PART IV

SHORT-TERM DEVELOPMENT PLAN

Chapter 20 Short-term Plan of the Greater Alexandria Port

20.1 The Basic Concept for Short-term Plan of the Greater Alexandria Port

The Short-term Plan is prepared as a first-phase plan for the development, re-development or rehabilitation of the Greater Alexandria Port for the target year 2007 in the framework of the Master Plan. The basic concept of the Short-term Plan is based on the following various aspects.

20.1.1 Local Container Handling

The Greater Alexandria Port has a natural harbour with deep waters which is maintained without heavy maintenance dredging. The water depths of the existing container terminals are 14m in Alexandria Harbour and 12m (under construction) and 14m in El Dekheila Port, and seem to be sufficient to serve local container handling. In addition, El Dekheila Port has spacious land areas for future expansion. While the Greater Alexandria Port has a large potential capacity for handling local containers (estimated at 1.5 million TEUs in total), the existing container-handling capacity is sufficient to meet a potential demand of 1.2 million TEUs in 2007.

Hence, so as to meet the large potential demand, it is necessary to increase the capacity of the Greater Alexandria Port as much as possible by investing additional super-structures and additional container-handling machines through making the most of the currently existing infrastructures including berths, and to allocate the excess containers to other Mediterranean ports including Port Said East Port.

20.1.2 Conventional General Cargo Handling

A great portion of the total conventional general cargo is being handled at the Greater Alexandria Port. Due to the lack of wharves for handling long, bulky and/or heavy cargo such as iron billets, steel bars, scraps and plant components which need deeper berths with spacious aprons and open storage yards right behind them to achieve efficient cargo-handling operations, these cargoes are handled together with other conventional cargoes which need to be stored in sheds. Thus, on-dock cargo-handling operations are conducted in chaotic conditions at these berths which are already close to being saturated, resulting in intricate cargo-handling within the port. In addition, barge operations at anchorage within the harbour basins are done for handling goods such as sawn timbers and dust cargo for the same reason mentioned above. Such cargo-handling results in inefficient, costly and time-consuming operations.

Hence, so as to resolve present problems in conventional-cargo handling and meet the increasing demand for handling long, heavy and/or bulky conventional general cargoes, it is necessary to construct a new multi-purpose terminal with deep berths and spacious open yards aiming at handling mainly long, heavy and/or bulky conventional cargoes in the Greater Alexandria Port by re-developing the existing berths, thereby reducing berth waiting costs of vessels in the off-shore anchorage.

20.1.3 Dry Bulk Cargo Handling

(1) Grain

In the Greater Alexandria Port, due to the shallow berth at Alexandria Harbour grain terminal, a great portion of grains is discharged at El Dekheila Port. Since there are only two units of rail-mounted grain unloaders at El Dekheila Port, however, a considerable amount of grain is discharged by using portable unloaders in direct unloading onto truck wagons. This results in low grain-handling productivity of less than 300 tons per hour per vessel and consequently all general cargo berths at El Dekheila Port are occupied by grain carriers.

Hence, so as to resolve present problems and meet the increasing demand for handling grains at the Greater Alexandria Port, it is necessary to construct a new 14m-deep-berth that will be connected with the existing silos through conveyors to receive panamax-type grain carriers in Alexandria Harbour.

(2) Coal and Coke

The berths at the coal/coke terminal in Alexandria Harbour are obsolete and shallow. Nevertheless, panamax-type coal carrier of around 69,000 DWT with a full draft of 13.3m and a length of 215m once called at the terminal on partially-loaded condition. Coal/coke could be transported inland by barges from/to El Dekheila Port by constructing new barge basins together with the creation of new canals or breakwaters in El Dekheila Harbour. The required gigantic resources, however, far outweigh the benefits to be obtained by such a plan.

Instead, it is advisable to prepare a deeper berth in front of the existing berth line with moderate investment so as to receive larger coal carriers at the existing coal/coke terminal in Alexandria Harbour.

20.1.4 Liquid Bulk Cargo Handling

The five marine oil terminals in the Petroleum Basin within Alexandria Harbour have sufficient capacity for the Alexandria Petroleum Company for the time being, if the existing broken-down loading/unloading arms are replaced together with the installation of new pipelines connecting the berths and back-side refinery plants of the company.

Within the free zone at Al Amrria, south of Alexandria, where another refinery in operation is using the petroleum terminal of the Alexandria Petroleum Company in Alexandria Harbour, MEDOR (Mediterranean Oil Refinery) is planning to operate a new refinery. The company also needs an outlet to export or import refined oil within the Greater Alexandria Port.

APA and MEDOR have recently agreed to have a new oil terminal at a basin between mineral quay (nos.90-1 and 90-2) and the berths (nos.92-1 and 92-2) in El Dekheila Port.

20.2 Container Handling

20.2.1 Target Volume of Containers to be Handled at the Greater Alexandria Port in 2007

Total volume of containers to be handled at the Greater Alexandria Port is estimated at 1.2 million TEUs in 2007. Concerning detailed assignment of containers among the container terminals and Ro-Ro berths within the Greater Alexandria Port in 2007, 0.45 million TEUs and 0.05 million TEUs of containers are expected to be handled at Alexandria Container Terminal and Ro-Ro berths respectively in Alexandria Harbour. The remaining 0.7 million TEUs of containers are expected to be handled at El Dekheila Container Terminal.

20.2.2 The Existing Container Handling Facilities at the Greater Alexandria Port

(1) Alexandria Container Terminal

APA recognizes that there exist three (3) 14m-deep-berths whose length is 560m in total at Alexandria Container Terminal. Since standardized container berth length of a 14m-deep-berth is defined as 350m (see Table 15.2.1), however, those berths should be counted as two (2) berths: a 14m-deep-berth (berth length is 350m) and a 11m-deep-berth (berth length is 250m).

There are three (3) panamax-type QGCs (Quayside Gantry Cranes) and six (6) RTGs (Rubber-Tired Gantry Cranes) being operated at Alexandria Container Terminal.

Table 20.2.1 Dimensions of Standardized Container Vessels and Standardized Container Berths

Dimensions of Container Vessels					Dimensions of Container Berths		
Loading Capacity	DWT	Full Draft	LOA	Breadth	Berth Depth	Berth Length	Remarks
(TEU)	(tons)	(m)	(m)	(m)	(m)	(m)	
300	6,500	6.7	120	19.0	7.5	150	
500	12,000	8.0	140	21.0	9.0	170	
800	16,000	9.0	170	23.0	10.0	200	
1,200	22,000	10.0	210	31.0	11.0	250	
1,500	27,000	11.0	230	32.2	12.0	280	
2,000	35,000	12.0	260	32.2	13.0	300	
3,000	50,000	13.0	290	32.2	14.0	350	Panamax
4,500	60,000	13.5	290	39.4	15.0	350	Post-Panamax

(2) Ro-Ro Berths in Alexandria Harbour

There are five (5) Ro-Ro berths (berth depth is 10.2m) currently in operation: berth nos. 14, 18/16, 18/20, 25 and 26 in Alexandria Harbour. Those berths are commonly used by both Ro-Ro vessels and general cargo vessels.

(3) El Dekheila Container Terminal

APA also recognizes that there exist two (2) 14m-deep-berths: berth nos. 96-1 and 96-2, whose length is 620m in total at El Dekheila Container Terminal as well as another two (2) 12m-deep-berths: berth nos. 97-1 and 97-2 (almost completed) whose length is 420m in total at El Dekheila Container Terminal.

Since standardized container berth lengths for a 14m-deep-berth and a 12m-deep-berth are defined as 350m and 280m (see Table 15.2.1), however, those berths should be counted as three (3) berths: two (2) 14m-deep-berth (berth length is 700m in total) and one (1) 12m-deep-berth (berth length is 340m). However, the latter berth can accommodate partially-loaded 3,000 TEU-container vessels.

There are three (3) post-panamax-type QGCs being operated at El Dekheila Container Terminal. No RTGs are presently installed at El Dekheila Container Terminal.

20.2.3 Requirement of Additional Container Handling Facilities

(1) Infrastructure

Container-handling capacities of both terminals in the Greater Alexandria Port are estimated using computer simulation in Section 13.3. Highly efficient operational conditions are assumed for computer simulation, taking account that Egyptian container terminals could be operated efficiently to a certain extent in 2007. (Operational conditions and simulation results are presented in Table 13.3.2.)

The capacity of Alexandria Container Terminal is estimated at 0.45 million TEUs, taking account of two (2) container berths to be available at the terminal. The capacity of El Dekheila Container Terminal is estimated at 0.73 million TEUs, taking account of three (3) container berths to be available at the terminal.

Since the future potential demand of local containers in Egypt in 2007 is assigned to both terminals up to their potential capacities as much as possible, however, no additional infrastructure such as berth is required. In fact, the target volume of containers for Alexandria and El Dekheila Container Terminals are 0.45 million and 0.7 million TEUs respectively.

(2) Superstructure

i) QGC (Quay-side Gantry Crane)

The available number of QGCs for handling containers at the terminals is a governing factor in determining the turnaround time of container ships. Hence, it is necessary to provide an optimum number of container handling equipment to ensure efficient loading and unloading operations within the shortest time possible. The required number of QGCs for handling containers can be estimated using the following formula on some assumptions.

$$Nqgc = A / (T \times \eta_1 \times \rho \times Pqgc \times \eta_2 \times E)$$

where,

Nqgc : Required number of quay side gantry crane (units),

A : Annual throughput in TEUs,

T : Maximum available working hours for the year (= 8,760 hrs/year),

ρ : Berth occupancy ratio,

(ρ = 0.50 for Alexandria Container Terminal: see Table 13.3.2)

(ρ = 0.65 for El Dekheila Container Terminal: see Table 13.3.3)

Pqgc : Net productivity of QGC (=30 boxes/hr/crane),

η_1 : Percentage of availability (=0.8),

η_2 : Cargo handling efficiency (=0.8), and

E : Conversion rate (=1.52 TEUs/box).

a) Alexandria Container Terminal

Assuming that the operational conditions above and a forecast annual throughput of 450,000 TEUs for Alexandria Container Terminal, the required number of QGCs is calculated as four (4) units for this terminal as below.

$$Nqgc_{\text{-Alexandria}} = A / (T \times \eta_1 \times \rho \times Pqgc \times \eta_2 \times E)$$

$$= 450{,}000 / (8{,}760 \times 0.8 \times 0.5 \times 30 \times 0.8 \times 1.52)$$

$$= 3.52 \rightarrow 4 \text{ (units)}$$

Since there are three (3) QGCs installed at the existing Alexandria Container Terminal, one (1) QGC is additionally required for this terminal.

b) El Dekheila Container Terminal

Assuming that the operational conditions above and a forecast annual throughput of 730,000 TEUs for El Dekheila Container Terminal, the required number of QGCs is calculated as five (5) units as below.

$$Nqgc_{\text{-El Dekheila}} = A / (T \times \eta_1 \times \rho \times Pqgc \times \eta_2 \times E)$$

$$= 730{,}000 / (8{,}760 \times 0.8 \times 0.65 \times 30 \times 0.8 \times 1.52)$$

$$= 4.39 \rightarrow 5 \text{(units)}$$

Since there are three (3) QGCs installed at the existing El Dekheila Container Terminal, two (2) QGCs are additionally required for this terminal.

ii) RTG (Rubber-Tired Gantry crane)

The required number of RTGs in the on-dock marshaling yard is estimated using the following formula on an assumption that all containers loaded/unloaded are to be stacked once temporarily in the on-dock marshaling yard.

$$Nrtg = Nrtg1 + Nrtg2 + Nrtg3$$
$$= 2 \times Nqgc + (\lambda \times A) / (T \times \eta_1 \times Prtg \times \eta_2 \times E) + 2$$

where,

Nrtg : Required number of RTGs (units),

Nrtg1 : Required number of RTGs mainly for quay-side operations (units),

Nrtg2 : Required number of RTGs mainly for in-yard operations (units),

Nrtg3 : Required number of stand-by RTGs to cope with pre-marshaling operation, immobilization due to repairs or periodical maintenance or other unforeseen circumstances (assumed as 2 units),

A : Annual throughput in TEUs,

T : Maximum available working hours for the year (= 8,760 hrs/year),

λ : Peaking factor to the daily average handling demand

(λ = (3,459+669)/(2,050+562) = 1.58 for Alexandria: see Table 13.3.2)

(λ = (6,202+1,392)/(4,555+1,249) = 1.31 for El Dekheila: see Table 13.3.3),

Prtg : Net productivity of RTG (=20 boxes/hr/crane),

η_1 : Percentage of availability (=0.8),

η_2 : Cargo handling efficiency (=0.8), and

E : Conversion rate (=1.52 TEUs/box).

a) Alexandria Container Terminal

Assuming that the operational conditions above and a forecast annual throughput of 450,000 TEUs for Alexandria Container Terminal, the required number of RTGs is calculated as14 units for this terminal as below.

$$\begin{aligned} Nrtg_{\text{-Alexandria}} &= Nrtg1 + Nrtg2 + Nrtg3 \\ &= 2 \times 4 + (1.58 \times 450{,}000) / (8{,}760 \times 0.8 \times 20 \times 0.8 \times 1.52) + 2 \\ &= 2 \times 4 + 3.97 + 2 = 13.97 \rightarrow 14 \text{ (units)} \end{aligned}$$

Since there are six (6) RTGs installed at the existing Alexandria Container Terminal, eight (8) RTGs are additionally required for this terminal.

b) El Dekheila Container Terminal

Assuming that the operational conditions and a forecast annual throughput of 1,000,000 TEUs for El Dekheila Container Terminal, the required number of RTGs is calculated as 18 units as below.

$$\begin{aligned} Nrtg_{\text{-El Dekheila}} &= Nrtg1 + Nrtg2 + Nrtg3 \\ &= 2 \times 5 + (1.31 \times 730{,}000) / (8{,}760 \times 0.8 \times 20 \times 0.8 \times 1.52) + 2 \\ &= 2 \times 5 + 5.61 + 2 = 17.61 \rightarrow 18 \text{ (units)} \end{aligned}$$

Since there is no RTGs presently installed at El Dekheila Container Terminal, 18 RTGs are additionally required for this terminal.

iii) Yard tractor-trailers

Yard tractor-trailers with chassis run between the quay side apron and the marshaling yard, and transport containers for loading onto or unloading from the container ships. One job cycle time of the yard tractor-trailers largely depends on the travelling distance between quay side gantry cranes and marshaling yard. The required number (Nytt) of yard tractor-trailers for each QGC is estimated on the conditions below.

$$\begin{aligned} Nytt_{\text{-Alexandria}} &= Nytt_{\text{-El Dekheila}} \\ &= (4 + 1.5/(15/60))/(3 \times 0.7) \\ &= 10/2.1 = 4.76 \rightarrow 5 \text{ (units/QGC)} \end{aligned}$$

Average travel speed of yard tractor-trailers:	15 (km/hour)
Handling time under quay-side gantry crane:	3 (minute/cycle)
Handling time under RTGs:	4 (minutes/cycle)
Average travelling length of yard tractors:	1.5 (km/cycle)
Operational factor:	0.7

Therefore, the required numbers of yard tractor-trailers in total are estimated at 20 (=5 ×4) units and 25 (=5×5) units for Alexandria Container Terminal and El Dekheila Container Terminal respectively.

20.2.4 Summary

(1) Alexandria Container Terminal

There is no space to expand the existing container terminal at the same place. However, cargo handling equipment would be in short supply for efficient operations in 2007, even though no additional infrastructure is expected. It is recommended that one (1) additional QGC, eight (8) additional RTGs and 20 units of tractor-trailers should be installed so as to efficiently handle 450,000 TEUs of containers in 2007.

(2) El Dekheila Container Terminal

There is 12m-deep container berth of 480m in total length, which has been almost completed and will be available in the near future. Therefore, El Dekheila Container Terminal would be able to dramatically increase its capacity with a relatively-small amount of investment on handling equipment. It is recommended that two (2) additional QGCs, 18 additional RTGs and 25 units of tractor-trailers should be installed so as to efficiently handle 730,000 TEUs of containers in 2007. A large amount of investment on container handling equipment is essential for the future utilization and development of El Dekheila Container Terminal.

20.3 Conventional Cargo Handling

20.3.1 Target Volume of Conventional Cargo to be Handled at the Greater Alexandria Port in 2007

Total volume of conventional cargo to be handled at the Greater Alexandria Port is estimated at 11.1 million tons in 2007. Package style-wise and commodity-wise volumes of those conventional cargoes are presented in Table 20.3.1. Bagged cargo (sugar, rice, flour , etc.) and bundled cargo (sawn timber and steel products) are expected to increase steadily up to the year 2007. Rolled paper and miscellaneous conventional cargo are also expected to increase steadily up to the year 2007.

Table 20.3.1 Package/Commodity-wise Volume of Conventional Cargo in 2007

(unit: thousand tons)

Package Style	Commodity	1997	2007	2017
Bag	Sugar, Rice, Flour, etc.	940	1,277	1,975
Bundle	Sawn Timber	1,632	3,634	4,783
Bundle	Steel Products	485	1,212	1,955
Roll	Paper	173	826	659
Break Bulk	Miscellaneous (to be stored in Shed)	1,867	2,073	1,815
Break Bulk	Miscellaneous (to be stored at Open yard)	1,867	2,073	1,815
Total		7,087	11,095	13,001

20.3.2 The Existing Conventional Cargo Handling Facilities at the Greater Alexandria Port

(1) Berths

While some berths are relatively short in length compared with their depth, those berths are identified with independent berths by APA. Consequently, those berth lengths are re-evaluated in terms of practical operation-ability, taking account of the maximum vessel size which can be accommodated with the berth depth. In fact, there are 64 practically-operable existing berths (49 berths in Alexandria Harbour and 15 berths in El Dekheila Harbour) within the Greater Alexandria Port. Since some berths (berth nos. 73, 75, 77, 79, 80, 97-1 and 97-2) have been recently constructed while being not available yet at this moment, those berths are considered operable in the future and included in 64.

(2) Sheds and Spacious Open Yards

There are 34 sheds and warehouses in the Greater Alexandria Port, and their total covered area is summed up at 110,222 sq.m. Spacious open yards of 42,880 sq.m are available in total, which are suitable for handling and storing long, bulky and/or heavy cargo adjacent to the berths (see Table 15.4.3).

20.3.3 Requirement of Additional Conventional Cargo Handling Facilities

Various kinds of conventional cargoes need to be handled through the existing facilities such as berths, sheds, warehouses and open storage yards. Long, bulky and/or heavy cargo such as iron billets, steel bars, scraps and plant components are presently handled together with the other conventional cargoes at the relatively shallow existing berths with narrow apron. Consequently, those conventional cargoes are handled in a considerably inefficient way due to a shortage of suitable handling equipment, poorly-maintained facilities, direct loading/unloading etc.

Handling the future volume of conventional cargo in 2007 through the existing facilities in a present way reveals considerably high berth occupancy ratio and a consequent long turn around time of vessels. Therefore, a new multi-purpose terminal with deeper berths and spacious open yard are essential to enable an efficient cargo-handling operations of long, heavy and/or bulky conventional cargoes apart from the remaining conventional cargoes, resulting in a synergistic effect on efficient-cargo handling of the remaining conventional cargoes through the existing facility.

(1) Required Dimensions of Berths

The required dimensions of conventional cargo handling facilities are estimated using computer simulations on the future (without-scenario / with-scenario) operational conditions (Table 20.3.2). Three gangs are defined to assign to one vessel at Multi-purpose Terminal so as to handle conventional cargoes such as “swan timber ”, “steel products”, “miscellaneous (shed)” and “miscellaneous (yard)”. Consequently, comparatively high productivity is expected at Multi-purpose Terminal to handle those cargoes.

Table 20.3.2 Package-wise Productivity of Conventional Cargo Operation for Computer Simulation

Package Style	Commodity	Present Productivity	Without Scenario Productivity	With Scenario Productivity
		(tons/hr/vsl)	(tons/hr/vsl)	(tons/hr/vsl)
Bag	Sugar, Rice, Flour, etc.	20	25.5	25.5
Bundle	Sawn Timber	47	59.8	159
Bundle	Steel Products (at narrow Apron)	39	48	48
Bundle	Steel Products (at spacious Apron)	39	-	105
Roll	Paper	35	70	70
Break Bulk	Miscellaneous (to be stored in Shed)	20	25.5	38.3
Break Bulk	Miscellaneous (to be stored at Open yard)	30	38.2	79.5

Computer simulation result based on “without-case” scenario reveals significantly long offshore waiting time on average (see Table 20.3.5). The expected offshore waiting times of conventional cargo vessels are calculated at 4.9 hours per vessel for “bagged cargoes”, 261.3 hours per vessel (”sawn timber”), 177.8 hours per vessel (”steel products”), 16.8 hours per vessels (“paper”), 14.7 hours per vessel (”miscellaneous cargo to be stored in shed”) and 206.5 hours per vessel (”miscellaneous cargo to be stored at open yard”). Handling long bulky and/or heavy cargoes such as “sawn timber”, “steel products” and “miscellaneous cargo to be stored at open yard” requires significantly long waiting time beyond the tolerable range. This implies that some additional berth facilities are essential to avoid a long turn around time of the vessels on the long term basis.

Table 20.3.3 Conventional Cargo Vessel Assignment and Simulation Results for Without-Case in 2007

Berth No.	Depth	Length	BOR	Other Cargo	Bag	Bundle	Bundle		Roll	Break Bulk	Break Bulk
	(m)	(m)	(%)		Sugar, etc.	Timber	Steel Prd		Paper	Misc-Shed	Misc-Yard
Conditions	Throughput in 2007 (tons/year)				1,277,000	3,634,000	1,212,000		826,000	2,073,000	2,073,000
	Unit Load (tons/vessel)				3,000	15,000	11,000		5,000	3,000	3,000
	Productivity (tons/hrs/vessel)				25.5	106.0	48.0	70.0	70.0	25.5	53.0
	No. of Assigned Berths				11	5	5	2	2	10	5
Simulation Results	No. of Vessels (vessels/year)				426	242	35	75	165	691	691
	BOR (%)				52.0	78.3	38.1	33.6	67.4	92.8	89.3
	Berthing Time (hours/vessel)				117.6	141.5	229	157	231.1	117.6	56.6
	Waiting Time (hours/vessel)				4.9	261.3	4.6	15.1	148.8	58.8	58.9
5/1-2	6.0	100	92.8							Misc-Shed	
5/3	6.0	100								Misc-Shed	
5/4	6.0	100								Misc-Shed	
10	8.0	130								Misc-Shed	
11	8.5	128								Misc-Shed	
12	8.5	100								Misc-Shed	
13	8.8	143								Misc-Shed	
14	10.0	180								Misc-Shed	
14-RoRo	10.2	-	---	Ro-Ro							
16	10.2	212	52.0		Sugar, etc.						
18-RoRo	10.2	-	---	Ro-Ro							
18	10.2	110	52.0		Sugar, etc.						
20	12.0	158			Sugar, etc.						
22	12.0	158			Sugar, etc.						
24	12.0	160			Sugar, etc.						
25-26	10.2	170			Sugar, etc.						
25-RoRo	10.2	-	---	Ro-Ro							
26-27	10.2	170	52.0		Sugar, etc.						
26-RoRo	10.2	-	---	Ro-Ro							
28	12.0	170	81.7				Steel		Paper		
34	6.5	125	67.4						Paper		
35-36	10.0	180	77.7		Sugar, etc.		Steel				
36-37	10.0	180			Sugar, etc.		Steel				
38	10.0	115	89.3								Misc-Yard
39	10.0	140	97.7				Steel				Misc-Yard
40	10.0	140					Steel				Misc-Yard
41	10.0	170	92.8							Misc-Shed	
42	7.5	138	52.0		Sugar, etc.						
43	7.5	138			Sugar, etc.						
44	6.5	150	92.8							Misc-Shed	
49-51	14.0	320	---	Container							
51-53	14.0	230	---	Container							
54-RoRo	14.0	160	---	Ro-Ro							
62-63	10.0	185	---	Coke							
63-64	10.0	270	---	Coal							
65	10.0	150	---	Salt, Others							
66	10.0	150	---	Salt, Others							
67	10.0	150	---	Cement							
71m	10.0	-	---	Molasses							
73	10.0	100	---	---							
75	10.0	185	78.3			Timber					
77	12.0	190				Timber					
79	12.0	190				Timber					
80	10.0	185				Timber					
82	10.0	190	---	Cement							
84	10.0	165	---	Barge							
85	10.0	130	---	Barge							
86	5.0	100	---	Barge							
87-1	10.0	236	---	Petroleum							
87-2	10.0	136	---	Petroleum							
87-3	12.0	148	---	Petroleum							
87-4	12.0	148	---	Petroleum							
87-5	12.0	94	---	Petroleum							
90-1	20.0	375	---	Iron /Coal							
90-2	14.0	255	---	---							
92-1	15.0	307	89.3								Misc-Yard
92-2	15.0										Misc-Yard
94-1	14.0	245	---	Wheat							
94-2	14.0	245	---	Maize/Wht							
95-1	12.0	500	33.6					Steel			
95-2	12.0							Steel			
95-3	12.0		78.3			Timber					
96	14.0	350	---	Container							
97-1	12.0	320	---	Container							
97-2	12.0	320	---	Container							
98	12.0	250	---	Sulfur, Fert							
99-1	12.0	300	---	Sulfur, Fert							
99-2	12.0		---	Other Liqd							

Table 20.3.4 Conventional Cargo Vessel Assignment and Simulation Results for With-Case in 2007

Berth No.	Depth	Length	BOR	OtherCargo	Bag	Bundle	Bundle	Roll	Break Bulk	Break Bulk
	(m)	(m)	(%)		Sugar, etc.	Timber	Steel Prd	Paper	Misc-Shed	Misc-Yard
Conditions	Throughput in 2007 (tons/year)				1,277,000	3,634,000	1,212,000	826,000	2,073,000	2,073,000
	Unit Load (tons/vessel)				3,000	15,000 – 35,000	11,000 – 35,000	5,000	3,000	3,000
	Productivity (tons/hrs/vessel)				25.5	106.0	70.0	70.0	25.5	53.0
	No. of Assigned Berths				9	7	4	2	10	6
Simulation Results	No. of Vessels (vessels/year)				426	242	110	165	691	691
	BOR (%)				63.5	65.2	65.8	67.4	92.8	74.4
	Berthing Time (hours/vessel)				117.6	141.5	157.1	71.4	120.0	56.6
	Waiting Time (hours/vessel)				4.1	17.0	48.7	45.0	60.0	11.9
Multi-P - 1	14.0	240	32.9			Timber				
Multi-P - 2	14.0	240					Steel Prds			
Multi-P - 3	14.0	240	36.0						Misc-Shed	
Multi-P - 4	14.0	240								Misc-Yard
Multi-P - 5	14.0	240								
Multi-P - 6	14.0	240								
5/1-2	6.0	100	60.0	Barge						
5/3	6.0	100		Barge						
5/4	6.0	100		Barge						
10	8.0	130							Misc-Shed	
11	8.5	128							Misc-Shed	
12	8.5	100							Misc-Shed	
13	8.8	143							Misc-Shed	
14	10.0	180	63.5		Sugar, etc.					
14-RoRo	10.2	-	---	Ro-Ro						
16	10.2	212	63.5		Sugar, etc.					
18-RoRo	10.2	-	---	Ro-Ro						
18	10.2	110	63.5		Sugar, etc.					
20	12.0	158			Sugar, etc.					
22	12.0	158			Sugar, etc.					
24	12.0	160			Sugar, etc.					
25-26	10.2	170			Sugar, etc.					
25-RoRo	10.2	-	---	Ro-Ro						
26-27	10.2	170	74.4							Misc-Yard
26-RoRo	10.2	-	---	Ro-Ro						
28	12.0	170	67.4					Paper		
34	6.5	125						Paper		
35-36	10.0	180	92.8						Misc-Shed	
36-37	10.0	180							Misc-Shed	
38	10.0	115							Misc-Shed	
39	10.0	140	74.4							Misc-Yard
40	10.0	140								Misc-Yard
41	10.0	170	92.8						Misc-Shed	
42	7.5	138	63.5		Sugar, etc.					
43	7.5	138			Sugar, etc.					
44	6.5	150	92.8						Misc-Shed	
49-51	14.0	320	---	Container						
51-53	14.0	230	---	Container						
54-RoRo	14.0	160	---	Ro-Ro						
62-63	10.0	185	---	Coke						
63-64	10.0	270	---	Coal						
65	10.0	150	---	Salt, Others						
66	10.0	150	---	Salt, Others						
67	10.0	150	---	Cement						
71m	10.0	---	---	Molasses						
73	10.0	100	---	---						
75	10.0	185	65.2			Timber				
77	12.0	190				Timber				
79	12.0	190				Timber				
80	10.0	185				Timber				
82	10.0	190	---	Cement						
84	10.0	165	---	Barge						
85	10.0	130	---	Barge						
86	5.0	100	---	Barge						
87-1	10.0	236	---	Petroleum						
87-2	10.0	136	---	Petroleum						
87-3	12.0	148	---	Petroleum						
87-4	12.0	148	---	Petroleum						
87-5	12.0	94	---	Petroleum						
90-1	20.0	375	---	Iron /Coal						
90-2	14.0	255	---	---						
92-1	15.0	307	74.4							Misc-Yard
92-2	15.0									Misc-Yard
94-1	14.0	245	---	Wheat						
94-2	14.0	245	---	Maize/Wht						
95-1	12.0	500	65.8				Steel Prds			
95-2	12.0						Steel Prds			
95-3	12.0		65.2			Timber				
96	14.0	350	---	Container						
97-1	12.0	320	---	Container						
97-2	12.0	320	---	Container						
98	12.0	250	---	Sulfur, Fert						
99-1	12.0	300	---	Sulfur, Fert						
99-2	12.0		---	Other Liqd						

Relatively large general cargo vessels are expected to transport long, heavy and/or bulky conventional cargo on the long-term basis. A maximum size of those general cargo vessels is expected at 45,000 tons in DWT and 12.5 meters in draft, which may need water depth of 14.0 meters for the additional berths. Again, computer simulation was made for searching the minimum requirement of the additional berths to mainly accommodate those relatively large vessels. Simulation result based on “with-case” scenario assuming four (4) additional 14.0 m-deep berths reveals a tolerable range of offshore waiting time on average (see Table 20.3.4). The expected offshore waiting times of commodity-wise conventional cargo vessels are calculated at 4.1 hours per vessel (“bagged cargoes”), 17.0 hours per vessel (”sawn timber”), 48.7 hours per vessel (”steel products”), 45.0 hours per vessels (“paper”), 60.0 hours per vessel (”miscellaneous cargo to be stored in shed”) and 11.9 hours per vessel (”miscellaneous cargo to be stored at open yard”). If “with-case” scenario of three (3) additional berths is assumed, however, the expected offshore waiting time will increase beyond the tolerable limit which does not compensate the savings of berth construction costs.

Consequently, in order to efficiently handle long, bulky and/or heavy cargoes such as “sawn timber”, “steel products” and “miscellaneous cargoes to be stored at open yard”, the optimum berth dimensions are estimated as four (4) 14.0 m-deep berths.

(2) Required Dimensions of Multi-purpose Quay-side Gantry Cranes

In case of conventional cargo handling, quay-side loading/unloading operations are generally performed with ship’s cranes/derricks or mobile shore cranes. However, two (2) units of multi-purpose QGCs are required to be installed to secure an efficient operation for handling extremely heavy cargoes and/or heavy bulky bare cargoes such as plant components, heavy vehicles, etc. Under-spreader lifting capacity of 30.5 tons is required to ensure to handle extremely heavy cargoes.

(3) Required Dimensions of Sheds and Warehouses

The required dimensions of commodity-wise sheds and warehouses are estimated using the following formula on the conventional cargo storage condition presented in Table 20.3.5.

$$A = (\lambda \times \delta \times V/T) / (\mu \times \xi \times \varepsilon)$$

where,

V : Annual cargo-wise throughput of conventional cargo (tons),

T : Maximum available working days for the year (= 365 days/year),

λ : Cargo-wise peaking factor to the daily average handling demand,

δ : Average dwelling time (=7 days),

μ : Cargo-wise unit load per square meter for storage,

ξ : Passage ratio (=0.5), and

ε : Operational factor (=0.75).

Table 20.3.5 Package-wise Storage Conditions of Conventional Cargo for Computer Simulation

Package Style	Commodity	Average dwelling time (days)	Peaking factor to daily average	Unit weight / space (ton/sqm)	Operat-ional factor	Passage ratio	Storage place
Bag	Sugar, Rice, Flour, etc.	7	1.63	3.0	0.75	0.5	Shed
Bundle	Sawn Timber	7	1.32	2.5	0.75	0.5	Yard
Roll	Paper	7	1.43	2.5	0.75	0.5	Shed
Bundle	Steel Products	7	1.75	2.0	0.75	0.5	Yard
Break Bulk	Miscellaneous (Shed)	7	1.20	2.5	0.75	0.5	Shed
Break Bulk	Miscellaneous (Open yard)	7	1.29	1.5	0.75	0.5	Yard

Remarks) Peaking factor is estimated cargo-wise by computer simulation.

Required area of covered are of sheds and warehouses is calculated at 110,549 sq.m on the conditions below, and that is approximately equal to the existing covered area of 110,222 sq.m in total. However, the existing sheds (nos.44 and 45) whose covered area of 3,791 sq.m in total should be demolished so as to efficiently handle “long, heavy and/or bulky conventional cargoes” at the existing berths (nos.39 and 40). Consequently, there is a need for additional sheds of approximately 6,000 sq.m in total as a covered area.

$$A_{shed} = (\lambda \times \delta \times V/T) / (\mu \times \xi \times \varepsilon)$$

$$= (1.63 \times 7 \times 1{,}277{,}000/365) / (3.0 \times 0.75 \times 0.5)$$

$$+ (1.43 \times 7 \times 826{,}000/365) / (2.5 \times 0.75 \times 0.5)$$

$$+ (1.20 \times 7 \times 2{,}073{,}000/365) / (2.5 \times 0.75 \times 0.5)$$

$$= 35{,}484 + 24{,}163 + 50{,}902$$

$$= 110{,}549 \text{ (sq.m)}$$

(4) Required Dimensions of Spacious Open Yard

The required dimensions of commodity-wise sheds and warehouses are estimated using the above formula. There will be some spacious open yards available behind or adjacent to the berths (nos.92-1, 92-1, 95-1, 95-2 and 95-3) where long, heavy and/or bulky conventional cargoes are to be assigned. The area of approximately 80,000 sq.m in total is expected be additionally available related to the above-mentioned berths. The existing spacious open yard is approximately 120,000 sq.m (= 42,880 sq.m + 80,000 sq.m), and the required area of spacious open yard is calculated at 243,538 sq.m on the conditions below.

$$A_{\text{-open yard}} = (\lambda \times \delta \times V/T) / (\mu \times \xi \times \varepsilon)$$

$$= (1.32 \times 7 \times 3{,}634{,}000/365) / (2.5 \times 0.75 \times 0.5)$$

$$+ (1.75 \times 7 \times 1{,}212{,}000/365) / (2.0 \times 0.75 \times 0.5)$$

$$+ (1.29 \times 7 \times 2{,}073{,}000/365) / (1.5 \times 0.75 \times 0.5)$$

$$= 98{,}128 + 54{,}236 + 91{,}174$$

$$= 243{,}538 \text{ (sq.m)}$$

Consequently, additional spacious open yard of 130,000 sq.m in total is essential to efficiently handle the future volume of conventional cargo.

(5) Required Dimensions of Conventional Cargo Handling Equipment

It is necessary to use pallets for landing cargoes on the quay so that forklifts could pick up, carry and sort the landed cargoes and store them in the sheds/warehouse behind the quay. In particular, bagged cargo, such as fertilizer and sugar, must be handled with pallets to increase the throughput. Concerning the unloading operation, commodity-wise cargo handling procedures of the typical conventional cargoes are summarized as below.

1) Bagged Cargo
Typical examples are sugar, rice, flour and fertilizer. These commodities are usually stuffed in bags made of hemp, vinyl or paper. Forklifts transfer cargoes from quayside to shed/warehouse and load cargoes onto trucks.

2) Steel bar, angle and beam
These commodities are unloaded with ship’s gear and landed onto flat bed trucks. The cargo is transferred to open yards.

3) Steel sheet
Steel sheets are enveloped with tin plate and attached with wooden skid. Forklifts transfer this cargo from quayside apron to open yards.

4) Steel coil
Wooden skid is attached with steel coils. Steel ram forklifts, which have a special attachment for handling a steel coil, should be used to transfer cargo from quay side to open yards.

5) Steel wire
This cargo should be handled with steel ram forklifts.

6) Timber (Length 3’, 6’, 9’ and 12’)

Timber is usually bundled with steel bands. There are two ways to unload timber, unloading on quay or barges.

a) Unloading on quay
Forklifts are used to transfer timber from quayside to open yards.

b) Unloading into barges
Truck cranes are used to unload timber from barges onto quayside. Forklifts are used to transfer timber from quayside to open yards.

7) Paper Products (craft paper, newsprint paper)
These commodities are enveloped with paper. Roll clamp forklifts should be used to handle the cargoes both at quayside and in warehouses/sheds.

8) Paper pulp
This cargo is enveloped with paper. Bale clamp forklifts should be used to handle the cargoes both at quayside and in warehouses/sheds.

Consequently, it is essential to introduce the sufficient number of forklifts in order to perform an efficient cargo handling operation for conventional cargoes. The required dimensions of forklifts is calculated at the peak condition that all the conventional cargo berths with spacious apron (19 berths are specified in Table 20.3.4) are occupied simultaneously.

1) Required number of forklifts for receiving the cargoes on the apron
2 (units/gang) x 1 (gang/vessel) x 19 (vessels/peak condition) = 38 (units).

2) Required number of forklifts for delivering the cargoes at the open yard
2 (units/gang) x 19 (gang/vessel) = 38 (units).

3) Required number of forklifts for handling the cargoes in ship's hold
1 (units/hold) x 2 (hold/vessel) x 19 (vessels/peak condition) = 38 (units).

Total required number of forklifts is calculated at 114 units based on the above-mentioned cargo handling procedures and conditions, and that for each zone/terminal is presented in Table 20.3.6.

Table 20.3.6 Required Number of Forklifts for Handling Conventional Cargo in 2007

No	Name of Zone/Terminal	No. of berths	Receiving at Apron	Delivering at Open Yard	Handling in Ship's Hold	Grand Total
Lifting Capacity of Forklift			5 tons +	5 tons +	3 tons +	
Alexandria Port						
1	Middle East Zone (Berth nos. 28, 34, 41, 44)	4	8	8	8	24
2	El Mahoudiya Quay (Berth nos. 39, 40)	2	4	4	4	12
3	Multi-purpose Terminal (4 Berths)	4	8	8	8	24
4	Timber Quay (Berth nos. 75, 77, 80, 82)	4	8	8	8	24
	Alexandria Port Sub Total	14	28	28	28	84
El Dekheila Port						
5	El Dekheila (Berth nos. 92-1, 92-2)	2	4	4	4	12
6	El Dekheila (Berth nos. 95-1, 95-2, 95-3)	3	6	6	6	18
	El Dekheila Port Sub Total	5	10	10	10	30
Grand Total		19	38	38	38	114

20.3.4 Summary

In order to achieve efficient conventional cargo handling operations and meet the future conventional cargo demand, it is essential to build four (4) 14 m-deep berths with spacious open yards of approximately 130,000 sq.m. Two (2) units of multi-purpose QGCs of which under-spreader lifting capacity is 30.5 tons are required to be installed to secure an efficient operation for handling extremely heavy cargoes and/or heavy bulky bare cargoes such as plant components, heavy vehicles, etc. While the requirement and the existing amount of covered area of sheds and warehouses nearly balances out, a covered area of approximately 6,000 sq.m is additionally required. One hundred fourteen (114) units of forklifts are also required to be introduced for an efficient cargo handling operation.

20.4 Dry Bulk Cargo Handling

20.4.1 Target Volume of Dry Bulk Cargo to be Handled at the Greater Alexandria Port in 2007

Dry bulk cargo to be handled at the Greater Alexandria Port is expected to increase to 13.3 million tons (annual growth rate of 2.7% for the first ten years) in 2007. Commodity-wise forecast volume of dry bulk cargoes such as grain, mineral, cement and others is also presented in Table 20.4.1.

Table 20.4.1 Commodity-wise Dry Bulk Cargo to be handled in 2007

(unit: thousand tons)

Package Style	Cargo Type	Commodity	1997	2007	2017
Dry Bulk	Grain	Wheat	2,178	3,897	3,846
	Grain	Maize	2,264	1,524	2,210
	Grain Sub Total		4,442	5,421	6,056
	Mineral	Iron Pellet	1,995	3,750	5,000
	Mineral	Coal	1,659	1,300	1,500
	Mineral	Coke	306	399	520
	Mineral Sub Total		3,960	5,449	7,020
	Cement	Cement	976	1,137	1,215
	Cement Sub Total		976	1,137	1,215
	Others	Sulfur	351	349	349
	Others	Fertilizer	258	195	416
	Others	Salt	235	573	972
	Others	Others	414	413	413
	Others Sub Total		1,258	1,530	2,150
Grand Total			10,636	13,337	16,541

20.4.2 The Existing Dry Bulk Cargo Handling Facilities at the Greater Alexandria Port

(1) Grain

There are three grain berths (nos.82, 84 and 85) which are considerably less utilized mainly due to insufficient water depth of 10.0 meters of those berths in Alexandria Harbour, while two pneumatic unloaders are installed and operable. There are four (4) grain berths (nos.94-2, 94-1, 92-1 and 92-2 with water depth of 14.0 meters) which are fully utilized and reveal high berth occupancy ratio of more than 80% at present in El Dekheila Harbour.

Both partially-loaded 120,000 DWT-class bulk carriers transporting “maize” and fully-loaded 65,000 DWT-class bulk carriers transporting “wheat” presently make a full use of a berth (no.94-2 with water depth of 14.0 meters), on which two highly-efficient mechanical grain unloaders are installed. Those bulk carriers place a second priority to use the berth (nos.94-1, 92-1 and 92-2 with water depth of 14.0 meters) which are practically operated with six (6) comparatively less-efficient mobile unloaders.

(2) Mineral (Iron Pellet, Coal and Coke)

i) Alexandria Harbour

There is a coke berth (no.62 with water depth of 10.0 meters) which is mainly used by 15,000 DWT-class general cargo vessels exporting “coke”. Berth nos. 63 and 64 are practically used as one coal berth (water depth of 10.0 meters) by partially-loaded 65,000 DWT-class bulk carriers transporting “coal” in Alexandria Harbour.

Cokes stockpile yard of approximate area of 14,000 sq.m (=50m*280m) is also located right behind the coke berth (no.62) and its stockpiling capacity is estimated at 45,000 tons. Coal stockpile yard of approximate area of 16,000 sq.m (=50m*320m) is located right behind the coal berths (nos.63 and 64) and its stockpiling capacity is estimated at 80,000 tons.

ii) El Dekheila Harbour

Both fully-loaded 65,000 DWT-class bulk carriers transporting “coal” and fully-loaded 120,000 DWT-class bulk carriers transporting “iron pellets” are able to use the berth (no. 90-1 with water depth of 20.0 meters) in El Dekheila Harbour.

Iron pellet stockpile yard of approximate area of 30,000 sq.m (=50m*600m) is located adjacent to the mineral berth (no.90-1) and its stockpiling capacity is estimated at 300,000 tons. Coal stockpile yard of approximate area of 30,000 sq.m (=50m*600m) is located adjacent to the mineral berth (no.90-1) and its stockpiling capacity is estimated at 150,000 tons.

20.4.3 Requirement of Additional Dry Bulk Cargo Handling Facilities

(1) Grain

Dry bulk grain cargo vessels are assigned so as to equally occupy the existing two grain berths (nos.94-1 and 94-2) for “without-case” scenario, and three berths (nos.94-1, 94-2 and a new grain berth proposed in this study) for “with-case” scenario in 2007. Highly-efficient unloading operation (gross productivity of 700 tons/hour/vessel) is expected at the berth (no.94-2) through mechanical grain unloaders installed on that. However, relatively-low unloading operation (gross productivity of 250 tons/hour/vessel) is expected at the berth (no.94-1) with mobile type unloaders.

The required dimensions of dry bulk grain cargo handling facilities are estimated by using offshore waiting time calculated based on UNCTAD study[1)]. The two existing berths (nos.94-1 and 94-2) are assumed available for “without-case” scenario. It is revealed that high BOR (Berth Occupancy Ratio) of 65.1% and a consequent long offshore waiting time of 112 hours per vessel are beyond a tolerable limit (Table 15.5.2).

Table 20.4.2 Berth Assignment of Dry Bulk Grain Cargo for the "Without-case" and "With-case" Scenarios in 2007

Scenario	Items	Berth Name	No. 94-2	No. 94-2	No. 94-1	New Berth
		Commodity	Maize	Wheat	Wheat	Wheat
Without-case (2007)	Throughput	(tons/yr.)	1,524,000	2,470,000	1,427,000	---
	Vessel size	(DWT)	120,000	65,000	65,000	---
	No. of vessels	(Vessels/yr.)	26	42	24	---
	BOR	(%)	65.1	65.1	65.1	---
	Average unloading rate	(tons/hr/vessel)	700	700	250	---
	Average berthing hours	(hours/vessel)	83	83	232	---
	Average waiting hours*	(hours/vessel)	121	112	311	---
With-case (2007)	Throughput	(tons/yr.)	1,524,000	776,500	821,000	2,299,500
	Vessel size	(DWT)	120,000	65,000	65,000	65,000
	No. of vessels	(Vessels/yr.)	26	6	16	44
	BOR	(%)	37.5	37.5	37.5	37.5
	Average unloading rate	(tons/hr/vessel)	700	700	250	700
	Average berthing hours	(hours/vessel)	83	83	232	83
	Average waiting hours*	(hours/vessel)	36	36	101	36

Remarks) Average waiting hours* are estimated using waiting-time factor presented by UNCTAD ("Port Development - A handbook for planners in developing countries (Second edition) -", TD/B/C.4/175/Rev.1

For "with-case" scenario, the two existing berths (nos.94-1 and 94-2) and the additional new grain berth with two units of highly efficient grain unloaders (gross productivity of 700 tons/hour/vessel) are assumed available. Then, it is revealed that reasonable BOR of 37.5% and a reasonable offshore waiting time of only 36 hours per vessel remain within a tolerable range (Table 20.4.2).

Therefore, the new grain berth with two units of highly efficient grain unloaders (nominal productivity of 1,000 tons/hour/crane) is essential to minimize inefficient unloading operations through mobile type unloaders at berth no.94-1. The entering draft of fully-loaded 65,000 DWT-class dry bulk grain carriers require water depth of at least 14.0 meters for the new berth.

(2) Mineral (Iron Pellet, Coal and Cokes)

Fully-loaded 120,000 DWT-class bulk carriers transporting "iron pellets" and "coal" which require berth depth of 20.0 meters can be accommodated only at the berth (no.90-1). Gross productivity of 1,227 (tons/hour/vessel) for "iron pellets" and 810 (tons/hour/vessel) for "coal" are assumed respectively for two units of highly efficient mechanical unloaders at berth no.90-1.

On the other hand, fully-loaded 65,000 DWT-class bulk carriers transporting "coal" which require berth depth of 14.0 meters can not be accommodated at the existing berth (no.63/64) due to insufficient present water depth of 10.0 meters for "without-case" scenario. Consequently, the berth (no.63/64) whose present water depth of 10.0 meters should be deepened to water depth of 14.0 meters so as to accommodate fully-loaded 65,000 DWT-class bulk carriers for "with-case" scenario in 2007.

[1)] "Port Development" - A handbook for planners in developing countries (Second edition) -", UNCTAD

Average BOR of the berth (no.90-2) is calculated at 41.9% remaining within a tolerable range and a consequent offshore waiting time is calculated based on UNCTAD study. Also, average BOR of the berth (no.62) is calculated at 25.2% within a tolerable range. Similarly, average BOR of the berth (no.63/64) is calculated at 11.6% which seems relatively low utilization of the berth. (Table 20.4.3)

However, fully-loaded 65,000 DWT-class bulk carriers transporting "coal" can not be accommodated at the existing berth (no.63/64) due to insufficient present water depth of 10.0 meters. It would be advisable to accommodate fully-loaded 65,000 DWT-class coal bulk carriers by deepening the existing berth (no.63/64) up to 14.0 meters.

Table 20.4.3 Berth Assignment of Dry Bulk Mineral Cargo for the "Without-case" and "With-case" Scenarios in 2007

Scenario	Items	Berth Name	No. 90-1	No. 90-1	No. 63/64	No. 62
		Commodity	Iron pellet	Coal	Coal	Cokes
Without-case (2007)	Throughput	(tons/yr.)	3,750,000	500,000	800,000	399,000
	Vessel size	(DWT)	120,000	120,000	65,000	15,000
	Berth depth	(m)	20.0	20.0	10.0	10.0
	No. of vessels	(Vessels/yr.)	35	5	14	30
	BOR	(%)	41.9	41.9	11.6	25.2
	Average unloading rate	(tons/hr/vessel)	1,227	810	786	181
	Average berthing hours	(hours/vessel)	88	133	50	75
	Average waiting hours*	(hours/vessel)	46	69	2	19
With-case (2007)	Throughput	(tons/yr.)	3,750,000	500,000	800,000	399,000
	Vessel size	(DWT)	120,000	120,000	65,000	15,000
	Berth depth	(m)	20.0	20.0	14.0	10.0
	No. of vessels	(Vessels/yr.)	35	5	21	30
	BOR	(%)	41.9	41.9	11.6	25.2
	Average unloading rate	(tons/hr/vessel)	1,227	810	786	181
	Average berthing hours	(hours/vessel)	88	133	74	75
	Average waiting hours*	(hours/vessel)	46	69	2	19

Remarks) Average waiting hours* are estimated using waiting-time factor presented by UNCTAD ("Port Development - A handbook for planners in developing countries (Second edition) -", TD/B/C.4/175/Rev.1

20.4.4 Summary

(1) Grain Handling

Grain terminals in El Dekheila Harbour would be over-utilized resulting in BOR of 65.1% and a consequent long turn-around time, if the existing grain terminals in Alexandria Harbour were not to be deepened to 14.0 meters and modernized with highly-efficient unloaders. Additionally, there exists available silos behind the existing grain terminals in Alexandria Harbour. Accordingly, <u>it is recommended that an additional 14.0 m-deep grain berth with two (2) units of highly efficient grain unloaders (nominal productivity of 1,000 tons/hour/unloader) should be built connecting to the usable existing silos.</u>

(2) Mineral (Iron Pellets, Coal and Cokes) Handling

Partially-loaded 65,000 DWT-class bulk carriers transporting "coal" could be fully loaded and save their transport costs, if the coal berth (no.63/64) were to be deepened to

14.0 meters. Consequently, it is recommended that the existing coal berth (no.63/64) should be deepened and utilize the existing structure with less investment.

(3) Dangerous Cargo (Sulfur and Fertilizer) Handling

Sulfur is presently handled together with fertilizer at the berths (nos. 65 and 66). These berths are located nearly at the center of the Alexandria Harbour and in front of the densely-populated city area. Dangerous cargo should be handled separately from flammable cargoes and located apart from the densely-populated area. Accordingly, it is recommended that those dangerous cargoes be assigned to the berths (nos.98 and 99-1) in the El Dekheila Harbour.

20.5 Liquid Bulk Cargo Handling

20.5.1 Target Volume of Liquid Bulk Cargo to be handled at the Greater Alexandria Port in 2007

Total volume of liquid bulk cargo to be handled at the Greater Alexandria Port is estimated at 4.8 million tons in 2007 and 6.5 million tons in 2017 (see Chapter 12). Commodity-wise liquid bulk cargo volumes are presented in Table 20.5.1. Petroleum oil and Grease are expected to increase moderately up to 2017. Molasses are expected to increase relatively rapid, while edible oil seems to decrease in the future.

Table 20.5.1 Commodity-wise Liquid Bulk Cargo Volume in 2007

(Unit: thousand tons)

Package Style	Commodity	1997	2007	2017
Liquid Bulk	Petroleum Oil	3,499	4,180	5,616
	Petroleum Oil (LPG, Butane, etc.)	71	85	115
	Edible Oil	483	124	135
	Grease	58	86	86
	Molasses	186	349	529
	Grand Total	4,297	4,824	6,481

20.5.2 The Existing Liquid Bulk Cargo Handling Facilities at the Greater Alexandria Port

There are five (5) oil terminals (three berths (nos.87-3, 87-4 and 87-5) with water depth of 12.0 meters / two berths (nos.87-1 and 87-2) with water depth of 10.0 meters) and one (1) molasses berth (no.71m / with water depth of 10.0 meters) as liquid bulk cargo handling facility in Alexandria Harbour, and no that kind facility in El Dekheila Harbour. Since the existing loading arms and pipelines are aged and partially broken down, however, petroleum oil (LPG, butane, etc.) is currently handled at a relatively-low operational productivity rate.

Relatively-large (35,000 DWT-class) liquid bulk carriers transporting “petroleum oil” are presently accommodated with the oil berths (nos.87-3, 87-4 and 87-5). Relatively-small

(15,000 DWT-class) liquid bulk carriers transporting "petroleum oil (LPG, butane, etc.)" presently use the relatively-shallow berths (nos.87-1 and 87-2). Also, relatively-small (10,000 DWT-class) liquid bulk carriers transporting "Molasses" presently use the relatively-shallow berths (nos.71m).

20.5.3 Requirement of Additional Liquid Bulk Cargo Handling Facilities

It is examined whether the existing berthing facilities for liquid bulk cargo would be sufficient to handle the future volume, assuming that the reasonable rate of future productivity in case that loading arms and pipelines are to be modernized (see Table 20.5.2). Estimated BOR (= 32.7%) and an average offshore waiting time (=1.8 hours/vessel) for "petroleum oil" handling indicate reasonable utilization and offshore waiting time.

Consequently, no additional berthing facility (infrastructure) is needed besides modernization of the existing aged loading arms and pipelines (superstructure).

Table 20.5.2 Berth Assignment of Liquid Bulk Cargo for "Without-case" Scenario in 2007

Scenario	Items	Berth Name	No.87-3, -4, -5 (3 berths/-12.0 m)	No.87-1, -2 (2 berths/-10.0 m)
		Commodity	Petroleum Oil	Petroleum Oil (LPG,Butane,etc.)
Modernization of loading arms and pipelines besides additional infrastructure (2017)	Throughput	(tons/yr.)	4,180,000	85,000
	Vessel size	(DWT)	35,000	15,000
	No. of vessels	(Vessels/yr.)	133	7
	BOR	(%)	32.7	2.8
	Average unloading rate	(tons/hr/vessel)	540	350
	Average berthing hours	(hours/vessel)	58.3	38.6
	Average waiting hours*	(hours/vessel)	1.8	0

Remarks) Average waiting hours* are estimated using waiting-time factor presented by UNCTAD ("Port Development - A handbook for planners in developing countries (Second edition) -", TD/B/C.4/175/Rev.1

20.5.4 Summary

<u>It is recommended that the existing aged loading arms and pipelines should be modernized without any additional berthing facilities.</u>

20.6 Common Port Facilities

20.6.1 Port Road Networking

It is recommended that a new bridge connecting the east and the central zones together with the development, re-development or renovation of the marine terminals.

(1) Present Port-related Cargo Flows to/from the Greater Alexandria Port

1) Containers
Origin and destination of containers handled at Greater Alexandria Port are accounted for 68.3% by the Cairo area, 28.3% by the Alexandria area and 3.4% by others. Approximately 70% of the containers handled at Alexandria Container Terminal are transported by trucks and the remaining 30% by rail. Almost all the containers handled at El Dekheila Container Terminal are transported by trucks.

2) General Cargo
Origin and destination of “agricultural products” are accounted for 65.4% by the Cairo area, 24.5% by the Alexandria area and 10.1% by others. On the other hand, origin and destination of “sawn timber” are accounted for 26.1% by the Cairo area, 66.1% by the Alexandria area and 7.8% by others. Almost all the general cargoes are transported by trucks.

