PART – 3

Implementation Plan as Japan's ODA Loan Project

14. Project Scope

14.1 Contents and Scale of the Project by MOT Decision

Based on Document 143/TTg-CN dated 23 January 2008 issued by PM on construction investment of Lach Huyen (Hai Phong) gateway seaport project;

Pursuant to Decision No. 2231/QD-BTNMT dated 31 October 2008 of Ministry of Natural Resource and Environment approving the report of EIA of the project "Hai Phong International Gateway Seaport Construction Investment", and

Considering the Report No. 2318/CHHVN-KHDT dated 30 November 2007 of VINAMARINE referring to proposal for approving Hai Phong International Gateway Seaport Construction Investment Project for the year 2010 to 2015, Report No. 203/HHVN-KHDT dated 21 February 2008 of VINALINES on proposal for approving Lach Huyen - Hai Phong Gateway Seaport Construction Investment Project (commencement stage),

MOT approved the Hai Phong International Gateway Seaport Construction Investment Project for the commencement stage by the Decision No. 3793/QD-BGTVT, dated 22 December 2008 with key contents as follow

This project is divided into two (2) components, i.e., Component A which shall be implemented by Government budget (ODA and counter fund) and Component B which shall be responsible by VINALINES.

1) Component A:

a) Vessel Channel and Turning Basin

- One (1) way channel, length 18km from Buoy "0", width 130m, depth -10.3m for 30,000DWT vessel (full load) and 50,000DWT (partial load).
- Vessel Turning Basin: diameter 560m and depth -10.3m.

b) Breakwater (Outer Breakwater)

- Length 3,900m, elevation +5.5m and retaining wall elevation +9.0m.

c) Sand (Protection) Dyke

- Length 5,700m, bottom elevation -3.0m, top elevation +2.0m (the length of the sand dyke will be determined in the technical design stage.)

d) Port Service Road

- Length 630m, 3 lanes with 12.5m each way, 16m median.

2) Component B

a) Berth Construction

- 2 container berths with 600m long, 50m wide, top elevation +5.5m, bottom elevation -14.0m.for receiving 4,000TEU container vessel or 50,000DWT general cargo vessel.
- Protection embankment for berth bottom and upstream and downstream of berth.

b) Reclamation and soft Soil Improvement

- Land reclamation for terminal yard and improvement of soft soil using sand pile with pre-load.

c) Road and Yard

- Road and yard inside the port

d) Architectural facilities

- Port gate, Weighing station, Managing office, Maintenance shop, Fuel station: 80m^2, Fence, Garages, Canteen, etc.

e) Utilities

- Power supply system, Freshwater supply system, Water drainage and sewage treatment system, Fire protection and fighting system, Telecommunications

f) Cargo handling equipment

- Equipment for container handling and break-bulk general cargo handling.

In addition to above, Component A includes "Land Clearance and Resettlement" and this component was independently assigned to Hai Phong People Committee as a subproject of Component A2 by PM's Document 1665/TTg-CN dated 17 October 2006.

14.2 Change of Scope and Scale

SAPROF study has reviewed above demarcation of scope and scale of project components and recommends changing the scope and scaling as follows:

14.2.1 Change of Scope

1) Land Reclamation and Soil Improvement

The land reclamation and soil improvement of terminal area is included in the Component B but VINALINES requested MOT to be included in the Component A and SAPROF study supports VINALINES' request by the following reasons:

(1) Huge Amount of Investment Cost

- If land reclamation is invested by the private sector, the decision how to use or sell the land will be made by the private sector. Lach Huyen Port has the great impact to the Vietnamese economic development; therefore, such a risk should be avoided by the public sector.
- The soil condition around the project site is very soft and once reclamation fill and surcharge is loaded, possible consolidation settlement of subsoil is anticipated at around 150cm in very long period. Therefore, soil improvement is inevitable for construction of container terminal. Almost all area (37 ha) is improved by PVD (Plastic board Vertical Drain) method since this method has many technical advantages and most economical. In addition, although more costly than PVD method, around 50m wide back-of-berth area (4.25 ha) that is intended for use as temporally yard for construction of berth structure is improved by CDM (Cement Deep Mixing) method to handover the reclaimed area for succeeding construction work of berth as early as possible. This soil improvement work will require about 40 million USD.
- Lach Huyen Port infrastructure development project requires huge amount of investment and was decided to be developed by PPP (Public Private Partnership) scheme by the GOV and the project owner, VINALINES, considered as the Private sector. In stead of requesting further investment from the Private sector, it is constructive that GOV shares the cost of this portion and encourage the private sector

(2) Economical Benefit for Public Sector

- For carrying out the land reclamation and soil improvement works, the private sector shall secure the fund from private bank with a high interest rate while the public sector can use ODA fund with a low interest rate. Therefore, based on the economic analysis under the assumptions that the loan interest is 5% p.a. and repayment period is 12 years after 8 years grace period for private finance and the ODA loan interest is 0.2% p.a. and repayment period is 30 years after 10 years grace period for public finance, the public sector can perform the works by less amount of NPV 33.8 million USD than the private sector.

(3) Risk of the Delay of the Schedule

- When land reclamation and soil improvement works shall be done by private sector, there will be the risk to cause the delay of the completion. Because the Private Sector considers that the completion of the basic infrastructure is one of the major risks for this project and will request the proof of the commencement of the public investment before commencement of their works. Therefore certain delay is not avoidable.

(4) Risk of the Decision on Application of STEP

- Reclamation and Soil Improvement in a limited amount of time requires the Japanese technology, so that it is easy to apply STEP (Special Terms for Economic Partnership). However, if these work items are not included in the public portion of works, it is not easy to justify the necessity of Japanese technology for remaining works.
- Compared to the ordinary terms of ODA Loan, STEP is more concessional terms, such as lower interest rate, longer repayment period, and larger coverage. This is great benefit to GOV.
- In addition, grant aid for detailed design can be arranged only in the case of STEP loan. If STEP loan can not be applied, substantial delay of the implementation schedule is not avoidable.

Based on the above reasons, SAPROF study would like to recommend that land reclamation and soil improvement works for the terminal yard of Berth No.1 & 2 be incorporated into the public investment portion.

From the same viewpoint, the protection embankment work for terminal land which is now included in Berth Construction of Component B should be transferred to Component A as a part of land reclamation work because the reclaimed land can not be functional without embankment.

14.2.2 Change of Scale

1) Design Vessel Size

As explained in Clause 11.1 of Chapter 11, design vessels for this Project was recommended by SAPROF to be 50,000DWT (full load) and 100,000DWT (partial load) container vessels instead of 30,000DWT (full load) and 50,000DWT (partial load) vessels of Decision by MOT. This change was already agreed by MOT in due course of this study.

The change of design vessel size will require the modification of scale of berth structure, terminal yard area, port service road, outer revetment and access channel.

2) Scale of Berth No.1 & 2

Based on the change of design vessels, the length of Berth No.1 & 2 shall be extended from 600m to 750m and terminal yard will also be widened accordingly. The water depth in front of berth structure may not be changed from original plan of -14m CDL for initial stage development, however, structural design depth of berth structure is recommended to be -16m CDL since this berth will be used by fully loaded 100,000DWT container vessels in future and reinforcement for -16m in future is very difficult and costly. For detailed plan of Berth No.1 & 2, refer to Figure 14.2.1.

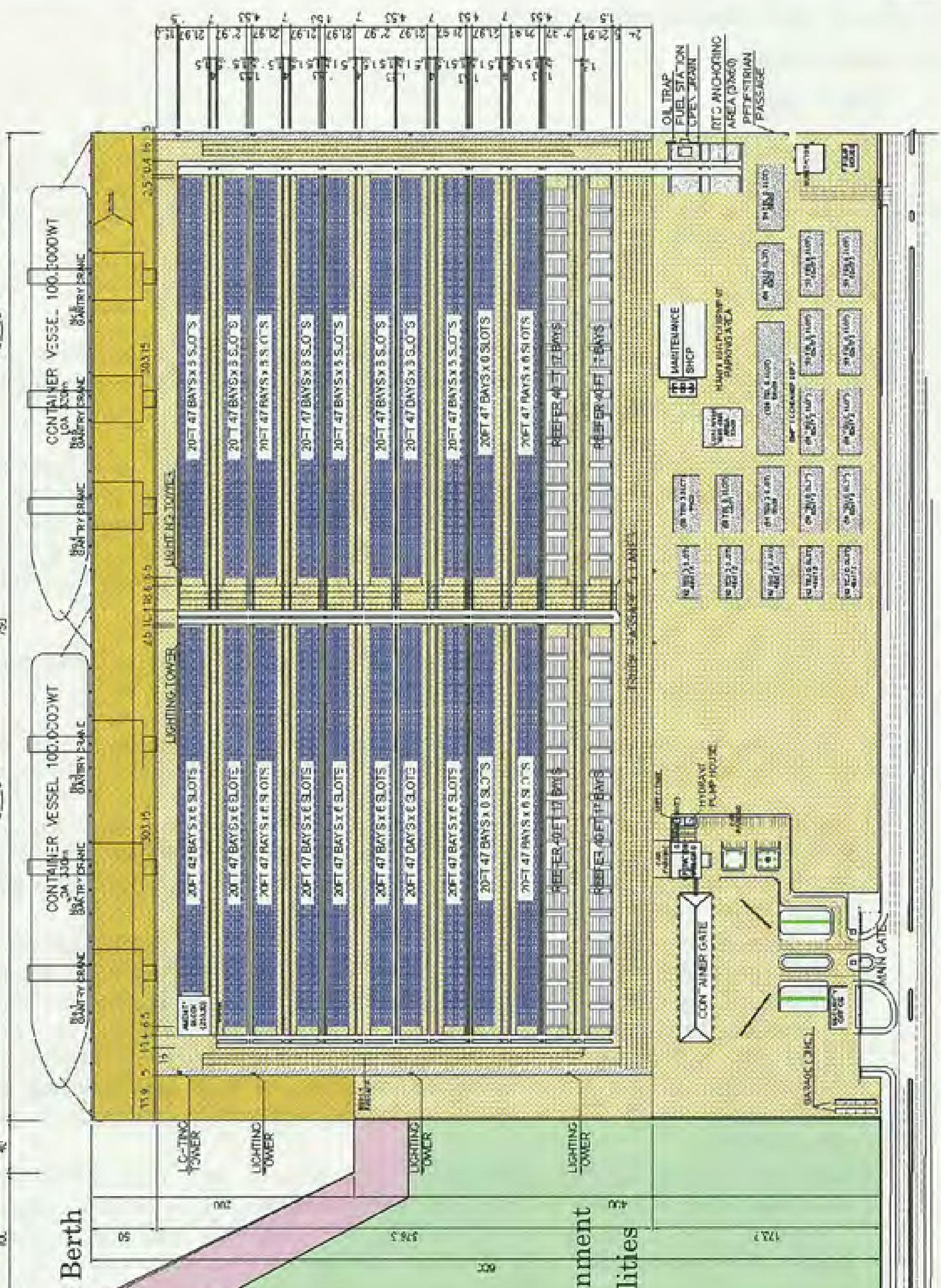


Figure 14.2.1 Layout of Container Terminal No.1 & No.2 and Government Facility Area

4) Scale of Access Channel and Turning basin

a) Access Channel

· Width of Channel

Based on the design vessel width of 100,000DWT container vessel and the existence or non-existence of sand protection dyke for access channel, the required width of access channel was determined in accordance with the guideline of PIANC as 160m with protection dyke and 210m without protection dyke, instead of 130m of Decision by MOT.

· Depth of Channel

In the Decision by MOT, the depth of vessel channel was mentioned as "ship running depth is 13.3m and designed elevation of channel bottom: -10.3m for 30,000DWT vessel with full load and 50,000DWT vessel with partial load".

Above vessel channel was intended to be constructed by 2013 as Initial stage development. However, considering the present situation of the Project, it is impossible to complete by 2013 and estimated to be completed in 2015. On the other hand, based on the approved FS prepared by TEDI, the 2nd stage development of this vessel channel is expected to be deepened up to -14.9m deep (at +3.0m tide level) and designed bottom elevation of -11.9m for 50,000DWT vessel with full load and 80,000DWT vessel with partial load by 2020.

In addition to above, 50,000DWT vessel with full load and 100,000DWT vessel with partial load are proposed to be applied from Initial stage development by SAPROF study.

Considering the above facts and following reasons, SAPROF study recommend to develop this vessel access channel -14m bottom elevation below CDL (Chart Datum Level) from Initial stage.

- 50,000DWT full loaded container vessel requires -14m water depth. This water depth should be available at any tidal conditions for such a large container vessel operation to keep the fixed tight shipping schedule. This is the international standard for international gateway ports like Lach Huyen Port.
- It is impractical condition to apply +3.0m tide level for access channel planning since occurrence probability of more than +3.0m is only 10% which means that only 2.4 hours are available in a day in average. Considering the length of this access channel of 18km, it is impossible for large vessels to enter the port after waiting for leaving of other large vessels. Further more, during neap tide period of around one week or so, there are no tide more than +3.0m which means large vessels shall wait more than one week for next calling and the available dates change every month. It is impossible for shipping companies to provide regular service.
- Even +2m tide level, occurrence probability is about 50% and ships more than 30,000DWT should wait more or less before enter into/ leaving from the port. In order to compare the economical viability between channel depth of -14m case and -12m case, an economic analysis was conducted by SAPROF study. The former case requires more initial and maintenance dredging cost than latter case but no ship waiting cost is required. The result showed that EIRR of -14m case was 12% which means -14m case is economically viable.
- Another economic analysis was conducted from the investment view point by the comparison of following two cases.

  Case 1: -14m channel is constructed at once by ODA loan.
  Case 2: -12m channel is constructed as 1st step development by ODA loan and it will deepened to -14m as 2nd step development 5 years later by Vietnamese own budget.

  The results showed that NPV (Net Present Value) of Case 1 was 4,393 million USD and

NPV of Case 2 was 5,855 million USD which means Case 1 is more economical than Case 2.

- If a port requires large container vessels to wait high tide before entering or leaving, such a port will lose the competitiveness against other ports in the region that will also oppose the Government policy to change the export driven industrialized country by introducing the foreign direct investment. There are many ports which have more than -14m berths already in the region such as Shenzhen, Guangzhou, Manila, Laem Chabang, Port Klang, Cai-Mep, etc.
- This project was determined to be developed by the PPP scheme. The shipping companies who are intended to participate in this project as private investors desire to introduce container mother vessels of Trans-Pacific routes by expanding their service range into Lach Huyen Port. To success the PPP scheme, the public sector should provide favorable investment environment to the private sector. Provision of -14m depth of channel is one of important investment environments for shipping companies.

b) Turning Basin

The diameter of turning basin should be determined for the length of design vessel of 100,000DWT as 660m (330m x 2) and the depth of turning basin should be the same with the depth of access channel of -14m CDL.

5) Port Service Road

The port service road shall be provided behind the terminal, therefore, in accordance with the change of berth and terminal length, the length of port service road should be extended from 630m to 750m. In addition, as will explain in next clause 14.3, the port service road should be provided behind the public related facilities area which requires 250m in length. Therefore, total length of port service road should be 1,000m.

The cross section of port service road was designed in Chapter 11 considering the traffic volume of terminals, waiting lanes for entering the gate, paved shoulders for motor-bike, median and sidewalks, which total width will be 44m instead of 41m of Decision of MOT.

14.3 Additional Scope

1) Barge Berth

To cope with the requirement of domestic container traffic demand, it is necessary to arrange a dedicated barge berth within the international container terminal for the most economical transportation of inland and coastal waterway. If this barge berth is arranged on the same face line of main berth of Panamax/Super Panamax container vessels, the effective container handling and safe mooring operation of the barge berth will be disturbed. Therefore, the location of barge berth is recommended to be arranged at the northern side of No.1 container terminal as shown in Figure 14.3.1.

The size of barges to be applied in this container terminal will be as follows:

Table 14.3.1 Dimensions of Target Barges

LOA (m)	Breadth (m)	Draft (m)	Capacity (TEU)
32	6.8	1.4	24
54	9.4	2.8	36
72	10.5	3.2	72
87	12.2	4.0	96

The length of barge berth should be 200m for accommodating 3 to 4 barges at same time.

2) Public Related Facilities

The public related facilities such as buildings for Maritime Administration, Customs, Immigration, Quarantine and amenity for port workers, and a mooring facility for service vessels are not included in the Scope of Project of Decision by MOT. However, SAPROF study team recommends these basic public related facilities to be included in the scope of project by the reasons as follows:

Smooth and quick cargo flow is the first target in the newly constructed port as the gateway port in North Vietnam. For this purpose it is indispensable that public related facilities should be located at the most convenient site. Then all the parties concerned of the port business, governmental officers, operator and supporting staff, shipping companies and cargo owners can perform their business smoothly and effectively.

Port administration buildings should contain all the functions for port matters; Port Authority, Customs, Immigration, Quarantine, Water Police, Coast Guard, Pilot office, Port security and Control. They have to moor various boats of port duty in their back, for expeditiously they can go to work on their duty. They are high-power tug boats for huge size of vessels, pilot boats, line handling boats, boat for water police and other port equipment maintenance etc. Therefore, the construction of port service boats berth is indispensable.

All the persons in port business will perform their duty in lump very expeditiously and simply in this area without troubles. Therefore, it is recommended that the public related facilities should be included in this project and all the governmental organization should begin their business at the same time on opening of Lach Huyen container terminal.

The proposed scales of public related facilities are as follows:

- Land reclamation : 344,000 m^3
- Dredging in front of berth : 104,000 m^3
- Service boats berth : 375m L x 30m W x -4m D
- Pavement : 121,000 m^2
- Buildings : 4,600 m^2
- Utilities and Others : 1 set

3) Navigation Aids

At present, there is a VTS station on Cat Hai island and buoy system along Lach Huyen channel for safe navigation control and no additional navigation aids are included in this Project, however, as explained in Chapter 23, SAPROF study recommends to provide following navigation aids by this Project:

a) Channel buoys (Spar Buoy 20 sets)

There are 21 sets of floating buoys along the channel at present. These floating buoys are moved by wind and current and such a moving range will become larger when channel depth is deepen to -14m by this project and could not show exact boundary of navigation channel. The new channel will have a width of 160m which is a very restricted width for 100,000DWT container vessels, therefore, it is recommended to replace existing floating buoys to spar buoys which will move only very limited range and can show exact location of boundary of channel.

b) Light Beacon on Sand Protection Dyke (4 sets)

The sand protection dyke will be constructed along the channel up to seabed elevation of -5.0m for 7,600m long with top elevation of +2.0m. This sand protection dyke becomes under water during high tide and couldn't see from small boats like fishing boats which are working around there. In order to eliminate collision between small boats and the sand protection dyke, light beacons should be installed on the dyke at 2km intervals for warning.

c) Pilot Assistance System (Personal Computer 7 sets)

In the limited width of channel, it is very important to know the accurate position of own vessel at real time. For that purpose, a handy display showing vessel position by GPS is very useful for pilot and during the berthing maneuvering the pilot should works outside of bridge, when if a handy display is available, maneuvering become easy for pilot.

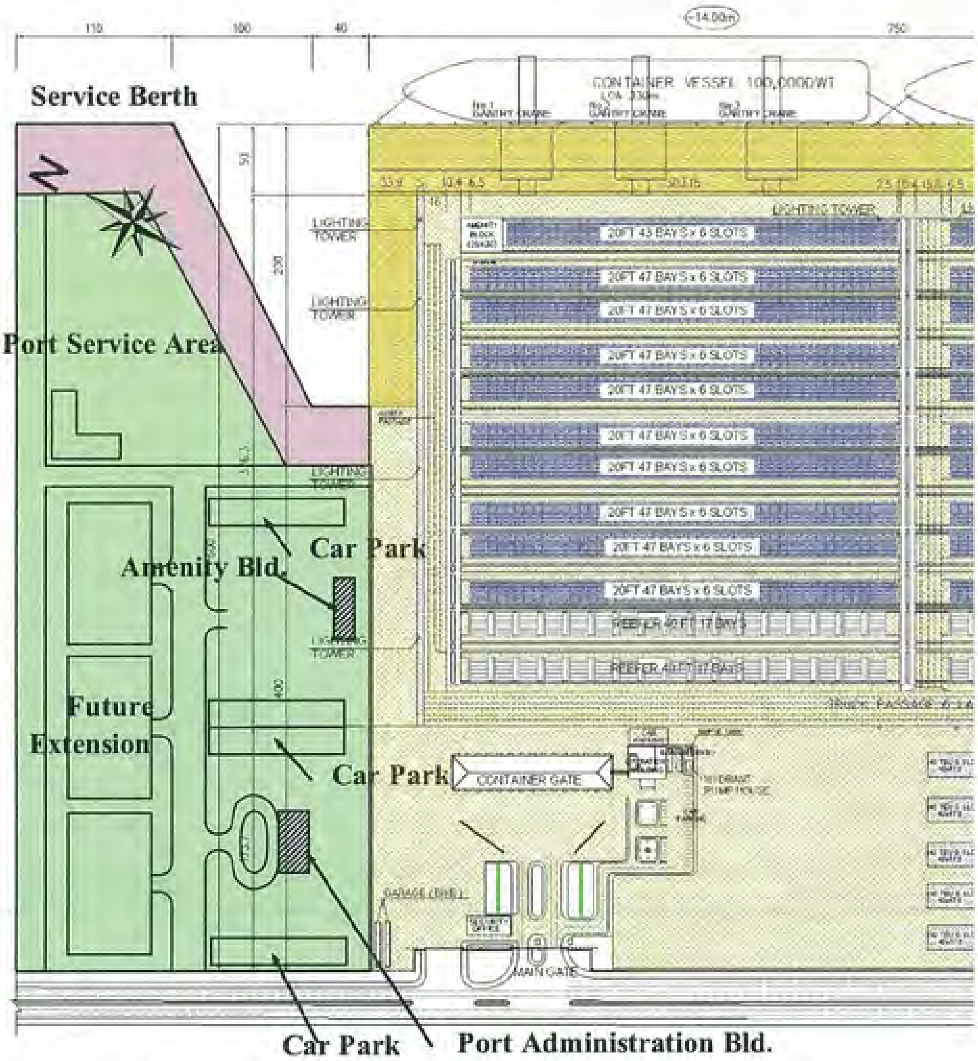


Figure 14.3.1 General Plan of Public Related Facility Area

14.4 Demarcation of Scope of Works for Public Sector and Private Sector

Based on the above discussion, the demarcation of scope of works for public sector and private sector is summarized in table below:

Table 14.4.1 Demarcation of Scope of Works for Public Sector and Private Sector

No.	Work Item	Demarcation	
		Public	Private
1	Dredging		
1.1	Vessel Channel	●	
1.2	Turning Basin	●	
1.3	Berth Area (Approx. 150,000m3)		●
1.4	Slope of Terminal Land Revetment		●
1.5	Service Boats Berth/Barge Berth	●	
2.	Container Terminal		
2.1	Land Reclamation w/t Soil Improvement and Embankment	●	
2.2	Berth Construction		●
2.3	Barge Berth		●
2.4	Yard & Road Pavement		●
2.5	Architectural Facilities		●
2.6	Utilities		●
2.7	Cargo Handling Equipment		●
3.	Port Service road		
3.1	Land Reclamation	●	
3.2	Road Pavement w/t Soil Improvement	●	
4.	Outer Revetment (Breakwater)	●	
5	Sand Protection Dyke	●	
6	Public Related Facilities		
6.1	Land Reclamation	●	
6.2	Service Boat Berth	●	
6.3	Road Pavement	●	
6.4	Buildings	●	
6.5	Utilities	●	
7	Navigation Aid	●	

14.5 Recommended project Scope

The recommended scope of Lach Huyen Port ODA Project is as follows.

