11.3.3 Preparation of Yards for Containers Carried by General Cargo Vessel

In the year 2010, 10% of the containers are carried by conventional type vessel. The type of container in TEUs is as follows:

- Export(Loaded): 11,870 (TEUs)
- Export(Empty): 27,690
- Import(Loaded): 38,770
- Import(Empty): 790

The necessary number of slots are calculated using the same premises as those in Section 11.4 except dwelling times, five days for exported container, and six days for imported containers. The number of slots is 550 TEUs and the area for the yard is 20,000 m^2.

11.4 Expansion Plan

11.4.1 Container Terminal

In order to meet the demand of container handling at the port in 2010, a new full scale container terminal (referred to as the Terminal-2) will be required adjacent to the existing container terminal(referred to as the Terminal-1) as mentioned in Section 11.2.

(1) Number of Containers

The number of containers handled at the Terminal-1 and Terminal-2 in the Latakia Port is assumed according to the demand forecast described in Chapter 9. The numbers are divided into imported and exported categories with the number of LCL, FCL, reefer and Empty categories shown as follows:

Unit:Thousand TEUs

Year	Import Empty	LCL	FCL	Reefer	Total
2010	7	17	349	3	356

Year	Export Empty	LCL	FCL	Reefer	Total
2010	249	5	107	2	356

(2) Major Shipping Routes

Referring to the present major shipping routes, the following routes are adopted:

Shipping route	Origin& Destination	Share(%)	Distance(miles)
East Med.-1	Limasol	13	132
East Med.-2	Beirut	17	250
East Med.-3	Mersin	10	100
East Med.-4	Damietta	13	340
West Med.	La Spezia	5	1,590
Black Sea	Constanza	8	1,070
Asia	Singapore	4	5,050
North Europe	Rotterdam	30	3,480

Transportation cost index by vessel size and destination is computed as follows:

Vessel Size (DWT)	(TEU)	Limasol	Beirut	Mersin	Damietta
3,800	210	110	119	107	123
6,500	400	100*	100*	100*	100*
12,000	500	119	113	22	110
22,000	1,200	139	117	147	107
27,000	1,500	154	126	165	113
35,000	2,000	183	146	198	129
50,000	3,000	235	182	256	158

Unit:SP/TEU

Vessel Size (DWT)	(TEU)	La Spezia	Constanza	Singapore	Rotterdam
3,800	210	196	174	363	239
6,500	400	144	130	189	172
12,000	500	143	132	182	168
22,000	1,200	107	104	122	115
27,000	1,500	100*	100*	108	103
35,000	2,000	103	106	105	102
50,000	3,000	109	117	100*	100*

Note: * minimum cost is expressed as 100 by destination

(3) Water Depth and Length of Terminal-2

Since the berth depth of the existing terminal(Terminal-1) is -13m, the alternatives of Terminal-2 are Case 2(-13m) with the same water depth of Terminal-1, and Case1 (Water depth -14m) which can receive panamax-size container vessels of 3,000 TEUs capacity. The results of calculation of Net Present Value of the costs (including shipping cost and berth construction cost) for 30 years are as follows:

	Case 1	Case 2
Cost Index	100	102

The terminal with a berth depth of -14m is more economical than that of -13m. To receive container vessels of 3,000 TEUs (Maximum LOA is 290m, molded breadth is 32.2m), berth length is determined to be 350m.

(4) Marshaling Yard

Required yard area is determined so as to receive containers dwelling at the yard in a peak condition. To estimate the required area, the simulation was conducted according to the following premises:

- Average cargo handling volume: 830 TEUs per vessel
- Number of calling vessels: 858 vessels
- Land transport by trucks
- Cargo Handling Productivity: 48 Boxes/hour
- Percentage of containers handled in the container terminals: 90 % (614 thousand TEUs)
- Annual working hours: 365 days
- Daily working hours: 24 hours

- Average dwelling time : All LCL containers: 1 day
  Other Imported containers: 5 days
  Other Exported containers: 3 days

- Percentage of CFS cargoes: 5 %

The resulting number of containers which must be stacked on yards at Terminal-1 and Terminal-2 as a total is as follows:

	Laden Container	Empty Container
- Average dwelling number	5,335	4,985
- Maximum dwelling number	9,790	8,418
- Peak ratio	1.84	1.69

In order to accommodate above containers, two alternatives are proposed, one with Straddle Carrier System, one with Transfer Crane System.

1) Straddle Carrier System

The following premises are adopted to determine the number:

- Operational factor in storage: 0.75
- Stacking height:
  Import(dry): 3
  Export(dry): 3
  Reefer: 2
  Empty: 4 (handled by top-lifters)

The total required slot numbers are as follows:

- Loaded container(dry): 4,280 TEUs
  Empty container: 2,810 TEUs
  Reefer container: 70 FEUs

The total required slot numbers are shared by Terminal-1 and Terminal-2. By subtracting the slot number of Terminal-1 mentioned Section 11.3.1, the required slot number of Terminal-2 is 2,790 for loaded containers.

Assuming that unit area of Terminal-2 per berth is 12.3 ha (350m× 350m), to eceive the required ground slots for loaded containers, two units are required, resulting terminal length is 700m and the number of berths is two. According to the result of the simulation, four berths, two each of Terminal-1 and Terminal-2 can receive container vessels with a berth occupancy rate of less than 50% in the stage of the Master Plan.

The number of slots for laden containers in the planned Terminal-2 with the dimension 700m× 350m is 3,600 TEUs exceeding the required slot number of 2,790 TEUs and it gives room to receive more containers beyond the year 2010.
On the other hand, the number of ground slots for empty containers within the both terminals is 2,380 TEUs as a total, and 85 % of empty containers in a peak condition can be stacked within the respective terminal areas.

It is advisable to place off-dock empty container storage yard near the container terminals, to receive the remaining number of containers.

2) Transfer Crane System

The following premises are adopted to determine the number:

- Container-handling efficiency: 0.75
- Number of layers of stacked containers:
  Import(dry): 4
  Export(dry): 4
  Reefer: 2
  Empty: 4

The total required slot numbers are as follows:

- Loaded container(dry): 3,210 TEUs
  Empty container: 2,810 TEUs
  Reefer container: 70 FEUs

The slot number of Terminal-2 for laden containers is 3,570 TEUs, exceeding the total required slot number of 3,210 TEUs.

Both systems have advantages and disadvantages. Straddle carrier has higher mobility, but necessary yard area is larger than that of transfer crane system. Since the newly developed yard is large enough, the straddle carrier system is selected.

(5) Container Freight Station

In order to determine the required area and number, the result of the above simulation is also adopted. According to the result, the cargo volume dwelling in CFSs fluctuates, showing a maximum volume equivalent to 507 TEUs and a peaking factor of 1.93

The required number of bays at CFSs for chassis or ordinary trucks is determined considering the fluctuation of the cargo volume passing through CFSs. The maximum volume equivalent to TEUs at container side is 149 TEUs.

The total principal dimensions of CFSs are determined as follows:

- Total number of bays on each side: 31
- Minimum width for bays: 125 m
- Area: 13,523 m^2

Since the floor space of existing CFSs is 11,200m^2, floor space of 2,323m^2 is additionally needed in the stage of the Master Plan. An additional CFS is planned to be prepared at Terminal-2.

(6) Terminal Office

The head office of the container terminal is planned as follows:

- Stories: 3
- Site area for building: 40m× 25m = 1,000 m^2
- Floor space: 3,000 m^2

(7) Workshop and Cleaning

- Workshop: 80m× 25m = 2,000 m^2
- Cleaning: 40m× 25m = 1,000 m^2

(8) Terminal Gates

According to the simulation, the traffic volume per day by each category is as follows:

	In	Out
- Loaded container	136	1,180
- Empty container	267	12
- Tractor/chassis	1,192	496

Since the total berth number is 5 including the existing terminal, this traffic is divided among two gates- gate 1 and gate 2. The lanes of each gate are as follows:

- Gate-1: 3 lanes for Inward-traffic (FCL/Empty, Tractor, Others)
  3 lanes for Outward-traffic (FCL, FCL/Empty, Tractor/Others)
- Gate-2: 4 lanes for Inward-traffic (FCL/Empty, 2Tractor, Others)
  4 lanes for Outward-traffic (3FCL/Empty, Tractor/Others)

(9) Promotion of Transhipment

1) Outline of Container Transhipment in the East Mediterranean Sea

The government of Syria intends to promote container transhipment at Latakia Port in the future: the government wishes Latakia Port become a hub container port in the East Mediterranean Sea facing the coasts of Greece, Turkey, Syria, Lebanon, Israel and Egypt. The principal container ports in this area and the historical trend of the number of containers handled at those ports are listed as follows:

Unit: '000 TEUs

No.	Port	1990	1991	1992	1993	Country
1	Damietta	98	252	416	561	Egypt
2	Piraeus	426	463	511	537	Greece
3	Haifa	237	323	386	405	Israel
4	Ashdod	179	157	182	272	Israel
5	Limassol	274	229	218	221	Cyprus
6	Alexandria	164	264	237	210	Egypt
7	Larnaca	102	95	134	192	Cyprus
8	Port Said	55	60	117	150	Egypt
9	Latakia	67	83	93	120	Syria
10	Mersin	108	103	106	100	Turkey

At a hub port (often referred to as a mother port), containers are transhipped from/to mother vessels in operation on a trunk shipping route to/from feeder vessels extending their services to local feeder ports. Currently, Damietta Port which ranks first in terms of the number of containers handled in 1993 (see above table) is the most vigorous hub port in the East Mediterranean Sea. Damietta Port has a decisive advantage in that it is situated along the trunk shipping route through the Suez Canal connecting Europe/Middle East/South Asia/Southeast Asia/Far East and other leading hub ports along the route including Algeciras, Colombo, Singapore, Hongkong and Kaohsiung. The feeder services originating from or destined to Damietta Port are extended to not only the East Mediterranean Sea but the West Mediterranean Sea. The ports of Limassol and Larnaca in Cyprus and Alexandria in Egypt are also functioning as hub ports contributing feeder services that extend to the East Mediterranean Sea. The ports of Limassol and Alexandria, however, are losing shares of container business in the East Mediterranean Sea in inverse proportion to the recent emergence of Damietta in container-handling.

Piraeus Port has also a disadvantage in deviation compared with Damietta Port and major shipping lines shifted their calling of mother vessels on the above trunk shipping route from Piraeus to Damietta. In addition to serving local users in its hinterland, Piraeus Port is functioning as a hub port receiving feeder vessels extending their feeder services to the Black Sea as well as Hifa Port.

2) Requirements to be a Hub Port Extending Transhipment Services

A hub port is selected according to the strategy of individual shipping lines. Generally, they use the following criteria in making their selection:

- Location along a trunk shipping route without deviation,
- A deep sea port which can receive a large-sized container vessel,
- Cheaper port tariff,
- Pilferage of transhipped cargo during customs procedure,
- Closed terminal system ensuring swift, safe and reliable container-handling,
- 24 hour and 365 day service,
- Berth allocation on priority basis with berth window,
- Abundant labor resources.

3) Long-Range Prospect of Latakia Port Becoming a Hub Port

In light of the requirements of a hub port extending transhipment services listed in "2)", if the new container terminal, Terminal-2, which is proposed in the Master Plan is constructed and opened as a modern container terminal in operation based on the closed terminal system, Latakia Port would have the potential to be a hub port in the future. To become a hub port, however, Latakia Port must attract mother container vessels of fickle shipping lines by presenting more attractive conditions in port tariff, customs procedure, etc as listed in "2) than competitors such as Damietta, Alexandria, Limassol and Piraeus in serious international container business.

4) Handling Capacity of Transhipped Containers

The container handling capacity per annum at the container terminals, Terminal-1 and Terminal-2, at Latakia Port is estimated to be around one million TEUs. The number of containers to be handled in the stage of the Master Plan is estimated to be around 700,000 TEUs. From the above, transhipped containers of much more than 300,000 TEUs could be received at Latakia Port, because dwelling time of transhipped containers is generally very short compared with local containers which need customs clearance.

Transhipped containers are generally stacked on a marshaling yard just behind an apron to ensure swift reloading onto a feeder or mother container vessel.

11.4.2 Conventional Terminal

In order to decide the proper number of new berths, the original plan (add three new berths- Case 1) is compared with other alternatives -- add two berths (Case 2) and add four berths (Case 3). A similar simulation is conducted and the results of Case 2 and Case 3 are as follows.

- Total ship waiting time:	Case 1:	1,373 days
	Case 2:	2,766 days
	Case 3:	1,127 days

The difference in cost among each case is described as follows:

	Cost Index (waiting cost + berth construction cost)
Case 1	100
Case 2	145
Case 3	102

Consequently, Case 1 is selected as the most economical plan. The depth of the new berths is decided based on the distribution of present general cargo vessels.

The new berths serve for the conventional type of vessels with various types of general cargoes. Since the vessels-size for these types of general cargoes is mostly below 5,000 DWT comparing vessels with mono single type of cargo, the water depth of these berths is determined to be -10m, that is 15,000 DWT.

11.4.3 Passenger Terminal

(1) Present Condition

Regular passenger vessel serves between Alexandria and Latakia weekly. The average number of passengers is around 50. In addition passenger vessels call Latakia Port from Germany, Russia, France and Greece irregularly. Average number carried on these vessels is around 500. Another passenger service between Libya and Latakia was discontinued in 1994.

(2) Future Estimation

- Regular Service: Regular service route will be increased in addition to the existing line. Since Cyprus is located close to Syria, tourists from Cyprus will increase in the near future. Passenger from Libya will visit regularly, because future development in industry will attract labors from north Africa.

- Irregular Service: Syrian Government lays emphasis on tourism. The more Syria open the door to foreigners, the more irregular passenger vessels will visit Syrian ports. Latakia, already famous for tourism, will attract more tourists including those by ship. Number of passenger vessels calling Latakia Port will be increased up to 20 to 30, twice a month.

Number of passenger will be (50+50+500) X 50 =30,000 (Regular Service)
500 X 2 X 12 = 12,000 (Irregular Service)
Total Number = 42,000

Peak condition: one regular service (500 passengers) + one irregular service (500 passengers) = 1,000 passengers (Peak Ratio=2.4%)

11.5 Cargo Handling System

Major cargo handling commodities at Latakia Port are container cargo, general cargo(Food, machinery, chemical, cotton and others), heavy cargo(iron and steel), wood and grain(maize and barley) for import and container cargo, wheat, cotton and others for export. Table 11.5.1 shows the cargo volume at Latakia Port except grain.

Table 11.5.1 Cargo Handling Volume at Latakia Port in 2010
(Except Grain)

Unit:thousand ton

Commodity	Import	Export	Total
Container	5260	1030	6290
Rice	240		240
Refind Sugar	49		49
Law Sugar			0
Flour	370		370
Foodstuff	20		20
Cotton		17	17
Fiber & Textile	10		10
Fertilizer	0		0
Chemical	185		185
Metal Products	716		716
Wood & Woodproduct	775		775
Machine & Equipment	215		215
Others	245	38	283
Total	8085	1085	9170

There are two types of cargo handling systems(except container cargoes and grain) at Latakia port. One is direct delivery/receiving and the other is delivery after custody in storage facilities in the port area. Direct delivery is mainly done for the cargo of government sectors.

The cargo handling system for container cargoes and grain is mentioned in 11.4.1 and 11.3.2 respectively.

As to the cargo flow of the former system(direct delivery), the cargo is first unloaded from ship onto trucks or rail wagons. Then, the cargo is sent to storage facilities of consignees. The cargo flow of direct receiving is the opposite of direct delivery.

The cargo flow of the latter system(delivery after custody in the storage facilities) has four steps, unloading from ship to apron, transferring from the apron to the storage facilities, storage at the facilities and delivery from the port.

In the former method, the cargo is to be only handled once in the port. Therefore, investment in cargo handling equipment is minimized. However, this system has the following demerits:

1. Many trucks are necessary for delivery of cargo in general.
2. Cargo handling efficiency is low because the landing of cargoes by cranes onto trucks/rail wagons is very difficult due to the small working area of each truck/rail wagon.

The major demerit of the latter system is the relatively large quantity of cargo handling equipment required, especially forklift and mobile cranes.

Based on the above mentioned, as for ideal cargo handling, direct delivery is only adopted for the handling of particular cargoes, such as dangerous cargoes, frozen cargoes, perishable cargoes and very heavy cargoes such as a large generator. But, in the master plan, small quantity of general cargoes(not above particular cargoes) are delivered to consignees, directly. Table 11.5.2 shows the percentage of direct delivery in the master plan for major commodities.

Table 11.5.2 Delivery Method at Latakia Port for Import Cargo

Unit: %

Commodities	Direct	Storage
Iron & Steel		100
Other Metal Products		100
Rice	10	90
Refined Sugar	10	90
Flour	10	90
Foodstuff	80	20
Wood & Wooden Product	25	75
Fiber & Textile		100
Fertilizer	10	90
Chemical	20	80
Machine & Equipment		100
Others	20	80

The cargo handling efficiency of palletized cargo is higher than un-palletized cargo in general. However, at present, some palletizable cargo, such as bagged cargoes and drums, is not yet palletized at Latakia port. All palletizable cargoes should be palletized in the master plan.

Actual cargo handling time of general cargo except passenger ship, container ship, Ro-Ro ship, refrigerated ship and livestock ship at Latakia port is from 8.15 to 2.30 for first shift and from 3.15 to 7.00 for second shift in general at present. In the master plan, three shift system is adopted, such as from 7.00 a.m. to 3.00 p.m. for first shift, from 3.00 p.m. to 11.00 p.m. for second shift and from 11.00 p.m. to 7.00 a.m. for third shift. Break time(about 15 minutes) is set at the middle of each shift, for example 11.00 a.m., 7.00 p.m., and 3.00 a.m..

11.5.1 Cargo Handling Systems in the Master Plan for Each Commodity

(1) General Cargo for import

Major commodities of the general cargo for import are food(bagged grain, rice, sugar), fertilizer, fiber & textiles, chemicals, machine & equipment and others.

At present, the bagged cargo, such as flour, rice, sugar, fertilizer, cotton and some of other chemical cargoes, drums and some of small cases, such as chemicals in drum and general cargoes in case, are bounded gathering 1 ton to 2 tons in the hold. Then the cargoes are unloaded without pallet by quay cranes or ship cranes. About 100% of rice and flour, 25% of refined sugar and fertilizer are transported outside the port by direct delivery.

In the master plan, 100% of these cargoes should be palletized in the hold. Then, almost all cargoes except dangerous cargoes should be transported to storage facilities after being unloaded from ship to apron. However, a few cargoes are delivered from the apron to consignees, directly. Bagged cargoes and cases are stored in sheds and drums are stored in sheds or open yards. At Main Quay, some of the bagged cargoes are directly transported from ship to the first floor or the second floor of transit sheds just behind the apron by quay cranes.

The cargo handling equipment for bagged cargo at apron and sheds is mainly forklift trucks. If these sheds are located near the berth which is concerned with the cargo handling, the cargoes are transported to the sheds by forklift trucks. If the location of the sheds is not near the berth, trucks are used for transportation to the sheds. As for rolled paper, forklift trucks with special attachment for rolled cargo are used for cargo handling at apron and sheds. If these sheds are located near the berth, the cargoes are transported to the sheds by the forklift trucks. If the location of the sheds is not near the berth, trucks are used for transportation to the sheds. As for machinery and others including cases, forklift trucks are used for cargo handling at apron and storage facilities. The transportation from the apron to the storage facilities is usually done by trucks. If the location of the storage facilities is very close to the apron, the forklift trucks carry the cargoes to the sheds, directly.

As to fiber and textiles, the packing style of these cargoes is mainly cases(including cartons) and bales. Almost all these cargoes will be containerized in the master plan stage. However, some of these cargoes will be imported by conventional packing style according to the demand forecast. These cargoes should be palletized in the hold, then unloaded from ship onto apron. All of these cargoes should be stored in sheds after unloading from ship. The cargo handling equipment and system will be same as in the case of bagged cargo.

The packing style of machine & equipment is mainly cases or cartons. In the master plan, these cargoes are palletized in the hold then unloaded from ship onto apron. Then, these cargoes are stored at sheds. Forklift trucks are used for cargo handling at the apron and sheds. As to transport between ship and sheds, the same system used for fiber and textile is adopted.

(2) General Cargo for Export
Major commodities of the general cargo for export are cotton in bag and others. At present, almost all of the bagged cotton is transported from storage facilities of shippers to sheds in the port by truck. Then, these cargoes are transported to apron by truck in general. But, a few cargoes are transported from shippers to the apron by trucks, directly. Cargo handling of above cargoes from trucks to apron is by forklift trucks. Then, these cargoes are loaded by quay cranes or ship cranes.

In the master plan, 100% of these cargoes should be stored at sheds in the port area. Then, the cargoes are transported to apron by trucks or forklift trucks after being palletized in sheds. The cargo handling of above cargoes at apron is done using forklift trucks. Then, the cargoes are loaded by quay cranes or ship cranes.

(3) Heavy cargo
At present, iron & steel and other metal products whose packing styles are mainly bundles, rolls and coil are handled by trailer and forklift truck after being unloaded from ship. Some of these cargoes are delivered from the apron to storage facilities of consignees, directly.

These cargoes should be handled by the heavy forklift truck with special attachments after being unloaded from ship to apron in the master plan. Then, these cargoes are sent to storage facilities in the port area by trailers(if the location of the storage facilities is not just behind the apron) or forklift trucks(if the location of the storage facilities is just behind apron). Iron bars and ingots are generally stored at open area behind the berths 10, 11, 12 and 12A in new port area. At the open yard, theses cargoes are handled by mobil crane. As for the cargo handling equipment in sheds, the forklift truck is adopted. Iron bars for construction material are stored in open yards and other iron and other metal products, such as steel roll and coil, steel sheets, steel and other metal pipes and frames, are stored in sheds.

(4) Wooden Products
Almost all of lumber and timber are currently directly delivered to storage facilities of consignees. However, some of them are stored at open yards in the port area. At present, other wooden products, such as plywood, are baled by a sheet, then these cargoes are stored at sheds in the port.

