PART V SHORT-TERM DEVELOPMENT PLAN FOR TEMA PORT

Chapter 24 Short-term Development Plan for Tema Port

24.1 Planning Requirement for Short-term Development Plan

(1) Strategy for Development

As explained in Chapter 14.1, Tema Port has advantages for future development and the port must make the most of its advantages to play its expected role. However, we must not forget that the port is competing with other ports in acquiring container and transit cargoes. This means that investment and construction of facilities should be implemented timely.

The strategy of the short-term development plan is that investment should be limited to the high priority project and other development necessity would be eased by making much use of existing facilities.

(2) Future Cargo Demand

Future cargo demand was forecasted and the results are summarized in Table 24.1.1 and Table 24.1.2. Main cargoes in which volumes will increase their volumes are clinker, bauxite and container cargo.

Table 24.1.1 Future Cargo Demand Forecast at Tema Port

(tons)

IMPORT	**1991**	**2000**	**2010**
Dry Bulk	1,061,685	1,652,557	2,157,747
Alumina	365,906	301,775	384,950
Clinker	470,277	972,772	1,262,240
Liquid Bulk	1,106,336	1,853,315	3,439,000
Crude Oil	165,112	1,000,000	2,575,747
Petrol Products	168,901	850,000	858,500
Bagged Cargo	301,253	537,553	597,518
General Cargo	201,898	235,135	701,388
Containerized Cargo	397,663	833,529	1,875,000
Total	**3,068,835**	**5,112,088**	**8,770,653**
Export	**1991**	**2000**	**2010**
Liquid Bulk	198,070	246,584	401,659
Bagged Cargo	84,092	104,370	26,891
General Cargo	192,109	156,230	106,734
Containerized Cargo	103,904	382,371	820,835
Total	**578,175**	**889,555**	**1,356,118**
Grand Total	**3,647,010**	**6,001,643**	**10,126,771**

Table 24.1.2 Future Container Cargo Demand Forecast at Tema Port

	1991	**2000**	**2010**
Import	35,071	81,861	202,447
Export	35,852	79,782	213,282
Transit		2,648	10,835
Transshipment		1,858	58,749
Total	70,923	166,149	485,313

24.2 Facility Requirement for Short-term Development Plan

(1) Cargo Handling Productivity

As explained in chapter 14.3 and the development strategy mention above, new container berths have a higher priority among projects in the master plan. Therefore, the cargo handling productivity at 2010 for cargoes handled at multipurpose berths is set at the same level of that of the year 2000.

Table 24.2.1 Gross Cargo Handling Productivity at Tema Port in 2000 and 2010

Type	Commodity	Unit	Productivity 2000	Productivity 2010	Remark
IMPORT					
DB	Alumina	t/hour/vessel	211	210	Unlader
DB	Clinker/Gypsum	t/hour/vessel	299	350	Belt conveyor
DB	Wheat	t/hour/vessel	70	150	Ship gear, grab
LB	Petro products	t/hour/vessel	385	600	Pipeline
BC	Rice, Fertilizer	t/hour/vessel	50	75	Ship gear
GC	Cars, Steel product	t/hour/vessel	70	70	Ship gear
GC	Gen. Valco	t/hour/vessel	125	125	Ship gear
CO	Container	box/hour/vessel	16	24	Container crane
EXPORT					
LB	Petro products	t/hour/vessel	385	385	Pipeline
BC	Cocoa beans	t/hour/vessel	30	75	Ship gear
GC	Aluminum	t/hour/vessel	85	85	Ship gear
GC	Cocoa products	t/hour/vessel	30	50	Ship gear
GC	S/Timber, Wood product	t/hour/vessel	30	75	Ship gear
CO	Container	box/hour/vessel	16	24	Container crane
RO	RoRo Cargo	t/hour/vessel	122	150	

Note: Productivity 2000 is calculated from data of Jan. to Nov. in 2000

(2) Vessel Size at Target Year

Vessel sizes in the year 2010 are set as described in Table 14.2.2.

Table 24.2.2 Vessel Size at the Target Year 2010 at Tema Port

Vessel Type	2000		2010 (Standard Size)		
	Max.DWT	$DWT_{1/4}$	DWT	Length	Draft
	(tons)	(tons)	(tons)	(m)	(m)
Bulk carrier	51,694	47,263	30,000	185	11.0
Cellular container	31,975	20,245	35,000	260	12.0
RO-RO	39,900	28,175	28,000	210	11.0

Note: $DWT_{1/4}$ means DWT of one fourths largest vessel

(3) Number of Berths Required

The result of required berth number by berth type is shown in Table 24.2.3.

Table 24.2.3 Scale of Berths for Short-term Development Plan of Tema

Berth	Commodity	Number	Depth	Length
Container Berth	Container	2	13.0m	300m

24.3 Port Facility Layout Plan for Short-term Development Plan

Fig. 24.3.1 shows the proposed layout. Table 24.3.1 shows the list of main facilities of the short-term development plan.

Table 24.3.1 List of Main Facilities for Short-term Development Plan of Tema Port

Facility	No.	Dimension / Capacity
Container Berths	2	Length 300m, depth 13m
Navigational aids	1	2 Light beacons, 2 Buoys
Tugboat	1	2,500Hp
New entrance channel	1	One way, width 160m, depth 15m
New turning basin	1	Radius 290m, depth 14m
Container yard	1	25ha
New breakwater	1	1,350m, 200m
Revetment	1	630m
Access road development	1	1 set
Inner harbour road	1	1 set
Parking space	1	12,200m^2
Container crane	4	45 tons
Transfer crane	12	40 tons, 1 over 4
Tractor head	16	For container cargo