Table 14.5.1 Recommended Project Scope for Japan's ODA Loan

No.	Work Item	Description
1.	**Dredging**	
1.1	Access Channel & Turning Basin	Channel: Width 160m (with sand protection dyke) 210m (without sand protection dyke), Depth -14.0m CDL, Slope 1:10, Length 17.4 km, Turning Basin: Diameter 660m, Depth -14m CDL, Slope 1:10, V=31,000,000m^3 including sedimentation of 2,000,000 m^3 during capital dredging period of 3 years.
2.	**Navigation Aids**	Channel buoy: Spar buoy 20 sets, Light Beacons on Sand protection dyke: 4sets, Pilot Assisting System: 7sets
3	**Container Terminal**	
3.1	Land Reclamation	750mL x 749mW, Top EL +5.5m, V=2,956,000m^3 including port service road area of 200mW.
3.2	Soil Improvement	ALICC: 50mW x 920mL including barge berth area PVD: 564,000m^2 including port service road area
3.3	Retaining Wall	Wharf side: Steel Sheet Pipe Pile Wall, Length 750m, Top EL +5.5m South side: Rubble mound, Length 750m, Top EL +5.5m
3.4	Port Service Road	Asphalt pavement, Width 44m, Length 1,000m
4.	**Protection Facilities**	
4.1	Outer Revetment	Top EL of Coping Concrete +6.5m, Covered by Wave Dissipation Concrete Blocks, Soil Improvement: 65,600m2Length 3,230m
4.2	Sand Protection Dyke	Top EL +2.0m, Covered by Wave Dissipation Concrete Blocks, Length 7,600m
5.	**Public Related Facility**	
5.1	Land Reclamation	Area 132,000m^2, V=344,000m^3 Including soil improvement: PVD 21,300m^2
5.2	Harbor Crafts Berth	374mL x 30mW x -4mD, Sheet Pile Wall structure Dredging: V=104,000m3
5.3	Buildings	4,600m^2 for Port Administration, Customs, Immigration, Quarantine, Coastal Guard, Security & Amenity Space
5.4	Utilities	Electricity supply, Water supply, Fire fighting, Sewage system within boundary.

General Layout of Lach Huyen Port Short Term Development and Location of Lach Huyen Port Short Term Development are presented in Figure 14.5.1 and Figure 14.5.2, respectively.

15. Preliminary Design

15.1 Design Conditions

15.1.1 Port Facilities

The following are the summary of design criteria recommended by SAPROF Study Team to apply to design work of the port facilities proposed in Lach Huyen Port Development Project (Partly reiteration from description in Chapter 12):

1) Meteorological and Oceanographic Conditions

a) Tides

- HHWL: CD + 4.43m
- HWL: CD +3.55 m
- MWL: CD +1.95 m
- LWL: CD +0.43 m
- LLWL: CD+0.03 (observed on January 2, 1991)

(CD referred and equals to Chart Datum which is nearly the level of Lowest Astronomical Tide)

b) Wave (Deep Offshore Wave)

- 50 Years Return Period of Wave

Wave Height	Hs = 5.6 m
Wave Period	T = 11.6 sec
Predominant Wave Direction	S to E

- Offshore Waves Less Than 50-Year Return Period

Return Period (Yr)	Wave Height (m)	Wave Period (Sec)
1	1.22	5.8
5	3.18	8.9
10	3.71	9.7
30	4.45	10.8

Wave Period: estimated by the relationship T=1.5539H+3.9222
(Source: Report on Port Capacity Reinforcement Plan in Northern Vietnam: Nippon Koei Co., Ltd. & Associates, September 2009)

c) Design Seismic Coefficient for Quay wall Structure

- Horizontal Design Coefficient kh = 0.04g
- Vertical Design Coefficient kv = 0.00g

d) Wind Velocity

- Design Wind Velocity 60 m/sec
- Wind in Operation 20 m/sec

2) Subsoil Conditions

The followings are the design subsoil conditions for each port facility proposed by JICA Study Team based on the major factual findings obtained from the subsoil investigation done by JICA Study Team and previous subsoil investigation works.

Table 15.1.1 (a) Subsoil Condition for Container Berth

Layer	Depth (CDL) (m)	Consistency	Soil Properties			
			N value	Unit Weight γ' (kN/m^3)	Strength	Lateral Pile Resistance: Kh (N/cm^3)
Upper Clay	GL to -10	Soft	1-3, N=2	7	qu=44 kN/m^2 C= 22 kN/m^2	3
Middle Clay	-10 to - 13	Stiff	8-17, N=13	9	C= 100 kN/m^2	20
Lower Clay	-13 to -21	Firm to Stiff	6-9, N=7	8	qu=88kN/m^2 C= 44 kN/m^2	10
Base Siltstone	> -21varies	Very Dense	N>50	---	qu= 30 N/mm^2	

Source JICA Study Team

Table 15.1.2 (b) Subsoil Condition at Reclamation Area

Layer	Depth (CDL) (m)	Consistency	Soil Properties			
			N value	Unit Weight γ' (kN/m^3)	Strength	Consolidation
Subsurface Sand	+0.5 to -1.0	Loose	N=5	10	ϕ=25^o	
Upper Clay	-1.0 to -9.0	Soft	2-5, N=3	7	qu=44 kN/m^2 C= 22 kN/m^2	e-logP: C1 Cv=65cm^2/d Pc=0.86Kg/cm^2
Middle Clay	-9.0 to – 12.0	Stiff	8-15, N=13	9	C= 100 kN/m^2	e-logP: C2 Cv=87cm^2/d Pc=1.22Kg/cm^2
Lower Clay	-12.0 to -27.0	Firm to Stiff	4-7, N=6	8	qu=88 kN/m^2 C= 44 kN/m^2	e-logP: C3 Cv=89cm^2/d Pc=2.66Kg/cm^2
Base Siltstone	> -27 varies	Very Dense	N>50	---	qu= 30 N/mm^2	

Source JICA Study Team
Note: Refer to Chapter 12 for e-log P Curve C1, C2 & C3

Table 15.1.3 (c) Subsoil Condition at Service Boats Berth

Layer	Depth (CDL) (m)	Consistency	Soil Properties			
			N value	γ ' (kN/m^3)	Strength	Lateral Pile Resistance: Kh (N/cm^3)
Upper Clay	-3.0 (Varies) to -10	Soft	1-3, N=2	7	qu=44 kN/m^2 C= 22 kN/m^2	3
Middle Clay	-10 to - 13	Stiff	8-17, N=13	9	C= 100 kN/m^2	20
Lower Clay	-13 to -21	Firm to Stiff	6-9, N=7	8	qu=88 kN/m^2 C= 44 kN/m^2	10
Base Siltstone	> -21varies	Very Dense	N>50	---	qu= 30 N/mm^2	

Source JICA Study Team

Table 15.1.4 (d) Subsoil Condition at Outer Revetment

Layer	Depth (CDL) (m)	Consistency	Soil Properties N value	γ' (kN/m³)	Strength	Consolidation
Subsurface Sand	±0.0 to -3.0	Loose	N=8	10	φ=25°	
Upper Clay	-3.0 to -14.0	Soft to Firm	2-7, N=3	7	qu=44 kN/m² C= 22 kN/m²	e-logP: C1 Cv=65cm²/d Pc=0.86Kg/cm²
Middle Clay	-14.0 to – 18.0	Stiff	9-13, N=12	9	C= 100 kN/m²	e-logP: C2 Cv=87cm²/d Pc=1.22Kg/cm²
Lower Clay	-18.0 to -25.0	Firm to Stiff	6-9, N=7	8	qu=88 kN/m² C= 44 kN/m²	e-logP: C3 Cv=89cm²/d Pc=2.66Kg/cm²
Base Layer	> -25	Hard	N>30	---	C= 30 N/m²	

Source JICA Study Team
Note: Refer to Chapter 12 for e-log P Curve C1, C2 & C3

Table 15.1.5 (e) Subsoil Condition along Sand Protection Dyke

Layer	Depth (GL) (m)	Consistency	Soil Properties N value	γ' (kN/m³)	Strength	Consolidation
Subsurface Sand	GL to -2.0	Loose	N=7	10	φ=25°	
Upper Clay	GL-2.0 to -10.0	Very Soft	0-2, N=1	7	C= 15 kN/m²	e-logP: C1td Cv=65cm²/d Pc=0.86Kg/cm²
Middle Sand	GL-10.0 to – 13.0	Loose	3-8, N=6	9	φ=25°	
Lower Clay	GL-13.0 to -18.0	Firm	3-6, N=5	8	qu=88kN/m² C= 44 kN/m²	e-logP: C3td Cv=89 cm²/d Pc=2.66Kg/cm²
Base Layer	>GL -18.0	Stiff to Very Stiff	13-21, N=18	8	C= 110 kN/m²	

Source JICA Study Team
Note: Refer to Chapter 12 for e-log P Curve C1td, C2td & C3td

Analysis of SPT and laboratory test results has established the soil type and classification encountered in each borehole. The soil strength parameter of each major subsoil layer is obtained based on shear strength test such as unconfined compression test. But, in the case where laboratory test results are not available, internal friction angle (φ) of sandy soil, cohesion (Cu) of clayey soil and lateral soil resistance of pile (Kh) was obtained from the following correlation with SPT N-value.

Table 15.1.6 Design Soil Parameter in correlation with N-Value

1) Internal Friction Angle of Sand: $\phi = \sqrt{(12xN)} + A$

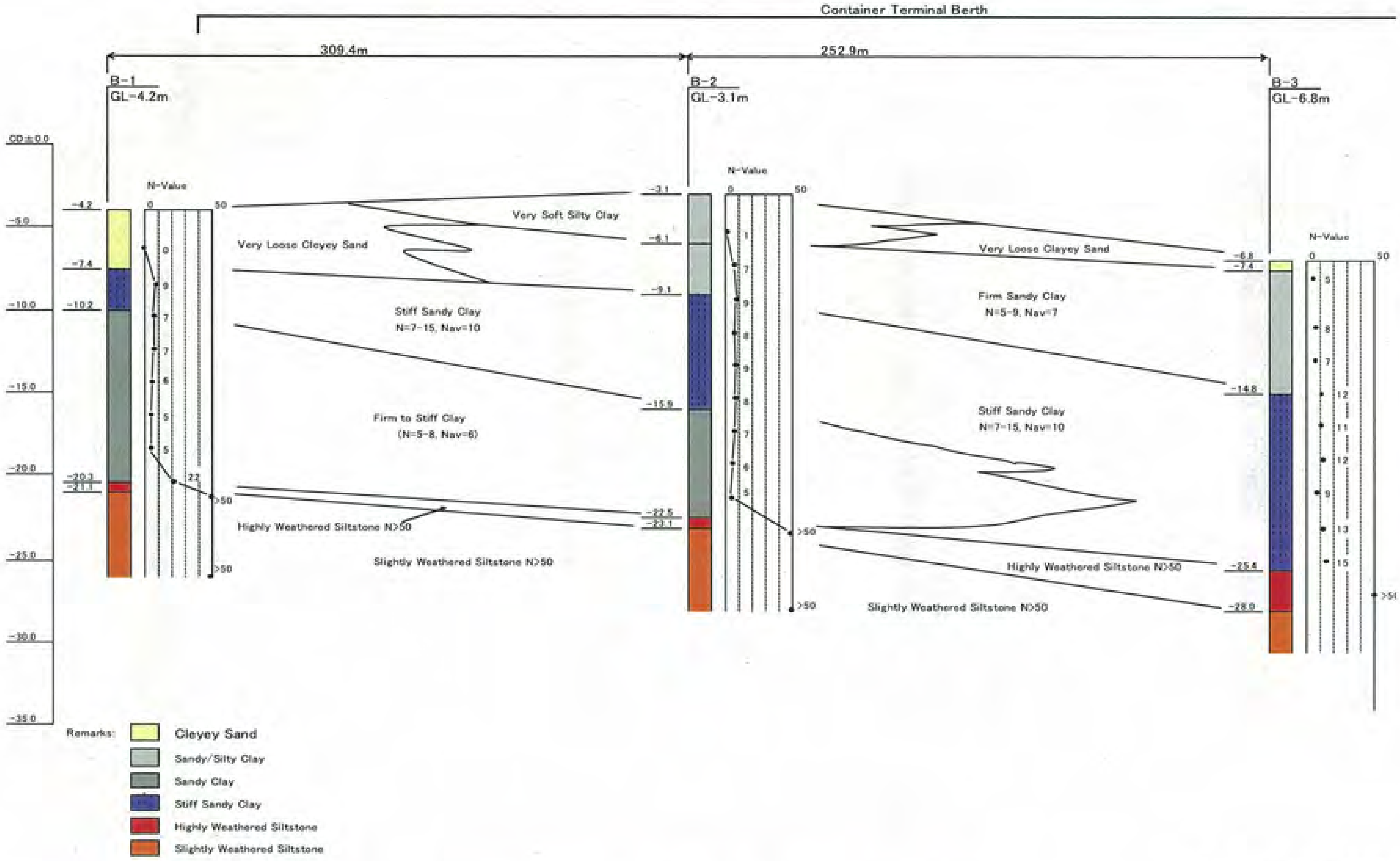
where,
- ϕ: Internal friction angle (degree)
- N: Blow counts in SPT
- A: Empirical coefficients depending on characteristics of sandy soils
  - 15: Poorly graded sandy soils with rounded particles
  - 20: Sandy soils of well graded with rounded particles or poorly graded with angular particles
  - 25: Well graded sandy soils with angular particles

2) Cohesion of Clay: Cu = qu/2=100 x N/B

where,
- Cu: Cohesion in unconsolidated and undrained (kN/m^2)
- qu: compression strength by unconfined and undrained compression test (kN/m^2)
- N: Blow counts in SPT
- B: Empirical coefficient depending on characteristics of cohesive soils
  - 3.2 to 8: for very soft clay
  - 8: for silty clay or clay of medium consistency
  - 8 to 16: for very stiff clay

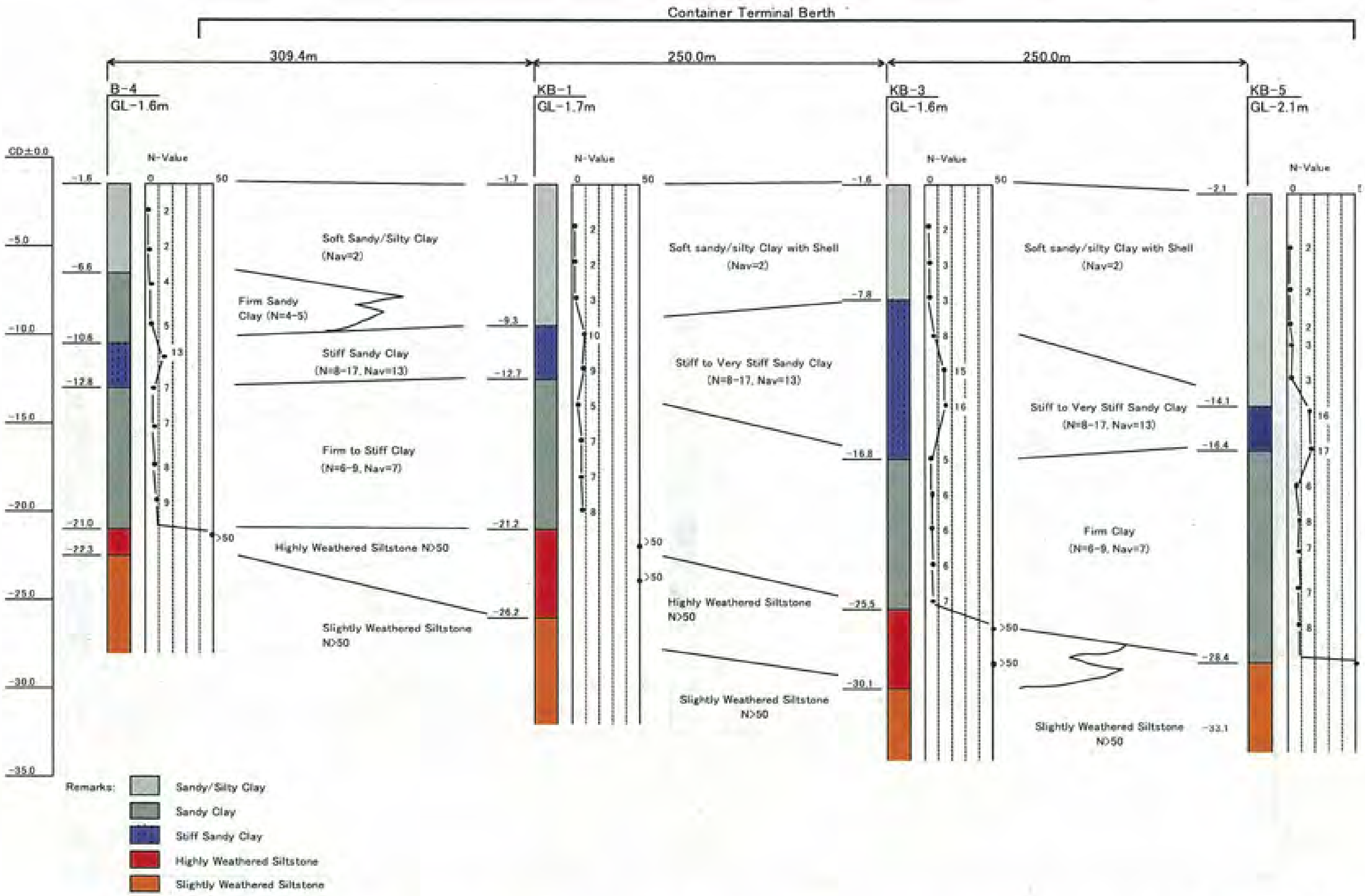
3) Lateral soil resistance of pile Kh= 1.5N (N/cm^3)

where, N: Blow counts in SPT



Source: JICA Study Team

Figure 15.1.1 (a) Subsoil Profile along Container Berth



Source: JICA Study Team

Figure 15.1.2 (b) Subsoil along Earth Retaining Wall for Container Berth

3) Design Conditions for Container Berth (by Private Sector under PPP Scheme)

a) Design Container Vessel 100,000 DWT Super Post Panamax

- Loa=330m
- Beam 45.5m (18 Rows of container stacking on deck)
- Molded Depth- 29.1m
- Draft=14.8m (Fully loaded for design of berth structure)

b) Geometry of Container Berth

- Berth Length 750 m/terminal
- Top Elevation at Cope-line of Berth CD +5.5 m
- Planned Water Depth CD -16.0 m
- Ditto but for Initial construction Stage CD -14.0 m
- Design Water Depth CD -16.0 m
- Apron Width Around 60 m

c) Loading Conditions

- Surcharge on Apron 35 kN/m^2
- Surcharge on Yard 45 kN/m^2
- Ship Berthing Condition Design Vessel 10,000DWT
  Ship Approach Velocity 0.1m/s
  Ship Berthing Angle 10°

  * Ship Impact Load estimated by JICA Study Team is 1,621kN (157 tf) to absorb 939.8kN-m ship impact energy under high energy absorption type of Rubber Docking Fender H1150mm size)
- Load on Bollard 1,000kN Hawser pull capacity
- Quay Gantry Crane: For container vessel of 18 rows container on deck

Table 15.1.7 Design Parameter of Quay Gantry Crane

	Container Vessel, 8,000 TEU Capacity, B=45 m
Number of Total Container Row on deck	18 rows
Lifting Capacity	41 tf under spreader
Out reach	52 m
Back reach	13 m
Lift above rail	38 m
Rail Gauge	30 m
Number of Wheel per Corner	12 wheels at 1.2m interval (wheel load reduced type of crane)
Total Weight	1,300 to 1,500 tf
Design Wind Load Operating Stowed	 20 m/s 40 m/s
Seaside Wheel Load (Approx) Wind Condition (Stowed) Operating Condition	 60 tf/wheel 55 tf/wheel
Landside Wheel Load (Approx) Wind Condition (Stowed) Operating Condition	 60 tf/wheel 50 tf/wheel

Source: JICA Study Team

- Other Container Handling Equipment on Berth Apron

d) Service Life:

BS 6349-1: 2000 stipulates that:

- The design working life of a structure can be taken as the specified period for which a structure is to be used for its intended purpose with planned maintenance;
- Normally a design working life of the order of 50 years or more is expected of maritime structures such as quay walls, jetties and docks but the design life is not necessarily the same as the return period of the design conditions;

Container berth structure including the pile and beam may be designed for a service life of 30 years.

e) Design Standards and Codes of Practice

- Technical Standards and Commentaries for Ports and Harbor Facilities in Japan, 2007
- British Standard Code of Practice for Maritime Structures (BS 6349)
  Part 1: General Criteria 2000
  Part 2: Design of quay walls, jetties and dolphins 1988
  Part 4: Code of Practice for designing fendering and mooring systems 1994

4) Design Conditions for Container Barge Berth (by Private Sector under PPP Scheme)

a) Design Container Vessel

The following size of container Barge may be applied in designing barge berth.

- Container Barge: Loading Capacity of 100 TEU
- Loa=87m
- Beam 12.2m
- Draft=4.0m

b) Geometry of Container Barge Berth

- Berth Length	200 m/berth (=Container berth width 50m +150m) (To accommodate two (2) largest size of barge simultaneously)
- Top Elevation at Cope-line of Berth	CD +5.5 m
- Planned Water Depth	CD -4.5 m
- Design Water Depth	CD -5.0 m
- Apron Width	30 m

c) Loading Conditions

- Surcharge on Apron	35 kN/m^2
- Ship Berthing Condition	Design Vessel 100TEU capacity Barge Ship Approach Velocity 0.25m/s Ship Berthing Angle 10°

*Ship Impact Load estimated by JICA Study Team is 424kN/m x 2.5m=1,060kN (108 tf) to absorb 71kN-m ship impact energy by V shaped type of Rubber Docking Fender H400mm x L2.50m (E=71.2kN-m/m x1.2m contact face=85.4kN-m)

- Load on Bollard	350kN Hawser pull capacity

- Harbor Mobile Crane: For container landing from/loading to barge
  Model: Liebherr –Werk Nenzing GmbH made Type LHM 250 Class

Supporting pad: 4 pad x 5.5m x 1.8m (=9.9 m2/pad)
Max. Outrigger Load for Normal (static excluding wind): 185 tf/corner
Quay Load Arrangement:
Uniformly distributed load 2.4 t/m^2
Max load per tyre: 6.0 t

- Other Container Handling Equipment on Berth Apron

d) Service Life:

Quay wall structure including the pile and beam may be designed for a service life of 30 years.

