2.2 Short-term Development Plans

2.2.1 Required Port Facilities for Short-term Plans

(1) The New Cebu Port

The required port facilities for the new Cebu port in short-term plan are obtained as the same formula in chapter 2.5.2 of Volume two.

1) Foreign Container Berth

a) Handling Productivity
The target productivity of gantry crane is 28box / hour in 2010 The handling productivity / berth is calculated as follows.

Handling productivity / berth
= Sum of (Handling productivity / gantry crane × Efficiency of each gantry crane)
= 28 box/h × (1+0.7+0.5) = 61.6box/h in 2010

b) Required Number of Berths
The required number of foreign container berths is two (2) in 2010. (See Table 2.2.1-1)

Table 2.2.1-1 Required Number of Foreign Container Berths

	Cargo Vol. (thousand TEUs)	Cargo Vol. (thousand boxes)	Handling Productivity (boxes/day)	Work Time (day/ship)	Total Berth Time (day-berth)	No.of required berth
2010	502	335	1,355	0.45	549	1.5

2) Ground Slots
Required grand slots is calculated at 4,281 TEU in 2010. Based on the above calculation and standard container yard layout, the planned container yard capacity is assumed to be as follows.

Dry Freight Container Stacking Ground Slot:	3,840 Ground Slots (TEU)
Reefer Container Stacking Ground Slot:	456 Ground Slots (TEU)
Total Container Stacking Ground Slot:	4,296 Ground Slots (TEU)

3) Foreign Multi Purpose Berth

a) Required Number of Berths
Assumptions for obtaining the required number of foreign multi purpose berths in 2010 are as follows:

Average loading / unloading cargo volumes = 8,400MT/vessel
Handling productivity = 35MT/h × 3gangs = 105MT/h
Number of calling vessels in 2010 = 57 vessels

The result of the calculation of the required number of berths is 0.8. The required number of berths for foreign conventional vessels is one (1) in 2010

4) Port Service Boats Berthing Facility

The berthing facility for the port service boats is required. Pontoon is appropriate berthing facility for these small boats and it can be replaced when the expansion of terminal area becomes necessary in the future. The required size of pontoon is assumed to be 25m x 10m. An access channel of 3m depth and 30m width is also required.

5) Access Road

a) Required Number of Lanes

According to the total traffic volume from/to the new Cebu Port (392 cars/hour) and the standard design traffic volume in Japan, two (2) lanes will be necessary in 2010. (See section 2.5.6 in Vol.2)

b) Land Acquisition of the Access Road

In the short-term plan, two (2) lane access road can accommodate the traffic volume of the new port. However, for the smooth and efficient implementation of the future expansion, the land area for four (4) lanes should be obtained in the short-term.

(2) Cebu Baseport

The development of the new Cebu Port is urgently required due to the constraints of Cebu Baseport, mainly shortage of its water depth and capacity. However, the operation of the new Cebu Port is considered in 2009 based on the earliest implementation schedule. Therefore, Cebu Baseport must accommodate both international and domestic cargo, together with passengers up to 2008. The required facilities in 2005, 2008, and 2010 are calculated as follows.

1) Foreign Container Berth

a) Required Number of Berths
The same formula is applied for calculating the required number of berths. Assumptions are as follows.

Cargo Volume = 197 thousand TEUs (2005), 298 thousand TEUs (2008)
Handling productivity / berth = 44boxes/h (gantry crane), 12boxes/h (ship gear)

As the result of the calculation, the required number of foreign container berths is one (1) in 2005 and two (2) in 2008.

2) Foreign Multi-Purpose Berth

a) Required Number of Berths
The same formula is applied for calculating the required number of berths. Assumptions are as follows

Average loading / unloading cargo volumes = 5,400MT/vessel (2005)
7,000MT/vessel (2008)
Handling productivity = 35MT/h × 3gangs = 105MT/h
Number of calling vessels = 95 vessels (2005), 73 vessels (2008)

The result of the calculation of the required number of berths is 0.9. The required number of berths for foreign conventional vessels is one (1) in 2005 and 2008.

3) Large RORO Ferry

a) Required Number of Berths
Assumptions for obtaining the required number of foreign conventional berths are as follows.

Average loading / unloading containers
= 181TEUs / vessel (2005), 204TEUs / vessel (2008), 219TEUs / vessel (2010),
Handling productivity = (10boxes/h/head × 5head) =50boxes / h
Number of calling vessels = 985 (2.7vessels/day) (2005), 1,178 (3.2vessels/day) (2008)
1,292 vessels (3.5vessels/day) (2010)

Considering the schedule of large RORO ferry services and berthing time, two (2) cycles at one berth per day is assumed. So the required number of the berths for large RORO ferries is two (2) in 2005, 2008 and 2010.

b) Passenger Terminal
Required space for large RORO ferry passenger terminal in 2010 is obtained as follows;

3,000(person/vessel) × 0.6 (load factor) × 0.7 (utilization ratio) × 1.2(m2/person)
× 1.5(space factor) × 1.5 (vessels) ≒ 3,500m2

4) Middle RORO Ferry (stern ramp)

a) Required Number of Berths

Assumptions for calculating the required number of middle RORO ferry berths are as follows.

Average loading / unloading cargo volumes
= 384MT / vessel (2005), 448MT / vessel (2008), 490MT / vessel (2010)
Handling productivity = 200MT/h
Number of calling vessels = 7,240 (19.8vessels/day) (2005), 7,620 (20.9vessel/day) (2008)
7,860 vessels (21.5vessels/day) (2010)

Considering the schedule of middle RORO ferry services, two (2) cycles at one berth per day is assumed up to 2010. So the required number of berths for middle RORO ferries is ten (10) in 2005, eleven (11) in 2008 and 2010.

b) Passenger Terminal

Considering the number of berths (11) in 2010, two (2) passenger terminals are planned in short-term. Required space for each passenger terminal is obtained as follows;

1200(person/vessel) × 0.6 (load factor) × 0.7 (utilization ratio) × 1.2(m2/person)
× 1.5(space factor) × 3 (vessels) ≒ 2,800m2

5) Domestic Container Vessel

a) Required Number of Berths

Assumptions for calculating the required number of domestic container vessels are as follows;

Average number of loading / unloading containers
= 233TEUs/vessel (2005), 243TEUs/vessel (2008), 250TEUs/vessel (2010)
Number of calling vessels
= 390vessels (2005), 436vessels (2008), 228vessels (2010)
Handling productivity = 12boxes/h (ship gear) (2005 and 2008)
44boxes / h (gantry crane) (2010)

The required number of berths for domestic container vessels is two (2) in 2005 and 2008, one (1) in 2010.

6) Domestic Conventional Cargo Vessel

a) Required Number of Berths

Assumptions for obtaining the required number of domestic conventional cargo vessel berths are as follows;

Average loading / unloading cargo volumes

= 812MT / vessel (2005), 844MT / vessel (2008), 865MT / vessel (2010)

Handling productivity = 25MT /h/gang × 3 gang =75MT / h

Number of calling vessels

= 2,350 vessels (2005), 2,850 vessels (2008), 3,240 vessels (2010)

The required number of berths for domestic conventional cargo vessels is six (6) in 2005, eight (8) in 2008 and nine (9) in 2010.

7) Passenger/Cargo Vessel

a) Required Number of Berths

Considering the schedule of Passenger/Cargo Vessel, three (3) cycles at one berth per day is assumed. The number of calling vessels and required berths for passenger/cargo vessels are as follows.

Forty (40) vessels / day and fourteen (14) berths in 2005.

Thirty nine (39) vessels / day and thirteen (13) berths in 2008.and 2010

8) Fast Craft

a) Required Number of Berths

Considering the schedule of fast crafts, five (5) cycles at one berth per day is assumed. The number of calling vessels and required berths for fast crafts are as follows.

Twenty (20) vessels / day and four (4) berths in 2005.

Twenty two (22) vessels / day and five (5) berths in 2008.

Twenty three (23) vessels / day and five (5) berths in 2010.

9) Metro Bus Ferry

a) Required Number of Berths

This service is operated by small boats. Assumptions for calculating the required number of metro bus ferry berths are as follows.

Number of cycles /day/berth = 24 (30minutes /vessel/berth)

Number of calling vessels = 47 vessels / day (in 2005-2010)

The number of required berths for metro bus ferry is two (2) in 2005-2010.

(3) Summary of Required Facilities

Required port facilities in 2005, 2008, and 2010 are summarized as below.

Table 2.2.1-2 Required Port Facilities for the New Cebu Port in 2010

	Berth length (m) (No. of berths)	Berth depth(m)	Others
Foreign Container Terminal	600 (2)	13	Area: 30ha 5 gantry cranes
Foreign Multi-Purpose Terminal	190 (1)	10	Area: 2ha Shed
Service Boat Mooring Area	pontoon	3	
	Length (km)	Width (m)	
Access Road	1.8	19	

Table 2.1.1-3 Required Port Facilities for Cebu Baseport in 2005, 2008, and 2010

	Berth length (m) (No. of berths)			Others
	2005	2008	2010	
Foreign Container Terminal	220 (1)	440 (2)	------	
Foreign Multi-Purpose Cargo Terminal	180 (1)	180 (1)	----	
Large RORO Ferry Terminal	450 (1)	450 (2)	450 (2)	Passenger Terminal (3,500m2)
Middle RORO Ferry Terminal	600 (10)	660 (11)	660 (11)	RORO ramps Passenger Terminals (2,800m2 x 2)
Domestic Container Terminal	350 (2)	350 (2)	175 (1)	
Domestic Conventional Cargo Terminal	600 (6)	800 (8.0)	900 (9)	
Passenger/Cargo Terminal	840 (14)	780 (13)	780 (13)	
Fast Craft Terminal	110 (4)	165 (5)	165 (5)	
Metro Bus Ferry	(2 pontoons)	(2 pontoons)	(2 pontoons)	

(4) Required Land Space for Domestic Container Vessels and RORO Ferries

1)Domestic Container Handling Area

Domestic containers handled at PMO 1 and 2 have two storage methods –the stacking system and the married system (containers are transported with trailer).

Total domestic container throughput is forecasted to be 565 thousand TEUs in 2010. 90% of the total cargoes will be handled at Cebu Baseport, while 10% of the total cargos will be handled at the new Cebu port. The required land space for cargo handling in 2010 is obtained from the same formula in chapter 2.5.2. in Vol.2.

The number of daily stacking containers, obtained from the cargo volume, is 700TEUs in 2010.

The result of the calculation shows that CIP capacity for stacking containers (2,300TEUs / day) is sufficient for the handling volume in 2010.

Regarding the parking space of vehicles for married container, the required land space is calculated 3.4ha. This shows that the required land space is beyond the present space in CIP (2.9ha). However, the present stacking container area also can be used for vehicles for married containers. Therefore, CIP area has sufficient space for domestic container handling in 2010.

2) Parking space of vehicles for break bulk cargo

Middle RORO ferries shall handle 40% of the total break bulk cargoes together with domestic containers. It is necessary to prepare parking areas for vehicles for break bulk cargoes. According to the demand forecast and the number of calling vessels, required land space in 2010 is obtained as follows.

- Average break bulk cargo volumes per vessel = 216MT
- Required number of vehicles
- 216MT ÷ (8MT/vehicle x 0.7(load factor)) = 39 vehicles
- Required parking space for 8 ton vehicle = 45 m2
- Total required parking space

  45m2 x 39vehicle x 11berth x 0.7(simultaneous berth occupancy ratio)

  = 1.4 ha

The result of the calculation shows that required land space for the vehicles of break bulk cargos is 1.4ha.

2.2.2 Required Cargo Handling Equipment for Short-term Plan

An important factor for the operation of the container port is the introduction of a fully efficient cargo handling system concerning loading/discharging and transporting containers in the port area. Hence, the JICA study term proposed the suitable container handling system based on the careful consideration on the local conditions, existing system and ability of Cebu Baseport workers.

The container handling system and capability of the equipment are to be planned as a total system based on the assumed number of containers to be handled, including seasonal variations. It is essential that each piece of equipment works efficiently as a part of the total system to perform the overall designed throughput capacity.

The container handling system is divided into the following three categories.

- Movement of containers between vessel and quay-side apron.
- Movement of containers between quay-side apron and CY.

- Stuffing cargo into or un-stuffing from containers in the CFS.

The following systems are considered as container handling equipment between quay-side apron and CY.

- Rubber Tier Mounted Gantry Crane System (RTG)
- Straddle Carrier System
- Forklift / Reach Stacker System
- On Trailer (Chassis) System
-

Each system has its own advantages and disadvantages as briefly mentioned in Table 2.2.2-1. To select the system, the following items should be taken into consideration as essential elements.

- Volume of container throughput in the yard
- Condition of the site, such as the available area and natural conditions
- Size of container feeder vessels
- Procurement cost of equipment
- Construction cost of yard pavement
- Maintenance cost and requirement

Table 2.2.2-1 Comparison of Container Handling Systems

Kind of Equipment	Straddle Carrier	RTG	Forklift/ Reach Stacker	On Trailer (Chassis)
Required CY Area	Medium	Small	Rather Large	Huge
Investment Cost	Medium	Medium	Low	High
Balance to Capacity of G/C	Excellent	Good	Good	Good
Efficiency of Work	Medium	Medium	Low	High
Flexibility of Work	High	Low	Medium	High
Damage Ratio of Container	Medium	Low	High	Very Low
Maintenance Cost & Repair Time	High	Medium	High	Low
Application of Automation	Medium	Easy	Medium	Medium
Construction Cost of Pavement	Heavy	Medium	Heavy	Low

Forecasted container throughput at the New Cebu Port in 2010 is shown in Table 2.2.2-2.

Table 2.2.2-2 Annual Container Throughput by TEUs

Foreign and Domestic Container Throughput	2010
Foreign Trade Container Throughput	445,024 TEUs
Domestic Trade Container Throughput Domestic Container Throughput at the New Cebu Port (10% of the total)	564,855 TEUsx10% 56,485 TEUs
Total Container Throughput by TEUs Total Container Throughput by Boxes (rate of 20'&40'=50:50)	501,509 TEUs 334,339 Boxes

(1) Number of Container Handling Units

Required number of container handling units can be obtained by the following formula.

1)Quay-side Gantry Crane

Nqc = A÷ (T x μ1 x P x Pqc x μ2 x E)

Where Nqc : Required number of quay-side gantry crane
A : Annual throughput in TEUs
T : Maximum annual available working hours
available working day per year = 361 days
actual working hours = 22 hours per day = 7,942 hours per year
P : Berth occupancy ratio (0.60)
Pqc : Productivity of quay-side gantry crane
28 boxes/hour/unit in 2010
μ1 : Percentage of availability (applied for ratio in 2000) = 0.7
μ2 : Container operation efficiency ratio = 0.8
E : Conversion rate of 20' / 40' (applied for ratio in 2000) by TEU
50% / 50% = 1.50

Nqc (2010) = 501,509 ÷ (7,942 x 0.7 x 0.6 x 28 x 0.8 x 1.50) = 4.47 ≒ 5.0 Units

Table 2.2.2.-3 Required Number of Quay side Gantry Crane

Kind of Equipment	Project Year 2010
Quay –side Gantry Crane	5 Units

2) Rubber Tire Mounted Gantry Crane (RTGs)

Nrc = Nrc1 + Nrc2 + Nrc3

Where Nrc : Required number of RTGs
Nrc1 : RTGs mainly used for quay side gantry crane operation
(Basically: one unit RTG x one unit quay side gantry crane)
Nrc2 : RTGs mainly used for container receiving/delivery operation
Nrc2 = Number of annual handling containers ÷ Amy ÷ T
Amy = μ1 x Prc x E
μ1: Percentage of available ratio (applied ratio in 2000) = 0.7
Prc: Productivity of RTG on the basis of gross
(23 boxes/hour/unit)
E: Conversion rate of 20' / 40' (1.50 TEUs / box)
Amy = 0.7 x 23 boxes x 1.50 = 24.15
T: Maximum available working hours per year
(361days x 22 hour = 7,942 hours/year)

Nrc3 : Stand-by RTGs for immobilization due to repairmen, periodical inspection or other unforeseen circumstances

Nrc3 = (Nrc1 + Nrc2) x 10%

Nrc 1 = 5 Units

Nrc 2 = (501,509 x 2.7) ÷24.15 ÷7,942 = 7.06

Nrc 3 = (5 Units + 7.06 Units) x 0.1 = 1.21

Nrc = 5 Units + 7.06 Units + 1.21 Units = 13.27 ≒ 14 Units

Table 2.2.2-4 Required Number of RTGs

For Ship Side Operation	5 Units
For C.Y Operation/Stand-by RTGs	9 Units
Total	14 Units

3)Prime Mover (Tractor / Trailer)

Travel speed of tractor head (Average) : 15km / hr

Handling cycle time under the gantry crane : 1.5 min/container

Handling cycle time under the RTGs : 2.0 min/container

Handling productivity of gantry crane : 28 boxes/hr

Container berth length and width : 600m / 500m

Table 2.2.2-5 Required Number of Prime Mover in 2010

For Container Loading/Discharging Operation QSGC 5 Units x 5 Prime Mover		25 Units
For Container Yard Movement Operation Including CFS/Maintenance Operation		Tractor 8 Units Trailer 15 Units
Prime Mover	Tractor Head	33 Units
	Trailer(20/40/45'Combine Type)	40 Units

4) Summary of Container Handling Equipment for Short-term

Table 2.2.2-6 Number of Container Handling Equipment

Kind of Equipment		Short-term
Quay-side Gantry Crane (QSGC)		5 Units
Rubber Tire Mounted Gantry Crane (RTGs)		14 Units
Prime Mover	Tractor Head	33 Units
	Trailer(20'/40'/45'Combine Type)	40 Units

(2) Cargo Handling Equipment of Container Freight Station (CFS)

The New Cebu Port is assumed to require a warehouse (CFS) with 3,200m2 (80m length and 40m width). The following number of fork lift trucks should be prepared for LCL cargo handling.

Table 2.2.2-7 Summary of LCL Cargo per Year

Category of LCL Cargo Handling	Short-term (2010)	
	Export Cargo	Import Cargo
LCL Cargo Handling Volume	570,348 x 4.36% = 24,867 t	2,092,727 1.14% = 23,857 t
Receiving and Delivering Volume	24,867 t	23,857 t
Cargo Handling Volume per Year (2 times)	49,734 t	47,714 t
Cargo Handling Volume per Week (52 weeks/year)	956 t	918 t

Table 2.2.2-8 Required LCL Cargo Handling Equipment for Short-term (2010)

Capacity of Forklift	Container Side	Truck Side
2.5 tons low mast type	2 Units	2 Units
3.0 tons low mast type	1 Unit	1 Unit
5.0 tons normal type	1 Unit	
10.0 tons normal type	1 Unit	

(3) Required Cargo Handling Equipment for the Multipurpose Terminal

As foreign conventional cargoes handled at the multi-purpose berth of the New Cebu Port are mainly steel products, lumbers and bagged goods, sheds should be constructed in order to prevent these cargoes from getting wet by rain. The main purpose of the sheds is not storage of these cargoes, but distribution of the cargoes. Dimensions of required cargo handling equipment are as follows.

Table 2.2.2-9 Summary of Foreign Conventional Cargo in 2010

Foreign Export Conventional Cargo	Foreign Import Conventional Cargo
35,147 tons/year	441,877 tons/year
Total Handling Foreign Conventional Cargo 477,024 tons	

Table 2.2.2-10 Required Foreign Conventional Cargo Handling Equipment of Multipurpose Berth

Capacity of Equipment	Short-term (2010)
3.5 tons Forlklift Truck	4 Units
5.0 tons Forlklift Truck	2 Units
10.0 tons Forklift Truck	1 Unit

2.2.3 Formulation of Layout and Phasing Plans

(1) The New Cebu Port

1) Phasing plan

At Cebu Baseport, all foreign cargoes are handled at CIP area, because only this area has container yard and gantry cranes. Large RORO ferries are also allocated at this area. But to accommodate increasing foreign cargoes, especially foreign container cargoes, it is planed that large RORO ferry berths will be shifted to B8-11 area in PMO 2, and CIP area will be used only for foreign cargoes, after the completion of off-shore expansion of the back-up area of B8-11.

However, the capacity of CIP is still insufficient for future foreign cargo volume. The quay length of CIP is 693m and it is assumed that around two thirds (2/3) of quay length can be used for foreign container vessels and one third (1/3) for foreign conventional vessels. Two gantry cranes are equipped at the quay, whose present productivity is 22boxes/hour. Some container vessels must use their ship gear, whose productivity is assumed at 12boxes/hour. Based on these assumptions, the annual container handling capacity of CIP berths is estimated as 300 thousand TEUs. Moreover, the yard capacity of CIP area is also critical. Its marshalling yard capacity is estimated as 220 thousand TEUs/year. The foreign container cargo volume is assumed to be above 220 thousand in 2006. Therefore, the new Cebu Port development is urgently required. Considering the implementation period, the new Cebu Port is assumed to start its operation with all required facilities in the short-term plan, including two (2) container berths, one (1) multi-purpose berth, and access road in 2009.

2) Layout Plan of the Short-term

This port development is off-shore island type connecting with the land side by an access road to be developed. Therefore, the two container berths near the access road, together with the backyard area, and adjacent one multi purpose berth with a shed should be developed in the short-term (up to 2010). Required cargo handling equipment, including five (5) gantry cranes, and necessary buildings, such as CFS and maintenance shop, also should be developed. The layout plan of the short-term is shown in Fig.2.2.3-1, 2, 3, 4.

