Chapter 7

Alternative Layout Plans of Port Facilities

Chapter 7 Alternative Layout Plans of Port Facilities

7.1 Basic Policy for Development of Alternative Layout Plans

7.1.1 Economy

Port should have necessary functions. The proposed layout should be feasible financially and economically, to use easily the port and keep operation costs at a reasonable level.

As Anzali Port is surrounded by the city area, the port area available for expansion is limited. The cargo volume excluding liquid bulk and containers will be less than 1 million tons for each packing style in the target year of the Master Plan. The distance by which the quay wall can be extended easily is about 1 km to the north from the existing break water. However, if berths have according to packing type each packing type cargo exclusively (except container and liquid bulk), a new berth will have to be constructed outside the existing break-water and the berth efficiency will deteriorate because the cargo handling volume by each packing style is not large enough to justify exclusive use of berths.

It is recommended that berths other than those for container ships and tankers should be multi-purpose berths.

7.1.2 Flexibility

Major trade partners of Anzali Port are the CIS countries, Azarbaijan and Russia. It is not possible to obtain reliable information on the present situation of statistics because these countries have been independent only for a short while and because the affairs of these countries, are not stable. It is therefore extremely difficult to forecast socioeconomic conditions including the cargo volumes.

The layout of the port should be such that it can cope with any radical deviations from the forecasted cargo volume and ship sizes. Reconstruction of existing Q5 berth should be started first, followed by construction of two berths for handling dry bulk and general cargo respectively. After these as berth are completed, the crowns from Q1 to Q4 should be raised. After these works are completed, it will be necessary to review the cargo volume forecast.

7.1.3 Post Master Plan

The target year for the Master Plan is 2010, and this study prepares plans up to the year 2010. The cargo volume is expected to continue increasing after 2010, and further expansion of the port facilities will be required.

As mentioned in section 6.1, the port facilities should be expanded toward the east along the Caspian coast.

7.2 Access to/from Port

7.2.1 Road

Anzali port--Qazvin--Tehran route : 365km

Anzali port--Qazvin : 217km Two-Lane Main Road
Qazvin--Tehran : 148km Six-Lane Freeway

Two-lane main road stretching 217km provides access between Anzali port and Qazvin while a six-lane freeway connects Qazvin with Tehran over a distance of 148km. Therefore, a freeway between Anzali port and Qazvin needs to be constructed while Tehran will be connected with Anzali port at the Caspian Sea by freeway. Road network plan of Anzali port is shown in Figure 7.2.1.1.

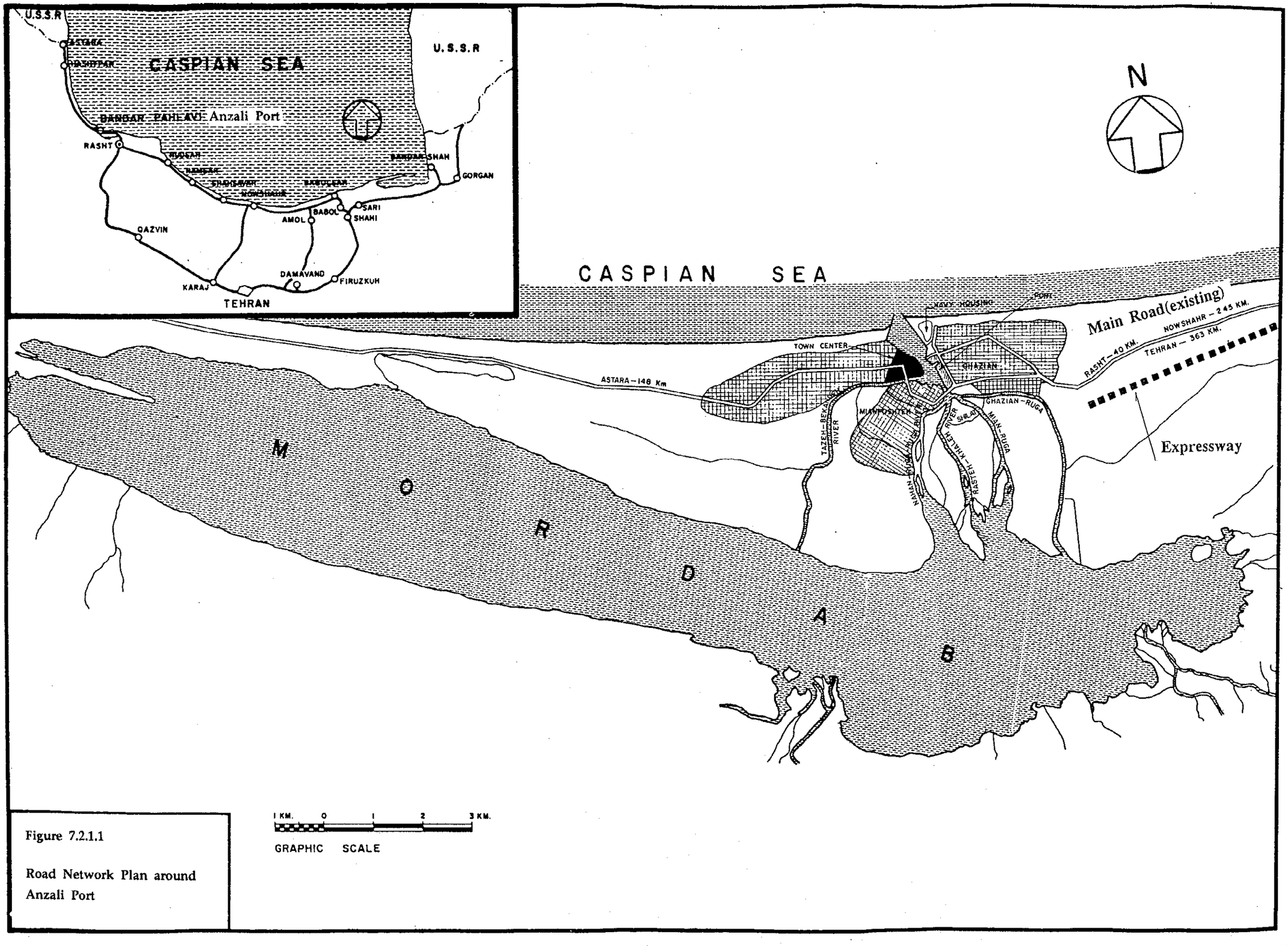


Figure 7.2.1.1

Road Network Plan around Anzali Port

7.3 Alternative Layout Plans

As mentioned in section 6.1, there should be five multi-purpose berths, three for containers, two for liquid bulk and one for dry bulk in the target year of the Master Plan.

The maximum length of a dry cargo ship which can use the multi-purpose berth in 2010 is about 135 m, the width is about 15 m and draft about 5.8 m. If it is a single berth, a quay length of about 170 m is required. When the quays are joined and there are quay walls on both sides of the berth, the required length of a berth is about 150 m. The water depth in front of the berth should be 6.5 m.

Two cranes will be used per ship in the case of container ships and dry bulk ships. A large trailer or super large truck will be required for cargo handling. Even if the berths are joined, the length of one berth should be 170 m. The maximum length of a tanker in 2010 is about 150 m, the width about 20 m and draft about 8.0 m. As most liquid bulk cargo handled at Anzali Port is classified as dangerous cargo, the berth length should be somewhat longer than that of a single berth as a safety precaution. Therefore, the length of a tanker berth should be about 180 m and the depth should be about 8.5 m.

7.3.1 Alternative 1 (See Figure 7.3.1.1)

(1) Anzali Port should be extended first toward the entrance of the port in the north and then eastward along the Caspian Coast.

(2) Three multi-purpose berths should be provided from Q2 to Q4. The remaining multi-purpose berths, dry bulk berth and the container berths should be provided by extending the berth north of the shipway by about 1,045 m.

Container berth: 170 m x 3B = 510 m
Multi-purpose berth (Q2,Q3 and Q4): 152 m + 153 m + 170 m = 475 m
Multi-purpose berth (reconstruction Q5): 150 m
Multi-ourpose berth (Unloader for dry bulk): 170 m
Dry bulk berth (Unloader for dry bulk): 170 m

(3) The berths for tanker (dolphin structure) should be located in front of the park on the opposite side (to the west of the passage) of the existing commercial port facilities.

Tanker berth: 180 m x 2B = 360 m

(4) In order to improve the calmness of the basin and the berths which will be newly constructed to the north of the existing mooring facilities, the existing western breakwater should be extended by about 800 m.

(5) In Alternative layout 1, the dredging volume will exceed the volume of the reclamation. Using the remaining dredging volume, the area immediately behind the new container terminal should be raised in order to prevent sub-merging of the area in the north of the back up area of the port from the rising water.

7.3.2 Alternative 2 (See Figure 7.3.2.1)

(1) A dolphin type tanker berth will be constructed about 400 m offshore from the north side of the west breakwater.

(2) The lay-out of the other mooring facilities should be the same as those for Alternative 1.

(3) In order to increase the calmness of the basin and the berths which will be newly constructed north of the existing mooring facilities, the existing western breakwater should be extended by about 100 m.

(4) In order to improve the calmness of the basin, the berths which are newly constructed north of the existing mooring facilities, and the new tanker dolphin to be constructed to the north of the western breakwater, a new breakwater of about 800 m should be constructed north of the existing western breakwater.

(5) The remaining dredging volume should be used as in the case of Alternative 1 to raise the area immediately behind the new container terminal.

7.3.3 Alternative 3 (See Figure 7.3.3.1)

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

(2) In order to improve the calmness of the basin and the new berths which will be constructed to the north of the existing mooring facilities (including the tanker berth), the existing western breakwater should be extended by about 600 m, and a new breakwater of about 800 m should be constructed to the north of the existing east be reak water.

(3) The dolphin type berths for tanker should be constructed inside the new breakwater to the north of the existing eastern breakwater.

(4) The lay out for the other mooring facilities should be the same as those for Alternative 1.

(5) The remaining dredging volume should be used to raise the area immediately behind the newly built container terminal as in Alternative 1.

7.3.4 Alternative 4 (See Figure 7.3.4.1)

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

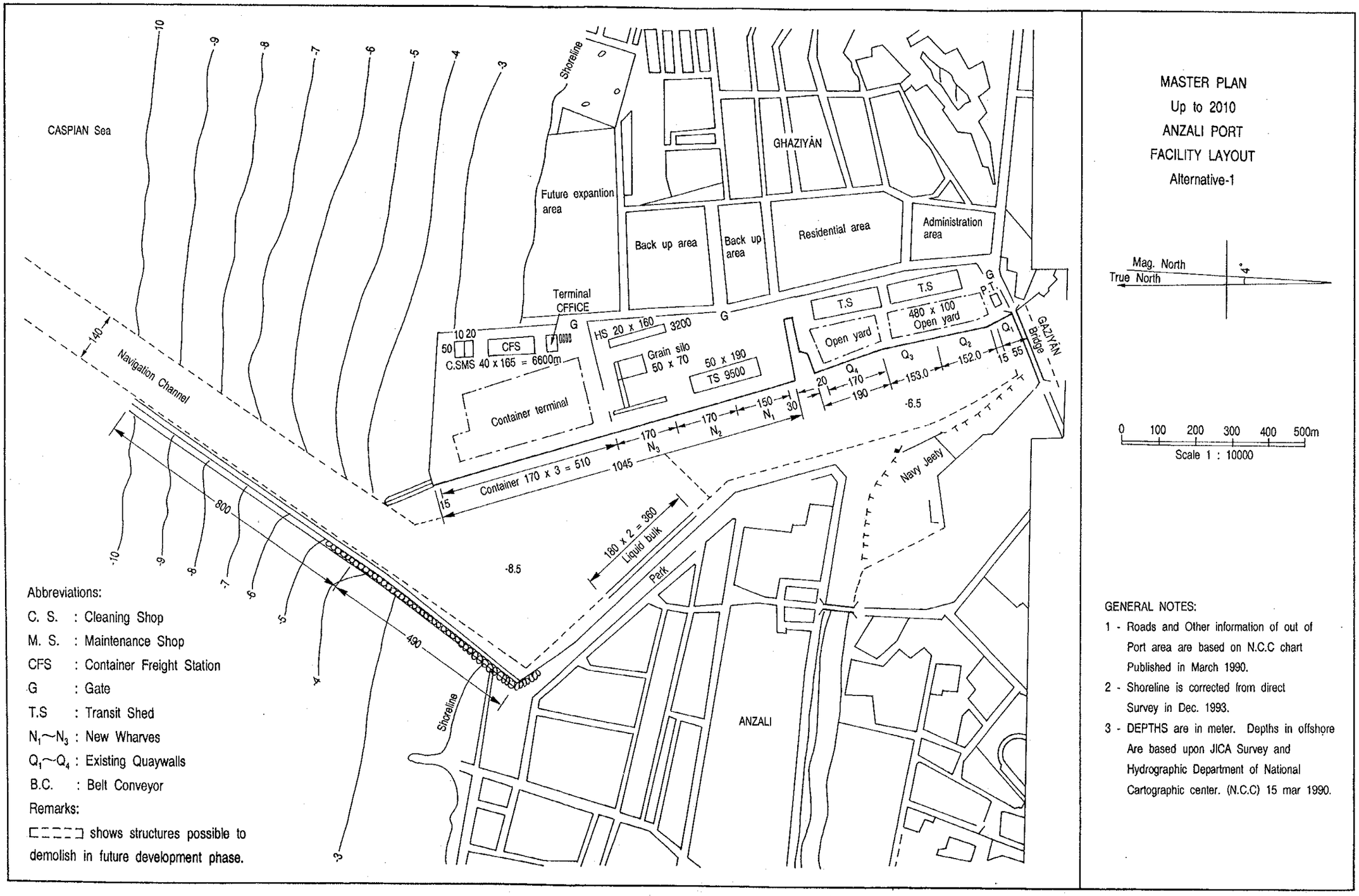
(2) The tanker berth should be located at the south end of the existing commercial port facilities.

(3) The lay out for the other mooring facilities should be the same as those for Alternative 1.

(4) The existing ship-way for repairing small crafts should be removed.

(5) In order to improve the calmness of the basin and the new berths which are constructed the north of the existing mooring facilities, the existing western breakwater should be extended about 500 m.

(6) The remaining dredging volume should be used to raise the area immediately behind the new container terminal as in Alternative 1.



