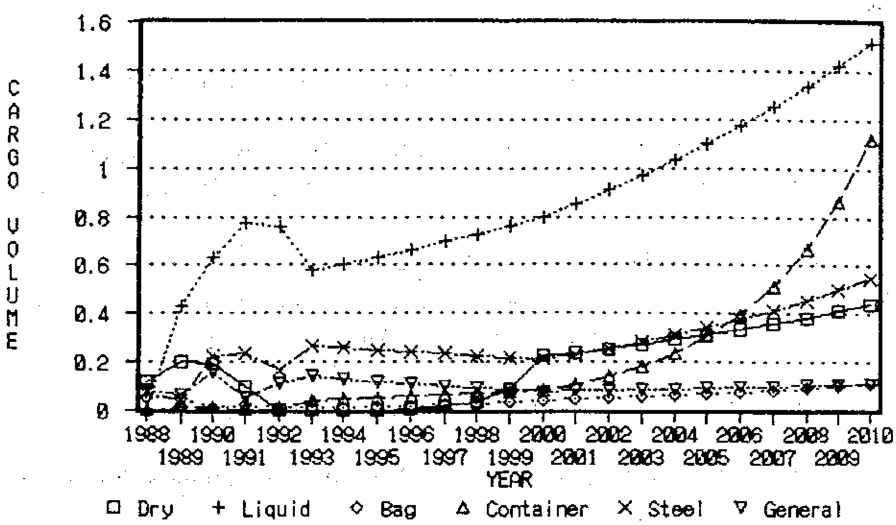


Figure 3.1.2.2 Forecast Import Cargo Traffic Movement
(unit: million tons)

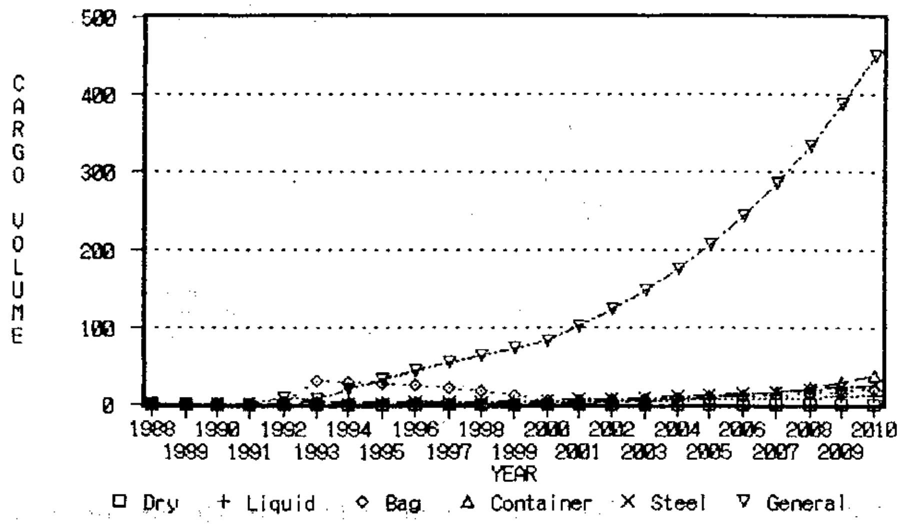


Figure 3.1.2.3 Forecast Export Cargo Traffic Movement
(unit: 1,000 tons)

3.2 Vessels

(1) Precondition of the estimate for vessel-size, type and number

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

(2) Procedure of the estimate for vessel size and number

The procedure of the estimate for size and number of calling ships in Anzali Port is explained by the following flow chart.

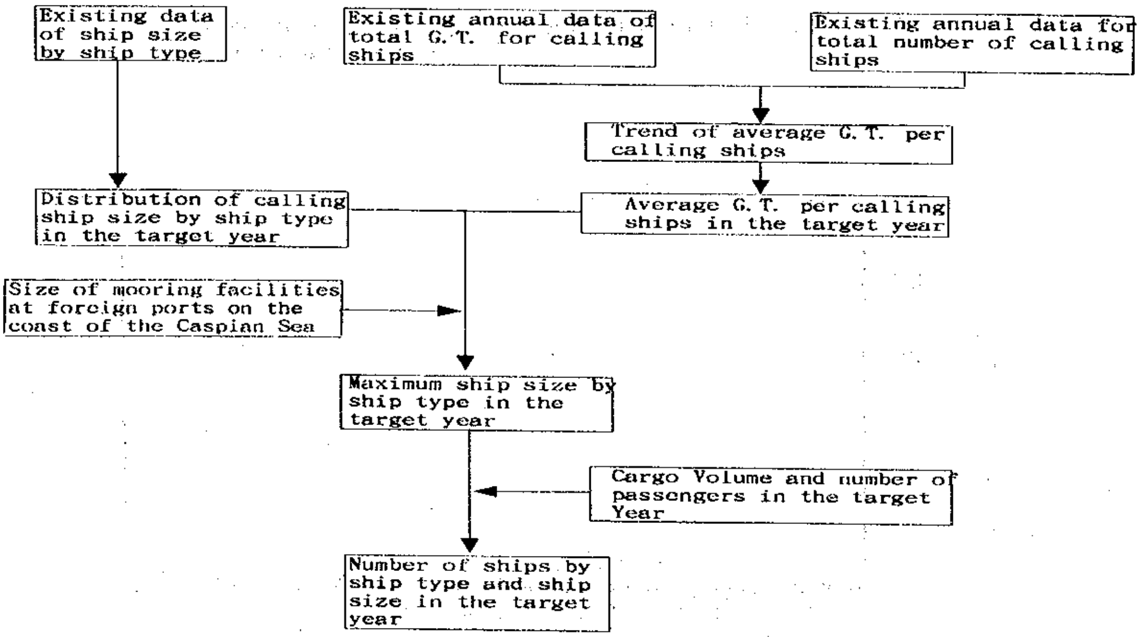


Figure 3.2.1.1 Flow Chart of Procedure of the Estimate for Ship Size and Number of Calling of Ships

Note (1): In this report, especial study for Anzali Port, dry cargo ship is a general term for dry bulk ship, conventional break bulk ship, container ship and steel ship.

(3) Average calling ship size by ship type

Average calling ship size in the target year is estimated using a regression line based on past data of calling ships at Anzali Port from 1982 to 1992.
Average G.T. (Gross tonnage)of all calling ships in 2000 and 2010 is calculated by the following formula. The result of the calculation is shown in Table 3.2.1.1.

$$Y=37.82\ x - 48{,}683$$

x:Year
Y:G.T.

Table 3.2.1.1 Estimate of Average Calling Ship Size in 2000 and 2010

The Chiristian Year	The Iranian Year	Average G.T.	
		Actual (ton)	Estimate (ton)
1988	1367	2,872	
1989	1368	3,220	
1990	1369	3,075	
1991	1370	3,221	
1992	1371	3,061	
1993	1372	2,760	
2000	1379		3,500
2010	1389		4,000

Source of the actual G.T.:PSO

Figure 3.2.1.2 shows the chronological changes from 1982 to 1992 in average G.T. for all calling ships in Anzali Port.

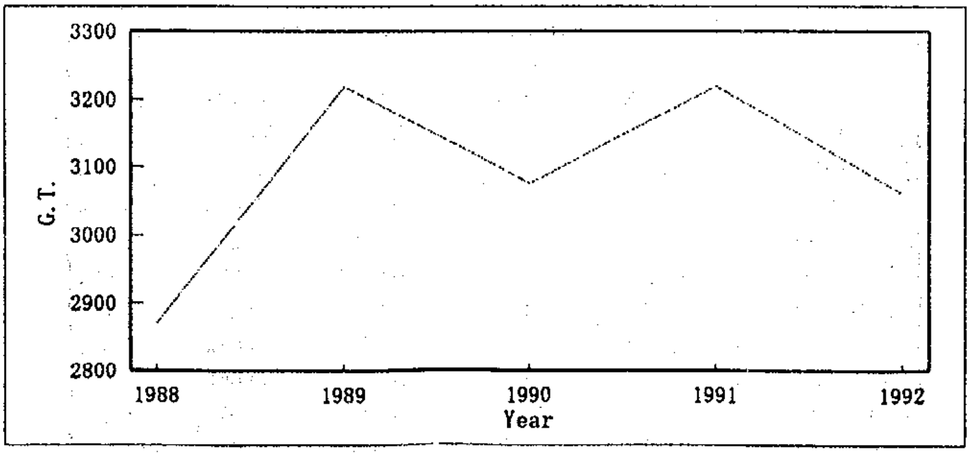


Figure 3.2.1.2 Chronological Changes of Average G.T. for All Calling Ship from 1982 to 1992 in Anzali Port

(4) Forecast of Distribution of Calling Ship Size by Ship Type in 2000 and 2010

Basically, future ship size distribution of all calling ships except tugboats, barges and passenger ships is determined by an extrapolation of current statistics on vessel size and distribution and the forecasted vessel size in the target years.
Table 3.2.1.2 shows the current calling ship size distribution by ship type in Anzali Port and Table 3.2.1.3 and 3.2.1.4 shows the calling ship size distribution by ship type in the target year in Anzali Port.

Table 3.2.1.2 Distribution of Number of Calling Ships by Size by type in Anzali Port in 1993

Class (G.T.)	D.C.Ship	Tanker	Passenger	Tug boat	Total
0-500	2.2%	0.0%	0.0%	66.7%	12.0%
500-1000	14.1%	2.3%	0.0%	33.3%	13.0%
1000-1500	2.2%	0.0%	0.0%	0.0%	1.1%
1500-2000	5.4%	0.0%	100.0%	0.0%	12.5%
2000-2500	19.6%	0.0%	0.0%	0.0%	9.8%
2500-3000	4.3%	0.0%	0.0%	0.0%	2.2%
3000-3500	18.5%	2.3%	0.0%	0.0%	9.8%
3500-4000	33.7%	0.0%	0.0%	0.0%	16.8%
4000-4500	0.0%	95.5%	0.0%	0.0%	22.8%
4500-5000	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source:PSO

Table 3.2.1.3 Distribution of Number of Ship Size by ship type in Anzali Port in 2010

(unit:%)

Class (G.T.)	D.C.Ship	Tanker	Passenger	Tug boat	Total
0-500	0.0%	0.0%	0.0%	66.7%	10.9%
500-1000	0.0%	0.0%	0.0%	33.3%	5.4%
1000-1500	0.0%	0.0%	0.0%	0.0%	0.0%
1500-2000	0.0%	0.0%	100.0%	0.0%	9.8%
2000-2500	2.0%	0.0%	0.0%	0.0%	1.0%
2500-3000	14.2%	2.3%	0.0%	0.0%	7.6%
3000-3500	2.2%	0.0%	0.0%	0.0%	1.1%
3500-4000	5.4%	0.0%	0.0%	0.0%	2.7%
4000-4500	18.2%	0.0%	0.0%	0.0%	9.1%
4500-5000	3.6%	0.0%	0.0%	0.0%	1.8%
5000-5500	20.0%	2.3%	0.0%	0.0%	10.5%
5500-6000	34.4%	0.0%	0.0%	0.0%	17.2%
6000-6500	0.0%	95.5%	0.0%	0.0%	22.8%
6500-7000	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3.2.1.4 Distribution of Number of Ship Size by ship type in Anzali Port in 2000

(unit:%)

Class (G.T.)	D.C.Ship	Tanker	Passenger	Tug boat
0- 500	0.0%	0.0%	0.0%	66.7%
500-1000	0.0%	0.0%	0.0%	33.3%
1000-1500	2.0%	0.0%	0.0%	0.0%
1500-2000	7.5%	2.3%	100.0%	0.0%
2000-2500	2.0%	0.0%	0.0%	0.0%
2500-3000	4.4%	0.0%	0.0%	0.0%
3000-3500	11.1%	0.0%	0.0%	0.0%
3500-4000	6.0%	0.0%	0.0%	0.0%
4000-4500	26.0%	2.3%	0.0%	0.0%
4500-5000	41.0%	0.0%	0.0%	0.0%
5000-5500	0.0%	95.5%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

Figure 3.2.1.3 and 3.2.1.4 show the calling ship size distributions by ship type at present and in the target year at Anzali Port.
The distributions of container ship size in 2000 and 2010 are forecast considering the size of the container ships for land-bridge cargoes that would be transported by container ships smaller than the current import/export container ships in Anzali Port. This is envisaged because interval of calling ships for container land bridge cargo is shorter than the current container ships.
Therefore, there is a slight difference between the calling ship size distribution at present and in the target years.

