PART – 2

Medium Term Port Development Plan (Target Year 2020)

11. Scale of Medium Term Port Development

11.1 Container Terminal

11.1.1 Design Vessel

Major shipping lines and Alliances are striving to remain competitive in the global market by building numbers of larger sized vessels, especially at the main routes such as Asia-North America (Trans Pacific) and Asia-Europe. Some container carriers operational in mid 2009 have already exceeded 14,500 TEU. However, when considering the geographical location of Lach Huyen Port, it is unlikely that mother vessels on Asia-Europe service routes with very tight schedules will call the Lach Huyen Port. However, it is very likely that mother vessels on Asia – North America routes will call the Lach Huyen Port by the following reasons:

(1) In accordance with the study report of the University of Mexico in 2001 regarding the economy of scale of container vessels, it is said that the shipping cost of container per TEU which is transported by 7,000TEU (90,000DWT) vessel will be 70% of that of by 4,000TEU (50,000DWT) vessels.

(2) In order to enjoy the economy of scale, the world container fleets are increasing its size year by year. In 2006, the maximum container vessel in the world was the Emma Maersk, 11,000TEU but at present, Dec. 2009, the maximum container vessels are 14,500TEU and number of container vessels more than 50,000DWT capacity owned by 20 main shipping lines only is more than 1,250.

(3) Super Post panamax ships with the capacity around 100,000DWT and length around 330 meters are considered to be the majority of the fleet on Trans-Pacific and Asia-Europe trade service by 2012.

(4) The enlargement of Panama Canal will be completed by 2014 after then Panamax ship now plying between Asia and East Coast of North America will be shifted to post Panamax ships and introduction of larger vessels will be accelerated in the Trans-Pacific shipping route.

(5) Traditionally, Northern Vietnamese export cargoes to USA are transshipped at Hong Kong or Kaohsiung and transported by mother vessels. Therefore, bearing the extra transshipment cost and the longer shipping time is inevitable, and the economy of scale can’t be achieved.

(6) Based on the information of shipping lines, if more than 1,000TEU/week of lot of containers is obtainable constantly, it will be feasible to extend the service range of 100,000DWT mother vessels in Trans-Pacific trunk route from Hong Kong/ Kaohsiung up to the Haiphong /Lach Huyen International Gateway Port.

(7) If Lach Huyen port can accept 100,000DWT mother vessels directly, it is achieved to lower the shipping cost due to larger vessel size, in addition to save the transshipment cost, which will result to increase competitiveness of export good prices and contribute to decrease domestic market prices by lower import prices, and that will stimulate Vietnamese national economy.

(8) As explained above, it is necessary the container traffic demand of more than 1,000TEU/week constantly for USA to attract 100,000DWT mother vessels. The demands for USA are calculated as follow:

    - Based on the TEDI’s FS, it is known that the shares of export and import cargoes to USA are 18% and 30% respectively.
    - The total container demand in Northern Vietnam at 2020 was forecasted as 1,719,000TEU for export and 1,719,000TEU for import.
    - Therefore, the export container volume to USA is calculated as follows: 1,719,000 × 0.18 / 52 = **5,950 TEU/week** and the import container volume from USA is: 1,719,000 × 0.30 / 52

= **9,917 TEU/week**.

As known from above calculation, there is enough container volume for plural 100,000DWT container mother vessels to call the Lach Huyen port every week.

On the other hand, when shipping lines make their shipping schedule, they will consider the Saturday/ Sunday/ Holyday of destination of USA and it will occur very often that plural vessels for Trans-Pacific route will start Lach Huyen Port at the same day. Therefore, if there are two (2) berths in one (1) terminal, it is preferable for both berths to be able to accommodate 100,000DWT vessels simultaneously.

However, 100,000DWT mother vessels from ports of Hong Kong, Kaohsiung will not call with its full-loaded condition, since Lach Huyen Port will be the terminal port of Asia - North America routes and many containers were loaded/unloaded at Hong Kong, Kaohsiung after/before calling at Lach Huyen Port. Therefore, the depth of access channel and berth will be designed for the partial loaded condition of 100,000DWT container vessel.

Therefore, the design vessel sizes for the Lach Huyen Port are proposed as follow:

- Fully loaded 50,000DWT Container Vessel
  LOA= 274m, Width= 32.3m, Draft= 12.7m
- Partial loaded 100,000DWT Container Vessel
  LOA= 330m, Width= 45.5m, Draft= 11.7m (80%)

11.1.2 Berth

1) Required Number of Berth

As explained in Clause 5.9, the total container volume to be handled at Lach Huyen Port in 2020 is forecasted at 2,229,000 TEUs (Medium Growth Case). To handle these containers, required number of container berth is calculated as follows:

a) Prerequisite Conditions

Composition of calling vessels is 20,000DWT: 50,000DWT: 80,000DWT: 100,000DWT = 20%: 30%: 20%: 30% in throughput bases.

Where, typical dimensions of each vessel are as shown below.

Table 11.1.1 Dimensions of Container Vessels

Ship Type	DWT	L (m)	B (m)	D (m)	TEU
Container Ship	20,000	177	27.1	9.9	1,300 - 1,600
	50,000	274	32.3	12.7	3,500 – 3,900
	80,000	300	40.0	14.2	5,800 – 6,200
	100,000	330	45.5	14.7	7,300 – 7,700

Source: Actual Data and Japanese Design Standard

- Unloading plus loading cargo volume of each calling vessel will be 50% of its capacity in average.
- 20’ box : 40’ box = 1 : 1
- Productivity of a Quay Gantry Crane = 30 boxes / hour
- Number of QGC applied for 20,000DWT, 50,000DWT, 80,000DWT and 100,000DWT are 2,

3, 3.5 and 4 respectively.

- Consuming vessel time other than cargo handling time is 5 hours considering one way channel and 18km of cannel length, etc.
- Basic berth length is 400m based on 100,000DWT vessel and in case of mooring of 20,000DWT vessels two (2) vessels at once can be moored but other vessels can moor one / berth.
- Design BOR (Berth Occupancy Ratio) is targeted less than 70%.

b) Required Number of Berth

The required number of berths is calculated based on the prerequisites mentioned above as shown in Table 11.1.2

Table 11.1.2 Calculation of Number of Container Berth

Item		Unit	Calculation	Container
20,000 DWT				
a	Number of Container	000 TEUs		460
b	Average Cargo Volume Handled	TEUs/Vessel		1,000
c	Number of Vessel Call	Call/year	a/b	460
d	Cargo Handling Productivity	TEUs/hour/vessel	45TEU/h × 2G × 0.7	63
e1	Total Berth Hour	Hour/year	(b/d+5) × c/2	4,799
50,000 DWT				
a	Number of Container	000 TEUs		690
b	Average Cargo Volume Handled	TEUs/Vessel		2,000
c	Number of Vessel Call	Call/year	a/b	345
d	Cargo Handling Productivity	TEUs/hour/vessel	45TEU/h × 3G× 0.7	95
e2	Total Berth Hour	Hour/year	(b/d+5) × c	9,023
80,000 DWT				
a	Number of Container	000 TEUs		460
b	Average Cargo Volume Handled	TEUs/Vessel		3,000
c	Number of Vessel Call	Call/year	a/b	153
d	Cargo Handling Productivity	TEUs/hour/vessel	45TEU/h × 3.5G×0.7	110
e3	Total Berth Hour	Hour/year	(b/d+5) × c	4,937
100,000 DWT				
a	Number of Container	000 TEUs		690
b	Average Cargo Volume Handled	TEUs/Vessel		4,000
c	Number of Vessel Call	Call/year	a/b	172
d	Cargo Handling Productivity	TEUs/hour/vessel	45TEU/h × 4G × 0.7	126
e4	Total Berth Hour	Hour/year	(b/d+5) × c	6,336
E	Grand Total Berth Hour	Hour/year	e1+e2+e3+e4	25,094
f	Available Hour for Using Berth	Hour/year	24 × 365 × 0.95	8,322
g	Berth Occupancy	%	E/(f × B)	60%
B	Number of Berth			5

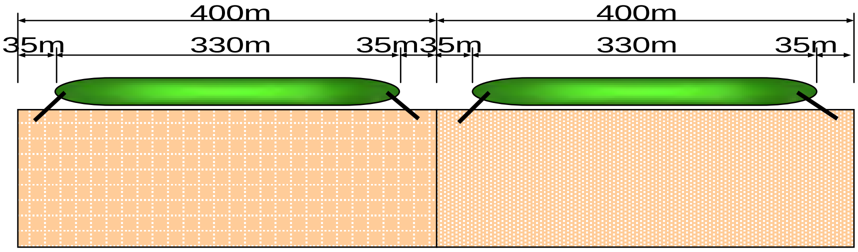
Source: Study Team

Based on the above conditions, required number of berths is calculated for Medium Growth Case as 5 berths at target year of 2020. If calculate for High Growth Case of 3,012,000TEU/year in 2020, the required number of berths will be 6 berths (BOR 66%). Therefore, It is recommended that although number of berths to be developed by 2020 should be determined based on the actual trend of container volume, the port layout for target year 2020 should be prepared for 6 container berths.

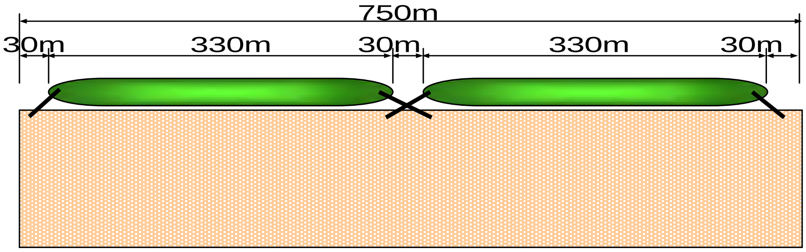
2) Dimension of Berth

a) Berth Length

The berth length is governed by the maximum design vessel length, i.e., 100,000DWT container vessel length of 330m. If each berth is operated and managed by different operator, the berth length for 100,000DWT should be 400m each. However, if 2 berths are operated and managed by one operator that is very common since terminal facilities and equipment can be utilized more efficiently than the case of 1 berth operated by 1 operator, the required berth length can be reduced to 750m per 2 berths as illustrated in Figure 11.1.1.



Case 1: 2 Berths operated by 2 Operators



Case 2: 1 Berth operated by 1 Operator

Figure 11.1.1 Berth Length of 100,000DWT Container Vessel

b) Height of Berth Structure

According to the following tide and frequency of water level in Lach Huyen port, the height of berth structure is determined.

- Water level per hour, frequency 1% : +3.55m
- Water level per hour, frequency 99% : +0.43m
- Water level per hour, frequency 50% : +1.95m
- Highest water level recorded : +4.21m

Based on the standard of Vietnam, it is calculated at between +3.95m to +4.55m. There are various standards in the world for determining the height of berth structure and TEDI FS checked some different standards such as Japanese, British, EAU standards and Carl A. Thoresen's Guideline, and obtained the heights between +3.45m and +5.66m. Based on these values, TEDI proposed to apply +5.5m.

SAPROF study considers +5.5m of height of berth structure is appropriate even if consider the sea level rise due to climate change of 75cm by year 2100, which is estimated by the Ministry of Natural Resources and Environment of Vietnam in August 2009.

c) Depth of Berth

The depth of berth is determined for design vessels by PIANC guideline which recommends to keep 10% of maximum draft as under keel clearance. Following depths are required:

- For 50,000DWT container vessel (full load): 12.7m x 1.1 = 14.0m
- For 100,000DWT container vessel (80% draft): 11.7m x 1.1 = 13.0m

Therefore, the depth of berth is governed by the fully loaded 50,000DWT vessel as -14.0m.

In TEDI FS the depth of berth is recommended also to be -14.0m and no modification is required. However, SAPROF study recommend that the design depth for berth structure should be -16.0m, because 100,000DWT container vessels with fully loaded condition will call at Lach Huyen Port in future when depth of berth should be deepened to -16m and the structure should be reinforced but the reinforcement at that time will be very difficult and costly.

d) Required Scale of Container Berth

As calculated above, number of berths required by 2020 is 5 for medium growth case and 6 for high growth case and it is recommended that 2 berths are operated and managed by one operator as much as possible from operational and economical viewpoints and the scale of container terminal of Lach Huyen port in 2020 will be as shown in Table 11.1.3.

Table 11.1.3 Required Scale of Container Berth (2020)

Type of Berth	Design Vessel Size	No. of Berth	Unit Length of Berth	Total Length of Berth	Design Depth of Berth	Dredging Depth of Berth
Container	50,000DWT (Full Load) 100,000DWT (Partial Load)	5 (6)	375m	1,875m (2,250m)	-16m	-14m

11.1.3 Container Yard

1) Required Ground Slot

The required storage number of containers is calculated by the following formula:

$$M_1 = (M_y \times D_w / D_y) \times P$$

Where:

M_1 : Required storage number of containers (TEUs)
M_y : Annual container throughput (TEUs)
D_w : Average dwelling days (=6 days)
D_y : Operation days (=365 days)
P : Peak Ratio (1.0)

Required number of ground slots

$$S_1 = M_1 / (L \times O)$$

Where:

S_1 : Required number of ground slots (TEUs)
M_1 : Required storage number of containers (TEUs)
L : Stacking height of containers (=4 layers)
O : Operation Factor (=0.75)

The number of container to be handled per one berth is as follow:

2,299,000 TEU / 5 berths = 459,800 TEU

Therefore, required storage capacity per berth is calculated as shown in Table 11.1.4.

Table 11.1.4 Required Storage Capacity / Berth in Container Yard

Item	Unit	Storage Capacity
Annual Container Throughput (M_y)	’000TEUs	460
$(M_y \times D_w / D_y) \times P$	TEUs	7,562
Stacking Height L × O	Layers	3.0
Required Number of Ground Slots	Slots	2,521

2) Reefer Storage

As to reefer yard, reefer ratio has been assumed as 10% of the total containers taking account of the historical trend of reefer ratio in Haiphong Port. The required ground slot number is calculated as follows:

7,562 TEUs × 10% / 1.5 (TEU unit ratio) / 3 (tiers) = 168 FEUs

Then, the required number of reefer plugs is calculated as follows:

168 FEUs in ground slots × 1 plug / FEU × 3 tiers = 504 plugs

To satisfy the above requirements, the following ground slots have been proposed by this study:

For dry containers: 50 (20’) bays × 6 slots × 10 lanes

For reefer containers: 17 (40’) bays × 6 slots × 2 lanes

3) Empty Container Stacking Yard

In addition to the above container-stacking yard to be equipped with RTGs, back storage yard has been proposed in this study. The back yard is planned mainly for empty container stacking to be equipped with empty handlers (side lifters & top lifters). The backyard (empty-container-stacking yard) is planned to cater for inventory movements of empty containers between the yard and outside importers/exporters rather than for movements from/to container ships. The ground slots of 250 TEUs have been planned, that is 10% of the total marshaling yard capacity.

11.1.4 Container Check Gate

Number of gates for one container berth is calculated as follow:

Number of container: 460,000TEU/1.5 = 306,667 box/year

306,667/365 × 1.0 (peak ratio) = 840 box/day

- Land transport : Inland Water transport = 95% : 5%

- Container through gate: 840 × 0.95 = 798 box/day, Say 800 box/day
- In Gate:

  400 tractor-trailer with loaded container
  40 tractor-trailer with empty container
  440 tractor-trailer without container
- Out Gate:

  400 tractor-trailer with loaded container
  40 tractor-trailer with empty container
  440 tractor-trailer without container
- Hourly peak ratio: 2.0
- Time for gate procedure: 3 minutes excluding tractor-trailer without containers at gate out
- Gate in: 880 vehicles / day / 24 × 2.0 / (60min / 3 min / lane) = 4 lanes
- Gate out: 440 vehicles / day/ 24 × 2.0 / (60 min / 3 min / lane) = 2 lanes

Actually the peak times of gate-in and gate-out traffic will not occur at the same time. So, 1 lane can be used alternatively for both purpose and total 5 numbers of lanes will be sufficient.

11.1.5 Other Facilities

Following buildings will be constructed in each container terminal. Total floor area will be approx. 8,855m^2 in case of one terminal consists of 1 berth and approx. 10,655 m^2 in case of one terminal consists of 2 berths.

Table 11.1.5 Proposed Scale of Terminal Buildings

Buildings		Story	Floor Area (m^2) 1 terminal 1 berth	Floor Area (m^2) 1 terminal 2 berths
1	Operation Office	4	4,800	4,800
2	Amenity block	2	750	1,500
3	Security office	1	75	75
4	Maintenance shop	2	1,500 + 500	1,500 + 500
5	Container repair shop	1	400	800
6	Substation	1	150	150
7	Fuel Station	1	30	30
8	Container Gate	1	650	1,300
	Total		8,855	10,655

11.1.6 Container Handling Equipment

Following cargo handling equipment will be required in each container berth.

Table 11.1.6 Required Main Cargo Handling Equipment

Cargo Handling Equipment		Unit 1 terminal 1 berth	Unit 1 terminal 2 berths	Basic Specification
1	Quay Gantry Crane	4	8	Capacit:60 tons, Outreach 56.6m, Rail gauge 30m, Lift Height 40.m, Twin 20' type,
2	RTG	12	24	Rail spun 23.47ｍ, Stacking Height 15.24m (1 over 4), 16 wheeler
3	Top Lifter	3	5	Lifting Capacity 35 tons, with Telescopic Spreader
4	Yard Chassis	30	55	Convertible 40' & 20' with strong steel beam type
5	Yard Tractor-Head	25	50	More than 350 HP
6	Multipurpose Forklift	2	4	Lifting Capacity 3tons, Mast height less than 2.2m
7	Hoist	1	2	Lifting capacity 5 tons with 24m outreach
8	Mobile Crane (for barge)	1	2	Lifting Capacity 40 tons with Outreach 4th row from Quay line available type

11.1.7 Summary of Land Requirement for Port Facilities

Table 11.1.7 summarizes the land requirements for the port facilities on the container terminal in the Lach Huyen Port.

Table 11.1.7 Land Requirement/Berth for Container Port Facilities

Description	Area	Dimensions
1. Storage Area inc. Road, Drainage etc.	375,000m^2	750m × 500m
- Dry Container	160,000m^2	-
- Reefer Container	32,000m^2	-
2. Building Area inc. Road, Parking, etc.	75,000m^2	750m × 100m
Total	450,000m^2	750m × 600m

Source: Study Team

11.2 Multi-Purpose Terminal

11.2.1 Design Vessel

In TEDI FS, the general cargo vessels were divided into general cargo vessel and bulker but in SAPROF study both type of vessels are not divided and regarded as a general cargo vessel and terminal is designed as Multi-Purpose Berth since reviewed demand forecast showed that the bulk cargo volume is not big amount.

The design vessel size is 50,000DWT, same as that of TEDI FS. The dimensions of general cargo vessels for Lach Huyen port are shown in table below.

Table 11.2.1 Dimensions of General Cargo Vessels

Ship Type	DWT	L (m)	B (m)	D (m)
General Cargo Ship	20,000	160	25	10.0
	30,000	185	27	11.0
	50,000	225	31	12.0

Source: Actual Data and Japanese Design Standard

11.2.2 Berth

1) Required Number of Berth

As explained in Chapter 5.9, the total general cargo and bulk cargo volume to be handled at Lach Huyen Port in 2020 is forecasted at 2,834,000 Tons. To handle these cargoes, required number of Multi-purpose berth is calculated as follows:

a) Prerequisite Conditions

- Composition of calling vessels is 20,000DWT: 30,000DWT: 50,000DWT = 40%: 40%: 20% in throughput bases.
- Unloading plus loading cargo volume of each calling vessel will be 50% of its capacity in average.
- Productivity of a Quay Gantry Crane = 60 ton / hour
- Number of gangs applied for 20,000DWT, 30,000DWT, and 50,000DWT are 4, 5 and 5 respectively.
- Consuming vessel time other than cargo handling time is 5 hours considering one way channel and 18km of cannel length, etc.
- Basic berth length is 250m based on 50,000DWT bulker.
- Design BOR (Berth Occupancy Ratio) is targeted at 60%.

b) Required Number of Berth

The required number of berths is calculated based on the prerequisites mentioned above as shown in Table 11.2.2.

Table 11.2.2 Calculation of Number of Multipurpose Berth

Item		Unit	Calculation	G.C.& Bulk
20,000 DWT				
a	Cargo Volume Handled	000 tons		1,134
b	Average Cargo Volume Handled	Tons/Vessel		15,400
c	Number of Vessel Call	Call/year	a/b	74
d	Cargo Handling Productivity	Tons/hour/vessel	60Ton/h × 4G × 0.7	168
e1	Total Berth Hour	Hour/year	(b/d+5) × c/2	7,042
30,000 DWT				
a	Cargo Volume Handled	000 tons		1,134
b	Average Cargo Volume Handled	Tons/Vessel		23,100
c	Number of Vessel Call	Call/year	a/b	49
d	Cargo Handling Productivity	Tons/hour/vessel	60Ton/h × 5G × 0.7	210
e2	Total Berth Hour	Hour/year	(b/d+5) × c/2	5,594
50,000 DWT				
a	Cargo Volume Handled	000 tons		567
b	Average Cargo Volume Handled	Tons/Vessel		38,500
c	Number of Vessel Call	Call/year	a/b	15
d	Cargo Handling Productivity	Tons/hour/vessel	60Ton/h ×5G × 0.7	210
e3	Total Berth Hour	Hour/year	(b/d+5) × c/2	2,758
E	Grand Total Berth Hour	Hour/year	e1+e2+e3	15,394
f	Available Hour for Using Berth	Hour/year	24 x 365 × 0.95	8,322
g	Berth Occupancy	%	E/(f × B)	62%
B	Number of Berth			3

Source: Study Team

c) Required Scale of Multi-purpose Berth

As calculated above, number of berths required by 2020 is 3 for medium growth case and the scale of multi-purpose berth of Lach Huyen port in 2020 will be as shown in Table 11.2.3.

Table 11.2.3 Required Scale of Multipurpose Berth (2020)

Type of Berth	Design Vessel Size	No. of Berth	Unit Length of Berth	Total Length of Berth	Design Depth of Berth	Dredging Depth of Berth
Multipurpose	50,000DWT	3	250m	750m	-13m	-13m

11.2.3 Storage Facility

Transit sheds for the Multi-purpose terminal will be provided along the berth apron. Open yards will be available behind transit sheds. Truck waiting areas will be built at both sides of the transit sheds to make the marshalling yard clear and minimize idle time.

The size of cargo handling and storage facilities including transit sheds and open yards have to be decided in consideration of the types, quantities of cargoes and the conditions of handling.

1) Transit Sheds

Based on the assumption that 20 % of annual volume of cargoes is stocked in the transit sheds, the required area for the transit sheds is calculated by the following formula:

$$A = (N \times p) / (R \times a \times W) / B$$

Where:

A : Required area of warehouses/transit sheds (m2)
N : Annual volume of cargoes handled (tons)
R : Turnover of transit shed (Average dwelling days = 7 days)
a : Utilization rate (=0.5)
W : Volume of cargoes per unit area (tons/m2)
P : Peak ratio (=1.3)
B : Efficiency storage rate (=0.75)

Therefore, the required area of the warehouses/transit sheds is as follows:

$$A = 7{,}000\ m^2 \text{ for 50,000 DWT Berth}$$

2) Open Storage Yards

Based on the assumption that 60 % of annual volume of cargoes is stocked in the open storage yards and another 20% of annual volume is delivered directly without keeping in the port, the required area for the open storage yards is calculated by the following formula:

$$A = (N \times p) / (R \times a \times W) / B$$

Where:

A : Required area of open storage yards (m2)
N : Annual volume of cargoes handled (tons)
R : Turnover of open storage (Average dwelling days = 14 days)
a : Utilization rate (=0.7)
W : Volume of cargoes per unit area (6 tons/m^2)
P : Peak ratio (=1.3)
B : Efficiency storage rate (=0.75)

Therefore, the required area of the open storage yards is as follows:

$$A = 30{,}000\ m^2 \text{ for 50,000 DWT Berth}$$

3) Other Facilities

Following building facilities are provided for the multipurpose terminal:

Table 11.2.4 proposes the recommended building facilities in the Multipurpose terminal.

Table 11.2.4 Building Facilities in a Multipurpose Terminal

Building Name	Ground Space (m^2)	Remarks
Administration Office and Amenity Block	2,500	2 to 3 floors
Maintenance Shop	500	Ceiling crane, Spare parts shelves, Office
Power/Fuel Station	500	
Main and Sub Gate	500	Gate house to be required
Others	1,000	
Total	5,000	

Source: Study Team

4) Cargo Handling Equipment

Equipment	Type	Nos. in demand	Remarks
Quay Crane	Jib type, Rail mounted	40 tons : 1 20 tons : 1	Outreach : 38m Outreach : 20m
Forklift	Finger Type	20 tons : 5 10 tons : 5	 With long mast type
Reach Stacker	Multipurpose, but mainly containers	4	For stuffed & empty Container handling.
Container Trailer	Yard type	10	
Hopper	For light weight cargo		For grain, fertilizer
Belt Conveyor	-“ -	(40m × 2) 2 sets	-“ -
Hopper	For heavy cargo		For ore loading
Belt Conveyor	-“-	Total 150m, 2 sets	-“-
Dump truck		20	Haulage quay/open yard
Reclaimer		2	For ore loading
Shovel loader		4	For ore loading
Excavator		2	For ore loading

Source: Study Team

5) Summary of Land Requirement for Port Facilities

Table 11.2.5 summarizes the land requirements for the port facilities on the Multipurpose terminal in the Lach Huyen Port.

Table 11.2.5 Land Requirement/Berth for Multipurpose Port Facilities

Description	Area	Dimensions
1. Storage Area inc. Road, Drainage etc.	85,000m^2	250m × 340m
- Transit Sheds	7,000m^2	-
- Open Yards	30,000m^2	-
2. Building Area inc. Road, Parking, etc.	15,000m^2	250m × 60m
Total	100,000m^2	250m × 400m

Source: Study Team

11.3 Access Channel

11.3.1 Required Number of Lane

In TEDI FS, it was planned that the design vessel of 50,000DWT should enter the port at high tide. However, it is not acceptable for international gateway port to ask container mother vessels of 100,000DWT class enter into the port only during high tide. Therefore, SAPROF study recommends that the access channel shall be acceptable the design vessel at any tidal conditions with its operation draft but not with its maximum draft.

TEDI FS adopted the one way channel to save capital and maintenance dredging costs, however, it didn’t show the sufficiency of one way for all calling vessels to Haiphong ports and Lach Huyen port. Therefore, SAPROF study tried to confirm the sufficiency of one way channel as follow.

At first, SAPROF team studied the trend of ship call of Haiphong ports and it was clarified that after new Lach Huyen channel was developed in 2005 by the Haiphong Port Rehabilitation Phase II Project, number of vessels more than 7,000DWT, especially more than 10,000DWT were increased drastically as shown in table below.

This data suggested that if deep water channel is provided, the shipping lines will introduce bigger vessels.

Table 11.3.1 Trend of Ship Call of Haiphong Port

Capacity (DWT)	Ship length	1990		2000		2001		2002		2004		2006		2007	
		Q'ty	(%)	Q'ty	(%)	Q'ty	(%)	Q'ty	(%)	Q'ty	(%)	Q'ty	(%)	Q'ty	(%)
<3000	<85	155	31	289	18	261	16	482	23	271	13	601	21	794	22
3001-5000	85 -125	96	19	1,043	65	1,123	67	342	17	431	20	550	19	542	15
5001-7000	125 - 140	97	19	158	10	135	8	555	27	827	39	489	17	488	14
7001-10000	140 - 160	141	28	81	5	110	7	427	21	440	21	758	26	1,109	31
>10000	160 - 185	10	2	40	2	49	3	254	12	141	7	473	16	596	17
Total		**499**	**100**	**1,611**	**100**	**1,678**	**100**	**2,060**	**100**	**2,110**	**100**	**2,871**	**100**	**3,529**	**100**

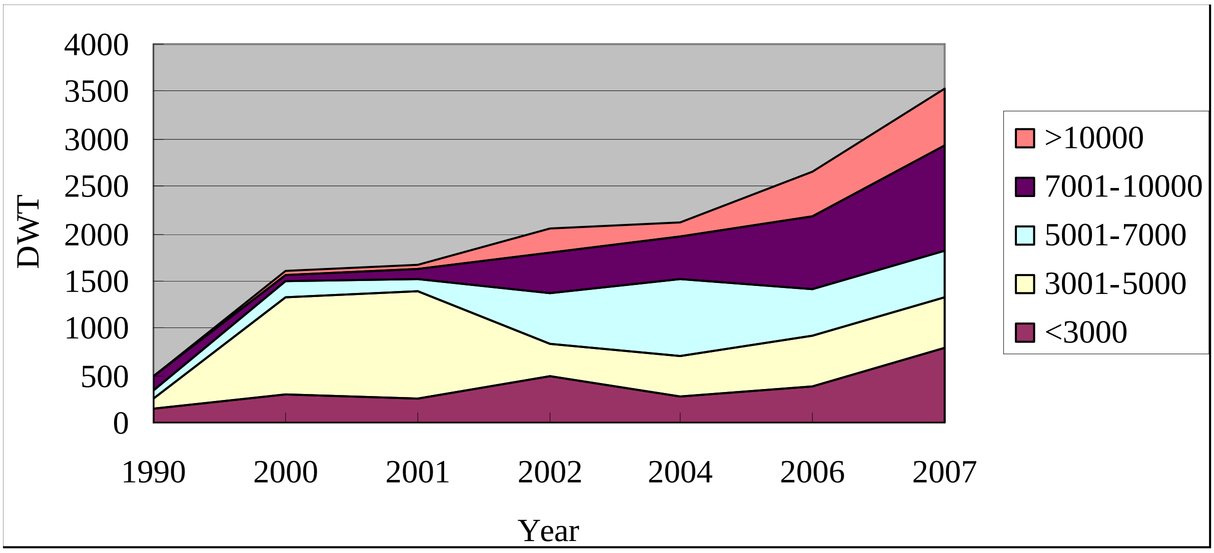


Figure 11.3.1 Ship Size Distribution of Haiphong Port

Based on the above data, future ship call was estimated as shown table below.

Table 11.3.2 Estimated Calling Vessels to Haiphong Ports (2020)

Type of Cargo	Vessel Size (DWT)	% of Vessel	Throughput (%)	Throughput (mil. ton) 2020	(a) No. of Call	(b) L average (m)	(a)x(b)	L average (m)
General Cargo + Bulk Cargo	< 3,000	23	4.4	1.62	1,406	75	105,585	
	3,001-5,000	15	7.7	2.84	924	100	92,387	
	5,001-7,000	14	10.7	3.95	856	112	95,859	
	7,001-10,000	31	33.7	12.44	1,903	125	237,850	
	>10,000	17	43.5	16.07	1,044	162	169,105	
Total		100	100	36.92	**6,134**		700,786	**114**

On the other hand, the calling vessels to Lach Huyen port were estimated based on the distribution of ship size used for calculation of required number of berth as follows.

Table 11.3.3 Estimated Calling Vessels to Lach Huyen Port (2020)

Type of Cargo	Size of Vessel (DWT)	Exchange of Cargo (/ship)	Throughput (%)	Throughput m.ton/m.TEU 2020	(a) No. of Call	(b) L average (m)	(a)x(b)	L average (m)
G Cargo + Bulk	20,000	15,400ton	40	1.13 m.ton	74	160	11,840	
	30,000	23,100ton	40	1.13 m.ton	49	185	9,065	
	50,000	38,500ton	20	0.57 m.ton	15	225	3,375	
Container	30,000	1,000TEU	20	0.46 m.TEU	460	203	81,420	
	50,000	2,000TEU	30	0.69 m.TEU	345	274	94,530	
	80,000	3,000TEU	20	0.46 m.TEU	153	300	45,900	
	100,000	4,000TEU	30	0.69 m.TEU	172	330	56,760	
Total					**1,268**		303,310	**239**

From above 2 tables, total number of call and average length of passing vessels through the Lach Huyen channel is obtained as follow.

- Total Ship Call : 7,402
- Average Ship Length : 136m

The capacity of Lach Huyen channel is calculated based on the following prerequisites.

- Navigation speeds in channel are 8 kt in daytime and 4 kt at night.
- Minimum intervals of ships are 8L in daytime and 16L at night.
- According the number of calling vessels to Lach Huyen port, the number of turning of vessel is 4 times/day and stop navigation of other vessels 0.5 hours/turning.
- The restriction of channel navigation due to one way operation is necessary 4 times a day and 1 time need 1.2 hours = 18km / (8kt × 1.852km/hr), however, this restriction is not a restriction for that vessel itself and 2.4 (= 2 × 1.2) hours/day is considered.
- Weather restriction factor : 1.5
- Safety factor : 1.5

Based on the above conditions, number of navigable vessels in a year is calculated as follows.

Day Time: 365d × (12h-2h-2.4h) / ((8 × 136m / (8 × 1,852m))＝37,775 ship

Night Time: 365d × 12h / ((16 × 136m/ (4 × 1,852m))＝14,911 ships

(37,775+14,911) / 1.5(Weather) / 1.5(Safety)＝23,416 ships

Total: 23,416 Ships/year = 11,708 Call/year > 7,402 call/year

Therefore, if all ship can call the port at any tidal conditions, one (1) way navigation channel is enough for ship calls at 2020.

11.3.2 Width of Channel

This channel is anticipated to be suffered considerable volume of sedimentation and the initial dimensions of this channel should be small as much as possible and after confirmed actual maintenance dredging volume this channel will be expanded. Therefore, since it was confirmed in above section that one way channel can accommodate required number of calling vessels, the width of access channel is planned as one (1) way channel.

For this access channel, a sand protection dyke will be provided along the channel and it will simultaneously function as a breakwater. Therefore, this access channel can be designed as so called in PIANC definition an “Inner Channel”.

In case of one way channel, required channel width is calculated by the PIANC formula as follow:

$$W = W_{BM} + \sum W_i + W_{Br} + W_{Bg}$$

Table 11.3.4 Calculation of Channel Width by PIANC

W_{BM}	Basic Maneuvering Lane	Moderate	1.5 B
W_1	Vessel Speed (knots)	8 - 12	0.0 B
W_2	Prevailing cross wind (knots)	<15 - 33	0.4 B
W_3	Prevailing cross current (knots)	negligible	0.0 B
W_4	Prevailing Longitudinal current (knots)	1.5 – 3.0	0.1 B
W_5	Significant wave height H (m) and length λ (m)	H < 1m, λ < L	0.0 B
W_6	Aid to Navigation	moderate with infrequent poor visibility	0.2 B
W_7	Bottom Surface	D < 1.5T, smooth & soft	0.1 B
W_8	Depth of waterway	1.15T < d < 1.5T	0.2 B
W_9	Cargo hazard level	Low	0.0 B
W_{Br}	Width of red side bank clearance	Sloping channel edge	0.5 B
W_{Bg}	Width of green side bank clearance	Sloping channel edge	0.5 B
	Total		3.5 B

Therefore, required channel width is:

$$W = 3.5 \times 45.5 = \mathbf{160\ m}$$

However, if this channel is not protected by sand protection dyke cum breakwater, the channel width should be calculated with the same formula but as an “Open Channel”:

Table 11.3.5 Calculation of Channel Width by PIANC (Open Channel)

W_{BM}	Basic Maneuvering Lane	Moderate	1.5 B
W_1	Vessel Speed (knots)	8 - 12	0.0 B
W_2	Prevailing cross wind (knots)	<15 - 33	0.4 B
W_3	Prevailing cross current (knots)	0.2 < v < 0.5 kt	0.2 B
W_4	Prevailing Longitudinal current (knots)	1.5 – 3.0	0.1 B
W_5	Significant wave height H (m) and length λ (m)	1 < H < 3, λ = L	1.0 B
W_6	Aid to Navigation	moderate with infrequent poor visibility	0.2 B
W_7	Bottom Surface	D < 1.5T, smooth & soft	0.1 B
W_8	Depth of waterway	1.15T < d < 1.5T	0.2 B
W_9	Cargo hazard level	Low	0.0 B
W_{Br}	Width of red side bank clearance	Sloping channel edge	0.5 B
W_{Bg}	Width of green side bank clearance	Sloping channel edge	0.5 B
	Total		4.7 B

Therefore, required channel width is:

$$W = 4.7 \times 45.5 = \mathbf{210\ m}$$

Above channel width will require sufficient tug assistance and appropriate navigation control system like VTS (Vessel Traffic Service).

11.3.3 Depth of Channel

As explained in 11.1.1 Design Vessel, 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.

The maximum design container vessel of 100,000DWT will put service into a trans-pacific route and Lach Huyen port will be terminal port. Therefore, ships will not call/leave with its full loaded condition. Thus, the average operation draft of 80% of maximum draft is considered for the design of channel depth. Depend on the PIANC guideline, the depth of inner channel may be 1.1 times of ship draft:

$$D_1 = 14.6\text{m} \times 0.8 \text{ x } 1.1 = 12.8 \text{ m} \quad \rightarrow \quad 13.0 \text{ m}$$

On the other hand, 50,000DWT container vessels which will be shifted from present trunk routes to the main feeder routes will provably call at Lach Huyen port with its full capacity. In this case, required channel depth become as follow:

$$D_2 = 12.7\text{m} \times 1.1 = 14.0\text{m} > D1$$

Therefore, the depth of channel is proposed to be **14.0m below CDL**.

However, in the Decision by MOT No.3793/QD-BGTVT dated December 22, 2008, 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.

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

(1) 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.

(2) 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.

(3) 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.

(4) 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.

(5) 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, since there are many ports which have more than -14m berths already (such as Shenzhen, Guangzhou, Manila, Laem Chabang, Port Klang, Cai-Mep, etc.).

(6) 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.

11.3.4 Slope of Dredged Channel

Based on the concept of underwater stability of slopes, the following rules of thumb for side slopes are presented in technical standard of Sea Channel Design Process of MOT.

Table 11.3.6 Side Slope of Channel

Soil Type and Soil Condition	Slope Value (m_o)
Clay mud, sandy clay, - strain condition	20 - 30
Clay mud, sandy clay, - fluid-plastic soil	15 - 20
Mud with shell	10 - 15
Plastic mud, sandy clay, dusty clay	7 - 10
Loose sand	7 - 9
Medium compact sand	5 - 7
Compact sand	3 - 5
Shell limestone	4 - 5
Clay and sandy clay, - soft and plastic	3 - 4
Clay and plastic sandy clay	2 - 3
Clay and sandy clay, - plastic and hard	1 - 2

Note: Side slope for channel depth of more than 5m shall be $2m_{o.}$

(Source: MOT Sea Channel Design Process 1998)

According to the subsoil boring data of KL 1 to 15 obtained by TEDI port, subsurface subsoil along the proposed channel is classified as CLAY. This clay deposit is classified as sandy/silty clay of which consistency is very soft to stiff having N-value in a range of 1 to 15 to the depth of CD-15m. Based on subsoil condition of loose fine sand (7 - 9) or the intermediate value between the sandy clay (7 - 10) and mud with shell (10-15) as indicated in the above table, it is proposed that a slope in 1 (V) to 10 (H) is applied for capital dredging work to deepen Lach Huyen access channel to the depth of CD-14m in initial development.

11.3.5 Turning Basin

The diameter of turning basin shall be more than 3 times of design vessel length when no tug assistance and 2 times of design vessel length when tug assistance is available.

In this design, it is assumed that sufficient tug assistance is available:

- For container vessel

  R = 2.0 × 330m = 660m
- For general and bulk cargo vessel

  R = 2.0 × 225 = 450m

The depth of turning basin shall be the same as depth of access channel.

11.3.6 Depth and Width of Berth

- Container Berth:

  Depth: 14m CDL (Fully loaded 50,000DWT container vessel)
  Width: 50m
- General/Bulk Berth

  Depth: 13m CDL (Fully loaded 50,000DWT bulker)
  Width: 50m

11.3.7 Distance between Quay and Access Channel

In TEDI's FS, the face line of berth was determined at around the existing -5.0m contour line and the distance between face line of berths and edge line of access channel were 260m at container berths to 365m at general cargo berths. No any other reasons were shown in their FS report and it is difficult to find out any technical and economical reasons. In general, when determining the distance between the face line of berth and edge line of navigation channel, it should be considered that the ship waves generating by sailing vessels in the navigation channel will not influence adversely to the cargo handling operation of the ship at berth.

Considering the navigation speed of vessels in Lach Huyen access channel of less than 10 knots in normal conditions, it is enough that the clearance between sailing vessels and moored vessels at berths is at most 100m. Therefore, from view points of saving the costs for capital and maintenance dredging, the distance between the face line of berths and bottom edge line of access channel is proposed to be reduced to **150m** instead of 260m – 365m of TEDI's FS.

11.4 Road and Railway behind Terminal

120m wide road and 80m wide railway were proposed behind the port terminal in the feasibility study on Lach Huyen Gateway Port (VINAMARINE, 2006). From the interview to F/S consultant, it was confirmed that the cross section for road and railway has not been studied in detail, and thus the road and railway width has not been fixed yet.

SAPROF study has estimated the road traffic volume for the container terminals and multi-purpose terminals in 2020 as follows:

1) Container Terminal

a) Container Tractor Trailer (2ways)

- Container Throughput (High growth case): 3,012,000 TEU/year = 2,008,000 box (=3,012,000/1.5)
- Number of tractor trailer with container = 2,008,000/365 = 5,500 vehicles/day
- Number of tractor trailer with empty container = 5,500 vehicles/day
- Number of tractor trailer with additional empty container = 5,500 x 10% x 2 ways =1,100 vehicles/day
- Number of tractor trailer without container = 5,500 x 2 + 1,100 = 12,100 vehicles/day
- Total number of tractor trailer = 24,200 vehicles/day

b) Other Vehicles (2 ways)

- Small car = 100 cars/day/berth = 100 x 6 berths x 2 ways = 1,200 cars/day
- Large car = 10 cars/day/berth = 10 x 6 berths x 2 ways = 120 cars/day

c) Number of PCU (Passenger Car Unit)

(24,200 + 120) x 3 + 1,200 = 74,160 PCU/day

2) Multi-purpose Terminal

a) Cargo Truck (2 ways)

- General Cargo Throughput (High growth case): 3,853,000 ton/year
- Average Load of Truck: 10 ton/vehicle
- Number of truck with load = 3,853,000/10 = 385,300 vehicles/year = 1,060 vehicles/day
- Number of truck without load = 1, 060 vehicles/day

- Total number of truck = 2,120 vehicles/day

b) Other Vehicles

- Small car = 100 cars/day/berth = 100 x 3 berths x 2 ways = 600 cars/day
- Large car = 10 cars/day/berth = 10 x 3 berths x 2 ways = 60 cars/day

c) Number of PCU (Passenger Car Unit)

(2,120 + 60) x 3 + 600 = 7,140 PCU/day

3) Required Lanes of Road

- Total Number of PCU = 74,160 + 7,140 = 81,300 PCU/day
- Number of PCU per peak hour = 81,300/24 x 2.0(peak ratio) = 6,775 PCU/hr.
- Capacity of 1 lane: 1,800 PCU/hour
- Required Number of lane = 6,775/1,800 = 3.77 lanes say, 4 lanes for 2 way

Therefore, 4 lanes of travelling lanes are required for Medium Term Development of target year 2020.

In addition to above travelling lanes, 2 lanes of waiting lanes along the terminal side are provided and 2.5m wide paved shoulders for motor-bike passage and emergency parking at accident are provided in both directions. Median is planned as 10m in consideration of U-turn of 45 feet container trailer. The total width of port road behind terminal is proposed to be 44m for Medium Term Development as illustrated in Figure 11.4.1.

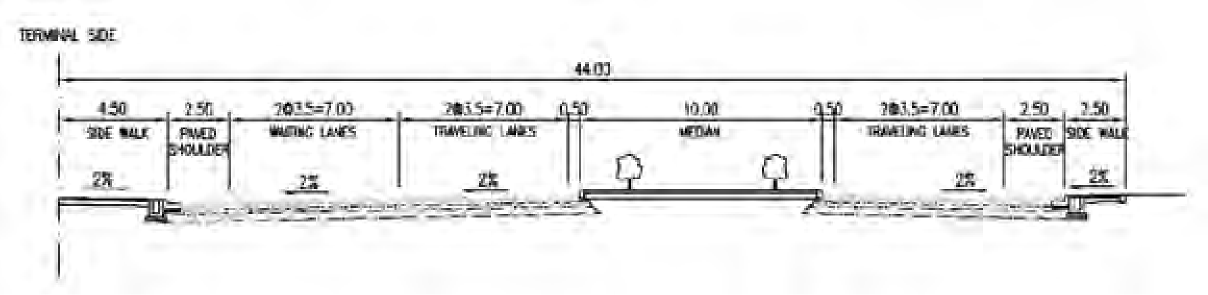


Figure 11.4.1 Typical Cross Section of Port Road for Medium Term Development (2020)

SAPROF study also considered that the road space for future port development should be reserved. However, there is no concrete future port development plan yet, therefore, in this study the number of reserved lanes for future development was estimated based on the following assumption:

Prerequisite: "Similar port development with Medium Term Development will be continued in future along the Lach Huyen access channel up to 15km offshore from container Berth No.1".

Total berth length of Medium Term Development is approximate 3km and another 4 times of berthing structures can be developed along the access channel. In such a condition, the hourly peak ratio will not be so high as 2.0 and may be reduced to 1.2 - 1.3. Therefore, the road traffic volume will become:

81,300/24 x 5 times development x 1.3 (hourly peak ratio) = 22,000 PCU/Hr

Required Number of lane = 22,000/1,800 = 12.2 lanes say, 12 lanes for 2 way

Therefore, considering the future port development of 15km long berths in total along access channel, road expansion space for 8 travelling lanes should be reserved.

Considering the smooth traffic flow in port roads, the terminals along access channel should be divided into several terminal groups and 4 travelling lanes roads are arranged just behind the each group of terminal and 8 travelling lanes road is arranged behind the terminal roads as a passing main road and finally total road width will be 95m as shown in Figure 11.4.2 and Figure 11.4.3.

The railway construction schedule is not determined yet and the land of 200m wide behind terminal area will be kept for future development as shown in Figure 11.4.4.

The connection of port road and access road of Cat Hai Island is proposed to be as shown in Figure 11.4.5 and Figure 11.4.6.

The length of transit section in each stage should be determined based on the design speed of Tan Vu – Lach Huyen Highway, 80km.

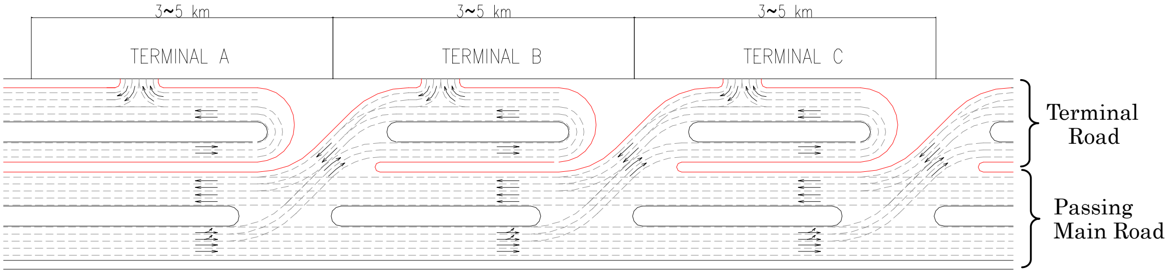


Figure 11.4.2 Layout of Each Terminal Road and Passing Main Road (Future)

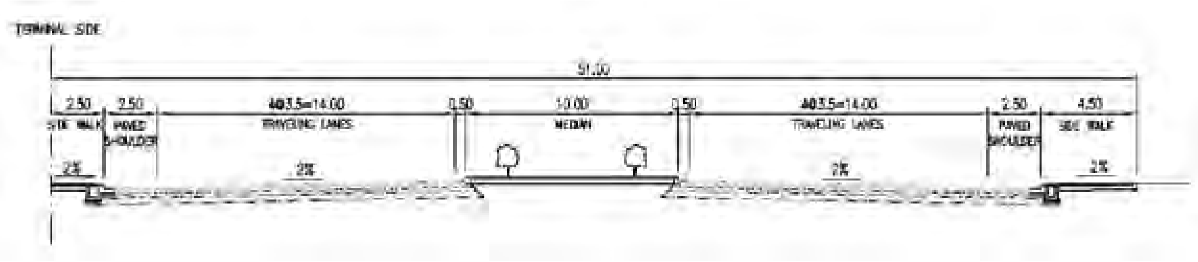


Figure 11.4.3 Typical Cross Section of Passing Main Road (Future)

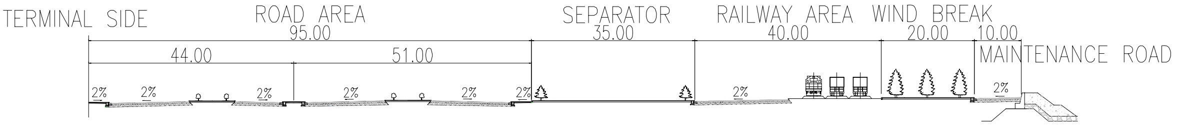


Figure 11.4.4 Typical Cross Section of Road and Railway behind Terminal (Future)

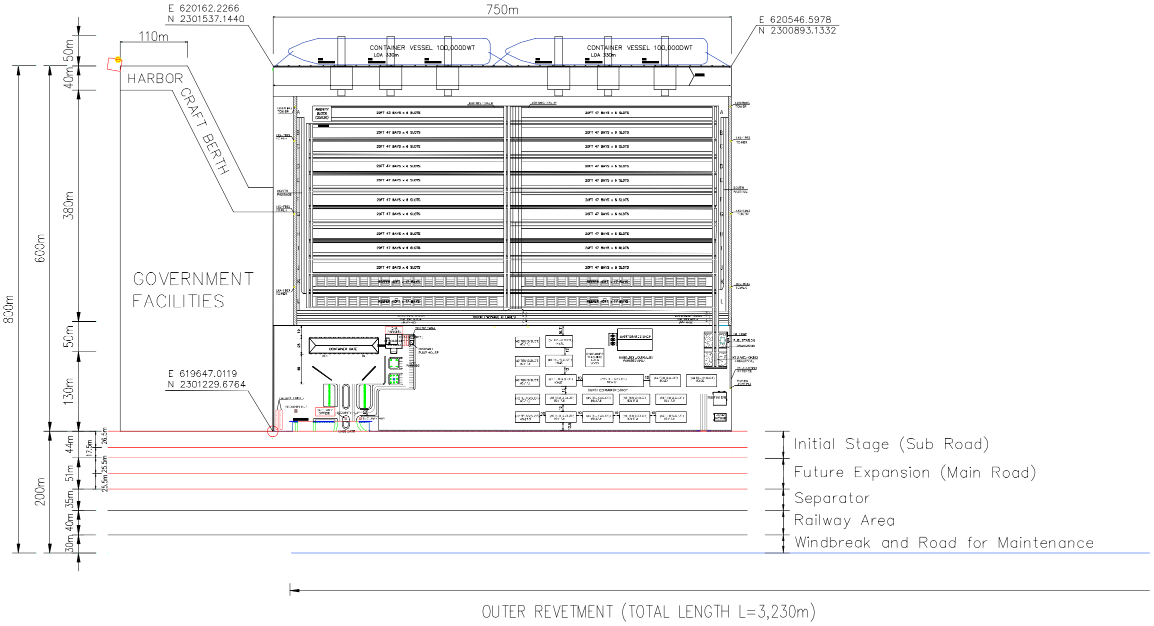
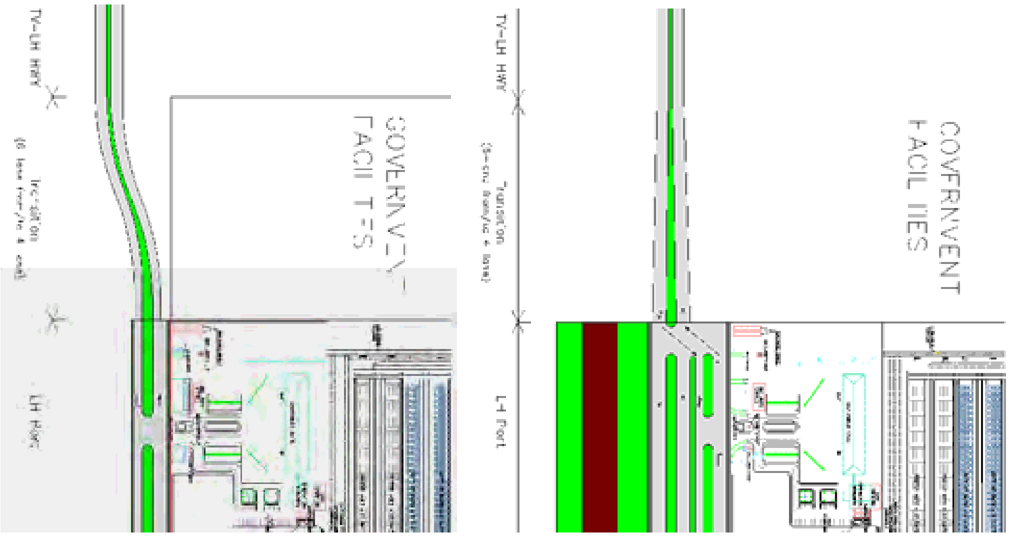


Figure 11.4.5 General Layout of Road and Railway behind Terminal



Initial Stage Future Stage

Figure 11.4.6 Connection Portion Detail of Port Road and Cat Hai Access Road (2015 & Future)

11.5 Port Protection Facilities

11.5.1 Outer Revetment

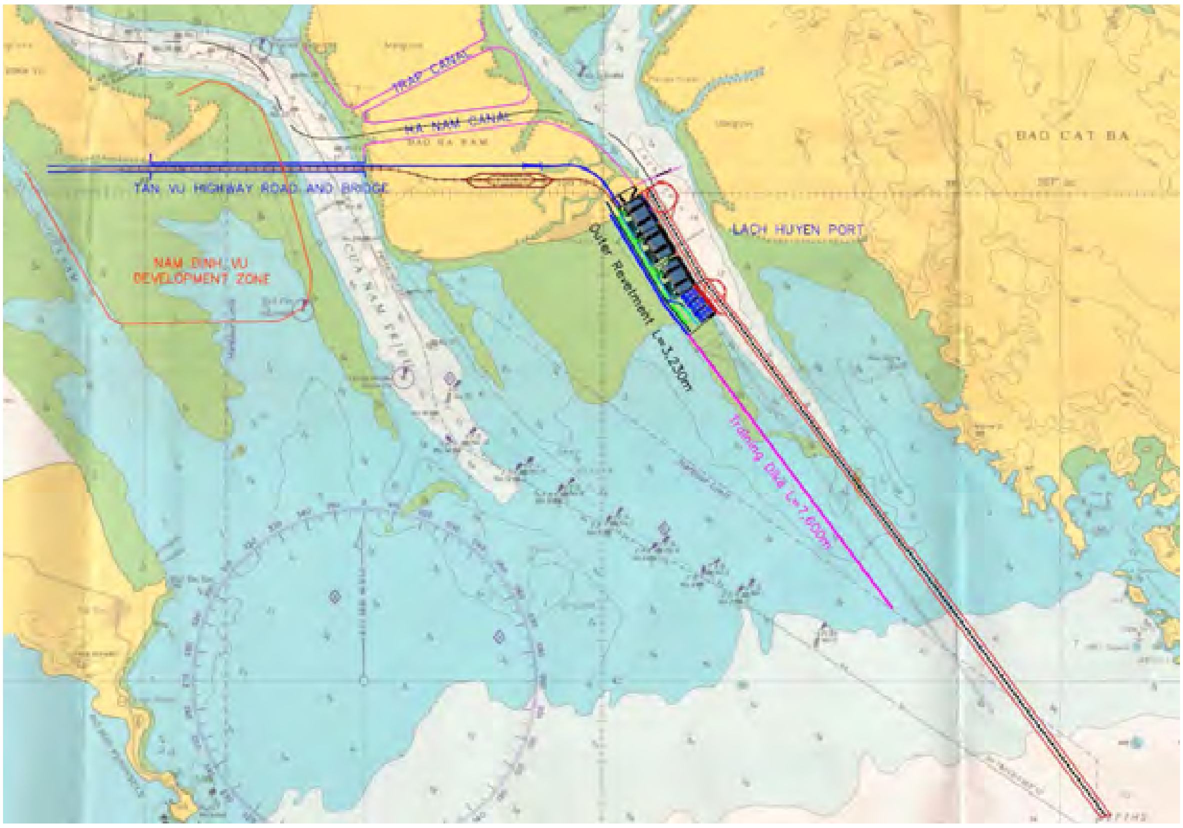
Almost once a year, Lach Huyen offshore area is subject to extreme wave attack which is generated by tropical typhoon. Therefore, it is essential that outer peripheral revetment of the reclamation area is protected as Seawall which is properly designed and constructed against to the extreme wave attack with provision of armored protection by wave-dissipating precast concrete units.

This seawall type of structure is required for 3,230m along the west side of reclamation area including future developing area by the year 2020. But, the south side area of the reclamation is provided with a sloped revetment armored by relatively smaller size of rocks for a length of around 750m once this water area shall be sheltered by offshore training dyke construction.

11.5.2 Sand Protection Dyke

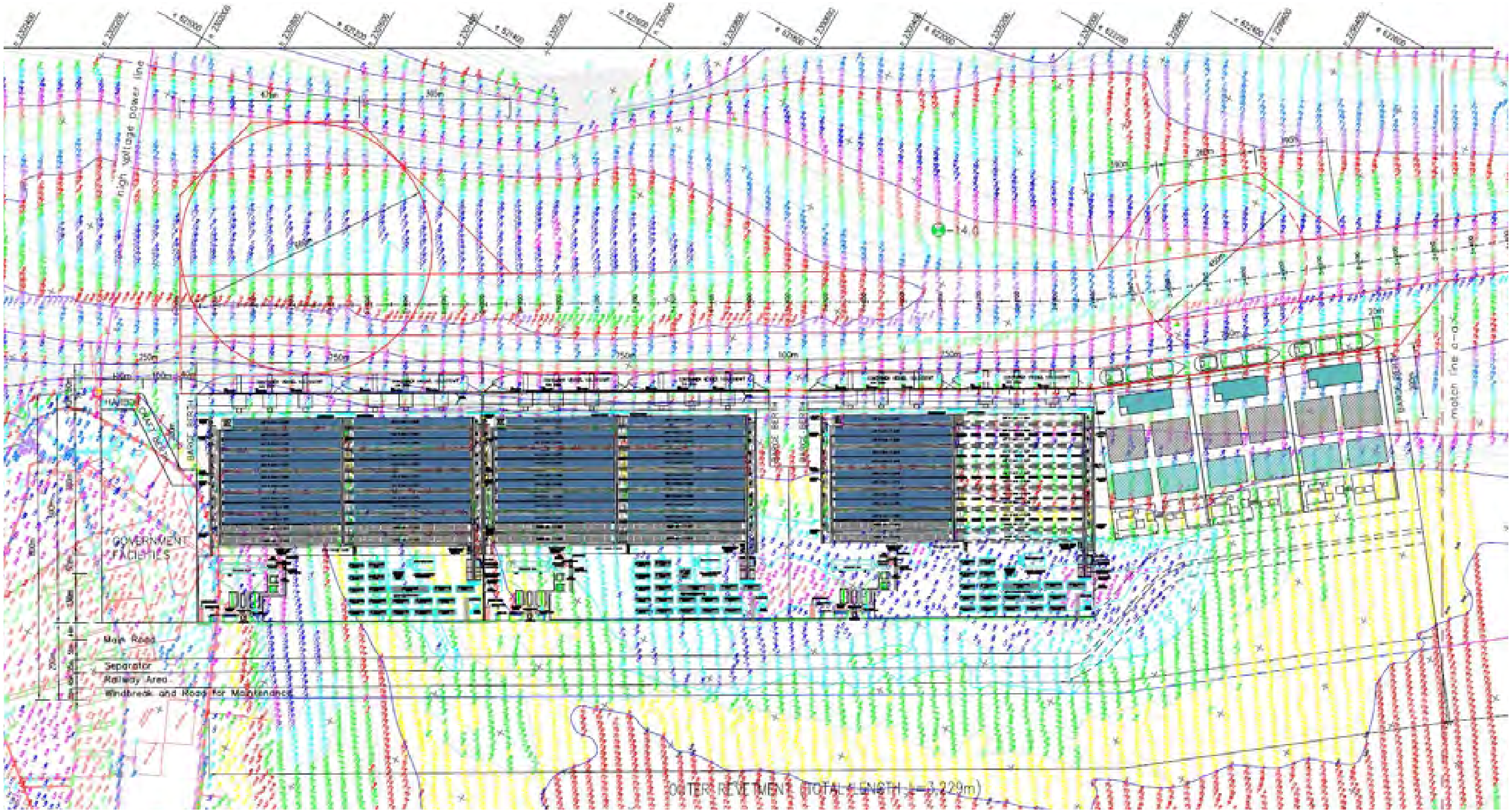
A dyke is provided on the same alignment of the outer revetment to protect the access channel from sedimentation of sand. It is recommended that the dyke is non-permeable type of structure with provision of enough stability against for extreme wave action. Based on the sedimentation simulation study results presented in Chapter 8, it is determined that the top elevation of dyke is positioned to be +2.00m above CDL to trap sand transportation and properly function as breakwater to shelter access channel water area and the dyke is extended up to sea bottom elevation of -5.0m CDL for a length of around **7,600m.**

Proposed general port layout plan which shows alignment of access channel and port protection facilities is illustrated in Figure 11.5.1, and Container and Multipurpose terminal layout plan is presented in Figure 11.5.2 and Figure 11.5.3.



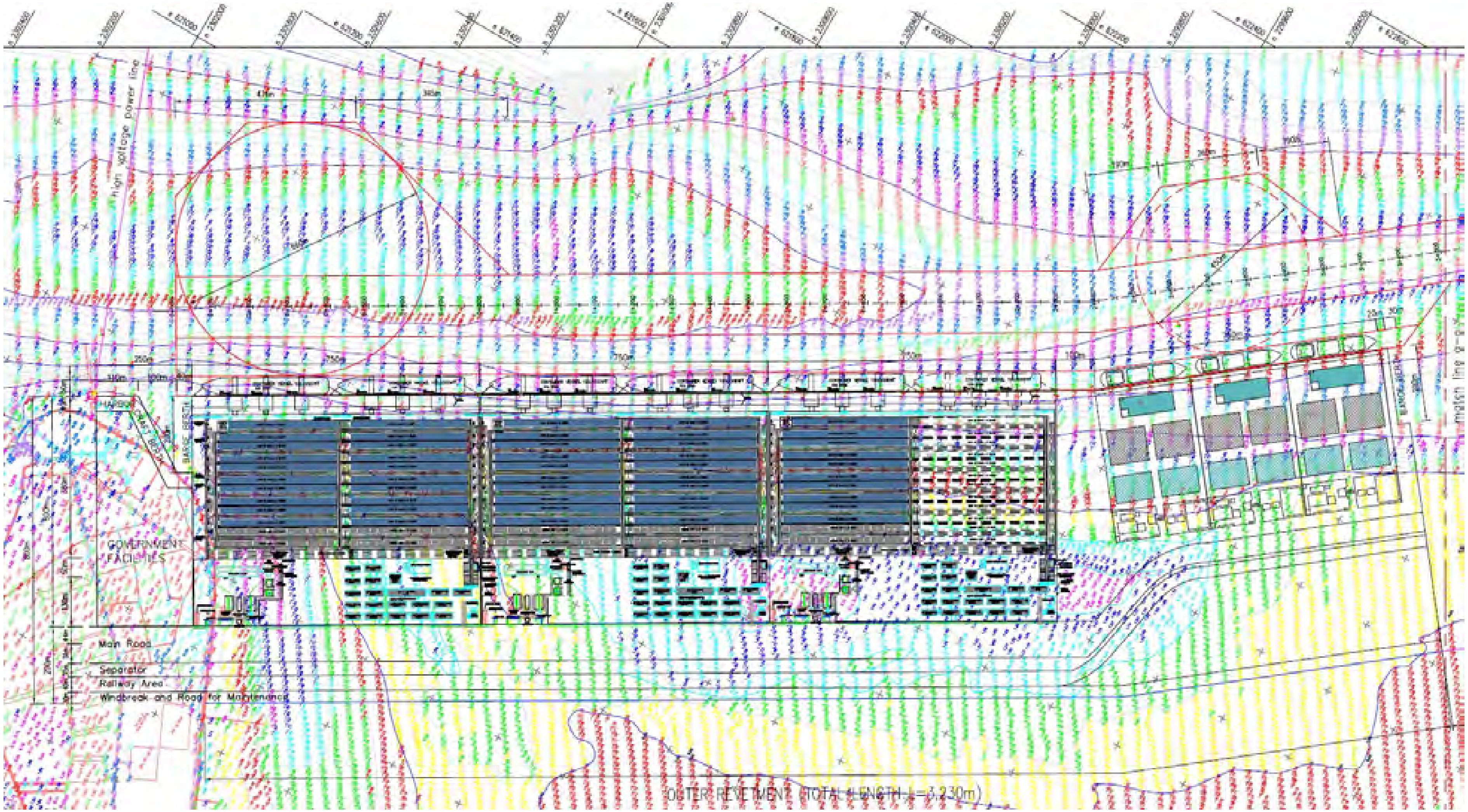
Source: Study Team

Figure 11.5.1 Development Layout Plan



Source: Study Team

Figure 11.5.2 General Layout Plan of Terminal Facilities (Alternative 1: Barge Berth Basin is arranged)



Source: Study Team

Figure 11.5.3 General Layout Plan of Terminal Facilities (Alternative 2: Barge Berth Basin is not arranged)

11.6 Port Layout Plan

11.6.1 General Port Layout

1) General Layout of Container Terminal

The layout for the container terminal conceived while bearing in mind the efficiency and safety of terminal operations in order to achieve maximum terminal output at reasonable cost. Road traffic in Vietnam is anchored on the “keep right lane rule”. It is desirable to keep traffic direction for vehicles in the yard in one way, and road marks and boards to show the right way clearly.

a) Quay Length and Width

A 750 m long berth is adopted to accommodate the simultaneous mooring of two Post Panamax type container vessels. The berthing length at 750 m is inclusive of the mooring bit structures to be provided at both ends of the berthing facility. Seven hundred fifty meters long quay will be provided with a 50 m wide of the berthing structure. Along the north edge of terminal a barge berth of 200m long and 30m wide is secured.

b) Apron width

The apron is 50 m wide and is to be provided with Crane rails 30 m in gauge for the installation of quayside gantry cranes to cater for container handling operations of Post Panamax type vessels. Sufficient space will be provided at the back of gantry cranes land-side rail for the placing of the vessel’s hatch covers, and for 4 truck lanes.

c) Container Yard

For efficient container handling operations, the stacking yard will be rectangular in shape. Each dry container lane has two 47 bays with 6 slots stowage space except north-east block and reefer container blocks. One container lane consists of 6 container bays and 1 truck lane under the RTG, of which tire spun is standard 77 feet or 23.47m.

The whole yard will be divided into two, north and south yards. Each yard will include 10 dry container lanes and 2 reefer container lanes.

Three RTG traversing passages will be provided at both ends and among the north and south yard. One reefer container lane has 17 bays with 6 slots only for 40 ft in one block. In case that 20ft reefer container is stowed, the remaining 20 feet length will be intentionally left vacant. Dry containers will be able to be stacked 4 tier-high containers, and reefer containers 2 tier-high.

Total Ground Slots for dry container are:

(47 + 47) bays × 9 lanes × 6 Slots = 5,076 TEU
(43 + 47) bays × 1 lanes× 6 Slots = 540 TEU Total 5,616 TEU

Reefer Container Ground Slots for 40 ft are:

16 bays ×4 lanes × 6 Slots = 384 FEU
1 bay × 4 lanes × 3 slots = 12 FEU Total 396 FEU

Naturally dry containers can be stored in reefer container lanes on demand.

d) RTG Traversing Passage

The traversing passages for the RTGs will be provided for easy transferring to another lane and to RTG maintenance area. The extreme south end traversing passage will reach close to the maintenance shop up to the maintenance depot of the RTGs.

e) RTG Repairing Depot

A depot will be provided closed to the maintenance shop to cater for the maintenance of RTGs. In the depot, other equipment and yard vehicles can be repaired and washed in addition to the RTGs. The perimeter of the depot will be provided with a trench as a measure against oil spillage. Bilge that has accumulated will be deposited onto a waste water treatment plant, and purified by the equipment here.

f) Reefer Receptacles

Each two reefer lanes in 2 blocks with 17 bays of 40 ft refrigerated containers will be provided electrical receptacles to provide power supply for two-tier stacked containers. All spaces are for 40 foot reefer containers in length, and will be secured with door-opening spaces for contents inspection. Twenty foot reefer containers will be also stored here with another 20 feet of vacant space.

g) Empty Container Depot (ECD)

An empty container depot will be provided outside of the stacking yard in a separate area in the container terminal. The space can be secured in the south of the terminal office building where respective container blocks for owners, and kinds and type of containers. A maintenance shop is located in the vicinity of empty container yard and dirty containers can be washed on clients' request here. The containers returned from consignees for delivery to shippers will be stored in sound condition for delivery.

h) Container Checking Gate

The checking gate is the dividing point of responsibility between the terminal side and cargo side. Container inspectors are tasked to examine outlook conditions of the containers and to check whether the container seals are intact on the container doors or broken. The checkers together with the truck drivers will verify the condition of the container and seals for any damage, and confirm contents on Equipment Interchange Receipt (EIR) with signature, whereas for the reefer containers, their inside temperatures will be confirmed by checkers and drivers.

Each gate lane will be provided with a processing booth to be installed on the elevated platform alongside the checking lanes. Weighing scales will be installed in certain selected In-lanes for checking of cargo payload of containers, for compliance with safety requirements and the formulation of the stowage plan on board the vessel to be prepared by the GM and individual discharging ports. The checking gate will be provided with overhead catwalks to facilitate the inspection of container roofs by checkers.

Open wide area will also be provided on the checking gate side to cater to oversized or huge cargo, and heavy equipment and machineries that cannot not pass through the checking gate lane and free trailers after the container delivery in the yard.

i) Terminal Operations Office

This building, which will be connected by passage with the terminal main gate, will house terminal operation personnel except for those involved with maintenance and stevedores. Both departments have their own offices separately in the terminal. The terminal office will be provided with compartments for members of the managing unit, documentation department, operation department, and computer facilities among other amenities to facilitate the 24 hours continuous operation of the terminal.

The office will be provided with parking spaces for customers including shippers, consignees, customs brokers, forwarders and truckers.

j) Container Freight Station (CFS)

No CFS is considered to be built inside of the container terminal at present. There are many ID, IZ, and independent industrial zones in suburbs of Hanoi and Hai Phong, in where several logistic companies have their own bonded warehouses. Cargos will be stuffed/unstuffed and delivered there on request from the factories and traders in the area. Consolidation of cargo is one of the important roles for them. It seems that most container cargos will be carried as CY containers from/to the terminal.

k) Maintenance Shop

The container terminal will be provided with a “maintenance shop” for repair and maintenance of all yard equipment and facilities including vehicles used in the terminal. The shop will be equipped with an overhead crane for lifting heavy objects and a trench-pit for the inspection of the under-flooring of vehicles.

Similarly, the RTGs will be maintained in RTG anchoring area.

Electricians will monitor the required temperature of reefer containers that are stacked in the reefer container lanes.

Office, spare parts stores, various repairing machines, and other amenities for persons in charge of maintenance will be secured in the shop. The shop has a partial 2nd floor for office, technicians’ amenity. Showers corner and washing area are separately at ground floor.

Refer to the proposed layout plan of container terminal shown in Figure 11.6.1.

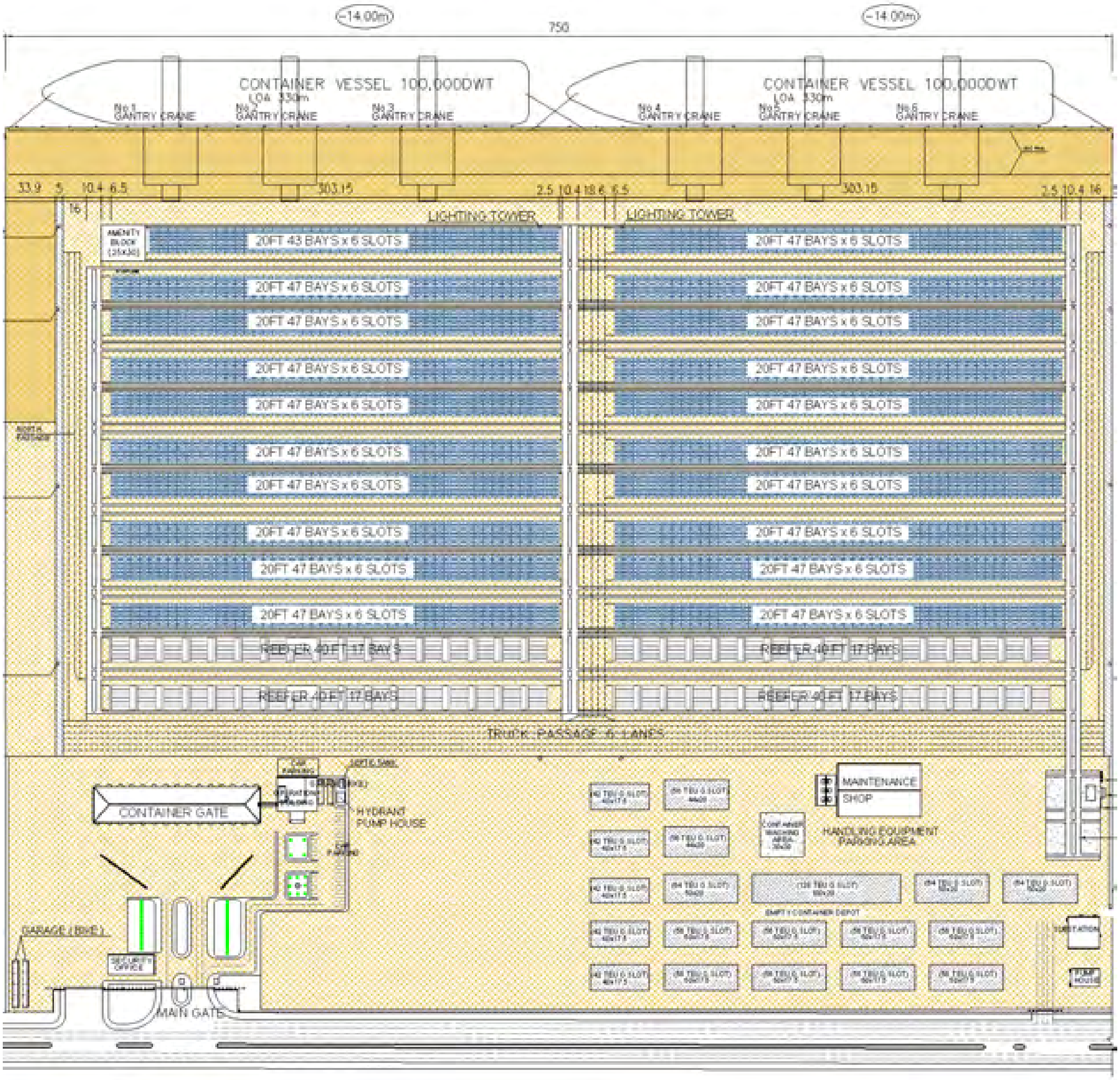


Figure 11.6.1 Layout of Container Terminal

2) General Layout of Multipurpose Terminal

General layout plan of multipurpose terminal in Lach Huyen Port is prepared considering the following issues.

Main general cargos discharged and loaded in Lach Huyen Port are mainly machinery & equipment, manufactured goods, ores for export and importing logs & timbers, gravel and grain.

The points for handling these cargos in the multipurpose terminal are described as follows:

- General cargo, non-containerized: To be discharged by ships' gears and jib cranes and carried into the sheds.
- Logs & Lumbers: To be carried to open yards by forklifts or trucks.
- Cargo in bulk: To be carried by belt conveyors through hoppers to the shed, or by truck to open yards. Gravel is carried to the open yard by dumping trucks.
- Containers: To be discharged by jib-Cranes and carried by trailers to open yards for stacking.

- Ore: excavators/declaimers to scoop ore to pour into hoppers, and belt conveyors to carry to ships hold.

a) Quay Length and Width

A 250 m long berth is adopted to accommodate the 50,000DWT type general and bulk cargo vessels. The berthing length at 250 m is exclusive of the mooring bit structures to be provided at both ends of the berthing facility. Two hundred fifty meters long quay will be provided with a 38 m wide of the berthing structure. The barges go on berth at the vacant space of the berth.

Two jib-type rail-mounted shore cranes of which rail spun is 20m are installed on each multipurpose terminal. One of them has the 45tons lifting capacity and the other has 20 tons. They are useful for handling containers with spreader, and cargo in bulk with buckets for assistance of ships' gears.

b) Apron Width

Considering the various kind of cargo type including containers from/to semi-container vessel to be handled in this terminal, apron will be better to have a wide space between transit shed and 50m was allocated.

c) Transit Shed

A transit shed is provided behind the apron with the area of 7,000 m^2. Four openings are settled along the quay side with lifting shutters; two double doors are in both gable ends, and two in the opposite side of the quay in the transit shed for easy cargo handling and truck passing. The floor of the shed keeps the same level as the apron.

When general cargos on pallets are stowed in this shed, the total storage capacity will be 10,917tons as following calculation.

The valid space in the shed: 7,000 m^2 – (Office and Substation Space) = 6,550 m^2
Half is to be deducted for forklift moving passage: 6,550 $m^2 \times 0.5$ = 3,275 m^2
Pallet size: 1.8 m^2 (1.2 m × 1.5 m), 2 tons cargos on a pallet, and 3 tiers to be stowed.
Total storage capacity: 3,275 m^2 / 1.8 m^2 × 3 tiers × 2 tons = 10,917 tons

When bulk cargos are stowed in the shed, they will be poured from the vessel side into the shed by belt conveyor, and made conic piling. The side walls of the shed inside are to be strengthened by stations and protected panels.

The stanchions, the walls and the windows of the shed should be protected from the cargo stored to be piled inside. About 2m high brick from the floor will sustain grain piled inside in order to stow it for silos.

d) Open Storage

Four separated open yard sections will be provided to stow main/lot cargo, ore, logs & lumbers, and iron & steel goods. Some cargos will need provisional canvas covers in protection from rain.

On both end-side of the transit shed, broad passage will be secured in order to carry long length goods like as logs & lumbers, and steel pipes on forklifts.

e) Terminal Office

A terminal office will be provided with separated compartments for related organizations, which consist of terminal management/administration and documentation.

f) Amenity Block

An Amenity Block is necessary for stevedores to rest and stand by for following duties, including at night time. The building includes various amenity facilities such as a dining room, rest rooms, etc.

g) Maintenance Shop

A Maintenance Shop is indispensable to maintain equipment in good condition. The shop is furnished with ceiling cranes of 7-10 tons, spare part shelves and an engineer's office. In addition, a special treatment facility for oil leakage will be required around the shop.

The layout plan of multipurpose terminal is presented in Figure 11.6.2.

3) Arrangement of Terminals

In TEDI's FS, the face lines of general cargo berths and bulk cargo berths were planned to be bent in U-shape. This plan has some advantages such as saving reclamation area and effective use of the waterfront along the access channel, however, this plan has also some disadvantages which make impossible to use full length of each berth. If face lines of neighboring berths are arranged in straight line, various lengths of ships can be berthed with minimum vacant berth space. Therefore, the berth arrangement of multipurpose terminal is proposed to be straight in this study.

Regarding the arrangement of container berths and multipurpose berths, it is preferable that the shallower berths, multipurpose berths shall be located landside of channel and the deeper berths, container berths shall be arranged in offshore side. However, in this study the container berths for medium term development are arranged landside and multipurpose berths are arranged in offshore side of the container berths by the following reasons, (1) the first 2 container berths are planned to be constructed at the beginning but initial investment cost become high if these berths are arranged offshore side, (2) the difference of depths of both kinds of berths is not so much only one meter, (3) TEDI's FS which was already approved by GOV adopted such arrangement.

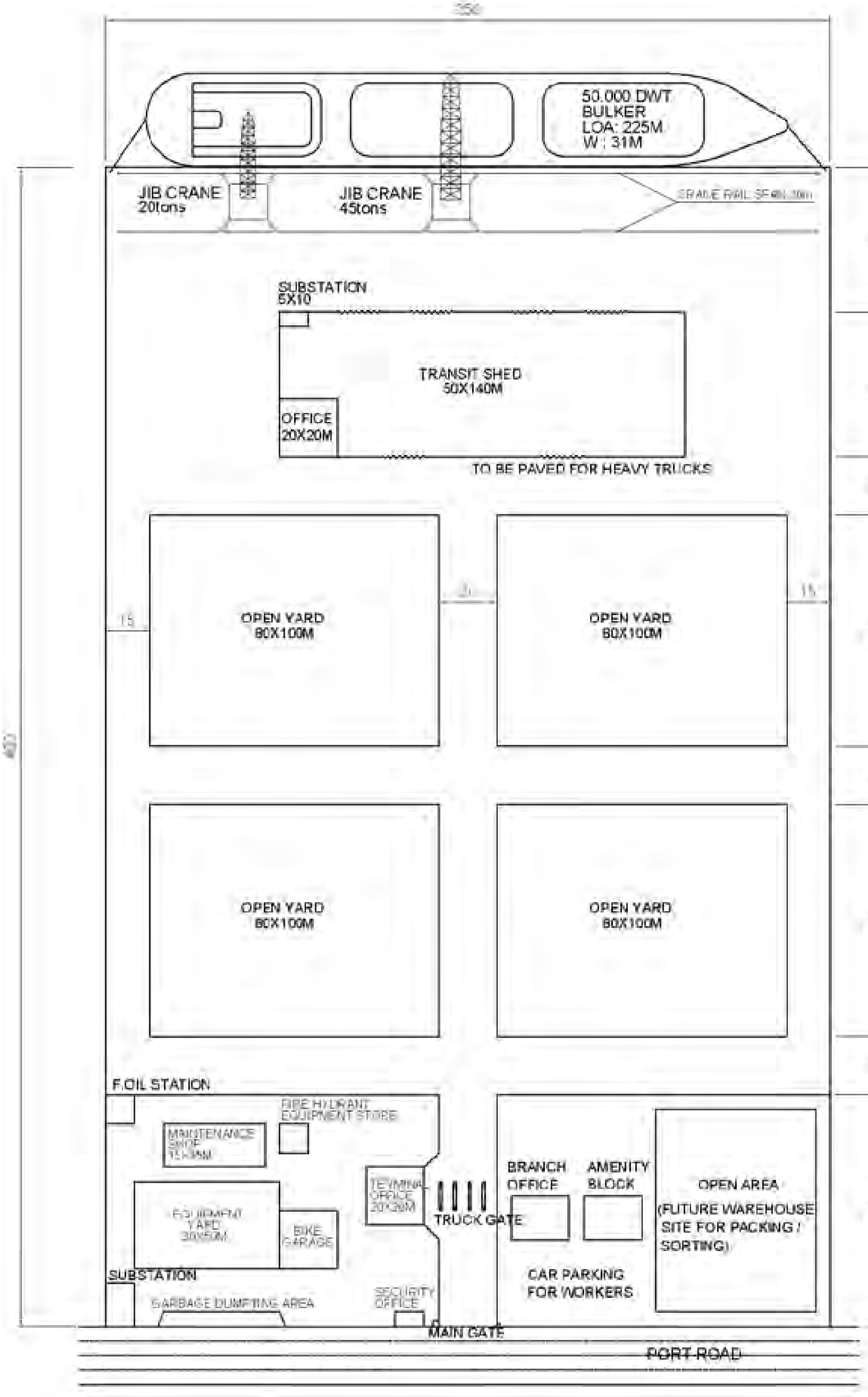


Figure 11.6.2 Layout of Multipurpose Terminal

11.6.2 Access Channel

1) Alignment of Access Channel

In this SAPROF study, an additional bathymetric survey around the existing Lach Huyen access channel was conducted in November 2009. The survey results showed that nevertheless no maintenance dredging for the existing Lach Huyen access channel haven't been carried out after 2006 when this channel was newly developed under the Hai Phong Port Rehabilitation Phase 2 Project, the deepest water is still located almost in the center of access channel. From this situation, there is no reason to rearrange or modify the alignment of existing access channel.

However, as mentioned in 11.3.7, the distance between quay and access channel should be reduced from original distance of 260m to proposed distance of 150m. This reduction of distance can be achieved by 2 options, i.e., one is to shift the face line of quay to channel side and another one is to shift channel alignment to quay side. Even latter case no significant influence for ship navigation or sedimentation phenomenon is anticipated since the alignment shifting area has wide enough deep water.

Therefore, above 2 options were compared by the construction cost regarding reclamation work and dredging work, and concluded that it is economical to keep face line of quay as TEDI's plan and to shift channel alignment westwards by 110m at berth No.1 point.

Therefore, the upstream side of channel alignment from existing bending point of Lach Huyen channel will be realigned by 2 degree westward.

2) Direction of Future Widening

Considering the number of ship calls to Hai Phong ports and Lach Huyen port and to minimize the capital and maintenance dredging costs, this channel will be developed as one lane channel at first and when number of ship calls will increase, the channel must be widened to two lanes channel. In such a case, it will be no problem to widen the channel to eastern wards, since future berth development will be done along the western side of access channel and the center of water flow of channel will gradually move to eastern side.

On the other hand, it is not recommendable to widen the access channel so much to the Cat Ba Island side because there are some possibilities that the rock will appear in seabed subsoil in the vicinity of island. However, it is not anticipated that such situation will no occur because required widening for two lanes channel will be about 100m only. To assure this issue, it is recommendable to carry out a seismic exploration during the field investigation for detailed design stage.

3) Turning Basin

In front of berths, the turning basin having a diameter of two times of LOA of berthing /deberthing vessel is required. Since Lach Huyen access channel is one lane and its navigation capacity is restricted, there is an idea that the turning basin should be arranged not to overlap with access channel in order to secure the navigation capacity of access channel.

However, as analyzed in previous section, it was proved that this Lach Huyen channel have an enough navigation capacity for the calling vessels in year 2020, even if turning operation will disturb the navigation of other vessels. The idea which arranges turning basin without overlapping access channel will require larger volume of capital dredging and following maintenance volume as well. Therefore, in this study this idea was discarded and the plan which turning basin is arranged to overlap with access channel as adopted in Hai Phong ports and Saigon ports at present.

12. Conceptual Design and Cost Estimate

12.1 Conceptual Design

12.1.1 Dredging Access Channel

1) Subsoil Profile

Present access channel is deepened to a water depth CD-14.0 m wide in Initial development to allow larger size of vessels to approach the Lach Huyen New Gateway port.

Subsoil data on borings KL1 to KL15 (located along the bottom of access channel) by TEDI Port Subsoil investigation (Nov. 2007) indicates that:

(1) The subsurface sediments to the depth of CD −14m are mostly very soft to soft, plastic and unconsolidated silty or clayey deposit of low liquid limit (CL or ML) with 60 to 85% of materials in particle distribution range of silt (0.075 to 0.005 mm) and clay (less than 0.005mm).

(2) But, at a certain depth of the area from KL5 (X=2,298,061, Y=622,752) to KL 8 (X=2,295,652.9, Y=624,540.1 according to VN200 Co-ordinate System) for around 3 km along the access channel way, the subsurface deposits are fine granular sandy soils of the particle range of 0.5 mm to 0.1 mm by 50 to 80% of content.

No SPT N-value is available for borings KL1 to KL15. But, according to the subsoil data along the access channel, the subsurface clayey deposit is classified as clay or silt of which consistency is very soft to stiff having N-value in a range of 1 to 15 to the depth of CD-15m.