MASTER PLAN
Up to 2010
ANZALI PORT
FACILITY LAYOUT
Alternative-1

Abbreviations:

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

Remarks:

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

GENERAL NOTES:

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

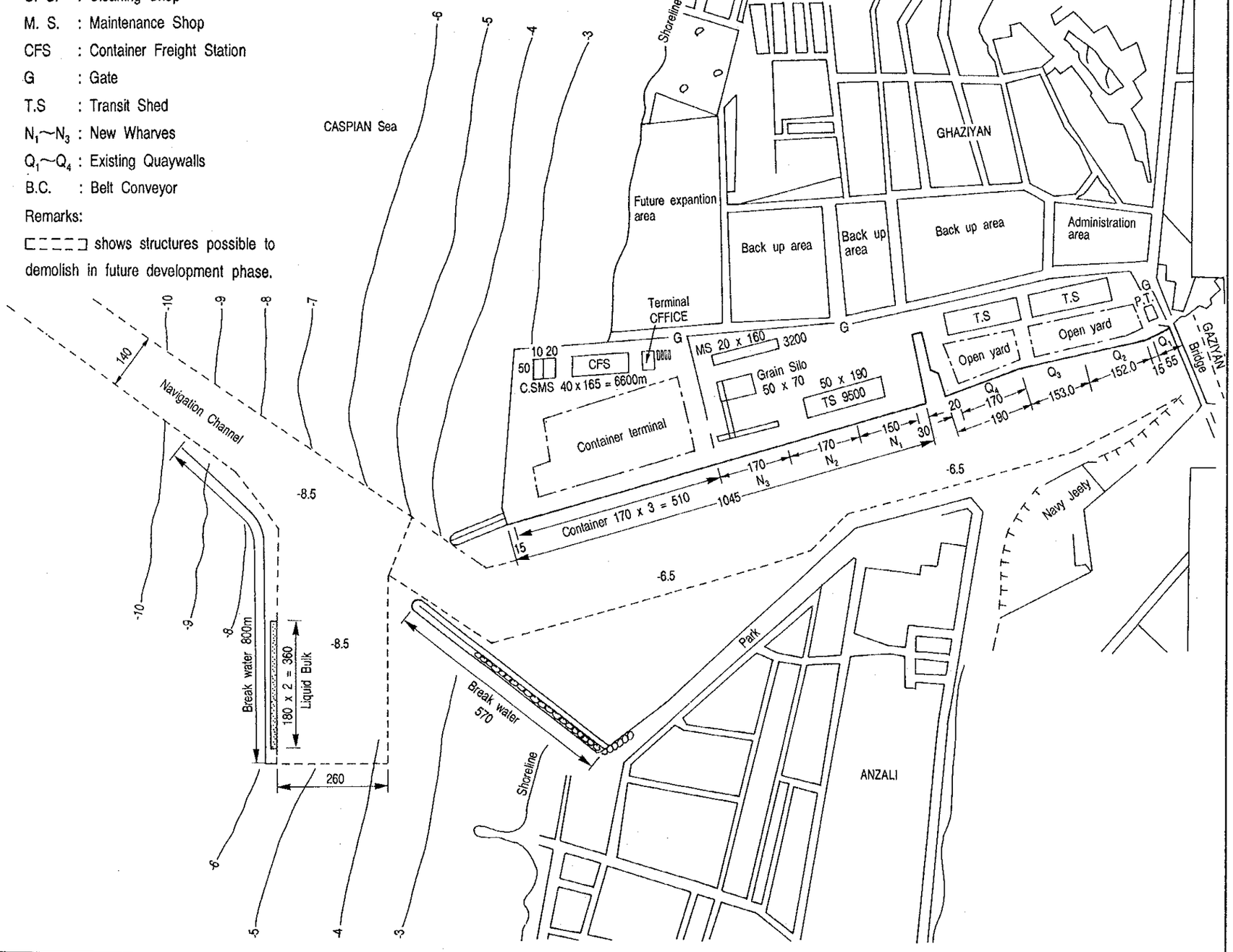
Figure 7.3.1.1 Alternative Plan 1 (Master Plan)

Abbreviations:

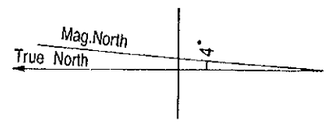
C. S. : Cleaning Shop
M. S. : Maintenance Shop
CFS : Container Freight Station
G : Gate
T.S : Transit Shed
N_1~N_3 : New Wharves
Q_1~Q_4 : Existing Quaywalls
B.C. : Belt Conveyor

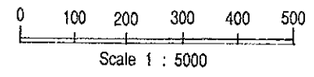
Remarks:

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



MASTER PLAN
Up to 2010
ANZALI PORT
FACILITY LAYOUT
Alternative-2

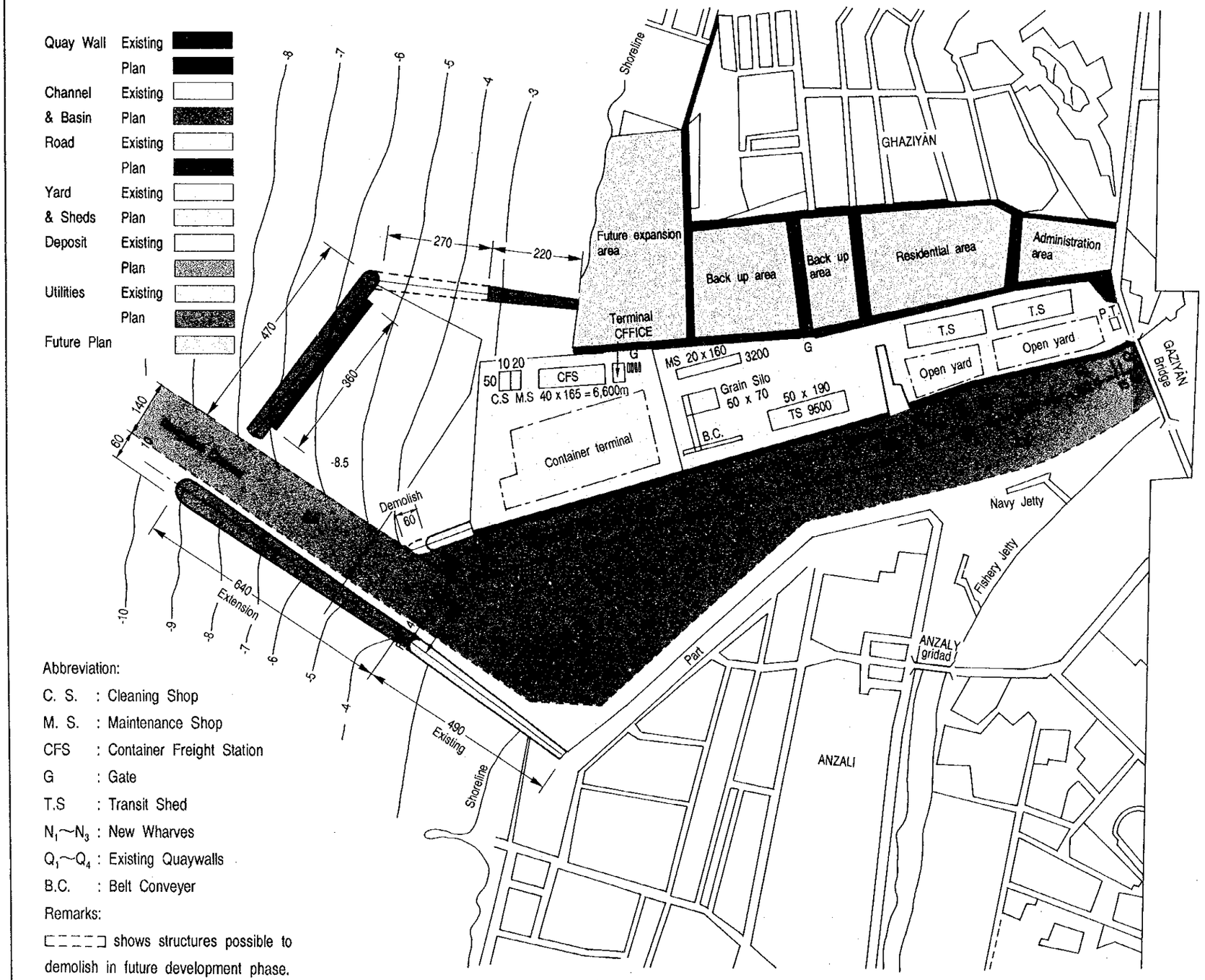




GENERAL NOTES:

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

Figure 7.3.2.1 Alternative Plan 2 (Master Plan)



Abbreviation:

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

Remarks:

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

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

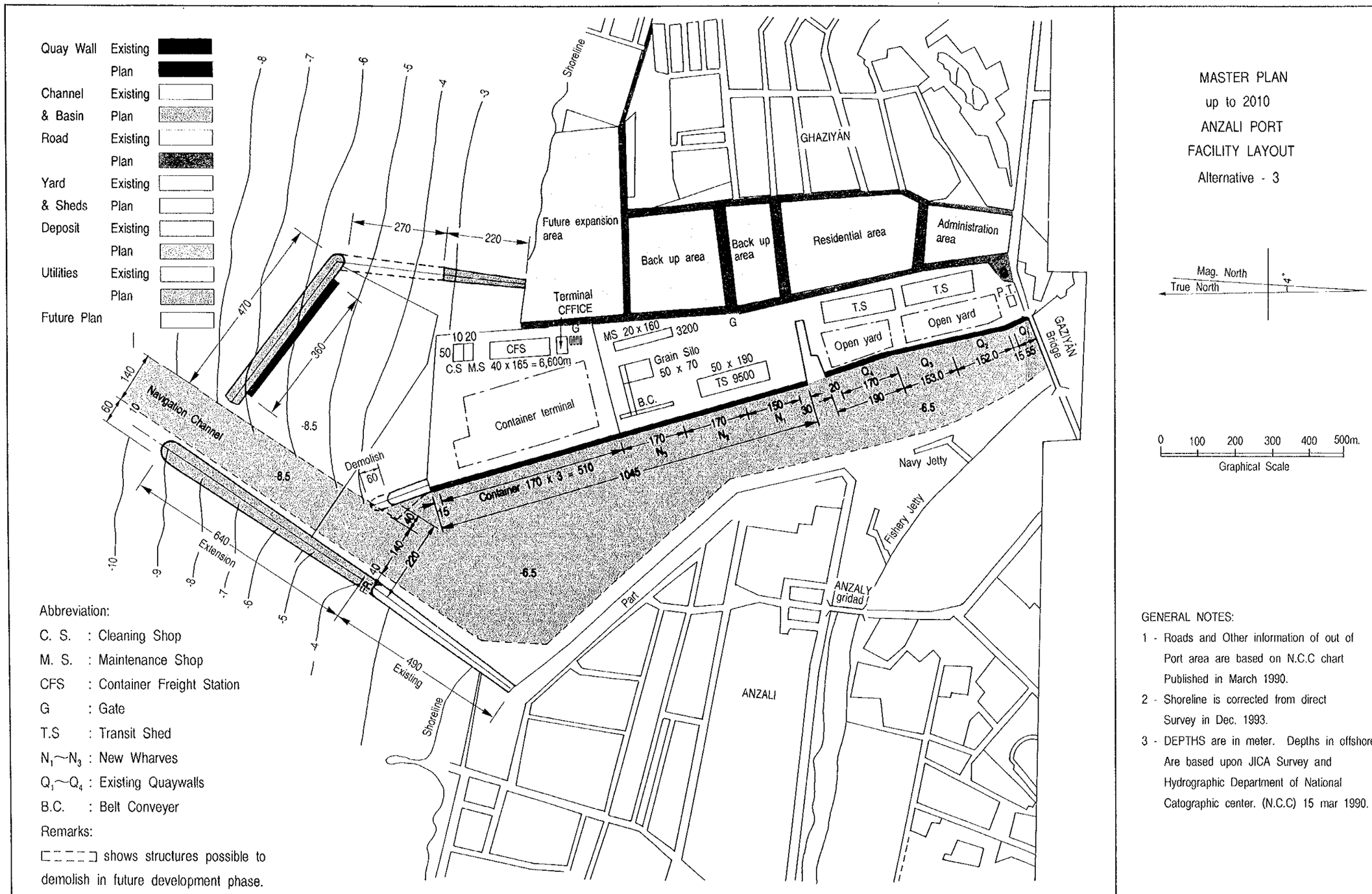
Mag. North
True North
4°

0 100 200 300 400 500m.
Graphical Scale

GENERAL NOTES:

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

Figure 7.3.3.1 Alternative Plan 3 (Master Plan)



Abbreviation:

C. S. : Cleaning Shop

M. S. : Maintenance Shop

CFS : Container Freight Station

G : Gate

T.S : Transit Shed

N_1~N_3 : New Wharves

Q_1~Q_4 : Existing Quaywalls

B.C. : Belt Conveyer

Remarks:

□□□□□ shows structures possible to demolish in future development phase.

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

Mag. North
True North
4°

0 100 200 300 400 500m.
Graphical Scale

GENERAL NOTES:

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

Figure 7.3.3.1 Alternative Plan 3 (Master Plan)

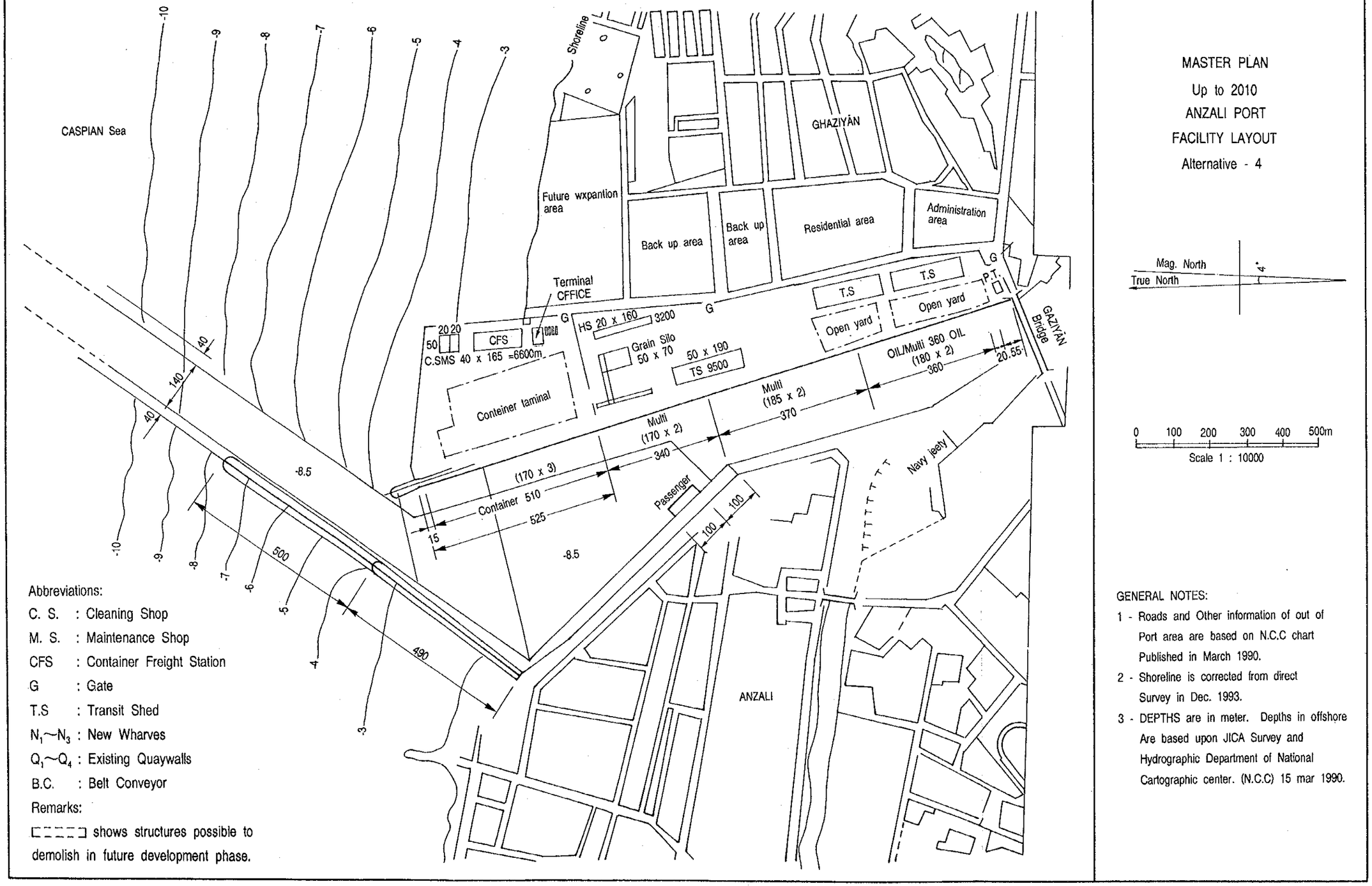


Figure 7.3.4.1 Alternative Plan 4 (Master Plan)

7.4 Container terminal

Location of container terminal is planned at the northern part of the expansion berth. Container terminal has three berths of 170 m in length. Figure 7.4.1.1 shows the layout of major facilities in the container terminal for the target year 2010/11.