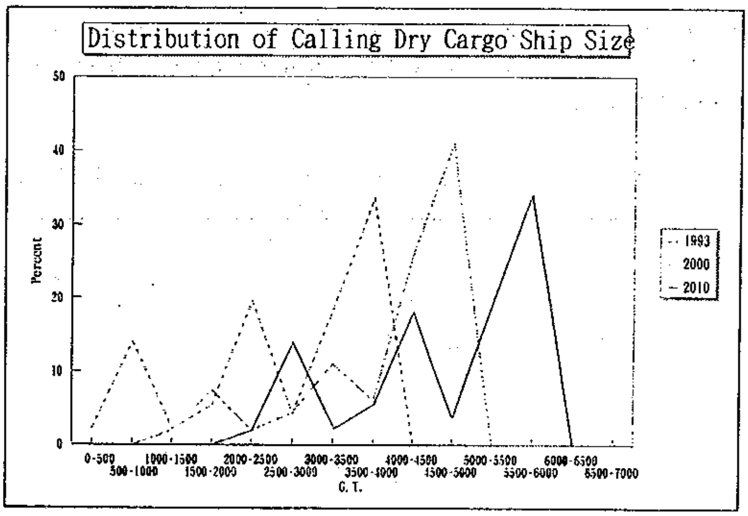


Figure 3.2.1.3 Distribution of Calling Dry Cargo Ship Size in Anzali Port in 1993, 2000 and 2010

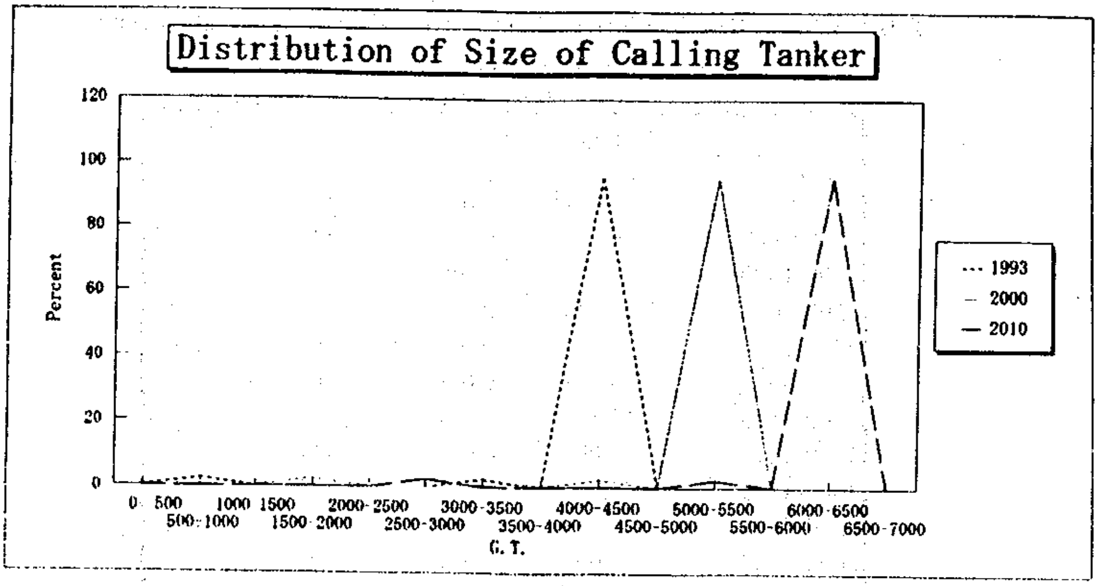


Figure 3.2.1.4 Distribution of Calling Liquid Bulk Tanker Size at Anzali Port in 1993, 2000 and 2010

(5) Dimension of Maximum Calling Ship in 2000 and 2010

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, D.W.T. or G.T. of internationally standard ships cannot be applied. Instead, dimensions of future calling ships at Anzali Port are estimated based on the actual dimensions of calling ships in Anzali Port.

Length of the future ships are estimated by the tendency of the length of calling ships at Anzali Port. According to Figure 3.2.1.5, the tendency of calling ship length at Anzali Port are converged to below 140 meter for 5,000 G.T.. So, the maximum length of calling ships at Anzali Port in Master Plan which are estimated 6,000 G.T. are estimated 140 meter.

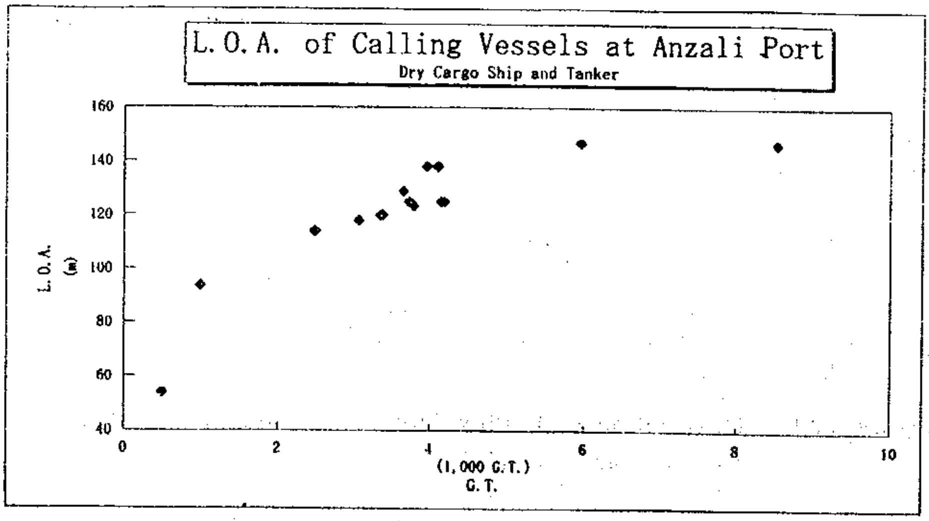


Figure 3.2.1.5 L.O.A. of Calling Vessels at Anzali Port

The draft of the future calling ships at Anzali Port are estimated by the tendency of calling dry cargo ship draft in Anzali Port. Figure 3.2.1.6 and 3.2.1.7 show the relation between the full load and GT..

According to Figure 3.2.1.6, the depth of dry cargo berths at Anzali Port is about 6.5 m in the Master Plan and 6.0 m in Short Term Plan. For tanker berth, the depth in the Master Plan and Short Term Plan are 7.0 m and 6.5 m, respectively. However, maximum draft of a tanker on the Caspian Sea is about 8.0 m. So, the depth of the liquid bulk berth and its related basin and channel is about 8.5 m in the Master Plan.

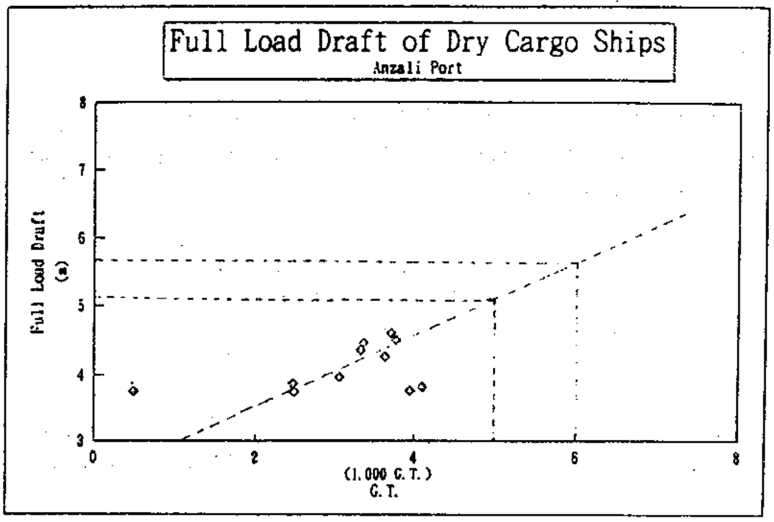


Figure 3.2.1.6 Full Load Draft of Dry Cargo Ships

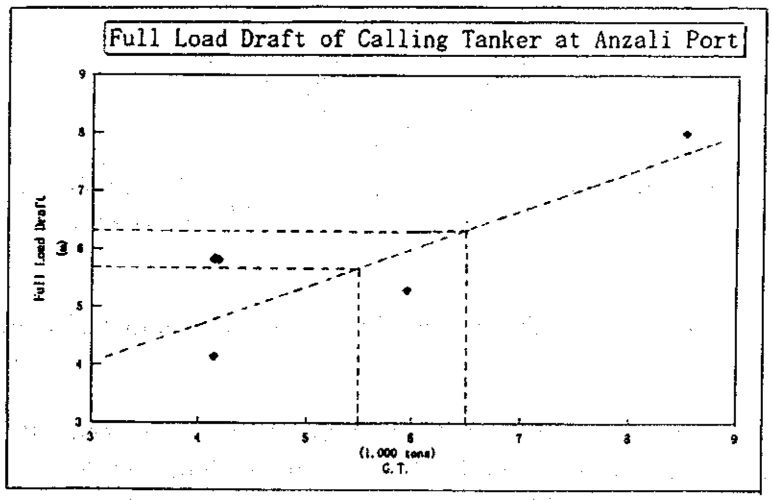


Figure 3.2.1.7 Full Load Draft of Tanker

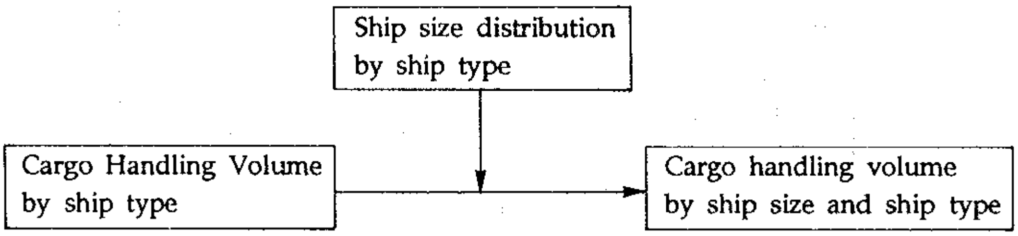
(6) Forecast of the Number of Calling Ships by Ship Type in 2000 and 2010

The procedure of the forecast for the number of calling ships by ship type in 2000 and 2010 is as follows:

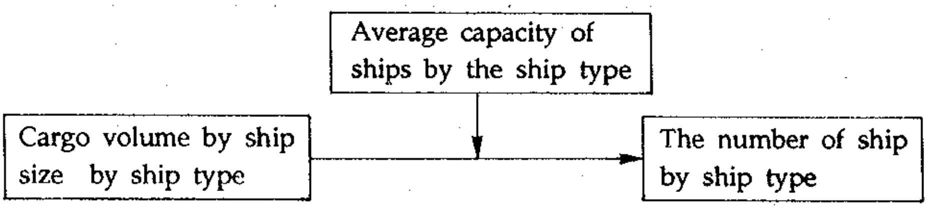
1) The cargo handling volume by ship type in 2000 and 2010 is forecasted based on the commodity-wise cargo volume in 2000 and 2010 in Anzali Port, respectively. The relations between the ship type and the packing style of cargo is as follows:

Dry cargo ship:Dry bulk cargo, bagged cargo, container cargo, steel and general cargo
Tanker:Liquid bulk ship
Barge(Tug boat):Bagged cargo and general cargo

2) The cargo handling volume by ship size and ship type in 2000 and 2010 is calculated using the ship size distribution by ship type in 2000 and 2010 and the cargo handling volume by ship type in 2000 and 2010.



3) The number of ships by ship type in 2000 and 2010 is calculated by the cargo handling volume by ship type and ship size.



(7) Maximum Calling Ship Size by Ship Type and Number of Calling Ships in 2000 and 2010

The maximum calling ship size for each ship type in 2000 and 2010 is obtained from the calling ship size distribution by ship type in 2000 and 2010. Table 3.2.1.5 shows the maximum calling ship size for each ship type in 2000 and 2010.

The number of calling ships by size and type is calculated by the calling ship size distribution and cargo handling volume by ship type. Table 3.2.1.6 and 3.2.1.7 show the number of calling ships by size and by type in 2000 and 2010.

Table 3.2.1.5 Maximum Calling Ship Size at Anzali Port in 2000 and 2010

Countory	Port	Maximum depth of existing berth	
		Name of berth	Depth(m)
Kazakhstan	Aktau	General berth	-6.0
Turkmenistan	Krasnovodsk	General berth No. 12	-6.4

Table 3.2.1.6 Number of Calling Ships by size by Type in 2010

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

Table 3.2.1.7 Number of Calling Ships by size by Type in 2010

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

Chapter 4

Functional Allotment and Capacity Evaluation of the Port Activities

Chapter 4 Functional Allotment and Capacity Evaluation of the Port Activities

4.1 Functional Allotment of Port Activities

4.1.1 Basic Concept of Port Function

Anzali Port is a gateway port for international trade in Iran. The cargo handling volume at Anzali Port is the biggest among Iranian ports along the coast of the Caspian Sea.