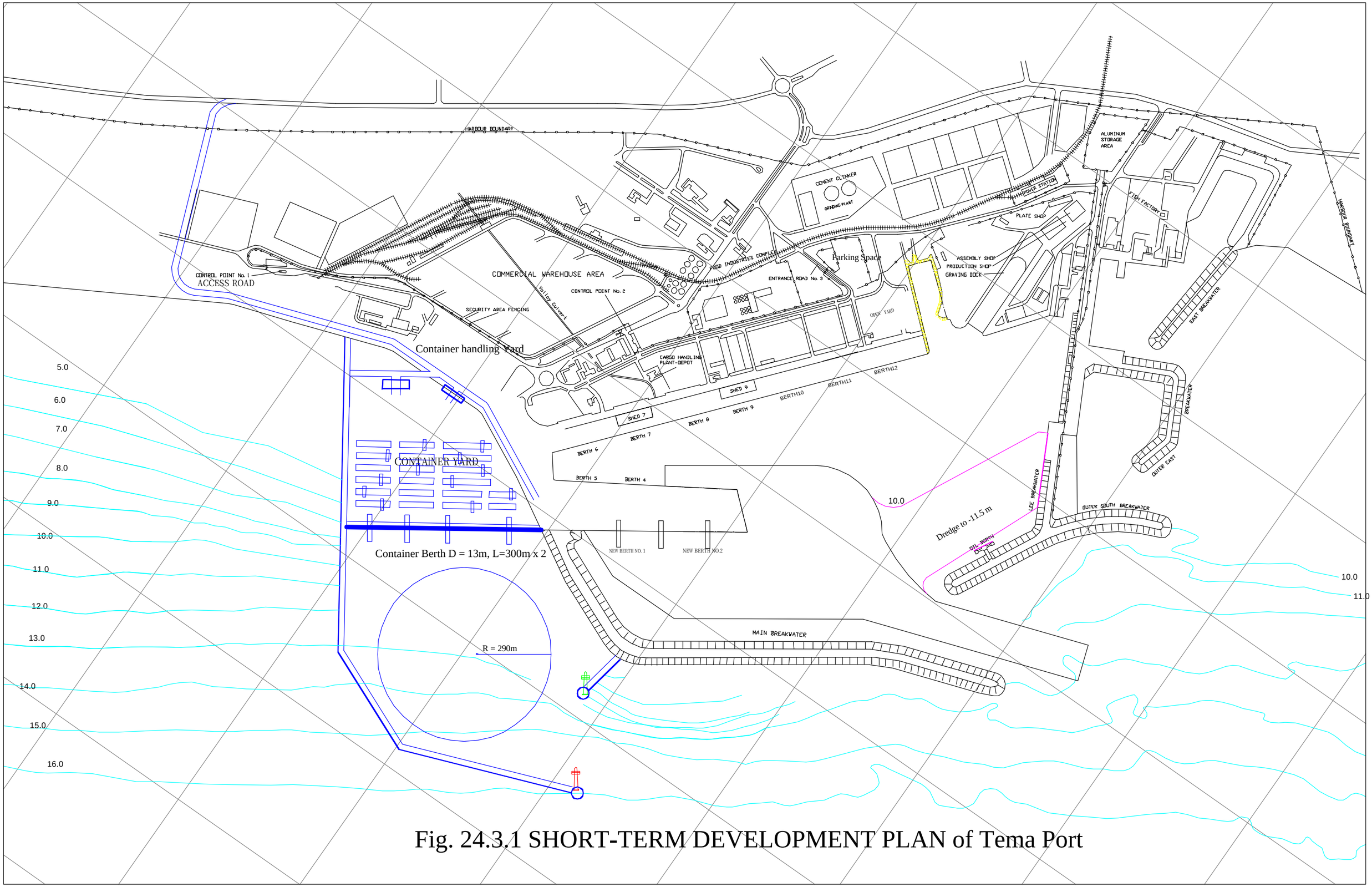


Fig. 24.3.1 SHORT-TERM DEVELOPMENT PLAN of Tema Port

24.4 Proposal for Efficient Port Operation

24.4.1 Container Cargo

(1) Container Handling at New Container Terminal

Table 24.4.1 Estimated Storage Area for Container cargo

Port of Tema		2000	2010	unit
Volume of Container Cargo		166,149	485,313	TEU
Volume of Container Cargo		128,798	376,212	Box
Productivity		16	24	box/hour/vessel
Working day		365	365	day
Cargo throughput in a day		455	1,330	TEU/day
Average Dwelling Time(Target)		12	6	day
Peak Ratio		1.3	1.3	
		2000	2010	
Required Capacity Volume for Container storage		7,098	10,374	TEU
Required Area for Container Storage	2 tiers	88,725	129,675	m2
	3 tiers	59,150	86,450	m2
	4 tiers	**44,363**	**64,838**	**m2**

Size of 20ft Container	
Length(l)	6.058 m
Widgh(w)	2.438 m
Height(h)	2.438 m
Bottom Area(=l x w)	15 m2
Area for 1slot	
(+ 50cm space on each side)	
lengh + 50cm x 2(ls)	7.058 m
widgh + 50cm x 2(ws)	3.438 m
Bottom Area(=ls x ws)	25 m2

- The construction of new container terminal at the western side of Tema port is proposed in the short-term plan (depth -13m x 300m x 2berths). The transfer crane method is suitable for terminals because it results in the most effective storage capacity in the same area.
- Fifty-five percent of container cargo will be handled at the new container terminal, and the rest (45%) will be handled at the existent berths such as berths 1-4 of Quay2 and Quay1 berths.
- Four gantry cranes should be installed in the new container berths (2 gantry cranes in 1 berth x 2 berths).
- The required number of transfer crane (RTG) for gantry cranes is 12 units
- Between quay side and marshaling yard, container cargo should be carried by yard tractor-trailers. The required number of yard tractor-trailers for each gantry crane is 16 units for 4 gantry cranes.

In total for new container terminals:	Quay side gantry crane:	4 units
	Transfer crane:	12 units
	Yard tractor trailer:	16 units
	Storage capacity:	7,480 TEUs
	(layouts	Figure 24.4.3)