5) Design Conditions for Harbor Service Boats Berth (by Public Sector under PPP Scheme)

a) Design Vessel

The following size of Tug Boat is considered in designing berth.

Table 15.1.8 Dimension of Tugboat

		2,000PS	3,000PS	4,000PS
Length	Loa	28.1	31.8	36.2
	Lpp	24.2	28.0	31.5
Beam	B	8.2	9.0	9.8
Depth	D	3.5	3.6	4.4
Draft	d	2.7	2.7	3.2
Displacement Tonnage	DT	320	435	544

JICA Study Team

b) Geometry of Berth

- Berth Length: 365 m
- Top Elevation at Cope-line of Berth: CD +5.5 or +4.5m
- Planned Water Depth: CD -3.6 m
- Design Water Depth: CD -4.0 m

c) Loading Conditions

- Surcharge on Apron: 10 kN/m^2
- Ship Berthing Condition: Design Vessel 4,000PS Tugboat
  Ship Approach Velocity 0.3m/s
  Ship Berthing Angle 10°
- Load on Bollard: 350kN Hawser pull capacity

d) Service Life:

Berth structure including the pile and beam is designed for a service life of 50 years for the quay wall.

15.1.2 Access Road and Bridge

1) Access Road

a) Design Standard

- Classification of Tan Vu-Lach Huyen Highway

The standard of Table 15.1.9 is adopted in this design base on the previous studies.

Table 15.1.9 Adoption Design standard

Description	Adoption	Remarks
Design Standard	TCVN4054-2005	
Design category	Technical Level 80	
Design speed	80km/h	

According to the TCVN4054-05 (Item 3.4 and 3.5), the classification of the highway is divided into 7 classes, as shown in Table 15.1.10 and Table 15.1.11.

Table 15.1.10 Highway Technical Classification according to function and design traffic volume

Design categories	Design traffic volume (PCU/daily)	Major functions of highway
Expressway	> 25.000	Arterial road, in compliance with TCVN 5729:1997
I	> 15.000	Arterial road, connecting large national economic, political, cultural centers National Highway
II	> 6.000	Arterial road, connecting large national economic, political, cultural centers National Highway
III	> 3.000	Arterial road, connecting large national and regional economic, political, cultural centers National Highway or Provincial Road
IV	> 500	Highway connecting regional centers , depots, residential areas National highways, Provincial road, District roads
V	> 200	Road serving for local traffic. Provincial road, district road, communal road
VI	< 200	District road, communal road
* These values are for reference. Selection of road classification should base on road function and terrain type.		

Source: TCVN4054-05

Table 15.1.11 Highway Design Speed

Design categories	I	II	III		IV		V		VI	
Topography	flat	flat	flat	mountain	flat	mountain	flat	mountain	flat	mountain
Design speed, V_{tk} (km/h)	120	100	80	60	60	40	40	30	30	20
NOTE: Classification of the terrain is based on common natural slope of the hill side and mountain side as follows: flat and rolling ≤ 30%; Mountain > 30%.										

Source: TCVN4054-05

b) Cross Section Layout

The lane width adopted in this study is 3.75m in accordance with the previous study report from the following reasons:

Many large-size cars are contained in Tan Vu-Lach Huyen Highway

The future of Tan Vu-Lach Huyen Highway will became a part of expressway which connects Hanoi-Lach Huyen Port (Haiphong international Gateway Port) directly.

According to decision No.501 of MOT, in a road individual case, lane constitution is 4 lanes +1 track in 6 lane and railway concomitant use.

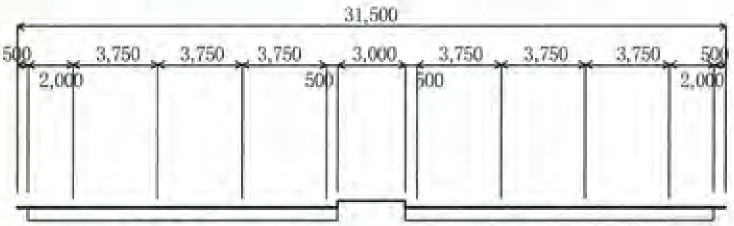


Figure 15.1.3 Typical Cross Section of Approach Road

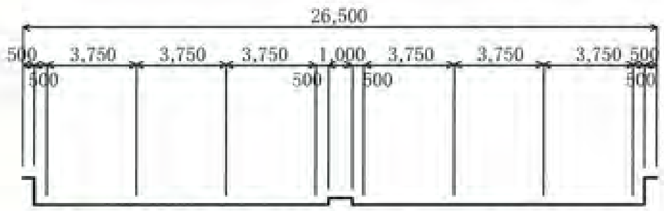


Figure 15.1.4 Typical Cross Section of Bridge

c) Geometric Design

The geometric design of Tan Vu-Lach Huyen Highway is set up as shown in Table 15.1.12.

d) Pavement Structure

According to the previous study, structures of flexible pavement and rigid pavement are Figure 15.1.5 and Figure 15.1.6 respectively. It is recommended to examine this pavement constitution at the next stage in detail.

Source: Planning Construction Investment project Tan Vu-Lach Huyen Highway Project in Hai Phong City, VIDIFI, 2009

Figure 15.1.5 Thickness of Flexible Pavement

Source: Planning Construction Investment project Tan Vu-Lach Huyen Highway Project in Hai Phong City, VIDIFI, 2009

Figure 15.1.6 Thickness of Rigid Pavement

Table 15.1.12 Geometric Design for Tan Vu-Lach Huyen Highway

Geometric Items			UNIT	Adoption
Road Classification				Design Category III
Design Speed			Km/h	80
Cross Section	Carriageway		m	4 x 3.75
	Shoulder		m	2 x 2.50
	Paved Portion		m	2 x 2.00
Minimum Radius			m	400 (250)
Minimum Radius of Horizontal Curves Depending on Deflection Angle			m	10,000 (1 degree) 6,000 (2 degree) 4,000 (3 degree) 3,000 (4 degree) 2,000 (5 degree) 1,000 (6 degree) 800 (8 degree)
Minimum Length of Curve			m	220 (250≦R≦275) 200 (275<R<300) 170 (300<R<350) 140 (350<R)
Minimum Length of Clothoid			m	110 (250≦R≦275) 100 (275<R<300) 85 (300<R<350) 70 (350<R)
Maximum Grades			%	5
Maximum Length of Longitudinal Grade			m	900 (4%) 700 (5%)
Vertical Curves	Crest	Minimum	m	4000
		Normal	m	5000
	Sag	Minimum	m	2000
		Normal	m	3000
	Minimum Length of Curves		m	70
Minimum Super-elevation			%	8
Minimum Radius which allows an inverse Super-elevation			%	2500
Minimum Stopping Sight Distance			m	100

2) Bridge

a) Design Standard and Design Criteria

Basically, the bridges and structures in this project shall be designed with the Vietnamese Design Standard (22 TCN 272-05) and AASHTO-LRFD (Load and Resistance Factor Design, 3rd Edition 2004). However, the some items shall be considered in accordance with the other standards.

The adopted items for this project are summarized in Table 15.1.13.

The items to which these standards cannot be appropriately applied shall be determined referring to AASHTO (Allowable stress design method, 17th Edition 2002) or Japanese Standard for Highway Bridge (JSHB-96)

Table 15.1.13 Adopted Specifications and Standards

	Specification	Standard
Design Method	Limit State Design	22 TCN 272-05
Design Life	100 years	22 TCN 272-05
Design Lane Width	3600 mm or 3750 mm	22 TCN 272-05
Load Combination		22 TCN 272-05
Live Load	HL-93	22 TCN 272-05
Dynamic Load Allowance, IM	0.25 for main part of bridge	22 TCN 272-05
Wind Load	Depend on the site	22 TCN 272-05
Vessel Collision Force	Depend on the site	22 TCN 272-05
Earthquake	Depend on the site	22 TCN 272-05
Seismic Earth Pressure	Depend on the site	Japanese
Stress Loss in Tendons		Japanese
Creep & Shrinkage		Japanese / CEB-FIP
Pile Foundation Analysis	Displacement Method	Japanese
Train Load	T-26D	22 TCN 272-05

b) Navigational Channel

The navigation channel for the large vessel will be shifted to northern side of deep see port, then the navigation for the bridge is the vessel of 1,000DWT. The Navigation Clearance at Nam Trieu Channel is as follows:

According to VINAMARINE, the navigation clearance is possibility in case of Figure 15.1.7 and Figure 15.1.8. It should be determined by Bridge SAPROF Team by discussion with VINAMARINE finally.

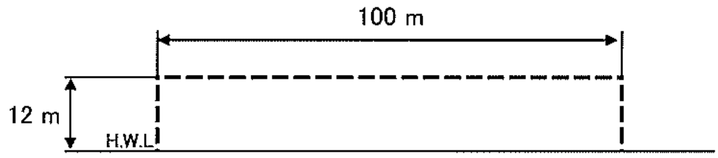


Figure 15.1.7 Navigation Clearance (W100 x 1)

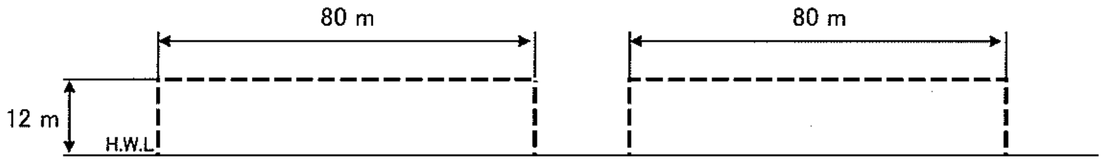
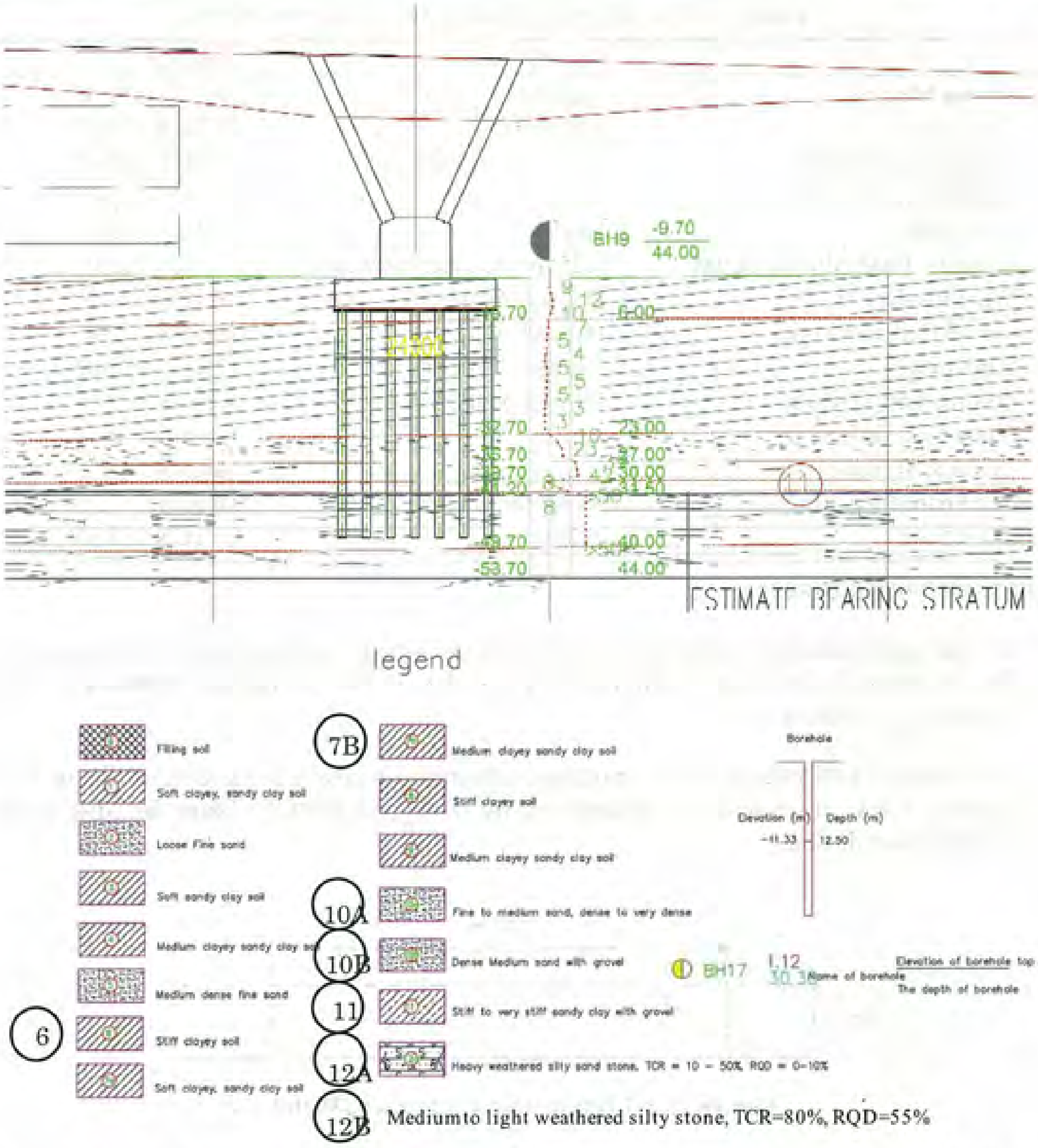


Figure 15.1.8 Navigation Clearance (W80 x 2)

c) Geological Conditions

The longitudinal profile of soil layers, bearing stratum assumed and piles for the design are as shown in Figure 15.1.9.



Source: Planning Construction Investment project Tan Vu-Lach Huyen Highway Project in Hai Phong City, VIDIFI, 2009

Figure 15.1.9 Geological Conditions

15.2 Preliminary Design

15.2.1 Port Structures

1) Soil Improvement at Reclamation Area

Soil Improvement work for each proposed facility of the Project is carried out in the following schedule.

Table 15.2.1 Schedule of Soil Improvement Work

<table>
<tr><td rowspan="2"></td><td rowspan="2">Facility</td><td colspan="2">Terminal</td><td rowspan="2">Access Road</td><td rowspan="2">Outer Revetment/ Breakwater</td><td rowspan="2">Sand Protection Dyke</td></tr>
<tr><td>50m wide Terminal Area immediately behind container berth structure</td><td>Other Area</td></tr>
<tr><td rowspan="4">SAPROF Study</td><td>Area</td><td>4.25Ha
Container Berth (50x750m)
Barge Berth (50x100m)</td><td>37.5Ha
(500x750m)</td><td>15.2 Ha
(190x800m)</td><td>6.65Ha
(21.1x3,150m)</td><td rowspan="4">Nil</td></tr>
<tr><td>Method</td><td>CDM-Low Rate of Replacement
Cement Column Method</td><td colspan="3">Plastic Board Vertical Drain Method
(PVD)+Preloading</td></tr>
<tr><td rowspan="2">Design</td><td>Dia. 1.0m x 2-shafts Driving</td><td colspan="3">@1.2 Square</td></tr>
<tr><td>Front 30m Area @2.1x3.1m Square
Back 20m Area @1.0x3.1m Square</td><td colspan="2">approx.L=25m</td><td>approx L=25m</td></tr>
<tr><td rowspan="3">TEDI F/S</td><td>Area</td><td colspan="2">33Ha
(550x600m)</td><td>12.4Ha
(190x650m)</td><td>23.21Ha
OR(49.1mx650m)
BR (61.6x3250m)</td><td>31.64Ha
(55.5x5700m)</td></tr>
<tr><td>Method</td><td colspan="5">Vertical Sand Drain Method (SD)+Preloading</td></tr>
<tr><td>Design</td><td colspan="3">D=0.6m @2.5m
L=25m</td><td>D=0.6m @1.6m
L=18m</td><td>D=0.6m @2.1m
L=18m</td></tr>
</table>

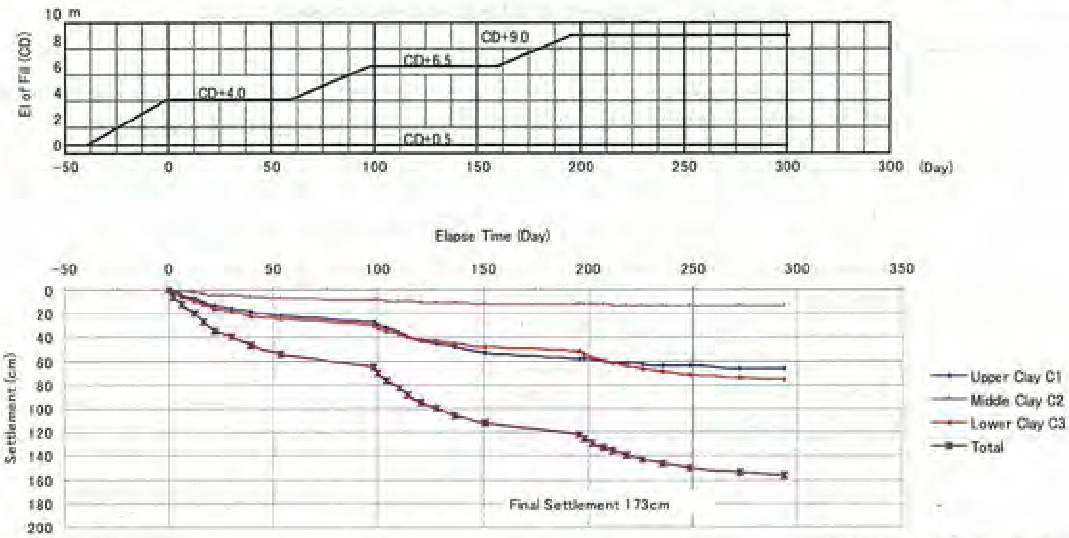
TEDI F/S for reference only
Source: JICA Study Team

a) PVD Method for Reclamation Area

In order to accelerate and complete the consolidation by reclamation fill during construction period, soil improvement is carried out by application of PVD method in combination with Preloading. As described in Chapter 12: Conceptual Design and Cost Estimate for Medium Term Development Plan, PVD method is applied in the following schedule for land reclamation work.

- Area subject to PVD method: Reclamation Area for Terminal including Access Road, Outer/Inner Revetment and Public Related Area
- Drain Pile Arrangement: 1.2 m square
- Depth of Drain Pile: Up to the depth of base rock surface or 1 m above the base rock layer
- Side Slope of Fill: 1 to 3 slope
- Preloading: Preload step by step, possibly divided into two (2) or three (3) stages of loading to preclude any side slope sliding of preloaded fill during preloading

Terminal reclamation area may be divided into several zones for construction and, at each construction zone, preloading will be carried out in three (3) stages of loading for which sequence of preloading and anticipated settlement by consolidation is estimated as follows.



Source: JICA Study Team

Estimate Condition:

1) PV Drain piled at 1.2m square
2) 3 stage of Preloading: 1st Load CD+4.0m, 2nd Load CD+6.5m and 3rd LoadCD+9.0m.
3) Each stage of preloading continues up to 80% degree of consolidation of Clay C2 & C3.
4) Increment of Fill work will be finished in 45 days for the succeeding stage of preloading.
5) Final Settlement by Preloading (U=80% of C2 & C3 Clay layer):
   S=156.5cm (=C1:67.2cm+C2:14.2cm+C3:75.1cm)

Figure 15.2.1 Preloading Sequence and Settlement Curve at Terminal Area by Application of PVD and Preloading Method

PVD soil improvement work precedes the construction of berth structure so that the berth structure is precluded from any adverse effect which may be caused by possible occurrence of lateral swelling of subsoil mass subject to consolidation settlement under PVD preloading operation.

b) CDM Method for Earth Retaining Wall Area along Container Berth

Other than PVD subsoil improvement, it is recommended that Cement Deep Mixing Method (CDM) is applied for the area immediately behind the container berth structure where earth retaining wall is constructed to sustain reclamation fill. The reasons for our recommendation are as follows:

- Around 50m wide back-of-berth area immediately behind berth is intended for use as temporally yard for construction of berth structure by Private Sector. It is required to handover the area to Private Sector to initiate and complete terminal construction as earlier as practically possible.
- The earth retaining wall for berth structure is required to design in combination with subsoil improvement applied at the area immediately behind the wall. Due to its weakness of in-situ subsoil, a considerable extent of active earth pressure works on a vertical type of retaining sheet piled wall installed onto these layers and the wall is in principle not stable unless the following relationship between overburden pressure to the wall (rh+w) and the strength of clayey soil (Cohesion of Clay: C) is obtained.

  $\Sigma(rh+w)-4C<0$

In case of earth retaining wall behind container berth or barge berth structure, the above relationship is calculated as follows.

Table 15.2.2 Stability of Sheet Piled Vertical Wall

Surcharge Load (w) (kN/m^2)	GL Behind Wall (CDL) (m)	GL Front Wall (CDL) (m)	Cohesion (C) (kN/m^2)	Σ(rh+w)－4C (kN/m^2)	Judgment	
35	+6.0	+3.5	22	2.5x18+35-4x22=－8	<0	Stable
35		+3.0	22	3.0x18+35-4x22=+1	>0	Not Stable
35	+5.5	+3.0	22	2.5x18+35-4x22=－8	<0	Stable
35		+2.5	22	3.0x18+35-4x22=+1	>0	Not Stable

Source: JICA Study Team

Therefore, it is mandatory that in-situ subsoil is subject to subsoil improvement to make vertical type of earth retaining sheet piled wall stable. But, even in case that the subsoil is subject to subsoil improvement by PVD and its strength is expected to increase by consolidation (refer to below), a trial design calculation based on design practice in Japan shows that vertical type of sheet piled wall is still not-stable and has to completely rely on the lateral resistance of the base rock layer which exists at CDL-21.0 m.

Table 15.2.3 Expected Extent of Increase in In-situ Clay Strength by PVD Subsoil Improvement

Clay Layer	C'=Co+ΔC	Comments
C1	22+22=44kN/m^2	
C2	100+25=125 kN/m^2	Slight increase and practically no increase to be considered
C3	44+3=47kN/m^2	

(Source: JICA Study Team)

Remarks:
1) Preload up to CDL +9.0m
2) Residual water level behind the wall=CDL+2.5m
3) Cohesion after consolidated: C'=Co+ΔC
Where, ΔC= (Ps-Pc) xU80x (ΔC/ΔP)
Ps: Pressure for consolidation
Pc: Pre-consolidation pressure
U80: 80 % Degree of consolidation
ΔC/ΔP: Rate of increase of Cohesion=0.3

A few increases in cohesive strength of the clayey soil are due to over-consolidated nature of in-situ subsoil. Therefore, soil improvement other than PVD method is applied to make vertical type of sheet piled wall stable.

Among Cement Deep Mixing method (CDM), Low Rate of Replacement Cement Column Method (ALiCC) is proposed to apply to the back-of berth area immediately behind the berth structure (Container berth as well as Barge berth). This method is to stabilize the soil in situ by forming cement mixed soil column in a low rate of replacement (less than ap=50%) for in-situ soil mass. This method does not require such construction period to spend as for preloading in PVD method of soil improvement and is able to complete soil improvement work in shorter period of time.