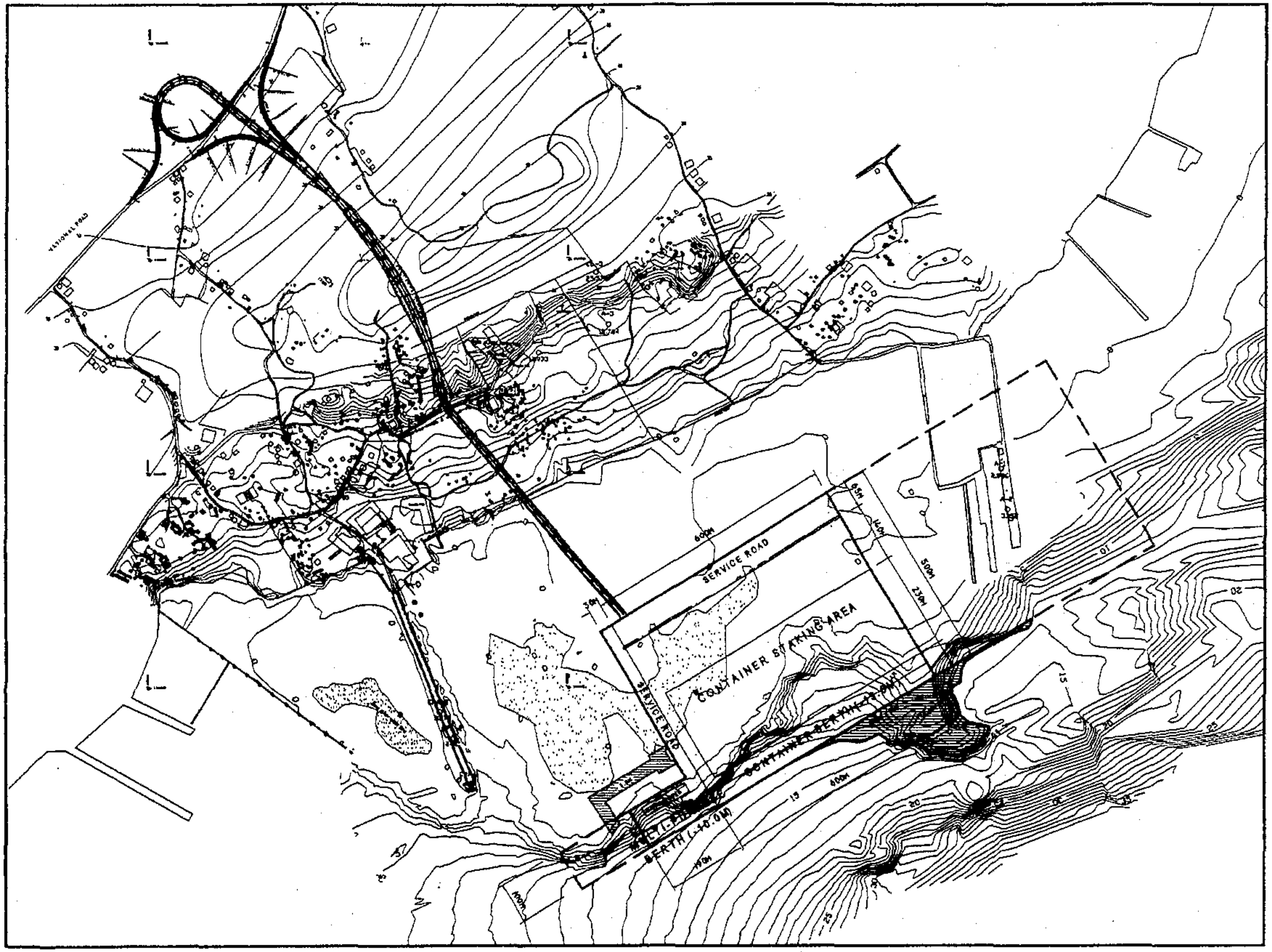


Fig.2.2.3-1 Short-term Development Plan of New Cebu Port (1)

Fig. 2.2.3-2 **Short-term Development Plan of New Cebu Port**

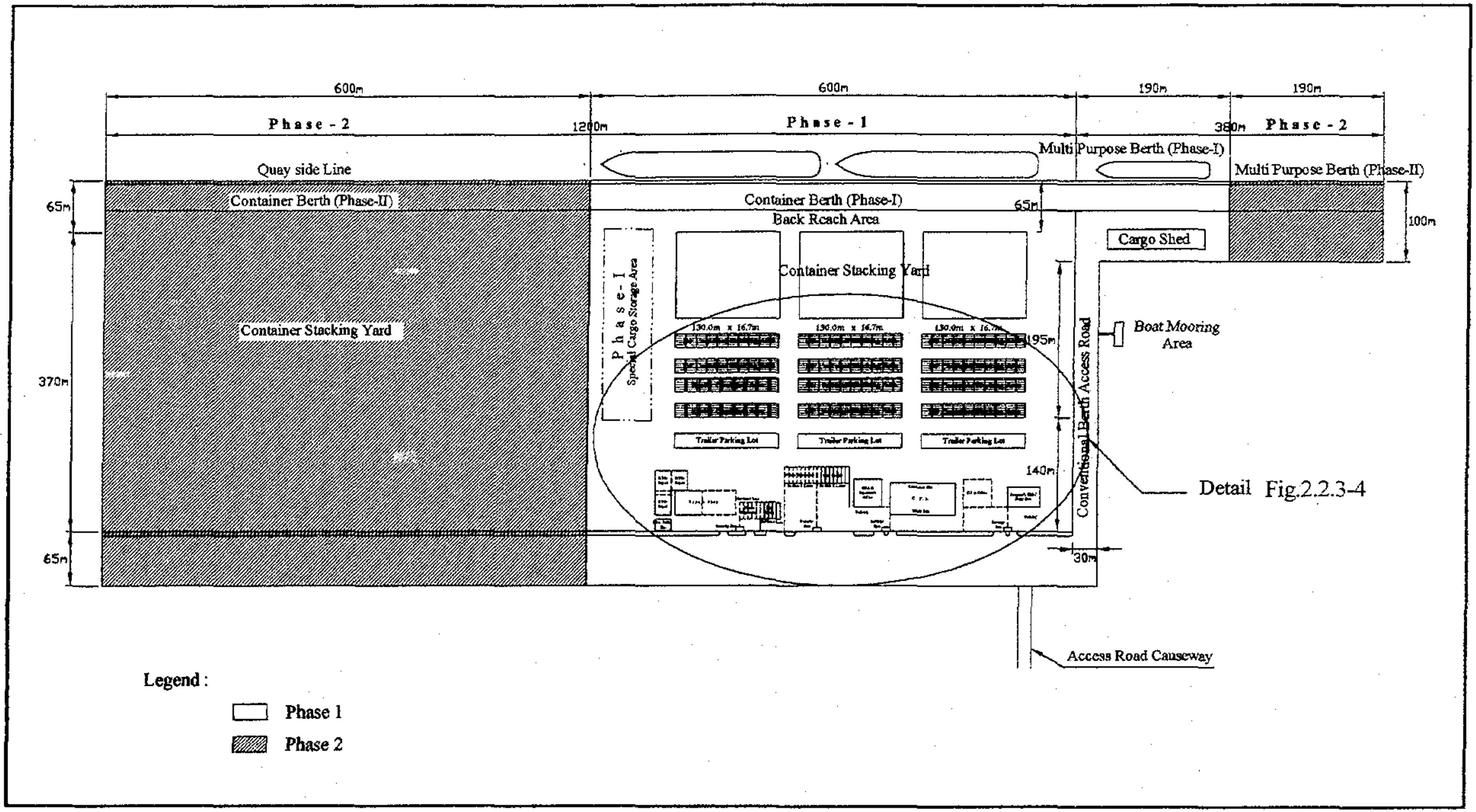


Fig. 2.2.3-3 Container Terminal Layout Plan

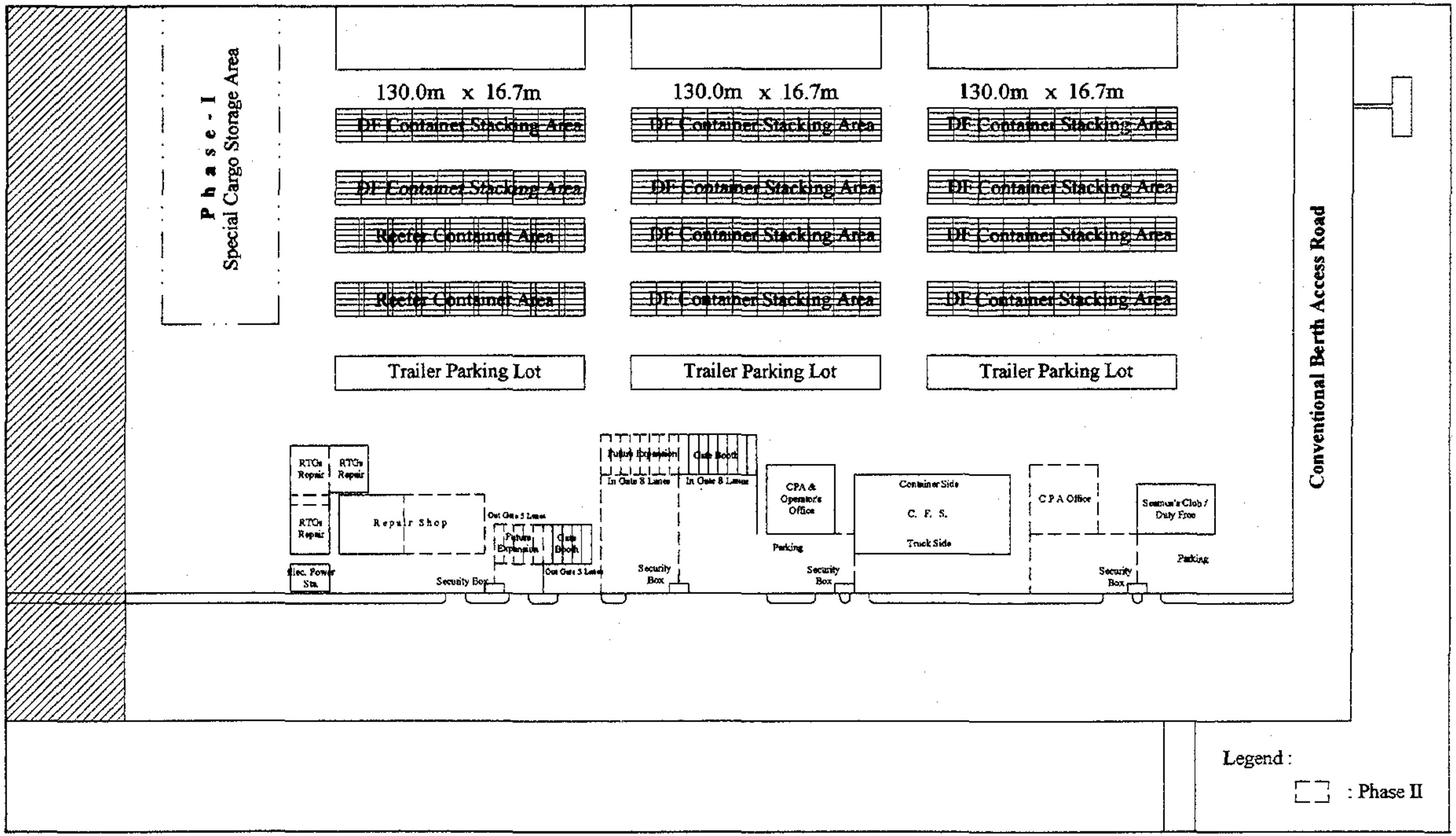


Fig.2.2.3-4 Container and Office Allocation Plan

(2) Cebu Baseport

1) Layout Plan in 2010

After the inauguration of the New Cebu Port, only domestic cargoes and passengers will be handled at Cebu Baseport. Layout plan in 2010, based on the master plan and required facilities, is considered as follows. (See Fig.2.2.3-5)

a) PMO1

Multi-purpose berth	(B2-3)
(domestic container and conventional cargo vessels)	
Large RORO ferry berth	(B3-7)
CIP area	
Passenger terminal	

b) PMO2

Large RORO ferry berth	(B8-9)
Conventional cargo berth	(B9-11)
Middle RORO ferry berth (RORO ramp)	(B11-17)
Passenger terminal	
Back-up area for RORO ferry	

c) PMO3

Fast craft terminal	(B18-19)
Passenger/cargo and metro bus ferry berth	(B20-23N)

d) PMO4

Passenger/cargo berth	(B23T-23S)
Conventional cargo berth	(B23S-27)

e) PMO5

Conventional cargo berth	(B28-30)

2) Development Plans in Short-term

Considering required facilities in short-term, urgency of each project, and on going rehabilitation works at pier 2 and berths of B28-30, the following development plans are proposed to be conduced in short-term. (See chapter 7.5.4)

a) Expansion (30m off-shore) of the backyard of conventional cargo berth (B21, 22, 24, 25)

The width of back yard at this area is only from 30 to 50m, including the traffic lane. For efficient cargo handling and smooth traffic flow, the widening of the back yard area is essential. Considering the apron area (15m), traffic lane (15m), cargo stacking area, and future quay lengths of the piers, 30m off-shore expansion of back yard area should be conducted.

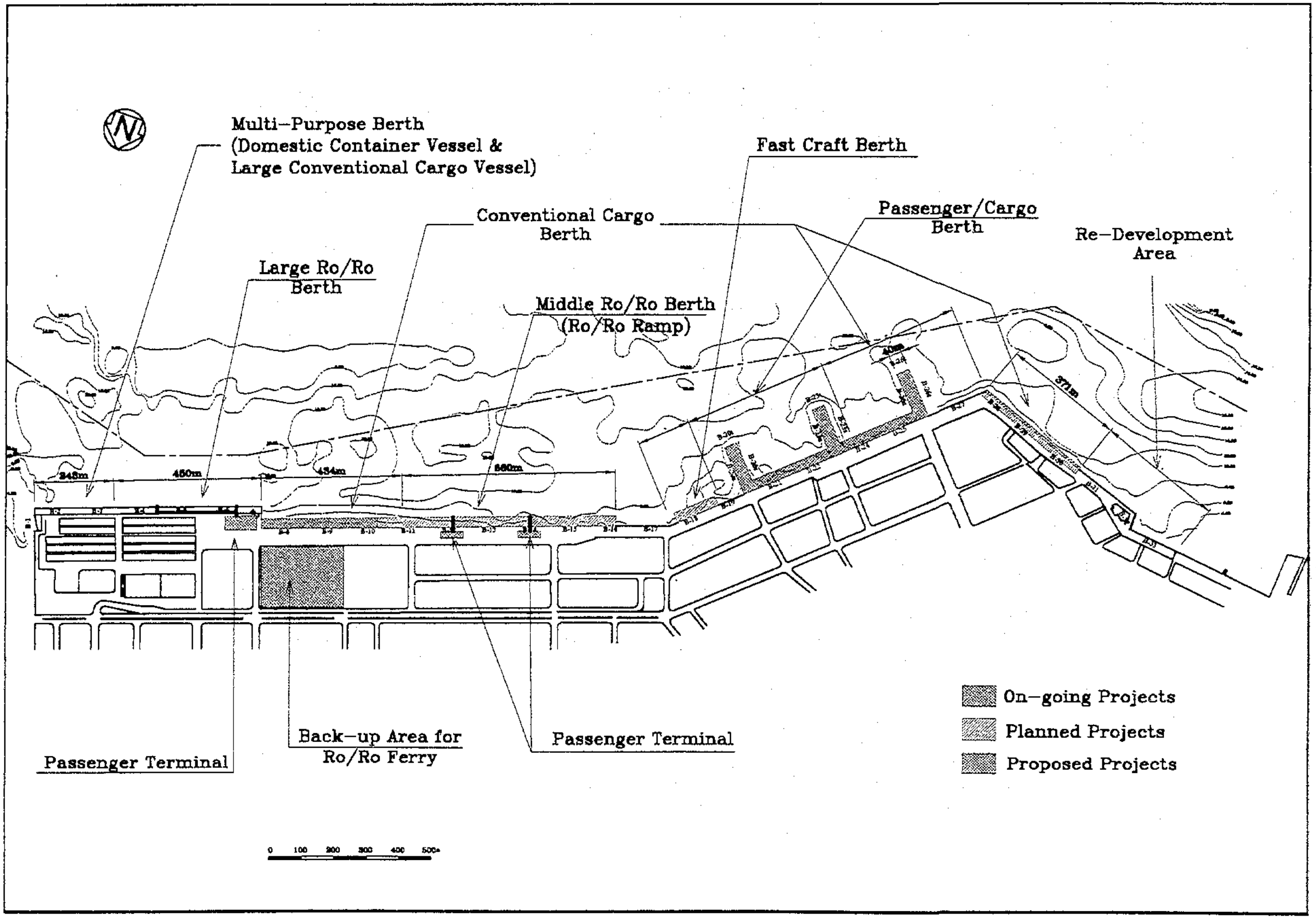


Fig.2.2.3-5 Cebu Baseport Development Plan (2010)

b) Renovation of pier1 and 3, including expansion of width of pier1 for large cargo vessels

Pier 1 and 3 are suffering from deterioration and to be renovated. Since the pier1 is planed to be allocated for the conventional cargo vessels, the renovation work includes the enforcement of the structure and expansion of the width of the pier to accommodate large conventional cargo vessels. The width of 40m is required to obtain a 15m wide apron area at both quay sides and 10m wide traffic lane at the center, while the old shed should be demolished because few cargoes require a shed. Pier 3 also should be renovated but the existing width of the pier is sufficient, because this pier is allocated for the passenger/cargo vessels, whose size and loading volume are small.

c) Construction of passenger terminal buildings with boarding bridge and elevated catwalk for RORO ferries

For the separation of passenger movement and cargo handling and convenience of passengers, one (1) passenger terminal building (3,500 m2) with boarding bridge for large RORO ferries should be developed at PMO 1. Two (2) passenger terminal buildings (2,800m2 x 2) with elevated cat walk for middle RORO ferries also should be developed at PMO 2. To set the traffic lane in strait line, the building overlapping this line at B13 area should be relocated.

d) Expansion of back-up area for RORO ferries

In the long-term plan, expansion of back-up area for domestic container cargo handling and parking space of cargo vehicles for RORO vessels is proposed at the private land behind the B8-9 in Port Zone, which is vacant or hardly utilized at present. In the short-term plan, during the CIP area being dedicated to foreign cargos, large RORO ferries should be shifted to the berths of B8-10. Foreign container cargo volume is estimated above the yard capacity of CIP from 2006 to 2008. The expansion of back-up area for RORO ferries and foreign container handling area is required until the foreign cargo vessels will be shifted to the new Cebu Port in 2009.

After 2009, CIP area will have sufficient space for RORO ferry cargo handlings. But the cargo and passenger handling volume will increase steadily and the above mentioned area has an advantage of being located near the middle RORO terminal area. This area should be developed as a back-up area for RORO ferries.

Short-term development plans of each area are shown in Fig. 2.2.3-6, 7, 8,9.