The sea bottom sediment to be dredged is mostly clayey soil but its consistency may differ from very soft to stiff, although SPT N-value was not obtained by a series of the previous subsoil investigation works carried out for the Project. Dredgeability of Lach Huyen access channel dredging is likely to be good and it is expected that fairy high production rate of dredging work could be achieved. The physical properties of the seabed materials to be dredged may require a deployment of Trailer Suction Hopper Dredger (TSHD) or Cutter Suction Dredger (CSD) or its combination dependent upon difference in subsoil nature of various strata and places.

2) Side Slope for Dredging

The stability of underwater slope for dredging depends upon the physical properties of the seabed subsoil and seawater conditions at the dredging site.

As recommended in Chapter 11, a slope in 1 (V) to 10 (H) is applied for capital dredging work to deepen Lach Huyen access channel to the depth of CD-14m in initial development. This may be derived from considerations to Vietnamese Standard as for the soil nature of Plastic Mud, Sandy Clay, Dusty Clay (1 to 7-10) or about 2-time of the value (1 to 3-4) as for the soil Clay and Sandy Clay－soft and plastic in the case of channel depth more than 5m as indicated in Table 11.3.6: Side Slope of Channel by Vietnamese Standard in Chapter 11.

The stability of underwater slope for dredging depends upon the physical properties of the seabed subsoil and seawater conditions at the dredging site. The typical side slopes for various types of subsoil are given in Vietnamese or Japanese Standard as follows.

Hon Dau Station records (3-year period from 2006 to 2008) shows that wave height less than 1.0 m occupies 91.4% of occurrence. Since the site water environment is normally calm with no significant wave actions or strong currents except in occasional rainstorm weather, the design dredging slope of

1(V): 10 (H) could be considered moderate in the planning stage and is expected to be likely stable. Previous study also applied a side slope of 1 (V): 10 (H). Submerged subsurface deposits are not fully consolidated and of relatively low density, and may not be stable during extreme dynamic marine environment such as storm weather. Though the average angle of repose of side slope is dependent primary upon the nature of the materials on the side slope and the manner in slope cutting, there may be resulted in side slope slumping down over time to the average angle of repose in more gradual slope. Therefore, the dredged slope in 1 to 10 for capital dredging might require recurrent maintenance dredging.

3) Use Dredged Materials in Reclamation

Material suitable for fill materials for reclamation will be well-graded, free-draining sand with a particle size distribution in the range of around 0.1 to 1.0mm. Sand mixed with gravel may be also suitable.

In view of the above, the dredged material from access channel is generally not suitable for the use of reclamation fill and therefore the bulk of the dredged soils should be disposed at designated offshore dumping site. But, the sandy materials at a certain depth in the area where KL5 to KL 8 borings were carried out could be considered as being suitable for use in reclamation fill. Once strict inspection and quality control on the dredged materials shall be exercised, reclamation fill may allow the use of these dredged materials which are sourced from a certain depth of the area where KL5 to KL 8 borings were located.

12.1.2 Natural Conditions for Port Facility Design

The design criteria were determined for the purpose of executing preliminary design works for the Project. In the process of determination of design criteria, primary design criteria proposed by the previous studies were carefully reviewed.

Chapter 7 of this report summarizes data and information on meteorology, oceanography and subsoil that were derived from the previous study report collected or supplementary obtained through the site survey and investigation during our 1st Field Survey. Based on these data and information, and the study on such design code of practice as British & Japanese Standard, meteorological, oceanographic and subsoil conditions are interpreted to produce key parameters in common use for the purpose of designing port facility components of the Project.

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)

Note: CD referred and equals to Chart Datum which is nearly the level of Lowest Astronomical Tide.

b) Waves

Deep Offshore Wave
50 Years in Return Period

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

For offshore waves less than 50-year return period, the following waves are used.

Table 12.1.1 Offshore Waves

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 = 0.00g
Vertical Design Coefficient	kv = 0.00g

Special consideration to TCXDVN leads to apply Level 3 (kh=0.04 or less for the projected area among 3 seismic activity levels in Vietnam. This criteria needs to be paid for evaluation of seismic effects on earth pressures of subsoil around marine structures and foundation for onshore structures. But, since the regional earthquake activities in and around the project area are deemed to be negligible, possible seismic effect on structures' stability will be neglected in this Study.

d) Wind Velocity

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

e) Subsoil Conditions

A series of offshore boring works was carried out at the Project as presented in Chapter 7. The design property of existing subsoil for each proposed facility is determined based on the subsoil data collected from each boring work at the relevant location as follows.

Table 12.1.2 Boring Data for Each Facility

Port Facility	Boring Data
Container Berth:	B-4 (Jan. 2009) and KB1 & KB3 (Nov. 2007) by TEDI Port
Multi-purpose Berth:	KB7 (Nov. 2007) by TEDI Port
Reclamation Area & Revetment:	SBH-1 to 4 (JICA Study Team) and KB2 & KB4 (Nov. 2007 by TEDI Port)
Sand Protection Dyke:	SBH-8 to 10 (JICA Study Team)

Table 12.1.3 Soil Properties along Container Berth

Layer	Depth (CD)	Soil Properties
Upper Clay	GL to-10m	Soft Clay, N=1-3, N_{av}=2, Unit Weight γ' =7 kN/m^3 q_u=44kN/m2, C= 22 kN/m^2, Lateral Pile Resistance Kh=3 N/cm^3
Middle Clay	-10 to -13m	Stiff Clay, N=8-17, N_{av}=13, Unit Weight γ' =9 kN/m^3 C= 100 kN/m^2, Lateral Pile Resistance Kh=20 N/cm^3
Lower Clay	-13 to -21m	Firm to Stiff, N=6-9, N_{av}=7, Unit Weight γ' =8 kN/m^3 q_u=88kN/m^2, C= 44 kN/m^2, Lateral Pile Resistance Kh=10 N/cm^3
Base Siltstone	> -21m varies	Very Dense, N>50, q_u=30 N/mm^2

Source: JICA Study Team

Table 12.1.4 Soil Properties along Multi-Purpose Berth

Layer	Depth (CD)	Soil Properties
Upper Clay	GL to-13m	Soft Clay, N=3, Unit Weight γ' =7 kN/m^3 C= 30 kN/m^2, Lateral Pile Resistance K_h=4.5 N/cm^3
Middle Clay	-13 to -26m	Stiff to Very Stiff Clay, N=8-23, N_{av}=17, Unit Weight γ' =9 kN/m^3 C= 100 kN/m^2, Lateral Pile Resistance Kh=20 N/cm^3
Lower Clay	-26 to -28m	Firm to Stiff, N=4-9, N_{av}=7, Unit Weight γ' =8 kN/m^3 C= 44 kN/m^2, Lateral Pile Resistance K_h=10 N/cm^3
Base Siltstone	> -28m varies	Very Dense, N>50, q_u=30 N/mm^2

Source: JICA Study Team

Table 12.1.5 Soil Properties at Reclamation Area & Revetment

Layer	Depth (CD)	Soil Properties
Subsurface Sand	+0.5 to -1.0m	Loose, N=5, Unit Weight γ' =10 kN/m^3, ϕ=25^o
Upper Clay	-1.0 to -9m	Soft Clay, N=2-5, N_{av}=3, Unit Weight γ' =7 kN/m^3 q_u=44kN/m^2, C= 22 kN/m^2 Consolidation e-logP Curve: C1, Cc=0.65, Cv=65cm^2/day
Middle Clay	-9 to -12m	Stiff Clay, N=8-15, N_{av}=13, Unit Weight γ' =9 kN/m^3,C= 100 kN/m^2 Consolidation e-logP Curve: C2, Cc=0.25, Cv=87cm^2/day
Lower Clay	-12 to -27m	Firm to Stiff, N=4-7, N_{av}=6, Unit Weight γ' =8 kN/m^3 q_u=88kN/m^2, C= 44 kN/m^2 Consolidation e-logP Curve: C3, Cc=0.54, Cv=89cm^2/day
Base Siltstone	around -27m (varies)	Very Dense, N>50, q_u=30 N/mm^2

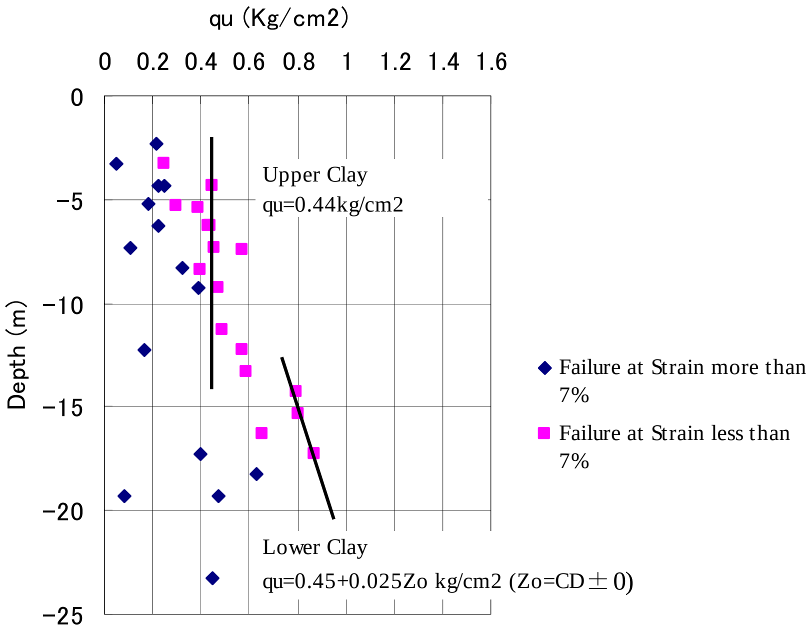
Source: JICA Study Team

Laboratory test on the undisturbed samples shows the following Unconfined Compression Strength (q_u).

Table 12.1.6 Uni-axial Compression Test Result

BH	Depth (m)	Layer	qu (kg/cm^2): failure at strain	
			Less than 7 %	More than 7%
Reclamation Area				
SBH1	2.0-2.6	Upper Clay		0.218
	4.0-4.7	Upper Clay		0.246
	6.0-6.6	Upper Clay		0.222
	8.0-8.6	Upper Clay		0.326
	13.0-13.6	Upper Clay	0.588	
	15-15.6	Lower Clay	0.803	
	17.0-17.6	Lower Clay		0.402
	19.0-19.6	Lower Clay		0.471
	23.0-23.6	Lower Clay		0.449
SBH2	4.0-4.6	Upper Clay	0.444	
	6.0-6.6	Upper Clay	0.429	
	17.0-17.6	Lower Clay	0.872	
SBH3	5.0-5.4	Upper Clay		0.185
	7.0-7.6	Upper Clay	0.453	
	9.0-9.6	Upper Clay	0.475	
	11.0-11.6	Upper Clay	0.492	
	19.0-19.6	Lower Clay		0.087
SBH4	3.0-3.6	Upper Clay	0.247	
	5.0-5.8	Upper Clay	0.393	
	7.0-7.8	Upper Clay	0.571	
	18.0-18.5	Lower Clay		0.629
Revetment B/Sand Protection Dyke				
SBH5	3.0-3.6	Upper Clay		0.049
	5.0-5.6	Upper Clay	0.298	
	7.0-7.6	Upper Clay		0.106
	9.0-9.6	Upper Clay		0.390
	12.0-12.6	Upper Clay	0.568	
SBH6	4.0-4.6	Upper Clay		0.220
	6.0-6.5	Upper Clay	0.439	
	8.0-8.8	Upper Clay	0.394	
	12.0-12.6	Upper Clay		0.168
	14.0-14.6	Lower Clay	0.796	
	16.0-16.6	Lower Clay	0.655	
Average		Upper Clay	0.45 (= 44.1 kN/m^2)	
		Lower Clay	0.78 (= 76.4 kN/m^2)	

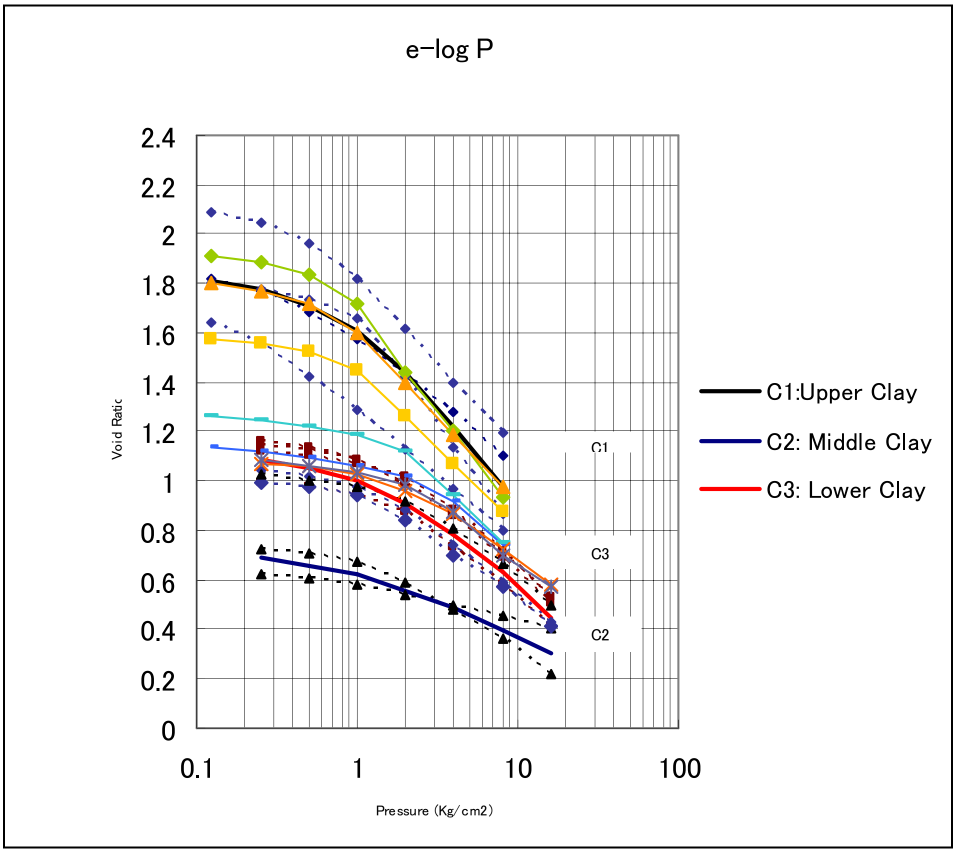
Source: JICA Study Team



Source: JICA Study Team

Note: Data on Boring No. SBH1~6 at Reclamation Area

Figure 12.1.1 Uni-axial Compression Strength vs. Depth



Source: JICA Study Team

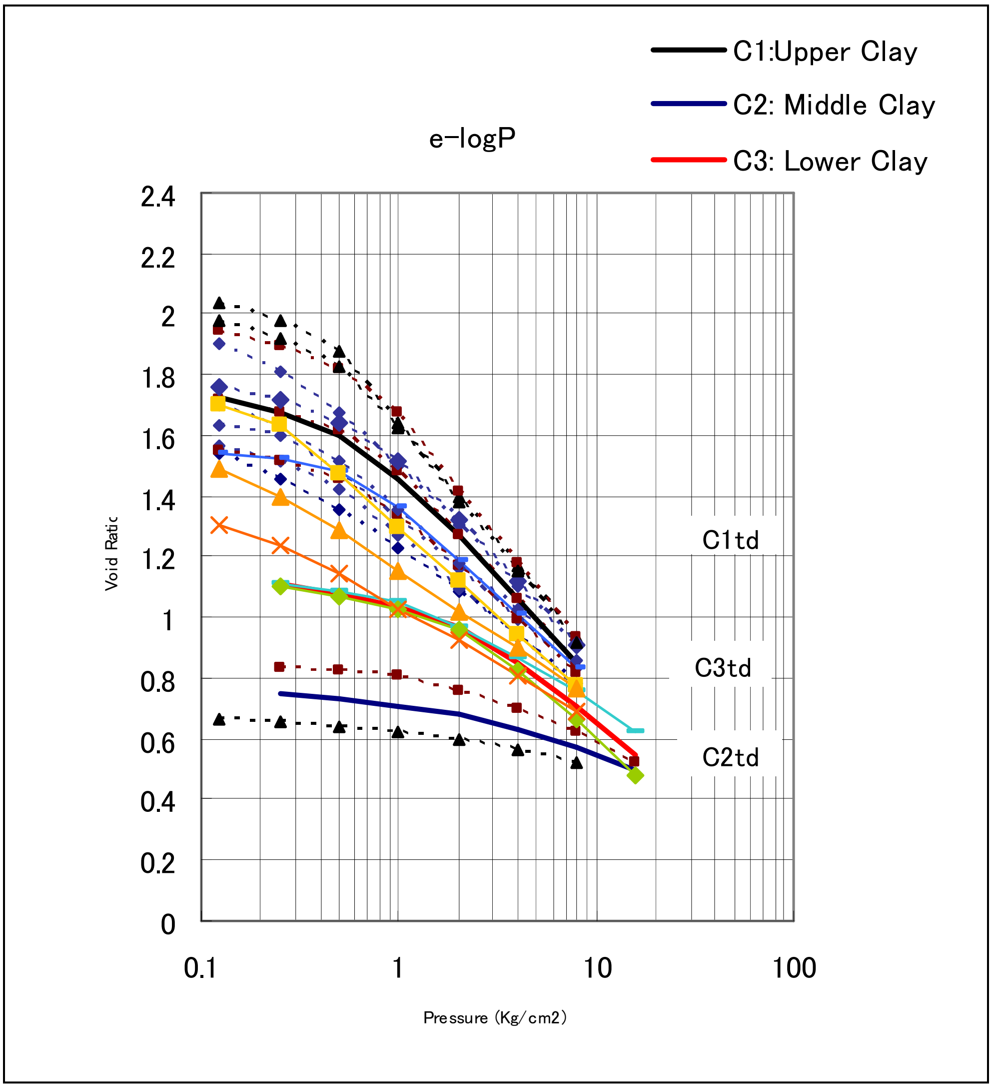
Note: Data on Boring No. SBH1 to 4 at Reclamation Area

Figure 12.1.2 e-log P Curve

Table 12.1.7 Soil Properties along Sand Protection Dyke

Layer	Depth (GL)	Soil Properties
Subsurface Sand	GL to -2.0m	Loose, N=7, Unit Weight γ' =10 kN/m^3, ϕ=25^o
Upper Clay	-2.0 to -8m	Very Soft Clay, N=0-2, N$_{av}$=1, Unit Weight γ' =7 kN/m^3 q$_u$=44 kN/m^2, C= 22 kN/m^2 Consolidation e-logP Curve: C1td, Cc=0.65, Cv=65cm^2/day
Clayey Sand	-8 to -11m	Loose Sand, N=3-8, N$_{av}$=6, Unit Weight γ' =10 kN/m^3, ϕ=25^o
Lower Clay	-11 to -16m	Firm Clay, N=3-6, N$_{av}$=5, Unit Weight γ' =8 kN/m^3 q$_u$=88kN/m^2, C= 44 kN/m^2 Consolidation e-logP Curve: C3td, Cc=0.54, Cv=89cm^2/day
Base Layer	> -16m varies	Stiff to Very Stiff, N=13-21, N$_{av}$=18, Unit Weight γ' =8 kN/m^3 C=110 kN/m^2

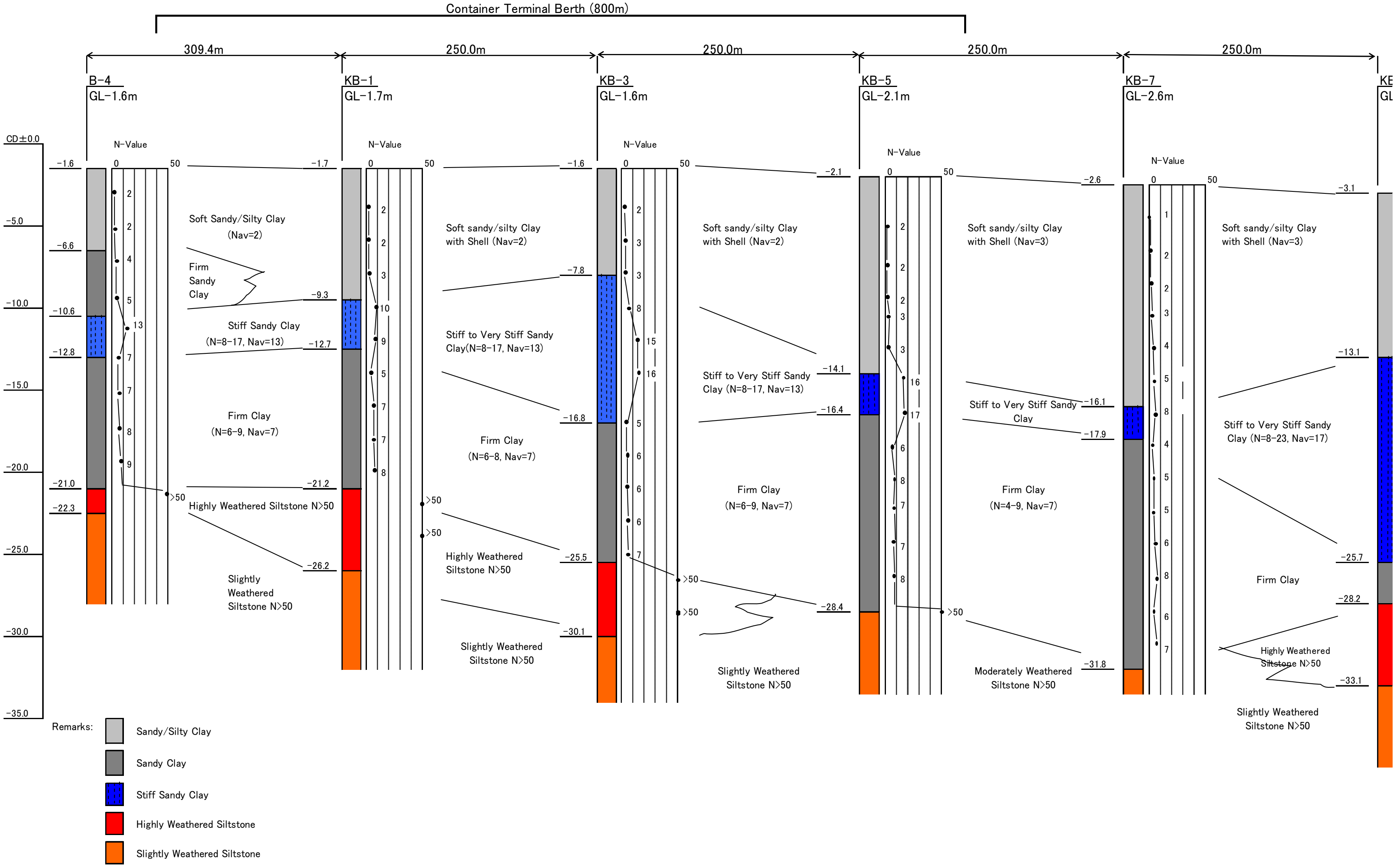
Source: JICA Study Team



Source: JICA Study Team

Note: Data on Boring No. SBH5 to 10 along Alignment of Sand Protection Dyke

Figure 12.1.3 e-log P Curve (Clay along Sand Protection Dyke)



Source: JICA Study Team

Figure 12.1.4 Subsoil Profile Along the Proposed Faceline of Berth

12.1.3 Land Reclamation and Revetment

1) Reclamation Fill

Reclamation area is planned to fill up to CD +5.5 to +6.0m. It is proposed that materials for reclamation fill will be sourced from river sand dredging. The materials may contain some amount of silty or clayey soils, but even though, considerable losses of materials finer than 0.1mm may occur during dredging, handling and placing. The materials with large amount of coarse sands more than 1.0 mm particle may not be properly conveyed through hydraulic pipeline for dredging. Fine materials have a tendency to segregate during hydraulic placing method for reclamation.

Because of the use of granular fill materials, even if these materials are placed through the hydraulic method, the settlement is normally rapid or instant once the surcharge load is applied. Any soil improvement techniques to accelerate the process of consolidation of the reclamation fill materials will not be required.

2) Consolidation Settlement by Reclamation Fill

The sandy/silty clay sediments below ground level at the Project site for reclamation are soft to firm with an N-value of 2 to 5 for upper clay or 4-7 for lower clay. These soils are clay or silt (CL or ML) of low liquid limit, plastic, cohesive and unconsolidated kind. The deposits are of a relatively low strength and decisively exhibit moderate compressibility once the overburden pressure is applied by reclamation fill and surcharges are loaded onto the reclamation fill for its intended use.

Therefore, unless proper method of soil improvement is applied, the clayey subsoil at the site is decisively subject to a process of consolidation by reclamation fill, which cause a considerable extent of settlement. The settlement is estimated to be more or less 1.5 m and will be quite slow because of its unconsolidated properties and low permeability (Refer to Table 12.1.8 & Figure 12.1.5). The consolidation test results show that the coefficient of consolidation (Cv) which governs the time rate of consolidation is in a range of 65 to 89 cm2/day.

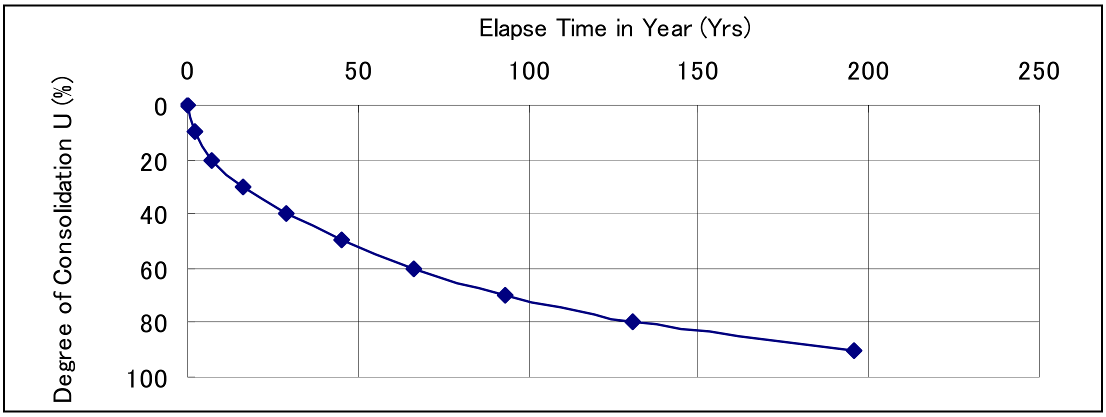
The value of pre-consolidation pressure indicates that the subsoil is over-consolidated clay (Refer to Figure 12.1.6). Therefore, the estimate on the consolidation settlement by reclamation fill and operational load is made based on e-logP curve for each layer of clayey deposits (C1, C2 & C3) and the following results are obtained.

Table 12.1.8 Consolidation Settlement at Reclamation Area

Layer	Layer Thickness (h) (cm)	Initial Earth Pressure (P_o) (kg/cm^2)	Vertical Pressure (ΔP) (kg/cm^2)	Total Pressure ($Po+\Delta P$) (kg/cm^2)	Initial Void Ratio (e_o)	Final Void Ratio (e_1)	Settlement (S) (cm)
C1:Upper Clay	800	0.43	1.03	1.46	1.72	1.49	68
C2:Middle Clay	300	0.85	1.03	1.88	0.63	0.56	13
C3:Lower Clay	1500	1.58	1.03	2.61	0.93	0.85	62
							Total 143

Source: JICA Study Team

Settlement (S)= h × (e_o-e_1)/(1+e_o)
Ground Elevation of Reclamation Area: CDL+5.5m
Planned Operational Surcharge in Yard: max. 4.5 t/m^2, 2.5 t/m^2 average
Ground Water Level: CDL+2.0m

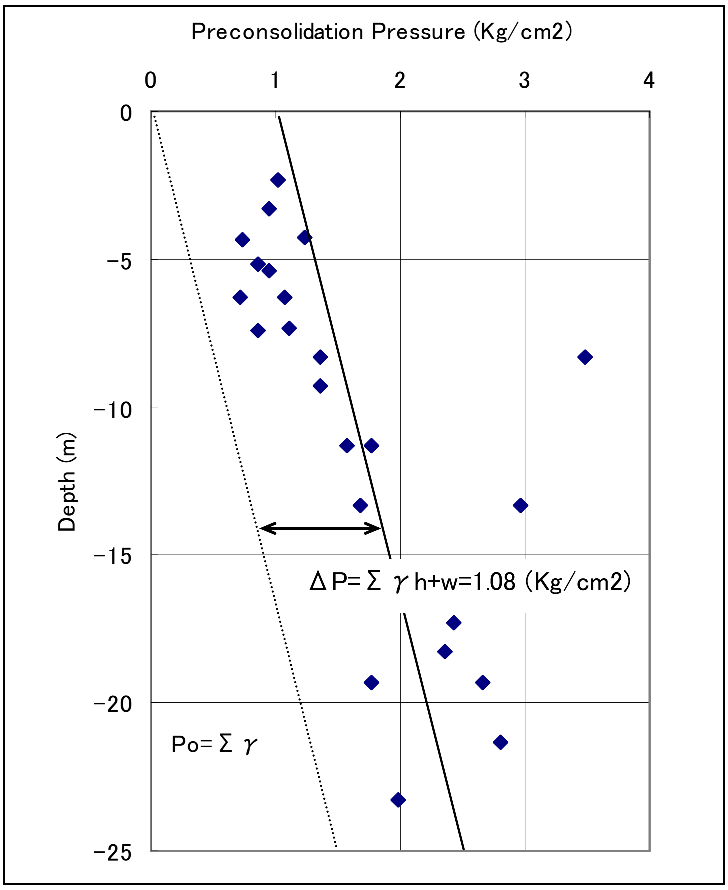


Source: JICA Study Team

$t= H^2 \times T/Cv1$

$H=\Sigma hi\sqrt{}(Cv1/Cvi)$

Figure 12.1.5 Consolidation Settlement Curve



Source: JICA Study Team

Remarks 1) Overburden Pressure In Site: Po=Σγh
2) Increase of Pressure by Reclamation Fill and Operational Load: ΔP=Σγh+w
3) Data on Boring No. SBH1-4 at Reclamation Area

Figure 12.1.6 Pre-consolidation Pressure and Depth

3) Soil Improvement at Reclamation Area

Various construction techniques for subsoil improvement such as pre-loading, soil replacement, vertical sand drain pile or prefabricated plastic board drain, cement deep mixing (CDM), etc., are currently applicable to improve very weak subsoil properties. Previous F/S report prepared by TEDI proposes vertical sand pile drain method (SD) to apply to the subsoil improvement for reclamation area, though the details thereof is silent in the report. It may be generally said that vertical sand pile drain method (SD) requires good quality control of sand material for the use of sand pile and sand piling work.

It is recommended to apply plastic board vertical drain method (PVD) in combination with preloading to accelerate the process of consolidation which may be caused by reclamation fill and surcharge loading during operation period. This method (PVD) is:

(1) Currently one of popular methods and frequently applied to subsoil improvement in various project constructions at very weak clayey soil condition,

(2) Applicable to this Project (Drain pile length less than 30m) and easier in construction,

(3) Minimum in disturbance of subsoil during piling work and drastically shorten the time for piling construction as compared with sand pile method,

(4) Economy in construction among others applicable (Unit Rate by rough comparison PVD=1.0: SD=1.3－1.5: CDM=4－10), and

(5) Technically improved nowadays and is proven its effectiveness to accelerate the rate of consolidation of clayey soil in combination of preloading during construction.

In the reclamation area, PVD method is applied in the following design.

(1) Tip Elevation of Plastic Board: Around CD-26 m till the bottom of lower clay layer,

(2) Plastic Board Interval: In square arrangement of 1.2 m interval (This scheme is equivalent to sand pile drain of 40cm dia. driven at about 2 m interval),

(3) Surcharge Load: To fill up to CD+9.5m by sandy materials of 18 kN/m^3 for preloading,

(4) Reclamation and Preloading: Step-by-step filling which may be divided into three (3) stages of filling and preloading,

(5) Objective degree of consolidation (U): U=80% which may be required the following elapse of time for each stage of preloading.

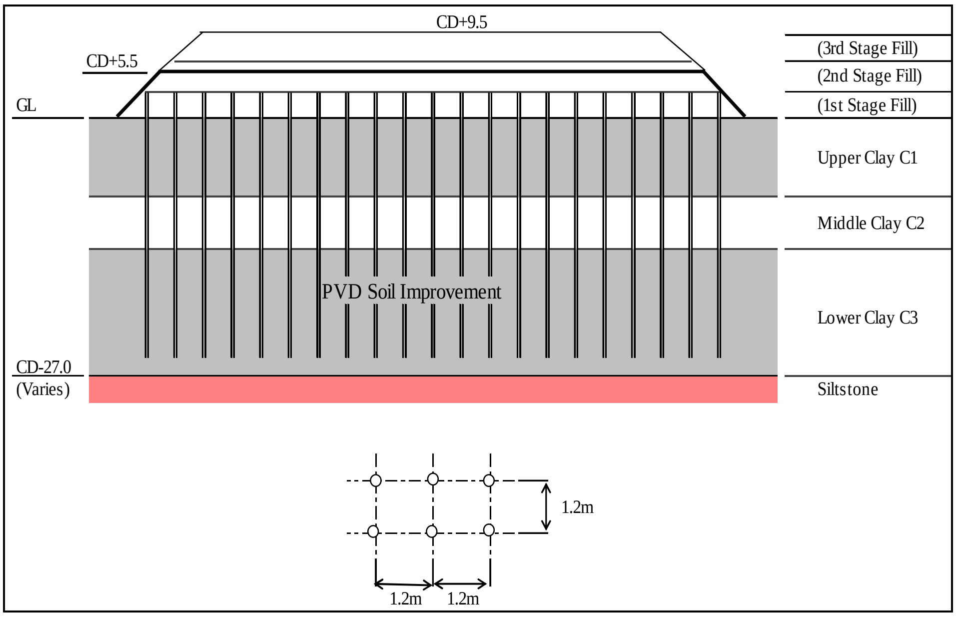
Table 12.1.9 Soil Improvement at Reclamation Area

Layer	Coefficient of Consolidation (cm^2/d)		Time Factor for U=80%	Consolidation Period (Day)	Consolidation Settlement (cm)
	Cv	Ch=2Cv	Th	t	S
C1:Upper Clay	65	130	0.5	71	68
C2:Middle Clay	87	174	0.5	53	14
C3:LowerClay	89	178	0.5	52	68

Source: JICA Study Team

Interval of drain pile: D=120cm in square alignment
Diameter of drain: Dw=5cm (equivalent to sand pile diameter)
Effective Diameter of Drain Pile: De=1.13 D=136cm
n=De/Dw=27
Consolidation Period: $t=De^2 \times Th/Ch$

It is anticipated that each stage of preloading needs 3.5 month period for preloading, measurement and settlement confirmation and 3 stages of pre-loading work will be complete in about 1.2-year period to obtained 80% degree of consolidation for the overburden pressure by pre-loading.



Source: JICA Study Team

Figure 12.1.7 Subsoil Improvement at Reclamation Area

4) Design of Outer Revetment (Revetment along West-side of Reclamation Area)

Due to the exposure conditions to the offshore wave action, Outer Revetment is subject to the extreme high wave which may be generated by tropical typhoon almost at least once a year. The following design offshore wave for the Project Site is applied for designing seawall (West-side Revetment at the reclamation area).

Deep Sea Offshore Wave of 1 in 50 years (50 years return period)
Wave Height Ho= 5.6m
Predominant Wave Direction S to E
Wave Period To= 11.6 sec

In this study, equivalent deep-sea wave height (Ho') for the Project site is assumed as follow.

$$Ho' = Kr \times Kd \times Ho = 1.0 \times 1.0 \times 5.6 \text{ m} = 5.6 \text{ m (Assumption)}$$

The water depth at the project site for reclamation varies from CD +1.0 m to ±0.0 m. Significant Wave Height ($H_{1/3}$) at each shallow water depth is calculated as follows by applying Goda's diagram (Figure 12.1.8) of significant wave height in breaker zone for irregular wave.

Tide level for estimating significant wave height ($H_{1/3}$): HHWL+4.43m CD
Water depth at each revetment: h= 4.43m
$Ho'/Lo=5.6/1.56 \text{ x } 11.6^2=0.026$
Seabed slope: 1/100

$h/Ho'=0.79$
$H_{1/3}/Ho'=0.56$
$H_{1/3}=0.56 \times 5.6=3.2\text{m}$

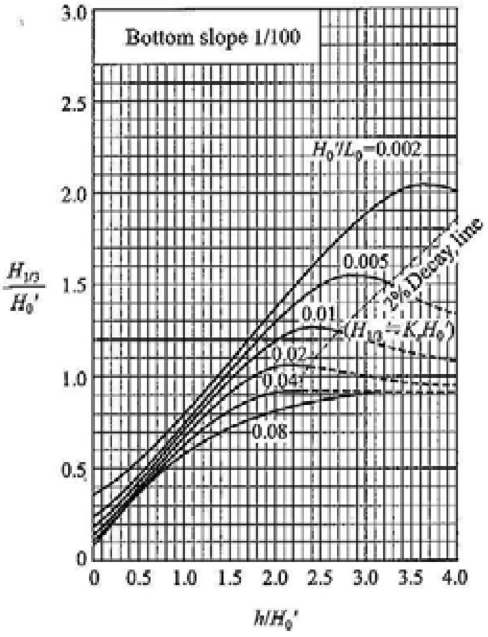
The above design wave ($H_{1/3}$) is used for designing revetment (Outer revetment for reclamation area).

The existing subsoil is subject to soil improvement by a combination of PVD and Preloading method to accelerate consolidation. Once the soil improvement shall be completed, the end of fill sand for pre-loading will be removed to the original seabed level.

Outer Revetment is designed as a seawall structure in the form of sloped protection from the wave action properly covered by armor units. Based on the significant wave height in 1 to 50 years, around 4 ton per piece is required for armor protection layer. Therefore, wave dissipating precast concrete units of 4 t/pc are used for armor layer of the revetment. The weight of armor unit (M: Mass of an armor unit in the primary cover layer) is calculated 4 t/pc using Hudson's equation for 50 year return period wave of H=3.2 m as follows:

$M = \rho H^3/Ns^3(Sr-1)^3$
= 2.3 x 3.23/11.04(2.3/1.03 – 1)3 = 3.6 t/pc

Where ρ: Density of Armor Unit =2.3 t/m^3
H: Wave Height= 3.2 m
Ns: Stability Number of Armor Unit used
($Ns^3 = K_d \cot \alpha$= 8.3 x 1.33 = 11.04)
Sr: Ratio of Specific Gravity of Armor Unit to Sea Water=2.3/1.03



(Source: Technical Standards and Commentaries for Port and Harbor Facilities in Japan)

Figure 12.1.8 Diagram of Significant Wave Height in Breaker Zone for Seabed Slope in 1/100

The core rubble stones in weight from 15 kg to 150 kg per piece are placed to form a mound on which vertical precast concrete gravity walls are installed. The seaside mound slope is formed in 1 (V) to 4/3 (H) and is protected by two layers of armor stones units, 4 ton/pc of wave dissipating precast unit for the first layer and armor stones of more or less 400 kg/pc for the second layer placed on the riprap mound. The toe of the seaside slope is protected by precast concrete blocks of 4 ton/pc.

The crest height of revetment wall is poisoned at CD +6.5m, which is roughly equivalent to the elevation of HHWL+ 4.43m plus 0.6 times of design wave height 3.2 m. In order to maintain the rate of overtopping (q) less 0.05 m3/m/s for Ho'= 5.6 m under the conditions h/Ho'=4.43/5.6=0.79 and Ho'/Lo=5.6/210=0.027, the ratio (hc/Ho' = 0.51) of the height above water level (hc) against Ho' is obtained by using Goda's graph (Figure 12.1.9 for wave of Ho'/Lo=0.017 as well as the graph for Ho'/Lo=0.036 which is not attached hereto) for estimating the rate of overtopping for a wave absorbing seawall.

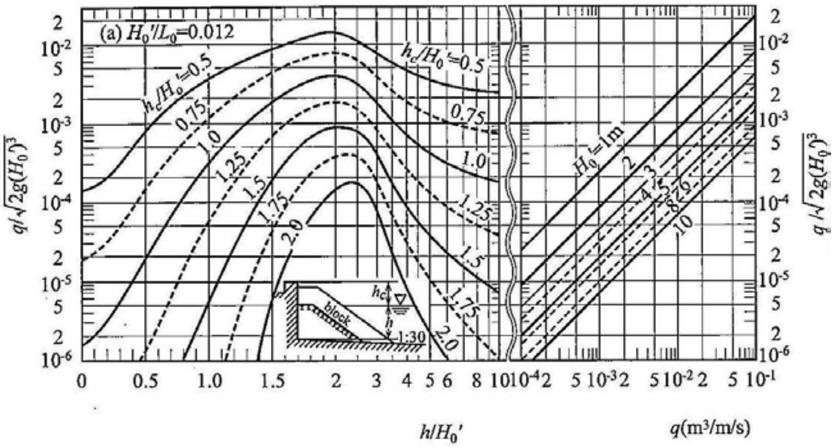
This ratio (hc/Ho') is reduced by 75% in considering diagonal wave direction to the revetment alignment.

$\beta=1-\sin^2 30°$ for case of $|\theta|>30°$
where θ: Wave direction perpendicular to revetment alignment

Therefore,

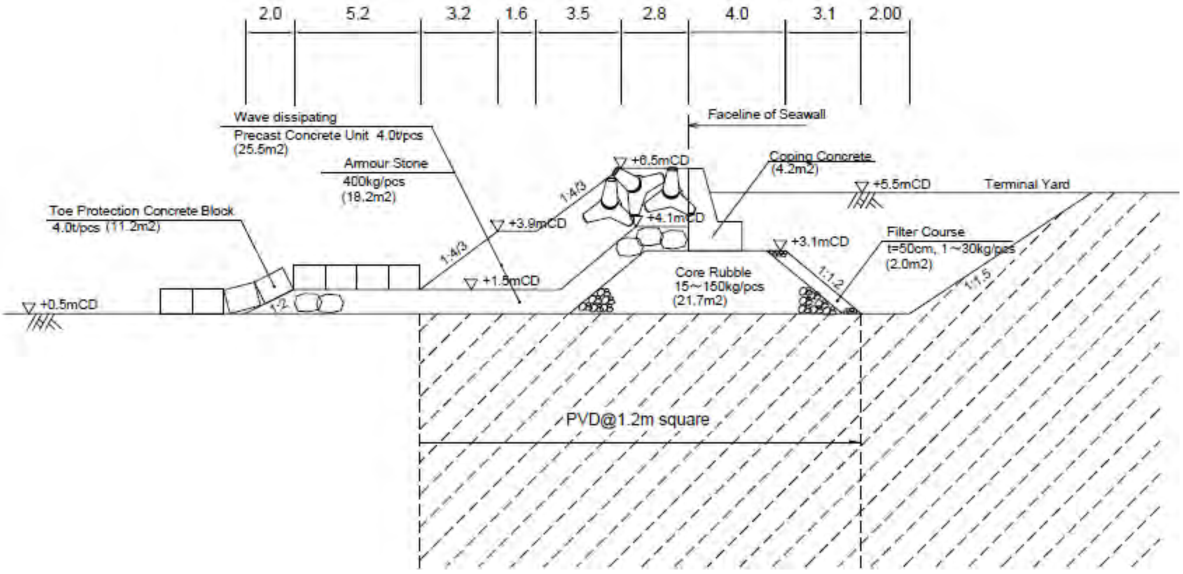
β = 0.75 for θ=60°
hc/Ho'=0.51 × 0.75=0.38
hc=0.38 × 5.6=2.1 m
Crest elevation of Revetment =HHWL + hc=CD4.43+2.1=CD+6.53m
Say positioned at CD+6.5 m

The degree of wave overtopping q=0.05m^3/m/s is allowable range for a revetment with unpaved apron immediately behind the wall. The above estimation on the crest height of revetment is based on the standard wave breaking work in front of the vertical wall, which is placed at 2-row of wave dissipating precast concrete units at the top of the work (TEDI F/S report suggests the crest elevation of CD+5.5m with provision of 13.7 m wide of wave breaking works or CD+9.0m with normal width of wave breaking works, i.e., 2-row of 2.9 m wide at the top in front of the revetment work).



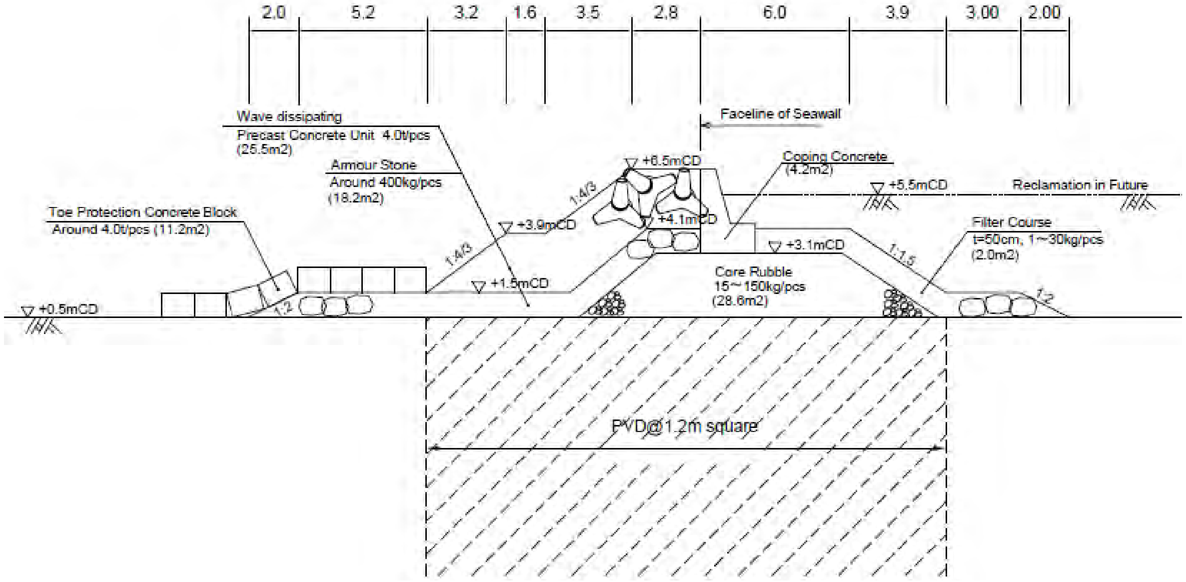
Source: Technical Standards and Commentaries for Port and Harbor Facilities in Japan

Figure 12.1.9 Goda's Graph for Estimating the Rate of Overtopping for a Wave Absorbing Seawall (Seabed Slope 1/30)



Source: JICA Study Team

Figure 12.1.10 Outer Revetment A (Seawall)



Source: JICA Study Team

Figure 12.1.11 Outer Revetment B (Seawall backfilled in future)

5) Inner Revetment (Revetment along the south-side of Reclamation Area)

Since Inner (South-side) revetment for reclamation area is temporary for future expansion of the proposed berth terminal, it should be designed in considering possible re-use of the materials for future expansion of new container terminal to offshore.

The following design offshore wave for the Project site is applied for designing Inner Revetment (South-side Revetment at the reclamation area).

Deep Sea Offshore Wave of 1 in 5 years (5 years return period)
Wave Height Ho= 3.18m
Predominant Wave Direction S to E
Wave Period To= 8.9 sec

In this study, equivalent deep-sea wave height (Ho') for the Project site is assumed as follow.

$$Ho' = Kr \times Kd \times Ho = 1.0 \times 1.0 \times 3.18 \text{ m} = 3.18 \text{ m (Assumption)}$$

The seabed elevation at the project site for reclamation varies from CD +1.0 m to ±0.0 m. Once the water area shall be sheltered by the construction of Sand Protection Dyke, inner revetment is subject to waves transmitted through Sand Protection Dyke or inner harbor waves, which may be estimated 1.0 to 1.5 m height in 1 to 5 years return period intruding from and diffracted at the entrance of access channel or waves generated inside port area.

Table 12.1.10 Design Wave Height for Inner Revetment

Condition	Seabed EL (CDL)	Water Level (m)	Water Depth (m)	h/H_o'	$H_{1/3}/Ho'$	$H_{1/3}$ (m)	$H=Kt \times H_{1/3}$ (m)
Inner harbor wave	±0.0	CD+4.43	4.43	---	---	1.0-1.5	---
Wave through sand protection dyke	±0.0	CD+4.43	4.43	1.39	0.84	2.7	1.8

Source: JICA Study Team

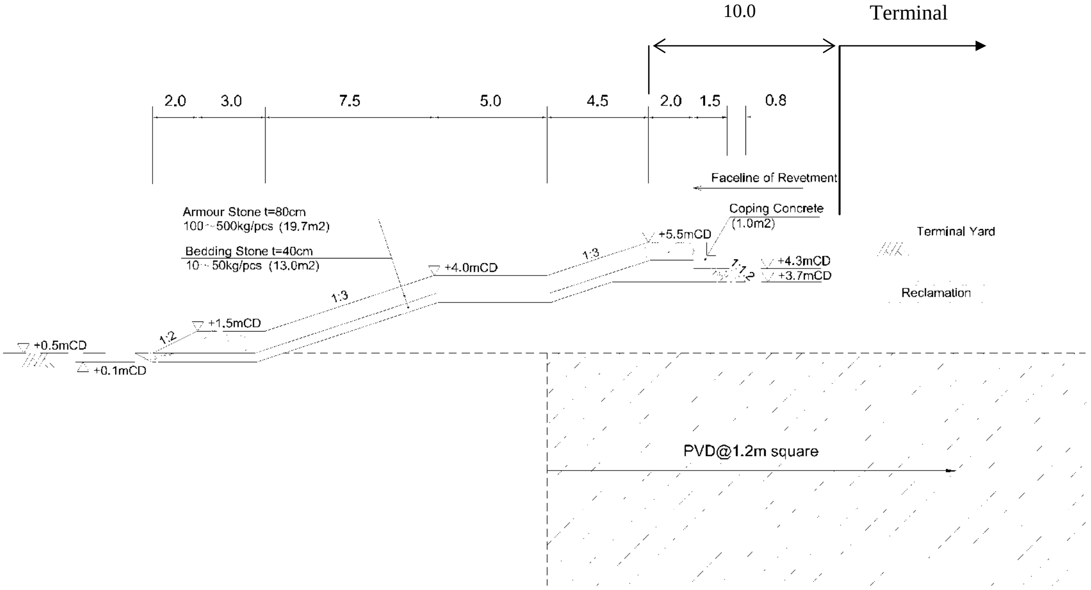
Ho’/Lo=3.18/1.56 × 8.92=0.026, Seabed slope: 1/100
Kt: Rate of wave transmission through sand protection dyke = 0.68

Inner Revetment area is provided with soil improvement by application of PVD and preloading in combination. After completion of soil improvement work, the seaside surface slope of the reclamation fill (preloading fill for soil improvement) is formed to a gentle slope of 1 (V) to 3 (H) along the south-side boundary of the reclamation area.

The revetment is designed in a form of sloped protection from the wave action covered by armor stones. The bedding stones of 10 to 50 kg/pc is placed in a seaside slope in 1 (V) to 3 (H) on which one layer of armor stone of 100 to 500 kg per piece are installed in considering design wave of around 1.8 m height (wave transmitted through sand protection dyke).

$$M = \rho H^3/Ns^3(Sr-1)^3$$
$$= 2.65 \text{ x } 1.8^3/12(2.65/1.03 - 1)^3 = 0.33 \text{ t/pc}$$

where $Ns^3 = Kd \cot \alpha = 4 \times 3 = 12$



Source: JICA Study Team

Figure 12.1.12 Inner Revetment (Temporary Revetment for Future Terminal Expansion)

12.1.4 Design of Berth Structure

1) Review of Berth Structure proposed by Previous Studies

The previous Feasibility study reports on Hai Phong-Lach Huyen Gate Way Port by TEDI summarized the preliminary design concept for facilities envisaged in the development plan. The previously established design concept are carefully examined and reviewed based on the scale of the port facilities and cargo handling operation which was formulated through updated future cargo demand forecast.

According to previous studies, primary criteria and berth concept of New Berth for the development plan in the year of 2015 and 2020 are summarized in Table 12.1.11.

a) Container Berth

Table 12.1.11 Outline of Container Berth Structure designed by Previous Studies

	TEDI F/S Report	**NK Study 2009**
1. Design Vessel	- Target Yr:2015 30,000 DWT - Target Yr:2020 50,000 DWT (3,000-4,000TEU) Loa=280m, B=35m, d=13.0m - Target Yr:2030 (if there is a demand) 80,000DWT (5,000-6,000TEU) Loa=325m, B=45m, d=15.5m	50,000 DWT Loa=278m, B=32.3m, d=12.7m
2. Berth Number & Length	- Target Yr: 2015 2 berth of 300m long each, total 600 m long - Target Yr: 2020 4 berths of 300m long each, total 1,200 m long - Target Yr: 2030 18 berths of 6 x 300m long for -14 m depth and 12 x 367m long for -17 m depth, total 6,200 m long	- Target Yr: 2015 2 berth of 300m long each, total 600 m long - Target Yr: 2020 (Case 2) 4 berths of 300m long each, total 1,200 m long - Target Yr: 2030 (Case 2) 5 berths of 300m long each, total 1,500 m long
3. Tides	- HWL= CDL+3.60m - LWL=CDL+0.43m	- HWL=CDL+3.6m - MSL=CDL+2.06m - LWL=CDL+0.60m
4. Geometry of Berth	- Water Depth: CDL-14.0 m for accommodation of 50,000 dwt vessel - Berth Cope-line Height: CDL+5.5m - Apron Width: 40 m - Depth of Terminal Yard: 600 m	- Water Depth: CDL-14.0 m for accommodation of 50,000 dwt vessel - Berth Cope-line Height: CDL+5.5m - Apron Width: 39.5 m - Depth of Terminal Yard: 880 m
5. Surcharge on Apron	4 t/m^2 (40kN/m^2)	20 kN/m^2
6. Quayside Crane	- Quayside Gantry Crane (Rail Gauge: 30m) Lifting Capacity: 50 tons Other Specifications: N.A. - Mobile Crane (Wharf No.1 subject to the use of mobile crane to ship-to-shore operation for handling miscellaneous packaged cargoes) : Specifications N.A.	- Quayside Gantry Crane (Rail Gauge: 30.5m) Crane Weight: 1,000 tons (Report indicates 10,000 tons) Lifting Capacity & Other Specifications: N.A. - Mobile Crane: Specifications: N.A.
7. Berth Fittings	Fender: at 15 m interval along copeline of berth Bollard: 150 tons pull capacity per unit at 30 m interval along copeline of berth	Fender: Height of 1000H for 1.5 times normal berthing by ship berthing of 50,000dwt at 10 cm/sec and 5 degree max berthing angle (Report indicates Fender reaction of 300 kN/unit) Bollard: 100 tons pull capacity per unit at 25 m interval

8. Concept of Recommended Structure	Based on the comparative study among structure of Type a) Concrete Caisson Box Gravity Wall b1) Open Piled Deck with Retaining Wall b2) Open Piled Deck Detached Pier with Access Bridge c) Steel Sheet Piled Walls with Relieving Platform, and d) Steel Sheet Piled Cellular Gravity Wall Type b1) Open Piled Deck with Retaining wall is recommended as best alternative and economy in construction. • Open Piled Concrete Quay 50 m wide reinforced concrete (RC) slab (cover concrete 15 cm on concrete slab 40 cm) deck & girder supported on Pre-stressed Concrete (PC) piles of 80cm dia. with 12 cm wall thickness (10 pile rows 5 m apart and transverse spacing of 5 m). One block of deck is 75 m wide. Three (3) pile rows including pile foundation for crane rail girders are provided with coupled rake piles in 1 (H) to 6 (V) verticality. Under the deck, the sea bed is formed in slope of 1 (V): 2.5 (H) and 1 (V): 2.5 (H) by rock mound placed on 1 (V) to 4 (H) sea bed slope • Retaining Wall L-Shaped RC retaining wall on the rubble mound under the deck and supported by two (2) rows of 45 cm square concrete piles (one vertical pile and one rake pile)	Based on the comparative study among structure of Type A: Open Piled Concrete Platform B: Concrete Platform on Braced Pile Foundation C: Steel Sheet Piled Wall supported by PC Piles and anchored by Coupled Rake Steel Pipe Piles, and D: Double Concrete Wall supported by PC Piles, Type A: Open Piled Concrete Platform is recommended as best economical in construction. • Open Piled Concrete Quay 39.5 m wide reinforced concrete (RC) slab (cover concrete 15 cm on concrete slab 40 cm) & girder deck supported on (8 pile rows 5 to 5.25 m apart in transverse direction). One block length of deck is not available. Two (2) pile rows for crane rail girders foundation is supported by coupled rake steel pipe pile of 1,016 mm dia. of 14 mm wall thickness which are driven in 1 (H) to 6 (V) verticality while other pile rows are supported by Pre-stressed Concrete (PC) vertical piles of 80cm dia. with 12 cm wall thickness. Under the deck, the sea bed is formed in slope of 1 (V): 3 (H) protected by rubble stone and geo-textile. • Retaining Wall Steel sheet piled curtain wall is provided at the extreme end longitudinal beam and fixed to the concrete deck for retaining back fill material
9. Subsoil Conditions along the proposed berth	Apply the TEDI subsoil data obtained for port area by TEDI port. • Layer ② Very soft to soft lean clay, elastic silt, sandy silty clay, silt with sand • Layer ⑤ Stiff fat clay, sandy lean clay with sand • Layer ⑥ Medium stiff fat clay elastic silt • Layer ⑧ Highly weathered siltstone • Layer ⑨ Moderately to slightly weathered siltstone The boundary level for each layer above is indicated in TEDI F/S report drawings. But the report is silent on the design subsoil parameters.	Apply subsoil profile at KB-4 (NK report indicates KB-1) boring for the whole area of New Berth as follow: 3) Reclamation to CDL-0.5m: γ =18 kN/m3, N=10 4) Clay with shell from CDL-0.5 to -11.0m: C=10 kPa, γ =17 kN/m3, N=3 5) Sandy Clay from CDL-11.0 to -13.0m: C=35 kPa, γ =20 kN/m3, N=12 6) Clay from CDL-13.0 to -27.0m: C=32 kPa, γ =18 kN/m3, N=6 7) Hard Clay from CDL-27.0 to -31.0m: C=28 kPa, ϕ =15°, γ =20 kN/m3, N>50 8) Lightly weathered dark purple silt/clay stone from CDL-31.0m

Source1): Feasibility study reports on Hai Phong-Lach Huyen Gate Way Port by TEDI

Source2): Report on Port Capacity Reinforcement Plan In Northern Vietnam, September 2009, Nippon Koei., Ltd. & Associates

b) Multi-purpose berth

TEDI F/S report is silent for the structural design for bulk cargo berth to accommodate 50,000 DWT vessel as well as general and bagged/packed cargo berths for 30,000 DWT vessels. No preliminary design work may have not studied for the proposed multi-purpose terminal berth to be developed in 2020 and 2030 in NK 2009 Study.

The geometry of these berths proposed by TEDI F/S report is summarized as follow.

- Design Vessels:

Cargo Ship	DWT	LOA (m)	Beam (m)	Draft (m)	Remarks
General	30,000	185	27	11.0	2020 Yr
Bulk	50,000	225	31	12.0	2020 Yr

- Geometry of General Cargo Berth

Water Depth:	CD -12.0 m
Berth Length:	210 m
Berth Cope-line Height	CD+5.5 m
Quayside Gantry Crane:	Rail mounted crane with outreach 32m × 40 tons hook operation

- Geometry of Bulk Cargo Berth

Water Depth:	CD -13.0 m
Berth Length:	260 m
Berth Cope-line Height:	CD+5.5 m
Quayside Gantry Crane:	Rail mounted loader of capacity 1,200 t/hr for loading export bulk cargo to vessel and Rail mounted unloader with outreach 36m × 32 tons hook operation for import bulk cargo

(Source: Feasibility study reports on Hai Phong-Lach Huyen Gate Way Port by TEDI)

c) Comments or Issues on the Proposed Container Berth Structure

Berth Planning

(1) In future, the proposed berth can not cope with possible future enlargement of container vessel size to the expected 80,000 DWT or more in view of the water depth as well as berth length. The typical ship dimension of 80,000 DWT container vessels may be 300 to 310 m LOA of 38 m beam to allow 15 rows of container box in deck and more or less 14.5 m fully loaded draft.

(2) Berth apron width is too narrow. Since the ship hutch cover of around 11 to 16m wide is placed at the backyard of quay gantry crane, the berth apron should have a width of around 55 to 60 m to provide a space of 3-5 m from berth cope-line to seaside crane rail, 30 m gantry crane rail span, 20 m back space for 16m for hutch cover placement and 3.5 m wide chassis passage.

(3) No criterion is given for cargo handling operation for container barge unloading and loading operation.

Berth Design

(1) All the Pre-stressed Concrete (PC) Pile foundation piles are designed to drive into very hard siltstone strata having more than 50 N-value. To drive PC pile into a subsoil layer of 30 N-value is possible but generally not easy to drive into hard layer for more than 1-2 m depth. The laboratory test result indicates that this base rock has very high compression strength of 400 to

700 kg/cm^2.

(2) A combination of pile hammer driving and rock auger drilling may be necessary for the piles to be properly driven into these very hard deposits to the intended depth for the piles to rest. Pre-stressed Concrete pile driving into base rock layer is possible but not so easy to drive pile, particularly in case of rake pile due to heavy weight of a pile.

(3) Careful attention must be exercised for possible negative skin friction which may work on piles due to possible residual settlement or secondary consolidation process of the original subsoil on which slope protection rock mound is placed under the deck.

(4) During irregular berthing or de-berthing operation, there may be an accident that a bulbous bow of ship hit seaside raked pile provided at the extreme seaside pile row along cope-line of berth.

2) Basic Considerations for Berth Structure Design

The berth structure is designed based on the understanding of detailed site information on natural conditions such as subsoil at the proposed site, operational requirements and other project conditions. The following understanding will be so important to be reflected in the process of the conceptual design of berth.

(1) Berth Water Depth of -16m

Proposed berth is dimensioned to have -16.0 m water depth (for future), so deep enough to accommodate Super Post Panamax type container vessels.

(2) Quayside Gantry Crane Operation

Container unloading/loading operation will be carried out by the use of heavy Ship-to-Shore Gantry Crane (approx. 1,100 - 1,300 tf/unit) capable of handling container 18 rows on ship deck. In addition, Harbor Mobile Crane may be used for unloading from/loading to container barge.

(3) Site Marine Condition

Sea condition at the proposed site for construction is normally calm during whole seasons of a year. Therefore, there is no difficulty in productive execution of offshore works such as pile driving (normally only workable less than 0.5 m wave height condition) or setting out concrete blocks or caisson boxes (workable less than 0.7 m wave height).

In particular, the subsoil condition is one of the important factors to select the type of structures which will critically govern the suitability of structure such as its structural stability and efficiency for construction. The followings are the major factual findings at the proposed site obtained from the subsoil investigation done by JICA Study Team and previous subsoil investigation works.

(4) Site Subsoil Conditions

The subsoil at the Project site composes of;

- Upper Clay

  This layer is basically composed of very soft to soft plastic sediment of N-value ranging 1 to 4. This layer is compressive and is subjected to consolidation of clayey deposits once overburden pressure shall be applied on the subsoil. But, consolidation test results indicate that this underlying subsoil is over-consolidated clayey deposit for about 6 t/m^2 pressure. The thickness of this subsoil layer is changeable in places but exists at deeper depth of more or less CD-10 to -12m. In places or offshore area, 1-3m thin loose sandy sediment is observed on this clayey layer.

- Middle Clay

  Middle clayey Soil is firm to stiff plastic clay having N-value of 8 to 17. In certain places, this layer shows a larger content of sand materials and changes to silty/clayey sand deposits. This layer is also compressive.

- Lower Clay

  This layer is clayey sediment deposited on the moderately/highly weathered siltstone base rock at the Project site. The thickness of this layer is 6 to 16m, changeable in places. The consistency of this layer is low having N-value of 2 to 9 and is compressive due to consolidation.

- Base Rock

  Base Rock layer composes of moderately/highly weathered siltstone layer which exists at the shallowest depth of CD-21 m and becomes deeper to direction for the offshore area. Uni-axial compression test shows that the strength of this layer is about 300 kg/cm^2 ranging from 70 -760 kg/cm^2, which is approximately equal or higher value of artificial concrete strength.

3) Comparative Evaluation on Suitable Type of Structure

Typical type of marine berthing structure has their own characteristics for suitability to the specific subsoil conditions or adaptability to the requirements of the proposed facility such as water depth of wharf, which should be rationally reflected into technical evaluation of structural stability, efficiency in construction, cost for construction, easiness for maintenance during post-construction stage;

The type of berth structure may be classified as either solid (gravity walls and sheet piled walls) or open-piled suspended deck. A variety of different type of structures is firstly examined among the type of structures which commonly used for the projected type of berth structure (marginal wharf) for screening off on the following viewpoints:

- Structural Adaptability
- Suitability to Subsoil Condition
- Durability
- Construction Method
- Overall Cost

Previous F/S report by TEDI port has studied container berth structure in details. Among such other alternatives as Concrete Caisson gravity wall, Steel Sheet Piled Cellular type gravity wall and Steel Sheet Piled Walls with Relieving Platform, the technical solution recommended is Open Piled concrete deck structure as the best alternative among applicable type of structure for the designated container berth. The JICA Study Team is in the same opinion as recommend by TEDI in technical view of the subsoil conditions at the Project site which mainly consist of clayey layer deposits.

The following is our comparative evaluation among common types of structure which is considered practical and applicable to the projected berth structure. Piled Open type of reinforced concrete slab deck and beam structure is one of the most common and practical and is recommended for the new berth structure for container terminal and Multi-purpose terminal as well.

Table 12.1.12 Comparative Evaluation for Various Types of Berth Structure

	A. Gravity Walls				B. Sheet Piled Cellular Gravity Walls		C. Steel Sheet Piled Wall		D: Open Piled Deck	
	A1:Concrete Caisson Box		A2:Concrete Blocks							
Structural Adaptability	△	Need to install on rubble mound of 45-60 t/m2 (caisson) or 50-60t/m2 (block) bearing capacity which is placed on subsoil sustainable to withstand for 45 t/m2 (caisson) or 50 t/m2 (block) pressure load. Seaside and landside crane rail rests on each different foundation.			△	Normally stable for medium dense or hard subsoil condition. Seaside and landside crane rail rests on each different foundation.	△	Normally less -10m water depth. But, Steel Sheet Pipe Piles Walls may be applicable for deeper water. Seaside and landside crane rail rests on each different foundation.	○	Applicable for more than -16m deep water. Quay Gantry Crane rest on the united deck and slab structure.
Suitability to Subsoil Conditions	△	Not suitable for weak subsoil or not applicable especially for very soft clayey soil except for the case in a combination with subsoil improvement such as sand replacement or CDM. Considerable scale of Subsoil Foundation Improvement work required to change subsoil nature up to the depth around CD-27.0m			△	Require Subsoil Foundation Improvement as well as Soil Improvement for subsoil inside cell	△	$\Sigma\gamma h+q-4C \leqq 0$. Hence, subsoil improvement is necessary for subsoil in front to sheet pile wall. Penetration of pile into very dense deposit required	△/○	Most common for weak subsoil conditions. Penetration of pile into very dense deposit required
Durability	○	Use only concrete members. No steel corrosion protection needed and generally maintenance-free.			△	Steel Sheet Pile materials subject to corrosion	△	Steel Sheet Pile materials subject to corrosion	△/○	PHC Concrete Pile may be applicable but with limitation in pile size up to 100 -120cm. Steel Pipe Pile subject to corrosion
Construction Method	×	Floating Dock (FD) required to fabricate concrete caisson. Around 13-14m water depth is required to tow prefabricated caisson box to site	△	Large capacity of Lifting Equipment is required to convey and install pre-fabricated concrete blocks at site	△	Pre-fabrication yard for cell construction and Large capacity of Lifting Equipment is required to prefabricate, convey and install pre-fabricated cell at site.	○	Steel sheet piles are relatively light and easy to handle for construction	○	Piling works are relatively light and easy to handle for construction. Construction equipment will be comparatively easy to be mobilized.
Overall Cost	△	Costly	△	Relatively costly	△	Relatively costly	△	Relatively costly	△	Relatively Costly
Evaluation	×	Not Applicable	△	Not Recommended	△	Not Recommended	△	Not Recommended	○	Recommended

Source: JICA Study Team

4) Design of Container Berth

The followings are our conceptual design output on open concrete deck piled structure.

a) Design Container Vessel

Table 12.1.13 Design Container Vessels

	Possible Future Maximum Size (Super Post Panamax)	Possible Maximum Size (Post Panamax) Phase 2	Ordinary Size (Sub Panamax or Panamax)
Capacity (TEU)	8,000-9,000	5,000 – 6,000	3,000 – 4,000
Weight (DWT)	100,000	80,000	50,000
LOA (m)	330	305	270
Beam MLD (m)	45.5	38.0	32.2
Molded Depth (m)	29.1	25.7	21.2
Full loaded Draft (m)	14.8	14.5	13.0
Stacking Row on Deck	18	15	13
Design Condition	Fully loaded	Fully loaded	Fully draft

The container berth is planned to accommodate partially loaded 100,000dwt vessel in initial stage of Lach Huyen Port development. But, the structural design of container berth is made for accommodation of fully loaded 100,000DWT container vessel.

b) Geometry of Container Berth

Berth Length	400 m/berth
Top Elevation at Cope-line of Berth	CD +5.5 m
Planned Water Depth	CD -16.0 m
(Water Depth in front of berth	CD -14.0m for initial construction of Phase 1)
Design Water Depth	CD -16.0 m or -16.5 m dependent upon the type of structure and dredging
Apron Width	around 60 m

c) Loading Conditions

(1) Surcharge Load

Surcharge on Apron	35 kN/m^2
Surcharge on Yard (full loaded stacked 3.5 layers average)	45 kN/m^2

Surcharge load by container is considered as indicated in the following table which provides equivalent uniform distributed load for container stacking by BS6349-1:

Table 12.1.14 Container Stacking Load

Type of container stacking	Equivalent Load (kN/m^2)
Empty stacked 4-high	15
Full load by 1-high	20
Full load stacked 2-high	35
Full load stacked 4-high	55

Source: BS6349-1

(2) Quay Crane:

1,300 ton/ unit Quayside Gantry Crane For container vessel of 18 rows container on deck
Mobile Crane 250 ton capacity Class

(3) Ship Docking Load

According to the established design method of docking fender by Technical standards for port and harbor facilities in the Japan and BS 6349 codes of practice, the fender system is designed under the following conditions for berthing and the selection of type of fender system. In designing docking fender system, berthing velocity of ships with tug assistance is assumed to be 0.10 m/sec perpendicular to berth cope line for the design container vessels.

Table 12.1.15 Ship Berthing Condition – Container Berth

Design Vessel		8,000 – 9,000 TEU Container Vessel
Ship Impact Load	Ship approach velocity normal to the dock face	0.1 m/s with tug assistance
	Approach angle	10° perpendicular to dock face
	Berthing Method	1/4 point contact to berth
	Interval	Rubber Fender spaced at 15 m ~20.0 m

Source: JICA Study Team

The rubber type docking fenders with high energy absorption under low reaction force H 1150 mm × one (1) unit are installed at around 15 m interval to accommodate objective vessels berthing ranging from conventional vessels to 8,000 – 9,000 TEU capacity vessels.

Energy Absorption = 939.8 kN-m (95.8 t-m)
Fender Reaction Force = 1,621 kN (157 t)

(4) Load on Bollard

Japanese Standard recommends mooring bollards of 1,000 kN Hawser Pull force capacity per unit for vessels from 50,000 to 100,000 GT (equivalent to 57,000 to 114,000 DWT) to berth at a mooring conditions of 15 m/sec wind speed. Standard interval of installation is 45 m or 8-unit per berth. But, considering possible berthing by smaller size of vessel less than 50,000 GT, 1,000 kN Hawser pull bollards are provided at 15 - 30 m c/c spacing along the face-line of berth (min. 8 nos. per berth).

d) Outline of Open Deck Type of Piled Structure

Designed typical section of open type berth structure is shown in Figure 12.1.13. Open piled concrete deck structure is applied. The berth structure has an overall width of 43.5 m to fully support Quayside gantry crane and consists of:

(1) Pile Foundation

A combination of vertical pile and coupled rake pile foundation is used to support concrete deck structure. It is imperative that the pile foundation is driven into hard base rock for a certain depth of penetration to obtain sufficient end bearing capacity of a pile which is attributed to this base rock stratum. In this design, all the piles are embedded into hard base rock layer for a length of 3-4 times of its diameter so as to obtain full bearing capacity of the base rock layer. In order to drive foundation piles into hard base rock layer, steel pipe piles are used in view of easiness in handling, and driving operation of rake piles with supplemental method of rock auger drilling. The transverse and longitudinal beams for concrete deck are supported by steel pipe piles in diameter 1.0 m of 14mm wall thickness. In transverse direction of berth, four (4) number of coupled piles by rake pile in 1 (H) to 5 (V) are provided for each docking fender installation to resist lateral force working on the fenders while ship docking.

(2) Deck Structure

RC longitudinal front beam installed at each pile foundation row. The 1st and 5th pile rows support Quayside Gantry Crane Load on Rail. The seaside beam is provided with service outlets for utility supply pipelines and box-outs for electrical and communication cables. An RC side apron along the cope line is extended down to around CD+2.5 m level with a provision of rubber fenders on the seaside face and bollards on top of the cope line.

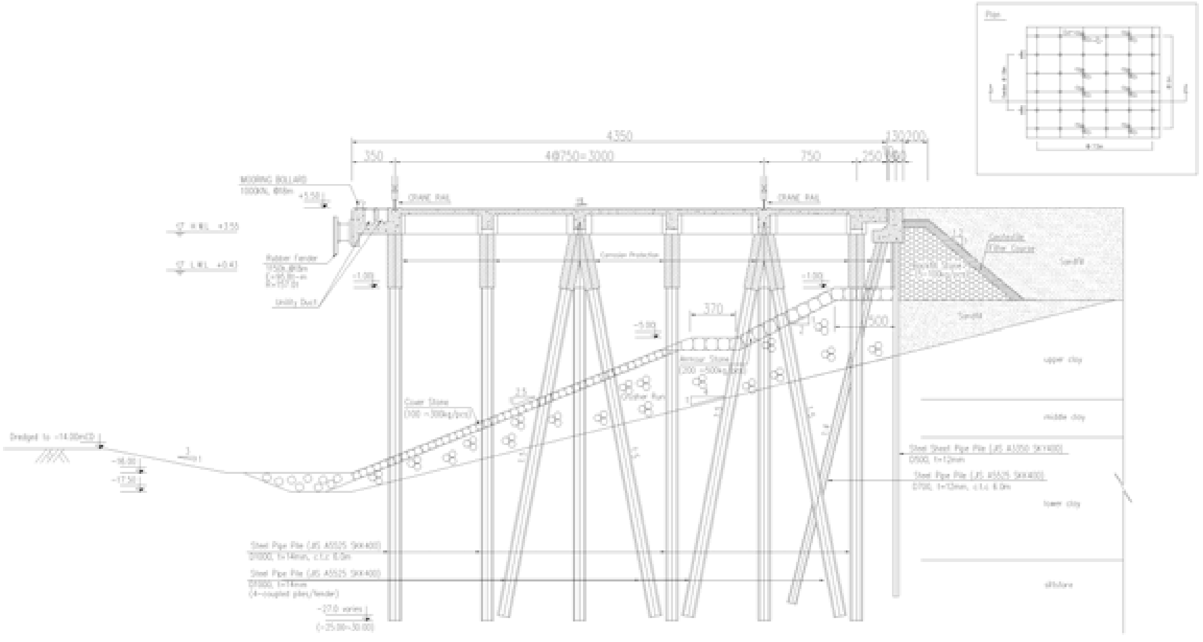
The RC deck superstructure is divided into each block of approximately 34 m width for construction. The 1st seaside row of pile is positioned at 3.5m distance behind the cope-line of berth. A thick RC deck slab of about 40 cm is cast on which paving concrete of 10cm thick is provided for container cargo handling operation on berth apron. The deck is supported by RC transverse beams of every 6.0 m interval and by longitudinal beam of every 7.5 m interval.

(3) Earth Retaining Wall

Steel Sheet Pipe Pile (SSPP 500mm diameter of 12mm wall thickness, JISA5530, SKY400) wall is installed immediately behind the concrete deck structure. SSPP wall is supported by the 1 (H) to 4 (V) rake piles (Steel Pipe Pile of 700 mm diameter, 12mm wall thickness) which are installed at interval of 6 m along the berth alignment. SSPP wall and rake supporting pile as well is driven into hard base rock in order to preclude any downward settlement of the wall which may be possible caused by residual or secondary consolidation settlement of subsoil.

(4) Seabed Slope under the Deck

Under the deck, an excavation is carried out to the depth of CD-16.0m at the face line of berth to form 1 (V) to 4 (H) seabed slope on which a slope of 1 (V) to 2.5 (H) with the provision of a slope protection stone layer is provided by placing crusher run. The surface of slope under the deck is protected by armor stone of 200-500kg/pc to the depth CD-5.0m, below which level smaller size of rock ranging 100-300kg/pc is used for covering the seabed slope.



Source: JICA Study Team

Figure 12.1.13 Typical Section of Container Berth

The structural outline of the berth is as follows.

- Top Level of Structure at Faceline of Berth: CD +5.5 m
- Width of Structure: 43.5 m
- Designed Dredging Level: CD −16.0 m
- Spacing of Deck Structure Expansion Joints: 34 m
- Spacing of Pile: Pile Rows: 7.5 m, Pile Bent: 6.0m
- Material of Piles:

  Deck Foundation: Steel Pipe Pile of 1.0 m dia., 14 mm wall thickness (JIS A5525, STK400) with anti-corrosion protection to the level at CD-1.0m and cathodic protection under water

  Earth Retaining Wall: Steel Sheet Pipe Pile (SSPP 500mm Diameter of 12mm wall thickness, JIS A5530, SKY400) and Supporting Rake Pile (SPP of 700mm diameter, 12 mm wall thickness, JIS A5525 STK400) for earth retaining wall, all of which are with provision of anti-corrosion protection to the depth CD-1.0m.
- Pile Tip Elevation: varies from CD-25m to CD-30m
- Working Axial Load on a Pile:

  By Dead and Surcharge Load: Pv= 2,820kN/pile
  By Dead Load and Seaside Gantry Crane Wheels: Pv= 4,245 kN/pile
  By Dead Load and Landside Gantry Crane Wheels: Pv= 4,290 kN/pile
  Ditto but Pull-out Force: Pp=460kN/pile
- Ultimate Bearing Capacity of a Pile:

  $Ru=Qd \text{ x } Ap + Fi \times As$

  Where Ru: Ultimate bearing capacity of a pile (kN)
  Qd: Bearing capacity of ground at the pile toe (kN/m^2)
  Ap: Tip area of a pile (m^2)
  Fi: Friction between the pile face and pile embedded ground (kN/m^2)
  As: Total peripheral area of a pile (m^2)

  For 1.0 m diameter pile embedded into base rock layer for a length of 4 × D, it is estimated that:
  Ultimate Bearing Capacity of a Pile: Ru=12,370 kN/pile
  Ultimate Pull-Out Resistance of a Pile: Rup=4,950 kN/pile

5) Design of Multi-Purpose Berth

a) Design Vessel

Table 12.1.16 Design Vessels for Multi-purpose Berth

	General Cargo	Bulk Cargo
Weight (DWT)	30,000	50,000
LOA (m)	185	225
Beam MLD (m)	27	31
Molded Depth (m)	---	---
Full loaded Draft (m)	11.0	12.0
Design Condition	Fully loaded	Fully loaded

Source: JICA Study Team

b) Geometry of Container Berth

Berth Length	250 m
Top Elevation at Face-line of Berth	CD +5.5 m
Planned Water Depth	CD -13.0 m
Design Water Depth	CD -13.0 m or -13.5 m dependent upon the type of structure and dredging
Apron Width	35-40 m

c) Loading Conditions

(1) Conventional Cargo Loads at Berth Apron

Table 12.1.17 Loading Conditions – Multi Purpose Berth

Uniformly Distributed Load at Apron	40 kN/m^2 (without Quay Crane)
	30 kN/m^2 (for the space not occupied by Quay Crane)

Source: JICA Study Team

Uniformly distributed load due to rubber-tyred port vehicle is normally less than 30 kN/m^2 (BS 6349-1:2000, Clause 45.6)

(2) Quay Crane and Other Movable Equipment

The following multi-purpose quay-side crane is considered.

Number of Wheel per corner: 8 wheels at 1.0m interval
Maximum Wheel Load: Seaside 35 ton/wheel, Land side 30 ton/wheel

In addition, various type of movable crane or equipment will be expected to mobilize for unloading cargoes at multi-purpose berth. But, since these are light weight furniture even under cargo loaded during operation, the intensity of such dead loads deems less than the uniformly distributed design load of 30kN/m^2 for wharf apron.

(3) Ship Docking Load

In designing docking fender system of wharf, berthing velocity of ships with tug assistance is assumed to be 0.10 m/sec perpendicular to berth cope line for the design vessels. Rubber type of fenders spaced at 10 to 20 m will be installed to accommodate design vessels up to 50,000DWT carrier.

Table 12.1.18 Ship Berthing Conditions – Multi-Purpose Berth

Design Vessel		50,000 DWT bulk Carrier Vessel
Ship Impact Load	Ship approach velocity normal to the dock face	0.1 m/s with tug assistance
	Approach angle	10° perpendicular to dock face
	Berthing Method	1/4 point contact to berth
	Interval	Rubber Fender spaced at 15 m ~20.0 m

Source: JICA Study Team

Fender used for the multi-purpose berth is selected as follows:

- Type of System: Rubber formed fender system (Elastomeric Unit Type)
- Type of Rubber Fender: Hollow Cylindrical to absorb high berthing energy of ship at low fender reaction

The following is the summary of the selection of the fender system for critical cases of ship berthing:

Table 12.1.19 Selection of Fender Size

Size of Ship	Berthing Velocity (m/sec)	Fender Interval (m)	Berthing Energy of Ship (kN-m)	Fender H (mm) × Unit	Energy Absorption (kN-m)	Fender Reaction (kN)
A. Japanese Standard						
50,000DWT	0.10	---	275.4	H800 × 1 Unit	280.6	659.2
				H600 × 2 Unit	280.6	882.9
B. BS Standard (Including Safety Factor of 1.5)						
50,000DWT	0.10	---	421.3	H900 × 1 Unit	451.3	943.7
				H900 × 2 Unit	447.3	1,202.7

Source: JICA Study Team

The rubber type docking fenders with high energy absorption under low reaction force H 900 mm × one (1) unit are installed at around 15 -18 m interval to accommodate design vessels berthing ranging from conventional vessels to 50,000DWT vessels.

- Energy Absorption = 421.3 kN-m (46.0 t-m)
- Fender Reaction Force = 943.7 kN (96.2 t)

(4) Load on Bollard

Japanese Standard recommends mooring bollards of 1,000 kN Hawser Pull force capacity per unit for vessels from 20,000 to 50,000 GT (equivalent to 37,000 to 92,000 DWT) to berth at a mooring conditions of 15 m/sec wind speed. Standard interval of installation is 35 m or 8-unit per berth. But, considering possible berthing by smaller size of vessel less than 50,000DWT, 1,000 kN Hawser pull bollards are provided at 15 - 30 m c/c spacing along the face-line of berth (min. 8 nos. per berth).

d) Outline of Open Deck Type of Piled Structure

Designed typical section of open type deck structure is shown in the Figure 12.1.14. Open piled concrete deck structure is applied. The berth structure has an overall width of 39 m to fully support Quayside gantry crane and consists of

(1) Pile Foundation

Only vertical concrete pile foundation is used to support concrete deck structure in view of easiness for handling, and pile driving operation into hard base rock layer with supplemental method of rock auger drilling. Lateral working force on a deck is supported by the lateral bending momentum resistance of a group of vertical piles. Pre-stressed Spun High Strength Concrete Pile (PHC Pile) is used. The dimension of PHC pile is 1.0 m diameter, 130mm wall thickness which is locally available within a few years period in future. All the piles are embedded into hard base rock layer for 2 m long of 2 times of its diameter so as to obtain the end bearing capacity of the pile required to sustain the working load on pile.

(2) Deck Structure

RC longitudinal front beam installed at each pile foundation row. The 1st and 4th pile rows support Quayside Gantry Crane Load on Rail. The seaside beam is provided with service outlets for utility supply pipelines. An RC side apron along the cope line is extended down to around

CD+2.5 m level with a provision of rubber fenders on the seaside face and bollards on top of the cope line.

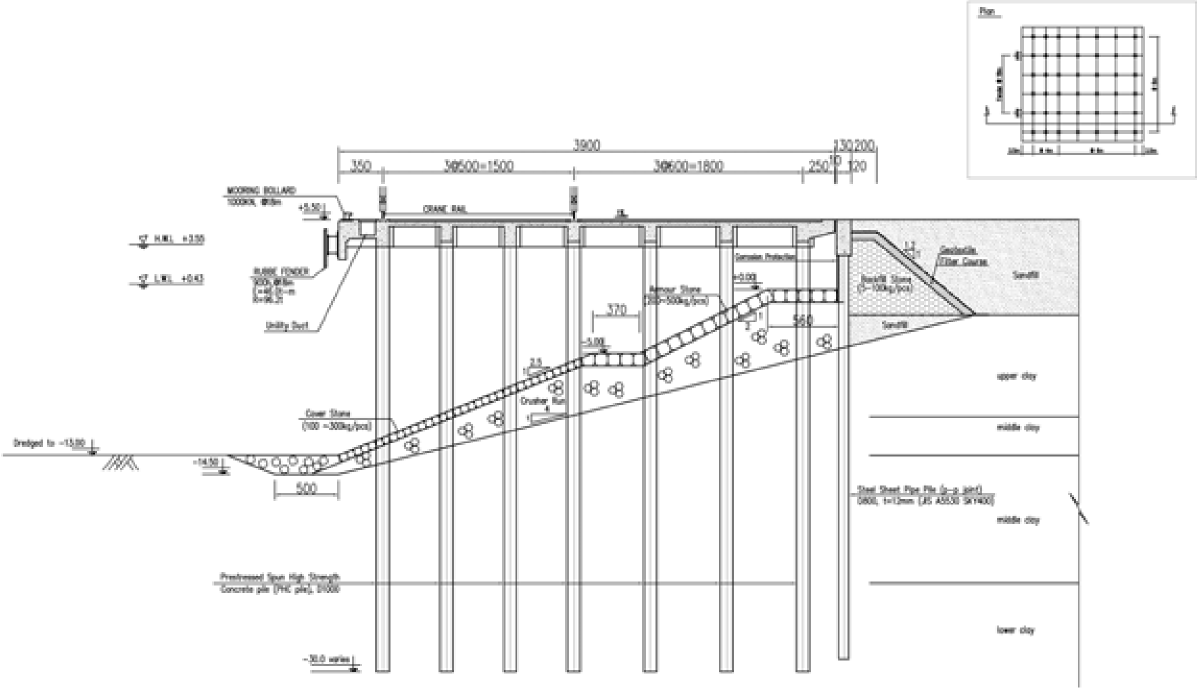
The RC deck superstructure is divided into each block of approximately 34 m width for construction. A thick RC deck slab of about 40 cm is cast on which paving concrete of 10cm thick is provided for cargo handling operation on berth apron. The deck is supported by RC transverse beams of every 6.0 m interval and by longitudinal beam of every 5.0m or 6.0 m interval.