This method is practically applied to a 50m wide area behind the berth structure to obtain the following effects and objects for construction.

- To handover the reclaimed area immediately behind the berth to Private Sector for the succeeding construction of berth to initiate earlier as practically possible,
- To reduce active earth pressure working on vertical type of earth retaining wall installed

immediately behind the open type of container berth structure, and

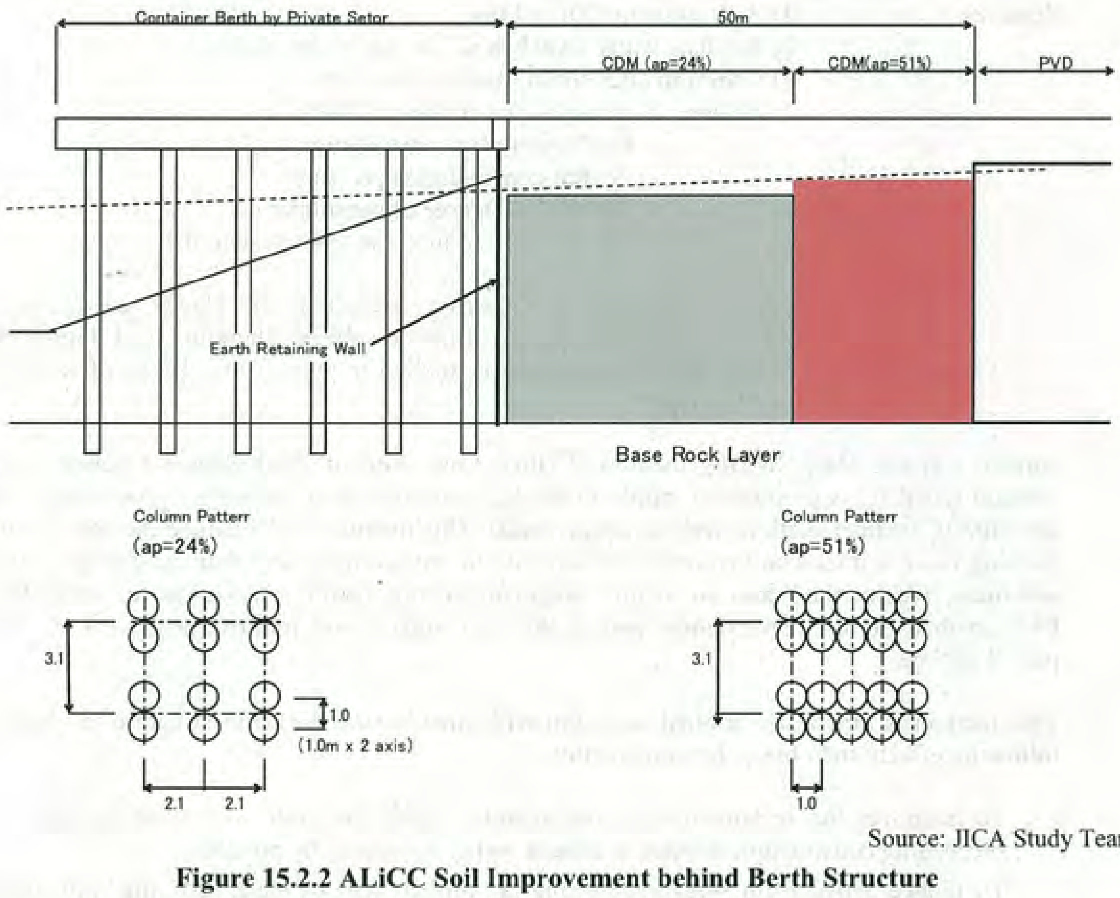
- To shorten overall working period in subsoil improvement work for the terminal construction by a combined application of PVD and ALiCC soil improvement method.

Low Rate of Replacement Cement Column method (ALiCC) is applied in the following schedule. The 20m wide rear zone adjacent to the reclamation area subjected to PVD method is provided as a buffer zone to sustain lateral swell deformation of subsoil mass which may be occurred during a process of consolidation under PVD preloading operation.

Table 15.2.4 Work Schedule of ALiCC at back-of-berth Area for 50m

	Front 30m Area	Back 20m Area
Objective Effect	1) Preclude Consolidation settlement 2) Reduce earth pressure on wall 3) Earlier handover working yard for berth construction	1) Preclude Consolidation settlement 2) Earlier handover working yard for berth construction 3) Sustain lateral swell movement of soil mass subjected to PVD method
Rate of Replacement (ap)	24%	51%
Diameter of Cement Treated Column	Dia. 1.0m x 2 shafts	Dia. 1.0m x 2 shafts
Column Arrangement	2.1m x 3.1m Square	1.0m x 3.1m Square

Source: JICA Study Team



Source: JICA Study Team

Figure 15.2.2 ALiCC Soil Improvement behind Berth Structure

2) Earth Retaining Wall behind Container Terminal Berth

The following two (2) types of earth retaining walls are required to construct by Public Sector along the rear face of berth structure by Private Sector:

- Earth Retaining Wall behind Container Berth Structure
- Ditto but for Barge Berth Structure

a) Earth Retaining Wall behind Container Berth

TEDI F/S or METI 2010 Study for PPP Project recommends open deck type of structure for container berth. Open deck type of structure supported by foundation piles is also studied in this Study (refer to Chapter 12). The following are the structural concept of berth proposed by previous study as well as the SAPROF Study.

Table 15.2.5 Proposed Container Berth Structures

Study	Outline of Berth Structure/Retaining Wall	Geometry	Cost
TEDI F/S	• Berth: Open Deck supported by PC Vertical & Coupled Rake Piles • Retaining Wall: L-shaped wall on rubble mound and supported by pile foundation	- Cope-line: CD+5.5m - Slope under deck=1:2.5 - CD-14.0m water depth - Deck Width= 50m	Moderate
METI 2010 Study for PPP Project	• Berth: Open Deck supported by PC Pile (Vertical) & Steel Pipe Pile (Vertical & Coupled Rake) • Retaining Wall: Anchored Sheet Piled Wall (Assumption)	- Cope-line: CD+5.5m - Slope under deck=1:3 - CD-16.0m water depth - Deck Width=50m	Moderate
SAPROF Study for Medium Term Development Plan (Ch.12)	• Berth: Open Deck supported by Steel Pipe Piles (Vertical & Coupled Rake) • Retaining Wall: Sheet Piled Wall supported by Raked Piles	- Cope-line: CD+5.5m - Slope under deck=1:2.5 - CD-16.0m water depth - Deck Width=43.5m	Costly

Source: As described

Container Berth is constructed by Private Sector under PPP program. The berth structure should be designed carefully in combination with earth retaining wall immediately behind the berth which is scheduled to construct by Public Sector. In view of economy in construction, the berth structure proposed by METI 2010 Study for PPP Project is recommended for construction by Private Sector under PPP program though the conceptual design of berth proposed by METI 2010 Study must be subject to technical detailed review on design conditions, arrangement of foundation piles and structural details in DD stage.

The structural outline of container berth proposed by METI 2010 Study is summarized as follow:

Table 15.2.6 Outline of Container Terminal proposed by METI 2010 Study

Design Vessel	100,000 DWT	50,000DWT
	Loa=330m Beam=45.5m Draft=11.7m (80% load)	Loa=274m Beam=32.3m Draft=12.7m
Load Condition - Quay Crane - Apron Surcharge Load	 Two alternative (1,000 and 1,500 ton/unit with 30m rail span) 30kN/m^2	
Geometry of Berth - Length of Berth - Cope-line Elevation - Berth Water Depth - Width of Berth Apron	 750m CD+5.5m CD-16.0m (Turning Basin CD-14.0m) 50m	
Berth Structure - Type of Structure - Width of Berth Deck - Pile Foundation - Seabed Slope under Deck - Fender System - Bollard	 Slab & Beam RC Deck supported by Piles 50m In combination of vertical PC Pile and vertical & coupled rake (1:4) Steel Pipe Pile (SPP) 1 (V) to 3 (H) constant slope H1300mm at 18m interval 100 ton capacity	

Source: Additional Study on Hai Phong International Gateway Port (Lach Huyen) Development Project in the Socialist Republic of Viet Nam, Final Report March 2010 prepared by METI (METI 2010 Study)

Under the pre-requisite that 50 m wide container berth is constructed based on the conceptual design of berth proposed by METI 2010 study, SAPROF Study Team comparatively studies the following two(2) alternative types of earth retaining walls to be constructed along the rear face of open type of berth structure.

Table 15.2.7 Alternatives for Retaining Wall behind Container Berth

Alternative	Type of Wall	Soil Improvement	Comments/Recommendation
A (Figure 15.2.3)	Anchored Steel Sheet Pipe Piled (SSPP) Wall Structure	ALiCC subsoil Improvement for back-of wall area	◎: Recommended
B (Figure 15.2.4)	Rubble Mound with vertical curtain wall suspended from berth deck	ALiCC subsoil Improvement for rubble mound base foundation area as well as back-of wall area	X: Not Recommended 1) Berth piling work precede formation of rubble mound, 2) Slope under berth deck must be revised to 1:2.5 slope

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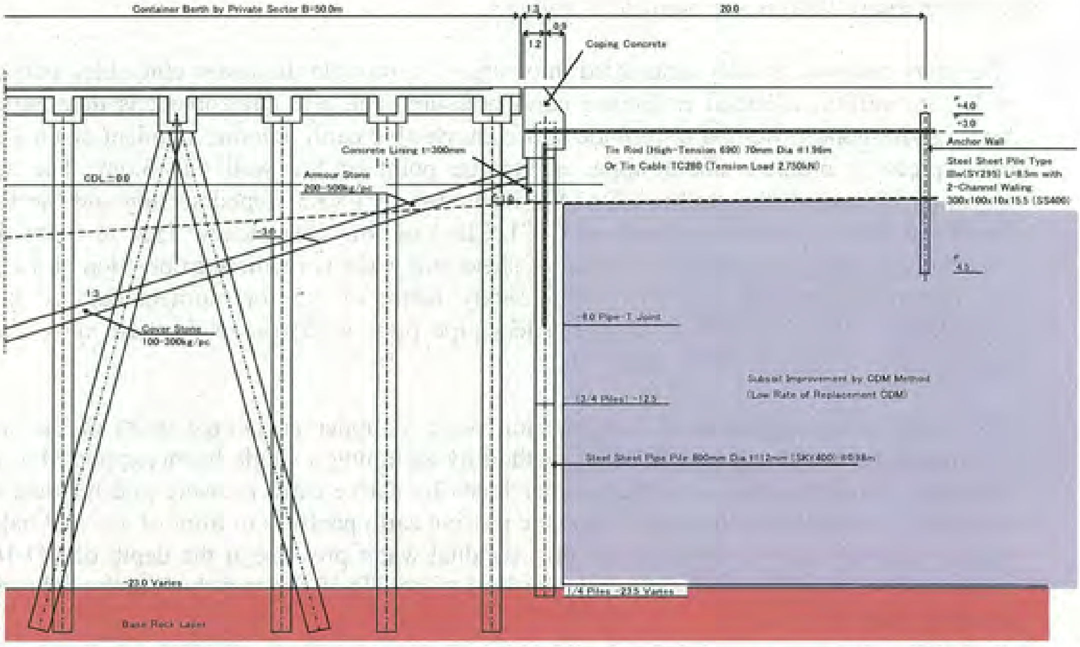
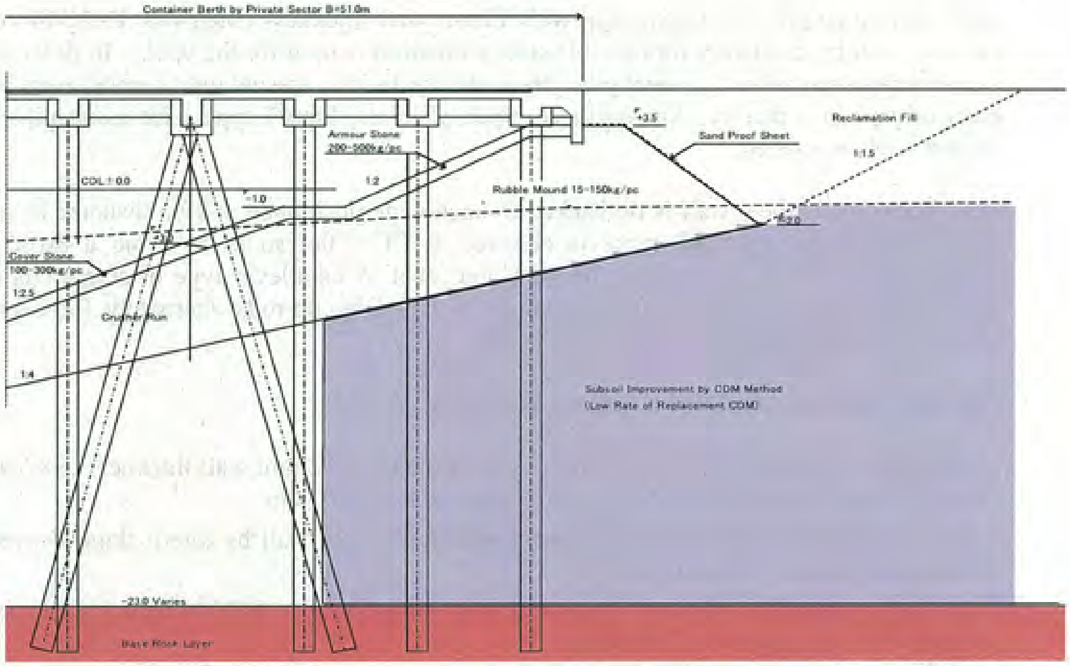


Source: JICA Study Team

Figure 15.2.3 Earth Retaining Wall behind Container Berth, Alternative A: Anchored Steel Sheet Pipe Piled Wall



Source: JICA Study Team

Figure 15.2.4 Earth Retaining Wall behind Container Berth, Alternative B: Rubble Mound with Vertical Curtain Wall

Alternative A: Anchored Steel Sheet Pipe Pile Wall is recommended for construction. Alternative B "Rubble Mound Type of Wall" must precede or execute in line with the construction of berth structure and therefore deems not suitable to apply for construction to be executed under PPP Program. The structural outline of Recommended Earth Retaining Wall (Alternative A: Anchored

Steel Sheet Piled Wall) is summarized as follows:

The sheet pile wall is fully embedded into subsoil to provide the lower embedded part of the wall with sufficient lateral resistance earth pressure. The pile embedment is determined by Free-Earth Support Method to provide sufficient passive earth pressure moment against active earth pressure moment about upper anchorage point of the wall CD+3.0m. The seabed elevation in front of the wall is CD+1.0m at the top of 1 to 3 sloped section and the subsoil under the deck of berth is clayey soil (C1 Clay) of low consistency. Due to these design conditions of the wall, the toe elevation of sheet pile walls is required to position at the depth of more or less CD-12.5 m to provide safety factor of 1.5 for moment balance in wall embedment. One (1) of four (4) steel sheet pipe piles is driven to the base rock layer to preclude any settlement of the wall.

The working bending moment and reaction force at upper anchorage point of the wall is determined using the equivalent beam method by assuming a single beam supported at upper anchorage point and the sea bottom under loads by active earth pressure and residual water pressure working behind the wall. Since the passive earth pressure in front of the wall balances with or exceeds active earth pressure plus residual water pressure at the depth of CD-10.0m, the virtual sea bottom of the wall is determined to be CD-10.0m and the length of the simple beam becomes 13m long.

- Reaction at Upper Anchorage point: 312 kN per meter of wall
- Reaction at Virtual Sea Bottom: 109 kN per meter of wall
- Maximum Bending Moment on Beam: 694 kN-m per meter of wall

Steel sheet pipe pile of 800mm dia. with 12mm wall thickness (SKY400, Z=5,510 cm^3 per meter of wall by deduction for possible steel corrosion) is used for the wall. In order to form a continuous sheet of wall, a steel pipe pile is attached with a special joint on both right and left sides of pipe at a factory. Among these types of joints, Pipe-T type joint using pipe and T shaped steels is applied.

The upper end of sheet wall is tie-backed to anchorage positioned at 20m distance behind the walls. Upper tie and anchorages is elevated at CD+3.0m so as to avoid a difficulty in installation of anchors and waling below water level. A cantilever type of single continuous wall construction is used for the anchorage and tied by tie-rods alternately for every two (2)-front sheet pipe pile at an interval of 1.96m.

The major materials used to the wall are as follows:

- Steel Sheet Pipe Pile Wall: 800 mm outside diameter x 12 mm wall thickness (SKY400) of 16.5m long (3/4 piles) & 27.5m long (1/4 pile) spaced at 0.98m
- Pipe-T type Wall joint Plate to form continuous sheet of wall by interlocking between the pipe piles (Mortal fill inside pipe)
- RC coping concrete at the top of the wall with lining concrete (t=300mm) for steel corrosion protection extended to CD-1.0m level
- 70 mm diameter Tie Rods (High-tension 690)or Tie Cable (Tension Load 2,750kN) and Accessories positioned at the elevation of CDL+3.00m at interval of 1.96m
- Continuous Anchor Wall: Steel Sheet Pile Wide Section Type IIIw (SY295) of 8.5 m long with Waling coupled by two(2) number of Channel shaped Steel of 300 x 100 x 10 x 15.5 mm Size (SS400)

b) Earth Retaining Wall behind Barge Berth

Barge Berth together with container berth is constructed by Private Sector under PPP program.

Open deck type of structure supported by foundation piles was studied for container berth structure in the METI 2010 Study for PPP Project. The proposed structure by METI 2010 Study must be subject to technical detailed review on design conditions, design load requirements, arrangement of foundation piles and structural details in DD stage and is expected to be designed carefully in combination with the design of earth retaining wall immediately behind the berth and will be finalized by Public Sector. Outline of barge berth proposed by Private Sector is summarized as follow:

Table 15.2.8 Outline of Barge Berth proposed by MITI 2010 Study

Design Vessel	100 TEU capacity Barge
Load Condition	
- Quay Crane	n.a.
- Apron Surcharge Load	n.a.
Geometry of Berth	
- Length of Berth	200m (including 50m for container berth width)
- Cope-line Elevation	CD+5.5m
- Berth Water Depth	CD-5.0m
- Width of Berth Apron	Approx. 30m
Berth Structure	
- Type of Structure	Slab & Beam RC Deck supported by Piles
- Width of Berth Deck	30m
- Pile Foundation	Vertical & coupled rake PHC Pile
- Seabed Slope under Deck	1 (V) to 3 (H) slope
- Fender System	V-shape 300mm, L3.0m at 6m interval
- Bollard	35 ton capacity

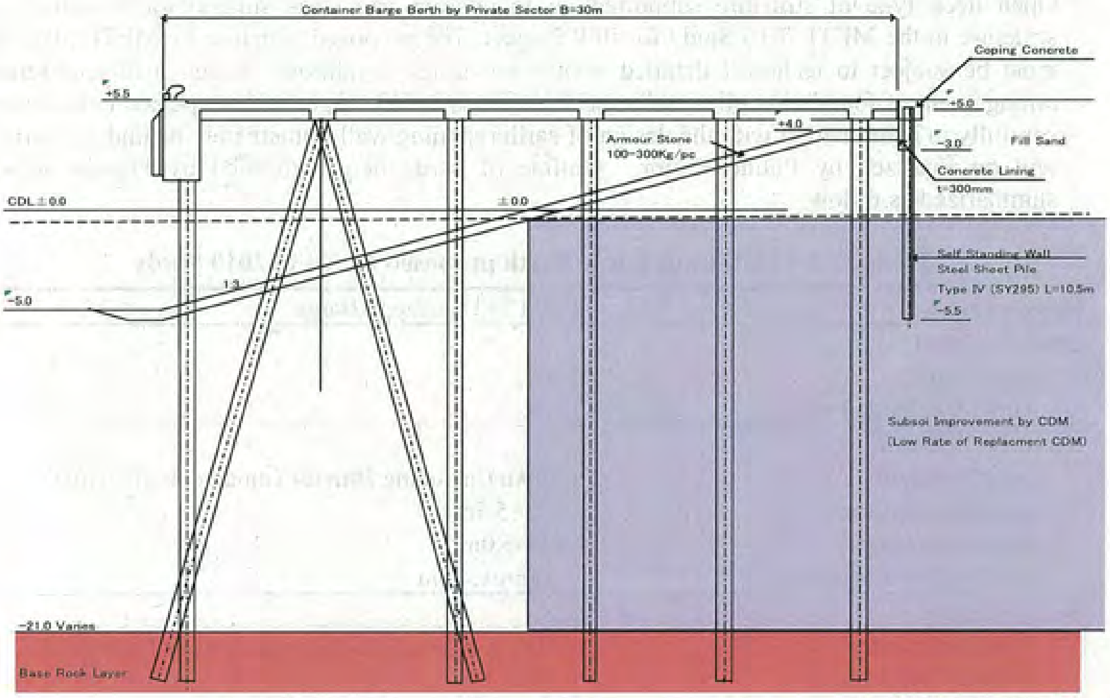
Source: Additional Study on Hai Phong International Gateway Port (Lach Huyen) Development Project in the Socialist Republic of Viet Nam, Final Report March 2010 prepared by MITI (MITI 2010 Study)

In this SAPROF Study, the following three (3) alternative types of wall (Among others, Alternative C is alternative structure for open type barge berth proposed by METI 2010 Study and functions for both barge berth and earth retaining wall for reclamation fill) are comparatively studied on earth retaining wall to be constructed immediately behind the berth structure.