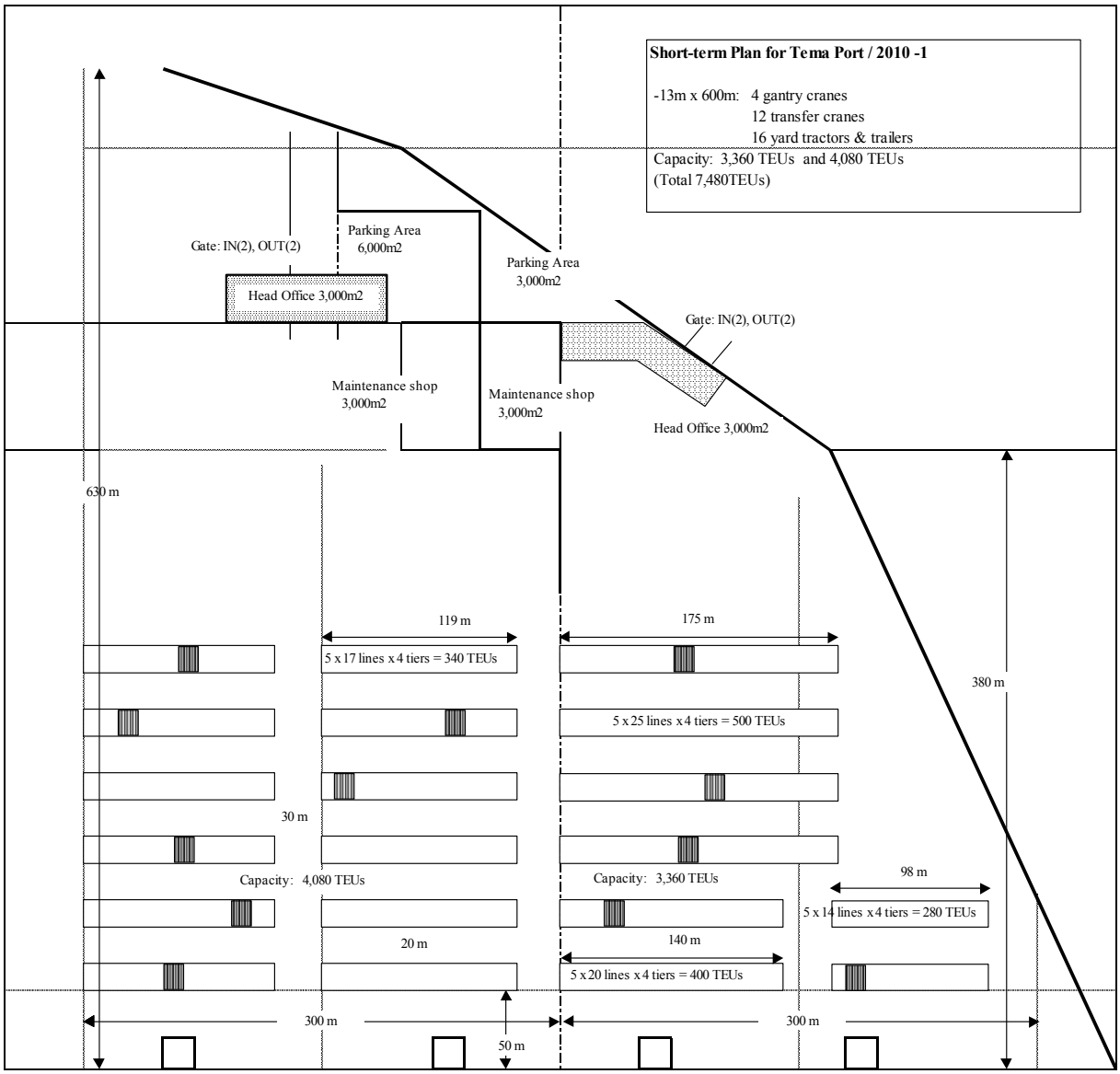


Figure 24.4.3 Layout of New Container Berth (Depth -13m, 300m x 2 berths)

(i) The Container Yard at the existing port area (Quay1 and Quay2)

- Forty-five percent of container cargo will be handled at the Quay1 berths and at the container terminal on Quay2 that will be re-constructed.
- At present, there are some container yards behind berths 10-11 (about 37,000m^2). In addition, GPHA plans to establish a new container yard at the Quay2 (945 slots, 23,625 m^2) and in the area where the cocoa shed is currently located (about 52,000m^2). These container yards behind berth 10-11 and new container yard are sufficient for future container storage (3-tier stacking) at the existing port area.

(ii) Additional Measures to Increase Efficiency of Port Operation

Refer to Chapter 13.5.2(1)-(f).

(2) Bulk Cargo (Clinker)

For highly bulk cargo handling efficiency, these bulk cargo such as clinker, gypsum are supposed to be handled mainly at the berths 10-12.

(3) Bagged Cargo

Refer to Chapter 14.5.2 (4).

(4) Ro/Ro Cargo, General Cargo

Refer to Chapter 14.5.2 (5).

(5) Introduction of a Three-Shift Working System and Training System.

Refer to Chapter 13.5.2(4).

(6) Introduction of Port EDI System

Refer to Chapter 15.1.4.

Chapter 25 Structural Design of Main Port Facilities

25.1 Design Requirements and Conditions

(1) Required Facilities of Short Term Development Plan

The following facilities are planned in the Short Term Development:

Table 25.1.1 Facilities Required in Short Term Development Plan

Facilities	Requirement
1. Breakwater	- Construction of New breakwaters for New Container Terminal · Type I (water depth: -7.0 ~ -15.5m): L = 1,350m (Total) Type IA (water depth: -10.0 ~ -15.5m) Type IB (water depth: -7.0 ~ -10.0m) · Type II (water depth: -5.0 ~ -12.0m): L = 200m
2. Container Berths and Container Yard	- Construction of New container berths: · -14.0m x 300m x 2 berths: Total 600m - Reclamation: Approxi. 28 ha - Revetment: L = 650m
3. Basin and Navigation	- Dredge to -13.0m for New container berths and channel - Navigation Aids: Two (2) lighted buoy, Two (2) light beacons
4. Building & Utilities	- Admin. Office & Gate, Maintenance shop for New Container Terminal, Lighting, etc.
5. Others	- New Port Access Road, Drainage, Yard Paving, Removal of a part of exist. breakwater parapet/wave walls to fit the new container terminal area

(2) Basic Design Conditions

The following conditions on the objective vessels and design wave are applied in the design:

Table 25.1.2 Design Vessels Specification

Vessel Type	Max .DWT (GT)	Length Overall (m)	Breadth (m)	Max. Draft (m)	Remarks
Container ship	35, 000	260	32.0	12.0	Container wharf
Bulk carrier	30, 000	185	27.5	11.0	Valco berth
General cargo ship	30, 000	185	27.5	11.0	Valco Berth
Oil Tanker	30, 000	180	29.2	10.9	Oil Berth

Table 25.1.3 Design Wave (50 years return period)

Wave Direction	SW	S	SE	E
Wave Height ($H_{1/3}$)	3.70m	4.40m	4.40m	3.80m
Wave Period ($T_{1/3}$)	9-11 sec.			5-9 sec.

25.2 Breakwater

In other to obtain necessary calmness for the New Container wharf, new breakwaters are required at total length 1,550 m. The structural type recommended for the breakwaters is rubble mound type and its crown height at C.D. +5.0m. The required sizes of the armor stone for main breakwater is 10.0 ~ 15.0 tf/pcs for Type IA (water depth -15m average) based on the design wave height of 4.4 m. The typical sections of the breakwater is shown in Figure 25.2.1

The calmness ratio estimated from the analysis with provisions of the planned breakwaters is around 98% (operative wave limit at 0.5m).