(3) Earth Retaining Wall

Self-standing Steel Sheet Pipe Pile (SSPP 800mm Diameter of 12mm wall thickness, JIS A5530, SKY400) wall is installed immediately behind concrete deck structure. SSPP wall is driven onto hard base rock in order to preclude any downward settlement of the wall which may be possible caused by residual or secondary consolidation settlement of subsoil.

(4) Seabed Slope under the Deck

Under the deck, an excavation is carried out to the depth of CD-13.0m at the face line of berth to form 1 (V) to 4 (H) seabed slope on which a slope of 1 (V) to 2.5 (H) with the provision of a slope protection stone layer is provided by placing crusher run. The surface of slope under the deck is protected by armor stone of 200-500kg/pc to the depth CD-5.0m, below which level smaller size of rock ranging 100-300kg/pc is used for covering the seabed slope.



Source: JICA Study Team

Figure 12.1.14 Typical Section of Multi-purpose Berth

The structural outline of the multi-purpose berth is as follows.

- Top Level of Structure at Face-line of Berth: CD +5.5 m
- Width of Structure: 40 m
- Designed Dredging Level: CD −13.0 m
- Spacing of Deck Structure Expansion Joints: 34 m

- Spacing of Pile: Pile Rows: 5 m under the crane gauge and 6 m, Pile Bent: 6m
- Material of Piles:

  Deck Foundation Pile (PHC Pile of 1,000mm diameter, 130mm wall thickness, Type B: 8N/mm^2 Effective Pre-stress)

  Earth Retaining Wall: Steel Sheet Pipe Pile (SSPP 800mm Diameter of 12mm wall thickness, JIS A5530, SKY400) with anti-corrosion protection to the depth CD-1.0m and cathodic Protection under water
- Pile Tip Elevation: varies but more or less CD-30m
- Working Load on a Pile:

  By Dead and Surcharge Load: Pv= 2,512kN/pile
  By Dead Load Gantry Crane Wheels: Pv= 3,003 kN/pile
  Bending Moment at Pile Top while docking: M=562 kN-m
- Ultimate Bearing Capacity 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)
  Ap: Tip area of a pile (m^2)
  Fi: Friction between the pile face and pile embedded ground (kN/m^2)
  As: Total peripheral area of a pile (m^2)

  For 1.0 m diameter pile embedded into base rock layer for a length of 2xD (Pile diameter), it is estimated that:

  Ultimate Bearing Capacity of a Pile: Ru=10,500 to 11,150 kN/pile

12.1.5 Pavement

1) Container Terminal Yard

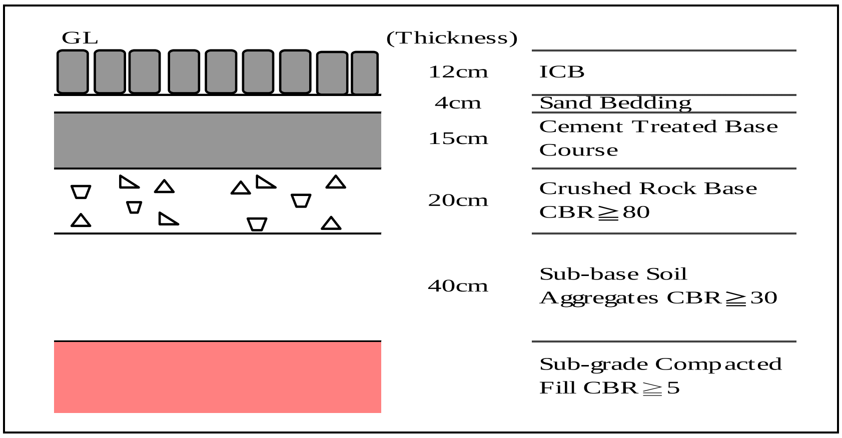
Containers are stacked at maximum 4-layer high at container stacking yard as follows:

- Laded Container: 2-4 layers
- Empty Container: 4 layers

Live Load at Container Yard is estimated to be 45 kN/m^2 for fully loaded containers stacked in 3.5 layers.

Interlocking Concrete Block (ICB) heavy duty pavement will be applied. Paving surfacing is covered by the use of 120 cm thick heavy duty Interlocking Concrete Blocks above 4cm bedding sand layer. A 15cm cement treated base and 20cm crushed stone base layer is placed on the sub-base course of 40 cm sand compacted to 98 % modified AASHOTO density. Sub-grade course is formed by sand layer of 30cm on well compacted in-situ material.

In container yard, RTG crane foundation is used along with interlocking concrete block yard pavement in the same area to support higher loads of crane wheels. RTG crane foundation will be of cast-in-place type, pre-stressed with post-tensioning system or RC slab structure. RC container stacking foundation slab is provided to place at the edge corner of container for stacking container in layers at yard.



Source: JICA Study Team

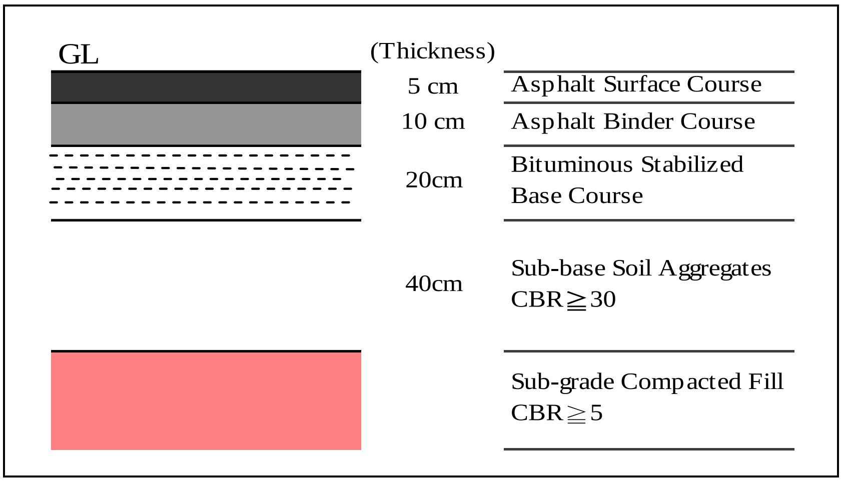
Figure 12.1.15 Container Terminal Yard Pavement Structure

2) Multi-purpose Terminal Yard

Uniformly distributed load due to rubber-tyred port vehicle which may be used in the terminal yard is normally less than 30 kN/m2 (BS 6349-1:2000, Clause 45.6).

Open yard will be used for conventional cargoes, of which loads imposed depends on the commodities of cargoes, the height of stacking and effective density of the commodities as stacked. BS 6349-1 recommends that if better information is not available, the loading from general cargo can be taken as 20 kN/m^2.

Asphalt pavement is applied to multi-purpose terminal yard pavement in view of economy for construction. Heavy duty two (2) bituminous layer of surface with bituminous stabilized base layer is placed on substantially compacted sub-base and sub-grade courses.

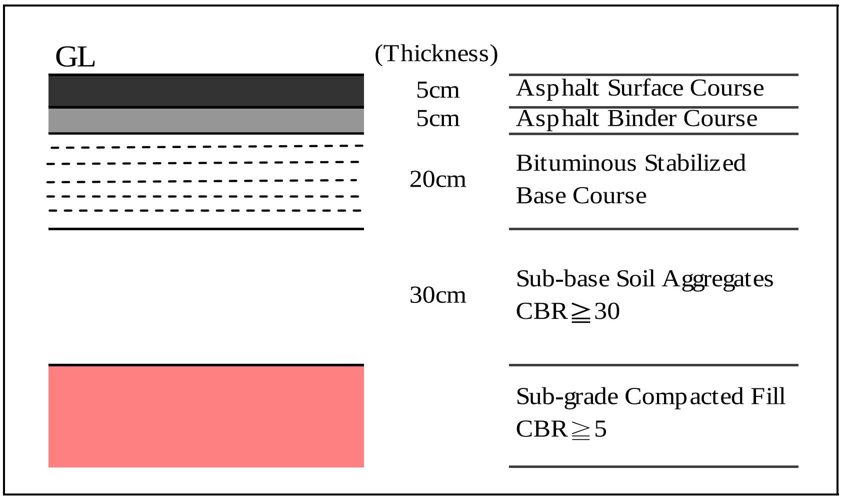


Source: JICA Study Team

Figure 12.1.16 Multi-Purpose Terminal Yard Pavement Structure

3) Access Road

Asphalt pavement is applied to access road in view of economy for construction and easiness for maintenance.



Source: JICA Study Team

Figure 12.1.17 Access Road Pavement Structure

12.1.6 Sand Protection Dyke

1) Principles for Designing Structure:

Shoaling is a sedimentation or siltation progressed in such area as port basin, navigation channel or anchorage areas to shallow water depth by accretion of suspended sediment discharged out of river or tidal flow, by deposition of littoral material transported by wave or current agitation in littoral breaker zone, or wind-blown sand. Shoaling phenomenon in question along the Lach Huyen access channel waterway area is possibly caused by:

(1) Shoaling by subsidence and deposition of suspended sediment discharged from the Lach Huyen waterway flow,

(2) Shoaling by suspended sediment transport discharged out of Bach Dang or Nam Trieu and Cam river in the Haiphong Bay area and extended to the part of the littoral surf zone area where Lach Huyen access channel locates and runs to south offshore , and

(3) Accretion by invasion or deposition of suspended sediment drift agitated from the seabed surface by wave turbulent action and transported by breaking wave flow and/or current action in the littoral surf zone of the Haiphong Bay estuary.

The protection dyke for the Project is designed under the following principles:

(1) The Primary function is to train and confine river or tidal flow into access channel waterway and prevent or reduce possible shoaling at the water area for access channel. The dyke should be therefore a structure non-permeable on water flow and is extended southerly to offshore in parallel with and as closer as practically possible to Lach Huyen access channel waterway (**Training Jetty Function to minimize shoaling of access channel by suspended sediments out from river flow**).

(2) The dyke also serves to interpose a total littoral barrier to shelter the access channel in the littoral surf zone. This function is to barrier off the access channel area from suspended sediment inflow from Bach Dang or Nam Trieu, and Cam river or possible littoral suspended sediment transport agitated from the seabed surface by wave turbulent actions and transported by breaking wave flow or current in littoral breaker zone. For this function, the structure should be designed as non-permeable in general to prevent suspended sediment transport from intrusion through its structure by currents or waves (**Sand Protection Jetty or Groin Dyke Function to barrier off or trap littoral suspended sediment transport into access channel**).

(3) The crest elevation of the dyke is so positioned to direct river or tidal flow, and to minimize inflow of suspended sediments in overtopping water to access channel area.

(4) Nearly once a year, Lach Huyen offshore area is subject to extreme high wave attach generated by tropical typhoon. Therefore, due to exposure condition to offshore waves, the dyke must maintain structural stability against extreme high wave action. This requirement for the dyke incidentally serves as breakwater to shelter access channel water area from offshore waves (**Incidental Breakwater Function to protect port area from wave and to create calm water in access channel waterway**).

(5) Since possible consolidation settlement of subsoil layer is expected not considerable, any subsoil improvement is not applied in designing structure. Instead, a 1.0 to 1.5 m thick rubble mound is placed onto the seabed subsoil to sustain overburden pressure loaded by its core materials and to function as counter weight to preclude underlying clayey soil from circular failure. Some allowance is provided in positioning the top of dyke for possible future settlement of consolidation in foundation subsoil mass.

The function as groin dyke seems imperative to the proposed Lach Huyen Sand Protection Dyke structure because that, according to the post-dredge survey for capital dredging in 2005,

- It show substantially small rate of shoaling at Lach Huyen section (from P19 to P15 buoy) where the Lach Huyen waterway substantially becomes wider run of flow;
- The progress of substantial shoaling is observed at the section from P15 buoy to offshore, but relatively high rate of shoaling occurs at Inner Sea Reach (from P5 to P9 buoy) though this rate is a record obtained immediately after initial dredging work;
- At deeper area of Outer Sea Section (from P0 to P3 buoy), the seabed level is relatively stable;
- The high rate of accretion may occur during wet season (June to September)

High rate of accretion at section P5 to P9 buoy may indicate that:

- The downstream velocity of Lach Huyen waterway becomes minimum at theses sections due to the widening water flow, and
- The progress of shoaling along Lach Huyen waterway is sensitive to possible littoral suspended sediment transport which may be caused by wave agitation, because this area (original water depth around CD-1.0 to -3.0 m) seems to be wave breaker zone of relatively high waves ($H_{1/3}$= about 1.5m for 1Yrs return period) which are generated by strong rainstorm or tropical typhoon in particular.

There may be high risk of possibility that the higher rate of accretion is most likely to occur due to marine conditions agitated by tropical typhoon when the extreme high waves intrude into the Lach Huyen water area. Therefore, it is important that the dyke also functions as sand protection jetty or groin dyke to trap littoral drift or sediment transport agitated by offshore waves or current movement.

2) Length of Sand Protection Dyke

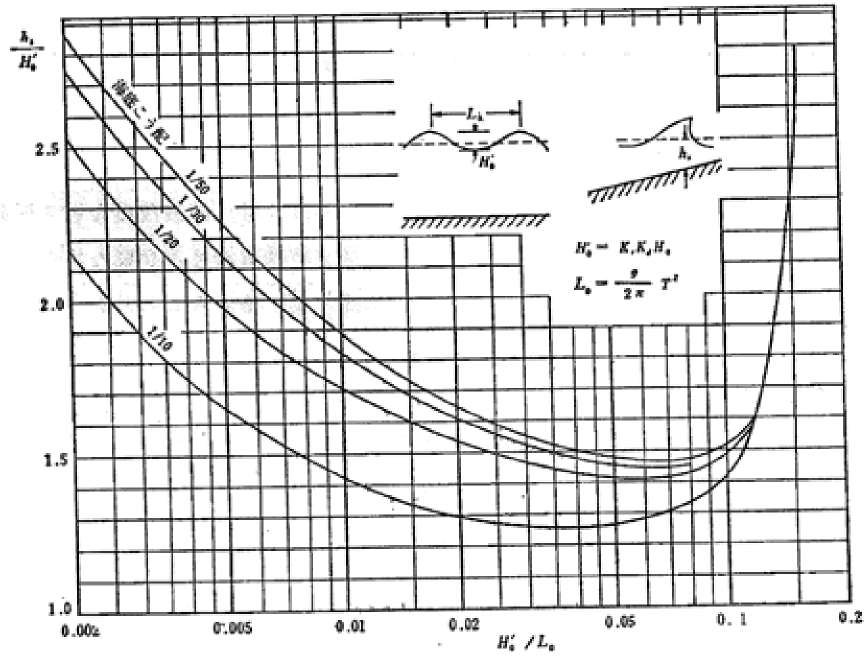
The length of dyke will be determined based on the simulation study on quantitative sedimentation estimate along the Lach Huyen waterway.

It is common practice that Training Jetty is extended to offshore water depth where water depth is the same as access channel or, in economical way of construction, till the offshore zone in wave breaker line. And in case of Sand Protection Jetty or Groin Dyke structure, the offshore head of structure is located at water zone where water depth is the same as for the access channel waterway or at wave breaker line with provision of recurrent maintenance dredging since seabed agitation is mostly caused in breaker line.

So called breaker zone is changeable dependent upon heights of waves intruding into the water area where sand protection dyke is constructed. In Lach Huyen offshore area, the breaker line is considered around 6 to 10 m water depth (h) based on the estimate of breaker depth as follows for the case of the wave braking in assuming of extreme high waves of 3.71 m to 4.45m height in 10 to 30 years return period:

- By estimation for Regular Wave based on Figure 12.1.18.

  Ho'/Lo = 3.71/147 or 4.45/182=0.025 or 0.024
  Seabed gradient=1/50
  h_b/Ho'=1.6
  Breaker Depth: h_b =1.6 × Ho'=1.6 × (3.71 to 4.45) = 5.9 to 7.1m

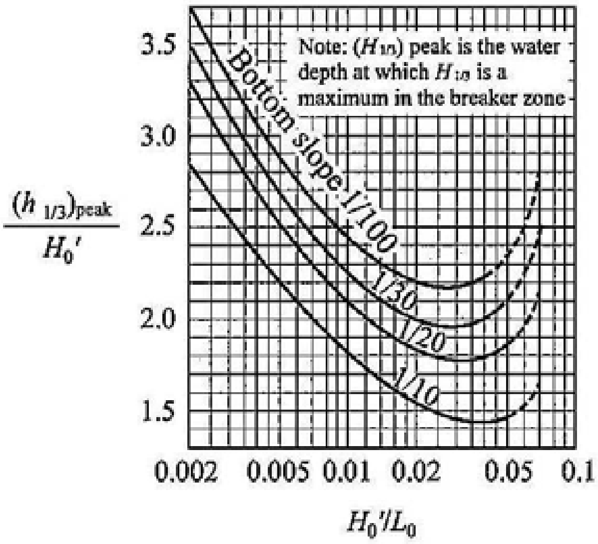


Source: Manual for Construction of Shore Protection Facilities in Japan

Figure 12.1.18 Diagram of Breaker Depth and Wave Steepness for Regular Waves

- By estimation for Irregular Wave based on Figure 12.1.19)

  Ho'/Lo = 0.025 or 0.024
  Seabed gradient=1/100
  (h1/3) peak /Ho'=2.2
  Breaker Depth: (h1/3) peak =2.2 x Ho'=2.2 x (3.71 to 4.45) = 8.1 to 9.8m



Source: Technical Standards and Commentaries for Port and Harbor Facilities in Japan

Remark: $(h_{1/3})$ peak=Water Depth at which significant wave height become maximum:

Figure 12.1.19 Diagram of Water Depth at which maximum Significant Wave Height occurs in Breaker Zone for Irregular Waves

In design practice, therefore, the offshore head of the sand protection dyke could be located at a water level around CD-6 to -10 m with provision of recurrent maintenance dredging or may be extended to deeper offshore area of the same depth as access channel waterway.

3) Crest Elevation of Sand Protection Dyke

As far as sediment transport caused by wave agitation at offshore breaker zone, most suspended sediments remains in sea bottom layer of flow near the seabed under bed load transport condition. In addition, since overtopping water contains minimum sediments, wave overtopping could be permeable in case of sand protection dyke for this Project. Therefore, in view of economy in construction, the crest elevation of training dyke is positioned at the level of CD+2.0m. The followings are discussion on crest elevation for each function required to the dyke.

a) Elevation as for Training Jetty

For training jetty function, it should be a structure extended into offshore area with ample crest elevation to guide or confine river flow so as to maintain water depth of access channel waterway by bed-load transport force of the river flow under ebb tide as well as flood tide conditions. Therefore, the crest elevation for training jetty is so positioned at the level of the water level plus allowance to properly stabilize the water flow by guiding river water flow even during flood period, which is preferable to elevate:

- Crest Elevation as for Training Jetty:

  = Water Level (=MWL) + Allowance for Tide and Settlement
  = CD+1.95m + Allowance for Flood Tide (=1.0~1.5m) +Allowance for Settlement (=0.5m)
  =CD+3.45~ +3.95m

b) Elevation as for Sand Protection Jetty

It is common and preferable that sand protection jetty does not allow wave overtopping in order to prevent the inflow of suspended sediments which are raised up from the seabed by wave turbulent action and the top elevation of sand protection jetty is basically determined under the following guidelines.

Table 12.1.20 Guideline of Crest Elevation for Sand Protection Jetty

Function	Water Zone	Guideline	Top Elevation
Sand Protection Jetty	Around Shoreline	A wave run-up should not be allowed to overtop the dyke. Sediment transport may overtop the dyke with overtopping water when the dyke is elevated low.	HWL + the height of wave Run-up
	Between Shoreline and Breaker Zone	It is common to elevate the top of dyke at a level of $0.6H_{1/3}$ above the HWL. Raising the top of dyke by 0.6H1/3 above HWL may preclude substantial suspended sediments in overtopping water.	$HWL+0.6H_{1/3}$
	Area Off-Breaker Zone	The top of dyke can be elevated at a level above HWL with some allowance. As far as sediment transport caused by wave agitation at this zone, most suspended sediments remains near the seabed and overtopping water contains minimum sediments. Therefore, wave overtopping can be permeable.	HWL + Some Allowance

Source: JICA Study Team derived from Commentaries of Technical Standards and Commentaries for Port and Harbor Facilities in Japan

In case of sand protection jetty at breaker zone, it is preferable that the crest height is positioned at the level of $0.6H_{1/3}$ above HWL in order for the jetty to trap suspended sediment and prevent suspended sediment inflow into channel area by normal wave overtopping. Breaker zone is changeable dependent upon the wave heights. In determine the crest height of the sand protection jetty, ordinary high waves ($H_{1/3}$=1.0 - 1.5 m height for waves of 1 to 2 Years return period) and/or some allowance (for possible settlement by consolidation) is considered to determine the top of jetty to ensure essential functions for suspended sediment transport control while normal marine environment.

- Crest Elevation as for Sand Protection Jetty for Section Off-Breaker Zone:
  =HWL: CD+3.55 + 0.6 $H_{1/3}$ (=0.6~0.9m) +Allowance for Settlement (0.5 m)
  =CD+4.65 ~+ 4.95m

c) Elevation as for Groin Dyke

Outer section of groin dyke is extended from its intermediate sloped section and the crest height is set according to intended interruption of littoral sediment transport. Suspended sediment in littoral transport, which is agitated from the sea bottom surface by wave turbulent actions, is basically very dense near sea bottom layer under bed load transport condition in breaker zone and overtopping wave water contains minimum suspended sediments.

In view of the above, the top at outer offshore section of dyke can be elevated at a level above MLWL with some allowance. This section of most type of groins is set horizontally at such low elevation as practical in view of economy in construction. Therefore, it is recommended for such function as groin to position the crest height at MLWL plus allowance.

- Crest Elevation as for Groin Dyke of Section extended Offshore Water Zone:
  =MLWL (=CD+0.90) + Allowance for Wave (=0.6~0.9m) and Settlement (0.5 m)
  =CD+2.0 ~ +2.3m

d) Design of Dyke Structure

In order to barrier off the access channel area from suspended sediment inflow, Sand Protection Dyke is designed:

- To position the crest height at CD+2.0m,
- To be non-permeable for a core portion of the dyke about 3-5 m high above seabed and/or up

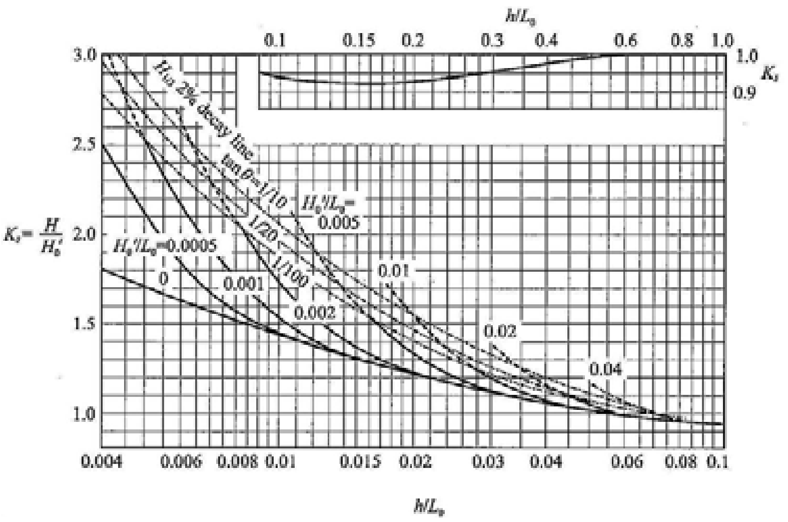
to the bottom level of wave dissipating concrete armor unit for deeper water section of the dyke, and

- To be stable against extreme high wave for around 30 to 50 years return period at the proposed offshore area.

The following design offshore wave for the Project Site is applied for designing sand protection dyke.

Deep Sea Offshore Wave: 1 in 30 years Return Period
Wave Height: Ho= 4.45 m (based on extreme wave height probability)
Predominant Wave Direction: S to E
Wave Period: To= 10.8 sec (based on extreme wave height probability)
Equivalent deep-sea wave height: Ho’= Kr x Kd x Ho=1.0 x 1.0 x 4.45 m = 4.45 m

The water depth along the alignment of sand protection dyke varies from CD -1.0 m to – 10.0 m to offshore. Significant Wave Height ($H_{1/3}$) at each shallow water depth point is calculated by applying Goda’s diagram (Figure 12.1.8) of significant wave height in breaker zone for irregular wave or Shoaling Coefficient at relevant point based on Shuto’s nonlinear long wave theory (Figure 12.1.20 below):



Source: Technical Standards and Commentaries for Port and Harbor Facilities in Japan

Figure 12.1.20 Shuto’s Graph for Evaluation of Shoaling Coefficient

Table 12.1.21 Design Waves ($H_{1/3}$) for Sand Protection dyke at Each Depth of Water

Seabed EL (CD)	Water Level (m)	Water Depth (m)	h/Ho’	h/Lo	$H_{1/3}$/Ho’	Ks	$H_{1/3}$ (m)
-1.0	CD+3.55	4.55	1.02		0.66		2.9
-3.0	CD+3.55	6.55	1.47		0.86		3.8
	CD+0.43	3.43	0.77		0.55		2.4
-5.0	CD+3.55	8.55	1.92		0.98		4.4
	CD+0.43	5.43	1.22		0.77		3.4
-7.0	CD+3.55	10.55	2.37		1.0		4.5
	CD+0.43	7.43	1.67		0.91		4.0
-10.0	CD+3.55	13.55	3.04	0.074		0.96	4.3
	CD+0.43	10.43	2.34	0.057		1.0	4.5

Source: JICA Study Team

Water Level= HWL+3.55 m CD, LWL+0.43m CD
Ho’/Lo=4.45/1.56× 10.82=0.024
Seabed slope: 1/100

The above design waves ($H_{1/3}$) obtained is used for designing sand protection dyke at each seabed elevation.

Along alignment of sand protection dyke, quarry run and rocks in a weight of 100 to 200 kg/pc is placed to form bedding course of 1.0 to 1.5 m thickness. The same size of core rock in a weight of 100 to 200kg/pc is mounted on the bedding course and the core rock layer is protected by inner armor stone layer and by outer amour layer of wave dissipating precast concrete units on the relatively gentle surface slope of 1 (V) to 2 (H). Assuming significant wave height ($H_{1/3}$) in a range of 2.9 m to 4.5m for waves of 30 years return period, the weight of armor unit for outer protective layer required is obtained as follows.

$$M= \rho H_{1/3}{}^3/Ns^3(Sr-1)^3$$
$$= 2.3\times H^3/16.6(2.3/1.03 - 1)^3 \quad t/pc$$

Where Ns^3 = Kd cot α= 8.3 × 2.0 = 16.6

Table 12.1.22 Armor Unit Weight Estimate for Sand Protection dyke

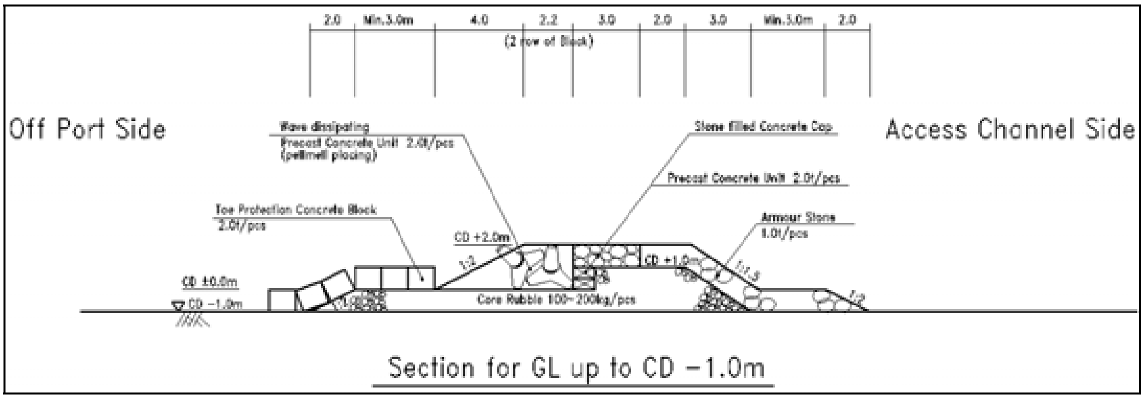
Seabed EL (CDL)	Water Level (m)	Water Depth (m)	$H_{1/3}$ (m)	M (ton)	Weight of Armor Unit (ton/pc)
-1.0	CD+3.55	4.55	2.9	1.80	2.0
-3.0	CD+3.55	6.55	3.8	4.06	4.0
	CD+0.43	3.43	2.4	1.02	
-5.0	CD+3.55	8.55	4.4	6.30	6.3
	CD+0.43	5.43	3.4	2.90	
-7.0	CD+3.55	10.55	4.5	6.73	8.0
	CD+0.43	7.43	4.0	4.73	
-10.0	CD+3.55	13.66	4.3	5.88	8.0
	CD+0.43	10.43	4.5	6.73	

Source: JICA Study Team

Therefore, the following schedule applied for the weight of outer layer of armor unit to be placed along alignment of training jetty.

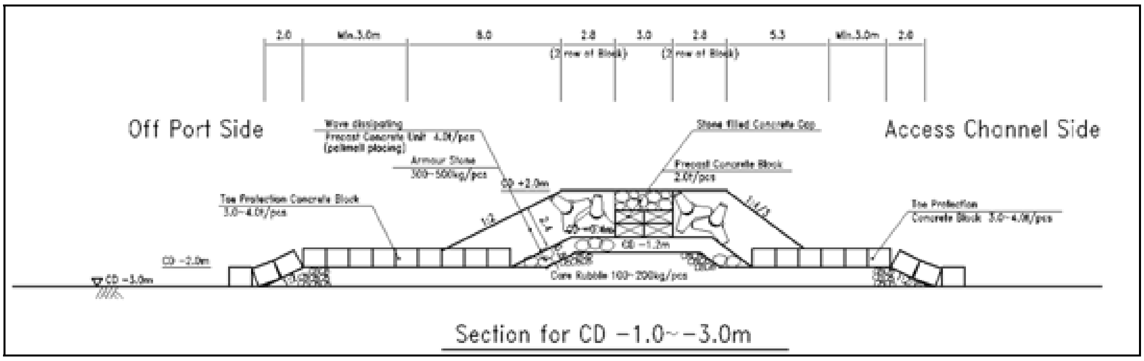
Seabed Elevation to CD-1.0m: 2t/pc Armor Unit
Ditto but from CD-1.0m to -3.0m: 4 t/pc Armor Unit
Ditto but from CD-3.0m to -5.0m: 6.3 t/pc Armor Unit
Ditto but from CD-5.0m to -10.0m: 8.0 t/pc Armor Unit

This outer armor layer forms by use of wave dissipating precast concrete units which rest on the crest concrete placed on the top of core stones to form non-permeable structure to the crest elevation of the dyke at CD+2.0m.



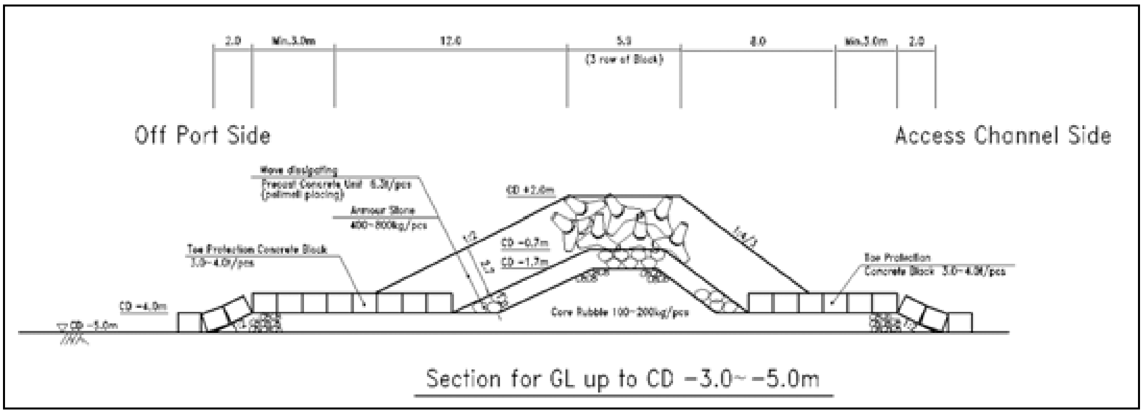
Source: JICA Study Team

Figure 12.1.21 Sand Protection Dyke at GL-1.0



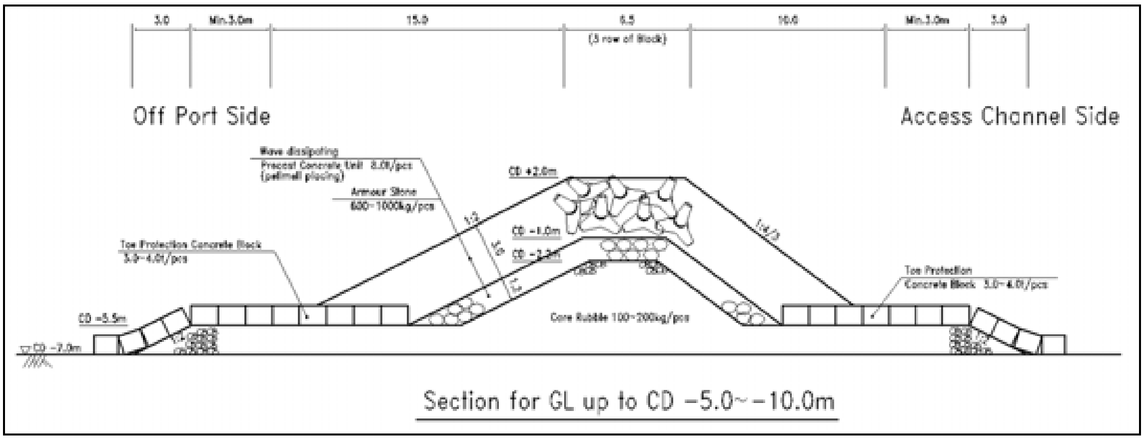
Source: JICA Study Team

Figure 12.1.22 Sand Protection Dyke at GL-1.0 to -3.0m



Source: JICA Study Team

Figure 12.1.23 Sand Protection Dyke at GL-3.0 to -5.0m



Source: JICA Study Team

Figure 12.1.24 Sand Protection Dyke at GL-5.0 to -10.0m

e) Bearing Capacity of Subsoil Mass

The section of the dyke induces overburden loads onto the subsoil by its own weight. At the section of the dyke installed at water depth of CD-7.0m, the overburden load by its own weight is equivalent to uniformly distributed load of around 7.5 t/m^2. Bearing capacity of upper clayey soil mass (q_d) is estimated as

$$q_d = (3.8 \text{ to } 5.14) \times Cu = 8.4 \text{ to } 11.3 \text{ t/ms}$$

Core stones for the dyke are installed onto 1.0-1.5m thick rubble mound. Therefore, it is expected that overburden load up to (8.4 ~11.3) + 1.5 (counter weight of 1.5 m thick rubble mound) = 9.9 to 12.8 t/ms of pressure could be applied onto the underlying subsoil without provision of subsoil improvement.

f) Expected Consolidation Settlement in Foundation Subsoil

It is estimated that possible settlement by consolidation along sand protection dyke is minimum and will be around 30 to 60 cm in long term basis which does not include instant settlement caused during construction work.

Table 12.1.23 Consolidation Settlement along Sand Protection Dyke

Layer	Layer Thickness (h) (cm)	Initial Earth Pressure (Po) (kg/cm^2)	Vertical Stress in Foundation Soil Mass ($\Delta P = \sigma \times Iz$) ($kg/cm^2$)	Total Pressure ($Po + \Delta P$) (kg/cm2)	Initial Void Ratio (e_o)	Final Void Ratio (e_1)	Settlement (S) (cm)
1) Sand Protection Dyke at Water Depth of CD-3.0m							
Subsurface Sand	200	0.10	---	---	---	---	0
C1:Upper Clay	600	0.41	0.40	0.81	1.62	1.50	27
Clayey Sand	300	0.77	---	---	---	---	0
C3:Lower Clay	500	1.12	0.35	1.47	1.02	1.00	5
Total							32cm
2) Sand Protection dyke at Water Depth of CD-5.0m							
Subsurface Sand	200	0.10	---	---	---	---	0
C1:Upper Clay	600	0.41	0.51	0.92	1.62	1.48	32
Clayey Sand	300	0.77	---	---	---	---	0
C3:Lower Clay	500	1.12	0.47	1.59	1.02	0.98	10
Total							42cm
3) Sand Protection dyke at Water Depth of CD-7.0m							
Subsurface Sand	200	0.10	---	---	---	---	0
C1:Upper Clay	600	0.41	0.65	1.06	1.62	1.45	39
Clayey Sand	300	0.77	---	---	---	---	0
C3:Lower Clay	500	1.12	0.62	1.68	1.02	0.97	12
Total							51cm

Source: JICA Study Team

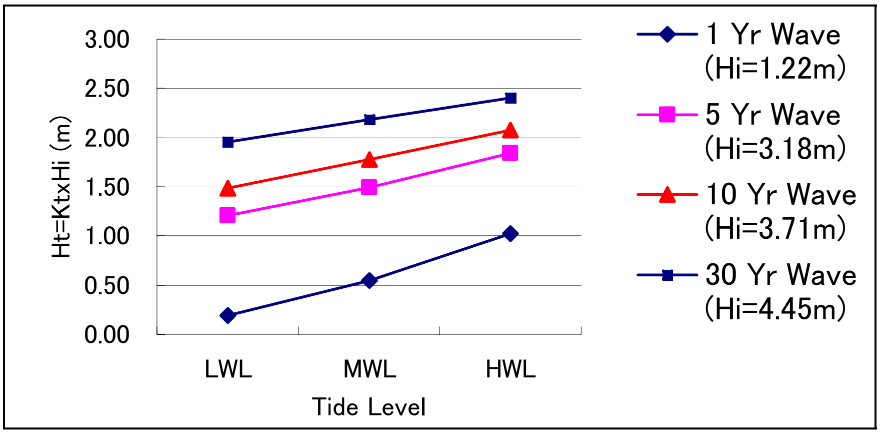
Settlement (S)= $h \times (e_o - e_1)/(1+e_o)$
Top Elevation of Sand Protection dyke: CDL+2.0m
Water Level: CD+2.0m
Vertical Stress in Foundation Soil Mass at the soil depth: as indicated as above at the center of the Dyke

g) Wave Height Transmitted through the Dyke

The sand protection dyke functions as breakwater to create calm waterway for vessel navigation once it shall be installed along access channel. The crest level of the dyke is elevated at CD+2.0m, wave height transmitted through the dyke is estimated as shown in Figure 12.1.25 for waves from 1 to 30-year Return Period under such tide level as LWL, MWL and HWL. For the wave of 1-year return period (Ho=1.22 m) for instance, the transmitted wave height through the dyke is estimated for tide level at LWL, MWL and HWL as follows.

- Wave Intrudes: One (1) Year Return Period Ho=1.22m
  Hi=Ks×Kr×Kd×Ho=1.0×1.0×1.0×1.22=1.22m
- Dyke Section: At Seabed Elevation of CD-7.0m
- Wave Height Transmitted (Ht):
  Ht= 0.20 m (at LWL=CD+0.43m),
  Ht= 0.55m (at MWL= CD+1.95m), and
  Ht= 1.02m (at HWL= CD+3.55m)

Since the crest height is elevated at low level, it is very likely that the rate of wave height reduction through the protection dyke is not so significant to protect access channel water area particularly in case of tide level at HWL.



Source: JICA Study Team

Figure 12.1.25 Wave Height Transmitted Through Sand Protection Dyke

12.2 Construction Method and Schedule

12.2.1 General

The construction of Lach Huyen terminal is planned in two phases: 2015 and 2020. In initial phase of 2015, two container terminals are planned to be constructed. While in 2nd phase of 2020, total of five container terminals and three multi-purpose terminals are planned of which the total length is 3,150m. The major scope of work is as follows, and the construction quantity for 2020 stage is shown in the Table 12.2.1. The detail of each scope is explained in the following sections.

- Dredging of the access channel
- Dumping of the dredged material
- Reclamation of the terminal yard
- Soil improvement work
- Construction of berth structure
- Port protection facilities (Outer revetment and Training Dike)

Table 12.2.1 Major construction volume for 2020

Item	Unit	Quantity	Remarks
1.Berth structure			
Container terminal L=750m	berth	5	2 berth by 2015
Multi purpose terminal L=250m	berth	3	-
2. Dredging works			
Access channel	m3	32,300,860	-
Wharf slope	m3	2,239,000	Private scope
Berth box	m3	338,000	Private scope
Between berth box and access channel	m3	654,000	Private scope
3. Reclamation works			
Terminal area	m3	12,090,000	
4. Protection Works			
Inner Revetment	m	750	-
Outer Revetment	m	3,230	-
Sand Protection Dike	m	7,600	-
5. Soil Improvement work			
Terminal area	m2	2,095,000	-
Inner revetment	m2	4,550	-
Outer revetment	m2	65,500	-
Access Road behind Port	m2	601,600	
6. Access road			
Access road behind port	m	3,150	W=200m
7. Public facility area			
CIQ building and service boat berth	m2	130,200	-

Source: JICA Study team
Note: quantity is including the initial phase of 2015

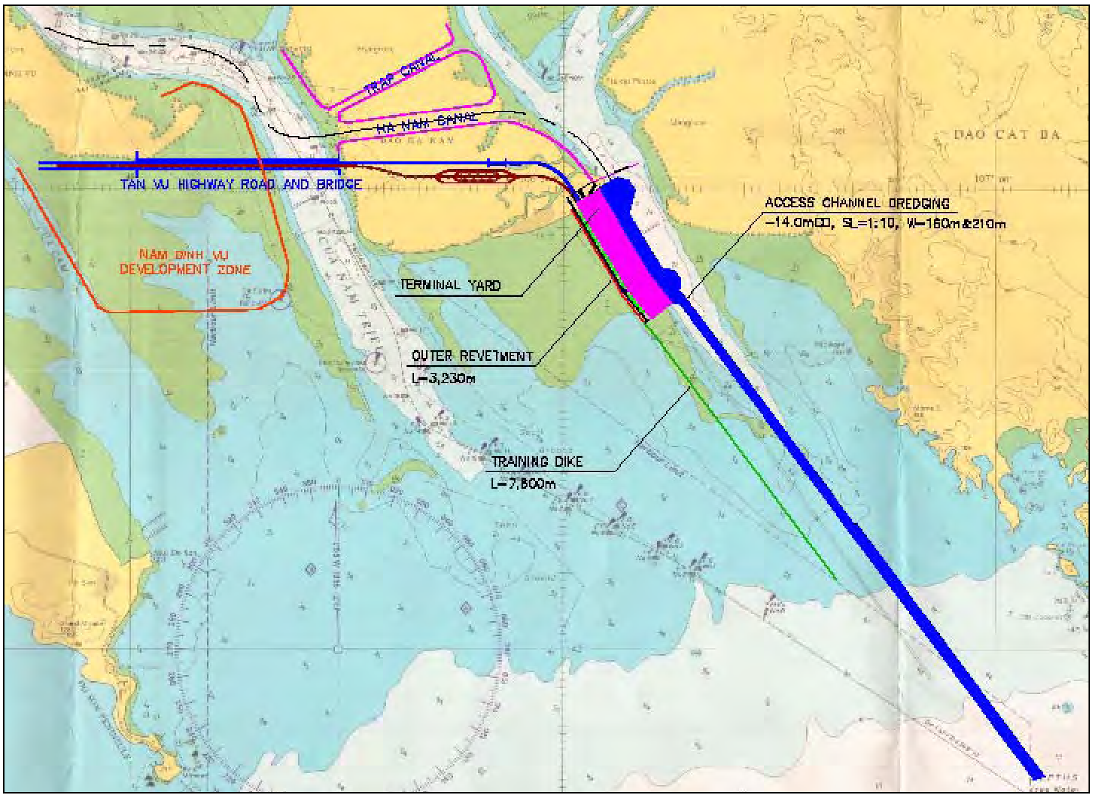


Figure 12.2.1 Work Plan

12.2.2 Dredging of the Access Channel

The existing access channel with design depth of -7.2m CD and the width of 100m will be dredged to the elevation of -14.0m CD with the width of 160m by 2015. After 2015, maintenance dredging of the channel shall be necessary and its estimate volume is subject to the simulation result.

The design slope is 1:10 considering the actual soil condition on site, and the total dredging volume is estimated around 32,300,860 m^3.

Cutter suction dredger (CSD) and Trailing Suction Hopper Dredger (TSHD) will be used for the dredging work. Both types of dredgers are available at the local dredging company, but their capacity is rather small and insufficient to complete the dredging work on time. Therefore, foreign dredgers with larger capacity such as CSD of 6,000ps class and TSHD with hopper capacity of 10,000 - 20,000m^3 shall be mobilized.

For the maintenance dredging, it is recommended to use TSHD (which requires no anchoring) in order not to disturb the ongoing port operation and to ensure safety of berthing/un-berthing of the vessel.

12.2.3 Dumping Area for the Dredging Material

Since existing soil of the channel is not suitable as the reclamation material, basically all the dredged material will be dumped at the designated dumping sites. When CSD is used, the dredged material is pumped into the hopper barge moored alongside, and it will be pushed to the dumping ground by pusher tug boat for dumping. After dumping is completed, the barge will be moored alongside CSD for next loading. As for TSHD, she will sail to the dumping ground by herself once her hopper is full.

12.2.4 Reclamation of the Terminal Yard

The terminal yard including access road of 200m in width behind the terminal will be reclaimed to the elevation of +5.5mCD to +6.0mCD. Main reclamation material is the sand from river, and the total reclamation volume is estimated to be around 12,090,000m^3.

The sand will be transported to the site by barges, and it will be pumped into the terminal yard by sand pump. The reclamation will basically start from the land side towards the sea.

12.2.5 Soil Improvement Work

After reclamation, the ground will be improved by PVD (Plastic board Vertical Drain) method. The base machine will install casing with plastic drain material into the reclaimed ground @1.2m square as shown in Figure 12.2.2. The total area to be improved for the terminal yard (including access road width of 200m behind the terminal) is around 2,380,000m^2.

After the installation of the plastic board drain material, thin layer of the sand (Sand mat: thickness around 0.5m to 1.0m) will be laid in order to create drain layer. Then preloading will be commenced by embankment. Embankment will be carried out by excavator, bull dozer and pay loader. Embankment material will be transported by barge, and loaded up to the sand stock yard within the reclamation site. Once the required consolidation degree is achieved, the embankment will be removed and leveled to the design elevation for the next step of work.

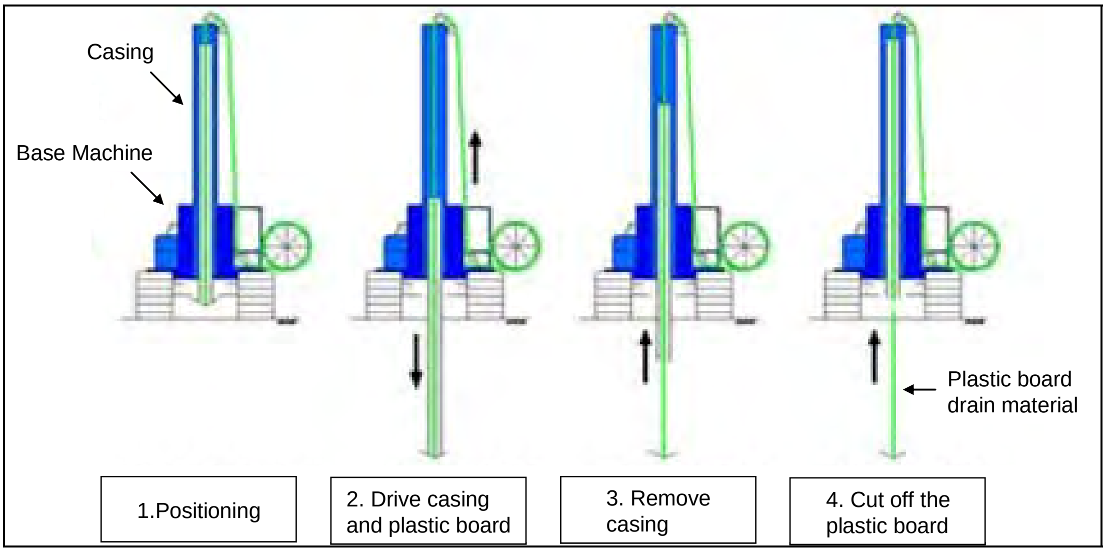


Figure 12.2.2 Construction procedure of PVD

12.2.6 Construction of Container Wharf Structure

1) Construction of the Earth Retaining Wall

Once reclamation and soil improvement is completed for some area, steel sheet pipe pile (SSPP) of D800mm and steel sheet pile anchor wall (SP) will be driven by land piling machine equipped with the diesel hammer or hydraulic hammer to construct earth retaining wall. SSPP will be driven until 1/4D (200mm) of the pile penetrates into the silt stone layer. The driven SSPP and SP will be connected with tie rod or tie cable. After tie rods or cable ties are tensioned, capping concrete will be casted and the area will be backfilled by sand or soil.

2) Dredging of the Slope in front of the Quay and Berthing Box

After the construction of the earth retaining wall, the slope in front will be dredged with the slope gradient of 1:3 by grab dredger. The slope near the earth retaining wall may require trimming from the land in order not to damage the retaining wall.

3) Marine Piling

After the dredging of the slope is completed, piling for the berth structure will be commenced by piling barge. The piles are transported and stocked on a barge and moored alongside the piling barge. Pile position will be checked and confirmed by the survey from the land before the driving. The piles needs to be driven into the silt stone layer in order to obtain sufficient bearing and tension capacity, and may require pre-boring by earth auger prior to the driving in case when sufficient penetration cannot be achieved.

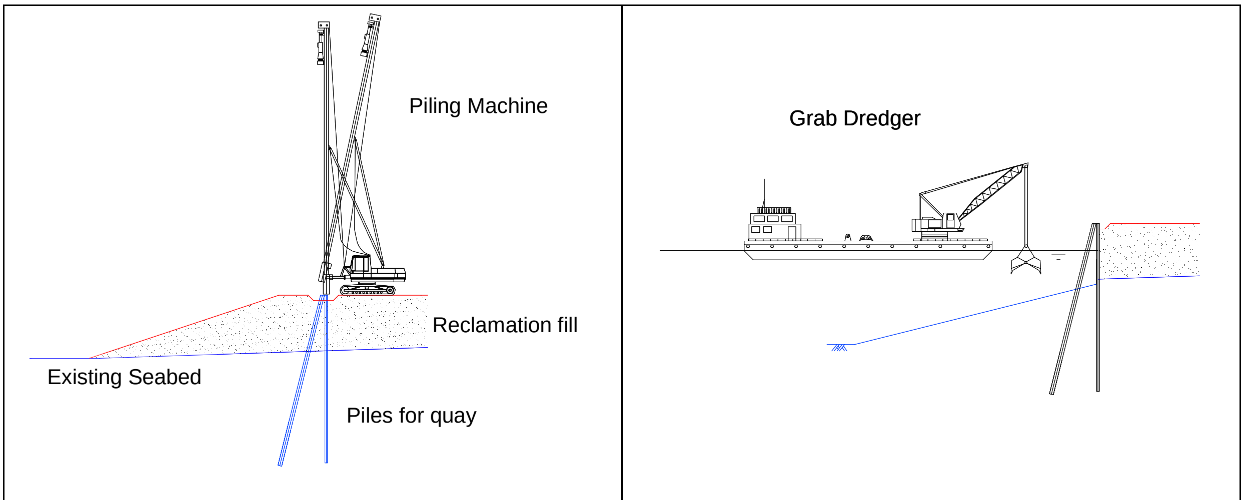
4) Slope Protection Work

The slope will be protected by placing small stone and armor stone transported to the site by barges. The stone work will be carried out both from the land and from the sea. Crawler crane and long arm excavator will be used on the land, while crane barge with orange bucket and/or flat barge with long arm excavator mounted will be used for the sea. The stone will be placed by hand as well.

5) Superstructure Work

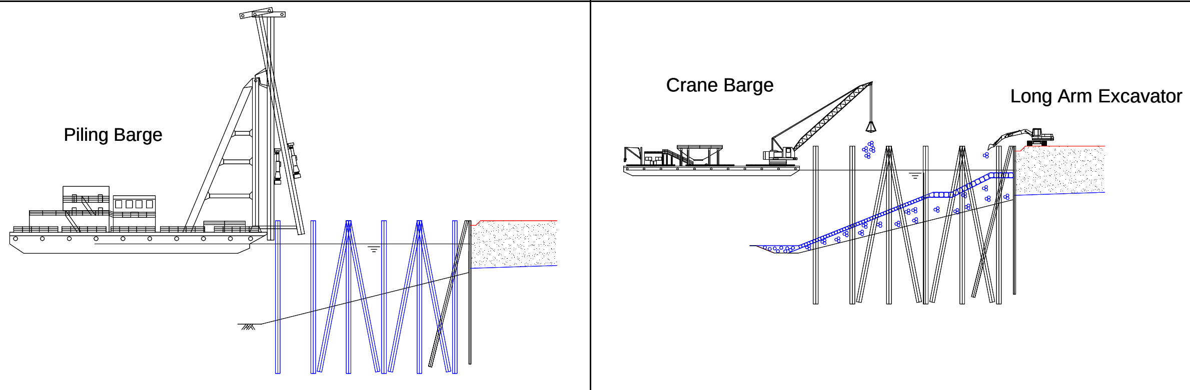
Where the slope protection is completed, temporary staging (H-beam) will be installed on the piles. Then the pre-fabricated beams will be launched by crawler crane on land and crane barge from the sea.

After launching, rebar tying and form work will start followed by in-situ concrete casting to joint pre-fabricated beams. The slab will be pre-fabricated on land as well and they will be launched by crawler crane on land and crane barge from the sea. The final elevation of the jetty surface will be adjusted by the topping concrete casted on top of the precast slab. It is planned to make prefabricated concrete as much as possible so that the construction period can be shorten.



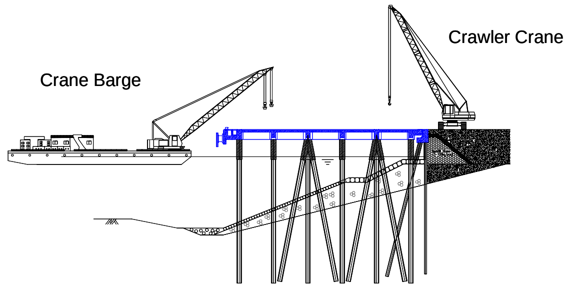
1. Piling of the earth retaining wall

2. Dredging of the slope



3. Piling from the sea

4. Slope Protection work



5. Superstructure work

Figure 12.2.3 Sequence of the Berth Construction

6) Pavement

Interlocking concrete block (ICB) heavy duty pavement and asphalt pavement will be applied for the container terminal and multi-purpose terminal / access road respectively.

ICB pavement consists of Base (sub-base soil and crushed rock base), Concrete base, Sand bedding and ICB. Base material will be transported by barge and loaded up into the dump truck from the temporary jetty by excavator and bulldozer. It will be compacted with required thickness and CBR by compaction roller and/or tire roller. Concrete base will be casted on top of the compacted Base followed by the sand bedding. ICB will be installed by man power after adjusting the elevation of sand bedding.

Asphalt pavement consists of Sub-base, Base course, Binder course and Surface course. Base material will be transported, loaded up and compacted in the same method as ICB base material. Then bituminous stabilized base course delivered from the asphalt plant will be laid and compacted. Prime court will be sprayed on top of bituminous stabilized base, and Asphalt binder course will be spread by asphalt finisher and compacted by roller. Tack coat will be applied on the binder course surface, and Asphalt surface course will be sprayed by asphalt finisher and compacted by roller. All the asphalt will be produced in the asphalt plant set up in the project site.

12.2.7 Construction of Multi-Purpose Wharf Structure

The construction method and sequence of the multi-purpose terminal is more or less same as the container terminal. One of the differences is the pile design which is Pre-stressed Spun High Strength pile (PHC pile) instead of the steel pipe pile, but the driving method of the pile is basically the same.

12.2.8 Port Protection Facilities (Outer revetment and Sand protection dike)

1) Outer revetment

The total length of outer revetment is 3,230m and it will be constructed in the initial phase. The base of outer revetment requires soil improvement, and it will be reclaimed by sand pump to the elevation of around +4.0mCD in order to enable soil improvement work by land machine. After the ground soil is improved, the seabed will be excavated to +0.5mCD by long arm excavator to place core rubble and amour stone. Then capping concrete casting and backfilling will be commenced followed by the installation of toe protection concrete block and wave dissipating concrete blocks. All the work shall be carried out from the land.

2) Sand Protection Dike

The total length of sand protection dike is 7,600m and it will be constructed in the initial phase. The base of dike does not require improvement, and the stone mound will be directly placed on the existing seabed by flat barge with long arm excavator mounted and/or crane barge with orange bucket. Then capping concrete will be casted followed by installation of wave dissipating concrete blocks. Installation of wave dissipating concrete blocks will be done by crane barge.

As the construction of the terminals progress after the initial phase, the sand protection dike needs to be reinforced to be used as outer revetment.

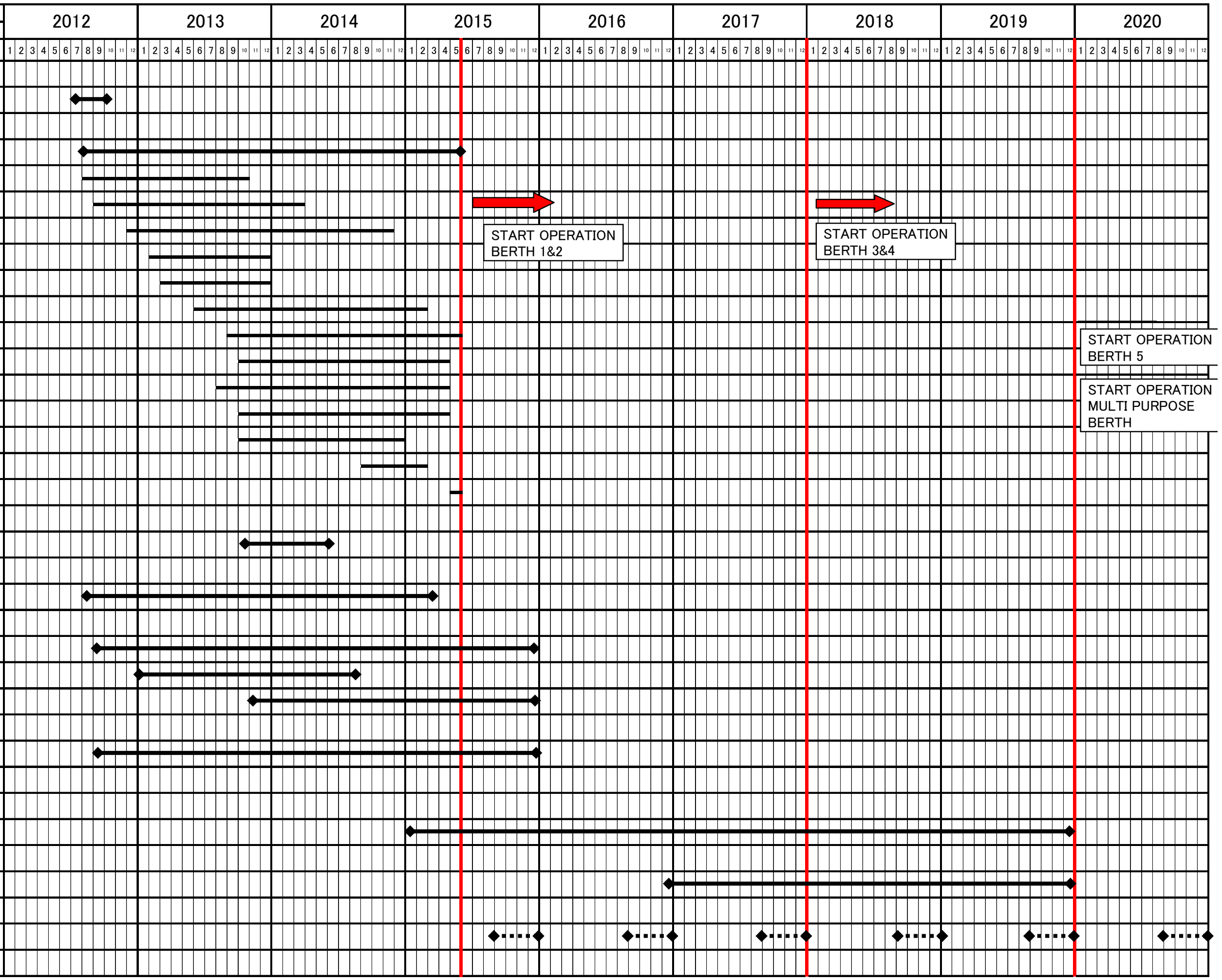
12.2.9 Construction schedule

Due to the weather condition on site, four days are not workable through the year; two (2) days due to foggy weather, and two (2) days due to the storm. Furthermore, there are nine (9) public holidays and fifty two (52) Sundays. Thus, the workable days for marine work are estimated to be 300days per year, which makes 25days per month.

The tentative construction schedule for medium term development is shown in the Table 12.2.2. It should be noted that this schedule is planned based on the estimation that all the steps such as the detail design, procurement as well as construction works will progress in a timely manner without any delay or accident. With reference to the berth 3 and 4, it should be developed when the cargos for berth 1 and 2 increased beyond its capacity. The actual time of development is decided based on the actual condition of the market at that time. Since the berth 1 and 2 will be developed by PPP scheme, the development of berth 3 and 4 are to be commenced when the public and private agree on the condition that the profitability of berth 1 and 2 will not be impaired by the development.

Table 12.2.2 Tentative Construction Schedule for Medium Term Development of Lach Huyen Port

ID	Task	Unit	Quantity	Remark
YEAR 2015 STAGE				
1	Preparation Work	ls	1	Office, loading jetty etc
2	Container Terminal Construction	m	750	375m x 2berth
2–1	Reclamation	m3	2,955,483	Sand Pump
2–2	Soil improvement	m2	625,769	CDM and PVD
2–3	Preload	m3	2,680,000	Sand
2–4	Earth Retaining Wall	m	750	Land Piling
2–5	Dredging of the slope	m3	568,000	Grab Dredger
2–6	Marine Piling	no	1,330	–
2–7	Berth Structure	m	750	–
2–8	Pavement	m2	409,500	ICB
2–9	Equipment	ls	1	Gantry crane etc
2–10	Utility	ls	1	–
2–11	Building	ls	1	–
2–12	Access Road behind the port	m	1,000	W=200m
2–13	Inspection and Clean up	ls	1	–
3	Inner Revetment (South)	m	750	–
4	Access Channel Dredging	m3	29,000,000	Cutter Suction Dredger
5	Outer Revetment	m	3,230	
	Type–A	m	720	Behind the terminal
	Type–B	m	2,510	Future reclamation on port side
6	Training Dike	m	7,600	
YEAR 2020 STAGE				
7	Container Terminal Construction	m	1,600	400m x 4berth
8	Multi–Purpose Terminal Construction	m	750	250m x 3berth
9	Maintenance Dredging of Channel	m3	–	–



12.2.10 Material Availability

Basically most of the construction material can be found around project site. For the reclamation sand, there are some concerns in the transportation capacity and permitted volume of dredging.

The survey on sand potential of two rivers in Hai Duong Province (about 70km distant by river from Lach Huyen port location) was carried out in 2004. After one year of the study, it was found that there are 19 sand accumulation sites which can be used for sand digging with the total volume of around 530,000,000m^3.

By the information obtained from local sand supplier in Hai Duong District, there is one area permitted to dredge about 6million m3 of sand at the time of SAPROF study (March, 2010) and the application of two other area with total estimated volume of 12million m3 was in progress, which are estimated to be approved by summer of 2010. The distance from their sand source to Lach Huyen project area is about 70km by river way, and according to them, it takes 3 days to make 2 trips (1.5days/trip). The size of the barge varies from 300m3 to 500m3, and all the barges are equipped with the sand pump. There are many barges which can be mobilized according to the necessity.

Table 12.2.3 Sand sources in Hai Duong District

No.	Name of sand area	Area (ha)	Borehole depth for reserve evaluation (m)	Reserve amount (m3)
I, Thai Binh River				23,281,785
1	Hiep Cat No, 1	32	-3	960,000
2	Hiep Cat No, 2	11	-3	330,000
3	Kenh Vang	20	-3	600,000
4	Thai Tan 2	53	-3	1,590,000
5	Duc Chinh	222.93	-3	667,000
6	Minh Tan	28	-3	840,000
7	Dai Dong	210	-5	4,630,765
8	Phuong Hoang	12	-3	360,000
9	Tu Xuyen	220	-5	4,404,020
10	An Thanh	96	-3	2,880,000
II, Kinh Thay River				30,556,634
1	Nam Hung	29.2	-9.5	2,774,000
2	Vinh Tru	223.71	- 6	8,485,714
3	Dong Lac	62	-9.5	5,890,000
4	Cong Hoa	218,0	- 8	7,317,920
5	Phuc Thanh	18.1	-9.5	1,719,000
6	Cau Quan	20	-9.5	1,900,000
7	Le Ninh	11	-9.5	1,045,000
8	Ben Trieu	03	-9.5	285,000
9	Kinh Chu	12	-9.5	1,140,000
Total (I+II):				53,838,419

Source: Hai Duong Government Electronic Getway; on August 2005 by Mr. Vuong Duc Tranh, Chief of Natural Resource Management Division, Hai Duong DONRE

12.2.11 Facility for the site

Currently the only access to the project site is by the ferry. Therefore, during the construction period it is necessary to set up concrete batching plant, asphalt plant and pre-cast concrete yard within the project area. Their location is either in the reclamation site, or in Cat Hai Island.

In addition to above, temporary jetty needs to be constructed in order to load/unload the construction materials such as the sand, the rock and soil, pre-cast items, and so on.

12.3 Development Cost

The estimated total development cost for target year 2020 is shown in the below table. Premise and calculation basis is mentioned in Chapter 16.2.

Table 12.3.1 Estimated Development Cost for Target Year 2020

No.	Item	Unit	Quantity	in **VND**		in **USD**	in **JPY**
				Unit Price	Amount	Amount	Amount
I	**Construction Expenses**						
1	**Container Terminal**				***7,481,918,618,937***	***440,898,776***	***39,504,530,308***
a	Container Terminal	m	2,000.0	3,620,535,912	7,241,071,823,382	426,706,018	38,232,859,227
b	Barge Berth	m	150.0	1,605,645,304	240,846,795,555	14,192,758	1,271,671,081
2	**Dredging**				***5,918,886,127,689***	***348,791,504***	***31,251,718,754***
a	Access Channel	m3	32,300,860.0	160,927	5,198,064,989,137	306,314,544	27,445,783,143
b	Wharf Slope Dredging	m3	2,238,598.0	223,127	499,491,342,362	29,434,311	2,637,314,288
c	Berth Box	m3	337,886.0	223,127	75,391,442,191	4,442,710	398,066,815
d	Between Channel and Berth Box	m3	654,060.0	223,127	145,938,353,999	8,599,939	770,554,509
3	**Reclamation**				***2,454,564,015,423***	***144,643,951***	***12,960,098,001***
a	Terminal Area with Access Road	m3	12,088,923.0	203,042	2,454,564,015,423	144,643,951	12,960,098,001
4	**Port Protection Facilities**				***2,634,183,351,319***	***155,228,662***	***13,908,488,095***
a	Inner Revetment	m	750.0	40,162,324	30,121,742,708	1,775,031	159,042,801
b	Outer Revetment-A	m	720.0	193,692,006	139,458,244,549	8,218,075	736,339,531
c	Outer Revetment-B	m	2,510.0	193,692,006	486,166,935,860	28,649,123	2,566,961,421
d	Training Dike-1	m	3,110.0	135,785,924	422,294,223,886	24,885,195	2,229,713,502
e	Training Dike-2	m	3,290.0	332,374,699	1,093,512,759,260	64,439,145	5,773,747,369
f	Training Dike-3	m	1,200.0	385,524,538	462,629,445,055	27,262,092	2,442,683,470
5	**Soil Improvement**				***3,423,654,172,886***	***201,751,049***	***18,076,894,033***
a	Terminal Area	m2	1,730,975.0	1,356,451	2,347,983,425,697	138,363,309	12,397,352,488
b	Barge Berth Area	m2	5,000.0	3,373,909	16,869,543,472	994,098	89,071,190
c	Inner Revetment	m2	4,550.0	2,324,418	10,576,099,708	623,234	55,841,806
d	Outer Revetment A	m2	13,104.0	2,094,872	27,451,201,872	1,617,660	144,942,346
e	Outer Revetment B	m2	52,459.0	5,019,258	263,305,260,915	15,516,203	1,390,251,778
f	Access Road	m2	652,000.0	1,161,762	757,468,641,221	44,636,545	3,999,434,426
6	**Access Road behind Port**				***233,938,987,178***	***13,785,690***	***1,235,197,852***
a	Access Road	m	3,260.0	71,760,426	233,938,987,178	13,785,690	1,235,197,852
7	**Public Related Facilities (CIQ)**				***504,218,092,199***	***29,712,852***	***2,662,271,527***
a	Reclamation	m3	344,131.0	203,042	69,873,186,320	4,117,527	368,930,424
b	Dredging	m3	103,897.0	223,127	23,182,211,365	1,366,095	122,402,076
c	Quaywall	m	375.0	476,452,600	178,669,725,151	10,528,752	943,376,149
d	Pavement	m2	120,800.0	1,071,745	129,466,780,803	7,629,292	683,584,603
e	Building	L.S.	1.0	59,935,258,841	59,935,258,841	3,531,899	316,458,167
f	Utilities	L.S.	1.0	28,349,124,722	28,349,124,722	1,670,573	149,683,379
g	Soil Improvement	m2	23,600.0	624,653	14,741,804,996	868,714	77,836,730
8	**Multi Per Purpose Terminal**				***1,061,519,133,890***	***62,553,806***	***5,604,821,027***
a	Multi Purpose Terminal	m	750.0	1,415,358,845	1,061,519,133,890	62,553,806	5,604,821,027
9	**Navigational Aids**				***121,719,208,121***	***7,172,739***	***642,677,419***
a	New Channel Buoys	nos	20.0	5,438,764,550	108,775,290,991	6,409,973	574,333,536
b	Relpace Existing Buoy	nos	3.0	97,456,616	292,369,849	**17,229**	1,543,713
c	Light Beacon	nos	4.0	909,915,542	3,639,662,168	214,480	19,217,416
d	Pilot Assistance System	L.S.	1.0	9,011,885,114	9,011,885,114	531,058	47,582,753
	Total Construction Expense				**23,834,601,707,642**	**1,404,539,029**	**125,846,697,016**
I	**Equipment Expenses**				***6,909,301,597,091***	***407,155,273***	***36,481,112,433***
1	**Equipment for Container Terminal**	Berth	5.0	1,038,827,888,000	5,194,139,440,000	306,083,217	27,425,056,243
2	**Equipment for Multi Purpose Terminal**	Berth	3.0	571,720,719,030	1,715,162,157,091	101,072,056	9,056,056,189
	Total Equipment Expense				**6,909,301,597,091**	**407,155,273**	**36,481,112,433**
	Total Cost				**30,743,903,304,732**	**1,811,694,302**	**162,327,809,449**

13. Consideration of Natural and Social Environment

After the comprehensive review of the TEDI's Lach Huyen port infrastructure construction study, SAPROF study team recommended some change in design of the TEDI's port design. After the fact finding mission by the JICA representatives in March 2010, MOT agrees the recommended change in design. Following are the major changes between TEDI-F/S and SAPROF study.

Item	TEDI F/S	SAPROF study team	Remarks
1. Design vessel for container berth	Fully loaded 30,000DWT vessel Partial loaded 50,000DWT vessel	Fully loaded 50,000DWT vessel Partial loaded 100,000DWT	Total berth length changes from 600m to 750m accordingly
2. Channel Width and Depth	130m wide, -10.3m deep below CDL	160m to 210m wide, -14m deep below CDL	Due to change of design vessels.
3. Length of sand protection dyke	Applying till -3m	Applying till -5m	Total length changes from 5,700m to 7,600m
4. Public Related Facilities/ Service Berth	Not included	1) Land reclamation 2) Service boats berth, 3) Port Admin. Bld., 4) Amenity Bld. 5) Pavement	1) Land Reclamation: 344,000 m^3/Berthfront dredging: 104,000 m^3 2) 375mL x 30m W, -4m, 3) & 4) 4,600 m^2 5) 121,000 m^2

Expected impacts on the natural and social environment with the SAPROF proposal are summarized as follows.

13.1 Natural Environment

Natural environmental consideration is concerned to basically both the construction and subsequent operation stages of the Lach Huyen gateway port development project as proposed by the Mid Term Development Plan up to the year 2020. In this report the related bridge across Bach Dang Estuary to facilitate road (and also railway) link between mainland Hai Phong and the port (in Cat Hai Island) is not taken into consideration. This Bridge Project is conducted as separate SAPROF Study.

Consequent of the changes in design by the SAPROF in comparison to the original TEDI F/S (The quantity of works are summarized in Table 12.2.1 of Chapter12), on overall basis, the following changes and it effects, if any, on natural environment are regarded as most significant.

(1) Effect due to extension of sand protection dyke from 5.7 km to 7.6 km and the resultant sedimentation phenomenon of sand trapped by the dyke in the exterior seabed area of the access channel facing the offshore of Nam Trieu (Bach Dang) Estuary

(2) Effect in the phenomenon of dispersion of oil in case of accidents due the expansion of port terminal area in addition to the extension of sand protection dyke as noted above and

(3) Effects due to expansion in lateral area (widening) and depth (deepening) of dredging (the length of access channel dredging in fact slightly decreased from 18 km to 17.4 km) that resulted in very significant increase in the quantity of dredged material to about 33 million m^3 from about 9 million m^3 as of TEDI F/S.

Still overall effects due to construction works and the required mitigation measures that are short-term effects confined to the period of construction works that basically involves reclamation works and dredging works remained unchanged even though the quantity of work requirement very significantly increased in case of dredging works. The entire effects (both natural and social environmental effects) due to both construction and operation of the port facility with relevant mitigation measures are summarized in the JBIC Environmental Checklist shown in Table 13.3.1. The significant relevant natural environmental aspects including mitigation measures separated between construction and operation stages of the project are briefly dealt with below.

13.1.1 Construction Stage Aspects

The natural environmental issues concerned to construction stage of the project falls into 3 broader categories. They are; (1) Effects due to sourcing of required material for construction works, in particular sand, soil, gravel, stones and rocks that would involve sourcing of these materials from natural environmental areas of lands and also underwater (in particular sand and gravel are widely sourced in Vietnam from rivers and estuaries), (2) Dredging and dredged material management issues which is very significant in particular considering the generation of high quantity of dredged material consequent to the deepening of access channel (the dredged material quantity is estimated around 33 million m3) and (3) EHS (environment, health and safety) management and monitoring aspects of construction works (by the construction contractor).

The relevant mitigation measures are incorporated in the approved EIA Report (2008) that basically proposed near-shore locations for the disposal of dredged materials. These aspects including the relevant alternative means of dredged material disposal and mitigation measures are further dealt with below.

1) Sourcing of Materials for Construction of Port Facilities

The locations for sourcing the required construction materials have been indicated in the Appendix 1 of the approved EIA Report (2008). Those locations are also agreed upon among all relevant stakeholders including MONRE (Ministry of Natural Resources and Environment). Accordingly, those locations are regarded as legally approved quarry sites determined with due diligence so as not no cause significant adverse environmental effects consequent to the sourcing of those materials like sand, soil and other natural resources. Still, considering the rapid pace of ongoing infrastructure development in Vietnam, in this region of northern Vietnam in particular (Hai Phong being the third largest city with closest port facility from Hanoi), these identified sites might run out of the sources by the time for the start of actual construction works for the project. Accordingly, during construction planning by the construction contractor, availability and suitability of these sites has to be reevaluated and reconfirmed along with other potential alternative legally approved sites so that the required source material could be procured. Due diligence has to be exercised by the construction contractor to ensure all procurement of such natural resources for construction of port facilities like sand, soil and stones are obtained from legally certified and approved suppliers located as close as possible from the construction site so as to economize the procurement cost as well.

The proposed construction plan for the project duly confirmed that the procurement of all required natural resources for construction could be supplied by legally certified suppliers located close to project site in Hai Phong and nearby Hai Duong areas. In this regard it is noted that some of those areas mentioned in the EIA Report (Appendix 1) for souring of construction materials like sand are located far away from the project site (the proposed locations for souring of sand at Son Lo, Viet Tri and Phu Tho are located very far at upstream Red River reaches of Hanoi) and it is not necessary to go this far to procure materials required for construction works.

2) Dredging and dredged material management

Maintenance dredging works for the existing approach canal to the Hai Phong port has been done periodically over a long period of time and hence Hai Phong port has a lot of experience in dredging and dredged material management disposal in the area planned for the port construction works. In this regard also locations suited for disposal of dredged materials have been agreed upon among all relevant stakeholders and included in the Appendix 1 of the EIA Report (2008). Those locations that have been agreed upon are the coastal inland lowland area located in the vicinity of Bach Dang Estuary with the planned South Dinh Vu (Nam Dinh Vu) reclamation area being the largest and easily accessed coastal area with capacity to receive even up to 50 million m^3 of dredged material. The quantity of dredged material, though not significantly contaminated and could be regarded as natural dredged material (refer to Section 9.2 of Chapter 9), is quite large of about 33 million m^3 principally due to access channel widening and deepening requirement up to 14 m below CDL for the planned Lach Huyen Port. Still it is less than the available capacity of 50 million m^3 in the South Dinh Vu Area. Accordingly it is possible to dispose the entire dredged material derived by this project in this easily accessed Nam Dinh Vu area (Refer to Figure 16.1.5 of Chapter 16 for the disposal location of Nam Dinh Vu area and also other smaller disposal areas located in communes as also identified in the approved EIA Report of 2008).

Still this Nam Dinh Vu area is also targeted for reclamation to be an industrial estate and it may not be available for dredged material disposal during the conduct of (capital) dredging works of this project if the reclamation work has already been accomplished by that time. Accordingly, during detailed engineering more alternative sites for the disposal of dredged materials may be required to be investigated including potential sites for offshore disposal since such large quantity of dredged material could not be disposed in a timely manner other than in Nam Dinh Vu area.

In such a case environmental effects and mitigation measures for other locations and means of disposal like offshore disposal shall be studied as component of change in design of dredging works of the detailed engineering design and the relevant additional (supplementary) EIA Report shall be formulated for approval by MONRE prior to the start of construction works. There is sufficient time frame to conduct such environmental impact studies during detailed engineering design works (that would also include tendering stage, if necessary) and to formulate and obtain approval for additional EIA Report if additional alternative disposal means like offshore disposal for dredged material is deemed necessary.

A time frame of 6 months is considered adequate to conduct EIA study focused on alternative offshore locations for dredged material disposal (due to capital dredging). Since offshore disposal seems to be the physically viable option, alternative offshore locations with seawater depth of at least 20m and possibly located in between the offshore area bounded by the planned Sand Protection Dyke and Do Son (also known as Bac Bo Bay as shown in Figure 16.1.5 of Chapter 16) is regarded as suitable since this offshore area should have naturally high turbidity (located at offshore of Bach Dang/Nam Trieu Estuary with high sediment load and also sufficiently far away from Cat Ba Island but still close to the dredging area). Alternative locations in this offshore area shall be studied with simulation on the area and extent of spread of turbidity (SS/suspended solids) consequent to the disposal of dredged material with due consideration to significant constraints like effect due to spread of turbidity on important fishing grounds, Cat Ba Island and other coral reef islands.

During this capital dredging work navigation safety of dredger operation is very important since this access channel targeted for dredging is traversed by vessels to Hai Phong Port (functional access channel). It is also noted that some adverse effects due to dredging works for widening and deepening of the existing access channel on marine biota (in particular on seabed benthos) are inevitable. Still any adverse effect is regarded as not that significant in consideration to the past experience of similar works and also the availability of vast unaffected seabed area in the vicinity of the dredged area serving as habitat for marine biota.

3) EHS Aspects of Construction Works

Due diligence to ensure implementation of necessary environment, health and safety (EHS) measures in integral manner during the execution of the construction works by the construction contractor (also could be referred to as proper construction management or good construction practice) need not be overemphasized considering also the location of the construction works in offshore area. Contractor as the first priory shall ensure the safety of his construction works and workers with strictly in compliance with “Safety First” concept that would also include mandatory use of necessary safety gears by the workers like protective clothing, helmets, ear plugs, goggles, safety shoes and others (personal protective equipment/PPE) as appropriate. Navigation safety of transport barges of construction materials (with proper scheduling to avoid congestion and interference to other boats and ships in the area adjacent to the functional Hai Phong port) is also very important. Waterway is the only available accessible means to the project site in Cat Hai Island.

Moreover, all wastes generated due to the construction works including living wastes generated by the work force has to be managed sanitarily and treated as appropriate and disposed in such a manner so as not to cause water pollution and in the sensitive offshore area of the construction site located near Cat Ba Island (protected national park and ecotourism area) and also to ensure the cleanness of the work environment, which is also important to mitigate any disease and health issues in the work force attributed to unsanitary or unhealthy environmental condition. This also includes due focus on 3R (reduce, reuse and recycle) with segregation and management disposal of solid wastes generated. Fugitive (dust) emission from stock piles of sand and others need to be duly controlled with water spray or vinyl covering as appropriate. This is regarded as the most significant mitigation measure of air pollution control at construction site.

Moreover, contractor shall conduct (contractor may be obliged to conduct) periodic regular environmental monitoring in both on-land area of Cat Hai Island and offshore area of the construction site at Lach Huyen Estuary by using the services of an independent reputed organization to conduct all such environmental monitoring related sampling and analysis work.

In this regard, the required environmental monitoring plan is basically incorporated on a preliminary basis in Chapter 6 in the EIA Report (2008), which is also updated in the SUPPLEMENTAL EIA Report study by the SAPROF. Still this is a tentative monitoring plan that needs to be reviewed and reformulated in detailed engineering. The reformulated environmental monitoring plan for construction stage during detailed engineering will be duly included in the technical specifications and contract tender documents in accordance with relevant contract packages (in this case 2 construction contract packages are proposed separated between dredging works and port terminal and related facility construction works as given in Section 17.4 of Chapter 17). The tentative environmental monitoring plan (program) as updated by the SUPPLEMENTAL EIA Report is given in Appendix 13-1

13.1.2 Operation Stage Aspects

Operational safety in port terminal including navigational safety in ship berthing and effective measures to handle emergency situation like ship accidents, fire and oil spills is the most significant aspect of port operation. Moreover, effective surveillance system to ensure all ship originated wastes are duly disposed in the port terminal and not illegally dumped into the port waters is also very important. The other significant aspect is management of maintenance dredging works including disposal management of dredged materials. These measures have added significance also considering the location of the port in the vicinity of Cat Ba Island (a protected national park). In effect port operational (and also navigational) safety and both port operation and ship related pollution control issues (including maintenance dredged material management that is dealt with under port waste management of below and also in Chapter 22) are the most significant aspects of port operational impacts. All these port operational aspects could be comprehensively categorized as EHS (environment, health and safety) of port operational management.

The relevant mitigation measures of these aspects are basically incorporated in Chapter 4 of the approved EIA Report (2008), which is further dealt with below.

Concerned to the aspects of change in design due to sedimentation phenomenon of sand trapped by the dyke in the exterior seabed area of the access channel facing the offshore of Nam Trieu (Bach Dang) Estuary and effect in phenomenon of dispersion of oil in case of accidents due the expansion of the area of berth development (as well as extension of sand protection dyke) the relevant simulation studies done in approved EIA Report were redone based on the revised project design by the SAPROF as a very significant component of SUPPLEMENTAL EIA Study. The study results confirmed that any potential effect due to change in design is not that significant from the original projection both with respect to spread of oil in case of accidents and any potential change in the exterior seabed topography of the sand protection dyke. In effect potential accumulation of trapped material at the exterior area of the sand control dyke is not that significant and also the dispersion of oil in case of rare accident could be controlled.

1) Port Operational Safety

Concerned to direct port terminal operation, overall operational safety including the safety in cargo handling work and work force (stevedores and others), in particular with respect to the handling of container cargo, is the most important aspect to be duly enforced by port operator/authority. In addition navigational safety of ship maneuver and berthing is the important aspect of near-shore safety of ships and vessels around the coastal waters of the port area. (The required navigational safety and vessel traffic control is described in Chapter 23.) Moreover, the necessary facilities and resources to deal with emergency situation like vessel accidents, vessel drifting, and fires including accidental oil spills (that might occur in rare instance) need to be incorporated and ready for action at short notice as the emergency management system of the port operation. These should also be regarded as essential technical requirement to be met for effective port operational management. These aspects including the management system to handle potential accidents and even simulation study on areas potentially affected in case of accidental oil spills are incorporated in Chapter 6 of the approved EIA Report (2008). The simulation study on oil spill is updated in the SUPPLEMENTAL EIA Report by SAPROF as mentioned above.

Still, at present in this port development plan up to the year 2020, the proposed port berth development is confined to handle only container and general cargo. So it is presumed that no oil terminals to handle significant (and large) quantity of oil as cargo (oil tanker vessels) and also significant noxious liquid cargo in bulk form (chemical tanker vessels) that would correspond to also generation of significant wastes corresponding the Annex I and Annex II of MARPOL 73/78 of IMO (International Maritime Organization) would be involved at this stage of port development. Still ships (in particular large container vessels) could carry significant quantity of bunker oil for combustion power requirement for ship movement. So accidental oil spills could occur in some rare instances due to damage of storage tanks of bunker oil in case of ship accidents. Accordingly, emergency management system to deal with potential oil spills as well (in addition to other emergency situations) is necessary as included in the approved EIA Report even when oil as cargo is not involved in the current port development plan (2020).

In this respect, even in future, provision of oil terminal facility in such a sensitive coastal water environmental area located in the vicinity of a number of protected and ecotourism oriented terrestrial and marine environmental areas of both national and international importance, namely, Cat Ba Island cum Lan Ha Bay and Ha Long Bay need to be carefully investigated along with alternative sites elsewhere since the risk of ecological damage caused by potential accidental (and large-scale) oil spill consequent to oil tanker vessel accidents to the protected coastal marine environment (and also to tourism) could be very severe even with the provision of all the necessary facilities well-intended to handle potential oil spill as significant component of emergency management system of port operation.

2) Port waste management

Considering the proximity of the port to Cat Ba Island (with its Cat Ba National Park, protected area) located basically at a distance in the range of only about 1 to 3 km away from the port across the Lach Huyen Estuary, minimization of waste generation at source in the first place consequent to the operation of port terminal and related facilities such as warehouses and cargo handling works (in particular potential excessive fugitive dust generation consequent to the handling of general cargo need to be controlled with proper cargo packaging and use of proper cargo handling equipment and methods since container cargo is in packed form within containers and hence could be regarded as clean cargo as long as packing work takes place elsewhere) and effective management of all wastes generated both consequent to port operation and ship berthing activities is utmost important. In this respect the necessary waste reception, treatment and disposal systems shall be incorporated as integral component of the port design. The necessary port waste management facilities are included in Chapter 4 of the EIA Report (2008).

Such waste reception and treatment facilities would include sewage (wastewater) treatment system to treat both human waste generated due to port terminal operation and also sewage disposed by berthing ships and vessels (waste corresponding to Annex IV of MARPOL 73/78), waste oil reception facility to receive oily bilge waste from berthing ships and vessels (waste corresponding to Annex I of MARPOL 73/78) and solid waste (garbage) reception facilities to manage both solid waste generated due to port terminal operation and also solid waste disposed by berthing ships and vessels (waste corresponding to Annex V of MARPOL 73/78).