Table 15.2.9 Proposed Alternatives for Retaining Wall behind Barge Berth

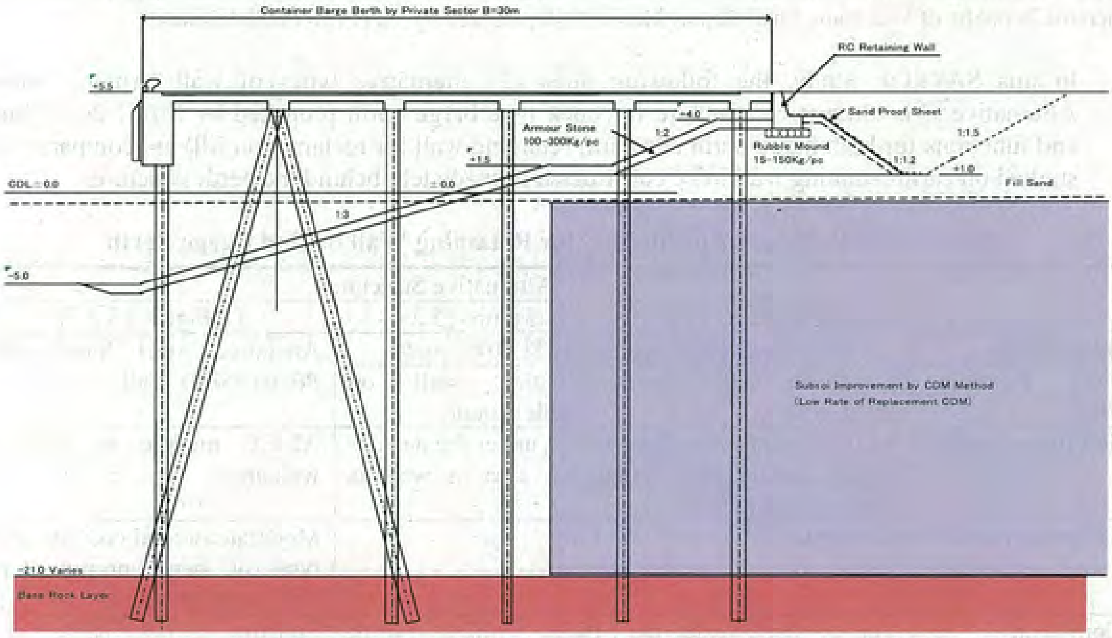
	Alternative Structure		
	A (Figure 15.2.5)	B (Figure 15.2.6)	C (Figure 15.2.7)
Barge Berth	Open Deck proposed by METI 2010 Study		Anchored Steel Sheet Pipe Piled (SSPP) Wall
Earth Retaining Wall	Cantilever type Sheet Piled Wall	Retaining wall on Rubble mound	
Soil Improvement	ALiCC method for upper sloped under the deck or rubble mound base foundation area as well as back-of wall area		ALiCC method for back-of wall area
Construction Cost	Moderate	Low	Moderate in total cost for open type of berth proposed by METI 2010 Study
Comments	Top of slope under the deck must be formed by sandy soil	Berth piling work precedes formation of rubble mound	Function as both barge berth and retaining wall for reclamation
Recommendation	(O) Recommended Suitable to form the same type of wall as retaining wall provided at container berth	(X) Not Recommended	(△) Recommended Suitable in case earth retaining wall for container berth is constructed by SSPP wall to form continuous wall

Source: JICA Study Team



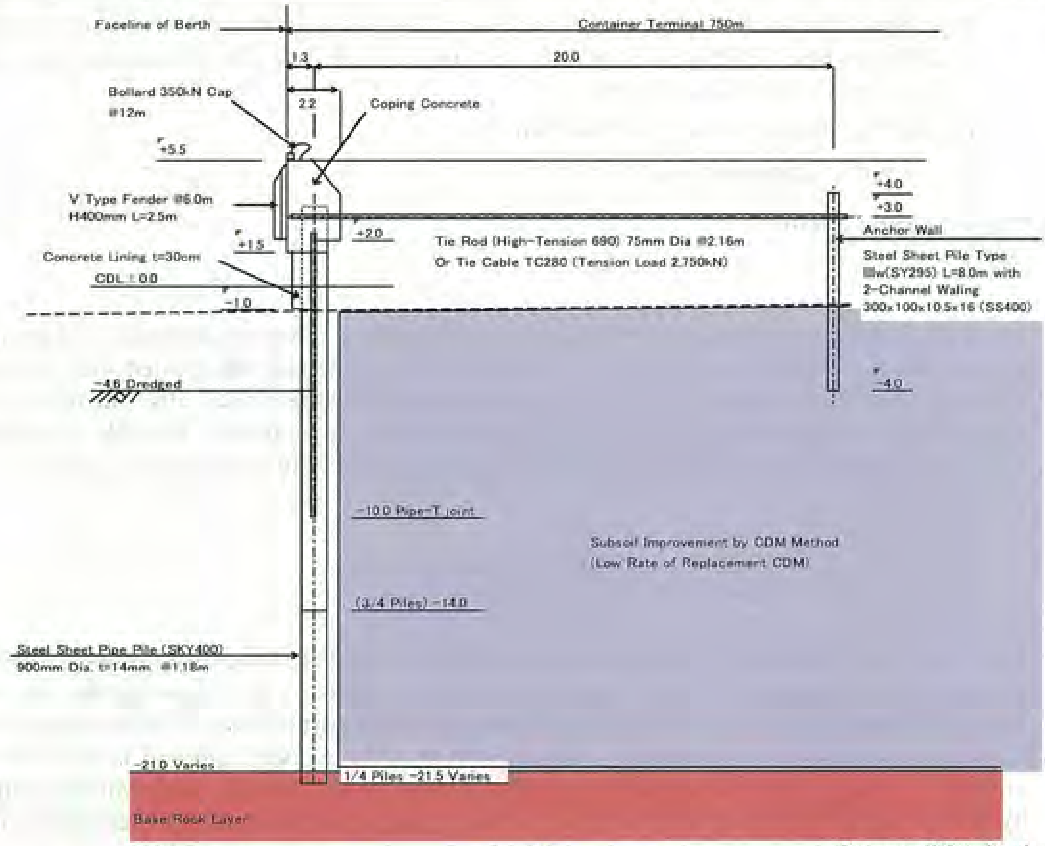
Source: JICA Study Team

Figure 15.2.5 Earth Retaining Wall behind Barge Berth, Alternative A: Cantilever Type Self-standing Sheet Piled Wall



Source: JICA Study Team

Figure 15.2.6 Earth Retaining Wall behind Barge Berth, Alternative B: Retaining Wall on Rubble Mound



Source: JICA Study Team

Figure 15.2.7 Earth Retaining Wall functioned as Barge Berth, Alternative C: Anchored Steel Sheet Pipe Piled Wall

Alternative C is the one of suitable type of structure for barge berth as far as proper consent with private sector could be obtainable in the type of berth structure and the corresponding share in construction work and cost by private sector. Therefore, application of Alternative C and its demarcation of investment between public and private should be determined in the detailed design stage for the Project.

In this Study, under the pre-requisite that 30 m wide open deck barge berth is constructed based on the conceptual design of berth proposed by METI 2010 study, Alternative A: Cantilever Type Self-standing sheet pile wall is adopted for construction of earth retaining wall immediately behind the open type piled deck berth structure constructed by Private Sector. The upper part of the seabed slope under the deck must be formed by use of sandy soil from the existing seabed around CD±0.0m so that the wall could be laterally sustained by reaction force along the wall embedment into sandy soil mass without such adverse effect as creep deformation by clayey subsoil.

The structural outline of Earth Retaining Wall behind Barge Berth (Alternative A: Cantilever Type Self-standing Sheet Piled Wall) is as follows:

> Cantilever type of self standing wall is formed by steel sheet piles. The wall sustains the active earth and residual water pressure working from the back of wall by lateral reaction force of subsoil mass in front of the wall. The sandy soil is used to form seabed mound under the deck in a slope of 1 (V) to 3 (H) from the existing seabed ground around CD±0.0m to the top of the sloped mound CD+4.0m.
>
> The major materials used to the wall are as follows:

- Steel Sheet Pile Wall: Steel sheet pile of type IV section (SY295) of 10.5m with provision of concrete lining (t=300mm) for seaside face of the wall extended from coping concrete to CDL+3.0m for corrosion protection
- RC coping concrete at the top of the wall

3) Facilities at Public Related Area

a) Harbor Crafts Berth

(Berth Structure)

Sheet pile wall construction with provision of earth pressure relieving platform is recommended to apply in view of weakness of clayey subsoil condition at the site. Sheet piled wall is very rigid structure owing to the soil backfilling immediately behind the sheet pile walls. The in-situ subsoil around the wall is subject to PVD soil improvement to complete possible consolidation settlement during construction by which the cohesion of clayey soil is expected to increase to:

Upper Clay: C' =Co +DC=35kN/m^2
Middle Clay: C'=100kN/m^2 (Substantially no increase)
Lower Clay: C'=44kN/m^2 (Substantially no increase)

Type IVw wide section of sheet pile is used as a member of wall. Sheet piled walls are backfilled by sandy fill to moderate active earth pressures from the retained soil. The sheet pile wall must be fully embedded into subsoil to provide the lower embedded part of the wall with sufficient lateral resistance by passive earth pressure. Active earth pressure working on wall is relieved by the provision of independent RC platform installed immediately behind the wall which is supported by RC piles. Owing to the presence of relieving platform, the designated toe elevation of sheet pile walls is estimated to be more or less CD-11 m level for 7 m long embedment.

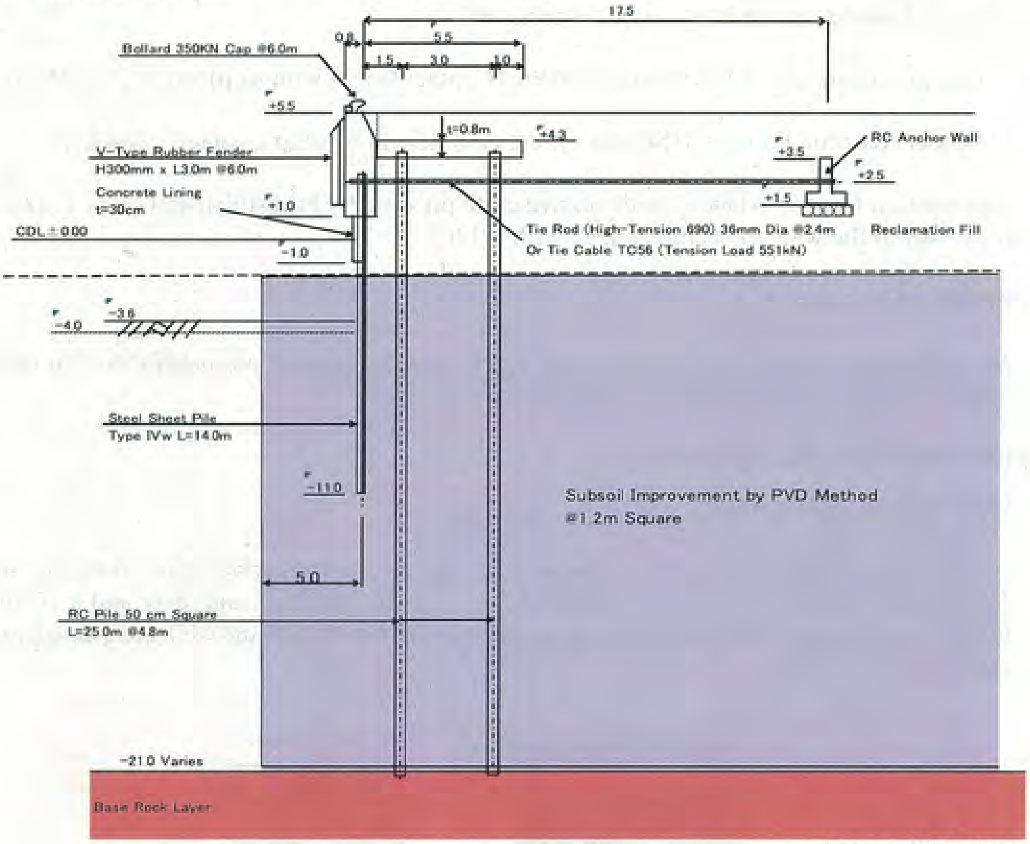
50cm square RC piles for the relieving platform are installed at 2 sectional pile rows at longitudinal interval of 4.8m and are driven onto base rock layer to eliminate any settlement of the structure.

RC Pile Tip Elevation: CD-21.0 m to rest upon base rock layer
Working Vertical Load on a Pile by Dead and Surcharge Load: Pv= 609.6kN/pile
Ultimate Load of a Pile: Ru=Qd x Ap + Fi x As
Where Ru: Ultimate bearing capacity of a pile (kN)
Qd: Bearing capacity of ground at the pile toe (kN/m^2)
- Lower Clay: Qd=352kN/m^2
- Base Rock Siltstone: Qd=12,000kN/m^2
Ap: Tip area of a pile (m^2)
Fi: Friction between the pile face and pile embedded ground (kN/m^2)
Upper Clay C1: F1=C=35kN/m^2
Middle Clay C2: F2=C=100kN/m^2
Lower Clay C3: F3=C=44kN/m^2
As: total peripheral area of a pile (m^2)
For 50cm square pile embedded onto base rock layer, it is estimated for a pile,
Ru=2,022 kN/pile
Safety Factor for Pile Bearing=3.3

The upper end of sheet wall is tie-backed to anchorage positioned at proper distance behind the walls. Upper tie and anchorages is elevated at CD+2.5m so as to avoid a difficulty in installation of anchors and waling below water level. A RC continuous wall construction is used for the anchorage and tied by tie-rods alternately for every four (4) front sheet piles.

The major materials used to the wall are as follows:

- Steel Sheet Pile Wall: Steel sheet pile of type IVw wide section (SY295) of 14m long with provision of concrete lining (t=300mm) for seaside face of wall extended from coping concrete to CDL-1.0m for corrosion protection
- RC coping concrete at the top of the wall with such berth fittings as fender system, curb concrete and bollard
- 36 mm diameter Tie Rods (High-tension 690)or Tie Cable (Tension Load 551kN) and Accessories positioned at the elevation of CDL+2.50m at interval of 2.4m
- Continuous RC Anchor Wall
- Relieving Platform: 80cm thick RC slab supported by two(2) row of pile foundation
- Supporting Pile: 50cm square RC pile of 24m long in two (2) rows installed at longitudinal interval of 4.8m



Source: JICA Study Team

Figure 15.2.8 Typical Section of Service Boats Berth

(Fender System)

Berthing velocity of such design vessel as tugboat is assumed 0.3 m/sec perpendicular to berth cope-line for the design vessels. The corresponding berthing angle to the wharf cope line is taken as 10° at the quarter-point berthing of ship. V-shaped Rubber type of fenders spaced at 6 m will be installed to accommodate smaller sizes of boats.

The following is the summary of the design output and selection of the fender system:

Table 15.2.10 Selection of Fender Size

Size of Ship	Berthing Velocity (m/sec)	Fender Interval (m)	Berthing Energy of Ship (kN-m)	Fender V type H (mm) x Length (m)	Energy Absorption (kN-m)	Fender Reaction (kN)
Japanese Standard						
4,000PS Tugboat	0.3	6.0	31.2	H400 x 3.0m	44.3 (L=0.9m)	977(L=3.0m)
				H300 x 3.0m	32.5 (L=0.9m)	954(L=3.0m)

Source: JICA Study Team

The rubber type docking fender of V shaped type H300mm x L3.0m are installed at 6 m interval to accommodate service boats used for new port.

Energy Absorption = 40.1kN-m/m x 0.9m (Contact length with ship) x 0.9=32.5 kN-m

Fender Reaction Force = 318kN/m x 3.0m (Full length for ship Contact) =954 kN

The reaction force is balanced with passive earth pressure by back-filled soil mass working on the back-face of the wall upon ship contact with berth.

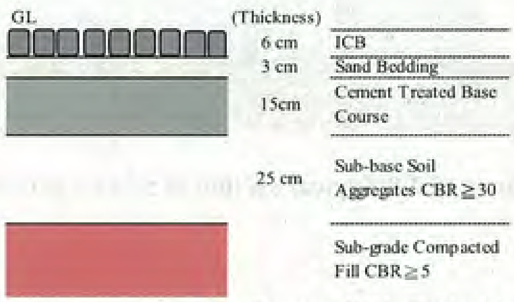
(Mooring Bollard)

Mooring bollards of 350 kN Hawser Pull force capacity per unit are provided at an interval 6m along the face-line of berth to accommodate design vessel.

b) Pavement for Public Related Area

(Service Boats Berth Area)

Interlocking Concrete Block (ICB) pavement is applied. Paving surfacing is covered by the use of 6 cm thick Interlocking Concrete Blocks placed on 3 cm bedding sand layer and a 15cm-cement treated base course. Sub-base and sub-grade course is provided on well compacted in-situ fill materials.

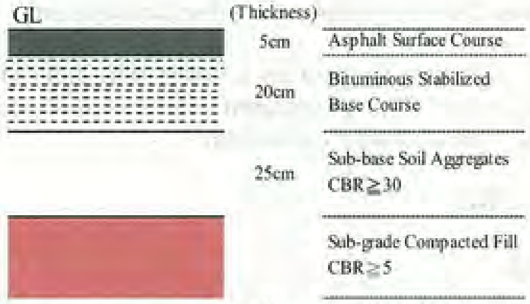


Source: JICA Study Team

Figure 15.2.9 Pavement Structure for Service Boats Berth Area

(In-port Road)

Flexible type of asphalt pavement is applied to in-port road at Public related Area in view of economy for construction and possible maintenance for residual settlement due to the nature of in-situ clayey subsoil. One (1) bituminous layer of surface with bituminous stabilized base layer is placed on substantially compacted sub-base and sub-grade courses.



Source: JICA Study Team

Figure 15.2.10 In-port Road Pavement Structure

4) Other Designs for Major Port Facilities

The same structures as those designed for Medium Term Development Plan (Part-2 of this report) is applied to the works done by Public Sector for Implementation Plan as Japan ODA Loan Project as follows:

Table 15.2.11 Design of Other Major Port Facilities for Japan ODA Loan Project

Facility	Design of Structure	Remarks
1. Inner Revetment (South –side Temporary Revetment at Reclamation Area	Sloped Revetment covered by armour stones with provision of PVD subsoil improvement	Refer to Item 5) in Chapter 12.1.3
2. Outer Revetment A (West-side Seawall along Access Road Area for Initial Development)	L shaped wall on rubble mound with wave breaking work elevated CD+6.5m at cope-line with provision of PVD subsoil improvement	Refer to Item 4) in Chapter 12.1.3
3. Outer Revetment B (West-side Breakwater along Access Road Area for Medium Term Development Terminal Area)	L shaped wall on rubble mound with wave breaking work elevated at CD+6.5m at cope-line with provision of PVD subsoil improvement	Ditto
4. Sand Protection Dyke (Sand Protection Dyke extended from Outer Revetment B to CD-5.0m depth offshore	Non-permeable rubble mound with wave breaking work elevated to CD+2.0m	Refer to Cross Sections for seabed level GL-1.0 to -5.0m in Chapter 12.1.6
5. Pavement at Access Road	Asphalt pavement of 10cm thick surfacing Layer	Refer to Item 3) in Chapter 12.1.5

Source: JICA Study Team

15.2.2 Cargo Handling Equipment

Numbers of cargo handling equipment in need should be provided in accordance with the increasing container throughput. But they are able to be minimized on the good operation procedure and better maintenance for them.

Here, the prerequisite particulars of each equipment is described, and the numbers to be provided will be finally decided by the terminal operator' policy for productive handling and safe operation. But it is recommended that the standard numbers to be provided are described in the relative items.

Daily check and inspection for all handling equipment in the terminal is most important for displaying full performance functioning in operation and actual extension of service life to procure. Moreover, good maintenance can keep the equipment in minimum numbers in the terminal, and no more additional spare than the terminal deserves shall not be provided, in order to save the investment.

Quick repair shall be performed if any points in out-of-order are found.

Mark sheets checking system by drivers/operators is better to be induced on commencing working and on finishing. The covering manual shall be prepared and the terminal members should be ceaselessly educated/trained according to the operation curriculum.

1) Quay Gantry Crane (QGC)

Total 8 Units to be installed.

Eight units of QGC can handle 1,019,200 TEU (Double throughput of 526,000 TEU for 2 terminals) in full operation in a year, as follows;

- QGC productivity: 25 boxes/hr., working time 21 hrs. per day, working days 364 days/yr.,
- 20FT : 40 FT = 1 : 1 coefficient 1.5.
  25 boxes x 21 hrs. x 364 d/s x 8 units / 1.5 = 1,019,200 TEU
  30 boxes as normal productivity can be operated to raise productivity 20 %.
  1,223,040 TEU (30 boxes per hour) excess sufficiently double of 525,000 TEU.
- The rail spun: 30m.
- Outreach from waterside rail: 56.6m. Applicable for 18 rows of containers loaded on deck.
- Twin 20 ft type.
- Rated load: 40.6 tons for container, Hoisting load: 54 tons
- Crane weight: 1,500 tons
- Height of lift above the rail level: 29m
- Height of lift below the rail level: 13m (But these should be adjusted upon sea water level)
- Other system to be attached:
  Overweight alarm for containers on lifting
  Sensor for showing truck adjusting position
  Mechanical Anti-Sway System
  Elevator

2) Rubber Tired Gantry Crane (RTG)

Total 24 Units of 16 wheelers.

- Wheel spun: 23.47m (16 units out of 24 to be allotted for 8 QGCs, and 8 units for external trailers and railway sidings.
- Applicable for 6 slots of containers and 1 truck passage between the wheels.
- Container loadable height: one over four (height under spreader 15.24m).
- 16 units out of 24 to be allotted for 8 QGCs and 8 units for external trailers and railway sidings.

RTG numbers in need are 2 units per 1 QGC on the difference of handling time 2.4 minutes and 3.5 minutes, as follows.

- QGC productivity 25 boxes/hr., 2.4 minutes/box
- And RTG productivity 3.5 minutes/box in 3.5 tiers stowed, including slot-shifting time.

3) Tractor Head and chassis

50 units of Head and 55 Units of chassis to be provided.

Numbers are calculated as follows;

- Trailer: terminal 1round 5.7 minutes, (Average distance for 1 round 1,900m, speed 20km, 5.7 minutes for 1 round), QGC handing time 2.4 minutes and RTG handling time 3.5 minutes.
- 2.4 m + 3.5m + 5.7 m = 11.6m 11.6/2.4 = 4.8 5 trailers should be provided per QGC (To be adjusted to QGC handling time).
- 40 trailers (Heads and chassis) to be allotted for 8 QGCs and 8 trailers for haulage from/to railway sidings and for mounting over-sized container cargo.
- 2 heads and 4 chassis are spares for maintenance.

These are dedicated only in the yard operation and not used outside of the terminal. These tractor heads should have more than strong engines rather than the ones under general use, because rapid acceleration and sudden slamming of the brakes occurs frequently during working.

Chassis is 20ft/40ft convertible and should have strong steel beams for providing violent and quick mounting /dismounting containers by QGC/RTG during yard operation and simple coupling with heads and for easy attachment/detachment of twist-locks on containers on chassis by lashers.

4) Forklift, with telescopic spreader (Top-lifter)

Total 5 units to be provided.

This is used for lifting up/down, and carrying laden containers, and empty containers on piling. Flat-rack/open-top containers loading oversized cargo can be handled by Top-lifter.

Telescopic spreader can be adjusted both for 40 ft and 20 ft containers.

- Rated load: 32/35 tons
- Container lifting capacity: 3 or 4 tiers high.

5) Forklift, with side telescopic spreader (Side-lifter)

Total 3 units of Side-lifters to be provided.

This is used for lifting up/down only for piling empty containers, whose lifting capacity of 8 tons and 6 tiers high. The height depends on the layout in ECD (Empty Container Depot). This versatile forklift is used in ECD only.

Telescopic side-spreader can be adjusted both for 40ft and 20 ft containers.

6) Forklift, with finger type

This is used for lifting up/down and carrying heavy/long break-bulk cargo, and also for 20 ft containers with fork pockets

Its related load will be enough 12 tons. The above top-lifter can work instead of finger type forklift using wire rope lifting from the spreader.