25.3 New Container Berth

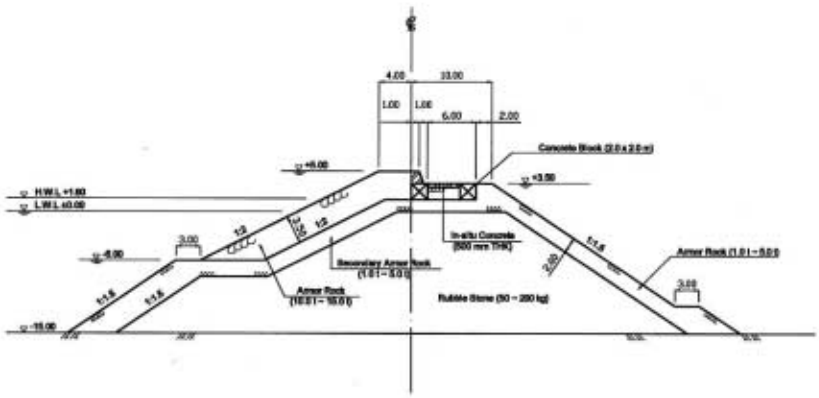
Based on the preliminary design results for the new container berths, the following structural type and dimensions are recommended.

	Objective Vessel	Crown Height	Water Depth	Structural Type
Container Berth	50,000 DWT	+3.30 m	-14.0 m	Concrete Caisson (11.0^{B} x 15.0^{H} x 20.0^{L} m)

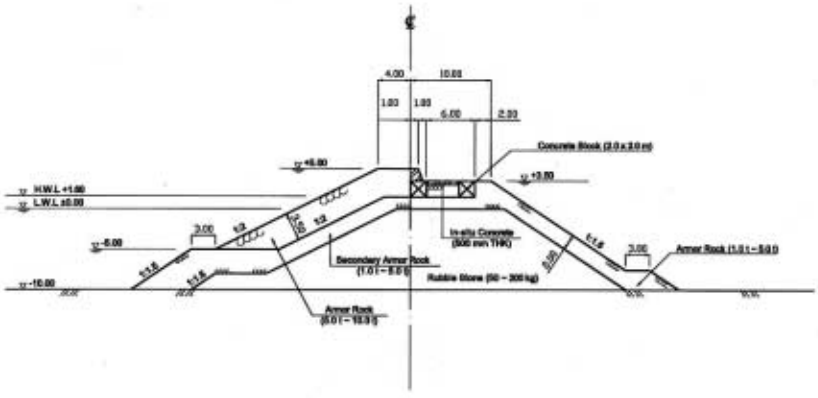
The typical section of the new container berth is shown in Figure 25.3.1.

25. 4 Revetment

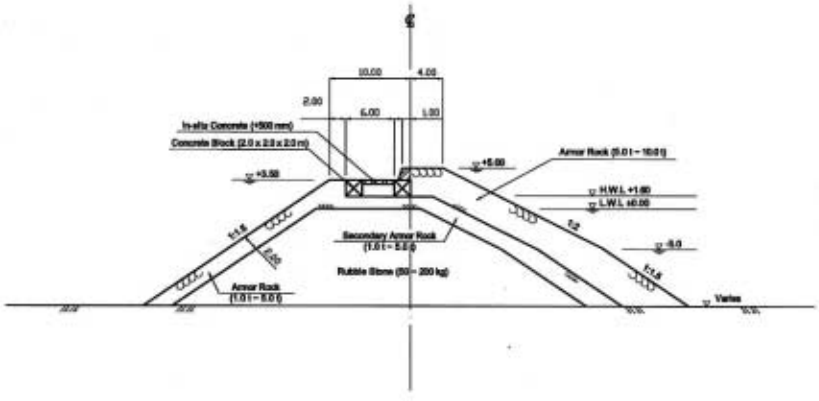
A 650m long revetment is required to form the reclamation area for the container terminal. It is recommended to design the revetment as a sort of breakwater, especially its water depth deeper than C.D. -5.0 m, since the revetment is subjected to severe wave conditions.



Type I-A (-10.0 m and Over)



Type I-B (Less -10.0 m)



Type II (-5.0 ~ -12.0 m)

