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PORTS AND SHIPPING ORGANIZATION

THE ISLAMIC REPUBLIC OF IRAN

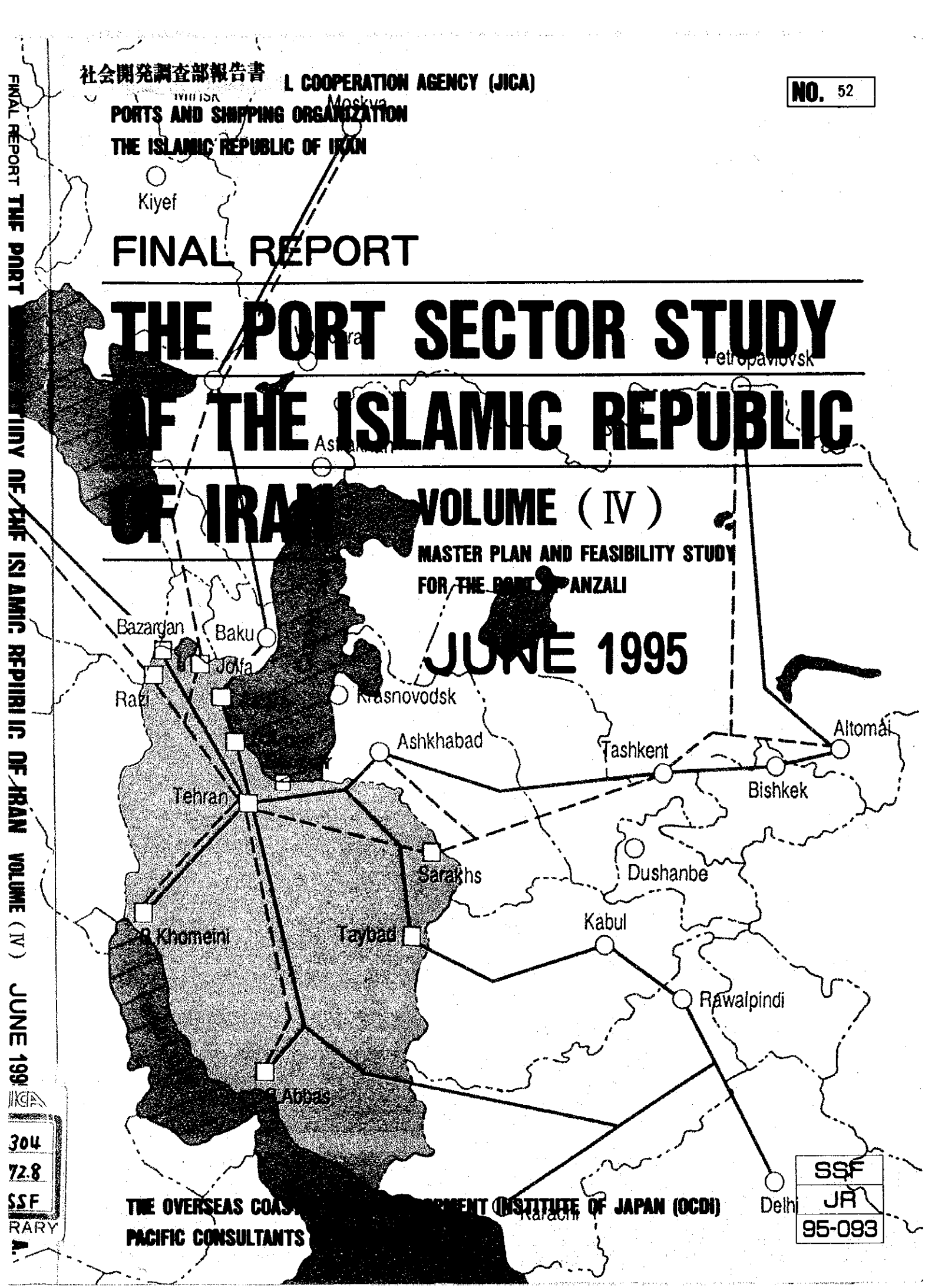
FINAL REPORT

THE PORT SECTOR STUDY OF THE ISLAMIC REPUBLIC OF IRAN

VOLUME (Ⅳ)

MASTER PLAN AND FEASIBILITY STUDY FOR THE PORT OF ANZALI

JUNE 1995



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US$1.00 = 2,000 Iranian Rials (as January 1994)

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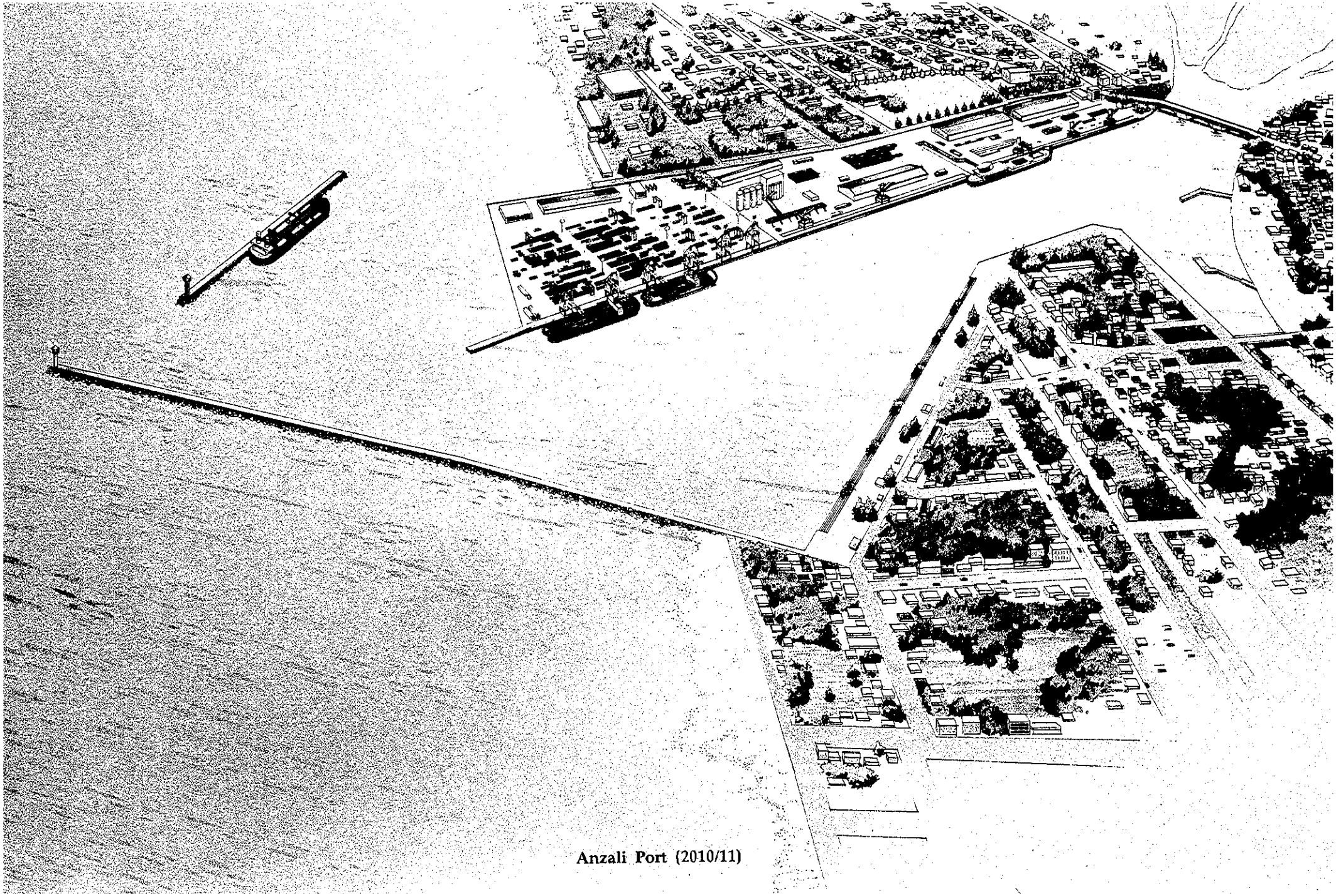

Anzali Port (2010/11)

THE PORT SECTOR STUDY OF THE ISLAMIC REPUBLIC OF IRAN

VOLUME(IV)

Master Plan for The Port of Anzali

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List of Abbreviations

CIS	:	Commonwealth of Independent States
EIRR	:	Economic Internal Rate Return
EIA	:	Environmental Impact Assessment
PSO	:	Ports and Shipping Organization
IIRR	:	Islamic Iranian Republic Railways
DCDR	:	Deputy for Construction and Development of Railway Network
METRA	:	Railway Developing Consulting Engineers IRAN
DOE	:	Department of the Environment
STD	:	Short Term Development
LTD	:	Long Term Development
CIF	:	Cost, Insurance, and Freight
FOB	:	Free on Board
SCF	:	Standard Conversion Factor
CFC	:	Conversion Factor for Consumption
PES	:	Preliminary Environmental Survey
IEE	:	Initial Environmental Examination
FIRR	:	Financial Infernal Rate of Return
DWT	:	Dead Weight Tonnage
MRT	:	Ministry of Roads and Transportation
PBO	:	Planning and Budget Organization
G.T.	:	Gross Tons

SYMBOLS

Negligible fraction	-
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Introduction

The PSO last formulated the Master Plan of the Iranian Ports in 1974, though various short term plans and rehabilitation plans have been conducted in the interim. Construction of port facilities has at each port has been completed in accordance with the said Master Plan.

At this time, a new port master plan that includes a cargo demand forecast for the coming century is required.

This volume presents the Master Plan for Anzali port. The proposed master plan reflects the requirements of the commercial port in 2010/11.

Before 2010/11, Anzali port should be expanded to accommodate larger vessels and to modernize the cargo handling system. Development plans for the container and oil port are included in the Master Plan.

The Report VOL(II) presented the cargo demand forecast of Iranian port and functional allotment of each port. The transhipment cargo volume was also forecasted based on the information available at the time of study. The volume should be read in conjunction with The Report VOL(II).

Chapter 1

Development Concept of the Port

Chapter 1 Development Concept of The Port

1.1 Major Roles of The Port in the Iranian Port Network

Importance of the port sector as the sea-borne cargo traffic center in total foreign trade, as the cargo distribution center, as the transition point of transport mode and as the industrial and commercial service center was already described.

In this section, the role as transition point of the major Iranian port network is illustrated with considering the cargo throughput.

The share of cargo volume handled in Anzali port to the total volume in the Caspian Sea has ranged from 71% to 75% during the last 5 years except 1990. The share will exceed 57% in 2000, and 65% in 2010 according to the forecast of the Study. The average annual growth rate is 7.9% from 1989 to 1993.

In future, major roles in the Caspian Sea should be performed by Anzali and Now Shahr port. At the same time, the new port (Amir Abad and Torkaman port) will play important roles in the Caspian Sea as sub-ports. The share of cargo volume handled in the new port to the total volume in Caspian Sea will be 23% in 2000/01, and 16% in 2010/11.

Figure 1.1.1.1 show past and future shares of the total cargo volume at each port.

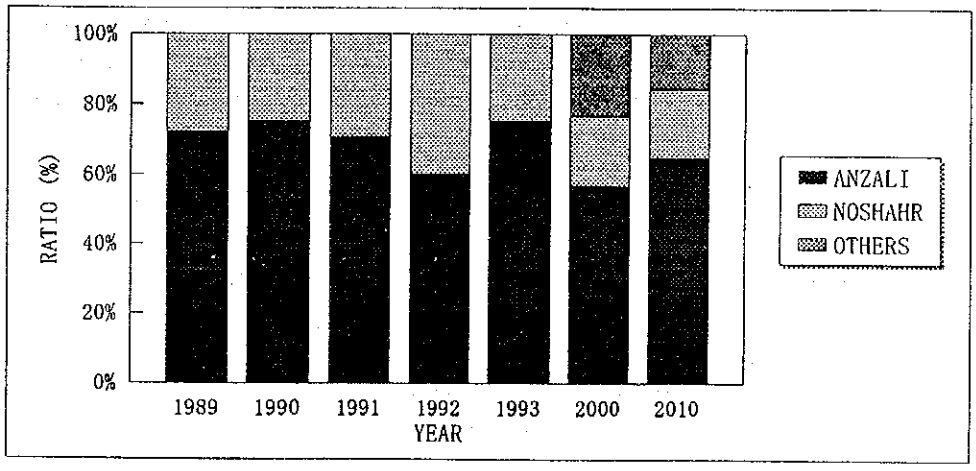


Figure 1.1.1.1 Shares of the Total Cargo Volume at Each Port

1.2 Location and Hinterland of the Ports

1.2.1 Location

Anzali, Now Shahr and other ports under construction which face the CIS countries through Caspian Sea have the same locational characteristics. These ports are close to Teheran. Ports are located at the bottom of mountains.

Although the cargo volume from the European countries will be not so large through the Caspian Sea, cargo from CIS countries will increase. An enhanced inland transportation system, in particular the improvement of roads is necessary for these ports to perform gateway functions.

1.2.2 Hinterland

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

For the ports in the Persian Gulf, the surrounding land is separated into eight areas considering transportation infrastructure, road and railway. Cargo volume of ports to/from area related to the population is shown in Table 1.2.2.1.

For the ports in the Caspian Sea, since the existing two ports (Anzali port and Nowshahr port) are near Tehran and each other, their hinterlands are considered to be identical. To check the cargo volume share of each port in the Caspian Sea, a cost analysis is not employed because the actual share is determined by many factors, not simply the transportation cost to/from the ports.

Table 1.2.2.1 Hinterlands of Ports in the Caspian Sea

Area	Province	Population Share
Tehran	Tehran,Zanjan an,Seman,Gilan Mazandaran,East Azarbayejan West Azarbayejan	0.450
Esfahan	Esfahan	0.067
Mashhad	Khorasan	0.107

1.3 Future Pattern of Cargo Flow and Corresponding Function of the Ports

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

(1) International transit cargoes, including land bridge cargo, may increase depending on the relevant factors including availability of services to be provided by the competing foreign transportation system

(2) The scale of sea-borne cargo flow through the Caspian Sea ports will increase steadily in the long term basis according to the economic development of CIS Republics.

(3) Export cargo volume will increase steadily in line with the governments policy to seek a balanced trade that is not dependent on oil.

(4) Substantial increase in cargo traffic through Bandar Abbas area can be expected due to active improvement of port facilities and its accessibility together with development of free trade area.

(5) Composition of cargo commodities will be diversified according to growth of economic activities and close relations with neighboring countries.

(6) Domestic sea-borne cargo flow will considerably increase according to progress of local port and coastal area development.

(7) Total in/out flow of international trading cargoes through road or rail directly to/from the neighboring countries (overland cargo flow) will increase its share of the cargo traffic through the ports (sea-borne cargo flow).

(8) Grain bulk cargo will still be imported from foreign countries although domestic production will increase to meet the consumption needs of a growing population.

(9) Oil products cargo will decrease as self-sufficiency is gradually attained.

1.4 Overall Cargo Traffic Demand for Major Ports

In Chapter 3 of Interim Report(1), commodity-wise cargo handling volume at each study port in the target years 2000/01 and 2010/11 was forecasted (refer to Table 1.4.1.1).
From the perspective of future cargo traffic demand, the following assumptions have been applied to determine commodity-wise cargo handling volume at each study port in the target years.

(1) Present commodity shares of handling cargo at each study port are expected to be basically maintained in the target years 2000/01 and 2010/11.

(2) Containerization ratio of total cargo (import and export) in Iranian ports will be 20.7% in the year 2000/01 and 53% in the year 2010/11.

(3) Container cargo volume at Imam Khomeini port in the year 2010/11 will have grown to the same level as that of Rajaee port.

Table 1.4.1.1 Total Forecast Commodity-wise Volume at Each Study Ports

Import & Export Cargo of North Ports

Unit: 1,000 tons

	Anzali				Noshahr				Amir Abad				Fereydunkener				Total	
	2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01	2010/11
Dry Bulk	222	14.4%	444	10.1%	56	10.0%	136	8.8%	25	9.8%	33	8.4%	36	9.8%	67	8.4%	339	680
Bag Cargo	49	3.2%	131	3.0%	97	17.5%	299	19.3%	44	17.0%	74	18.5%	63	17.0%	148	18.5%	253	651
Container	86	5.6%	1,159	26.3%	7	1.3%	120	7.8%	3	1.3%	29	7.2%	5	1.3%	58	7.2%	101	1,366
Refrigerated	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Steel	218	14.2%	575	13.1%	46	8.2%	144	9.3%	21	8.0%	36	8.9%	30	8.0%	71	8.9%	314	826
Mineral	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
General Cargo	162	10.6%	563	12.8%	53	9.5%	159	10.3%	31	11.8%	59	14.7%	43	11.8%	117	14.6%	289	897
Total	736		2,872		256		857		125		231		177		461		1,297	4,421

Import & Export Cargo of South Ports

Unit: 1,000 tons

	Imam				Rajaee				Bahonar				Bushehr				Behesti				Khorramshahr				Abadan				Total	
	2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01	2010/11
Dry Bulk	3,711	23.7%	4,505	15.0%	2,478	17.6%	3,037	10.8%	16	0.4%	20	0.4%	194	9.2%	252	7.7%	407	34.9%	591	29.8%	79	7.9%	103	10.3%	0	0.0%	0	0.0%	6,884	8,508
Bag Cargo	3,375	21.5%	5,405	18.1%	1,202	8.5%	2,121	7.6%	213	4.8%	206	3.7%	149	7.1%	187	5.8%	157	13.4%	219	11.1%	22	2.2%	10	1.0%	6	3.2%	4	2.0%	5,124	8,152
Container	914	5.8%	8,167	27.3%	975	6.9%	8,386	29.9%	0	0.0%	0	0.0%	6	0.3%	35	1.1%	30	2.6%	214	10.8%	130	13.0%	293	29.3%	0	0.0%	0	0.0%	2,055	17,095
Refrigerated	219	1.4%	410	1.4%	49	0.4%	87	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	268	497
Steel	4,434	28.3%	6,650	22.2%	1,507	10.7%	2,975	10.6%	61	1.4%	98	1.8%	291	13.8%	472	14.5%	71	6.1%	135	6.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6,365	10,330
Mineral	99	0.6%	133	0.4%	302	2.1%	432	1.5%	653	14.8%	701	12.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1,053	1,265
General Cargo	2,762	17.6%	4,473	14.9%	2,744	19.5%	5,389	19.2%	1,876	42.4%	2,996	54.0%	789	37.3%	1,506	46.3%	121	10.4%	302	15.2%	769	76.9%	595	59.5%	194	96.8%	196	98.0%	9,254	15,458
Total	15,513		29,743		9,256		22,428		2,819		4,021		1,429		2,453		785		1,461		1,000		1,000		200		200		31,003	61,305

	Anzali Port						Imam Khomeini					
	1993/94		2000/01		2010/11		1993/94		2000/01		2010/11	
Dry Bulk	0	0.0%	222	14.4%	444	10.1%	2,071	20.6%	3,711	23.7%	4,505	15.0%
Bag Cargo	41	3.8%	49	3.2%	131	3.0%	2,661	26.5%	3,375	21.5%	5,405	18.1%
Container	46	4.3%	86	5.6%	1,159	26.3%	38	0.4%	914	5.8%	8,167	27.3%
Refrigerated	0	0.0%	0	0.0%	0	0.0%	66	0.7%	219	1.4%	410	1.4%
Steel	266	24.7%	218	14.2%	575	13.1%	3,679	36.6%	4,434	28.3%	6,650	22.2%
Mineral	0	0.0%	0	0.0%	0	0.0%	0	0.0%	99	0.6%	133	0.4%
General Cargo	148	13.7%	162	10.6%	563	12.8%	1,463	14.6%	2,762	17.6%	4,473	14.9%
Total	501		736		2,872		9,978		15,513		29,743	

(4) The cargo handling volume of the ports currently under construction, Amir Abad and Fereydunkenar port, is estimated to be 400,000 tons and 800,000 tons respectively in the target year 2010/11. The share of import/export cargo volume and commodity-wise cargo is considered to be the same as Nowshahr port.

(5) The cargo handling volumes of the newly opened ports of Khorramshahr and Abadan port are estimated to be 1,000,000 tons and 200,000 tons in the target years 2000 and 2010 respectively. The share of import/export cargo volume will be equal. General cargo and container cargo are the main commodities to be handled at these ports.

1.5 Basic Policy of Port Development

Future port development and planning should be based on the following five subjects.

(1) To assist smooth trading in Iran, especially the land bridge cargo and increasing export cargo
(2) To support industrial/commercial development and free trade area activities
(3) To cope with the growing trend of containerization
(4) To maintain efficiency with regards to port operation and management
(5) To offer good service to port users

While considering the port development, it is also important to consider the environment surrounding the port, as well as economic and financial issues.

