DIVISION – III

DETAILED DESIGN

Package 8 Channel Dredging and Disposal Part A
Package 9 Channel Dredging and Disposal Part B

15. CHANNEL DREDGING

15.1 Design Standards and Conditions

The design standards and literature referred to in this chapter are listed hereunder:

(1) Technical standards and commentaries for port and harbor facilities in Japan
(2) Japanese Port and Harbors Construction Cost Estimation Standard (2010)
(3) Price Table of Construction Equipment (Japan, 2009)
(4) Cost Standards for Dredging Equipment 2005, R.N. Bray
(5) Maritime Structures, British Standard BS6349-5
(6) Approach Channels, A Guide for Design, PIANC
(7) Vietnamese cost estimation manuals and standards.

15.2 Channel Plan

15.2.1 General Layout Plan

The size and configuration of the Channel and turning basin are shown below and in Figure 15.2.1 and Figure 15.2.2.

(1) Channel depth : DL-14 m
(2) Channel bottom width : 160 m
(3) Side slope : (Above DL-10 m) 1:15

: (Below DL-10 m) 1:10

: (Berth area) 1:5

(4) Diameter of turning basin : 660 m
(5) Berth box width : 50 m
(6) Major points coordination of the Channel center

Table 15.2.1 Coordination of Major Points on the Channel Center

Point	Description	VN2000 Coordinate System, Central Meridian 105^{o}45', zone 3^{o}, CD		Longitude/Latitude Coordinate System, Central Meridian 105^{o}45', zone 3^{o}, CD	
		E	N	E	N
Station 27Km+000	Land side end of the Channel	620,364.97	2,301,704.78	106^{o}54'22.49"	20^{o}48'18.53"
Station 29Km+255	Bending point of the Channel	621,521.82	2,299,767.70	106^{o}55'02.01"	20^{o}47'15.28"
Station 44Km+350	Outer end of the Channel	630,520.71	2,287,649.88	107^{o}00'09.88"	20^{o}40'39.11"

(7) Bearing direction of the Channel center line

Table 15.2.2 Bearing Direction of the Channel Center Line

Station (Km+m)	Bearing direction
27+000 to 29+255	149° 9’13” - 329° 09’13”
29+255 to 44+350	143° 24’7” - 323° 24’7”

(8) Extra depth for sedimentation

Table 15.2.3 Extra Depth for Sedimentation

The Channel Stations	Extra depth
From Sta 27 km +000 to Sta 35 km + 000 From Sta 40 km +000 to Sta 44 km + 350	0.5 m below the Channel depth
From Sta 35 km +000 to Sta 40 km + 000	0.8 m below the Channel depth

Notes:
1. The starting point of the Channel stations is at Hai Phong Port as Station 0 km+000
2. The Channel cross sections in this Chapter are facing the sea. (East is on the left side and west is on the right side)

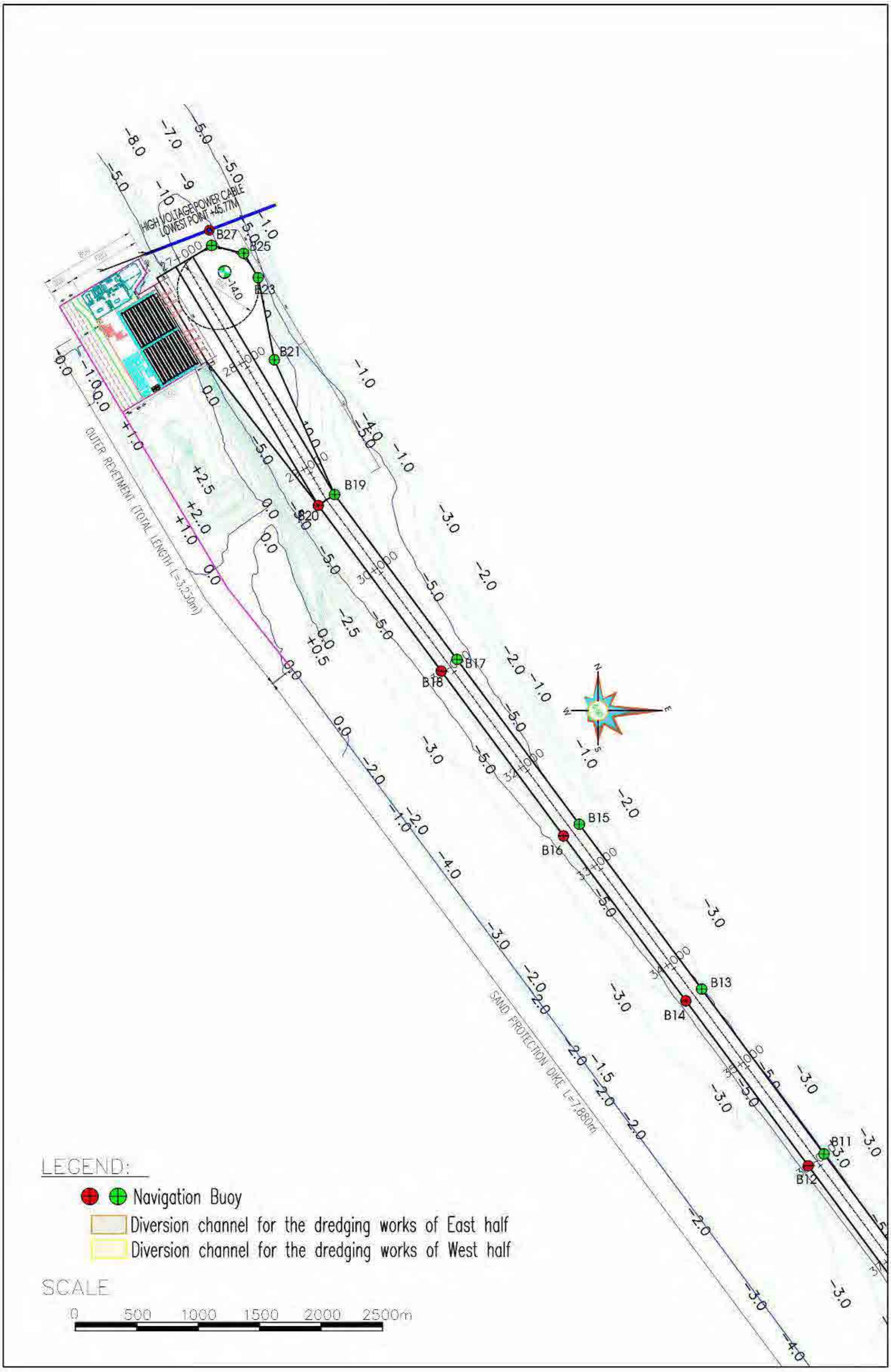


Figure 15.2.1 General Layout Plan of the Channel (1)

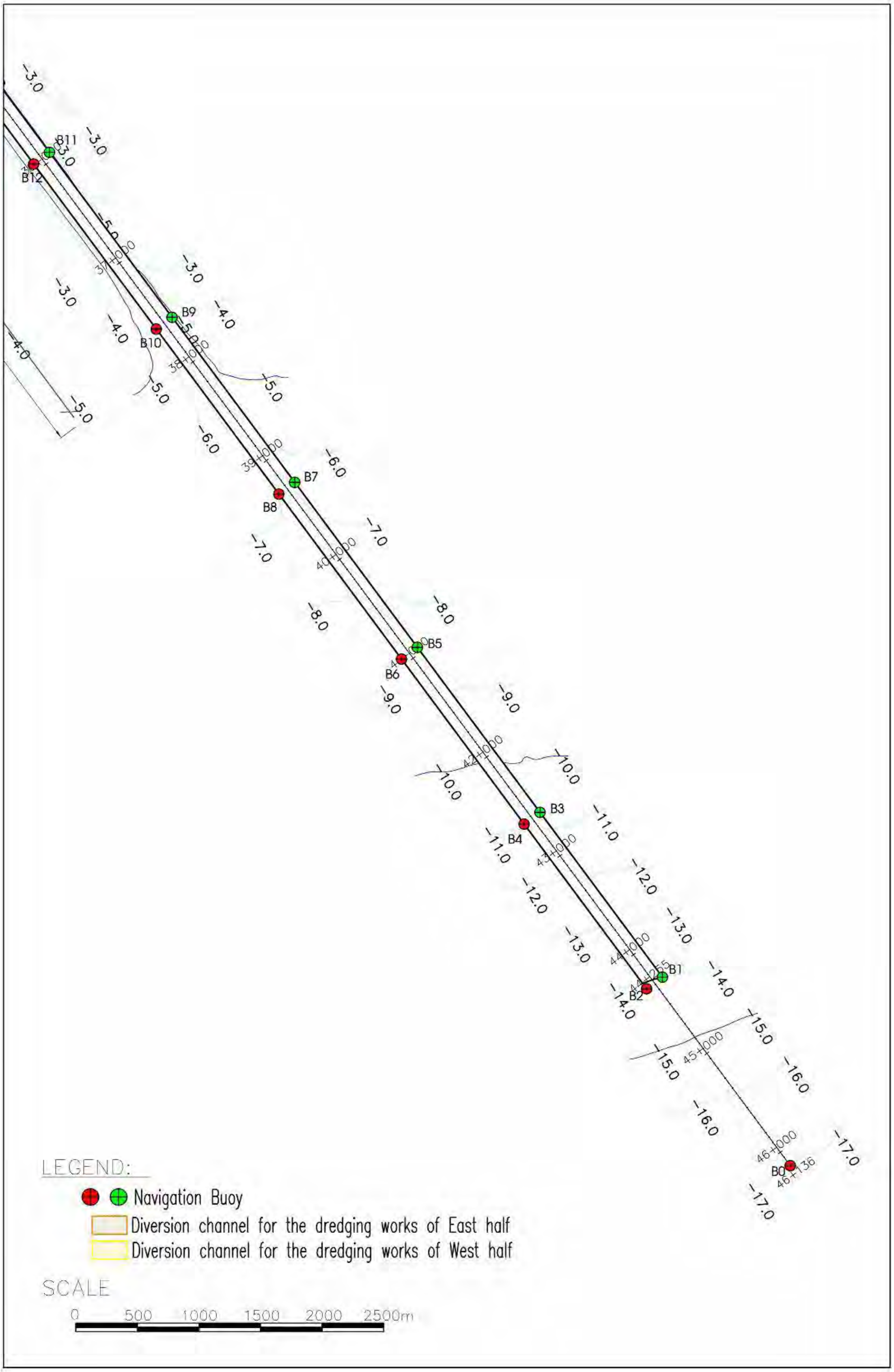


Figure 15.2.2 General Layout Plan of the Channel (2)

15.2.2 Typical Cross and Longitudinal Sections

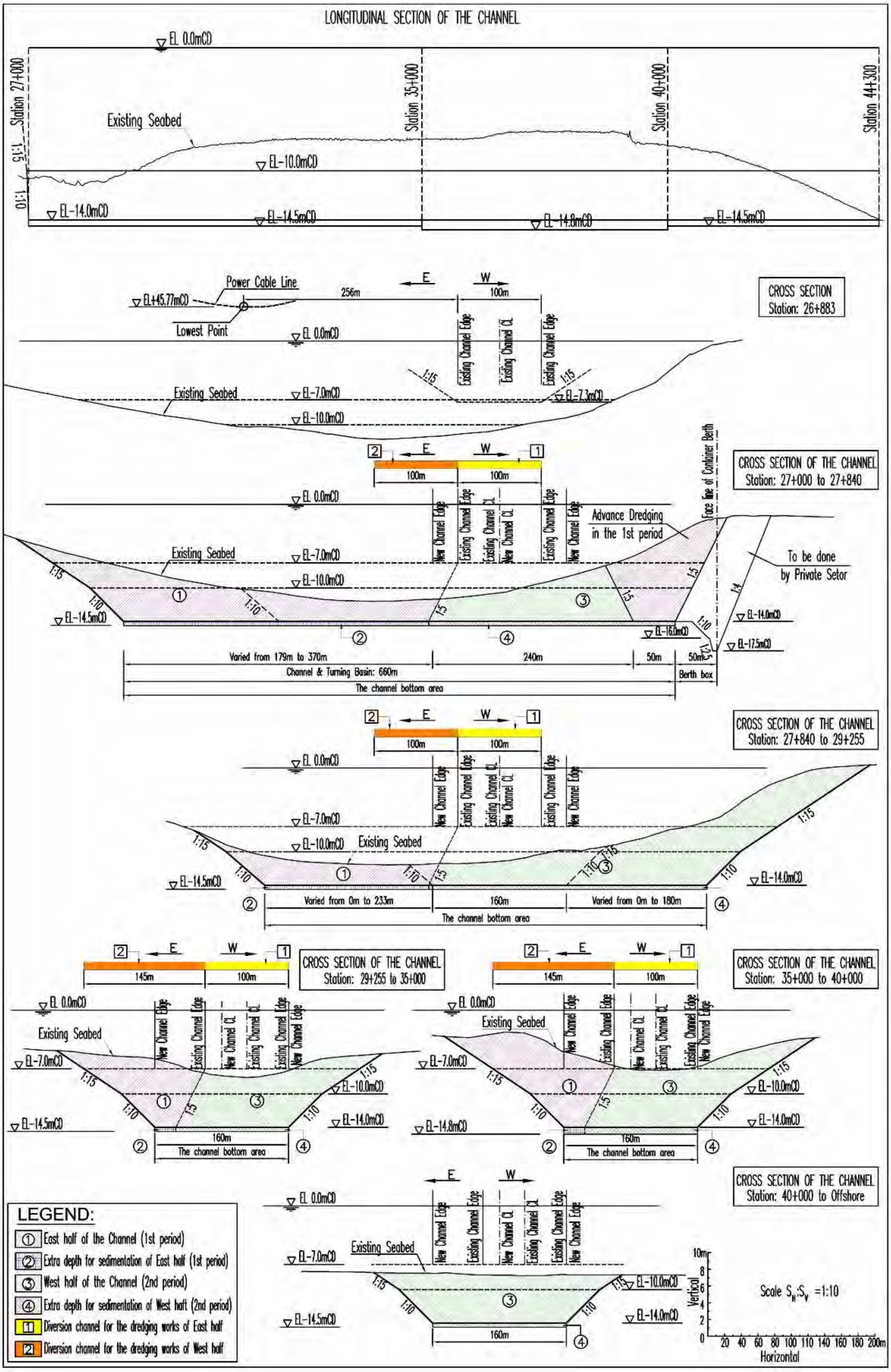


Figure 15.2.3 Longitudinal and Typical Cross Section of the Channel and Turning Basin

15.3 Channel Dredging

15.3.1 Dredging Volume

1) Main Channel dredging volume

The net dredging volume of the Channel was calculated based on the general layout plan of the Channel as described in the previous section, and the results of the bathymetric survey conducted by JICA DD Team in May 2011 for the area between Station 27 km to 34 km and in July for the area of Station 34 km to offshore. The total volume is divided into two sections of east and west halves along the east edge of the existing channel, considering the dredging works to be done in two periods: the first period for the east half and the second period for the west half.

Table 15.3.1 Net Volume of Channel Dredging

Station		Net Volume (m^3)		Total
from	to	East half	West half	
27+000	28+000	1,362,964	1,748,753	3,111,717
28+000	29+000	451,236	1,275,857	1,727,093
29+000	30+000	504,038	836,495	1,340,533
30+000	31+000	773,179	989,714	1,762,893
31+000	32+000	895,257	1,011,654	1,906,911
32+000	33+000	1,024,244	1,032,717	2,056,961
33+000	34+000	1,037,385	1,093,380	2,130,765
Sub Total 27 to 34 km		6,048,303	7,988,569	14,036,872
34+000	35+000	1,058,670	1,153,453	2,212,123
35+000	36+000	1,086,313	1,188,118	2,274,431
36+000	37+000	1,168,169	1,201,952	2,370,121
37+000	38+000	1,059,736	1,128,434	2,188,171
38+000	39+000	886,722	1,014,982	1,901,704
39+000	40+000	681,960	908,006	1,589,966
Sub Total 34 to 40km		5,941,571	6,594,945	12,536,516
40+000	41+000	515,281	778,111	1,293,391
41+000	42+000	372,171	627,780	999,951
42+000	43+000	222,509	421,734	644,244
43+000	44+000	80,221	179,180	259,400
44+000	44+300	3,551	8,342	11,893
Sub Total 40km and off-shore		1,193,732	2,015,146	3,208,878
Total		**13,183,606**	**16,598,660**	**29,782,265**

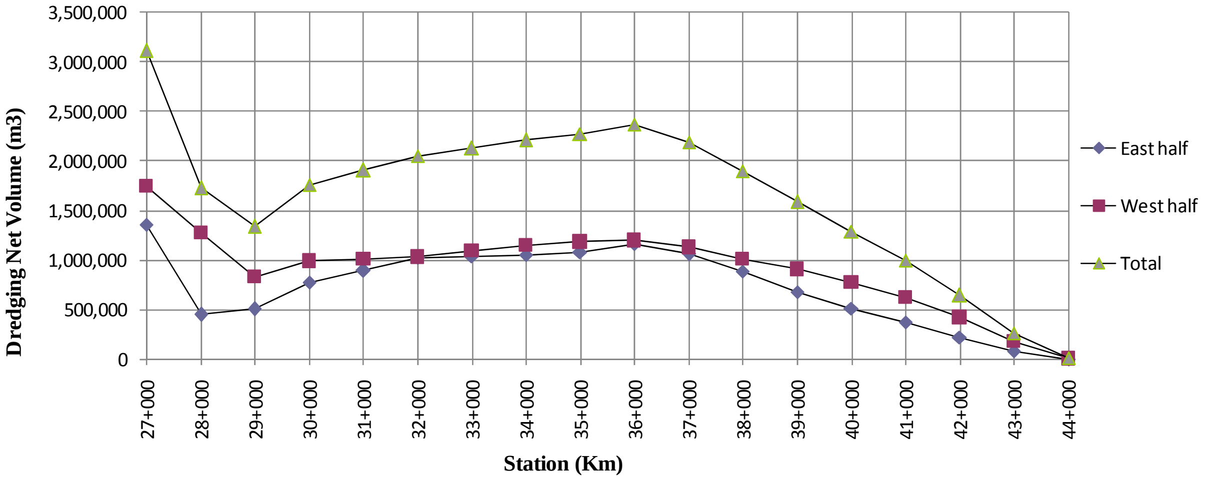


Figure 15.3.1 Net Volume of Channel Dredging by Area and Station

2) Extra Volume due to Extra Depth of the Channel for Annual Maintenance of Post Construction Period

Based on the output of the sedimentation simulation study, an extra depth margin was determined to cover the sedimentation volume due to two episodes of stormy weather and the sediments caused by average energy waves for a one-year period. The total volume of all station is 1,605,955 m^3, as shown in Table 15.3.2. The extra depth for sedimentation is shown in the last column of the same Table and in Figure 15.3.2 by the red line. The total extra volume due to extra depth is 1,873,757m^3 and included as a part of the initial dredging volume.

Table 15.3.2 Summary of Volume for Extra Depth of the Channel

Station		Extra depth for the volume of predicted sedimentation in the case with Sand Dyke			Averaged sedimentation thickness	Extra depth of sedimentation
from	to	Stormy weather considered two (2) times	Average Energy	Total		
(km + m)		(m3/year)			(m)	(m)
27+000	28+000	2,694	37,378	40,072	0.07	0.50
28+000	29+000	1,855	27,907	29,762	0.09	
29+000	30+000	1,846	28,272	30,118	0.19	
30+000	31+000	2,554	36,872	39,426	0.25	
31+000	32+000	3,754	40,971	44,725	0.28	
32+000	33+000	7,784	52,586	60,369	0.38	
33+000	34+000	13,937	69,834	83,771	0.52	
34+000	35+000	8,783	87,614	96,397	0.60	
35+000	36+000	26,352	89,930	116,282	0.73	0.80
36+000	37+000	56,998	101,255	158,254	0.99	
37+000	38+000	74,862	109,977	184,839	1.16	
38+000	39+000	73,374	92,811	166,185	1.04	
39+000	40+000	73,996	78,434	152,430	0.95	
Sub total	Up to 40 km	348,789	853,841	1,202,630		
40+000	41+000	75,518	60,658	136,176	0.85	0.50
41+000	42+000	70,749	38,494	109,242	0.68	
42+000	43+000	58,840	20,994	79,834	0.50	
43+000	44+000	45,445	12,177	57,621	0.36	
44+000	44+300	16,606	3,846	20,452	0.13	
Sub Total		267,158	136,168	403,326		
Total		615,947	990,009	**1,605,955**		

Note: Sand dike location is 100 m west side of the Channel with top height +3 m above seabed, length up to DL −5 m

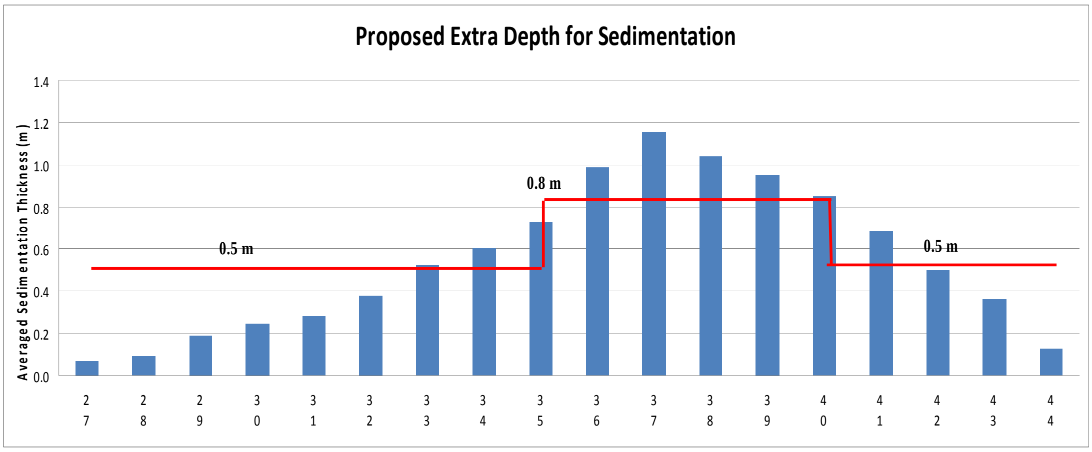


Figure 15.3.2 Distribution of Sediment Thickness by Station and Extra Depth for Sedimentation

3) Volume due to the sedimentation during initial dredging of the Channel

The sedimentation volume during the initial dredging period of three (3) years was determined based on a simulation study. The volume consists of sediment caused by average wave energy for a three-year period and sediment due to stormy weather assumed to occur once every year. The total volume of sediment for three (3) years for all Channel stations is 6,075,710 m³ as shown in the following Table.

Table 15.3.3 Predicted Sedimentation Volume during Initial Dredging Work Period

Station		Predicted sedimentation volume during initial dredging works period											
from	to	By Average Energy					By Stormy Weather						Grand Total
		Averaged Annual Sedimentation			Sedimentation Period	Predicted Sedimentation	4 times per year			1 time per year	Sedimentation Period	Predicted Sedimentation	
		Without Sand Dyke	With Sand	Average			Without Sand	With Sand	Average				
		(m^3)	(m^3)	(m^3)	(year)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(year)	(m^3)	(m^3)
27+000	28+000	101,691	34,834	68,263	3	204,788	33,929	7,063	20,496	5,124	3	15,372	220,160
28+000	29+000	199,649	30,026	114,838	3	344,514	39,070	8,024	23,547	5,887	3	17,660	362,174
29+000	30+000	77,098	35,317	56,207	3	168,622	31,615	9,771	20,693	5,173	3	15,520	184,142
30+000	31+000	59,861	43,516	51,688	3	155,065	25,844	14,551	20,198	5,049	3	15,148	170,214
31+000	32+000	81,272	50,973	66,123	3	198,368	29,630	25,836	27,733	6,933	3	20,800	219,168
32+000	33+000	93,487	65,612	79,550	3	238,649	36,082	35,960	36,021	9,005	3	27,016	265,665
33+000	34+000	130,291	87,660	108,975	3	326,926	72,680	80,059	76,369	19,092	3	57,277	384,203
34+000	35+000	144,586	111,583	128,085	3	384,255	106,570	97,971	102,270	25,568	3	76,703	460,957
35+000	36+000	219,677	112,787	166,232	3	498,696	162,663	125,280	143,971	35,993	3	107,979	606,674
36+000	37+000	292,575	116,665	204,620	3	613,861	218,323	170,578	194,450	48,613	3	145,838	759,698
37+000	38+000	161,839	138,214	150,027	3	450,080	230,385	201,497	215,941	53,985	3	161,956	612,036
38+000	39+000	126,264	130,466	128,365	3	385,094	211,550	194,231	202,890	50,723	3	152,168	537,262
39+000	40+000	98,445	121,768	110,106	3	330,319	196,273	180,455	188,364	47,091	3	141,273	471,592
40+000	41+000	74,953	86,407	80,680	3	242,040	189,343	192,035	190,689	47,672	3	143,017	385,056
41+000	42+000	47,384	51,706	49,545	3	148,634	173,963	204,964	189,463	47,366	3	142,097	290,731
42+000	43+000	25,744	27,523	26,633	3	79,900	143,671	180,676	162,173	40,543	3	121,630	201,530
43+000	44+000	14,899	15,587	15,243	3	45,728	110,202	146,493	128,348	32,087	3	96,261	141,989
44+000	44+300	4,696	4,871	4,784	3	14,351	38,306	57,914	48,110	12,028	3	36,083	50,434
Total		1,954,411	1,265,515	1,609,963	3	4,829,889	2,050,099	1,933,355	1,991,727	497,932	3	1,493,795	**6,323,684**

Note: Tolerance factor 1.22

4) Total dredging volume

Adding aforementioned items 1) to 3), the total dredging volume was obtained as shown in Table 15.3.4 and summarized hereunder:

1) Main Channel dredging volume	29,782,265 m³
2) Extra volume due to extra depth of the Channel	1,873,757 m³
Sub total	31,656,023 m³
3) Predicted sedimentation volume during initial dredging period	6,323,684 m³
Total initial dredging volume	37,979,707 m³

Of the above total dredging volume, the sub total of items 1) and 2) will be indicated in the Bid and Contract quantities (BOQ), while item 3) predicted sedimentation volume will be deemed inclusive in the unit cost of each dredging pay item.

Table 15.3.4 Total Dredging Volume

Station		Net Volume (m^3)						Extra Depth (m^3)		Sedimenta-tion (m^3)	Total (m^3)
from	to	East half (1st period)		West half (2nd period)		Total		East half	West half		
		Above -10m	Below -10m	Above -10m	Below -10m	Above -10m	Below -10m				
27+000	28+000	311,157	1,051,806	626,544	1,122,208	937,702	2,174,015	148,684	142,810	220,160	3,623,370
28+000	29+000	45,974	405,262	349,775	926,081	395,749	1,331,343	47,494	120,905	362,174	2,257,665
29+000	30+000	257,256	246,782	251,636	584,859	508,892	831,641	13,955	67,483	184,142	1,606,114
30+000	31+000	493,179	280,000	469,714	520,000	962,893	800,000	18,130	59,370	170,214	2,010,607
31+000	32+000	615,257	280,000	491,654	520,000	1,106,911	800,000	18,130	59,370	219,168	2,203,579
32+000	33+000	744,244	280,000	512,717	520,000	1,256,961	800,000	18,130	59,370	265,665	2,400,125
33+000	34+000	757,385	280,000	573,380	520,000	1,330,765	800,000	18,130	59,370	384,203	2,592,467
Sub Total		3,224,453	2,823,850	3,275,420	4,713,149	6,499,872	7,537,000	282,652.4	568,678.5	1,805,724.6	16,693,927
Volume of West half in front of the berth to be dredged in 1st period		395,246	233,184								
Total		3,619,699	3,057,034	2,880,173	4,479,965						
Total of Package 8		6,676,733		7,360,139		**14,036,872**		**851,330.9**		**1,805,725**	**16,693,927**
34+000	35+000	778,670	280,000	633,453	520,000	1,412,123	800,000	18,357	60,246	460,957	2,751,683
35+000	36+000	806,313	280,000	668,118	520,000	1,474,431	800,000	27,200	94,400	606,674	3,002,706
36+000	37+000	888,169	280,000	681,952	520,000	1,570,121	800,000	27,200	94,400	759,698	3,251,419
37+000	38+000	779,736	280,000	608,434	520,000	1,388,171	800,000	27,200	94,400	612,036	2,921,807
38+000	39+000	606,722	280,000	494,982	520,000	1,101,704	800,000	27,200	94,400	537,262	2,560,566
39+000	40+000	401,960	280,000	388,006	520,000	789,966	800,000	27,200	94,400	471,592	2,183,158
Sub Total		4,261,571	1,680,000	3,474,945	3,120,000	7,736,516	4,800,000	154,357	532,246	3,448,219	16,671,338
Sub total of Pack 9		5,941,571		6,594,945		12,536,516		686,602.5		3,448,219	16,671,338
40+000	41+000	515,281		778,111		1,293,391		18,357	60,246	385,056	1,757,050
41+000	42+000	372,171		627,780		999,951		18,130	59,370	290,731	1,368,182
42+000	43+000	222,509		421,734		644,244		18,130	59,370	201,530	923,273
43+000	44+000	80,221		179,180		259,400		18,130	59,370	141,989	478,889
44+000	44+300	3,551		8,342		11,893		5,852	18,870	50,434	87,048
Sub total		*1,193,732*		*2,015,146*		*3,208,878*		78,599	257,226	1,069,740	4,614,442
Sub total of Pack 9						*3,208,878*		335,824		1,069,740	4,614,442
Total of Package 9		*7,135,303*		*8,610,091*		***15,745,394***		**1,022,427**		**4,517,960**	**21,285,780**
Total		**13,812,036**		**15,970,230**		**29,782,265**		**1,873,757**		**6,323,684**	**37,979,707**

15.3.2 Dredging Methodology

1) General

In consonance with the Decision of the MOT, the Channel dredging work was determined in this Detail Design (D/D) study to be carried out using a diversion channel within the cross-sectional area of the Channel. The potential dumping site of the dredged soil will be off-shore.

2) Conditions to be considered for dredging works

The actual type of the dredgers will be proposed by the dredging contractor. In this D/D, therefore, the most appropriate types of dredgers were determined for study purposes, considering the following points:

1. Big dredging volume (37 million m³ including predicted sedimentation volume)
2. Required dredging work duration to be completed within 3 years
3. Configuration of the Channel (17 km long, 160 m width, -14 m deep)
4. The dredging works should be carried out beside the diversion channel within the cross-sectional area of the planned Channel, while commercial ships are running, thus limiting working space which needs to be shifted from the east navigation lane to the west and vice versa, from time to time.
5. The potential dumping site at off-shore water area.
6. Environmental consideration to minimize the turbid sea water
7. Two (2) contract packages for the Channel dredging works.

3) Diversion channel and dredging methodology

Diversion channels are determined to allow passage of maritime traffic in the existing Lach Huyen channel with a width of 100 m and a depth of -7 m. The layout plan and cross sections of the diversion channel are shown in Figure 15.3.4 and Figure 15.3.8.

By means of the diversion channel, the dredging methodology is enumerated as per the following sequence:

For the area of Sta 27 km+000 to Sta 40 km+000

1. East half, which is the area on the east side of the east edge of the existing channel. (Red zone indicated in Figure 15.3.4 through Figure 15.3.8)
2. West half, which is the area on the west side of the east edge of the existing channel. (Green zone indicated in Figure 15.3.4 through Figure 15.3.8)

For the area of Sta 40 km+000 to Sta 44 km+300

3. Entire width of the Channel. (Green zone indicated in Figure 15.3.8)

The dredging will be carried out in the following steps:

a) For the area of Sta 27 km+000 to Sta 40 km+000 (See Figure 15.3.4 through Figure 15.3.8)

Step 1: Pre-construction survey for the entire dredged area. (First period)

Step 2: The east half (Red zone) will be dredged down to roughly the designated Channel depth together with slope depth. (First period)

Advance dredging to CD-14.5 m with 50 m width along the berth box in between Sta.27+000 and Sta.27+840 will be made during the first period.

Step 3: Tentative post-construction survey for east half (Red zone) (First period).

Step 4: Tentative pre-construction survey for west half (Green zone) done simultaneously with Step 3. (Second period)

Step 5: Navigation buoys preparation and installation (newly purchased or relocated) to indicate the east side diversion channel (area shown in orange).

Step 6: Diversion of the marine traffic from the existing channel (area shown in yellow) to the east side diversion channel (area shown in orange).

Step 7: The west half (Green zone) will be dredged down to the designated Channel depth together with slope depth. (Second period)

Step 8: Tentative post-construction survey for west half (Green zone) (Second period).

Step 9: Tentative pre-construction survey for finish dredging of east half (Red zone) done simultaneously with Step 8. (Second period)

Step 10: Diversion of the marine traffic from the east side diversion channel (area shown in orange) to the existing channel (area shown in yellow).

Step 11: Finish dredging works for east half down to the designated Channel depth together with slope depth. (Second period)

Step 12: Post-construction survey for the entire Channel area (Red and Green zones) (Second period). Release of the contractor from maintenance of east half will follow.

b) For the area of Sta 40 km+000 to Sta 44 km+300 (Second period)

Step 13: (simultaneously with Step 1) Pre-construction survey for entire Channel area.

Step 14: Dredging works for the entire Channel area down to the designated Channel depth together with slope depth. (Second period)

Step 15: (simultaneously with Step 12) Post-construction survey for the entire Channel area (Second period). Release of the contractor from maintenance will follow.

Figure 15.3.3 Offshore Dumping Site

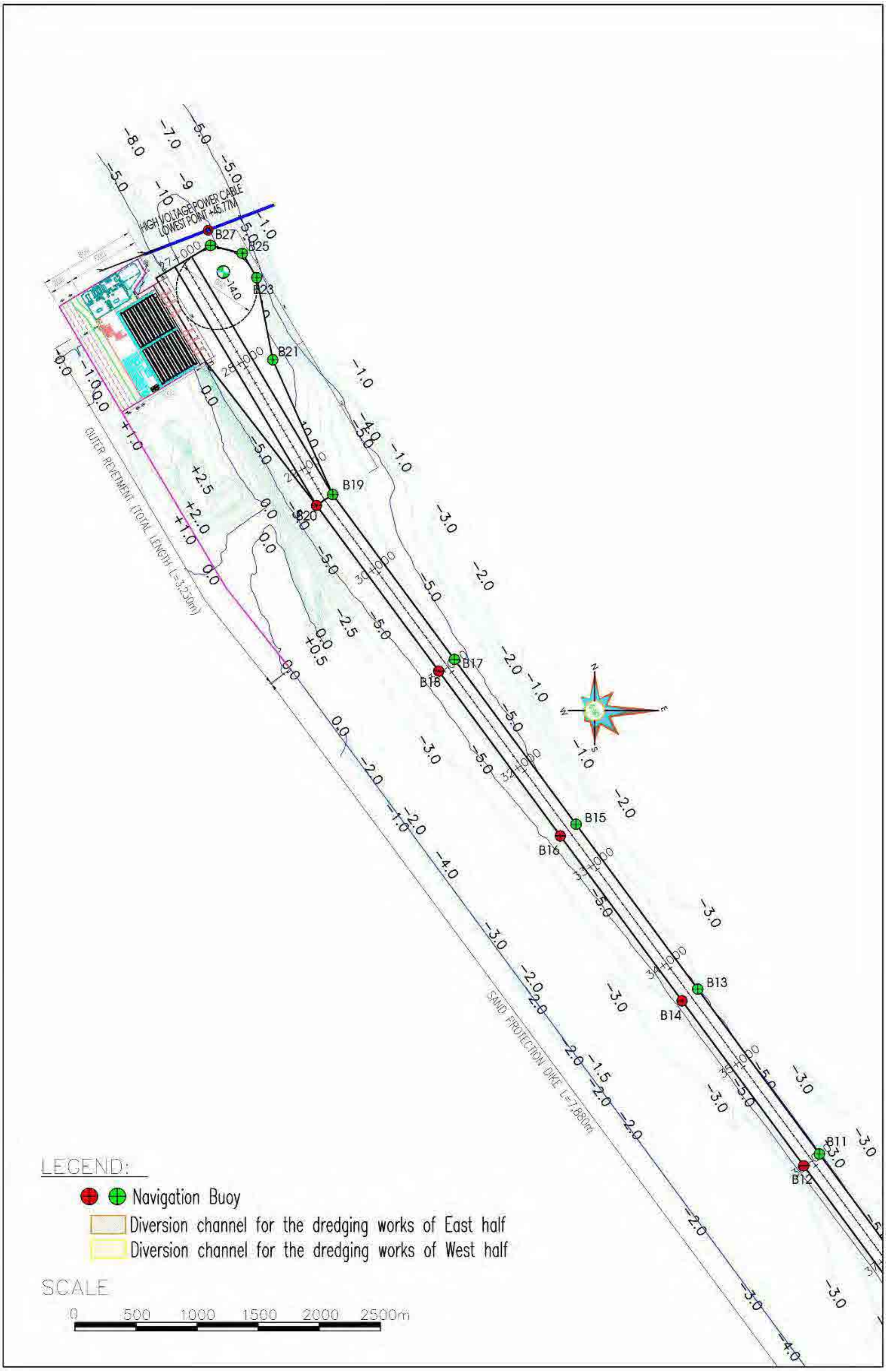


Figure 15.3.4 General Layout Plan of the Diversion Channel within Cross-sectional Area of the Channel (1)

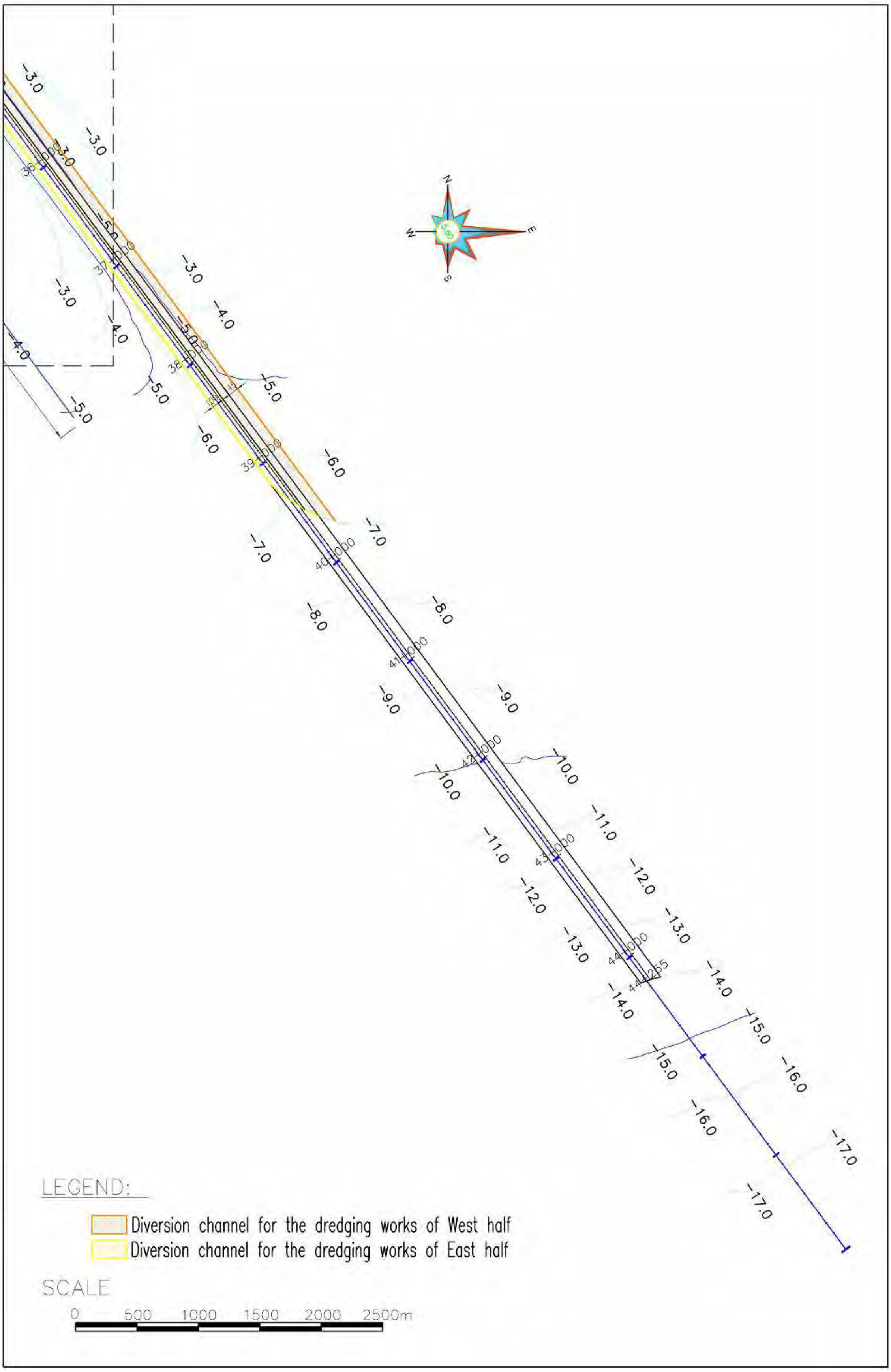


Figure 15.3.5 General Layout Plan of the Diversion Channel within Cross-sectional Area of the Channel (2)

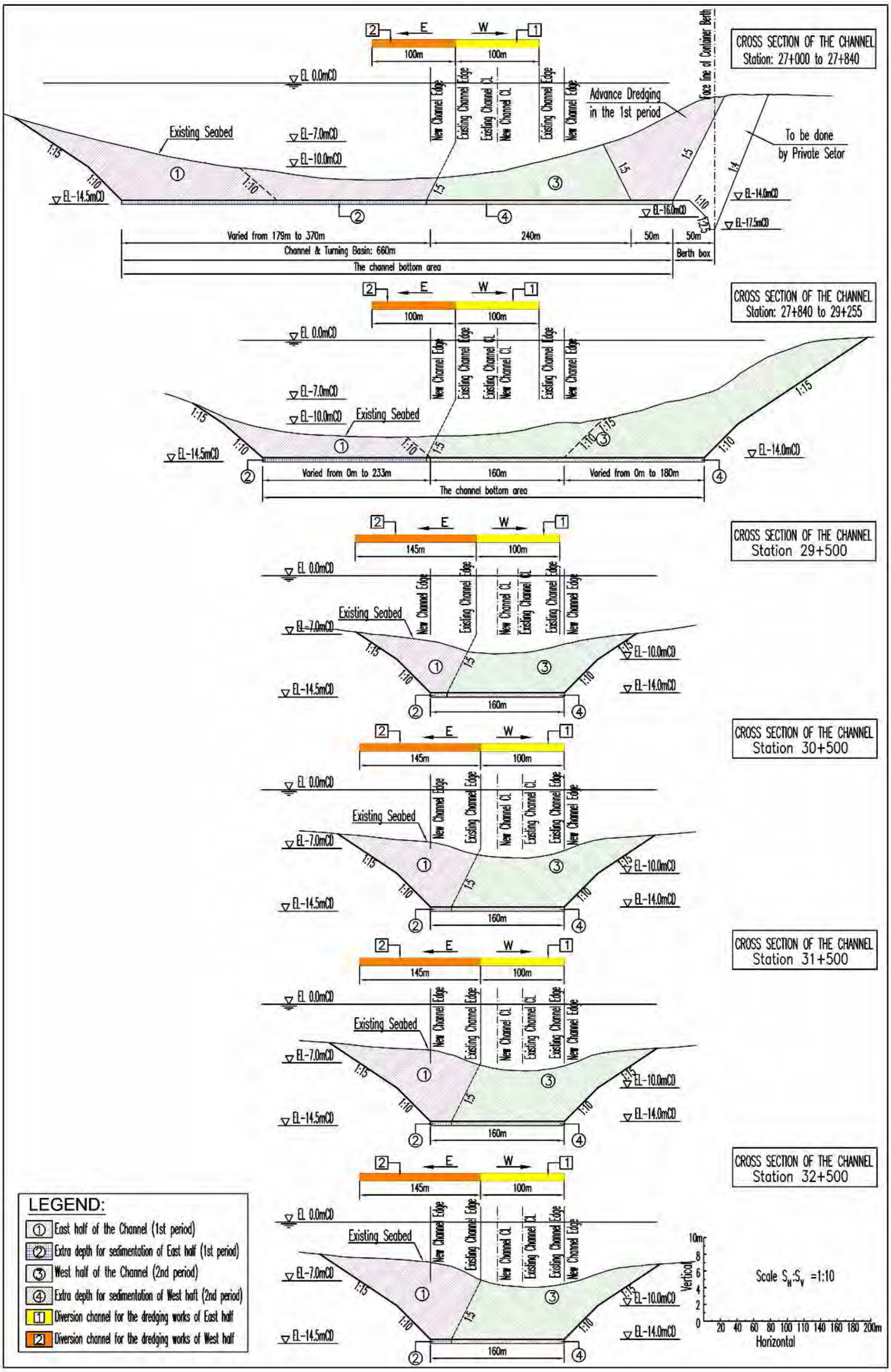


Figure 15.3.6 Cross Sections of the Diversion Channel within Cross-sectional Area of the Channel (1)

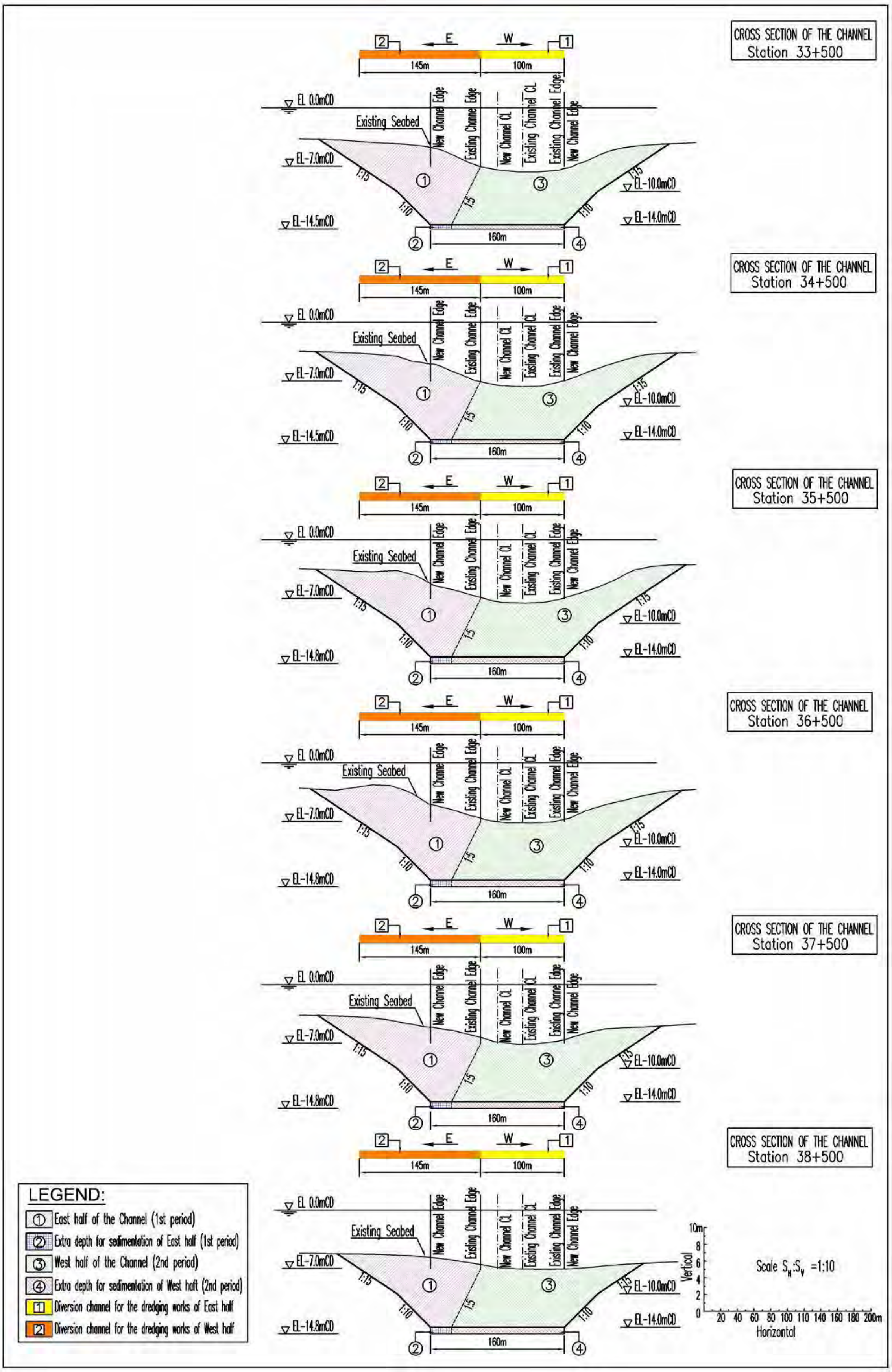


Figure 15.3.7 Cross Sections of the Diversion Channel within Cross-sectional Area of the Channel (2)

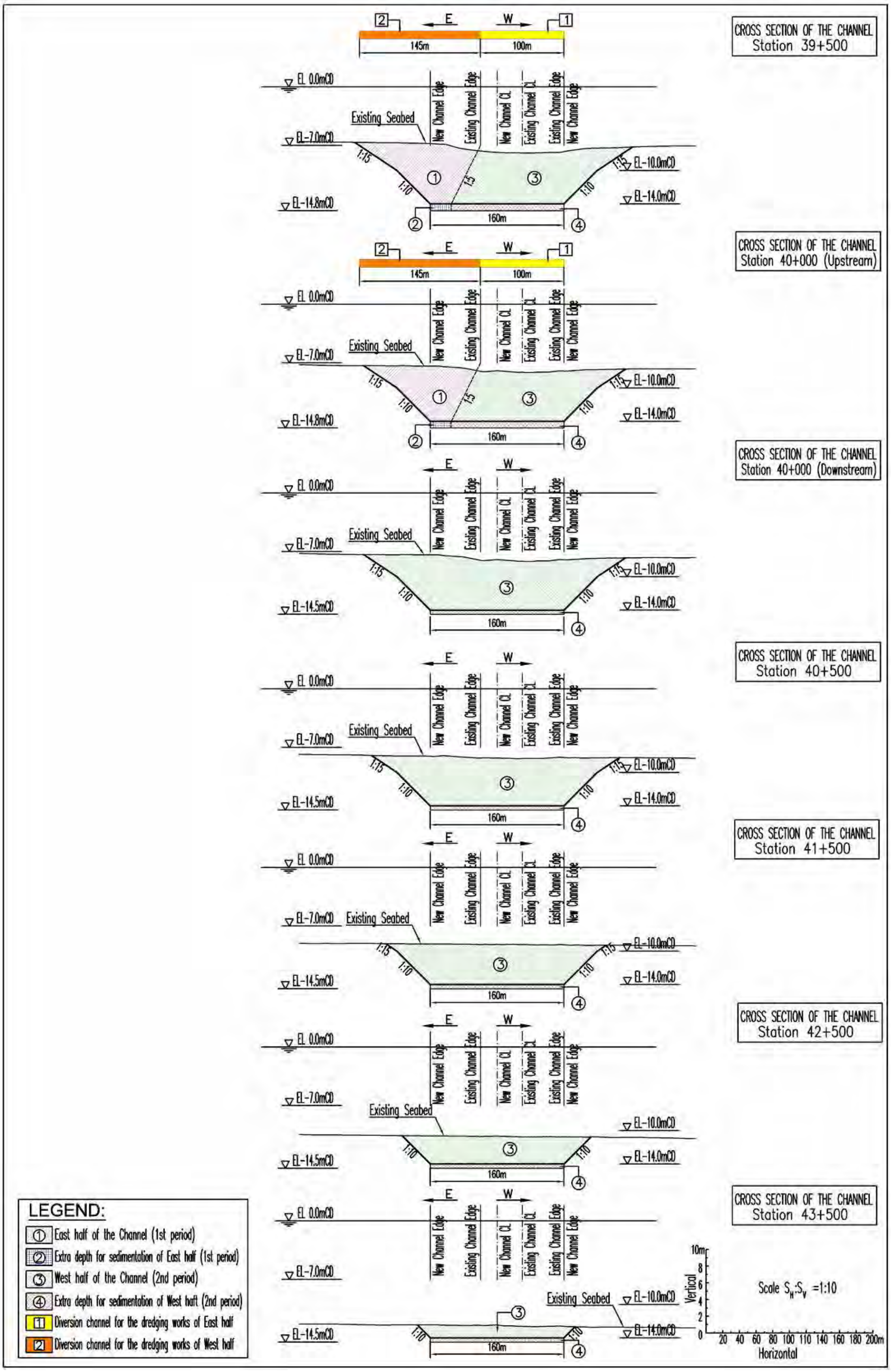


Figure 15.3.8 Cross Sections of the Diversion Channel within Cross-sectional Area of the Channel (3)

c) For the area of Sta 27 km+000 to Sta 29 km+560 (Second period)

Existing high voltage electric power cables cross above the navigation channel along the land-side edge of the turning basin at around Sta. Km 26+900. The cables are supported in the air by tall towers and sag to height of CD+45.77 m above water level at the lowest point. The location of the power cables and the lowest point are indicated by the red points in Figure 15.3.4 and Figure 15.3.9. In order for commercial ships to avoid the power cables, temporary diversion of the navigational fairway will be required. A sample of the channel diversion plan was determined and summarized as shown in Figure 15.3.9. In this plan, the diversion channel will be shifted during the 2nd Dredging Period (in which the west side of the Channel will be dredged) as indicated in Figure 15.3.9 from the (Existing) channel to (2A), (2B), and (2C). The dredging works therein will be carried out in consonance to the diversion channel shifting.

Aside from the above diversion, advance dredging during the 1st Dredging Period will be required along the east side of the berth box to allow for the private sector working on the berth structure construction. The location of the advance dredging area and berth box are indicated in Figure 15.3.9. (see Existing Channel plan) The corresponding volume of advance dredging is indicated in Table 15.3.4.

Photograph of high voltage towers and cables crossing the Channel. The photograph was taken from Cat Ba Island. Cat Hai side can be seen in the distance.

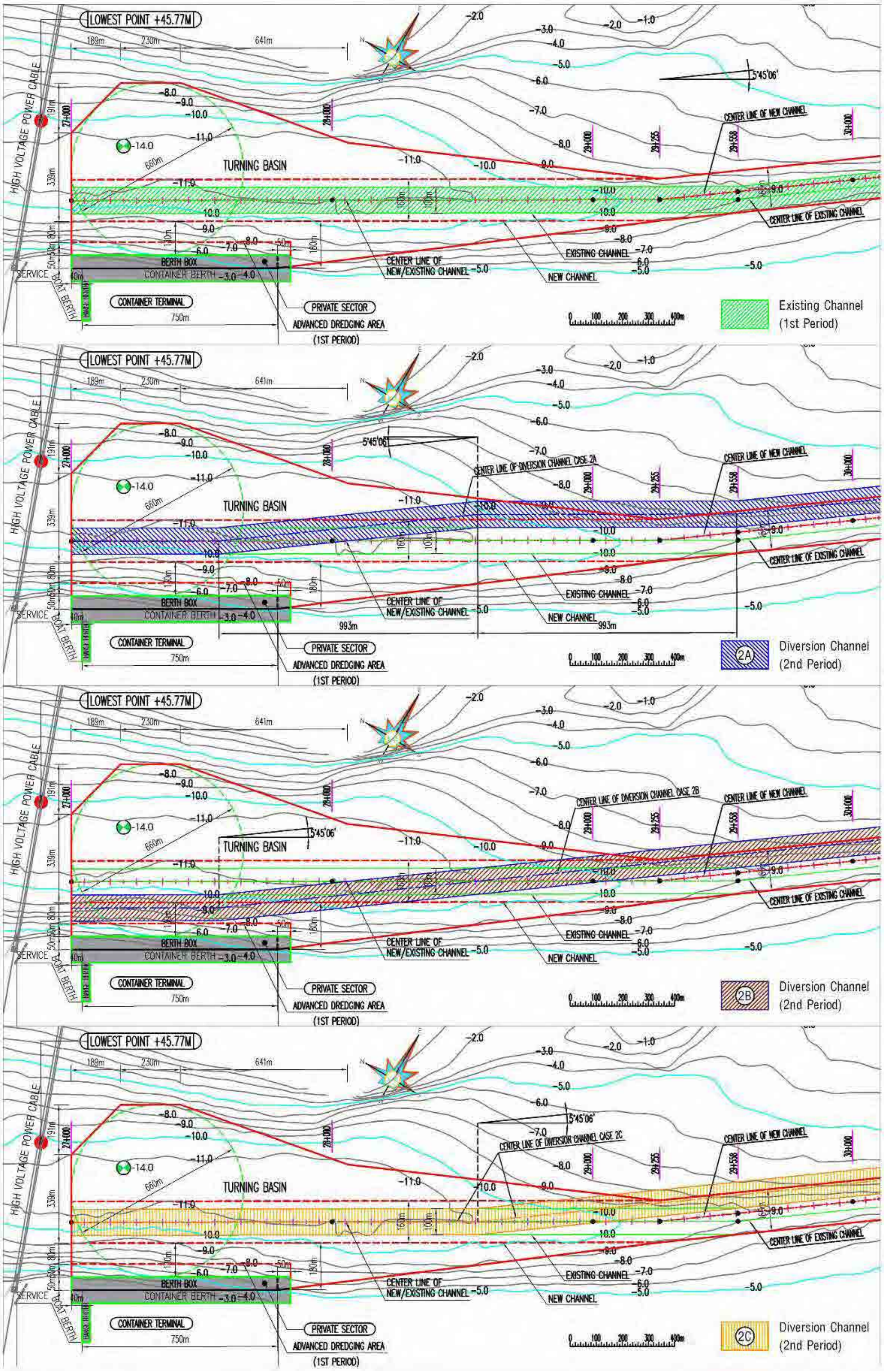


Figure 15.3.9 Sample of Channel Diversion Plan for avoiding High Voltage Cables

15.3.3 Type of Dredgers

Taking the restricted working conditions as described in previous “Section 15.3.2 Dredging methodology”, the combination of dredging fleet in the following Table 15.3.5 has been determined as the having the most potential. For the particulars and comparison of types of dredgers, refer to Chapter 12.1.

Table 15.3.5 Types of Dredgers

Station	Potential Type of dredger		No of unit
27 km+000 to 40 km+000	Grab Dredger (GD) fleets	GD 23m3	**4**
		Hopper barge 1,300 m3 with pusher tug boat	**16**
	Trailing Suction Hopper Dredger (TSHD) 16,000 m3		**2**
	Trailing Suction Hopper Dredger (TSHD) 3,500 m3		**4**
40 km+000 to 44 km+300	Cutter Suction Dredger (CSD) fleet	CSD 8,000 ps with low hydraulic head ladder suction pump	**1**
		Hopper barge 5,000 m3 with pusher tug boat	**2**

15.3.4 Productivity of Dredgers

The productivity of each type of dredger is summarized in Table 15.3.6 and Table 15.3.7.

Table 15.3.6 Productivity of Dredgers (1)

CSD (Cutter Suction Dredger)				
Power				D 8,000 ps
Discharge method				Direct discharge to hopper barges
Classification of the soil				Cohesive soil
Dredging position				Lach Huyen Channel, thin layer
Daily stand-by time			hr	0
Average N-value				5
Distance of discharge			km	0
Basic capacity of the dredger		q	m3/hr	2,800
Work efficiency	Dredging	E1		1.0
	Thickness of layer	E2		0.7
	Configuration of the dredging area	E3		1.0
	Cross section	E4		1.0
	Oceanographical Conditions	E5		0.9
	etc.	E6		0.9
	Ratio for idling	E7		0.9
Working hour per day		T	hr	16
Daily stand-by hours			hr	0
Daily stand-by ratio		Sr		0
Daily productivity: Q=(q x E1 x E2 x E3 x E4 x E5 X E6 x T)X(1-Sr)			m3 /day	**21,230**

GD (Grab Dredger)			
Type of dredger			GD
Grab bucket size			23m3
Discharge method			Hopper barge
Classification of the soil			Cohesive soil
Dredging position			Lach Huyen channel
Basic capacity of the dredger	q	m3/hr	787
Work efficiency (Thickness of	E1		0.85
Work efficiency	E2		0.95
Work efficiency (Water depth)	E3		1
Ratio for idling	E4		0.9
Working hour per day	T	hr	16
Daily stand-by hours		hr	0
Daily stand-by ratio	Sr		0
Daily productivity:	Q	m3/day	**9,150**

Source: (Tables 15.3.5 and !5.3.6)

1) Port and harbors construction cost estimation standards (2010,Japan)
2) Cost Standards for dredging equipment, 2005, R. N. Bray
3) Hearing to marine contractors

Table 15.3.7 Productivity of Dredgers (2)

TSHD (Trailing Suction Hopper Dredger)				
Hopper size			**16,000 m3**	**3,500 m3**
Hopper size		m3	16,000	3,500
Effective mud ratio			0.4	0.4
Effective soil volume	(1)	m3	6400	1400
Dumping site			Off shore	Off shore
Distance to dumping site		nm	14	14
of which dist. Within the channel		nm	8	8
Speed within the channel		knot	8	8
Running time within the channel		hr	1	1
Distance of outer sea		nm	6	6
Speed outer sea		knot	14	14
Running time outer sea		hr	0.43	0.4
Running time round trip		hr	2.86	2.9
Dredging time		hr	3.00	3.0
Dumping time		hr	0.50	0.5
Waiting time for existing ships		hr	1.00	1.0
Total cycle time		hr	7.36	7.4
Daily working time		hr	24	24
Number of daily trip	(2)	times	3.26	3.3
Oceanographical Conditions	(3)		0.9	0.9
Ratio for idling	(4)		0.9	0.9
Day off ratio	(5)		0.9	0.9
Daily stand-by hours		hr	0	0
Daily stand-by ratio	Sr		0	0
Daily productivity: Q=(1) x (2) x (3) x (4) x (5)x(1-Sr)		m3/day	**14,660**	**3,210**

15.3.5 Dredging Period and Volume

On the basis of the descriptions in the previous Section 15.3.2 “Dredging methodology”, 1) Net dredging volume, 2) Volume for extra depth, and 3) Sedimentation volume during initial dredging volume, the construction has been divided into two periods as shown in Table 15.3.8. The contract package is assumed to be two (2) packages with 2 to 3 pay items each as shown in the last column of Table 15.3.8.

Table 15.3.8 Provable Type of Dredgers by Segment Volumes and relevant Bid/Contract Pay Items

Package	Station No.			Item of volume		Net volume		Extra Depth	Volume for Extra depth of sedimentation		Area Ratio in the Package	Average sediment volume per package/year	Sediment period	Volume Ratio in the Package		Predicted sedimentation		Total					Bid/ Contract	
	from	to	total dist.													Total volume							Number of Contract	Pay Item No.
						Above -10 m	Below -10 m		Above -10 m	Below -10 m				Above -10 m	Below -10 m	Above -10 m	Below -10 m	Local Dredger	GD	TSHD	CSD	Total		
						(1)		(2)	(3)		(4)	(5)	(6)	(6*)		(7)		(10)						
																(7)=(4)x(5)x(6)x(6*)		(1)+(3)+(7)						
	(km+m)		(km)			(m3)		(m)	(m3)			(m3/year)	(Year)			(m3)		(m3)						
8	26 +930	34	7.1	1st Period	East half	3,619,699	3,057,034	0.5		282,652	0.44	601,908	1.300	1.0		344,291		730,368	6,573,310		-	7,303,677	1	1
				2nd Period	West half	2,880,173	4,479,965	0.5		568,678	0.56	601,908	3.000	0.4	0.6	404,482	606,723	894,002	2,956,190	5,089,831	-	8,940,023		2
					Sedimentation of 2nd period for East half						0.44	601,908	1.700		1.0		450,227	450,227			-	450,227		
					Sub Total (2nd period)	2,880,173	4,479,965			568,678						404,482	1,056,951	1,344,230	2,956,190	5,089,831	-	9,390,250		
				Total (1st+ 2nd Periods)		**6,499,872**	**7,537,000**			**851,331**						**748,774**	**1,056,951**	**2,074,597**	**9,529,500**	**5,089,831**	**-**	**16,693,927**		
9	34	40	6	1st Period	East half	4,261,571	1,680,000	0.5 & 0.8		154,357	0.46	1,149,406	1.300	1.0		687,345		678,327	6,104,945		-	6,783,272	1	1
				2nd Period	West half	3,474,945	3,120,000	0.5 & 0.8		532,246	0.54	1,149,406	3.000	0.52	0.48	968,260	893,778	898,923	3,998,885	4,091,422	-	8,989,229		2
					Sedimentation of 2nd period for East half						0.46	1,149,406	1.700		1.0		898,836	898,836			-	898,836		
					Sub Total (2nd period)	3,474,945	3,120,000			532,246						968,260	1,792,614	1,797,759	3,998,885	4,091,422	-	9,888,065		
				Total (1st+ 2nd Periods)		**7,736,516**	**4,800,000**			**686,603**						**1,655,605**	**1,792,614**	**2,476,086**	**10,103,830**	**4,091,422**	**-**	**16,671,338**		
	40	44 +300	4.3	2nd Period	Whole area (East + West)	**3,208,878**		**0.5**	**335,824**		**1.00**	**356,580**	**3.000**			**1,069,740**					**4,614,442**	**4,614,442**		3
Sub total				1st Period		12,618,304			437,009							1,031,637		14,086,950				14,086,950		
				2nd Period		17,163,962			1,436,748							5,292,048		23,892,757				23,892,757		
																		4,550,683	**19,633,329**	**9,181,252**	**4,614,442**	**37,979,707**		
Total			17.4	Total (1st+ 2nd Periods)		**29,782,265**			**1,873,757**							**6,323,684**		**37,979,707**				**37,979,707**	2	

15.3.6 Schedule of Dredging Works

The schedule of dredging works was determined based on the potential composition of the dredging fleet, corresponding productivity and environmental aspects into consideration. The environmental impact of turbid water was determined to be minimized by composition and number of dredgers. The potential composition of dredging fleet for each Contract Package and harmonized time schedule were indicated in Table 15.3.9.

As described in the previous Section 15.3.2 “Dredging methodology”, the working time is divided into two (2) periods. The first period is for the east half of the Channel and the second period is for the west half of the Channel for Station 27 km to 40 km and the succeeding finish dredging works. The area of Station 40 km to 44 km+350 (offshore portion) will be dredged in the second period since the existing water depth of the offshore portion is deeper than -7 m and does not require provision of a diversion channel.

After the completion of the first period (east half), maritime ship traffic will be diverted from the existing channel to the east-side diversion channel.

After the completion of the west half, the second maritime ship diversion will be done at this time from the west to east diversion channel, and the final dredging will be carried out for the east half. The final post-construction survey and demobilization of the dredging fleet will follow.

The particulars of the dredging works are summarized below: (see Table 15.3.9)

1. Working time:	1st period	14.0 months
	2nd period	21.6 months
	Total period	35.6 months
2. Dredging volume	1st period	14,086,950 m^3
	2nd period	23,892,757 m^3
	Total period	37,979,707 m^3

3. Number of diversions for maritime ships during construction period: 2 times

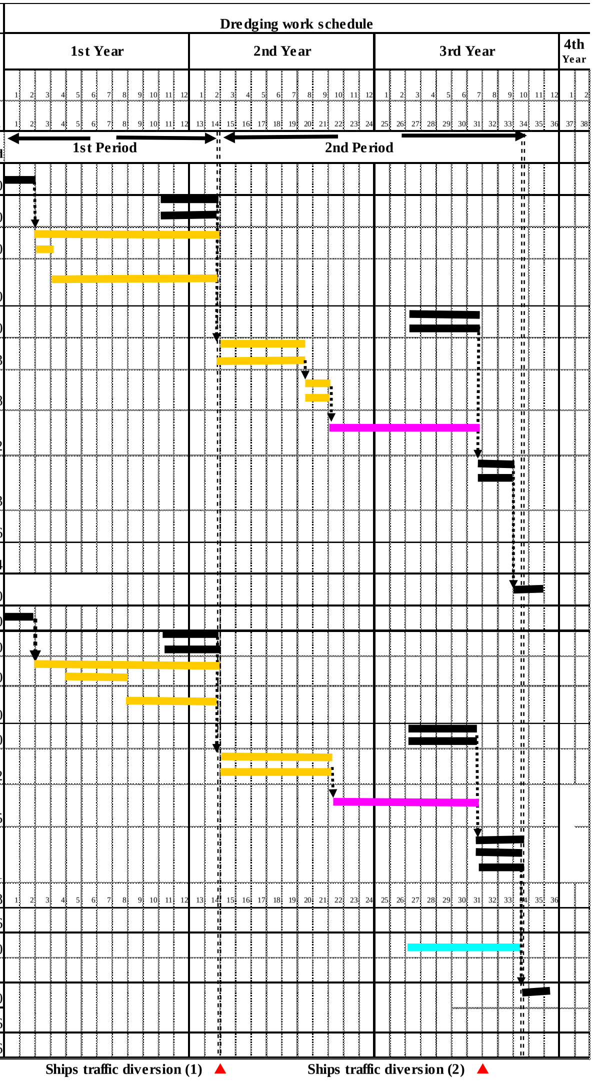
15.3.7 Soil conditions

The Channel dredging soil characteristics represented volume-wise by soil classification and N-value (SPT: Standard Penetration Test) are shown in Table 15.3.10 and Figure 15.3.10.

The composition between cohesive and sandy soil is 86% to 14% while the composition of the hardness (N-value) among the cohesive soil is (N<5) : (5<N<19) : (10<N<15) = 83% : 15% : 2%. This shows that the dredging soil mainly consists of soft cohesive soil, which can be dredged by GD, CSD or TSHD. For the offshore area at Sta 40 km to Sta 44 km, all soil consists of soft mud, and CSD is the most suitable and has the lowest cost. In this D/D study, the efficiency of the dredgers is determined with an average N-value = 5.

Table 15.3.9 Schedule of Dredging Works (Dumping off-shore)

Package	Station No.			Item of volume		Dredging volume				Type of Dredger	Productivity	No of dredging fleet	Duration		
	from	to	total dist.			Net volume	Volume for Extra depth of sedimentation	Predicted Sedimentation	Total				For each work	Critical path	
	(km+m)		(km)			(m3)	(m3)	(m3)	(m3)		(m3/day/ fleet)		(day)	(day)	month
															Dredging Period
8	26 + 930	34	7.1	Mobilization									60	60	2.0
				1st Period	East half	6,676,733	282,652	344,291	730,368	TSHD 3,500 m^3	3,210	2.0	114	0	0.0
									3,567,592	GD 23 m^3	9,150	1.1	361	361	12.0
									3,005,718	GD 23 m^3 (below -10 m)	9,150	1.0	328	0	0.0
				2nd Period	West half	7,360,139	568,678	1,011,206	894,002	TSHD 3,500 m^3	3,210	2.0	139	0	0.0
									2,956,190	GD 23 m3	9,150	2.0	162	162	5.3
									1,000,000	GD 23 m^3 (below -10 m)	9,150	2.0	55	55	1.8
									4,089,831	TSHD 16,000m^3 (below -10 m)	14,660	1.0	279	279	9.2
					Sedimentation of the 2nd period for East half			450,227	450,227	TSHD 3,500 m^3	3,210	2.0	70	70	2.3
					Sub Total (2nd period)	7,360,139	568,678	1,461,433	9,390,250					565	18.6
				Total (1st+ 2nd Periods)		14,036,872	851,331	1,805,725	16,693,927					986	32.4
	Inspection survey/demobilization												60	60	2.0
9	34	40	6	Mobilization									60	60	2.0
				1st Period	East half	5,941,571	154,357	687,345	678,327	TSHD 3,500 m3	3,210	2	106	0	0.0
									4,454,024	GD 23 m^3	9,150	1.4	361	361	12.0
									1,650,921	GD 23 m^3 (below -10 m)	9,150	1.0	180	0	0.0
				2nd Period	West half	6,594,945	532,246	1,862,038	898,923	TSHD 3,500 m^3	3,210	2	140	0	0.0
									3,998,885	GD 23 m^3	9,150	2.0	219	219	7.2
									4,091,422	TSHD 16,000m^3 (below -10 m)	14,660	1.0	279	290	9.5
					Sedimentation of the 2nd period for East half	0	0	898,836	898,836	TSHD 3,500 m^3	3,210	3	93	93	3.1
					Sub Total (2nd period)	6,594,945	532,246	2,760,874	9,888,065					602	19.8
				Total (1st+ 2nd Periods)		12,536,516	686,603	3,448,219	16,671,338					962	31.6
	40	44 + 300	4.3	2nd Period	Whole area	3,208,878	335,824	1,069,740	4,614,442	CSD 8,000 ps	21,230	1	217	0	0.0
					Total (2nd period)										
	Inspection survey/demobilization												60	60	2.0
	Total (1st+ 2nd Periods)					15,745,394	1,022,427	4,517,960	21,285,780					1,082	35.6
Total						29,782,265	1,873,757	6,323,684	37,979,707					1,082	35.6



Legend
🟧 GD (Grab Dredger) 23m^3,
🟦 CSD (Cutter Suction Dredger) 8,000 P.S
🟪 TSHD (Trailing Suction Hopper Dredger)>16,000m^3
⬛ TSHD (Trailing Suction Hopper Dredger) 3,500m^3

Table 15.3.10 Soil Characteristics Distribution with N-Value by Net Dredging Volume

Station		Net Volume by N-Value (m^3)								Total
		East half				West half				
		Mud	Clayey soil		Sand	Mud	Clayey soil		Sand	
from	to	N<5	5<N<10	10<N<15		N<5	5<N<10	10<N<15		
27+000	28+000	688,419	807,428	0	0	682,940	935,664	0	0	3,114,451
28+000	29+000	0	300,253	0	98,913	0	968,877	0	212,321	1,580,364
29+000	30+000	340,776	72,272	0	50,446	384,659	294,241	0	192,759	1,335,153
30+000	31+000	697,172	54,473	0	0	852,198	176,254	0	0	1,780,097
31+000	32+000	741,226	86,532	20,037	37,227	692,366	199,670	45,066	128,013	1,950,138
32+000	33+000	873,580	0	53,312	87,084	711,868	0	109,085	261,517	2,096,445
33+000	34+000	967,960	0	0	71,193	914,951	0	0	226,118	2,180,223
Sub Total		*4,309,133*	*1,320,957*	*73,349*	*344,863*	*4,238,982*	*2,574,707*	*154,151*	*1,020,729*	*14,036,871*
		6,048,303				*7,988,568*				
34+000	35+000	986,847	0	13,927	62,799	926,252	0	26,906	190,212	2,206,943
35+000	36+000	649,642	0	34,499	407,816	786,044	0	96,634	299,432	2,274,066
36+000	37+000	531,078	0	0	659,816	784,083	0	0	409,542	2,384,519
37+000	38+000	702,766	0	0	375,429	900,509	0	0	233,353	2,212,057
38+000	39+000	705,991	0	0	158,261	926,138	0	0	107,601	1,897,992
39+000	40+000	652,700	0	0	0	908,239	0	0	0	1,560,938
Sub Total		*4,229,023*	*0*	*48,426*	*1,664,121*	*5,231,265*	*0*	*123,540*	*1,240,141*	*12,536,516*
		5,941,571				*6,594,945*				
40+000	41+000	532,512	0	0	0	774,260	0	0	0	1,306,772
41+000	42+000	372,380	0	0	0	629,400	0	0	0	1,001,780
42+000	43+000	211,099	0	0	0	420,880	0	0	0	631,979
43+000	44+000	74,370	0	0	0	181,147	0	0	0	255,518
44+000	44+300	3,371	0	0	0	9,458	0	0	0	12,829
Sub Total		*1,193,732*	*0*	*0*	*0*	*2,015,146*	*0*	*0*	*0*	*3,208,878*
		1,193,732				*2,015,146*				
Grand Total		9,731,888	1,320,957	121,775	2,008,984	11,485,392	2,574,707	277,691	2,260,870	29,782,265
		13,183,605				16,598,659				29,782,265

	Total				Total
	Mud	Clayey soil		Sand	
	N<5	5<N<10	10<N<15		
	21,217,280	3,895,664	399,466	4,269,854	29,782,265
	71%	13%	1%	14%	100%
Cohesive soil	25,512,410			NA	25,512,410
	83%	15%	2%		100%

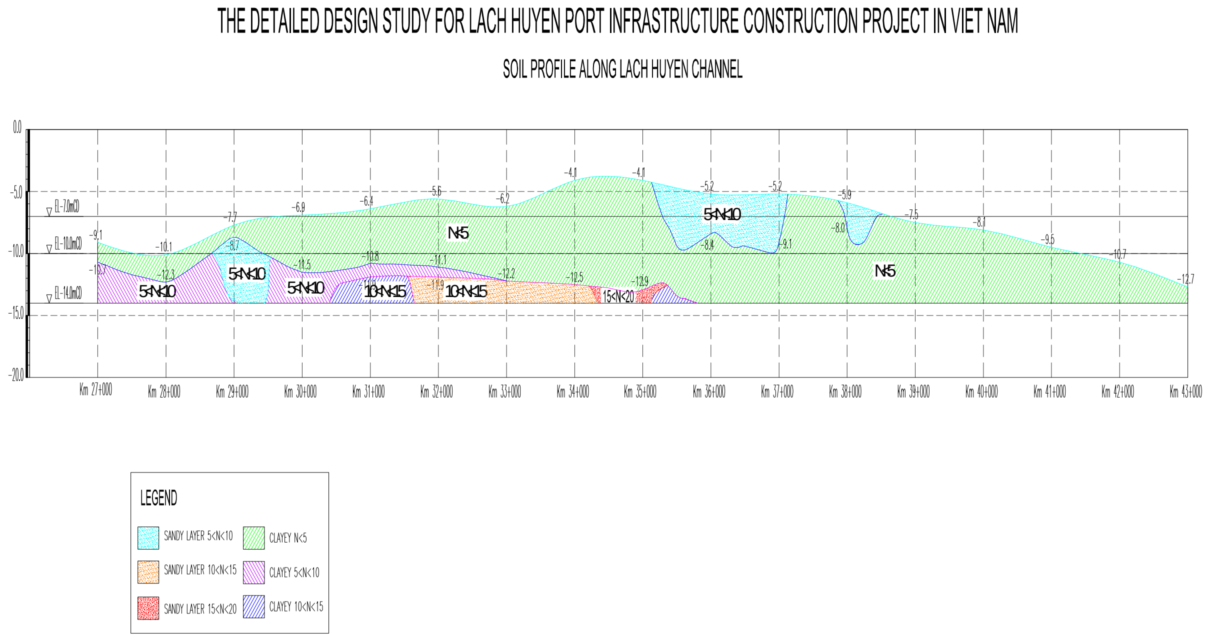


Figure 15.3.10 Soil Profile along the Channel

15.3.8 The Channel Slope Stability against Circular Slip Failure

The channel slope stability against the circular slip failure by the self weight of the seabed soil was examined in this section. Two (2) slope stabilities were determined: 1) for the Channel side slope stability for a completed slope of 1:10 inclination, and 2) for the Channel center slope expected to appear during the initial dredging works period along the East edge of the existing channel between the 1st and 2nd dredging period. The outputs of the calculations are given in Figure 15.3.11 to Figure 15.3.14.

The conditions of the calculation and the results are summarized in the following Table.

Table 15.3.11 Results of Calculation on Circular Slip Failure on the Channel Slope

Case	Location	Seabed configuration			Soil condition					Calculation results		
		Slope	Height		Cohesion (kN/m2)		φ :Phi: Internal friction angle (˚)	Unit weight (kN/m3)				
		Inclination	Slope top	Slope bottom	Upper layer	Lower layer		Upper layer	Lower layer	Safety factor	Partial factor	Remarks
1	Side slope	1:10	-3 m	-14 m	3	40	0	16	18	1.22	>1.1	OK
2	Side slope	1:10	-3 m	-14 m	7	40	0	16	18	2.90	>1.1	OK
3	Center slope	1:5	-7 m	-14 m	7	40	0	16	18	3.25	>1.1	OK
4	Center slope	1:3	-7 m	-14 m	7	40	0	16	18	2.41	>1.1	OK

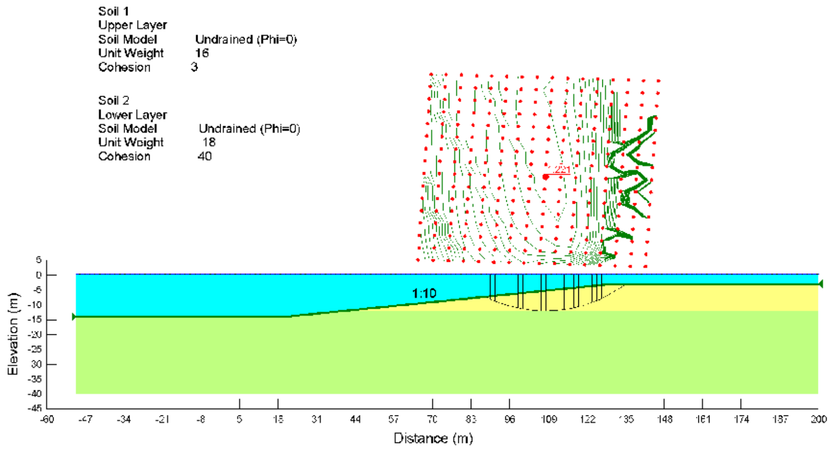


Figure 15.3.11 Safety Factor against Circular Slip Failure on the Channel Side Slope (Case 1)

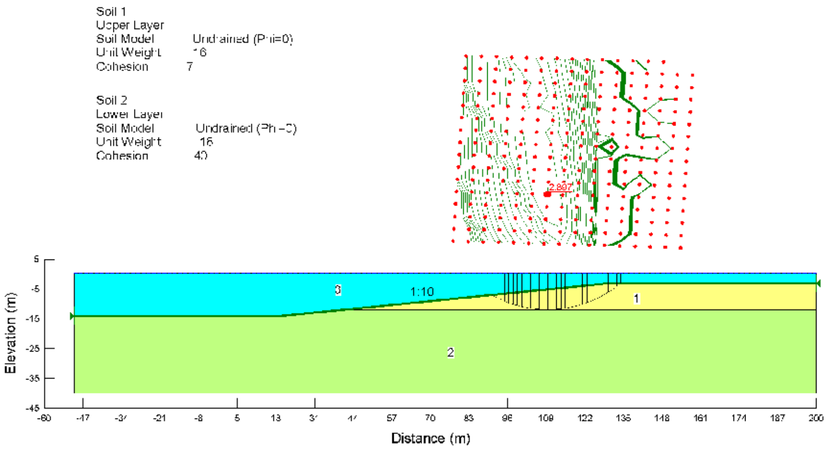


Figure 15.3.12 Safety Factor against Circular Slip Failure on the Channel Side Slope (Case 2)

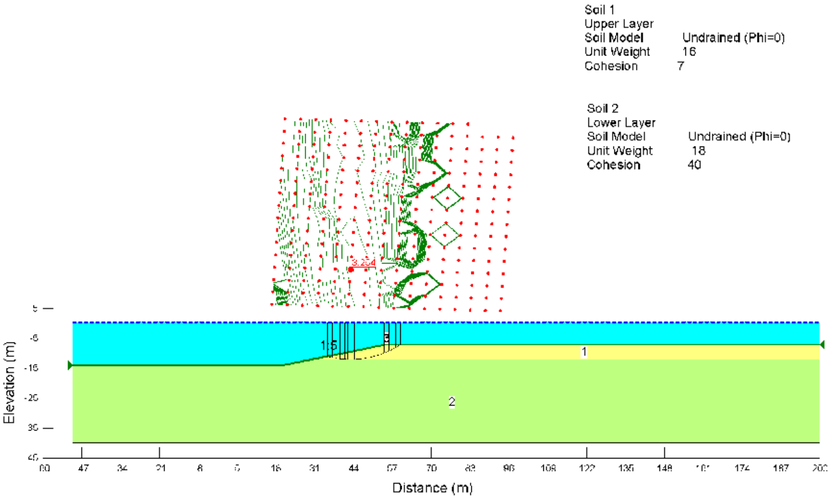


Figure 15.3.13 Safety Factor against Circular Slip Failure on the Channel Center Dredging Work Slope (Case 3)

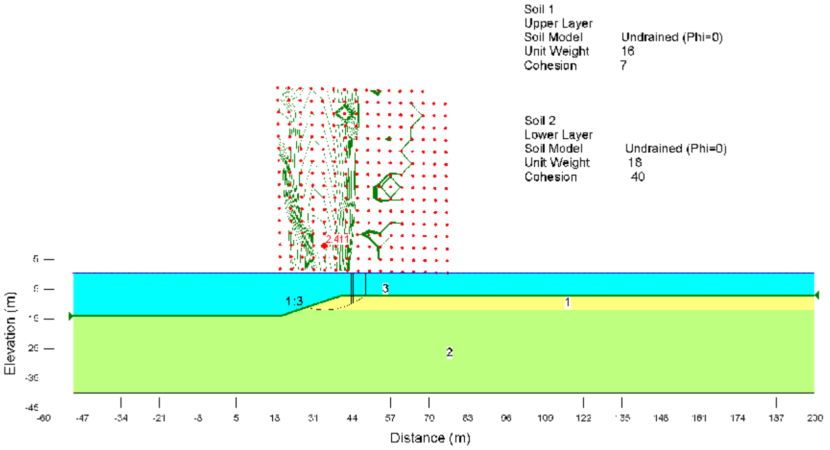
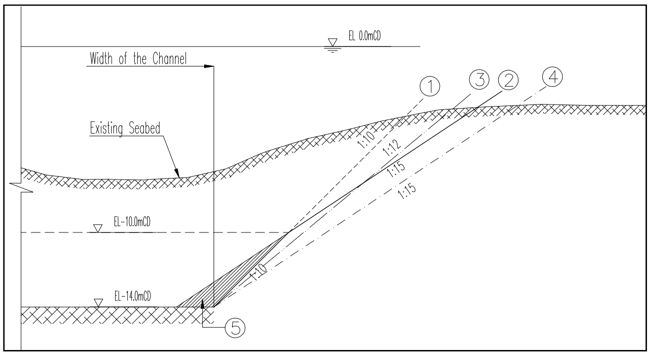


Figure 15.3.14 Safety Factor against Circular Slip Failure on the Channel Center Dredging Work Slope (Case 4)

15.3.9 The Channel Side Inclination against Erosion

The side slope inclination of the existing Lach Huyen channel is 1:15. Under this side slope, some portions along the channel have been eroded by rough sea conditions. The slope proposed in SAPROF (inclination 1:10) is reviewed using the following alternative cases as shown in Figure 15.3.15, Table 15.3.12 and the summary table shown below.



①Slope 1:10

②Combined slope 1:10 (below -10 m) and 1:15 (above -10 m)

③Slope 1:12

④Slope 1:15

⑤Assumed additional volume, within the extended 1:15 slope of Case 2 at the bottom of slope

Figure 15.3.15 Alternative Channel Side Slope Inclination

The incremental volume against case ① is summarized in the following table.

Alternative side slope Cases	**Dredging Volume (m^3)**				
	Slope	**Slope 1:10 & 1:15**		**Slope**	**Slope**
	1:10	**Net Volume**	**Slope Collapse**	**1:12**	**1:15**
	①	②	⑤	③	④
Total	**27,956,546**	**29,782,265**	**1,218,388**	**30,182,619**	**33,767,448**
Additional Vol to ① (1:10)	①-①	②-①	⑤	③-①	④-①
	0	**1,825,719**	**1,218,388**	**2,226,073**	**5,810,902**

Note: ①, ②, ③ and ④ are the Channel net dredging volume by individual slope while ⑤is an additional volume

In the D/D, Case ② is recommended. The volume assumed in Case ⑤ will be considered in succeeding monitoring stages in and after the construction period.

Based on above results of Sec (8) and (9), the Channel side slope is designed to be the combination of 1:15 and 1:10, and center slope to be 1:5.

Table 15.3.12 Dredging Volume by Alternatives of Dredging Side Slope

Station		**Dredging Volume (m^3)**				
from	**to**	**Slope**	**Slope 1:10 & 1:15**		**Slope**	**Slope**
		1:10	**Net Volume**	**Slope Collapse**	**1:12**	**1:15**
		①	②	⑤	③	④
27+000	28+000	2,927,758	3,065,371	43,203	3,038,317	3,283,808
28+000	29+000	1,514,664	1,607,124	68,132	1,600,269	1,812,298
29+000	30+000	1,289,389	1,339,634	80,346	1,390,807	1,554,502
30+000	31+000	1,662,349	1,766,879	80,446	1,808,786	2,037,757
31+000	32+000	1,799,711	1,926,816	80,446	1,962,363	2,216,146
32+000	33+000	1,911,984	2,062,393	80,446	2,090,424	2,370,654
33+000	34+000	1,972,972	2,147,013	80,446	2,168,306	2,468,547
34+000	35+000	2,018,776	2,222,406	80,446	2,233,593	2,562,242
35+000	36+000	2,061,011	2,290,786	80,446	2,292,696	2,646,409
36+000	37+000	2,164,862	2,392,952	80,446	2,394,888	2,749,506
37+000	38+000	2,059,175	2,225,146	80,446	2,248,224	2,537,002
38+000	39+000	1,830,632	1,921,285	80,446	1,966,260	2,172,228
39+000	40+000	1,543,514	1,591,606	80,446	1,643,947	1,795,739
40+000	41+000	1,279,072	1,298,103	80,446	1,349,488	1,455,828
41+000	42+000	1,002,186	1,006,233	80,296	1,048,191	1,117,375
42+000	43+000	642,138	642,163	48,368	664,462	697,948
43+000	44+000	263,034	263,034	12,922	268,188	275,931
44+000	44+300	13,319	13,319	211	13,409	13,530
Total		**27,956,546**	**29,782,265**	**1,218,388**	**30,182,619**	**33,767,448**
Additional Vol to ① (1:10)		①-①	②-①	⑤	③-①	④-①
		0	**1,825,719**	**1,218,388**	**2,226,073**	**5,810,902**

Note: ①, ②, ③ and ④ are the Channel net dredging volume by individual slope while ⑤is an additional volume

A special attention should be paid for the Channel side slope inclination at transitional part between berth structure (private sector) and the channel slope at station 27+800 to station 28+000 where the inclination is varied from 1:3 to 1:15. In case that the future expansion of the Container Terminal was not implemented continuously, slope protection should be determined.

15.4 Channel Dredging Monitoring and Maintenance Dredging Program

The prediction of the sedimentation volume is neither simple nor easy due to erratic natural phenomena. Even if the latest scientific numerical simulation model is utilized, a big margin of output is unavoidable. Therefore, the determination in Chapter 5 was made to include some allowance on the volume.

In Chapter 15, however, the volume was determined in a more practical way in order to assure that the uncertain part of the payment to the dredging work contractor would be less and reasonable by which overpayment would be avoidable. The predicted volume in Chapter 15 was made by assuming the annual number of typhoons to be one and by considering the influence of the sand dyke. The thickness of the extra depth of the Channel was also limited for the same reason.

The maintenance dredging plan shown in Chapter 15 was made based on the predicted volume in Chapter 5 to determine the preliminary scheme of the maintenance dredging works such as number, type, and size of dredgers, and dredging work time cycle.

In case that the actual sedimentation volume during the construction period is found to be bigger than the predicted volume, alterations will be made by using the contingency fund.

In order to grasp the sedimentation mechanism in the real Channel section, CDM (Channel Depth Monitoring) will be conducted throughout the construction stage. The maintenance dredging plan for the type, size, and number of dredging plants and the time cycle including the extra depth of the channel, will be established based on the actual sedimentation volume for each Channel segment prior to the commencement of the new port operation.

Taking the above situations into consideration, the predicted maintenance volume and procedure are described hereunder.

15.4.1 The Channel Dredging Monitoring

1) Initial Dredging Period

Channel Dredging monitoring will be done by pre and post-hydro surveys for each period of construction, and monthly progress surveys as indicated in Table 15.4.1. The survey area and intervals of the survey lines are shown in Table 15.4.2.

Table 15.4.1 Schedule of Dredging Works and Monitoring

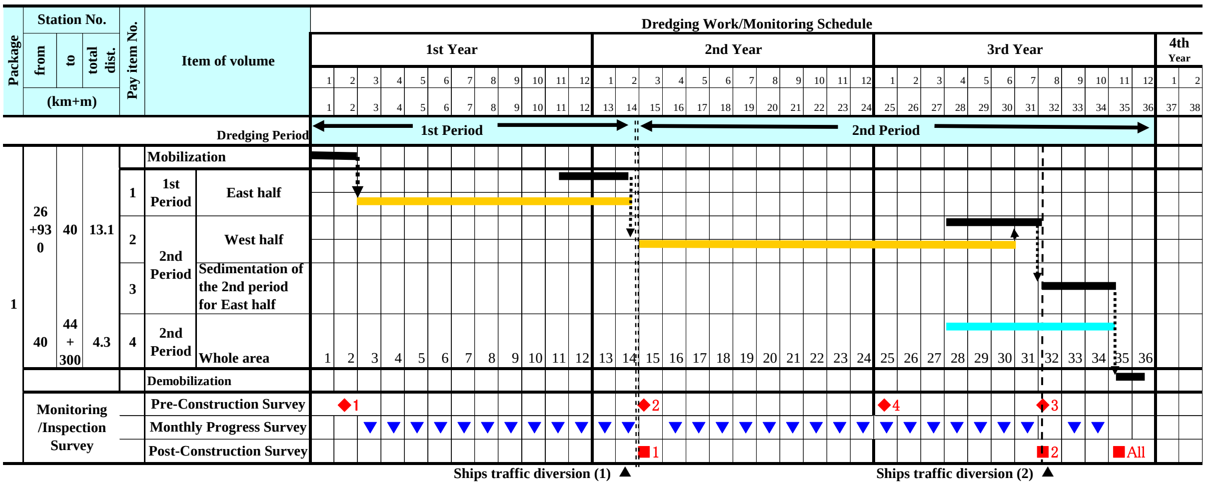


Table 15.4.2 Channel Dredging Area Monitoring Hydro Survey Requirements

Monitoring Survey Item	Symbol	Hydro-Survey Area				Survey output
		Cross Sectional Survey line Intervals	Cross section Width		Longitudinal Survey line	
			The Channel area	Turning Basin		
		(m)	(m)	(m)	(m)	(Within: days)
Pre-Construction Survey	◆1	25	1,000	400 m from slope bottom	1) Channel Center line 2) Channel slope bottoms 3) 100 m intervals for slope and outside area	30 days
Monthly Progress Survey	▼	50	500	300 m from slope bottom		10 days
Post-Construction Survey	■1	25	1,000	400 m from slope bottom		30days
Special Survey after rough weather (typhoon)	–	50	500	300 m from slope bottom		10 days

2) Post-construction Period

After the Channel dredging works are turned over to the Employer, a similar monitoring survey will have to be conducted by the Employer as indicated in the table below.

Table 15.4.3 The Channel Dredging Area Monitoring Hydro Survey during the Post-construction Period

Monitoring Survey Item	Hydro-Survey Area				Timing of survey
	Cross Sectional Survey line Intervals	Cross section Width		Longitudinal Survey line	
		The Channel area	Turning Basin		
	(m)	(m)	(m)	(m)	(days)
Periodical Survey	50	500	300 m from slope bottom	1) Channel Center line 2) Channel slope bottoms 3) 100 m intervals for slope and outside area	Once in every two (2) months for the 1st year. Once in every six (6) monthe for the 2nd year.
Annual Survey	50	1,000	400 m from slope bottom		Once in every year
Special Survey after rough weather (typhoon)	50	500	300 m from slope bottom		Immediately after typhoon

15.4.2 Maintenance Dredging Program

1) Predicted Annual Maintenance Dredging Volume

To determine the maintenance dredging program for the post-construction period, the sedimentation volume discussed in Chap. 5 is applied. The annual maintenance volume is predicted to be **3.39 million m^3** considering the following conditions: (1) the provision of sand dykes, (2) the occurrence of the highest waves 4 times per year, and (3) a tolerance factor of 1.50. Figure 15.4.1 and Figure 15.4.2 duplicates of the figures from Chapter 5, which show the distribution of the annual sediment volume for every 500 m longitudinal section and the relevant thickness of the sediment.

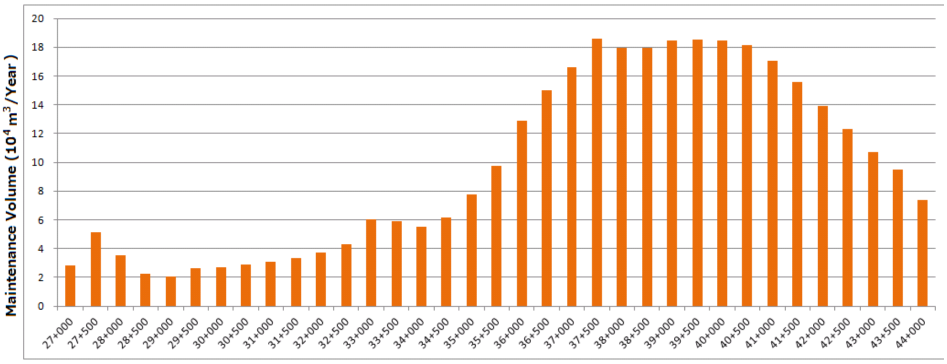
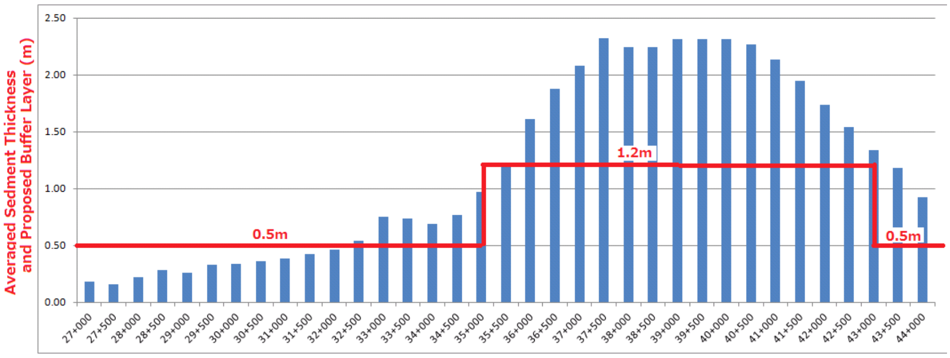


Figure 15.4.1 Maintenance Volume by Section (Chapter 5, Figure 5.10.1)



Note: The sediment is assumed to be concentrated within the Channel/Turning Basin bottom area

Figure 15.4.2 Proposed Buffer Layer for Infill (Chapter 5, Figure 5.10.2)

2) Local Dredgers

Local dredgers are to be used for the maintenance dredging works. The existing dredging fleet in Vietnam is indicated in Table 15.4.4 and Table 15.4.5. The dredgers owned by Vietnam Waterways Construction Corp. (VINAWACO: state-owned dredging company) are listed in Table 15.4.4 and those owned by other companies are listed in Table 15.4.5. For the Channel maintenance dredging works, the following dredgers are likely to be used depending on their availability at the time of the maintenance period:

1. TSHD with hopper size 3,250m^3 class: two (2) units owned by VINAWACO
2. TSHD with hopper size 1,500m^3 class: two (2) units owned by VINAWACO
3. TSHD with hopper size 1,500m^3 class: two (2) units owned by others
4. CSD 4,000ps class: three (3) units owned by VINAWACO
5. It’s not indicated but many units of GD (Grab Dredger) with 2 to 3 m^3 grab size are available according to VINAMARINE.

Some of the bucket type dredgers indicated in Table 15.4.4 are just within the range of the maximum dredging depth of 14 m. Taking the frequent maritime ship traffic in the Channel into account, the use of TSHD, small size GDs or a combination of the two types will be most suitable.