This port supplies Teheran and its vicinity with goods imported from northern countries and Europe. The main hinterland of this port consists of Teheran and Gilan Province but part of the cargo is distributed to or collected at the north-west area in of Iran.

The port will serve as a hub for container cargoes of the land-bridge cargoes between Russia, CIS countries, Azerbaijan and Arabic countries which are expected to increase rapidly in the near future.

4.1.2 Port Function Allocation

The main functions of this port are imported cargo handling such as oil products (which accounted for 50 percent of the total cargo handling volume), iron products and conventional break bulk cargo and exported cargo handling such as conventional break bulk cargo.

According to the cargo forecast, the main functions of this port in future will radically change: imported oil products will continue to make up the largest volume, but there will be followed by container (including land-bridge cargo), then iron products and dry bulk cargo (mainly wheat). In addition exports such as conventional break bulk cargo will be handled here. Therefore, Anzali Port will become to one of the major container ports in Iran.

At Anzali Port, cargo handling between ship and apron of quay wall is mainly carried out at four multi-purpose berths, namely, Q1, Q2, Q3 and Q4.

4.1.3 Functional Separation

(1) Water front facilities

There are five berths (Q1,Q2,Q3,Q4,Q5) operated by PSO. Tanker and passenger ships are berthed at Q1 and Q2. Steel ships which use jib crane for cargo handling are berthed at Q3 and Q4. Other ships including container ships are berthed from Q2 to Q4. Q5 is too small and serves only as the idle berth for work ships.
(Refer to Figure 4.1.3.1)

According to the cargo forecast, the cargo volume including the land-bridge cargo will be about 4.6 times (about 5 million tons) the current volume (1983/84) in the target year, and the calling ships will increase in size. Therefore, it is required to extend the existing berths and construct new ones. Volume of container cargo and liquid bulk cargo will reach about 1.84 million tons and 1.53 million tons respectively, thus exclusive berths will be required. In order to cope with the large increase in dry bulk cargo (mainly wheat imports), 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 an exclusive transit shed should be introduced for efficient use of the berth and for maintaining a low transportation cost. 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. Container ships, tankers and dry cargo ships mainly carrying dry bulk and iron products will be assigned to specific berths in accordance with these measures.

(2) Land use

Currently, the naval facilities occupy the southwestern part and a portion of the northeastern part, the fishing port occupies the northwestern part, and the commercial port area occupies the northeastern part in Anzali Port. (see Figure 4.1.3.1)

There is no storage facility or container depot in the commercial port area. These facilities should be constructed just behind the port facilities to cope with the increase in the cargo volume.

Following discussions with PSO, in the Master Plan, the mooring facilities and the sorting facilities will be provided in the northeastern area of the port including the navel facilities of which return to PSO is overdue. The port administration facilities will be moved to the east just behind the southern part of present port facilities. The housing for PSO personnel and custom's officers will remain immediately behind the present port area. Just behind the north part of the port area, a back up area for port activities and future expansion area will be allocated in the Master Plan.

(3) Cargo Handling Method by Cargo Volume

Container cargo handling at Anzali Port is mainly conducted using ship gears and mobile cranes alongside the ship and fork lifts in the yard. This method will be inadequate in future when the container cargo increases; the cargo handling efficiency at the apron will decrease and the yard will be too small for the number of containers to be stored per unit area. In the Master Plan, therefore, the quay will be equipped with a gantry crane for container handling and a transfer crane and a container trailer will be procured or a straddle carrier will be used for cargo handling.

At present, dry bulk cargo is discharged by an unloader and directly transported by trucks to the consignees' warehouse outside the port. If this method is to be used for handling a large volume of cargo efficiently, an incredibly large number of trucks would be required, thus pushing up the transportation costs and creating traffic congestion in the vicinity of Anzali Port. The Master Plan, therefore, proposes that a shed for dry bulk be constructed just behind the quay for short time storage of dry bulk cargo discharged from dry bulk ship.

About half of the conventional break bulk cargo is presently discharged and carried to the cargo owners' warehouse directly as in the case of dry bulk cargo. Since the increase in the cargo volume will also cause traffic congestion, the Master Plan adopts the system in which discharged cargo is tentatively placed in the cargo handling yard.

(4) Old Port

In Anzali Port, Q1 to Q4 were first built, followed by Q5. Since Q1 through Q4 were built before the water level began to rise in the Caspian Sea, their crown height is low, the difference between the top and the water surface being only 80cm at high tide. The quays will probably be submerged in the near future. Q5 was built after the water level to rise, and therefore has a higher crown height than the other quays, the difference between top and the water level being about 120cm at high tide.

Cargo handling 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 slope according to the Master Plan layout, and should be used as prescribed in the Master Plan after the raising work is done.(See Figure 7.3.1.1 and 7.3.1.2)

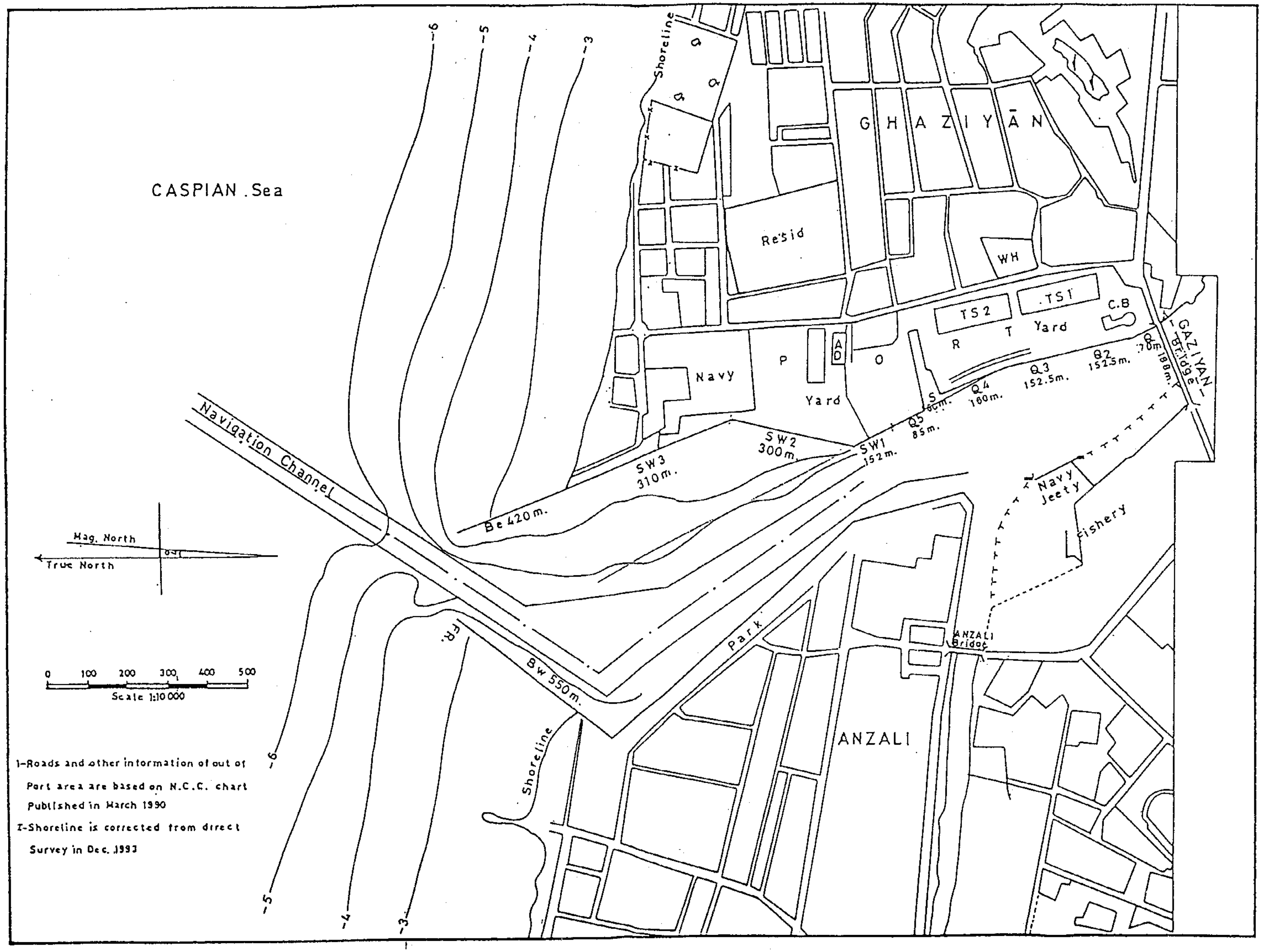


Figure 4.1.3.1 Anzali Port

4.2 Basic Concept for Capacity Evaluation

4.2.1 Basic Method of Capacity Calculation

Berth productivity depends on commodities to be handled, size and type of ship to be berthed, cargo handling system to be applied, cargo handling equipment to be used and working conditions.
All above items should be decided before calculation of the berth productivity.
The berth productivity at this stage will be calculated basically on the existing conditions except for the cargo handling equipment.
However working hours and days must be adjusted partially from the present conditions.
The reasons are as follows:

a. According to the site interview, the working days per year are 363 days and the working hours per day are 24 hours.
b. It is not supposed that their numerical values are expressed as actual working days and hours but they are expressed as workable days and hours due to the small cargo volume compared with the labor population and the existing equipment.
c. When cargo volume to be handled increases, it is very difficult to keep the above values.
d. Considering the berth occupancy, working days per year are limited.
e. Cargo handling equipment at the exclusive berth can not work full days through the year due to maintenance and repairs.
f. There are some unworkable days due to bad weather
g. Working conditions shall be improved to keep good labor and health.

The cargo handling system for bulk grain at the general cargo berth will be changed from direct delivery by truck to provisional storage behind the berth, so that unloading capacity can be increased.
For cargo handling equipment, it is considered that the required numbers of equipment and facilities should be fully arranged and maintained in good condition.

4.2.2 Major Elements for Evaluation

1) Handling Capacity per gang per net working hour

a. The type of crane that his capacity is expressed by the capacity per hour
This is calculated by the following formula:

$$Qa = Qn \times Eu$$

Qa : Actual handling capacity (t/h)
Qn : Nominal or design capacity per hour (t/h)
Eu : Handling efficiency

Handling efficiency (Eu) will be quoted from the result of actual handling through put by the existing equipment.
b. The type of crane that his capacity is expressed by the lifting capacity
This is calculated by the following formula:

$$Qa = Ta \times 60 / Cy$$

Ta : Actual lifting weight (t)
Cy : Average cycle time (minutes)

Actual lifting weight (Ta) is calculated by the following formula

$$Ta = Np \times W$$

Np : Number of packages at one lifting
W : Unit weight of package (t)

Average cycle time will be quoted from the result of site investigation

2) Number of gangs per ship (Ng)

a. Exclusive berth with the fixed handling equipment
Number of gangs at the exclusive berth is equal to the number of handling equipment.
b. Non-exclusive
Number of gangs at the non-exclusive berth is decided normally by the ship size (number of hatches of the ship) to berth.

3) Berth productivity(Bp) per net working hour

This is calculated by the following formula

$$Bp = Qa \times Ng$$

4) Berth productivity per year

This is calculated by the following formula

$$By = Bp \times Dy \times Bo \times Hs \times Ew$$

By : Berth productivity per year or Berth capacity per year (t/y)
Dy : Working days per year (day/year)
Bo : Berth occupancy
Hs : Working hours per day (hours/day)
Ew : Working time efficiency

a. Working days per year (Dy)
This value will be decided by the two elements.
One is the number of unworkable days, e.g. holidays which are decided by P.S.O. policy. Another one is the number of days required for corrective maintenance and preventive maintenance of equipment.
b. Berth occupancy (Bo)
This is the balance of merits and losses of ship charterage due to berth waiting
c. Working hours per day (Hs)
This is decided by the PSO policy and working circumstances.
d. Working time efficiency (Ew)
The following factors and elements will be included in this item
* Required preparation and setting time before and after the operation
* During the operation, slight interruption due to change of hatches, working method, some trouble of the operation and equipment, and others

4.3 Engineering Aspect

4.3.1 Port related facilities and its conditions

(1) Structure

The general layout plan of the port facilities and its surroundings is shown in next page. The main port facilities are summarized as shown in Table-1.2.1.