1.6 Basic Direction of the Ports Planning

1.6.1 Concerning on the Ports Development Policy

Some subjects are described as follows;

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

1.6.2 Problems and Other Issues

Anzali

(1) Keeping calmness in the basin area
(2) Insufficient land for development plan in future
(3) Insufficient railway network
(4) Rising of the Water Level of the Caspian Sea etc.

Chapter 2

Current Situation of the Port

Chapter 2 Current Situation of the Port

2.1 Natural Condition

2.1.1 Purpose of the Study

The study of the natural condition is one of the important items for the port facility planning, design, cost estimate and construction works.

This chapter deals with the natural condition of Anzali port and its surroundings. The items described here cover the following conditions.

(1) Meteorology
(2) Oceanography
(3) Topography
(4) Bathymetric sounding
(5) Geotechnics
(6) Sedimentation
(7) Seismology

2.1.2 Meteorological Condition

(1) General Climate in Iran

Data and Information on general climate in Iran are described in subsection 2.4 of Volume-1.

(2) General Climate Around Anzali Port

Summary

The climate of the narrow coast along the Southern Caspian is quite distinct from that of the rest of Iran. Unlike the climate in the plateaus and mountains of central and southern Iran, the Caspian shore is characterized by moderate temperature, low daily and annual temperature ranges, high humidity and heavy precipitation. Mean summer temperatures along the coast are about 26℃ and mean winter temperatures +7℃. Average annual precipitation decreases from west to east, with average annual rainfalls of 2,000 mm in Anzali, 1,400 mm in Nowshahr, 800 mm in Babolsar and 500 mm in Gorgan. Heaviest rainfalls in Anzali are generally in the autumn. The driest months are early summer. Precipitation distribution in Iran is shown in Figure 2.1.2-1.

Weather at Anzali is moderate in summer, and in winter temperatures at Anzali rarely goes more than several degree below freezing point.
Ice sometimes forms on the fresh water of the port basin.

In summer the absolute maximum daily high temperature rarely reaches 35℃ and shipping as well as tourist activities are very pleasant.

The yearly precipitation ranges from 1,600 to 2,300 mm, but as much as 353 mm has been recorded in day.

Monthly rainfall ranges from about 4 days of 1 mm or more rain in the summer, to around 10 or 12 days during six winter months. The rain frequency is a factor in cargo movement and in covered storage requirements.

Relative humidity is extreme in Anzali. Average daily humidity ranges from 85% to 99% in July.

Fog occurs in Anzali Port but usually only for an hour or two, on about 30 days of the year.

The prevailing wind in this area is from the north, as shown in Figure 6.2.1. Storms are frequent, and maximum wind can reach 107 knots or 55 m/sec.

Northern winds prevail in the Western regions of the Iranian Caspian Sea Coast. In the Eastern region, the direction of prevailing winds is predominantly east and west. The frequency of winds over 10 m/sec. and maximum wind velocity also varies from west to east.

Table 2.1.2.1 WIND INTENSITY - CASPIAN COAST

Meteorological Station	Frequency (% Per year)			Max.Wind Velocity (m/sec.
	Calms	Winds up to 10m	Winds above 10m/sec	
Anzali	8.0	85.0	75.0	48-55
Ramsar	15.0	76.0	8.0	34-40
Babolsar	48.0	50.5	1.5	28-33
Gorgan	45.5	50.5	4.5	28-33

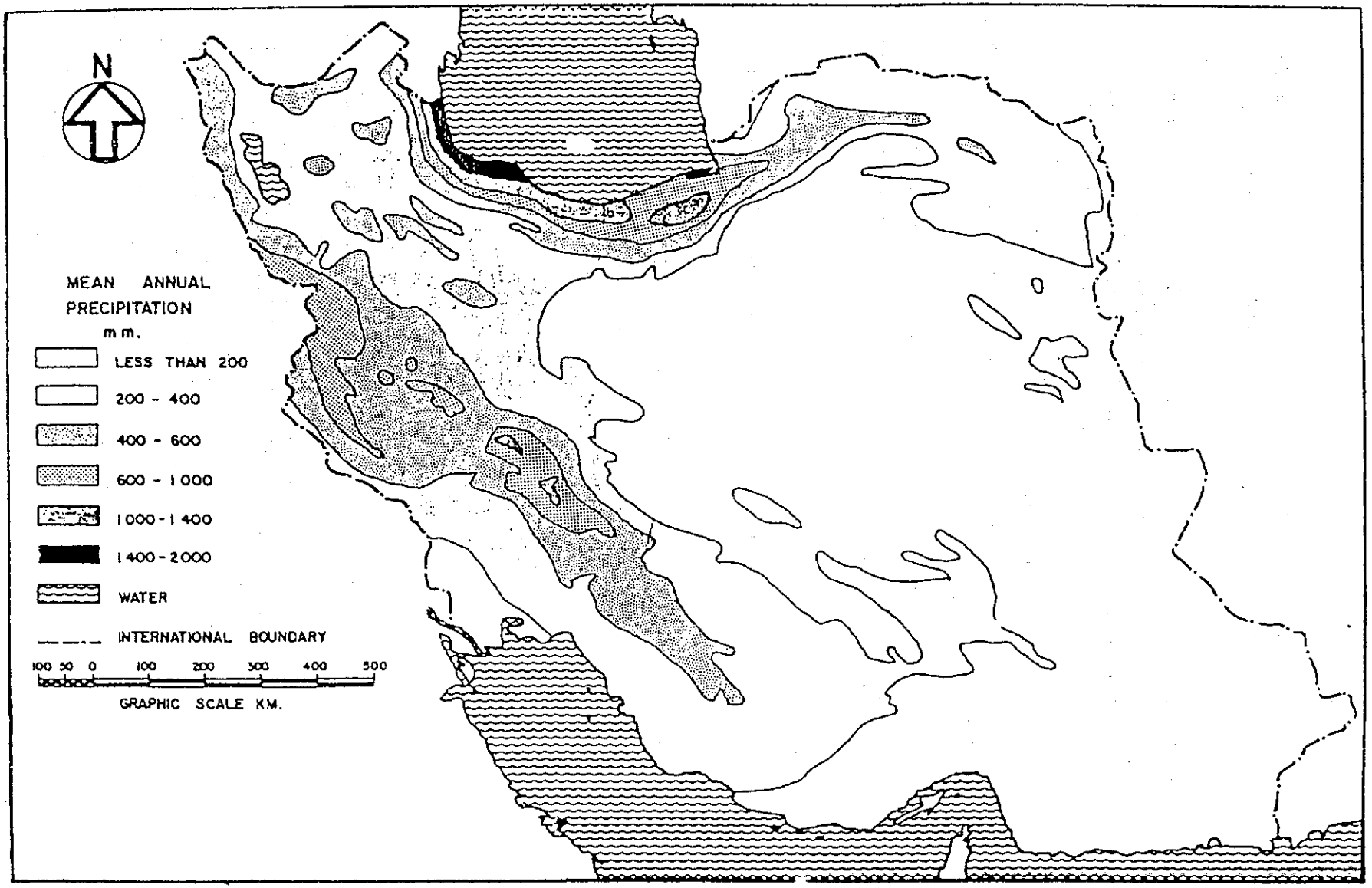


Figure 2.1.2.1 Iran Rainfall Distribution

(3) Data in the Last Study Report

Related data are collected from the Report "Improvement and Extension of Marine Structures, Anzali Port" prepared by Sakoo consulting Engineers, October 1993, (Sakoo Report). It shows as bellows.

- Monthly values of Air Relative Humidity at Bandar Anzali station (1970-1985)
- Mean values of precipitation parameters at Bandar Anzali station (1970-1985)
- Mean yearly frequency of individual storm Type (Wave Fields) over Caspian Sea
- Wind transitions over the Caspian Sea during extreme storms, (1947-1957)
- Wind rose at Anzali
- Maximum wind speed at Bandar Anzali Station
- Maximum probable wind speeds at Bandar Anzali Station based on 40 years data (1950-1990)

In addition to these data, detailed wind observation data by Iranian Meteorological Organization (IMO) Data Processing Center is available. It shows the IMO Wind Data (1951-1975), in Appendixes A3-1.

Table 2.1.2.2

Monthly Values of Air Temperature Parameters at BANDAR ANZALI Station (1970-1985)

Temperature Parameter	Dey	Bah.	Esf.	Far.	Ord.	Kho.	Tir	Mor.	Sha.	Mehr	Aban	Azar	Annual
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
Absolute Maximum	29.	27.	33.	33.	36.	34.	37.	36.	32.	34.	34.	31.	37.
Mean of Maximum Daily	9.4	9.2	11.1	16.8	22.2	27.3	30.3	29.3	26.1	21.0	16.6	12.3	19.3
Mean of Mean Daily	6.7	6.5	8.6	13.9	19.1	23.6	26.4	25.6	22.7	17.9	13.6	9.4	16.1
Mean of Minimum Daily	4.0	3.8	6.1	10.9	16.0	19.9	22.5	21.7	19.4	14.8	10.6	6.4	13.0
Absolute Minimum	- 6.	-11.	- 4.	2.	8.	13.	16.	16.	12.	5.	3.	- 2.	-11.

Table 2.1.2.3

Monthly Values of Air Relative Humidity at BANDAR ANZALI Station (1970-1985)

(%)

Measurment Order	Dey	Bah.	Esf.	Far.	Ord.	Kho.	Tir	Mor.	Sha.	Mehr	Aban	Azar	Annual
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
6:30 (3:00 GMT)	89.	91.	92.	92.	92.	88.	86.	83.	92.	93.	92.	90.	90.
12:30 (9:00 GMT)	81.	82.	83.	79.	75.	67.	65.	69.	76.	79.	81.	80.	76.
18:30 (15:00 GMT)	85.	86.	86.	83.	79.	72.	69.	74.	80.	84.	87.	85.	81.

Table 2.1.2.4

Mean Values of Precipitation Parameters at BANDAR ANZALI Station (1970-1985)

Parameter	Dey	Bah.	Esf.	Far.	Ord.	Kho.	Tir	Mor.	Sha.	Mehr	Aban	Azar	Annual
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
Precipitation Depth (mm)	207.	132.	115.	47.	50.	41.	40.	115.	183.	348.	321.	254.	1853.
Monthly Percent (%)	11.2	7.1	6.2	2.5	2.7	2.2	2.2	6.2	9.9	18.8	17.3	13.7	100.
Seasonal Percent (%)	24.5			7.4			10.3			49.9			100.

Table 2.1.2.5

Mean Yearly Frequency of Individual Storm Types (Wave Fields) Over the CASPIAN SEA with Various Unintermittent Duration

(%)

Type	Sub-Type	Duration (hours)								
		0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40<
North-Westernly	I	—	—	39.6	24.2	16.7	7.5	5.8	2.7	3.5
	II	33.3	54.5	9.1	0.0	0.0	0.0	0.0	0.0	0.0
	III	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	IV	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northernly (North-Easternly)	I	—	—	18.8	21.1	23.5	14.1	7.0	6.3	9.4
	II	5.3	57.9	26.2	5.3	5.3	0.0	0.0	0.0	0.0
	III	71.4	14.3	14.3	0.0	0.0	0.0	0.0	0.0	0.0
	IV	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Easternly	I	—	—	0.0	37.5	37.5	25.0	0.0	0.0	0.0
Southernly	I	—	—	20.2	22.6	20.3	15.5	4.8	7.2	9.5
South-Easternly	I	—	—	0.0	25.0	25.0	0.0	0.0	0.0	50.0
	III	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Westernly	I	—	—	0.0	50.0	0.0	50.0	0.0	0.0	0.0
Transitional from Southernly to North-Westernly	I	—	—	100.0	0.0	0.0	0.0	0.0	0.0	0.0

Remark: Dash Indicates that the Winds of the First Subtype having a Duration to 10 Hours Have not been Discussed.

Table 2.1.2.6

Wind Transitions Over the CASPIAN SEA During Extreme Storms, Period 1947-1957

Date	Direction	Velocity Range (m/s)	Max. Velocity During the Storm (m/s)	Preceding Synoptic Situation
October 1948	NW	10-30	28	Southernly Winds 10-15 m/s
February 1952	NNW-N	20-25	23	Weak Winds 5 m/s
March 1952		10-30	28	
November 1952	SE	10-25	24	Southernly Winds 5-10 m/s
November 1957	N	10-30	30	Southernly Winds 10-15 m/s

Table 2.1.2.7

Maximum Wind Speed at BANDAR ANZALI Station

(m/s)

Year	Direction		
	North-West	North	North-East
1951	13.0	26.0	13.0
1952	15.0	29.0	22.0
1953	16.5	22.0	17.0
1954	20.0	12.0	——
1955	19.0	23.0	——
1956	17.5	22.5	13.0
1957	25.0	17.5	11.0
1958	16.0	22.5	——
1959	15.0	19.0	6.0
1960	16.0	16.5	11.5
1961	15.0	19.0	11.0
1962	22.5	22.5	——
1963	17.0	22.0	——
1964	9.5	17.0	13.0
1965	12.0	17.5	14.0
1966	12.5	19.0	17.5
1967	14.5	17.0	——
1968	15.0	21.5	10.0
1969	14.0	17.5	12.5
1970	18.5	17.5	12.5
1971	12.5	19.0	16.0
1972	16.0	18.0	16.0
1973	16.0	19.0	15.0
1974	13.0	17.5	13.0
1975	14.0	12.0	14.0
1976	19.0	15.5	16.0
1977	13.0	14.0	14.0
1978	12.0	14.0	10.5
1979	13.5	12.5	10.0
1980	17.5	8.5	12.5
1981	15.0	15.0	11.5
1982	18.0	15.0	12.0
1983	13.0	15.0	——
1984	13.0	11.0	12.0
1985	13.0	11.0	11.0
1986	23.0	19.0	11.0
1987	21.0	20.0	12.0
1988	23.0	20.0	11.0
1989	15.0	30.0	12.0
1990	22.0	16.0	10.0

Table 2.1.2.8

Maximum Probable Wind Speed at BANDAR ANZALI Station
(Based on 40 Years data 1951-1990)

(m/s)

Probability (%) / Return Period (Yr.)	50 / 2	20 / 5	10 / 10	5 / 25	2 / 50	1 / 100	Selected Method
North-West	15.5	18.7	20.9	23.5	25.5	27.5	Gumble
North	17.3	21.4	24.1	27.5	30.1	32.6	Gumble
North-East	12.3	14.9	16.5	18.7	20.2	21.8	Gumble

(4) Related Data to Port Facility Design

This is subsection deals with the climatic condition in relation with the facility design. Wave and water rise conditions will be discussed later.

1) Temperature

Special consideration of low temperature as the concrete quality should be taken into account, it is recommended to place concrete under the temperature between +35℃ and +5℃.

Concrete placed out of these range, an ordinary quality will not be achieved due to insufficient curing of concrete.

2) Precipitation

Anzali is the place of high precipitation in Iran, about 2,000 mm a year. The monthly mean value is observed in October to January, 250 mm to 350 mm and in April to July, 40 mm to 50 mm.

Rainfall intensity is one of governing factors to perform a design of storm water drainage.

High precipitation might affect on the workability at the construction works including concrete placing, pavement work, earth work and pile driving. Anzali from October to January generally has heavy precipitation, 300 mm a month. Efficiency of site work during these month will be worse than those of ordinary month.

3) Humidity

The humidity in Anzali area is extremely high. Therefore, it is recommended that special consideration of high moisture content in the warehouses and storages should be taken into account.

4) Wind

The Wind intensity by direction is an essential factor for planning pier and channel for vessel safely maneuvering in the inner basin. The wave calmness study will be carried out based on the estimated wave recurrence by the intensity, when necessary.

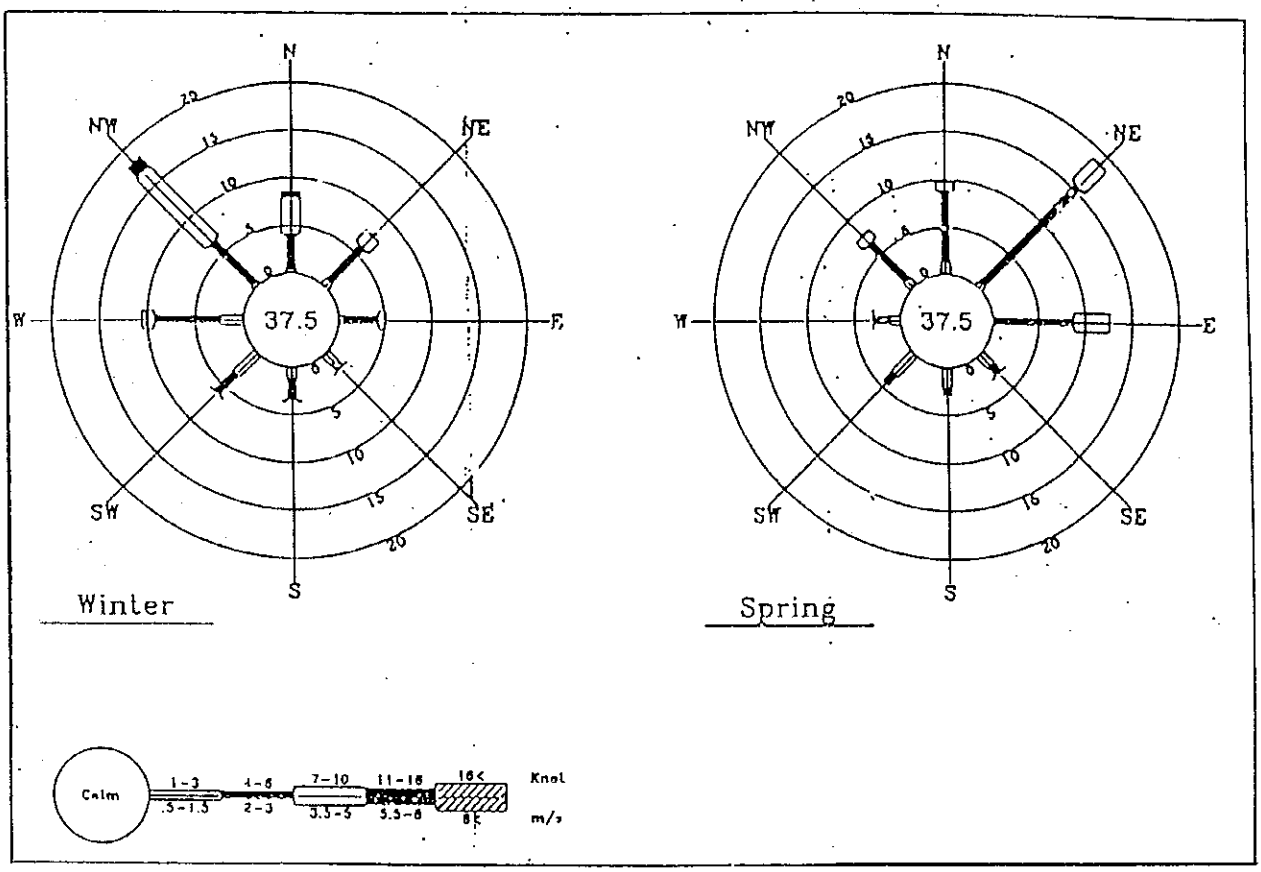
The main wave source in the project site seems the wave generated by the Northwest and Northeast wind.

During the marine works, wind intensity is one of the governing factors of operation efficiency. The limit of wind for the marine works by floating equipment is generally 10 m/sec. Rate of occurrence of this wind in Anzali Port is about 4% per year.

The air depression during the winter season may generate heavy winds and it may relate to the design wind velocity for superstructures, buildings, lighting towers and gantry cranes.

It is roughly estimated that non-working days of marine works during the autumn and winter seasons will raise up to 50%. This is related to the heavy rain, heavy wind, heavy wave and air depression and should be taken into consideration in construction schedule and cost estimation.

The wind rose of Anzali is shown in Figure 2.1.2.2.