3) Coal/coke
Imported coal through Alexandria Harbour is transported inland by rail (approximately 30%) and barges (the remaining 70%). On the other hand, imported coal through El Dekheila Harbour is transported inland by rail (100%).

4) Grain
Almost all the grains are imported and stored in silos temporarily and transported to the hinterland. Inland transportation to the hinterland is accounted for approximately 90% by trucks and 10% by rail.

5) Petroleum Oil
Ninety percent (90%) of petroleum oil handled at the Greater Alexandria Port is international and domestic outbound traffic. Most of the petroleum oil is refined at the refinery behind the port and transported to the port through pipelines.

(2) Present Problems to be resolved concerning Port-related Cargo Traffic in and around the Greater Alexandria Port

Port-related cargo traffic to/from the Greater Alexandria Port is suffering from heavy traffic congestion which is caused by together with heavy city traffic through downtown area in Alexandria city. Port-dedicated fly-over road behind the port from the gate no.27 to evacuate port-related cargo traffic apart from the heavy city traffic is now under construction so as to release both port-related and city traffic congestion.

Commodity-wise port cargo traffic is presently obliged to use the specific gate, which may cause redundant transportation between berths and gates or storage areas and gates, because the vessels are not always assigned to the berth closest to the expected gate. Furthermore, heavy weight cargo trucks are presently prohibited to run across the aged bridge between the berth no.32 and no.33 and consequently required to make a detour through downtown to avoid crossing the aged bridge.

(3) Port-dedicated Road behind the Port to Evacuate Port-related Traffic to/from Gate no.27

A new port-dedicated road behind the port is mostly available and being partly still developed between the port gate no.27 and the roundabout located adjacent to the Alexandria airport. This road leads to Cairo through either “the Agriculture Road” or “the Desert Road”, and is expected to smoothly evacuate port traffic to/from the Alexandria Harbour. The final stage of this road development is presently under construction right behind the gate no.27.

When the port-dedicated road behind the port is to be completed, most of the port-related cargo traffic is expected to use this port-dedicated road so as to minimize the land transport time. However, if heavy weight trucks should be still prohibited to ran across the aged port road bridge, the expected benefit of this road would be lost to a considerable extent. Therefore, this aged port road bridge is required to be re-constructed.

20.6.2 Waste Oil Receiving Facility

The Greater Alexandria Port has no independent treatment facilities either to treat the bilge waste or the ballast waste from the ships and oil tankers. Consequently, the port waters is visibly polluted with floating oil and others, as mentioned in Section 3.3.

It is also required to introduce a ship wasted oil processing plant at the Greater Alexandria Port in order to properly prevent the sea water pollution by processing the ship waste oil.

20.6.3 VTMS (Vessel Traffic Management System)

VTMS which covers all the area of the Greater Alexandria Port including El Dekheila Port was installed and used at the port control tower. However, the system is out of order now. It has also become old-fashioned so there is no point in repairing it. Navigation control is currently conducted through VHF between the control center and each ship. It is possible to monitor the movement of vessels after vessels come into sight. But there is no visual aid while vessels are out of sight. Furthermore, it is very difficult to monitor the vessels’ traffic during night time and bad weather. It is necessary to introduce an advanced VTMS to accommodate the increasing vessel traffic in the near future.

20.7 Multipurpose Terminal Project

20.7.1 Project Components

(1) Dimensions of the Project

Major components of the proposed plan are i) four (4) multipurpose berths of which water depth is 14.0 m and total length is 960 m, ii) spacious open yards whose total area is 130,000 sq.m, iii) one (1) unit of shed whose total covered area is 6,000 sq.m, iv) two (2) units of multipurpose QGCs, v) dedicated road merging to the existing fly-over, vi) dredging of ship-maneuvering area of which total volume is approximately 70,000 cu.m, and vii) 24 units of forklifts.

Figure 20.7.1 shows a layout plan for multipurpose terminal short-term development plan.

Table 20.7.1 Major Components of the Proposed Multipurpose Terminal Project

Component	unit	Infrastructure	Superstructure	Equipment
1. Multipurpose Berths (-14.0m*240m)	(berth)	4	---	---
2. Open Yards	(sq.m)	130,000	---	---
3. Sheds	(sq.m)	6,000	---	---
4. Multipurpose QGC	(unit)	---	2	---
5. Dedicated fly-over road	(m)	360	---	---
6. Dredging of Ship Maneuvering Area	(cu.m)	70,000	---	---
7. Forklifts	(unit)	---	---	24

(2) Open Yards and Sheds

The spacious open yards of which total area is 130,000 sq.m are located behind the berth. Also, two units of the sheds of which total covered area is 6,000 sq.m are located behind the northern end of the reclaimed area.

(3) Dedicated Fly-over Road merging to the Existing Fly-over

The existing fly-over connecting the Alexandria Container Terminal and the port gate (no.27) is presently available only for the traffic to/from the existing container terminal. A new dedicated port road behind the port is mostly available and being partly still developed between the port gate (no.27) and the roundabout located adjacent to the Alexandria airport. This road leads to Cairo through either “the Agriculture Road” or “the Desert Road”, and is expected to smoothly evacuate port traffic to/from the Alexandria Harbour. The final stage of this road development is presently under construction right behind the gate (no.27). The new multipurpose terminal needs good road connection through the existing fly-over between the new terminal and the port gate (no.27). The existing road along the eastern fence of the coal/coke terminal is presently being expanded to four (4)-lane-road. However, one (1) outbound lane by fly-over structure is required to exclusively merge with the existing fly-over so as to smoothly evacuate port traffic to/from the new terminal.

Figure 20.7.1 Layout Plan of Multi-purpose Terminal Short-term Plan

(4) Dredging the Ship-Maneuvering Area up to 14.0 meter below CD.

Two (2) ship-maneuvering basins are planned at water area between the coal/coke terminal and the grain terminal. These ship-maneuvering basins are to be designed for the fully-loaded 65,000 DWT-class dry bulk carriers transporting “coal” and “grain”. Since LOA of the 65,000 DWT-class dry bulk carriers is 230 meters, diameter of ship-maneuvering circle is to be determined as 460 meters (twice as long as LOA of 230 meter). One of the ship-maneuvering basins, which is expected to be commonly used by both general cargo vessels and dry bulk carriers, is located off the eastern end of the new terminal area (see Figure 20.7.1).

(5) Forklifts

Twenty four (24) units of forklifts (16 units for lifting capacity of 5 tons / 8 units for lifting capacity of 3 tons) are required to be introduced to ensure an efficient conventional cargo handling operations. Stevedoring companies are responsible to introduce these forklifts at each terminal.

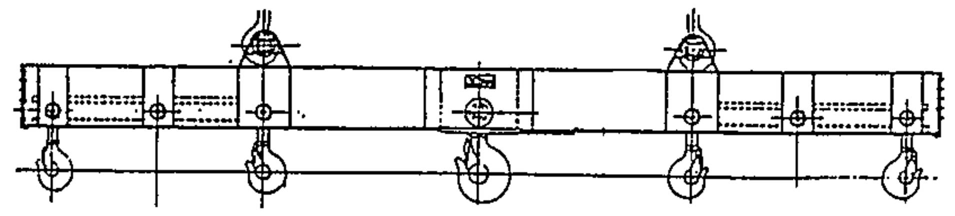
20.7.2 Conventional Cargo Handling System

(1) Quay-side Loading/Unloading Operations

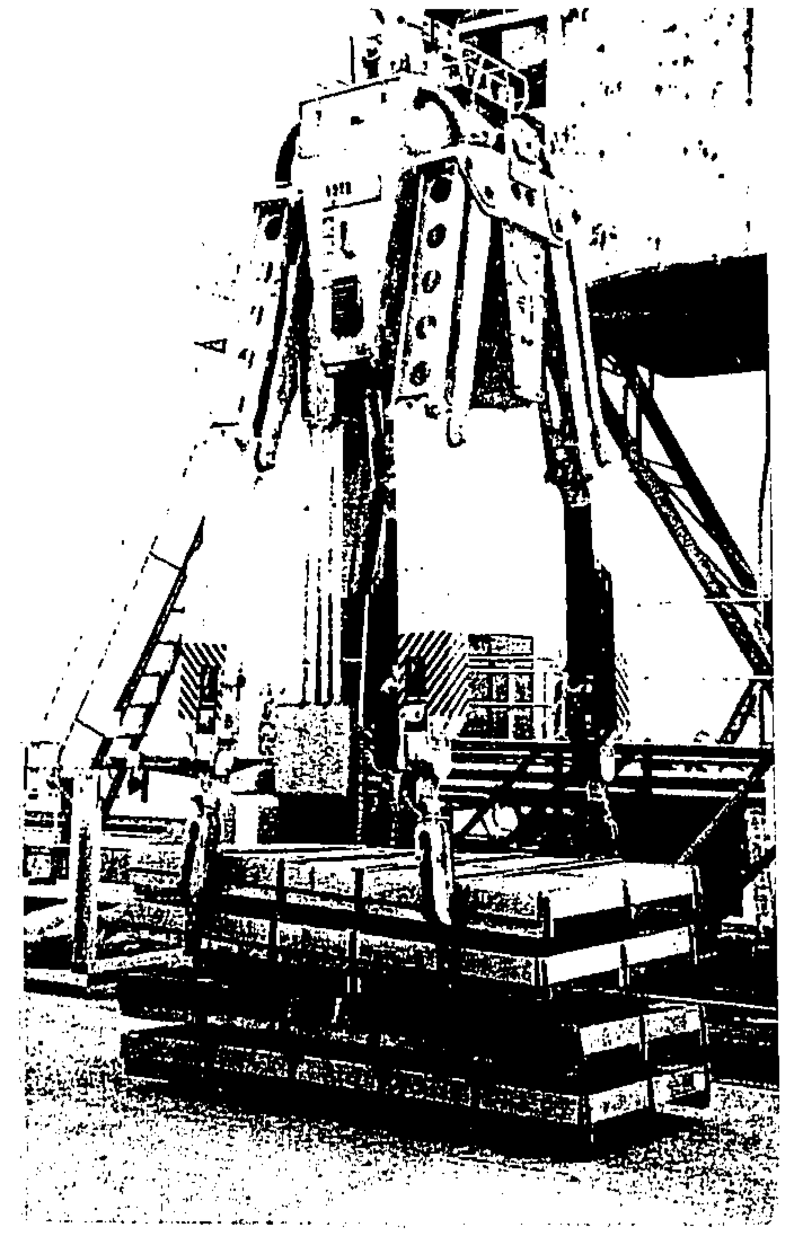
Concerning the berth assignment for the new multi-purpose terminal, two berths are assigned to sawn timber, another two berths to steel products, and the remaining two berths to miscellaneous cargoes to be stored either in the shed or at the open yard. In case of conventional cargo handling, quay-side loading/unloading operations are generally performed with ship’s cranes/derricks or mobile shore cranes. However, two units of multi-purpose QGCs of which under-spreader capacity is 40 tons are planned to be installed to secure an efficient operation for handling extremely heavy cargoes and/or heavy bulky bare cargoes such as plant components, heavy vehicles, etc. Additionally some kinds of attachments are required to enable to lift various kinds and shapes of above-mentioned heavy bulky cargoes. An example profile of the multi-purpose QGC is presented in Figure 20.7.2.

(2) Open Yard Operation between the Quay and the Open Yard.

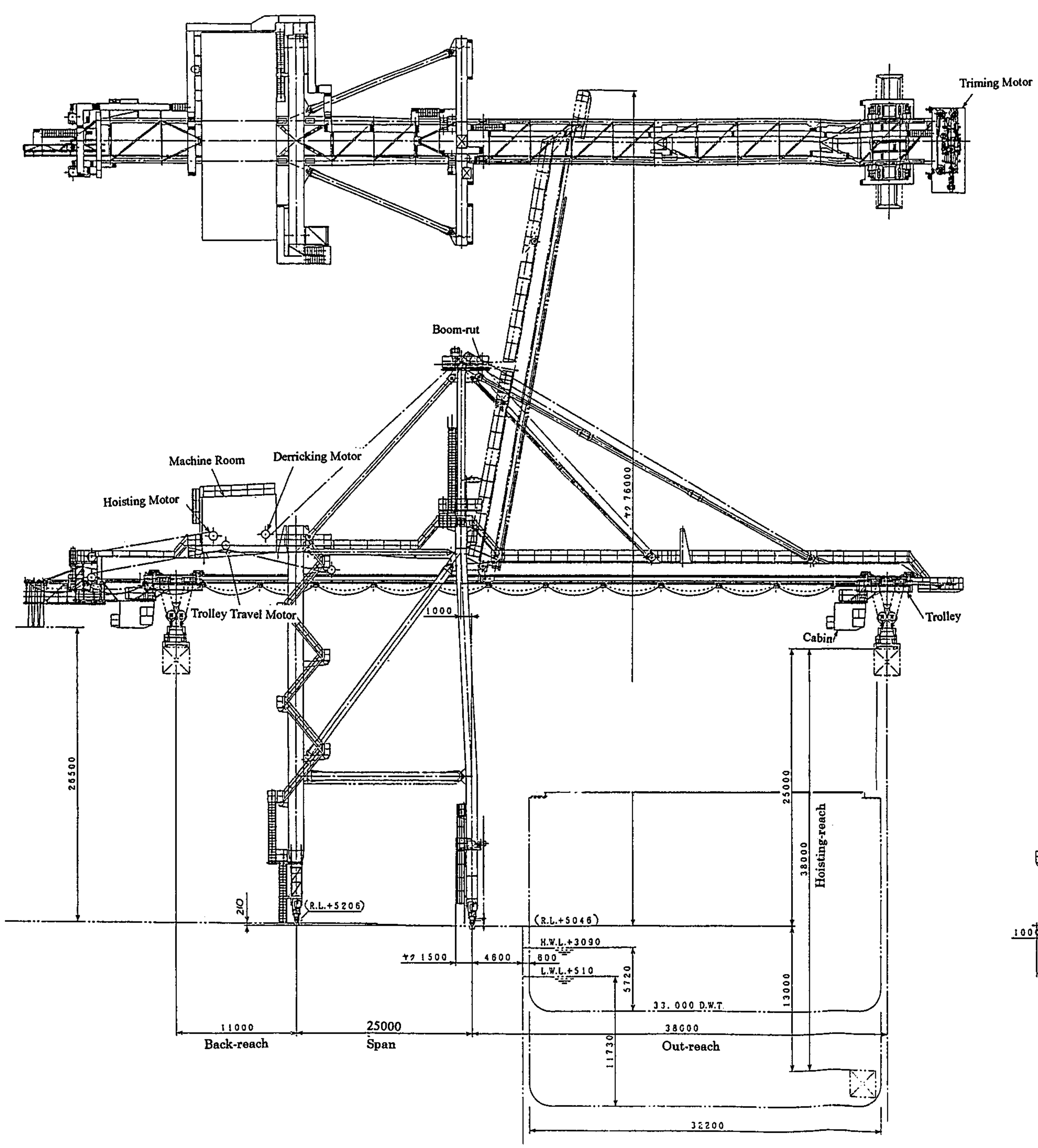
In handling heavy bulky conventional cargo such as sawn timber, steel products, etc., large apron and sorting/storing yards are needed for smooth operation. It is also necessary to use pallets for landing cargoes on the quay so that forklifts could pick up, carry and sort the landed cargoes and store them in the sheds and/or at the spacious open yard behind the quay. In particular, bagged cargo such as fertilizer and sugar, must be handled with pallets to increase the throughput. Therefore, it is recommended that the sufficient number (24 units) of the forklifts should be introduced for this terminal as mentioned in Section 20.3.

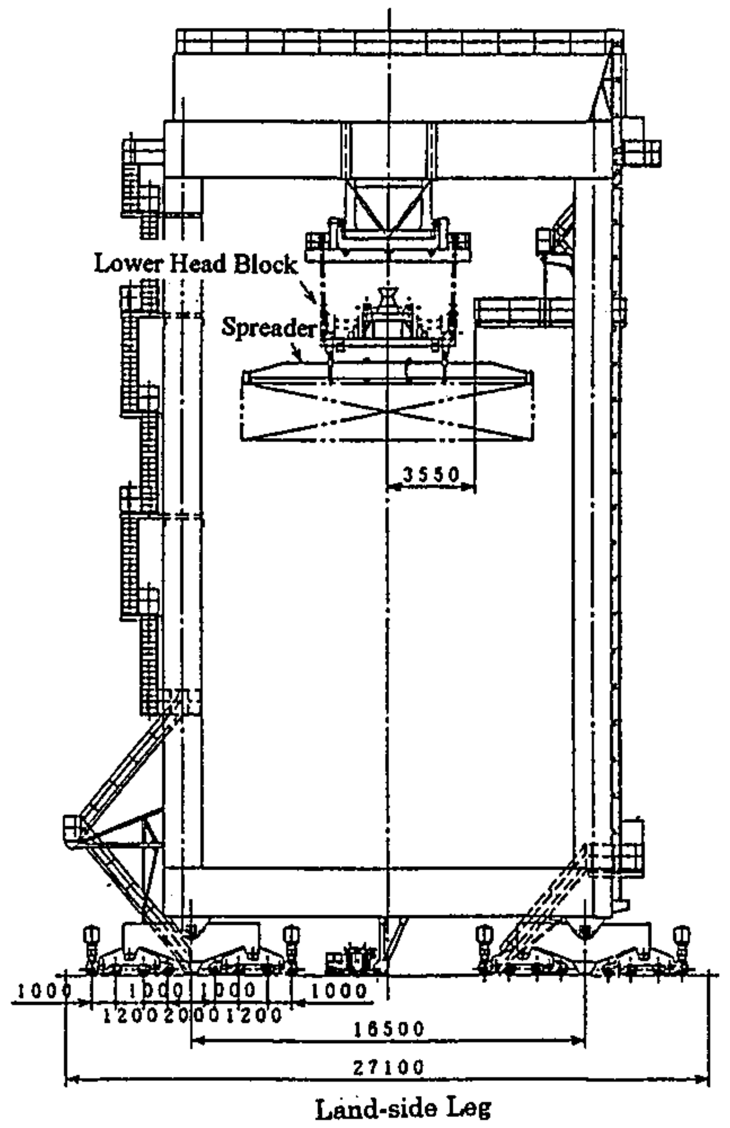


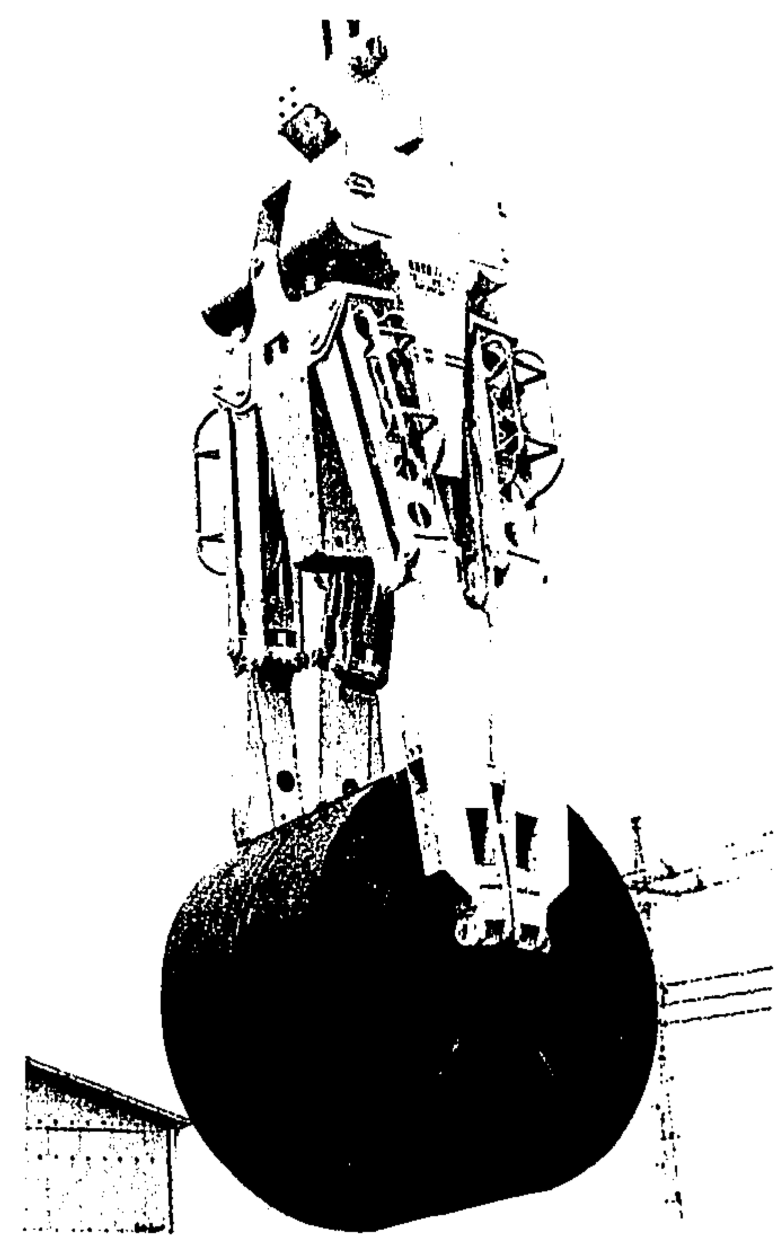
Heavy Cargo Lifting Beam with Hooks



Lifting Attachment for Steel Plates







Lifting Attachment for Steel Coil

Figure 20.7.2 An Example Profile of the Multi-purpose Quay-side Gantry Crane

Proper use of the cargo handling equipment such as special attachment is also recommended for handling various cargoes (to be mentioned in Section 18.4).

The traffic volume generated from the multi-purpose terminal in the year 2017 is estimated to be 280 vehicles per hour in two ways during peaking condition. Thus, a four-lane access road whose capacity is 1,400 vehicles per hour in total has sufficient capacity even considering merging traffic from the existing container terminal (300 vehicles per hour in two ways). This access road could be installed along between the boundary of the coal terminal and the existing railway sidings. At the narrowest point at the north end corner of the terminal, some portion of the outermost siding track needs to be dismantled to install the fourth lane.

As to railway sidings, there are five tracks behind the coal terminal. These railway tracks are not well used. From time to time, a unit train composed of around 30 coal/coke wagons stations on the track behind the coal terminal waiting for loading/unloading done on the siding track inside the terminal. Current coal traffic is small (less than one unit train a day on average). On the other hand, these siding tracks are also used for container flat cars, but not often, because major container transport mode is by road (see fig 4.3 of Appendix 4). Dismantling a part of the outermost siding trak will not affect railway traffic.

(3) Cargo Flows in and around the Terminal

In general, the throughput of cargoes depends on the arrival of trucks and the turn-around on the apron. Smooth truck flow in and around the terminal is essential to secure high productivity of the whole terminal. The open yard is divided into some blocks by removable-type flexible fences, which can be easily re-arranged to meet demand fluctuation among the terminal operators. It is recommended that incoming trucks should be controlled at the terminal gate, and move in one way along the passage within the open yard. This truck flow is presented in Figure 20.7.3.

Additionally, the dedicated terminal access road with a fly-over bridge is required to be connected to the existing fly-over bridge in order to secure a smooth evacuation of the cargo traffic from the terminal.

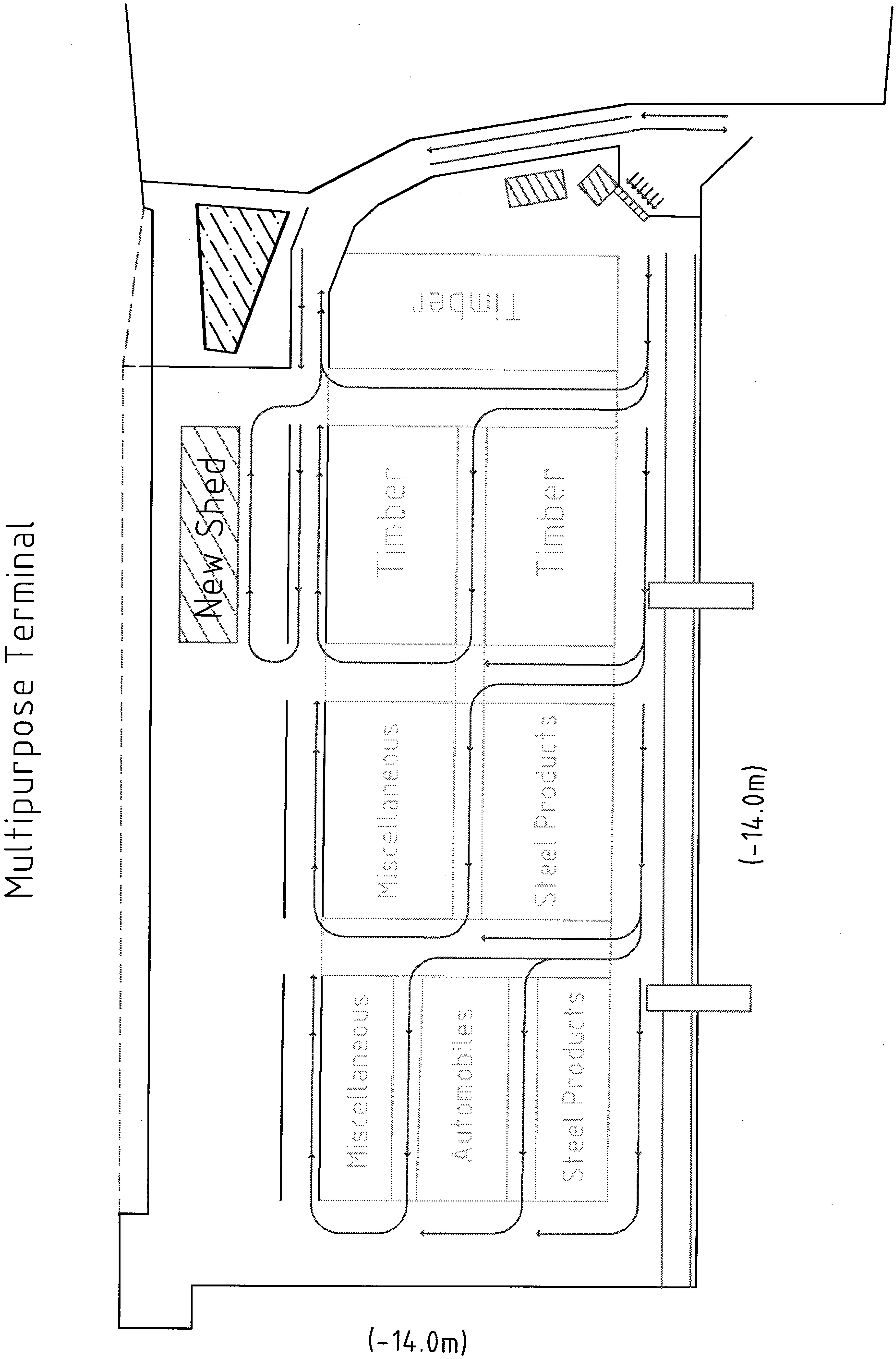


Figure 20.7.3 Cargo Flow in and around the Multi-purpose Terminal

20.8 El Mahmudiya Quay Re-development Project

20.8.1 Necessity of the Re-development

There are presently hundreds of damaged containers behind the warehouses (nos.44, 45, 46 and 47) within the El Mahmudiya Quay area. Consequently precious land space is not utilized in this area to a full extent. On the other hand, the berths (nos.39 and 40 with water depth of 10.0 meters) next to the Ro-Ro berth (no.41) would be suitable for handling “long, heavy and/or bulky conventional cargoes”, if the warehouses (no.44 and 45) were to be demolished (as mentioned in Section 20.3). This terminal is expected to be operated by the new terminal operators (which is proposed in Section 18.4).

20.8.2 Conventional Cargo Handling at the El Mahmudiya Quay

Miscellaneous cargoes to be stored at the open yard are assigned to the berths (bnos. 39 and 40). Those cargoes are expected to be handled by forklifts at the apron as well as the open yard where the warehouses (nos. 44 and 45) are to be removed. 12 units of the forklifts are essential to secure an efficient cargo handling at the El Mahmudiya Quay.

20.8.3 Layout of the El Mahmudiya Quay Re-development

The El Mahmudiya Quay Re-development is also expected to provide a space and opportunities for newly-entering private stevedores in the future. The layout plan is presented in Figure 20.8.1.

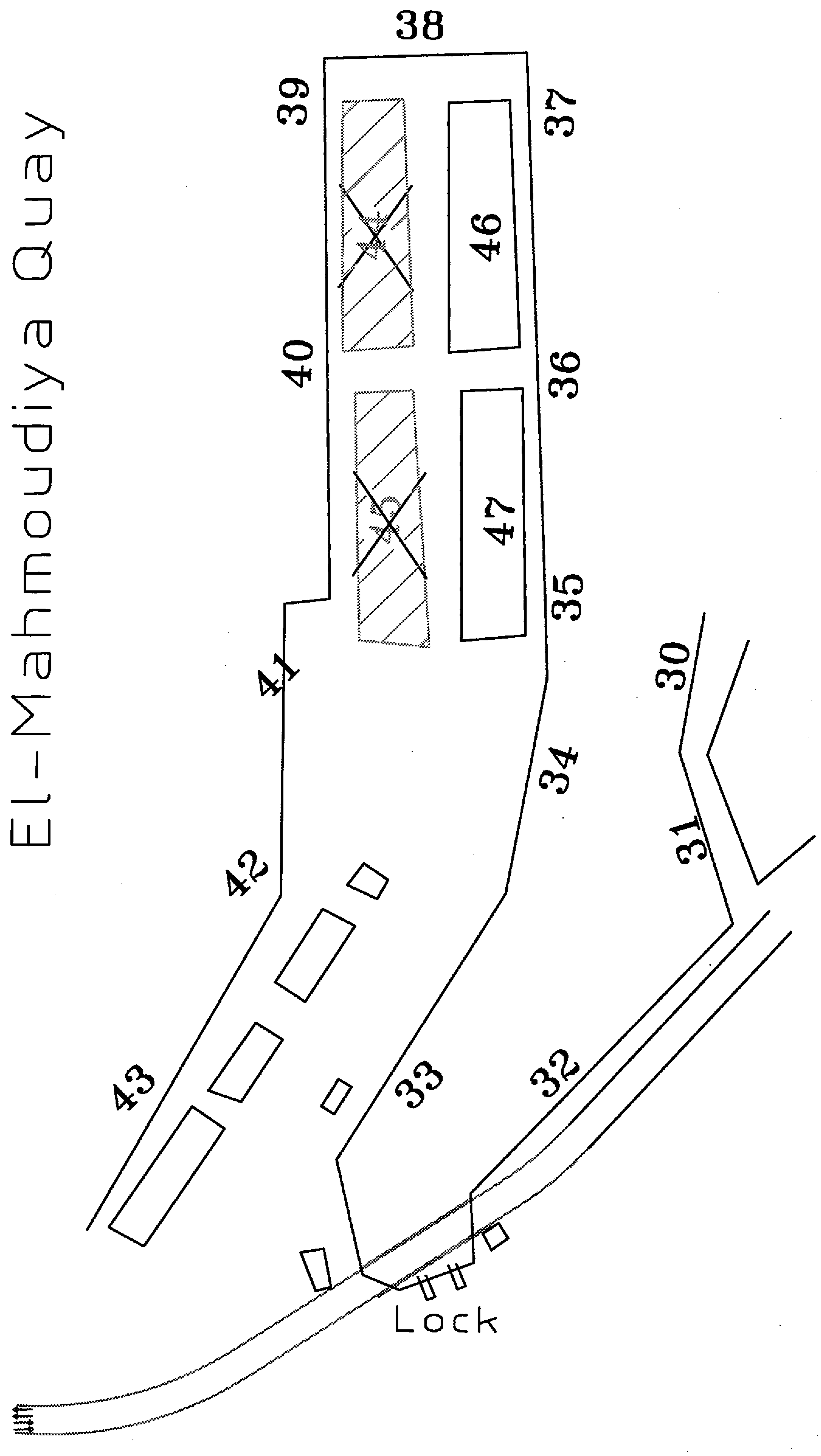


Figure 20.8.1 Layout of the El Mahmudiya Quay Re-development Project

20.9 New Port Road Bridge Project

20.9.1 Necessity of a New Port Road Bridge

Since the port road bridge on the lock between the berth no.32 and no.33 is aged and poorly-maintained as mentioned, heavy weight trucks are presently prohibited to ran across the bridge resulting in detour traffic through downtown and consequent heavy traffic congestion in the Alexandria city area. In order to fully utilize the port-dedicated road now under construction behind the port gate no.27, reinforcement of this bridge or a new bridge construction are essential.

20.9.2 Required Number of Lanes for the New Port Road Bridge

The lock between berth no.32 and no.33 belongs to the Water Transport Authority. It seems to be difficult to change or replace the bridge itself due to the port-related reasons. It is advisable to construct a new bridge right off the existing bridge, which will give no effective load on the lock.

Most of the cargo traffic originated from and destined to the East zone (berth no.5 through 17) and the Middle East zone (berth no.18 through 32) is expected to use the aged port road bridge in case that the new port road bridge is developed. Annual target volume of cargoes and the hourly maximum one-directional traffic are estimated and presented in Table 20.9.1. The hourly maximum one-directional traffic is estimated at 404 (vehicles/hour/direction), which implies that one (1) lane is required compared with the standard maximum hourly traffic volume per lane of 600 (vehicles/hour/lane). However, two (2) lanes for each direction should be planned taking into account of the case of emergency.

Table 20.9.1 Maximum Hourly Traffic through the New Port Road Bridge in 2007

Cargo Type	Annual volume	Expected using share of new bridge	Peaking factor to daily average	Peaking factor to hourly average	Unit load per vehicle	Maximum hourly traffic volume per lane
Unit	TEU/tons	%			TEU, tons /vehicle	Vehicles /hour/lane
Ro-Ro (TEUs)	50,000	100.0	1.37	2.5	1.5	13.0
Bagged	1,277,000	58.3	1.63	2.5	12	28.9
Bundled (Timber)	3,634,000	0.0	1.32	2.5	12	0
Bundled (Steel Prd)	1,212,000	0.0	1.43	2.5	12	0
Rolled (Paper)	826,000	50.0	1.75	2.5	8	25.8
Miscellaneous (Shed)	2,073,000	80.0	1.20	2.5	8	71.0
Miscellaneous (Yard)	2,073,000	33.3	1.29	2.5	8	31.8
Sub Total						170.5
Port-related traffic	Present port-related traffic percentage was measured as 57.8% to the total.*					233.6
Grand Total						404.1

Remarks) This percentage is calculated based on the traffic flow survey conducted by the Study Team. (see Table 3.4.5)

20.9.3 Layout of the New Port Road Bridge

Layout of the new bridge is planned right off the existing bridge, giving no effective load on the lock and avoiding demolishing the existing fire-fighting facilities. The layout plan is presented in Figure 20.9.1.

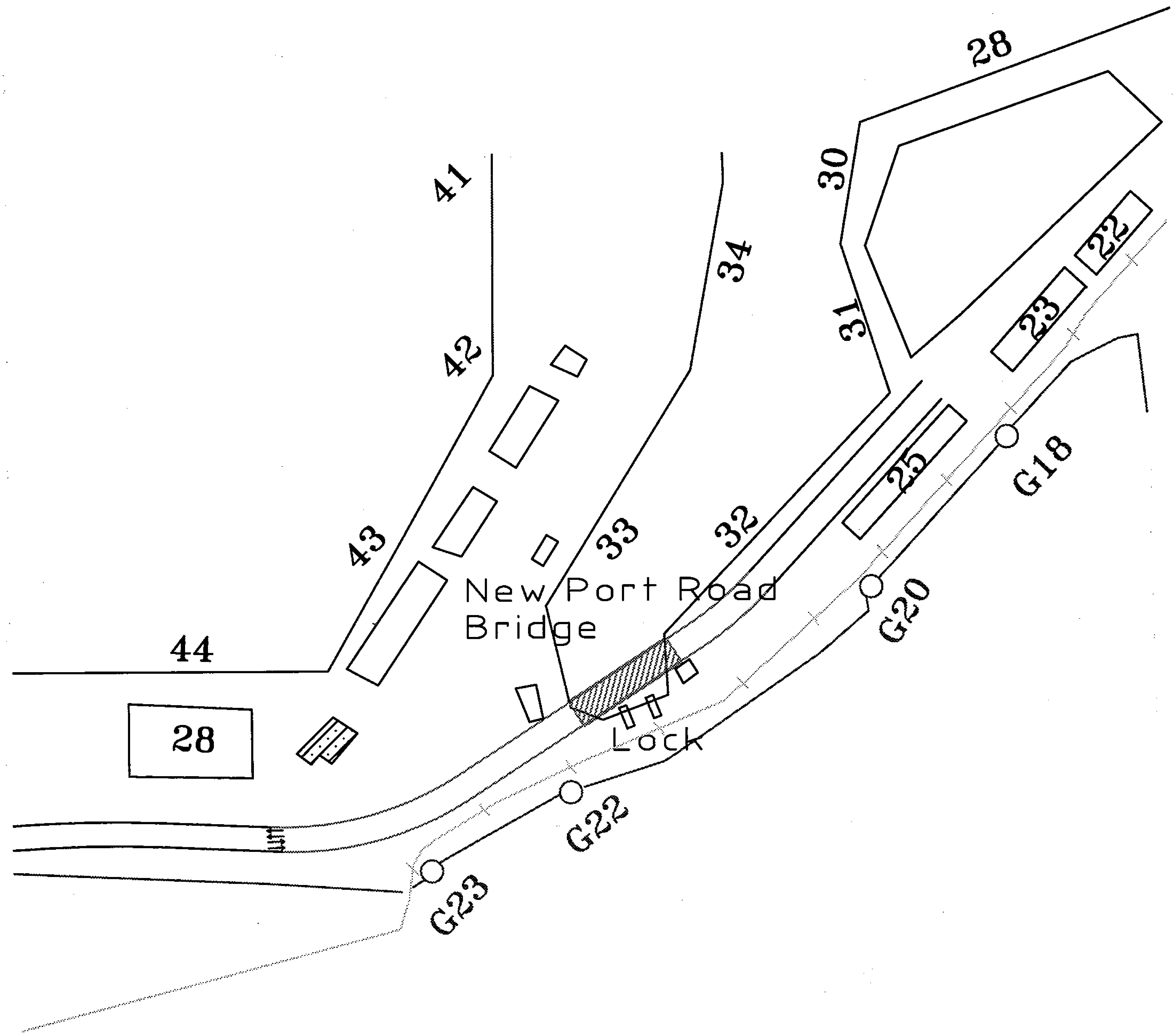


Figure 20.9.1 Layout of the New Port Road Bridge

20.10 Deep Water Coal Berth Project

20.10.1 Necessity of the Deep Water Coal Berth

Partially-loaded 65,000 DWT-class bulk carriers presently transporting “coal” could be fully loaded and save their transport costs, if the coal berths (no.63/64) were to be deepened to 14.0 meters below CD. Therefore, it is recommended that the existing coal berths (no.63/64) be deepened and utilize the existing infrastructure and handling and storing facilities with less investment (see Section 20.4).

20.10.2 Restrictions for the New Structure to Utilize the Existing Facilities

The new deep water coal berth is expected to accommodate fully-loaded 65,000 DWT-class dry bulk carriers (LOA is 230 (m) and moulded breadth is 32.2 (m)). Therefore, the required berth length and depth are 270 meters and 14.0 meters respectively. Additionally, it is recommended to utilize the existing infrastructure and handling and storing facilities so as to minimize the investment costs. The maximum additional extendable width of the berth without replacing the existing rail-mounted unloaders is examined and estimated at 10.0 meters, keeping the grabs reach approximately two thirds of the ship width. Some structure types will be examined and the optimum one will be proposed in the later chapter.

20.10.3 Layout of the Deep Water Coal Berth

Layout of the deep water coal berth (-14.0 m*270 m) is planned to extend toward at most 10.0 meters off the existing berth. All the other existing facilities will remain and be utilized to a full extent. Layout plan is presented in Figure 20.10.1.

Two (2) ship-maneuvering basins are planned at water area between the coal/coke terminal and the grain terminal. These ship-maneuvering basins are to be designed for the fully-loaded 65,000 DWT-class dry bulk carriers transporting “coal” and “grain”. Since LOA of the 65,000 DWT-class dry bulk carriers is 230 meters, diameter of ship-maneuvering circle is to be determined as 460 meters (twice as long as LOA of 230 meter). One of the ship-maneuvering basins, which is expected to be commonly used by both general cargo vessels and dry bulk carriers, is located off the eastern end of the new terminal area.

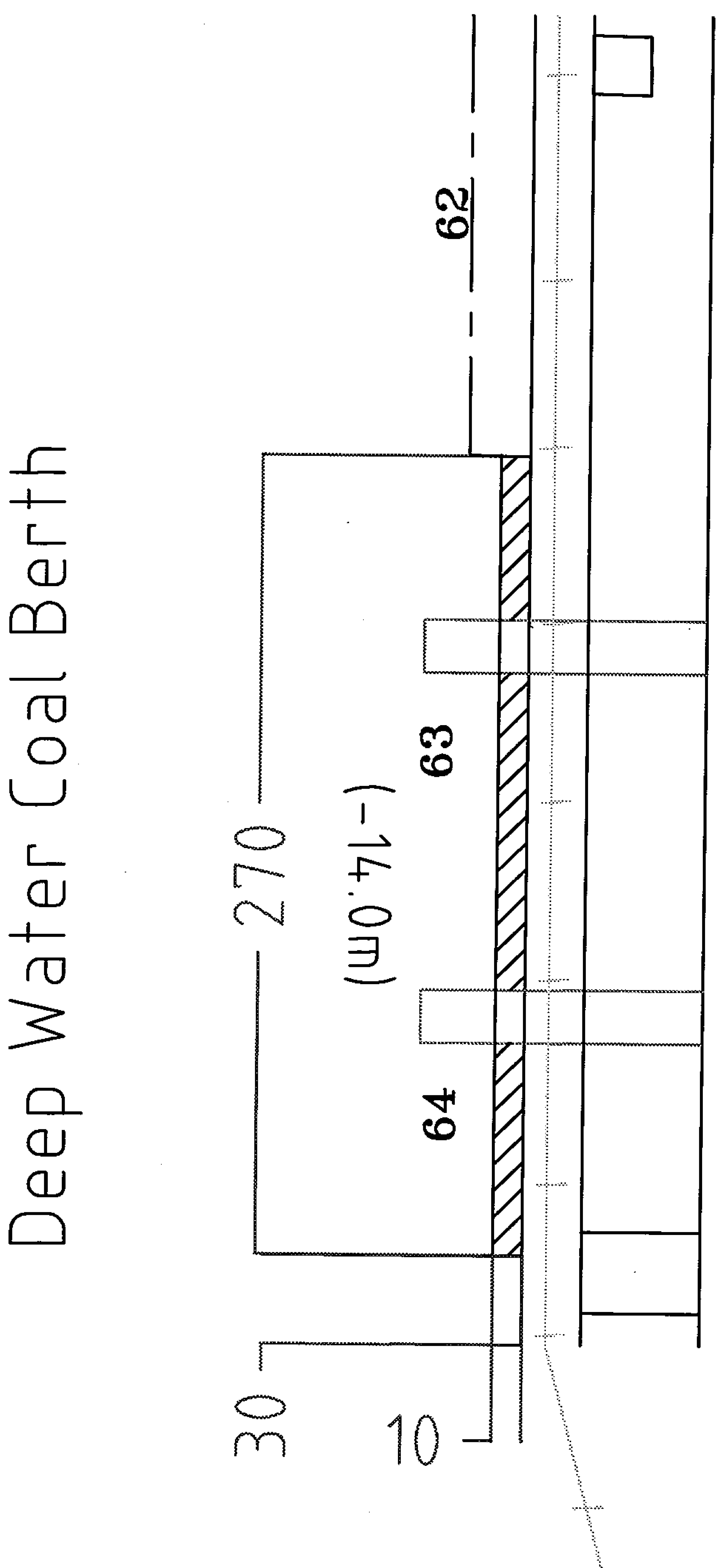


Figure 20.10.1 Layout of the Deep Water Coal Berth

20.11 Grain Terminal Modernization Project

20.11.1 Necessity of the Grain Terminal Modernization

Fully-loaded 65,000 DWT-class bulk carriers transporting “grain (wheat)” are presently using the existing 14.0-merter-deep berth (no.94-2) with two units of the highly efficient mechanical type unloaders. Since the water depth of the existing berths (no.82, 84 and 85) in the Alexandria Harbour is only 10.0 meters, these berths are extremely less utilized. Therefore, it is recommended that a new berth be constructed and utilize the existing silos with less investment (see Section 20.4).

20.11.2 Required Dimensions of the Facilities

The new grain terminal is expected to accommodate fully-loaded 65,000 DWT-class dry bulk carriers (LOA is 230 (m) and moulded breadth is 32.2 (m)). Therefore, the required berth length and depth are 270 meters and 14.0 meters respectively. A jetty-type structure of about 20 meters in width may be sufficient for a fully-automated grain terminal. However, the terminal will be used more flexibly with spacious back-up yards in case f maintenance and/or emergency. Therefore, the enclosed area by the existing breakwater and the new grain berth is recommended to be reclaimed and used as back-up yards.

Two (2) units of the efficient mechanical unloaders of which nominal productivity is 1,000 (tons/hour/unloader) are required to simultaneously be assigned to one ship so as to ensure an efficient grain cargo handling. Mechanical unloaders of which nominal productivity is 1,000 (tons/hour/unloader) are also required to ensure the same productivity of the unloaders installed at berth (no.94-2). Conveyor of 750 meters in length connecting the new grain berth and the existing silos is required so as to utilize the existing silos to a full extent.

Two (2) ship-maneuvering basins are planned at water area between the coal/coke terminal and the grain terminal. These ship-maneuvering basins are to be designed for the fully-loaded 65,000 DWT-class dry bulk carriers transporting “coal” and “grain”. Since LOA of the 65,000 DWT-class dry bulk carriers is 230 meters, diameter of ship-maneuvering circle is to be determined as 460 meters (twice as long as LOA of 230 meter). One of the ship-maneuvering basins is expected to be commonly used by both general cargo vessels and dry bulk carriers.

20.11.3 Layout of the Modernized Grain Terminal

Layout of the modernized grain terminal (-14.0 m*270 m) is planned at the east of the berth (no.85) along the existing breakwater surrounding the Mina Qamaria basin. Layout plan is presented in Figure 20.11.1.

An example profile of the mechanical grain unloader is also presented in Figure 20.11.2.

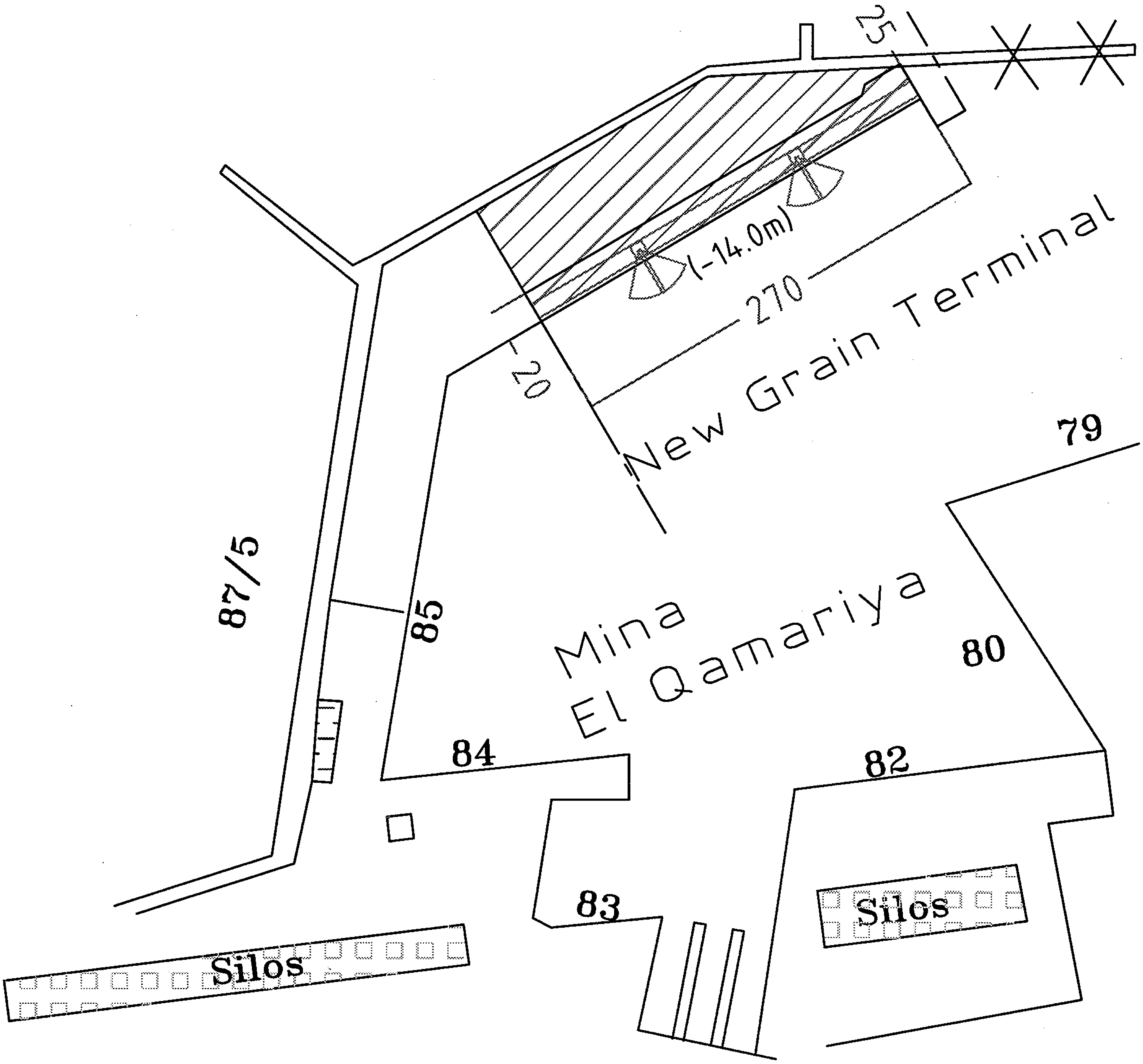


Figure 20.11.1 Layout of Modernized Grain Terminal

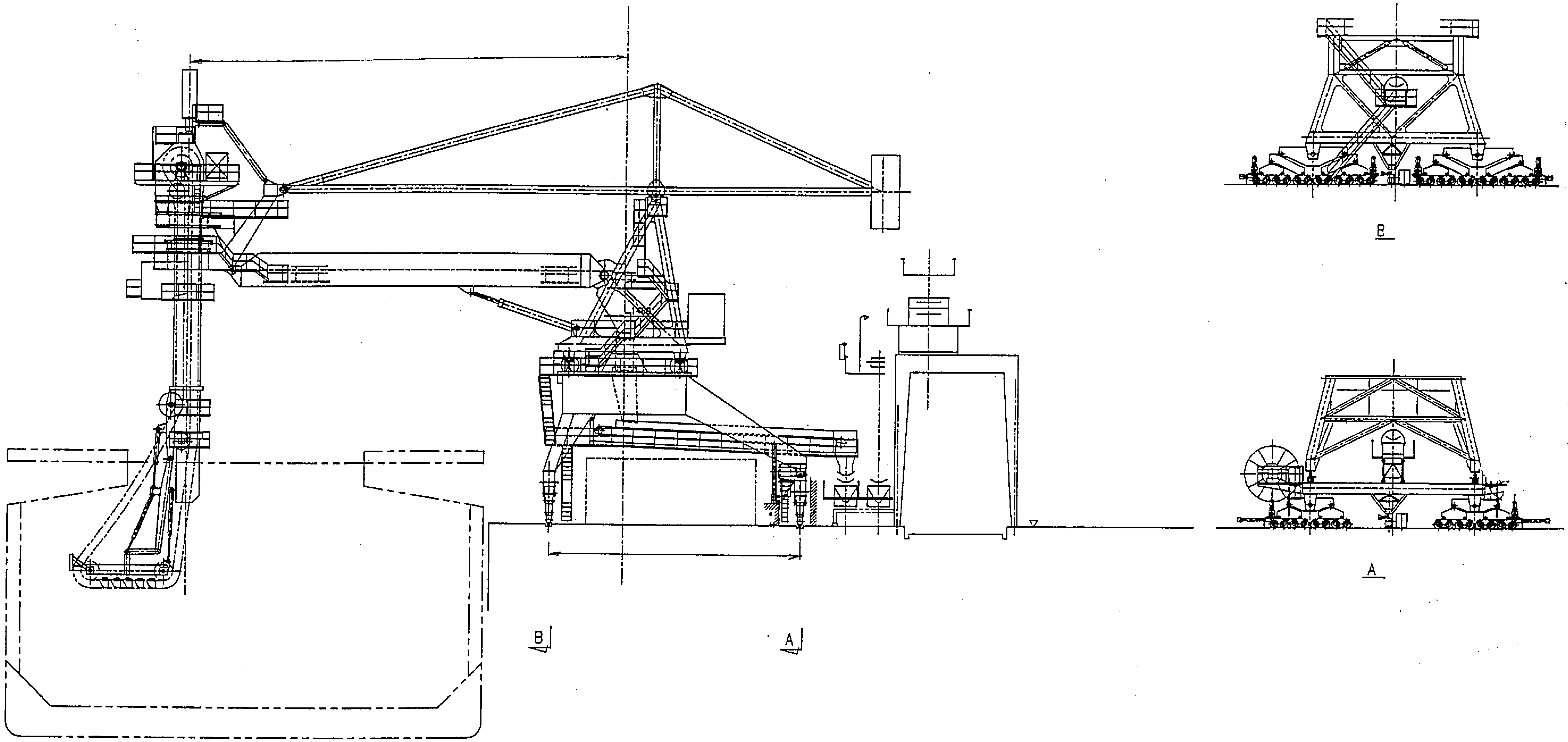


Figure 20.11.2 An Example Profile of the Mechanical Grain Unloader

Chapter 21 Preliminary Design

21.1 Design Conditions

Based on the results of the supplemental natural condition surveys, the design criteria for each Project proposed in the short term development plan were carefully studied. In particular, each boring log of bored hole and the result of laboratory tests were carefully reviewed for determination of design criteria and reflecting the construction program on the short term development plan as summarized below.

Existing Subsoil Design Properties

1) Subsurface Sand Layer	N=0-1, γ =1.8, ϕ =23°
2) Clay Layer	N=0-1, γ =1.6
	C=0.11xZo+0.8 (Zo=0 at DL±0.0)
3) Upper Sand Layer at Coal Berth (to –18.0 m)	N=10, γ =1.8, ϕ =30°
4) Second Sand Layer at Coal Berth (to –22.0 m)	N=30, γ =1.8, ϕ =35°
5) Lower Sand Layer at Coal Berth (below –22.0 m)	N=50, γ =1.8, ϕ =45°
6) Lower Sand Layer at Multi Purpose Pier	N=40, γ =1.8, ϕ =40°
7) Lower Sand Layer at Grain Berth	N=50, γ =1.8, ϕ =45°
8) Sand Layer at Canal Bridge (to –5.0m)	N=10, γ =1.8, ϕ =30°
9) Bearing Layer (below –5.0m)	N= 50, γ =1.8, ϕ =45°

As the result of review, the following design conditions were established to carry out design works of the proposed facilities for each Project.