7) Multipurpose forklift

Total 4 units of forklifts to be provided.

This folk lift is used mainly for inspection and maintenance of the container handling equipment and the terminal facilities.

Rated load of 3/5 tons is enough for this working, but this is desirable to have telescopic mast to lift up any objects to high points.

8) Reach stacker/Tire mounted mobile crane

2 units of stackers or mobile cranes to be provided.

These are used for container loading /unloading from/to barges berthed to the container terminal quay. Therefore their arms should reach third row of containers loaded on barges on the berth from the quay line. The capacity by reach stackers for lifting containers on the third row from the quay line in the barge will remarkably become weak, but mobile crane not so much. This choice should be considered on the type of motor barge, kinds of containers, and container handling system for barges on the terminal.

15.2.3 Access Road and Bridge

1) Access Road

a) Route Alignment in Cat Hai Island

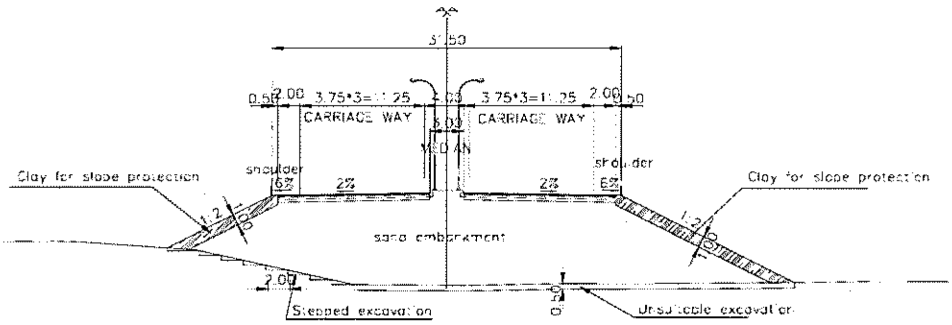
SAPROF study recommends the Alignment C in Figure 15.2.11 in order to reduce the number of resettlement. However, if the matter of resettlement will be not significant, VIDIFI's one (Alignment A) should be better for the future development plan in Cai Hai Island.

Source: JICA Study Team

Figure 15.2.11 SAPROF's Alignment in Cai Hai Island

b) Typical Cross Section of Access Road

In Initial stage in 2015, required traffic lane number is 2 traffic lanes, however, 3 traffic lanes are required in 2022 based on the future traffic demand forecast by VIDIFI. At the present time, SAPROF study recommends the typical cross section with 3 traffic lanes in initial stage in Figure 15.2.12. However, the number of traffic lane should be clarified again according to traffic demand forecasting in the further study.

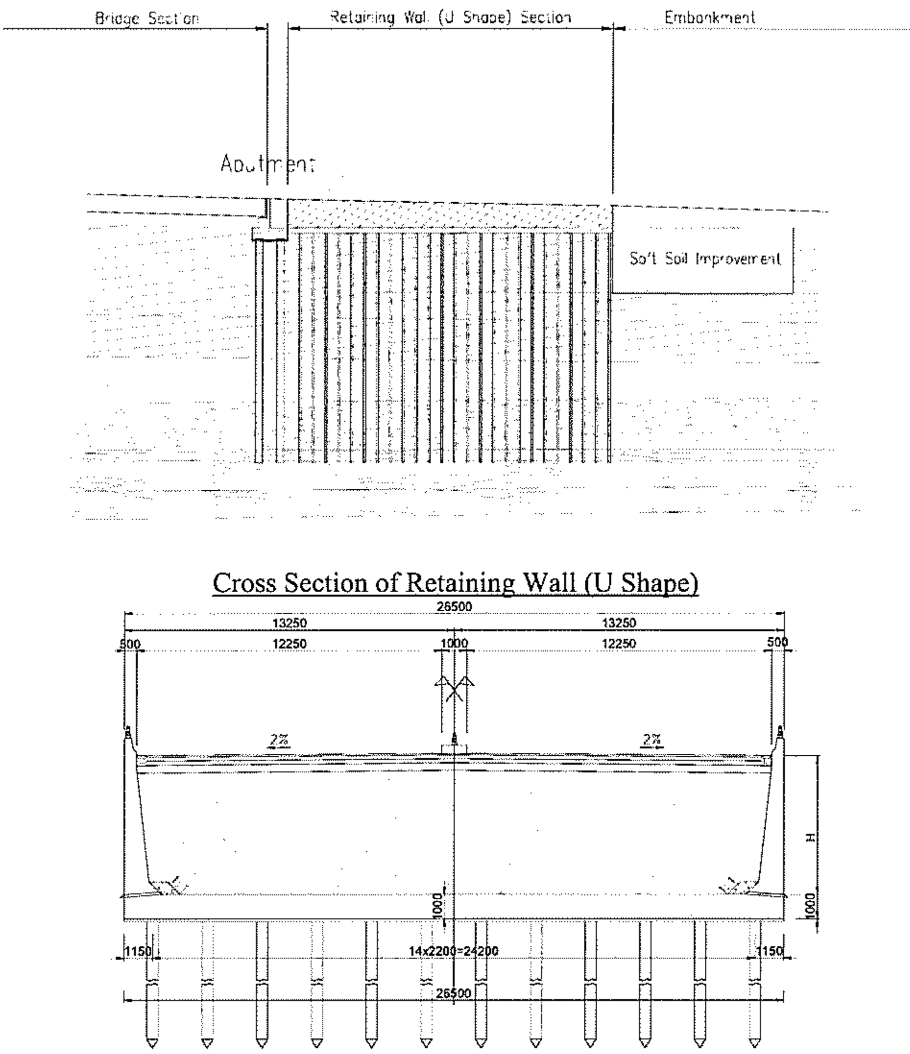


Source: Planning Construction Investment project Tan Vu-Lach Huyen Highway Project in Hai Phong City, VIDIFI, 2009

Figure 15.2.12 Typical Cross Section of Access Road

c) Structure of Connection to Approach Bridge

U Type wall structure is adopted for connection to approach bridge in the past study. Embankment with soft soil treatment is suitable in lower section, however parametric cost study will be needed to determine the length of each section. Structure has shown in Figure 15.2.13.

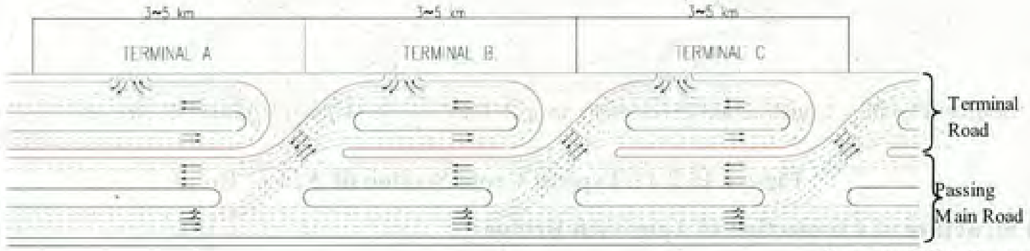


Source: JICA Study Team

Figure 15.2.13 Structure of Connection to Approach Bridge

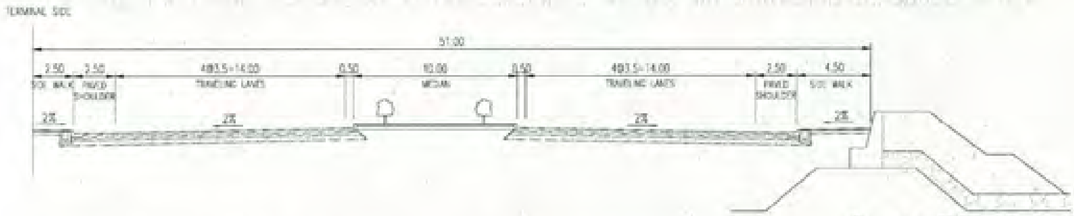
d) Layout of Terminal Road

Considering the smooth traffic flow in port roads, the terminals along access channel should be divided into several groups and 4 traffic lanes roads are arranged just behind the each group of terminal and 8 traffic lanes road is arranged behind the terminal roads as a passing main road and finally total road width will be 95 m as shown in Figure 15.2.14 and Figure 15.2.15.



Source: JICA Study Team

Figure 15.2.14 Layout of Each Terminal Road and Passing Main Road (Future)

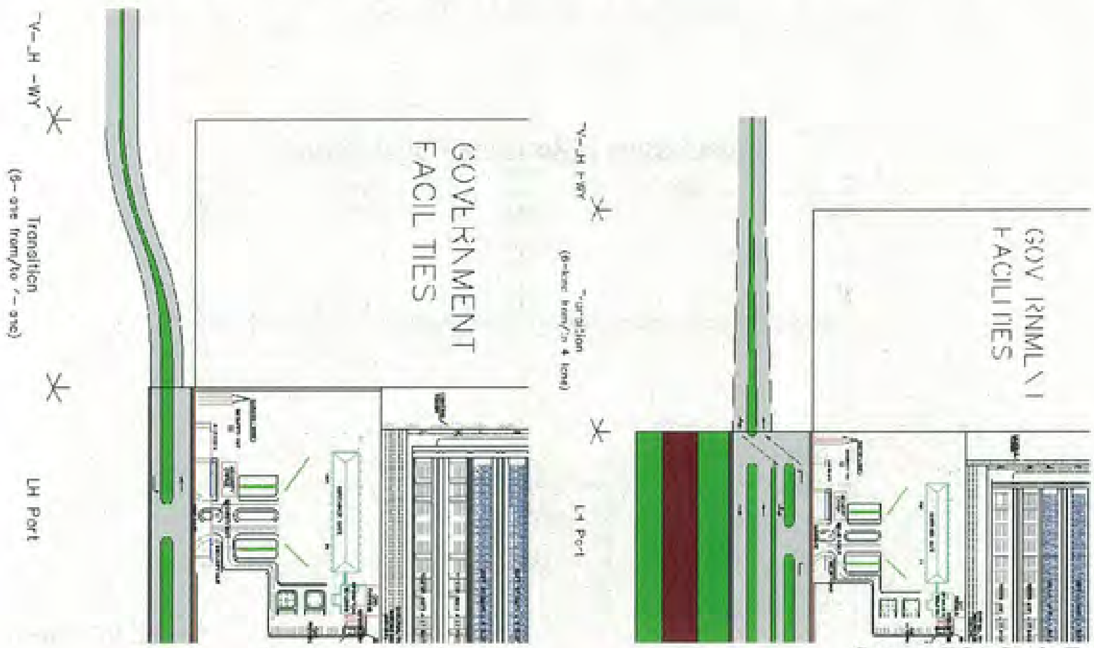


Source: JICA Study Team

Figure 15.2.15 Typical Cross Section of Passing Main Road (Future)

e) Connection of Terminal Road to Access Road

The connection of port road and access road of Cat Hai Island is proposed to be as shown in Figure 15.2.16. The length of transit section in each stage should be determined based on the design speed of Tan Vu – Lach Huyen Highway, 80 km.

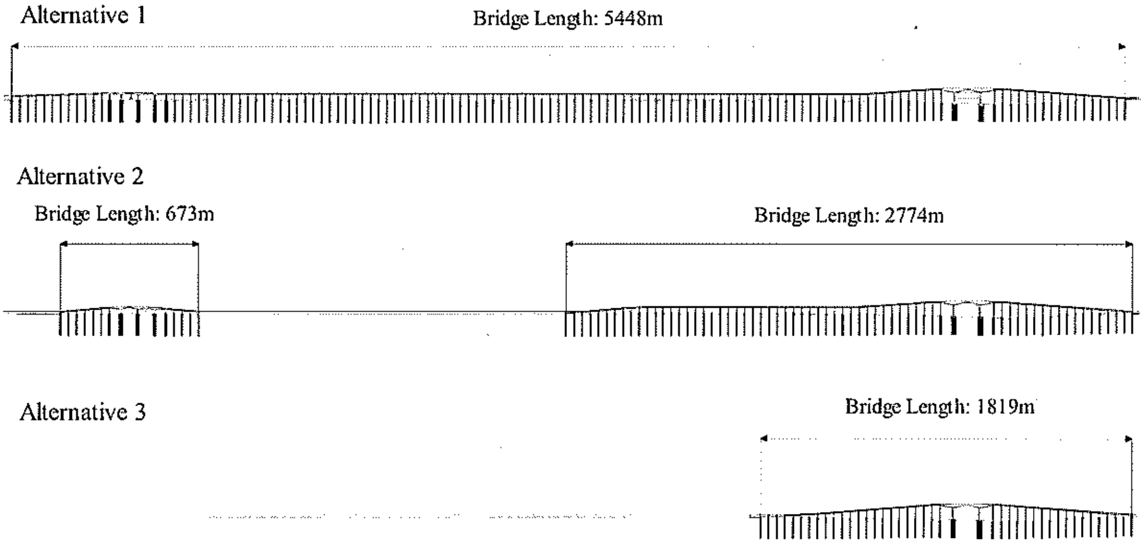


Source: JICA Study Team

Figure 15.2.16 Connection of Terminal Road and Access Road (2015 & Future)

2) Bridge

According to the recommendation of the review of previous studies, three alternatives should be studied comparatively. Profiles of each alternative have shown in Figure 15.2.7.



Source: JICA Study Team

Figure 15.2.17 Bridge Alternatives

At the present time, the most suitable alternative seems Alternative 2. However, some situation should be clarified and make consensus between relative agencies.

The final bridge plan should be determined by Bridge SAPROF Team after confirmation of following situations and conditions.

- The Width of Navigation Clearance
- Construction Schedule of the land reclamation for Dinh Vu IZ future zone
- Necessity of Flyover in Dinh Vu IZ
- Construction Cost
- Construction Period

16. Construction Plan and Cost Estimates

16.1 Construction Plan

16.1.1 General

In the initial stage of development, container terminal 1&2 will be constructed and the government of Vietnam is expecting its construction to be completed by 2014 in order to start the port operation from 2015. To minimize the construction period, sand supply capacity and soil improvement will be the key. In order to minimize the construction schedule and start the port operation as early as possible, cement mixing type of soil improvement shall be applied together with PVD method for the construction of container terminal 1and 2.

16.1.2 Construction of container terminal

The construction procedure is shown in the flowchart below. The yard will be handed over to the private contractor after the reclamation and soil improvement. All the construction methods are already explained in Section 12.2 except for the soil improvement by CDM method, and it will be explained in the following sub-section.

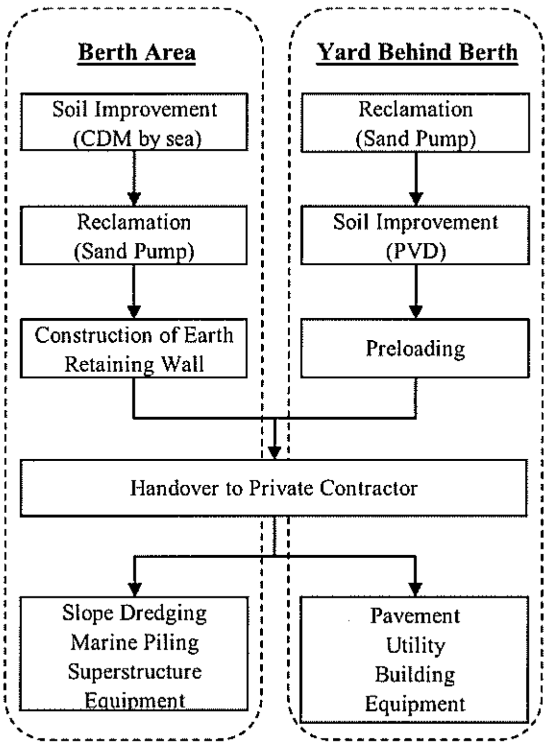
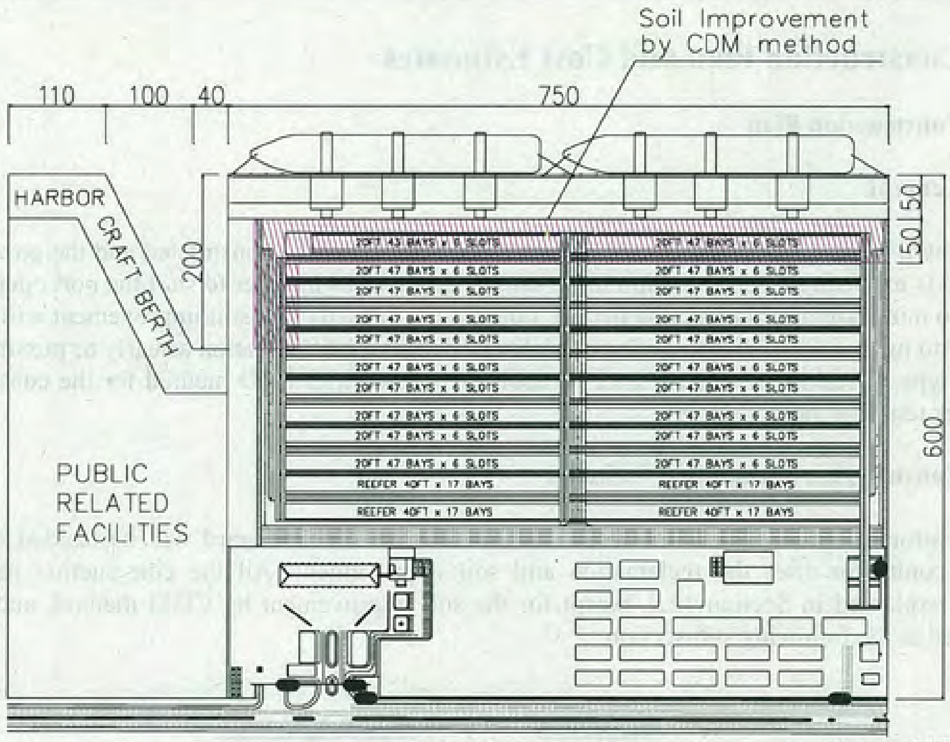


Figure 16.1.1 Flow chart of container terminal construction

16.1.3 Soil Improvement by Cement mixing method (CDM)

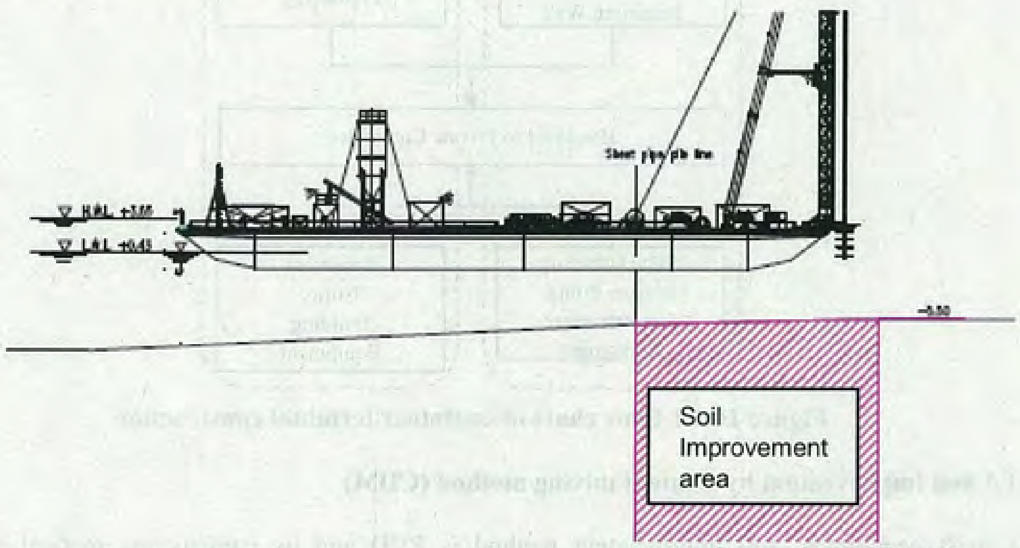
The most economical soil improvement method is PVD and its construction method is already explained in section 12.2.5. With this method, preloading is required after the installation of drain material and need to wait certain period until the original ground is consolidated enough. Therefore it requires longer construction period. In order to handover the berth area to private contractor as early as possible, it is recommended to apply cement mixing method for soil improvement at berth area shown in Figure 16.1.2.



Source: SAPROF team

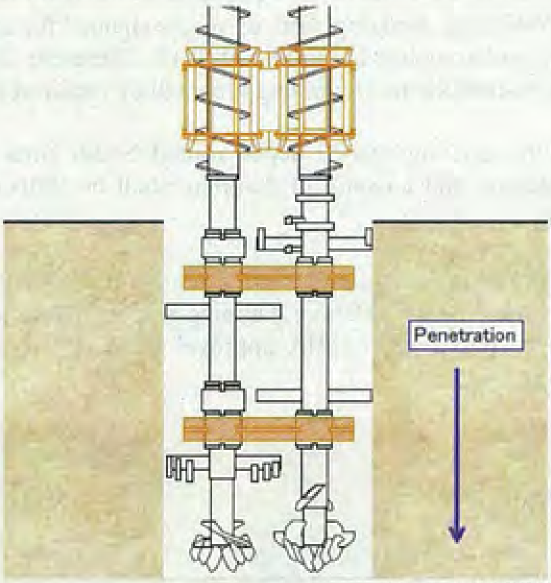
Figure 16.1.2 Proposed area of CDM method

Once the area is dredged to -2.0mCD to secure barge access, CDM barge equipped with twin-auger will lower down the auger until the design depth. After it reached the design depth, the auger will be pulled up while mixing the original soil with cement. The cement will be supplied from the silo barge moored alongside CDM barge. The design mix ratio and the pitch as well as the area to apply CDM method shall be studied in detail during detail design stage.



Source: SAPROF team

Figure 16.1.3 CDM by barge



Source: SAPROF team

Figure 16.1.4 Penetration image

16.1.4 Sand supply and transportation capacity

There are two issues regarding the reclamation sand. One is the total quantity of the sand permitted to dredge and the second is the transportation capacity.

・The sand quantity: Approved quantity to dredge from the river is already mentioned in Section 12.2.10, and there is enough sand for reclamation and preloading.

・Transportation capacity: In order to carry out the construction work without standby or delay, at least 250,000m3/month of the sand is required which is equivalent to 10,000m3/day. By using barges with capacity of 400m3, and considering the traveling time from sand source to the project site (1.5days/trip), around 38 to 40 barges need to be mobilized. With such number of barges, the project site can be very congested. Therefore the transportation of the sand shall be well planned and/or mobilization of larger barges or vessels shall be considered.

16.1.5 Dumping of the dredged material

The original soil is not suitable as a reclamation material, and thus most of the material will be dumped in the area designated by the people's committee of Hai Phong City (Hai Phong PC).

Hai Phong PC has designated following 2 areas with total capacity of 50,000,000m3 for dredged material from Lach Huyen Project as shown in Figure 16.1.5.

- 05 sites in communes with a total area of 35ha (land sites)
- 01 site on south Dinh Vu industrial zone in Hai An district with an area of 1,000ha

In case the dredged material is dumped at sites in communes which are on land, the cost of dumping will be higher and construction period will be longer due to the longer distance to sail and additional work to transport dredged clay up to the land from the barge. From these considerations, the dredged material is planned to be dumped at South Dinh Vu industrial zone.

