2.6 Master Plan of Toledo Port

2.6.1 Current Situation of Toledo Port

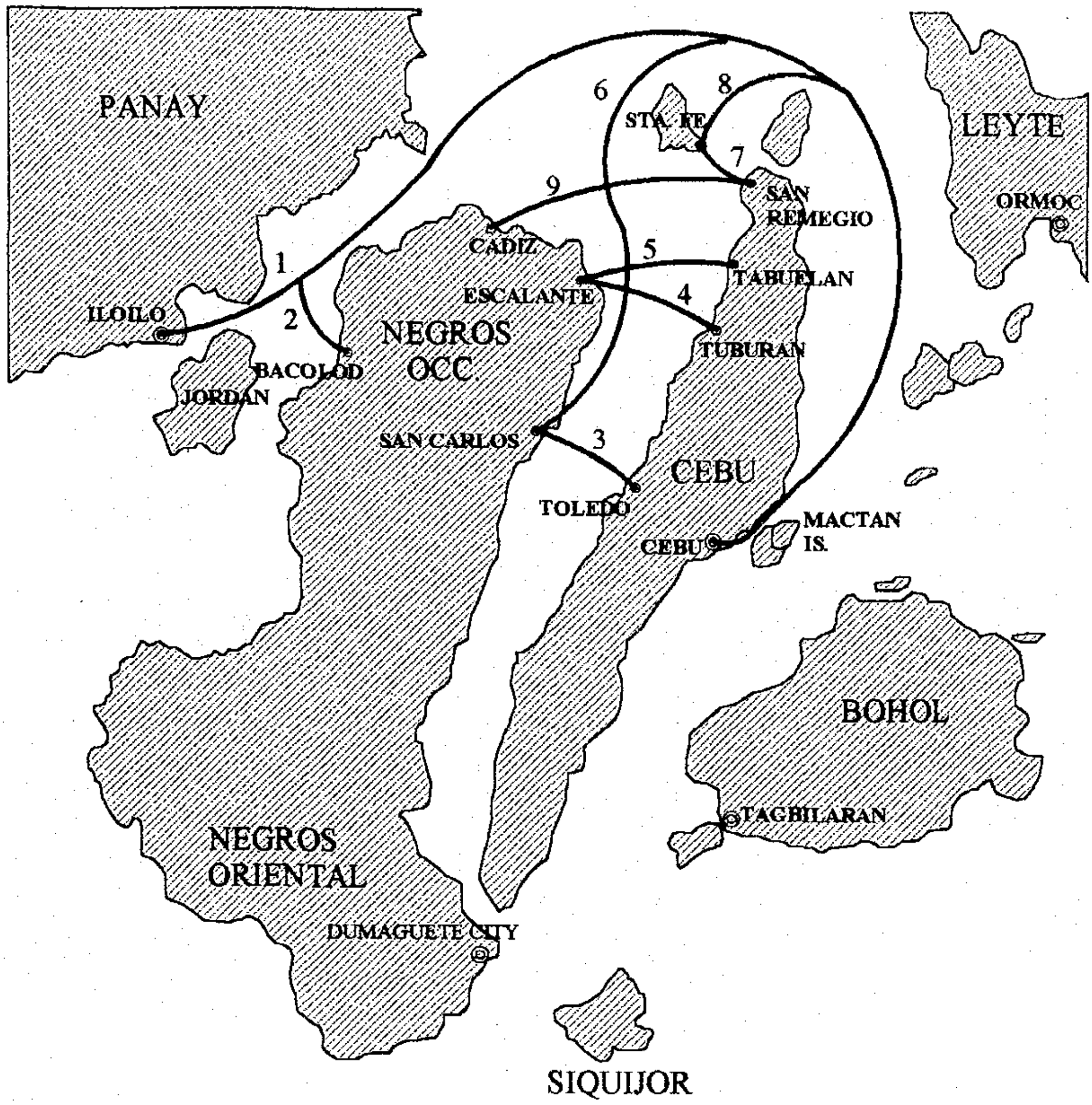
(1) Status of Toledo Port and Issues

Toledo City is located 50km west of Cebu City. However, the presence of mountains between them makes road access difficult, thus, physical distribution is not prosperous. San Carlos, the third largest city of Negros, lies on the opposite shore. San Carlos used to brag of its prosperous sugar mills but was affected with the Philippine sugar crises leading to the closure of all the mills. As a result, San Carlos lost its economic vibrancy.

Presently, Toledo Port serves as the handling port of in-bound and out-bound cargo of the factories within its vicinity. It also serves as the port where passengers are ferried to and from San Carlos, where its shoreline faces Toledo City.

There are three courses of transportation between Bacolod City, Negros, and Cebu City—the direct sea route, the straight course and the detour course. The direct sea route is only for ships while the straight course and the detour course have land trips prior to sea travel. The straight course passes Toledo-San Carlos while the detour course uses RORO vessels to cross Escalante and Tuburan. The direct sea route is a Bacolod to Cebu course. Among these courses, the detour course requires the shortest time travel and thus, most vehicles use the Escalante-Tuburan course passing through the coastal road. Passengers usually use the straight course and the time-consuming direct sea course. With the impending construction of an access road cutting through the mountains that separate Bacolod and San Carlos, the straight course will have the shortest distance in the future and thus, port users are expected to increase. (Note: Presently, Tuburan Port is closed due to damages and is presently being renovated. Tuburan port is recognized as one of Cebu`s regular ports. It has a bus terminal and a regular course connecting Escalante to Cebu Province. Although Tabuelan Port is operational, it cannot supplant the present function and role of the Tuburan.).

The number of trips between Cebu and Iloilo are 10 trips per week while those between Cebu and Bacolod numbered 3 trips per week. This shows that there are relatively more users coming to and from Iloilo.



Destination	Distance
1. Cebu - Iloilo	176.0 n.m.
2. Cebu - Bacolod	174.0 n.m.
3. Toledo - San Carlos	14.2 n.m.
4. Tuburan - Escalante	17.9 n.m.
5. Tabuelan - Escalante	19.4 n.m.
6. Cebu - San Carlos	126.1 n.m.
7. Hagnaya - Sta. Fe	10.2 n.m.
8. Cebu - Sta. Fe	80.3 n.m.
9. Hagnaya - Cadiz	39.2 n.m.

Fig. 2.6.1-1 Relevant Marine Routes for Toledo-San Carlos and San Remigio-Sta. Fe

Table 2.6.1-1 Traveling Time: Land Route – Sea Route – Land Route

(as of February 2001)

Route and Traveling hours	On Land	On Sea	On Land
Direct Sea Route 12h		Cebu – Bacolod (174 n.m.) 12h(Night trip)	
Straight Route 4h30m(coastal 6h30m)+waiting	Cebu – Toledo via Manipis (50km) 1h30m	Toledo – SanCarlos (14.2 n.m.) 1h30m	San Carlos – Bacolod (60km&coastal148km) 1h30m (coastal 3h30m)
Detour Route 7h15m+waiting	Cebu – Tabuelan (87km) 2h45m	Tabuelan – Escalante (17.9 n.m.) 2h	Escalante – Bacolod (110km) 2h30m

Table 2.6.1-2 Sailing schedules from Cebu to Bacolod/Iloilo

(as of February 2001)

Course	Vessel	Frequency	Company
Cebu – Bacolod	Asia Brunei (GRT964,LOA57,SR,CP)	Tu.,Th.,Sat.	Trans Asia Shipping Lines
Cebu – Iloilo	Asia Malaysia (GRT571,LOA72,SR,CP)	Daily	Trans Asia Shipping Lines
Cebu – Iloilo	Filipinas Iloilo (GRT4159,LOA81,SR,CP)	Tu,.Th.,Sat.	Cokaliong Shipping Lines

Source : Home Page of SKYCABLE

(2) Development Potential

Toledo Port is part of the main transport route in the Visayas region. If developed, Toledo port can be more advantageous than the Cebu Port because of its strategic location in which it can facilitate exchanges with neighboring islands, especially the provinces located north of Cebu such as Negros and Panay, among others.

A Japanese ship-building firm is located in the town of Balamban, a neighboring town adjacent to Toledo on the north. Thus, this area also has bigger potential for development because of the existence of favorable factors for heavy industrial development. Moreover, a power plant is located in the hinterland area of the port of Toledo. This power plant has a wharf used exclusively for the unloading of coal. Beside the power plant is a fertilizer factory—the supply base of adjacent islands. Therefore, Toledo City has the potential to be the regional supply center for all commodities in the future.

2.6.2 Development Policy of Toledo Port

According to the JICA Study implemented in 1992 for the Nationwide Roll-On Roll-Off Transport System, the Toledo-San Carlos route is the most appropriate route for the introduction of a RORO System. Thus, following the JICA study recommendation, the RORO route was materialized and is presently contributing to the improvement of transportation between Cebu Island and Negros.

In the plan, Toledo Port was designed to have a depth of 5.5m, but the design depth was reset to 6m to accommodate the berthing of cargo ships. San Carlos port, on the other hand, has a water depth of 7m and is suitable for the berthing of cargo vessels.

Furthermore, the Philippine government is planning to construct a passenger terminal and parking space for waiting passengers and vehicles. This plan is considered as a priority since the Philippine government is putting prime importance on the systematization of the vessel scheduling system. The plan is being considered vis-à-vis the annual average demand. Countermeasures for peak hour traffic shall be introduced including, among others, increasing the number of trips and the use of other nearby routes; thereby, avoiding excessive facility investment.

The function of Toledo Port is to provide smooth transportation between the islands of Cebu and Negros. To provide a smooth and efficient transportation between the two islands, a minimum waiting period for the scheduled trips should be actualized. Furthermore, rather than accommodating large ships that requires great depths, Toledo port could be more effective if it provides round trip services using medium-scale vessels. Necessary facilities include a waiting facility for people and vehicles and facilities for loading and unloading. For the handling of cargo, a storage place should be provided but no loading facilities will be made available.

Concerning required depth of the berth, it may change corresponding to the trend of vessel size that calls the port. Therefore the type of structure of the cargo berth is designed as available type that can dig deeply in the future.

2.6.3 Required Scale of Facilities

(1) Future Vessel Type

The standard vessel type in the present Cebu port and in neighboring ports will be the 2000-ton class ferry (800 passengers, 84 units passenger automobiles). The 200-passenger vessel will be the standard for fast ferry while the 2000-ton type will be the standard for the conventional cargo.

Table 2.6.3-1 Dimension and Capacity of Ferryboat

Size (GRT)	Dimension (m) LOAxBreadthxDraft	Max.Speed (knot)	Passenger	Vehicle (Passenger Car)
3000	90x17.5x3	20	1000	108
2000	80x17.5x3	20	800	84

Source:Study Team

Table 2.6.3-2 Dimension and Capacity of Fast Ferry

Dimension (m) LOAxBreadthxDraft	Max.Speed (knot)	Passenger
30x14x3	40	200

Table 2.6.3-3 Dimension and Capacity of General Cargo Vessel

Cargo Vassel Size by GRT	Dimension LOA(m)xBreadth(m)xDraft(m)
2000	83x13.1x4.9
1000	67x10.9x3.9
500	51x9.0x3.3

Source:Japanese Port Engineering Standard

Based on world operating vessel data, designed vessels are available on the second hand market. Table 2.6.3-4 and Fig. 2.6.3-1 show distribution by draft and GRT of ferryboat.

Table 2.6.3-4 Number of Operating Ferries classified by Draft and GRT

(total 549)

		Draft		
		0－3 m	3－5 m	5－9 m
GRT	0 – 5000 ton	**116**	**164**	**215**
		21 %	30 %	39 %
	5000- 60000 ton	**6**	**34**	**14**
		1 %	6 %	3 %

Source : Fairplay 2000

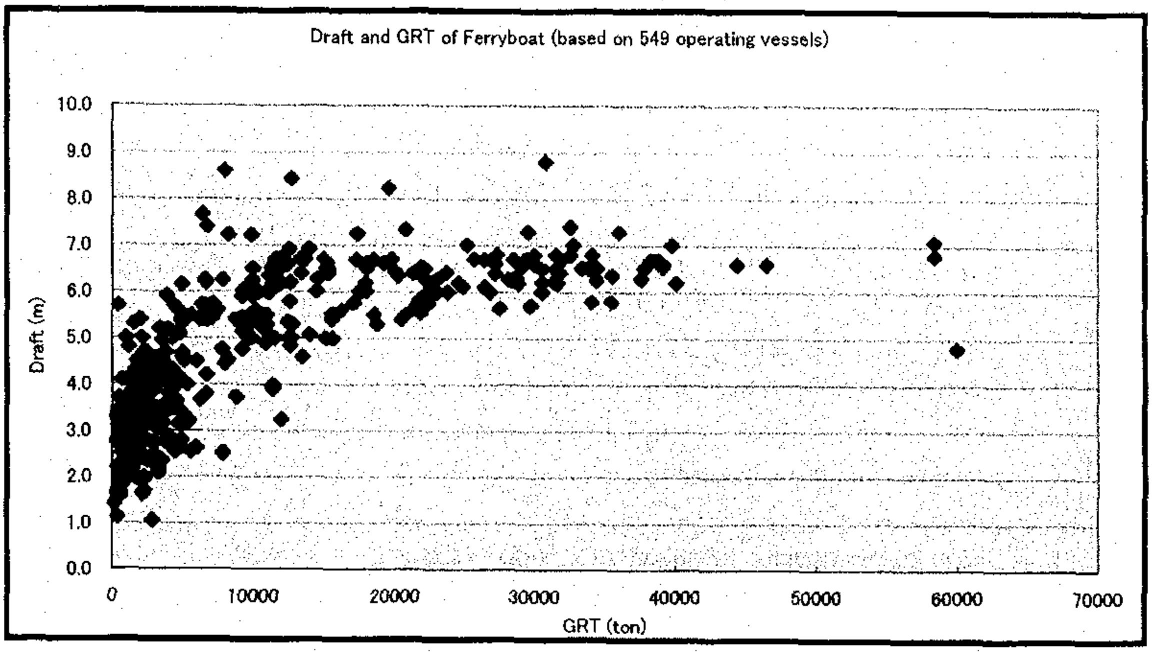


Figure 2.6.3-1 Vessel Distribution by Draft and GRT of Ferryboat in the World

(2) Standard Schedule of Voyage

Capacity and speed of the ferryboat are assumed to be at 84 PCU(passenger car unit) with 800 persons at maximum 20 knots. Those of fast ferry are 200 passengers at maximum 40 knots.

Distance between Toledo and San Carlos is 14.2 nautical miles. Therefore, ferryboat needs 60 minutes for one-way sailing and 2 hours for one-way trip. In case of fast ferry, 30 minutes are necessary for one-way sailing and 1 hour for one-way trip. Standard daily number of sailing is set at 8 times per day for ferry and 8 times for fast ferry but this can be extended to 12 times for fast ferry during peak season.

(3) Required Scale of Facilities

A depth of 4m is required for the wharf catering to passenger vessels, such as ferry and fast ferry, while a depth of 6m shall be the standard requirement for the cargo wharf. However, it should be considered to develop the ferry berths up to 6 m deep, if the deeper berth is necessary to accommodate the cargo vessels during the first stage.

Ferry and fast ferry berths will be located in a U-shaped reclamation area while the cargo berths will be parallel to the coast. At the first stage, the U-shaped area will be constructed. One ferry berth will be used by cargo vessels temporarily. Normal operations, as planned, will resume at the final stage of the implementation of the plan.

The following space is required within the port: 6000 square meter area of parking space for passenger automobiles, bus and trucks, and administrative cars; 1000 square meter area passenger terminal for departing and arriving passengers, which includes the ticketing office, shipping company offices, management offices; 1,800 square meter open yard for cargo; 1,800 square meter storage yard; and 500 square meter warehouse.

Required space for parking and terminal is planned based on the following considerations:

Size of passenger car = 2.75 m * 5.0 m

Truck (cargo weight = 8 ton) = 2.75 m * 7 m

Capacity of parking area = Number of loading cars on 2 ships
+ their 30 % for public car for one berth.

Estimated number of passenger car per ferryboat = 85

Space for passenger = 1.2 square meters per passenger

Estimated number of passenger per ship = 270 (ferry), 160 (fast ferry)

(4) Cargo Handling Equipment

Regarding cargo handling equipment at the cargo terminal, typical machine such as forklift will be required for general cargo. Two types of forklift are planned to be installed at the cargo terminal with respective capacities of ten tons and fifteen tons. And a truck with a loading capacity of 10 tons is also necessary for transportation inside the terminal. Those will be purchased corresponding to increasing cargo traffic. If special equipment is required for handling of bulk cargo or heavy one, temporarily that shall be arranged.

2.6.4 Alternative Layout Plan

(1) Alternative Proposals

Three alternative proposals are compared and considered. There can be two possible ways for the vessel course: ships can come alongside the quay in the same direction as the existing pier or ships can come alongside the quay parallel to the coastal line. In the former, there are two directions of harbor development being considered, to the south and to the north.

(2) Evaluation of Alternative Proposals

Three alternatives are evaluated based on such factors as maneuverability, maintenance and operation, construction cost, future expansion, environmental consideration, easiness of implementation, etc.