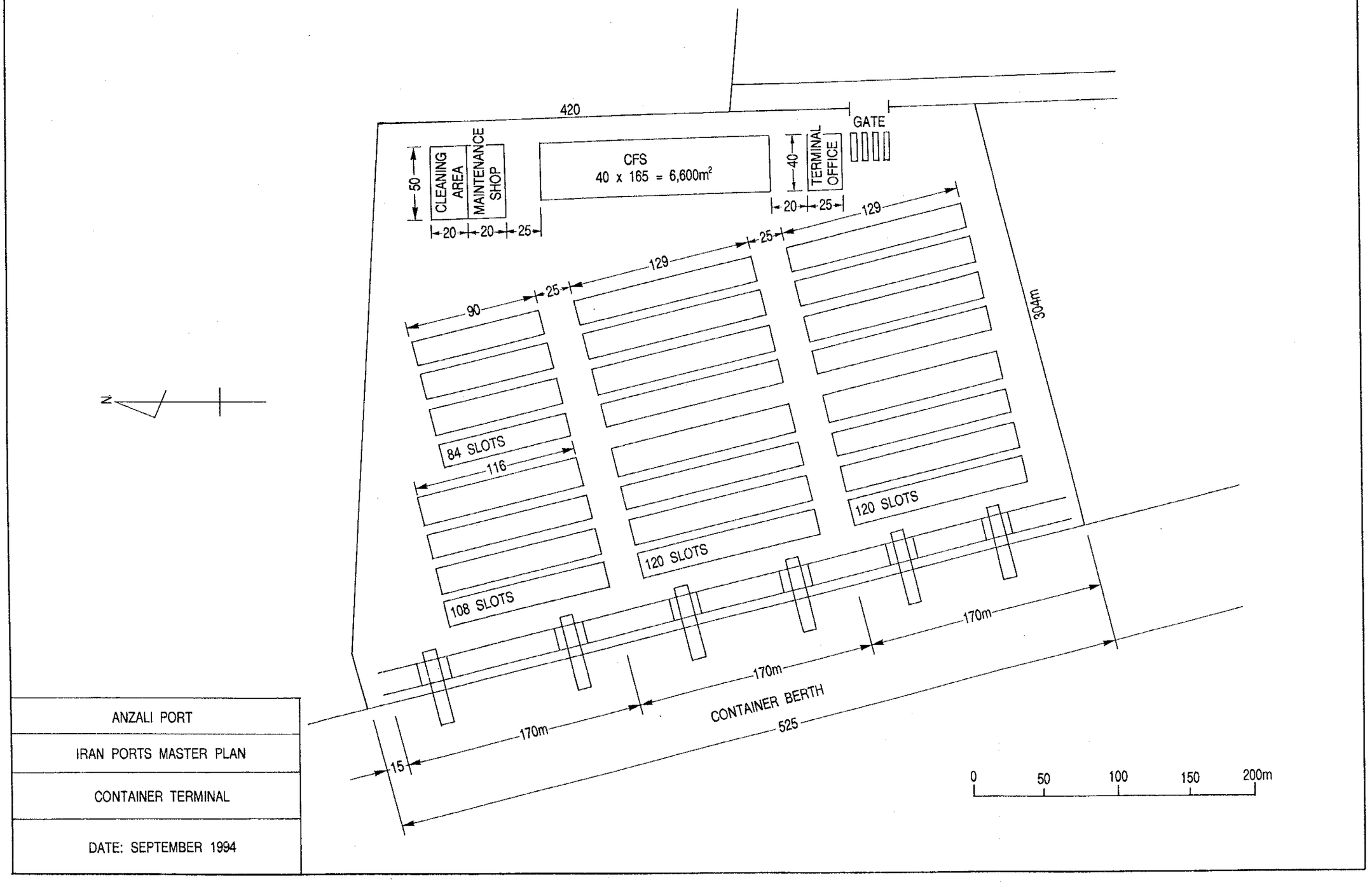


Figure 7.4.1.1 Layout of Major Facilities in the Container Terminal

7.5 Evaluation of Alternatives

An evaluation of the two alternatives by item is shown in the table below.

Table 7.5.1.1 Evaluation of Alternatives

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

Note A: Preferable B: Normal C:Not Preferable

(1) Construction cost

In chapter 12, comparative cost estimation is carried out for the major working items of the alternatives in the Master Plan.

Items dredging/reclamation, wharves/seawall, breakwater, facilities on land, pavement, equipments/machinery and others are common to both alternatives. Item wharves/seawall has the greatest influence on the construction cost.

The most economical alternative is Alternative 4.

(2) Development Potential

In all alternatives, the port facilities will be extended toward the east. Therefore, there is no difference in the development potential between Alternative 1, Alternative 2 and Alternative 4. Alternative 3 also has development potential. However, the development cost of Alternative 3 is much higher than others.

(3) Maneuvering of Ship

The oil berths are constructed in the inner port area in Alternative 1 and Alternative 4. Therefore, the maneuvering of ships in Alternatives 2 and 3 is easier than in

Alternatives 1 and 4 because the area of the basin in Alternatives 2 and 3 is larger.

(4) Calmness

Alternative 3 is calmest of all Alternatives because it includes a new eastern breakwater to depend against invading waves from the north-east.

(5) Protection of environment

Oil berths in Alternatives 1 and 4 are located in the port area, while Alternatives 2 and 3, they are near the port mouth. Therefore, the environmental condition of Alternatives 2 and 3 is much better than Alternatives 1 and 4.

(6) Other Factors

Difficulty in construction work and stage plan.

(7) Comprehensive evaluation

Based on the section from (1) to (3), it is judged that Alternative 3 is better than other Alternatives. In terms of construction cost, Alternative 1 is the most expensive than other Alternatives. But the difference between Alternative 3 and 4 is not so large different (8 % of the construction cost of Alternative 4).

7.6 Short Term Plan

There should be five multi-purpose berths, one for liquid bulk and one for dry bulk in the target year of the Short Term Plan.

As mentioned in section 3.2, the maximum draft of dry cargo ships and tankers in 2000 is about 5.2 meters and 5.7 meters respectively.

The tankers will have to use exclusive berth but container ships will not have to use exclusive berth.

The contents of the Short Term Plan are as follows:

-The target year of the Short Term Plan is 2000.

-The existing berths from Q1 to Q4 require filling to compensate for the rising water level of the Caspian Sea.

-The angle of the face line at Q5 should be moved to the north-east to increase the width of the basin in front of the quay-wall for berthing.

-Two multi-purpose berths (total length:170 m, depth:6.0 m) and one temporary liquid bulk berth (length:170 m, depth:6.5 m) will be constructed. In the Master Plan, the area of the temporary liquid bulk berth should be incorporated with the container berth.

-The existing western break-water shall be extended about 500 m.

-Depth of the existing channel and basin north of the temporary liquid bulk berth is -6.5 m, while it is -6.0 m to the south.

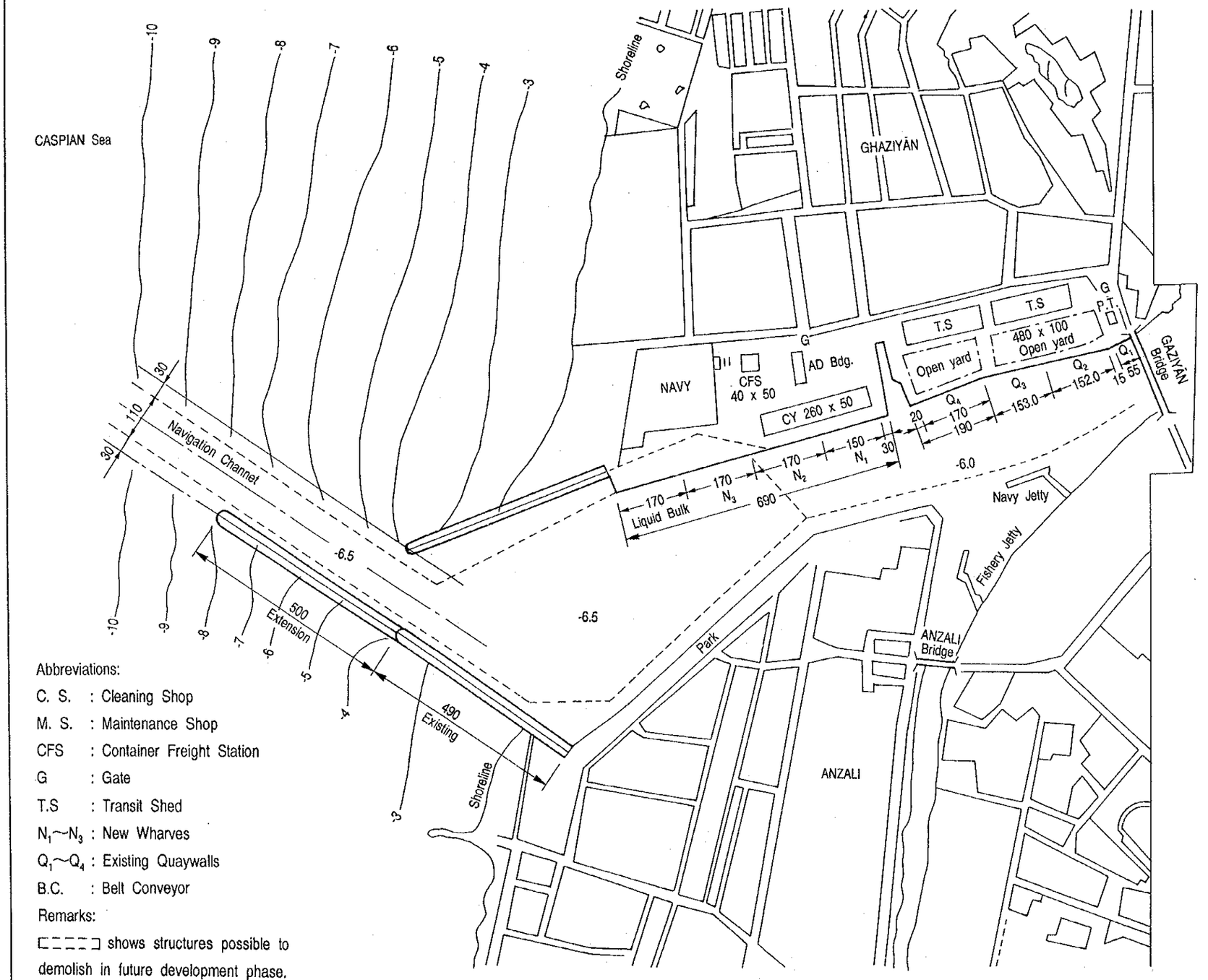


Figure 7.6.1.1 Short Term Plan

Chapter 8

Facility Design for Short-term Plan

Chapter 8 Facility Design for Short-term Plan

8.1 Design Criteria

8.1.1 Preface

On the study of the Master plan up to 2,010 and the feasibility study of the short-term plan up to 2,000, this chapter deals with the preliminary design of the required port facilities which are described in Chapter 6 and 7.

The design is based on the following conceptional items.

1) To be based on [Technical Standards for Port and Harbour Facilities in Japan] with careful consideration for Iranian local situation and condition.
2) To consider the stability of the structures.
3) To consider the economical design.
4) To consider proper design for the construction works at the site without any technical difficulties.
5) To use the local materials and workers as much as possible.

8.1.2 **Dimensions of Ship:** According to the study on the ship size accommodating in the Caspian sea, it is summarized as shown in the following table.

Table 8.1.2.1 Standard Size of Ships in the Caspian Sea

Type	Tonnage	Overall length	Moulded breadth	Full load draft
	Passenger GT 2,000	88m	13.2m	4.0m
	GT 3,000	99	14.7	4.5
	GT 5,000	120	16.9	5.2
	GT 8,000	142	19.2	5.8
	GT 10,000	154	20.4	6.2
	GT 15,000	179	22.8	6.8
	GT 20,000	198	24.7	7.5
Ferryboat	GT 2,000	69	17.1	4.4
	GT 3,000	113	18.9	4.9
	GT 4,000	127	20.2	5.3
	GT 6,000	138	22.4	5.9
	GT 10,000	170	25.4	6.5
	GT 13,000	188	27.1	6.7
	GT 15,000	200	28.1	6.9
Cargo ship	DWT 5,000	109	16.4	6.8
	DWT 6,000	-	-	-
	DWT 7,000	-	-	-
	DWT 8,000	126	18.7	8.0
Oil Tanker	DWT 5,000	104	16.2	6.5
	DWT 6,000	-	-	-
	DWT 7,000	-	-	-
	DWT 10,000	130	20.1	8.0
Oil tanker	DWT 1,000	70	11.7	5.0
	DWT 2,000	87	14.3	5.9
	DWT 3,000	99	16.1	6.6
	DWT 4,000	117	18.6	7.5
Tugboat	PS 400			
	PS 1,000			

[Note] Source: Japanese standards

Referring the above Table, the ship size to be accommodated is decided as below.

For Multi-Cargo (including Bulk)	8,000 DWT
For Oil Tanker	10,000 DWT

8.1.3 Maximum Draft of Ship To Be Accommodated and Design Depth of Berthing Facility

For Container	Maximum draft:	-8.0 m, Design depth: -8.5 m below C.D.
Bulk & GC' ships	Design depth:	-8.5 m below C.D.
For Oil Tanker	Maximum draft:	-8.0 m
	Design depth:	-8.5 m below C.D.

8.1.4 Ship's Berthing Energy

The energy is given as the following formula.

$$Es = \frac{Wd \times v}{2g} \times Ce \times Cm \times Cs \times Cc$$

where; Es : Ship's berthing energy .....tfxm
Wd : Water displacement of the berthing ship ....tf
V : Approach velocity of the berthing ship at the movement of impact against the fender ....m/sec
g : Acceleration gravity ....m/sec
Ce : Eccentricity factor
Cm : Virtual mass factor
Cs : Softness factor ....1.0 as standard
Cc : Sharp factor of berth ....1.0 as standard

8.1.5 Tractive force acting on Mooring post

Gross tonnage	on Bollard	on Bit
2,001 to 3,000	35t	35t
3,001 to 5,000	50	35
5,001 to 10,000	70	50

The force acting on mooring post should be 70t

8.1.6 Wave: Design Height of Wave

inside facilities: Hi = 1.0 m
outside facilities: Ho = 4.0 m to apply for breakwater

8.1.7 Tide: A few tidal range is observed in the Caspian sea due to the closed lake.

[Note]: Tidal current will be negligible.

HWL +0.4m
MSL +0.2m
LWL 0 = CD

8.1.8 Water Level

Lowest level in past: 1977/78		-2.00m bellow CD
Level in 1992/93		0
Period between 1977/78 & 1992/93		15 years
Changes		2.00 m
Speed		2/15 = +0.13 m / year
Estimated level in 2,000/01 0.13 x 8	=	+1.04 m
	=	+1.00m above CD
Estimated level in 2,010/11 1+ (0.13x10)	=	+2.30m above CD

2010/11 +2.30m
2000/01 +1.00m
1992/93 0:CD

1977/78 -2.00m

Designed Level:

	Higher case	Lower case
2,000/01	+1.00 above CD	±0:CD
2,010/11	+2.30 above CD	±0:CD

8.1.9 Soil Characteristics

The Gilan Plain including Anzali port consists of a triangle delta caused by the river Sefid-Rud. It is said in the view point of geological aspect that the area has an under layer of tertiary diluvial formation (65 mil. to 20 mil. years ago) and upper layer of sedimental Alluvial formation (2 mil. years ago to present).
Therefore, the main soil layer consists of the sedimental sand by the river in the surrounding area of the port.