Table 15.4.4 Dredgers owned by VINAWACO

No	Equipment name	Name, year of builder	Main parameter
1	Long Chau (Hopper Suction Dredger)	Germany (1969)	Main dimension (m) : L : 95 B : 16 H : 6 T : 5,3 Total capacity (Hp) : 5860 Dredging capacity (m^3/h) : 3500 Hopper capacity (m^3) : 3240 Dredging depth Max (m) : 20
2	Tran Hung Dao (Hopper Suction Dredger)	Germany (1969)	Main dimension (m) : L : 95 B : 16 H : 6 T : 5,38 Total capacity (Hp): 6650 Dredging capacity (m^3/h) : 3500 Hopper capacity (m^3) : 3250 Dredging depth max (m) : 20
3	HB88 (Hopper Suction Dredger)	Viet nam (1989)	Main dimension (m) : L : 53,7 B : 10 H : 4 T : 2,6 Total capacity (Hp): 1590 Dredging capacity (m^3/h) : 300 Dredging depth max (m) : 7
4	TH.12-9 (Cutter Suction Dredger)	Holland (1996)	Main dimension (m) : L : 32 B :10,3 H : 2,97 T: 2,05 Total capacity (Hp) : 3800 Dredging capacity (m^3/h) : 1500 Discharging Distance max (m) : 5000 Dredging depth max (m) : 16
5	HA-97 (Cutter Suction Dredger)	USA (1996)	Main dimension (m) : L : 34,7 B :9,17 H : 2,43 T: 1,65 Total capacity (Hp): 4070 Dredging capacity (m^3/h) : 1800 Discharging Distance max (m) : 6000 Dredging depth max (m) : 18
6	Viet-My (Cutter Suction Dredger)	USA (1996)	Main dimension (m) : L : 34,7 B :9,17 H : 2,43 T: 1,65 Total capacity (Hp) : 4070 Dredging capacity (m^3/h) : 1800 Discharging Distance max (m) : 6000 Dredging depth max (m) : 18
7	TC81 Bucket Dredger	France (1981)	Main dimension (m) : L : 69,8 B :12,6 H : 4 T: 2,4 Total capacity (Hp): 2060 Dredging capacity (m^3/h) : 800 Dredging depth max (m) : 16
8	TC82 Bucket Dredger	France (1981)	Main dimension (m) : L : 69,8 B :12,6 H : 4 T: 2,4 Total capacity (Hp) : 2060 Dredging capacity (m^3/h) : 800 Dredging depth max (m) : 16
9	TC54 Bucket Dredger	Germany (1954)	Main dimension (m) : L : 52,5 B :9,37 H : 3,3 T: 1,85 Total capacity (Hp): 665 Dredging capacity (m^3/h) : 300 Dredging depth max (m) : 14
10	TC91 Bucket Dredger	USSR (1981)	Main dimension (m) : L : 48 B : 9,4 H : 2,8 T: 1,6 Total capacity (Hp): 920 Dredging capacity (m^3/h) : 600 Dredging depth max (m) : 14
11	TC82 Bucket Dredger	USSR (1982)	Main dimension (m) : L : 44,6 B : 9,6 H : 2,8 T: 1,8 Total capacity (Hp): 490 Dredging capacity (m^3/h) : 275 Dredging depth max (m) : 12
12	Thai Binh Duong (Hopper Suction)	Germany (2002)	Main dimension (m) : L : 67,5 B : 14 H : 5,2 T : 4,6 Total capacity (Hp) : 4757 Dredging capacity (m^3/h) : 950 Hopper capacity (m^3) : 1500 Discharging Distance max (m) : 1000 Dredging depth max (m) : 21
13	Long Chau 02 dredger with low draft with hard arm	Vietnam (2001)	Main dimension (m) : L : 88,4 B : 14,6 H : 4,5 T : 3,8 Total capacity (Hp) : 4500 Dredging capacity (m^3/h) : 1500 Hopper capacity (m^3) : 1500 Discharging Distance max (m) : 2500 Dredging depth max (m) : 15
14	HB 02 (Hopper Suction)	Vietnam (2001)	Main dimension (m) : L : 52,5 B : 12 H : 3,6 T : 2,65 Total capacity (Hp) : 1790 Dredging capacity (m^3/h) : 1050 Hopper capacity (m^3) : 400 Dredging depth max (m) : 14
15	Binh Duong Clamshell Dredger	Japan (1980)	Main dimension (m) : L : 60 B : 20 H : 4 T : 2,5 Total capacity (Hp): 1950 Dredging capacity (m^3/h) : 437 Dredging depth max (m) : 80
16	TC02 Clamshell Dredger	Vietnam (2002)	Main dimension (m) : L : 35,3 B : 10,7 H : 2,7 T : 1,5 Total capacity (Hp): 390 Dredging capacity (m^3/h) : 140 Dredging depth max (m) : 25

Source: VINAWACO (Vietnam Waterway Construction Corp.)

Table 15.4.5 Dredgers Owned by Other Companies

Name of Dredger	Owner	Particulars
Song Gianh HB 11	Vinashin Maritime Transport Co.,	V=500m^3, capacity 2x480CV
Song Gianh 18	ditto	V=500m^3, depth 20m
HB Cuu Long	Phan Vu Co,	V=1570 m^3
HB 09	Mechanical and Services Company	V=836m^3
HB Que Huong 09	Que Huong Trading and Construction Joint Stock company	V=1500m^3

Notes 1. All above dredgers are Trail Suction Hopper type
2. Source: VINAMARINE

3) Current Activity of Local Dredgers

The current maintenance dredging situation of Hai Phong channel is summarized in Table 15.4.6 and Table 15.4.7. Hai Phong channel includes a number of navigation channels from 1) Cam River, 2) Bach Dang River, 3) Ha Nam Canal, and the existing 4) Lach Huyen channel.

Table 15.4.6 Current Maintenance Dredging Situation of Hai Phong Channel by Channel Section from 2006 to 2011

No.	Channel section	Dredging location		Dredging period		Dredging	Dredging volume (2)	Dred. Vol.	Remarks
		From	To	From	To	Days (1)		per day (2)/(1)	
I	Cam River								
	2007								No dredging
	2008	Cam Port	Hai Phong Port	23-Oct-08	23-Feb-09	123	139,408	1,133	
	2009	Cam Port	Hai Phong Port	12-Nov-09	5-Feb-10	85	69,314	815	
	2010								No dredging
	2011	Cam Port	Hai Phong Port				54,898		On-going
II	Bach Dang River								
	2007								No dredging
	2008	Buoy No. 34	Buoy No. 46	23-Oct-08	23-Feb-10	488	334,850	686	
	2009	Buoy No. 34	Buoy No. 46	12-Nov-09	5-Feb-10	85	493,796	5,809	
	2010								No dredging
	2011	Buoy No. 32	Dinh Vu Port				367,022		On-going
III	Ha Nam Canal								
	2007								No dredging
	2008	Buoy No. 19	Buoy No. 25	23-Oct-08	23-Feb-10	488	305,037	625	Only dredging at two
	2009	Buoy No. 19	Buoy No. 25	12-Nov-09	5-Feb-10	85	358,803	4,221	heads of the channel
	2010								No dredging
	2011	Buoy No. 19	Buoy No. 27				431,420		On-going
IV	Lach Huyen Channel								
	2007								No dredging
	2008								No dredging
	2009								No dredging
	2010								No dredging
	2011	Buoy No. 3, 4	Buoy No. 7, 8				51,840		On-going

Source: VINAMARINE

Table 15.4.7 Record of Annual Maintenance Dredging Activities at the Existing Hai Phong Navigation Channel by Year from 2000 to 2011

Year	Specifications for dredging			Volume (m3)	Cost (Mill VND)	Remarks	Unit cost (VND/m3)
	Width(m)	Height (m)	Slope (m)	①	②		③=②/①
2000	100/80	4.5	15/10	2,035,118	32,422		15,931
2001	100/80	4.5	15/11	2,199,002	32,381		14,725
2002	100/80	4.5	15/12	2,223,421	35,680		16,047
2003	100/80	4.5	15/13	2,083,824	53,466		25,658
2004	100/80	4.5	15/14	1,038,811	36,612		35,244
2005	100/80	4.5	15/15	819,933	27,427		33,450
2006		7.2/7.0/5.5				Hai Phong Port Project - Stage II	
2008							
2009	100/80	5.7	10	780,295	59,854		76,707
2010	100/80	6.3/5.5	10	921,913	79,612		86,355
2011	100/80	6.5/5.5	10/7	905,180	121,429	On-going	134,149

Notes Hai Phong Navigation Channel including 1) Cam River, 2)Bach Dang River, 3) Ha Nam Canal, 4) Lach Huyen channel (existing)
Source: VINAMARINE

The annual dredging volumes were varied up to a level of 2 million m^3 with a daily performance volume of 4,000 to 6,000 m³.

Table 15.4.8 to Table 15.4.9 show the total working days per year, which is approximately 200 to 250 days.

Table 15.4.8 Record of Local Dredgers Performance (Current Situation)

Trail Suction Hopper Dredger (TSHD)														
Name of dredger	size			Dredging capacity	Dredging productivity by depth(m^3/h)				Soil ratio in hopper	Discharge Capacity	Discharge productivity by distance			
	Hopper	Suction	HP	m^3/h	5 m	10 m	15 m	20 m	%	m^3/h	Rainbow	0.5 km	1.0 km	1.5 km
Tran Hung Dao	3250m3	800	6650	3,500	0	2600	2200	1050	80	3500				
Thai Binh Duong	1500m3	800	4757	950	0	715	600	320	80	950	800	800	720	650

Cutter Suction Dredger (CSD)											
Name of dredger	Size			Dredging capacity (m^3/h)	Dredging productivity by distance(m^3/h)						
	Suction Pump	Cutter Pump	Total HP		0km (alongside)	1 km	2 km	3 km	4 km	5 km	6 km
HA97	1910	559	4,070	1,800	1800	1800	1530	1350	1170	900	720
TH12/9	1712	552	3,800	1,500	1500	1500	1275	1125	975	750	600
VIET MY	1712	552	3,800	1,500	1500	1500	1275	1125	975	750	600

Source: VINAMARINE/VINAWACO

Table 15.4.9 Annual Working Time of Local Dredgers (Current Situation)

Name of Dredger	Size	Total service time	Work time	Stand-by				
				Bad weather	Repair	Idling (no job)	Other	Total
	Number of the days per yea							
TSHD								
Trang Hung Dao	3,250㎥	365	180	60	50	60	15	185
Thai Binh Duong	1,500㎥	365	180	60	50	60	15	185
CSD								
HA-97	4070HP	365	200	60	35	60	10	165
TH 12-9	3800HP	365	200	60	35	60	10	165
VIET MY	4070HP	365	200	60	35	60	10	165

Source: VINAMARINE/VINAWACO

4) Maintenance Dredging

Taking the aforementioned available local dredgers and the current capacity of the maintenance dredging activities into account, a combination of TSHD and small size GDs are recommended. The productivity of both types of dredgers concerned is shown in Table 15.4.10.

Three units of 3,250 m3 TSHD for the Channel main portion and 5 units of 2.5 m3 GD for the Channel side slope area, will be deployed as shown in the following Table 15.4.11.

The dumping site for the maintenance-dredged soil will be either at offshore water area or coastal area.

Considering the necessity of continuous maintenance dredging activity, the provision of one (1) TSHD for the exclusive use of the Lach Huyen Channel maintenance dredging is recommended.

Table 15.4.10 Productivity of Maintenance Dredgers

TSHD (Trail Suction Hopper Dredger)				
Hopper size		m3	3,250	3,250
Daily stand-by time		hr	0	0
Effective mud ratio			0.4	0.4
Effective soil volume	(1)	m3	1300	1300
Dumping site			Cat Hai	Off shore
Distance to dumping site		nm	6	14
of which dist. Within the channel		nm	6	8
Speed within the channel		knot	8	8
Running time within the channel		hr	0.8	1
Distance of outer sea		nm	0	6
Speed outer sea		knot	14	14
Running time outer sea		hr	0.0	0.4
Running time round trip		hr	1.7	2.9
Dredging time		hr	3	3.0
Dumping time		hr	0.75	0.5
Waiting time for existing ships		hr	1	1.0
Total cycle time		hr	6.4	7.4
Daily working time		hr	24	24
Number of daily trip	(2)	times	3.8	3.3
Oceanographical Conditions	(3)		0.9	0.9
Ratio for idling	(4)		0.9	0.9
Day off ratio	(5)		0.9	0.9
Daily stand-by hours		hr	0	0
Daily stand-by ratio	Sr		0	0
Daily productivity: Q=(1) x (2) x (3) x (4) x (5)x(1-Sr)		m3/day	**3,504**	**2,977**

GD (Grab Dredger)			
Type of dredger			GD
Grab bucket size			2.5m3
Discharge method			Hopper barge
Classification of the soil			Cohesive soil
Dredging position			Lach Huyen channel
Basic capacity of the dredger	q	m3/hr	128.3
Work efficiency (Thickness of layer)	E1		0.85
Work efficiency (Oceanographical	E2		0.95
Work efficiency (Water depth)	E3		1
Ratio for idling	E4		0.9
Working hour per day	T	hr	8
Daily stand-by hours		hr	0
Daily stand-by ratio	Sr		0
Q=(q x E1 x E2 x E3 x E4 x T)X(1-Sr)	Q	m3/day	**746**

Source:
1) Port and harbors construction cost estimation standards (2010,Japan)
2) Cost Standards for dredging equipment, 2005, R. N. Bray

Table 15.4.11 Maintenance Dredging Program

Station No.			Type of dredger	Productivity	No of dredging fleet	Total Duration		Dredging volume	1 Year											
from	to	total dist.		(m3/day/ fleet)					month											
(km+m)						(day)	Unit-month	(m^3)	1	2	3	4	5	6	7	8	9	10	11	12
27 km + 000	44 km + 300	17 km + 300	TSHD 3,250 m^3	2,977	1	300	10.0	893,100	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪		
					1	300	10.0	893,100			🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪
					1	163	5.4	485,251	🟪	🟪	🟪	🟪	🟪						🟪	🟪
				Sub total	3		25.4	2,271,451												
			GD 2.5 m^3	746	1	300	10.0	223,800	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨		
					1	300	10.0	223,800		🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	
					1	300	10.0	223,800			🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
					1	300	10.0	223,800	🟨			🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
					1	300	10.0	223,800	🟨	🟨			🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
				Sub total	5		50.0	1,119,000												
Total								3,390,451												

15.5 Environmental Evaluation on Dumping Activity at South Dinh Vu IZ and Offshore

15.5.1 Objective

The objective of this study is to evaluate the environmental impact on dumping of dredged soil from channel dredging in Lach Huyen Port Infrastructure Construction Project at South Dinh Vu IZ (SDV) and offshore area.

15.5.2 Present Condition of the Project Area

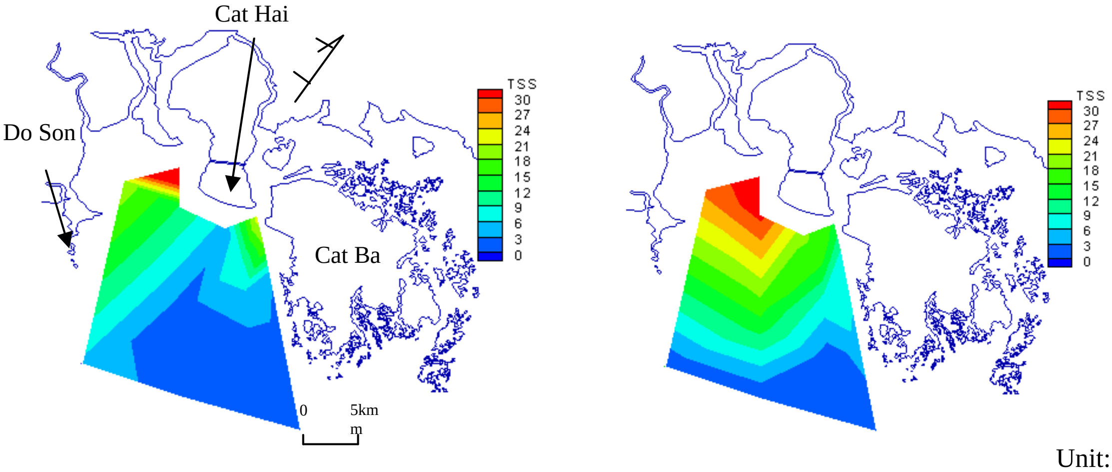
From May 2011 to August 2011, intensive field survey was conducted to know the present natural, biological and social conditions of the study area (refer to Chapter 3 of the Final Report for the details).

Table 15.5.1 summarizes the characteristics of the present condition understood from the field survey, comparing between near-shore area and offshore area.

Table 15.5.1 Characteristics of the Present Conditions

Item		Near-shore area (SDV)	Offshore area
Natural condition	Air quality	All parameters satisfy the Vietnamese Standard.	No survey was conducted
	Noise and Vibration	Sound and vibration levels satisfy the Vietnamese Standard	No survey was conducted.
	Water quality (see Figure 15.5.1 for TSS)	Average SS at surface is 16.1mg/L at high tide and 18.1mg/L at low tide. T-N and T-P concentrations are higher.	Average SS at surface is 2.2mg/L at high tide and 8.4mg/L at low tide. T-N and T-P concentrations are lower.
	Vertical profile of water temperature and salinity	Water temperature and salinity at surface is low by river water influence, showing clear stratification.	Vertical profile does not show clear stratification.
	Sediment quality	Concentrations of heavy metals are higher.	Concentrations of heavy metals are lower.
	PCB, DDT, Dioxins	Dioxins were detected with low concentration.	Dioxins were detected with low concentration.
Biological condition	Protected area	Cat Ba Island is designated as a national park and a Biosphere Reserve.	East to south of Cat Ba Island is the Ha Long Bay, World National Heritage.
	Variable Habitats (Base on the literature survey: see Figure 15.5.2)	Past study indicate that shallow coastal area of the Lach Huyen area contributes significantly to the high fish abundance.	Satellite image study with spot-check surveys confirmed the existence of coral reefs in Cat Ba Island, although they are diminishing.
	Mangrove	Large portion of mangroves are distributed.	-
	Seaweed/sea grass	Small patches of seagrass are distributed.	Small patches of seagrass are distributed.
	Coral	-	Coral reefs are distributed at south of Cat Ba Island and Long Chau Islands.
	Phytoplankton	No special characteristics showed.	No special characteristics showed.
	Zoo plankton	Fish larva was indentified. Zooplankton density is higher.	No fish larva was found. zooplankton density is lower.
	Zoo benthos	Species abundance is higher.	Species abundance is lower.

Item		**Near-shore area (SDV)**	**Offshore area**
	Demersal fish	Fish diversity and abundance tend to be higher. Two species listed in Vietnamese Red Book were found.	Fish diversity and abundance are lower.
Social condition	Economic activities and occupation	Salt production, aquaculture, fishing Vulnerable to environmental change Coastal fishing is the major occupation in Cat Hai Island. Detailed data is not available in SDV area.	Fishing



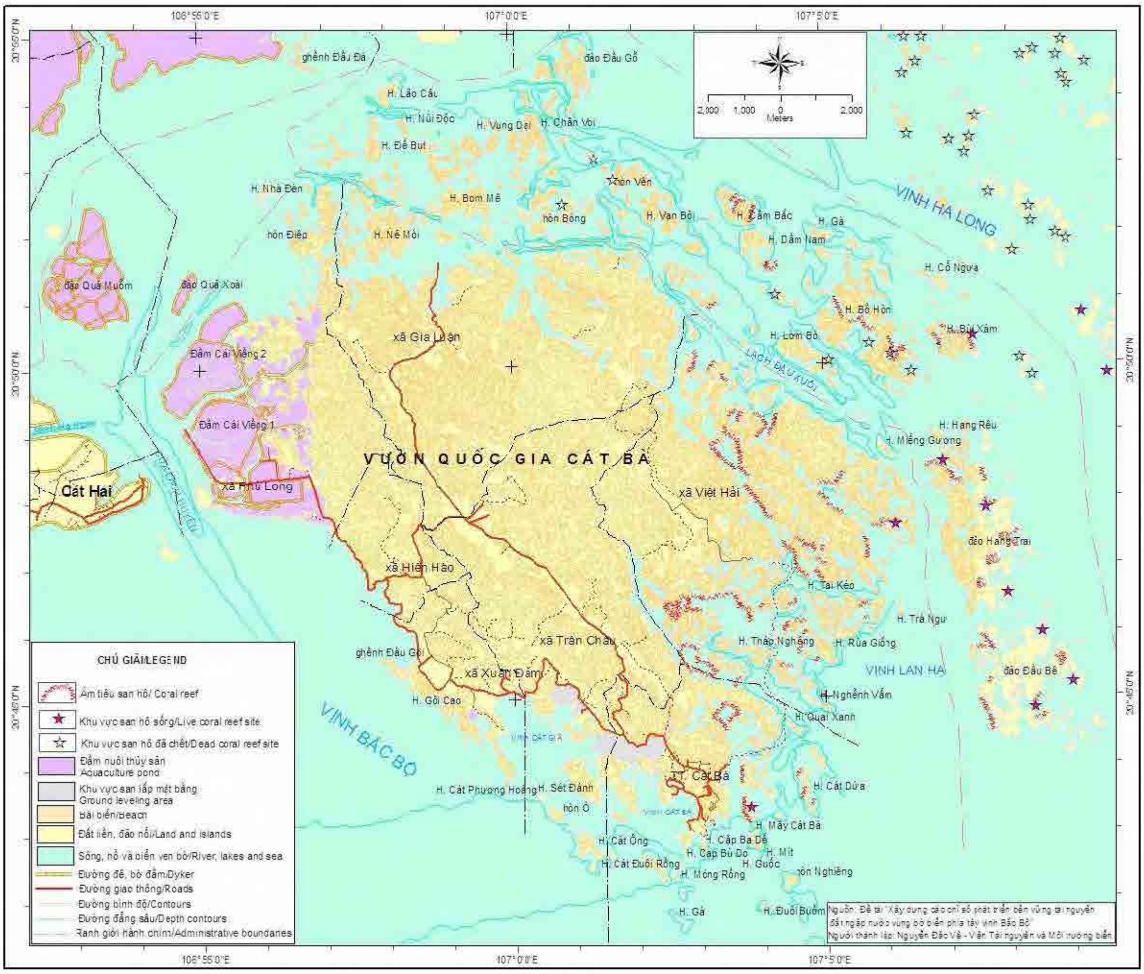
Unit: mg/L
Layer: surface

High tide Low tide

Source: Field survey on DD study (May 16-17, 2011)

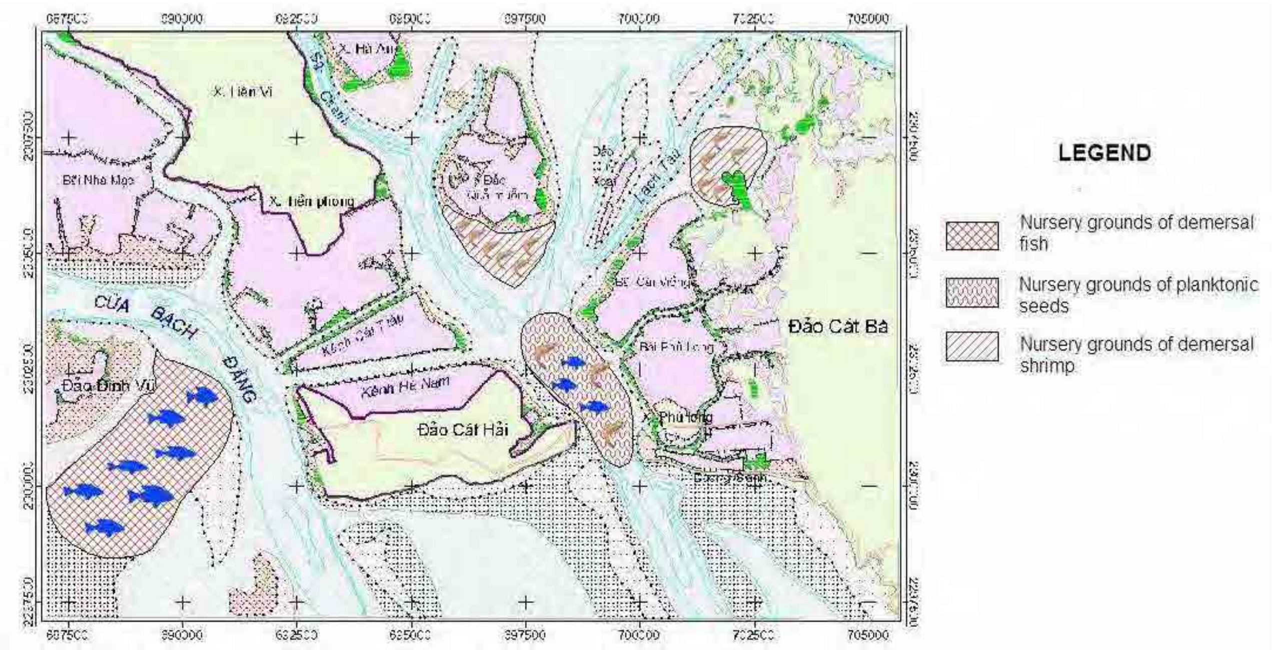
Comment: High turbid water can be seen at the head of Hai Phong Bay at both tides due to influence of river water discharge.

Figure 15.5.1 Horizontal Distribution of Total Suspended Solid (TSS)



Source: Nguyen Dac Ve (2010)

Distribution of coral reef around Cat Ba Island



Source: Nguyen Thi Thu et al. (2008)

Distribution of main nursery grounds around the Lach Huyen area

Figure 15.5.2 Important habitat based on the literatures

15.5.3 SS Dispersion Simulation

This section describes the outline of SS (Suspended Solid) dispersion simulation model. For the details, refer to the Chapter 12.3 and its Appendix of the Final Report.

1) Structure of the simulation model

The simulation model consists of two numerical models as shown below.

Hydrodynamic Model	: Vertical multilayer level model which considers ebb away and submerge of tidal flat by tide transition, tidal current, density flow and wind-driven current.
SS Dispersion Model	: A model which considers process of advection, diffusion and sedimentation of suspended solid. Water level, direction and speed of the flow which is calculated by the hydrodynamic model are used for simulation input conditions.

Basic structure and relationship between the two models is shown in Figure 15.5.3. And simulation area is shown in Figure 15.5.4.

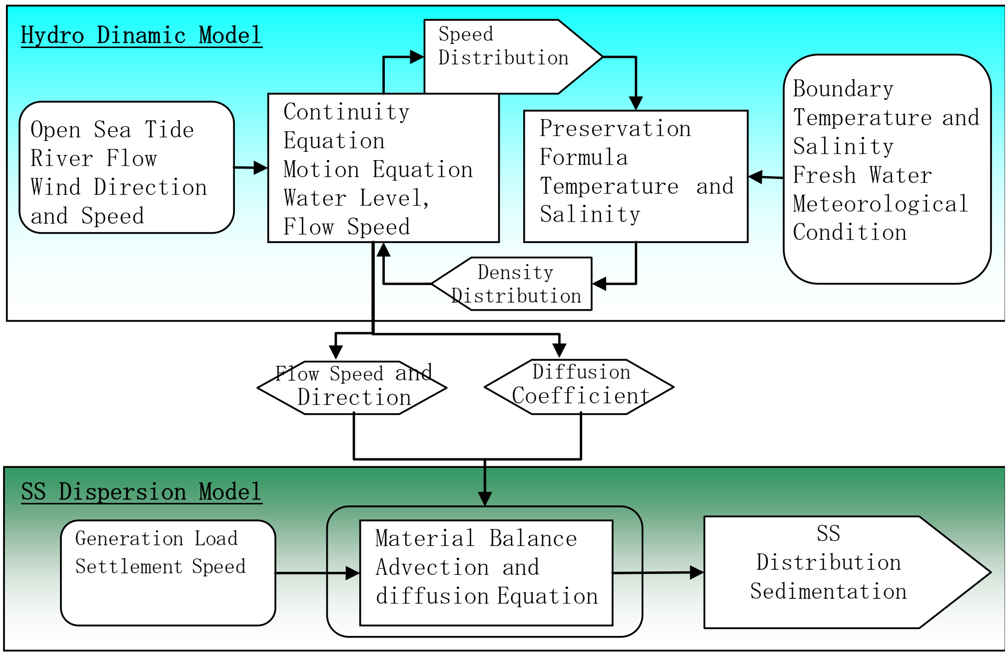


Figure 15.5.3 Basic Structure of the Models

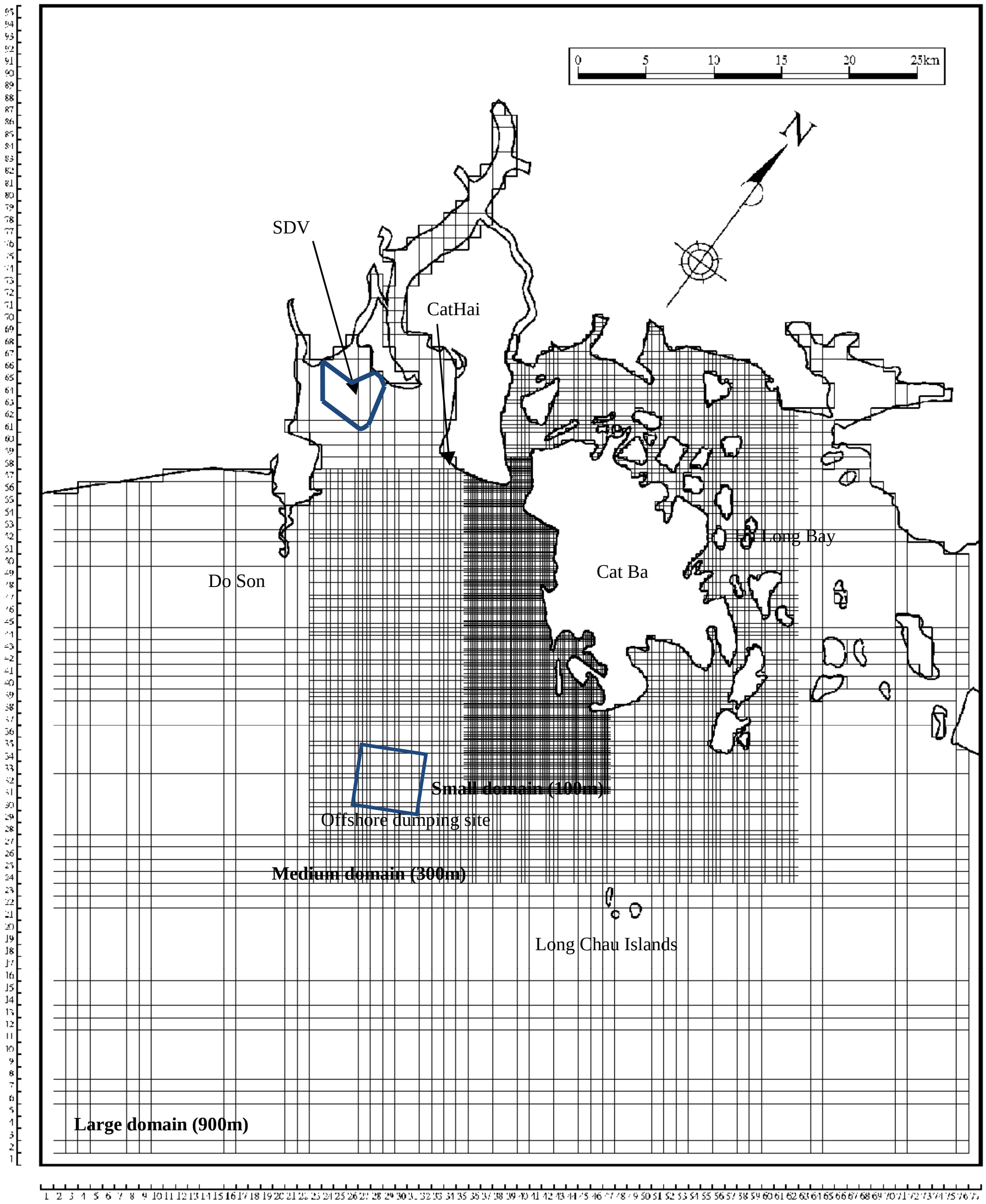


Figure 15.5.4 Simulation Area and Mesh Partition

2) Computation Conditions

a) Hydrodynamic model

i) Input data

Table 15.5.2 summarizes the data used for the hydrodynamic model. Integration time was set as 20 days until fresh water inflow from the rivers and sea water density influenced by heat balance between sea surface and atmosphere is stable. And the last 24 hours are used for analysis.

Table 15.5.2 Obtained Data for the Hydrodynamic Model

Item	Wet Season	Dry Season	Date of Data
Topography	x		Bathymetry survey data for Lach Huyen area from 2006 to 2011
Tide level	x		November 2009, May 2011
Temperature, Salinity	x		May 2006, May 2011
Fresh Water Inflow	x		September 1999, May 1999
Meteorological Condition	x	x	Averaged monthly data from 1975 to 2005
Flow	x	x	November 2009, May 2011

ii) Hydrodynamics resume

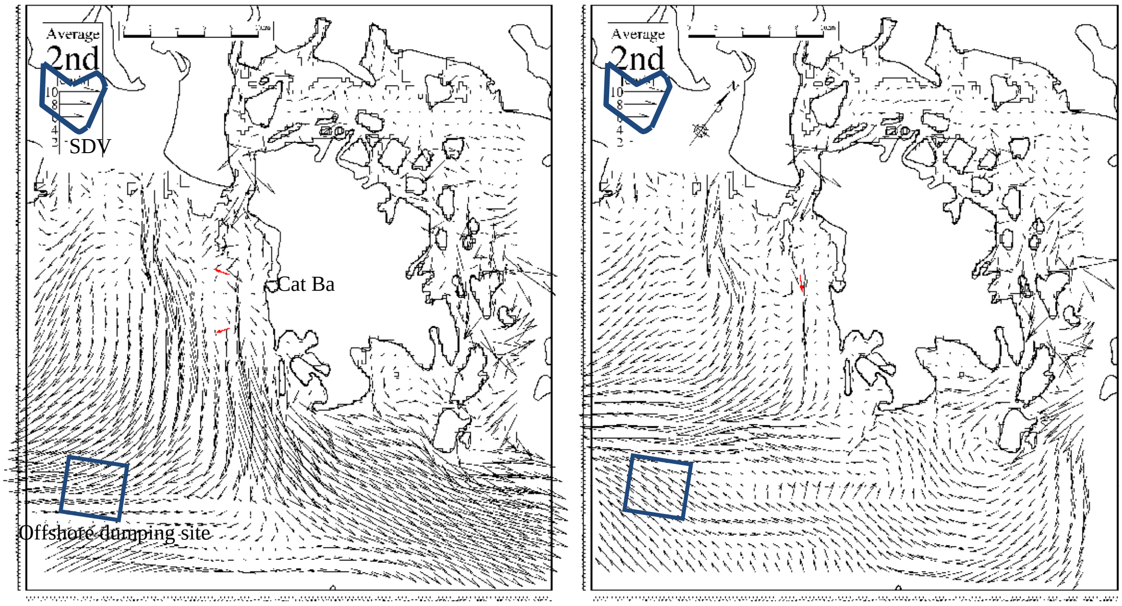
Residual (averaged) current distribution by simulation at the 2nd layer is shown in Figure 15.5.5. Field survey data is also plotted to be compared in the figures.

Residual current usually show the steady flow (dominated flow) pattern in the area.

In both seasons, offshore-ward current is dominant at near-shore area especially at the two river mouths, the east side and the west side of the Cat Hai Island.

Distribution of residual current in dry season at offshore area shows south-west ward current. Distribution of residual current in wet season, however, shows different resume. Offshore-ward current divides into two different direction, south-west ward and east-ward leading to the mouth of the Ha Long Bay.

Thus in this study, wet season hydrodynamics resume was used for the simulation of SS dispersion to know the worst influence to Ha Long Bay by the construction activities.



Wet Season
→: simulation, →: Survey(May,2011)

Dry Season
→: simulation, →: Survey(Nov-Dec,2009)

Figure 15.5.5 Distribution of Residual Current by Computation (medium domain, 2nd Layer: 2-4m below surface)

b) Suspended solid dispersion model

i) Input data

Initial condition and boundary value (background value) for concentration of Suspended Solid are set as 0 mg/L to evaluate the diffusion area and concentration caused by the construction activities.

DD survey data of grain size test in borehole experiment[1] was used for grain size of dredged soil for simulation. Sampling points and layers are uniformly distributed horizontally along with the sea route and vertically. All available data was averaged to obtain the composition shown in Table 15.5.3 and grain size distribution curve shown in Figure 15.5.6 was generated.

Table 15.5.3 Composition of Grain Size

	Grain Size	Composition
Sand	4.750-9.500 mm	0.2%
	2.000-4.750 mm	0.0%
	0.850-2.000 mm	0.6%
	0.425-0.850 mm	1.3%
	0.250-0.425 mm	0.2%
	0.075-0.250 mm	13.4%
Silt	0.005-0.075 mm	34.3%
Cray	<0.005 mm	50.0%

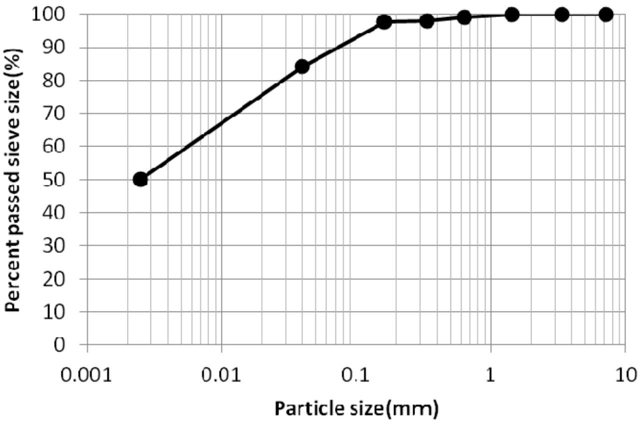


Figure 15.5.6 Grain Size Distribution Curve

Using this data and Stokes' sedimentation equation, sedimentation speed was determined. Unit load of suspended solid generation depends on the dredging/dumping method. A guideline[2] for prediction of suspended solid dispersion in Japan was referred to determine the unit load, averaging each unit load for fine particle fraction of the target dredging/dumping method in the guideline.

ii) SS Generation Load

SS generation load depends on construction method, such as grab dredging, cutter suction dredging and dumping by hopper barge, construction capability of the vessel and grain size of dredging/dumping material. The guideline[2 at page 42] lists a lot of such information based on

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[1] Soil Investigation Report for Port Portion - Part B-, Volume 2.3: The Appendices of Navigation Channel Area, August 2011, Portcoast

[2] Guideline for Prediction of Influence of Suspended Solid on Port Construction, April 2004, Ministry of Land, Infrastructure, Transport and Tourism, Japan

the experimental constructions carried out in Japan to obtain such parameters and suggests proper unit load on each construction method.

In this study, the unit loads listed in the guideline were averaged to use in the simulation model, because the grain size compositions in the guideline does not much with the grain size composition in the target area of the project.

And obtained unit load is used to calculate daily SS generation load, which is used as the input data of the simulation.

Table 15 summarizes each unit load and daily load of construction method.

For the simulation at different dumping site, sum of SS generation loads as follows was used as the input data:

Offshore dumping : a + b
Dumping at SDV : a + b + c + d
50% offshore dumping + 50% dumping at SDV : (a + b) / 2 + (a + b + c + d) / 2

Table 15.5.4 SS generation load

Work Type		Vessel Type	Guideline		Calculated unit load based on the actual particle size ((t/m3)×10−3)	Work Load (m3/day/vessel)	Number of Vessel	Total Work Load (m3/day)	Daily SS Generation Load (t/day)	Working Hour
			Capability	Unit Load(t/m3) $\times 10^{-3}$						
a	Dredging	Grab dredger	25m3	15.29	18.56	**18300**	4	73200	1358.6	16
b	Dumping	Hopper barge	500m3	15.79	22.26	**4575**	16	73200	1629.4	16
c	Dredging at temporal dumping basin	CSD	4000PS	4.26	5.3	**60000**	3	180000	954.0	24
d	Discharge from embankment*1)	—	—	—	—	—	—	—	7728.6	24

*1) To determine this value, following leteratures were refered.
Hazen's theory regarding ideal sedimentation basin (extrusion effluent model)
Guideline for designing of waterworks facility, 1990, Japan Water Works Association
Manual for prediction of influence of turbidity by dredging/reclamation, March 1982, Ministry of Transportation, Japan

Equation:

$$SSd = SSg \times (1 - r)$$

where:

SSd: Daily SS generation load (t/day)
SSg: SS generation load (t/day)
r: Removal ratio: 0.717

$$r = v_c / v_0$$

where:

Vc: Settlement sped of cray (m/day): 0.43
V0: Water moving speed: Q/A (m/day): 0.6
Q: Dumping volume (m3/day): 180000
A: Area of dumping site (m2): 300000

$$SSg = Dv \times \rho_t \times C_m / 100$$

where:

Dv: Dredging volume (m3/day): 90000
ρ_t : Wet density
Cm: Mud content (%): 20

$$D_v = C_p \times G_c / 100$$

where:

Cp: Dredging cpacity: m3/day): 180000
Gc: Grainsize composition of cray (%): 50

$$\rho_t = \frac{(1 + \omega / 100)\rho_w}{\rho_w / \rho_s + \omega / S}$$

where:

ω : Water content (%): 89%
ρ_w : Water density (g/cm3): 1.02
ρ_s : Density of soil perticles: 2.68
S: Saturation degree (%): 100

15.5.4 Comparison between Dumping at SDV and Offshore

1) Background of the Determination of the Dumping Site

a) Offshore Dumping Site

The location of the offshore dumping site was determined with following reasons (see Figure 15.5.7 for the location of the dumping site and Figure 15.5.8 for construction process of offshore dumping).

- Enough distance is secured (more than 10km) from the mouth of Ha Long Bay and small islands (Long Shau Islands) off coast of Cat Ba Island,
- Enough distance is secured (more than 10km) from Do Son swimming beach area,
  (Those distances was confirmed by simplified simulation SS dispersion with existing data such as SAPROF Study before conducting detailed simulation.)
- Enough water depth (more than -20m CDL) is secured to avoid disturbance of the sea bed by rough sea condition,
  (This basis is based on the perception that the sea bottom sediment, stirred up by 30cm/s of water current which is theoretically caused by 2m-high-with-7seconds-frequency-wave at 20m-depth area, may not reach to shallower water layer[3] [4])
- The location is away from the entrance of the navigation channel to Hai Phong Port to avoid interference to ship navigation, and
- The location is wide enough to secure the area of 5km x 5km to retain the thickness of the dumping material within 2m.

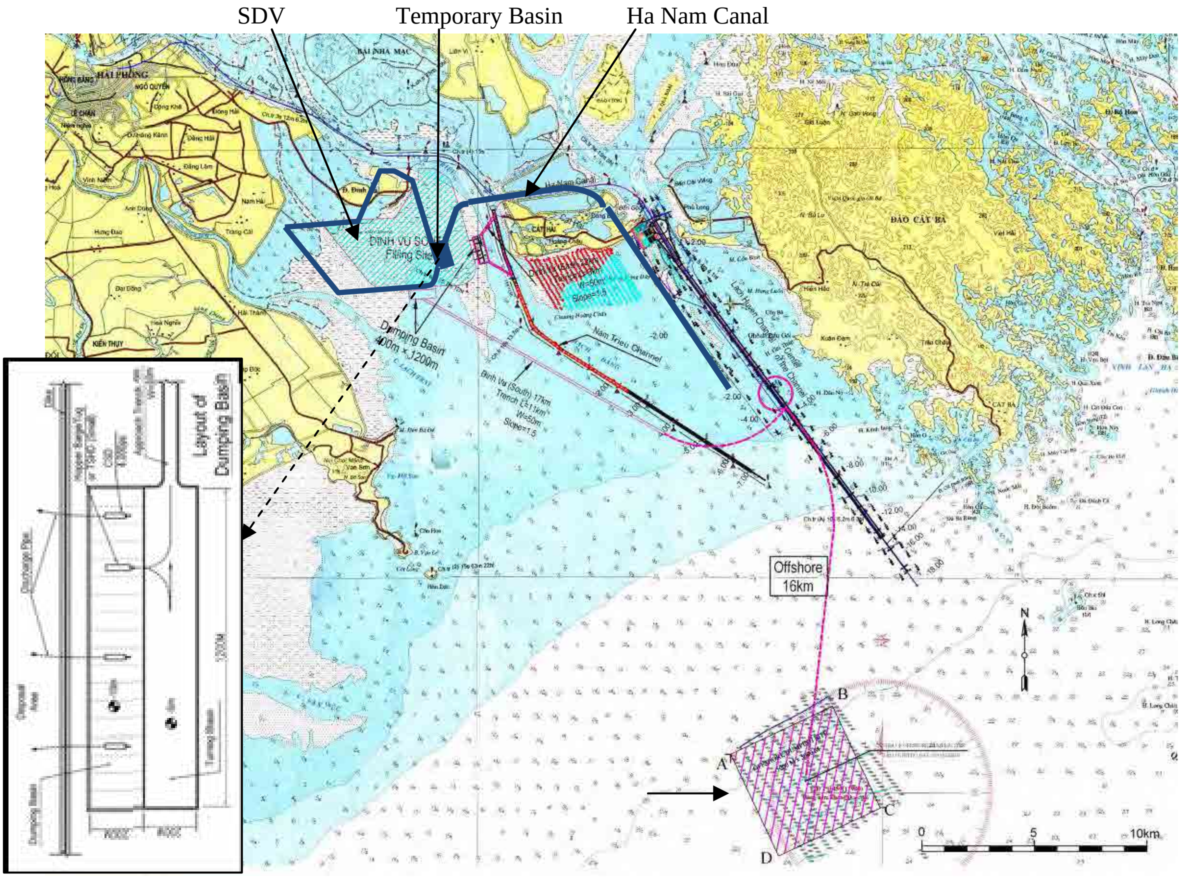

Figure 15.5.7 Locations of SDV, Temporary Basin, Ha Nam Canal and Offshore Dumping Site

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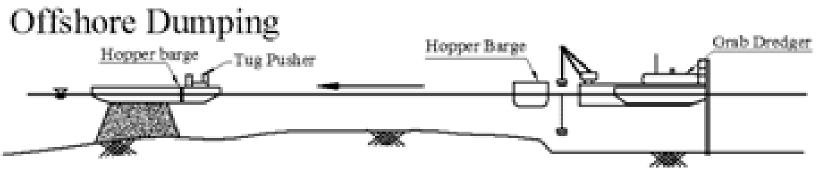
[3] http://www.dpri.kyoto-u.ac.jp/web_j/hapyo/03/p44.pdf
[4] http://library.jsce.or.jp/jsce/open/00549/2003/55-0097.pdf



Dredging	1) Dredging: Channel Dredging for Lach Huyen Port (-14M))
Transportation	2) Transportation: From Channel to Offshore Dumping Area
Dumping	3) Dumping: Direct Dumping by barge & TSHD

Figure 15.5.8 Construction Process of Offshore Dumping

b) Dumping site at SDV

Comparative study concluded that following conditions for dumping at SDV are reasonable from the viewpoint of time schedule and cost.

- Ha Nam Channel is used for transportation of dredged material (see Figure 15.5.7).
- Temporary dumping basin will be prepared at outside of the embankment (also see Figure 15.5.7 for the location and Figure 15.5.9 for the construction process).

Note: The coastal dumping and discharge at Cat Hai and South Dinh Vu is by Method 4 by CSD or GD

Temporary Jetty	1) Temporary Jetty: Materials etc. Shallow draft quay & Yard
Outer shore Protection, Bund	2) Temporary Jetty: Materials etc. Shallow draft quay & Yard
Approach Trench	3) Approach Trench: Dredging for Hopper Barge
Dredging	4) Dredging: Channel Dredging for Lach Huyen Port (-14M)
Transportation	5) Transportation: From Channel to Dumping Area
Dumping(Reclamation)	6) Dumping: Secondary Pumping by CSD
	7) Reclamation: Dredged soil executed in the Outer shore protection. (above 1)~2) is Vietnamese Portion)

Figure 15.5.9 Construction Process of Dumping at Near-Shore (SDV)

2) Simulation Results

a) Simulation scenarios

Simulation scenarios are shown in Table 15.5.5. Each case was performed based on the following purposes:

Table 15.5.5 Simulation scenarios

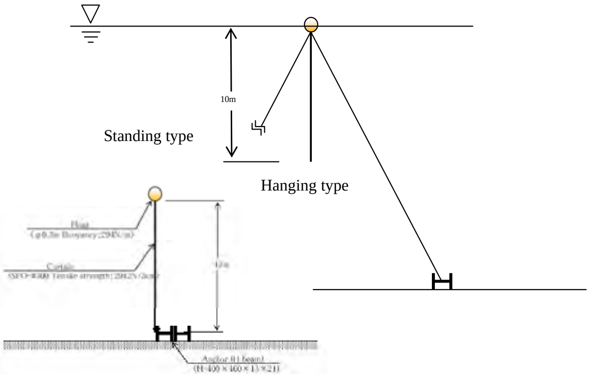
Case	Dredging		Dumping					Flow resume	Recommendation
	Method	Silt Protector	Location	Dumping ratio	Method	Embankment	Silt Protector		
Case 1	Grab 23m^3 x 4	No	Offshore	100%	*1	-	No	Wet season	acceptable
Case 2	Grab 23m^3 x 4	No	SDV	100%	*2	Yes	No	Wet season	
Case 3	Grab 23m^3 x 4	Yes	Offshore	100%	*1	-	No	Wet season	suitable
Case 4	Grab 23m^3 x 4	Yes	SDV	100%	*2	Yes	Yes	Wet season	
Case 5	Grab 23m^3 x 4	Yes	Offshore	50%	*1	-	No	Wet season	
	Grab 23m^3 x 4	Yes	SDV	50%	*2	Yes	Yes		

*1: Direct dumping by hopper barge
*2: Direct dumping by hopper barge at the temporary dumping basin and secondary discharging to inside the embankment by 3 units of 4,000ps-CSD (Cutter Suction Dredger)

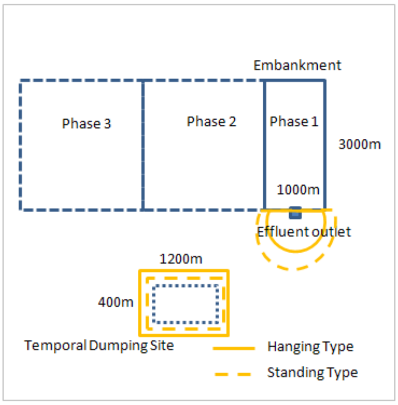
Counter measures to control SS generation is not considered in Case 1 and 2, while silt protector/curtain is considered in Case 3 and 4. Considered countermeasures to control SS generation/dispersion are as follows:

- Dredging: Frame with silt protector/curtain (see the photo in Figure 15.5.10) is installed with the grab dredger. Dredging is performed in the frame. Vertical coverage of the silt protector/curtain is 80% of the depth with 40% of SS removal ratio.
- Offshore dumping: No countermeasure is considered.
- Dumping at SDV: Silt protector/curtain surrounds the temporary dumping basin and drainage effluent outlet from the embankment (refer to Figure 15.5.10 for an example). SS removal ration of the silt protector/curtain is 40%.

Dredging frame with silt curtain
Source: Guideline for prediction of SS dispersion$^{2 \text{ at page } 42}$



Silt protector/curtain
Source: Taiyo Kogyo Corporation



Installment of silt curtains

Figure 15.5.10 Countermeasures to SS Dispersion

b) Evaluation Criteria

To evaluate the impacts by construction (human-being activity) on the environment, not much standard/guideline is available worldwide. In this study, Japanese and Canadian water quality guidelines that are aimed to protect fishery resources and aquatic life respectively were referred. Table 15.5.6 shows the water quality standard of SS for the Japanese and Canadian guidelines.

Table 15.5.6 Japanese and Canadian water quality standards for SS

Title of guideline	SS standard
Japanese water quality standards for the protection of fishery resources (2005 version)	Anthropogenic activities should not increase SS concentration by more than **2 mg/l** over background levels.
Canadian water quality guidelines for the protection of aquatic life	Anthropogenic activities should not increase SS concentration by more than **5 mg/l** over background levels (for long term exposure).

Source of Japanese guideline: Japan Fisheries Resource Conservation Association
Source of Canadian guideline: Canadian Council of Ministers of the Environment (http://ceqg-rcqe.ccme.ca/)

Since the Japanese standard (2 mg/l) is slightly stricter than the Canadian standard (5 mg/l), the Japanese standard was applied specifically to marine organisms that are sensitive to turbidity, in which this case was hard corals. The Canadian standard on the other hand was applied generally to the other marine organisms.

c) Comparison between Offshore Dumping and Dumping at SDV (Case 1 and Case 2, Case 3 and Case 4)

SS dispersion between Case 1 and 3 (offshore dumping) and Case 2 and 4 (dumping at SDV) was compared and shown in Figure 15.5.11 and Figure 15.5.12. Dredging method is performed by 4 vessels of grab dredger in all cases. And any countermeasures to control SS generation are not considered in Case 1 and 2, while existing of embankment in Case 2 are considered. SS dispersion patterns were compared between Case 3 (grab dredging and offshore dumping) and Case 4 (grab dredging and dumping at SDV) with countermeasures to SS dispersion respectively. As countermeasures, silt curtain frame (see Figure 15.5.10) is used for dredging in both cases and silt curtains (both hanging type and standing type: see Figure 15.5.10) are used at temporary dumping basin and at effluent outlet from dumping revetment of SDV for Case 4.

Out of all outputs from the simulation in the large domain, the 2nd layer (2-4m below surface: upper layer) and the 4th layer (6-8m below surface: lower layer) of daily maximum value in each case are selected as the representative layers for dredging and dumping respectively.

Daily maximum value, here, means the broadest SS dispersion in a day after dispersion is steady.

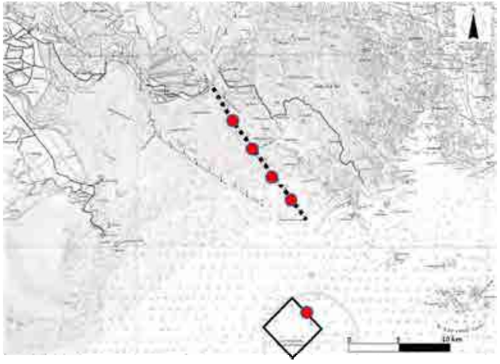
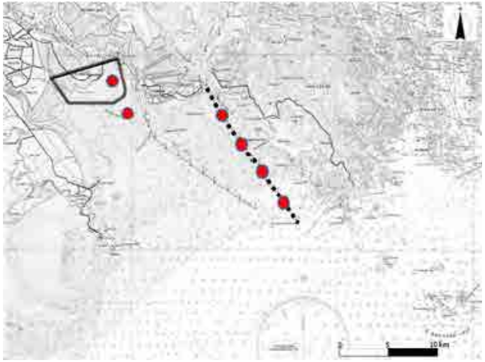
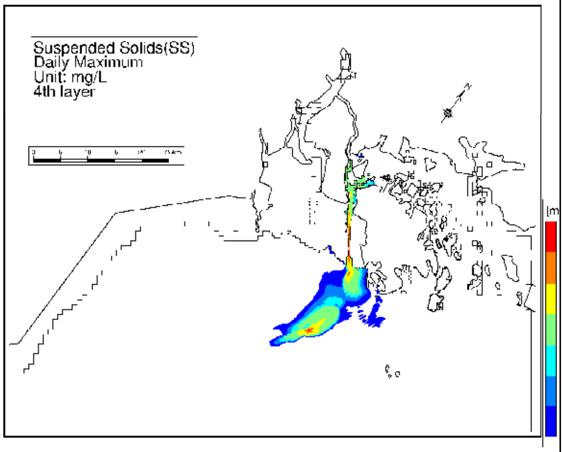
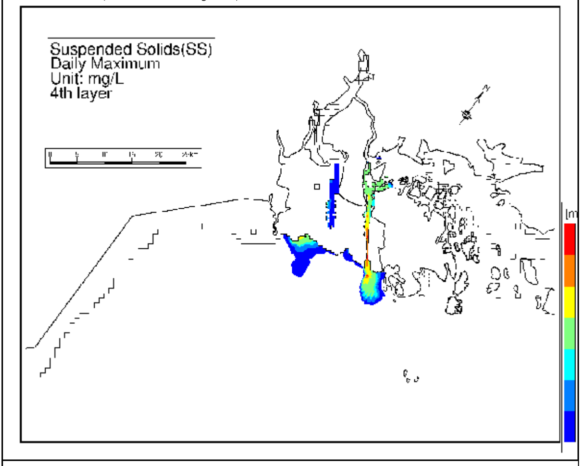
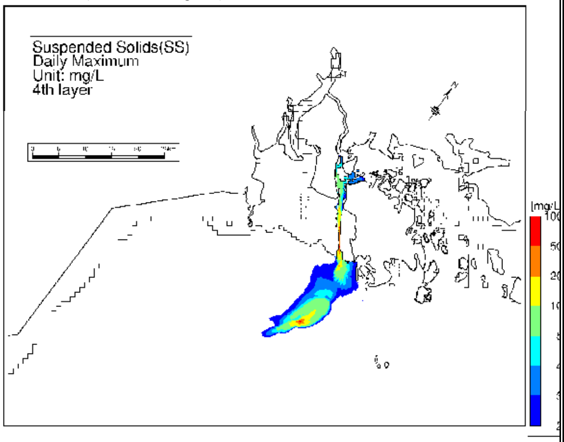
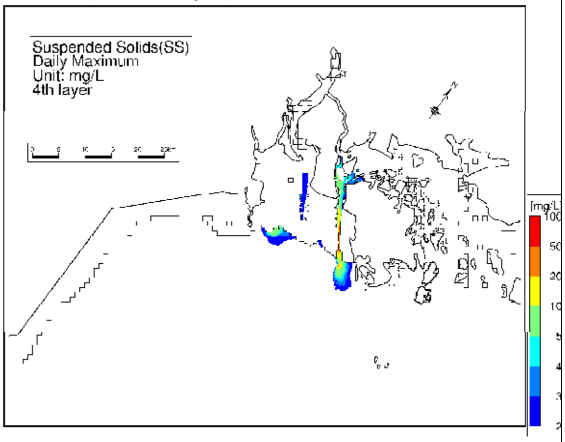
The contour lines show the additional SS to environmental generated by dredging and dumping activities. Pale blue contour line shows 2mg/L additional SS line and orange contour line is 5mg/L additional SS line.

In the upper layer in all cases, contour lines by dredging and dumping overlap each other. The contour line of 2mg/L by offshore dumping (Case 1) spreads southwest-east directions. The contour line of dumping in Case 2 is wider than that in Case 1. This is considered that SS load from outlet of embankment and influence of river water is great. 2mg/L contour line in Case 1 does not reach to environmentally important area such as Long Shau, Do Son beach area and Cat Ba beach area, while it in Case 2 reaches to Do Son beach area.

In the lower layer, the area of contour lines is limited in both cases. However, 2mg/L contour line in Case 2 still reaches to Do Son beach area.

Dispersion pattern in Case 4, SS generated by dredging activity and SS generated by dumping activity, shows tendency to flow out toward offshore along by river flow in the upper layer in Case 4, respectively. Its area in Case 4 is a bit larger than that in Case 3, suggesting that the load by near-shore dumping is greater than offshore dumping.

In the lower layer in Case 4, the area of SS dispersion by near-shore dumping is limited and it is smaller than that by offshore dumping in Case 3. But still, 2mg/L contour line is close to Do Son beach area.

	Case 1 and 3	**Case 2 and 4**
	(Offshore dumping)  ●: Load generation point	(Dumping at SDV)  ●: Load generation point
without silt curtain	**Case 1** (Lower layer)  	**Case 2** (Lower layer) 
with silt curtain	**Case 3** (Lower layer)  	**Case 4** (Lower Layer) 

<table>
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(without silt curtain)</th><th>Case 2 : 100% SDV Dumping
(without silt curtain)</th></tr>
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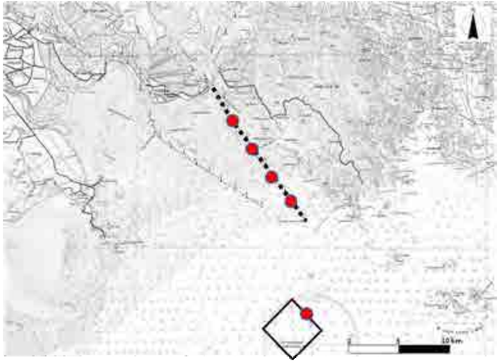
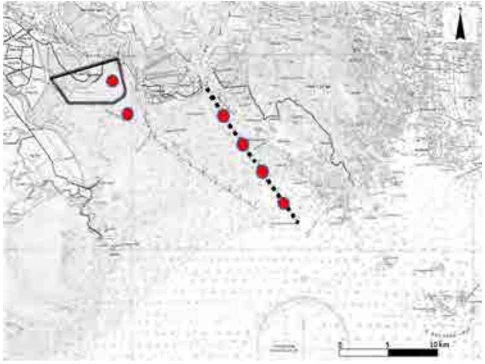

●: Load generation point</td><td>(Dumping at SDV)

●: Load generation point</td></tr>
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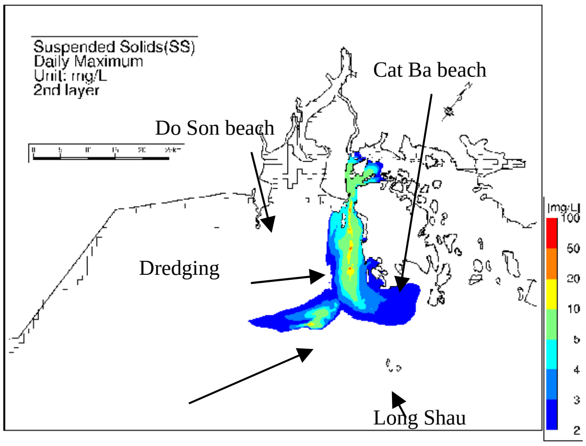
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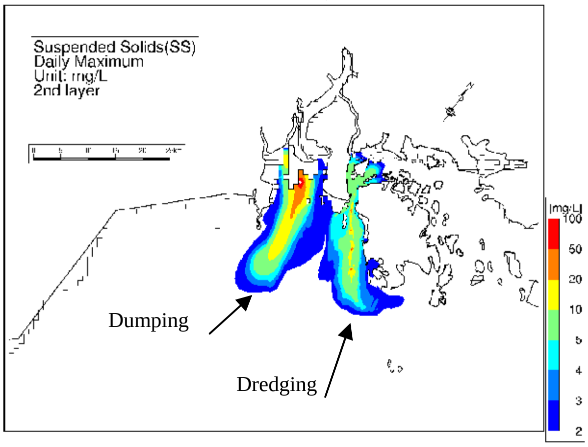
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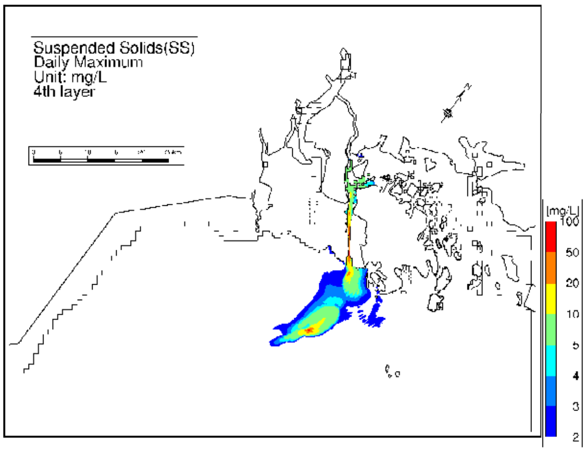
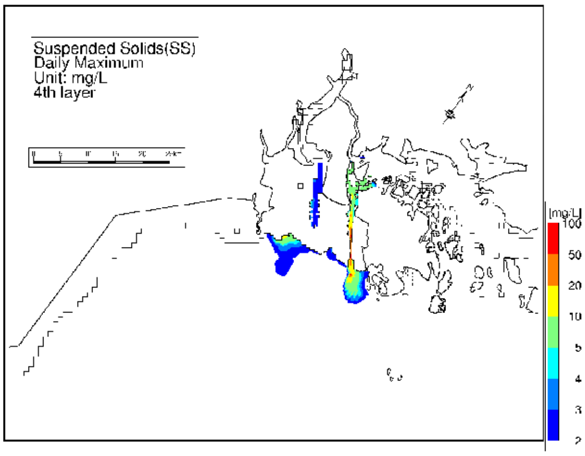

</td><td>Lower layer

</td></tr>
</table>

Figure 15.5.11 Simulation Result (Case1 and Case 2: large domain, daily maximum)

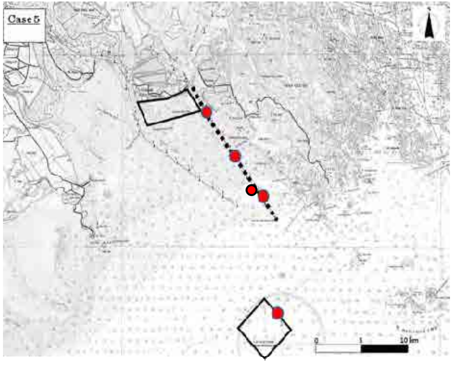
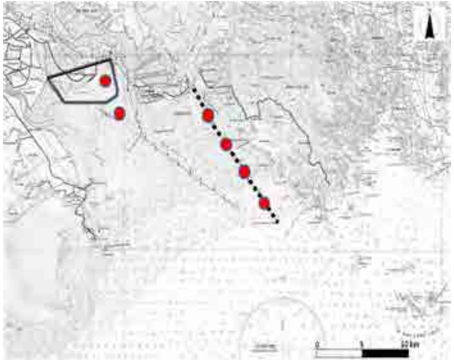
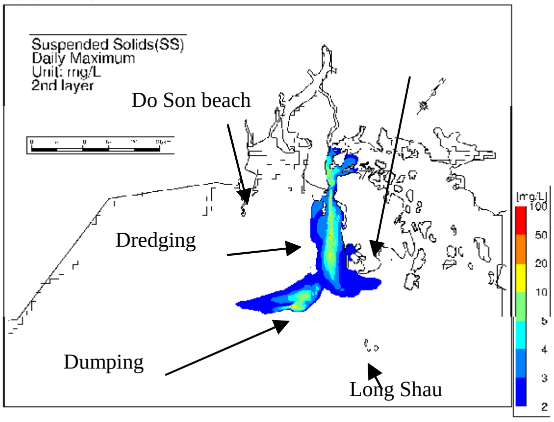
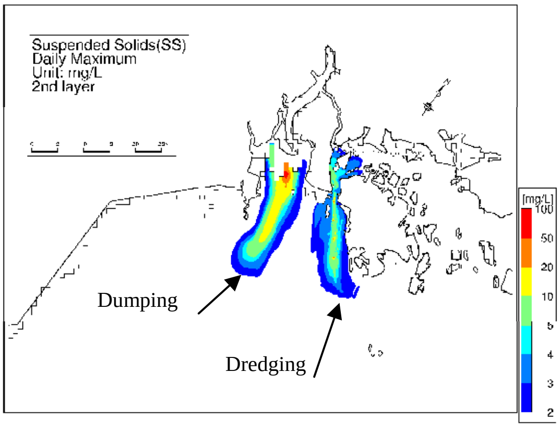
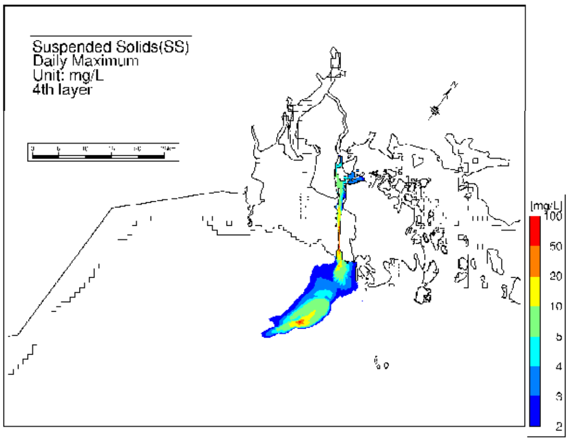
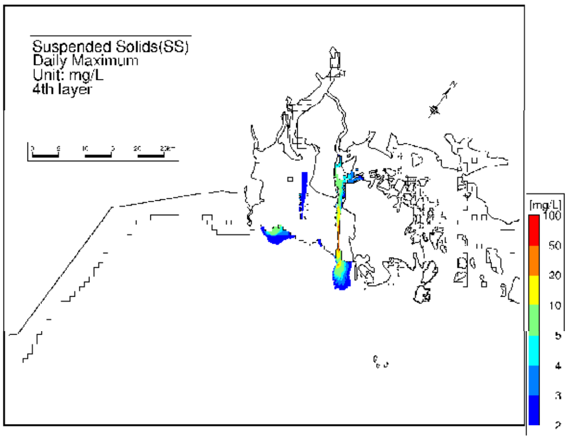
Case 3 : 100% Offshore Dumping (with silt curtain for dredging)	**Case 4** : 100% SDV Dumping (with silt curtain for dredging, dumping basin and drainage effluent outlet from embankment)
(Offshore dumping)  ●: Load generation point	(Dumping at SDV)  ●: Load generation point
(Upper layer) 	(Upper layer) 
(Lower layer) 	(Lower layer) 

Figure 15.5.12 Simulation Result (Case 3 and Case 4: large domain, daily maximum)

d) Effectiveness of mitigation measures (Case 1and 3, Case 2 and 4)

Effectiveness of mitigation measures by silt protector/curtain was compared between Case 1 and 3 and Case 2 and 4 respectively and shown in Figure 15.5.13 for upper layer and Figure 15.5.14 for lower layer. In both comparisons, it is clear that the area of SS dispersion by dredging is reduced by the measure and the dispersion area by dumping at SDV is also reduced. As countermeasures for offshore dumping is not considered in these cases, it is understand that the threat by SS dispersion to Cat Ba beach is mainly by dredging activity, not by offshore dumping.

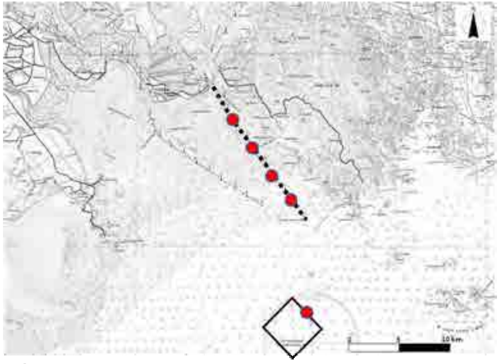
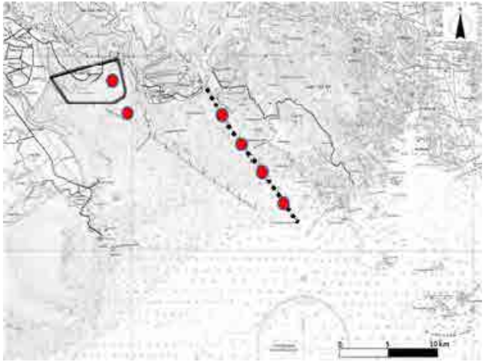
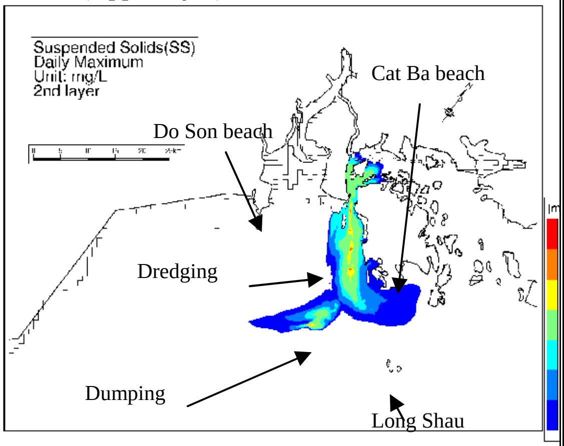
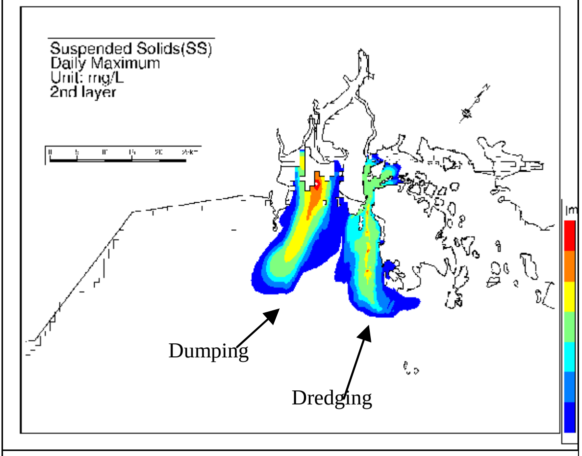
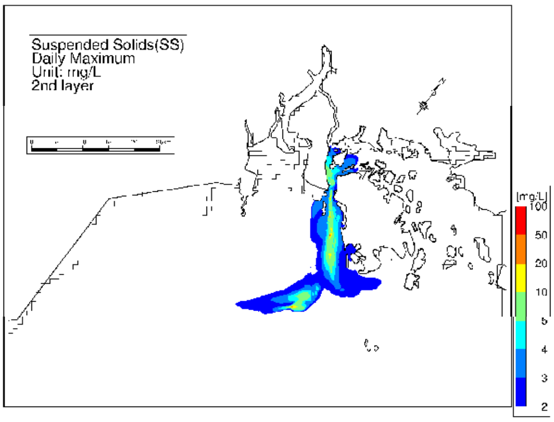
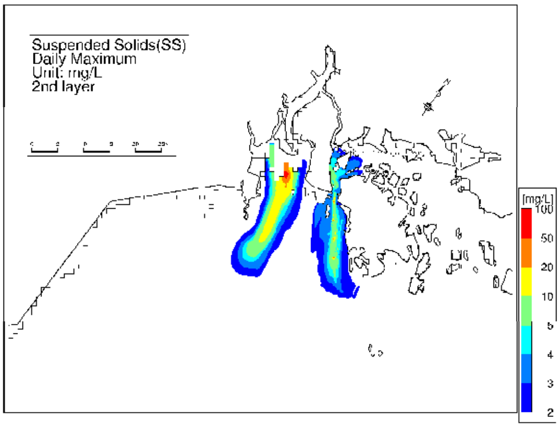
	Case 1 and 3	**Case 2 and 4**
	(Offshore dumping)  ●:Load generation point	(Dumping at SDV)  ●: Load generation point
without silt curtain	**Case 1** (Upper layer)  	**Case 2** （Upper layer） 
with silt curtain	**Case 3** (Upper layer）  	**Case 4** （Upper Layer） 

Figure 15.5.13 Simulation Result (Case 1 and 3, Case 2 and 4: Upper layer, large domain, daily maximum)

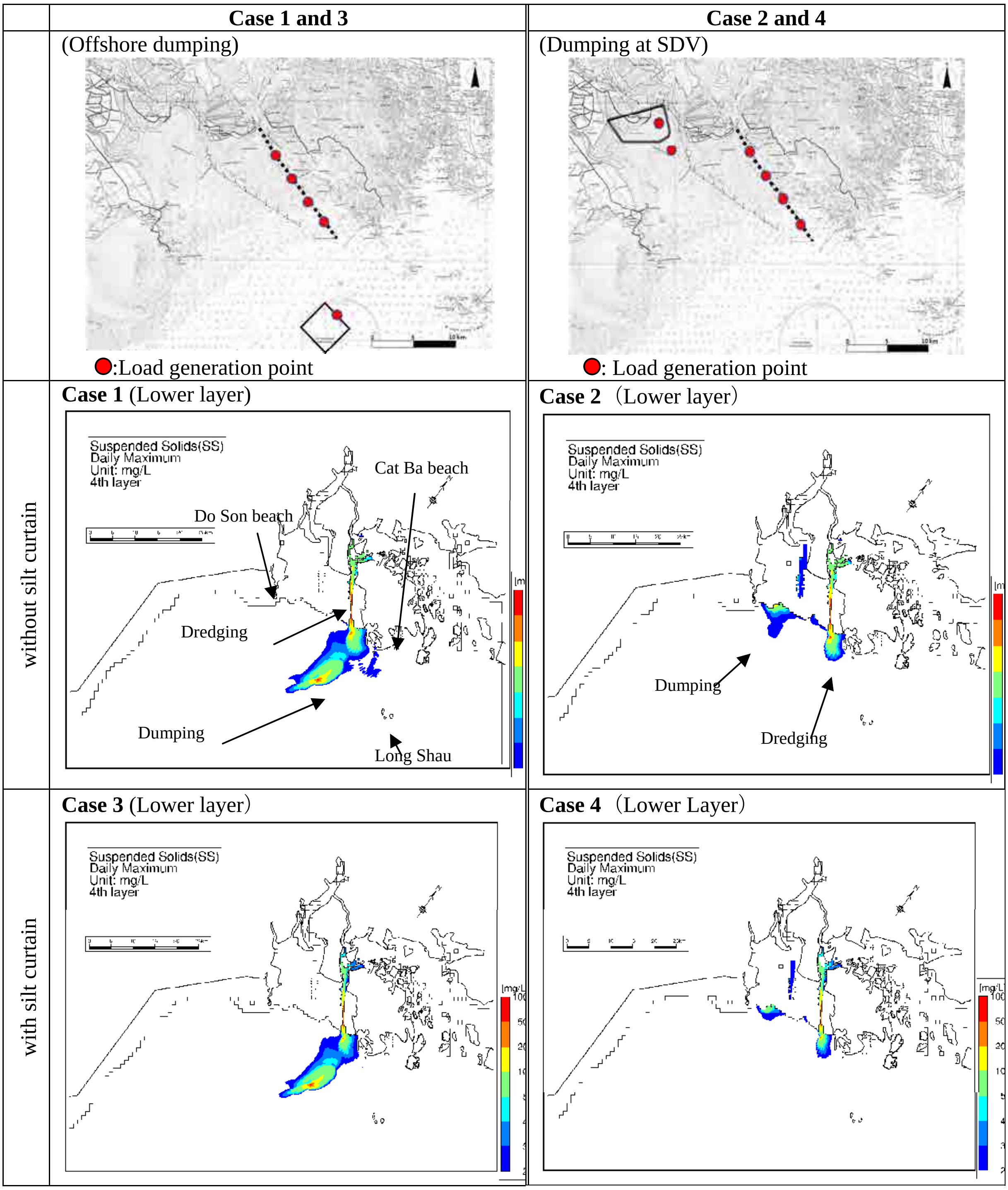


Figure 15.5.14 Simulation Result (Case 1 and 3, Case 2 and 4: Lower layer, large domain, daily maximum)

e) Combination dumping at different sites (Case 3, Case 4 and Case 5)

SS dispersion area by combination of different dumping site (e.g. 50% of dumping at offshore and 50% of dumping at SDV) was also studied, and shown in Figure 15.5.15 comparing with Case 3 (100% of dumping at offshore) and Case 4 (100% of dumping at SDV).

Mitigation measures in all cases are undertaken. SS dispersion area of each simulation case shown in Figure 15.5.12 and Figure 15.5.15 was comprehensively traced and lapped over. Figure 15.5.16 compares the comprehensive affected area by each dumping location.

The total area itself by combination dumping is smaller than that by other dumping location; however, comprehensive affected area by combination dumping is larger than that by dumping at single location. Combination of dumping sites remains possibility of affect to Do Son area although the area is smaller than that by 100% dumping at SDV.

Thus it can be concluded that 100% dumping at offshore is an ideal option

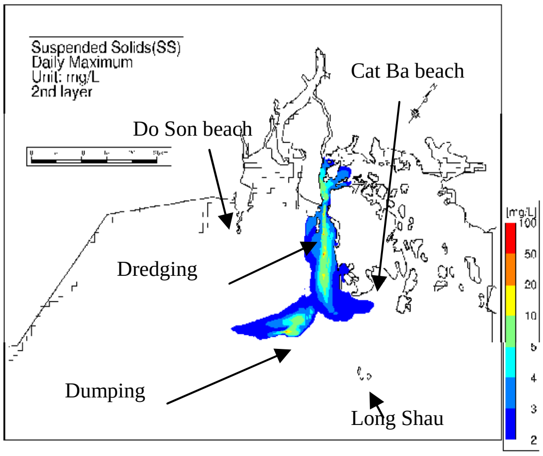
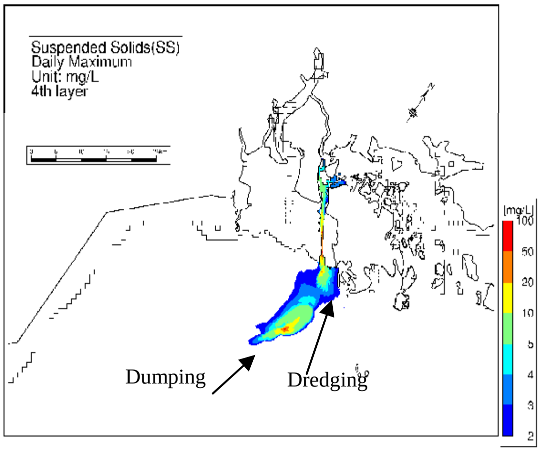
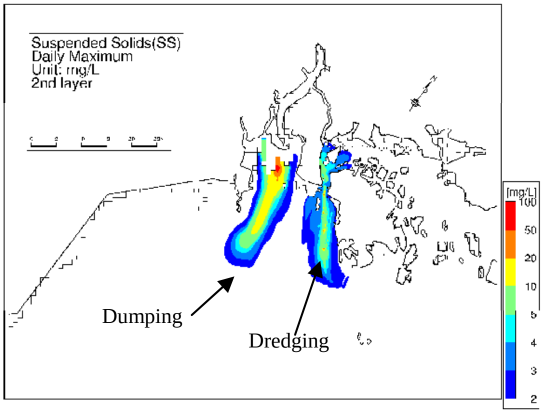
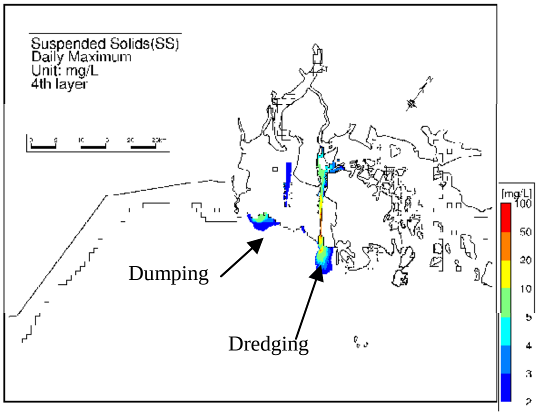
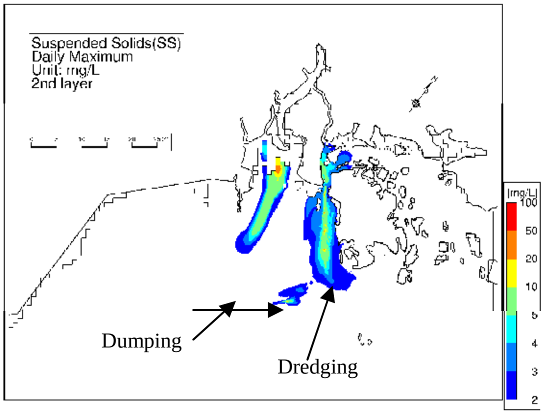
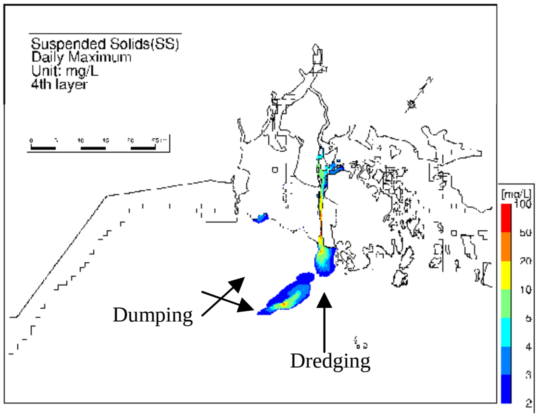
	Upper layer	**Lower layer**
	Case 3 : 100% Offshore Dumping (with silt curtain for dredging)	
100% dumping at offshore		
	Case 4 : 100% SDV Dumping (with silt curtain for dredging, dumping basin and drainage effluent outlet from embankment)	
100% dumping at SDV		
	Case 5: 50% SDV+50% Offshore Dumping(with silt curtain for dredging, dumping basin and drainage effluent outlet from embankment of SDV)	
50% offshore + 50% SDV		

Figure 15.5.15 Simulation Result (Case 3, Case 4 and Case 5: large domain, daily maximum)

Legend

☐ : Case 3 (100% dumping at offshore)
☐ : Case 4 (100% dumping at SDV)
▨ : Case 5 (50% dumping at offshore + 50% dumping at SDV)

SS dispersion area of each simulation case shown in Figure 15.5.12 and Figure 15.5.15was comprehensively traced and lapped over.

Figure 15.5.16 Comparison of Comprehensive affected Area between Dumping Sites

f) Findings from the simulation

The findings from the simulation are as follows:

- Comparing simulation results between offshore dumping and dumping at SDV, the area of SS dispersion by offshore dumping is smaller than that by dumping at SDV, because the impact by discharged water from outlet of embankment is great and the effect of river flow at SDV area also enhance the SS dispersion
- Biological and socially sensitive area such as Ha Long Bay, Cat Ba beach area, Do Son beach area, Long Chau Islands will not be affected directly by offshore dumping.
- The SS dispersion by dumping at SDV might reach to Do Son beach area.
- With countermeasures by silt protector/curtain for grab dredging, temporary dumping basin and discharge outlet from embankment at SDV, the area of SS dispersion will be reduced, although threat of impact to Do Son beach area by dumping at SDV still remains.
- By the combination of dumping at different location, such as 50% of dumping at offshore and 50% of dumping at SDV, the affected area will be broader than that by dumping at single location.

3) Impact to the Environment

Comparative summary of the environmental impact assessment for SS dispersion between near-shore (SDV) and offshore dumping without SS control measures are shown in Table 15.5.7.

Table 15.5.7 Summary of Environmental Impact Assessment

Type of impact		Near-shore (SDV)	Offshore
Natural environment	Impact on water quality (i.e. SS)	- The upper layer SS dispersion range was more extensive compared to offshore dumping. - The upper layer SS concentration was significantly higher compared to offshore dumping. - Near-shore dumping may result in a maximum ten-fold increase in SS concentration from current levels.	- The upper layer SS dispersion range was less extensive compared to near-shore dumping. - The upper layer SS concentration was significantly lower compared to near-shore dumping.
Biological environment	Impacts by loss of existing benthic habitat	- The diversity and abundance of marine organisms were higher compared to offshore dumping area. - The near-shore area probably functions as a nursery ground for various species. - The near-shore area probably supports two fish species listed under Vietnam Red Book.	- The diversity and abundance of marine organisms were lower compared to near-shore dumping area. - No significant ecological function was identified. - No endangered species was identified.
	Impacts by SS dispersion	- Impacts on marine organisms will be greater compared to offshore dumping, as SS dispersion was predicted to be more significant than offshore dumping.	- Hard corals in Cat Ba Island and Long Chau Islands are unlikely to be affected from SS dispersion. - Impacts of SS dispersion on marine organisms will be less than near-shore dumping, as SS dispersion was predicted to be less significant than near-shore dumping.
Social environment	Impacts by loss of existing fishing area & SS dispersion	- PAHs by loss of fishing area and SS dispersion would be all existing/conventional occupations depending on sea water. - Impact on tourism//beach resorts would be moderate at Do Son beaches while it would be great in Cat Ba beaches unless proper monitoring is considered.. - Detailed social condition near SDV is not available at moment. Further survey and assess will be necessary if dumping at SDV is chosen.	- PAHs by loss of fishing area and SS dispersion would be limited to offshore fishing households. - Impact on tourism//beach resort would be negligible or minimal.
Conclusion	Without SS control measures, either near-shore (SDV) or offshore dumping would cause impacts on natural, biological, and social environment. However, considering the environmental sustainability and avoidance and minimization of unnecessary environmental impacts, **offshore dumping** is the preferable option without SS control measures. Due to the higher extent of negative impacts, SS control measures for near-shore dumping would be technically difficult and costly to minimize and compensate the damages. Therefore, it is recommendable to dispose the dredged sediment at the offshore dumping site. Even with the offshore dumping, it is still required to apply SS control measures for dredging activity to minimize the impacts with effective, economical, and practical measures.		

15.5.5 Mitigation Measures and Monitoring

1) Mitigation Measures

Recommended mitigation measures are summarized in Table 15.5.8.

Table 15.5.8 Recommended Mitigation Measures

Phase	Category	Impact factor	Mitigation measure	Implementing organization	Cost (USD)
Pre-Construction phase	Social environment	Land acquisition (if any)	Acquisition/compensation & IRP[5] by Land law And/or Career change program or IRP by DCEZ'[6] safety guard policy	District PC	Shall be defined by the District PC for the DCEZ's safety guard policies
		Loss of fisheries ground	Career change program or IRP by DCEZ' safety guard policy		
		Aquaculture	Inventory survey	Construction contractor	
Construction phase	Natural environment	Dust	Water spray, etc.	Construction contractor	-
		Noise/Vibration	Securing distance	Construction contractor	-
		Suspended solid	Silt curtain Overflow prohibition	Construction contractor	2,300,000/3years (for dredging and sensitive area) 8,750,000/3years (for SDV)
		Sediment degradation	Silt curtain	Construction contractor	
	Biological environment	Impact on hard corals and other marine organism due to SS dispersion from dredging and dumping activities	- Prohibition of overflow from dredger. - Installation of silt curtain around the dumping site - Implementation of reactive monitoring	Construction contractor	Refer to the cost above.
	Social environment	Degradation of water quality by SS for salt/aquaculture/beach resorts/fishery	DCEZ' safety guard policy (career change program or other mitigation/compensation measures)	District PC	Shall be defined by District PC for the DCEZ's safety guard policies.
Operation phase	Natural environment	Dust, Exhaust gas	Water spray High-combustion-efficiency engine	Operator	-
		Noise/Vibration	Monitoring, Interview	Operator	3,000/year
		Discharged water	Discharge water management	Operator	-
		Ballast water	Offshore replacement	Operator	-
		Antifouling paint, Sediment quality	Regular monitoring	Project owner	37,500/year
	Biological environment	Any of impacts in Natural environment	Any of measures in Natural environment	Operator	Refer to the cost above.
	Social environment	Oil Spill Accident	- Capacity development of authority's disaster management skills - Preparation of disaster management materials and implementation structure	Lach Huyen Gateway Port Authority	Shall be defined by Lach Huyen Gateway Port Authority

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[5] IRP: Income Restpration Plan

[6] DCEZ: Dinh Vu-Cat Hai Economic Zone

2) Monitoring Plan

Recommended environmental monitoring plans are summarized in Table 15.5.9.

Table 15.5.9 Recommended Environmental Monitoring Plan

Phase	Category	Impact factor	Monitoring method	Implementing organization	Cost (USD)
Pre-Construction phase	Social environment	Land acquisition	2 time/year Standard methods for involuntary resettlement monitoring	District PC (legally responsible) with Collaboration of MPMU2	- Mandatory cost shall be defined by District PC - MPMU2's monitoring cost shall be 50,000/year
		Clearance of construction area (port & dumping site)	2 time/year Standard methods for involuntary resettlement monitoring		
Construction phase	Natural environment	Air quality, Noise, Vibration	1 time/month	Construction contractor	9,160/3years
		Suspended solid	Daily	Construction contractor	9,400/ 3years
		General environment	4 times/year	Project owner	375,000/year
	Biological environment	Impact on hard corals and other marine organism due to SS dispersion from dredging and dumping activities	**[Water quality monitoring]** - Daily monitoring of turbidity/SS levels at environmentally sensitive sites (3 sites) **[Coral health monitoring]** - Monthly monitoring of coral health at 2 hard coral sites (Cat Ba Island and Long Chau Island)	Construction contractor	130,000/3 years
		Impact on demersal fish/macro zoo benthos due to construction works	**[Demersal fish/macro zoobenthos monitoring]** - Seasonal monitoring of fish/macro zoo benthos status through trawling survey	Project owner	The cost is included in the cost for General environment of natural environment.
	Social environment	Degradation of water quality by SS for salt/aquaculture/beach resorts/fishery	2 time/year Standard methods for involuntary resettlement monitoring	District PC (legally responsible) with Collaboration of MPMU2	- Mandatory cost shall be defined by District PC - MPMU2's monitoring cost shall be 50,000/year including follow-up monitoring for pre-construction
Operation phase	Natural environment	General environment	2 times/year	Project owner	187,500/year
	Biological environment				
	Social environment	Follow-up monitoring for PAP	2 time/year Standard methods for involuntary resettlement monitoring	District PC (legally responsible) with Collaboration of the LH Gateway Port Authority	- Mandatory cost shall be defined by District PC - Port Authority's monitoring cost shall be 50,000/year

15.5.6 Conclusions and Recommendations

Based on the study of present natural, biological and social conditions and study of SS dispersion caused by dredging/dumping activities using simulation models, this study concludes and recommends as follows:

- The near-shore area is more environmentally sensitive being affected by river water flow.
- The near-shore area is likely to have greater ecological values than the offshore area. Hence impacts of benthic habitat loss through dumping activities will be more significant with near-shore dumping.
- Near-shore dumping may cause more significant impacts on conventional occupations depending on seawater, led by the loss of fishing area and degradation of productivities by higher SS concentration.
- Near-shore dumping may cause more significant impacts on coastal tourism especially during the beaching seasons led by the degradation of beaching attractiveness by higher SS concentration.
- According to the simulation results, biological and socially sensitive area such as Ha Long Bay, Cat Ba beach area, Do Son beach area, Long Chau Islands will not be affected directly by offshore dumping, however the SS dispersion by dumping at SDV might reach to Do Son beach area.
- Based on the findings listed above, offshore dumping is preferable.
- By the combination of dumping at different location, such as 50% of dumping at offshore and 50% of dumping at SDV, the affected area will be broader than that by dumping at single location.
- Countermeasures to SS dispersion such as silt protector/curtain will effectively work to reduce the impact by dredging/dumping activities.
- Past studies indicate that dumped sediment at offshore site is unlikely stirred up with normal sea state.
- Even though offshore dumping is likely to have naturally, biologically and socially less impact, continuous monitoring and measures to control SS generation/dispersion during the construction phase are highly recommended.

DIVISION – III

DETAILED DESIGN

Package 6 Infrastructure Construction Behind the Container Terminal

16. RECLAMATION AT TERMINAL AREA AND ACCESS ROAD AREA

16.1 Subsoil Improvement

16.1.1 Secondary Consolidation at Subsoil Improvement Area by PVD and Preload Method

In the Basic Design for subsoil improvement, settlement has been studied and calculated only for primary consolidation. Even though secondary consolidation settlement appears taking very long time and accurate estimation of them is not so easy from both of empirical and theoretical point of views, it is important to anticipate the amount of secondary consolidation settlement for future maintenance plan and works for port operation.

In this section, secondary consolidation settlement is anticipated based on subsoil investigation results in this study.

1) Secondary Consolidation Settlement

Consolidation Settlement is calculated as sum of primary consolidation settlement and secondary consolidation settlement by the following formula.

$$Sc = Sf + Ss$$

Where,
Sc : Consolidation Settlement (m)
Sf : Primary consolidation settlement (m)
Ss : Secondary consolidation settlement (m)

According to the subsoil investigation results in this study, coefficient of Secondary Consolidation Cα (= Δe/Δlog t, Cαε= Cα /(1+e_0)) for each layer is estimated by the following formula as follows;

Cα(NC)/ Cc = 0.04± 0.01 (after Ladd et al, 2003)

Adopted here, Cα(NC)/ Cc = 0.03

- Layer 1b: Cα(NC) = 0.009, Cαε = 0.005
- Layer 2 : Cα(NC) = 0.018, Cαε = 0.008
- Layer 3b : Cα(NC) = 0.009, Cαε = 0.005
- Layer 4 : Cα(NC) = 0.012, Cαε = 0.006
- Layer 5 : Cα(NC) = 0.018, Cαε = 0.008

Secondary consolidation settlement (Ss) is calculated by the following formula;

$$Ss = C\alpha\varepsilon H \log\left(\frac{tf}{tp}\right)$$

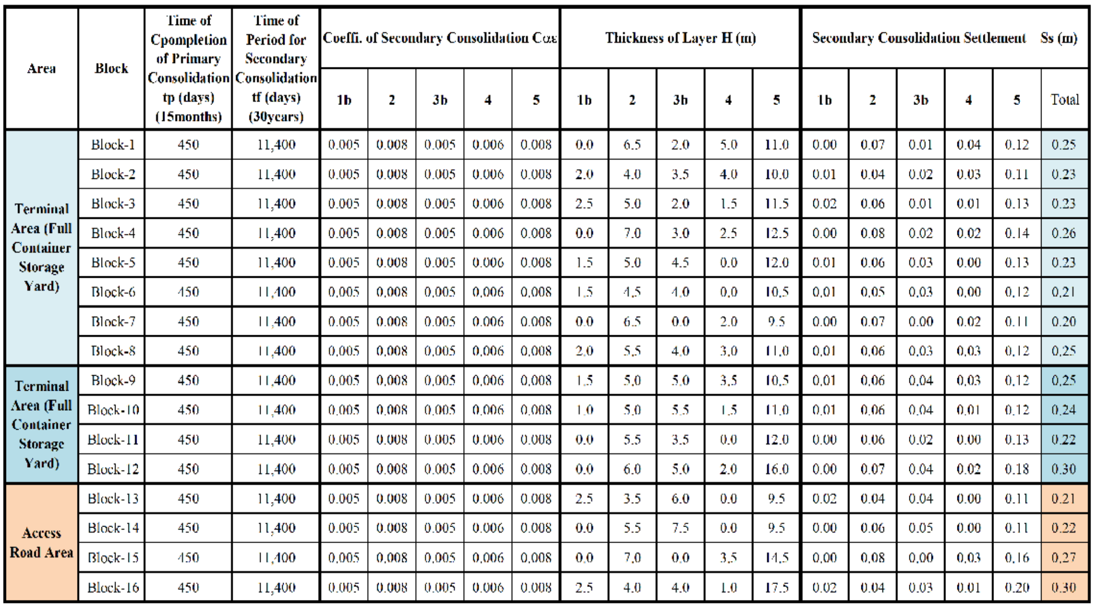
Where,
Caε : Coefficient of secondary consolidation
H : Thickness of layer (m)
tp : Time of completion of primary consolidation settlement

(Assumed that handing over time is 15 months after reclamation work started;
(Shortest case = 450 days))
tf : Time of period to consider the secondary consolidation settlement
(Assumed 30 years later after handing over (= 450 days + 10,950 days = 11,400 days)
Soil layer model for each block is used with the same one as shown in Chapter 7.

Calculation result of secondary consolidation settlement for 30years after handing over is shown in Table 16.1.1.

As shown in the table secondary consolidation between 20 and 30 cm is anticipated to occur in 30 years after handing over to private sectors in the reclamation area.