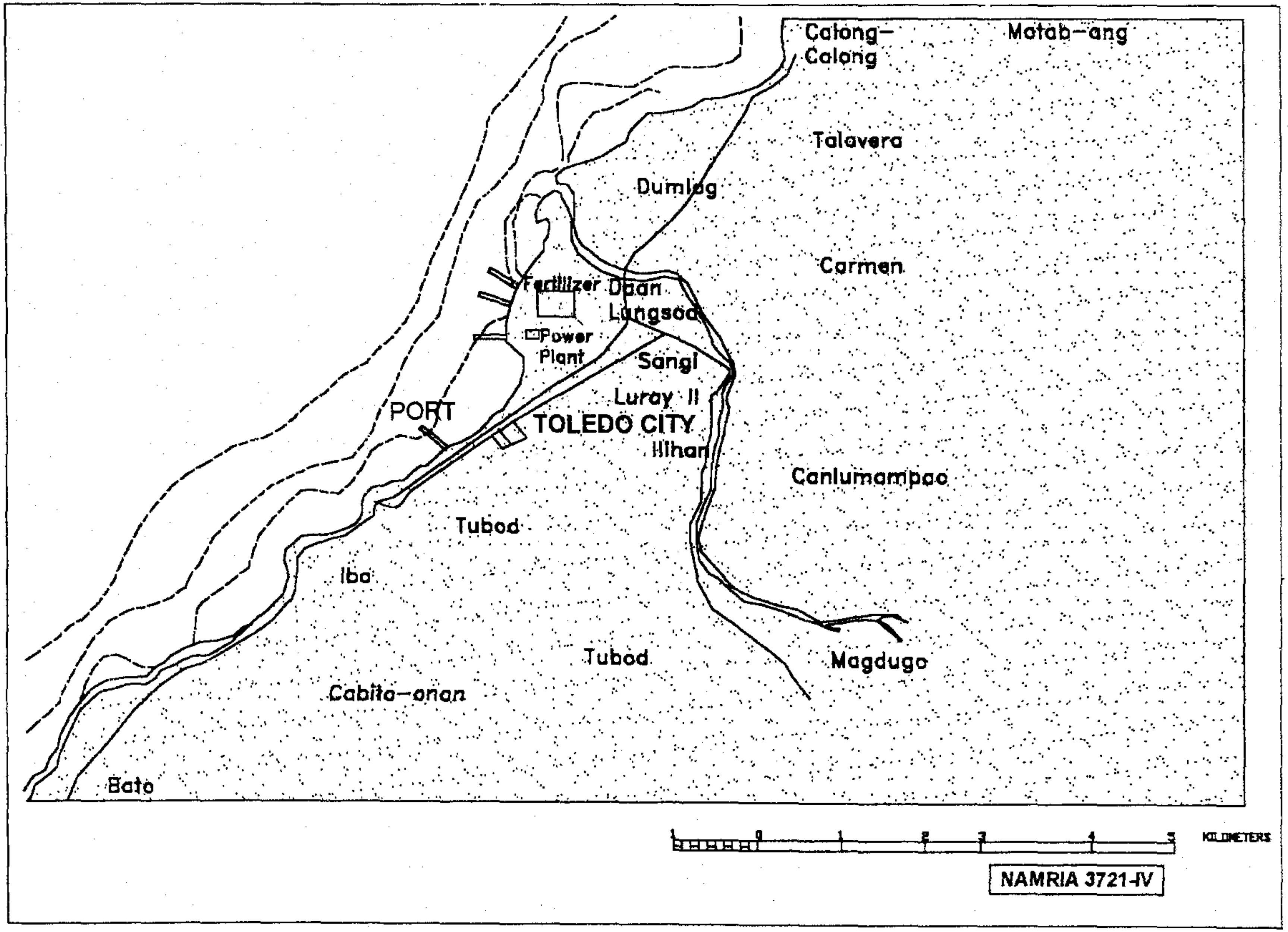


Fig. 2.6.4-1 Map of Toledo City

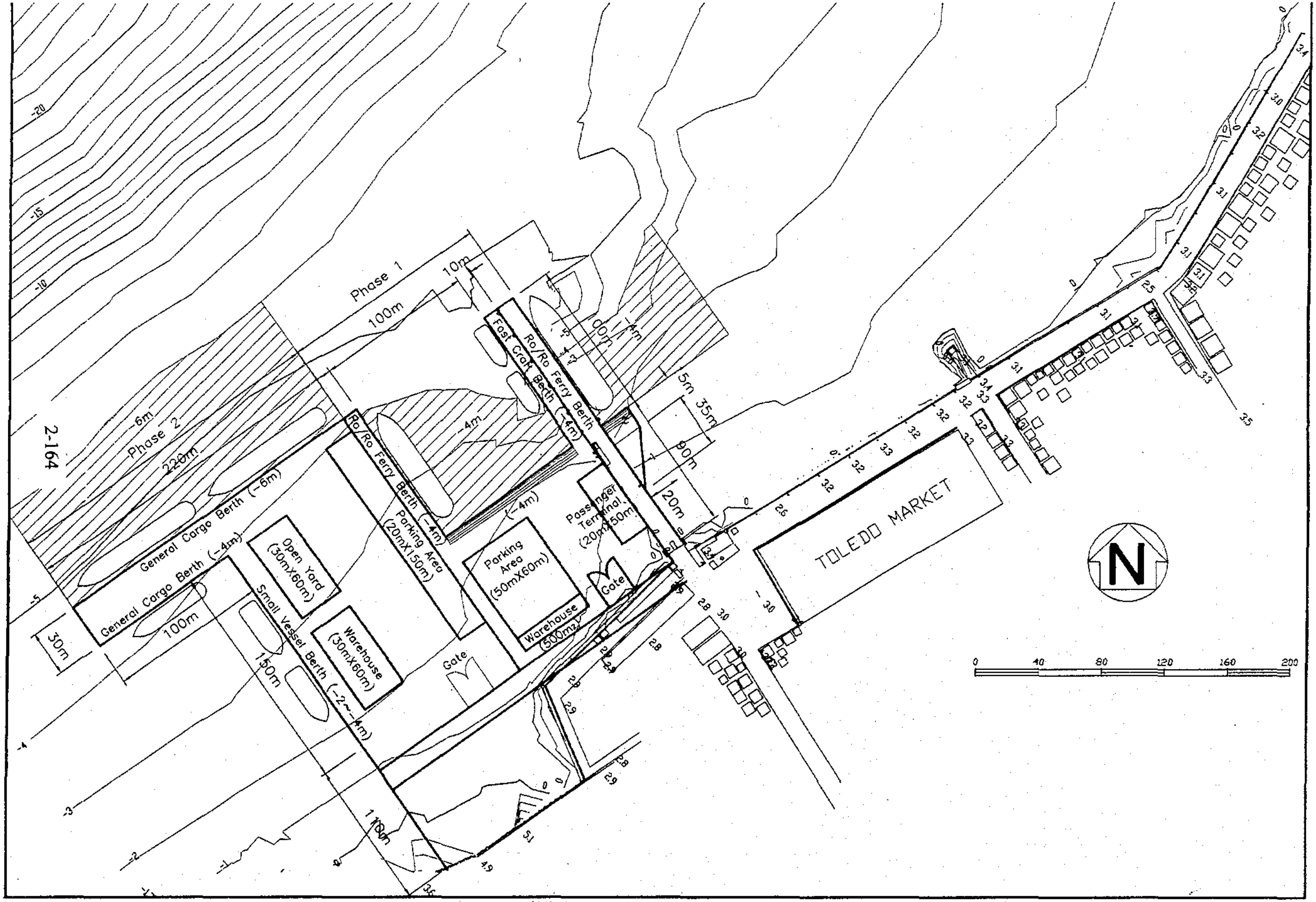


Fig. 2.6.4-2 Toledo Port Master Plan 1

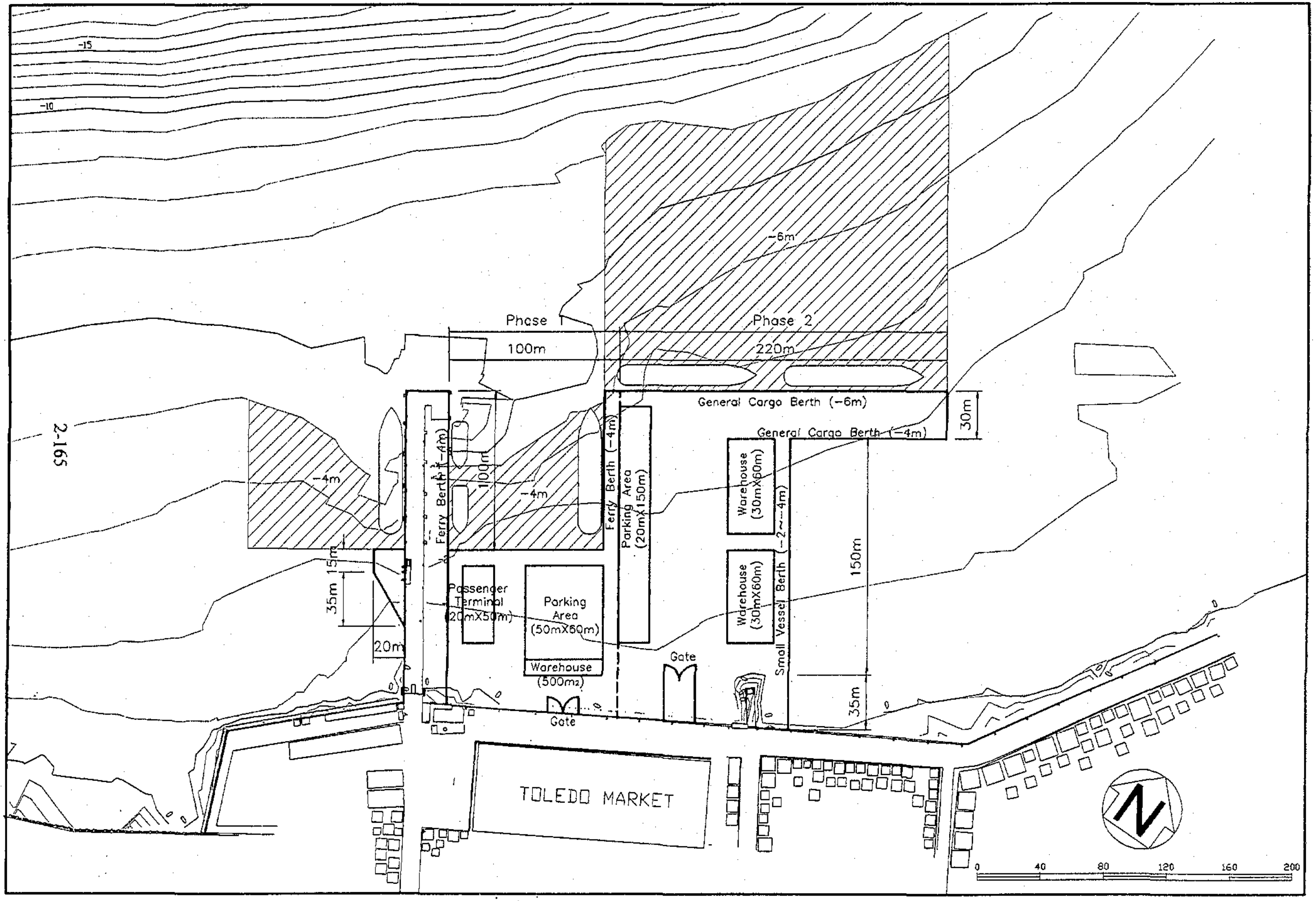


Fig. 2.6.4-3Toledo Port Master Plan 2

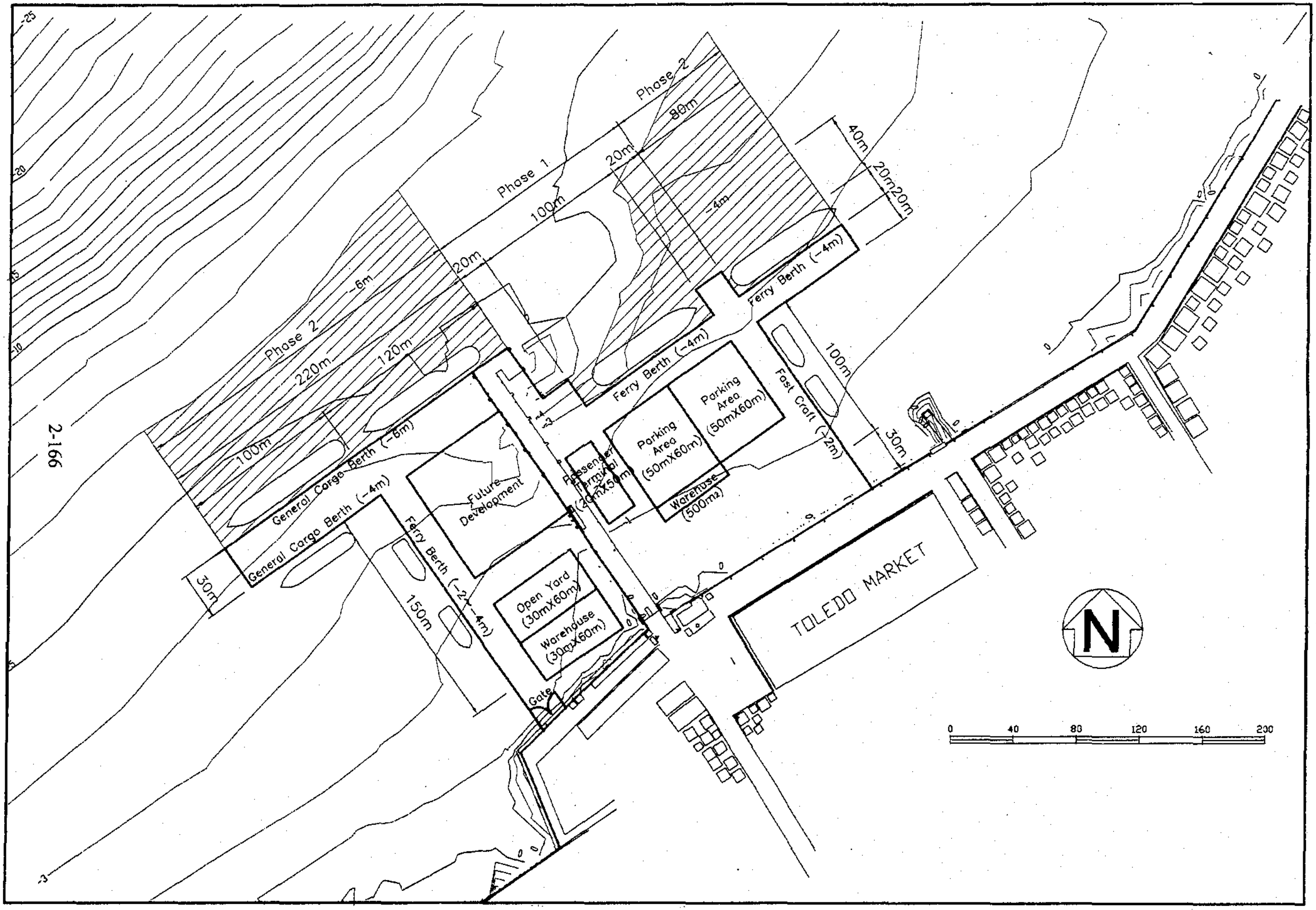


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Fig. 2.6.4-4 Toledo Port Master Plan 3

1) Maneuverability

Direction of approaching vessel alongside quay will be the same as the current practice (i.e. vessel direction is backward).

Maritime service shall stop during strong monsoons and operating vessels shall take refuge while the storm is still present. San Carlos Port is protected from the North-eastern wind while Toledo Port is expected to be safer against the South-western wind.

2) Maintenance and Operation

The size of port area, items to be maintained, and access of major port users are compared.

3) Construction Cost

Volume and level of works are evaluated by cost estimation.

4) Future Expansion

Possibility or restriction of future expansion is assessed.

5) Environmental Consideration

Environmental aspects were evaluated by determining the characteristics of the cargo and the site.

6) Easiness of Implementation

Necessary negotiation and adjustment were pointed out.

7) General Evaluation

The OX system was used in evaluating the three alternatives.

As a result of the evaluation, Plan 1 is recommended as the master plan. (See Table 2.6.4-1)

Table 2.6.4-1 Comparison of Evaluating Items

Alternative Proposal	Plan 1:Southward Development	Plan2:Northward Development	Plan3:Parallel Quay
Maneuverability	X Difficult for Ferry to come alongside quay O Advantageous for countermeasures against southerly winds	X Difficult for Ferry to come alongside quay	O Easy for Ferry to come alongside quay
Maintenance and Operation		O Ease of transport between existing fertilizer factory and the cargo wharf	X The width of the harbor region becomes longer
Construction Cost	- 970 M Peso	- 940 M Peso X additionally fishery pier shall be replaced	- 960 M Peso
Future Expansion	O Possible	O Possible	O Possible
Environmental Consideration	O Existing harbor area O No dangerous and bulk cargo	O Existing harbor area O No dangerous and bulk cargo	O Existing harbor area O No dangerous and bulk cargo
Easiness of Implementation	O Few adjustments vis-à-vis the constructed coastal road	X Much adjustments vis-à-vis the constructed coastal road	
General Evaluation	OOOO (oooοοx-)	O (ooooxxx)	OOO (ooοοx-)

2.6.5 Road Development Plan in the Hinterland

(1) Access Road

This plan is an expansion plan of the present harbor in anticipation of the increase in harbor demand. At present, an access road leading to the present harbor and a parking space for large buses are already existent. There is no need to construct a new access road. Traffic management near the gate leading towards the harbor area needs to be improved.

(2) Need for Development of Cebu-Toledo Road

Presently, the 50km distance between these two cities takes two hours and a half (2 1/2 hours) of travel, with cars traversing unpaved roads. However, based on the distance, it should only take one and a half (1 1/2) hours.

The route improvement connecting Bacolod, Negros Island, and San Carlos is almost complete. The expected result of this improvement is the decrease of travel time of the trips plying Bacolod and Cebu.

2.6.6 Phasing Plan

The main works for expanding the treatment capacity of Toledo Port are as follows:
1) Expansion of the existing berths and construction of new berths.
2) Development of the port area by reclamation for RORO terminal /passenger terminal,
3) Construction of road traffic-related facilities.

RORO ferry and fast craft berths will be located in a U-shaped reclamation area while the cargo berths will be parallel to the coast. The long-term development project is planned to be carried out separately in two phases. At the first phase, the U-shaped area will be constructed. Cargo vessels will use one RORO ferry berth temporarily. Normal operations, as planned, will resume at the second stage of the implementation of the plan. The initial development is expansion of the existing jetty and replacement of the existing RORO ramp in order to improve the vessel maneuvering and vehicle movement.

Table 2.6.6-1 Phasing Plan of Toledo Port

Works	Short-term (Phase 1)	Long-term (Phase 2)
Total dredging works	20,000 m3	44,000 m3
Total reclamation works	60,000 m3	180,000 m3
Berthing Facilities	2 unit of RORO berth (temporally conventional vessel use) Fast craft berth	2 unit of RORO berth Fast craft berth General cargo berth 320m Small vessel berth 150 m
Revetment	280 m	250 m
Total Pavement works	12,500 m2	38,000 m2
Access Road	Not required	Not required
Passenger Terminal Building	500 m2	1,000 m2
Warehouse	500 m2	2,300m2
Utility Supply	Water, electricity	Water, electricity
Land acquisition	Not required	Not required

2.7 Master Plan of the New San Remigio Port

2.7.1 Current Situation of existing Hagnaya Port and New Port

(1) Status of New San Remigio Port and Issues

The Hagnaya port, located in the northwestern part of Cebu, has a depth of less than 2m along its channel. Consequently, ferries can only come along its quay during high tide. Passengers with cargo do not use this route because of the existing port conditions of Hagnaya.

The Hagnaya port is the main port infrastructure of the 110,000 inhabitants of Bantayan Island, who rely on Cebu Island for its social and economic activities. The port of Hagnaya, thus, needs to be improved since it is within the course connecting mainland Cebu and Bantayan.

Table 2.7.1-1 Traveling Time by Route (as of February 2001)

Course and Traveling Time	Land	Sea
Maritime Course 7h	- -	Cebu – Sta.Fe (80.3 n.m.) 7h (Night trip)
Ferry Course 4h30m-5h+waiting	Cebu – San Remigio(110km) 2h30m	San Remigio – Sta. Fe (10.2 n.m.) 2h-2h30m

Source: JICA Study Team

(2) Potential for Development

A satisfactory harbor facility is non-existent in Hagnaya despite the relatively large population it can potentially support. Aside from the 110,000 inhabitants of Bantayan Island, the hinterland area of Hagnaya Port has a population of 230,000.

Rather than developing a large harbor in the area, the development of a local harbor facility is more appropriate and will be an access base to the island of Bantayan. It will also be a point for deepening the exchanges among other local ports since Hagnaya is only a short distance away from the provinces of Leyte, Negros, Panay, Masbate, and Samar. If enhanced, the port of Hagnaya could help improve the regional economy and enhance the people's standard of living.

2.7.2 Development Policy of New San Remigio Port

Harbor development in the region should first consider the expansion of the existing harbor. Dredging works of about 2.5 km from the mouth of Hagnaya Bay is necessary to deepen the harbor to a depth of 4m. Since the scale of construction for the required facilities and the cost for expansion of the existing harbor and the building of new facilities do not greatly differ, the cost of dredging works and the cost of maintenance and management are the determining factors favoring a new port construction as part of the Master Plan.

In the Master Plan level, the construction of two berths for the fast ferry and another two berths for the ferry is necessary in order to satisfy the volume of the cargoes loaded on trucks and the number of passengers according to the demand forecast. Two piers are planned for construction. Each pier will have a fast ferry berth and a ferry berth on both sides of the pier.

2.7.3 Required Scale of Facilities

(1) Future Vessel Types

The 500-ton class ferry (400 passengers, 40 units of vehicles) presently traversing the Toledo – San Carlos route is planned to be the main vessel while for fast ferry, the 70-passenger vessel will be used as the standard vessel.

Table 2.7.3-1 Dimension and Capacity of Ferryboat

Size (GRT)	Dimension (m) LOAxBreadthxDraft	Max.Speed (knot)	Passenger	Vehicle (Passenger Car)
500	50x12x2.5	20	400	40

Source:Study Team

Table 2.7.3-2 Dimension and Capacity of Fast Ferry

Dimension (m) LOAxBreadthxDraft	Max.Speed (knot)	Passenger
26x8x3	40	70

(2) Standard Schedule of Voyage

Capacity and speed of ferryboat are assumed to be at 40 PCUs with 400 persons at maximum 20 knots. Fast ferries will be with 70 passengers at maximum 40 knots.

Distance between San Remigio and Sta. Fe is 10.2 nautical miles. Therefore, ferryboat needs 40 minutes for one-way sailing and 2 hours for one-way trip. In case of fast ferry, 20 minutes are necessary for one-way sailing and 1 hour for one- way trip. Standard daily number of sailings is set at 8 times per day for ferry and 8 times for fast ferry but this can be extended to 12 times for fast ferry during peak seasons. One trip to Masbate and one trip to Negros shall be included in a daily sailing schedule.

(3) Required Scale of Facilities

A depth of 4m is required for the ferry and fast ferry wharf.

Two piers are prepared for two fast ferry and two ferryboats. Initially, one pier for a fast ferry and a ferryboat is set to operate depending on the demand.

The following areas are required within the port: 3,000 square meter area for parking space of passenger cars, buses and trucks; 600 square meter area for the waiting facilities of the departing and arriving passengers, which include the ticketing office, the ship companies offices, and management offices; 600 square meter area for the warehouse (maintenance shop, cargo depository); and 600 square meter area for cargo loading and public parking place.