(1) Multi-purpose Terminal

1. Objective Vessel

Max. Size	3,000TEU full Container Carrier 45,000DWT
	(L=250m, B=32.2m, D=12.0m)
Ordinary Size	15,000DWT
	(L=153m, B=22.3m, D=9.3m)

2. Water Depth of Berth

Planned Water Depth	DL. -14.0 m
Design Water Depth	DL. -14.0 m

3. Tides

(1)	H.W.L.	D.L.+0.8 m approximately
(2)	L.W.L.	D.L.+0.2 m approximately
(3)	Residual Water Level behind Quay Wall	
	Gravity type Quay Wall	1/3(HWL-LWL)+LWL= DL. +0.4 m
	Sheet Pile Wall	2/3(HWL-LWL)+LWL= DL. +0.6 m
4.	Copeline Height of Berth	D.L. +2.4 m
5.	Apron Width	30 m
6.	Loads	
(1)	Uniform Load at Apron	3.0 tf/sq.m
(2)	Uniform Load at Yard	3.0 tf/sq.m
(3)	Uniform Load	2.0 tf/sq.m (for circular sliding analysis)
(4)	Mooring Force	100 tf for Bollard and 70 tf for Bitt
(5)	Approach Velocity of Berthing	15 cm/s perpendicular toward berth face line
(6)	Movable Load of Equipment	Quay Gantry Crane
		Max. lifting capacity : 48.0 tf
		Lift Capacity under spreader : 35.0 tf
		Rail Span : 25 m
		Two (2) units for the Terminal
7.	Soil Conditions :	
(1)	Sand Reclamation	ϕ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(2)	Sand Fill	ϕ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(3)	Back-fill Stone	ϕ=35º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(4)	Rubble Mound	ϕ=40º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(5)	Sand Replacement (N=5~10)	ϕ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(6)	Filling Sand for Concrete Caisson	γ = 1.8 tf/cu.m (2.0 tf/cu.m in 100% saturated)
(7)	Original Subsoil	
	Subsurface Sand Layer (N=0-1)	γ =1.8 ϕ =23°
	Clay Layer (N=0-1)	γ =1.6, C=0.11xZo+0.8 (Zo=0 at DL±0.0)
	Lower Sand Layer(N=40)	γ =1.8 ϕ =40°
8.	Unit Weight	
(1)	Plain Concrete	w=2.2 tf/cu.m
(2)	Reinforced Concrete for Deck & Beams	w=2.35 tf/cu.m
(3)	Reinforced Concrete for Caisson	w=2.35 tf/cu.m

9. Design Standard: The following Japanese Standards are applied.

(1) Technical Standards for Port and Harbor Facilities : Japan Port & Harbor Association

(2) Standard Specifications for Concrete : Japan Society of Civil Engineers

(3) Standard Specifications for Prestressed Concrete : Japan Society of Civil Engineers

(4) Principles of Asphalt Pavement : Japan Road Association

(5) Standard Specifications for Road Bridges : Japan Road Association
(6) Japanese Industrial Standards : Japanese Standards Association

(2) New Grain Berth

1. Objective Vessel	
Maximum Size	Panamax-type Grain Carrier of 65,000DWT (L=230m, B=32.2m, D=12.7m)
2. Water Depth of Berth	
Planned Water Depth	DL. -14.0 m
Design Water Depth	DL. -14.0 m
3. Tides	
(1) H.W.L.	D.L.+0.8 m approximately
(2) L.W.L.	D.L.+0.2 m approximately
(3) Residual Water Level behind Quay Wall	
Gravity type Quay Wall	1/3(HWL-LWL)+LWL= DL. +0.4 m
Sheet Pile Wall	2/3(HWL-LWL)+LWL= DL. +0.6 m
4. Copeline Height of Berth	DL. +2.4 m
7. Apron Width	20 m
6. Loads	
(1) Uniform Load at Apron	2.0 tf/sq.m
(2) Uniform Load	1.0 tf/sq.m (for circular sliding analysis)
(3) Mooring Force	100 tf for Bollard and 70 tf for Bitt
(4) Approach Velocity for Berthing	15 cm/s perpendicular toward berth face line
(5) Movable Load of Equipment	Mechanical Continuous Grain Unloader 700 t/hr capacity Rail Span : 12 m Two(2) units per berth
8. Soil Conditions :	
(1) Sand Reclamation	ϕ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(2) Sand Fill	ϕ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(3) Back-fill Stone	ϕ=35º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(4) Rubble Mound	ϕ=40º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(5) Sand Replacement (N=5~10)	ϕ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(6) Filling Sand for Concrete Caisson	γ = 1.8 tf/cu.m (2.0 tf/cu.m in 100% saturated)
(7) Original Subsoil	
Subsurface Sand Layer (N=0-1)	γ ＝1.8、ϕ＝23°
Clay Layer(N=0-1)	γ ＝1.6, C=0.11xZo+0.8 (Zo=0 at DL±0.0)
Lower Sand Layer(N=50)	γ ＝1.8、ϕ＝45°

8. Unit Weight

(1) Plain Concrete	w=2.2 tf/cu.m
(2) Reinforced Concrete for Deck & Beams	w=2.35 tf/cu.m
(3) Reinforced Concrete for Caisson	w=2.35 tf/cu.m

9. Design Standard: The same Japanese Standards as those listed in Multi-purpose terminal are applied.

(3) Coal Berth

1. Objective Vessel	Panamax-type Coal Carries of 65,000 DWT (Vessel Size: L=230m, B=32.2, D=12.7m)
2. Water Depth of Berth	
Planned Water Depth	DL. -14.0 m
Design Water Depth	DL. -14.0 m
3. Tides	
(1) H.W.L.	D.L.+0.8 m approximately
(2) L.W.L.	D.L.+0.2 m approximately
(3) Residual Water Level behind Quay Wall	
Gravity type Quay Wall	1/3(HWL-LWL)+LWL= DL. +0.4 m
Sheet Pile Wall	2/3(HWL-LWL)+LWL= DL. +0.6 m
4. Copeline Height of Berth	D.L. +2.4 m
10. Apron Width	not applicable
6. Loads	
(1) Uniform Load at Apron	2.0 tf/sq.m
(2) Coal Stacking Load	4.0 tf/sq.m at Yard
(3) Uniform Load at Yard	2.0 tf/sq.m (for circular sliding analysis)
(2) Mooring Force	100 tf for Bollard and 70 tf for Bitt
(5) Approach Velocity of Berthing	15 cm/s perpendicular toward berth face line
(6) Movable Load of Equipment	None (loaded only on the existing quay wall)
11. Soil Conditions :	
(1) Sand Fill	φ=30º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(2) Rubble Mound	φ=40º, γ = 1.8 tf/cu.m (1.0 tf/cu.m in water)
(3) In-situ Subsoil	
Upper Sand Layer(N=10)	γ＝1.8、φ＝30°
Second Sand Layer(N=30)	γ＝1.8、φ＝35°
Lower Sand Layer(N=50) (below –22.0 m)	γ＝1.8、φ＝45°

8. Unit Weight

(1) Plain Concrete	w=2.2 tf/cu.m

(2) Reinforced Concrete for Deck & Beams w=2.35 tf/cu.m

(3) Reinforced Concrete for Caisson w=2.35 tf/cu.m

9. Design Standard: The same Japanese Standards as those listed in Multi-purpose terminal are applied.

(4) New Port Bridge

1. Dimensions of Bridge

Bridge Span	90 m
No. of Lane	4 lanes (2 ways × 2 lanes) = 6.5m width for one way
Elevation of Road Surface	D.L.+4.3 m (the same as existing bridge)

2. Live Loads for Road Bridge: in compliance with the Egyptian code of practice

Truck Load	60 tons Trailer Truck

3 Soil Conditions

Upper Sand Layer(N=5)	$\gamma=1.8$、$\phi=28°$
Lower Sand Layer(N=50)	$\gamma=1.8$、$\phi=45°$ (below DL –5.0 m)

(5) Fly-over Bridge for the New Multi-purpose Terminal

1. Road Way Dimensions

Bridge Span	15 m standard span
No. of Lane	One (1) lane (1 way × 1 lane) = 5 m width for one way

2. Live Loads for Road Bridge : in compliance with the Egyptian code of practice

Truck Load	60 tons Trailer Truck

21.2 Preliminary Design

(1) General

Preliminary design for the facilities envisaged in the short-term development plan was carried out and the standard section profile of berth structures was established. This design work was carried out based on the scrutiny of the results of survey on the water depth, subsoil investigation and seabed quality which was carried out at the proposed site area for the short term development in the third field survey in Egypt.

According to the subsoil investigation, a subsoil profile in the proposed site for the multi-purpose terminal, coal & coke berth and new grain berth shows uniformly developed middle layer of clayey subsoil in general. This clay deposit is sandwiched by the subsurface soft sand and dense sand layer except for the area at coal & coke berth where possibly original clayey deposits had already replaced by sand material.

But, the present subsoil in front of the south portion of the existing coal berth is composed mostly of sandy soils having 10-30 N-value in SPT, which would be the replaced sands in the construction of the existing coal berth construction. In contrary, the subsoil at the area where the new multipurpose terminal and the new grain berth are planned is basically composed of very soft clayey soils of 0-1 N-value. Since uni-axial compression strength (Qu) of these very soft clayey deposits are more or less 0.6 kg/cm2 and therefore the adoption of the subsoil improvement technique will be mandatory to construct the new terminal.

The above subsoil data obtained through the soil investigation will be reflected to the work for the selection of most suitable type of quay front structures at the multipurpose terminal, deepened coal berth and new grain berth envisaged in the short term development scheme. The best-suited type of quay wall structure is carefully studied among other alternatives. The height of quay wall along face-line is set forth to be +2.4 m above datum, which would be suitable level for quay wall for receiving objective vessels under the tide levels of the Greater Alexandria Port. Utmost utilization of locally available materials is considered in easier maintenance of view.

In addition, reviewing laboratory test results on the subsoil samples such as uni-axial compression strength, consolidation test and other subsoil properties, the study on the applicable method of subsoil improvement will be carefully carried out.

(2) Comparative Study of Quay Wall Structure

By judging from the subsoil condition at the proposed site, a comparative study of structure is made for the following three types of structure which are selected among applicable construction method of structure.

[Multi-purpose Terminal]
Alternative A: Gravity Type of Wall by Concrete Blocks
Alternative B: Gravity Type of Wall by Concrete Caissons
Alternative C: Open Type Deck supported by Piles

[New Grain Terminal]
Alternative A: Gravity Type of Wall by Concrete Blocks
Alternative B: Gravity Type of Wall by Concrete Caissons
Alternative C: Open Type Deck supported by Piles

[Deep Water Coal Berth]
Alternative A: Detached Pier provided at a certain interval
Alternative B: Open Type Continuous Deck with Underwater Retaining Sheet Pile Wall
Alternative C: Open Type Continuous Deck supported by Batter Piles

The above type of structures selected as alternatives has various advantages and disadvantages as mentioned below.

1) Gravity Type Quay Wall

In general, gravity type is not suitable as quay wall structure required a deeper water depth or constructed at the area where the subsoil condition is relatively soft or loose deposit. But, since gravity type by concrete blocks is broadly used for constructing quay wall structure at the Greater Alexandria Port, this type of construction has greater advantages in view of the construction technique already experienced in the past. Large size of concrete blocks or concrete caissons will be manufactured on shore temporary site or floating dock and therefore the construction period to be required will be shortened. The concrete block or caisson type gravity quay wall has the following major advantages or disadvantages in construction:

i) Such construction materials as cement, sands and gravel for concrete use and reinforcing bars are locally available
ii) Construction period will be minimized owing to pre-fabrication
iii) Due to weakness of subsoil, pre-dredging for sand replacement along faceline of berth is mandatory for receiving concrete blocks or caissons
iv) Good quality of workmanship will be required surface treatment for rock base mound to install concrete blocks or caisson thereon

2) Open Type Deck

This type is effective to adopt for structures to be constructed upon soft to medium subsoil due to its lightness of structure. Pile construction such as steel pipe piles to penetrate soft deposits to bearing stratum by pile driving is used to obtain necessary resistance for supporting deck and beam concrete superstructure. The open deck piled structure has the following characteristics.

i) Basically no settlement will be expected after completion
ii) This type will be adopted in combination with retaining wall construction behind the deck
iii) Its flexibility of structure is effective for resisting such lateral force as seismic or berthing loads
iv) Construction of deck structure is off shore site work

Most suitable type of structure is selected for each Project in view of technical and economical points. Tables 21.2.1 and 21.2.2 show a comparative study of the above described three type of structures. As the result of study, gravity type quay wall by concrete blocks is recommended for the multi-purpose terminal and new grain berth while open type continuous deck supported by batter piles for coal berth with deeper water depth. Standard cross section of recommended quay wall structure as well as those of alternatives is presented in Fig. 21.2.1.

Structures of new port road bridge and fly-over bridge for multi-purpose terminal were designed and typical section profile of the structure is presented as shown in Fig. 21.2.1. In designing the new port bridge crossing Mahmudia Canal, the following considerations are incorporated in dimensioning the structure.

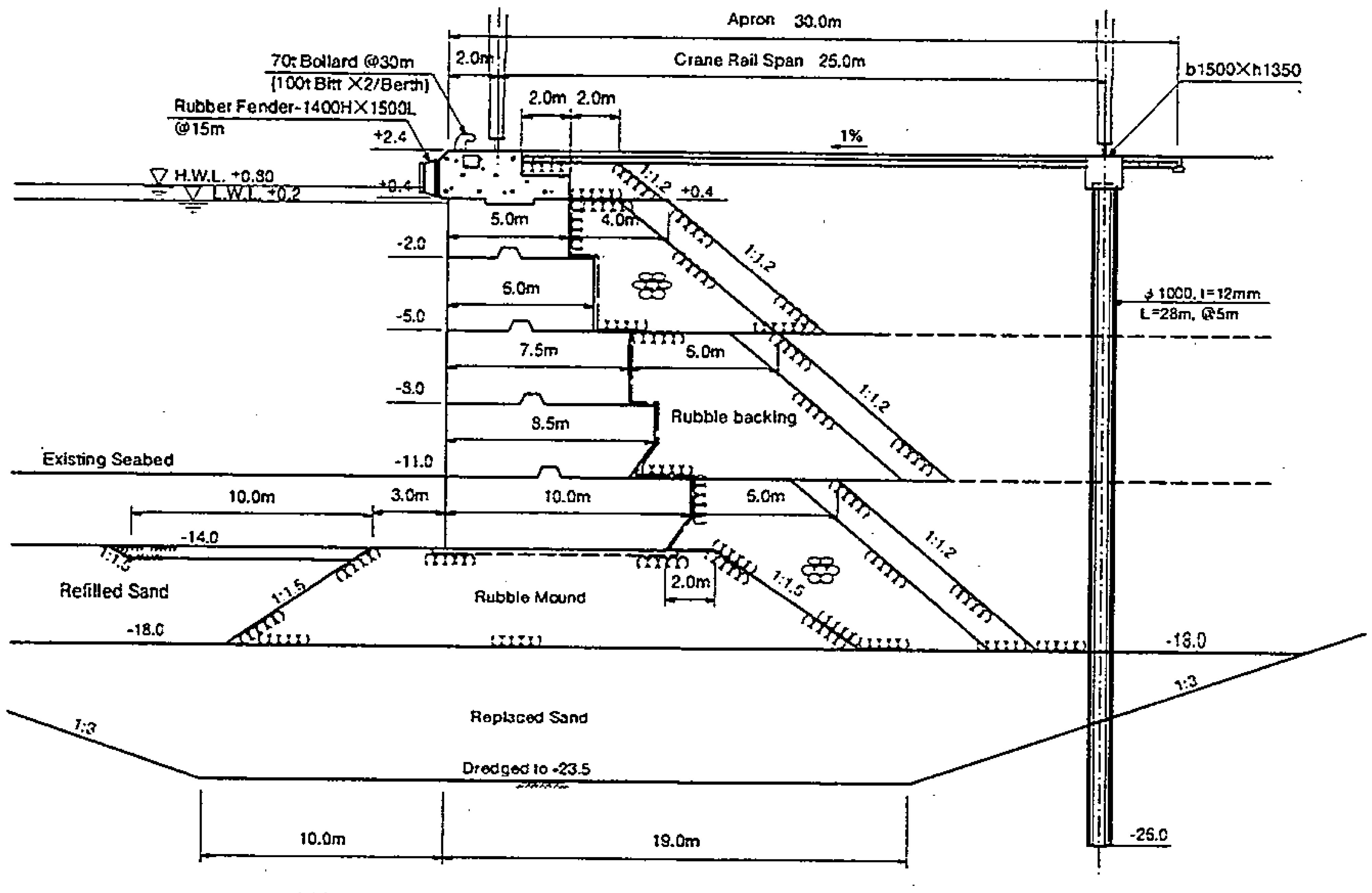
a. Since new approach to the new port bridge is inevitably cross the existing site of fire station, fire station building must be remove to an appropriate location in due course.
b. The elevation of new port bridge should be set out in consideration of possible future utilization of Mahmudia Canal by barges. In this study, the bridge roadway elevation is assumed +4.3 m as the same of the existing bridge.

Table 21.2.1 Comparison of Type of Quay Wall for Multi-purpose Terminal & Grain Berth

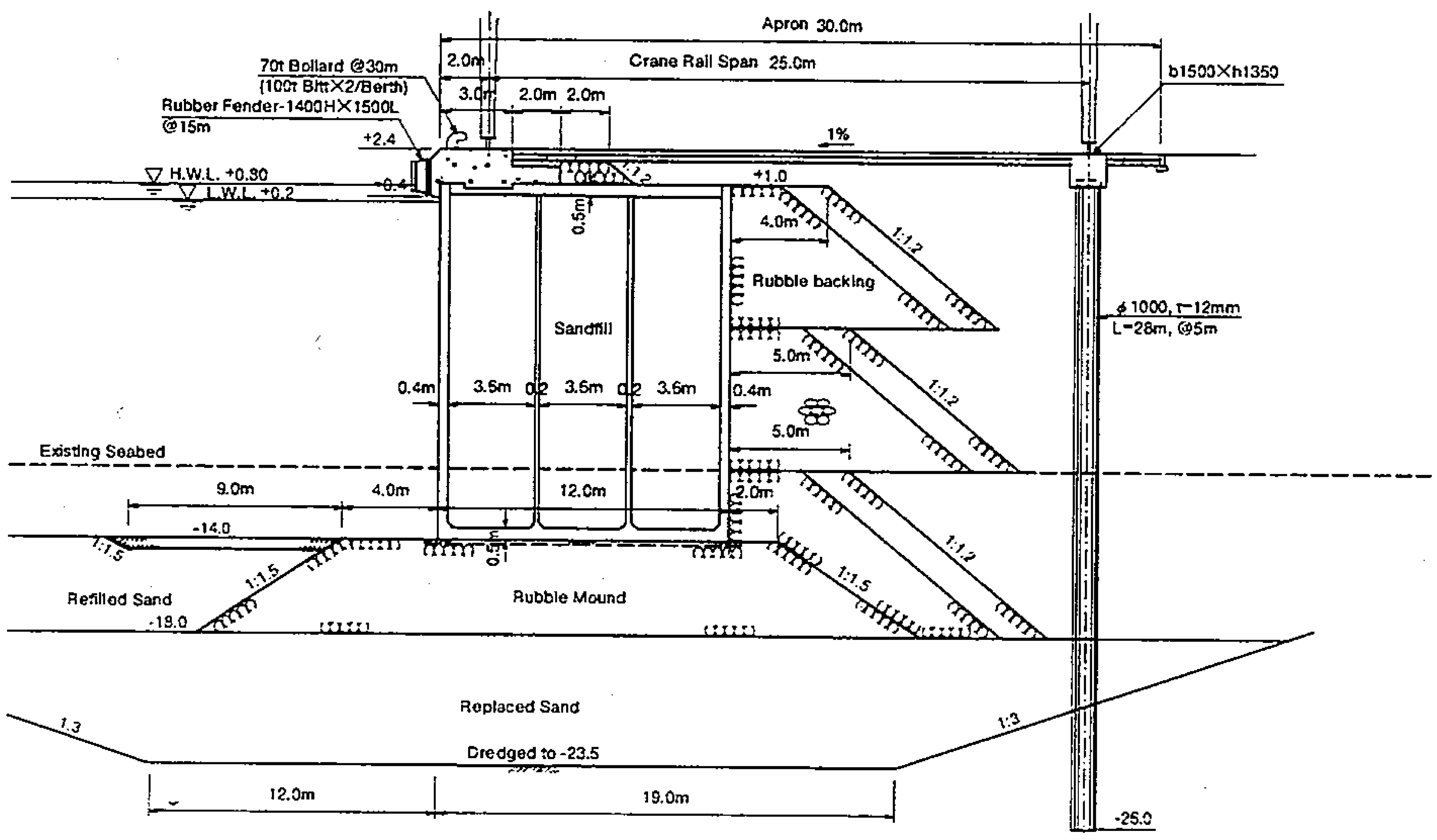
Alternative	Alternative-A		Alternative-B		Alternative-C	
	Gravity Type Wall by Concrete Blocks		Gravity type Wall by Concrete Caisson		Open Deck supported by Steel Pipe Pile	
Structural Concept	Before placing concrete blocks, original weak clay subsoil must be replaced by sandy soil along quay wall alignment so as to eliminate settlement by own weight of blocks. Layers of concrete blocks are installed on the rubble mound base and in-site coping concrete is provided at the top of quay wall.		Before placing concrete caisson, original weak clay subsoil must be replaced by sandy soil along quay wall alignment so as to eliminate settlement by own weight of caissons. Concrete caisson are installed on the rubble mound base and in-site coping concrete is provided at the top of quay wall.		The gravity type wall is provided on the top of underwater slope protection for retaining reclamation fill at the terminal yard. Beam and deck superstructure is supported by pile foundation. The original clay subsoil under the open deck must be replaced by sandy soil in order for the under-the-deck slope to be stable for circular sliding.	
Particulars	△	Clayey subsoil are replaced by sandy soils to sustain vertical weight of gravity wall	△	Clayey subsoil are replaced by sandy soils to sustain vertical weight of gravity wall	△	Clayey subsoil are replaced by sandy soils for under-the deck slope stability
	○	High stability by relying on own weight of concrete blocks	○	High stability by relying on own weight of concrete caisson	△	Structure is in combination with R.C. superstructure and Steel Pipe Pile foundations
	△	Full precaution needed in formation of base mound and possible settlement in particular.	△	Full precaution needed in formation of base mound and possible settlement in particular.	△	Steel pipe piles are materials to be imported
	△	Accuracy in installing concrete blocks is required to maintain structural stability.	△	Accuracy in installing concrete caissons is required to maintain structural stability.	△	A series of offshore works must be systematically carried out
	△	Unity of block structure is less than the case of caisson type	○	Unity of caisson structure is excellent	△	Anti-corrosion measure in absolutely need for steel pipe pile protection.
Structural Stability	△	Full precaution needed for possible vertical settlement in particular.	△	Full precaution needed for possible vertical settlement in particular.	○	High structural flexibility for vertical and lateral loads
	△	Flow away of backfill materials must be precluded by effective measures	△	Flow away of backfill materials must be precluded by effective measures	△	Horizontal displacement of deck occurs due to its flexibility
Construction	○	Easiness in onshore fabrication of concrete block and block fabrication yard is needed	△	Floating dock or wide onshore area is required for caisson fabrication.	△	Easiness in construction except for piling work which is required heavy pile driving hammer
	△	Large scale subsoil replacement by sands is required along berth alignment.	△	Large scale subsoil replacement by sand is required along berth alignment.	△	Large scale subsoil replacement by sand is also required along berth alignment
	△	Relatively large crane is needed for block installation.	○	Such large size crane as required for Alternative A is not needed for installation caisson at site	△	Piling and deck & beam concrete works upon temporary stage are carried out at offshore work
Cost for Multi-purpose Terminal (ratio of cost)	lowest		medium		costly	
	1.00		1.15		1.71	
Cost for New Grain Berth (ratio of cost)	lowest		medium		costly	
	1.00		1.32		1.53	
Assessment	◎		○		△	

Table 21.2.2 Comparison of Type of Quay Wall for Coal Berth

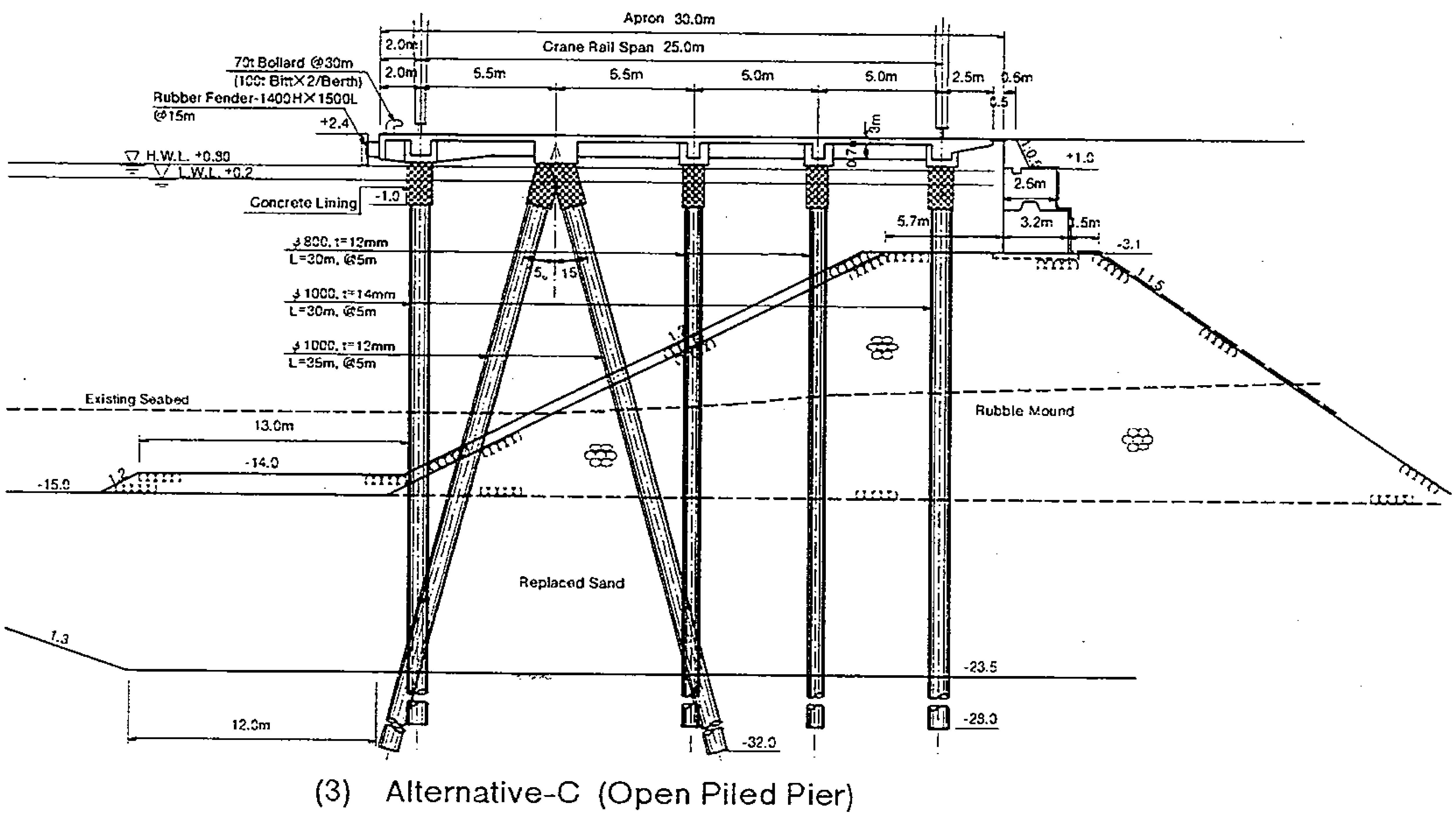
Alternative	Alternative-A		Alternative-B		Alternative-C	
	Detached Pier supported by Batter Pile Foundatio		Open Pier with Underwater Sheet Pile		Continuous Open type Pier supported by Piles	
Structural Concept	Open type detached dolphin structure is adopted in order to receive lateral impact load at vessel berthing. Deepening of water depth can be made by providing underwater slope in front of the existing quay wall		Open type piled deck is provided in front of the existing quay wall. Coupled pile foundation system is adopted in order to minimize bending moment on the piles and displacement of wharf block. Deepening of water depth can be made by dredging sea bed in front of sheet piled underwater wall		Open type piled deck is provided in front of the existing quay wall. Coupled pile foundation system is adopted in order to minimize bending moment on the piles and displacement of wharf block. Deepening of water depth can be made by providing underwater slope in front of the existing quay wall	
Particulars	△	Detached piers are installed at a certain interval	○	Continuous deck pier is installed	○	Continuous deck pier is installed
	△	Large size of coupled batter piles is needed	△	Foundation piles in combination of vertical and batter piles	△	Foundation piles in combination of vertical and batter piles
	△	Approach walkway will be necessary for mooring operation and maintenance	○	Pier deck is additionally provided in front of existing quay wall	○	Pier deck is additionally provided in front of existing quay wall
	△	Full precaution in dredging and slope protection work in view of stability of existing quay wall	○	Easiness in dredging work control	△	Full precaution in dredging and slope protection work in view of stability of existing quay wall
	△	Anti-corrosion measure in absolutely need.	△	Anti-corrosion measure in absolutely need.	△	Anti-corrosion measure in absolutely need.
Structural Stability	△	Each detached pier structure is subjected to large magnitude of bending moment and horizontal displacement of pier.	○	One block of deck pier (=25 m length) unitedly resists to lateral impact load at vessel berthing	○	One block of deck pier (=25 m length) unity resists to lateral impact load at vessel berthing
Construction	△	Piling work must be operational for plus & minus batter directions	○	Piling work must be operational for vertical and plus batter directions	△	Piling work must be operational for plus & minus batter directions
	△	Large size foundation pile driving is required	○	Piles to be driven are relatively smaller size than Alternative- A.	○	Piles to be driven are relatively smaller size than Alternative- A.
Cost (ratio of cost)	costly		costly		medium	
	1.19		1.39		1.00	
Assessment	△		○		◎	



(1) Alternative-A (Concrete Blocks)

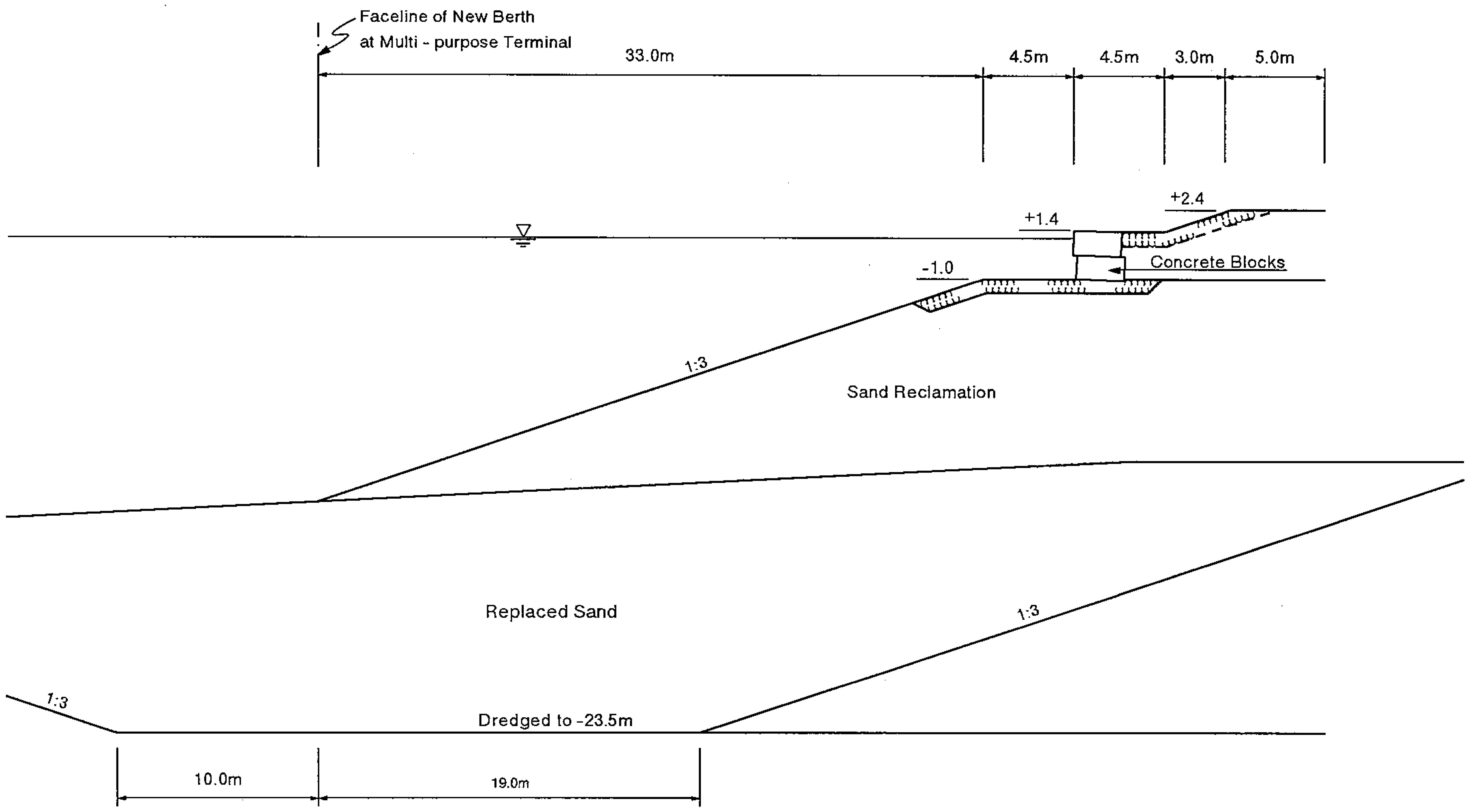


(2) Alternative-B (Concrete Caisson)

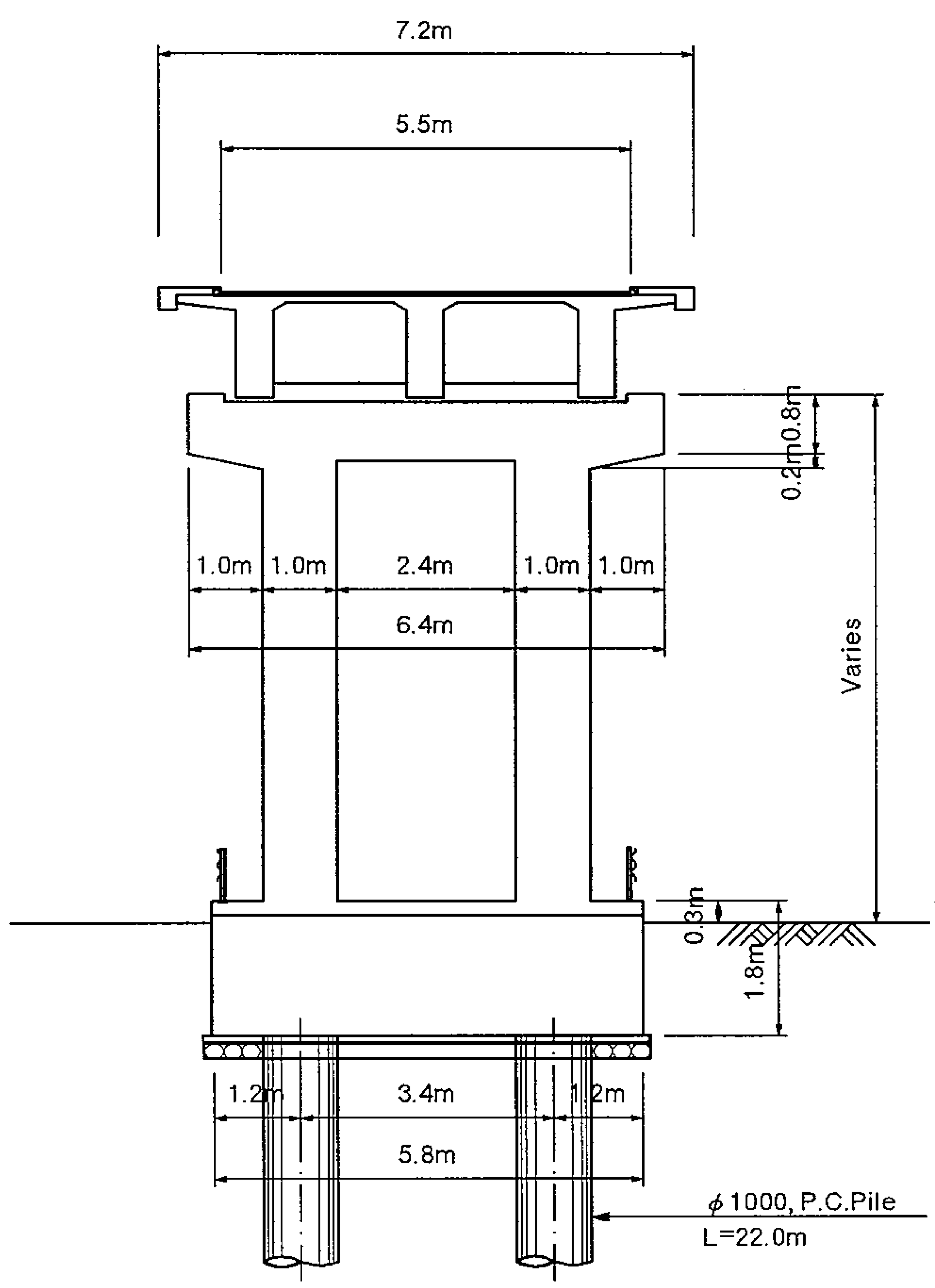


(3) Alternative-C (Open Piled Pier)

Fig. 21.2.1 Alternative Type of Quay Wall for New Multi -purpose Terminal

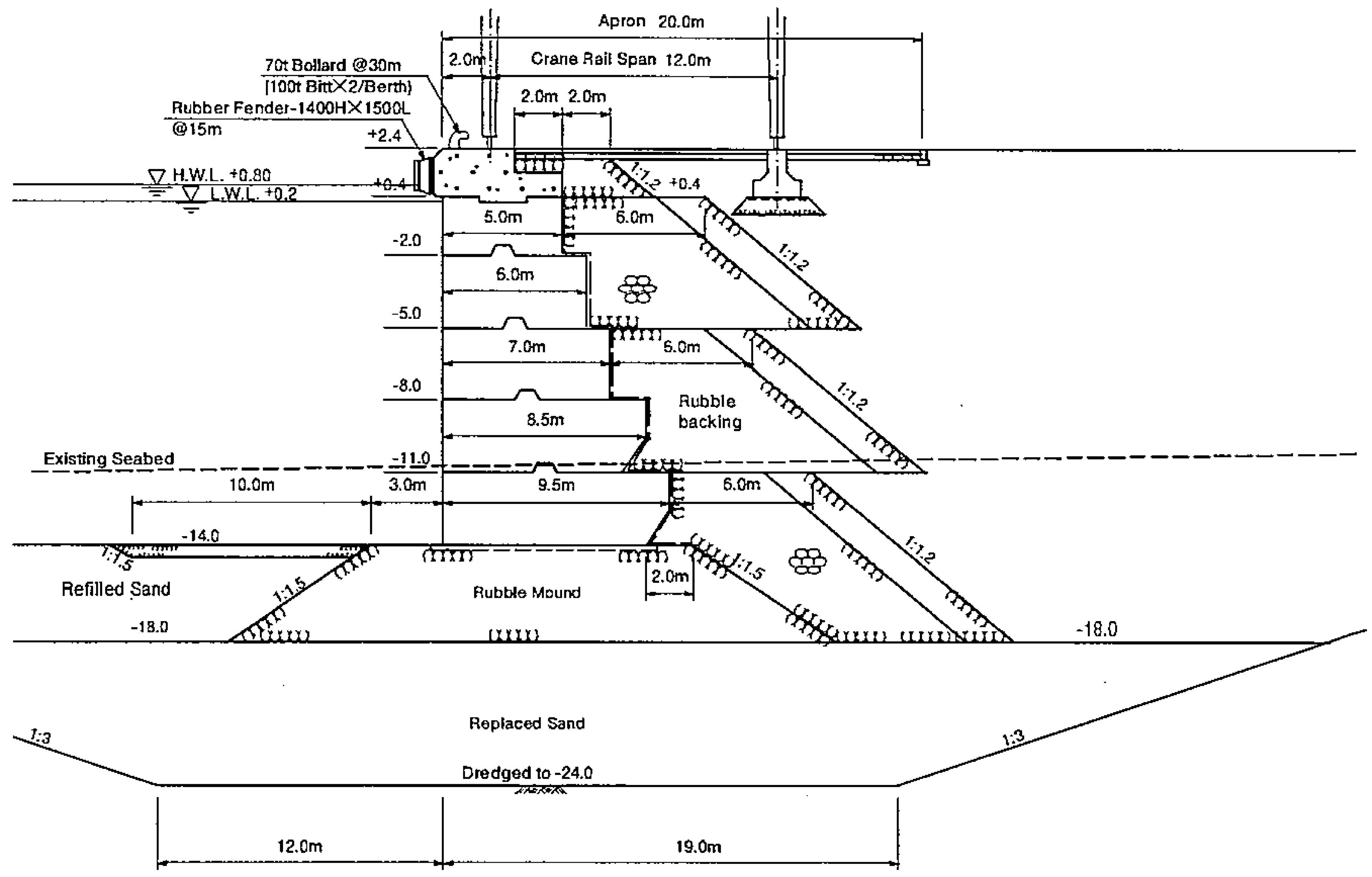


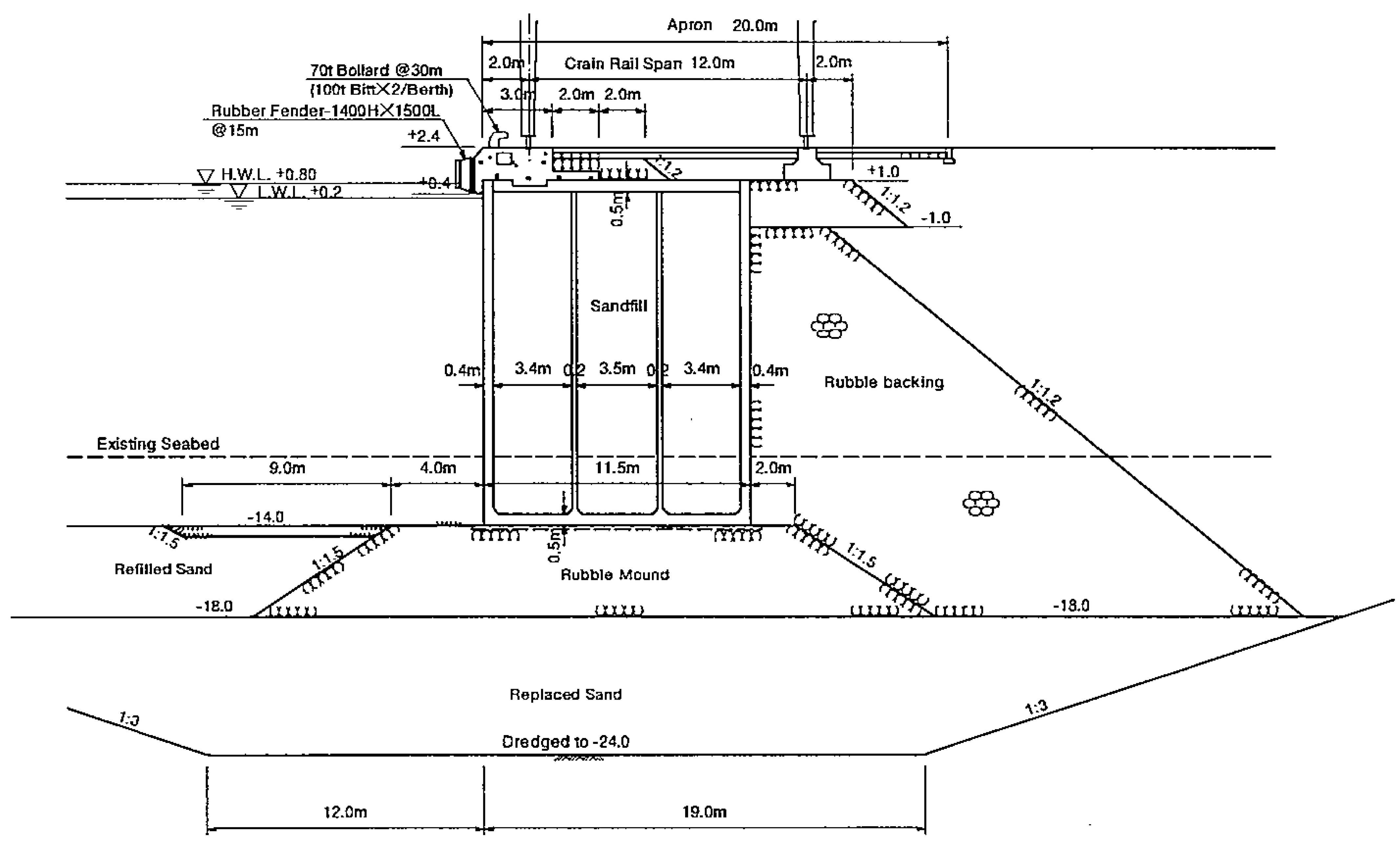
(1) Temporary Revetment



(2) Fly -Over Bridge

Fig. 21.2.2 Other Structures for Multi -purpose Terminal


(1) Alternative-A (Concrete Blocks)


(2) Alternative-B (Concrete Caisson)

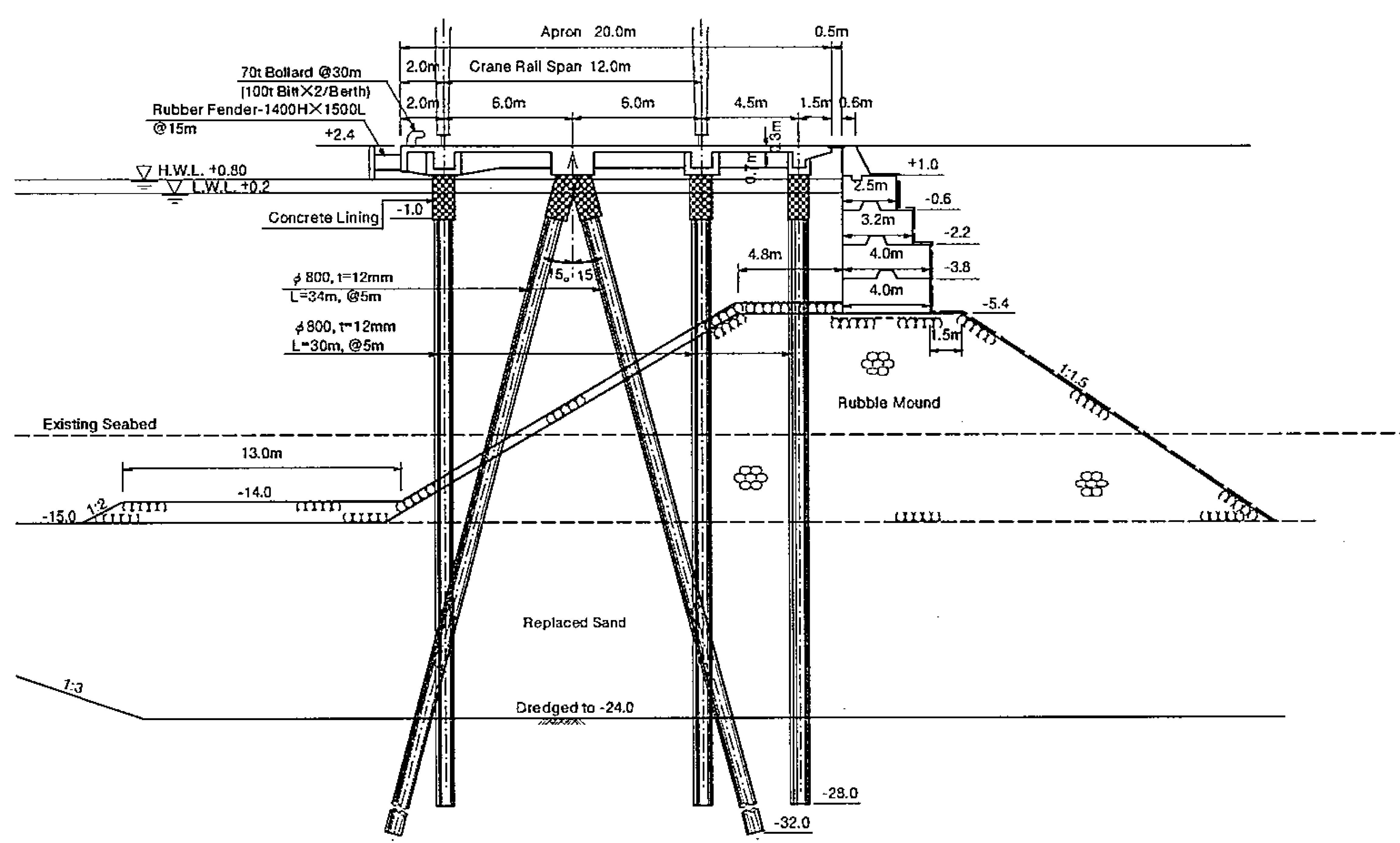
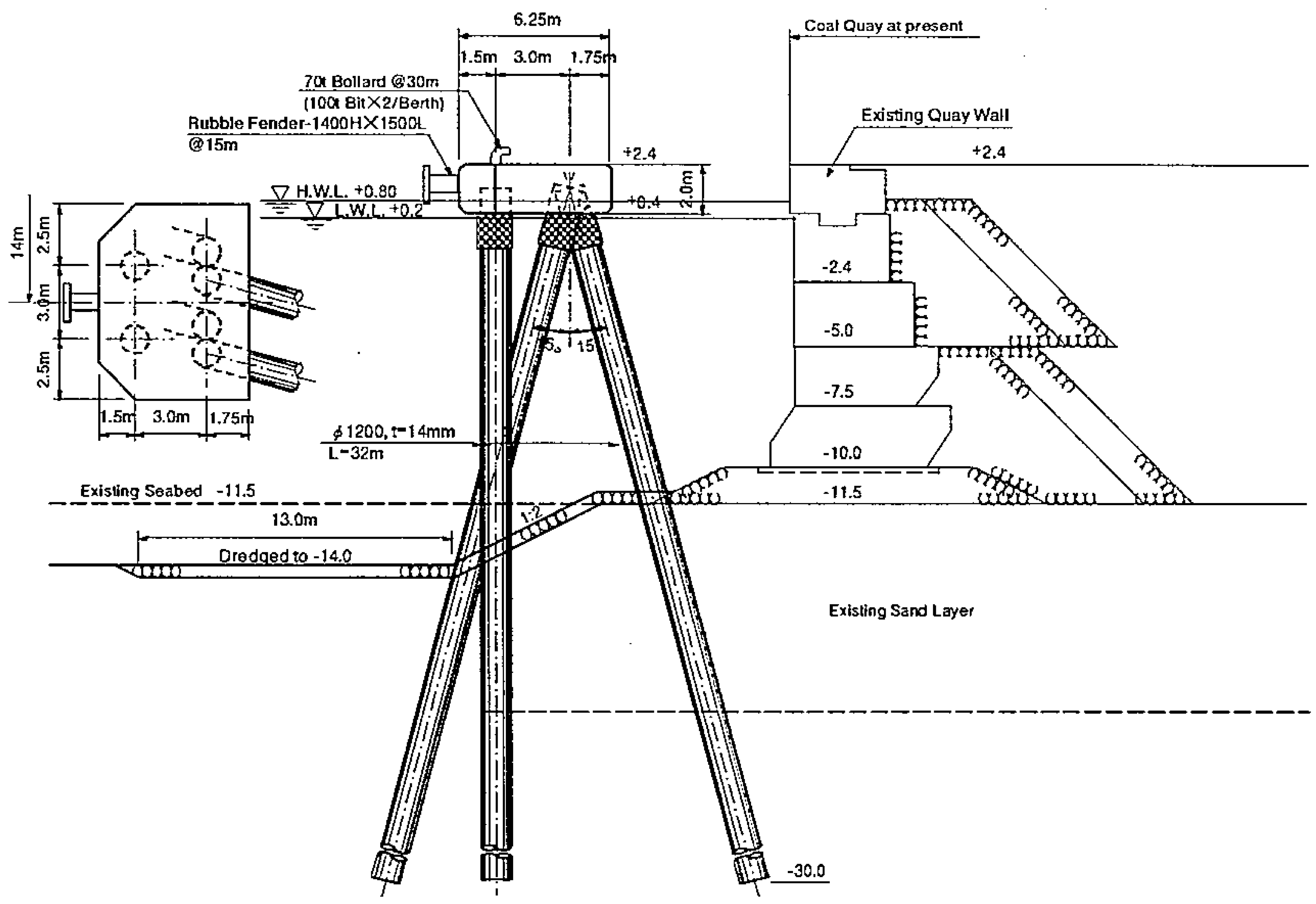
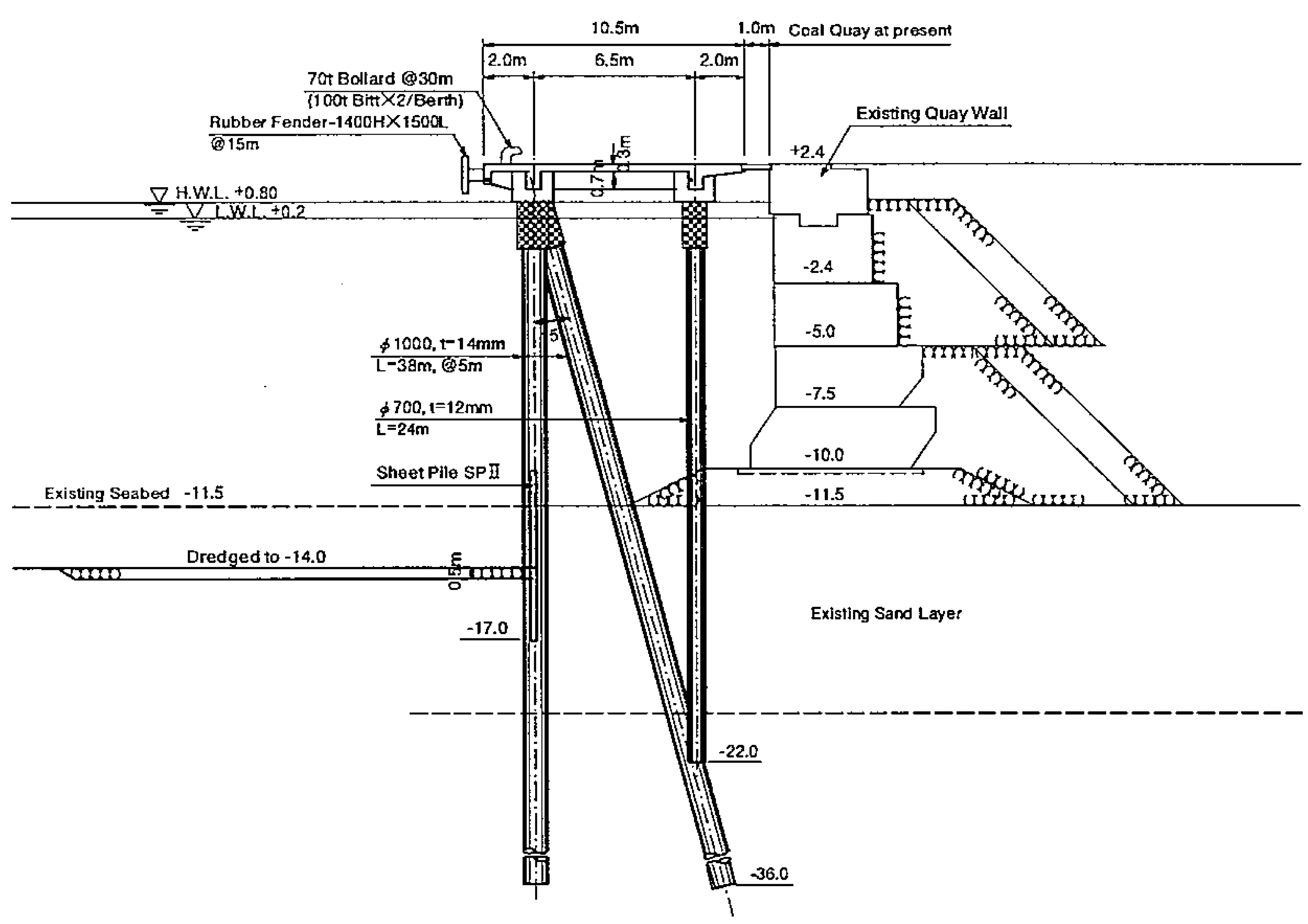