Table 4.3.1.1 Port Facilities in Anzali Port as of 1993

Name of facility	Description
1. General Cargo Wharf	
1-1 Berth No. 1 (Q1)	L: 70 m, D: -3.1 m to -6.3 m bellow CD, EL at apron front: +1.1 m use for oil/gas tanker or passenger boat
1-2 Berth No.2 (Q2)	L: 152.5 m, D: -6.3 m, EL: +1.0 m with 10 t wuay crane
1-3 Berth No. 3 (Q3)	L: 152.5 m, D: -5.0 m, EL: +1.0 m with 16 t quay crane
1-4 Berth No. 4 (Q4)	L: 185.0 m, D: -5.3 m, EL: +1.0 m with 16 t quay crane
Total length of berths: 560.0 m	
[Note] These berths (Q1 to Q4) are used for general cargo ships including container cargo.	
1-5 Berth No. 5 (Q5)	L: 90.0 m, D: -4.7 m, EL: +1.8 to 2.5 m for small crafts/service vessels
2. Slipway	L: 60.0 m, Ship repair capacity: 2,000 t
3. Seawall	
3-1 Seawall (SW1)	L: 152.0 m
3-2 Seawall (SW2)	L: 300.0 m
3-3 Seawall (SW3)	L: 310.0 m
Total length of east seawall: 762.0 m	
4. Breakwater	
4-1 East breakwater (Be)	L: 420.0 m, D: -4.0 m at top-end
4-2 West breakwater (Bw)	L: 550.0 m, D: -4.0 m at top-end
Total length of breakwaters: 970.0 m	

Note 1) L: Length, D: Depth, EL: Elevation, CD: Chart Datum
2) Refer to Fig. 4.3.1.1

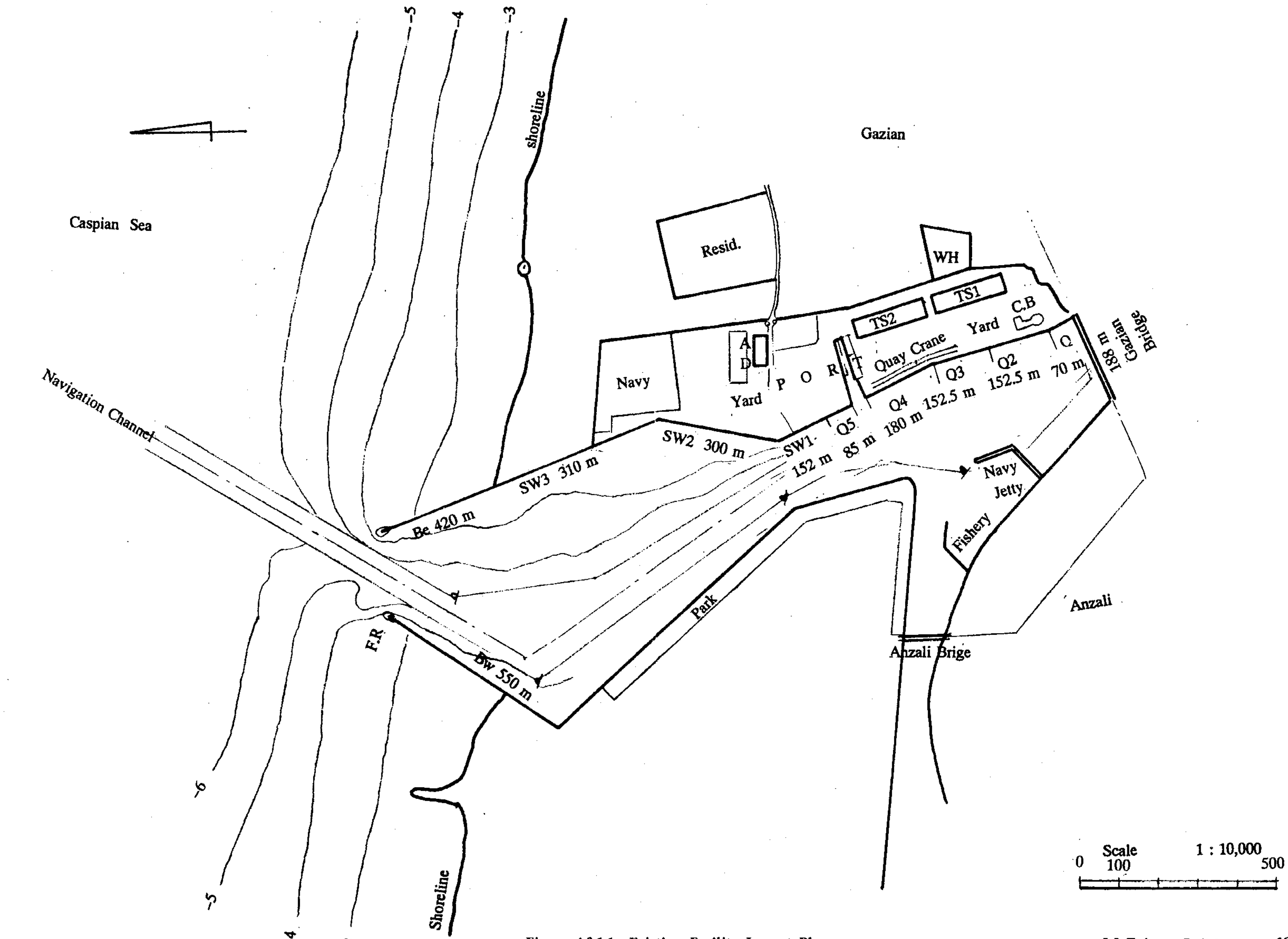


Figure 4.3.1.1 Existing Facility Layout Plan

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5. Channel/Basin

5-1 Channel	Width: 90 m~110 m~130 m~90 m~210 m, Min.: 90 m, Max.: 130 m D: -4.9m to -7.5 m, Maintenance dredging depth: -5.0 m bellow CD
5-2 Basin	150 m dia. circle in front of Q3

6. Navigation Aids

6-1 Harbour entrance lights (leading lights) 2 sets
on the breakwaters

6-2 Channel markers: 6 light buyos

6-3 Beacons: 1 set at the west seawall

7. AD building	1st floor: car park 1,850 sq.m 2nd & 3rd floors: office 3,710 sq.m Total foor area: 5,560 sq.m
8. Transit Shed	
8-1 Transit shed-1	L: 196 m, W: 50.15 m, H: 7.28 m, Area: 9,830 sq.m
8-2 Transit shed-2	L: 196.2 m, W: 51.5 m, H: 7.2 m, Area: 10,104 sq.m
8-3 Warehouses	3 warehouses for export materials
9. Customs building	
10. Utilities	
10-1 Electricity	2 transformers station connected to Manjil dam with 11kv 1,650 & 500 KVA 2 emergency generators with 500 & 250 KVA
10-2 Fresh water	
Facilities:	2 lines @4" dia. to Transit shed 1 line 4" dia. to residential area 1 line 4" dia. to residential area 1 line 0.75" dia. to resident area 1 line 0.5" dia. to resident area City distribution pipe: Pressure: 3.0 m water column = 0.3 atmospher = 0.3 HP (Hect Pascal) 8 water hydrulants at berth apron front for ships
Consumption:	3,000 cub.m/month for transit shed 800 cub.m/month for redidential area 200 to 250 cub.m/month for gate area 2,500 to 3,000 cub.m/month for 100 houses
10-3 Sewage	Sewage treatment plant for sidential area No facility in the port area

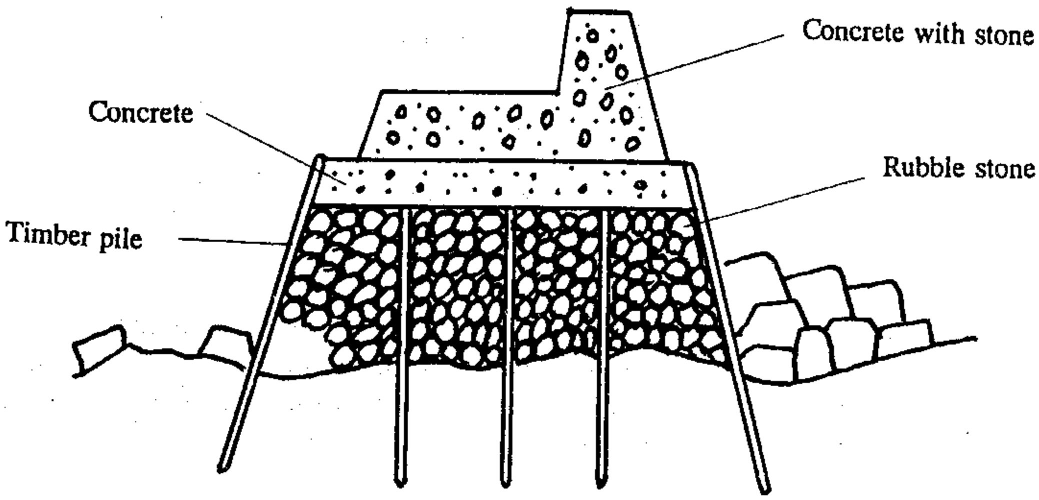
10-5 Lighting System	9 towers of 16 m height with 30 units Sodium steam system each unit: 170,000 lux, 2,080 W, 10.3 Amp, 920 cd/sq.cm, 380 v for cranes/yeard area
Future demand:	48,000 lux, 400 W
10-6 Fire Alarm System	2 system totaled 1 system of city 1 system: under ground container tank of 72 cub.m, pumpinf ayarwm pressure: 10 atmosphers 3 trucks of 7 t with 1 t mechanical phone 2 trucks with 250 kg powder gas 1 ambulance 1 fire pick-up truck 20 persons 24 hours shift 24 smoke detectors for transit shed 2 sensors for each transit shed 110 temperature (heat) detectors for transit shed 36 detectors for export warehouses 290 small sensors for administration bdg cost: 30,000,000 Rls.
10-7 Drainage	2 drainage lines, pavement surface slope of 2% in yard area
10-8 Communucation system	Micro-wave phone system to main cities in Iran are available 200 sets of Walkie/Talkie available
10-9 Others	
11. Residential Housing	280 x 200 = 56,000 sq.m
12. Equipment	
12-1 Quay Crane:	2 nos numbers quay crane of 16 t lifting capacity 1 no numbers quay crane of 10 t lifting capacity
12-2 Yard Crane:	2 nos numbers yard crane of 10 t lifting capacity
13. Service Vessels	
13-1 Hopper-suction Dredger:	Hopper capacity 1,000 cub.m
13-2 Cutter-suction Dredger:	750 ps
13-3 Service boat:	Tug boats, Floating crane 60 t 2 Barges of 1,000 m^3, 1 barge of 400 m^3

Therefore, when new structure is proposed on the same ground site, the checking calculation against the liquifaction shall be required.

An other important point is the top elevation of the berth apron front. The elevation of the existing quaywall is about +1.00 m above CD (Chart Datum) at Anzali port. The water level in Caspian sea has been rising up recently about 2.0 m since 1977. It will be estimated to reach +2.0 m in 2010. It is necessary to make adquate solution on the matter. (refer to Design Criteria)

(2) Breakwater

There are two (2) breakwaters located at the entrance of the port. The structure of the breakwater consists of the stone mounted bank covered partially by concrete blocks (tetra-pods). The sketch shows the typical cross section (at middle part).



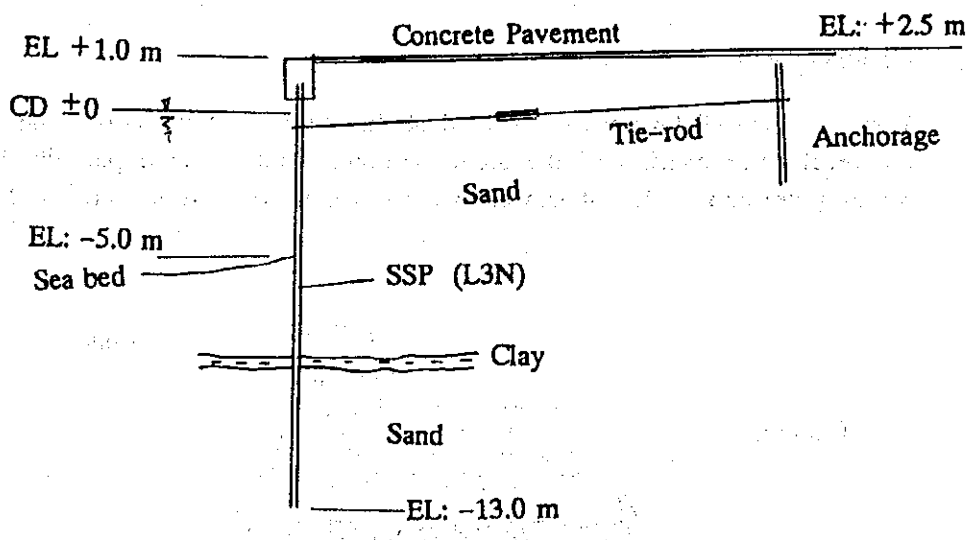
Some parts of the breakwater foundation are rushed out caused by rough waves and the effort of the maintenance works have been made in time.

The alignment of the existing 2 breakwaters is not so effective to the wave directions during rough weather season. The study on the matter is required.