Required space for parking and terminal is planned based on the following considerations:

Size of passenger car = 2.75 m * 5.0 m
Truck (cargo weight = 8 ton) = 2.75 m * 7 m
Capacity of parking area = Number of loading cars on 2 ships
+ their 30 % for public car for one berth.
Estimated number of passenger car per ferryboat = 40
Space for passenger = 1.2 square meters per passenger
Estimated number of passenger per ship = 190 (ferry), 100 (fast ferry)

(4) Cargo Handling Equipment

Berthing time of a ferry is less than one hour in case of Bantayan route that is the major function of this port. That is short and quick ride on and ride off is necessary. Therefore most of cargoes are loaded on board as a container or a pallet on van truck. But ferry boat service to/from Masbate or Negros islands is infrequent, usually just a few times a week. Therefore sometimes those cargoes are stocked at the port until the next ferry.

Cargo handling equipment is required for goods to/from Masbate and Negros islands in order to transport those goods between the warehouse and a ferry. Two forklifts with capacities of 5 tons and 10 tons are suitable for this operation. Smaller one is required for the first berth and the larger one for the second.

2.7.4 Alternative Layout Plan

(1) Candidate Site for Future Port

Three alternatives are considered for the future port site: the mouth of the bay, the private development area, and the site of the existing port.

It is difficult to find a suitable area for the port on the coast—from the mouth of Hagnaya Bay to the existing Hagnaya Port. Near the mouth, a small area with a coastal length of 165m is available. This is located between a resort hotel and a residential house of an American expatriate. Approximately 500m away from this area, the Hagnaya Bay Development Corporation, a private investor, is starting a port development project and has already partially constructed a causeway. This area has enough coastal length, which could qualify as a candidate site due for Master Plan selection. The third alternative is the expansion of the existing port.

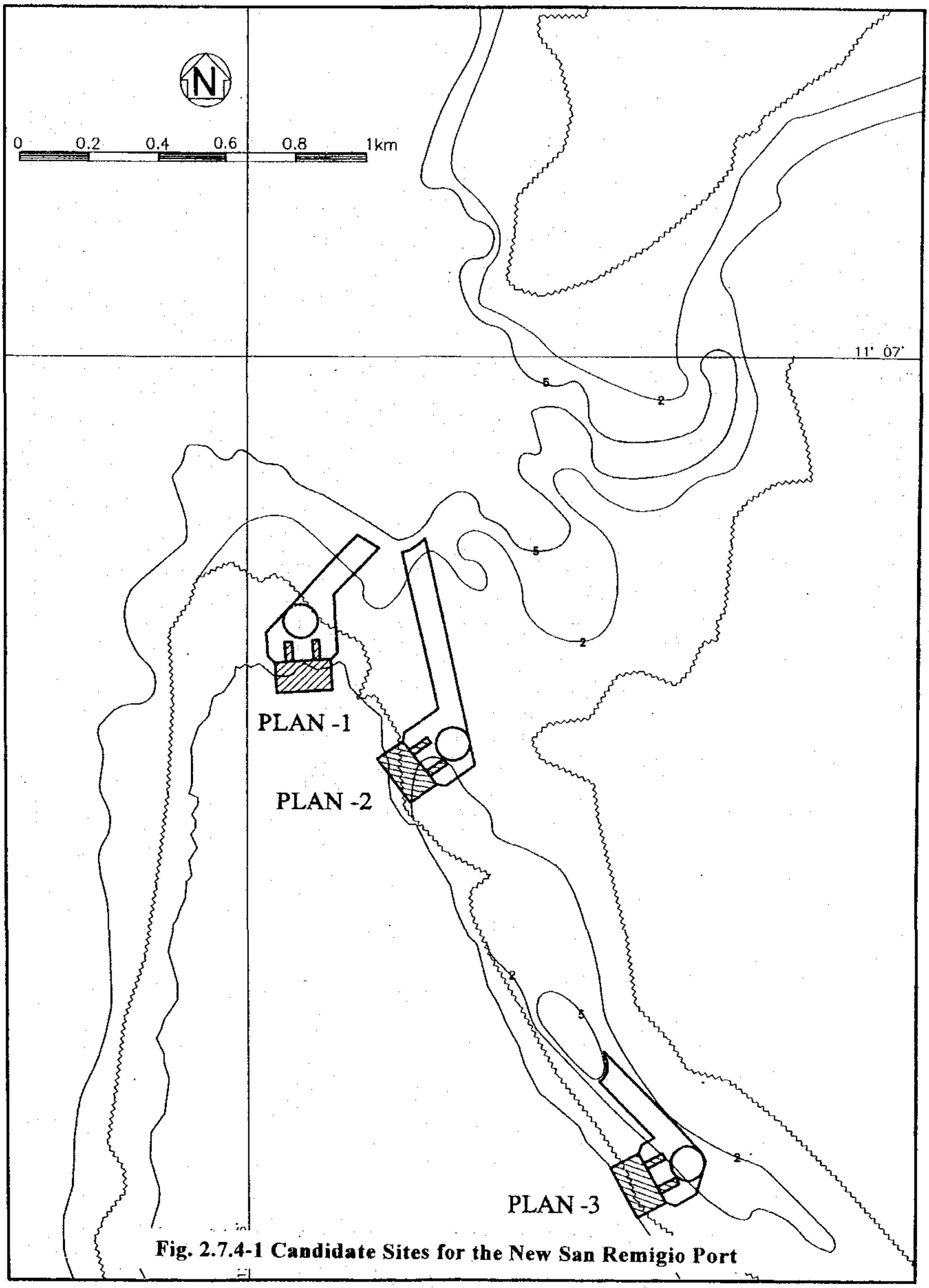


Fig. 2.7.4-1 Candidate Sites for the New San Remigio Port

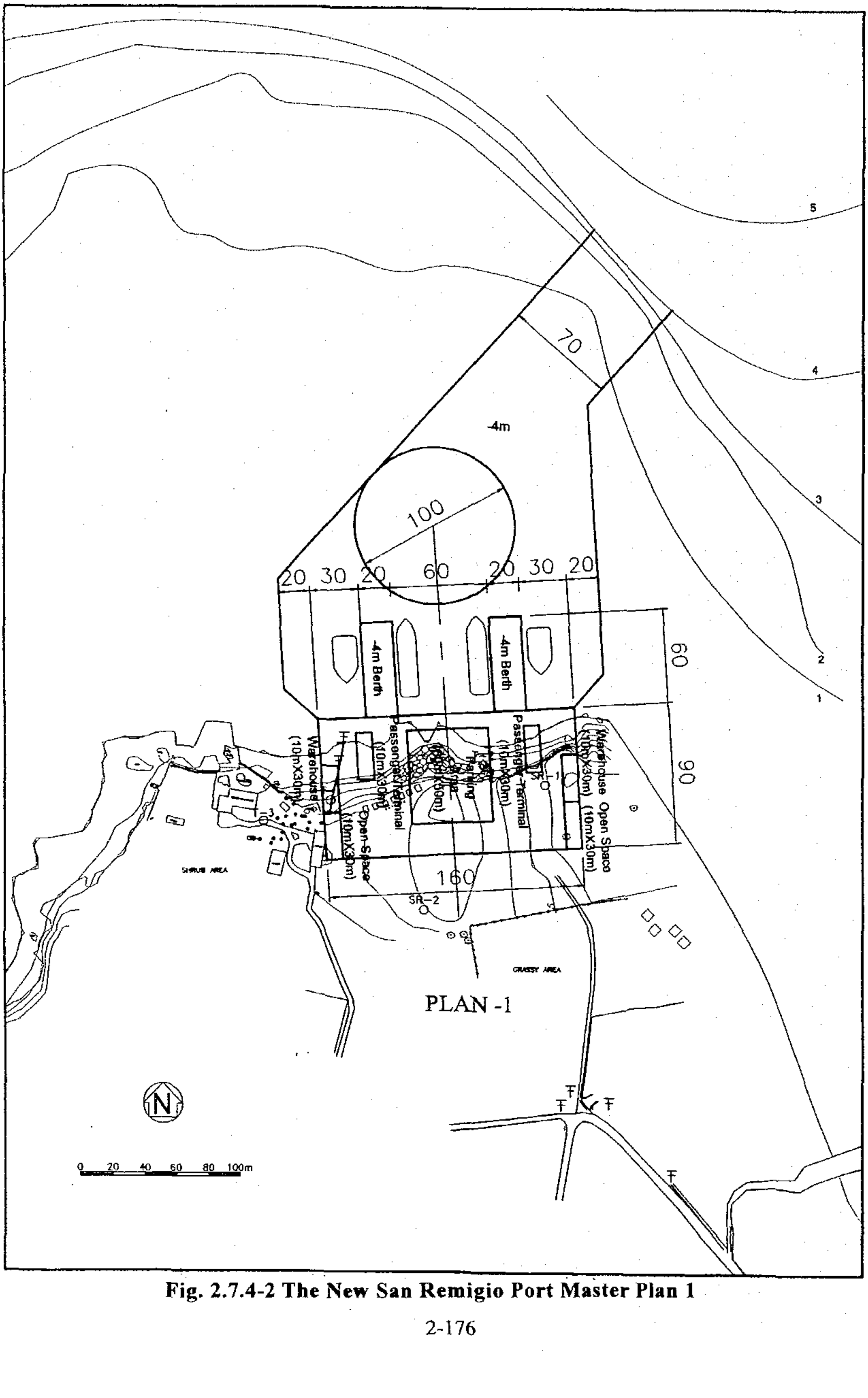


Fig. 2.7.4-2 The New San Remigio Port Master Plan 1

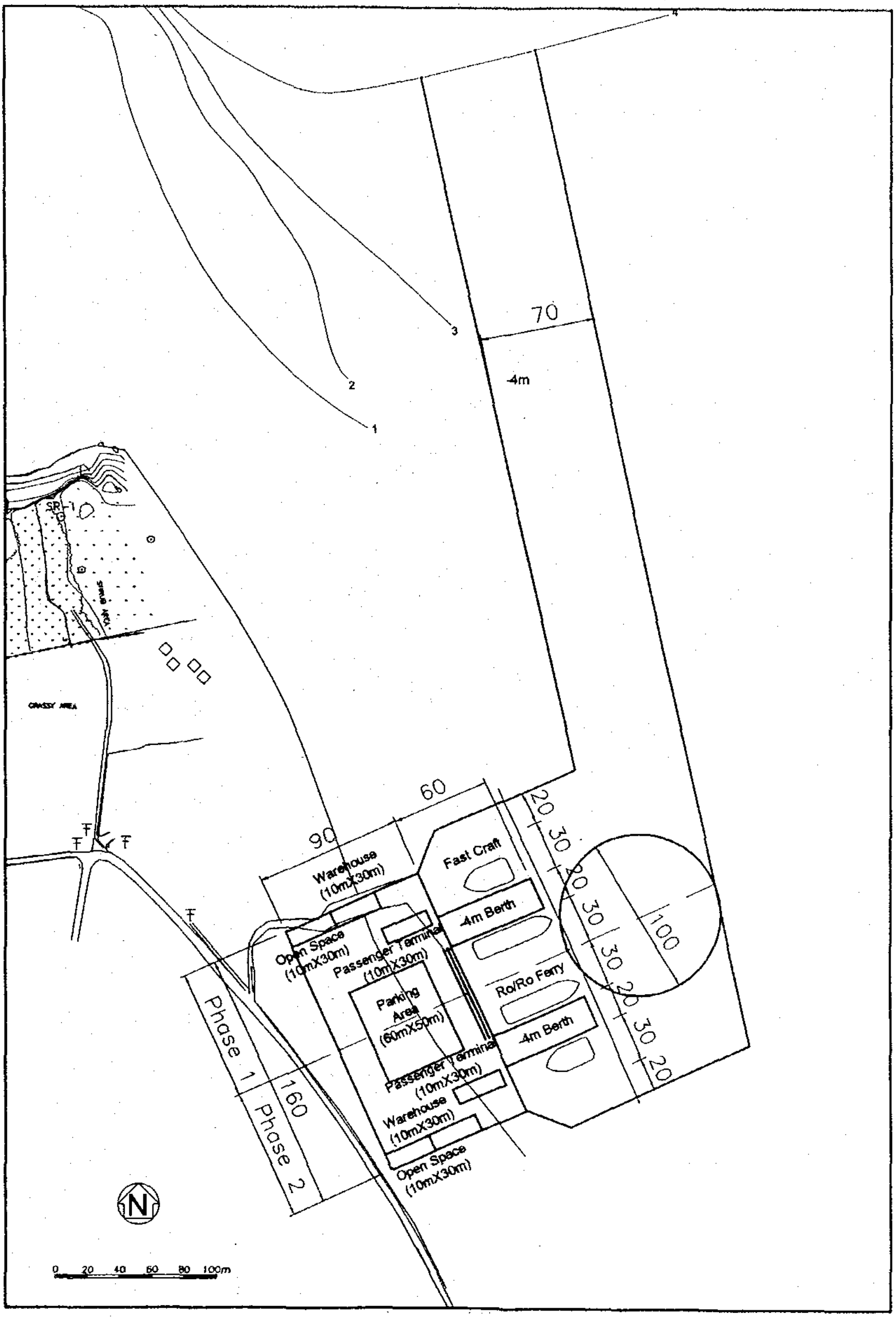


Fig. 2.7.4-3 The New San Remigio Port Master Plan 2

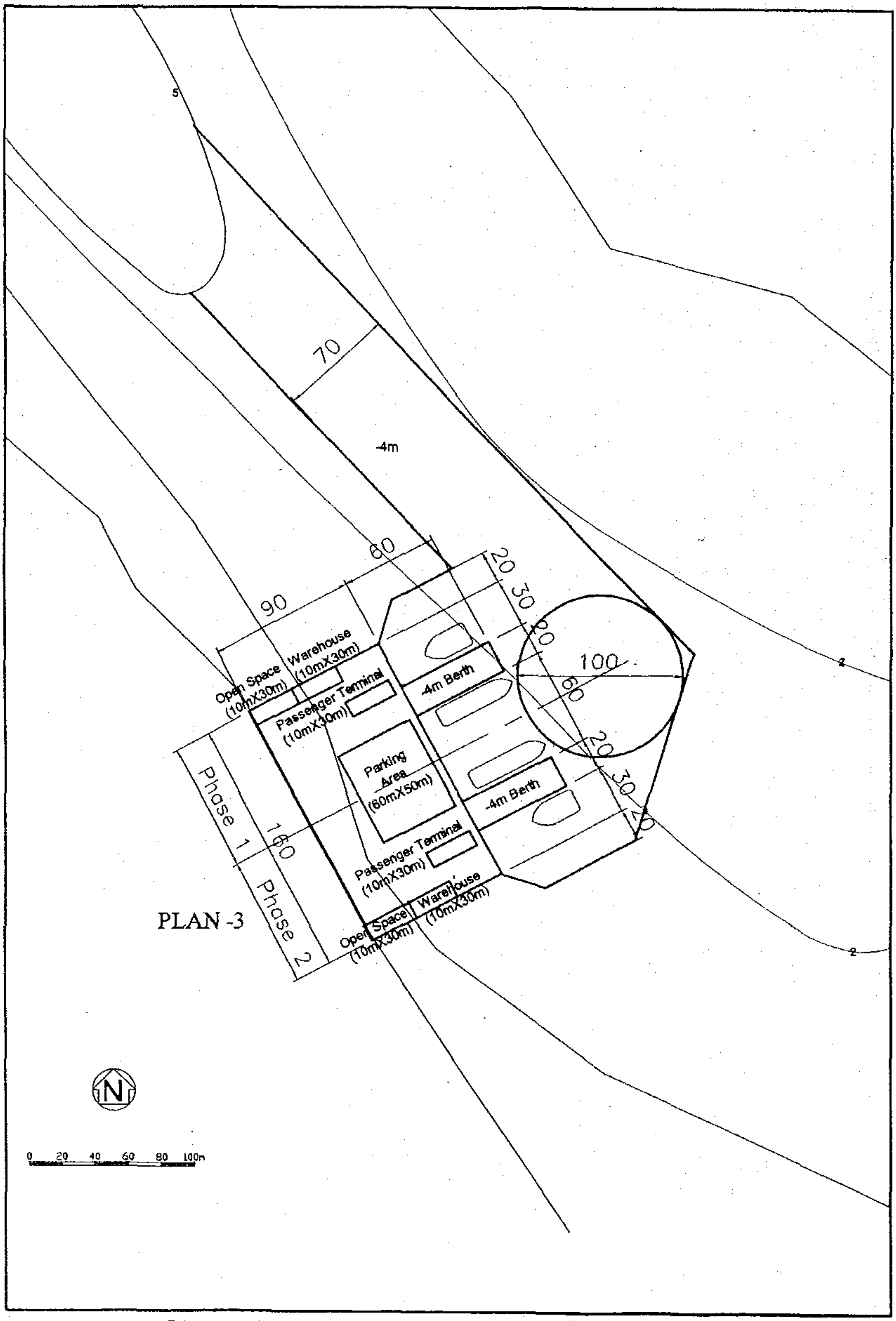


Fig. 2.7.4-4 The New San Remigio Port Master Plan 3

(2) Evaluation of Alternative Proposals

Three alternatives are evaluated according to factors such as maneuverability, maintenance and operation, construction cost, future expansion, environmental consideration, easiness of implementation, etc.

1) Maneuverability
Maneuverability is mostly affected by calmness of the sea. Maneuverability is easier inside the bay than on the open sea.

2) Maintenance and Operation
Necessity of maintenance dredging was evaluated.

3) Construction Cost
Construction of access road and volume of dredge influence total construction cost.

4) Future Expansion
Surroundings of candidate sites for the new port are already developed as a resort or a firm. Possibilities for their future expansion should be evaluated.

5) Environmental Consideration
Environmental aspects were evaluated by determining the characteristics of the cargo and the site.

6) Easiness of Implementation
Necessary negotiation and adjustment were pointed out.

7) General Evaluation
The OX system was used in evaluating the three alternatives.

Table 2.7.4-1 Comparison of Evaluating Items

Alternative Proposal	Plan 1: Mouth of the Bay	Plan 2: Private Development Area	Plan 3: Expansion of Existing Port
Maneuverability	X near the open seas, degree of calmness is not favorable	- Degree of calmness is a little high	O Degree of calmness is high
Maintenance and Operation	O Does not require channel maintenance		X Requires channel maintenance
Construction Cost	X Cost of construction of access road is high O Little dredging works O 490 M Peso	- Cost of access road is medium O Little dredging works O 500 M Peso	O Access road already exists X Much dredging works X 630 M Peso
Future Expansion	X Difficult	O Possible	- Not impossible
Environmental Consideration	X Resort area	O Planned area for harbor development	O Located in existing harbor
Easiness of Implementation	X Requires acquisition of site so hard discussion with locals is expected	O Acquisition and preparation of site is easy X Needs adjustment vis-à-vis the development plan which has already started	X Requires thorough discussion with the locals for the acquisition of the site
General Evaluation	XX(oooxxxxx)	OOOO(oooooox--)	X(oooxxxx-)

As a result of evaluation, Plan 2 is recommended as the master plan.

2.7.5 Development Plans for Roads

(1)Access Roads

The planned development site lies along the coastal line. This area has people residing along the coasts and has no access road with the required width. In

Plan 1, there are proposals to expand the existing road to about 2km (in between the dwellings), or expanding a one-lane unpaved road to about 3km. In Plan 2, the aforementioned expansion between dwellings shall be reduced to 1.5km. In Plan 3, there is no need for construction of access roads.

2.7.6 Phasing Plan

The long-term development project is planned to be carried out separately in two phases. One pier is included in the first phase to cater to the RORO ferries and fast crafts, while two piers should be developed in the long term. The north pier near the mouth of the bay should be developed in the first phase for the reduction of the initial investment of dredging cost.

Table 2.7.6-1 Phasing Plan of the New San Remigio Port

Works	Short-term (Phase 1)	Long-term (Phase 2)
Total dredging works	200,000 m3	250,000 m3
Total Reclamation works	4,000 m3	10,000 m3
Berthing Facilities	1 jetty of 60 m x 20 m RORO ramp 30 m	2 jetties of 60m x 20m RORO ramp 60 m
Revetment	45 m	60 m
Total pavement works	7,000 m2	14,000 m2
Total access road works	1,500 m	1,500 m
Passenger Terminal Building	300m2	600m2
Warehouse	300 m2	600m2
Utility Supply	Water, electricity	Water, electricity
Total land acquisition	22,000 m2	28,000 m2

2.8 Engineering Design for Long-term Plan

2.8.1 Design Criteria

(1) Objective Vessels

As described in the previous chapters, the dimensions of the vessels used for the design of new port facilities are summarized in Table 2.8.1-1.