Table 16.1.1 Calculation results of Secondary Consolidation Settlement at Reclamation Area



Area	Block	Time of Cpompletion of Primary Consolidation tp (days) (15months)	Time of Period for Secondary Consolidation tf (days) (30years)	Coeffi. of Secondary Consolidation Cαε					Thickness of Layer H (m)					Secondary Consolidation Settlement Ss (m)					
				1b	2	3b	4	5	1b	2	3b	4	5	1b	2	3b	4	5	Total
Terminal Area (Full Container Storage Yard)	Block-1	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	6.5	2.0	5.0	11.0	0.00	0.07	0.01	0.04	0.12	0.25
	Block-2	450	11,400	0.005	0.008	0.005	0.006	0.008	2.0	4.0	3.5	4.0	10.0	0.01	0.04	0.02	0.03	0.11	0.23
	Block-3	450	11,400	0.005	0.008	0.005	0.006	0.008	2.5	5.0	2.0	1.5	11.5	0.02	0.06	0.01	0.01	0.13	0.23
	Block-4	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	7.0	3.0	2.5	12.5	0.00	0.08	0.02	0.02	0.14	0.26
	Block-5	450	11,400	0.005	0.008	0.005	0.006	0.008	1.5	5.0	4.5	0.0	12.0	0.01	0.06	0.03	0.00	0.13	0.23
	Block-6	450	11,400	0.005	0.008	0.005	0.006	0.008	1.5	4.5	4.0	0.0	10.5	0.01	0.05	0.03	0.00	0.12	0.21
	Block-7	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	6.5	0.0	2.0	9.5	0.00	0.07	0.00	0.02	0.11	0.20
	Block-8	450	11,400	0.005	0.008	0.005	0.006	0.008	2.0	5.5	4.0	3.0	11.0	0.01	0.06	0.03	0.03	0.12	0.25
Terminal Area (Full Container Storage Yard)	Block-9	450	11,400	0.005	0.008	0.005	0.006	0.008	1.5	5.0	5.0	3.5	10.5	0.01	0.06	0.04	0.03	0.12	0.25
	Block-10	450	11,400	0.005	0.008	0.005	0.006	0.008	1.0	5.0	5.5	1.5	11.0	0.01	0.06	0.04	0.01	0.12	0.24
	Block-11	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	5.5	3.5	0.0	12.0	0.00	0.06	0.02	0.00	0.13	0.22
	Block-12	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	6.0	5.0	2.0	16.0	0.00	0.07	0.04	0.02	0.18	0.30
Access Road Area	Block-13	450	11,400	0.005	0.008	0.005	0.006	0.008	2.5	3.5	6.0	0.0	9.5	0.02	0.04	0.04	0.00	0.11	0.21
	Block-14	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	5.5	7.5	0.0	9.5	0.00	0.06	0.05	0.00	0.11	0.22
	Block-15	450	11,400	0.005	0.008	0.005	0.006	0.008	0.0	7.0	0.0	3.5	14.5	0.00	0.08	0.00	0.03	0.16	0.27
	Block-16	450	11,400	0.005	0.008	0.005	0.006	0.008	2.5	4.0	4.0	1.0	17.5	0.02	0.04	0.03	0.01	0.20	0.30

16.1.2 PVD Installation, Sand Mat and Preload

The finish elevation of reclamation at Terminal area in the Component A of the Project is 4.5m CDL. The reclamation materials shall be cohesion-less, well-graded sandy materials and shall contain less than 5% in weight of particles passing sieve 74 µm and shall not contain gravel and rock. The filling materials shall be free from vegetation and roots. Suitable materials shall not have topsoil, roots, vegetation, organic matter silt, contaminating matter and other materials which are combustible or which can decay. After reclamation by sand filling up to CD+4.0m, Sand Mat will be spread in two layers, 1st one is from CD+4.0m to CD+4.5m and 2nd one is from CD+4.5m to CD+5.0m. This sand mat material shall have the following grading characteristics to keep the good permeability as described Vietnam Standard (22 TCN 262-2000) as follows;

- 0.25mm grain or bigger size weight > 50%
- 0.08mm grain or smaller size weight < 5%
- $D_{60} / D_{10} > 6$ or $1 < (D_{30})^2 / D_{10} \cdot D_{60} < 3$
- Organic Content < 5%

Sand Mat spreading area is shown in Figure 16.1.2.

Preload called in this project is the fill above Sand Mat level (CD+5.0m) is shown together with temporary counter fill for retaining slope stability during subsoil improvement period at outside of revetment face line in Figure 16.1.3. The Preload fill material shall be free from lumps of dirt, organic matter or any other deleterious matter. The Preload fill materials shall satisfy the following requirements:

- Wet density	: > 18kN/m^3.
- Organic content	: < 5%
- Calcium carbonate content	: < 3%
- Silt and clay content (size <0.075 mm)	: < 5%

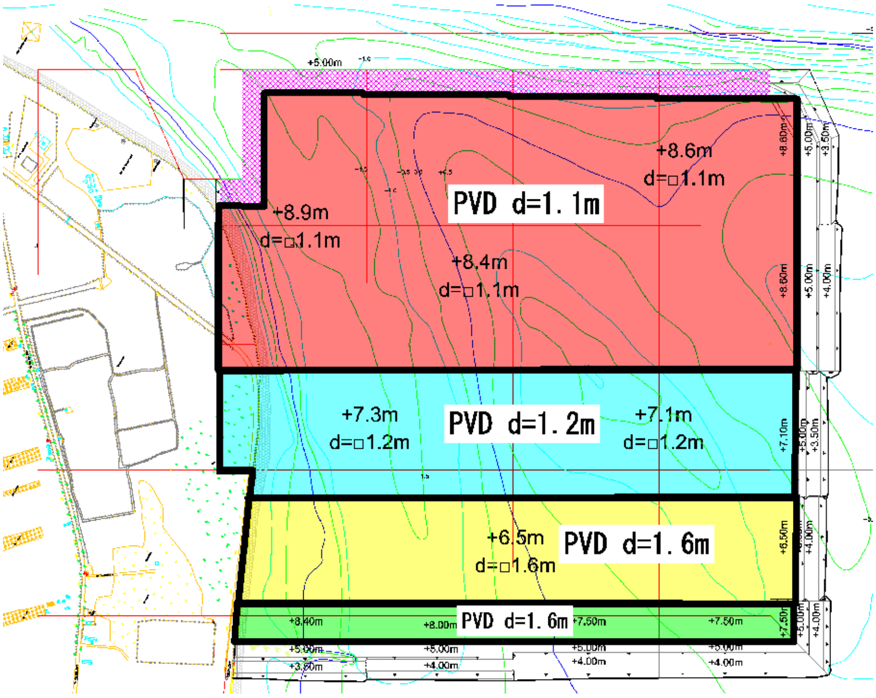


Figure 16.1.1 PVD Installation Layout Plan

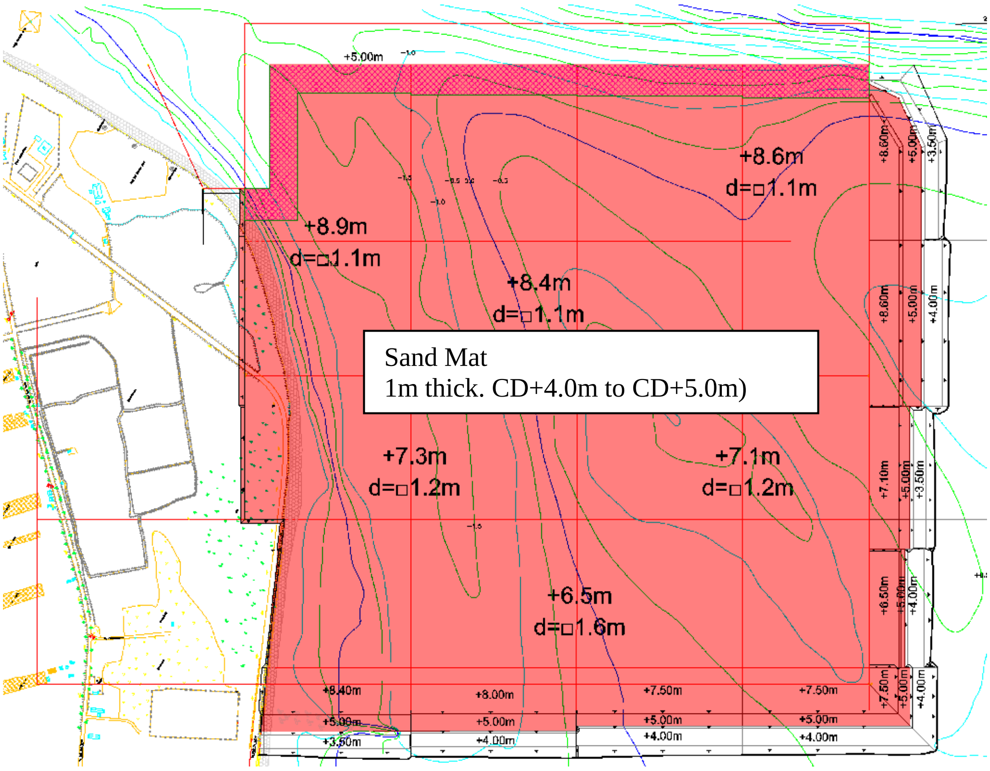


Figure 16.1.2 Sand Mat (CD+4.0m to CD+5.0m) Spread Area

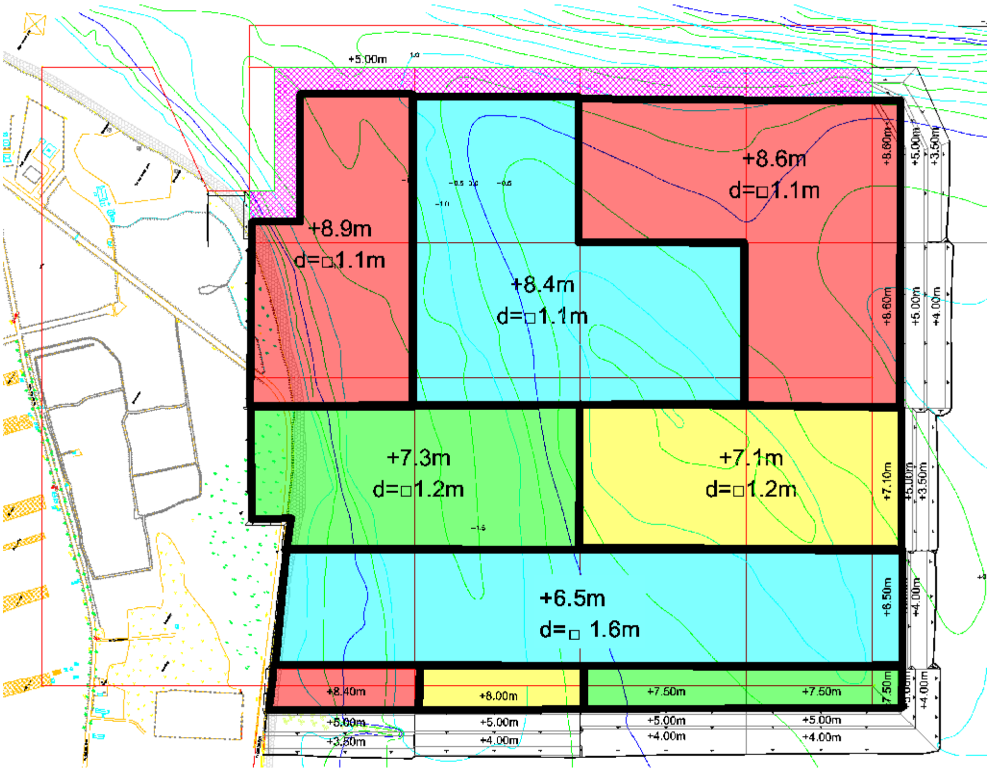


Figure 16.1.3 Preload Layout Plan at Reclamation Area including Revetment Area

Total PVD length, Sand Mat volume and Preload Volume and Temporary Counter Fill Volume at revetment portion up to CD+4.0 m for the Reclamation Area including Revetment Area are summarized as follows;

- PVD : 12,378,000 m
- Sand Mat: 637,000 m^3
  (Inside revetment: 553,000 m^3 + Temporary Counter Fill (Outside revetment) Area: 84,000 m^3)
- Preload: 1,598,000 m^3
  (Inside revetment: 1,452,000 m^3 + Temporary Counter Fill (Outside revetment) Area: 146,000 m^3)
- Counter Fill at Revetment: 455,000 m^3

Details of above quantities are shown in Table 16.1.2, Table 16.1.3 and Table 16.1.4, and detailed drawings are shown in Appendix 16-1.

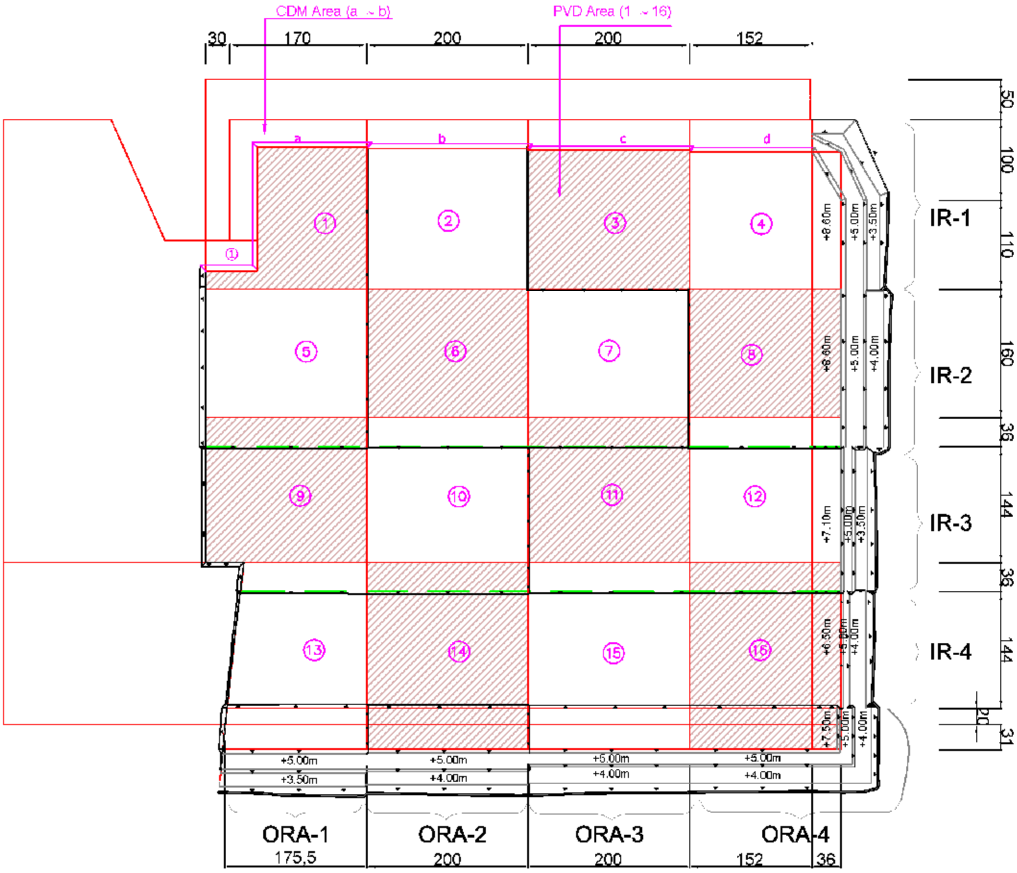


Figure 16.1.4 Blocks and Sections for Reclamation Area and Revetment Area

Table 16.1.2 Quantities for PVD Installation

Block	PVD spacing (m)	Amount (point)	PVD length (m)	Total length (m)
1	1.1	20,998	30.5	640,439
2	1.1	28,598	30.5	872,239
3	1.1	28,392	32.0	908,544
4	1.1	26,334	32.5	855,855
5	1.1	26,390	31.0	818,090
6	1.1	26,245	31.0	813,595
7	1.1	26,390	31.0	818,090
8	1.1	24,795	33.0	818,235
9	1.1	6,006	30.5	183,183
	1.2	19,920	30.5	607,560
10	1.1	5,973	31.0	185,163
	1.2	20,040	31.0	621,240
11	1.1	6,006	33.0	198,198
	1.2	20,040	33.0	661,320
12	1.1	5,643	36.0	203,148
	1.2	18,720	36.0	673,920
13	1.2	3,841	30.5	117,151
	1.6	9,265	30.5	282,583
	1.6	3,513	30.0	105,390
14	1.2	5,010	31.5	157,815
	1.6	11,250	31.5	354,375
	1.6	4,000	32.0	128,000
15	1.2	5,010	34.0	170,340
	1.6	11,250	34.0	382,500
	1.6	4,000	34.0	136,000
16	1.2	4,680	35.0	163,800
	1.6	10,600	35.0	371,000
	1.6	3,776	34.5	130,272
Total		**386,685**		**12,378,044**

Table 16.1.3 Quantities for Sand Mat and Preload at Reclamation Area (Within Face Line of Revetment)

		Preload			Sand mat (CD+4.0m to +5.0m)		
		Area (m^2)	Height (m)	Quantity (m^3)	Area (m^2)	Height (m)	Quantity (m^3)
CDM Area	a	9,696.6	-	-	9,696.6	1.0	9,696.6
	b	7,196.8	-	-	7,196.8	1.0	7,196.8
	c	7,616.8	-	-	7,616.8	1.0	7,616.8
	d	6,108.0	-	-	6,108.0	1.0	6,108.0
	①	2,433.6	-	-	2,433.6	1.0	2,433.6
Reclamation Area	1	25,369.9	3.9	98,942.6	25,369.9	1.0	25,369.9
	2	34,803.2	3.4	118,330.9	34,803.2	1.0	34,803.2
	3	34,391.6	3.6	123,809.8	34,391.6	1.0	34,391.6
	4	25,812.0	3.6	92,923.2	25,812.0	1.0	25,812.0
	5	32,000.0	3.9	124,800.0	32,000.0	1.0	32,000.0
	6	32,000.0	3.4	108,800.0	32,000.0	1.0	32,000.0
	7	32,000.0	3.4	108,800.0	32,000.0	1.0	32,000.0
	8	24,320.0	3.6	87,552.0	24,320.0	1.0	24,320.0
	9-1	7,200.0	3.9	28,080.0	7,200.0	1.0	7,200.0
	9-2	28,800.0	2.3	66,240.0	28,800.0	1.0	28,800.0
	10-1	7,200.0	3.4	24,480.0	7,200.0	1.0	7,200.0
	10-2	28,800.0	2.3	66,240.0	28,800.0	1.0	28,800.0
	11-1	7,200.0	3.4	24,480.0	7,200.0	1.0	7,200.0
	11-2	28,800.0	2.1	60,480.0	28,800.0	1.0	28,800.0
	12-1	5,472.0	3.6	19,699.2	5,472.0	1.0	5,472.0
	12-2	21,888.0	2.1	45,964.8	21,888.0	1.0	21,888.0
	13-1	5,551.1	2.3	12,767.4	5,551.1	1.0	5,551.1
	13-2	23,787.0	1.5	35,680.6	23,787.0	1.0	23,787.0
	13-3	3,489.3	3.4	11,863.5	3,489.3	1.0	3,489.3
	14-1	7,200.0	2.3	16,560.0	7,200.0	1.0	7,200.0
	14-2	28,800.0	1.5	43,200.0	28,800.0	1.0	28,800.0
	14-3	4,000.0	3.0	12,000.0	4,000.0	1.0	4,000.0
	15-1	7,200.0	2.1	15,120.0	7,200.0	1.0	7,200.0
	15-2	28,800.0	1.5	43,200.0	28,800.0	1.0	28,800.0
	15-3	4,000.0	2.5	10,000.0	4,000.0	1.0	4,000.0
	16-1	5,472.0	2.1	11,491.2	5,472.0	1.0	5,472.0
	16-2	21,888.0	1.5	32,832.0	21,888.0	1.0	21,888.0
	16-3	3,040.0	2.5	7,600.0	3,040.0	1.0	3,040.0
Total		**552,335.8**		**1,451,937.1**	**552,335.8**		**552,335.8**

Table 16.1.4 Quantities for Temporary Counter Fill (Fill, Sand Mat and Preload) at Revetment Area (Outside of Face Line of Revetment)

		1st Counter Fill (< CD+4.0m)				2nd Counter Fill (Upto CD+4.0m)				Sand mat (CD+4.0m to +5.0m)				Preload (> CD+5.0m)				Fill protection sectional length	Fill protection area
		Sectional Area (m^2)	Height (m)	Distance along Revet. (m)	Volume (m^3)	Sectional Area (m^2)	Height (m)	Distance along Revet. (m)	Volume (m^3)	Sectional Area (m^2)	Height (m)	Distance along Revet. (m)	Volume (m^3)	Sectional Area (m^2)	Height (m)	Distance along Revet. (m)	Volume (m^3)	(m)	(m^2)
IR-1	1-1	265.2	3.0	110.0	29,172.0	33.6	0.5	110.0	3,692.7	64.9	1.0	110.0	7,139.0	139.3	3.6	110.0	15,325.2	30.2	3,325.3
	1-2				33,851.1				2,225.4				3,607.3				4,575.6	27.6	3,508.2
IR-2		278.7	3.0	200.3	55,820.8					64.9	1.0	200.3	12,998.8	139.3	3.6	200.3	27,904.4	34.7	6,940.0
IR-3		219.5	3.0	172.7	37,901.2	26.5	0.5	172.7	4,568.2	50.7	1.0	172.7	8,747.8	78.9	2.1	172.7	13,628.5	29.2	5,048.3
IR-4		245.0	3.5	143.7	35,199.2					43.4	1.0	143.7	6,228.1	55.7	1.5	143.7	8,001.0	34.2	4,913.5
ORA-1		330.4	4.0	178.7	59,039.2	29.9	0.5	178.7	5,346.4	57.6	1.0	178.7	10,292.5	114.1	3.4	178.7	20,383.2	33.4	5,966.5
ORA-2		297.1	4.0	200.0	59,426.0					57.0	1.0	200.0	11,400.0	99.8	3.0	200.0	19,950.0	30.2	6,046.0
ORA-3		315.0	4.0	200.0	63,000.0					51.3	1.0	200.0	10,250.0	82.2	2.5	200.0	16,438.0	35.8	7,162.0
ORA-4	4-1	231.8	4.0	187.2	43,379.0					51.3	1.0	187.2	9,593.0	82.2	2.5	187.2	15,384.3	32.7	6,113.3
	4-2	291.8	3.0	31.0	9,044.3					71.3	1.0	31.0	2,208.8	132.2	2.5	31.0	4,097.9	32.7	1,012.2
	4-3	127.5	3.0	102.3	13,038.2					16.5	1.0	102.3	1,687.3					32.7	3,338.8
Total		**2,601.9**	**34.5**	**1,525.8**	**438,870.8**	**89.9**	**1.5**	**461.4**	**15,832.6**	**528.7**	**10.0**	**1,525.8**	**84,152.5**	**923.6**	**24.7**	**1,423.5**	**145,688.1**	**353.3**	**53,374.0**

1. Fill (upto CD+4.00m) =	454,703.44 m^3
2. Sand mat (CD+4.0m to CD+5.0m)=	84,152.53 m^3
3. Preload =	145,688.07 m^3
4. Fill protection area =	53,374.05 m^2

As for the drainage of water from PVD, to prevent troubles like multi-function of sand mat due to unforeseen considerable differential settlement by heavy construction machinery, pumping water from sand mat layer is recommended as shown in the following figures. Water pumped up from sand mat layer shall be discharged to the outside of reclaimed area using flexible pipe or ditch.

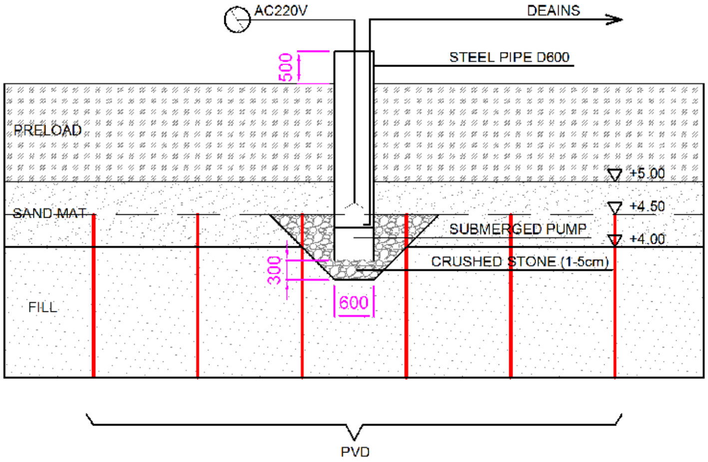
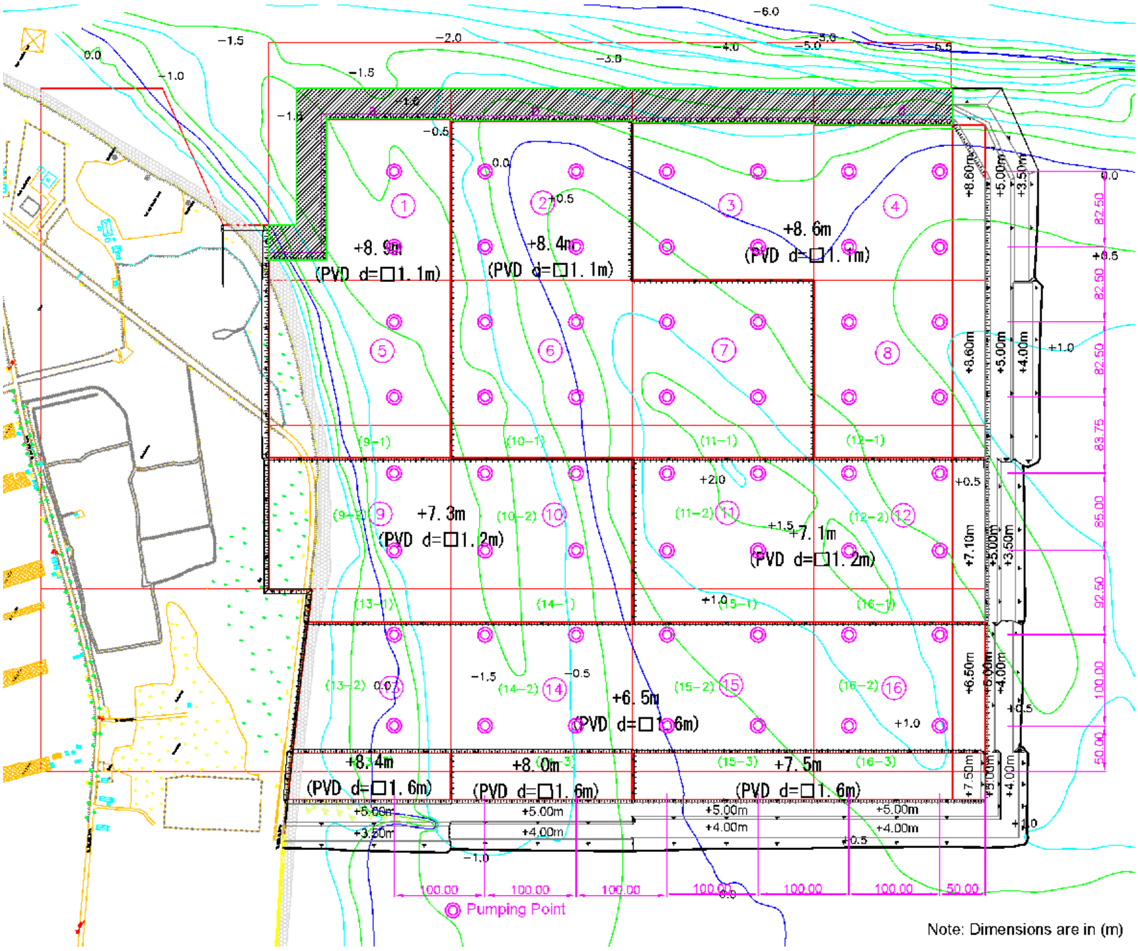


Figure 16.1.5 Details of Pumping Point



Note: Dimensions are in (m)

Figure 16.1.6 Layout Plan of Pumping Points

16.1.3 CDM Piles Construction

Soil improvement by CDM piles behind quay wall of container berth and service berth has been studied at Chapter 7 in the Basic Design of this report as shown in Figure 16.1.7.

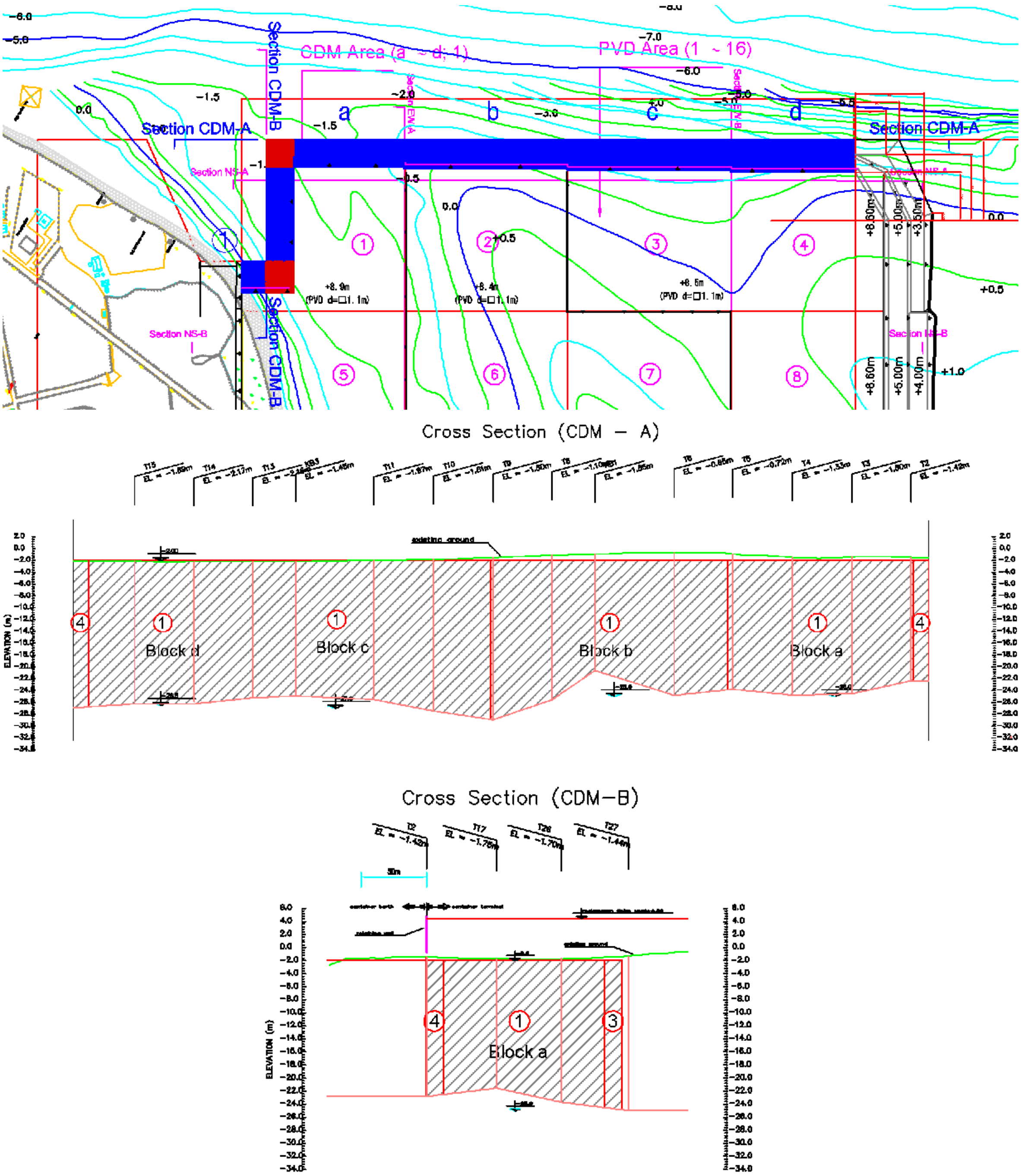


Figure 16.1.7 CDM Layout Plan and Cross Sections

Details of layout plan of CDM and CDM pile quantities are as shown in Figure 16.1.8 and Table 16.1.5 respectively. Detailed layout of CDM piles are shown in Appendix 16-1.

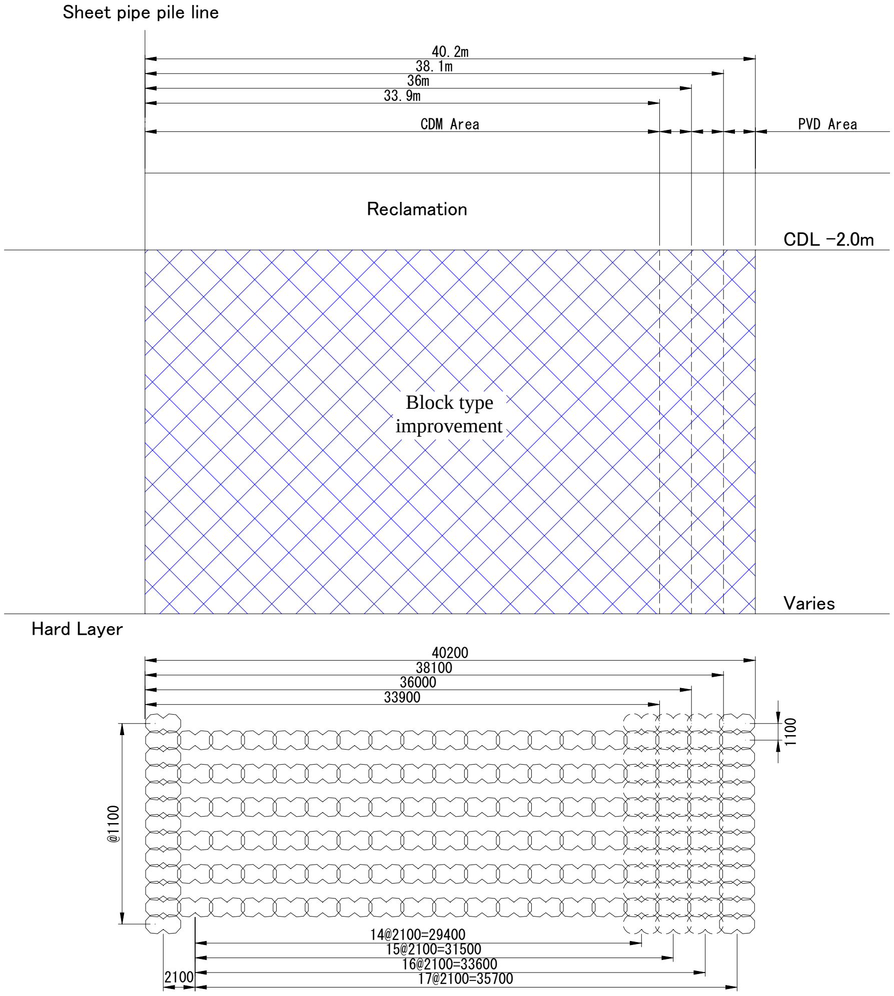


Figure 16.1.8 Details of CDM Piles Layout Plan and Cross Sections

Table 16.1.5 Quantities of CDM Piles

Block	Area	Length of area (m)	Number of piles per 1m of length (piles/m)	Piles of improvement (piles)	Specification of improvement					Soil volume of improvement	
					Formation level CDL (m)	Upper end CDL (m)	Lower end CDL (m)	Length of unimprovement (m)	Length of improvement (m)	Part of unimprovement (m^3)	Part of improvement (m^3)
①		204.0	3.64	746.0	5.0	-2.0	-26.0	7.0	24.0	13,368.3	45,834.2
a		640.0	3.64	2,485.0	5.0	-2.0	-25.0	7.0	23.0	44,531.2	146,316.8
b		472.0	3.64	1,727.0	5.0	-2.0	-25.0	7.0	23.0	30,947.8	101,685.8
c		476.2	3.64	1,821.0	5.0	-2.0	-27.0	7.0	25.0	32,632.3	116,544.0
d		384.7	3.64	1,450.0	5.0	-2.0	-26.5	7.0	24.5	25,984.0	90,944.0
Total		2,176.9		8,229.0						147,463.7	501,324.8

CDM piles are planned to construct on the water by the ship rigged with CDM pile forming machine (hereinafter it is called CDM ship) after excavation of the seabed up to CDL-2.0m. Minimum required area for excavation for the CDM ship to be able to enter the CDM construction area is shown in Figure 16.1.9.

CDM pile forming work can be started right after excavation of seabed block by block so that excavation work does not so much influence the schedule of CDM pile forming work. And also excavation depth is not so much; it is between 0.5m and 1.5m according to existing seabed level.

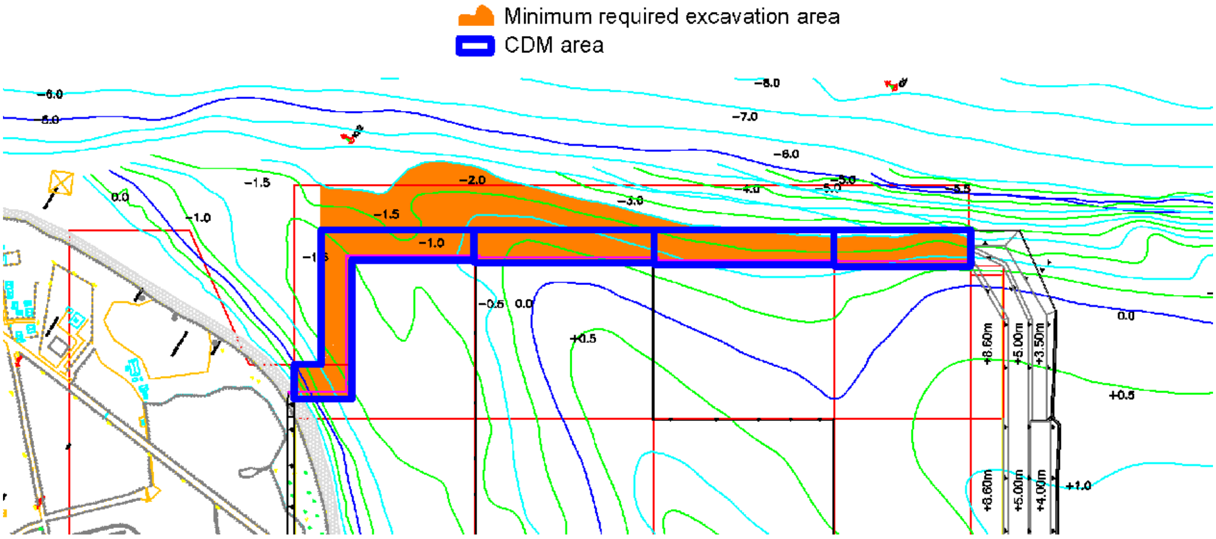


Figure 16.1.9 Minimum required excavation area for CDM Ship (Excavation up to CDL-2.0m)

16.1.4 Temporary Revetment for Reclamation Work and Counter Fill Protection at Revetment

Temporary Revetment will be necessary for reclamation work surrounding the reclamation area from environmental point of views. And also temporary slope protection along the counter fill for revetment area will be necessary especially against erosions by high wave during the windy and rainy season.

As for the above temporary revetment and temporary slope protection for counter fill at revetment area, there are several methods to implement temporary revetment and counter fill protection. Two examples among those methods are shown here as follows;

1) Geotextile bags 2) Geotube:

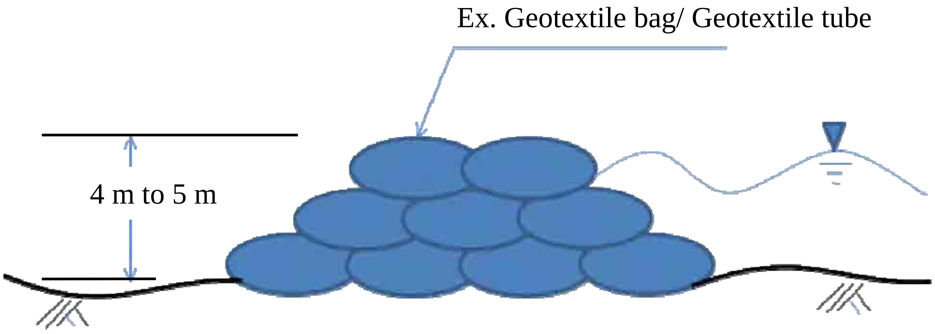


Figure 16.1.10 Temporary Revetment for Reclamation Work

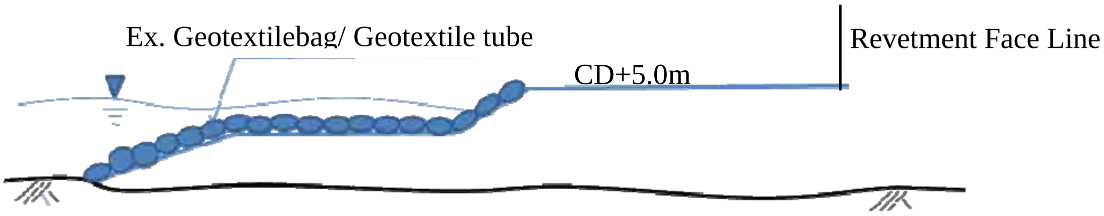


Figure 16.1.11 Temporary Slope Protection for Counter Fill at Revetment Area

Total length for Temporary Revetment for reclamation work and total area for Temporary Slope Protection for temporary counter fill at revetment area is as follows;

- Temporary Revetment Length: 1,500 m
- Temporary Slope Protection Area: 53,400 m^2

The locations and areas for temporary revetment and temporary fill protection are shown in Figure 16.1.12.

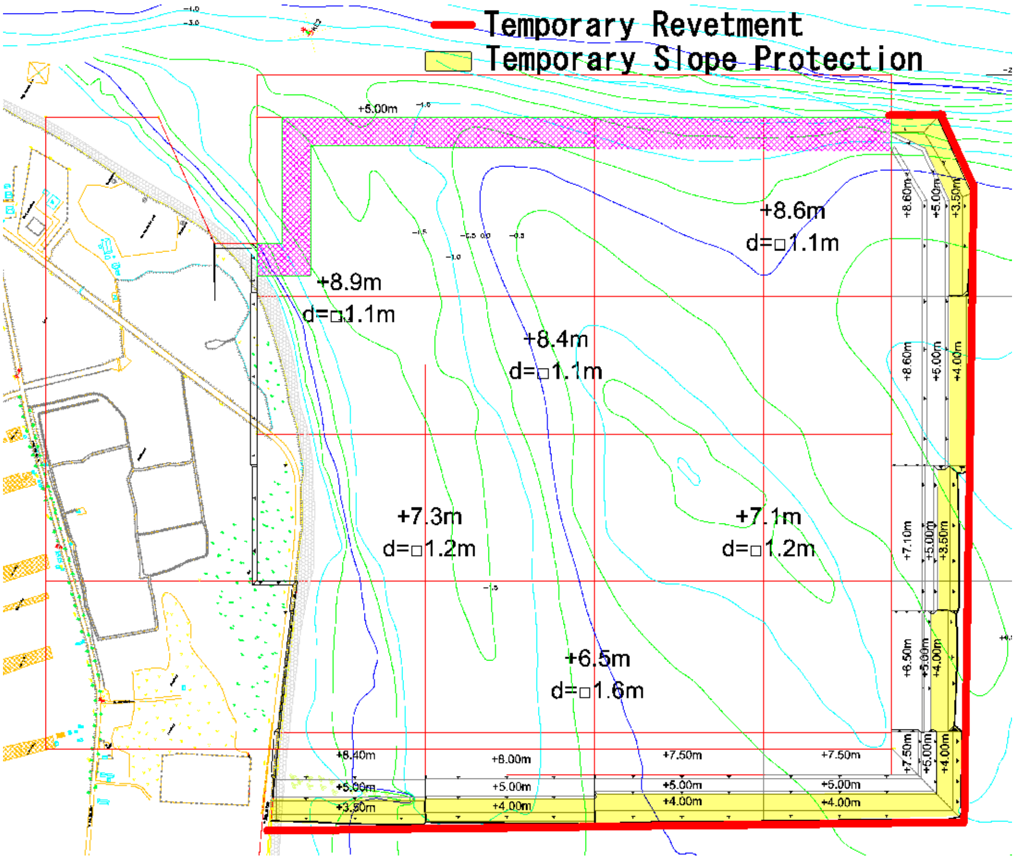


Figure 16.1.12 Locations of Temporary Revetment and Temporary Fill Protection

In case the area at South of Cat Hai Island where is close to Outer Revetment A is utilized as dumping site for dredged material of navigation channel, above temporary revetment and temporary slope protection may not be necessary depending on the schedule and procedure of its dumping. And also some of counter fill along the Outer Revetment A may not be necessary if dredged material already dumped closely in front of Outer Revetment A before filling work for Outer Revetment A.

16.2 Ground Deformation Analysis under Subsoil Improvement

16.2.1 Purpose of Analysis

One of important issues for design of subsoil improvement is deformation of ground under subsoil improvement process. Especially horizontal deformation of container berth and revetment cannot be analyzed by ordinary design method to calculate future settlement and slope stability.

In this Section, totally 4 locations (1 location at Terminal Berth, 2 locations at Inner Revetment, 1 locations at Outer Revetment A, Refer to Figure 16.2.1) are selected to analyze those deformation under subsoil improvement process with consolidation progress.

In order to predict the container berth and revetment deformation, the soil/water coupled elasto-visco-plastic FEM analysis, code name of which is DACSAR that can calculate vertical and horizontal displacement (two dimensional analyses) was conducted. The character of FEM analysis is shown as follows:

- It is possible to calculate shear deformation and consolidation deformation generated by fill and preload construction following construction schedule.
- Construction process can be simulated with adding and removing the elements.
- Geotechnical parameters for FEM analysis can be set from ordinary laboratory test results.

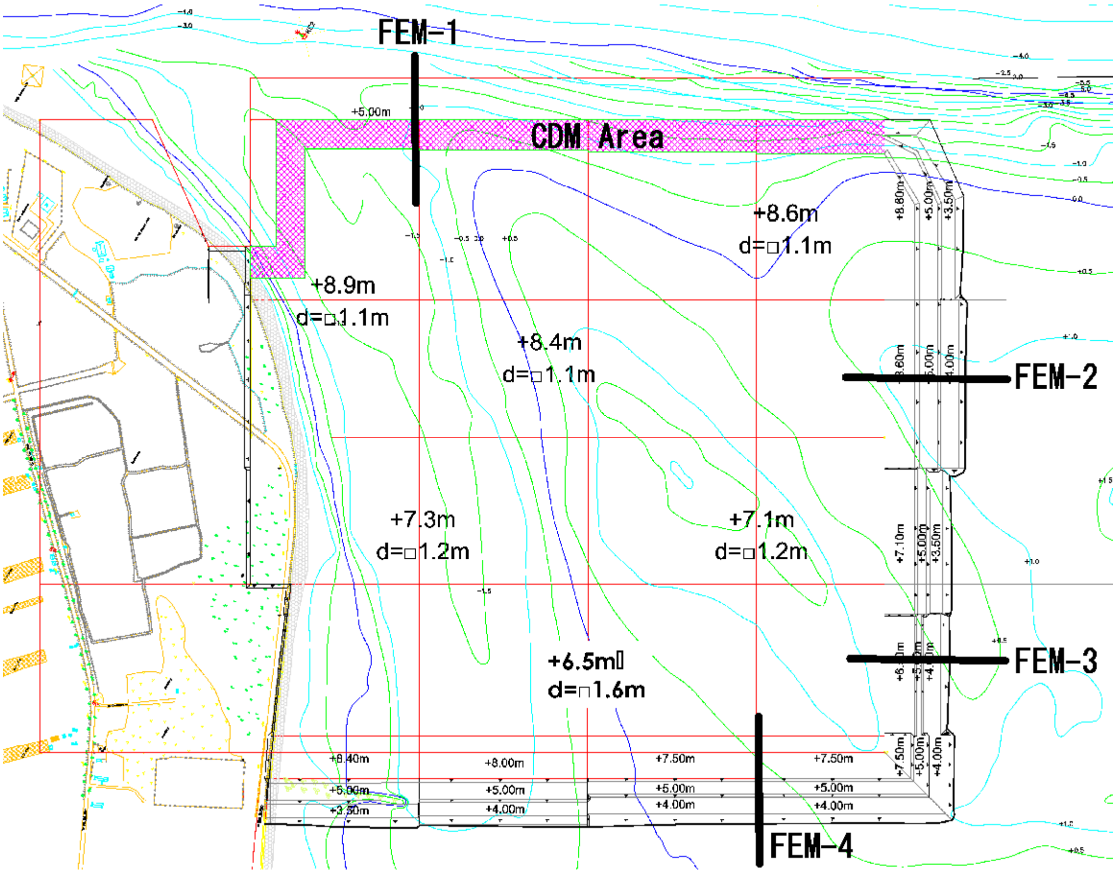


Figure 16.2.1 Location of Revetment Sections for Deformation Analysis by FEM

16.2.2 Flow of FEM Analysis and Consolidation Conditions

1) Flow chart of FEM analysis

FEM analysis flow chart is shown in Figure 16.2.2

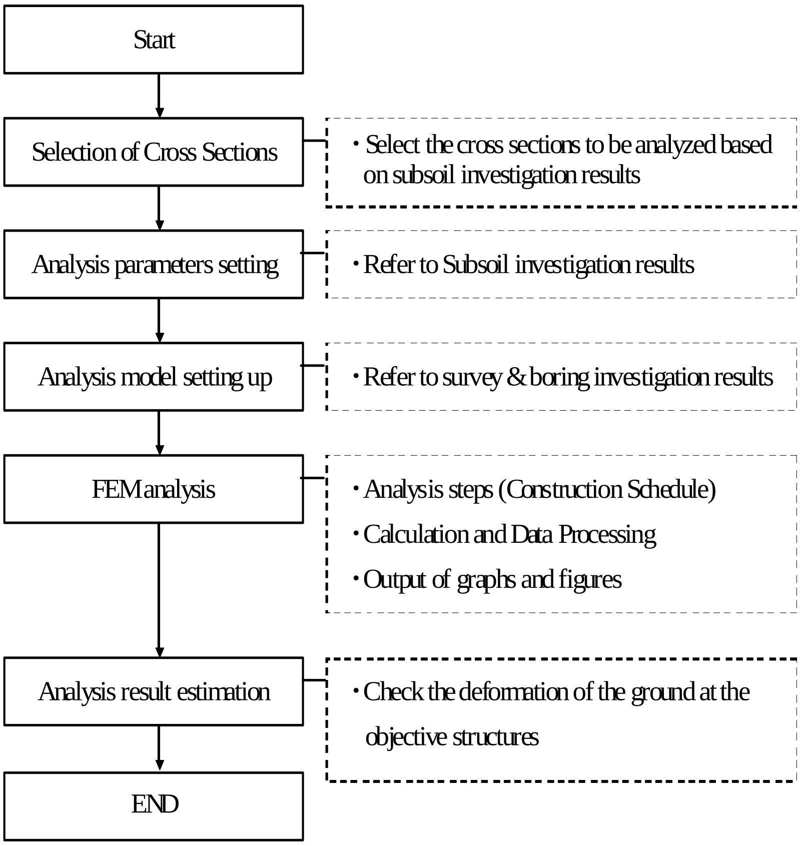


Figure 16.2.2 Deformation Analysis Flow by FEM

2) Analysis model, mesh and construction schedule

Analysis model, mesh and construction schedule are shown in the following Section for Analysis Result.

3) Constitutive equation

Constitutive equations were set separately based on the soil property of the each layer.

- Clayey soil layer (Layer 1b, 2, 3b, 4, 5) : visco-elasto-plastic model
- Fill and Preload, Sandy soil layer (Layer 1a, 3a, 3c) : linear elastic model

4) Boundary condition

- Analysis model right and left end : X direction (horizontal direction) fixed
  : Y direction (vertical direction) free
- Analysis model bottom : fixed in both X direction and Y direction

5) Water boundary condition

- Fill and uppermost sandy soil layer (1a) : drainage layer

6) Groundwater Level

- Groundwater level for analysis is set as follows;

Reclaimed area : CD+1.47m (Residual Water Level)
Sea side : CD+0.43m (Low Water Level)

16.2.3 Soil Parameters for FEM analysis

1) Soil Parameters for fill, Preload and sandy soil layer (linear elastic model)

In this FEM analysis, embankment and sandy soil layers (Layer 1a, 3a, 3c) were modeled as linear elastic material and their parameters for FEM analysis were selected based on field and laboratory test result as shown in Table 16.2.1.

Table 16.2.1 List of Input Parameters for Sandy Soil Layers (Linear Elastic Model)

Layer Name	Layer Thick. (m)	Average N	Specific Gravity Gs	Unit Weight γ_t (kN/m^3)	Submerged Unit Weight γ' (kN/m^3)	Deformation Factor E (kN/m^2)	Poisson's Ratio ν	20%Grain Size D_{20} (mm)	Permeability k (x=y) x 10^{-5} (m/sec)
Fill	-	3	2.7	18.0	10.0	2,100	0.333	0.10	2.0
1a	2.0	4	2.7	18.0	8.0	2,800	0.333	0.11	2.0
3a	1.5	4	2.7	19.0	9.0	2,800	0.333	0.10	2.0
3c	3.5	6	2.7	19.0	9.0	4,200	0.333	0.10	2.0

* E = 700 x N (kN/m^2) * k is assumed by D_{20} in Creager Table.

2) Soil Parameters for fine soil layers (visco-elasto-plastic model)

In this FEM analysis, fine soil layers (Layer 1b, 2, 3b, 4, 5) were modeled as visco-elasto-plastic (Sekiguchi-Ohta Model) material and their parameters for FEM analysis were selected based on field and laboratory test result as shown in Table 16.2.3. Induced process of parameters from laboratory test results is shown as below.

Input parameters are set following the flow in Figure 16.2.3. Since tri-axial compression test (CU) was not conducted in this study, effective internal friction angle φ' was calculated from plasticity index IP.

3) Parameters for Steel Structures at Container Berth

Parameters for steel structures at Container Berth (Section FEM-1) are set as shown in the following Table 16.2.2.

Table 16.2.2 List of Input Parameters for Steel Structures with Anchor Wall at Container Berth

Material Name	Deformation modulus E (kN/m^2)	Sectional area A (m^2/m)	Moment of inertia I (m^4/m)
Sheet Pipe pile φ800mm x 10mm (SKY400)	2.1x10^8	3,271x10^{-5}	2,230x10^{-6}
Tie bars between Steel sheet pipe pile and Counter Pile	2.1x10^8	5,193x10^{-7}	100x10^{-12}
Material Name	**Deformation modulus E (kN/m^2)**	**Unit Weight γ (kN/m^3)**	**Poisson's Ratio ν**
Anchor Wall	2.400x10^7	23.0	0.333

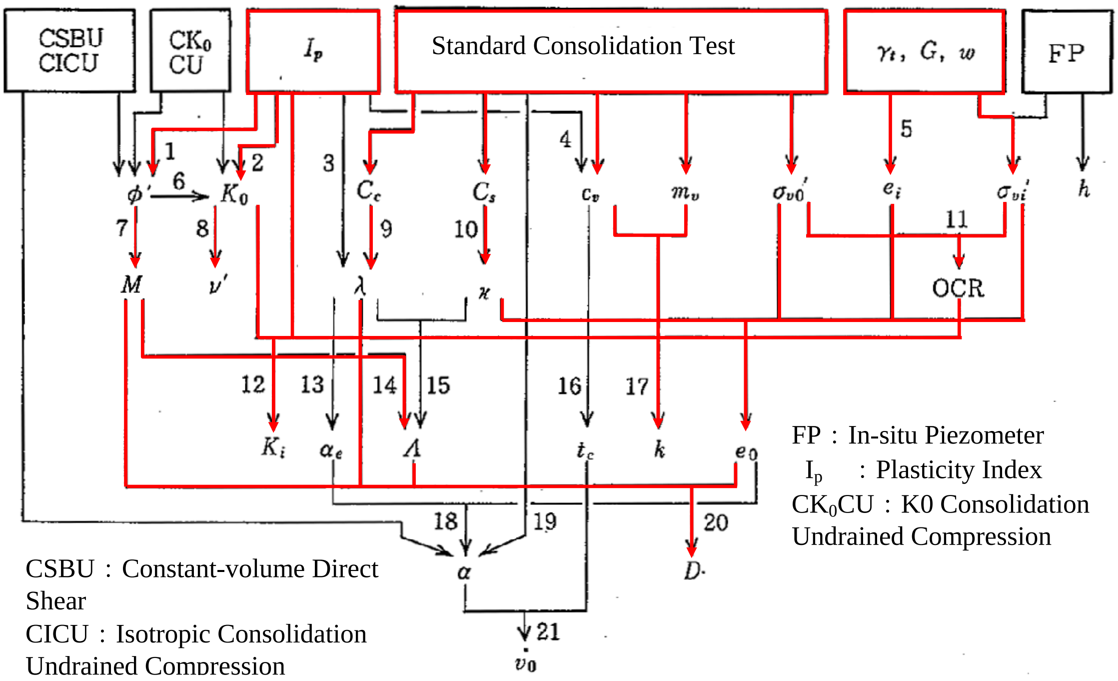
Table 16.2.3 Input Parameters for Clayey Soil Layers (Visco-Elasto-Plastic Model)

Layer	Ave. Layer Thickness H (m)	Average N	Specific Gravity Gs	Unit Weight γ_t (kN/m^3)	Submerged Unit Weight γ' (kN/m^3)	Natural Water Content Wn (%)	Plasticity Index PI	Initial Void Ratio e_0	Compression Index Cc	Recompression (Swelling) Index Cr	Coeefi. of volumetric Compression m_v x 10^{-3} (m^2/kN)	Coeefi. Conso. Cv (OC) x 10^{-7} (m^2/sec)	Coeefi. Conso. Cv (NC) x 10^{-7} (m^2/sec)	(a) Preconsoidation Pressure $\sigma v0'$ (kN/m^2)	(b) Effective Overburden Pressure $\sigma vi'$ (kN/m^2)	(c) Coeffi. Secondary Conso. $C_{\alpha\varepsilon}$
1b	2.5	1	2.7	18.0	8.0	37	19	1.05	0.30	0.07	0.15	1.2	1.2	80	$\Sigma\gamma'$z	0.004
2	6.0	1	2.7	17.0	7.0	52	37	1.45	0.60	0.12	0.30	1.0	0.6	80	$\Sigma\gamma'$z	0.007
3b	4.5	5	2.7	19.0	9.0	29	18	0.80	0.25	0.05	0.15	1.2	1.2	$\Sigma\gamma'$z + 50	$\Sigma\gamma'$z	0.004
4	4.0	10	2.7	19.0	9.0	32	28	0.85	0.35	0.04	0.10	1.2	0.8	$\Sigma\gamma'$z + 100	$\Sigma\gamma'$z	0.006
5	12.5	6	2.7	17.5	7.5	44	36	1.20	0.60	0.08	0.20	2.2	0.8	$\Sigma\gamma'$z + 75	$\Sigma\gamma'$z	0.008

Layer	(1) Sin ϕ'	(2) Critical State Parameter M	(3) Effective Poisson's Ratio ν'	(4) Permeability at OC k (x=y) x 10^{-10} (m/sec)	(5) Permeability at NC k (x=y) x 10^{-10} (m/sec)	(6) Coeffi. of Earth Pressure at Rest K_0	(7) Coeffi. of in-situ earth Pressure at Rest K_i	(8) Coeeficient of Secondary Compression α	(9) Elapsed time from soil layer fromed tc = t	(10) Initial Volumetric Strain Ratio v_0' (1/day)	(11) Void Ratio at Preconsolidated state e	(12) Compression Index λ	(13) Swelling Index κ	(14) Irreversibility Ratio Λ	(15) Over Consolidation Ratio OCR
1b	0.51	1.23	0.33	1.8	1.8	0.49	$K0(OCR)^{0.54exp(-PI/122)}$	0.0017	511	3.4E-06	1.05	0.13	0.03	0.71	$\sigma_{v0}'/\sigma_{vi}'$
2	0.44	1.04	0.36	3.0	1.8	0.56	$K0(OCR)^{0.54exp(-PI/122)}$	0.0030	5889	5.2E-07	1.45	0.26	0.05	0.60	$\sigma_{v0}'/\sigma_{vi}'$
3b	0.52	1.25	0.33	1.8	1.8	0.48	$K0(OCR)^{0.54exp(-PI/122)}$	0.0017	1656	1.0E-06	0.80	0.11	0.02	0.71	$\sigma_{v0}'/\sigma_{vi}'$
4	0.47	1.12	0.35	1.2	0.8	0.53	$K0(OCR)^{0.54exp(-PI/122)}$	0.0026	1963	1.3E-06	0.85	0.15	0.02	0.64	$\sigma_{v0}'/\sigma_{vi}'$
5	0.45	1.05	0.36	4.4	1.6	0.55	$K0(OCR)^{0.54exp(-PI/122)}$	0.0035	19170	1.8E-07	1.20	0.26	0.03	0.60	$\sigma_{v0}'/\sigma_{vi}'$

(1) $\sin\phi' = 0.81 - 0.233 \log PI$ (Kenney 1959)
(2) $M = 6\sin\phi'/(3 - \sin\phi')$
(3) $\nu' = K_0/(1+K_0)$
(4), (5) $k = Cv \times mv \times \gamma w$
(6) $K_0 = 1 - \sin\phi'$
(7) $Ki = K_0(OCR)^{0.54exp(-PI/122)}$ (Alpan 1967)
(8) $\alpha = 0.434 \times Cc/(1 + e_0)$
(9) $tc = t90 = H^2 \times (Tv90\%=0.848)/Cv$
(10) $v_0' = \alpha/tc$
(11) From labo test result ($e = e_0$)
(12) $\lambda = 0.434\,Cc$
(13) $\kappa = 0.434\,Cr$
(14) $\Lambda = M/1.75$ (Karube 1975)
(15) $OCR = \sigma_{v0}'/\sigma_{vi}'$
(a) From Labotest result (= Pc)
(b) From Boring & Labotest results $\sigma_{vi}' = \Sigma\gamma' \times z$
(c) $C_{\alpha\varepsilon} = C\alpha e/(1+e_0)$
* $\gamma w = 10$ kN/m3

①Stress History of Past：$\sigma_{vo}'\cdot K_0$　②Initial Stress of Present：$\sigma_{vi}'\cdot K_t\cdot h$
③Soil Parameter：Compression･Shear：Λ･M･D, Time Dependency：$\alpha\cdot v_0$, Seepage：k



(“Iizuka,A.and Ohta,H.:A Determination Procedure of Input Parameters in Elasto-Visco-plastic Finite Element Analysis, Soils and Foudations,Vol.27,No.3,pp.71 - 87,1987.”)

Figure 16.2.3 Parameter setting for FEM Analysis from Laboratory Test Results

16.2.4 Analysis result

In this section, FEM analysis results for the following analyzed sections are shown as follows;

Section FEM-1 at Container Terminal Berth

Section FEM-2 at Inner Revetment beside Full Container Storage Yard

Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

Section FEM-4 at Outer Revetment A

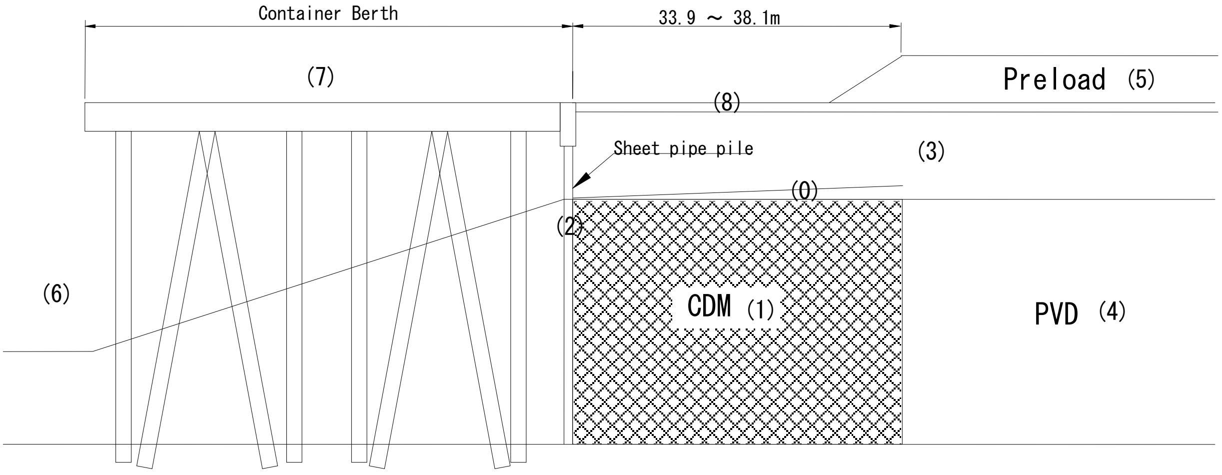
1) Section FEM-1 at Container Terminal Berth

a) Model Mesh for Section FEM-1 at Container Terminal Berth

Analysis model and its mesh are drawn based on subsoil investigation result and container berth design data. Figure 16.2.5 and Figure 16.2.6 show the analysis model and analysis mesh respectively.

b) Analysis Steps (Construction Schedule) for Section FEM-1 at Container Terminal Berth

Analysis steps based on assumed construction schedule for Section FEM-1 at Container Terminal Berth are shown in Figure 16.2.4 and Table 16.2.4.



No.	Items of Works	Assumed Construction Period
1	Excavation for CDM Works (0)	1 month (3.2013)
2	CDM Forming (1)	2 months (4.2013)
3	Earth Retaining Wall (SSP) (2)	2 months (6.2013)
4	Filling (3)	2 months (8.2013)
5	Installation of PVD (4)	2 months (10.2013)
6	Retaining Period for Fill	4 months (12.2013)
7	Preloading (5)	2 months (4.2014)
8	Retaining Period for Preload	4 months (6.2014)
9	Removal of Preload (5)	2 months (10.2014)
10	Excavation in front of SSP (6)	2 months (12.2014)
11	Construction of Container Berth (7)	4 months (2.2015)
12	Pavement (8)	1 month (6.2015)

Figure 16.2.4 Analysis Steps based on assumed Construction Schedule for Section FEM-1 at Container Terminal Berth

Table 16.2.4 Analysis Steps based on assumed Construction Schedule for Section FEM-1 at Container Terminal Berth

	Item	Start	End	Period	Elapsed Time
Step 1	Initial			0	0
Step 2	Excavation for CDM	1/3/2013	31/3/2013	31	31
Step 3	Construction of CDM	1/4/2013	31/5/2013	61	92
Step 6	Sheet Pipe Pile	1/6/2013	31/7/2013	61	153
Step 7	Fill Work-1	1/8/2013	15/8/2013	15	168
Step 8	Fill Work-2	16/8/2013	31/8/2013	16	184
Step 9	Fill Work-3	1/9/2013	15/9/2013	15	199
Step 10	Fill Work-4	16/9/2013	30/9/2013	15	214
Step 11	Construction of PVD	1/10/2013	30/11/2013	61	275
Step 12	Retaining Period 1-1	1/12/2013	31/12/2013	31	306
Step 13	Retaining Period 1-2	1/1/2014	31/1/2014	31	337
Step 14	Retaining Period 1-3	1/2/2014	28/2/2014	28	365
Step 15	Retaining Period 1-4	1/3/2014	31/3/2014	31	396
Step 16	Preload-1	1/4/2014	13/4/2014	13	409
Step 17	Preload-2	14/4/2014	25/4/2014	12	421
Step 18	Preload-3	26/4/2014	7/5/2014	12	433
Step 19	Preload-4	8/5/2014	19/5/2014	12	445
Step 20	Preload-5	20/5/2014	31/5/2014	12	457
Step 21	Retaining Period for Preload 2-1	1/6/2014	30/6/2014	30	487
Step 22	Retaining Period for Preload 2-2 & 1 year later	1/7/2014	31/7/2014	31	518
Step 23	Retaining Period for Preload 2-3	1/8/2014	31/8/2014	31	549
Step 24	Retaining Period for Preload 2-4	1/9/2014	30/9/2014	30	579
Step 25	Removal of Preload-1	1/10/2014	13/10/2014	13	592
Step 26	Removal of Preload-2	14/10/2014	25/10/2014	12	604
Step 27	Removal of Preload-3	26/10/2014	6/11/2014	12	616
Step 28	Removal of Preload-4	7/11/2014	18/11/2014	12	628
Step 29	Removal of Preload-5	19/11/2014	30/11/2014	12	640
Step 30	Excavation of Front Soil-1	1/12/2014	13/12/2014	13	653
Step 31	Excavation of Front Soil-2	14/12/2014	26/12/2014	13	666
Step 32	Excavation of Front Soil-3	27/12/2014	7/1/2015	12	678
Step 33	Excavation of Front Soil-4	8/1/2015	19/1/2015	12	690
Step 34	Excavation of Front Soil-5	20/1/2015	31/1/2015	12	702
Step 35	Construction of Container Barth-1	1/2/2015	28/2/2015	28	730
Step 36	Construction of Container Barth-2	1/3/2015	31/3/2015	31	761
Step 37	Construction of Container Barth-3	1/4/2015	30/4/2015	30	791
Step 38	Construction of Container Barth-4	1/5/2015	31/5/2015	31	822
Step 39	Pavement	1/6/2015	30/6/2015	30	852
Step 40	1 month & 2 years later	1/7/2015	31/7/2015	31	883
Step 41	3 months	1/8/2015	30/9/2015	61	944
Step 42	6 months	1/10/2015	31/12/2015	92	1036
Step 43	1 year	1/1/2016	30/6/2016	182	1218
Step 44	2 years	1/7/2016	30/6/2017	365	1583
Step 45	3 years	1/7/2017	30/6/2018	365	1948
Step 46	5 years later after construction of structure	1/7/2018	31/7/2018	31	1979
Step 47	5 years	1/8/2018	30/6/2020	700	2679
Step 48	10 years later after construction of structure	1/7/2020	31/7/2023	1126	3805
Step 49	10 years	1/8/2023	30/6/2025	700	4505
Step 50	15 years later after construction of structure	1/7/2025	31/7/2028	1127	5632
Step 51	15 years	1/8/2028	30/6/2030	699	6331
Step 52	20 years later after construction of structure	1/7/2030	31/7/2033	1127	7458

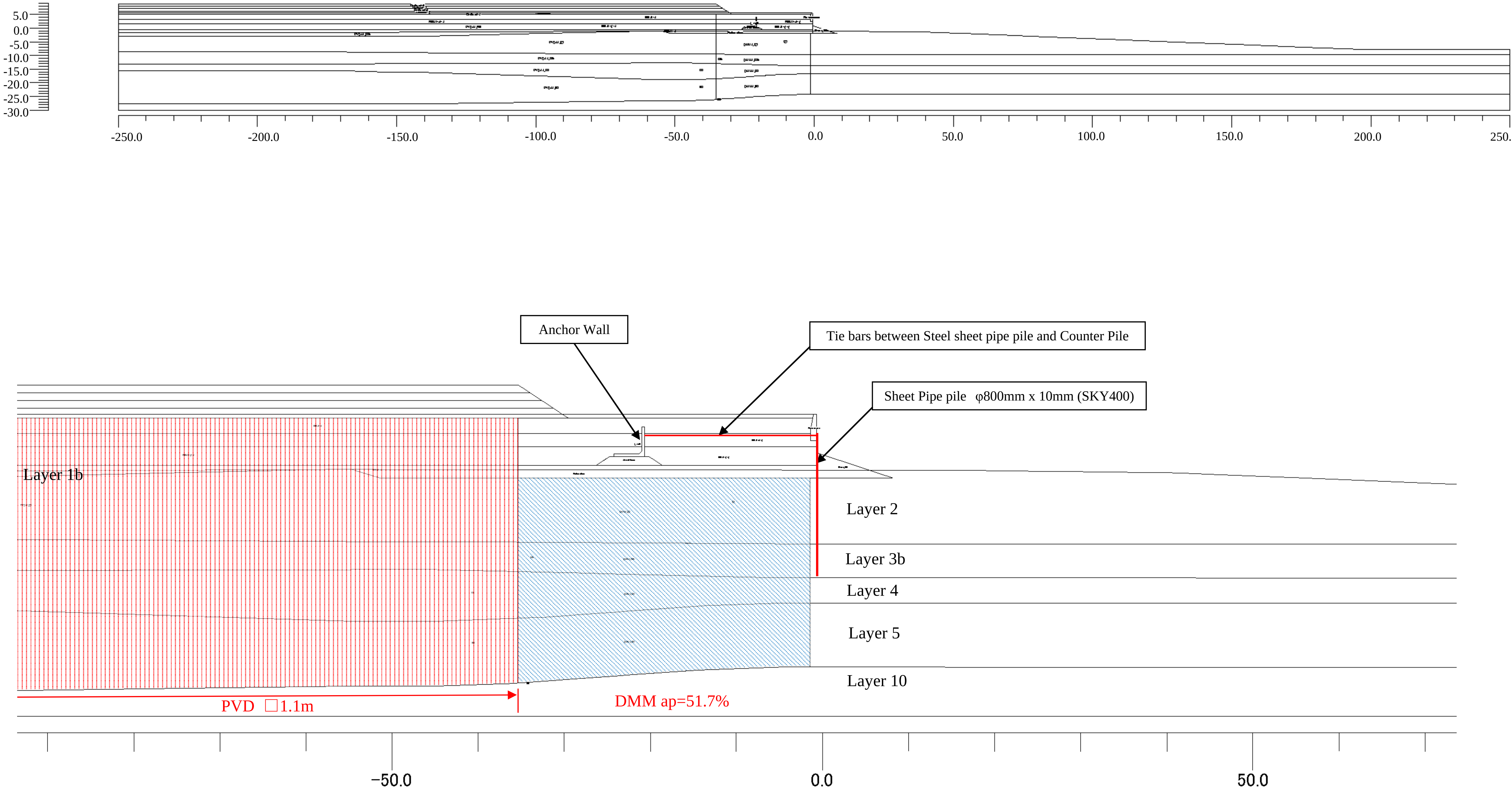
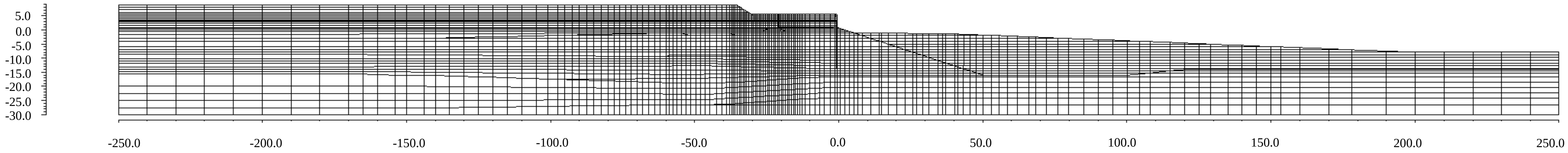


Figure 16.2.5 Analysis Model (Area) Figure for Section FEM-1 at Container Terminal Berth



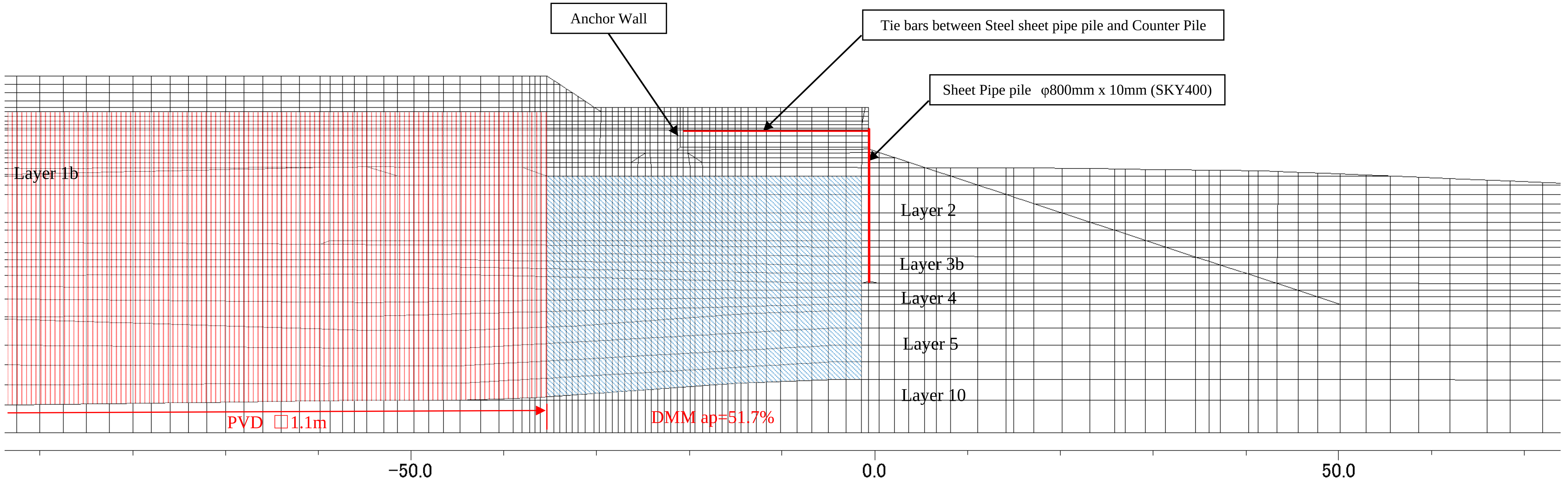


Figure 16.2.6 Analysis Mesh Figure for Section FEM-1 at Container Terminal Berth

c) Analysis Result for Section FEM-1 at Container Terminal Berth

i) Vertical Deformation

Vertical deformations with time (construction steps) at face line of quay wall at different elevations are shown in Table 16.2.5 and Figure 16.2.7.

As shown in Table 16.2.5 and Figure 16.2.7, top of sheet pipe pile and seabed surface at face line of quay wall are subsiding about 12cm and 14cm respectively at the time of completion of Pavement. These absolute values show almost no changes even at 15years later after completion of Pavement.

Table 16.2.5 Vertical deformation with construction steps at face line of quay wall (Section FEM-1)

Analysis Steps		Top of sheet pipe pile	Seabed Surface	Bottom of Layer 2	Bottom of Layer 3b	Bottom of Layer 4	Bottom of Layer 5	Top of Coping Concrete (Aft. Cast.)
Construction Steps	Time (days)							
Initial Elevation CDL (m)	-	3.20	-1.50	-9.72	-13.72	-16.72	-24.22	5.50
1) Start of fill	153	0.000	0.000	0.017	0.012	0.008	0.001	0.000
2) Completion of Fill	214	-0.032	-0.052	-0.035	-0.037	-0.019	-0.001	0.000
3) Start of Preload	396	-0.022	-0.042	-0.024	-0.026	-0.008	-0.001	0.105
4) Completion of Preload	457	-0.031	-0.050	-0.033	-0.035	-0.014	0.000	0.002
5) Start of Removal of Preload	579	-0.032	-0.051	-0.034	-0.035	-0.013	-0.001	0.001
6) Completion of Removal of Preload	640	-0.030	-0.050	-0.032	-0.033	-0.011	-0.002	0.003
7)Completion of Excavation	702	-0.080	-0.099	-0.082	-0.078	-0.031	-0.003	-0.047
8) Construction of Pavement	852	-0.115	-0.135	-0.117	-0.112	-0.044	-0.002	-0.083
9) 1year later after completion of Pavement	1218	-0.121	-0.140	-0.123	-0.116	-0.045	-0.003	-0.088
10) 2years later after completion of Pavement	1583	-0.123	-0.143	-0.125	-0.118	-0.046	-0.003	-0.090
11) 5years later after completion of Pavement	2679	-0.124	-0.144	-0.126	-0.120	-0.047	-0.003	-0.092
12) 10years later after completion of Pavement	4505	-0.123	-0.143	-0.125	-0.119	-0.047	-0.003	-0.091
13) 15years later after completion of Pavement	6331	-0.121	-0.141	-0.123	-0.117	-0.047	-0.003	-0.089

*Unit: m, +: Sea side, -: Land Side

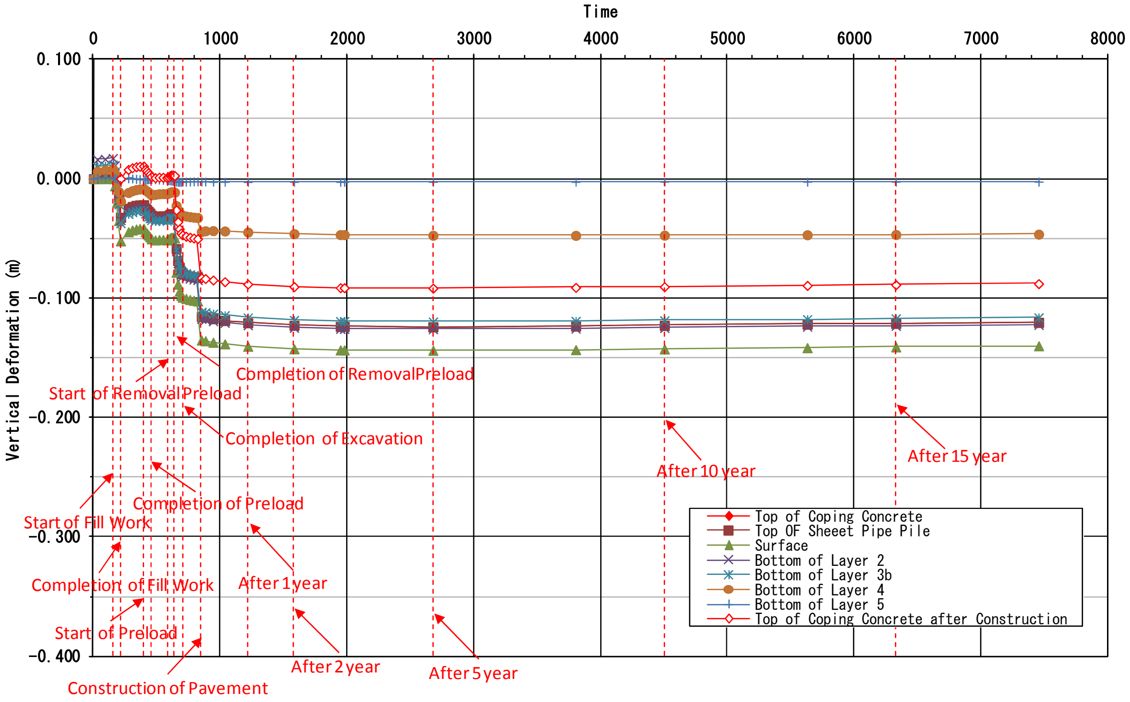


Figure 16.2.7 Vertical deformation with construction steps at face line of quay wall (Section FEM-1)

ii) Horizontal Deformation

Horizontal deformations with time (construction steps) at face line of quay wall at different elevations are shown in Table 16.2.6 and Figure 16.2.8.

As shown in Table 16.2.6 and Figure 16.2.8, top of sheet pipe pile and seabed surface are moving horizontally toward sea side about 16cm and 20cm respectively at the time of Pavement completion. Once they moved toward sea side by filling and preloading, then they move back a little to land side during consolidation process. These absolute values are reducing with time and finally they reached to 13cm and 17cm respectively from original positions toward sea side at 15years later after Pavement completion.

Table 16.2.6 Horizontal deformation with construction steps at face line of quay wall (Section FEM-1)

Analysis Steps		Top of sheet pipe pile	Seabed Surface	Bottom of Layer 2	Bottom of Layer 3b	Bottom of Layer 4	Bottom of Layer 5	Top of Coping Concrete (Aft. Cast.)
Construction Steps	Time (days)							
Initial Elevation CDL (m)	-	3.20	-1.50	-9.72	-13.72	-16.72	-24.22	5.50
1) Start of fill	153	0.000	0.000	0.018	0.015	0.012	0.000	0.000
2) Completion of Fill	214	0.083	0.145	0.123	0.103	0.088	0.007	0.000
3) Start of Preload	396	0.002	0.080	0.083	0.069	0.063	0.005	-0.091
4) Completion of Preload	457	0.084	0.144	0.121	0.100	0.088	0.007	0.001
5) Start of Removal of Preload	579	0.081	0.133	0.105	0.085	0.077	0.006	0.002
6) Completion of Removal of Preload	640	0.025	0.084	0.070	0.056	0.054	0.004	-0.057
7)Completion of Excavation	702	0.089	0.134	0.103	0.088	0.081	0.006	0.015
8) Construction of Pavement	852	0.163	0.195	0.139	0.117	0.105	0.008	0.096
9) 1year later after completion of Pavement	1218	0.141	0.177	0.124	0.101	0.092	0.007	0.070
10) 2years later after completion of Pavement	1583	0.138	0.175	0.122	0.098	0.089	0.007	0.067
11) 5years later after completion of Pavement	2679	0.134	0.171	0.118	0.093	0.084	0.006	0.063
12) 10years later after completion of Pavement	4505	0.131	0.168	0.114	0.089	0.082	0.006	0.059
13) 15years later after completion of Pavement	6331	0.128	0.166	0.112	0.087	0.080	0.006	0.057

*Unit: m, +: Sea side, -: Land Side

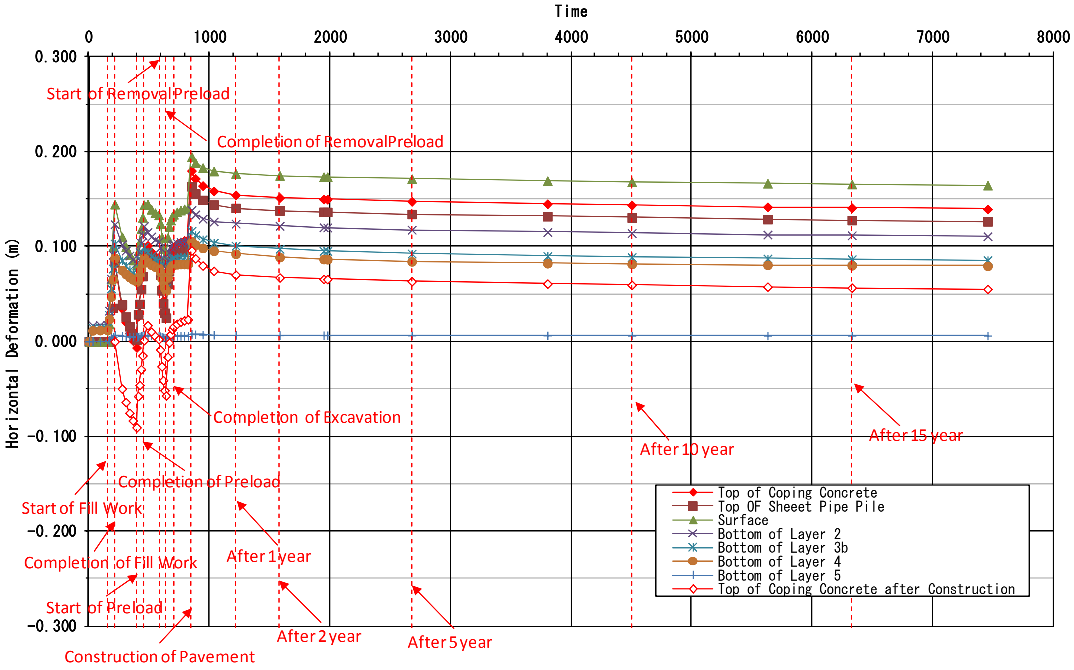
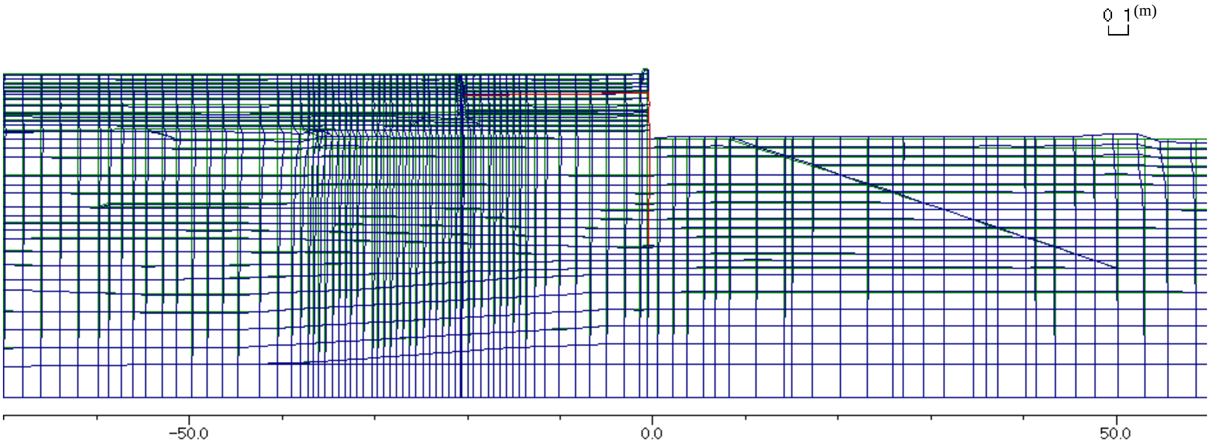
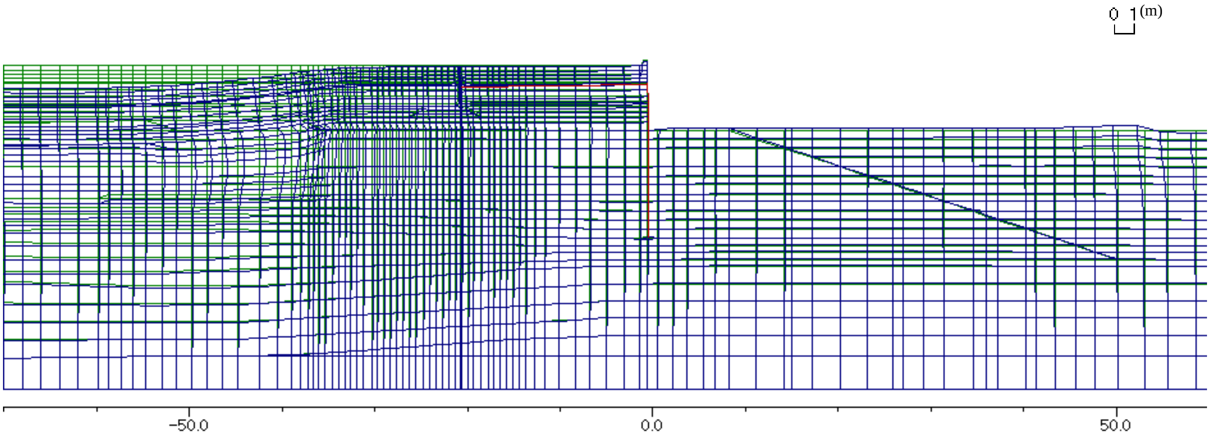


Figure 16.2.8 Horizontal deformation with construction steps at face line of quay wall (Section FEM-1)

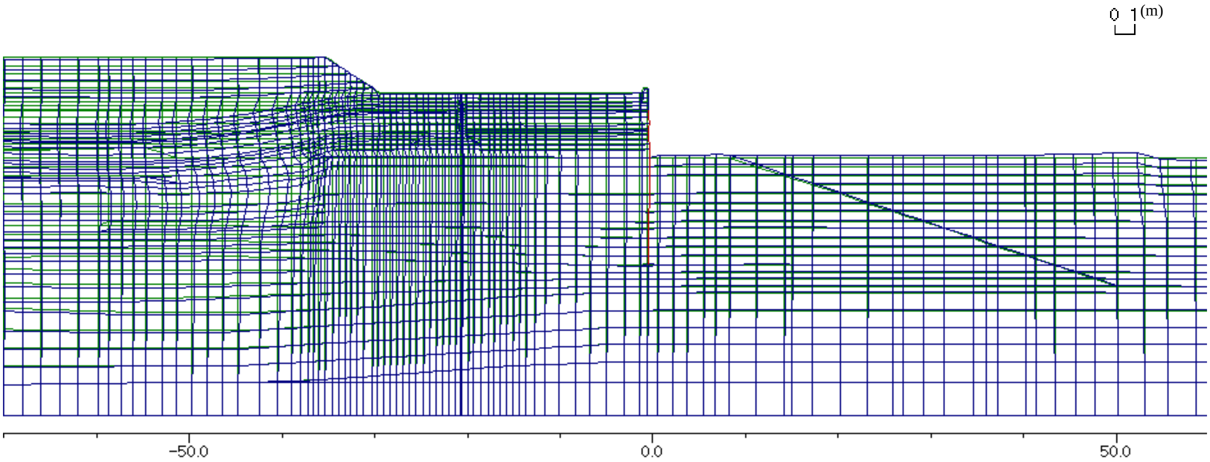
Deformation figures of representative construction steps are as shown in Figure 16.2.9.



Completion of Fill Work (214 days passed from Start of Construction) (1/9)

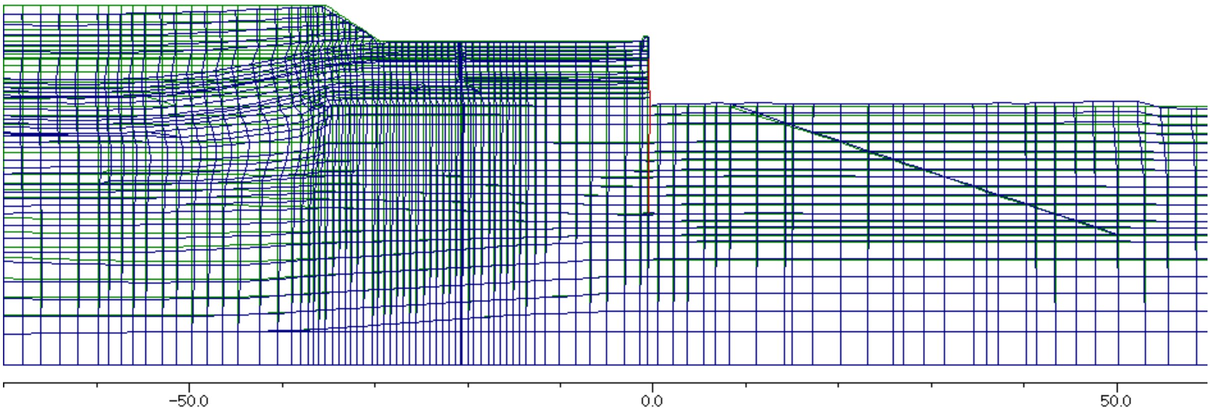


Start of Preload (397 days passed from Start of Construction) (2/9)

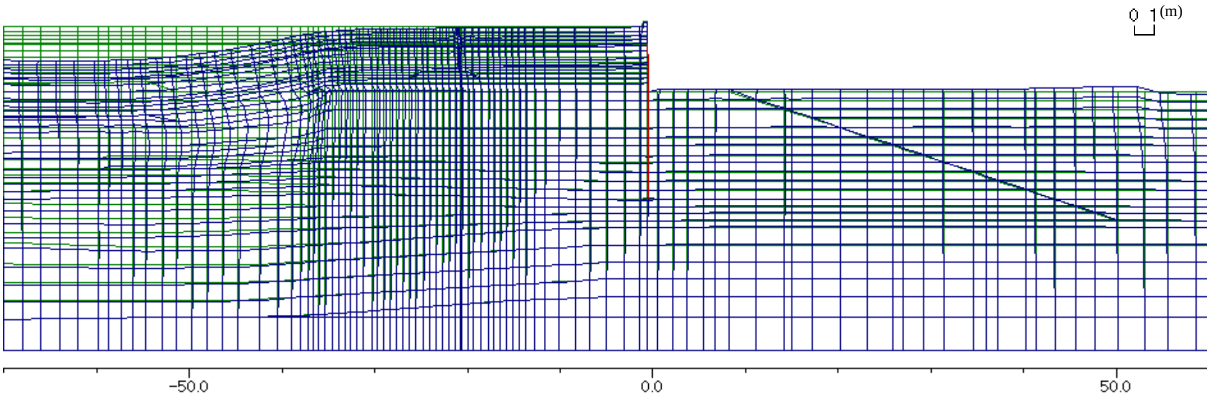


Completion of Preload (457 days passed from Start of Construction) (3/9)

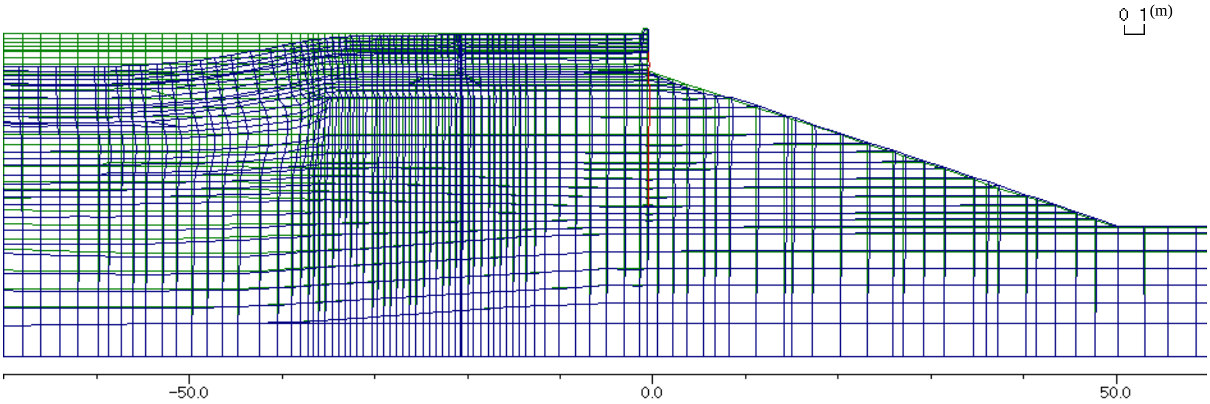
0 1 (m)



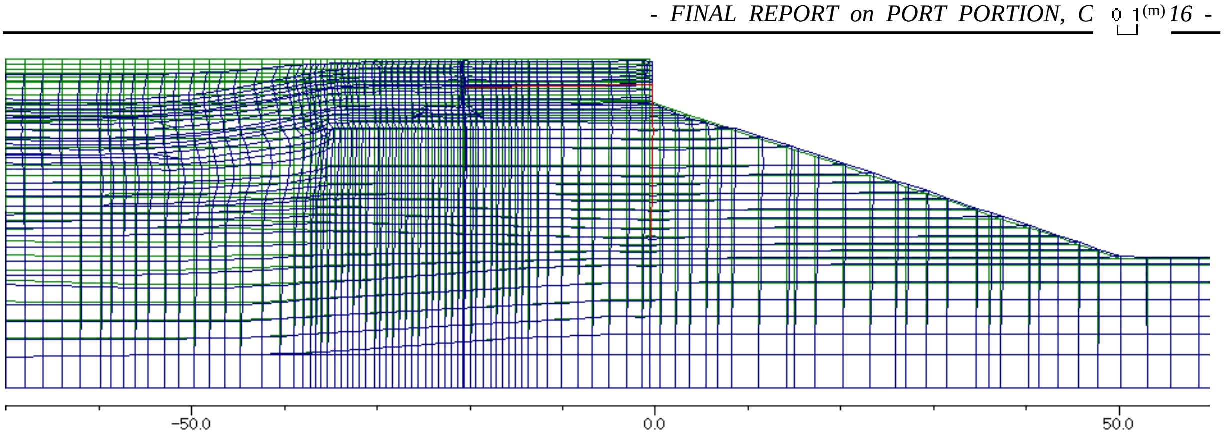
Completion of Excavation (591 days passed from Start of Construction) (4/9)



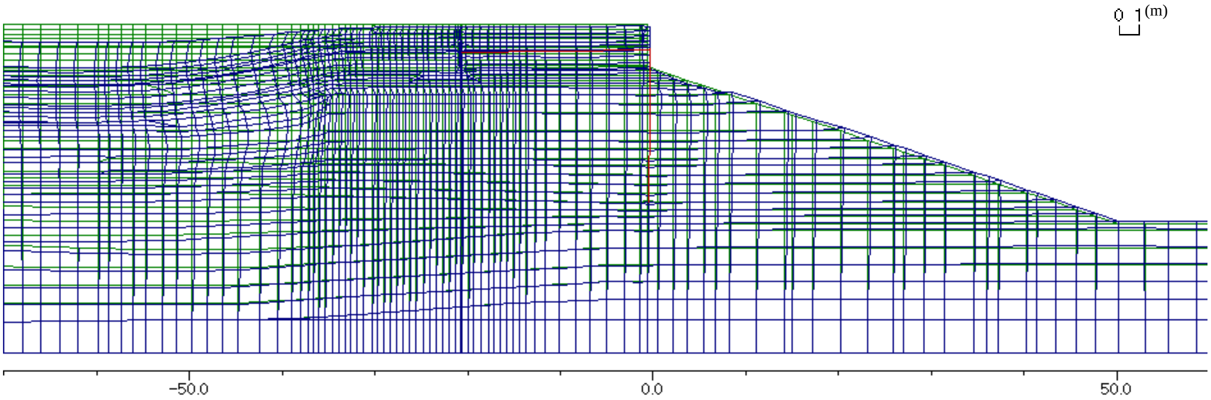
Start of Removal of Preload (640 days passed from Start of Construction) (5/9)



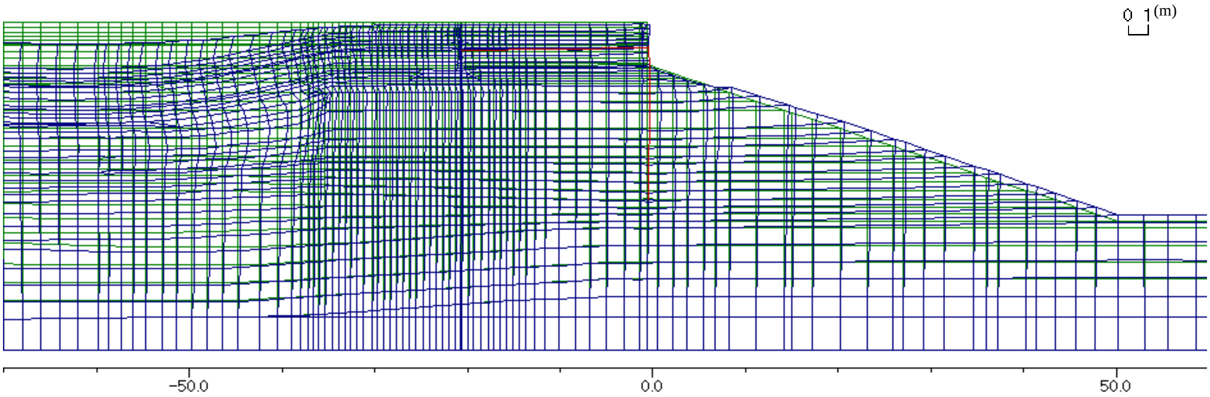
Completion of Excavation (702 days passed from Start of Construction) (6/9)



Construction of Pavement (852 days passed from Start of Construction) (7/9)



1 year later after Pavement completion (1218 days passed from Start of Construction) (8/9)



15 years later after Pavement completion (6331days passed from Start of Construction) (9/9)

Figure 16.2.9 Deformation Figure with construction steps for Section FEM-1 at Container Terminal Berth

2) Section FEM-2 at Inner Revetment beside Full Container Storage Yard

a) Model Mesh for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

Analysis model and its mesh are drawn based on subsoil investigation result and Inner Revetment design data. Figure 16.2.10 and Figure 16.2.11 show the analysis model and analysis mesh respectively.