In some parts of the sand layer, there are a few silt/clay layers. Especially at the mouth of the port entrance (i.e. outside of the breakwaters) it consists mainly of sand layer.
It is remembered remarkably that there was an earthquake with magnitude of 7.7 in 1990 at Rudbar.
The sub-soil boring data is shown in the next page.

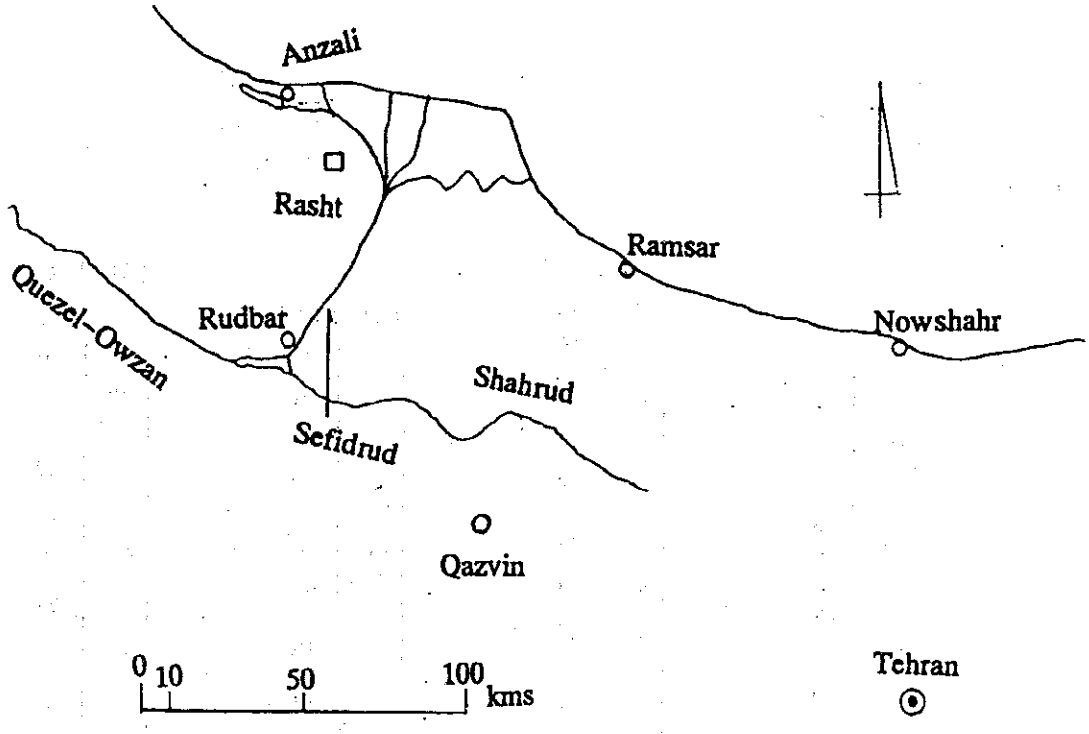


Figure 8.1.9.1

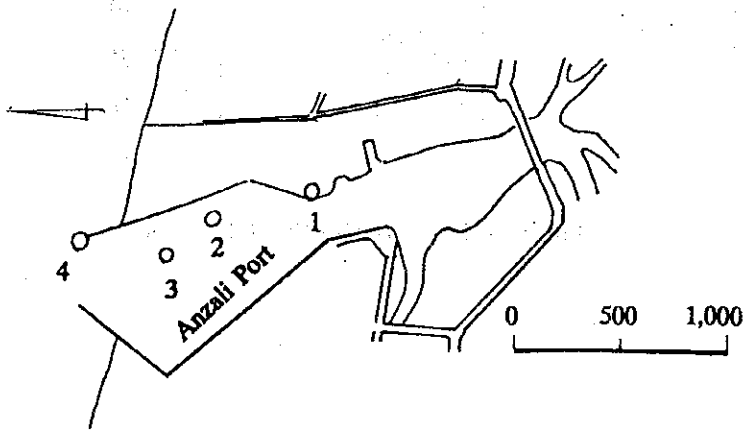


Figure 8.1.9.1 Location of Soil Boring

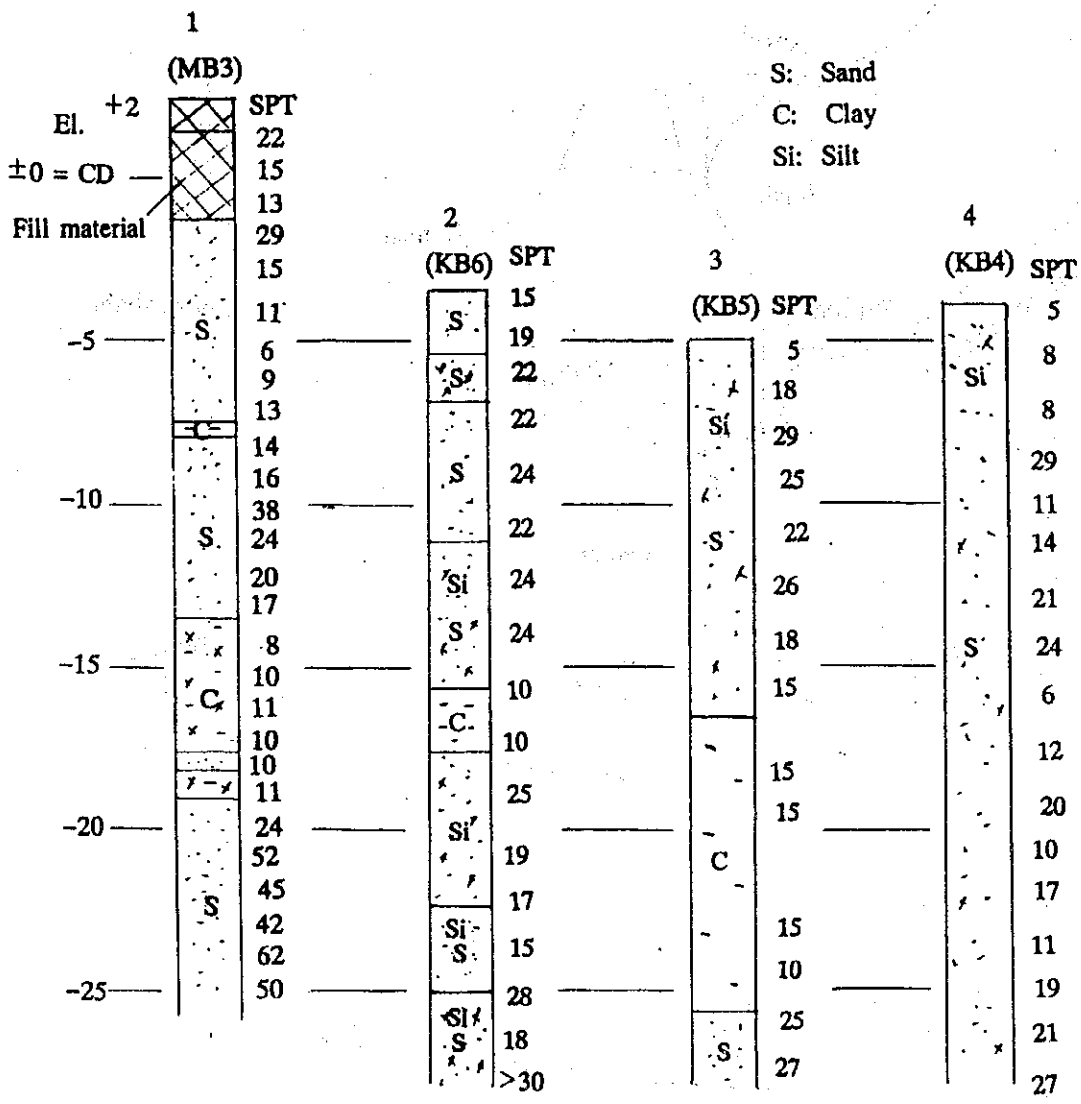


Figure 8.1.9.2 Boring Test Results

8.1.10 Earthquake and Seismic Force

Iran is one of the seismic countries like Japan. So that Iranian people has much interest in the earthquake, and many studies on the earthquake have been made.
The figure as shown in the next page is one of the seismic zonning map in Iran. Considering the earthquake at Rudbar in 1980's, the possibility of the earthquake in Anzali is much higher than Tehran.
The design seismic coefficient is obtained in the following formula.

$dSc = Cr \times Sc \times Ci$

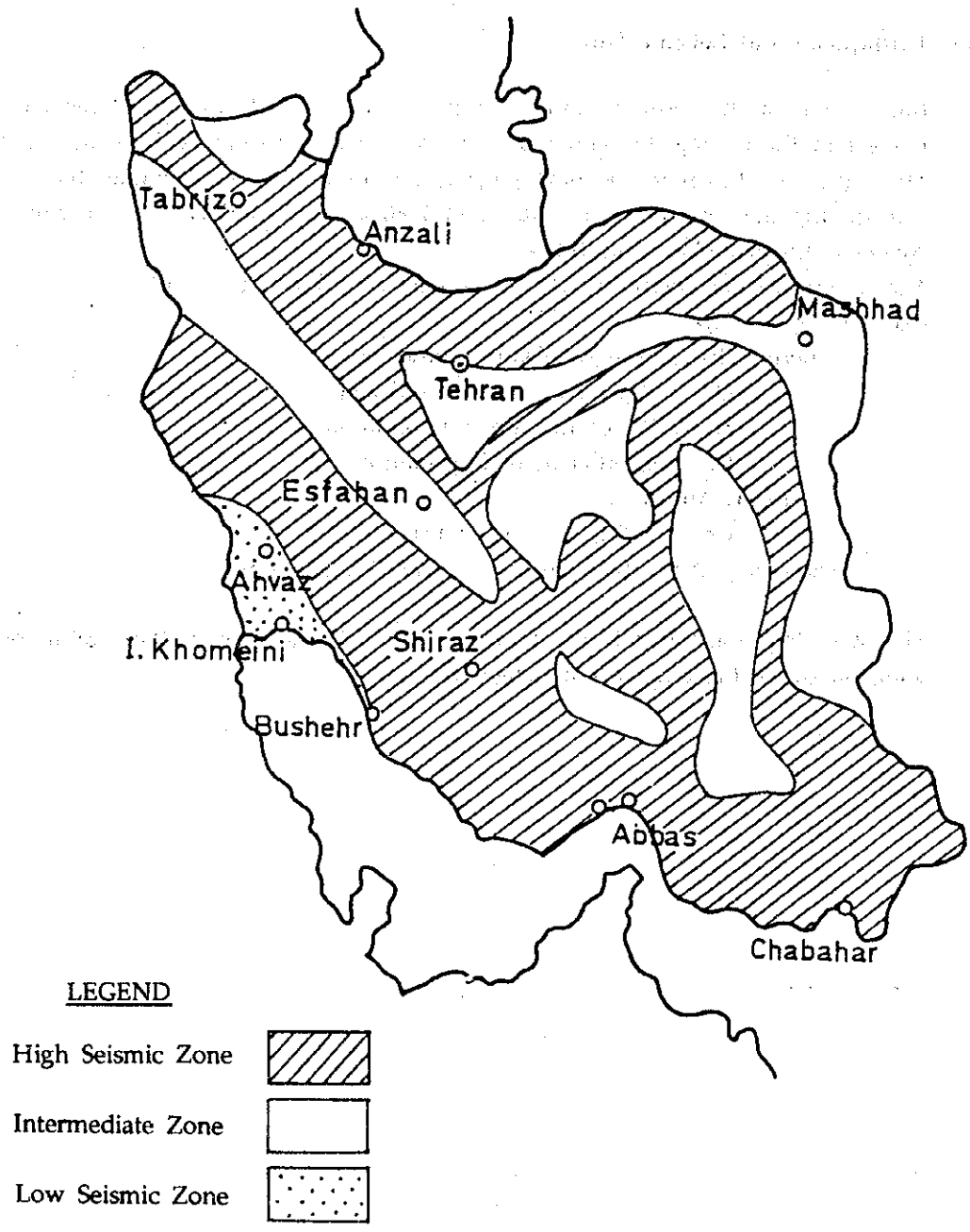
Where; dSc : Design seismic coefficient
Cr : Regional seismic coefficient
Sc : Factor for sub-soil condition
Ci : Coefficient of importance

in case at Anzali,

Cr = 0.1, Sc = 1.2, Ci=1.5

Therefore, dSc = 0.18 (refer to Table-8.1.2 to 8.1.5)
= 0.2

The other important item in the area consisting of sand layer is the careful consideration on the stability against liquefaction.



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

Figure 8.1.10.1 Seismic Zoning Map in Iran

Table 8.1.10.1 Regional Seismic Coefficients

Region	District	Regional Seismic Coefficient
1st Region	Hokkaido (Nemuro, Kushiro, Tokachi & Hidaka) Kanto (Chiba, Tokyo & Kanagawa) Chubu (Shimuoka, Aichi & Fukui) Kinki Shikoku (Tokushima)	0.15
2nd Region	Hokkaido (Ishikari, Iburi, Shiribesh, Hiyama, Oshima, Rumoi) Tohoku Kanto (Ibaragi) Chubu (Niigata, Toyama & Ishikawa) Shikoku (Ehime, Kochi & Kagawa) Chugoku (Tottori, Okayama, Hiroshima & Shimane) Kyushu (Oita, Miyazaki, Kumamoto & Amami Is.)	0.10
3rd Region	Hokkaido (Soya & Abashiri) Chugoku (Yamaguchi) Kyushu & Okinawa (Fukuoka, Saga, Nagasaki, Kagoshima except Amami Is. & Okinawa)	0.05

Note: Source: Japanese Standard

For the factor for sub-soil condition, the value shown in Table 8.1.10.2 sould be taken. Sub-soil classes shall be determined according to Table 8.1.10.3 in consideration of the thickness of the quarternary deposits such as alluvium and diluvium.
The coefficient of importance shall be determined in accordance with the value in Table 8.1.10.4 depending on the degree of importance of the structure concerned.

Table 8.1.10.2 Factors for Sub-soil Condition

Subsoil Class	Class 1 Sub-soil	Class 2 Sub-soil	Class 3 Sub-soil
Factor	0.8	1.0	1.2

Note: Source: Japanese Standard

Table 8.1.10.3 Subsoil Classes

Thickness of Quarternary Deposits	Sand Gravel Layer	Ordinary Sand, Clay Subsoil	Poor Subsoil
Less than 5m	Class 1	Class 1	Class 2
5-25m	Class 1	Class 2	Class 3
More than 25m	Class 2	Class 3	Class 3

Note: Source: Japanese Standard

Table 8.1.10.4 Coefficient of Importance

Classification of Structure	Character of Structure	Coefficient of Importance
Special Class	Structures of which the charactors (1)-(3) are strongly evident among the characters in Class A.	1.5
Class A	(1) Structures tending to cause loss of life and property upon seismic damage. (2) Structures playing an important role in recovery from earthquake disaster. (3) Structures handling hazardous materials and tending to cause serious damage to life or property upon seismic damage. (4) Structures causing serious influences on the economic and social activities of areas concerning seismic damage. (5) Structures of which considerable difficulty is expected for recovery from seismic damage.	1.2
Class B	Structures other than the Special Class, Class A and Class C.	1.0
Class C	Small structures other than the Special Class and Class A, and permitting recovery with ease.	0.5

Note: Source: Japanese Standard

8.1.11 Surcharge (Deadweight and Load)

a) Deadweight

When the unit weight of materials for obtaining the deadweight are not known, the values shown in Table 8.1.11.1 should be taken.