In the master plan, slings for loose lumber and timber should be installed slings in the hold, then the cargo is unloaded onto trailers. But, bundled timber and lumber are unloaded to apron. After unloading of lumber and timber for both packing styles, almost all these cargoes are stored at open yards in the port. But, some of them are directly delivered to consignees.

The cargo handling for the lumber and timber at open storage yards is carried out by forklift trucks. As for the transportation from apron to open storage yards for bundled timber and lumber, forklift trucks or trailers are used.

Table 11.5.3 shows the major cargo handling equipment except between ship and apron(or truck/wagon of train) for import except direct delivery at Latakia Port.

Table 11.5.3 Cargo Handling Equipment for Import Cargo (Except Direct Delivery) at Latakia Port

Commodities	At Apron	Apron to Storage Fasility	At Storage Facility
Iron & Steel	Heavy Forklift	Heavy Forklift or trailer	Mobil crane or Heavy forklift
Other Metal Products	Heavy Forklift	Heavy Forklift or trailer	Mobil crane or Heavy forklift
Rice	Forklift	Forklift or truck	Forklift
Refined Sugar	Forklift	Forklift or truck	Forklift
Flour	Forklift	Forklift or truck	Forklift
Foodstuff	Forklift	Forklift or truck	Forklift
Wood & Wooden Product	Forklift	Truck	Forklift or lumber fork
Fiber & Textile	Forklift	Forklift or truck	Forklift
Fertilizer	Forklift	Forklift or truck	Forklift
Chemical	Forklift	Forklift or truck	Forklift
Machine & Equipment	Forklift	Forklift or truck	Forklift
Others	Forklift	Forklift or truck	Forklift

Forklift : Forklift truck

11.6 Access Channel and Basins

The largest vessel that moors at Latakia Port is container vessel. Its dimensions are as follows:

- Capacity: 3,000 TEUs (50,000 DWT)
- Draft: 13 m
- LOA(Length Over All): 290 m
- Breadth: 32.2 m

Entrance to the port is at the northern end of the port. Access channel between the port entrance and the basin in front of Container Terminal-2 has 290m width with a water depth of 15m at the entrance. The width is decided as 1L(LOA of the maximum container vessel). Beyond Container Terminal-2, the width of access channel to the existing port zone becomes 260m, that is to say, navigable container vessel with capacity of 2,000 TEUs.

A turning basin is planned in front of the Terminal-2, with 580m(2 X Vessel Length) of diameter and -14m of depth. Mooring basins for new container terminal, general cargo terminals and grain terminal are also planned.

Total dredging volume for these basins is 1.9 million m^3, while total reclamation volume is estimated to be 2.2 million m^3. The balance of dredged and reclaimed materials indicates that there is a small shortage.

11.7 Breakwaters

Table 11.7-1 shows the distribution of calmness at point A, B and C which are situated at container berth, general cargo berth and turning basin respectively. The following 3 cases of plan were examined.

Plan-1 No extension (existing breakwater)
Plan-2 600m extension of main breakwater
Plan-3 600m extension of main breakwater and 900m length sub-breakwater

Table 11.7.1 Calmness in the Basin

Plan-1

Wave Height	Point A	Point B	Point C
0~0.3m	66.10%	58.01%	58.01%
0.3~0.6m	11.82%	19.99%	19.99%
0.6~1.0m	9.06%	5.80%	10.58%
1.0~2.0m	0.93%	9.36%	9.36%
2.0m~		2.03%	2.03%

Plan-2

Wave Height	Point A	Point B	Point C
0~0.3m	84.11%	74.96%	85.38%
0.3~0.6m	8.27%	13.98%	7.07%
0.6~1.0m	4.66%	6.94%	4.59%
1.0~2.0m	2.22%	3.19%	2.22%
2.0m~	0.71%	0.90%	0.71%

Plan-3

Wave Height	Point A	Point B	Point C
0~0.3m	90.52%	89.56%	86.63%
0.3~0.6m	6.51%	7.48%	9.00%
0.6~1.0m	2.14%	2.00%	2.88%
1.0~2.0m	0.72%	0.95%	1.36%
2.0m~	0.11%		0.12%

Two container berths to be constructed require the calmness less than 30cm to handle the containers safely.
Plan-1 and Plan-2 are impossible to handle containers with over 90% workable condition.
As for the calmness of general cargo berths and turning basin, Plan-3 maintains the most preferable calmness.
Taking into account the above requirements, Plan-3 is appropriate.
Fig. 11.7-1 shows the example of wave diffraction from the SW deep water wave.

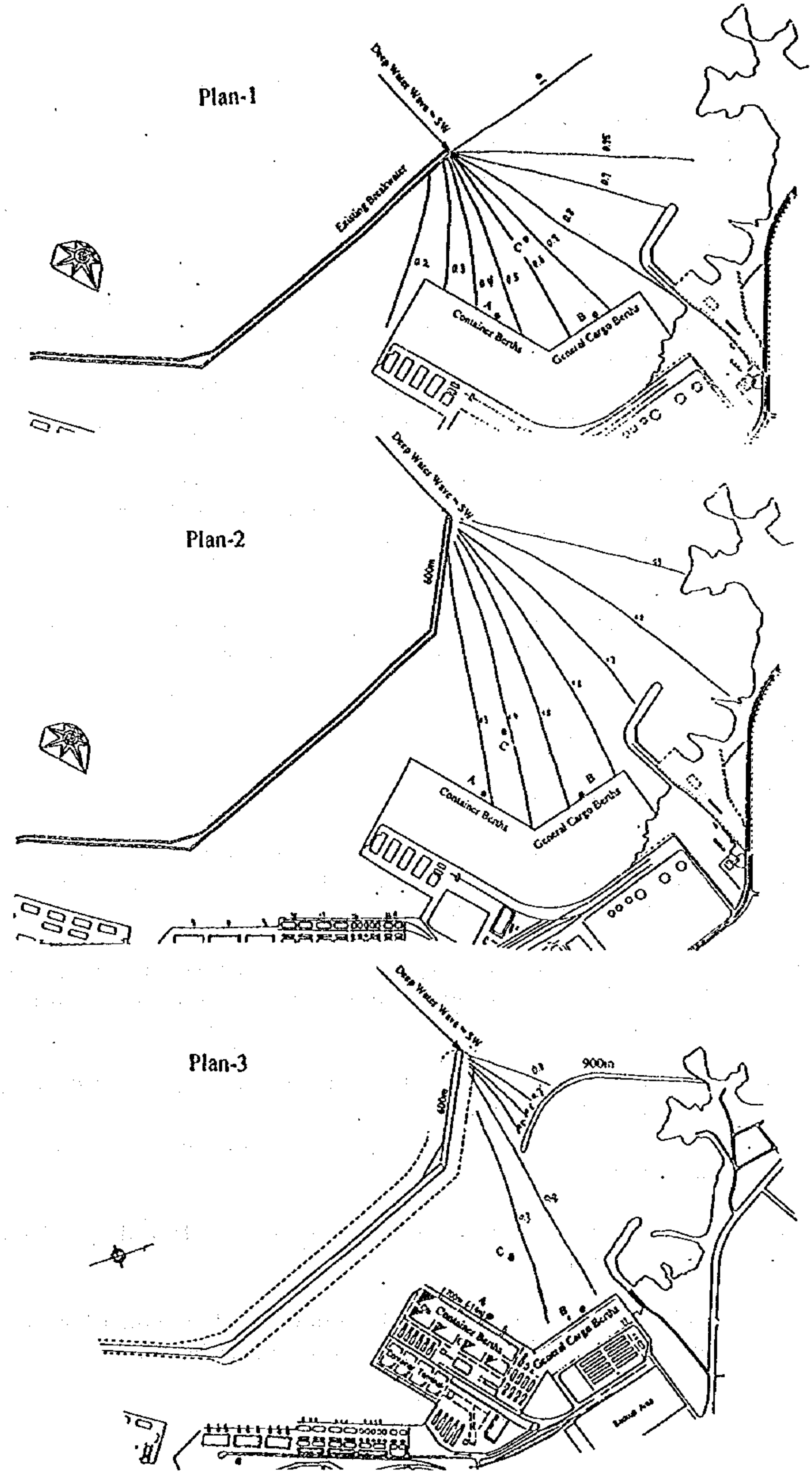


Figure 11.7.1 Wave Diffraction from the SW Deep Water Wave

11.8 Access Roads and Railways

The traffic volume of vehicles originating from or destined to the port in the year 2010 is estimated to be 8,378 vehicles per day each way in total. The hourly traffic is estimated to be 1,048 each way.

Traffic volume related to container is estimated to be 1,295 per day and 162 per hour each way. Since the procedure of container is special comparing with other cargoes, the access to the container terminal is planned separately. In order to avoid mixture of container related traffic with other traffic, access roads with two lanes are planned to enter the port at the north area of the port.

As hourly capacity of traffic volume per road lane is estimated as 600 vehicles, two lanes each way need to be shared for the entire traffic above. Since the port has two entrances, two access roads with two lanes each way are planned.

As for railway wagons, daily traffic is estimated to be 60. Since the present railway has enough capacity, the plan does not include new railways.

11.9 Alternative Layout Plans

11.9.1 Layout of Expanded Facilities

Expanded facilities in the Master Plan are, container terminals, general cargo terminals, grain terminals, passenger terminal and yard for containers handled outside of the container terminals.

The new container terminals and the new general cargo terminals are planned to be located in the north of the existing port, because the existing urban area adjoins in the south and east of the port.

Three alternatives are proposed in relation to the future expansion of the port (see Fig.11.9-1, Fig.11.9-2, Fig.11.9-3).

- Case 1: Concentration Type: The new general cargo berths are located adjacent to the new container terminal.

- Case 2: Separate Type: The new general cargo berths are located opposite of the new container terminal.

- Case 3: Mixed Type: The area for the future container terminal is reserved between the new terminals and the new general cargo terminal.

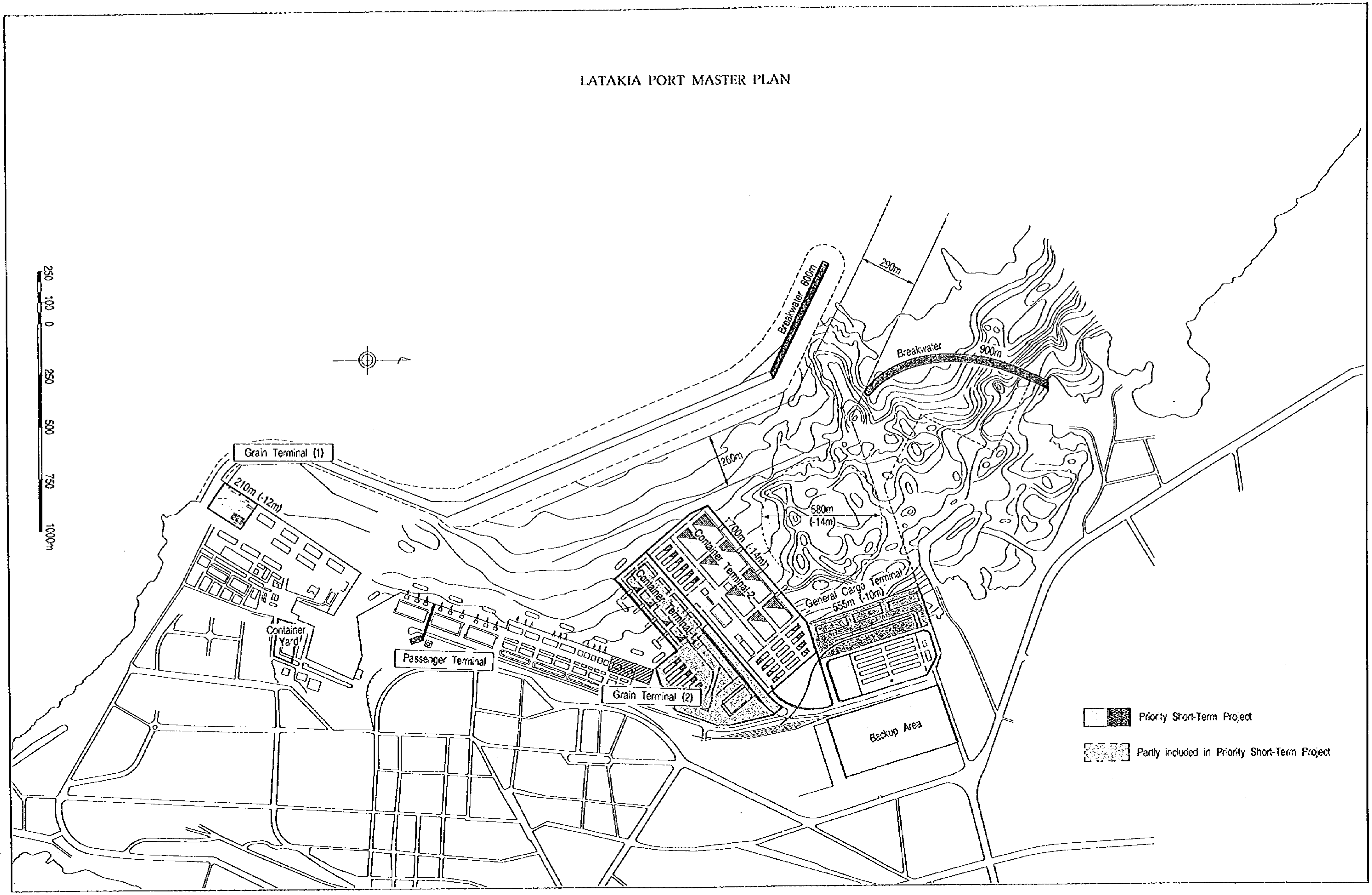


Fig. 11.9.1 Master Plan of LATAKIA PORT - Case (1) -

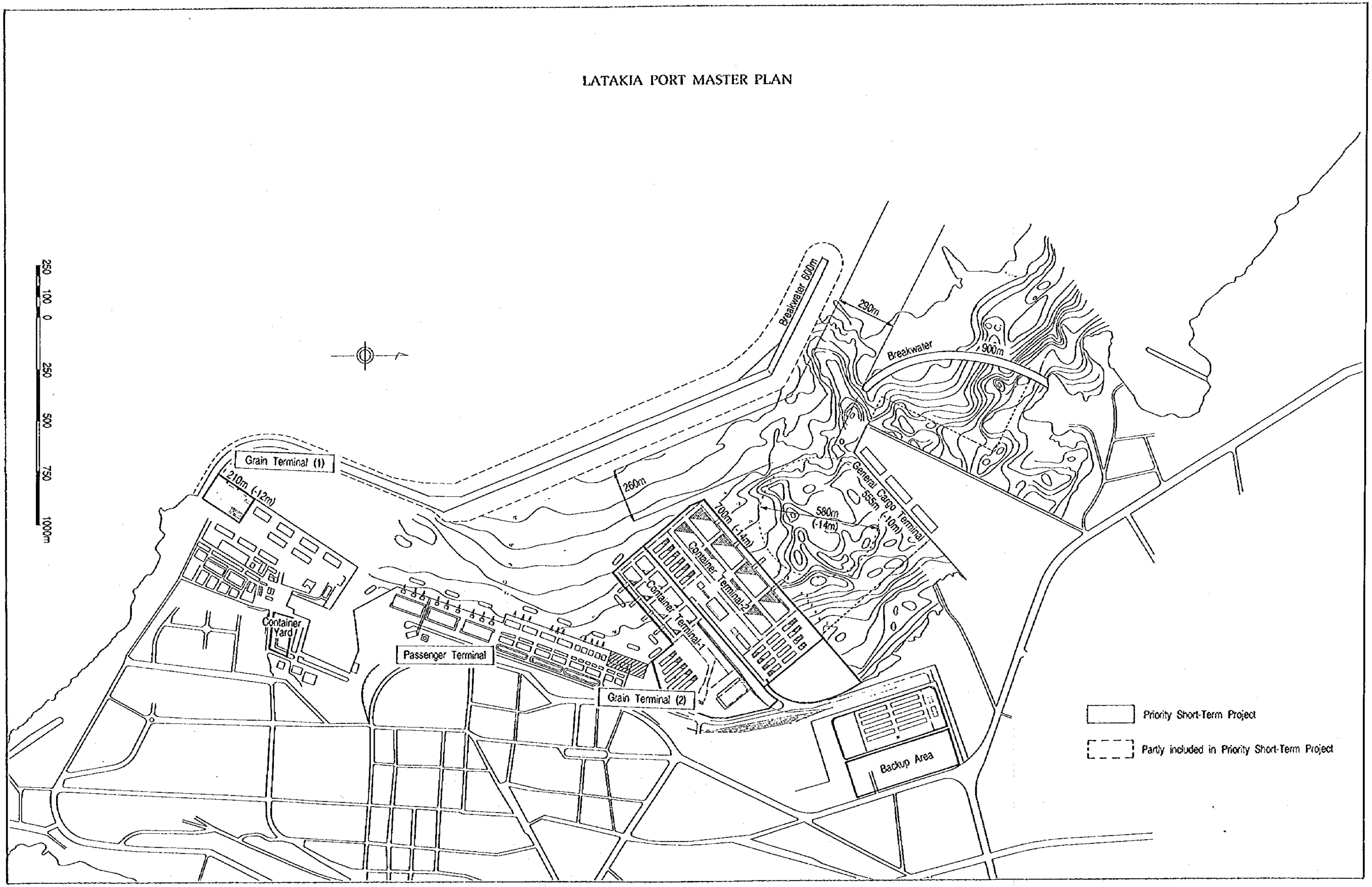


Figure 11.9.2 Master Plan of LATAKIA PORT - Case (2) -

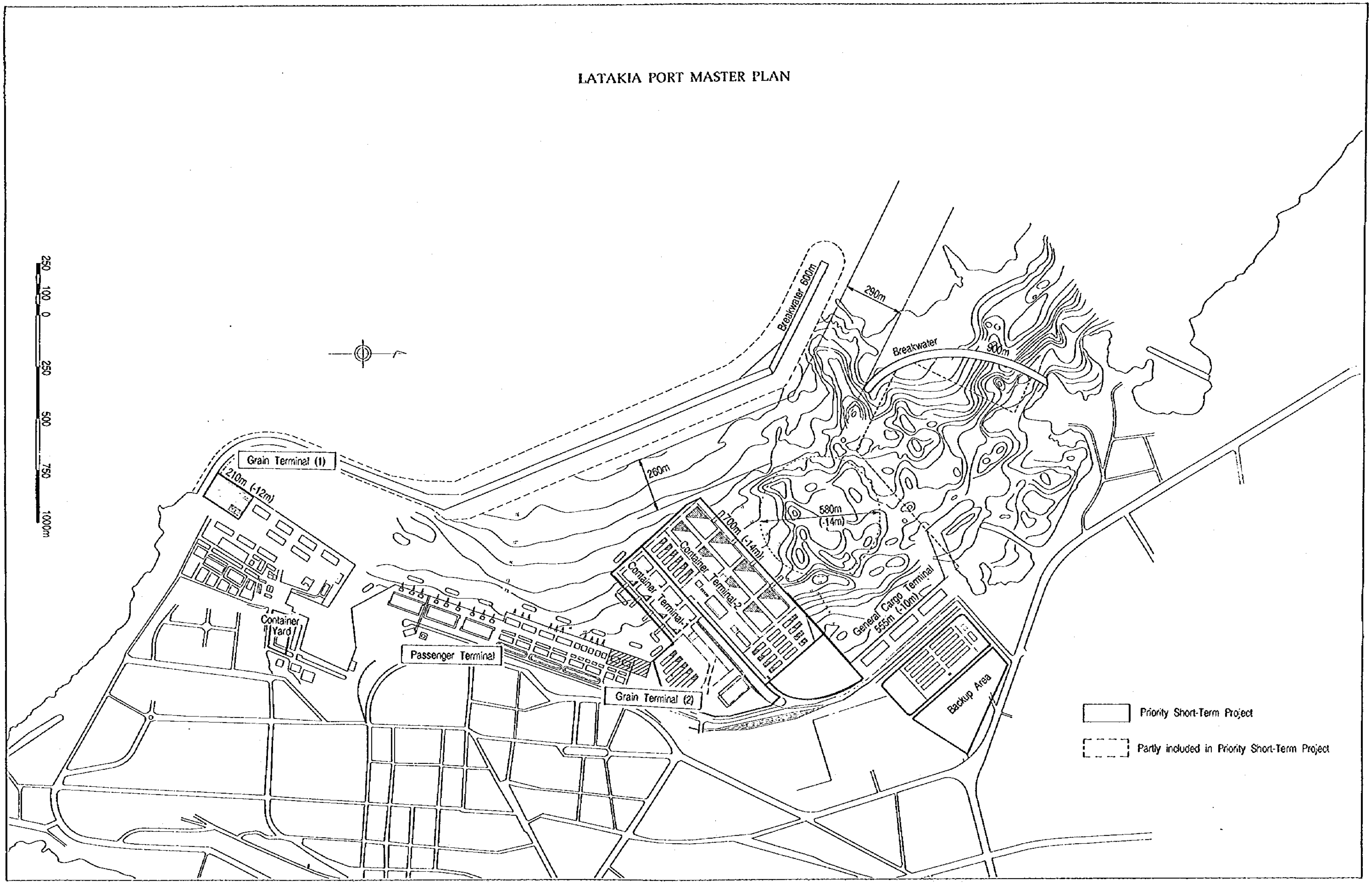


Figure 11.9.3 Master Plan of LATAKIA PORT - Case (3) -

a. Potential for Further Expansion Beyond the Target Year

In Case 1, expansion of the port is possible without restrictions. The entire area between the new general cargo terminal and the breakwaters is available for the port facilities. In Case 2, though the new general cargo terminal is isolated, in the long term, the general cargo terminal will expand to the north and the container terminal will expand between the existing container terminal and the new general cargo terminal. In Case 3, the land for the future container terminal is reserved between the new general cargo terminal and the new container terminal.
A floating dock with the capacity of 100,000 DWT vessel, pier, berth and relative factories will be planned after the year 2010.
Case 1 and Case 3 are affordable for that dock.

b. Access and Land Acquisition

In Case 1 and Case 3, land acquisition and accessibility is easy, because the new port facilities are concentrated. In Case 2, the new road must be constructed only for the isolated general cargo terminals. Area of land acquisition in Case 2 is larger than that of other cases.

c. Impact of existing use

The planned expansion area is used for storage of oil products, storage of bulk cargo and berths for small vessels. In Case 2, the area for oil storage is shifted for container storage area in the year 2010. Moreover, in Case 2, the present small vessel berths should be relocated by the year 2010.

d. Construction Cost

Result of comparison of costs is as follows:

(Unit: Million SP)

	Case 1	Case 2	Case 3
Civil Works	6,633	7,148	7,090
Building	489	489	489
Utilities	98	98	98
Handling Equipment	5,717	5,717	5,717
Others	300	300	300
Total	13,237	13,752	13,694

Note: Civil Works include dredging, wharf, reclamation, breakwater.
Building includes silo.
Others include tax, physical contingency and engineering fee.