(3) Alternative-C (Open Piled Pier)

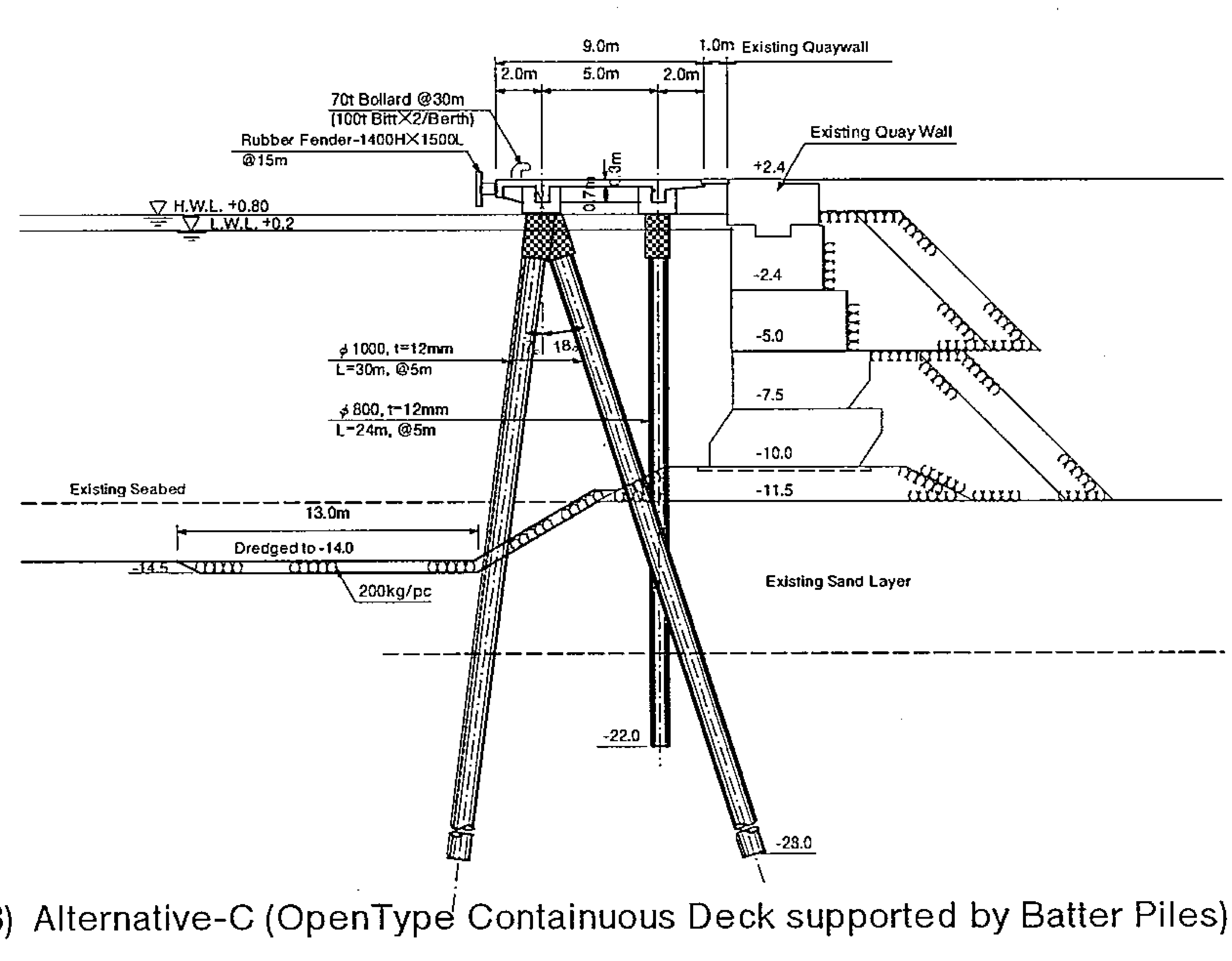
Fig. 21.2.3 Alternative Type of Quay Wall for New Grain Berth



(1) Alternative-A (Detached Pier provided at 14m interval)

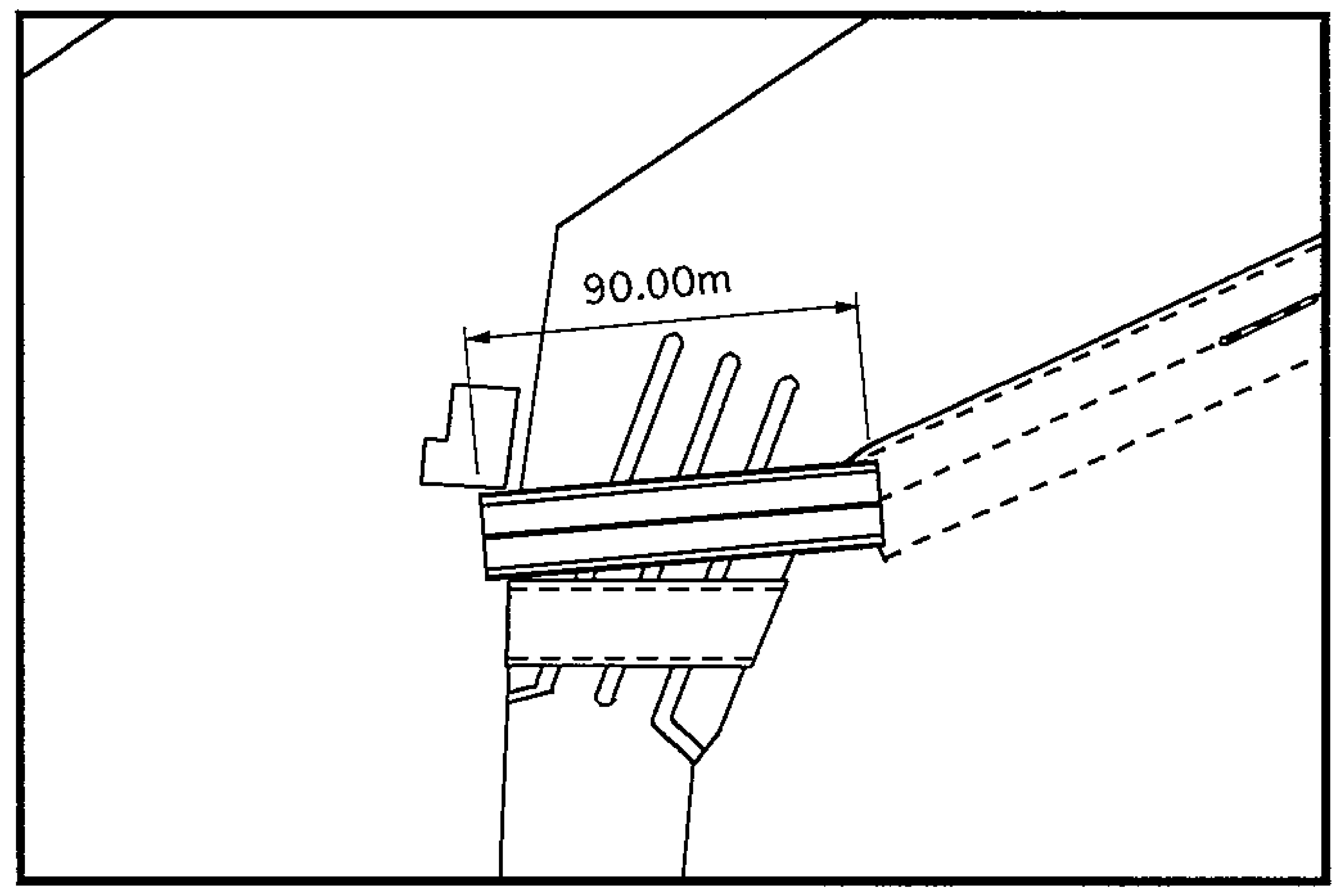


(2) Alternative-B (OpenType Containuous Deck with Underwater Sheet Pile Retaining Wall)



(3) Alternative-C (OpenType Containuous Deck supported by Batter Piles)

Fig. 21.2.4 Alternative Type of Quay Wall of Deep Water Coal Berth



Location Map

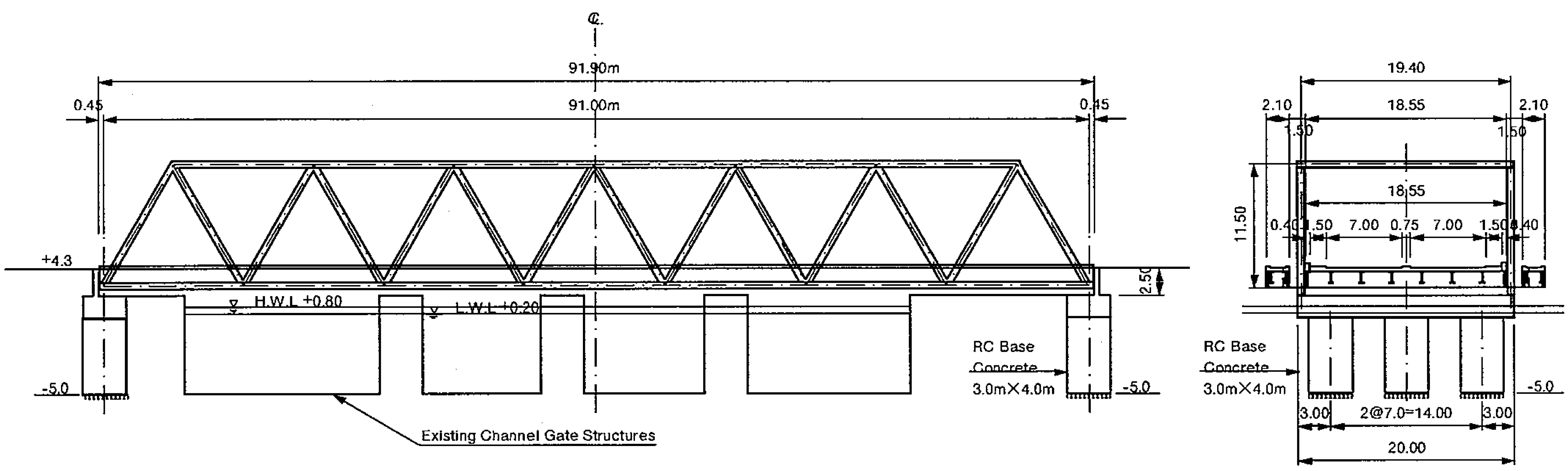


Fig. 21.2.5 Profile of New Port Bridge at Mahmudia Canal

(3) Consolidation and Reclamation

Subsoil properties for consolidation are also evaluated based on the test data of consolidation test, which are summarized as follows:

[Multi-purpose Terminal]

Compression Index	Cc＝0.715
Coefficient of Volume Compressibility	mv＝0.124 cm2/kg
Coefficient of Consolidation	cv ＝ 0.3 m2/year=0.006 cm2/min (at applied pressure of p=1.0~1.5 kg/cm2)
Initial Voids Ratio	eo＝1.934

[Grain Berth]

Compression Index	Cc＝0.442
Coefficient of Volume Compressibility	mv＝0.112 cm2/kg
Coefficient of Consolidation	cv ＝ 0.3 m2/year=0.006 cm2/min (at applied pressure of p=1.0~1.5 kg/cm2)
Initial Voids Ratio	eo＝2.062

Based on the above consolidation properties of the clayey subsoil at the site, expected process of consolidation due to the reclamation are calculated as follows:

a) Multi-purpose Terminal

Effective earth pressure at present	pv＝5x0.8+3x0.6=5.8t/m2
Newly Applied Earth Pressure	Δp1=10.4x1.0+2.0x1.8=14.0t/m2
Earth Pressure by Surcharge Load	Δ p2=0-3.0t/m2, hence assumed to be 1.5t/m2
Newly Applied Overburdened Pressure	Δp=14.0+1.5=15.5 t/m2
Depth of Subsoil for Consolidation	h=10.0m

Expected Amount of Settlement Calculation by using Compression Index

$$S=Cc/(1+eo) \cdot h \cdot \log[(pv+\Delta p)/pv]$$

$$= \frac{0.715}{1+1.934} x 10 x \log\frac{5.8+15.5}{5.8} = 1.38\text{m}$$

Expected Amount of Settlement Calculation by using Coefficient of Volume Compressibility

$$S=mv \cdot h \cdot \Delta p = 0.124x1000x1.55 = 192.2\text{cm} = 1.92\text{m}$$

b) New Grain Berth

Effective earth pressure at present	pv＝1x0.8+4x0.6=3.2t/m2

Newly Applied Earth Pressure	Δp1=16.3x1.0+2.0x1.8=19.9t/m2
Earth Pressure by Surcharge Load	Δp2=0-1.0t/m2, hence assumed to be 0.5t/m2
Newly Applied Overburdened Pressure	Δp=19.9+0.5=20.4 t/m2
Depth of Subsoil for Consolidation	h=5.2m

Expected Amount of Settlement Calculation by using Compression Index

$$S=Cc/(1+eo)\cdot h \cdot \log[(pv+\Delta p)/pv]$$

$$=\frac{0.442}{1+2.062}x5.2x\log\frac{3.2+20.4}{3.2}=0.65m$$

Expected Amount of Settlement Calculation by using Coefficient of Volume Compressibility

$$S=mv \cdot h \cdot \Delta p==0.112x520x2.04=119cm=1.19\mathbf{m}$$

Based on the result of the above estimation on possible consolidation process of existing clayey subsoil, the following measure will be carried out for construction of reclamation fill.

a. In multi-purpose terminal area, the consolidation of clayey deposit is estimated 1.4 to 1.9m height due to newly reclaimed earth pressure and surcharge load. Therefore, soft clayey deposits along the face-line of quay wall will be pre-dredged for replacement of clayey soil by sandy materials so as to receive gravity type quay wall to be placed on the rock base mound. In addition, in order to complete the process of consolidation in shorter construction period, soft clayey deposits within multi-purpose terminal reclamation area will be preloaded by newly applied earth pressure of reclamation fill and additional surcharge. Adopting sand drain soil improvement technique will possibly accelerate consolidation process.
b. Since no onshore facilities is planned to be constructed at the back of new grain berth, this area will not be needed to subject to any subsoil improvement technique. Therefore, pre-dredging along the faceline of berth will be carried out for replacing soft clay subsoil by sandy soil

Chapter 22 Implementation Program

22.1 Construction Works

(1) Construction Materials

The approximate quantities of major materials to be used for the construction works are roughly estimated as follows.

Table 22.1.1 Quantities of Construction Materials

Material \ Project				Multipurpos Berths	Coal & Cok Berth	Grain Berth	New Bridg & Others	TOTAL
1	Sand, Fill Material		m3	4,354,000	1,000	411,000	1,000	4,767,000
2	Stone, Gravel		m3	321,000	3,000	67,000	0	391,000
3	Concrete		m3	223,000	2,000	36,000	1,000	262,000
4	Asphalt Concrete		m3	2,420	0	0	0	2,420
5	Base Coarse, Crusher-run		m3	269,000	1,000	31,000	1,000	302,000
6	Reinforced Steel	Steel ba	ton	4,230	160	131	51	4,572
7	Steel Pipe Pile		ton	429	1,294	0	0	1,723
8	Structural Steel		ton	420	0	0	564	984

1) Soils and Stones

Such soil and stone materials as sands, fill materials, stones, gravel, base coarse and crusher-run will be used for structural foundation and earth works and will be transported by 20 tons (12 m^3 load) dump trucks from the borrow pits to the project sites.

There are many wadi (dry up river) located at around southern west direction on the Sahara desert from the Alexandria Port at a distance of about 40 – 60 km from the site. Since these wadi produce a large amount of natural sands and gravel suitable for the use of aggregates for concrete and asphalt concrete, these will be possible sources of sand and gravel materials for the projects. The natural gravel obtained from these sites will be a better quality of consistency to be used for concrete mixing than crushed stones. The round trip of dump truck for transportation to the project site will take 3 hours and 4 hours for sands and stones respectively.

A considerable large amount of sand materials is required for the projects. Most of the materials will be used in underwater as sand replacement for pre-dredging, sand piles for pre-consolidation of subsoil, refilled sand and reclamation material. These sandy materials will be obtained from borrow pits locating at coastal areas or possible offshore sources. The sandy materials will be transported by self-propelled sand barges of 500 to 1000 cubic meters capacity. Table 22.1.2 shows the estimate of transportation efficiency of sand & stone materials from the sources to the project site.

Table 22.1.2 Construction Equipment and Manpower required for Transportation of Sand and Stone Materials

Description	Unit	Coastal Sands	Onland Sands	Stones
Transport Barge or Dump Truck		500m3 barge	12m3 dump truck	12m3 dump truck
Handling Quantity required	m3	3,072,000	1,695,000	693,000
Times of Round Trip	trip	6,144	141,250	57,750
Cycle Time for round trip	hrs	9	3	4
Working Hours per day	Hrs	18	18	18
Times of transportation per day	Trip	2	6	4.5
Total Days required for transportation	days	3,072	23,542	12,833
Working days in Schedule	days	300 (1 year)	600 (2 years)	450 (1.5 year)
Number of Equipment Required	nr	11 (fleets)	40 (units)	29 (units)
Handling Volume per day	m3	11,000	2,880	1,566
Horse Power / Fuel Consumption	hp/rate	1,000 / 0.224	550 / 0.04	550 / 0.04
Main Fuel Consumption	kl	13,300 (Heavy Oil)	9,500 (Gas oil)	5,170(Gas oil)
Auxiliary Machine at Loading Site		—	Power Shovel	Power Shovel
Number / Fuel Consumption for the above		—	8 units/1,625kl	3 units/765 kl
Auxiliary Machine at Unloading Site		—	Bulldozer (283hp)	Manpower
Number / Fuel Consumption for the above		—	5 units/467 kl	—
Manpower		—	—	—
Skilled Labor	mm	264	1,425	592
Unskilled Labor	mm	528	432	108

2) Steel Products

Most of steel-products for civil and building construction are locally available in Egypt. Steel bars and structural steels will be also locally obtainable in the Egyptian market. But steel pipe piles will be imported from the outside countries due to non-availability in Egypt.

3) Material and Equipment to be imported

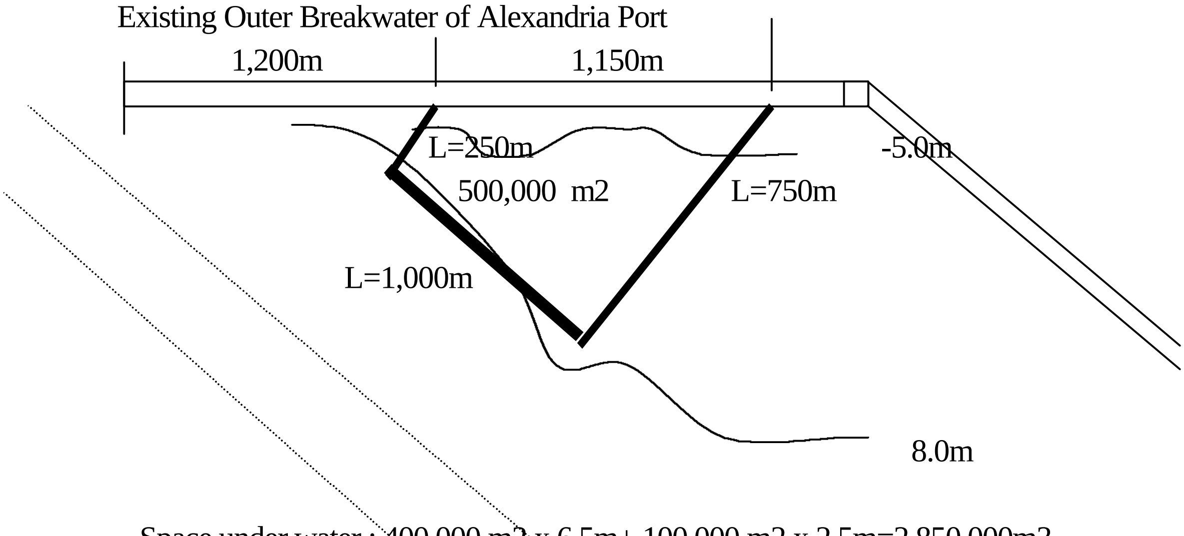
Table 22.1.3 shows the list of materials to be imported from outside countries.

Table 22.1.3 List of Materials to be imported

	Project	Material and Equipment	Unit	Quantity	Remarks
1	Multi-purpose & Coal Berth	Steel Pipe Pile 800～1000mm dia.	ton	1,723	FRP cover
2	All berths	Rubber Fender (H＝1.4m, L=1.5m)	unit	104	
3	All berths	Bollard and Bitt	unit	64	
4	Coal berth	Grating (h=more than 50mm, w=1.5m)	sq.m	405	270mm x 1.5m

(2) Dredging and Pre-dredging Works

The quality survey of the continuous seabed soil from subsurface to 3 meter depth shows that high contaminated level of heavy metals exist at the seabed surface within 1 meter depth. Therefore, a offshore dumping area for disposing dredged materials including the contaminated dredged materials is proposed to constructed at inside of the existing outer breakwater of Alexandria port. Possible location is approximately shown in Figure 22.1.1. The structure of embankment of the offshore dumping area will be the gravity type of concrete blocks placed on stone bedding, of which the typical section is shown in Figure 22.1.2.



Space under water : 400,000 m2 x 6.5m+ 100,000 m2 x 2.5m=2,850,000m3
Space above water (up to +3.0m) : 500,000 m2 x 3 m= 1,500,000m3
Length of Embankment (-8.0m depth) : 1,000m
Length of Embankment (-6.5m depth) : 800m
Length of Embankment (-2.5m depth) : 200m

Figure 22.1.1 Proposed Location of Dumping Area for Dredged Subsoil

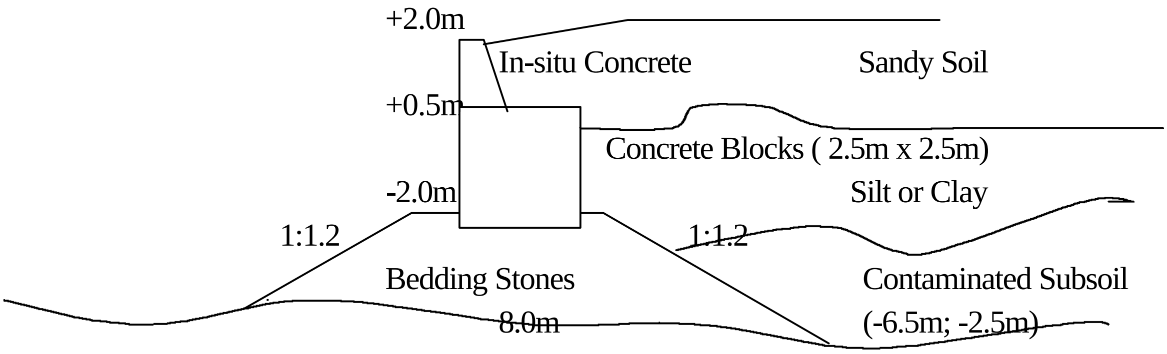


Figure 22.1.2 Section Profile of Embankment for Dumping Area (at –8.0m water depth)

The quantity of subsoil to be dredged from the project is roughly estimated as follows. A water area having 50 hector for dumping the materials will be required in order to dispose the dredged materials of about 2.1 million cubic meters.

Table 22.1.4 Quantity of Dredging required by the Project Unit:m3

Project	Multi-purpose	Coal berth	Grain berth	TOTAL
Dredging of Subsurface Soil	475,000	25,000	75,000	575,000
Pre-dredging at surface soil	75,000	0	28,000	103,000
Total of surface bed soil	550,000	25,000	103,000	678,000
Dredging at the other parts	334,000	45,000	25,000	404,000
Pre-dredging at the other parts	854,000	0	189,000	1,043,000
Total of the other parts	1,188,000	45,000	214,000	1,447,000
Grand Total	1,738,000	70,000	317,000	2,125,000

The distance from the dredging site to the disposed area will be 3 to 5 km and therefore a cutter suction pump dredger of 6,000 to 8,000 hp capacity would be the most recommendable.

Table 22.1.5 Cutter Suction Pump Dredger

Description	6,000 Hp Dredger		8,000 Hp Dredger	
Efficiency of Dredging per hour	Surface Silt or clay Sand	450 m3 930 m3 690 m3	Surface Silt or clay Sand	570 m3 1,190 m3 870 m3
Dredging hours 678,000 m3 724,000 m3 723,000 m3	Surface Silt or clay Sand	1,507 hrs 778 hrs 1,048 hrs	Surface Silt or clay Sand	1,190 hrs 608 hrs 831 hrs
TOTAL hours (400hrs/mon.)	8.3 month	3,333 hrs	6.6 month	2,629 hrs
Consumption of Fuel (Heavy Oil)	0.24l/hp.hr	4,800 kl	0.24l/hp.hr	5,048 kl
Number of Crew	Captain High-class Crew	2 6 38		2 6 42
Discharging Pipe Line 1) Floater Pipe Line 2) Submarine Pipe Line 3) Onshore Pipe Line	710mm dia. 2 lanes	Length 300 m 700 m 3 〜5 km	860mm dia. 2 lanes	Length 300 m 700 m 3 〜5 km
Fleet of Dredger 1) Anchor Barge 2) Flat Barge 3) Transportation Boat	Pump power 5,000 Hp 30 ton-lift self propeller 200 ton 1 fleet 20 passenger 2 fleet		Pump power 8,000 Hp 50 ton-lift self propeller 200 ton 1 fleet 30 passenger 2 fleet	
Machinery on Dumping Site 1) Hydraulic Bulldozer 2) Tire-shovel 3) Payloader	10〜15 ton 2 m3 shovel 3 ton catch-fork		10〜15 ton 2 m3 shovel 3 ton catch-fork	
Evaluation	1) Economic 2) Minimum loss in surface dredging Recommendable		1) Loss of efficiency may be considerable in case surface dredging. Not recommended	

(3) Quay Construction by Concrete Block

Quay walls structures for multi-purpose terminal and grain berth will be constructed by gravity type of concrete blocks. Concrete blocks to be used is estimated to be 90 tons weight in average and 2.67 units per linear meter of berth length. Pre-cast concrete blocks of about 4,200 units will be required to manufacture within 1.5 years (450 working days). Temporary yard space for stacking 100 units of block will be necessary for producing and curing pre-cast concrete blocks. This will be a space equivalent to an area of 2,000 sq. meters. The temporary yard must be located in front of waterfront line of 150 meter in minimum length.

At present, there is not available such yard inside the Alexandria port, adequate survey must be conducted before initiating detailed design and construction. Such existing facilities as jetty, breakwater, fishery boat yard, etc. in the eastern harbor may be alternative site suitable for such temporary yard for the project.

Table 22.1.6 shows construction work scheme of concrete block quaywalls.

Table 22.1.6 Construction Scheme of Concrete Block Quay Walls

Work Item	Description	Quantity of Work
Time Schedule	Construction Period (1.5 years = 450 days)	18 months
Foundation	Rubble Stones 300 m3/day Leveling stone 3 fleets of diver boat	7,500 m3 1,900 m2
Materials of Block	Concrete Temporary Transport for placing	9,400 m3 250 units
Installation of Block	150 t floating crane (self propelled : 1200 hp) 200～300tons flat barge 500 Hp Tug boat Diver boat	2 fleets 3 fleets 1 fleets 1 fleets
Back Filling	Rubble Stones Rough Grading 2 fleets of diver boat	13,500 m3 2,700 m2
Superstructure	In-situ Concrete	1,000 m3
Pavement	Apron Pavement Concrete 750 m3	2,500 m2

22.2 Construction Schedule

(1) Preconditions

Preliminary planning for the implementation of the civil work construction and equipment procurement is carried out under the following assumptions:

1) The financial arrangement for the project will be completed before the year 2001 and a engineering consulting for detailed design and supervision of construction will be procured in middle of 2001.
2) Actual detailed design is to be commenced in early 2002 so that the 1st year in the coming tables or figures may be replaced by the year of 2002.
3) Civil and building works of the projects including dredging works are to be executed under the one package contract.
4) The cargo handling operation at the new berth terminal is assumed to start from the 6th year. Therefore all construction works and installation of equipment are scheduled to complete within the 5th year.

(2) Dredging works

Prior to the commencement of dredging work, embankment at the inner water basin behind the existing breakwater must be constructed so that dredged subsoil could be discharged into the dumping area. Thereafter, permanent construction works will be initiated by dredging works. Construction period for dredging works will be given only 1 year among overall construction period of 3 years.

Work Item	Description	Quantity	1/4	2/4	3/4	4/4
Dredging	Mobilization					
	Discharging Piping Work	1,000m				
	Dredging	2,125,000m3				
Embankment	Stone Bedding Work	118,000m3				
	Concrete Block	11,300m3				
	In-situ Concrete	2,200m3				
Earth Work	Backfilling					
	Leveling					

Fig. 22.2.1 Time Schedule of Dredging Works

(3) Construction Schedule of the Project

The Project will take 5 years after the commencement of the engineering services for detailed design to the completion of construction excluding maintenance period. Overall actual construction works will take 3 years and 1 year for maintenance period.

Figure 22.2.2 shows construction time schedule of the short-term development plan. Each time schedule by project (Multi-purpose terminal, coal & coke berth, new grain berth and other projects) is presented in Figure 22.2.3.

	Works Item			Quantity	1st	2nd	3rd	4th	5th	6th
A	Construction Work									
1	Detailed Design of Civil Works									
2	Tendering and Selection of Contractor									
3	Construction Supervision & Maintenance									
4	Dredging of all projects	dredging	m3	979,000						
5	Pre-dredging including Subsoil	pre-dredging	m3	1,146,000						
	Replacement and Pre-consolidation	replacement	m3	3,009,400						
6	Quaywall Construction	Multi-purpose	l.m	1,650						
	including Revetment Works	Grain Berth	l.m	280						
		Coal and Coke	l.m	270						
7	Reclamation	Multi-purpose	m3	3,431,000						
		Grain Berth	m3	265,000						
8	Building, Pavement, Utilities	Multi-purpose	ls	1						
B	Procurement of Equipment									
9	Detailed Design of Equipment & Training									
10	Tendering and Selection of Supplier									
11	Procurement and Installation of Equipment									
	2-Gantry Cranes	Multi-purpose								
	2-Mechanical Unloaders	Grain Berth								
	2-lanes Grain Conveyor Line	Grain Berth								
	3-units of Truck Scale Instrument	Multi-purpose								
	Vessel Traffic Management System									
	Waste Oil Receiving Facility									

Figure 22.2.2 Construction Time Schedule of the Short Term Development Plan

	Construction Item		year	1st	2nd	3rd	4th	5th	6th
A	CIVIL WORKS	Unit	Quantity						
1	Quay & revetment	Lm	1,300						
2	Reclamation & earth works	m3	3,431,000						
3	Pavement of Yard & Road	m2	179,500						
4	Buildings / gate, truck scale	m2	6,000						
5	Utilities(power, water, lightin	sum	1						
6	Fly-over Bridge	Lm	360						
B	DREDGING	m3	1,738,000						
C	PROCUREMENT								
D	ENGINEERING SERVICES								

Figure 22.2.3(1) Construction Schedule by Project - Multi-purpose Berths -

	Construction Item		year	1st	2nd	3rd	4th	5th	6th
A	CIVIL WORKS	Unit	Quantity						
1	Quay (Pile Foundation)	Lm	4,967						
2	Slope Protection	m3	3,100						
3	Super Structure	Lm	270						
4	Accessories	set	11						
B	DREDGING	m3	70,000						
C	ENGINEERING SERVICES								

Figure 22.2.3(2) Construction Schedule by Project - Coal Berth -

	Construction Item		year	1st	2nd	3rd	4th	5th	6th
A	CIVIL WORKS	Unit	Quantity						
1	Quay & revetment	Lm	280						
2	Crane foundation	Lm	250						
3	Reclamation / backfill	m3	397,000						
4	Utilities(power,water,lighting	m2	22,000						
B	DREDGING	m3							
C	PROCUREMENT								
D	ENGINEERING SERVICES								

Figure 22.2.3(3) Construction Schedule by Project - Grain Berth -

	Construction Item		year	1st	2nd	3rd	4th	5th	6th
	Aged Bridge Replacement								
	Installation of Vessel Traffic Management System								
	Installation of Waste Oil Receiving Facility								

Figure 22.2.3(4) Construction Schedule of Other Projects

Chapter 23 Cost Estimation of the Project

23.1 Major Facilities of the Project

Table 23.1.1 summarizes major facilities involved in each project for the short term development plan. In addition, Table 23.1.2 shows equipment to be procured through the project

Table 23.1.1 Major Facilities of the Project

Project: Facility Item	Location	Construction Item	
To be Improved		Construction Facility	Quantity
1. Multi-purpose Berth	Around coal		
New Berth	Quay No.55-61	3 Berths for Conventional Ships	720 l.m
		1 Berth of Heavy Cargo	400 l.m
		Rubber Fender (h=1.4m,L=1.5m)	75 units
		70 tf bollard	39 units
		100 tf bitt	6 units
		Revetment	280 l.m
		Temporary Revetment	350 l.m
		Crane Foundation	700 l.m
Land Reclamation		Filling Sand with Pre-consolidation	17.5 ha
Yard Area		Open Storage & Concrete Pavement yard	7.8 ha
		AsphaltConcrete Pavement Yard	8 ha
		Transit Shed	6,000 sq.m
Road Area		Road Pavement	22,000 sq.m
		Gate House with Truck Scale	1,200 sq.m
New Fly-over Bridge		Fly-over PC Bridge (2 lanes)	360 l.m
2. Deep Water Coal Berth	Behind of		
Front Extension of Berth	Military quay	1 Berth for Coal & Coke Ships	270 l.m
		Rubber Fender (h=1.4m,L=1.5m)	18 units
		70 tf bollard	9 units
		100 tf bitt	2 units
3.New Port Bridge			
Steel Truss Superstructure		91 m x 17.35 m; 545 tons	1 unit
Abutment		RC base concrete 20x4x6.3h	2 units
Road & Walkway		W=15.85m; 2.10x2 lane	91 L.m
4.New Grain Terminal	Mina Qamariya		
New Berth		-14.0 m grain berth	270 l.m
		Rubber Fender (h=1.4m ,L=1.5m)	18 units
		70 tf bollard	9 units
		100 tf bitt	2 units
		Revetment	10 l.m
		Crane Foundation	250 l.m
Land reclamation		Back-of-berth yard	2.2 ha

Table 23.1.2 Equipment procured through the Project

Name of Equipment	Specification of Equipment	Procured Number	Detailed description
Gantry Crane	Panamax type Crane Rail Span=25 m	2 units	Multi-purpose berth 2 or more necessary In future
Mechanical Unloader	Capacity 700 tons/hour Crane rail span = 12 m	2 units	Grain berth
Quay Conveyor	Capacity 800t/hr lane 2 lanes with dust cover	750 l.m	Grain berth: 2 angle towers to existing grain silo
Truck Scale	4 units for container 2 units for heavy cargo	6 units	Multi-purpose berth Set up at gate-house

23.2 Cost Estimation

The cost of the construction and equipment procurement for the short-term development plan is estimated based on the following considerations:

A) Quantities of main civil works are based on the preliminary designs of facilities. In estimating construction costs, the physical contingency of 10% for civil works and 3% for equipment procurement are included in the cost estimates by this study.

B) Unit rates of the onshore works collected during the site surveys are adopted in the cost estimate. Unit rates of the offshore works such as beams and slab concrete of the pier are obtained by multiplying those of onshore concrete works by certain factors.

C) Unit prices of equipment are based on the currently prevailing costs by potential suppliers

D) In costing construction costs, engineering service cost for the detailed design, assistance in construction tendering and construction supervision amounting of 10% for civil works and 3% for procurement are included in the cost estimates by this study.

E) The exchange rate of 1.0 US$ against to 3.4 L.E. and 136 Japanese Yen as of May, 1998 is adopted.

Total project cost for short-term development plan is estimated to be about 596 million Egyptian Pound (L.E.). The foreign currency portion is about 242 million L.E. (71 million US$) which is equivalent to 41% for the total cost of the project. Total project cost and each project cost are presented in Table 23.2.1 to 23.2.7. The breakdown costs of major facilities are shown in Table 23.2.8. The quay wall construction costs by structural alternatives are shown in Table 23.2.9, which are used for comparison of structures in Chapter 21.

In addition, annual fund requirement for construction and equipment procurement is prepared based on study results of construction cost estimate and implementation program as presented in Figure 23.2.1.

Table 23.2.1 Total Project Cost for Short Term Development Plan

Unit : L.E. (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
A	Civil Works							
1	Multi-purpose Berth	4berths	sum	1		303,538,515	28%	85,171,500
2	Coal & Coke Berth	1berth	sum	1		17,804,663	67%	11,987,989
3	Grain Berth	1berth	sum	1		36,564,850	21%	7,717,173
4	Aged Bridge Replacement		sum	1		8,044,540	33%	2,084,883
	TOTAL of Civil Works					365,952,568	29%	106,961,545
B	Dredging							
1	Multi-purpose Berth	4berths	sum	1		37,510,000	59%	22,132,000
2	Coal & Coke Berth	1berth	sum	1		1,525,000	69%	880,000
3	Grain Berth	1berth	sum	1		6,855,000	59%	4,026,000
	TOTAL of Dredging					45,890,000	59%	27,038,000
C	Procurement							
1	Multi-purpose Berth	4berths	sum	1		30,000,000	83%	24,900,000
3	Grain Berth	1berth	sum	1		62,500,000	85%	53,125,000
5	Installation of VTMS		sum	1		2,700,000	90%	2,430,000
6	Waste Oil Receiving Facility		sum	1		1,000,000	90%	900,000
	TOTAL of Procurement					96,200,000	85%	81,355,000
D	Engineering services							
	Civil Works & Dredging		%	10%	411,842,568	41,184,257	30%	12,355,277
	Procurement		%	3%	96,200,000	2,886,000	30%	865,800
	TOTAL of Engineering services					44,070,257	30%	13,221,077
E	Physical contingency							
	Civil Works & Dredging		%	10%	411,842,568	41,184,257	30%	12,355,277
	Procurement		%	3%	96,200,000	2,886,000	30%	865,800
	TOTAL of Physical contingency					44,070,257	30%	13,221,077
	GRAND TOTAL					596,183,082	41%	241,796,699

Table 23.2.2 Project Cost of Multi-purpose Berth

Unit : L.E. (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
A	Civil Works							
1	Quaywalls		Lm	1,020	85,186	86,889,720	23%	19,984,636
2	Crane foundation		Lm	700	18,836	13,185,200	50%	6,592,600
3	Revetment		Lm	280	74,364	20,821,920	14%	2,915,069
4	Temporary revetment		Lm	350	4,626	1,619,100	14%	226,674
5	Reclamation		m3	3,431,000	23	78,913,000	15%	11,836,950
6	Replace & backfill	sand	m3	463,000	38	17,594,000	10%	1,759,400
7	Pavement of yard		m2	157,500	116	18,270,000	13%	2,375,100
8	Road pavement	As-con	m2	22,000	82	1,804,000	7%	126,280
9	Transit shed		m2	6,000	400	2,400,000	10%	240,000
10	Gate & truck scale	20x20/unit	unit	3	1,167,825	3,503,475	23%	805,799
11	Sand drain consolidation	L=12.5m	m3	2,414,400	19	45,873,600	75%	34,405,200
12	Power & Lighting	17.5Ha	Ha	17.5	232,800	4,074,000	43%	1,751,820
13	Utilities		Ha	25.2	3,450	86,940	30%	26,082
14	Fly-over bridge		Lm	360	23,621	8,503,560	25%	2,125,890
	(SUB TOTAL)					303,538,515	28%	85,171,500
B	Dredging							
1	Dredging; of surface soil		m3	475,000	25	11,875,000	40%	4,750,000
2	Dredging;		m3	334,000	20	6,680,000	70%	4,676,000
3	Pre-dredging; of surface soil		m3	75,000	25	1,875,000	40%	750,000
4	Pre-dredging;		m3	854,000	20	17,080,000	70%	11,956,000
	(Sub Total)					37,510,000	59%	22,132,000
C	Procurement							
1	Gantry Crane	Panamax	unit	2	12,000,000	24,000,000	85%	20,400,000
2	Scale units		nos.	6	1,000,000	6,000,000	75%	4,500,000
3	(Sub Total)					30,000,000	83%	24,900,000
D	Engineering service							
1	Civil works & Dredging		%	10%	341,048,515	34,104,852	30%	10,231,455
2	Procurement		%	3%	30,000,000	900,000	30%	270,000
3	(Sub Total)					35,004,852	30%	10,501,455
E	Physical Contingency							
1	Contingency		%	10%	341,048,515	34,104,852	30%	10,231,455
2	Contingency		%	3%	30,000,000	900,000	30%	270,000
3	(Sub Total)					35,004,852	30%	10,501,455
	GRAND TOTAL					441,058,218	35%	153,206,411

Table 23.2.3 Project Cost of Deep Water Coal Berth

Unit : L.E. (Egyptian Pound)

No.	Item	Spec	Unit	Quantities	Prices	Amount	F/c %	F/c Portion
A	CIVIL WORKS							
1	Steel pipe pile t=12mm	D=800-1000	ton	1,294	4,800	6,211,200	90%	5,590,080
2	Piling of SPP		m	4,697	462	2,170,014	61%	1,323,709
3	Concrete lining		m2	997	1,344	1,339,968	90%	1,205,971
4	Rubble stone		m3	3,100	66	204,600	0%	0
5	Leveling of stone		m2	1,890	132	249,480	10%	24,948
6	Beam concrete		m3	825	898	740,850	15%	111,128
7	Deck slab		m2	2,430	397	964,710	14%	135,059
8	Stage work		m2	3,000	268	804,000	27%	217,080
9	Supporting	jack base	m2	2,430	300	729,000	27%	196,830
10	Grating		m2	405	600	243,000	80%	194,400
11	Fender		nos.	19	120,000	2,280,000	90%	2,052,000
12	Bollard		nos.	11	50,000	550,000	80%	440,000
13	miscellaneous		sum	1		1,317,841	10%	496,784
14	(SUB TOTAL)					17,804,663	67%	11,987,989
B	Dredging							
1	Dredging		m3	45,000	20	900,000	70%	630,000
2	Dredging of surface soil		m3	25,000	25	625,000	40%	250,000
	(Sub Total)					1,525,000	69%	880,000
C	Engineering services							
1	Civil works & Dredging		%	10%	19,329,663	1,932,966	30%	579,890
2	(Sub Total)					1,932,966	30%	579,890
D	Physical Contingency							
1	Contingency		%	10%	19,329,663	1,932,966	30%	579,890
2	(Sub Total)					1,932,966	30%	579,890
	GRAND TOTAL					23,195,596	60%	14,027,769

Table 23.2.4 Project Cost of Grain Berth

Unit : LE

No.	Item	Spec	Unit	Quantities	Prices	Amount	F/c %	F/c Portion
A	Civil Works							
1	Quaywalls		Lm	270	85,086	22,973,220	23%	5,283,841
2	Crane foundation		Lm	250	5,082	1,270,500	50%	635,250
3	Revetment		Lm	10	74,254	742,540	14%	103,956
4	Reclamation		m3	265,000	23	6,095,000	15%	914,250
5	Replace & backfill	sand	m3	132,000	38	5,016,000	10%	501,600
6	Power supply		sum	1	460,000	460,000	60%	276,000
7	Utilities		Ha	2.2	3,450	7,590	30%	2,277
8	(Sub Total)		Lm	280		36,564,850	21%	7,717,173
B	Dredging							
1	Dredging		m3	25,000	20	500,000	70%	350,000
2	Dredging of surface soil		m3	75,000	25	1,875,000	40%	750,000
3	Pre-dredging		m3	189,000	20	3,780,000	70%	2,646,000
4	Pre-dredging of surface soil		m3	28,000	25	700,000	40%	280,000
	(Sub Total)					6,855,000	59%	4,026,000
C	Procurement							
1	Mechanical Unloader	700t/hrs	unit	2	20,000,000	40,000,000	85%	34,000,000
2	Quay conveyor	800t/hrX2	lm	750	30,000	22,500,000	85%	19,125,000
	(Sub Total)					62,500,000	85%	53,125,000
D	Engineering Services							
1	Engineering service		%	10%	43,419,850	4,341,985	30%	1,302,596
2	Engineering service		%	3%	62,500,000	1,875,000	30%	562,500
3	(Sub Total)					6,216,985	30%	1,865,096
E	Physical Contingency							
1	Contingency		%	10%	43,419,850	4,341,985	30%	1,302,596
2	Contingency		%	3%	62,500,000	1,875,000	30%	562,500
3	(Sub Total)					6,216,985	30%	1,865,096
	GRAND TOTAL		Lm	270	438,347	118,353,820	58%	68,598,364

Table 23.2.5 Project Cost of New Port Road Bridge

Unit : L.E. (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
A	CIVIL WORKS							
1	Truss unit	Steel	tons	545	12,000	6,540,000	30%	1,962,000
2	Water diversion work	25x8m,h=7m	lot	2	287,320	574,640	2%	11,493
3	RC base concrete	concrete	m3	360	1,330	478,800	10%	47,880
4	Abutment	concrete	m3	270	1,330	359,100	10%	35,910
5	Pavement		m	92	1000	92,000	30%	27,600
6	(Sub Total)					8,044,540	33%	2,084,883
B	Engineering services		%	10%	8,044,540	804,454	30%	241,336
C	Physical Contingency		%	10%	8,044,540	804,454	30%	241,336
	GRAND TOTAL					9,653,448	27%	2,567,555

Table 23.2.6 Project Cost of the Installation of Vessel Traffic Management System

Unit : L.E. (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
A	Procurement							
1	Equipment of VTMS		sum	1	2,700,000	2,700,000	90%	2,430,000
2	(Sub Total)					2,700,000	90%	2,430,000
B	Engineering services		%	3%	2,700,000	81,000	30%	24,300
C	Physical Contingency		%	3%	2,700,000	81,000	30%	24,300
	GRAND TOTAL					2,862,000	87%	2,478,600

Table 23.2.7 Project Cost of the Installation of Waste Oil Receiving Facility

Unit : L.E. (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
A	Procurement							
1	Equipment		sum	1	1,000,000	1,000,000	90%	900,000
2	(Sub Total)					1,000,000	90%	900,000
B	Engineering services		%	3%	1,000,000	30,000	30%	9,000
C	Physical Contingency		%	3%	1,000,000	30,000	30%	9,000
	GRAND TOTAL					1,060,000	87%	918,000

Table 23.2.8 Cost Estimation of the Project Major Facility

Table 23.2.8 (1) Quaywall of the Multi-purpose Berths

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount	F/C	F/C amount
	Quay wall (Concrete block type)		Lm	1				
1	Rubble mound		m3	80	55	4,400	0%	0
2	Armor stone		m3	5	55	275	0%	0
3	Leveling of rubble stone		m2	11	110	1,210	10%	121
4	Rough leveling & grading		m2	10	55	550	10%	55
5	Block concrete		m3	106.5	328	34,932	15%	5240
9	Transport & place blocks	pre-loading	unit	2.67	2,526	6,744	20%	1349
10	Install blocks		unit	2.67	3,328	8,886	20%	1777
11	Joint sealing	Rubber pad	Lm	10	131	1,310	63%	825
12	Rubble backing	0-50kg	m3	153.5	40	6,140	0%	0
13	Rough grading of rubble		m2	30	55	1,650	10%	165
14	Fabric filter sheet		m2	45	10	450	20%	90
15	In-situ concrete		m3	10.6	328	3,477	15%	522
18	Rubber fender		unit	0.06	120,000	7,200	90%	6480
19	Bollard , bitt		unit	0.04	50,000	2,000	80%	1600
20	Crane rail	single	Lm	1.37	600	822	50%	411
21	Apron pavement		m2	24.5	174	4,263	15%	639
22	Miscellaneous		sum	1		877	63%	551
23	TOTAL		Lm	1		85,186	23%	19,825

Table 23.2.8 (2) Revetment of the Multi-purpose Berths

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount	F/C	F/C amount
	Table 23.2.8(1) Total		Lm	1		85,186	23%	19,825
	Reduce 18 to 20, and a part of 22		sum	1		-10,822	85%	-9,211
	TOTAL		LM	280	266	74,364	14%	10,614

Table 23.2.8 (3) Crane Foundation of the Multi-purpose Berths

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount	F/C	F/C amount
	Crane Foundation		Lm	250				
1	Steel pipe pile	800-1000mm	tons	429	4,000	1,716,000	90%	1,544,400
2	Pile driving		Lm	1,428	1,623	2,317,644	16%	370,823
3	concrete	steel	m3	506	1,200	607,200	71%	431,112
4	Gravel & lean concrete		m3	200	66	13,200	10%	1,320
5	Excavation		m3	1,000	30	30,000	0%	0
6	RC beam		Lm	250	100	25,000	10%	2,500
7	TOTAL		Lm	250	18,836	4,709,044	50%	2,350,155

Table 23.2.8 (4) Fly-Over Bridge at the entrance of the Multi-purpose Berths

Unit: LE (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
1	Site preparation		sum	1	91,011	91,011	7%	6,111
2	Foundation piles	D-1000,L=22	sum	1	3,515,550	3,515,550	20%	718,265
3	Abutment concrete		unit	25	54,466	1,361,658	18%	240,677
4	PC slab / beam	L=15m	unit	24	147,304	3,535,284	34%	1,197,901
5	TOTAL		Lm	360	23,621	8,503,503	25%	2,162,954

Table 23.2.8 (5) Consolidation by Sand Drain of the Multi-purpose Berths

Unit: LE (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
1	Sand drain pontoon	12 stroke	hrs	7	13,800	96,600	95%	91,770
2	Casing pipe	L=30m	nos.	12	250	3,000	95%	2,850
3	Pusher barge	650m2x2fleet	day	2	3,200	6,400	20%	1,280
4	Tug boat (pusher)	600ps	hrs	6	410	2,460	20%	492
5	Anchor barge	30t/lift	day	1	12,000	12,000	95%	11,400
6	Marine diesel oil	6000x0.25x7	KL	10.5	400	4,200	0%	0
7	Captain/high crew		men	4	1,200	4,800	70%	3,360
8	Seaman /skill labor		men	8	80	640	0%	0
9	Seaman (normal)		men	16	60	960	0%	0
10	Miscellaneous		%	10%	131,060	13,106	70%	9,174
11	Penetrate material/tools		m	4,320	2	8,640	50%	4,320
12	Sand D=400	0.125m2	m3	650	20	13,000	0%	0
13	TOTAL	consolidation	m3	8,640	19	165,806	75%	124,646

Table 23.2.8 (6) Crane Foundation of the Grain Berth

Unit: LE (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
	Crane Foundation		Lm	250				
1	Crane rail	single	Lm	500	600	300,000	90%	270,000
2	Beam concrete	steel bar110kg	m3	250	1,200	300,000	16%	48,000
3	Concrete	foundation	m3	375	1,200	450,000	71%	319,500
4	Gravel & lean concrete		m3	500	66	33,000	10%	3,300
5	Excavation		m3	6,250	30	187,500	0%	0
6	TOTAL		Lm	250	5,082	1,270,500	50%	640,800

Table 23.2.8 (7) Water Diversion Works of the New Port Road Bridge

Unit: LE (Egyptian Pound)

No.	Item	Spec	Unit	Quantity	Prices	Amount	F/c %	F/c Portion
	Water diversion		lot	1				
1	Sheet pile rental	66m ; L=7m	ton	70	500	35,000	0%	0
2	Supporting/rigging of wall		m2	462	200	92,400	0%	0
3	Excavation		m3	2,000	30	60,000	0%	0
4	Water pump	generator	set	2	11,000	22,000	10%	2,200
5	Manpower		men	5	800	4,000	0%	0
6	Piling/demolish/cleaning	8000/250m/day	Lm	2,310	32	73,920	5%	3,696
7			Lot	1		287,320	2%	11,792

Table 23.2.9 Cost of Alternative Structural Types of Quaywall

Table 23.2.9 (1). Multi-Purpose Berth

1) Alternative-A Gravity Type of Concrete Block

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Pre-Dredging	Below -14.0m	m3	566	20	11,320
2	Replaced sand		m3	262	38	9,956
3	Refilled sand		m3	108	38	4,104
4	Rubble mound	stone	m3	80	55	4,400
5	Armor stone		m3	5	55	275
6	Leveling of rubble mound		m2	11	110	1,210
7	Rough leveling of armor stone		m2	10	55	550
8	Precast concrete block	concrete	m3	107	326	34,719
9	Rough installation of blocks	preloading	unit	3	2,526	6,744
10	Installation of blocks		unit	3	3,328	8,886
11	Joint sealing		Lm	10	131	1,310
12	Rubble backing	stone	m3	154	40	6,140
13	Rough grading of rubble stones		m2	30	55	1,650
14	Fabric filter sheet		m2	45	10	450
15	Insitu-concrete		m3	11	325	3,445
16	Rubber fender		unit	0.067	120,000	8,000
17	Bollard , bitt		unit	0.04	50,000	2,000
18	Crane rail & the foundation		Lm	1	19,436	19,436
19	Apron pavement		m2	25	174	4,263
20	TOTAL		Lm	1		128,858

2) Alternative-B Gravity Type of Concrete Caisson

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Pre-Dredging	Below -14.0m	m3	566	20	11,320
2	Replaced sand		m3	262	38	9,956
3	Refilled sand		m3	108	38	4,104
4	Rubble mound	stone	m3	94	55	5,170
5	Armor stone		m3	5	55	275
6	Leveling of rubble mound		m2	13	110	1,430
7	Rough leveling of armor stone		m2	10	55	550
8	Fabrication of caisson	concrete	m3	41	902	36,982
9	Caisson fabrication yard	floating pontoon	day	2	13,600	27,200
10	Sandfill		m3	134	33	4,422
11	Cover concrete		m3	5.60	290	1,624
12	Installation of caisson		unit	0.10	5,350	535
13	Joint sealing		Lm	1.50	131	197
14	Rubble backing	stone	m3	142	40	5,680
15	Rough grading of rubble stones		m2	30	55	1,650
16	Fabric filter sheet		m2	45	10	450
17	Insitu-concrete		m3	11	325	3,445
18	Rubber fender		unit	0.067	120,000	8,000
19	Bollard , bitt		unit	0.04	50,000	2,000
20	Crane rail & the foundation		Lm	1	19,436	19,436
21	Apron pavement		m2	25	174	4,263
22	TOTAL		Lm	1		148,689

3) Alternative-C Open Piled Pier Type

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Pre-Dredging	below -14.0m	m3	886	20	17,720
2	Replaced sand	below -15.0m	m3	767	38	29,146
3	Rubble mound		m3	372	55	20,460
4	Armor stone		m3	14	55	770
5	Leveling of rubble mound		m2	14	110	1,540
6	Rough leveling of armor stone		m2	38	55	2,090
7	Steel Pipe Pile	D=800-1000	ton	11.40	4,800	54,720
8	Piling works		Lm	38.40	462	17,741
9	Concrete lining		m2	9	1,344	12,096
10	Beam concrete		m3	17	898	15,266
11	Deck slab		m2	30	1,028	30,840
12	Crane rail	2 lane on deck	m	2	600	1,200
13	Rubber fender		unit	0.067	120,000	8,000
14	Bollard , bitt		unit	0.04	50,000	2,000
15	Block & In-situ concrete		m3	13.25	328	4,346
16	Installation of concrete block		ton	28	64	1,792
17	TOTAL		Lm	1		219,727