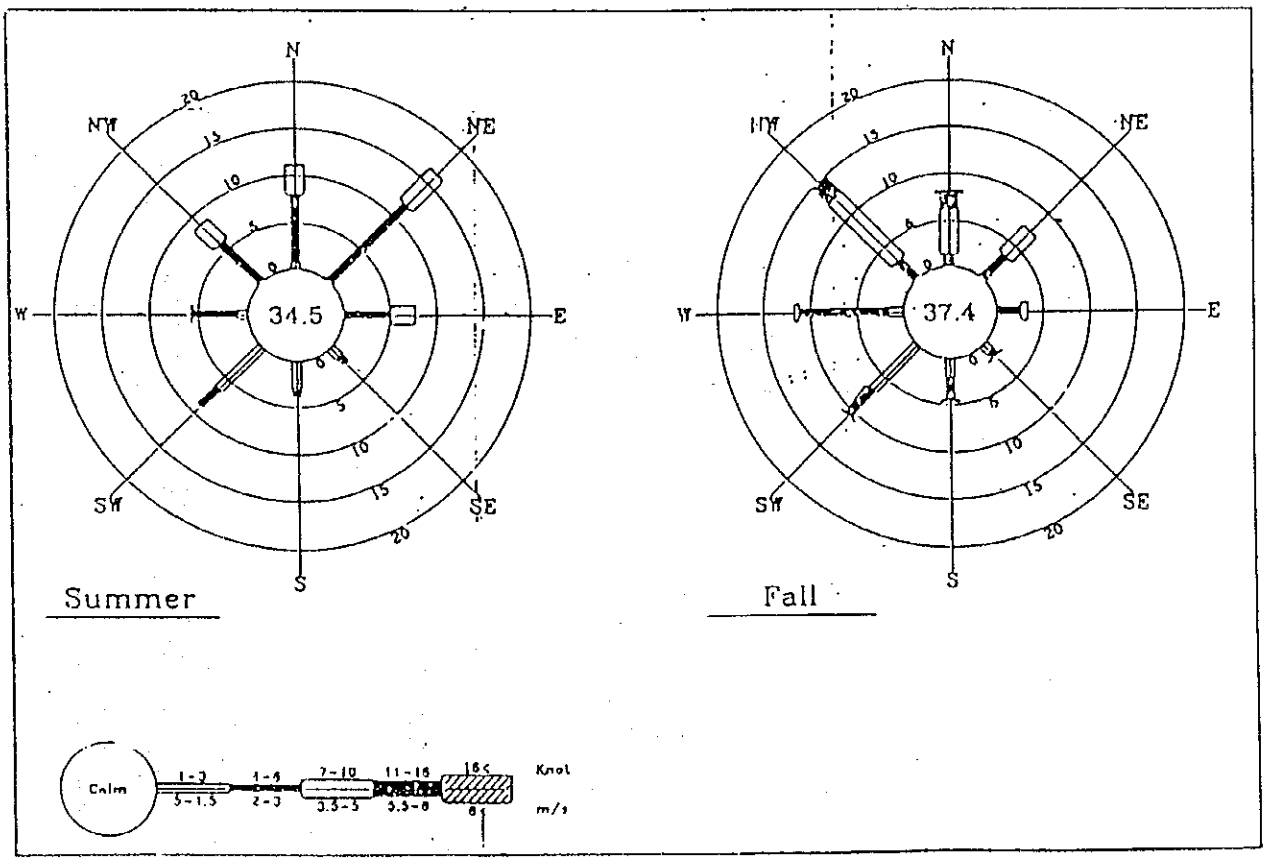
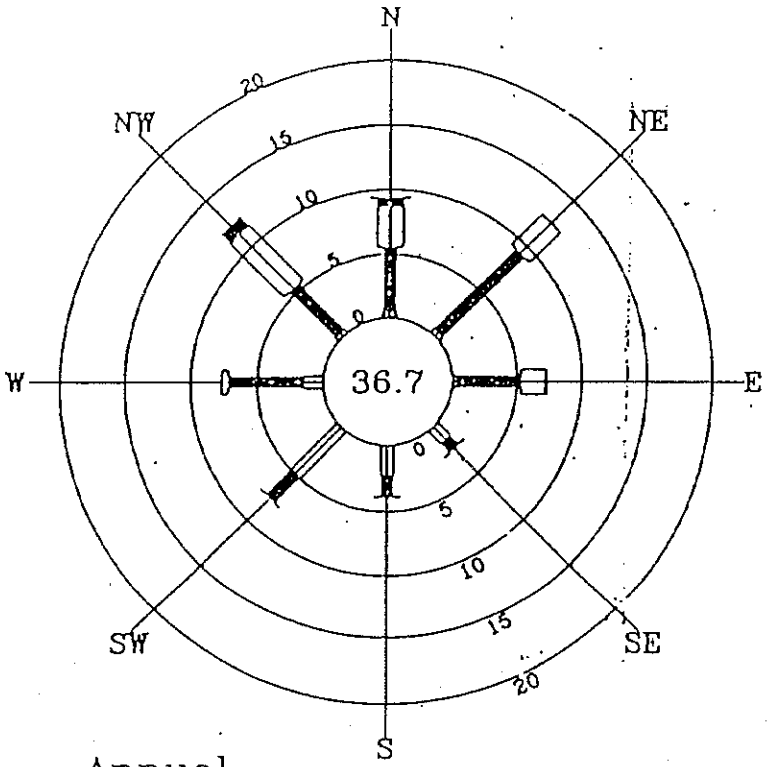
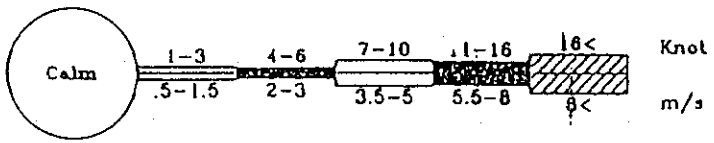


Figure 2.1.2.2 Wind Rose of Anzali (1)





Wind Speed (m/s)

Dir.	.6-1.6	2-3	3.6-6	6.6-8	8<
N	0.5	5.0	3.1	0.7	0.1
NE	0.4	8.9	3.3	0.1	0.0
E	0.3	5.0	1.9	0.1	0.0
SE	1.4	1.0	0.0	0.0	0.0
S	2.2	1.8	0.1	0.0	0.0
SW	4.9	2.7	0.0	0.0	0.0
W	1.5	5.7	0.5	0.0	0.0
NW	0.4	5.1	5.8	1.1	0.0

Figure 2.1.2-2 Wind Rose of Anzali (2)

Figure 2.1.2.2 Wind Rose of Anzali (2)

2.1.3 Oceanographic Conditions

This section deals with the governing marine conditions including the water level, current and waves. Coastal changes by littoral drift and siltation will be discussed also.

(1) Water Level

The Caspian Sea has no tide; however, due to the changing balance of precipitation, discharge and evaporation, as seasonal water level variation of 30 to 40 cm occurs each year.

Since 1869 of the reported highest +1.3 m above C.D., the level of the Caspian Sea has dropped almost 3.3 m up to the bottom, -2.0 m below C.D in 1977. An average drop was 3 cm/year. (330 cm ÷ 108 years)
Since 1978, the level is under the recovery process and becomes same level of Chart Datum (C.D). An average increase is 13 cm/year. (200 cm ÷ 15 years).
If this speed is maintained for next ten years, water level will be +1.3 m above C.D. which is the same with recorded highest in 1869. (refer to Figure 2.1.3.1 and Table 2.1.3.1)

Nobody knows the time when the level can touch the ceiling and how high the level. However, it should be noted that the level was already +1.3 m C.D. 125 years ago.

The causes of water level variation is a closed basin such as the Caspian Sea, are usually the following:

- General changes in weather
- Artificial or natural changes in the course and flows of rivers
- Seismic changes under the seabed, altering the seabed elevations or rate of infiltration or seepage losses.

Table 2.1.3-1 shows the up and down of water level in Caspian Sea since 1869.

In the sense of port engineering practice, such a maximum change in 3.3 m height is within the ordinary condition. For example, the change of water level or Imam Khomeini port is more than 4.5 m. Thus the problem is on the structures which were built during the lower water period, for example 23 years from 1954 to 1977. If the structures were designed to meet the water level at that time, they should meet the problem during the higher water period, presently or going.
Figure 2.1.3.1 is a data prepared by BERG/ZAIKOV and shows the Caspian Sea Water level changes since 1650.

Other than this long term level changes, there is short term level rises, namely a natural rise by a discharge from the lagoon and wave setup. The former takes place when a large amount of discharge goes to the open sea through the passage. The

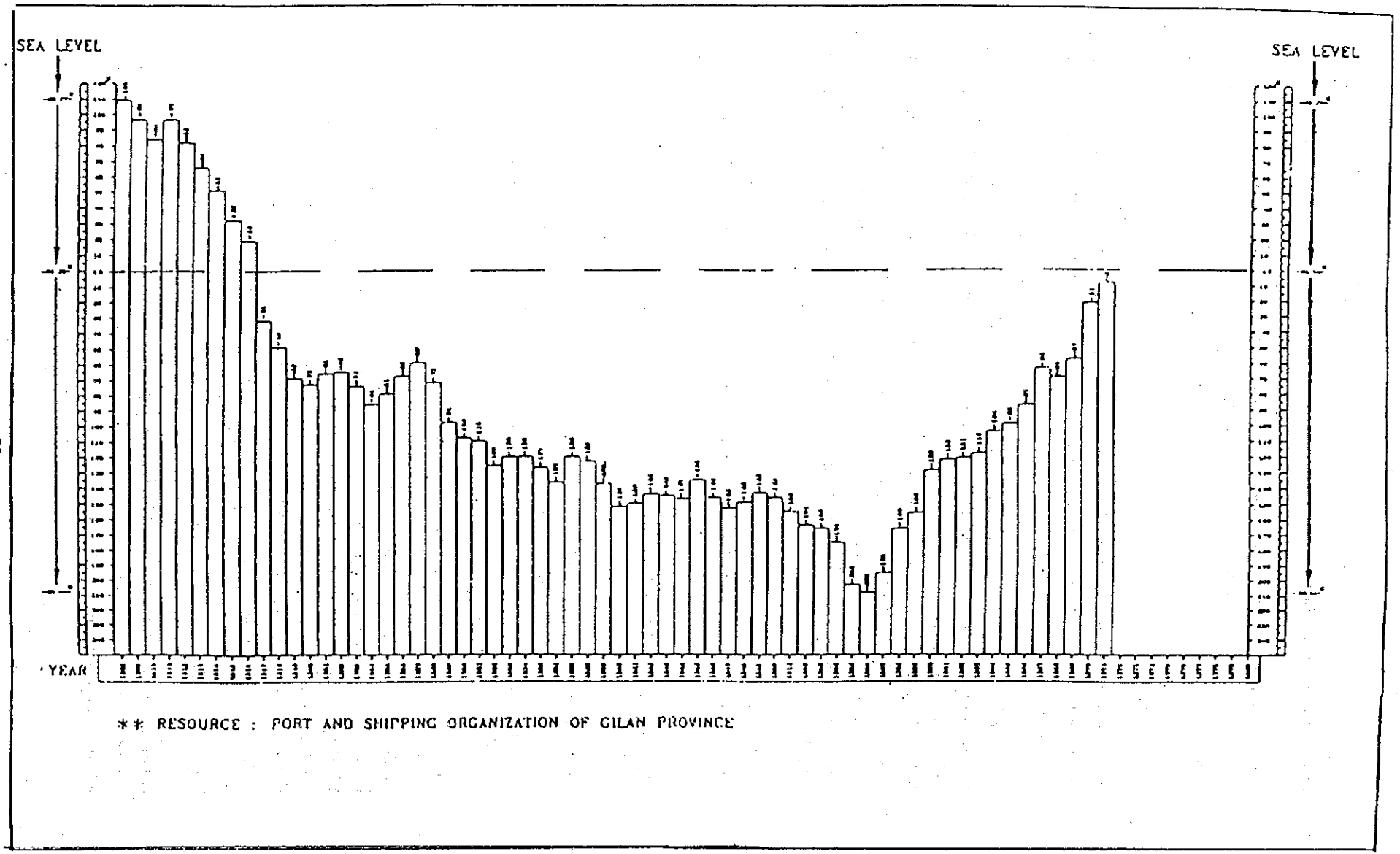


Figure 2.1.3.1 The Caspian Sea Water Level years 1308 - 1371

latter happens by a concentration of wave energy at the on-shore area.

Table 2.1.3.1 Up and Down of Water Level since 1869 the Caspian Sea

Iran-ian year	Greg-orian year	Up&Down	Water Level(m) PSCD CSCD	Period (year)	Changes (m)	Speed cm / year
	-	Up				
1,248	1,869	Edge	-25,1 +1.3			
	-	Even	--	61	-0,5	-1
1,309	1,930	Edge	-25,6 +0.8	-	-	-
	-	Down	-	24	-2,4	-10
1,333	1,954	Edge	-28,0 -1.6	-	-	-
	-	Even	-	23	-0,4	-2
1,356	1,977	Edge	-28,4 -2.0	-	-	-
	-	Up	-	15	+2,0	+13
1,371	1,992	Up	-26,4* ±0.0	-	-	-
	-	Up	-	10	+1,3	+13
1,381	(2,002)	Edge	(-25,1)(+1.3)	-	-	-
	-	Even		-	-	-
	-	Edge		-	-	-

Notes: 1) PSCD = Persian Gulf Chart Datum, MSL
CSCD = Caspian Sea Chart Datum, MSL
CSCD - PSCD = -26.36m

2) Data in 1992 is neither the peak nor the bottom. Water level change at present is on the progress.

3) "Edge" means a turning point in macro view.

4) Figures in parentheses show the value estimated if the next peak level is +1.3 C.D, and water rising speed is 13 cm/y.

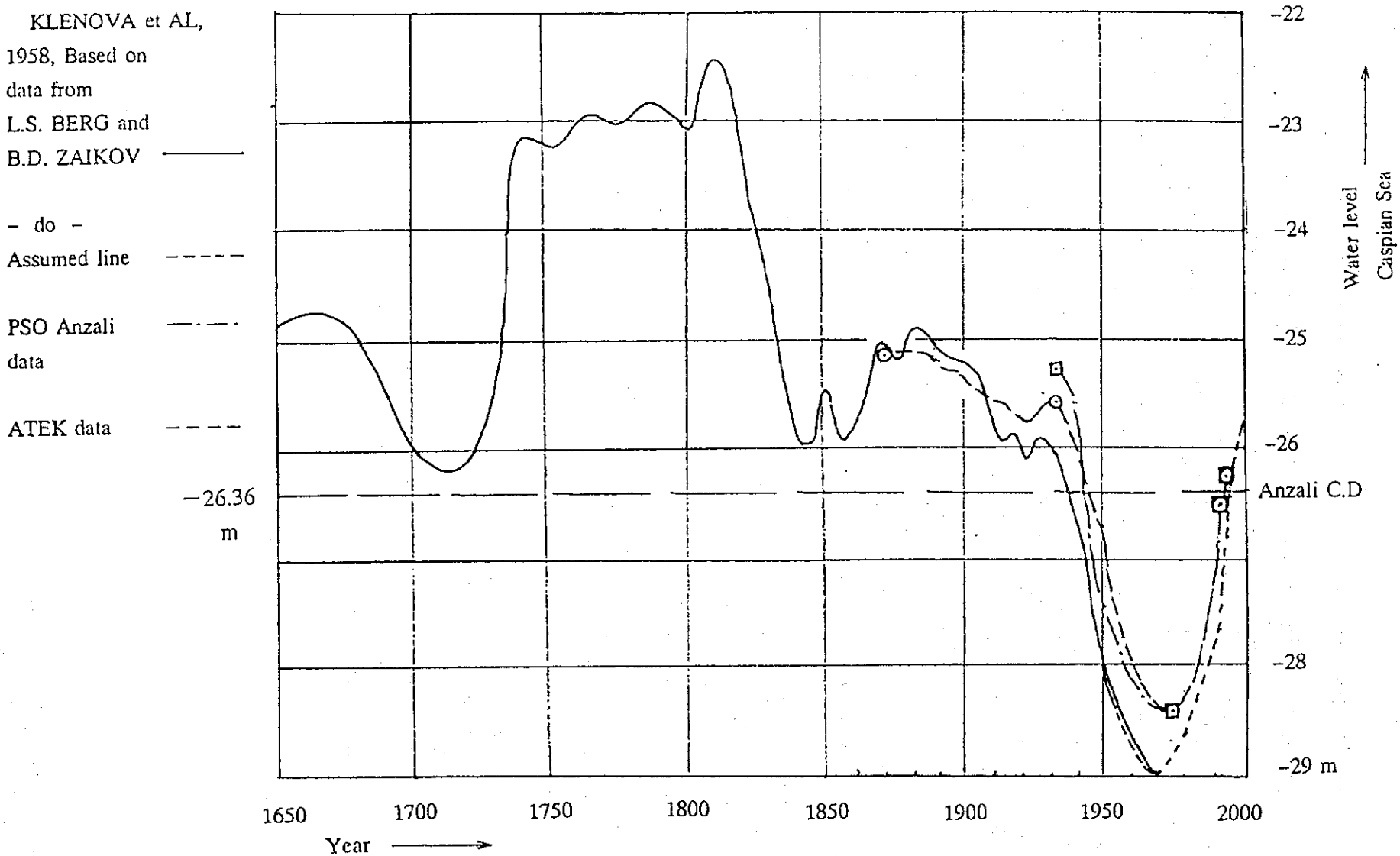


FIGURE 2.1.3.2 YEARLY ELEVATION OF THE CASPIAN SEA

2) Currents

There are two basic currents, namely the river currents caused by lagoon discharges and sea current. The former is the prevailing currents in the port basin and inner channel. The discharges run the basin and go the open sea through the breakwater opening. It is reported that this river current is about one knot (0.5 m/sec).

Fine materials are carrying by this currents and settle near the entrance.

Alongshore currents, coupled with wave action, create a littoral drift that may destroy or build up beaches. The short term water level variations in the Caspian Sea are due to local effect, such as wind, barometric pressure gradients and seiche effects.

These also influence the current patten of the sea, but the greatest overall determinate of current velocity and direction are surface winds, river inflows, the earth's rotation, water density gradients and differences in rate of evaporation within the individual basins and from basin to basin.

The general surface current directions are indicated on Figure 2.1.3.3 for the southern basin. The counter-clockwise rotation pattern of the currents in the southern basin is also observed in the central basin. Therefore, main direction of the littoral drift along the seashore at Anzali port is caused from the west to the east due to this rotation of the currents.

One sample of the evidence of this phenomena is observed a sand-bar near Bandar-E-Kiyashahr as shown in Figure 2.1.3.4.