Table 2.8.1-1 Objective Vessels Size of the Project Ports for 2010 to 2020

	Type of Vessel	DWT (GRT)	LOA (m)	Water Depth (m)
New Cebu Port	Container vessel	40,000 DWT	270	13.0
	Cargo vessel	18,000 DWT	165	10.0
Cebu Baseport	Container vessel	7,000 DWT	150	8.0
	Large Ro-Ro	18,000 GRT	195	8.0
	Middle Ro-Ro	4,000 GRT	120	6.0
	Cargo vessel	2,000 DWT	83	6.0
	Passenger cargo	500 GRT	50	4.0
	Fast craft*	500 GRT	40	3.0
	Metro bus ferry	30 GRT	—	—
Toledo Port	Ro-Ro ferry	2,000 GRT	80	4.0
	Fast craft	200 GRT	30	4.0
	Cargo vessel	2,000DWT	83	6.0
New San Remigio Port	Ro-Ro ferry	500 GRT	50	4.0
	Fast craft	150 GRT	26	4.0

Note: *catamaran type

(2) Natural Conditions for Preliminary Design

The criteria and parameters for the preliminary design are determined based on the results of the field surveys, the natural conditions of the Cebu province and the project area as described in Chapter 3 and other references such as Design Manual For Port and Harbor Facilities in the Philippine Ports Authority. The summary is shown below.

1) Tide, Current and Wave Conditions

Table 2.8.1-2 Tide, Current and Wave Conditions of Project Ports

	Cebu Baseport	New Cebu Port	Toledo Port	San Remigio Port
Tide (m)[1,2]				
High Water Level (HWL)	+1.80	+1.90	+1.80	+2.10
Mean Sea Level (MSL)	+0.72	+0.58	+ 0.79	+0.60
Design Low Tide Level (DLT)	-0.35	-0.35	-0.35	+0.00
Current (m/sec)[2]				
Maximum velocity	0.70	0.70	-[3]	0.70
Average velocity at strength	0.45	0.45	-	0.45
Wave at Berth, $H_{1/3}$(m)				
Significant Wave Height $H_{1/3}$	-	1.80 m	-[4]	-[4]
Significant Wave Period $T_{1/3}$	-	4.60 sec	-	-

Source 1: Design Manual For Port and Harbor Facilities in the Philippine Ports Authority (1995)
2: 1991 Predicted Tide and Current Tables, Department of Environment and Natural Resources, etc.
3: Current in Toledo is assumed negligible, but San Remigio is assuming the similar order of Consolacion area
4: Wave data for Toledo and San Remigio are not available

2) Wind

Design wind is stipulated in National Structural Code of the Philippines. Cebu Island belongs to Zone II and the parameters are as shown below.

Table 2.8.1-3 Design Wind

Item	Design Value	Remarks
Wind Velocity	V = 49 m/s	Cebu Port area, 20 m/sec Max. last 30 years
Wind Pressure	p = 245 kg/m^2	h > 30m
	p = 196 kg/m^2	9 m < h < 30m
	p = 147 kg/m^2	0 m < h < 9m

3) Subsoil Condition

According to the geotechnical investigation in the new Cebu port area, the following parameters are used for the preliminary design for the new Cebu port facilities.

Deep Area		Shallow Area	
-10.0 m	Sandy coral very loose N = around 10 or less	0 m	Sandy clay N= 1-3
-25.0 m	Sand Gravel of coral fossils N = around 50 c = 30 kPa, ϕ = 25°, γ' = 0.9 tf/m^3	-20 m	Sand gravel N = 12 on average c = 30 kPa, ϕ = 25°, γ' = 0.9 tf/m^3
-37.0 m	Sandy coral non-plastic (Dense to very dense) N = 10-30 c = 0 kPa, ϕ = 35°, γ' = 1.0 tf/m^3	-33 m	Gravel N = around 10-30 c = 0 kPa, ϕ = 35°, γ' = 1.0 tf/m^3

The Soil Profile of new Cebu port area is shown in Fig. 2.1.2-5 and 2.1.2-6.

4) Earthquake and Seismic Coefficient

The seismic coefficient is calculated by the following formula:

Kh = Kh1 x C1 x C2

Where :

Kh = Seismic Coefficient

Kh1 = Regional Seismic Coefficient (= 0.1)

C1 = Factor for Subsoil Condition

C2 = Coefficient of Importance

The regional seismic coefficient (Kh1) of the Philippine is shown in Fig. 3.1.7-2.

Table 2.8.1-4 Factor for Subsoil Condition C1

Subsoil Class	Class 1	Class 2	Class 3
Factor C1	0.80	1.00	1.20

Source: Design Manual For Port and Harbor Facilities in the Philippine Ports Authority (1995)

Table 2.8.1-5 Subsoil Classes

Thickness of Quaternary Deposits	Sand Gravel Layer	Ordinary Sand, Clay Subsoil	Poor Subsoil, N<4, C<1tf/m2
Less than 5m	Class 1	Class 1	Class 2
5 - 25m	Class 1	Class 2	Class 3
More than 25m	Class 2	Class 3	Class 3

Source: Design Manual For Port and Harbor Facilities in the Philippine Ports Authority (1995)

Table 2.8.1-6 Coefficient of Importance

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

Source: Design Manual For Port and Harbor Facilities in the Philippine Ports Authority (1995)

The seismic coefficient for the proposed ports are computed as follows:
The Cebu Province is located in the Region 2 of the regional seismic coefficient, Kh 1 =0.1

Kh = Kh1 x C1 x C2 = 0.10 x 1.0 x 1.5
= 0.15 (for the new Cebu port)
= 0.10 x 1.0 x 1.0 = 0.10 (for the Cebu Baseport, Toledo port and the new San Remigio port)
Kv = not considered = 0

5) Materials
Quality of construction materials shall conform to Japan Industrial Standard (JIS) and other applicable standards used in the Philippines.

a. Concrete
Concrete shall be classified into the following on the basis of cylinder sample compressive strength @ 28 days.

Table 2.8.1-7 Concrete Strength of Class for Use

Class	Strength (kgf/cm^2)	Use
A	140	Lean Concrete
B	240	Structural Reinforced Concrete
C	350	Structural Reinforced Concrete (Bridge)

b. Reinforcing Bar
Reinforcing bar for work will be PBS 275.

c. Steel Pile and Sheet Pile
Steel pile sheet piles shall conform to the following requirements.

Table 2.8.1-8 Steel Pile Specifications

Pile	Kind of Steel	Specification
Steel Pipe Pile	SKK 400	JIS A5525 / ASTM A161
Steel H Pile	SHK 400	JIS A5526
Steel Sheet Pile	SY 390	JIS A5528
Steel Pipe Sheet Pile	SKY 400	JIS A5530

6) Corrosion Rate of Steel Members

Table 2.8.1-9 Corrosion Rate of Steel Members

Corrosion Environment		Corrosion Rate (mm/yr.)
Sea Side	Above H.W.L.	0.30
	H.W.L. ~ (L.W.L. -1.0 m)	0.25
	(L.W.L. - 1.0 m) ~ Seabed	0.20
Land Side	In marine atmosphere	0.10
	In soil above the residual water table	0.03
	In soil below the residual water table	0.02

7) Unit Weight of the Materials

Unit weight of the materials is assumed in the design as listed below except otherwise specified.

Table 2.8.1-10 Unit Weight of Material

Materials	Unit Weight γ (tf/m^3)
Reinforced Concrete	2.4
Plain Concrete	2.4
Mortar	2.0
Asphalt	2.3
Structure Steel	7.85

8) Unit Weight and Strength Parameters of the Fill Materials

Unit weight of the materials is assumed in the design as listed below except otherwise specified.

Table 2.8.1-11 Unit Weight and Strength of Fill Materials

Materials	Unit Weight in Air γ (tf/m)	Effective Unit Weight γ' (tf/m)	Angle of Shearing Resistance φ (deg.)
Sand	1.8	1.0	30
Rock / Stone	1.8	1.0	35
Gravel	1.8	1.0	35

9) Other Considerations

a. Increase in the Allowable Stress

For each type of structure, appropriate loading combinations are considered in order to design safer structures against possible loading conditions. The combination of loading will be explicitly indicated in the design process.

In some extreme cases of loading, a certain increase of the allowable stresses is permitted in the working stress design method. In principle, the allowable stresses of each structural component can be increased 50% during storm and seismic conditions.

b. Surcharge Loads during Earthquakes
In the design of quay wall structures against earthquakes, the surcharge loads on the apron are considered as half of those used in the normal case.

c. Safety Factors for Earthworks and Foundations
The following safety factors are considered in design of earthworks and foundation for their bearing capacity, slope stability of circular arc slips and earth-pressure induced moment balance used for sheet pile walls.

Table 2.8.1-12 Safety Factor of Earthworks and Foundation Works

Conditions	S.F. (Normal)	S.F. (Extreme)
Circular Arc Slip (Slope Stability)	1.3	1.0 ~ 1.1
Stability of Gravity Type Structures		
Sliding	1.2	1.0
Over-Turning	1.2	1.1
Sheet Pile Embedment		
Moment Balance due to Earth-Pressure	1.5	1.2
Anchor Block Stability	1.5	1.2
Bearing Capacity		
Shallow Foundation	2.5	1.5
Gravity Type Structure (Circular Arc Slip)	1.2	1.0
Bearing Capacity of Piles		
Bearing Capacity	2.5	1.5
Pullout	3.0	2.5

2.8.2 Preliminary Design

(1) Design of Berthing Structure

1) Crown Height
The crown height of the berth is normally determined by the following formula:

H = HWL + (1.0 to 2.0 m);
(large berth with tidal range smaller than 3.0m)
H = HWL + (0.5 to 1.5 m);
(large berth with tidal range smaller than 3.0m)

The crown height affects greatly the construction cost of the port. The strength of the quaywall structure and reclamation volume are proportional to the crown height. On the

other hand, as it becomes lower, the chance of the berth being flooded by high waves becomes larger. Therefore, this must be studied carefully in consideration of wave conditions.
As a preliminary design of the new Cebu port, considering that wave height of 1.8 m and tidal difference of 1.90m, the crown height is fixed at 3.0m from MLLW.

$$HWL + H_{1/3} = +3.0$$

The crown height of Cebu Baseport, Toledo and the new San Remigio ports the existing level of + 3.0 m from MLLW will be applied.

2) Water Depth along side the Berth
Water depth is determined by the following formula:

Water Depth = LWL - (ship max draft + 10% of ship draft)

The required water depths for each berth are as follows:

New Cebu Port	For Container Terminal	-13 m from MLLW
	For Multipurpose Berth	-10 m from MLLW
Cebu Baseport	Reconstruction of Pier No.1	- 6 m from MLLW
	Reconstruction of Pier No.3	- 4 m from MLLW
Toledo Port	For Cargo Berth	- 6 m from MLLW
	For RoRo Ferry / Fast Craft	- 4 m from MLLW
New San Remigio Port	For RoRo Ferry / Fast Craft	- 4 m from MLLW

(2) Loading conditions

1) Surcharge Loads and Live Loads on the Apron
a. Surcharge Loads
On the apron of the berths for the new Cebu port, the following surcharge is considered as a dead load by assuming temporary stack of containers;

- Normal condition: 2.5 tf/m²
- Seismic Condition: 1.0 tf/m². (50% of the normal condition)

For the Cebu Baseport and the Toledo and the new San Remigio ports, surcharge loads at normal conditions 1.0 tf/m² will be considered. for design.

b. Live Loads
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 : approximately 750 tf/unit;
- Nominal rated capacity : 41 tf under spreader.

In the design of the apron, only trailer trucks and standard trucks with full loaded containers are considered as handling equipment. The following wheel loads are considered as the basis at the new Cebu port, and Pier of the Toledo and the new San Remigio ports:
Standard Truck (H22 - 44) : 8.0 tf/wheel
Tractor Trailer (40') : 5.8 tf/wheel

Table 2.8.2-1 Loading Conditions of the Wharf

Uniform Distributed Load	2.50 t / m^2 (without QGC)
Uniform Distributed Load	1.35 t/ m^2 (with QGC)
The worst possible combination of Live Load generated by cargo handling equipment and transporting equipment.	Loads of equipment is shown in Table 2.8.2-2 (Impact factor shall be considered)
Gantry Crane Load	40.0 t rated load x30m span x 36 to 38 m outreach.

The live load for Quay Gantry Crane (QGC) is adopted as shown in the figure and table below. The typical section of planned Quay Gantry Crane is shown in Fig. 2.8.2-.4.

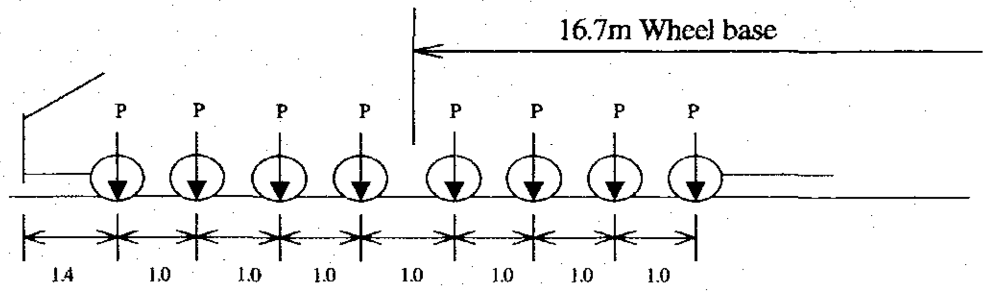


Fig. 2.8.2-1 Live Load of QGC

Table 2.8.2-2 Load Condition of Quay Gantry Crane

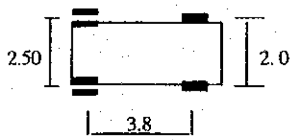
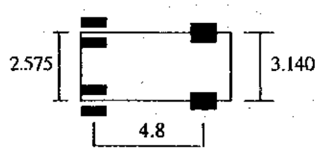
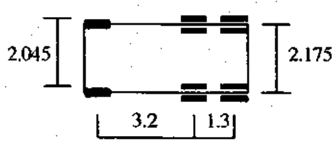
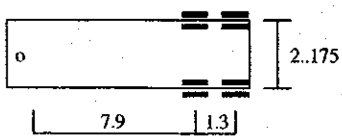
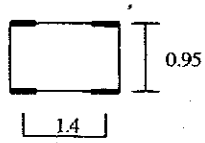
Conditions	Direction		Wheel Loads (P) on Sea-side Rail	Wheel Loads (P) on Land-side Rail	Remarks
Operating (wind =16m/s)	Vertical		Pv max= 38 t	Pv max= 34 t	Dynamic coefficient 1.25
Stormy (wind) (V=55m/s)	V	Wind from sea side	Pve max= 44 t	Pve max= 63 t	
	V	Wind from land side	Pve max= 54 t	Pve max= 44 t	
	V	Wind from Gantry side	Pve max=33 t	Pve max=42 t	
	Horizontal		Phe max=4.7 t	Phe max.=4.7 t	
Seismic (Kh=0.15)	Horizontal		Phe max= 3.8 t	Phe max=3.8 t	Perpendicular to load at Crane Rail

2) Live load on Container Yard and Road

a. Load of Container Handling Equipment

Equipment Loads in the pavement at the Container yard and Roads as shown in Table 2.8.2-3 are adopted in the design of pavements. In operation condition, the load dynamic coefficient are considered for dynamic effect (1.2.)

Table 2.8.2-3 Cargo handling Equipment Loads

Equipment	Description	Outline of Wheel	Load Condition	Front Wheels	Rear Wheels
Top Lifter (Reach Stacker) for Empty Container	4.5t under Spreader		With Load	8.6t x4 wheels	3.1 t x 2 wheels
			Without Load	5.4t x4 wheels	7.5 t x 2 wheels
Top Lifter (Reach Stacker) For loaded Container	4 tiers, 30.5t under Spreader		With Load	21.2 t x4 wheels	7.5 t x 2 wheels
			Without Load	9.7 t x4 wheels	12.9 t x 2 wheels
Tractor Head for Container Transport	40.5 t Container Chassis Towing		With Load	3.2 t x2 wheels	2.5t x 8 wheels
			Without Load	2.0 t x2 wheels	0.6 t x 8 wheels
Chassis for Container Transport	2 x 20ft or 1 x 40/45 ft		With Load	Load on The Tractor Head	3.8 t x 8 wheels
			Without Load		0.4 t x 8 wheels
Fork Lift Track for General Use	2.5 t		With Load	2.9t x2 wheels	0.6 t x 2 wheels
			Without Load	1.3t x2 wheels	0.9 t x 2 wheels

b. Load of RTG (Rubber Tired Gantry Crane)

The Proposed RTG (Rubber Tired Gantry Crane) is 40 tons rated capacity under the spreader, having 23.47 m of gauge span. Live Load of the RTG is shown in Fig. 2.8.2-2 and Table 2.8.2-4

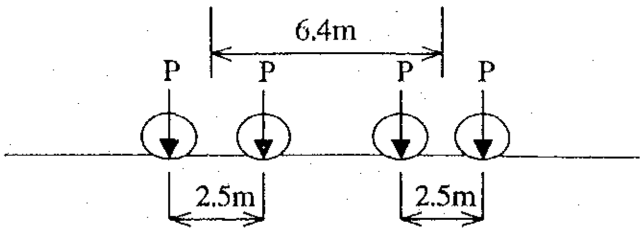


Fig. 2.8.2-2 Live Load of RTG

Table 2.8.2-4 Load of RTG

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

Dynamic Coefficient = 1.2 shall be multiplied to the static load

c. Load of Container (Container Yard)

The weight of the containers in the following figure, will be taken as 4 stacking containers weight which is also the height of the RTG. The empty container will be stacked less than 8 tiers height.