According to Nam Dinh Vu Investment who is the project owner of the industrial zone, the reclamation work of South Dinh Vu industrial zone is scheduled to start from May of 2010 and complete by early 2013. While the dredging work of access channel for Lach Huyen Port is planned to start from middle of 2012 and complete by middle of 2015. Therefore if the reclamation of industrial zone will complete as their schedule, new dumping area will be required from 2013.

It should be noted that the existing seabed depth around South Dinh Vu industrial zone is quite shallow. Therefore the method and location of dumping shall be further studied and discussed with Nam Dinh Vu Investment.

Considering above schedule of reclamation by Nam Dinh Vu Investment and the natural condition of the area, it may be more economical if offshore dumping site with sufficient seabed depth is available. It is recommended that the possibility of EIA approval for such offshore dumping site should be studied during detail design stage.

Source: SAPROF team

Figure 16.1.5 Map of Dumping Grounds

16.1.6 Handover to the private contractor

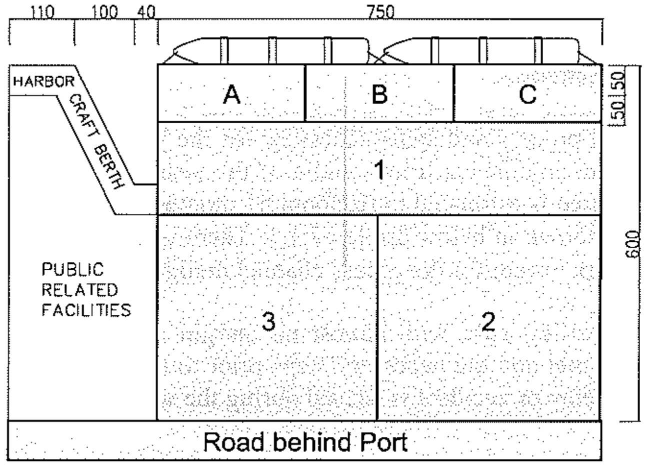
Since Lach Huyen Port Project will be implemented by PPP scheme, the area needs to be handed over to the private contractor portion by portion.

The berth area is divided into 3 portions (A, B and C as in Figure 16.1.6) and they will be handed over to the private contractor once soil improvement (CDM) and reclamation work as well as the construction of the earth retaining wall are completed for each portion. Thereafter, private side will commence slope dredging by grab dredger and marine piling followed by the superstructure work.

The yard behind berth area is divided into 3 portions as well (1, 2 and 3 as in Figure 16.1.6), and they will be handed over to the private contractor once reclamation and soil improvement (PVD) are completed. The private contractor will commence pavement and utility work as well as the building work.

Plan of handover area is subject to change depending on whether the terminal operation of berth 1and

2 will commence at the same time or separately (i.e., start the operation of berth 1 first).



Source: SAPROF team

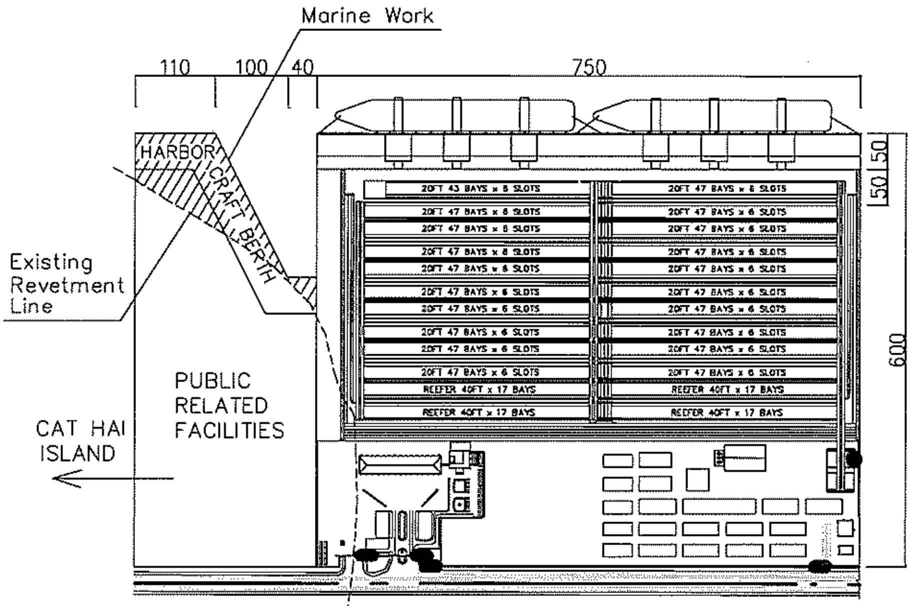
Figure 16.1.6 Plan of Hanover area

16.1.7 Public Related Facilities

The proposed location of public related facilities is mostly on existing land in Cat Hai Island as shown in Figure 16.1.7.

For the marine work part, the land will be reclaimed in the same way as the terminal yard, and the original soil will be improved by PVD method followed by preloading. After preloading is completed, steel sheet pile as well as RC piles will be driven by land piling machine along the quay line of harbor craft berth. The steel sheet pile wall will be tied to the anchor wall by tie rod or tie cable. In front of the sheet pile wall will be dredged to the elevation of -4.0mCD by grab dredger in order to secure draft for the service boats.

For the land work part, the existing ground will be paved and the building work will be carried out. The existing ground elevation is around +3.0~4.0mCD and therefore requires earth work to fill up to the design final elevation.



Source: SAPROF team

Figure 16.1.7 Layout of Public Related Facilities

17. Project Implementation Plan

17.1 Implementation Schedule

Considering the standard process and steps necessary for the yen loan agreement, it is estimated that the construction work can commence from middle of the year 2012 at the earliest. As the minimum construction period required is estimated to be about 41 months, the port operation can only be started earliest in July, 2015 as shown in below Table 17.1.1. There is defect liability period of two (2) years after the construction work except for the access channel dredging.

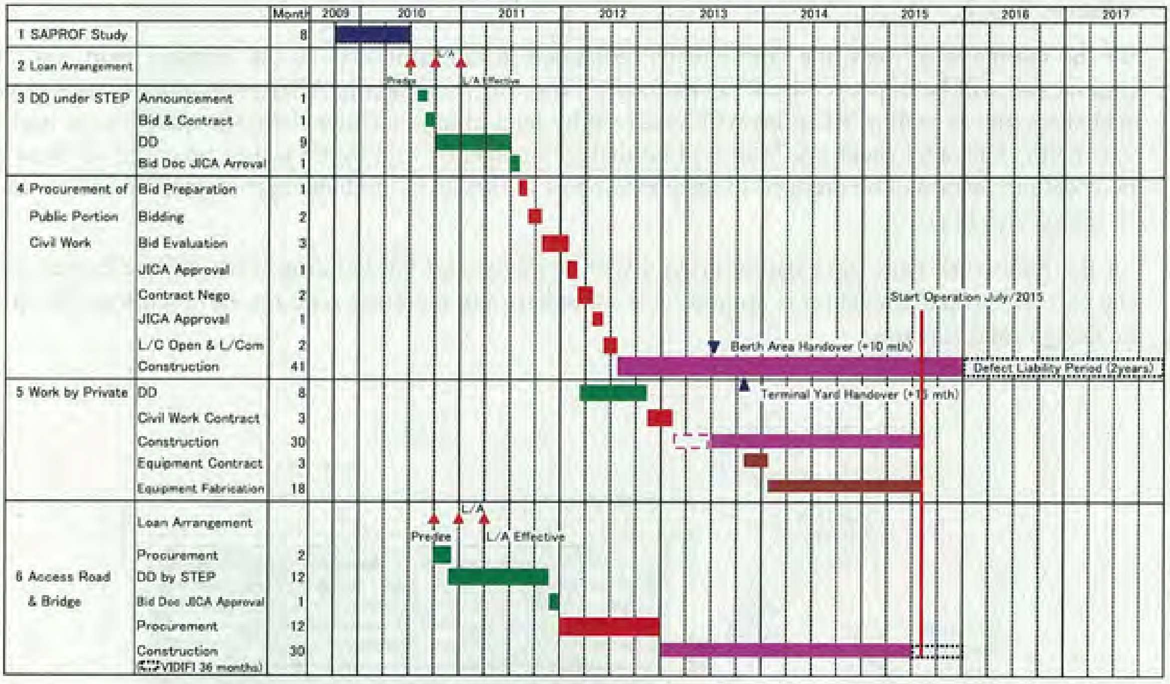
Below schedule is the earliest case with almost no margin which can only be achieved when the following conditions are met and the necessary steps prior to the construction work are completed on time. In case when any delay or accident is caused during the whole process, the start of port operation will be delayed as well.

(1) Minimum 250,000m^3/mth of the sand will be delivered to the site for reclamation.

(2) The CDM method (Cement Deep Mixing) will be applied for the soil improvement at berth area

(3) The dumping location is secured during the whole construction period

Table 17.1.1 Project implementation schedule



In order to start the port operations as early as possible, following options were studied (Above implementation schedule is based on the Option-1).

- Option-1 (Original plan): Soil improvement by CDM and PVD method
- Option-2: Gradual opening of the terminal (i.e., start the operation of berth 1 first)

Option-2 is the plan to construct half of the yard preferentially in order to start the port operation with one berth (berth1). However, by this plan, the facilities behind container stacking yard such as entrance gate, hydrant pump house, maintenance shop etc will not be completed by the start of the port operation. Therefore, Option-1 is recommended.

In addition, it should be noted that minimum four (4) month is usually required prior to the start of the actual construction (in this case reclamation work) as a preparation period, which is not included in above and below schedule. The preparation includes obtaining the company chop, approval and sub-contracting of the sub contractor, pre-survey of the project site, confirmation and approval of the pre-survey result etc.

Table 17.1.2 Tentative construction schedule – Option 1

	ID	Task	Unit	Quantity	Period (mth)
	YEAR 2015 STAGE				
	1	Preparation Work	ls	1	3
Public	2	Container Terminal Construction	m	750	31
Public	2-1	Reclamation	m3	2,955,483	16
Public	2-2	Soil Improvement by Cement Mixing	m2	43,500	11
Public	2-3	Soil improvement (PVD)	m2	625,769	19
Public	2-4	Preload	m3	2,680,000	24
Public	2-5	Earth Retaining Wall	m	750	11
Public	2-6	Access Road behind the port	m	1,000	6
Private	2-7	Dredging of the slope	m3	568,000	10
Private	2-8	Marine Piling	no	1,330	21
Private	2-9	Berth Structure	m	750	21
Private	2-10	Pavement	m2	409,500	19
Private	2-11	Equipment	ls	1	21
Private	2-12	Utility	ls	1	19
Private	2-13	Building	ls	1	15
Private	2-14	Inspection and Cleanup	ls	1	1
Public	3	Inner Revetment (South)	m	1,000	7
Public	4	Access Channel Dredging	m3	32,300,860	34
Public	5	Outer Revetment	m	3,230	36
Public		Type-A	m	720	21
Public		Type-B	m	2,510	26
Public	6	Sand Protection Dyke	m	7,600	41
Public	7	Public Related Facility	m2	132,000	14

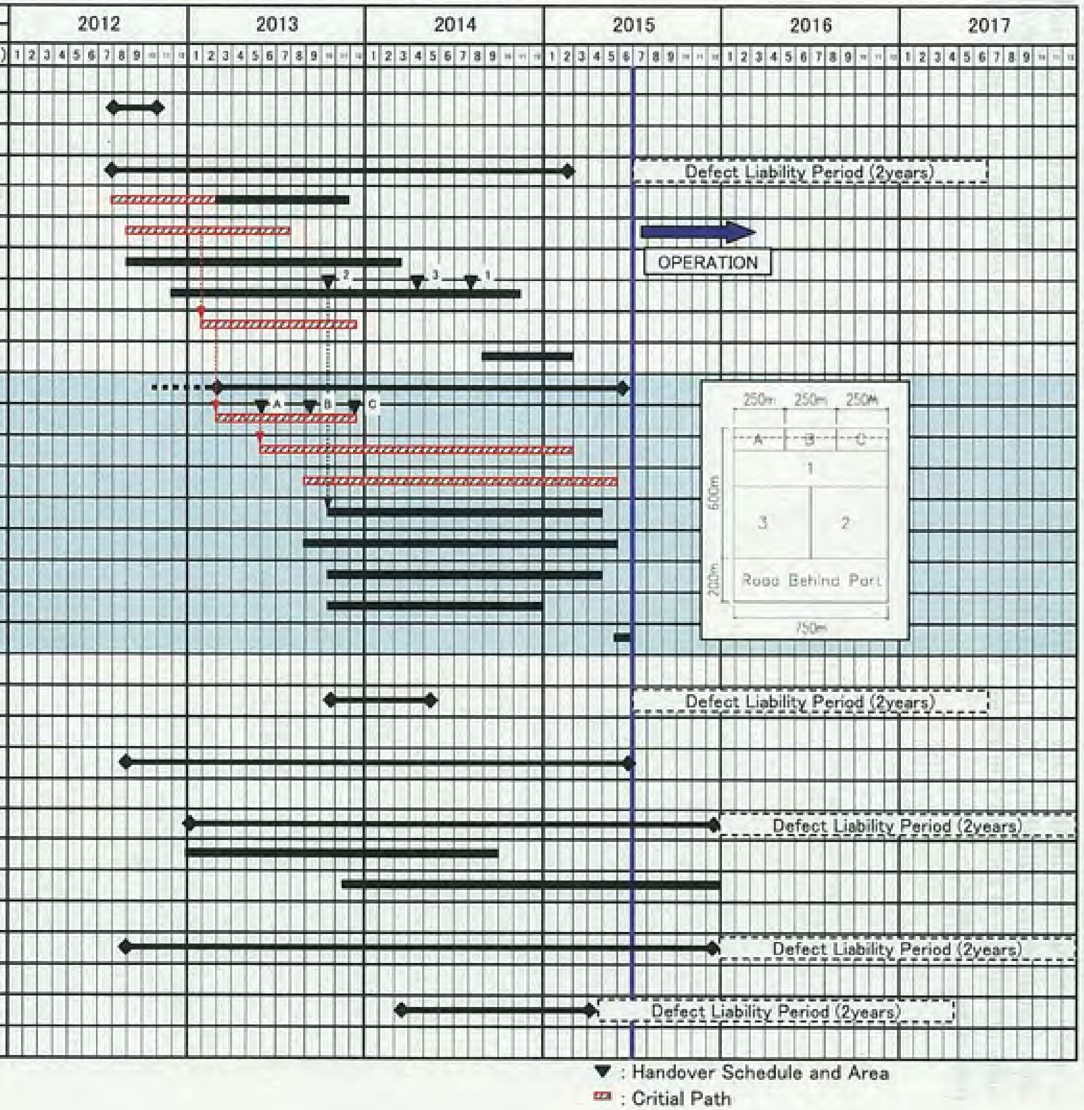
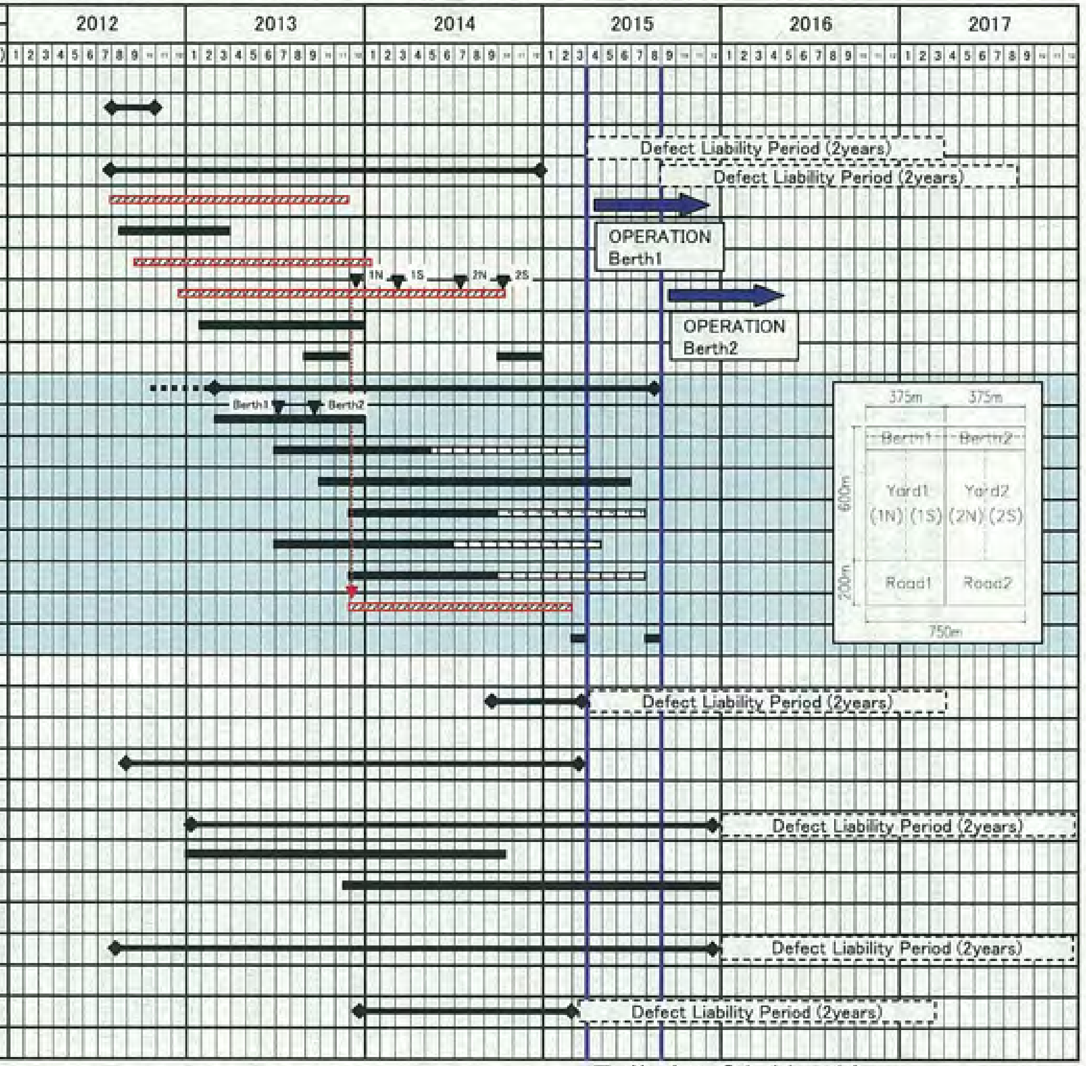


Table 17.1.3 Tentative construction schedule – Option 2

ID	Task	Unit	Quantity	Period (mth)
YEAR 2015 STAGE				
1	Preparation Work	ls	1	3
2	Container Terminal Construction	m	750	29
2-1	Reclamation	m3	2,955,483	16
2-2	Soil Improvement by Cement Mixing	m2	43,500	8
2-3	Soil improvement (PVD)	m2	625,769	16
2-4	Preload	m3	2,680,000	22
2-5	Earth Retaining Wall	m	750	11
2-7	Access Road behind the port	m	1,000	6
2-6	Dredging of the slope	m3	568,000	10
2-8	Marine Piling	no	1,330	21
2-9	Berth Structure	m	750	21
2-10	Pavement	m2	409,500	20
2-11	Equipment	ls	1	21
2-12	Utility	ls	1	20
2-13	Building	ls	1	15
2-14	Inspection and Cleanup	ls	1	2
3	Inner Revetment (South)	m	1,000	7
4	Access Channel Dredging	m3	32,300,860	32
5	Outer Revetment	m	3,230	36
	Type-A	m	720	21
	Type-B	m	2,510	26
6	Sand Protection Dyke	m	7,600	41
7	Public Related Facility	m2	132,000	14



▼ : Handover Schedule and Area
▭ : Critial Path

17.2 Organizational Structure for Project Implementation

17.2.1 General

This project consists of a port portion and a road & bridge portion. Therefore, harmonization and coordination between the two portions is indispensable in term of keeping consistency of the Project. However, this SAPROF study is responsible for the port portion and the road & bridge portion is handling by another SAPROF team, therefore, the organization structure of road & bridge construction will not discuss in detail in this report.

The port portion of this Project was determined to be implemented by PPP (public Private Partnership) framework by GOV that is the first experience in Vietnam for port development applying Japan's ODA loan. Therefore, close coordination between the public portion and the private portion is essential and discussion on important issues including specification and allocation of responsibilities and risks of each side should be held among the stakeholders including MOT, VINAMARINE, VINALINES and other private parties in order to ensure such coordination.

17.2.2 Executing Agency

The organizations concerned for implementation of the Project were determined by the GOV as follows:

(1) Public Sector

a) Borrower: Ministry of Finance (MOF)

(For the Port Portion)

b) Line Agency: Ministry of Transport (MOT)
c) Project Owner: VINAMARINE
d) Implementing Agency: Maritime Project Management Unit 2 (MPMU II), VINAMARINE
Organization Chart of MPMU II is presented in Figure 17.2.1.

(For the Road and Bridge Portion)

e) Line Agency: Ministry of Transport (MOT)
f) Project owner: Ministry of Transport (MOT)
g) Implementation Agency: Project Management Unit 2 (PMU 2), MOT
Organization Chart of PMU 2 is presented in Figure 17.2.2.