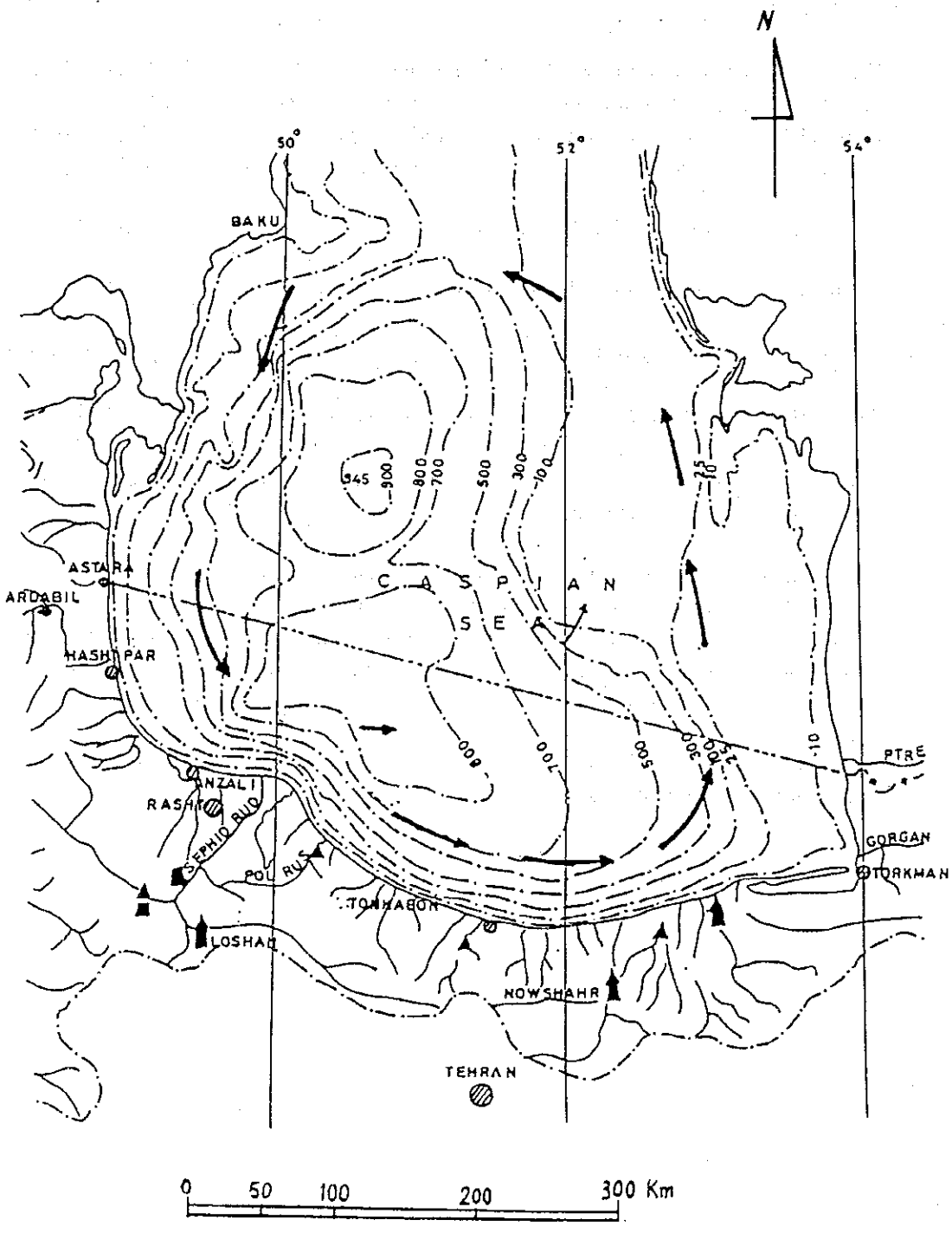


Figure 2.1.3.3 Alongshore Currents, South Caspian Sea

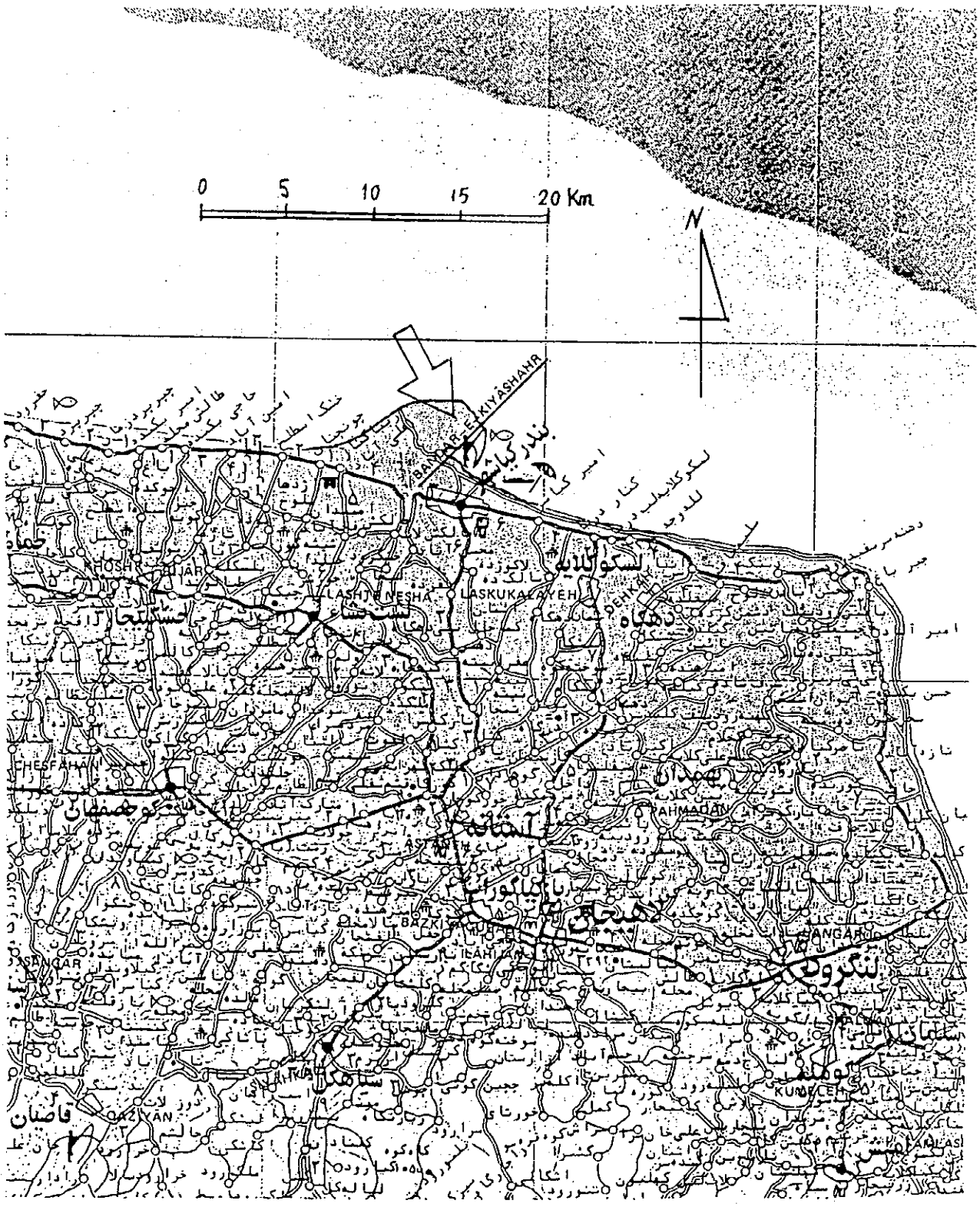


Figure 2.1.3.4 Seashore line near Bandar-E-Kiyashahr

(3) Waves

1) Purpose of Study

Wave data collection aims at two holds, firstly to know wave characteristics at the possible approaching channel and anchorage for new breakwater arrangement, secondly to know the wave calmness at the proposed berths in order to ensure that the counted operatable days are going to be more than an acceptable figure.

Design wave height will also be assumed through obtained wave data in order to design the breakwater or other heavy waterfront structures.

Waves in the shoal water may change their energy into costal current which will enhance the littoral drift and sedimentation.

2) Description in MP-74 and Available Report

Along the western Iranian coast the most intense wave action is from the North, the direction of the stronger prevailing winds and of the longer fetch.
Wave heights and direction were observed visually 3 times daily for one year at/from this data it was seen that Anzali Port experiences a relatively high frequency of waves of over 1.0 m height. Storm waves of 3.5 m or more were observed principally in the winter months.

The frequency of storm winds decreases sharply from west to east. Storm wave frequency also decreases in the Gorgan-Babolsar region to about 20% of treat in the West.

Forecasts of wave heights from existing wind data show significant wave heights of 1% probablity may be as high as 4.0 m at Anzali.

Sakoo Report also provides wave observation data together with wave forecasts.

3) Design Wave Heights

According to the available reports and information and computer similation results, design waves are assumed. Design waves should be decided by place and by structure to be designed.

a) Waves out of breakwaters

Breakwaters will be attacked directly by waves.
Following wave can be applied to the waterfront facilities directly faced open sea.

H=4.0 m or larger

For the breakwater design, the maximum wave that exists at the depth where the objective structure is.

b) Port basin in front of new wharves

Seawall and other waterfront structures to be constructed in the new wharves.

H=2.0 m

c) Port basin in front of the existing wharves

Wave intensity might decreases extensively in this area. If the wave absorption is made by the concrete blocks or also to be installed in front of seawall, this wave height will considerably be reduced.

H=1.0 m or less

Table 2.1.3.2 Wave Forecast, Anzali Port
(Sakoo Report 1993)

WAVE CHARACTERISTICS (RETURN PERIOD: 50 YEAR)

			SHALLOW - WATER			DEEP - WATER			
DIRECTION	WIND SPEED m/s	DURATION hr	HEIGHT m	PERIOD sec.	LENGTH m	HEIGHT m	PERIOD sec.	LENGTH m	FETCH km
NORTH	30.1	3	8.93	11.54	218.54	4.84	8.09	102.18	267.57
NORTHEAST	20.2	8	7.04	10.63	176.42	5.68	9.46	139.72	381.54
EAST	24	4	6.29	9.44	139.13	4.37	7.91	97.69	154.74
WEST	19.6	8.5	2.05	4.89	37.33	2.1	5.13	41.09	18.33
NORTHWEST	25.5	3	5.47	8.47	112.01	3.66	7.3	80.2	90.92

WAVE CHARACTERISTICS (RETURN PERIOD: 25 YEAR)

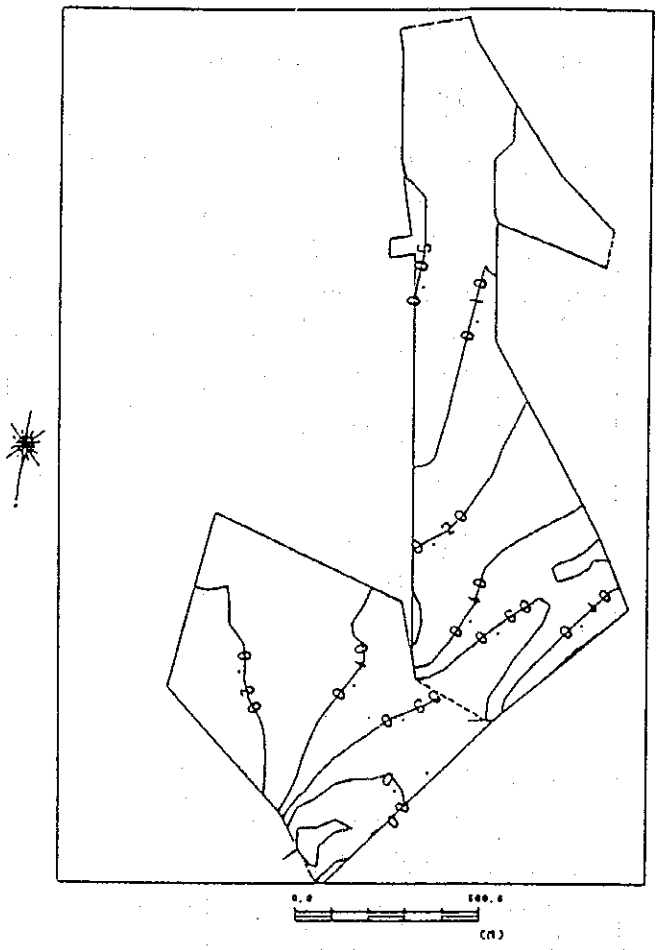
			SHALLOW - WATER			DEEP - WATER			
DIRECTION	WIND SPEED m/s	DURATION hr	HEIGHT m	PERIOD sec.	LENGTH m	HEIGHT m	PERIOD sec.	LENGTH m	FETCH km
NORTH	27.5	3	8.31	11.17	194.8	4.20	7.65	91.37	267.57
NORTHEAST	18.7	9.5	6.6	10.31	150.74	5.79	9.68	133.73	381.54
EAST	22.1	6	5.83	9.15	130.72	5.22	8.88	123.12	154.74
WEST	18.2	10	1.9	4.76	35.30	1.94	4.09	36.89	18.33
NORTHWEST	23.5	4.5	5.06	8.22	105.49	4.62	8.2	104.98	90.92

4) Calmness Similation

The calmness similations in port basin are carried out by the study team in Japan. The results of the study are summaried as below.

a) The proposed alternative-3 plan is effective to keep the calmness in the port basin. (refer to Figure below)
b) The plan with the lee breakwater is also effective, but it has some problems such as ship's maneuvaring and limited area for the future development.

CASE-6 MASTER-PLAN (NE)
WAVE HEIGHT (M)



2.1.4 Topographic Conditions

(1) Purpose of Study

The port layout will be drawn to meet its requirements and following to the available land space. The physical port layout heavily depends on the shape of port limits. In this project, of course the existing PSO territory should be taken into account, then then the boundary between the PSO territory and the surrounding APN area should be taken into consideration. In case that the port expansion is required into its surrounding area which is used by other purpose, demolishing or removal the existing facility is inevitable.

For the construction arrangement, the existing condition of the site should also be surveyed. Ground condition of new port area will affect the design of basic facility and its cost estimates.

In order to make sure these, the supplemental topographic surveys were carried out.

The Study Team initially intended to carry out a topographic survey in 50 ha of the all area including the Navy area. However, this scope was modified based on the available data which PSO currently is undertaking under a survey contract with a service company, Abnegar.

New scope of survey covers items which likely require to be made.

(2) Survey Datum in Anzali Port

1) Datum and Horizontal Control

For the elevation management, following datum is used.

This datum is defined as an elevation −26.36 m below the mean see level in the Persian Gulf PGCD. In some survey data, another datum is used.

Datum 96.0=±0.0 m C.D=−26.36 PGCD

Survey Datum of this study is the same one utilized currently by PSO which is C.D., Chart Datum and horizontal control is based on the C.D.. C.D. system is an authorized method and utilized by the Survey Department, Both on-land topographic survey and sounding of water depth are normally based on C.D..

Another horizontal control system currently used by PSO. This system is only applicable to the port area.

Figure 2.1.4.1 Shows a relation between both datum in the Persian Gulf and the Caspian Sea.

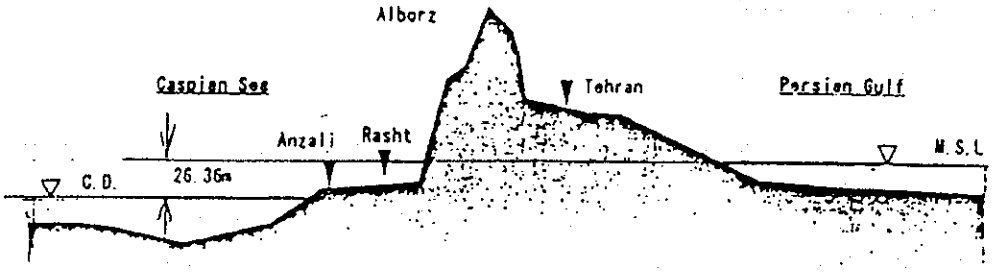


Figure 2.1.4.1 Chart Datum of Anzali Port.

2) Benchmark Used

Anzali port established a well organized benchmark network in its territory. The Study Team used one of these particulars.

(3) Available Data

1) Existing Topographic Maps

Existing topographic map were collected by the Study Team. They are rather old except few maps.
Major maps are shown below:

* General Layout Plan by ADIBI-Harris 1974
* General Layout Plan by Moshara 1983

In order to make an up-dated map for new planning, the study team carried out a very detailed topographic survey in Anzali Port by Abnegar in 1993. The survey results are shown in Figure 2.1.4.1.
The details of the survey are contained in Field Report.
Currently PSO Anzali is conducting a demolishing and cleaning operation in respect of scattered old buildings. Thus all the previous maps should be corrected accordingly.

2) Aerial Photograph

An aerial photograph is available in Anzali Port. The photograph covers coastal area, Anzali city and the port area taken in 1982. This shows various information including.

a. Developed area
b. Five major channels
c. Bridges
d. Coastline

One of the important things to be noted is the shape of coastal line. It is suggested that the prevailing direction of littoral drift is to the west. Refer to subsection 2.1.3 (2).

Figure 2.1.4.2 shows this aerial photograph.

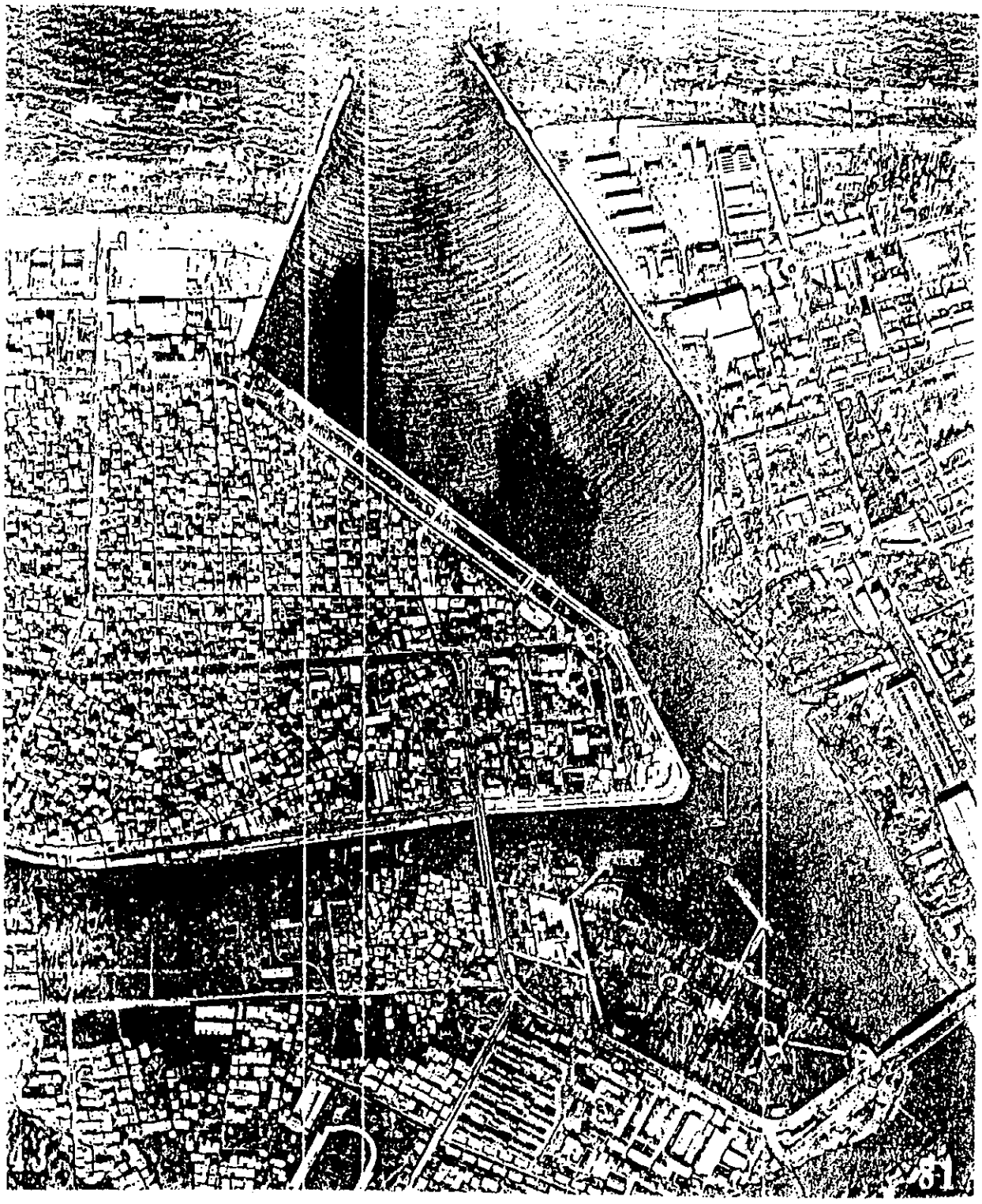


Figure 2.1.4.2 Aerial Photograph, Anzali Port in 1982

(4) Survey by Study Team in 1993

In order to obtain necessary topographic information, the Study Team conducted various survey as follows:

1) Topographic survey (T1)

a. Location: Port area of Bandar Anzali as shown in figure 6.4.3.
b. Survey area: Approximately 8.5 hectares.
c. Survey method: by theodolite and level for control and level survey and a plane table survey.
d. Level survey: 10 m intervals in general and 5 m intervals in steeper area more than 1:40.
e. Establishment of Bench Mark: Two (2) benchmarks.
f. Mapping scale: 1:1000
g. Contour interval: 1 m

2) Topographic Mapping

a. Location: As shown in Figure 6.4.3.
b. Survey area: 600 m × 30 m = 18,000 sq.m 600 m along the east breakwater in approx. 30 m width.
c. Mapping method: Preparation of maps utilizing the latest sectional drawing.
d. Level survey: None in site.
e. Mapping scale: 1:500
f. Counter interval: 1 m or results in the latest sectional drawings.

3) Topographic Mapping (T3)

a. Location: As shown in Figure 6.4.3.
b. Survey area: Approximately 33.5 hectares, same area with the latest survey map by Abnegar.
c. Mapping method: Preparation of maps utilizing the latest survey map.
d. Level survey: None in site
e. Mapping scale: 1:400, by means of scale reduction of existing map major writings should be translated into English.
f. Counter interval: 1 m or results in the latest map.

4) Existing Shoreline survey (T4)

a. Location: As shown in Figure 6.4.3.
b. Survey area: 800 m from the Navy area and 800 m from the west breakwater outer face.
c. Survey method: Tracing of counter line of the mean sea level in 50 m interval except Navy area.

5) Section survey and Sounding (T5)

a. Location: As shown in Figure 6.4.3.
b. Survey area: 15 sections of existing quaywall in the east face and seawall in the west face.
c. Survey method: Sectional survey in 60 m width each, 30 m land-ward and 30 m seaward.
d. Level survey: Level survey as required for section (landward) Sounding at every five (5) m (seaward)
e. Section scale: 1:100

6) Sounding (T6)

a. Location: As shown in figure 6.4.3.
b. Survey area: 4 lines, out of breakwater 2 lines on the shoreline out of east breakwater.
   2 lines on the shoreline out of west breakwater.
   3 lines up-stream of the channels.
c. Survey method: Sounding up to the counter line of minimum six below the means sea level.
d. Level survey: Every ten (10) m.
e. Mapping scale: 1:1000

Detailed survey results and maps are attached to the Field Report FR NO. 1 "Topographic Survey at Anzali Port" . The Study Team was advised by PSO that Abnegar would be selected for the works because that survey company was employed by PSO for topographic survey in Anzali Port. Abnegar was selected by the Study Team. Survey results are summarized as shown in Figure 2.1.4.3.