The effective operation of all relevant waste reception facility in the port shall be complemented with an effective surveillance system to mitigate illegal dumping of wastes by ships and vessels (with high levy as fine to deter illegal dumping) within the port waters and its vicinity.

The waste management system for the port operation would also include effective management of periodical maintenance dredged materials. Periodic maintenance dredging would be necessary in the access channel to ensure continuity of design navigation depth. As far as possible near-shore disposal as practiced currently in the existing Hai Phong Port will be continued. This aspect on maintenance dredging is further dealt with in Chapter 22.

The above environmental protection and mitigation measures focused on the EHS of overall port operation shall be complemented with the implementation of regular periodical port environmental monitoring focused at least as the first priority on the monitoring of surrounding estuarine coastal port water environment of Lach Huyen Estuary. An overall port environmental monitoring plan is included in the EIA Report (2008) that is further updated in the SUPPLEMENTAL EIA Report formulated by this SAPROF and given in Appendix 13-1. This environmental monitoring plan is tentative and need to be reviewed and reformulated during the detailed engineering as also noted under Item 3) on EHS aspects of construction works (Section 13.1.1 of above).

13.2 Social Environment

13.2.1 Preparation Stage Aspects

For the consideration of the social environmental impacts during the preparation stage, following two primary issues are expected to be addressed. They are; 1) land acquisition, and 2) development and enforcement of safeguard policy for loss of coastal fishing area (Figure 13.2.1).

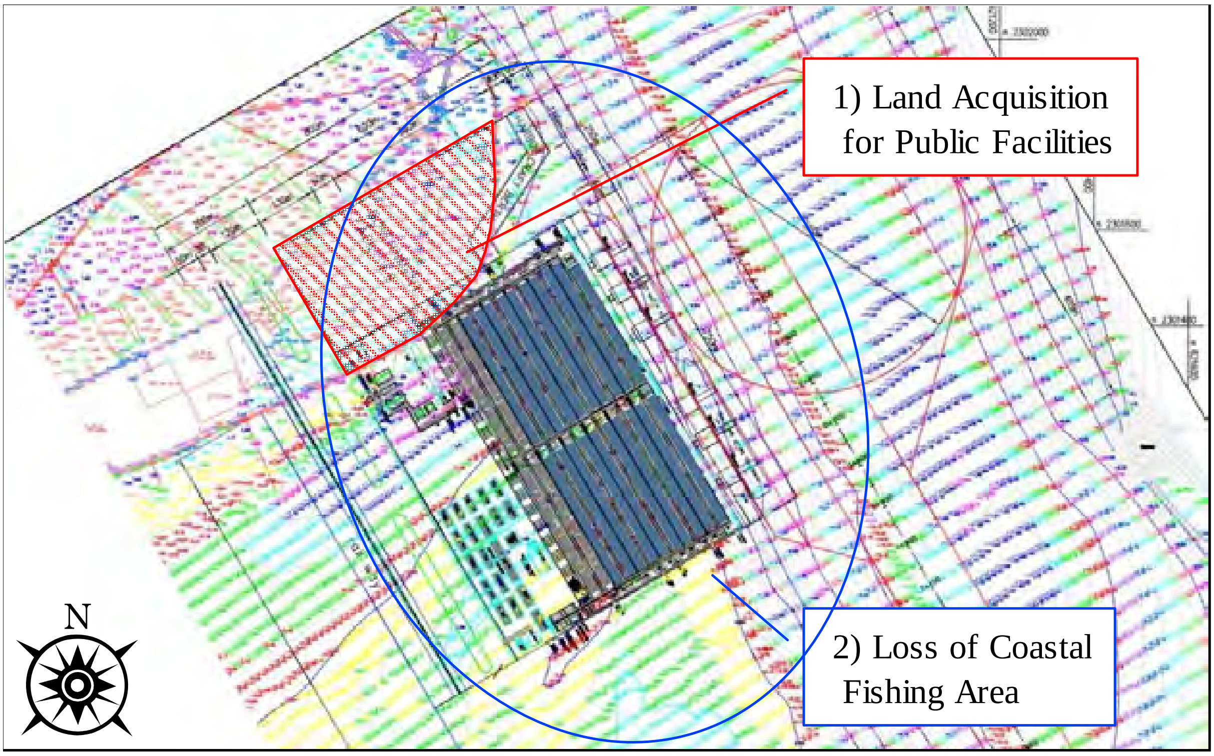


Figure 13.2.1 Special Attention Area for Social Environmental Consideration

1) Land Acquisition

Expected land acquisition area is shown in Figure 13.2.1 with red hutching area. Based on the field survey, there are no residential houses in the land clearance area. Based on the field survey at the project site with MPMU II, there are five (5) old graves along the coast, a border patrol office, a VINAMARINE VTS station, two roads, six (6) blocks of aquaculture ponds, and some bare ground and community forest. Due to the function of the border patrol office and VTS station, they are likely to sustain their function and facilities as present condition within the additionally proposed public facilities.

The expected impact of land use change would be 11.4Ha (considerable impact) excluding the existing government facilities, which is likely to function as a part of the new port's public facilities without major change (Table 13.2.1). Based on the field observation by SAPROF experts and MPMU II representatives at the site, there are no aquaculture activities in the expected land clearance pond.

At this moment, MPMU II is preparing the detailed land survey and land acquisition plan with the collaboration with relevant authorities. Detailed land use information and land acquisition plan will be given and implemented in six (6) month after MPMU II starts the initial process (Appendix 13-1). Thus, we assumed the potential impacts on the land as follows:

Table 13.2.1 Expected Impacts by the Land Acquisition

Present Use	Area (m^2)	Potential Impacts
1. Unknown use	7,200	There are no sign of land use at this moment. However, the property is just next to residential area so that the land use rights may belong to private. In case it does not belong to public, it is necessary to acquire the land with market price as defined by the effective regulations.
2. Gov. facilities	13,600	No potential impacts are expected due to its continuous functionality and no or little change in their facilities and properties for the new port.
3. Bare ground	26,300	There are no sign of land use at this moment except 5 graves. 5 graves will be relocated by the full support of responsible authorities.
4. Salt pan	1,500	This salt pan is still active in use. Though the acquired portion of the land would be minority of the targeted area, but it would be majority of the targeted area in case we count affected area by TanVu-LachHuyen Highway land clearance. In the case of the minor impacts, it would be only compensated by monetary under present regulation. In the case of the major impacts with the consideration of highway construction, not only monetary or land to land compensation but also support for livelihood recovery is also needed.
5. Aquaculture pond	64,700	Based on the MPMU II’s explanation, the aquaculture ponds belong to the border control office adjacent to the ponds. Since there are no activities in the pond at this moment, we assumed no impacts on the either local communities and the border control office.
6. Forest	10,200	The forest belongs to the local community and there are no sign of the environmentally essential species. Due to the land clearance for the highway, majority of the community forest will be cleared.
7. Road	4,300	These two (2) roads are primary connection between Cat Hai TT (town) and Got harbor at this moment. Reroutes along the public facilities of the port will be constructed and present necessary connection between Cat Hai TT and Got harbor.
Total	127,800	Total area
Considerable impacts	**114,200**	**Potentially required area for the land clearance**

There are three items (graves, aquaculture ponds, bare ground) belong to private property or economic activities, which are likely to be covered by effective land law and relevant safeguard policies. However, as described in section 9.3.2, there are some gaps between the JBIC Guideline/WB OP 4.12 and Vietnamese safeguard policies. Also, the separately studied connecting highway between Tan Vu and Lach Huyen port is likely to be required to adapt the JBIC Guideline. Thus, a CONSISTENT POLICY on resettlement, compensation, and support for the recovery of PAP’s livelihood between port portion and shall be considered as the Japanese ODA projects in the same area under MOT.

2) Development and Enforcement of Safeguard Policy for Coastal Fishing Activities

Expected loss of coastal fishing area is shown in Figure 13.2.1 with blue circle area. Based on the sample fishing survey at the project site and surrounding area, there are continuous and regular fishing activities at the proposed port development area. The project affected fishing boats (PAB) could be a couple of hundred to several hundred. However unlike farming, fishermen regularly move around to gain the fish yield so that impacts for such fishermen are relatively smaller than that of other land related economic activities, but it is not easy to estimate for the consideration of safeguards. However, it is highly recommendable to conduct detailed base line survey to consider the potential safeguard policy for such affected people.

In addition, unlike aquaculture and other farming activities, there are many immigrant fishermen living on their boats. Some of such immigrant fishermen regularly take fish, shrimp, shell fish at and around the proposed port area. As described in the previous section (9.3.4 Fishing Activities around the Proposed Project Site 2), the potentially affected fishermen do not have strong opinion for or against the proposed port development.

As shown bellow, the maximum source of impact area would be 208 ha in and around Lach Huyen estuary adjacent to Cat Hai island.

Table 13.2.2 Expected Impacts on Coastal Fishing

Proposed Use	Area (m^2)	Potential Impacts
1. Container terminal with service road	561,750	There is active coastal fishing in the area due to the favorable environment for small fish, shell fishes, and shrimp, and octopus are actively taken by local and immigrant fishermen living on the fishing boats. The fishing area will be permanently removed so that it is highly recommendable to provide reasonable safeguard measures to maintain or improve the standard of living for those who depend on coastal fishing in the project area. Though there are no safeguard policies at this moment under Vietnamese law and regulation, Hai Phong people's committee (the responsible authority) and MPMU II (the responsible implementation agency of the project) shall pay attention to such fishermen and implement a safeguard policy for such people on time.
2. Access Channel	278,400	Few potential impacts are expected due to its present functions. Though there are some fixed fishing nets along the existing channel, they have already been compensated for the relocation of the net for the port development project. However, deepening and widening of the channel might lead further loss of the fishing area.
3. Turning Basin	342,200	Some fixed fishing nets are observed at the proposed turning basin. Such fishing net owner may have already been given a 500,000VND for the relocation of the fishing net in the past. There are also some coastal fishing activities in the area at this moment.
4. Sand Protection Dyke	334,400	The cross section of the dyke increases water depth respectively. The dyke is also constructed on the shallower area along the channel where preferable fishing area at this moment. It is highly recommended to conduct detailed fishing survey to estimate the potential loss of fishing and discuss any possibility of occupation change as a sustainable solution.

For the consideration of the safeguard measures for the project affected fishermen, it is not quite common to consider such measure in Vietnam due to the lack of legal status/rights for offshore fishing activities. WB's safeguard policy also recognized the difficulties for a government of loan bellowers to provide compensation without legal status even if the government is willing to provide some safeguards. Considering the JBIC policy/WB OP 4.12, such safeguard measures could be considered by "Resettlement assistance." By the definition of WB OP 4.12, "Resettlement assistance may consist of land, other assets, cash, employment, and so on, as appropriate" for the compensation of land without any legal rights.

Based on the records of public consultation in the approved EIA and public hearing by MPMU II in

April 2010, vocational training is the highest interest for local residents to adapt the new environment and enjoy the potential benefits from the proposed port development. In order to address such interests and cooperatively guide the local communities, all concerned authorities as well as privates, for the potential employment in the construction and operation stage, should provide adequate training programs not only for project affected people but also those who are willing to work in the region at construction and operation stage.

Following column is the extraction of the JBIC Guideline on the safeguard policy.

Table 13.2.3 Extraction of the JBIC Guidelines for Confirmation of Environmental and Social Considerations, 2002

Part 2.

1. Environmental and Social Considerations Required for Funded Projects

In principle, appropriate environmental and social considerations are undertaken, according to the nature of the project, based on the following:

(Involuntary Resettlement)

· **Involuntary resettlement and loss of means of livelihood** are to be avoided where feasible, exploring all viable alternatives. When, after such examination, it is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected;

· People to be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by the project proponents, etc. in timely manner. The project proponents, etc. **must make efforts** to enable the people affected by the project, **to improve their standard of living, income opportunities and production levels, or at least to restore them to pre-project levels.** Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting the means for an alternative sustainable livelihood, and providing the expenses necessary for relocation and the re-establishment of a community at relocation sites; and

· **Appropriate participation** by the people affected and their communities must be promoted in **planning, implementation and monitoring** of involuntary resettlement plans and **measures against the loss of their means of livelihood.**

Following column is the extraction of the OP 4.12 for the reference of relevant safeguard policy.

Table 13.2.4 Extraction of the World Bank Operations Manual: Involuntary Resettlement (OP 4.12)

< http://go.worldbank.org/DZDZ9038D0>

Impacts Covered

3. This policy covers direct economic and social impacts5) that both result from Bank-assisted investment projects,6) and are caused by

(a) the involuntary7) and are caused by taking of land8)
  - i. relocation or loss of shelter; resulting in
  - ii. lost of assets or access to assets; or
  - iii. loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or

(b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

5) Where there are adverse indirect social or economic impacts, it is good practice for the borrower to undertake a social assessment and implement measures to minimize and mitigate adverse economic and social impacts, particularly upon poor and vulnerable groups. Other environmental, social, and economic impacts that do not result from land taking may be identified and addressed through

environmental assessments and other project reports and instruments.

7) For the purposes of this policy, "involuntary" means actions that may be taken without the displaced person's informed consent or power of choice.

8) "Land" includes anything growing on or permanently affixed to land, such as buildings and crops. This policy does not apply to regulations of natural resources on a national or regional level to promote their sustainability, such as watershed management, groundwater management, fisheries management, etc. The policy also does not apply to disputes between private parties in land titling projects, although it is good practice for the borrower to undertake a social assessment and implement measures to minimize and mitigate adverse social impacts, especially those affecting poor and vulnerable groups.

Eligibility for Benefits[18)]

14. Upon identification of the need for involuntary resettlement in a project, the borrower carries out a census to identify the persons who will be affected by the project (see the Annex A, para. 6(a)), to determine who will be eligible for assistance, and to discourage inflow of people ineligible for assistance. The borrower also develops a procedure, satisfactory to the Bank, for establishing the criteria by which displaced persons will be deemed eligible for compensation and other resettlement assistance. The procedure includes provisions for meaningful consultations with affected persons and communities, local authorities, and, as appropriate, nongovernmental organizations (NGOs), and it specifies grievance mechanisms.

15. Criteria for Eligibility. Displaced persons may be classified in one of the following three groups:
(a) those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country);
(b) those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets--provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan (see Annex A, para. 7(f)); and[19)]
(c) those who have no recognizable legal right or claim to the land they are occupying.

16. Persons covered under para. 15(a) and (b) are provided compensation for the land they lose, and other assistance in accordance with para. 6. Persons covered under para. 15(c) are provided resettlement assistance[20)] in lieu of compensation for the land they occupy, and other assistance, as necessary, to achieve the objectives set out in this policy, if they occupy the project area prior to a cut-off date established by the borrower and acceptable to the Bank.[21)]
Resettlement Planning, Implementation, and Monitoring Persons who encroach on the area after the cut-off date are not entitled to compensation or any other form of resettlement assistance. All persons included in para. 15(a), (b), or (c) are provided compensation for loss of assets other than land.

18) Paras. 13-15 do not apply to impacts covered under para. 3(b) of this policy. The eligibility criteria for displaced persons under 3 (b) are covered under the process framework (see paras. 7 and 30).

19) Such claims could be derived from adverse possession, from continued possession of public lands without government action for eviction (that is, with the implicit leave of the government), or from customary and traditional law and usage, and so on.

20) Resettlement assistance may consist of land, other assets, cash, employment, and so on, as appropriate.

21) Normally, this cut-off date is the date the census begins. The cut-off date could also be the date the project area was delineated, prior to the census, provided that there has been an effective public dissemination of information on the area delineated, and systematic and continuous dissemination subsequent to the delineation to prevent further population influx.

13.2.2 Construction Stage Aspects

For the consideration of the social environmental impacts during the construction stage, following four (4) primary issues are expected to be addressed. They are; 1) labor safety and community health, 2) Socio economic, 3) Transport, 4) Coastal fishing. Such aspects and counter measures are described in the approved EIA report except 4) Coastal fishing.

1) Labor safety and community health

Due to the massive construction work, hundreds of construction workers are expected to settle at and around the construction site. Level of the immigrant workers are likely to vary so that fatal accidents could be occurred without proper training and safety gears. In order to secure the labor safety, sufficient and continuous training and management of EHS officers/managers would be minimal requirement for contractors. Either local or immigrant worker should also take sufficient vocational training for each requirement.

Another issue would be the control of the transmittable diseases. Introduction of transmittable disease by immigrant workers and spread not only in the workers community but also adjacent local communities are quite common issue for large scale long term project. As a primary part of HES training for EHS officers and workers as well as local residents, adequate education for such diseases and protection would be minimal requirements for contractors. Control of the physical contacts between immigrant workers and locals, such as workers' township, would be another possible option to reduce the risk of speeding the diseases.

2) Socio economic impacts

Due to the substantial numbers of non-local residents' inflow in the Cat Hai island, pricing of goods are likely to increase. Though the pricing of Cat Hai island will definitely increase even without project, gradual settlement is necessary for local communities. There would be many measures to reduce the negative impacts on local communities such as encouragement of higher income jobs and providing sufficient goods with competitive prices through cost-effective logistic system. Physical separation between local communities and workers community would be another solution for the initial stage by means of sufficient goods supply in the workers' township.

Follow-up for the resettlement would be another important matter in the construction stage. Due to no requirement for the residential resettlement, follow-up for livelihood support should be focused. Because the initial stage of the livelihood support is critical moment to reduce the failure of the support programs, active participation of monitoring and modification of support program are recommendable.

3) Coastal Fishing

Once the construction starts, the proposed port area will be closed for the safety purpose that may lead less fishing yield or higher cost of fishing due the longer trip to the new fishing location. Periodical sample survey to monitor the fish yield and income level of the project affected fishermen would be recommendable. If it is necessary to provide additional support based on the sample survey result, responsible authorities shall consider modification of the safeguard policy for coastal fishing or additional counter measures such as encouragement of job transfer.

13.2.3 Operation Stage Aspects

For the consideration of the social environmental impacts during the operation stage, monitoring the implemented safety guard measures in the previous stages would be the primary matter in this stage. As a part of environmental management plan (EMP) and responsibility of the implementation agency, MPMU II shall cooperate with VINALINE and other privates, expected operator of the port, to ensure the EMP including the proper implementation and follow-up of the safe guard measures.

Following column is the extraction of the JBIC Guideline on Required Monitoring items.

Table 13.2.5 Extraction of the JBIC Guidelines for Required Monitoring Items

· Monitoring

6. Items Requiring Monitoring

Items requiring monitoring shall be decided according to the sector and nature of the project, with reference to the following list of items.

Items:

1. Permits and approvals, explanations

· Response to matters indicated by authorities

2. Anti-pollution measures

· Air quality : SO2, No2, CO, O2, soot and dust, suspended particulate matter, coarse particulate, etc.

· Water quality : pH, SS (suspended solids), BOD (biochemical oxygen demand) / COD (chemical oxygen demand), DO (dissolved oxygen), total nitrogen, total phosphorus, heavy metals, hydrocarbons, phenols, cyanogen compounds, mineral oils, water temperature, etc.

· Waste

· Noise and vibration

· Odors

3. Natural environment

· Ecosystems : Impact on valuable species, countermeasures, etc

4. Social environment

· Resettlement

· Lifestyle and livelihood

13.3 Environmental Check List for the Lach Huyen Port

Confirmation of the environmental and social considerations for the proposed port project is summarized with the environmental checklist of the JBIC Guideline.

SAPROF Experts’ assessments on the project, MD/ updates, change of scope

Table 13.3.1 Environmental Checklist for Lach Huyen Port Development Project

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	① Have EIA reports been officially completed? ② Have EIA reports been approved by authorities of the host country's government? ③ Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? ④ In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	① EIA Report has already been completed. ② EIA Report has already been officially approved by MONRE, responsible agency for the Government of Vietnam on October 31, 2008 (Official Letter No.2231/QD-BTNMT) ③ EIA Report was approved with commitment from the project owner VINAMARINE to implement the necessary environmental protection measures given in EIA and the EIA approval. Detailed conditions to be satisfied in future with beginning of construction works for the port ④ No additional permit requirement is considered necessary from any other regulatory agency of Vietnam
	(2) Explanation to the Public	① Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities?	① Yes, adequate explanation was given and opinion of the potentially affected people (PAP) was collected by both responsible local authorities and PAP's communities (fatherland front committee), which are required by Law and relevant regulations. In addition to the required public consultation by the Vietnam regulations, the responsible implementation agency-MPMU II voluntary conducted a public consultation to have PAP understand the project further and encourage active participation of the project. Though there is little consideration for coastal fishing where the proposed port project will eliminate the fishing activities in approved EIA, adequate consideration will be defined in a supplementary EIA shortly, which is required by Vietnam regulations for the change in design after the approval of EIA and compliance of the JBIC loan policy. ② Yes, the local authorities and communities' responses are recorded and mentioned in the approved EIA. The regulatory authorities' comments are also given in the approval letter of the project EIA.

Category	**Environmental Item**	**Main Check Items**	**Confirmation of Environmental Considerations**
2 Mitigation Measures	(1) Air Quality	① Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted from various sources, such as ships, vehicles, and the ancillary facilities comply with the country's emission standards and ambient air quality standards?	① During both construction and subsequent operation of the port the necessary national ambient air quality standard requirement of Vietnam has to be complied (TCVN5937-2005). It is presumed it could be duly complied with proper construction management and operation of the port with due diligence. The baseline ambient air quality is evaluated as clean in the planned project site of Cat Hai Island.
	(2) Water Quality	① Do general effluents from the related facilities comply with the country's effluent standards and ambient water quality standards? ② Do effluents from ships and ancillary facilities (e.g. dock) comply with the country's effluent standards and ambient water quality standards? ③ Are adequate measures taken to prevent spills and discharges of materials, such as oils and hazardous materials to the surrounding water areas? ④ Is there a possibility that oceanographic changes, such as alteration of ocean currents, and reduction in seawater exchange rates (deterioration of seawater circulation) due to modification of water areas, such as shoreline modifications, reduction in water areas and creation of new water areas will cause changes in water temperature and water quality? ⑤ In the case of the projects including land reclamation, are adequate measures taken to prevent contamination of surface water, seawater, and groundwater by lactates from the reclamation areas?	① Construction work contractor shall ensure the necessary waste management system is provided to meet the effluent and ambient water quality standards of Vietnam (QCVN10-2008/BTNMT, QCVN 14-2008/BTNMT). The necessary waste treatment facilities for port operation are included in the EIA Report. With proper operation of the treatment facilities the necessary effluent and ambient water quality standard requirement could be met. ② Operational management of the port shall make sure the ships comply with the necessary national and international standard requirement (TCVN5945-2005, TCVN5944-1995, TCVN5943-1995), including MARPOL 73/78 of IMO. ③ The emergency management plan in the EIA Report included oil spill response system with the necessary facilities like oil skimmers and also simulation study on oil spread area in case of accidental oil spills. Still, serious oil spill emergency situation is regarded as very rare occurrence under the current port development plan that is limited to handle only container and general cargo. In this respect even in future port expansion projects, considering the ecological importance of the vicinity of this area (near Cat Ba Island), terminals for oil and other hazardous liquid-bulk cargo handling development is not recommended. ④ No significant potential exists for shoreline change in the Lach Huyen Estuary consequent to the offshore extension of terminal and sand control

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
			dyke design by this project. Still, simulation study on exterior accumulation of sediments retained by the sand control dyke was done in the EIA Report and it was concluded as not that significant. ⑤ Necessary land reclamation and other construction material could be procured from nearby areas by the construction contractor (It is possible from Hai Phong and Hai Duong areas) . The contractor shall ensure the necessary quality requirement for the reclamation material is met so as not to cause significant sea water pollution (a short-term adverse effect basically confined to the period of reclamation works), though this issue is not dealt with in the EIA Report.
	(3) Wastes	① Are wastes from ships and the related facilities properly treated and disposed of in accordance with the country's standards? ② Is offshore dumping of dredged materials and soils properly performed in accordance with the country's standards to prevent impacts on the surrounding waters? ③ Are adequate measures taken to prevent discharge or dumping of hazardous materials to the surrounding water areas?	① Required waste reception facilities for ship originated wastes are included in the EIA Report (Sewage, garbage and oily bilge waste). Proper operational management of the treatment system is required in future port operation. Relevant standards to be followed are TCVN5945-2005, TCVN5944-1995 and TCVN5943-1995, including MARPOL 73/78 of IMO. Moreover, effective surveillance to mitigate illegal dumping of wastes by ships with high penalty levy as deterrence is also required. ② Both near-shore and offshore dumping of dredged material are taken into consideration in the EIA Report. Still, the areas approved for near-shore dumping (Official document No. 2702/UBND-GT dated May 19, 2008 as given in Appendix 1 of EIA Report) have sufficient capacity to accommodate all dredged material and hence offshore dumping is regarded as not necessary. ③ No significant quantity of hazardous material is expected to be generated due to the port plan to handle container and general cargo. The results of seabed material survey conducted for the EIA Report indicated

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
			no significant contamination in seabed area targeted for dredging.
2 Mitigation Measures	(4) Noise and Vibration	① Do noise and vibrations comply with the country's standards?	① No significant noise and vibration effect is anticipated due to construction works since it is offshore area located far from residential area. Noise and vibration effects due to port operation has to be regulated and controlled by the port operation authority so as to meet the national standard requirement (TCVN5949-1998, TCVN6962-2001)
	(5) Odor	① Are there any odor sources? Are adequate odor control measures taken?	① No significant odor source is expected due to the port development to handle container and general cargo
	(6) Sediment	① Are adequate measures taken to prevent contamination of sediments by discharges or dumping of materials, such as hazardous materials from ships and the related facilities?	① Any hazardous waste disposed by ships has to be properly managed by the port authority. Relevant national standards and decrees to be complied with respect to waste management include TCVN 6772-2000 on wastewater treatment, Decree No. 71/2006/ND-CP on seaport and maritime management and Circular No. 12/2006/TT-BTNMT on hazardous waste management.
3 Natural Environment	(1) Protected Areas	① Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	① The project area is located in the vicinity of Cat Ba national park, a protected forest park. Still, ship movement has been in occurrence in this area for long time with no apparent adverse effect. So as long as oil and other noxious liquid cargo are not handled any potential high risk to the protected area due to accidental spillage is minimized. Current port development plan does not include such cargo. Even in future it is recommended to not to develop port terminals in this area located in the vicinity of ecologically important areas like Cat Ba Island to handle such cargo like oil and other noxious liquid substance in bulk.

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
	(2) Ecosystem	① Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g. coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? ④ Is there a possibility that the project will adversely affect aquatic organisms? If significant impacts are anticipated, are adequate protection measures taken to reduce the impacts on aquatic organisms? ⑤ Is there a possibility that the project will adversely affect vegetation and wildlife of coastal zones? If significant impacts are anticipated, are adequate measures taken to reduce the impacts on vegetation and wildlife?	① Mangroves (near Cat Ba Island coast) and tidal flats (Bach Dang Estuary) of ecological significance are located in the vicinity of the project area. Moreover, Cat Ba Island has richly diversified and protected ecological area with primeval forests and tropical rain forests as well. Still, port is not anticipated to affect these areas as it is located not within such protected and ecologically important areas and would handle only container and general cargo. ② Project area does not encompass habitats of rare, endangered or other ecologically vulnerable species ③ No significant ecological impacts are anticipated due to the handling of cargo by this project development limited to container and general cargo. ④ No significant long-term adverse effect on aquatic organism is anticipated even due to very significant dredging works of 33 million m3 and offshore dredged material disposal when such works are planned and executed with due diligence (Still offshore dumping of dredged material is regarded as not required). The dredging works involve widening and deepening of the existing and already dredged access channel and there is no rare and endangered marine biota inhabiting the area. Moreover, similar dredging works for access channel and subsequent maintenance dredging for port and also IWT navigation has been done in variety of offshore and inland waterways both in Vietnam and other countries and there is no evidence of any serious long-term adverse effects on aquatic marine organisms due to the construction and operation of such navigation channels. This is attributed to availability of large area of unaffected seabed in the vicinity of navigation channels to serve as habitats for marine organisms. In particular offshore dredged material dumpsite location, if required in future, shall be selected away from coral

Category	**Environmental Item**	**Main Check Items**	**Confirmation of Environmental Considerations**
			reef areas to mitigate potential adverse effects due to turbidity on coral reefs. ⑤ Project is not anticipated to significantly affect wildlife of coastal zone even when the area is located near Cat Ba Island. This is particularly so since the cargo handled is limited to non hazardous container and general cargo as per this stage of port development plan.
	(3) Hydrology	① Is there a possibility that installation of port and harbor facilities will cause oceanographic changes? Is there a possibility that installation of the facilities will adversely affect oceanographic conditions, such as induced currents, waves, and tidal currents?	① The development facility for the port is not such large scale to cause significant change in natural oceanographic condition such as currents, waves and tides even though the port in Lach Huyen Estuary is located in a complicated area with respect to oceanography and sediment movement. In this respect simulation study was also conducted in the EIA Study and it was confirmed potential sedimentation beyond the sand control dyke is not that significant.
	(4) Topography and Geology	① Is there a possibility that installation of port and harbor facilities will cause a large-scale alteration of topographic and geologic features in the surrounding areas or elimination of natural beaches?	① No large-scale alteration of topographic and geologic features in the surrounding areas or elimination of natural beaches is anticipated since the port development facility is not such large scale to cause such effects as also noted just above. Also there is no beached in nearby areas of the planned port.

Category	**Environmental Item**	**Main Check Items**	**Confirmation of Environmental Considerations**
4 Social Environment	(1) Resettlement	① Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? ⑦ Is a plan developed to monitor the impacts of resettlement?	① No, there is no resettlement required for the project. However, land acquisition is required for public related facilities, which requires resettlement of toms and assurance of PAP's living standard, who will lose the fishpond and may lose the job. ② Yes, Hai Phong city and local commune authorities, who are responsible for the resettlement and land acquisition by law and regulation, have already consulted with PAP for fishpond and relatives of the toms. The detail plans will be defined in detail design stage by the consultation with PAP. ③ Yes, since the proper compensation and restoration of livelihoods and living standards are required by law, a resettlement plan/land acquisition plan shall be prepared based on updated market values of the land and properties and actual situation of livelihoods and living standards. ④ No, based on the authorities, there are no vulnerable groups or persons in the affected area so that there no need for such attention. In case of the fishermen's communities coming from outside of the affected communities, particular attention might be needed though there is no detailed information at this moment. ⑤ Yes, though the detailed condition will be settled in detail design stage, agreements were given by the PAP through initial consultation. ⑥ Yes, Hai Phong city is responsible for the resettlement/land acquisition and has capacity to implement the resettlement/land acquisition throughout the variety of resettlement activities in the area. The budget will be secured and transferred from the MOT, responsible ministry of the project owner-VINAMARINE, to Hai Phong city. ⑦ Yes, preparation of monitoring is mandate by law and monitoring will be included in the land acquisition plan.

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
	(2) Living and Livelihood	① Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? ② Is there a possibility that changes in water uses (including fisheries and recreational uses) in the surrounding areas due to project will adversely affect the livelihoods of inhabitants? ③ Is there a possibility that port and harbor facilities will adversely affect the existing water traffic and road traffic in the surrounding areas? ④ Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the project? Are considerations given to public health, if necessary?	① Yes, any price including daily food and other commodities is likely to increase due to the project implementation and substantial business activities at and around the project site. Separation of the immigrant workers and local residence at the initial stage and gradual merger are proposed for local residence to adapt such price rise. ② Yes, the proposed project will eliminate some part of coastal fishing area. Though the consideration for such fishermen was initially omitted due to the small scale of activities, the supplemental EIA will include the measures to maintain same or better level of the living standard for such fishermen. ③ Yes, the sand control dike (7,600m long) is likely to prevent daily transport by small transport boats/fishing boats between Cat Hai and Cat Ba. However, such impacts will be minimal and traffic will be taken over by the existing water traffic between the God port, Cat Hai and Cat Ba with road transport naturally. ④ Yes, during the construction and operation stages, a large number of construction workers and port workers may introduce some transmittable diseases such as HIV/AIDS, which are verified in Vietnam, in the communities. Not only for workers but also local communities, awareness education and prevention measures will be provided by the relevant authorities with the collaboration of local communities, contractors of the project and operator of the port. In addition, separation measures of immigrant workers and local residence, such as construction workers' temporally township, are recommended in the approved EIA. Detailed measures will be proposed in detail design stage.
	(3) Heritage	① Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with	① No, based on EIAs, there are no heritage sites in the proposed sites.

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
		the country's laws?	
	(4) Landscape	① Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	① No, though offshore land fill and long bridge & road will significantly change the landscape of the local communities, the change will be rather considered as positive change in landscape. The change of the landscape could be considered as the symbol of the contemporary development area as categorized as Hai Phong development master plan.
	(5) Ethnic Minorities and Indigenous Peoples	① Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? ② Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	① Yes, though there are no concerned people in the project area, the proposed project will fully comply with minority protection if it's necessary. ② No, there are no concerned communities in the project area.
5 Others	(1) Impacts during Construction	① Are adequate measures considered to reduce impacts during construction (e.g. noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? ④ If necessary, is health and safety education (e.g. traffic safety, public health) provided for project personnel, including workers?	① The necessary mitigation measures are examined in the EIA Report. The contractor shall be obligated to strictly adhere to EHS (environment, health and safety) aspects of the construction works in integral manner with due formulation and execution of EHS management and monitoring. ② With due EHS management and monitoring by contractor as above adverse effects could be mitigated. ③ Yes, adequate measures will be applied to prevent the adverse effects on the local communities for the construction period, especially consideration for local communities and immigrant workers communities. Temporally township for immigrant workers and occasional opportunities, such as meeting or festival, to bridge the gap between locals and immigrant workers are proposed by the responsible authorities. ④ EHS management program and monitoring shall be implemented by construction contractors supervised by relevant authorities.

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
	(2) Monitoring	① Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? ② Are the items, methods and frequencies included in the monitoring program judged to be appropriate? ③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? ④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	① Overall monitoring program focused on all relevant environmental elements is included in the EIA Report. This has to be reviewed and detailed environmental monitoring program with clear separation between construction and operation stages of the project shall be formulated during detailed engineering of the project ② On preliminary basis at the feasibility study level of the project they are judged to be adequate and detailed environmental monitoring program shall be formulated during detailed engineering of the project. ③ Detailed environmental monitoring program formulated during detailed engineering of the project shall include the definite framework for monitoring as well. ④ Detailed environmental monitoring program formulated during detailed engineering of the project shall include the reporting system and other regulatory compliance of monitoring as well.
6 Note	Note on Using Environmental Checklist	① Where necessary, impacts on groundwater hydrology (groundwater level drawdown and salinization) that may be caused by alteration of topography, such as land reclamation and canal excavation should be considered, and impacts, such as land subsidence that may be caused by groundwater uses should be considered. If significant impacts are anticipated, adequate mitigation measures should be taken. ② If necessary, the impacts to transboundary or global issues should be confirmed (e.g. the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).	① The project include offshore land reclamation. The necessary technical studies and design will be a component of project planning and detailed engineering. However, no significant long-term adverse effects are anticipated consequent to this limited offshore land reclamation works. ② No transboundary issues are anticipated considering the confined nature of the project for port development.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

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.

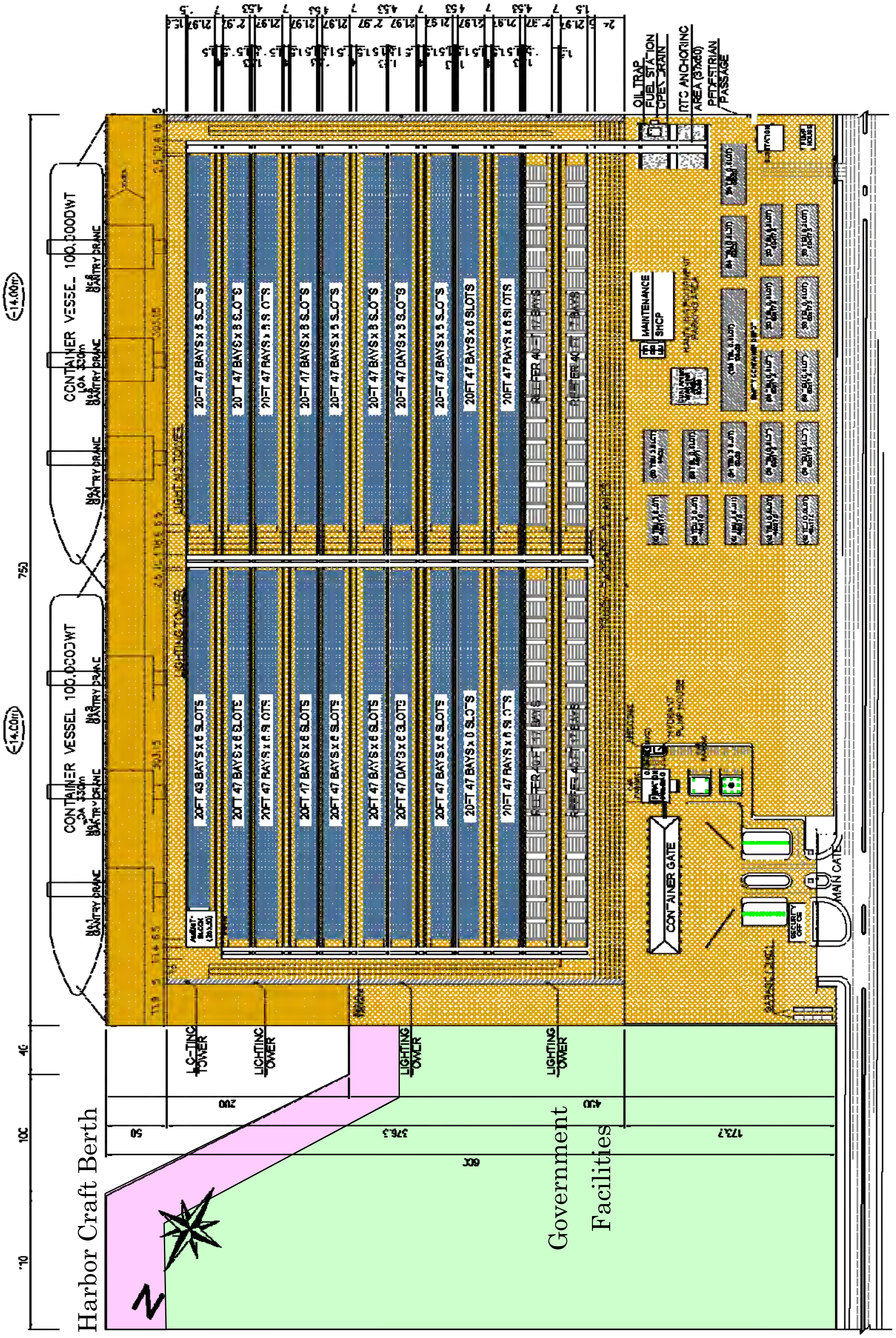


Figure 14.2.1 Layout of Container Terminal No.1 & No.2 and Government Facility Area

3) Scale of Port Protection Facilities

a) Outer Revetment (Breakwater)

As explained in Chapter 5, it was forecast that container traffic demand will increase more than TEDI FS but general cargo demand will not so increase. In addition, the design container vessel size was enlarged as mentioned above, therefore, required number and length of berths became 6 berths and 2,400m long (including space of barge berths) for container and 3 berths and 750m long for general cargo for Medium Term Development of target year 2020. As a result, total length of outer revetment (breakwater) has to be changed from 3,900m to 3,230m.

b) Sand Protection Dyke

As regard Sand Protection Dyke for the Project, Decision by MOT indicates that “sand dyke is designed to connect to the breakwater forming yard with total estimative length of 5,700m (up to elevation of -3.0m) under the condition that the length of the sand dyke will be materially defined in the technical design stage”.

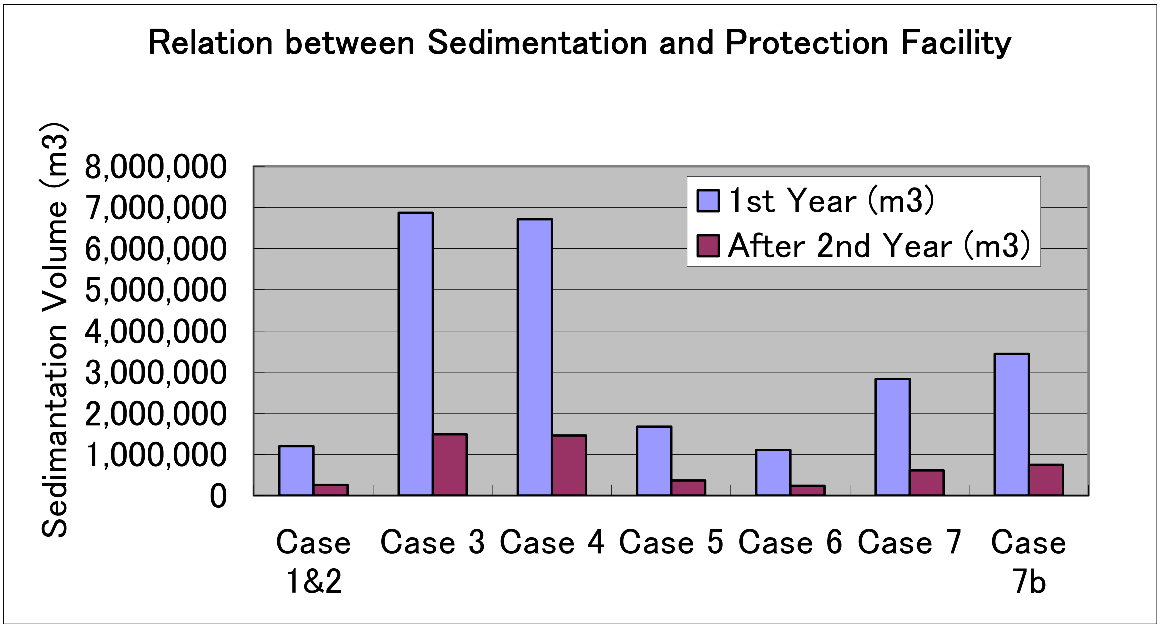
SAPROF Study carried out a series of simulation study on possible extent of siltation along the new access channel for alternative layout of sand protection dyke. Based on the results of the said simulation study, SAPROF Study recommends a construction of sand protection dyke to the water depth of CDL-5.0m for 7,600m long and top elevation of +2.0m in Initial stage of the port development under the conditions that the Government of Vietnam make sure the budget for recurrent maintenance dredging to maintain the designated water depth of the access channel.

The followings are technical findings and recommendations by the SAPROF Study:

(1) The Results of Simulation Study for Siltation

The results of simulation study on the siltation by SAPROF Study Team are summarized as follows (Refer to Figure 14.2.2 and Figure 14.2.3 below).

- Once channel is dredged to -14m water depth without provision of any terminal or protective facilities (Case 3 in Figure 14.2.2), the volume of sedimentation is estimated at 1,491,000 m^3 per year (6,873,000 m^3 for 1st year). This annual rate of sedimentation by siltation along Lach Huyen access channel is smaller as compared with those predicted in the previous studies.
- Sedimentation by siltation could be decreased by the construction of sand protection dyke along access channel (Cases 4 to 7)
- .Possible volume of sedimentation is estimated around 1,456,000 m^3 per year (6,712 th m^3 for 1st year) in case of that only Terminal facilities are constructed without provision of sand protection dyke (Case 4 in Figure 14.2.2), but this could be decreased to 364,000 m^3 per year (1,678 th m^3 for 1st year) or 614,000 m^3 per year (2,829 th. m^3 for 1st year) in case that sand protection dyke is constructed up to the water depth -10m or -5m respectively (Case 5 and 7 in Figure 14.2.2)
- All above simulations are conducted for the top elevation of +4.0m of sand dykes. Only Case 7b is for top elevation of +2.0m with other same conditions of Case 7. The construction costs of Case 7 and 7b are estimated at 295 mil US$ and 205 mil US$ respectively. Nevertheless the difference of construction costs is large, the difference of sedimentation volumes is not so much.
- The rate of sedimentation differs by the location along the access channel waterway. Once the sand protection dyke is constructed to -10m or -5m water depth (Case 5 and 7 in Figure 14.2.3), it is predicted that the accretion zone along the channel occurs at the offshore area from a distance of 37 km from Hai Phong Port.



Case	Protection Facilities	1st Year (m3)	After 2nd Year (m3)
Case 1&2	Present state (approx. −8m)	1,200,000	260,000
Case 3	−14m without Structure	6,873,000	1,491,000
Case 4	−14m with Terminal Facilities	6,712,000	1,456,000
Case 5	−14m with Terminal Facilities and Training Dyke up to −10m deep and 1.5km apart from Channel	1,678,000	364,000
Case 6	−14m with Terminal Facilities and Training Dyke up to −10m deep and closed to Channel	1,107,000	240,000
Case 7	−14m with Terminal Facilities and Training Dyke up to −5m deep with 1.5km apart from Channel	2,829,000	614,000
Case 7b	−14m with Terminal Facilities and Training Dyke up to −5m deep with 1.5km apart from Channel (hc=2.0m)	3,442,000	747,000

Figure 14.2.2 Relation between Sedimentation and Protection Facility

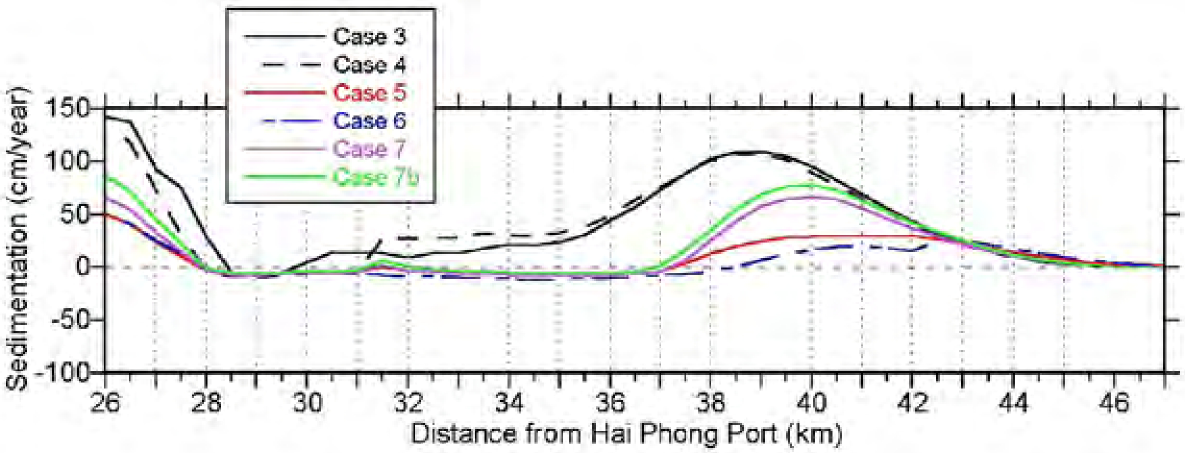


Figure 14.2.3 Predicted sedimentation speed with channel of 14 m in depth

(2) Review by Alternative Way of Sand Protection Dyke Construction

The following three (3) cases of construction scenarios are studied and it is found that although the considerable extent of maintenance dredging is required, Scenario 3 (to construct Sand Protection dyke up to a water depth of -5m and top elevation of +2.0m in initial stage and no extension) is most economical in view of economy in construction of sand protection dyke and maintenance of access channel (Refer to Table 14.2.1).

Table 14.2.1 Construction Scenario of Sand Protection Dyke

	Scenario 1	**Scenario 2**	**Scenario 3**
Water Depth	Up to -10m initially	Up to -5m initially and extend to -10m after 5 years	Up to -5m initially and no extension in future
Length and Top elevation of Dyke	11,500m +4.0m	7,600m initially and 11,600m after 5 years +4.0m	7,600 m initially (with provision of wider access channel for the portion of no protection dyke) +2.0m
Investment Cost	529 mil. US$	575 mil US$ (295 mil US$ +280mil.US$)	294 mil US$ (205 mil US$ +89 US$)
Maintenance Dredging Volume	1st Yr: 1,678 th.m^3/y Succeeding Yrs: 364 th. m^3/y	1st Yr: 2,829 th.m^3/y Succeeding Yrs: 614 th. m^3/y After 9 Yrs: 364 th. m^3	1st Yr: 3,442 th.m^3/y Succeeding Yrs: 747 th. m^3/y
Maintenance Dredging Cost	1st Yr: 8,3900 th. US$ Succeeding Yrs: 1,820 th.US$/y	1st Yr: 14,145 th. US$ Succeeding Yrs: 3,070 th.US$/y After 9 Yrs: 1,820 th US$/y	1st Yr: 17,210 th. US$ Succeeding Yrs: 3,735 th.US$/y
NPV for 50 Yrs	**494 mil US$**	**475 mil US$**	**322 mil US$**
Evaluation	-	-	**Recommendable**

To initially construct sand protection dyke up to -5.0m water depth (length about 7.6km) and top elevation of +2.0m is recommended in view of economy in construction cost of dyke and suitable balance between capital investment and maintenance dredging. But the annual maintenance dredging estimated to be required is considerable as compared with those of the construction scenario 1 or 2 and, therefore, it is recommended that the Government of Vietnam makes sure:

- Institutional arrangement to regularly conduct monitoring for water depth and siltation along access channel, and
- Annual budgetary allocation for recurrent maintenance dredging

Table 14.2.2 Comparison of Construction Scenario

Case 1		Case 2		Case 3	
Initial Dyke – 10m (mil USD)	529	Initial Dyke – 5m (mil USD)	295	Initial Dyke – 5m (mil USD)	205
		Extention Dyke -10m (mil US$)	280	Widening Channel (mil US$)	89
Maint. Dredge 1st Yr (000㎥)	1,678	Maint. Dredge 1st Yr (000㎥)	2,829	Maint. Dredge 1st Yr (000㎥)	3,442
Maint. Dredge after (000㎥)	364	Maint. Dredge 2-8 Yr (000㎥)	614	Maint. Dredge after (000㎥)	747
		Maint. Dredge after (000㎥)	364		

Year		Case 1 Trainning Dyke	 Maintenance Dredging	 Total	Case 2 Trainning Dyke	 Maintenance Dredging	 Total	Case 3 Trainning Dyke	 Maintenance Dredging	 Total
Total		529.0	90.3	619.3	575.0	102.3	677.3	294.0	185.3	479.3
(NPV)		462.0	38.8	493.9	471.8	49.4	474.5	256.8	79.6	322.3
2011	1	52.9		52.9	29.5		29.5	29.4		29.4
2012	2	158.7		158.7	88.5		88.5	88.2		88.2
2013	3	158.7		158.7	88.5		88.5	88.2		88.2
2014	4	158.7		158.7	88.5		88.5	88.2		88.2
2015	5		8.4	8.4		14.1	14.1		17.2	17.2
2016	6		1.8	1.8		3.1	3.1		3.7	3.7
2017	7		1.8	1.8		3.1	3.1		3.7	3.7
2018	8		1.8	1.8		3.1	3.1		3.7	3.7
2019	9		1.8	1.8	140.0	3.1	143.1		3.7	3.7
2020	10		1.8	1.8	140.0	3.1	143.1		3.7	3.7
2021	11		1.8	1.8		1.8	1.8		3.7	3.7
2022	12		1.8	1.8		1.8	1.8		3.7	3.7
2023	13		1.8	1.8		1.8	1.8		3.7	3.7
2024	14		1.8	1.8		1.8	1.8		3.7	3.7
2025	15		1.8	1.8		1.8	1.8		3.7	3.7
2026	16		1.8	1.8		1.8	1.8		3.7	3.7
2027	17		1.8	1.8		1.8	1.8		3.7	3.7
2028	18		1.8	1.8		1.8	1.8		3.7	3.7
2029	19		1.8	1.8		1.8	1.8		3.7	3.7
2030	20		1.8	1.8		1.8	1.8		3.7	3.7
2031	21		1.8	1.8		1.8	1.8		3.7	3.7
2032	22		1.8	1.8		1.8	1.8		3.7	3.7
2033	23		1.8	1.8		1.8	1.8		3.7	3.7
2034	24		1.8	1.8		1.8	1.8		3.7	3.7
2035	25		1.8	1.8		1.8	1.8		3.7	3.7
2036	26		1.8	1.8		1.8	1.8		3.7	3.7
2037	27		1.8	1.8		1.8	1.8		3.7	3.7
2038	28		1.8	1.8		1.8	1.8		3.7	3.7
2039	29		1.8	1.8		1.8	1.8		3.7	3.7
2040	30		1.8	1.8		1.8	1.8		3.7	3.7
2041	31		1.8	1.8		1.8	1.8		3.7	3.7
2042	32		1.8	1.8		1.8	1.8		3.7	3.7
2043	33		1.8	1.8		1.8	1.8		3.7	3.7
2044	34		1.8	1.8		1.8	1.8		3.7	3.7
2045	35		1.8	1.8		1.8	1.8		3.7	3.7
2046	36		1.8	1.8		1.8	1.8		3.7	3.7
2047	37		1.8	1.8		1.8	1.8		3.7	3.7
2048	38		1.8	1.8		1.8	1.8		3.7	3.7
2049	39		1.8	1.8		1.8	1.8		3.7	3.7
2050	40		1.8	1.8		1.8	1.8		3.7	3.7
2051	41		1.8	1.8		1.8	1.8		3.7	3.7
2052	42		1.8	1.8		1.8	1.8		3.7	3.7
2053	43		1.8	1.8		1.8	1.8		3.7	3.7
2054	44		1.8	1.8		1.8	1.8		3.7	3.7
2055	45		1.8	1.8		1.8	1.8		3.7	3.7
2056	46		1.8	1.8		1.8	1.8		3.7	3.7
2057	47		1.8	1.8		1.8	1.8		3.7	3.7
2058	48		1.8	1.8		1.8	1.8		3.7	3.7
2059	49		1.8	1.8		1.8	1.8		3.7	3.7
2060	50		1.8	1.8		1.8	1.8		3.7	3.7

Unit Cost for Maintenance Dredging: 5 US$

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.

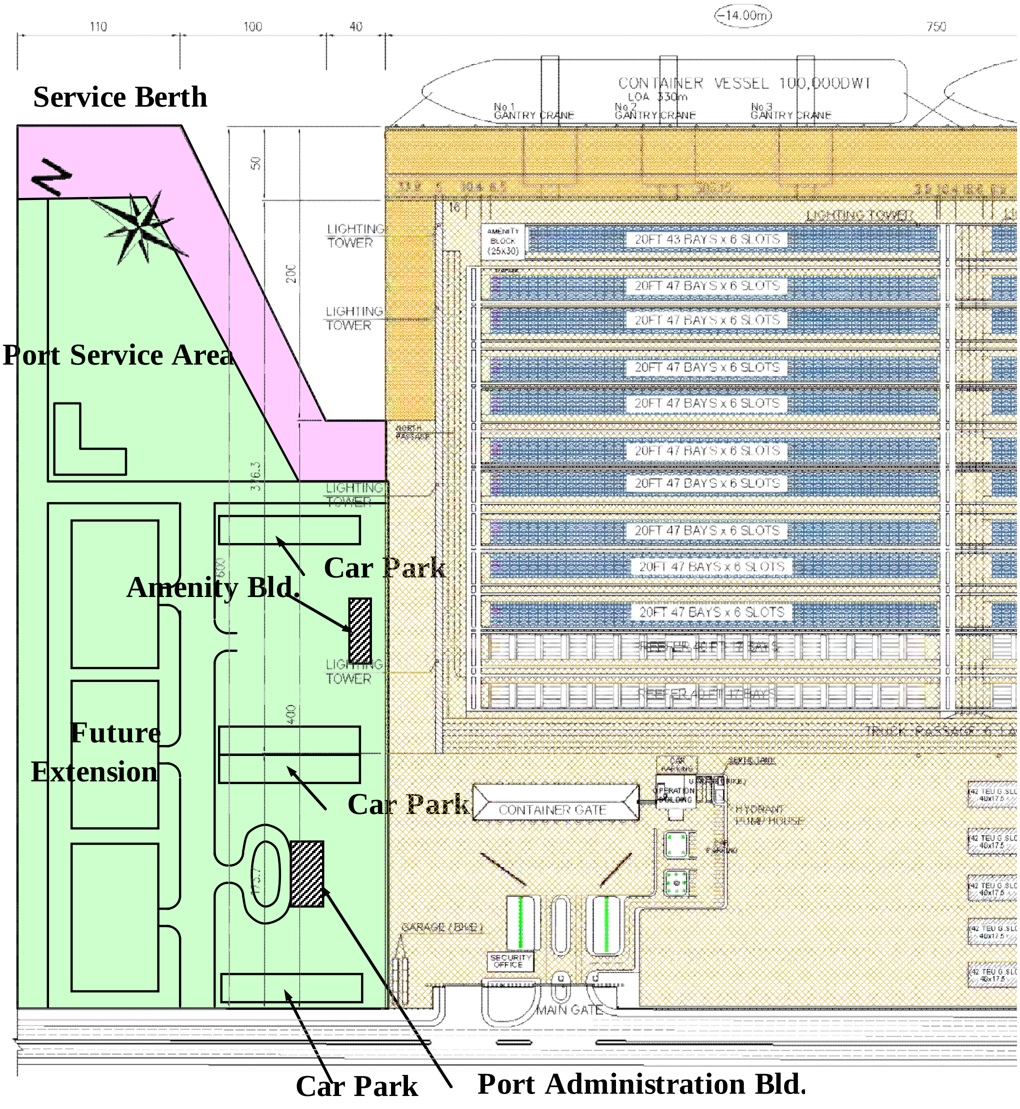


Figure 14.3.1 General Plan of Public Related Facility Area

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.

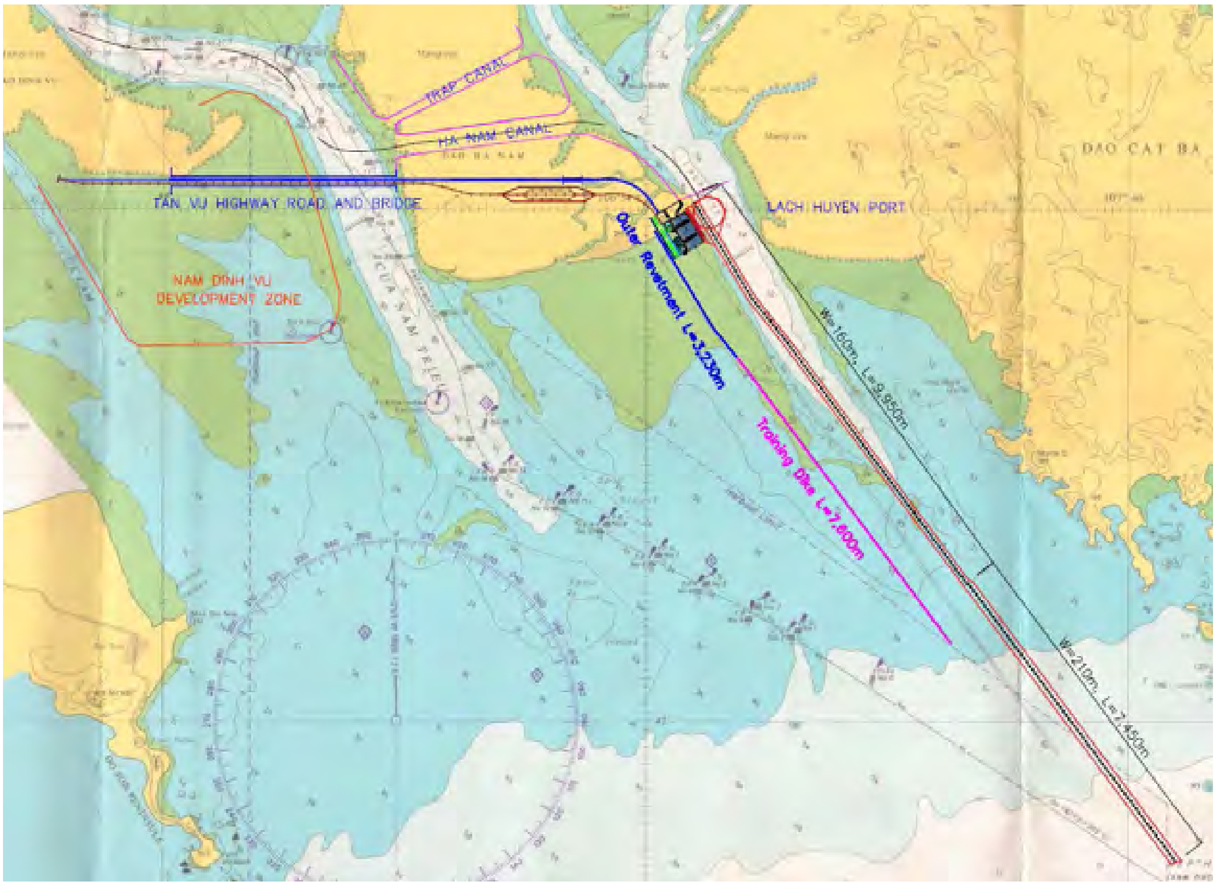


Figure 14.5.1 General Layout of Lach Huyen Port Short Term Development

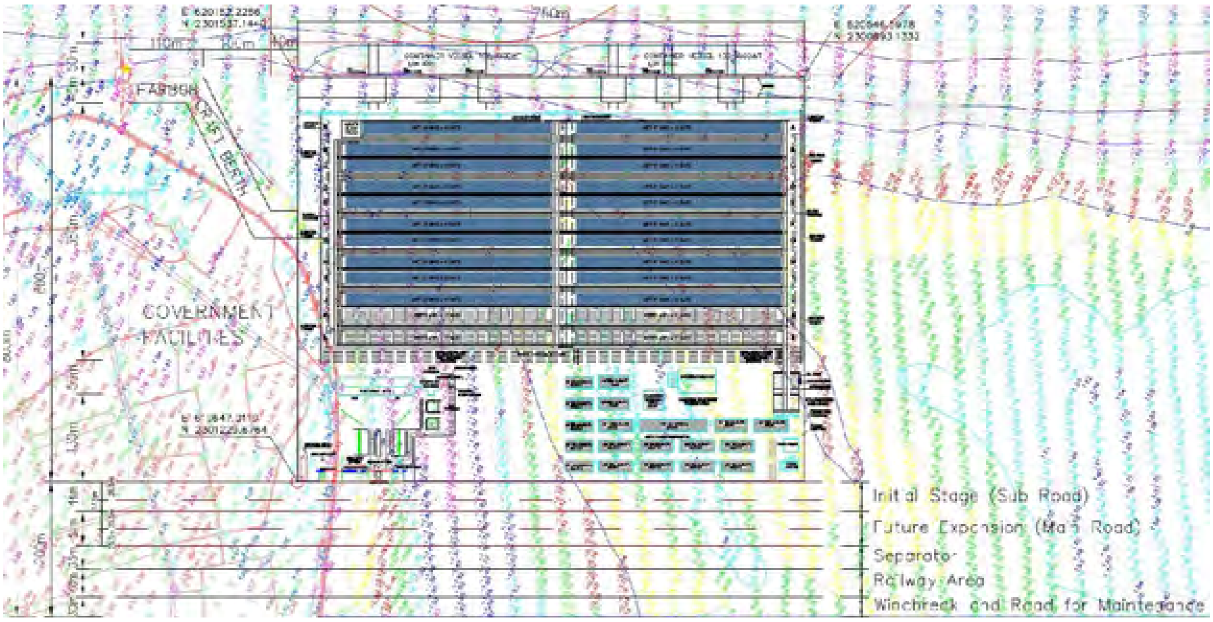


Figure 14.5.2 Location of Lach Huyen Port Short Term Development

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

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

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

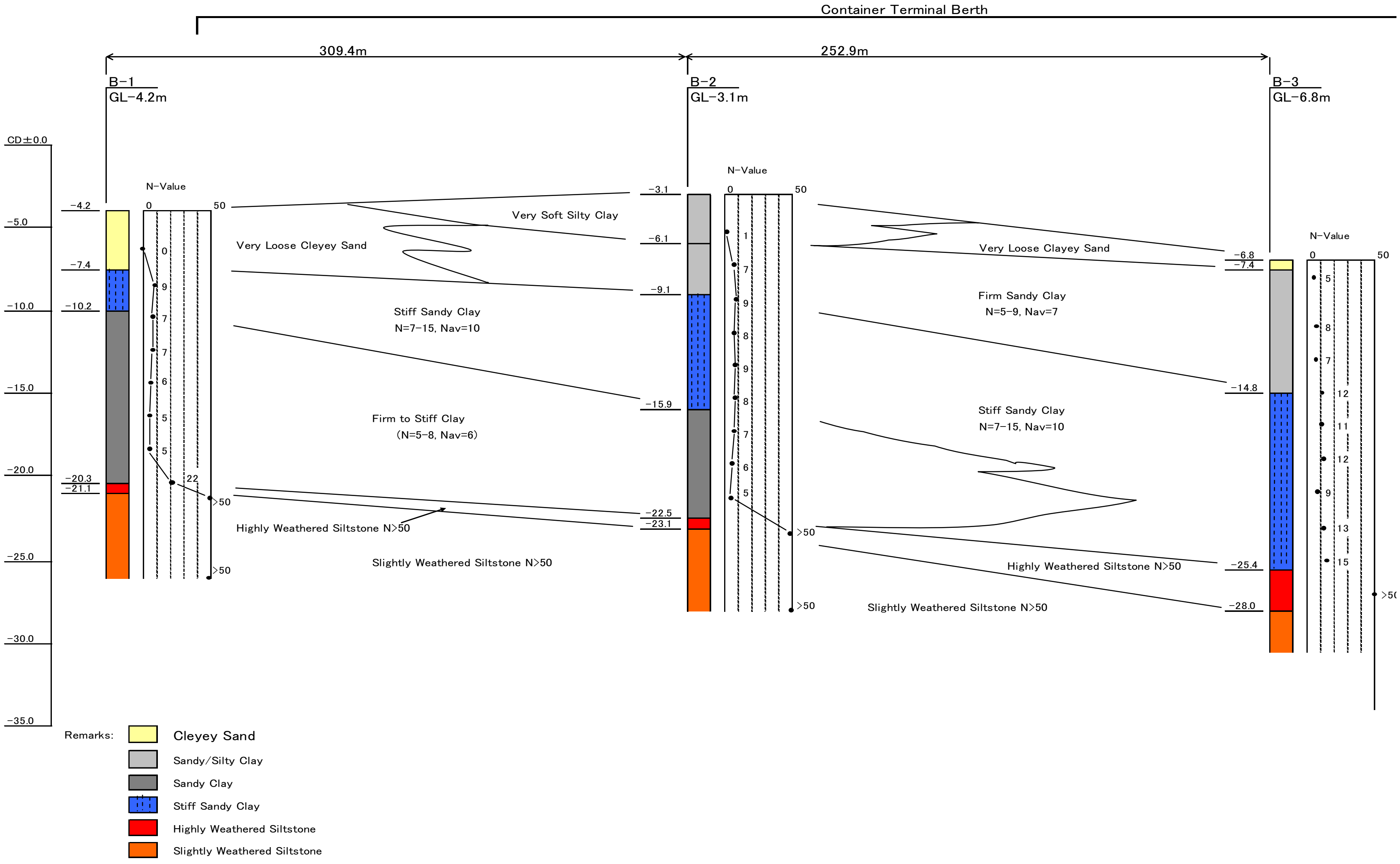
3.2 to 8: for very soft clay

8: for silty clay or clay of medium consistency

8 to 16: for very stiff clay

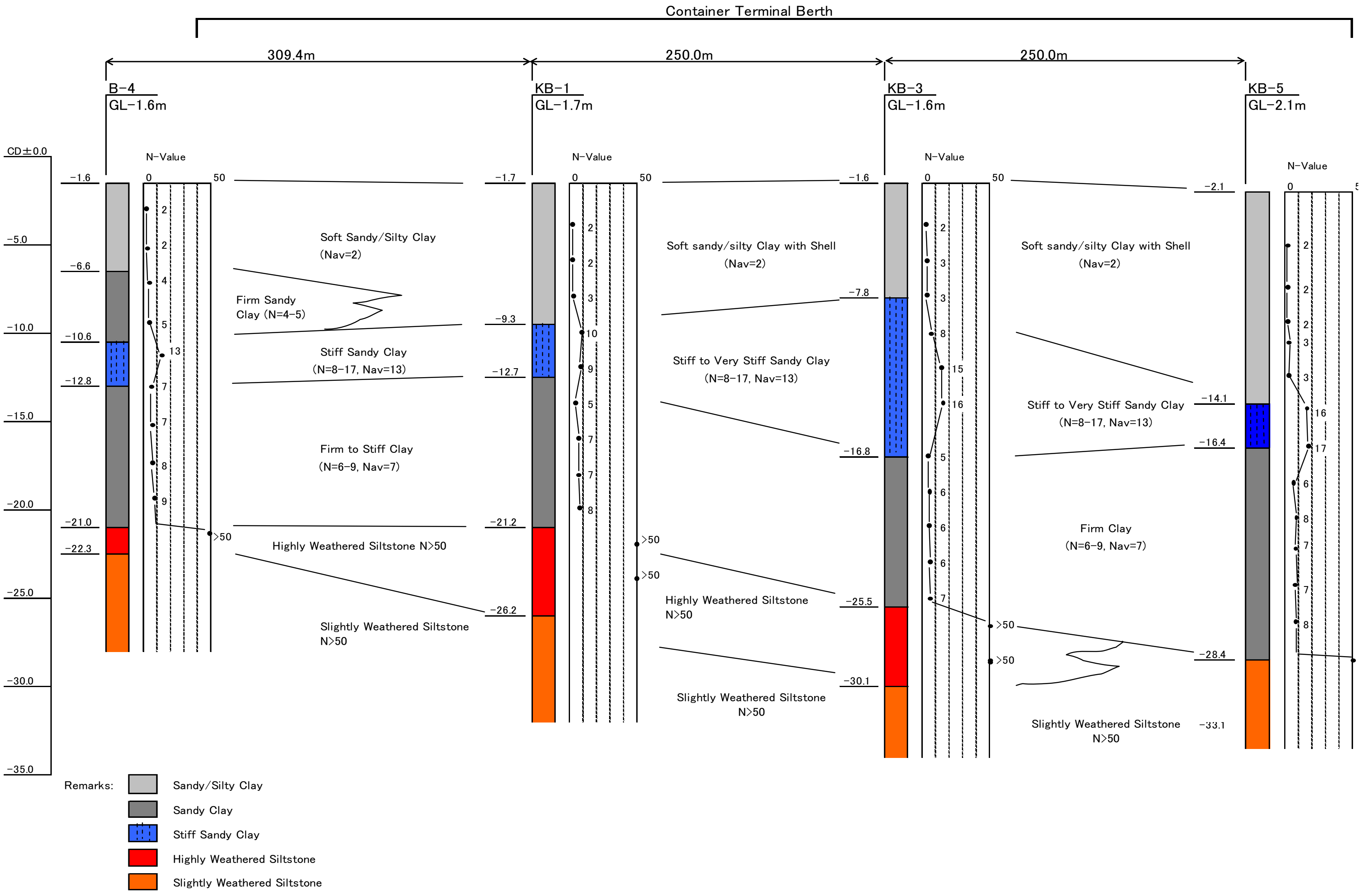
3) Lateral soil resistance of pile Kh= 1.5N (N/cm^3)

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	20 m/s
Stowed	40 m/s
Seaside Wheel Load (Approx)	
Wind Condition (Stowed)	60 tf/wheel
Operating Condition	55 tf/wheel
Landside Wheel Load (Approx)	
Wind Condition (Stowed)	60 tf/wheel
Operating Condition	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

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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.

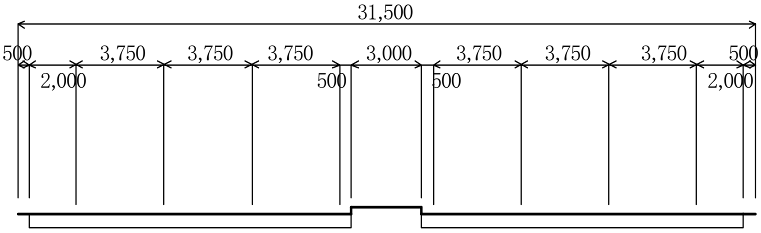


Figure 15.1.3 Typical Cross Section of Approach Road

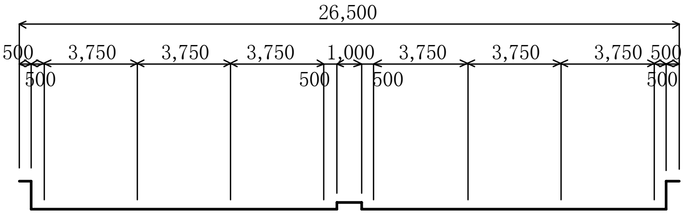


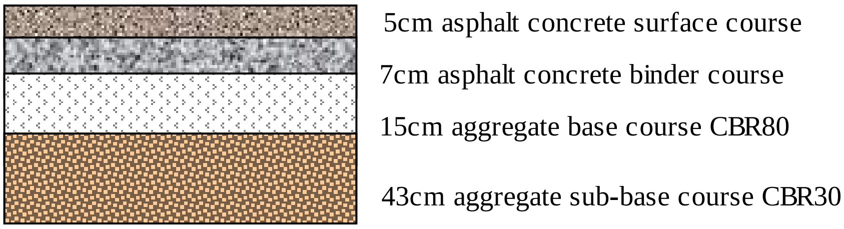
Figure 15.1.4 Typical Cross Section of Bridge

c) Geometric Design

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

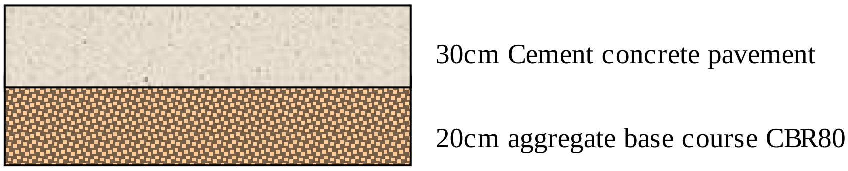
d) Pavement Structure

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.

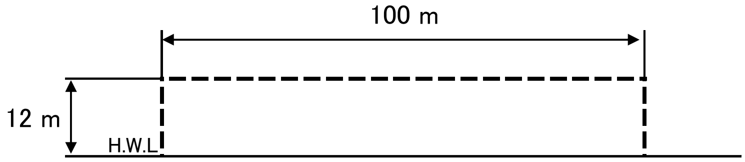


Figure 15.1.7 Navigation Clearance (W100 x 1)

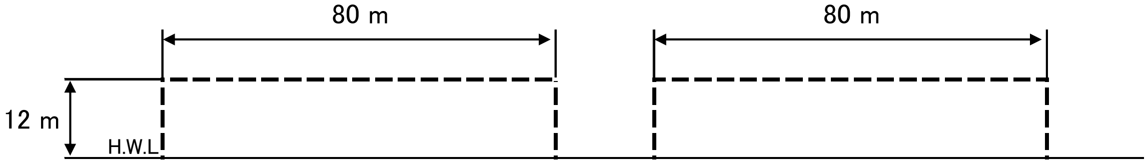
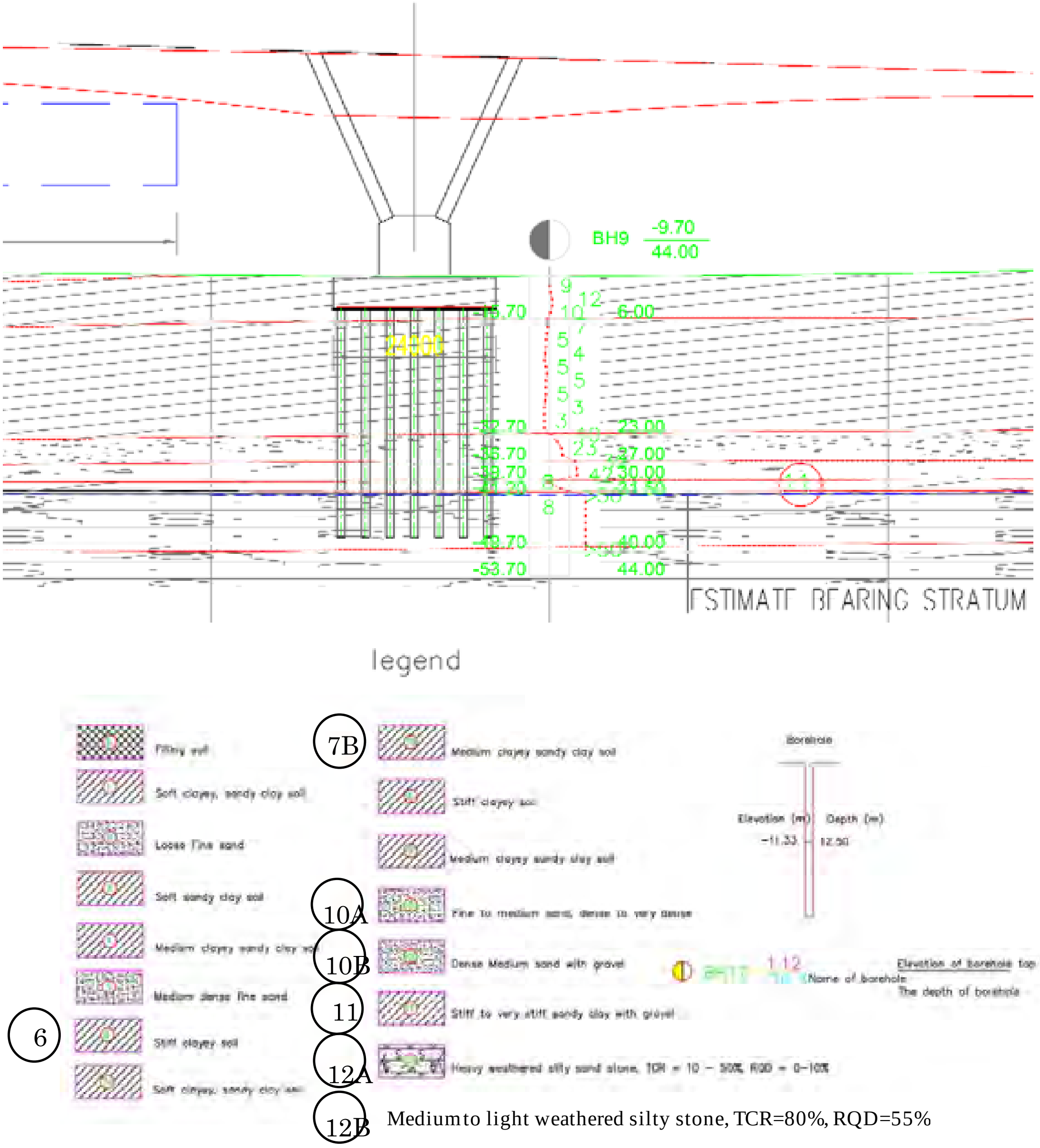


Figure 15.1.8 Navigation Clearance (W80 x 2)

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>

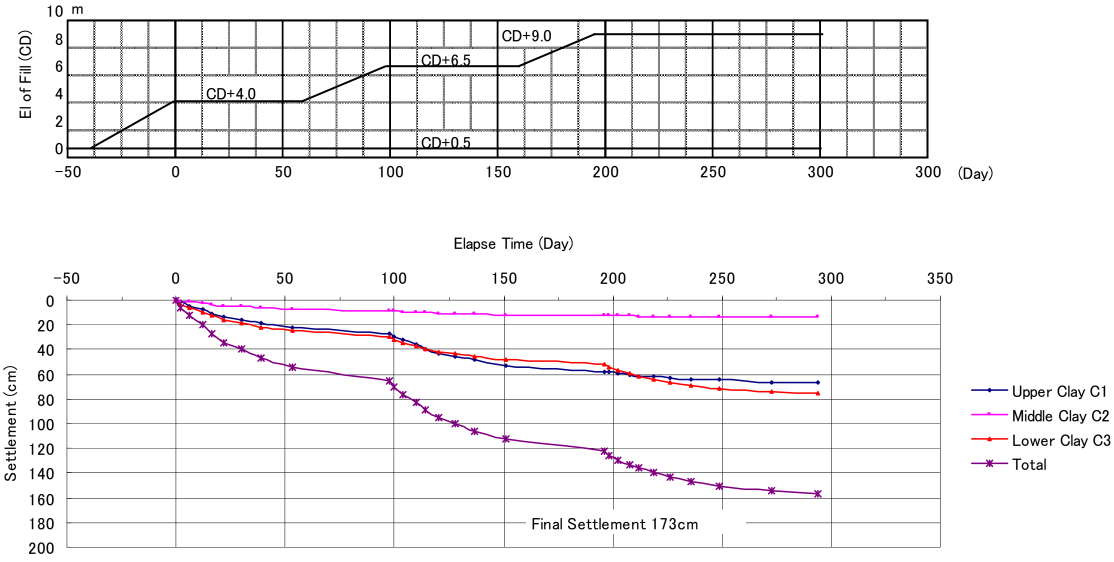
TEDI F/S for reference only
Source: JICA Study Team

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

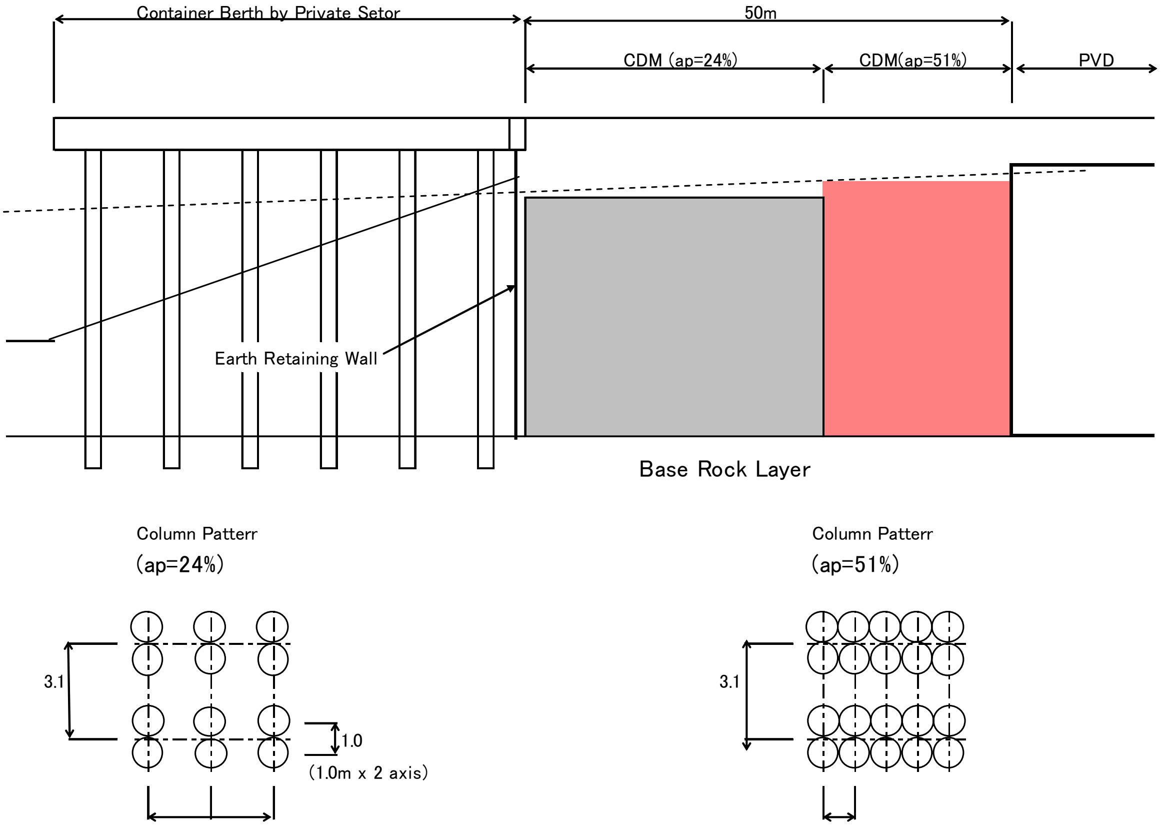
- To shorten overall working period in subsoil improvement work for the terminal construction by a combined application of PVD and ALiCC soil improvement method.