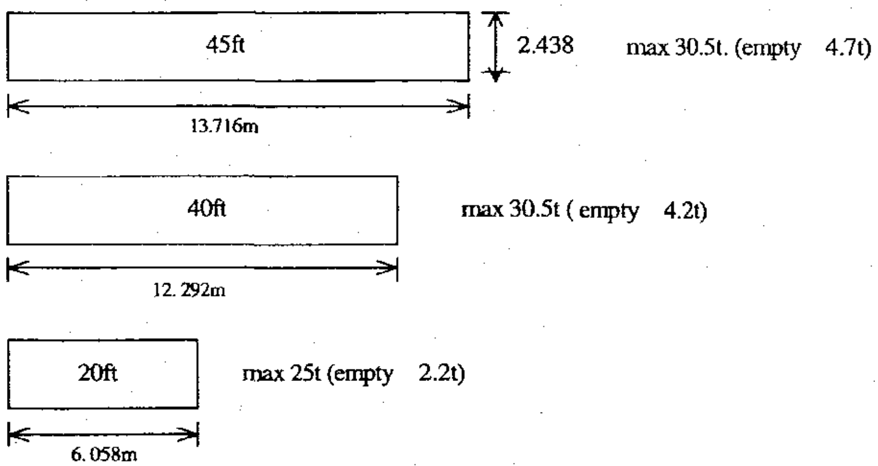


Fig. 2.8.2-3 Load of Container Boxes

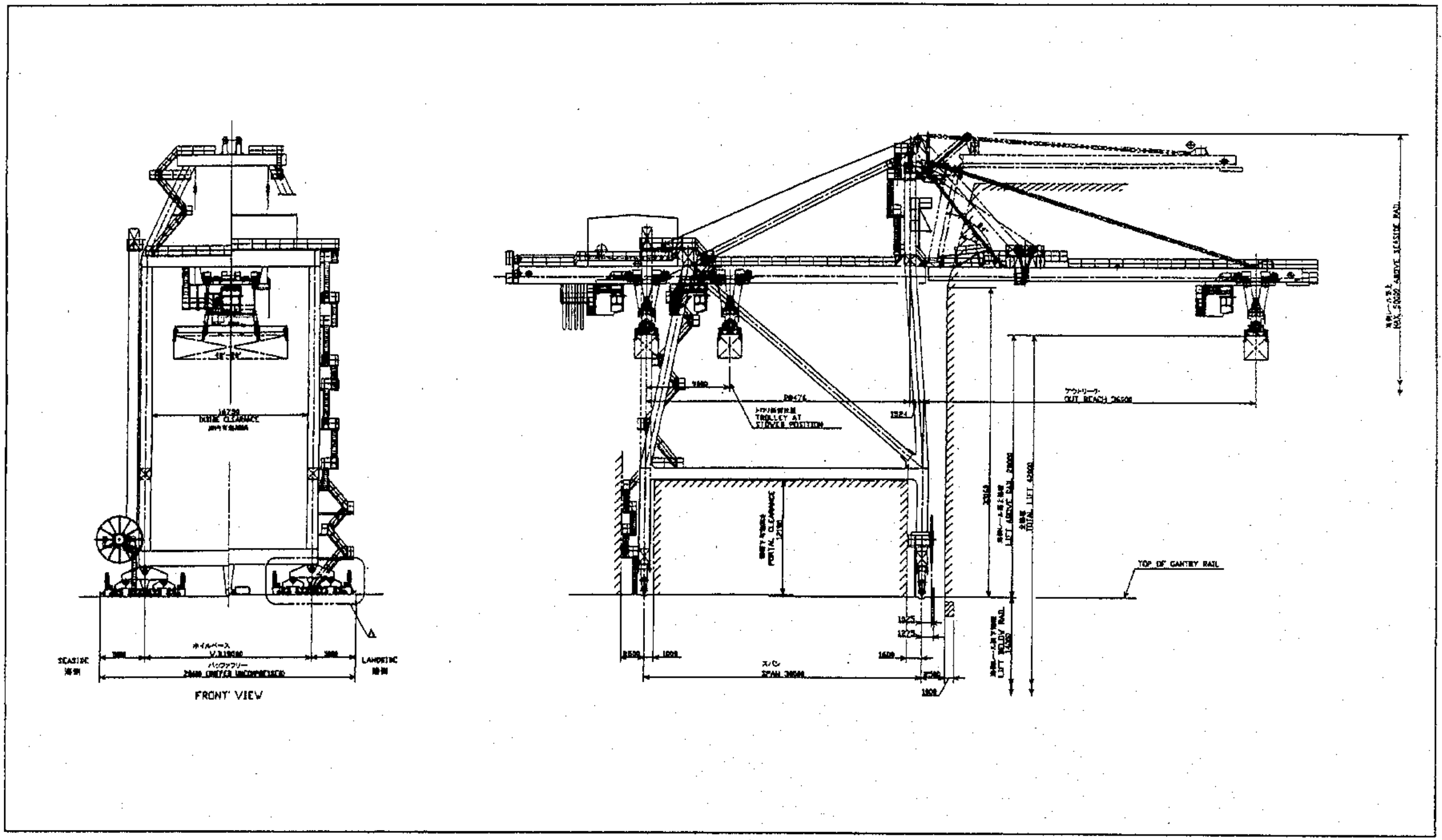


Fig. 2.8.2-4 Typical Sections of Quay Gantry Crane

3) Tractive Force and Berthing Force

a. Mooring

Tractive force acting on mooring bitts are 100 tf per unit for the vessels from 10,000 to 40,000 DWT for the new Cebu port which are spaced at 35 m. Regarding the Cebu Baseport and Toledo port and the new San Remigio port the tractive force acting on mooring bitts by cargo ships of 2,000 to 200GRT at Cebu Baseport and Toledo port, and 500 GRT at the new San Remigio port is 15 ton per unit which are spaced at 10 m.

b. Fender System

In design of the fender system to absorb the shock of ship berthing energy, berthing speed of vessels to be adopted is as follows:

- 5,000 ~ 10,000 DWT 0.30 m/sec.
- 10,000 ~ 20,000 DWT 0.15 m/sec.
- 20,000 ~ 50,000 DWT 0.10 m/sec.

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

4) On-land Facilities

a. Roads

Design traffic volumes inside the new Cebu port area and access road way up to the target year of 2020 are estimated as follows:

Table 2.8.2-5 Estimated Traffic Volume of Vehicles (car/hr) in 2020

Cargo Classification	Traffic Volume	Unit	Heavy Vehicle Ratio %
From Container	904	Vehicles/day-2 way	100
From General Cargoes	107	Vehicle/day-2 way	60
Sub-total	1,011	Vehicle/day-2 way	

(3) Design of Yard and Pavement

1) Pavement

Based on the operation planning inside the container terminal of the new Cebu port and selection of the pavement type to be adopted, the following wheel loads are the critical condition for each type and area of the pavements, on which the design will be conducted:

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 of the Toledo and the new San Remigio ports will be by interlocking concrete blocks.

Table 2.8.2-6 Critical Wheel Load for Pavement Design

Area Particulars	Access / Service Road	Container Terminal Area		Stock Yard		Multipurpose Berth	
		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

2) Drainage

Selection of the drainage type and relevant coefficient for drainage design of the container terminal at the New Cebu port are summarized in the Table 2.8.2.-7 below:

Table 2.8.2-7 Drainage Design

	Service Route	Container Yard	Container Stock Yard	Open Stock Yard
Drain Type	L-Type Curb with Catch Basin - Concrete Pipe	U-Type Ditch - Concrete Pipe	Gutter with Catch Basin - Concrete Pipe	Gutter with Catch Basin - Concrete Pipe
Concentration time for Surface Water: Tc (min)	5	5	5	5
Coefficient of Runoff: C	0.95	0.9	0.9	0.9

(4) Buildings

All the buildings inside the container terminal and cargo berth of the new Cebu port area will be designed in conformity with relevant national codes and standards, such as National Structural Code for Buildings, National Plumbing Code of the Philippines, Philippine Electrical Code, Fire Code of the Philippines, etc. Requirements of the floor area for each building and other criteria are described here.

1) Required Area of Buildings for Container Terminal and Multipurpose Berth

Office buildings planned inside the container terminal of the new Cebu port, their required floor space are summarized in the following table.

Table 2.8.2-8 Office Building Space Requirement (sq.m)

Building	Floor Area
CPA Office Building	5,000
Container Terminal Building	5,000
Container Freight Station	3,200
Multipurpose Berth Cargo Shed	4,200
Maintenance Shop	2,250
Power Generator House	1,000
Water Supply Reservoir	2,000

The CPA office building around 200 sq.m at Toledo and San Remigio ports will be planned as parts of the passenger waiting hall in total of around 600 sq.m together with the vehicles parking lots.

(5) Utilities

1) Water Supply

The following volume of water demand for the new Cebu port will be required. Water supply system included in the Project will consist of water reservoir, pump house, elevated water tank and distribution system for general purpose of the office, ship, hydrant, and fire fighting inside of the port area. The water source should be from the main supply line of the public water of the Metro Cebu Water Works Department (MCWWD) for the new Cebu port area and of the Local Unit Water Authority (LUWA) for the Toledo and the new San Remigio ports. The water supply pits and pipeline along the berth of the new Cebu port will be provided to supply the water to ships.

Table 2.8.2-9 Requirement of Water Supply for New Cebu Port Area

Demand	Design
1) Domestic Consumption	
1-1) Average Domestic Consumption per Capita	100 l/day
1-2) Maximum Daily Consumption	+ 30 %
1-3) Losses	10 %
2) Ship Supply	
2-1) 2% of Full Tank for average 10,000 GWT Vessel	200 tons/call
3) Fire Fighting	
3-1) Maximum Reserve	200 tons/day

Minimum pressure at the farthest supply point should be 50 psi for the domestic demand and ship supply, while much higher pressure of 65 psi should be provided for the fire fighting.

2) Power Supply

Electric power demand in the new Cebu port is summarized in the following Table:

The electric power requirement of the new Cebu port will be supplied from the Visayas Electric Cooperation (VECO) and of the Toledo and San Remigio ports is assumed to get from the National Power Corporation (NPC). A stand by generator set for emergency purpose of the office use in the port will be installed.

Table 2.8.2-10 Requirement of Power Supply at New Cebu Port Area

Demand Source	Design Values
Gantry Cranes per Unit	1,000 KVA (demand) 4.16 KV, 3 Φ
Reefer Container per Unit	6 KW 440 V, 3 Φ
Lighting	230 V, 3 Φ
Others	230 V, 3 Φ
TOTAL DEMAND	15 MVA

(6) Environmental Treatment Facilities

The following environmental treatment facilities will be provided for the new Cebu port area and Cebu Baseport area respectively.

- Drainage/sewerage outfall facilities
- Solid wastes management facilities
- Ballast and Bilge Waste Treatment System

1) Drainage/sewage outfall facilities

The septic tanks as sewerage facilities will be provided at each building and water thereof will flows out through the drainage pipes. Drainage facilities are provided together with the pavement works.

2) Solid waste management facilities

For the solid wastes management facilities, necessary number of garbage bins are provided and installed inside the port area and CPA will make a contract with garbage collection companies to collect such garbage who will take to the specified garbage dumping site.

The above arrangement of solid waste treatment and garbage collection have been conducted at the Cebu Baseport by CPA since 1985.

3) Ballast Bilge Waste Treatment System

In November 1967 "International Agreement for the Prevention of the Sea Water Pollution with Oil came into the Oil of Ship" was enforced in 1990, as the domestic law.

This oil treatment plant accepts wasted oil (mainly ballast water and bilge water) directly from the smaller coastal service tanker or oil barge, should be the oceanic environment.

The proposed ballast and bilge water treatment plant by this master plan is aimed at mitigation potential ship related oil pollution due to indiscriminate disposal of ship based oily waste into the port waters. It is noted that the port water is visibly polluted with floating oil, which is an aesthetic nuisance in addition to a water pollution issue.

This is considered as the very first step in controlling potential pollution due activities directly concerned to the operation of the port. Moreover, the provision of ballast and bilge waste treatment by the port is to meet its legal obligation as mandated by the DENR Administration Order No.34 (Water Quality Criteria Amendment Section 68 and 69 issued in 1990).

A bilge water disposal plant, if established, will employ a biological processing where activated sludge by mechanical aeration will accelerate the digestion of organic substances in the bilge water. A bilge water (sewage) disposal plant, effluent from which must comply with the decree put down by Philippine national laws, will be considered..

2.8.3 Preliminary Design Concept of Quay Wall Structure

Based on the above design criteria and berth requirement, the type of berth foundation is determined considering the site, topographic, hydrographic and soil conditions as follows:

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

1) Berth Structure for Container Berth and Multipurpose Berth
The berth structure is considered in two cases, one for multipurpose berth to handle general cargo and other for exclusive container berth. The same type of berth structure is adopted for both berths providing the continuation of longer berth utilization for berthing by number of cargo ships at the same time, and considering the following soil conditions.

According to the sub-soil data, the alluvium composed of underlain is mainly of cohesive granular material consisting of sand, gravel and gravel-size broken corals. The soil profile are described as follows:

- The uppermost 11.0 m average thick of alluvium consists of layers of cohesive fines (clays) and non-plastic granular material (sand, corals and gravel). N-value generally ranged from 2 to 3, with higher N-values ranging from 5 to 10.
  It is composed generally of soft, gray, silty clay, with appreciable amount of coral fragments and broken shells. It consists of sand and broken corals mixture. Thickness of this layer vary from around 7.0 to 10.0 meter. It would indicate that this layer is normally consolidated. Therefore, relatively large consolidation settlement is expected should there be high embankment or fill.

- The second granular layer (below 11.0 - 30 m) consists mainly of sand with large amount or coarse gravel-size broken corals. Very stiff to hard, yellowish brown clay with varying thickness was also observed embedded within the layer at varying depths. N-values generally ranged from 10 to 30. Higher N-blows exceeding 50 were frequently encountered between 20 to 25 meter depth in the boreholes. The substantial increased in the N-value was probably due to the large amount of coarse, gravel-size, broken corals that was hit during the conduct of SPT.

- The percentage of gravel-size broken corals (25 mm max. size) ranged from a low of 20% to a high of 80%. The amount of sand (including sand-size shell and coral fragments) ranged from 20% to 45%, while the amount of clay varies from 20% to a high of 60%.

- The soil below 30.0 m is the last granular layer described as dense to very dense, yellowish to grayish brown silty, gravely sand, with gravel-size corals. N-values generally ranged between 30 to 50. The granular layer found below 28.0 to 32.0 meter depth (average 30 m), described as dense to very dense, silty or gravelly sand may be regarded as bearing layer. N-values generally ranged from 40 to50.

Considering such soil conditions and steep slope of seabed topography, the following alternatives types of berth foundation are considered. The comparison of advantage and disadvantage of each type is shown in the Table 2.8.3-1 below.

Table 2.8.3-1 Comparison of Quaywall type structure of the New Cebu Port

	Steel Pipe Sheet Pile (SPSP)	Caisson Type	Steel Pipe Pile (SPP)
Evaluation	Simple in works and Good. Typical cross section is shown in Fig. 2.8.3-1	Complicated in works and longer period of works. Typical cross section is shown in Fig. 2.8.3-2	Simple and Fair in cost and construction period Typical cross section is shown in Fig. 2.8.3-3
Advantage	• The construction period may be the shortest among the alternatives • Large apron and backup area by backfill can be provided • Volume of dredging and reclamation will be minimal • Sheet piling works and dredging/reclamation works can be conducted at the same time • SPSP structure is flexible to cope with strength by the change of soil conditions and sea bed topography.	• Material locally available can intensively be used, thus economically be superior. • Relatively suitable to deeper water depth • Maintenance is easy and structure is relatively durable	• Volume of reclamation works will be minimal. • Sheet Pile driving works and reclamation works can be progressed separately at the same time.
Disadvantage	• Corrosion of SPSP should be considered. • SPSP and tie wires have to be imported • The construction cost may be almost same as caisson type	• Caisson yard or floating dock is required for fabrication. • Large floating equipment is required during installation. • The construction works is complicated to make level of mound for caisson installation and to set exact position for installation. • Construction period may be the longest.	• Corrosion of SPP should be considered. • SPP have to be imported. • Dredging works should be progressed before pile driving works. • Large offshore pile driving equipment may be required. • SPP is not easy to adjust its length by changes of soil and sea bed topography • Additional retaining wall is required for reclamation works • Construction period will be longer than SPSP type structure.

The SPSP type structure is considered suitable and adopted for the preliminary design. The steel pipe sheet pile (SPSP) of 1,200 mm Φ will be driven up to 30 m depth, which is anchored at the rear by 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 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 bearing of the soil foundation, once the bearing layer is encountered to deeper, the pile length should be extended.

2) Quay Crane Foundation

The rear container crane rail foundation piles are installed at 30 m away for the crane wheel gauge from the sea side foundation piles separately from the anchor piles for crane installation.

3) 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 runway of rubber tired gantry cranes and container trucks are paved with pre stress concrete blocks.

(2) Preliminary design of Toledo Port

According to the hydrographic survey charts, the present seabed depth around the existing berthing facilities of Ro-Ro ship is about - 4 to - 5m. The new berth facilities for Ro-Ro ferry and passenger fast craft is planned around this depth.

The soil investigation is not carried out at this port. However, CPA had constructed concrete pile supported mooring dolphin along the existing pier in year 2000. The concrete square piles (40 cm x 40 cm) were driven into the sandy soil of the seabed surface up to -15 m (pile length of 18 m). From this experience, the soil profile is assumed to be cohesive sandy soil.

- The berth structure for 2,000 GRT (LOA=80m, D=3.0m) class Ro-Ro ferry will be designed for the water depth of -6.0m along side the berth by using the SSP of Type IV (400 mm x 150 mm x 13 mm) to be driven up to - 15 m and anchor piles (H shape piles) will be driven up to - 11 m at 10 m interval to function as the retaining wall of the filling material of land reclamation and berthing facilities. Typical cross section of planned cargo berth is shown in Fig. 2.8.3-.4 and Fig. 2.8.3-5. The existing hyperbolical slope for Ro-Ro ship ramp landing stage shall be improved by widening the landing stage area for large buses and trucks to turn smoothly and safely for changing direction.

- The berthing facilities for fast passenger vessels of 200GRT (LOA= 30m, D = 3.0m) will be preliminary designed by using the concrete square piles of 40 cm x 40 cm and to be driven up to around -20 m for supporting concrete deck because of accommodating the small vessels and the same type structure of the existing jetty and mooring dolphin.

(3) Preliminary Design of the New San Remigio Port

There are two sites considered for a new port development. One site is adjacent to the resort area of the Warren beach. The other is adjacent to the ice plant jetty located inside the

Hagnaya Bay. It is alternatively also considerable to expand the existing Hagnaya port facility by dredging the approach channel to depth of - 4.0 m.

According to the hydrographic survey chart of the Warren beach area, the water depth within coastal area is shallow ranging from 0.0 to - 2.0 m depth. The planned port site is shallow and the water depth of about -3 to - 4m is available at approximately 300 - 400 m away from the coastal line.

Other site is considered in adjacent to the existing ice plant factory / berth area where the water depth is -3.0 m around the tip of the existing causeway.

However there is a shallow area which is less than -2.0 m depth with hard coral layer in front of this site being used for the navigation channel. In order for ships to sail in all weather and tidal conditions such shallow parts are required to be dredged to - 4.0 m.

According to the site reconnaissance survey of seabed soil condition at both sites it was observed that the seabed is coral and sandy mixed soil conditions. The berth structure of both sites is designed for water depth of - 4.0 m along side the berth with the pre-cast concrete piles supporting concrete deck which is the same type of the existing jetty at the Hagnaya port. The vertical piles of berthing structure will be driven up to - 15.0 m. It will require that new soil data at construction site and more accurate sea bed topography of port area to determine the exact dimension and length of concrete piles. The typical cross section of the pier structures is shown in Fig. 2.8.3-6

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

1) Results by Damaged Investigation of Piers Structural Conditions

According to the results of investigations of the existing structural conditions of pier 1 to 3 carried out in January to February 2001, 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. The samples from such structure were analyzed chemically. It had identified that carbonation is main cause of corrosion of steel in concrete, which means the less durability than the specified strength of material.

It is observed by the chemical tests result that some of the existing beams, pile heads, slabs of these piers are contaminated with the chlorides and sulfur contents. They are very weak and less sustainable conditions and recommendable for immediate rehabilitation for further service. CPA has already started the rehabilitation works of slab, beams and pile heads of pier No.2 from May 2001and scheduled to complete in March 2002.