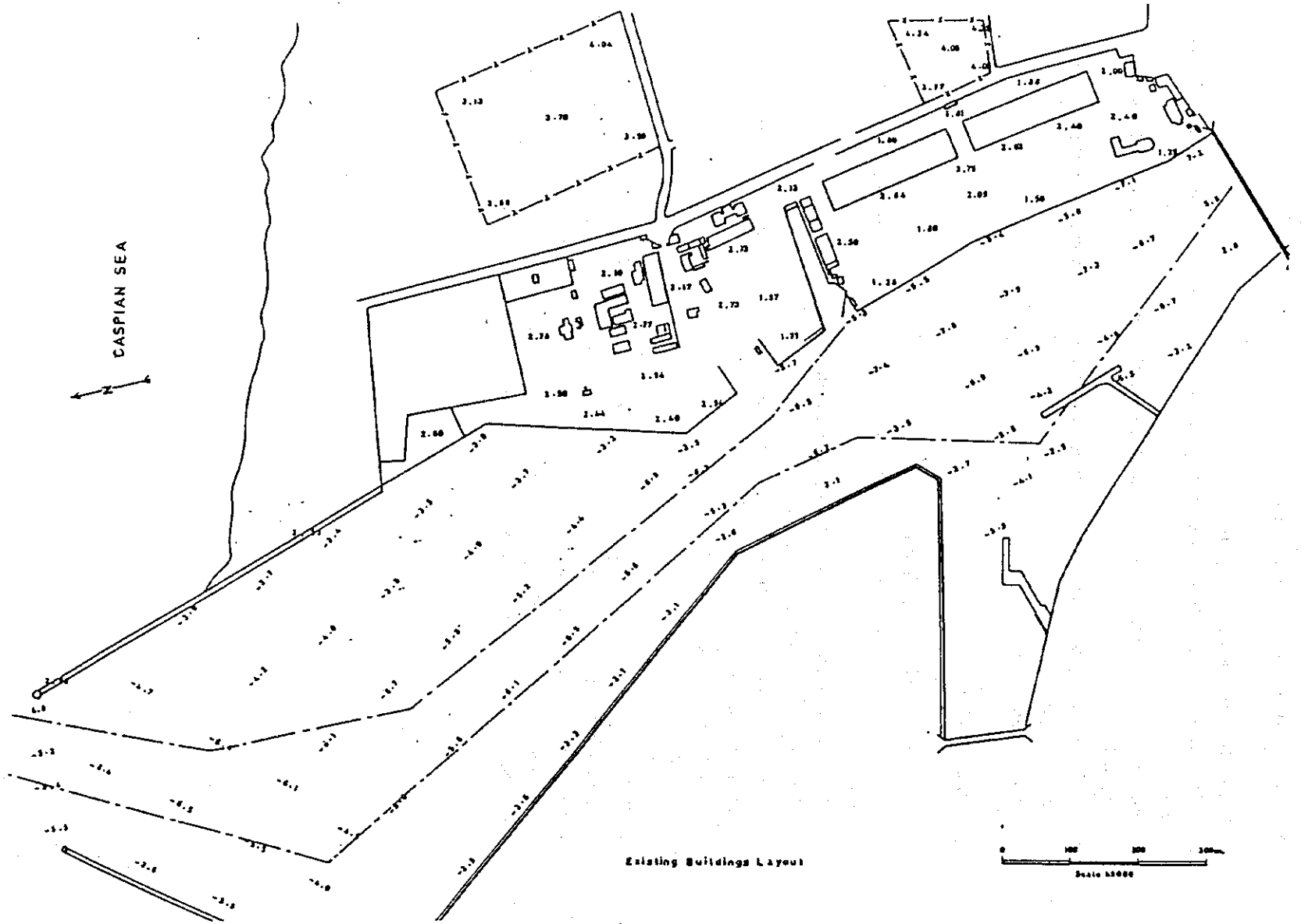


Figure 2.1.4.3 Topographic Survey Map in Anzali Port

2.1.5 Bathymetric Condition

(1) Purpose of Study

Bathymetric data are required for the evaluation of the existing water depth. They can also provide information in respect of siltation and deposit.
Study area covers the on-shore area, approach channel, port basin and passage to the lagoon.

PSO currently is conducting a regular bathymetric survey every year. In the port area, there are established survey marks indicating on the water front facilities.

In order to supplement PSO routine section survey, several additional survey were conducted by the Study Team.

a. Sounding survey in on-shore area (T6)
b. Sounding survey in channels to lagoon (T6)
c. Sounding survey in front of the main quaywalls (T5)

(2) Datum of Survey

The same Datum to topographic survey was applied.

(3) Previous Bathymetric Data

Data in 1992

As discussed before, PSO Anzali implements a routine sounding every year. This work aims primarily at planning of maintenance dredging both channel and basin. Sounding map carried out by PSO is shown in Figure 2.1.4.3. Detailed sounding survey results are contained in Field Report.

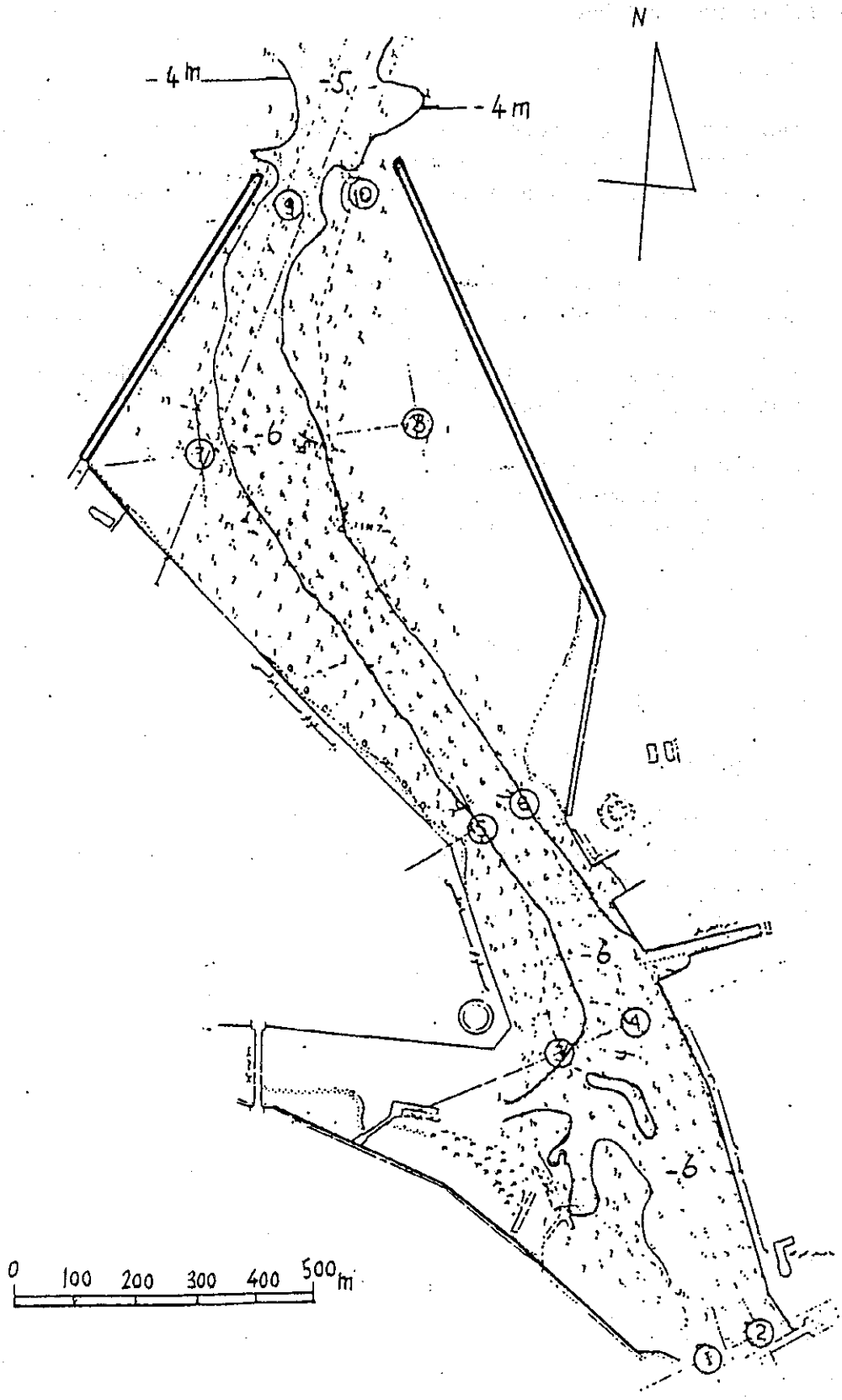


Figure 2.1.4.4 Sounding Map at Anzali Port by PSO

2.1.6 Geotechnical Condition

Geotechnical condition of the site is one of the most important items with respect to design of port facility.

(1) Purpose of Study and its Scope

Geotechnical condition of the proposed sites was studied through the existing boring data collected and performing new five boring. Purpose of this study is to confirm the basic geotechnical conditions including:

a. Composition of layers
b. Characteristics of each layer
c. Existing of rock foundation built before
d. Bearing Stratum and its characteristics

Since there are various boring data previously conducted, analysis of new boring was carried out together with the previous data. Most significant soil data carried out in the past are as follows:

a. Soil boring for MP-74 (1974)
b. Soil boring for the new alignment of breakwaters
c. Soil boring by Iran-Khak (1993-1994)

In order to strengthening these data, the Study Team conducted additional boring of five holes, approximately 150 meters long.

This survey was sub-contracted to Mandro Company of Iran. Laboratory tests conducted its facility in Tehran city.

(2) Summary of Boring Results by the Study Team

The first boring (MB.1) commenced on November 24, 1993 and the last one (MB.5) ended on December 12, 1993. This subsection deals with the preliminary findings shown in the interim report submitted by Mandro Company on December 18, 1993.

1) Purpose of Boring

The investigations at this site were done in order to determine and to assess the following:

- General geology of the area
- Type and thickness of soil layers
- Physical and mechanical properties of soil
- Type of foundation
- Allowable soil pressure and foundation
- Lateral soil pressure coefficient

Five exploratory boreholes as shown in Appendix A3-2 up to the depth of 30 meters drilled.

2) Method of Drilling

In order to determine the type and thickness of soil layers, the five boreholes were drilled with rotary drilling equipment B-61 Mobile Drill. Since the soil layers were consisted of sand, casing were installed in order to prevent the caving of the drilled boreholes.

The relative density or consistency of soil layers were obtained by the use of Standard Penetration Test. The SPT were performed at each 1 meter interval. In this test the number of blows of a free falling hammer of 64.0 kg weight from a distance of 76.0 cm. to cause 30.0 cm. penetration of a circular split spoon sampler of 5.0 cm. outside diameter is recorded.

The results of SPT are presented in the log of boreholes. In order to compare the relative density or stiffness of the soil layers, the diagrams showing the variations in the number of blows with depth were drown.

3) Soil Layer

There are four distinct types of soil. The characteristics of each layer is given below:

1-Fill Materials

This layer is consisted of 10 cm of asphalt on the top of 30 cm of sub-base materials consisting of sand and gravel. Under the pavement there are fill materials composed of sand with angular fragment of rocks with a 3.0 to 3.20 meters thickness. The average SPT values are between 6 to 16.

2-Upper Fine Sand

Under the fill material a layer of grey fine sand with a thickness of 6.0 to 6.50 meters are observed. Small amount of shell fragments is detected in this layer. A very distinct behavior which is observed in this layer is the very low SPT values of 4 to 12 at the depth between 5 to 9 meters at B.H 2, 3, 4 and 5.

There is a possibility that a loose layer of sand is deposited at this depth during the sedimentation. However, it is also possible that the fill materials consisting of clean fine sand is deposited. As fragments of artificial materials were not observed up to depth of 5 to 9 meters, it has not been possible to distinguish fill material from the naturally deposited fine sand. In fact it is also reasonable to argue that the naturally deposited sand starts at the very low SPT values at difference boreholes.

3-Thin layer of Silty Clay (or Clayey Silt)

There is a thin layer of silty clay with a thickness of 30 cm to 50 cm at the depth of 9.0 to 10 m. The SPT value of the layer is between 10 to 15.

4-Lower Fine Sand

From the depth of 10 to 16 meter a relatively dense layer of fine sand is observed. The SPT valued increases with depth up to the maximum values of 30 at B.H 3 and 50 at B.H 4. It is believed that the increase is the SPT values and relative density are due to the overburden pressure during the geological time of frequent earthquakes.

5-Lower Clay Silt

Underneath the layer of fine sand a thick layer of fine materials consisting clay silt or silty clay with a thickness of 5.0 to 6.0 meters at all boreholes are observed. The importance of this layer is due to the low SPT values of approximately 0 to 10.

6-Dense Sand

From the depth of approximately 21.0 meters to 30 meters a very dense grey fine sand is observed. The SPT values are more than 50.

4) Preliminary Evaluation

1: The problem of liquefaction for the upper layer of fine sand is of interest. It is possible to have liquefaction. (refer to APPENDICES III-4)

2: The thin layer of silty clay at the depth of 8 to 10 meters might prevent the pore pressure dissipation of lower sand layer during the earthquake. It also effect the distribution of lateral pressure on sheet piles.

3: The thick layer of silty clay at the depth of 15 to 20 meters might cause the settlement of heavy foundations placed at depth or can cause substantial reduction in the resisting friction of lower sand layer for the design of pile foundations.

4: Chemical test on soil and water samples show that special precautions against sulphate attack are required, and cement type V may be used. The corrosion of concrete reinforced bars as the result of chloride effect is not expected.

5: Gilan area with particular area of Bandar Anzali is located in the zone of high seismic relative hazard. It is essential to design according to standard 2800 publication No. 32 Ministry of Housing and Urban Development.

Note: Sub-Soil Boring Result at Anzali Port by JICA shown in APPENDIX III-2.
Sub-Soil Boring Result at Anzali Port by Iran Khak shown in APPENDIX III-3.

2.1.7 Sedimentation (Littoral Drift and Siltation)

(1) General Description

There is few erosion in the port basin, although the discharge current is 0.5 m/sec. Water plants can be seem in the port basin, this may imply a few seabed changes.

While the siltation amounting to 250,000 m^3 per year is observed. This volume is supported by study in MP-74 and the PSO records of maintenance dredging. About two third of this is deposited in front of the main quaywalls. It is assumed that remaining one third settles at the anchorage bewared the western breakwater and the port entrance.

Figure 2.1.7.1 shows three zones discussed above.

Zone A In front of the main quaywalls at the second port basin
Zone B Widest area at the first port basin
Zone C Port entrance

Dredging records indicate few situation at zone B. It is assumed that fine deposits may be removed to the upstream then return to the open sea through the channel.

Siltation at Zone C will be mixed deposits between the discharged ones and littoral drift.

(2) Littoral Drift

Littoral drift at the port entrance might be affected dy various phenomena including the current, waves discharges from the passage, seabed materials, water level and shape of breakwater. It is assumed that the basic direction of coastal currents are west to east. Wave induced currents might take mixed direction since it depend on wave direction.

Thus, the direction of coastal currents may change places one after another. An extensive study on the siltation problems has been conducted by MP-74. Following are extracts from the report.

a) With the use of available dredging records and 15 successive sounding charts of the port, taken over a 3-years period, the average rate of schooling for 24 areas of the harbor was computed.

b) Shoaling was found to vary from about 1.0 m/year in the areas just outside and inside the port entrance to 0.3 m/year in the inner basin near the berths. The total sedimentation was estimated to be 390,000 m^3 /year by this method which compares well with reported dredging of 300,000 to 400,000 m^3 /year.

c) Therefore the siltation appears to be more severe in the approach channel than in the inner basin, where, however, it is still considerable.

Since from one half to one third of the total amount of siltation comes from the sea, this would reduce the total siltation to 215,000 - 270,000 m^3 per year.

(3) Sediment Discharge from the Lagoon

One of the major sediment sources is the lagoon. MP-74 provides a short description as follows:

River sediment transport is of direct influence for the Caspian Sea ports of Anzali, Nowshahr and the others. Several rivers bring sediment into the lagoon which subsequently is emptied into the Caspian by way of Anzali Port. In periods of decreasing sea level the lagoon no longer acts as a settling basin and excess sediments from the bed of the lagoon are sluiced into Anzali Port causing sedimentation along the quays and in the dredged channels.

These sedimentation are caused both by river sediments and littoral drift of sands along the coast.

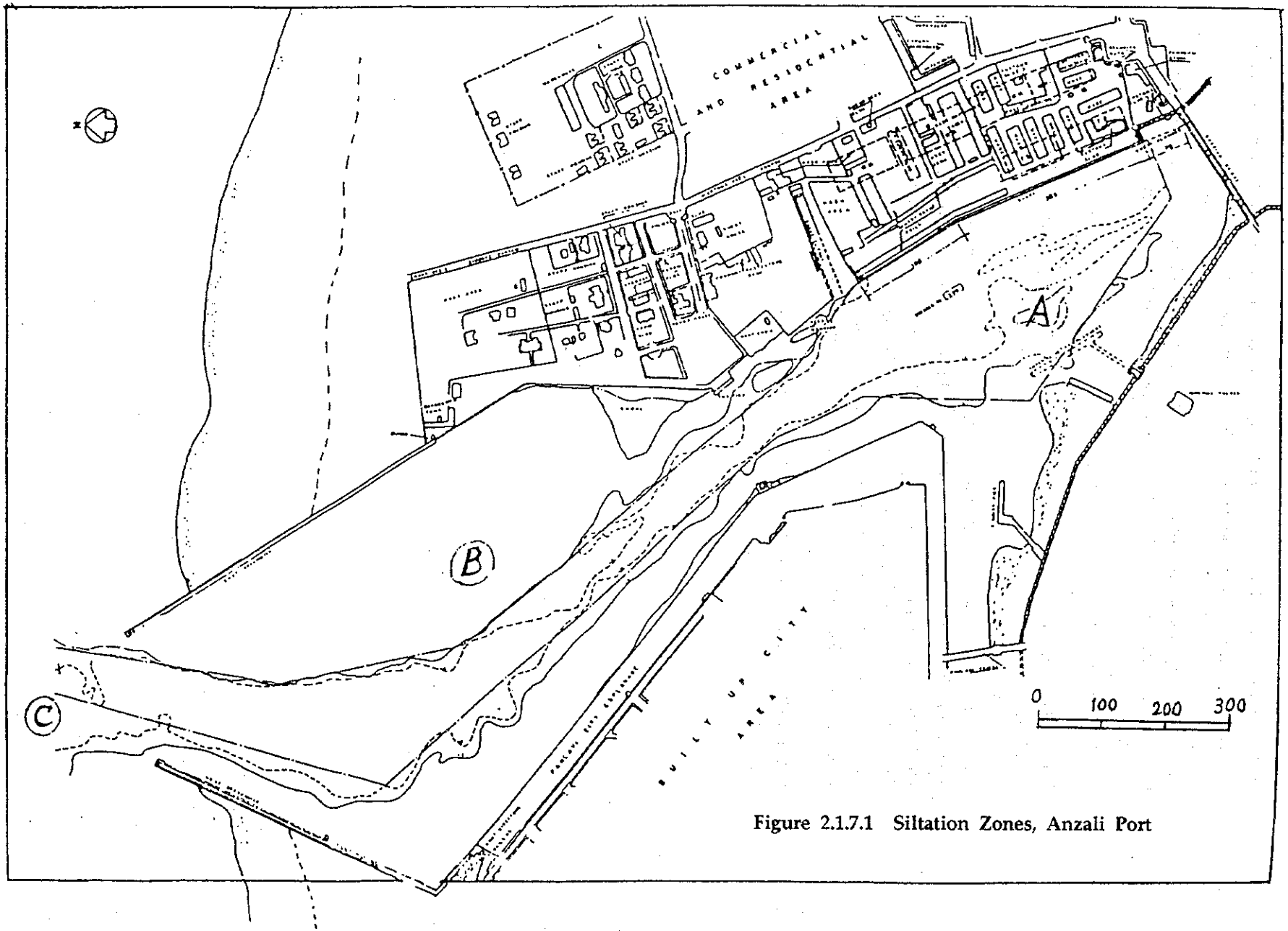


Figure 2.1.7.1 Siltation Zones, Anzali Port

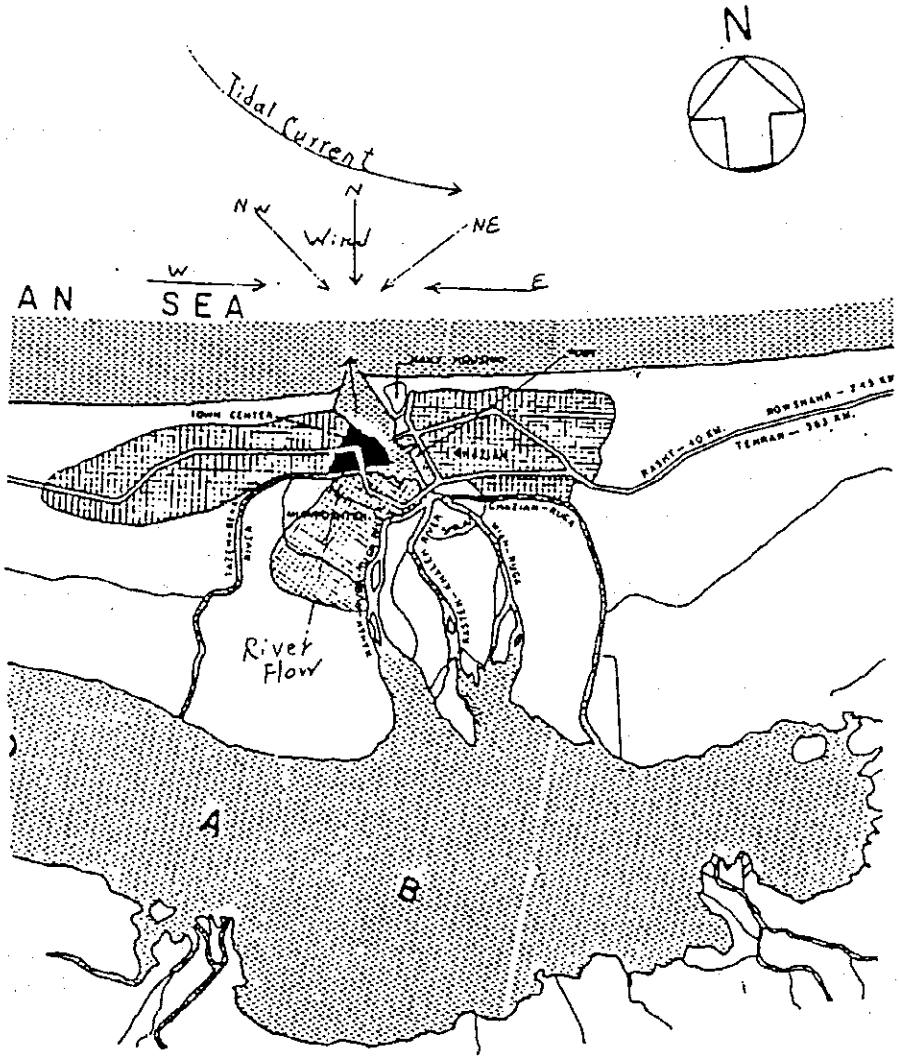


Figure 2.1.7.2 Littoral Drift Map, Anzali Port

(4) Estimate of Sedimentation Volume

1) Preface

The port of Anzali is located along the southern coastal area of the Caspian Sea and is connected with the Lagoon by 5 rivers.
Therefore, the sedimentation in the port is caused by these 2 sources i.e. the river flow from the lagoon and the littoral drift at the seashore.