Consequently, Case 1 is the most economical among the alternatives.

As for grain terminals, two alternatives are proposed. In the concentration case, all grain handling facilities are concentrated to the new port area (behind Berth No.12A). In the split case, existing grain terminal is improved with berth of -12m and new loading/unloading equipment in addition to the new terminal behind Berth No.12A. As for containers loaded/unloaded in the general cargo terminals, the yards are located at the existing container yard behind the South Quay. Since such kind of cargo is estimated to decrease, the existing yard is sufficient for storage.

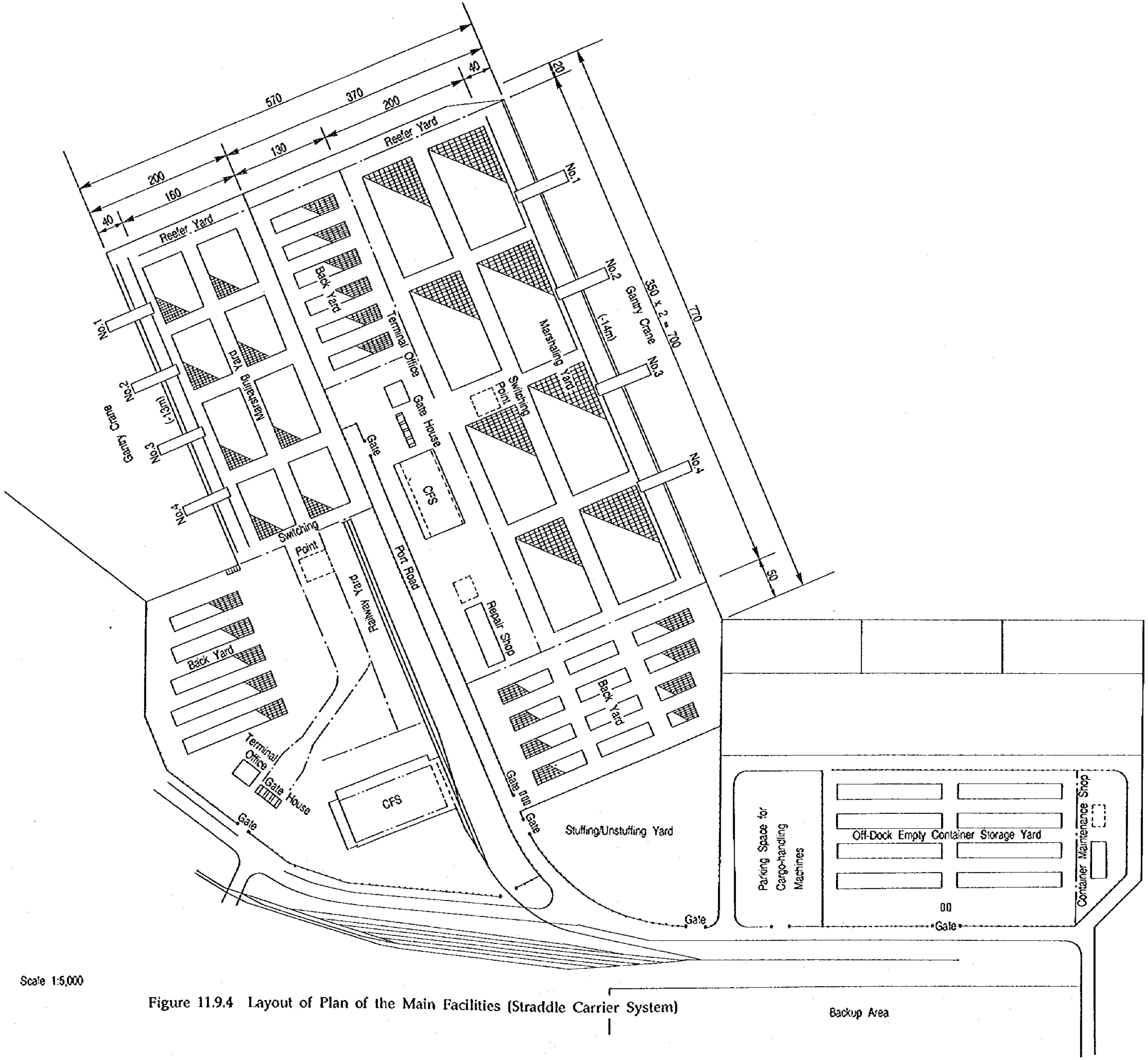
11.9.2 Layout of the New Container Terminals

The main facilities of Terminal-2, of which the required sizes are shown in the previous section, are arranged. Then the required terminal area is computed according to the different cargo-handling systems. The allocated areas are summarized as follows:

Unit:m^2

	Straddle Carrier	Transfer Crane
Total area	245,000	245,000
Marshaling Yard		
Sub-total	139,650	138,250
Slot area	87,620	64,970
Others	52,030	73,280
Apron	28,000	28,000
Backyard		
Sub-total	77,350	78,750
CFS	13,300	13,300
Head Office	750	750
Repair Shop	2,000	2,000
Open Yard	19,100	14,000
Others	42,200	48,700

Layout of the Facilities is shown in Fig. 11.9.4.



Scale 1:5,000

Figure 11.9.4 Layout of Plan of the Main Facilities (Straddle Carrier System)

11.10 Initial Environmental Examination

a) Existing situation

The existing water quality and sediment quality were assessed by the site survey and the results were given in Chapter 7. Not all of these parameters are covered by standards but those which are subject to water quality guidelines are discussed below.

The results obtained at Latakia are given in Table 11-10-1 and are compared with the relevant standard.

Temperature of the seawater should not be raised by more than 2°C although a mixing zone where temperature can be higher is usually allowed. Thermal discharges are normally expected from power stations or large industry that have cooling water requirements. These do not presently exist at Latakia and none are planned in the future. Therefore this parameter is acceptable.

Values for **pH** varied between 7.5 and 7.8. An acceptable range is 7.0-8.3 This parameter is slightly low for the ocean but is acceptable.

Salinity should not be allowed to change by more than 5% on the background level. The level in the Mediterranean Sea is consistently high due to the high evaporation and high total dissolved salts load from rivers. Therefore this parameter is acceptable.

Dissolved Oxygen (DO) varied from 5.8 mg/l to 12.5 mg/l, but otherwise averaged around 9 mg/l. The Japanese standard is 7.5 mg/l although fish may survive at 4 mg/l and anaerobic conditions generally may not arise until the DO drops below 2 mg/l. It should be noted that the level of 5.8 mg/l was measured at the most restricted part of the port in an area where the natural flushing action of the harbour will be lowest, and in the area that receives the flows from three sewage outfalls. This must impose a heavy organic load and the DO figures can be expected to be low. The situation is approaching the limit at which anaerobic conditions may start to occur leading to odor problems if biological loads increase further. However Latakia is currently implementing a major sewage treatment scheme with the assistance of the World Bank and this should ensure that the organic loads actually decrease in the future. The result of this will be to allow the DO levels to revert to a normal level (which will vary with temperature throughout the year) and adverse effects on fish life are not anticipated. Although the situation is currently borderline the new waste treatment facilities will make this parameter acceptable. It is not anticipated that the new facilities will impose an organic load on the harbour waters.

Transparency (or secchi depth) varied from 96cm which is low and indicates turbid

TABLE 11-10-1 COMPARISON OF SITE DATA WITH STANDARDS-LATAKIA

ENVIRONMENTAL PARAMETERS FOR WHICH STANDARDS APPLY										Sites which exceed standard				
PORT: LATAKIA														
PARAMETER	SAMPLE TYPE	UNITS	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	STANDARD	SOURCE	1	2	3	4	5
TEMPERATURE	WATER	°C	18.0	18.4	18.4	18.2	18.2	<+2 increase	AUS	-	-	-	-	-
pH	WATER	pH	7.6	7.5	7.7	7.8	7.8	7.0-8.3	JAPAN	-	-	-	-	-
SALINITY	WATER	PPTHOUSAND	37.7	37.7	38.7	38.7	39.2	<5% change	AUS	-	-	-	-	-
DISSOLVED OXYGEN	WATER	mg/l	12.5	5.8	9.8	9.5	9.2	7.5	JAPAN	-	○	-	-	-
TRANSPARENCY	WATER	cm.	118	96	120	260	261	250	JAPAN	○	○	○	-	-
COD	WATER	mg/l	7.3	4.3	8.5	7.9	6.5	8	JAPAN	-	-	○	-	-
SULPHIDE	WATER	ppm	3.2	2.4	0.0	0.0	0.0	0.002	USEPA	●	●	-	-	-
TOTAL NITROGEN	WATER	µg/l	0.10	0.08	0.07	0.07	0.06	60	AUS	-	-	-	-	-
TOTAL PHOSPHORUS	WATER	mg/l	0.07	0.13	0.08	0.03	0.05	0.01	AUS	○	●	○	○	○
PHOSPHATE	WATER	mg/l	0.23	0.41	0.26	0.08	0.16	0.015	JAPAN	●	●	●	○	●
SUSPENDED SOLIDS	WATER	mg/l	65	133	20	166	39	25	USEPA	○	○	-	○	○
OIL GREASE	WATER	mg/l	19.7	11.9	9.2	12.3	4.0	0.5	JAPAN	●	●	●	●	○
CHLORINE	WATER	mg/l	trace	trace	trace	trace	trace	2	MALAYSIA	-	-	-	-	-
COLIFORMS	WATER	N/100ml	35	13	28	9	33	1000	JAPAN	-	-	-	-	-
ARSENIC	SEDIMENTS	ppm(dry weight)	5	20	45	4	0.4	12.5	USA	-	○	○	-	-
COPPER	SEDIMENTS	ppm(dry weight)	19	177	53	36	10	45	CANADA	-	○	○	-	-
MERCURY	SEDIMENTS	ppm(dry weight)	7	36	52	2	2	0.15	USA	●	●	●	●	●
ZINC	SEDIMENTS	ppm(dry weight)	124	431	186	195	2	105	USA	○	○	○	○	-

Compliance with standard
"-" within standard
" ○ " Exceeds standard by small amount (less than 10)
" ● " Exceeds standard by large amount (more than order of magnitude)

water to 261cm. The standard is 250cm. Two of the five sites were in compliance with the standard; three were slightly infringing it. For a port this indicates clean water.

Chemical Oxygen Demand (COD) varied between 4.3 mg/l and 8.5 mg/l. The standard is 8 mg/l. One site was slightly above this. In general there is not an excessive organic or inorganic pollution load in the harbour, although there are localised areas of high pollution, and this parameter is considered acceptable.

Sulphide was highly variable. At three locations where the natural flushing action is high none was detected. At two sites which are very restricted and under heavy load sulphide levels were high. This suggests anaerobic conditions and stirring up of the bottom sediments should be avoided.

Total Nitrogen varied between 0.06 mg/l to 0.10 mg/l. The standard for avoidance of eutrophication is 0.06 mg/l. This area of ocean is known to be low in naturally occurring available nutrients and the situation is considered acceptable.

Free Chlorine was not detected in significant concentrations.

Total Phosphorus varied from 0.026 mg/l to 0.132 mg/l. These are marginally above the standard of 0.01 mg/l. This is probably due to the pollution from the town as phosphorus can occur in many sources including sewage, fertilisers, and detergents. The implementation of the new sewage treatment plant should remedy this situation.

Phosphates varied between 0.08 mg/l and 0.4 mg/l which is significantly higher than the standard of 0.015 mg/l. The highest levels occurred in the restricted area near the sewage outfalls which is again indicative of urban pollution and runoff.

Suspended Solids varied between 20 mg/l and 166 mg/l. The standard is 25 mg/l. This corresponds to a range of clear to moderately turbid water which can be considered acceptable quality for a port.

Oil and Grease varied from 4 mg/l to 19.7 mg/l. Ambient standards for oil and grease in receiving waters are not common but when they do exist they are low. For example Malaysia requires 0.5 mg/l although some countries stipulate none at all. The levels measured are high but are thought to originate from the town, not the ships in the harbour. The new sewage treatment facility should redress this situation.

Coliform counts varied from 9 to 35 organisms per 100ml of sample water. The standard is 1000/100ml and so there is little evidence of bacterial contamination in the harbour waters. These standards are generally associated with bathing waters and so are not strictly applicable to the port but do indicate that the waters adjacent to the port should not pose a health threat to recreational bathers.

Sediments

There are no generally accepted standards for sediments as their ability to effect the surrounding waters varies with local conditions. A major concern is heavy metals which can pass into the water and result in biomagnification and bioaccumulation in the various trophic layers of the food chain. These are discussed below. Standards which can be applied relate to dumping of sludge and are drawn from USEPA, Canada and Japan. This would be a similar situation to dredging, or dumping of dredged material.

Arsenic varied from 0.4ppm to 45ppm against a standard of 12.5ppm. This is considered to be a borderline case of exceeding the standard.

Copper varied from 10ppm to 117ppm against a standard of 45ppm. This is considered to be a borderline case of exceeding the standard.

Zinc varied from 124ppm to 431ppm inside the port with a level of 2ppm at the site located outside the port. The standard is 105ppm. This is considered to be a significant but not excessive case of exceeding the standard.

Total Mercury varied from 2ppm to 52ppm against a standard of 0.15ppm. This represents a serious exceedance of the standard at all locations and suggests that large concentrations of mercury are present in the harbour bottom sediments. If dredging were to take place these sediments could be disturbed, reentrained into the water, and the mercury could then pose a potential environmental threat.

b) Changes to Port Construction

The fundamental changes to the existing port construction will involve facilities for the export of grain and wheat, and the import of maize. These could include :

- o Continue to export/import in the present location and dredge to increase the depth from 8.5m to 12m.
- o New container and general cargo berths at the northern side of the site. This could require dredging from 10m to 14m.

It should be noted that all dredged material will used for reclamation purposes.

c) Initial Environmental Examination

The Initial Environmental Examination(IEE) has been assessed in a tabular form in accordance with the layout recommended in the publication "Environmental Assessment for Port Development Projects", MOT, December 1993. This is shown in Table 11-10-2. The significance of impacts are shown by the entries in the tables; those in the left column representing no impact and those in the right column representing major impacts.

As can be seen the planned activities at Latakia have no major impacts. The majority of the intended construction activities will have minimal or no environmental impact and are of no further concern. The activities that may have an impact are dredging and tipping of the dredged material. The degree of these impacts are classed as large but not major as the dredged material will be used in the reclamation and will not be tipped at sea. Also there are no shellfish breeding grounds in the immediate vicinity which may be affected. Therefore a full EIA is not considered necessary. It is recommended that at the time of the dredging monitoring of seawater quality be carried out. This should be at a minimum of three locations; immediately next to the dredging, at the entrance to the harbour, and at a control point outside the harbour. The seawater should then be analysed for heavy metals, particularly mercury, and compared with ambient seawater quality standards. This should be carried out for the duration of the dredging contract at regular intervals and then afterwards at regular but less frequent intervals until no evidence of leaching from the landfill can be detected.

d) **IEE Overview**

The IEE given in Table 11-10-2 is quite comprehensive and a synopsis and overview is given in Table 11-10-3. This is in accordance with JICA requirements given in the Checklist for Scoping Port and Harbours, "Environmental Guidelines for Infrastructure Projects - Ports and Harbours", JICA Environmental Guidelines, September 1992.

As can be seen their are no overriding environmental impacts associated with the planned development, a full EIA is not considered necessary and no remedial measures are required. Monitoring is recommended.

e) **Conclusions**

The baseline data from the environmental survey has been reviewed. In general the water quality is acceptable and in fact could be classed as of good quality for a port where some polluting discharges are inevitable, and the beneficial uses of the water are not so demanding of high water quality as say bathing beaches. Areas of concern are the high sulphides and low dissolved oxygen (at one location) which together with the marginally high COD indicate that a substantial pollution load is entering the harbour. However this may be attributed to the large number of sewage outfalls which enter the harbour, and the new planned sewage master plan should overcome these problems.

Heavy metals in the sediments are high, particularly mercury and to a lesser extent zinc. Disturbance of the seabed is to be avoided, if possible, and if not possible the disposal of any dredged material must be done in a controlled fashion. However at the moment the intention is to use the dredged material for reclamation.

There are no overriding environmental reasons why the planned activities should not proceed and a full EIA and remedial measures are not considered necessary. Monitoring during dredging is recommended.

TABLE 11-10-2 IEE OF EXISTING PORT: LATAKIA

After OCDI 1993

Environmental Impact Factors	Environmental Impact	Countermeasures	Size of Impact: None	Small	Large	Major	Reason	Recommendation
1. Impact from construction works								
1.1 Operation of working boats, construction machines	1.1.1 Air pollution	1.1.1 Management of construction process, selection of working hours, smoke prevention fence.	O					
	1.1.2 Generation of noise and vibration	1.1.2 Selection of construction methods/machines, selection of working hours, placement of sources of noise/vibration	O					
	1.1.3 Changes in terrestrial ecosystem	1.1.3 Selection of construction methods/machines.	O					
1.2 Dredging, stirring of bottom soil, soil dumping into water.	1.2.1 Pollution of water and bottom sediments (SS, hazardous materials)	1.2.1 Settling pond, sedimentation coagulant, selection of construction methods/machines, silt curtains.			O		Dredging of berths. Dredged material to go to reclamation	Monitoring
	1.2.2 Offensive odor	1.2.2 Selection of construction methods /machines, introduction of odor treatment methods.	O					
	1.2.3 Reduction of aquatic lives	1.2.3 Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains, selection of construction period, monitoring of alternative habitats.		O			No fishing grounds or shellfish beds nearby	Monitoring
	1.2.4 Pollution of marine products	1.2.4 Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains, selection of construction period, monitoring pollution of fishery products.	O				Dredging only inside port. No tipping outside port. No effect on fishing	None
	1.2.5 Devaluation of tourism resources	1.2.5 Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains,	O					
1.3 Soil removal	1.3.1 Changes in topography, underground water system	1.3.1 Prior elucidation of underground water system	O					
	1.3.2 Extinction of terrestrial ecosystem	1.3.2 Transplantation of important species, vegetation.	O					
1.4 Generation of surplus soil, wastes, dumping of dredged soil on ground	1.4.1 Pollution of water/bottom sediments	1.4.1 Treatment site planning	O				Spoil used for reclamation	None
	1.4.2 Impact on terrestrial ecosystem	1.4.2 Disposal site planning	O					
1.5 Employment of laborers	1.5.1 Inflow of alien cultures	1.5.1 Employment planning, disclosure of information	O					
	1.5.2 Change in economic activities	1.5.2 Employment planning, vocational training	O					
1.6 Congestion of work vehicles and boats	1.6.1 Economic loss (traffic jam)	1.6.1 Construction of access roads	O				Roads already exist	
	1.6.2 Devaluation of fishing ground	1.6.2 Alternative fishing ground	O					
2. Impact from port facilities and site								
2.1 Emergence of site (including landfill)	2.1.1 Pollution of water and bottom sediments	2.1.1 Change of face lines, dredging sludge, promotion of seawater exchange	O					
	2.1.2 Beach erosion and accretion	2.1.2 Change of face lines, construction of breakwaters against beach erosion, littoral nourishment	O				No major structural changes	
	2.1.3 Changes in coastal currents	2.1.3 Change of face lines, construction of breakwaters, selection of type of offshore structure	O				No major structural changes	