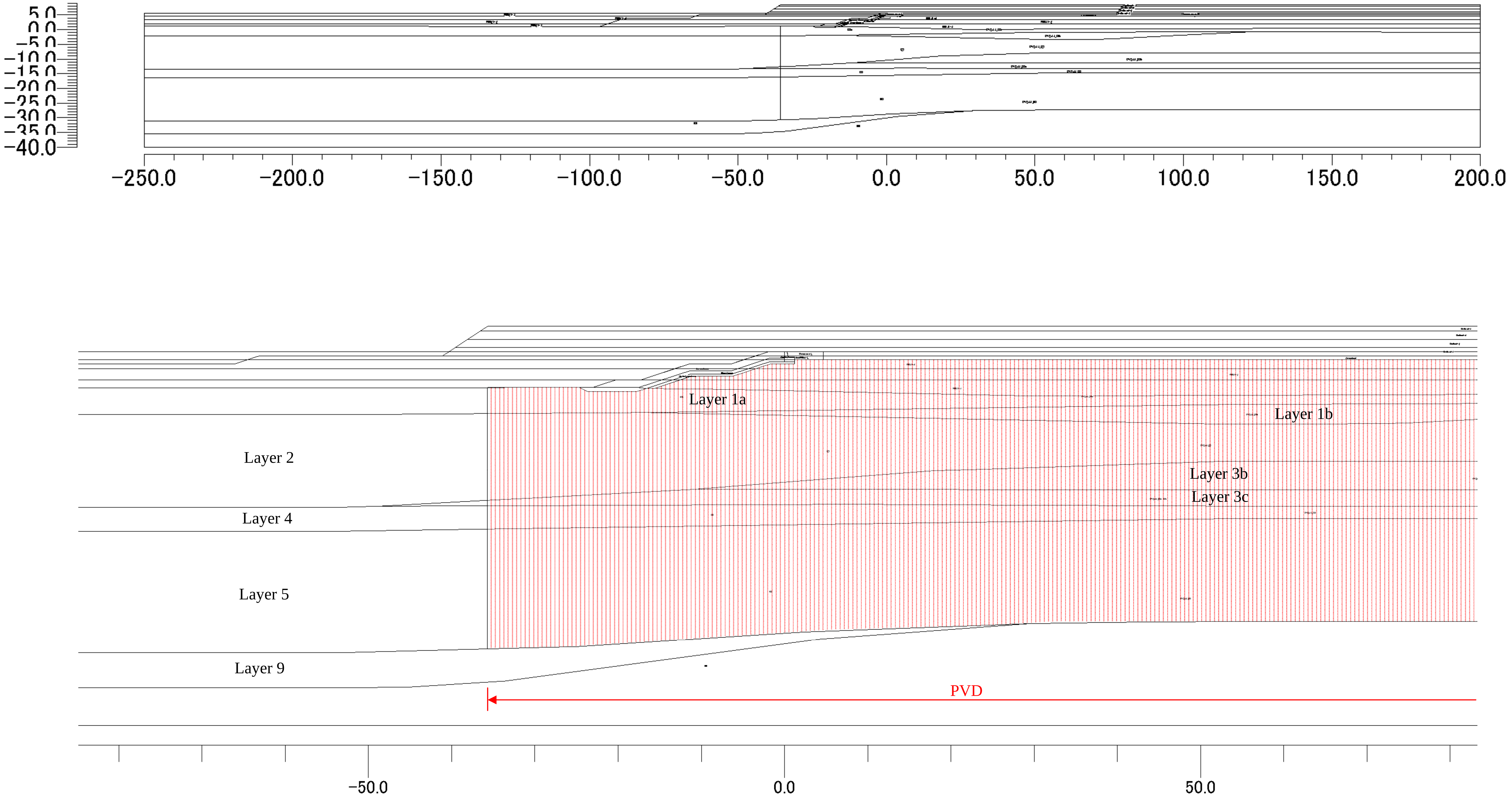
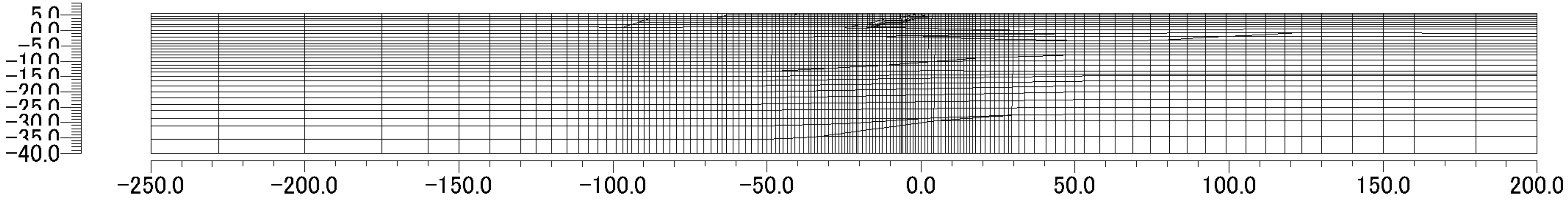


Figure 16.2.10 Analysis Model (Area) Figure for Section FEM-2 at Inner Revetment beside Full Container Storage Yard



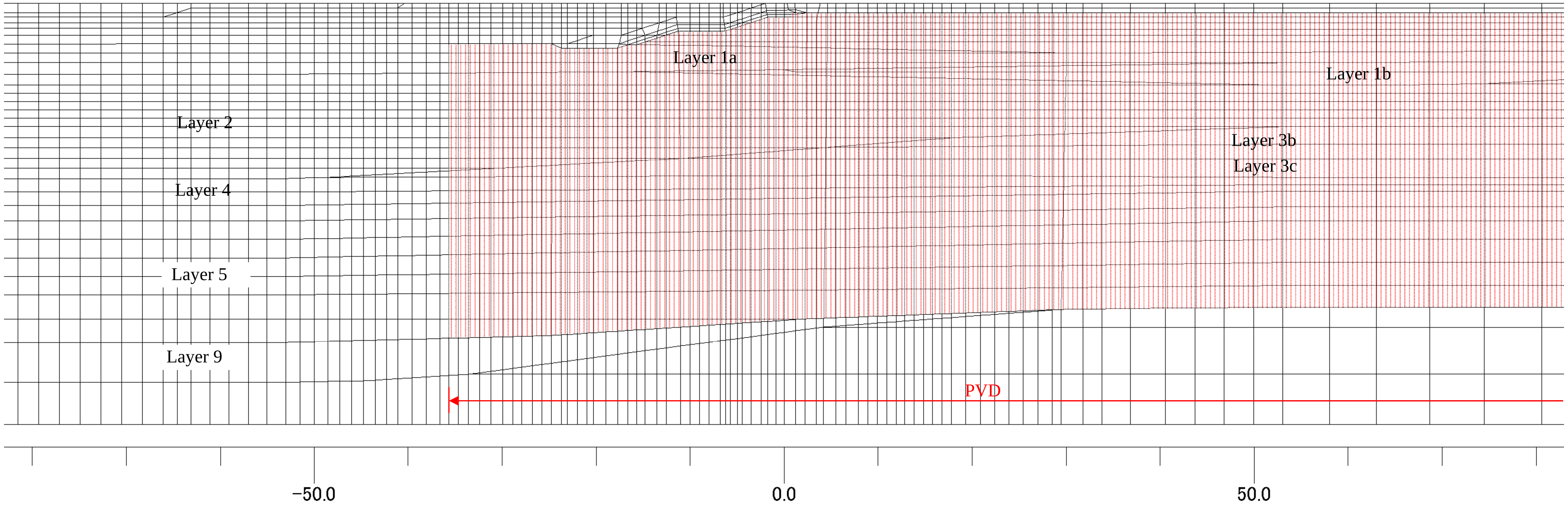


Figure 16.2.11 Analysis Mesh Figure for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

b) Analysis Steps (Construction Schedule) for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

Analysis steps based on assumed construction schedule for Section FEM-2 at Inner Revetment beside Full Container Storage Yard are shown in Figure 16.2.12 and Table 16.2.7.

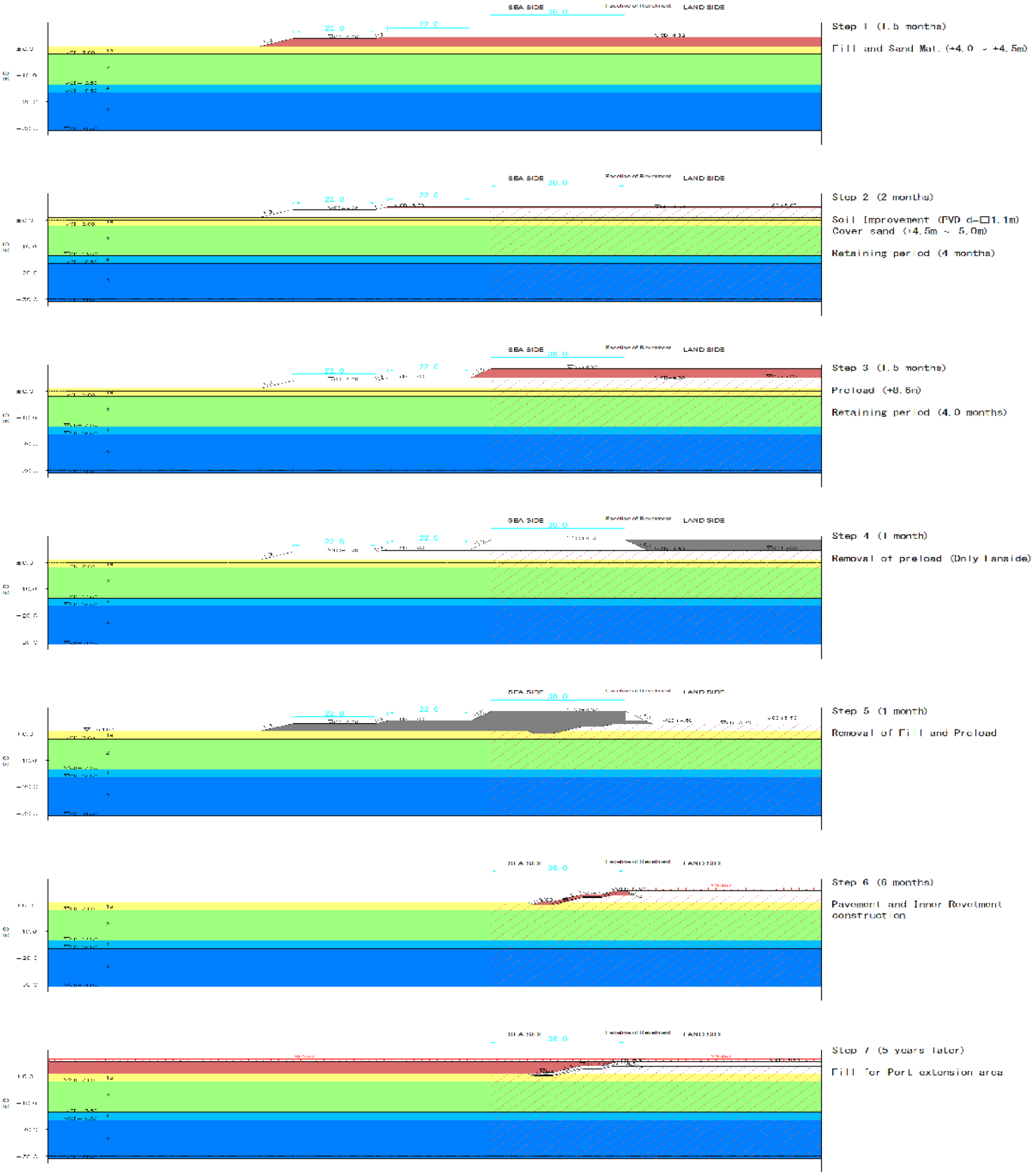


Figure 16.2.12 Analysis Steps based on assumed Construction Schedule for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

Table 16.2.7 Analysis Steps based on assumed Construction Schedule for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

	Item	Start	End	Period	Elapsed Time
Step 1	Initial			0	0
Step 2	Fill (1)-1	1/8/2012	15/8/2012	15	15
Step 3	Fill (1)-2	16/8/2012	31/8/2012	16	31
Step 4	Fill (1)-3	1/9/2012	15/9/2012	15	46
Step 5	Cover Sand	16/9/2012	30/9/2012	15	61
Step 6	Soil Improvement	1/10/2012	15/11/2012	46	107
Step 7	Leave1-1	16/11/2012	15/12/2012	30	137
Step 8	Leave1-2	16/12/2012	15/1/2013	31	168
Step 9	Leave1-3	16/1/2013	15/2/2013	31	199
Step 10	Leave1-4	16/2/2013	15/3/2013	28	227
Step 11	Preload-1	16/3/2013	26/3/2013	11	238
Step 12	Preload-2	27/3/2013	6/4/2013	11	249
Step 13	Preload-3	7/4/2013	18/4/2013	12	261
Step 14	Preload-4	19/4/2013	30/4/2013	12	273
Step 15	Leave2-1	1/5/2013	24/5/2013	24	297
Step 16	Leave2-2	25/5/2013	17/6/2013	24	321
Step 17	Leave2-3	18/6/2013	12/7/2013	25	346
Step 18	Leave2-4	13/7/2013	6/8/2013	25	371
Step 19	Leave2-5	7/8/2013	31/8/2013	25	396
Step 20	Removal of Land Side Preload-1	1/9/2013	10/9/2013	10	406
Step 21	Removal of Land Side Preload-2	11/9/2013	20/9/2013	10	416
Step 22	Removal of Land Side Preload-3	21/9/2013	30/9/2013	10	426
Step 23	Removal of Fill and Preload-1	1/10/2013	8/10/2013	8	434
Step 24	Removal of Fill and Preload-2	9/10/2013	16/10/2013	8	442
Step 25	Removal of Fill and Preload-3	17/10/2013	24/10/2013	8	450
Step 26	Removal of Fill and Preload-4	25/10/2013	31/10/2013	7	457
Step 27	Pavement and Revetment Construction	1/11/2013	30/4/2014	181	638
Step 28	Leave 1 year	1/5/2014	30/4/2015	365	1003
Step 29	Leave 2 year	1/5/2015	30/4/2016	366	1369
Step 30	Leave 3 year	1/5/2016	30/4/2017	365	1734
Step 31	Leave 4 year	1/5/2017	30/4/2018	365	2099
Step 32	Leave 5 year	1/5/2018	30/4/2019	365	2464
Step 33	Fill (2)-1	1/5/2019	30/6/2019	61	2525
Step 34	Fill (2)-2	1/7/2019	31/8/2019	62	2587
Step 35	Fill (2)-3	1/9/2019	31/10/2019	61	2648
Step 36	Fill (2)-4	1/11/2019	31/12/2019	61	2709
Step 37	1 month	1/1/2020	31/1/2020	31	2740
Step 38	3 months	1/2/2020	31/3/2020	60	2800
Step 39	6 months	1/4/2020	30/6/2020	91	2891
Step 40	1 year	1/7/2020	31/12/2020	184	3075
Step 41	2 years	1/1/2021	31/12/2021	365	3440
Step 42	3 years	1/1/2022	31/12/2022	365	3805
Step 43	5 years	1/1/2023	31/12/2024	731	4536
Step 44	10 years	1/1/2025	31/12/2029	1826	6362
Step 45	15 years	1/1/2030	31/12/2034	1826	8188

c) Analysis Result for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

i) Vertical Deformation

Vertical deformations with time (construction steps) at face line of Inner Revetment at different elevations are shown in Table 16.2.8 and Figure 16.2.13.

As shown in Table 16.2.8 and Figure 16.2.13, top of revetment and seabed surface at face line of revetment are subsiding about 6cm and 128cm respectively at the time of start of Fill Work 2 (reclamation of future port extension; it is assumed about 5years later after completion of revetment construction). These absolute values are gradually increasing with time and finally they reached to 23cm and 143cm respectively at 20years later after completion of revetment construction (15 years later after Fill Work 2).

Table 16.2.8 Vertical deformation with construction steps at face line of Inner Revetment (Section FEM-2)

Analysis Steps		Seabed Surface	Bottom of Layer 1b	Bottom of Layer 2	Bottom of Layer 3b	Bottom of Layer 4	Bottom of Layer 5	Top of Revetment (Aft. Const.)
Construction Steps	Time (days)							
Initial Elevation CDL (m)	-	0.77	-2.23	-10.40	-11.27	-15.58	-28.75	5.50
1) Start of fill 1	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2) Completion of Fill 1	46	-0.057	-0.012	-0.004	-0.004	-0.004	-0.001	0.000
3)Completion of Fill Work and Preload	273	-1.110	-1.001	-0.323	-0.300	-0.230	-0.004	0.000
4) Start of Removal of Preload and Fill	396	-1.403	-1.292	-0.489	-0.459	-0.358	-0.007	0.000
5) Completion of Removal of Preload and Fill	457	-1.207	-1.137	-0.450	-0.419	-0.336	-0.005	0.000
6) Construction of Revetment	638	-1.214	-1.119	-0.376	-0.345	-0.264	-0.004	0.000
7) Start of Fill Work 2	2464	-1.275	-1.181	-0.415	-0.383	-0.298	-0.004	-0.059
8) Completion of Fill Work 2 (5years later after completion of revetment construction)	2709	-1.338	-1.245	-0.456	-0.424	-0.331	-0.005	-0.134
9) 1year later after Completion of Fill Work 2 (6years later after completion of revetment construction)	3075	-1.398	-1.305	-0.504	-0.471	-0.372	-0.006	-0.194
10) 2years later after Completion of Fill Work 2 (7 years later after completion of revetment construction)	3440	-1.404	-1.310	-0.508	-0.475	-0.376	-0.006	-0.200
11) 5years later after Completion of Fill Work 2 (10 years later after completion of revetment construction)	4536	-1.413	-1.319	-0.514	-0.481	-0.382	-0.006	-0.210
12) 10 years later after Completion of Fill Work 2 (15 years later after completion of revetment construction)	6362	-1.423	-1.328	-0.521	-0.488	-0.388	-0.006	-0.221
13) 15 years later after Completion of Fill Work 2 (20years later after completion of revetment construction)	8188	-1.431	-1.335	-0.527	-0.494	-0.394	-0.006	-0.230

*Unit: m, +: Heaving, -: Settlement

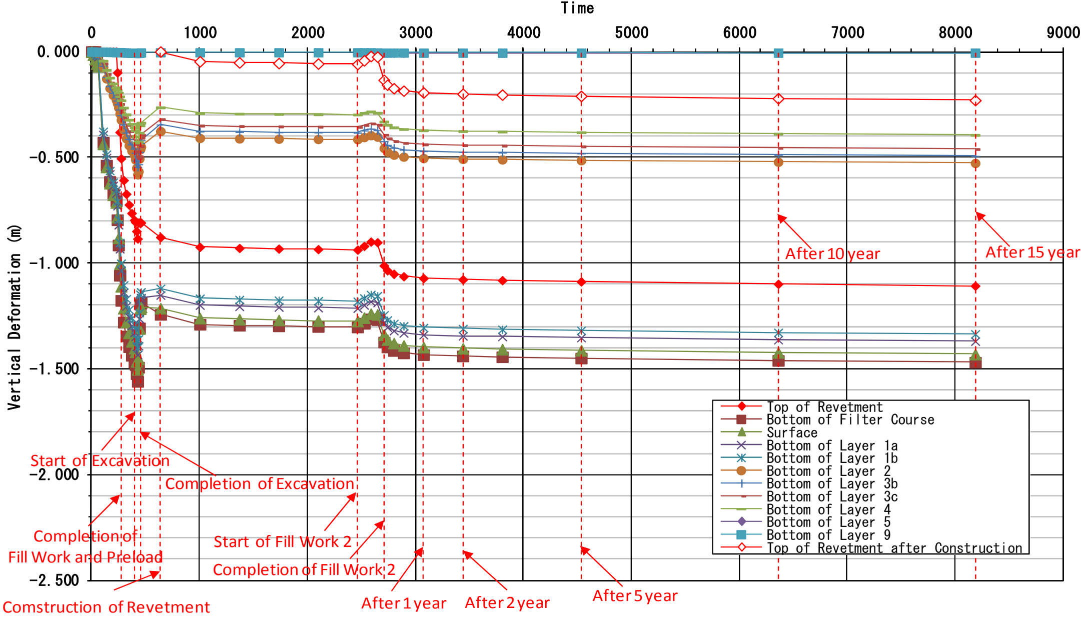


Figure 16.2.13 Vertical deformation with construction steps at face line of Inner Revetment (Section FEM-2)

ii) Horizontal Deformation

Horizontal deformations with time (construction steps) at face line of Inner Revetment at different elevations are shown in Table 16.2.9 and Figure 16.2.14.

As shown in Table 16.3.4.9 and Figure 16.3.4.17, top of revetment and seabed surface are moving horizontally toward reclaimed land side about 4cm and 15cm respectively at the time of start of Fill Work 2 (reclamation of future port extension; it is assumed about 5years later from completion of revetment construction). Once they moved land side under consolidation process, then they move back to sea side due to reclamation work for future extension area. These absolute values are increasing with time and finally they are moving toward sea side about 20cm and 17cm respectively from original position at 20years later after completion of revetment construction (15 years later after Fill Work 2).

Table 16.2.9 Horizontal deformation with construction steps at face line of Inner Revetment (Section FEM-2)

Analysis Steps		Seabed Surface	Bottom of Layer 1b	Bottom of Layer 2	Bottom of Layer 3b	Bottom of Layer 4	Bottom of Layer 5	Top of Revetment (Aft. Const.)
Construction Steps	Time (days)							
Initial Elevation CDL (m)	-	0.77	-2.23	-10.40	-11.27	-15.59	-28.75	5.50
1) Start of fill 1	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2) Completion of Fill 1	46	-0.086	-0.087	-0.055	-0.054	-0.046	-0.002	0.000
3)Completion of Fill Work and Preload	273	-0.004	0.037	-0.037	-0.055	-0.048	-0.002	0.000
4) Start of Removal of Preload and Fill	396	-0.007	0.045	0.031	0.003	-0.006	-0.001	0.000
5) Completion of Removal of Preload and Fill	457	-0.035	0.007	0.004	-0.030	-0.042	-0.004	0.000
6) Construction of Revetment	638	-0.106	-0.078	-0.028	-0.064	-0.078	-0.005	0.000
7) Start of Fill Work 2	2464	-0.154	-0.130	-0.046	-0.082	-0.096	-0.005	-0.039
8) Completion of Fill Work 2 (5years later after completion of revetment construction)	2709	0.138	0.195	0.213	0.178	0.144	0.001	0.169
9) 1year later after Completion of Fill Work 2 (6years later after completion of revetment construction)	3075	0.155	0.214	0.230	0.195	0.161	0.001	0.184
10) 2years later after Completion of Fill Work 2 (7 years later after completion of revetment construction)	3440	0.155	0.215	0.233	0.198	0.165	0.001	0.184
11) 5years later after Completion of Fill Work 2 (10 years later after completion of revetment construction)	4536	0.159	0.219	0.240	0.205	0.172	0.000	0.188
12) 10 years later after Completion of Fill Work 2 (15 years later after completion of revetment construction)	6362	0.166	0.227	0.251	0.216	0.184	0.000	0.195
13) 15 years later after Completion of Fill Work 2 (20years later after completion of revetment construction)	8188	0.173	0.235	0.259	0.225	0.193	0.000	0.203

*Unit: m, +: Sea side, -: Land Side

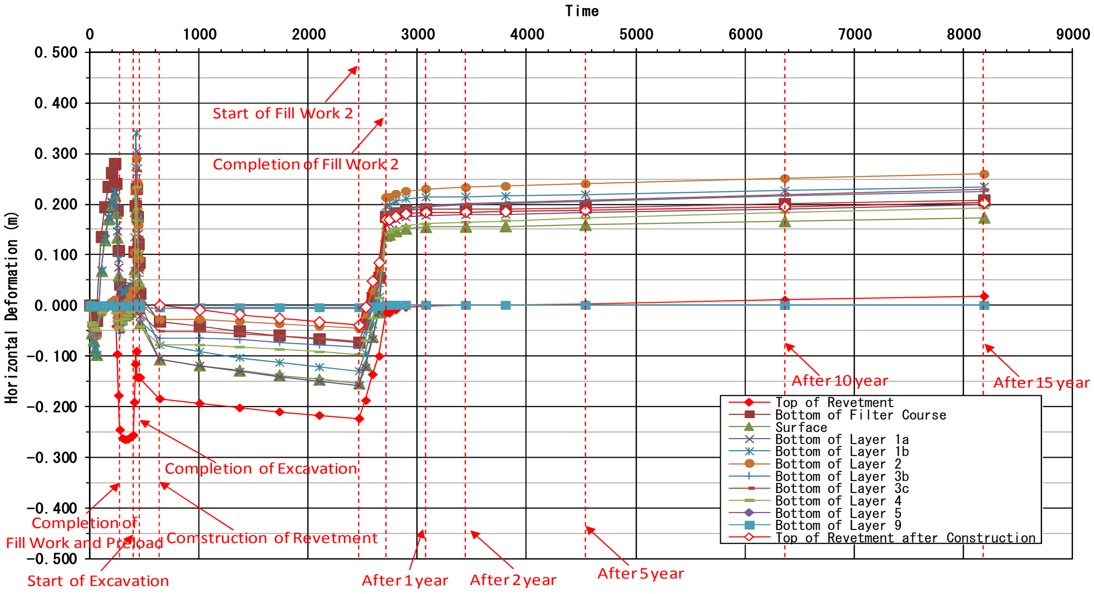
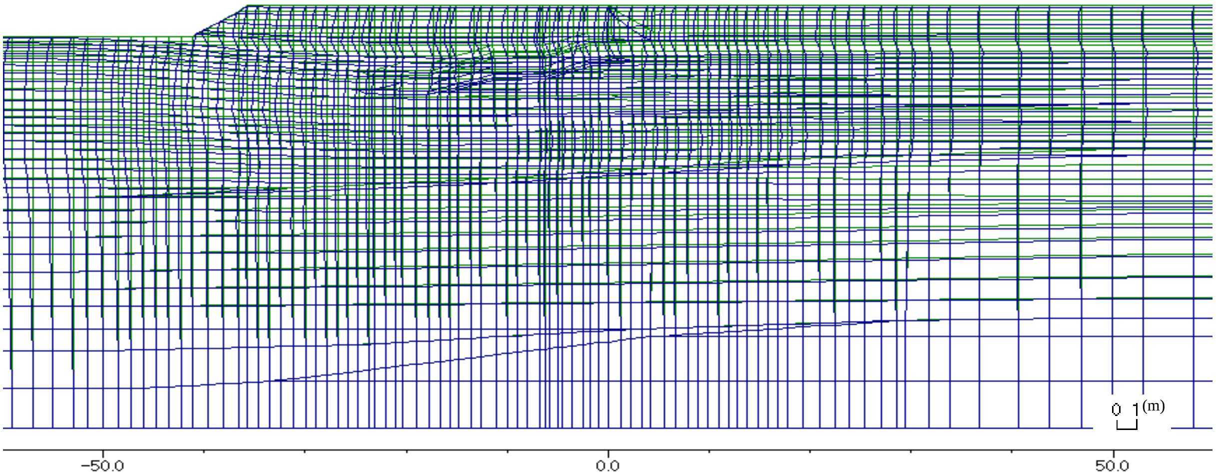
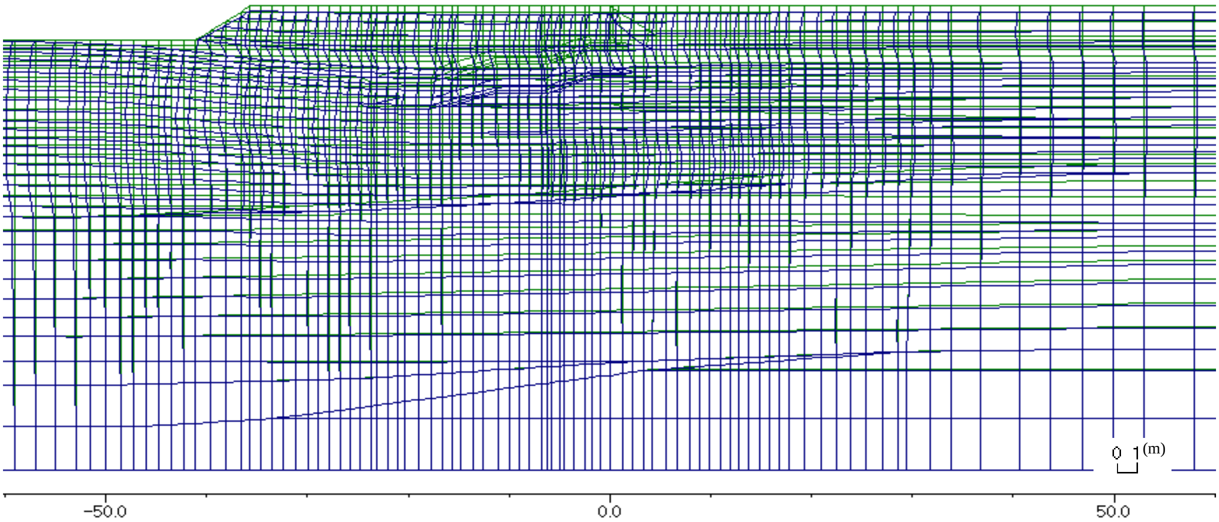


Figure 16.2.14 Horizontal deformation with construction steps at face line of Inner Revetment (Section FEM-2)

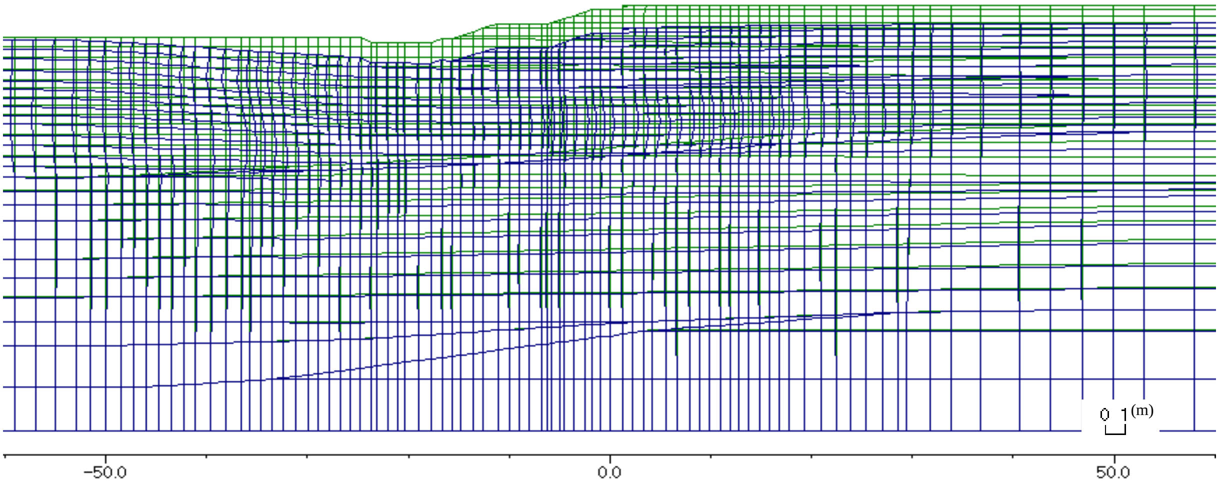
Deformation figures of representative construction steps are as shown in Figure 16.2.15.



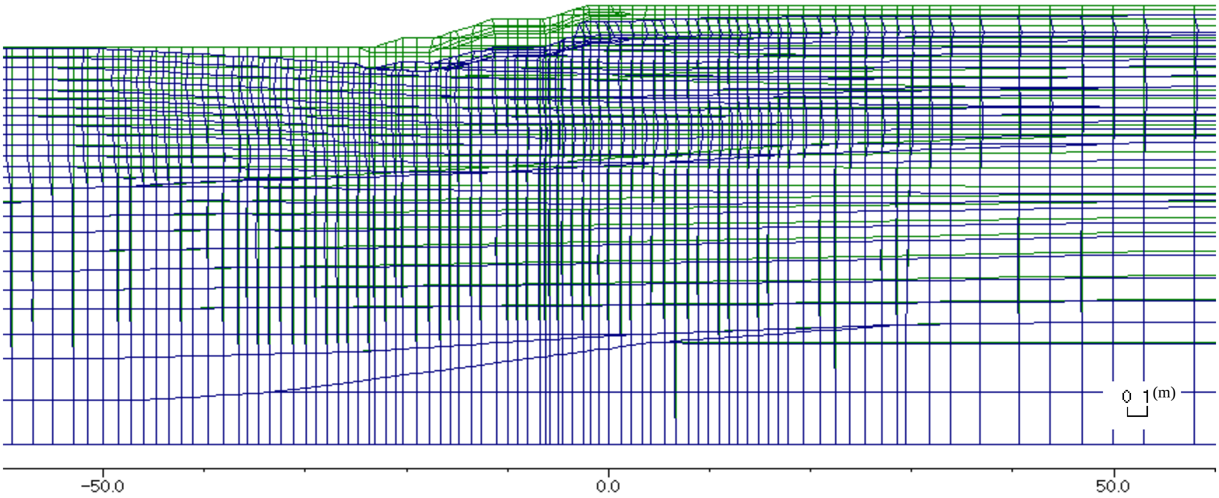
Completion of Fill Work and Preload (273 days passed from Start of Construction) (1/9)



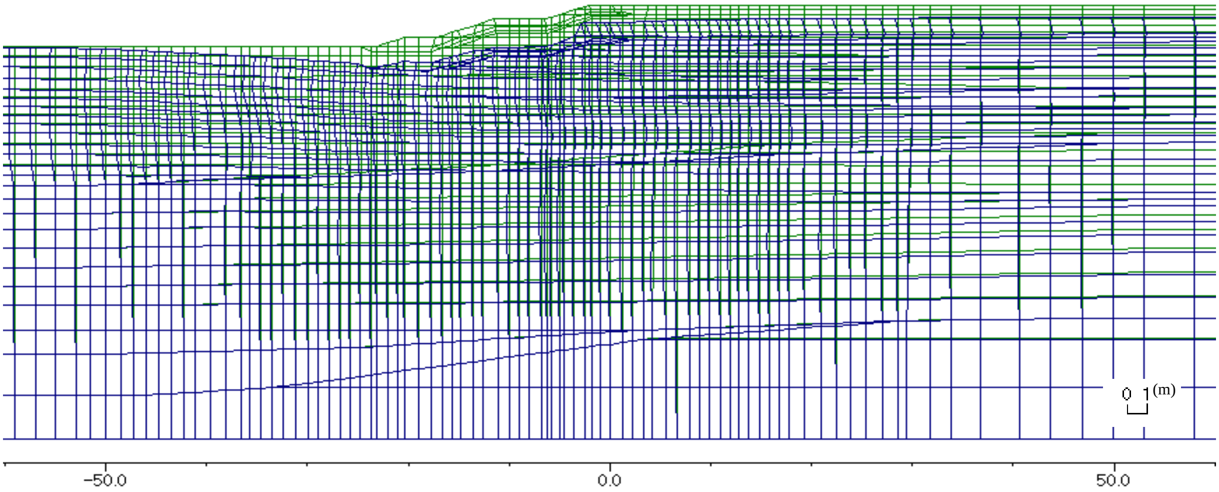
Start of Excavation (Removal of Fill and Preload) (396 days passed from Start of Construction) (2/9)



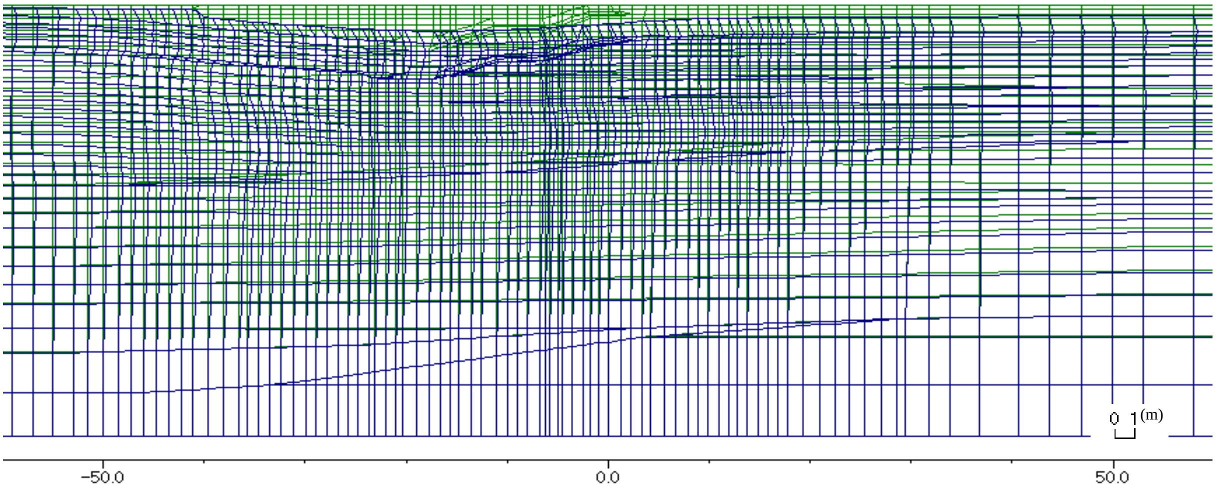
Completion of Excavation (Removal Fill and Preload)
(457 days passed from Start of Construction) (3/9)



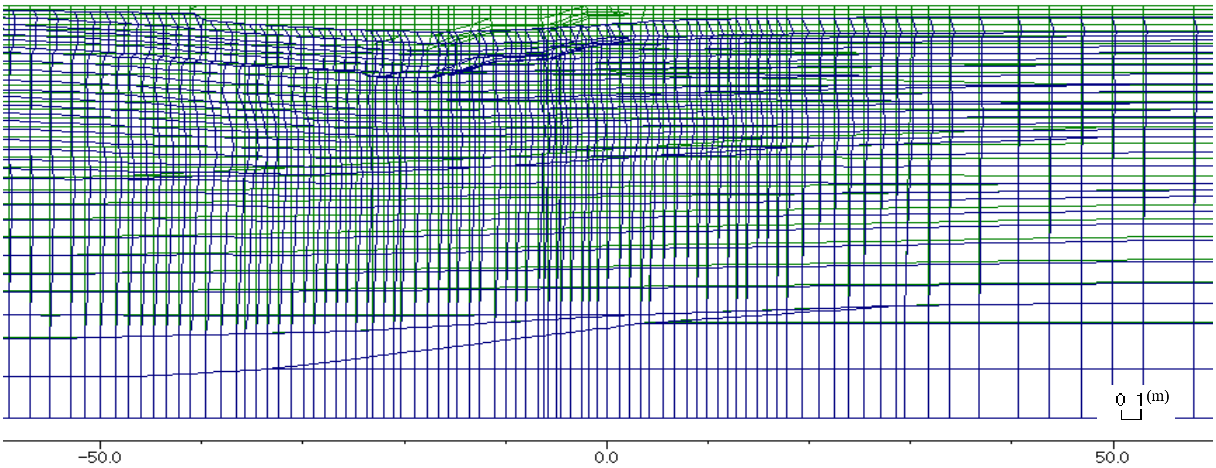
Construction of Revetment (638 days passed from Start of Construction) (4/9)



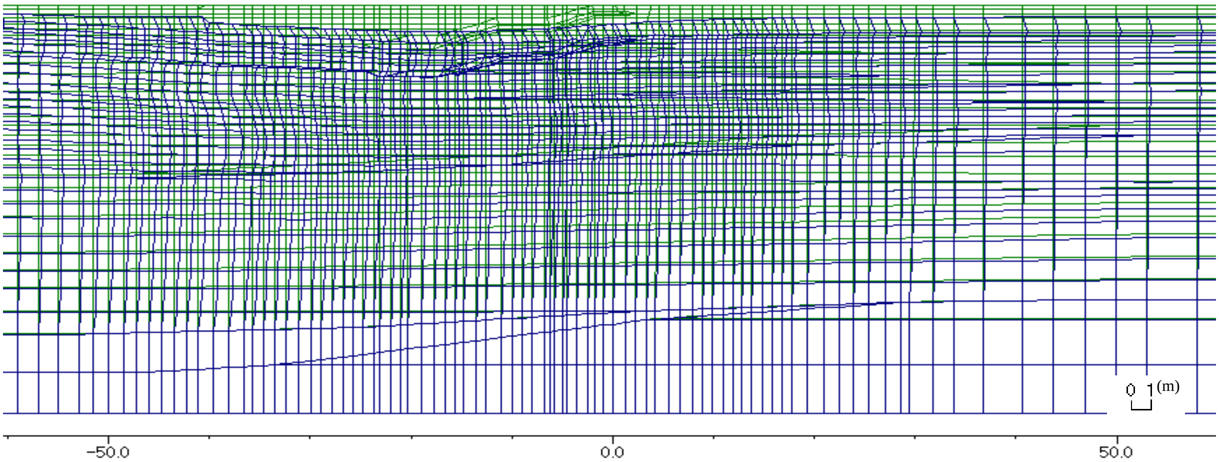
Start of Fill Work 2
(4.3 years later after completion of revetment construction; 2464 days passed from Start of Construction) (5/9)



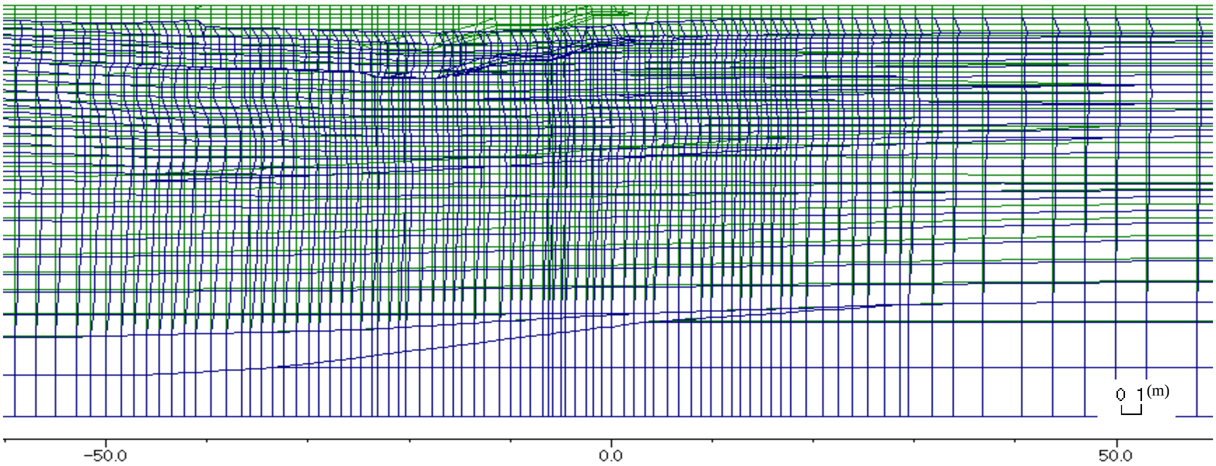
Completion of Fill Work 2
(5 years later after completion of revetment construction; 2709 days passed from Start of Construction) (6/9)



1 year later from completion of 2nd Reclamation
(6 years later after completion of revetment construction; 3075days passed from Start of Construction) (7/9)



5 years later from completion of 2nd Reclamation
(10 years later after completion of revetment construction; 4536 days passed from Start of Construction) (8/9)



15 years later after completion of 2nd Reclamation
(20 years later after completion of revetment construction; 8188 days passed from Start of Construction) (9/9)

Figure 16.2.15 Deformation Figure with construction steps for Section FEM-2 at Inner Revetment beside Full Container Storage Yard

3) Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

a) Model Mesh for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

Analysis model and its mesh are drawn based on subsoil investigation result and Inner Revetment design data. Figure 16.2.17 and Figure 16.2.18 show the analysis model and analysis mesh respectively.

b) Analysis Steps (Construction Schedule) for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

Analysis steps based on assumed construction schedule for Section FEM-3 at Inner Revetment beside Full Container Storage Yard are shown in Figure 16.2.16 and Table 16.2.10.

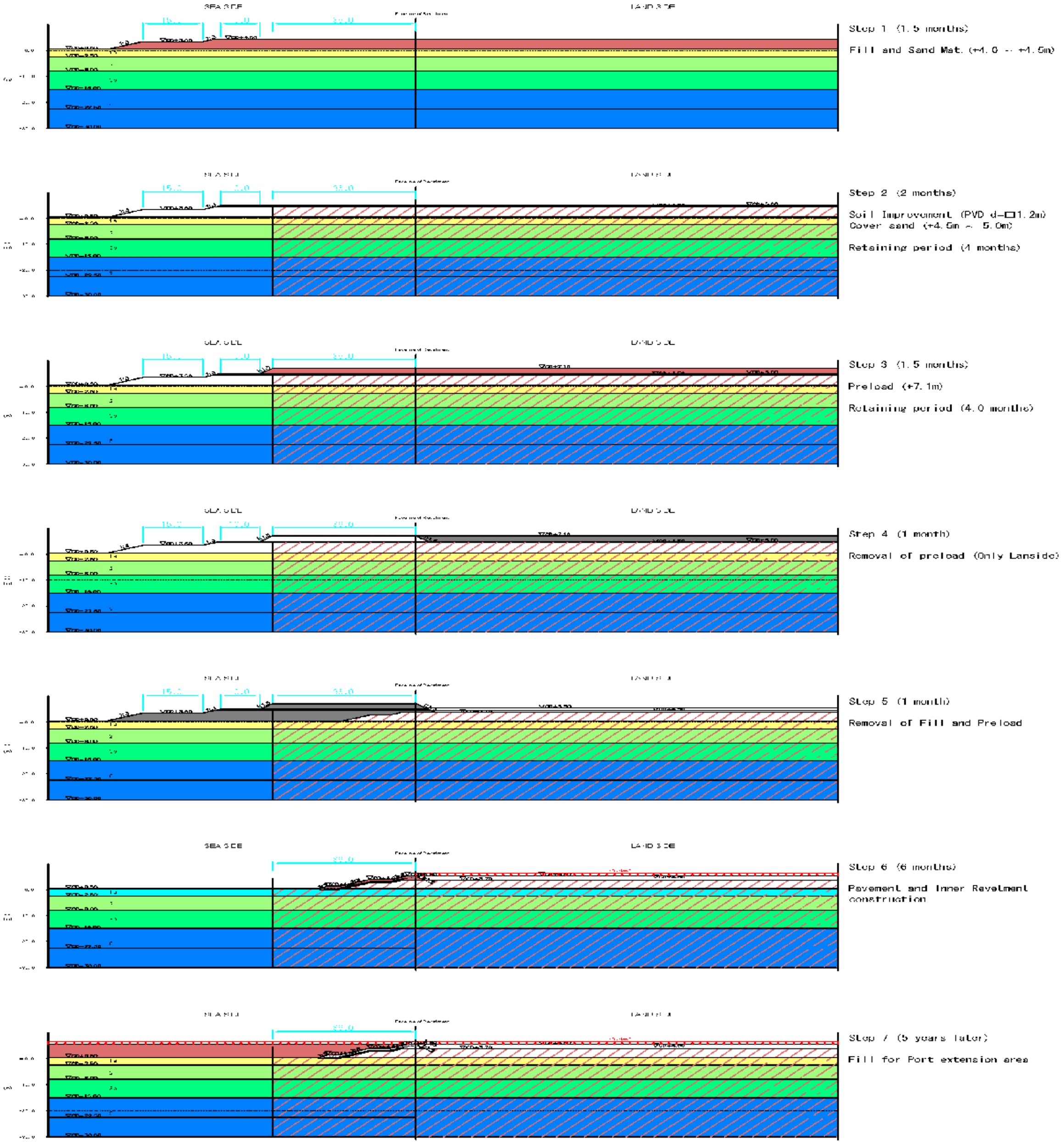
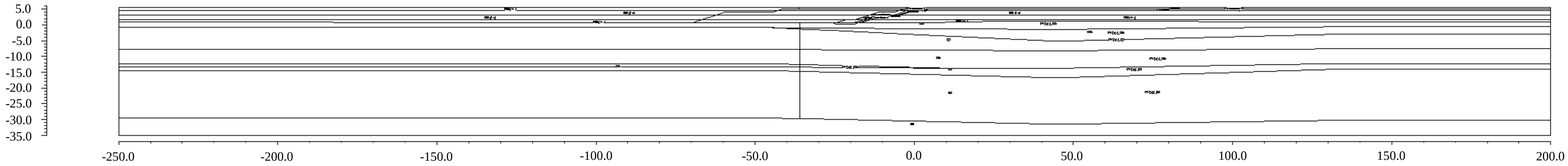


Figure 16.2.16 Analysis Steps based on assumed Construction Schedule for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

Table 16.2.10 Analysis Steps based on assumed Construction Schedule for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

	Item	Start	End	Period	Elapsed Time
Step 1	Initial			0	0
Step 2	Fill (1)-1	1/8/2012	15/8/2012	15	15
Step 3	Fill (1)-2	16/8/2012	31/8/2012	16	31
Step 4	Fill (1)-3	1/9/2012	15/9/2012	15	46
Step 5	Cover Sand	16/9/2012	30/9/2012	15	61
Step 6	Soil Improvement	1/10/2012	15/11/2012	46	107
Step 7	Preload-1	16/11/2012	30/11/2012	15	122
Step 8	Leave-1	1/12/2012	11/2/2013	73	195
Step 9	Leave-2	12/2/2013	25/4/2013	73	268
Step 10	Leave-3	26/4/2013	7/7/2013	73	341
Step 11	Leave-4	8/7/2013	18/9/2013	73	414
Step 12	Leave-5	19/9/2013	30/11/2013	73	487
Step 13	Removal of Land Side Preload-1	1/12/2013	15/12/2013	15	502
Step 14	Removal of Fill and Preload-1	16/12/2013	31/12/2013	16	518
Step 15	Removal of Fill and Preload-2	1/1/2014	15/1/2014	15	533
Step 16	Pavement and Revetment Construction	16/1/2014	15/7/2014	181	714
Step 17	Leave 1 year	16/7/2014	15/7/2015	365	1079
Step 18	Leave 2 year	16/7/2015	15/7/2016	366	1445
Step 19	Leave 3 year	16/7/2016	15/7/2017	365	1810
Step 20	Leave 4 year	16/7/2017	15/7/2018	365	2175
Step 21	Leave 5 year	16/7/2018	15/7/2019	365	2540
Step 22	Fill (2)-1	16/7/2019	15/9/2019	62	2602
Step 23	Fill (2)-2	16/9/2019	15/11/2019	61	2663
Step 24	Fill (2)-3	16/11/2019	15/1/2020	61	2724
Step 25	Fill (2)-4	16/1/2020	15/3/2020	60	2784
Step 26	1 month	16/3/2020	15/4/2020	31	2815
Step 27	3 months	16/4/2020	15/6/2020	61	2876
Step 28	6 months	16/6/2020	15/9/2020	92	2968
Step 29	1 year	16/9/2020	15/3/2021	181	3149
Step 30	2 years	16/3/2021	15/3/2022	365	3514
Step 31	3 years	16/3/2022	15/3/2023	365	3879
Step 32	5 years	16/3/2023	15/3/2025	731	4610
Step 33	10 years	16/3/2025	15/3/2030	1826	6436
Step 34	15 years	16/3/2030	15/3/2035	1826	8262



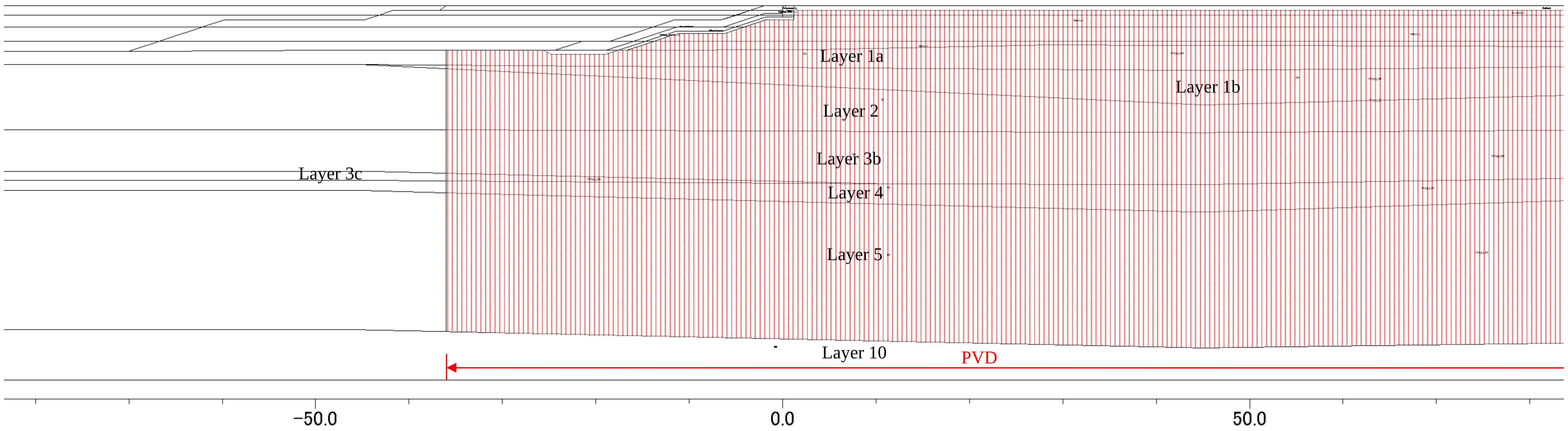


Figure 16.2.17 Analysis Model (Area) Figure for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

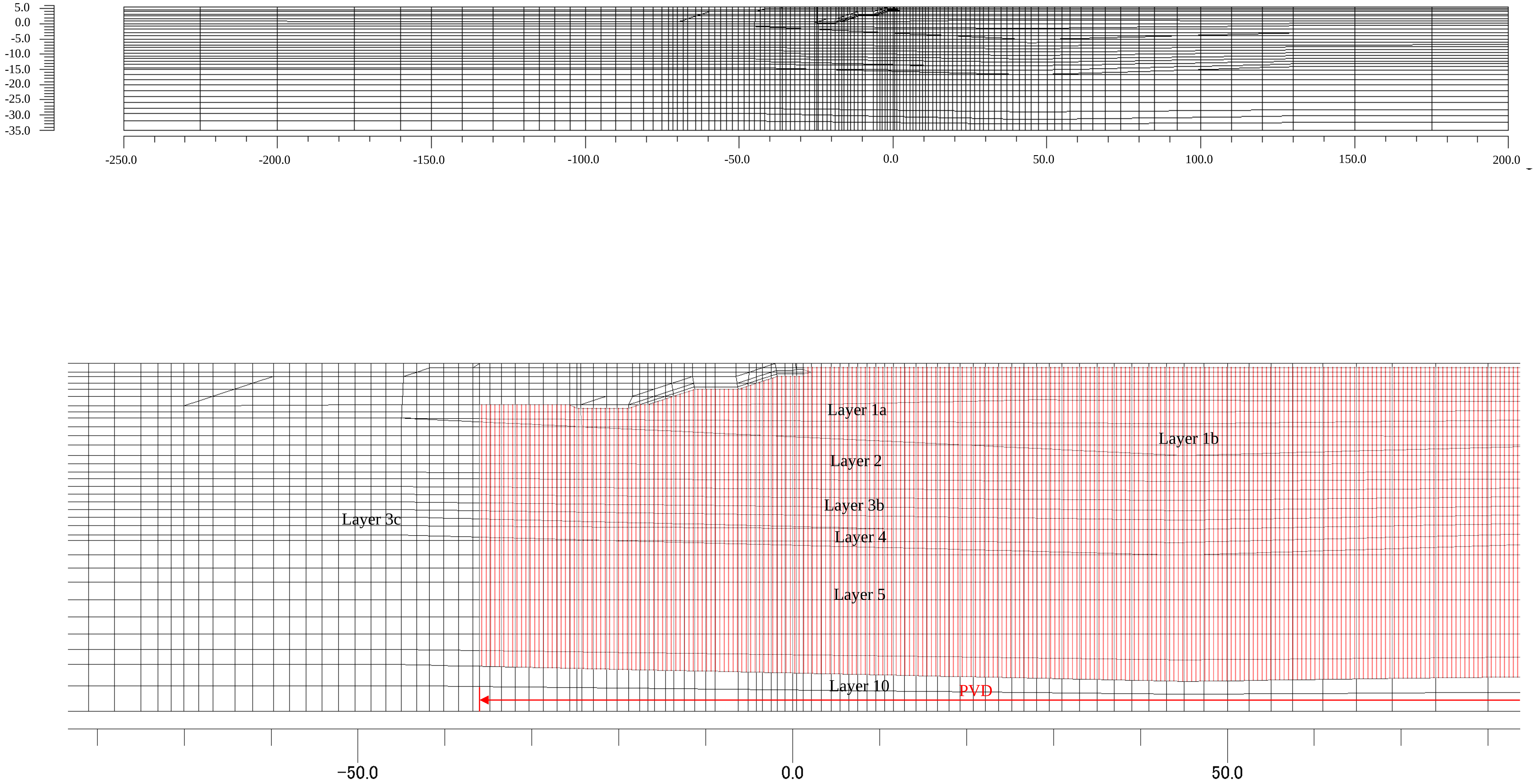


Figure 16.2.18 Analysis Mesh Figure for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

c) Analysis Result for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

i) Vertical Deformation

Vertical deformations with time (construction steps) at face line of Inner Revetment at different elevations are shown in Table 16.2.11 and Figure 16.2.19.

As shown in Table 16.2.11 and Figure 16.2.19, top of revetment and seabed surface at face line of revetment are subsiding about 8cm and 88cm respectively at the time of start of Fill Work 2 (reclamation of future port extension; it is assumed about 5years later after completion of revetment construction). These absolute values are gradually increasing with time and finally they reached to 16cm and 96cm respectively at 20 years later after completion of revetment construction (15 years later after Fill Work 2).

Table 16.2.11 Vertical deformation with construction steps at face line of Inner Revetment (Section FEM-3)

Analysis Steps		Seabed Surface	Bottom of Layer 1b	Bottom of Layer 2	Bottom of Layer 3b	Bottom of Layer 4	Bottom of Layer 5	Top of Revetment (Aft. Const.)
Construction Steps	Time (days)							
Initial Elevation CDL (m)	-	0.77	-3.02	-8.02	-13.44	-15.62	-28.40	5.50
1) Start of fill 1	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2) Completion of Fill 1	46	-0.078	-0.035	-0.027	-0.016	-0.009	-0.001	0.000
3)Completion of Fill Work and Preload	122	-0.451	-0.339	-0.122	-0.080	-0.063	0.000	0.000
4) Start of Removal of Preload and Fill	487	-0.854	-0.732	-0.388	-0.299	-0.264	-0.002	0.000
5) Completion of Removal of Preload and Fill	533	-0.778	-0.682	-0.376	-0.291	-0.257	-0.002	0.000
6) Construction of Revetment	714	-0.805	-0.688	-0.353	-0.264	-0.233	-0.001	0.000
7) Start of Fill Work 2	2540	-0.880	-0.760	-0.402	-0.294	-0.260	-0.002	-0.075
8) Completion of Fill Work 2 (5years later after completion of revetment construction)	2784	-0.829	-0.708	-0.364	-0.267	-0.238	-0.002	-0.028
9) 1year later after Completion of Fill Work 2 (6years later after completion of revetment construction)	3149	-0.909	-0.788	-0.427	-0.318	-0.283	-0.002	-0.105
10) 2years later after Completion of Fill Work 2 (7 years later after completion of revetment construction)	3514	-0.925	-0.804	-0.440	-0.329	-0.293	-0.002	-0.122
11) 5years later after Completion of Fill Work 2 (10 years later after completion of revetment construction)	4610	-0.942	-0.820	-0.452	-0.340	-0.303	-0.002	-0.139
12) 10 years later after Completion of Fill Work 2 (15 years later after completion of revetment construction)	6436	-0.954	-0.832	-0.459	-0.346	-0.308	-0.002	-0.152
13) 15 years later after Completion of Fill Work 2 (20years later after completion of revetment construction)	8262	-0.964	-0.840	-0.464	-0.350	-0.312	-0.002	-0.163

*Unit: m, +: Heaving, -: Settlement

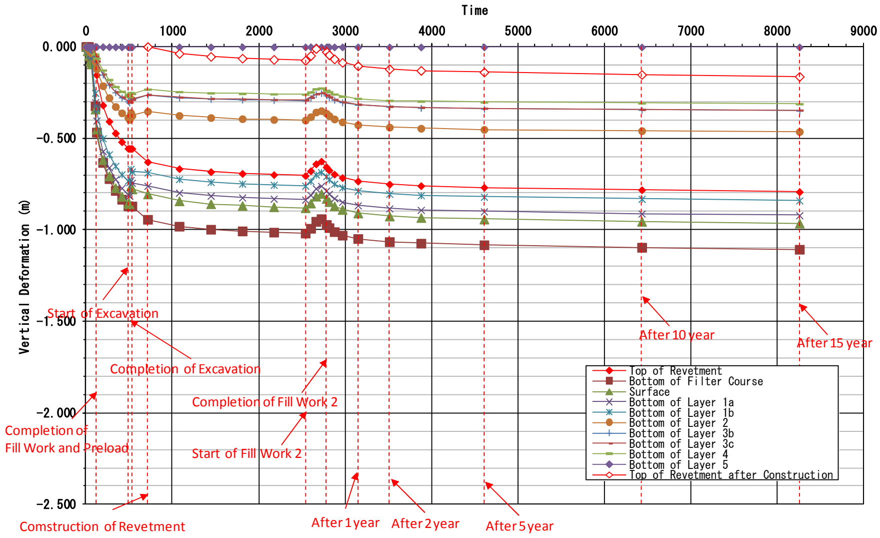


Figure 16.2.19 Vertical deformation with construction steps at face line of Inner Revetment (Section FEM-3)

ii) Horizontal Deformation

Horizontal deformations with time (construction steps) at face line of Inner Revetment at different elevations are shown in Table 16.2.12 and Figure 16.2.20.

As shown in Table 16.2.12 and Figure 16.2.20, top of revetment and seabed surface are moving horizontally toward reclaimed land side about 4cm and 14cm respectively at the time of start of Fill Work 2 (reclamation of future port extension; it is assumed about 5years later from completion of revetment construction). Once they moved land side under consolidation process, then they move back to sea side due to reclamation work for future extension area. These absolute values are increasing with time and finally they are moving toward sea side about 12cm and 8cm respectively from original position at 20years later after completion of revetment construction (15 years later after Fill Work 2).

Table 16.2.12 Horizontal deformation with construction steps at face line of Inner Revetment (Section FEM-3)

Analysis Steps		Seabed Surface	Bottom of Layer 1b	Bottom of Layer 2	Bottom of Layer 3b	Bottom of Layer 4	Bottom of Layer 5	Top of Revetment (Aft. Const.)
Construction Steps	Time (days)							
Initial Elevation CDL (m)	-	0.77	-3.02	-8.02	-13.44	-15.62	-28.40	5.50
1) Start of fill 1	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2) Completion of Fill 1	46	-0.036	-0.030	-0.025	-0.020	-0.016	0.000	0.000
3)Completion of Fill Work and Preload	122	-0.036	-0.024	-0.059	-0.050	-0.043	0.000	0.000
4) Start of Removal of Preload and Fill	487	0.067	0.075	0.008	-0.005	-0.001	0.000	0.000
5) Completion of Removal of Preload and Fill	533	-0.044	-0.064	-0.107	-0.127	-0.122	-0.002	0.000
6) Construction of Revetment	714	-0.072	-0.100	-0.117	-0.135	-0.131	-0.002	0.000
7) Start of Fill Work 2	2540	-0.137	-0.180	-0.163	-0.147	-0.143	-0.002	-0.041
8) Completion of Fill Work 2 (5years later after completion of revetment construction)	2784	0.102	0.086	0.057	0.077	0.076	0.001	0.152
9) 1year later after Completion of Fill Work 2 (6years later after completion of revetment construction)	3149	0.089	0.076	0.040	0.061	0.063	0.000	0.129
10) 2years later after Completion of Fill Work 2 (7 years later after completion of revetment construction)	3514	0.089	0.076	0.040	0.062	0.063	0.000	0.128
11) 5years later after Completion of Fill Work 2 (10 years later after completion of revetment construction)	4610	0.086	0.074	0.038	0.061	0.062	0.000	0.124
12) 10 years later after Completion of Fill Work 2 (15 years later after completion of revetment construction)	6436	0.082	0.071	0.033	0.057	0.060	0.000	0.120
13) 15 years later after Completion of Fill Work 2 (20years later after completion of revetment construction)	8262	0.080	0.069	0.030	0.055	0.057	0.000	0.116

*Unit: m, +: Sea side, -: Land Side

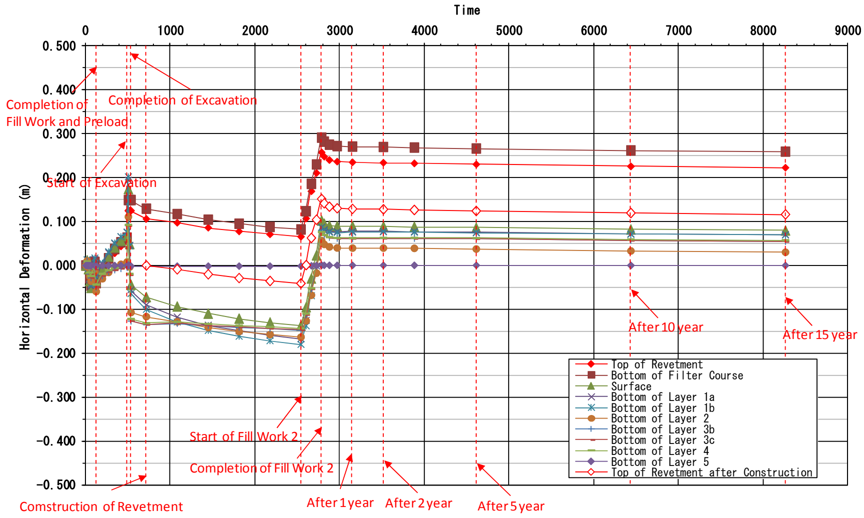
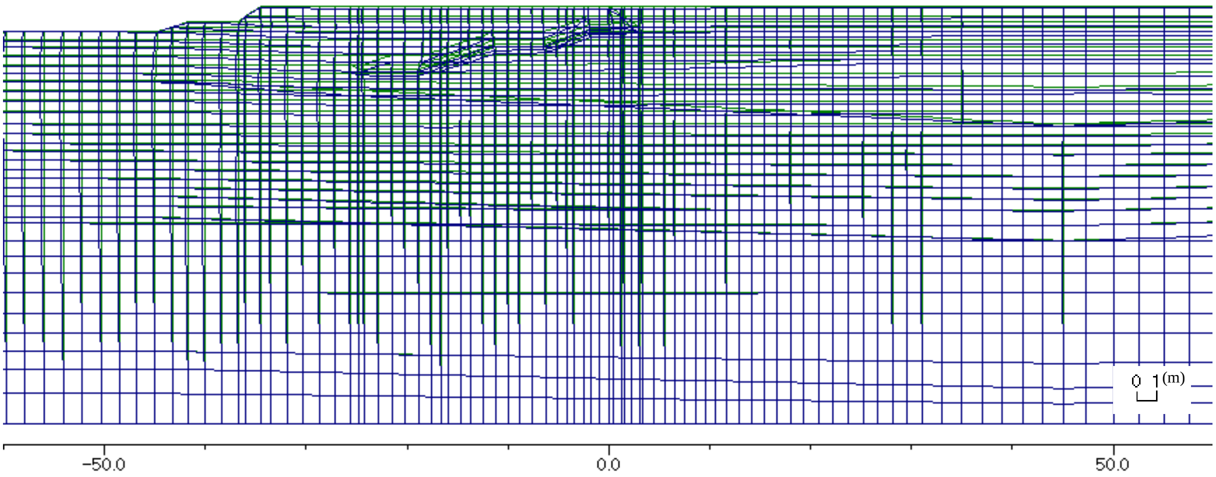
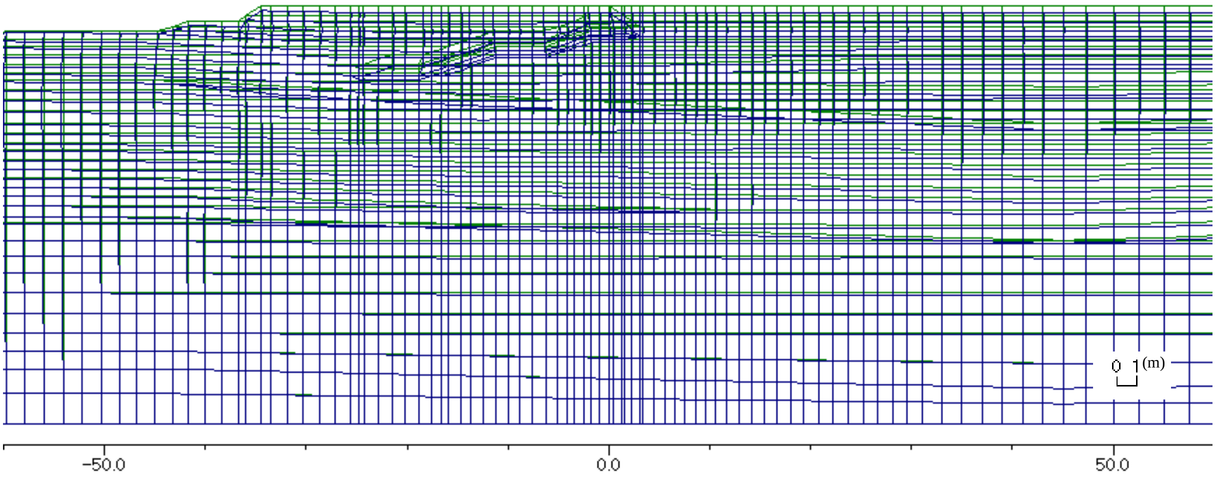


Figure 16.2.20 Horizontal deformation with construction steps at face line of Inner Revetment (Section FEM-3)

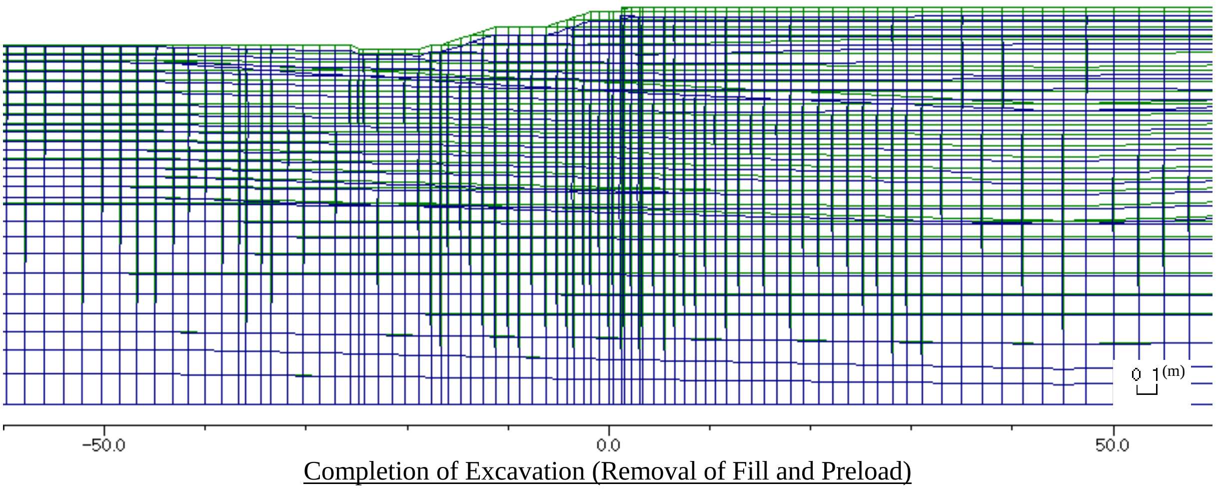
Deformation figures of representative construction steps are as shown in Figure 16.2.21.



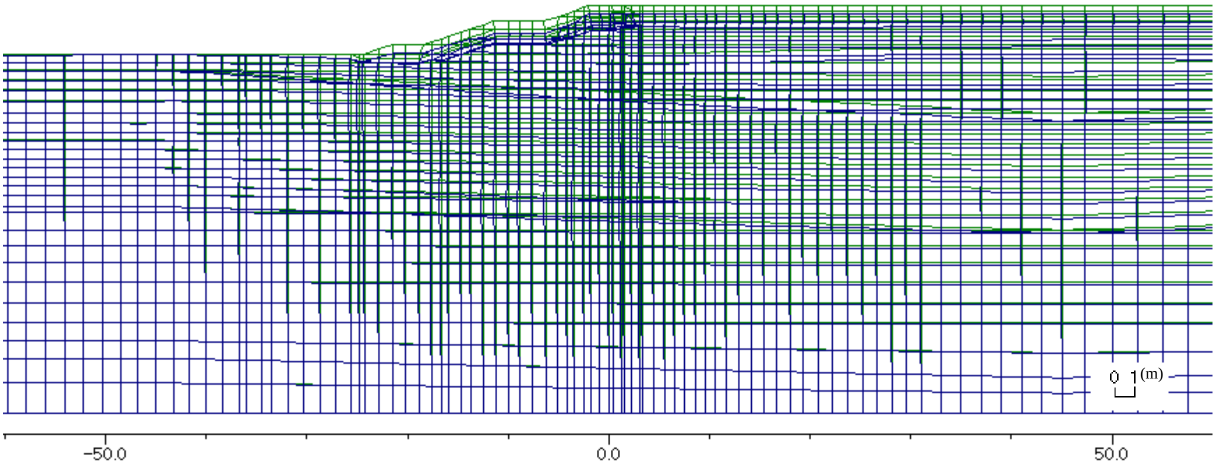
Completion of Fill Work and Preload (122 days passed from Start of Construction) (1/9)



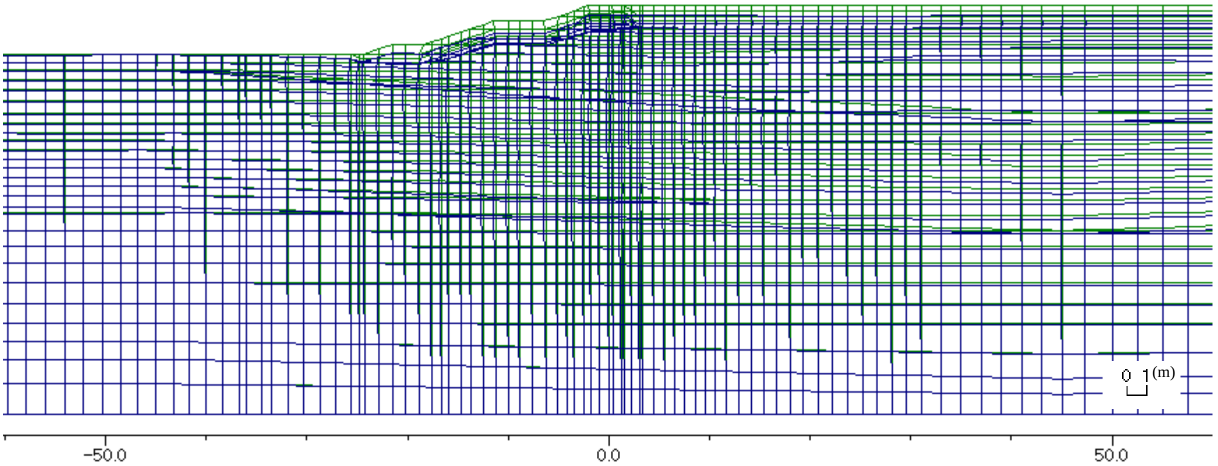
Start of Excavation (Removal of Fill and Preload) (487 days passed from Start of Construction) (2/9)



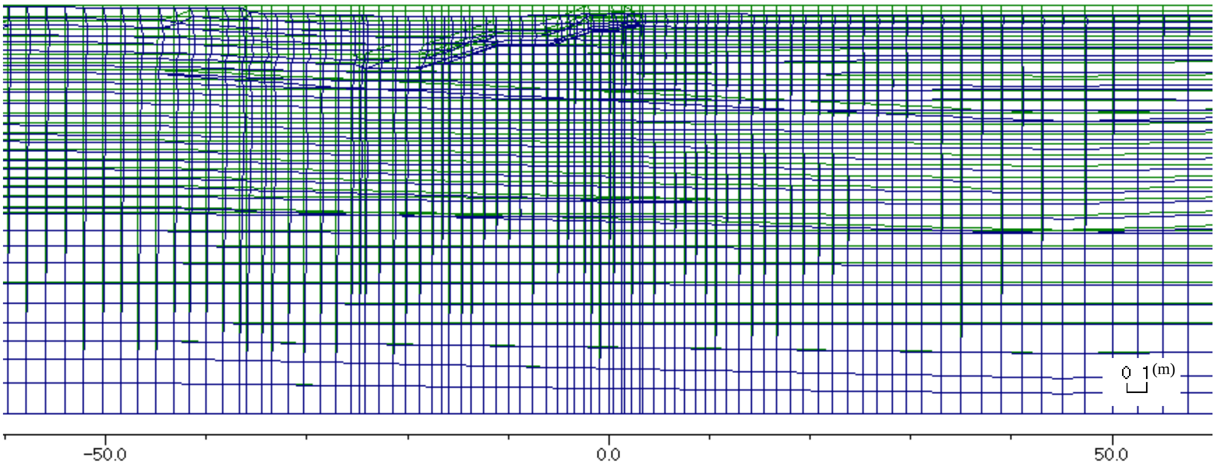
Completion of Excavation (Removal of Fill and Preload)
(533 days passed from Start of Construction) (3/9)



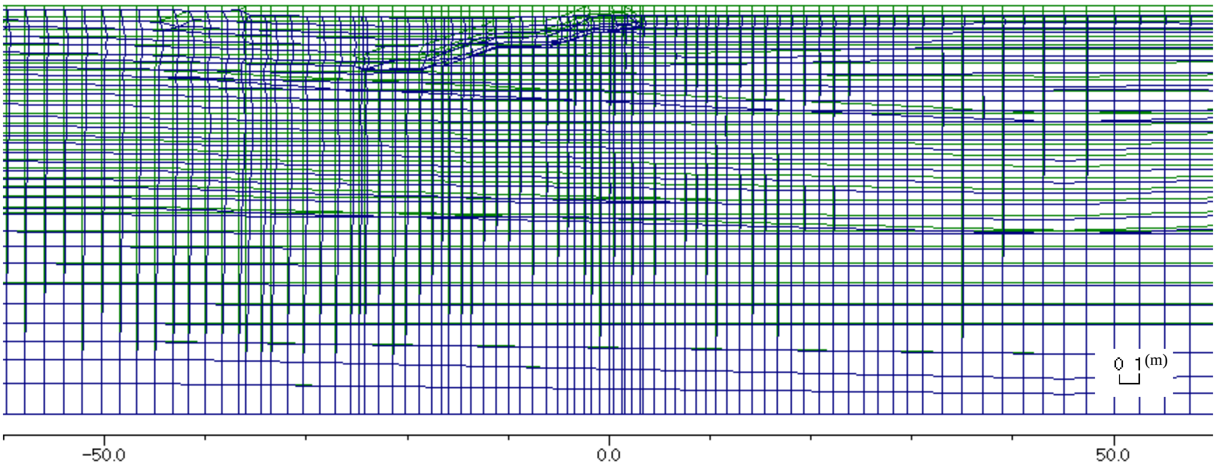
Construction of Revetment (714 days passed from Start of Construction) (4/9)



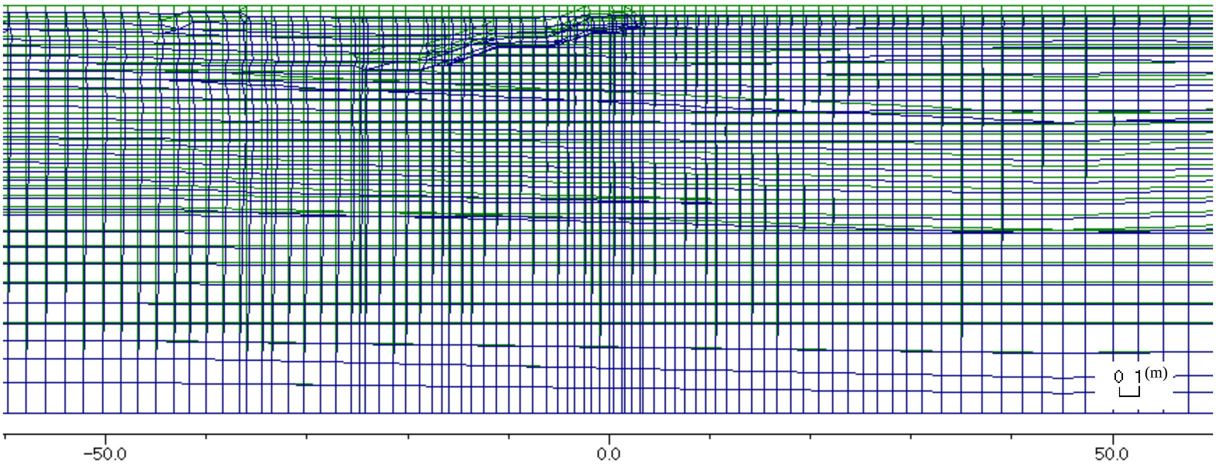
Start of Fill Work 2
(4.3 years later after completion of revetment construction; 2540 days passed from Start of Construction) (5/9)



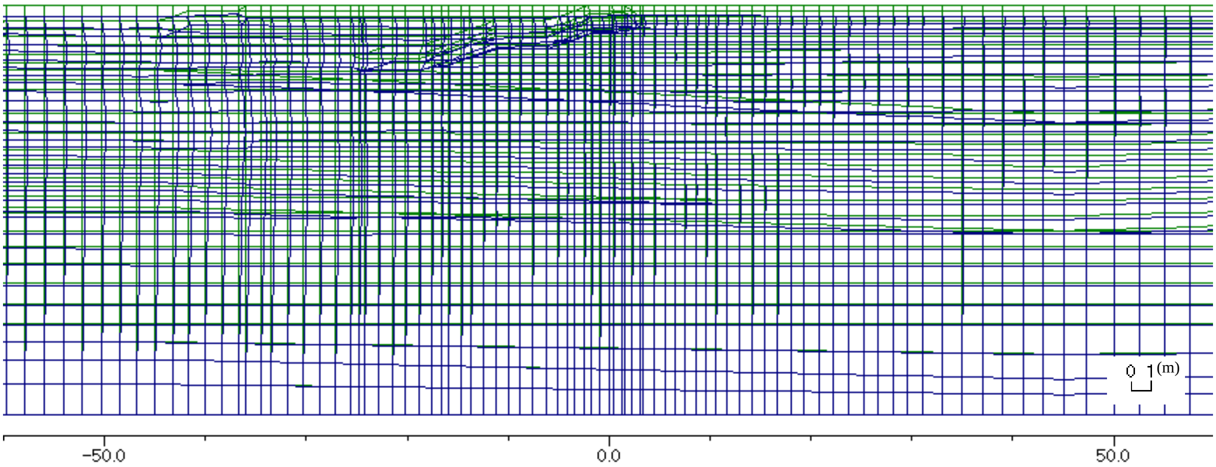
Completion of Fill Work 2
(5 years later after completion of revetment construction; 2784 days passed from Start of Construction) (6/9)



1 year later from completion of 2nd Reclamation
(6 years later after completion of revetment construction; 3149days passed from Start of Construction) (7/9



5 years later after completion of 2nd Reclamation
(10 years later after completion of revetment construction; 4610 days passed from Start of Construction) (8/9)



15 years later after completion of 2nd Reclamation
(20 years later after completion of revetment construction; 8262 days passed from Start of Construction) (9/9)

Figure 16.2.21 Deformation Figure with construction steps for Section FEM-3 at Inner Revetment beside Empty Container Storage Yard

4) Section FEM-4 at Outer Revetment A

a) Model Mesh for Section FEM-4 at Outer Revetment A

Analysis model and its mesh are drawn based on subsoil investigation result and Outer Revetment A design data. Figure 16.2.23 and Figure 16.2.24 show the analysis model and analysis mesh respectively.

b) Analysis Steps (Construction Schedule) for Section FEM-4 at Outer Revetment A

Analysis steps based on assumed construction schedule for Section FEM-4 at Outer Revetment A are shown in Figure 16.2.22 and Table 16.2.13.

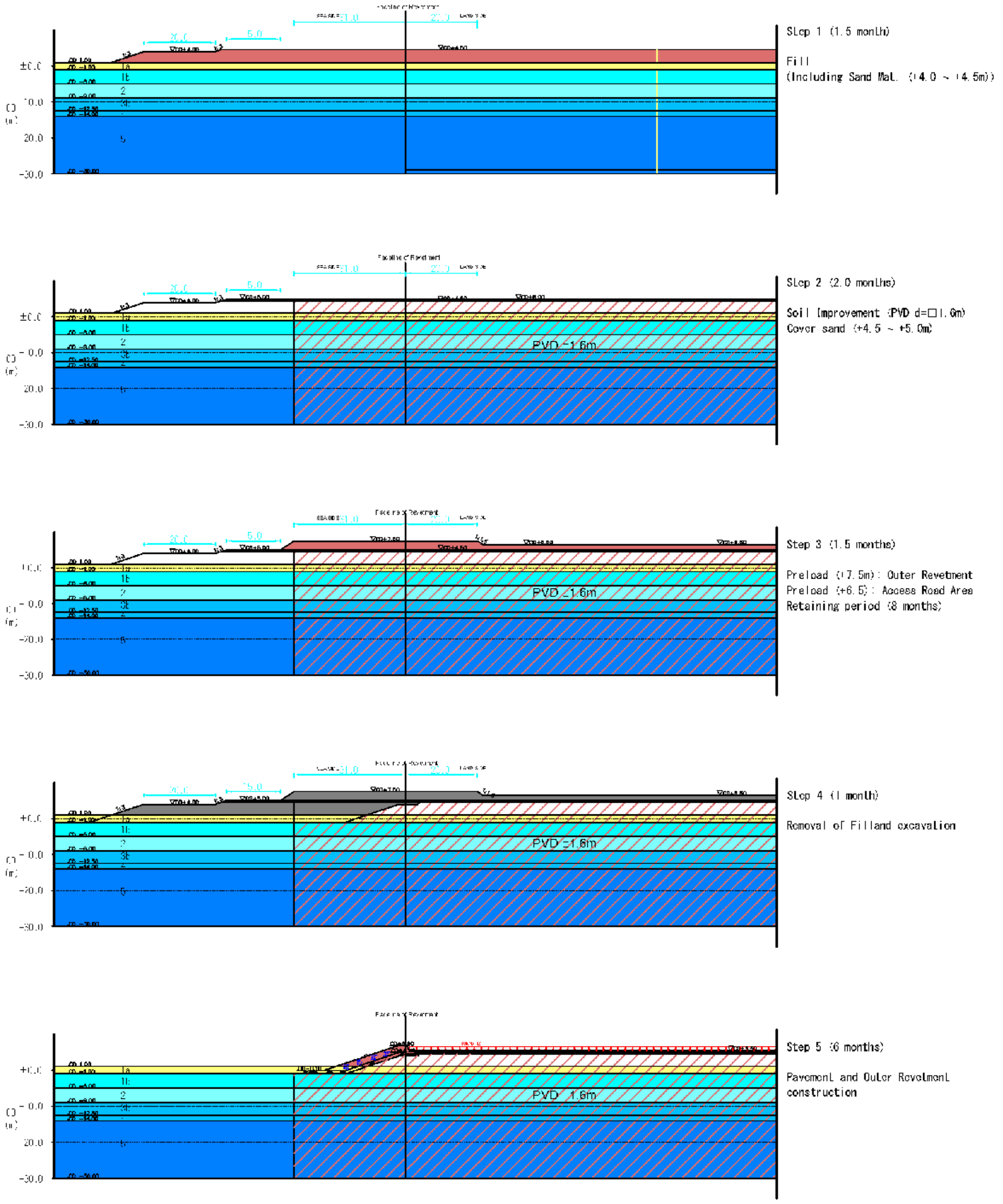


Figure 16.2.22 Analysis Steps based on assumed Construction Schedule for Section FEM-4 at Outer Revetment A

Table 16.2.13 Analysis Steps based on assumed Construction Schedule for Section FEM-4 at Outer Revetment A

	Item	Start	End	Period	Elapsed Time
Step 1	Initial			0	0
Step 2	Fill (1)-1	1/8/2012	15/8/2012	15	15
Step 3	Fill (1)-2	16/8/2012	31/8/2012	16	31
Step 4	Fill (1)-3	1/9/2012	15/9/2012	15	46
Step 5	Cover Sand	16/9/2012	30/9/2012	15	61
Step 6	Soil Improvement	1/10/2012	15/11/2012	46	107
Step 7	Preload-1	16/11/2012	5/12/2012	20	127
Step 8	Preload-2	6/12/2012	31/12/2012	26	153
Step 9	Leave-1	1/1/2013	16/2/2013	47	200
Step 10	Leave-2	17/2/2013	6/4/2013	49	249
Step 11	Leave-3	7/4/2013	25/5/2013	49	298
Step 12	Leave-4	26/5/2013	13/7/2013	49	347
Step 13	Leave-5	14/7/2013	31/8/2013	49	396
Step 14	Removal of Fill and Preload-1	1/9/2013	10/9/2013	10	406
Step 15	Removal of Fill and Preload-2	11/9/2013	20/9/2013	10	416
Step 16	Removal of Fill and Preload-3	21/9/2013	30/9/2013	10	426
Step 17	Pavement and Revetment Construction	1/10/2013	31/3/2014	182	608
Step 18	1 month	1/4/2014	30/4/2014	30	638
Step 19	3 months	1/5/2014	30/6/2014	61	699
Step 20	6 months	1/7/2014	30/9/2014	92	791
Step 21	1 year	1/10/2014	31/3/2015	182	973
Step 22	2 years	1/4/2015	31/3/2016	366	1339
Step 23	3 years	1/4/2016	31/3/2017	365	1704
Step 24	5 years	1/4/2017	31/3/2019	730	2434
Step 25	10 years	1/4/2019	31/3/2024	1827	4261
Step 26	15 years	1/4/2024	31/3/2029	1826	6087

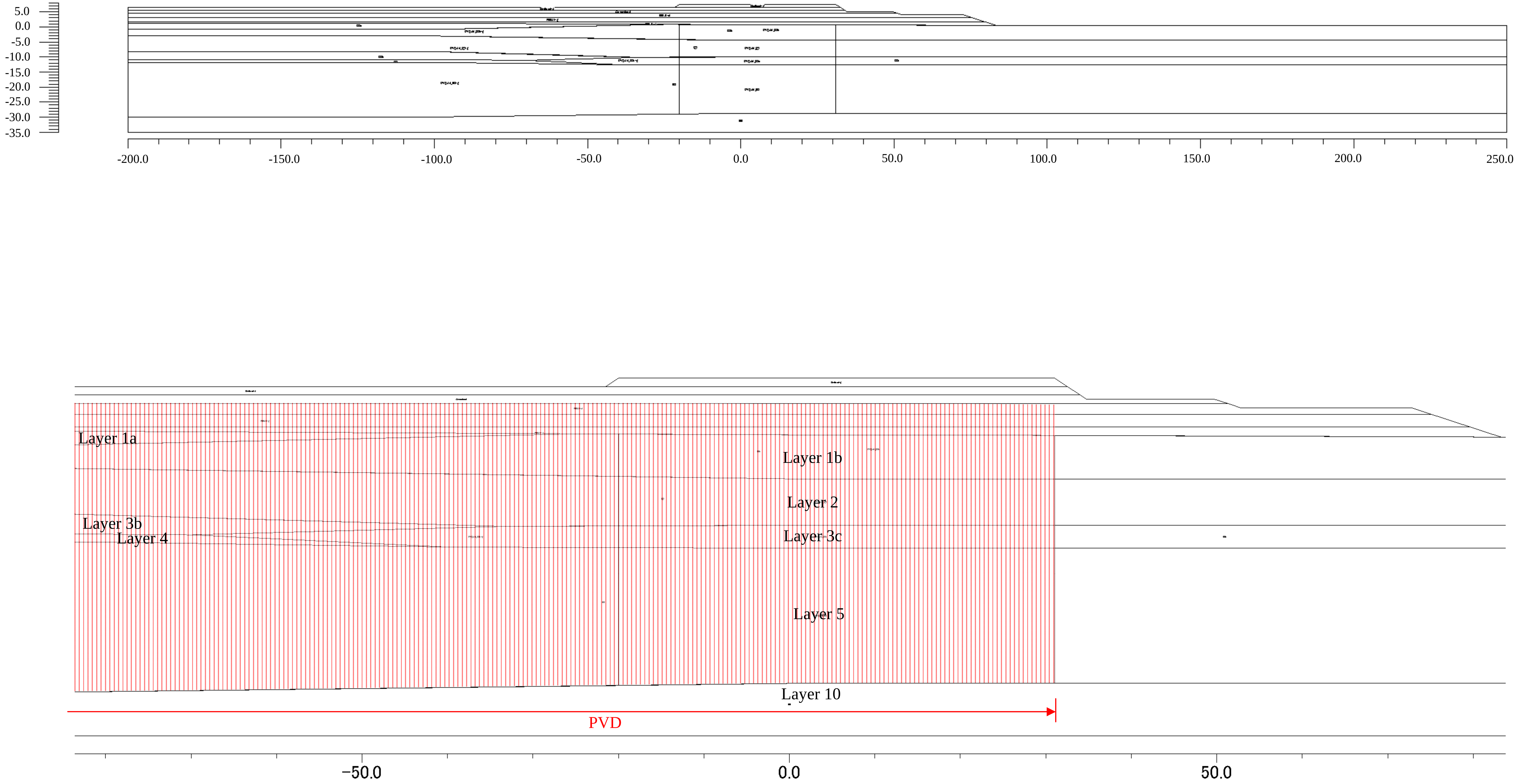


Figure 16.2.23 Analysis Model (Area) Figure for Section FEM-4 at Outer Revetment A

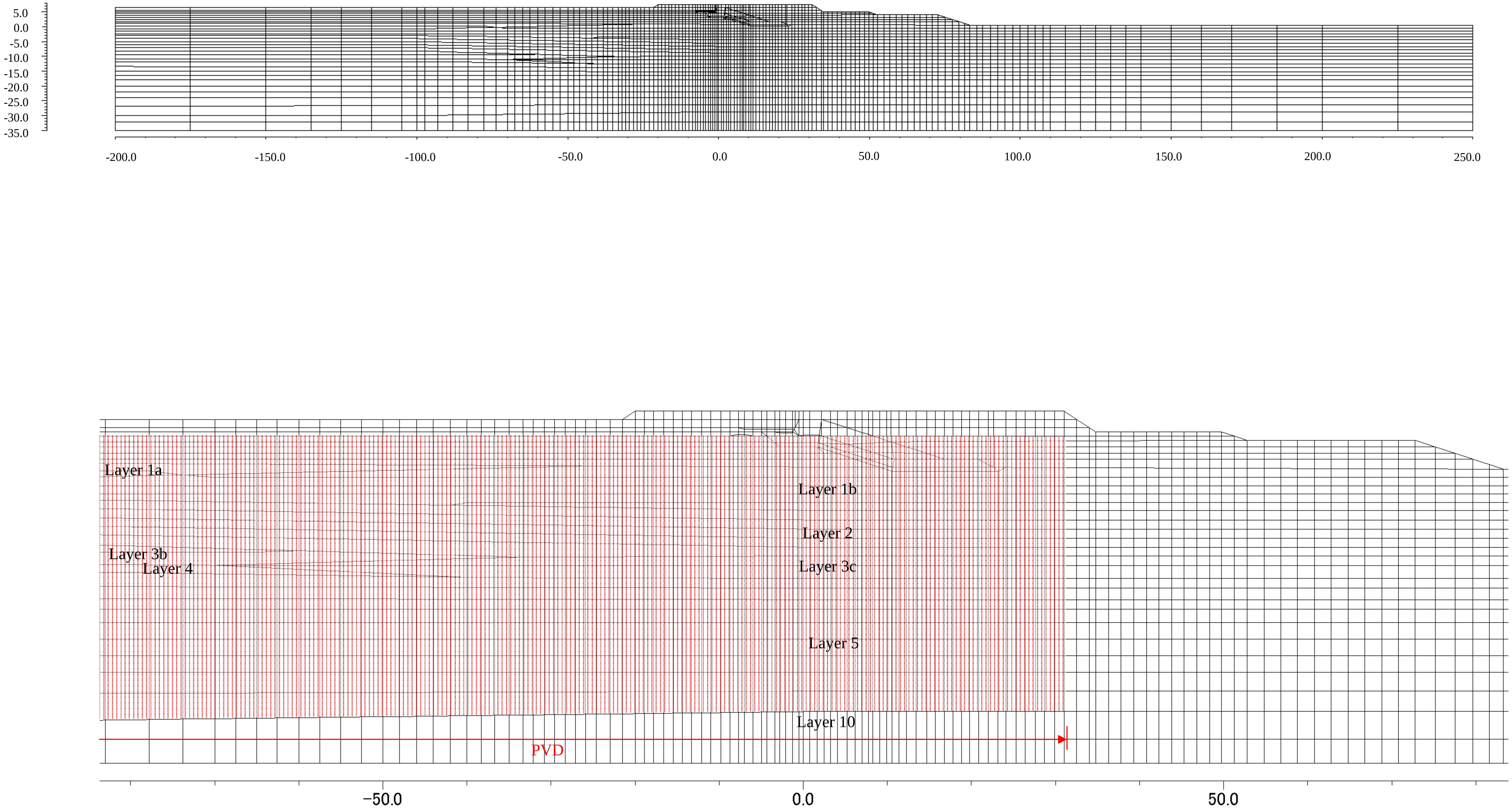


Figure 16.2.24 Analysis Mesh Figure for Section FEM-4 at Outer Revetment A

c) Analysis Result for Section FEM-4 at Outer Revetment A

i) Vertical Deformation

Vertical deformations with time (construction steps) at face line of Outer Revetment A at different elevations are shown in Table 16.2.14 and Figure 16.2.25.