2) Past records and technical analysis

According to the ADIBI-Harris report (1974), it is summarized as below.

Total estimated volume of sedimentation = 390,000 m^3/ year
Estimated volume from the lagoon = 230,000 m^3/year (60%)
Estimated volume from the sea = 160,000 m^3/year (40%)

Assuming to construct the breakwaters at both sides, the sedimented volume is also estimated as below.

The maintenance dredging volume
= The sedimentation volume
= Total volume from sea side × 10%
= 16,000 m^3/year

3) Past Dredging Records

The maintenance dredging works are carried out constantly for the sedimented materials. The recorded volume of the maintenance dredging by PSO is as below.

1988	393,160 m^3/year
1989	326,803
1990	na
1991	222,400
1992	226,220

The volume is currently decreased about 40% of ADIBI-Harris's figure.
390,000 × 60% = 226,220 m^3 = 230,000 m^3/year

Thus, sedimentation from the lagoon and the sea are assumed using the same ratio of ADIBI-Harris.
230,000 × 60% = 138,000 m^3/year from lagoon
230,000 × 40% = 92,000 m^3/year from sea

4) Proposed layout by study team

a) Expansion of west breakwater : 500 m (Short-Term)

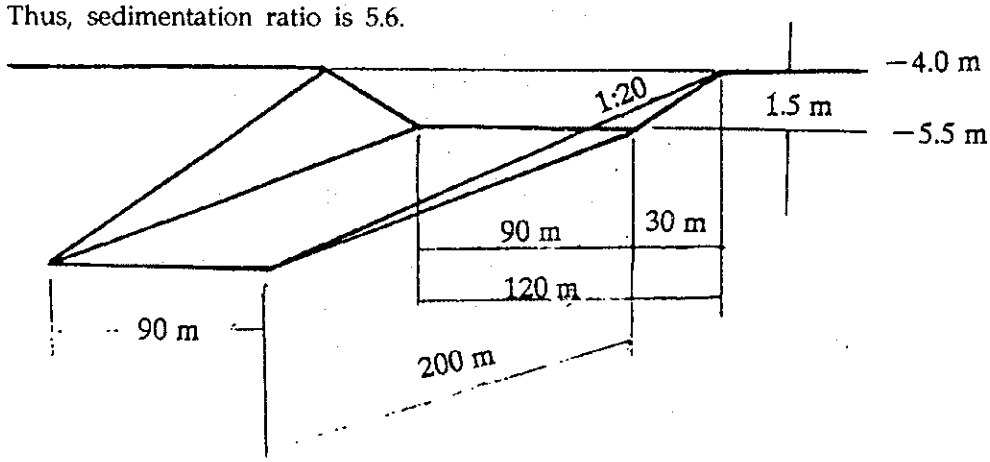
b) Deepening of channel and basin : from -5.5 m to -8.5 m below C.D.

5) The estimated volume of the future stage

a) Trial calculation in the existing situation for checking the sedimentation ratio.

Initial dredged volume:	Vai	=	(1.5 m × 200 m × 1/2 × 90 m)
			+ (1/3 × 30 m × 1.5 m × 200 m)
		=	13,500 + 3,000 m^3
		=	16,500 m^3 (refer to sketch below)
Estimated volume	Vae	=	Vai × I (Index of past data)
to be dredged:		=	16,500 × 5.6 = 92,000 m^3
		=	Actual dredged volume of item 3)

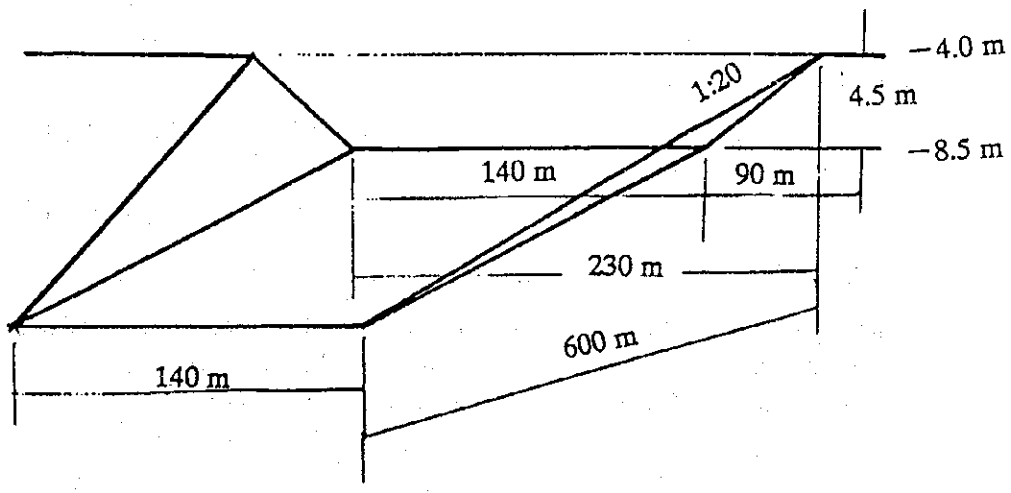
Thus, sedimentation ratio is 5.6.



b) Deepening of Channel and Basin Without Breakwater:

Estimated volume (Short-term plan up to 2,000):

Depth: D = -4.0 m - (-8.5 m) = 4.5
Width: Flat bottom = 140 m
Slope = 90 m
Total = 230 m
Length: 800 m



Volume: Vb = (4.5 m × 140 m × 600 m × 1/2 = 189,000 m^3)
+ (1/3 × 90 m × 4.5 m × 600 m = 81,000)
Total = 189,000 + 81,000 = 270,000 m^3
Estimated volume: 270,000 × 5.6 = 1,512,000 m^3
Volume from lagoon = 138,000 m^3
Estimated total volume = 1,650,000 m^3 /year

c) Deepening Channel and Basin With West Breakwater:

Proposed Scheme

Estimated volume = Vce = Vbe × 90/3 %
= 1,512,000 × 30 %
= 453,600 = 454,000 m^3 from sea
Volume from lagoon = 138,000 m^3
Total estimated volume for 2,000 = 454,000 + 138,000
= 592,000 m^3/year

d) Deepening Channel and Basin with the breakwater at both sides:

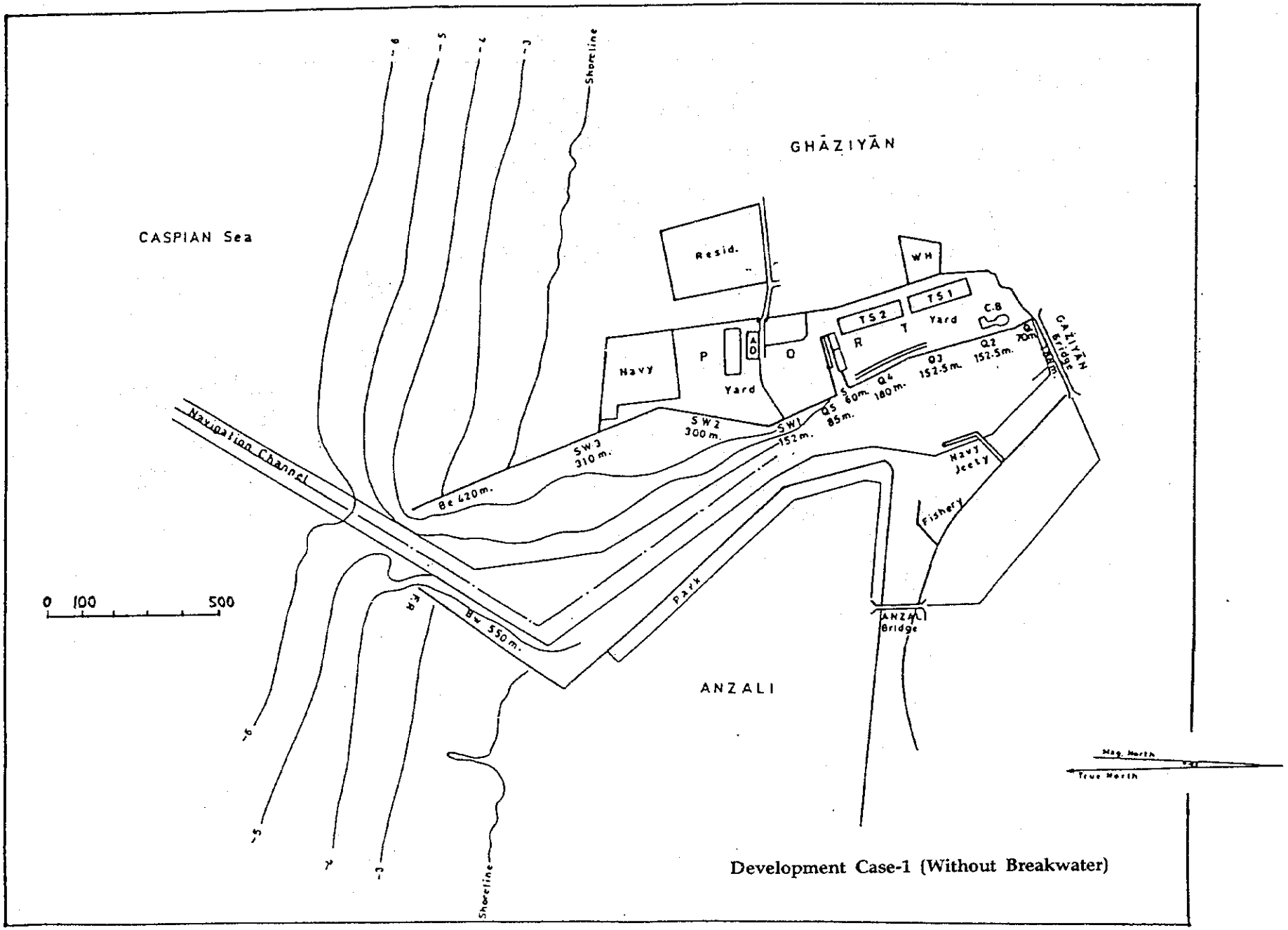
Estimated volume: Vde = 1,512,000 × 10 % = 151,000 m^3
Volume from lagoon = 138,000 m^3
Total estimated volume = 151,000 + 138,000
= 289,000 m^3/year

e) Cost comparison:

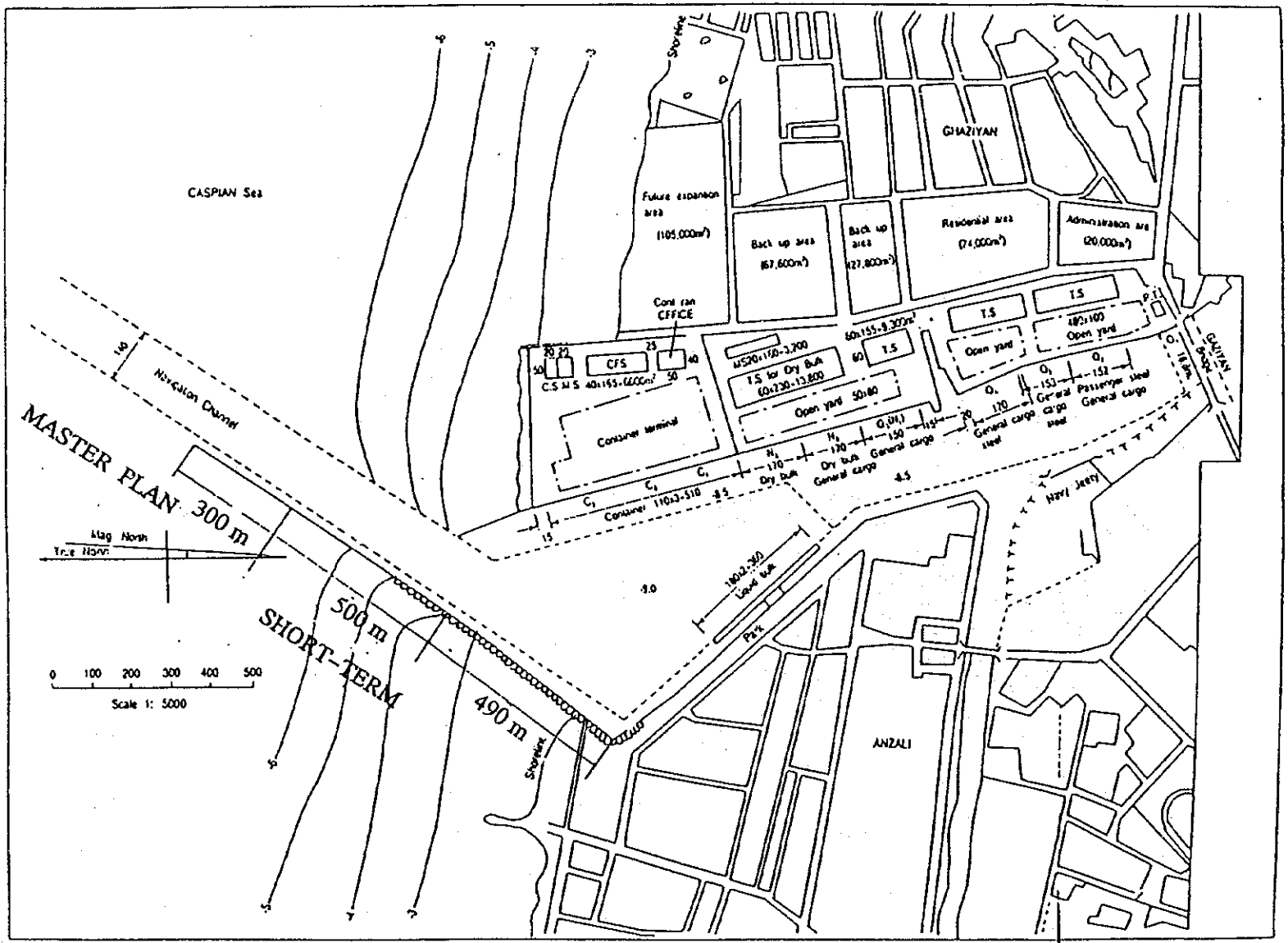
Annual maintenance dredging cost for each scheme is estimated using four (4) US Dollar per one cubic meter dredging. These costs includes both costs for the port basin and channel.

Description	Estimated Sedimentation Volume (cubic m)	Cost US$/year
Existing situation	230,000	920,000
Development case-1 without breakwaters	1,650,000	6,600,000(571%)
Development case-2 with west breakwater	592,000	2,368,000(205%)
Development case-3 with west/east breakwaters	289,000	1,156,000(100%)

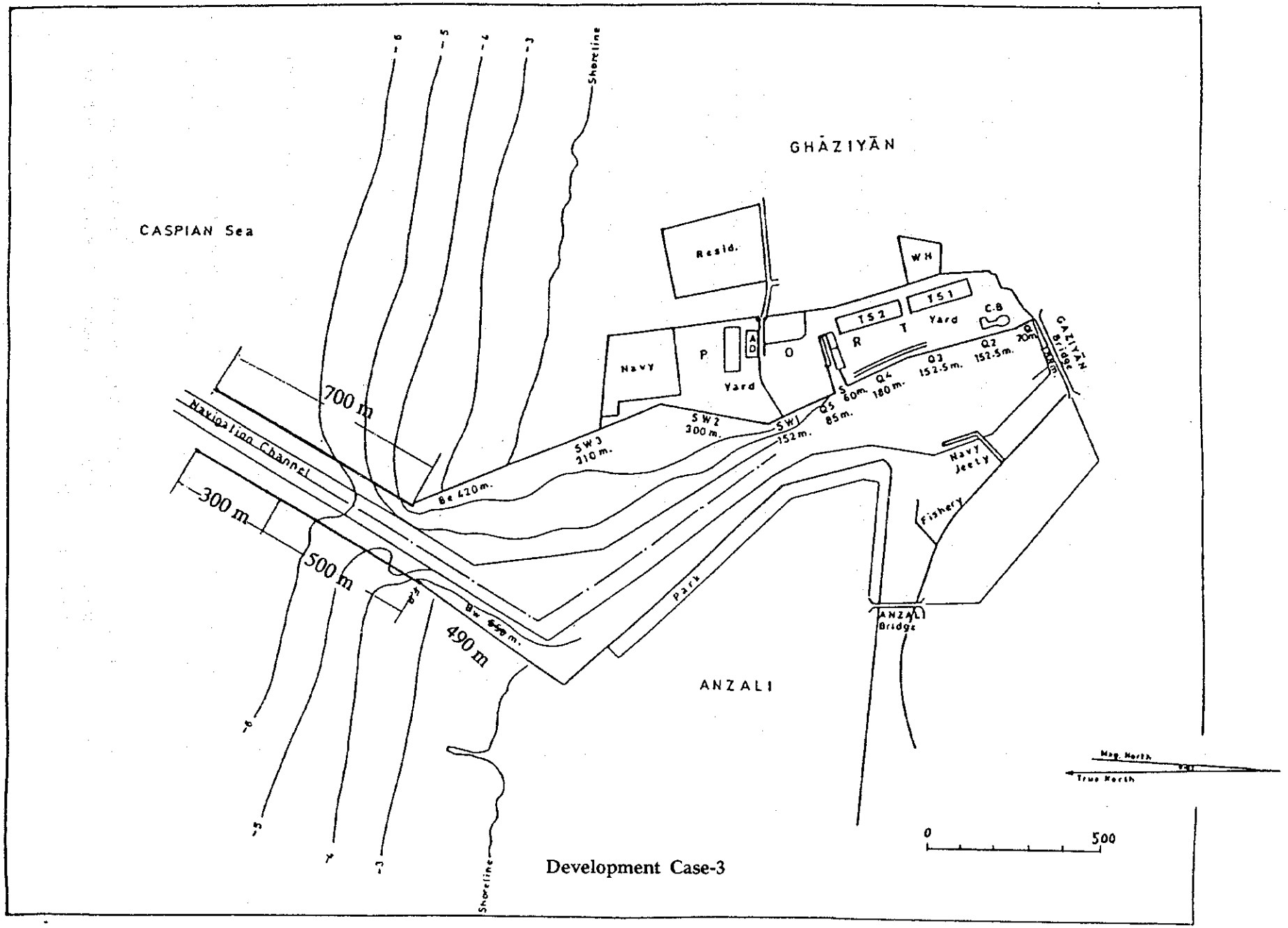
Construction cost of the east breakwater is about 15.0 million US Dollars.
It is recommended to adopt case-2 to minimize the initial cost.
Construction of east breakwater can be made when so required.



Development Case-1 (Without Breakwater)



Development Case-2



Development Case-3

2.1.8 Seismic Condition (Earthquake)

(1) General Information

Earthquake is one of natural disasters to be taken into account. Earthquake may cause various direct damage to the port including:

a. Damage of gravity structures by a slope failure.
b. Damage of structure on the loose sand layer by "quick sand" or liquefaction.
c. Damage by a long wave "Tsunami" when an earthquake happens under the deep sea.

Port structures should be planned and designed taking these into consideration.

Note: So far, there is no information on the damage of earthquake in Anzali Port.

(2) Earthquake and Structures

An earthquake makes the ground shake. Soft layer like a mud layer section generally accelerates its movement by earthquake energy. It is essential for port structure planning to decide the earthquake design magnitude together with its design method.