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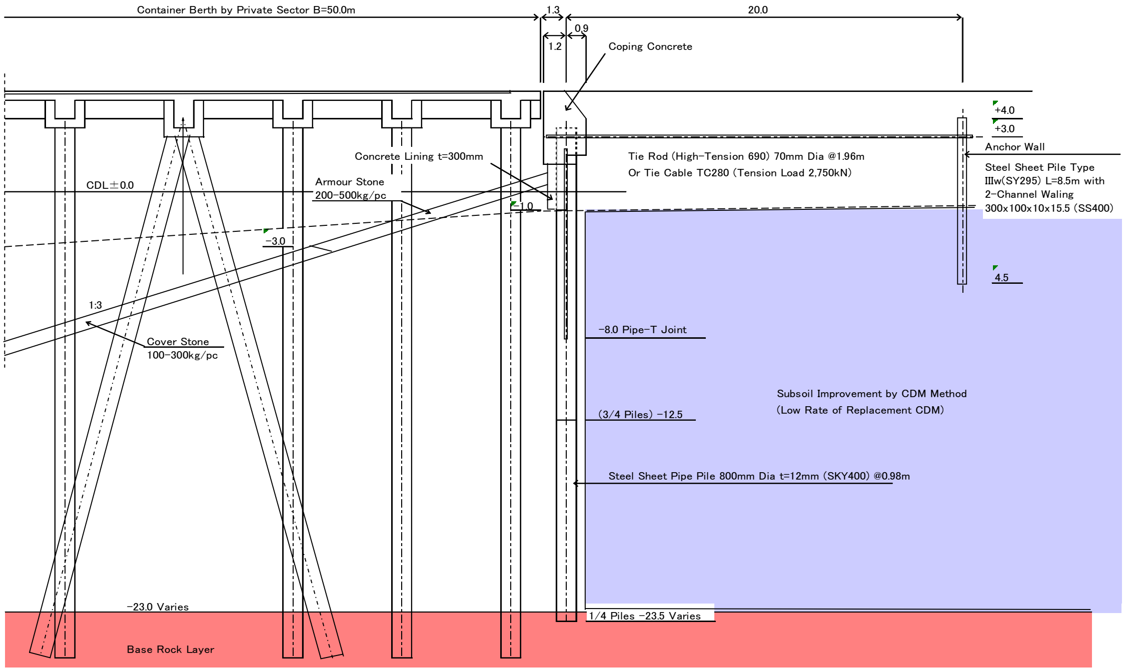
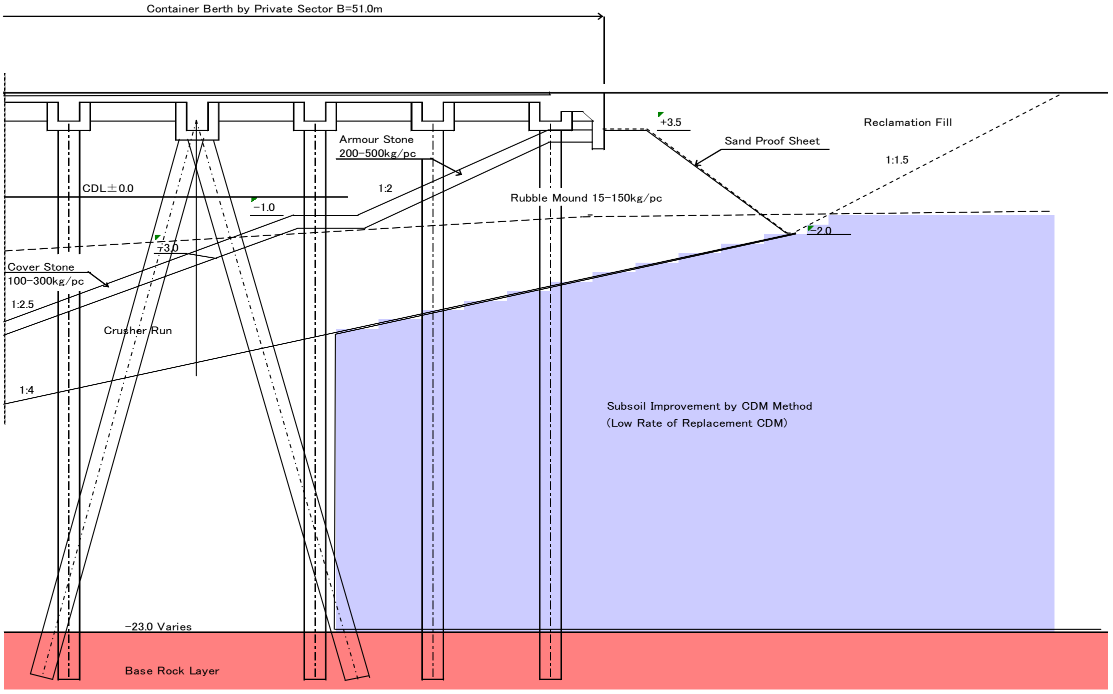


Source: JICA Study Team

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

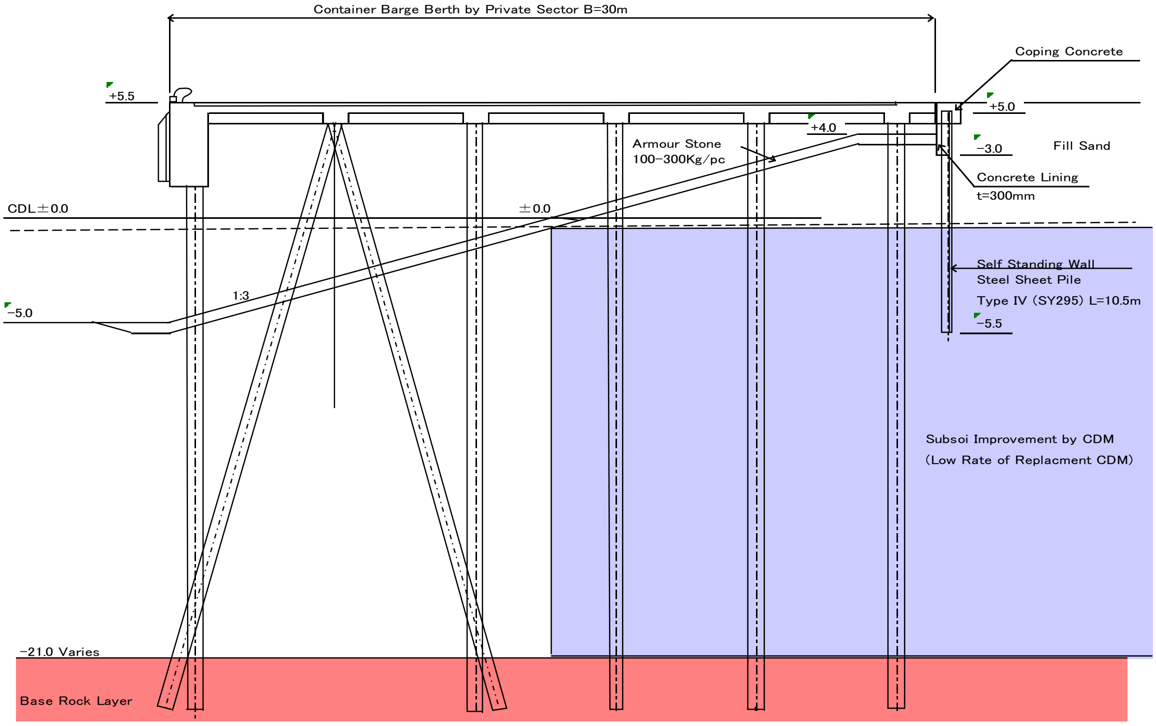
Source: Additional Study on Hai Phong International Gateway Port (Lach Huyen) Development Project in the Socialist Republic of Viet Nam, Final Report March 2010 prepared by MITI (MITI 2010 Study)

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

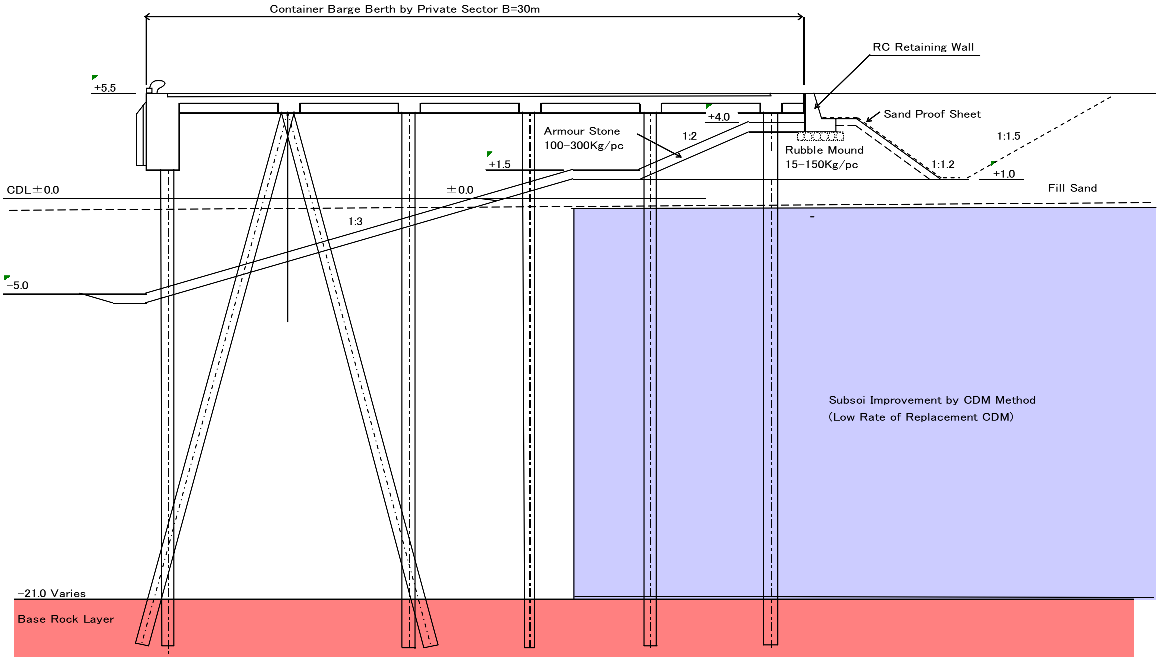
	Alternative Structure		
	A (Figure 15.2.5)	B (Figure 15.2.6)	C (Figure 15.2.7)
Barge Berth	Open Deck proposed by METI 2010 Study		Anchored Steel Sheet Pipe Piled (SSPP) Wall
Earth Retaining Wall	Cantilever type Sheet Piled Wall	Retaining wall on Rubble mound	
Soil Improvement	ALiCC method for upper sloped 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	(○) 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



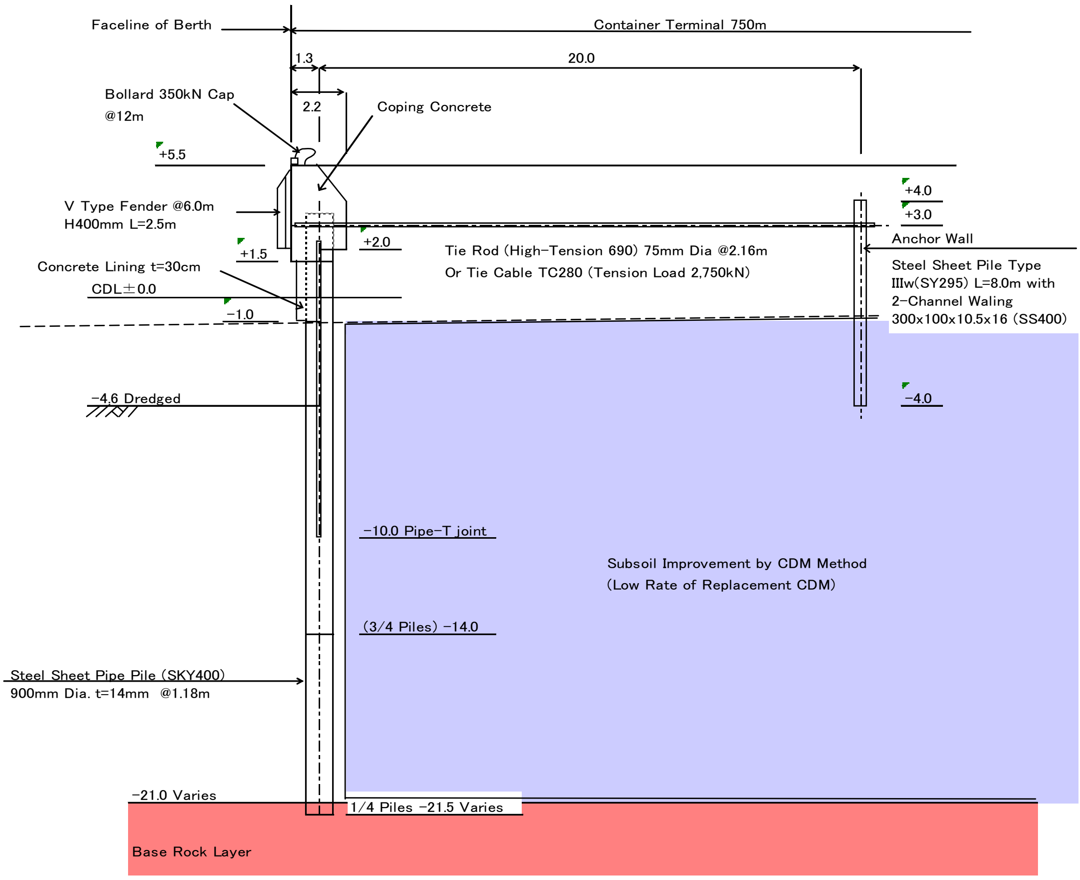
Source: JICA Study Team

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

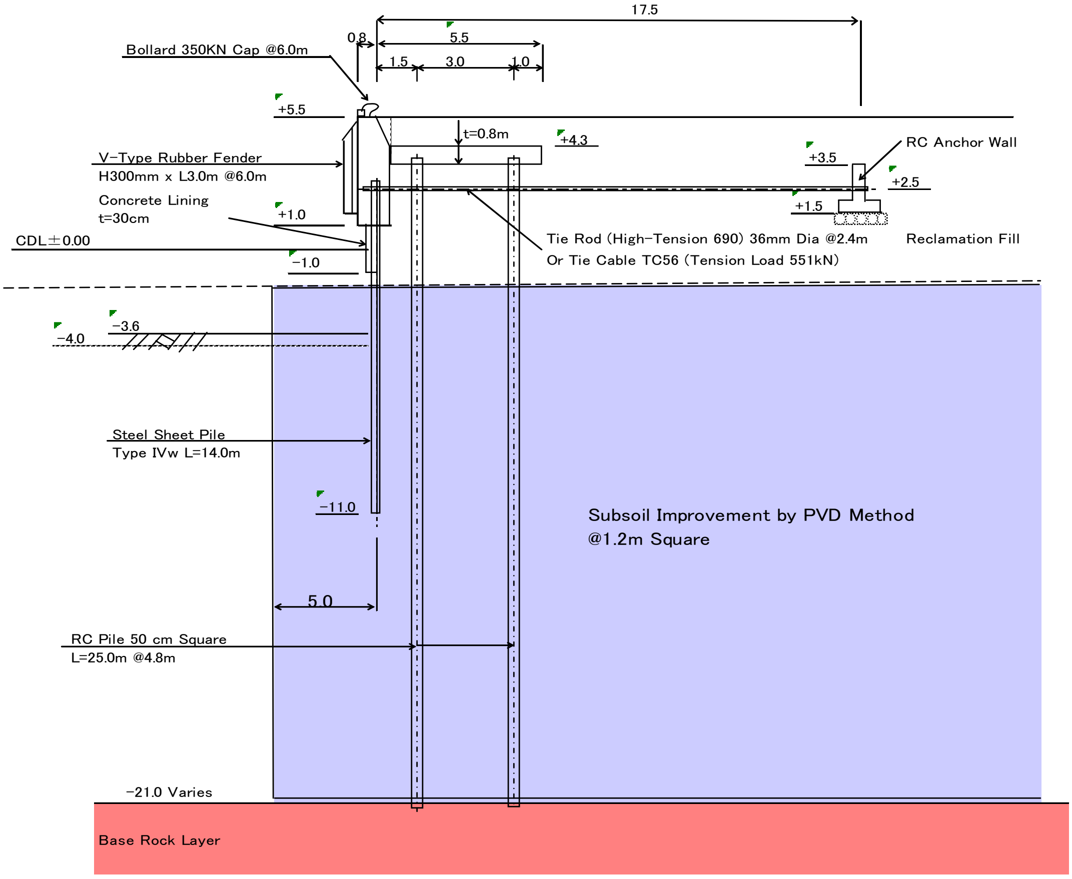
Ap: Tip area of a pile (m^2)
Fi: Friction between the pile face and pile embedded ground (kN/m^2)
Upper Clay C1: F1=C=35kN/m^2
Middle Clay C2: F2=C=100kN/m^2
Lower Clay C3: F3=C=44kN/m^2
As: total peripheral area of a pile (m^2)

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.

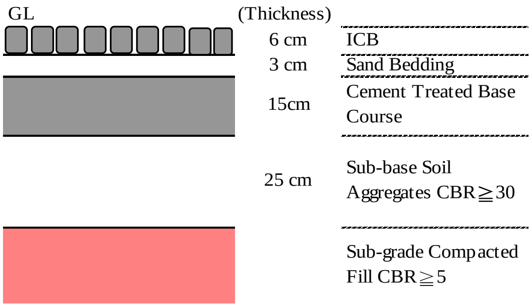
(Mooring Bollard)

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.

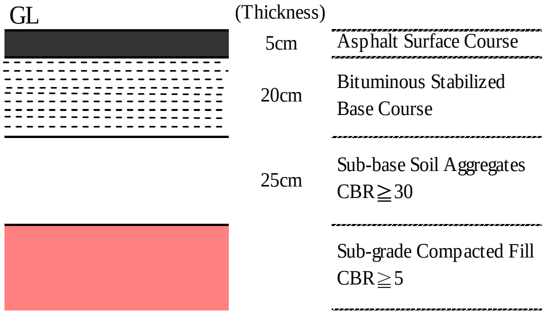


Source: JICA Study Team

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

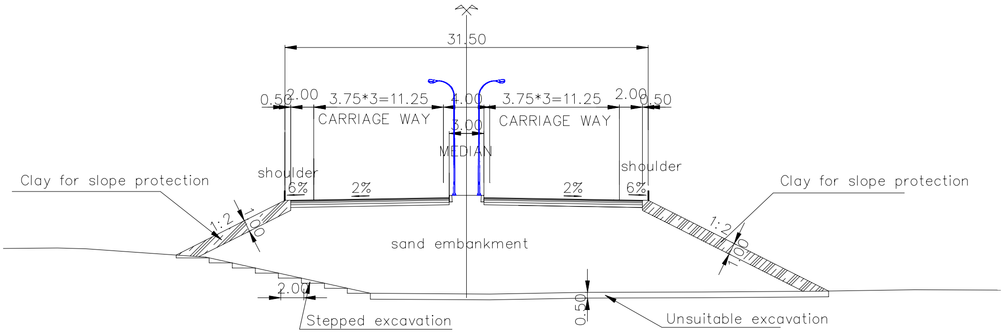
SAPROF study recommends the Alignment C in Figure 15.2.11 in order to reduce the number of resettlement. However, if the matter of resettlement will be not significant, VIDIFI's one (Alignment A) should be better for the future development plan in Cai Hai Island.

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.

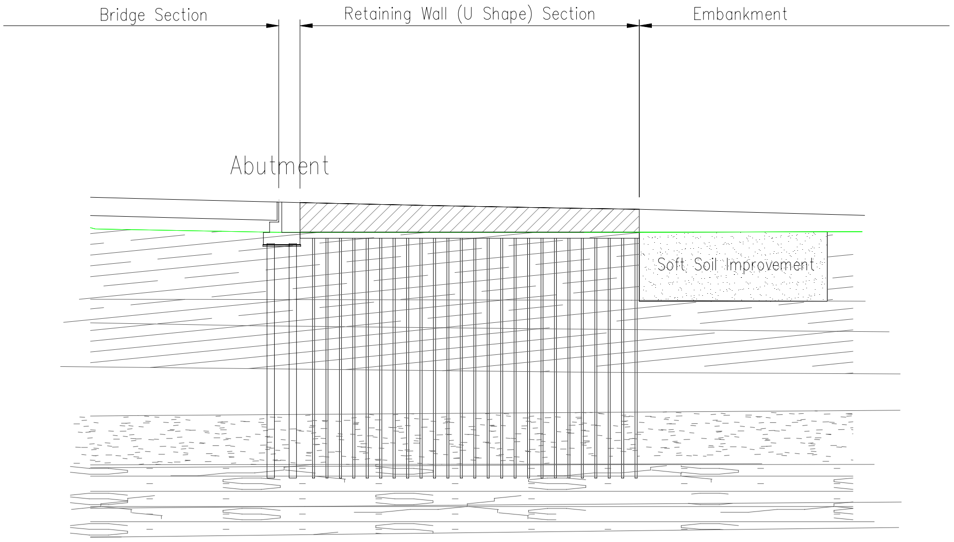


Source: Planning Construction Investment project Tan Vu-Lach Huyen Highway Project in Hai Phong City, VIDIFI, 2009

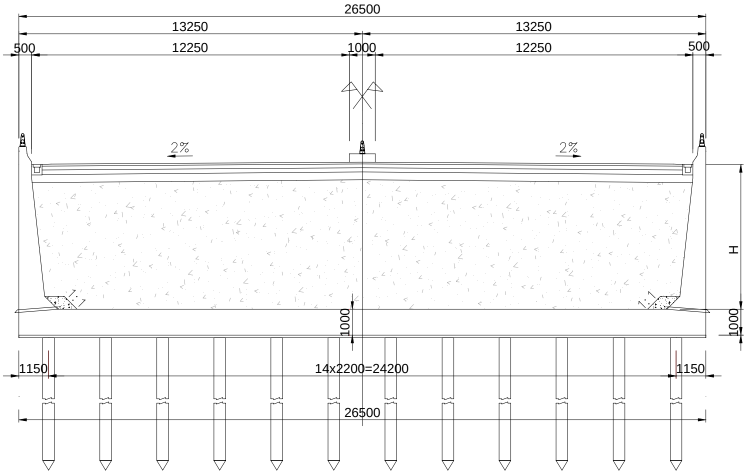
Figure 15.2.12 Typical Cross Section of Access Road

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.



Cross Section of Retaining Wall (U Shape)

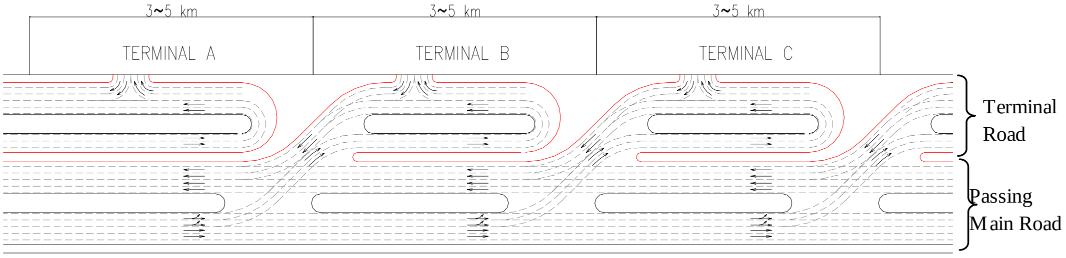


Source: JICA Study Team

Figure 15.2.13 Structure of Connection to Approach Bridge

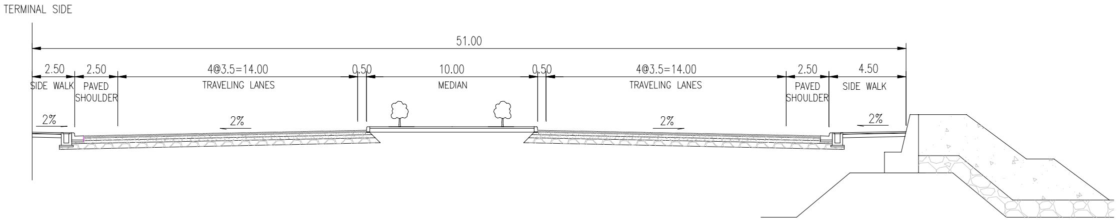
d) Layout of Terminal Road

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)

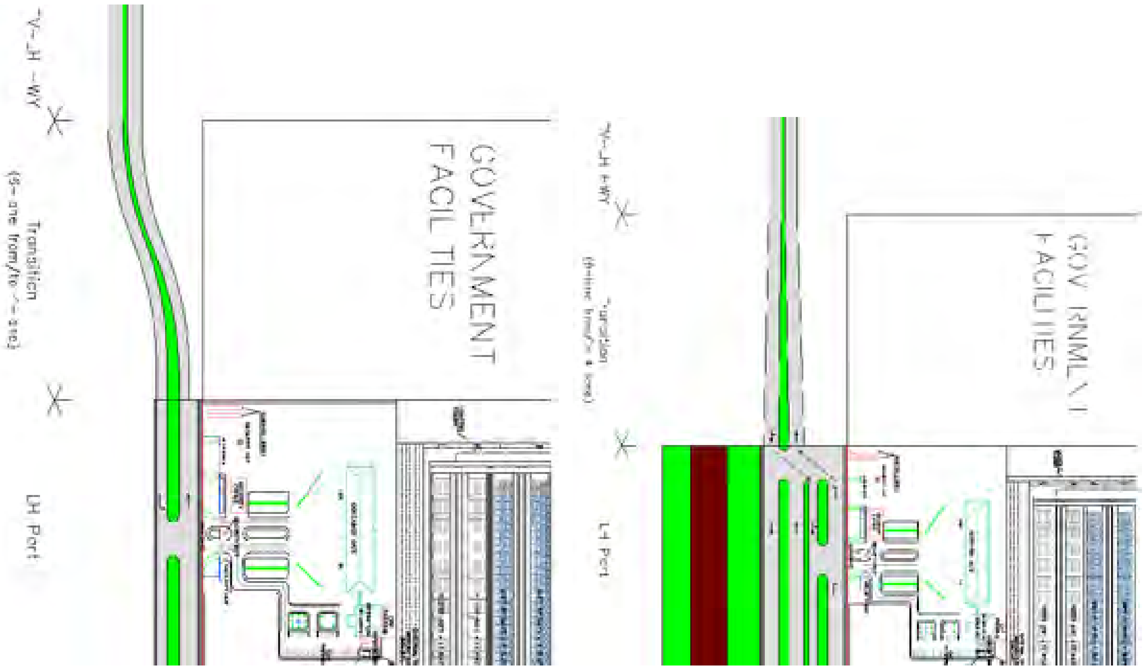


Source: JICA Study Team

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.

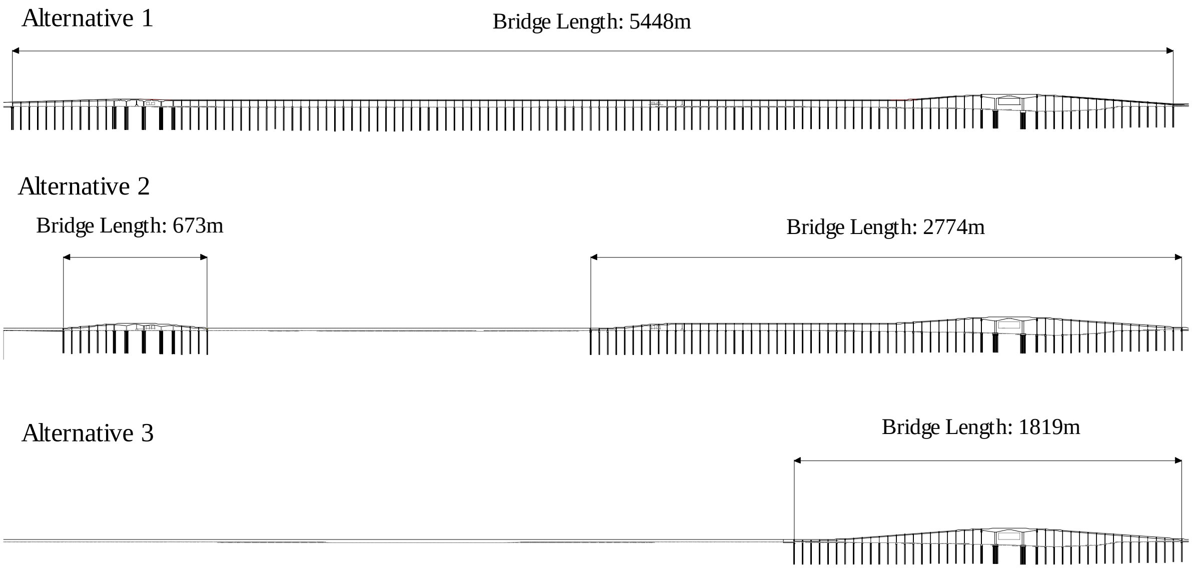


Source: JICA Study Team

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.

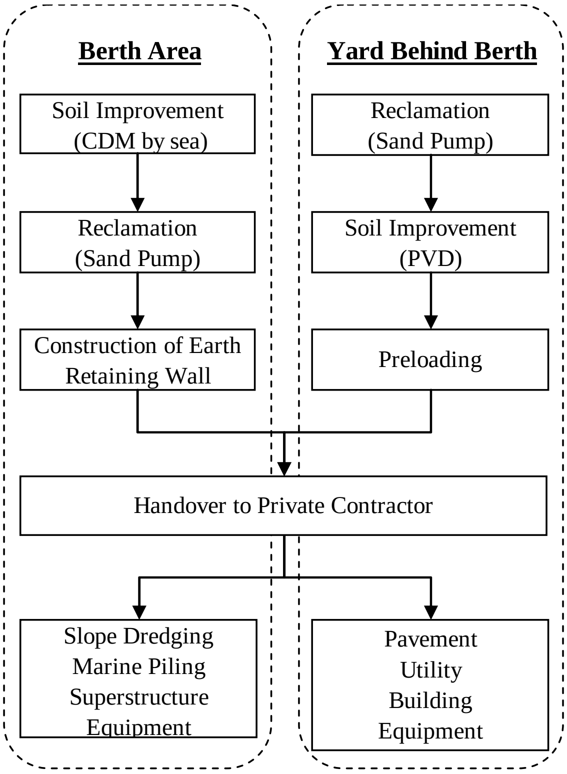
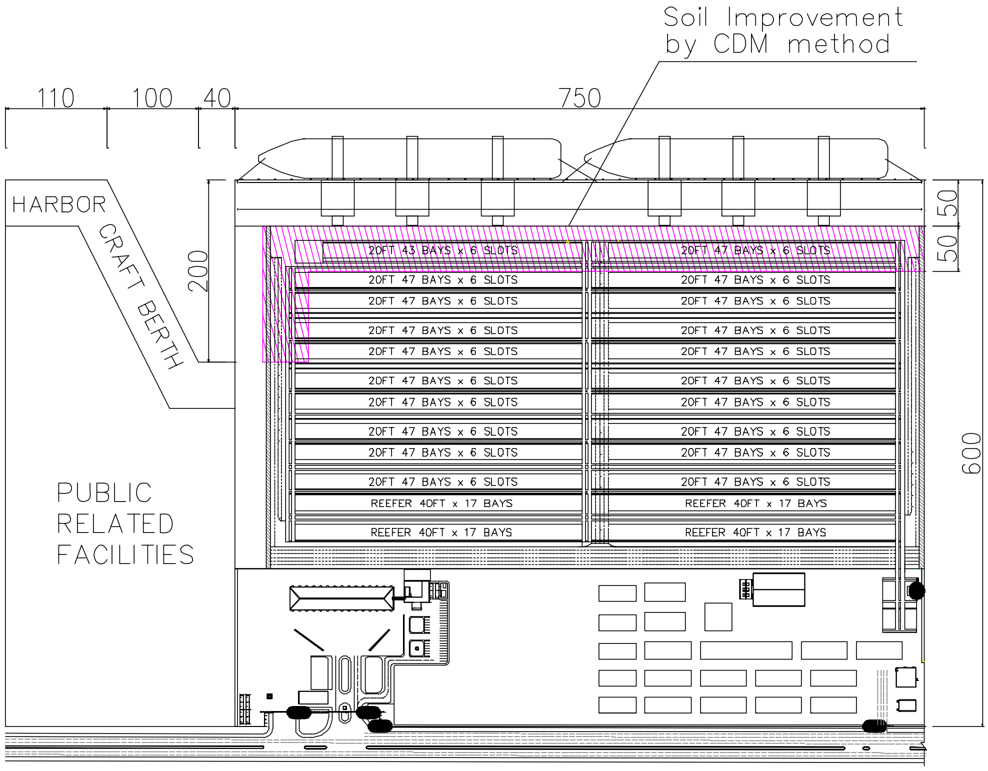


Figure 16.1.1 Flow chart of container terminal construction

16.1.3 Soil Improvement by Cement mixing method (CDM)

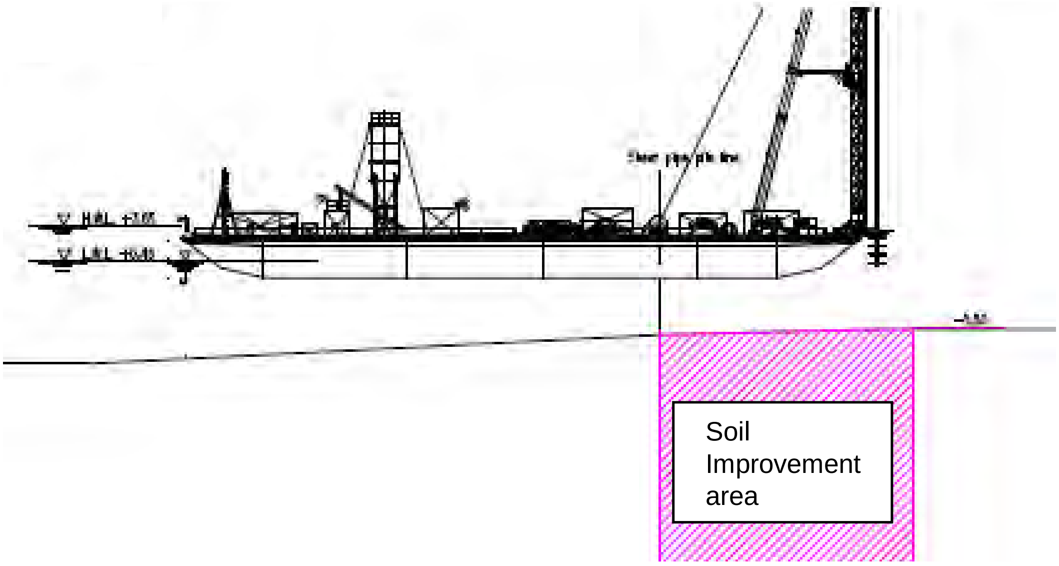
The most economical soil improvement method is PVD and its construction method is already explained in section 12.2.5. With this method, preloading is required after the installation of drain material and need to wait certain period until the original ground is consolidated enough. Therefore it requires 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

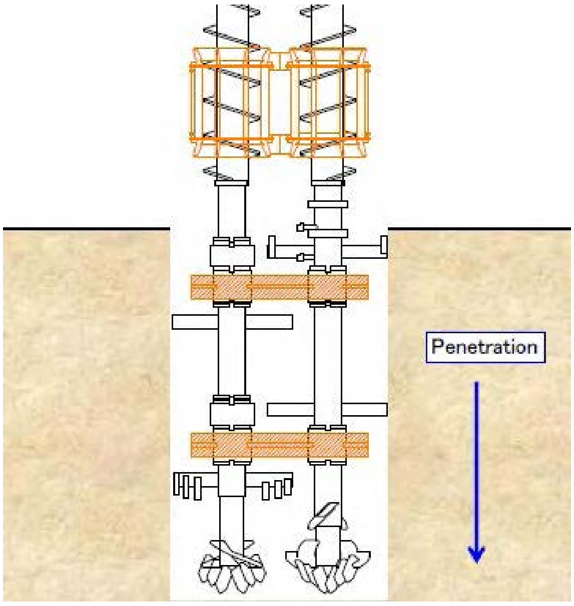
Figure 16.1.2 Proposed area of CDM method

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

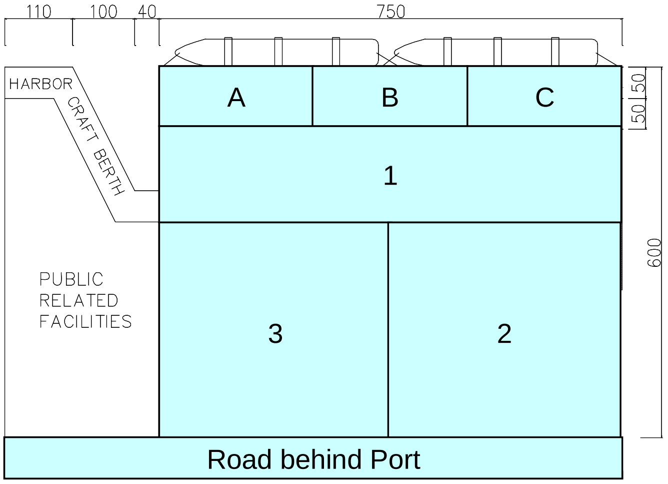
Since Lach Huyen Port Project will be implemented by PPP scheme, the area needs to be handed over to the private contractor portion by portion.

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

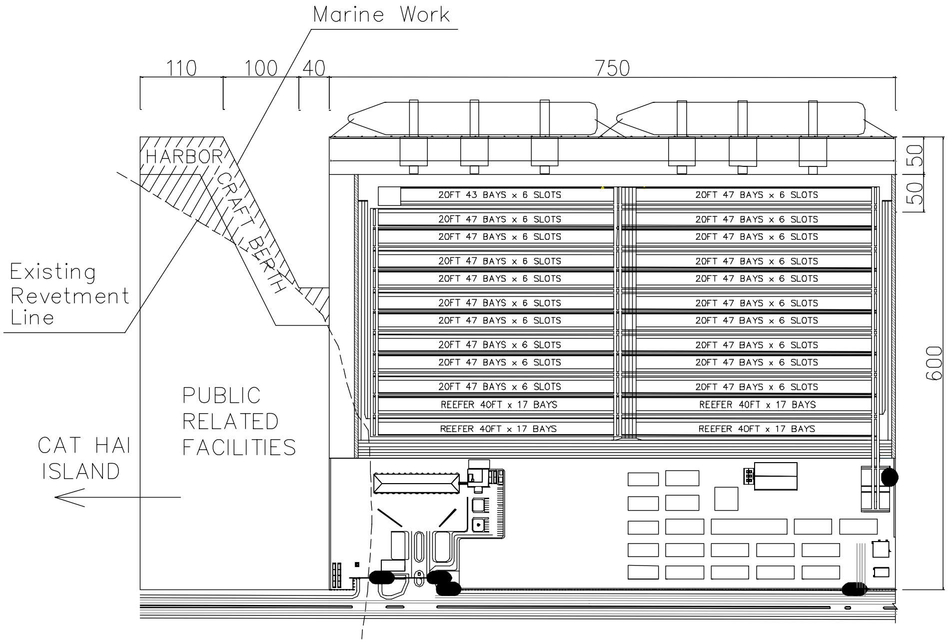
Figure 16.1.6 Plan of Hanover area

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

16.2 Cost Estimates

As described in Chapter 14, according to the approved FS, the Berth No.1 and No.2 were designed for the container vessels of 30,000DWT (Full Load) and 50,000DWT (Partial Load) requiring a berth length of 600m. However, the SAPROF Study recommended that the design container vessel for Berth No.1 & No.2 should be 50,000DWT (Full Load) and 100,000DWT (Partial Load) as the Initial Stage development. 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.

The construction cost was carefully calculated based on above changes in project scale, modified facilities design, construction schedule, and also based on the latest construction environment in the Northern Vietnam.

16.2.1 Scope of Cost Estimate

The following facilities / works are the scope of cost estimate:

- Temporary facilities for construction
- Earth retaining wall behind the berth
- Access channel dredging
- Reclamation works
- Port protection facilities including Inner Revetment, Outer Revetment and Sand Protection Dyke
- Soil improvement works
- Access road behind the Port
- Public related facilities
- Navigational aids

The following facilities / works are not included the scope of cost estimates:

- Container terminal including container berth, barge berth, apron / yard pavement, buildings and utilities
- Slope dredging underneath the berth
- Berth box dredging
- Dredging between the access channel and the berth box
- Cargo handling equipment

16.2.2 Basic Conditions of Cost Estimate

In order to calculate an approximate project cost, the following conditions are taken into account:

1) Exchange Rate

Exchange rates applied to the cost estimate are the ones as per set by JICA Fact Finding Mission in March 2010.

- VND 1 = JPY 0.00528
- USD 1 = JPY 89.60

(VND 1 = USD 0.000058928 = JPY 0.00528)

2) Assumed Price Escalation Rate

Assumed price escalation rates for both local and foreign currency portions are the ones as per set by JICA Fact Finding Mission in March 2010. Price escalation is calculated for both foreign and local currency portions based on the project implementation schedule.

- Foreign currency portion:	3.1% per annum
- Local currency portion:	10.3% per annum
- Base year used in cost estimation:	March 2010

3) Physical Contingency (5%)

A rate of physical contingency is 5% as per set by JICA Fact Finding Mission in March 2010. Physical contingency is obtained by multiplying the rate by the total of:

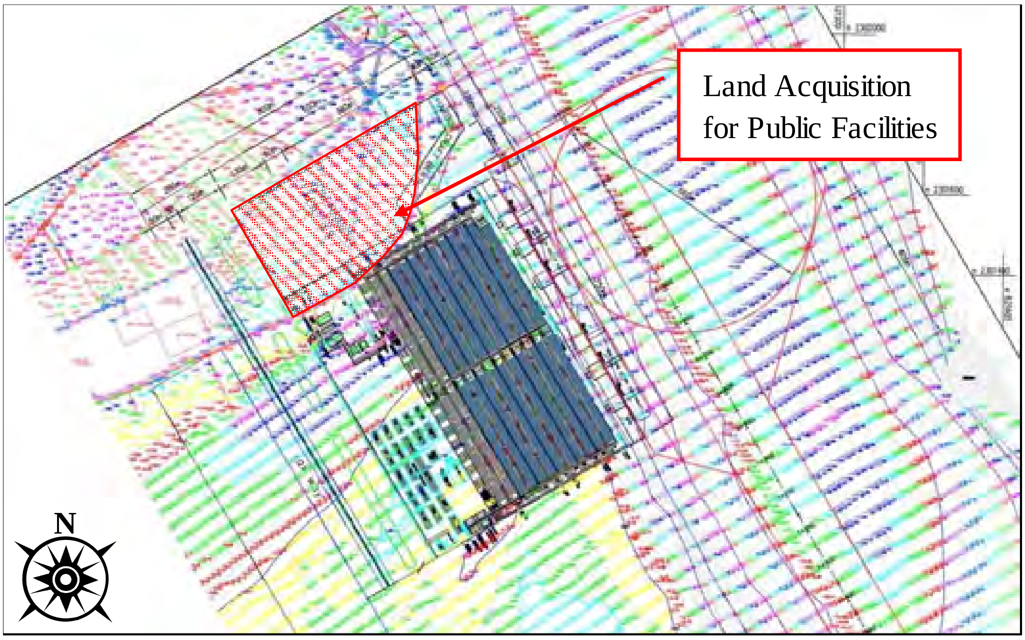
- Construction cost
- Price escalation

4) Consulting Service

Consulting service is calculated based on the schedule of necessary man-power during the construction. Consulting service includes price escalation and physical contingency.

5) Land Acquisition

The cost for land acquisition is considered in the cost estimate. The area for land acquisition is illustrated in Figure 16.2.1 and the necessary cost for land acquisition is summarized in Table 16.2.1.



Source: SAPROF Team

Figure 16.2.1 Area for Land Acquisition

Table 16.2.1 Land Acquisition Cost

Present Use	Area (m^2)	Compensation/support Cost (million VND)	
1. Unknown use land between residential building and VTS Station	7,200		237.6
2. Gov. facilities	N/A		
3. Bare ground along the coast with 5 graves	26,300	- Land: - 5 Graves:	867.9 34.5
4. Salt pan	N/A		
5. Aquaculture pond	64,700	- Land: - Bank creation: - Facilities: - Labor tool: - Fence: - Pond treatment: - Living facilities: - Aquaproduct: - Labor:	640.53 25.0 1,220.8 77.64 20.0 97.05 7.0 679.35 7,117
6. Forest	10,200	- Land:	67.32
7. Road	3,500		3,500.0
Total			**7,481.807**

Source: SAPROF Team

6) Assumed Administration Cost (5%)

A rate of administration cost is assumed as 5%. The cost for mine checking and bomb-disposal is considered to be covered by administration cost. Administration cost is obtained by multiplying the rate by the total Local Currency portion of:

- Construction cost
- Price escalation
- Physical contingency
- Consulting service
- Land acquisition

7) Value Added Tax (10%)

A rate of Value added tax (VAT) is assumed as 10%. VAT is computed by multiplying the rate by the total of:

- Construction cost
- Price escalation
- Physical contingency
- Consulting service

8) Import Tax (10%)

A rate of Import tax is assumed as 10%. Import tax is applied only to the Foreign Currency portion and is computed by multiplying the rate by the total of :

- Construction cost (foreign currency portion)
- Price escalation (foreign currency portion)
- Physical contingency (foreign currency portion)

9) Interest during construction (Assumed STEP Loan scheme)

Since the Project is assumed to be funded by Japanese ODA loan under the Special Terms for Economic Partnership (STEP), the following interest rates are considered during construction:

- For Construction	0.2% per annum
- For Consultancy Service	0.01% per annum

The interest during construction is estimated based on the construction schedule and manpower schedule.

10) Commitment Charge (0.1% per annum)

The commitment charge is the charge made for holding available the undisbursed balance of a loan commitment after the effective date of Loan Agreement (L/A). It is a fixed-rate charge of 0.1 percent a year calculated on the basis of the undisbursed balance.

11) Unit Cost used in Cost Estimate

Unit costs of construction items in cost estimate are mainly based on prevailing regulations set by Central Government, Hai Phong City and the latest market price in Hai Phong City as of May 2010. As for the unit costs of materials imported from Japan are based on the market price as of April 2010. The site management cost and overhead and profit of the Contractor are considered in the unit cost.

12) Conditions for STEP application

As described in Chapter 14, the Project is considered to be funded by Japanese ODA loan under the Special Terms for Economic Partnership (STEP). Although STEP application has advantages other than low interest rate, such as:

- Flexibility of the timing of processing
- Available for Grant Assistance for Detailed Design
- Support to feasibility study by JICA and JETRO.

, it also requires the following conditions:

(1) Procurement Conditions

- Prime contractors are tied to Japanese firms. Joint ventures (JV) with recipient countries are also admitted on condition that Japanese firm is a leading partner and the total share of work of Japanese partners is more than 50 %.
- Sub-contractors are untied and opened to all countries

(2) Country of Origin of Goods Procured under STEP

- Total cost of goods procured from Japan shall be no less than 30% of the total amount of contract(s) (except consulting services) financed by STEP loan.
- Each contractor should submit a declaration letter for the portion of goods procured from Japan

In the cost estimate, the following construction works / materials are considered to be procured from Japan:

- Channel dredging
- Steel Sheet Pipe Pile, Steel Sheet Pile, Tie Rod, Structural Steel,

- Cement Deep Mixing Method including ALiCC method.
- Mooring Bollards for the quay wall of public facility area
- Rubber Fenders for the qua wall of public facility area
- Channel Buoys, Light Beacons, and Pilot Assistance System

As for the percentage of Japan portion, the total of “Construction Cost”, “Price Escalation” and “Physical Contingency” should be no less than 30% of the total project cost.

13) Contract Package

As described in Clause 17.4, the following contract packages for construction are considered in the cost estimate:

Package 1: Dredging of Navigation Channel

Package 2: Construction of Container Terminal, Port Protection Facilities and Public Related Facilities

Package 3: Consulting Services for Construction Supervision

16.2.3 Major Changes in Project Scope / Scale compared to Approved FS

1) Additional Scope

The following items are added to the approved FS:

(1) Construction of Barge Berth

Length: 200m, for 3 to 4 barge alongside at the same time

Although the construction of barge berth itself is not the scope of the Project, the retaining wall behind the barge berth is the scope of the Project.

(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 included in the scope of the Project. The major construction items are listed 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

Although there is a navigational assistance system is available at present, considering the large vessels sailing in the narrow passage, the following navigational aids are added to the Project:

- Channel buoys	: Spar Buoy 20 sets
- Light Beacon	: 4 sets on Sand Protection Dyke

- Pilot Assistance System : Personal Computer 7 sets

(4) Extra Depth of Dredging for Access Channel

According to the Vietnamese standard, the access channel should be dredged 0.4m below the designed depth. In addition, as described in Chapter 8, sedimentation activities are estimated to some extent during the channel dredging period. Therefore, the following volumes of dredging are included in the Project:

- Extra volume due to the extra depth of the channel
  K0 - Km9.95 : 636,800 m^3
  Km9.95 - Km17.4 : 625,800 m^3
  Total : 1,262,600 m^3
- Extra volume due to the sedimentation activities during the channel dredging
  Estimated volume : 2,000,000 m^3
- Total additional dredging volume : 3,262,600 m^3

2) Major Change in Project Scale

The major change in project scale compared to the initial stage of the approved FS is summarized in Table 16.2.2.

Table 16.2.2 Comparison of Main Port Facilities between TEDI and Study Team

Facility / Items	Proposed by Study Team	Initial Stage of TEDI's F/S
Design Vessel	50,000DWT (Full), 100,000DWT (Partial)	30,000DWT (Full), 50,000DWT (Partial)
Container Terminal		
No. of Berth	2	2
Length of Berth	750 m	600 m
Depth alongside Berth	-14.0 m CDL	-14.0 m CDL
Crown Height of Berth	+5.5 m CDL	+5.5m CDL
Earth Retaining Structure	Steel Sheet Pipe Pile Wall	Rubble Mound
Reclamation Volume	2,955,483 m^3	2,636,000 m^3
Soil Improvement	ALiCC: 50mW x 920mL PVD: 564,000m^2	Sand Pile: 420,000 m^2
Port Service Road	Width: 44m, Length: 1,000m	Width: 41m Length: 630m
Access Channel Dredging		
Width	160.0 m / 210.0m	130.0 m
Length	17.4 km	14.0 km
Dredged Depth	-14.0 m CD	-10.3 m CD
Diameter of Turning Basin	660 m	560 m
Dredging Volume	32,300,860 m^3 (Including extra depth)	8,941,000 m^3
Port Protection Facilities		
Outer Revetment	Top elevation: +6.5m CDL Length 3,230 m	Top elevation: +5.5m CDL Length: 3,900 m
Sand Protection Dyke	Top elevation: +2.0m CDL Length: 7,600m	Top elevation: +2.0m CDL Length: 5,000m
Public Related Facility		
Land Reclamation	Area: 132,000m^2, V=344,000m^3 Soil improvement: PVD 21,300m^2	Area: 141,250 m^2
Harbor Crafts Berth	374mL x 30mW x -4mD Sheet Pile Wall structure Dredging: V=104,000m^3	Length: Approx. 270m
Buildings	4,600m^2 for Port Administration, Customs, Immigration, Quarantine, Coastal Guard, Security & Amenity Space	-
Utilities	Electricity supply, Water supply, Fire fighting, Sewage system within boundary.	-
Navigation Aids		
Channel Buoy	Spar buoy: 20 sets	-
Light Beacons	4 sets on sand protection dyke	-
Pilot Assisting System	7 sets	-
Extra Dredging		
Volume due to extra depth	1,262,600 m^3	-
Volume due to sedimentation	2,000,000 m^3	-

16.2.4 Result of Cost Estimate

1) Summary of Project Cost

The total project cost is computed as:

VND 12,561,058,322,289 for local currency portion,

and **JPY 27,131,642,178** for foreign currency portion.

This amount is equivalent to:

17,699,626,916,589 in VND

93,454,030,120 in JPY

As for the percentage of Japan portion, the total of “Construction Cost”, “Price Escalation” and “Physical Contingency” are computed as follows:

Item	VND	JPY
Construction cost	6,782,536,322,839	22,028,165,322
Price Escalation	2,742,219,111,537	2,437,148,434
Physical Contingency	476,237,771,719	1,223,265,688
Total	10,000,993,206,094	(1) 25,688,579,443
Total in JPY		(2) 78,493,823,572
Percentage of Japan Portion		(1) / (2) **32.73 %**

The project cost is summarized in Table 16.2.4, the breakdown of the cost is shown in Table 16.2.5, project cost by year is shown in Table 16.2.3, respectively. And cost comparison table between approved FS and SAPROF prepared by Vietnamese side for the internal approval process is referred in Table 16.2.6.

Table 16.2.3 Cost by Year

Breakdown of Cost	Total (in million JPY)	Public Portion (in million JPY)	Others (in million JPY)
2010	80	80	0
2011	80	80	0
2012	11,948	10,254	1,694
2013	37,339	31,998	5,341
2014	30,408	26,070	4,338
2015	13,348	11,521	1,827
2016	202	197	5
2017	47	43	5
Total	**93,454**	**80,244**	**13,211**

Source: SAPROF Team

Table 16.2.4 Summary of the Project Cost

Breakdown of Cost	Foreign Currency Portion (in million JPY)			Local Currency Portion (in million VND)			Total (in million JPY)		
	Total	Public Portion	Others	Total	Public Portion	Others	Total	Public Portion	Others
Package-1	16,473	16,473	0	2,093,062	2,093,062	0	27,525	27,525	0
Package-2	5,555	5,555	0	4,689,474	4,689,474	0	30,315	30,315	0
Price Escalation	2,437	2,437	0	2,742,219	2,742,219	0	16,916	16,916	0
Physical Contingency (5%)	1,223	1,223	0	476,238	476,238	0	3,738	3,738	0
Consulting Service	646	646	0	58,071	58,071	0	952	952	0
Land Acquisition	0	0	0	7,482	0	7,482	40	0	40
Administration Cost	0	0	0	503,327	0	503,327	2,658	0	2,658
VAT	0	0	0	1,504,659	0	1,504,659	7,945	0	7,945
Import Tax	0	0	0	486,526	0	486,526	2,569	0	2,569
Interest during Construction	477	477	0	0	0	0	477	477	0
Commitment Charge	320	320	0	0	0		320	320	0
Total	**27,132**	**27,132**	**0**	**12,561,058**	**10,059,064**	**2,501,994**	**93,454**	**80,244**	**13,211**

Source: SAPROF Team

Table 16.2.5 Breakdown of the Project Cost

No.	Item	Unit	Quantity	Local Currency Portion (in VND)		Foreign Currency Portion (in JPY)		Remarks
				Unit Price	Amount	Unit Price	Amount	
I	**Construction Expenses**							
A	**Package-1 (Dredging)**				***2,093,062,015,200***		***16,473,438,600***	Public Portion
0	**Temporary Facility**				***34,851,216,000***		***0***	Public Portion
a	Temporary Yard	m2	8,000.0	4,356,402	34,851,216,000	0	0	
1	**Dredging**				***2,058,210,799,200***		***16,473,438,600***	Public Portion
a	Access Channel	m3	32,300,860.0	159,300	2,058,210,799,200	850	16,473,438,600	VN40:JP60
b	Wharf Slope Dredging	m3	567,514.0	N.A.	0	0	0	*Private Portion*
c	Berth Box	m3	54,553.0	N.A.	0	0	0	*Private Portion*
d	Between Channel and Berth Box	m3	98,142.0	N.A.	0	0	0	*Private Portion*
B	**Package-2 (CT, Protection, Public Facilities)**				***4,689,474,307,639***		***5,554,726,722***	Public Portion
0	**Temporary Facility**				***139,404,864,000***		***0***	Public Portion
a	Temporary Yard	m2	32,000.0	4,356,402	139,404,864,000	0	0	
1	**Container Terminal**				***79,073,459,100***		***2,350,001,970***	Public Portion
a	Berth Structure	L.S	1.0	N.A.	0	0	0	*Private Portion*
b	Earth Retaining Wall	m	750.0	103,054,818	77,291,113,500	3,027,009	2,270,256,750	
c	Earth Retaining Wall for Barge Berth	m	180.0	9,901,920	1,782,345,600	443,029	79,745,220	
2	**Reclamation**				***600,087,179,286***		***0***	Public Portion
a	Terminal Area	m3	2,955,483.0	203,042	600,087,179,286	0	0	
3	**Port Protection Facilities**				***2,473,677,207,710***		***0***	Public Portion
a	Inner Revetment	m	750.0	40,162,324	30,121,743,000	0	0	
b	Outer Revetment-A	m	720.0	193,692,006	139,458,244,320	0	0	
c	Outer Revetment-B	m	2,510.0	198,346,558	497,849,860,580	0	0	
d	Training Dike-1	m	3,110.0	119,133,461	370,505,063,710	0	0	
e	Training Dike-2	m	3,290.0	307,135,810	1,010,476,814,900	0	0	
f	Training Dike-3	m	1,200.0	354,387,901	425,265,481,200	0	0	
4	**Soil Improvement**				***1,004,710,309,560***		***2,100,315,625***	Public Portion
a	Terminal Area	m2	366,625.0	1,261,246	462,404,314,750	4,665	1,710,305,625	
b	Barge Berth Area	m2	5,000.0	3,373,909	16,869,545,000	78,002	390,010,000	
c	Inner Revetment	m2	4,550.0	2,324,418	10,576,101,900	0	0	
d	Outer Revetment A	m2	13,104.0	2,094,872	27,451,202,688	0	0	
e	Outer Revetment B	m2	52,459.0	5,019,258	263,305,255,422	0	0	
f	Access Road	m2	192,900.0	1,161,762	224,103,889,800	0	0	
5	**Access Road behind Port**				***62,027,985,000***		***0***	Public Portion
a	Access Road	m	1,000.0	62,027,985	62,027,985,000	0	0	
6	**Public Related Facilities (CIQ)**				***328,503,425,659***		***472,238,250***	Public Portion
a	Reclamation	m3	344,131.0	203,042	69,873,046,502	0	0	
b	Dredging	m3	103,897.0	223,127	23,182,225,919	0	0	
c	Quaywall	m	375.0	237,948,361	89,230,635,375	1,259,302	472,238,250	
d	Pavement	m2	40,300.0	1,071,745	43,191,323,500	0	0	
e	Building	L.S.	1.0	59,935,258,841	59,935,258,841	0	0	
f	Utilities	L.S.	1.0	28,349,124,722	28,349,124,722	0	0	
g	Soil Improvement	m2	23,600.0	624,653	14,741,810,800	0	0	
7	**Navigational Aids**				***1,989,877,324***		***632,170,877***	Public Portion
a	New Channel Buoys	nos	20.0	74,547,220	1,490,944,400	28,323,068	566,461,360	
b	Relpace Existing Buoy	nos	3.0	97,456,616	292,369,848	0	0	
c	Light Beacon	nos	4.0	51,640,769	206,563,076	4,531,691	18,126,764	
d	Pilot Assistance System	L.S.	1.0	0	0	47,582,753	47,582,753	
	Total Expense				**6,782,536,322,839**		**22,028,165,322**	
II	**Price Escalation**				**2,742,219,111,537**		**2,437,148,434**	Public Portion
III	**Physical Contingency (5%)**				**476,237,771,719**		**1,223,265,688**	Public Portion
IV	**Consulting Service**				**58,071,069,646**		**645,546,327**	Public Portion
V	**Land Acquisition**				**7,481,807,000**		**0**	Other Portion
VI	**Administration Cost**				**503,327,304,137**		**0**	Other Portion
VII	**VAT**				**1,504,658,809,587**		**0**	Other Portion
VIII	**Import Tax**				**486,526,125,823**		**0**	Other Portion
IX	**Interest during Construction**				**0**		**477,285,786**	Public Portion
X	**Commitment Charge**				**0**		**320,230,622**	Public Portion
	Total Project Cost				**12,561,058,322,289**		**27,131,642,178**	
	(In VND)				17,699,626,916,589			
	(In JPY)						93,454,030,120	

Source: SAPROF Team

Table 16.2.6 Cost Comparison Table (for reference)

No.	Item	Unit	(a) TEDI F/S Initial Stage (Price in **2006**)			(b) SAPROF Team Year 2015 Development (Price in **2010**)					Remarks
			Quantity	Cost Estimate (in VND)		Quantity	Local Currency Portion (in VND)		Foreign Currency Portion (in JPY)		
				Unit Price	Amount		Unit Price	Amount	Unit Price	Amount	
I	**Construction Expenses**										
0	**Temporary Facility**				***0***			***174,256,070,902***		***0***	Not specified in TEDI's FS
a	Temporary Yard	m2		N.A.	0	40,000.0	4,356,402	174,256,070,902	0	0	
1	**Container Terminal**				***820,048,000,000***			***79,073,458,702***		***2,350,002,011***	**Scale Change**
a	Berth Structure	m	600.0	763,640,000	458,184,000,000	750.0	N.A.	0	N.A.	0	*Private*
b	Earth Retaining Wall	m		N.A.	0	750.0	103,054,818	77,291,113,163	3,027,009	2,270,256,715	
c	Earth Retaining Wall for Barge Berth	m		N.A.	0	180.0	9,901,920	1,782,345,539	443,029	79,745,296	
d	Yard Pavement	m2	330,000.0	723,018	238,596,000,000		N.A.		N.A.		*Private*
e	Building and Utilities	LS	1.0	123,268,000,000	123,268,000,000		N.A.		N.A.		*Private*
2	**Dredging**				***694,989,000,000***			***2,058,204,654,895***		***16,467,469,886***	**Scale Change, -10.3m to -14.0m**
a	Access Channel	m3	8,941,434.0	77,727	694,989,000,000	32,300,860.0	159,300	2,058,204,654,895	850	16,467,469,886	
b	Wharf Slope Dredging	m3		N.A.	0	567,514.0	N.A.	0	0	0	
3	**Reclamation**				***335,176,000,000***			***600,087,179,286***		***0***	**Scale Change, L=600m to L=750m**
a	Terminal Area	m3	2,636,157.0	127,146	335,176,000,000	2,955,483.0	203,042	600,087,179,286	0	0	
4	**Port Protection Facilities**				***3,088,525,000,000***			***2,473,677,209,790***		***0***	
a	Inner Revetment	m	1,400.0	41,539,285	58,155,000,000	750.0	40,162,324	30,121,742,708	0	0	**Change in Scale and design**
b	Outer Revetment-A	m	3,900.0	329,206,879	1,283,907,000,000	720.0	193,692,006	139,458,244,549	0	0	
c	Outer Revetment-B	m		N.A.	0	2,510.0	198,346,558	497,849,861,568	0	0	
d	Training Dike-1	m	5,700.0	306,397,000	1,746,463,000,000	3,110.0	119,133,461	370,505,064,597	0	0	
e	Training Dike-2	m		N.A.	0	3,290.0	307,135,810	1,010,476,814,706	0	0	
f	Training Dike-3	m		N.A.	0	1,200.0	354,387,901	425,265,481,661	0	0	
5	**Soil Improvement**				***331,450,000,000***			***1,039,614,928,503***		***2,229,456,124***	
a	Terminal Area	m2	420,000.0	789,167	331,450,000,000	366,625.0	1,356,451	497,308,986,812	5,017	1,839,447,485	**Change in Scale, design and construction method**
b	Barge Berth Area	m2		N.A.	0	5,000.0	3,373,909	16,869,543,472	78,002	390,008,639	
c	Inner Revetment	m2		N.A.	0	4,550.0	2,324,418	10,576,099,708	0	0	
d	Outer Revetment A	m2		N.A.	0	13,104.0	2,094,872	27,451,201,872	0	0	
e	Outer Revetment B	m2		N.A.	0	52,459.0	5,019,258	263,305,260,915	0	0	
f	Access Road	m2		N.A.	0	192,900.0	1,161,762	224,103,835,723	0	0	
6	**Access Road behind Port**				***235,178,000,000***			***62,027,985,255***		***0***	**Scale Change**
a	Access Road	m	600.0	391,963,333	235,178,000,000	1,000.0	62,027,985	62,027,985,255	0	0	
7	**Public Related Facilities (CIQ)**				***0***			***232,973,044,595***		***472,238,395***	**Added Scope**
a	Reclamation	m3		N.A.	0	344,131.0	203,042	69,873,046,502	0	0	
b	Dredging	m3		N.A.	0	103,897.0	223,127	23,182,211,365	0	0	
c	Quaywall	m		N.A.	0	375.0	237,948,361	89,230,635,249	1,259,302	472,238,395	
d	Pavement	m2		N.A.	0	40,300.0	1,071,745	43,191,318,430	0	0	
e	Building	L.S.		N.A.	0	1.0	N.A.	0	0	0	
f	Utilities	L.S.		N.A.	0	1.0	N.A.	0	0	0	
g	Soil Improvement	m2		N.A.	0	12,000.0	624,653	7,495,833,049	0	0	
8	**Navigational Aids**				***0***			***15,860,917,800***		***0***	**Added Scope**
a	New Channel Buoys	L.S.		N.A.	0	1.0	15,860,917,800	15,860,917,800	0	0	
	Total Expense				**5,505,366,000,000**			**6,735,775,449,728**		**21,519,166,415**	
	(TEDI II Equipment)	L.S.	1.0	639,795,000,000	**639,795,000,000**		N.A.	**0**	N.A.	**0**	
	(TEDI III Other Cost)	L.S.	1.0	120,016,000,000	**120,016,000,000**		N.A.		N.A.		
II	**Price Escalation**	L.S.	1.0	N.A.	**0**			**2,725,269,682,726**		**2,367,614,253**	
III	**Physical Contingency**	L.S.	1.0	626,920,000,000	**626,920,000,000**			**473,052,256,623**		**1,194,339,033**	
IV	**Consulting Service**							**92,423,999,999**		**1,187,000,000**	
V	**Land Acquisition**							**7,481,807,000**		**0**	
VI	**Administration Cost**							**501,700,159,804**		**0**	
VII	**VAT**							**1,500,154,405,997**		**0**	
VIII	**Import Tax**							**475,021,206,477**		**0**	
IX	**Interest during Construction**							**0**		**316,075,618**	
X	**Commitment Charge**							**0**		**318,587,391**	
	(TEDI V Total Investment without Loan nterest)				6,892,097,000,000		N.A.		N.A.		
	(TEDI V 1 Loan Interest)	L.S	1.0	0	0		N.A.		N.A.		
	(TEDI V 2 Initial Working Capital)	L.S	1.0	122,699,000,000	122,699,000,000		N.A.		N.A.		
	Total Project Cost				**7,014,796,000,000**			**12,510,878,968,353**		**26,902,782,711**	
	(In VND)							17,606,102,966,649			
	(In JPY)									92,960,223,664	

Source: MPMU II

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.

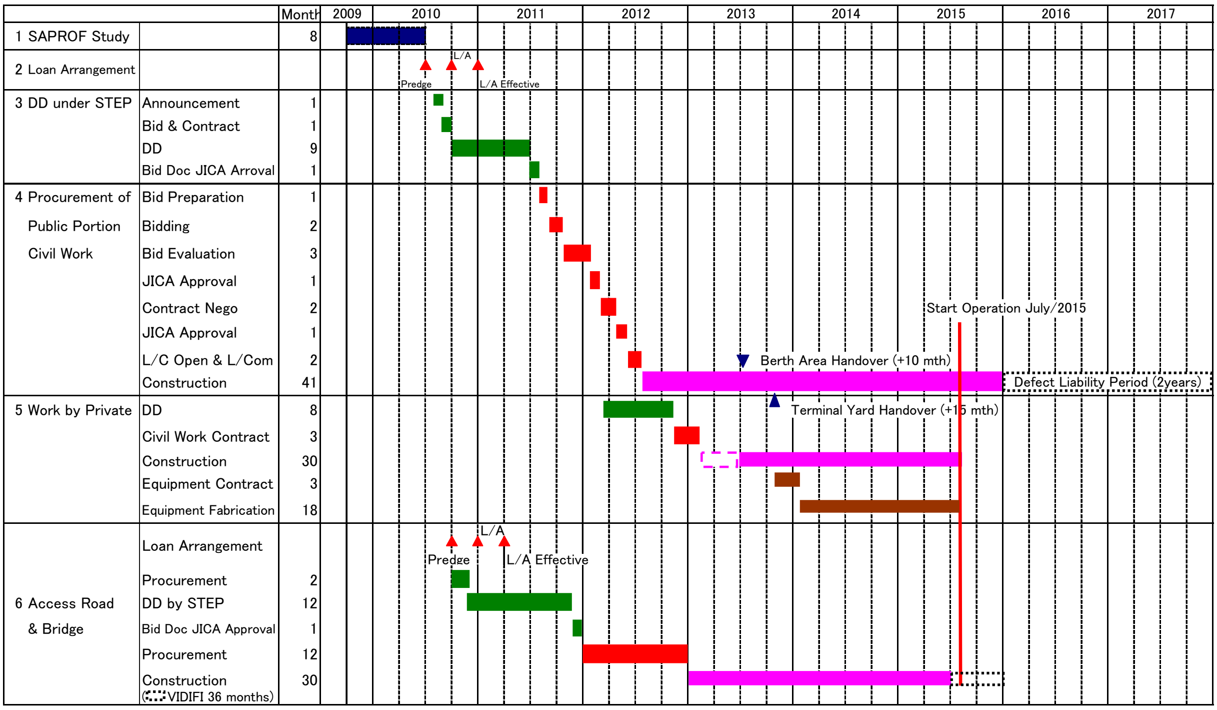
Below schedule is the earliest case with almost no margin which can only be achieved when the following conditions are met and the necessary steps prior to the construction work are completed on time. In case when any delay or accident is caused during the whole process, the start of port operation will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



		Month
1 SAPROF Study		8
2 Loan Arrangement		
3 DD under STEP	Announcement	1
	Bid & Contract	1
	DD	9
	Bid Doc JICA Arroval	1
4 Procurement of Public Portion Civil Work	Bid Preparation	1
	Bidding	2
	Bid Evaluation	3
	JICA Approval	1
	Contract Nego	2
	JICA Approval	1
	L/C Open & L/Com	2
	Construction	41
5 Work by Private	DD	8
	Civil Work Contract	3
	Construction	30
	Equipment Contract	3
	Equipment Fabrication	18
6 Access Road & Bridge	Loan Arrangement	
	Procurement	2
	DD by STEP	12
	Bid Doc JICA Approval	1
	Procurement	12
	Construction (⬚VIDIFI 36 months)	30

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

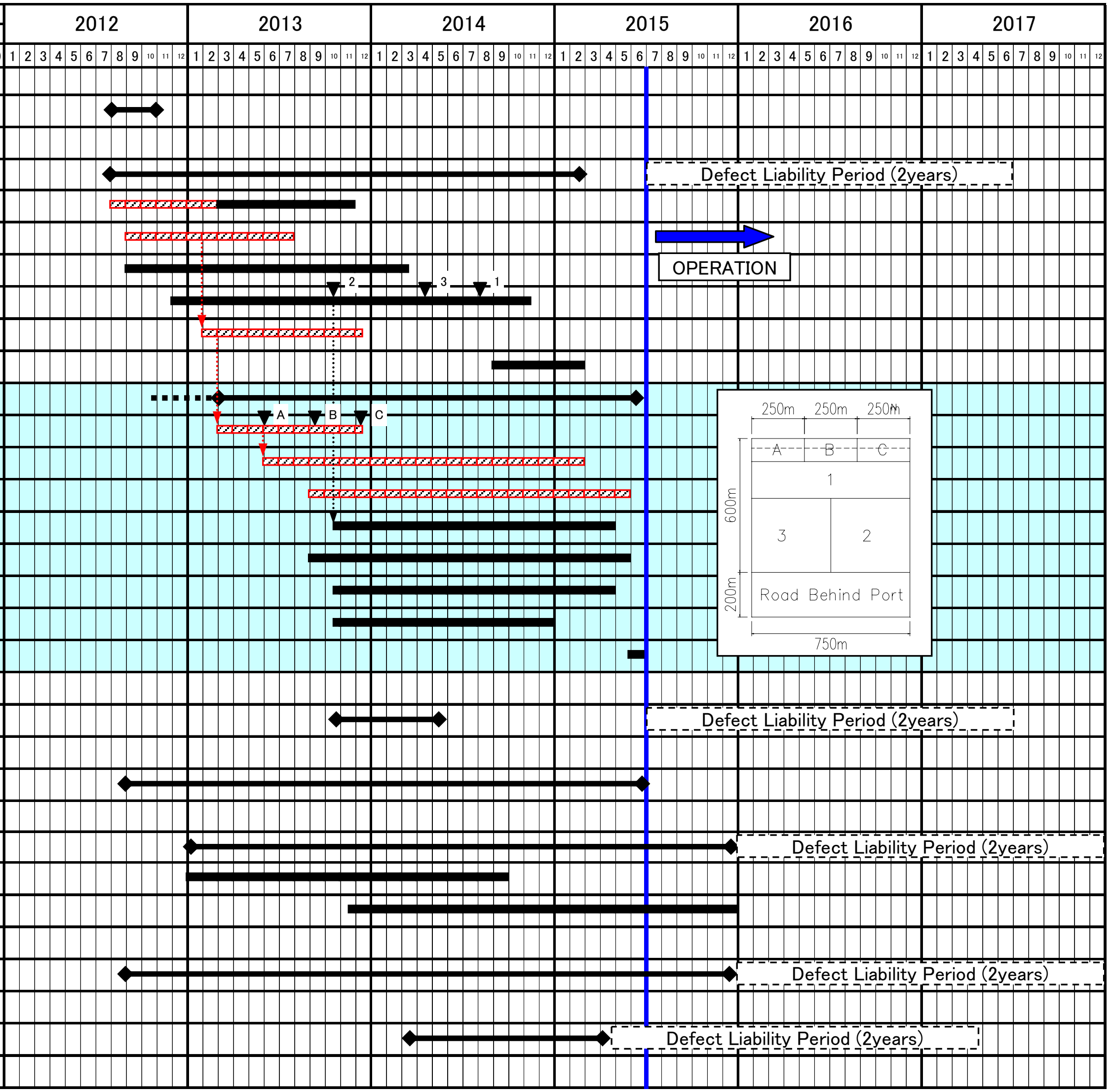
- Option-1 (Original plan): Soil improvement by CDM and PVD method
- Option-2: Gradual opening of the terminal (i.e., start the operation of berth 1 first)

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			
Public	1	Preparation Work	ls	1	3
	2	Container Terminal Construction	m	750	31
	2-1	Reclamation	m3	2,955,483	16
	2-2	Soil Improvement by Cement Mixing	m2	43,500	11
	2-3	Soil improvement (PVD)	m2	625,769	19
	2-4	Preload	m3	2,680,000	24
	2-5	Earth Retaining Wall	m	750	11
	2-6	Access Road behind the port	m	1,000	6
Private					
	2-7	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	19
	2-11	Equipment	ls	1	21
	2-12	Utility	ls	1	19
	2-13	Building	ls	1	15
	2-14	Inspection and Cleanup	ls	1	1
Public	3	Inner Revetment (South)	m	1,000	7
	4	Access Channel Dredging	m3	32,300,860	34
	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

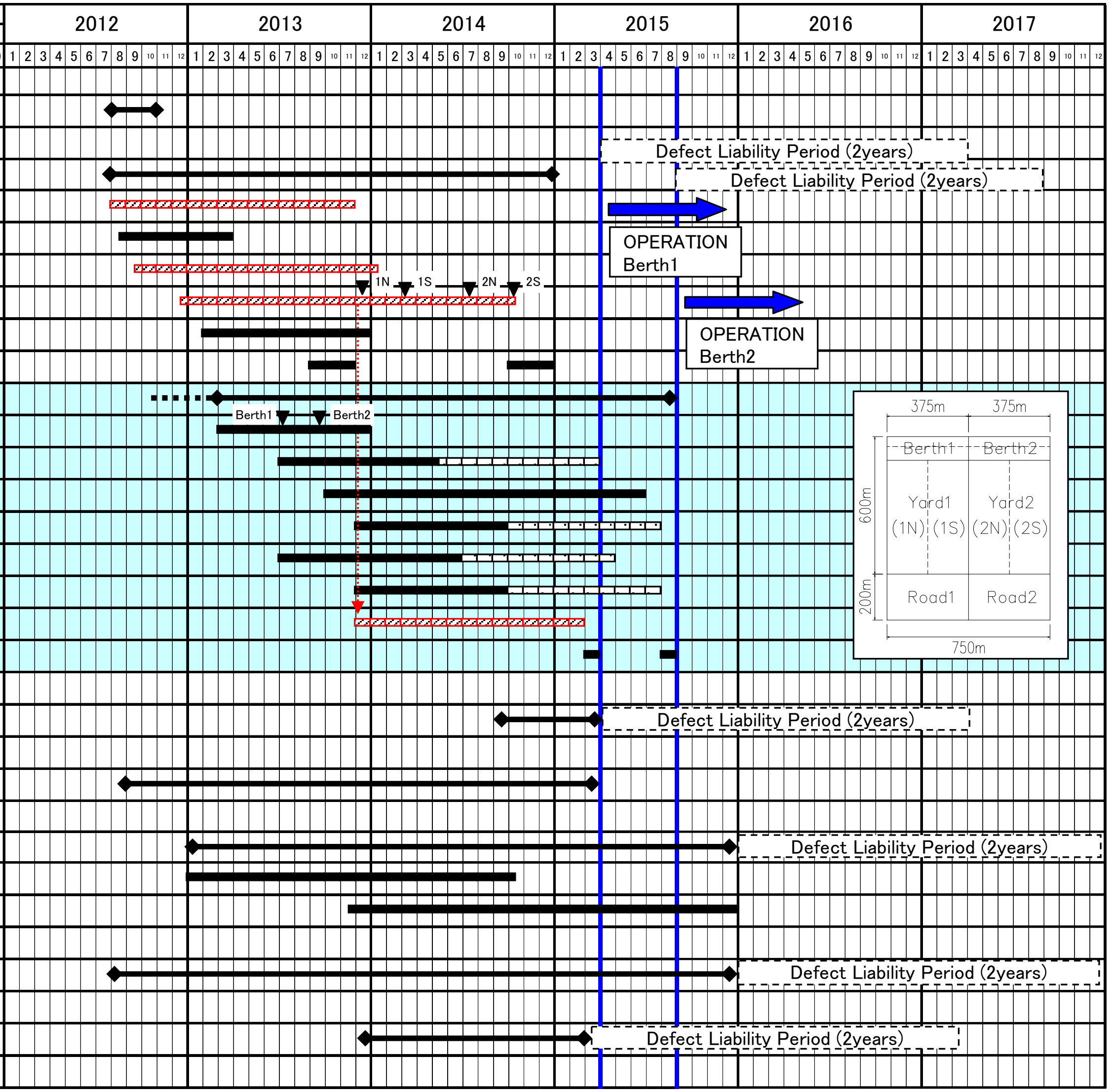


▼ : Handover Schedule and Area

▨ : Critial Path

Table 17.1.3 Tentative construction schedule – Option 2

	ID	Task	Unit	Quantity	Period (mth)
	YEAR 2015 STAGE				
Public	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
Private					
	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
Public					
	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

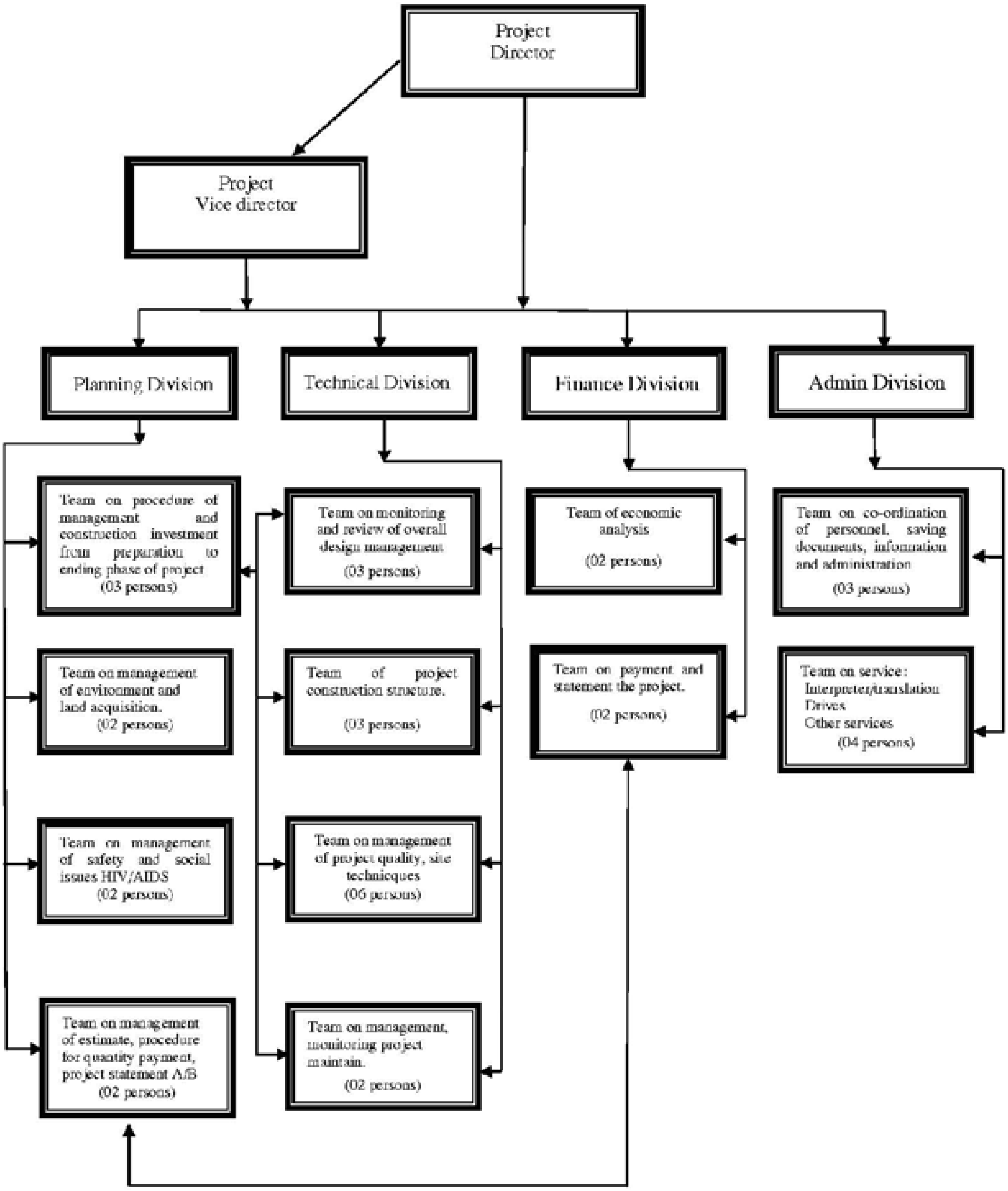


Figure 17.2.1 Organization Chart of MPMU II

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

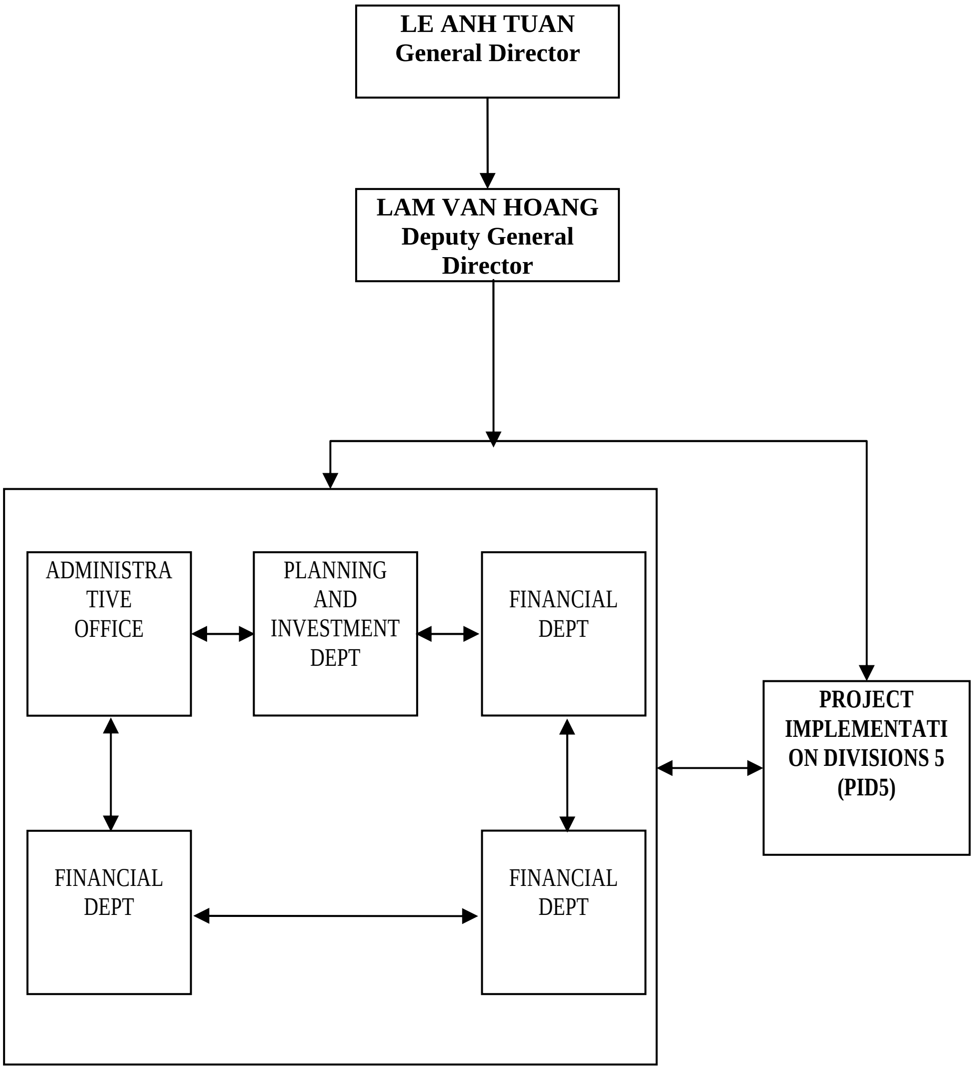


Figure 17.2.2 Organization Chart of PMU 2

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.

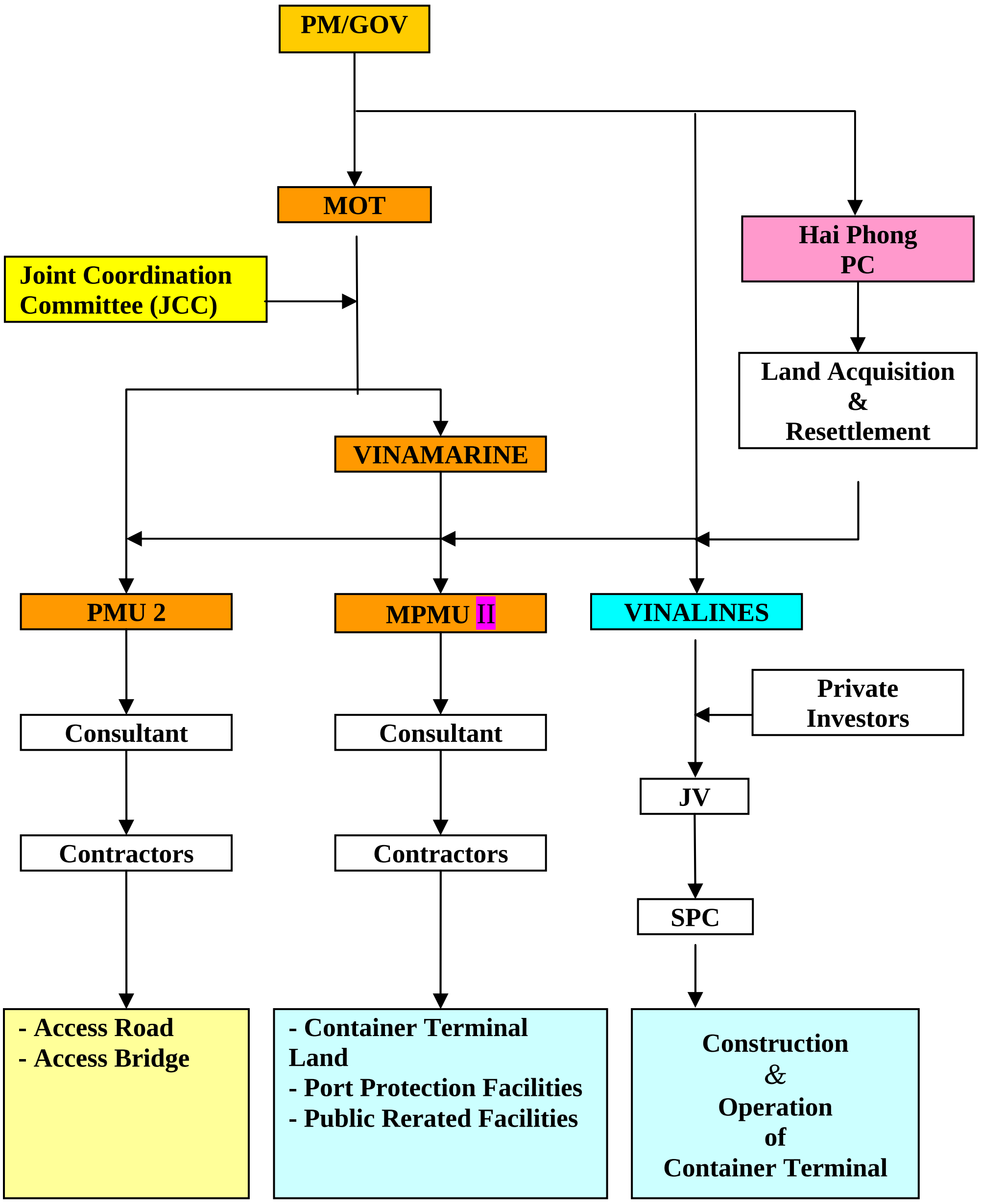


Figure 17.2.3 Organization Structure for Project Implementation

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.