As shown in Table 16.2.14 and Figure 16.2.25, top of revetment and seabed surface at face line of revetment are subsiding about 8cm and 113cm respectively at the time of 1 year later after completion of revetment construction. Once they show the rebounds due to removal of temporary fill and preload, then these absolute values are gradually increasing with time and finally they reached to 18cm and 124cm respectively at the time of 15years later after completion of revetment construction.

Table 16.2.14 Vertical deformation with construction steps at face line of Outer Revetment A (Section FEM-4)

Analysis Steps		Seabed Surface	Bottom of Layer 1b	Bottom of Layer 2	Bottom of Layer 5	Top of Revetment (Aft. Const.)
Construction Steps	Time (days)					
Initial Elevation CDL (m)	-	0.78	-4.45	-9.95	-28.75	6.50
1) Start of fill	0	0.000	0.000	0.000	0.000	0.000
2) Completion of Fill	46	-0.047	-0.033	-0.024	-0.001	0.000
3)Completion of Fill Work and Preload	153	-0.671	-0.417	-0.175	-0.001	0.000
4) Start of Removal of Preload and Fill	396	-1.124	-0.811	-0.375	-0.002	0.000
5) Completion of Removal of Preload and Fill	426	-0.952	-0.691	-0.300	-0.001	0.000
6) Construction of Revetment	608	-1.054	-0.755	-0.320	-0.002	0.000
7) 1year later after completion of revetment construction	973	-1.136	-0.832	-0.359	-0.002	-0.082
8) 2years later after completion of revetment construction	1339	-1.167	-0.860	-0.373	-0.002	-0.113
9) 5years later after completion of revetment construction	2434	-1.200	-0.890	-0.385	-0.002	-0.146
10) 10years later after completion of revetment construction	4261	-1.222	-0.909	-0.393	-0.002	-0.168
11) 15years later after completion of revetment construction	6087	-1.236	-0.921	-0.398	-0.002	-0.182

*Unit: m, +: Heaving, -: Settlement

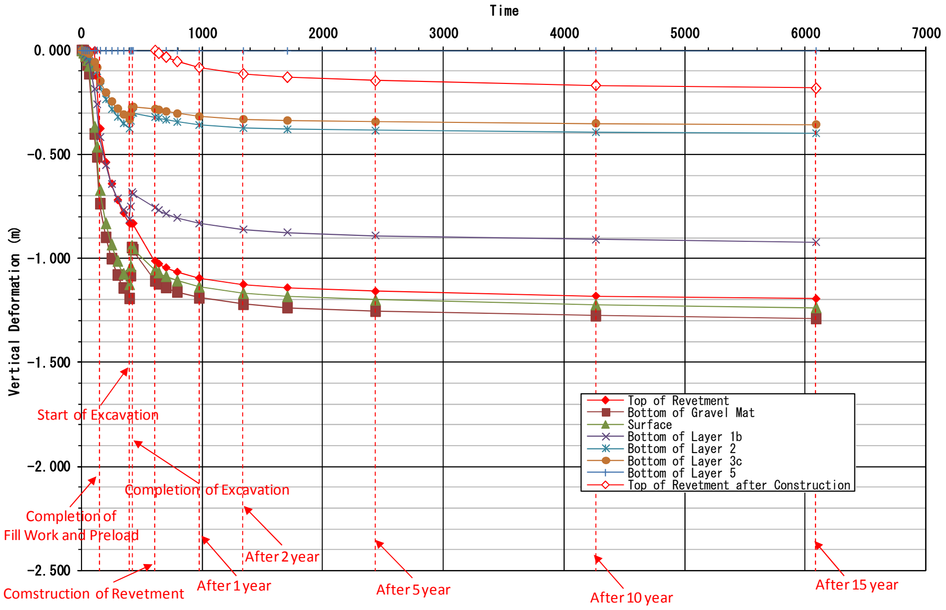


Figure 16.2.25 Vertical deformation with construction steps at face line of Outer Revetment A (Section FEM-4)

ii) Horizontal Deformation

Horizontal deformations with time (construction steps) at face line of Outer Revetment A at different elevations are shown in Table 16.2.15 and Figure 16.2.26.

As shown in Table 16.2.15 and Figure 16.2.26, top of revetment and seabed surface are moving about 6cm to seaside and 6cm to seaside respectively at the time of 1year later after completion of revetment construction. Once they moved land side under consolidation process, then they move back to sea side direction due to removal of temporary fill and preload. Then these absolute values are increasing with time and finally they are moving toward sea side about 18cm and 19cm respectively from original position at the time of 15years later after completion of revetment construction.

Table 16.2.15 Horizontal deformation with construction steps at face line of Outer Revetment A (Section FEM-4)

Analysis Steps		Seabed Surface	Bottom of Layer 1b	Bottom of Layer 2	Bottom of Layer 5	Top of Revetment (Aft. Const.)
Construction Steps	Time (days)					
Initial Elevation CDM (m)	-	0.78	-4.45	-9.95	-28.75	6.50
1) Start of fill	0	0.000	0.000	0.000	0.000	0.000
2) Completion of Fill	46	0.028	0.021	0.014	0.000	0.000
3)Completion of Fill Work and Preload	153	-0.010	-0.009	0.020	0.000	0.000
4) Start of Removal of Preload and Fill	396	-0.132	-0.118	-0.007	0.000	0.000
5) Completion of Removal of Preload and Fill	426	-0.027	0.073	0.170	0.003	0.000
6) Construction of Revetment	608	-0.002	0.086	0.162	0.003	0.000
7) 1year later after completion of revetment construction	973	0.058	0.151	0.167	0.002	0.056
8) 2years later after completion of revetment construction	1339	0.086	0.180	0.173	0.002	0.082
9) 5years later after completion of revetment construction	2434	0.129	0.224	0.185	0.002	0.121
10) 10years later after completion of revetment construction	4261	0.166	0.262	0.199	0.002	0.153
11) 15years later after completion of revetment construction	6087	0.192	0.289	0.212	0.002	0.176

*Unit: m, +: Sea side, -: Land Side

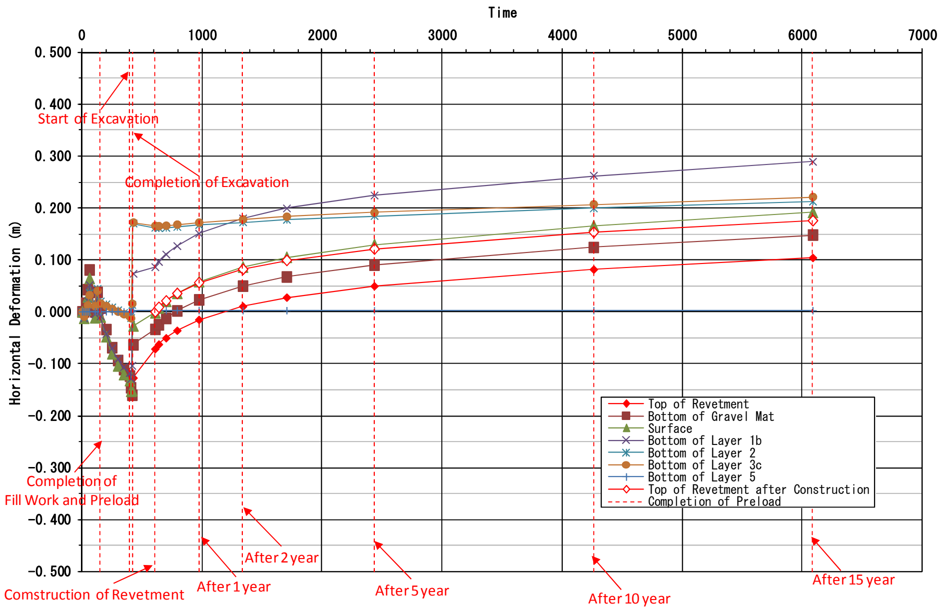
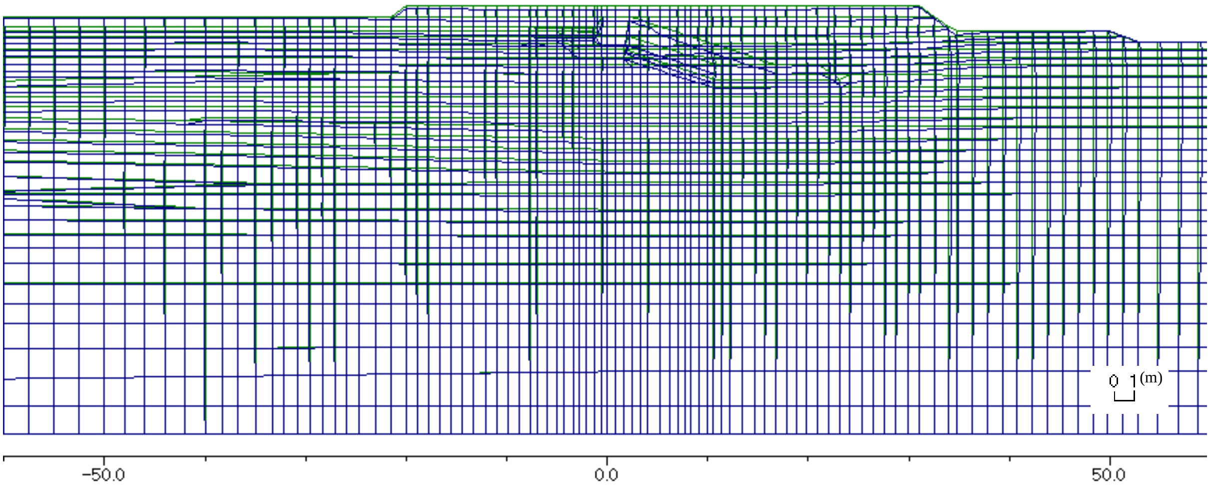
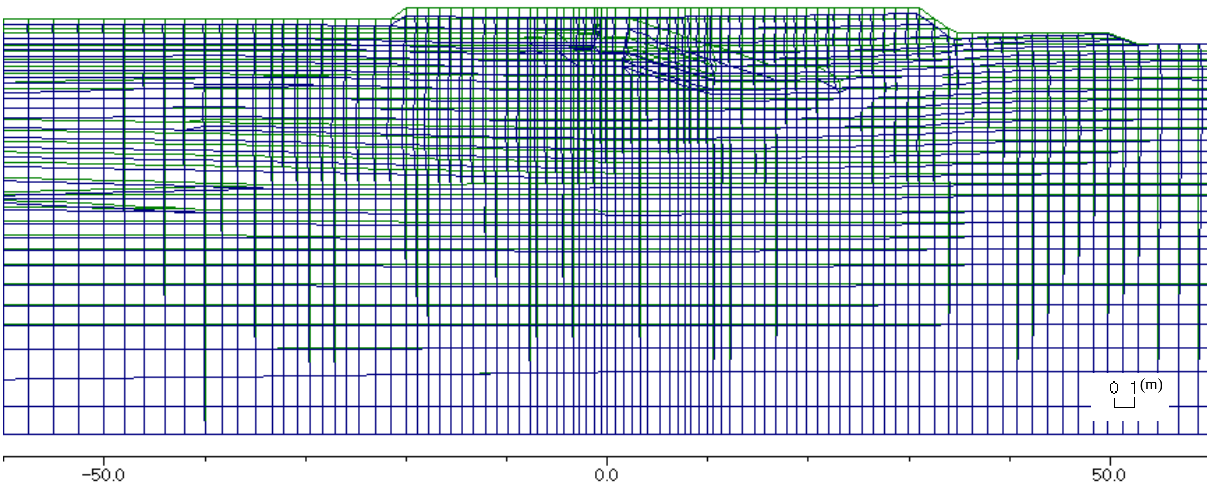


Figure 16.2.26 Horizontal deformation with construction steps at face line of Outer Revetment A (Section FEM-4)

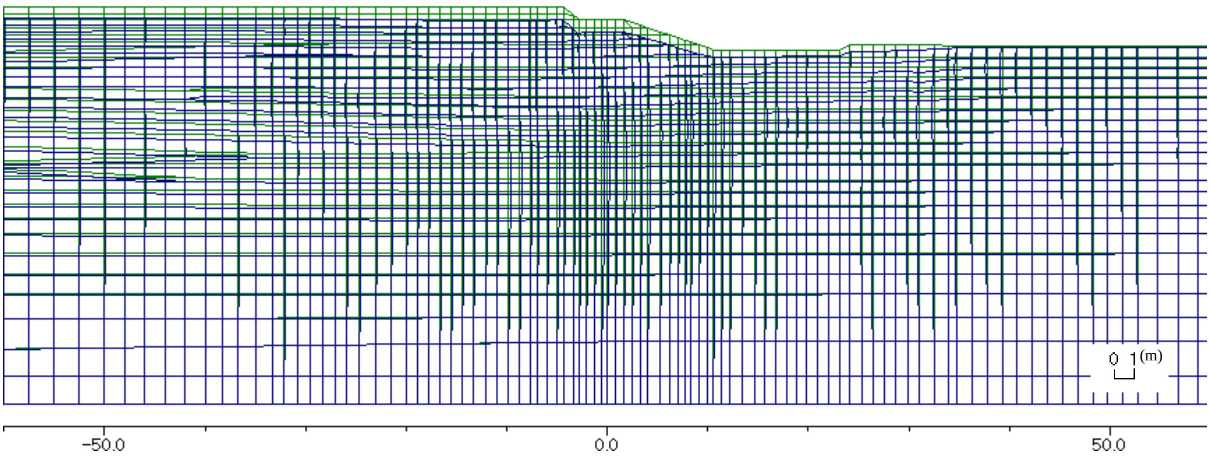
Deformation figures of representative construction steps are as shown in Figure 16.2.27.



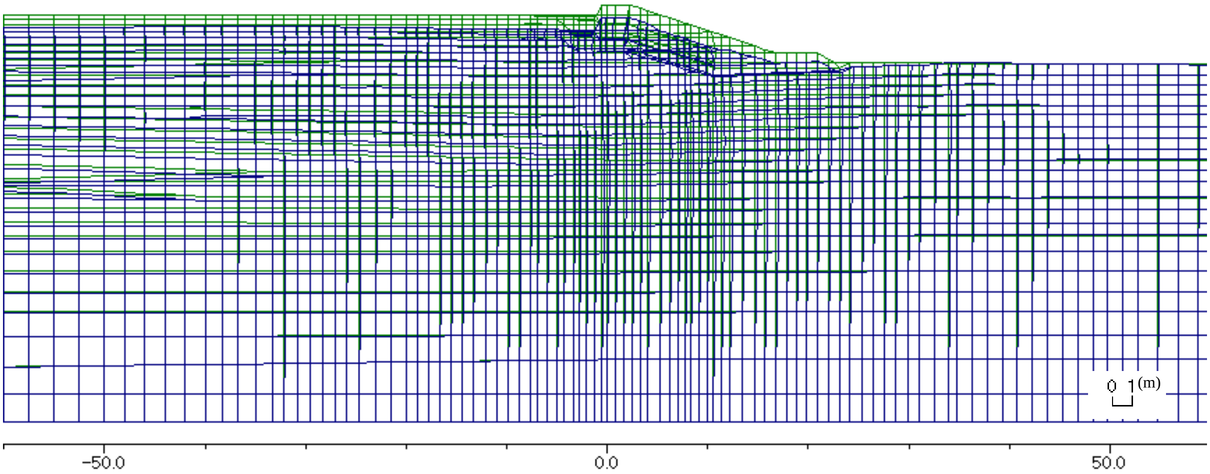
Completion of Fill Work and Preload (122 days passed from Start of Construction) (1/7)



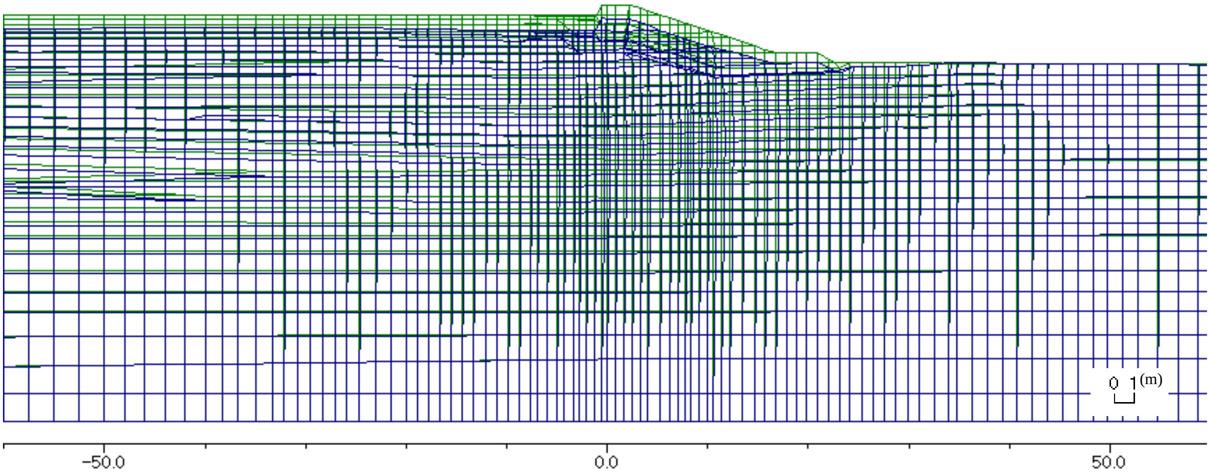
Start of Excavation (Removal of Fill and Preload)
(396 days passed from Start of Construction) (2/7)



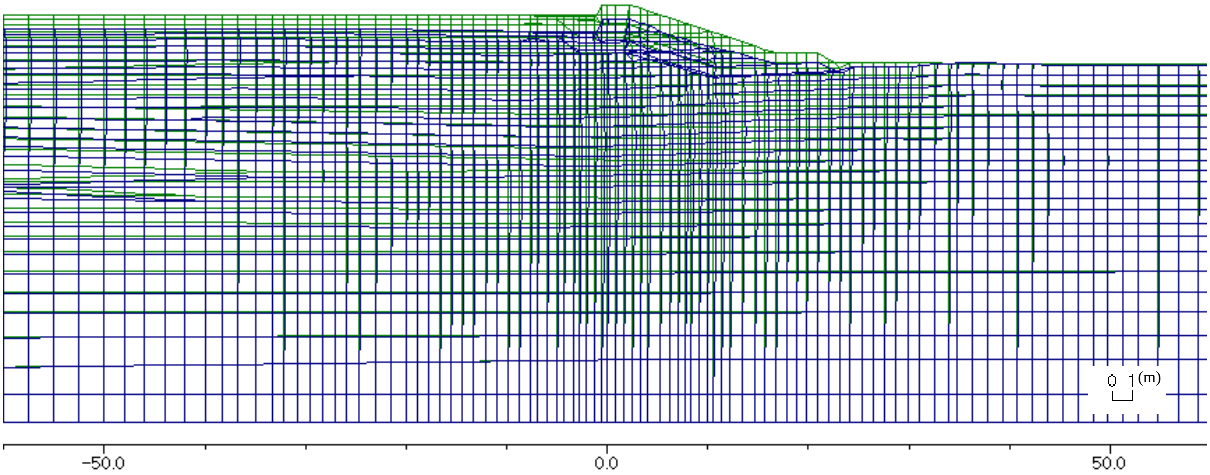
Completion of Excavation (Removal of Fill and Preload)
(426 days passed from Start of Construction) (3/7)



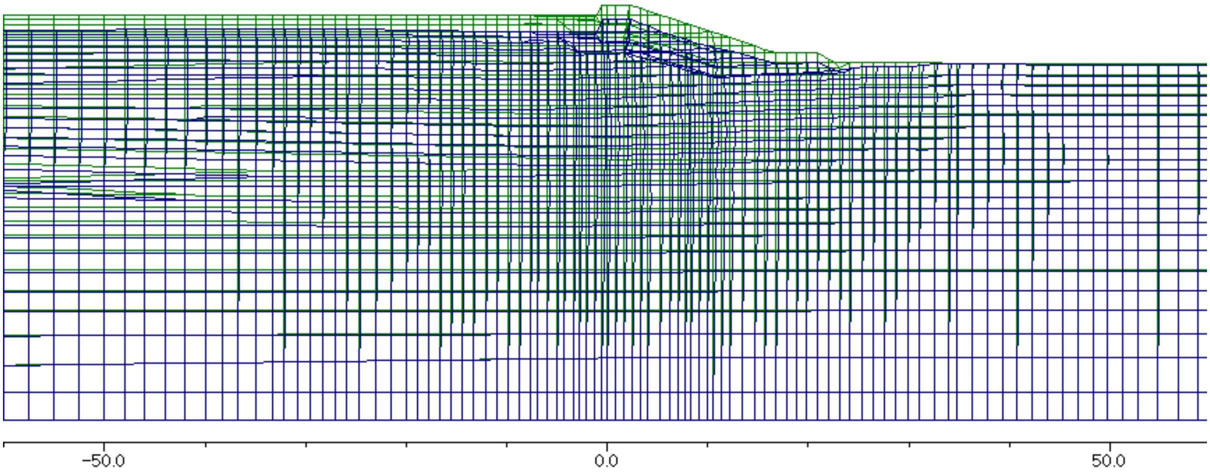
Construction of Revetment (608 days passed from Start of Construction) (4/7)



1 year later after completion of revetment construction (973 days passed from Start of Construction) (5/7)



5 years later after completion of revetment construction (2434 days passed from Start of Construction) (6/7)



15 years later after completion of revetment construction (6087 days passed from Start of Construction) (7/7)

Figure 16.2.27 Deformation Figure with construction steps for Section FEM-4 at Outer Revetment A

5) Summary of FEM Analysis Results

In above sections, FEM analysis results for the following analyzed sections have been shown and explained.

(1) Section FEM-1 at Container Terminal Berth
(2) Section FEM-2 at Inner Revetment beside Full Container Storage Yard
(3) Section FEM-3 at Inner Revetment beside Empty Container Storage Yard
(4) Section FEM-4 at Outer Revetment A

Vertical and horizontal deformation values of top of structures such as Container berth and Revetments after completion of those constructions are summarized as shown in Table 16.2.16.

Table 16.2.16 Vertical and horizontal deformation values of top of container berth and revetments after completion of those constructions

Analysis Steps	Section FEM-1 Container Berth Top of Sheet Pipe Pile		Section FEM-2 Inner Revetment Full Container Yard Top of Revetment		Section FEM-3 Inner Revetment Empty Container Yard Top of Revetment		Section FEM-4 Outer Revetment A Top of Revetment	
Construction Steps	Vertical (m)	Horizontal (m)	Vertical (m)	Horizontal (m)	Vertical (m)	Horizontal (m)	Vertical (m)	Horizontal (m)
1) Right after completion of Construction for Sheet pipe pile wall/ Revetment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2) 1year later after construction completion of structure	0.001	0.005	-0.046	-0.009	-0.037	-0.009	-0.082	0.056
3) 2years later after construction completion of structure	-0.084	0.072	-0.052	-0.018	-0.054	-0.020	-0.113	0.082
4) 5years later after construction completion of structure	-0.091	0.053	-0.059	-0.039	-0.075	-0.041	-0.146	0.121
5) 10years later after construction completion of structure	-0.091	0.048	-0.210	0.188	-0.139	0.124	-0.168	0.153
6) 15years later after construction completion of structure	-0.089	0.045	-0.221	0.195	-0.152	0.120	-0.182	0.176

* Unit: m, +:Heaving, -:Settlement for Vertical displacement, +:Sea side, -:Land Side for Horizontal displacement

As shown in Table 16.2.16, vertical and horizontal displacement of sheet pipe pile at container berth are 9cm subsidence and 5cm toward sea side from initial positions respectively at the time of 15 years later after completion of those structures' construction. As for the revetment areas, vertical and horizontal displacements of top of revetment are between 15cm and 22cm of subsidence and between 12cm and 20cm toward sea side respectively as well.

16.3 Ground Deformation Monitoring Program during Construction

16.3.1 General

It is commonly understood among the geotechnical engineers that the prediction of the exact final settlement or time-settlement relationship using the equations for the consolidation settlement seems very difficult due to several reasons such as the clay disturbance caused by the processes of sample-taking from the ground, the transportation from the site to the laboratory, the trimming of sample for preparation of shear tests and so on. The soft clay ground is not a uniform and furthermore the equations for the consolidation settlement had been induced by consolidation unit model, which is simply composed of two materials of the grain of clay and water.

Considering such a lot of factors affecting the settlement obtained by the calculation, it might be common to understand that there will be a large discrepancy between the calculated and the monitored one. Therefore, the designed settlement, which is predicted by the information of the soil investigation, should be revised by analyzing the newly obtained information such as the monitored settlement, the pore water pressure in the clay and so on. Thus the predicted settlement could be converged to the exact settlement through the monitoring and the back-analysis of the monitored data. In this regard, the monitoring method had been proposed by Terzaghi in 1950 and introduced in his book and it had been proposed in Japan 35 years ago. The damage to the structure after the completion of the project can be minimized by the monitoring method and crucial technique for meeting the allowable residual settlement in case of a high quality of the reclaimed land on soft clayey ground.

In the applied soil improvement methods to this site, PVD with preloading method is to accelerate the consolidation and to reduce the residual consolidation settlement generated by future’s operation load. The effects of soil improvement by the methods are evaluated by monitoring a settlement during a construction period and by predicting future’s settlement based on its monitored data.

It is necessary for the settlement control as mentioned above to monitor the settlement and groundwater systematically during a construction period. Moreover, a lateral displacement is also required to be monitored for the stability examination at toe lines of preload embankment and face lines of terminal berth and revetments.

In this Section, the evaluation method of consolidation settlement for the termination of preloading period and monitoring method during a construction period are described.

16.3.2 Procedure for Settlement Prediction and Stability Retaining

Monitoring and Observation Construction flow for this site is shown in Figure 16.3.1

When filling and preloading work is on-going, stability control is to be carried out based on monitored data of horizontal and vertical displacements of ground. If unstable condition of slope reaching to failure can be anticipated, filling is suspended and leaving it for some period for fill or preloading slope to become stable. In case slope become stable, filling can be proceeded, on the other hand, in case slope can not cover the stability, some countermeasures such as counter weight fill or etc. shall be studied and executed. Thus filling and preloading work is to execute up to required elevation with monitoring the ground deformation and confirming the slope stability.

During retaining period of filling and preload, the following settlement analysis are to be carried out based on monitored data of settlement.

(1) Comparison between theoretical consolidation settlement (designed value) and monitored value
(2) Prediction of future settlement by monitored settlement data
(3) Evaluation of residual settlement and Consolidation Degree

Time of preload removal have to judged based on evaluation result whether residual settlement can be within required value after designated preload retaining period. If there is considerable deviation between theoretical settlement (design value) and monitored one, theoretical calculation is to be carried out again to fit the monitored one and appropriate time of preload removal is to be evaluated.

Future settlement anticipation is to be carried out not only at the time of preload removal but at the middle of preload retaining period. If preload removal cannot be executed due to consolidation delay, countermeasures such as additional preload, etc. are to be studied and implemented earlier.

When evaluation of shear strength increase by consolidation, boring investigation shall be planned and executed to take the undisturbed samples of clays.

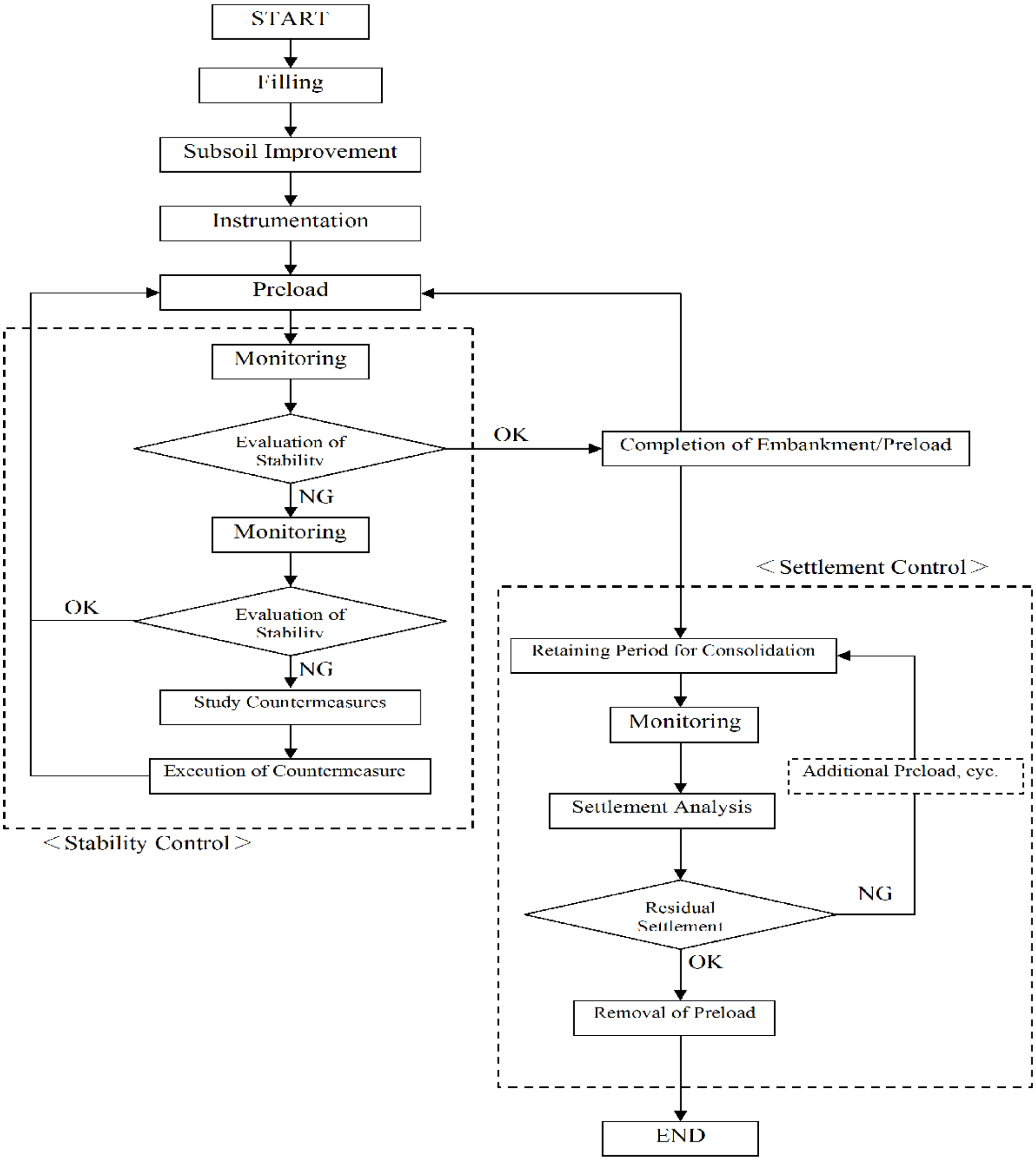


Figure 16.3.1 Monitoring management flow for subsoil improvement

16.3.3 Monitoring Plan

1) Monitoring Instruments

It is very important to understand the actual ground behaviors and evaluate the monitored data properly to perform the subsoil improvement target as designed and as scheduled.

The subsoil problems estimated at this project site are as follows;

- Consolidation settlement and its duration
- Stability of revetment (Ground deformation and Increase of undrained shear strength)

The following monitoring instruments are necessary to control the performance of subsoil improvement and analysis the monitored data as shown in Table 16.3.1.

Table 16.3.1 Monitoring Instruments

Monitoring Instruments	Measurement Item
1) Settlement Plate	Settlement at the existing ground surface
2) Magnetic Extensometer	Settlement or heave at each layer
3) Electric Piezometer	Pore water pressure
4) Stand Pipe	Ground water level
5) Inclinometer	Horizontal movement each ground depth
6) Alignment Stakes	Horizontal and vertical movement

2) Layout Plan for Monitoring Instrument

Layout Plan for monitoring instruments at Reclamation Area including Revetment portion is shown in Figure 16.3.2 as a basic example. Basically monitoring instrument layout shall be planned considering actual working schedule and procedure not to give any damages to monitoring instruments.

Cross sections for installed conditions of monitoring instruments are shown in Figure 16.3.2.

Layout plan for monitoring instruments are planned considering the following conditions.

- Monitoring instruments are selected based on actual performance and experiences in Japan and Vietnam.
- Monitoring instruments are located at as close points to existing boring points as possible to clarify and obtain the subsoil conditions at installed points of instruments for later analysis and evaluation of monitored data.
- Settlement plates are located in about 80 m to 100 m intervals in reclamation area.
- To analyze the consolidation settlement for each layer, totally 8 detailed monitoring points are placed with a set of instruments such as Magnetic Extensometer, Electric Piezometer, Pore Water Pressure and Stand Pipe. However actual arrangement of these detailed monitoring points shall be layout at earlier construction blocks to utilize and feed forward the analysis result of monitored data to later construction blocks.
- Settlement monitoring targets of Magnetic Extensometer shall be installed at proper depths to catch the settlement of each layer (Layer 1b, 2, 3b, 5 except Layer 4).
- Electric Piezometer shall be installed at center of each layer to monitor the dissipation of excess pore water pressure of each layer.
- Only one Electric Piezometer shall be installed in one borehole to catch the accurate excess pore water pressure. It shall be installed at 50cm below the bottom of borehole by smooth penetration.

- Inclinometers are layout at 8 sections at revetment portions together with settlement plates.

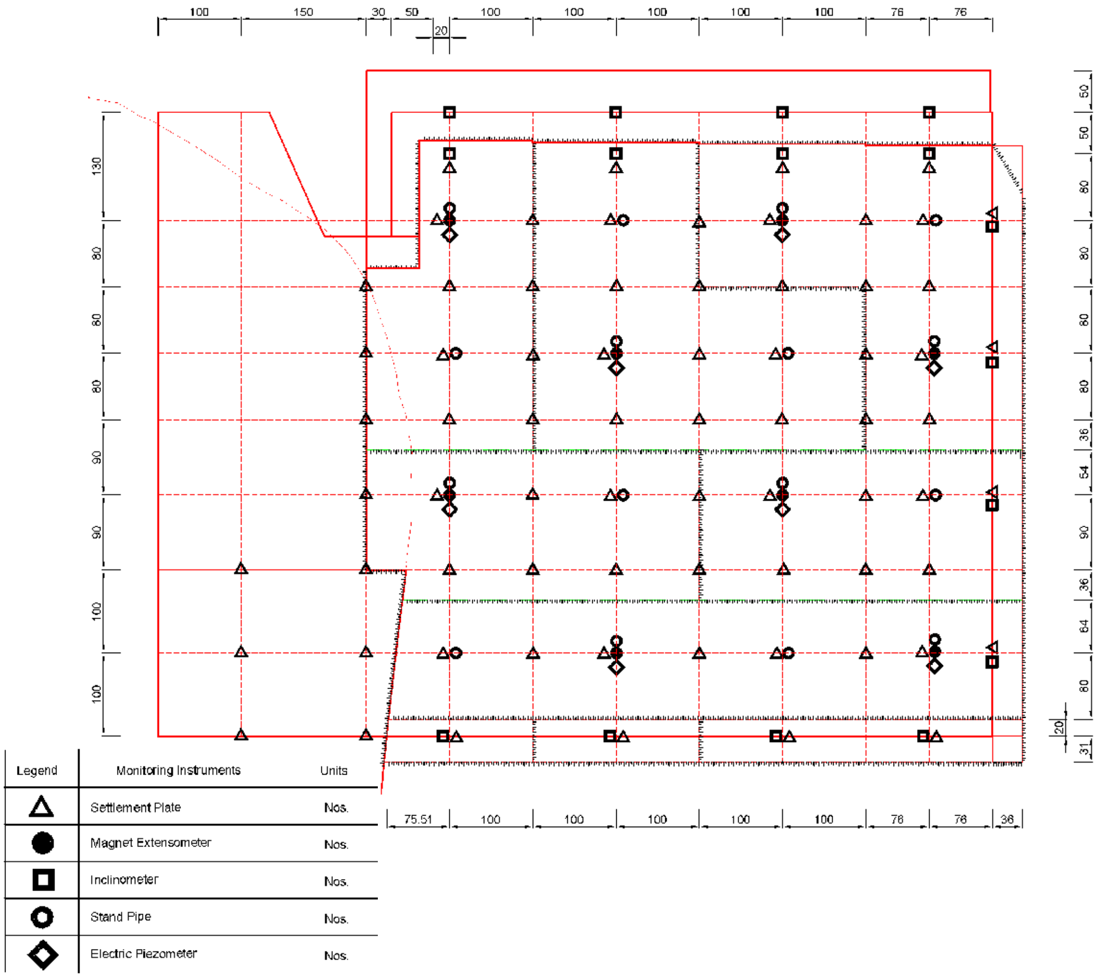


Figure 16.3.2 Monitoring Instrument Layout Plan for Subsoil Improvement

Quantities of monitoring instruments in Figure 16.3.2 are shown as follows;

Table 16.3.2 Quantities of Monitoring instruments

Monitoring Instruments	Unit	Qty.	Remarks
1) Settlement Plate	Nos.	71	
2) Magnetic Extensometer	Nos.	8	
3) Electric Piezometer	Nos.	32	8 locations x 4 layers
4) Stand Pipe	Nos.	16	
5) Inclinometer	Nos.	16	
6) Alignment Stakes	Locations.	30 to 60	Nos. of locations is changeable depending on preloading schedule.

3) Frequency of Monitoring

The frequency of monitoring of all instruments shall be determined by a number of factors including the rate of filling, the consolidation periods, level of stability against slip failure and the presence of any observable or suspected distress in the embankments or underlying soils.

The basic frequency of monitoring for the affected areas during construction is shown in Table 16.3.3. Basically monitoring frequency shall be modified and changed dependent on the condition of site work and ground deformation.

Table 16.3.3 Frequency of Monitoring

Instrument	During construction of Surcharge Fill	After Completion of Surcharge Fill			After Removed Surcharge Fill
		First 1 month	1 to 3 months	Over 3 months	
Settlement Plate	Once a day	Once/2days	Once/1week	Once/2week	Timely
Extensometers	Once a day	Once/2days	Once/1week	Once/2week	Timely
Piezometers, Stand Pipe	Once a day	Once/2days	Once/1week	Once/2week	Timely
Stand pipe	Once a day	Once/2days	Once/1week	Once/2week	Timely
Inclinometers	Once a day	Once/2days	Once/1week	Timely	—
Alignment Stakes	Once a day	Once/2days	Once/1week	Timely	—

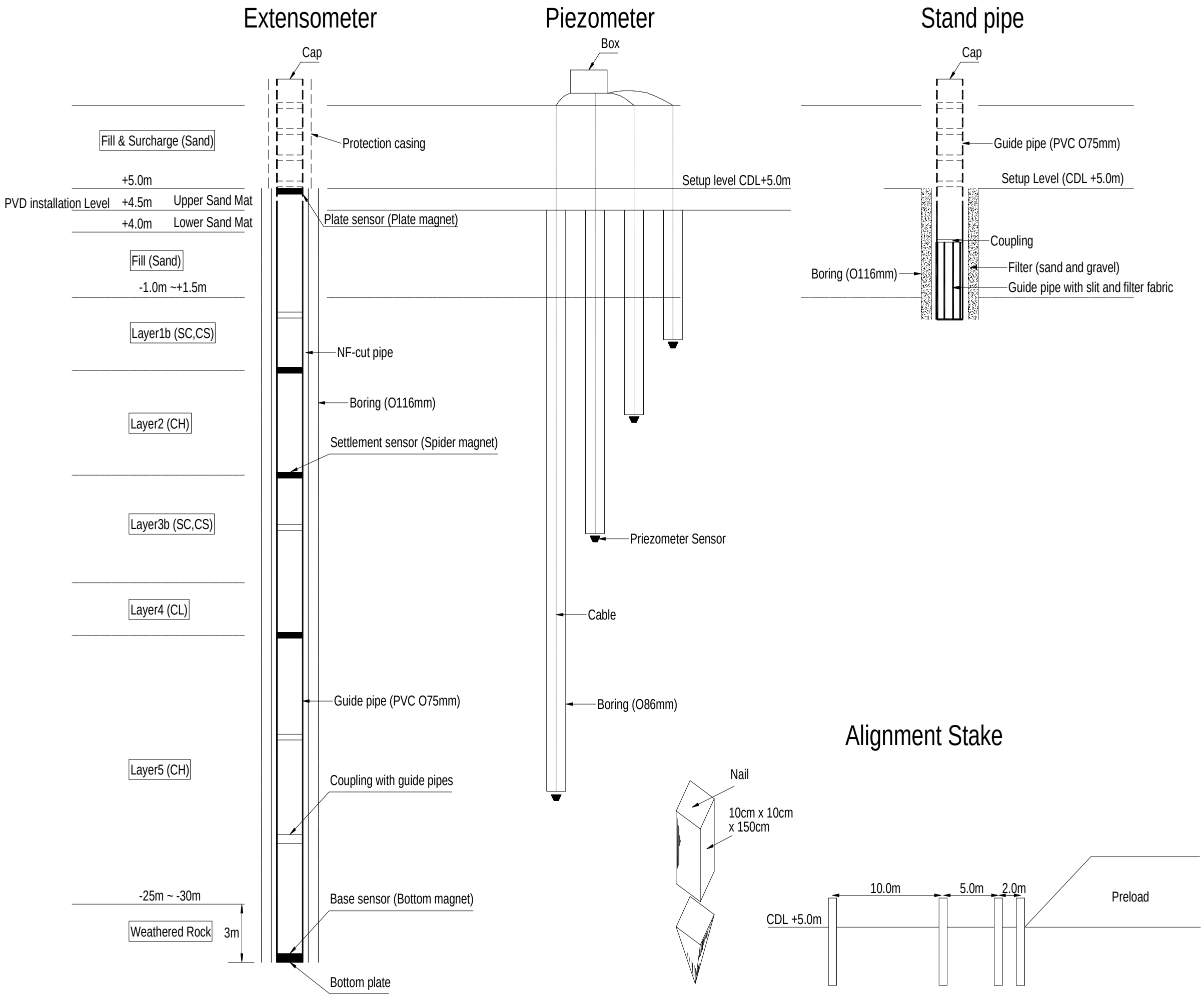


Figure 16.3.3 Detail figure of setting up Extensometer, Piezometer, Stand pipe, Alignment Stakes

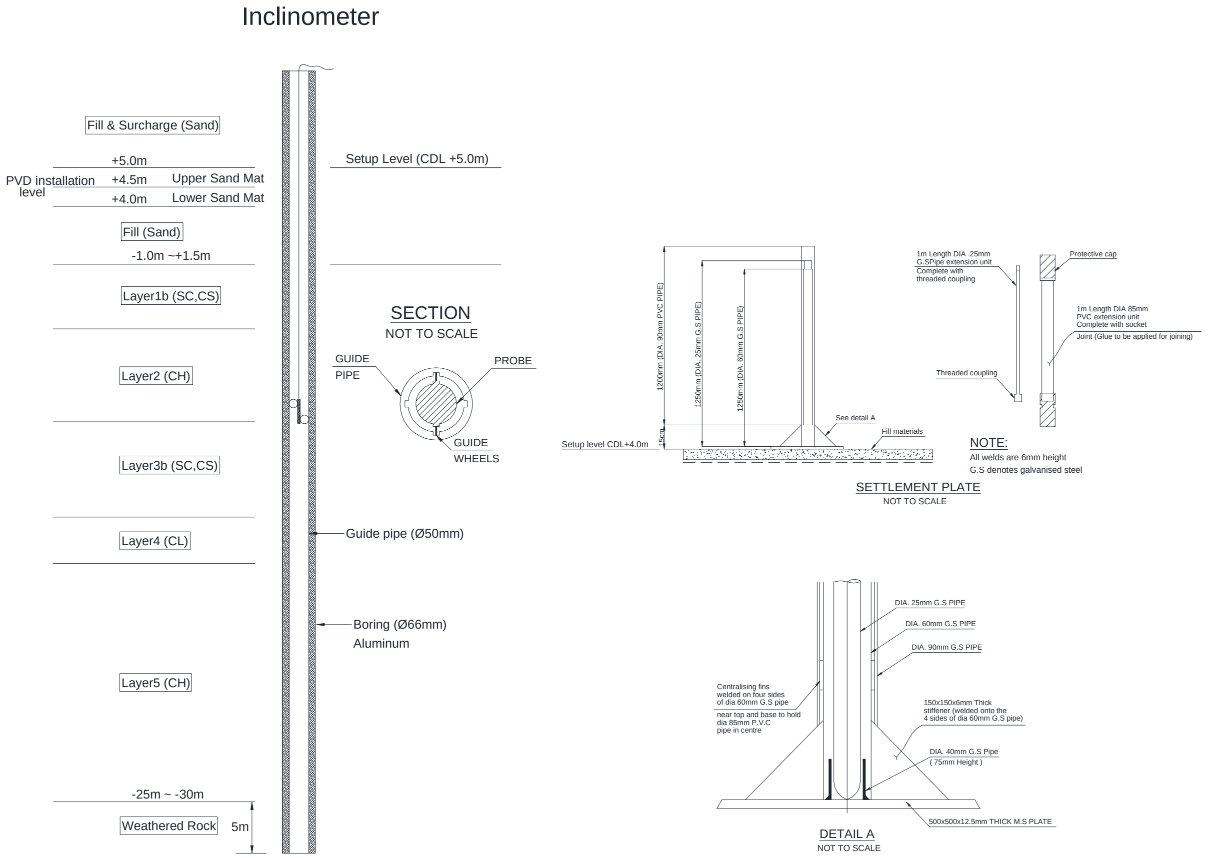


Figure 16.3.4 Detail figure of setting up Inclinometer and Example of Settlement Plate

4) Monitoring Procedures for each instrument

There are several monitoring methods to obtain field data. In this section, some typical monitoring methods are shown as follows.

a) Settlement Plate

The settlement monitoring for settlement plate is usually carried out by level survey as shown in Figure 16.3.5. The settlement amount can be obtained to calculate both difference initial level and measured level of settlement plate. The outer pipe (G.S pipe) which cuts the friction induced by the fill earth pressure will be extended before the next filling work.

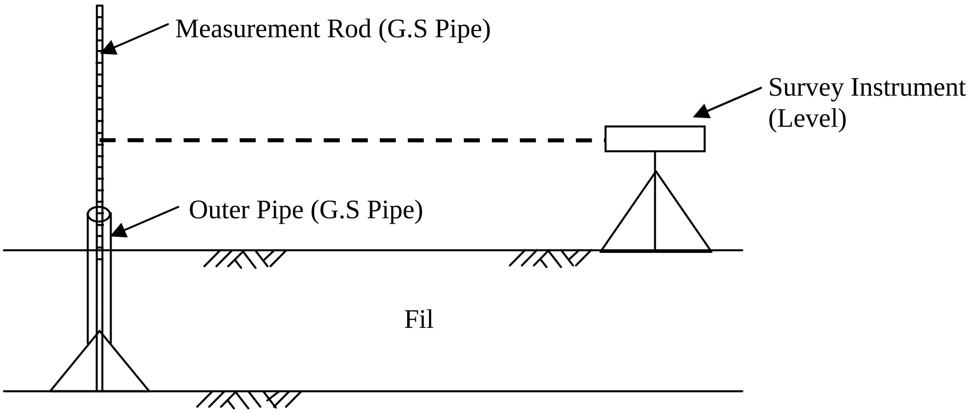


Figure 16.3.5 Monitoring Method for Settlement Plate

b) Stand Pipe

The monitoring of ground water level is usually carried out by using a water level meter as shown in Figure 16.3.6. Monitoring is carried out by manual control. The level of the top of pipe is measured by level survey.

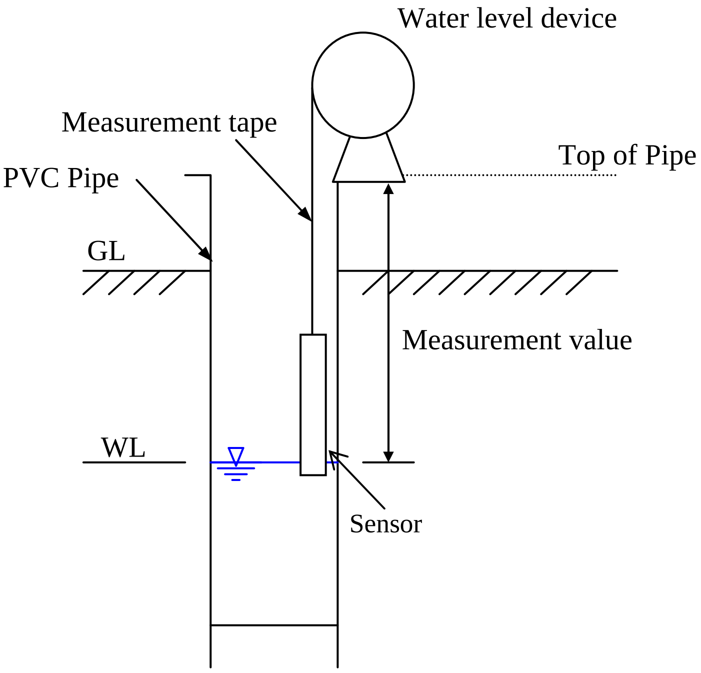


Figure 16.3.6 Monitoring Method for Water Stand Pipe

c) Extensometer

Released spider magnet attached to NF cut pipe generates magnetism by passing the sensor (Detector) up and down in the measurement pipe. The position of the spider magnet can be obtained by detecting the change of the magnetism generated by the spider magnet. The settlement amount can be estimated by comparing both the initial data and current observed data.

At first, the detector inserted in the bottom of the pipe shall be left for a while until the detector adapting to a water temperature in the hole. After then, zero adjustment of the indicator shall be made and the measurement starts passing the detector up and down in the measurement pipe. The level of top of the pipe shall be measured by level survey at every measurement time.

d) Inclinometer

Measurement for inclinometer is usually carried out by taking the inclined angle of guide pipe at each measurement depth. The principle of measurement mechanism is shown in the figure below. The observed data is recorded in data logger (Handy terminal) at site and transfer to the computer at office as shown in Figure 16.3.7.

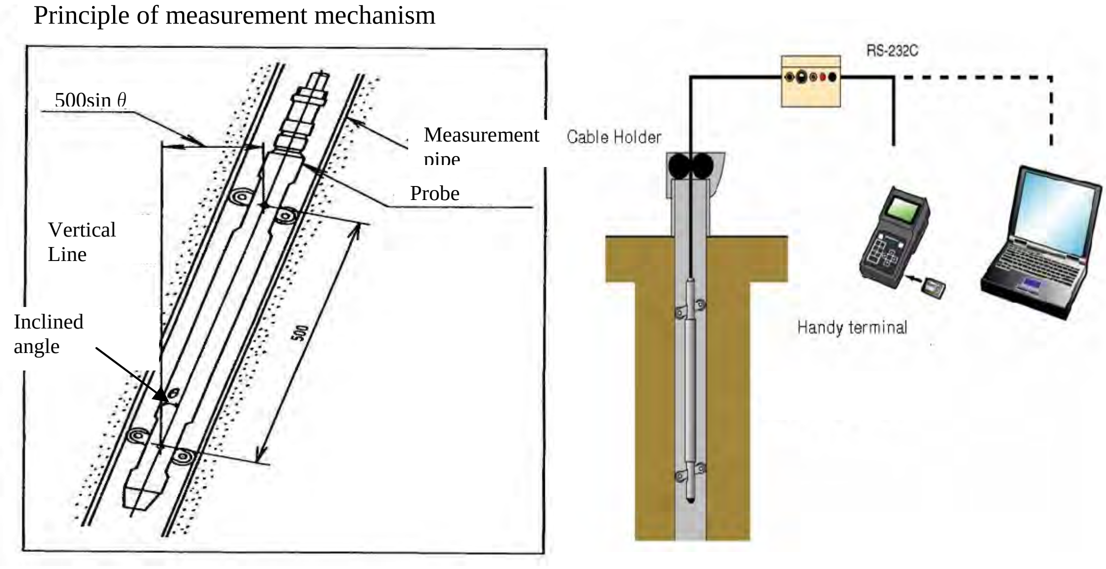


Figure 16.3.7 Monitoring Method of Inclinometer

e) Alignment Stakes

Alignment stakes shall be installed at the toe of preload embankment as shown in Figure 16.3.8. It is necessary to secure a stability of the preload embankment by monitoring lateral displacement.

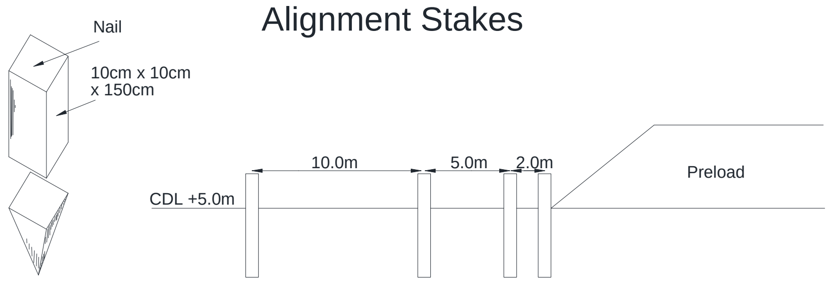


Figure 16.3.8 Schematic Figure of Lateral Displacement Stake

16.3.4 Future Settlement Prediction Method and Confirmation of Consolidation Progress

1) Future Settlement Prediction Method

There are some future settlement prediction methods proposed by several researchers. However as a future settlement prediction method, Asaoka method which has been used at many projects in Vietnam is to be used.

The analysis of settlement prediction is carried out by using following formula;

$$Sj = \beta o + \Sigma\beta i \cdot Sj\text{-}1 \quad : \quad (i=1 \text{ to } n)$$

Final settlement (S_∞) can be estimated by plotting practical data on the chart as shown in Figure 16.3.9 and Figure 16.3.10.

$$\mathrm{Sf} = \frac{\alpha}{1-\beta}$$

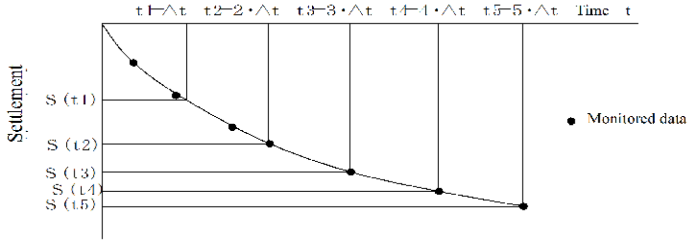


Figure 16.3.9 tj - S(tj) Relation in Asaoka's Method

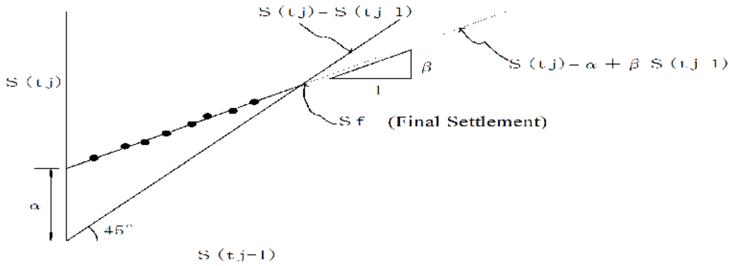


Figure 16.3.10 S(tj) - S(tj-1) Relation in Asaoka's Method

2) Confirmation of Consolidation Progress

Preloading period by PVD+Preload method is set at 80% consolidation degree, it is between 4 and 9 months depending on spacing of PVD. Settlement analysis necessary for confirmation of consolidation progress shall be carried out at least two (2) times as followings;

(1) **1st Time**: Settlement prediction analysis by Asaoka's method is done at the time of three (3) months after preloading completion. In case that the consolidation degree is more than 75% according to the analysis result, it is evaluated that the consolidation is progressing on schedule. In case of less than 80% of consolidation degree, additional measures, additional surcharge filling or extension of pre-loading period shall be examined.

(2) **Step2**: Settlement prediction analysis by Asaoka's method and theoretical consolidation settlement analysis based on monitoring settlement data are done at the time of six (6) months after pre-loading completion. In case that estimated consolidation degree at the removal time is more than 80% and residual settlement analyzed by theoretical consolidation settlement analysis can satisfy design criteria, it is evaluated that the pre-loading is terminated and removed.

The examination and decision for the additional measures to accelerate the consolidation shall be done in the analysis stage of Step1. In the analysis stage of step2, a final evaluation for the consolidation progress shall be done.

The settlement analysis is carried out for the area where the settlement plate is installed. Soil parameters and soil profile used for the theoretical consolidation settlement analysis are obtained from the initial design for the study on soil improvement work. In the analysis of fitting theoretical consolidation settlement curve with actual settlement curve, some soil parameters are to be modified to meet the both settlement curves.

16.3.5 Slope Stability Control for Filling Work

In this Section, the method of stability control based on the monitoring data is described. Required monitoring data used for the stability control are lateral movement at the toe of fill slope and vertical settlement at the top of fill.

The deformation of the ground occurred by fill loading is not simply explained, because of its complicated deformation mechanism. Generally, the ground deformation during construction work is occurred complicating shear failure and consolidation settlement as shown in Figure 16.3.11. In case that consolidation settlement exceeds the shear deformation in the amount, the ground is considered to be stable. On the other hand, in case that shear deformation exceeds consolidations settlement, the ground is considered to be unstable.

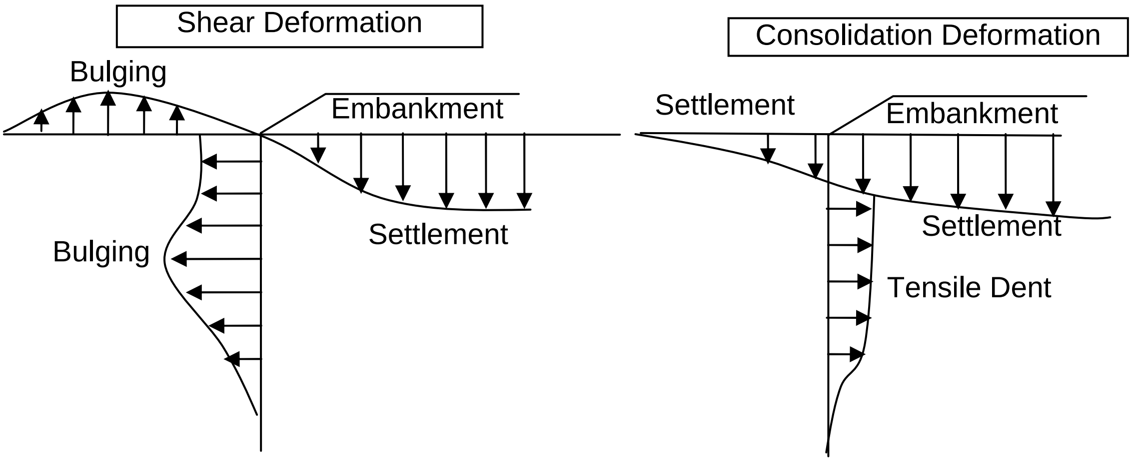


Figure 16.3.11 Typical Schematic Figure of Ground Deformation

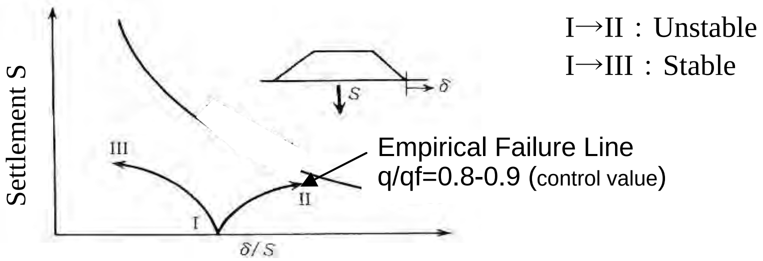
The characteristic tendency of the ground occurring shear failure or becoming unstable are as follows;

- Hair cracks are appeared at the top or toe of fill slope
- Lateral deformation at the toe of fill slope rapidly increases toward the out of fill
- The ground around the toe of fill slope is rapidly bulged

Three (3) methods for slope stability control commonly used are explained as follows;

(1) Matsuo-Kawamura Method

The data of S and δ/S obtained from monitoring data, vertical settlement (S) and lateral movement (δ) are plotted in the chart as shown in Figure 16.3.12. In case the plotted data is proceeding toward the failure line, it indicates unstable, and in case of proceeding toward the opposite of the failure line, it indicates stable.



I→II : Unstable
I→III : Stable

Figure 16.3.12 Matsuo-Kawamura Method

(2) Tominaga-Hashimoto Method

Vertical settlement (S) and lateral movement (δ) are plotted in the chart as shown in Figure 16.3.13. In case lateral movement (δ) exceeds vertical settlement (S), it indicates unstable due to shear deformation. And in case vertical settlement (S) exceeds lateral movement (δ), it indicates stable due to consolidation settlement.

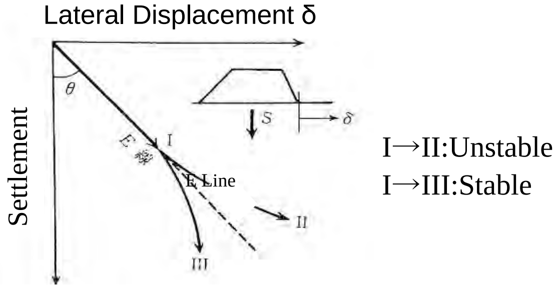


Figure 16.3.13 Tominaga-Hashimoto Method

(3) Kurihara-Mochinaga Method

This method is to manage the stability control by observing lateral movement speed (Δδ/Δt). Criteria of the movement speed (Δδ/Δt) shall be set before commencement of construction work for the control of safe filling work.

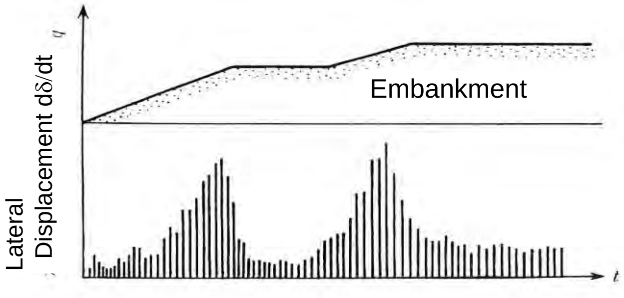


Figure 16.3.14 Kurihara-Mochinaga Method

During construction of fill, the stability control based on the monitored data is essential for the safety construction work.

Above three stability control methods are summarized in Table 16.3.4. In addition to stability control below, it is necessary to carry out the daily visual check for abnormality, deformation etc at site.

Table 16.3.4 Method of Stability Control

Method of Name	Monitoring Data for use	Control Method (Stability Control Chart)	Example of Stability Control Criteria *
Tominaga-Hashimoto (S – δ) Method	S : Settlement δ : Lateral Displacement	Plot monitoring data in (S – δ) Chart (refer to Figure 16.3.12)	Check the trend of the angle (θ= δ/S) I → II : Unstable I → III : Stable It can be judged as unstable when δ/S is bigger than δ/S at initial stage of filling.
Matsuo-Kawamura (S – δ/S) Method	S : Settlement δ : Lateral Displacement	Plot monitoring data in (S – δ/S) Chart (refer to Figure 16.3.13)	Check the trend of the plot data I → II : Unstable I → III : Stable Comparison with empirical Failure Line (q/qf) Plot data < (q/qf) = 0.8-0.9 (control value) It can be judged as unstable when plot data approached the empirical failure line (q/qf = 1.0).
Kurihara-Mochinaga (Δδ/Δt – t) Method	δ: Lateral Displacement	Plot monitoring data in (Δδ/Δt – t) Method (refer to Figure 16.3.14)	Ratio of Lateral Displacement Δδ/Δt < 1 to 2 cm/day (control value) It can be judged as unstable when plot data approached the control value

* The criteria (control value) shall be finally determined by discussion of concerned organization based on monitored data

16.4 Detailed Design of Inner Revetment

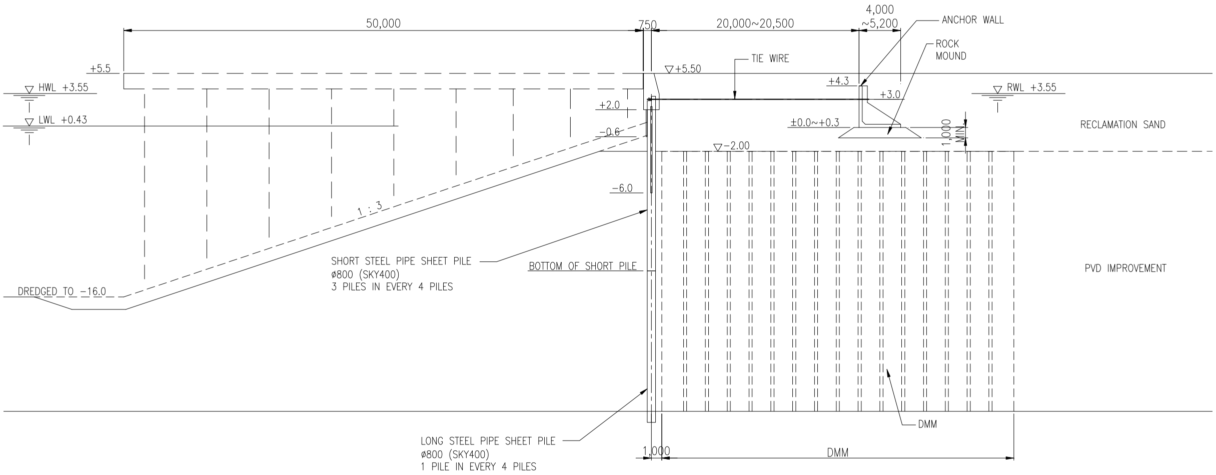
Since the structure of Inner Revetment is uncomplicated, the basic design mentioned in Chapter 7.5 is understood as detailed design.

16.5 Detailed Design of Earth Retaining Walls

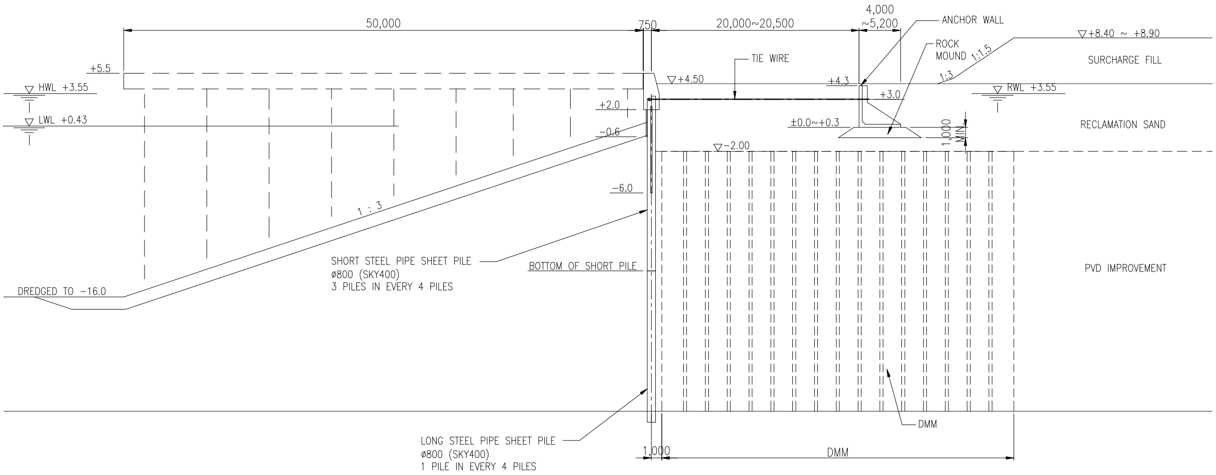
16.5.1 Design Condition

1) Typical section

- During Construction



- After Completion (in operation)



2) Design Codes and Standards

No	Title	Publisher
1	Technical Standards and Commentaries for Port and Harbour Facilities in Japan 2002	The Overseas Coastal Area Development Institute of Japan
2	Specifications for Highway Bridges - March 2002	Japan Road Association
3	Standard Specification for Concrete Structures - 2007	Japan Society of Civil Engineers

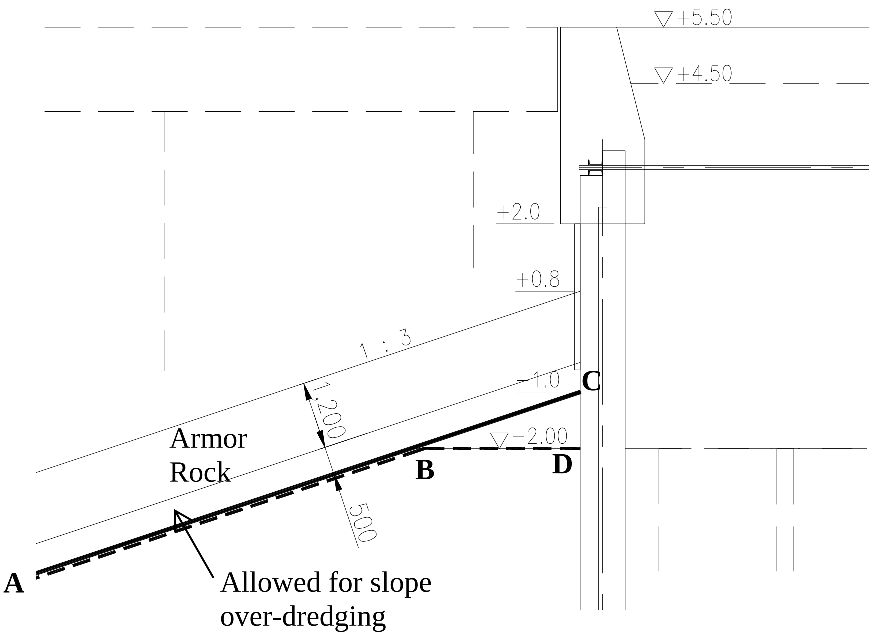
3) Design life

- 50 years

4) Elevations

Block	Condition	Finished ground level	Seabed level	Slope gradient in front of retaining wall	Top elevation of DMM
Block- a, b, c & d	During construction	+4.50m	-2.0m *	1 : 3	-2.0m
	After completion	+5.50m	-1.0m *	1 : 3	-2.0m
Block-1	During construction	+4.50m	-5.0m	Horizontal	-2.0m
	After completion	+5.50m	-5.0m	Horizontal	-2.0m

Note * : Estimated top elevation of the armor stone layer in front of the retaining wall is +0.8mCD. Assuming the thickness of the armor stone layer of 1.2m, the bottom elevation of the armor stone layer will be -0.465mCD at the retaining wall position. The design seabed profile after completion is taken as line A-B-C with dredging allowance of 0.5m. Similarly, the design seabed profile during construction is determined as line A-B-D. For the case after completion, the weight of armor rock is neglected conservatively.



5) Tide and Residual Water Level

- H.W.L : +3.55 mCDL
- L.W.L : +0.43 mCDL
- R.W.L : +3.55 mCDL (higher impermeability is assumed)

6) Design Superimposed Load

- After Completion : w = 30 kPa
- During Construction : w = 20 kPa
- Filling sand : γ = 18kN/m^3 , ϕ = 30^o.

7) Material

a) Concrete

Characteristic 28 days compressive strength of concrete is as follows.

Characteristic 28 days compressive strength		Modulus of elasticity
Cube strength	Cylinder strength	
40 MPa	30 MPa	28 kN/mm^2

b) Steel

Type	Specification	Yield strength	Allowable stress
Steel sheet pipe pile (SPSP)	SKY400	235 MPa	140 MPa
Structural steel	SS400	235 MPa	140 MPa
Steel reinforcement	SD295	295 MPa	180 MPa

8) Corrosion protection for steel material

a) Steel pipe sheet pile (SPSP)

- Concrete lining in front of the SPSP will be provided from the bottom of the cope concrete down to the seabed level. No cathodic protection will be provided.
- For the SPSP surface directly contacting to the soils, a corrosion loss based on the corrosion rate of 0.03mm/year is taken into account. The design corrosion loss is 1.5mm (t = 0.03mm/yr × 50 yrs = 1.5mm).

b) Waling beam

- No corrosion allowance is considered for the waling beams for the SPSP since they will be fully embedded into the cope concrete.
- A corrosion loss of the waling beams for the steel sheet piles based on the corrosion rate of 0.03mm/year is taken into account. The design corrosion loss is 1.5mm (t = 0.03mm/yr × 50 yrs = 1.5mm).

9) Seismic Load

- Not considered

10) Factors of Safety

a) Embedded length of SPSP

Design method	Factor of safety
Deflection curve method	FS=1.2
Free earth support method	FS=1.2

b) Anchoring resistance of anchor block (for L-wall type)

<u>General criteria</u>

Case	Factor of safety	Allowable Criteria	Remarks
After completion	FS=2.5	Tp +Pa ≤ Pp/FOS (see note)	Tp : tension force of tie wire Pa : active earth pressure Pp : passive earth pressure
During construction	FS=2.0		

Note : In this design, L-shaped wall is adopted as the anchor system. Since the tie setting point is significantly deviated from the centroid of the earth pressure, an effect of the rotation of the L-wall needs to be considered. Accordingly, the above criterion was further modified as follows:

<u>Modified criteria</u>

Case	Factor of safety	Acceptance Criteria	Remarks
After completion	FS=2.5	Tp +Pa ≤ (Pp'+F)/FOS (see note)	Tp : tension force of tie wire Pa : active earth pressure Pp' : passive earth pressure reduced considering elasto -plastic effect F : base resistance of L-wall
During construction	FS=2.0		

Note : To ensure that this condition is met, following analysis is carried out.

- L-wall and overburden soils are assumed as a monolithic structure.
- Soil springs are provided on the front (seaside) and the bottom surface.
- Apply the dead load, the active earth pressure (Pa) and the tie tension force (Tp).
- Carry out two runs. One is to apply unfactored (Pa+Tp) to check if the lateral displacement at the tie setting point is acceptable and the other is to apply factored (Pa+Tp), i.e. FOS×(Pa+Tp), to check if the passive earth resistance to resist the factored (Pa+Tp) can be mobilized with relatively smaller rotation angle of the L-wall.
- Acceptance criteria are set as below table.

Case	Analysis	Acceptable displacement	Acceptable rotation angle
After completion	Unfactored analysis	$\delta \leq 30$mm	$\theta \leq 0.02$ rad
During construction	Factored analysis	not applicable	$\theta \leq 0.02$ rad

Note: A limitation of 0.02 rad (≈ 1˚) was determined based on the Specifications for Highway Bridges - March 2002.

c) Pile bearing capacity

Case	Factor of safety	Acceptance Criteria	Remarks
Ordinary condition (with negative friction)	FS=2.5	$P \leq Ra$	$Ra \leq Ru/FS$ Ru : ultimate resistance

d) Crack control of concrete structure

Flexural crack width due to loads under serviceability state shall not exceed the following values:

- Concrete surfaces exposed to seawater : w = 0.0035 C
- Other concrete surfaces : w = 0.0040 C

Where, C is the concrete over to the reinforcement.

11) Soil condition

Design Parameres

Layer No.	Typical Soil Type	SPT-N	γ (kN/m3)	γ' (kN/m3)	Cu (kN/m2)	ϕ (°)	Cc	Cr	Cα (%)	Pc (kN/m2)	e0	Cv (OC) x 10^{-3} (cm2/s)	Cv (NC) x 10^{-3} (cm2/s)	Cu/P for NC
1a	SP	4	18.0	8.0	0	25.0	-	-	-	-	-	-	-	-
1b	CL	5	18.0	8.0	15	0.0	0.30	0.07	0.4	80	1.05	1.20	1.20	0.30
2	CH	1	17.0	7.0	15	0.0	0.60	0.12	0.7	80	1.45	1.00	0.60	0.30
3a	SP	4	19.0	9.0	0	25.0	-	-	-	-	-	-	-	-
3b	CL	5	19.0	9.0	25	0.0	0.25	0.05	0.4	Σγ'z+50	0.80	1.20	1.20	0.30
3c	SP	6	19.0	9.0	0	25.0	-	-	-	-	-	-	-	-
4	CH, CL	10	19.0	9.0	50	0.0	0.35	0.04	0.6	Σγ'z+100	0.85	1.20	0.80	0.30
5	CH	6	17.5	7.5	40	0.0	0.60	0.08	0.8	Σγ'z+75	1.20	2.20	0.80	0.30
Fill,Emb	S	-	18.0	10.0	0	30.0	-	-	-	-	-	-	-	-

*NC: Normal conslidated State OC: Over consolidated State

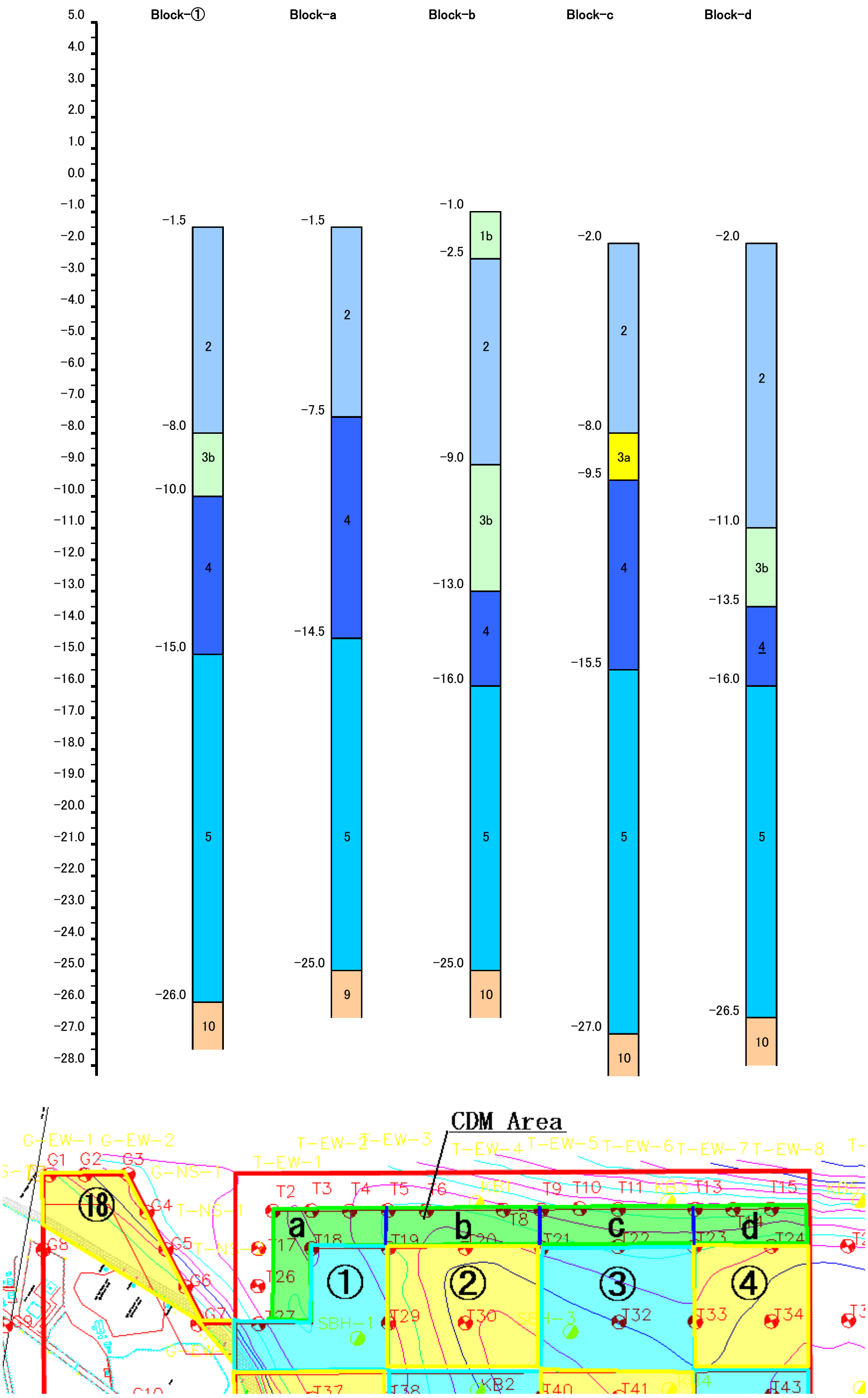


Figure 16.5.1 Applied Soil Condition

16.5.2 Design of Retaining wall (SPSP)

In this section the summarized calculation results are described. The detailed calculation results are shown in Appendix 7-7 and 7-8.

1) Steel Sheet Pile Wall

Steel pipe pile with 800mm of diameter and P-T joint of 180mm wide shall be applied for retaining wall. The thickness of SPP is determined base on maximum bending moment and allowable stress of material. Stress on pipe wall section is specified by following equation:

$\delta = M_{max} / Z$

where,
M_{max} : Maximum bending moment (per 1m)
Z : Section modulus (per 1m) after corrosion

The calculation result of pile wall section is summarized in the table below. The detailed calculation results are shown in Appendix 7-7 and 7-8.

	Block a	Block b	Block c	Block d	Block 1
Max. Bending moment	457.1 kNm	524.7 kNm	509.3 kNm	546.9 kNm	786.6 kNm
Designed SPP	D800, t=10	D800, t=10	D800, t=10	D800, t=10	D800, t=14
Max. tress of section	109.1 MPa	125.2 MPa	121.5 MPa	130.5 MPa	129.6 MPa
Allowable stress	140 MPa	140 MPa	140 MPa	140 MPa	140 MPa
Judgment	OK	OK	OK	OK	OK

2) Tie Wire

Tension force on Tie Wire is determined by following formula:

$T = A_p \cdot L \cdot \sec\theta_1 \cdot \sec\theta_2$

where;
T : tension force on tie wire (kN/wire)
Ap : reaction force of the pipe wall at tie setting point (kN/m)
L : spacing of the tie wire (m)
θ_1 : vertical angle of the tie wire to horizontal (deg.)
θ_2 : plan angle of the tie wire to the direction perpendicular to the revetment line (deg.)

Required tensile strength of tie wire: R = T x FS (FS =3.8 - Factor of safety – OCDI).

The calculation result is gathered in the table below:

	Block a	Block b	Block c	Block d	Block 1
Max. reaction force at tie point	249.1 kN/m	264.2 kN/m	260.9 kN/m	275.2 kN/m	319.3 kN/m
Tension force	488.3 kN	518.0 kN	511.4 kN	539.5 kN	625.8 kN
Minimum tensile strength	1855.8 kN	1968.2 kN	1943.4 kN	2050.1 kN	2378.1 kN
Required tensile strength	>1856 kN	>1969 kN	> 1944 kN	>2051 kN	> 2379 kN
Type of Tie Wire	TR - 202	TR - 202	TR - 202	TR - 221	TR - 255

3) Waling Beam of the front wall

Maximum Bending Moment of Waling beam is specified by the following equation:

$$M_{maz} = \frac{T \cdot L}{10.0}$$

where;
M_{max} : maximum bending moment on the waling beam (kN-m)
T : tension force on tie wire (kN/wire)
L : spacing of the tie wire (m)

Stress on pipe wall section is determined as below:

$\delta = M_{max} / Z$

where,

M_{max} : Maximum bending moment (per 1m)
Z : Section modulus (per 1m) of waling beam

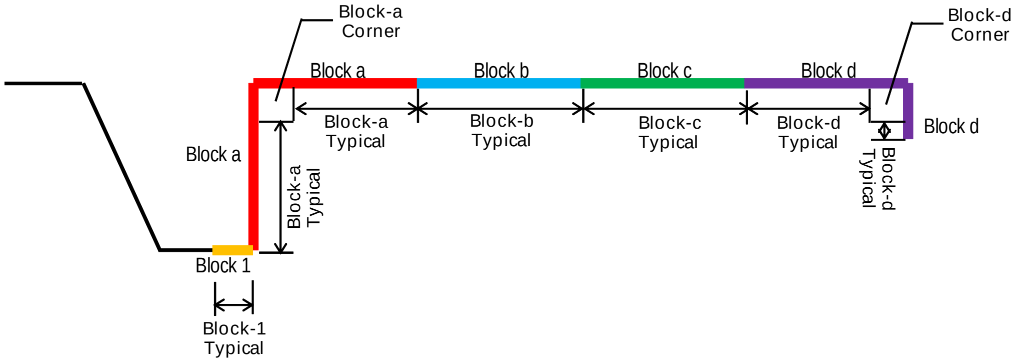
The calculation result of waling beam is gathered in the table below:

	Block a	Block b	Block c	Block d	Block 1
Max. Bending moment	95.7 kNm	101.5 kNm	100.2 kNm	100.3 kNm	122.7 kNm
Designed Waling beam	2x [250x 90x11x14.5	2x [250x 90x11x14.5	2x [250x 90x11x14.5	2x [250x 90x11x14.5	2x [300x 90x11x15.5
Max. tress of section	128.0 MPa	135.7 MPa	134.0 MPa	138.1 MPa	124.1 MPa
Allowable stress	140 MPa	140 MPa	140 MPa	140 MPa	140 MPa
Judgment	OK	OK	OK	OK	OK

4) Anchor System

a) Type of Anchor System

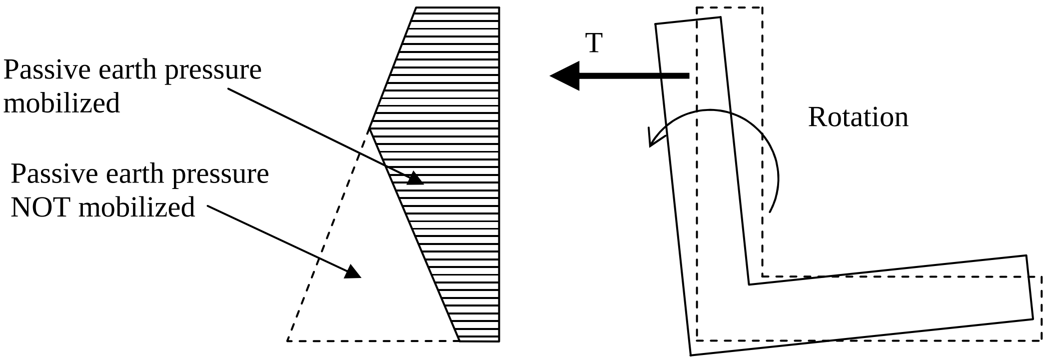
L-wall type concrete wall type is applied to the anchor system of steel sheet pipe pile wall.



b) Calculation of L-wall type anchor wall

i) Method of calculation

For the case of the L-wall type anchor block with tie setting point at +3.0 m CDL, a rotation of the L-wall would be an issue since the centroid of the passive earth pressure will be much lower than the tie setting point. Due to the rotation, a mobilization of the passive earth pressure at the lower portion of the wall would be insufficient.



The L-wall type anchor block was designed taking into account the above rotational effect. Details of verification method are shown in Appendix 16-2

ii) Results of Stability Analysis

Dimensions of the L-wall sections are determined as follows.

Block No.	Top Level	Bottom Level	Width	Thickness	
				Wall	Base Slab
Block-1	+4.30 mCDL	+0.00 mCDL	5.20 m	0.45 m	0.60 m
Block-a	+4.30 mCDL	+0.30 mCDL	4.00 m	0.45 m	0.60 m
Block-b	+4.30 mCDL	+0.30 mCDL	4.20 m	0.45 m	0.60 m
Block-c	+4.30 mCDL	+0.30 mCDL	4.20 m	0.45 m	0.60 m
Block-d	+4.30 mCDL	+0.30 mCDL	4.50 m	0.45 m	0.60 m

The design check was carried out along with the abovementioned procedure by using Microsoft Excel spreadsheet. The details of the analysis are shown in Appendix 16-2 and the results are summarized in the following table.

			Block-1		Block-a		Block-b		Block-c		Block-d	
			During Construction	After Completion	During Construction	After Completion	During Construction	After Completion	During Construction	After Completion	During Construction	After Completion
Working Load	Rotation angle θ		0.0025 rad	0.0028 rad	0.0028 rad	0.0032 rad	0.0027 rad	0.0031 rad	0.0027 rad	0.0031 rad	0.0025 rad	0.0030 rad
		Acceptance Criteria	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad
		Check	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
	Horizontal Deflection δ		6.3 mm	7.6 mm	5.1 mm	6.3 mm	5.3 mm	6.5 mm	5.2 mm	6.4 mm	4.9 mm	6.2 mm
		Acceptance Criteria	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm	$\delta \leq 30$mm
		Check	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
Ultimate Load (Factored Load)	Factor imposed on Working Load		$\gamma_f = 2.0$	$\gamma_f = 2.5$	$\gamma_f = 2.0$	$\gamma_f = 2.5$	$\gamma_f = 2.0$	$\gamma_f = 2.5$	$\gamma_f = 2.0$	$\gamma_f = 2.5$	$\gamma_f = 2.0$	$\gamma_f = 2.5$
	Rotation angle θ		0.0062 rad	0.0103 rad	0.0071 rad	0.0104 rad	0.0078 rad	0.0155 rad	0.0069 rad	0.0106 rad	0.0046 rad	0.0051 rad
		Acceptance Criteria	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad	$\theta \leq 0.02$rad
		Check	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
	Horizontal Deflection δ		27.7 mm	53.6 mm	22.4 mm	39.8 mm	25.0 mm	53.2 mm	23.2 mm	42.6 mm	19.6 mm	33.2 mm
		Acceptance Criteria	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Check	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5) Check of reinforcement

It is obvious that the design forces under the case of operation (after completion) are greater than that under the case of during construction. Therefore, the reinforcement was designed by the forces under the case of operation. The dimensions of anchor block are shown as below:

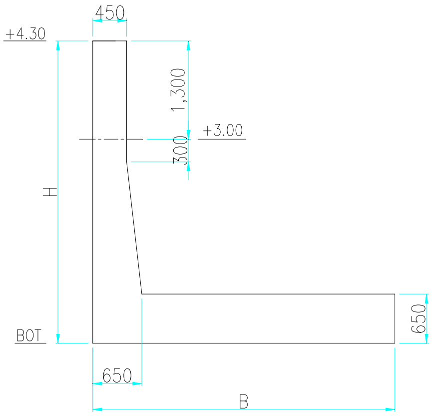


Figure 16.5.2 Dimensions of Retaining Wall Block

Block No.	B (mm)	H (mm)	Bottom Level (m CDL)
Block-1	4,000	4,000	+0.30
Block-a	4,200	4,000	+0.30
Block-b	4,200	4,000	+0.30
Block-c	4,500	4,000	+0.30
Block-d	5,200	4,300	±0.00

The calculation results of reinforcement are shown as the following tables.

Table 16.5.1 Reinforcement Calculation Result (front wall (seaside) and base slab (lower))

Concrete Section Design by Allowable Stress Method

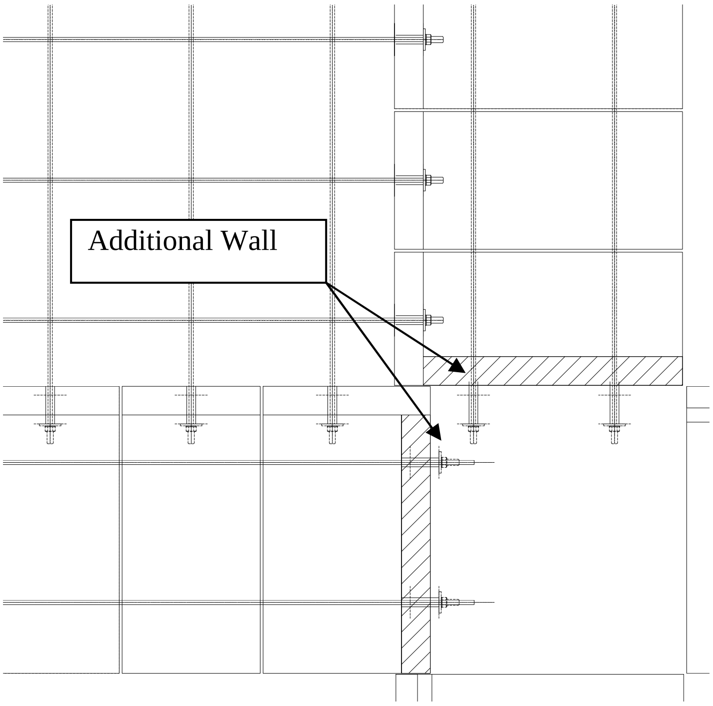
		Sym.	Unit	Block-1	Block-a	Block-b	Block-c	Block-d
Type of Member								
				Slab	**Slab**	**Slab**	**Slab**	**Slab**
Section Property								
Breadth of Section		b	mm	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
Height of Section		h	mm	**450**	**450**	**450**	**450**	**450**
Effective height for tensile bar		d	mm	**364**	**364**	**364**	**364**	**364**
Design Load								
Bending Moment		M	kNm	77.90	78.32	78.21	77.69	74.66
Shear Force		S	kN	219.95	150.13	165.10	162.63	175.20
Allowable Stress - Reinforcement								
Material				**SD295**	**SD295**	**SD295**	**SD295**	**SD295**
Allowable stress		σsa	MPa	180	180	180	180	180
Allowable Stress - Concrete								
Standard Strength 28 days cylinder		σck	MPa	**30**	**30**	**30**	**30**	**30**
Allowable bending compressive stress		σca	MPa	11.0	11.0	11.0	11.0	11.0
Allowable shear stress without links		τa	MPa	1.00	1.00	1.00	1.00	1.00
Young's modulus ratio		n		7.14	7.14	7.14	7.14	7.14
Rebar Arrangement								
<Tensile bar>		Bar-1		**6.67 -D22**	**6.67 -D22**	**6.67 -D22**	**6.67 -D22**	**6.67 -D22**
		Bar-2		**0 -D16**	**0 -D16**	**0 -D16**	**0 -D16**	**0 -D16**
		As	mm^2	2,535	2,535	2,535	2,535	2,535
		p		0.006966	0.006966	0.006966	0.006966	0.006966
Cover		C	mm	75	75	75	75	75
Spacing		Cs	mm	150	150	150	150	150
<Link>				**0 -D13**	**0 -D13**	**0 -D13**	**0 -D13**	**0 -D13**
		Area	mm^2	0	0	0	0	0
		Spacing	mm	200	200	200	200	200
Working Stress								
Increment Factor for Allowable Stress				**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Concrete Compressive Stress	Working stress	σc	MPa	4.79	4.82	4.81	4.78	4.59
	Allowable stress	σca	MPa	11.00	11.00	11.00	11.00	11.00
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**
Steel Reinforcement	Working stress	σs	MPa	92.74	93.24	93.11	92.49	88.88
	Allowable stress	σsa	MPa	180.00	180.00	180.00	180.00	180.00
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**
Shear	Working stress	τ	MPa	0.66	0.45	0.50	0.49	0.53
	Allowable stress	τa	MPa	1.00	1.00	1.00	1.00	1.00
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**
Crack Width								
Flexural Crack	Calculated crack width	w	mm	0.263	0.264	0.264	0.262	0.255
	Allowable crack width	wa	mm	0.300	0.300	0.300	0.300	0.300
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**

Table 16.5.2 Reinforcement Calculation Result (front wall (landside) and base slab (upper))

Concrete Section Design by Allowable Stress Method

		Sym.	Unit	Block-1	Block-a	Block-b	Block-c	Block-d
Type of Member								
				Slab	**Slab**	**Slab**	**Slab**	**Slab**
Section Property								
Breadth of Section		b	mm	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
Height of Section		h	mm	**650**	**650**	**650**	**650**	**650**
Effective height for tensile bar		d	mm	**559.0**	**564.0**	**564.0**	**564.0**	**562.5**
Design Load								
Bending Moment		M	kNm	372.08	193.63	218.40	217.40	250.67
Shear Force		S	kN	219.95	150.13	165.10	162.63	175.20
Allowable Stress - Reinforcement								
Material				**SD295**	**SD295**	**SD295**	**SD295**	**SD295**
Allowable stress		σsa	MPa	180	180	180	180	180
Allowable Stress - Concrete								
Standard Strength 28 days cylinder		σck	MPa	**30**	**30**	**30**	**30**	**30**
Allowable bending compressive stress		σca	MPa	11.0	11.0	11.0	11.0	11.0
Allowable shear stress without links		τa	MPa	1.00	1.00	1.00	1.00	1.00
Young's modulus ratio		n		7.14	7.14	7.14	7.14	7.14
Rebar Arrangement								
<Tensile bar>		Bar-1		**5 -D32**	**5 -D22**	**5 -D22**	**5 -D22**	**5 -D25**
		Bar-2		**5 -D25**	**5 -D19**	**5 -D22**	**5 -D22**	**5 -D22**
		As	mm^2	6,476	3,318	3,801	3,801	4,355
		p		0.011584	0.005884	0.006740	0.006740	0.007742
	Cover	C	mm	75	75	75	75	75
	Spacing	Cs	mm	100	100	100	100	100
<Link>				**0 -D13**	**0 -D13**	**0 -D13**	**0 -D13**	**0 -D13**
		Area	mm^2	0	0	0	0	0
		Spacing	mm	150	150	150	150	150
Working Stress								
Increment Factor for Allowable Stress				**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Concrete Compressive Stress	Working stress	σc	MPa	8.06	5.29	5.67	5.64	6.20
	Allowable stress	σca	MPa	11.00	11.00	11.00	11.00	11.00
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**
Steel Reinforcement	Working stress	σs	MPa	115.60	112.90	111.77	111.26	112.94
	Allowable stress	σsa	MPa	180.00	180.00	180.00	180.00	180.00
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**
Shear	Working stress	τ	MPa	0.44	0.29	0.32	0.32	0.34
	Allowable stress	τa	MPa	1.00	1.00	1.00	1.00	1.00
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**
Crack Width								
Flexural Crack	Calculated crack width	w	mm	0.278	0.279	0.277	0.276	0.277
	Allowable crack width	wa	mm	0.300	0.300	0.300	0.300	0.300
	Check !!			**OK**	**OK**	**OK**	**OK**	**OK**

The calculation result of reinforcement for the additional wall located at corner block is shown as the following table.



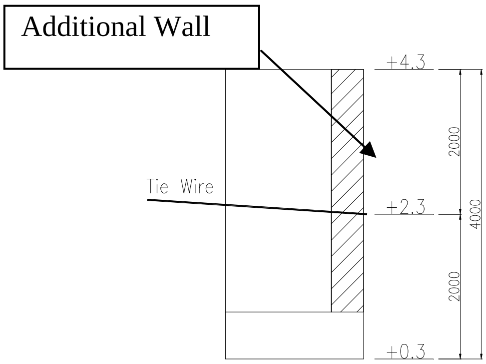


Figure 16.5.3 Plan and Side view of Additional Wall

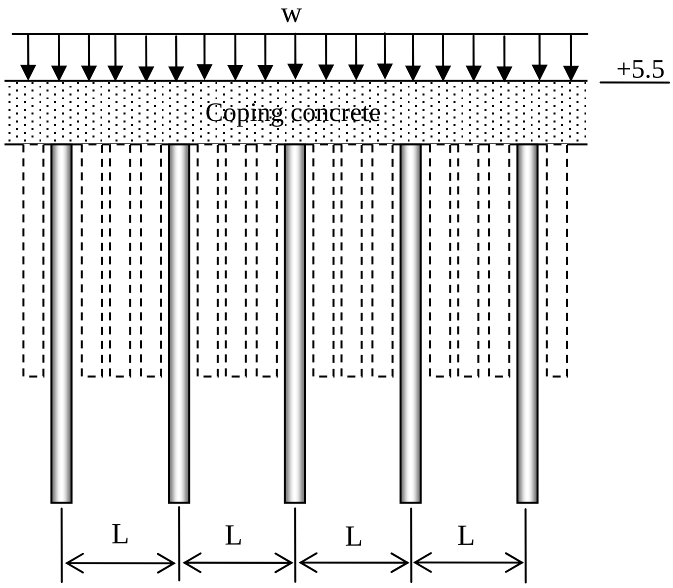
Table 16.5.3 Reinforcement Calculation Result (additional wall)

Concrete Section Design by Allowable Stress Method

		Sym.	Unit	**Horizontal Direction**	**Vertical Direction**
Type of Member					
				Slab	**Slab**
Section Property					
Breadth of Section		b	mm	**1,000**	**1,000**
Height of Section		h	mm	**450**	**450**
Effective height for tensile bar		d	mm	**345**	**364**
Design Load					
Bending Moment		M	kNm	32.29	134.48
Shear Force		S	kN		
Allowable Stress - Reinforcement					
Material				**SD295**	**SD295**
Allowable stress		σsa	MPa	180	180
Allowable Stress - Concrete					
Standard Strength 28 days cylinder		σck	MPa	**30**	**30**
Allowable bending compressive stress		σca	MPa	11.0	11.0
Allowable shear stress without links		τa	MPa	1.00	1.00
Young's modulus ratio		n		7.14	7.14
Rebar Arrangement					
<Tensile bar>		Bar-1		**6.67 -D16**	**5 -D22**
		Bar-2		**0 -D16**	**5 -D22**
		As	mm^2	1,341	3,801
		p		0.003887	0.010443
Cover		C	mm	75	75
Spacing		Cs	mm	150	100
<Link>				**0 -D13**	**0 -D13**
		Area	mm^2	0	0
		Spacing	mm	200	200
Working Stress					
Increment Factor for Allowable Stress				**1.00**	**1.00**
Concrete Compressive Stress	Working stress	σc	MPa	2.78	7.12
	Allowable stress	σca	MPa	11.00	11.00
	Check !!			**OK**	**OK**
Steel Reinforcement	Working stress	σs	MPa	75.03	108.75
	Allowable stress	σsa	MPa	180.00	180.00
	Check !!			**OK**	**OK**
Shear	Working stress	τ	MPa	0.00	0.00
	Allowable stress	τa	MPa	1.00	1.00
	Req'd area of rebar	Aw req	mm^2	0.00	0.00
	Rebar provided	Aw	mm^2	0.00	0.00
	Check !!			**OK**	**OK**
Crack Width					
Flexural Crack	Calculated crack width	w	mm	0.227	0.271
	Allowable crack width	wa	mm	0.300	0.300
	Check !!			**OK**	**OK**

6) Coping concrete

Alongside the retaining wall, coping concrete is divided into sections with maximum length of 25m. The coping concrete is considered as the beam spanning between the bearing piles. The bending moments and shear forces are calculated as continuous beam.