Table 8.1.11.1 Unit Weight of Materials

Materials	Unit Weight
Steel	7.85
Casting steel	7.85
Casting iron	7.25
Plain concrete	2.3
Reinforced concrete	2.45
Timber	0.8
Asphalt concrete	2.3
Stone	2.6
Sand/gravel/rubble in dry condition	1.6
// in wet conditon	1.8
// in saturated condition	2.0
// effective weight in water	1.0

Note: Source: Japanese Standard

b) Surcharge

for container yard (3 stacks of loaded)	3.0 t/sq.m
25t/8ft x 40ft = 0.87 t/sq.m	
Bulk and general cargo yard	1.0 t/sq.m
Berth apron	1.0 t/sq.m
Steel yard	4.0 t/sq.m
quay/yard crane lifing capacity	40 t/unit
Total weight (own weight + load)	300 t/unit
Container crane	600 t/unit
Traffic loads	
(Tractor/triller + 40 ft container)	35 t/unit

Note: Based on local condition

8.2 Preliminary Design of Main Facilities

8.2.1 Preface

On the study of the Master plan up to 2010 and the feasibility study of the short-term plan up to 2000, this chapter deals with the preliminary design of the required port facilities which are described in Chapter 7 and 8.

The design is based on the following conceptional items.

1) To base on [Technical Standards for Port and Harbour Facilities in Japan] with carefully consideration to Iranian local situation and condition.
2) To consider the stability of the structures.
3) To consider the economical design.
4) To consider proper design for the construction works at the site without any technical difficulties.
5) To use as possible as the local available materials and workers.

8.2.2 Preliminary Design of Main Facilities

(1) Quaywall

There are various kinds of the berthing facility types mentioned below for ships. Among of them, 2 or 3 types will be selected for the ship's berthing considering the site conditions.

1) Type of quaywall

These types are shown in Appendix III-5.

a. Concrete block
b. L-shaped wall
c. Concrete caisson
d. Cellar bulkhead
e. Concrete monolith
f. Steel Sheet Pile (SSP)
g. Concrete pile pier with vertical piles
h. Concrete pile pier with batter piles
i. Dolphin
j. Floating pontoon
k. SEP

2) Primary comparative study of each berthing type

The various design types of the quaywall facility were described in the section 8.2.2). 1). Among them, more proper types of 2 or 3 for the proposed facility will be selected considering the following three (3) elements for the evaluation of the comparative study.

a) Stability
b) Cost
c) Non difficulty for the implementation of the works.

The study is summarised as shown in the following table.

Table 8.2.2.1 Comparison table of Each Type of Quaywall

	Description	Stability	Cost	Workability	Evaluation	
a.	Concrete Block	N	G	G	N	
b.	L-shaped wall	N	G	G	N	
c.	Concrete caisson	G	N	M	N	
d.	Cellar bulkhead	G	N	N	N	
e.	Concrete Monolith	G	N	N	N	
f.	SSP	G	G	G	G	R
g.	Concrete Pile Pier (CPP, vertical piles)	G	G	G	M	
h.	CPP with batter piles	G	G	G	G	R
i.	Dolphin	G	G	G	M	
j.	Flating pontoon	N	G	G	N	
k.	SEP	G	N	G	N	

[Note] G: Good, M: Midium, N: No good, R: Recommend,
SSP: Steel Sheet Pile, CPP: Concrete Pile Pier,
SEP: Self Elevating Pontoon

According to the above evaluation on each type of quaywall, the type f. SSP or type h.
CPP are recommended for the proposed wharves at Anzali port.

3) Secondary selection of proposed type

Two (2) alternatives are compared with more details.
Tentative designs of these alternatives are shown as follows.

The costs of these two (2) alternatives are as follows.

Alternative-1 SSP type quaywall	40,000	US$/m
Container crane foundation	7,000	US$/m
Sub-total	47,000	US$/m
Alternative-2 CCP with batter piles	31,000	US$/m
Container crane foundation	7,000	US$/m
Sub-total	38,000	US$/m

4) Evaluation of 2 Alternatives

A-1 SSP:

Advantage:
1) It is experienced type because it is the same as existing quaywall
2) It is easy to be carried out for the construction and takes shorter period for construction
3) It needs a few maintenance works/items

Alternative-1

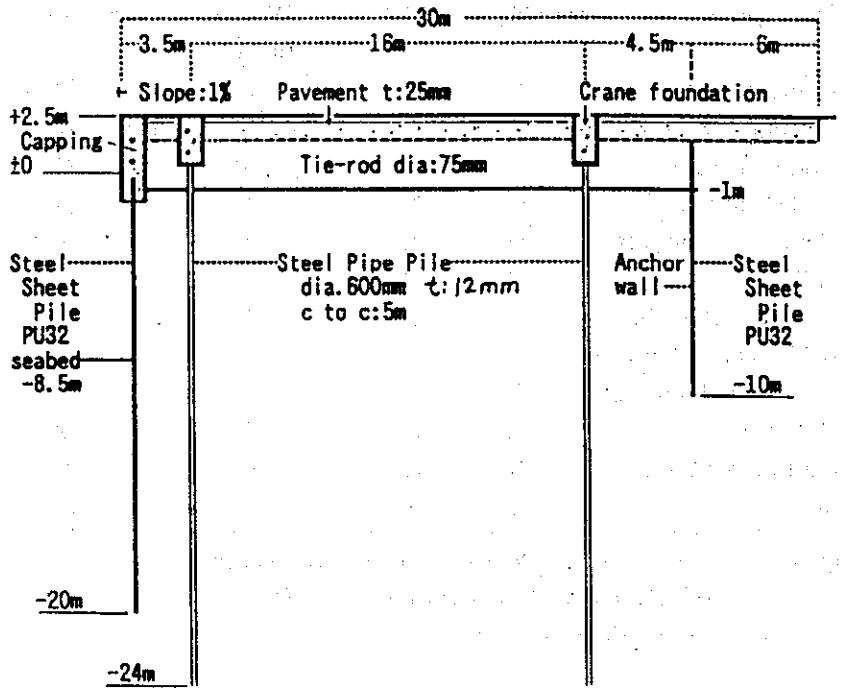


Figure 8.2.2.1 Typical Cross-Section of Proposed Quay wall

Alternative-2

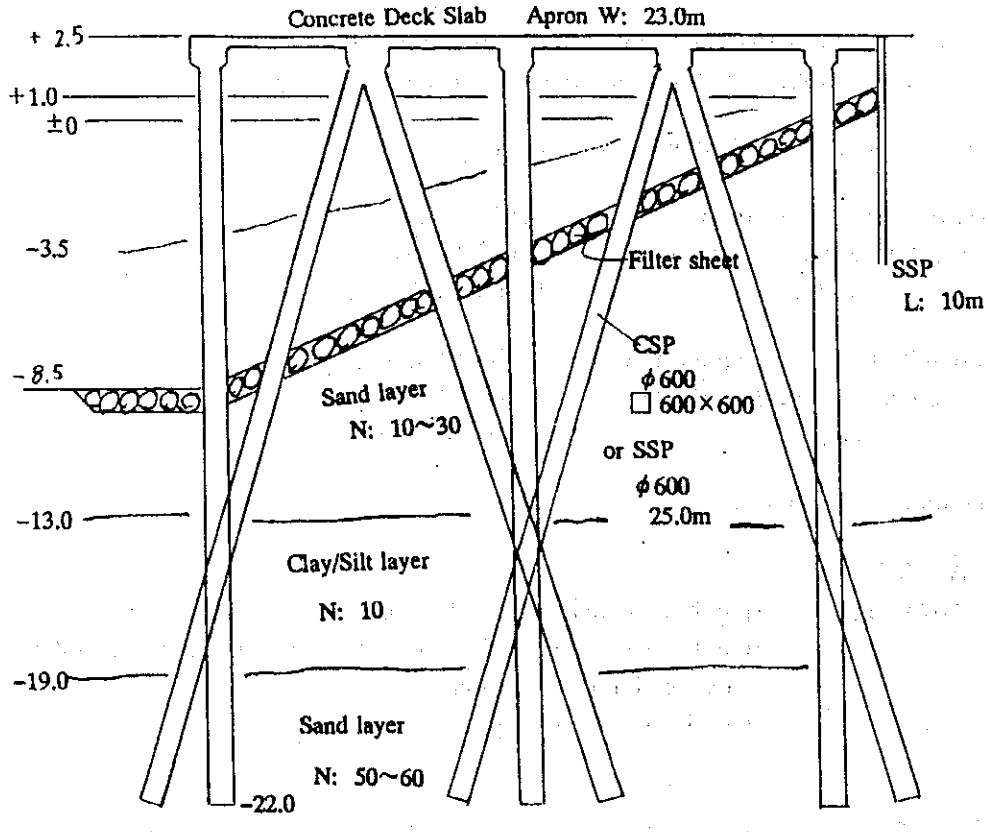


Figure 8.2.2.2 Typical Section of Concrete Piles

Disadvantages: 1) More higher cost is required for procurement of steel sheet piles due to the imported one.
2) The stability against liquefaction is required esp at the time of an earthquake.

A-2 CPP:

Advantages: 1) More economical
2) Experienced type in Iran
3) More stable for liquefaction

Dis-advantage: 1) There are some difficulties for construction and takes longer period
2) There are some difficulties for maintenance

5) Proposed type of quaywall

According to comparative study, the Steel Sheet Pile (SSP) type of quaywall structure is recommended for the new wharves.

(2) Breakwater

1) Types

There are various types of the breakwater mentioned below as the same as the quaywall.
Among them, 2 or 3 types will be selected for the proposed breakwater considering the site conditions.
These types are shown in Appendix A3-6.

a) Stone mound
b) Stone mound with Armour stone
c) Concrete block-1
f) Combined type (Caisson + Block)
g) Over-flow type
h) Submarine type
i) Air/water jet type
j) Caisson with holes
k) SSP Double wall

2) Primary Comparison of each type of Breakwater

Item	Stability	Cost	Workability	Applied Evaluation	
a) Stone	G	G	M	0 to -2	
b) Armour	G	G	M	-2 to -3	
c) Concrete Block-1	G	G	G	-2 to -3	
d) Concrete Block-2	G	G	G	-4 to -6	R
e) Concrete Caisson	G	M	G	-10 to -12	
f) Caisson + Block	G	M	G	-7 to -9	R
g) Over-flow	G	M	G	-6 to -10	
h) Sub-marine	M	G	N	-5 to -8	
i) Air/Water Jet	M	G	N	-3 to -15	
j) Caisson with hole	G	M	G	-10 to -15	

[Note] G: Good, M: Midium, N: No good, R: Recommend

According to the above evaluation on each type of breakwater, the team would recommend type d for shallow water area and type f for deeper water area in the sea.

3) Cost of 2 Alternatives

A1: Concrete Block-2 (Stone + Concrete Block)

According to the existing data on the renovation work of the breakwaters -6 m deep, the unit cost of the breakwater is:

12,000 US$/lin.m

A2: Caisson + Block

Design water depth: -8.0 m below CD

10,000 US$/lin.m

4) Evaluation of 2 Alternatives

A-1 Concrete Block-2 (stone + concrete block)

Advantages:
1) Experienced type the same as the existing one
2) Lower cost
3) Applicable for sea water depth of -4 to -6 m

Disadvantages:
1) Ratio of cost increasing should be up according to deeper water depth
2) Difficulty of demolishment

A-2 Concrete Caisson + Block
Advantage: 1) Applicable for sea water depth of -7 to -9
Disadvantage: 1) A few experienced type on caisson

5) Proposed type of breakwater

According to the comparative study, the combined type with stone and concrete block of the structure is recommended for the new breakwater. The typical cross-section of the proposed breakwater is shown in Figure. below:

6) Alternative type to be removed

If the constructed breakwater is required to be removed or demolished after the Master Plan, the SSP double wall type of breakwater is recommended.
(refer to Appendix IV-5)

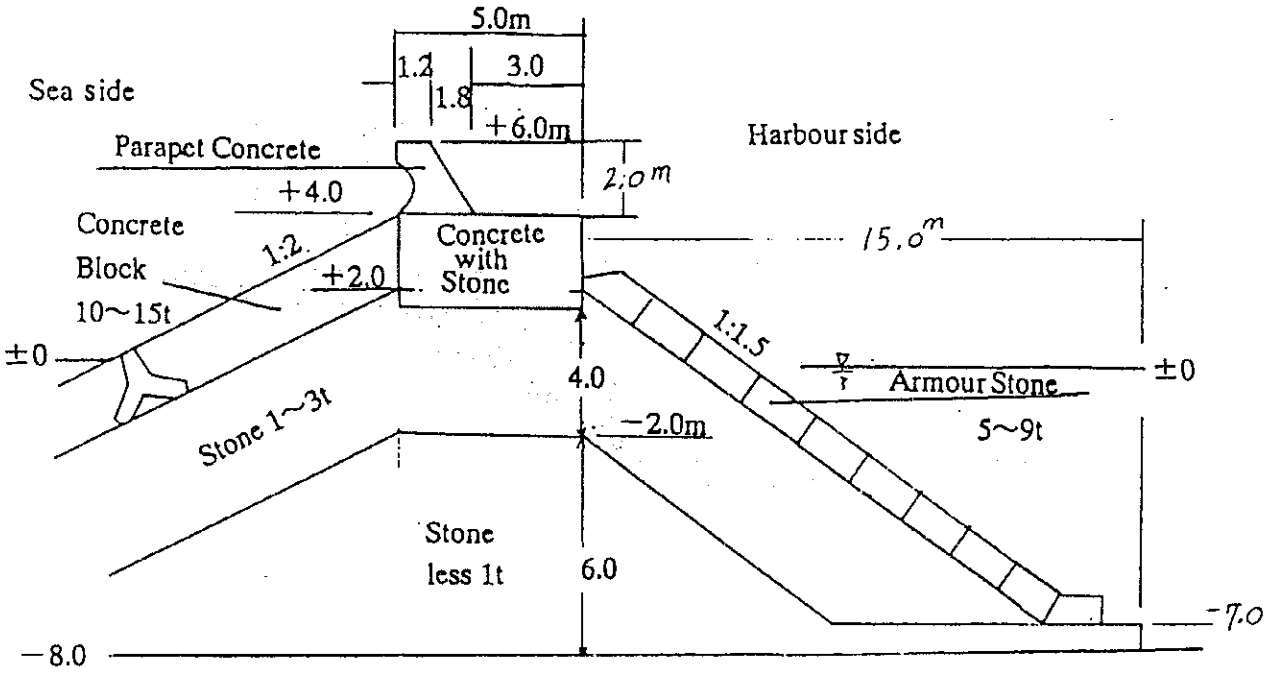


Figure 8.2.2.3 Typical Cross-section of Proposed Breakwater

(3) Seawall

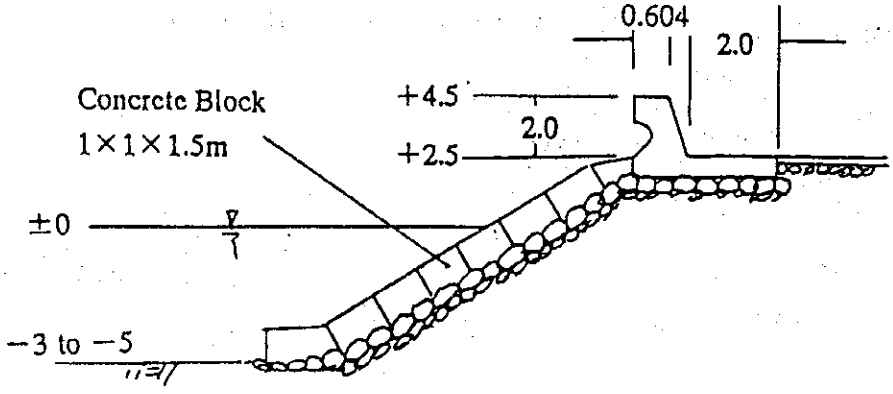
There are various types of the seawall well same as the quaywall. According to the comparison study mentioned below, the concerned block with the concrete parapet wall type is recommended.