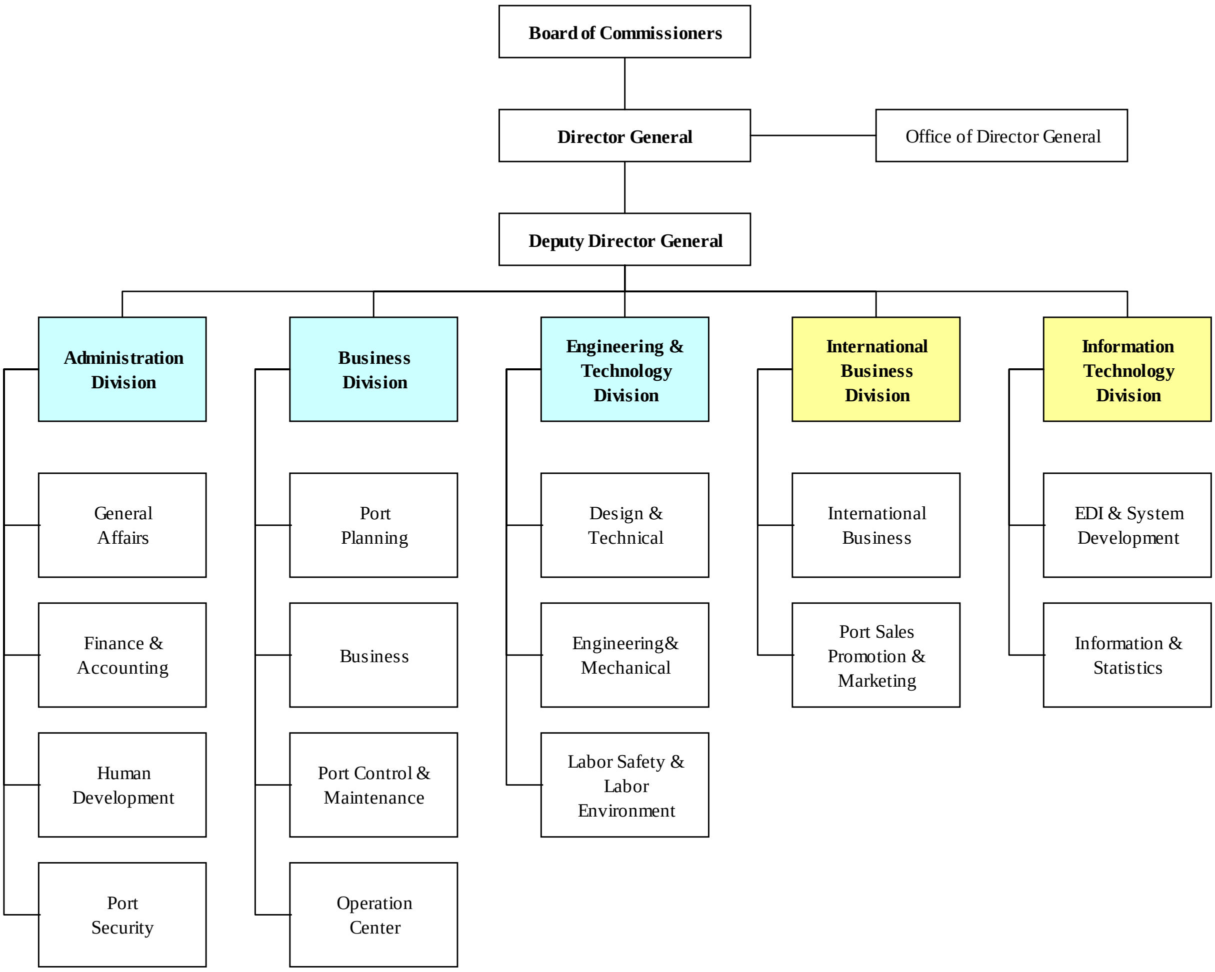


Figure 17.2.4 Organization Chart of SPC of Container Terminal Berth No.1 & 2

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”.

17.2.7 Operation and Maintenance of Port Infrastructures

1) O & M responsible to Private Sector

The private sector, JV of VINALINES will invest for the construction of berthing structure, dredging in front of berth, road & yard pavement, buildings and utility supply system in the container terminal No.1 & 2. All of these facilities should be operated and maintained under the responsibility of SPC, private operation company under JV of VINALINES.

2) O & M responsible for Public Sector

The Public Sector, GOV will invest for dredging of navigation channel and construction of terminal land, outer revetment, sand protection dyke and public related facilities including service berth, buildings and utility supply system. After completion of reclamation and subsoil improvement of terminal land, 200m wide land behind the terminal and land for public related facilities, the O & M of these lands will be carried out by VINAMARINE or Hai Phong PC.

The Port Owner of VINAMARINE should be responsible for operation and maintenance of other infrastructures such as Navigation Channel, Outer Revetment, Sand Protection Dyke and Public Related Facilities. The maintenance of these infrastructures will be performed by VINAMARINE.

17.3 Financial Implementation Plan

17.3.1 Principal idea for Financial Implementation Plan

Public investment portion shall be mainly financed by Japan's ODA Loan. As indicated in Chapter 14, Japanese technology is indispensable to achieve the successful implementation of PPP scheme. Particularly, critical points are i) the construction method to complete the required work volume in the limited time and ii) the tight construction schedule management. Therefore STEP (Special Terms for Economic Partnership) condition should be applied.

STEP condition is as under;

Interest Rate:	0.2 percent per annum on outstanding balance (as for the cost of Consultant for Supervision: 0.01 percent per annum on the respective outstanding balance) Interest during the construction is also financed by ODA Loan, same as the other loans for Vietnam.
Repayment Period:	40 years including 10 years grace period
Coverage:	100 percent of the eligible finance portion
Commitment Charge:	0.1percent per annum on un-disbursed amount. Commitment Charge is also finance by ODA Loan, same as the other loans for Vietnam.
Currency:	Japanese Yen

The cost of Consultant for detailed design is covered by JICA Technical Assistance Grant* (*This arrangement is only applicable for STEP Loan).

Non-eligible for ODA loan is financed by the Government of Vietnam. Non-eligible portions of the Project are; 1) Land Acquisition Cost, 2) Administration Cost and 3) Tax and Duties. Although taxes and duties are exempted in accordance with the agreement between Vietnamese and Japanese Government, executing agency should pay the tax as a practice. Therefore the necessary budgetary arrangement is required.

Operation and maintenance cost should be responsible to the Government of Vietnam.

17.3.2 ODA Loan Amount and Annual Disbursement

Disbursement is made according to the progress of the Project. Annual disbursement and total amount of the loan for each eligible portion as well as the interest during construction and commitment charge to be financed by ODA Loan are as shown in Table 17.3.1.

Table 17.3.1 ODA Loan Annual Disbursement

Unit: Million Japanese Yen

	2010	2011	2012	2013	2014	2015	2016	2017	Total
Temporary Facility			999			237			1,236
Container Terminal				3,292					3,292
Dredging			4,034	12,851	13,662	4,847			35,394
Reclamation			1,265	3,069					4,334
Port Protection Facilities			2,086	5,521	6,089	6,157			19,853
Soil Improvement			1,578	4,570	3,919				10,067
Access Road behid Port				231	254				485
Public Related Facilities (CIQ)				2,109	957				3,066
Navigational Aids					766				766
Sub Total			9,962	31,643	25,647	11,241			78,493
Supervision Consultant			208	249	286	127	39	43	952
Total			10,170	31,892	25,933	11,368	39	43	79,445
IDC		0	10	52	110	147	158	0	477
Commitment Charge	80	80	75	54	24	6	0	0	319
Grand Total	80	80	10,255	31,998	26,067	11,521	197	43	80,241

17.3.3 Annual Budgetary Requirement

Annual requirement of Vietnamese Government for construction period is shown in Table 17.3.2.

Table 17.3.2 Annual requirement of Budget

billion Vietnam Dong

	2010	2011	2012	2013	2014	2015	2016	2017	Total
Land Acquision Cost		7							7
Administratiion Cost		1	69	193	157	83	0	0	503
VAT		0	193	604	491	215	1	1	1,505
Import Tax		0	51	214	173	48	0		486
Total		0	313	1,011	821	346	1	1	2,492

17.4 Contract Package

This ODA project of port portion consists of following four (4) main works:

(1) Navigation Channel
(2) Container Terminal
(3) Port Protection Facilities
(4) Public Related Facilities

Each above work consists following sub-work items:

(1) Navigation Channel
  - Dredging work
  - Installation of navigation aid

(2) Container Terminal

- Land reclamation
- Sheet pile wall revetment
- Soil improvement
- Rubble stone embankment
- Pavement of port road behind terminal

(3) Port Protection Facilities

(a) Outer Revetment
- Soil improvement
- Placing of rubble stone
- Placing of concrete blocks
- Coping concrete

(b) Sand Protection Dyke
- Placing of rubble stone
- Placing of concrete blocks
- Coping concrete

(4) Public Related Facilities

- Land reclamation
- Service berth made of Sheet pile wall revetment
- Soil improvement
- Pavement of road and yard
- Buildings and utility works

Table 17.4.1 Sub-work Items of Each Main Work

No.	Sub Work Item	(1) Navigation Channel	(2) Container Terminal Yard	(3) Port Protection Facilities	(4) Public Related Facilities
1	Dredging	●			
2	Installation of Navigation Aids	●			
3	Reclamation		●		●
4	Steel Sheet Pile wall		●		●
5	Soil Improvement		●	●	●
6	Rubble stone placing		●	●	
7	Pavement of port road		●		●
8	Wave dissipation concrete block placing			●	●
9	Coping Concrete		●	●	●
10	Building work				●
11	Utility work				●

It is known that the main work items 2, 3 and 4 are consisting of similar sub-work items but the main work item 1 is consisting of completely different sub-work items which means that the main work item 1 and others works will require completely different capability of work.

On the other hand, the construction costs of each main work are estimated as follows:

Table 17.4.2 Construction Cost of Each Work Item

No.	Work Item	Construction Cost
1	Navigation Channel	US$ 315 million
2	Container Terminal	US$ 138 million
3	Port Protection Facilities	US$ 166 million
4	Public Related Facilities	US$ 27 million

From above technical aspect and financial scales of each work, following two alternatives are considered regarding the contract packaging for the implementation of port portion of Project:

(1) Alternative 1:

Package 1: Dredging of Navigation Channel

Package 2: Construction of Container Terminal and Public Related Facilities

Package 3: Construction of Port Protection Facilities

(2) Alternative 2:

Package 1: Dredging of Navigation Channel

Package 2: Construction of Container Terminal, Port Protection Facilities and Public Related Facilities

Comparing with Alternative 2, Alternative 1 has following disadvantages:

- Temporary construction facilities such as temporary site office, temporary storage yard, temporary berth, etc., need to be prepared separately and construction cost will increase.
- Handover the works between Package 2 and 3 will need agreement by both parties and the procedure will require time which will cause to delay of construction works and to increase of construction cost.
- The construction works should be carried out in and around the narrow existing navigation channel which is used by the calling/leaving ships to/from Haiphong port and safe navigation control, reporting system to authorities concerned and obtaining work permit are inevitable. Due to the many packaging, the measures to be taken by the contractors at emergency will require time and become difficult keeping safety and consequently it will cause to delay of project implementation.
- By the execution of separate packaging, it is highly probable that the responsibility of each party for the interface portion become unclear.
- Selection of contractors will require longer period and will be a factor of delay for project completion.

From above consideration, SAPROF study would like to recommend Alternative 2, two package systems for construction contract. In addition the consulting service for construction supervision for both constructions should be added as Package 3 as follows:

Package 1: Dredging of Navigation Channel

Package 2: Construction of Container Terminal, Port Protection Facilities and Public Related Facilities

Package 3: Consulting Services for Construction Supervision.

18. Financial and Economic Analysis

18.1 Financial Analysis

18.1.1 Purpose and methodology for Financial Analysis

Financial analysis is made in order to confirm 1) the financial viability of public investment portion and 2) the financial affordability of private investment portion. As the Project is designed as PPP concept, the financial arrangement is intended to fulfill the requirement of both public and private.

Public sector requires the reasonable return to cover the weighted average capital cost in long term. Therefore financial rate of return is utilized as the indicator to analyze the financial viability. Weighted average capital cost is calculated on the base that 100 percent of eligible portion is financed by ODA Loan (STEP condition*) and non-eligible portion is financed by the budget of the Government of Vietnam. (*Terms and condition of STEP is shown in Chapter 17.3.1.)

The weighted average capital cost of the Project is 0.32 percent as calculated in Table 18.1.1.

Table 18.1.1 Weighted Average Capital Cost

Financial Source	Amount (mil. Yen)	Weight	Cost	Reference
ODA Loan for Construction	79,290	84.8	0.2%	Interest
ODA Loan for Consultant	952	1.0	0.01%	Interest
Vietnamese Gov. Budget	13,211	14.1	15%	Capital Opportunity Cost
Total	93,453	100.0	**0.32%**	**WACC**

As far as the financial rate of return is above the weighted average capital cost, it is evaluated as financially viable for public investment.

On the other hand, private sector requires the reasonable return on their equity to cover the opportunity cost of the capital (15% is considered as the opportunity cost). Therefore rate of return on equity (hereinafter referred as ROE) is the indicator to analyze the financial affordability. As various financial conditions are decided through the negotiation among private investors, this financial analysis is made utilizing the assumptions as agreed preliminary and informed to the study team.

As far as ROE is above 15 percent, it is evaluated as financially affordable for private investment.

Financial arrangement for private investment portion is considered as “Project Finance”, for which debt services depends on primarily the cash generated by the project. Therefore the private banks may request that the cash available for debt service should have an enough margin. Debt service coverage ratio is the indicator to analyze the debt sustainability.

As far as the average debt service coverage ratio is above 1.5, it is evaluated as financially sound for private debt services.

Flow of the cash relating to the Project is illustrated in Figure 18.1.1.

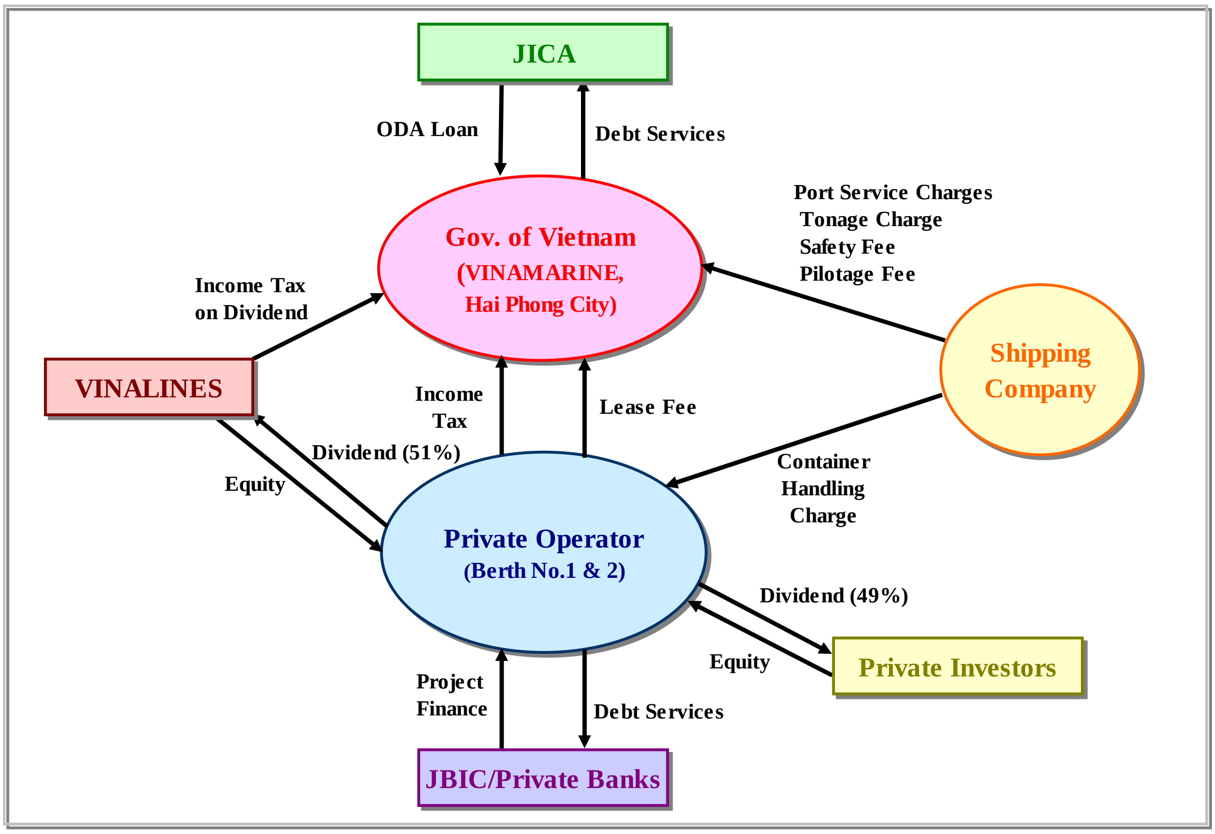


Figure 18.1.1 Flow of Cash relating to the Project

18.1.2 Assumption for Financial Analysis of Public Investment

Project life is set as 40 years (same as ODA loan repayment period) from commencement of construction.

Construction cost does not include the navigation channel, port protection facilities and public related facilities. Public related facilities are used for the government authorities such as port administration, customs, quarantine and others. Navigation channel and port protection facilities are managed by the different state owned company (Maritime Safety Company No.1) with the government budget. According to the decision No. 26/2009/QQ-TTg dated February 20, 2009, VINAMARINE, which is the supervisory organization of Maritime Safety Company No.1, has a clear policy that cost regarding the channel and port protection facilities should be managed by the Government budget, not by the charges and fees to the private sector. In addition, channel is utilized by the vessels which enter the other berths and ports than the berth No.1 & 2. Therefore as for financial analysis, cost related to the navigation channel (channel dredging and port protection facilities) and public related facilities are excluded. By other way of description, the temporary facilities, container terminal, reclamation, soil improvement and access road behind port are the components of construction cost for financial evaluation. As the inflation is not included for other component for financial evaluation, the base cost of the construction without price escalation is also applied for financial evaluation.

Maintenance cost is assumed as 1 percent of the above construction cost annually.

Administration cost is based on the new port management organization described in Clause 17.2.5 of Chapter 17. The organization of 500 personnel staff with the cost of 3,570 thousand US dollar is assumed to be finalized in 2020. Initially, 200 personnel organization is established in 2011 and is continued to 2017, then gradually increase according to the handling volume of the containers in Lach Huyen Port.

As for the cash inflow, two kinds of inflow are assumed. One is the inflow from the private operator for berth No.1 and No.2. Private operator will pay the lease fee to the peoples' committee of Hai Phong City as the controller of the national land. Private operator shall pay the income tax based on the profit of the berth operation. Although the Private operator enjoys the tax incentive for 12 years (exemption and reduction), certain profit is expected. In addition, 25 percent of the expected dividend to VINALINES, Vietnamese investor, is assumed to be collected through the business tax.

Another inflow is maritime service charges to the ships entering into the berth No.1 and No.2. These charges will be collected by the Maritime Administrator. Charges are collected according to "Decision No: 98/2008/QD-BTC, Ministry of Finance" dated November 4th, 2008. Charge is set as Table 18.1.2 and Table 18.1.3.

Table 18.1.2 Maritime Charges and Fees (International)

Unit: US Dollar

Charge / Fee		Base	Cotainer		General Cargo	Reference
			20 ft	40 ft		
1	Tonnage Charges	Ship / GT	0.032		0.032	Discount to frequent voyage (40% - 60%) Discount to 50,000 GT or more (60%)
2	Maritime Safety Assurance Fee	Ship / GT	0.1		0.1	Discount to frequent voyage (20% - 70%) Discount to 50,000 GT or more (70%)
3	Pilotage Charges	Ship / GT-mile	0.0034 0.0022 0.0015 200		0.0034 0.0022 0.0015 200	Up to 10 neutical miles Up to 30 neutical miles Over 30 neutical miles minimum Liable charge for testing, techinical breakdowns and wihtout advance Discount to frequent voyage (20% - 50%)

Table 18.1.3 Maritime Charges and Fees (Domestic)

Unit: Vietnam Dong

Charge / Fee		Base	Cotainer		General Cargo	Reference
			20 ft	40 ft		
1	Tonnage Charges	Ship / GT	500		500	Discount to frequent voyage (30% - 50%)
2	Maritime Safety Assurance Fee	Ship / GT	600 1,550		600 1,550	2,000 GT or under over 2,000 GT Discount to frequent voyage (20 - 50%)
3	Pilotage Charges	Ship / GT-HL	25 500,000		25 500,000	minimum per time Liable charge for testing, techinical breakdowns and wihtout advance notice Discount to frequent voyage (50%)

Size of the ship called is forecasted in Chapter 11. Based on the ship called for international container, total gross tonnage is calculated as shown in Table 18.1.4.

Table 18.1.4 Size of Vessels called (900,000 TEU handling)

Size of Vessel (DWT) (A)	through-put	Container / Vessel	No. of Call (B)	Container carried (TEU)	Total GT (A x B) x 1.1
20,000	20%	1,000	180	180,000	3,960,000
50,000	30%	2,000	135	270,000	7,425,000
80,000	20%	3,000	60	180,000	5,280,000
100,000	30%	4,000	68	270,000	7,480,000
Total			443	900,000	24,145,000

All of domestic containers are assumed to be carried by Berge Vessels.

18.1.3 Financial Analysis of Public Investment

Financial Internal Rate of Return for middle growth case (Base Case) is 1.24 percent. It is above WACC (0.32 percent). It means after the successful repayment and payment of interest for ODA Loan, the Vietnamese Government can recover the investment opportunity cost (15 percent). Cash flow is shown in Table 18.1.5.

Sensitivity analysis is made regarding container handling volume (high growth case, low growth case), and investment cost (+5%, +10%). Result of sensitivity analysis is shown in Table 18.1.6. Although FIRR is above WACC for all cases, capital cost increase will affect sensitively. It is suggested that the attention should be paid to management of the capital cost.

Table 18.1.5 Cash Flow for Financial Analysis of Public Investment (Base Case)

Unit: million US$

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cash Inflow	0.0	0.0	0.0	0.0	0.0	3.7	3.7	4.4	4.8	5.5	5.7	6.3	6.4	6.6
Lease Fee						0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Maritime Adm. Fee						1.3	2.3	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Tax						0.0	0.0	0.0	0.0	0.7	0.7	0.9	1.0	1.0
Dividend						1.9	0.8	1.3	1.7	1.7	1.8	2.3	2.4	2.5
Cash Outflow	0.0	1.4	35.5	96.6	33.4	3.8	3.1	3.1	4.1	4.7	5.2	5.2	5.2	5.2
Investment Cost 1	0.0	0.0	34.1	95.2	32.0	1.5	0.0							
Maintenance Cost						0.8	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Administration Cost	0.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	2.5	3.1	3.6	3.6	3.6	3.6
Net Cash Flow	0.0	-1.4	-35.5	-96.6	-33.4	-0.0	0.6	1.3	0.7	0.8	0.5	1.1	1.2	1.4

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Cash Inflow	7.2	7.4	9.3	9.9	11.8	2.0	7.1	16.9	16.9	16.9	16.9	16.9	16.9	16.9
Lease Fee	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Maritime Adm. Fee	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Tax	1.2	1.2	1.8	2.0	4.1	0.0	4.0	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Dividend	2.9	3.0	4.3	4.8	4.7	0.0	0.0	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Cash Outflow	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Investment Cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance Cost	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Administration Cost	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Net Cash Flow	2.0	2.2	4.1	4.7	6.6	-3.2	1.9	11.7	11.7	11.7	11.7	11.7	11.7	11.7

	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	Total
	29	30	31	32	33	34	35	36	37	38	39	40	
Cash Inflow	16.9	16.9	18.6	18.6	18.6	18.6	-0.5	3.1	17.4	17.4	17.4	17.4	400.4
Lease Fee	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	21.0
Maritime Adm. Fee	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	86.4
Tax	9.9	9.9	11.2	11.2	11.2	11.2	0.0	0.0	10.4	10.4	10.4	10.4	191.9
Dividend	3.8	3.8	4.3	4.3	4.3	4.3	0.0	0.0	4.0	4.0	4.0	4.0	101.1
Cash Outflow	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	341.7
Investment Cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.8
Maintenance Cost	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	56.2
Administration Cost	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	122.7
Net Cash Flow	11.7	11.7	13.4	13.4	13.4	13.4	-5.7	-2.1	12.2	12.2	12.2	12.2	58.7

FIIR = 1.24%

Table 18.1.6 Result of Sensitivity Analysis

Case		FIRR
Container Volume	High Gowth Case	1.33%
	Middle Growth Case (Base Case)	1.24%
	Low Growth Case	1.11%
Capital Cost	Base Case + 10 %	0.74%
	Base Case + 5 %	0.98%
	Base Case	1.24%

18.1.4 Assumption for Financial Analysis of Private Investment

Project life is set as 30 years after commencement of berth operation for this analysis.

Main revenue of the berth operation is the handling charge of containers. Detailed assumption of the volume and tariff is explained in 18.1.5. However, other charges relating to the container handling, e.g. shed use fees, refrigerated container cargo-handling facility use fees, container storage use fees, are also generated. Percentage of other charges is assumed as 10 percent of total revenue.

Capital cost and the annual disbursement are estimated by the Study team as shown in Table 18.1.7.

Table 18.1.7 Capital Cost of Private Investment

Unit: million US$

	2013	2014	2015	Total
Berth Construction	79.5	63.6	15.9	159.0
Cargo Handling Equipment	71.2	30.5	0.0	101.8
Total	150.7	94.1	15.9	260.7

Land lease is now negotiating between VINALINES and Peoples' Committee of Hai Phong City. For analysis, the prevailing land unit cost multiplied by the land occupied by the private berth operator (750m x 600 m) is considered as the total land lease cost amounting 30 million US dollar. Payment is divided by leasing period (50 years). Therefore annual lease fee is assumed as 600 thousand US dollar. For only the first year, 50% of the annual payment is made because operation is also assumed as half of its capacity.

Terms and conditions of the project finance arranged by Japan Bank for International Cooperation and private banks are as under;

Interest Rate:	LIBOR + 400 basis points For this analysis, it is calculated 5 percent per annum
Repayment:	12 years equal installment after completion of construction (2017- 2028)
Debt - Equity Ratio:	70 percent of capital cost responsible to the private is beard by debt and 30 percent of capital cost is born by equity
Drawdown of loan:	Proceeds of the loan is withdrawn in accordance with the progress of the capital investment after the total equity is invested

With regard to taxes, this project is located in Din Vu – Cat Hai economic zone, therefore, the private investors enjoy the incentives to corporate income tax and import tax. 10 percent tax rate is applied as corporate income tax for 15years after commencement of operation in spite that normal tax rate is 25 percent. In addition, corporate income tax is exempted for 4 years from the year when the operational profit is registered and corporate income tax is reduced to 50% from 5th to 9th year.

Operation cost is assumed 11 US dollar per 1 unit of container. This assumption is based on the fuel, material and others to be used for container handling.

As for maintenance cost, it is assumed that 1 percent of construction cost plus 0.5 percent of equipment cost is required annually. Refurbishment of equipment is made every 15 years amounting a half of the capital cost.

As for administration cost, it is assumed that 1.3 million US dollar is required annually when maximum container handling of 900,000 TEU with approximately 200 workers is achieved. It is expected that from 2017 and after maximum handling is achieved. For the previous years, administration cost is assumed proportionately to the handling volume.

Depreciation is assumed that the equipment cost is depreciated with 10 years equal amount installment.

18.1.5 Revenue Projection

Containers to be handled by Lach Huyen Port are estimated according to Chapter 5. Regarding the Berth No.1 & 2, in the case that the required handling volume is less than their capacity or No.3 and others are not constructed, the Berth No.1 & 2 will handle the all containers to be handled by Lach Huyen Port. In the case that the required handling volume exceeds the capacity and No.3 and others are constructed, the Berth No.1 & 2 will handle the containers up to their capacity even with competition to other berths. In particular, it is assumed that the Berth No.1 and 2 will concentrate the international containers and domestic containers will be handled by other berths. Summary of projection is shown as Table 18.1.8. Construction of other births is assumed to be started from 2016. It takes three years for construction. Therefore commencement of each berth is considered as; No.3 - 2019, No.4 - 2019, No.5 - 2020.

Table 18.1.8 Container Handling Projection (Lach Huyen Port / Berth No. 1 & 2)

Middle Growth Lach Hyuen	Unit	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	000 TEU	220	392	565	740	915	1,058
	000 Box	147	261	377	493	610	705
40 ft	000 Box	73	131	188	247	305	353
Laden	000 Box	24	44	63	82	102	118
Empty	000 Box	49	87	126	164	203	235
20 ft	000 Box	73	131	188	247	305	353
Laden	000 Box	49	87	126	164	203	235
Empty	000 Box	24	44	63	82	102	118
Import	000 TEU	220	392	565	740	915	1,058
	000 Box	147	261	377	493	610	705
40 ft	000 Box	73	131	188	247	305	353
Laden	000 Box	49	87	126	164	203	235
Empty	000 Box	24	44	63	82	102	118
20 ft	000 Box	73	131	188	247	305	353
Laden	000 Box	24	44	63	82	102	118
Empty	000 Box	49	87	126	164	203	235
Domestic	000 TEU	23	42	60	79	98	113
	000 Box	16	28	40	53	65	78
40 ft	000 Box	8	14	20	26	33	39
Laden	000 Box	4	7	10	13	16	20
Empty	000 Box	4	7	10	13	16	20
20 ft	000 Box	8	14	20	26	33	39
Laden	000 Box	4	7	10	13	16	20
Empty	000 Box	4	7	10	13	16	20
Total	000 TEU	463	826	1,191	1,559	1,928	2,229
	000 Box	309	551	794	1,039	1,285	1,489
40 ft	000 Box	154	275	397	520	643	744
Laden	000 Box	77	138	199	260	321	372
Empty	000 Box	77	138	199	260	321	372
20 ft	000 Box	154	275	397	520	643	744
Laden	000 Box	77	138	199	260	321	372
Empty	000 Box	77	138	199	260	321	372

Middle Growth Berth No.1& 2	Unit	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Export	000 TEU	220	392	450	450	450	450
	000 Box	147	261	300	300	300	300
40 ft	000 Box	73	131	150	150	150	150
Laden	000 Box	24	44	50	50	50	50
Empty	000 Box	49	87	100	100	100	100
20 ft	000 Box	73	131	150	150	150	150
Laden	000 Box	49	87	100	100	100	100
Empty	000 Box	24	44	50	50	50	50
Import	000 TEU	220	392	450	450	450	450
	000 Box	147	261	300	300	300	300
40 ft	000 Box	73	131	150	150	150	150
Laden	000 Box	49	87	100	100	100	100
Empty	000 Box	24	44	50	50	50	50
20 ft	000 Box	73	131	150	150	150	150
Laden	000 Box	24	44	50	50	50	50
Empty	000 Box	49	87	100	100	100	100
Domestic	000 TEU	23	42	0	0	0	0
	000 Box	16	28	0	0	0	0
40 ft	000 Box	8	14	0	0	0	0
Laden	000 Box	4	7	0	0	0	0
Empty	000 Box	4	7	0	0	0	0
20 ft	000 Box	8	14	0	0	0	0
Laden	000 Box	4	7	0	0	0	0
Empty	000 Box	4	7	0	0	0	0
Total	000 TEU	463	826	900	900	900	900
	000 Box	309	551	600	600	600	600
40 ft	000 Box	154	275	300	300	300	300
Laden	000 Box	77	138	150	150	150	150
Empty	000 Box	77	138	150	150	150	150
20 ft	000 Box	154	275	300	300	300	300
Laden	000 Box	77	138	150	150	150	150
Empty	000 Box	77	138	150	150	150	150

Container handling charges are decided by the operator of each berth every year through the negotiation with the customers. The volume and frequencies are also taken into consideration. There is no regulation or control by the government authorities. Therefore, the charges will be assumed to be set in accordance with the financial profitability as well as the market competition. It is assumed that the structure of the charges is following other cases in Vietnam. If the handling charge for international laden 40 feet container is 100, 60 is charged for international empty, 75 is charged for international laden 20 feet container, and 50 is charged for domestic laden 40 feet container.

Base case is assumed 100 US dollar is charged for international laden 40 feet container.

18.1.6 Financial Analysis of Private Investment

Return on Equity (ROE) for middle growth case (Base Case) is 16.2 percent. It is above the investment opportunity cost (15%). It is financially affordable to Private investors. Average debt service coverage is 1.68. It means the available cash after project implementation is bigger enough to cover the payment of interest and repayment of the private banks' Project Finance. Profit and Loss as well as Cash Flow of the base case is shown in Table 18.1.10 and Table 18.1.11 respectively.

Sensitivity analysis is made regarding container handling volume (high growth case, low growth case), investment cost (+5%, +10%) and container charge. Result of sensitivity analysis is shown in Table 18.1.9 Although ROE is not so low as well as enough debt service coverage for all cases, container charge will affect to ROE sensitively. In addition, Public FIRR is not decreased to negative. It is suggested that the attention should be paid to structure of container handling charges. As far as the Private Investor for berth operation can decide the container handling charges without any restriction, the mechanism to share the profit not through taxation is to be discussed further.

Table 18.1.9 Result of Sensitivity Analysis

Case		ROE	DSCR	Public FIRR
Container Volume	High Gowth Case	18.2%	1.68	1.33%
	Middle Growth Case (Base Case)	16.2%	1.68	1.24%
	Low Growth Case	14.0%	1.66*	1.11%
Capital Cost	Base Case +10 %	13.3%	1.53	1.21%
	Base Case +5%	14.7%	1.60	1.23%
	Base Case	16.2%	1.68	1.24%
Container Charges	85$	12.8%	1.44*	0.17%
	95 $ for 40 feet (Base Case)	16.2%	1.68	1.24%
	105$	19.5%	1.93	2.15%

*: Less than 1.0 for the first repayment year

Table 18.1.10 Profit and Loss for Financial Analysis of Private Investment (Base Case)

Unit: 000 US$

【Profit & Loss】	2012	2013	2014	2015 1	2016 2	2017 3	2018 4	2019 5	2020 6	2021 7	2022 8	2023 9	2024 10	2025 11	2026 12	2027 13	2028 14	2029 15
Revenue				22,007	39,260	43,890	46,523	46,523	46,523	49,315	49,315	49,315	52,274	52,274	52,274	55,410	55,410	55,410
Container (000 TEU)				463	826	900	900	900	900	900	900	900	900	900	900	900	900	900
Unit Price for 40 ft Laden 1				95	95	95	101	101	101	107	107	107	113	113	113	120	120	120
Average Unit Price				65	65	67	70	70	70	75	75	75	79	79	79	84	84	84
Operation Cost				6,142	11,185	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	62,372
Operation 11				5,093	9,086	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900
Maintenance				1,049	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099
Refurbish																		50,374
Lease Fee				600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Administration Cost				669	1,193	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Depreciation					10,176	10,176	10,176	10,176	10,176	10,176	10,176	10,176	10,176	10,176	0	0	0	0
Interest on Loan	0	0			9,976	9,976	9,145	8,313	7,482	6,651	5,819	4,988	4,157	3,325	2,494	1,663	831	0
Income before Tax	0	0	0	14,596	6,130	9,839	13,304	14,135	14,967	18,589	19,421	20,252	24,042	24,873	35,881	39,849	40,680	−8,862
Business Tax				0	0	0	0	707	748	929	971	1,013	1,202	1,244	1,794	1,992	4,068	0
Rate of Tax				0%	0%	0%	0%	5%	5%	5%	5%	5%	5%	5%	5%	5%	10%	10%
Income after Tax	0	0	0	14,596	6,130	9,839	13,304	13,428	14,218	17,660	18,450	19,239	22,840	23,630	34,087	37,857	36,612	−8,862
Cummulative Income		0	0	14,596	20,726	30,565	43,869	57,297	71,516	89,176	107,625	126,864	149,704	173,334	207,421	245,278	281,890	273,028

【Profit & Loss】	2030 16	2031 17	2032 18	2033 19	2034 20	2035 21	2036 22	2037 23	2038 24	2039 25	2040 26	2041 27	2042 28	2043 29	2044 30
Revenue	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735	58,735
Container (000 TEU)	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
Unit Price for 40 ft Laden 1	127	127	127	127	127	127	127	127	127	127	127	127	127	127	127
Average Unit Price	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
Operation Cost	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	11,999	62,372
Operation 11	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900
Maintenance	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099	2,099
Refurbish															50,374
Lease Fee	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Administration Cost	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Depreciation	5,037	5,037	5,037	5,037	5,037	5,037	5,037	5,037	5,037	5,037	0	0	0	0	5,037
Interest on Loan															
Income before Tax	39,799	39,799	39,799	39,799	39,799	39,799	39,799	39,799	39,799	39,799	44,836	44,836	44,836	44,836	−10,575
Business Tax	3,980	9,950	9,950	9,950	9,950	9,950	9,950	9,950	9,950	9,950	11,209	11,209	11,209	11,209	−2,644
Rate of Tax	10%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Income after Tax	35,819	29,849	29,849	29,849	29,849	29,849	29,849	29,849	29,849	29,849	33,627	33,627	33,627	33,627	−7,931
Cummulative Income	308,847	338,696	368,545	398,395	428,244	458,093	487,942	517,791	547,640	577,489	611,117	644,744	678,371	711,998	704,067

Table 18.1.11 Cash Flow for Financial Analysis of Private Investment (Base Case)

Unit: 000 US$

【Cash Flow】	2012	2013	2014	2015 1	2016 2	2017 3	2018 4	2019 5	2020 6	2021 7	2022 8	2023 9	2024 10	2025 11	2026 12	2027 13	2028 14	2029 15
Cash Inflow	0	0	0	14,596	16,307	20,016	23,480	24,312	25,143	28,766	29,597	30,428	34,219	35,050	35,881	39,849	40,680	−8,862
Income before Tax	0	0	0	14,596	6,130	9,839	13,304	14,135	14,967	18,589	19,421	20,252	24,042	24,873	35,881	39,849	40,680	−8,862
Depreciation	0	0	0	0	10,176	10,176	10,176	10,176	10,176	10,176	10,176	10,176	10,176	10,176	0	0	0	0
Cash Outflow	0	78,220	0	0	0	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	0
Equity 1	0	78,220	0	0														
Loan Repayment					0	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	16,626	
Net Cash Flow for ROE	0	−78,220	0	14,596	16,307	3,389	6,854	7,685	8,517	12,139	12,971	13,802	17,592	18,424	19,255	23,223	24,054	−8,862
Cumulative net cash				14,596	30,902	34,292	41,146	48,831	57,348	69,487	82,458	96,260	113,852	132,275	151,530	174,753	198,807	189,945
Net Cash Flow for ROI	0	−150,720	−94,117	−1,301	26,283	29,991	32,625	32,625	32,625	35,416	35,416	35,416	38,375	38,375	38,375	41,512	41,512	−8,862

【Cash Flow】	2030 16	2031 17	2032 18	2033 19	2034 20	2035 21	2036 22	2037 23	2038 24	2039 25	2040 26	2041 27	2042 28	2043 29	2044 30
Cash Inflow	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	−5,537
Income before Tax	39,799	39,799	39,799	39,799	39,799	39,799	39,799	39,799	39,799	39,799	44,836	44,836	44,836	44,836	−10,575
Depreciation	5,037	5,037	5,037	5,037	5,037	5,037	5,037	5,037	5,037	5,037	0	0	0	0	5,037
Cash Outflow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loan Repayment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow for ROE	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	−5,537
Cumulative net cash	234,781	279,617	324,453	369,290	414,126	458,962	503,798	548,634	593,471	638,307	683,143	727,979	772,815	817,652	812,114
Net Cash Flow for ROI	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	44,836	−5,537

Return on Equity = 16.2%
15%

Return on Investment= 7.4%

【Debt Service Coverage】		2006 1	2017 2	2018 3	2019 4	2020 5	2021 6	2022 7	2023 8	2024 9	2025 10	2026 11	2027 12	2028 13
Available Cash (A)		26,283	29,991	32,625	32,625	32,625	35,416	35,416	35,416	38,375	38,375	38,375	41,512	41,512
Debt Service (B)		9,976	26,602	25,771	24,940	24,108	23,277	22,446	21,614	20,783	19,952	19,120	18,289	17,458
Coverage (B)/(A)	Average 1.68	2.63	1.13	1.27	1.31	1.35	1.52	1.58	1.64	1.85	1.92	2.01	2.27	2.38

18.2 Economic Analysis

18.2.1 Objectives and Methodology

The objective of the economic analysis is to appraise the economic feasibility for construction project of Lach Huyen Port Project, focusing on the International Gateway Port of Northern Vietnam in the target year 2020, from the viewpoint of the national economy.

“With” and “Without” cases are composed in the economic analysis. All benefits and costs of the Lach Huyen Port Project are calculated in market price at first, and then converted into economic price. Evaluation of the Lach Huyen Port Project is carried out using this economic price, based on the border price concept.

There are various kinds of methods to evaluate the feasibility of infrastructure investment projects. Economic Internal Rate of Return (EIRR) is a rate which makes the present value of project costs equal to the present value of the project benefits during project life. EIRR means a real and gross profit ratio of a project which is measured from the economic and social point of view.

The present value is calculated assuming the given discount rate. In this analysis, the social discount rate or the opportunity cost of capital in the Vietnam (12%) is an evaluation criterion for EIRR, and is used as the given discount rate. In general, EIRR is the most popular index for evaluating a project. In this study, economic internal rate of return (EIRR) based on cost-benefit analysis is adopted in order to appraise the feasibility of project.

18.2.2 Economic Analysis

1) “With” and “Without” Case

In the cost-benefit analysis, benefits and costs of projects are defined as the difference between “With” and “Without” case of projects. Therefore, the definition of “With” and “Without” case is very important in order to evaluate the feasibility of the port development projects. The following conditions are assumed in this economic analysis.

a) “With” Case

In an economic analysis, benefits are mainly brought by reduction of transport cost through the mother vessel accommodation with Lach Huyen Port.

Therefore, the “With” case scenario is construction of Lach Huyen Port in medium term port development project (5 container cargo berths of totally 2,000m in length, 2 multi purpose berths of totally 750m in length, access channel of -14m in depth, sand protection dike, revetment, etc.) for project design target in 2020, including Tan Vu-Lach Huyen Highway Project for access road and bridge to Lach Huyen Port for the project design target in 2020.

However, in addition, in the alternative investment case study of access to Lach Huyen Port, instead of Tan Vu-Lach Huyen Highway Project, barge transport system between Din Vu Island to Cat Hai Island consider for comparison.

b) “Without” Case

No investment is made for the existing port after 2012. The forecast volume of cargoes is same as “With” case. In the one of the “Without” case, the handling cargo in Hai Phong and Cai Lan Port is transported on the existing feeder service routes. In the other “Without” case, the overflowed cargo more than the port capacity of Hai Phong and Cai Lan is assumed to handle in Hong Kong Port and is transported by land transport between Hong Kong Port and the Northern Vietnam area.

18.2.3 Prerequisites of Economic Analysis

In order to estimate costs and benefits of projects, the following requisites are assumed for analysis.

(1) Project Life

- Taking the depreciation period of main port facilities into account, the period of calculation for the economic analysis (project life) is assumed to be 30 years (2021-2052) after the completion of medium term port development project implementation.

(2) Foreign Exchange Rate

- Foreign exchange rate adopted for this analysis is US$1.00= JPY 89.60, VND1=JPY 0.00528 as of March 2010, the same rate as used in the cost estimation.

18.2.4 Economic Prices

1) Method of Conversion from Market Prices to Economic Prices

For the economic analysis, prices are expressed at economic prices rather than market prices, based on the border price concept. There are various methods to convert market prices to economic prices. Here, economic prices are calculated by eliminating transfer items such as taxes and subsides etc. The prices of tradable goods are expressed in CIF and FOB value for import goods and export goods respectively. These values indicate the actual border price. However, since the border price of non-tradable goods cannot be converted directly, the border price of inputs that are needed to produce non-tradable goods must be examined and adopted.

2) Transfer Items

Import and export duties, other taxes and subsidies are merely transfer items which do not actually reflect any consumption of nature resources. Therefore, these transfer items should be eliminated from costs and benefits of projects for the economic analysis.

3) Standard Conversion Factor (SCF)

Standard conversion factor is introduced to the analysis to determine the economic price of certain goods which cannot be directly revalued at the border price. These goods include most non-tradable goods and services. The standard conversion factor of the Vietnam is estimated to be 0.84 by average SCF from 2007 and 2008, applying the following simple approximate equation and basic data.

$$SCF = \frac{(X + M)}{(X + M + D)}$$

Where:
X: Commodity exports
M: Commodity imports
D: Import duty and taxes

Moreover, in the recent F/S study of Vietnam’s transport sector, SCF applied 0.85 in the economic analysis. Therefore, in this study, 0.85 use for SCF in the economic analysis.

18.2.5 Cost of Projects

1) Alternatives of Access Road and Bridge

Firstly, access road and bridge for Lach Huyen Port already studied in the VIDIFI’s F/S report. In this analysis, the construction cost of access road and bridge is applied in the basic case. However, following two cases instead of access road and bridge starting from 2015 are studied for in the alternative cases.

- Case-1: Barge and RoRo vessels transport system starting from 2015 to 2017, Access road and bridge transport operation after 2018.
- Case-2: Barge and RoRo vessels transport system starting from 2015 to 2020

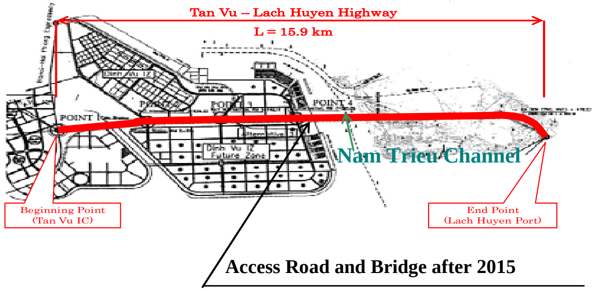
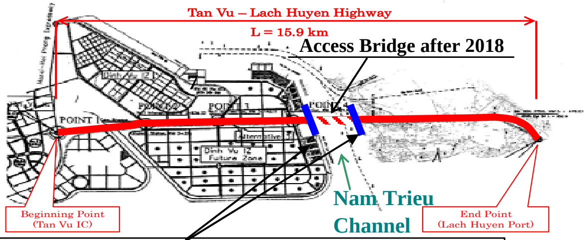
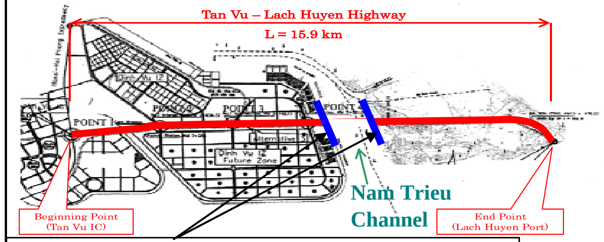
Table 18.2.1 shows Case-1 and Case 2 as alternatives of access road and bridges. Project cost of Case-1 and Case 2 is around twice bigger than base case, because barge and RoRo berth is necessary almost same cargo handling capacity of Lach Huyen port. Also the operation cost of Case-1 and Case 2 is more costly than base case, because many barges, RoRo vessels and cargo handling equipment are necessary for operation of forecast volume of Lach Huyen Port.

Moreover, Case-1 and Case 2 have many demerits for operation. Many vessels (32 vessels for Case-1, 56 vessels for Case-2) under 24 hours a day have to operate across Nam Trieu channel. Therefore, it is necessary for safety control of navigation and the heavy sea traffic congestion make a negative impact to environment. Furthermore, it is really difficult to path fishing vessels for fishing activity through Nam Trieu Channel.

Consequently, barge and RoRo vessel transport system is very costly for investment and operation, not speedy, not safety and influence to environment negatively. In contrast, access road and bridge is not more costly than barge and RoRo vessel transport system, speedy, safety and small influence to surrounding environment.

Thus, barge and RoRo vessel transport system is not suitable for access system of Lach Huyen Port. Therefore, the constructions of access road and bridge work should be completed for port operation from 2015, simultaneously.

Table 18.2.1 Alternative Cases Instead of Access Road and Bridge from 2015

Basic Case		**Alternative Case-1**		**Alternative Case-2**	
Access Road and Bridge		Barge and RoRo Vessel Transport System (2015-2017) and Access Road and Bridge (after 2018)		Barge and RoRo Vessel Transport System after 2015 (Target year 2020)	
		 **Barge Barth & RoRo Vessel Berth for 2015-2017** **Required Facilities, Vessels and Cargo Handling Equipment** - Barge and RoRo Vessel Barth : 2,300m (1,150m each) - Barge (90 TEU, 1,000-1,400DWT) : 20 vessels - Ro Ro Ship (500GRT, 1300-1800DWT) : 12 vessels - Reach Stacker (40ton) : 20 Nos. - Trailer (head and chassis for 40') : 65 Nos.		 **Barge Barth & RoRo Vessel Berth after 2015** **Required Facilities, Vessels and Cargo Handling Equipment** - Barge and RoRo Vessel Barth : 4,200m (2,100m each) - Barge (90 TEU, 1,000-1,400DWT) : 36 vessels - Ro Ro Ship (500GRT, 1300-1800DWT) : 20 vessels - Reach Stacker (40ton) : 36 Nos. - Trailer (head and chassis for 40') : 125 Nos.	
Project Cost in Economic Price (1,000 USD)	**388,007**	Project Cost in Economic Price (1,000 USD)	**701,635**	Project Cost in Economic Price (1,000 USD)	**750,503**
O/M Cost in Economic Price(1,000 USD/year)	**4,912**	O/M Cost in Economic Price(1,000 USD/year)	**7,171**	O/M Cost in Economic Price(1,000 USD/year)	**43,457**
Merit - Smooth and quick traffic to Lach Huyen Port without disturbing and congestion. - Safety traffic to Lach Huyen Port , no impact to maritime traffic (mainly fishing vessels) across Nam Trieu Channel. - Timely transport with access bridge conduce to reliable Lach Huyen port operation as International Port with mother vessel accommodation		***Demerit*** - Both berths are necessary almost same cargo handling capacity of Lach Huyen berthing capacity, therefore, huge cargo handling necessary. - Barge transport takes about 7 hours from Din Vu barge berth to Cat Hai barge berth including cargo handling in both berths. - 32 vessels under 24 hours a day have to operate across Nam Trieu channel. Therefore, it is necessary for safety control of navigation and the sea traffic congestion impact to surrounding environment negatively. - 32 vessels under 24 hours a day have to operate across Nam Trieu channel. Therefore, it is difficult to path fishing vessels for fishing activity through Nam Trieu Channel.		***Demerit*** - Both berths are necessary almost same cargo handling capacity of Lach Huyen berthing capacity, therefore, huge cargo handling necessary. - Barge transport takes about 7 hours from Din Vu barge berth to Cat Hai barge berth including cargo handling in both berths. - 56 vessels under 24 hours a day have to operate across Nam Trieu channel. Therefore, it is necessary for safety control of navigation and the heavy sea traffic congestion make a negative impact to environment. - 56 vessels under 24 hours a day have to operate across Nam Trieu channel. Therefore, it is really difficult to path fishing vessels for fishing activity through Nam Trieu Channel.	

2) Components of Projects

Components of project cost are tabulated in the Table 18.2.2. The values of components are converted from the financial price basis into the economic price basis. The construction cost of port facilities and road, and procurement costs in the economic cost are shown in Table 18.2.3.

Table 18.2.2 Components of Project Costs

Components of Project Costs	Definition of Components of Project Costs
Construction Cost	The construction cost in economic price is estimated for port facilities (5 container cargo berths of totally 2,000m in length, 3 multi purpose berths of totally 750m in length, access channel of -14m in depth, sand protection dyke, revetment, etc.,), access bridge and road, and procurement costs of cargo handling equipment. Furthermore, residual values of cargo handling equipment costs appropriate to end year of project life.
Maintenance Cost	It is an annual cost for maintaining expected functions or throughput of the port facilities and access bridge/road. Cost of maintaining facilities and equipment are usually estimated by a fixed proportion of original construction and purchasing costs. As for maintenance cost, it is assumed that 1% of construction cost and 0.5% of equipment cost.
Maintenance Dredging Cost	Based on the results of simulation for maintenance dredging in the previous Chapter 8, yearly maintenance dredging volume applied as follows. 1’st year : 3.44 million m^3 After 2’nd year: 0.75 million m^3
Operation Cost	It is an annual cost for operating the facilities. It is mainly composed of personal cost, communication cost, travel cost material and fuel cost. Required staffs of operation and management body applied in 2020 as follows. Operation and Management Body — Number of Staffs New Lach Huyen Port Organization — 500 5 Container Berths — 500 3 Multi Purpose Berths — 1,350 USD 11/TEU is estimated for container handling operation, and USD 3/ton is estimated for general and dry bulk cargo handling operation.
Refurbishment of equipment	Refurbishment of equipment is made every 15 years amounting a half of the capital cost.

Table 18.2.3 Economic Price of Project Costs for Medium Term Port Development Project including Access Bridge and Road (2020)

Constrcution	Economic Price (1,000USD)
2 Container Berth (-14m depth), Channel (-14m) & Dyke	864,695
Aditional 3 Container Berths & 3 General Cargo Berths for Medium Term Development (2020)	734,939
Access Bridge & Road	397,180
Total	***1,996,813***
Total O/M Cost (2011-2052)	**Economic Price (1,000USD)**
Maintenance Dredging	85,808
New Lach Huyen Port Management Body	107,160
O/M Cost for Container & General Cargo Berths	2,960,055
O/M Cost for Access Bridge & Road	63,737
Total	***3,197,134***

18.2.6 Benefits of Projects

1) Benefit Items

Owing to the Lach Huyen International Gateway Port projects, Vietnam economy enjoys:

(1) Reduction of transport cost due to trunk line system by accommodation with mother vessel avoiding from the existing transshipment transport system
(2) Reduction of transport cost by accommodation with bigger container vessels
(3) No vessel waiting time for until the rising of the tide due to shallow channel
(4) Shorter transport service time
(5) Enhancement of transport reliability
(6) Promotion of logistics business
(7) Promotion of FDI businesses at the port and along the connecting highways
(8) Improvement of maritime transport safety
(9) Increasing employment and income regarding Lach Huyen Port Terminal
(10) Increasing employment and income regarding port related industry
(11) Increasing employment and income regarding Lach Huyen Port Terminal
(12) Increasing employment and income regarding Lach Huyen Port Terminal Construction
(13) Stability and development of regional industry
(14) Improvement of international competitiveness of industry

From various benefits of the Projects, items above (1) to (2) are adapted to EIRR analysis as direct economic benefits.

2) Calculation of Benefits

In the container demand forecast, “With” and “Without” case are applied in Figure 18.2.1.

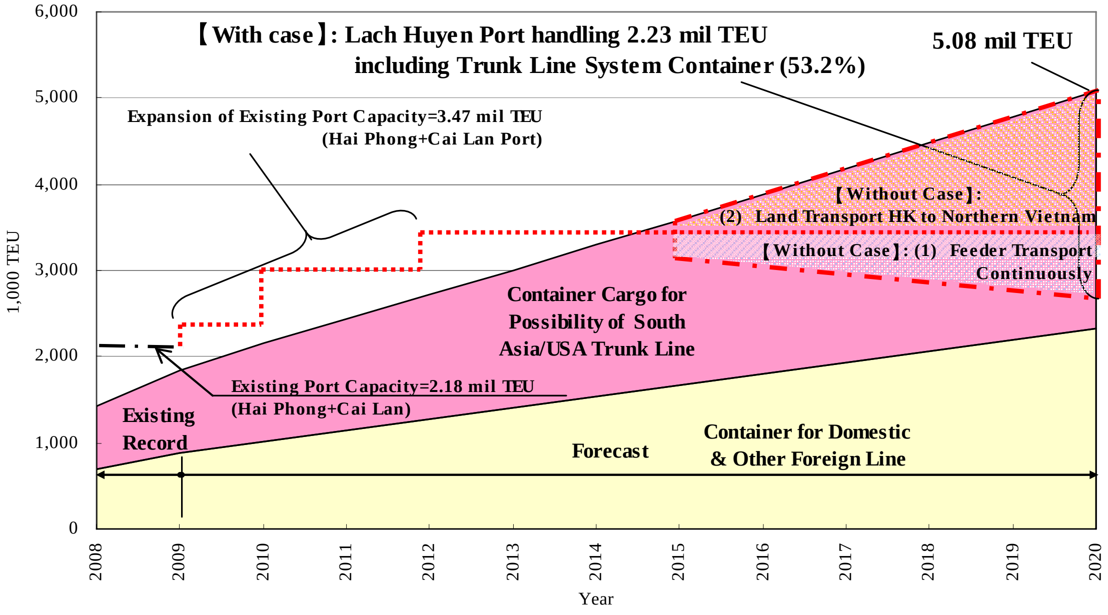


Figure 18.2.1 Container Cargo Demand of “With” and “Without” case

“With Case”: Forecast container cargo (not including domestic container cargo, container cargo by less than 50,000 DWT vessels and container cargo without S.E. Asia-America Trunk Line) in Lach Huyen Port is directly handled in Trunk Line Services. Container cargo in Trunk Line Services is estimated 53.2% in total forecast container cargo.

“Without Case”-(1): Forecast container cargo (not including domestic container cargo, container cargo by less than 50,000 DWT vessel and container cargo without S.E. Asia-America Trunk Line) is handled at existing Hai Phong and Cai Lan port until the handling capacity.

“Without Case”-(2): Forecast container (not including domestic container cargo, container cargo by less than 50,000 DWT vessel and container cargo without S.E. Asia-America Trunk Line) more than the handling capacity in the Hai Phong and Cai Lan Port is handled in Hong Kong Port as alternative port and transport to Northern Vietnam through land transport.

In the border land transport, the regular scheduled road transport service from Hanoi to China has begun in 2007 and then, using the return transport, the consolidation service for multi customers also started. Presently, from Vietnam border to Hong Kong (Youyiguan – Nanning – Zhanjiang – Guangzhou) area, the expressway already completed, moreover, in 2008, for facilitation of the movement of Chinese goods, Vietnam Government has the planning of six-lane expressway from Hanoi to Vietnam border.

The Figure 18.2.2 was described transport route and system for “With” and “Without” case.

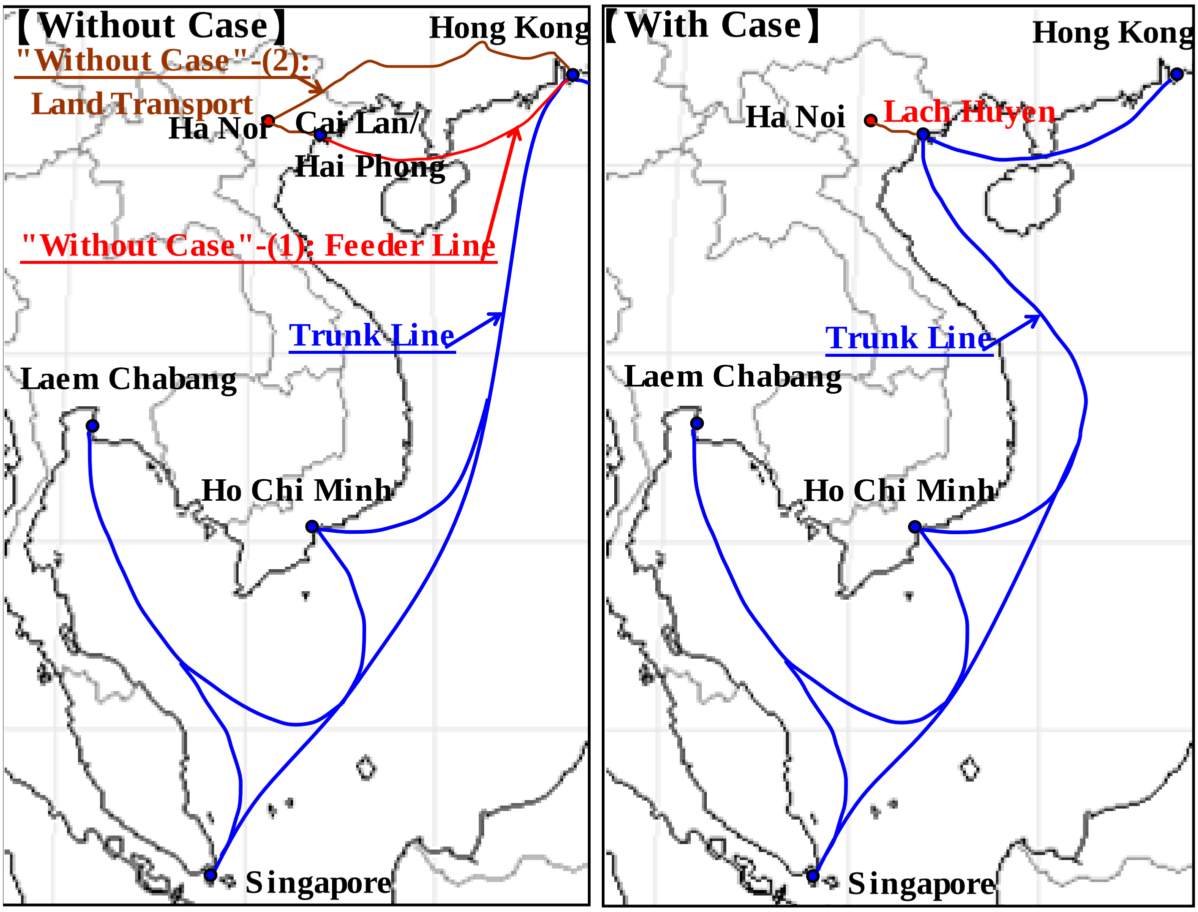


Figure 18.2.2 Transport System between “With” and “Without” Case

a) "Without Case"-(1)

The benefits were calculated from comparison between the existing vessel transport cost by feeder line system and trunk line in South East Asia-America. The reduction benefits of cargo transport cost can be assumed as follows.

RCS = CS(WO) - CS(W)
CS(W) = $S1_{Tlm}$
CS(WO) = $S2_{Tl'm} + S2_{Fl'm} + S2_{HK} \times 2$
Where
RCS = Reduction of cargo transport cost per TEU
CS(W) = Cargo transport cost per TEU on "With case" as trunk line (per TEU)
CS(WO) = Cargo transport cost per TEU on "Without case" as feeder Line (per TEU)

$S1_{Tlm}$ = Cargo transport cost per TEU on trunk line through Lach Huyen Port.
Trunk line was adapted as following routes.
- Singapore Port-Lach Huyen Port-Hong Kong Port (3,630km km)
- Ho Chi Minh Port -Lach Huyen Port-Hong Kong Port (2,668km)

$S2_{Tl'm}$ = Cargo transport cost per TEU on the existing trunk line through Hong Kong Port.
The existing trunk line was adapted as following routes.
- Singapore Port-Hong Kong Port (2,705km)
- Ho Chi Minh Port -Hong Kong Port (1,718km)

$S2_{iFm}$ = Cargo transport cost per TEU on feeder line transport cost of round trip between Hai Phong port to Hong Kong port (per TEU)
- Hai Pong Port-Hong Kong Port-Hai Pong Port (2,361km)

$S2_{HK}$ = Transshipment container handling cost (per TEU) in Hong Kong Port

$S2_{HK} \times 2$ = USD85/TEU, USD110/FEU. USD65/TEU can be applied as case of 1.5 TEU/Box ratio.

Most of trunk line port for origin and destination of feeder line in the Hai Phong Port are through Hong Kong Port. Therefore transshipment cargo handling cost in Hong Kong Port applied for this analysis as follows.

Table 18.2.4 Relay Charges in Hong Kong Port

Container Size	USD
20' container	85
40' container	110
TEU/Box ratio: 1.5	
65 USD/TEU	

Based on the existing share of 20' container and 40' container in Hai Phong port, TEU/Box ratio applied 1.5. Consequently, 55.25USD per TEU in economic price can applied as reduction transport cost by transshipment cargo handling.

The difference of transport distance between "With" case and "Without" case are shown in Table 18.2.5.

Table 18.2.5 Difference of Transport Distance between “With” and “Without” case

"Without" Case	**Ho Chi Minh-Hong Kong (km)**	**Singapore-Hong Kong (km)**
Ho Chi Minh-Hong Kong (Trunk Line)	1,718	2,705
Hai Phong- Hong Kong - Hai Phong (Feeder Line)	2,361	2,361
Total	4,078	5,066
"With" Case	**Ho Chi Minh-Hong Kong (km)**	**Singapore-Hong Kong (km)**
Ho Chi Minh or Singapore-Lach Huyen -Hong Kong (Trunk Line)	2,668	3,630
Difference: "With"-"Without"	**Ho Chi Minh-Hong Kong (km)**	**Singapore-Hong Kong (km)**
Feeder Line Transport	2,361	2,361
Trunk Line Transport	-951	-925
Total	1,410	1,436

The difference of transport cost by container vessel size between “With” case and “Without” case is shown in Table 18.2.6.

Table 18.2.6 Transport Cost by Container Vessel Size

Vessel	Lease Cost US$/day/vessel	Container Cost US$/day/vessel	Fuel Cost US$/day/vessel	Total US$/day/vessel	Total US$/day/TEU
10,000DWT (1,000TEU)	13,289	1,200	30,624	45,113	45.1
50,000DWT (4,000TEU)	30,000	4,800	65,472	100,272	25.1
80,000DWT (6,000TEU)	37,000	7,200	68,640	112,840	18.8
100,000DWT (7,500TEU)	47,000	9,000	74,439	130,439	17.4

Note: 1. Container cost is assumed 1.2US$/TEU
2. Fuel cost is the price of bunker oil as 528US$/ton based on report of World Shipping Company (2008-2009)

10,000DWT(1,000TEU) of container vessel is applied for average size of feeder vessel. 50,000DWT (4,000TEU), 80,000DWT (6,000TEU), and 100,000DWT (7,500TEU) are applied for truck line vessel with 38%, 25% and 38% in allocation, respectively. Average vessel speed is estimated 20 Nautical Mile/hour (37.04km/hour) in each vessel.

Consequently, based on the above formula, USD 83 per TEU in economic price is estimated for forecast container cargo volume until the existing port capacity.

b) “Without Case”-(2)

The reduction benefits of cargo transport cost can be assumed as follows.

RCL = CL(WO) - CL(W)
CL(W) = $S1_{Tlm}+ SL1$
CL(WO) = $S2_{Tl'm} + SL2$

Where
RCL = Reduction of cargo transport cost per TEU
CL(W) = Cargo transport cost per TEU on “With case” trunk line through Lach Huyen Port and land transport to Hanoi (per TEU)
CL(WO) = Cargo transport cost per TEU on “Without case” trunk line through Hong Kong Port and land transport to Hanoi (per TEU)

$S1_{Tlm}$ = Cargo transport cost per TEU on trunk line through Lach Huyen Port.
Trunk line was adapted as following routes.
- Singapore Port-Lach Huyen Port-Hong Kong Port (3,630km)
- Ho Chi Minh Port -Lach Huyen Port-Hong Kong Port (2,668km)

$S2_{Tl'm}$ = Cargo transport cost per TEU on the existing trunk line through Hong Kong Port.
The existing trunk line was adapted as following routes.
- Singapore Port-Hong Kong Port (2,705km)
- Ho Chi Minh Port -Hong Kong Port (1,718km)

SL1 = Cargo transport cost per TEU on land transport cost between Hong Kong port to Hanoi (per TEU)
Based on transport analysis (Door to Door services, 20' container) by report of JETRO, land transport cost is USD2,000 for 20' container between Hanoi Area to Hong Kong Area.

SL2 = Cargo transport cost per TEU on land transport cost between Lach Huyen port to Hanoi (per TEU) Based on hearing of transport company in Hanoi, land transport cost is USD200/TEU between Hanoi Area to Hai Phong Area.

Consequently, based on the above formula, in the consideration of 1.5 in box/TEU ratio, USD 921.47 per TEU in economic price is estimated for forecast container cargo volume in "Without Case"-(2).

18.2.7 Economic International Rate of Return (EIRR)

1) Calculation of EIRR

EIRR is introduced to the economic analysis to appraise the economic feasibility of projects. EIRR is the discount rate which makes the present value of project costs equal to the present benefits during the project life. It is calculated by using the following formula,

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

Where:
n: Project life
Bi: Benefit in the i-th year: first year is the base year
Ci: Cost in the i-th year
R: Discount rate

2) EIRR Results

EIRR of the base case of the Lach Huyen Port project with Tan Vu-Lach Huyen Highway Project is estimated at 23.9%, which exceeds the social discount rate or opportunity cost of capital in the Vietnam.

Accordingly, it can be concluded that the project is economically feasible.

3) Sensitivity Analysis

In order to examine the feasibility of a project when the given assumptions are changed, the following sensitivity analysis is carried out.

- Project costs increase by 10% and 20%, and
- Project benefits decrease by 10% and 20%

On the results of sensitivity analysis, Lach Huyen Port project can be concluded that the projects are economically feasible, even if the project cost is increased 20% and at same time, the benefits are decreased by 20% from the base case. (See Table 18.2.7)

Table 18.2.7 Sensitivity Analysis of EIRR for Medium-tem Development Project in 2020 (5 Container Terminals and 3 Multi Purpose Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	23.9%	21.9%	19.7%
	10% up	21.9%	20.1%	18.1%
	20% up	19.7%	18.6%	16.6%

4) EIRR for Short-term Development Project (2 Container Terminals)

For reference, based on following components, the short-term development project (2 container terminals) is also considered for analyzing of EIRR.

Table 18.2.8 Components of Short-term Development Project (2 Container Terminals) Costs

Components of Project Costs	Definition of Components of Project Costs
Construction Cost	The initial construction cost in economic price is estimated for port facilities (2 container cargo berths of totally 750m in length and procurement costs of cargo handling equipment). Furthermore, residual values of cargo handling equipment costs appropriate to end year of project life.
Maintenance Cost	It is an annual cost for maintaining expected functions or throughput of the port facilities and access bridge/road. Cost of maintaining facilities and equipment are usually estimated by a fixed proportion of original construction and purchasing costs. As for maintenance cost, it is assumed that 1% of construction cost and 0.5% of equipment cost.
Maintenance Dredging Cost	Based on the results of simulation for maintenance dredging in the previous Chapter 8, yearly maintenance dredging volume applied as follows. 1’st year : 3.44 million m^3 After 2’nd year: 0.75 million m^3
Operation Cost	It is an annual cost for operating the facilities. It is mainly composed of personal cost, communication cost, travel cost material and fuel cost. Required staffs of operation and management body applied for 2 container terminals as follows. Operation and Management Body: Number of Staffs New Lach Huyen Port Organization: 200 2 Container Berths: 200 USD 11/TEU is estimated for container handling operation.
Refurbishment of equipment	Refurbishment of equipment is made every 15 years amounting a half of the capital cost.

The benefit concept of “With” and “Without” cases are same condition as economic analysis for medium term project. The cargo handling capacities of 2 container terminals are assumed 890,000TEU per year. And the period of calculation for the economic analysis (project life) is assumed to be 30 years (2015-2046) after the completion of short-term port development project implementation.

EIRR for the Short-term Project (2 Container Terminals) are also estimated at 14.3%/annum. Therefore, the project is economically feasible for both short-term and medium-term development project

Table 18.2.9 Sensitivity Analysis of EIRR for Short-term Development Project (2 Container Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	14.3%	12.8%	11.1%
	10% up	12.8%	11.4%	9.9%
	20% up	11.1%	10.3%	8.8%

Reference:

(1) EIRR only for Port Project

EIRR for Port Project without Road & Bridge construction cost is as follow:

Table 18.2.10 Sensitivity Analysis of EIRR for Medium-term Port Development Project (5 Container Terminals and 3 Multi Purpose Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	29.8%	27.3%	24.7%
	10% up	27.3%	25.2%	22.7%
	20% up	24.7%	23.3%	20.9%

(2) EIRR for Short-Term Development Project

The public infrastructures such as access channel, port protection facilities, public related facilities and access road & bridge to be constructed in short-term development is designed for medium-term development of the target year of 2020, which means that these public infrastructures are not constructed only for container berth No.1&2 but also available for container berths No.3 to No.5 and multi-purpose berths No.1 to No.3 without any additional investment. Therefore, there is an opinion that it is reasonable to consider a part of the public infrastructures cost to short term development in the calculation of EIRR for short-term development. Based on this opinion, if 40% of public infrastructures cost (Container berth: 2 berths/ 5 berths = 40%) is charged to the short term development project, the EIRR for short term development becomes **22.4%** as shown below.

Table 18.2.11 Sensitivity Analysis of EIRR for Short-term Development Project (40% of project costs are considered)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	22.4%	20.3%	18.1%
	10% up	20.3%	18.5%	16.4%
	20% up	18.1%	16.9%	15.0%

19. Performance Standard Indicators

19.1 Performance Standard Indicators

There are several types of indicators to evaluate the performance of port activities that are widely accepted in the world port industry. These indicators are used to monitor the productivity, efficiency and cost competitiveness of the port.

They can be updated regularly to trace the evolution of the port and compared with the industry standards for improvement. Some of them are commonly included in the concession agreement as benchmark indicators that the concessionaire must observe. A failure to attain such commitment as identified in the agreement should constitute a violation and cause a breach against the contractual obligation.

1) Ship Turn-Round Time

This is the indicator to measure how fast ships are serviced by tallying the total time counted from a vessel arrives at anchorage to a vessel exits from a port. It can be divided into time at berth and time at outside. Idle time for a ship to stay at outside for waiting a berth and/or waiting for a high tide should be minimized.

2) Waiting Rate

The waiting rate is measured by dividing berth wait time at outside by time at berth. This indicator shows the information about berth congestion problems at the port. A large number indicates that a ship is forced to stay idle at outside until a berth becoming available. There is no universal benchmark number but it is said that the best practice at world-class ports for a container ship is 5%.

3) Berth Occupancy Rate

This indicator represents the percentage of total time that berth is occupied by ships. This is an indicator to be used for measuring berthing efficiency but must be utilized with other indicators such as the ship turn-round time and cargo working time at berth since high value of this rate does not necessarily mean that a port is used efficiently, or rather it could be regarded as an inefficient port if a ship is not handled in a productive manner and is forced to stay longer due to low productivity.

4) Working Time over Time at Berth

If it is the same or closer to the time at berth, a ship is fully serviced or with minimum idle time. A smaller value signifies the ship is idle most of the time while staying at berth. In detailed information the idle time is identified due to meal hour, weather, crane failure or other reasons.

5) Cargo Dwell Time

It is the elapsed time between cargos is discharged from a ship until it exits the port for an import cargo or the reverse operation for an export cargo. It is measured in container days and naturally the smaller value represents higher port's efficiency. This information can easily be obtainable from the computerized container tracking system; otherwise a laborious data collection would be mandatory by tracking every container movements. Again there is no industry benchmark number but it is said that at the best productive ports record around 4.7 days as far as the container terminal productivity is concerned.

It is a significant indicator that affects the terminal storing capability. This indicator however does not necessarily depend on port efficiency. Other factors such as Customs and Quarantine cargo clearance system and trade practices are other components that affect cargo dwell time indicators in greater degree.

6) Quay Gantry Crane Productivity

It is widely accepted common productivity indicators to measure container terminal capability.

Either number of containers or TEU handled per hour per crane is used as a popular indicator to compare terminal productivity. It is further detailed into a gross productivity and net crane productivity. A net crane hour deducts meal hours and loss time due to weather from gross crane hours.

It sometimes referred as total moves per hour by multiple quay gantry cranes such as 220 container moves per hour recorded by one of UASC vessel at Khor Fakkan Container Terminal in April 2009. (UNCTAD Review of Maritime Transport, 2009)

7) Handling Cost per TEU and Other Performance Indicators

It is a reference benchmark to identify the cost efficiency of the port. It would not be a universal measurement indicator since the cost components vary considerably country-by-country and even by a container terminal by terminal where they were worked under the different terminal concession contract.

It is noteworthy that in some concession contracts, customer satisfaction is incorporated as one of the performance measurement to demonstrate customer-oriented posture of the authority.

19.2 Data Collection Efforts vs. Labor

It should be prudently devised to avoid excessive labor and costs for implementing, monitoring and enforcing the rigidly defined standards on the part of port authority. When excessively defined standards are set in the contract, the costs for allocating personnel to monitor the performance would be prohibitive.

They can be easily compiled from the data accumulated in the computerized vessel movement and container tracking system that will be input during the course of routine daily job by terminal operating personnel. Manual data collection and analysis needs a lot of labor. Especially when a consolidated data for Haiphong port is needed, it may not be easy under the current port management system in view of the fact that the port consists of segmented independent container terminals e.g. Transvina, Hoang Dieu, Doan Xa, Chua Ve, Dinh Vu.

19.3 Benchmark Performance Key Indicators

In general, key operational performance indicators that are used commonly in the port industry for container terminal are:

- Berth Occupancy Rate,
- QGC productivity,
- Container Dwell Time, and
- Cargo Throughput.

These factors are also applied to determine on the number of berth, number of QGC and container yard requirement when the basic design of container terminal is studied. As discussed above there are no universal standard benchmark values for these indicators since they vary port by port.

For example Berth Occupancy Rate depends on the accessibility from the anchorage, channel traffic constraint, number of berth, QGC productivity and shipping lines' port call schedule that may not spread evenly through the week. QGC productivity tends to be influenced by the composition of the type of containers and stowage besides crane driver's skill. Container dwell time fluctuates depending on the trade practices, type of container, export/import/domestic mixture, Customs and Quarantine formalities, etc.

19.4 Performance Guidelines for Lack Huyen Port

In order for the government to evaluate and justify the investment into the Lach Huyen port development project, the study team recommends to measure following performance indicators as a minimum guideline to be met by January 2017, within two years after the commencement of the Berth One and Two into operations.

They are selected among other common performance indicators that are going to be tallied by the terminal operators as a part of their daily routine operation activities, to be reported to an administrative port management body.

As regards Item 1 Berth Occupancy Rate, for fulfilling the business plan target to handle 500,000 TEU in 2016 it is required that the occupancy rate should not be less than 30%.

The addition of the Item 4 in the guideline table below, a specific measurement item for Lach Huyen port, intends to identify the largest Deadweight Tonnage of the vessels of more than 50,000 DWT docked at Berth One and Two during 2 years from the commencement of operation. Large amount of investment for deepening the fairway channel should be justified if upgraded large line haul vessels that provide a direct U.S. West Coast route start to make regular calls at Haiphong as expected.

Table 19.4.1 Performance Guidelines

	Measuring Item	Guideline
1	Berth Occupancy Rate	30%
2	Container Dwell Time	6 Days
3	Throughput	500,000TEU in 2016 750,000TEU in 2020
4	Maximum DWT of Vessels Docked at Berth One and Two	More than 50,000DWT vessels

JICA is going to review and appraise these performance indicators in 2017 in order to justify the government initiative to grant capital investment for upgraded deep-water container berths at Lach Huyen port. Port management body is requested to coordinate and collect necessary data to confirm whether the progress of the development is in order as expected.

20. Operations and Management Organization

20.1 Business Environment Surrounding Port Industry

20.1.1 Port Business Environment

After the Lehman shock, all world trade began to shrink rapidly. Starting in September 2008, the volume of world trade began to plummet sharply. It's not just that exports to the United States but the flow of goods everywhere, in all directions, has fallen. The Lehman shock has been contracting U.S. economy and the failed U.S. financial system could drag the global economy into its first recession since World War II.

Nevertheless, for a longer term perspective, there seems to be no rational need to change a perspective of the general growth pattern of the world container trade mainly due to spectacular high growth in newly industrialized economies, the BRICS for example, followed by the next group of newly industrializing economies including Vietnam and Indonesia in the Asian region.

The business environment in which ports operate today has dramatically changed. The pressure from port customers for better and cheaper services is getting greater and diversified. Ports are expected to improve efficiency continuously to satisfy and hold current customers, and further to attract additional traffic into the port, in order to become financially sound and independent.

While the ports, which are able to meet the customers' diversifying expectation, can thrive and capture an additional traffic, other ports, which cannot afford to evolve themselves in the rapidly changing environment, would lose their marketability in the port business.

Port administrators therefore should try to upgrade their organizational capabilities to fulfill ever-changing customers' needs. The market situation surrounding port industries is getting rougher and more competitive.

20.1.2 Deployment of Mega Containership

Particular phenomena that influence the industry are:

(1) Rapid growth of huge market in China and India's increasing economy;

(2) A deployment of larger containerships in the major trade lanes which may minimize the ports of call and results in a change of the feeder ships' networks. As of October 2009 about 4,700 containerships are in service and about 1,100 ships on order including 136 ships of 12,000TEU and above, 72 ships with 8,000 – 9,000 TEU due into service up to 2012 according to the shipping industry news paper;

(3) A globalization of economy brought by the evolvement of supply chain management system by taking advantage of IT solutions.

These drastic changes in the trade make a world shipping business volatile through realignment of alliance partners and unpredicted acquisition and mergers.

A possible shipping business reorganization resulted from the deployment of super over panamax containerships in the major trade lanes may inevitably affect the ports in Vietnam to greater extent. Minimizing number of ports of call by larger ships necessarily involve a feeder ship network reorganization.

Another foreseeable change due to an introduction of mega containerships would be a replacement of fleet in the regional services with the containerships redeployed from the major trunk routes. A possible cascading down of ships now deployed in the major East-West trunk routes to the regional shipping lanes would cause changes in the aspect of near sea and feeder ships network eventually.

20.1.3 Port Development to cope with Vietnam Trade Growth

Port management body in Vietnam should in this respect keep watch carefully the movement of world shipping industries. Otherwise, if it happens and the port is not ready to accommodate such larger ships, smaller ports may easily be downgraded to a second feeder ports because of inability to accommodate larger and deep draft ships. It would consequently turn out to bring a negative impact to the Vietnamese national economy.

Recent inauguration of the direct service connecting Ho Chi Minh and the U.S. West Coast by APL and MOL, alliance members of TNWA was a milestone for Vietnam. A successive introduction of the direct service to the U.S. in last June has demonstrated to the market the potential capability of the South Vietnamese port that can accommodate a larger and deeper container ship.

Taking advantage of an active port development plan and a surging container cargo volume to and from Vietnam, the ocean carriers are eagerly tackling with enhancing Vietnam services on the major East-West trade lanes between Asia and North America and Europe.

20.1.4 Deep-Water Port Development Plan

Working out a national port development plan to upgrade port capability in the northern region of Vietnam is definitely legitimate and completely in accordance with the national economic growth policy. For facilitating export promotion of Vietnam products, a thrust engine for Vietnamese economic growth, the direct line haul calls by large mother vessels serving North America, Europe and other Asian ports is indispensable.

The construction of a new deep sea container port or renovation of existing port facilities require enormous capital outlay for not only the port infrastructure such as anchorage, fairway, quay and berth but also superstructure including quay gantry cranes and modern cargo handling equipment as well as an installation of state of the arts terminal computer system.

At a Business Forum held in Hanoi in December 2009, foreign participants claimed that infrastructure in this country is not satisfactory and called for an urgent need for private sector participation in infrastructure development, financial and management, especially in power generation and deep-water seaports.

20.2 Public Private Partnership (PPP)

20.2.1 Significance of PPP

In discussing Public Private Partnership (PPP) in this study, the public sector is referred sometimes as a port authority besides a port administration or port management, the most common terminology to represent the public sector entity that is a governing body for port management and administration.

The port authority in this report therefore is not construed as a specific central, regional or local governmental organization such as Haiphong Port Authority under VINAMARINE. It is rather a general term representing pubic interests. The port authority under VINAMARINE is now referred as the Port Administration as per MOT Ministerial Decision No. 57/2005/QD-BGTVT October 28, 2005. The role and function of VINAMARINE port administration will be reviewed separately in the latter part of this report.

Private enterprise participation in the port development, management and operations emerged as significant issues in the 1980s and is very common trend not only in the developing countries but all over the world, especially for the construction of a new large container port.

The primary reason of a proliferation of private sector participation in the port industry is financial constraints on the part of the public sector. A port construction requires tremendous financial burden covering infrastructure construction, including anchorage, fairway, berth, container yard, maintenance shop, railway side track, road access, installing cargo handling equipment, etc.

By mobilizing private funds through various forms of PPP in the port development, a government can afford to invest freed up money for the other priority objectives.

Another advantage expected by the PPP in the port management and operations is to improve port productivity and to enhance handling efficiency in order to meet port customer’s expectation. If a qualified private partner is selected, such as a reputable world container terminal operator, a public entity can take advantage of learning container terminal management and operation know-how to upgrade skills and quality of terminal performance.

Summing up significance of PPP is:

- To reduce high investment burden of government;
- To improve efficiency and productivity through fair competition;
- To offer high quality of service with cheaper price to port customers;
- To provide modern operations technology and management know-how.

20.2.2 Various Modes of PPP

Private sector involvement is one of the processes for the port administrators to rely on in attaining port performance improvement, which could not easily be realized without an introduction of private sector in the port management and operations.

The widely accepted definition of privatization is that “Privatization is the transfer of ownership of assets from the public to the private sector or the application of private capital to fund investments in port facilities, equipment and systems” according to the UNCTAD Guidelines for Port Authorities and Governments on the Privatization of Port Facilities.

In narrower application of the UNCTAD definition, the transfer of ownership of port assets from the public to the private or the reliance of the private fund on the development of port facilities and procurement of various equipment are constituent of privatization but it is applied more broadly to include Contracting Out and Management Contract that do not necessarily pertain to the transfer of assets and the private fund utilization.

As mentioned in the foregoing section, the supply of infrastructure has traditionally been the responsibility of governments.

However many governments now have difficulty in allocating adequate resources and huge gap exists between infrastructure demands and available public sector financing resources.

Additionally poor performance of the public sector in supplying infrastructure services has compelled many developing counties to look for alternative ways to develop infrastructure.

It is now generally agreed that under appropriate circumstances the involvement of private sector, with adequate support and control, can go some way towards satisfying the need for financial resources and greater efficiency.

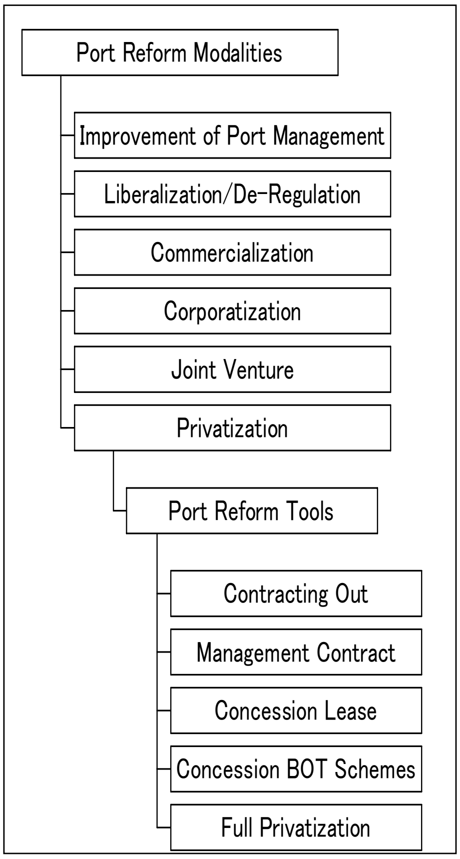


Figure 20.2.1 Port Reform Modalities

20.2.3 Two Variants of Privatization

There are two variants in regard to the privatization mode due to the depth of private sector involvement.

1) Comprehensive Privatization:

Through the sale of public sector's assets including site and equipment or even sale of bare site for development, private company becomes the owner and operator of all assets and all land and water. In this scheme, a public sector has a limited involvement in the port administration such as a strategic port development plan, management rules and regulations, international commitments on the safety and port security, setting up a regulatory regime and dispute settling mechanisms, adopting antimonopoly laws, etc.

In the strict sense of interpretation, this extreme privatization mode is not popular in the world and is an exceptional case only envisaged at Felixstowe in England and Tauranga in New Zealand. This is not an option for a Vietnamese port because of the constitutional prohibition of private ownership of land as specifically defined that all land in Vietnam is owned and administered by the State.

2) Partial Privatization

Only a part of the assets and activities are transferred to the private sector from a public port body including a concession to a private company to build and operate a certain facilities and the transfer of pilotage or towage service department to a private company.

This form of privatization constitutes PPP and usually combined with the introduction of a landlord type port authority. This formula of privatization, where public side and private side share the responsibilities as well as risks of the construction of container terminal, installation of cargo handling equipment and maintenance of them and management and operation of the terminal activities, is predominant in the port industry.

The course of privatization to be followed depends on the purpose and aims of privatization. If an efficiency improvement is only sought then a management contract suffices. If trying to relieve and alleviate financial burdens on a part of public side, a concession agreement may be a viable choice for a public sector to take.

20.2.4 Port Reform Strategies

As discussed above there are several tools to implement partial privatization. They are proven to be useful to balance public and private interests and are popular modalities to be adopted by the relevant public sector agencies that are eagerly looking for port productivity and efficiency improvement.

In real application of PPP schemes, however, there is neither a fixed type nor common single mode that is applicable to every PPP projects. There are various combination and mixture of methods to fit for the respective PPP scheme in implementation.