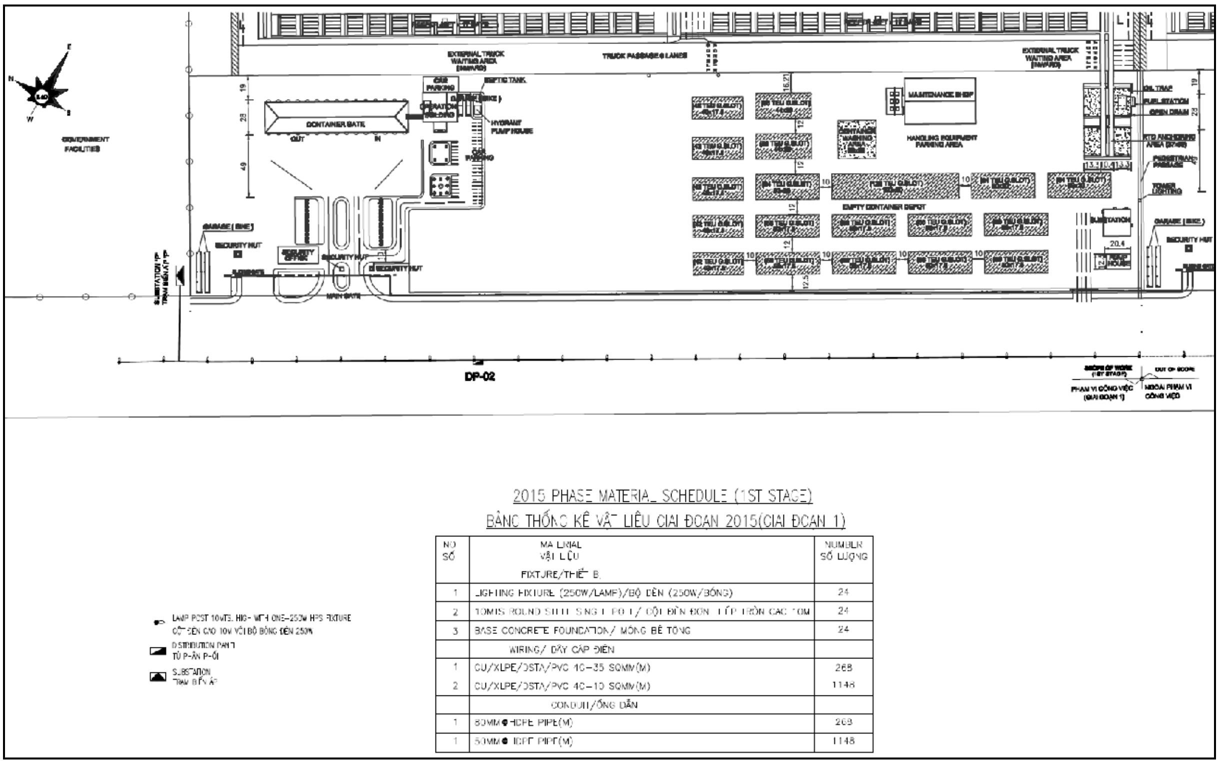
At the side view, coping is considered as cantilever beam and subjected to active earth pressure and water pressure. For more detail of calculation of coping refer to Appendix 16-2.

16.6 Utility Works

16.6.1 Lighting along Access Road Area

Road lighting is not installed and therefore road lighting along access road area is not included in ODA loan Project.

For reference, in case of road lighting system is installed by Vietnamese side, the electric power supply system is studied by JICA DD Study Team. Electrical power supply to the access road lighting may be required as shown in Figure 16.6.1.



2015 PHASE MATERIAL SCHEDULE (1ST STAGE)
BẢNG THỐNG KÊ VẬT LIỆU GIAI ĐOẠN 2015(GIAI ĐOẠN 1)

NO SỐ	MATERIAL VẬT LIỆU	NUMBER SỐ LƯỢNG
	FIXTURE/THIẾT BỊ	
1	LIGHTING FIXTURE (250W/LAMP)/BỘ ĐÈN (250W/BÓNG)	24
2	10M IS ROUND STEEL SINGLE POLE / CỘT ĐÈN ĐƠN THÉP TRÒN CAO 10M	24
3	BASE CONCRETE FOUNDATION/ MÓNG BÊ TÔNG	24
	WIRING/ DÂY CÁP ĐIỆN	
1	CU/XLPE/DSTA/PVC 4C-35 SQMM(M)	268
2	CU/XLPE/DSTA/PVC 4C-10 SQMM(M)	1148
	CONDUIT/ỐNG DẪN	
1	80MMΦ HDPE PIPE(M)	268
1	50MMΦ HDPE PIPE(M)	1148

Figure 16.6.1 Road Lighting Layout for Terminal Access Area 1st Stage (Reference Only)

Illumination level of the road has been designed based on the standards of Vietnam. In addition, the lighting arrangement is designed with the same level as Road & Bridge Potion. The lighting wiring shall be as shown in Figure 16.6.2.

In addition, road lightings may be mounted on the on-off switching control Phone-cell to the local lighting panel.

The Terminal Access Road Area, which provided the Road Lighting, Maintenance and Operation is recommended to be managed by Public related area.

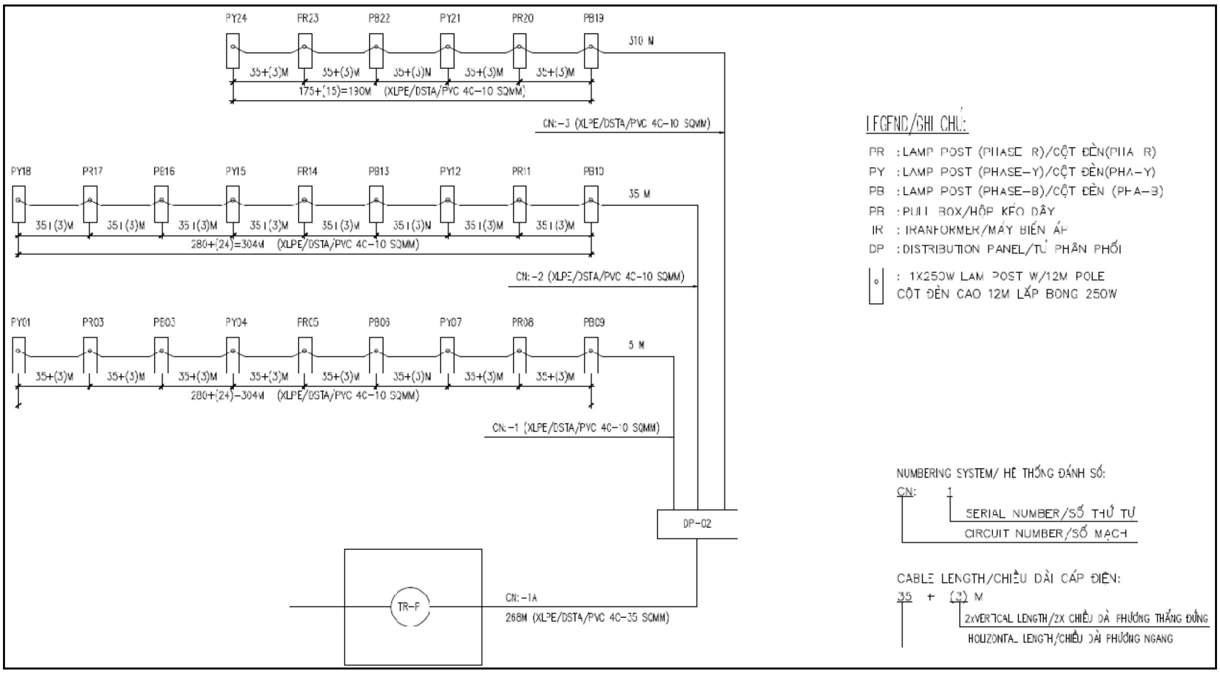


Figure 16.6.2 Schedule of Supply Diagram for Terminal Access Area 1st Stage (Reference Only)

16.6.2 Electric and Water Supply

Both main utility lines for electric and water supply along access road and connection to container terminal as well as public related area will be installed by Vietnamese Government.

16.7 Detailed Design of Access Road

Since the structure of Access Road is uncomplicated, the basic design mentioned in Chapter 7.7 is understood as detailed design.

17. OUTER REVETMENT

17.1 Determination of Crown Height

17.1.1 Required Crown Height for Wave Overtopping

As mentioned in section 8.3.1 2), the crown height for outer revetment shall be determined to fulfill the requirement of the setting permissible rate of wave overtopping. As the permissible rate of wave overtopping, Q<0.02 ($m^3/s/m$) was set under the design wave and tide conditions taking into account of utilization at hinterland. The required crown height was calculated by using the following formula presented in the design manual (EurOtop, 2007) as a simple armored slope revetment.

$$\frac{q}{\sqrt{g \cdot H_{m0}^3}} = 0.2 \cdot \exp\left(-2.3 \frac{R_c}{H_{m0} \cdot \gamma_f \cdot \gamma_\beta} \right)$$

Here, q: flow rate for wave overtopping ($m^3/s/m$)

H_{m0}: wave height at toe of structure (m)

R_c: height of armor crest from seawater level (m)

γ_f: roughness factor for each type of armor layer (0.38: tetrapods, 0.38: RAKUNA-IV, 2 layers and random positioning)

γ_β: coefficient for the effect of oblique waves

(=1-0.0063 |β| for 0°< |β|< 80°, for |β|>80° result β=80°can be applied, β: wave angle)

As wave height at toe of structure H_{m0}, the design wave height shown in Table 8.2.11 was employed. Calculation condition and the obtained result for each section were shown in Table 17.1.1.

Table 17.1.1 Calculation Condition and Result for Wave Overtopping

X (m)	0 ~ 750	750 ~ 1,750	1,750 ~ 2,770	2,770 ~ 3,230
H_{m0} (=$H_{1/3}$) (m)	3.0	2.7	3.2	3.2
β (deg)	47	56	80	82
Crown Height (C.D.)	+6.5			
Seawater Level (C.D.)	+4.43			
Rc (m)	2.1			
Q ($m^3/s/m$)	0.017 (<0.02) OK	0.005 (<0.02) OK	0.004 (<0.02) OK	0.004(<0.02) OK

The calculated rate of wave overtopping from X=750m to offshore side for the area of outer revetment B was smaller than the setting permissible rate. However, considering the design elevation for reclamation land and uncertainty between calculated result and actual, it is recommended to maintain the same crown height, CD+6.5m for both outer revetment A and B.

17.1.2 Future Consolidation Settlement for Outer Revetment A

As mentioned in section 8.3.1 and 8.3.2, the additional increase of crown height taking into account of future causing consolidation shall be considered to determine the crown height of outer revetment. Predicted future settlement for 15 years and 20 years are considered for outer revetment A and B, respectively. The detail for consolidation analysis for revetment A was presented in section 7.4. The result was summarized as follows.

- Due to the preloading for PVD method by soil embankment with +2.5m to +8.4m height during the construction period, the primary consolidation was expected to reach 100% and further settlement caused by primary consolidation was not expected after completion of the outer revetment A.
- The secondary consolidation might be continued during a long period. However it is expected that the secondary consolidation settlement is not so significant.
- Based on this understanding, the increase of the crown height due to the settlement of future consolidation was decided not to consider for outer revetment A.

17.1.3 Future Consolidation Settlement for Outer Revetment B

1) Conditions for settlement calculations

Future consolidation settlement of outer revetment B on the ground treated by Sand Replacement method has been calculated due to the following conditions.

a) Sections and Cross Section for settlement calculations

Sections for settlement calculations of outer revetment B have been selected based on information of soil conditions as shown in Figure 17.1.1. And also typical cross section for outer revetment B with sand replacement is shown in Figure 17.1.2.

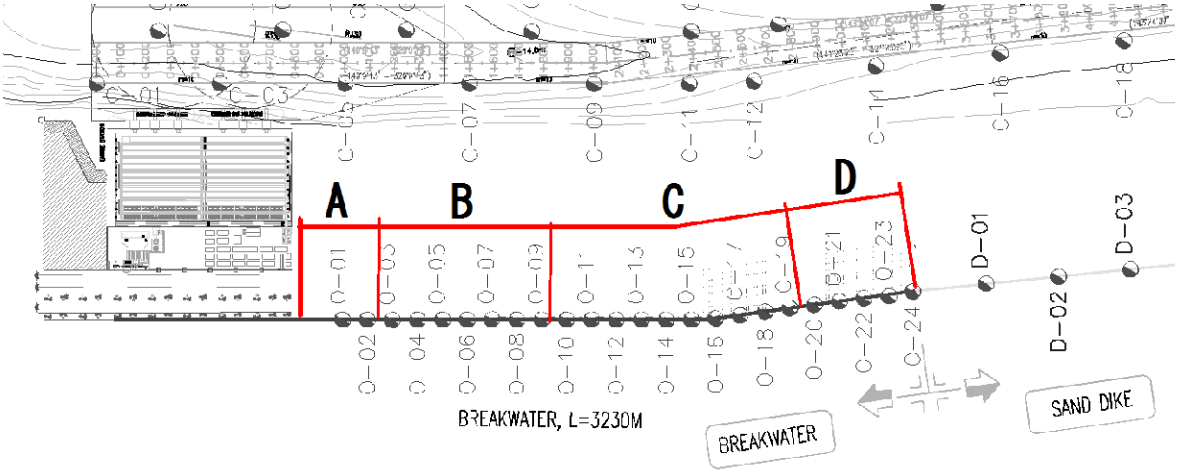


Figure 17.1.1 Sections for consolidation settlement calculations

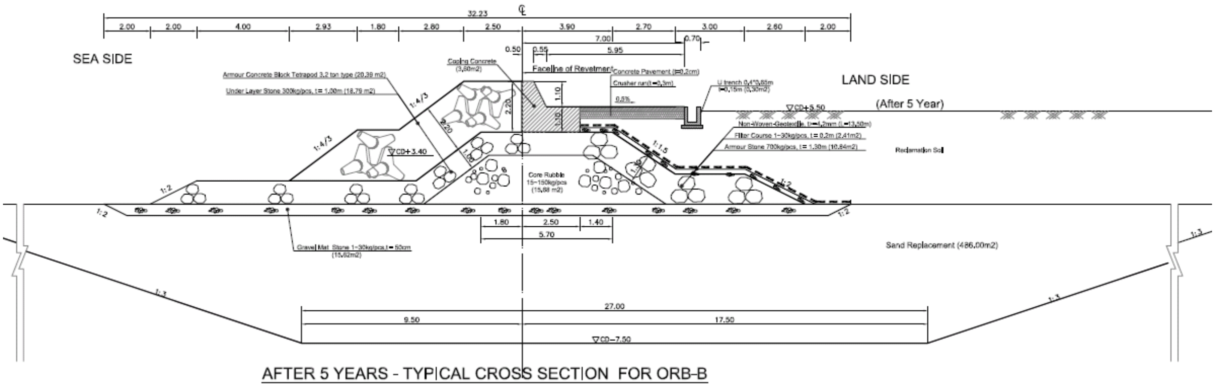


Figure 17.1.2 Typical Cross Section for Outer Revetment B with Sand Replacement

b) Soil layer models for settlement calculations

Settlement calculations have been carried out for the soil layer models as shown in Figure 17.1.3 with those soil parameters tabulated in Table 17.1.2.

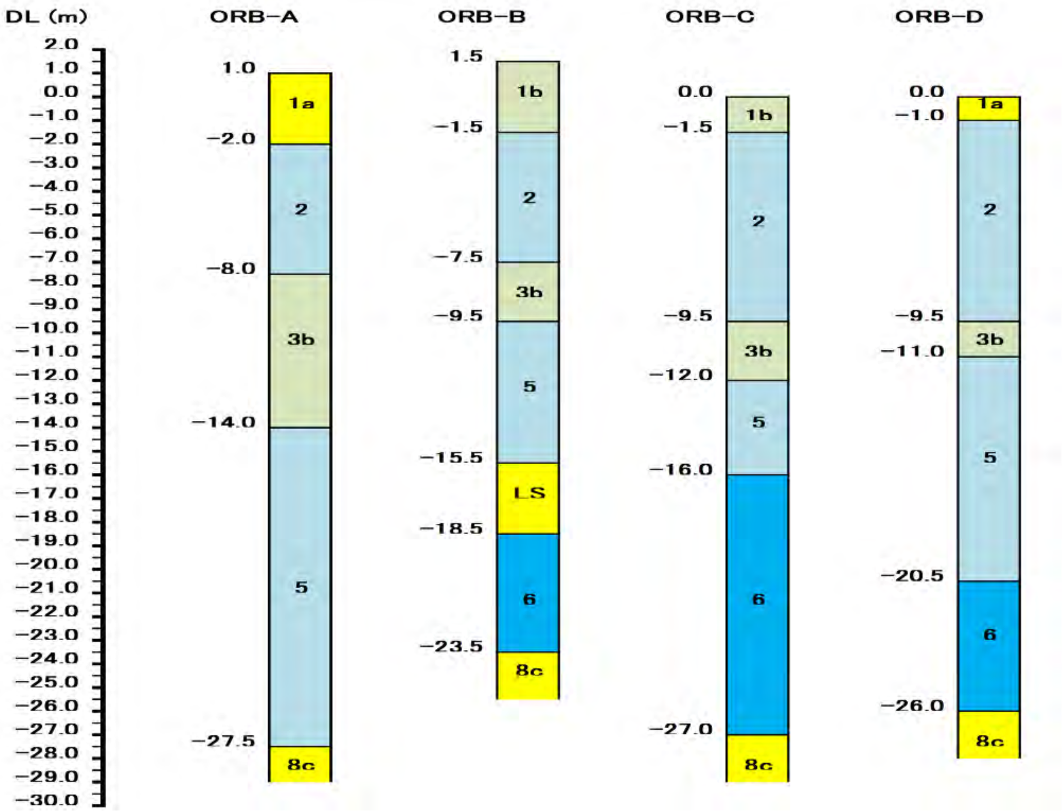


Figure 17.1.3 Soil layer models for settlement calculation sections

Table 17.1.2 Soil Parameters for Settlement Calculations for Outer Revetment B

Design Parameres for Outer Revetment B

Layer No.	Typical Soil Type	SPT-N	γ (kN/m^3)	γ' (kN/m^3)	Cu (kN/m^2)	ϕ (°)	Cc	Cr	Cα (%)	Pc (kN/m^2)	e0	Cv (OC) x 10^{-3} (cm^2/s)	Cv (NC) x 10^{-3} (cm^2/s)	Cu/P for NC
1a	SP, SP-SM	6	18.0	8.0	0	25.0	-	-	-	-	-	-	-	-
1b	SM, SC-SM	5	18.0	8.0	10 + 2Z	0.0	0.30	0.07	0.4	$\Sigma\gamma'z + 25$	1.05	1.20	1.20	0.25
2	CH	1	16.5	6.5	10 + 2Z	0.0	0.60	0.06	0.7	$\Sigma\gamma'z + 25$	1.55	1.00	0.60	0.25
3a	SP, SP-SM	5	19.0	9.0	0	25.0	-	-	-	-	-	-	-	-
3b	SM, SC-SM	6	19.0	9.0	10 + 2Z	0.0	0.25	0.05	0.4	$\Sigma\gamma'z + 25$	0.80	1.20	1.20	0.30
3c	SM	21	19.0	9.0	0	33.0	-	-	-	-	-	-	-	-
5	CL	5	17.5	7.5	10 + 2Z	0.0	0.55	0.04	0.8	$\Sigma\gamma'z + 50$	1.15	0.30	0.20	0.25
6	CL	12	19.0	9.0	50		0.15	0.01	0.3	$\Sigma\gamma'z + 100$	0.80	0.30	0.15	0.30
8a	SM	7	18.0	8.0	0	25.0	-	-	-	-	-	-	-	-
8b	SC-SM, SP-SM	17	19.0	9.0	0	30.0	-	-	-	-	-	-	-	-
8c	SM, SC-SM	44	20.0	10.0	0	35.0	-	-	-	-	-	-	-	-
Fill,Emb.	S	-	18.0	10.0	0	30.0	-	-	-	-	-	-	-	-

*NC: Normal conslidated State, OC: Over consdlidated State * z : Depth GL-(m) * z : Depth GL-(m)

c) Calculation conditions

Conditions of settlement calculation for Outer Revetment B are shown in Table 17.1.3.

Table 17.1.3 Summary Table of Settlement Calculation Conditions

Item	Design Criteria and Conditions
(a) Residual Settlement	・Outer Revetment B: During the time of 20 years after operation started : Sr_{20} ≦ 30cm (Primary consolidation)
(b) Design Load	・For future approach road area beside the Outer Revetment B : q＝10kN/m^2
(c) Water Level	MWL is applied for settlement calculation. ・HWL (High Water Level) : CD+3.55m ・MHWL (Mean High Water Level) : CD+3.05m ・MWL (Mean Water Level) : CD+1.95m ・MLWL(Mean Low Water Level) : CD+0.91m ・LWL(Low Water Level) : CD+0.43m
(d) Design Elevation	・Outer Revetment : Top elevation of Revetment: CD+6.50m ・For future approach road area : CD+5.50m
(e) Construction Progress Ratio	・Completion of Revetment B Construction: Before operation started. ・Future reclamation beside Outer Revetment B: 5 years later after 1st Phase operation started

2) Method of settlement calculations

Same methods with Terminal Area and Access Road Area are applied (refer to section 7.3).

3) Result of settlement calculations

Consolidation settlement calculation results are shown in Table 17.1.4 together with settlement curves for calculated sections (ORB-A to D) in Figure 17.1.4 to Figure 17.1.7.

Table 17.1.4 Consolidation Settlement Calculation Result for Outer Revetment B

Sections	Final Settlement by Revetment and Reclamation Load Sf (m)	Settlement after 5years from Revetment construction completed Sr5 (m)	Settlement for 20 years after revetment construction completed Sr20 (m)	Settlement Criteria
ORB-A	0.535	0.069	0.281	< 30cm
ORB-B	0.315	0.173	0.298	< 30cm
ORB-C	0.329	0.047	0.207	< 30cm
ORB-D	0.487	0.043	0.287	< 30cm

From the result, 30cm increase of the crown height was considered as the increase of crown height due to consolidation for outer revetment B based on the result of the settlement analysis.

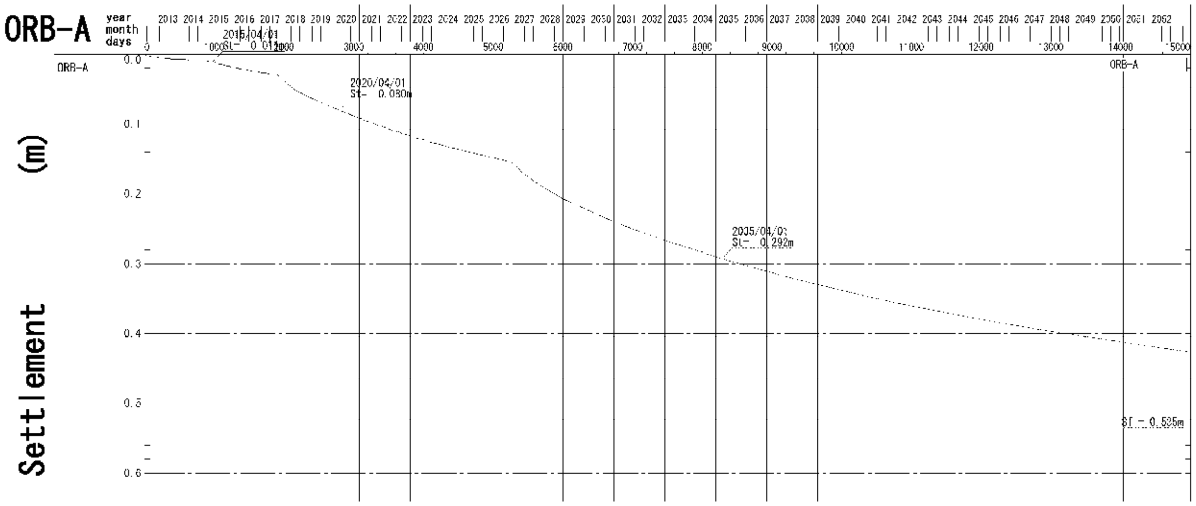


Figure 17.1.4 Settlement Curve for Section-A of Outer Revetment B (ORB-A)

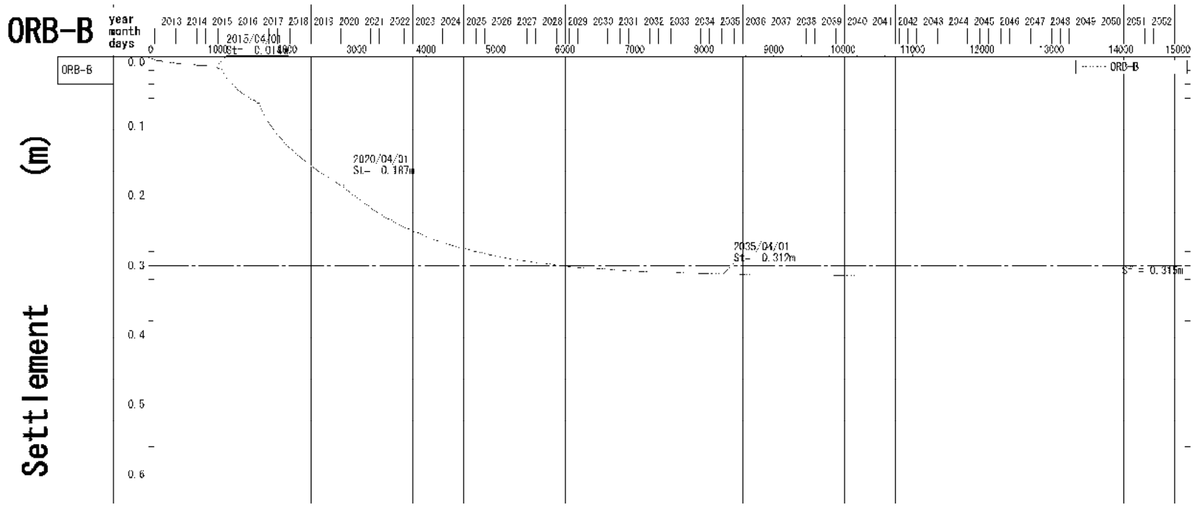


Figure 17.1.5 Settlement Curve for Section-B of Outer Revetment B (ORB-B)

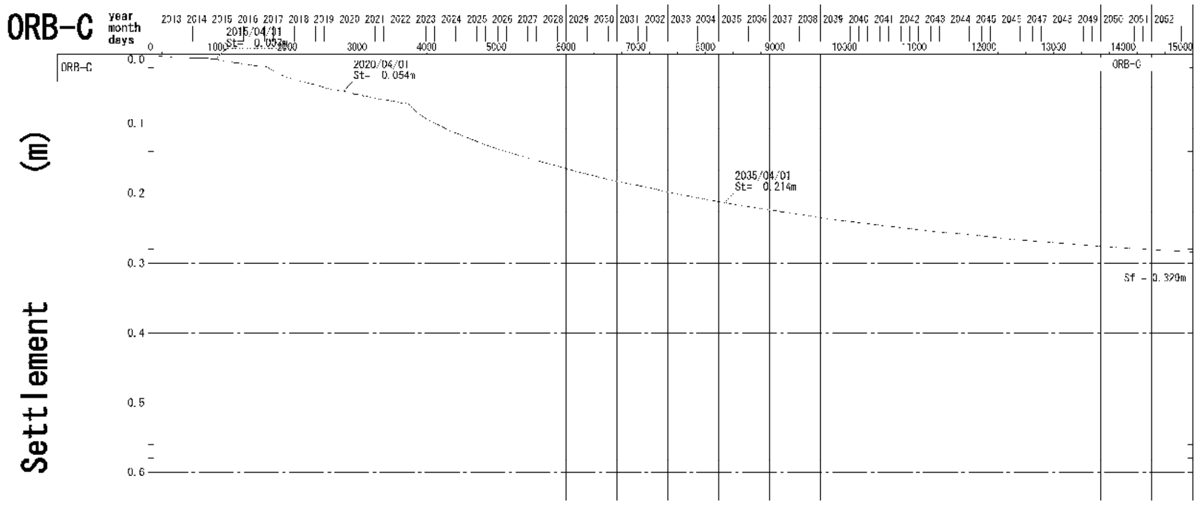


Figure 17.1.6 Settlement Curve for Section-C of Outer Revetment B (ORB-C)

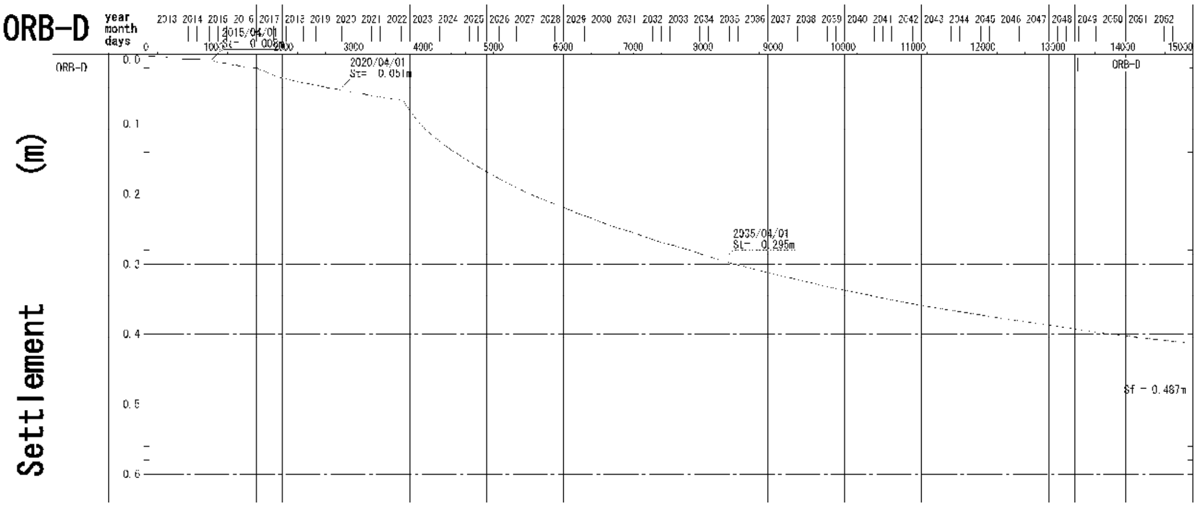


Figure 17.1.7 Settlement Curve for Section-D of Outer Revetment B (ORB-D)

17.2 Structure Design for Outer Revetment A

Based on the design principle explained in sections 8.3 and 8.4, the basic structure design for outer revetment was carried out under this section. The design for each structural component is presented below.

17.2.1 Design of Armor Concrete Block

As presented in Section 8.4, it was recommended to adopt the 1:3 slope gradients taking into account the soil stability of the reclamation subject to underwater condition. Assuming this slope, the required weight of concrete armor block was calculated using Hudson's formula. The corresponding calculation conditions and the results are shown in Table 17.2.1 and Table 17.2.3.

Table 17.2.1 Calculation Condition and Resulting Required Armor Weight

$H_{1/3}$	X (m)	K_D	Slope	Required weight	Type of Block
3.0 m	0 ~750	6.93 (breaking)	1:3	1.55 ton/unit	2 ton-type

According to the design manual for Tetrapod, placing two or more layers of armor and two or more rows at the crown part are recommended for the rubble type revetment. The typical dimension of the armor layer is presented in Table 17.2.2 and .

Table 17.2.2 Typical Dimensions of Armor Layer

Type of Block	Thickness (for two layers)	B'	B
2 ton-type	1.9 m	2.2 m	1.9 m

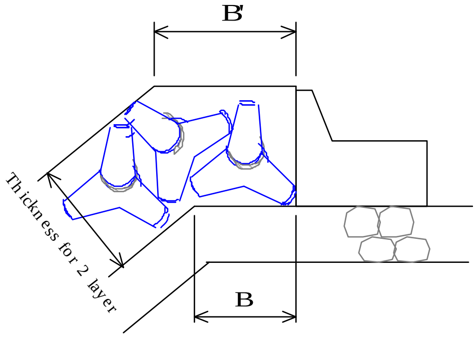


Figure 17.2.1 Definition of the Armor Layer Dimensions

Table 17.2.3 Calculation Condition and Resulting Required Armor Weight (RAKUNA-IV, for reference)

$H_{1/3}$	X (m)	K_D	Slope	Required weight	Type of Block
3.0 m	0 ~750	10.8	1:3	1.03 ton/unit	2 ton-type

According to the RAKUNA-IV catalog, placing two or more layers of armor and two or more rows at the crown part are recommended for the rubble type revetment. The typical dimension of the armor layer is presented in Table 17.2.4.

Table 17.2.4 Typical Dimensions of Armor Layer (RAKUNA-IV, for reference)

Type of Block	Thickness (for two layers)	B'	B
2 ton-type	1.8 m	1.95 m	1.66 m

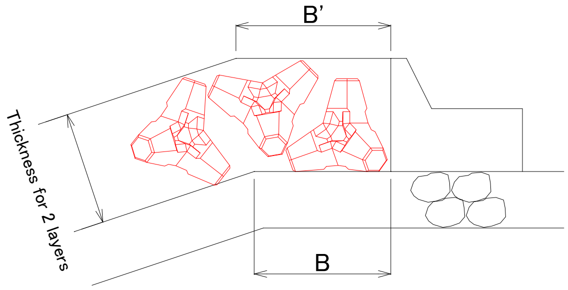


Figure 17.2.2 Definition of the Armor Layer Dimensions (RAKUNA-IV, for reference)

17.2.2 Design of Underlayers and Core Rubbles

According to the design standard for rubble-type breakwater exposed to waves on one side (seaward), W/10 ~ W/15 weight for underlayers (where W: weight of the 1st layer of armor material) is recommended. The weight of the third layer (core rubble) is recommended to be W/200 ~ W/4000 while the thickness of the underlayer, r, can be calculated using the following formula:

$$r = nk_{\Delta}(W/W_r)^{1/3}$$

Where, r : thickness of underlayer
n : number of quarry stones
k_{Δ} : layer coefficient (=1 for quarry stone)
W : mass of individual armor unit
Wr : mass density per cubic meter

Table 17.2.5 shows the weight and thickness of underlayers and core rubbles.

Table 17.2.5 Typical Weight and Dimension of Underlayers and Core Rubbles

Underlayer		**Core Layer**	
Weight	Thickness	Weight	Thickness
200 kg/pc	0.9 m	15- 150 kg/pc	0.5 m

17.2.3 Design of Concrete Cap

The stability of the concrete cap against wave forces was evaluated using Goda's modified wave force calculation formula, proposed by Tanimoto and Kojima (1983). Table 17.2.6 shows the design condition to be employed in the stability analysis of concrete cap for outer revetment A. The obtained results of the size of concrete cap for outer revetment A are shown in Table 17.2.7 and Table 17.2.8. In the calculation, the effect of backfilling sand at lee side of the revetment A as passive earth pressure was considered. The calculation in detail is presented in the Appendix-17 (17.6).

Table 17.2.6 Design Wave Condition for Stability Analysis of Concrete Cap

$H_{1/3}$	**H_{max}**	**T**	**$\beta^{*)}$**	**L**	**Seabed Elevation**	**Tide Level**
3.0 m	3.9 m	13.3s	32°	81m	+0.5m	+4.43m

$^{*)}$ Angle between the wave direction and the perpendicular to the face line of revetment considering 15° safety side

Table 17.2.7 Obtained Result of Size of Concrete Cap

Size of Concrete Cap					**Friction Factor, μ**	**Safety Factor**	
B1	B2	B3	H1	H2		Sliding	Overturning
0.5 m	1.2 m	2.5 m	2.8 m	1.2 m	0.6	3.65 (>1.2)	1.28 (>1.2)

Table 17.2.8 Obtained Result of Size of Concrete Cap (for RAKUNA-IV, for reference)

Size of Concrete Cap					Friction Factor, μ	Safety Factor	
B1	B2	B3	H1	H2		Sliding	Overturning
0.5 m	1.2 m	2.5 m	2.7 m	1.1 m	0.6	1.23 (>1.2)	1.29 (>1.2)

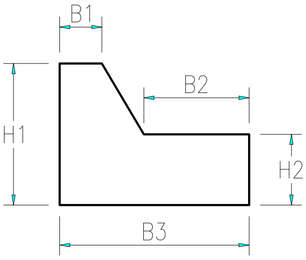


Figure 17.2.3 Concrete Cap Dimensions

17.2.4 Toe Protection

As explained in Section 8.3, it was recommended to employ the filter layer method using the combination of dumping of rock materials at the toe part, with sufficient width from the toe end, taking into account the site's soil conditions and recommended structural type, i.e., the armor concrete-type.

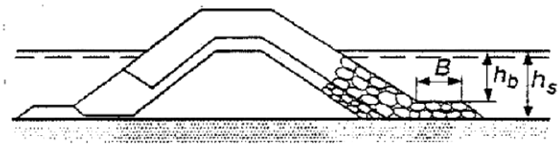
In case to consider stability of toe protection, The Rock Manual (2007) will be employed to analysis. Detail of toe stability calculation is presented in appendix 17 (17.4).

No design criteria have been established to determine the required width of toe protection. Thus, the width of toe protection will be estimated by following the same concept presented in the Coastal Engineering Manual (CEM, 2004), for practical purposes. Figure 17.2.4 illustrates the design of toe protection for rubble-mound breakwaters and jetties presented in CEM.

$$B = 3 \times t \quad for(W_{50})berm$$

Where, W_{50} : (= 2 t)
γ : (= 2.3 t/m^3)

$\therefore$ t = 0.87, B = 3 × t = 2.6 m



Two layer armor stone toe berm for exposed sides of rubble-mound breakwaters and jetties (CERC 1986)

$B = 3t$ for (W_{50}) berm
where $t = (W_{50} / \gamma)^{1/3}$

Figure 17.2.4 Toe Protection for Rubble-Mound Breakwaters and Jetties (CEM, 2004)

From the calculation, the width of the toe protection at sea side is set to 4 m. The same size of quarry stones as underlayers are also applied as toe protection. Furthermore, a gravel mat (1–30 kg) serving as filter layer is recommended to be placed below the underlayers.

17.2.5 Design of Drainage Facility for Wave Overtopping

The outer revetment was designed to fulfill the permissible rate of wave overtopping, Q<0.02 ($m^3/s/m$) under the condition of design wave height with 50-years return period and extreme tide condition with 100-years return period. The capacity of the drainage is basically designed to be able to flow out this design water inflow.

The drainage using the culvert at leeside was employed taking into account of ordinary utilization at water front area. The dimension and layout of the drainage was calculated by the flow calculation using Chezy's formula. Table 17.2.9 shows the calculation result and the dimension of the drainage. Detail is presented in the Appendix 17.

Table 17.2.9 Result of Drainage Calculation

Water Flow	**Culvert**			**Drain Pile**		
Q ($m^3/s/m$)	Width (m)	Height (m)	Slope (%)	D (mm)	Slope (%)	Interval (m)
0.02	0.4	0.65	0.5	700	0.85	50

17.3 Structure Design for Outer Revetment B

17.3.1 Design of Armor Concrete Block (Outer side)

The required weight of concrete armor block (Tetrapod) at outer side of the revetment was calculated using Hudson's formula under the condition of 3:4 slope with two design wave height conditions as shown in Table 8.2.11. The calculation condition and the result are shown in Table 17.3.1.

Table 17.3.1 Calculation Condition and Obtained Result of Armor Weight

$H_{1/3}$	X (m)	K_D	slope	Required weight	Type of Block
2.7 m	750 ~1,750	6.93 (breaking)	1:4/3	2.55 ton/unit	3.2 ton-type
3.2 m	1,750 ~3,230			4.24 ton/unit	5 ton-type

The typical dimensions of the armor layer are presented in Table 17.3.2.

Table 17.3.2 Typical Dimensions of Armor Layer

Type of Block	Thickness (Two Layers)	B'	B
3.2 ton-type	2.2 m	2.5 m	1.8 m
5 ton-type	2.5 m	2.9 m	2.1 m

The required weight of concrete armor block (RAKUNA-IV) at outer side of the revetment was calculated using Hudson's formula under the condition of 3:4 slope with two design wave height conditions as shown in Table 8.2.11. The calculation condition and the result are shown in Table 17.3.3.

Table 17.3.3 Calculation Condition and Obtained Result of Armor Weight (RAKUNA-IV, for reference)

$H_{1/3}$	X (m)	K_D	slope	Required weight	Type of Block
2.7 m	750 ~1,750	10.8	1:4/3	1.68 ton/unit	2 ton-type
3.2 m	1,750 ~3,230			2.80 ton/unit	4 ton-type

The typical dimensions of the armor layer are presented in Table 17.3.4.

Table 17.3.4 Typical Dimensions of Armor Layer (RAKUNA-IV, for reference)

Type of Block	Thickness (Two Layers)	B’	B
2 ton-type	1.8 m	2.26 m	1.66 m
4 ton-type	2.2 m	2.76 m	2.03 m

17.3.2 Design of Armor Stone (Inner side)

The required weight of armor stone at inner (channel) side shall be calculated taking into account of expected incident waves from the inner side and the time duration as the breakwater.

As shown in Table 8.2.14 in Section 8.2, the design wave height at inner side was calculated to $H_{1/3}$=2.4m. The armor layer at inner side is only required during the limited period of the time duration as the breakwater. After the reclamation of the yard will be commenced, the armor layer will not become useless. It should be considered this condition when the stability of the armor will be examined.

The stability coefficient, which is employed for the calculation of weight of armor unit, is commonly taken as the condition for the damage level of 0 to 5%. Considering above mentioned particular condition at inner side and if the same damage level will considered, this is rather over design for the stability of armor unit. Thus, the value of 10 to 15% was assumed as appropriate damage level for the calculation of armor stone at inner side.

Due to change of damage level for the armor, the relation of damage level parameter (S_d) can be increased based on that for damage level is 0% as shown in Table 17.3.5.

Table 17.3.5 H_s /$H_{s;\ D=0}$ as a Function of Armor Layer Damage

Armor Type	Relative Wave Height	Damage D(%) with corresponding damage level (S_d)					
		0 – 5 (S_d=2)	5 – 10 (S_d=6)	10 -15 (S_d=10)	15 – 20 (S_d=14)	20 – 30 (S_d=20)	30 – 40 (S_d=28)
Smooth armor stone	H_s /$H_{s;\ D=0}$	1.00	1.08	1.14	1.20	1.29	1.41
Angular armor stone		1.00	1.08	1.19	1.27	1.37	1.47

Source: Rock Manual, 2007

The stability coefficient (K_D- value) for armor stone under breaking wave condition was proposed as K_D=2.0 for rough angular and random placing in SPM (1984) using $H_{1/10}$ as a relative wave height. The relation between H_s (=$H_{1/3}$) and $H_{1/10}$ is $H_{1/10}$ =1.27 Hs. The relationship between stability number and the structure slope and the stability coefficient, K_D is;

$$N_s = \frac{H_s}{\Delta D_n} = \frac{(K_D \cot \alpha)^{\frac{1}{3}}}{1.27}$$

According to the study of Van Gent et al was proposed in 2004 to modify the formulae of Van der Meer (1988b) applying in shallow water condition, the stability number given here as bellow equations;

- For plunging conditions ($\xi_{s-1,0} < \xi_{cr}$):

$$\frac{H_s}{\Delta D_n} = c_{pl} P^{0.18} \left(\frac{S_d}{\sqrt{N}}\right)^{0.2} \left(\frac{H_s}{H_{2\%}}\right) \left(\xi_{s-1,0}\right)^{-0.5}$$

- For surging conditions ($\xi_{s-1,0} \geq \xi_{cr}$):

$$\frac{H_s}{\Delta D_n} = c_s P^{-0.13} \left(\frac{S_d}{\sqrt{N}}\right)^{0.2} \left(\frac{H_s}{H_{2\%}}\right) \sqrt{\cot\alpha} \left(\xi_{s-1,0}\right)^{P}$$

Applying above relation of wave height between $H_{1/10}$ and H_s, together with the increase of damage level parameter, S_d for the damage level from 0 ~ 5% to 10 ~ 15%, the required size of armor stone at inner side was calculated as shown in Table 17.3.6. Detail of required armor stone calculation of channel side of Outer revetment B is presented in Appendix 17 (17.5).

Table 17.3.6 Required Size of Armor Stone at Inner Side

$H_{1/3}$	S_d	N_s	D_n	Required weight	Thickness
2.4 m	10	2.4	0.63 m	700 kg/pc	1.28 m

17.3.3 Design of Underlayers and Core Rubbles

The weight and thickness of under layers and core rubbles for outer revetment B were calculated using the same way as that for outer revetment A as shown in Table 17.3.7.

Table 17.3.7 Typical Dimensions of Underlayers and Core Rubbles

Under Layer		Core Layer	
Weight	Thickness	Weight	Thickness
300 kg/pc	1.0 m	15- 150 kg/pc	-

17.3.4 Design of Concrete Cap

The stability of the concrete cap against wave forces was evaluated using the calculation formula by Tanimoto and Kojima (1983) same as the analysis for revetment A. However, the following two different conditions shall be considered for the stability analysis of outer revetment B.

(1) Before backfilling
For this case, the wave condition with 5 years return period was assumed to be employed as the design condition. However, the effect of backfilling sand at lee side of the revetment B as passive earth pressure cannot be considered.

(2) After backfilling
For this case, the wave condition with 50 years return period was assumed to be employed as the design condition. The effect of backfilling sand can be considered.

Table 17.2.6 shows the design condition to be employed in the stability analysis of concrete cap for outer revetment B. The obtained result of the size of concrete cap is shown in Table 17.3.8. Table 17.3.9 and Table 17.3.10show the obtained results of concrete cap and safety factor for sliding and overturning.

The calculation in detail is presented in the Appendix 17 (17.7 and 17.8).

Table 17.3.8 Design Wave Condition for Stability Analysis of Concrete Cap

Return Period	x	$H_1/3$	H_{max}	T	$\beta^{*)}$	L	Seabed Elevation	Tide Level
5 years	750 ~1,750	2.3 m	3.1 m	11.0s	41°	59.6m	+1.0m	+3.55m (HWL)
	1,750~3,230	2.6 m	3.4 m	11.0s	66°	62.3m	0.0m	
50 years	750 ~1,750	2.7 m	3.5 m	13.3s	41°	76.9m	+1.0m	+4.43m (HHWL)
	1,750~3,230	3.2 m	4.3 m	13.3s	66°	85m	0.0m	

Table 17.3.9 Size of Concrete Cap and Obtained Results

Armor Type	Return Period	x	Size of Concrete Cap					μ	Safety Factor	
			B1	B2	B3	H1	H2		sliding	over turning
3.2 ton	5 years	750 ~ 1,750	0.5 m	1.45 m	2.5 m	2.2 m	1.1 m	0.6	2.55 (>1.2)	7.93 (>1.2)
	50 years								1.23 (>1.2)	1.82 (>1.2)
5.0 ton	5 years	1,750 ~ 3,230	0.5 m	1.35 m	2.5 m	2.4 m	1.1 m	0.6	2.52 (>1.2)	7.26 (>1.2)
	50 years								2.06 (>1.2)	1.89 (>1.2)

Table 17.3.10 Size of Concrete Cap and Obtained Results (for RAKUNA-IV, for reference)

Armor Type	Return Period	x	Size of Concrete Cap					μ	Safety Factor	
			B1	B2	B3	H1	H2		sliding	over turning
2 ton	5 years	750 ~ 1,750	0.5 m	1.90 m	2.5 m	1.8 m	1.6 m	0.6	2.93 (>1.2)	12.16 (>1.2)
	50 years								1.20 (>1.2)	2.88 (>1.2)
4 ton	5 years	1,750 ~ 3,230	0.5 m	1.45 m	2.5 m	2.2 m	1.1 m	0.6	2.12 (>1.2)	7.65 (>1.2)
	50 years								1.25 (>1.2)	2.09 (>1.2)

17.3.5 Design of Sand Replacement

To determine the dimension of sand replacement, soil stability analysis was carried out using the recommended upper structure design.

The following design principle was employed for the determination of the dimension of sand replacement.

- Considering the soil properties at outer revetment B obtained from the latest soil analysis, the soil replacement is undertaken until Layer-2 (refer to Figure 17.1.3, Table 17.1.2).
- The gradient of the slope part for sand replacement was set to 1:3
- The distance from the center line up to the end of sand replacement at sea side was set taking into account the presumed failure circle of the soil based on soil stability analysis
- The distance from the center line up to the end of sand replacement at lee side was set taking into account the expected influenced area for the settlement due to future reclamation load at port extension area.

Figure 17.3.1 shows one of the examples for the result of the soil stability analysis for recommended design (section ORB-D). Other calculation results are presented in Appendix 17 (17.9 to 17.14). Table 17.3.11 shows the summary for the required dimension of soil replacement obtained by soil stability analysis.

Table 17.3.11 Obtained Dimension of Soil Replacement

Section	Depth	Width	Slope	Vol. (m^3/m)
ORB-A	CD -8.0	37.5	1 : 3	580.5
ORB-B	CD -7.5	27.0	1 : 3	486.0
ORB-C	CD -9.5	29.5	1 : 3	551.0
ORB-D	CD -9.5	34.0	1 : 3	593.0

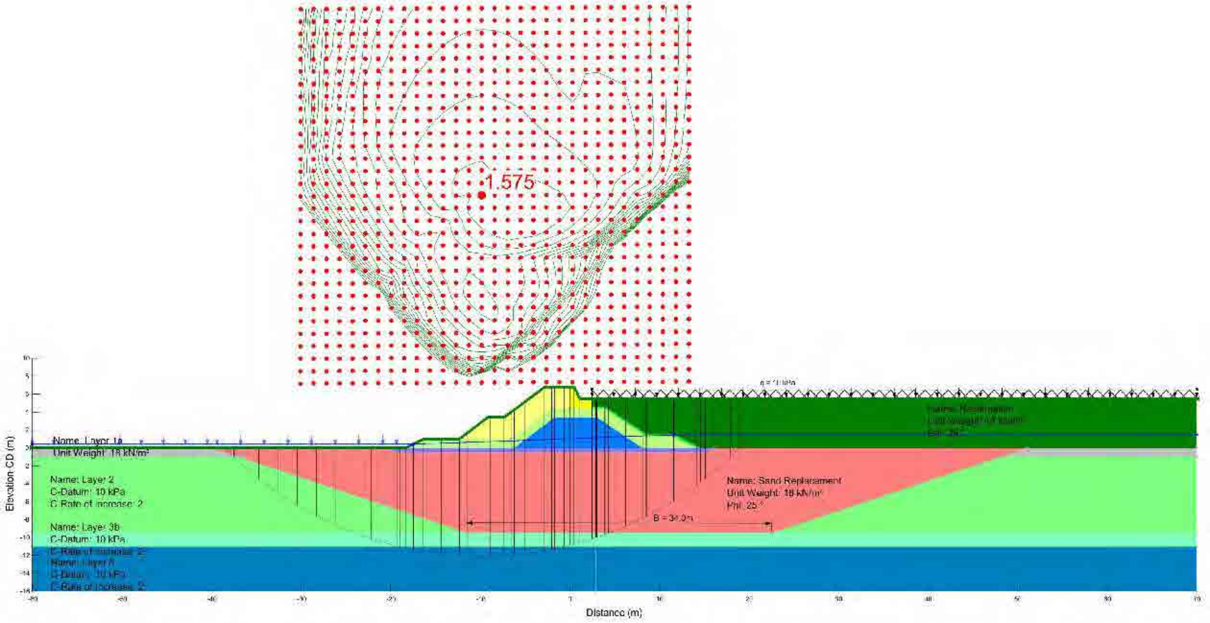
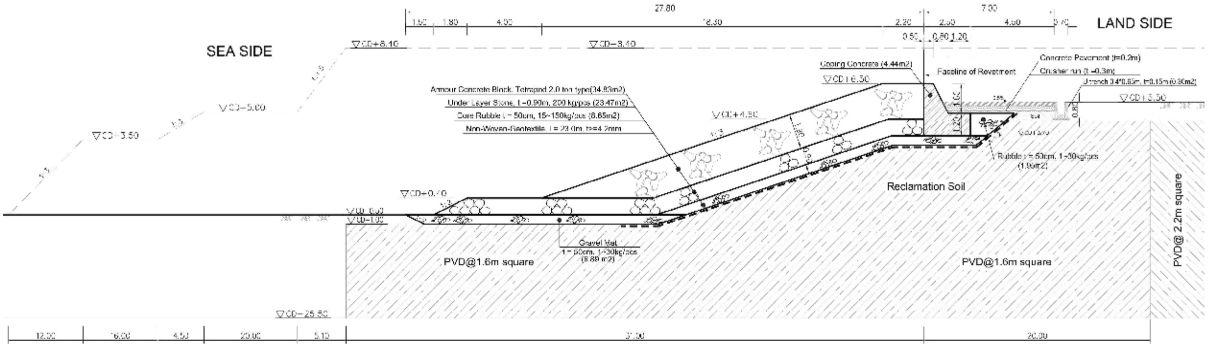


Figure 17.3.1 Example of Calculation Result of Soil Stability Analysis (Section ORB-D)

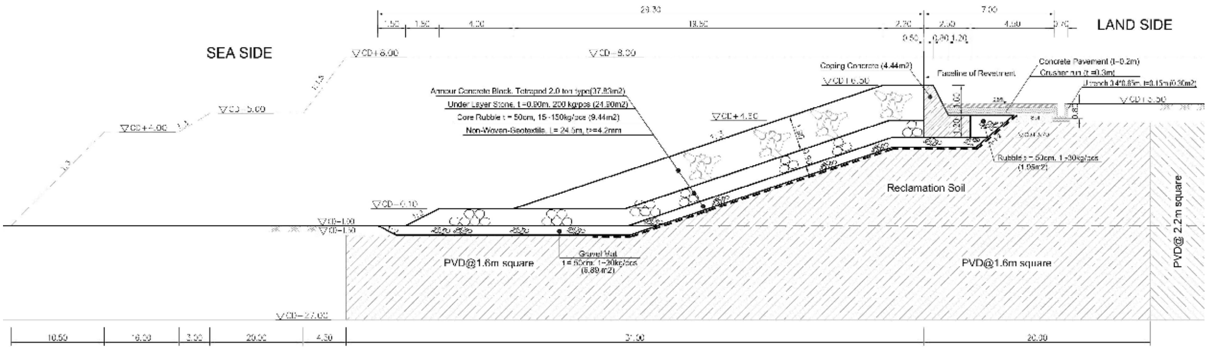
17.4 Typical Cross Section for Outer Revetment A and B

17.4.1 Outer Revetment A

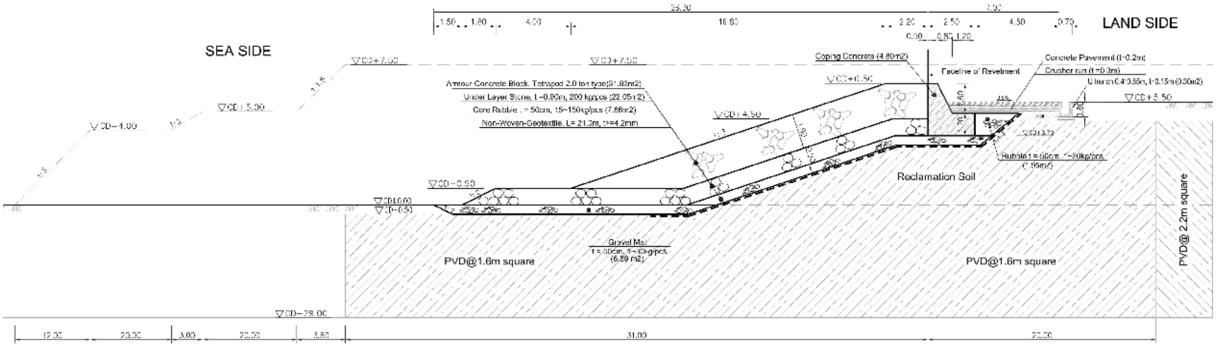
The typical cross sections for outer revetment A at 4 representative sections are shown in Figure 17.4.1.



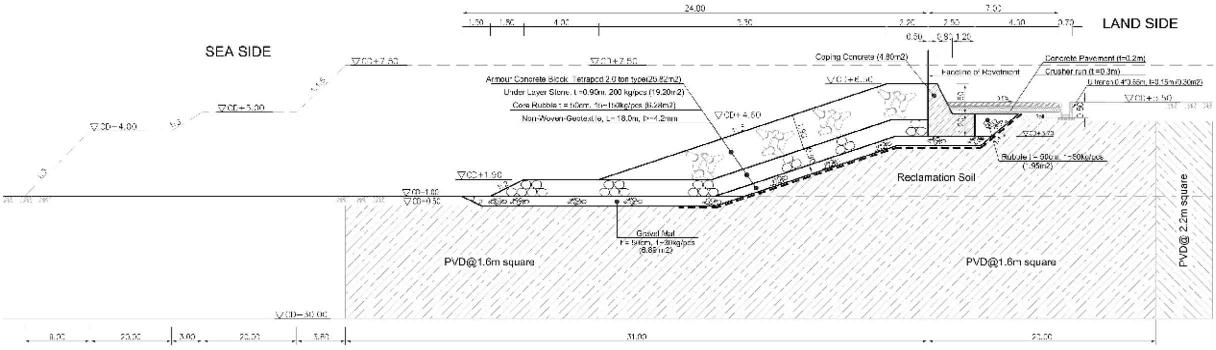
CROSS SECTION FOR ORA-1



CROSS SECTION FOR ORA-2



CROSS SECTION FOR ORA-3



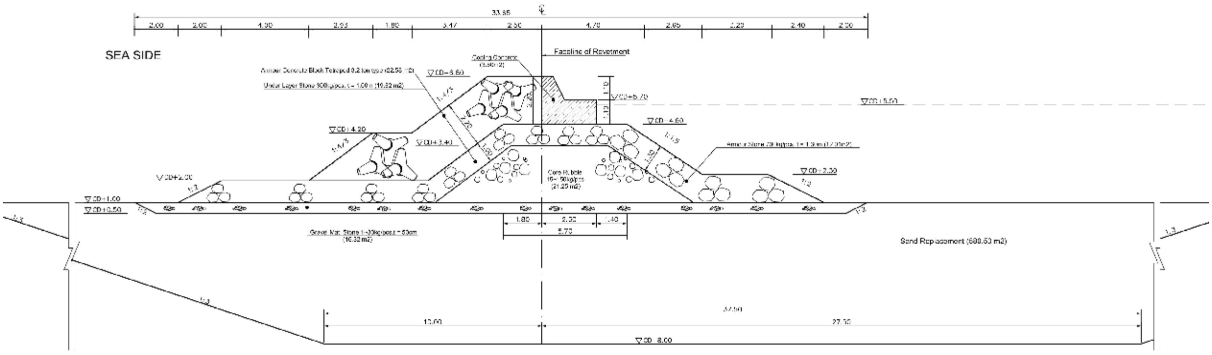
CROSS SECTION FOR ORA-4

Source: JICA Study Team

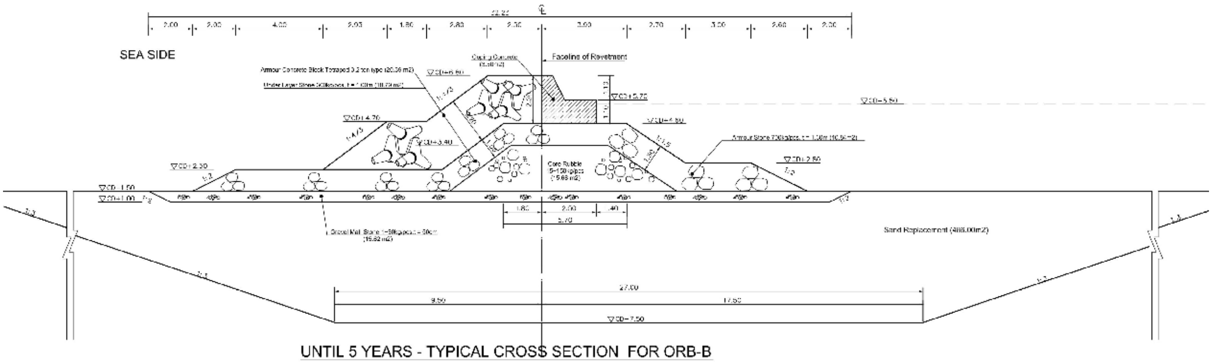
Figure 17.4.1 Typical Cross Section for Outer Revetment A

17.4.2 Outer Revetment B

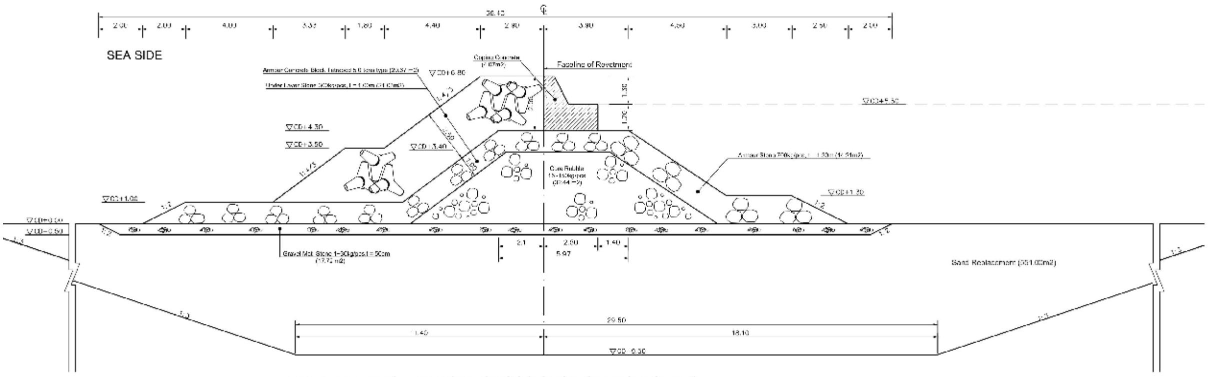
The typical cross sections for outer revetment B at 4 representative sections are shown in Figure 17.4.2. The final image drawings of the outer revetment after the reclamation at backyard are also shown in Figure 17.4.3 as a reference.



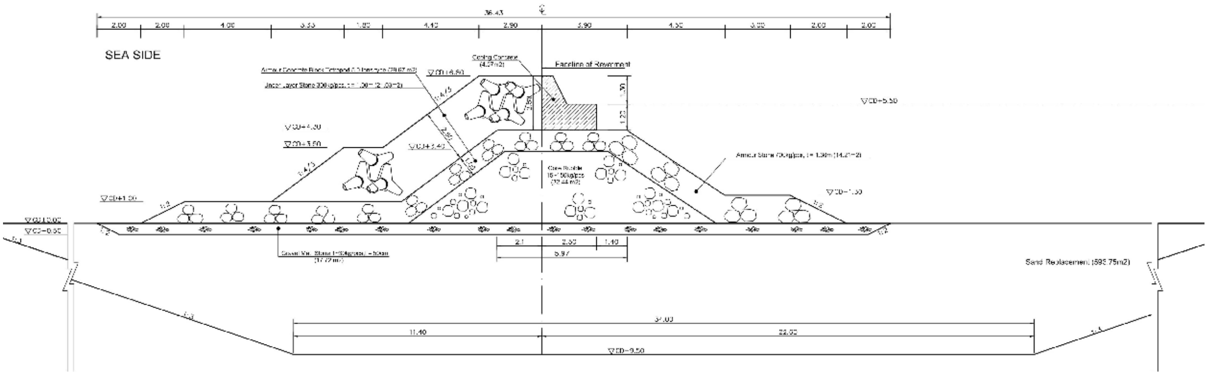
UNTIL 5 YEARS - TYPICAL CROSS SECTION FOR ORB-A



UNTIL 5 YEARS - TYPICAL CROSS SECTION FOR ORB-B



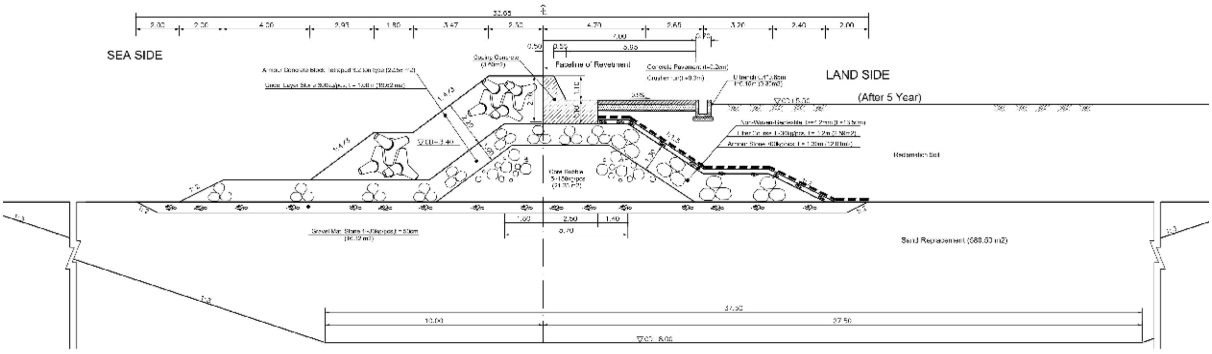
UNTIL 5 YEARS - TYPICAL CROSS SECTION FOR ORB-C



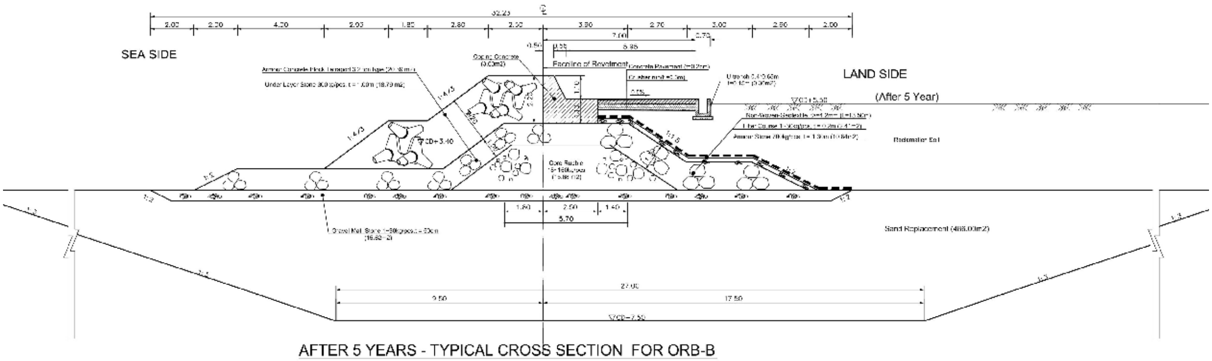
UNTIL 5 YEARS - TYPICAL CROSS SECTION FOR ORB-D

Source: JICA Study Team

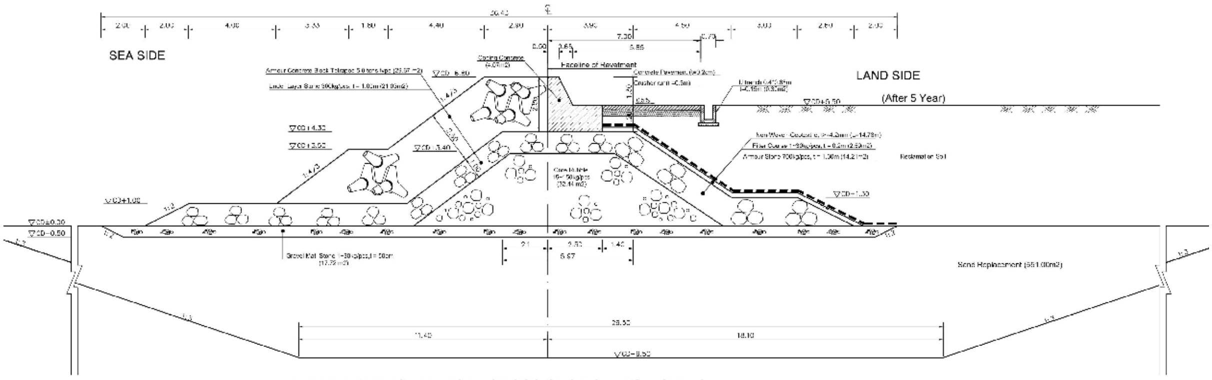
Figure 17.4.2 Typical Cross Section of Outer Revetment B



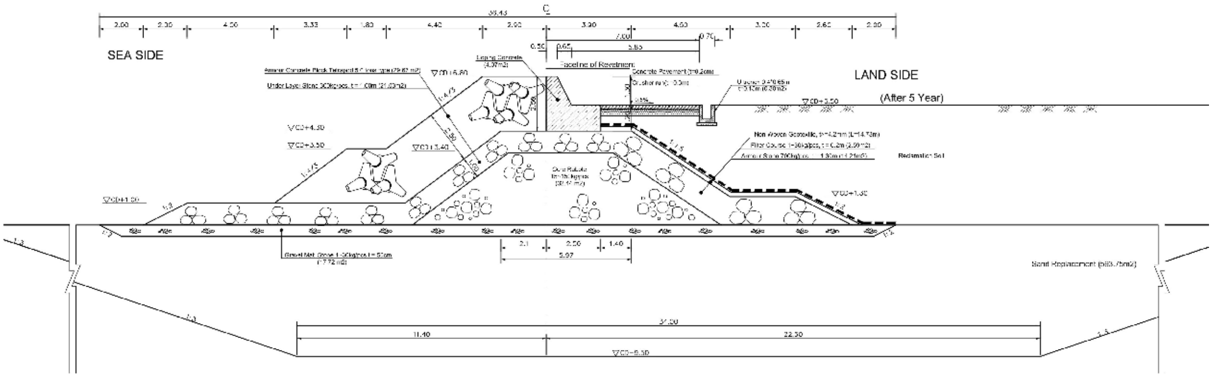
AFTER 5 YEARS - TYPICAL CROSS SECTION FOR ORB-A



AFTER 5 YEARS - TYPICAL CROSS SECTION FOR ORB-B



AFTER 5 YEARS - TYPICAL CROSS SECTION FOR ORB-C



AFTER 5 YEARS - TYPICAL CROSS SECTION FOR ORB-D

Source: JICA Study Team

Figure 17.4.3 Image of Typical Cross Section for Outer Revetment B After Reclamation (As Reference)

18. PUBLIC RELATED AREA

18.1 Detailed Design of Service Boat Berth (Calculation of Reinforcement Arrangement)

18.1.1 Design Condition

1) Design code applied

No	Title	Publisher
1	Technical Standards and Commentaries for Port and Harbour Facilities in Japan	The Overseas Coastal Area Development Institute of Japan
2	Specifications for Highway Bridges - March 2002	Japan Road Association
3	Standard Specification for Concrete Structures - 2007	Japan Society of Civil Engineers

2) Main dimensions of service boat berth

- Ground elevation	+5.50 m CDL
- Seabed elevation	-5.00 m CDL
- Top of the sheet pile	+1.50 m CDL
- Bottom level of Relieving platform	+3.00m CDL
- Width of Relieving platform (from the face line)	17.00m
- Tip elevation of sheet pile	-14.0m

3) Environmental Condition

- High Water Level (H.W.L)	+3.55 m CDL
- Low Water Level (L.W.L)	+0.43 m CDL
- Residual Water Level (R.W.L)	+2.51 m CDL

4) Material conditions

a) Concrete

Characteristic 28 days compressive strength of concrete is as follows.

Characteristic 28 days compressive strength		Modulus of elasticity
Cube strength	Cylinder strength	
40 MPa	30 MPa	28 kN/mm^2

b) Reinforcement bar

Reinforcement bar used in the calculation is SD295 of the Japanese Industrial Standard (JIS) JIS G 3112 "Steel bars for concrete reinforcement".

Grade	Modulus of elasticity
SD295	200 kN/mm^2

c) Steel Sheet Pile

Type	Grade	Allowable Stress
IVw	SY295	180 MPa

- Design life time : 50 years
- Effect of cathodic protection : 90%
- Corrosion rate : 0.030 mm/year (0.3mm/year × 10%)

- Corrosion allowance : t = 0.030 × 50 years = 1.50 mm (all surfaces)

d) Prestressed Concrete Spun Pile

Type	Effective Prestress	Compressive Strength	Modulus of Elasticity
Type-B	8.0 MPa	85 MPa	37 kN/mm^2

5) Concrete Cover

The concrete cover is 75mm for the upper surface and 100mm for the other surface of the relieving platform as shown in the following figure.

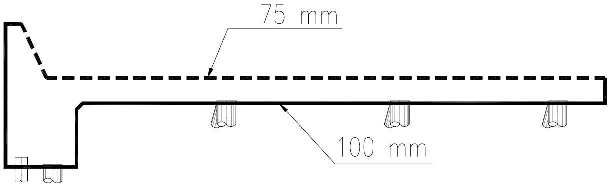


Figure 18.1.1 Concrete Cover

6) Allowable crack width

The allowable crack width under the operational condition is specified by the following formula:

Allowable crack width = 0.004 ×C (mm)

where,
C : Concrete cover (mm)

7) Design Load

- Live Load	10.0 kPa
- Mooring Load (150kN bollard @12m)	12.5 kN/m

8) Seismic Load

- Not considered

18.1.2 General Arrangement of Service Boat Berth

1) Berthing line

The operation berth line is comprised of 3 sections with the lengths of 70m, 164.2m and 49.5m, respectively. In order to avoid any adverse affect to foundation of High voltage electric tower, the dredging area is placed 63m far from it. The water depth in front of berth is -5m CDL. Apron pavement is 10m in width along the berth line.

General layout of berth is as shown in the figure below:

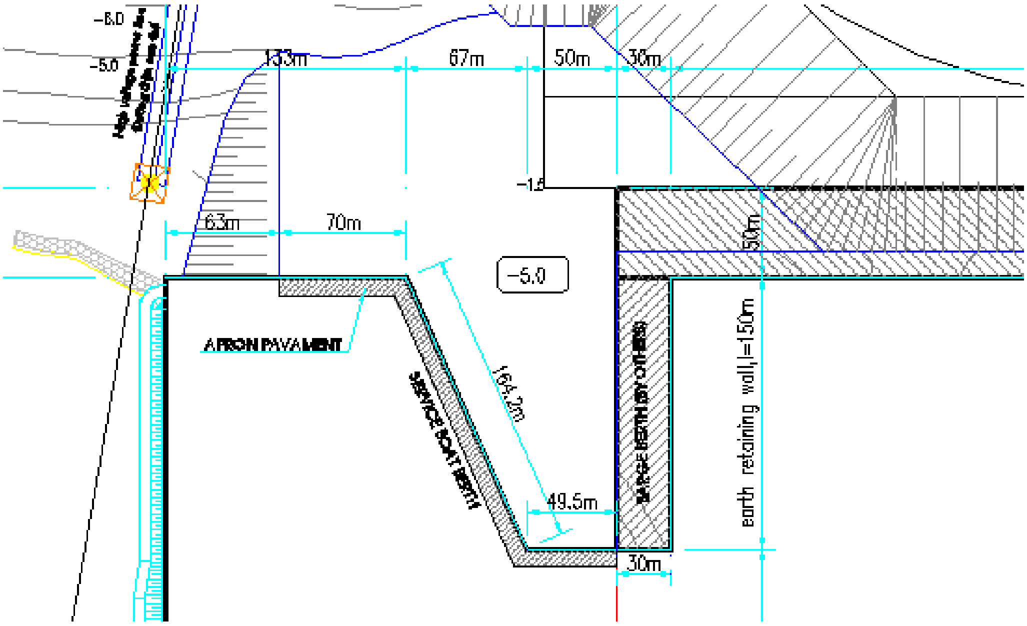


Figure 18.1.2 General Arrangement of Service Boat Berth

2) Steel sheet pile wall

Steel sheet pile wall is composed of Steel sheet pile IVw type. The tip elevation of sheet pile is -14.0m CDL for all blocks. In order to reduce corrosion on the steel sheet pile, all sheet pile are protected by cathodic protection system from -0.6m CDL to -5.0m CDL and by concrete lining protection from -0.6m CDL to the bottom level of coping concrete.

3) Relieving platform

Total structure length of Service Boat Berth is 346.7m. From left to right, the relieving platform is divided into 10 blocks with each length of: 3x35m + 56m (corner block) + 3x35m + 31.2m +36.5m (corner block) +35m, respectively. Expansion joints of 2cm width are placed between the blocks.

General arrangement of relieving platform blocks are shown in the figure below:

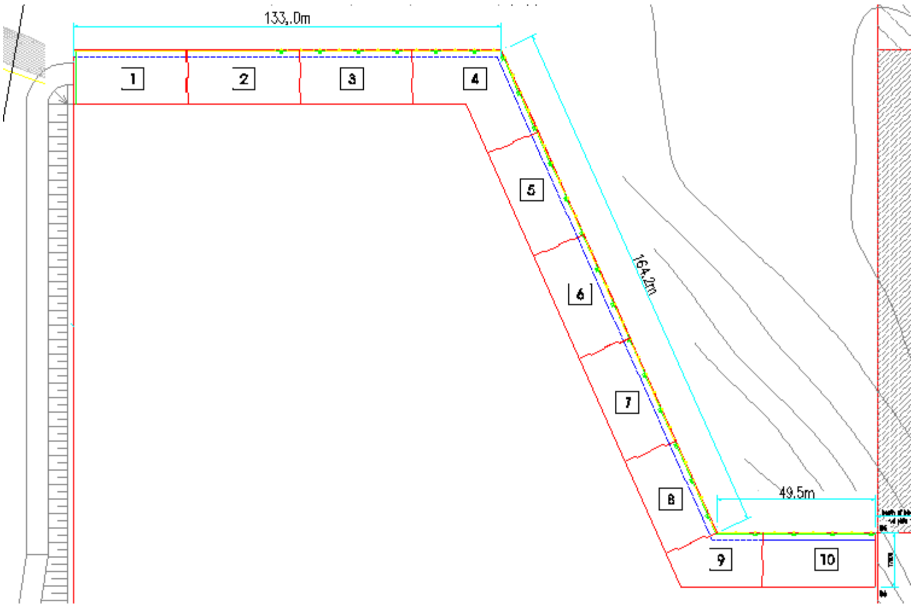


Figure 18.1.3 General Arrangement of Relieving Platform

The front view and cross section of typical blocks are as shown in the figure below:

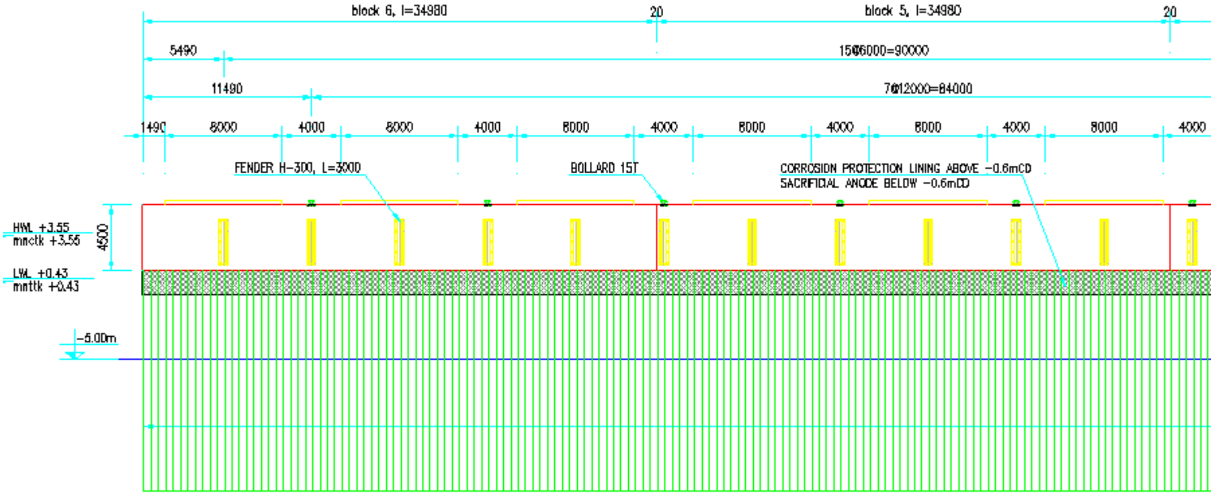


Figure 18.1.4 Front View of Service Boat Berth (Typical)

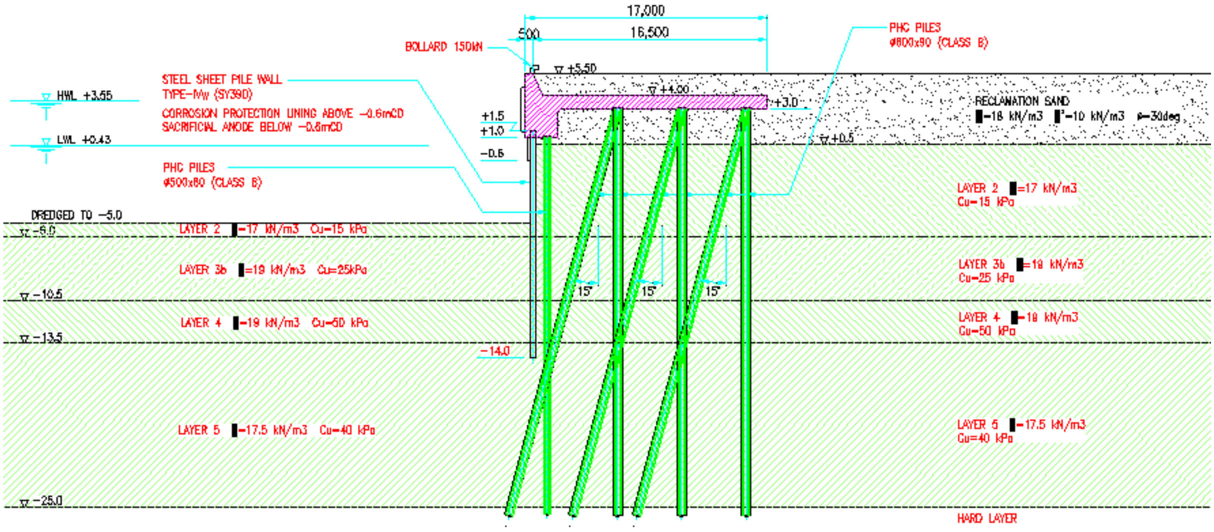


Figure 18.1.5 Typical Cross Section of Service Boat Berth

Plan of pile foundation and relieving platform of typical blocks is as shown in the figure below:

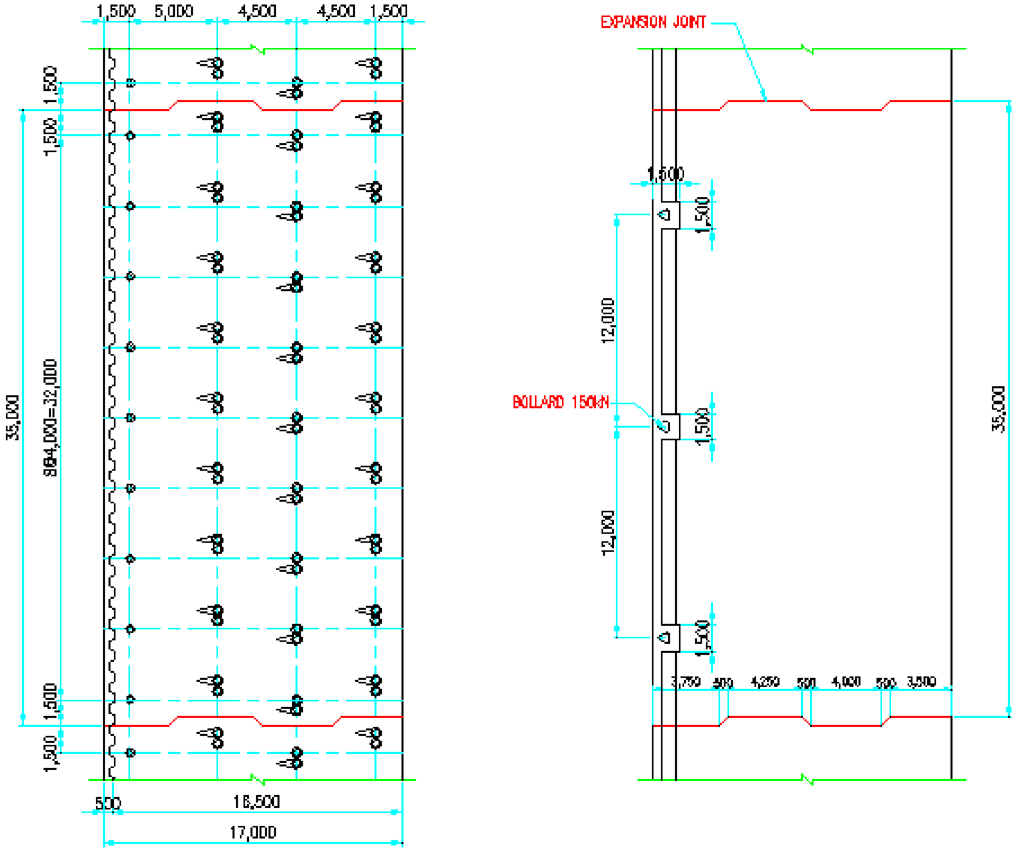


Figure 18.1.6 Plan of Pile Foundation and Relieving Platform

18.1.3 Calculation of the Main Components

The summary of the calculation for main components of relieving platform is described bellow. The detailed calculation results are shown in Appendix 10-2 for standard section and in Appendix 10-3 for corner section.

1) Steel sheet pile wall

a) Sheet pile section

Steel Sheet Pile Type SP-IVw is selected. Section properties are listed as following:

- Modulus of elasticity : $E = 200.0$ kN/mm^2
- Moment of inertia : $I = 56,700$ cm^4/m
- Section modulus : $Z = 2,700$ cm^3/m

<u>After corrosion</u>

- Design life : 50 years
- Corrosion rate : 0.030 mm/year (effect of cathodic protection = 90%)
- Corrosion allowance : $t = 2 \times 0.030 \times 50$ years $= 3.000$ mm
- Moment of inertia : $I = 46,454$ cm^4/m
- Section modulus : $Z = 2,228$ cm^3/m

Check the stress of sheet pile

Maximum bending moment generated in the sheet pile is as follows:

- Deflection curve method : 362.450 kN-m/m --- adopted
- Free earth support method : 244.886 kN-m/m

$$\sigma = \frac{362.450\times10^{6}}{2228\times10^{3}} = 162.7 \le \sigma_{a} = 180.0 ... OK$$

b) Corrosion Protection

The steel sheet pile is protected as mentioned below in order to avoid corrosion on it.

- From +1.0m CDL (bottom level of coping) to -0.6m CDL (under LWL) : concrete lining protection
- The remaining part of Sheet pile: cathodic protection system is applied along the sheet pile wall with the average interval of 5.0m.

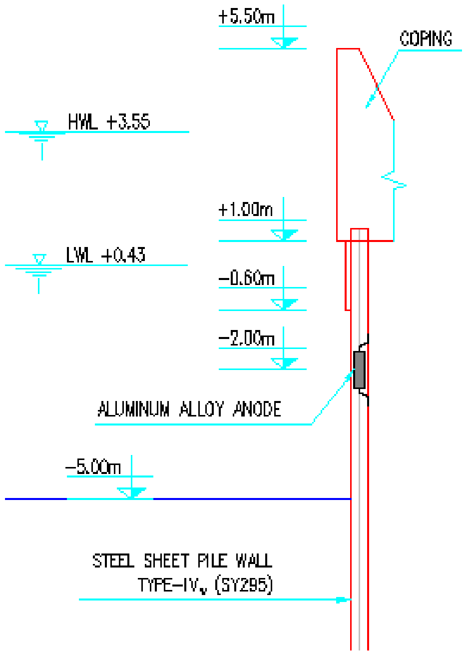


Figure 18.1.7 Corrosion Protection of Steel Sheet Pile

The characteristic of cathodic protection system is summarized in the table below. The detailed calculation of cathodic protection system is shown in Appendix 18-1.

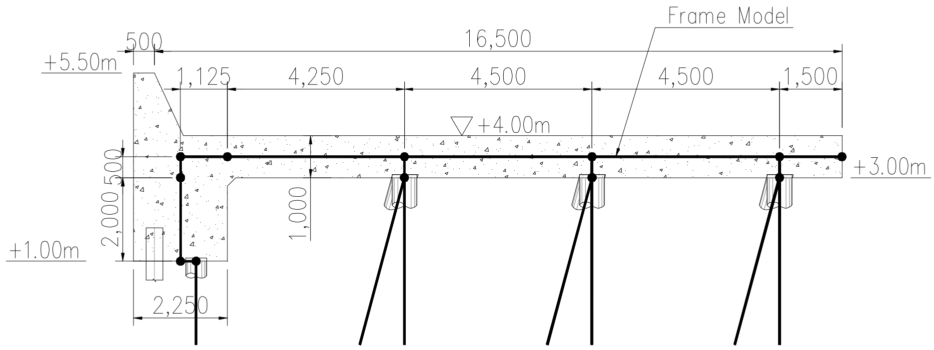
Material	Aluminum alloy anode :
Dimension	(255+300) x 280 x 1420
Net weight [kg]	295.6
Gross weight [kg]	312.0
Capacity[Ah/kg]	2600
Closed circuit Potential(mV vs. SCE)	-1050
Output current (Initial) [A/pc.] At 35 ohm.cm	3.5
Output current (Average) [A/pc.]	1.75
Life time[year]	50
Number of quantity	140 pcs
Number of potential measuring terminal	07 pcs

2) PHC Pile Design

a) Structural Analysis Model

Two dimensional frame models were built up with all structural components and piles were considered as rigidly connected to the deck structure. The pile-soil interaction was modeled by providing horizontal spring. The analysis model is shown as below.

Transversal Direction:



Longitudinal Direction

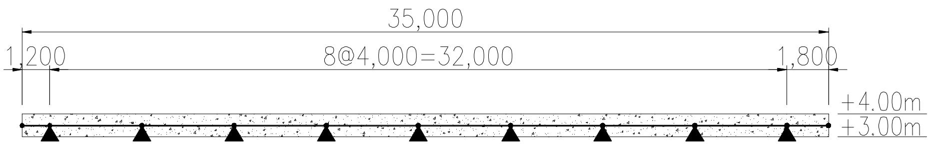


Figure 18.1.8 Calculation Model

b) Design load

Applied load combination is summarized as follows:

Case		DL of Con. (a)	DL of Soil (b)	Live Load (c)	Water Pressure (d)	Soil Pressure (e)	Mooring Load (f)	Reaction Force (g)	Increase of Allowable Stress
Ordinary Case	Case1	x	x	x	x	x		x	1.0
	Case2	x	x		x	x		x	
Mooring Case	Case3	x	x	x	x	x	x	x	1.0
	Case4	x	x		x	x	x	x	

c) Check the working stress of PHC pile

The prestressed concrete spun piles were checked by working stress design. The results of maximum axial forces and bending moments are summarized as below.

Ordinary Case

	Axial Force (kN)	Bending Moment (kNm)
PHC ϕ500	687	74
PHC ϕ600	1100	110

Mooring Case

	Axial Force (kN)	Bending Moment (kNm)
PHC ϕ500	701	76
PHC ϕ600	1124	123

The interaction curve diagrams were obtained based on the following formula.

Compression: $$\sigma_c = \frac{P}{A} + \frac{M}{Z} + \sigma_e \leq \sigma_{ca}$$

Tension: $$\sigma_t = \frac{P}{A} - \frac{M}{Z} + \sigma_e \geq \sigma_{ta}$$

where,

σ_c : maximum compressive stress (N/mm^2)
σ_t : maximum tensile stress (N/mm^2)
P : axial force (N) … positive in compression and negative in tension
M : bending moment (N-mm)
A : cross sectional area (mm^2)
Z : elastic modulus (mm^3)
σ_e : effective prestress (N/mm^2)
σ_{ca} : allowable compressive stress (N/mm^2)

$$\sigma_{ca} = \begin{cases} 27.0MPa: \text{ for Long Term} \\ 40.5MPa: \text{ for Short Term} \end{cases}$$

σ_{ta} : allowable tensile stress (N/mm^2)

$$\sigma_{ta} = \begin{cases} 0MPa: \text{ for Long Term} \\ 5MPa: \text{ for Short Term} \end{cases}$$

The plotted results of all loading combinations under working load condition are shown in Appendix 10-2 and 10-3.

d) Check of Pile Head Reinforcement

The reinforcement at the pile head is designed based on the internal force shown in the table below:

		Axial Force		Bending Moment	Reinforcing bar
		Max.(kN)	Min(kN)	Max.(kNm)	
Ordinary Case	PHC ϕ 500	687	548	74	8 ϕ 19
	PHC ϕ 600	1110	103	110	10 ϕ 22
Mooring Case	PHC ϕ 500	701	562	76	8 ϕ 19
	PHC ϕ 600	1124	77	123	10 ϕ 22

The detailed calculation results are shown in Appendix 10-2 and 10-3.

e) Check of Pile Bearing Capacity

Ultimate bearing capacity is calculated as following formulas.

The piles driven into sandy ground by hammer:

$$R_u = 300NA_p + 2\overline{N}A_s$$

where,

R_u : ultimate bearing capacity of pile (kN)
A_p : toe area of pile (m^2)
A_s : total circumferential area of pile (m^2)
N : nominal N-value for end bearing
$\overline{N}$: mean N-value for total penetration length of pile

The nominal N-value for end bearing is calculated by equation below.

$$N = \frac{N_1 + \overline{N_2}}{2}$$

where,

N_1 : N-value at the toe of pile
$\overline{N_2}$: mean N-value in the range from the toe of pile to the level 4B above
B : diameter or width of pile (m)

The piles driven into clayey ground by hammer

$$R_u = 8c_p A_p + \overline{c_a} A_s$$

where,

cp : cohesion at pile toe (kN/m^2)
$\overline{c_a}$: mean adhesion for total embedded length of pile (kN/m^2)

The adhesion value may be calculated as follows:

ca = c : $c \leq 100$ kN/m^2
ca = 100kN/m^2 : $c > 100$ kN/m^2

Factor of Safety

Allowable working axial loads on piles are obtained by dividing ultimate pile capacity by factors of safety shown as below.

	Compressive	Pulling
Ordinary/Mooring Case	2.5	3.0

The calculation results of the bearing capacity are summarized in the following table.

		Allowable Bearing Capacity Ra		Max. Axial Force P		Pile Weight	Check		Judge
		Comp. (kN)	Pulling (kN)	Comp (kN)	Pulling (kN)	W (kN)	P+W Comp (kN)	P-W Pulling (kN)	< Ra ?
PHC ϕ500	Ordinary Case	1,307	432	687	-	39	726	-	OK
	Mooring Case			701	-		740	-	
PHC ϕ600	Ordinary Case	1,775	531	1100	-	57	1,157	-	OK
	Mooring Case			1124	-		1,181	-	

3) Deck Slab

Summary of internal forces and rebar arrangement of Transversal direction is shown in the table below:

	Unit	Bottom 1	Bottom 2	Bottom 3	Top 1	Top 2	Top 3
Ordinary Case							
Internal force							
Bending moment	kNm	694.2	15.7	74.9	165.0	197.1	68.6
Shear force	kN	313.8	313.8	182.2	313.8	182.2	92.3
Rebar Arrangement							
1st	Bar-1	5- D19	5- D19	5- D19	5- D19	5- D19	5- D19
	Bar-2	5- D32			5- D19	5- D19	
2nd	Bar-1	5 - D22					
	Bar-2	5 - D22					
Mooring case							
Internal force							
Bending moment	kNm	668.0	9.9	79.0	182.7	202.0	68.6
Shear force	kN	310.2	310.2	185.2	310.2	185.2	91.5
Rebar Arrangement							
1st	Bar-1	5- D19	5- D19	5- D19	5- D19	5- D19	5- D19
	Bar-2	5- D32			5- D19	5- D19	
2nd	Bar-1	5 - D22					
	Bar-2	5 - D22					

Summary of internal forces and rebar arrangement of Longitudinal direction is shown in the table below:

	Unit	Parapet	Front wall	Bottom	Top
Internal force					
Bending moment	kNm	28.1	675.7	55.1	98.8
Shear force	kN	22.8	198.7	133.5	133.5
Rebar Arrangement					
1st	Bar-1	5-D16	5 - D16	5 - D19	5 - D19
	Bar-2		5 - D16		

18.2 Revetment for Public Related Area

Since the structure of Revetment for Public Related Area is uncomplicated, the basic design mentioned in Chapter 10.3 is understood as detailed design.

18.3 Utility Works

Since service boat berth is scheduled to be constructed under ODA loan, ship hydrant and connection pipes at service boat berth are installed under ODA loan Project.

Basic design of total utility supply system for electric water supply to Public Related Area has been carried out by Vietnamese Government. The electric and water supply system for Public related area should be well-planned and designed considering total system to public related area and it is expected that the system is to be planned, designed and constructed by the organization which uses such facilities.

18.3.1 Electric Power Supply

Electric supply system in public Related Area and the connection to the main cable is deemed to design and construct by Vietnamese side. External lighting at berth apron area for service boat berth is also designed in details and constructed by the Project Owner.

18.3.2 Water Supply

The plan and basic design of total water supply system in the Public Related Area has been developed by Vietnamese Government. In this ODA project, the water supply at service boat berth area is constructed simultaneously with the construction of service boat berth and apron pavement.

In this DD Study, the water supply to the service boat berth is planned and designed based on the proposed connection point of water supply between the Public Related Area and service boat berth. It is recommended that the plan and design of water supply to the service boat berth should be reviewed when water supply system in the Public Related Area will be designed in details by Vietnamese side.

1) Plan of Water Supply to Service Boat Berth

a) Connection to Service Boat Berth

The JICA Study Team proposes the location shown in Figure 18.3.1.