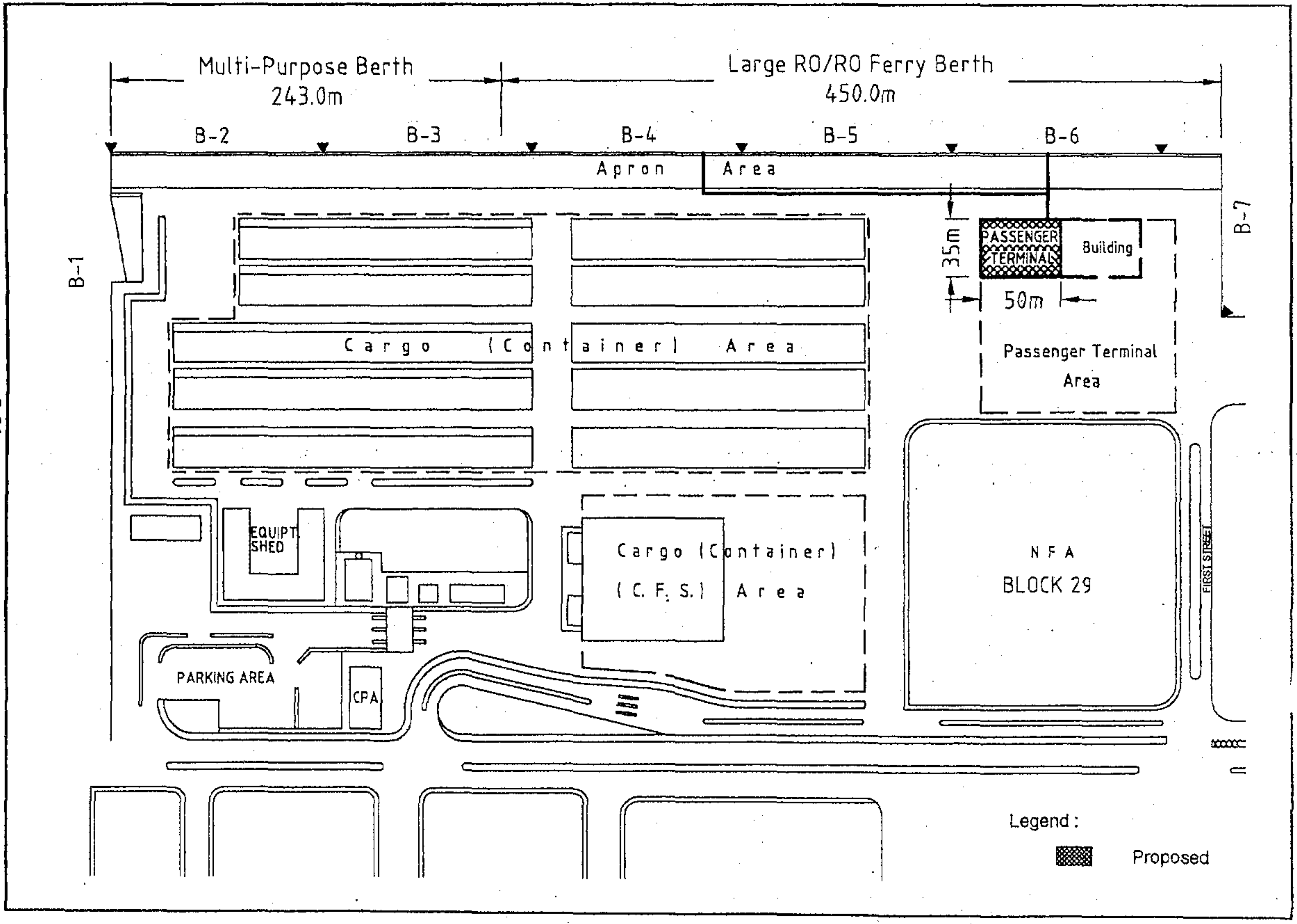


Fig.2.2.3-6 Short-term Development Plan (2010 : PMO 1)

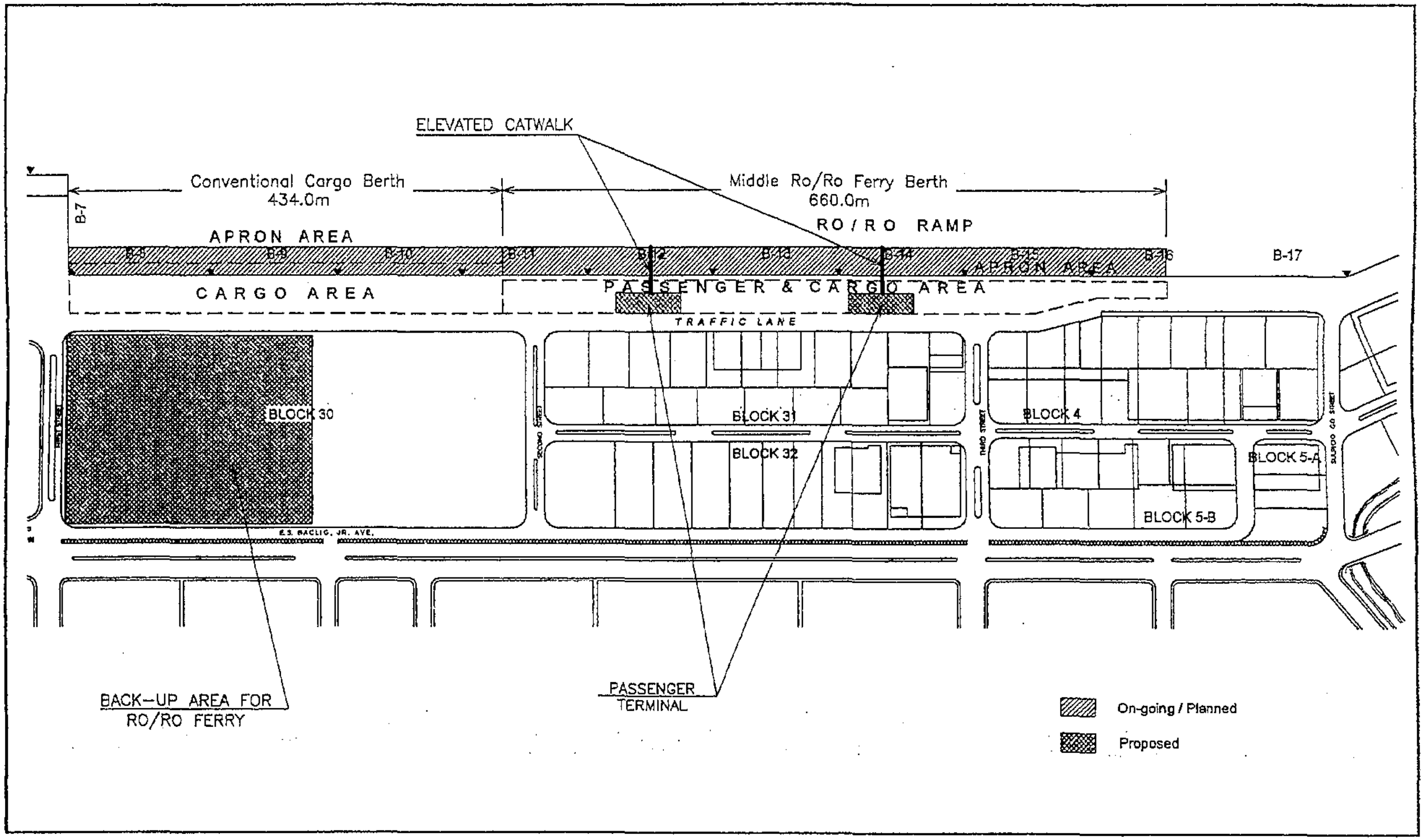


Fig 2.2.3-7 Short-term Development Plan (PMO 2)

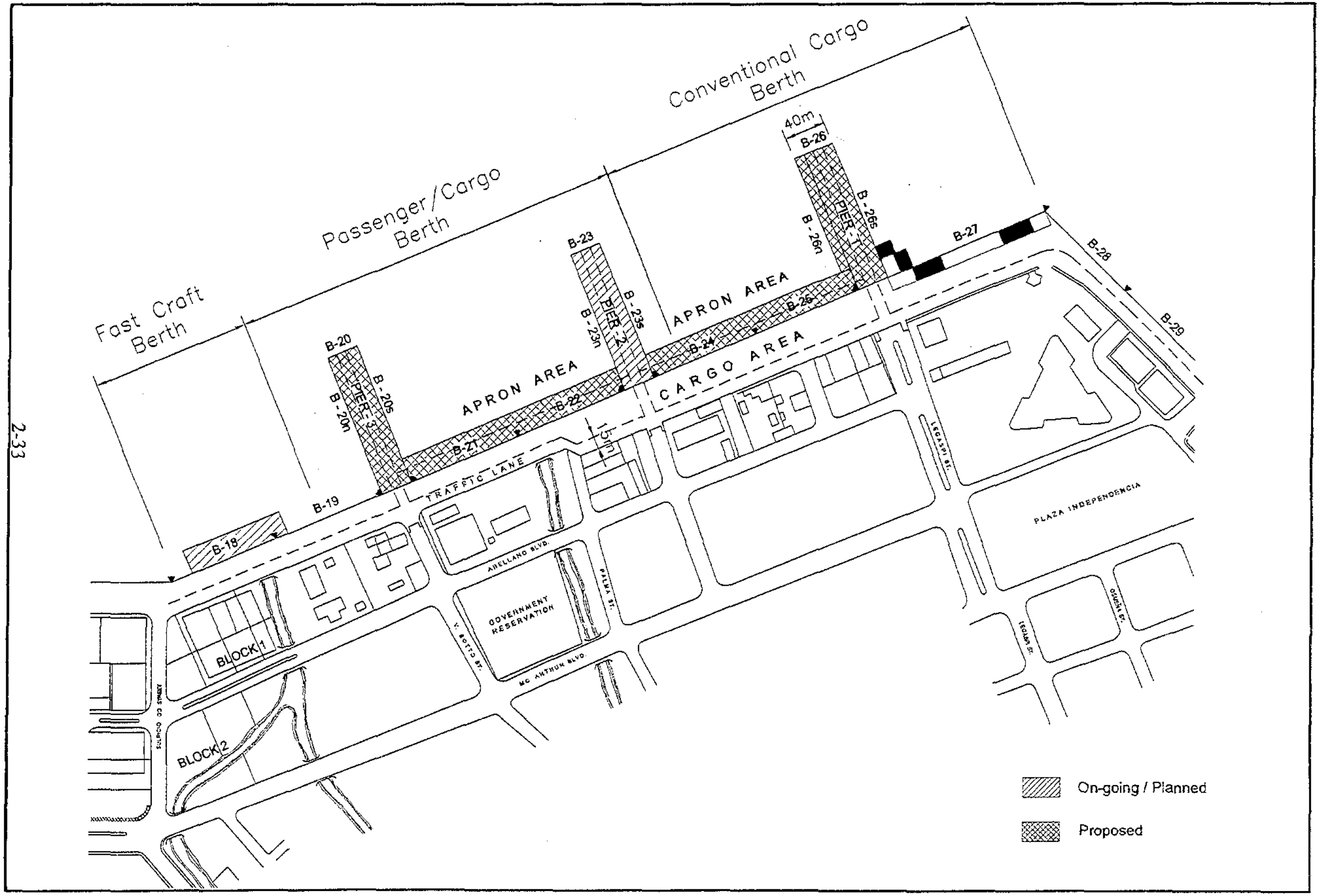


Fig. 2.2.3-8 Short-term Development Plan (PMO 3 & 4)

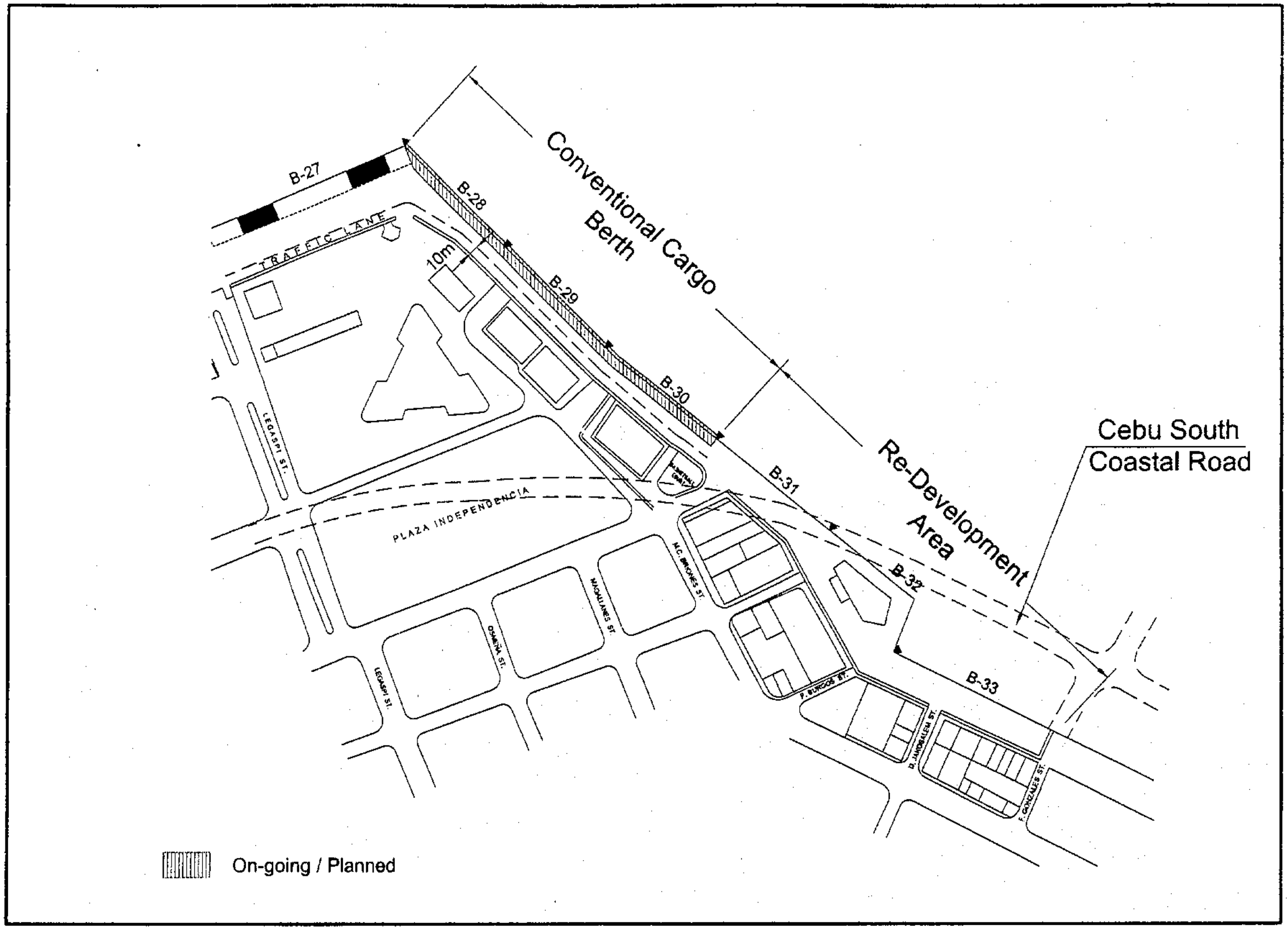


Fig 2.2.3-9 Short-term Development Plan (PMO 5)

(3) Phasing Plan

1) Layout Plan during CIP area dedicated to the foreign vessels

Based on the demand forecast, large RORO ferry berth at CIP area should be shifted in 2006 to accommodate foreign cargo vessels there. The layout plan, while CIP area will be dedicated to the foreign vessels, is shown in Fig.2.2.3-10.

2) Basic Implementation Plan

In making the phasing plan of Cebu Baseport, berth shifting during the construction period should be carefully taken into consideration. Basically, development of Cebu Baseport needs to be carried out part by part. The priority also should be considered. Development of RORO ramps is urgent in this port.

The basic implementation plan based on the berth shifting is as follows.

- Following the completion of the rehabilitation of pier2 (2001), the cargo vessels berthing at B18-19 will be shifted to pier2
- A new fast craft terminal development at B18-19 area can be started (2002).
- Following the shift of fast craft terminal from B13-14 area to B18-19 area, converting of existing marginal wharf for RORO ramp and extension of back yard of B13-14 can be started (2004).
- After the above conversion works are completed, total quay length of new RORO ramps will reach 460m. RORO vessels at B15-17 can be shifted to the new RORO berths and the extension of RORO ramps can be continued at B15-17 area

Following the development work at PMO2 area, renovation of piers and expansion of back up area at PMO3, 4 should be conducted. Construction of the passenger terminal building for large RORO ferries should be started in 2009 because all CIP area needs to be used for foreign container cargo handling before the inauguration of the new Cebu Port. Therefore, the existing passenger terminal building should be used up to 2010. (See Table 2.2. 3-1)

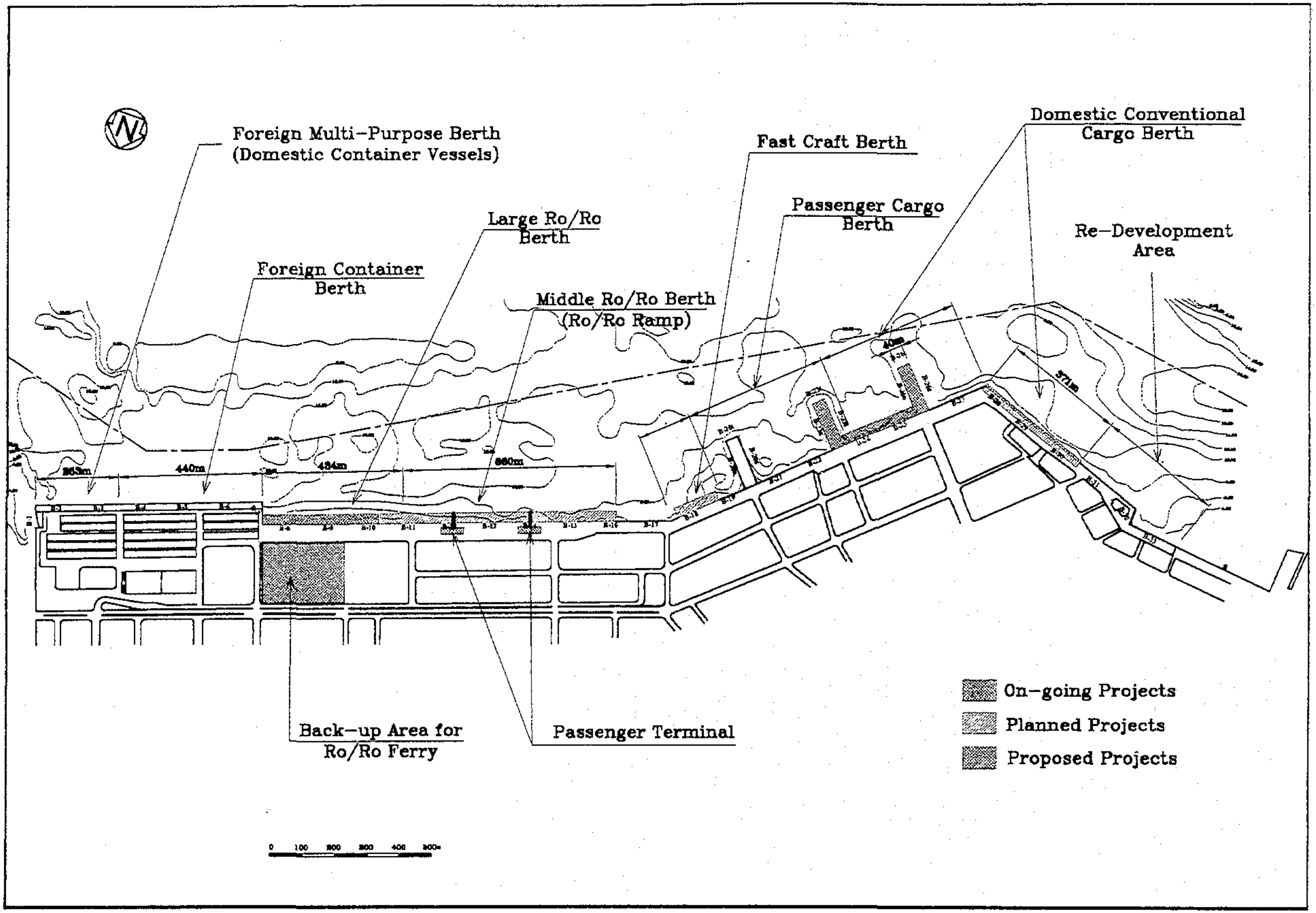


Fig2.2.3-10 Cebu Baseport Layout Plan (PMO 1 Area dedicated to foreign vessels)

Table2.2.3-1 Development Schedule of Cebu Baseport

PROJECT DESCRIPTION	QUANTITY	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(PMO 1)																						
Passenger Terminal Building (Large RO/RO)	7,000 m2										■	■				■	■					
(PMO 2)																						
Rehabilitation of Quaywall & Extension of Back-up Area (Berth 8-10)	354 m	■	■																			
Convert Existing Marginal Wharf for RO/RO ramp & Extension of Back-up Area (Berth 10-12)	*301 m* (RO/RO ramp 221m)			■																		
Convert Existing Marginal Wharf for RO/RO ramp & Extension of Back-up Area (Berth 13-14)	240 m					■																
Convert Existing Marginal Wharf for RO/RO ramp & Extension of Back-up Area (Berth 15-16)	199 m						■															
Convert Existing Marginal Wharf for RO/RO ramp & Extension of Back-up Area (Berth 17)	60 m																	■				
Passenger Terminal Building (Middle RO/RO)	2,800 m2 x 3			■	■		■	■										■	■			
Back-up Area Expansion for RO/RO Ferry	6 ha					■	■															
(PMO 3-4)																						
Rehabilitation & Expansion of Pier 1	320 m							■	■													
Rehabilitation of Pier 2	343 m		■																			
Expansion of Pier 2	290 m															■	■					
Rehabilitation of Pier 3	313 m									■	■											
Passenger Terminal Building & Berthing Facility for Fast Craft (Berth 18-19)				■	■																	
Extension of R.C. Deck & Back-up Area (Berth 21-22)	260 m										■	■										
Extension of R.C. Deck & Back-up Area (Berth 24-25)	250 m								■	■												
(PMO 5)																						
Rehabilitation of Fender System (Berth 28-30)	371 m		■																			
Rehabilitation of Working Apron & R.C. Deck (Berth 28-30)	371 m			■																		
Expansion of R.C. Deck and Back-up Area (Berth 28-30)	371 m														■	■						

2.2.4 Evaluation of the Water Calmness of the New Cebu Port

An important consideration in the design of the New Cebu Port is the assessment of wave conditions in the basin due to wind waves. The level of wave activity in the berthing area affects both the vessels' motion and their handling operations.

Besides, there is a question where the port should expand after 2020. The major concern in expanding the berth to Northeast is wave conditions. Since it is exposed to outer sea, rougher wave conditions are foreseen.

The Study Team has simulated the wave conditions and evaluated the calmness of the berth both for the short-term plan (Plan 1), long-term plan (Plan 2) and future development plan after 2020 (Plan 3). Fig. 2.2.4-1 shows the computation points.

(1) Methodology

1) Deepwater Wave

The occurrence frequency of deep wave height was calculated from the frequency of wind speed and direction, based on the measurement between 1971 and 1995 by NAMRIA, using SMB method.

2) Wave Propagation Model

Wave transformations from deep to shallow water were simulated using the energy balance model of Karlsson (1969), which calculates the propagation and transformation of irregular multidirectional waves taking into account of their refraction, diffraction and shoaling.

The computation domain covers an area of 10 km x 7.5 km. Seven different cases, different wave directions, were simulated. Table 2.2.4-1 summarizes the computation conditions of these simulations and Fig. 2.2.4-2 shows one of the computation models.

Table 2.2.4-1 Technical Specifications of the Wave Propagation Model

Computation Area		10 km x 7.5 km
Mesh Size		100m
Mesh Numbers		101 x 76
Incident Deep water Wave Conditions	Height (m)	0.5
	Direction	N - SE (7 directions)
	Period (sec)	3

The bathymetric data used in the simulation was obtained from available nautical charts and the survey results

3) Reflection and Diffraction at the Berth

Wave conditions in front of the berth are calculated using Takayama Method. This model can simulate the propagation and transformation of multidirectional irregular waves in harbors due to processes such as diffraction, reflection and refraction. Table 2.2.4-2 summarizes the computation conditions.