Fig. 25.2.1 Typical Section of Breakwater

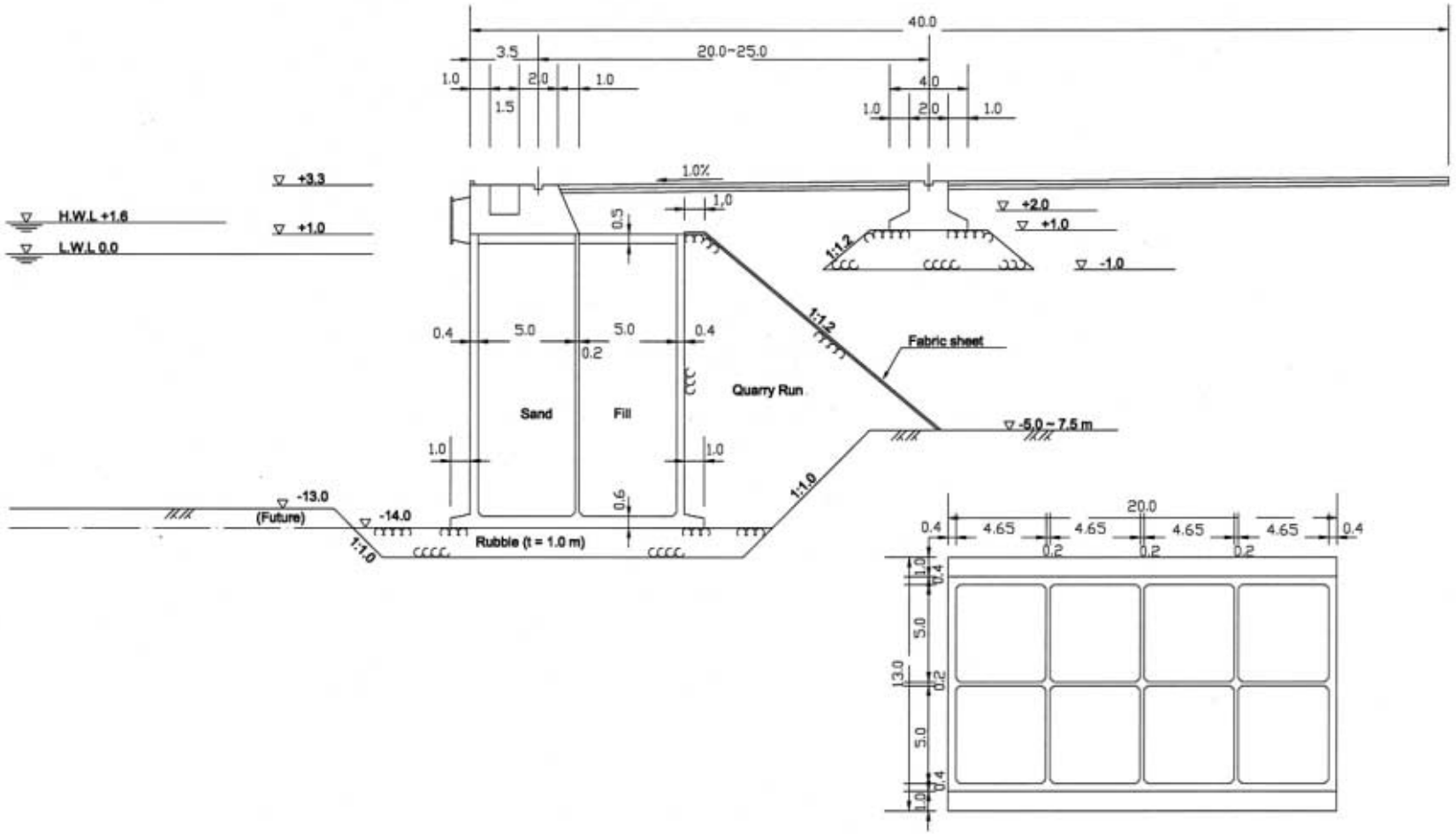


Figure 25.3.1 Typical Section of New Container Berth (-14.0m)

Chapter 26 Implementation Program

26.1 Construction Plan for Major Works

(1) Dredging and Reclamation

The estimated dredging volume is approxi. 1.2 million m^3, of which more than 60% is thought to be rock materials. The rock materials to be dredged is, according to the soil investigation carried out in the Study, expected to be mostly weathered rock with its compressive strength less than 50 MPa (categorized as soft rock) which can be dredged without blasting (but use of rock breaking hammer).

For dredger type to be employed, a grab type dredger (18 ~ 20 m^3 grab capacity) is recommended as similar conditions with Takoradi Port Development

As for hard rock dredging, a same method applied for Takoradi Port Development will be used that is to blast using Mini-SEP before dredging by the grab dredger.

The estimated volume for the reclamation is approximately 2.0 million m^3. The dredged material will be utilized as much as possible (about 1.0 million m^3) and the balance should be taken from available sand borrow pit (50% of the balance be taken from sea area).

(2) Concrete Caisson Berth Construction

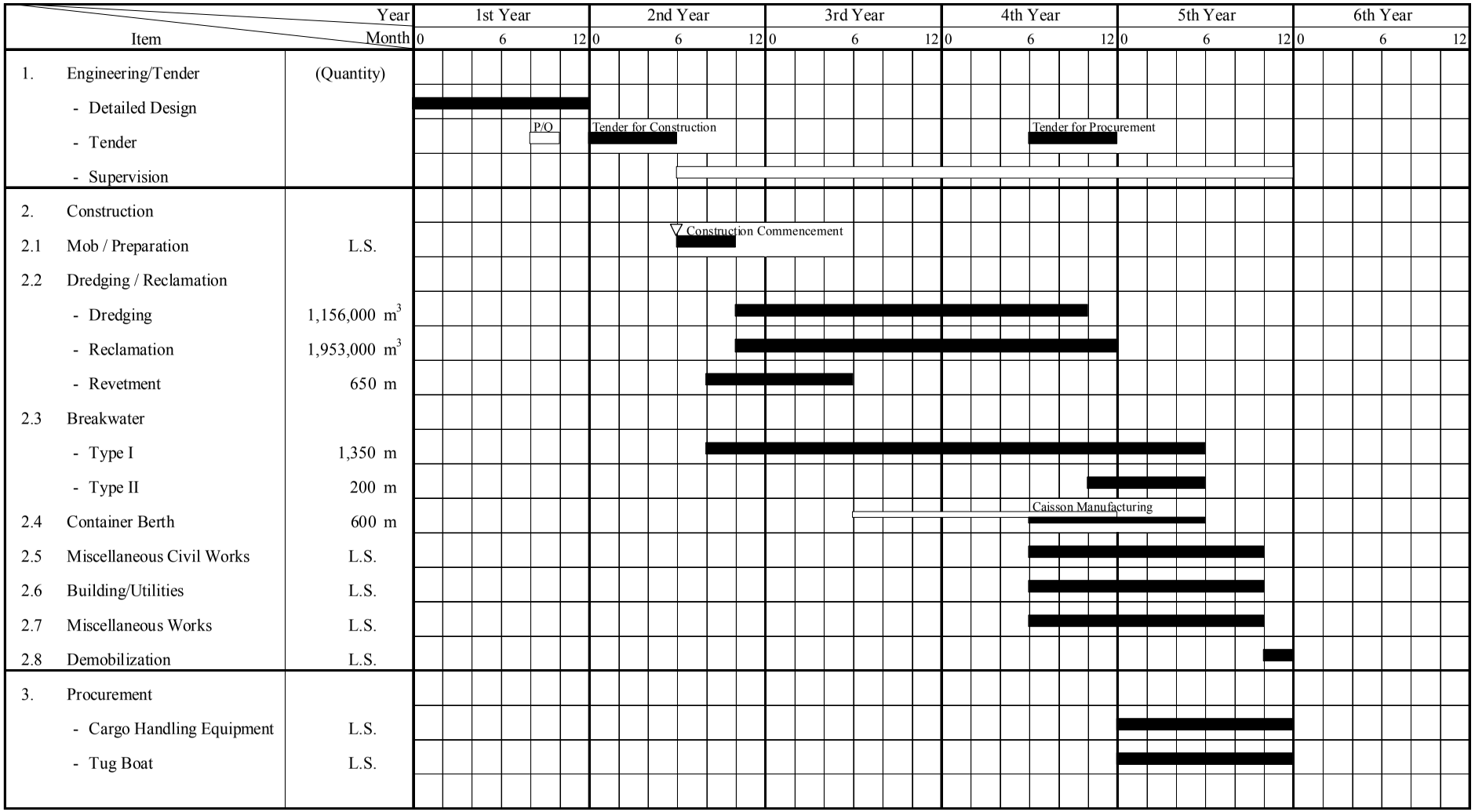
Floating dock of 6,000 ~ 8,000 DWT will be employed to fabricate the caisson units. In order to obtain necessary calmness and water depth for the caisson fabrication, the inside area of Tema Port, just behind the main breakwater area is recommended. The required period for the caisson fabrication (31 units) is estimated about 18 months.