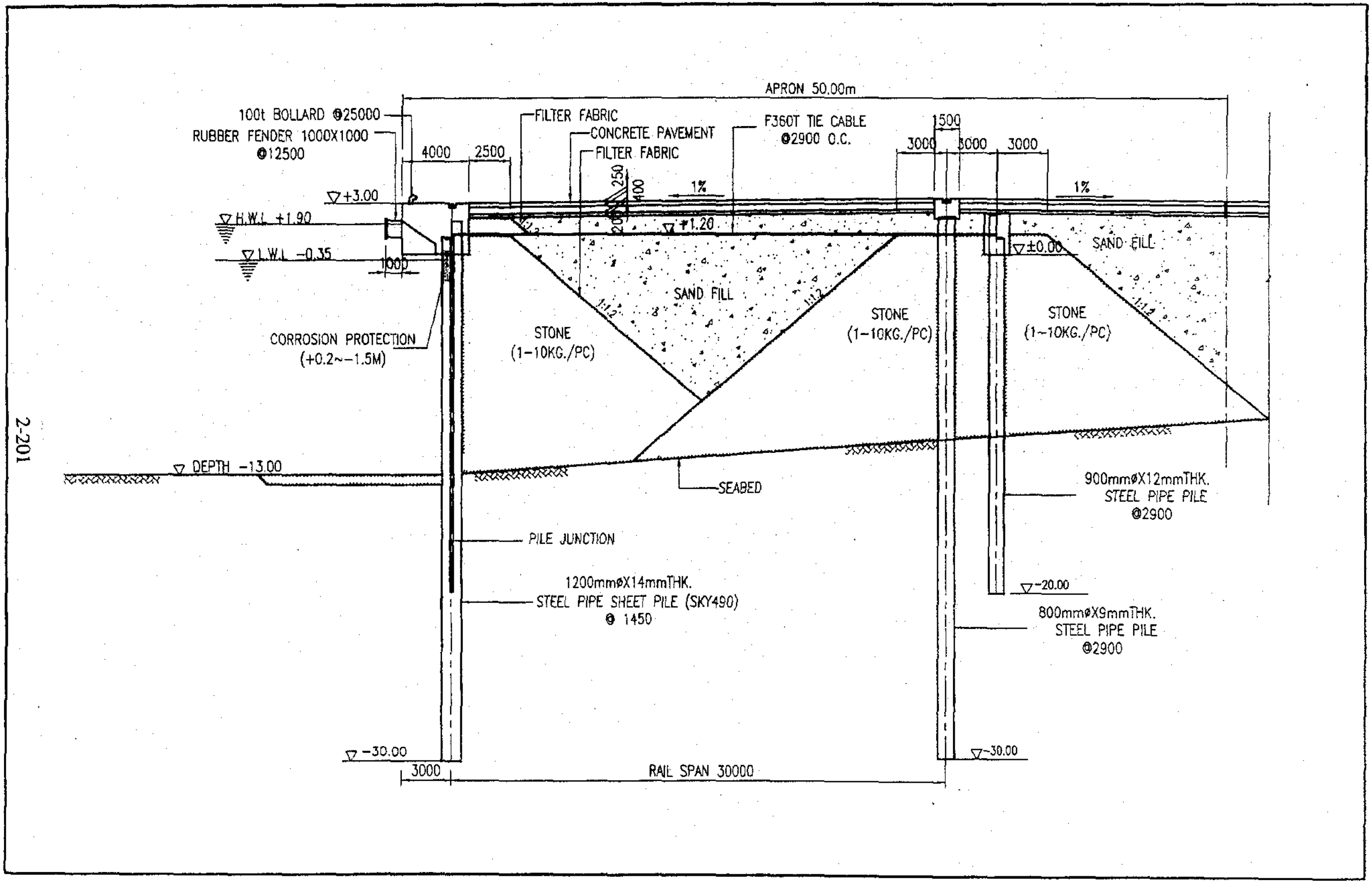


Fig. 2.8.3-1 Steel Pipe Sheet Pile Type Quaywall for Container Berth

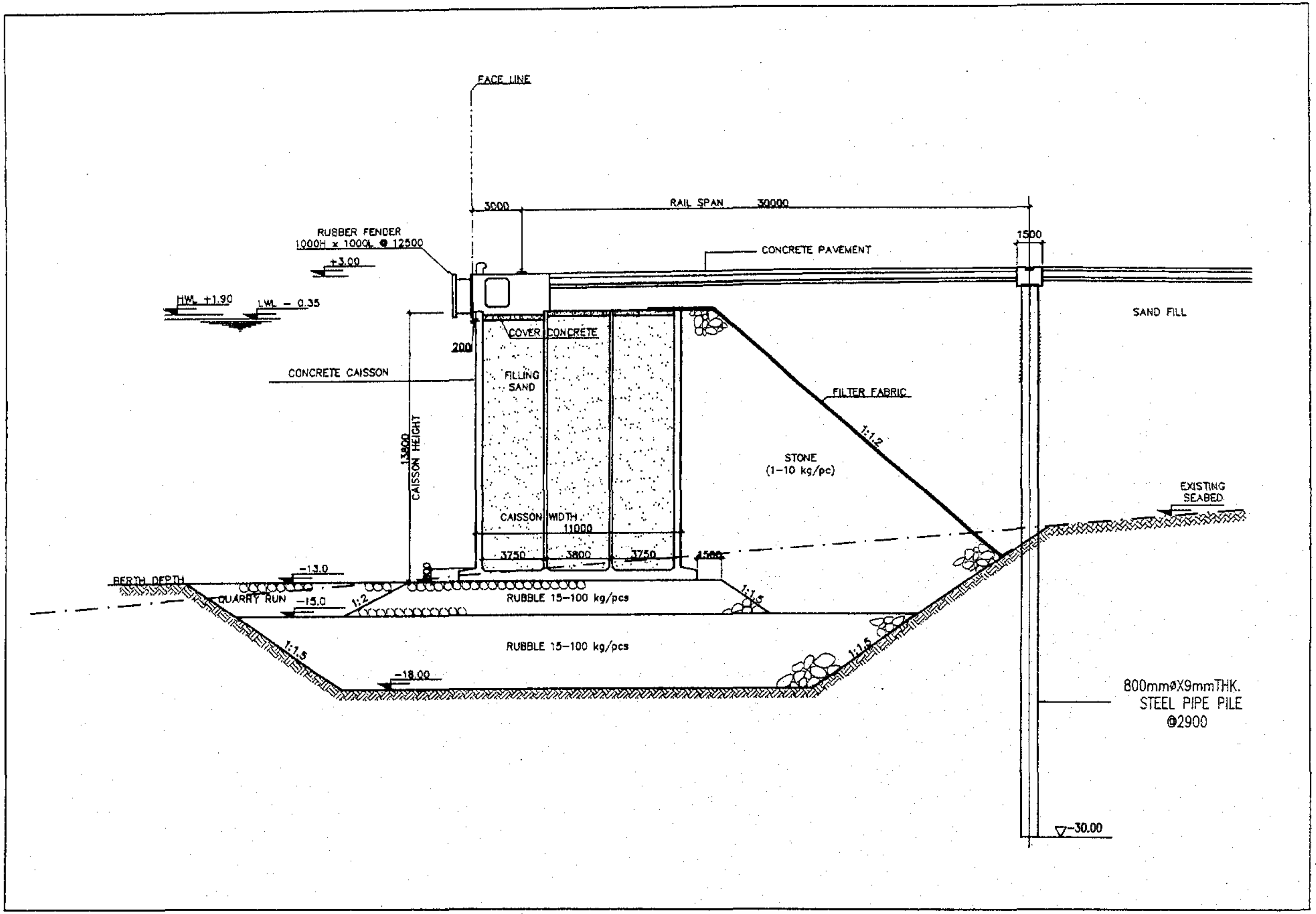


Fig. 2.8.3-2 Caisson Type Quaywall for Container Berth

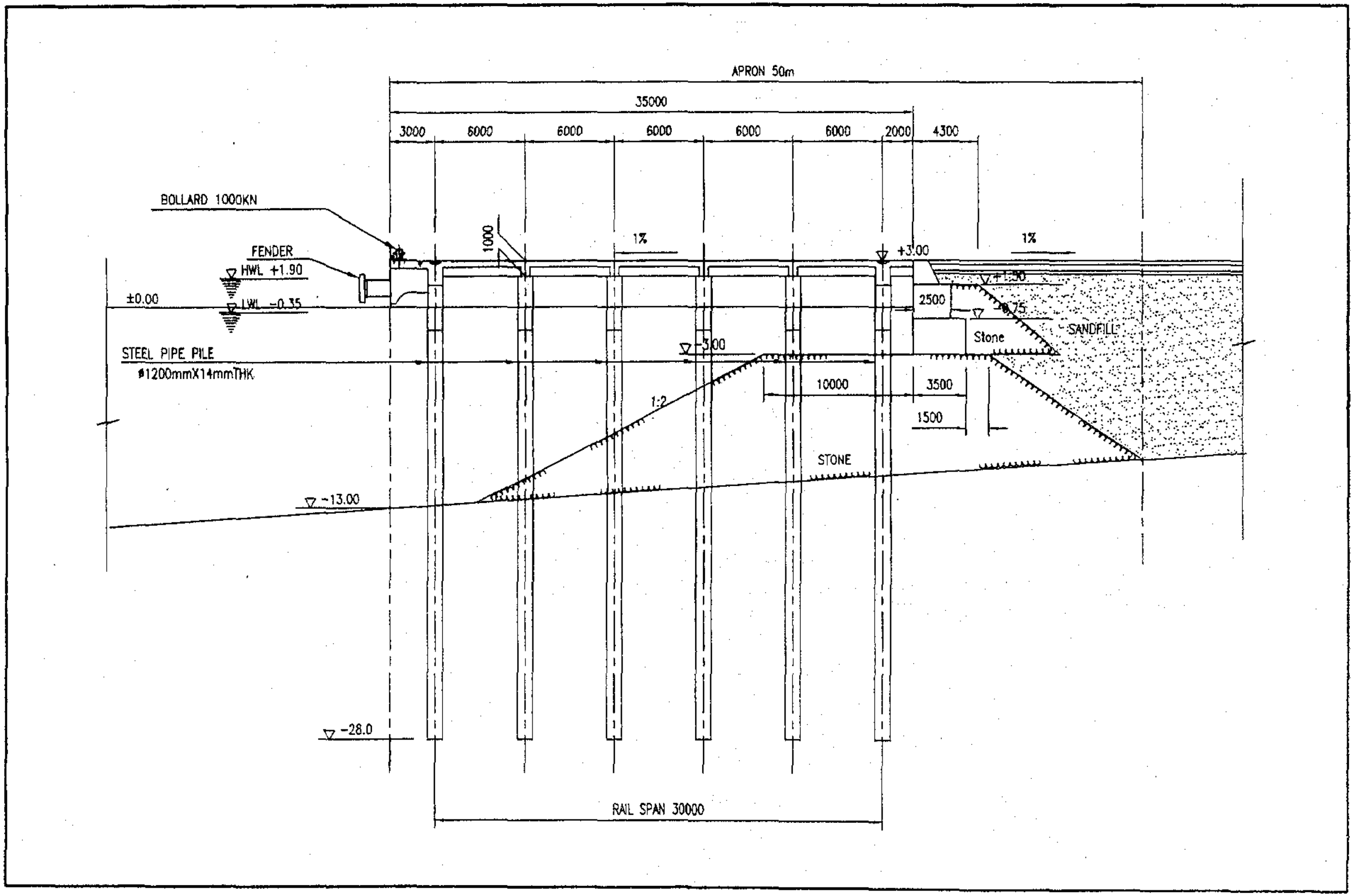


Fig. 2.8.3-3 Open Deck Type Quaywall for Container Berth

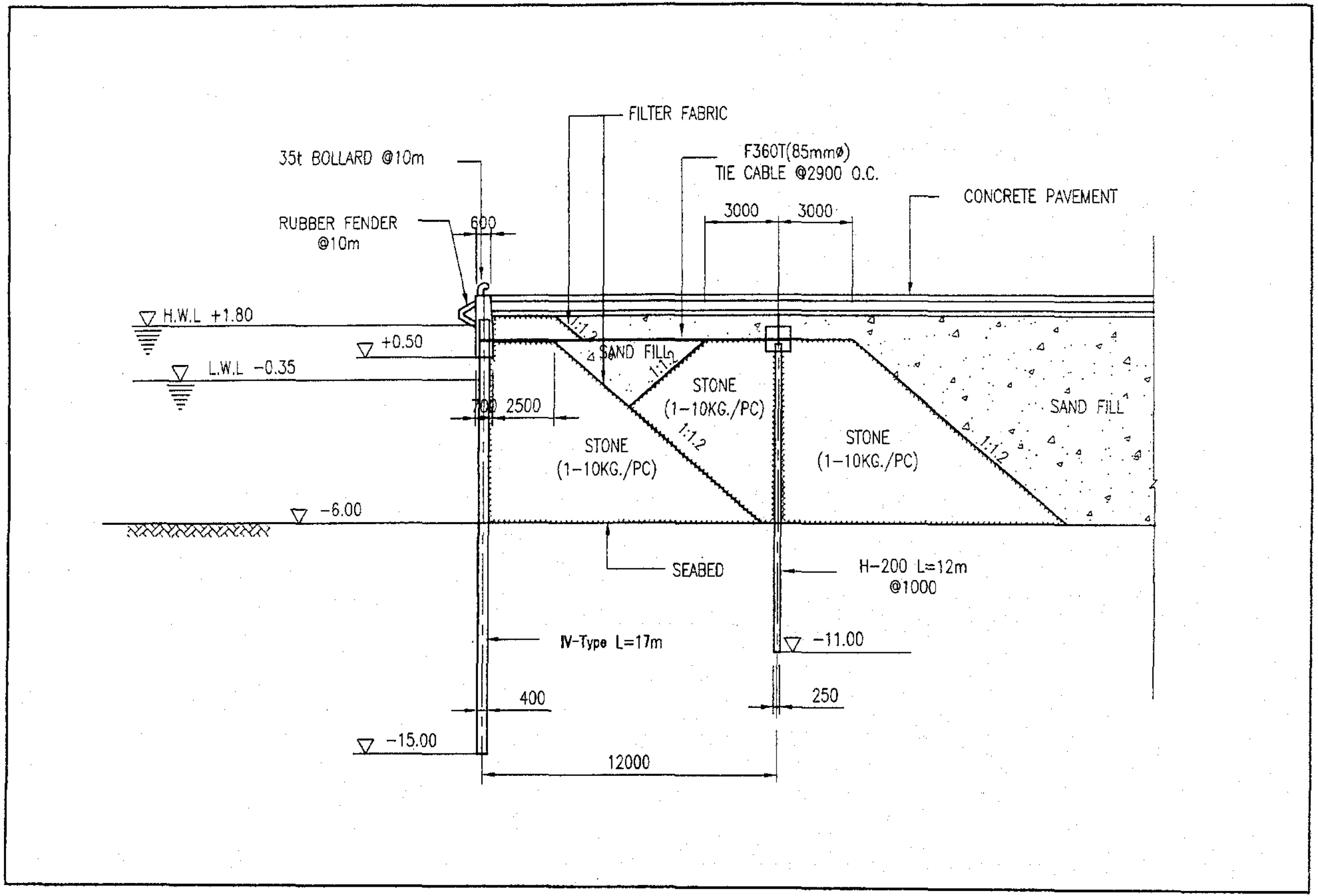


Fig. 2.8.3-4 Sheet Pile Type Quaywall for Toledo Port

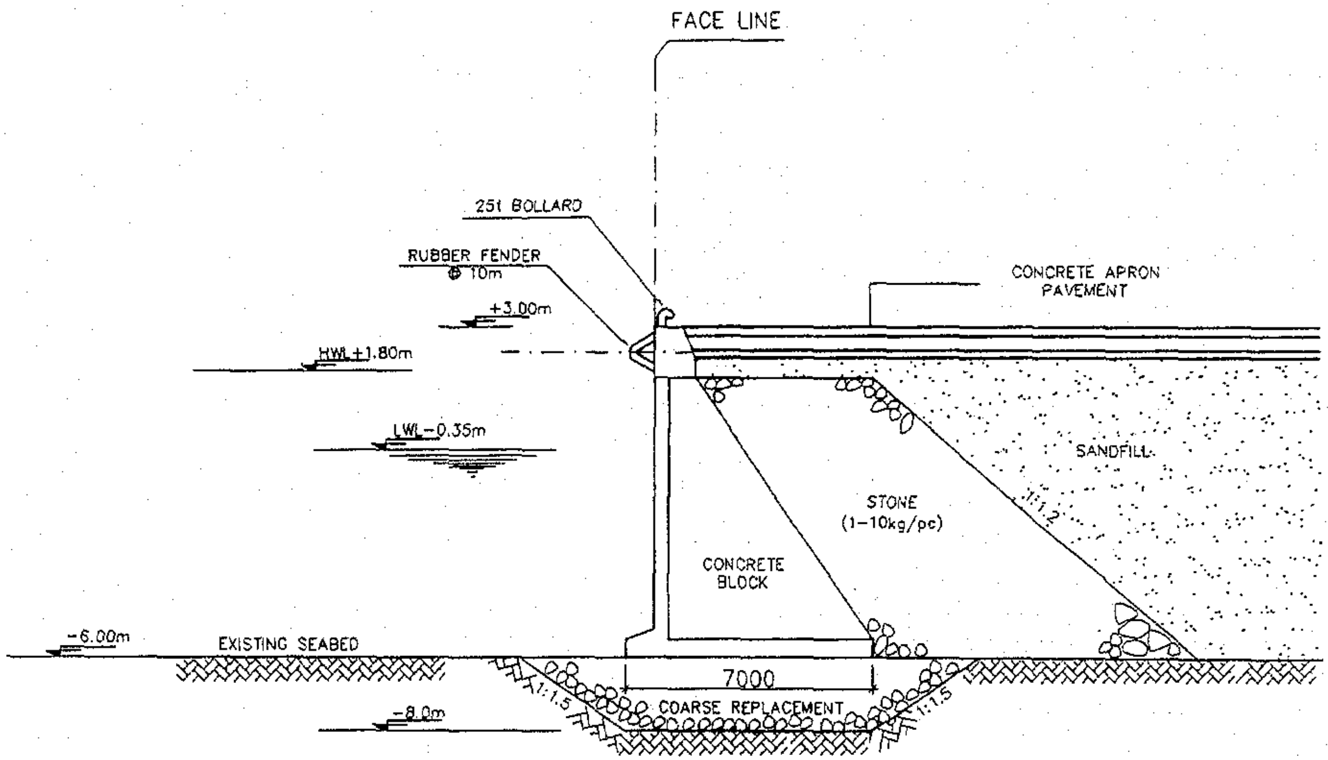


Fig. 2.8.3-5 L-shape Quaywall alternative for Toledo Port

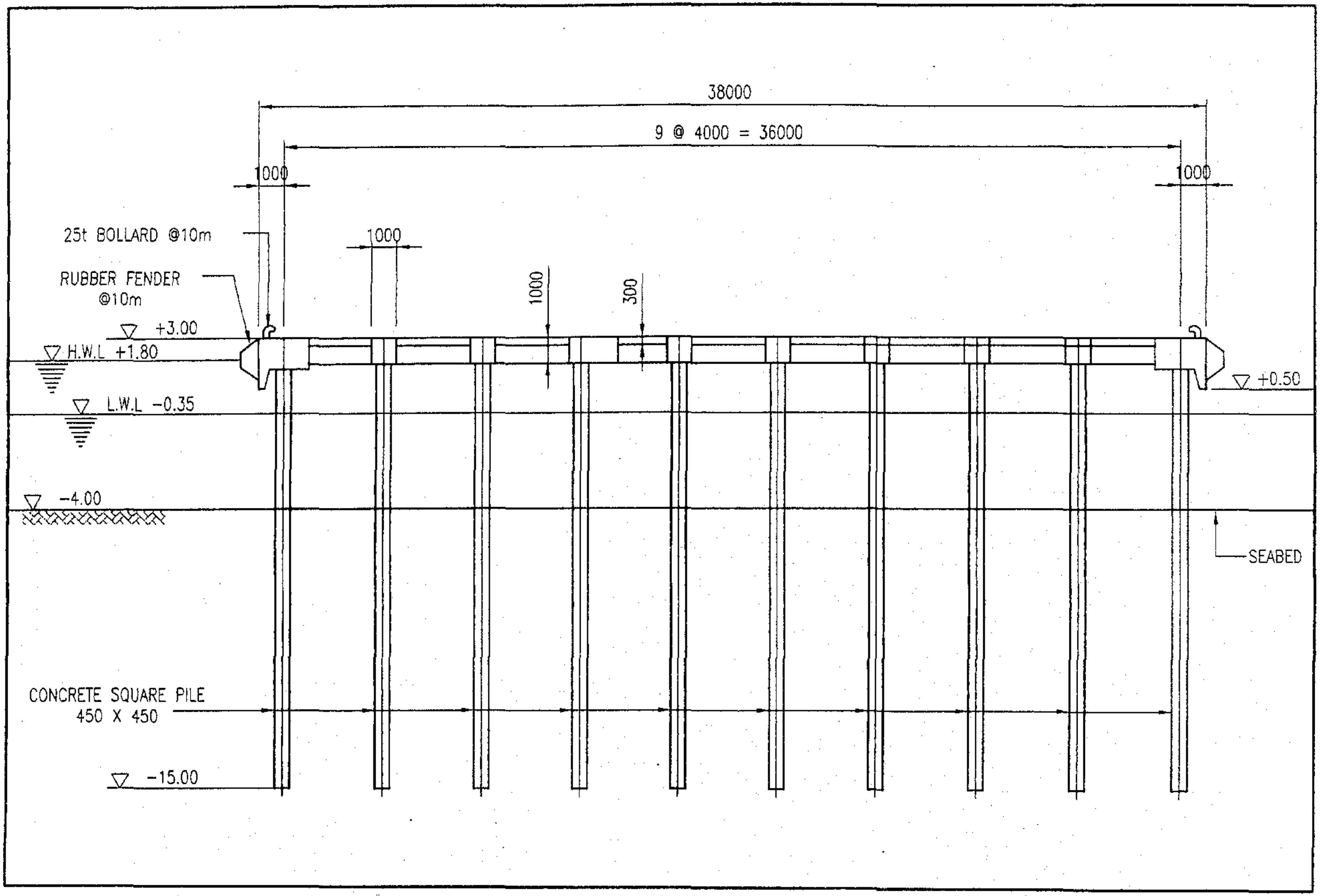


Fig. 2.8.3-6 Open Deck type Berth for the New San Remigio Port

2) Pier No.1 reconstruction for large cargo ship

Under such conditions that the existing pier structures will accommodate cargo ships of around 2,000 DWT, the existing pier structure should be reconstructed. It is considered tentatively that the structure will be constructed with steel sheet piles to be driven along side of the existing pier and filled reclamation material inside of the surrounded sheet piles area after demolishing the slab and beams. The existing concrete piles will be buried with the filling material.