In reality, a combination of several privatization options is common phenomena for example formation of a joint venture comprised of public port authority and private enterprise including lease and BOT element as seen in many Chinese container ports, Shanghai, Qingdao, Yantian, Tianjin, etc.

1) Contracting Out

Instead of executing certain functions by the public agencies, these may be contracted out to a private party, especially for non-core business activities such as pilotage towage and line handling for mooring and unmooring services wherever these services are carried out at lower prices through competitive bidding process.

Possible concern of this option is that there is limited number of operators in the market that tends to hinder business competition among operators. This may include the licensing of stevedores to undertake cargo- handling function.

2) Management Contract

The entire or a section of the port is temporarily handed over to the private sector against management fee. A private company provides managers for certain activities and receives a management fee for the activities, for instance, royalty payment per move or TEU handled. In this model the management company will not be required to make large investments. They do not involve a transfer of ownership either.

3) Commercialization

A pubic sector, a port administration in particular, is managed and operated by following market principles and practices under commercialization scheme. Essentially a port administration is managed and operated on a commercial basis even though an authority is empowered a greater autonomy, yet subject to national government regulations, over budgeting, procurement employment of personnel, setting strategic planning, etc. under more decentralized decision making process.

A good example of commercialization is The Port of Singapore Authority which, as a statutory body, is operated under a great deal of autonomy in managements and operations to the extent that PSA is self financing and can explore their terminal operation business opportunities worldwide.

4) Corporatization

It does not involve a transfer of ownership from the public side to private sector but setting up an independent entity that is still owned by the government, yet operated with commercial principles. The normal corporate structure is to be incorporated as wholly owned subsidiaries of a government holding company. Legally it is a private company although full share holding is retained with the government.

Many port authorities in China e.g. Shanghai International Port (Group) co. Ltd., the exclusive operator of all the public terminals in Shanghai (former Shanghai Port Authority), Shenzhen Yantian Port Group which invests in Yantian International Container Terminal at Shenzhen, Tianjin Port Group (reformed former Tianjin Port Authority) which operates JV container terminals teamed up with foreign terminal operating companies in the port of Tianjin. These holding companies are listed in the stock market in Hong Kong or Shanghai to raise money in the stock market for further port facility expansion.

5) Concession

This type of arrangement is very similar to the leasehold contract but differs that a concession allows a more freedom and flexibility to a concessionaire to operate the terminal.

Another conspicuous difference with a lease contract is that it requires a certain degree of capital investment for developing terminal facilities and cargo handling equipment. Concession normally includes a commitment for the private sector to make a specific investment to improve the quality and capacity of these services.

The prime purpose of concession agreement is to raise funds through private financing resources for port development and improvement without compromising ownership of the port facilities. Under this scheme a successful concessionaire is given an exclusive long-term container terminal operating right to operate the port. The port administration could retain full ownership of land and assets and would play no part in cargo handling operations.

The port administration, depending on the final terms of the concession agreement, would most likely receive a fixed payment for use of assets, and variable, volume related payment that reflects the growth in the port business. Such an arrangement would not remove all financial risks from the port administration, but it would quantify the financial gap between income and loan repayments, and acts as a strong incentive to increase traffic volume in order to gain a share in the increased revenue.

a) Landlord Option

The “Landlord” option has very few disadvantages, which is why it has become so popular in the international port concession formula.

Under this option, the port administration, as an owner of the facilities covers following responsibilities:

(1) To hold ownership of land and properties;

(2) To grant exclusive and long term operating rights to a qualified container terminal operator;

(3) To remain responsible for all loan repayments;

(4) To receive lease fee at agreed level from the terminal operator to cover the costs of investment in facilities and assets. This is most likely to consist of a fixed fee for asset use, and a variable payment or profit component that is related to volumes of container handled;

(5) To play no major part in terminal operations;

A terminal operator's responsibilities are:

(1) To make a regular rent payment to the port administration;

(2) To make additional variable payments that relate to the number of containers passing through the terminal subject to the concession contract condition;

(3) To undertake all maintenance at its own costs and subject to inspection by the port administration;

(4) To provide supplementary equipment and replacement necessary for efficient operations;

(5) To undertake to upgrade equipment, container tracking software and any other improvement necessary for the port to remain competitive;

(6) To promote active marketing efforts for the terminal in order to bring in an additional traffic to the port.

Concession is a most popular private participation method in the port sector. In South Asia almost 79% of the container port development were green field utilizing BOT and joint partnership modes according to UNCTAD Review of Maritime Transport 2004.

6) Lease

Existing facilities, equipment and infrastructure in the port are leased out to the private sectors that provide services with using these assets as set forth in the leasehold contract. Lease contract usually does not require for a lessee to invest for port basic infrastructure and major cargo handling equipment. Well- known example is the Thailand Laem Chabang container terminals two, three and four that are leased to the private terminal operators including quay gantry cranes and cargo handling equipment.

7) BOT (Build-Operate-Transfer), BOO (Build-Operate-Own)

This type of privatization modality is often applicable when investment in new infrastructure facilities is sought by the public entity. The most popular pattern in case of a container terminal development at a green field site is that the private sector makes major investment in both infrastructure and superstructure. At some future date the facility would revert to the government under BOT scheme. Under BOO agreement an ownership of facility remains at the hands of a private developer.

BOT is a preferable option that is suitable for a large container terminal development project, which requires high capital costs and long payback periods.

8) Stock Market Floatation

This privatization option entails the sale of shares to the private sector. Alternatively the government tries to retain a qualified amount of shares to retain a political influence over strategic industries such as ports that are key infrastructure which contribute to the national trade and economy promotion.

It is not a popular method in the industry as a means of privatization. A few cases are recorded and example is the port of Tauranga in New Zealand where the port corporation shares were floated in the country's stock exchange and another case was taken place in England.

20.2.5 Balance of Interests of Public and Private Sector

Among all of these discussed heretofore, Concession including Lease and BOT are prevalent options when the public sector considers private sector participation.

In selecting the best alternative of privatization, a critical component to be negotiated between a public sector and a private sector is a balance of interests between parties besides financial capability of the public sector.

For a port that is expected to grow with throughput increase, a private sector tends to pursue unrestricted revenue share in the longer contract period without a revenue sharing rent formula. Naturally a private sector bears a greater risk of insufficient revenue until the volume to build up to projected level for a certain period since a private side is required to keep pay rent regardless of shortfall of volume.

A private sector intrinsically pursues a level of freedom and greater flexibility in the management whereas public sector looks for control and authoritative administrative power as its natural tendency. Their interests are not necessarily accord but are conflicting each other.

Additionally it should be discussed between the public sector and private sector to follow popular international practice for the rent structure that consists of a fixed price to cover mainly the loan repayment in combination with the variable portion that reflects revenue increase.

A revenue sharing scheme to share profits exceeding certain level of container volume or revenue is prevalent in the industry. Public sector would outlay such income for refurbishment and maintenance of the facilities and for a new port development.

For the balance level of variable portion should be determined through negotiation between the public side and private sector in anticipation of a win-win relationship.

20.2.6 The Role of Public Sector

An increase of private sector participation in the port operations does not necessarily mitigate the responsibility of the public sector in the management and operations of the port. Rather it will require a more effective involvement to check the private sector activities that tends to focus on the short-term revenue generation instead of long-term perspectives aiming at the growth of national economy through efficient and economical operations in the port.

Unrestricted PPP tends to ignore the public interests including environmental consideration and living condition of the people. Moreover it sometimes results in monopolization, which leads to high cost of service. A private monopoly is one of the more contentious issues to introduce port privatization.

As a result, a private sector may disregard the non-profitable infrastructure and the whole efficiency of an infrastructure may fall due to a lack of adequate maintenance in the longer operating period. This tendency is remarkable before the transfer of the infrastructure at the end of concession contract.

As the landlord owners' function, the majority of the world port administrators engage in the development and maintenance of the basic port infrastructure such as anchorage, fairway channel, wharf, etc

Another important role of the port administration in the port management is the obligation to protect the public interests. Since the port plays a significant role for development of the national economy, the administration must put an importance of maintaining the national port system as a part of effective nationwide distribution network.

Especially rapidly expanding economy such as Vietnam needs an efficient, economical and effective distribution management, in which ports become a critical component of nation's total logistical transportation network.

Also the port land and facilities are a part of precious national assets. In this regard, government sovereignty, public interests and public ownership of port properties should clearly be identified and protected.

20.2.7 Demarcation of Responsibilities of Port Administration and Terminal Operator

Followings are based on the general practices observed in the world container terminal and are universally accepted popular standards that in many cases are incorporated in a concession contract.

Under the typical Landlord Concession Agreement public sector holds responsibility for:

(1) Preparation of long, medium and short-term port development policy;
(2) Ownership of port land;
(3) Development and maintenance of port infrastructure;
(4) Regulatory function related to security, safety, and environmental protection;
(5) Protection of public interest and prevention of discriminatory practices;
(6) Promotion of trade facilitation and intermodal cargo traffic;
(7) Facilitating value added logistical services in the port area.

Basic responsibilities of the terminal operator in the concession contract are:

(1) Cargo handling operation on board vessels and onshore, cargo delivery and storage;
(2) Maintenance of cargo handling equipment;
(3) Procurement and maintenance of supplemental mobile cargo handling equipment:
(4) Additional investment for replacement and procurement of equipment to protect traffic volume increase;
(5) Updating vessel operations and yard management software;
(6) Securing incremental cargo volume through marketing effort;
(7) Terminal security;

20.3 Port Privatization Examples

20.3.1 Laem Chabang Port

In 1973, after long preparatory studies and investigations, Thai government has finally selected Laem Chabang as the best site to construct a new deep-water multi purpose port on account of technical feasibilities and huge potential for future expansion.

In 1982, the government of Thai has decided to accelerate the development of Laem Chabang Port (LCP). A new port facility at Laem Chabang was regarded as a critical infrastructure to encourage the production of light consumer goods, which would lead export ridden Thai economy.

Also expected was to deal with the heavy port congestion at Klong Toey and chronic traffic in the capital city of Bangkok that resulted from fast rising economic growth of the country. The government commenced to implement the Laem Chabang project with the loan assistance from Japan in 1983. Actual site construction began in 1987.

The port of Laem Chabang began operations in 1991. Laem Chabang Port (LCP) provides various port facilities including containers, general cargoes, bulk cargo for foreign trade, domestic, long haul international traffic, feeder services, RO/RO, passengers, etc. It has become the biggest port in the country and one of the busiest ports in the world. In 2008 LCP handled 4.6 million TEUs.

Under the Phase 1 development plan, five identical container terminals have been developed, B-1 through B-5. Upon completion of Phase 2 development plan, six berths, C1-C3 and D1–D3, will be added bringing total container handling capability to 10.8 million TEUs by 2011. With an addition of Phase 2 terminals LCP can accommodate Post Panamax size ships of 8,500 TEU ships.

1) Port Authority of Thailand

The Port Authority of Thailand (PAT) has made further port development plan of Phase 3 in preparing for surging container volume in accordance with country’s economic growth and international trade expansion. It is expected the facilities will be operational in 2018. LCP will be reinforced to become an international marine hub on the Asia-North America and Asia-Europe trade lanes.

PAT is a state owned enterprise under control of the Ministry of Transport and Communication. It provides the services including dredging and maintenance of anchorage and fairway, installation of navigation aids and cargo handling operations at Bangkok Port and LCP.

One of the important policy direction set by the Thailand government was privatization of state enterprise to invite the private sector in the management and operation of the ports. Fully complying with the central governmental policy for privatization, PAT has successfully given the concessions to private enterprises since Phase 1 development.

The basic methodology PAT utilized to attain privatization policy was Lease Contract. The principal features of PAT’s Lease Contract are:

- 30 years contract period with an extension option subject to mutual consent;
- Concession fees comprised of a Fixed Rate per annum and a Variable Fee depending on the terminal revenue or number of TEU throughput that exceeds certain level of amount;
- At the end of the Lease Contract all infrastructure, cargo-handling equipment, buildings purchased and installed by the terminal operator will be taken over by PAT.

Table below shows dedicated Container Terminals, Multi-Purpose Terminals, Passengers and RO/RO, Agri-Bulk and a Coastal Berth operated by the private companies at LCT.

Table 20.3.1 Private Terminal Operators at LCP

Terminal	Length (m)	Depth (m)	Private Operator
A-0	250	10	LMCT Co., Ltd.
A-1	365	14	Laem Chabang Cruise Centre Co., Ltd.
A-2	400	14	Thai Laem Chabang Terminal Co., Ltd.
A-3	350	14	Hutchison Laem Chabang Terminal Co., Ltd.
A-4	350	14	Aawthai Warehouse Co., Ltd.
A-5	225	14	Namyong Terminal Co., Ltd.
B-1	300	14	Laem Chabang Container Terminal 1 Co., Ltd
B-2	300	14	Evergreen Container Terminal (Thailand) Co., Ltd
B-3	300	14	Eastern Sea Laem Chabang Co., Ltd.
B-4	300	14	TIPS Co., Ltd.
B-5	400	14	Laem Chabang International Terminal Co., Ltd.
C-1	700	16	Hutchison Laem Chabang Terminal Co., Ltd.
C-2	500	16	Hutchison Laem Chabang Terminal Co., Ltd.
C-3	500	16	Laem Chabang International Co., Ltd.
D-1	700	16	Hutchison Laem Chabang Terminal Co., Ltd.
D-2	500	16	Hutchison Laem Chabang Terminal Co., Ltd.
D-3	500	16	Hutchison Laem Chabang Terminal Co., Ltd.

Note: B-5 berth was developed under BOT scheme.

Under the normal Lease Concession Contract, PAT provides basic port infrastructures, reclamation, berth construction and installation of quay gantry cranes and buildings including CFS, administration building, M&R shop while a lessee, a private operator provides cargo handling equipment.

The Thai government is striving for private participation in the port industry in looking for financial assistance from the private sector and improvement in operational efficiency both of which are necessary prerequisite for promoting port infrastructure modernization.

It is however not necessarily unconditional. A private enterprise that intends to explore port business opportunity by taking advantage of the Thai government privatization policy must be licensed by the relevant governmental agencies and their operations are subject to surveillance by a competent surveillance committee. In case of a JV with foreign capitals, at least Thai nationals should hold 51% of the stock.

20.3.2 Tianjin Port

Tianjin Port is a gateway port for the capital city Beijing. In 2008 the port has handled 8.5 million TEUs and ranked at 14th place among the world top 20 container ports. Tianjin was the first port in the mainland China that opened full container terminal in 1980. The port still maintains a leading position of container traffic in the northern China region and is expanding vigorously to enhance its capability.

Following the direction set by the communist party, China has adopted the policy to reform the country to accelerate the process of establishing and fostering the socialist market system in the latter half of ‘80. Many state owned enterprises have been reformed to modern corporate structure.

Preparing for an entry into WTO the Chinese government has determined to open the transportation market to foreign funded companies, which undoubtedly try to create favorable external conditions for fair competition in port industry.

Tianjin port has grown steadily by teaming up with well-known world container terminal operators and shipping lines in that the Port Authority of Tianjin (now reorganized as Tianjin Port Group listed, TPG, on the Shanghai Stock Exchange) remains as a major stakeholder.

Other major shipping lines, the CMA-CGM, MSC, and Evergreen are also looking for an investment opportunity in the port of Tianjin. The central government of Beijing has a long term plan to develop a business center in Tianjin of financial market next to Shanghai. It has been reported that the French based CMA-CGM group has signed a 50-year concession agreement to build and operate 1.7 million TEU container terminals at Tianjin.

Table 20.3.2 JV Container Terminals in Tianjin

	No of Berth	Length	JV Partner
Tianjin Container Terminal	4	1,300M	100%Owned by TPG
Tianjin Orient Container Terminal	4	1,150M	DP World
Tianjin Wuzou International Container Terminal	4	1,200M	TPG (40%) COSCO and other Chinese investment companies
Tianjin Port Alliance International Container Terminal	4	1,100M	TPG (40%) PSA (20%) APM Terminals (20%) OOCL (20%)
Tianjin Port Pacific International Terminal	6	2,300M	TPG (51%) PSA (49%)
Tianjin Port Euroasia International Container Terminal	3	1,100M	Tianjin Port Development (40%) COSCO Pacific (30%) APM Terminals (30%)

20.3.3 Port of Singapore

The Port of Singapore Authority (PSA), before its corporatization in 1997, was a single state unit under the Ministry of Communications and Information Technology that acted as both regulatory and terminal operator. Divestiture of PSA was a part of the nationwide movement towards privatization of state owned enterprises in Singapore.

The Maritime and Port Authority of Singapore (MPA), under the jurisdiction of the Ministry of Communications and Information Technology took over the regulatory functions while the PSA Corporation Limited (PSA Corp) succeeded a terminal operator’s business.

Current PSA Corp, which still has a banner of PSA, an abbreviation of Port Authority of Singapore, is a terminal operator but does not have a regulatory function at all. MPA is the legitimate regulatory organ that is responsible for administrating port and maritime affairs. As a port regulator MPA grants an official license for pilotage and towage services and other port services. Public licenses for port facilities and services have been issued to the PSA Corp and to Jurong Port Pte. Ltd.

By the divestiture of former PSA into two separate independent entities in 1997, PSA Corporation as a privatized terminal operator and MPA as the public administrator and regulator, the status of the Singapore port has been changed from a publicly managed and operated port to a landlord type port where the basic infrastructures such as fairway and breakwater as well as terminal infrastructure including wharf and reclamation are provided by the public side while terminal superstructure of QGC, CHE and buildings are installed by a private enterprise. It constitutes the most common public private participation pattern.

Following is a matrix how these two organizations, PSA Corp and MPA share the functionality.

Table 20.3.3 MPA and PSA Function

Functions	MPA	PSA
Law and Regulations	○	
Ships' Traffic Control	○	
Ships' Entry/Departure	○	
Port Planning/Development	○	○
Pilotage		○
Towage		○
Cargo Handling		○
Construction & Maintenance of Fairway/Breakwater	○	
Construction & Maintenance of Wharf	○	
Collection of Wharfage		○
Land Reclamation	○	
Yard Pavement		○
Construction of Admin Building, CFS, Gate, Power Station		○
Installation of QGC and CHE		○
Collection of Port Due	○	

When PSA Corp has been divested in 1997, the corporation made a lump sum payment of 30 years rent to the government. Upon termination of the current leasehold contract it may not be precluded, subject to further deregulation being progressed in Singapore, that the other terminal operator from abroad may win the nomination through an international bidding process.

Since 1996, PSA Corp has expanded international business started with its first international joint venture with Port of Dalian Authority. Dalian Container Terminal, which owns, develops, manages and operates three container berths at Dalian.

For expanding and facilitating international container terminal network, PSA International Pte. Ltd has been formed as the holding arm for the PSA Group business deployment. Under PSA International, PSA Marine has been set up to provide pilotage and towage services. As long as towage is concerned, the towage service business has been liberalized further. There are six licensed towage operators in the port. PSA Marine Vietnam Pte. Ltd. with which Saigon Port signed a joint venture contract has established to form a SP-PSAM Tugboat Company Ltd. in June 2009.

20.3.4 Different Functionality of Port Authorities

In China, it is common that the public sectors positively involve in the operations of the container terminal, e.g. Tianjin Port Group, Qingdao Port Group, Shanghai International Port Group, and Shenzhen Yantian Port Group. They are former Port Authorities and are now converted to the holding companies that are listed on the Shanghai, Hong Kong and Shenzhen stock markets.

Historically the Chinese port authorities used to carry out the cargo handling operations. As a typical service port, the port authorities were responsible for the port development, administration and regulatory agencies, and cargo-handling operators.

As cargo volume dramatically being increased following the drastic Chinese economy expansion, a great deal of ports have been developed and modernized almost all at once. In order to cope with the demands for building modern ports that can accommodate larger vessels, many Chinese port authorities were looking for foreign capitals and up-to-date port operations techniques.

One of first instances for a foreign transportation company made inroad into the Chinese port industry was US based container terminal operator, CSX World Terminals. CSX Orient Tianjin Container

Terminal Co., Ltd. (CSXOT) was founded in October 1998 which was a joint venture enterprise invested by the Port of Tianjin Port Authority and CSX World Terminals New World (Tianjin) Limited with registered capital of $29.2 million. Tianjin Port Authority invested with current mechanical equipments, holding 51% of the total shares, CSX invested with cash, holding 49% of total shares. CSXOT rent such facilities as quay, yard and buildings.

Chinese port authorities hereafter successively have sought for a business tie-up with well-known container terminal operators or leading container shipping lines to make up a joint venture terminal operations companies in which the port authorities retain the majority. By investing into the container terminal operation enterprises through the stock holding companies, the port authorities still engage in the cargo handling operation.

The Port Authority of Thailand (PAT) who manages Laem Chabang and MPA in Singapore on the other hand does not involve in the cargo handling operations of the container terminals. The private terminal operators, who lease out the container terminals under the lease concession agreement, are actually engaged in the terminal cargo handling operations. The scope of PAT and MPA functionality mainly concern with a regulator and administrator of landlord port.

20.4 PPP in the Lach Huyen Port Project

20.4.1 Public Sector Investment vs. Private Sector Investment

As regards the project implementation of the Berth One and Two of Luck Huyen port, GOV has determined and issued the specific direction that VINALINES has been nominated as a Project Owner for the private portion.

Originally, as specified in MOT Decision No. 3793/QD-BGTVT dated December 22, 2008, VINALINES was tasked to invest in the Component B comprised of Wharf, Yard Road, Container Yard, Parking Area, Warehouse for CFS, Yard Embankment, Architectural Facilities and Water and Electric Power Source. For other major basic port infrastructure Component A, including Vessel Channel, Turning Basin, Breakwater, Sand Dyke, Port Service Road, were allocated to the other project owner (VINAMARINE of MOT has been nominated later).

In the official Minutes of Meeting on The Mission for the Preparatory Survey on Lach Huyen Port Infrastructure Construction agreed by the GOV and JICA dated July 23, 2009, GOV made explanation that the Reclamation and Soil Improvement works should be incorporated into the scope of project (public investment portion) while alignment and embankment work for the Berth One and Two would be conducted under the private investment portion.

VINALINES, having been granted the development right of Berth One and Two, has initially proceeded to construct Berth One and Two by its own fund and seek for foreign capital participation for development of Container Berth Three and Four. In 2008 GOV and VINALINES then have revised their direction and determined to synchronize the fund rising for infrastructure construction and container terminal development of Berth One and Two.

Through negotiations with VINALINES and MOT, the MOU has been concluded in October 2008 between VINALINES and several private enterprises, as reportedly, to team up a joint venture to cover private portion construction works on the premises that for the public portion Japan’s ODA assistance is prerequisite for the basic port infrastructure construction. Participation of private firms such as reputable shipping lines in the joint venture would be instrumental not only to utilize their terminal management and operations know-how but also to expect their vessel and cargo inducement into the Lach Huyen gateway port.

20.4.2 Joint Venture (JV)

This form of privatization is usually equity partnership between a government body and a private sector party. Several Joint Venture examples are taken place in the Saigon port. For an example of the latest case Japanese carrier MOL and other international shipping lines, Hanjin Shipping Co. of Korea and Wan Hai Lines of Taiwan set up a JV with Saigon Newport Company of Vietnam to develop and operate an international container terminal at Cai Mep district of Saigon.

It would involve setting up a subsidiary company with a joint venture partners as a form of a joint stock company or a limited liability company. This option reduces, but does not eliminate, public enterprise's financial risk.

Under the Joint Venture option, a port operating company would be established specifically to operate container terminals at Berth One and Two of Luck Huyen Port. Ownership of the JV Company would be shared between VINALINES and the commercial private JV partners. By definition, the JV would be fully independent from both VINALINES and the other JV partners.

An independent board of directors would be appointed, based on nominations from both parties. The voting powers reflect shareholding levels. The influence for a critical business decision making over the terminal operating company will be proportionately adjusted owing to the share of capital contribution to the JV.

JV would be responsible for operating deficits for the initial years and would also remain responsible for loan repayments in the event of failure of the JV Company. These risks should be compensated and shared by the JV members in proportion to capital fund contribution.

20.4.3 Joint Venture of VINALINES and Partners

Under the guideline of GOV, VINALINES will team up with competitive private sector enterprise(s) to make up a joint venture company that will finance the projects for the infrastructures and superstructures at Lach Huyen Berth One and Two e.g. wharves, container yards, buildings for administration, CFS, power station, and cargo handling equipment of quay gantry cranes and other CHE.

As long as the benefits and risks of JV should be shared by the percentage of capital funded by the participants of the JV, the greater share of JV equity contributes to the greater revenues as well as the greater risks of business.

Wherever VINALINES wishes to wield a dominant administrative power over the JV company operations, VINALINES should be the largest shareholder of JV that assures VINALINES ultimate objective to contribute to an expansion of the nation's economy by providing reasonable transport costs with productive and efficient port services.

Possessing a leading position in the JV, VINALINES may be placed in a position to check the private enterprise(s)' motive that tends to focus on a short-term profit. A VINALINES as a SOE initiative to guide the other private firm(s) of JV toward the right direction that accords with the national policy is indispensable for this challenge.

20.4.4 VINALINES Business Partner(s)

Prospective candidates of JV partners include:

- Regional stevedoring company;
- Global shipping line;
- International container terminal operator;

- Trading company; and
- Transport company.

1) Regional Stevedore Company

One of possible candidates is a regional stevedore company who has sufficient experience and knowledge to operate a dedicated modern container terminal with sophisticated IT technology to perform loading, unloading and execute container delivery with port customers.

It is prerequisite that a company has strong financial capability to invest capital for construction and purchase of necessary CHE as a joint venture partner. In this respect, there are a limited number of such capable candidates who can afford to meet such high level requirements.

2) Global Shipping Line

Global shipping line, that can afford to collect a lot of information on port performance on a global basis, takes an advantage to compare port productivity indicators, operating costs as well. A port therefore is required to provide a high and consistent standard of service in order to remain competitive in the industry.

Most of major world shipping lines operate dedicated container terminals worldwide. They have originally developed their own container terminal networks in order to maintain schedule integrity and the operational costs containment purpose.

Since the containerization is advancing progressively, they realize the fact that operating container terminal is lucrative business and they have shifted their corporate container terminal operations section from the mere cost center to a profit center to yield revenue to their corporations. They therefore possess a lot of expertise to manage and operate container terminal with relying on the effective use of computerized terminal operations systems.

In addition to their superior technical know-how, another great advantage for teaming up with a world class shipping line is that it can bring cargoes and vessels into the port. For the port, especially for a newly developed container port, an incremental business is critical element to recoup a huge initial capital outlay.

a) Shipping Lines’ Container Terminal Business

Looking at a business opportunity to operate the container terminal, the shipping companies are now trying to enhance their control over terminal assets and actively participate in the terminal operations.

They think that a port and inland infrastructure will become the critical issues. Those shipping companies who weather those challenges better than the others will have service differentiation and pricing advantage. At the same time, many of the shipping companies who operate container terminals invites smaller lines, that cannot afford to generate traffic to warrant operating their own facilities, as a third party terminal business.

Shipping lines are becoming more involved in terminal operations because the volume of their cargo, especially for the alliances, justifies the investment in fixed assets. Maritime shipping continues to produce low returns, but port terminal can produce healthy returns even in competitive situations. Every line therefore wants equity in terminal today. In recent years, terminal operators are trying to team up with shipping lines to form a joint venture in taking advantage of shipping line’s potential base cargo.

A landlord port authority on the other hand prefers to lease their property to shipping companies on the assumption that they would bring with them a secure base cargo. Port authorities are therefore seeking equity participation by shipping companies.

It is recommendable for VINALINES to enthusiastically look for business partnership with world class shipping companies, which will not only bring in the base cargo to Lach Huyen Port but also facilitate developing modern container terminal, and other prospective private partner who would be instrumental to generate an incremental business into the port.

3) International Terminal Operator

Well known international terminal operators have developed knowledge and expertise, financial strength, and also a leveraging power to negotiate with shipping lines. Nowadays, container port operations have become so complex that they require sophisticated workflows supported by software programs, which the international terminal operators are able to provide as essential standard tools.

International terminal operators have the required highly specialized managerial and technological knowledge but they may also bring substantial initial and continuous financial investment to build, operate and maintain more efficient ports. A limited number of well known global container terminal operators such as the top five of global container terminal operators, PSA, Hutchison Port Holdings (HPH), APM Terminals, DP World, and Cosco (Review of Maritime Transport, 2009) are handling majority of world container volume.

4) Trading Company

Looking at high profitability of the container terminal operations, Japanese major trading companies are also interested in the container terminal business and seeking for business opportunities especially in the developing countries.

They can contribute to bringing in an incremental business and help invite additional shipping lines into the port. In view of their financial strength, global network, a logistical expertise, a wide range of business coverage, evidenced success of container terminal operations as a JV partner at Viet Nam, Thailand and other regions worldwide, it is recommendable to consider forming a JV with them.

20.4.5 Foreign Investment

As regards a JV tie-up with a foreign enterprise in the port industry, there is no specific rule and regulation in the Law on Investment. A foreign application for investment in the port industry undergoes local governmental agencies' scrutiny as well as relevant central government agencies' judgment and handled on a case-by-case basis. Only guidance that concerns with a foreign participation in the port industry is WTO Commitment in October 2006 that refers to permissible percentage of foreign investment in each sector:

- Container Handling Services	Not more than 50%
- Container Station and Depot Services	Not more than 50%

Above restriction will be lifted up within seven years and will be open by 100% for foreign investor's participation.

20.4.6 Competition among Private Operators

The potential of creating a private monopoly has become one of the more contentious issues in the efforts to introduce port privatization. Many port authorities consider the creation of competitive conditions among port operators is the cornerstone of their port policy.

In the modern container ports, therefore, many port authorities put greater weight on the creation of competitive environment among port operators as the foundation of their policy. They think that the competition in the port is the root of progress and basic management strategy for providing better services to the customers that ultimately contributes to the growth of national trade through efficient and productive port services with affordable prices.

In the longer perspective though, it is desirable to introduce competitive pricing mechanisms to use market value of the services as the tariff determinant factor.

Some contracts, as a result of contract negotiation between the port authority and the terminal operator, bear the clause that protects the terminal operator from competition. For example, the port may not be allowed for a specified period of time to offer a similar contract to the terminal operator's competitors.

Conversely, in Indian ports of Mumbai, Jawaharlal Nehru and Cochin, the port authority that precludes the company from tendering for the new container terminals on the grounds that the same operator cannot run two terminals in the same port.

An adverse effect of monopolistic behavior by the powerful terminal operator can be seen in Indonesia. Reportedly Hutchison Port Holdings and its partner the state owned port-operating company at Tanjung Priok Port effectively controls 75 % of the Jakarta's container market. Indonesia's anti-monopoly body, Competition Supervisory Commission stepped in January 2004 and made six-month investigation against the complaint of high cargo handling tariff filed by the Chamber of Commerce.

As discussed above, port authorities usually stimulate intra-port competition. However, medium sized and smaller ports, because of their limited traffic, often accommodate only one port terminal operator. In such cases, port authorities may exert their regulatory powers to regulate port charges and tariffs. It largely depends on the level of competition in the regional market and more likely the negotiation power of the port authority.

20.4.7 Attractiveness of Port to the Private Entity

Followings are prerequisites for attracting foreign private enterprises with which the public sector to form a JV to the port in the developing countries (UNCTAD meeting on Port Logistics: Opportunities and Challenges for Developing Countries, December 2007 quoted in the Review of Maritime Transport, 2008).

- A clean and transparent bidding process;
- Quality and capacity of landside multimodal connections and port infrastructure;
- No government cap on profits;
- Good safety and security requirements;
- A training and retrenchment of labor plan;
- A clear role for the port authority (e.g. landlord model);
- Smooth customs procedures; and
- Absence of corruption.

20.5 Responsibilities of Port Administrator and Terminal Operator

20.5.1 Port Administrator in Haiphong

There is a Maritime Administration (used to be Port Authority) in Haiphong port under VINAMARINE. Their involvement in the port administration is very limited as discussed in the latter part of this study. As a matter of fact Haiphong Port Maritime Administration mainly focuses on the maritime administration, maritime safety management and maritime security management in the port of Haiphong, a narrower domain in comparison with the other port authorities in the port industry.

It concerns little with a regulatory functionality over cargo handling operations that is the major business objectives of port e.g. supervision of cargo handing activities, controlling terminal operators' business, maintaining port tariff in a reasonable level to promote and protect port customers, exporters and importers.

The most important role of the port administration in the port management is the obligation to protect the public interests. Since the ports play a significant role for development of the national economy, the administration must put an importance of maintaining the national port system as a part of effective nationwide distribution system. Rapidly expanding world economy especially needs an efficient, economical and seamless distribution management, in which ports become a critical component of total logistical transportation network.

20.5.2 Privatization Method for Lach Huyen Port

The most modern port privatization method in the industry is the Landlord Port Model and its variations, in which a pubic port administration retains ultimate property rights over land and infrastructure and fulfills all regulatory functions under which the commercial operations are carried out by private operators with lease and concession agreements.

Historically a port administration used to be involved in the dual functions as an administrator on the one hand and on the other as a cargo-handling operator. It has turned out that the operations by public employees and systems are not necessarily to meet the increasing demand of improving cargo-handling capabilities. This is the prime reason the function of container handling operations are separated and handed over to a private sector.

The most common privatization mode in Vietnam is a JV comprised of public sectors and private port operators. Public entities in the JV are VINALINES and its subsidiary of Saigon Port Company and other public enterprises such as Saigon New Port Company (a port operating company under the Ministry of Defense), Saigon Investment Construction & Commerce Company Limited and Tan Thuan Industrial Promotion Company (IPC, an industrial park related company under Ho Chi Minh Peoples' Committee). They are teamed up with private port terminal companies as follows.

Table 20.5.1 JV Container Terminals in Vietnam

Container Terminal	SOE/Pubic Corporations	Private Sector
VICT (First Logistics Company)		Mitsui & Co. NOL, Vietnam Partners
SP-SSA Intern'l Container Terminal	Saigon Port	SSA Marine
Cai Mep Intern'l Terminal	Saigon Port, Vinalines	APM Terminals
SP-PSA International Port	Saigon Port, Vinalines	PSA Vietnam
Saigon Premier Container Terminal	IPC	DP World
Cai Lan Intern'l Container Terminal	Cai Lan Port Joint Stock Co.	SSA
Maersk & Saigon Port	Saigon Port	APM Terminal
Tan Cang Cai Mep Intern'l Terminal	Saigon New Port	Hanjin, MOL, Wan Hai
Saigon Intern'l Terminals Vietnam Ltd	Saigon Investment Construction & Commerce Co. Ltd	HPH

The big four world container terminal operators, PSA International, HPH, APM Terminals and DP World are all participating as private side JV partners. It clearly demonstrates the fact that a potential business opportunity in the port industry in Vietnam is significantly remarkable.

Not only for mobilizing financial resources from private sectors in order to mitigate public monetary burden and free up funds for other policy achievement but also catching up terminal management and operations expertise from JV partners would be major objectives to inaugurate a JV. Private JV partner’s contribution to cargo generation by bringing in an incremental business into the port is a direct product attributable to JV partnership.

20.6 Port Stake Holders

There are several major stakeholders in the Vietnamese ports. One of them is the administrative bodies that manage overall port development. They include most likely the central government agencies, the Ministry of Transportation, the Ministry of Planning and Investment, the Ministry of Defense, the Ministry of Agriculture and Rural Development, the Ministry of Construction, the Ministry of Finance, their regional agencies and People’s Committee.

The other major stakeholder is operational bodies that operate the port by providing various port services such as cargo handling, tugboat assistance, pilot service, water and fuel supply, ships’ crew handling, etc. The most of those services are carried out by the corporatized SOE and private enterprises in this country.

Port users including shipping lines, forwarders, truckers, importers and exporters are other important stakeholders who use port facilities and services provided by the administration and port service providers.

As ports evolve themselves to meet the progress of supply chain management system, ports are no more simple conventional transport nodes between seaborne and other means of transportation modes. Ports are now regarded as critical component of logistical cargo movement where a variety of value added services such as sorting, storing, labeling, distributing and even manufacturing works are provided in the port complex. Port administrator should be aware that port users are looking for such capabilities in the port.

20.7 Port Development Plan vs. Shipping Lines’ Needs

Another major stakeholder in the port is a user who utilizes the port assets and services to make contribution to the logistical movements of nation’s export and import trades. Shipping lines and exporters and importers are therefore critical components of the port users. They are the final decision makers to select the port of call and their service networks.

Although the speed is a bit slowed down due to the world stagnation originated in the financial crisis in the US in 2008, the container cargo volume is expected to increase steadily. In order to cope with the constant trade growth, the development of port infrastructure is a must for facilitating logistical cargo movement.

There is a common argument in the port industry that whether ships’ call must first be secured for planning port infrastructure development or the port facility must be developed beforehand in preparation for accommodating larger ships to cope with the growing cargo demand. This type of argument is taken place often when a port administrator tries to expand port facilities to accommodate a larger and deep containership that is not currently making the port call.

A proponent for an expansion to construct a deep-water berth may insist that the reason of missing a larger and deeper containership call at a port is the lack of adequate port facility. The port falls behind the other neighboring deep-water ports if a deep-water port is not readily available. They say the port must be ready to accept such a larger containership otherwise the port competitiveness is lost and the port may be downgraded to a feeder port.

An opponent may emphasize that there must be sufficient cargo in the port to justify an enormous investment for an expansion or a construction of new deep-water berth.

In case of Vietnam, the former position may weigh heavier due to the fact that the port facilities in Vietnam are inadequate and far behind of needs of port customers. As the major historical ports in the Southern and South Eastern countries are located along the rivers near the cities that impose a draft restriction. In Vietnam, Haiphong in the northern part of the country and Saigon ports in the south have a problem of draft limitation which hampers the shipping lines from deploying a mother containership in these ports. Extra transportation costs resulted from the use of feeder services burden Vietnamese traders that eventually work negative to weaken economical competitiveness of Vietnamese products.

20.8 Multi-Purpose Port of Lach Huyen

When talking about the port management organization of Lach Huyen port, the fact that the port will handle various kinds of cargo, containers, general cargoes and bulk cargoes, chemical and petroleum should be taken into account. The management organization should therefore reflect this fact and be effective enough being capable to handle diversified requirements. The scope of port organization would evolve in parallel with the expansion of the port that will be taken shape step by step in the longer project period

20.9 Haiphong Maritime Administration and Haiphong Port Holding

As long as Berth One and Two, the focal point of this study, are concerned, VINAMARINE’s Port Authority and VINALINES’s affiliate of Haiphong Port Holding Limited Liability Co. (Haiphong Port) are critical governmental entities that directly involve in the development manage and operate the first two container berths.

VINALINES is a state owned corporation directly under the Prime Minister’s Office established on Jan 1, 1996. VINALINES is currently operated as a holding company for a VINALINES group, which includes 14 dependent accounting units and 61 subsidiaries, joint stock companies, and joint venture companies with a combined labor force of more than 28,619 employees.

20.9.1 Haiphong Port Holding

Haiphong Port is a subsidiary of VINALINES that is in charge of following activities:

- Development and maintenance of infrastructure and superstructure;
- Cargo loading and discharging, storage, receipt and delivery, tallying and warehousing;
- Transporting and freight forwarder;
- Setting cargo handling tariff;
- Tugboat services;
- Collection of wharfage;
- Transportation arrangement within the port compound;
- Shipping agency;
- Logistical services;
- Terminal security.

Figure 20.9.1 shows the organization chart of Haiphong Port Holding.

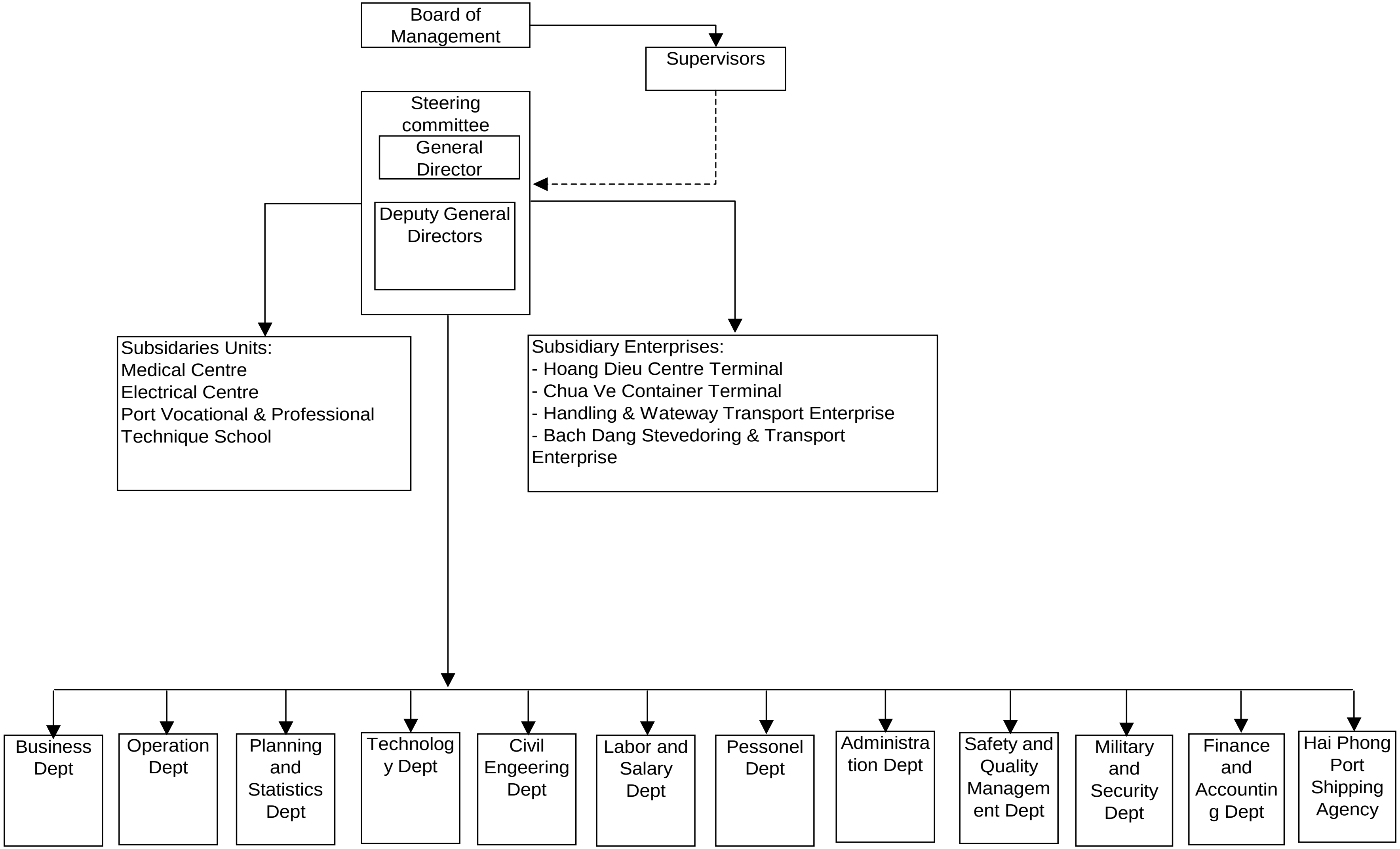


Figure 20.9.1 Haiphong Port Holding

20.9.2 Haiphong Maritime Administration

VINAMARINE was established under the Ordinance of Vietnamese Government No. 239/HDBT dated June 29 1992 and is one of the executive agencies under MOT. VINAMARINE has following major branches under its jurisdiction:

- Maritime Administration;
- Vietnam Maritime Safety Agency;
- Vietnam Maritime Safety Inspectorate;
- Vietnam Maritime Search and Rescue Co-Ordination Center;
- Vietnam Ship Communication and Electric Company; and
- Vietnam Liaison Office to IMO.

VINAMARINE has three representative offices at Haiphong, Ho Chi Minh City and Da Nang City, 24 Maritime Administration Offices and many other offices under its control. Duties and responsibilities of the Maritime Administration are in accordance with the Article 66 of the Vietnam Maritime Code, (No. 40/2005/GH11) June 14,2005 e.g.

(1) To organize the implementation of regulations and management of maritime shipping activities in seaports; inspect and supervise seaports channels, the system of navigation aids and supervise maritime shipping activities,

(2) To grant permits, supervise seagoing vessels leaving, entering and operating in seaports; prohibit seagoing vessels which fail to meet all necessary conditions on maritime navigation safety, maritime navigation security and prevention of environmental pollution from entering seaports,

(3) To execute seagoing vessels arrest decisions,

(4) To temporarily detain seagoing vessels,

(5) To organize search and rescue of persons in distress; mobilize persons and necessary means for conducting search and rescue or handling environmental pollution incidents,

(6) To organize the registration of seagoing vessels, registration of crewmen; collect, manage and use assorted seaport dues,

(7) To organize maritime inspection, investigation and handle maritime accidents,

(8) To assume the prime responsibilities for and administer the coordination of activities of state management agencies,

(9) To sanction administrative violations in the maritime domain,

(10) To perform other tasks and exercise other powers as provided for by law.

There are six divisions under Director and Vice Directors i.e.

- Maritime Safety & Inspectorate Division
- Financial & Accounting Division
- Legislation Division
- Administration & Personnel Division
- Port Management Division
- Cat Hai Representative

Broadly they engage in three major spheres of responsibilities:

- Maritime Administration;
- Maritime Safety Management; and
- Maritime Security Management.

There are seventy Maritime Administration staffs to support those activities.

The Maritime Administration in Vietnam has a little engagement in the "port administration" except port and fairway traffic control, vessels' entry and departure formalities and collection of Tonnage Charges, Maritime Safety Assurance Fee as prescribed by the law on Maritime Charges, Fees and the Table of Maritime Charges and Fees, MOF Decision No: 98/2008/QD-BTC. The Maritime Administration pursuant to the Decree No.172/2007/ND-CP shall collect pilotage.

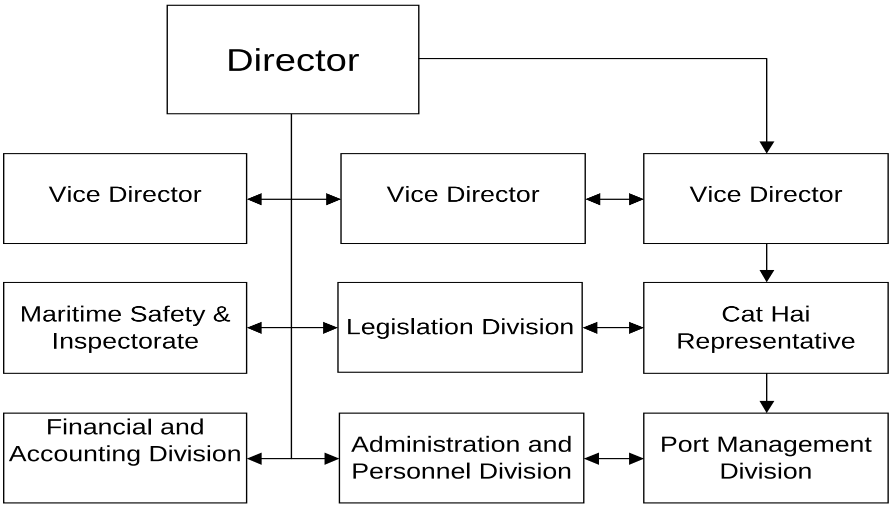


Figure 20.9.2 Haiphong Maritime Administration

20.10 Upgrading Port Management Capability

The country has so far relied on the public service port model where the State invests in the infrastructure and assigns a SOE to manage and operate the ports. The government has got remuneration in the forms of tax and investment capital recovery. Such a port management scheme little contributes to utilizing non-State sector strengths including a joint stock company and a joint venture enterprise.

In order to fully utilize such potential resources of the private sector, Vietnam needs to establish a competent port management unit that engages in the supervision and coordination of the entire port investment project. Very possibly Vietnam would further promote BOT type private participation in anticipating more active investment fund raising by a private sector.

A reshaped port management unit would manage concession contracts as well as protecting port land and water area ownership. Under the current port development, management and operations scheme in Vietnam, there are many stakeholders involved in and seems to be little consistent in the line of management.

20.10.1 Port Authority Model

1) Port Authorities Responsibilities

Generally, a port authority, which is largely responsible for the tasks of construction and administration of port facilities, bears following characteristics and responsibilities:

- It shall be a financially independent juristic person;
- It shall be a public entity in order to protect public interests;
- To provide autonomous management and operation business practices;
- In principle, no financial subsidy is provided from the central, regional and municipal government and no contribution of proceeds to the government bodies;
- To be represented and led by a board of commissioners who are nominated by the Council of Ministers;
- To be empowered to execute administrative decisions that are deemed necessary for materializing port development plan such as land exploitation right, a taxation right.

Japanese Port and Harbor Law defines the role and responsibility of the port administrator as follows:

- Preparation of port development plan;
- Maintenance of port area and port facilities;
- Construction of port facilities and execution of other necessary works;
- Administration and operations of port facilities;
- Management and operations of mooring facilities;
- Designation of mooring facility and fixing their use regulations, reception of vessel entry and departure report;
- Arrangement of fire protection devices and emergency equipment;
- Investigation and research on the port development, preparation of statistical data and public relation activities;
- Water supply and waste oil disposal works;
- Lease of port facilities;
- Regulation for use of leasing port facilities;
- Management and operations of industrial waste disposal facilities and waste oil disposal facilities;
- Arrangement and management of welfare facilities;
- Preparation and publication of public port tariff.

Although it is not specifically delineated in the law, security compliance in accordance with the ISPS requirements is a part of responsibility of the port administrator.

2) Port Authority of Thailand

Port Authority of Thailand (PAT) is regarded as a successful model of port administration body in the South East Asia. PAT was established in 1951 succeeding the Office of the Port of Bangkok as an autonomous body under the general supervision of the Ministry of Transport and Communication and the Ministry of Finance. PAT manages two ports of Bangkok and Laem Chabang Port.

Under the section 9 of the Port Authority of Thailand Act, the scope of powers vested to the PAT is described as follows:

(1) To construct, purchase, acquire, dispose of, hire, let and operate port equipment, services and facilities;

(2) To purchase, acquire, lease, hire, let, own, possess, dispose of or operate in connection with movable and immovable properties;

(3) To determine charges for the use of its ports, services and facilities, and to issue regulations regarding the method of payment of such charges;

(4) To issue regulations regarding safety, the use of its ports services and facilities;

(5) To borrow money;

(6) To dredge and maintain channels in the Authority Area;

(7) To control, develop and provide facilities and safety in port undertakings and navigation in the Authority Area;

(8) To fix the rates of various dues and charges within the Authority Area,

(9) To issue bonds or any other instruments for the purpose of investment;

(10) To form a limited company or a limited public company for the conduct of port undertakings and other businesses within the scope of the objectives of the Port Authority of Thailand, provided that shares of the said limited company or limited public company shall be held by aliens as defined by the law on alien business in the amount of not exceeding forty-nine percent of its registered capital:

(11) To form a joint venture with other parties of to hold shares of a limited company or a limited public company for the benefit of the businesses of the Port Authority of Thailand.

It is noteworthy that the provision contains the specific clause that PAT is authorized to fix the rates of dues and charges. Also it clarifies the basic rules applicable for establishing a limited company or a joint venture to conduct port businesses.

The act also defines the role of Board of Commissioners that represents PAT. It is given the power and duty to lay down the policy, and to control and supervise the activities of the PAT. The Council of Minister appoints the Chairman and the member of the Board and number of member of the Board are not less than six but not more than ten.

Current member of the Board of Commissioners are nine from the Marine Dept, Customs Dept, Federation of Thai Industries, Thai Oil Power Co. Ltd, National Defense Studies Institute, scholars from various universities and from the Prime Minister’s Office. PAT’s experience may constitute a good guideline when GOV tries to reform a port management system.

As discussed PAT is not engaged in the cargo handling operations at LCP. It is a typical landlord type management style in that PAT provides basic port infrastructure and superstructure and terminal lessee installs mobile cargo handling equipment in most cases. Instead PAT is involved in the administrative and regulatory matters to maximize private sector participation and to coordinate their activities for the purpose of protecting port customers for the benefits of Thailand national economical expansion.

PAT’s organization is as per Figure 20.10.1.

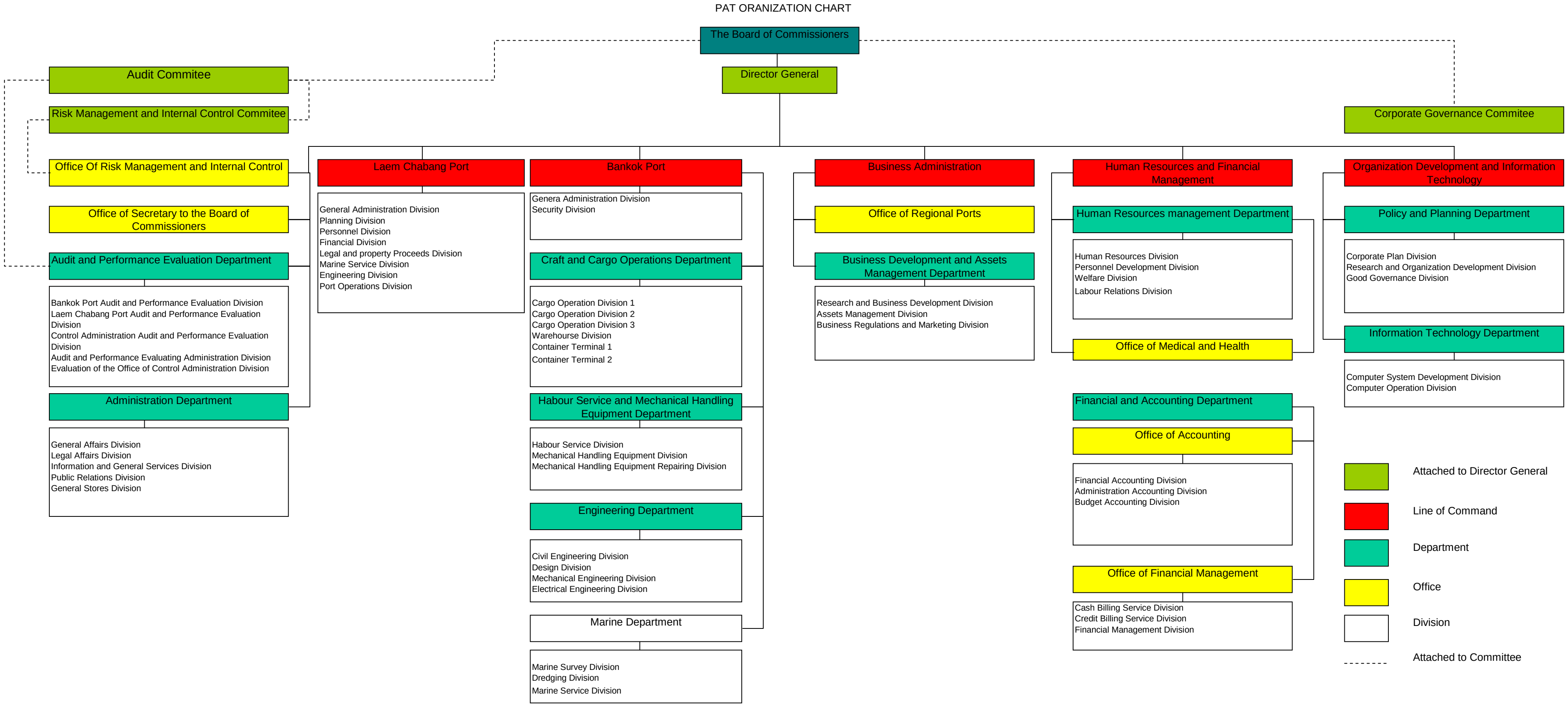


Figure 20.10.1 PAT Organization Chart

20.10.2 Port Administrator's Role

One of items to be considered when the port administration reform is going to be taken place is an involvement of a port administrator in the port tariff decision process. Admittedly as a port plays a critical role in the development and expansion of nation's economy, providing a stable and efficient port services are prerequisite for a growth assurance. The development of sound port infrastructures is fundamental factor for building up a reliable logistical support networks.

Another paramount importance for the economy is the cost burden on the port customers that should be fair, reasonable, stable, predictable and competitive enough to assure an economical and dependable transportation system in the port.

It is not unpopular to include in the responsibilities of the port administrator to intervene whenever the port service rates quoted by a port operator tends to fluctuate unrestrictedly. Through this administrative corrective action by a port administrator, the port service rates remain on the certain steady and reasonable level that would eventually help both the port service providers and port users as well.

A port administration body, as a state enterprise, must act not only to protect the national properties as its intrinsic government enterprise responsibility, but also try to guard the port customers, shipping lines, exporters and importers as well whenever they are going to be exposed to unreasonable rate pressures from the port operators.

It may not be the case as long as the competition mechanism works as expected and market oriented pricing rule is observed. Port customers are allowed to choose competitive rates through a rate negotiation. The participation of SOE in the form of joint venture with other commercial companies as in the case of Lach Huyen port, for an example, may work to restrict a predatory rate action by a private operator, which is regarded as one of deficiency caused by port privatization due to monopolistic way of business practices of private port entities.

It is a universal rule that a prime business objective of the private sectors is the maximization of their profits and sub-optimizing port customer's interests. As Vietnam tries to rely on more foreign investment to cope with shortage of domestic funds, more influential foreign capitals intends to participate in the fundamental infrastructure works through BOT, BOO and similar fund mobilizing methods.

20.11 Port Management Body (PMB)

Current responsibility held by the Maritime Administration at Haiphong Port is limited in its scope that covers almost the harbor master function in the other similar ports abroad.

The JICA report on the "Final Report for The Port Development Study in the South of The Socialist Republic of Vietnam" dated December 2002 has recommended establishing a new form of

PMB, which will bear broader responsibilities and duties over port operations that cover following area such as:

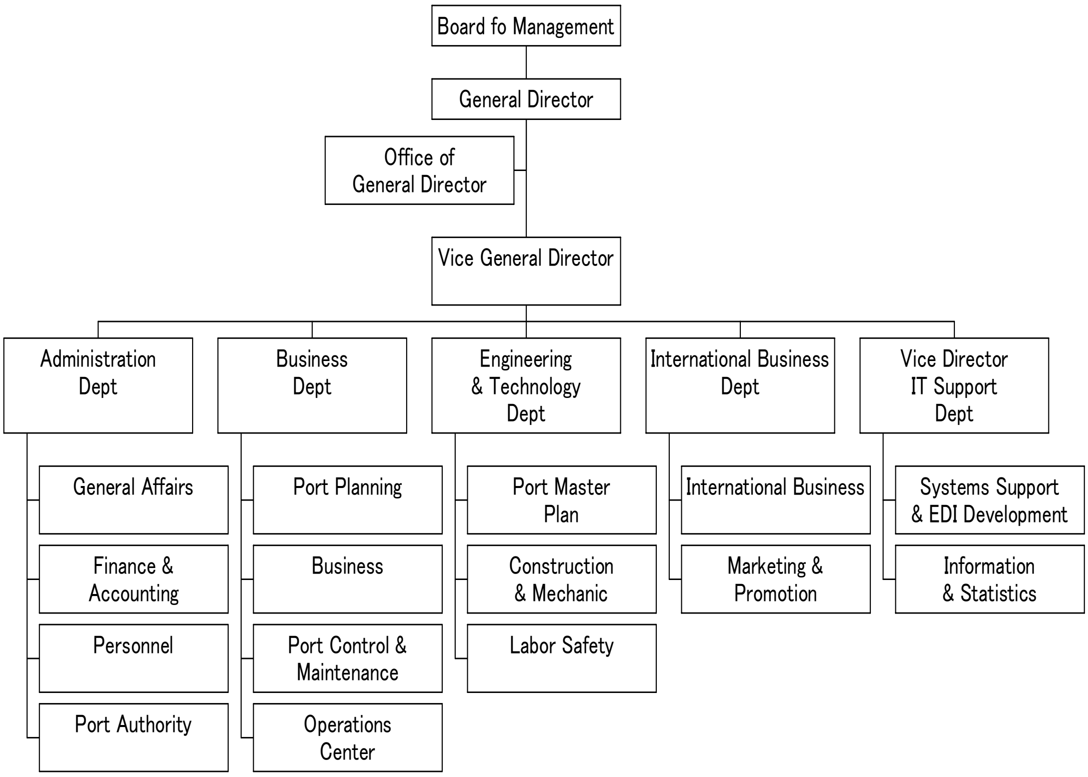
- Ownership of port assets including land and equipment,
- Long term/Medium term port development plan,
- Execution of port development plan,
- Construction and improvement of additional port facilities,
- Management over port businesses,
- Port tariff governance, and
- Conclusion of lease or concession agreement.

It is not an easy task to reform a port administration system since many relevant stakeholders have involved in the port management scheme in this country. Hesitations from those who have various kinds of interests in the current port management system may persistently emerge. An establishment of streamlined port system, however, under a straightforward line of management is indispensable challenge for GOV to deal with the future for more open foreign investment and participation in the Vietnam port industry.

In dealing with a lack of effective port management system in the current administrative framework and looking for great growth opportunities of the Lach Huyen port, a TEDI study also recommends to set up a Port Management Unit.

It says in I 1.2.4.1 under the title of "The Organization Structure of Port Management Unit" of the TEDI's Feasibility Study on "Haiphong Lach Huyen Gateway Port Construction Investment Project that "To gain high effect of administration management and port exploitation, management, a Management Unit should be formed. There is an organization under the steering of Board of Directors and functional departments who in charge of daily management and exploitation activities. Board of Management is main factor to set up Management Unit effectively, independence of finance and following the development directions of branch, region and to be under the supervision of Vietnam National Maritime Bureau (VINAMARINE)".

Undoubtedly it should be a right direction and is recommendable to organize such Port Management Body. A proposed organization chart is as per Figure 20.11.1. The scope and size of Port Management Body should be adjusted and modified in accordance with the progress of phased development of the Lach Huyen port project.



Source: SAPROF Team

Figure 20.11.1 Proposed Port Management Body

As described heretofore, the size and scope of the PMB organization depends largely on the port reform challenges by VINAMARINE for streamlining port administration and management system as well as the progress of the Lach Huyen port development. VINAMARINE has worked out a comprehensive reform plan under the technical assistance of JICA on improvement of the Vietnamese port management system in November 2008. It is strongly advisable to follow the direction identified in the study in order to enhance and improve port management capability that is essential prerequisite for accomplishing a Master Plan on the development of Vietnam's seaport system for 2020.

20.11.1 PMB Organization

Followings are job descriptions of the divisions proposed by the study team for a new PMB.

1) Administration Division:

a) General Affairs;

Responsible for general affairs matters concerning PMB and shall assume a coordinating function to adjust businesses handled by the other PMB divisions.

b) Finance and Accounting;

Dealing with financial matters of PMB including the collection of facility rentals,

Budget compilation,

Management of the incomes and disbursements.

c) Personnel;

Management of human resources including recruitment and staff training of PMB personnel.

d) Port Authority;

Representing public sector to deal with private sector enterprises to protect public interests,

Assuming ownership of infrastructure and port assets and their administrative management,

Overseeing maritime safety in the port including activities vessels traffic management,

Port security including fire fighting, dangerous cargo storage, international requirements in respect of the ISPS codes.

Implementing the environment protection.

2) Business Division:

a) Port Planning;

Making up a port development plan in accordance with the national port development master plan and in coordination with the relevant central ministerial agencies.

b) Business;

Negotiating a berth lease/concession contract and execution of an agreement,

Conclusion of the lease/Concession contract,

Selection of a terminal operator,

Port tariff management to ensure competitiveness of the port.

c) Operations Center;

Overseeing and controlling operations of each port facility,

Coordinating overall operations activities to maximize port capability,

3) Engineering and Technology Division:

a) Port Master Plan;

Preparing a short term overall port maintenance schedule.

b) Construction and Mechanic;

Responsible for construction, expansion and renovation of the public facilities,

Overseeing maintenance works handled by the facility lessees to protect public interests and for integrity,

c) Labor Safety;

Supervising labor practices to assure no labor casualties.

4) International Business Division;

a) International Business:

Maintaining an international relationship with other foreign ports and port industry organizations,

Participating international conventions, conferences and agreements in regard to the port administration and management.

b) Marketing and Promotion:

Promotion activities to invite additional port customers, shipping lines, cargoes, logistics businesses into the port.

5) IT Support Division;

a) Systems Support and EDI;

Providing IT support and facilitating EDI networks with port related governmental agencies and port users.

b) Information & Statistics;

Establishment of IT based port statistics collection system.

As long as Luck Huyen Container Berth 1 and 2 are concerned it has been decided that the MPMUII is assigned to execute the project until the completion of the ODA project in 2015 and VINALINES and its JV companies are appointed as a terminal operator, it is recommended for VINAMARINE and their regional agency to form a preparatory department with about 50 staffs to work out a concrete and realistic plan in order to set up an effective PMB organization for Lach Huyen middle term project that includes 5-6 container berths and 3 multi-purpose berths aiming at being operational in 2020 in full swing.

If it is intended to follow PAT as a model case for the landlord type port administration and management scheme it may need about 200 PMB staffs to fulfill responsibilities.

A size of PMB depends on;

- The scope of responsibilities which a PMB will cover,
- The size of port and a type of berths, public general cargo berths, dedicated container berths, passenger, bulk cargoes, industrial private berths, vehicle, etc.,
- The amount of cargoes in tonnage or TEU,
- Share of responsibilities between public and private in case of lease/concession contract,
- Either to execute the technical engineering works by own PMB employees or by contracting out to outside,
- Use of IT technology to rationalize daily routine business.

There is no universal benchmark for a size of staff to be employed by a PMB. At Laem Chabang that is referred as a model case of the typical landlord container port in this study employs about 200 to handle 5.2 Mil TEU containers.

The most significant factor to affect the size of PMB in case of the landlord type container port may be an alternative to carry out the engineering works. In case of Hamburg Port Authority it employs 439 engineering mechanics and skilled labor for maintenance dredging and other civil engineering works over road, bridges, embankment, etc. of public facilities out of total 1,716 PMB staffs. Port of Rotterdam on the other hand has only 10-11 engineering staffs who engage in the inspection and supervisory role over the contractors that are hired to do pubic facilities maintenance works.

Yokohama Port and Harbor Bureau has 316 total staff including 127 engineering staff. Yokohama Port Development Public Corporation which specializes to administer and manage 10 container berths and 8 general cargo liner terminals has 42 staffs.

The size of PMB varies by port by port and is not liable for comparison.

For an initial period current MA may take care of PMB functions under the present laws and regulations for the time being but for an implementation of full responsibilities it should need a specific legislative framework to justify the rights and obligations of PMB.

21. Collaboration between Public and Private Sector

21.1 Basic Demarcation

Basic demarcation between pubic entity and private side on the construction of Lach Huyen port is laid out in the Decision No. 3793/QD-BGTVT dated December 22, 2008. This baseline has been clarified further in the MOM of July 23, 2009 signed between MOT, MPI, VINALINES and JICA that the reclamation and soil improvement works for the Berth One and Two should be incorporated into the scope of the Project (public investment portion) while alignment and embankment would be conducted by under the private investment portion.

As discussion is still underway between VINAMARINE, the project owner of public side investment and VINALINES and its Japanese JV candidates, there would be various alternatives for investment demarcation.

Table 21.1.1 Demarcation between Public and Private Sectors

	Baseline	Alternative 1	Alternative 2	Alternative 3
Vessel Channel	●	●	●	●
Vessel Turning Basin	●	●	●	●
Breakwater	●	●	●	●
Sand Dyke	●	●	●	●
Port Service Road/Bridge	●	●	●	●
Berth Construction	○	○	●	●
Reclamation/Soil Improvement	○	●	●	●
Container Yard	○	○	○	●
Buildings (Gate/Admin/M&R)	○	○	○	●
Water/Power Supply/Sewage	○	○	○	●
QGC	○	○	○	●
Other CHE	○	○	○	○
CIQ Offices	-	●	●	●

Note: ● Public Investment ○ Private Investment

Base Case is as per Decision 3793 while Alternative 3 can be seen in a typical lease contract where a public administrator provides all the facilities and CHE except movable CHE.

There is no universal division of investment responsibilities for port development. It depends on the financial capabilities of the public side, political implications in accordance with the government policy, commercial willingness and intention on a part of a private investor.

If a commercial private investor wishes to hold a dominant decision making power in respect of terminal management and operations, a private investor may try to invest more in the facility and equipment to gain a hegemony. A lease fee imposed by a public entity might be pegged lower, in this case, due to less investing burden made by a public side.

In view of pure financial consideration, the use of governmental ODA loan is beneficial for reducing total project costs lower due to a marginal interest rate and deferred repayment schedule applicable in the official loan to an initial grace period.

21.2 Private Investment in Seaport Construction

Vietnam Maritime Code stipulates the terms in regard to the investment in building, management and operation of, seaports and seaports channels that domestic and foreign organizations and individuals may invest in building seaports and seaport channels shall decide the forms of management and operations of seaports and seaport channels under the Article 64.

It further goes on to say that the government shall provide in detail for investment in building, management and operation of seaports and seaport channels.

It clearly specifies a government responsibility to provide detail for investment scope and an investor who contributes to construction funds in accordance with the government decision on the investment shall decide on the forms of management and operation of seaports.

There is no specific legal requirement for a private sector to invest in PPP scheme. It depends on the government decision on the scope of infrastructure that should be invested by a private sector. It is not precluded, therefore that a port that is constructed with whole government fund can be leased out to a private company through an open international bidding process.

In the near future, PPP with BOT, BOO and their variants will increasingly be introduced and become popular method for the construction of container ports in Vietnam.

21.3 Enhancement of Public/Private Collaboration

21.3.1 SAPROF Study Team Recommendation

In order to make the development plan more realistic and effective by taking advantage of public and private partnership, SAPROF team has proposed various recommendations e.g.

- Construction of a Port Administration Building that will house governmental agencies including CIQ (Customs, Immigration and Quarantine) offices, Maritime Administration, Maritime Safety Company, Pilot, and Tugboat companies, etc.

  An accommodation of these governmental agencies in one building should be a first step to further provide a One Stop Service that precludes shipping lines’ agents and exporters and importers from physically running between those offices with paper documents although a real One Stop Service in the modern port is to use a computerized system that enables to share electronically the same information on the ship and cargo among governmental offices;

- Providing a mooring facilities for Port Service Area for tag boat, pilot boats and other small crafts;

- Constructing a 750M berth for a 50,000 DWT ship for full load and a 100,000 DWT ship for partial load in accordance with the team’s demand forecast;

- A 160M width –14M CDL for access channel for the passage of above sized vessels in the belief that forced loss time at outside in waiting for high tide should hold off shipping lines’ motives to deploy mother ships for U.S. West Coast line haul service lane. In view of port competition among neighboring ports a 14M depth in the fairway is a critical prerequisite;

- Reclamation and Soil Improvement should be borne by the public investment, as per Alternative 1 in the Table 21.1.1, due to

a) a great amount of money for the works on the shoulder of the private sector,

b) alleviating heavy financial burden on the private side which would inevitably be passed over to exporters and importers by high port usage costs,

c) relying on the use of lower interest loan, and

d) facilitating works by utilizing STEP loan and coordinating progress with other basic infrastructure works by Japanese undertakings.

21.3.2 Further Collaboration with Private Sector

For the success of this PPP project, a close well-devised work plan is decisively indispensable for both public and private sectors. Possible contention from the private side may include:

(1) A concrete timetable and commitment by the government on the completion of works of the following components that is fatally important for smooth inauguration of Lach Huyen port.

- Land Reclamation and Soil Improvement
- Access channel dredging
- Cat Hai Bridge and Port Access Road

They are integral part of comprehensive development plan. Without a timely completion of the works in a coordinate fashion, the real aim of the Lach Huyen development plan i.e. providing efficient port service with reasonable costs might unjustifiably be affected. A synchronized coordination between public sector and private sector is a key for success of this project.

(2) An introduction of Berth Three and Four should be adjusted in order to ensure sound throughput growth at Berth One and Two. The insistence by the private investors of first two berths is that unless the container volume at Berth One and Two exceeds certain planned level or otherwise subject to negotiation with JV operation company, the government should not commence construction of Beth Three and Four;

22. Mitigation Measures for Environmental Impacts

22.1 Natural Environment

The project component as the implementation plan as ODA (by 2015) is the initial phase of the Medium Term Development Plan until 2020. The most significant aspect of this plan from port operational view point is only container terminal to handle “clean” container cargo will be provided. (Multipurpose terminal to handle general cargo will be the part of future plan including the provision of additional container terminals). Still, the overall construction work requirement of this plan (2015) is quite similar to the year 2020 plan though of rather smaller scale. Accordingly the construction stage environmental impacts and mitigation measures are basically same as described under Section 13.1.1 of Chapter 13.

Even regarding operational impacts and mitigation measures, they are quite similar to that described under Section 13.1.2 of Chapter 13, except for the fact that potential for air pollution due to cargo handling related fugitive emission is virtually eliminated as only container is handled. Accordingly relevant salient features of environment mitigation measures described in Section 13.1 of Chapter 13 are summarized below with emphasis on important mitigations measures.

22.1.1 Construction Stage Mitigation Measures

1) Sourcing of Materials for Construction of Port Facilities

The proposed construction plan for the project duly confirmed that the procurement of all required natural resources for construction could be supplied by legally certified suppliers located close to project site in Hai Phong and nearby Hai Duong areas. The construction contractor shall ensure all construction materials are procured from legally certified suppliers.

2) Dredging and dredged material management

The proposed dredged material disposal site at Nam Dinh Vu area as shown in Figure 16.1.5 of Chapter 16 has sufficient capacity to accommodate the entire dredged material derived (33 million m3) that is not contaminated. Still its availability during actual dredging works can not be guaranteed since this area is targeted for land reclamation to be an industrial estate.

Since offshore disposal seems to be the most viable alternative option, environmental effects and mitigation measures of offshore disposal may be studied as component of change in design of dredging works of the detailed engineering design and the relevant additional (supplementary) EIA Report shall be formulated for approval by MONRE prior to the start of construction works. Alternative study on offshore disposal is expected to require 6 months.

The proposed offshore location for alternative study on dredged material disposal is Bac Bo Bay area (Refer to Figure 16.1.5) located in between the planned Sand Protected Dyke and Do Son with water areas having depth of at least 20m. Being located at offshore of Bac Dang Estuary this area is expected to have relatively high natural turbidity and regarded as most suited area for alternative study on offshore disposal of dredged material and hence to select the most suitable location.

3) EHS Aspects of Construction Works

Due diligence to ensure implementation of necessary environment, health and safety (EHS) measures in integral manner during the execution of the construction works by the construction contractor (also referred to as proper construction management or good construction practice) need not be overemphasized considering also the location of the construction works in offshore area. Contractor as the first priory shall ensure the safety of his construction works and workers with strictly in compliance with “Safety First” concept that would also include mandatory use of necessary personal protective equipment/PPE. Navigation safety of transport barges of construction materials with proper scheduling is also very important. Moreover, all wastes generated due to the construction works including living wastes has to be managed sanitarily and treated as appropriate so as not to cause water pollution and in the sensitive offshore area of the construction site located near Cat Ba Island and to maintain the cleanness of the work environment. This also includes due focus on 3R (reduce, reuse and recycle) with segregation and management disposal of solid wastes generated. Fugitive (dust) emission from stock piles of sand and others need to be duly controlled with water spray or vinyl sheet covering as appropriate. Moreover, all construction machinery and equipment should be in good workable condition and meet the air emission standard requirement.

Contractor shall conduct (contractor may be obliged to conduct) periodic regular environmental monitoring in both on-land area of Cat Hai Island and offshore area of the construction site at Lach Huyen Estuary by using the services of an independent reputed organization to conduct all such environmental monitoring related sampling and analysis work.

A tentative environmental monitoring program (plan) as updated in the SUPPLEMENTAL EIA Report study by the SAPROF is given in Appendix 13-1. This tentative plan shall be reviewed and reformulated in detailed engineering. The reformulated environmental monitoring plan for construction stage will be duly included in the technical specifications and contract tender documents in accordance with the 2 relevant contract packages (dredging works and port terminal cum related facility construction works) as proposed in Section 17.4 of Chapter 17.

22.1.2 Operational Stage Mitigation Measures

Comprehensively, the required overall environmental mitigation measures could be categorized as EHS (environment, health and safety) of port operational management, in reality container terminal operational management for this initial phase of the project by 2015.

1) Port Operational Safety

Overall operational safety including the safety in container cargo handling work and work force (stevedores and others) is very important. In addition navigational safety of ship and vessels is the important aspect of access through navigation channel and subsequent berthing. The required navigational safety and vessel traffic control is described in Chapter 23. Moreover, the necessary facilities and resources to deal with emergency situation like vessel accidents including accidental oil spills (that might occur in rare instance) need to be provided and ready for action at short notice as the emergency management system of the port operation. These are essential technical requirement to be met for effective port operational management.

Still, this project at this stage will handle only container cargo and even by 2020 only general cargo will be additionally handled. So no oil terminals to handle significant (and large) quantity of oil as cargo (oil tanker vessels) and also significant noxious liquid cargo in bulk form is involved. So there is no possibility to encounter large scale oil spills.

In this respect, even in future, provision of oil terminal facility in such a sensitive coastal water environmental area need to be carefully investigated along with alternative sites elsewhere since the risk of ecological damage caused by potential accidental (and large-scale) oil spill consequent to oil tanker vessel accidents to the protected coastal marine environment of Ha Long and Lan Ha bays located near the port (and also to tourism), could be very severe even with the provision of all the necessary facilities to handle potential oil spill as significant component of emergency management system of port operation.

2) Port waste management

Considering the proximity of the port to Cat Ba Island (with its Cat Ba National Park, protected area) located basically at a distance in the range of only about 1 to 3 km away from the port across the Lach Huyen Estuary, effective management of all wastes generated both consequent to port (container terminal) operation and ship berthing activities is utmost important.

Container cargo is clean and hence there is no potential air pollution directly due to cargo handling. All machinery, vehicles and equipment in the port in particular container trailer trucks shall be in good operational condition and meet the air emission standards. Under such condition good ambient air quality in the port located near topographically favorable offshore area could be duly attained.

In this respect the necessary waste reception, treatment and disposal systems shall be incorporated as integral component of the port design. The waste reception and treatment facilities as also incorporated in the approved EIA Report include sewage treatment system to treat both human waste generated due to port (container) terminal operation and also that disposed by berthing ships (waste corresponding to Annex IV of MARPOL 73/78), waste oil reception facility to receive oily bilge waste from berthing ships (waste corresponding to Annex I of MARPOL 73/78) and solid waste (garbage) reception facilities to manage both solid waste generated due to port terminal operation and also that disposed by berthing ships (waste corresponding to Annex V of MARPOL 73/78).

The effective operation of these waste reception facility in the port shall be complemented with an effective surveillance system to mitigate illegal dumping of wastes by ships (with high levy as fine to deter illegal dumping) within the port waters and its vicinity.

The above environmental protection and mitigation measures focused on the EHS of overall port operation shall be complemented with the implementation of regular periodical port environmental monitoring focused at least as the first priority on the monitoring of surrounding estuarine coastal water environment of Lach Huyen Estuary. A tentative port operational environmental monitoring plan is included in the EIA Report (2008) that is further updated in the SUPPLEMENTAL EIA Report formulated by this SAPROF and given in Appendix 13-1. This tentative environmental monitoring plan needs to be reviewed and reformulated during the detailed engineering.

3) Maintenance dredged material management

The waste management system for the port operation would also include effective management of periodical maintenance dredged materials. Periodic maintenance dredging would be necessary in the access channel to ensure continuity of design navigation depth and hence to ensure navigation safety of vessels. As far as possible near-shore disposal as practiced currently in the existing Hai Phong Port will be continued including those in the communes as proposed in the EIA Report and shown in Figure 16.1.5 of Chapter 16 though those locations are rather far from the port requiring high transportation cost. Moreover, other potential beneficial uses such as ecological restoration of coastal areas and wetlands of Bach Dang Estuary also recommended. Nam Dinh Vu area is regarded as no longer available by the time of the port operation since land reclamation for industrial estate is expected to be already completed by that time.

Since the proposed port is expected to expand its facilities in the future, it is highly recommendable to consider “Sustainable solution” for the dredged material management. For the limited time flame for the initial two (2) container terminal and a common berth, it is recommendable to utilize the permitted dump site, but other sustainable measures such as:

(1) offshore dumping with appropriate environmental measures to avoid the negative impacts on enclosed waters and surrounding ecosystem,

(2) beneficial use for the estuary/tidal flat creation adjacent to the sand control dyke, which is subject

to provide favorable environment for tidal and coastal organism, especially for juvenile fish and shell fish

shall be considered in the detail design stage.

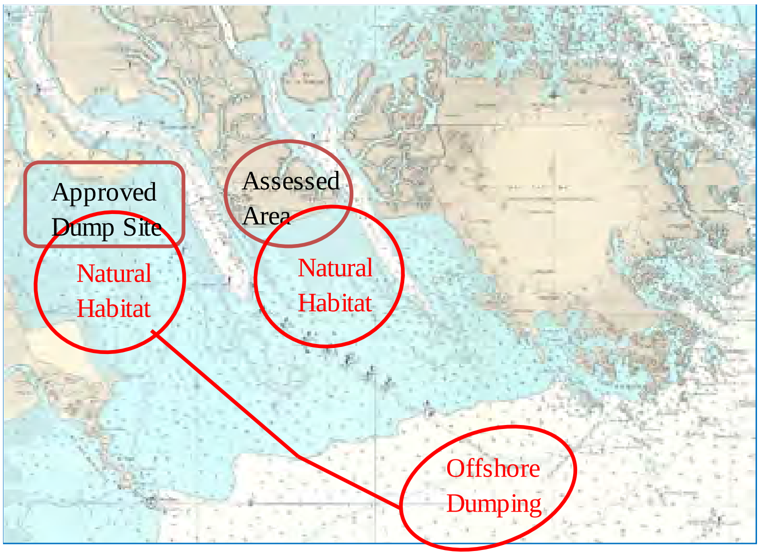


Figure 22.1.1 General Location of the Potential Mitigation Measures

Considering the sustainability and practicability of the offshore dumping, it is economically and practically favorable for the port development. However, careful consideration of the environmental impacts should be studied with substantial number and period of baseline study. With the sufficient studies and appropriate counter measures to reduce the environmental impacts, it would be possible to acquire the approval of the EIA and permission of the dumping.

Considering the beneficial use of dredged material, it would be good opportunity to utilize dredged material as natural habitat restoration rather than costly reclaimed landfill material or no value dumping. Due to the elimination of the coastal mangrove forests for decades in the region, substantial decline of the fish catch has been observed and reported by fishermen in the region. It would be a good opportunity for the Hai Phong City to restore the tidal flat with tidal vegetation such as mangroves, which would be able to add further benefits in the region from recovery of fish catch with sustainable solution for dredged material management. In this respect feasibility of creation of artificial wetland at the rear side of the port terminal facing the Nam Trieu Estuary using the maintenance dredged material as soil conditioner as a means of ecological enhancement in the surroundings of the newly created port is recommended to be studied after commencement of port operation. This option is also regarded as the most economical means of maintenance dredged material management requiring minimum transport of dredged materials.

Since both offshore dumping and tidal flat creation is likely take time to develop reliable design/plan, it is recommendable to consider the utilization of the permitted dumpsite for the initial construction and explore the sustainable management measures for the maintenance dredging. In addition to the detailed dredging plan at the detailed design stage, it is recommendable to analyze the potential options for the sustainable management measures for the maintenance dredging.

22.2 Social Environment

22.2.1 Preparation Stage Mitigation Measures

In addition to the recommended mitigation measures in chapter 4 of approved EIA report (2008) and approved letter of the EIA report (Decision No 2231/QD-BTNMT), SAPROF's recommended mitigation measures for potential impacts on social environment pointed out in Section 13.2 are shown bellow. In addition, SAPROF experts' updated and recommended mitigation measures based on the discussions with MPMU II are also given in "Chapter 4 and CONCLUSION AND RECCOMENDATION" of the SUPPLEMENTAL EIA report (Appendix 13-1). Followings are the summary of the recommendable mitigation measures in social environment as a Japanese ODA project.

1) Land Acquisition

Based on the fundamental concept of the Vietnamese land acquisition policy for the publics' needs, the land acquisition shall be only sufficient level to achieve the objectives of the projects. Based on the discussion with MPMU II, some public facility area (presently salt pan and road) proposed by the SAPROF can be avoidable to sufficiently allocate the public facilities (Figure 22.2.1). Summary of the expected impacts and mitigation measures are shown in Table 22.2.1 and expected cost for the land acquisition is shown in Table 22.2.2 respectively.

Table 22.2.1 Summary of the Expected Impacts and Recommended Mitigation Measures

Present Use	Area (m^2)	Recommended Mitigation Measures
1. Unknown use land between residential building and VTS Station	7,200	There are no sign of land use at this moment so that it is recommendable to acquire the land either it belongs to public or private. The compensation shall be settled by the compensation policy of Hai Phong City (Decision No 130/2010/QD-UBND)
2. Gov. facilities	13,600	It is recommendable to continuously utilize the existing facilities (border control and the VTS station) without major change in facilities and properties. In case of need for land acquisition, it shall be followed by the Decision No 130/2010/QD-UBND.
3. Bare ground along the coast with 5 graves	26,300	This portion is necessary to be acquired for the public facilities. At this moment, there are no sign of land use except 5 graves. 5 graves shall be relocated by the full support of responsible authorities following Decision No 130/2010/QD-UBND.
4. Salt pan	1,500 **Reduced to 0**	It is recommendable to avoid the land clearance since this portion could be avoidable by the rearrangement of the public facilities. VINAMARINE/MPMU II are also agreeable to avoid the land clearance of the salt pan.
5. Aquaculture pond	64,700	This portion is necessary to acquire the land for the public facilities. At this moment, there are no sign of aquaculture usage. The aquaculture ponds belong to the border control office. The compensation shall be settled by Decision No 130/2010/QD-UBND.
6. Forest	10,200	This portion is necessary to acquire the land for the public facilities. The forest belongs to the local community and there are no sign of the environmentally essential species. The compensation shall be settled by Decision No 130/2010/QD-UBND.
7. Road	4,300 **Reduced to 3,500**	Due to the VINAMARINE/MPMU II's preference and possibility of the design arrangement, one of two roads could be avoidable to aquaculture. As a result the necessary land acquisition could be reduced to 3,500m^2. Although both roads will be cut off by the Tan-Vu – Lach Huyen Highway, it is required to maintain the function of the existing two roads connecting between Cat Hai TT and Got harbor. Such counter measures shall be prepared by the responsible implementation agency of the highway.