Table 23.2.9 (2). Deep Water Coal Berth

1) Alternative C : Open Piled Pier Type

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Slope protection rubble stone		m3	12	66	759
2	Leveling of rubble stone	leveling & grading	m2	7	132	924
3	Steel Pipe Pile	D=800-1000	ton	4.80	4,800	23,040
4	Piling works		Lm	17.40	462	8,039
5	Concrete lining		m2	3.70	1,344	4,973
6	Beam concrete		m3	3.06	898	2,748
7	Deck slab		m2	9	1,028	9,252
8	Grating		m2	1.50	600	900
9	Rubber fender		unit	0.07	120,000	8,400
10	Bollard , bitt		unit	0.04	50,000	2,000
17	TOTAL		Lm	1		61,034

2) Alternative - A Dolphin Type

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Slope protection rubble stone		m3	13	66	858
2	Leveling of rubble stone	leveling & grading	m2	22	132	2,904
3	Steel Pipe Pile	D=800-1000	ton	6.00	4,800	28,800
4	Piling works		Lm	14.22	462	6,570
5	Concrete lining		m2	2.35	1,344	3,158
6	Deck concrete		m3	7.08	898	6,358
7	Deck works		m2	3.54	1,028	3,639
8	Rubber fender		unit	0.074	120,000	8,880
9	Bollard		unit	0.074	50,000	3,700
10	TOTAL		Lm	1		64,867

3) Alternative - B Open Type with Sheet Pile Wall

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Steel Sheet Pile	SPII	ton	0.672	3,250	2,184
2	Piling works of steel sheet pile		Lm	14	185	2,590
3	Steel Pipe Pile	D=700-1000	ton	6.15	4,800	29,520
4	Piling works of steel pipe pile		Lm	19.20	462	8,870
5	Concrete lining		m2	4.25	1,344	5,712
6	Beam concrete		m3	6.11	898	5,487
7	Slab concrete		m2	10.50	1,028	10,794
8	Grating		m2	1.00	600	600
9	Rubber fender		unit	0.07	120,000	8,400
10	Bollard		unit	0.04	50,000	2,000
17	TOTAL		Lm	1		76,157

Table 23.2.9 (3). Grain Berth

1) Alternative - A Gravity Type of Concrete Block

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Pre-Dredging	Below -14.0m	m3	610	20	12,200
2	Replaced sand		m3	294	38	11,172
3	Refilled sand		m3	116	38	4,408
4	Rubble mound	stone	m3	94	55	5,170
5	Armor stone		m3	6	55	330
6	Leveling of rubble mound		m2	11	110	1,210
7	Rough leveling of armor stone		m2	10	55	550
8	Precast concrete block	concrete	m3	107	326	34,719
9	Rough installation of blocks	preloading	unit	3	2,526	6,744
10	Installation of blocks		unit	3	3,328	8,886
11	Joint sealing		Lm	10	131	1,310
12	Rubble backing	stone	m3	154	40	6,140
13	Rough grading of rubble stones		m2	30	55	1,650
14	Fabric filter sheet		m2	45	10	450
15	Insitu-concrete		m3	11	325	3,445
16	Rubber fender		unit	0.067	120,000	8,000
17	Bollard , bitt		unit	0.04	50,000	2,000
18	Crane rail & the foundation		Lm	1	5,682	5,682
19	Apron pavement		m2	15	174	2,610
20	TOTAL		Lm	1		116,676

2) Alternative-B Gravity Type of Concrete Caisson

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Pre-Dredging	Below -14.0m	m3	610	20	12,200
2	Replaced sand		m3	294	38	11,172
3	Refilled sand		m3	116	38	4,408
4	Rubble mound	stone	m3	94	55	5,170
5	Armor stone		m3	6	55	330
6	Leveling of rubble mound		m2	24.0	55	1,320
7	Rough leveling of armor stone		m2	14	55	770
8	Fabrication of caisson	concrete	m3	40	902	36,080
9	Caisson fabrication yard	floating pontoon	day	2	13,600	27,200
10	Sandfill		m3	128	33	4,224
11	Cover concrete		m3	5.40	290	1,566
12	Installation of caisson		unit	0.10	5,350	535
13	Joint sealing		Lm	1.50	131	197
14	Rubble backing	stone	m3	230	40	9,200
15	Rough grading of rubble stones		m2	30	55	1,650
16	Fabric filter sheet		m2	45	10	450
17	Insitu-concrete		m3	11	325	3,445
18	Rubber fender		unit	0.067	120,000	8,000
19	Bollard , bitt		unit	0.04	50,000	2,000
20	Crane rail & the foundation		Lm	1	19,436	19,436
21	Apron pavement		m2	25	174	4,263
22	TOTAL		Lm	1		153,616

3) Alternative-C Open Piled Pier Type

Unit : L.E. (Egyptian Pound)

	ITEM	SPEC	Unit	Quantity	Unit Price	Amount
1	Pre-Dredging	below -14.0m	m3	886	20	17,720
2	Replaced sand	below -15.0m	m3	767	38	29,146
3	Rubble mound		m3	261	55	14,355
4	Armor stone		m3	30	55	1,650
5	Leveling of rubble mound		m2	6	110	660
6	Rough leveling of armor stone		m2	40	55	2,200
7	Steel Pipe Pile	D=800-t=12mm	ton	7.60	4,800	36,480
8	Piling works		Lm	31.60	462	14,599
9	Concrete lining		m2	6.30	1,344	8,467
10	Beam concrete		m3	12	898	10,776
11	Deck slab		m2	20	1,028	20,560
12	Crane rail	2 lane on deck	m	2	600	1,200
13	Rubber fender		unit	0.067	120,000	8,000
14	Bollard , bitt		unit	0.04	50,000	2,000
15	Block & In-situ concrete		m3	23.04	328	7,557
16	Installation of concrete block		ton	50	64	3,200
17	TOTAL		Lm	1		178,571

		Unit : L.E. (Egyptian Pound)			1st year		2nd year		3rd year		4th year		5th year		6th year	
No.	Item	Amount	F/c	F/c Portion	Total	F/C	Total	F/C	Total	F/C	Total	F/C	Total	F/C	Total	F/C
A	Civil Works		%													
1	Multi-purpose Berth	303,538,515	28%	85,171,500					65,230,882	18,516,004	139,302,658	39,966,259	99,004,955	26,689,237		
2	Coal & Coke Berth	17,804,663	67%	11,987,989							6,797,727	4,407,399	1,006,936	7,580,597		
3	Grain Berth	36,564,850	21%	7,717,173							12,493,130	3,011,524	24,071,720	4,705,651		
4	Aged Bridge Replacement	8,044,540	33%	2,084,883									8,044,540	2,084,883		
	TOTAL of Civil Works	365,952,568	29%	106,961,545					65,230,882	18,516,004	158,593,515	47,385,182	132,128,151	41,060,368		
B	Dredging															
1	Multi-purpose Berth	37,510,000	59%	22,132,000					37,510,000	22,132,000						
2	Coal & Coke Berth	1,525,000	69%	880,000					1,525,000	880,000						
3	Grain Berth	6,855,000	59%	4,026,000					6,855,000	4,026,000						
	TOTAL of Dredging	45,890,000	59%	27,038,000					45,890,000	27,038,000						
C	Procurement															
1	Multi-purpose Berth	30,000,000	83%	24,900,000							9,000,000	7,470,000	18,000,000	14,940,000	3,000,000	2,490,000
3	Grain Berth	62,500,000	85%	53,125,000							18,750,000	15,937,500	37,500,000	31,875,000	6,250,000	5,312,500
5	Installation of VTMS	2,700,000	90%	2,430,000									2,700,000	2,430,000		
6	Waste Oil Receiving Facility	1,000,000	90%	900,000									1,000,000	900,000		
	TOTAL of Procurement	96,200,000	85%	81,355,000							27,750,000	23,407,500	59,200,000	50,145,000	9,250,000	7,802,500
D	Engineering services															
	Civil Works, exclude A-4	35,790,803	30%	10,770,089	16,105,861	4,846,540	1,789,540	538,504	5,368,620	1,615,513	5,368,620	1,615,513	5,368,620	1,615,513	1,789,540	538,504
	Ditto, A-4	804,454	30%	208,488									804,454	208,488		
	Dredging	4,589,000	30%	1,376,700					4,589,000	1,376,700						
	Procurement	2,886,000	30%	865,800							865,800	259,740	1,731,600	519,480	288,600	86,580
	TOTAL of D	44,070,257	30%	13,221,077	16,105,861	4,846,540	1,789,540	538,504	9,957,620	2,992,213	6,234,420	1,875,253	7,904,674	2,343,481	2,078,140	625,084
E	Physical contingency															
	Civil Works, exclude A-4	35,790,803	30%	10,770,089	16,105,861	4,846,540	1,789,540	538,504	5,368,620	1,615,513	5,368,620	1,615,513	5,368,620	1,615,513	1,789,540	538,504
	Ditto, A-4	804,454	30%	208,488									804,454	208,488		
	Dredging	4,589,000	30%	1,376,700					4,589,000	1,376,700						
	Procurement	2,886,000	30%	865,800							865,800	259,740	1,731,600	519,480	288,600	86,580
	TOTAL of E	44,070,257	30%	13,221,077	16,105,861	4,846,540	1,789,540	538,504	9,957,620	2,992,213	6,234,420	1,875,253	7,904,674	2,343,481	2,078,140	625,084
	GRAND TOTAL	596,183,082	41%	241,796,699	32,211,723	9,693,080	3,579,080	1,077,009	131,036,123	51,538,431	198,812,356	74,543,189	207,137,500	95,892,331	13,406,280	9,052,669
					5%		1%		22%		33%		35%		2%	

Figure 23.2.1 Annual Fund Requirement for Construction and Equipment Procurement

Chapter 24 Economic Analysis

24.1 Purpose and Methodology of Economic Analysis

(1) Purpose

The purpose of the economic analysis is to appraise the economic feasibility of the Short-term Development Plan for the Greater Alexandria Port in the target year (2007) from the viewpoint of the national economy. The economic analysis is conducted to study the economic benefits as well as the economic costs arising from this project, and to evaluate whether the benefits of the project exceed those that could be obtained from other investment opportunities in Egypt.

(2) Methodology

Economic analysis will be carried out according to the following method. The short-term Development Plan will be defined and it will be compared to the “Without the project” case (hereinafter referred to as the “Without” case). All benefits and costs in market price of the difference between “With the project” case (hereinafter referred to as the “With” case) and “Without” case will be calculated and it will be converted to economic price. All benefits and costs are evaluated using economic prices.

In this study, the economic internal rate of return (EIRR) and the benefit/cost ratio (B/C ratio) based on a cost-benefit analysis are 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. The benefit/cost ratio is obtained by dividing the benefits by costs based on the present value. The procedure used for this economic analysis is shown in Figure 24.1.1.

24.2 Prerequisites for Economic Analysis

(1) Base Year

The “Base Year” here means the standard year in the estimation of costs and benefits. In this study, 1998 is set as the “Base Year”.

The target year of the Short-term Development Plan is 2007 and starting year (Year No.1) is assumed 5 years prior to the target year (Year No.6) considering the period of construction.

(2) Project Life

The period of calculation (project life) in the economic analysis is assumed to be 30 years from the starting year, taking into consideration the depreciation period of the main facilities.

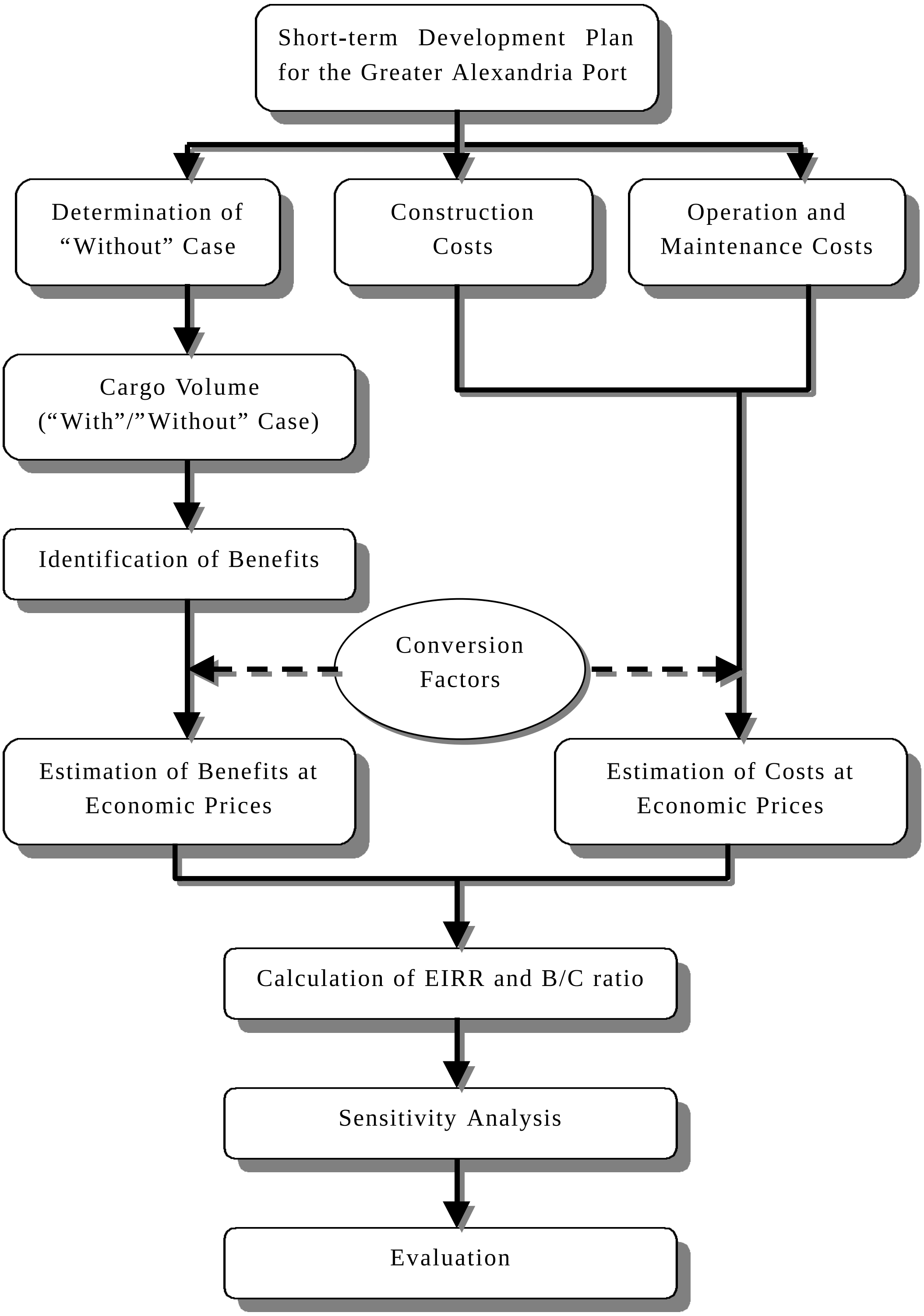


Figure 24.1.1 Procedure of Economic Analysis

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = LE 3.40 = ¥ 136.00 (as of May 1998), the same rate as used in the cost estimation.

(4) “With” Case

As a cost-benefit analysis is conducted on the difference between the “With” case and the “Without” case, it is important to define the “With” case and the “Without” case.

In the economic analysis, the four projects, Multipurpose Terminal Project, Grain Terminal Modernization Project ,Deep Water Coal Berth Project and New Port Road Bridge Project are assessed individually, the same as in the preliminary economic analysis.

In an economic analysis, benefits are mainly brought about by improvement and expansion in handling capacity. Therefore, the “With” case scenario includes improvements in productivity and expansion of port facilities in the Short-term Development Plan.

(5) “Without” Case

No investment is made for the Short-term Development Plan. In the “Without” case scenario, when handling volume reaches the maximum volume of handling capacity of the port, the excess cargoes are assumed to divert to new berths in Damietta Port. Following conditions are adopted as the "Without" case for each project.

1) Multipurpose Terminal Project
   a) No investment is made for the port. (4 berths in Multipurpose Terminal are not constructed.)
   b) New berths are constructed in Damietta Port to handle the excess cargoes of the port.
   c) The working efficiency of cargo handling is not the same as the “With” case.

2) Grain Terminal Modernization Project
   a) No investment is made for the port. (New berth in Grain Terminal is not constructed.)
   b) The working efficiency of cargo handling is not the same as the “With” case.

3) Deep Water Coal Berth Project
   a) No investment is made for the port. (The coal terminal is not improved.)
   b) Coal berth is not deepened from present level.
   c) The size of vessels is the same as the "With" case, but the unit load per vessel is not the same.

4) New Port Road Bridge Project
   a) No investment is made for the port. (A new port road bridge is not constructed.)
   b) The time and distance required for the land transportation is not the same as the “With” case.

24.3 Economic Prices

24.3.1 General

For the economic analysis, all prices must be expressed in economic prices which means the international prices or border prices. In general, the value of goods quoted at market price doesn't always represent the value of goods. The market prices often include transfer items, such as customs duties, subsidies, etc, which don't actually reflect any consumption of resources. Therefore, the market prices can be converted into economic prices by eliminating these.

All costs and benefits are assumed to be divided into the following items. The economic prices of each item are calculated by multiplying the market prices by the conversion factor corresponding with each item.

(1) Tradable goods
(2) Non-tradable goods
(3) Labor
Labor is further classified into skilled labor and unskilled labor.

24.3.2 Conversion Factors

(1) Standard Conversion Factor (SCF)

Customs duties creates a price difference between the domestic market and the international market. The SCF is used to determine the economic prices of non-traded goods that have only market prices, and makes up for this price difference. The SCF is calculated by the following formula.

$$SCF = \frac{I + E}{(I + Di) + (E - De)}$$

where, I : Total value of imports (CIF)
E : Total value of exports (FOB)
Di : Total value of import duties
De : Total value of export duties

In this report, total value of duties is inferred from duty rate and value of each trade goods, and the average SCF from 1991 to 1996 is adopted. The Standard Conversion Factor is calculated as 0.848 (See Table 24.3.1).

Table 24.3.1 Standard Conversion Factor

Year	1991	1992	1993	1994	1995	1996	Average
SCF	0.859	0.852	0.852	0.839	0.842	0.843	0.848

(2) Conversion Factor for Consumption (CFC)

This conversion factor is used to convert the market prices of consumer goods into the border prices. The Conversion Factor for Consumption is usually calculated in the same manner as the Standard Conversion Factor, replacing total imports and exports by total imports and exports of consumer goods. The CFC is calculated by the following formula.

$$CFC = \frac{Ic + Ec}{(Ic + Dic) + (Ec - Dec)}$$

where, Ic : Total value of consumer goods imports (CIF)
Ec : Total value of consumer goods exports (FOB)
Dic : Total value of consumer goods import duties
Dec : Total value of consumer goods export duties

The average CFC from 1991 to 1996 is calculated as 0.887 (See Table 24.3.2).

Table 24.3.2 Conversion Factor for Consumption

Year	1991	1992	1993	1994	1995	1996	Average
SCF	0.884	0.885	0.890	0.895	0.886	0.880	0.887

(3) Conversion Factor for Skilled Labor (CFSL)

The cost of skilled labor is calculated based on actual market wages, assuming that the market mechanism is functioning properly. However, as the data are domestic prices or market prices, they should be converted to border prices by multiplying by the Conversion Factor for Consumption. The Conversion Factor for Skilled Labor (CFSL) is calculated by the following formula.

$$CFSL = \frac{\text{Opportunity cost of skilled labor}}{\text{Actual market wages of skilled labor}} \times CFC$$

where, *Opportunity cost of skilled labor / Actual market wages of skilled labor* = 1
CFC : Conversion Factor for Consumption (0.887)

The CFSL is calculated using above formula as 0.887.

(4) Conversion Factor for Unskilled Labor (CFUL)

As the wage rate is controlled by a minimum wage system and other regulations despite the existence of a large amount of unskilled labors, the wages paid to unskilled labors by a project are generally above the opportunity cost. Hence, these wages shouldn’t be used for calculation of the economic value of the unskilled labors. Assuming that the inflow of unskilled labors to the project is mainly from the agriculture sector, the marginal productivity of an unskilled labor is assumed equal to the per capita GDP of the agriculture sector in

Egypt. The Conversion Factor for Unskilled Labor (CFUL) is calculated by the following formula.

$$CFUL = \frac{Opportunity\ cost\ of\ unskilled\ labor}{Nominal\ wage\ rate\ of\ unskilled\ labor} \times CFC$$

$$= \frac{Per\ capita\ GDP\ of\ agriculture\ sector\ in\ Egypt}{Nominal\ wage\ rate\ of\ unskilled\ labor} \times CFC$$

where, CFC : Conversion Factor for Consumption (0.887)

In this report, the Conversion Factor for Unskilled Labor is calculated as 0.613 using the data in 1996/97 (See Table 24.3.3).

Table 24.3.3 Conversion Factor for Unskilled Labor

Year	GDP of Agriculture Sector in Egypt (million LE)	Population of Agriculture Sector in Egypt (thousand LE)	Per Capita GDP of Agriculture Sector in Egypt (LE)	Nominal Wage Rate of UL (LE)	CFUL
1996/97	25,310	4,886	5,180	7,500	0.613

Source: Statistical Year Book 1992-1997, Central Agency for Public Mobilization and Statistics

24.4 Benefits of the Projects

24.4.1 Benefit Items

As benefits brought about by the short-term development plan of the study port, the following items are identified.

(1) Saving in ship staying costs at a berth
(2) Saving in ship waiting costs at an offshore anchorage
(3) Saving in sea transportation costs
(4) Saving in land transportation costs
(5) Saving in construction costs of new berths for handling the excess cargoes in another port
(6) Reduction of cargo damage and accidents at the port
(7) Promotion of regional economic development
(8) Increase in employment opportunities and income
(9) Reduction of the traffic congestion

Item (1), (2), (3), (4) and (5) are considered countable in this study and the monetary benefits of those items are counted.

24.4.2 Calculation of Benefits

(1) Saving in ship staying costs and ship waiting costs

In the “With” case, total ship staying cost at berths and total ship waiting cost at offshore anchorages are less than that of the “Without” case owing to implementing the Multipurpose Terminal Project and the Grain Terminal Modernization Project. The difference of ship costs between the “With” case and the “Without” case is counted as a benefit of the projects. It is assumed that 50% of the benefits in Multipurpose Terminal Project and 100% of the benefits in Grain Terminal Modernization Project accrue to Egypt through the world trading market. Saving in ship staying costs at berths is shown in Table 24.4.1, and ship waiting costs at offshore anchorages is shown in Table 24.4.2.

Table 24.4.1 Saving in Ship Staying Costs at Berths (Unit: thousand LE)

Project / Year No.	Multipurpose Terminal	Grain Terminal Modernization
6	45,675	2,343
10	44,033	2,453
20	40,920	2,728
30	37,981	3,102
Total of 6 to 30	1,039,032	67,144

Table 24.4.2 Saving in Ship Waiting Costs at Anchorages (Unit: thousand LE)

Project / Year No.	Multipurpose Terminal	Grain Terminal Modernization
6	42,654	17,214
10	42,716	21,583
20	42,467	37,706
30	40,629	78,611
Total of 6 to 30	1,055,754	961,440

(2) Saving in sea transportation costs

Generally speaking, if the loading capacity of a vessel increases, the vessel can transport cargo at lower cost. In the “Without” case of the Deep Water Coal Berth Project, the berth depth is –10m which means the vessel can’t be loaded to capacity. But in the “With” case which the berth depth is increased to –14 m, the vessel can come alongside the berth with full draft. Hence, sea transportation costs in the “With” project are less than those in the “Without” case. The difference of transportation costs between the “With” case and the “Without” case is counted as a benefit of the Deep Water Coal Berth Project. Saving in sea transportation costs is shown in Table 24.4.3.

Table 24.4.3 Saving in Sea Transportation Costs (Unit: thousand LE)

Project / Year No.	Deep Water Coal Berth
6	11,896
10	11,896
20	11,896
30	11,896
Total of 6 to 30	297,402

(3) Saving in land transportation costs

In the "With" case of the New Port Road Bridge Project, the cargo generated from the eastern part of the port needs not go through the downtown area in Alexandria to use the bridge and by-pass. Hence, in the "With" case, land transportation costs, that is to say time costs of persons and running costs of trucks, are less than those in the "Without" case. The difference of land transportation costs is counted as a benefit of the New Port Road Bridge Project. Saving in land transportation costs is shown in Table 24.4.4.

Table 24.4.3 Saving in Land Transportation Costs

(Unit: thousand LE)

Project / Year No.	New Port Road Bridge
6	1,717
10	1,764
20	1,680
30	1,638
Total of 6 to 30	42,445

(4) Saving in construction costs of new berths for handling the excess cargoes in another port

In the "Without" case of the Multipurpose Terminal Project, as the volume of cargo exceeds the handling capacity at the Greater Alexandria Port, new berths have to be constructed at another port to receive the excess cargoes. It is assumed that the port is Damietta Port. The construction cost for new berths at Damietta Port is counted as a benefit of the Multipurpose Terminal Project. Construction cost of new berths is shown in Table 24.4.4.

Table 24.4.4 Saving in Construction Cost of New Berths

(Unit: thousand LE)

Project / Year No.	Multipurpose Terminal (in Market Price)	Average Overall Conversion Factor	Multipurpose Terminal (in Economic Price)
1	11,635	0.894	10,398
2	1,293	0.894	1,155
3	24,974	0.945	23,600
4	48,619	0.926	45,031
5	67,326	0.912	61,396
6	1,293	0.894	1,155
Total of 1 to 5	155,140	0.920	142,735

Furthermore, maintenance cost after Year No.6 is annually LE.930 in economic price.

24.5 Costs of the Projects

24.5.1 Construction Costs

Construction costs are divided into the categories of foreign currency portion and local currency portion consisting of skilled labor, unskilled labor and non-tradable material. The costs at market prices are converted to economic price using the conversion factor. Table 24.5.1 shows construction costs in the Short-term Development Plan which are economic prices which have been converted from market prices.

Table 24.5.1 Construction Costs in the Short-term Development Plan

(1) Multipurpose Terminal Project

(Unit: thousand LE)

Item	Project Cost in Market Price	Foreign Portion	Local Portion			Overall Conversion Factor	Project Costs in Economic Price
			Skilled Labor	Unskilled Labor	Non-Tradable Material		
		1.000	0.887	0.613	0.848		
Quay & Revetment	122,516	24%	10%	18%	48%	0.848	103,845
Reclamation & Earth Works	142,381	34%	17%	22%	27%	0.854	121,597
Pavement of Yard Road	20,074	12%	10%	27%	51%	0.807	16,200
Buildings, Gate & Track Scale	5,903	18%	22%	22%	37%	0.831	4,906
Utilities (Power, Water & Lighting)	4,161	43%	14%	14%	29%	0.885	3,682
Flyover Bridge	8,504	25%	12%	14%	49%	0.859	7,304
Engineering Service & Contingency	60,708	30%	31%	17%	21%	0.865	52,498
Dredging	45,012	54%	12%	17%	17%	0.896	40,334
Equipment(gantry crane, scale unit)	31,800	80%	7%	7%	6%	0.955	30,362
Vessel Traffic Management System	2,862	87%	4%	3%	6%	0.973	2,786
Waste Oil Receiving Facility	1,060	87%	4%	3%	6%	0.973	1,032
Forklift	2,040	100%	0%	0%	0%	1.000	2,040
Total	447,020					0.865	386,585

(2) Grain Terminal Modernization Project

(Unit: thousand LE)

Item	Project Cost in Market Price	Foreign Portion	Local Portion			Overall Conversion Factor	Project Costs in Economic Price
			Skilled Labor	Unskilled Labor	Non-Traded Material		
		1.000	0.887	0.613	0.848		
Quay & Revetment	23,716	23%	10%	15%	52%	0.850	20,161
Crane Foundation	1,271	50%	11%	17%	23%	0.890	1,130
Reclamation & Backfill	11,111	13%	22%	27%	38%	0.813	9,034
Utilities (Power, Water & Lighting)	468	60%	10%	10%	20%	0.919	430
Engineering Service & Contingency	7,313	30%	32%	17%	21%	0.865	6,324
Dredging	8,226	54%	12%	17%	17%	0.896	7,367
Equipment (unloader, conveyor)	66,250	82%	6%	7%	5%	0.959	63,546
Total	118,354					0.912	107,992

(3) Deep Water Coal Berth Project

(Unit: thousand LE)

Item	Project Cost in Market Price	Foreign Portion	Local Portion			Overall Conversion Factor	Project Costs in Economic Price
			Skilled Labor	Unskilled Labor	Non-Tradable Material		
		1.000	0.887	0.613	0.848		
Quay	9,721	84%	5%	5%	7%	0.965	9,381
Slope Protection	454	5%	24%	34%	37%	0.786	357
Super Structure	3,239	20%	18%	23%	39%	0.831	2,691
Accessaries	4,391	72%	6%	8%	14%	0.943	4,139
Engineering Service & Contingency	3,561	30%	32%	17%	21%	0.865	3,079
Dredging	1,830	53%	12%	17%	18%	0.894	1,635
Total	23,196					0.918	21,282

(4) New Port Road Bridge Project

(Unit: thousand LE)

Item	Project Cost in Market Price	Foreign Portion	Local Portion			Overall Conversion Factor	Project Costs in Economic Price
			Skilled Labor	Unskilled Labor	Non-Tradable Material		
		1.000	0.887	0.613	0.848		
Truss	6,540	30%	18%	18%	35%	0.859	5,620
Water Diversion Work	575	2%	32%	29%	36%	0.795	457
RC Base Concrete	479	10%	23%	32%	36%	0.798	382
Abatment	359	10%	22%	32%	36%	0.798	287
Walkway	92	30%	18%	25%	28%	0.843	78
Engineering Service & Contingency	1,609	30%	31%	18%	21%	0.865	1,391
Total	9,653					0.851	8,214

24.5.2 Maintenance and Operation Costs

(1) Maintenance costs

The annual costs of maintaining the port facilities are estimated as a fixed rate, to put it concretely 1% for structure (excluding dredging and reclamation) and 4% for equipment of the original construction costs.

Table 24.5.2 Maintenance Costs for Structure and Equipment

(Unit: thousand LE)

	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	New Port Road Bridge
Structure	1,884	280	196	82
Equipment	1,449	2,542	0	0
Total	3,333	2,822	196	82

(2) Re-investment costs

The equipments will be renewed in consideration of the project life and the period of depreciation (unloader and conveyor are 15 years, gantry crane and scale unit are 15 years, and forklift is 10 years.).

Table 24.5.2 Re-investment Costs

(Unit: thousand LE)

	Multipurpose Terminal	Grain Terminal Modernization
Unloader and Conveyor	0	63,546
Gantry Crane and Scale unit	30,362	0
Forklift	2,040	0

(3) Personnel and administration costs

The annual personnel costs are estimated based on the required number of employees to manage and operate the future port facilities (see the section "Financial Analysis"). And administration costs are estimated as 50% of the personnel costs. This includes the welfare costs for labor and the general management costs.

Table 24.5.3 Personnel and Administration Costs

	Multipurpose Terminal		Grain Terminal Modernization	
	Skilled Labor	Unskilled Labor	Skilled Labor	Unskilled Labor
No. of Personnel	475	360	80	12
Annual Wage (LE)	10,500	7,500	10,500	7,500
Conversion Factor	0.887	0.613	0.887	0.613
Personnel Costs (thousand LE)	6,079		800	
Administration Costs (thousand LE)	3,040		400	
Total (thousand LE)	9,119		1,200	

24.5.3 Total Costs

Table 24.5.2 shows total costs at economic prices in the Short-term Development Plan by each project.

Table 24.5.2 Total Costs in the Short-term Development Plan

(Unit: thousand LE)

Project Year No.	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	New Port Road Bridge	Whole
1	23,624	2,846	1,386	0	27,855
2	2,625	316	154	0	3,095
3	103,682	8,315	2,097	0	114,094
4	135,300	30,658	6,748	0	172,707
5	115,693	59,186	10,744	8,214	193,836
6	18,113	10,694	350	82	29,239
7	12,452	4,023	196	82	16,753
8	12,452	4,023	196	82	16,753
9	12,452	4,023	196	82	16,753
10	12,452	4,023	196	82	16,753
11	12,452	4,023	196	82	16,753
12	12,452	4,023	196	82	16,753
13	12,452	4,023	196	82	16,753
14	12,452	4,023	196	82	16,753
15	14,492	4,023	196	82	18,793
16	12,452	4,023	196	82	16,753
17	12,452	4,023	196	82	16,753
18	12,452	4,023	196	82	16,753
19	12,452	4,023	196	82	16,753
20	42,813	67,569	196	82	110,661
21	12,452	4,023	196	82	16,753
22	12,452	4,023	196	82	16,753
23	12,452	4,023	196	82	16,753
24	12,452	4,023	196	82	16,753
25	14,492	4,023	196	82	18,793
26	12,452	4,023	196	82	16,753
27	12,452	4,023	196	82	16,753
28	12,452	4,023	196	82	16,753
29	12,452	4,023	196	82	16,753
30	1,884	-15,960	196	82	-13,798
Total	721,750	252,122	26,194	10,267	1,010,333

24.6 Evaluation of 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.

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

where, n : Period of economic calculation (project life = 30 years)

Bi : Benefits in i-th year

Ci : Costs in i-th year

r : Discount rate

The results of the EIRR calculation are shown in Table 24.6.1.

Table 24.6.1 Result of EIRR Calculation (Unit: %)

Project	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	New Port Road Bridge	Whole
EIRR	23.0	18.2	39.1	19.8	22.7

(2) Calculation of the Benefit/Cost Ratio

The benefit/cost ratio is obtained by dividing the benefit by the cost. The results of the B/C are shown in Table 24.6.2. The discount rate adopted for calculation of B/C is 10% in this study.

Table 24.6.2 Result of B/C Calculation

Project	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	New Port Road Bridge	Whole
B/C	1.70	1.74	4.34	1.74	1.80

(3) Calculation of the Net Present Value (NPV)

The Net Present Value is calculated by using the following formula.

$$NPV= \sum_{i=1}^{n} \frac{Bi - Ci}{(1+r)^{i-1}}$$

where, n : Period of economic calculation (project life = 30 years)

Bi : Benefits in i-th year

Ci : Costs in i-th year

r : Discount rate = 10%

The results of the NPV calculation are shown in Table 24.6.3.

Table 24.6.3 Result of NPV Calculation (Unit: thousand LE)

Project	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	New Port Road Bridge	Whole
NPV	265,295	82,331	56,772	4,539	408,937

Table 24.6.4 EIRR and B/C of Multipurpose Terminal Project

(Unit : thousand LE)

Year	Benefit					Cost						Difference	Net Present Volume(NPV)		
	Ship Staying Cost	Ship Waiting Cost	New Berth Cost		Total	Constructio Cost	Maintenanc Cost	Administratio Cost	Re-investmen Cost	Residual Values	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
			Constructio Cost	Maintenance Cost											
1			10,397		10,397	23,624					23,624	-13,226	10,397	23,624	-13,226
2			1,155		1,155	2,625					2,625	-1,470	1,050	2,386	-1,336
3			23,600		23,600	103,682					103,682	-80,082	19,504	85,688	-66,184
4			45,031		45,031	135,300					135,300	-90,269	33,832	101,653	-67,821
5			61,396		61,396	115,693					115,693	-54,297	41,934	79,020	-37,085
6	45,675	42,654	1,155	930	90,413	5,661	3,333	9,119			18,113	72,301	56,140	11,247	44,893
7	44,994	42,729		930	88,654		3,333	9,119			12,452	76,202	50,043	7,029	43,014
8	44,647	42,648		930	88,225		3,333	9,119			12,452	75,773	45,273	6,390	38,884
9	44,429	42,747		930	88,106		3,333	9,119			12,452	75,654	41,102	5,809	35,293
10	44,033	42,716		930	87,679		3,333	9,119			12,452	75,227	37,184	5,281	31,904
11	43,707	42,663		930	87,299		3,333	9,119			12,452	74,848	33,658	4,801	28,857
12	43,705	42,301		930	86,936		3,333	9,119			12,452	74,484	30,470	4,364	26,106
13	43,302	42,717		930	86,949		3,333	9,119			12,452	74,498	27,705	3,967	23,737
14	42,567	42,707		930	86,204		3,333	9,119			12,452	73,753	24,970	3,607	21,364
15	42,804	42,745		930	86,478		3,333	9,119	2,040		14,492	71,987	22,772	3,816	18,956
16	41,980	42,697		930	85,606		3,333	9,119			12,452	73,155	20,494	2,981	17,513
17	41,707	42,646		930	85,283		3,333	9,119			12,452	72,831	18,560	2,710	15,850
18	41,440	42,590		930	84,960		3,333	9,119			12,452	72,509	16,809	2,463	14,345
19	41,178	42,531		930	84,638		3,333	9,119			12,452	72,187	15,223	2,240	12,983
20	40,920	42,467		930	84,317		3,333	9,119	30,362		42,813	41,504	13,787	7,000	6,786
21	40,668	42,399		930	83,997		3,333	9,119			12,452	71,545	12,486	1,851	10,635
22	40,301	42,260		930	83,491		3,333	9,119			12,452	71,039	11,282	1,683	9,600
23	39,941	42,113		930	82,984		3,333	9,119			12,452	70,532	10,194	1,530	8,665
24	39,589	41,957		930	82,476		3,333	9,119			12,452	70,024	9,211	1,391	7,820
25	39,243	41,793		930	81,966		3,333	9,119	2,040		14,492	67,475	8,322	1,471	6,850
26	38,905	41,621		930	81,456		3,333	9,119			12,452	69,004	7,518	1,149	6,369
27	38,669	41,388		930	80,986		3,333	9,119			12,452	68,535	6,795	1,045	5,750
28	38,436	41,144		930	80,510		3,333	9,119			12,452	68,059	6,141	950	5,191
29	38,207	40,891		930	80,028		3,333	9,119			12,452	67,576	5,549	863	4,686
30	37,981	40,629		930	79,539		3,333	9,119		-10,568	1,884	77,656	5,014	119	4,895
Total	1,039,032	1,055,754	142,735	23,243	2,260,764	386,585	83,328	227,963	34,442	-10,568	721,750	1,539,014	643,421	378,125	265,295

EIRR = 23.0%

B / C = 1.70

Table 24.6.5 EIRR and B/C of Grain Terminal Modernization Project

(Unit : thousand LE)

	Benefit			Cost						Difference	Net Present Volume(NPV)		
Year	Ship Staying Cost	Ship Waiting Cost	Total	Construction Cost	Maintenance Cost	Management Cost	Re-investment Cost	Residual Values	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1				2,846					2,846	-2,846	0	2,846	-2,846
2				316					316	-316	0	287	-287
3				8,315					8,315	-8,315	0	6,872	-6,872
4				30,658					30,658	-30,658	0	23,034	-23,034
5				59,186					59,186	-59,186	0	40,425	-40,425
6	2,343	17,213	19,557	6,671	2,822	1,200			10,694	8,863	12,143	6,640	5,503
7	2,371	18,112	20,483		2,822	1,200			4,023	16,461	11,562	2,271	9,292
8	2,398	19,633	22,032		2,822	1,200			4,023	18,009	11,306	2,064	9,241
9	2,426	20,569	22,995		2,822	1,200			4,023	18,972	10,727	1,877	8,851
10	2,453	21,583	24,036		2,822	1,200			4,023	20,013	10,194	1,706	8,488
11	2,481	22,995	25,475		2,822	1,200			4,023	21,453	9,822	1,551	8,271
12	2,508	24,251	26,759		2,822	1,200			4,023	22,736	9,379	1,410	7,969
13	2,536	25,710	28,246		2,822	1,200			4,023	24,223	9,000	1,282	7,718
14	2,563	27,467	30,030		2,822	1,200			4,023	26,007	8,699	1,165	7,533
15	2,591	29,152	31,743		2,822	1,200			4,023	27,720	8,359	1,059	7,300
16	2,618	30,573	33,191		2,822	1,200			4,023	29,168	7,946	963	6,983
17	2,646	32,171	34,817		2,822	1,200			4,023	30,794	7,577	875	6,702
18	2,673	34,056	36,729		2,822	1,200			4,023	32,706	7,267	796	6,471
19	2,700	36,259	38,959		2,822	1,200			4,023	34,936	7,007	724	6,284
20	2,728	37,706	40,434		2,822	1,200	63,546		67,569	-27,135	6,611	11,048	-4,437
21	2,755	40,865	43,620		2,822	1,200			4,023	39,598	6,484	598	5,886
22	2,783	43,202	45,985		2,822	1,200			4,023	41,962	6,214	544	5,670
23	2,810	45,770	48,580		2,822	1,200			4,023	44,558	5,968	494	5,474
24	2,838	48,657	51,495		2,822	1,200			4,023	47,472	5,751	449	5,302
25	2,872	51,986	54,858		2,822	1,200			4,023	50,835	5,569	408	5,161
26	2,918	56,274	59,192		2,822	1,200			4,023	55,170	5,463	371	5,092
27	2,964	60,996	63,960		2,822	1,200			4,023	59,938	5,367	338	5,029
28	3,010	65,803	68,813		2,822	1,200			4,023	64,791	5,249	307	4,942
29	3,056	71,824	74,880		2,822	1,200			4,023	70,857	5,192	279	4,913
30	3,102	78,611	81,713		2,822	1,200		-19,983	-15,960	97,673	5,151	-1,006	6,157
Total	67,144	961,440	1,028,584	107,992	70,558	30,009	63,546	-19,983	252,122	776,462	194,007	111,676	82,331

EIRR = 18.2%

B / C = 1.74

Table 24.6.6 EIRR and B/C of Deep Water Coal Berth Project

(Unit : thousand LE)

	Benefit		Cost			Difference	Net Present Volume(NPV)		
Year	Sea Transportation Cost	Total	Construction Cost	Maintenance Cost	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1			1,386		1,386	-1,386	0	1,386	-1,386
2			154		154	-154	0	140	-140
3			2,097		2,097	-2,097	0	1,733	-1,733
4			6,748		6,748	-6,748	0	5,070	-5,070
5			10,744		10,744	-10,744	0	7,338	-7,338
6	11,896	11,896	154	196	350	11,546	7,387	218	7,169
7	11,896	11,896		196	196	11,700	6,715	111	6,604
8	11,896	11,896		196	196	11,700	6,105	101	6,004
9	11,896	11,896		196	196	11,700	5,550	92	5,458
10	11,896	11,896		196	196	11,700	5,045	83	4,962
11	11,896	11,896		196	196	11,700	4,586	76	4,511
12	11,896	11,896		196	196	11,700	4,170	69	4,101
13	11,896	11,896		196	196	11,700	3,790	63	3,728
14	11,896	11,896		196	196	11,700	3,446	57	3,389
15	11,896	11,896		196	196	11,700	3,133	52	3,081
16	11,896	11,896		196	196	11,700	2,848	47	2,801
17	11,896	11,896		196	196	11,700	2,589	43	2,546
18	11,896	11,896		196	196	11,700	2,354	39	2,315
19	11,896	11,896		196	196	11,700	2,140	35	2,104
20	11,896	11,896		196	196	11,700	1,945	32	1,913
21	11,896	11,896		196	196	11,700	1,768	29	1,739
22	11,896	11,896		196	196	11,700	1,608	27	1,581
23	11,896	11,896		196	196	11,700	1,461	24	1,437
24	11,896	11,896		196	196	11,700	1,329	22	1,307
25	11,896	11,896		196	196	11,700	1,208	20	1,188
26	11,896	11,896		196	196	11,700	1,098	18	1,080
27	11,896	11,896		196	196	11,700	998	16	982
28	11,896	11,896		196	196	11,700	907	15	892
29	11,896	11,896		196	196	11,700	825	14	811
30	11,896	11,896		196	196	11,700	750	12	738
Total	297,402	297,402	21,282	4,912	26,194	271,208	73,753	16,980	56,772

EIRR= 39.1%

B / C= 4.34

Table 24.6.7 EIRR and B/C of New Port Road Bridge Project

(Unit : thousand LE)

	Benefit		Cost			Difference	Net Present Volume(NPV)		
Year	Land Transportatio Cost	Total	Constructio Cost	Maintenance Cost	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1						0	0	0	0
2						0	0	0	0
3						0	0	0	0
4						0	0	0	0
5			8,214		8,214	-8,214	0	5,610	-5,610
6	1,717	1,717		82	82	1,635	1,066	51	1,015
7	1,726	1,726		82	82	1,644	974	46	928
8	1,735	1,735		82	82	1,653	891	42	848
9	1,732	1,732		82	82	1,650	808	38	770
10	1,764	1,764		82	82	1,682	748	35	713
11	1,752	1,752		82	82	1,670	676	32	644
12	1,766	1,766		82	82	1,684	619	29	590
13	1,735	1,735		82	82	1,653	553	26	527
14	1,748	1,748		82	82	1,666	506	24	483
15	1,718	1,718		82	82	1,635	452	22	431
16	1,721	1,721		82	82	1,639	412	20	392
17	1,711	1,711		82	82	1,628	372	18	354
18	1,700	1,700		82	82	1,618	336	16	320
19	1,690	1,690		82	82	1,608	304	15	289
20	1,680	1,680		82	82	1,598	275	13	261
21	1,670	1,670		82	82	1,588	248	12	236
22	1,667	1,667		82	82	1,585	225	11	214
23	1,664	1,664		82	82	1,582	204	10	194
24	1,661	1,661		82	82	1,578	185	9	176
25	1,657	1,657		82	82	1,575	168	8	160
26	1,654	1,654		82	82	1,572	153	8	145
27	1,650	1,650		82	82	1,568	138	7	132
28	1,646	1,646		82	82	1,564	126	6	119
29	1,642	1,642		82	82	1,560	114	6	108
30	1,638	1,638		82	82	1,556	103	5	98
Total	42,445	42,445	8,214	2,053	10,267	32,178	10,658	6,119	4,539

EIRR = **19.8%**

B / C = **1.74**

Table 24.6.8 EIRR and B/C of Whole Project

(Unit : thousand LE)

	Benefit					Cost					Difference	Net Present Volume(NPV)		
Year	Multipurp Terminal Project	Grain Terminal Project	Coal Terminal Project	New Bridge Project	Total	Multipurp Terminal Project	Grain Terminal Project	Coal Terminal Project	New Bridge Project	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1	10,397				10,397	23,624	2,846	1,386		27,855	-17,458	10,397	27,855	-17,458
2	1,155				1,155	2,625	316	154		3,095	-1,940	1,050	2,814	-1,763
3	23,600				23,600	103,682	8,315	2,097		114,094	-90,494	19,504	94,293	-74,789
4	45,031				45,031	135,300	30,658	6,748		172,707	-127,676	33,832	129,757	-95,925
5	61,396				61,396	115,693	59,186	10,744	8,214	193,836	-132,440	41,934	132,393	-90,458
6	90,413	19,557	11,896	1,717	123,583	18,113	10,694	350	82	29,239	94,345	76,736	18,155	58,581
7	88,654	20,483	11,896	1,726	122,759	12,452	4,023	196	82	16,753	106,006	69,294	9,457	59,838
8	88,225	22,032	11,896	1,735	123,888	12,452	4,023	196	82	16,753	107,135	63,574	8,597	54,977
9	88,106	22,995	11,896	1,732	124,729	12,452	4,023	196	82	16,753	107,976	58,187	7,815	50,372
10	87,679	24,036	11,896	1,764	125,375	12,452	4,023	196	82	16,753	108,622	53,171	7,105	46,066
11	87,299	25,475	11,896	1,752	126,423	12,452	4,023	196	82	16,753	109,670	48,742	6,459	42,283
12	86,936	26,759	11,896	1,766	127,357	12,452	4,023	196	82	16,753	110,604	44,638	5,872	38,766
13	86,949	28,246	11,896	1,735	128,826	12,452	4,023	196	82	16,753	112,073	41,048	5,338	35,710
14	86,204	30,030	11,896	1,748	129,879	12,452	4,023	196	82	16,753	113,126	37,621	4,853	32,769
15	86,478	31,743	11,896	1,718	131,835	14,492	4,023	196	82	18,793	113,042	34,716	4,949	29,768
16	85,606	33,191	11,896	1,721	132,414	12,452	4,023	196	82	16,753	115,661	31,699	4,011	27,688
17	85,283	34,817	11,896	1,711	133,707	12,452	4,023	196	82	16,753	116,954	29,098	3,646	25,453
18	84,960	36,729	11,896	1,700	135,285	12,452	4,023	196	82	16,753	118,533	26,766	3,314	23,451
19	84,638	38,959	11,896	1,690	137,184	12,452	4,023	196	82	16,753	120,431	24,674	3,013	21,661
20	84,317	40,434	11,896	1,680	138,328	42,813	67,569	196	82	110,661	27,667	22,618	18,094	4,524
21	83,997	43,620	11,896	1,670	141,183	12,452	4,023	196	82	16,753	124,430	20,986	2,490	18,496
22	83,491	45,985	11,896	1,667	143,039	12,452	4,023	196	82	16,753	126,286	19,329	2,264	17,065
23	82,984	48,580	11,896	1,664	145,124	12,452	4,023	196	82	16,753	128,371	17,828	2,058	15,770
24	82,476	51,495	11,896	1,661	147,527	12,452	4,023	196	82	16,753	130,774	16,476	1,871	14,605
25	81,966	54,858	11,896	1,657	150,378	14,492	4,023	196	82	18,793	131,585	15,267	1,908	13,359
26	81,456	59,192	11,896	1,654	154,199	12,452	4,023	196	82	16,753	137,446	14,232	1,546	12,686
27	80,986	63,960	11,896	1,650	158,493	12,452	4,023	196	82	16,753	141,740	13,298	1,406	11,893
28	80,510	68,813	11,896	1,646	162,866	12,452	4,023	196	82	16,753	146,113	12,423	1,278	11,145
29	80,028	74,880	11,896	1,642	168,446	12,452	4,023	196	82	16,753	151,693	11,681	1,162	10,519
30	79,539	81,713	11,896	1,638	174,787	1,884	-15,960	196	82	-13,798	188,584	11,018	-870	11,888
Total	#######	#######	297,402	42,445	#######	721,750	252,122	26,194	10,267	1,010,333	2,618,861	921,838	512,901	408,937

EIRR = 22.7%

B / C = 1.80

(4) Sensitivity Analysis

In order to see whether the project is still feasible when some conditions change, a sensitivity analysis is made for the following three alternatives.

Case A: The costs increase by 10%
Case B: The benefits decrease by 10%
Case C: The costs increase by 10% and the benefits decrease by 10%

The results of the sensitivity analysis are shown in Table 24.6.9.

Table 24.6.9 Sensitivity Analysis for EIRR and B/C Ratio

Project	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	New Port Road Bridge	Whole
Base Case	23.0%	18.2%	39.1%	19.8%	22.7%
	1.70	1.74	4.34	1.74	1.80
Case A	20.1%	16.6%	36.4%	17.8%	20.1%
	1.55	1.58	3.95	1.58	1.63
Case B	19.8%	16.4%	36.1%	17.6%	19.6%
	1.53	1.56	3.91	1.57	1.60
Case C	17.2%	15.0%	33.6%	15.8%	17.3%
	1.39	1.42	3.55	1.43	1.45

Note: The upper figure is EIRR and the lower figure is B/C ratio.

(5) Evaluation

In general, it is said that a project with an EIRR of more than 10% is economically feasible considering the opportunity cost of capital. As for this study, the resulting EIRRs of the four projects and whole project are in the range of 15.0% - 39.1%, exceeding the above criterion, and all B/C ratios are greater than one. Therefore, all projects proposed in the Short-term Development Plan are considered to be feasible from the viewpoint of the national economy.

Chapter 25 Financial Analysis

25.1 Purpose and Methodology

25.1.1 Purpose

The purpose of the financial analysis is to appraise the financial feasibility of the Short-term Development Plan. The analysis focuses on the viability of the project itself and the financial soundness of the terminal management entity during the project life.

25.1.2 Methodology

The procedure of the financial analysis is shown in Figure 25.1.1.

(1) Viability of the project

The viability of the project is evaluated using the Financial Internal Rate of Return (FIRR). The FIRR is a discount rate which makes the cost and the revenue during the project life equal. The FIRR is calculated by the following formula.

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

n : Project life
R_i : Revenue in the i th year
C_i : Cost in the i th year
r : Discount rate

The revenues and the costs in the calculation of FIRR are summarized in Table 25.1.1.

Table 25.1.1 The Revenues and the Costs in the Calculation of FIRR

Revenues	Costs
1) Operating revenues by the project	1) Initial and renewal investment costs for the project 2) Operating expenses by the project such as maintenance, personnel and administration costs

The revenues and costs excluded from the calculation of FIRR are summarized in Table 25.1.2.

Table 25.1.2 The Revenues and the Costs excluded from the Calculation of FIRR

Revenues	Costs
1) Fund management income	1) Repayment of the principal 2) Interest on loans

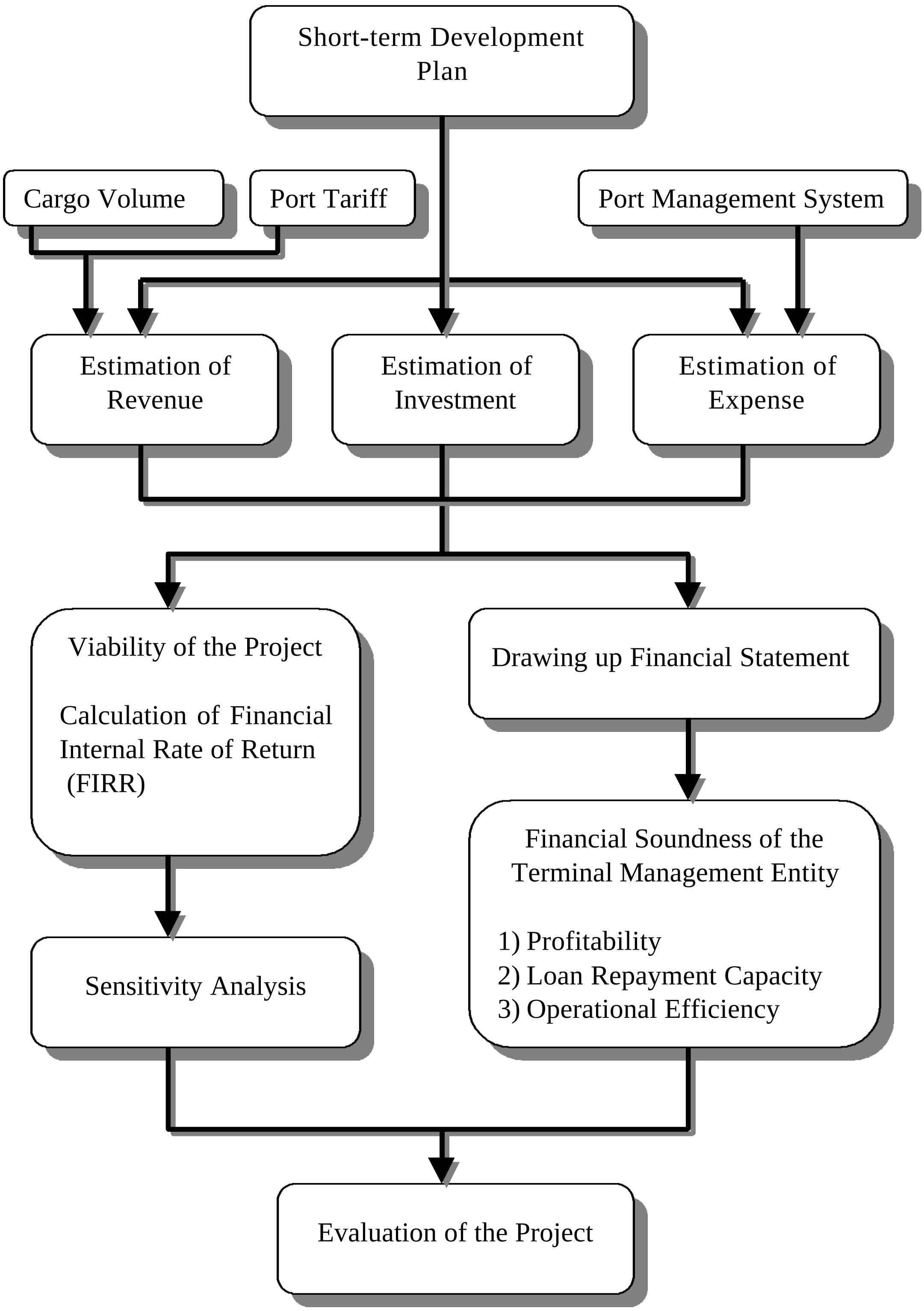


Figure 25.1.1 Procedure of Financial Analysis

When the calculated FIRR exceeds the weighted average interest rate of the total funds for investments of the project, the project is regarded as financially feasible.