Alternatively concrete blocks type of berth structure will be applicable by installing such blocks along the periphery of the pier and existing concrete piles in the central parts of the pier are used to support a newly constructing slab and beams. The construction cost and period of both cases are compared as follows;

Table 2.8.3-2 Comparison of Quay Wall Structure of Cebu Baseport

Type of structure for reconstruction	By Steel Sheet Pile	By Concrete blocks and existing concrete piles
Construction cost	Imported materials are required. The cost will be expenses.	Local available materials are used. The cost will be economical
Construction period	*Shorter than concrete structure*	*Period will be longer*
Construction method	Simple and faster.	Complicated by sea bed improvement for placing blocks

The typical cross section of pier No.1 by using SSP type berth structure is the similar as planned for Toledo Port as shown in Fig. 2.8.3-4 and concrete blocks is shown in Fig. 2.8.3-5.

3) Pier No.3 reconstruction for passenger ships

In case pier No.3 will be used for small passenger ships due to shallower depth, the upper structure of such pier will be demolished and new upper structure is reconstructed on the existing concrete piles in similar manner as rehabilitation works of Pier No.2. Some of the concrete piles along the periphery of the pier No.3 are damaged, and they should be repaired.

2.8.4 Preliminary Design Concept of Access Road Way Structure

The access road is required to connect between the existing national road of Mandaue to Liloan and the planned new Cebu port area to run 40 ft containers trucks. The topographic surveys of the access road area was carried out for planning the alignment of the access road way. The preliminary design concept of the access road is described as follows.

(1) Number of Required Traffic Lanes

According to the required number of lanes based on the traffic, 4 lanes are required for 2020 traffic. The width of a traffic lane which is 3.25 m to 3.5 m with two lanes on one way side are planned.

In 2010, 2 lanes will be enough but the area for future additional 2 lanes will be reserved. For long-term development plan, the width of the access road ways should be planned to have 2 lanes on one side of the road.

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

Basically the access road alignment is planned 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 1,570 m to 1,800 m including the approach embankment to the existing national road

There are large difference in the high and low ground level in the planned road area. The road alignment is planned to have maximum gradient of 4 % for safety running of 80 km/hr by 40 ft container trucks. The following alternative access road plans are considerable on the land side such as:

- Widening the existing road,
- Constructing a new road on the ground and partially fly over,
- Constructing a new road with overhead type over the resident, factories area and offshore.

The considerable advantages and disadvantages of above three alternatives are listed below:

1) Widening the existing road, which have many small bends is required large land acquisition and relocation of residents along the road, which will cause social environmental problems.
The foundation of the existing road should be reinforced for running of heavier loaded container trucks.

2) The existing topography of the planned area is hilly condition with ground level difference between high (+30.0 m) and low (+3.0 m). It is not convenient and safe for container trailers running on such variation of the ground level. It is considered safer for container transport on the limited gradient slope of the road. The construction of a new road on the ground by embankment /cut will require a larger land acquisition and relocation of resident of total road area.

3) Constructing a new road with flyover type will require the minimum land acquisition and relocation of residents for the width of the road area only, which means to minimize the social environmental problem. But construction cost will be higher for fabrication/ installation of beam/slab for road structure and foundation than the constructing on the

existing ground.

Tentatively the new access road alignment is planned with the flyover type in the land area from the port area up to the hill, then the road is developed by cutting high hilly parts of the existing ground between two existing narrow road ways in order to avoid / minimize social environmental problems and to expedite the implementation of the project.
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. The connection with the existing 2-lanes national road will be planned by interchange of flyover and ramp approach roads.

(3) The Design concept of Bridge Pier, Beams and Foundation

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 land side 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 every 30 - 40 m interval starting from the newly reclaimed area for the New Cebu Port island. For the long term plan in the case of increasing traffic volume additional footing and supporting column for widening to 4 lanes will be constructed. The land acquisition of the access road for the short-term plan will be 3 lanes portion (14 m width) and for long term plan the additional area of 1 lane portion (around 6 m) is required.

The superstructure of 15.0 m width of the road area for short-term plan will be designed with 8 pieces PCI-girder (span = 30 m) to be placed in one span and concrete pavement on the slab on the PC I-girder beam.

Interchange with the existing national road is planned by combination of approach embankment of around 75 m long and flyover of 150 to 160 m long. The planned alignment, typical cross and longitudinal section of the access road is shown in Fig. 2.8.4-.1

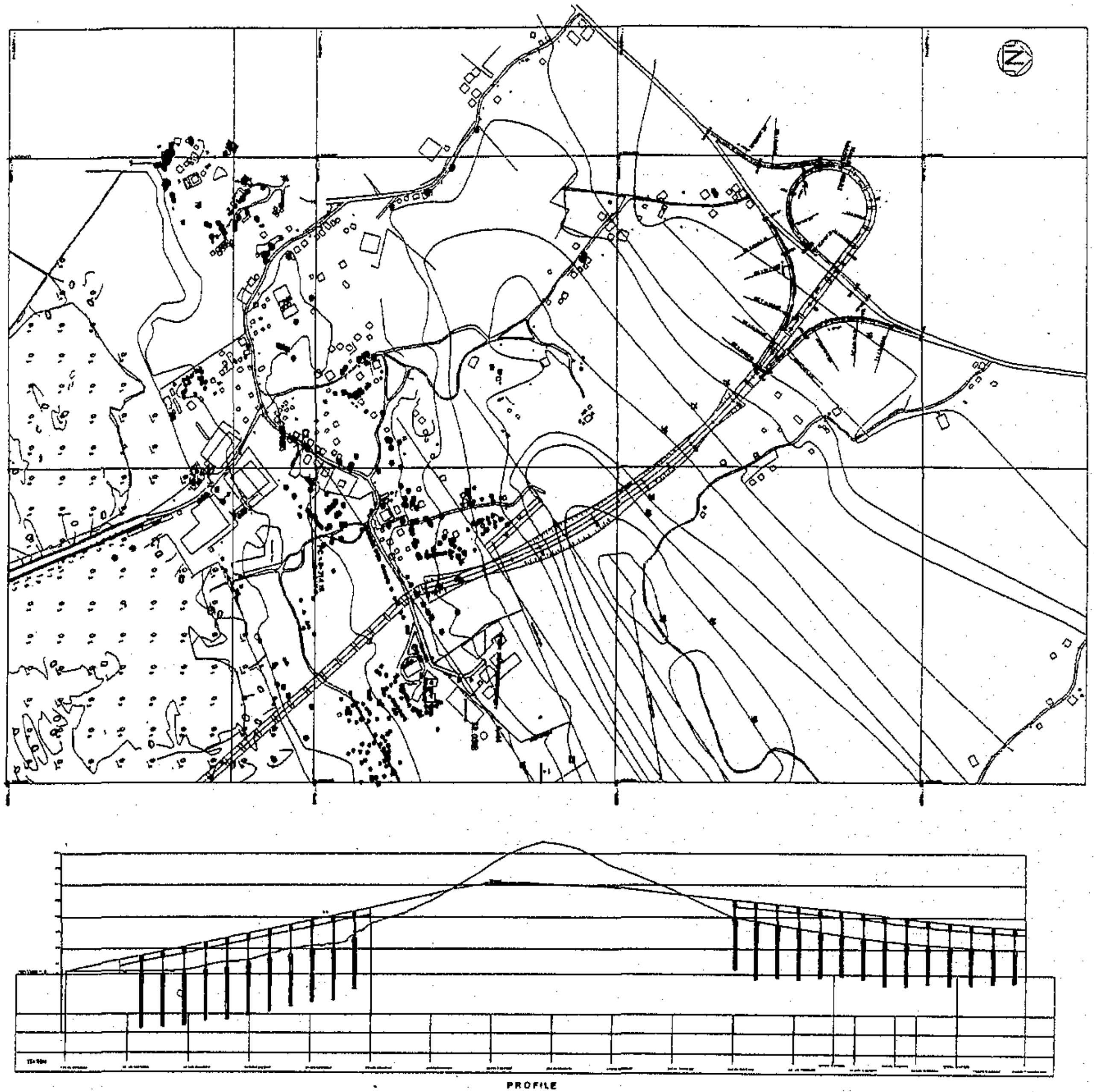


Fig. 2.8.4-1 Access Road Alignment and Longitudinal Section

2.9 Preliminary Cost Estimation and Implementation Planning

An implementation schedule and total project cost of the long-term development plans for the four project components are studied. This section describes firstly the implementation plan of the project and then preliminary cost estimation.

2.9.1 Implementation Plan

As described in the previous chapters, the demand of the cargo and passengers in all the studied ports will exceed the port capacities shortly. Therefore immediate actions for the development thereof are necessary. In this plan it is assumed that the anticipated procedure of project implementation will start immediately after the master plan and feasibility study is completed.

(1) Master Schedule

As described in previous sections, the long-term plans will be developed in two phases. The requirement in scheduling is that the first phase has to be commenced soon after this study because of its urgency, and the second phase has to be completed before the port capacity of first phase becomes full. According to the demand forecast, the first phase will be saturated by 2012, therefore, it is planned that a part of the second phase becomes operational by the beginning of 2013. (See Fig. 2.9.1-1(1)) This is the general parties that before actually seeing the phase 1 operation, the second phase project should not be started because it is too risky to invest a large amount of money in such uncertainty.

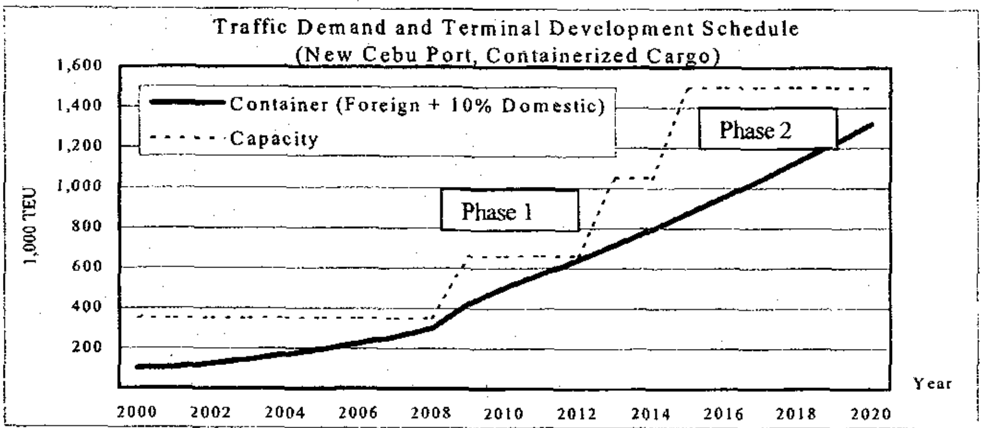


Figure 2.9.1-1(1) Traffic Demand and Terminal Development Schedule (New Cebu Port, Container Terminal)

Accordingly the master schedule of the project, consisting of a development of the New Cebu Port and New San Remigio Port, rehabilitation and expansion of Cebu Baseport and Toledo Port, is shown in Fig. 2.9.1-1(2). The required period of the projects are summarized in Table 2.9.1-1.

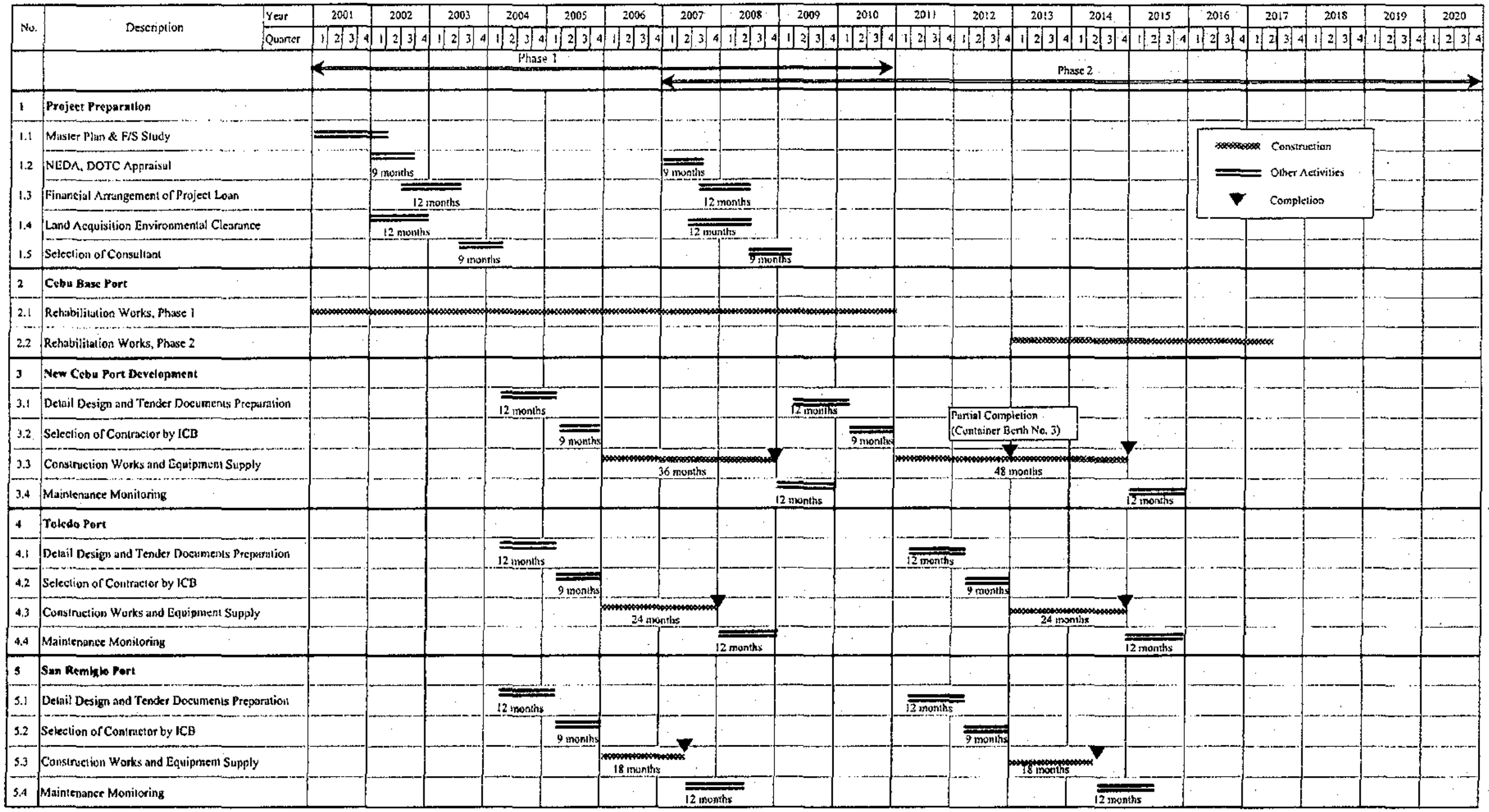


Fig. 2.9.1-1(2) Master Schedule

Table 2.9.1-1 Required Period of the Project (Phase 1 and 2)

	New Cebu Port	New San Remigio port	Toledo Port
NEDA, DOTC Appraisal	9 months		
Financial Arrangement, Land Acquisition and Environmental Clearance	12 months		
Selection of Consultant	6 months		
Detail Design	12 months	9 months	
Selection of Contractor	9 months	9 months	
Construction Works - Phase 1	36 months	18 months	24 months
Construction Works - Phase 2	48 months		

(2) Construction Method and Schedule

Some of the important construction aspects and construction schedules for the selected alternative plans are briefly described below.

1) The New Cebu Port

a) Dredging Work

According to the soil investigation results, the soil to be dredged is sandy coral and silty clay. Although the number of samples is limited, the dredged soil seems not suitable for the reclamation and may have to be dumped at the site designated by CPA.

The estimated total dredging volume for phase 1 and 2 is approximately 260,000 m^3. In this implementation plan, 6 m^3 capacity Grab Dredger is considered with the average dredging volume 1,500 m^3/day.

b) Reclamation Work

Total volume of 2,400,000 m^3 of soil will be required to fill the area of 65.3 ha to elevation between 2.2 m and 3.2 m (finished ground level will be between 3 and 4 m). The sufficient volume of soil can be obtained in the quarries both in Cebu Island and surrounding islands such as Bohol and Leyte. At this moment, obtaining soil from the sea bottom is not considered due to the negative impact on environment. Assumed average daily volume is approximately 5,000 m^3.

c) Rock Work

Approximately 1,000,000 m3 of rock is required for backfill stone behind the quaywall and the revetments. Sufficient volume of good quality marblize stone is available in the western part of the island.

Assumed daily production rate of rock works is as follows.

- Backfill stone behind the quaywall (1 - 10 kg/pc) : 2,000 m^3/day

- Core stone for revetment and causeway (1 - 30 kg/pc) : 400 m^3/day
- Armor rock for revetment and causeway (> 100 kg/pc) : 100 m^3/day

d) Piling Work

1,580 m berths comprise approximately 900 steel pipe sheet piles and 900 steel piles. 2 barge mounted piling rigs will be necessary; one for driving sea-side sheet piles and another for landside piles. The daily production rate are assumed as follows.

Steel Pipe Sheet Pile : 3 piles (driving length, approx. 50m)/day
Landside Pile; anchor pile : 6 piles (driving length, approx. 50m)/day
Landside Pile; crane rail foundation pile: 4 piles (driving length, approx. 70m)/day

2) Cebu Baseport

Rehabilitation and expansion works comprise the following work items:

- Concrete Pile Work
- Concrete Work
- Steel Sheet Pile Work
- Paving Work
- Reclamation Work
- Building Work
- Utility Work

The works are mainly continuation of the on-going projects except for building works and renovation of Pier 1. Each rehabilitation or expansion project have been scheduled to be finished in one or two years in accordance with berth allocation plans. The required construction periods are estimated based on the past and on-going works at Cebu Baseport.

According to the results of investigations of the existing structural conditions of Piers 1 and 3, it was found that the existing concrete piles are heavily damaged. Additionally it is recommended that Pier 1 be converted to accommodate 2,000 dwt class cargo ships. Pier 1 will be reinforced by driving steel sheet piles along side the entire length of the existing pier. The construction period is estimated at 2 years.

3) The New San Remigio Port

The proposed port site is now being developed by a private firm as a port. Approximately 50m of the quaywall with bollard and some filling have been completed. The proposed plan is to purchase the facility and utilize most of it. Other remaining works other than completion of the quaywall and yard development will include dredging of channel and constructing access road.

a) Dredging Work

The total dredging volume for the access channel and port basin is approximately 220,000 m3. At this moment there is no latest data on soil, topographic and hydrographic conditions. The plan was prepared based on the visual observation, discussions and old chart and maps. It is reported that seabed of hard rock is found at the entrance of Hagnaya Bay. The exact location and required port area is unknown, however according to meeting/discussion it is probably in the south of the planned port location. Therefore the seabed material to be dredged is assumed as coral and dense sandy mixed soil and 3,200 PS cutter suction dredger is considered. Estimated average dredging volume is 1,500 m3/day.

b) Construction of Access Road
There is an existing dirt road between Hagnaya port and the proposed site. In construction of the access road, land acquisition is required. The area is mostly waste or farm land with scattered houses. Thus resettlement of some families will be involved.

4) Toledo Port
New 700m-berths and a 38,000 m2 - back yard is planned attached to the existing pier. The construction work will include:

- Steel Sheet Pile Work for quaywall
- Dredging of basin to -4m and -6m
- Concrete Pile work and concrete work for expansion of the existing pier
- Reclamation
- Utilities

a) Dredging Work
Like the case in the new San Remigio Port, the soil condition at the site is unknown. From the experience of concrete piling for construction of the mooring dolphin by CPA, the sea bed material is assumed as cohesive sandy clay. As the dredging volume is small, 0.8m3 grab dredger is considered for such work. Estimated dredging volume is 200 m3/day.

b) Reclamation Work
Approximately 130,000m3 of reclamation work is required. The filling materials can be obtained from the quarries near the port or dredged material may be used for the reclamation. The daily volume is estimated at 500m3/day.