26.2 Implementation Schedule

Short Term Development will require at least five (5) years for its implementation including 1.5 year for Engineering and Tendering before the commencement of the construction, and is to be completed by the end of year 2009.

The proposed implementation schedule for the Short Term Development of Tema Port is indicated in Figure 26.2.1.

Figure 26.2.1 Implementation Schedule



Chapter 27 Cost Estimation

27.1 Estimation Conditions

The following conditions are adopted for the cost estimation as same applied for Takoradi Port Development:

1) Costs are expressed in US dollars under the following exchange rate;

1 U.S. dollars = 6,700 Cedis

2) Costs for land acquisitions or any compensations are not considered.

3) The implementation period is 5 years and includes 1.5 years for engineering and tendering.

27.2 Implementation Cost

The total cost estimated for the implementation of Short Term Development is indicated in Table 27.2.1, and the yearly cost disbursement is shown in Table 27.2.2.

Table 27.2.1 Implementation Cost of Short Term Development Plan

Item	unit	Quantity	Unit Price (USD)	Foreign Cost (x1,000 USD)	Local Cost (x1,000 USD)	Total Cost (x1,000 USD)
1. Dredging						
1.1 Hard Rock	m^3	85,000	68.0	5,491	289	5,780
1.2 Soft Rock	m^3	641,000	25.0	15,224	801	16,025
1.3 General Soil	m^3	430,000	6.0	2,451	129	2,580
2. Reclamation						
2.1 Dredged Material Fill	m^3	1,000,000	2.0	1,800	200	2,000
2.2 Borrow Material Fill	m^3	953,000	7.5	4,289	2,859	7,148
3. Breakwater						
3.1 Type1A(-15.0mAverage)	m	950	32,000.0	25,840	4,560	30,400
3.2 Type1B(-10.0mAverage)	m	400	19,500.0	6,630	1,170	7,800
3.3 Type-2	m	200	15,000.0	2,550	450	3,000
4. Revetment						
4.1 Revetment (Less-5.0m)	m	500	8,300.0	2,283	1,868	4,150
4.2 Revetment(-5.0~-10.0m)	m	150	15,000.0	1,238	1,013	2,250
4. Container Wharf						
4.1 Wharf (-14.0m)	m	600	36,800.0	18,768	3,312	22,080
4.4 Yard Paving	m^2	200,000	35.0	3,360	3,640	7,000
5. Other Items						
5.1 Building Works	L.S.	1	3,700,000	1,480	2,220	3,700
5.2 Lighting/Electrical Works	L.S.	1	1,300,000	780	520	1,300
5.3 Access Road	L.S.	1	2,000,000	1,800	200	2,000
5.4 Drainage	L.S.	1	600,000	240	360	600
5.5 Navigation Aids	L.S.	1	100,000	98	2	100
5.6 Miscellaneous	L.S.	1	150,000	75	75	150
Total Construction Cost				**94,395**	**23,667**	**118,063**
6. Equipment						
6.1 Container Cranes	L.S.	1	32,000,000	32,000	0	32,000
6.2 Other Equipment	L.S.	1	1,906,000	1,906	0	1,906
6.3 Floating Equipment	L.S.	1	3,000,000	3,000	0	3,000
Total Equipment Cost				**36,906**	**0**	**36,906**
7. Physical Contingency	L.S.	1	10,921,000	9,028	1,893	10,921
8. Engineering Cost	L.S.	1	5,903,000	4,720	1,183	5,903
Grand Total				**145,049**	**26,744**	**171,793**

Table 27.2.2 Implementation Cost Disbursement

Item	1st Year		2nd Year		3rd Year		4th Year		5th Year	
	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local
(New Port Area)										
1. Dredging			1,931	102	11,583	609	9,652	508		
2. Reclamation			469	235	2,810	1,412	2,810	1,412		
3. Breakwater			3,184	562	12,735	2,247	12,735	2,247	6,366	1,124
4. Revetment			1,056	864	2,463	2,017				
5. Container Berth					4,692	828	9,384	1,656	4,692	828
6. Yard Paving									3,360	3,640
7. Building works							555	278	925	1,942
8. Lighting/ Electrical							293	195	487	325
9. Access road							675	75	1,125	125
10. Drainage							120	180	120	180
11. Navigation									98	2
12. Miscellaneous									75	75
Total	0	0	6,640	1,763	34,283	7,113	36,224	6,551	17,248	8,241
Contingency			531	141	2,743	569	2,898	524	1,380	659
13. Equipment										
-Container cranes									32,000	0
-Other equipment									1,906	0
-Tug boat									3,000	0
Total									36,906	0
Contingency									1,476	
Total Construction	0	0	6,640	1,763	34,283	7,113	36,224	6,551	17,248	8,241
Total Equipment	0	0	0	0	0	0	0	0	36,906	0
Total Contingency	0	0	531	141	2,743	569	2,898	524	2,856	659
Engineering	**1,416**	**355**	**826**	**207**	**826**	**207**	**826**	**207**	**826**	**207**
Grand Total	**1,416**	**355**	**7,997**	**2,111**	**37,852**	**7,889**	**39,948**	**7,282**	**57,836**	**9,107**

Chapter 28 Economic Analysis

28.1 Methodology

The method of analysis in this case is the same as that of Takoradi Port mentioned in Chapter 20.

28.2 Costs of the Project

The items that should be considered as costs of the projects are construction costs, maintenance costs and renewal investment costs. These project costs must be converted from market prices into economic prices for the economic analysis.

(1) Construction Costs

Construction costs and investment schedule at economic prices are summarized in the following table.

Table 28.2.1 Annual Investment Schedule at Economic Prices

(Unit: '000US$)

Item	2005	2006	2007	2008	2009	Total
Economic Price	1,925	9,422	42,022	43,384	62,768	159,521

(2) Maintenance Costs

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

Table 28.2.2 Maintenance Costs at Economic Price – Tema Port

(Unit:thousand US$)

Item	Construction Costs At Market Price	Maintenance Costs at Market Price	Overall Conversion Factors	Maintenance Costs at Economic Price
Dredging	24,385	0	0.996	0
Reclamation	9,148	0	0.973	0
Breakwater	41,200	412	0.992	409
Quaywall	22,080	221	0.980	217
Revetment	6,400	64	0.963	62
Pavement	9,000	90	0.994	89
Building	3,700	37	0.927	34
Ancilary	2,150	22	0.971	21
Machine & Equip.	36,906	1,476	1.000	1,476
Total	154,969	2,322	-	2,308

(3) Renewal Investment Costs

The renewal costs for cargo handling equipment after their economic durable periods should be considered. The economic durable periods of equipment are planned as follows. This investment will be done by foreign portion.