(For Land Clearance, Compensation and Resettlement)

h) Hai Phong People Committee

(2) Private Sector

(For the Port Portion)

a) Project Owner: VINALINES

ORGANIZATION CHART
COMPONENT A – LACH HUYEN PORT CONSTRUCTION PROJECT - HAI PHONG MARITIME PROJECT MANAGEMENT UNIT II

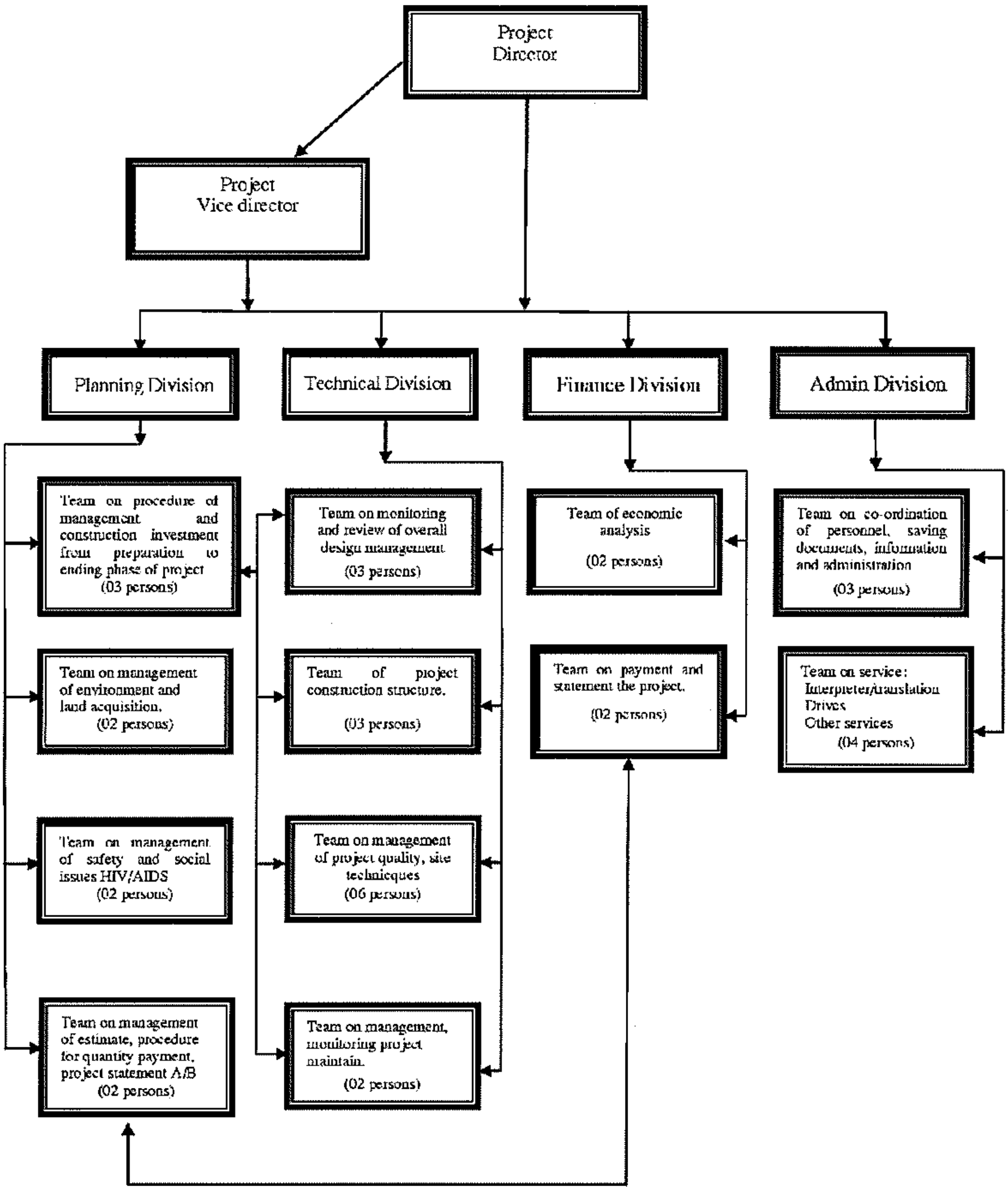


Figure 17.2.1 Organization Chart of MPMU II

ORGANIZATION CHART OF PMU2
IMOOLEMENTATION OF TAN VU – LACH HUYEN HIGWAY CONSTRUCTION PROJECT

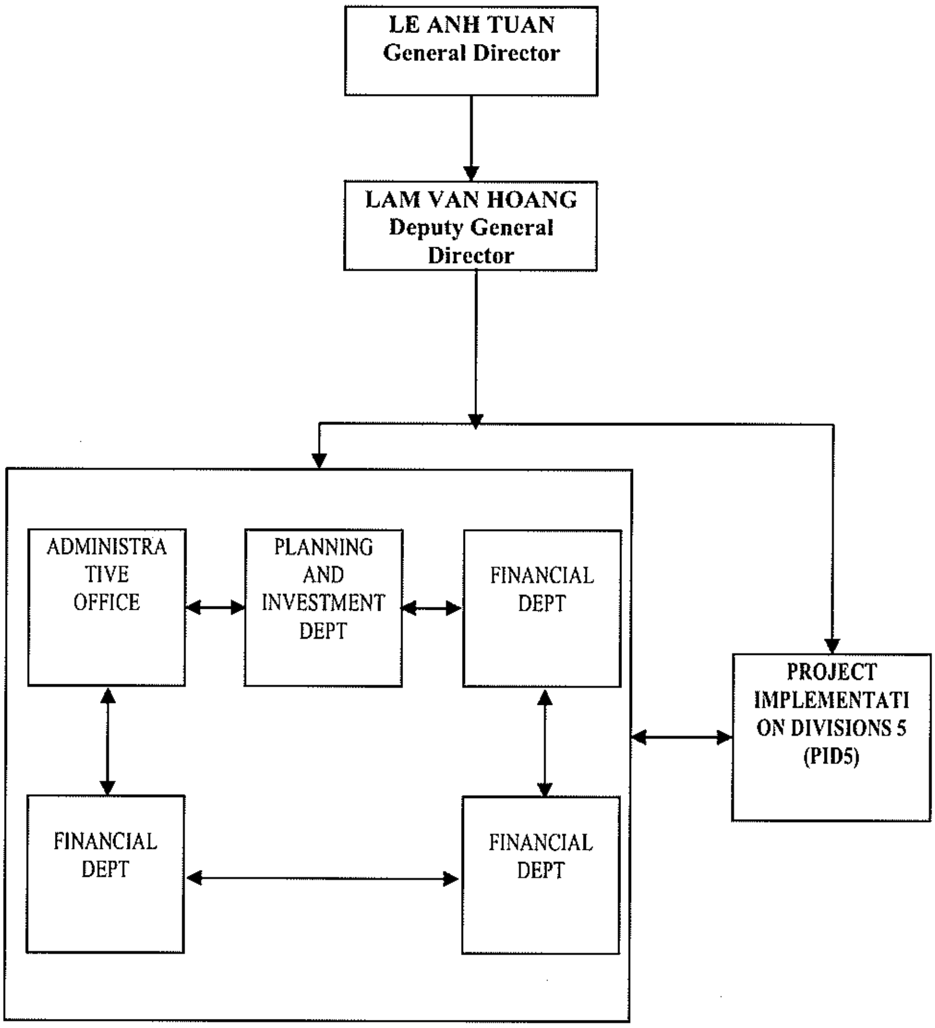


Figure 17.2.2 Organization Chart of PMU 2

17.2.3 Implementation Agency (MPMU II) for Port Portion

1) Establishment

MPMU II was established in accordance with the Decision 960/2002-QD-BGTVT dated April 4, 2002 of the Minister of MOT. The predecessor of MPMU II was Seaway Construction Unit I (SCU I) established in 1967 under Seaway Transportation Administration of MOT for the management and supervision of Hai Phong Expansion Project funded by the Union of Soviet Socialist Republic (USSR) and Pha Rung Shipyard Construction Project funded by Finland. Then it became 213 Construction Unit under the Base Construction Administration of MOT in 1969 for managing the Ha Long Shipyard Construction Project funded by Poland.

Since then, MPMU II is ongoing to develop itself in the field of infrastructure construction applying advanced technologies and modern equipments and performed management and supervision of infrastructure construction in good results. All construction works and projects under management and supervision of MPMU II were highly appreciated by the State and the Employers as well and received diplomas of merit of the State and the Ministry concerned.

2) Experience

a) Construction Works and Projects under the management and supervision of MPMU II:

(i) Hai Phong Expansion Project: Hai Phong Port, Chua Ve Port and Vat Cach Port consisting of berths, storage yard, warehouse, power system, water drainage, water supply system, repair shop, and cargo handling equipments.
(ii) Ha Long Shipbuilding Yard Construction Project: This project was implemented under the aid of Poland.
(iii) Pha Rung Shipyard Company Project: This project was implemented by the aid of Finland.
(iv) Lighthouse Project:: Song Tu Tay, An Bang, Da Tay, Da Lat, Bach Long Vi, Phu Quy Dao Tran, Hon Dau, etc.
(v) Chan May Access Channel Project (Thua Thien Hue Province)
(vi) Improvement and Upgrade Project of Access Channel of Cua Viet Port (Quang Tri Province)
(vii)Can Tho Construction Project.

b) Construction Works and Projects under the Management of MPMU II:

(i) Cai Lan Port Development Project: This project consists of berths, road, storage yard, power system, water drainage and supply system, wastewater treatment system, offices, cargo handling equipments and computer system.

c) Construction Works under the Supervision of MPMU II

(i) Construction of the Main Office of Quang Ninh Port Authority.
(ii) Construction of the Main Office of Hai Phong Port at 4A Tran Phu str., Hai Phong city.
(iii) Construction of Offices of Vietnam Maritime Agency at Hai Phong, Nghe An and Ha Tinh.
(iv) Construction of Dry Dock for 3,000T vessel of Nam, Trieu Shipbuilding Company.
(v) Construction of Slip-way for 30,000T vessel, a new plate shop, a 30,000T berth, warehouse, office of Pha Rung Shipyard Company.
(vi) Dredging and Maintenance of Channels between Da Nang and Northern Vietnam, such as Ky Ha, Da Nang, Cua Gianh, Tranh Hoa, Hai Phong, Hon Gai, etc.

3) Personnel

Table 17.2.1 Professional Personnel of MPMU II

Professional Personnel	Number	Year of Working			Remarks
		≥5year	≥10year	≥15year	
University Graduate					
Waterway Engineer	20	10		10	Supervision Certificate of MOT
Maritime Safety Engineer	6	3			Supervision Certificate of MOT
Civil Engineer	2	1		1	Supervision Certificate of MOT
Mechanical Engineer	1		1		
Economist	8	3			
Intermediate Staff					
Construction	2			2	
Finance	1			1	
Accountant	1			1	

17.2.4 Joint Coordination Committee (JCC)

In order to secure the smooth implementation and consistency between the two portion, the port portion and the road & bridge portion, MOT will establish a "Joint Coordination Committee (JCC)" which chairman will be the Vice Minister of MOT and assistant chairman will be deputy director of Department of Planning and Investment (DPI) of MOT and representatives of relevant stakeholders, such as VINAMARINE, MPMU II, PMU 2, TEDI, VINALINES, MPI, MOF, Hai Phong PC, etc., will be the members of the JCC and they would hold the JCC periodically. JICA requested and MOT agreed that JICA representatives will take part in the JCC.

17.2.5 Organization Structure for Project Implementation

Each implementation agency will employ consultants for technical supervision and coordination of implementation of both portions of Project and will procure the contractors and construct the each portion of the Project.

The project owner of private sector, VINALINES will form a Joint Venture (JV) with foreign investors and establish a Special Purpose Company (SPC) and implement the construction of terminal. After completion of the terminal SPC will manage and operate the terminal.

The land acquisition, resettlement and compensation are the responsibility of Hai Phong People Committee.

All works for implementation of the Project would be coordinated by the JCC. Figure 17.2.3 shows organization structure for Project implementation.

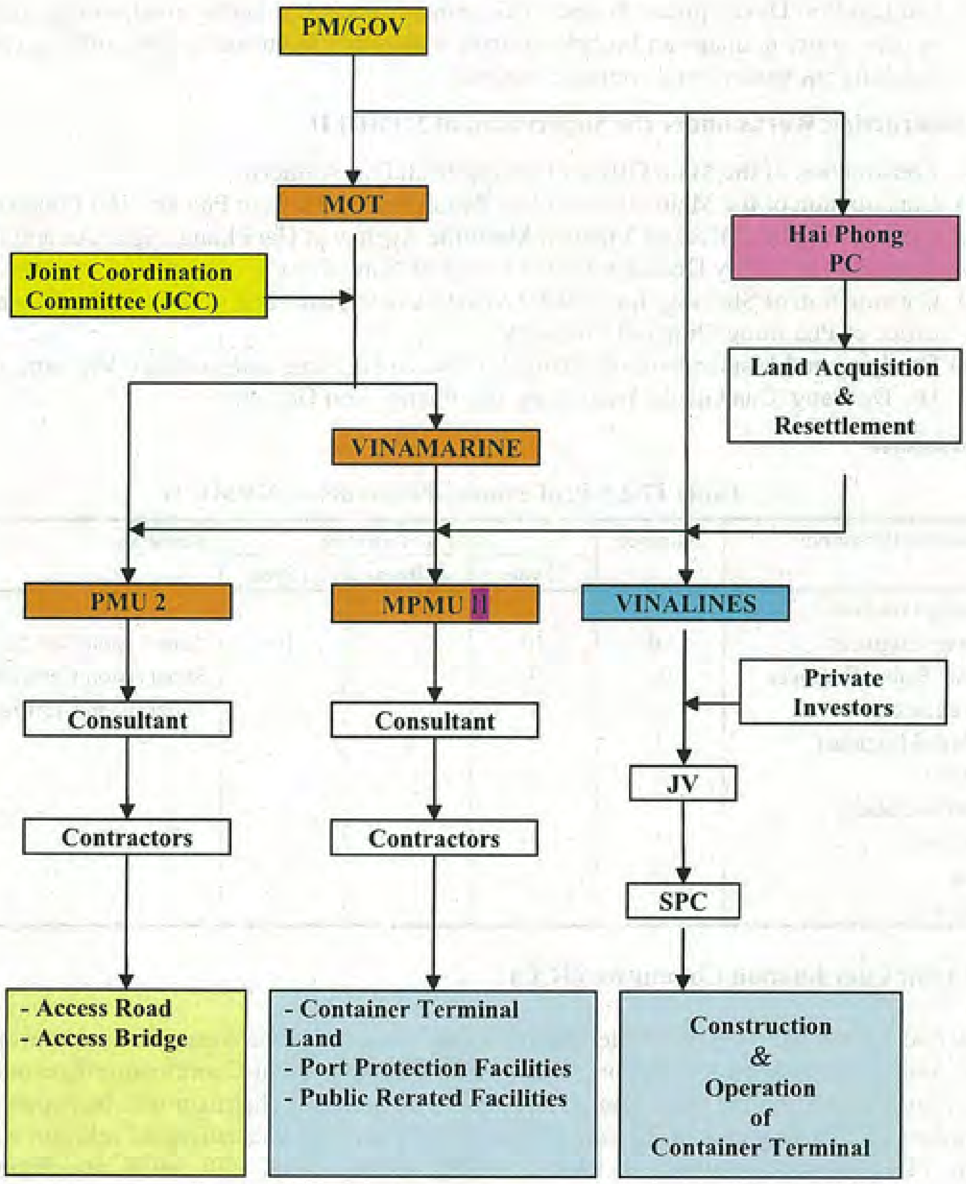


Figure 17.2.3 Organization Structure for Project Implementation

17.2.6 Organization Structure of SPC

1) Organization Structure

The Special Purpose Company (SPC) will be established as a 100% daughter of the JV company of VINALINES and operated as private company with profit-making obligations.

Taking into consideration the structure of the Hai Phong Port and other ports in South East Asia, the proposed structure of the SPC consists of a Board of Commissioners and of five divisions under a Director General is presented in Figure 17.2.4. The structure takes into account requirements for landlord ports and maintaining the relationship between the port and the JV managing the port.

a) The Board of Commissioners

The Board consists of 3 voting members directly assigned by JV of VINAMALINES. The Board of Commissioners will have responsibility over the Administration which includes financing and activities of all divisions of the SPC.

The Board would be further strengthened with a limited number of "independent experts" as advisors to the Board and therefore have no voting powers. The experts would be selected on the basis of port needs, with a particular accent on Information Technology and Automation, two issues critical for port competitiveness.

b) Administrative Division

The Administrative Division handles all administrative aspects such as administration (contracts, agreements, documentation, etc.), human resources, and financial transactions. The Administrative Division is also responsible for the accounting obligation and will report on the state of the accounts to the Board. The Human Resources Department will also provide training and education to port personnel to ensure that personnel possesses and maintaining the necessary and up-to-date know-how to execute their tasks.

c) Business Division

The Business Division includes Departments that facilitate port activities and support the works of the SPC. These Departments are Planning, Business, Port Control & Maintenance and Operation Center. The Planning Department develops and sustains the vision of the port and the methods how growth and expansion of port activities. The Business Department is there to deal with the port users. Port Control & Maintenance Department will assemble all aspects dealing with the safe movement of vehicles and ships in the port area. The Operation Center will have full responsibility for carrying out container receiving and delivery including the management of cargo handling equipment and stevedores.

d) Engineering Division

The Engineering Division consists of a Design & Technical, Engineering & Mechanical and Labor Safety & Labor Environment Departments.

The Design & Technical Department is responsible for designing civil and mechanical facilities and for specification and contract documents. The Engineering and Mechanical Department is responsible for the maintenance and management of the execution of engineering schemes in the port area, including civil, electrical and mechanical works. The Labor Security & Labor Environment Department is responsible for the maintenance and improvement of safety of working conditions and environmental situation in port area.

e) International Business

The South and East China Sea area around Vietnam is one of the noteworthy areas where the maritime industry has highly developed. Several large Hub-Ports such as Singapore, Kaohsiung, Shanghai and Hong Kong are located there. And now, within these areas, the hot competition trying to attract ships and container cargoes among the ports exists. Port sales promotion and marketing activities are, therefore, most important for the future development. The SPC should positively play the important role conducting these activities with following materials:

- Port Brochure,
- Promotion Video and CD,
- Internet,
- Promotion Seminar, etc.

f) Information Technology

The Information Technology Division consists of EDI & System Development and Information & Statistic Divisions. The EDI & System Development Division is responsible to introduce a "one-stop service system" and a full-scaled EDI (Electronic Data Interchange) system. The Information & Statistic Division is responsible for preparing port statistics which should be edited in a unified style so that they can be easily accessed and understood by all of the nation and concerned parties. At major ports of the world, port management bodies acting as a port operator are obligated to compile port statistics according to stipulated methods.

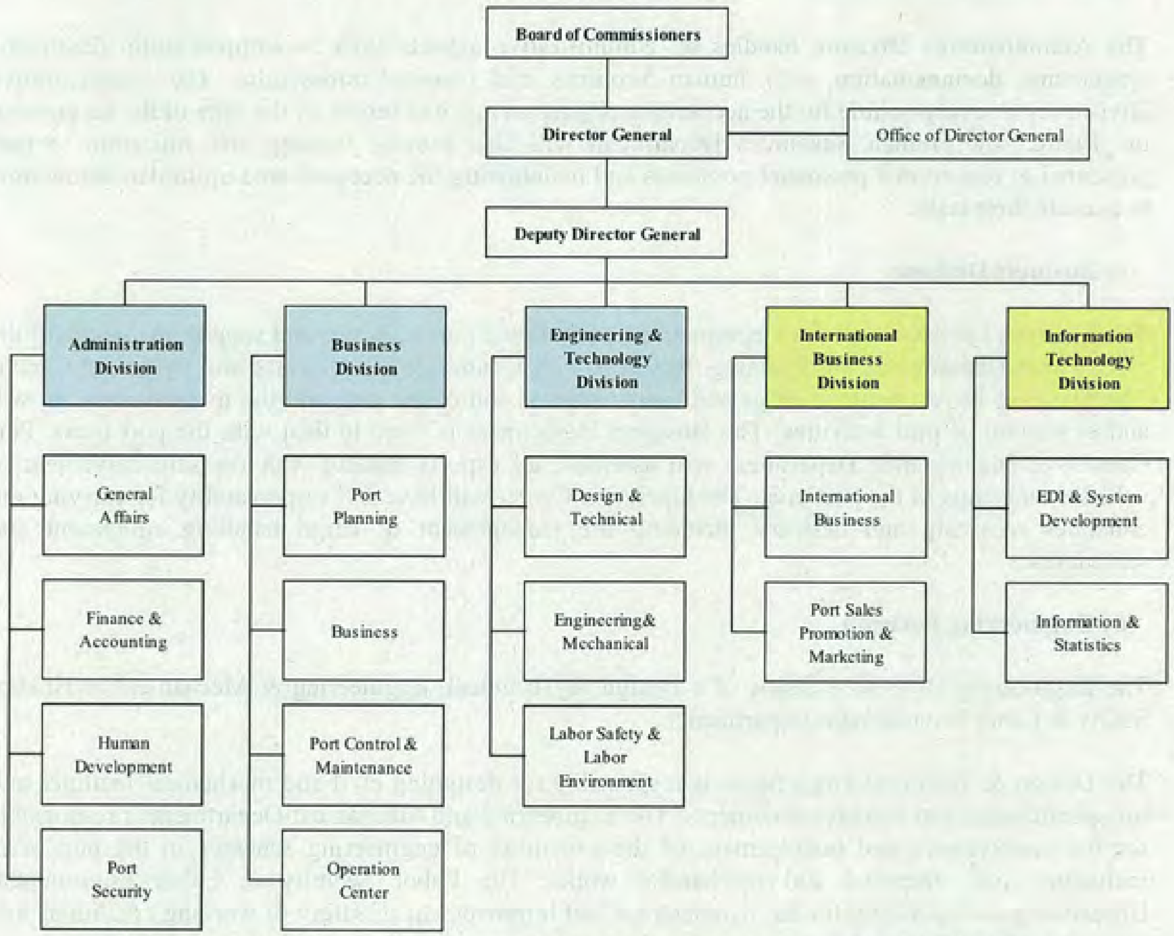


Figure 17.2.4 Organization Chart of SPC of Container Terminal Berth No.1 & 2

2) Human Resource need for SPC

It should be made explicitly clear that the estimates for the number of necessary personnel for the SPC of the Berth No.1 & 2 remain tentative and that a final decision regarding employment falls entirely under the authority of the private investors.

Although the final decision lies with the private investors to determine the structure and staffing of the future SPC, the staffing of Hai Phong port, the estimates for the Cai Mep Container terminal and similar work in Vietnam can be used as "guideline" to estimate the appropriate staffing level.

Considering the above roles of SPC, a summary view on the expected staffing of the SPC is prepared as shown in Table 17.2.2 and it suggests that new SPC before and after the commencement of the terminal operation will need approximately 200 and 500.

Table 17.2.2 Human Resources Needs for the SPC (before and after the Commencement of Terminal Operation)

Human Resources	Before	After	Description of Each Position after the Commencement of Terminal Operation
Board of Commissioners			
Financial & Legal Advisors	3	3	The Board of Directors will have to supervise the financial situation of the SPC. Three financial experts will most likely be sufficient to review the accounting of the SPC on a regular basis. It is recommended to have at least 1 legal expert to advise the Board and the SPC on the legal aspects associated with the content and conditions of agreements and contracts.
Independent Experts	3	3	It is suggested to have at least 3 independent experts on the Board. They will be appointed in an advisory capacity without voting power. Particular attention should be devoted in the selection process to the special activities related to the port function of the SPC and to the need for automation and information technology, a competitive imperative.
Port Management Committee			
General Manager	1	1	Responsible for the operation of the terminal and responding directly to the Board. He is a non-voting member of the Board.
Director	5	5	Each supervising one Department of the SPC, responsible for the working of the Department and reporting directly to the General Manager
Department Managers	15	15	One manager for each of the divisions within the department. They are responsible for the efficient working of these divisions and report directly to the Department Director
High-level Experts (Officers)	15	30	These experts have a "project supervision" role and lead different projects or department sections.
Low-level Experts	70	350	These experts have a "project execution" role and including yard operators/ stevedores (most of staff will be out-sourced).
Supporting Staffs	88	103	These persons have a supporting role, for example, they man the counter, perform archiving or secretarial works, etc.
Total Staff	200	500	

Note: 1. "Before" the commencement of the terminal operation means "until the end of 2014".
: 2. "After" the commencement of the terminal operation means "after 2015".