2) Comparison

Description	Stability	Cost	Evaluation
a) Stone	G	G	
b) Armour stone	G	G	R
c) Concrete Block	G	G	R
d) Concrete	G	M	R
e) Sheet Pile	G	N	
f) Concrete wall (L-shaped)	G	N	

Note: G: Good, M: Midium, N: No good, R: Recommended

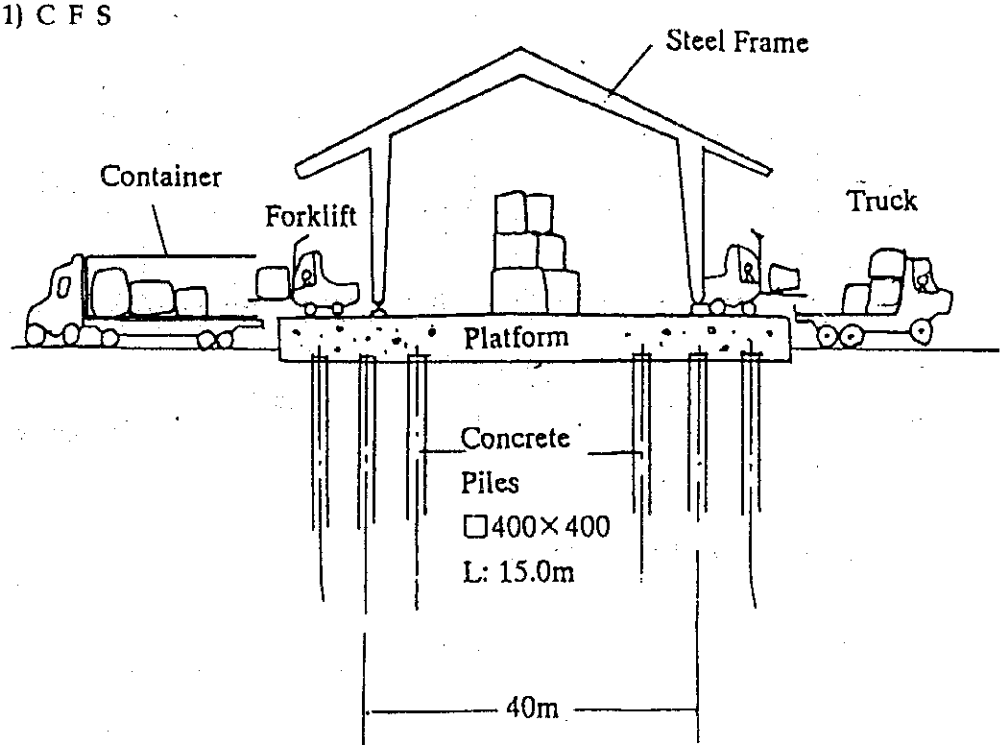
The typical cross-section of this type is shown below.



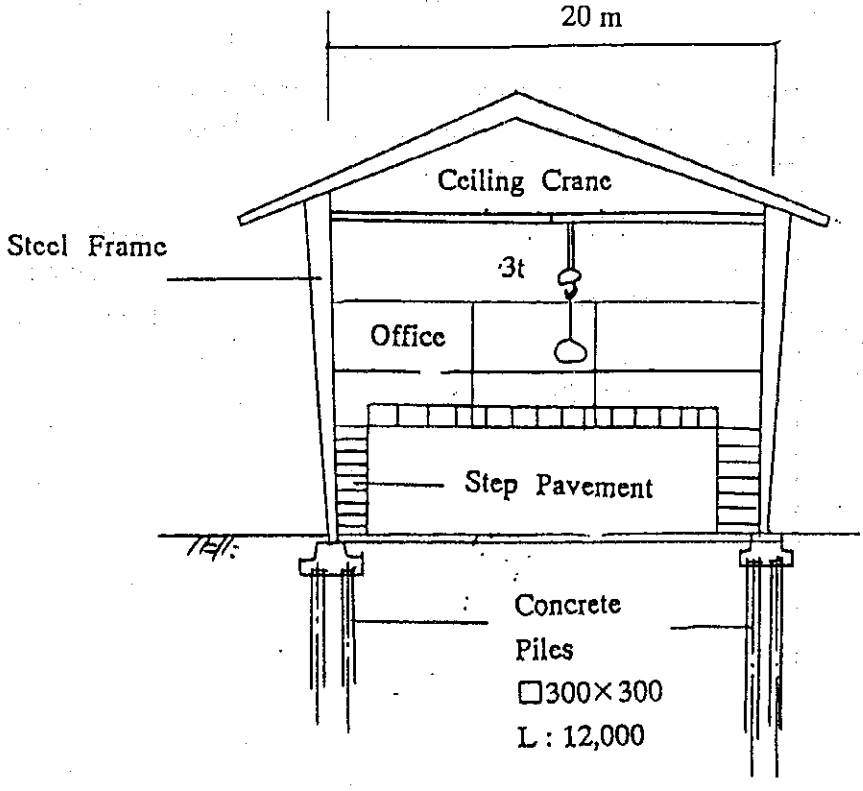
(4) Other Facilities

The other facilities such as CFS, Maintenance Shop, Port Road, Improved Quaywall and Grain Silo are shown in following figures.

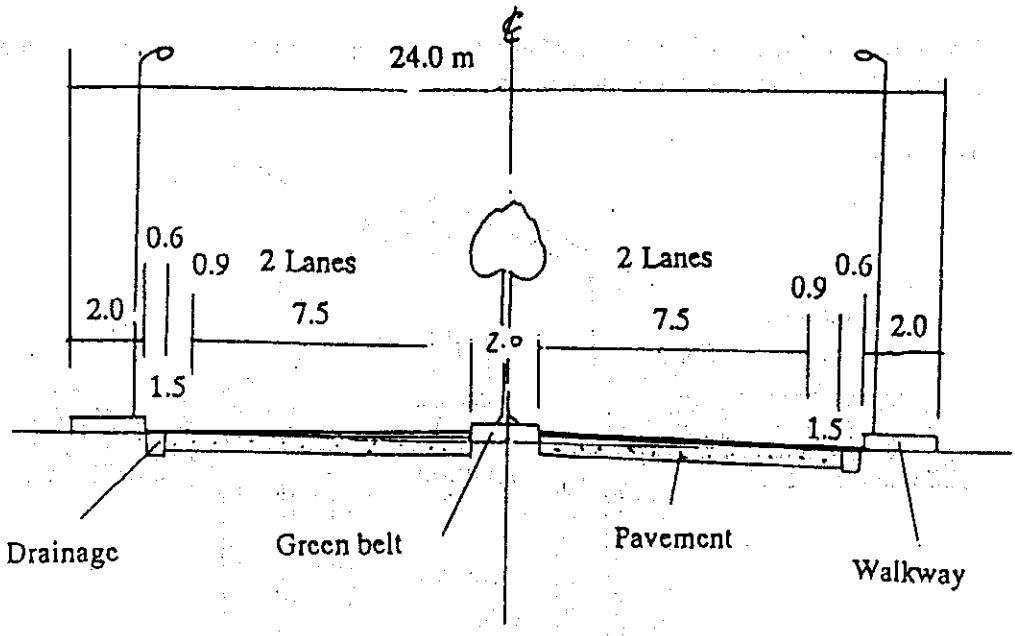
1) C F S



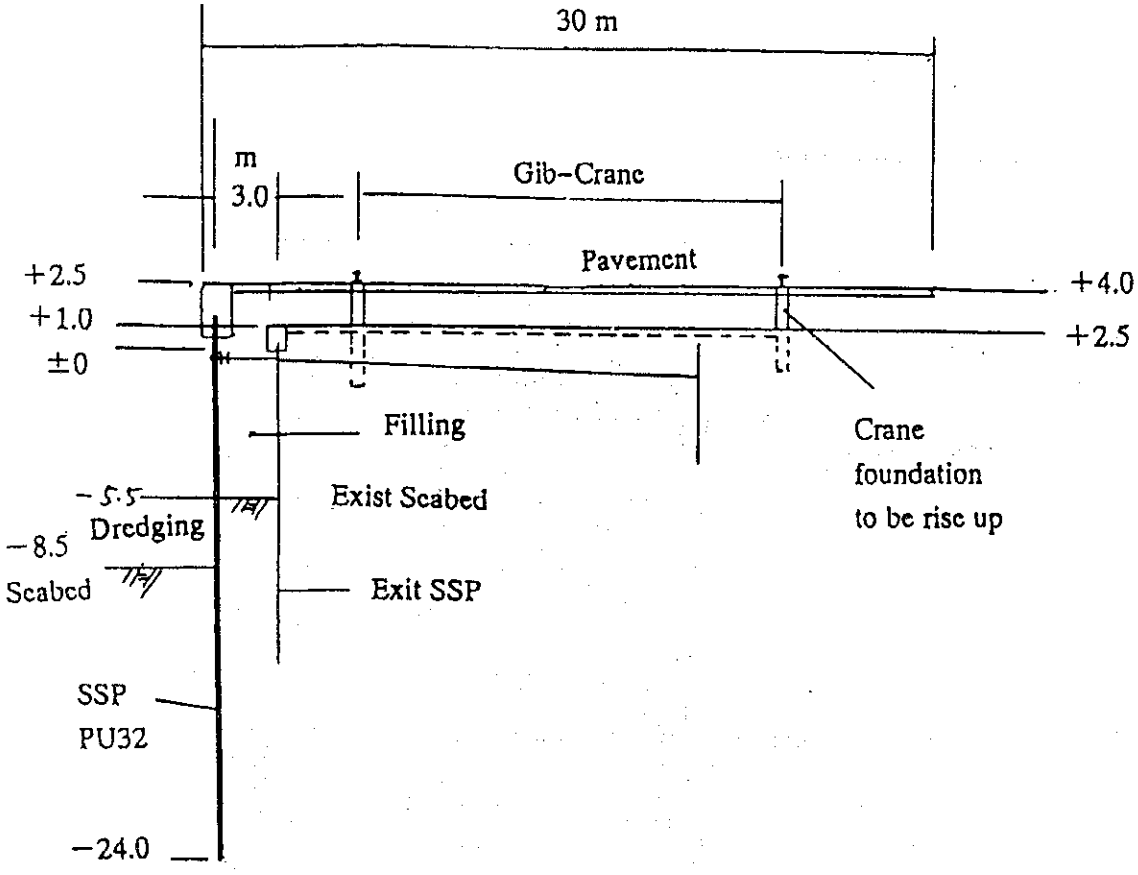
2) Maintenance Shop



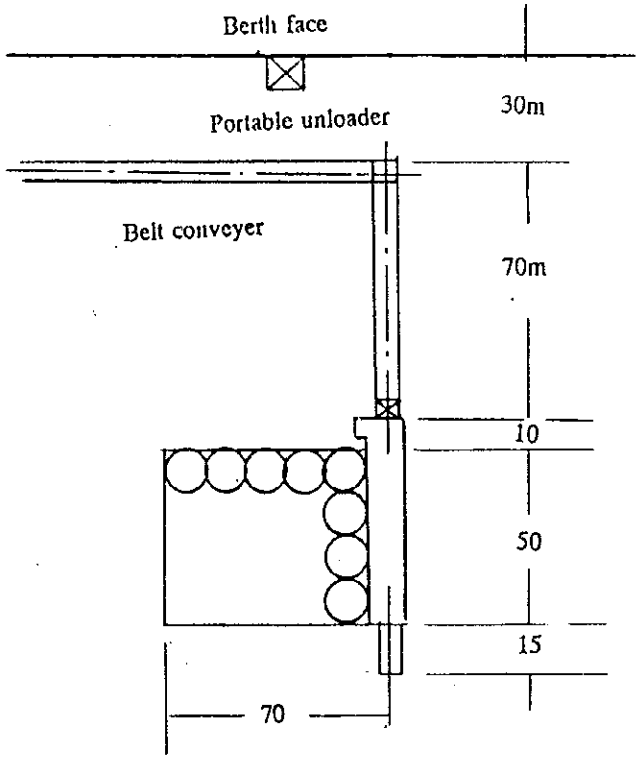
3) Port Road

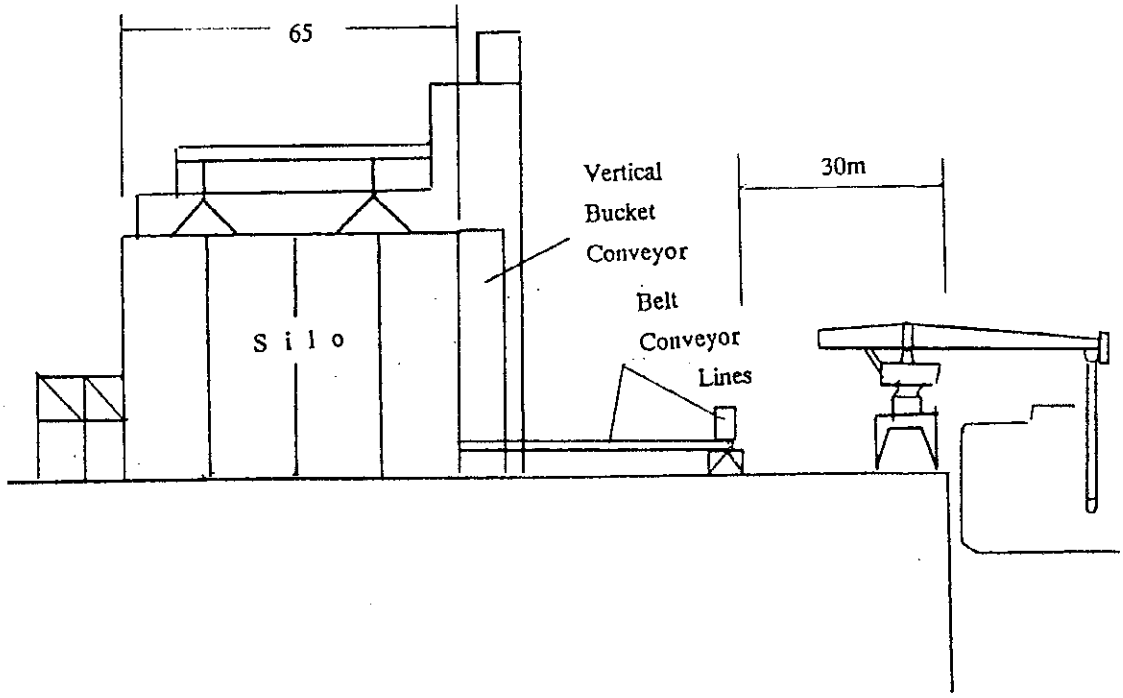


4) Improved Quaywall of Existing one



5) Grain Silo


Berth face
Portable unloader
30m
Belt conveyer
70m
10
50
15
70


65
Vertical
Bucket
Conveyor
30m
Belt
Conveyor
Lines
S i l o

Chapter 9

Navigation Aides

Chapter 9 Navigation Aides

9.1 Navigation Channel and Basins

The current depth of the navigation channel and basins in Anzali Port is -5.5 m at the shallowest point. The channel width is about 50 m at its narrowest. The depth and the width shall be increased to secure safe navigation for all calling ships in target years of the Master Plan and the Short Term Plan. (See section 3.4.)