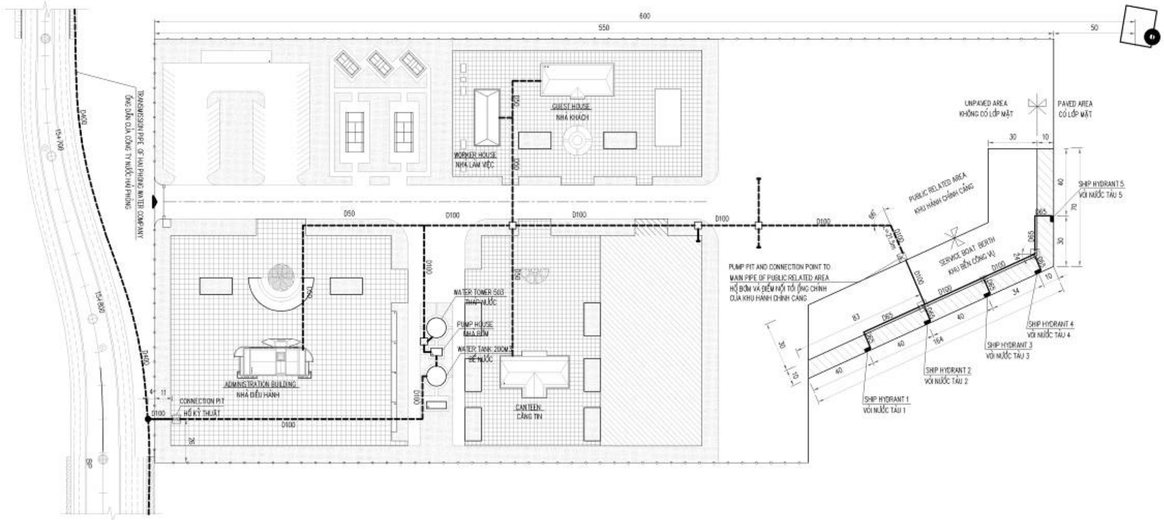


Figure 18.3.1 Proposed Water Supply System to Service Boat Berth

Regarding the pipe size of water supply, D76 is applied to water supply for the connection part between building area and service boat berth in the Public Related Area. The JICA Study Team recommends that D76 should be replaced by D100 considering the expected water consumption in the service boat berth.

b) Plan of Ship Hydrant

The number of ship hydrant is determined based on the Vietnamese guideline considering the Japanese guideline. The former requires the interval of 40~50m for service boat. The latter does that of 30m. In this study, the interval of within 40m is applied to the planning of ship hydrant in the service boat berth, and total five ship hydrants will be installed in the service boat berth as shown in Figure 18.3.2.

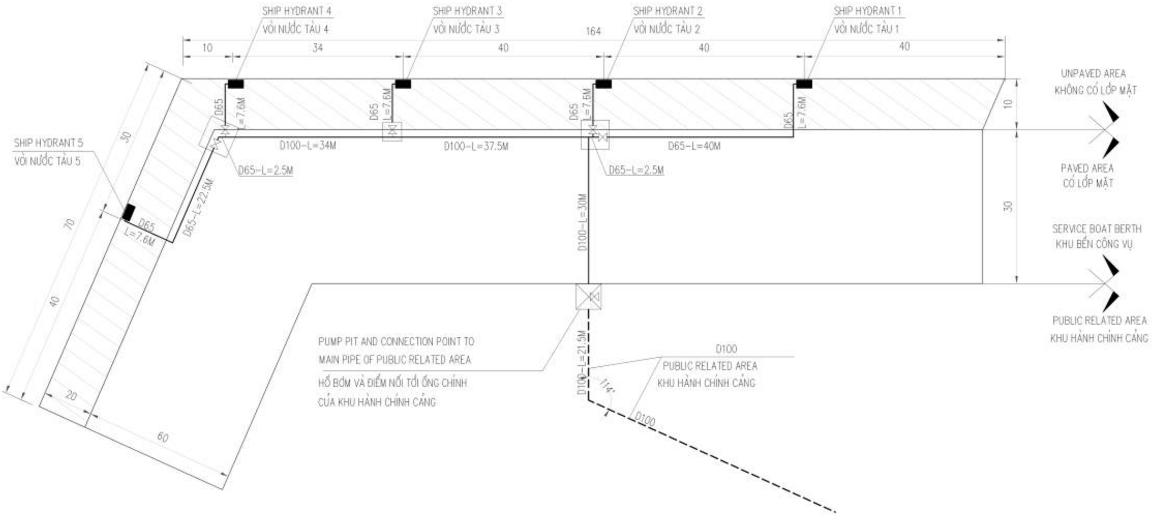


Figure 18.3.2 Plan of Ship Hydrant in Service Boat Berth

2) Design of Water Supply to Service Boat Berth

a) Connection Pit between Public Related Area and Service Boat Berth

This connection pit is planned to have a water pump, as water tower has not been designed yet by Vietnamese Government. If sufficient water head at each hydrant is available, water pump can be cancelled.

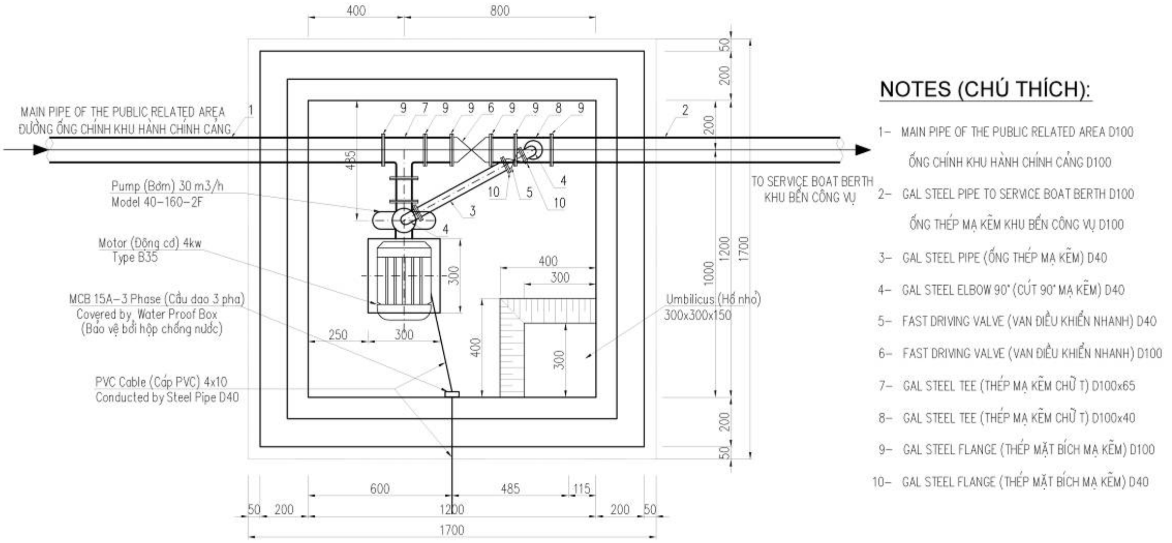


Figure 18.3.3 Connection Pit between Public Related Area and service Boat Berth

b) Connection Pit to Ship Hydrants

The two types of connection pits to ship hydrants are planned and designed to check the water supply volume to ships and to shut off water pipeline for the convenience of maintenance service. The left one has one valve, and the right has two valves in each connection pit.

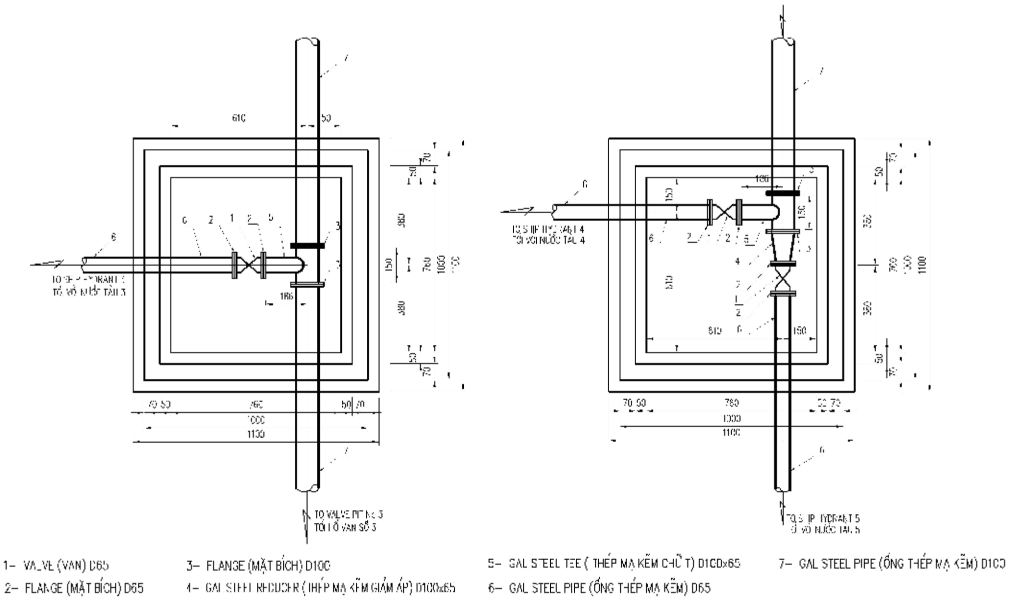


Figure 18.3.4 Connection Pits to Ship Hydrants (2 types)

c) Ship Hydrant

Figure 18.3.5 shows the detail of ship hydrant in the service boat berth.

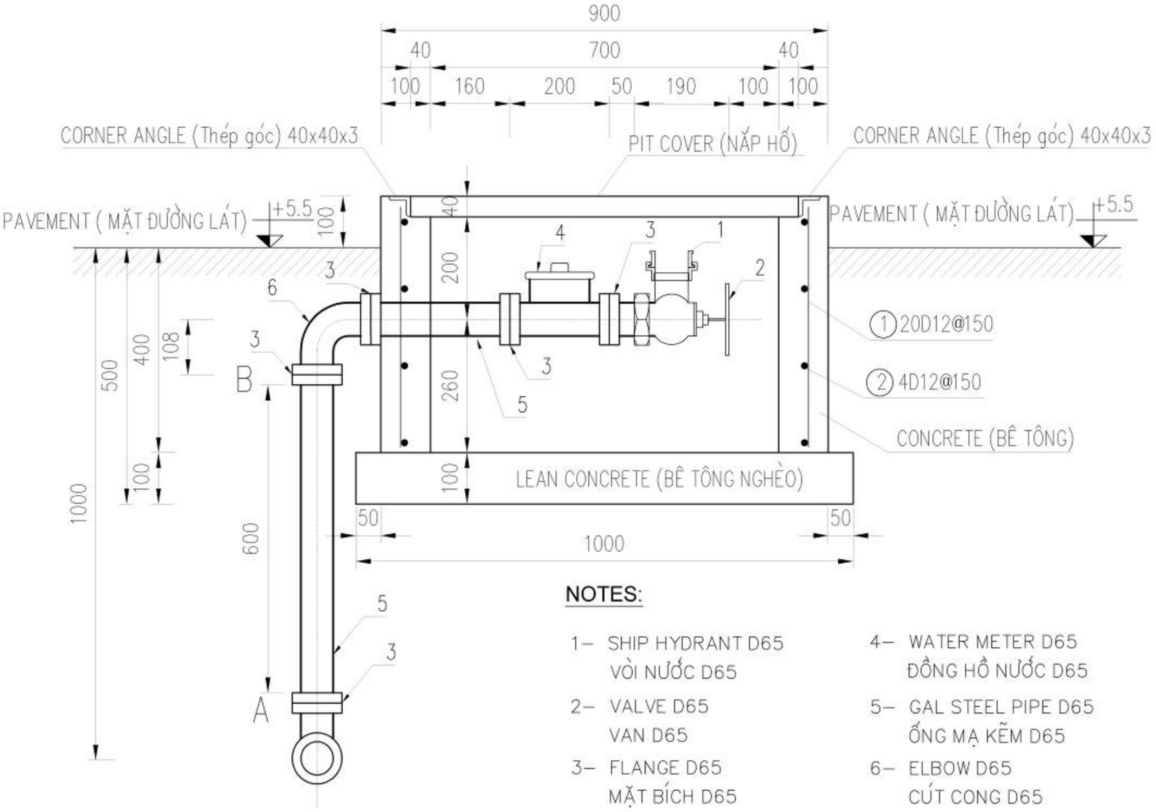


Figure 18.3.5 Ship Hydrant

Package 10 Breakwater and Sand Protection Dyke

19. SAND ROTECTION DYKE

19.1 Design Standards and Conditions

Basically, Japanese standard for port and harbor structures, Technical Standards and Commentaries for Port and Harbor Facilities (OCDI-2002), are employed for the design while Vietnamese standard will be used for checking the results, in case that the latter exhibit significant difference with those of the Japanese standard. Following design standards were also applied as references when detailed information was required.

- Design Manual for Coastal Facilities (JSCE, 2000)
- Shore Protection Manual (US Army Corps of Engineers, 1984)
- Coastal Engineering Manual (US Army Corps of Engineers, 2004)
- Design of Vertical Breakwaters (Port and Airport Research Institute, Japan)
- Design Guideline of Tetra-pod (Tetra-pod Co., Ltd., 1995)
- The Rock Manual. The use of rock in hydraulic engineering, 2nd edition (C683, CIRIA, London, 2007)

Natural conditions such as tides, offshore design waves were presented in the previous section. Return period of 30 years of offshore design waves is considered and H.H.W.L is not considered in the design of the structure considering the rather low effect on safety issues.

Layout and the crown height of the structure were determined through the study of numerical sedimentation simulation in Chapter 5. Ground settlement will not considered in the design on conditions that cautious periodical inspection and survey and execution of appropriate maintenance work shall be done during the course of port operation.

19.2 Detailed Design of Sand Protection Dyke

19.2.1 Design Conditions

1) Alignment and the type of the structure

Figure 19.2.1 shows the alignment of Sand Protection Dyke together with the information of sea bottom depth obtained by latest bathymetric survey. Figure 19.2.2 shows the sea bottom profile along the structure.

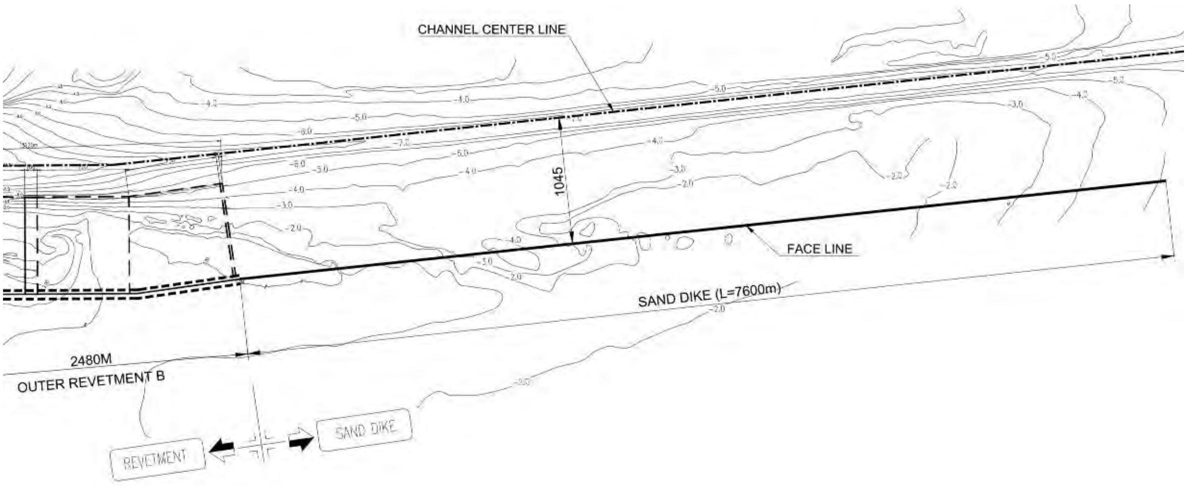


Figure 19.2.1 Alignment layout of Sand Protection Dyke

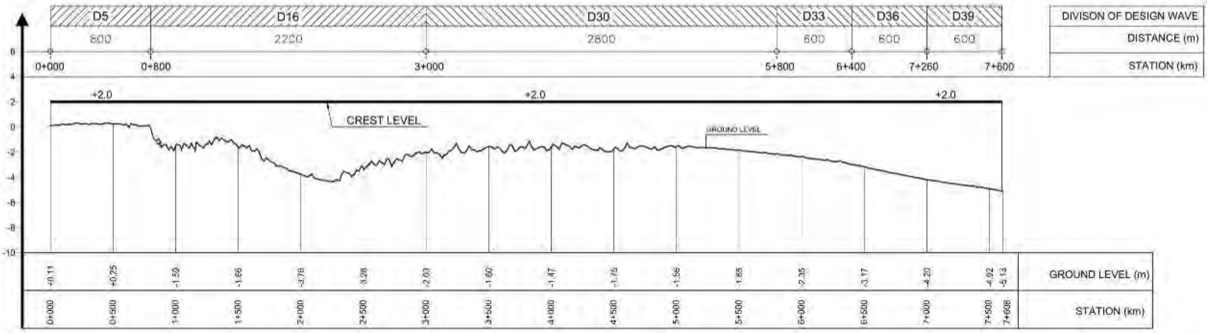


Figure 19.2.2 Sea bottom Profile of Sand Protection Dyke

Sloping dyke with wave dissipating concrete block of Tetra-Pod as an outer armor layer for both side and with concrete cellular caisson as a superstructure was employed through the comparison study with other candidate type of structure in Chapter 8. Crown height of the structure was also determined in this study to be not less than 3.0m from the sea bottom.

2) Tide and Waves

Natural conditions Tides and Offshore Design Waves are shown in Chapter 16. H.H.W.L was not considered and offshore wave condition of return period of 30 years was considered.

Design wave heights of H_{max} and $H_{1/3}$ were shown in the tables in Chapter 2.

3) Sub soil conditions

Although the Subsoil conditions along the alignment of Sand Protection Dyke were not available, the necessity of soil improvement work for the structure was studied in Chapter 8 using the data obtained at the alignment originally planned Sand Protection Dyke in SAPROF study in previous chapter 2 and soil improvement work was found out to be unnecessary.

19.2.2 Wave Dissipating Concrete Block and Foot Protection Block

“- The Rock Manual - The use of rock in hydraulic engineering, 2nd edition (C683, CIRIA, London, 2007)” was used.

Design procedure for determination of weight of wave dissipating concrete block was written in Chapter 9 and the results are shown in Table 9.3.1. Slope gradient of 1:2 for wave dissipating block was employed.

Design procedure for determination of weight of foot protection block was discussed in Chapter 9 and the results are shown in Table 9.3.3.

Following the recommendation given by Standards and Commentaries for Port and Harbor Facilities (OCDI-2002), 1.5 times larger weight of wave dissipating concrete block at the head of the structure were employed.

19.2.3 Superstructure

Necessary dimension of cellular caisson as a superstructure against the incident wave force was shown in Table 9.3.3 in Chapter 9. Horizontal dimension of 2.5 and 3.0m x 2.0m and maximum height of 3.5m for each cellular caisson was determined by taking into consideration of the easiness of handling and placing the structure at the site.

Precast concrete block was used as an alternative structure of cast-in capping concrete.

19.2.4 Cellular Caisson

Wave force and internal earth pressure by filled rubble material were considered for the design of cellular caisson. Incident wave force was calculated by Goda's Formula shown in equation (9-3). Filled core rubble mound properties for the design were shown Table 19.2.1. The results of these calculations were shown in Table 19.2.2.

Table 19.2.1 Properties of core rubble mound

No.	Properties	Value	Unit
1.	Specific weight (γ_s)	2.6	t/m^3
2.	Buoyant unit weight (γ')	1.575	t/m^3
3.	Porosity (P)	37	%
4.	Angle of internal friction (ϕ)	40	degree

Dimension of caissons will be determined by results of stability calculation due to wave pressure with 30 years of period. All dimensions of caissons for each water depth were shown in Table 9.3.3 in Chapter 9. The results of stability calculations of cellular caisson were shown in Table 19.2.2, the fiction factor between rubble cellular and rubble mound is 0.8 in case of sliding. Detailed design procedure for stability calculations of cellular caisson were presented in Appendix 19-1.

Table 19.2.2 Results of stability calculation of cellular caisson against wave pressure

No.	Alternative	Seabed Elev. (m)	SAFETY FACTORS	
			SLIDING	OVERTURNING
1	CASE B-1	0.0	1.95	9.70
2		-1.0	1.81	10.10
3		-2.0	1.57	5.00
4		-3.0	1.38	6.98
5		-4.0	1.30	4.71
6		-5.0	1.83	5.60
7	CASE B-2	0.0	2.25	17.89
8		-1.0	2.08	16.53
9		-2.0	2.56	20.62
10		-3.0	2.29	18.49
11		-4.0	1.84	14.86
12		-5.0	2.00	16.15

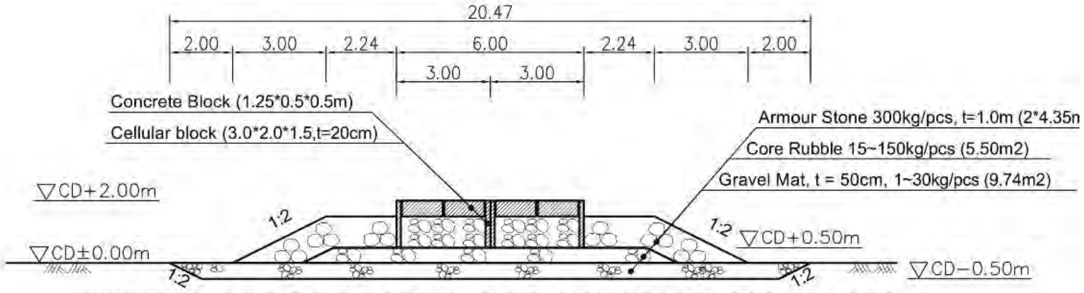
Basing on typical dimension of cellular caisson as results of stability analysis due to wave pressure were presented in Appendix 19-6, 2Lm x 3.0Bm x 2.5Hm x 0.2THKm of cellular caisson was selected to calculate structure due to external forces as representative of all cellular caissons. External forces acting on surface wall of cellular caisson including of wave force and filling soil pressure. Re-bar arrangement was calculated basing on Vietnamese Standard, TCVN 4116-85. Detailed design procedure for structure calculations of cellular caisson were presented in Appendix 19-17. Summary of results see below table:

Table 19.2.3 Results of structural calculation of cellular caisson

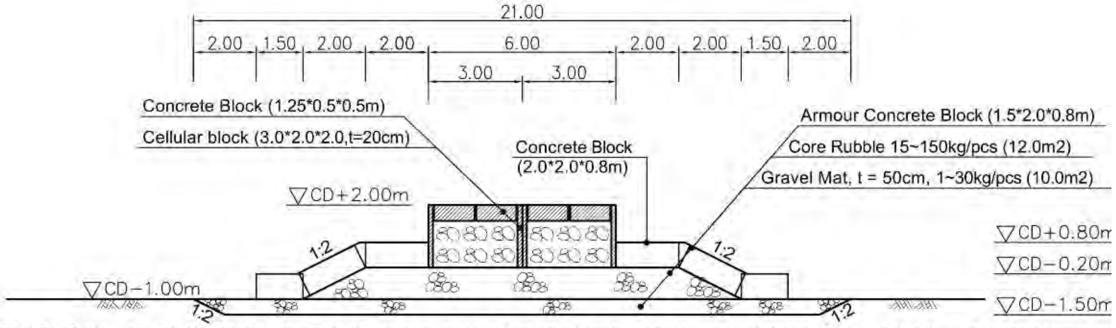
No.	Items	Results
1	Bending moment of cellular caisson wall: Mspan Msupport	 1.38 t.m 0.69 t.m
2	Re-bar arrangement (both side)	ϕ14 @200mm
3	Concrete cover	min. 5 cm

19.2.5 Typical Cross Section

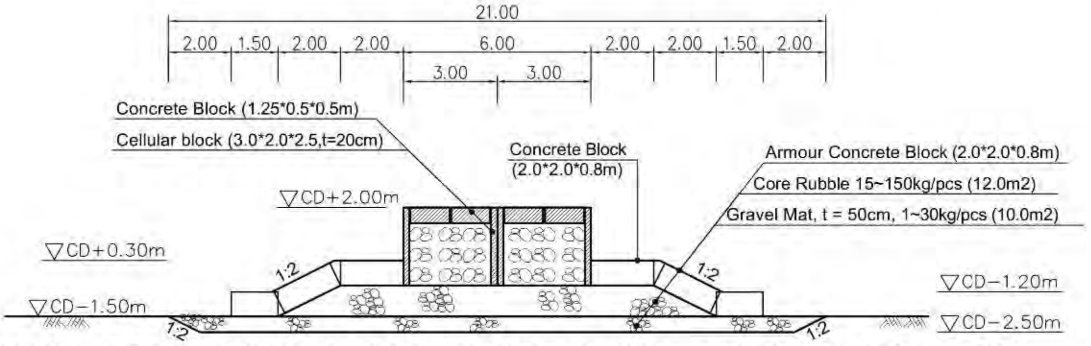
Typical cross sections of Sand Protection Dyke for each water depth were shown in Figure 19.2.3.



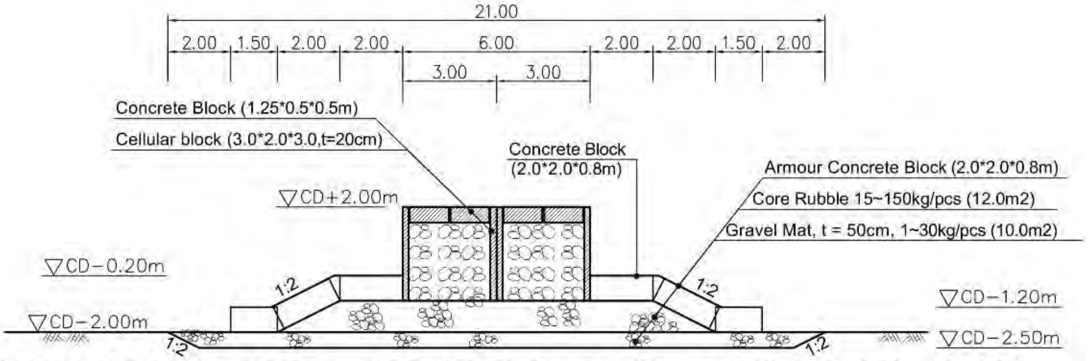
TYPICAL CROSS SECTION FOR STATION 0+000 ~ 0+800



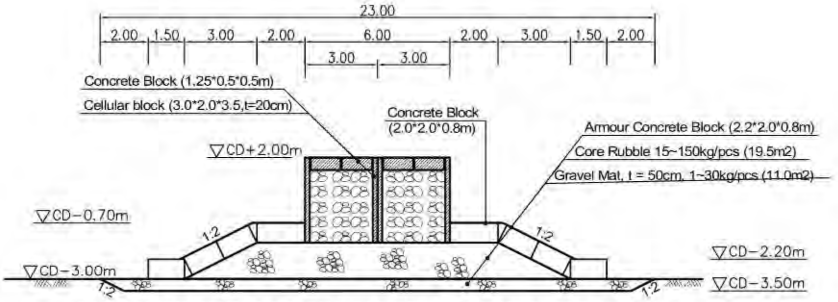
TYPICAL CROSS SECTION FOR STATION 0+800 ~ 0+900 & 1+250 ~ 1+450



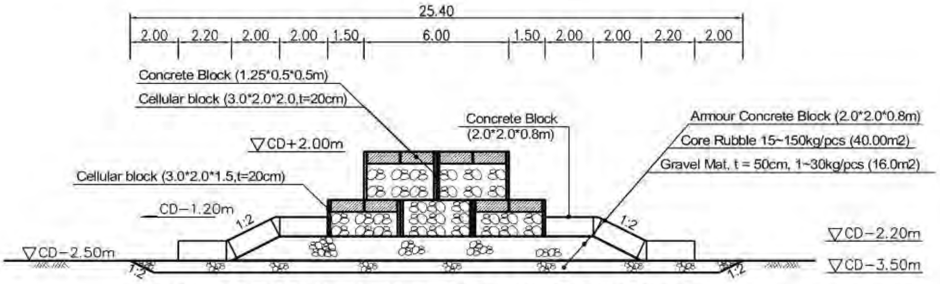
TYPICAL CROSS SECTION FOR STATION 0+900 ~ 1+250 & 1+450 ~ 1+700



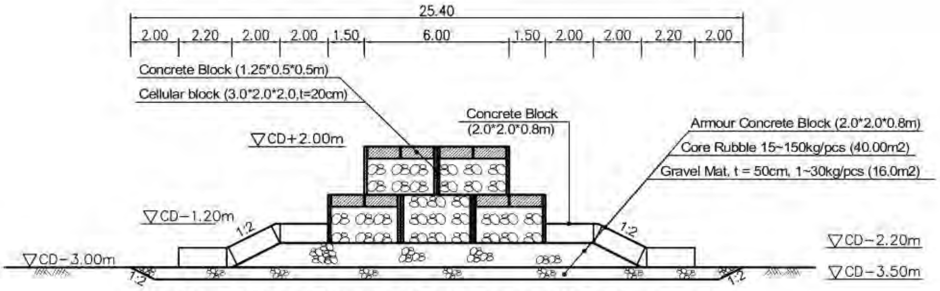
TYPICAL CROSS SECTION FOR STATION 1+700 ~ 1+800 & 2+950 ~ 6+000



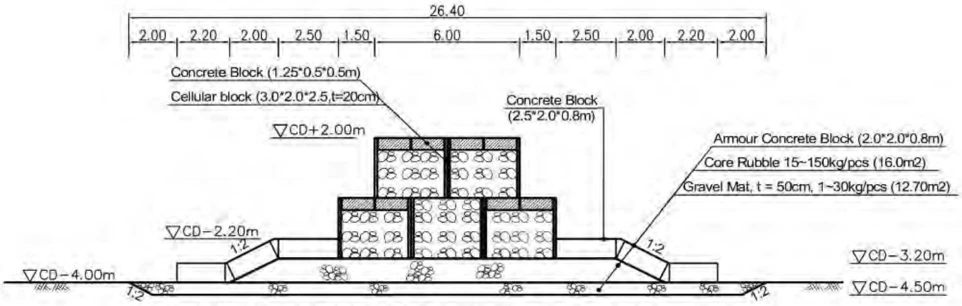
TYPICAL CROSS SECTION FOR STATION 1+800 ~ 2+950



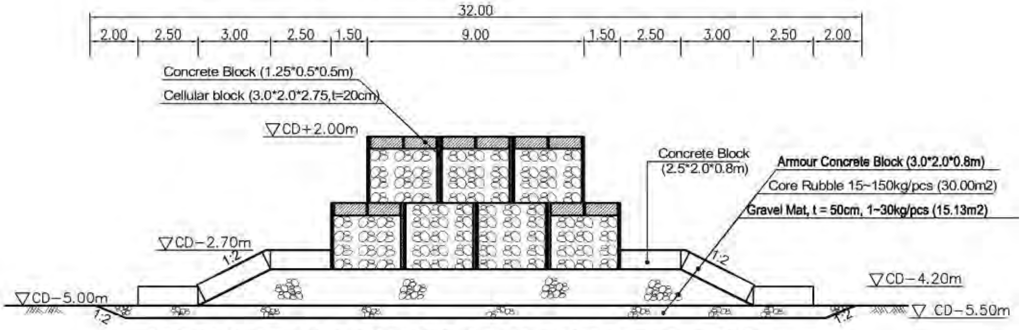
TYPICAL CROSS SECTION FOR STATION 6+000 ~ 6+350



TYPICAL CROSS SECTION FOR STATION 6+350 ~ 6+600



TYPICAL CROSS SECTION FOR STATION 6+600 ~ 7+150



TYPICAL CROSS SECTION FOR STATION 7+150 ~ 7+600

Figure 19.2.3 Typical Cross Sections of Sand Protection Dyke for Each Water Depth

19.2.6 Improvement of Important Area

In order to ensure the safety for the head part of Sand Protection Dyke, wave dissipating blocks of 16 tons (12 tons: RAKUNA-IV, for reference) was employed. Although the necessary weight of 10.0 tons (8 tons: RAKUNA-IV, for reference) was obtained by employing Hudson’s formula in normal case, 1.5 times of necessary weight for wave dissipating blocks were considered for ensuring the safety at the head part of the dyke structure.

The area of installation of wave dissipating blocks was determined by considering the hazardous wave direction as shown in Figure 19.2.4. Considering the necessary width of 7m for dyke structure, the length of 10m from the tip of the dyke for channel side and the length of 20m from the tip for offshore sea side were employed as the area of installation of wave dissipating blocks.

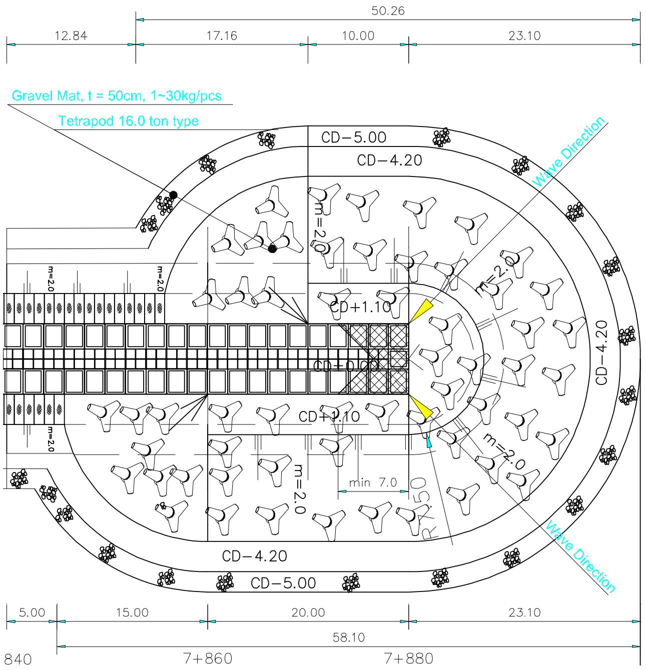


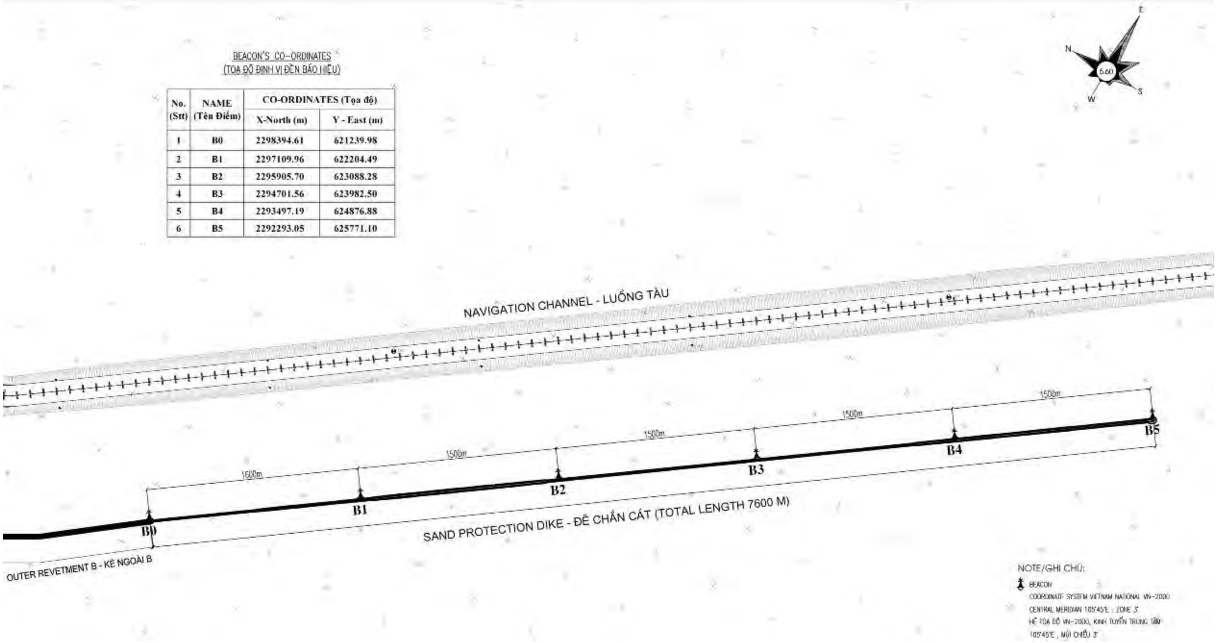
Figure 19.2.4 Plan of Head part of Sand Protection Dyke

19.3 Beacon Marker

Because the crest of Sand Protection Dyke were not more than CDL+2.00, every part of the structure were not visible during high tide. Beacon markers were placed at 6 locations which were shown in Figure 19.3.1.

As mentioned above, Sand Protection Dyke will be invisible during higher tidal level due to its crest level of CDL +2.00 m. Prestressed High Strength Concrete Pile (PHC Pile) is proposed as the foundation of beacon markers in order to avoid adverse effect on the Sand Protection Dyke structure occurring in a case that ordinary concrete block is placed on the Sand Protection Dyke for foundation of beacon marker. Figure 19.3.2 shows the example of light beacon cross section. The detailed calculation of PHC pile is shown in Appendix 19-18.

Specification of beacon marker should be followed by the National Technical Regulation on Aids to Navigation. Table 19.3.1 shows the specification of the light beacon on sand protection dyke. Figure 19.3.3 shows the example of 5m light beacon marker.



BEACON'S CO-ORDINATES
(TOẠ ĐỘ ĐỊNH VỊ ĐÈN BÁO HIỆU)

No. (Stt)	NAME (Tên Điểm)	CO-ORDINATES (Tọa độ)	
		X-North (m)	Y - East (m)
1	B0	2298394.61	621239.98
2	B1	2297109.96	622204.49
3	B2	2295905.70	623088.28
4	B3	2294701.56	623982.50
5	B4	2293497.19	624876.88
6	B5	2292293.05	625771.10

Figure 19.3.1 Beacon marker location

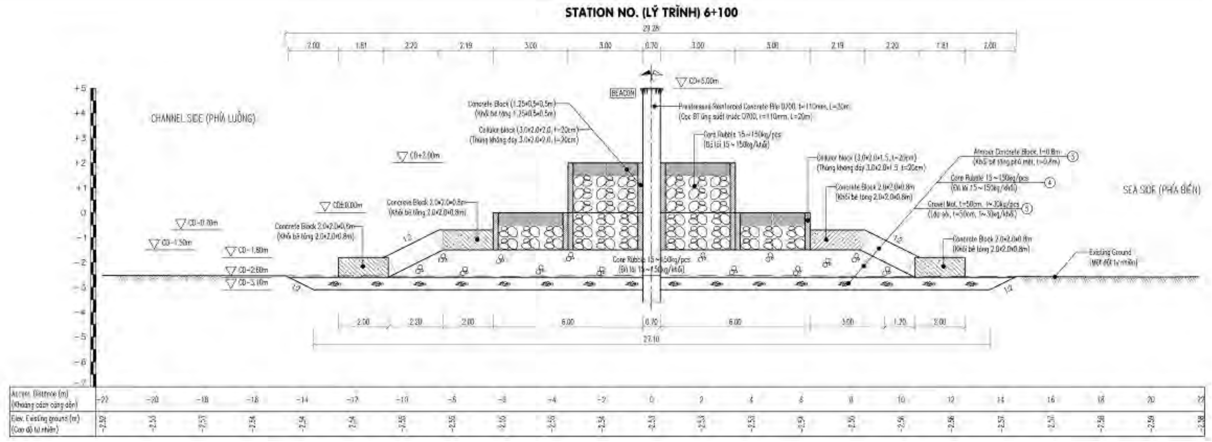


Figure 19.3.2 Typical Section of Sand Protection Dyke at the Location of Beacon Marker

Table 19.3.1 Technical Specification of Light Beacon on Sand Protection Dike

Beacon Body		Lighting Equipment		Power Source	
Overall Length	approx. 5.27m	Light Source	Super High Intensity LED	Solar Cell Module	Output (8V, 1.3W)x4pcs
Focal Plane Height	approx. 5.23m	Light Color	Followed by VMS	Total Output Power	8V 5.2W
Total Mass	approx. 350kg	Light Character	FI.3s (M=0.5sec) (0.5+2.5)	Storage Battery	Sealed Lead Acid Battery (NP10-6x2pcs)
Painting Color	Followed by VMS	Flasher	Microprocessor type	Mass	approx. 4kg
		Fixed Intensity	27cd		
		Effective Intensity	14cd (M=0.5sec)		
		Luminous Range	2.9N.M (T=0.74)		

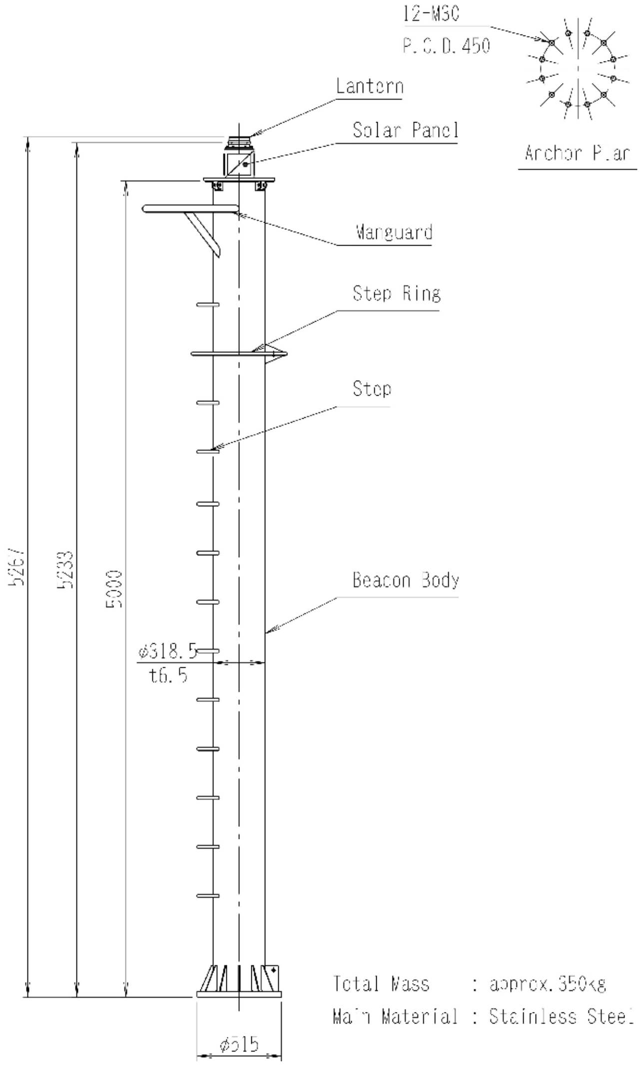


Figure 19.3.3 Example of Light Beacon (5m height)

DIVISION – IV

PROJECT EXECUTION AND EVALUATION

20. DETAILED CONSTRUCTION PLAN

20.1 Scope of Construction

The construction works for the Lach Huyen Port Project are listed as the following:

Table 20.1.1 Work Scope

Package No.	Works Contents	Unit	Quantity
6	Infrastructure Construction Behind the Container Terminal		
1	Inner Revetment	M	709
2	Outer Revetment-A	M	750
3	Reclamation	M3	2,201,525
4	Soil Improvement	M2	552,327
5	Service Berth	M	347
6	Port Service Road	M	1,000
8	Channel Dredging and Disposal Works Part A		
	Channel & turning basin dredging and disposal at off shore dumping site	M3	16,693,927
9	Channel Dredging and Disposal Works Part B		
	Channel & turning basin dredging and disposal at off shore dumping site	M3	21,285,780
	Total Dredging Volume	M3	37,979,707
10	Breakwater and Sand Protection Dyke Works		
1	Sand Protection Dyke	M	7,600
2	Outer Revetment B	M	2,480

Source: JICA Study Team

Indicated works and quantities are estimated based on the Detail Design.

Construction method and work schedule are described in this Chapter. These methods are to be foundations of the Cost Estimation for the Project.

20.2 General Conditions of the Site

General conditions of the site are mentioned in the Chapter-13[Preliminary Construction Plan].

20.3 Construction Sites

Construction sites are mentioned in the Chapter-13[Preliminary Construction Plan].

20.4 Material Availability

Material availability is studied and mentioned in the Chapter-13[Preliminary Construction Plan].

20.5 Equipment Availability

Equipment availability is studied and mentioned in the Chapter-13[Preliminary Construction Plan].

20.6 Temporary Works

20.6.1 Temporary Yard

Prior to the commencement of permanent structures construction, temporary yard should be constructed mainly for the following works:

- Fabrication and stockpile of the Concrete block and wave dissipating block
- Temporary stockpile of the main materials like stone, Re-bar and steel pile

Temporary road, stockpile yard, fabrication yard, and administrating area are to be located in this temporary yard. Temporary jetty with suitable loading and unloading crane is required for transporting above materials from this yard to construction site. Temporary yard should be prepared and arranged by the Contractor in accordance with the Specifications by their own risk. Tentative plan of the temporary yard is studied for the estimation of the Project schedule in this Report.

In this tentative plan, Temporary yard is to be constructed at Cat Hai Island as instructed by the Vietnamese side.

1) Location and area of the Temporary Yard

a) Location

There are 2 candidate lands supposed to be used for the temporary yard, At Cat Hai and at South Dinh Vu. As the result of discussions between JICA study team and Vietnamese side, Cat Hai area is tentatively applied for the purpose of construction planning and cost estimates in this DD Study. According to review consultant, the comparison is made as the following:

Table 20.6.1 Work Scope Comparison of Temporary Yard Location

Comparison of Proposed Site		
	Cat Hai	South Dinh Vu
Land Acquisition	Done by the Employer	By the contractor
Procurement Period	Shorter	Longer
Land Reclamation	Shorter (Existing on-land area)	Longer
Initial Cost (Estimate)	37.35 billion VND	41.39 billion VND
	(For costs of reclamation, temporary fence, removal of temporary yard, transportation of waste materials, etc.)	
Rental Cost	NIL	1.8 billion VND

Source: Portcoast Letter No. 12041007/CNPB dated April 10, 2012

Figure 20.6.1 Map of Cat Hai Area

b) Area

Tentative Plan of the Temporary Yard is shown in the Figure 20.6.2 [Sketch of Temporary Yard]. According to this plan, recommended area of the Temporary Yard is summarized as follow.

No.	Name of Area	Purpose	Area (m^2)
1	Temporary Road	For transporting	15,000
2	Fabrication Yard	For Concrete Block and Armor Block	10,000
3	Fabrication Yard	For Cellular Block	5,000
4	Fabrication Yard	For Wave Dissipating Block	8,000
5	Stockpile Yard 1	For Concrete Block and Armor Block	3,000
6	Stockpile Yard 2	For Cellular Block	4,000
7	Stockpile Yard 3	For Wave Dissipating Block	2,000
8	Stockpile Yard 4	For Piles before splicing	2,000
9	Stockpile Yard 5	For Piles after splicing	1,000
10	Splicing Yard	For SSP, PHC Pile and SSPP	1,000
11	Temporary Jetty	For transporting	3,000
12	Administrating area	For controlling	6,000
		Total	60,000

These areas are calculated based on the following preliminary conditions.

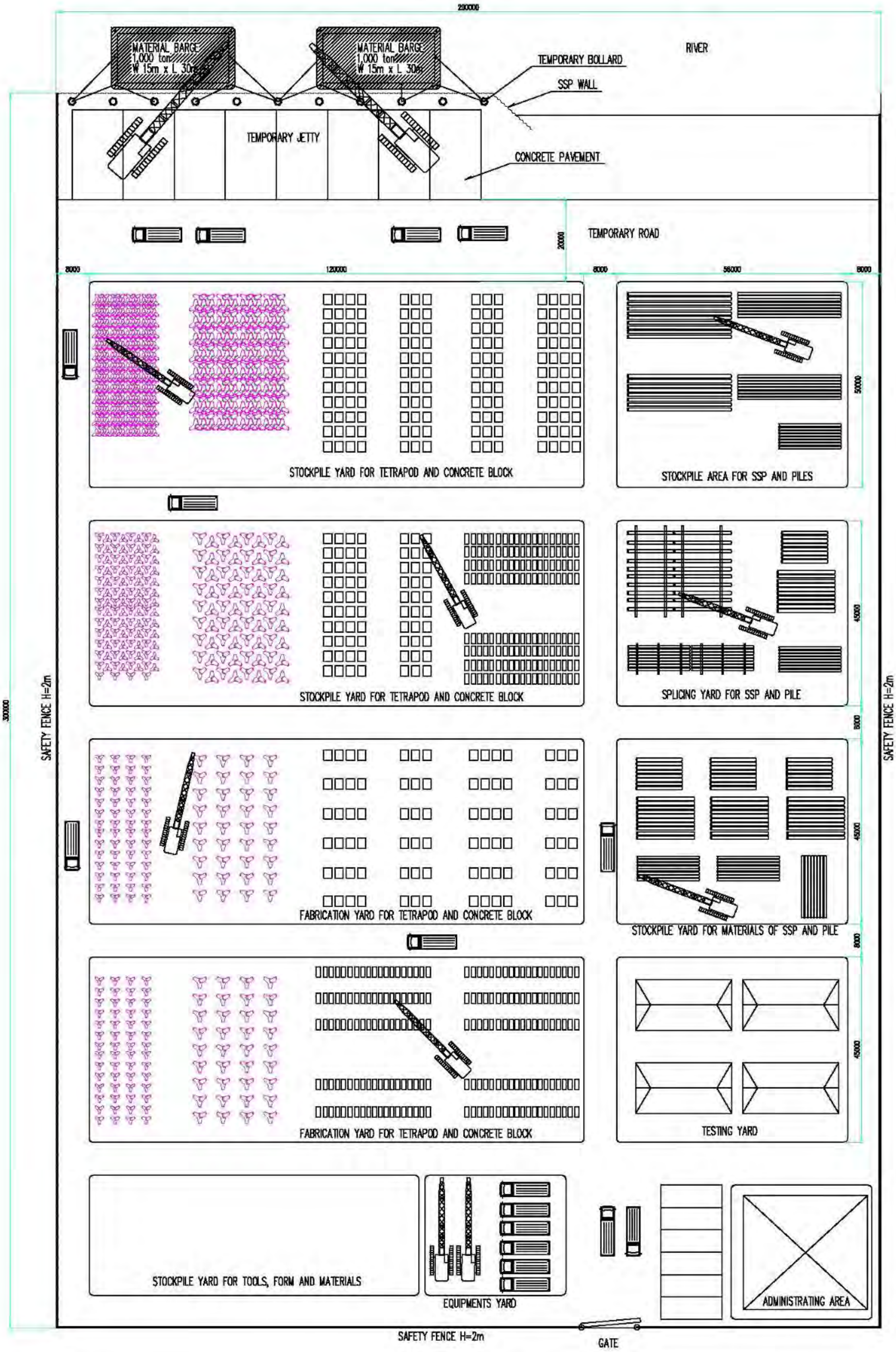
- Required supply number of the Wave Dissipating Block :	59	nos/day
Package 6 (Outer revetment A: 2ton type)	30	nos/day
Package 10(Outer revetment B : 3.2ton type)	12	nos/day
Package 10(Outer revetment B : 4.0ton type)	17	nos/day
- Required number of the Cellular Block (Package 10):	15	nos/day
- Required number of the Cellular Cover (t=0.8m):	78	nos/day
- Required supply number of the Concrete Block (Package 10):	10	nos/day
- Required supply number of the Armor Block (Package 10):	8	nos/day

Although Sand protection dyke has another armor block 12, 16 ton type, but the installation is only at the head edge, that is, the total manufacturing number is small compared to total manufacturing time, so required number is less than 1 / day. Considering total number of required concrete blocks, daily required concrete volume to manufacture the blocks will be 266m^3/day, which is consisted of: Package 6: 60m^3/day, and Package 10: 206m^3/day.

A basic productivity of common concrete plant in Vietnam is known as approximately 100m^3/day with a margin, so the whole Project requires 3 sets of the plant system.

To maintain the above large quantities, it is recommended that concrete beaching plants are established in the temporary yard. Considering the big scale of the Project, initial investment for the installation of the concrete plants will be paid and it will bring merits on the point of constant concrete providing and less potential risks depending on unstable local ready-mix suppliers.

The following Figure shows an idea of temporary yard. In case of installing concrete plant in this yard, considering huge work volume with a safety margin, the required space will be hopefully 5,000m^2/plant, 1,200m^2/plant as minimum, that is, minimum 3,600m^2 will be needed for 3 sets. This space will be acquired in the equipment yard & material stock pile yard shown in the bottom of Figure and where should be closer to the entrance of the yard for easy material off loading without disturbing other activities in the yard.



Source: JICA Study Team

Figure 20.6.2 Sketch of Temporary Yard

2) Land Development

For keeping a good & sound land for temporary works, land development is necessary. Material for the land development is by sand and it should be transported by the sand barge and pumped up to the planned elevation. Edge of the yard should be protected by sand bags and rubble stone against the wave should be installed. Designed elevation supposed to be +4.5m which is 1.0 m above the H.W.L. Filled sand should be compacted with the compaction machine. Soil improvement is not necessary because the purpose of the yard is for temporary and used for less than 5 years only.

3) Temporary Gate, Road and Fence

Temporary gate and fence should be constructed for the protection and safety purpose to the yard. Installation of the fence should be before material placing and when land development is completed. Type of fence is simple wire mesh type and height of fence should be 2.0m or over. Such works will be carried out by manpower with Backhoe or small size crane. For the activities in the temporary yard, temporary access road should be prepared and maintained during the construction period by the Contractor’s responsibility. Its sub-grade should be compacted by compaction roller and base gravel (0 – 40mm) should be placed & compacted with 300mm thickness on the sub-grade.

4) Fabrication Yard and Stockpile Yard

Stockpile yard should be covered by the base gravel (0 – 40mm) with 200mm thickness for easy movement & access of the equipment. Also, it will be effective to prevent material from getting dusty. Splicing yard and fabrication yard of the concrete block should be covered by base gravel (0 – 40mm) with 200mm thickness and surface concrete with 100mm thickness to keep quality of the splicing and concrete block. Gravel should be leveled by Bulldozer and compacted by compaction roller. Concrete should be installed by mixing truck and leveled by manpower. As a matter of course, steel material like Re-bars, shaped steel and tie-rod should not be placed directly on the ground but on squared timber to prevent getting rusty. Cement should be kept in silo or closed warehouse to avoid moisture and weathering. Sand and stone should be kept under roof & wall to maintain water content and prevent from flying & distributing.

5) Temporary Jetty

Temporary jetty for loading of the blocks, piles and other materials should be constructed at the riverside of the temporary yard. Width, length and height of the temporary jetty should be considered based on the loading equipment and draft of material barge. Revetment of the temporary jetty should be made by Steel Sheet Pile (SSP). Inside of the Revetment should be filled with sand and surface of the temporary jetty should be covered with base gravel (0 – 40mm) with 300mm thickness and covering concrete with 200mm thickness for the stability of the loading equipment. SSP should be placed with vibro hammer attached with backhoe or equipped to truck crane.

20.6.2 Temporary Access Road for the Site

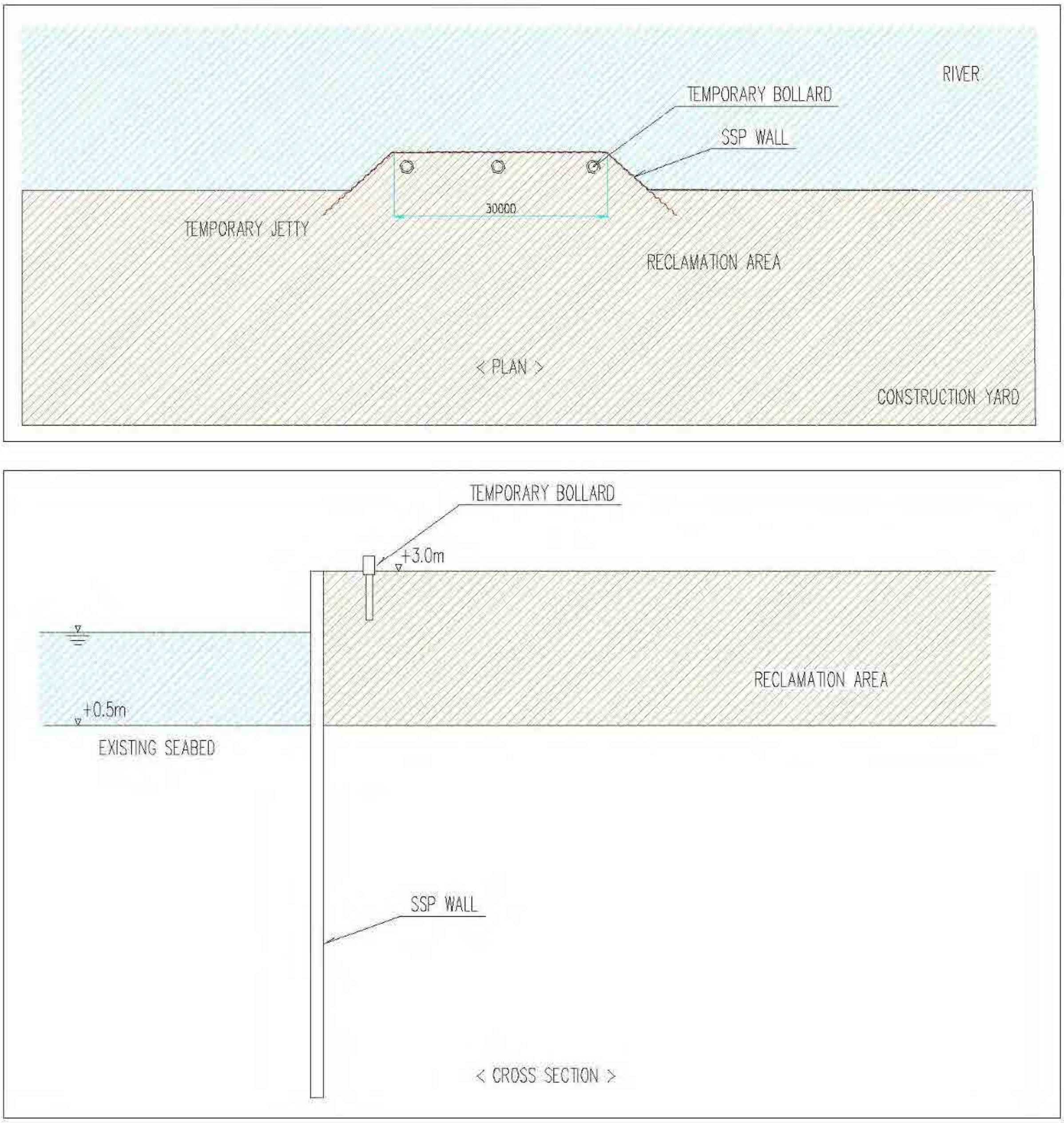
As for Lach Huyen Project, the main structures are located at off shored, like Revetment, Reclamation and Soil Improvement, therefore, main access will be by marine access and on land access is not so important. However, total length of Revetment & Sand Protection Dyke are quite long, and related to this, manufacturing concrete blocks has many variations & numbers and total volume is a quite big so the on land temporary access to the temporary yard is very important to maintain the daily big demand for the block concreting.

20.6.3 Temporary Jetty for the Port Facility Works

Heavy earth equipments for the Soil Improvement, Service Berth and Service Road should be mobilized to the work site by Barge because some of them are too heavy for the ferry boat to transport.

There are some existing jetties in the Cat Hai Island however existing road to the site is too narrow for the transportation of the heavy equipments. Construction of the temporary jetty on the reclamation area is recommended.

Reference sketch of the Temporary Jetty is shown in Figure 20.6.3.



Source: JICA Study Team

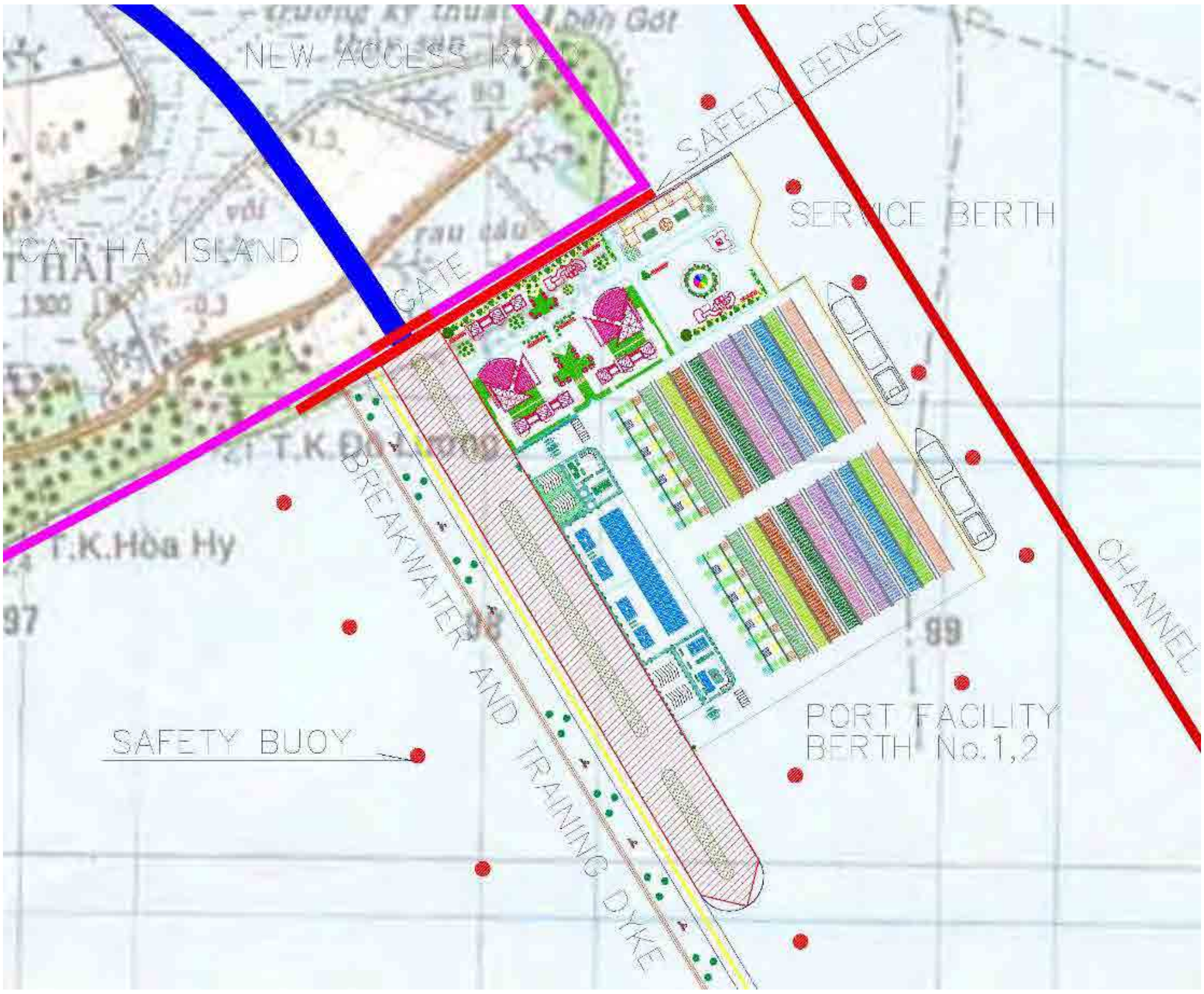
Figure 20.6.3 Sketch of Temporary Jetty

Temporary Jetty should be located in the Reclamation Area. Location should be selected with consideration of the work sequence and schedule.

20.6.4 Safety Fence, Safety Buoy and Gate of Site

Work site should be surrounded by fencing with safety gate and bordered from public area and other construction project site. Safety fence should be enough strength against the wind & heavy rains and invade by criminals. Safety buoy should be installed to indicate that there are working sites, Terminal Reclamation, Revetment and Sand Protection Dyke. As a reference, location of the temporary fence, buoy and gate is shown in Figure 20.6.4.

Detail location in accordance with the Vietnamese Law should be mentioned in the Section 20.13 [Construction Safety].



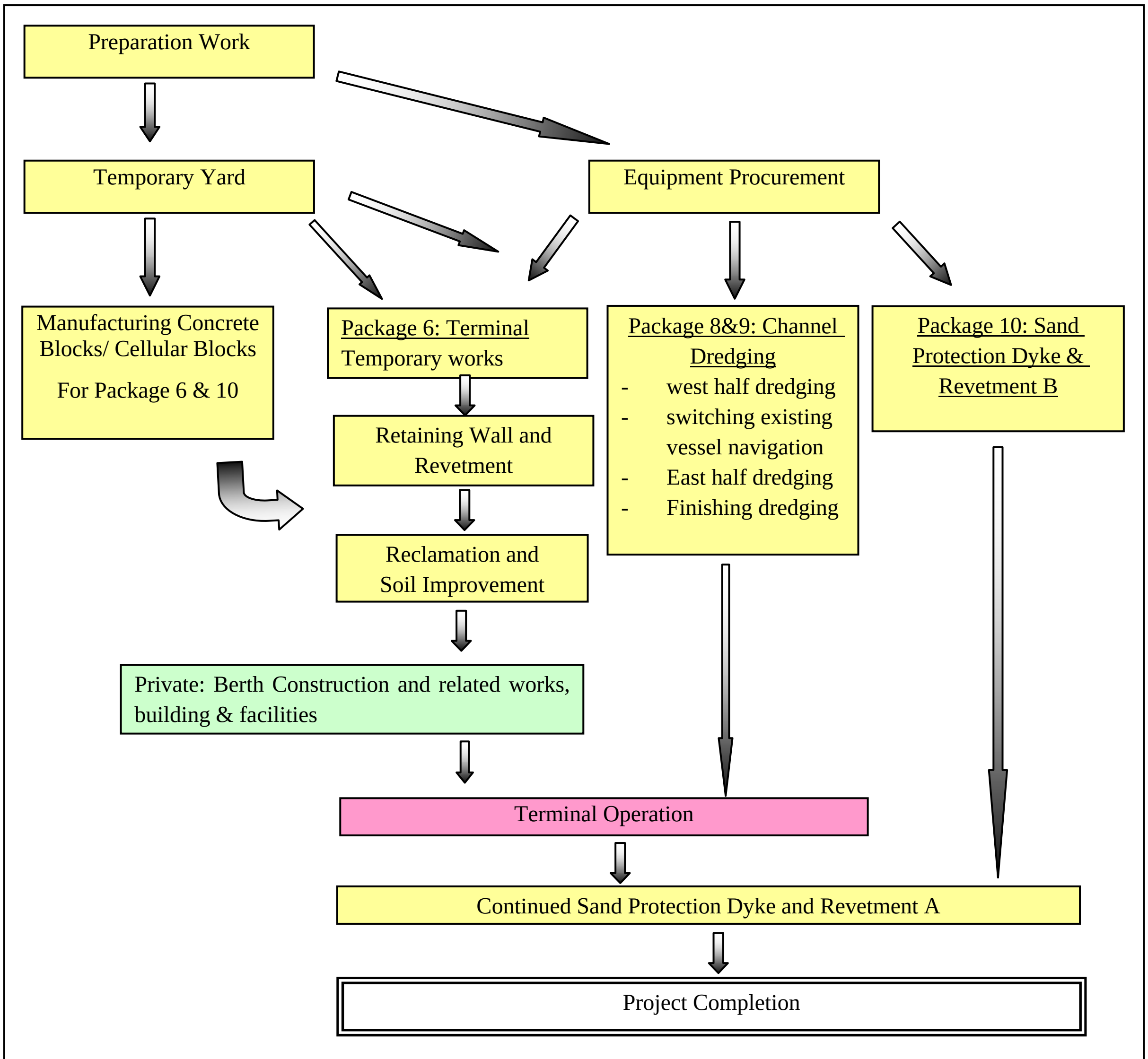
Source: JICA Study Team

Figure 20.6.4 Location of Temporary Fence, Buoy and Gate

20.7 Work Execution Flow on Major Work Items

20.7.1 Overall Work Execution Flow

Execution Flow of the overall construction is shown in the Figure 20.7.1



Source: JICA Study Team

Figure 20.7.1 Overall Execution Flow

20.7.2 Preparation Works

Preparation works consists of mobilization of manpower, equipment and site office, arrangement of obtaining required permission, contract with sub-contractor, procurement of steel pipe sheet piles and another necessary preparation for the commencement of construction.

20.7.3 Temporary Yard

In accordance with study of the Temporary Works, Temporary Yard should be constructed as explained in the Section 20.6 [Temporary Works]

20.7.4 Equipment Procurement

Equipment procurement should be based on the procurement plan approved by the Engineer. As well recognized, this Lach Huyen Project has very tight schedule compared to the work volume, and beside, the employer eager to shorten the original schedule as shown in this report, therefore, plural bigger & more effective equipment should be procured in time for the required timing.

20.8 Work Execution Flow of Package 6: Infrastructure Construction Behind the Container Terminal

20.8.1 Retaining Wall (behind Container Berth)

Construction of Retaining Wall behind the Berth is on the critical pass of the whole Project and it will affect to following works if it is delayed. Also, Berth construction by Private Sector can commence after this Retaining Wall works. On this view point, this work is very important and should not be delayed.

According to hearing investigation results to Japanese steel pipe manufacturers, it takes 3months at earliest from placing an order to material placing to the site, therefore, Contractor should quickly prepare the procurement soon after the construction commencement. At the same time, construction method should be examined carefully to try to make the construction period shorter as much as possible to reply the demand by Project Owner.

1) Execution Flow

Execution flow of the Retaining Wall behind Berth is shown in the Figure 20.8.1.

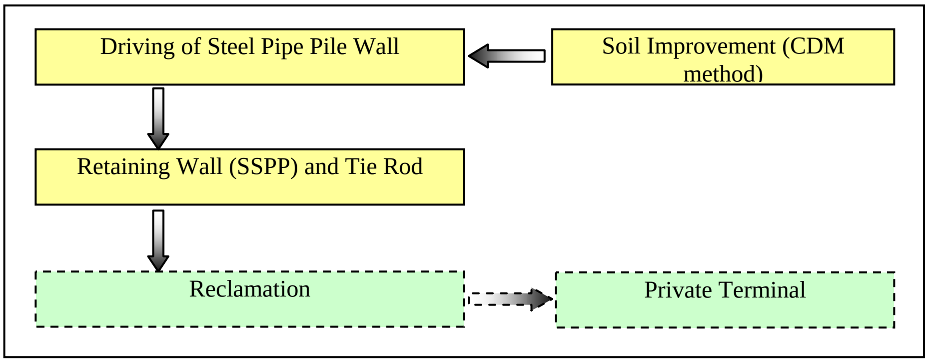


Figure 20.8.1 Execution Flow of the Retaining Wall (behind Berth)

2) Soil Improvement (CDM Method)

Mainly there are two purposes to procure CDM method at the behind of Retaining Wall. The first is to degrease the risk of ground slip accident at the edge of reclamation. The second is to provide a certain area for Berth construction by Private Sector. As well know that CDM is to make soil cement columns and it will not bring residual settlement if the improvement is done to a bearing layer. Its cost is relatively higher than PVD but it is much more effective than PVD on the point of shortening the construction period. CDM should be carried out as marine work by CDM barge because work efficiency is better than on land work. Considering natural condition at the site and draft of CDM ship, sea bed in some location should be excavated to accommodate CDM ship. This work should be carried out prior to the installation of the SPP Wall.

3) Splicing of the Steel Sheet Pipe Pile (SSPP)

In case there is an enough space at designated temporary yard, Steel Sheet Pipe Pile should be transported from manufacturer to the temporary yard for splicing. Splicing should be carried out on the Splicing Platform by welder. At that time, both pile edges to be connected should be clean, no damage and free from rust. An appropriate route gap should be kept based on the technical specification and inner band should be installed according to manufacturers' instruction. Spliced Steel Sheet Pipe Pile should be loaded by crawler crane to the material barge and transported to the site by Tug toeing. Welding part should be inspected based on the specifications and confirm the quality.

4) Driving of SSPP Wall

Prior to the Reclamation, Steel Sheet Pipe Pile Wall (SSPP Wall) should be driven by the piling barge. The capacity of hammer should be decided based on the natural soil component and pile size. Basically maximum batting numbers for steel pile is up to 3000 times, 1500 times for last 10m pile length. If actual betting is beyond/ equal the numbers, hammer size should be bigger. However, in case such hard situation is happened, contractor has to carefully investigate the driven pile condition to avoid damages to the pile. In case that sticky hard clay seems to be appeared and disturb pile driving, friction cutter (pile toe band) should be installed. In this case, the thickness of the friction cutter should be less than 9mm. If the thickness is over it, effect of friction cutter is too big to maintain perimeter friction of the pile surface and it will bring qualitative insufficient for pile structure. When a pile driving is stopped under recognition of sufficient penetration to the bearing layer, the penetration per butting at that time should be from 2 to 10 mm. Final confirmation for pile driving completion is based on rebound amount, process of the piling, total piling numbers and calculation result of ultimate bearing capacity. In case that vibro-hammer is used, chucking plate should be always in good condition to avoid pile damage by slipping. In case that single chucking is procured, grab plate should be installed in the center of steel pile without disturbing pile connections. Usually pile driving stopping by vibro-hammer is based on the management of electric current, voltage and sometimes hydraulic pressure. However, it is not accurate compared to hummer type and therefore, test pile is recommended.

5) Fabrication and Installation of Anchor Wall (L-Shaped Block)

Prior to installation of Anchor Wall (L-Shaped reinforced concrete block), rubble stone mound shall be placed. Rubble Stone shall be transported by material barge and installed by Backhoe Barge. Installed rubble stone shall be leveled by Backhoe Barge and manpower.

Anchor Wall shall be fabricated in the Temporary yard and transported to the work site by material barge. They will be installed by Backhoe Barge or Crane Barge supported by manpower. Anchor Wall shall be connected with SSPP wall by tie wire prior to the reclamation.

6) Tie Wire

Tie wire is flexible compared to tie rod so it is easier installation than tie rod. The key for the installation is management of tie wire tension, so the contractor should carefully execute the work based on the manufacturer's instruction and Technical Specifications. As mentioned in the chapter of cost estimates, the material is categorized as Japanese procurement portion and this material is not manufactured by Japanese company in Vietnam as of now so the material has to be from Japan. As mentioned before, Retaining Wall work is on critical pass of the whole Project so the material procurement should not be delayed even if it is from overseas. Therefore, the contractor has to make a procurement plan with consideration not only material manufacturing process but also transportation & custom clearance time with some margins. Related to the Tie Wire works, shaped steels like H type and/or C type are necessary and these materials are also categorized as Japanese Procurement portion. Sometimes in Vietnam, bad quality shaped steel can be seen. Such qualitative insufficient materials should be not allowed to the Project.

7) Main Used Equipment

Main used equipment is shown in below.

No.	Name of Equipment	Capacity	Used for	No.
1	CDM Barge	Twin	Soil Improvement	2
2	Piling Barge	40m	Driving SPSP wall	1
3	Material Barge	1,000t	SPSP Wall	2
4	Tug Boat	300ps	Crane Barge	3
5	Crawler Crane on the barge	50t	Retaining wall	4
6	Backhoe Barge	0.7m3	All works	6
7	Material Barge	600t	Supply materials	6

20.8.2 Temporary Dyke, Outer Revetment-A and Inner Revetment

In the first step of the construction of package 6, temporary dyke is prepared to start reclamation work without waiting for the completion of permanent structures, Outer Revetment-A and Inner Revetment. The purpose of the temporary dike is to prevent flow out of sand and muddiness of water. As shown in the general construction schedule, terminal construction is on critical pass of the whole Project and the key is earlier commencement of the reclamation so this temporary work has to be completed quickly. However, considering the required time of the temporary dyke, to hold reclamation material during almost all the terminal construction work, it should be sound and strong enough otherwise main permanent work will be stopped so often to repair the damaged temporary dyke therefore, secured work should be done. Basically sand bags will be used for the temporary work. Temporary dyke will be constructed as described below execution flow.

Execution flow of the Outer Revetment-A and Inner Revetment is shown in the Figure 20.8.2.

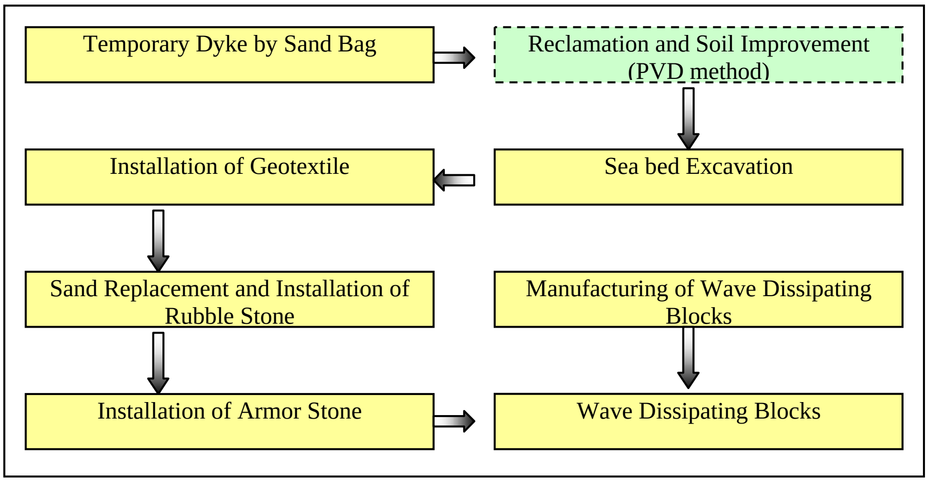


Figure 20.8.2 Execution Flow of the Outer Revetment-A and Inner Revetment

1) Temporary Dyke by Sand Bags

As described in previous paragraph, prior to the reclamation work, sand bag dyke should be constructed outside of the Revetment line. For the construction, Backhoe Barge will be used. Sand for the sand bags will be provided by the sand barge & pump barge.

2) Sea bed Excavation

Based on the natural geographic condition, sea bed excavation will be executed to make design shape of foundation to be filled by the sand. Excavated soil will be basically dumped at designated area. Excavation works will be carried out basically by grab dredgers to keep design slope shape. Immediately after the excavation, replace material place and trimmed as indicated on the Drawing.

3) Installation of Geotextile

Geotextile sheet should be installed between the reclaimed sand and stone protection to prevent the flow out of the sand. Surface of the Revetment should be leveled by the sand or small sand bags prior to the installation of the sheet. The sheet materials should be transported by material barge or Backhoe Barge and the handling is needed to be with care not to tear or damaged. Final installation and adjustment should be carried out by manpower and fixed to the slope by steel pins.

4) Installation and leveling of Filter Stone

Filter stone should be transported by material barge and installed on the Geotextile by backhoe barge. Before the commencement of installation works, inspection for the placed material has to be done based on the Technical Specifications. Only the compatible material to the Specifications should be installed & leveled by backhoe barge and manpower. The installation and leveling & trimming works have to be executed gently not to tear/ damage the sheets.

5) Installation and leveling of Armor Stone

Armor stone will be transported by material barge as same manner of filter stone work and installed on the filter stone by backhoe barge or crane with chain to complete designed slope. Quality management of specific gravity is important therefore periodical inspection on specific gravity should be done according to the Specifications.

6) Fabrication and Installation of Wave Dissipating Block

Wave dissipating block should be fabricated in the temporary yard and transported to the work site by material barge. Related to the large project scale within a relatively short construction period, the total required number of the manufacturing blocks is a quite big, so daily productive number also becomes big. Although the manufacturing works is monotones and repetitive, this big manufacturing work is one of very important factors for the Project. Therefore, this manufacturing method including temporary yard plan should be examined dutifully. At that time, material procurement method for concreting, sand, stone, cement &water, has to be secured to manage such daily big manufacturing. In case that temporary yard is located at the Cat Hai, isolated island, all material has to depend on marine transportation and it has a big concern that some of the materials will be short, if marine transportation is declined cause of bad marine condition. As for mixing water, domestic water in Cat Hai seems to be not enough for daily huge concrete mixing and as the result, the mixing water is also needed to be transported from inland.

7) Main Used Equipment

Main used equipment is shown in below.

No.	Name of Equipment	Capacity	Used for	No.
1	Backhoe	0.7m3	Seabed excavation	3
2	Grab Dredger	2.0m3	Seabed excavation	2
3	Backhoe Barge	0.7m3	All works	4
4	Material Barge	600t	Supply materials	8
5	Tug Boat	300ps	For Barges	8

20.8.3 Reclamation

Reclamation quantity is quite huge so this work schedule is on the critical pass of the whole Terminal construction. This work will be commenced after completion of temporary perimeter dyke not to diffuse the reclaimed sand. In DD result, the reclamation will start from land side and berth side. This reason is that land side first is caused by easiness to commence the work and berth side first is for earlier commencement of Private sector. Immediately after the reclamation, the following soil improvement has to be commenced. As descried in previous chapter, 2 types of PVD are planned to be executed, PVD and CDM. Although PVD has many merits like conservative & many experienced and relative cheaper, PVD has a big demerit, that is, it needs a long time waiting for surcharging and it will affect to the whole construction schedule. Besides, sometimes actual surcharge time is beyond the calculation result and those are regarded as a big potential risks for on time completion. As for CDM, it will be contribute to faster completion of land development although it is more expensive than PVD, if the work is done properly. However, sometimes estimation of improved strength is not match to the site condition so trial work is important to make sure of the mixing proportion in advance.

1) Execution Flow

Tentative execution flow of the Reclamation is shown in the Figure 20.8.3.

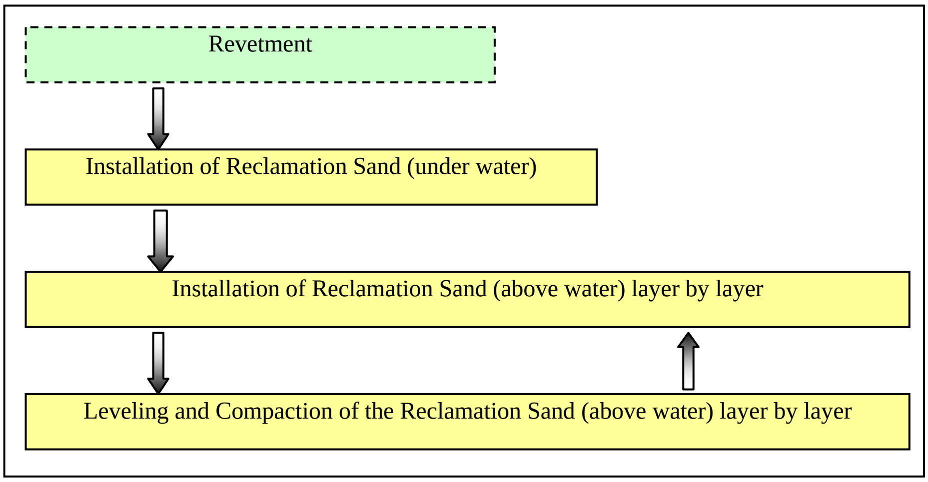


Figure 20.8.3 Execution Flow of the Reclamation

2) Placing of Reclamation Sand (under water)

Reclamation sand will be transported by sand barge which capacity is various from 200m3 to 1,500m^3. Transported sand will be pumped to the reclamation area by the sand pump attached to the sand barge or sand pump barge. This is very common in Vietnam.

3) Placing of Reclamation Sand (above water)

Sand will be pumped up on the filled area. After the sand is filled up, on land equipment like bulldozer and wheel loader will spread, make level, and compact the sand. Filling up area of the pumped sand will be far from the Revetment sufficiently and the height of sand filling should be controlled to avoid the risk of ground slip failure.

4) Leveling and Compaction

Reclamation sand above the underground water level should be compacted by the bulldozer and compaction roller. The compaction should be not in a time, layer by layer to uniform land development.

5) Main Used Equipment

Main used equipment is shown in below.

No.	Name of Equipment	Capacity	No.
1	Sand Pump Barge	240m^3/h	5
2	Bulldozer	D6	5
3	Compaction Roller	10t	2

20.8.4 Soil Improvement

After reclamation, most of all part of reclaimed soft land should be improved by PVD method. PVD method consists of Sand mat, PVD driving, surcharge fill, settlement monitoring and surcharge removal. Considering wide space at the reclaimed area, PVD installation can be done with plural machines so work-flow seems not so hard, however, considering the long driven length, almost 30m or over with narrow pitch, work management especially maintaining vertical will be difficult. If the angle is over tolerance, the bottom end of PVD seems to be cross and/or touch to others and it will bring inappropriate vertical drain effort. In the worse case, there is a concern not only longer surcharge period but also qualitative error on the reclamation. Therefore, more sensitive work management should be required under the supervision of experienced professional engineers.

1) Execution Flow

Tentative execution flow of the Soil Improvement (CDM Method and PVD Method) is shown in the Figure 20.8.4.

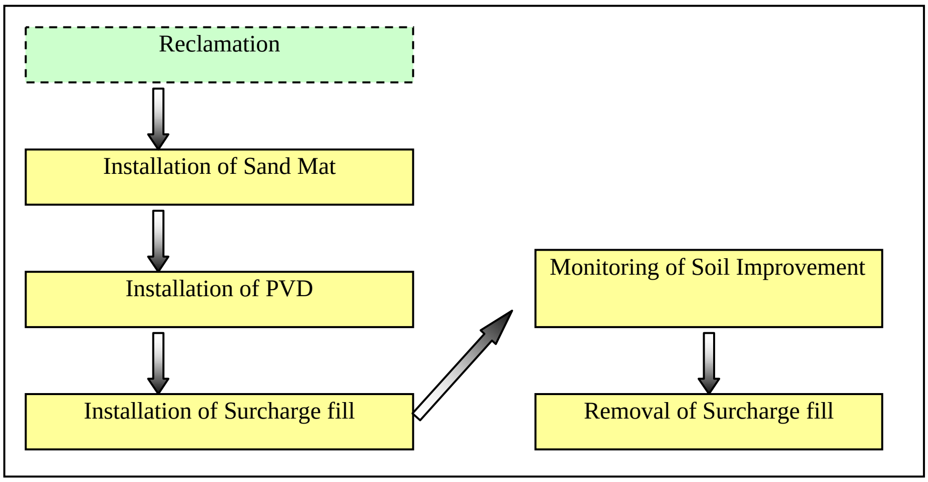


Figure 20.8.4 Execution Flow of the Soil Improvement

2) Installation of Sand Mat

Sand mat is a part of horizontal drainage so quality of the material should be strictly controlled. The sand will be transported by sand barge and unloaded by clamshell. Unloaded sand will be transported by dump truck to the site and leveling by Bulldozer.

3) Installation of PVD

PVD will be driven by PVD machine up to the designed elevation. Location of PVD will be marked prior to driving. For keeping the vertical within a tolerance, theodlites should be installed at least from 2 points and monitor the driving. If the tilted angle is out of tolerance, indicate the operator and try to fix it immediately. After driving PVD, horizontal drainage such as PVC pipe and Pump well will be installed depend on the condition.

4) Installation of Surcharge Fill

Surcharge fill will be installed on the horizontal drainage as next step. Normally, sand material is used for the surcharge material. Thickness of the surcharge will be determined based on the design load of the yard and surcharge period prior to the work commencement. As surcharging time goes on, settlement condition will be different from the calculation result, so the work plan will be revised and adjusted based on the actual settlement condition confirmed by accurate monitoring result. Surcharge material will be transported by sand barge, pumped to the site and leveled formed by Bulldozer and Backhoe.

5) Monitoring of Soil Improvement

Settlement monitoring will be carried out from the commencement of the reclamation. Settlement plate and monitoring gauge will be used to the monitoring. Settlement plate is installed prior to the reclamation and monitoring gauge should be installed at the completion of reclamation. Monitoring should be continuously carried out until settlement reaches the required value.

6) Removal of Surcharge Fill

When ground condition becomes required quality, extra surcharge fill should be removed by backhoe and dump Truck. Considering a wide surcharged area, surcharge sand to be removed is massive volume so removal plan including dumping area should be secured in advance of the work.

7) Main Used Equipment

Main used equipment is shown in below.

No.	Name of Equipment	Capacity	No.
1	PVD machine	H30m	4
2	Sand Pump Barge	$240m^3/h$	3
3	Clamshell	$2.0m^3$	2
4	Dump Truck	10t	4
5	Bulldozer	D4	4
6	Backhoe	$0.7m^3$	4

20.9 Work Execution Flow of Package 8 &9: Channel Dredging and Disposal Works

Lach Huyen channel spans 17.4km length from 27km post with 100m width and CD-14m depth all along the channel. Turning basin is planned in front of berth with a circle. As mentioned in the beginning of this chapter, the channel dredging works is really divided into 2 packages. Package 8 covers almost half of the planned dredged channel where is closer to land side, starts from 27km post to 34 km including turning basin and the all dredged soil is planned to be disposed at off shore dumping site. Package 9 covers the remained area where is from 34km post to the off shored end of the channel and the disposal of all dredged soil is at the same off shore dumping site as Package-8.

The key point is that the huge volume over 37 million m^3 should be completed within a short period as 36 months, that is, over 1 million m^3 per month of dredging has to be continued for a long period, 3 years. It can be said that the required productivity, 1 million m3 per month, is the highest class in the past Vietnamese national projects. To achieve on time completion of the work, the highest class of dredgers should be procured.

Another key is the dredging methodology. As the result of many discussions about the methodology with Vietnamese side, it is decided that the dredging should be done within existing channel method. Usually, to keep such a higher productivity, potential obstructs for the dredging work should be removed from planned dredging area. In the case of Lach Huyen Channel, public vessels navigation seems to be the obstacles therefore diversion channel should be planned to avoid the these navigation. However, diversion method was canceled due to initial cost saving and Vietnamese affirmation of which they can manage the navigation in safety & it will not affect to dredging works. In the wake of the method decision as dredging within existing channel, procured dredger will be mainly by Grab Dredger type which can work in narrow and limited area but lower productivity compared to Cutter Suction Dredger/ Trail Hopper Dredger.

Related to the decided dredging methodology within existing channel, sectional steps method have to be executed, concretely in the Lach Huyen channel, east half of the channel is dredged firstly and the remained west half will be dredged secondly to keep channel for public vessel navigations during the dredging works. Such work method with safety public vessel navigations are a little complicated so the detailed work methodology is explained in the Chapter 15.

20.9.1 Procurement of Big Dredgers and Temporary Works

1) Procurement of Huge Dredgers

Considering a massive dredging volume within a short period, large class of dredgers should be necessary to be procured. Such large class dredgers are very special and impossible to be procured in Vietnam. On the other hand, major Japanese marine contractors own such big work vessels and, considering PPP scheme to be applied to the project, it should be categorized as Japanese procurement portion. According to hearing results from several Japanese contractors and quotations for a big vessel mobilization, it is assumed that traveling time needs for 12 days from Tokyo Japan to Lach Huyen site. Also, before navigation to Vietnam, special outfitting works for open sea navigation is necessary and usually it takes 10 – 14 days time, depend on the condition of each vessel. Besides, considering time for custom clearance in Japan & Vietnam, 2-3 days including inspection at each country is necessary, as the result, physically total 1 month is necessary for procurement of a big vessel. In the case of these procurements from a nearer country, it will be shorter period than 1 month, however, same steps are necessary and only traveling time can be shorter, that is, the procurement time will not become dramatically shorter. In addition to these time requirement, there is one more concern that procurement of such big vessels is not easy because those availabilities are very limited. Basically, those big vessels are not so many and recently the vessels are occupied by several national works not only in Asia but in the world, therefore, for making construction plan, a certain margin time, hopefully for another 1 month, should be secured to make & adjust schedule of required plural numbers of the vessel.

As the result of DD study, Package 8 should have 2 fleets of Grab Dredger 23m^3 class & 1 of TSHD 16,000 m^3 class is necessary, and Package 9 should keep 2 fleets of GD 23m^3, 1 of Trailer Suction Hopper Dredger 16,000 m^3 & 1 fleet of Cutter Suction Dredger 8,000ps, that is, total 7 big dredgers and related soil barge fleets should be procured accordingly. Therefore, procurement plan of big vessels has to be carefully made in advance of the work commencement with considering of above difficulties.

2) Temporary Works

In the temporary yard or other appropriate place, temporary stand-by Berth or Jetty should be provided. This Berth/ Jetty is used for the stand-by time under bad weather, when dredgers need relatively lighter repair & maintenance and an emergency situation requires to suspend work. Also, evacuation place for each work vessel against extremely high wind, waves has to be secured in advance of the work commence. Such planning should be done in the time for preparatory works. In case of fuel charging to big work vessels and change of labor watch, feeder boats will be hired. These small work boats will also use the same stand-by berth/ Jetty. Therefore, the area behind the Berth/ Jetty should have a certain space to accommodate fuel tank, simple work shop, & warehouse for lubricants & some spear parts.

The stand by area should have temporary gate & fence not to allow the third persons to enter the area. Type of fence should be the wire meshed and the height should be over 2 m.

20.9.2 Maritime Safety for Public Vessels

Basically Vietnamese side has a responsibility to maintain safety maritime navigation for public vessels during the dredging works. However, considering complicated dredging methodology within existing channel, the Consultant has to keep close communication with Vietnamese side and affirmatively assists for public maritime safety. As a matter of course, the dredging packages 8 &9 should have a responsibility for safety dredging works, mainly by installation of temporary buoys & patrol ship(s). The temporary buoys are installed surrounding the work site with a safety margin. These buoys have to be clearly seen from other public vessels and recognized marine works are on going. Patrol ship stays at the work area during work time and keeps watching & monitoring other ship passages. If some of the pubic vessels come closer to the work area, the patrol ship has to caution to the vessels. For work vessels, mainly there are 2 roles. The first is to protect safety for the work vessels, for example, when unusual big waves are ready to affect work vessels, the patrol ship have to caution to the vessels with radio communication immediately after the reorganization. The second is to monitor the dredging work condition. If machine trouble happened in a vessel and oil/ fuel spill is spreading, the patrol ship has to warn the work vessel immediately after the detection and try to stop the work before expansion of its dispersion.

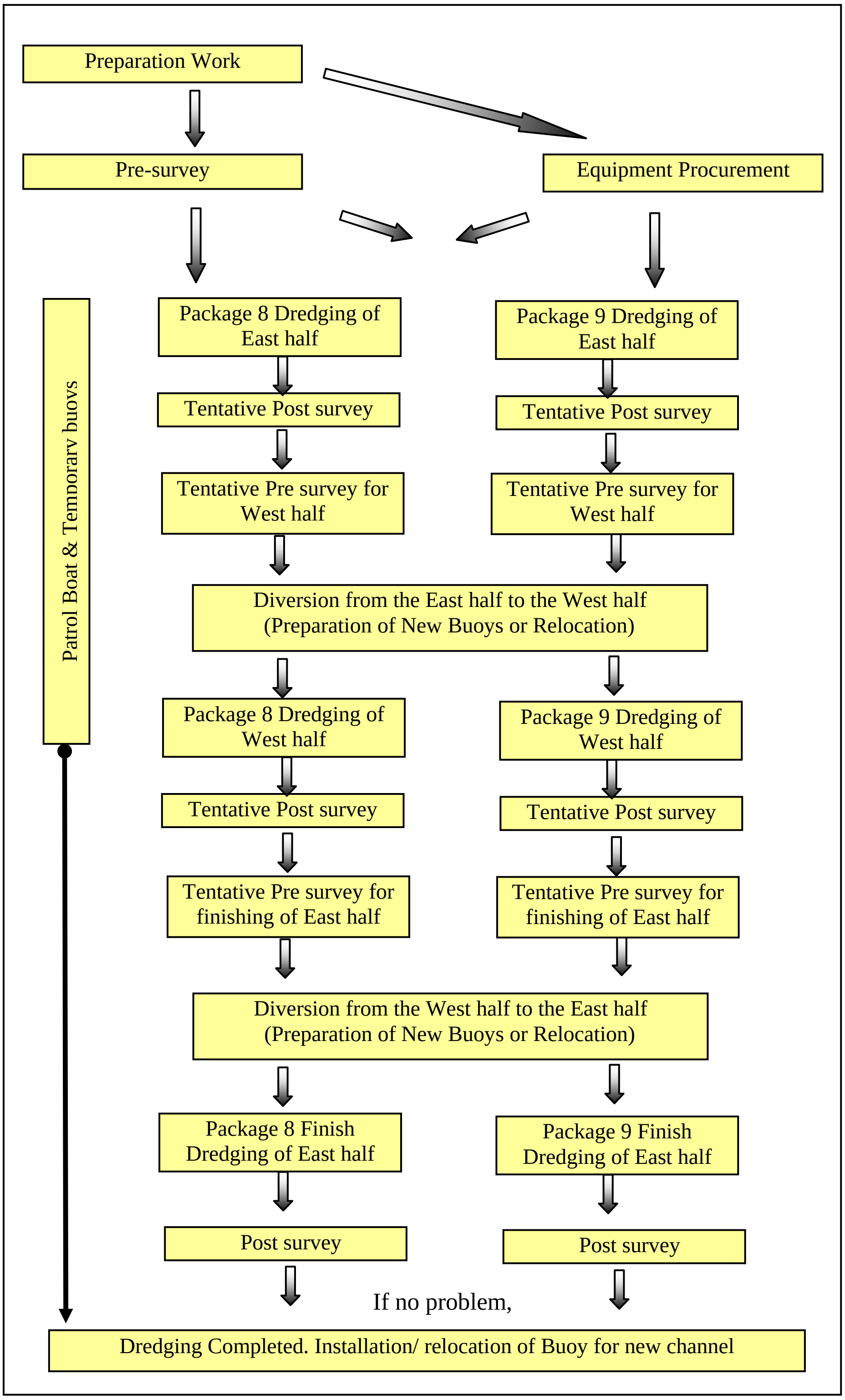
As briefly explained before, dredging methodology has to be stepwise as section by section work, east half is dredged firstly and west half is done after that. Considering tight schedule, the switching from the east half to the west should be done immediately, that is, hopefully the switching have to be completed within only a few days. On the other hand, total channel length is a very long 17.4 km and almost 30 nos. of navigation buoys will be installed. If the switching should be completed within a few days, as a matter of course, these buoys also have to be shifted within the same days. Assuming the situation, it seems to be very difficult to complete the buoys relocation within the days temporally & from work quantitative stand point. As countermeasure against it, preparation of extra buoys and/or procurement of many plural crane barges are candidates. The former needs extra cost for the preparation of buoys but it seems safer the later because the installation work itself can be done in advance of the switching (but should not light-on before switching). The latter also needs more cost to hire plural fleets of crane barge to keep on time shifting but it is dangerous for public vessels because some buoys are not in proper position during the relocation. Also, another potential risk emerges, that is, plural barges are on work at the same time just by the public vessel navigations and it will enhance the risk of accidental contact to the public vessels. Therefore, on the view point of safety first and easier management, the preparation of extra buoys seems to be better, however, the responsibility of these countermeasures belongs to Vietnamese side and final decision should be made by them.

Terminal area is also surrounded by safety buoys during all the construction works. The main role of these buoys is to let public vessels recognize the Terminal construction.

As described, the roles of temporary buoys & patrol ship are very important. So periodically each of buoys should be inspected & maintained to keep in good condition and patrol ship have to be inspected every morning before the daily work starts during all the construction period. A sample figure of buoy, temporary fence & gate is shown in the previous paragraph of this chapter.

20.9.3 Overall Execution Flow of Channel Dredging

Flow chart of dredging work is briefly shown in the following Figure 20.9.1 and detailed methodology is described in the Chapter 15.



Source: JICA Study Team

Note: From 40km post to 40km +300, Dredging by Cutter suction Dredger is planned in the second period of Package 9. The manner is described in the Chapter 15.

Figure 20.9.1 Overall Execution Flow of Channel Dredging Works

20.9.4 Main Dredgers

Main dredgers for package 8 & 9 are listed in the below table.

Table 20.9.1 Main Dredgers

No.	Name of Equipment	Capacity	Procurement	No.
Package 8				
1	Grab Dredger	23 m^3	Japan	2
2	TSHD 16,000m^3	16,000 m^3	Japan	1
3	TSHD 3,500m^3	3,500 m^3	Vietnam	2
Package 9				
4	Grab Dredger	23 m^3	Japan	2
5	TSHD 16,000m^3	16,000 m^3	Japan	1
6	Cutter Suction Dredger	8,000 ps	Japan	1
7	TSHD 3,500m^3	3,500 m^3	Vietnam	2-3

Source: JICA Study Team

Japanese dredgers above listed are called as the maximum size in Japanese marine construction field and recently those are busy with several works in the world, therefore, procurement plan should be carefully made based on the surroundings of the market. Also, under the present circumstances in Vietnam, it seems difficult to acquire the above number of TSHD 3,500m^3 at the same period. As long as the procurement of TSHD 3,500 m^3, it is not so big problem because the procurement of TSHD 3,500m^3 is not so difficult if the procurement area is expanded within neighbor countries and its related cost is not expensive, that is, it can be said that the related additional cost is within a tolerance of total dredging cost.