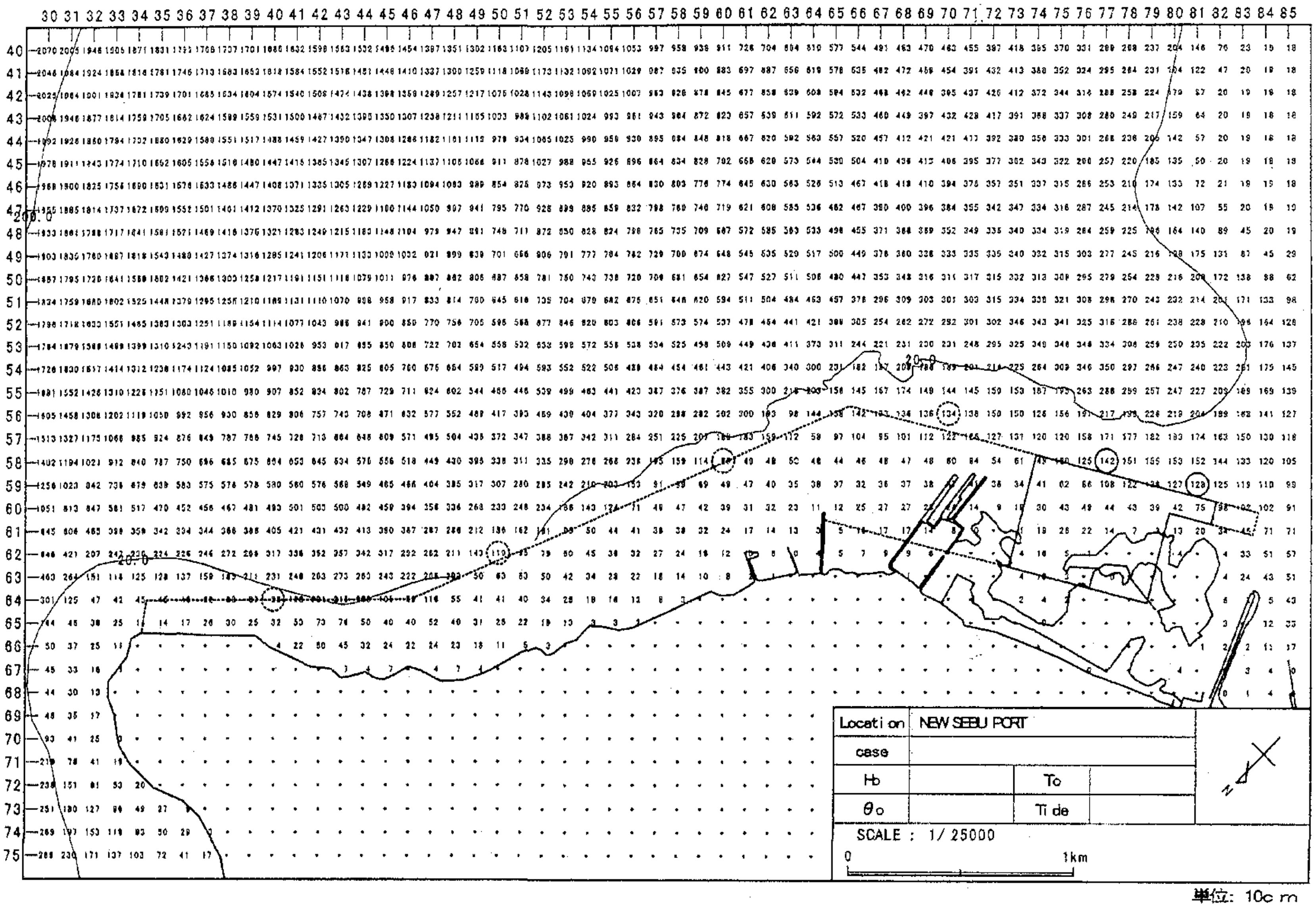
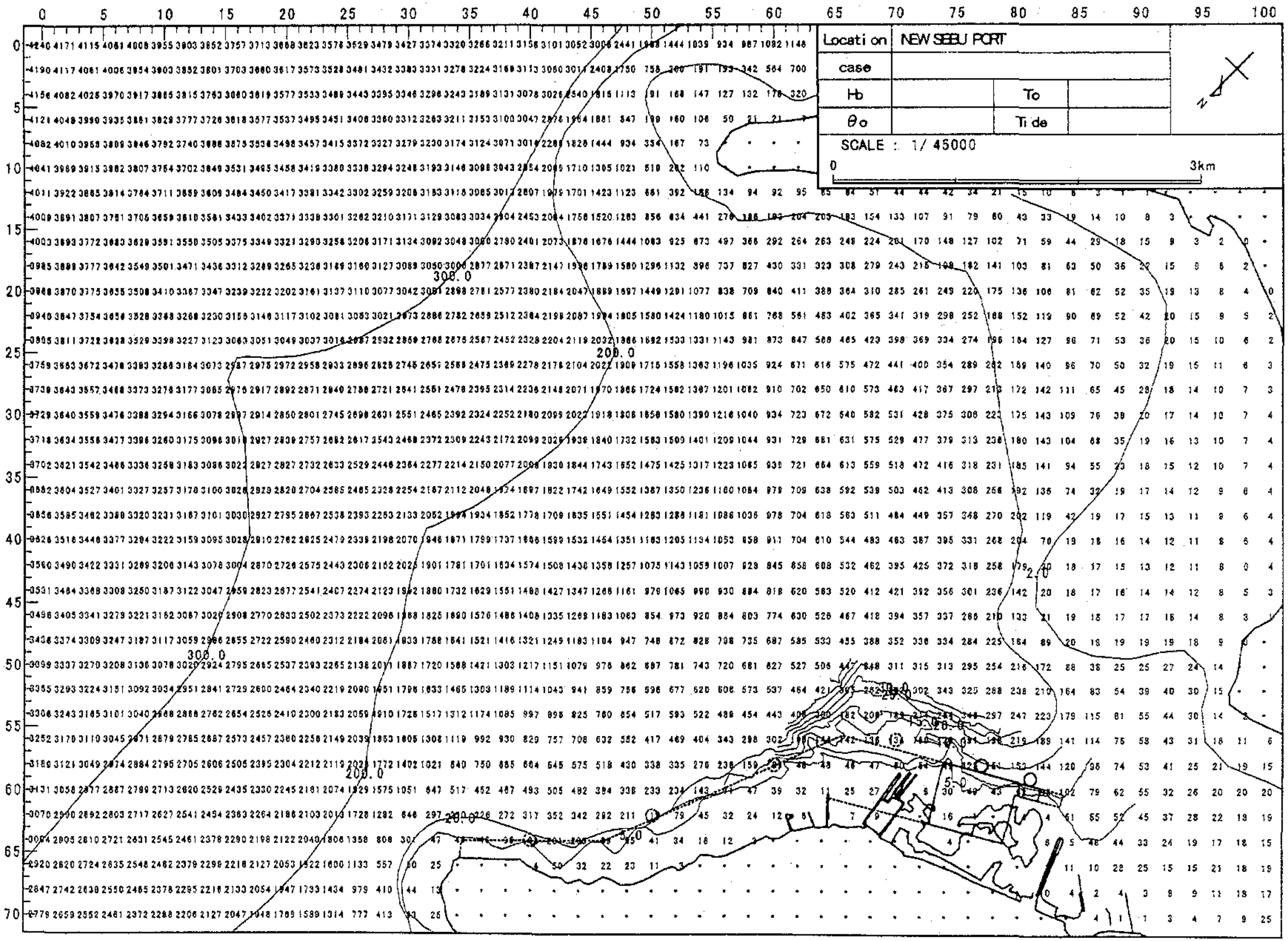


Fig. 2.2.4-1 Computation Points



単位: 10c m

Fig. 2.2.4-2 Calculation Model (Numbers shown are depths in 10 cm)

Table 2.2.4-2 Technical Specifications of the Wave Propagation Model

		Plan 1				Plan 2 and 3		
Computation Area		1,000 m x 500 m				4,500 m x 1,400 m		
Mesh Size		100m						
Mesh Numbers		11 x 6				46 x 15		
Incident Deep water Wave Conditions (Plan 1)	Deep wave direction	N	NNE	NE	ENE	E	ESE	SE
	Height (m)	0.19	0.26	0.34	0.39	0.40	0.32	0.24
	Wave direction (degrees)	49.5	54.0	60.0	71.0	89.5	97.0	101.0
Incident Deep water Wave Conditions (Plan 2 and 3)	Deep wave direction	N	NNE	NE	ENE	E	ESE	SE
	Height (m)	0.24	0.32	0.40	0.45	0.46	0.42	0.35
	Wave direction (degrees)	42.3	45.8	48.0	69.3	90.5	111.0	124.0

(2) Calculation Result

Results of the computations are shown in Table 2.2.4-3 through 8 and Fig. 2.2.4-3 through 2.2.4-8. It can be observed that:

- The most frequent direction of the incident wave is NE and 34.8% of the waves come from that direction.

- In Plan 1 and 2; the short-term and long-term plan, the highest waves are from E direction. The expected yearly highest wave height in front of the berth is, from Tables 2.2.4-3, 4 and 5, approximately 0.8 - 1.1 m.

- In Plan 3 (No 1 and No 2); the future development plan, the highest waves are from NE direction. The expected yearly highest wave height is approximately 1.0 - 1.2 m. See Tables 2.2.4-6 and 7.

- In Plan 3 (No 3), the highest waves are from E direction. The expected yearly highest wave height is approximately 1.2- 1.4 m. See Table 2.2.4-8.

Table 2.2.4-3 Accumulative Exceedance at Plan 1, Short-term Plan (No. 1)

Wave Height	N	NNE	NE	ENE	E	ESE	SE	others	Total
0.00 -	9.1	6.7	34.8	5.2	9.5	0.4	0.8	33.5	100
0.10 -	0.5	0.9	16.1	2.6	5.2	0.2	0.4		25.9
0.20 -	0.1	0.3	7.6	2.1	4.4	0.2	0.2		14.9
0.30 -		0.2	1.8	1.2	3.2	0.1			6.5
0.40 -			1.2	0.4	1.6				3.2
0.50 -			0.9	0.1	0.5				1.5
0.60 -			0.6		0.2				0.8
0.70 -			0.3		0.2				0.5
0.80 -					0.1				0.1
0.90 -									0
1.00 -									0
1.20 -									0
1.40 -									0
1.60 -									0

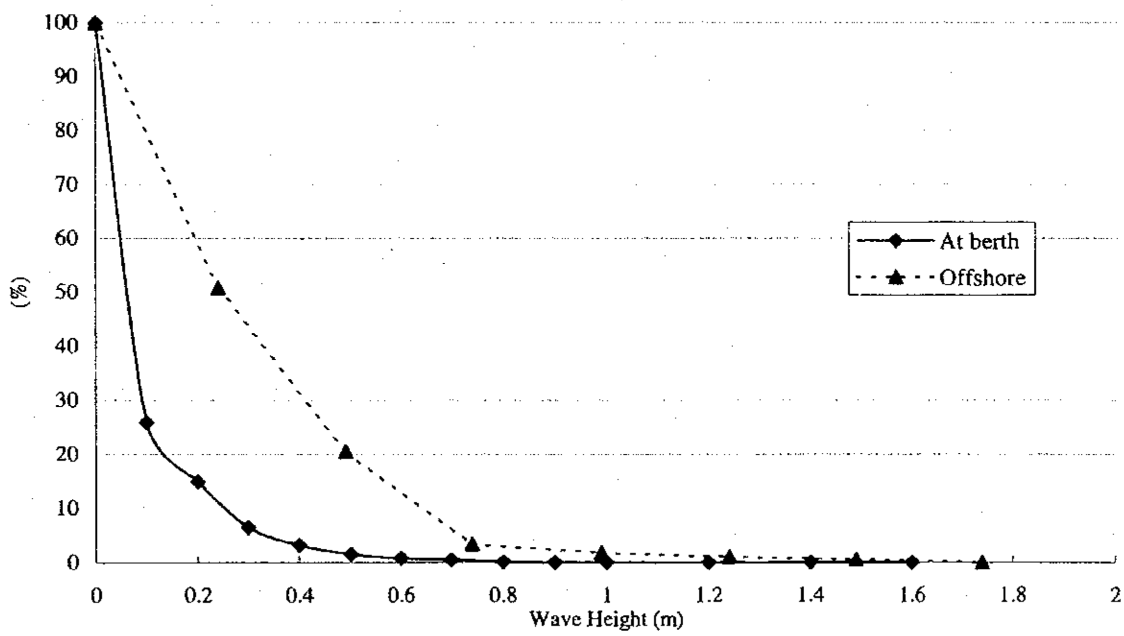


Fig. 2.2.4-3 Accumulative Exceedance at Plan 1, Short-term Plan (No. 1)

Table 2.2.4-4 Accumulative Exceedance at Plan 1, Short-term Plan (No. 2)

Wave Height	N	NNE	NE	ENE	E	ESE	SE	others	Total
0.00 -	9.1	6.7	34.8	5.2	9.5	0.4	0.8	33.5	100
0.10 -	0.6	1.4	16.2	2.6	5.9	0.2	0.4		27.3
0.20 -	0.2	0.4	8.0	2.1	4.7	0.2	0.2		15.8
0.30 -		0.3	2.0	1.2	4.1	0.1			7.7
0.40 -		0.1	1.3	0.4	2.9	0.1			4.8
0.50 -			0.9	0.1	1.4				2.4
0.60 -			0.6		0.6				1.2
0.70 -			0.3		0.2				0.5
0.80 -					0.2				0.2
0.90 -					0.1				0.1
1.00 -									0
1.20 -									0
1.40 -									0
1.60 -									0

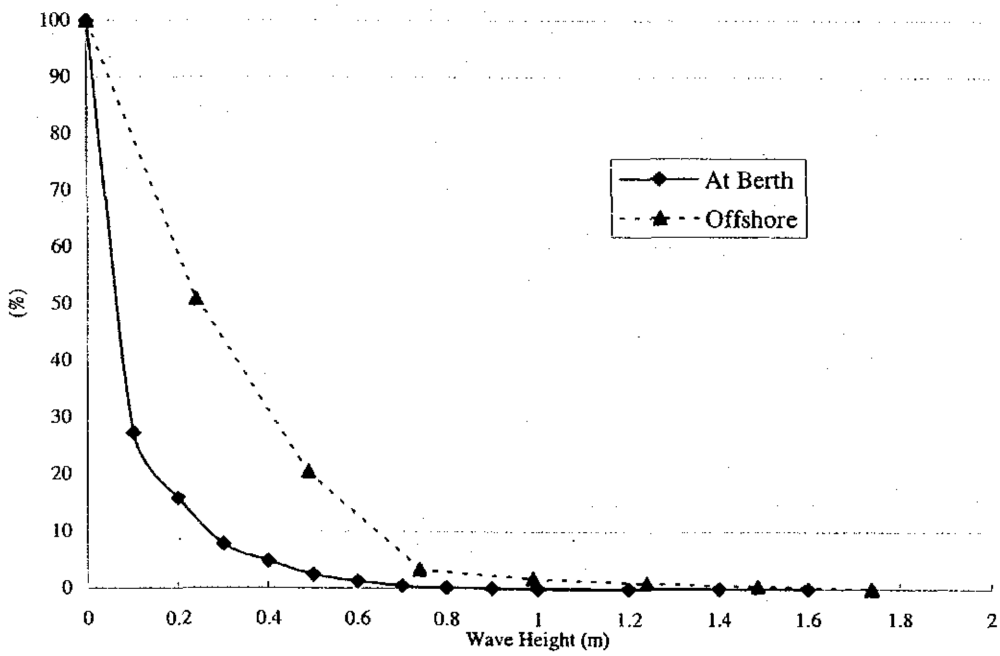


Fig. 2.2.4-4 Accumulative Exceedance at Plan 1, Short-term Plan (No. 2)

Table 2.2.4-5 Accumulative Exceedance at Plan 2, Long-term plan

Wave Height	N	NNE	NE	ENE	E	ESE	SE	others	Total
0.00 -	9.1	6.7	34.8	5.2	9.5	0.4	0.8	33.5	100
0.10 -	0.2	0.3	1.4	1.5	6.4	0.2	0.4		10.4
0.20 -		0.1	0.8	0.2	4.9	0.2	0.3		6.5
0.30 -					4.5	0.1	0.1		4.7
0.40 -					3.8	0.1			3.9
0.50 -					2.5				2.5
0.60 -					1.5				1.5
0.70 -					0.7				0.7
0.80 -					0.3				0.3
0.90 -					0.2				0.2
1.00 -					0.1				0.1
1.20 -									0
1.40 -									0
1.60 -									0

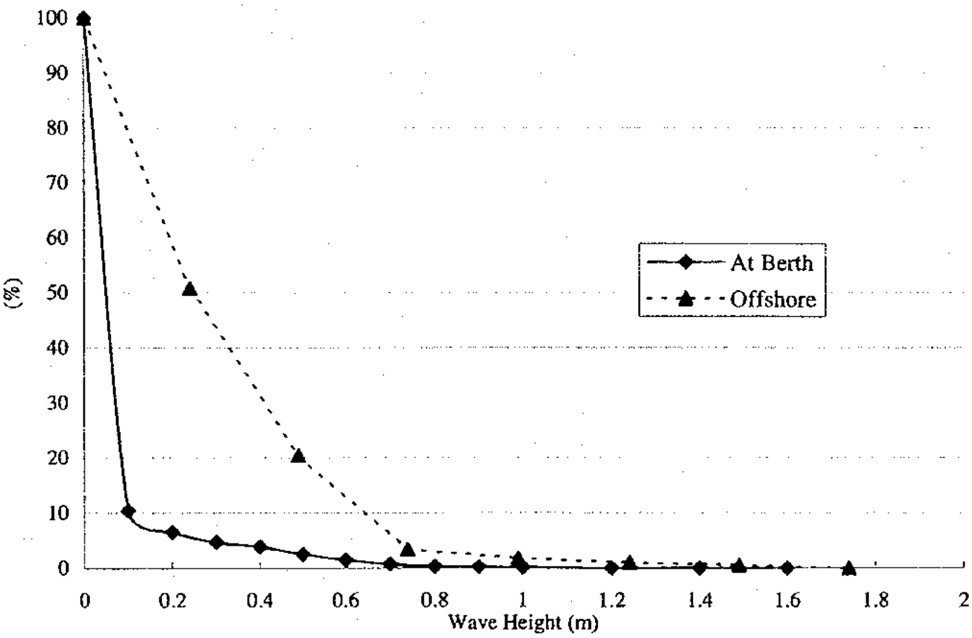


Fig. 2.2.4-5 Accumulative Exceedance at Plan 2, Long-team Plan

Table 2.2.4-6 Accumulative Exceedance at Plan 3, Future Development Plan (No. 1)

Wave Height	N	NNE	NE	ENE	E	ESE	SE	others	Total
0.00 -	9.1	6.7	34.8	5.2	9.5	0.4	0.8	33.5	100
0.10 -	4.3	3.5	20.1	3.5	6.4	0.3	0.4		38.5
0.20 -	2.3	2.6	17.0	2.7	5.0	0.2	0.4		30.2
0.30 -	0.8	1.4	13.0	2.4	4.6	0.2	0.2		22.6
0.40 -	0.5	0.6	7.3	2.0	3.9	0.1	0.1		14.5
0.50 -	0.4	0.4	3.2	1.4	2.9	0.1			8.4
0.60 -	0.2	0.3	1.4	0.8	1.7				4.4
0.70 -	0.1	0.3	1.3	0.4	0.8				2.9
0.80 -		0.2	1.1	0.1	0.3				1.7
0.90 -		0.1	0.9	0.1	0.2				1.3
1.00 -			0.5		0.1				0.6
1.20 -									
1.40 -									
1.60 -									

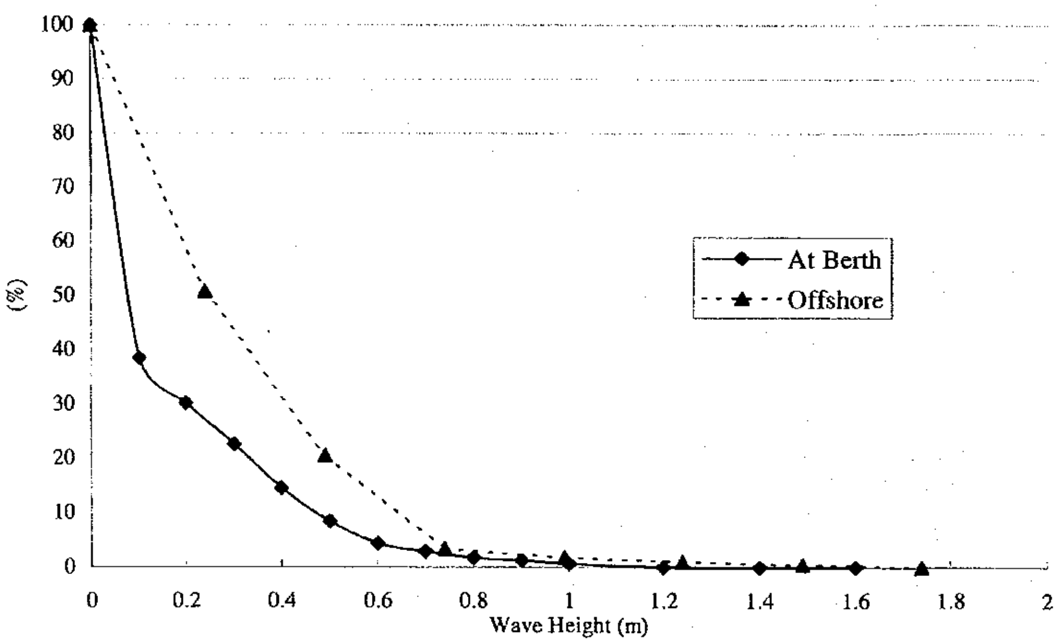


Fig. 2.2.4-6 Accumulative Exceedance at Plan 3, Future Development Plan (No.1)