TABLE 11-10-2 IEE OF EXISTING PORT: LATAKIA

After OCDI 1993

	2.1.4 Decrease of habitats for aquatic lives	2.1.4 Transplant, discharge of seeds and saplings	O					
	2.1.5 Decrease of habitats for terrestrial lives	2.1.5 Change of face lines, designation of nature conservation areas, artificial tidal flats, transplant	O					
	2.1.6 Change in scenic beauty	2.1.6 Location of facilities, selection of color, plantation	O					
	2.1.7 Resettlement of local residents and culture	2.1.7 Transfer planning, information disclosure	O					
	2.1.8 Extinction of fishing grounds	2.1.8 Expansion of functions of fishing ports, marine products transportation functions	O					
2.2 Emergence of external facilities	2.2.1 Pollution of water and bottom sediments	2.2.1 Change of face lines, dredging sludge, promotion of seawater exchange	O					
	2.2.2 Beach erosion and accretion	2.2.2 Change of face lines, construction of breakwaters against beach erosion, littoral nourishment	O					
	2.2.3 Change in coastal currents	2.2.3 Change of face lines, construction of breakwaters for wave prevention , selection of type of offshore structure	O					
	2.2.4 Decrease of habitats for aquatic lives	2.2.4 Transplant, discharge of seeds and saplings	O					
	2.2.5 Change of scenic beauty	2.2.5 Changes in shape of facilities and selection of colors	O					
2.3 Emergence of sea route	2.3.1 Change in coastal currents	2.3.1 Change of face lines, construction of breakwaters for wave prevention	O					
	2.3.2 Decrease of habitats for aquatic lives	2.3.2 Transplant, discharge of seeds and saplings	O					
2.4 Emergence of anchorage	2.4.1 Change in coastal currents	2.4.1 Change of face lines, construction of breakwaters for wave prevention , selection of type of offshore structure	O					
	2.4.2 Decrease of habitats for aquatic lives	2.4.2 Transplant, discharge of seeds and saplings	O					
3. Impact from utilisation of facilities in water area and anchorage								
3.1 Impact from boats	3.1.1 Air pollution	3.1.1 Reduction of stoppage time in ports, compulsory use of high quality oil	O					
	3.1.2 Water pollution (bilge)	3.1.2 Strengthening of laws and regulations		O			More shipping anticipated	Enforcement of harbour regulations
	3.1.3 Beach erosion caused by furrow wave	3.1.3 Speed limit, beach protection structure	O					
	3.1.4 Generation of wastes (dredged material included)	3.1.4 Strengthening of laws and regulations, recycling/disposal systems		O			More waste to municipal tip	Authorities to implement correct waste disposal practices
	3.1.5 Obstruction to fisheries activities	3.1.5 Alternative fishing ground and artificial fishing sites, expansion of function of fishing ports and transportation of marines products	O					
4. Impact from cargo loading and utilisation of storage facilities								
4.1 Cargo loading and utilisation of storage facilities	4.1.1 Air pollution (dust)	4.1.1 Establishment of buffer zone, enclosure, surface treatment, selection of loading machines		O			Some dust due to grain handling	None
	4.1.2 Pollution of water and bottom sediments	4.1.2 Establishment of buffer zone, enclosure, surface treatment, selection of loading machines, shape of apron	O					
	4.1.3 Generation of noise	4.1.3 Zoning, sound proof fence/hood	O					
	4.1.4 Generation of offensive odor	4.1.4 Zoning, sealing of storage facilities, deodorisation facilities	O					
	4.1.5 Change in coastal ecosystem	4.1.5 Establishment of buffer zone, enclosure, surface treatment, selection of loading	O					

TABLE 11-10-2 IEE OF EXISTING PORT: LATAKIA

After OCDI 1993

		machines, shape of apron, monitoring of pollution of marine products						
	4.1.6 Generation of wastes	4.1.6 Planning for collection, treatment and disposal of wastes	O					
	4.1.7 Employment effect	4.1.7 Vocational training	O					
5. Impact from operation of facilities handling hazardous materials								
5.1 Operation of oil distribution base and facilities handling hazardous materials	5.1.1 Air pollution	5.1.1 Reduction of air pollutants (dust collection, desulphurisation, denitrification) promotion of dispersion	O					
	5.1.2 Pollution of water and bottom sediments (oil)	5.1.2 Facilities for waste oil treatment, oil fence			O		No contingency plan for spill from oil storage area	Relocate oil terminal
	5.1.3 Generation of offensive odor	5.1.3 Change of zoning, containment of offensive odor, deodorser	O					
	5.1.4 Change in coastal ecosystem	5.1.4 Facilities for waste oil treatment, oil fence, monitoring of pollution of marine products	O					
	5.1.5 Change in terrestrial ecosystem	5.1.5 Facilities for waste oil treatment, oil fence, establishment of nature conservation area			O		Possible effect on beaches to north of Latakia	Relocate oil terminal
	5.1.6 Decrease in amount of agricultural products, fisheries products and price	5.1.6 Facilities for waste oil treatment, oil fence, monitoring of pollution of marine products	O					
6. Impact from waste treatment and disposal								
6.1 Operation of waste treatment facility	6.1.1 Air pollution	6.1.1 Reduction of air pollutants (dust collection, desulphurisation, denitrification)	O					
	6.1.2 Pollution of water and bottom sediments	6.1.2 Reduction of discharge, drainage treatment facilities	O					
	6.1.3 Generation of offensive odor	6.1.3 Zoning, containment of offensive odor, deodorser	O					
	6.1.4 Change in coastal ecosystem	6.1.4 Prevention of water pollution	O					
	6.1.5 Change in terrestrial ecosystem	6.1.5 Prevention of air/water pollution	O					
6.2 Impact from waste disposal facility	6.2.1 Air pollution	6.2.1 Establishment of buffer zone, surface treatment, fence	O					
	6.2.2 Pollution of water and bottom sediments	6.2.2 Sheet cover (rain prevention) settling ponds selection of bulkhead structure	O					
	6.2.3 Generation of offensive odor	6.2.3 Zoning	O					
	6.2.4 Change in coastal ecosystem	6.2.4 Prevention of water pollution	O					
	6.2.5 Change in terrestrial ecosystem	6.2.5 Prevention of air/water pollution	O					
	6.2.6 Formation of slums	6.2.6 Management plans for disposal site	O					
7. Impact from Traffic function								
7.1 Road Traffic	7.1.1 Air pollution	7.1.1 Improvement of transportation system routes, establishment of buffer zone, road pavement, green belt, cover on a bed of trucks		O			Some increase in road traffic	None
	7.1.2 Generation of noise and vibration	7.1.2 Correction of routes, establishment of buffer zone, selection of road/trackage, structure road pavement, soundproof fence		O			Some increase in road traffic	None
	7.1.3 Change in terrestrial ecosystem	7.1.3 Correction of routes, establishment of buffer zone/nature conservation area, prevention of air pollution	O					
	7.1.4 Change in local population distribution	7.1.4 Information disclosure, enlightening the local people on the concerned project	O					
	7.1.5 Traffic jams/accidents	7.1.5 Relocation of routes/overpass	O					
8. Impact from industrial production activities								
8.1 Operation of factories and plants	8.1.1 Air pollution	8.1.1 Reduction of air pollutants (dust collection, desulphurisation, denitrification) promotion of dispersal	O					
	8.1.2 Pollution of water and bottom sediments	8.1.2 Reduction of discharge, drainage treatment facilities	O					
	8.1.3 Generation of noise and vibration	8.1.3 Zoning, establishment of buffer zone, sound proof fence/hood	O					

TABLE 11-10-2 IEE OF EXISTING PORT: LATAKIA

After OCDI 1993

	8.1.4 Generation of offensive odor	8.1.4 Zoning, containment of offensive odor, deodorisation facilities	O					
	8.1.5 Ground subsidence	8.1.5 Regulation on the use of underground water	O					
	8.1.6 Change in coastal ecosystem	8.1.6 Prevention of water pollution, dredging of sludge	O					
	8.1.7 Change in terrestrial ecosystem	8.1.7 Establishment of nature conservation area	O					
	8.1.8 Generation of wastes	8.1.8 Planning for collection treatment and disposal of wastes	O					
	8.1.9 Change in local population distribution	8.1.9 Establishment of employment planning, information disclosure	O					
	8.1.10 Employment effect	8.1.10 Vocational training	O					
9. Impact from storage and distribution functions								
9.1 Storage functions (including outdoor storage)	9.1.1 Air pollution (dust)	9.1.1 Zoning, establishment of buffer zone, containment, sprinkling, sheet cover, surface treatment	O					
	9.1.2 Pollution of water and bottom sediments	9.1.2 Zoning, containment, sheet cover, establishment of drains, and settling ponds	O					
	9.1.3 Generation of offensive odor	9.1.3 Zoning, containment of odor, deodoriser	O					
9.2 Cargo handling	9.2.1 Generation of noise	9.2.1 Zoning, establishment of buffer zone, selection of machines, sound proof fence and sound proof hoods	O					
	9.2.2 Employment effect	9.2.2 Vocational training	O					
10. Impact from operation of recreational facilities								
10.1 Utilisation of hotels, marinas, artificial beaches	10.1.1 Pollution of water and bottom sediments	10.1.1 Water quality control through laws and regulations, water quality improvement in the shallow coastal area including artificial beaches	O					
	10.1.2 Change in coastal ecosystem	10.1.2 Prevention of pollution of water and bottom sediments			O		Contingency plan for oil spill from oil storage area	Prepare contingency plan
	10.1.3 Generation of wastes	10.1.3 Planning for collection treatment and disposal of wastes	O					
	10.1.4 Inflow of alien culture	10.1.4 Selection of project location, information disclosure, enlightening the local people on the concerned project	O					
	10.1.5 Employment effect	10.1.5 Employment planning, vocational training	O					
	10.1.6 Obstruction to fishing activities	10.1.6 Securing of alternative fishing grounds	O					

TABLE 11-10-3 IEE OVERVIEW

After JICA 1992

CHECKLIST FOR SCOPING (PORTS AND HARBOURS)			
PORT:	LATAKIA		
	ENVIRONMENTAL ITEM	EVALUATION	REASON
		A/B/C/D	
SOCIAL ENVIRONMENT			
1	RESETTLEMENT	D	
2	ECONOMIC ACTIVITIES	D	Impact is positive
3	TRAFFIC/PUBLIC FACILITIES	D	
4	SPLIT OF COMMUNITIES	D	
5	CULTURAL PROPERTY	D	
6	WATER RIGHTS AND RIGHTS OF COMMONS	D	
7	PUBLIC HEALTH CONDITIONS	D	
8	WASTE	D	
9	HAZARDS(RISKS)	B	Minor risk of oil spill from oil storage terminal. Contingency plan recommended.
NATURAL ENVIRONMENT			
10	TOPOGRAPHY AND GEOLOGY	D	
11	SOIL EROSION	D	
12	GROUNDWATER	D	
13	HYDROLOGICAL SITUATION	D	
14	COASTAL ZONE	D	
15	FAUNA AND FLORA	D	
16	METEOROLOGY	D	
17	LANDSCAPE	D	
POLLUTION			
18	AIR POLLUTION	D	
19	WATER POLLUTION	B	Dredging of bottom sediments to be carefully controlled and monitored.
20	SOIL CONTAMINATION	D	
21	NOISE AND VIBRATION	D	
22	LAND SUBSIDENCE	D	
23	OFFENSIVE ODOR	D	

A=Serious impact is expected
B=Some impact is expected
C=Extent of impact is unknown. Examination is needed.
D=No Impact is expected. IEE/EIA not necessary.

11.11 Facility Design

In the Master Plan of Latakia Port, the extension of the breakwater and the development of the berths (2 container berths and 3 general cargo berths) are planned based on the long term demand forecast.

11.11.1 Design Conditions

(1) Oceanographic Conditions

1) Deep Water Waves

The provable wind velocities for the frequency level of single event per 50 years (F=0.02) are extrapolated according to data presented in the Table 11.11.1-1. They show that stormy winds near the Latakia Port may reach the following velocities as S-20m/sec, SW-27m/sec, W-27m/sec, and NW-23m/sec. (Ref. Extension of the Port of Latakia, 1980, USSR State Design and Research Institute of Sea Transport)

Table 11.11.1-1 Frequency of Stormy Winds over the Eastern Part of the Mediterranean Sea in Event per Year

(%)

Wind Velocity (in m/sec)	Wind Direction (in azimuth)			
	S	SW	W	NW
24-	-	0.03	0.03	-
20-24	0.02	0.09	0.06	0.03
16-20	0.10	0.38	0.16	0.09
12-16	0.55	1.70	0.55	0.40
8-12	3.00	9.50	2.90	2.00

Note: Average time duration of a storm - "event" - is assumed to be 14 hours. It was determined by the time of cyclone which caused storms in the northern part of the Mediterranean Sea.

Consequently, deep water waves corresponding to above wind elements are estimated by using SMB method by S, SW, W and NW directions based on the eight azimuth as shown in Table 11.11.1-2.

Table 11.11.1-2 Deep Water Waves in 50 Years Return Period

Wave Characteristics	Deep Water Wave Direction (in azimuth)			
	S	SW	W	NW
Ho(m)	6.0	7.0	7.0	6.0
To(sec)	9.0	10.0	10.0	9.0
Lo(m)	126	156	156	126

It is evident that the stormiest months are December-March. During these periods, the maximum values of wave parameters were recorded in Latakia Port. The maximum wave height during the period under investigation was 6 m. It was observed at the south-west storm on the 13th of December, 1979.

In Old Port Area, the breakwater was damaged in 1968 by storms and the armored stones were partly dissipated. (see, 6.1.6)
According to this damage, the wave height is estimated to be around 5 meters at the corner. (-10m)

In both cases, deep water wave heights are estimated to be 7 meters approximately.

2) Design Waves

In a shallow water area, waves are subject to refraction due to local change of the wave velocity with change of the water depth so that the resulting changes of the wave direction and wave height should be taken into consideration.
In an area where the water depth is greater than about one-half of the wave length, i.e., a region of deep water, waves propagate without being affected by the sea bottom. When waves enter into a region of shallow water, however, the direction of wave propagation gradually shifts and the wave crestlines are bent into the pattern of the depth contours of the sea bottom.
Wave elements in the zone of the breakwaters at depth of -18m can be determined based on their deep water characteristics using reduction coefficient for refraction, energy losses and wave transformation at lesser depths.

There are no exact bathymetricmaps over the whole Syrian coastal areas. However, Syrian coastal line stretches north and south, and by assuming the Syrian coastal area with straight, parallel depth-contours, the variation of the wave direction and the refraction coefficient of the waves can be obtained by following formulas.

$$\sin\alpha = \sin\alpha_0 \tanh\frac{2\pi h}{L}$$

$$Kr = \sqrt{\frac{\cos\alpha_0}{\cos\alpha}}$$

where L, α and α_0 denote the wave length at the depth h, the incident angle of the wave to the contour line at the planned depth h, and the incident angle of the deep water wave to the off-shore contour line, respectively.

The following table shows the values of refraction coefficient of regular waves (K_r) and the incident angle α at the -18mdepth.

Table 11.11.1-3 Refraction Coefficient and Incident Angle of Waves

Wave Characteristics	Deep Water Wave Direction (in azimuth)			
	SSW	SW	W	NW
H_0(m)	6.0	7.0	7.0	6.0
T_0(sec)	9.0	10.0	10.0	9.0
L_0(m)	126	156	156	126
H_0/L_0	0.048	0.045	0.045	0.048
α_0	68	45	0	45
h(m)	18	18	18	18
Kr	0.83	0.89	0.95	0.90
α	48	32	0	35

The south direction wave undergoes the most intensive refraction due to the slanting approach towards isobaths; the least refracted waves are those of the W direction which extend towards isobaths perpendicularly.

Where the water depth is less than about 3 times the equivalent deep water wave height, attenuation of the wave height due to wave breaking shall be considered.

The wave elements regime in the area of the breakwaters construction at the depth of -15 m is given in the following table by assuming the sea bottom slope to be 1/100. The relations, h/H_0'-$H_{1/3}/H_0'$ and h'/H_0'-H_{max}/H_0' are calculated according to a theoretical model of wave breaking. In this Table, H_0' represents the equivalent deep water wave height, $H_{1/3}$ the significant wave height, H_{max} the maximum wave height and L_0 the wave length of deep water waves.

Table 11.11.1-4 Design Wave Heights

Wave Characteristics		Deep Water Wave Direction (in azimuth)			
		SSW	SW	W	NW
H_0(m)		6.0	7.0	7.0	6.0
T_0(sec)		9.0	10.0	10.0	9.0
L_0(m)		126	156	156	126
h(m)		18	18	18	18
K_r		0.75	0.91	1.00	0.93
H_0'(m)*1		4.5	6.4	7.0	5.6
$H_{1/3}$	h/H_0'	4.00	2.83	2.57	3.23
	h/L_0	0.143	0.115	0.115	0.143
	$H_{1/3}/H_0'$	0.92	0.93	0.93	0.92
	$H_{1/3}$	4.1	5.9	6.5	5.1
H_{max}	h'(m)*2	18.2	18.3	18.3	18.3
	h'/H_0'	4.05	2.97	2.62	3.27
	H_{max}/H_0'	1.66	1.67	1.67	1.66
	H_{max}(m)	7.5	10.7	11.7	9.2

*1: $H_0' = H_0 \times K_r$
*2: $h' = h + 5H_{1/3} \times (1/100)$

The design wave heights by depth of the planned breakwater are estimated as follows based on the hydraulic experiments. The critical wave conditions can be disignated depending on the marine facilities arrangement.

Table 11.11.1-5. Design Waves by Depth, Wave Direction

Deep Water Wave	H0 (m)	α_0 (degree)	Depth (m)	H1/3 (m)	Hmax (m)	α (degree)
SSW	6.0	68	-18	4.1	7.5	48
		68	-15	4.0	7.2	45
SW	7.0	45	-18	5.9	10.7	32
		45	-15	5.8	9.6	30
W	7.0	0	-18	6.1	11.7	0
		0	-15	6.1	9.8	0
NW	6.0	45	-18	5.1	9.2	35
		45	-15	5.1	8.7	32

3) Tides

Very low tides are characteristic for the sea level of Latakia Port. The tidal range does not exceed ±0.5 m from the Latakia Port datum.
The following tidal conditions are adopted for the facility design in Latakia Port.

Mean High Water Spring (H.W.L.)	+0.50 m
Mean High Water Neap (M.H.W.N.)	+0.15 m
Mean Sea Level (D.L.)	±0.00

(2) Geological Conditions

According to the above mentioned study, the following soil characteristics at the extension area are referred: The geological structure of the site of the breakwaters is not uniform. Rock represented by limestone of mean strength is underlayed the root and shoreside sections of the breawater. However, great part of underlaying grounds are loose silts with a thickness of up to 8 m. Geological conditions of the near shore are relatively uniform and represented by rock, except of a small area where lenses of coarse and gravel sands are present. In this study, geological conditions of the planned facilities are assumed to be silty sand with N-value of 30.

(3) Seismicity

The past earthquakes in Syria have been estimated based on the related information. (see, 2.2) According to this analyses, few earthquakes are estimated at the area including Latakia. Furthermore, records of big earthquakes at the coastal area in Syria do not exist. For the design of port facilities in this study, seiamic coefficient 0.03 is adopted referring to the preceding case of Latakia Port. The seismic forth acting on the structure will be calculated by the seismic coefficient method.

11.11.2 Structural Design

(1) Breakwater

Design conditions at the extension area are seemed to be almost same as the existing breakwater excepting geological conditions. Sub-soil survey should be carried out at the stage of detailed design. The maximum water depth of planned breakwater will reach to -18 m depth which is deeper than the existing ones.
It is generally said that the construction cost of rubble mound breakwater in the deep water increases sharply due to the increase of construction materials. So, two alternatives, that is, rubble mound type and caisson type are proposed and investigated technically and economically.
The standard cross section of the existing breakwater is chosen for the rubble mound type. (see, Fig. 11.11.2-1,-2)
On the other hand, the standard cross sections shown in Fig.11.11.2-3, -4 are designed for the caisson type breakwater. These caisson type sections are planned with wave dissipating concrete blocks to reduce the overtopping of wave and the reflected wave into approach channel. These concrete blocks decrease the caisson weight as well.
In the case of caisson type, it is necessary to prepare the caisson yard and the slipway for the construction and the setting of concrete caissons.
The cost for the preparation works in the caisson type will be higher than the rubble mound type.

1) Determination of Cross Section

In determining the cross sections of the breakwaters, the following premises are taken into consideration.

1. The crown height of the breakwater is determined to be +5.0 m as same as the existing ones.

2. In the caisson type, the gradient of concrete blocks is recommended to be 1:4/3, and the gradients of the slopes of the rubble mound are designed to be 1:3 at the seaward side and 1:2 at the harbor side respectively considering the stability of the rubble mound.