4.3.2 **Basic Facilities and Structural Analysis**

(1) Wharves

The structural type of all existing five (5) wharves are same type of quaywall using steel sheet piles (SSP) foundation with the anchorage wall connected by the tie-rods. (refer to sketch below)



The wharves are constructed in 1970's, and aged about 20 years old. However, the quality of the steel piles are quite well maintained according to the test results for its thickness and length conducted by the Study Team mainly due to low sanitary contents in the Caspian sea water.

It is estimated that the durability of the material (SSP) itself against such as rusting of steel will be maintained in future. The other parts of the quaywall structure are generally well maintained except some parts of the surface concrete pavement and the fender system.

There is a check-point on the stability of the quatwall structure. A remarkable earthquake happenned at Rudbar, Gilan province, about 70 km far from Anzali city in 1980's. It is recorded in magnitude of 7.8.

The sub-soil of the port consists mainly sand sedimentation caused by the river and the sand drift on seashore including some of silt/clay strata in thin lager. As usual the sand layer has enough stableity to suppor the structures.

When it is an earth coming comes quake, the sand layer will bebecome such as a liquid due to the liquefaction and instudiliey.

4.4 Standard of Evaluation of Current Cargo Handling Capacity by Commodity

4.4.1 Transit Shed and Storage Facility

Capacity of storage facilities is calculated by the following formula.

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

where Mb : Capacity of storage facilities (ton/year)
Ab : Area of storage facility (m^2)
Rt : Turnover ratio (times/year)
w : Volume of cargo per unit area (ton/m^2)
r : Utilization ratio
p : Peak ratio

Following parameters based on actual data in Japanese ports are used for evaluation of capacity.

- For transit shed
  - Peak ratio : 1.3
  - Turnover ratio : 12 times/year
  - Volume of cargo per unit area:
    - 2.5 ton/m^2 for bagged cargo
    - 2.0 ton/m^2 for metallic cargo
    - 2.0 tom/m^2 for general cargo
  - Utilization ratio : 0.7

- For warehouse and open yard
  - Peak ratio : 1.0
  - Turnover ratio : 12 times/year
  - Volume of cargo per unit area:
    - 2.5 ton/m^2 for bagged cargo
    - 2.0 ton/m^2 for metallic cargo
    - 2.0 tom/m^2 for general cargo
  - Utilization ratio : 0.7

4.4.2 Navigation Channel and Basin

The depth of the channel and the basin in Anzali Port is currently kept at -5.5 m at least. The width of the channel is 50 m at the narrowest point and the maximum width of the turning basin of ship is 120 m.

The maximum length of a ship that may be turned using a tug boat and the tidal current in a basin which is 120 m wide is about 80 m, and the full draft of a ship that can navigate or berth in the channel or a basin of -5.5 m is about 5 m. The ship size which concurrently satisfies these two conditions is about 2,000 DWT (GT for passenger ship) for dry cargo ships, tankers and passenger ships.

According to the Japanese standard, a ship with the length of 50 m (700 DWT) is the largest ship that can safely navigate a channel of 50 m width. However, larger ships such as big tankers (125m in length and 17m in width) which are larger than the Japanese standard can be entered by the navigation control.

4.4.3 Cargo Handling Equipment (per day)

1) Dry Bulk (Grain)

Most of grain to be unloaded at the port will be handled by pneumatic unloaders. A grub bucket system will be only complementary and not included in unloading capacity.

Qd = Qn x En x Nu x Hd x Ew

- Qd : Actual unloading capacity per day (t/d)
- Qn : Nominal unloading capacity per hour (280 t/h)
- En : Handling efficiency (0.7)
- Nu : Number of unloaders (2)
- Hd : Working hours per day (24)
- Ew : Workihg time efficiency (0.8)

Qd = 280 x 0.7 x 2 x 24 x 0.8
= 7,520 t/d

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

Considering the structure of the ship hatches, two (2) gangs are required to attend.

Qd = W x Np x 60/Cy x Ng x Hd x Ew

- Qd : Actual unloading capacity per day (t/d)
- W : Unit weight of bag (50 kg)
- Np : Number of bags at one lifting (48 bags)
- Cy : Average cycle time (4 minutes)
- Ng : Number of gangs (2 gangs)
- Hd : Working hours per day (24)
- Ew : Working efficiency (0.8)

Qd = 0.05 x 48 x 60/4 x 2 x 24 x 0.8
= 1,382 t/d

3) Iron products

Most of cargoes will be unloaded by portal jib cranes are installed at No-3 and No-4 berths.

The average lifting weight is assumed to be 5 t.

Qd = Ta x 60/Cy x Ng x Hd x Ew
= 5 x 60/6 x 2 x 17 x 0.8
= 1,920 t/d

4) Container

All containers will be handled by container cranes installed at the berth.

Qh = Nh x Nc x Kc

- Qh : Number of containers to be handled per net working hours (TEU/Hn)
- Nh : Number of container boxes to be handled per crane per net working hours (Boxes/Nc.Hn)
- Nc : Number of container cranes to be installed

Kc : Conversion ratio from box to TEU

Qh = 25 x 2 x 1

= 50 TEU / h

4.4.4 Access Transport Facility to/from the Port

(1) Access Road to/from Anzali port

Tehran is the main hinterland of Anzali port and there are three routes that connect Anzali port with Tehran. Table 4.4.1 shows the condition of these routes; Anzali port-Rasht-Qazvin-Tehran route is the most frequently used one.

Table 4.4.4.1 Main route between Anzali port and Tehran by road

Route	Distance	Remark
Anzali-Rasht-Qazvin-Tehran	365km	Six lane Freeway
Anzali-Chalus-Karaj-Tehran	430km	Two lane Main road
Anzali-Amol-Tehran	530km	Two lane Main road

(2) Access Railway to/from Anzali port

There is not a railway station near Anzali port and the nearest railway station is Qazvin. This railway section is part of the Tehran-Tabriz line.

(3) Access Airway to from Anzali port

There is no airport in Anzali port; the nearest airport is Rasht airport.

4.4.5 Port Area at Anzali

The approximate dimensions of major current facilities at Anzali Port are as follows:

Breakwaters(two)	970	m
channel and basins	448,000	m^2
Length of quay wall (-5.5 m depth)	540	m
Open yard	44,500	m^2
Transit shed	19,900	m^2
Maintenance shops (two)	1,840	m^2
PSO administration building	1,850	m^2
Customs Office building	1,080	m^2
Other main buildings	5,600	m^2
Total area of commercial port facilities (excluding the basins, navigation channel and breakwaters)	280,000	m^2

Chapter 5

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

Chapter 5 Potential Cargo Handling Capacity Expected by Improving Existing Facilities and Operation System

5.1 Basic Concept of Physical Possible Improvement

(1) Structure

-The rising water level of the Caspian Sea is one of the most serious problems at Anzali Port because the facilities are gradually being submerged. This problem should be counteracted by fill up at low elevation area.

-Mooring facilities and storing facilities should be improved in the target year of the Master Plan to cope with the increased cargo volume, especially container and dry bulk cargo.

-The depth of the existing berths should be dredged to adjust to the draft of calling ships in the target year.

-In order to maintain the calmness in the inner harbor, the west breakwater and the new breakwater at the east side of the port mouth should be extended.

(2) Channel and Basin

-The depth and width of the channel and the basin should be increased to accommodate the larger-sized ships calling in the target year.

-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.

(3) Access Transport

The province of Tehran is the main hinterland of Anzali port. There is no railway station near Anzali port; the nearest railway station is Qazvin. Anzali port-Tehran section is currently under study but this section will not be completed in the period of this master plan.
Therefore, road is the principal transportation. It is important that Qazvin will be connected with Anzali port by expressway in future.

5.2 Improvement Plans for Cargo Handling Equipment and Cargo Handling System

5.2.1 Cargo Handling Equipment

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

(1) Very old handling equipment will be replaced.
(2) Equipment damaged due to poor maintenance will be repaired to recover the capacity as original planned.
(3) Equipment required for handling cargoes will be fully supplied.
(4) Further,equipment required due to change of the cargo handling system will be also supplied.
(5) Full preventive maintenance will be conducted for all equipment.
(6) Spare equipment to cover shortage of the capacity during preventive maintenance will be supplied.
(7) Appropriate supply and management system of spare parts will be established for timely maintenance work.

The proposed measures are as follows;

(1) Dry Bulk (Grain)

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

1) Pneumatic unloaders

Two pneumatic unloaders are installed at present.
Considering the hatch cover, the maximum number of gangs to work at a time is two (2) and their nominal capacity is 280 t/h each.

2) Belt conveyors

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

3) Shovel loaders

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

(2) Bagged cargoes

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

1) Mobile cranes for handling cargoes from/to ships

Mobile cranes are used for handling cargoes from/to ships.

2) Fork-lift trucks

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

(3) Metallic Products

Comparatively heavy cargoes shall be handled with suitable sling

1) Jib cranes for handling cargoes from/to ships

Most of cargoes will be handled by jib cranes installed at the quay.

2) Jib cranes for handling cargoes at the storage yard located behind the berth

Cargoes stored at the storage yard will be handled by jib cranes installed at the yard.

(4) Miscellaneous

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

(5) Container

Container cranes installed at the quay side will handle cargoes from/to ships.
A top lifter handling system is introduced at present.
Judging from the handling volume of containers and the available storage space, however, a tire-mounted transfer crane system is considered more suitable at the terminal.

1) Container cranes

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

2) Transfer cranes

Transfer cranes will be used for loaded containers at the container yard and a standard type will be introduced.

3) Top lifters

Top lifters are used only for reefer containers and for general services for loaded containers.

4) Fork-lift trucks

Middle-sized fork-lift trucks are used for handling empty containers and small-sized fork-lift trucks for stuffing and un-stuffing containers.

5) Chassis

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

6) Tractors

Tractors are used for pulling a chassis.

5.2.2 Cargo Handling System

(1) Dry bulk cargo (Grain) at general berth

Belt conveyor system using transit shed instead of direct delivery system should be introduced for future plan. This system consists of the following equipment.

Pneumatic unloaders
Belt conveyors
Fixed belt conveyors
Movable (tire mounted) belt conveyors
Shovel loaders

Pneumatic unloaders would be used for unloading cargo from vessel to belt conveyor at the apron. Unloaded cargo should be transported to transit shed by belt conveyors. Stored cargo should be loaded to trucks by shovel loaders in transit shed.

(2) Bagged cargo

Pallet system instead of the current net sling system should be introduced for handling of bagged cargo. Cargo with pallet can be handled easily by fork lift truck.

(3) Metallic Products

Existing two jib cranes should be used for handling of metallic products. Other metallic cargo can be handled by mobile crane, ship gear or combination of both. At the apron and storage area, fork lift truck should be used for handling cargo with pallet basically. Heavy cargo that can not be handled by folk lift truck should be handled by mobile crane in the open yard.

(4) General cargo

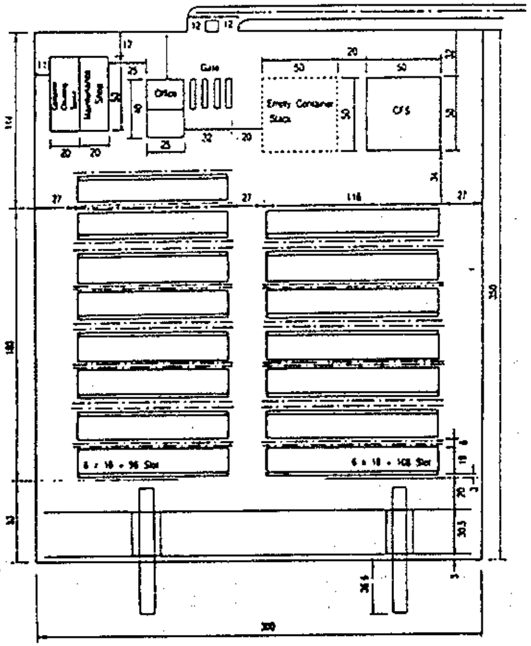
General cargo should be handled by same method for bagged cargo or metallic products.