Although the subsoil condition is unknown, there might be a consolidation settlement of the reclaimed land. In this plan, some allowances for soil improvement is included. This will have to be further studied in the detail design. In addition, more soil borings may be carried to determine the actual soil condition.

5) Proposed Schedule
With the above assumptions, construction schedules of the New Cebu Port, New San Remigio

Port and Toledo Port are prepared and shown in Fig. 2.9.1-2 through 2.9.1-4. The total construction period is summarized in Table 2.9.1-2.

Table 2.9.1-2 Summary of Construction Period

	Total Construction Period	
	Phase 1	Phase 2
The new Cebu port	36 months	48 months
The new San Remigio port	18 months	
Toledo port	24 months	

2.9.2 Cost Estimation

For the purpose of economic and financial project evaluation, the cost of the total project life is estimated. The required costs are divided into four (4) categories, of which the basic characteristics are shown in Table 2.9.2-1.

Table 2.9.2-1 Basic Characteristics of Cost Categories

Cost Categories	Type			Remarks
	Civil Works	Equipment	Total	
(1) Capital Costs	X	X	X	
(2) Replacement Costs		X		Replacement of initial and additional equipment after its life time
(3) Maintenance Costs	X	X		All the initial and additional investment
(4) Operation Costs			X	Starting from 2009 (assumed) for New Cebu Port

(1) Assumptions of Cost Estimation

This cost estimate is prepared using the market price of June 2001 and based on the cargo volume for evaluation period, terminal facilities as required and equipment and operational schemes prepared for the long term development plan presented in the previous chapters.

The basic conditions and assumptions applied for the cost estimates are as follows:

- 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 in the country.
- The estimated cost for each item of works and service 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

Work Item	Description of Works	Unit	Quantity	Required Months
1	Civil Works			
1.01	Mobilization and Demobilization			
1.02	Dredging Works	m3	135,000	4.0
1.03	Container Berth (Depth -13m) Construction	m	600	11.0
1.04	Multi-purpose Berth (Depth -10m) Construction	m	190	6.0
1.05	Revetment	m3	70,000	8.0
1.06	Reclamation	m3	1,300,000	11.0
1.07	Soil Improvement	m2	331,000	15.0
1.08	Yard Pavement (incl. Transfer Crane Foundation)	m2	290,000	16.0
1.09	Small Boat Mooring Pontoons	sum	1	12.0
2	Utilities	sum	1	16.0
3	Building Works	sum	1	16.0
4	Access Road	m	3,500	18.0
5	Navigation Aids and Vessel Traffic System	sum	1	12.0
6	Cargo Handling Equipment	sum	1	24.0

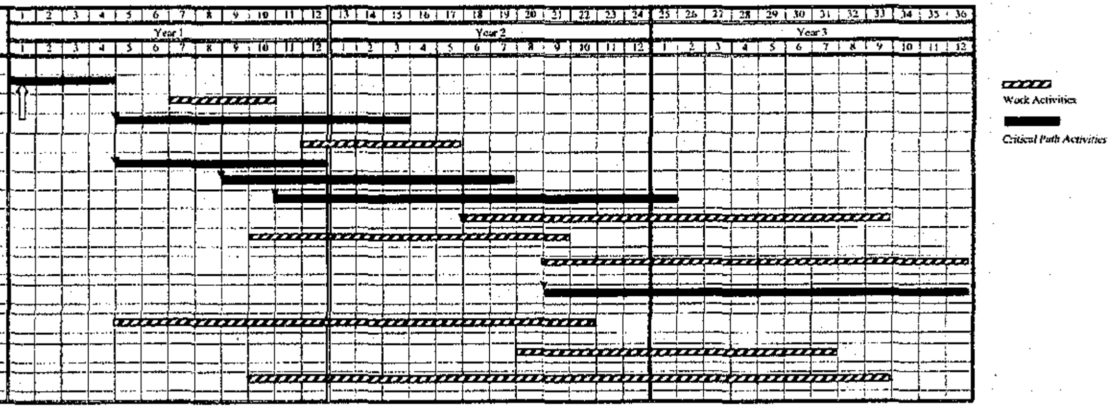


Fig. 2.9.1-2 Construction Schedule (The New Cebu Port - Phase 1)

Work Item	Description of Works	Unit	Quantity	Required Months
1	Civil Works			
1.01	Mobilization and Demobilization			
1.02	Dredging Works	m3	13,000	3.0
1.03	Berth (Depth -4m)	m	210	4.0
1.04	Revetment (sheet pile)	m	110	3.0
1.047	Revetment (rubble mound)	m	210	3.0
1.054	Concrete Deck type	m2	1,650	5.0
1.063	Reclamation	m3	60,000	5.0
1.068	Preloading	m2	13,000	5.0
1.075	Yard Pavement	m2	13,000	4.0
2	Utilities			10.0
3	Building Works			10.0

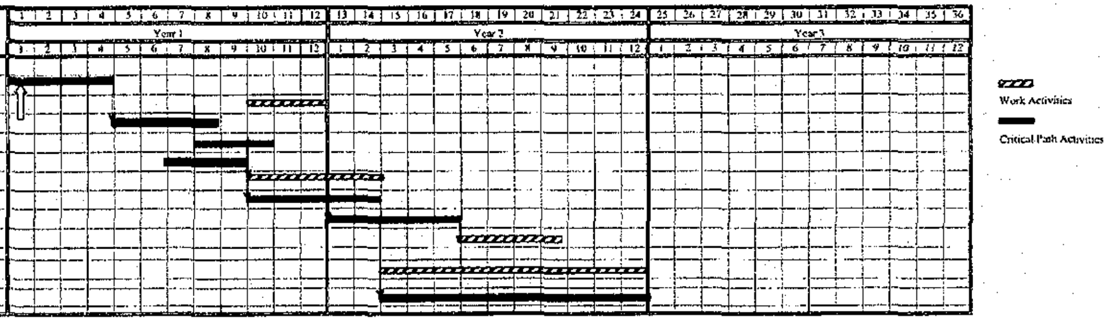


Fig. 2.9.1-3 Construction Schedule (Toledo Port - Phase 1)

Work Item	*Description of Works*	Unit	Quantity	Required Months
1	Civil Works			
1.01	Mobilization and Demobilization			
1.02	Dredging Works	m3	200,000	5.0
1.03	Piling	nr	190	2.0
1.04	Concrete Deck	m2	1,200	3.0
1.05	Ro-Ro Berth and Revetment	m	75	2.0
1.06	Reclamation	m3	40,000	2.0
1.07	Yard Pavement	m2	7,000	3.0
1.08	Access Road	m	1,500	6.0
2	Utilities	m2	7,000	10.0
3	Building Works			10.0

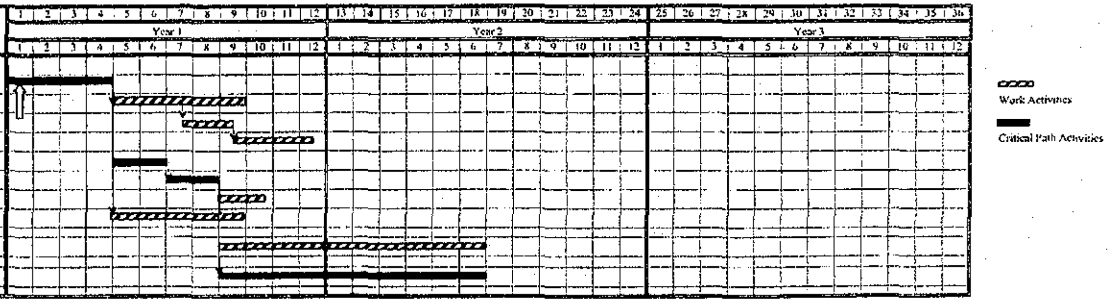


Fig. 2.9.1-4 Construction Schedule (San Remigio Port - Phase 1)

(2) Capital Costs of Each Port

The capital project costs comprise construction, equipment procurement, land acquisition cost, engineering services, contingencies, etc. The quantities are worked out from the preliminary layout and design drawings shown in the previous chapters and topographic, soil and other data.

1) Construction Cost

Construction costs comprise Direct Construction Costs, Indirect Construction Costs and the Contractor's Indirect Costs, as shown in Table 2.9.2-2.

Table 2.9.2-2 Composition of Costs

Construction costs	- Direct construction costs	- Labor costs - Material Costs - Equipment Costs - Other component of the costs
	- Indirect construction costs	- Mobilization costs - Temporary facilities
	- Contractor's Indirect costs (Overhead)	- Site office expenses - Home office expenses - Profits

a) Direct Construction Costs

Direct construction costs are estimated on the basis of unit prices and lump sum amounts comprising labor cost, material cost, machinery cost and subcontracting cost.

- Labor Cost comprises the daily wages and monthly salaries of personnel engaged in direct works. This includes overtime, allowances, social insurance and so on.

- Material Cost comprises the purchase prices and inland and/or ocean transportation costs of permanent materials. Value added taxes and import duties are not included in the material costs.

- Machinery Cost comprises depreciation, repair, ownership & maintenance costs and operating costs

The unit prices are calculated based on the data collected from various sources such as CPA, local contractors and consultant's own experience in the similar projects. The unit prices of the major items used for the estimate are shown in Table 2.9.2-3.

Table 2.9.2-3 Unit Costs of Major Materials and Works (Direct Cost)

Works/Materials	Unit	Unit Cost (Peso)
Earth Work		
Reclamation (including hauling and compaction)	m3	245
Dredging	m3	230 - 372
Supply and Place Rubble Stone	m3	500
Excavation	m3	160
Paving		
Sub-base course (including spreading and compaction)	m3	550
Base course (including spreading and compaction)	m3	580
Concrete Pavement	m3	2,600
Concrete Works		
Fine Aggregate (material)	m3	400
Course Aggregate (material)	m3	380
Cement (material)	bag (40 kg)	130
Reinforcement (installation and erection)	kg	30
Concrete (3000 psi); material	m3	2,000
Concrete (4000 psi); material	m3	2,500
Formwork (incl. forming and stripping)	m2	300 - 900
Piling Works		
PC Pile (incl. supply and drive)	m	2,000
Steel Pipe Sheet Pile SKY 490 (ϕ = 1200mm, excl. junction); material only	kg	53.2
Steel Pipe Sheet Pile SKY 400 (ϕ = 800mm); material only	kg	47.1

b) Indirect Construction Costs

Indirect Construction Costs comprise:

- Mobilization and demobilization of major construction equipment, plant and personnel
- Contractor's temporary site facilities
- Engineer's temporary site office
- Survey and laboratory equipment and operation

Indirect construction cost is assumed at 4% of the direct construction cost.

c) Contractor's Indirect Costs

The Contractor's Indirect Costs comprise site office expenses, head office expenses and profits.

The contractor's indirect costs were estimated at 22% of the Direct Construction Costs (12% for the overhead and 10% for the profit) and included in the unit price.

d) Cost Component of Unit Price

Unit prices (direct construction cost + contractor's indirect cost) are divided into local and foreign components based on the composition of each cost items. The proportions of local and foreign components of works are estimated as shown in Table 2.9.2-4.

Table 2.9.2-4 Breakdown of Local and Foreign Components

Descriptions	Local	Foreign
Dredging	20%	80%
Reclamation	40%	60%
Concrete Work	40%	60%
Piling Work	10%	90%
Pavement Work	40%	60%
Drainage Work	30%	70%
Utilities Work	40%	60%
Building Work	40%	60%
Cargo Handling Equipment	10%	90%

2) Equipment Procurement

Equipment procurement costs comprise Equipment Cost and Spare Part Costs, as shown in Table 2.9.2-5. The equipment costs are estimated based on the results of the international competitive biddings in various countries. The manufacturer's indirect cost (overhead and profit) are deemed included in the unit costs.

Table 2.9.2-5 Composition of Equipment Procurement Costs

Equipment Procurement Costs	- Equipment Costs	- Material and Manufacturing costs
		- Transportation Costs
		- Installation Costs
		- Manufacturer's Indirect Cost, Overhead and Profit
	- Spare Part Costs	- Material and Manufacturing costs
		- Transportation Costs
		- Manufacturer's Indirect Cost, Overhead and Profit

3) Engineering Services

The cost for engineering services, comprising design, tender assistance and construction supervision is estimated at 7% of the construction and equipment procurement cost excluding land acquisition and other compensation cost.

4) Contingencies

Physical contingency is assumed at 10% of the total cost. Price contingency is not considered since the estimate is expressed in the fixed price of June 2001.

5) Summary of Cost Estimation of Study Port

The capital cost of the alternative layouts for each port is estimated. The summary is shown in Table 2.9.2-6 and the breakdown is attached in the appendix. The summary of major work volume and preliminary cost estimate based on the recommended layout are also shown in Table 2.9.2-7 through 10.

Table 2.9.2-6 Cost Comparison of Alternative Layout plans (million Pesos)

Port	Plan 1	Plan 2	Plan 3
New Cebu Port	18,200	17,900	
Toledo Port	970	940	960
San Remigio Port	490	500	630

Note: VAT is included

Table 2.9.2-7 Major Work Volume and Preliminary Cost Estimate of Cebu Base Port

Description	Quantity	Local (Million Pesos)	Foreign (Million Pesos)	Total (Million Pesos)
Rehabilitation & Extension of Berth 8-10	354m	63.2	147.4	210.5
RORO Berth 10 - 12	301 m	53.7	125.3	179.0
RORO Berth 13 - 14	240 m	42.8	99.9	142.7
RORO Berth 15 - 16	199 m	35.5	82.8	118.4
RORO Berth 16 - 17	120 m	21.4	50.0	71.4
Passenger Terminal for Super Ferry	7,000 m2	98.0	147.0	245.0
Boarding Bridge	450 m	5.7	22.7	28.4
Passenger Terminal A for RORO	2,800 m2	39.2	58.8	98.0
Passenger Terminal B for RORO	2,800 m2	39.2	58.8	98.0
Passenger Terminal C for RORO	2,800 m2	39.2	58.8	98.0
Container Yard	60,000 m2	46.9	187.6	234.5
Rehabilitation of Pier 1	313m	63.8	148.9	212.7
Rehabilitation of Pier 2	5,000 m2	16.6	38.7	55.2
Expansion of Pier 2	290 m	59.1	138.0	197.1
Rehabilitation of Pier 3	5,000 m2	16.6	38.7	55.2
Building and Berthing for Fast Craft (Berth 18 - 19)	2,800 m2	33.6	78.4	112.0
Expansion of Berth 21-22	260 m	52.3	121.9	174.2
Expansion of Berth 24-25	250 m	50.3	117.3	167.5
Rehabilitation of Fendering System (Berth 28 - 30)	371 m	1.6	3.8	5.4
Rehabilitatio of Berth 28 - 30	371 m	6.4	14.9	21.2
Expansion of Berth 28 - 30	371 m	66.2	154.5	220.6
Navigation Aids	Sum	0.9	16.1	17.0
Total		**852.0**	1,910.0	2,762.1
Engineering Cost	7 %	63.8	129.5	193.3
Contingency	10 %	91.6	204.0	295.5
VAT	10 %	325.1	0	325.1
Grand Total		**1,332.5**	2,243.6	3,576.1

Table 2.9.2-8 Major Work Volume and Preliminary Cost Estimate of the New Cebu Port

Description	Quantity	Local (Million Pesos)	Foreign (Million Pesos)	Total (Million Pesos)
1. Civil Works				
Dredging	210,000 m3			
Container Berth (Depth -12m)	1,200 m			
General Cargo Berth (Depth -10m)	380 m	1,927.8	4,580.5	6,508.4.3
Reclamation	2,400,000m3			
Yard Pavement	450,000 m2			
Reefer Container Yard	1,296 TEU			
2. Utilities				
Power Supply				
Lighting System (Exterior)				
Telecommunications		205.8	381.9	587.7
Water Supply, Sewage, Firefighting				
Environmental Treatment Facilities				
Improvement in Information Tech.				
3. Buildings				
Terminal Building	4,900 m2			
CFS	3,200 m2			
Maintenance Shop	2,250 m2			
Gate	26 lane	256.2	453.5	709.7
Port Authorities Office	4,900 m2			
Seamen's Club & Duty Free Shop	400 m2			
Conventional Berth Cargo Shed	4,200 m2			
4. Access Road				
Access Road	1,500 m	92.7	169.8	262.5
Causeway	300 m			
5. Vessel Support				
Vessel Traffic Control System	Sum	1.0	119.0	120.0
Navigation Aids	Sum			
6. Cargo Handling Equipment				
Quay Gantry Crane	10 nr			
Rubber Tired Transfer Crane	32 nr			
Tractor Head (for yard)	65 nr	556.6	5,009.0	5,565.5
Chassis (20' - 40')	78 nr			
Forklift Truck	25 nr			
Computer System	1 nr			
7. Other				
Land	40,000 m2			
Mangrove	60,000 m2	95.1	-	95.1
Relocation	sum			
Total		**3,186.5**	**11,115.8**	**14,302.3**
Engineering Cost		317.7	645.1	962.8
Contingency (10%)		335.3	1,145.8	1,481.2
VAT (10%)		1,629.3	-	1,664.3
Grand Total		**5,417.5**	**12,504.5**	**17,922.1**

Table 2.9.2-9 Major Work Volume and Preliminary Cost Estimate of the New San Remigio Port

Description	Quantity	Local (Million Pesos)	Foreign (Million Pesos)	Total (Million Pesos)
1. Civil Works				
Dredging	250,000 m3			
Berth (Depth -4m)	2,400 m2	91.0	186.5	277.5
Yard Pavement	14,000 m2			
Access Road	1,500 m			
2. Utilities				
Power Supply				
Lighting System (Exterior)		2.4	3.5	5.9
Telecommunications				
Water Supply, Sewage, Firefighting				
3. Buildings				
Passenger Terminal	600 m2			
Gate	Sum	14.8	22.1	36.9
Warehouse	600 m2			
4. Vessel Support		0.4	8.0	8.4
Navigation Aids	Sum			
5. Cargo Handling Equipment				
Forklift Truck	9			
Mobile Crane	1	4.9	44.3	49.3
Trailer/ Truck	4			
6. Land Acquisition				
Access Road	15,000 m2			
Port Area	12.800 m2	9.4	-	9.4
Quaywall and revetment	110 m			
Total		**122.8**	264.5	387.2
Engineering Cost		8.7	17.7	26.4
Contingency (10%)		13.2	28.2	41.4
VAT (10%)		45.5	-	45.5
Grand Total		**190.2**	310.4	500.6

Table 2.9.2-10 Major Work Volume and Preliminary Cost for Toledo Port

Description	Quantity	Local (Million Pesos)	Foreign (Million Pesos)	Total (Million Pesos)
1. Civil Works				
Dredging	28,000 m3			
Reclamation	185,000 m3	164.2	371.1	535.3
Berth (Depth -6m)	380 m			
Yard Pavement	38,200 m2			
2. Utilities				
Power Supply				
Lighting System (Exterior)		6.4	9.6	16.0
Telecommunications				
Water Supply, Sewage, Firefighting				
3. Buildings				
Passenger Terminal	1,000 m2			
Gate	Sum	31.9	49.0	83.9
Warehouse	2,300 m2			
4. Cargo Handling Equipment				
Forklift Truck	17			
Mobile Crane	1	11.5	103.5	115.0
Trailer/ Truck	13			
Total		**214.0**	533.2	747.2
Engineering Cost		17.3	35.0	52.3
Contingency (10%)		23.1	56.8	79.9
VAT (10%)		87.9	-	87.9
Grand Total		**342.3**	625.1	967.3

(3) Service Life of Facilities

The service life of major facilities normally considered is as follows:

Civil Works	50 years
Buildings	30 years
Quay Gantry Cranes	20 years
Yard Cranes	10 years
Forklift	10 years
Other equipment	10 - 20 years

For the estimation of cashflow, replacement cost is added every 10 to 20 years depending on the service life.

(4) Maintenance Cost

Maintenance costs are estimated at 1%/year of construction cost and 3%/year of equipment procurement cost.

(5) Operation Cost

Operation cost comprises personnel salary of CPA and stevedores and equipment fuel/energy consumption cost for cargo handling. Cargo handling charges are regulated by CPA and vary with commodities and cargo types. The operation cost is assumed at approximately 80% of the average handling charges as shown below:

International Containerized Cargo:	850 pesos/TEU
International Non-Containerized Cargo:	80 pesos/ton
Domestic Containerized Cargo:	300 pesos/TEU
Domestic Non-Containerized Cargo:	50 pesos/ton