Earthquake intensity in the design should be one which may happen every 50 years or more, (at a recurrence probability of 50 years or more). The longer year of recurrence, the larger seismic magnitude. Recurrence year should generally be longer than the project life.

It is also important to know the design of the earthquake for the existing port facility.
Unfortunately, no design report is available for the existing structures.

(3) Intensity of Earthquake Forces

Damage by earthquake largely depends on the its intensity, distance from an epicenter and soil condition. Among them, most prevailing factor is a size of earthquake, or intensity.

The Institute of Geophysics, Tehran University, has analyzed 70 years of earthquake data for Iran.

The south Caspian Sea coast is subject to earthquakes of magnitude 6 and 7 Modified Marcel scale, except that to the east between Nowshahr and Farahabad the scale is 7 to 8.

It should be noted that, June 21st 1990, Manjil, Rudbar area in Gilan and Zanjan Provinces were attacked by a large scale earthquake, intensity of which was Magnitude 7.7 in the Richter Scale.

Figure 6.7.1. shows an earthquake zoning map in Iran. As shown in the figure, Anzali Port is located at the High Seismic Zone.

(4) Design Earthquake Intensity

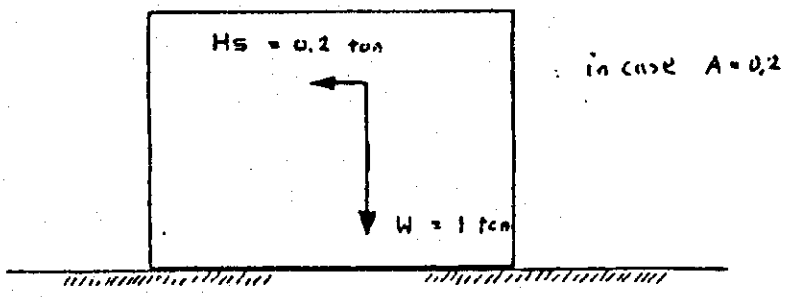
It is recommended to adopt the conventional calculation method which is statical structural calculation. Lateral seismic force can be obtained using the following formula.

$Hs = A \times W$

Where, Hs = Horizontal force acting on the mass. (Not dynamic but statical one)

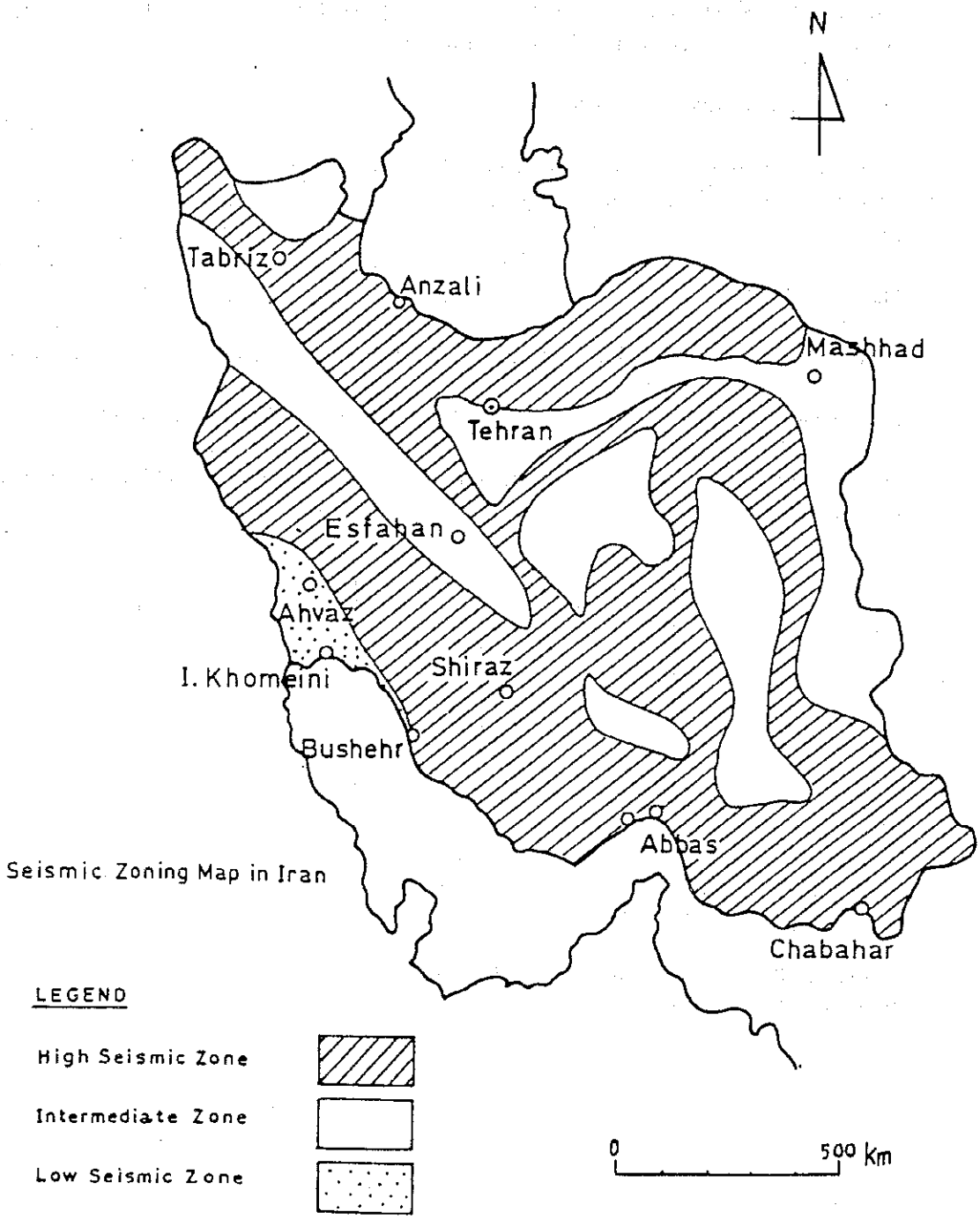
A = Seismic coefficient. This figure depends on the local seismic condition.

W = Dead weight of structure mass to be analyzed for the stability during the earthquake.



Note: Seismic coefficient of 0.2 means that 0.2 ton to seismic force may act on the structure of 1.0 ton dead weight.

Seismic coefficient for Anzali Port should be decided carefully.
(refer to subsection 8.1.9)



Source: BHRC, Iranian Code for Seismic Resistant Design of Buildian, 1988

Figure 2.1.8.1 Seismic Zoning Map in Iran

2.2 Port Function and its Activities

2.2.1 Cargo Handling Activities

(1) General

Total cargo volume handled at Anzali port reached 501 thousand tons in 1993/94. Commodities and share of handling cargo in 1993/94 are shown in following Table 2.2.1.1.

Table 2.2.1.1 Commodities and share of handling cargo

Commodities	Volume (x1,000 tons)	Share (%)
Dry bulk cargo :Barely, Wheat, Corn	0	0.0
Bagged cargo :Fertilizer, Sugar, Rice, Soy bean, Chemical material	41	8.2
Refrigerated cargo :Meat	0	0.0
Metallic products :Steel, Ingot	266	53.1
General cargo	148	29.5
Container	46	9.2
Total	501	100.0

Major handling equipment for loading/unloading are two tire-mounted pneumatic unloaders for dry bulk cargo at berth No.Q4, three portal jib cranes at berth No.Q3 and No.Q4 and mobile cranes. In the open yard, two portal jib cranes are used for cargo handling.

(2) Cargo Handling Operation by Commodity

1) Dry bulk cargo

Tire-mounted pneumatic unloader is used for discharging dry bulk cargo at berth No.Q4. Dry bulk cargo to be discharged by pneumatic unloader is loaded to truck through hopper at the apron and then transported out of the port directly. This direct delivery system sometimes causes a long line of trucks due to long loading time. At this time, some of the cargo spill onto the apron or into the sea causing pollution.

2) Bagged cargo and general cargo

Bagged cargo is discharged by jib cranes, ship gears, mobile cranes or a combination of them with sling system instead of pallet system. Some of the cargo is conveyed to the transit shed located behind the open yard by tractor with flat bed chassis. Remaining cargo is transported out of the port by truck directly.

3) Metallic products

Metallic products are discharged by same method as bagged cargo with sling system. Metallic products are generally stored in the open yard. Fork lift truck and mobile crane are used for handling in the open yard.

4) Container cargo

There are no container cranes at berths, therefore generally container cargo is unloaded from ship to flat-bed chassis or truck by mobile cranes, ship gears or a combination of both. In the storage area behind berth no. Q5, fork lift truck (top lifter) and flat bed chassis with tractors are used for container handling.

(3) Direct delivery

Ratios of direct delivery are shown in Table 2.2.1.2.

Table 2.2.1.2 Transportation Mode

(x1,000 ton)

Year	Direct Delivery	Through Storage Facilities	Total
1992/3	767(71.0 %)	314(29.0 %)	1,081
1993/4	607(59.3 %)	417(40.7 %)	1,024

Source: PSO/Anzali port

2.2.2 Port Related Facilities of Port and its Conditions

(1) Cargo Handling Equipment

a. Existing Cargo Handling Equipment

The existing cargo handling equipment at the port are shown in Table 2.2.2.1.
The working days of them seems to be full and the old equipment (over 20 years old) are working under good maintenance.
Furthermore the portal jib cranes which are located at berth No 3 and 4 are used effectively.

b. Problems to be reviewed

The handling system and layout behind of the berth No 3 and 4 shall be reviewed on the following points

* Insufficient space
* Quality and quantity of the cargo to be handled
* Discharge and transportation system of the cargo to be unloaded.

c. Problems at present

There are some very old equipment and their age is prejudiced.
Procurement and disposal shall be carried out on schedule.
In order to keep each piece of equipment safety and to make the most of its original function display, maintenance, especially, preventive maintenance is indispensable. Then effective maintenance system shall be established.

Table 2.2.2.1 List of Cargo Handling Equipment (1/2)

Name	Type	Loc. (No.of Berth)	Capacity	Procured		No. of equ.			Remarks
				year	age	T.	G.	B.	
	Portal Jib Cranes (Rail mounted)	A4	16 t			2	2		Quay Cranes
	Do	A4	10 t			1	1		Quay Crane
	Do	Behind A4	10 t			2			Yard Cranes
	Pneumatic unloader (tyre mounted)	Mainly used A4	150 t/h			2			2
	Mobile Cranes		62 t	1992		1	1		
			60 t	1976		1		1	1
			60 t	1979		1		1	
			40 t	1981		2	2		2
			40 t	1991		1	1		
			40 t	1992		1	1		2
			25 t	1992		3	3		
			20 t	1992		1	1		2
			16 t	1992		2	2		
			15 t	1981		1	1		
			15 t	1985		1	1		
			10 t	1972		3	1	2	
				1973		2	1	1	4
				1979		3	1	2	
			6 t	1992		1	1		3
						24			
	Forks-lift trucks (Top lifter)		42 t	1992		2	2		
	Forks-lift trucks		13.5 t	1985		1	1		

Table 2.2.2.1 List of Cargo Handling Equipment (2/2)

:(2/2)

Name	Type	Loc. (No. of Berth)	Capacity	Procured		No. of equ.			Remarks
				year	age	T.	G.	B.	
	Fork-lift trucks		10 t	1984		2	2		
			10 t	1979		1		1	
				1985		2	1	1	
				1990		2	2		
			7 t	1984		4		4	
			7 t	1991		1	1		
			7 t	1992		1	1		
			5 t	1991		2	2		
			4.5 t	1992		2	2		
	Tractors650			1974		3	3		
				1975		1	1		
				1977		7	7		
				1979		8	8		
				1980		1	1		
				1981		2	2		
	285			1993		2	2		
				1993		4	4		

Note:
T: Means Total
G: Means Good
B: Means Bad

(2) Access Road and Railways

1) Road networks around Anzali port

The mountains of the Alborz range occupy the northern part of Iran. These mountains form a high and narrow barrier and separate the Caspian Sea from the interior desert region. Access roads to Bandar Anzali through these mountains are not in good condition.

Road networks of major cities, Tehran, Mashhad, Esfahan, Tabriz are advanced (Freeways and expressways are arranged around these cities). Freeways in the Tehran-Tabriz section are the most advanced while the Tehran-Qazvin section (148km) has already been constructed, and the Qazvin-Zanjan section (170km) is under construction. This route is a part of Asian Highway Route 1.
Tabriz-Tehran-Mashhad route in the northern part of Iran is the most advanced among road networks in the east and west directions.

Table 2.2.2.2 Distance between Main Cities and Anzali Port by Road

Route	Distance	Remark
Anzali------Tehran	365 km	
Anzali---Rasht	40 km	Two-lane Main road
Rasht ---Qazvin	177 km	Two-lane Main road
Qazvin---Tehran	148 km	Six-lane Freeway
Anzali-----Esfahan	804 km	
Anzali---Qazvin	217 km	Two-lane Main road
Qazvin---Tehran	148 km	Six-lane Freeway
Tehran---Qom	160 km	Six-lane Freeway
Qom------Meymeh	159 km	Two-lane Main road
Meymeh---Esfahan	120 km	Four-lane Expressway
Anzali---Tabriz	450 km	Two-lane Main road
Anzali---Zanjan	388 km	Two-lane Main road
Anzali---Arak	658 km	Two-lane Main road
Anzali---Hamadan	424 km	Two-lane Main road
Anzali---Khomeini	1,389 km	Two-lane Main road
Anzali---Abbas	1,699 km	Two-lane Main road

International road networks

Iran is connected to Europe and Central Asia by road through Turkey, Azarbaijan,

Turkmenistan, Afghanistan, and Pakistan.
Present main transport routes are Turkey through Bazargan and Azarbaijan through Astara.

2) Railway network around Anzali port

There is no railway station near Anzali port; the nearest railway station is Qazvin, which is a section of the Tehran-Tabriz line. The only railway station facing The Caspian sea is Bandar Torkaman. Qazvin-Anzali port-Astara route is currently under study.

Table 2.2.2.3 Railway Network around Anzali Port

No	main section	distance	operation year
1	B.Torkaman-Tehran	461 km	1937
2	Gorgan-B.Torkamen	35 km	1960
3	Tehran-Tabriz	736 km	1958
4	Tabriz-Jolfa	149 km	1916

International railway networks

Iran is linked to three countries by rail. The most active route at present is the one to Azerbaijan through Julfa. Turkey is the geographical junction that connects Asia and Europe,and constitutes an important portion of the Trans Euro-Asian railway route. At the Turkish border near Razi, the railway stops at Lake Van.

The borders from where the cargoes are transported by railways are Azerbaijan (Julfa---Tabriz---Tehran) and Turkey (Razi---Tabriz---Tehran)in the present network.

(3) Industrial and Commercial Entities

There are four big industrial and commercial areas near Anzali port. Rasht area, Qazvin area, Tehran area and Tabriz area.

Note

Freeway : *Six-lanes road with fence on sides and without traffic signal*
Expressway : *Four-lanes road*
Main road : *The total width is 11.0m-13.3m and includes 1.85m-2.0m on each side(shoulder)*

Major industries are shown in the following Table.

Table 2.2.2.4 Major Industries near Anzali Port

Rasht	Qazvin	Tehran	Tabriz
Distance	40km	217km	365km	450km
Power Station	Thermal 1 Water 1	Thermal 1 Water 2	Thermal 2	Thermal 1
Oil Refinery			Tehran 1	Tabriz 1
Petrochemical			Karaj 1	Tabriz 1
Metal Industry	Vehicle Machinery	Vehicle Machinery	Vehicle Machinery	Vehicle Machinery
Light Industry	Electrical Appliances			Carpet Textiles

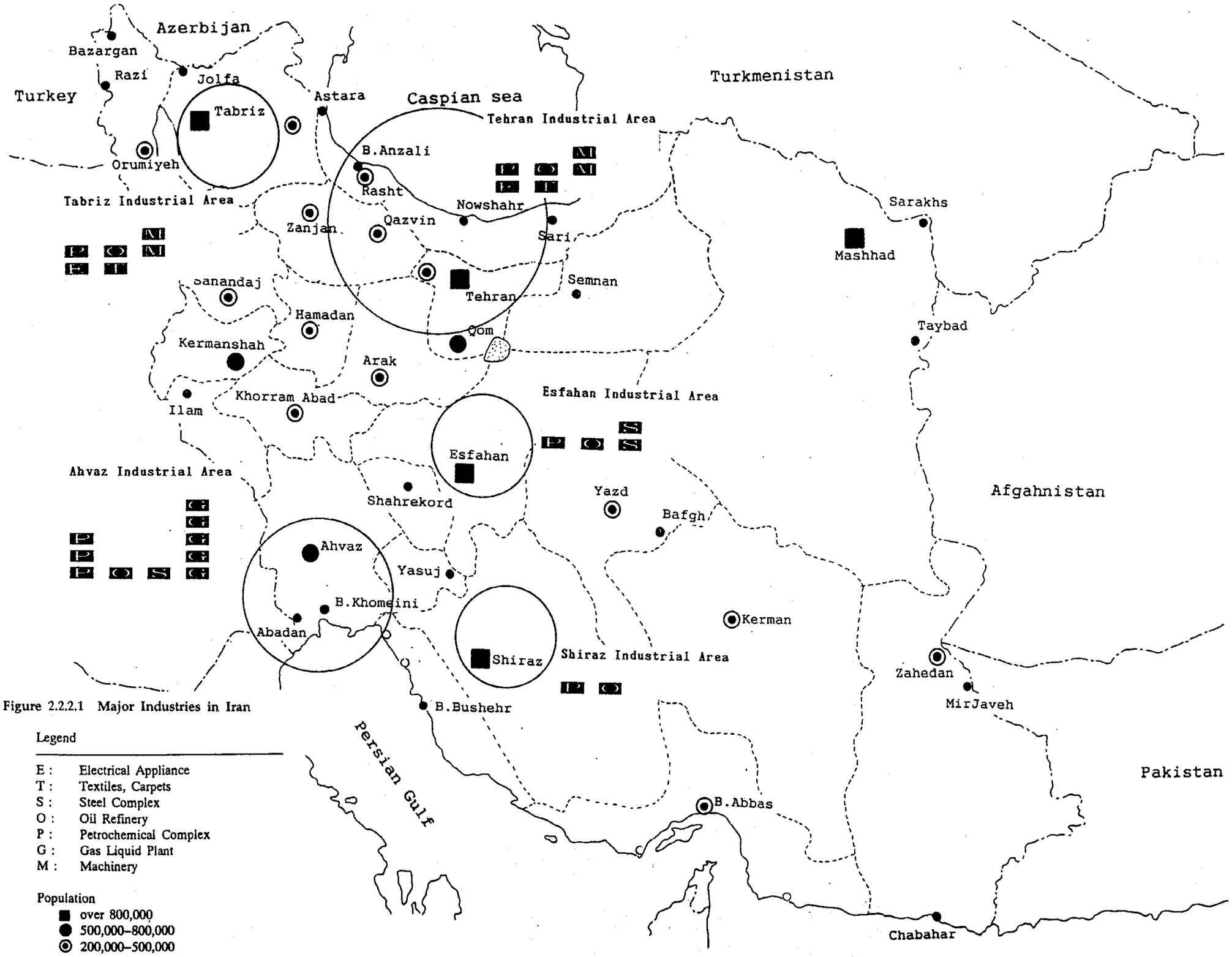


Figure 2.2.2.1 Major Industries in Iran

Legend

E :	Electrical Appliance
T :	Textiles, Carpets
S :	Steel Complex
O :	Oil Refinery
P :	Petrochemical Complex
G :	Gas Liquid Plant
M :	Machinery

Population

- over 800,000
- 500,000–800,000
- 200,000–500,000
- under 200,000

2.3 Port Management and Operation

2.3.1 Port Management

(1) Port Authority

Under PSO head office, seven port authorities, shown below, have been established. These authorities manage and operate commercial ports and administrate the coastal and water areas.

1) Abbas Port Authority (ABPA)
2) Imam Khomeini Port Authority (IKPA)
3) Bushehr Port Authority (BPA)
4) Chabahar Port Authority (CPA)
5) Anzali Port Authority (ANPA)
6) Now Shahr Port Authority (NSPA)
7) Urumia Port Authority (UPA)

These authorities normally administrate plural ports and water area of oil ports and small local ports. For example, Abbas port authority administrates two major ports (Shahid Rajaee Port, Shahid Bahonar Port), two minor ports (Lengeh, Jask), water area of several minor local ports and two oil ports. At the major ports, the port authorities conduct cargo handling operation. Table 2.3.1.1 shows the name of the ports controlled by each port authority.
Figure 2.3.1.1 shows the organization chart of Imam Khomeini port authority (IKPA, and so forth).

(2) Imam Khomeini Port Authority (IKPA)

As shown in Figure 2.3.1.1, Port Director holds the highest position. Under the Port Director, some offices are established such as Public Relations Office, Program and Planning Center, Port Guard Office, Security and Legal Advisor.
In addition, four main departments, namely Finance and Administration Department, Technical Department, Civil Engineering Department and Operation Department, are established and they are headed by the four Deputy Port Directors.