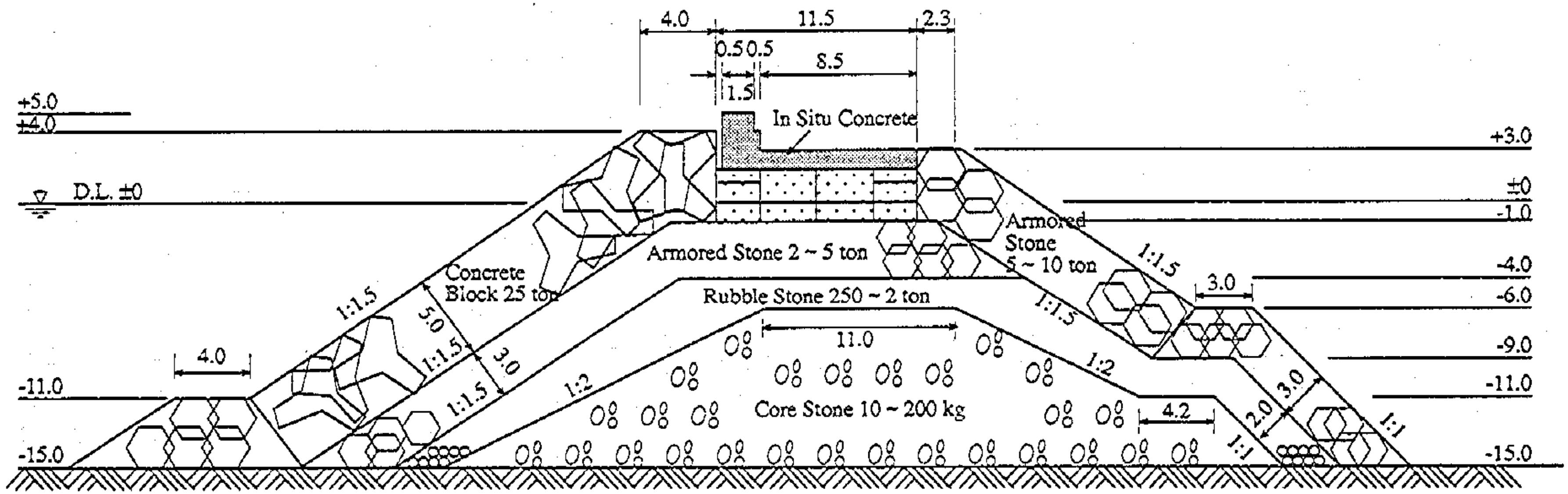


Fig. 11.11.2-1 Typical Cross Section of Breakwater - Latakia Port Rubble Mount (-15.0 m)

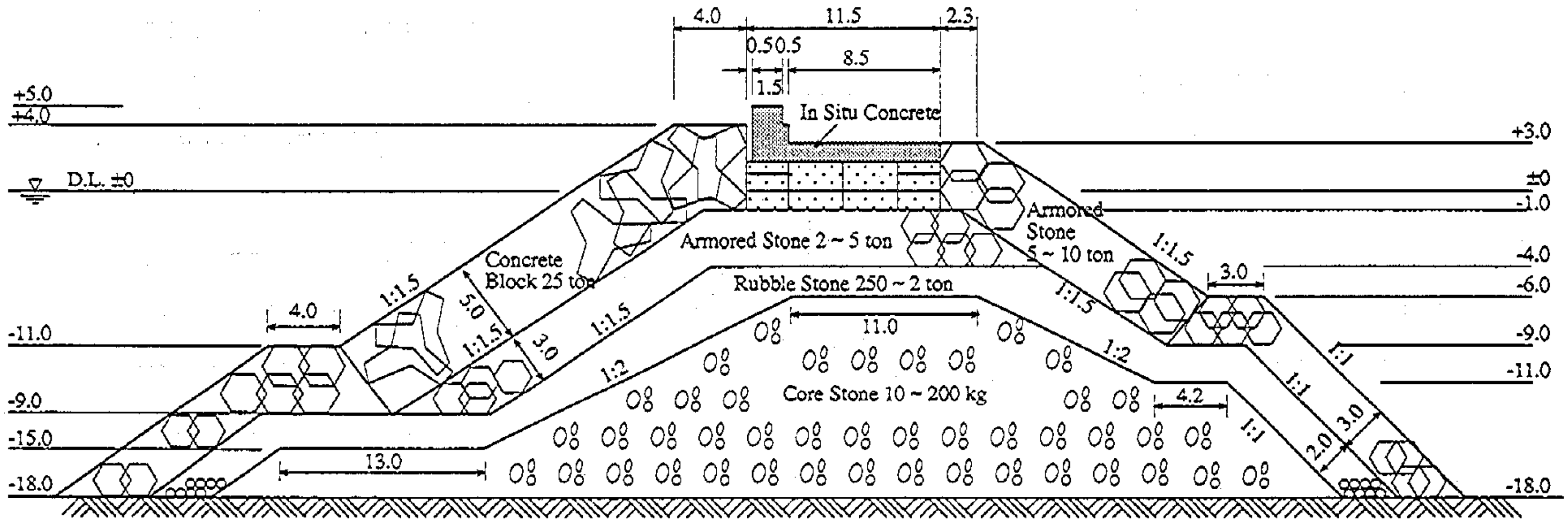


Fig. 11.11.2-2 Typical Cross Section of Breakwater - Latakia Port
Rubble Mount (-18.0 m)

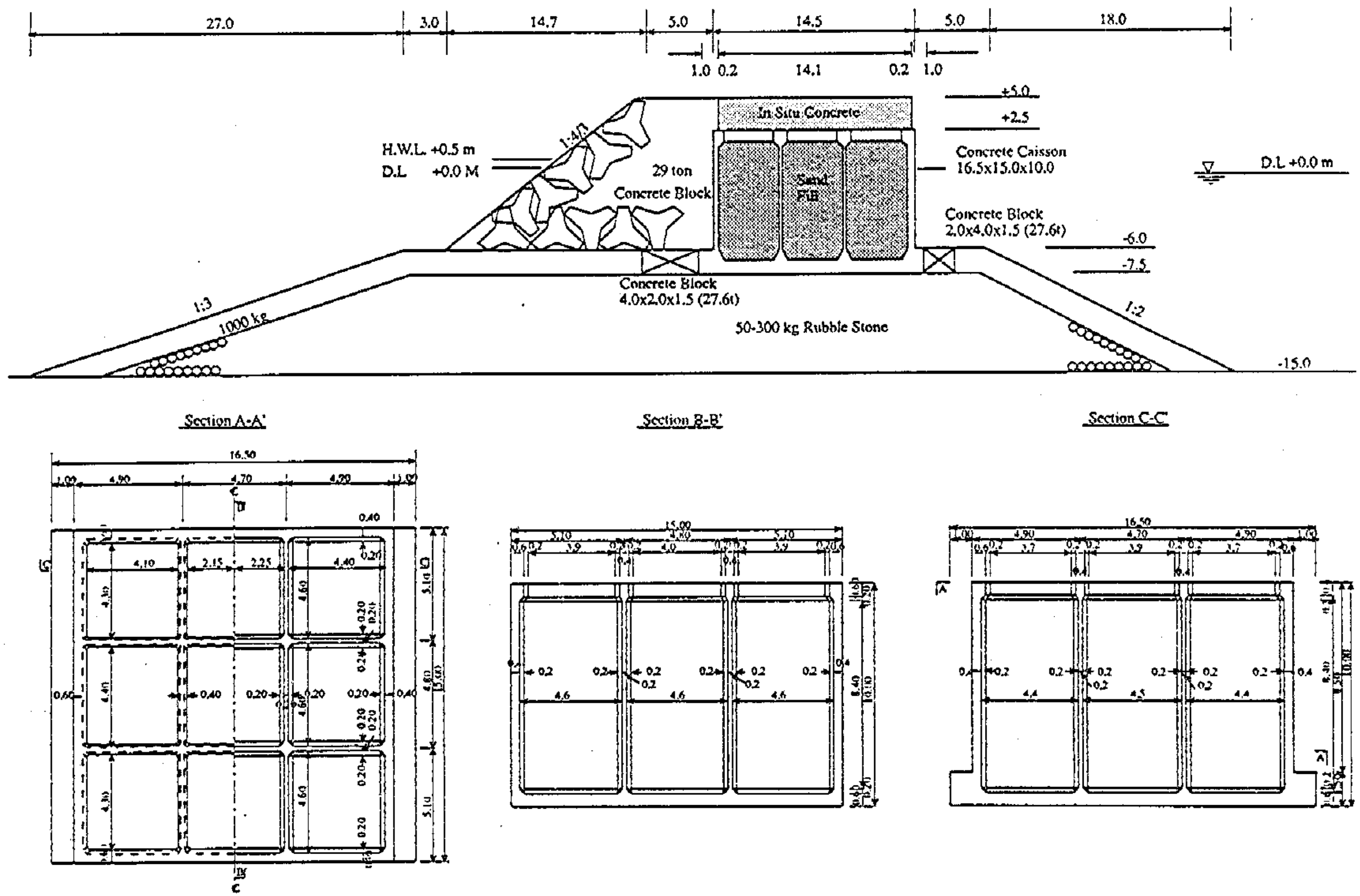


Fig. 11.11.2-3 Typical Cross Section of Breakwater - Latakia Port Caisson Type (-15.0m)

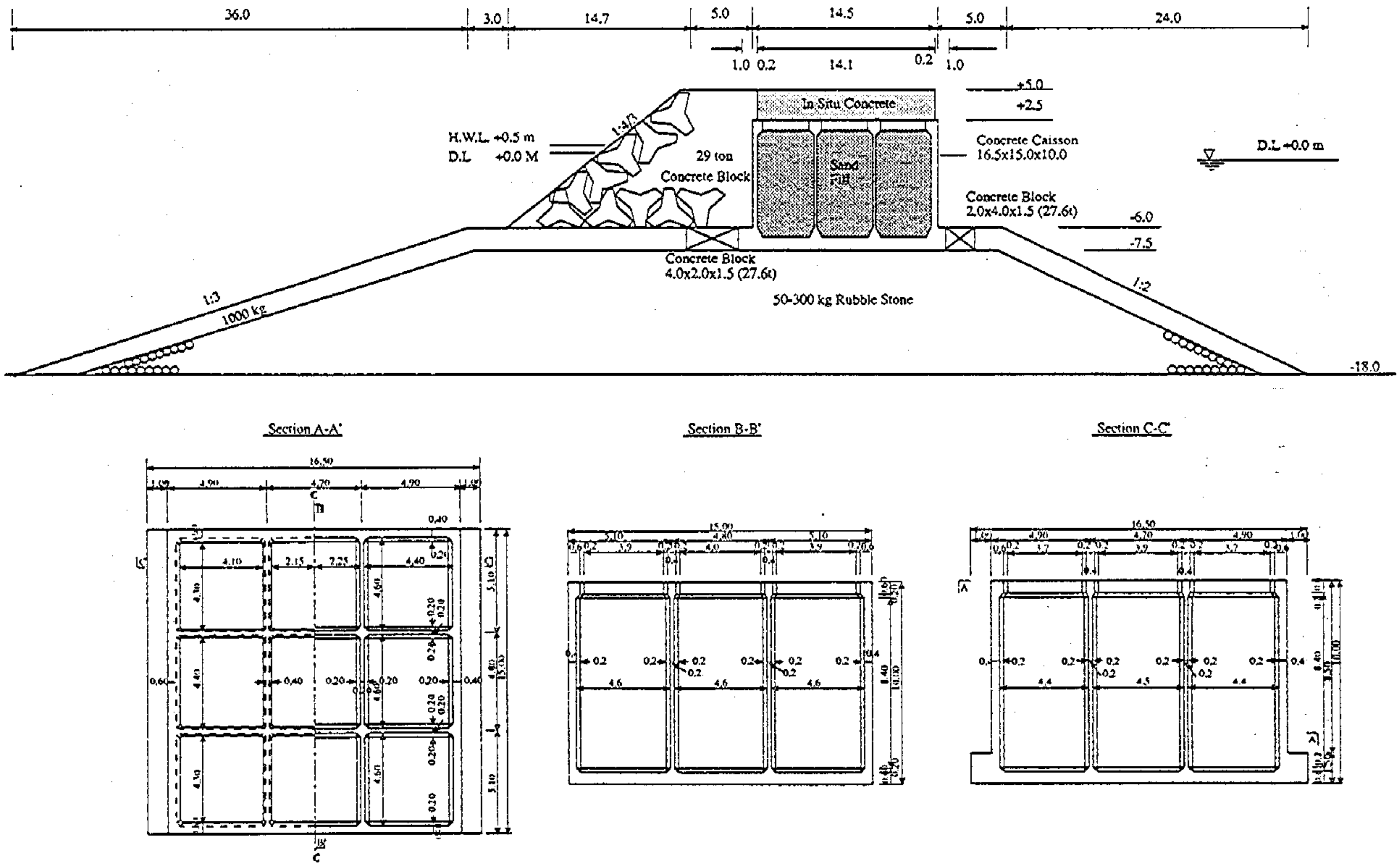


Fig. 11.11.2-4 Typical Cross Section of Breakwater - Latakia Port Caisson Type (-18.0m)

3. In the caisson type, breakwaters having the incident angle less than 15 degrees are designed with wave dissipating concrete blocks to prevent the increase of caisson weight. So, the net weight of concrete caisson can be lowered than 1,300 tons.

4. An inspection platform shall be provided at the breakwater head for the turning of vehicles and mounting of navigational aids.

2) Weight of Armored Stones

The weight of concrete blocks covering the slope surface of the structure receiving the wave action is calculated using the following formula:

$$W = \frac{\gamma H3}{KD(Sr-1)3\cot\alpha} \quad *$$

where;

W :Minimum weight of rubbles or concrete blocks (tons)
γ :Unit weight of rubble or block in air (t/m3), 2.65
Sr :Specific gravity of rubble or block to sea water, 2.65/1.03
α :Angle of the slope to horizontal plane (degrees), 37
H :Significant wave height H1/3 at the water depth where the structure is constructed (m)
K_D :Constant determined by the armoring material and damage rate, 4

* :Hudson, R.Y, "Laboratory Investigation of Rubble-Mound Breakwater", proc. ASCE, Vol.85.

The weight of concrete blocks are calculated to be 2.5-29 tons depending on the sea depths.

3) Dimensions of Breakwater

The main dimensions of breakwater are summarized in the Table 11.11.2-1. The standard cross sections of the breakwaters are shown in Fig.11.11.2-1,-4.

Table 11.11.2-1 Main Dimensions of Breakwater

Depth (m)	H1/3 (m)	Crown Height (m)	Weight of Armored Block (tons) Gradient of Slope 1:4/3
-18	6.1	+5.0	29
-15	6.1	+5.0	29

4) Safety Factors of Caisson Type Breakwaters

The caisson of a breakwater must be designed to be safe against sliding and overturning. At the same time, the bearing capacity of the rubble mound foundation and the seabed should be examined to ascertain that they remain below the allowable limit. The safety factors against sliding and overturning of caisson under wave action are defined by the following:

Against sliding: $S.F.=\dfrac{\mu(W-U)}{P}$

Against overturning: $S.F.=\dfrac{Wt-M_U}{M_P}$

where;

W :Weight of caisson per unit extension in still water (tons)
U :Total uplift pressure (tons)
P :Total wave pressure (tons)
μ :Coefficient of friction between the caisson and the rubble mound
t :Horizontal distance between the center of gravity and the heel of the caisson (m)
M_U :Moment of uplift pressure (ton-m)
M_P :Moment of wave pressure (ton-m)

According to the standard cross sections shown in Fig.11.11.2-3,-4, the safety factors for sliding (S.F.1), the safety factors for overturning (S.F.2) and the largest bearing pressures at the heel (p_e) result in the Table 11.11.2-2.
Usually, the coefficient of friction μ is assumed to be 0.6, and the breakwaters are to be designed with the safety factors over 1.2.
Therefore, above caissons have sufficient stability against sliding and overturning.
The bearing capacity of the rubble mound can be examined by comparing the allowable bearing capacity (q_{ta}) with the largest bearing pressure (p_e) caused by the resultant of dead weight and wave forces which is usually eccentric and inclined.
The allowable bearing limit of the rubble mound (q_{ta}) is to be kept below the value of 40 to 50 t/m2 based on the experience. As for the largest bearing pressure (p_e), it is assumed that a trapezoidal or triangular distribution of bearing pressure exists beneath the bottom of the caisson, and the largest bearing pressure at the heel is calculated as

$$p_e=\frac{2W_e}{3t_e} \qquad : t_e\le\frac{1}{3}B$$

or, $$p_e=\frac{2W_e}{B}\left(2-3\frac{t_e}{B}\right) \qquad : t_e>\frac{1}{3}B$$

where;

$$t_e=\frac{M_e}{W_e},\quad M_e=Wt-M_U-M_P,\quad W_e=W-U$$

The largest bearing pressures shown in Table 11.11.2-2 are far less than the allowable bearing limit, and above cases are enough safe concerning the bearing capacity of the rubble mound.

Table 11.11.2-2 Safety Factors of Caisson Type Breakwaters

Depth (m)	Wave Dissipating Concrete Blocks	Max.Reaction (t/m2)	S.F.1 for Sliding	S.F.2 for Overturning
-18	w/	27.6	1.57	2.74
-15	w/	25.3	1.48	2.56

5) Comparison of Construction Costs of Breakwaters

Construction costs of breakwaters are compared by structural type as shown in Table 11.11.2-3.

Table 11.11.2-3 Cost Index of Breakwaters by Structural Type

Depth (m)	Rubble Mound Type	Caisson Type
-15	100	100
-18	120	120

6) Conclusion

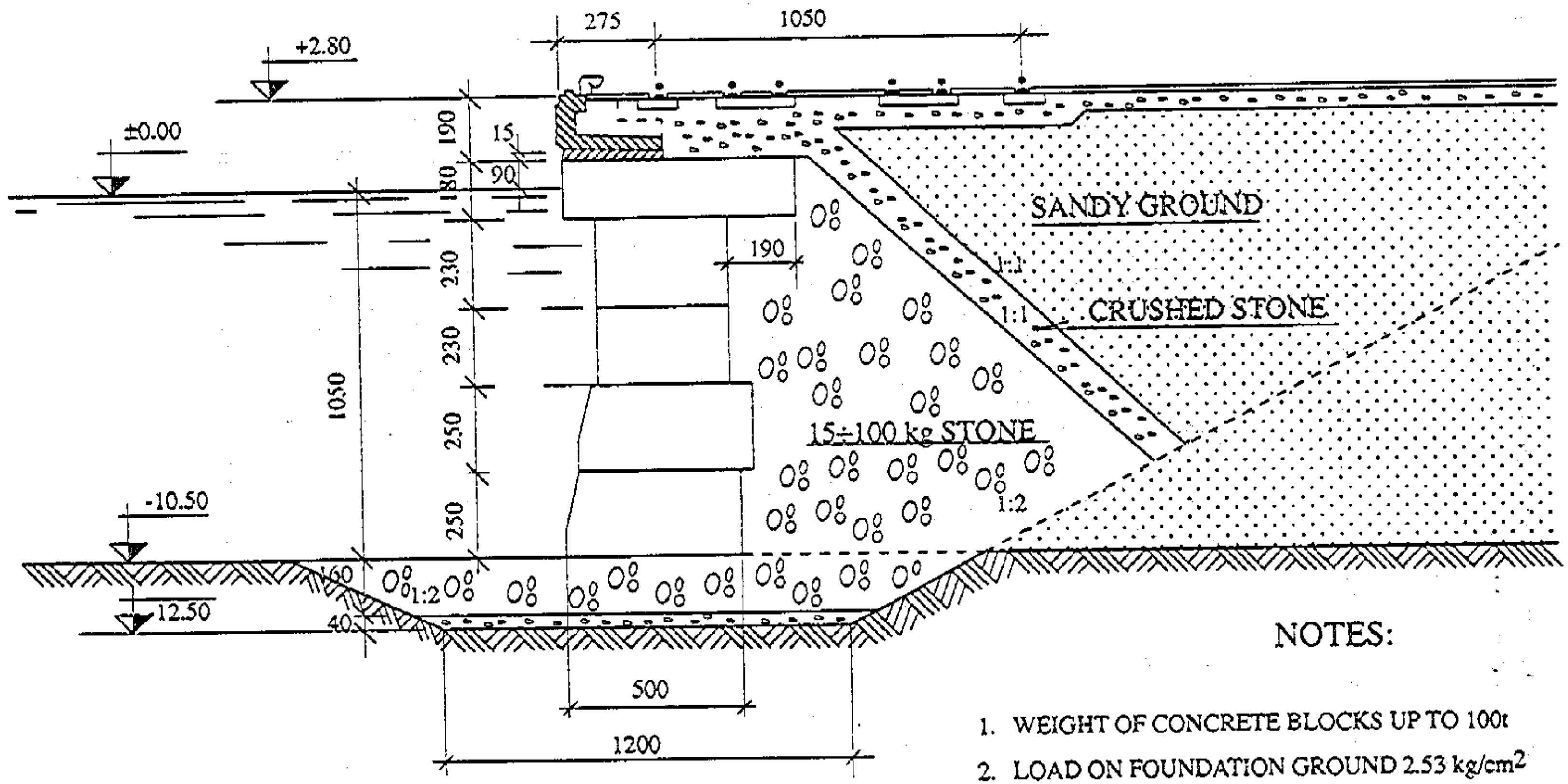
The comparison of both types is summarized in Table 11.11.2-4.
The construction cost of caisson type is almost same as the rubble mound type. It is noticed that the caisson type breakwater has not been constructed in Syria so far, and that the caisson type has some difficulties when weak sub-soil conditions appear. But, judging from the past experience of the port construction in Syria, both types are feasible technically.
Though the final decision depends on the future subsoil survey, the rubble mound type is chosen due to its easy construction method in this study.

Table 11.11.2-4 Comparison of Two Types of Breakwater

Structural Type	Rubble Mound Type	Caisson Type
Ancillary Works	Yard for Const. Materials, Service Boats Area	Caisson Yard, Slipway, Yard for Const. Materials Service Boats Area
Working Vessels	Diver's Boat, Open Berge, Tilting Hopper Berge, Tug Boat, Sand Carrier with Grab Bucket, Floating Crane	Diver's Boat, Open Berge, Tilting Hopper Berge, Tug Boat, Sand Carrier with Grab Bucket, Floating Crane
Main Construction Materials	Stones	Stones, Rainforced Concrete
Weights of Construction Materials	Concrete Block: Max. 25 t, Armor Stone: Max. 5-10 t	Concrete Caisson: Max. 1,223 t, Concrete Block: Max. 29 t, Armor Stone: Max. 1 t
Effect of Ground Condition	Less affected	Affected
Construction Method	Easy	Complexed
Cost Index	100	100

(2) Berths

Geological conditions at the planned site will be different by location. But, existing berths at Latakia Port were mostly constructed by adopting the gravity type, that is, concrete block type excepting the inner port area where the steel sheet pile type berths were partly constructed due to the weak ground condition. So, in this study, standard cross sections of the existing berths are adopted. (Fig 11.11.2-5)



NOTES:

1. WEIGHT OF CONCRETE BLOCKS UP TO 100t
2. LOAD ON FOUNDATION GROUND 2.53 kg/cm^2
3. DIMENSIONS IN cm; ELEMENT IN m

Fig. 11.11.2-5 Typical Cross Section of Quay - Latakia Port

(3) Container Yard

Cement concrete pavement is recommended for the container yard. The design loads are presumed as follows.

Forklift truck	15 t
Straddle carrier	60 t

The standard composition of concrete pavement is designed below.

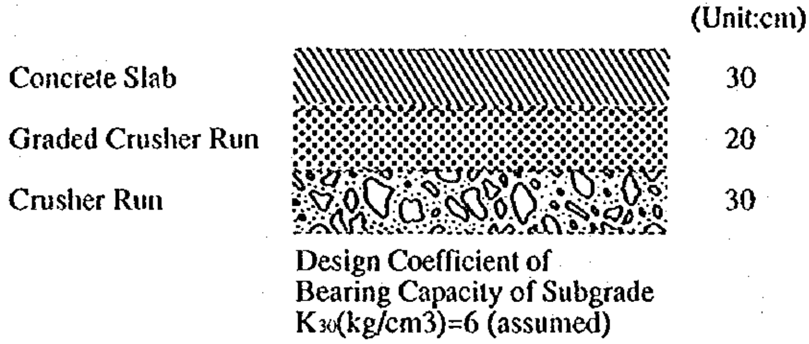


Fig. 11.11.2-6 Standard Cross Section of Container Yard

(4) Open Yard, Road

Open Yard, apron and road are planned to be paved by asphalt concrete. The design load are set as follows.

Truck	T-14
Tractor trailer	20 ft, 40 ft

The composition of the bituminous pavement is shown below.