(2) Financial soundness of the terminal management entity

The financial soundness of the terminal management entity is appraised with its projected financial statements (income statement, cash flow statement and balance sheet). The appraisal is made from the viewpoints of profitability, loan repayment capacity and operational efficiency, using the following ratios.

1) Profitability

$$\text{Rate of Return on Net Fixed Assets} = \frac{\text{Net Operating Income}}{\text{Total Fixed Assets}} \times 100\ \%$$

The rate of return on net fixed assets shows the profitability of the investments that are presented as net total fixed assets. It is necessary to keep the rate higher than the average interest rate of the funds for investment.

2) Loan repayment capacity

$$\text{Debt Service Coverage Ratio} = \frac{\text{Net Operating Income Before Depreciation}}{\text{Repayment of Principal and Interest on Long-term Loan}}$$

The debt service coverage ratio shows whether the operating income can cover the repayment of principal and interest on long term loans. The ratio must be higher than 1.0 and it is generally preferable to be higher than 1.75.

3) Operational efficiency

$$\text{Operating ratio} = \frac{\text{Operating Expenses}}{\text{Operating Revenues}} \times 100\ \%$$

The operating ratio shows the operational efficiency of the terminal management entity, namely the ratio of port revenue that is consumed by operating expenses. Generally it must be less than 70-75%.

$$\text{Working ratio} = \frac{\text{Operating Expenses} - \text{Depreciation}}{\text{Operating Revenues}} \times 100\ \%$$

Working ratio shows the efficiency of the routine operations of the port. Generally it must be less than 50-60%.

25.2 Prerequisites of the Financial Analysis for the Project

25.2.1 General

(1) Scope of the Financial Analysis

Scope of this financial analysis is the projects in the Short-term Development Plan. The concrete projects are as follows.

1) Multipurpose Terminal Project including New Port Road Bridge Project
2) Grain Terminal Modernization Project
3) Deep Water Coal Berth Project

(2) "With" case and "Without" case

The viability of the project, namely FIRR is analyzed based on the difference of revenues and costs between "With" case and "Without" case. Here, "With" case is the case which the Short-term Development Plan is executed while "Without" case represents the existing situation. The financial soundness of the terminal management entity is analyzed using "With" case.

(3) Base Year

All costs and revenues are indicated in prices as of 1998, when the price survey was conducted. We call this year the "Base Year".

(4) Project Life

Considering the long-term loans and the service lives of the port facilities, the project life in the financial analysis is assumed to be 30 years including the period of detailed design and construction work. Neither inflation nor an increase in nominal wages are considered during the project life.

25.2.2 Fund Raising

Fund raising is divided into foreign fund and domestic fund. In this study, referring to funding conditions of soft loan by international financial institute including OECF, as for foreign fund, its upper limit of finance is assumed to be the total amount of foreign portion or 75% of initial investment costs, whichever is higher. In the proposed projects, seventy-five percent of initial investment costs is assumed to be raised by foreign fund. The remaining initial investment costs (25%) and all of renewal investment are assumed to be raised by domestic fund. Conditions of loans are assumed as follows.

(1) Foreign funds

Loan period	: 30 years, including a grace period of 10 years
Interest rate	: 2.2 %
Repayment	: Fixed amount repayment of principal

(2) Domestic funds

Loan period : 10 years
Interest rate : 14.5%
Repayment : Fixed amount repayment of principal

(3) Weighted average interest rate

5.275% (= 2.2%×0.75+14.5%×0.25)

25.2.3 Cargo Handling Volume

(1) Conventional cargo (Multipurpose Terminal Project)

Projected volume of conventional cargo at Greater Alexandria Port is shown in Table 25.2.1.

Table 25.2.1 Projected Cargo Volume

"With" case (Unit: tons)

Commodity / Year	6	10	20	30
Sugar, Rice, Flour	1,277,000	1,556,200	1,626,000	1,,626,000
Sawn Timber	3,634,000	4,093,600	5,242,600	6,391,600
Paper	826,000	759,200	592,200	425,200
Steel Products	1,212,000	1,509,200	2,252,200	2,995,200
Miscellaneous (Shed)	2,073,000	1,969,600	1,711,100	1,452,600
Miscellaneous (Yard)	2,073,000	1,969,600	1,711,100	1,452,600
Total	11,095,000	11,857,400	13,135,200	14,343,200

"Without" case (Unit: tons)

Commodity / Year	6	10	20	30
Sugar, Rice, Flour	1,277,000	1,277,000	1,277,000	1,277,000
Sawn Timber	2,725,500	2,725,500	2,725,500	2,725,500
Paper	619,500	619,500	619,500	619,500
Steel Products	909,000	909,000	909,000	909,000
Miscellaneous (Shed)	2,073,000	2,073,000	2,073,000	2,073,000
Miscellaneous (Yard)	1,554,750	1,554,750	1,554,750	1,554,750
Total	9,158,750	9,158,750	9,158,750	9,158,750

Difference between "With" case and "Without" case (Unit: tons)

Commodity / Year	6	10	20	30
Sugar, Rice, Flour	0	279,200	349,000	349,000
Sawn Timber	908,500	1,368,100	2,517,100	3,666,100
Paper	206,500	139,700	-27,300	-194,300
Steel Products	303,000	600,200	1,343,200	2,086,200
Miscellaneous (Shed)	0	-103,400	-361,900	-620,400
Miscellaneous (Yard)	518,250	414,850	156,350	-102,150
Total	1,936,250	2,698,650	3,976,450	5,184,450

(2) Dry bulk grain cargo (Grain Terminal Modernization Project)

In the same year, projected volumes of dry bulk grain cargo for “With” case (handling at No.94-1, 94-2, new berth) and “Without” case (handling at No.94-1, 94-2 berth) are the same. Therefore, there is no difference in the cargo handling volume between the two cases.

(3) Dry bulk coal cargo (Deep Water Coal Berth Project)

As Projected volumes of dry bulk coal cargo (handling at No.63/64 berth) for “With” case and “Without” case are the same, there is no difference in cargo handling volume between the two cases.

25.2.4 Revenues

(1) Multipurpose Terminal Project

In the “With” case, projected volume of conventional cargo increases after year 6 as a result of constructing the Multipurpose Terminal. But in the “Without” case, the cargo volume exceeds the handling capacity in year 6 and remains fixed after that point. The excess cargoes are transferred from the Greater Alexandria Port to another port (Damietta Port). Based on the difference of conventional cargo volume for “With” case and “Without” case at the Greater Alexandria Port, revenues for the Multipurpose Terminal Project are calculated using the official tariff (Charges and Services Tariff at Alexandria Port, Storing Services Tariff).

Private stevedoring companies which recently obtained licenses according to Decree No.30 for promoting private participation are offering their own stevedoring charges. The above mentioned official tariff and their charges offered by private companies were cross-checked. There is no decisive difference between them regarding stevedorage. The official tariff used for calculation is as follows.

1) Charges from vessels

a) Port due	US$ 0.30 per GRT
b) Birth hire	US$ 0.01 per GRT per day
c) Light house due	US$ 0.05 per GRT

d) Stay due: This charge is collected from the 16th day after berthing date. It is assumed that all vessels leave the berth within 16 days. Therefore stay due is not considered.

2) Cargo handling charge (loading or discharging)

a) Inside holds	US$ 0.85 per ton
b) On or from quay	US$ 1.25 per ton

3) Labor charge

a) Supervisor	US$ 12.00 per person per sift
b) Foreman	US$ 8.25 per person per sift
c) Winchman	US$ 5.75 per person per sift
d) Tally clerk	US$ 10.00 per person per sift
e) Hatchman	US$ 6.75 per person per sift

f) Forklift operator US$ 5.75 per person per sift

3) Transport fee

This is the fee of transport from the ship to the storage yard (from the storage yard to the ship). It is US$ 2.25 per ton.

4) Storage charge

First three days L.E. 0.5 per ton per day

Next four days L.E. 1.0 per ton per day

It is assumed that import and export cargoes are stored in the yard for seven days on average following the date of discharging (prior to the date of loading).

(2) Grain Terminal Modernization Project

As projected volumes of dry bulk grain cargo for "With" case and "Without" case are the same, it is assumed that saving in ship staying costs and waiting costs given in the Economic Analysis represents revenue for the Grain Terminal Modernization Project.

(3) Deep Water Coal Berth Project

As projected volume of dry bulk coal cargo for "With" case and "Without" case are the same, it is assumed that saving in sea transportation costs given in the Economic Analysis represents revenue for the Deep Water Coal Berth Project

25.2.5 Expenses

(1) Investment in capital assets

Investment costs are shown in chapter 24.5. According to the construction schedule, investment will be made. The equipment will be replaced after service life with internal fund. Service lives and re-investment costs are as follows.

- Unloader, conveyor, gantry crane, scale unit : 15 years
- Forklift : 10 years

Table 25.2.2 Re-investment Costs (Unit: thousand LE)

	Multipurpose Terminal	Grain Terminal Modernization
Unloader and Conveyor	0	66,250
Gantry Crane and Scale unit	31,800	0
Forklift	2,040	0

The annual depreciation of the equipment is calculated by the straight line method. In this analysis, residual values at the end of the project life are not considered because selling of the equipment on that occasion is actually difficult due to the obsoleteness.

(2) Maintenance costs

The annual maintenance costs for the port facilities are calculated as follows.
Infrastructure : 1.0% of the original construction cost
Equipment : 4.0% of the original procurement cost

Table 25.2.3 Maintenance Costs for Structure and Equipment (Unit: thousand LE)

	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth
Structure	2,315	328	214
Equipment	1,510	2,650	0
Total	3,826	2,978	214

(3) Personnel and administration costs

Estimation of annual personnel costs is based on the required number of employees to manage and operate the future port facilities. Administration costs which include the welfare costs for labor and the general management costs are estimated as 50% of the personnel costs. Assumed numbers of personnel are as follows.

1) Multipurpose Terminal Project
  a) Administration personnel 223
  b) Loading/unloading division
    - Supervisor 12(1 persons*4beths *3 shifts)
    - Foreman 24(2 persons*4beths *3 shifts)
    - Winchman 36(3 cranes*4beths*3 shifts)
    - Tally clerk 36(3 persons*4berths*3 shifts)
    - Signalman 72(2 pesons*3 cranes*4berths*3 shifts)
    - Forklift operator 72(2 pesons*3 cranes*4berths*3 shifts)
    - Holdman 360(10 pesons*3 cranes*4berths*3 shifts)
  c) Total - Skilled labor 475
    - Unskilled labor(Holdman) 360

4) Grain Terminal Modernization Project
  a) Administration personnel 56
  b) Loading/unloading division
    - Supervisor 3(1 persons*3 shifts)
    - Foreman 3(1 persons*3 shifts)
    - Signalman 6(2 pesons**3 shifts)
    - Operator 12(2 persons*2 cranes*3 shifts)
    - Holdman 12(2 persons*2 cranes*3 shifts)
  c) Total - Skilled labor 80
    - Unskilled labor(Holdman) 12

Table 25.2.4 Personnel and Administration Costs (Unit: thousand LE)

	Multipurpose Terminal		Grain Terminal Modernization	
	Skilled Labor	Unskilled Labor	Skilled Labor	Unskilled Labor
No. of Personnel	475	360	80	12
Annual Wage	10.5	7.5	10.5	7.5
Personnel Costs	7,688		930	
Administration Costs	3,844		465	
Total	11,531		1,395	

25.3 Evaluation of the Project

25.3.1 Viability of the Project

(1) Calculation of FIRR

The result of the FIRR calculation is shown in Table 25.3.1. In all the projects, FIRR exceeds the weighted average interest rate of the funds. (5.275%)

Table 25.3.1 Result of FIRR Calculation

	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	Whole
FIRR	10.2% (Table25.3.2)	16.6% (Table25.3.3)	36.4% (Table25.3.4)	12.6% (Table25.3.5)

(2) Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes such as cargo volume, construction cost, inflation or exchange rate. The following cases are envisioned.

- Case 1 : The investment costs increase by 10%
- Case 2 : The revenues decrease by 10%
- Case 3 : The investment costs increase by 10% and the revenues decrease by 10%

The results of the sensitivity analysis are shown in Table 25.3.6. In all the cases, FIRR exceeds the weighted average interest rate of the funds (5.275%)

Table 25.3.6 Sensitivity Analysis for FIRR

	Multipurpose Terminal	Grain Terminal Modernization	Deep Water Coal Berth	Whole
Case 1	9.0%	15.1%	33.9%	11.4%
Case 2	8.9%	15.0%	33.6%	11.2%
Case 3	7.8%	13.6%	31.2%	10.0%

(3) Evaluation

Judging from the above, this project is regarded as financially feasible under the assumptions in chapter 25.2.

Table 25.3.2 FIRR of Multipurpose Terminal Project

(Unit : thousand LE)

	Revenue							Cost					Difference	Net Present Volume(NPV)		
									Expense							
Year	Sugar, Rice, Flour	Sawn Timber	Paper	Steel Products	Misc. (Shed)	Misc. (Yard)	Total	Investment	Maintenanc Cost	Managemen Cost	Re-investme Cost	Total	Revenue - Cost	Revenue	Cost	Revenue - Cost
1								27,318				27,318	-27,318		27,318	-27,318
2								3,035				3,035	-3,035		2,803	-2,803
3			Tq					119,349				119,349	-119,349		101,796	-101,796
4								157,949				157,949	-157,949		124,418	-124,418
5								142,807				142,807	-142,807		103,890	-103,890
6		20,850	5,039	7,104		14,355	47,348	6,215	3,826	11,531		21,572	25,775	31,811	14,494	17,317
7	1,897	23,498	4,619	8,850	-643	13,653	51,875		3,826	11,531		15,357	36,518	32,188	9,529	22,659
8	3,773	26,106	4,220	10,597	-1,285	12,929	56,340		3,826	11,531		15,357	40,983	32,286	8,800	23,485
9	5,650	28,755	3,820	12,309	-1,915	12,205	60,824		3,826	11,531		15,357	45,467	32,190	8,127	24,063
10	7,547	31,403	3,401	14,056	-2,557	11,503	65,352		3,826	11,531		15,357	49,995	31,942	7,506	24,436
11	9,424	34,011	3,001	15,802	-3,200	10,778	69,817		3,826	11,531		15,357	54,460	31,515	6,932	24,583
12	9,424	36,660	2,602	17,549	-3,829	10,076	72,481		3,826	11,531		15,357	57,124	30,216	6,402	23,814
13	9,424	39,308	2,182	19,261	-4,472	9,352	75,055		3,826	11,531		15,357	59,698	28,897	5,913	22,984
14	9,424	41,916	1,782	21,008	-5,101	8,628	77,657		3,826	11,531		15,357	62,300	27,612	5,460	22,152
15	9,424	44,565	1,383	22,754	-5,744	7,926	80,307		3,826	11,531	2,040	17,397	62,910	26,372	5,713	20,659
16	9,424	47,213	963	24,501	-6,386	7,201	82,915		3,826	11,531		15,357	67,558	25,146	4,657	20,489
17	9,424	49,821	564	26,213	-7,016	6,477	85,483		3,826	11,531		15,357	70,126	23,943	4,301	19,642
18	9,424	52,470	164	27,960	-7,658	5,775	88,134		3,826	11,531		15,357	72,777	22,798	3,972	18,825
19	9,424	55,118	-276	29,706	-8,301	5,051	90,722		3,826	11,531		15,357	75,365	21,673	3,669	18,004
20	9,424	57,726	-675	31,453	-8,930	4,349	93,346		3,826	11,531	31,800	47,157	46,189	20,595	10,404	10,191
21	9,424	60,374	-1,075	33,165	-9,573	3,625	95,940		3,826	11,531		15,357	80,583	19,549	3,129	16,420
22	9,424	63,023	-1,494	34,911	-10,202	2,900	98,561		3,826	11,531		15,357	83,204	18,547	2,890	15,657
23	9,424	65,319	-1,894	36,658	-10,845	2,198	100,860		3,826	11,531		15,357	85,503	17,529	2,669	14,860
24	9,424	67,954	-2,293	38,405	-11,488	1,474	103,475		3,826	11,531		15,357	88,118	16,608	2,465	14,143
25	9,424	70,589	-2,713	40,117	-12,117	772	106,071		3,826	11,531	2,040	17,397	88,674	15,723	2,579	13,144
26	9,424	73,186	-3,113	41,863	-12,760	48	108,649		3,826	11,531		15,357	93,292	14,874	2,102	12,771
27	9,424	75,821	-3,512	43,610	-13,389	-699	111,255		3,826	11,531		15,357	95,898	14,066	1,942	12,124
28	9,424	78,456	-3,932	45,356	-14,032	-1,401	113,872		3,826	11,531		15,357	98,515	13,296	1,793	11,503
29	9,424	81,053	-4,331	47,069	-14,674	-2,125	116,415		3,826	11,531		15,357	101,058	12,554	1,656	10,898
30	9,424	83,689	-4,731	48,815	-15,304	-2,850	119,044		3,826	11,531		15,357	103,687	11,856	1,529	10,326
Total	207,341	1,308,883	3,701	699,091	-191,420	144,201	2,171,796	456,674	95,642	288,281	35,880	876,477	1,295,320	573,785	488,860	84,925

FIRR = 10.2%

Table 25.3.3 FIRR of Grain Terminal Modernization Project

(Unit : thousand LE)

	Revenue			Cost					Difference	Net Present Volume(NPV)		
Year	Savings in Ship Staying Cost	Savings in Ship Waiting Cost	Total	Investment	Expense: Maintenance Cost	Expense: Management Cost	Expense: Re-investment Cost	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1				3,291				3,291	-3,291		3,291	-3,291
2				366				366	-366		318	-318
3				9,323				9,323	-9,323		7,032	-7,032
4				33,465				33,465	-33,465		21,920	-21,920
5				64,919				64,919	-64,919		36,929	-36,929
6	2,343	17,213	19,557	6,991	2,978	1,395		11,363	8,193	9,662	5,614	4,048
7	2,371	18,112	20,483		2,978	1,395		4,373	16,111	8,788	1,876	6,912
8	2,398	19,633	22,032		2,978	1,395		4,373	17,659	8,209	1,629	6,580
9	2,426	20,569	22,995		2,978	1,395		4,373	18,622	7,441	1,415	6,026
10	2,453	21,583	24,036		2,978	1,395		4,373	19,663	6,755	1,229	5,526
11	2,481	22,995	25,475		2,978	1,395		4,373	21,103	6,218	1,067	5,150
12	2,508	24,251	26,759		2,978	1,395		4,373	22,386	5,672	927	4,745
13	2,536	25,710	28,246		2,978	1,395		4,373	23,873	5,200	805	4,395
14	2,563	27,467	30,030		2,978	1,395		4,373	25,657	4,801	699	4,102
15	2,591	29,152	31,743		2,978	1,395		4,373	27,370	4,407	607	3,800
16	2,618	30,573	33,191		2,978	1,395		4,373	28,818	4,002	527	3,475
17	2,646	32,171	34,817		2,978	1,395		4,373	30,444	3,646	458	3,188
18	2,673	34,056	36,729		2,978	1,395		4,373	32,356	3,340	398	2,942
19	2,700	36,259	38,959		2,978	1,395		4,373	34,587	3,077	345	2,732
20	2,728	37,706	40,434		2,978	1,395	66,250	70,623	-30,189	2,773	4,844	-2,071
21	2,755	40,865	43,620		2,978	1,395		4,373	39,248	2,598	260	2,338
22	2,783	43,202	45,985		2,978	1,395		4,373	41,612	2,379	226	2,153
23	2,810	45,770	48,580		2,978	1,395		4,373	44,208	2,183	196	1,986
24	2,838	48,657	51,495		2,978	1,395		4,373	47,122	2,009	171	1,839
25	2,872	51,986	54,858		2,978	1,395		4,373	50,485	1,859	148	1,711
26	2,918	56,274	59,192		2,978	1,395		4,373	54,820	1,742	129	1,613
27	2,964	60,996	63,960		2,978	1,395		4,373	59,588	1,635	112	1,523
28	3,010	65,803	68,813		2,978	1,395		4,373	64,441	1,527	97	1,430
29	3,056	71,824	74,880		2,978	1,395		4,373	70,507	1,443	84	1,359
30	3,102	78,611	81,713		2,978	1,395		4,373	77,340	1,368	73	1,295
Total	67,144	961,440	#######	118,354	74,442	34,875	66,250	293,921	734,663	102,733	93,426	9,306

FIRR = 16.6%

Table 25.3.4 FIRR of Deep Water Coal Berth Project

(Unit : LE)

	Revenue		Cost			Difference	Net Present Volume(NPV)		
Year	Sea Transportation Cost	Total	Investment	Expense Maintenance Cost	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1			1,602		1,602	-1,602		1,602	-1,602
2			178		178	-178		135	-135
3			2,364		2,364	-2,364		1,352	-1,352
4			7,332		7,332	-7,332		3,170	-3,170
5			11,541		11,541	-11,541		3,773	-3,773
6	11,896	11,896	178	214	392	11,504	2,941	97	2,844
7	11,896	11,896		214	214	11,682	2,224	40	2,184
8	11,896	11,896		214	214	11,682	1,682	30	1,651
9	11,896	11,896		214	214	11,682	1,272	23	1,249
10	11,896	11,896		214	214	11,682	961	17	944
11	11,896	11,896		214	214	11,682	727	13	714
12	11,896	11,896		214	214	11,682	550	10	540
13	11,896	11,896		214	214	11,682	416	7	408
14	11,896	11,896		214	214	11,682	314	6	309
15	11,896	11,896		214	214	11,682	238	4	233
16	11,896	11,896		214	214	11,682	180	3	176
17	11,896	11,896		214	214	11,682	136	2	133
18	11,896	11,896		214	214	11,682	103	2	101
19	11,896	11,896		214	214	11,682	78	1	76
20	11,896	11,896		214	214	11,682	59	1	58
21	11,896	11,896		214	214	11,682	44	1	44
22	11,896	11,896		214	214	11,682	34	1	33
23	11,896	11,896		214	214	11,682	25		25
24	11,896	11,896		214	214	11,682	19		19
25	11,896	11,896		214	214	11,682	15		14
26	11,896	11,896		214	214	11,682	11		11
27	11,896	11,896		214	214	11,682	8		8
28	11,896	11,896		214	214	11,682	6		6
29	11,896	11,896		214	214	11,682	5		5
30	11,896	11,896		214	214	11,682	4		4
	297,402	297,402	23,196	5,341	28,537	268,865	12,050	10,292	1,757

FIRR = 36.4%

Table 25.3.5 FIRR of Whole Project

(Unit : thousand LE)

Year	Revenue				Cost				Difference	Net Present Volume(NPV)		
	Multipurp Terminal	Grain Terminal Modenization	Deep Water Coal Berth	Total	Multipurpos Terminal Project	Grain Terminal Modenization	Deep Wate Coal Berth	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1					27,318	3,291	1,602	32,212	-32,212		32,212	-32,212
2					3,035	366	178	3,579	-3,579		3,254	-3,254
3					119,349	9,323	2,364	131,036	-131,036		108,294	-108,294
4					157,949	33,465	7,332	198,746	-198,746		149,321	-149,321
5					142,807	64,919	11,541	219,266	-219,266		149,762	-149,762
6	47,348	19,557	11,896	78,800	21,572	11,363	392	33,327	45,473	48,929	20,694	28,235
7	51,875	20,483	11,896	84,254	15,357	4,373	214	19,943	64,311	47,559	11,257	36,302
8	56,340	22,032	11,896	90,268	15,357	4,373	214	19,943	70,325	46,322	10,234	36,088
9	60,824	22,995	11,896	95,715	15,357	4,373	214	19,943	75,772	44,652	9,304	35,348
10	65,352	24,036	11,896	101,284	15,357	4,373	214	19,943	81,340	42,954	8,458	34,496
11	69,817	25,475	11,896	107,189	15,357	4,373	214	19,943	87,245	41,326	7,689	33,637
12	72,481	26,759	11,896	111,136	15,357	4,373	214	19,943	91,193	38,952	6,990	31,962
13	75,055	28,246	11,896	115,197	15,357	4,373	214	19,943	95,254	36,705	6,355	30,351
14	77,657	30,030	11,896	119,583	15,357	4,373	214	19,943	99,640	34,639	5,777	28,862
15	80,307	31,743	11,896	123,946	17,397	4,373	214	21,983	101,963	32,639	5,789	26,850
16	82,915	33,191	11,896	128,002	15,357	4,373	214	19,943	108,059	30,643	4,774	25,869
17	85,483	34,817	11,896	132,196	15,357	4,373	214	19,943	112,253	28,770	4,340	24,429
18	88,134	36,729	11,896	136,758	15,357	4,373	214	19,943	116,815	27,057	3,946	23,111
19	90,722	38,959	11,896	141,577	15,357	4,373	214	19,943	121,634	25,464	3,587	21,877
20	93,346	40,434	11,896	145,676	47,157	70,623	214	117,993	27,683	23,819	19,293	4,526
21	95,940	43,620	11,896	151,456	15,357	4,373	214	19,943	131,513	22,513	2,964	19,549
22	98,561	45,985	11,896	156,442	15,357	4,373	214	19,943	136,499	21,140	2,695	18,445
23	100,860	48,580	11,896	161,336	15,357	4,373	214	19,943	141,393	19,819	2,450	17,370
24	103,475	51,495	11,896	166,866	15,357	4,373	214	19,943	146,923	18,635	2,227	16,408
25	106,071	54,858	11,896	172,825	17,397	4,373	214	21,983	150,842	17,546	2,232	15,314
26	108,649	59,192	11,896	179,737	15,357	4,373	214	19,943	159,794	16,589	1,841	14,748
27	111,255	63,960	11,896	187,111	15,357	4,373	214	19,943	167,168	15,700	1,673	14,026
28	113,872	68,813	11,896	194,581	15,357	4,373	214	19,943	174,638	14,842	1,521	13,321
29	116,415	74,880	11,896	203,191	15,357	4,373	214	19,943	183,248	14,090	1,383	12,707
30	119,044	81,713	11,896	212,653	15,357	4,373	214	19,943	192,709	13,406	1,257	12,148
Total	#######	1,028,584	297,402	#######	876,477	293,921	28,537	#######	2,298,848	724,710	591,572	133,138

FIRR = 12.6%

25.3.2 Financial Soundness of the Terminal Management Entity

The projected financial statements and financial indicators (the rate of return on net fixed assets, debt service coverage ratio, operating ratio and working ratio of the terminal management entity) with regard to the Short-term Development Plan are summarized in Table 25.3.6.

(1) Profitability
The rate of return on net fixed assets exceeds the weighted average interest rate of funds from year 6, the beginning of the operation.

(2) Loan Repayment Capacity
Throughout the project life, the debt service coverage ratio exceeds 1.0. This means that there will be no difficulty in repaying long-term loans from the annual operating revenues.

(3) Operational Efficiency
Both the operating and working ratios maintain favorable levels. It shows that the operation will be efficient.

25.3.3 Conclusion

Judging from the above analysis, all the projects are regarded as financially feasible. However, the terminal management entity should make continuous efforts to secure forecast cargo volume, to improve cargo handling efficiency and to reduce operating expenses.

Table 25.3.6 Financial Statements

Income Statement (Unit:tho

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Operating Revenue	0	0	0	0	0	78,800	84,254	90,268	95,715	101,284	107,189	111,136	115,197	119,583
Operating Expenses	0	0	0	0	0	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545
Personnel & Administration	0	0	0	0	0	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926
Maintenance	0	0	0	0	0	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017
Depreciation	0	0	0	0	0	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602
Net Operating Income	0	0	0	0	0	50,256	55,709	61,723	67,170	72,739	78,644	82,591	86,652	91,038
Interest on Long-term Loans	0	709	787	3,670	11,023	30,410	29,129	26,956	24,784	22,611	20,439	18,231	16,019	13,663
Net Surplus	0	-709	-787	-3,670	-11,023	19,846	26,581	34,767	42,387	50,128	58,205	64,360	70,633	77,375
Accumulated Earnings	0	-709	-1,496	-5,166	-16,189	3,657	30,238	65,005	107,392	157,519	215,724	280,085	350,718	428,093

Cash Flow

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cash Beginning	0	0	-709	-1,496	-5,166	-18,613	-4,713	15,486	43,873	79,878	123,625	173,839	230,029	285,939
Cash Inflow	32,212	3,579	131,036	198,746	219,266	72,241	64,311	70,325	75,772	81,340	87,245	91,193	95,254	99,640
Net Operating Income	0	0	0	0	0	50,256	55,709	61,723	67,170	72,739	78,644	82,591	86,652	91,038
Depreciation	0	0	0	0	0	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602
Long-term Loans	32,212	3,579	131,036	198,746	219,266	13,384	0	0	0	0	0	0	0	0
Cash Outflow	32,212	4,288	131,824	202,416	232,713	58,342	44,111	41,939	39,766	37,594	37,032	35,003	39,343	45,712
Investment	32,212	3,579	131,036	198,746	219,266	13,384	0	0	0	0	0	0	0	0
Repayment of principal	0	0	0	0	2,423	14,548	14,983	14,983	14,983	14,983	16,593	16,772	23,324	32,050
Interest on Long-term Loans	0	709	787	3,670	11,023	30,410	29,129	26,956	24,784	22,611	20,439	18,231	16,019	13,663
Cash Balance	0	-709	-787	-3,670	-13,446	13,899	20,200	28,386	36,006	43,747	50,214	56,190	55,911	53,927
Cash Ending	0	-709	-1,496	-5,166	-18,613	-4,713	15,486	43,873	79,878	123,625	173,839	230,029	285,939	339,867

Balance Sheet

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Current Assets	0	0	0	0	0	0	15,486	43,873	79,878	123,625	173,839	230,029	285,939	339,867
Cash & Deposit	0	0	0	0	0	0	15,486	43,873	79,878	123,625	173,839	230,029	285,939	339,867
Fixed Assets	32,212	35,791	166,827	365,573	584,839	589,622	581,020	572,419	563,817	555,216	546,614	538,012	529,411	520,809
Total Assets	32,212	35,791	166,827	365,573	584,839	589,622	596,507	616,291	643,695	678,841	720,453	768,041	815,350	860,676
Liabilities	32,212	36,499	168,323	370,739	601,028	585,965	566,269	551,286	536,304	521,321	504,728	487,956	464,632	432,583
Short-term Loans	0	709	1,496	5,166	18,613	4,713	0	0	0	0	0	0	0	0
Long-term Loans	32,212	35,791	166,827	365,573	582,416	581,251	566,269	551,286	536,304	521,321	504,728	487,956	464,632	432,583
Net Worth	0	-709	-1,496	-5,166	-16,189	3,657	30,238	65,005	107,392	157,519	215,724	280,085	350,718	428,093
Total Liabilities & Net Worth	32,212	35,791	166,827	365,573	584,839	589,622	596,507	616,291	643,695	678,841	720,453	768,041	815,350	860,676

Financial Indicators

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Rate of Return Fixed Assets						8.5%	9.6%	10.8%	11.9%	13.1%	14.4%	15.4%	16.4%	17.5%
Debt Service Coverage Ratio						1.31	1.46	1.68	1.91	2.16	2.36	2.61	2.42	2.18
Operating Ratio						36.2%	33.9%	31.6%	29.8%	28.2%	26.6%	25.7%	24.8%	23.9%
Working Ratio						25.3%	23.7%	22.1%	20.8%	19.7%	18.6%	17.9%	17.3%	16.7%

Table 25.3.6 Financial Statements

usand LE) (Unit:thousand LE)

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
123,946	128,002	132,196	136,758	141,577	145,676	151,456	156,442	161,336	166,866	172,825	179,737	187,111	194,581	203,191	212,653
28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545	28,545
12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926	12,926
7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017	7,017
8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602
95,401	99,458	103,651	108,214	113,032	117,131	122,912	127,898	132,791	138,321	144,281	151,192	158,567	166,037	174,647	184,108
11,115	8,811	8,254	7,761	7,268	6,775	6,281	5,788	5,295	4,802	4,309	3,815	3,322	2,829	2,336	1,842
84,286	90,647	95,397	100,452	105,764	110,356	116,630	122,109	127,496	133,519	139,972	147,377	155,245	163,208	172,311	182,266
512,380	603,027	698,424	798,876	904,640	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
339,867	396,187	472,582	554,160	640,794	732,740	731,228	834,040	942,331	#######	#######	#######	#######	#######	#######	#######
104,003	108,059	112,253	116,815	121,634	125,733	131,513	136,499	141,393	146,923	152,882	159,794	167,168	174,638	183,248	192,709
95,401	99,458	103,651	108,214	113,032	117,131	122,912	127,898	132,791	138,321	144,281	151,192	158,567	166,037	174,647	184,108
8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602	8,602
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47,682	31,665	30,674	30,181	29,688	127,245	28,701	28,208	27,715	27,222	28,768	26,235	25,742	25,249	24,755	24,262
2,040	0	0	0	0	98,050	0	0	0	0	2,040	0	0	0	0	0
34,527	22,854	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420	22,420
11,115	8,811	8,254	7,761	7,268	6,775	6,281	5,788	5,295	4,802	4,309	3,815	3,322	2,829	2,336	1,842
56,321	76,394	81,579	86,634	91,946	-1,512	102,812	108,291	113,678	119,701	124,114	133,559	141,426	149,389	158,493	168,447
396,187	472,582	554,160	640,794	732,740	731,228	834,040	942,331	#######	#######	#######	#######	#######	#######	#######	#######

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
396,187	472,582	554,160	640,794	732,740	731,228	834,040	942,331	#######	#######	#######	#######	#######	#######	#######	#######
396,187	472,582	554,160	640,794	732,740	731,228	834,040	942,331	#######	#######	#######	#######	#######	#######	#######	#######
514,248	505,646	497,045	488,443	479,842	569,290	560,689	552,087	543,486	534,884	528,323	519,721	511,120	502,518	493,917	485,315
910,435	978,228	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######
398,056	375,202	352,782	330,362	307,942	285,522	263,102	240,682	218,262	195,843	173,423	151,003	128,583	106,163	83,743	61,323
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
398,056	375,202	352,782	330,362	307,942	285,522	263,102	240,682	218,262	195,843	173,423	151,003	128,583	106,163	83,743	61,323
512,380	603,027	698,424	798,876	904,640	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######
910,435	978,228	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######	#######

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
18.6%	19.7%	20.9%	22.2%	23.6%	20.6%	21.9%	23.2%	24.4%	25.9%	27.3%	29.1%	31.0%	33.0%	35.4%	37.9%
2.28	3.41	3.66	3.87	4.10	4.31	4.58	4.84	5.10	5.40	5.72	6.09	6.49	6.92	7.40	7.94
23.0%	22.3%	21.6%	20.9%	20.2%	19.6%	18.8%	18.2%	17.7%	17.1%	16.5%	15.9%	15.3%	14.7%	14.0%	13.4%
16.1%	15.6%	15.1%	14.6%	14.1%	13.7%	13.2%	12.7%	12.4%	12.0%	11.5%	11.1%	10.7%	10.2%	9.8%	9.4%

Chapter 26 Improvement Plan of the Port Management and Operations

26.1 Principles of Port Management and Operations

26.1.1 Background on Management, Operations and Institutional Matters of Alexandria Port

Although Alexandria Port is a landlord port, cargo-handling operations have not necessarily been efficient owing to monopolistic operations by the state-owned companies. Private companies had been allowed to conduct only limited operations. However, recent decrees (including Decree No.30, May 1998) on private participation have dramatically changed this situation. Private companies are now able to participate in various maritime works including loading/discharging works, storage/warehouses activities, container activities and shipping agency services if they satisfy the conditions stipulated by the decrees, and private companies are getting licences stipulated by Decree No. 30.

26.1.2 Effective Measures to Promote Privatization and Private Sector Participation

(1) Effective Measures to Promote Private Sector Participation (PSP)

As explained before, it is essential for the government to induce private companies to participate in terminal operations within the port in order to secure swift and economical port services with high quality for port users. From this viewpoint, it is recommended that the government authorities concerned take the following measures.

1) Basic philosophy of PSP shall be established and reaffirmed among relevant agencies. In this case, the concept of “fairness of opportunity”, “transparency” and “competition” shall be emphasized
2) Legal framework (relevant laws and regulations) shall be arranged transparently so that private sector can participate in terminal operations as freely as possible.
3) In addition, legal framework regarding foreign investment shall be carefully considered. In this case, guarantee of rights of foreign investors shall be emphasized.
4) It is advisable for the government to establish guidelines for PSP based on clear legal frameworks.
5) The guidelines shall clarify working fields of port services that the private sector can participate in. It is advisable for the government to prepare project lists.
6) Competitive bidding needs to be promoted to select the responsive terminal operators beneficial to the national economy.
7) Desirable environment where private sector can easily take part in needs to be created.

(2) Measures to Mitigate the Impact brought by Privatization and Private Sector Participation

On the other hand, for the existing state-owned companies, privatization and subsequent competition among private companies would bring considerable impact on both management and employees due to possible restructuring and downsizing. They may opt to reduce their personnel.

In such cases, the following mitigation measures shall be taken

1) To conduct gradual and prudent restructuring so as not to cause social unrest due to unemployment.
2) To retrain the current employees so as to enable them to find new jobs.
3) To provide government assistance for displaced workers looking for new jobs
4) To generate new employment opportunity within the port through the increase in port capacity and promotion of new port business by APA

26.1.3 Reorganization to Encourage Competition in the Port Sector

(1) Principles of Private Participation and Privatization of State-Owned Companies

To improve cargo handling efficiency, it is necessary to introduce competition in the field of cargo handling operation. According to the new law, private companies can perform stevedoring operation using mechanical equipment at quay. All the companies could compete on equal conditions; encouraging competition between state-owned companies and private companies will improve the service level. As a method of privatization of state-owned companies, Egyptian Government opted to sell their shares to the public. If capital gain or dividend is not expected due to the poor performance of the company, nobody might be interested in subscribing for the shares. Therefore, the performance of the company must first be improved to attract potential investors.

(2) Monitoring the Performance of Operators

APA should monitor the performance of operators and recommend the improvement of productivity if the performance is poor and reject the renewal of lease contract if improvement is not expected. APA needs to put pressure on port operators to improve the productivity of operation.

(3) Financial Independence of Port Authority

Every year APA has to negotiate with the central government to decide the budget for APA. It is necessary to ensure that APA is independent or self-sustainable financially in order to spend its budget flexibly, timely or effectively in accordance with requirement.

26.2 Future Port Management and Operations

26.2.1 Improvement of Conventional Cargo Handling

(1) Establishment of Terminal Operators

It is necessary to establish terminal operators that perform general cargo handling operation comprehensively. APA should designate the new multi-purpose terminal, Timber Quay and Mamoudiya Quay as port terminal for handling conventional cargoes. These areas are divided into some portions and they are allocated to the terminal operators. Each terminal should have the appropriate size for conventional cargo handling and have open storage yards and warehouses for exclusive use. The following Table indicates the recommendable use of new terminals.

Terminal	Developer	Ownership & Port Management Body	Operator
New Multi-purpose Terminal	APA	APA	Private Companies

(2) Avoiding Direct Loading/Delivery

Currently, unloaded cargoes from a vessel are directly loaded onto trucks/trailers. Although this method reduces cargo damage during operation, productivity is lower than when landing on the quay. It is advised that this method should be adopted only for handling specific cargoes such as hazardous cargoes.

26.2.2 Measures to Mitigate the Impact on Barge Operators

Prior to constructing a new multi-purpose terminal, sawn timber landing operations from barges at quays Nos. 57-61 need to be relocated elsewhere in the harbor. For achieving gradual conversion of barge operation into quayside operation smoothly, it is proposed that the Government take the initiative in conducting measures to give barge operators licenses to perform quayside operation. In addition, it is recommended to provide retraining programs to obtain necessary knowledge, techniques or skills for quayside operation.

26.2.3 Improvement of Container Handling Operation

(1) Separating Alexandria Container Handling Company

The Government must sell some stakes (at least 25%) of the company to private companies interested in the container terminal business on an auction basis. By having the stakes of the container handling companies, it is possible for the private investors with superior experience of operating a private container terminal elsewhere to dispatch their executives and participate in management of the companies. These executives, as operational directors, must have enough authority to improve operational efficiency. It is expected that the private investors will introduce the most advanced equipment or technologies and know-how, and they will train personnel for efficient operation.

(2) Necessary Measures to Achieve the Targeted Productivity

It is required to achieve the targeted productivity (24 boxes/hour per crane) of container loading/unloading operation to handle the future container traffic in the existing facilities. In order to do so, the effective measures shall be prompted as explained in Chapter 18.

(3) Introduction of Advanced Technology

To improve the efficiency of container handling operation, it is essential to exchange information and communicate effectively between crane operators and the supervisor at the control center. The following systems for transmitting information are currently used at container terminals.

1) Radiotelephone (handy talkies) system
2) Mobile radio terminal on vehicle system
3) Mobile telephone system (PHS = Personal Handy phone System)
4) Global Positioning System (GPS)

(4) Introduction of Computer Systems

1) Container Inventory Control

Inventory control of containers stored in CY is the most important task in container terminal operation. It is essential to grasp the location and kind of containers stored in CY to operate a container terminal efficiently. Gate offices, yard control center and container handling equipment should be linked with each other to exchange information effectively and assure the accuracy of information on containers.

2) Container delivering/receiving control system

Gate offices of container terminal play important roles in receiving/delivering containers from/to shippers/consignees. In receiving an export container, it is important to decide its optimum location in CY based on the container's information for efficient operation. In delivering an import container, it is important to instruct the tractor/trailer driver to go to the location of the containers quickly and to inform the operator of container handling equipment of the tractor/trailer's arrival.

3) Loading/unloading operation control system

In loading export containers, it is very important to load containers based on the yard planning system by weight, port of discharge and container size for stability and safe navigation of vessels. Necessary information on containers should be obtained from shipping lines or agents as early as possible. Obtaining the information in advance enables a terminal operator to prepare the working schedule indicating the order of unloading/loading containers and to minimize the operation time.

(5) Minimizing the Breakdown Time of Container Handling Equipment

To achieve the targeted productivity, it is essential to minimize the breakdown time of container handling equipment. Competent personnel should be appointed as a yard operator. This yard operator should always stand by in the terminal office to monitor both loading/unloading and yard operation. To minimize the breakdown time of quayside gantry crane or RTG, backup spreaders must be procured. It is also advisable to conduct preventive maintenance at a regular interval.

26.2.4 Others

(1) Introduction of Computer Systems Concerning Documentation

Computerization in many fields such as documentation, berth assignment, accounting, administration work and personnel management as well as statistics will make it unnecessary to enter the same information on other documents and possible to use repeatedly the information once fed into computers.

(2) Preventing Traffic Congestion

At the passenger terminal, where many conventional cargo vessels berth, it is very difficult to secure sufficient space for marshalling area for break bulk cargo handling by forklifts. It is necessary to prepare a waiting area for trucks, where a truck driver stays with a mobile phone or walkie-talkie to communicate with a foreman.

(3) Gate Traffic Control

Truck/trailers carrying timber must pass through Gate No.54. It takes three minutes to finish measuring the volume of timber on one truck. However, more than ten trucks make lines in front of the gate, causing traffic congestion. Furthermore, since Gate No.54 allows two-way traffic, incoming vehicles not related to cargo transport make the congestion around the gate worse. It is necessary to maintain one-way traffic only for outgoing cargo trucks at Gate No.54 as incoming vehicles can pass through another gate, No.46.

(4) Simplifying Physical Inspection of Customs Clearance

The number of samples for physical inspection is approximately 10 % of the whole consignment. To speed up customs clearance, the ratio of sample check should be 5%. At first, customs officers should select and inspect only one container physically regardless of the volume of consignment. If they do not find contraband in this container, they should end the physical inspection.

(5) Reducing Empty Containers in the Port Area

Due to the imbalance between import containers and export containers, there are many empty containers at Alexandria port, which are stacked outside the container terminal in the port area. It is necessary to reduce empty containers in the port area by making the container storing charge greater than that of the yard outside the port.

(6) Removing Wrecked Ships in the Port Area

A lot of wrecked ships are found inside the water area of the Alexandria port. Some of them are staying in the Coal Basin. They are obstacles to developing the new multi-purpose terminal. Before construction of the new multi-purpose terminal, it is required to remove the wrecked ships at the expense of owners. However, in many cases, APA has no choice but to remove the wrecked ships at its own expense. Procedure for removing the ships needs to be expedited.

(7) Port Environmental Improvement Action Plan

The Alexandria port water and sea bed material are severely polluted and it would require genuine concerted effort by APA to reserve this seeming trend of ever continuing indiscriminate disposal of wastes. At first pollution control due to the direct ship movement and cargo handling be given the highest priority. APA is legally bound to provide ballast and bilge waste treatment plant.Ballast and Bilge Waste Treatment System is provided by this master plan to treat the ballast and bilge waste generated in the port except the petroleum basin.

Chapter 27 Environmental Impact Assessment (EIA)

27.1 Introduction

The target year of the master plan and rehabilitation scheme of the Greater Alexandria Port is 2017 and that of the Short-term Development Plan (SDP) forming the initial development phase of the master plan is 2007. A detailed description of the facilities of the master plan is presented in Chapter 15 and the corresponding initial environmental examination (IEE) of the master plan in Chapter 19, of Part III. Moreover, the project components of the SDP are elaborated in Chapter 20 and preliminary design of the facilities in Chapter 21, followed with construction planning, scheduling and project cost estimation in Chapters 22 and 23.

The environmental impact assessment (EIA) is principally aimed at identification, evaluation of significance and appropriate mitigation measures against potential adverse effects due to the execution of the significant project components of the SDP (short-term development plan). In this respect this EIA could also be regarded as a detailed delineation of the IEE of Chapter 19, but targeting only the significant project components of SDP. A significant project component is defined as a project having significant project activity and hence has significant potential to cause adverse environmental effects or a project by its nature alone has significant potential to cause adverse environmental effects.

Essentially based on the scale of the project, the following four (4) project components of the SDP illustrated from Section 20.7 to Section 20.10 of Chapter 20 are selected as significant projects to be subjected to EIA.

- Multipurpose Terminal Project
- Deep Water Coal Berth Project
- Grain Terminal Modernization Project
- New Port Road Bridge Project

It is noted that there are two (2) significant port safety and environmental improvement projects of the SDP. They are the provision of waste oil (ballast and bilge waste) treatment system and a modern VTMS (Vessel Traffic Management System) type navigation system. Though the scale of these projects is small their environmental benefits are highly significant and are not subjected to this EIA. Nevertheless, their environmental benefits are illustrated under IEE in Chapter 19.

27.2 Baseline Environmental Condition of the Port

The baseline environmental condition and the relevant environmental issues of the port area are described in details in Chapter3. The port water quality is visibly deteriorated. This is confirmed from the sampling results of sea water and seabed material quality conducted by the Study Team. As per the port sea water quality, high suspended solids level in the range of about 1000-4000 mg/l was measured. Also high oil and grease level mostly exceeding 10 mg/l was measured. Concerning the seabed material quality, details could be referred to the supplemental environment survey, conducted by the Study Team on depth-wise variation in seabed material quality in the offshore SDP area, illustrated in Section 3.5 of Chapter 3.

The causative elements for this severe water pollution problem of the port are very complex due to very long operational history of the port and a variety of potential pollution sources involved. The variety of pollution sources is both due to direct port operational activity as well as indirect non-port activities attributed to land based industrial, agricultural and domestic pollution load run-off into the port waters. The environmental issues concerned to these pollution sources of direct port operational activity and that of indirect non-port activity are illustrated respectively in section 3.3.1 and section 3.3.2 of Chapter 3.

Still, it is noted that the pollution sources of indirect non-port activity have been steadily declining with the progressing sewerage development of the Alexandria city, though there are still some sewage out-falls discharging directly into the port water environment. Even concerning these remaining sewage out-falls they are suspected of discharging significant quantity of wastewater originating from the land based port administrative buildings and other facilities directly concerned to port operational activity. So it is high time for the port authority (APA) to undertake its own clean-up measures to control the pollution sources of port water environment due to direct port operational activity. In this respect the provision of waste oil (ballast and bilge waste) treatment plant by this SDP is an important step in source targeted port water pollution control measure due to direct port operational activity.

The supplemental environment survey on vertical profile variation in seabed material quality described in Section 3.5 of Chapter 3 has much relevance in defining the baseline environmental quality of the project area of this SDP. This is in consideration to the fact that the off-shore port water area involving potential dredging for three (3) major project components of this SDP, other than the on-land project component of New Port Road Bridge Project, constituted this supplemental survey area. This could be visualized from Fig. 3.5.1 of Chapter 3 indicating the sampling locations.

The results of analysis of this supplemental survey and the corresponding evaluation in depth-wise variation in seabed material quality are shown respectively in Table 3.5.1 and Table 3.5.2 of Chapter 3. For the purpose of evaluation of seabed material quality the Dredged Material Quality Standards of Netherlands (1987), as referred to in the World Bank publication on Environmental Considerations for Ports and Harbor Developments (1990), was used.

The analysis results clearly indicated overall decrease in heavy metal content with increasing depth of seabed. The results of evaluation on the depth-wise variation in seabed material contamination level with respect to heavy metallic elements indicated that the seabed material up to a maximum depth of one (1) meter in the SDP area is contaminated beyond allowable limit. The allowable limit is the maximum heavy metal content level for simple unconstrained deep-sea disposal of dredged material as per the

Netherlands Standards. Accordingly, at-least this contaminated 1meter top layer of the seabed material consequent to dredging requires controlled disposal in a designated confined area.

The above state of seabed material quality and its depth-wise variation in contamination level clearly demonstrated the degraded nature of baseline environmental quality of the port.

From the above discussion it is evident that the port water environmental quality deterioration is severe and its improvement would require long-term programs targeting the control of pollution sources of both due to direct port operational activity and indirect non-port activity. In this respect the required environmental improvement action program for the port is delineated in Section 18.10 of Chapter 18, Part III.

It is emphasized that the required entire environmental action programs are amenable for early independent implementation, though they are essentially beyond the scope of this master plan. Still, the provision of waste oil (ballast and bilge waste) treatment system by this SDP would contribute very significantly to the long-term port water environmental improvement. This waste oil treatment system is intended at mitigating ship-borne oil pollution attributed to direct port operational activity, an important source targeted pollution control measure.

27.3 Description of the Project

A pertinent brief description on each of the four (4) significant project components of the SDP (short-term development plan) of the port until the year 2007, selected for the conduct of EIA (environmental impact assessment), is given below. The four (4) significant projects are, namely, Multipurpose Terminal Project, Deep Water Coal Berth Project, Grain Terminal Modernization Project and New Port Road Bridge Project. The former three (3) projects are offshore terminal related projects while the remaining one (New Port Road Bridge Project) is on-land based. Moreover, only the three (3) offshore projects involve dredging work. This offshore and on-land distinction is used to determine the chronological sequence of the four projects in this chapter on EIA. This sequence is different from that used in sections 20.7 through 20.10 of Chapter 20 on detailed project description of the above four project components.

27.3.1 Multipurpose Terminal Project

The Multipurpose Terminal Project is basically aimed at the provision of a spacious open yard to facilitate handling on a priority basis, specialized conventional cargo such as long, heavy and bulky cargo, thereby increasing the overall efficiency of conventional cargo handling in the Alexandria port. The layout of the Multipurpose Terminal is shown in Fig. 20.7.1 of Chapter 20 and an imagery of the terminal in Fig. 15.8.6 of Chapter 15. The offshore area of the terminal will have a minimum seabed level of 14m below the datum level to ensure sufficient draft for direct access by Panamax type bulk carriers (ships of 65,000 DWT). This project is the largest among the all three offshore terminal related projects, since an entirely new multipurpose terminal having a total of six (6) berths will be constructed as per the master plan until the year 2017. However, by this project as per the SDP until the year 2007 only four (4) of the six (6) berths will be constructed. Also significant installation work of the project include the provision of 2 multipurpose QGCs (quayside gantry cranes).

The total project includes in-addition to the new multipurpose terminal (about 740m in length and 400m in width), the common area to facilitate simultaneous independent maneuvering of two ships with a maximum LOA of 230m. These ship maneuvering areas are denoted as two circular areas each having a diameter of 460m in Fig. 20.7.1. This common area adjacent to all three (3) offshore terminal related project components of the SDP, except the on-land New Port Road Bridge Project, will be deepened with dredging to have a minimum seabed level of 14m below the datum level, if required. This is also to ensure sufficient draft for direct access by Panamax type bulk carriers to all three offshore terminals of this SDP. In fact the seabed of this common area is mostly deeper than 14m and hence the dredging requirement in this common area is not very significant.

The dredging work of this common area though encompasses the surroundings of all three offshore terminals of this SDP, for practical purpose it is treated as a single dredging work item and incorporated as an integral component of this Multipurpose Terminal Project. Still the most significant quantity of dredging work would be for creation of the new multipurpose terminal that requires a maximum depth of excavation of about 13m of seabed. The seabed material is of clayey soil type having poor geotechnical characteristics to be the basic supporting material for the basement of the new terminal. Hence the seabed material below the basement of the terminal will be removed and replaced initially with sand, which will be followed with the reclamation, quay-wall construction and other works for the subsequent creation of the new multipurpose terminal. The total quantity of dredging for this project component, including that of common area, is estimated at about 1.74 million m3. This dredging quantity is the largest among all three offshore project components of SDP (short-term development plan).

A typical section of the new multipurpose terminal illustrating its structural elements is shown in Fig. 21.2.1 and Fig. 21.2.2 of Chapter 21.

The significant activities involved during the civil work construction of the new multipurpose terminal, including dredging and other auxiliary work, are as follows;

- Transportation of equipment and material for construction and installation work
- Dredging for basement (foundation) of the terminal (multipurpose terminal)
- Back-filling of basement (foundation)
- Basement for crane installation
- Quay-wall and revetment construction
- Back-filling and reclamation of the terminal
- Dredging of common area
- Disposal of dredged material as appropriate including related structures
- Construction of fly-over bridge

- Roads, paving, terminal lighting, bollard and other final auxiliary work including sheds

The significant equipment and installation related work includes installation of multipurpose gantry cranes (2 units) and the provision of forklifts (24 units).

27.3.2 Deep Water Coal Berth Project

The Deep Water Coal Berth Project is basically aimed at deepening the seabed level of the existing coal (a dry-bulk cargo) berth in the Alexandria port to 14m below datum level, with minimum investment, to facilitate direct access by Panamax type bulk carriers. Accordingly, the new construction work in the coal berth is planned to a minimum with maximum permissible utilization of existing infrastructure in the berth, including the cargo (coal/coke) handling and storage facilities. The location of the Coal Berth is adjacent to the proposed new Multipurpose Terminal as shown in Fig. 20.7.1 of Chapter 20.

The existing (concrete block gravity type) coal berth will be extended offshore by about 10m, the maximum possible extendable breadth for the berth so that the existing rail mounted unloaders in the berth could be continuously used without replacement. The length of the berth will be 270m. Hence the new civil construction work in the existing coal berth, the only significant work of this project component, will be the creation of an additional open deck type (non-reclaimed) berth area of about 10m width and 270m length with a deepened water depth of 14m. With this 10m extension, the amalgamated overall breadth of the expanded coal berth would become about 32m. Since the extension of the berth with open deck does not involve any dredging work concerned to the basement, unlike the multipurpose terminal of above, the required quantity of dredging for this project component is the lowest among the all three (3) offshore components of this SDP. The total quantity of dredging is estimated at only about 70,000 m3.

A typical section of the deep and expanded coal berth by this project illustrating its structural elements is shown in Fig. 21.2.4 of Chapter 21.