1) The Finance and Administration Department has four divisions related to general administration matters and financial and fiscal matters. The Service Division is in charge of providing miscellaneous services to the internal personnel such as cleaning service of the office buildings and commuter bus service. The Financial Division is in charge of financial matters including invoices of port charges to shipping agencies. The Logistics Division oversees procurement procedures.

Table 2.3.1.1 Port Authority Offices and their Jurisdictional Ports

Port Authority Office	It's Jurisdictional Ports		Refference
Imam Khomeini Port Authority	Major Port	Imam Khomeini	
	Minor Port	Khoramshahr	War-Damaged
		Abadan	War-Damaged
	Oil Port	Mahshahr	
Abbas Port Authority	Major Port	Shahid Rajaee	
		Bahonar	
	Minor Port	Lengeh	
		Jask	
	Other Port	Hormoz	
		Qeshm	
		Abu Musa	
		Dargahan	
		Kish Island	
		Kong	
	Oil Port	Sirri	
		Lavan Island	
Bushehr Port Authority	Major Port	Bushehr	
	Minor Port	Deylam	
		Genaveh	
		Dayyer	
		Asalu	
		Kangan	
		Kharg Island	
	Oil Port	Kharg Island	
Chabahar Port Authority	Major Port	Chabahar	
Anzali Port Authority	Major Port	Anzali	
Now Shahr Port Authority	Major Port	Now Shahr	
	Minor Ports	Amir Abad	Under Construction
		Fereydunkenar	Under Construction
Urumia Port Authority	Other Port	Urumia	

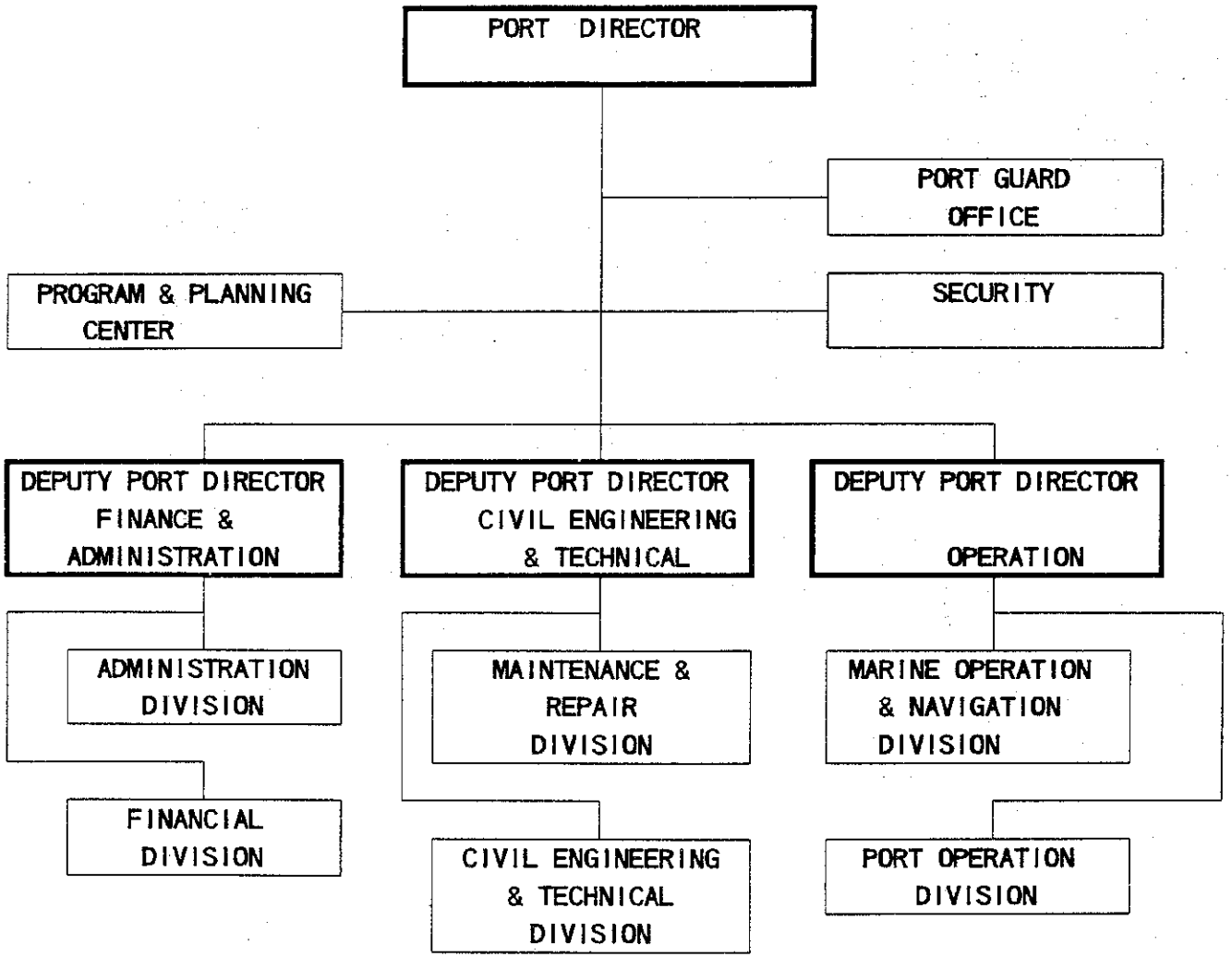


Figure 2.3.1.1 Organization Chart of Anzali Port Authority

2) The Technical Department has three divisions which are in charge of maintenance and repair of marine equipments and on land cargo handling equipment.

3) The Civil Engineering Department has four divisions related to construction works in the port.
The Construction Division is in charge of the investment plan of the ports which is under the jurisdiction of the port authority. This division drafts the annual budget and five-year plans and submits them to PSO head office. In addition, this division conducts demand forecast for large scale port development plans. This division is also responsible for the introduction of an information system.

4) The Operation Department has three divisions related to provision of marine service and cargo handling service including tallying. At Imam Khomeini port, cargo handling service, excluding on the ship, is provided by the port authority personnel, who belong to the Port Operation Division. Pilotage, towage and line handling services are provided by the Marine Operation Division.

Table 2.3.1.2 shows the number of PSO head office and IKPA employees by age in 1993. IKPA has 1,872 personnel which is about 31% of the total PSO personnel, the largest number of personnel in the port authorities in Iran. This is because it administrates comparative large-scale ports and employs its own personnel to conduct cargo handling service by itself.

As shown in the Table 2.3.1.2, 71% of the employees at IKPA are age 41 and over. The same age group represents 64% of the total at PSO head office. Compared to PSO head office, employees of IKPA thought to be older. Increase of young employees is necessary.

Table 2.3.1.2 Number of PSO Employees by Age Group (in 1993)

	Total	Years Old				
		-30	31-40	41-50	51-60	61-
PSO Head Office	382	57	81	180	58	6
share(%)	100.0%	14.9%	21.2%	47.1%	15.2%	1.6%
Imam Khomeini Port	1872	165	375	709	523	100
share(%)	100.0%	8.8%	20.0%	37.9%	27.9%	5.3%
PSO TOTAL	5992	503	1348	2697	1234	210
share(%)	100.0%	8.4%	22.5%	45.0%	20.6%	3.5%

Source: PSO

2.3.2 Port Operation

(1) Berth Allotment

At Imam Khomeini port, berth allotment is generally on a first come first serve basis. Container vessels without crane are given priority, however, at the container berths which have gantry cranes.
The Marine Operation Division of IKPA is in charge of berth allotment.
A shipping agent which wants to use the berth has to inform the port authority of the Estimate Time of Arrival (ETA) 48 hours prior to port entry. The Marine Operation Division of IKPA checks that the agency paid the port charge and then has a meeting with the agency to decide the berth. The Marine Operation Division allots the berth taking into consideration the dimensions of the ship (length and draft of the ship), type of cargo, location of the shed or open area to be used. As there is currently no congestion at the ports, it has not been necessary for plural shipping agents to hold meetings to coordinate berthing places.

(2) Cargo Handling Service

At Imam Khomeini Port private entities provide cargo handling service on ships in principal, and IKPA conducts cargo handling, stowage and cargo transport in the port area. Most berths of this port are general cargo berths. This port also has four container berths (Berth No 11 to No 15) and two container gantry cranes. PSO stuff operate the gantry cranes. One of them is out of service at present. A regular container service line, however, does not call this terminal.
A ship unloader and belt conveyers for aluminum powder is installed at Berth No 5. Open storage yard for aluminum is behind the Berth No 5. An private company rent the land from PSO, and installed facilities for aluminum. This terminal is a unique one in this port.
Between Berth No 3 and No 4, a floating crane for iron powder is moored, which is operated by PSO.
This port has a grain terminal with one jetty, two ship unloaders, conveyer and silo. The grain terminal is located at the western side of Berth No 1 beyond a basin for small ships. The grain facilities are also owned and operated by PSO. Ships used to be able to use both sides of the jetty, depth on the western side of the jetty became shallow, and now ships can berth only no one side.
A chemical factory and petro chemical factory are located on the western side of the grain terminal. These factories are not included in the port area. Thus, they have jetties, which are operated by the factories. However, since vessels which enter these factories must use the access channel for Imam Khomeini port, they take a PSO pilot on board at the entrance of the access channel.

(3) Mooring, Water Supply and Bunkering

At the major ports, each port authority provides mooring and water supply services. At Imam Khomeini port, the Maritime Operation Division of IKPA is in charge of

these services, which are undertaken by their own force.
Bunkering service is carried out by private companies.

(4) Introduction of Information System at IKPA

IKPA has started to introduce information systems. It uses personal computers for some items such as statistics, salary calculation, personnel record management. Only one semi-expert has been hired.

2.3.3 Procurement System

In the past, PSO head office was totally in charge of procurement procedures and conducted all paper work. A procurement request would be first submitted from each division of IKPA to the Technical Logistics Division of PSO head office. This division conducted all procurement procedures.
The system has changed. At present, IKPA can procure necessary items whose prices are lower than 2,000,000 RLs and within its budget.
The Logistics Division of IKPA is in charge of the procurement procedure. It directly enters contracts with foreign companies to procure something which is not available in Iran. The change has meant that necessary items such as parts for cargo handling equipment can be procured more easily and quickly.

PSO head office, however, still conducts procurement procedure for large size cargo handling equipment because the permitted limit is still low, and there are some port authorities which do not have enough experience in such procurement procedures. In this case, each port authority submits a list of necessary equipment to the Operation Division of PSO head office. The Port Operation Division collects and submits the lists to the Board of Directors. After approval of the board, the Equipment and Maintenance Division technically examines them, and the Technical Logistics Division conducts procurement procedures.

2.3.4 Financial Condition and Port Tariff

(1) Financial Condition

PSO receives a subside from Government. In this context, PSO is not financially independent from Government. Table 2.3.4.1 shows the financial condition of the PSO special account over a recent six-year period.
According to this Table, PSO was able to make a profit. This is mainly because the amount of cargo handling revenue is large, and large scale investment is done by the general account of Government.
The working ratio of port operation[1], however, was around 70% over a recent six-year period (1987-1992). This figure should be lower than normal ratios of 50-60% if an entity is to be able to invest in port development. Therefore, the financial

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*Note: (*)Working Ratio:(Operation Expense-Depreciation)/Operation Revenue*100 (%)*

condition of PSO is not sound enough to allow for investment in large scale port development.

Table 2.3.4.1 Income Statement of the PSO Special Account

(Mn. RLs)

	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
Operating Revenue	24,416	24,507	28,789	46,380	61,210	71,615
-Terminals & Marine Operational Income	9,664	8,774	8,838	9,754	12,290	14,379
-Port Operation Income	215	243	261	397	601	703
-Loading and Unloading Income	13,988	14,931	18,999	35,380	46,924	54,901
-Others	549	559	691	849	1,395	1,632
Operation Expense	21,363	19,402	23,110	35,476	47,220	54,615
-Personnel Expense	9,562	10,152	12,167	14,901	20,426	23,694
-Contract Services	2,086	2,374	3,290	6,963	9,747	11,306
-Fuel & Electricity	380	510	613	709	1,370	1,589
-Maintenance	1,582	3,004	3,811	7,784	11,482	13,319
-General Expenses	1,450	1,722	1,556	3,290	2,527	2,931
-Others	175	200	235	261	168	195
-Depreciation	6,128	1,440	1,438	1,568	1,500	1,581
Operating Income	3,053	5,105	5,679	10,904	13,990	17,000
Non-Operating Revenue	0	0	0	0	0	0
	-	-	-	-	-	-
Non-Operating Expense	0	0	0	3,176	1,798	1,000
-Interest	0	0	0	0	0	0
-Taxes	0	0	0	0	0	0
-Provision Years Lost Claims	0	0	0	3,176	1,798	1,000
Non-Operating Income	0	0	0	-3,176	-1,798	-1,000
Surplus or Deficit	3,053	5,105	5,679	7,728	12,192	16,000
Working Ratio(*)	62.4%	73.3%	75.3%	73.1%	74.7%	74.1%

Note: (*)Working Ratio: (Operation Expense - Depreciation Cost) / Operating Revenue
Source: PSO

There is no financial statement by each port. At Imam Khomeini port, however, a balance sheet of incomes and expenses is prepared as shown in table 2.3.4.2.
Both income and expenses of IKPA have been increasing since 1991/92, the balance has been in black. By tariff revise in 1993/94, income has increased drastically. However, on the basis of conference with PSO head office, net income is returned to PSO head office, therefore, it isn't available to IKPA. The amount of net income decreased drastically in 1992 because of increasing personnel expenses and general expenses.

Table 2.3.4.2 Income & Expenditure of Imam Khomeini Port

Anzali

Income Title	Amount (Mn. RLs)		
	1991/92	1992/93	1993/94
Marine and Terminal Operations Income	226.7	237.2	4,531.8
Port Operations Income	1.3	2.0	44.1
Loading/Unloading Operations Income	2,732.4	2,815.8	2,397.8
Equipment Service Income	5.9	7.5	18.1
Miscellaneous Income	85.5	162.8	172.4
Income Total (1)	3,051.8	3,225.3	7,164.2
Expenditure Title			
Salary and Benefits paid to Employees Expenses	1,432.9	1,851.0	1,700.9
Other Personnel Expenses	489.5	625.7	706.2
Contractual Services Expenses	113.5	132.9	231.9
Repair and Maintenance Expenses	487.7	493.5	444.8
Fuel Expenses	15.2	17.2	19.1
Services Expenses	32.9	46.7	50.1
Wages Expenses	439.3	538.1	628.6
General Expenses	119.9	464.8	375.2
Contingency Expenses	0.9	14.2	2.5
Depreciation Expenses	40.0	38.4	68.9
Expenditure Total (2)	3,171.8	4,222.5	4,228.2
Balance (1)-(2)	-120.0	-997.2	2,936.0

Source: PSO

(2) Port Tariff

The main tariff of PSO (June 1994) is shown in Table 2.3.4.3, Table 2.3.4.4 and Table 2.3.4.5.

As shown in the Table, cargo handling charges are levied because PSO provides a part of cargo handling service in the ports. Cargo handling charges for container are defined in RLs. PSO does not have a special tariff for container transhipment cargo. As shown below, there are two ways(one for shipping companies, and another for cargo owners) to collect the charges.

1) The charges which shipping companies should pay such as port entry charge and pilotage are paid by shipping agencies. The Financial Division of port authorities issues the bills to the shipping agencies. The shipping agencies pay the charge to the banks.

   These kinds of charges are defined in dollars in principal, and are decided on the basis of operational cost of PSO taking into consideration the tariffs of neighboring countries such as the U.A.E., Kuwait, Bahrain, Saudi Arabia. The Supreme Council has authority to revise these charges.

2) The charges which consignees of cargo should be paid, such as cargo handling charge in the yard, are paid to the Customs office with customs duties by the consignees. The Customs office deposits the charges into the special account of PSO. These kinds of charges are defined in rls in principle. These have not been changed for a long time.

The Supreme Council has authority to revise almost all charges. Permission of the parliament, however, is necessary to change seven items when the level is to be increased by more than 30% (see Table 2.3.4.3). PSO does not have a designated division for the preparation of the tariff. Instead, each division of the Operation Department of PSO head office prepares the draft, and the Financial Division is in charge of compiling them.

These had been also defined in rls in the past. The foreign shipping companies had to pay after exchanging foreign currency at the official fixed rate of the Iranian Central Bank (one dollar = 70 RLs). Therefore, the foreign shipping companies received handicapped treatment because the official rate was different from the actual value.

The fixed rate was abandoned at the beginning of the fiscal year 1993', the tariff for the foreign shipping companies began to be calculated in dollars, while domestic shipping companies began to have to pay the same value rls with the tariff for the foreign shipping companies. The exchange rate, determined on the basis of the rate on the last day in each month, is announced by port authorities. Hence the problem with the tariff was solved partly. The new tariff in dollars, however, was calculated by using the old rate (one dollar = 70 RLs), therefore the tariff is still comparatively high.

Table 2.3.4.3 Main Tariff of PSO (In Jun. 1994)

Item		Tariff
		(Cent)
For ships	Entering the port entrance (*)	6 / GRT
	Entering the port (*)	10 / GRT
	Pilotage	40 / GRT
	For dredging	41 / GRT
	Loading and Discharging (*)	
	a) At berth	22 / GRT
	b) At ancharage	11 / GRT
	Side wharfage	10 / GRT / day
	For Lighthouses, signs (*)	4 / GRT
	Gabage colletion	3 / GRT
		(Rial)
Berth charge on cargo	Unloading	180 / ton
	Loading	95 / ton
Dues on cargo	Inward (*)	40 / ton
	Outward (*)	10 / ton
	Quarantine duties under control of the Ministry of Pulic Healthe (*)	10/ton
Cargo handling charge on land	Inward cargo (not direct delivery, by PSO worker)	1,650 / ton
	Outward cargo (not direct delivery, by PSO worker)	412 / ton
	Inward cargo (direct delivery, by consignee worker)	330 / ton
	Inward cargo (direct delivery, by PSO worker)	660 / ton
	Outward cargo (direct delivery, by consignee worke	83 / ton
	Outard cargo (direct delivery, by PSO worker)	165 / ton
	Stacking on truck and wagon	412 / ton
Loading and unloading charge	Unloading from ship by port crane	380 / ton
	Loading to ship by port crane	95 / ton
Warehousing	Warehousing	
	untill 15 days	0.05 / day / 10 kg
	16 ~ 30	0.10 / day / 10 kg
	31 ~ 45	0.40 / day / 10 kg
	46 ~ 60	0.60 / day / 10 kg
	61 ~ 90	1 / day / 10 kg
	more days	2 / day / 10 kg

Note: (*)Permission is necessary for raises more than 30%

: Charge for towage differs by each tug boat. This will be unified.

Source: PSO

Table 2.3.4.4 Main Tariff of PSO (Container) (In Jun. 1994)

(Rial / Unit)

Item	~20 ft		~40 ft	
	Full	Empty	Full	Empty
Unloading by port crane	22,000	10,000	28,000	12,000
Loading by port crane	22,000	10,000	28,000	12,000
Unloading by ship crane	20,000	8,000	26,000	10,000
Loading by ship crane	20,000	8,000	26,000	10,000
Unloading (Ro Ro)	20,000	10,000	26,000	10,000
Loading (Ro Ro)	20,000	10,000	26,000	10,000
Unloading by port crane (direct delivery)	6,500	5,000	10,000	8,000
Loading by port crane (direct delivery)	6,500	5,000	10,000	8,000
Supervision of container handling				
Unloading (Ro Ro)	4,500	4,500	8,000	8,000
Loading (Ro Ro)	4,500	4,500	8,000	8,000
Unloading by ship crane	4,500	4,500	8,000	8,000
Loading by ship crane	4,500	4,500	8,000	8,000
Shift inside ship hold (without using yard)	4,000	4,000	6,000	6,000
Shift inside ship hold (using yard)	7,000	7,000	10,000	10,000
Shift from ship to ship (without using yard)	7,000	7,000	10,000	10,000
Shift from ship to ship (using yard)	16,000	12,000	20,000	16,000
Container movement in yard	3,000	3,000	4,500	4,500
Unloading or Loading from track or wagon	3,500	2,500	4,500	3,500
Unstuffing	1,000			
Stuffing	1,000			
Open or close hachcover	4,000			
Container Creaning	4,000		6,000	
Lashing and unlashing	400			

Source: PSO

Table 2.3.4.5 Tariff for Container Storage (In Jun. 1994)

Item	20 ft		40 ft	
	Without shassis	On shassis	Without shassis	On shassis
1 ~ 15 days	300	400	400	800
16 ~ 30 days	400	800	800	1,600
31 ~ 45 days	600	1,200	1,200	2,400
46 ~ 60 days	800	1,600	1,600	3,200
more than 60 days	1,000	2,000	2,000	4,000

Source: PSO