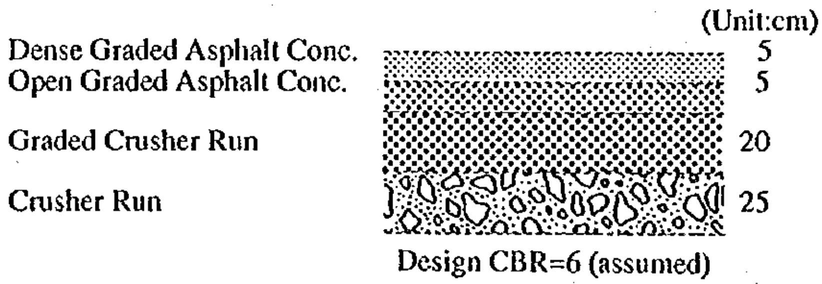


Fig. 11.11.2-7 Standard Cross Section of Yard, Apron

11.12 Cost Estimate

11.12.1 Conditions of Cost Estimate

General conditions of cost estimate are mentioned in Chapter 6.3, and estimate is carried out based on the design and quantities of each facility.

11.12.2 Total Cost

Three alternatives are proposed in the Master plan as shown in Chapter 11.9, and total cost of each alternative are summarized as follows:

(Unit : Million S.P)

	Case-1	Case-2	Case-3
Civil Works	6,633	7,148	7,090
Building	489	489	489
Utilities	98	98	98
Cargo Handling Equipment	5,717	5,717	5,717
Others	300	300	300
Total	13,237	13,752	13,694

Note : Civil Works include dredging, wharf, reclamation breakwater.
Building include grain silo, machinery tower etc.
Others include physical contingency and engineering fee.

As the comparison of costs, layout plan of Case-1 is selected as the master plan of Port Latakia, and the detail of cost is shown in Table-11.12.2-1. As concerns Cargo Handling Equipment, the breakdown of equipment to be installed in Master Plan is shown in Table 11.12.2-2.

Table 11.12.2-1 Total Cost of Master Plan Case-1

No.	Facilities	Unit	Q'ty	Uni Cost (Unit:S.P)			Cost (Unit:1,000 S.P)		
				F.C	L.C	Total	F.C	L.C	Total
A	Civil Works								
1	Berakwater								
	Main Breakwater	m	600	0	1,750,000	1,750,000	0	1,050,000	1,050,000
	Sub-Breakwater	m	900	0	1,035,000	1,035,000	0	931,500	931,500
	Sub-Total						0	1,981,500	1,981,500
2	Grain Terminal(1)								
	Dredging(-12m)	m3	300,000	600	0	600	180,000	0	180,000
	Wharf(-12m)	m	210	235,000	800,000	1,035,000	49,350	168,000	217,350
	Revetment	m	20	0	490,000	490,000	0	9,800	9,800
	Reclamation	m3	330,000	0	300	300	0	99,000	99,000
	Sub-Total						229,350	276,800	506,150
3	Container Terminal								
	Wharf(-14m)	m	700	222,000	898,000	1,120,000	155,400	628,600	784,000
	Transition	m	50	302,000	898,000	1,200,000	15,100	44,900	60,000
	Revetment	m	370	302,000	898,000	1,200,000	111,740	332,260	444,000
	Dredging(-14m)	m3	1,643,000	600	0	600	985,800	0	985,800
	Reclamation	m3	1,886,000	0	300	300	0	565,800	565,800
	Marshaling/Back Yard etc	m2	315,000	0	1,100	1,100	0	346,500	346,500
	Stuffing Yard etc	m2	44,000	0	1,000	1,000	0	44,000	44,000
	Sub-Total						1,268,040	1,962,060	3,230,100
4	General Cargo Terminal								
	Wharf(-10m)	m	555	130,000	690,000	820,000	72,150	382,950	455,100
	Revetment	m	140	0	300,000	300,000	0	42,000	42,000
	Dredging(-10m)	m3	370,500	600	0	600	222,300	0	222,300
	Reclamation	m3	92,500	0	300	300	0	27,750	27,750
	Open Space etc	m2	230,000	0	720	720	0	165,600	165,600
	Sub-Total						294,450	618,300	912,750
5	Mobilization	LS	1	2,500,000	0	2,500,000	2,500	0	2,500
	Total of Civil Works						1,794,340	4,838,660	6,633,000
B	Building								
1	Grain Silo(Metalic)	LS	1	117,600,000	50,400,000	168,000,000	117,600	50,400	168,000
2	Machinery Tower(new)	Nos	1	0	105,000,000	105,000,000	0	105,000	105,000
3	Machinery Tower(exist)	Nos	1	0	94,500,000	94,500,000	0	94,500	94,500
4	C.F.S	m2	2,400	0	12,000	12,000	0	28,800	28,800
5	Terminal Office	m2	3,000	0	12,000	12,000	0	36,000	36,000
6	Work Shop/Cleanning	m2	3,000	0	12,000	12,000	0	36,000	36,000
7	Passenger Terminal&	m2	2,300	0	9,130	9,130	0	21,000	21,000
	Total of Building						117,600	371,700	489,300
C	Utilities	LS	1				0	98,056	98,056
D	Cargo Handling Equipment								
	Total of Equipment	LS	1				5,716,770	0	5,716,770
E	Physical Conti/Engineering Fee	LS	1				260,000	40,000	300,000
F	Grand Total						7,888,710	5,348,416	13,237,126

Table 11.12.2-2 Cargo Handling Equipment
Latakia Port

Unit Cost:1,000Sp

Items	Capacity	Unit Price	Master Plan	
			Q'ty	Cost
1. Grain Silo(Exclude Silo & M.T)				1,915,200
1-1 Grain Terminal at New Port(Exclude Silo & M.T)				1,050,000
Loader/Unloader	400/400t/h	126,000	2	252,000
Handling Equipment		798,000	1	798,000 *
1-2 Existing Grain Silo(Exclude M.T)				865,200
Loader/Unloader	400/200t/h	96,600	2	193,200
Handling Equipment		672,000	1	672,000 *
2. Container Terminal				2,968,020
Container Cranes	(Panamax)	239,400	8	1,915,200
Straddle Carriers		39,860	24	956,640
Forklift Trucks	3t	1,680	18	30,240
Forklift Trucks	2t	1,050	18	18,900
Tractors		4,200	4	16,800
Trailers		1,680	18	30,240
3. Conventional Berths				833,550
Portal Jib Cranes	16tx32m	35,320	3	105,960
Portal Jib Cranes	6.3tx27m	26,040	6	156,240
Portal Jib Cranes	6tx27m	25,230	3	75,690
Portal Jib Cranes	4tx27m	20,960	9	188,640
Mobil Cranes	65t	31,500	4	126,000
Forklift Trucks	5t(Special)	2,520	8	20,160
Forklift Trucks	5t	2,100	31	65,100
Forklift Trucks	3t	1,680	57	95,760
Total				5,716,770

* Remarks; Breakdown of the cost is shown in appendix 18.

11.12.3 Investment in Every Term

Based on the implementation schedule which is mentioned in the previous section, tentative investment in every term is assumed as shown in Table 11.12.3-1.

Table 11.12.3-1 Investment in Every Term

(Unit : Million S.P)

		Short-Term	Second-Half	Master Plan
A	Civil Works	509	6,124	6,633
B	Buildings	388	101	489
C	Utilities	48	50	98
D	Cargo Handling Equipment	3,815	1,902	5,717
E	Physical Contingency and Engineering Fee	150	150	300
F	Grand Total	4,910	8,327	13,237

11.13 Stage Plan

Since the volume of exported grain is estimated to be the same as that in the year 2010, the grain terminal is planned to be completed before the year 2003. The new container terminal and the general cargo terminal need not be completed before 2003. However, since the volume of container is estimated to exceed 300,000 TEUs in 2003, cargo handling productivity of the existing container terminal needs to be improved drastically by procuring gantry cranes and related cargo-handling equipment. Moreover, the new terminals are planned to be completed at the early stage after the year 2003. The stage plan is as follows:

Stage I (-2003)

- Modernization of the existing container terminal
  (4 gantry cranes, relocation of yard facilities, straddle carriers, forklift trucks)
- Establishment of a new grain terminal (Silo, loader/unloader)
- Modernization of the existing grain terminal
  (Berth, unloader/loader)
- Preparation of required cargo-handling machines
  (Jib cranes)

Stage II (2004-2007)

- Establishment of a new container terminal (1 berth and marshaling yard behind)
- Cargo-handling equipment(2 gantry cranes, Straddle carrier, Forklift)
- Construction of breakwater

Stage III (2007-2010)

- Completion of a new container terminal (1 berth and marshaling yard)
- Establishment of general cargo berths

11.14 Preliminary Economic Analysis

11.14.1 Methodology

(1) Purpose

The purpose of the preliminary economic analysis is to appraise the economic feasibility of the master plan for the study ports before a feasibility study on the short term plan can proceed.
The preliminary economic evaluation of a project should show whether the project is justifiable from the viewpoint of the national economy by assessing its contribution to the national economy.

(2) Methodology

An economic analysis will be carried out according to the following method. Master plan will be defined and it will be compared to the "Without" case. All benefits and costs of it in market price for the difference from "With" case will be calculated and evaluated.

There are various methods to evaluate the feasibility of this type of development project. Here, the economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the feasibility of the project. The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal.

11.14.2 Prerequisites of Analysis

(1) Base Year

The "Base Year" here means the standard year in the estimation of costs and benefits. Taking into consideration the base year in cost estimation of construction, 1995 is set as the "Base Year" for this study.

(2) Project Life

Taking into consideration the depreciation period of the main facilities of 30 years and the construction period of 5 years, the period of calculation (project life) in the economic analysis is assumed to be 35 years from the beginning of construction.

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = 42 S.P., the same rate as used in the cost estimation.

(4) "With"case

In an economic analysis, benefits are mainly brought about by improvements and expansions in handling capacity. Therefore, the "With" case scenario includes all improvements in productivity and all expansions of port facilities for the master plan.

(5) "Without"case

A cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases. In this study, the following conditions are adopted as the "Without" case.

i) No investment is made for the port
ii) Handling capacity of the existing grain terminal is estimated to be about 800,000 tons. The overflowed grain is assumed to be handled at the general cargo berth.
iii) Handling capacity of the existing container terminal is estimated to be about 316,000 TEUs. The overflowed container cargoes are assumed to be handled in a foreign port and carried by truck between Latakia Port and a foreign port.
iv) As for the container and grain terminal project, the size of vessels and the working efficiency of cargo handling are not the same as "With" case.

The results of forecast on the handling volume by categories of berth are shown in Table 11.14.2-1
The size of ships and the working efficiency of cargo handling in the "With" and "Without" cases are shown in Table 11.14.2-2.

11.14.3 Costs of the Projects

The items that should be considered as costs of the projects are construction costs and maintenance costs.

(1) Construction Costs

Construction costs are divided into such categories as civil costs and mechanical costs. Main mechanical costs are purchasing of handling equipment.

(2) Maintenance Costs

The costs of maintaining the port facilities are estimated as a fixed proportion (1 % for structures, 4 % for handling equipment) of the original construction costs excluding the costs of dredging and reclamation costs.

Table 11.14-2.1 Handling Cargo Volume by Categories of Berth in Latakia Port

["Without"case] (Unit: thousand ton)

Classification of Berth		1994	2003	2004	2005	2006	2007	2008	2009	2010
Container Terminal		-	2,601	2,923	3,277	3,668	4,098	4,571	5,091	5,663
Grain Terminal: Export		113	800	800	800	800	800	800	800	800
: Import		0	0	0	0	0	0	0	0	0
Grain	Export	0	600	600	600	600	600	600	600	400
	Import	288	260	280	302	326	351	379	408	440
General			961	987	1,013	1,040	1,067	1,096	1,125	1,155
Food			394	402	410	418	426	434	443	451
Steel		-	246	281	320	365	416	474	541	617
Wood			264	289	317	347	380	416	456	500
Machine			221	228	236	245	253	262	271	281
Chemical			120	133	148	164	183	203	225	250
Ro/Ro			129	142	156	172	189	208	229	252
General Berth Total		-	3,195	3,343	3,503	3,677	3,866	4,073	4,299	4,347
Total		2,864	6,596	7,066	7,580	8,145	8,764	9,444	10,190	10,809

Table 11.14-2.2 Size of Ship and Working Efficiency of Cargo Handling in both Cases

			"Without"	"With"
Ship Size (DWT)	Container		6500-22000	6500-50000
	Grain	Terminal: Export	10000	20000-30000
		: Import	-	30000-50000
		General Berth : Export : Import	15000	-
Working Efficiency (ton/hr)	Container(TEU/hr)		27	48
	Grain	Terminal: Export	120	320
		: Import	-	236
		General : Export	115	-
		Berth : Import	60	-
	General	General	33.3	
		Foodstuff	35.4	
		Steel	80.0	
		Wood	22.2	
		Machine	15.4	
		Chemical	36.8	
		Ro/Ro	36.4	

Table 11.14-3.1 Costs of the Projects

(Unit: million S.P.)

Items		Costs
Construction Costs (Total)		13,237.1
Maintenance Costs per Year		279.5
	Structure	50.8
	Equipment	228.7

11.14.4 Benefits of the Projects

(1) Benefit Items

As benefits brought about by the master plan of study port, the following items are identified.

1) Savings in waiting costs of ships
2) Savings in water transportation cost by enlargement of ship size
3) Savings in land transportation costs
4) Savings of cost in cargo handling
5) Savings in interest of cargo costs
6) Reduction of cargo damage and accidents at the port
7) Promotion of regional economic development
8) Increase in employment opportunities and incomes

Items 1), 2), 3), 4) and 5) are considered countable and in this study the monetary benefits of items 1), 2) and 3) are calculated.

(2) Calculation of Benefits

1) Savings in waiting costs of ships

In accordance with the implementation of the projects, the total ship staying time, namely ship waiting time for berthing and ship mooring time for unloading/loading in the port, will be greatly decreased. The reduction of the ship staying time under the "With" case is one of the major benefits of the projects. The benefits that will accrue to Syria from the projects can be calculated by the following formula.

Savings in ships' waiting costs
= Difference in waiting time between "With" and "Without" cases
  x Ship's staying cost (unit cost)
  x Share of benefits accruing to Syria (= 0.5)

2) Savings in water transportation cost by enlargement of ship size

When the size of calling ships becomes larger to capitalize on mass transportation, large ship can call at deep berths but can not at existing shallow berths. The water transportation cost per ton of cargo will become cheaper by enlargement of ship size. The benefit that will accrue to Syria from the projects can be calculated by the following formula.

Savings in water transportation cost by enlargement of ship size
= Difference in water transportation cost between "With" and "Without" cases (unit cost)
  x Handling cargo volume
  x Share of benefits accruing to Syria (= 0.5)

3) Savings in land transportation costs

When handling volume reaches the maximum volume of handling capacity of the port, the cargoes which can not be handled in the port will be handled in other foreign ports and then be transported to Syria by trucks. In accordance with the implementation of the projects, it is not necessary to transport the cargoes by trucks. The benefit that will accrue to Syria from the projects can be calculated by the following formula.

Savings in land transportation costs
= Difference in handling cargo volume between "With" and "Without" cases
  x Land transportation cost (unit cost)

In the overflowed container and general cargoes, the cargoes originated from Asian countries are assumed to be handled in Aqaba Port with the share of 20 %. Other container cargoes are assumed to be handled in Beirut Port and general cargoes in Iskendern Port.

Table 11.14-4.1 Benefits of the Projects

(Unit: million S.P.)

Item / project	Waiting Cost	Mooring Cost	Land Trans -portation	Ship Size	Total
Container	0.0	663.2	1,068.0	94.6	1,825.8
Grain	407.4	560.2	0.0	198.9	1,166.5
General Cargo	981.8	0.0	0.0	0.0	981.8
Total	1,389.2	1,223.4	1,068.0	293.5	3,974.1

11.14.5 Evaluation of the Projects

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project.
The EIRR is the discount rate which makes the costs and benefits of a project during the project life equal. It is calculated by using the following formula.

$$\sum_{i=1}^{n} = \frac{B_i - C_i}{(1+r)^{i-1}} = 0$$

where, n: Period of economic calculation (project life)
Bi: Benefits in i-th year
Ci: Costs in i-th year
r: Discount rate

The EIRR of the master plan is calculated as 19.0 %. Result of calculation is shown in Table 11.14.5-1.

(2) Evaluation

The leading view is that the project is feasible if the EIRR exceeds the opportunity cost of capital. In general, the opportunity cost of capital is considered to range from 8 % to 10 % according to the degree of development in each country. It is generally considered that a project with an EIRR of more than 10 % is economically feasible for infrastructure or social service projects.

As for this project, even though the economic calculation only takes into account the items which are easily quantified, the EIRR exceeds 10 %. Therefore, this master plan development project is feasible from the viewpoint of the national economy.

Table 11.14-5.1 Cost/Benefit Analysis of Master Plan in Latakia Port

(Unit: million S.P.)

	Year	Cost			Benefit	Benefit - Cost	Net Present Value (NPV)		
		Construction	Maintenance	Total	Total		Benefit	Cost	Benefit - Cost
1	2005	2647	0	2647	0	-2647	0	2647	-2647
2	2006	2647	0	2647	0	-2647	0	2224	-2224
3	2007	2647	0	2647	0	-2647	0	1869	-1869
4	2008	2647	0	2647	0	-2647	0	1570	-1570
5	2009	2647	0	2647	0	-2647	0	1319	-1319
6	2010	0	280	280	3974	3695	1664	117	1547
7	2011	0	280	280	3974	3695	1398	98	1300
8	2012	0	280	280	3974	3695	1175	83	1092
9	2013	0	280	280	3974	3695	987	69	918
10	2014	0	280	280	3974	3695	829	58	771
11	2015	0	280	280	3974	3695	697	49	648
12	2016	0	280	280	3974	3695	586	41	544
13	2017	0	280	280	3974	3695	492	35	457
14	2018	0	280	280	3974	3695	413	29	384
15	2019	0	280	280	3974	3695	347	24	323
16	2020	0	280	280	3974	3695	292	21	271
17	2021	0	280	280	3974	3695	245	17	228
18	2022	0	280	280	3974	3695	206	14	192
19	2023	0	280	280	3974	3695	173	12	161
20	2024	0	280	280	3974	3695	145	10	135
21	2025	0	280	280	3974	3695	122	9	114
22	2026	0	280	280	3974	3695	103	7	95
23	2027	0	280	280	3974	3695	86	6	80
24	2028	0	280	280	3974	3695	72	5	67
25	2029	0	280	280	3974	3695	61	4	57
26	2030	0	280	280	3974	3695	51	4	48
27	2031	0	280	280	3974	3695	43	3	40
28	2032	0	280	280	3974	3695	36	3	34
29	2033	0	280	280	3974	3695	30	2	28
30	2034	0	280	280	3974	3695	26	2	24
31	2035	0	280	280	3974	3695	21	2	20
32	2036	0	280	280	3974	3695	18	1	17
33	2037	0	280	280	3974	3695	15	1	14
34	2038	0	280	280	3974	3695	13	1	12
35	2039	0	280	280	3974	3695	11	1	10
	Total	13237	8385	21622	119223	97601	10359	10359	0

EIRR= 0.19017

Chapter 12 Master Plan of Tartous Port

12.1 The Basic Concept of the Port Development

The purpose of the Master Plan (target year 2010) is to serve as a target and guideline for phase plans including the Short-Term Plan (target year 2003). The Master Plan shall be an integrated plan covering the layout plans for new facilities, modernization plans for existing facilities and effective management and operation systems. In making the Master Plan for Tartous Port, the following various aspects concerning the port development are recognized:

(1) Inefficient container-handling

The degree of containerization of the cargoes which pass through Tartous Port still remains at a modest level. In 1994, the number of containers which passed through the port is around 23,000 TEUs with an increase rate of 7.2% from the preceding year and the percentage of containerization is 12.1% in import and 54.2% in export.

At Tartous Port, containers are mainly discharged/loaded from/onto container vessels by using ship cranes/derricks. Containers are also discharged/loaded from/into Ro-Ro vessels. As mentioned in Section 11.1.1, container-handling productivity by ship cranes/derricks is much lower compared with that of a quay-side crane. The container-handling productivity in Ro-Ro vessels is also generally low, because a forklift of large lifting capacity of over 30 tons needs to be operated on a narrow deck inside a hold.

In addition, the container marshaling yard is not allocated just behind the quay No.7 of the pier B, but placed adjacent to the bottom end of the pier. In the marshaling yard, straddle carriers are used, but they can not approach the dock-side. Thus, tractor-trailer units are used to haul container boxes between the dock-side and the marshaling yard where straddle carriers receive/hand over containers from/to the tractor-trailer units. Container boxes are lifted directly onto/from tractor-trailer units by ship cranes/derricks. Those complicated and time-consuming operations are contributing to low container-handling productivity and consequent longer berthing times of costly container vessels. An average gross container-handling productivity in the first half of 1994 is estimated to be 4.9 boxes/hr/vessel.

Presently, in the port, there are no toplifters which can lift on/off container boxes without risking damage, especially in handling a 40ft container box most of which have no forklift pockets. Hence, instead of toplifters, forklift trucks with the capacity of 10-35 tons are mainly used at the terminal, sometimes resulting in damage to container boxes.

(2) Limited phosphate-handling capacity and dust emission problem

A great part of the phosphate rock produced in Syria has been exported. The volume of phosphate rock product peaked in 1989, amounting to 2,250,000 tons. The volume of exported phosphate rock peaked in the previous year, recording 1,763,000 tons, of which major portion was shipped from the phosphate terminal at Tartous Port operated by the General Company of Phosphate and Mines. Since then to 1993, both product and export of phosphate rock in Syria have shown a continuous downward trend, presumably as a result of the political and economic chaos in Eastern Europe and Russia which were major importers of Syrian phosphate rock triggered by the vanishing of the Soviet Union.