(5) Container Cargo

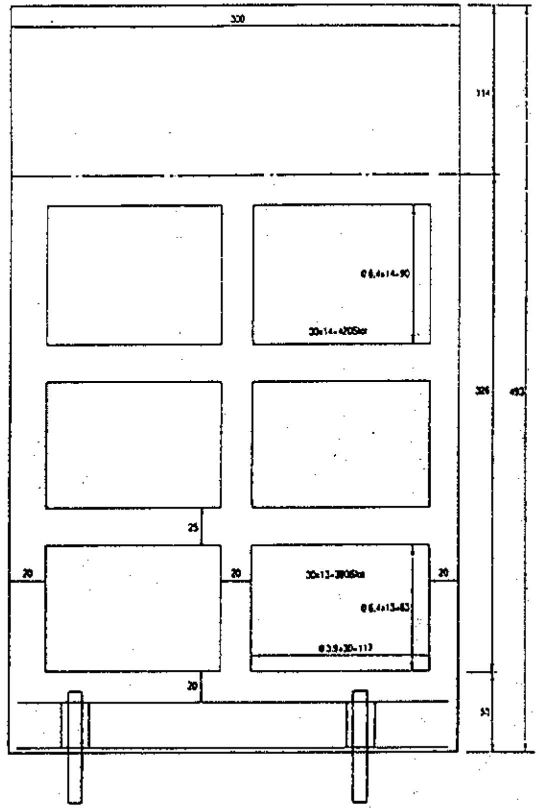
There are several container handling systems at container yards (marshalling yards) such as transfer crane system, straddle carrier system, chassis system and top lifter (fork lift truck) system. Anzali port has been using the top lifter system. Table 5.2.2.1 shows comparison of handling systems. Figure 5.2.2.1 shows typical layouts by cargo handling systems with same storage capacity. Anzali port does not have enough space for port area even in the target year. Therefore, transfer crane system is selected as the most suitable system considering space for container yard, cost, ease of operation and safety.

Table 5.2.2.1 Comparison of Handling Systems

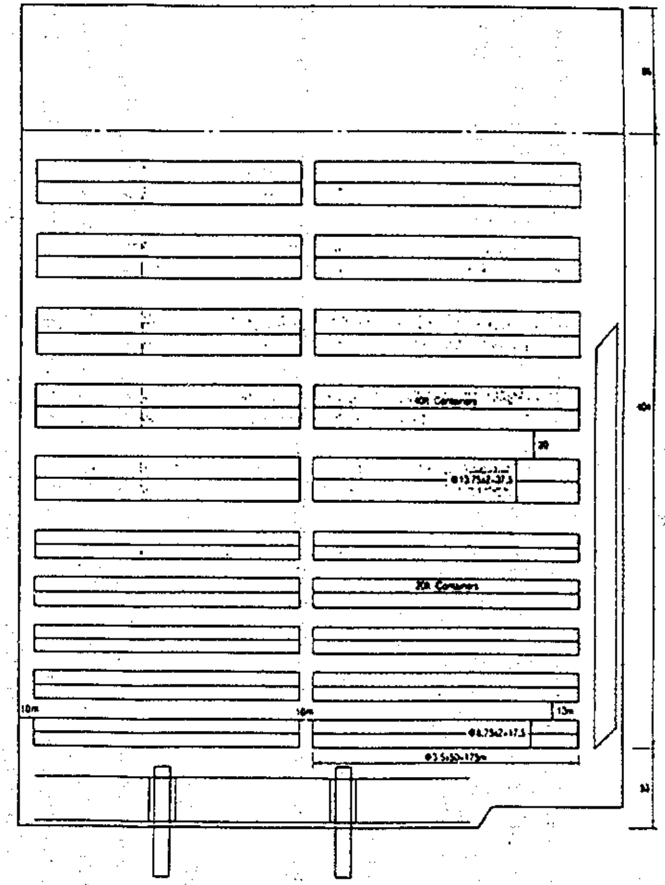
Item	Chassis system	Stradlle carrier system	Transfer crane system	Folk lift system (Top-loader)
Land utilization	large	medium	small	large
Height of stack	low	medium	high	medium
Efficiency of container crane	low	high	long	high
Working hour for taking in/out container	short	medium	long	medium
Damege ratio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



(A) Short Term Plan Transfer Crane System



(B) Straddle Carrier System



(C) All Chassis System

Figure 5.2.2.1 Typical Layouts of Container Handling Systems

5.3 Capacity Evaluation

There are five mooring berths at Anzali Port: Q1(length:70 m, depth:-5.5 m), Q2(153 m, -5.4 m), Q3(152 m, -5.5 m), Q4(180 m, -5.5 m), Q5(85 m, -5.5 m). Three jib cranes are installed at Q2, Q3 and Q4. There are three open yards: one is located in the area behind Q1 to Q4 and has an area of 29,000 sq.m, one is behind Q5(19,500 sq.m), and other is north of Q5(15,200 sq.m). There are transit sheds in the area behind Q2, Q3 and Q4,and another one is east of the road behind Q3. Total area of these two transit sheds is about 19,900sq.m. Almost of all the cargoes at Anzali port are handled at multipurpose berths,namely Q1,Q2,Q3 and Q4.

A precise evaluation of capacity of the present multi-purpose berths is very difficult. Therefore, the cargo handling capacity at Anzali port is evaluated by two methods. Firstly, the cargo handling capacity is evaluated by converting into general cargo. Next, the cargo handling capacity is evaluated from a simulation based on the queuing theory. As for the former method, the waiting time of ship for berthing is not considered. The procedure of the former method is as follows:
1) Calculation of the cargo handling productivity of general cargo per day.
2) Deciding the number of available annual working days of cargo handling.
3) Calculation of the maximum annual cargo handling volume per berth.
4) Calculation of the maximum general cargo handling volume in Anzali port.
Result of the calculation is about 1.0 million tons per year.
The formulas are as follows:

$$Qd = Tw \times 60/Cy \times Ew \times Hd \times Ng$$

Where Qd : Unloading capacity per day(t/d)
Tw : Capacity of one lifting(2.5 tons)
Cy : Average cycle time(4 minuets)
Ew : Working efficiency(0.8)
Hd : Working hours per day(20)
Ng : Number of gangs(2 gangs)

Available annual working days:Dy(240 days)

Available annual general cargo handling volume per berth:Qd

$$Qy = Qd \times Dy$$

Annual capacity of cargo handling volume for general cargo at Anzali:Qt

$$Qt = Qy \times Nb$$

Where Nd:Number of berth at Anzali Port(3.5 berths)
(The cargo handling capacity of Q1 is assumed to be half that of a other berths)

As for the latter method, the premises of the simulation are as follows:

Q2 and Q3 are to be used as multi-purpose berths for handling all commodities except passengers. Q4 is to be used as a multi-purpose berth handling all commodities except passengers and liquid bulk. Steel cargoes will be handled by using jib cranes. New jib cranes with the same capacity as the current one should be installed at Q3. Depth of Q2,Q3,Q4 should be increased to -6.5 m at Q2, -6.0 m and Q3, Q4. Q5 should be extended to 150m from 85m, and the depth to -6.0 m for use by dry cargo ships. As the length of the quaywall is short, Q1 should be used by passenger ships and barges. Two mobile cranes should be used for cargo handling at Q1.

When the maximum permissible berth waiting time for all calling ships by ship type is assumed to be less than one day, the cargo handling volume at these berths is approximately 1.5 million tons including liquid bulk.

Table 5.3.1.1 shows the result of the simulation. According to Table 5.3.1.1 and result of the former method, the existing capacity of cargo handling volume at Anzali port can be expressed between 1 million tons and 1.5 million tons.

Table 5.3.1.1 Major Input Data and OutPut of Berth Use Simulation (Tentative Improvement Plan)

Imput data	Berth Imformation						Ship Imformation			
	Name	Length (m)	Depth (m)	OPen time (hour/day)	No.cranes (No.)	Productibity of crane (tons/hour)	Ship Type	Number ships (ships/year)	Number of ship gear per snip	Productibity of ship gear (tons/hour)
	Q1	70	5.5	24(19)	0	0	Dry bulk	45	(2)	105
	Q2	153	6.5	24(19)	0	0	General cargo	40	2	25
	Q3	152	6.0	24(19)	2	50	Container	68		
	Q4	180	6.0	24(19)	2	50	Steel	51	0	0
	Q5(N1)	150	6.0	24(19)	0	0	Barge	24	0	0
							Tanker	128	0	0
							Passenger	52	0	0
Out put	Type of ship		(Unit)	Dry bulk	General cargo	Container	Steel	Barge	Tanker	Passenger
	Average waiting time		(Hours)	6.8	15.4	2.9	23.3	1.4	15.6	0.5
	Name of berth			Q1	Q2	Q3	Q4	Q5(N1)		
	Berth occupancy rate		(%)	30.3	58.7	57.4	63.0	45.6		

Chapter 6

Physical Requirements for Future Port Development

Chapter 6 Physical Requirement for Future Port Development

6.1 Capacity and Functional Requirements for Future Port Related Facilities

6.1.1 Mooring Facilities

As mentioned in 5.5, berths should be allotted by ship type. In particular, exclusive berths should be prepared for container ships and tankers.

Two methods are used to obtain the required number of berths. In the first method, the number of berths are obtained by tentative assuming the berth occupancy rate. The other method uses the queuing theory by computer. In the latter method, the simulation is carried out based on the result of the former method.

Figure 6.1.1.1 shows the procedure of the estimation for the required number of berths.

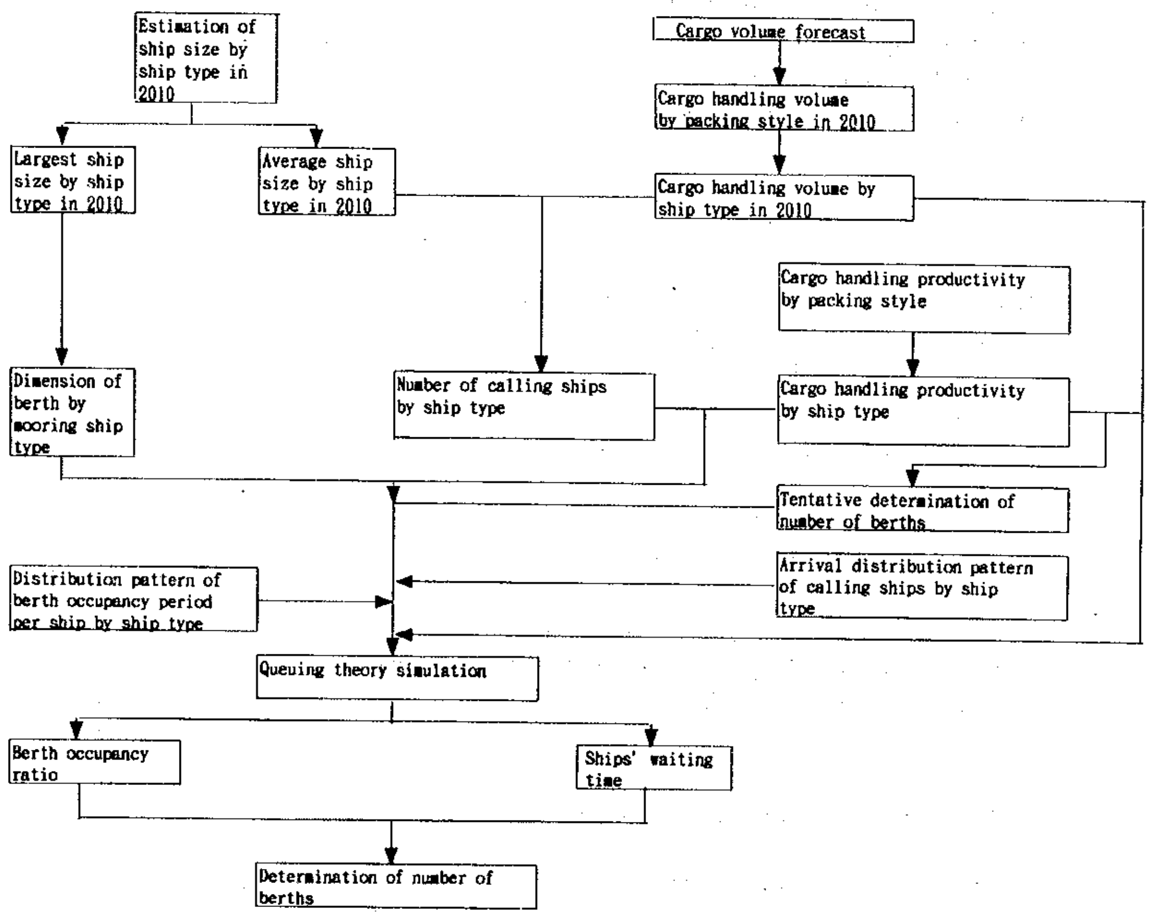


Figure 6.1.1.1 Flowchart for Determining Number of Berths

As for the former method, the number of required berths are calculated by packing style. Then, these results are summed up for estimating the number of required berths. The procedure of the former method is as follows:

1) Calculation of the cargo handling productivity by ship type per day.
2) Calculation of the required cargo handling hour per year.
3) Deciding the berth occupancy rate for calculation.
4) Calculation of the required total berthing days in a year
5) Calculation of the required number of berths by ship type
6) Calculation of the required total number of berth.