Table 28.2.3 Economic Durable Periods and Costs of Equipment

Equipment	Durable Periods	Costs('000US$)
Gantry Crane, Transfer Crane, Tug Boat	20 Years	35,000
Tractor, Trailer	10 Years	1,906

28.3 Benefits of the Project

The following items are considered as tangible benefits in terms of the cost-benefit analysis in this study.

1) Savings in staying costs of ships

2) Savings in water transportation cost by increase of cargo volume per ship

3) Savings in land transportation costs

4) Earnings of foreign currency in cargo handling

Benefits of the projects at economic price are summarized in the following table.

Table 28.3.1 Benefits of the Projects for Short-term Plan – Tema Port
(Unit: thousand US$)

Items	Benefits
Ships' Staying Time	10.689
Water Transportation Cost	12,083
Land Transportation Cost	4,962
Earnings of Foreign Currency	5,982
Total	33,716

28.4 Evaluation of the Project

The EIRR of the project at Tema Port is calculated as 16.3%. The results of calculation are shown in Table 28.4.1.

It is generally recognized that the project is feasible if the EIRR exceeds the opportunity cost of capital. Usually, the opportunity cost of capital is considered to range from 8% to 10% according to the degree of development in each country. It is acceptable that a project with an EIRR of more than 8% is economically feasible for infrastructure or social service projects.
As for this project, even though the economic calculation only takes into account the items that are easily quantified, the EIRR is still 10.4% in the worst case. Therefore, this short-term development project is feasible from the viewpoint of the national economy.

Table 28.4.1 Results of Sensitivity Analysis on Short-Term Plan for Tema Port

	EIRR 16.3%	Increase in Investment Cost		
		0%	10%	20%
Decrease Benefits	0%	16.3%	14.8%	13.5%
	10%	14.7%	13.2%	12.3%
	20%	12.9%	11.6%	10.4%

Chapter 29 Financial Analysis

29.1 Purpose and Methodology

29.1.1 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 port management body during the project life.

29.1.2 Methodology

(Refer to 21.1.2)

29.2 Prerequisites of the Financial Analysis

29.2.1 General

(1) Scope of the Financial Analysis

Scope of this financial analysis is the project in the Short-term Development Plan. The specific project is as follows.

・New Container Terminal 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 the “With Case” and the “Without Case”. Here, the “With Case” is the case in which the Short-term Development Plan is executed while the “Without Case” is the case which represents the existing situation. The financial soundness of the port management body is analyzed using the “With Case”.

29.2.2 Base Year

(Refer to 21.2.2)

29.2.3 Project Life

(Refer to 21.2.3)

29.2.4 Fund Raising

(Refer to 21.2.4)

29.2.5 Revenue and Expenditure

Operating Revenues are estimated from the difference of revenues between the “With Case” and the “Without Case”. All revenues are calculated by multiplying cargo volume and the number of calling vessels by present tariffs.

Revenues)

1) Operating Revenues

Operating Revenues are estimated from the difference of revenues between the “With Case” and the “Without Case”. All revenues are calculated by multiplying cargo volume and the number of calling vessels by present tariffs.

Expenditures)

1) Project Costs

Project Costs are estimated in Chapter 27. According to the construction schedule, investment will be made.

2) Personnel Costs

While it is assumed that the New Container Terminal will be leased to a private company, we estimate newly required personnel cost including for cargo handling here.
Required staff for cargo handling is as follows.

Snr. Staff 46
Jnr. Staff 190

Required annual personnel costs for the New Container Terminal are calculated by multiplying number of staff by average unit wages estimated according to present levels.

Snr. Staff = 46 persons × US$6,970 / person・year = US$320,620 / year
Jnr. Staff = 190 persons × US$2,750 / person・year = US$522,500 / year
Total US$843,120 / year

Required personnel cost for administration, security and marine services of GPHA with construction of New Container Terminal are estimated as follows.

US$240,200 / year・berth

Therefore required total personnel cost for the New Container Terminal are calculated as follows.

US$843,120 / year + US$240,200 / year・berth × 2berth = US$1,323,520 / year

29.3 Evaluation of the Project

29.3.1 Viability of the Project

(1) Calculation of FIRR

The result of the FIRR calculation is shown in Table 29.3.1. FIRR exceeds the weighted average interest rate of the funds (2.73%).

Table 29.3.1 Result of FIRR Calculation

	New Container Terminal Project
FIRR	10.3%

(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 29.3.2. FIRR exceeds the weighted average interest rate of the funds (2.73%).

Table 29.3.2 Sensitivity Analysis of FIRR

	Base Case	Case 1	Case 2	Case 3
FIRR	10.3%	9.3%	8.9%	7.9%

(3) Evaluation

Judging from the above, this project is regarded as financially feasible under the assumptions in Chapter 29.2.

29.3.2 Financial Soundness of the Port Management Body

1) Profitability

Throughout the project life, the rate of return on net fixed assets exceeds the weighted average interest rate of funds.

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. This shows that the operation will be efficient.

29.3.3 Possibility of Private Company Participation in the New Container Terminal

After the passage of the Landlord Port Bill, private company participation in the operation of the New Container Terminal will become a real possibility.

(1) Roles of GPHA and Private Company

(a) GPHA
・Construction, ownership and management of Infrastructure
・Marine services

(b) Private company
・Procurement, ownership and management of cargo handling facilities
・Terminal operation

(2) Revenues and expenditures of GPHA and private company

(a) GPHA

Revenues
・Revenue from Port Dues
・Revenue from vessel services
・Rent for Container Terminal
Expenditures
・Project Costs
・Personnel Costs
・Maintenance Costs
・Administration Costs

(b) Private company

Revenues
・Revenue from Cargo handling (Present tariff is used in this study)
Expenditures
・Project Costs (including renewal investment)
・Personnel Costs

・Maintenance Costs
・Administration Costs
・Rent for Container Terminal

(3) Calculation of FIRR

The result of FIRR calculation under variable rental conditions is shown in Table 29.3.3.