Hence, the company is now extending its market of phosphate export to Western Europe in addition to its old trade partners, Eastern Europe and Russia. Thus, the volume of phosphate rock exported through Tartous Port bottomed out in 1993, and has been increasing gradually since then.

The phosphate company, however, is facing a limited phosphate-handling capacity due to the shortage of silo capacity and locomotives/railway wagons. To extend the market of phosphate, presently, phosphate must be stored in silos separately, according to ten different degrees of quality, whereas phosphate was classified into only one degree in the past. Thus the present actual phosphate-handling capacity of the Tartous marine terminal is said to be around 1.2 million tons per annum, which means that purchase offers from phosphate importers must often be refused. The phosphate company fears the possible demurrage in shipment due to the shortage of the terminal capacity. Even if sufficient locomotives and railway wagons are provided, the capacity is estimated to be at most in the range of 1.5-2 million tons which is much lower than the originally designed capacity.

In the meantime, phosphate dust which is harmful to both humans and agriculture is often emitted from the phosphate terminal through its operations due to the inadequately designed system to prevent and collect phosphate dust. Therefore, it is strictly required to prevent dust emissions. The terminal facilities of the first stage were built in 1972 and hence are already obsolete.

(3) Non-existence of a terminal with spacious open yards for handling long and/or heavy products such as iron/steel and wood products

The volume of iron/steel products unloaded at Tartous in 1994 amounted to 784,000 tons which is 2.4 times as much as that of Latakia in the same year. At the pier A, transit sheds are located just behind the quays and open yards are not spacious, and therefore, steel products are often directly discharged onto trucks/tractors by a quay-side crane, and hauled to open yards apart from the pier A, or directly brought out to outside the port. On the other hand, at the pier B, open yards are located just behind the quays, but there are no quay-side cranes. At the pier B, mobile tower cranes or ship cranes/derricks are used. Under such conditions, gross cargo-handling productivity of iron/steel products is very low, 20.8 tons/hr in the first half of 1994.

(4) Future demand for use of the port

According to the demand forecast mentioned in Chapter 10, the volume of cargoes to be handled at Tartous Port in 2010 is estimated as 7.56 million tons, 2.1 times as much as the volume in 1994. The volume of imports is estimated as 6.57 million tons, accounting for 86.9% of the total. In imports, the volume of general cargo in break-bulk takes the largest share (35.3% of the total), followed by container cargo (23.3%), iron and steel products (17.9%), wood (13.4%) and grains in bulk (10.1%). On the other hand, the volume of exports is estimated as 1.20 million tons. In exports, the volume of grains in bulk take large share (67.0%) followed by container cargo (32.2%).

(5) Effective utilization of the existing facilities

In the first step of making the Master Plan, the effective utilization of the existing facilities to meet the forecast demand needs to be examined so as to save investment cost for a new project as much as possible along with improvement of management and operation systems of the port including institutional matters aiming at efficient cargo-handling.

(6) Economic transportation

In making the port investment plan, it is necessary to put emphasis on economic transportation, considering both the investment cost for port facilities and ship transportation cost from the standpoint of the national economy.

(7) Safe operations

In making the port plan, safe operations need to be considered both on water and land. In order to ensure safe operations within the port area, it is necessary to prepare sufficient yard areas with required facilities adequately laid out, since congestion risks accidents in port operations.

(8) Environmental impact on areas around the port induced by the port development

In making the port plan, environmental impact on the area both during the periods under construction and after the start of operations must be considered.

Based on the above, the following concept of the development of Tartous Port is proposed for the purpose of achieving safe, efficient and reliable operations for the customers:

(1) Modernization of the existing container terminal

The number of containers to be handled at the port in 2010 is estimated as 200,000 TEUs. To receive the forecast container traffic, it is necessary to increase the present container-handling capacity of the existing container terminal as much as possible by modernization through the preparation of required container-handling machines including dock-side container gantry cranes and the relocation of the yard facilities including ground slots, terminal gate, and a terminal control office.

(2) Introduction of a closed system in the container terminal

It is advisable to introduce a closed container terminal system controlled by a terminal operator that takes the responsibility of receipt, storage and delivery of containers at the terminal by conducting yard planning and inventory control of containers which is indispensable for a modernized container terminal.

(3) Transfer of the phosphate terminal from Tartous Port to the new port and convension of it to an additional grain terminal.

It is proposed to transfer the phosphate terminal from Tartous Port to the new port to be created in south Hamidieh so as to resolve the dust emission problem which currently affects urban areas in Tartous and lift the limitation of the phosphate-handling capacity of the existing terminal at Tartous Port.

It is proposed to convent the existing phosphate terminal to an additional grain terminal to cope with the increasing volume of grain export to the future. It is also proposed to reclaim the bottom of the existing phosphate pier, for the purpose of receiving Ro-Ro' and small-sized general cargo ships when the pier is not occupied by grain carriers.

(4) Preparation of additional general cargo and Ro-Ro berths

Despite the anticipated progress of containerization, it is forecast that considerable volume of general cargo in break-bulk still needs to be received in the stage of the Master Plan.
In the meantime, Ro-Ro traffic is expected to be encouraged to the foreseeable future as it was until 1981, especially through Iraq.
In the limited space enclosed by the existing breakwaters, additional new

berths can be constructed by reclamation in touch with the south breakwater and so proposed.

12.2 Usage Plan for the Existing Port Facilities

Vessels calling at Tartous Port at present are divided into five types; general cargo vessel, Ro/Ro vessel, cereal carrier, full-cellular container vessel and phosphate carrier. These five types of vessels are further divided into the following eleven categories. Phosphate carriers are planned to shift into the new port.

- General cargo vessel laden with various kinds of cargoes
- General cargo vessel laden with one kind of commodity
  - Foodstuffs or agricultural products except livestock
  - Livestock (sheep, cattle)
  - Steel products
  - Wood
  - Car, machine and equipment
  - Chemical products
- Ro/Ro vessel
- Grain carrier(Import)
- Grain carrier(Export)
- Container vessel

The volume of cargoes estimated in the demand forecast(see Chapter 10) is distributed to vessels categorized above. The usage plan for the existing port facilities by vessel type is proposed as follows.

(1) General Cargo Vessel(Various Kinds of Cargoes)

The total volume of cargoes to be transported by the vessel of this type through Latakia Port is estimated 1.022 million tons in 2010, an increase of 560,000 tons from 1994. In making the plan for berth allocation for the vessels, the following premises are adopted considering the actual operations. Average cargo handling volume and Hourly cargo handling productivity are the same as that at present.

- Total volume of cargoes: unloaded: 1.16 million tons
  loaded: 28,000 tons
- Average cargo handling volume: 1,710 tons per vessel
- Number of calling vessels: 696 vessels per year
- Cargo handling productivity: 33 tons per hour
- Average dwelling time: 7 days
- Storage: Shed
- Land transport: 100% by trucks

Since general cargo volume will become more than double the present cargo volume, most of the existing berths are planned to accommodate general cargoes. The following berths are allocated:

- Quay No.4, No.5, No.9, No.10, No.12, No.14, No.18, No.19, No.21
- New Berths (No.23, No.24, No.25) (15 berths)

Existing phosphate pier will be utilized both for general cargo vessels and grain vessels.

(2) General Cargo Vessel(Foodstuffs or agricultural products)

The following premises are adopted considering the record of actual operations.

- Total volume of cargoes unloaded from the vessels: 512,000 tons
- Average cargo handling volume: 3,560 tons per vessel
- Number of calling vessels: 144 vessels
- Cargo handling productivity: 88 tons per hour
- Average dwelling time: 7 days
- Storage: Shed
- Land transport by trucks

Foodstuffs and agricultural products show similar cargo handling conditions to general cargo. The following berths are planned to serve the vessels.

- Quay No.9, No.10, No.12, No.13 No.14 (7 berths)

(3) General Cargo Vessels(Livestock)

Tartous Port is the major import port of sheep and cattle. The number of calling vessels carrying livestock is the largest in Tartous Port.
The following premises are adopted considering the record of actual operations.

- Total volume of cargoes unloaded from the vessels: 327,000 tons
- Average cargo handling volume: 260 tons per vessel
- Number of calling vessels: 1,258 vessels
- Cargo handling productivity: 12 tons per hour
- Average dwelling time: within 1 day
- Storage: Open yard
- Land transport by trucks

Since livestock are carried by trucks just after being unloaded from the vessels, area for storage is small. Quay No.4, No.5, No.16 and No.17 (total 4 berths) are allocated for livestock vessels. These vessels have priority to moor these berths.

(4) General Cargo Vessels(Steel products) (see Section 12.3)

At present, heavy cargoes--steel or wood products-- are handled widely throughout Tartous Port. In order to avoid congestion of such heavy cargoes with other general cargoes in one area, it is better to concentrate these cargoes.
The following premises are adopted considering the record of actual operations.

- Total volume of cargoes unloaded from the vessels: 1.06 million tons
- Average cargo handling volume: 2240 tons per vessel
- Number of calling vessels: 475 vessels
- Cargo handling productivity: 80 tons per hour
- Average dwelling time: 9 days
- Storage: Open yard
- Land transport by trucks

Since wide open area is necessary for steel, present sulphur berth(Quay No.21) and Newly constructed berth (No.23) that has large open yard is allocated for the steel vessels.
Existing berths No.4, No.5 and also utilized for steel vessels.
Average dwelling time is the same as at present.

(5) General Cargo Vessels(Wood)

The following premises are adopted considering the record of actual operations.

- Total volume of cargoes unloaded from the vessels: 693,000 tons
- Average cargo handling volume: 1,390 tons per vessel
- Number of calling vessels: 499 vessels
- Cargo handling productivity: 24.4 tons per hour
- Average dwelling time: 7 days
- Storage: Open yard
- Land transport by trucks

Since the volume of the wood will be doubled in 2010, it requires a wide storage area. The following berths are allocated:

- Quay No.4, No.5, No.9, No.21 (5 berth)
- New berths (1 berth)

(6) General Cargo Vessels(Car, machine,equipment)

The following premises are adopted considering the record of actual operations.

- Total volume of cargoes unloaded from the vessels: 295,000 tons
- Average cargo handling volume: 520 tons per vessel
- Number of calling vessels: 568 vessels

- Cargo handling productivity: 39 tons per hour
- Average dwelling time: 7 days
- Storage: Open yard
- Land transport by trucks

Since car, machine and equipment are handled through the entire area, similar berthing condition should be kept in the year 2010. The following berths are allocated:

- Quay No.9, No.10, No.11, No.12, No.14 (7 berths)

(7) General Cargo Vessels (Chemical products)

The following premises are adopted considering the record of actual operations.

- Total volume of cargoes unloaded from the vessels: 480,000 tons
- Average cargo handling volume: 1,990 tons per vessel
- Number of calling vessels: 122 vessels
- Cargo handling productivity: 32.2 tons per hour
- Average dwelling time: 7 days
- Storage: Shed
- Land transportation by trucks

Since the chemical products will be doubled comparing with that in 1994, a wide area is necessary for storage. The following berths are planned to serve the vessels;

- Quay No.4, Quay No.9, Quay No.12 (7 berths)

(8) Ro/Ro Vessels

Ro/Ro vessels are berthing mainly at three existing berths with Ro/Ro facilities (Quay No.5, No.6 and No.10, No.21 and New Berth (No.25). Since wide open yard is already developed behind these berths, these berths are allocated also in the year 2010. The following premises are adopted considering the record of actual operations.

- Total volume of cargoes: unloaded: 138 thousand tons
  loaded: 16 thousand tons
- Average cargo handling volume: 1,270 tons per vessel
- Number of calling vessels: 122 vessels
- Cargo handling productivity: 34.4 tons per hour
- Average dwelling time: 5 days
- Storage: Open yard
- Land transportation by trucks

(9) Grain Carrier(Import)

The volume of grain (maize and barley) to be unloaded at the port in the year 2010 is estimated as 660,000 tons, a 124% increase over that in 1994.

The following premises are adopted considering the record of actual operations.

- Average cargo handling volume: 16,640 tons per vessel
- Number of calling vessels: 40 vessels
- Cargo handling productivity: 168 tons/hr
- Average dwelling time in silo: 10 days
- Land transport by trucks

In addition to the existing berth Quay No.12, existing phosphate piers will be converted for the grain and general cargo vessels.

(10) Grain Carrier(Export)

Exported grain volume is expected to the amount of 800,000 tons in the year 2010. The following premises are adopted considering the record of actual operations.

- Average cargo handling volume: 20,000 tons per vessel
- Number of calling vessels: 40 vessels
- Average dwelling time in silo: 10 days
- Cargo handling productivity: 202 ton/hr
- Land transport by railway and trucks

Grain is export through both existing grain berth and converted phosphate piers.

(11) Container Vessel

The number of containers to be handled at the port is estimated as 222,000 TEUs in 2010, 9.5 times greater than that in 1992. In order to accommodate these containers, full-scale container terminal is needed. Since Tartous Port has limited room for expansion, existing general cargo terminal is shifted to a container terminal.

In the next step, the proposed usage plan for the existing port facilities is determined by using a computer simulation, excluding containers that are planned to be handled at the container terminals. In this study, reference to the actual statistical distribution forms for ship arrivals and mooring periods at the Latakia Port is made. Operational conditions at the port are as follows.

- Annual working days: 365 days
- Daily working hours: 24 hours

A result of the simulation is summarized as follows.

- Average ship waiting time:

1 General cargo vessels(Various kinds of cargoes): 3.1 hrs
2 General cargo vessels(Foodstuffs/agricultural products): 14.6 hrs
3 General cargo vessels(Livestock): 5.1 hrs
3 General cargo vessels(Steel products): 6.8 hrs
4 General cargo vessels(Wood): 7.9 hrs
5 General cargo vessels(Car, machine and equipment): 12.3 hrs
6 General cargo vessels(Chemical products): 22.2 hrs
7 Ro/Ro vessels: 7.4 hrs
8 Grain carrier(Import): 1.2 hrs
9 Grain carrier(Export): 0.5 hrs

- Percentage of berth occupancy

Quay No.4+5: 85.2(%)
Quay No.7+6: 91.2
Quay No.9+10: 88.4
Quay No.11+12: 86.0
Quay No.13: 73.3
Quay No.14: 80.9
Quay No.15: 76.0
Quay No.16: 76.2
Quay No.17: 77.3

Areas of public sheds and open yards occupied by various cargoes fluctuate according to daily arrivals, dwelling time and departures of the cargoes. When estimating the required areas for storing them, a daily maximum occupied area is adopted. The result of the simulation is as follows.

- Area in sheds: 12.2 ha
- Area in open yards: 11.0 ha
- Total area: 19.4 ha

Existing sheds and warehouses occupy 7.9 ha and open yards occupy 18.5 ha excluding the container yard, CFS and Ro/Ro marshaling yard. Since the total area of the existing storage facilities exceeds the necessary area, it is possible to accommodate future cargo within the existing port.

Total ship waiting days in 2010 excluding container vessels are estimated as 1,518 days, a 2% reduction from that of 1534 days in 1994.

12.3 Modernization Plan of the Existing Facilities

12.3.1 Container Terminal

In order to meet the demand of container handling at the port in 2010, a new full scale container terminal will be required as mentioned in Section 12.2. Since the expansion of the port is difficult due to the limited land, the existing general cargo terminal in the north of Pier-B is planned to be modernized and converted into the container terminal.

(1) Number of Containers

The number of containers handled at the terminal in Tartous Port is assumed according to the demand forecast described in Chapter 9. The numbers are divided into imported and exported categories with the number of LCL, FCL, reefer and Empty categories shown as follows:

Unit:Thousand TEUs

Year	Import Empty	LCL	FCL	Reefer	Total
2010	2	5	98	1	100

Year	Export Empty	LCL	FCL	Reefer	Total
2010	70	2	30	1	100

(2) Major Shipping Routes

Referring to the present major shipping routes, the following routes are adopted:

Shipping route	Origin& Destination	Share(%)	Distance(miles)
East Med.-1	Piraeus	17	650
East Med.-2	Beirut	23	150
West Med.	La Spezia	12	1,590
Black Sea	Novorossisk	25	1,400
North Europe	Hamburg	23	3,780

Transportation cost by vessel size is computed as follows:

Vessel Size (DWT)	(TEU)	Piraeus	Beirut	Laspezia	Novoros.	Hamburg
3,800	210	144	112	196	189	245
6,500	400	121	100*	144	140	176
12,000	500	116	118	143	140	171
22,000	1,200	100*	134	107	106	117
27,000	1,500	101	148	100*	100*	104
35,000	2,000	110	175	103	104	103
50,000	3,000	128	224	109	112	100*

Note: * minimum cost is expressed as 100 by destination

(3) Water Depth along Berth

Since the berth depth of the existing general cargo terminal is -13m, the alternatives of the terminal are Case 1:with the same water depth of the general cargo terminal, and Case 2(Berth Depth -14m) which can receive panamax-size container vessels of 3,000 TEUs capacity. The results of calculation of Net Present Costs (including shipping cost and berth construction cost) for 30 years are as follows:

	Case 1	Case 2
Cost Index	100	106

The terminal with a berth depth of -13m is more economical than that of -14m.

Thus it is not necessary to deepen the existing water depth of -13m along the north of Pier-B.

(4) Marshaling Yard

Required yard area is determined so as to receive containers dwelling at the yard in a peak condition. To estimate the required area, the simulation was conducted according to the following premises:

- Average cargo handling volume: 630 TEUs per vessel
- Number of calling vessels: 317 vessels
- Land transport by trucks
- Cargo Handling Productivity: 48 Boxes/hour
- Percentage of containers handled in the container terminals: 90 % (200 thousand TEUs)
- Annual working hours: 365 days
- Daily working hours: 24 hours
- Number of berths 1 (350m)
- Average dwelling time : All LCL containers: 1 day
  Other Imported containers: 5 days
  Other Exported containers: 3 days

- Percentage of CFS cargoes: 5 %

Resulting number of containers which must be stacked on yards at the terminal is as follows:

Unit:TEUs

	Laden Container	Empty Container
- Average dwelling number	1,770	1,580
- Maximum dwelling number	3,103	3,010
- Peak factor	1.75	1.90

In order to accommodate above containers, two alternatives are proposed, one with Straddle Carrier Systems, one with Transfer Crane Systems.

1) Straddle Carrier System

The following premises are adopted to determine the number:

- Operational factor in storage: 0.75
- Stacking height:
  Import(dry): 3
  Export(dry): 3
  Reefer: 2
  Empty: 4 (handled by top-lifters)

The total required slot numbers are as follows:

- Loaded container(dry): 1,340 TEUs
  Empty container: 1,000 TEUs
  Reefer container: 20 FEUs

Since the area of the north side of Pier-B is around 7ha, it is possible to allocate the above required ground slot space there for stacking laden containers. On the other hand, there is no room to stack empty containers just behind the berths of Pier-B. They must be stacked in and around the bottom of Pier-B.

2) Transfer Crane Systems

The following premises are adopted to determine the number:

- Operational factor in storage: 0.75
- Number of layers of stacked containers:
  Import(dry): 3
  Export(dry): 3
  Reefer: 2
  Empty: 4

The total required slot numbers are as follows:

- Laden container(dry): 1,260 TEUs
  Empty container: 1,000 TEUs
  Reefer container: 20 FEUs

Considering no spacious marshaling yard at Pier-B, even in case of transfer crane system, the maximum stacking height is curbed up to 3 high. Thus laden containers can be narrowly received at the marshaling yard of Pier-B in a peak condition as well as the case of straddle carrier system.

(5) Container Freight Station

In order to determine the required area and number, the result of the above simulation is also adopted. According to the result, the cargo volume dwelling in CFSs fluctuates, showing a maximum volume equivalent to 154 TEUs and a peaking factor of 1.97

The required number of bays at CFSs for chassis or ordinary trucks is determined considering the fluctuation of the cargo volume passing through CFSs. The maximum volumes equivalent to TEUs at container side is 33 TEUs.

The required dimensions of CFSs are as follows:

- Total number of bays on each side: 8
- Minimum width for bays: 32m each
- Area: 4,107 m^2

Since the area of existing CFSs is 14,400m^2, it is possible to accommodate future LCL cargo.

(6) Terminal Office

The head office of the container terminal is planned as follows:

- Stories: 2
- Site area for building: 43m X 25m = 750 m^2
- Floor space: 1,500 m^2

(7) Workshop and Cleaning

- Workshop: 80m X 25m = 2,000 m^2
- Cleaning: 40m X 25m = 1,000 m^2

(8) Terminal Gates

According to the simulation, the traffic volume per day by each category is as follows:

	In	Out
- Loaded container	132	306
- Empty container	170	3
- Tractor/chassis	309	302

In order to handle this traffic an exclusive gate for the containers is necessary. The lanes of the gate are as follows:

- Lane-1: Inward-traffic (FCL)
    2: Inward-traffic (Empty/Tractor)
    3: Inward-traffic (Others)
    4: Outward-traffic (FCL)
    5: Outward-traffic (FCL/Empty)
    6: Outward-traffic (Tractor/trailer, Others)

12.4 Expansion Plan

12.4.1 Conventional Terminal

In order to decide the proper number of new berths, three cases, construction of three berths, two berths one berth, will be compared. Location of the new berths is behind the breakwater. A similar simulation is conducted and the results are as follows.

- Total ship waiting time: one berth: 1,030 days
  two berths: 660 days
  three berths: 540 days

The difference in cost among each case is described as follows:

	Cost Index (waiting cost + berth construction cost)
one berth	120
two berths	100
three berths	102

(5,000 DWT general cargo vessels)
(Project Life: 30 years, Discount Rate 0.1)

Consequently, Case 1 is selected as the most economical plan. The depth of the new berths is decided based on the distribution of present general cargo vessels.

Since steel products and wood products are mainly handled in No.21 and new berth in front of shipyard (No.23), the area behind these berths are used for these cargoes. The necessary area for these cargoes is around 60,000 m^2. In addition, this area is planned to be used by various kinds of car. Since the vessel-size carrying steel and wood is below 10,000 DWT, the water depth of new berths is determined as -10m,that is, 15,000 DWT.