The formulas are as follows:

-Cargo handling productivity
(For general cargo(including bagged cargo) ship and Steel ship)
$Qd = Tw \times 60/Cy \times Ew \times Hd \times Ng$
Where
Qd:Unloading Capacity per day(tons/day)
Tw:Capacity of one lifting(ton)
Cy:Average cycle time(minuet)
Ew:Working efficiency(0.8)
Hd:Working hours per day(20 hours)
Ng:Number of gangs(2 gangs)

(For barge)
$Qd = Tw \times 60/Cy \times Ew \times Hd$
Where
Qd:Unloading Capacity per day(tons/day)
Tw:Capacity of one lifting(ton)
Cy:Average cycle time(minuet)
Ew:Working efficiency(0.8)
Hd:Working hours per day(20 hours)

(For Dry bulk cargo ship)
$Qd = Qn \times En \times Nu \times Ew \times Hd$
Where
Qd:Unloading capacity per day(tons/day)
Qn:Nominal unloading capacity per hour(tons/hour)
En:Handling efficiency(0.7)
Nu:Number of unloaders
Ew:Working efficiency(0.8)
Hd:Working hours per day(20 hours/day)

-Annual cargo handling hours
$Ht = Vp \ / \ Qd$
Where
Ht:Annual cargo handling hours by packing style
Vp:Annual cargo handling volume by packing style

-Berth occupancy rate for calculation:

$P = Po \times (1\text{-}Dw)$

Where

P :Berth occupancy rate for calculation(0.46)

Po:Berth occupancy rate in normal condition(0.70)

Dw:Ratio of impossible working days due to weather condition(0.34)

-Total Berthing days:

$Db = Ht / P / (Hd \times Ew)$

Where

Db:Annual berthing days by packing style

-Required Number of berths by packing style

$Bp = Db / Dy$

Where

Bp:Required number of berths by packing style

Dy:365 days

The result of calculation is shown in Table 6.1.1.1.

Table 6.1.1.1 Tentative Calculation of Required Number of Berth

		Unit	General cargo	Container	Dry Bulk	Steel	Berge
One gang	Capacity of one lifting	ton	2.5			5	
	Average cycle time	minute	4	3			-
	Productivity one hour	tons(TEU)	37.5	25	150	6	86
	Working efficiency		0.8	0.8	0.8	0.8	0.8
	Handling efficency				0.7		
	Average working time	hour	24	24	24	24	24
	Productivity one day	tons(TEU)	720	480	2016	960	1651.2
Number of gangs		Gangs	2	2	2	2	2
Annual working days		days	240	313	240	240	240
Berth occupancy rate			0.46	0.6	0.46	0.46	0.46
Productivity per berth		tons(TEU)	158976	180288	445132.8	211968	364584.96
Cargo volume		tons(TEU)	660000	275281	444000	541000	68000
Number of berth		berths	4.2	1.5	1.0	2.6	0.2

As for the latter method, berth use simulation using the queuing theory is conducted by inputting the forecast cargo volume, the average ship size by ship type, the cargo handling efficiency, the number of calling vessels and assumed number of berths (which is slightly changed from the number of berths obtained in the former method). The results show the average waiting time for berthing for all the calling ships by ship type, average cargo handling time per ship by ship type, and berth occupancy ratio by berth.

The maximum permissible average berth waiting time for all calling ships except container ships is assumed to be less than one day. For container ships, maximum permissible berth waiting time on average of all calling container ships is assumed to be less than six hours because the price of container cargo is generally higher than other cargo. In addition, the construction cost of container ship is higher than conventional dry cargo ship. In the Master Plan, container ships and tankers will have to use exclusive berths.

The input data and the main output items for the four cases used directly for determining the number of berths are shown in Table 6.1.1.2 and 6.1.1.3 for the the Master Plan and 6.1.1.4 and 6.1.1.5 for the Short Term Plan.

Based on the results of above simulations, the number of berths as obtained in Case B and D are adopted for the Master Plan and Short Term Plan, respectively. (See Table 6.1.1.3 and 6.1.1.4).

Table 6.1.1.2 Major Input Data and Output of Berth Use Simulation (Case-A) for Master Plan

Imput										Out put			
Berth Imformation						Ship Imformation							
Name	Length (m)	Depth (m)	OPen time (hour/day)	No.cranes (No.)	Productibity of crane (tons/hour)	Ship Type	Number ships (ships/year)	Number of ship gear per snip	Productibity of ship gear (tons/hour)	Ship type	Average waiting time (Hours)	Name of berth	Berth occupancy rate (%)
Q2	152	6.5	24	2	50	Dry bulk	108			Dry bulk	4.1	Q2	33.9
Q3	153	6.5	24	2	50	General cargo	130	2	25	General cargo	1144	Q3	unkown
Q4	170	6.5	24	2	50	Container	330			Container	344	Q4	unkown
N1(Q5)	150	6.5	24	2	157	Steel	127			Steel	157	N1(Q5)	30.6
N2	170	6.5	24	2	157	Barge	75			Barge	9.1	N2	14
C1	170	6.5	24	2	25(TEU)	Tanker	206			Tanker	31.4	C1	unkown
C2	170	6.5	24	2	25(TEU)	Passenger	87			Passenger	-	C2	unkown
O1	180	8.5	24	0	330							O1	75.6

Table 6.1.1.3 Major Input Data and Output of Berth Use Simulation (Case-B) for Master Plan

Imput										Out put			
Berth Imformation						Ship Imformation							
Name	Length (m)	Depth (m)	OPen time (hour/day)	No.cranes (No.)	Productibity of crane (tons/hour)	Ship Type	Number ships (ships/year)	Number of ship gear per snip	Productibity of ship gear (tons/hour)	Ship type	Average waiting time (Hours)	Name of berth	Berth occupancy rate (%)
Q2	152	6.5	24	2	50	Dry bulk	108			Dry bulk	14.4	Q2	31.5
Q3	153	6.5	24	2	50	General cargo	130	2	2.5	General cargo	1.8	Q3	53.5
Q4	170	6.5	24	2	50	Container	330			Container	2.2	Q4	55.3
N1(Q5)	150	6.5	24	0		Steel	127			Steel	8.8	N1(Q5)	62.2
N2	170	6.5	24	2	157	Barge	75			Barge	9.6	N2	26.7
N3	170	6.5	24	2	157	Tanker	206			Tanker	3.4	N3	16.5
C1	170	6.5	24	2	25(TEU)	Passenger	87			Passenger	1.1	C1	52.7
C2	170	6.5	24	2	25(TEU)							C2	31.9
C3	170	6.5	24	2	25(TEU)							C3	24.7
O1	180	8.5	24	0	330							O1	58.7
O2	180	8.5	24	0	330							O2	38.3

Table 6.1.1.4 Major Input Data and Output of Berth Use Simulation (Case-C) for Short Term Plan

Input: Berth Information Name	Length (m)	Depth (m)	OPen time (hour/day)	No.cranes (No.)	Productibity of crane (tons/hour)	Ship Information: Ship Type	Number ships (ships/year)	Number of ship gear per snip	Productibity of ship gear (tons/hour)	Out put: Ship type	Average waiting time (Hours)	Name of berth	Berth occupancy rate (%)
Q2	152	6.0	24	0	0	Dry bulk	38			Dry bulk	8.5	Q2	48.0
Q3	153	6.0	24	2	50	General cargo	21	2	25	General cargo	14.9	Q3	42.8
Q4	170	6.0	24	2	50	Container	70			Container	3.4	Q4	54.2
N1(Q5)	150	6.0	24	0	0	Steel	35			Steel	36.0	N1(Q5)	35.4
N2	170	6.0	24	0	0	Barge	21			Barge	19.6	N2	35.1
N3	170	6.0	24	2	157	Tanker	108			Tanker	17.9	N3	35.1
										Passenger	-		

Table 6.1.1.5 Major Input Data and Output of Berth Use Simulation (Case-D) for Short Term Plan

Input: Berth Information Name	Length (m)	Depth (m)	OPen time (hour/day)	No.cranes (No.)	Productibity of crane (tons/hour)	Ship Information: Ship Type	Number ships (ships/year)	Number of ship gear per snip	Productibity of ship gear (tons/hour)	Out put: Ship type	Average waiting time (Hours)	Name of berth	Berth occupancy rate (%)
Q2	152	6.0	24	0	0	Dry bulk	38			Dry bulk	8.5	Q2	29.2
Q3	153	6.0	24	2	50	General cargo	21	2	25	General cargo	15.3	Q3	36.3
Q4	170	6.0	24	2	50	Container	70			Container	5.0	Q4	23.9
N1(Q5)	150	6.0	24	0	0	Steel	35			Steel	7.4	N1(Q5)	40.7
N2	170	6.0	24	0	0	Barge	21			Barge	2.9	N2	32.9
N3	170	6.0	24	2	157	Tanker	108			Tanker	10.3	N3	30.2
O1	180	6.5	24	0	330					Passenger	-	O	47.1

Table 6.1.1.6 Major mooring facilities at Anzali Port in 2,000 and 2,010

	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

6.1.2 Container Terminal

Container terminal should be provided with the following main facilities.

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

(1) Container Yard

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

MI = (My x Dw x p) / Dy

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

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

SI = MI / L

where SI : Required number of ground slots (TEUs)
MI : Required storage number of container (TEUs)
L : Stacking number of container (TEUs)

SI is calculated as 554 slots for 2000/01 and 2,668 slots for 2010/11 as shown in following Table 6.1.2.1 and 6.1.2.2.

Table 6.1.2.1 Required Storage Capacity in container Yard 2000/01

2000/01	Import	Export	Empty	Transit	Total
Container Cargo Volume (ton)	84,000	2,000	-	273,000	359,000
Unit Weight (ton/TEU)	11.00	11.00	-	11.00	9
Annual Container Throughput (TEUs)	7,636	182	8,200	24,818	40,836
Dwelling days	7	7	7	7	-
Operating Days	313	313	313	313	-
Peak Ratio	1.3	1.3	1.3	1.3	-
Required Storage Number (TEUs)	222	5	238	722	1,187
Stacking Height	2.0	2.0	3.0	2.0	
Required Ground Slots	111	3	79	361	554

Table 6.1.2.2 Required Storage Capacity in container Yard 2010/11

2010/11	Import	Export	Empty	Transit	Total
Container Cargo Volume (ton)	1,120,000	39,000	-	680,000	1,839,000
Unit Weight(ton/TEU)	11.00	11.00	-	11.00	?
Annual Container Throughput (TEUs)	101,818	3,545	108,100	61,818	275,282
Dwelling days	7	7	7	7	-
Operating Days	313	313	313	313	-
Peak Ratio	1.3	1.3	1.3	1.3	-
Required Storage Number (TEUs)	2,960	103	3,143	1,797	8,003
Stacking Height	3.0	3.0	3.0	3.0	
Required Ground Slots	987	34	1,048	599	2,668

(2) Container Freight Station

Required area for CFS is calculated by the following formula.

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

where A : Required area of CFS (m2)
Mc : Annual handling volume of container cargo through CFS (ton)
Dw : Dwelling days at CFS (7 days)
p : Peak ratio (1.3)
w : Volume of cargo per unit area (1.5 ton/m2)
r : Utilization ratio of CFS (0.7)
Dy : Operating days per year (313 days)

There is no actual statistical data of the ratio of LCL (less than container load cargo) cargo in Anzali port. Considering data of other ports (Ratio of LCL cargo is 3 to 6 percent of total cargo in Japan, 4 to 20 percent in Manila port, 20 percent in Bangkok Port), the ratio of LCL cargo is assumed at 20 percent including allowance for 2000/01 and 2010/11.

Table 6.1.2.3 Required Area of Container Freight Station

	2000/01	2010/11
Annual container cargo volume (ton)	86,000	1,159,000
LCL cargo volume : Mc (ton)	17,200	231,800
Required area of CFS : A (m2)	476	6,418

One new CFS of 6,600 m^2 (40 m x 165 m) should be required in 2010/11.

(4) Maintenance Shop

Required area for maintenance shop depends on certain factors such as rate of damaged container, type and number of cargo handling vehicles and machines to be used in terminal. Following dimensions are planned in the target year 2010/11.

Area : 1,000 m2 (20 m x 50 m)
Height : 10 m
Width of space in front of maintenance shop : more than 10 m

(5) Container Cleaning Space

For washing and cleaning of empty containers, container cleaning space should be planned at the container terminal. Container cleaning space of 1,000 m^2 (20 m x 50 m) is planned in the master plan.

(6) Terminal Gate

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

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

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

Required number of truck lane is as follows.

Table 6.1.2.4 Required Number of Truck Lanes

	2000/01	2010/11
Annual containers throughout (TEUs)	40,836	275,282
Truck lanes	1	4

(7) Terminal Office

Terminal office is planned next to the terminal gate for management and operation of the container terminal. Following dimensions are planned in target year 2010/11.

Area : 1,000 m^2 (25 m x 40 m)
Storey : 3 stories

6.1.3 Transit Shed and Storage Facility

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

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

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

Parameters mentioned above are assumed as follows.