Table 2.2.4-7 Accumulative Exceedance at Plan 3, Future Development Plan (No. 2)

Wave Height	N	NNE	NE	ENE	E	ESE	SE	others	Total
0.00 -	9.1	6.7	34.8	5.2	9.5	0.4	0.8	33.5	100
0.10 -	3.7	3.5	21.0	3.3	6.6	0.3	0.5		33.9
0.20 -	1.3	2.8	17.5	2.6	5.2	0.2	0.4		30.0
0.30 -	0.6	1.6	14.2	2.3	4.7	0.2	0.4		24.0
0.40 -	0.4	0.7	9.3	1.8	4.0	0.2	0.3		16.7
0.50 -	0.2	0.4	4.5	1.1	3.1	0.1	0.1		9.5
0.60 -	0.1	0.3	1.9	0.6	2.0	0.1	0.1		5.1
0.70 -		0.3	1.4	0.2	1.1				3.0
0.80 -		0.2	1.2	0.1	0.5				2.0
0.90 -		0.2	1.0		0.2				1.4
1.00 -			0.7		0.2				0.9
1.20 -			0.3		0.1				0.4
1.40 -									0
1.60 -									0

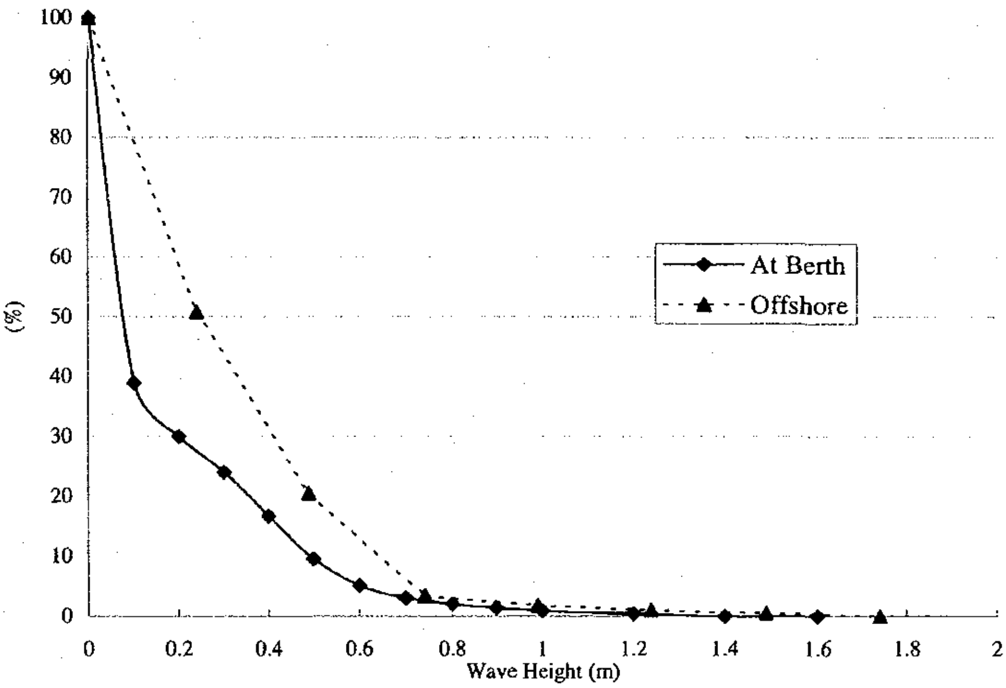


Fig. 2.2.4-7 Accumulative Exceedance at Plan 3, Future Development Plan (No.2)

Table 2.2.4-8 Accumulative Exceedance at Plan 3, Future Development Plan (No. 3)

Wave Height	N	NNE	NE	ENE	E	ESE	SE	others	Total
0.00 -	9.1	6.7	34.8	5.2	9.5	0.4	0.8	33.5	100
0.10 -	2.4	3.2	18.0	3.2	6.8	0.3	0.5		34.4
0.20 -	0.6	1.9	14.5	2.5	5.5	0.2	0.4		25.6
0.30 -	0.4	0.7	7.8	2.1	4.8	0.2	0.4		16.4
0.40 -	0.2	0.4	2.8	1.5	4.3	0.2	0.3		9.7
0.50 -		0.3	1.4	0.8	3.6	0.1	0.2		6.4
0.60 -		0.2	1.2	0.3	2.7	0.1	0.1		4.6
0.70 -		0.1	0.9	0.1	1.6				2.7
0.80 -			0.7		0.9				1.6
0.90 -			0.4		0.4				0.8
1.00 -					0.2				0.2
1.20 -					0.1				0.1
1.40 -									
1.60 -									

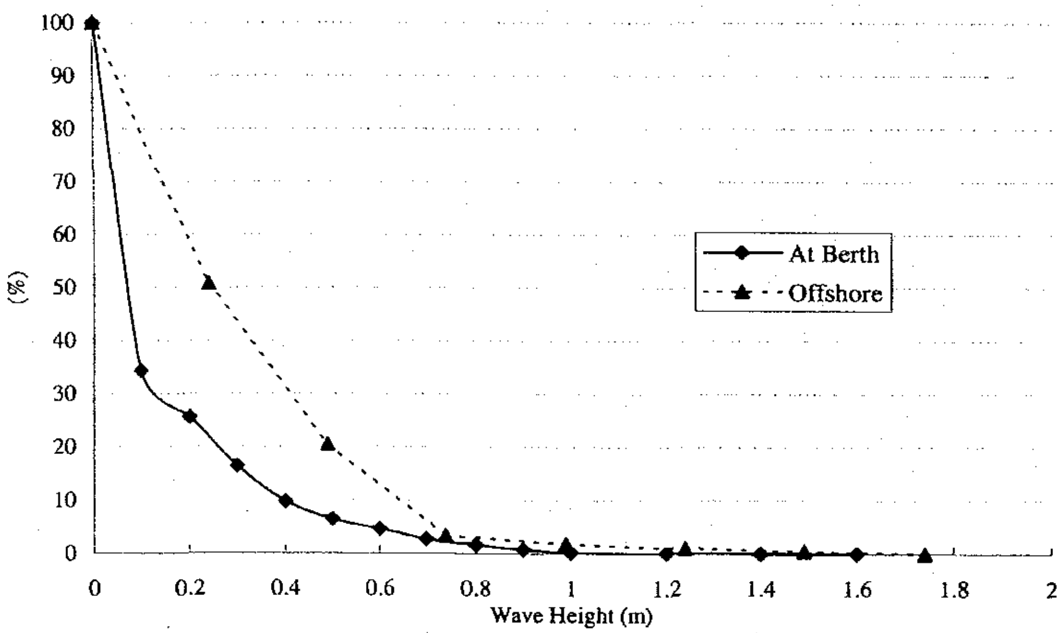


Fig. 2.2.4-8 Accumulative Exceedance at Plan 3, Future Development Plan (No.3)

The criteria often used to judge water calmness in port planning is that the probability of the wave height inside the basin or in front of the berth smaller than the critical wave height should exceed 97.5% as shown in Table 2.2.4-9. According to this table, the probability of the wave height exceeding 0.5m are calculated and shown in Tables 2.2.4-10, 11 and 12.

Table 2.2.4-9 Criteria of Water Calmness

Vessel Size	Critical Wave Height for workable conditions	Required probability of workable conditions
< 500 GRT	0.3 m	97.5 % or more
500 GRT - 50,000 GRT	0.5 m	
> 50,000	0.7 - 1.5 m	

Table 2.2.4-10 Water Calmness of New Cebu Port (Short-Term Plan; Plan 1)

Area	Description	Incident Wave Direction							TOTAL (%)
		N	NNE	NE	ENE	E	ESE	SE	
	H/H_0	0.217	0.325	0.559	0.775	0.893	0.849	0.599	
No. 1	Limit of H_0 (H_{0lim})	2.30	1.54	0.89	0.65	0.56	0.59	0.83	
	Probability of H_0 exceeding H_{0lim}(%)	0.0	0.0	0.9	0.1	0.5	0.0	0.0	1.5
	Probability of Workable Conditions								**98.5**
	H/H_0	0.246	0.367	0.567	0.784	1.064	0.878	0.595	
No. 2	Limit of H_0 (H_{0lim})	2.03	1.36	0.88	0.64	0.47	0.57	0.84	
	Probability of H_0 exceeding H_{0lim}(%)	0.0	0.0	0.9	0.1	1.4	0.0	0.0	2.4
	Probability of Workable Conditions								**97.6**

Table 2.2.4-11 Water Calmness of New Cebu Port (Long-term Plan; Plan 2)

Area	Description	WAVE HEIGHT							TOTAL (%)
		N	NNE	NE	ENE	E	ESE	SE	
	H/H_0	0.155	0.208	0.265	0.426	1.241	0.914	0.740	
Plan 2	Limit of H_0 (H_{0lim})	3.23	2.40	1.89	1.17	0.40	0.55	0.68	
	Probability of H_0 exceeding H_{0lim}(%)	0.0	0.0	0.0	0.0	2.5	0.0	0.0	2.5
	Probability of Workable Conditions								**97.5**

Table 2.2.4-12 Water Calmness of New Cebu Port (Future Development Plan)

Area	Description	WAVE HEIGHT							TOTAL (%)
		N	NNE	NE	ENE	E	ESE	SE	
	H/H_0	0.568	0.722	0.924	1.233	1.269	1.151	0.871	
No. 2	Limit of H_0 (H_{0lim})	0.88	0.69	0.54	0.41	0.39	0.43	0.57	
	Probability of H0 exceeding H_{0lim}(%)	0.4	0.4	3.2	1.4	2.9	0.1	0.0	8.4
	Probability of Workable Conditions								**91.6**
	H/H_0	0.479	0.756	0.988	1.152	1.321	1.250	1.110	
No. 3	Limit of H_0 (H_{0lim})	1.04	0.66	0.51	0.43	0.38	0.40	0.45	
	Probability of H_0 exceeding H_{0lim}(%)	0.2	0.4	4.5	1.1	3.1	0.1	0.1	9.5
	Probability of Workable Conditions								**90.5**
	H/H_0	0.385	0.599	0.752	1.061	1.438	1.219	1.134	
No. 4	Limit of H_0 (H_{0lim})	1.30	0.83	0.66	0.47	0.35	0.41	0.44	
	Probability of H_0 exceeding H_{0lim}(%)	0.0	0.3	1.4	0.8	3.6	0.1	0.2	6.4
	Probability of Workable Conditions								**93.6**

From the above results the berth area for the short-term and long-term plan is generally calm with the probability of workable days between 97.5 and 98.5% as it is protected from outside waves mainly by Mactan Island. However, in the future plan, when the berths are extended to North East, the probability of workable conditions is as low as 90% to 94%. Therefore the wave calmness will become an issue in expanding the port to North East in the future. Thus, further studies will be needed.

One of the causes for such rough conditions around the berthing area will be that the berth alignment is planned perpendicular to the predominant wave directions. As a result, the reflected waves disturb the water calmness with incoming waves.

In terms of reducing wave reflections, the following countermeasures can be considered as some of alternatives in preparation of a long-term development plan.

- Design the berth structure in such a way that it will absorb the wave energy as providing a slope underneath the suspended deck apron, etc.
- Lay out the berths perpendicular to the coastline, which resembles to finger pier.
- Align the berth near the coastline and provide breakwaters along the -15m depth line. This will require a large volume of dredging.

In this study, wave is estimated from observed wind data, however, to make the future wave assessment more accurate with use of actual recorded data, it is useful and proposed to install a wave gauge as soon as possible and make a wave record for a long period.

The above alternative studies for planning the longer term development to identify the feasible countermeasures should be conducted based on the actual recorded wave data as a part of detail engineering studies for the short-term development plan.

2.2.5 Evaluation of Berthing Capacity

A numerical simulation model "Witness", was employed to evaluate whether the port capacity would be sufficient to deal with the increasing cargo and vessel traffic throughout the planning period (see Table 2.2.5-1 and Table 2.5.6-2).

Table 2.2.5-1 Calling Vessels at the New Cebu Port (in 2010)

Vessel type	Frequency of call	Cargo handling productivity (Net)	Cargo volume / year Cargo volume / vessel	Maneuvering and idling time
Container Vessel (40,000DWT)	3 calls/week	Max 3 gantries 45-62 boxes/hour	93 thousand TEU 600TEU/vessel	3.7 hours
Container Vessel (30,000DWT)	3 calls/week	Max 3 gantries 45-62 boxes/hour	79 thousand TEU 510TEU/vessel	3.7 hours
Container Vessel (16,000DWT)	5 calls/week	Max 2 gantries 43 boxes/hour	109 thousand TEU 420TEU/vessel	3.7 hours
Container Vessel (8,000DWT)	4 calls/week	Max 2 gantries 40 boxes/hour	95 thousand TEU 460TEU/vessel	3.2 hours
Container Vessel (6,000DWT)	5 calls/week	Max 2 gantries 33 boxes/hour	69 thousand TEU 260TEU/vessel	3.2 hours
Domestic Container Vessel	4 calls/week	Max 2 gantries 33 boxes/hour	57 thousand TEU 270TEU/vessel	3.2 hours
Conventional Cargo Vessel	57 calls/year	102 ton/hour	477,000ton 8,400 ton/vessel	3.7 hours

Note: Assumptions of each vessel's characteristic are based on their operation routes.

Table 2.2.5-2 Calling Vessels at Cebu Baseport (in 2010)

Vessel type	Frequency of call	Cargo handling productivity (Net)	Cargo volume / year	Maneuvering and idling time
Large RoRo	1,292 calls/year	2 cycle/day/berth	282 thousand TEU	2.8 hours
Middle RoRo	7,860 calls/year	2 cycle/day/berth	3,850 thousand ton	2.8 hours
Container	228 calls/year	26 boxes/hour	57 thousand TEU	2.8 hours
Conventional	3,240 calls/year	64 ton/hour	2,799 thousand ton	2.8 hours
Passenger Cargo	14,065 calls/year	3 cycle/day/berth	560 thousand ton	1.4 hours
Fast Craft	8,260 calls/year	5 cycle/day/berth	—	1.4 hours
Metro Bus	17,122 calls/year	24 cycle/day/berth	—	0.9 hours

In the case of Cebu Baseport, we evaluated both two-way and one-way navigation system of the access channel.

Vessels subject to one-way are as follows:

Container ship, Large RoRo, Middle RoRo of more than 100m LOA, and Conventional cargo of more than 120m LOA.

Berth occupancy rate and average waiting time are shown in Table 2.2.5-3, Table 2.2.5-4, Table 2.2.5-5 and Table 2.2.5-6

Table 2.2.5-3 Berth Occupancy Rate of the New Cebu Port

Berth	Berth occupancy rate
Container	0.60
Conventional	0.60

Table 2.2.5-4 Berth Occupancy Rate of Cebu Baseport

Berth	Berth occupancy rate	
	Two way	One way
Large RoRo	0.67	0.66
Middle RoRo	0.69	0.69
Container	0.16	0.16
Conventional	0.42	0.42
Passenger Cargo	0.44	0.44
Fast Craft	0.42	042
Metro Bus	0.50	0.50

Table 2.2.5-5 Waiting Time of the New Cebu Port

Berth	Average waiting time(minutes)
Container	18
Conventional	0

Table 2.2.5-6 Waiting Time of Cebu Baseport

Berth	Average waiting time(minutes)	
	Two way	One way
Large RoRo	0	0
Middle RoRo	0	0
Container	0	0
Conventional	0	1
Passenger Cargo	0	0
Fast Craft	0	0
Metro Bus	0	0

In the case of the New Cebu Port, short waiting time occurs. But it does adversely affect the schedule of a container vessels.

In the case of Cebu Baseport under two-way system, there is no-waiting time. In the case under one-way system, there is a little waiting time. Therefore, CPA should set up one-way navigation system of the access channel to improve the safety of the calling vessels by introduction of VTMS (Vessel Traffic Management System).

2.3 Basic Engineering Design

2.3.1 Design Conditions

The port facilities required for the short-term development plan for 2010 is designed based on the design criteria and conditions as set in the chapter 2.8 of Vol. 2 except the following.

(1) Objective Vessels

The objective vessels size for the short term plan is set as shown in Table 2.3.1-1. Subsequently the dimension of port facilities and preliminary design thereof are reviewed.

Table 2.3.1-1 Objective Vessels Size, Required Berth Length and Water Depth of the Project Ports for 2010

Port	Type of Vessel	Vessel Size	LOA	D	Berth Length	Water Depth
New Cebu Port	Container vessel	40,000 DWT	270	12	300	13
	Conventional Cargo vessel	18,000 DWT	165	9	190	10
Cebu Baseport	Container vessel	7,000 DWT	150	7	175	8
	Large RORO	18,000 GRT	195	7	225	8
	Middle RORO	4,000 GRT	120	5	60	6
	Cargo vessel	2,000 DWT	83	5	100	6
	Passenger/cargo vessels	500 GRT	50	3.5	60	4
	Fast Craft	500 GRT	40	2	55/2 berths	3
	Metro Bus Ferry	30 GRT	-	-	-	-

Note: Vessel size DWT (GRT); Dead Weight Ton (Gross Registered Ton)
LOA: Overall Vessel Length (m), D: Draft of Vessel (m)
Berth length: Required in meter Water depth: Required depth along side the berth in meter

2.3.2 Basic Design of Port Facilities

The facilities required for the short-term development plan is planned as follows:

(1) For New Cebu Port

Waterfront Facilities

1. Container berth (Length 600 m, water depth 13 m) with crane rail foundation
2. Multipurpose cargo berth (Length 190 m, water depth 10m)
3. Small boat basin with 25 m x 10 m x 2.6 m, water depth -3m.
4. Revetment, retaining wall for protecting reclamation works
5. Reclamation Works and Dredging works (dredging up to -13 m, for container berth, -10m for multipurpose cargo berth, - 3m for small boat basin)

On land Facility	1.	Service road construction with drainage system inside the port area
	2.	Container stock yard pavement works with drainage system
	3.	Open yard for conventional cargo
	4.	Fence and Landscaping
Utility supply facilities	1.	Water supply reservoir over head tank with supply piping to buildings, firefighting,
	2.	Electric power supply to buildings, cargo handling equipment, lighting to buildings and container yard,
Buildings	1.	Container Terminal - CFS, - Gate booth - Terminal operation building, - Container maintenance/repair work shops, ,
	2.	Conventional cargo shed,
	3.	Utility Supply Buildings - Electrical power station, - Seamen's Club,
Environmental treatment facilities	1.	Sewerage treatment,
	2.	Solid waste treatment,
	3.	Garbage collecting disposal facilities,
Access Road	1.	2-lanes road connecting port area and existing national road,
Equipment	1.	Container handling equipment on the apron, in the yards, in the CFS,
	2.	Conventional cargo handling equipment,
	3.	Computer system
	4.	Navigation Aids, Vessel Traffic Control Facilities

(2) For Cebu Baseport

Water Front Facility	1.	Redevelopment of the Existing Piers 1 and 3
	2.	Existing Berth widening of B21-22, 24-25 and Rehabilitation of B 28-30
On land Facilities	1.	Expansion of Open Yard
Utility Facilities	1.	Water Supply Facilities
	2.	Electric Power Supply Facilities
Environmental treatment facilities	1.	Sewerage treatment,
	2.	Solid waste treatment,
	3.	Garbage collecting disposal facilities
Building Works	1.	Passenger Terminal Building 1 units for Large RORO
	2.	Passenger Terminal Building 2 units for Middle RORO berths area

Passenger Boarding Bridge from the terminal building to berthing area

(3) Design Criteria of Berthing Structure

1) Crown Height

For the basic design of the new Cebu port, the crown height of the quay wall is fixed at 3.0m from MLLW. For Cebu Baseport, the crown height of the piers is taken the existing height of piers of + 3.0 m

2) Water Depth along side of Berth

The required water depths for each berth are set as follows:

New Cebu Port,	Container Terminal:	-13 m from MLLW
	Multipurpose Cargo Terminal:	-10m from MLLW
Cebu Base Port,	Reconstruction of Pier No. 1:	- 6 m from MLLW
	Reconstruction of Pier No. 3:	- 4 m from MLLW

3) Surcharge Loads and Live Loads on the Apron

a. Surcharge Loads

On the apron of the berths for New Cebu Port, the following surcharge is considered as a dead load by assuming temporary stack of containers:

Normal condition:	2.5 tf/m
Seismic Condition:	1.0 tf/m

b. Live Loads

In the design of the apron, only trailer trucks and standard trucks with full loaded containers are considered. The following wheel loads are considered for design of the apron pavement.

Uniform Distributed Load	2.50 t/m^2 (without QGC) for the new Cebu port
Uniform Distributed Load	1.35 t/m^2 (with QGC)
Gantry Crane Load	40.0 t rated load x 30m span x 36 to 38 m outreach.
Standard Truck (H22 - 44)	8.0 tf/wheel for the pier 1 and 3 of Cebu Baseport
Tractor Trailer (40')	5.8 tf/wheel

4) Live load on Container Yard and Road

Load of Container Handling Equipment for the design of the pavement at the container yard and roads as shown in Table 2.3.2-1 are adopted. In operation condition, the load dynamic coefficient are considered for dynamic effect (1.2.)