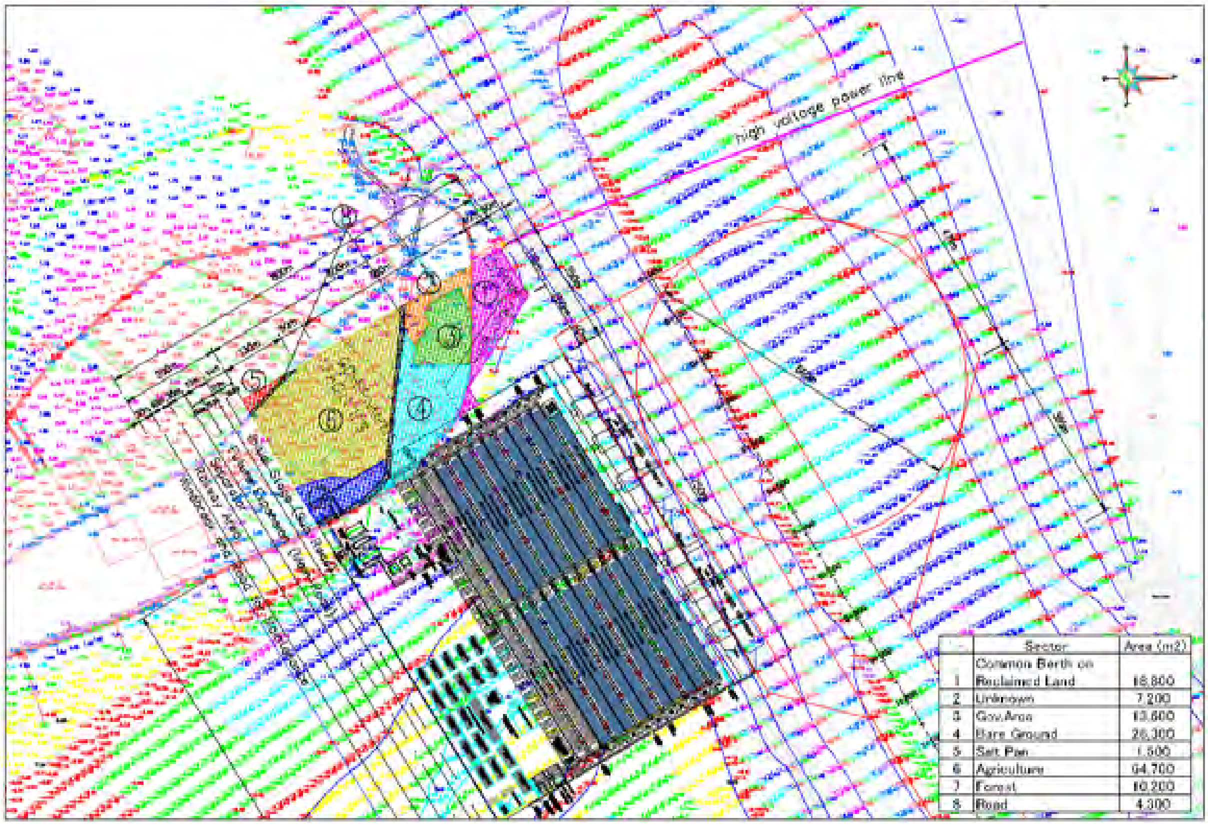


Figure 22.2.1 Present Land Use of the Proposed Public Facility Area

Table 22.2.2 Mitigated Cost of Land Acquisition (SAPROF ESTIMATION)

Present Use	Area (m^2)	Compensation/support Cost (million VND)
1. Unknown use land between residential building and VTS Station	7,200	237.6
2. Gov. facilities	N/A	
3. Bare ground along the coast with 5 graves	26,300	- Land: 867.9 - 5 Graves: 34.5
4. Salt pan	1,500 Reduced to 0	
5. Aquaculture pond	64,700	- Land: 640.53 - Bank creation: 25.0 - Facilities: 1,220.8 - Labor tool: 77.64 - Fence: 20.0 - Pond treatment: 97.05 - Living facilities: 7.0 - Aquaproduct: 679.35 - Labor: 7.12
6. Forest	10,200	- Land: 67.32
7. Road	3,500	3,500.0
Total		**7,482 (Thousand USD441)**

There are three items (graves, aquaculture ponds, bare ground) belong to private property or economic activities, which shall be properly mitigated to meet the JBIC Guideline. As there are still some gap between JBIC Guideline/WB OP 4.12 and Vietnamese safeguard policy described in Chapter 9 and 13, we would recommend referring the resettlement policy framework (RPF) of "Northern Delta

Transport Development Project", which is ongoing project by MOT supported by the World Bank. Though the RPF is different donor project, it is reasonable to apply WB OP4.12 due to the consistency of ODA projects' safeguard policy in the same region and same ministry as well as the original reference of the JBIC Guideline.

2) Development and Enforcement of Safeguard Policy for Coastal Fishing Activities

Though there are hardly to provide adequate safeguard measures for project affected fishermen under existing legal framework in Vietnam, it would be required to consider proper consideration for such project affected people to meet the JBIC Guideline. Since fishermen regularly change their fishing location to gain the fishing yields, it is not easy to estimate accurate value of the loss of the catch in the proposed port development area. Following article 16 of WO OP4.12, the best solution for the compensation is not always money. It is actually preferable to provide prolong solution rather than pinpoint money solution. As commonly experiencing in other compensation program in Vietnam, land-to-money compensation is not always successful due to the PAP's unfamiliarity of financial management. Based on the local communities' demands, vocational training for the new job opportunities is preferable for the sustainable solution in the communities.

In addition, unlike aquaculture and other farming activities, there are many immigrant fishermen living on their boats. Consideration for such fishermen is also essential. In order to accurately estimate the potential impacts and necessary budget for the support of such fishermen, we would recommend conducting the fishing survey by individual socio economic experts who do not belongs to any stakeholder of this Lach Huyen port development project. Such survey report shall be referred to finalize the safeguard policy of the coastal fishing.

As requested by JICA, MPMU II and responsible authorities started making efforts to develop reasonable safeguard policies to treat PAP reasonably and meet the Japanese ODA policy. Though there are few legal frameworks to maintain or support the potentially affected fishermen, the people's committee of Hai Phong is actively working on the new safeguard policy development to take care of such project affected fishermen at this moment. Since there are no legal frameworks for such matter at this moment, the Hai Phong PC has requested relevant authorities of Hai Phong city, such as DONRE, department of land management, department of agriculture, fishery and rural development, and department of finance to consider the possible option for such project affected fishermen. Since there is not good enough information to develop a realistic policy, it is highly recommendable to conduct "Detailed base line survey" to understand the reality of the fishing activities and to consider the potential safeguard policy for such affected people.

Although the development of the safeguard policy is not the responsibility of VINAMARINE/MPMU II, both authorities are keen to contribute to such safeguard policies as the project owner and implementation agency of the port development. MPMU II has actively consulted with the people's committee of Hai Phong to meet the requirement of the necessary land delivery with timely manner as well as the commitment of the Vietnamese authorities under the Japanese ODA loan processes. However, due to the new policy development, it is likely to take more than six (6) months. However, in the case of the higher priority matter suggested by appropriate higher authorities, the process might be shortened. In order to acquire the majorities of the project affected fishermen and meet the tight schedule of the port development, it is highly recommendable to develop such safeguard policy as soon as possible and lead smooth transaction of the construction stage. In order to convince the appropriate higher authorities to accelerate such process, JICA or relevant Japanese agency may be able to support such matter by official request form or other means.

Due to the lack of educational opportunity and financial support, majority of the fishermen have fear of occupation change is highly recommendable to encourage such fisherman to participate the supporting program such as vocational training for the potential employment. Based on other emerging countries experiences, improvement of language skill is also effective skill training to adapt new employment opportunities. Based on the Article 22 (Support for job change and creation) of

Decree 69/2009/ND-CP, there are many authorizes involved in the development of such policies, but MPMU II or VINAMARINE shall also make efforts to ensure the development and enforcement of such safeguard policy meet the development schedule of the proposed Lach Huyen port development project. As long as the SAPROF study, the enforcement of such policy shall be the beginning of the detail design stage which would be fall of 2010.

22.2.2 Construction Stage Mitigation Measures

1) Labor safety and community health

Considering the labor safety, proper training and management is essential. As the responsible agency for the project implementation, MPMU II shall include the supervisory mechanism to ensure the contractor's EHS training and enforcement on the ground in the EMP.

As for the control of the transmittable diseases, proper supervision and collaboration with contractors for the health care training are recommendable. Since the self protection is the most effective measures to control such diseases, periodical and continuous efforts to maintain the workers' and local communities' awareness are recommendable. Control of the physical contacts between immigrant workers and locals, such as workers' township, would be another recommendable option to reduce the risk.

2) Socio economic impacts

It is highly recommendable to control the expected sharp inflation of pricing in the Cat Hai island. In order to maintain the affordability of goods for the local communities, it is recommendable to monitor the price indexes and affordability/income level of the local communities. Such monitoring result shall be shared among MPMU II and local authorities to consider necessary measures if it is necessary. Physical separation between local communities and workers community would be a solution for the initial stage by means of sufficient goods supply in the workers' township.

Follow-up for the resettlement would be another important matter in the construction stage. Due to no requirement for the residential resettlement, follow-up for livelihood support should be focused. Although MPMU II is not responsible for the implementation of the safeguard policy, it is recommendable to include a mechanism to check the appropriate implementation of such policy in EMP. If it is necessary to improve such safeguard measures, MPMU II shall coordinate responsible authorities to ensure the effective implementation as the responsible agency for the project implementation.

3) Coastal Fishing

In order to monitor unexpected negative impacts on fishing communities, it is recommendable to conduct periodical sample survey including the fish yield and income level of the project affected fishermen. If it is necessary to provide additional support based on the sample survey result, responsible authorities shall consider modification of the safeguard policy for coastal fishing or additional counter measures such as encouragement of job transfer. In the case of necessity to improve the safeguard policy for the coastal fishing, MPMU II shall coordinate responsible authorities to improve the modified policy as the responsible agency for the project implementation.

22.2.3 Operation Stage Mitigation Measures

For the consideration of the social environmental impacts during the operation stage, monitoring the implemented safety guard measures in the previous stages would be the primary matter in this stage. As a part of environmental management plan (EMP) and responsibility of the implementation agency, MPMU II shall supervise VINALINE and other private operators to ensure the EMP including the proper implementation and follow-up of the safe guard policies described in section 13.2.3.

23. Navigational Safety and Vessel Traffic Control

23.1 Natural Environment

23.1.1 Wind Condition

Table 23.1.1 shows the frequency in occurrence of wind in Hai Phong. The climate in northern Vietnam and adjacent area is relatively calm except for stormy season (from June to November).

The frequency of the wind velocity more than 10m/sec is 2.26%. The prevailing wind direction in the category 10-15m/sec is SSE (37%) and East (24%). Although frequency of strong wind more than 10m/sec is rare, in case of East wind, the vessel drifts to the side end of the channel due to receiving the wind from the side. It is possible to affect to the vessel maneuvering.

Table 23.1.1 Frequency in Occurrence of Wind in Hai Phong

Wind Direction	Wind Force (m/sec)										Total	
	Calm		1.0-4.0		5.0-9.0		10.0-15.0		>15.0			
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
N			432	9.97	132	3.05	4	0.09	0	0.00		
NNE			89	2.05	36	0.83	1	0.02	0	0.00		
NE			241	5.56	63	1.45	3	0.07	0	0.00		
ENE			134	3.09	12	0.28	0	0.00	0	0.00		
E			578	13.35	482	11.13	23	0.53	0	0.00		
ESE			227	5.24	123	2.84	1	0.02	0	0.00		
SE			307	7.09	132	3.05	4	0.09	0	0.00		
SSE			87	2.01	126	2.91	36	0.83	0	0.00		
S			180	4.16	144	3.32	11	0.25	0	0.00		
SSW			21	0.48	51	1.18	13	0.30	0	0.00		
SW			50	1.15	24	0.55	0	0.00	0	0.00		
WSW			4	0.09	0	0.00	0	0.00	0	0.00		
W			36	0.83	3	0.07	0	0.00	1	0.02		
WNW			20	0.46	1	0.02	0	0.00	0	0.00		
NW			155	3.58	15	0.35	0	0.00	0	0.00		
NNW			108	2.49	16	0.37	1	0.02	0	0.00		
Total	204	4.71	2,669	61.63	1,360	31.40	97	2.24	1	0.02	4,331	100.0

Source: Report on Port Capacity Reinforcement Plan in Northern Vietnam: Nippon Koei Co., Ltd & Associates, Sep. 2009

23.1.2 Current and Tide Condition

The current at Lach Huyen estuary is governed semi-diurnal tidal flow. The survey in January 1987 shows that average current speed is 0.3 – 0.5m/sec. It is not so serious to large vessel. But, due to the effects of wind and wave generated flow, the current velocity becomes the maximum speed of 1.0 to 1.2m/sec (2.3knots) at flood as well as ebb tide and may reach to the greatest speed at 1.5 to 1.8m/sec during ebb tides at the river estuaries. It is expected that current direction is alongside the river. It is expected that the influence by current is small because the vessel receives current from head on or following.

Although the current form Cua Nam Trieu affects vessel from side, the current flow is blocked by the training dike that is built from the end of the berth to offshore (abt. 7.6km).

Table 23.1.2 shows that the height of tide at Hon Dau, and Table 23.1.3 shows the height of designed training dike. As these Tables show that the height of the training dike is lower than MHWL and equal to MWL, it is expected that the training dike is under the water when tidal level is high.

In this way, vessels are not able to find the location of the dike under high water level. The deep draft vessels do not go close to the dike due to their draft, however the small crafts have the possibility to go close to the dike. Accordingly, it is necessary to designate the dike with a light beacon for small crafts.

Table 23.1.2 Tidal Range

HWL	CD+3.55m
MHWL	CD+3.05m
MWL	CD+1.95m
MLWL	CD+0.91m
LWL	CD+0.43m

Table 23.1.3 Crown Height of Training Dike

Training Dike	CD+2.0m

23.1.3 Wave Condition

Table 23.1.4 shows the frequency in occurrence of normal wave height at Hon Dau Station (2006 – 2008). Although the wave height that is less than 1.0m occupied 91.4% of occurrence, the category wave height 0.5 - 1.0m occupied 47.1% of occurrence. In this category, the wave in the East occupied 54.6%. It is not so serious maneuvering for a large vessel.

Table 23.1.4 Frequency in Occurrence of Normal Wave Height by Direction

Wave Direction	Wave Height (m)										Total	
	0-0.25		0.25-0.5		0.5-1.0		1.0-1.5		>1.5			
	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%	Nr	%
N			3	0.09	57	1.74	8	0.24	1	0.03		
NE			0	0.00	47	1.43	16	0.49	0	0.00		
E			184	5.60	844	25.71	63	1.92	5	0.15		
SE			37	1.13	429	13.07	89	2.71	6	0.18		
S			4	0.12	149	4.54	75	2.28	13	0.40		
SW			0	0.00	10	0.30	5	0.15	1	0.03		
W			0	0.00	1	0.03	0	0.00	0	0.00		
NW			0	0.00	10	0.30	0	0.00	0	0.00		
Total	1,226	37.34	228	6.94	1,547	47.12	256	7.80	26	0.79	3,283	100.0

Source: Report on Port Capacity Reinforcement Plan in Northern Vietnam: Nippon Koei Co., Ltd & Associates, Sep. 2009

23.1.4 Fog Frequency

Table 23.1.5 shows the frequency in occurrence of foggy day in Hai Phong. The fog occurrence concentrates in winter season from December to April. The average frequency of foggy day is 21.2 days annum and 6.5 days in peak month of March. Although it is not high frequency in average, it is possible to be in fog when the vessel is passing the channel. Accordingly, it is indispensable to know its definite position, clearance to the side end of the channel, other vessels location, etc.

Table 23.1.5 Frequency in Occurrence of Foggy Day (1984 – 2004)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean
Max	15	9	20	16	3	0	2	0	6	2	5	15	61
Avr.	2.4	4.0	6.5	4.6	0.3	0	0.1	0	0.3	0.2	0.6	2.1	21.2

Source: Report on Port Capacity Reinforcement Plan in Northern Vietnam: Nippon Koei Co., Ltd & Associates, Sep. 2009

23.2 Traffic Environment

23.2.1 Vessel Traffic

Table 23.2.1 shows the calling vessel record of Hai Phong Port in 2006. The record shows 2,960 vessels entered to Hai Phong Port, and the maximum number of the vessel was 277 in month (August and October).

Table 23.2.1 The Entering Vessels Record in Hai Phong Port (2006)

Classification of Vessel Size	Month (2006year)												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
-1,000GT	31	16	35	27	26	29	34	35	34	39	20	9	335
1,000-3,000GT	68	39	54	66	66	64	62	54	46	64	69	57	709
3,000-6,000GT	72	66	57	76	73	74	79	98	76	77	69	76	893
6,000-10,000GT	64	52	74	76	77	71	70	81	81	88	86	91	911
10,000GT-	7	9	11	10	7	14	10	9	6	9	12	8	112
Total	242	182	231	255	249	252	255	277	243	277	256	241	2,960

Table 23.2.2 shows the number of the vessel in August on each day. The table shows the number of vessels in August. August 2nd and 16th are the maximum number of vessels, and in August 2nd, small and middle size vessels occupied relatively, and in August 16th, middle and large size vessels occupied relatively.

Table 23.2.3 and Table 23.2.4 show the number of the vessel in 2nd and 16th in August on each hour. The maximum number of the vessel is at most 4 vessels. Accordingly, it is expected that the conflict with other vessel is relatively small. But the handling cargos and calling vessels are more and more increase in Vietnam. It is necessary to evaluate about efficiency of the vessel traffic in prospective cargo volume.

Table 23.2.2 The Number of Vessel in August By Day

Classification of Vessel Size	Day (August 2006)																															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
-1,000GT	3	3		1		1	3		1		1	2			2				3	1		2	1	3	2	1		2	3			35
1,000-3,000GT	2	4					4	2	3	4	2	2		2	2		1	2	5	1	6	4				1	3	1	2		1	54
3,000-6,000GT	7	5			2	2	3	6	6			4	2	3	3	9	1	2	2	2	3	5	6		4	3	2	2	6	4	4	98
6,000-10,000GT	1	4	4	2	2	2	3		5	4	3	2			4	6	4	2	2	4	4	3	4	3	1	2		1	2	2	5	81
10,000GT-					1	1				1						1		1								1	1		1		1	9
Total	13	16	4	3	5	6	13	8	15	9	6	10	2	5	11	16	6	7	12	8	13	14	11	6	7	8	6	6	14	6	11	277

Table 23.2.3 The Number of Vessel in August 2nd by Time

Classification of Vessel Size	direction	Hour (August 2nd, 2006)																								Total
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
-1,000GT	enter													2				1								3
	leave									1				1												2
1,000-3,000GT	enter		1										1											2		4
	leave																2									2
3,000-6,000GT	enter		1							2							2									5
	leave									1	2								2						2	7
6,000-10,000GT	enter												2							2						4
	leave																									0
10,000GT-	enter																									0
	leave																									0
Total	enter		2							2			3	2			2	1		2				2		16
	leave									2	2			1			2		2						2	11
	Total		2							4	2		3	3			4	1	2	2				2	2	27

Table 23.2.4 The Number of Vessel in August 16th by Time

Classification of Vessel Size	direction	Hour (August 2nd, 2006)																								Total
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
-1,000GT	enter																									0
	leave							1																		1
1,000-3,000GT	enter																									0
	leave										2															2
3,000-6,000GT	enter							2			3						1	1		2						9
	leave									2											2					4
6,000-10,000GT	enter								4													2				6
	leave	2																	2							4
10,000GT-	enter			1																						1
	leave																									0
Total	enter			1				2	4		3						1	1		2		2				16
	leave	2						1		2	2								2		2					11
	Total	2		1				3	4	2	5						1	1	2	2	2	2				27

23.2.2 Activity of Fishing Boats

The fishing activities is catching small fishes by the fixed shore net, the throwing net, the setting bait net and so on around shallow water area. There is no large fishing boat that is catching fishes by the trawl net. The trawl net fishing boats are carried out on offshore. The relative large fishing boats that have the boom with the net from the bow are catching squid, however their operations are not carried out in the channel.

Although basically the fishing boats operations are not carried out in the channel, if they were to work in the channel, the Maritime Administration would instruct directly them to go out from the channel by their boat.

In this way, it does not affect to the vessels that are passing the channel. However, it may have a risk that capsizing of the fishing boats that is operated on close to the channel.

Figure 23.2.1 Fishing Boat in Hai Phong

Figure 23.2.2 Fishing Activity by the Throwing Net

Figure 23.2.3 Mark of the Fixed Shore Net

23.3 Navigation Assistance

23.3.1 Pilot

There are 39 pilots in Hai Phong area (as of April 2010). Table 23.3.1 shows the classification of the pilot. Pilot qualification is divided into 4 classes by their career. The pilot who is able to maneuver to 100,000DWT container ship is the Premier Class (currently 7 pilots available).

The parson who wants to be Maritime Pilot must satisfy some conditions. After graduation from maritime university or college, he should attend the maritime pilot training program. Then he should take part in intern as maritime pilot ClassIII, and after having 300 vessels or for at least 36 months in intern period with at least 150 vessels, they receive certification of maritime pilot competency.

The existing pilot station on the chart is pointed at South of the Nam Trieu Channel (20°40’.0N,106°51’.0E). This point is supposed for the vessels in the Nam Trieu Channel, however, for the Lach Huyen Channel, pilots should embark and disembark at around south of Lach Huyen Channel.

Table 23.3.1 Classification of Pilot

Classification of Pilot	Maneuverable Vessel Size	Maneuverable Vessel Length (LOA)
Class III	- 4,000GT	- 115m
Class II	4,000 – 10,000GT	115 – 145m
Class I	10,000 – 20,000GT	145 – 175m
Premier Class	20,000GT -	175m -

23.3.2 Tug Boat Assistance

Table 23.3.2 shows the number of tug boats in Hai Phong Port. In the current situation, there is only one 3,200HP tug boat in Hai Phong Port.

Table 23.3.2 The Number of the Tug boats in Hai Phong

Port	Tug boat Company	Nos. of Tug	Capacity
Main Port, Chua Ve, Doan Xa, Dinh Vu	Port of Haiphong	2	500 HP
		1	800 HP
		2	1,200 HP
		3	1,300 HP
		1	3,200 HP
Transvina, Green port, Nam Hai	Marina Hanoi & Falcon	2	1,200 HP
		2	800HP

Assistance by the tug boat is compulsory for all vessels except the ones having LOA less than 80m. Requirement on tug boat depends on the vessel length. Table 23.3.3 shows the requirement on tug boat assistance by the vessel length.

Table 23.3.3 Requirement of Assistance Tug Boat

Vessel Length (LOA)	Required Nos. of Tug	Required Tug Power	
80 – 90m	1	500HP	
90 – 110m	2	500HP, 800HP	Total pulling power: at least 1,300HP
110 – 130m	2	800HP, 1,000HP	Total pulling power: at least 1,800HP
130 – 150m	2	1,000HP, 1,200HP	Total pulling power: at least 2,200HP
150 – 160m	2	1,000HP, 3,000HP	Total pulling power: at least 4,000HP
160m -	3	1,000HP * 2 3,000HP	Total pulling power: at least 5,000HP

Following shows estimated required tug power for 100,000DWT class container ship (8,000TEU) when it receives wind from the side.

Table 23.3.4 shows model ship that is assumed in calculation. The model ship assumed actual container vessel that is as large as the designed vessel in this plan. Table 23.3.5 shows result of the force of wind that vessel receives from the side. And Table 23.3.6 shows assumed power of 3,200HP tug boat.

As table indicates, under 5m/sec wind, the force of wind is estimated 25.1ton, this force is less than the usual tug power (85% of maximum power), one tug boat is enough under this wind condition.

However, under 10m/sec wind, the force of wind is estimated 100.3ton, it is required three tugs. In addition, under stronger wind, it is required additional tug.

Actually, a large container ship expects to have the thruster with almost the same power as a large tug boat. Accordingly it is possible to reduce the tug boat, however tug boat is insufficient for the large container ship in the current situation.

Above estimation is static result, hereafter it is necessary to confirm about requirement of tug efficiency (tug power, the number of tug) under the windy condition by dynamic estimation such as the ship-handling simulator.

Table 23.3.4 Model Ship

LOA	337.0m
LPP	321.0m
Breadth	45.6m
Draft	12.7m (UKC10% in depth 14m)
Vessel Side Area above WL	9,458m2

Table 23.3.5 Estimation of the Wind Force

Wind Velocity	Win Force
5m/sec	25.1t
8m/sec	64.2t
10m/sec	100.3t
15m/sec	144.5t
20m/sec	225.7t

Table 23.3.6 Assumed Power of 3,200HP Tug Boat

Maximum Power	Push: 46.0t Pull: 39.8t
Usual Power (85% of Maximum Power)	Push: 39.1t Pull: 33.8t

23.3.3 Vessel Traffic Control

1) Actual Condition of Vessel Traffic Control in Vietnam

The vessel control in Vietnam is basically same in whole area.

Planning of vessel's berth and un-berth schedule is made by Maritime Administration after consulting with port operators and pilots. Under this control, it does not occur that berthing vessels and un-berthing vessels exist at the same time in the narrow sea area. As the control area is wide range, berthing and un-berthing vessels are allowed to pass each other in some areas. Maritime Administration is able to confirm vessels location by the vessel notice position.

There are VTS stations in HCM in southern port of Vietnam and in Hai Phong in northern port of Vietnam. The VTS station in HCM has been not used for long time. It is necessary to replace or to maintain VTS device. The prospects for the investment from government are nothing so far.

The VTS station in Hai Phong was built at Cat Hai island. It has two radars and AIS monitor and some communication devices. The radar was installed few months ago, AIS monitor was installed about three years ago. Now it is used as trial.

2) Actual Condition of Vessel Traffic Control in Hai Phong / Lach Huyen

Planning of vessel's berth and un-berth schedule is made by Maritime Administration after consulting with port operators and pilots. Basically it does not occur that berthing vessels and un-berthing vessels exist at the same time. However, it is allowed vessel's passing in some areas for passage allowance. (cf. Figure 23.3.1)

Although VTS exists in Hai Phong (east part of Cat Hai) at present, VTS system has just been installed and it is used on trial. It has two radars and AIS monitor and some communication devices. However, since the north part of chart data is old, the radars have not been operated in the current situation.

Vessel's berth and un-berth schedule is made by Maritime Administration previously. This schedule is sent to the VTS station twice a day (10:00 / 16:00). If schedule is modified, rescheduled plan is sent to the VTS station by e-mail, fax and so on.

The vessels have obligation to inform their position at three points in Figure 23.3.1. VTS operators are able to know about vessel's location and moving by these information and AIS. Currently two operators work at the station all the time (2days rotation). The operator not only monitors vessels but also gives instructions to vessels when some vessels are close each other.

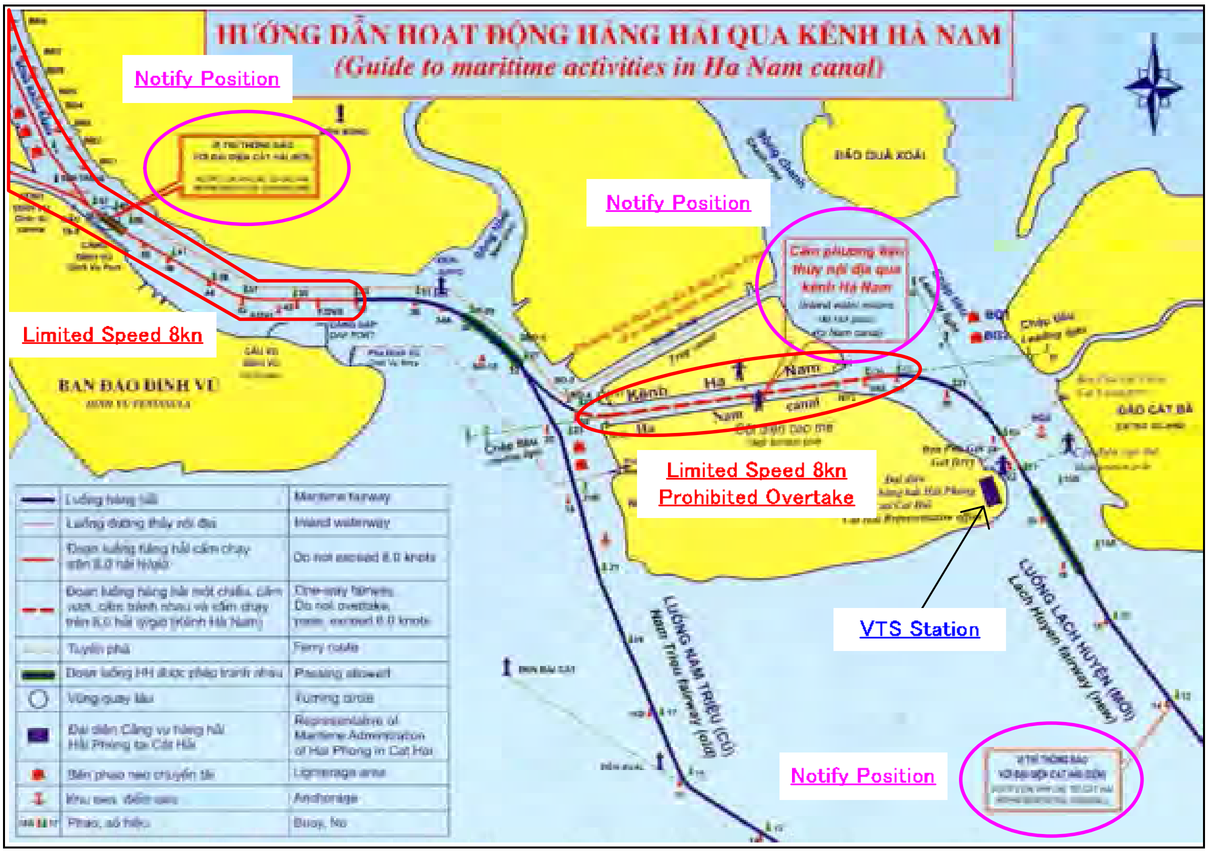


Figure 23.3.1 Guide to maritime activities in Ha Nam Canal

Figure 23.3.2 VTS Station at Cat Hai in Hai Phong

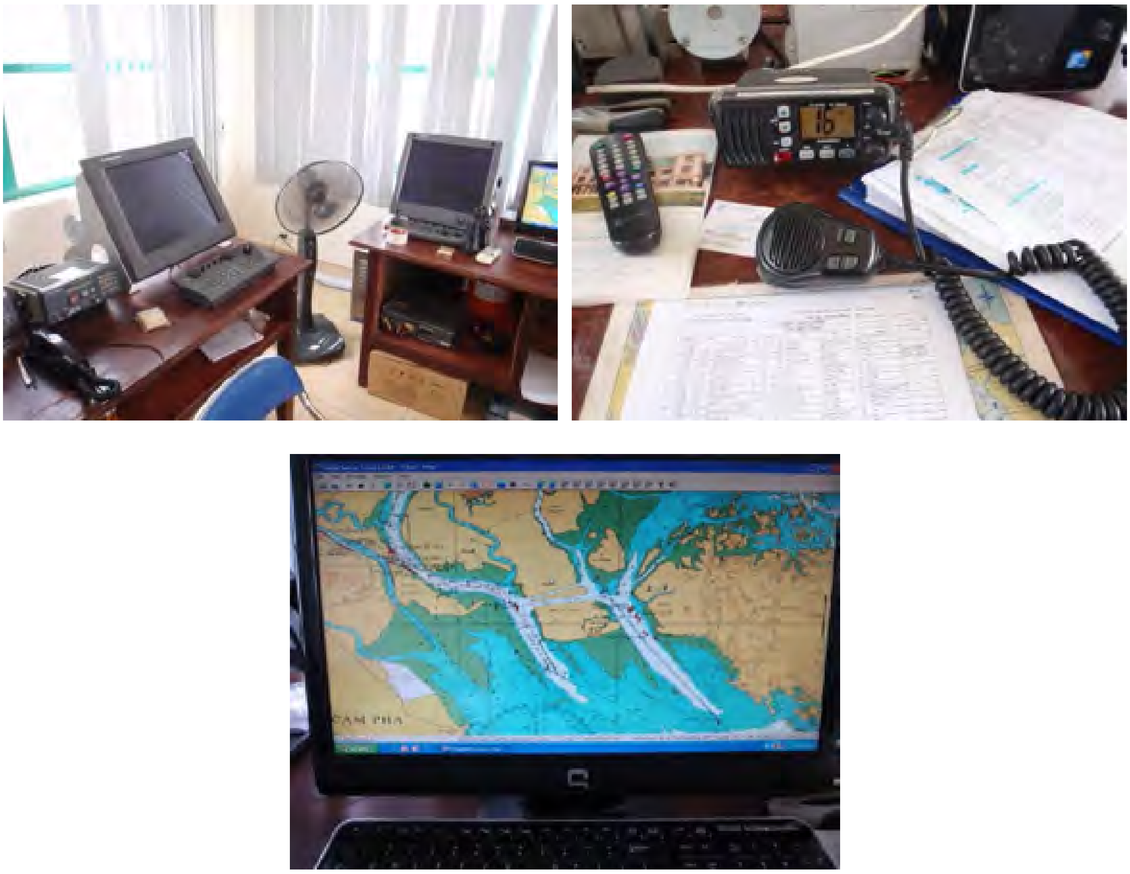


Figure 23.3.3 Radar, VHF and AIS Monitor

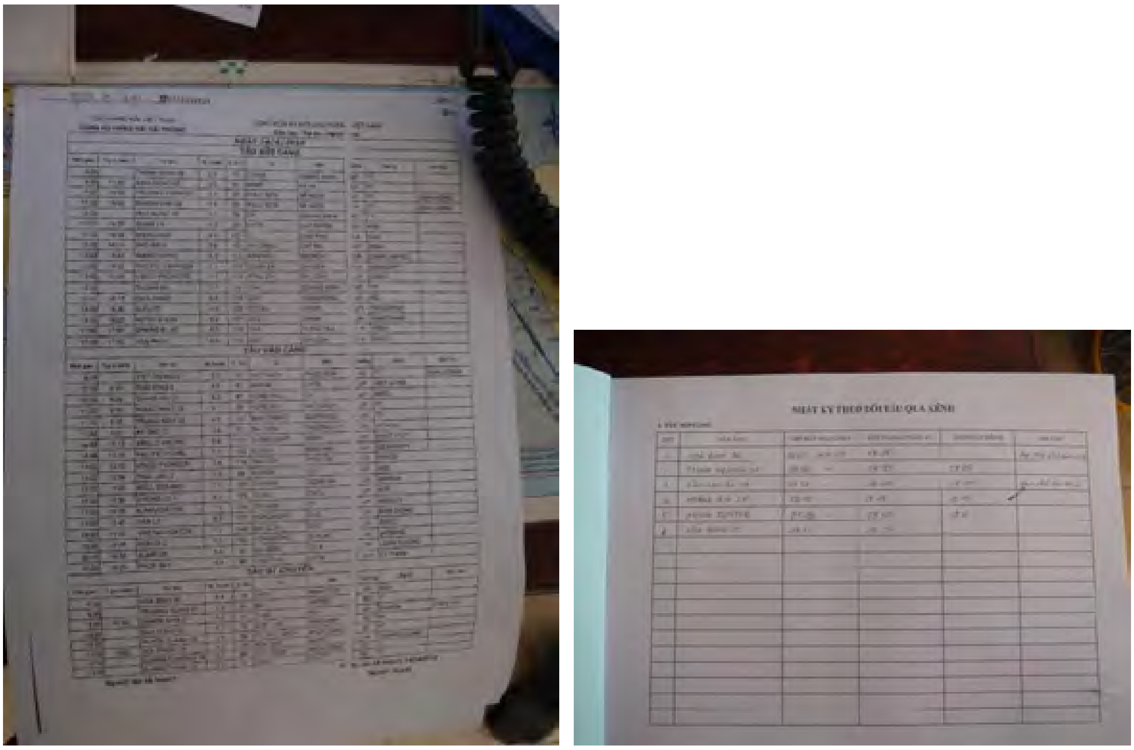


Figure 23.3.4 Checklist of the Berth/Un-berth Time and Checklist of the Vessel's Notice

23.3.4 Buoys in the Lach Huyen Channel

Figure 23.3.7 shows the current location of the buoys along Lach Huyen channel. Along the current Lach Huyen channel, 26 buoys are set on both sides about every 1,600m.

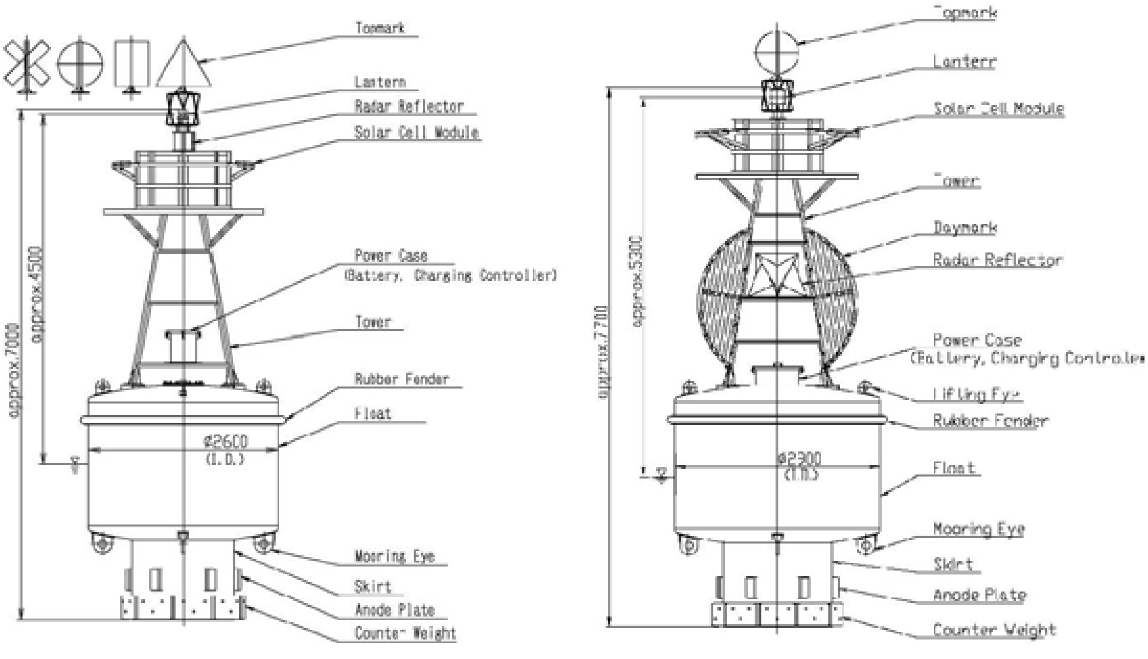


Figure 23.3.5 Buoy in the Lach Huyen Channel

Figure 23.3.6 Buoy in the Nam Trieu Channel

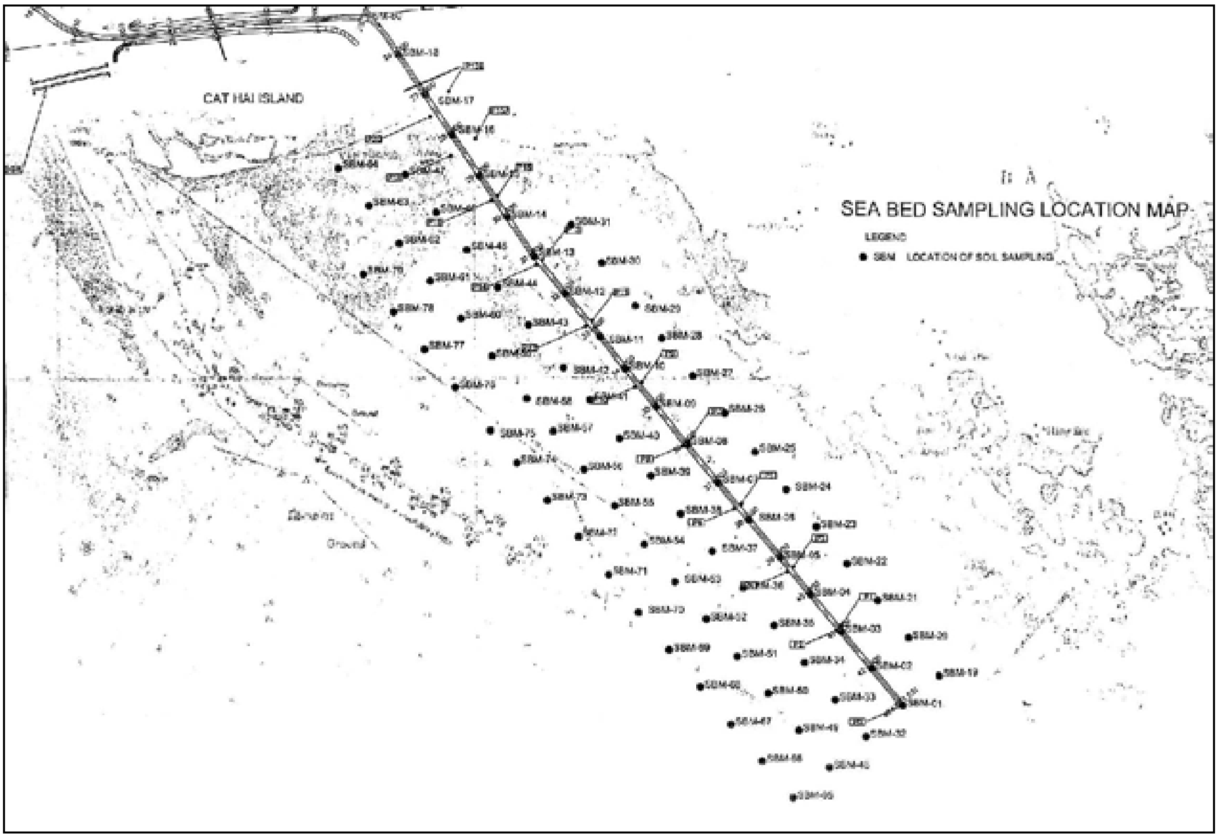


Figure 23.3.7 Current Location of Buoys in the Lach Huyen Channel

23.4 Requirement of Function in Lach Huyen Channel

23.4.1 Buoy in Lach Huyen Channel

A beacon has the role of indicating a boundary, but it also serves as an obstacle to vessels in operation. The passage for a 100,000 DWT class container ship along a designed channel with a breadth of 160m is considered to be a narrow channel with a restricted navigable area of water. Shown below are the functional conditions of a navigational aid:

to indicate the boundary of a channel and turning basin

to prevent vessels from spinning around due to wind, waves, and tidal currents to be capable of being viewed from outside a harbor at night

When the calculations are made in accordance with the Technical Standards of Ports/Harbors, the maximum interval between beacons for a fairway with a breadth of 160 m is 1,250 m as shown in Table 23.4.1. This is the result for a case in which beacons are installed at both ends of a fairway, and it is desirable to provide beacons at both ends of a fairway to minimize positional deviations of the own vessel. However, the smaller the number of beacons the better, as they serve as obstacles to vessels in operation, restricting the navigable breadth of a fairway; and in this connection, beacons are arranged one after the other at one side, and it is assumed that recognition of the positional deviation of the own vessel is dependent on information assistance provided by GPS, etc.

From Table 23.4.2 to Table 23.4.4 show the specification plan of the buoy, and Figure 23.4.2 and Figure 23.4.3 show the location plan of the buoys. The types of existing buoys are the floating buoy, however the floating buoy moves easily by wind and current. In addition, as water depth will be deeper in the future (-14 m), the moving range of the buoy will be wider than the present. Accordingly, it proposes the Spar Buoy that is able to designate specific position of side edge of the channel.

Table 23.4.1 Buoy Interval by Technical Standards of Ports/Harbors

Measure that Recognition of deviation	Buoy Interval	Necessary Route Width
Recognize deviation by buoy	926m (0.50 nm)	134.1m (0.4L, 3.1B)
	1,250m (0.67nm)	159.4m (0.5L, 3.6B)
Recognize deviation by GPS	—	100.8m (0.3L, 2.4B)

Table 23.4.2 Specification Plan of Buoy

Specification		Example
Type	Spar Buoy	Spar Buoy
Light Source	LED	Height: abt.21.0m
Source of Power	Solar Cell	Focal Plane Height: abt.7.6m
Flashing	Synchronized	Weight: abt.5.8t
Luminous Range	more than 4nm	

Figure 23.4.1 Example of Spar Buoy

Table 23.4.3 Cost of Installation New Buoy (Approx.)

		1JPY=VND	**189.39**
DESCRIPTION	Q'ty	VND	JPY
		UNIT PRICE	UNIT PRICE
Supply And Install Navigation Buoy			
Material			
Spar Buoy	1.0		25,000,000
Sinker	1.0	20,218,900	
Equipment			
Equipment for Installation	1.0	37,817,000	
Labour			
Labour for Installation	1.0	7,764,900	
Total		**65,800,800**	**25,000,000**
		(347,428 JPY)	**(4,734,848,485 VND)**

Total for Supply And Install Navigation Buoy / 1Unit	**VND**	**4,800,649,285**
	JPY	**25,347,428**

Description	Nos. of Unit	Unit Price	Total
Installation New Buoy	20	JPY 25,347,428 USD 282,895	JPY 506,948,564 USD 5,657,908

Table 23.4.4 Cost of Replace Existing Buoy (Approx.)

		1JPY=VND	**189.39**
DESCRIPTION	Q'ty	VND	JPY
		UNIT PRICE	UNIT PRICE
Replace Existing Buoy			
Equipment			
Equipment for Collection	1.0	35,694,100	
Equipment for Re-Installation	1.0	37,817,000	
Labour			
Labour for Collection	1.0	4,746,300	
Labour for Re-Installation	1.0	7,764,900	
Total		**86,022,300**	**-**
		(454,198 JPY)	**(0 Vnd)**

Total for Replace Existing Buoy / 1Unit	**VND**	**86,022,300**
	JPY	**454,198**

Description	Nos. of Unit	Unit Price	Total
Replacement of Existing Buoy	3	JPY 454,198 USD 5,069	JPY 1,362,594 USD 15,208

Table 23.4.5 Total Cost of Installation / Replacement of Buoy (Approx.)

Description	Nos. of Buoy	Cost
Total Cost of Installation / Replacement of Buoy	23	JPY 508,311,158 USD 5,673,116

Figure 23.4.2 Proposed Location of the Buoys in Lach Huyen Approach Channel (1)

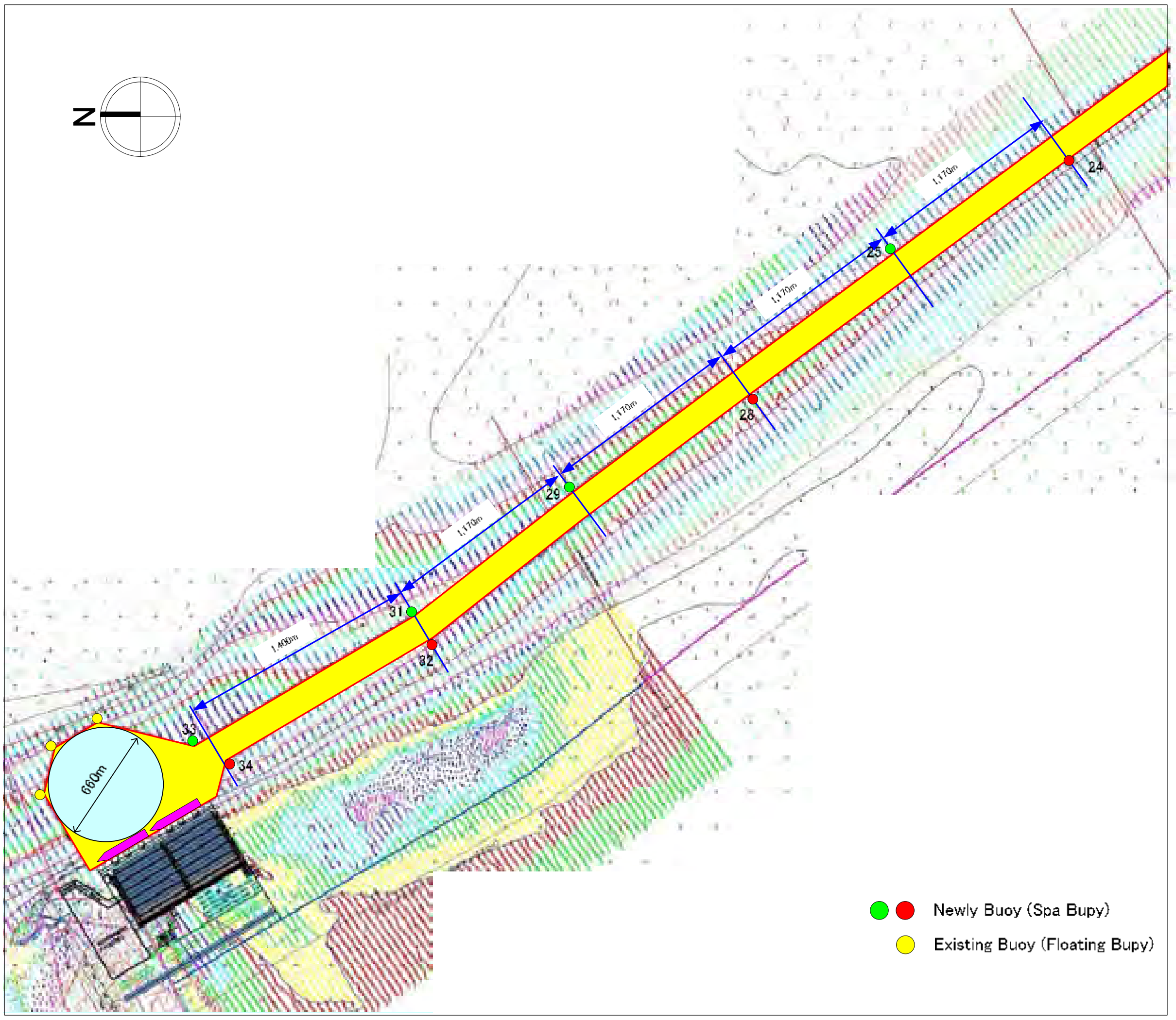


Figure 23.4.3 Proposed Location of the Buoys in Lach Huyen Approach Channel (2)

23.4.2 Installation of Light Beacon on Training Dike

Construction of an approximately 7.6 km long training dike is planned at a position 1,000 m from the edge of the channel. The water depth in fairways other than the Lach Huyen channel is very shallow and passage of a large vessel is impossible, but use of the fairway by small craft and boats may be considered.

Against the height of the training dike, i.e., CD + 2.0m, the water depth at high tide is CD + 3.55m, so the training dike could be submerged and becomes invisible during high tide, thus beacons suggesting the positions of the training dike are necessary. Table 23.4.6 and Table 23.4.7 show the specification plan of the light beacon on the training dike.

Table 23.4.6 Specification Plan of Light Beacon on Training Dike

Specification		Example
Type	Light Beacon	Straight Light Beacon 5m Type
Height of Light	more than 5m	Height: abt.5.43m
Light Source	LED	Height of light: abt.2.25m
Source of Power	Solar Cell	Weight: abt.395kg
Luminous Range	more than 5km	
Installation Interval	2,000m	

Figure 23.4.4 Example of Light Beacon (Straight Light Beacon 5m Type)

Table 23.4.7 Cost of Setting on Light Beacon (Approx.)

		1JPY=VND	**189.39**
DESCRIPTION	Q'ty	VND	JPY
		UNIT PRICE	UNIT PRICE
Supply And Install Light Beacon			
Material			
Light Beacon	1.0		4,000,000
Equipment			
Equipment for Installation	1.0	37,817,000	
Labour			
Labour for Installation	1.0	7,764,900	
Total		**45,581,900**	**4,000,000**
		(240,672 JPY)	**(757,575,758 VND)**

Total for Supply And Install Light Beacon / 1Unit	**VND**	**803,157,658**
	JPY	**4,240,672**

Description	Nos. of Unit	Unit Price	Total
Install of Light Beacon	4	JPY 4,240,672 USD 47,329	JPY 84,813,448 USD 946,579

23.4.3 Installation of Pilot Assistance Device

In a narrow channel with a restricted breadth of navigable water, it is extremely important to instantaneously identify the accurate position of the own vessel within the channel, deviation from planned course, leeway angle, and clearance from the side edge of the channel. Not a few large vessels built in recent years are equipped with an electronic chart system, and a radar provided with multiple functions, but not all vessels are necessarily provided with the most sophisticated equipment: moreover, when approaching a berth, or carrying out berthing/un-berthing operations to or from the berth, the pilot takes command, in many cases, on the bridge wing outside the wheelhouse. In such a case, ship-handling cannot be carried out while viewing information equipment inside the wheelhouse. Further, when beacons are arranged alternately at each side, it is difficult to grasp deviations, and measuring accuracy is degraded.

Accordingly, it is necessary for the pilot who maneuvers the vessel to have an information-assisting system capable of enabling him to acquire correct positional information of the vessel, deviation information, drift angle, distance to the side end of the channel, and the distance to the berth.

Proposed in Table 23.4.8 and Table 23.4.9 are pilot information-assisting systems.

Table 23.4.8 Proposal for Pilot Assistance System

Function of Pilot Assistance System	
Device	Personal Computer
Ship's Location	Use Pilot Cable of AIS device
	If the vessel do not have AIS device, use GPS antenna
AIS Monitor	Use Pilot Cable of AIS device
Chart	ECDIS
Other function	Display vessel wake on screen
	Display vessel information (velocity, lateral speed, leeway angle etc.) on screen
	Display other vessel that has AIS device on screen

Table 23.4.9 Cost of the Pilot Assistance System (Approx.)

Description	Nos. of Unit	Unit Price	Total
Pilot Assistant System	7	JPY 6,000,000 USD 66,964	JPY 42,000,000 USD 468,750

Note: including installation / instruction

23.5 Problems to be solved

(1) The full load draft of a planned 50,000DWT container ship is considered to be approximately 12.7m, and the partial load (80% of full load) draft of a planned 100,000DWT container ship is considered to be approximately 11.8m. Therefore, it is hard to think that the vessel can proceed in the channel with a sufficient under-keel clearance. Under such a condition with a small under-keel clearance, the maneuverability of the vessel is significantly deteriorated due to shallow water effects.

The approach run of the vessel to the Lach Huyen container terminal is featured by a progressive speed reduction as the vessel approaches the berth to the extent that the final speed becomes as slow as 2 or 3 knots. As the vessel's speed decreases, the impacts of wind, waves, and tidal currents increase, making maintenance of vessel's position significantly difficult. Further, on the berth front, turning motions are required (berthing stbd. side to: at entering port; berthing port side to: at leaving port), and strong impacts of wind and tidal currents such as drift currents are received.

Berthing or un-berthing acceptance criteria under strong winds are currently left to the judgment of the pilot. This constitutes no problem by itself, but it suggests that there is a need to judge whether or not ship-handling safety when a 100,000DWT container ship received by this port for the first time can be well verified through, for example, a ship-handling simulator for the entire process of proceeding in the narrow and shallow channel, berthing and un-berthing operations, while receiving shallow water effects, and influences of winds, waves, and tidal currents, and successfully and safely making the final approach to the berth. By making use of the results of verifications, there must be discussions on the required tug assistance for the safe passage of the vessel through the channel, and berthing and un-berthing ship handling, as well as the acceptable limits of critical wind speed, etc.

(2) Operational records for 2006 show that the maximum number of vessels entering the port classified by time belt is four or thereabouts at maximum, and the number of vessels leaving the port is about two. It is therefore considered that there would not be much of a restrictive influence on vessels leaving the port when a large container ship enters. Note, however, that the volume of

cargo in North Vietnam is increasing year by year, and in association therewith the number of large vessels entering the port is also tending to increase.

When using the Lach Huyen container terminal, negative effects such as the need to reduce vessel's speed within the channel, and the required turning motions at the berth front with a consequential longer time occupying the channel must be taken into account as factors extending the waiting times of other vessels. It is, therefore, desired that a study be conducted on operational efficiency, paying due account to a future increase of vessels entering the port.

(3) No fishing operations are carried out within the channel, but in waters near the channel, some fishing operations are conducted, and fix shore nets are arranged in waters in the vicinity. It is feared that these small fishing boats would be vulnerable to the effects of big waves produced by large container ships (effects of ship motions) when they proceed, resulting in the small fishing boats capsizing. Furthermore, when the berth is extended in the future, we are concerned about the mooring effects caused by the motions of a moored vessel and effects of cargo operation.

It is desired that studies be carried out in the future on the effects of the motions of a large vessel and resultant waves produced when a large vessel is proceeding in the channel.

PART – 4

Conclusion and Recommendation

24. Conclusion and Recommendation

24.1 PPP

This Lach Huyen Port Infrastructure Construction Project consists of the port portion and the road & bridge portion, and the port portion was determined by GOV to be implemented by PPP framework. The private portion, construction and operation of container berth No.1 & No.2 will be executed by the responsibility of VINALINES who will plan to form a Joint Venture with Japanese investors and the public portion, other port infrastructures such as land reclamation, access channel dredging, and constructions of port service road, protection facilities, CIQ buildings, service berth, etc., will be executed by the responsibility of MPMU II of VINAMARINE by the GOV's own fund and Japan's ODA loan. This project will be the 1st port development to be implemented by PPP framework for Japan's ODA assistance in Vietnam.

24.2 STEP Loan

The GOV has requested GOJ to provide the STEP (Special Terms for Economic Partnership) loan for implementation of this Project. The terms and conditions of the STEP loan are an interest rate of 0.2% p.a., loan coverage of 85% of project cost, repayment period of 40 years, and grace period of 10 years. In case the STEP loan is accepted by GOJ, the cost of consultant for detailed design is covered by JICA Technical Assistance Grant, which will be applicable soon after signing of loan agreement and be able to minimizing the implementation schedule for detailed design. These conditions are taken into consideration of construction planning, cost estimate, economic and financial analyses.

24.3 Demand Forecast and Port Development Scale

The estimated total cargo volume to be handled in Northern Vietnam was not so much different between SAPROF study and TEDI FS, however the share of container cargo and other general cargo were different very much between both studies, i.e., the container cargo of SAPROF study are 3.59 million TEU in 2015 and 5.08 million TEU in 2020 but those of TEDI FS were 1.68 million TEU and 3.45 million TEU respectively. On the other hand, the general cargo and bulk cargo of SAPROF study are 11.2 million ton in 2015 and 12.9 million ton in 2020 but those of TEDI FS were 25.84 million ton and 30.43 million ton.

The reason why such big differences occur was that TEDI FS was made in 2006 using cargo data up to 2004 but the shares of container cargo and general cargo were changed from 50% and 50% respectively in 2004 to 69% and 31% respectively in 2008. SAPROF study was conducted using cargo data up to 2008 and above forecast cargo volumes were reflected the change of traffic trends after 2004. As a result, the container volume and general & bulk cargo volume for Lach Huyen Port are estimated as 2.23 million TEU and 2.38 million ton respectively in 2020.

In order to handle these cargoes in Lach Huyen port in 2020, the **five (5) container berths** (L=375m x 5, D= -14m CDL) for 50,000 DWT fully loaded vessels and 100,000 DWT partial loaded vessels and **three (3) multi-purpose berths** (L=250m x 3, D= -13m CDL) for 50,000DWT fully loaded vessels need to be constructed.

24.4 Container Berth No.1 & No.2 Development by 2015

In the frame work of Medium Term Development Plan of Lach Huyen Port for target year of 2020, the first two (2) container berths has been decided to be implemented by VINALINES as a Project Owner by the Prime Minister Decision dated April 11, 2007 and MOT Decision on December 22, 2008. Therefore, this Initial Development Plan for the target year of 2015 is prepared for the first two (2) container berths development and other related port infrastructure development.

The scale and scope of container berths development was reviewed by SAPROF study and following modifications on original plan were proposed:

(1) The design container vessel sizes should be 50,000DWT (full load) and 100,000DWT (partial load) instead of 30,000DWT (full load) and 50,000DWT (partial load).

(2) According to the above modification for vessel sizes, total length of berths No.1 & 2 should be extended from 600m to 750m.

(3) The terminal yard area should be enlarged from 36ha to 45ha.

(4) Quay Gantry Cranes should be large-size one suitable for 100,000DWT container vessels.

(5) Barge berths for domestic waterway traffic should be constructed in the north-eastern part of terminal.

(6) The construction of terminal land reclamation and soil improvement should be carried out by the public sector instead of VINALINES.

24.5 Vessel Access Channel

In the original plan, the dimensions of vessel access channel were one way traffic system, 130m in width, -10.3m CDL in depth and 1:10 of side slope, however, SAPROF study recommended following modifications:

(1) Dimension

- The width of channel should be 160m for the portion protected by the sand protection dyke and 210m for the portion without sand protection dyke, suitable for 100,000DWT container vessels in accordance with the guidelines of PIANC.
- The depth of channel should be -14m CDL from initial stage since there is high possibility that mother container vessels more than 50,000DWT (4,000TEU) of international trunk route of Asia – North America (Trans Pacific) will call Lach Huyen Port directly and the international gateway port should be able to accept such mother vessels at any tidal conditions.

(2) New Navigation Aid

- The Lach Huyen channel to be developed in initial stage is one way lane having a minimum width for 100,000DWT container vessels. Therefore, channel buoys should be replaced from the existing floating buoys to Spar Buoys which will not move around like a floating buoy and be able to show exact position.
- Small ships like fishing boats will sale around the sand protection dyke but the dyke will be underwater during high tide and invisible for fishermen. Therefore, light beacons should be installed on the sand protection dyke to show the existence of obstacle for fishermen.
- A pilot assistance system which could display own ship position at real time should be provided to the pilot office.

(3) Measures against Sedimentation

- The sand protection dyke should be constructed up to seabed elevation of -5.0m CDL for 7,600m long.

24.6 Port Service Road

The port service road will not require three (3) lanes for each direction in initial stage and SAPROF study proposed to be two (2) lanes for each direction but to provide two (2) waiting lanes along the terminal side and also to provide a paved shoulder for motor-bike passage and emergency parking at accident for each direction. The total width of port service road in initial development stage should be

44.0m instead of 41.0m of original plan and the total length of port service road should be 1,000m instead of 630m of original plan since container berths length is extended and public related facilities area is added. The future expansion area for road and railway will be kept at 200m wide behind the terminal as proposed in original plan.

24.7 Outer Revetment

TEDI F/S suggested the crest elevation of +5.5m CDL with provision of 13.7 m wide of wave breaking works or +9.0m CDL with normal width of wave breaking works, i.e., 2-row of 2.9 m wide at the top in front of the revetment work. Due to the exposure conditions to the offshore wave action, Outer Revetment is subject to the extreme high wave which may be generated by tropical typhoon almost at least once a year. Therefore, SAPROF study recommends that the crest height of revetment wall is positioned at **+6.5m CDL**, which is roughly equivalent to the elevation of HHWL+ 4.43m plus 0.6 times of design wave height 3.2 m. This outer revetment consists two (2) types, one is back-filled by reclaimed sand and the other is not back-filled by reclaimed sand at present but will be filled in future and is protected its back side slope by armor rock against wave action. Total length of outer revetment will be **3,230m** instead of 3,900m of original plan.

24.8 Sand Protection Dyke

A sand protection dyke is provided on the same alignment of the outer revetment to protect the access channel from sedimentation of sand. The Decision by MOT indicates that “sand dyke is designed to connect to the breakwater forming yard with total estimative length of 5,700m (up to elevation of -3.0m) under the condition that the length of the sand dyke will be materially defined in the technical design stage”.

SAPROF study carried out a series of simulation study on possible extent of siltation along the new access channel for alternative layout of sand protection dyke. Based on the results of the said simulation study presented in Chapter 8, SAPROF Study made comparison study for 3 Alternatives, i.e., Alternative 1: Dyke with top elevation of +4.0m CDL is constructed up to seabed elevation -10m CDL in initial stage, Alternative 2: Dyke with top elevation of +4.0m CDL is constructed up to seabed elevation of -5.0m CDL in initial stage and be extended up to -10m CDL after 5 years and Alternative 3: Dyke with top elevation of +2.0m CDL is constructed up to seabed elevation of -5.0m CDL in initial stage and no extension will be made, and evaluated Alternative 3 is the most economical and recommends a construction of sand protection dyke up to the water depth of -5.0m CDL for **7,600m long.**

Since possible consolidation settlement of subsoil layer is expected not considerable, at around 30 to 60 cm in long term basis, any subsoil improvement is not recommended from the viewpoints of function of sand protection dyke, saving the construction cost and shortening the construction period. Instead, a 1.0 to 1.5 m thick rubble mound is placed onto the seabed subsoil to sustain overburden pressure loaded by its core materials and to function as counter weight to preclude underlying clayey soil from circular failure.

24.9 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. However, SAPROF study team recommends these basic public related facilities to be included in the scope of Project.

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 shipping companies and cargo owners can perform their business smoothly and effectively.

The proposed scales of public related facilities are 1) Land reclamation: 344,000 m^3, 2) Dredging in front of berth: 104,000 m^3, 3) Service boats berth: 375m L x 30m W x -4m D, 4) Pavement: 121,000 m^2, 5) Buildings: 4,600 m^2 and 6) Utilities and Others: 1 set.

24.10 Soil Improvement

TEDI FS proposed to apply vertical sand pile drain method for the subsoil improvement of reclamation area but the details thereof were not explained in the report. SAPROF study recommends to apply plastic board vertical drain method (PVD) in combination with preloading to accelerate the process of consolidation which may caused by reclamation fill and surcharge loading during operation period. This method (PVD) has advantages as follows:

(1) Currently one of popular methods and frequently applied to subsoil improvement in various project constructions at very weak clayey soil condition,

(2) Minimum in disturbance of subsoil during piling work and drastically shorten the time for piling construction as compared with sand pile method,

(3) Economy in construction among others applicable, and

(4) Technically improved nowadays and is proven its effectiveness to accelerate the rate of consolidation of clayey soil in combination of preloading during construction.

Other than PVD subsoil improvement, it is recommended that Low Rate of Replacement Cement Column Method (ALICC) of 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. Because 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 possible.

24.11 Implementation Schedule

GOV wants to complete the construction of container Berth No.1 & 2 by the end of 2014 and commence operation from beginning of 2015, however, considering the standard process and steps necessary for the yen loan agreement, it is estimated that the construction work will commence from middle of the year 2012. As the construction work period is required about 41 months, the port operation can only be started in July 2015. However, if it is accepted to start operation of berths one by one, the 1st berth can start operation in April 2015 and the 2nd berth can be started in September 2015.

It should be noted that above implementation schedule is prepared based on the assumption that all procurement process proceeds without any delay.

24.12 Contract Packages

This ODA project of port portion consists of four (4) main works as shown in Table below.

Table 24.12.1 Estimated Construction Cost of Each Work Item

No.	Work Item	Construction Cost
1	Navigation Channel	US$ 315 million
2	Container Terminal	US$ 138 million
3	Port Protection Facilities	US$ 166 million
4	Public Related Facilities	US$ 27 million

Considering the required technical qualification for each main work, interface between each work, financial scale of each work, smooth and quick implementation of work, etc., the packaging of contract for the port portion of ODA Project is recommended to be divided into two (2) packages as follows:

- Package 1: Dredging of Navigation Channel
- Package 2: Construction of Container Terminal, Port Protection Facilities and Public Related Facilities.

In addition to above 2 construction packages, the consulting service of construction supervision for both constructions should be added as Package 3.

- Package 3: Consulting Services for Construction Supervision

24.13 Organization Structure

1) 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

(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

(For Land Clearance, Compensation and Resettlement)

h) Hai Phong People Committee

(2) Private Sector

(For the Port Portion)

a) Project Owner: VINALINES

2) Joint Coordination Committee (JCC)

In order to secure the smooth implementation and consistency between 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 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.

It is recommendable that JCC meeting should be held monthly until L/A signing and every three (3) months until commencement of construction work and then JCC meeting may be held casually on demand basis, however, should be held at least once in six (6) months.

3) Operation and Maintenance

The private sector, **JV** of **VINALINES** will invest for the construction of berthing structure, dredging in front of berth, road & yard pavement, buildings and utility supply system in the container terminal No.1 & 2. All of these facilities should be operated and maintained under the responsibility of **SPC**, private operation company under JV of VINALINES.

The Public Sector, GOV will invest for dredging of navigation channel and construction of terminal land, outer revetment, sand protection dyke and public related facilities including service berth, buildings and utility supply system.

After completion of reclamation and subsoil improvement of terminal land, 200m wide land behind the terminal and land for public related facilities, the O & M of these lands will be carried out by **VINAMARINE** or **Hai Phong PC**.

The Port Owner of **VINAMARINE** should be responsible for operation and maintenance of other infrastructures such as Navigation Channel, Outer Revetment, Sand Protection Dyke and Public Related Facilities. The maintenance of these infrastructures will be performed by VINAMARINE.

24.14 FIRR and EIRR

24.14.1 FIRR

Public sector requires the reasonable return to cover the weighted average capital cost (WACC) in long term. 84.3 percent of the project is financed by ODA loan (STEP condition) and 15.7 percent is financed by the budget of the Government of Vietnam. The budget portion should have a reasonable return to cover the opportunity cost of the capital (15%). WACC is calculated as 0.32 percent.

Financial Internal Rate of Return (FIRR) of the public investment in the middle growth case is **1.24 percent**, which is above WACC. It is considered that the public investment is financially viable.

Private sector requires the return on their equity to cover at least the opportunity cost of the capital. 15 percent is considered as the opportunity cost. At the same time, private banks request the enough margins of the available cash to debt service. Average annual debt service coverage ratio (DSCR) should be bigger than 1.5

Return on Equity (ROE) of the private investment in the middle growth case is **16.2 percent**, which is above the opportunity cost. Average DSCR for this case is **1.68**, which is above 1.5. It is considered that the private investment is financially affordable.

The results of sensitivity analysis are summarized in table below.

Table 24.14.1 Results of Sensitivity Analysis of Financial Analysis

Case		ROE	DSCR	Public FIRR
Container Volume	High Gowth Case	18.2%	1.68	1.33%
	Middle Growth Case (Base Case)	16.2%	1.68	1.24%
	Low Growth Case	14.0%	1.66*	1.11%
Capital Cost	Base Case +10 %	13.3%	1.53	1.21%
	Base Case +5%	14.7%	1.60	1.23%
	Base Case	16.2%	1.68	1.24%
Container Charges	85$	12.8%	1.44*	0.17%
	95 $ for 40 feet (Base Case)	16.2%	1.68	1.24%
	105$	19.5%	1.93	2.15%

*: Less than 1.0 for the first repayment year

24.14.2 EIRR

1) EIRR for Medium Term Development (2020)

The objective of the economic analysis is to appraise the economic feasibility for construction project of Lach Huyen Port Project, focusing on the International Gateway Port of Vietnam in the target year 2020, from the viewpoint of the national economy. “With” and “Without” cases are composed in the economic analysis.

The “With” case scenario is construction of Lach Huyen Port in medium term port development project (5 container cargo berths of totally 2,000m in length, 3 multi purpose berths of totally 750m in length, access channel of -14m in depth, training dike, revetment, etc.) including Tan Vu-Lach Huyen Highway Project.

In the “Without” case, the sea cargo in Hai Phong and Cai Lan Port is transported on the existing feeder service routes and the overflowed cargo more than the port capacity of Hai Phong and Cai Lan is assumed to handle in Hong Kong Port and is transported by land transport between Hong Kong Port and the Northern Vietnam area.

EIRR of the Lach Huyen Port project with Tan Vu-Lach Huyen Highway Project is estimated at **23.9%** which exceeds the social discount rate or opportunity cost of capital of 12% in the Vietnam. Accordingly, it can be concluded that the project is economically feasible.

The results of sensitivity analysis for medium term development are summarized in table below.

Table 24.14.2 Sensitivity Analysis of EIRR for Medium-tem Development Project in 2020 (5 Container Terminals and 3 Multi Purpose Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	23.9%	21.9%	19.7%
	10% up	21.9%	20.1%	18.1%
	20% up	19.7%	18.6%	16.6%

2) EIRR for Short Term Development (2015)

The benefit concept of “With” and “Without” cases are same condition as economic analysis for medium term project. The cargo handling capacities of 2 container terminals are assumed 890,000TEU per year. And the period of calculation for the economic analysis (project life) is assumed to be 30 years (2015-2046) after the completion of short-term port development project implementation.

EIRR for the Short-term Project (2 Container Terminals) is calculated at 14.3% and it can be said that the short term development project is also economically feasible.

The results of sensitivity analysis for short term development are summarized in table below.

Table 24.14.3 Sensitivity Analysis of EIRR for Short-term Development Project (2 Container Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	14.3%	12.8%	11.1%
	10% up	12.8%	11.4%	9.9%
	20% up	11.1%	10.3%	8.8%

24.15 Port Management Unit (PMU)

It will be very important for the Lach Huyen Port to manage the non-profitable assets like a navigation channel, navigation aids, breakwater and sand protection dyke properly for the functional port operation and sustainable port development and the port administrator should have strong power and enough resources for that purpose. However, current responsibility held by the Maritime Administration at Haiphong Port is limited in its scope that covers almost the harbor master function in the other similar ports abroad.

Therefore, it is strongly advisable to enhance and improve port management capability that is essential for accomplishing a sustainable development of Lach Huyen Port .In dealing with a lack of effective port management system in the current administrative framework and looking for great growth opportunities of the Lack Huyen port, a Port Management Unit (PMU) which will bear broader responsibilities and duties over port operations is recommended to be set up under the supervision of VINAMARINE.

24.16 Detailed Design Stage

In addition to ordinary scope of Detailed Design, following issues are recommended to be studied and surveyed.

1) Dredged Material Dumping Site

The dredged material of Lach Huyen channel is mostly disturbed clayey soil and will not be suitable for land reclamation work.

At present the dumping site for dredged material is planned in South Dinh Vu area because this area is nearest candidate site among the dumping sites already approved by Hai Phong P.C. in EIA report. However this dumping site requires constructing a temporary dyke which is very costly and the dumped soil land shall be improved with huge cost before using there for IZ development since the dredged material is not suitable for reclamation.

Comparing with south Dinh Vu site, the future expansion site of Lach Huyen Port for “Natural habitats restoration" or Lach Huyen offshore area for "Offshore dumping" will be better candidate sites from the viewpoint of beneficial or/and economical options for long-run (Figure 24.16.1). Therefore, it is recommendable to conduct a feasibility study on alternative measures for sustainable dredged material management as soon as possible. If it's technically and economically feasible for such measures for the initial operation and/or construction of the proposed new port, it is also recommendable to conduct an EIA for such option(s) and acquire approval from EIA authorities concerned before bidding for selection of dredging contractor(s) for each construction and operation stage. Detailed description of the recommended alternative measures for the "Sustainable dredged material management" shall be addressed in Chapter 22 of Mitigation Measures for Environmental Impacts.

Considering the preparation of the EIA report, it highly depends on the EIA consultant's capability of the EIA reporting but it would likely to take six (6) to twelve (12) months to prepare the EIA report. In the case of sufficient baseline information, especially on natural environment to cover the annual impacts, the preparation would only take several months after the collection of sufficient baseline information.

Considering the appraisal of the EIA report, the procedures and MINIMUM period of the approval are described in Appendix 24-1 of Circular No. 05/2008/TT-BTNMT on Guiding the Strategic Environment Assessment, Environmental Impact Assessment and Environmental Protection Commitments. However, based on the consolation with a representative of EIA division, MONRE, it is likely take three (3) to six (6) months at least to acquire the final approval for a national level approval by MONRE, and also it highly depends on the scale and kinds of the project.

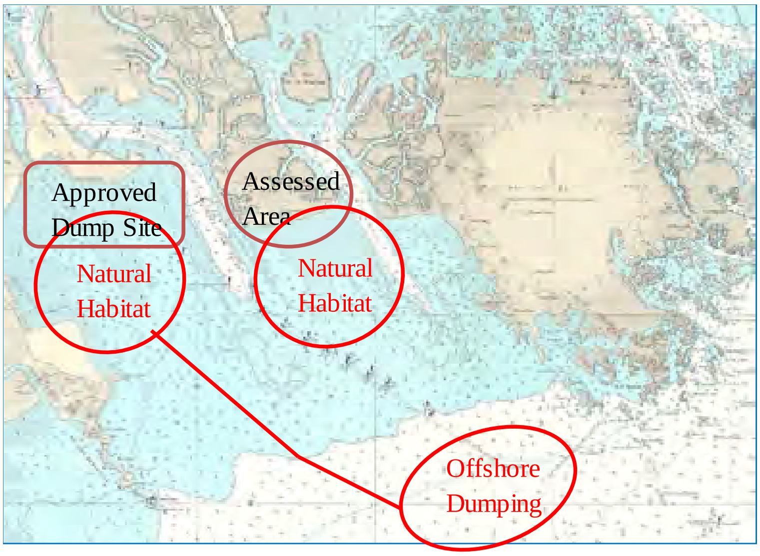


Figure 24.16.1 Candidate Site for the Sustainable Mitigation Measures for Dredged Material

2) Ship Maneuvering Simulation

This Lach Huyen Channel is one way, width of 160m with sand protection dyke and 210m without sand protection dyke and length of approx. 18 km. For the partial loaded 100,000DWT container vessel, the navigation in this channel is not easy when marine conditions and climate conditions are not favorable. In order to know the limit natural conditions and suitable tug assistance, therefore, the ship maneuvering simulation is recommended to be conducted during detailed design stage.

24.17 Construction Stage

1) Maintenance Dredging Plan

In order to establish a reliable maintenance dredging plan, check surveys on actual sedimentation phenomena and marine conditions should be carried out at every three (3) months during capital dredging period and mathematical sedimentation analysis should be conducted by the Consultant.

24.18 Operation Stage

1) Operation and Efficiency Indicators

In order to evaluate the efficient utilization of the facilities constructed in this ODA Project, following operation and efficiency indicators should be checked in 2017, after 2 years from the commencement of Lach Huyen Port operation.

Table 24.18.1 Performance Guidelines

	Measuring Item	Guideline
1	Berth Occupancy Rate	30%
2	Container Dwell Time	6 Days
3	Throughput	500,000TEU in 2016 750,000TEU in 2020
4	Maximum DWT of Vessels Docked at Berth One and Two	More than 50,000DWT vessels

24.19 Natural and Social Environment Consideration

The desk review of the Approved EIA and the comprehensive study of “The Preparatory Survey on Lach Huyen Port Infrastructure Construction in Viet Nam” by SAPROF study team concluded that the potential impacts on natural and social environment of the SAPROF’s change in port design would not be significant compared to the TEDI’s port design except the management of the maintenance dredging material in the long-run. In addition, some potential impacts, which were not addressed in The Approved EIA, and insufficiency of the baseline survey on natural environment were identified the SAPROF experts.

The summary of the environmental impact assessment relevant to the SAPROF’s change in port design are shown below:

Table 24.19.1 Summary of the SAPROF Port Design and Identified Potential Impacts

Item	SAPROF’ Design	Potential Impacts
EIA of the SAPROF Port Design		
1. Design vessel for container berth	Fully loaded 50,000DWT vessel Partial loaded 100,000DWT	• No significant impacts are expected.
2. Extension of channel Long, Width and Depth	160m to 210m wide, -14m deep below CDL	• Due to the sufficient capacity of disposal site, no significant impacts are expected for the initial dredging though there is significant increase in volume. • Due to the higher requirement of maintenance dredging, alternative and sustainable solution(s) shall be critically needed.
3. Extension of sand	Applying till -5m	• Based on the results of the sedimentation

Item	SAPROF' Design	Potential Impacts
protection dyke		simulation model, no significant impacts are expected. However due to the difficulties to simulate the detailed/localized phenomena, continuous monitoring will be required. • Based on the results of the oil spill simulation model, fewer impacts were shown. However due to the complex environment of the study area, both The APPROVED EIA results and this SUPPLEMENTAL EIA results may contain some errors. Evaluation of the simulation model and further consideration is recommendable in the following ADDITIONAL EIA.
4. Public related facilities and service/common berth	1) Land reclamation 2) Service boats berth, 3) Port Admin. Bld., 4) Amenity Bld. 5) Pavement	• Due to the least land use activities in the land clearance area, no significant impacts are expected. However, timely implementation of the land acquisition including grave resettlement and land acquisition shall be essential to meet the critically scheduled project implementation.
Identified Potential Impacts		
5. Insufficiency of the ecological baseline survey	Recommending additional ecological monitoring at widely allocated additional monitoring points	• Because of the single ecological baseline survey in close area, it is hardly to evaluate the potential impacts in the region by season. Additional ecological survey at additional monitoring points is recommended in the following ADDITIONAL EIA.
6. Impacts on coastal fishing	Recommending development of a safeguard policy and reasonable care for project affected people	• Though the Approved EIA evaluated minimal impacts on the coastal fishing activities, SAPROF study has confirmed the regular fishing activities in the project area. Consideration for the loss of the coastal fishing activities and limited capability to adapt the expected new job opportunities were confirmed in the potentially affected communities.

Development of the Hai Phong International Gateway Port will definitely enable the economic development of the northern Viet Nam, but the identified impacts on natural and social environment shall be addressed in the following ADDITIONAL EIA, required by the effective regulation on environmental protection, to achieve such potential impacts with smart ways. In accordance with Article 13 of Decree No.80/2006/ND-CP and Article 6 of Decree No.21/2008/ND-CP Amending Article 13, b/ of Decree No.80/2006/ND-CP, it is required to prepare the Additional EIA report. The ADDITIONAL EIA requires covering:

a/ Changes in the project's content,

b/ Changes in the natural environmental conditions and economic and social factors up to the time the additional environmental impact assessment report is made,

c/ Changes in environmental impacts and measures to minimize negative impacts,

d/ Changes in the project's environmental management and monitoring program, and e/ Other changes.

As the official agreement between JICA and the Government of Vietnam recorded and signed in the minutes of discussion in March 2010 on the Lach Huyen International Gateway Port Development, the necessary additional survey on natural environment and a baseline survey on coastal fishing followed by the completion of the ADDITIONAL EIA and acquisition of the appraisal of the ADDITIONAL EIA shall be included in the detail design of the new port development supported by JICA. In order to meet the tight construction schedule, the approval of the ADDITIONAL EIA must be acquired before the completion of the following detail design.

24.19.1 Natural Environment

1) Baseline Environmental Condition Surveys

The baseline environmental surveys done at the project site and its surroundings, considering its vicinity to Cat Ba National Park is regarded as adequate as the minimum requirement for the purpose of the approved EIA Report (2008). The baseline surveys covered ambient air, coastal water, coastal seabed sediment and groundwater including coastal water ecological sampling (phytoplankton, zooplankton and seabed benthos) in the planned port water areas. Moreover, the coastal wetland flora located along the western coast of Cat Ba Island (Phu Long area), where significant mangrove vegetation exists, is also included. Still the important limitation of the survey is that it was done only once (in May 2006) and hence cannot be regarded as fully representative to account for seasonal variation. Accordingly, during the detailed engineering stage ecosystem surveys with at-least 2 times of sampling as appropriate to account for the 2 predominant dry and rainy seasons is recommended to clearly define the baseline environmental condition to facilitate future comparative evaluation with the results of environmental monitoring during the stages of project construction and subsequent operation.

2) Significant Aspects of Construction Stage of the Project

The inshore areas proposed in the EIA Report, in particular the Nam Dinh Vu area having ease of access have adequate capacity to accommodate the entire dredged material generated that is in the order of 30 million m3. Still, other possible options for the disposal management of dredged material including offshore disposal might be required and if so need to be studied in details during detailed engineering design. The construction contractor shall fully comply with EHS (environment, health and safety) aspects concerned to the execution of construction works with due diligence in integral manner, in particular, strictly adhering the concept of “Safety First”. The contractor shall ensure all natural resources required for the construction of port such as sand, soil and stones are procured from legally certified suppliers. Moreover, the contractor shall be obligated to use the service of an independent reputed organization to conduct regular periodical environmental monitoring of the construction site and its vicinity that would cover ambient environment of on-land area (Cat Hai Island) and coastal water environment (Lach Huyen Estuary).

3) Significant aspects of operation stage of the project

Strict adherence by port operational agency on the EHS aspects of port operation is the basic requirement. Operational safety covers both the safety of port terminal operation and navigation safety. The port shall be equipped with operational waste reception, treatment and disposal facilities as appropriate to manage all wastes generated both due direct port operation and wastes disposed by ships and vessels. Moreover, an emergency management system to effectively deal with potential emergency situation like accidents, fires and oil spills shall be in place with capability to activation at short notice. Port operational agency shall be obligated to conduct regular periodical environmental monitoring with priority focus on the estuarine coastal water environment of the port area and its vicinity of Lach Huyen Estuary including the western coastal areas of Cat Ba Island located opposite side of the port.

24.19.2 Social Environment

1) Significant Aspects of Preparation Stage of the Project

Land acquisition and safeguard policy for coastal fishing activities are two primary social impacts to be addressed. Though there will be minimal impacts from the land clearance and little difficulties to complete the land acquisition as long as the responsible authorities follow the DRAFT land acquisition plan prepared by MPMU II, on time delivery of the necessary land is critical to meet the tight construction schedule. It is highly recommendable for MPMU II and VINAMARINE to continuously communicate with the PC of Hai Phong, the representative of the responsible authority, for securing the on time delivery.

Consideration of the fishermen should be also seriously addressed by the responsible authorities-the PC of Hai Phong with the active contribution by the MPMU II and VINAMARINE. Due to the lack of the legal framework for the fishing activities, the safeguard policy in “Support” for the recovery of livelihood defined by law on land and its relevant regulations shall be referred to develop a “New safeguard policy” for PAP, who are not covered by the law on land including fishermen. As there are some gap between JBIC Guideline/WB OP 4.12 and Vietnamese safeguard policy, it is recommendable to refer the resettlement policy framework (RPF) of “Northern Delta Transport Development Project”, which is ongoing project by MOT supported by the World Bank. Though the RPF is different donor project, it is reasonable to apply WB OP4.12 due to the consistency of ODA projects’ safeguard policy in the same region and same ministry as well as the original reference of the JBIC Guideline. The definition of WO OP4.12 (article 16), it is not necessary to compensate by money but support for livelihood recovery or vocational training for job transfer. It is actually preferable to provide prolong solution rather than pinpoint money solution. Based on the local communities’ demands, vocational training for the new job opportunities is preferable for the sustainable solution in the communities.

Though the identified impacts may not be serious issues at the initial stage of the project implementation, such issues may possibly turn critical abstraction in the future. Historical records proved that the PROACTIVE actions to solve the hidden/potential impacts with REASONABLE manner are likely to avoid the potential further loss of POST-Actions such as delay of project implementation and higher costs of compensation with further social disturbance.

2) Significant Aspects of Construction Stage of the Project

1) Considering the labor safety, proper training and management is essential. As the responsible agency for the project implementation, MPMU II shall include the supervisory mechanism to ensure the contractor’s EHS training and enforcement on the ground in the EMP.

As for the control of the transmittable diseases, proper supervision and collaboration with contractors for the health care training are recommendable. Since the self protection is the most effective measures to control such diseases, periodical and continuous efforts to maintain the workers’ and local communities’ awareness are recommendable. Control of the physical contacts between immigrant workers and locals, such as workers’ township, would be another recommendable option to reduce the risk.

2) It is highly recommendable to control the expected sharp inflation of pricing in the Cat Hai island. In order to maintain the affordability of goods for the local communities, it is recommendable to monitor the price indexes and affordability/income level of the local communities. Such monitoring result shall be shared among MPMU II and local authorities to consider necessary measures if it is necessary. Physical separation between local communities and workers community would be a solution for the initial stage by means of sufficient goods supply in the workers’ township.

Follow-up for the resettlement would be another important matter in the construction stage. Due to no requirement for the residential resettlement, follow-up for livelihood support should be focused. Although MPMU II is not responsible for the implementation of the safeguard policy, it is recommendable to include a mechanism to check the appropriate implementation of such policy in EMP. If it is necessary to improve such safeguard measures, MPMU II shall coordinate responsible authorities to ensure the effective implementation as the responsible agency for the project implementation.

3) In order to monitor unexpected negative impacts on fishing communities, it is recommendable to conduct periodical sample survey including the fish yield and income level of the project affected fishermen. If it is necessary to provide additional support based on the sample survey result, responsible authorities shall consider modification of the safeguard policy for coastal fishing or additional counter measures such as encouragement of job transfer. In the case of necessity to improve the safeguard policy for the coastal fishing, MPMU II shall coordinate responsible authorities to improve the modified policy as the responsible agency for the project implementation.

3) Significant aspects of operation stage of the project

For the consideration of the social environmental impacts during the operation stage, monitoring the implemented safety guard measures in the previous stages would be the primary matter in this stage. As a part of environmental management plan (EMP) and responsibility of the implementation agency, MPMU II shall supervise VINALINE and other private operators to ensure the EMP including the proper implementation and follow-up of the safe guard policies.