The maximum ship size forecast in section 3.4 is 8,500 GT for tanker, followed by 6,000 GT for dry cargo ship. However, since the present largest tanker on the Caspian Sea is about 8,500 GT., the maximum calling tanker at Anzali Port is assumed 8,500 GT. A water depth of -8.5 m and a width of 140 m for the channel and basin between the port mouth to the tanker berths should therefore be secured. The depth of channel or basin where tankers do not pass should be -6.5 m in the Master Plan.

In the Short Term Plan, the maximum ship size is 5,500 Gt for tanker and 5,000 Gt for dry cargo ship. A water depth -6.5 m for the channel and basin between the port mouth to the tanker berths is required. The depth of channel and basin where tankers do not pass should be -6.0 m.

9.2 Rehabilitation Plan and Short-Term Development Plan

The following factors should be borne in mind;

* Removal of the wrecks
  (near the Naval area)
* Maintenance and accurate positioning of light buoys and beacons
  (Periodical maintenance dredging and sounding of the channel)

Chapter 10

Preliminary Design of Cargo Handling Equipment

Chapter 10 Preliminary Design of Cargo Handling Equipment

10.1 Basic Strategy of Preliminary Design of Cargo Handling Equipment

Basic strategy of preliminary design of cargo handling equipment is as follows.

(1) All cranes to be installed at the exclusive berth will be of a rail-mounted type

(2) All cranes, except portal jib crane, to be installed at the general cargo berth will be of a tire-mounted type and they can be used at any berth.

(3) All bulk grain will be handled by pneumatic unloaders to prevent air pollution.

(4) Cargoes except bulk of large ships at the general cargo berth where jib cranes are not installed will be handled by ship gears.

(5) Two(2) sets of handling equipment per ship are normally required.

(6) Prevention of air pollution shall be considered for all equipment handling bulk cargoes.

(7) Rail-mounted equipment for handling cargoes do not have any spare equipment.

(8) Tire-mounted equipment for handling cargoes will have basically 10% spare equipment for preventive maintenance and collective maintenance.

(9) Cargo handling from/to ships at the berth with lib cranes Cargoes from/to ships will be handled by jib cranes.

(10) Cargo (metallic) handling at the apron,yard and the shed 80% of cargoes will be stored provisionally at the transit shed or the open yard.
Half of cargoes to be stored will be handled by fork-lift trucks with a unit-load system and the rest will be handled by mobile cranes and chassis.

(11) Cargo (except metallic) handling at the apron,yard and the shed 80% of cargoes will be stored provisionally at the transit shed or the open yard.
Three quarter of cargoes to be stored will be handled by fork-lift trucks with a unit-load system and the rest will be handled by mobile cranes and chassis.

(12) Required capacity of the mobile cranes

For from/to ships	60 t and 40 t
For yard	40 t and 25 t

(13) Required capacity of the fork-lift trucks 3 t and 5 t

(14) The design conditions for silo are as follows:

1) Total volume to be handled	444,000t/y
2) Storage ratio	80%
3) Peak ratio	1.3
4) Turnover	24 times/year
5) Specific gravity	0.75

10.2 Designs of Cargo Handling Equipment and Related Equipment

10.2.1 Dry Cargo (Steel,General Cargo,)(-5.5, -8.5 x 3)

(1) Jib Cranes

For from/to ship	16 t	2 Units
	10 t	1 Unit
For Yard	10 t	2 Units

(2) Mobile Cranes

For from/to ship	60 t	1 Unit
	40 t	2 Units
	30 t	2 Units
For Yard	40 t	2 Units
	25 t	2 Units

(3) Fork-lift Trucks	5 t	8 Units
	3 t	10 Units
(4) Trailers		4 Units

10.2.2 Dry Bulk (-8.5)

(1) Tire-mounted pneumatic unloaders

	150 t/h	2 Units

10.2.3. Container (-8.5)

(1) Mobile crane	100 t	2 Units

(2) Transfer Cranes (Tire-mounted)

	30.5 t	1 Unit
	20.t	2 Units

(3) Fork-lift Trucks

For general services	20 t	1 Unit
For empty	5 t	1 Unit
	3 t	1 Unit

	2 t	Units
(4) Tractors		7 Units
(5) Chassis		8 Units
(6) Truck Scales		1 Unit

10.3 List of the Total Handling Equipment to Be Required

The total required handling equipment will be counted by both the totalling of required equipment of each cargo and following factors.

1) Working time ratio: It is assumed to be 0.6 considering the berth occupancy.
2) Direct delivery ratio: It is assumed to be 0.2
3) Spare equipment: It is assumed to be 0.1 of the required equipment.

The results of calculation are shown in Section 10.2.1.

10.4 Preliminary Cost Estimation

10.4.1 List of The Total Handling Equipment to Be Procured

The total handling equipment to be procured is balance of the existing available equipment and the total handling equipment to be required.
The results are shown in Table 10.3.1.

10.4.2 Preliminary Cost Estimation

The results of preliminary cost estimation are shown in Table 10.4.2.1.

Table 10.4.2.1 List of Equipment

Units: 1,000 US$ (ANZALI)

	Capacity	Existing	Unit Price	Master Plan			Short Term			Remarks
				Required	Procurement	Cost	Required	Procurement	Cost	
Portal Jib Crane	16	2		2	0		2	0		
〃	10	3		3	0		3	0		
Container Crane	30.5 t	0	6,000	6	6	36,000				
Pneumatic Unloader	280 t/h	0	4,000	2	2	8,000				
〃	150 t/h	2					2	0		
Silo	19,240 t	0	5,000	1	1	5,000				
Related Equipment		0	10,000	1	1	10,000				
Transfer Crane	30.5	0	2,500	3	3	7,500	1	1	2,500	
〃	20 t	0	2,000	14	14	28,000	2	2	4,000	
Mobile Crane	100 t	0	1,500				2	2	3,000	
	62 t	1								
	60 〃			1	0		1	0		
	40 〃	4		4	0		4	0		
	30 〃			2	0		2	0		
	25 〃	3		3	0		2	0		
	20 〃	1			0			0		
	16 〃	2			0			0		
	15 〃	2			0			0		
	10 〃	3			0			0		
	6 〃	1			0			0		
Fork-lift Truck	42 〃	2			0			0		
	40 〃	0		1	0			0		
	20 〃		300	2	1	300	0	0		
	13.5 〃	1			0			0		
	10 〃	5			0			0		
	7.5 〃			1	0			0		
	7.0 〃	2			0			0		
	5 〃	2		11	0		4	0		
	4.5 〃	2		0	0		0	0		
	3 〃	0	35	11	11	385	6	6	210	
	2 〃	0	25	5	5	125	2	2	50	
							0	0	0	
Tractor Head			150	37	13	1,950	8	0	0	
Trailer		28	0	4	0	0	4	0	0	
Chassis			50	46	22	1,100	9	0	0	
Truck-scale			150		3	450		1	150	
						98,810			9,910	

10.5 Maintenance and Repair

(1) Basic strategy

In order to keep each piece of handling equipment in a condition of safety and to make the most of its original function display, maintenance (checking and repair) is dispensable.
Therefore effective maintenance system shall be established.
Maintenance can be divided roughly into two categories.
1) Preventive maintenance
2) Corrective maintenance

(2) Preventive maintenance

Preventive maintenance is to check and repair before the equipment breaks-down or its function deteriorates, and to avoid breaking-down and ensure its original function. On the other hand, corrective maintenance is a passive form of maintenance which are restored the original function of the equipment by carrying out repairs after the trouble occurred. In order to handle cargo economically, cargo handling equipment must be used economically, on the following basic concepts:
1) To ensure the high operating availability ratio
2) To ensure preventive maintenance costs and corrective maintenance costs to minimizes.

a) Operating availability ratio is determined by the sum of preventive maintenance days and corrective maintenance days.
b) Number of corrective maintenance (number of break-down x number of average days required for repair) depends on the quality of preventive maintenance.
c) Corrective maintenance cost (number of break-down x average required cost) depends on the quality of preventive maintenance cost.
d) The kind of spare parts to be kept will be reduced by sufficient preventive maintenance.

Optimum preventive maintenance level shall be established to get minimum maintenance cost.

(3) Maintenance Shop

It is desired to have sufficient maintenance shop for handling equipment and to maintain the equipment in good condition.
A minimum required machinery for maintenance shall be prepared in the shop.

However, it will be recognized that parts will be made at the shop in emergency only and it is not normal work to make parts at the shop.

(4) Spare parts

To stock a sufficient amount of spare parts is necessary for reducing the maintenance period, but stocking too many spare parts is not preferable measures because of the resulting heavy financial burden.

The most appropriate amount of spare parts to be stocked must be determined from economical point of view.

The biggest and the only merit of stocking spare parts is the reduction of the maintenance period. The demerits, on the other hand, are as follows:

1) Burden of interest
2) Inventory control costs
3) Losses caused by deterioration of quality attendant on long term inventory.

Therefore, the most appropriate amount of spare parts is determined by the time loss occurred from non-working hours of equipment, the interval of parts required, term of deliver and units cost.

On the other hand, the required term of internal procedure for spare parts procurement shall be shortened.

The number and types of spare parts have been increased and inevitably, management work has become complicated. Therefore it is recommended to use computer fully for spare parts management.

10.6 Outline of the Large Equipment(tentative)

10.6.1 Container Crane

Hoisting capacity		
Under Spreder	For Hatch cover	35.6 t
	For Container	30.5 t
Outreach		27 m
Rail gauge		14 m
Lift (total)		27 m

10.6.2 Containr Transfer Crane

(1) For 40 '

Hoisting capacity (Under spreader)	30.5 t
Span	23.47 m
Lift	12.2 m

(2) For 20 '

Hoisting capacity (Under spreader)	20 t
Span	23.47 m
Lift	10.0 m

10.6.3 Grain Terminal

(1) Silo

Total capacity		19,240 t
Number of silo bins		20 bins
Type of silo		Reinforced concrete
Shape	Independently self-standing	Cylinder Shape
Dia of silo (inside)		11 m
Hight (from grand to top of silo bin)		Approximate 23 m

(2) Handling Equipment

Receiving line	300 t/h x 2 lines
Delivery line	300 t/h x 2 lines
Recycle line	100 t/h x 1 line

(3) Others

Weighing equipment	1 Unit
Fumigation equipment	1 Unit
Removal equipment for foreign material	1 Unit
Dust collection equipment	1 Unit
Safety measures	1 Unit

Chapter 11

Project Implementation and Stage Development

Chapter 11 Project Implementation and Stage Development

11.1 Basic Strategy

The major problem at Anzali Port is the rising water level of the Caspian Sea mentioned in section 5.1.2. It is therefore necessary to raise the crown heights and the aprons for Q1, Q2, Q3 and Q4. The reconstruction of Q5(N1) and construction of the quay walls for the two new berths, namely, N2 and N3, and their aprons should at least be completed by the end of 1999.

Almost of all the cargo handling volume in Anzali is handled from Q1 to Q4. Q5 is mostly used for mooring or working crafts with little cargo handling, Because the length of the berth is too short and width of the basin in front of the quay wall is narrow. Q1 will cease to be used when the calling ships increase in size. According to the demand forecast, mentioned in section 3.1, the cargo handling volume in 2000, the target year for the short term plan of this study, will amount to approximately 1,810,000 tons (the cargo volume excluding liquid bulk is about 1,000,000 tons). If this cargo is to be handled at Q2, Q3 and Q4, approximately 2,060 tons will be handled in a year per meter berth length. In addition, when liquid bulk cargo is included in this estimate, the congestion at berths is expected and the number of ships waiting for berthing will iincrease. (This will be confirmed by simulations in the study of the Short term plan)

The stage development plan of this project will give due consideration to the above situation.

11.2 Stage Development

The tentative stage development plan of this project is as follows:

1) Construction of a new breakwater approximately 500m in length, improvement of Q5, construction of the quay wall and apron of the two new multi-purpose berths with the open yard at 100 meter depth to inland from the face line of the pier, raising Q4, and increasing the water depth in front of Q4. These works should be completed by the end of 1999.

2) The following works should be completed until end of 1999, according to the Master Plan. Construction of the breakwater, the mooring facilities, and the cargo handling facilities, improving and relocating the port buildings, improving the back up area and the administration area, improving the roads behind the port facilities, raising and improving Q1 through Q3, and expanding the width and depth of the navigation channel and basins. Before executing these works, a review of cargo handling volumes and the size of calling ships will be conducted in order to make adjustments for any gaps between the plan and the actual situation.

3) After completion of the Master Plan, regular study should be done to grasp trends and movements of the trading partners for socioeconomic condition, the cargo

handling volumes, and the type and size of calling ships. The post-Master Plan will be prepared promptly in order to enable efficient use of port facilities and to avoid the shortage of port facilities.

11.3 Construction Method

This section deals with the implementation method of construction works. The main construction works are including the following items.

a) Wharves (quaywall)
b) Breakwaters
c) Seawalls
d) Dredging
e) Reclamation
f) Administration building
g) Transit shed
h) Container Freight Station
j) Maintenance shop
k) Pavement of Yard
l) Utilities
m) Others

However, almost all items of the above are experienced for the local contractors. So that, in this section, some special items will be described hereinafter.

11.3.1 Dredging and Reclamation

The dredging work by the cutter-suction dredger is more proper method for the reclamation work in which the dredged materials are used for the reclamation. However, in the case that the quantity to be reclaimed is not so large, the hopper-suction dredger is also able to reclaim instead of the cutter-suction dredger although the cost is higher than the cutter-suction one.
Summarizing the above engineering aspect, we will recommend as bellow.

1 Cutter-suction dredger
\+ for Alternative-I
1 Hopper-suction dredger
2 Hooper-suction dredgers for Alternative -II

11.3.2 Breakwater

The height of the proposed breakwater will be measured about 13 m at the most deepest location as shown in the calculation below.

Top elevation of the breakwater:	+ 5.0 m above CD
Bottom elevation of the breakwater:	- 8.0 m below CD
Height of the breakwater:	+ 5.0 m - (-8.0 m) = 13.0 m

In such high height of the breakwater, the proper construction method of the breakwater is using the concrete caisson type instead of the stone mound one due to the quick period for the construction.
However, there are some difficulties to apply this case of concrete caisson method such as the manufacturing yard and the installation etc.
Therefore, we will recommend to use the combined method of the concrete blocks (such as the Tetra-pods) and the stone mound for the safety and stability of the structures. It is also well, experienced method of the Iranian contractors.

11.4 Preliminary Implementation and Stage

11.4.1 Phasing of Project Implementation

The whole projects in Anzali Port are included as shown below.

Project — Short-Term Plan up to 2000/01
Urgent Plan up to 1999/00
Improvement Plan up to 2000/01

Master Plan up to 2010/11

It is necessary to proceed various works for the required facilities by 1999/00 written in Chapter 4.5 and 4.6. However, there is not enough time for the implementation of the works. The proper actions for each development stages are required.