5) Tractive Force and Berthing Force

a. Mooring

The mooring bitts of 100 tf per unit for the vessels from 15,000 to 40,000 DWT for the New Cebu Port are installed in spacing of 35 m.

b. Fender System

In design of the fender system, berthing speed of vessels to be adopted for the new Cebu port and Cebu Base port is set at 15 cm/sec.

Maximum berthing angle is 10 degrees. Spacing of rubber fenders is installed for 15.0 m. Fender frame is attached as parts of fender system.

(4) Design Conditions of Pavement of the Road and Yard

Based on the operation planning inside the container terminal, yard area, apron of berth and road area of the new Cebu port, the following wheel loads are considered for selection of type and area of the pavements, which the design is conducted:

Table 2.3.2-1 Design Load and Type of Pavement of Terminal Area

Area Particulars	Access/ Service Road	Container Terminal Area		Stock Yard		Multipurpose Cargo Terminal	
		Berth/ Apron	Road way	RTG passage way	Stock yard	Berth/ Apron	Yard Area
Critical Wheel Load Type	Standard Truck (H20-44)	Standard Truck (H20-44)	Forklift Truck (25 tf)	RTG (40ft)	Reach stacker (4.5 tf)	Standard Truck (H20-44)	Forklift Truck (25 tf)
Critical Wheel Load (ton)	8.0	8.0	12.8	40	8.1	8.0	12.8
Pavement Type	Concrete	Concrete	Concrete	PC slab	Inter -lock block	Concrete	Concrete

PC slab: pre-stressed concrete block slab

Special provision of pre-stressed concrete block slab pavement is adopted for the track of rubber transfer cranes (RTG), whose wheel loads exceed well enough 40 tf/wheel.

The pavement of the parking lots on the reclaimed land will be by interlocking concrete blocks.

2.3.3 Design Concept of Quay Wall Structure

Based on the above design criteria and berth requirement, the type of berth structures is determined considering the topographic, hydrographic and soil conditions of site. The design concept of the major facilities of the new Cebu port and Base port is described as follows:

(1) Design of Quay Wall Structure of New Cebu Port

1) Berth Structure for Container Berth and Multipurpose Cargo Berth

Two type of berth structure are considered, one for multipurpose cargo berth to handle break bulk general cargo and other for exclusive container berth. The same type of berth structure is adopted for both berths, considering the soil conditions and future possibility of utilization by container vessels.

Considering the soil conditions and steep slope of seabed topography, the three alternatives types of berth foundation are studied during the long term plan stage. The advantage and disadvantage of each alternative is reviewed and compared in the cost, construction period and environmental considerations. The SPSP type of berth structure is found suitable among the alternatives. The typical section is shown in Fig 2.3.3-1 (1)

From the detailed review of the soil data at site, the soil layers are found not uniformed layers of sandy or silty clay, but the coral mixed fragment soil conditions. The SPSP gravity type structure are adjustable and flexibly to the changes of soil resistance at site by broken coral and cohesive granule. Steel pipe piles is supporting the upper super structure by point and friction bearing of the soil foundation, once the bearing layer is encountered to the deeper layer, the pile length should be extended. The design concept of SPSP structure is as follows;

> The steel pipe sheet pile (SPSP) of 1,200 mm Dai to be driven up to 30 m depth, which is anchored by rear steel pipe pile with tie wire at about 30 m away from the frontal piles, and the area between two piles are filled with sand and stones to make a gravity type.

The multipurpose berth is also designed with SPSP considering the possibility of utilizing for the container berth in future. The typical cross section is shown in Fig 2.3.3-1 (2).

The rear container crane rail foundation piles are provided 30 m away for the crane wheel gauge from the seaside foundation piles separately from the anchor piles for crane installation.

2) Pavement of Yard

The surface of the reclaimed area will be paved with interlock concrete block on the cemented treated sand fill for container storage yard. The run away of Rubber Tired Gantry Cranes are paved with PC block plate and container trucks running area are paved with concrete.

3) Small boats basin

The berthing facility for port service boats like tug boats and pilot boats is planned on the landside of the multipurpose cargo berth. The access channel and basin in front of the berth is dredged to the depth of - 3.0 m. The general layout plan is shown in Fig 2.3.3-2. The berthing structure will be designed with reinforced concrete pontoon (25 m x 10 m x 2.6 m) anchored by steel pipe pile and an access trestle of steel structure is installed to connect the land and pontoon.

4) Building works

The preliminary design of the terminal operation building with pile foundation, Container Freight Station and gate booth with footing foundation are planned. The typical plan and section of each building are shown in Fig 2.3.3-3 (1) (2) and (3) respectively.

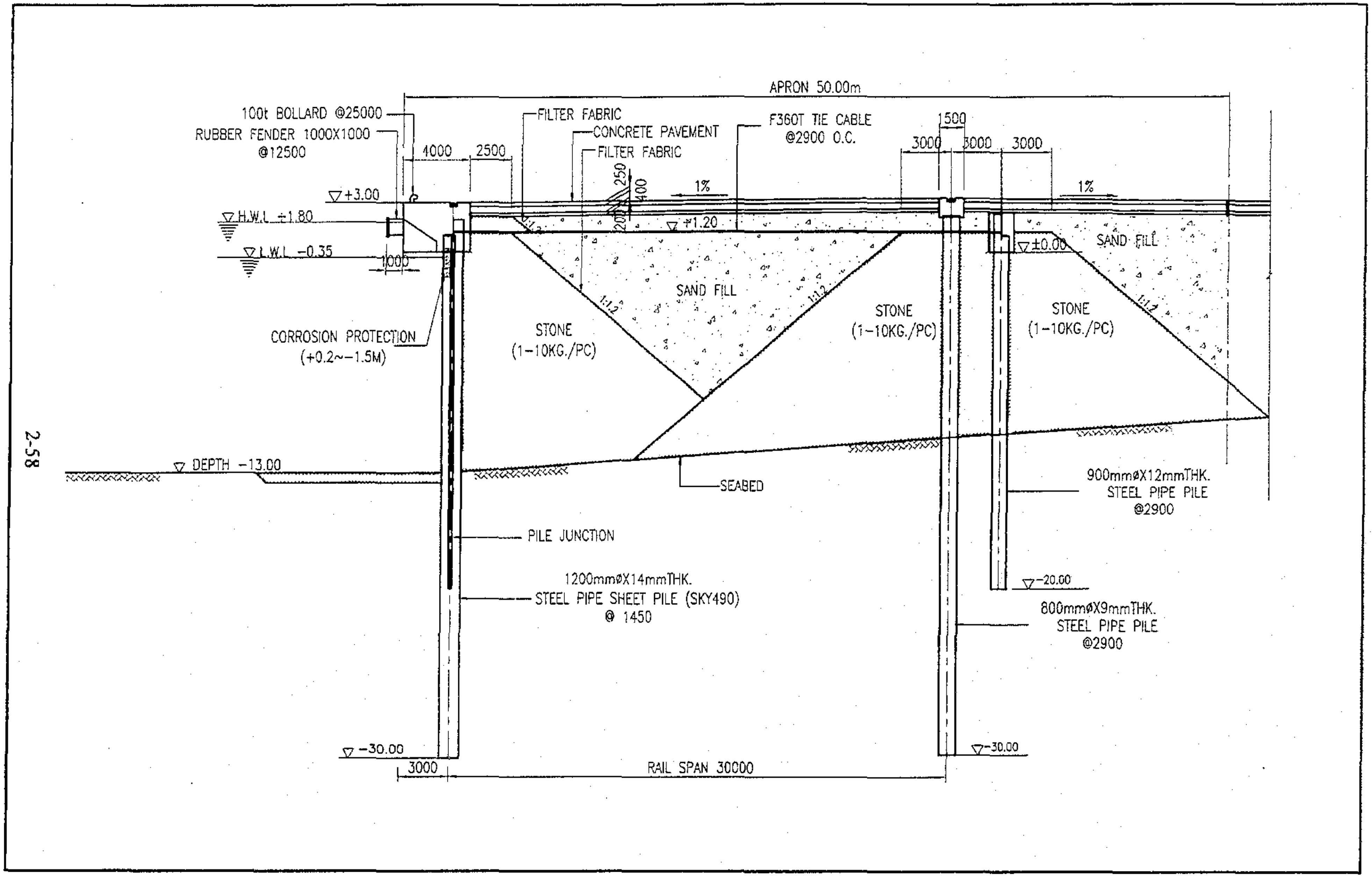


Fig. 2.3.3-1 (1) Steel Pipe Sheet Pile Type Quaywall for Container Berth

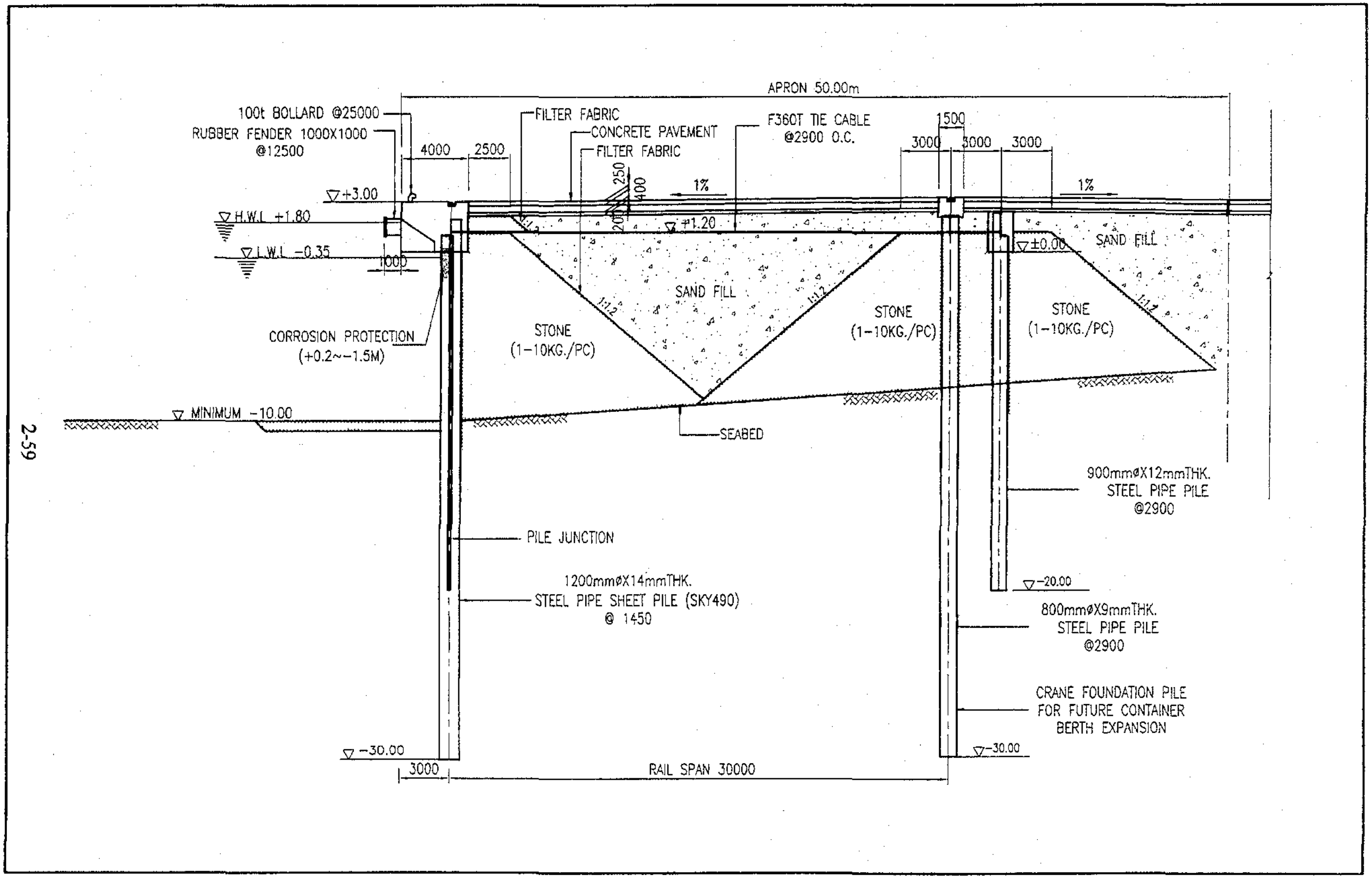


Fig. 2.3.3-1 (2) Steel Pipe Sheet Pile Type Quaywall for Multi Purpose Berth

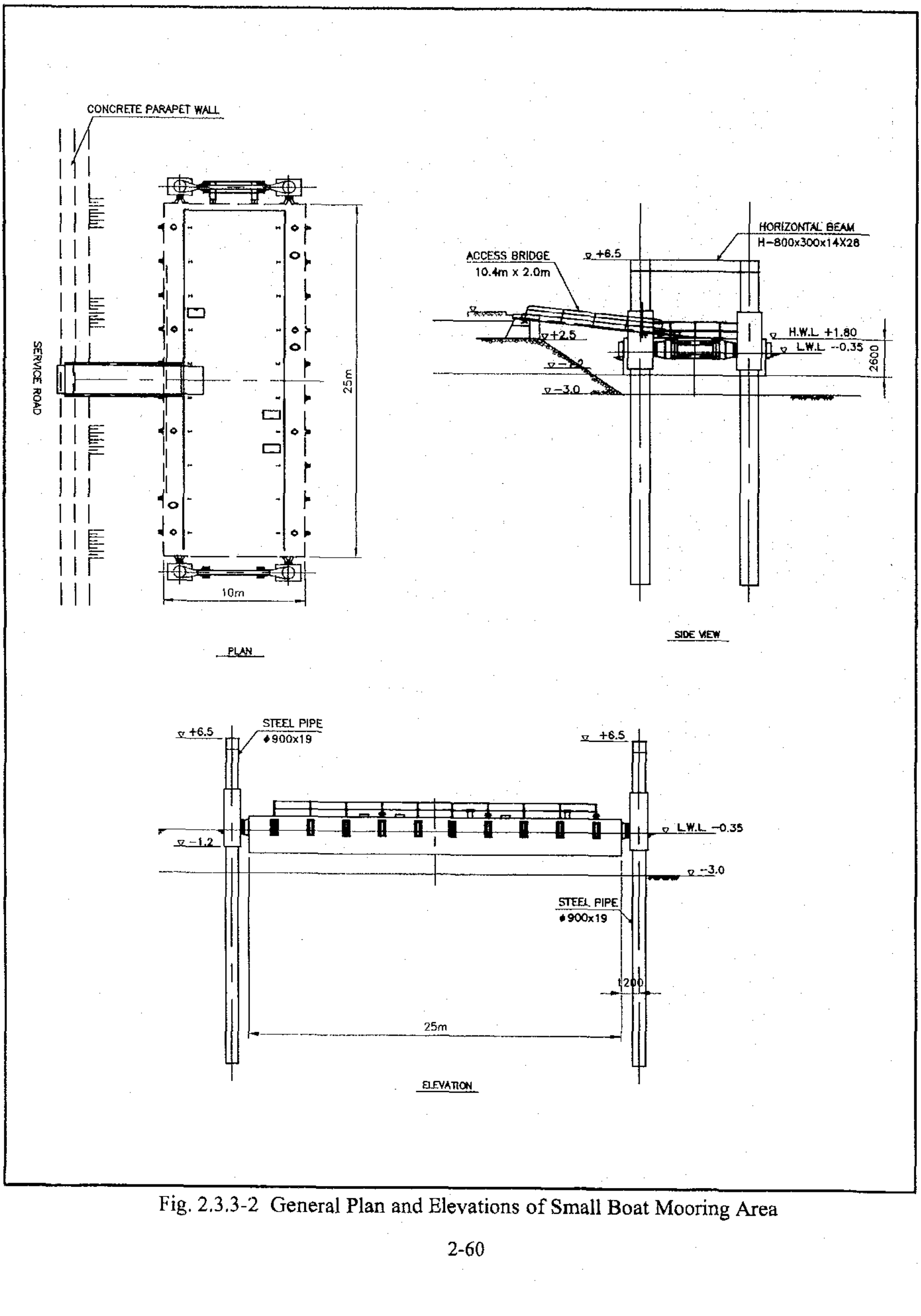
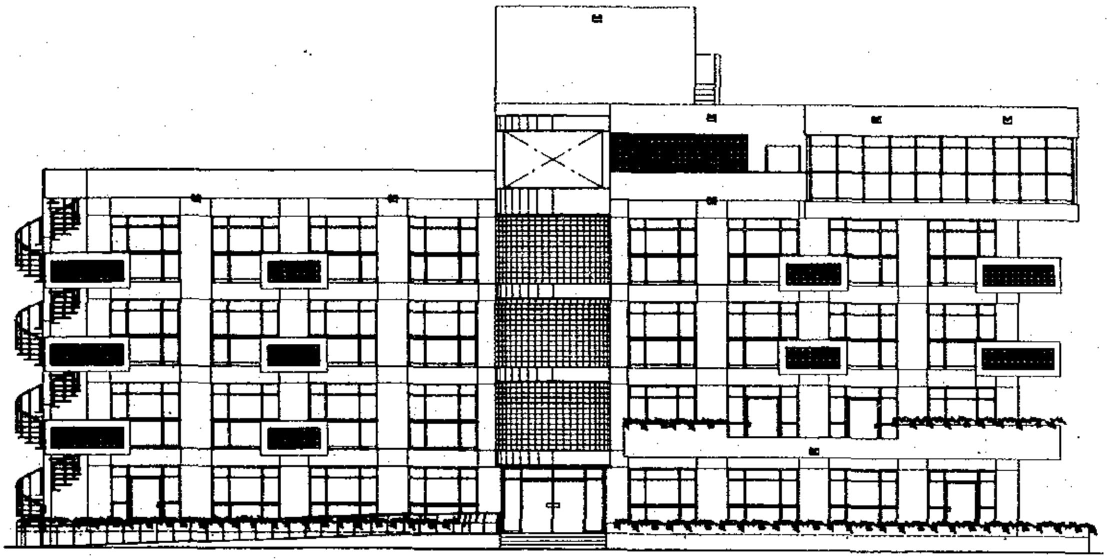
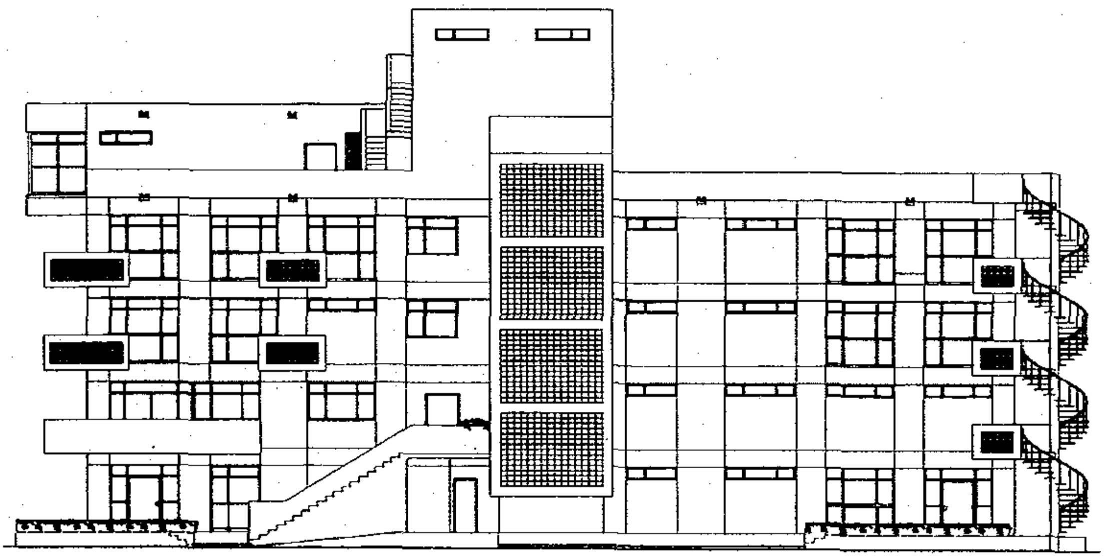