Livestock, handled around the present phosphate pier, is planned to be handled behind the phosphate terminal. The revetment with the length of 140m is redeveloped into the berth. Since the vessel-size carrying livestock is under 5,000 DWT, present depth (-10m) is sufficient for these type of vessels.

Since developable area wthin Tartous Port is very limited, new berths will be

located in the back of the breakwater.
Since the new berths will occupy navigation area, reclamation area should be as small as possible.

12.4.2 Passenger Terminal

(1) Present Condition

At present there is no regular service. Regular passenger vessel serves between Larnaka and Tartous by-weekly. The average number of passengers is around 60. In addition passenger vessels call Tartous Port from Germany, Ukraine, Italy and Greece irregularly. Average number carried on these vessels is around 500. Estimated total number of passengers visiting in 1995 will be over 6,000.

(2) Future Estimation

- Regular Service: Regular service route between Cyprus will start in the near future, because future development in tourism will attract tourists and business persons from Cyprus. In addition, the New Port will attract many labors from north Africa.

- Irregular Service: Syrian Government lays emphasis on tourism. The more Syrian opens door for the foreigners, the more irregular passenger vessels will visit Syrian ports. Tartous around which the tourism resources, for example Arwad Island, are located, will attract more tourists including by ship. Number of passenger vessels calling Tartous Port will be increased up to 20 to 30, twice a month.

Number of passenger will be (60+500) X 50 =28,000 (Regular Service)
500 X 2 X 12 = 12,000 (Irregular Service)
Total Number = 40,000

Peak condition: one regular service (500 passengers) + one irregular service (500 passengers) = 1,000 passengers (Peak Ratio=2.5%)

12.5 Cargo Handling System

Major cargo handling commodities at Tartous Port are container cargo, general cargo(food, machinery, fertilizer, chemicals and others), livestock, heavy cargo(metal products), cars, wood and grain(barley and maize) for import, and container cargo, phosphate, wheat and others for export. Table 12.5.1 shows the cargo handling volume at Tartous Port except grain.

Table 12.5.1 Cargo Handling Volume at Tartous Port in 2010 (Except Grain)

Unit:thousand ton

Commodity	Import	Export	Total
Container	1530	180	1710
Rice	80		80
Refind Sugar	125		125
Law Sugar	150		150
Flour	310		310
Foodstuff	330		330
Cotton	0	1	1
Fiber & Textile	0		0
Fertilizer	0		0
Chemical	610		610
Metal Products	1175		1175
Wood & Woodproduct	880		880
Machine & Equipment	500		500
Others	215	9	224
Total	5905	190	6095

The cargo handling systems and cargo flow except container cargo, grain and cars at Tartous Port are the same as at Latakia Port.

The cargo handling system for container cargo is mentioned in 12.3.1. Phosphate at Tartous Port will be moved to New Port. As for the grain cargo at Tartous, the facility with silo will not be expanded or modernized in the master plan. Therefore, the general cargo, heavy cargo, cars, woods & wood products and others are mentioned in this section.

The cargo handling system for general cargo, heavy cargo and woods & wood products in the master plan is the same as at Latakia Port in general. The cars are transported by car carrier. Then, the imported cars are stored in open yard in the port area. Livestock is unloaded from special ship to special trucks on apron using slope. Then, all of the livestock is delivered to consignees, directly. Table 12.5.2 shows the percentage of direct delivery in the master plan for major commodities in Tartous Port.

Table 12.5.2 Delivery Method at Tartous Port for Import Cargo

Unit: %

Commodities	Direct	Storage
Iron & Steel		100
Other Metal Products		100
Rice	10	90
Refined Sugar	10	90
Law Sugar	10	90
Flour	10	90
Foodstuff	80	20
Live Stock	100	
Wood & Wooden Product	25	75
Fertilizer		100
Chemical	20	80
Machine & Equipment		100
Others	20	80

As for the palletizable cargo, all palletaizable cargoes should be palletized in the master plan. This is the same as at Latakia Port.

The official cargo handling time at Tartous Port should be changed to agree with Latakia Port in general. In the master plan, the shift system of cargo handling should be changed to agree with Latakia Port in Master Plan, such as from 7.00 a.m. to 3.00 a.m. for first shift, from 3.00 p.m. to 11.00 p.m. for second shift and 11.00 p.m. to 7.00 p.m. for third shift. Break time is set about 15 minutes at middle of each shift, such as 11.00 a.m., 7.00 p.m. and 3.00 a.m..

12.5.1 Cargo Handling System in the Master Plan for Each Commodity

(1) General Cargo(Except Container Cargo)

Major commodities of general cargoes for import at Tartous Port are food(rice, Sugar, flour in bags and foodstuff), fertilizer, chemicals, machine & equipment and others. Major export general cargoes is only others in the master plan.

Present cargo handling situation is similar to Latakia Port. In the master plan, the cargo handling system for general cargo at this port should adopt the system used at Latakia Port, such as palletization of palletizable cargo, storing in the port for almost all general cargo including bagged cargoes, cases and cartons are stored at sheds. Drums are stored at sheds or open yard. Cargo handling equipment is mainly forklift trucks at apron and storage facilities. Transportation between apron and storage facilities is by trucks if the location of the storage facilities is not near the berth. If these storage facilities are located near the berth, the cargo is transported by forklift trucks.

(2) Heavy cargo

Major commodities of heavy cargo at Tartous Port are metal products, such as iron & steel and other metal products for import in the master plan.

At present, packing style and cargo flow of heavy cargo are similar to Latakia Port, major packing styles are bundles, rolls and coils for iron & steel and some of metal products are baled by sheet. Almost all of these cargoes are stored at storage facilities in the port. However, some of these cargoes are delivered from apron to consignees, directly. In the master plan, this packing style is not drastically changed. As for the cargo flow, however, one hundred percent of metal products should be stored at storage facilities in the port.

In the master plan, the heavy cargoes are handled at apron,and are transported to storage facility by heavy forklift trucks. Iron bars and ingots are transported from apron to open yard by heavy forklift trucks because these cargoes are stored at open yard just behind 21 Berth for steel. Other metal products except iron bars and ingots are transported from apron to shed by trailers because the distance between apron and sheds is not suitable for transportation by forklift trucks.

(3) Wooden Products

At present, the cargo flow of import lumber and timber is the same as at Latakia port. Viz., almost all of theses cargoes are directly delivered to consignees. Other import wooden products except lumber and timber, such as plywood are stored at shed in the port.

The packing style of wooden products at present is the same as at Latakia Port. As for lumber and timber, there are two types of packing styles, namely loose style and bundled style. Other wooden products are mainly baled by sheets.

In the master plan, the cargo handling system of wooden products is the same as at Latakia Port. Loose lumber and timber should be installed in the hold of ship by slings, then the cargo is unloaded from ship onto trucks, directly. Almost all of the loose timber and lumber are transported to open yard in the port. Bundled timber and lumber is handled at apron by forklift trucks after being unloaded from ship to apron. Almost all of the bundled lumber and timber are transported to storage facilities by forklift trucks(if the location of the storage facility is just behind apron) or trailers(if the location of the storage facilities is not just behind apron). However, portions of both lumber and timber are directly delivered to consignees. Cargo handling equipment for lumber and timber, forklift truck is employed at open yards.

Table 12.5.3 shows the major cargo handling equipment except between ship and apron(or truck/wagon of train) for import except direct delivery at Tartous Port.

Table 12.5.3 Cargo Handling Equipment for Import Cargo (Except Dirct Delivery) at Tartous Port

Commodities	At Apron	Apron to Storage Fasility	At Storage Facility
Iron & Steel	Heavy Forklift	Heavy Forklift or trailer	Mobil crane or Heavy forklift
Other Metal Products	Heavy Forklift	Heavy Forklift or trailer	Mobil crane or Heavy forklift
Rice	Forklift	Forklift or truck	Forklift
Refined Sugar	Forklift	Forklift or truck	Forklift
Law Sugar	Forklift	Forklift or truck	Forklift
Flour	Forklift	Forklift or truck	Forklift
Foodstuff	Forklift	Forklift or truck	Forklift
Wood & Wooden Product	Forklift	Truck	Forklift or lumber fork
Fertilizer	Forklift	Forklift or truck	Forklift
Chemical	Forklift	Forklift or truck	Forklift
Machine & Equipment	Forklift	Forklift or truck	Forklift
Others	Forklift	Forklift or truck	Forklift

Forklift : Forklift truck

12.6 Access Roads and Railways

The traffic volume of vehicles originating from or destined to the port in the year 2010 is estimated to be 8,590 vehicles per day each way in total. The hourly traffic corresponding to that daily traffic is also estimated to be 1,074 vehicles each way.

The traffic volume of container is estimated to be 428 per day each way. And hourly traffic corresponding to the daily traffic is estimated to be 54 each way. Since the containers require special procedures at the gate of the port, container related vehicles are separated at the north gate of the port.

The remaining hourly traffic volume is 1,020. As hourly capacity of traffic volume per lane is estimated as 600 vehicles, two lanes each way needs to be shared for the entire traffic. Two entrances are kept for general and other cargo, main entrance with two lanes and sub entrance with two lanes.

As for railway traffic, daily number of wagons is estimated to be 184 in total. Since the trains for phosphate are shifted to the new port, the tracks for the phosphate are converted for grain wagons.

12.7 Alternative Layout Plans

12.7.1 Container Terminal

The main facilities of the terminal, of which the required sizes are shown in Section 12.3.1, are arranged. Then the required terminal area is computed according to the different cargo-handling systems. The allocated areas of the marshaling yard are summarized as follows:

Unit:m^2

	Straddle Carrier	Transfer Crane
Total area	70,200	70,200
Marshaling yard		
Sub-total	48,600	48,600
Slot area	27,470	22,260
Others	21,130	26,340
Apron	21,600	21,600

Layout of the facilities is shown in Fig. 12.7.1.

12.7.2 Conventional Terminal

The present phosphate pier and silo will be converted into grain terminals. The pier will also be utilized for general cargo vessels. The root of the pier will be reclaimed to reserve necessary area for trucks and cargo handling. The present sulphur berth will be used for general cargo vessels, Ro/Ro vessels and passenger vessels. Yard behind the existing sulphur berth will be used mainly for steel and wood.

New berths will be planned in the back of the breakwater, one of the berths is used both for Ro/Ro and general cargo vessels.
The berths are connected by the road that passes behind the breakwater.

The yard for containers loaded outside of the container terminal is planned to be located in the areas surrounded by Road k, Road D and Road E.

Layout of the Mater Plan is shown in Fig. 12.7.2.

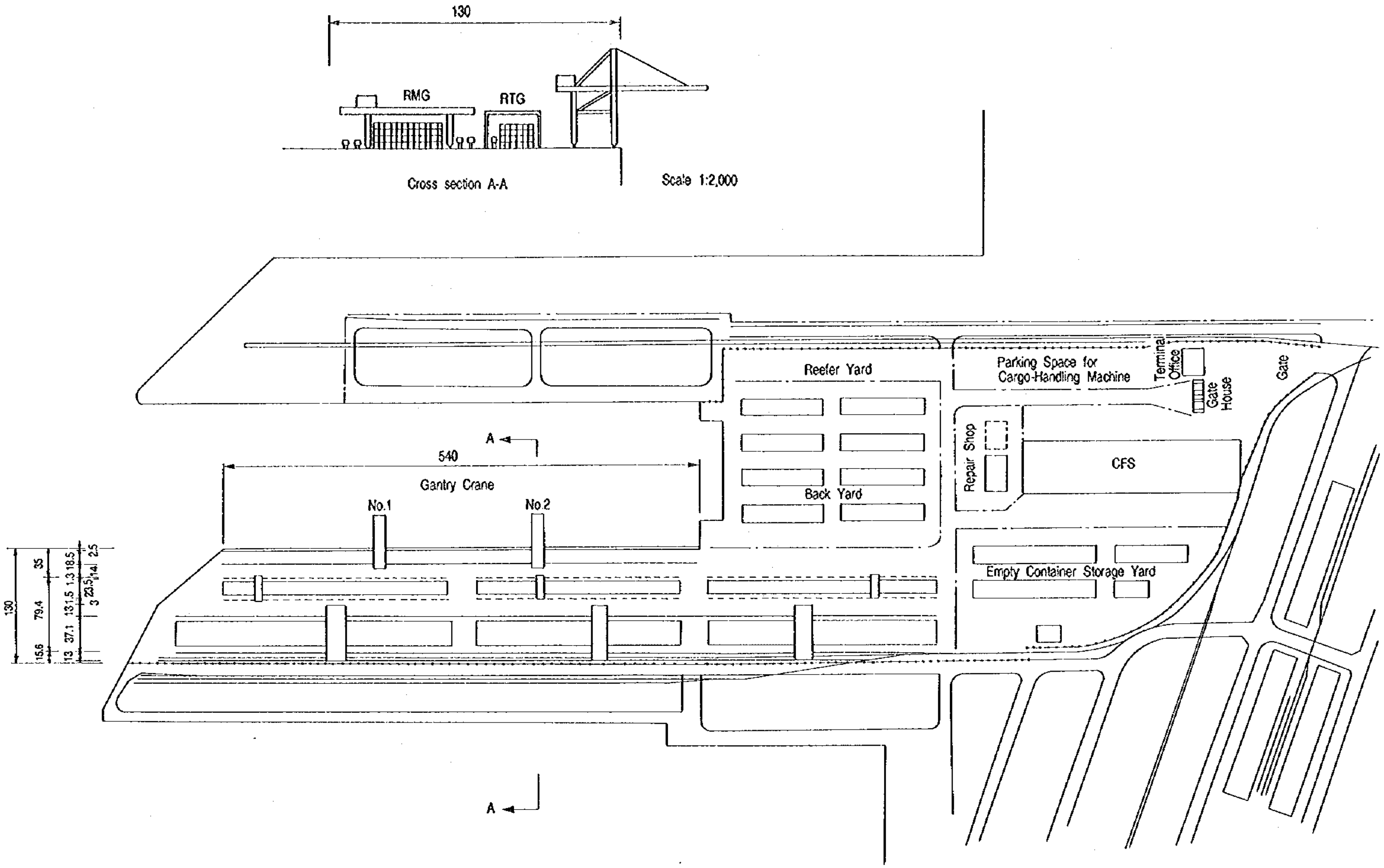


Figure 12.7.1 Layout Plan of the Main Facilities (Transfer Crane System) Scale 1:5,000

TARTOUS PORT MASTER PLAN

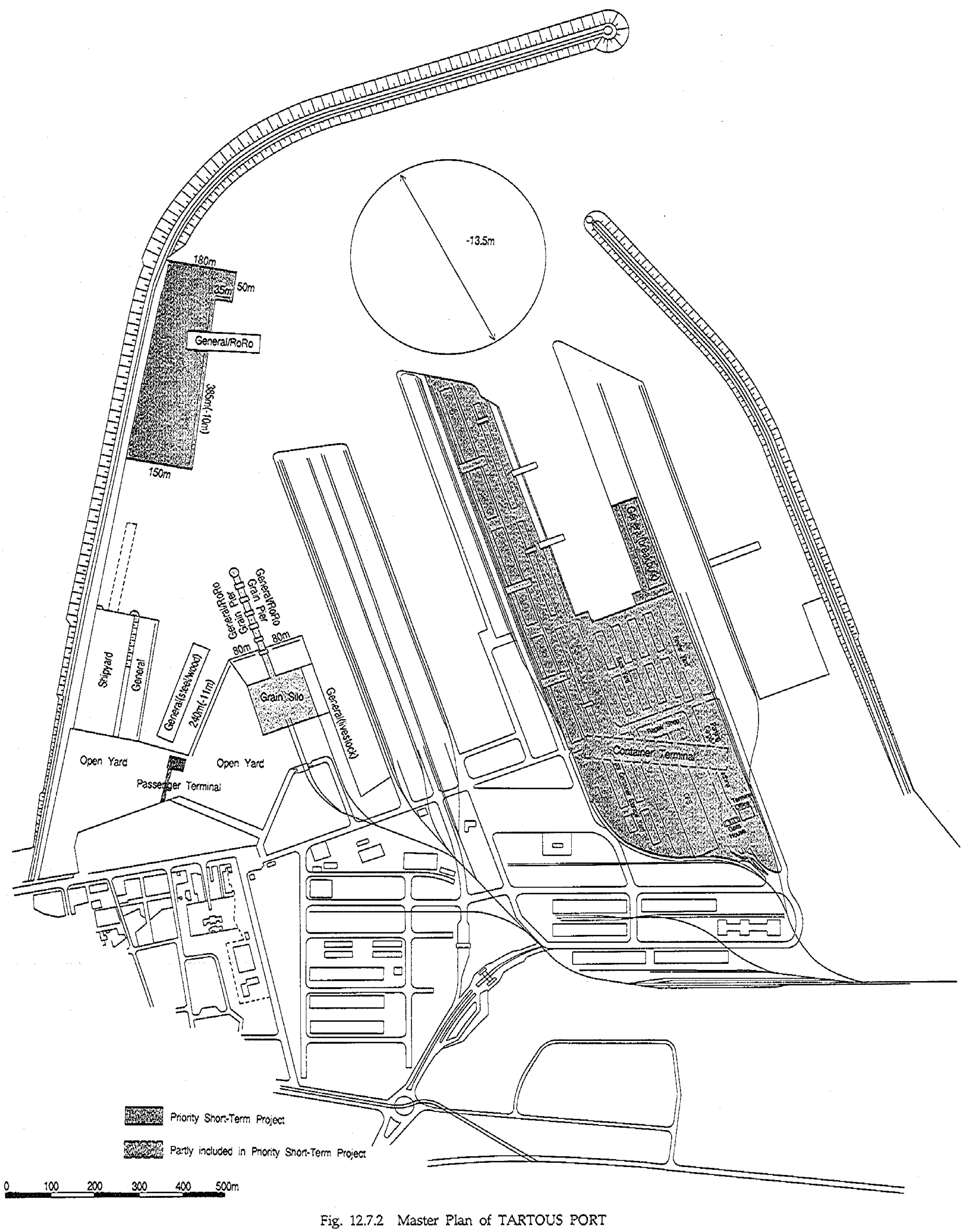


Fig. 12.7.2 Master Plan of TARTOUS PORT

TARTOUS PORT MASTER PLAN

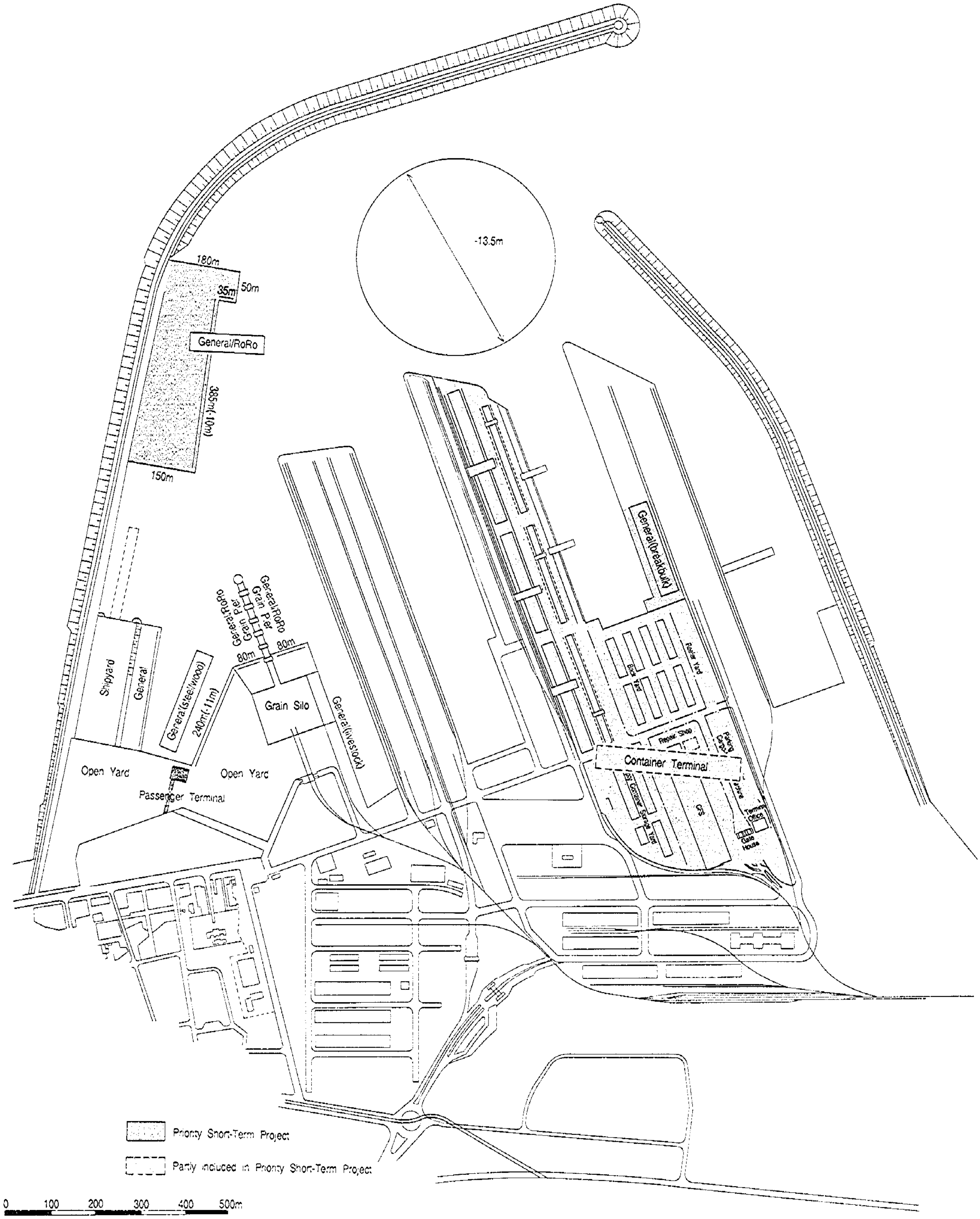


Fig. 12.7.2 Master Plan of TARTOUS PORT