Table 29.3.3 Result of FIRR calculation

Rent（US$'000 / year・berth）	FIRR of GPHA	FIRR of Private Company
2,000	6.6%	27.2%
2,500	7.4%	24.3%
3,000	8.1%	21.4%
3,500	8.8%	18.4%
4,000	9.4%	15.2%
4,500	10.1%	11.8%
5,000	10.7%	8.1%

Judging from the above calculation and fund raising conditions of both parties, assuming that rent is set at US$3,500,000 / year, FIRR of GPHA and the private company are well-balanced.

(4) Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes in cargo volume, construction cost, inflation or exchange rate. FIRR is checked on condition that rent is set at US$3,500,000 / year. 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 29.3.4. In all cases, FIRR of GPHA exceeds the weighted average interest rate of the funds (2.73%) and FIRR of private company exceeds the general interest rate of domestic funds (8.0%).

Table 29.3.4 Sensitivity Analysis for FIRR

	FIRR of GPHA	FIRR of Private Company
Base Case	8.8%	18.4%
Case 1	8.0%	16.4%
Case 2	7.6%	13.1%
Case 3	6.9%	11.4%

(5) Evaluation

Judging from above analysis, it is financially feasible for a private company to participate in the operation of the New Container Terminal.

29.3.4 Conclusion

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

Chapter 30　Port Management and Operation

30.1　Proposal for Efficient and Reliable Port Management

30.1.1　General Problem for Privatization of Tema Port

Refer to Chapter 22.1.1.

30.1.2　Privatization of Port Management and Operation

For Ghana Sea Ports, it is recommended to select the D-type form of privatization（see Chapter 15.1.2 and Table 15.1.1). Different approaches should be taken in some instances. Details for Tema port are as follows.

（1）New Container Terminal

Two berths of the new container terminal on the western side of Tema port are desired to be leased one by one to a single operator because many companies will utilize this container terminal. GPHA constructs the basic facilities while the operating company is responsible for equipment procurement and operation. There are plural possibilities concerning the make-up of that single operator.

・One private company such as shipping company, stevedoring company
・One joint venture company of private companies.
・One joint venture company of these private companies and GPHA

It will be important work for GPHA to ensure that all terminal users are fairly treated. It is also required to monitor the tariff structure, performance of operations such as effective use of facilities and productivity of cargo handling.

Container cargo will be handled at both the new container terminal and the new container berths at the existing port area. New container berth is appropriate to be managed and operated by private companies. But to promote efficient port management, these two container operators should be competing with each other.

（2）New Container Terminal at Quay2

GPHA plans to make Quay2 into new container terminal. The container terminal which gantry cranes and transfer crane method will be installed is under construction. As shown in former section, this new container berth and two new container berths on the west side of existing port are desired to be leased one by one to private sector and the competition between them will be generated.

（3）Berth 11（Bulk Berth for Clinker）

Management and operation of berth 11（for bulk cargo handling berths）is desired to be managed as a public berth by GPHA and to be operated by private companies. Maintenance of facilities will be

done by GPHA or private companies by contract with GPHA. Private companies can be expected to adopt the most efficient way of providing services and handling cargoes in these berths.

(4) Others

Berths 6-9 for other cargoes (Ro-Ro cargo, general cargo, bagged cargo) are desired to be managed by GPHA and operated by private companies. Maintenance of facilities will be done by GPHA or private companies by contract with GPHA. Cargo handling equipment will be provided by private companies.

30.1.3 Monitoring the Performance of Operation

Refer to Chapter 22.1.3.

30.1.4 Maintenance of Cargo Handling Equipment

Refer to Chapter 22.1.4.

30.1.5 Three-Shift Working System

Refer to Chapter 13.5.2(4).

30.1.6 Port EDI System

Refer to Chapter 15.1.4.

30.1.7 Port Promotional Activities for Tema Port

In West Africa, Ghana Sea Ports enjoy a reputation for reliability thanks to the stability of the Ghanaian government. Recently, some seaports in neighbouring countries have problems concerning reliability, and some shipping companies plan to shift their cargo-handling to Ghana Sea ports. Important points for promoting Ghana Sea Ports in future are below:

- To emphasize the high stability and reliability of Ghana Sea Ports.
- To emphasize the greater convenience and performance of Ghana Sea Ports that can be effected once the Landlord Port Bill is passed.

In addition, holding periodic meetings with port users such as shipping companies and agents is useful for identifying and solving problems.

30.1.8 Port Tariff

Refer to Chapter 22.1.8.

Chapter 31 Environmental Impact Assessment

An EIA was conducted based on the Short-term Development Plan of Tema Port. The TOR for EIA for Master Plan of Tema Port development was applied to the EIA for the Short-term Development Plan, because the master plan's components of the construction works and operation activities entirely contained those of the short-term development plan. Hence it can be said that the TOR for EIA on the master plan cares all of the possible environmental impacts of the short-term development plan of Tema Port.

Environmental problems such as waste disposal and noise nuisance in the residential area and Ramsar Site were predicted to occur. The following mitigation measures were suggested to minimize the above environmental problems:

- Construction of fences or planting of trees,
- Cooperation with the local government,
- Others.

Summary of the EIA is shown in Table 31.1. The proposed short-term development plan of Tema Port is feasible from the environmental point of view.

The environmental management plan was proposed including environmental monitoring plan, waste treatment plan and contingency plan. The contents of these plans were proposed.

Table 31.1 Summary of Evaluation of Environmental Impact (Tema Port)

Phase	Impact	Mitigation	Positive effect	Negative effect	Total
Preparation	No activity	-	-	-	-
Construction	Dredging & other marine works	Silt protection curtain	Sediment quality	Waste Water quality Noise	-6
	Construction machines, vehicles, and vessels	Setting signals Announcement to local residents	Local economy	Waste Air quality Safety Noise	+1
	Reclamation	Carefully designed containment	Waste	Air quality Water quality	-1
	Demolition of existing facility	Enhanced waste handling capacity	-	Waste Air quality Noise	-7
	Employing construction workers	Local employment and vocational training	Local economy	Waste Water quality	+8
Operation	Altered port configuration	Announcement to fishermen	-	Sediment quality Erosion	-8
	Increased ship-call	Waste reception facility	Local economy	Waste	+4
	Increased cargo-handling	Dust protection fence or plantation Proper waste management program	Local economy	Waste Noise	+2
	Increased port workers	Proper waste management program	Local economy	Waste	+9
	Port-associated development	Improvement of road Coordination with city planning	Infrastructure	-	+10
	Rearrangement of facilities	-	-	-	0
	Increased land transportation	Setting signals Soundproof fence	Local economy	Fauna and Flora Air quality Noise Safety	-4
Demolition	Not applicable	-	-	-	-
Total					+8