Fig. 2.3.3-2 General Plan and Elevations of Small Boat Mooring Area



Ⓐ ELEVATION 1



Ⓑ ELEVATION 2

Fig. 2.3.3-3 (1) Terminal Office Building for New Cebu Port

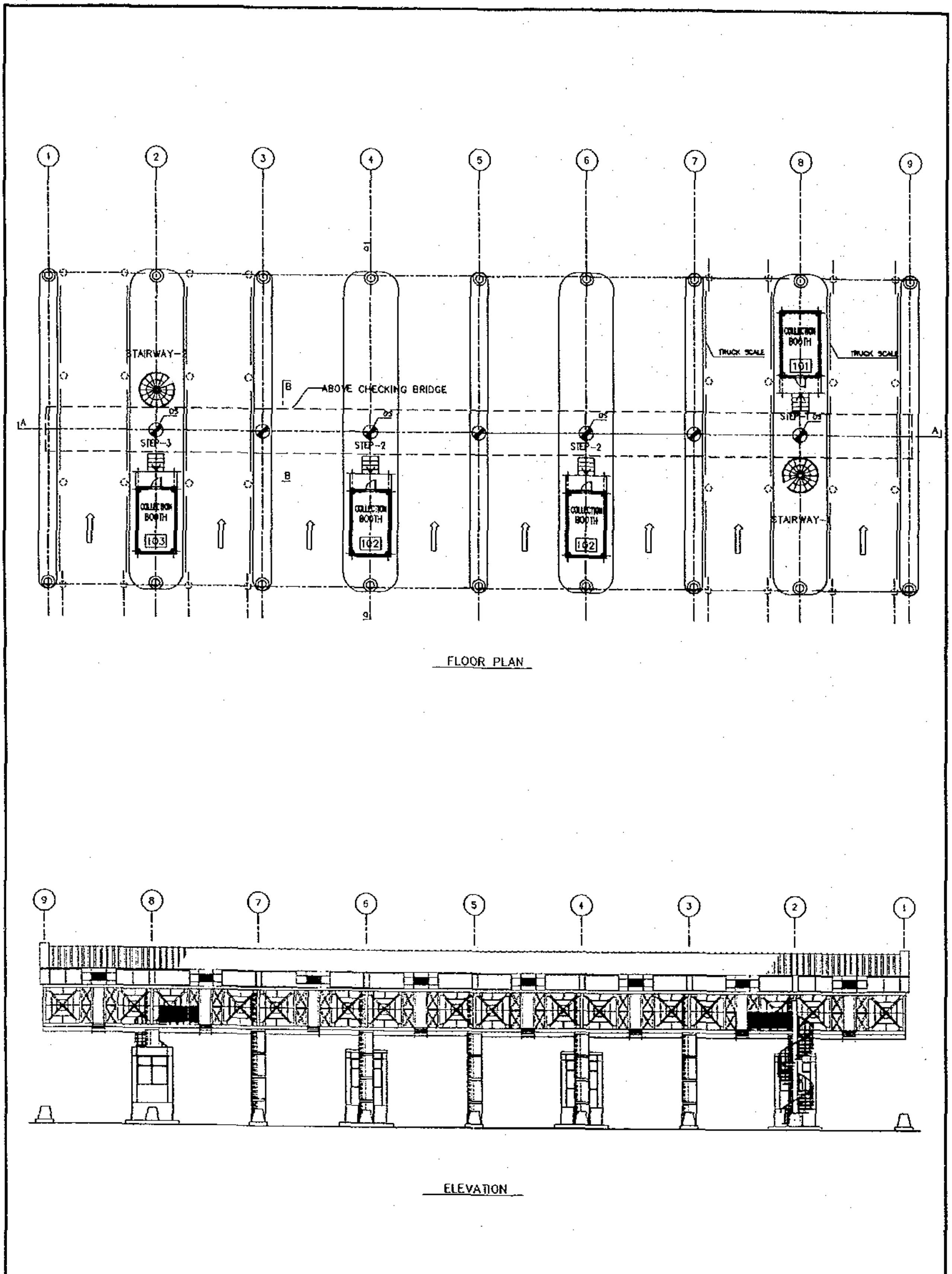


Fig. 2.3.3-3 (2) Gate Booth for New Cebu Port

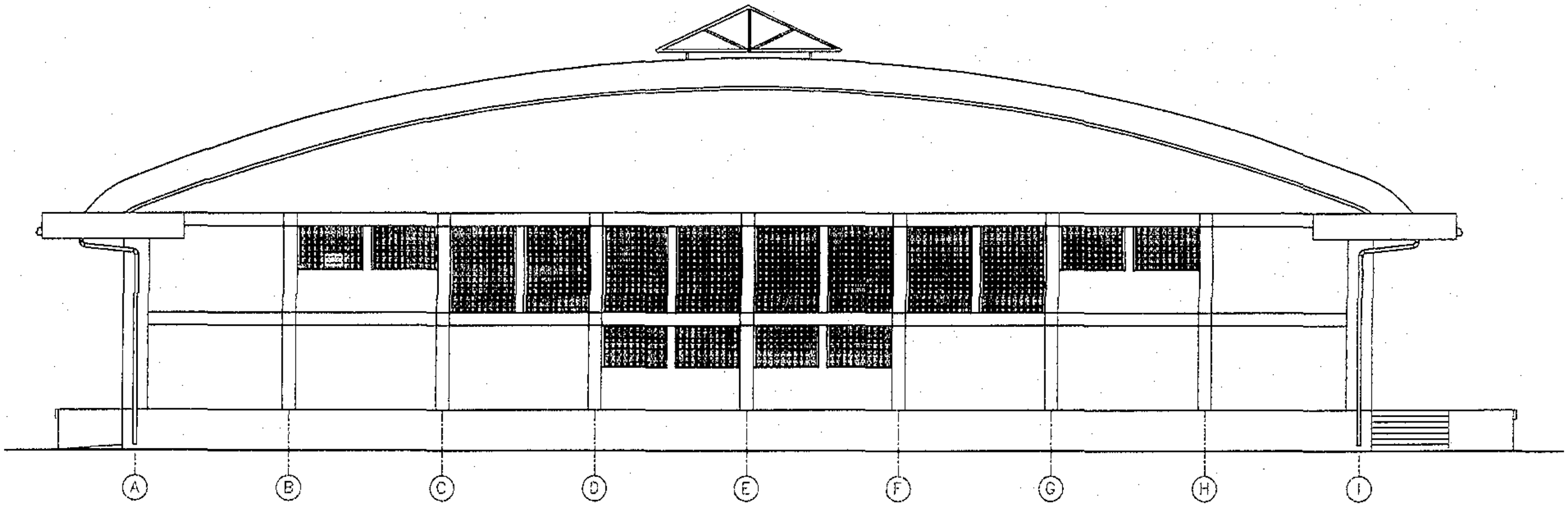


Fig. 2.3.3-3 (3) Container Freight Station for New Cebu Port

(2) Design of Redevelopment of Pier 1 and 3 at Cebu Baseport

1) Reconstruction of Pier No. 1 for large cargo ship
According to the results of investigations of the damaged survey at the pier 1 to 3 of Base port, it was found that the existing concrete slab and beams and pile head connection with beams of these piers are heavily damaged particularly those along the periphery of the each pier.

Under such damaged conditions, in case the existing pier No. 1 structure will be used for cargo ships of around 2,000 DWT the berthing facilities as a whole should be reconstructed.

There is no geological data around the Pier No 1 area, but the experiences of the concrete piles (length of 24 m) supporting mooring dolphin construction carried out by CPA, the sea bed soil is assumed to be sand silty clay and to be encountered bearing soil layer around -15 m depth.

Two alternative types of quay wall are studied during the long-term plan stage. It was reviewed and compared in cost, construction period and environmental aspects. It was found that SSP type quay wall structure is simple construction method and minimum environmental impacts.

The typical cross section of pier No. 1 by using SSP berth structure is shown in Fig 2.3.3-4.

2) Rehabilitation of Pier No. 3 for passenger ships

The pier No. 3 is planned for small passenger ships of 500 GRT class due to shallower depth around the pier No. 1 area. The existing concrete piles at the central parts of the pier is observed durable for such small ships, but some of the piles along the periphery of the pier which were heavily damaged should be replaced with new concrete piles to be driven in adjacent to the damaged pile.

The existing upper structures of pier No 3 shall be demolished and new upper structures is reconstructed on the top of the existing concrete piles. The typical cross section thereof is shown in Fig. 2.3.3-5.

2.3.4 Design Concept of Access Road Way Structure

(1) Number of Required Traffic Lanes

1) Design Traffic For Access Road
Design traffic volumes inside the new Cebu port area and access road way up to the target year of 2010 are estimated as follows:

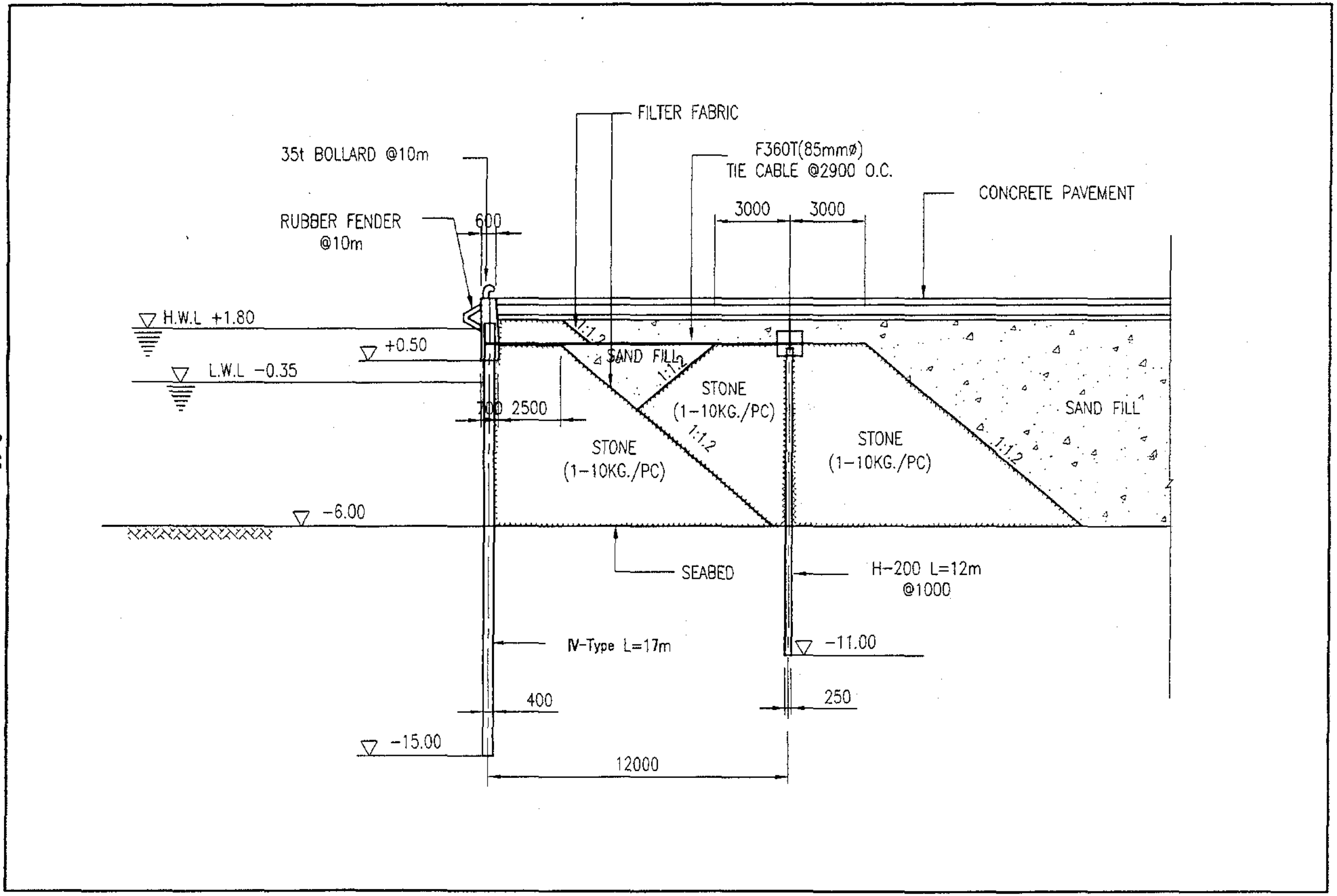


Fig. 2.3.3-4 Sheet Pile Type Quaywall for Reconstruction of Pier 1

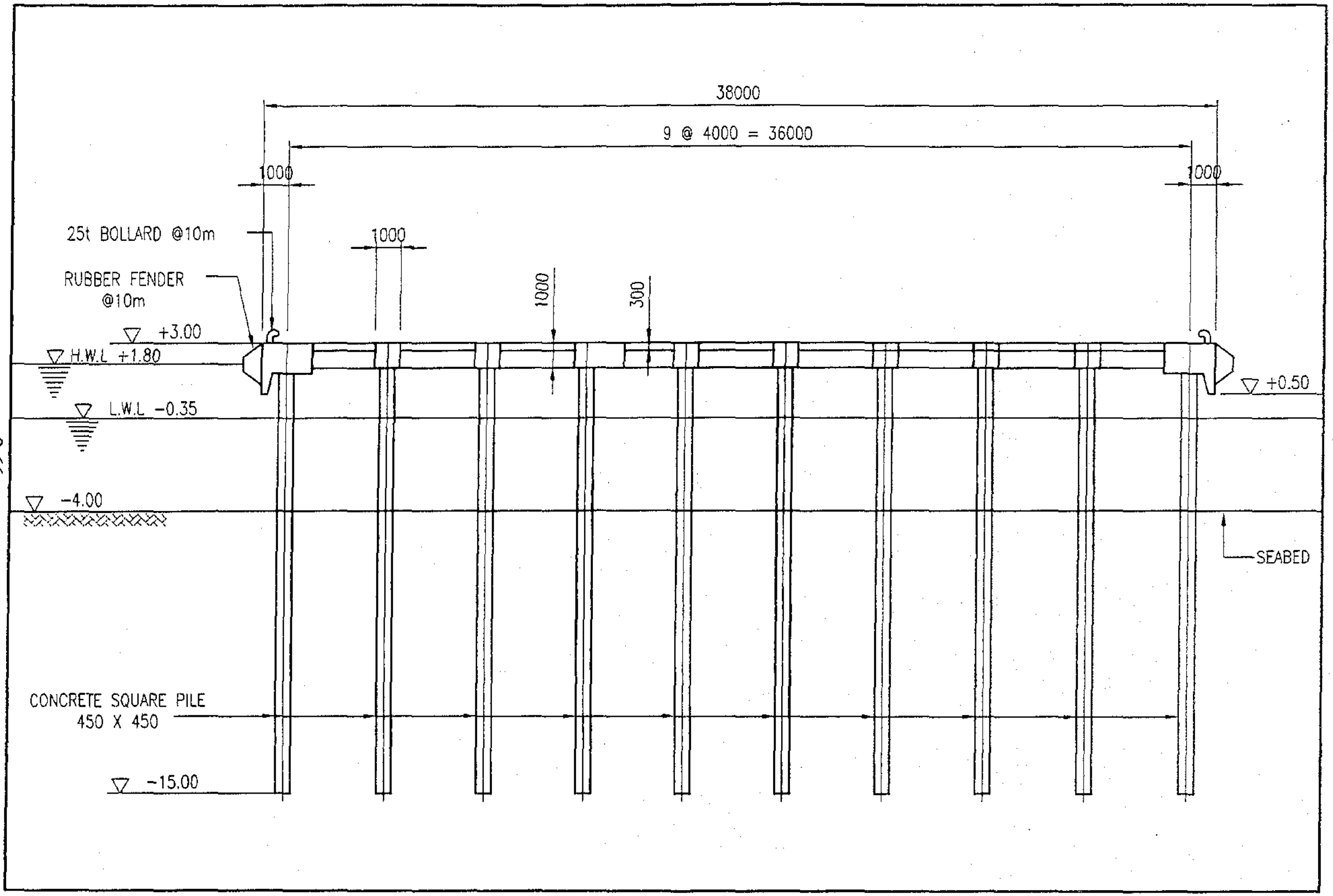


Fig. 2.3.3-5 Open Deck Type Berth for Reconstruction of Pier 3

Table 2.3.4-1 Estimated Traffic Volume of Vehicles (car/hr) in 2010

Cargo Classification	Traffic Volume(car/hr)	Unit
Port Inside Service Road and Access Road		
From Containers	326	Vehicles/hour-2 way
From General Cargo	66	Vehicle/hour-2 way
Total	392	Vehicle/hour-2 way

According to the traffic volume, the width of a traffic lane of 3.25 m to 3.5 m is planned. For the short-term plan, 2 lanes will be enough but the area of 4 lanes will be reserved.

(2) Planning the Access Road Alignment Outside of the Port Area

The preliminary alignment of the access road was reviewed by the site reconnaissance survey. The alignment is selected basically by minimizing the interference of the existing houses, factories, dormitories and its related facilities and not cutting plants existing on the coastal area. The planned access road length will become around 1,800 m including the approach embankment to the existing national road. The alignment of the access road is shown in Fig. 2.3.4-1.

The existing topographic features of the planned road area are undulated in high (+30 m) and low ground level (+3 m). The road alignment is planned to have maximum gradient of 4 % for safe running of 80 km/hr by 40 ft container trucks.

The access road on the offshore area till the port area is planned by combination of flyover and the causeway to connect the reclamation area so as to make water flow surrounding the reclaimed port island by the tidal current.

The access road on the land is planned by cutting hilly parts by 4 lanes portion. The connection with the existing 2-lanes national road is planned by interchange of flyover of 150 to 160 m long and ramp approach roads with embankment of around 75 m long.

The typical cross section of Fly over parts and on the ground parts are shown in Fig. 2.3.4-2 (1), (2) and (3) respectively

(3) Design Concept of Bridge Pier, Beams and Foundation

1) The width of the Access Road for the short-term plan

At the beginning of the short-term plan, the foundation and pier to support the beams of the flyover structure should be designed to sustain the 4 lanes width required for the long term plan. Thus the land acquisition of the access road parts should be 4 lanes portion (18.9 m width). But for the short-term plan, the beams shall be placed on the pier for 2 lanes portion (15.5 m width).

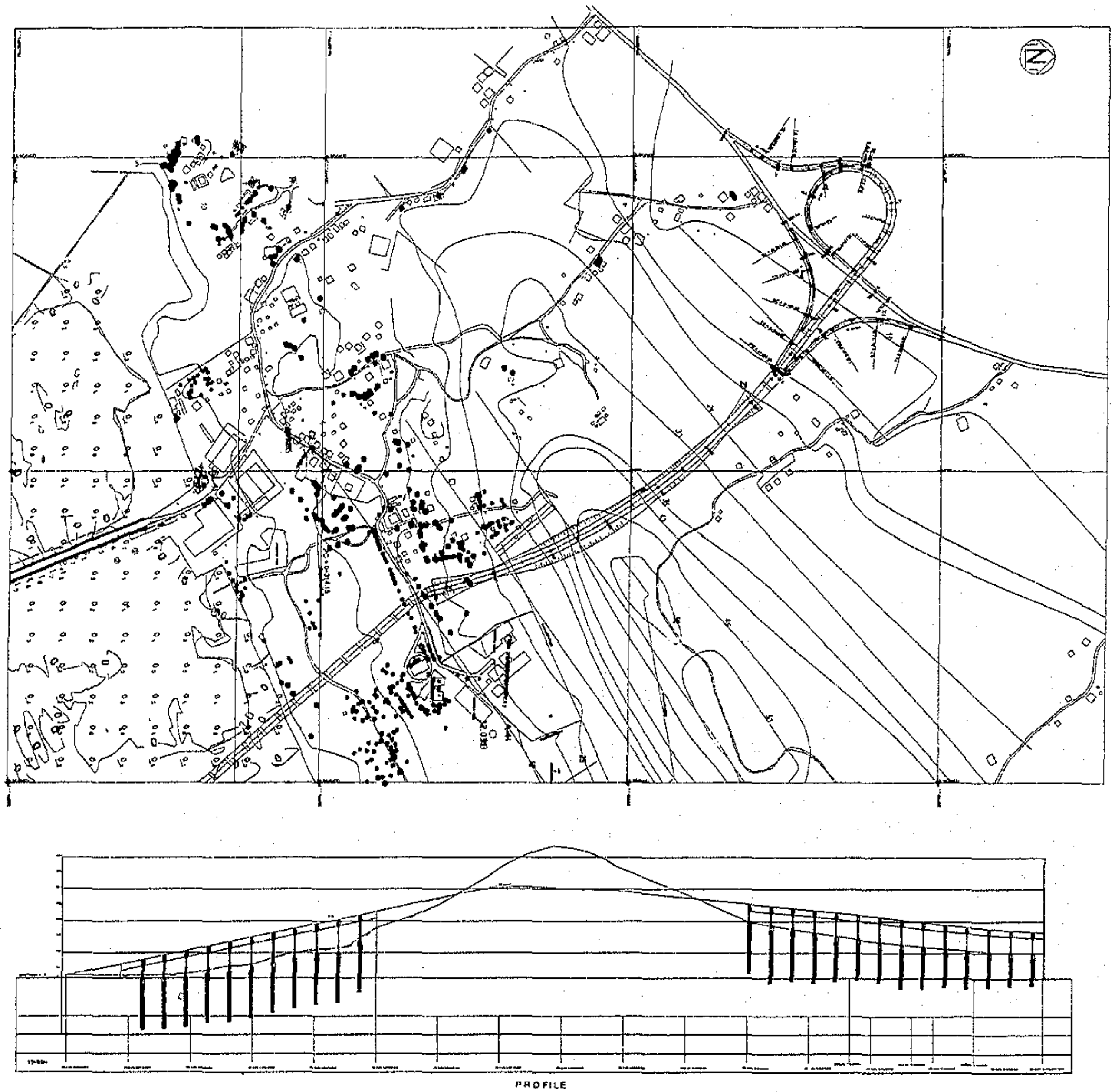


Fig. 2.3.4-1 Access Road Alignment and Longitudinal Section

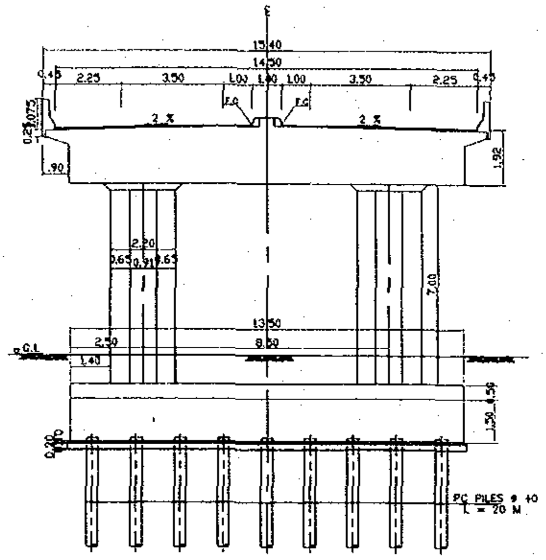


Fig. 2.3.4-2 (1) Access Road - Cross Section of Flyover (Option 1)

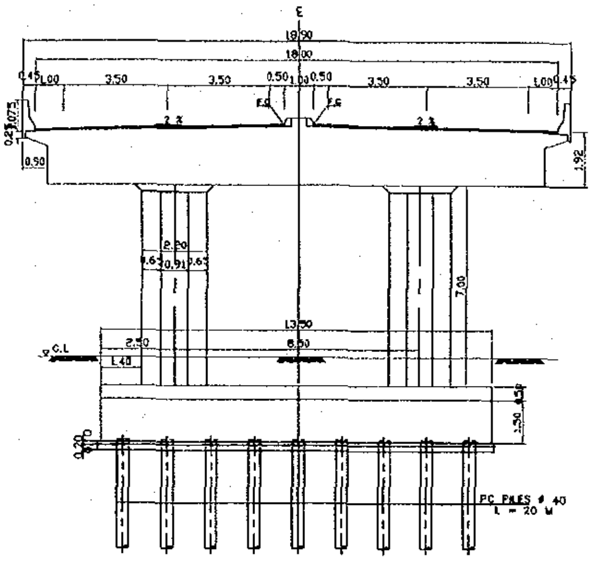


Fig. 2.3.4-2 (2) Access Road - Cross Section of Flyover (Option 2)

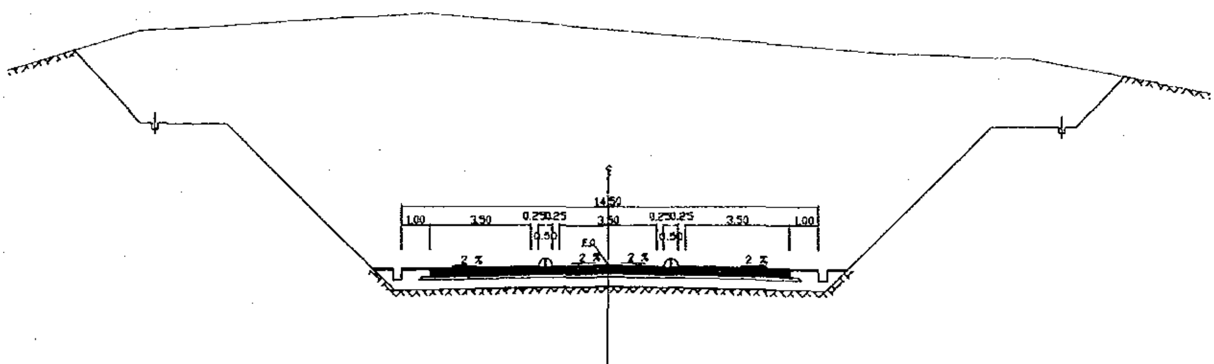


Fig. 2.3.4-2 (3) Access Road - Cross Section of Excavated Area

The cutting width on the hilly parts should be reserved for 4 lanes portion, but for the short-term 2 lanes parts with shoulder on both sides will be paved with concrete. The remaining parts will be reserved for future development.