The significant activities involved during the civil work construction of the coal berth, including dredging and other auxiliary work, are as follows;

- Transportation of equipment and material for construction and installation work
- Dredging of the seabed area in the extended coal berth area
- Basement for the extended open deck type berth area
- Reinforced concrete platform of the open deck type berth area
- Disposal of dredged material as appropriate including related structures
- Paving, bollard and other final auxiliary work

27.3.3 Grain Terminal Modernization Project

Basically the objective of the Grain Terminal Modernization Project is very similar to that of the above two (2) project components, Multipurpose Terminal project and Deep Water

Coal Berth project. The project is intended at creating a new modern grain (also a dry-bulk cargo) handling terminal, adjacent to the underutilized grain terminal, having direct access for Panamax type bulk grain carriers (65,000 DWT). Hence the offshore area of the terminal (berth) will have a minimum seabed level of 14m below the datum level. The length of the berth will be 270m. The terminal will be constructed by reclaiming the enclosed inner portion of the offshore area of the existing breakwater. It is noted that the modernized terminal will lead to effective utilization of the existing grain silos sited near the new terminal. The location of the new grain terminal project area is near the Petroleum Basin as shown in Fig. 20.7.1 of Chapter 20.

It is noted that similar to that of new multipurpose terminal project (section 27.3.1), creation of the new modernized grain terminal would also involve significant quantity of dredging work requiring a maximum depth of excavation of about 13m of seabed. The seabed material is of clayey soil type having poor geotechnical characteristics to be the basic supporting material for the basement of the new terminal. Hence the seabed material below the basement of the terminal will be removed and replaced initially with sand, which will be followed with the reclamation, quay-wall construction and other works for the subsequent creation of the new modernized grain terminal. Still the total quantity of dredging is significantly lower than that of the multipurpose terminal project (refer to section 27.3.1) mainly due to smaller area requirement for the new grain berth. The total quantity of dredging is estimated at about 317,000 m3.

A typical section of the new modernized grain terminal illustrating its structural elements is shown in Fig. 21.2.3 of Chapter 21.

The significant activities involved during the civil work construction of the new grain terminal, including dredging and other auxiliary work, are as follows;

- Transportation of equipment and material for construction and installation work
- Dredging for basement (foundation) of the grain terminal
- Back-filling of basement (foundation)
- Basement for mechanical unloader installation
- Quay-wall and revetment construction
- Back-filling and reclamation of the terminal
- Disposal of dredged material as appropriate including related structures
- Paving, bollard and other final auxiliary work

Significant equipment installation work of the project include the provision of 2 mechanical unloaders and conveyor of 750m length connecting the new grain terminal with the existing silos.

27.3.4 New Port Road Bridge Project

The New Port Road Bridge is intended as an effective link between Berth No.32 and Berth No.33 of the Alexandria Port across the water underneath and the only significant land based project component of SDP until the year 2007. Still the scale of this project is the smallest among the four (4) project components of SDP. This new bridge would essentially replace the existing old bridge prohibited for passage by heavy weight trucks due to its precarious condition. The span length of the new bridge is 90m having 4 lanes with 2 lanes in each direction and is essential to ensure efficient overall operation of the new multipurpose terminal illustrated in foregone section 27.3.1. This new bridge will eliminate unwanted detour of port related heavy trucks through congested Alexandria City center. The layout of the New Port Road Bridge is shown in Fig. 20.9.1 of Chapter 20.

A typical section of the new port road bridge illustrating its structural elements is shown in Fig. 21.2.5 of Chapter 21.

The significant activities involved in the new bridge project are basically confined to the civil work construction works and are as follows;

- Transportation of equipment and material for construction and installation work
- Basement/foundation of the bridge with concrete abutment (bridge substructure)
- Steel truss superstructure of the bridge
- Reinforced concrete carriage way and other related works of walkway
- Paving, lighting and other final auxiliary work

27.4 Environmental Impacts and Mitigation

In general environmental impacts by a project are caused due to activities involved in the execution of the project concerned. Three significant stages of a project execution (implementation) are;

- Pre-construction stage
- Construction stage
- Post-construction (Operation) stage

The activities involved and the relevant environmental impacts during each of the above three (3) stages of a project execution are distinct. In particular, impacts during construction stage of a project are essentially of short term (temporary) in nature being confined to the duration of the construction activities while those of operation stage are potentially of long term (permanent) in nature. It is noted that most temporary impacts due to construction activities could be managed and minimized, if not entirely eliminated, with careful planning and execution of the construction/installation works. Potential environmental impact during pre-construction stage of a project is principally social aspects in nature, and caused by potential land acquisition and the subsequent housing compensation and resettlement issues, if any.

All the land areas and the coastal waters assigned to all four (4) project components of this SDP (short-term development plan) targeted for EIA (environmental impact assessment) belong to APA (Alexandria Port Authority) and confined within the existing port boundaries. Hence no land acquisition or resettlement is involved, and the potential adverse effects during the pre-construction stage of the SDP as a whole are evaluated as insignificant. Consequently in the subsequent sections relevant impacts and mitigation measures for each of the 4 significant components of the SDP, during the construction and operation (post-construction) stages only are elaborated.

27.4.1 Multipurpose Terminal Project

(1) Construction activity impacts

This being the largest project in which an entirely new terminal of 740m in length and 400m in width having 4 berths (as per the SDP until 2007) is constructed has the potential for significant construction related adverse effects, particularly on the surrounding port water environment. Still any adverse effect would only be temporary and to be assessed realistically in comparison to the existing (baseline) water quality of the port, which is evaluated as highly polluted.

Construction activities having potential to cause water quality deterioration principally due to increased turbidity (suspended solids level) are dredging of seabed, back-filling and reclamation for the new terminal area.

In fact potential adverse effects due to dredging are most significant since the adverse effects would cover, in addition to increased water turbidity, the following;

- Noise nuisance attributed to operation of the dredger
- Probable encounter and potential damage of any buried archeological treasure
- Remobilization of contaminants within the sediment to water environment since the seabed material is contaminated with heavy metal
- Odor nuisance associated with exposure of anoxic sediment to ambient environment
- Since the dredged material is contaminated its disposal may adversely affect the disposal area and hence would require careful planning
- Dredging and the subsequent disposal of dredged material would affect the biota (fauna and flora) inhabiting the concerned seabed areas of these project related activities.

It is noted that the above potential adverse effects concerned to dredging are basically common to all 3 offshore projects of SDP, other than the New Port Road Bridge Project, since all these projects involve dredging work, though of varying degree. This is evident from the project activities delineated in the foregone section 27.3.

Other potential adverse effects concerned to the overall execution of the construction works for this new multipurpose terminal are as follows;

- Transportation of construction material and equipment may interfere with regular road traffic and as well as traffic within the port area. Also transportation of fine particulate construction materials such as sand may cause dust nuisance
- Construction works may interfere with the regular ship and vessel movement within the port water area
- Construction and installation works would cause dust, noise and vibration effects

Again it is emphasized at-least some of the above adverse effects would be encountered with the other project components of SDP as well.

(2) Construction impact mitigation

The significance of impacts and conceivable mitigation measures for each of the significant construction related activity is illustrated below. The significant construction related activities of the new multipurpose terminal are categorized into the following five (5) groups.

- Material and equipment transportation activity
- Dredging activity
- Dredged material disposal activity
- Back-filling and terminal reclamation activity
- Overall construction and installation activity

1) Material and equipment transportation activity

Potential interference with regular traffic outside the port area, the city center area of Alexandria, consequent to the transportation of construction and installation related equipment and material could be mitigated by adopting off-peak and nighttime hours for the transportation of items in bulk quantity. Interference with road traffic within the port area is somewhat inevitable, but still could be minimized by reserving specific port gates and routes for traffic concerned to construction work. Using covered transportation trucks could mitigate potential spread of dust nuisance concerned to the transportation of fine particulate materials such as sand. If open truck/trailer transportation is inevitable, vinyl sheet covering shall be a mandatory minimum requirement.

2) Dredging activity

As pointed out under the project description in section 27.3.1 of above, dredging work for the creation of the new multipurpose terminal is very significant requiring a maximum depth of excavation of about 13m of seabed.

The water quality deterioration due to increased turbidity by dredging is evaluated as insignificant since the effect will be principally limited to the inner port water area confined by the outer breakwater structure. Moreover, baseline port water quality is severely deteriorated and hence the added temporary adverse effect by increased turbidity on port water quality is considered as not significant.

Potential noise nuisance due to dredger operation is evaluated as insignificant since it will be confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is tolerable.

There is no known previous finding of buried archeological treasures (artifacts) in the offshore area of the Alexandria port. Still, in consideration to the rich historical and cultural heritage of the city, the probability of encountering artifacts during dredging, in particular the deep seabed dredging for the basement of the new terminal with a maximum excavation depth of 13m, has to be anticipated. Accordingly, dredging work need to be proceeded with care so that any buried artifact could be recovered with minimum damage. In case any artifact is encountered dredging work shall be suspended until a professional archeological survey is carried out to retrieve any remaining buried artifacts. In particular, the dredger operator shall be made aware of the delicate nature of the dredging operation, having the possibility of encountering artifacts.

Concerning the remobilization of contaminants during dredging it is inevitable to some extent since the surface layer of seabed is significantly contaminated with heavy metal constituents. Still, adverse effect is evaluated as insignificant in consideration to the planned disposal area for the contaminated sediments and the proposed sequential execution of the dredging work. The dredging work will be sequenced so that the contaminated 1m depth surface layer of the seabed will be dredged initially which will then be followed with the dredging of uncontaminated deeper layers of the seabed. The planned contaminated dredged material disposal area is located by the side of the outer breakwater structure, within a maximum transportation distance of 2 km. Accordingly, exposure time of sediments to aerobic environment, the principal cause of remobilization of contaminants, would be limited both due to short transportation distance and sequential dredging, in which contaminated surface layer will be dredged and transported first, as illustrated above. Moreover, any remobilization will be limited to the polluted inner port water area confined by the breakwater structure. Details concerning the confined contaminated dredged material disposal area in the form of an artificial island are provided in the subsequent item on “dredged material disposal activity”.

Potential odor nuisance due to the exposure of anoxic dredged material to aerobic environment would be mostly limited to the contaminated seabed surface sediments. Nevertheless, in consideration to the open sea environment and well as the limited exposure time of contaminated dredged material until its disposal as delineated above, any adverse effect is considered as insignificant.

3) Dredged material disposal activity

The dredged material disposal is a very important environmental issue concerned to the execution of not only this Multipurpose Terminal Project but also that of the other two (2) offshore projects of the SDP, other than the on-land New Port Road Bridge Project. This is due to the fact that all three (3) offshore projects involve dredging work and the surface layer of the seabed material of the port is contaminated with heavy metals. As evident from section 27.2 on Baseline Environmental Condition of the Port, up to a maximum depth of 1m of the seabed area of the Port targeted for dredging need to be considered as contaminated and hence not amenable for unrestrained open deep sea disposal.

A dredged material confinement facility in the form of an artificial island will be provided to contain the seabed material dredged from the surface layer up to a depth of 1m in anoxic condition. In fact this artificial island will contain the entire dredged material arising from the execution of all three offshore project components of this SDP and hence will be a common element of this SDP. The planned location of this artificial island type confinement facility is adjacent to the outer breakwater structure within the inner port area as schematically shown in Fig.15.2.1 of Chapter 15. Moreover, typical structural details of the confinement facility are shown in Fig. 22.1.1 and Fig.22.1.2 of Chapter 22. It is noted that the initial base layer of this artificial island will be made of the dredged material derived from the dredging of the contaminated 1m depth surface layer of the seabed material. This base layer will then be covered with cleaner uncontaminated dredged material dredged from a depth deeper than 1m of seabed, thereby forming the artificial island. This sequential artificial island creation procedure would ensure that the disposed contaminated dredged material remained under anoxic condition in the form of buried subsoil.

The anoxic status of the contaminated sediment in the form of buried subsoil of the artificial island would mitigate remobilization of the heavy metal contaminants to the surrounding water environment thereby preventing their bio-availability. Bio-availability of heavy metal constituents and their subsequent metabolism and accumulation in the food-chain of higher order marine biota such as fish is the important environmental concern of heavy metal contamination. It is noted that the baseline condition of the inner port area within the outer breakwater structure area is contaminated, which further justified the location of the proposed dredged material confinement facility in the form of an artificial island.

The above carefully formulated mitigation plan is evaluated as the most suited economically and environmentally viable means to contain the contaminated dredged material. Also the created upper layers of the artificial island will contain uncontaminated soils derived form the dredging of deeper layers of the seabed of the three offshore project areas of this SDP.

Finally it is noted that the dredging activity and the subsequent creation of an artificial island using the dredged material would adversely affect the biota (fauna and flora) inhabiting the targeted seabed areas. Still since the seabed is contaminated any limited loss of the potentially contaminated seabed biota is evaluated as ecologically insignificant. In fact the creation of an artificial island having uncontaminated surface layer on an originally contaminated seabed is considered as a limited beneficial effect, since in the process at-least the contaminated sediments in all three offshore project areas of this SDP is removed and buried. In effect this dredging work represents a limited, though unintended and impermanent, cleanup of the dredged seabed area.

4) Back-filling and terminal reclamation activity

Similar to that of dredging activity illustrated under Item 2) of above, the most significant potential adverse effect of this activity on the surrounding port sea water quality would be increased turbidity. Still the effect would be temporary and confined to the inner port waters within the outer breakwater structure. Moreover, in consideration to the degraded baseline port water quality any added water quality deterioration by increased turbidity is considered as insignificant.

The steel pipe pile (SPP) driving work for the basement (foundation) of the quayside gantry crane (QGC) of the terminal is considered to be the most significant activity to cause potential noise and vibration. Still, any adverse effect will be mostly confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is admissible, as also pointed out under Item 2) on “dredging activity”. Still, all activities with high potential to cause significant noise and vibration like pile driving could be restricted to day-time only to minimize the inherent adverse effect in the form of an “environmentally responsible means of construction planning”.

5) Overall construction and installation activity

The most significant potential adverse effect attributed to the overall construction and installation works of the new multipurpose terminal, in particular the construction works, is the interference to regular ship movement and hence cargo handling in the port area. Even though interference to some degree may be inevitable and shall be tolerated, still it could be minimized with careful stage-wise planning of the construction work. In particular limiting and optimizing the activity area targeted for construction work at a time shall be an integral part of the construction plan. In case interference is inevitable, reallocation of affected vessels to alternative berths, including those in Dekheila Port, could be adopted.

Potential noise and vibration is inevitable with respect to the miscellaneous construction and installation works, in particular with respect to the installation of quayside gantry cranes. Still, any adverse effect will be mostly confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is admissible, as also pointed out under Item 4) of above. Still, all activities with high potential to cause significant noise and vibration could be restricted to day-time only to minimize the inherent adverse effect in the form of an “environmentally responsible means of construction planning”.

Potential dust generation due to the construction works of the new terminal is considered as not very significant since under-water works constitute the major portion of construction works. Still acute dust generation may be controlled with targeted water spraying of potential dust emission sources, again in the form of an “environmentally responsible means of construction planning”.

(3) Operation activity impacts

Effective operation of the new multipurpose terminal requires the functioning of the new port road bridge to be constructed as per this SDP and described in Section 27.3.4. Accordingly, construction of both of these project facilities would essentially occur in tandem, so that their operation could commence in tandem as well. The new port road bridge is essential for the efficient transportation of the ship-borne cargo from the new multipurpose terminal, thereby ensuring the effective use of the new multipurpose terminal. Accordingly, this new multipurpose terminal operational activity impact assessment is made under the condition that both of these project facilities are fully operational as planned by the SDP (short-term development plan).

Potential adverse effects concerning the operation of the new terminal are as follows;

- Increased cargo handling and transportation may lead to potential ambient air quality deterioration due to increased exhaust gas emission inherent to increased operation of cargo handling machinery and transportation trucks
- Increased traffic may lead to traffic congestion and hence inefficient use of the new terminal
- Periodic maintenance dredging may be required in and around the offshore terminal area of the terminal, including the common area as illustrated in section 27.3.1, in order to maintain the design water depth of 14m below datum level, resulting in the generation of potentially contaminated dredged material requiring controlled disposal. In fact this maintenance dredging issue is common to all three (3) offshore project components of SDP.

(4) Operation impact mitigation

The potential ambient air quality deterioration due to increased emission of air pollutants is evaluated as insignificant in consideration to the favorable topographic condition of the new multipurpose terminal area having open-air environment with active exchange of air between land and sea. It is noted that in general since ports are located invariably along sea coast, ambient air quality deterioration is not a serious concern due to their favorable topographic location having active exchange of air between land and sea and the resultant diffusion and dispersion of air pollutants. Accordingly no specific mitigation measures against ambient air quality deterioration is proposed. Still, it is recommended to establish an ambient air quality monitoring station within the port by APA. In fact the existing wind observatory in the port could amalgamate ambient air quality measurement as well.

No significant traffic congestion is expected, provided a proper operational management of the new terminal is ensured. It is noted that the terminal is designed with vast open space. Also the required cargo handing machinery of QGCs (quayside gantry cranes) and forklifts to facilitate efficient cargo handling is provided. Operational training of management personnel of the terminal prior to the beginning of the terminal operation is the basic requirement to ensue proper operation of the terminal and hence to mitigate traffic congestion. Such a training program may include, among others, trial operational runs for the terminal. Still, traffic congestion in the terminal area may occur in the course of operation, at times under inevitable circumstances. Any significant event of traffic congestion shall be investigated to confirm its inevitability and to undertake the required remedial measures as appropriate if the cause of traffic congestion is found to be otherwise. The key to mitigate traffic congestion in the new terminal and hence to facilitate efficient operation of the terminal is to ensure that all traffic rules and regulations in the terminal such as parking spaces, loading and unloading areas and others are duly adhered to.

Concerning potential siltation of the dredged seabed area of the new terminal, dredged to 14m below datum level as the design depth, there are no significant internal sources to cause potential siltation within the port seabed area. This is in consideration to the calmness of the entire inner water area of the port confined by the outer breakwater. Moreover the coastline of the port is stable. Accordingly the entire offshore area dredged as per all three offshore project components of this SDP is not expected to encounter any significant siltation and the resultant reduction in water depth consequent to any internal movement of seabed.

However, the very calmness nature of the inner port waters would result in siltation of seabed due to external input of particulate materials. The existing sewage out-falls into the port waters are not only potential sources of particulate materials causing siltation in port seabed but also contaminants of port seawater and seabed material quality. Accordingly APA (Alexandria Port Authority) is strongly recommended to eliminate all sewage out-falls and discharge pipes discharging into the port waters as early as possible. Such a sewage out-fall elimination program is incorporated also as a component of the "Port Environmental Improvement Action Plan" illustrated in Section 18.10 of Chapter 18.

Finally elimination of external siltation sources of the port seabed is identified as the important mitigation measure of maintenance dredging requirement and the subsequent inherent disposal issues of potentially contaminated dredged material. Moreover, regular conduct of bathymetric survey in the port water area is required to confirm the design water depth and hence to ensure the navigational safety of Panamax type vessels.

27.4.2 Deep Water Coal Berth Project

(1) Construction activity impacts

This is the smallest offshore SDP project component, since the extension of the existing coal berth with open deck type structural construction is the major work involved. Other significant work is the dredging of the seabed area to meet the design water depth of 14m below datum level. Still the quantity of dredging (70,000 m3) as well as the depth of dredging (mostly not more than 2.5m) is the lowest among all three offshore SDP projects. Accordingly the magnitude of adverse effects due to the construction activity of this project would be lower than that of the Multipurpose Terminal Project dealt with in the foregone section, even though the nature of the potential adverse effects are quite similar.

Similar to that of the Multipurpose Terminal Project dealt with in the foregone section of 27.4.1, potential adverse effects concerned to dredging are as follows;

- Increased port water turbidity
- Noise nuisance attributed to operation of the dredger
- Probable encounter and potential damage of buried archeological treasure

- Remobilization of contaminants within the sediment to water environment
- Odor nuisance associated with exposure of anoxic sediment to ambient environment
- Disposal issues of contaminated dredged material
- Adverse effect on biota (fauna and flora) inhabiting the concerned seabed areas of dredging and dredged material disposal

Moreover, other potential adverse effects concerned to the overall execution of the construction works for the deep-water coal berth are as follows;

- Interference to regular road traffic and as well as traffic within the port area due to the transportation of construction material and equipment. Also transportation of fine particulate construction materials such as sand may cause dust nuisance
- Construction works may interfere with the regular ship and vessel movement within the port water area
- Construction and installation works would cause dust, noise and vibration effects

(2) Construction impact mitigation

The significance of impacts and conceivable mitigation measures for each of the significant construction related activity is illustrated below. The significant construction related activities of the deep-water coal berth are categorized into the following four (4) groups.

- Material and equipment transportation activity
- Dredging activity
- Dredged material disposal activity
- Overall construction and installation activity

1) Material and equipment transportation activity

The mitigation measures to traffic interference are basically the same as that illustrated under the foregone multipurpose terminal project (section 27.4.1). They are adopting off-peak and nighttime hours for the transportation of items in bulk quantity to mitigate interference with traffic beyond the port area. As per traffic within the port area it is somewhat inevitable, but still could be minimized by reserving specific port gates and routes for traffic concerned to construction work. Potential spread of dust nuisance could be mitigated mandating vinyl sheet covering as the minimum requirement of open type transportation trucks.

2) Dredging activity

As pointed out above, the quantity of dredging work involved is not very significant.

The water quality deterioration due to increased turbidity by dredging is evaluated as insignificant since the quantity of dredging is not very significant. Moreover, any adverse effect will be principally limited to the immediate surroundings of the coal berth area only.

Potential noise nuisance due to dredger operation is evaluated as insignificant since it will be confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is tolerable.

No finding of buried archeological treasures (artifacts) in the coal basin is anticipated in consideration to the shallow depth of dredging (2.5m) work involved. Still, as a precautionary measure dredging work need to be proceeded with care so that any buried artifact could be recovered with minimum damage.

Concerning the remobilization of contaminants during dredging it is inevitable to some extent since the surface layer of the seabed, accounting for bulk of the dredged material of this project component, is significantly contaminated with heavy metal constituents. Still, adverse effect is evaluated as insignificant in consideration to the planned common disposal area in the form of an artificial island, for all three offshore project components of SDP, as illustrated under Item (2) of the foregone Section 27.4.1 on the construction impact mitigation of the Multipurpose Terminal Project. It is noted that the dredging work will be sequenced so that the contaminated 1m depth surface layer of the seabed will be dredged initially which will then be followed with the dredging of uncontaminated deeper layers of the seabed.

Potential odor nuisance due to the exposure of anoxic dredged material to aerobic environment is evaluated as insignificant. This is in consideration to the open sea environment and as well as the limited exposure time of contaminated dredged material until its disposal in the designated area for the creation of the artificial island adjoining the outer breakwater.

3) Dredged material disposal activity

The dredged material disposal system is the same as that described in the foregone section on the Multipurpose Terminal Project. The confinement facility in the form of an artificial island will contain the entire dredged material arising from the execution of all three offshore project components of this SDP and hence will be a common element of this SDP. The planned location of this artificial island type confinement facility is adjacent to the outer breakwater structure within the inner port area as schematically shown in Fig.15.2.1 of Chapter 15. Moreover, typical structural details of the confinement facility are shown in Fig. 22.1.1 and Fig.22.1.2 of Chapter 22. It is noted that the initial base layer of this artificial island will be made of the dredged material derived from the dredging of the contaminated 1m depth surface layer of the seabed material. Accordingly, the dredged material from this project component will contribute significant quantity of the base layer of the artificial island formed. This is in consideration to the shallow depth of dredging work involved with the deepening of the coal terminal, resulting in the generation of significant quantity of contaminated dredged material.

The anoxic status of the contaminated sediment in the form of the buried base layer (subsoil) of the artificial island would mitigate remobilization of the heavy metal contaminants to the surrounding water environment thereby preventing their bio-availability. Bio-availability of heavy metal constituents and their subsequent metabolism and accumulation in the food-chain of higher order marine biota such as fish is the important environmental concern of heavy metal contamination.

Finally, same as that of the multipurpose terminal project, it is noted the dredging activity and the subsequent creation of an artificial island using the dredged material would adversely affect the biota (fauna and flora) inhabiting the targeted seabed areas. Still since the seabed is contaminated any limited loss of the potentially contaminated seabed biota is evaluated as ecologically insignificant. In fact the creation of an artificial island having uncontaminated surface layer on an originally contaminated seabed is considered as a limited beneficial effect, since in the process at-least the contaminated sediments in all three offshore project areas of this SDP is removed and buried. In effect this dredging work represents a limited, though unintended and impermanent, cleanup of the dredged seabed area.

4) Overall construction and installation activity

The steel pipe pile (SPP) driving work for the basement (foundation) of the open deck type berth extension of the existing coal berth is considered to be the most significant activity to cause potential noise and vibration. Still, any adverse effect will be mostly confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is admissible, as also pointed out under Item 2) on “dredging activity”. Still, all activities with high potential to cause significant noise and vibration like pile driving and other miscellaneous work could be restricted to day-time only to minimize the inherent adverse effect in the form of an “environmentally responsible means of construction planning”.

Moreover, the overall construction works for the extension of the coal berth would interfere with regular coal/coke cargo handling activity in the berth area. Even though interference to some degree may be inevitable and shall be tolerated, still it could be minimized with careful stage-wise planning of the construction work. In particular limiting and optimizing the activity area targeted for construction work at a time in the form of stage-wise construction shall be an integral part of the construction plan. In case interference is inevitable, reallocation of affected vessels to alternative berths, including those in Dekheila Port, could be adopted.

Potential dust generation due to the construction works of the coal berth extension is considered as not very significant considering the limited nature of the civil construction works involved. Still acute dust generation may be controlled with targeted water spraying of potential dust emission sources, again in the form of an “environmentally responsible means of construction planning”.

(3) Operation activity impacts

It is noted that this project is aimed at the improvement of the existing coal berth that is operational. Accordingly, no significant adverse environmental effect due to the improved and efficient operation of the coal berth is anticipated. Still potential siltation of the dredged seabed area requiring periodic maintenance dredging in order to maintain the design water depth of 14m below datum level, resulting in the generation of potentially contaminated dredged material requiring controlled disposal, may occur. In fact this maintenance dredging issue is common to all three (3) offshore project components of SDP as pointed out under Item (3) of the foregone section 27.4.1.

(4) Operation impact mitigation

Concerning potential siltation of the dredged seabed area of the deep water coal berth, as also pointed out under Item (4) of the foregone section on the Multipurpose Terminal Project, the possible cause would be the external input of particulate materials. The existing sewage out-falls into the port waters are not only potential sources of siltation in port seabed but also contaminants of port seawater and seabed material quality. Accordingly APA (Alexandria Port Authority) is strongly recommended to eliminate all sewage out-falls and discharge pipes discharging into the port waters as early as possible. Such a sewage out-fall elimination program is incorporated also as a component of the "Port Environmental Improvement Action Plan" illustrated in Section 18.10 of Chapter 18.

Elimination of external siltation sources of the port seabed is the identified mitigation measure of maintenance dredging requirement. Moreover, regular conduct of bathymetric survey in the port water area is required to confirm the design water depth and hence to ensure the navigational safety of Panamax type vessels.

27.4.3 Grain Terminal Modernization Project

(1) Construction activity impacts

The overall construction activities of this Grain Terminal Modernization Project are very similar to the Multipurpose Terminal Project dealt with in the foregone section of 27.4.1. However, this project is of a smaller scale in comparison to the Multipurpose Terminal Project and does not involve steel pipe pile (SPP) foundation work.

Dredging is a significant activity of this project component as well and involves deep seabed dredging for the basement of the terminal, similar to the Multipurpose Terminal Project. Still the total quantity of dredging of this Grain Terminal Modernization Project (317,000 m3) is much lower than that of the Multipurpose Terminal Project (1,740,000 m3).

The potential adverse effects due to dredging are very similar to those two offshore projects of SDP dealt with in the foregone sections, and are as follow;

- Increased port water turbidity
- Noise nuisance attributed to operation of the dredger
- Probable encounter and potential damage of buried archeological treasure
- Remobilization of contaminants within the sediment to water environment
- Odor nuisance associated with exposure of anoxic sediment to ambient environment
- Disposal issues of contaminated dredged material
- Adverse effect on biota (fauna and flora) inhabiting the concerned seabed areas of dredging and dredged material disposal

Moreover, similar to the other foregone SDP projects, potential adverse effects concerned to the overall execution of the construction works for the modernization of the grain terminal are as follows;

- Interference to regular road traffic and as well as traffic within the port area due to the transportation of construction material and equipment. Also transportation of fine particulate construction materials such as sand may cause dust nuisance
- Construction works may interfere with the regular ship and vessel movement within the port water area
- Construction and installation works would cause dust, noise and vibration effects

(2) Construction impact mitigation

The significance of impacts and conceivable mitigation measures for each of the significant construction related activity is illustrated below. The significant construction related activities of the modernized grain terminal, same as the new multipurpose terminal, are categorized into the following five (5) groups. It is also noted that the mitigation measures are the same as that for the new multipurpose terminal project dealt with under Item (2) of section 27.4.1.

- Material and equipment transportation activity
- Dredging activity
- Dredged material disposal activity
- Back-filling and terminal reclamation activity
- Overall construction and installation activity

1) Material and equipment transportation activity

Interference with regular traffic outside the port area, in particular, the city center area of Alexandria, could be mitigated by adopting off-peak and night time hours for the transportation of items in bulk quantity. Interference with road traffic within the port area is somewhat inevitable, but still could be minimized by reserving specific port gates and routes for traffic concerned to construction work.

Potential spreading of dust nuisance concerned to the transportation of fine particulate materials such as sand could be mitigated using covered transportation trucks. If open truck/trailer transportation is inevitable, vinyl sheet covering shall be a mandatory minimum requirement.

2) Dredging activity

As pointed out under the project description in section 27.3.3 of above, dredging work for the creation of the modernized grain terminal is quite significant requiring a maximum depth of excavation of about 13m of seabed.

The water quality deterioration due to increased turbidity by dredging is evaluated as insignificant since the effect will be principally limited to the inner port water area confined by the breakwater structure adjoining the project site.

Potential noise nuisance due to dredger operation is evaluated as insignificant since it will be confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is tolerable.

There is no known previous finding of buried archeological treasures (artifacts) in the offshore area of the Alexandria port. Still, in consideration to the rich historical and cultural heritage of the city, the probability of encountering artifacts during dredging, in particular the deep seabed dredging for the basement of the modernized grain terminal with a maximum excavation depth of 13m, has to be anticipated. Accordingly, dredging work need to be proceeded with care so that any buried artifact could be recovered with minimum damage. In case any artifact is encountered dredging work shall be suspended until a professional archeological survey is carried out to retrieve any remaining buried artifacts. In particular, the dredger operator shall be made aware of the delicate nature of the dredging operation, having the possibility of encountering artifacts.

Concerning the remobilization of contaminants during dredging it is inevitable to some extent since the surface layer of the seabed material is significantly contaminated with heavy metal constituents. Still, adverse effect is evaluated as insignificant in consideration to the planned common disposal area in the form of an artificial island, for all three offshore project components of SDP, as illustrated under Item (2) of the foregone section 27.4.1 on the construction impact mitigation of the Multipurpose Terminal Project. It is noted that the dredging work will be sequenced so that the contaminated 1m depth surface layer of the seabed will be dredged initially which will then be followed with the dredging of uncontaminated deeper layers of the seabed.

Potential odor nuisance due to the exposure of anoxic dredged material to aerobic environment is evaluated as insignificant. This is in consideration to the open sea environment and as well as the limited exposure time of contaminated dredged material until its disposal in the designated area resulting in the creation of the artificial island adjoining the outer breakwater.

3) Dredged material disposal activity

The dredged material disposal system is the same as that described in the foregone section 27.4.1 on the Multipurpose Terminal Project. The confinement facility in the form of an artificial island will contain the entire dredged material arising from the execution of all three offshore project components of this SDP and hence is a common element of this SDP. The planned location of this artificial island type confinement facility is adjacent to the outer breakwater structure within the inner port area as schematically shown in Fig.15.2.1 of Chapter 15. Moreover, typical structural details of the confinement facility are shown in Fig. 22.1.1 and Fig.22.1.2 of Chapter 22. It is noted that the initial base layer of this artificial island will be made of the dredged material derived from the dredging of the contaminated 1m depth surface layer of the seabed material. This base layer will then be covered with cleaner uncontaminated dredged material dredged from a depth deeper than 1m of seabed, thereby forming the artificial island. This sequential artificial island creation procedure would ensure that the disposed contaminated dredged material remained buried under anoxic condition in the form of subsoil.

The anoxic status of the contaminated sediment in the form of the base layer (subsoil) of the artificial island would mitigate remobilization of the heavy metal contaminants to the surrounding water environment thereby preventing their bio-availability. Bio-availability of heavy metal constituents and their subsequent metabolism and accumulation in the food-chain of higher order marine biota such as fish is the important environmental concern of heavy metal contamination.

Finally, same as the two foregone offshore SDP projects, it is noted the dredging activity and the subsequent creation of an artificial island using the dredged material would adversely affect the biota (fauna and flora) inhabiting the targeted seabed areas. Still since the seabed is contaminated any limited loss of the potentially contaminated seabed biota is evaluated as ecologically insignificant. In fact the creation of an artificial island having uncontaminated surface layer on an originally contaminated seabed is considered as a limited beneficial effect, since in the process at-least the contaminated sediments in all three offshore project areas of this SDP is removed and buried. In effect this dredging work represents a limited, though unintended and impermanent, cleanup of the dredged seabed area.

4) Back-filling and terminal reclamation activity

Similar to that of dredging activity illustrated under Item 2) of above, the most significant potential adverse effect of this activity on the surrounding port sea water quality would be increased turbidity. Still any adverse effect would be temporary and confined to the inner port waters within the adjoining breakwater structure and hence considered as insignificant.

5) Overall construction and installation activity

The most significant potential adverse effect attributed to the overall construction and installation works of the modernized grain terminal, in particular the construction works, is the interference to regular ship movement and hence cargo handling in the port area. Even though interference to some degree may be inevitable and shall be tolerated, still it could be minimized with careful stage-wise planning of the construction work. In particular limiting and optimizing the activity area targeted for construction work at a time shall be an integral part of the construction plan. In case interference is inevitable, reallocation of affected vessels to alternative berths, including those in Dekheila Port, could be adopted, as also emphasized for the other two foregone offshore project components of SDP.

Potential noise and vibration is inevitable with respect to the miscellaneous construction and installation works, in particular with respect to the installation of the mechanical grain unloader. Still, any adverse effect will be mostly confined to the open port water environment. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is admissible, as also pointed out in case of the foregone project components. Still, all activities with high potential to cause significant noise and vibration could be restricted to day-time only to minimize the inherent adverse effect in the form of an "environmentally responsible means of construction planning".

Potential dust generation due to the construction works of the modernized grain terminal is considered as not very significant since under-water works constitute the major portion of construction works, similar to the new multipurpose terminal. Still acute dust generation may be controlled with targeted water spraying of potential dust emission sources, again in the form of an "environmentally responsible means of construction planning".

(3) Operation activity impacts

It is noted that this grain terminal modernization project, similar to the deep water coal berth project of the foregone section, is basically aimed at the replacement of the existing underutilized grain berth that is operational. Accordingly, no significant adverse environmental effect due to the improved and efficient operation of the modernized grain terminal is anticipated.

Still potential siltation of the dredged seabed area requiring periodic maintenance dredging in order to maintain the design water depth of 14m below datum level, resulting in the generation of potentially contaminated dredged material requiring controlled disposal, may occur. In fact this maintenance dredging issue is common to all three (3) offshore project components of SDP as pointed out under Item (3) of the foregone sections 27.4.1 and 27.4.2.

Moreover, the belt conveyor transfer of grain from the mechanical unloaded to the grain silos may result in dust emission, a concern of ambient air quality deterioration.

(4) Operation impact mitigation

Concerning potential siltation of the dredged seabed area of the deep water coal berth, as also pointed out under Item (4) of the foregone sections 27.4.1 and 27.4.2, the possible cause would be the external input of particulate materials. The existing sewage out-falls into the port waters are not only potential sources of siltation in port seabed but also contaminants of port seawater and seabed material quality. Accordingly APA (Alexandria

Port Authority) is strongly recommended to eliminate all sewage out-falls and discharge pipes discharging into the port waters as early as possible. Such a sewage out-fall elimination program is incorporated also as a component of the “Port Environmental Improvement Action Plan” illustrated in Section 18.10 of Chapter 18.

Elimination of external siltation sources of the port seabed is the identified mitigation measure of maintenance dredging requirement. Moreover, regular conduct of bathymetric survey in the port water area is required to confirm the design water depth and hence to ensure the navigational safety of Panamax type vessels.

Potential ambient air quality deterioration due to emission of dust from the conveyor belt system is evaluated as insignificant. The belt conveyor of the modern mechanical unloader is of covered (pipe) type and hence the conveyed grains will not be exposed to the ambient environment. The covered type belt conveyor system is in fact an “in-built mitigation measure” against dust emission.

27.4.4 New Port Road Bridge Project

(1) Construction activity impacts

This is the smallest and the only on-land based SDP project component. The major civil construction work involved is the provision of a bridge with a short span length of only about 90m. Moreover no dredging work is involved. Accordingly the magnitude of potential adverse effects due to the construction activity of this project would be the lowest among all four (4) project components of SDP.

The potential adverse effects concerned to the overall execution of the bridge construction works are as follows;

- Interference to regular road traffic and as well as traffic within the port area due to the transportation of construction material and equipment. Also transportation of fine particulate construction materials such as sand may cause dust nuisance
- Construction works may interfere with the regular ship and vessel movement within the port water area, in particular in and around the berths No.32 and No.33
- Construction and installation works would cause dust, noise and vibration effects

(2) Construction impact mitigation

The significance of impacts and conceivable mitigation measures for each of the significant construction related activity is illustrated below. The significant construction related activities of the new port road bridge are categorized into the following three (3) groups.

- Material and equipment transportation activity
- Bridge substructure (basement) construction activity
- Bridge super structure construction activity

1) Material and equipment transportation activity

The mitigation measures to traffic interference are basically the same as that illustrated in case of the foregone project components of SDP. They are adopting off-peak and nighttime hours for the transportation of items in bulk quantity to mitigate interference with traffic beyond the port area. As per traffic within the port area it is somewhat inevitable, but still could be minimized by reserving specific port gates and routes for traffic concerned to construction work. Mandating vinyl sheet covering as the minimum requirement of open type transportation trucks could mitigate potential spread of dust nuisance.

2) Bridge substructure (basement) construction activity

The abutment of bridge, as the basement, is of concrete structure only and no pile driving work is involved. Hence potential noise and vibration effect is considered as insignificant. Still the abutment construction works, in particular the earth works, has the potential to interfere both with in-port road traffic and offshore vessel movement in its vicinity. Still, in consideration to the small scale of this activity, mostly such interference should be tolerable, in particular with respect to the in-port road traffic movement. In case of extreme interference to vessel movement, reallocation of affected vessels to alternative berths could be adopted. Potential dust generation due to the construction works of the abutment, including earth works, is considered as not very significant considering the limited nature of the civil construction works involved.

3) Bridge superstructure construction activity

The installation works of steel truss as the base of the superstructure of the bridge is considered as the most significant activity to cause potential noise and vibration. Still, any adverse effect will be mostly confined to the interior port area. Moreover, the port is essentially an industrial area away from commercial and residential area of the city and hence a higher noise level is admissible, as also pointed in the cases of the other foregone project components. Still, all activities with high potential to cause significant noise and vibration could be restricted to day-time only to minimize the inherent adverse effect in the form of an “environmentally responsible means of construction planning”. Potential dust generation due to the construction works of the superstructure of the bridge is considered as insignificant.

(3) Operation activity impacts

It is noted that this project component is aimed at alleviating traffic congestion and also to facilitate effective operation of the new multipurpose terminal, the major project component of this SDP, described in Section 27.3.1. Efficient operation of the multipurpose terminal is impossible without effective access to the terminal by the cargo transportation vehicles bypassing the congested city center of Alexandria. This new port road bridge would serve as the above effective bypass link. Accordingly, no significant adverse effect due to the functioning (operation) of the new bridge is anticipated.

The only conceivable adverse effect due to the new bridge, in fact for a bridge in general, is the potential traffic congestion at the entrance and exit reaches of the bridge, the “bottle-neck” locations.

(4) Operation impact mitigation

No specific mitigation measures are considered as necessary since the no significant adverse environmental effects are anticipated. Even potential traffic congestion at entrance and exit “bottle-neck” reaches of the bridge is evaluated as insignificant. This is in consideration to the provision of dual (two-lane) carriage way over the bridge in each direction, even though the provision of single lane carriage way was determined to be adequate to handle the traffic under normal condition.

27.5 Conclusion and Recommendation

27.5.1 Conclusions

The following findings are made based on the EIA (environmental impact assessment) study illustrated in the foregone sections.

(1) Dredging as the most significant activity concerned to the execution of the SDP

Dredging, that results in the generation of potentially contaminated dredged material, is identified as the most significant activity with potential adverse effects consequent to the execution of the three (3) offshore project components of this SDP (short-term development plan). The three offshore project components are Multipurpose Terminal Project, Deep Water Coal Berth Project and Grain Terminal Modernization Project.

(2) Artificial island as the mitigation system of contaminated dredged material

Creation of an artificial island adjacent to the outer breakwater of the port using the entire dredged material generated by the three offshore SDP projects assessed as the economically and environmentally feasible means of contaminated dredged management. In the process of creating the artificial island the contaminated dredged material derived from the dredging of the surface layer of the seabed is buried, by forming the base layer of the artificial island. The burial of contaminated dredged material ensures their state under anoxic condition, permanently. Consequently, potential bio-availability of heavy metals in the contaminated dredged material to marine biota, and hence the potential accumulation of heavy metals in the food chain of marine biota, is mitigated. Bio-accumulation of heavy metals in the food chain of marine biota like fish is the important environmental concern of contaminated dredged material, in general.

Accordingly, the most significant potential adverse effect consequent to the inevitable execution of the dredging work by this SDP is evaluated as mitigated with the creation of the artificial island using the dredged material.

(3) Potential siltation of dredged seabed as the long-term environmental concern

Potential siltation of the dredged port seabed area of the three offshore project facilities of this SDP is considered as the most significant long-term environmental concern, during the operational stage. Such a siltation would require periodic maintenance dredging to ensure navigational safety resulting in the generation of potential contaminated dredged material requiring controlled disposal. The existing sewage out-falls are identified as the potential sources of siltation causing particulate matters to the calm port waters. Moreover, they are contaminants of port sea water and seabed material quality.

The elimination of sewage out-falls into the port waters is very important to ensure not only the long-term sustainability of the offshore project facilities of this SDP but also to the improvement of port water and seabed material quality.

Finally, based on the above findings, it is concluded that potential adverse environmental effects consequent to the execution of the project facilities of the SDP are insignificant in an overall sense, on the presumption that the derived contaminated dredged material will be buried in the formation of the artificial island.

Moreover, it is pointed out that the proposed project facilities of the SDP are principally aimed at enhancing the operational safety and efficiency of the functional port. This would also lead to overall long-term environmental improvement of the port as well in tandem, in comparison to the baseline (present) environmental condition of the port. In particular the enhancement of navigational safety with the provision of modern VTMS (Vessel Traffic Management System) type navigation system and the mitigation of ship and vessel based oil pollution of port waters with the provision of Waste Oil (ballast and bilge waste) Reception Facility by this SDP are emphasized. These two project components, though of small scales, are specifically targeted at port safety and environmental improvement.

Still, the most crucial constraint in achieving these multiple benefits of port operational safety and efficiency as well as environmental improvement is the effective enhancement of the port operational management, including the human resources development. This would ensure proper operational management of the facilities provided by this SDP and hence the realization of multiple benefits including effective port environmental improvement.

27.5.2 Recommendations

The following recommendations are made based on the identified environmental issues of the port.

(1) The elimination of all sewage out-falls into the port waters is urgent and strongly recommended. This is required to mitigate both potential siltation of seabed and continued degradation of port water and seabed material quality. Moreover, such an

elimination program need to be undertaken independent of this SDP by the port authority (APA) as a component of the "Port Environmental Improvement Action Plan" delineated in Section 18.10 of Chapter 18. In fact the implementation of the entire "Port Environmental Improvement Action Plan" delineated in the above Section 18.10 is recommended.

(2) Regular conduct of bathymetric survey in the port waters is required to ensure the required design water depth and the navigational safety of ships and vessels.

(3) As a long-term environmental monitoring program of the Greater Alexandria Port, establishment of an ambient air quality monitoring station and a set of port water quality monitoring stations is recommended. The ambient air quality monitoring station could be established within the wind observatory of the port.

(4) Finally implementation of the proposed short-term development plan (SDP) of the Alexandria Port is strongly recommended to realize the enhancement of the port operational safety and efficiency and hence the long-term improvement of the environmental condition of the port.

APPENDIX

Appendix

Appendix 1 Micro Forecast

1.1 Import

1.1.1 Containerizable Cargo

(1) Miscellaneous Cargo
The volume of Miscellaneous cargo handled at the Greater Alexandria Port in the target years, combined with General Cargo handled at the ports of Damietta and Port Said because the characteristics of their cargoes are same, are forecast using a time series analysis. The correlation is expressed by the following equation.

$$Y = 256.31074 \times t - 50{,}648.02$$

where; Y : Cargo volume
t : the Target year (2007, 2017)

Total volume is allocated referring to cargo shares of the three ports of 1997(see Table A.1.1).

Table A.1.1 Forecast Volume of Miscellaneous

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	4,096	6,418	8,492
Damietta (Others)	331	519	686
Port Said (Others)	636	996	1,318

(2) Frozen Food (including Fish and Meat)
The volume of Frozen Food including Fish and Meat is forecast by the balance between consumption and production in Egypt. Consumption and production volumes at the target years are estimated by time series analysis(see Table A.1.2).

Table A.1.2 Production and Consumption Volume of Frozen Food

(Unit: thousand tons)

	2007	2017
Production (1)	945	1,090
Consumption (2)	1,100	1,240
Shortage (Import) (1)-(2)	155	149

Total import volume is allocated to the three ports referring to cargo shares of 1997(see Table.A.1.3).

Table A.1.3 Forecast Volume of Frozen Food

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	164	73	70
Damietta	138	62	59
Port Said	45	20	19

(3) Lash Cargo

The past volume of Lash Cargo has varied greatly year by year showing no obvious trend. Therefore, the volume of the largest value in the past ten years is adopted as the volume in the target years(see Table A.1.4).

Table A.1.4 Forecast Volume of Lash Cargo

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	122	150	150

1.1.2 Statistically Mixed Cargo in Containerization

(1) Timber

Timber volume is forecast by consumption volume which is computed by consumption per capita multiplied by population(see Table A.1.5).

Table A.1.5 Consumption Volume of Timber

(Unit: thousand tons)

	2007	2017
Consumption Volume	4,280	5,787

Timber volume is allocated to the two ports of the Greater Alexandria and Damietta referring to shares of 1997(see Table A.1.6).

Table A.1.6 Forecast Volume of Timber

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	1,629	3,763	5,088
Damietta	197	406	549

(2) Ro-Ro Cargo

The volume of Ro-Ro cargo is forecast using the GDP growth rate. The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr \times E_L)^{(t-1997)}$$

where; Yo : Cargo volume in 1997

Gr : GDP growth rate towards target year (6.9% for 1997-2007, 7.6% for 2007-2017)

E_L : Elasticity (0.961)

The volumes in the target years are shown in Table A.1.7.

Table A.1.7 Forecast Volume of Ro-Ro Cargo

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	1,250	2,376	4,808

(3) Sugar

The volumes of Sugar in the target years are forecast using the balance between consumption and production in Egypt. Total sugar consumption is calculated by consumption per capita multiplied by population while total sugar production is obtained from the national plan of the Ministry of Planning(see Table A.1.8).

Table A.1.8 Production and Consumption Volume of Sugar

(Unit: thousand tons)

	2007	2017
Production (1)	1,900	2,300
Consumption (2)	2,323	3,165
Shortage (Import) (1)-(2)	423	865

Total import volume is allocated to the two ports of the Greater Alexandria and Port Said referring to cargo shares of 1997(see Table A.1.9).

Table A.1.9 Forecast Volume of Sugar

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	661	288	590
Port Said	308	134	275

(4) Paper

The volume of Paper in the target years are forecast by total consumption volume which is calculated by consumption per capita multiplied by population(see Table A.1.10).

Table A.1.10 Forecast Volume of Paper

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	221	1,332	1,886

(5) Flour

Flour volumes in the target years are forecast by total consumption volume which is calculated by consumption per capita multiplied by population and the whole consumption volume is imported. The consumption volumes in the target years are shown in Table A.1.11.

Table A.1.11 Forecast Volume of Flour in Consumption

(Unit: thousand tons)

	2007	2017
Consumption (Import) Volume	346	390

Total import volume is allocated to the two ports of the Greater Alexandria and Port Said referring to cargo shares of 1997 Flour volume in the target years is shown in Table A.1.12.

Table A.1.12 Forecast Volume of Flour

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	53	238	268
Port Said	24	108	122

1.1.3 Non-Containerizable Cargo

(1) Iron and Steel Products

Iron and steel products is forecast using the balance between consumption and production in Egypt. Production is estimated based on information from the existing steel companies, Alexandria National Iron and Steel Company in Dekheila (hereinafter referred to as "ANSDK") and Egyptian Iron & Steel Company in Helwan, and consumption is estimated by consumption per capita multiplied by population. Production and consumption volumes are shown in Table A.1.13.

Table A.1.13 Production and Consumption Volume of Iron and Steel Products

(Unit: thousand tons)

		2007	2017
Production (1)	ANSDK	2,400	3,200
	Egyptian Iron & Steel Co.	1,000	1,000
	Total	3,400	4,200
Consumption (2)		6,760	10,450
Shortage (Import) (1)-(2)		3,360	6,250

Total import volume in target years is allocated to the three ports referring to cargo shares of 1997. Iron and Steel Products volume is estimated as shown in Table A.1.14.

Table A.1.14 Forecast Volume of Iron and Steel Products

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	293	712	1,325
Damietta	622	1,512	2,813
Port Said	118	243	531

(2) Scrap

The largest value in the past ten years is adopted as the volume in the target years(see Table A.1.15).

Table A.1.15 Forecast Volume of Scrap

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	16	201	201

(3) Car

The largest value in the past ten years is adopted as the volume in target years. The volumes in the target years are shown in Table A.1.16.

Table A.1.16 Forecast Volume of Car

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	10	36	36

(4) Livestock

The average value in the past five years is adopted as the volume in the target years of 2007. In the next ten years, the volume is estimated increasing with the same growth rate 1.2% as the population growth rate. The volumes in the target years are shown in Table A.1.17.

Table A.1.17 Forecast Volume of Livestock

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	6	70	79

1.1.4 Dry Bulk

(1) Grains (Wheat and Maize)

The volume of Grains(Wheat and Maize) in the target years are forecast using the balance between consumption volume and production volume in Egypt. Total grains consumption is calculated by consumption per capita multiplied by population, and total grains production is forecast by time series analysis (see Table A.1.18).

Table A.1.18 Production and Consumption Volume of Wheat and Maize

(Unit: thousand tons)

	2007			2017		
	Wheat	Maize	Sub-total	Wheat	Maize	Sub-total
Production (1)	9,133	5,759	14,892	12,028	6,287	18,315
Consumption (2)	18,411	9,389	27,800	21,184	11,550	32,734
Shortage (Import) (1)-(2)	9,278	3,630	12,908	9,156	5,263	14,420

Total import volumes in the target years are allocated to the three ports of the Greater Alexandria, Damietta and Port Said referring to cargo shares of 1997. Grains volumes in the target years are estimated as shown in Table A.1.19.

Table A.1.19 Forecast Volume of Wheat and Maize

(Unit: thousand tons)

	1997			2007			2017		
	Wheat	Maize	Sub-total	Wheat	Maize	Sub-total	Wheat	Maize	Sub-total
Greater Alexandria	2,161	2,264	4,425	3,897	1,524	5,421	3,846	2,210	6,056
Damietta	2,544	1,147	3,691	3,250	1,272	4,522	3,208	1,844	5,051
Port Said	1,678	0	1,678	1,478	578	2,056	1,458	838	2,297

(2) Iron Pellets

The volume of Iron Pellets in the target years are forecast according to the production plan of ANSDK. The volume of iron pellets in the target years are estimated as shown in Table A.1.20.

Table A.1.20 Forecast Volume of Iron Pellets

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	1,988	3,750	5,000

(3) Coal

The volumes of coal in the target years are forecast based on the volume required through Alexandria Port for the production of coaks, which is caused mainly for iron and steel manufacturing at Egyptian Iron and Steel Company in Helwan and some portion is extend. Coal volumes in the target years are shown in Table A.1.21.

Table A.1.21 Forecast Volume of Coal

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	1,659	1,300	1,500

(4) Cement

The volume of Cement in the target years are forecast by the balance between consumption volume and production volume in Egypt. In the forecast total cement consumption is estimated by consumption per capita multiplied by population, while the target volume of cement production adopted by Egyptian government is used(see Table A.1.22).

Table A.1.22 Production and Consumption Volume of Cement

(Unit: thousand tons)

	2007	2017
Production (1)	30,000	40,000
Consumption (2)	33,119	43,334
Shortage (Import) (1)-(2)	3,119	3,334

Import volume is allocated to the two ports the Greater Alexandria and Damietta referring to cargo shares of 1997(see Table A.1.23)

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Table A.1.23 Forecast Volume of Cement

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	976	1,137	1,215
Damietta	1,686	1,964	2,099

(5) Sulfur

The largest value in the past four years is adopted as the volumes in the target years(see Table A.1.24)

Table A.1.24 Forecast Volume of Sulfur

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	349	349	349

(6) Fertilizer

The volume of Fertilizer in the target years are forecast by the balance between consumption volume and production volume in Egypt. Total volume of fertilizer consumption is calculated by consumption per hector multiplied by cultivated area, and total fertilizer production is forecast by the production growth rate given by the Egyptian government(see Table A.1.25).

Table A.1.25 Production and Consumption Volume of Fertilizer

(Unit: thousand tons)

	2007	2017
Production (1)	2,492	4,766
Consumption (2)	2,705	5,223
Shortage (Import) (1)-(2)	213	457

Total import volume is allocated to the two ports of the Greater Alexandria and Damietta referring to cargo shares of 1997(see Table A.1.26).

Table A.1.26 Forecast Volume of Fertilizer

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	239	195	416
Damietta	7	6	12

(7) Others

The largest value in the last five years is adopted as the volume in the target years at Greater Alexandria Port, and average volume in the last five years is adopted as the volume in the target years at Damietta Port(see Table A.1.27).

Table A.1.27 Forecast Volume of Others

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	413	413	413
Damietta	3	167	167

1.1.5 Liquid Bulk

(1) Petroleum

Imported and exported petroleum at the Greater Alexandria Port and Port Said Port is refined oil while crude oil is exported at Sid-Creal marine oil terminal west to Alexandria Port. Petroleum oil volume in target years is forecast by the balance between consumption and refined oil production in Egypt. Total refined oil consumption of petroleum oil is estimated by consumption per capita multiplied by population, while the target petroleum production adopted by the Egyptian government is used. Total volumes of production and consumption in Egypt is forecast as shown in Table A.1.28.

Table A.1.28 Production and Consumption Volumes of Petroleum

(Unit: thousand tons)

	2007	2017
Production (1)	28,754	31,433
Consumption (2)	30,072	33,882
Shortage (Import) (1)-(2)	1,318	2,448

All imported petroleum is allocated to the Greater Alexandria Port taking account of the existing and planned oil handling facilities at the port. The volumes in the target years are shown in Table A.1.29.

Table A.1.29 Forecast Volume of Petroleum

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	614	488	906

(2) Edible Oil

Edible oil volumes in the target years are forecast by the balance between consumption and production in Egypt (see Table A.1.30).