The phasing of the short-term plan shall be proceeded as the following procedure.

(1) Urgent Plan: It is required to rise up the elevation of the existing facilities to cope with the water level will be rising up in the Caspian sea. During these construction period, the port activities should be kept. Therefore, first of all, the new facilities such as the new quaywalls and the expansion of the existing breakwater etc. are implemented.

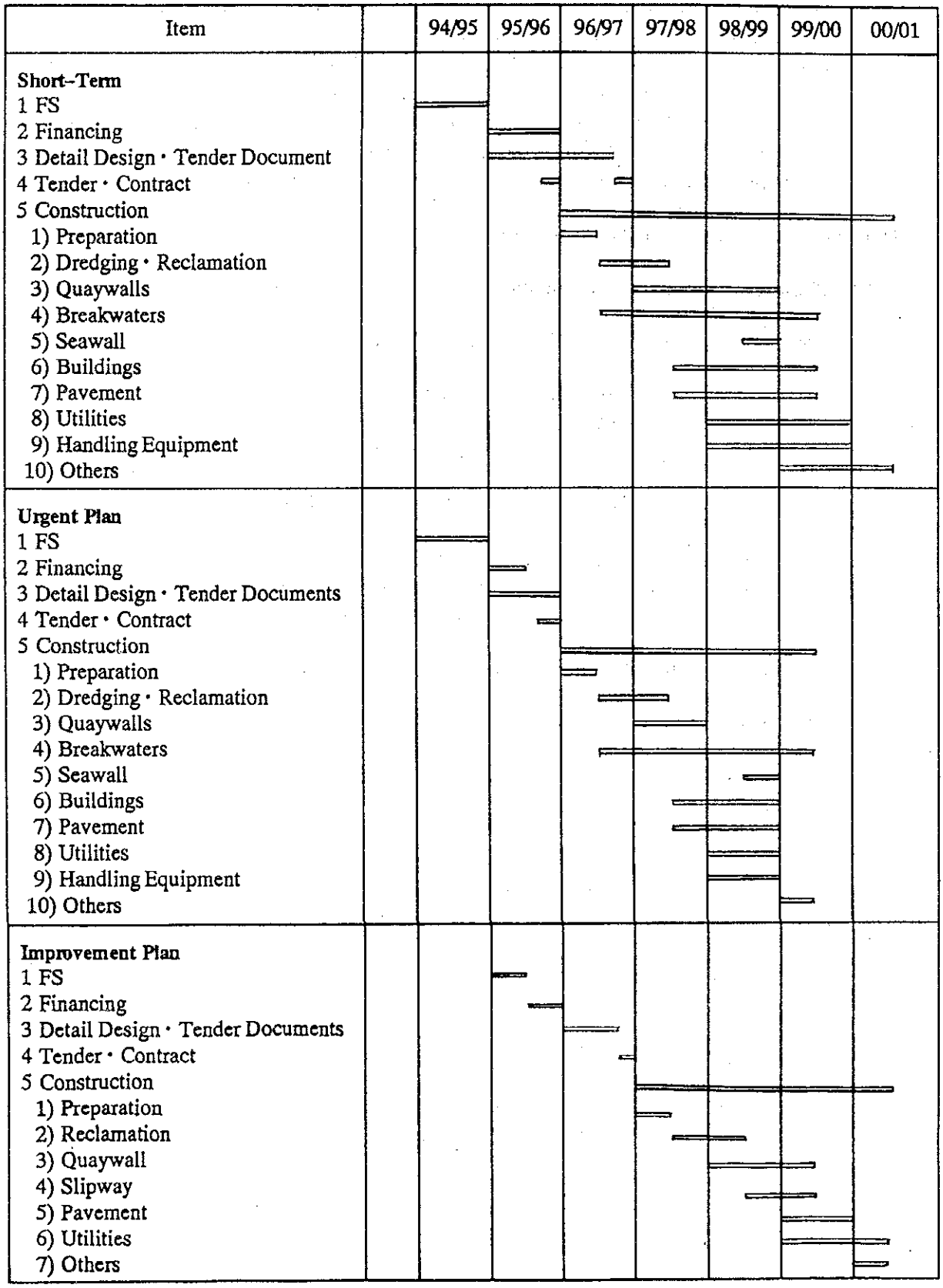
(2) Improvement Plan: The existing facilities such as quaywalls, crane foundations and yards etc. should be rising up for the improvement and rehabilitation.

The working period for the required facilities by 2009/10 is enough for being carried out.

11.4.2 Project Implementation Plan

According to Sub-Section 4.8.1, the project implementation plans are sheduled as shown in the following tables.

Project Implementation Schedule



Chapter 12

Project Cost Estimation

Chapter 12 Project Cost Estimation

12.1 Costing Criteria

The costing criteria is itemized as below.

1) The unit prices are based on the prices of 1993 which are referred to the market prices, the PBO prices and the international prices.
2) The costing currency is U.S. Dollar to avoid the price fluctuation of the Iranian currency.
3) The exchange rate is as below.
   1 U.S. Dollar = 2,000 Rials = 100 Japanese Yen
4) The cost includes the local tax but excludes the import duties.
5) The price contingency is not included noting the stability of U.S. Dollar.
6) The physical contingency is estimated 10%.
7) The engineering fee is estimated 10%.

12.2 Current Basic Unit Price to Be Applied for The Cost Estimate

Table 12.2.1.1 Current Unit Costs

No.	Item/Descriptions	Unit Cost (US$)
01	Portland Cement	80.00/t
02	Cement Type-5	200.00/t
03	Gravel	5.00/m^3
04	Sand	3.00/m^3
05	Stone	5.00/m^3
06	Reinforced Steel Bar	360.00/t
07	Steel Frame	300.00/t
08	Steel Sheet Pile	1,200.00/t
10	Steel Pipe Pile	450.00/t
11	Wooden Form	300.00/m^3
20	Concrete 1:2:4	35.00/m^3
21	Reinforced Concrete with form work	50.00/m^3
22	Earth Moving	1.25/m^3
30	Minimum Labor's Wage	
31	Average Labor's Wage	61.40/month
32	Labor in Marine Works	400.00/month
33	Re-bar Bender	480.00/month
34	Operator	600.00/month
35	Welder	720.00/month
36	Typist	400.00/month
40	Bulldozer D8	14,000.00/month
41	Mobil Crane 15t	10,000.00/month
42	Piling Pontoon	24,000.00/month

12.3 Cost Estimation for Short-term Plan up to 2000

The cost estimate for short-term plan up to 2,000/01 is shown in Table 4.9.3.1.

Table 12.3.1.1 Cost Estimate for Short-term Plan

No.	Description	Quantity	Unit cost US$	Amount US$
New Facilities:				
01	Preparation/Mobilization/Demobilization	LS		6,000,000
02	Dredging/Reclamation	200,000m^3	5	1,000,000
	Dredging/Dumping	800,000m^3	4	3,200,000
03	Reclamation	150,000m^3	5	750,000
04	Multi. Berth, D:-6.5m	695m	47,000	32,430,000
05	Multi. Berth, D:-8.5m	565m	30,000	16,950,000
06	Breakwater, D:-8.0~4.0m	625m		7,000,000
07	Seawall	60m	1,800	110,000
08	Slipway,	LS		1,000,000
09	Buildings			1,190,000
10	Pavement			8,520,000
11				
12	Utilities	LS		2,530,000
13	Others (Navigation aids)	LS		1,300,000
14	Cargo Handling Equipment	LS		11,000,000
15	Sub-total			92,980,000
16	Physical Contingency	10% of 15		9,298,000
17	Engineering Fee	10% of 15		9,298,000
18	Sub-total	16 + 17		18,596,000
	Total	15 + 18		111,576,000

Table 12.3.1.2 Cost Estimate of Urgent Plan

No.	Item	Amount (US$)	Remarks
01	Preparation	5,000,000	Including Mobilization/ Demobilization
02	Dredging/Rec.	4,200,000	
03	Seawall	110,000	Total length 60 m
04	Quaywall	32,430,000	-8.5 m Total length 690 m
05	Breakwater	7,000,000	Total length 500 m
07	Pavement	5,520,000	Road/Yard
09	Gate etc.	590,000	
12	CFS	600,000	Area 2,000 m^2
16~22	Utilities	2,000,000	
23	Navigation Aids	200,000	
25	Environment	300,000	Water quality etc.
26	Handling Eq.	11,000,000	Grain unloader etc.
27	Survey	700,000	Natural condition
	Sub-total	69,650,000	
28	Physical Contingencies	6,965,000	
29	Engineering Fee	6,965,000	
	Total	83,580,000	

Table 12.3.1.3 Cost Estimate of Improvement Plan

No.	Item	Amount (US$)	Remarks
01	Preparation	1,000,000	
02	Reclamation	750,000	Rising up
04	Quaywall	16,950,000	Total length 565 m
06	Slipway	1,000,000	Rehabilitation
07	Pavement	3,000,000	Existing roads
16~22	Utilities	330,000	
27	Others	300,000	Reinforcement of Breakwaters
	Sub-total	23,330,000	
28	Physical Contingencies	2,333,000	
29	Engineering Fee	2,333,000	
	Total	27,996,000	

Table 12.3.1.4 Foreign/Local Portion of Cost

Unit: 1,000 US$

No.	Item	Amount	Portion	Local Currency	Foreign Currency
01	Preparation	6,000	25:75	1,500	4,500
02	Dredging/Rec.	4,950	40:60	1,980	2,970
03	Seawall	110	100:00	110	0
04	Quaywall	49,380	60:40	29,628	19,752
05	Breakwater	7,000	90:10	6,300	700
06	Slipway	1,000	70:30	700	300
07	Pavement	8,520	90:10	7,668	852
08					
09	Gate etc.	590	90:10	531	59
12	CFS	600	60:40	360	240
16	Utilities	2,330	70:30	1,631	699
23	Navigation Aids	200	40:60	80	120
25	Environment	300	60:40	180	120
26	Handling Eq.	11,000	20:80	2,200	8,800
27	Survey	1,000	60:40	600	400
	Sub-total	92,980	57:43	53,468	39,512
28	Physical Contingencies	9,298	57:43	5,300	3,998
29	Engineering Fee	9,298	20:80	1,860	7,438
	Total	111,576	54:46	60,628	50,948

The cost of each item in the short-term plan consists of the costs of plant, materials and labors with the portions mentioned in the table below. The costs of common labors are estimated by 20% of the labor's costs.

Table 12.3.1.5 Cost for Common Labors

Unit: 1,000 US$

No.	Item	Amount	Portion of Plants, Materials, Labors	Local Cost	Common Labor's Cost
01	Preparation	6,000	70:10:20	1,200	240
02	Dredging/Rec.	4,950	70:10:20	990	198
03	Seawall	110	20:40:40	44	9
04	Quaywall	49,380	30:40:30	14,814	2,963
05	Breakwater	7,000	20:40:40	2,800	560
06	Slipway	1,000	30:40:30	300	60
07	Pavement	8,520	30:40:30	2,556	511
08					
09	Gate etc.	590	20:50:30	177	35
12	CFS	600	20:50:30	180	36
16	Utilities	2,330	30:40:30	699	140
23	Navigation Aids	200	30:40:30	60	12
25	Environment	300	30:40:30	90	18
26	Handling Eq.	11,000	80:10:10	1,100	220
27	Survey	1,000	30:40:30	300	60
	Sub-total	92,980	27.0	25,310	5,062
28	Physical	9,298	27.0	2,531	506
29	Contingencies Engineering Fee	9,298	5:5:90	8,368	1,674
	Total	111,576	32.5	36,209	7,242

Table 12.3.1.6 Investment Plan

Investment Plan (Short-term)

Upper line: Urgent
Lower line: Improvement/Rehabilitation

Item		94/95	95/96	96/97	97/98	98/99	99/00	00/01
1 FS								
2 Financing								
3 Detail Design · Tender Document	4.72		3.79	0.93				
4 Tender · Contract								
5 Construction								
1) Preparation	6.00			3.50			1.50	
2) Dredging · Reclamation	4.95				1.00 2.20	2.00		
3) Quaywalls	0.11					0.75 0.11		
4) Breakwaters	49.38				32.43			
5) Seawall	7.00			1.50	2.00	16.95 2.00	1.50	
6) Slipway	1.00							
7) Pavement	8.52				2.52	1.00 3.00		
8) Gate etc.	0.59					0.59	3.00	
9) CFS	0.60					0.60		
10) Utilities	2.33				1.00	1.00		
11) Navigation Aids	0.2					0.20	0.33	
12) Environment	0.3					0.30		
13) Handling Equipment	11.00					5.00	6.00	
14) Survey etc.	1.00					0.70		
Subl-total	92.98		3.79	5.00 0.93	40.15 1.00	15.5 18.70	0.30 9.00 3.63	
Physical Contingencies	9.298		0.298	1.50	2.167 0.333	2.00 1.00	1.00 1.00	
Engineering Fee	9.298			0.578	0.80 *0.50*	0.80 *0.50*	1.00 *0.40*	
Total	111.576		4.088	8.008	43.117 1.833	18.30 20.20	11.00 5.03	

12.4 Cost Estimation for Master Plan up to 2010

(1) Project Cost Estimate

The cost estimate for the master plan based on the costing criteria is shown in the following table. The cost includes not only the construction of the new facilities but also the improving and rehabilitating works of the existing facilities.

(2) Implementation Schedule

Table 12.4.1.1 Implementation Schedule of Master Plan

No.	Description	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
1	Feasibility Study															
2	Finance for Investment															
3	Detail Design Tender Document															
4	Tender Selection of Contractor															
5	Construction															
5-1	Preparation															
5-2	Dredging Reclamation															
5-3	Wharves															
5-4	Breakwater															
5-5	Seawall															
5-6	Facilities on Land															
5-7	Pavement															
5-8	Utilities															
5-9	Others															

Table 12.4.1.2 Project Cost of Master Plan (Alternative-3)

No.	Item	Amount (US$)	Remarks
01	Preparation	6,000,000	Including Mobilization/ Demobilization
02	Dredging/Rec.	9,095,000	
03	Seawall	1,422,000	Total length 790 m
04	Quaywall	76,865,000	Total length 1,970 m
05	Breakwater	32,580,000	Total length 1,600 m
06	Slipway	1,000,000	Rehabilitation
07	Pavement	18,880,000	Road/Yard
09	Gate etc.	310,000	
10	Control Office	9,090,000	Floor area 16,200 m^2
11	Meintenance Shop	2,340,000	Floor area 5,200 m^2
12	CFS	1,980,000	Floor area 6,600 m^2
13	Transit Shed	2,850,000	Floor area 9,500 m^2
14	Warehouse	10,000,000	Including Grain Silo
15	Passenger Terminal	270,000	Floor area 600 m^2
16	Electrical power Equipment	1,400,000	
17	Weighing Facilities	130,000	
18	Water Supply Facilities	1,000,000	
19	Fire Extinguishing Facilities	670,000	
20	Drainage Facilities	670,000	
21	Lighting Facilities	900,000	
22	Correspondence Facilities	1,340,000	
23	Navigation Aids	600,000	
24	Removal Fee	600,000	Breakwater
25	Environment	500,000	Water analysis, Drainage management
26	Handling Equipment	100,000,000	Including Container Crane
27	Others	1,700,000	Survey Equipment etc.
	Sub-total (01~27)	282,192,000	
28	Physical Contingencies	28,219,000	10%
29	Engineering Fee	28,219,000	10%
	Total	338,630,000	