2) The Concept of Flyover structure

The PC concrete piles (Φ 40 cm, 20 to 15 m long) to be driven up to - 20 m at sea area and -15m on the landside will be used for foundation of pier column. The penetration length of piles is depending on the soil conditions. The depth of piles is estimated based on the site reconnaissance survey of the land area. The footing foundation (6 m x 13 5 m supported by 36 piles for the short term plan) will be constructed around every 30 m interval starting from the newly reclaimed area of the new Cebu port island.

The superstructure of 15.5 m width of the road area for short-term plan will be designed with 8 pieces of PCI-girder (span = 30 m) to be placed for one span and concrete pavement on the slab made on the PC I-girder beam.

2.3.5 Concept of Container Handling Equipment

(1) Container Quay Crane

1) Outline of Specification of Gantry Crane

Quay wall structures of container berth for the New Cebu Port is designed to sustain the following container cranes with the provisions of their foundation:

- Rail Gauge: 30 m
- Overall Weight: 750 tf/unit (approximately)
- Nominal rated capacity: 41 tf under spreader.

Outline specification of quay cranes for Panamax size container vessels is planned with the following dimension. The outline of the planned quay crane is shown in Fig. 2.3.5-1.

Span	30.0 m
Outreach from sea-side rail center	Min. 37.5 m
Back reach from land-side rail center	Min. 11.0 m
Lift: Total:	Min. 37.0 m
Above rail level	Min. 26.0m
Below rail level	Min. 11.0 m
Max. boom height above rail	48.90 m
Overall width	Max. 27.0 m (Bumper free)
Power supply by electricity:	A.C. 6,000 V, 50 Hz, 3 Phase
Hoisting Capacity	40.0 ton
Approx. Working speed	5 m/min
Main hoist with full load	53 m/min
Main hoist with unload	128 m/min

Trolley Travel	153 m/min
Gantry Travel	45 m/min
Boom Hoist	5 m/one way

(2) RTG Crane

1) Outline of Specification

The RTG is planned to have the space of 4 stack plus 1 over pass, 6 rows plus 1 trailer lane, with the following specification: The outline of RTG is shown in Fig. 2.3.5-2.

- Auto-steering system
- Anti-sway control system
- Spreader skew adjusting device
- 90-degree steering for changing traveling lane
- Monitoring system

Rated load (under the spreader):		40.6 Metric Tons
Type of spreader		20 ft/40 ft telescopic spreader
Span:		23.5 m
Lift	- Lowest:	GL + 0 m
	- Highest:	GL+ Min. 15.2 m (9 ft -6 inch container)
Wheel base:		Min. 6.4 m
Overall width:		Max. 12.2 m
Number of gantry wheels:		4 tires/corner (total 16 wheels)
Hoist: Rated load under spreader:		21 m/min
No load under spreader		52 m/min
Trolley traverse		75 m/min
Gantry travel		135 m/min
Power supply		Diesel engine electric power generator on the crane

2) Load of RTG (Rubber Tired Gantry Crane)

The load of the planned RTG (Rubber Tired Gantry Crane) is as follows:

Conditions		Wheel Load (P)
With Rated Load	Static	Pv max = 26 t
(wind 15m/s condition)	During Acceleration	Pv max = 32 t
With No Load	Static	Pv max = 18 t
	Acceleration	Pv max = 21 t

Dynamic Coefficient = 1.2 shall be multiplied to the static load

(3) Load of Container for Container Yard

The weight of the containers of the following will be taken as 4 stacking containers weight. The empty container will be stacked less than 8 tiers height.

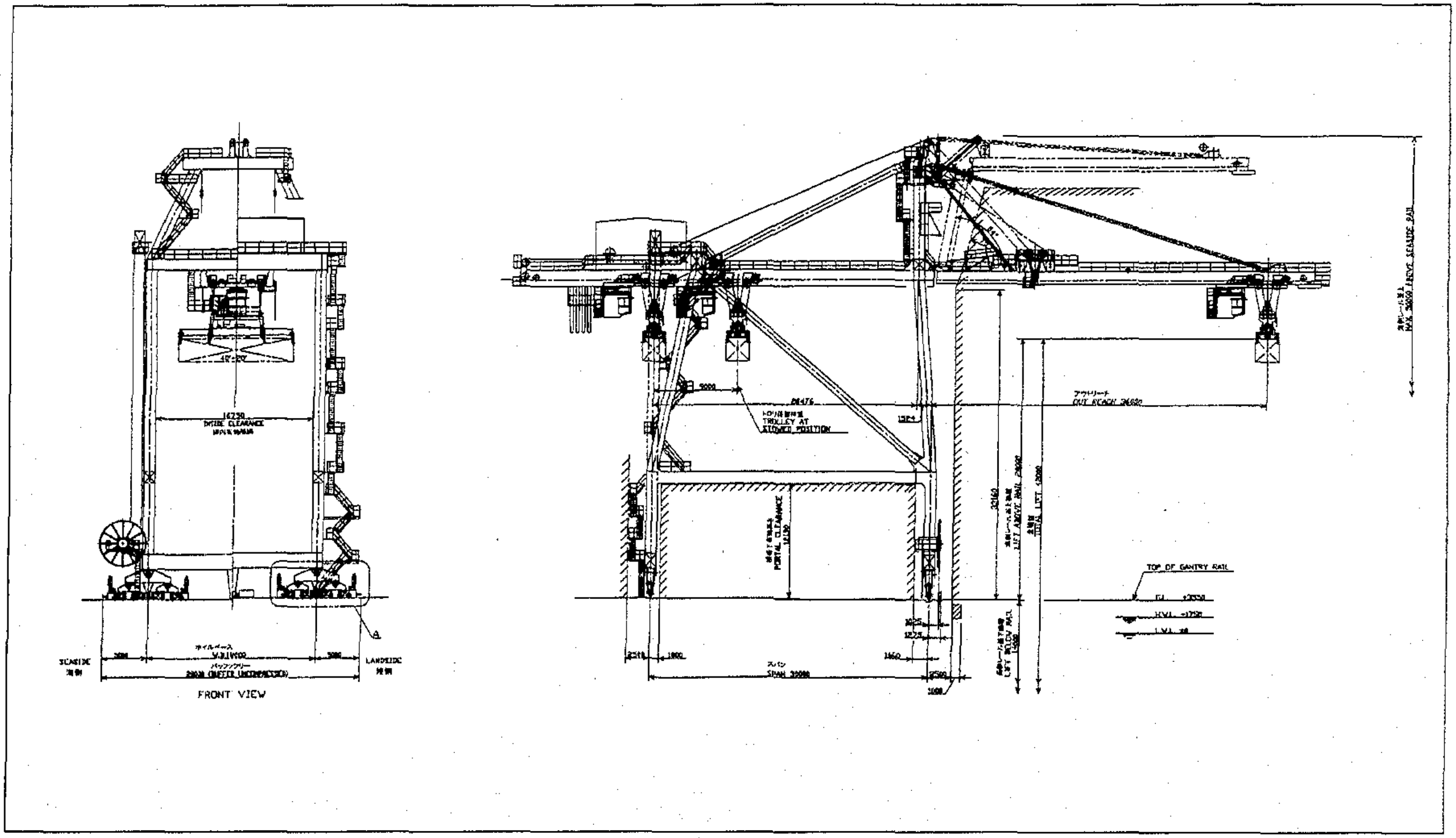


Fig. 2.3.5-1 Typical Sections of Quay Gantry Crane

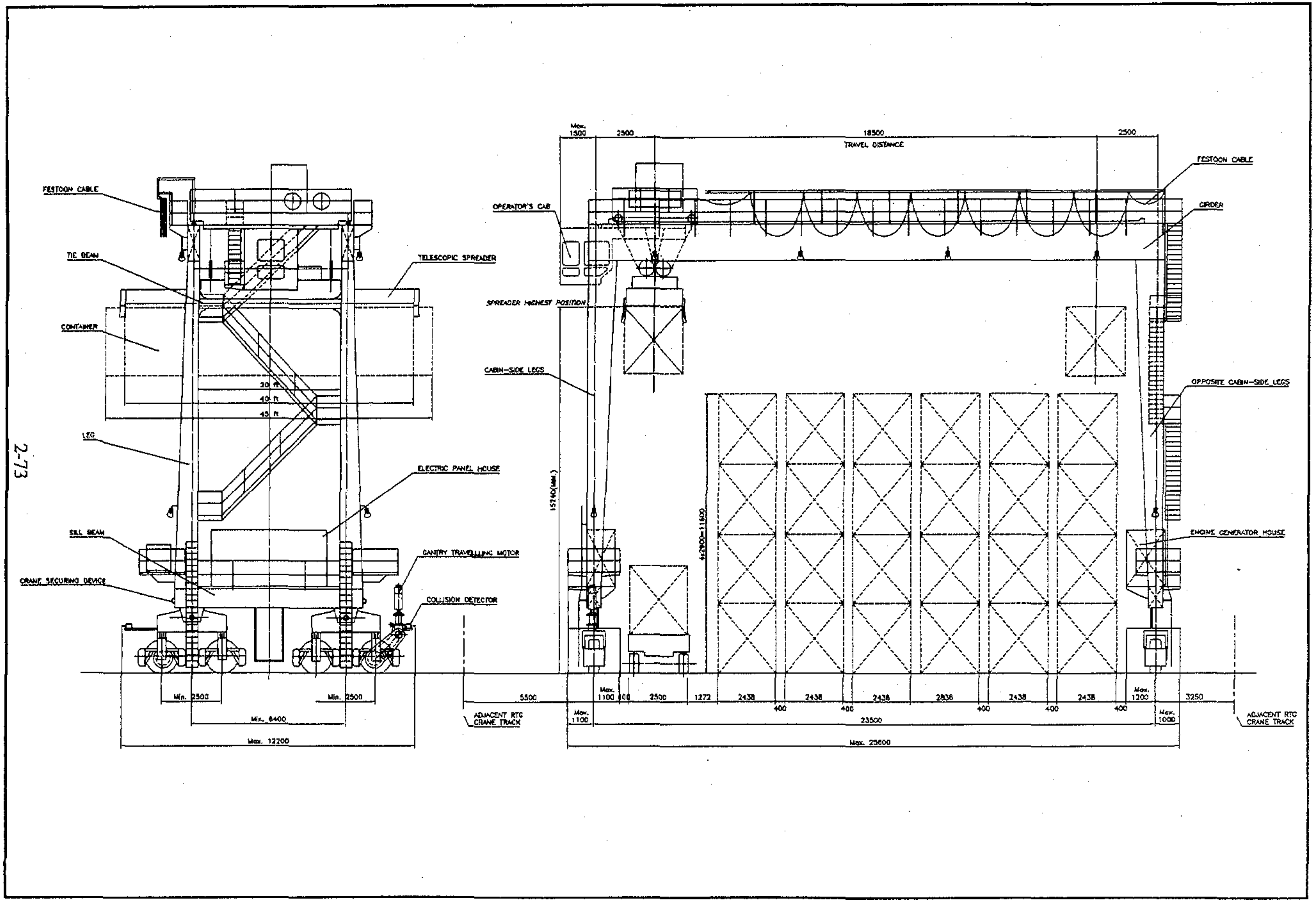


Fig. 2.3.5-2 Typical Sections of RTG Crane

Container Box Size	Weight per box
45 ft	Max. 30.5 ton (empty 4.7 t)
40 ft	Max. 30.5 ton (empty 4.2 t)
20 ft	Max. 25.0 ton (empty 2.2 t)

2.4 Cost Estimation for Short Term Plans

2.4.1 Financial Source and Executing Body

In preparing a implementation program and cost estimation, it is assumed that majority of construction of the new Cebu port and a part of the rehabilitation works in Cebu Baseport will be undertaken with ODA fund while the rest of the works may be executed either by CPA or private operators with their own financial sources or local funds. More detail discussions on investment plan are described in other sections. The financial sources and the executing bodies are assumed as shown in Table 2.4.1-1.

Table 2.4.1-1 Financial Sources and Executing Bodies

Description	Financial Source	Executing Body
The New Cebu Port		
Civil Works, Buildings , Quay Gantries	ODA	CPA
Cargo Handling Equipment except for Quay Gantry	Private Operator(s)	Private Operator(s)
Cebu Baseport		
Rehabilitation/Expansion of Berth 8 - 16, 21 - 25, 28 - 30 Pier 1, 2, 3	CPA/ Local Fund/ ODA	CPA
Passenger Terminal, Open Yard	Private Company(s)	Private Company(s)

2.4.2 Basis of Estimates and Exchange Rate

Cost estimates are based on the current market prices in June 2001, of materials, fuel, labor rates and equipment rates prevailing in Cebu and other regions inside the country.

- The cost estimated for each item will comprise a foreign currency portion and a local currency portion computed in Philippine Pesos.

- In this cost estimate, the average exchange rate of June 2001 is used:

US$ 1.00 = 52.5 Pesos = 125 Yen, 1 Peso = 2.38 Yen

2.4.3 Estimate of Project Cost

Summary of the project cost is shown below.

Table 2.4.3-1 Major Work Volume and Preliminary Cost Estimate of Cebu Baseport

Description	Quantity	Local (Million Pesos)	Foreign (Million Pesos)	Total (Million Pesos)	Note
Rehabilitation & Extension of Berth 8-10	354m	63.1	147.4	210.5	CPA's Plan
RORO Berth 10 - 12	301 m	53.7	125.3	179.0	CPA's Plan
RORO Berth 13 - 14	240 m	42.8	99.9	142.7	CPA's Plan
RORO Berth 15 - 16	199 m	35.5	82.8	118.4	CPA's Plan
Passenger Terminal for Super Ferry	3,500 m^2	49.0	73.5	122.5	Private Company
Boarding Bridge	450 m	5.7	22.7	28.4	Private Company
Passenger Terminal A for RORO	2,800 m^2	39.2	58.8	98.0	Private Company
Passenger Terminal B for RORO	2,800 m^2	39.2	58.8	98.0	Private Company
Container Yard	60,000 m^2	46.9	187.6	234.5	Private Company
Rehabilitation of Pier 1	313 m	63.8	148.9	212.7	Proposed
Rehabilitation of Pier 2	5,000 m^2	16.6	38.7	55.2	CPA's Plan
Rehabilitation of Pier 3	5,000 m^2	16.6	38.7	55.2	Proposed
Building and Berthing for Fast Craft (Berth 18 - 19)	2,800 m^2	33.6	78.4	112.0	Private Company
Expansion of Berth 21-22	260 m	52.3	121.9	174.2	Proposed
Expansion of Berth 24-25	250 m	50.3	117.3	167.5	Proposed
Rehabilitation of Fendering System (Berth 28 - 30)	371 m	1.6	3.8	5.4	CPA's Plan
Rehabilitation of Berth 28 - 30	371 m	6.4	14.9	21.2	CPA's Plan
Navigation Aids	sum	0.9	16.1	17.0	Proposed
Total CPA's Plan		**219.7**	**512.7**	**732.5**	
Total Proposed		**183.8**	**442.9**	**626.7**	
Total Private Company		**213.6**	**479.8**	**693.3**	
Total Construction		**617.1**	**1,435.4**	**2,052.5**	
Engineering Cost	7 %	47.4	96.3	143.7	
Contingency	10 %	66.4	153.2	219.6	
VAT	10 %	241.6	0	241.6	
Grand Total		**972.5**	**1,684.8**	**2,657.3**	

Note: CPA plan : CPA has already programmed to execute
Proposed : The project proposed by this study
Private Company : The projects which is already planned or should be executed by a private company

Table 2.4.3-2 Major Work Volume and Preliminary Cost for New Cebu Port (Phase 1)

Description	Quantity	Local (Million Pesos)	Foreign (Million Pesos)	Total (Million Pesos)	Note
1. Civil Works					
Dredging	130,000 m^3				
Container Berth (Depth -12m)	600 m				
General Cargo Berth (Depth -10m)	190 m	**961.3**	**2,307.6**	**3,269.0**	CPA
Reclamation	1,300,000 m^3				
Yard Pavement	250,000 m^2				
Reefer Container Yard	648 TEU				
2. Utilities					
Power Supply					
Lighting System (Exterior)					
Telecommunications		**106.5**	**216.4**	**322.8**	CPA
Water Supply, Sewage, Firefighting					
Environmental Treatment Facilities					
3. Buildings					
Terminal Building	4,900 m^2	**149.0**	**265.7**	**414.7**	CPA
Gate	13 lane				
Seamen's Club & Duty Free Shop	2,000 m^2				
CFS	3,200 m^2	**73.7**	**145.3**	**219.0**	Operator
Maintenance Shop	900 m^2				
Conventional Berth Cargo Shed	2,100 m^2				
4. Access Road					
Access Road	1,500 m	**92.7**	**169.8**	**262.5**	CPA
Causeway	300 m				
5. Vessel Support					
Vessel Traffic Control System	Sum	**1.0**	**119.0**	**120.0**	CPA
Navigation Aids	Sum				
6. Cargo Handling Equipment (CPA)		**150.0**	**1,350.0**	**1,500.0**	CPA
Quay Gantry Crane	5 nr				
7. Cargo Handling Equipment (Operator)					
Rubber Tired Transfer Crane	14 nr				
Tractor Head (for yard)	33 nr				
Chassis (20' - 40')	40 nr	**122.1**	**1,098.5**	**1,220.5**	Operator
Forklift Truck	14 nr				
Computer System	1 nr				
8. Other					
Land	40,000 m^2	**85.1**	**0**	**85.1**	CPA
Mangrove	30,000 m^2				
Relocation	sum				
Total CPA		**1,545.6**	**4,428.4**	**5,974.1**	
Total Private Operator		**122.1**	**1,098.5**	**1,220.5**	
Total		**1,667.7**	**5,526.9**	**7,194.6**	
Engineering Cost		164.2	333.4	497.7	
Contingency (10%)		178.3	590.9	769.2	
VAT (10%)		846.1	0	846.1	
Grand Total		**2,856.4**	**6,451.2**	**9,307.6**	

2.4.4 Composition of Cost

The estimated costs of construction works are further divided into four cost components, i.e. material cost, equipment cost, labor cost (unskilled labor cost) and others (overhead, profit, etc). The composition of the cost is shown in Table 2.4.4-1.

Table 2.4.4-1 Composition of Cost

Description	Material (%)	Equipment (%)	Labor (unskilled labor) (%)	Others (overhead, profit, etc) (%)
Civil Works	63	12	3 (1.5)	22
Utilities	54	4	20 (10)	22
Buildings	54	4	20 (10)	22
Access Road	59	12	7 (4)	22
Vessel Support	100	-	-	-
Cargo Handling Equipment	100	-	-	-
Other	-	-	-	100
Total	74	7	4 (2)	15