- For transit shed
  - Peak ratio : 1.3
  - Turnover ratio : 12 times/year
  - Volume of cargo per unit area:
    - 2.5 ton/m2 for bagged cargo
    - 2.0 ton/m2 for metallic cargo
    - 2.0 tom/m2 for general cargo
  - Utilization ratio : 0.7

- For warehouse and open yard
  - Peak ratio : 1.0
  - Turnover ratio : 12 times/year
  - Volume of cargo per unit area:
    - 2.5 ton/m^2 for bagged cargo
    - 2.0 ton/m^2 for metallic cargo
    - 2.0 tom/m^2 for general cargo
  - Utilization ratio : 0.7

Direct delivery is performed for approximately 70 percent of the total cargo volume. Table 6.1.3.1 shows the percentage of cargo using storage facilities and for direct delivery by commodity.

Table 6.1.3.1 Cargo in 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 calculated by above formula and parameters are shown in following Table 6.1.3.2 and 6.1.3.3.

Table 6.1.3.2 Required Area of Storage Facilities in 2000/01

Commodity	Total cargo volume (ton)		Transit shed	Warehouse	Open yard
Bagged	49,000	Share (%) Cargo volume (ton) Area (m2)	40 19,600 1,416	40 19,600 1,089	0 0 0
Metallic	218,000	Share (%) Cargo volume (ton) Area (m2)	10 21,800 1,968	10 21,800 1,514	60 130,800 9,083
General	162,000	Share (%) Cargo volume (ton) Area (m2)	35 56,700 5,119	35 56,700 3,938	10 16,200 1,125
		Total area (m2)	8,502	6,540	10,208

Table 6.1.3.3 Required Area of Storage Facilities in 2010/11

Commodity	Total cargo volume (ton)		Transit shed	Warehouse	Open yard
Bagged	131,000	Share (%) Cargo volume (ton) Area (m2)	40 52,400 3,784	40 52,400 2,911	0 0 0
Metallic	575,000	Share (%) Cargo volume (ton) Area (m2)	10 57,500 5,191	10 57,500 3,993	60 345,000 23,958
General	563,000	Share (%) Cargo volume (ton) Area (m2)	35 197,050 17,789	35 197,050 13,684	10 56,300 3,910
		Total area (m2)	26,765	20,588	27,868

6.1.4 Inter-port Access Road, Railway

An expressway between Anzali port and Qazvin needs to be constructed as well as a expressway connected with the main road near Anzali town. Bypass be will needed between Anzali port and expressway.

6.1.5 Utility Mains

(1) Water Supply

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

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

(2) Power Supply System

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

Stand-by generators will be required providing container wharf cranes with back-up power to prevent the container cargo operation from the power failures.

(3) Sewerage System

Present system should be improved by the advanced septic tank system and treated effluent should be discharged to underground though the seepage pipes.

size of the septic tank should meet the volume of waste volume per PSO employees during the peak number of them.

Central treatment plan will neither be effective nor economical since its operation and maintenance require skilled biochemical engineers.

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

(4) Bunker Supply System

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

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

However, more detailed alternative study should be carried out between these two methods. The latter method will provide PSO with various advantages including lower risk of incidents. Initial investment cost of port facility will be reduced.

6.1.6 Navigation Facility

(1) General

In adopting measures to promote navigation safety in the ports, or to minimize the occurrence of sea accidents, it is useful to make a detailed examination of past records, in particular to trace the origins of past accidents.
The direct causes and indirect factors in the background of sea accidents are assumed to be as follows;

* Hostile weather and sea condition
* Difficult hydrographical condition
* Negligence of maneuvering
* Mal-stowage
* Machinery trouble, mishandling, defective design and materials
* Loophole of traffic regulations and control
* Lack of navigational aids
* Deficiency of weather and sea observation and distribution system
* Lack of hydrographical information
* Deficiency of rescue force and emergency information network and sea protest
* Loophole of inspection for hull, machinery and equipment
* Over-congestion of traffic
* Lack of seafarers' training, loophole of certification system
* Unjustifiable working system for crew
* Lack of safe patrol
* Lack of tug and fire-fighting fleet
* Debris and other navigational obstacles
* Others

Based on experience, an accident involves a variety of complex factors. However, except unavoidable causes such as unusual natural conditions, most of the factors are enclosed by proper countermeasures that lead to minimizing accidents.

Minding that the accidents of small boats and lighters in tow frequently involve casualties. The promotion of vocational training for seamen is extremely important as a long-range policy, and might lead to a dramatic reduction in the number of accidents caused by accidentally.

Though countermeasures to control sea accidents, e.g., navigational aids such as light buoys indicating center line of the fairway and lateral light buoys indicating boundary of the fairway, are arranged. But some of them are unreliable their position, and not sufficient at the berth approach and manoeuvering area. Maintenance dredging is not periodically executed. Compulsory pilotage for foreign vessels and more than 1500 GRT Iranian Vessels is being enforced, but the current vessel traffic is not enough experience for Pilot to manoeuver in the vessel.

Although the report has already mentioned a tendency for calling vessel that is increased both in size and number in line with the socioeconomic growth in Iran. Even if the current vessel traffic is to remain unchanged in future, it is an important issue for Iranian port to plan a strategy for preventing loss of lives and property from sea accidents.

Accordingly, to improve the present hydrographical conditions, we feel that the following factors should be borne in mind;

* Maintenance of light buoys and beacons, including accurate positioning
* Periodical maintenance of dredging and sounding of the channel
* Definition of waiting anchorage
* Relocation of the Pilot boarding point
* Removal of the wrecks
* Provision of a lighthouse at the new breakwater entrance
* Training for Pilots

Furthermore, we recommend that local traffic regulations, which are primarily the responsibility of the PSO, should be revised to include the following;

* Definition of "Fairway" "Anchorage" "Port Limit"

* Priority of Vessels proceeding along the fairway

* Restriction of anchoring within the fairway in principle

* Restriction on overtaking and parallel proceeding within the specified fairway

* Priority of departing vessels in possible meeting at entrance of the fairway

* Limit on the maximum speed in specified sections of port area

* Restriction on the length and width and operation on lighters in tow

These are all for the purpose of navigation safety.
But it is necessary to adjust the circumstances with NIOC, fishery organization and users of the water area.

(2) The channel marking

Conventional methods of buoying a channel are either by staggered buoys or a gate buoy system. The gate buoy system provides the vessels with a greater accuracy in maintaining theirs chosen track, with a reduced risk of grounding. The closer the buoy spacing the better the ship's performance in maintaining it's chosen track.

(3) Existing Situation

The main direction of approach to Anzali port will be from the Northeast, where larger vessels will keep the course 207° 30′ by the transit lights.
The approach will be made by the sea buoy, located about 1700 m Northeast of breakwater entrance. Two breakwater entrance lights and 6 buoys indicate the manoeuvering area. But two buoys are currently damaged.

(4) The fairway approach

The sea buoy should be relocated to a position approximately 640 m to the northeast. It is the reason for the newly extended breakwaters.
The provision of lighthouses at the breakwater entrance is required, as well as periodical maintenance dredging and sounding of the channel.

(5) Berth approach and manoeuvering Area

Inside the breakwater, the fairway and the area of basin must be defined by light buoys.
Maintenance and accurate positioning of light buoys and beacons are required.

(6) Summary of requirements

* Relocation of the sea buoy to a position 640 m to the northeast.

* Relocation of the Pilot boarding point to a position near the new sea buoy.

* Construction of the new lighthouses at the entrance of break waters.

* Relocation of the channel buoy after completion of dredging of manoeuvering area.

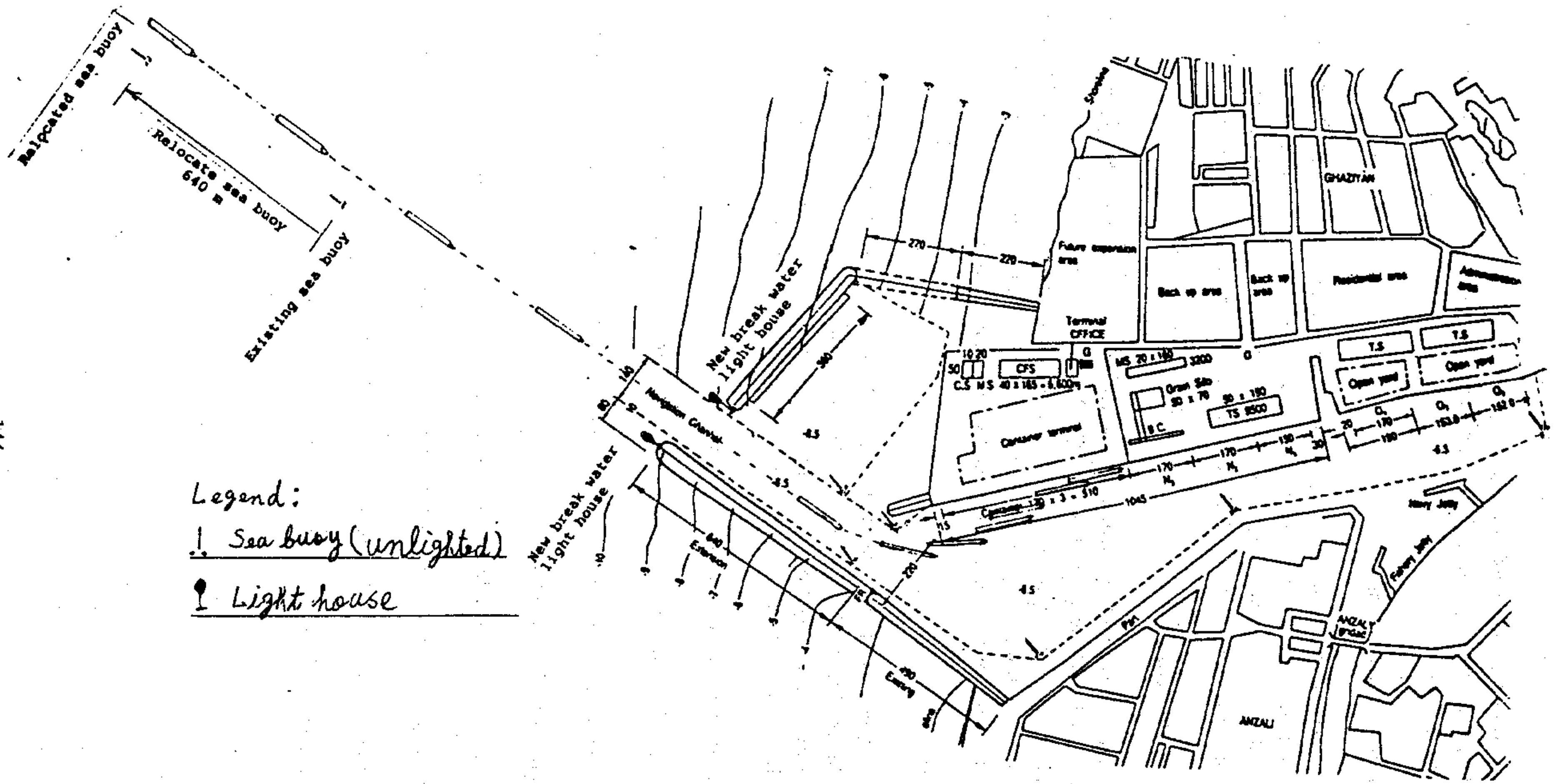


Figure 6.1.6.1 Navigation Facility

6.1.7 Back up Area

Container cargo volume at Anzali Port will increase rapidly according to the cargo volume forecast. As mentioned above, back up areas for container (about 30,000sq.m), such as the empty container storage yards operated by shipping companies and parking area for container trailer, warehouse (about 24,000 sq.m) etc. should be built near the port.

There is a housing area for port workers just behind the port, of which expansion is included in the Master Plan (about 74,000sq.m). The back up areas shall be prepared just behind the existing port facilities.

6.1.8 Space Reserved for Future Extensions

Anzali Port is surrounded by urban areas to the east and west, wetlands in the south and the Caspian Sea to the north. Following discussions with PSO on the direction of expansion, it has been concluded that in view of costs and ease of construction, the existing mooring facilities should be extended from north to the entrance of the passage (bordering the Caspian Sea) first, and then along the shoreline of the Caspian Sea to the eastern side where the population density is comparatively small.

Liquid bulk cargo is handled at the multi-purpose berth on the east side of the passage at present. If it is possible from financial and economic view points, the liquid bulk berth should be moved from present location to the western bank of the passage or to a point north of the present port mouth.

Based on the above, the mooring facilities should be extended basically to the north near the passage entrance, and then along the Caspian Sea coast to the eastern side. Therefore, after the Master Plan, back up facilities should be extended east from just behind the current facilities.