Table A.1.30 Production and Consumption Volume of Edible Oil

(Unit: thousand tons)

	2007	2017
Production (1)	235	433
Consumption (2)	359	568
Shortage (Import) (1)-(2)	124	135

(3) Grease

The largest value in the past five years is adopted as the volumes in the target years (see Table A.1.31).

Table A.1.31 Forecast Volume of Grease

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	58	86	86

1.2 Export

1.2.1 Containerizable Cargo

(1) Miscellaneous

The volume of Miscellaneous cargo is forecast using future GDP growth rate of 2.48% as major trading partners of Egypt such as USA, Italy, France, Germany and Netherlands (see Table A.1.32).

Table A.1.32 Forecast Volume of Miscellaneous

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	511	653	835
Damietta (Others)	695	888	1,135
Port Said (Others)	221	282	361

(2) Citrus

The volume of Citrus is forecast by the balance between production and consumption in Egypt(see Table A.1.33).

Table A.1.33 Forecast Volume of Citrus

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	12	441	632

(3) Cotton and Fiber

The volume of Cotton and Fiber is forecast by the balance between production and consumption in Egypt(see Table A.1.34).

Table A.1.34 Forecast Volume of Cotton and Fiber

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	67	193	422

(4) Agricultural Products

The volume of Agricultural Products is forecast using a growth rate deducting “growth rate of population” from “growth rate of agricultural GDP”(the Ministry of Planning). The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr)^{(t-1997)}$$

where; Yo : Cargo volume in 1997
Gr : Growth rate of cargo (2.5% for 1997-2007, 3.0% for 2007-2017)
t : the Target year (2007, 2017)

The volumes in the target years are shown in Table A.1.35.

Table A.1.35 Forecast Volume of Agricultural Products

(Unit: thousand tons)

	1997	2007	2017
Port Said	76	97	131

(5) General Cargo

The volume of General Cargo is forecast using future GDP growth rates of major trading partners of Egypt. The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr)^{(t-1997)}$$

where; Yo : Cargo volume handled in Damietta and Port Said in 1997
Gr : GDP Growth rate of trading partner (2.48% for 1997-2017)
t : the Target year (2007, 2017)

The volumes in the target years are shown in Table A.1.36.

Table A.1.36 Forecast Volume of General Cargo

(Unit: thousand tons)

	1997	2007	2017
Damietta	695	888	1,135
Port Said	221	282	361

1.2.2 Statistically Mixed Cargo in Containerization

(1) Ro-Ro Cargo

The volume of Ro-Ro Cargo is forecast using future GDP growth rates of major trading partners of Egypt. The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr)^{(t-1997)}$$

where; Yo : Cargo volume handled in Damietta and Port Said in 1997
Gr : GDP Growth rate of trading partner (2.48% for 1997-2017)
t : the Target year (2007, 2017)

The volumes in the target years are shown in Table A.1.37.

Table A.1.37 Forecast Volume of Ro-Ro Cargo

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	266	340	434

(2) Rice

The volume of Rice is forecast by the balance between production and consumption in Egypt. The production and consumption volumes of Rice are shown in Table A.1.38.

Table A.1.38 Production and Consumption Volume of Rice

(Unit: thousand tons)

	2007	2017
Production (1)	5,134	7,746
Consumption (2)	4,362	6,353
Surplus (Export) (1)-(2)	772	1,393

Total export volume is allocated to the Greater Alexandria Port referring to the cargo share of 1996. The volume in target years is shown in Table A.1.39.

Table A.1.39 Forecast Volume of Rice

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	49	297	537

1.2.3 Non-Containerizable Cargo

(1) Iron and Steel Products

The volume of Iron and Steel Products is forecast taking account of future production of ANSDK(see Table A.1.40).

Table A.1.40 Forecast Volume of Iron and Steel Products

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	192	500	630

(2) Special Cargo

The largest value in the past five years is adopted as the volumes in the target years (see Table A.1.41).

Table A.1.41 Forecast Volume of Special Cargo

(Unit: thousand tons)

	1997	2007	2017
Damietta	9	9	9
Port Said	2	2	2

1.2.4 Dry Bulk Cargo

(1) Coke

The volume of coke in the target years are forecast considering the future GDP growth rates of major trading partners of Egypt; including USA, Japan, Italy, France, Turkey and Greece. The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr)^{(t-1997)}$$

where; Yo : Cargo volume in 1997

Gr : GDP Growth rate of trading partner towards target year (2.68% for 1997-2017)

Coke volumes in the target years are shown in Table A.1.42.

Table A.1.42 Forecast Volume of Coke

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	306	399	520

(2) Fertilizer

The volume of Fertilizer is forecast using future GDP growth rates of major trading partners of Egypt. The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr)^{(t-1997)}$$

where; Yo : Cargo volume handled in Greater Alexandria Port in 1997

Gr : GDP Growth rate of trading partner (2.48% for 1997-2017)

t : the Target year (2007, 2017)

The total volumes in the target years are shown in Table A.1.43.

Table A.1.43 Total Forecast Volume of Fertilizer

(Unit: thousand tons)

	2007	2017
Export Cargo	571	730

The exported volume is allocated to the two ports of Damietta and Port Said referring to cargo shares of 1997(see Table A.1.44).

Table A.1.44 Forecast Volume of Fertilizer

(Unit: thousand tons)

	1997	2007	2017
Damietta	130	166	212
Port Said	139	179	227

(3) Salt

The volume of Salt is forecast by the balance between production and consumption in Egypt(see Table A.1.45).

Table A.1.45 Production and Consumption Volume of Salt

(Unit: thousand tons)

	2007	2017
Production (1)	2,591	3,873
Consumption (2)	1,679	2,325
Surplus (Export) (1)-(2)	912	1,547

The exported volume is allocated to the two ports of the Greater Alexandria and Port Said referring to cargo shares of 1997(see Table A.1.46).

Table A.1.46 Forecast Volume of Salt

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	235	573	972
Port Said	139	339	575

1.2.5 Liquid Bulk

(1) Petroleum

The volume of petroleum is forecast using future GDP growth rates of major trading partners of Egypt. The correlation is expressed by the following equation.

$$Y = Yo \times (1+Gr)^{(t-1997)}$$

where; Yo : Cargo volume handled in Greater Alexandria Port in 1997

Gr : GDP Growth rate of trading partner (2.48% for 1997-2017)

t : the Target year (2007, 2017)

The volumes in the target years are shown in Table A.1.47.

Table A.1.47 Forecast Export Volume of Petroleum from Egypt

(Unit: thousand tons)

	2007	2017
Export Cargo	5,593	7,146

Total export volume is allocated to the two ports of the Greater Alexandria and Port Said referring to cargo shares of 1997(see Table A.1.48).

Table A.1.48 Forecast Export Volume of Petroleum through the Two Ports

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	2,956	3,777	4,825
Port Said	704	899	1,149

(2) Molasses

The volume of Molasses is forecast by the balance between production and consumption in Egypt(see Table A.1.49).

Table A.1.49 Production and Consumption Volume of Molasses at Egypt

(Unit: thousand tons)

	2007	2017
Production (1)	635	850
Consumption (2)	285	322
Surplus (Export) (1)-(2)	349	529

The whole export volume of Molasses is exported through the Greater Alexandria Port in the target years(see Table A.1.50).

Table A.1.50 Forecast Volume of Molasses

(Unit: thousand tons)

	1997	2007	2017
Greater Alexandria	186	349	529

Appendix 2 Economic Appraisal for the Construction Plan of a Secondary Breakwater at Dekheila Port

2.1 Background of the Construction Plan of a Secondary Breakwater

Dekheila Port is protected by the existing breakwater extending from the east end of the Alexandria bay to the access channel in the northeast direction. The contours of the seabed showing the same water depths run almost parallel in the northeast direction, the same as the breakwater. Offshore waves, which vary from the west to northeast in direction, gradually become perpendicular to the seabed contours as the waves reach the shallower waters near the coast due to wave refraction. Thus, berths of Dekheila Port are effectively protected from penetrating waves from the outer sea by the existing breakwater in the case of handling conventional cargo at berths Nos. 92 and 94 and mineral cargo at berth No. 90: a workability rate of 95% is maintained through the year. The workability rate is estimated based on the maximum permissible limit of wave height in front of a berth which is 50cm for conventional cargo handling and 70cm for mineral cargo handling.

In case of container-handling at berth No. 94, however, workability alongside a container vessel is estimated to be under 90% due to the stricter maximum permissible limit of wave height (30cm). Hence, to increase service level in container handling by reducing wave agitation, a secondary breakwater needs to be constructed. Taking into account that container-handling is managed to be conducted presently with only the existing breakwater, the necessity of a secondary breakwater which requires a large capital investment must be economically assessed by comparing costs and benefits.

In this regard, APA entrusted the study on the possibility of construction of a secondary breakwater at Dekheila Port to the Delft Hydraulic Research Institute (DHRI). Although eagerly awaiting the results of the DHRI study, the study team has made its own rough assessment on whether the construction of a secondary breakwater at Dekheila Port is economically justified or not because this study should not be completely silent on the matter and it is unclear at present whether the final results of the DHRI study would be revealed or not by the end of this study. The results of the rough assessment by the study team are presented below.

2.2 Selection of Alternative Cases for a Secondary Breakwater

There are two key factors in the selection of alternative cases for a secondary breakwater at Dekheila Port: one is direction and the other is length. When considering the direction of a new breakwater, reflecting waves from the existing breakwater at Alexandria Port need to be prevented from penetrating the inner basins at Dekheila Port. In this view, a line connecting the tips of the existing breakwaters of Dekheila and Alexandria (in the direction of ENE) is envisaged as a standard alignment for a new breakwater. The more alignment is rotated counterclockwise with the center at the tip of the existing breakwater at Dekheila, the more reflecting waves from the Alexandria breakwater penetrate into Dekheila. Conversely, the more alignment is rotated clockwise, the more reflecting waves from the new breakwater generate agitation along the access channel (in the direction of ESE) to Alexandria Port. Thus, in this study, the standard alignment mentioned above is selected. On the other hand, as to length of a optional new breakwater, three lengths, 500m, 1,000m and 1,500m, have been compared (see Fig A1.1).

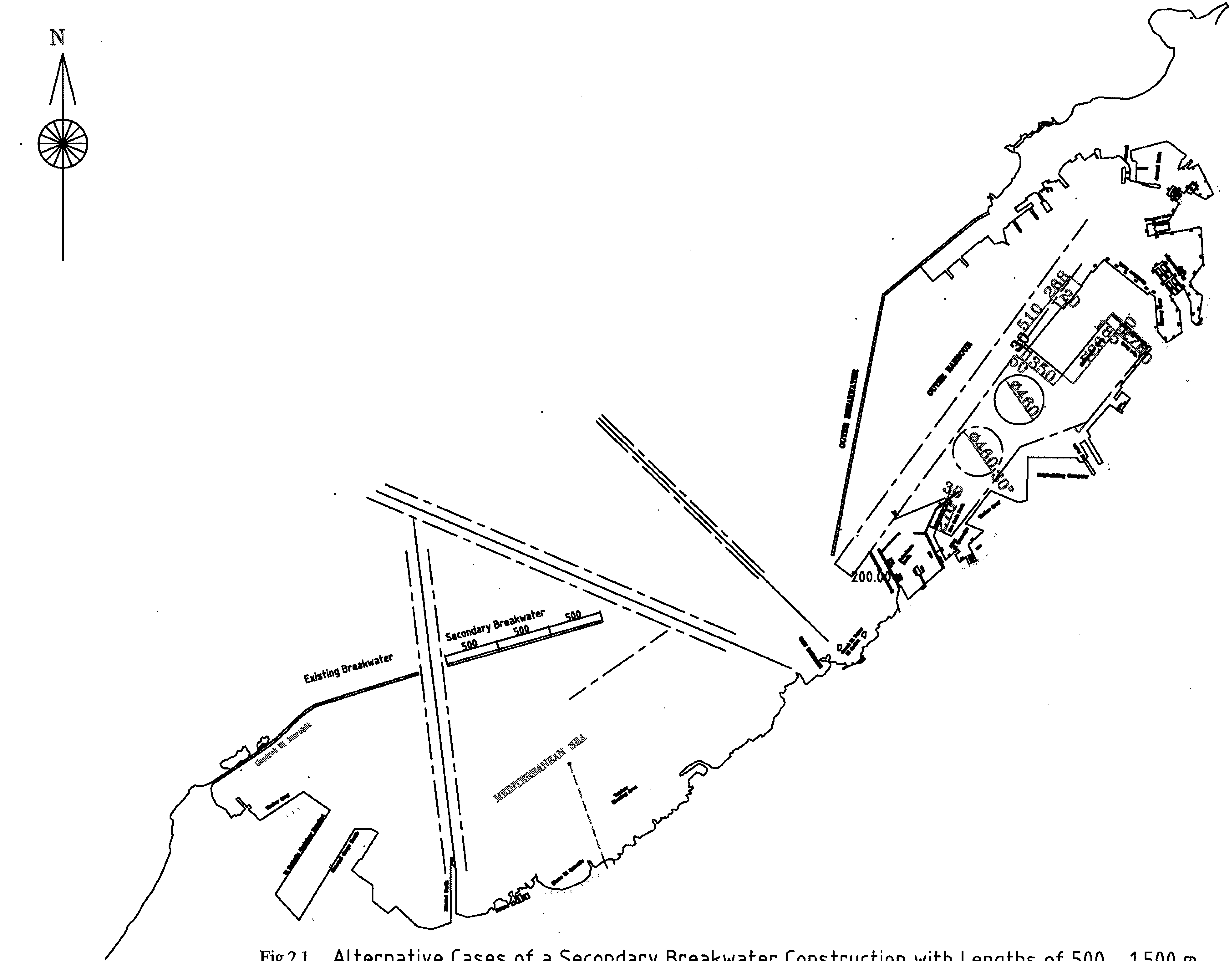


Fig 2.1 Alternative Cases of a Secondary Breakwater Construction with Lengths of 500 - 1,500 m

Scale 1:50,000

2.3 Non-excess Probability of Penetrating Waves at a Berth for the Maximum Permissible Limit to Handling Cargo Alongside

The results of the estimation of non-excess probability of penetrating waves at a berth for the maximum permissible limit to handling cargo alongside are shown in Table A1.1. In the estimation, transformation of waves comprising refraction, shoaling, reflection and diffraction are roughly considered using the available diagrams.

Table A.1.1 Non-excess Probability of Penetrating Waves at Dekheila Port

Berth		Permissible Limit of Waves to Cargo Handling	Planned Length of New Breakwater			
No.	Cargo		0 m	500 m	1,000 m	1,500 m
96	Container	30 cm	88.3%	91.7%	93.7%	95.3%
94	Conventional	50 cm	95.9%	96.0%	96.6%	98.1%
90	Mineral	70 cm	95.5%	96.4%	97.1%	98.4%

2.4 Economic Appraisal

The construction project of a secondary breakwater at Dekheila Port has been economically assessed by comparing the costs for constructing the breakwater and the benefits generated from an increase in on-dock workable time under calm conditions in the basin protected by the said breakwater. The estimated breakwater construction costs, however, far outweigh the expected benefits from the project, regardless of planned lengths of the breakwater as shown in Table A.1.1.

2.5 Long-Term Prospect of Breakwater Alignment beyond the Year 2017 in Alexandria Bay

Alexandria Bay extending between Alexandria Port and Dekheila Port is the most superior natural bay on the Mediterranean coast in Egypt in terms of port construction. The ports of Alexandria and Dekheila have natural deep-water access channels which can be maintained almost without any maintenance dredging as well as inner basins with natural deep-waters.

The water area between the ports of Alexandria and Dekheila is still not being used for port activities despite the advantageous natural conditions. If the area is protected by new breakwaters connecting the two ports and new lands are created by reclamation behind the breakwaters along the coast line, the most can be made of this valuable water area for port activities. Hence, if a secondary breakwater of Dekheila Port is planned, its alignment needs to be determined deliberately taking account of far-sighted utilization of the above valuable waters between the two ports without focusing only on Dekheila Port. Long-term prospect of breakwater alignment beyond the year 2017 in Alexandria Bay is shown in Fig.A.1.2.

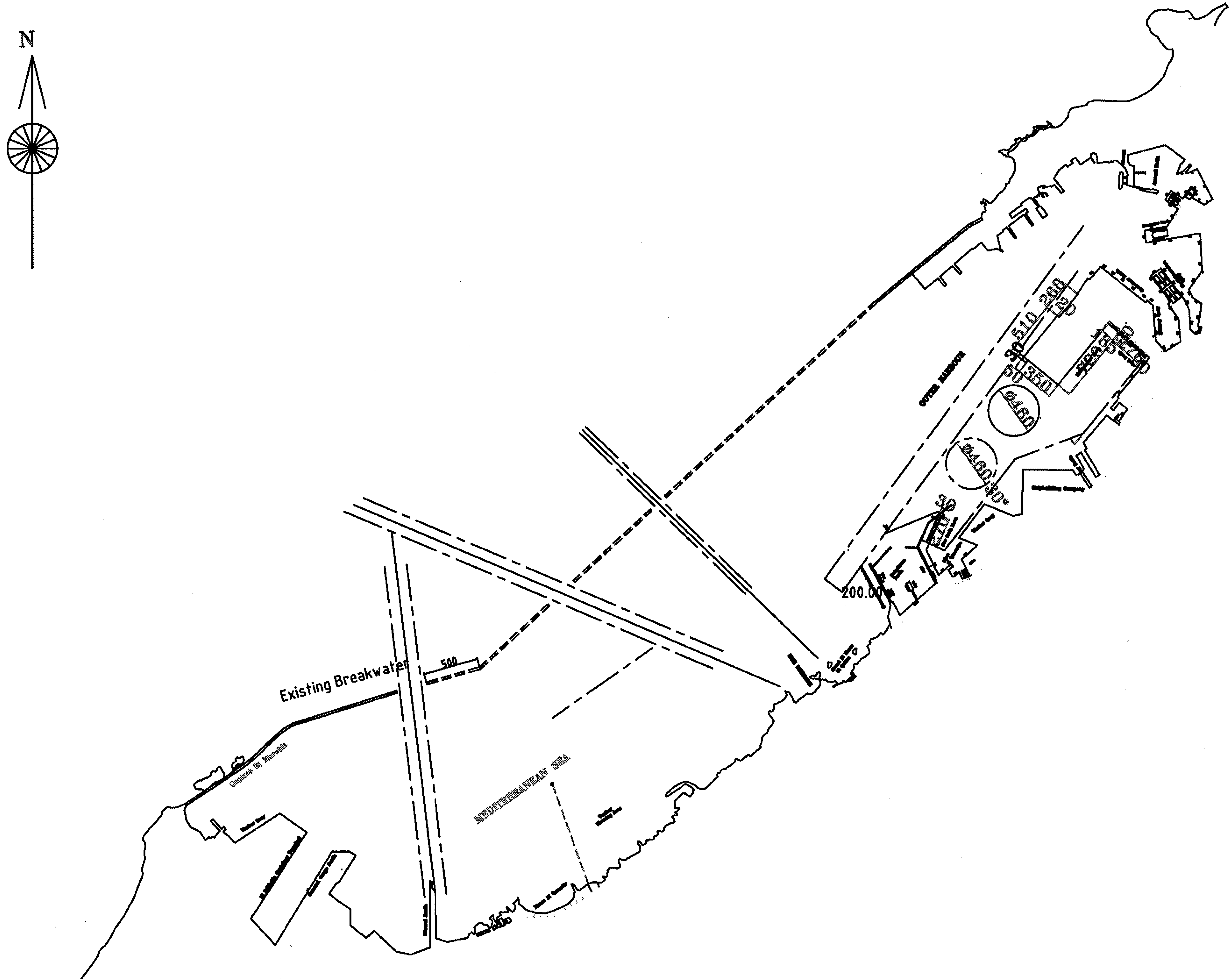


Fig 2.2 Long-Term Prospect of Breakwater Alignment beyond the Year 2017 in Alexandria Bay

Scale 1:50,000

2.6 Another Alternative for a Secondary Breakwater to the West of the Access Channel

2.6.1 Outline of the Results of the Study by Delft Hydraulics

As mentioned in the section 2.1, a study entitled "El Dekheila Wave Disturbance Project" was recently conducted by Delft Hydraulics. The Delft Hydraulics study proposed two alternatives. One is a plan (Alternative 1) to construct a secondary breakwater of 500 m in length to the west of the access channel (see Fig 2.3). The other is a plan (Alternative 2) to dredge the shallow sea bottom behind the existing breakwater. The former is said to be more effective in terms of reduction of "downtime" which is defined as the time when efficiency of loading and unloading is reduced though quay-side cargo-handling operations are not necessarily stopped.

As to limiting wave heights by ship type, the following figures are presented in Table 2.2.

Table 2.2 Limiting Wave Heights Used for Downtime Analysis

type of ship	size (DWT)	limiting wave height (cm)
container	<20,000	25
	>30,000	40
general cargo	<15,000	40
	>25,000	60
bulk (unloading)	80,000	75
	100,000	100

The effectiveness of the two alternatives is presented in Table 2.3.

Table 2.3 Effectiveness of Alternative 2 (Breakwater) in Present Layout

type of ship	size (DWT)	base case downtime (days/year)	Alternative 2 downtime (days/year)
container	<20,000	112	8
	>30,000	41	1
general cargo (mole A, west)	<15,000	69	2
	>25,000	17	0
general cargo (mole A, east)	<15,000	48	16
	>25,000	8	2
bulk (unloading)	80,000	5	7
	100,000	2	2

Construction costs for Alternative 2 (breakwater) is estimated as 14 million LE.

2.6.2 Comments on the Results

Generally, the economic viability of a project is assessed comparing costs and benefits expressed quantitatively in money terms. The effectiveness of the project (Alternative 2) proposed by Delft

Hydraulics, however, is expressed by the reduction of downtime. Hence, economic viability of the project is not necessarily clear. In this regard, the "downtime" concept in which reduction of efficiency is expressed in the conceptual range is somewhat obscure

On the other hand, it is said that the waves which reflect at the existing outer breakwater of Alexandria Port and then reach Dekheila Port often contribute to agitation in its basins. The degree of the influence of the reflected wave propagation is not clearly mentioned.

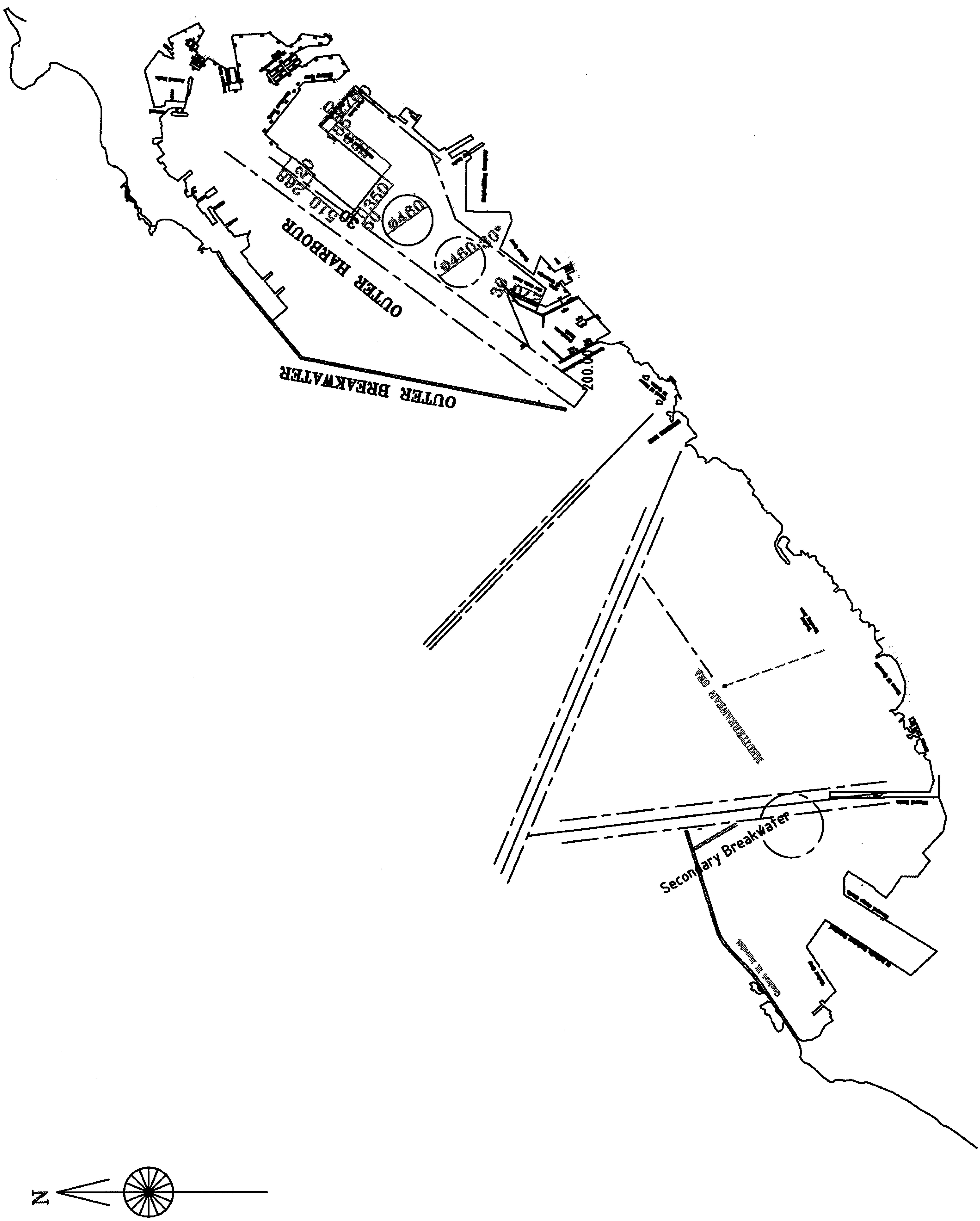


Fig. 2.3 Alternative Case of a Secondary Breakwater Proposed by Delft Hydralics

Scale 1:50,000

Appendix 3 Economic Appraisal for the Plan for Shifting Current Coal/Coke Handling in Alexandria to Dekheila

3.1 Background of the Plan for Shifting Coal/Coke Handling

At the coal/coke terminal in the Alexandria harbor, the berths are obsolete and shallow (10 m in design water depth). Nevertheless, a Panamax-type coal carrier of around 69,000 DWT with a full draft of 13.3 m and a length of 215 m once called the terminal in partly-loaded draft condition. To receive larger coal carriers in fully-loaded conditions and save ocean transport costs for coal, a plan has been envisaged in which coal/coke handling is shifted to the existing vacant mineral jetty of berth No 90/2 with water depths of 14 m at Dekheila from the existing Alexandria coal/coke terminal to the Dekheila coal terminal (referred to as "the shifting plan"). The plan entails investment in coal/coke handling machines, wave-proof barges, barge basins and a storage yard in addition to the existing facilities at the Dekheila coal terminal.

On the other hand, another alternative plan has also been envisaged in which a new berth with a water depth of 14 m is constructed in front of the existing berth line at the Alexandria coal/coke terminal (referred to as "the redevelopment plan").

The respective benefits generated from those alternative plans are almost the same because they have the same berth water depth and there seems to be no decisive difference in coal handling productivity alongside between them. Thus, prior to comparing those alternatives as "with-the-project" case to "without-the-project" case in the economic analysis, their project costs has been compared to select "the least cost project" which is the optimum alternative by adopting so called "the least cost method"

3.2 The Results of the Last Cost Comparison

In case of the "the redevelopment plan", the project costs are estimated as L.E. 34.7 million (see Table 17.3.1 of Chapter 17). On the other hand, in case of "the shifting plan", the project costs need to cover the following project components:

(1) Coal/coke handling equipment
  1) 1 unit of coal unloader: capacity of 700 tons/hr
  2) 1 unit of coke/ coal loader: capacity of 500 tons/hr
  3) 1 unit of stacker: capacity of 700 tons/hr
  4) 1 unit reclaimer: capacity of 500 tons/hr
  5) 2 units of belt conveyors: capacity of 700 tons/hr: length of 500 m
  6) 2 units of belt conveyors: capacity of 500 tons/hr: length of 500 m

(2) Stockyard
(3) Barge basin
(4) Wave-proof barges

The costs for procuring coal/coke handling equipment are estimated as L.E. 56.0 million which far outweighs the total project cost of "the redevelopment plan" though the former represents only a portion of the total project cost. Hence, “the redevelopment plan” is selected as the optimum plan in terms of coal/coke handling in the Greater Alexandria Port. The results of the preliminary economic assessment which compares “the redevelopment plan” as “with-the-project” case to “without-the-project” case where no investment is made is shown in Chapter 17.

Appendix 4 Economic Appraisal for the Construction Plan of a Barge Terminal at Dekheila Port

4.1 Background

Different from the ports of Alexandria and Damietta which have accesses to canals connected to the Nile River for barge navigation, inland transport means from/to Dekheila Port are currently limited to roads and railways. In the previous master plan of Dekheila Port, it was proposed to construct a barge terminal with a 600-meter-long berth at the bottom of the existing mineral jetty, though the plan has not yet been materialized. One reason why the plan has not yet taken shape is that economic justifiability of the said project has not necessarily been clearly demonstrated.

The possibility of modal shift from railway or road transport to barge transport in terms of sea trade cargoes which pass through Dekheila Port has been examined and the results are shown below. Containers and coal were selected as the representative cargoes to examine the possibility of modal shift

4.2 Possibility of Modal Shift from Road to Barge in Inland Container Transport

4.2.1 Conceptual Design of a Container Barge

Currently, almost all containers which are passing through Dekheila Port are transported by road inland. To transport imported containers from Dekheila Port to Cairo Metropolis or upriver cities along the Nile via Alexandria Harbour and Nabariya Canal and vice versa in exported containers, barges specialized for container transport need to be prepared. Main requirements are listed below:

- Principal dimensions to allow a barge to navigate along the canal (summer draft, air draft, moulded breadth)
- Sufficient engine power and water-proof structure to allow a barge to cross the outer sea
- Competitive freight against road transport

Barges which are currently used in Alexandria Harbour or the above-mentioned inland waterway are designed neither for crossing the outer sea nor for transporting containers. In this study, conceptual designs of two types of container barges navigable on the route of Dekheila-Alexandria-Nabariya Canal- the Nile –Cairo were conducted: one with a laden capacity of 15 TEUs and the other 30 TEUs. Both are designed as double-bottom type to hold water ballast tanks to clear air-draft restriction under the bridges over Nabariya Canal (see Figs 4.1 – 4.2). Eventually, the barge of 30 TEU capacity was judged to be unsuitable due to the excessive summer draft.

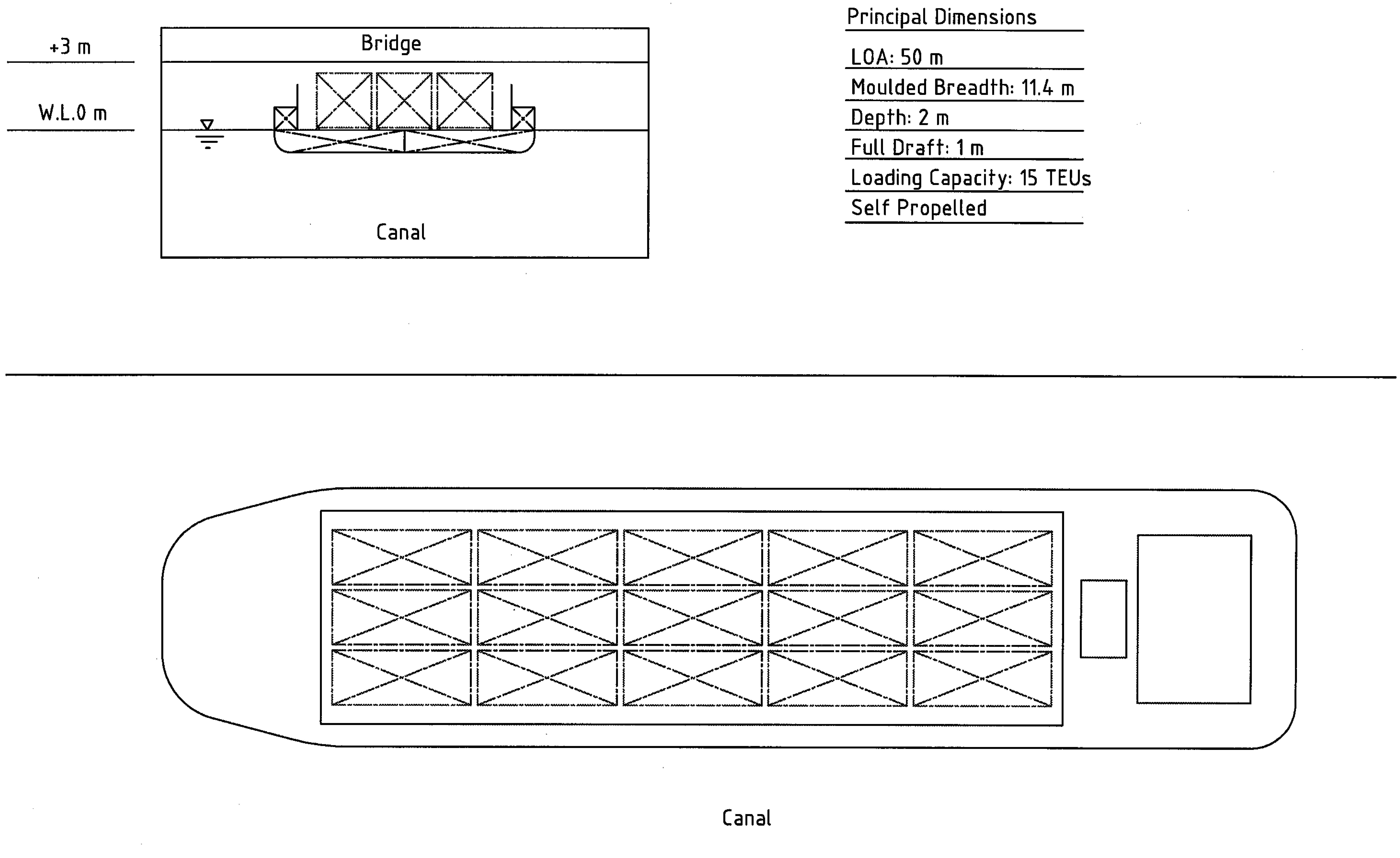
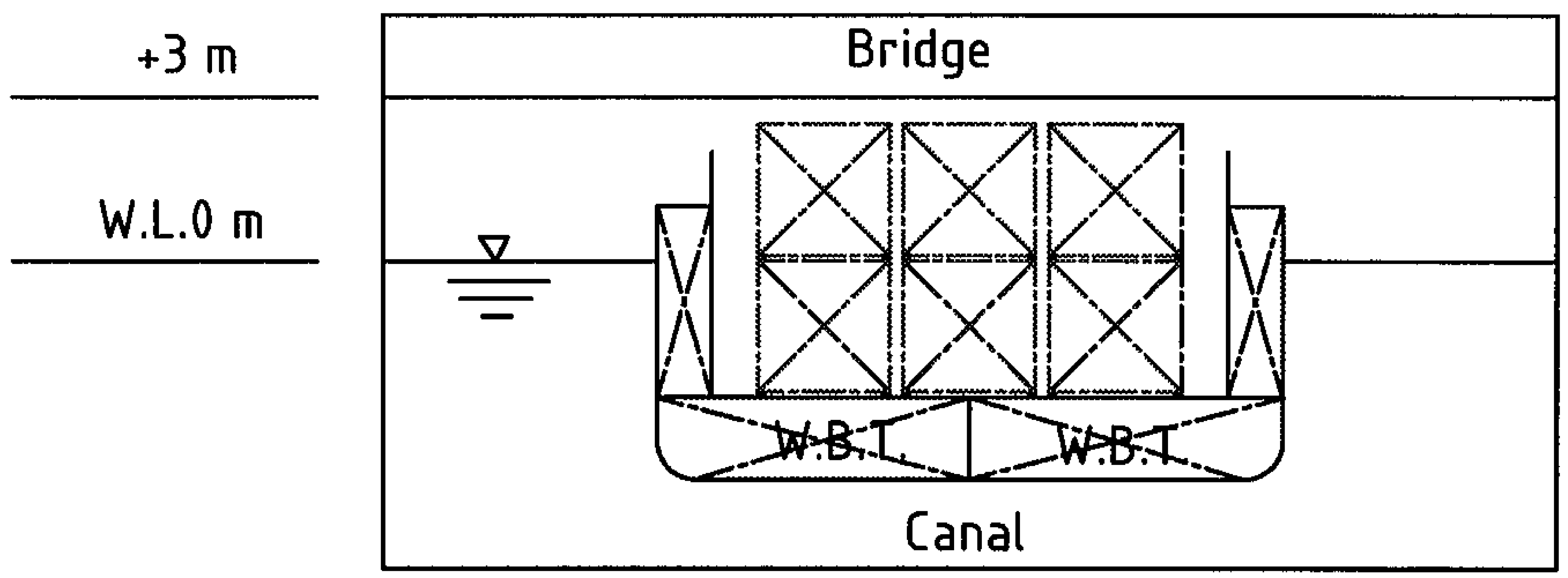


Fig.4.1 Concept of Container Barge Navigable on the route of Dekheila-Alexandria-Cairo (15 TEUs)

Scale 1:250



Principal Dimensions

- LOA: 50 m
- Moulded Breadth: 11.4 m
- Depth: 5 m
- Full Draft: 4 m
- Loading Capacity: 30 TEUs
- Self Propelled

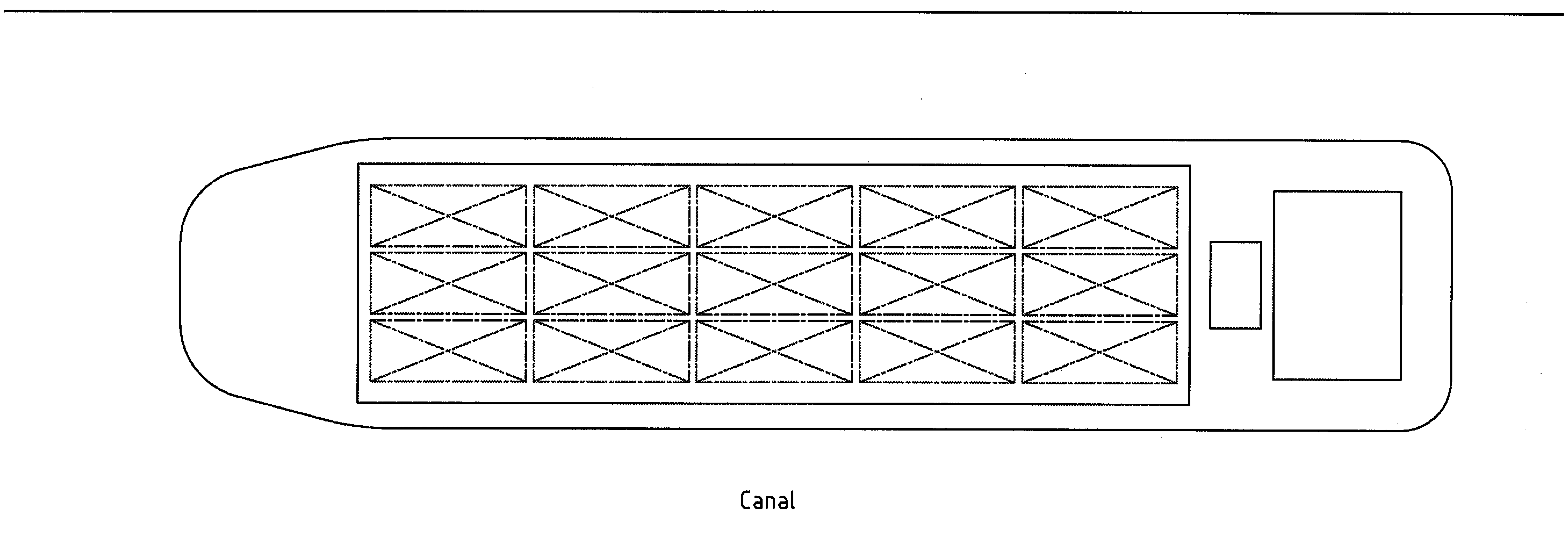


Fig.4.2 Concept of Container Barge Navigable on the route of Dekheila-Alexandria-Cairo (30 TEUs)

Scale 1:250

4.2.2 Conceptual Plan of a Barge Terminal at Dekheila Port

In this modal analysis of inland container transport, a unit of a barge terminal with the following facilities is assumed to be prepared:

- Location: the bottom of the Mineral Jetty
- Berth length: 60 m per terminal unit
- Water depth: 4 m
- Backside yard: 5,000 sq.m
- Truck crane: one unit: lifting capacity of 80 tons
- Top lifter: one unit: lifting capacity of 42 tons
- Tractor-chassis unit: 3 units
- Annual capacity: 88,000 TEUs per terminal unit

4.2.3 Results of the Comparison between the Three Transport Modes

In the cost comparison between the three transport modes, viz. road, barge and railway, depreciation costs of the existing infrastructures such as railway tracks were excluded as so-called “sunk costs”. Depreciation costs of container-handling machines, maintenance costs of infrastructures, operating costs at both end terminals of barge or railway transport, haulage between consignees/consignors and both end terminals of barge or railway transport were considered. Lift-on and lift-off costs at consignees/consignors are excluded as the costs common in every transport mode. Thus, the cost comparison between the three transport modes inland was conducted on a door-to-door basis. The results are shown in Fig. 4.3 and Table 4.1. According to the results, road transport is the most economical up to 500 km in distance and then replaced by railway.

Regarding competitiveness between road and railway in container transport in the USA, it is said that road has an advantage over railway up to approximately 800 km. Although the conditions of the comparison are considerably different between the USA and Egypt in terms of infrastructures, wage level, customs duties, etc., the results coincide with the world-wide tendency in which road has advantage in shorter distance, and railway in longer distance.

On the other hand, competitiveness between inland waterway and road or railway depends largely on the size of barge. In Europe where the inland waterway network is well established, river barges with at least over 100 TEU capacity are commonly used. Costs at both end terminals where containers are loaded on to or discharged from barges are costly and take considerable share. In Japan, it is said that for container transport by coaster of 120 TEU capacity over a short distance (under around 300 km), marine terminal costs take in the range of a half to two thirds of the total transport cost, and even over a longer distance where coaster has an advantage over road, in the range of one third to a half. In the case in Egypt, a similar tendency is found (see Table 4.1). Thus transport by barge over short distances is disadvantageous compared with road transport.

Although transport costs by self-propelled barge of 1500 DWT with container laden capacity of 120 TEUs in Fig 4.3 show competitiveness against even road, the barge is not navigable through small-scaled Nabariya Canal. In case of a barge of 280 DWT with capacity of 15 TEUs, barge can not compete with road within the Nile Delta.

Fig 4.3 Inland Transport Costs for Containers by Transport Mode
(Terminal costs are included and sunk costs of infrastructures are excluded)

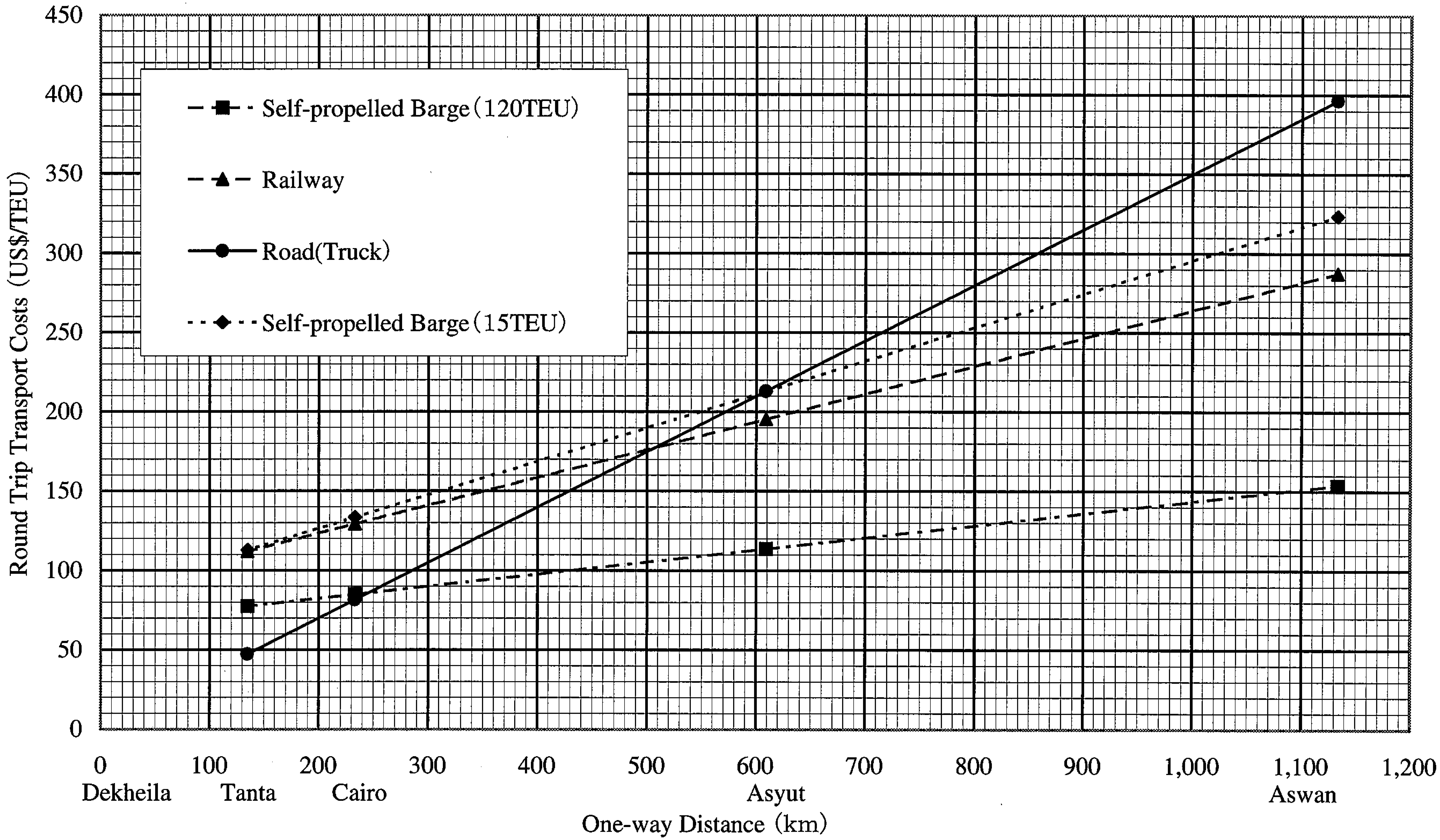


Table 4.1 Inland Transport Costs for Containers by Transport Mode

Transport Mode	Cost Breakdown	Dekheila - Tanta (135km)		Dekheila - Cairo (233 km)		Dekheila - Asyut (609 km)		Dekheila - Aswan (1,133 km)	
		US$/TEU	Share	US$/TEU	Share	US$/TEU	Share	US$/TEU	Share
Self-propelled barge (120 TEUs)	Transport cost by barge	12	32%	16	38%	30	54%	50	66%
	Terminal cost	18	48%	18	43%	18	32%	18	24%
	Delivery cost by truck	8	21%	8	19%	8	14%	8	10%
	One-way total cost	39	100%	42	100%	57	100%	77	100%
Self-propelled barge (15 TEUs)	Transport cost by barge	19	33%	29	43%	69	65%	124	77%
	Terminal cost	29	51%	29	44%	29	27%	29	18%
	Delivery cost by truck	9	16%	9	13%	9	8%	9	5%
	One-way total cost	56	100%	67	100%	106	100%	162	100%
Railway	Transport cost by block train	29	51%	36	55%	62	64%	99	69%
	Terminal cost	16	29%	16	25%	16	16%	16	11%
	Railway track maintenance cost	2	4%	4	6%	11	11%	20	14%
	Delivery cost by truck	9	16%	9	14%	9	9%	9	6%
	One-way total cost	56	100%	65	100%	98	100%	144	100%
Road	Round Trip	47	100%	82	100%	213	100%	396	100%

4.3 Possibility of Modal Shift from Railway to Barge in Inland Coal Transport

Currently, coal which is discharged at Dekheila Port is transported to Helwan coal processing plant by railway. To transport imported coal from Dekheila Port to Helwan along the Nile via Alexandria Harbour and Nabariya Canal, barges navigable in the outer sea across Alexandria Bay are required.

In the cost comparison between the three transport modes, viz. road, barge and railway, depreciation costs of the existing infrastructures such as railway tracks and the riverside barge jetty at Helwan were excluded as so-called "sunk costs". Depreciation costs of coal-handling machines, maintenance costs of infrastructures, operating costs at both end terminals of barge or railway transport were considered.. The results are shown in Fig. 4.4 and Table 4.2. According to the results, railway transport is the most economical all the way to upriver of the Nile.

On the other hand, a barge fleet composed of a self-propelled barge and a non-self-propelled barge with a laden cargo capacity of 200 – 300 tons each tied up with each other are currently used to transport coal from the coal terminal in Alexandria Harbour to Helwan via Nabariya Canal and the Nile. These barges are a type of river barge which are lower in cost than the barge designed to reach Dekheila Port across the outer sea. As shown in Fig. 4.4, the coal transport by barge fleet navigating between Alexandria Harbour and Helwan is the most economical (due to the lower barge costs and the existence of the coal terminal whose depreciation costs of infrastructures are regarded as sunk costs) all the way to the upriver of the Nile.

4.4 Conclusions

The results of the appraisal of the said plan at Dekheila Port are concluded as follows:

(1) As to container transport inland from/to Dekheila Port, transport by road (tractor-chassis unit) is the most economical mode compared with barge (self-propelled barge with 15 TEU capacity navigable across the outer sea and through the existing Nabariya Canal) and railway over a short distance (approximately 500 km and under) and also offers quicker delivery on a door-to-door basis.

(2) As to transport of bulk cargo such as coal inland between Dekheila Port and a river-side place along the Nile, transport by railway is the most economical mode compared with barge (self-propelled barge navigable across the outer sea and through the existing Nabariya Canal) and road all the way to the upriver of the Nile. However, transport from/to Alexandria Harbour by barge fleet (river barge type) currently in operation is more economical than railway.

(3) As to transport of bulk cargo from/to Dekheila, until railway capacity becomes saturated, there seems to be no need to induce modal shift from railway to barge. If such a situation occurs in the future, it is advisable to examine the feasibility of the renovation of the existing Nabariya Canal including a pair of lock gates so as to receive larger barges.

Fig 4.4 Inland Transport Costs for Coal by Transport Mode
(Terminal costs are included and sunk costs of infrastructures are excluded.)

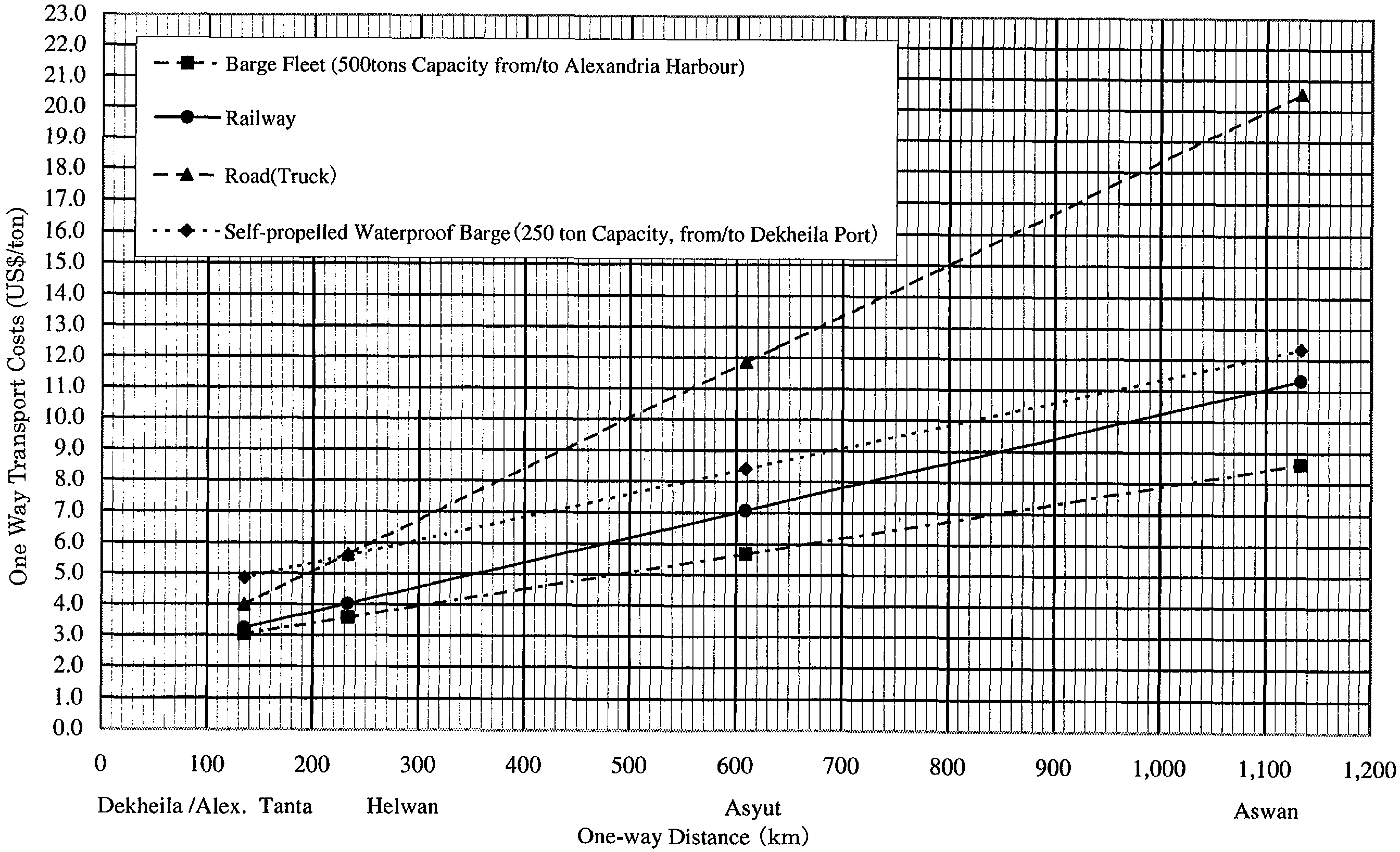


Table 4.2 Inland Transport Costs for Coal by Transport Mode

Transport Mode	Cost Breakdown	Dekheila - Tanta (135km)		Dekheila - Helwan (233 km)		Dekheila - Asyut (609 km)		Dekheila - Aswan (1,133 km)	
		US$/ton	Share	US$/ton	Share	US$/ton	Share	US$/ton	Share
Barge fleet (500 ton capacity from/to Alexandria Harbour)	Transport cost by barge fleet	0.9	30%	1.5	42%	3.6	63%	6.5	76%
	Terminal cost	2.1	70%	2.1	58%	2.1	37%	2.1	24%
	One-way total cost	3.0	100%	3.6	100%	5.7	100%	8.6	100%
Self-propelled barge (250 ton capacity, from/to Dekheila)	Transport cost by barge	1.3	27%	2.0	36%	4.8	57%	8.7	71%
	Terminal cost	3.6	73%	3.6	64%	3.6	43%	3.6	29%
	One-way total cost	4.9	100%	5.6	100%	8.4	100%	12.3	100%
Railway	Transport cost by block train	2.2	69%	2.9	73%	5.4	76%	8.9	79%
	Terminal cost	0.8	25%	0.8	20%	0.8	11%	0.8	7%
	Railway track maintenance cost	0.2	6%	0.3	8%	0.9	13%	1.6	14%
	One-way total cost	3.2	100%	4.0	100%	7.1	100%	11.3	100%
Road	Transport cost by truck	2.2	55%	3.9	68%	10.1	85%	18.8	91%
	Terminal cost	1.8	45%	1.8	32%	1.8	15%	1.8	9%
	One-way total cost	4.0	100%	5.7	100%	11.9	100%	20.6	100%