20.10 Work Execution Flow of Package 10: Breakwater and Sand Protection Dyke Works

Almost all works of this package 10 is comprised by local portion and the design is conservative, compound type. Therefore, as long as technical aspect, it is not special and no difficult to construct but the work volume is a quite big, so the detailed work execution plan including material procurement should be made carefully. The work execution flow of this package is mainly divided into 2 parts, one is manufacturing concrete blocks at temporary yard and the other is works at site however, those two has close relation and the both should be in good progress then the work can be completed on time. As briefly described in previous paragraph, the works at temporary yard has 2 keys, that is, (1) monotonous & repeating works but the volume is quite big (2) materials procurement for concreting should be continuous constantly. As for (1), to manage such a big volume, temporary yard should be at good accessible location and should have enough space for the manufacturing. Considering the Project scale, the cost share for temporary yard is tiny even if it is constructed at new developed land SDIZ. On the other hand, this manufacturing speed is so fast never ever before experienced in Vietnam, so the place should be decided as work efficiency first with deep considerations. As for the temporary yard wideness, too wide space get to bring waste cost and difficulty of land acquisitions, so on this view point, appropriate required space should be calculated in advance of the work with deep examinations, and make sure that how many numbers of block should be manufactured in a day within a decided whole construction time. As shown in the later general construction schedule, this package work is not on the critical pass for terminal operation however, shorter construction time brings benefit for contractor and Vietnamese side so all related bodies should cooperate together to achieve earlier completion of the works.

20.10.1 Outer Revetment-B

Outer Revetment locates same line as the revetment of Port Service Road to protect port facilities from waves. This Breakwater is conservative compound type, which is consisted of rubble stone, armor stone, wave dissipating block, and coping concrete.

1) Execution Flow

Tentative execution flow of the Outer Revetment-B is shown in the Figure 20.10.1.

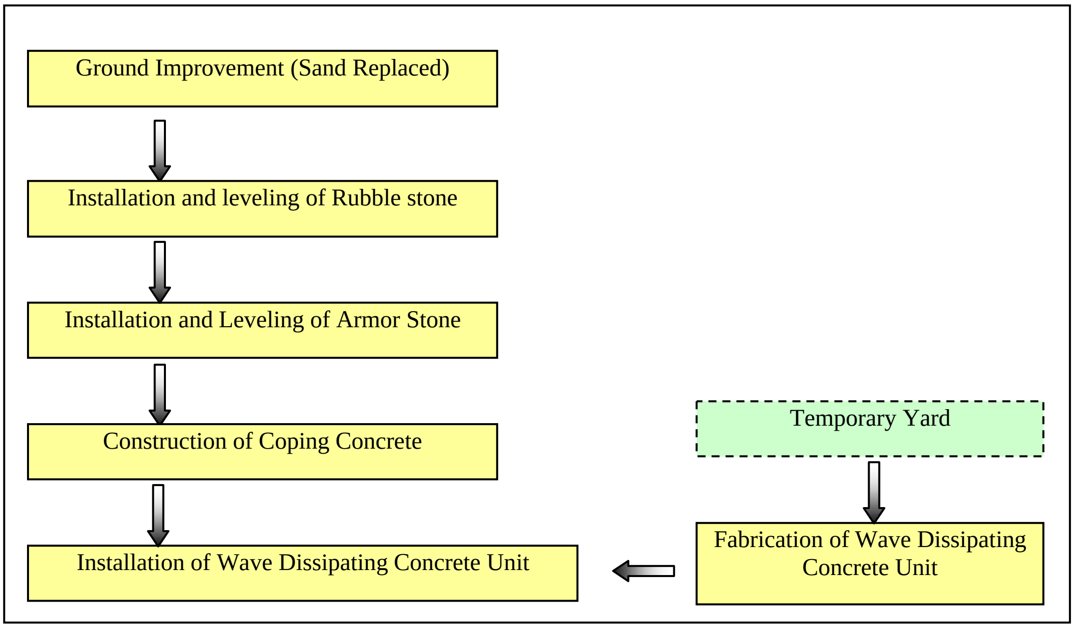


Figure 20.10.1 Execution Flow of the Outer Revetment-B

2) Soil Improvement

Soft soil seabed should be improved by the sand replacement method. Seabed will be excavated by grab dredger along the design and the excavated soil is dumped at off shore dumping site where is designated area for dredging packages 8 & 9. Immediately after the excavation, sand will be placed by sand pump up to the designed elevation. Replaced sand will be transported by sand barge or flat barge, and pump barge will be used for the placing.

3) Installation and Leveling of Rubble Stone

Rubble stone is transported by barge or dump truck and installed by backhoe or backhoe barge. Installed rubble stone will be leveled by divers supported by backhoe or backhoe barge according to the design. Congested works between divers and equipment is dangerous therefore work space in between two has to be secured and indication & communication method should be clearly confirmed in advance of the works to avoid any accidental contact.

4) Installation and Leveling of Armor Stone

Rubble Stone should be protected by Armor Stone. Armor Stone will be transported, installed, and leveled almost as same manner as rubble stone works.

5) Fabrication and Installation of Wave Dissipating Block

Wave dissipating block should be fabricated at temporary yard. Fabricated block should be transported by material barge to the installation area. Steel form of the block should be assembled by mobile crane with manpower. Ready mixed concrete should be transported from concrete batching plant and installed by the concrete pump truck. After the curing period, forms should be removed and the block should be shifted to the stockpile area by truck for further curing and wait for installation works. The block should be loaded on the material barge from temporary jetty and material barge should be towed to the site by tug boat and finally, blocks will be installed by crane barge along the design slope. Combining method of each block should be confirmed based on the manufactures instruction manual.

6) Main Used Equipment

Main used equipment is shown in below. Equipment in the Temporary Yard in not included in the Table.

No.	Name of Equipment	Capacity	No.
1	Grab Dredger	2.0 m^3	3
2	Backhoe Barge	0.7 m^3	3
3	Crawler Crane on the Barge	50t crane on the 1,000t barge	3
4	Material Barge	600t	6
5	Tug Boat	300ps	6

20.10.2 Sand Protection Dyke

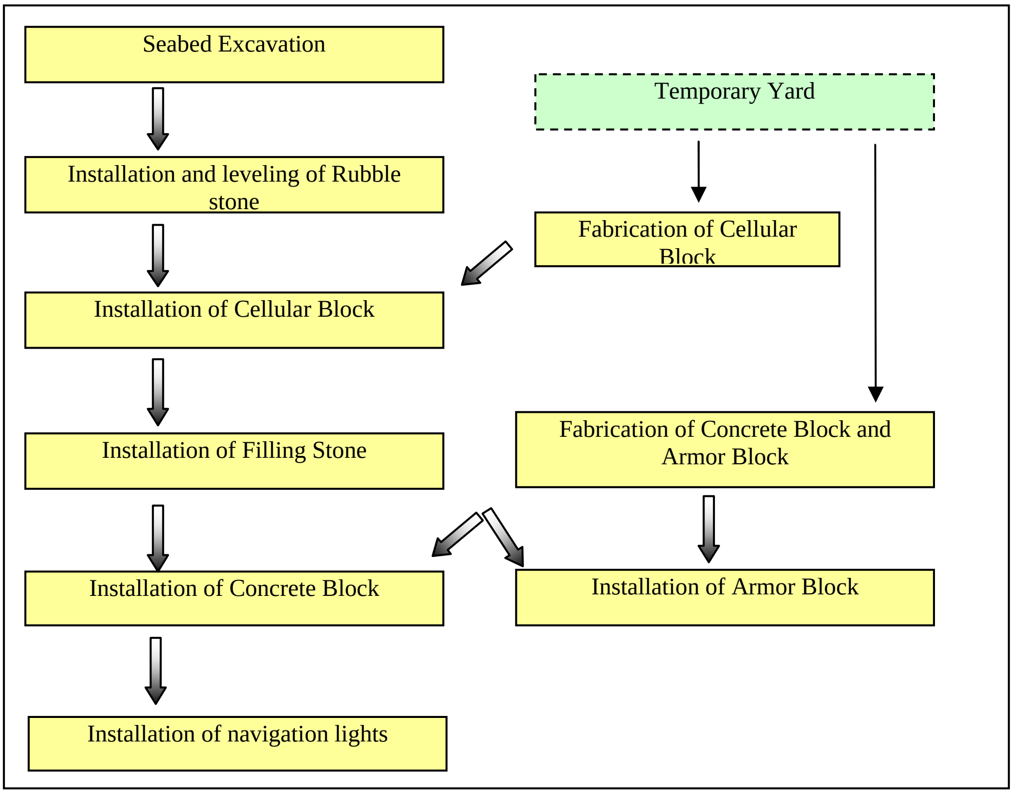
Sand Protection Dyke is located along the west side of the channel. There were many discussions about the alignment of Dyke through DD study. In the beginning, DD study team recommended a plan of which alignment of the dyke was bent and closer to the channel to enhance protective effect toward influence of sedimentation with cheaper cost. On the other hand, Vietnamese insisted to set the alignment with straight parallel to the channel line on the view point of future cost saving, that is, they want to share the faction as sand protection and future revetment function of next berths. Considering maintenance cost for a long time span, it is largely doubtful whether or not their idea comes true but finally, Vietnamese idea was adopted. However, In any case, there is no big different on the point of work execution plan. The design is compound type but top coping is Cellular type. Cellular blocks should be manufactured at temporary yard together with wave dissipating blocks so demarcation of these manufacturing should be carefully examined in the construction stage based on the detailed work execution plan.

1) Execution Flow

This work consists of the following work items

- Seabed Excavation
- Installation and Leveling of Rubble mound
- Fabrication and installation of Cellular block
- Installation of filling stone
- Fabrication and installation of Concrete block
- Fabrication and installation of Armor block
- Installation of navigation lights

Execution flow of the Sand Protection Dyke is shown in the Figure 20.10.2.



Source: JICA Study Team

Figure 20.10.2 Execution Flow of the Sand Protection Dyke

2) Seabed excavation

Seabed will be excavated by grab dredger up to the designed elevation and the excavated soil is dumped at off shore dumping site where is designated area for dredging packages 8 & 9. Immediately after the excavation, gravel mat will be installed by Backhoe barge up to the designed elevation. Gravel mat will be transported by material barge or flat barge.

3) Installation and leveling of the Rubble Stone

Rubble stone is transported by barge or dump truck and installed by backhoe or backhoe barge. Installed rubble stone will be leveled by divers supported by backhoe or backhoe barge according to the design. Congested works between divers and equipment is dangerous therefore work space in between two has to be secured and indication & communication method should be clearly confirmed in advance of the works to avoid any accidental contact.

4) Fabrication and Installation of Cellar Block

Cellular Block should be fabricated at the temporary yard. Fabricated blocks should be transported by material barge to the installation area. Steel form or wood form of the Block should be assembled by manpower supported by mobile crane. Re-Bar should be formed and assembled in the form by manpower. Concrete should be transported from Concrete batching plant and placed to the Form by concrete hopper attached with backhoe or mobile crane. After the curing period, the form should be removed after an appropriate curing time and the blocks should be shifted to the stockpile area by truck for further curing and wait for installation on the site.

Blocks should be loaded on the material barge from temporary jetty and material barge should be towed to the site by tug boat. Cellular block should be installed by backhoe barge or crane barge in the designed position. Divers should support the installation.

5) Filling stones into Cellular Block

Rubble stone should be filled in the Cellular blocks. Rubble stone should be transported by material barge and installed by backhoe barge. Surface of the stone will be leveled by manpower.

6) Fabrication and installation of Wave dissipating Blocks

Wave dissipating block should be fabricated at temporary yard. Fabricated block should be transported by material barge to the installation area. Steel form of the block should be assembled by mobile crane with manpower. Ready mixed concrete should be transported from concrete batching plant and installed by the concrete pump truck. After the curing period, forms should be removed and the block should be shifted to the stockpile area by truck for further curing and wait for installation works. The block should be loaded on the material barge from temporary jetty and material barge should be towed to the site by tug boat and finally, blocks will be installed by crane barge along the design slope. Combining method of each block should be confirmed based on the manufactures instruction manual.

7) Fabrication and installation of Concrete block

Covering Concrete block will be fabricated at temporary yard. The structure of the block is very simple but many numbers should be manufactured. Edges of block are easy to be damaged/ broken especially just after form striking so the handling should be cared. Installation should be by manpower with support of crane.

8) Main Used Equipment

Main used equipment is shown in below. Equipment in the Temporary Yard in not included in the Table.

No.	Name of Equipment	Capacity	No.
1	Grab Dredger	2.0 m^3	3
2	Backhoe Barge	0.7 m^3	4
3	Crawler Crane on the Barge	50t crane on the 1,000t barge	4
4	Material Barge	600t	6
5	Tug Boat	300ps	6

20.11 Packaging of Project

Packaging of the Project should be considered with following elements.

- Construction work quantity
- Environmental consideration
- Construction cost
- Construction schedule
- Critical pass of the Project
- Construction conditions and site condition
- Handover facilities and timing to the Private Sector Project

20.11.1 Merit and Demerit of the Packaging

1) Merit of the Packaging

- Expansion of opportunity to many contractors. Many of different approach about skills & experiences will be able to contribute to the project.

- Each package can select an appropriate contractor who has a specialty field about each package, e.g. dredging package can choose experienced marine contractor.

2) Demerit of the Packaging

- Confliction between packages related with schedule, work area or supply materials may be happen.
- Testing, Inspection and documentation become complex. It means supervising works and procedures by implementing agency become bigger and complicated.

Although there are some merits and demits about packaging, finally the Project was divided into 4 packages. In the result of SAPROF, terminal construction included Outer Revetment B as well, however, many discussions were done through DD study and as the result, Outer Revetment B was incorporated into the package of Sand Protection Dyke mainly from a view point of cost balance compared to other packages. As for the channel dredging & disposal, it was divided into 2 packages. The most concern of this packaging is confliction when the channel switching is done (note: refer to the work execution flow of this chapter and dredging methodology in the previous chapter 15). Considering big dredging volumes in Package 8 as 16,693,927 m^3 and Package 9 as 21,285,780 m^3, the amicable adjustment will be very difficult.

20.12 Construction Schedule

There were many discussions about construction schedule in DD study. DD team insists that it takes 52months to terminal operation and 58 months to all project completion if the work commencement is on time. On the contrary, Vietnamese side insists to make it shorter as 46 months or shorter period. DD team had to consider a certain safe margin under the instruction of JICA because DD study itself is not in the construction stage and needless to say, further detailed information for the construction cannot get properly. Besides, DD team recognized that it is very dangerous to make it shorter without proper reasons, and in the worst case, it would bring a big construction disaster again like a bridge collapse in 2007, at South Vietnam. However, as reply to the strong instruction from Vietnamese side, DD team did propose a conditional shorter schedule as 46 months for terminal operation.

Under these understanding, component of construction schedule in each package is shown in the following.

20.12.1 Package-6: Infrastructure Construction Behind the Container Terminal

Required quantity, required work team, estimated progress with considering activity ratio for Package-6 works are computed and the results are shown in the below.

Table 20.12.1 Work Quantity and Progress for Package 6

No.	Work Item	Unit	Quantity	Team No.	Progress (/day)	Activity ratio	Required period (month)
1	CDM for Revetment	piles	5,918	2	14	0.71	9.9
2	SPP wall	piles	783	2	4	0.64	5.1
3	Retaining wall and Tie Rod	piles	1,268	2	12	0.64	2.8
4	Reclamation Lot a-d	m3	400,000	5	2,000	0.77	1.7
5	Reclamation Lot 1-4	m3	450,000	5	2,000	0.77	1.9
6	Reclamation Lot 5-8	m3	450,000	3	2,000	0.77	3.2
7	Reclamation Lot 9-12	m3	450,000	2	2,000	0.77	4.9
8	Reclamation Lot 13-16	m3	450,000	2	2,000	0.77	4.9
9	Soil Improvement (Lot 1-4)	m2	112,320	1		0.80	18.0
10	Soil Improvement (Lot 5-8)	m2	120,320	1		0.80	18.0
11	Soil Improvement (Lot 9-12)	m2	135,360	1		0.80	18.0
12	Soil Improvement (Lot 13-16)	m2	184,327	1		0.80	18.0
13	Outer Revetment-A Stone Works	m3	28,889	2	500	0.73	1.3
14	Outer Revetment-A Coping Concrete	m3	3,286	2	20	0.71	3.9
15	Outer Revetment-A Wave dissipating Block Fabrication	nos	13,768	1	40	0.71	16.2
16	Outer Revetment-A Wave dissipating Block Installation	nos	13,768	3	24	0.64	10.0
17	Inner Revetment Stone Works	m3	34,172	2	500	0.73	1.6
18	Inner Revetment Coping Concrete	m3	585	2	20	0.71	0.7
19	Service Road (Drainage)	m	3,321	5	20	0.71	1.6
20	Service Road (Base of Pavement)	m3	21,104	2	500	0.73	1.0
21	Service Road (Pavement works)	m2	40,057	2	200	0.71	4.7
22	Service Berth (Reclamation)	m3	125,199	1	2,000	0.77	2.7
23	Service Berth (SSP Wall)	piles	729	1	12	0.64	3.2
24	Service Berth (PHC Piling)	piles	798	2	2	0.64	10.4
25	Service Berth (Superstructure)	m3	7,683	2	20	0.64	10.0

*Quantity of Reclamation and Soil Improvement includes area of Service Road.

Based on above calculations, it is recommended that construction period is 58 months and time to terminal operation is 52 months from the commencement of the Works.

20.12.2 Package 8 & 9: Channel Dredging and Disposal Works

Required quantity, required work team, estimated progress with considering activity ratio for Package-8 & 9 are computed and the results are shown in the Table 20.12.2.

Since the DD study had started, it has been examined that dredging period is for 36 months as an assumption of the project. However, considering huge dredging volume as over 37 million m^3, the schedule is very tight even if the maximum size of dredgers is procured. Usually it is widely recognized that tight schedule brings no merit but higher potential risks on the point of unexpected expense (in the case of this project, compensation related to the channel switching is one of big potential risk) and in the worst case, such trouble leads declination of the work for solving the trouble, consequently, it would delay the dredging completion. Therefore, it is recommended that longer period than 36 months should be acquired for the dredging work for just in case. Having observed overall project schedule shown in hereafter, the dredging works are not on the critical pass if all dumping is at off shore. In this case, there are some time margins especially before the commencement of dredging. If the commencement can be earlier, it is preferable.

Table 20.12.2 Work Quantity and Progress for Package 8 & 9

No.	Work Item	Unit	Quantity	Team No.	Progres s (/day)	Required period (month)
Package 8			16,693,927			**36**
1	East half (1st period)	m3	7,303,677			14
	TSHD3,500m3	m3	730,368	2	3,210	4
	GD 23 m3	m3	6,573,310	2	9,150	12
2	West half (2nd period)	m3	9,390,250			19
	TSHD3,500m3	m3	1,344,230	2	3,210	5
	GD 23 m3	m3	3,956,190	2	9,150	7
	TSHD16,000m3	m3	4,089,831	1	14,660	9
Package 9			21,285,780			**36**
1	East half (1st period)	m3	6,783,272			14
	TSHD3,500m3	m3	678,327	2	3,210	4
	GD 23 m3	m3	6,104,945	2	9,150	12
2	West half (2nd period)	m3	9,888,065			19
	TSHD3,500m3	m3	1,797,759	3	3,210	5
	GD 23 m3	m3	3,998,885	2	9,150	7
	TSHD16,000m3	m3	4,091,422	1	14,660	10
	CSD 8,000ps	m3	4,614,442	1	21,230	7

Source: JICA Study Team

Note: Details of the calculation is shown in the Chapter 15.

20.12.3 Package 10: Breakwater and Sand Protection Dyke Works

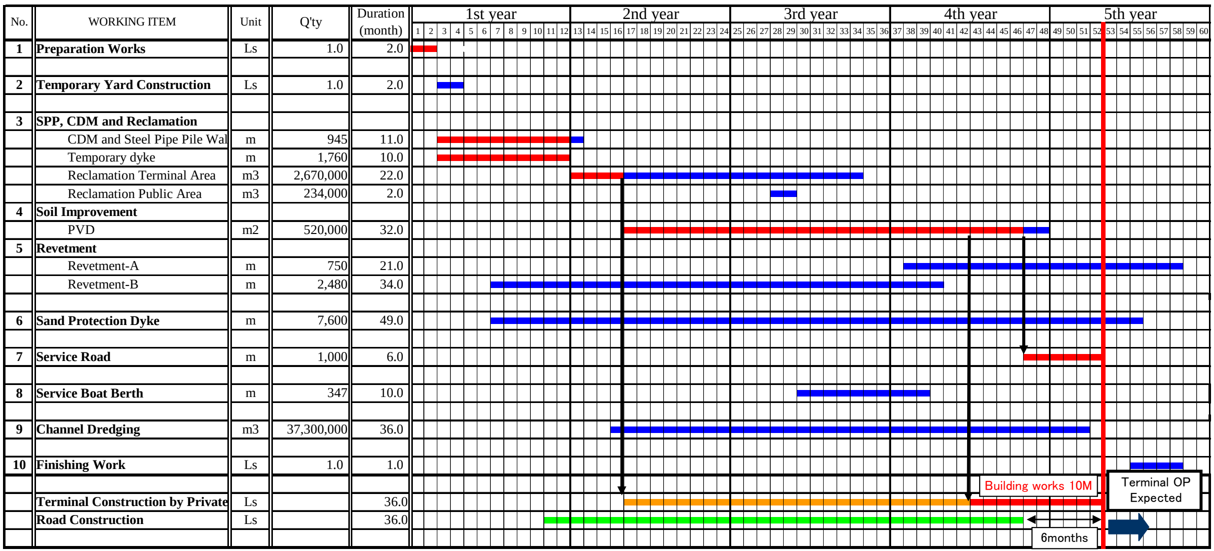
Required quantity, required work team, estimated progress with considering activity ratio for Package-6 works are computed and the results are shown in the below.

Table 20.12.3 Work Quantity and Progress for Package 10

No.	Work Item	Unit	Quantity	Team No.	Progress (/day)	Activit y ratio	Required period (month)
Sand Protection Dyke							**49**
1	Seabed excavation	m3	99,816	2	700	0.70	4.2
2	Rubble mound + Gravel mat	m3	203,071	3	500	0.73	9.0
3	Cellular Block fabrication	Nos	10,458	1	30	0.71	24.0
4	Cellular Block installation	Nos	10,458	3	10	0.64	26.7
5	Rubble stone filling	m3	93,549	5	500	0.73	3.0
6	Conc. Block fabrication	m3	13,858	3	90	0.71	45.6
7	Conc. Block installation	m3	13,858	1	36	0.64	31.6
8	Armor Block fabrication	m3	8,327	1	20	0.71	32.1
9	Armor block installation	m3	8,327	2	20	0.64	17.8
Outer Revetment B							**34.0**
11	Seabed excavation	m3	1,393,960	5	700	0.70	19.0
12	Sand filling	m3	1,351,858	4	1,000	0.73	15.4
13	Rubble mound	m3	107,604	1	500	0.73	9.8
14	Under layer stone	m3	5,0909	1	300	0.73	7.7
15	Wave Dissipating Block Fabrication	nos	20,297	1	40	0.71	23.8
16	Wave Dissipating Block Installation	nos	20,297	3	20	0.64	13.2
17	Cooping concrete	m3	9,626	1	30	0.71	15.1

Source: JICA Study Team

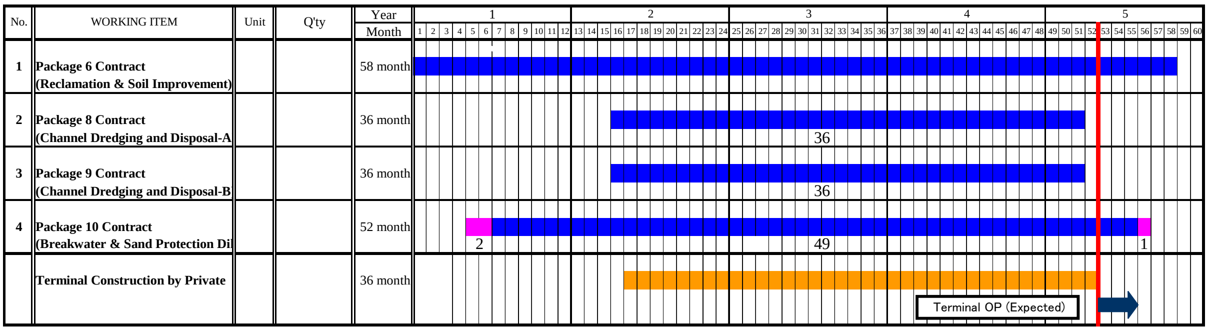
As the result of above calculations, it is recommended that construction period is for 58 months and the period to terminal operation is for 52 months, if the work commencement is on time.



No.	WORKING ITEM	Unit	Q'ty	Duration (month)
1	**Preparation Works**	Ls	1.0	2.0
2	**Temporary Yard Construction**	Ls	1.0	2.0
3	**SPP, CDM and Reclamation**			
	CDM and Steel Pipe Pile Wal	m	945	11.0
	Temporary dyke	m	1,760	10.0
	Reclamation Terminal Area	m3	2,670,000	22.0
	Reclamation Public Area	m3	234,000	2.0
4	**Soil Improvement**			
	PVD	m2	520,000	32.0
5	**Revetment**			
	Revetment-A	m	750	21.0
	Revetment-B	m	2,480	34.0
6	**Sand Protection Dyke**	m	7,600	49.0
7	**Service Road**	m	1,000	6.0
8	**Service Boat Berth**	m	347	10.0
9	**Channel Dredging**	m3	37,300,000	36.0
10	**Finishing Work**	Ls	1.0	1.0
	Terminal Construction by Private	Ls		36.0
	Road Construction	Ls		36.0

Note:
1) Dredging schedule is shown in Chapter 15.
2) JICA study team recommends that 58 months for construction period except channel dredging.

Construction Period by Contract Package



No.	WORKING ITEM	Unit	Q'ty	Year Month
1	**Package 6 Contract (Reclamation & Soil Improvement)**			58 month
2	**Package 8 Contract (Channel Dredging and Disposal-A**			36 month
3	**Package 9 Contract (Channel Dredging and Disposal-B**			36 month
4	**Package 10 Contract (Breakwater & Sand Protection Di**			52 month
	Terminal Construction by Private			36 month

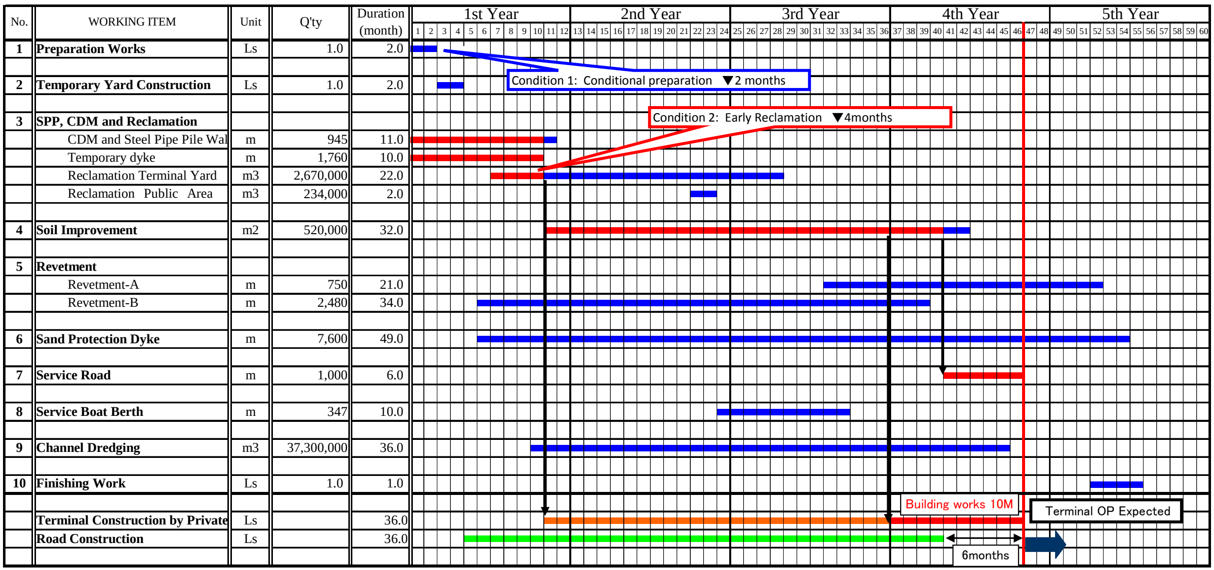
Source: JICA Study Team

Figure 20.12.1 Overall Construction Schedule

20.12.4 Conditional Construction Schedule (Earlier commencement of reclamation)

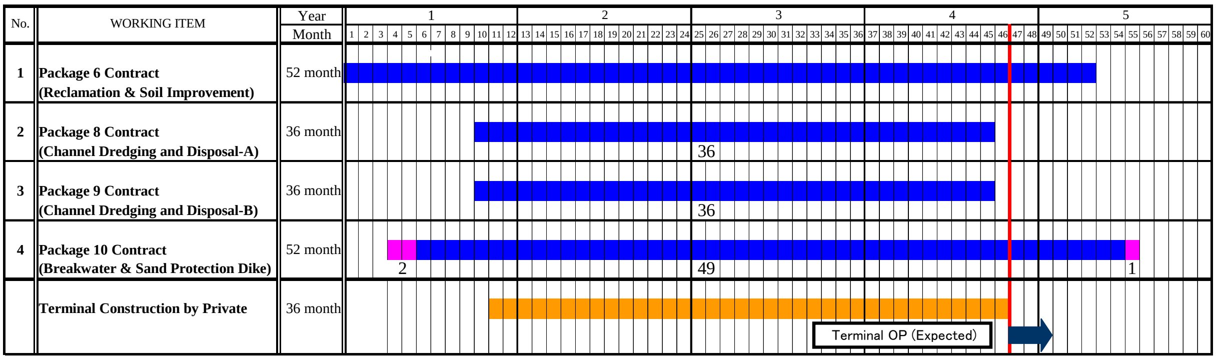
In reply to strong requests from Vietnamese side to shorten the construction schedule, conditional schedule for Package6 is proposed. Consequently, 6 months shorter than the schedule proposed by JICA Study Team, that is, for 46 months to terminal operation and for 52 months to complete whole works except channel dredging. The conditions are:

- Procurement of Steel pipe pile, piling equipment, CDM ships from Japan and cement is not considered in the construction schedule. As the result, 2 months shorter. (as shown in condition 1)
- Reclamation work starts 4 months earlier under the condition of 60% completion of temporary dyke, and it is essential to get environmental approval procedures by MONRE and HPC. (as shown in condition 2)
- Time for terminal operation will be more depending on construction by private sector, further discussion with private sector is necessary if this schedule is adopted.



Note:
1) Dredging schedule is shown in Chapter 15.
Above schedule is conditional. This schedule is 6 months shorter than the schedule proposed by JICA DD Team under the Conditions:-
Condition 1(2 months shorter): Preparation works shown in above 1 dose not include procurement of Piling equipment, Steel Pipe Piles, CDM equipment from Japan and cement.
Condition 2(4 months shorter): Reclamation works can start 4 months earlier if Vietnamese side take responsibility and approve the work commencement upon about 60% progress of temporary dyke as scheduled above.
2) For Condition 2, Vietnamese side have to accept the condition especially on the aspect of Environment. (MONRE and HPC should approve the work procedure.)
3) Further discussions with private sector are necessary for Container Terminal construction time schedule if this schedule is adopted.

Construction Period by Contract Package



Source: JICA Study Team

Figure 20.12.2 Conditional Overall Construction Schedule

As described before, package 10 is not on the critical for whole project schedule including time for terminal operation, that is, it means package 10 will not disturb terminal operation even if the for terminal operation is set earlier.

20.13 Construction Safety

20.13.1 General

The following safety measures should be dully considered in the implementation of the project and the contractors are requested to prepare and submit as a Safety Management Plan for the review and acceptance by the Project Safety Committee;

(1) Organization of the contractor on the Construction Safety including the organization chart and responsible person(s), communication/ contact procedure or list, responsible persons for respective works in the project and emergency communication chart.

(2) General plan on Construction Safety, which specifies at least the following items;

- Safety and Security plan on the Construction sites, such as safety fencing, sign boards indicating the area possessed by the contractor for the project.

- Safety and Security plan for Temporary facilities arranged by the contractor, such as contractor’s office and camp, yards, material and equipment stockpiling, etc.
- Safety monitoring plan, including safety/security system provided and its maintenance procedure.
- Safety patrol procedure and safety meetings plan of the contractor.
- Training plan of workers on safety.
- Fire detection and protection procedure.
- Procedure on explosives and other dangerous material handling and stockpiling

(3) Safety Plan for Marine Works

- Meteorological & Oceanographic conditions forecast and information system to work vessels.
- Work stoppage and suspension criteria and conditions including instruction procedure.
- Maritime accidents prevention procedure (especially ship collision prevention) including contingency plan in case of accidents.
- Diver’s work procedure.
- Refuge location and evacuation procedure of work vessels in case of adverse weather and sea conditions.

(4) General Protection and Contingency plan against natural disasters

(5) UXO detection and settlement procedure

(6) Emergency case communication and action plan

(7) Preliminary Risk Analysis and Prevention Plan for respective work components and activities

20.13.2 Work Component

For the discussion of potential risks on each package, main work components with the Quantity, work duration time and equipment to be used are listed up in the following. As the beginning, work component for Package 6 is shown hereafter.

Table 20.13.1 Work Component for Package 6

Package/Facility	Work Component	Unit	Quantity	Work Duration	Main Equipment	Remarks
PACKAGE-6	**INFRASTRUCTURE CONSTRUCTION BEHIND THE TERMINAL**					
Land Reclamation at Terminal & Access	Retaining wall behind Berth	m	750	11 months	Piling barge, Material	Marine works
	Reclamation	m3	2,670,000	22 months	Sand Pump barge, Bulldozer, Compaction Roller	Marine work, partly on-land work
	Soil improvement by CDM	Nos.	8,230	11 months	CDM machine, Sand pump barge	Marine work
	Soil improvement by PVD	m2	520,000	32 months	PVD machine, Sand pump barge, Bulldozer, Backhoe, Dump truck	On-land work
Outer Revetment	Revetment A	m	750	21 months	Backhoe barge, Crane barge,	Marine work
Port Service Road	Pavement and utilities	m	750	6 months	Grader, Compaction roller, Spreader, Asphalt Finisher, Mobile crane, Bulldozer, Dump truck,	On-land work

Source: JICA Study Team

Work component for Package 8 &9: Channel dredging and disposal works, is shown hereafter.

Table 20.13.2 Work Component for Package 8 & 9

Package	Work item	Unit	Quantity	Duration	Main Equipment	Remarks
Package 8	Dredging & Dumping	m3	16,693,927	36 months	GD23m^3, TSHD16,000m^3	Big dredgers
Package 9	Dredging & Dumping	m3	21,285,780	36 months	GD23m^3, TSHD16,000m^3 CSD 8,000ps	Big dredgers

Source: JICA Study Team
Legend: GD=Grab Dredger, TSHD=Trailer Suction Hopper Dredger, CSD=Cutter Suction Dredger

Finally, work component for Package 10: Breakwater and Sand protection Dyke is shown hereafter.

Table 20.13.3 Work Component for Package 10

Package/Facility	Work Component	Unit	Quantity	Work Duration	Main Equipment	Remarks
PACKAGE 10	**TRAINING DYKE CONSTRUCTION**					
Sand Protection Dyke	Sand Protection Dyke	m	7,200	49 months	Backhoe barge, Crane barge, Material barge, Tugboat	Marine work
Outer Revetment	Revetment B	m	2,480	34 months	Material barge, Tugboat	

Source: JICA Study Team

20.13.3 Potential Risks and Countermeasures

1) Package 6: General

a) Features of the Work

- The reclamation work is carried out at Container Yard and Port service Area, which is relatively a limited area, but a several works are also carried out one after another with some overlapping (such as Revetments works, Soil improvement works, Berths construction, etc.).
- The work will be done mostly from seaside by pumping up sand transported by Sand Barge.
- After filling up to above sea level, the reclamation sand will be thoroughly spread over and compacted layer by layer by use of land equipment.

b) Consideration on Possible Risks and Prevention Measures

Since the work will be carried out within a relatively limited area with some overlapping with other works, the following risks on the construction accidents should be carefully studied, and effective precautions and safety measures should be considered in the execution plan;

- Collision of ships, anchoring wire/rope break, grounding or drifting, etc.
- Sudden changes of weather and sea conditions.
- Mechanical troubles of work vessels.
- Accidental contact among on land equipment and workers

c) Safety Measures to be provided

Considering the above risks on the construction safety, the following safety measures are at least required;

- A well coordinated work execution plan, which avoid or minimize any crossing of work vessels and keeping a sufficient safe distance with the followed works, should be considered.
- Area(s) indication light buoys with warning sign boards should be installed at proper locations, including access route/direction indicators.
- Arrangement of a patrol boat with watchmen.
- Proper communication equipment.

2) Package 6: Soil Improvement Works

a) Features of the work

- The work is composed of Cement Mixing Methods (CDM) and PVD method provided underneath the reclamation, revetments and port service road works.
- The soil improvement work by CDM will be done mainly as a marine work prior to reclamation and retaining wall works, while the work by PVD method will be carried out as Onshore works after reclamation.
- The work will be carried out with an overlapping with reclamation works.

b) Consideration on Possible Risks and Prevention

The work may require a large number of installation machines and equipment due to a limited implementation time frame of the construction work, by which the following possible risks on serious accidents should be studied and effective prevention measures should be considered;

- Collision with other working ships and barges, anchoring or tying wire/rope breaking or dragging by other ships or like, if floating equipment is used in the work.
- Fall-down of on-land equipment caused by a lack of stability of ground or adverse weather conditions.
- UXO risk: UXO survey should be conducted prior to the installation works.

c) Safety Measures to be provided

The following safety measures should be considered;

- Safe distance should be kept always with other equipment and passing vehicles/passengers
- To this end, the working area and passages should be clearly separated by safety fencing or barricade, with appropriate lighting when visibility is low.
- Watchmen should be arranged at entrance/exit gate with a proper communication system.
- Stability of the reclaimed land area should be checked before the commencement of the work, and monitored during the implementation of the work.

3) Package 6 (Terminal): Revetments Work

a) Work Features

The revetments work will be divided into the following types;

- Outer Revetment functioning as a breakwater located at west side of the container yard and the Port Service Road, and constructed with stone works and concrete block works.
- Retaining wall behind container berths, constructed by steel pipe pile wall.
- Revetment at south side of Container Yard, constructed by Stone works and Concrete Works.

The above revetments works will be mostly done from seaside by use of floating equipment, followed by the reclamation work with some overlapping in the construction time frame.

b) Consideration on Possible Risks and Prevention Measures

As most of the work will be done as marine works, similar possible risks on the accidents to other marine works such as Reclamation work or Soil Improvement work may cause. It should however be noted that a considerably large numbers of work vessels for stone placing and material transport barges are required, which are always moving in the adjacent areas within the designated working site.

To this end, a more precise working plan and safe ship movement procedure are necessary in order to prevent any serious accidents such as collisions or wire/rope cutting.

c) Safety Measures to be provided

Similar safety arrangement with Reclamation work should be adopted.

4) Package 6: Service Boat Berth Work

a) Work Feature

Steel pipe pile supported berth will be constructed by use of piling barge and concrete plant barge, or from landside for the upper part of the berth by in-situ concrete work.

b) Consideration on Possible Risks and Prevention Measures

The work will be done in parallel to container berth construction (by Private Sector) and channel dredging work. Therefore, it may be likely to collide with other work vessels if no coordination among the contractors. To this end, a close communication and well coordinated work scheduling will be essential in order to prevent an excessive crossing and too close distance.

c) Safety Measures to be provided

- Well coordinated work execution plan and schedule considering other works plans and progress.
- Appropriate lighting system
- A Patrol boat with watchmen

5) Package 6 (Terminal): Port Service Road and Other Works

Port Service Road and Utility works such as water supply pipelines, power cables and drainage lines are constructed as on-shore works.

Since a several works under separate contracts will be carried out utilizing this area, the following Safety Measures/ provisions should be thoroughly considered;

- Safety fence and barricade dividing the working areas and hauling/passage areas.
- Safety and warning signboards.
- Lightings/signals during night time and for low visibility conditions.
- Watchmen at gate(s) or intersections to control traffics.

6) Package 8&9: Channel Dredging and Disposal Works

a) Work Features

Lach Huyen Channel dredging spans 17.4 km in length, 100 m of width and a basin dredging is planned in front of berths. Total dredging volume is a quite huge, over 37 million m^3 including consideration of extra depth and influence of sedimentation. All dredged soil is dumped at off shore dumping site where is located 16km off shored from the center point of Lach Huyen channel. Such a big work volume should be completed within 36 months, it means a big demand, almost 1 million m^3 per month, is required to complete it on time. Therefore, plural fleets of the maximum class dredgers are planned to be procured for the dredging works.

b) Consideration on Possible Risks and Prevention Measures

As many dredging vessels work in the same time, there is a concern to be happened accidental contact. Also, marine accident caused by bad weather is easily imagined. Moreover, considering characteristics of this dredging works, a large volume within a short period, it should be noted that a considerably large numbers of work vessels and material transport barges are required, which are always moving each other in the same occupied area. Therefore, the following possible risks on the construction accidents should be carefully studied, and effective precautions and safety measures should be considered in the execution plan.

- Collision to other work vessels, anchoring wire/rope break, grounding or drifting, etc.
- Collision to other public vessels during material transportations/ work vessels relocations.
- Accident by higher waves and winds.
- Sudden changes of weather and sea conditions.
- Accident by yawing caused by unexpected big waves.
- Mechanical troubles of work vessels and the related oil outflow.
- Contact accident between heavy equipment and workers especially around grab bucket.
- Falls into the hopper bottom of barge/ TSHD.
- Involved and caught in a machine like big winch/ motor.
- Drowning of marine workers/ divers.

To this end, a more precise working & safety plan including ship movement procedure is necessary in order to prevent any serious accidents.

c) Safety Measures to be provided

Considering the above risks on the construction safety, the following safety measures are at least required;

- Basic safety management plan including emergency contact list not only for each package but also for whole project should be prepared.
- Set unified signal/ indication method by each supervisor and observe it strictly.
- A well coordinated work execution plan, which avoid or minimize any crossing of work vessels and keeping a sufficient safe distance including anchoring plan of each work vessels should be prepared on daily work basis.
- Area(s) indication light buoys with warning sign boards should be installed at proper locations, including access route/direction indicators.
- Proper communication system between site office and work vessels and share the related work information including weather forecast and oceanographic conditions.
- To prescribe upper limit of workable condition especially about maximum wind & maximum wave height on marine works and observe the rule strictly.
- To organize emergency evacuation method & map and execute regular trainings.
- Arrangement of a patrol boat with watchmen not only for work vessels but also for public vessels including fishermen boats.
- Daily inspection whether or not there are enough safety gears on each work vessel and workers.
- Daily/ weekly inspection of machinery not only for continues operation but also prevention of oil outflow.

7) Package 10: Breakwater and Sand Protection Dyke Works

a) Work Features

Sand Protection Dyke & Outer revetment B are located at off shore side of terminal and therefore the work will be mostly done from seaside by use of floating equipment except manufacturing of several concrete blocks. The off shored location of these structures is largely affected oceanographic condition and it will bring higher risk especially in rain season.

b) Consideration on Possible Risks and Prevention Measures

As most of the work will be done as marine works, possible risks on the accidents to other marine works such as accidental contact with other work vessels may cause. Also, marine accident caused by bad weather is easily imagined. Moreover, considering characteristics of this Lach Huyen project, that is a large scale within short period, it should be noted that a considerably large numbers of work vessels for stone placing and material transport barges are required, which are always moving in the adjacent areas within the designated working site. Therefore, the following risks on the construction accidents should be carefully studied, and effective precautions and safety measures should be considered in the execution plan.

- Collision to other work vessels, anchoring wire/rope break, grounding or drifting, etc.
- Collision to other public vessels during material transportations/ work vessels relocations.
- Sudden changes of weather and sea conditions.
- Mechanical troubles of work vessels and the related oil outflow.
- Contact accident between heavy equipment and workers especially under block installations.
- Drowning of marine workers/ divers.

To this end, a more precise working & safety plan including ship movement procedure is necessary in order to prevent any serious accidents.

c) Safety Measures to be provided

Considering the above risks on the construction safety, the following safety measures are at least required;

- Basic safety management plan including emergency contact list not only for each package but also for whole project should be prepared.
- Set unified signal/ indication method by each supervisor and observe it strictly.
- A well coordinated work execution plan, which avoid or minimize any crossing of work vessels and keeping a sufficient safe distance including anchoring plan of each work vessels should be prepared on daily work basis.
- Area(s) indication light buoys with warning sign boards should be installed at proper locations, including access route/direction indicators.
- Proper communication system between site office and work vessels and share the related work information including weather forecast and oceanographic conditions.
- To prescribe upper limit of workable condition especially about maximum wind & maximum wave height on marine works and observe the rule strictly.
- To organize emergency evacuation method & map and execute regular trainings.
- Arrangement of a patrol boat with watchmen not only for work vessels but also for public vessels including fishermen boat.
- Daily inspection whether or not there are enough safety gears on each work vessel and workers.
- Daily/ weekly inspection of machinery especially on the prevention of oil outflow.

21. ENVIRONMENTAL MANAGEMENT PROGRAM AND MONITORING PLAN

21.1 Environmental Impact Assessment

Based on the BASIC DESIGN (Chapter 7 – Chapter 15 of DIVISION II), section (21.1) gives the over view of the potential impacts on natural and social environment by the proposed port design and two dredging-dumping alternatives (near-shore and offshore) without any counter measures. Based on the initial evaluation in this section, following section (21.2) aims to evaluate the potential counter measures for the recommended construction alternative in this section and recommend necessary counter measures to meet Vietnamese environmental regulation and the JBIC Guideline 2002.

21.1.1 Basis of the Environmental Impact Assessment and Sources of Impacts

1) Basis of the Environmental Impact Assessment

As described in section 3.1.1 (Legal Framework of Environmental and Social Consideration in Vietnam), the new environmental regulations enforced in 2001(Decree No.29/2011/ND-CP and Circular No.26/2011/ TT-BTNMT) require a new EIA approval by MONRE for the Lach Huyen Port. Those new regulations require project owners to hire qualified environmental organizations and specify the qualification of the eligible organizations shown below (Article 12 and 16, Decree No.29/2011/ND-CP).

- Having professional staff in environment (05) years experience or more if you have a college degree, three (03) years if there is a master, a (01) years for doctoral degree;
- There are professional staffs with projects related to university degree or higher;
- Facilities: technical and specialized equipment for measurement, sampling, processing and analysis of environmental samples, ensuring technical requirements. In the absence of specialized equipment to meet the requirements, the qualified facilities must be installed or leased.

As a part of this Detail Design Study to prepare for the project implementation, environmental experts of JICA D/D study team and a legally qualified local environmental organization evaluated the potential environmental impacts and prepared the EIA report for the Lach Huyen Port project. Although the dredging and dumping impacts were not focused in the previously approved EIA for the Lach Huyen Port (MONRE No. 2231/QD-BTNMT) due to the separately approved EIA for the dumping site, in this section, the potential impacts of the dredging and dumping activities were also considered due to the additional requirement of the new dumping site(s) for the channel and port basin dredging.

Since the Vietnamese environmental standards and legal frameworks for the environmental considerations are principally reasonable level compared to the Japanese standards, evaluation was made based on the Vietnamese environmental standards and legal frameworks. However, in the case of no reference standard(s) or appropriate legal frameworks, internationally common standards and similar legal frameworks in Vietnam were referred and recommended in this chapter.

Based on the Appendix 2.5 of “The structure and requirements for the contents of the report of environmental impact assessment” (Circular No.26/2011/ TT-BTNMT), required information are clearly specified in Chapter 1 of project description, which may be required but were not specified in the replaced circular. In addition, further assessments and description are required in Chapter 3 of Environmental Impact Assessment. Furthermore, in addition to the official response to local authorities and representatives for the residents in Chapter 6 of public consultation, now project owners are required to communicate with 1) project affected organizations (ex. businesses) and 2) EIA approval agencies and prepare for the official response to their opinions to receive the agreement for the project implementation. Followings are the primary difference between the presently active regulation and replaced regulations (Table 21.1.1).

Table 21.1.1 Primary Difference Between New Circular/2011 and Replaced Circular/2008

ACTIVE: Circular No.26/2011/ TT-BTNMT	REPLACED: Circular No.26/2011/ TT-BTNMT
Chapter 1 Project Description	
4.Project content 4.1 Project objective description 4.2 Volume and scope of Project items 4.3 description of the measures, the volume of construction work of the project 4.4 Production technology, operation 4.5 List of equipment and machines 4.6 raw materials (input) and product category (output) of Project 4.7 Project Schedule 4.8 Investment Capital 4.9 Management organization and Project implementation	4. Project content
Chapter 3 Environmental Impact Assessment	
1.1 Impact assessment during planning stage 1.2 Impact assessment during construction stage 1.3 Impact assessment during operation stage **1.4 Assess the impact of different stages of the project (dismantling, closure, environmental rehabilitation and other activities likely to cause environmental impacts)** **1.5 Impact risks and incidents**	1.1 Impact assessment during planning stage 1.2 Impact assessment during construction stage 1.3 Impact assessment during operation stage
Chapter 8 Public Consultation	
1. Opinions of the commune PC 2. Opinions of resident community representative person (if any) **3. Opinions of Project affected organizations (if any)** **4. Opinions of EIA approval agency for infrastructure construction Projects (Production, Business, Concentrate Service (if any))** 5. Responding and commitment of Project owner for recommendation, petition, request from Agencies, Organizations consulting	1. Opinions of the commune PC 2. Opinions of resident community representative person (if any) 3. Responding and commitment of Project owner for Opinions of the commune PC and Opinions of the commune father land front

2) Potential Sources of Impacts

Due to the separate responsibilities and development schemes of ODA portion (component A) and private portion (component B), only the potential impacts of ODA portion were considered though the Lach Huyen Port project is comprised of construction of port foundation for privates' container terminals with publics' port facilities and privates' container terminal construction. Based on the DETAILED DESIGN (Chapter 15 – Chapter 19 of DIVISION III) and Detailed Construction Plan (Chapter 20 of DIVISION IV), potential impact sources are summarized as follows (Table 21.1.2).

Table 21.1.2 Potential Sources of Negative Impacts

Potential Source of Impact	Extent of the impact*	Primary Potential Impact**
Preparation Stage		
Land acquisition	Moderate	- <S> Loss of productive land leading occupational change - <S> Grave relocation - <S> Loss of social infrastructures and public facilities
Near-shore fishing area clearance (all port structure)	Significant	- <S> Loss of coastal fishing area leading occupational change
Construction Stage		
Construction machines	Minimal	- <N/S> Air degradation by air pollutants and dust - <N> Soil and water contamination by fuel and lubricant oil spill - <N/S> Disturbance by vibration and noise
Transportation of construction material	Minimal	- <N/S> Air degradation by cargo ships and trucks' exhaust - <N/S> Disturbance by vibration and noise - <S> Traffic accidents (resident/worker/car/ship)
Land reclamation and soil improvement (CDM/ALiCC)	Moderate	- <N> Loss of biologically high value shallow water - <N/S> Water quality and salt/aquaculture productivity degradation by high turbidity discharge
Construction of port structure (port and sand protection training dike)	Moderate	- <N> Loss of biologically high value shallow water
Channel/port basin dredging and sediment dumping <Cat Hai South/ near-shore dumping case>	Significant	- <N> Loss of biologically high value shallow water by channel widening and sediment dumping at near-shore - <N/S> Water quality and salt/aquaculture/fishing productivity degradation by high turbidity discharge - <S> Degradation of water quality in beach resort area
Channel/port basin dredging and sediment dumping <Offshore dumping case>	Significant	- <N> Loss of biologically high value shallow water by channel widening - <N/S> Water quality and salt/aquaculture/fishing productivity degradation by high turbidity discharge - <S> Degradation of water quality in beach resort area
Immigrant workers	Minimal	- <S> Disturbance in local communities caused by habitual difference - <S> Spread of transmittable disease - <S> Sharp inflation led by radical demand and consumption
Operation Stage		
Sewage and other wastewater from offices and runoff from the public port facilities	Minimal	- <N> Surrounding water contamination by runoff
Oil spill by maritime accidents***	Minimal - Significant	- <N/S> Surrounding water and sediment contamination by oil

* **Significant**: Causing unrecoverable impacts and requiring extensive efforts to minimize the impacts, **Moderate**: causing recoverable or unrecoverable impacts with ordinal/common mitigation measures, **Minimal**: causing minimal impacts and requiring no or minimum mitigation measures.
** <N> Potential impacts on natural environment including ecosystem, <S> Potential impacts on social environment, <N/S> Potential impacts on both natural and social environment
*** the extent of the impacts highly depends on the type of accident and vessels and capability to handle such accidents by Vietnamese maritime agencies and capable privates.

As common construction activities in Vietnam, potential impacts considered as Minimal in the Table 21.1.2 shall be addressed and treated with common good practices, which would be considered as common practices and reasonable consideration for the environment in Vietnam. In order to focus on the potentially significant impacts, only Moderate and Significant impacts were assessed with reasonable and practical recommendation/counter measurers in the following sections.

Based on the common practices, the negative impacts by soil improvement by CDM and ALiCC were minimal. However due to the permanent loss of the biologically high value shallow water (Figure 21.1.7) by the land reclamation, the set of land reclamation and soil improvement are considered as Moderate impact. As similar reasons, the potential impacts of the port structure and sand protection training dike are considered as Moderate impact due to the permanent loss of the shallow water. Loss of such shallow water area is summarized in Table 21.1.3. Detailed description of ecological value is described in section 21.1.3 below.

Table 21.1.3 Permanent Loss of Biologically High Value Shallow Water Area

Component	Expected Loss (Ha)
Public Port Portion (common berth & basin)	
Public facilities and common berth	
Port basin	
Foundation of Private Port Portion (berth & basin)	
Container terminal/berth, access road, outer revetment	
Port basin	
Channel and Sand Protection Training Dike	
Channel	
Turning basin	
Sediment Dumping (one of two options shall be applied)	
Adjacent to South Coast of Cat Hai Island (Near-shore)	
Offshore	**2,500**

Although the permanent loss of mentioned shallow water shall not be negligible for the regional ecosystem and fishery based economy, such impacts are considered as Moderate in respect for the Vietnamese national development plan on seaport[1] and regional development plan[2] by HPPC (Figure 21.1.1). Based on those decisions, GOV decided to set the 40km of Hai Phong coast between Thai Binh river mouth (southwest end) and Cat Hai (northeast end) as modernized development area and secure the Cat Ba island as natural reserve (Figure 3.3.1). Since there would be long term and significant efforts to achieve such development goals, it is highly recommendable to monitor the negative impacts on regional ecosystem and societies highly depending on conventional economic activities during the transition period. In the case of the unexpected negative impacts, GOV shall take necessary actions to achieve its development goals with sustainable ways.

Therefore, this section (21.1) mainly focuses on potentially significant impacts by channel and port basin dredging and its dumping. Following sections (21.1.2-21.1.5) compare the environmental impacts of offshore and near-shore dumping, by focusing specifically on the impacts that will occur through dredging and dumping activities. Impacts were compared for natural, biological and social environment.

Table 21.1.4 summarizes the assumed dredging and dumping methods for offshore and

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[1] Prime Minister’s Decision No. 1601/QD-TTG dated 15 October, 2009 “APPROVING THE MASTER PLAN ON DEVELOPMENT OF VIETNAM’S OCEAN SHIPPING UP TO 2020 AND ORIENTATIONS TOWARDS 2030” and MOT Decision No.174/QĐ-BGTVT Aug. 2011 “Detail Planning for Northern Se Port Group-1 2020 with vision to 2030”

[2] Resolution No. 32-NQ/TW dated 05 August, 2003 of the Politburo on construction and development of Hai Phong City in the period of industrialization and modernization of the country and Decision No. 1448/QD/TTG dated 16 Sep, 2009, approving adjustment on general plan on developing Hai Phong city up to 2025 and vision to 2050

near-shore dumping, which are considered as primary impacts on natural and social impacts from the proposed Lach Huyen Gateway Port project.

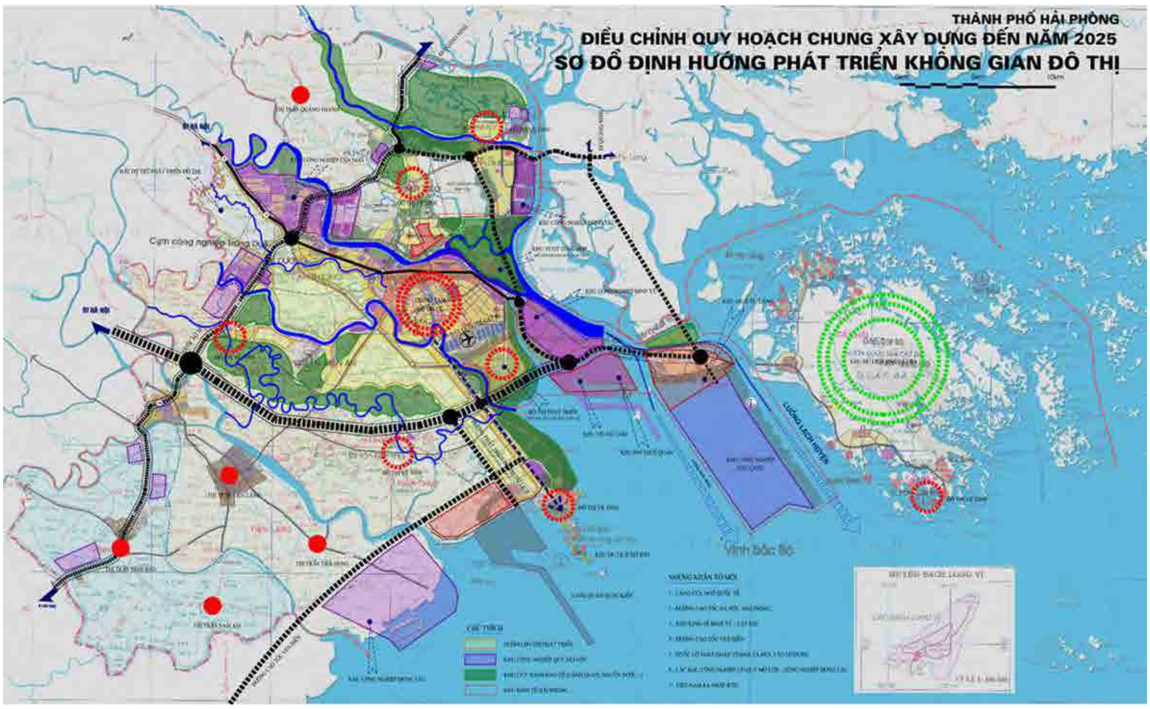


Figure 21.1.1 General Plan on Developing Hai Phong City up to 2025

Table 21.1.4 Assumed dredging and dumping methods for offshore and near-shore dumping

	Offshore dumping	**Near-shore dumping**
Dredging method and volume*	- <Primary> Use of cutter-suction dredgers (CSD) with or without overflow - <Secondary> Use of trailer-suction hopper (TSHD) or grab dredgers (GD) - Expected volume of the dredged sediment is 37,979,707 m^3.	
Dumping method and volume*	- <CSD/GD> Dredged sediment will be dumped with a hopper barge within the designated dumping area with SS control measures. - <TSHD> Dredged sediment will be dumped by TSHD within the designated dumping area with SS control measures. - Expected volume of the dumping sediment is 37,979,707 m^3.	- <CSD/TSHD/GD> Dredged material will be initially dumped with a hopper barge at a temporary dumping site in front of the near-shore dumping site. - Other CSD dredgers will be used to transport the dumped dredged sediment from the temporary dumping site to the near-shore dumping site via pipes. - Overflow from the near-shore dumping site will be discharged via outlet(s) with SS control measures. - Expected volume of the dumping sediment is 37,979,707 m^3.

*Details shall be referred to Chapter 15.

3) Summary of the Primary Impacts and Comparison of Environmental Aspects

A comparative summary of the potential impacts by dredging and its sediment dumping and relevant aspects on environment are shown in Table 21.1.5. Each evaluation on natural, biological and social impacts are described in section 21.1.2, 21.1.3, 21.1.4 respectively. Then, comparative summary of the potential impacts by dredging and dumping and recommendable dumping site and relevant counter measures are addressed in section 21.1.5.

Table 21.1.5 Comparative Summary of the Potential Impacts by Dredging & Sediment Dumping and Relevant Environmental Aspects

		Cat Hai island South Coast (Near-shore)	**Offshore area**
1. Permits	(1) EIA Revision and Approval	Need EIA revision and approval (require approx. 6 months to obtain approval)	Need EIA revision and approval (require approx. 6 months to obtain approval)
	(2) MOT & HPPC approval	Already approved by MOT & HPPC (MOT Decision 476 QD-BGTVT, 2011)	Need MOT & HPPC approval (roughly 3-6 months, then EIA approval)
2. Natural environment	(1) Impact on water quality	• According to SS dispersion simulation (Ch.12&21), sediment dispersion will be significantly large due to excessive work load by dredging and discharge of turbid water from effluent outlet of the dumping site. • Extensive cautions shall be taken for the control of SS spreading with combined loads of dredging and dumping activities and potential impacts on environmentally and economically sensitive area around Cat Ba Island.	• According to SS dispersion simulation (Ch.12&21), sediment dispersion will spread widely in east-west direction from designated offshore dumping area. • Extensive cautions shall be taken for the practicality of SS control measures at offshore and potential impacts on environmentally sensitive area around Cat Ba Island.
3. Biological environment	(1) Ecological value of the dumping sites	• Field survey results indicate that the near-shore areas have higher ecological value (e.g. higher species diversity and abundance, presence of nursery ground) compared to the offshore area.	• Field survey results indicate that the offshore area has lower ecological value (e.g. lower species diversity and abundance) compared to the near-shore areas.
	(2) Impact on valuable marine habitats (e.g. coral reef, mangrove, seagrass/seaweed, tidal flat).	• Results of SS dispersion simulation indicate that near-shore dumping could have significant impacts on valuable marine habitats even with common/standard counter measures. • Effective SS control measures and extra caution for the SS spread in sensitive area shall be considered.	• Results of SS dispersion simulation indicate that offshore dumping will have fewer impacts compared to the near-shore dumping with common/standard counter measures. • However, practicability/applicability of the SS control measures in offshore and extra caution for the SS spread in sensitive area shall be considered.
4. Social environment	(1) Impact on fisheries (coastal and offshore)	• Impact could be significant as the adjacent area is a primary fishing area for Cat Hai and Cat Ba fishermen. • Livelihood recovery program shall be considered and approved by the affected people and implemented before the construction.	• Impact should be less significant compared to the near-shore area, as the adjacent area is not a primary offshore fishing area.
	(2) Impact on aquaculture and salt production on land	• Impact could be significant as the coastal water is the only source of both aquaculture and salt production. Degradation of coastal water quality shall be unavoidable. • Counter measures to reduce degradation of water	• Results of SS dispersion simulation indicate that dumping in the offshore area will have fewer impacts compared to dumping in the near-shore areas. However, the degradation of coastal water quality shall be unavoidable by the dredging works.

		Cat Hai island South Coast (Near-shore)	**Offshore area**
		quality shall be considered. Also, appropriate assistance program for the livelihood recovery shall be considered and approved by PAP and implemented before the construction.	• Counter measures to reduce degradation of water quality shall be considered. Also, appropriate assistance program for the livelihood recovery shall be considered and approved by PAP and implemented before the construction
	(3) Impact on tourism	• Results of SS dispersion simulation indicate that dumping in the near-shore area could cause negative impacts on beach resorts on Cat Ba Island by visible turbidity. Counter measures especially for the beach resort season are recommendable.	• Results of SS dispersion simulation indicate that dumping in the offshore area will have fewer impacts on beach resorts compared to the near-shore dumping. However, the turbidity may be occasionally visible. Extra caution to control the turbidity is recommendable in the beach resort season.
5. Summary of the potential impacts		• Dumping in the near-shore areas are likely to have relatively more significant impacts on natural, biological and social environment, as dumping activities and wastewater discharge from the landfill area will generate significant amounts of SS. • While dumping in the near-shore areas are not recommended from an environmental perspective, if unavoidable, effective countermeasures must be implemented to minimize impacts (e.g. installation of silt curtain, control of wastewater discharge, implementation of livelihood recovery programs). • In the case of near-shore dumping, it would require extensive efforts to control the SS level to meet the Vietnamese environmental standards. Such counter measures would be much costly and technically challenging compared to that of offshore dumping also requiring SS control measures.	• Dumping in the offshore areas are likely to have relatively less significant impacts on natural, biological and social environment compared to dumping in the near-shore areas, thus is recommended from an environmental perspective. • Nevertheless, certain impacts are likely and hence effective countermeasures must be implemented to minimize sediment dispersion (e.g. installation of silt curtain).

21.1.2 Natural Environment

1) Comparison of SS dispersion between offshore and near-shore dumping

Impacts of offshore and near-shore dumping on the natural environment were compared by focusing on how dredging and dumping activities will affect the local water quality. Suspended solid (SS) was used as the indicator of water quality, as SS will be the most obvious pollution source from dredging and dumping activities. The concentration of SS was predicted by conducting SS dispersion simulation. Note that countermeasures against SS dispersion were not considered in the simulation.

For the comparison purposes, representative dumping cases in offshore (case 3) and near-shore (case 4) are summarized as follows (Figure 21.1.2). While the pattern of SS dispersion will vary with water depth, for the sake of simplifying the assessment, SS dispersion impacts were compared by referring only to the dispersion pattern of the upper (2-4 m depth) and bottom layers (10-12 m depth). Figure 21.1.3 (large domain) and Figure 21.1.4 (medium domain) show the predicted SS dispersion pattern for near-shore and offshore dumping. (See section 12.3 for details). Note that the predicted SS values do not incorporate background SS levels and show only the SS contribution from dredging and dumping activities.

According to the simulation, the SS dispersion range in the upper layer was more extensive with near-shore dumping in all directions, and was predicted to reach even towards east of Cat Ba Island and Ha Long Bay. SS concentration was also significantly higher with near-shore dumping, except within the vicinity of the offshore dumping site. With offshore dumping, high SS concentration was limited to the vicinity of the dredging and dumping sites with maximum value at around 10 mg/l. On the other hand, for near-shore dumping, the area of high SS concentration extended over an extremely wide range, with maximum value reaching 100 mg/l. Since the surface background SS levels was around 10-15 mg/l (according to the May field survey), near-shore dumping will have significant impacts on surface water quality and may results in a maximum ten-fold increase in SS concentration, especially in areas offshore of Cat Hai Island. As for the bottom layer, SS concentration was generally higher with offshore dumping but high levels were limited to the vicinity of the dumping site.

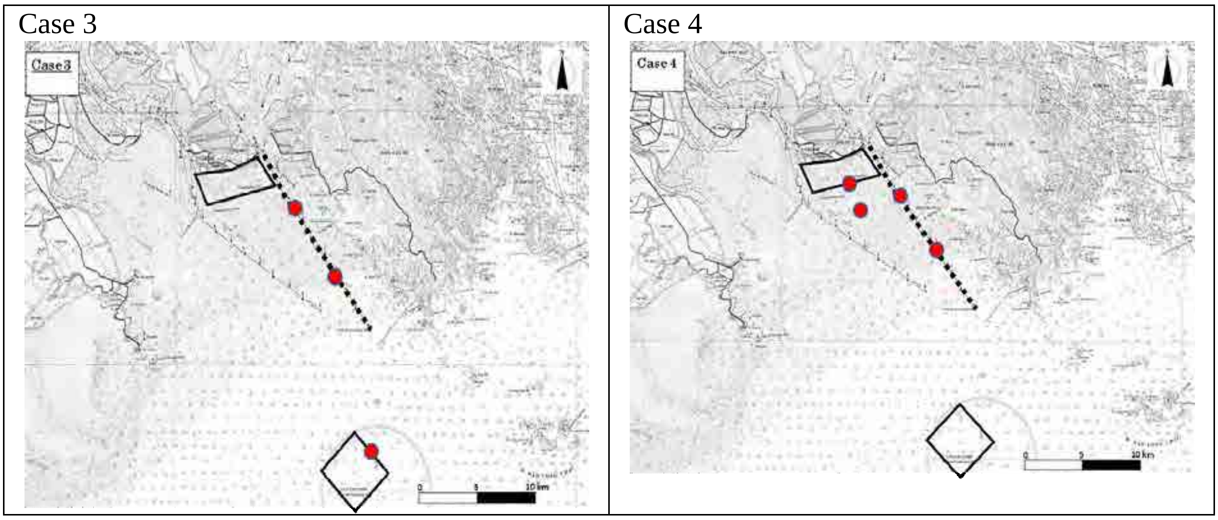
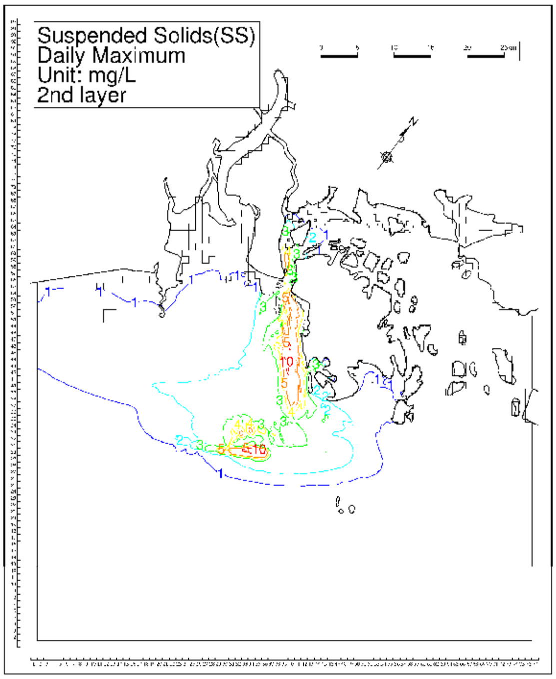
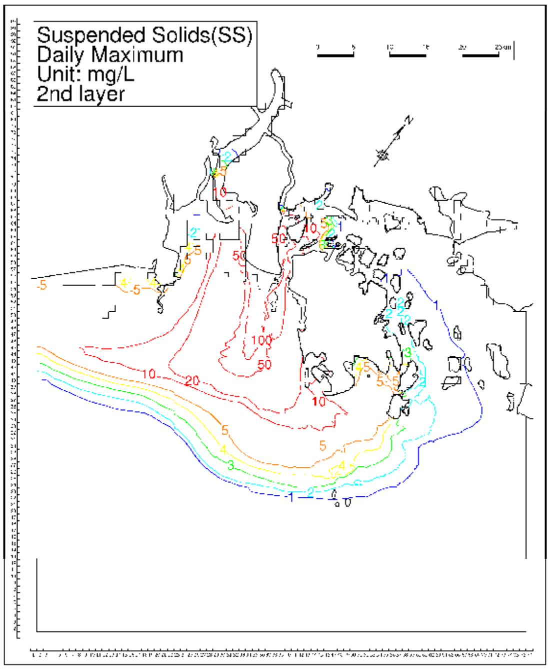

Case 3
Case 4

Figure 21.1.2 Representative Cases for the Offshore (case3) and Near-shore (case4) Dumping

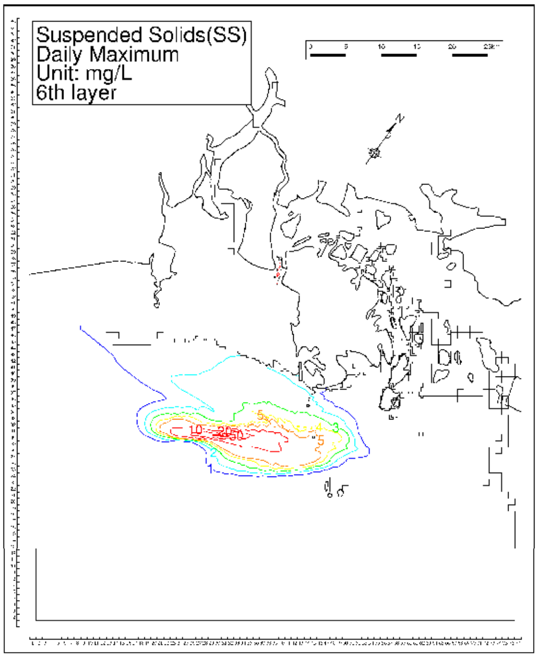
Offshore dumping (Case 3, 2-4 m)



Near-shore dumping (Case 4, 2-4 m)



Offshore dumping (Case 3, 10-12 m)



Near-shore dumping (Case 4, 10-12 m)

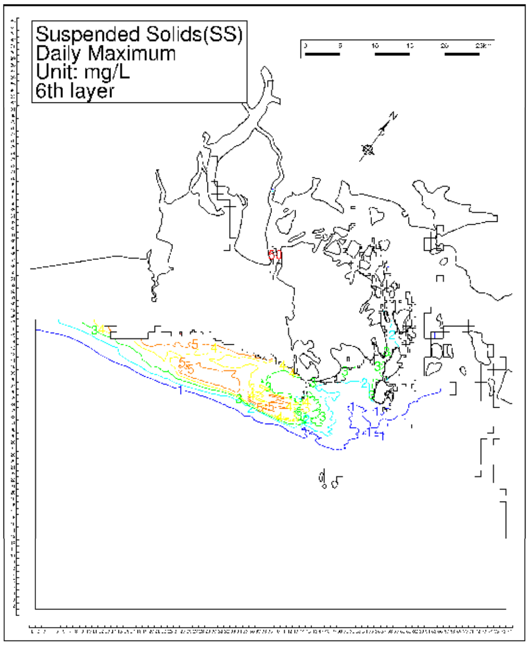
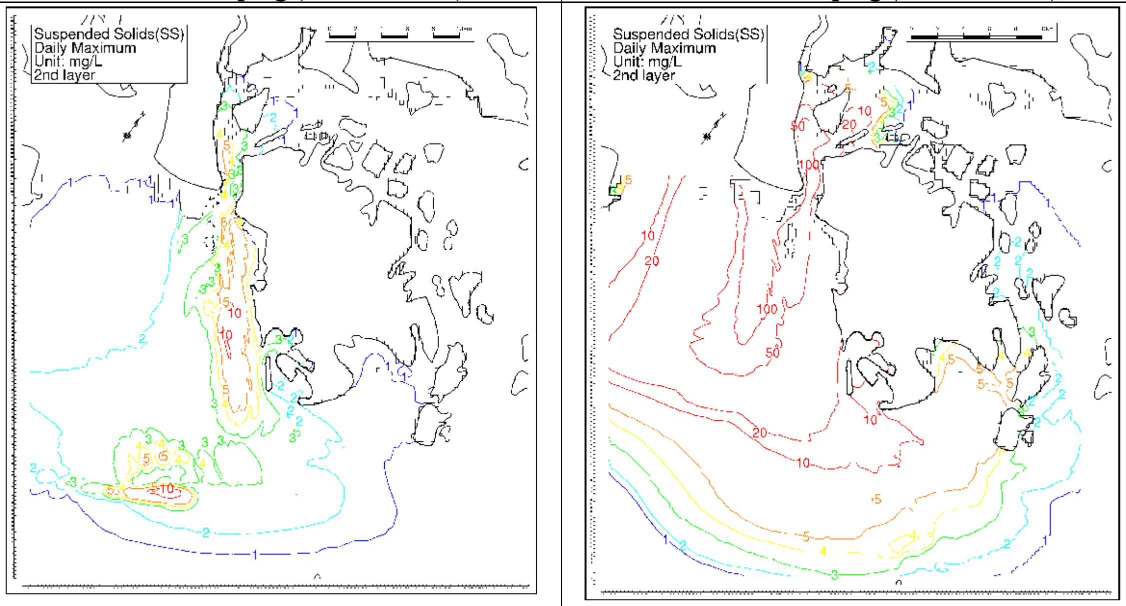
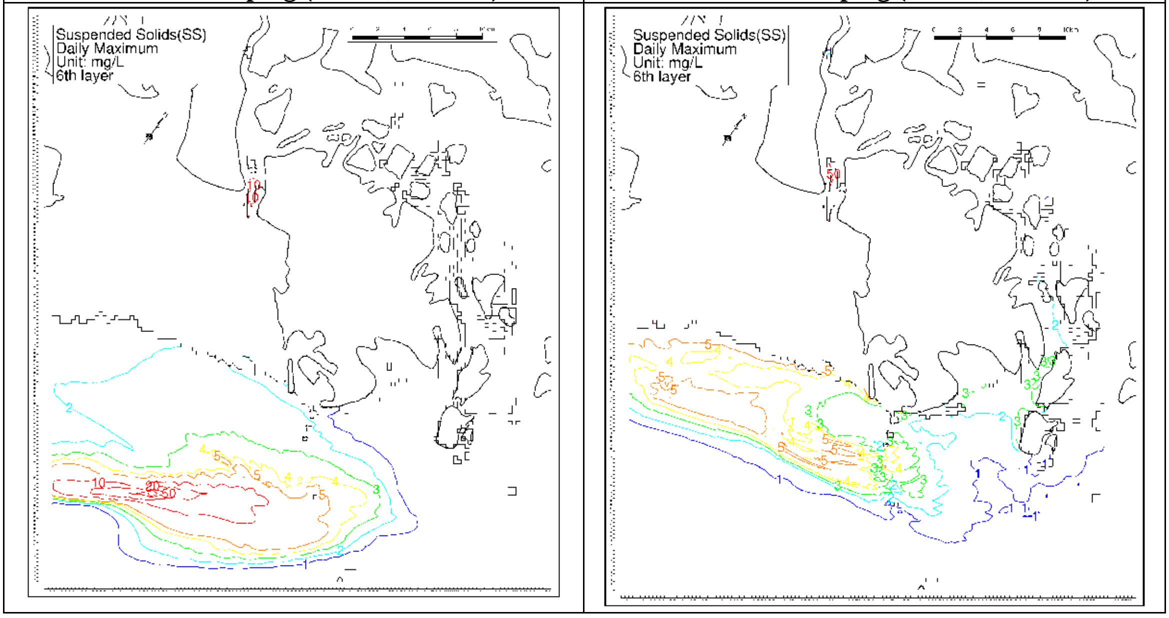


Figure 21.1.3 Predicted daily maximum SS dispersion pattern of offshore and near-shore dumping (large domain)



Offshore dumping (Case 3, 2-4 m) **Near-shore dumping (Case 4, 2-4 m)**



Offshore dumping (Case 4, 10-12 m) **Near-shore dumping (Case 4, 10-12 m)**

Figure 21.1.4 Predicted daily maximum SS dispersion pattern of offshore and near-shore dumping (Medium domain)

2) Conclusion

Following are the main findings derived through the comparison of SS dispersion of near-shore and offshore dumping.

- The upper layer SS dispersion range will be more extensive with near-shore dumping and may reach even towards east of Cat Ba Island and Ha Long Bay.
- Upper layer SS concentration will generally be significantly higher with near-shore dumping, with maximum SS value reaching 100 mg/l (maximum value of offshore dumping was around 10 mg/l).
- Near-shore dumping may result in a maximum ten-fold increase in SS concentration from current levels, especially in the areas offshore of Cat Hai Island.
- In conclusion, near-shore dumping will have greater impact on water quality than offshore

dumping.

21.1.3 Biological Environment

Impacts of offshore dumping and near-shore dumping on the biological environment were compared by focusing on the following main impacts that will occur through dredging and dumping activities:

- Impacts on the biological environment through loss of existing benthic habitats at the dumping sites
- Impacts on the biological environment through dispersion of suspended solids (SS)

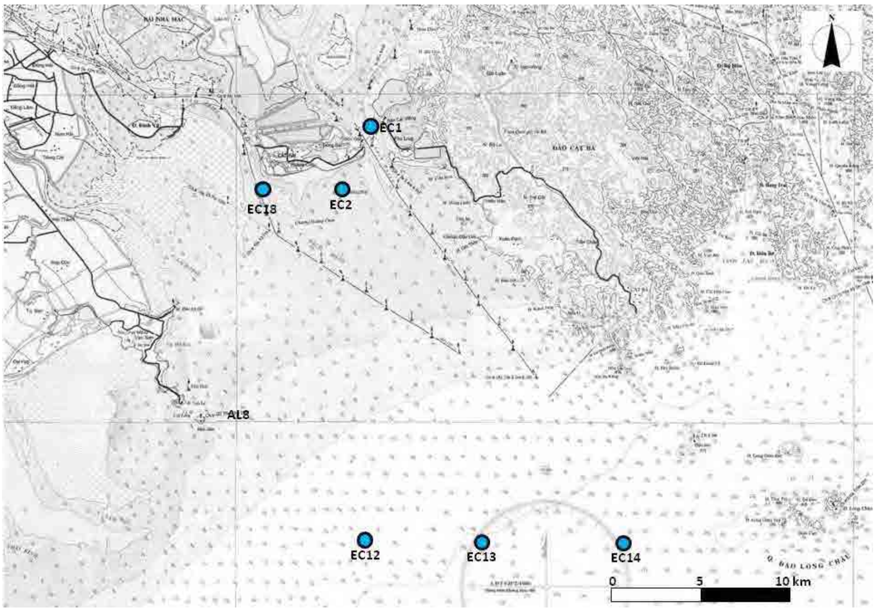
1) Impacts on the biological environment through loss of existing benthic habitats at the dumping sites

According to the field survey, the seabed of both dumping sites primarily consists of silty-sandy habitat, which will inevitably be lost due to smothering by dredged material. This as a consequence may have a range of adverse impacts on the marine organisms that currently reside or depend on the dumping site areas. However, the significance of such impacts could differ between offshore and near-shore dumping, depending on their ecological value (i.e. the site with lower ecological value will have less impact on the biological environment upon its loss). Hence the ecological values of both dumping sites were compared by focusing on factors such as:

- species diversity/abundance of demersal fish and macrozoobenthos
- presence of endangered species
- ecological function

a) Comparison of ecological value

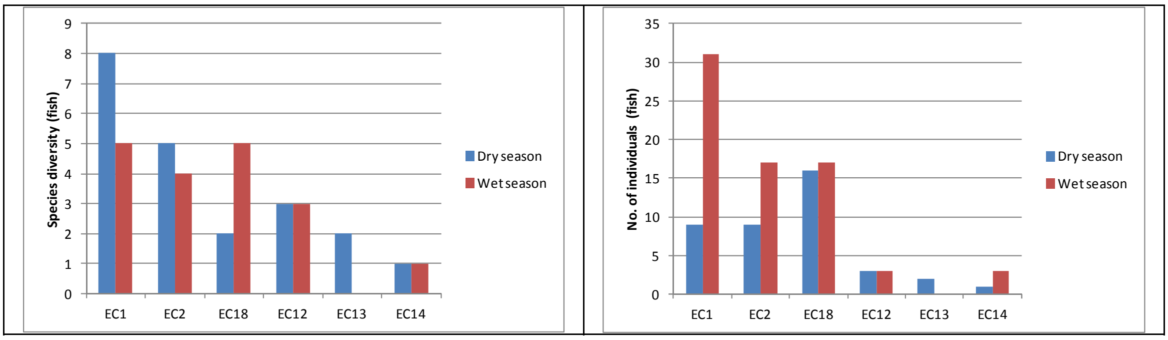
Species diversity and abundance of demersal fish and macrozoobenthos at the dumping sites were compared by referring to the results of the trawling survey conducted in May and August, 2011. While the trawling survey was conducted at 12 sites, 3 representative sites were selected for each dumping site. Sites EC1, EC2 and EC18 were selected for the near-shore dumping site; and sites EC12, EC13 and EC14 were selected for the offshore dumping site. See Figure 21.1.5 for the approximate location of the survey sites.



Note: EC1, EC2 and EC18 represent near-shore dumping site. EC12, EC13 and EC14 represent offshore dumping site.

Figure 21.1.5 Approximate location of the trawling survey sites

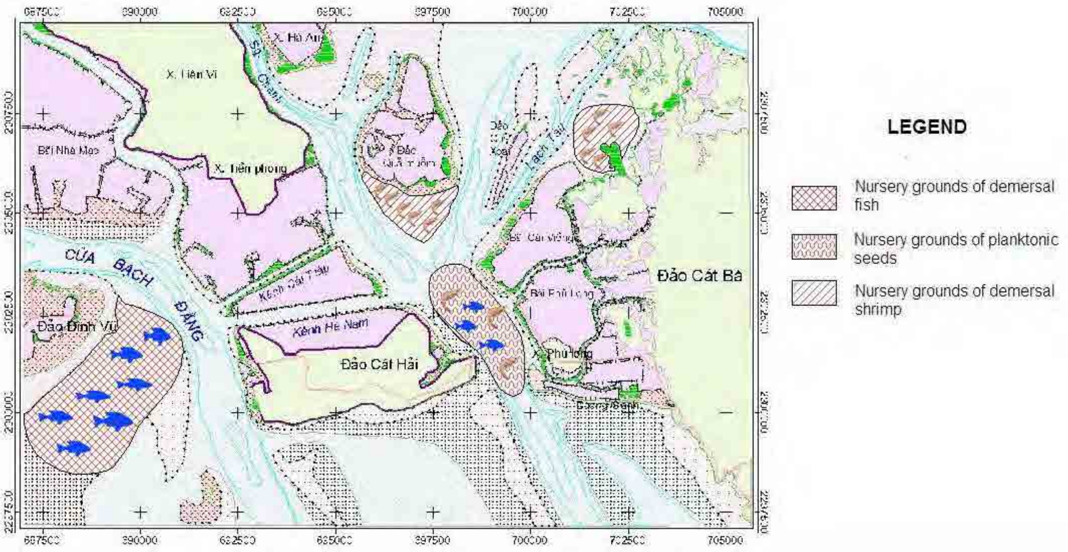
Figure 21.1.6 shows the species diversity and abundance of demersal fish at the near-shore and offshore survey sites.



Note: Wet season data of EC13 are not available as survey could not be conducted due to presence of fishing vessels.

Figure 21.1.6 Species diversity and abundance of demersal fish at the near-shore and offshore survey sites

In general, both diversity and abundance were higher at the near-shore area than the offshore area for both seasons. Typical demersal fish caught at the offshore area were tonguefishes, flatheads, gobies, flounders and croakers. In addition to the above fish types, the near-shore area also included: sleepers, whitings, soles, shads, lizardfishes, rabbitfishes, catfish and anchovies. Juvenile fishes (e.g. croakers) contributed significantly to the high fish abundance at the near-shore area, which indicates that the near-shore area has important function as a nursery ground for certain species. This finding was also consistent with past study of Nguyen Thi Thu et al. (2008), in which they identified the shallow coastal areas of the Lach Huyen area as important nursery grounds for various commercial fish and shrimp species. The zooplankton survey conducted in May 2011 also supported the above findings, as several species of fish larvae were found at the near-shore area, whereas no fish larvae were found at the offshore area. Figure 21.1.7 shows the distribution of the main nursery grounds in the shallow coastal areas of the Lach Huyen area, based on Nguyen Thi Thu et al. (2008).

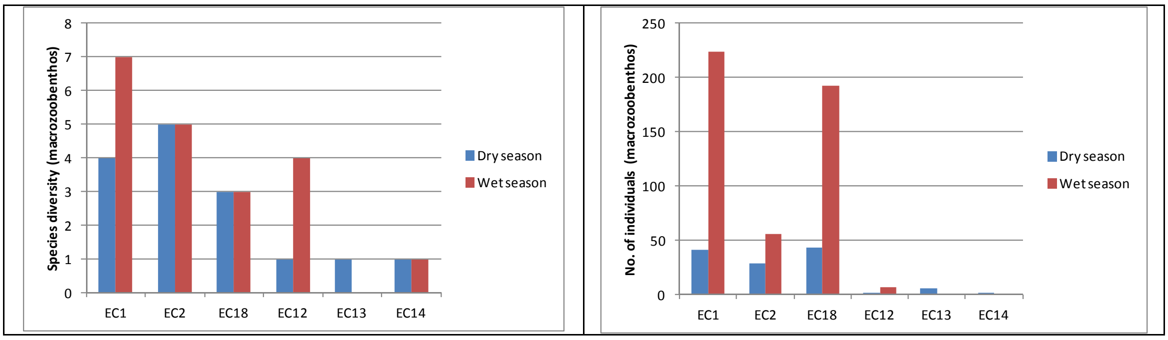


Source: Nguyen Thi Thu et al. (2008)

Figure 21.1.7 Distribution of main nursery grounds around the shallow coastal areas of the Lach Huyen area

Furthermore, two fish species (*Bostrichthys sinensis* and *Anodontostoma chacunda*) listed under Vietnam Red Book were found at the near-shore area (sites EC1 and EC2) for both seasons. Since these species were found during both seasons, the near-shore area is likely to be a permanent habitat for these endangered species.

Figure 21.1.8 compares the species diversity and abundance of macrozoobenthos at the near-shore and offshore survey sites.



Note: Wet season data of EC13 are not available as survey could not be conducted due to presence of fishing vessels.

Figure 21.1.8 Species diversity and abundance of macrozoobenthos in the near-shore and offshore survey sites

As it was the case with demersal fish, macrozoobenthos diversity was generally higher at the near-shore area for both seasons. While both sites had similar zoobenthos (e.g. crabs, shrimps, and mantis shrimp) composition, the macrozoobenthos abundance was significantly higher in the near-shore area. Two commercial shrimp species (*Palaemonetes sinensis* and *Parapenaeopsis tenella*) contributed significantly to the high zoobenthos abundance of the near-shore area, especially in the wet season.

b) Conclusion

Following are the main findings derived through the comparison of ecological values of near-shore and offshore areas.

- The results of the field survey show that the near-shore area has generally higher species diversity and abundance compared to the offshore area.
- The near-shore area probably functions as a nursery ground for various species.
- The near-shore area probably supports two fish species listed under Vietnam Red Book.

In conclusion, the near-shore area is likely to have greater ecological values than the offshore area. Hence impacts of benthic habitat loss through dumping activities will be more significant with near-shore dumping.

2) Impacts of SS dispersion from dredging and dumping activities

SS dispersion from dredging and dumping activities will likely have significant impacts on the biological environment, as elevated levels of SS may cause stress or in extreme cases mortality of marine organisms. However, impacts on the biological environment will likely differ between near-shore and offshore dumping due to differences in the extent of SS dispersion. The impacts of SS dispersion of near-shore and offshore dumping were compared by referring to results of the SS dispersion simulation.

a) Comparison of SS dispersion impacts

While the pattern of SS dispersion will vary with water depth, for the sake of simplifying the assessment, SS dispersion impacts were compared by referring only to the dispersion pattern of the upper (2-4 m depth) and bottom layers (10-12 m depth). See Figure 21.1.4 in Section 21.1.1 for the predicted SS dispersion pattern for near-shore and offshore dumping.

Impacts on the biological environment were assessed by referring to Japanese and Canadian water quality guidelines that are aimed to protect fishery resources and aquatic life respectively. Table 21.1.6 shows the water quality standard of SS for the Japanese and Canadian guidelines.

Table 21.1.6 Japanese and Canadian water quality standards for SS

Title of guideline	SS standard
Water quality standards for the protection of fishery resources (2005 version)	Anthropogenic activities should not increase SS concentration by more than **2 mg/l** over background levels.
Canadian water quality guidelines for the protection of aquatic life	Anthropogenic activities should not increase SS concentration by more than **5 mg/l** over background levels (for long term exposure).

Source of Japanese guideline: Japan Fisheries Resource Conservation Association
Source of Canadian guideline: Canadian Council of Ministers of the Environment (http://ceqg-rcqe.ccme.ca/)

Since the Japanese standard (2 mg/l) is slightly stricter than the Canadian standard (5 mg/l), the Japanese standard was applied specifically to marine organisms that are sensitive to turbidity, in which this case was hard corals. The Canadian standard on the other hand was applied generally to the other marine organisms. Following are the main findings of the assessment:

Impacts on hard corals

Hard corals are distributed in the east of Cat Ba Island and Long Chao Islands. Impacts on hard corals were assessed by referring to the SS dispersion of the upper layer, as the local coral reefs are mainly distributed in waters shallower than 10 m. According to the SS dispersion simulation, in the case of near-shore dumping, SS levels at the coral reef areas will be higher than 2 mg/l; whereas in the case of offshore dumping, SS increase at the coral reef areas will be less than 1 mg/l. This shows that impacts on hard corals will be more significant with near-shore dumping, even though the offshore dumping site is located closer to the coral reef areas.

Impacts on marine organisms (other than hard corals)

According to the SS dispersion simulation, the dispersion and concentration of SS in the upper layer will be significantly greater with near-shore dumping. For example, in the case of offshore dumping, areas above 5 mg/l will be limited to more or less in the vicinity of the dredging and dumping sites; whereas in the case of near-shore dumping, areas above 5 mg/l will extend towards west and south of Cat Ba Island, Do Song area and even near the Halong Bay area. As for the bottom layer, the spatial extent and concentration of SS will be slightly greater with offshore dumping. Overall, near-shore dumping will generally have greater impacts on marine organisms as the dispersion and concentration of SS will be significantly greater than offshore dumping, especially in the upper layer.

b) Conclusion

Following are the main findings derived through the comparison of SS dispersion of near-shore and offshore dumping.

- Impacts on hard corals will be more significant with near-shore dumping, due to the higher SS levels at the coral reef areas.
- Near-shore dumping will generally have greater impacts on marine organisms as the dispersion and concentration of SS will be significantly greater than offshore dumping, especially in the upper layer.

In conclusion, impacts of SS dispersion from dredging and dumping activities will be more significant with near-shore dumping.

21.1.4 Social Environment

Based on the social environmental survey results (section 3.4) and continuous communication with relevant authorities, potential impacts on local communities by the proposed project are described in this section. Since it hardly distinguishes the impacts by dredging and dumping works and other port development works, comparative evaluation includes all potential impacts by project activities.

1) Potential impacts on local communities and demands for the assistance for livelihood recovery

As described in section 3.4, the social environmental survey mainly focused on project affected households (PAHs) that may not be considered or eligible for any safety guard policies under the present legal system. As the land related compensation measures are well defined by the Vietnamese Land Law and its relevant policies, JICA study team had conducted quantitative social environmental survey especially at non-land related PAHs with standard evaluation methods for land related compensation. Due to the requests by commune PC representatives and comparison purpose, sample survey was also conducted at land related PAHs. Table 21.1.7 shows the number of total and interviewed PAHs.

Table 21.1.7 Number of Potentially Affected People in Local Communities

Commune/Communities	**Total # of HH***	**Potentially Affected Coastal/Offshore Fishing HH***		**Potentially Affected Salt Production & Aquaculture HH***	
	HH*	Total HH*	Interviewed HH*	Total HH*	Interviewed HH*
Hoang Chau	346	186	58 (31%)	55	7 (13%)
Nghia Lo	639	37	5 (14%)	585	25 (4%)
Van Phong	560	50	29 (58%)	510	11 (2%)
Dong Bai	298	76	8 (11%)	125	27 (22%)
Cat Hai town	1,668	253	121 (48%)	295	4 (1%)
Phu Long	520	180	54 (30%)	150	6 (4%)
Total	**4,031**	**782**	**275 (35%)**	**1,720**	**80 (5%)**
Immigrant Fishermen in Ben Pha Got Harbor	N/A	N/A	6***	0	0

* HH: house hold, ** N/A: Data is Not Available
*** reference purpose only, 6 HH/Fishing Boats (17 labors out of 27 people) were found and interviewed on the date of social environmental survey, but total number of immigrant HH is not known. All immigrants fishing HH live on the boat and go fishing around port development area or further offshore.
Source: Social environmental survey by JICA D/D Study team

a) Applicable safeguard policies

Presently, any impacts related to the land are generally well documented and continuously updated to address the issues on actual compensation activities. On the contrary, there are few applicable policies to define the eligibility and extent of the compensation for non-land related direct impacts such as fishing and aquaculture activities in the sea. In addition to such direct impact, there are also few applicable policies for indirect impacts such as degradation of salt and aquaculture productivities on land by high turbidity water from dredging and dumping activities.

Based on JBIC’s environmental consideration policies (Part 2, 1. Environmental and Social Considerations Required for Funded Projects (Involuntary Resettlement), JBIC Guideline 2002);

- 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.

- 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.

Although the significant impacts on fishing, salt production, and aquaculture by the proposed project activities are certain, no specific actions have been made to compensate such losses and livelihood recovery. Due to the lack of legal frameworks and reference cases in the past, HPPC-the response authority has had difficulties to define and develop such safeguard policies. Throughout the repeated and continuous communication with HPPC and Cat Hai District PC authorities, JICA study team and local environmental experts recognized shortage of time to develop a completely new safeguard policy to account for all losses and assistance for the recovery.

Since there are no specific legal rights for the coastal and offshore fishing area in Viet Nam, it is hardly to define the value and loss of fishing area for each fishing house hold. However, it is possible to define the loss of each fishing house hold and reasonable to consider the eligibility and extent of the livelihood recovery. In order to refer to the existing safeguard policies in livelihood recovery relevant to loss of land, most updated policies on livelihood recovery especially in occupational change and job creation assistance are summarized as follow (Table 21.1.8).

Specifically for the Lach Huyen Gateway Port project, the PAHs related to the loss of land or properties will be compensated by HPPC's Decision 1263/2010/QD-UBND dated 30/7/2010 and Decision 130/2010/QĐ-UBND dated 23/1/2010 of Hai Phong PPC modified and supplementary regulation for compensation, assistance and resettlement when the Government acquire land on Hai Phong territory.

Table 21.1.8 Summary of Available Safeguard Policy

Provision	Allowance	Allowance rate
Decision 130/2010/QĐ-UBND Chapter IV: provision 12		
Article2: assistance for allocated agricultural land	2.1 occupational change and job	-In-cash allowance equivalent to 2 times of agricultural land price depending on location and not more than regulated land size allocation. -Assistance of vocational training on PAP's requirement.
Loss between 30% - 70% of agricultural land	2.2 life stabilization	6 months (without relocation) and 12 months (with relocation) x 30kg rice /person/month
Loss over 70% of agricultural land		12 months (without relocation) and 24 months (with relocation) x 30kg rice /person/month
Decision 1263/2010/QD-UBND dated 30/7/2010 and Decision 130/2010/QĐ-UBND		
Assistance for occupational change for severely affected agricultural land, business and income generation activities	- **Eligibility**: all PAP of working age that are engaged in agricultural, or similar production and experience significant impacts on their productive land - **Assistance**: full assistance to attend vocational training programs in training centers for occupational change - **Assistance value**: up to a pre-agreed sum of US$200 per trainee with transitional allowance of US$100 per trainee during the training period - **Duration**: average three to six months	

b) Fundamentals for the consideration of effective livelihood recovery

In order to consider meaningful and practical assistance programs for the PAP, long-term regional development plan and essential indicators are summarized as follows.

i) Master Plan on Dinh Vu – Cat Hai Economic Zone

In January 2008, Prime Minister agreed to establish the Dinh Vu-Cat Hai economic zone (DCEZ) as the key component of northern key economic regional development (Decision No. 06/2008/QD-TTG dated January 10, 2008, establishing and promulgating regulation on operation of Dinh Vu-Cat Hai economic zone). DCEZ is one of primary marine economic centers of the Vietnamese North Coast. City of Hai Phong is aiming to offer a modernized industrial cluster and international logistic hub to realize the fundamental changes not only in the city but also in the northern region of Vietnam in the process of Vietnamese industrialization and modernization.

In order to realize such ambitious plan, HPPC has been preparing for a master plan on DCEZ. Du to the final stage of Prime Minister’s approval (as of September 2011), detail information of the master plan has not been published and disclosed. Based on the official communication with HPPC and Cat Hai District officials, from 2015, all land on Cat Hai Island is allocated only for industrial and commercial purpose with relocation sites for the existing residents and cemetery. If the master plan is implemented as planned by 2015, almost all residents of Cat Hai Island are required to apart from their traditional farming/fishing activities to modernized economic activities by drastic occupational change.

With the discussion with District PC officials – the designated authority for the development and implementation of the safeguard policies, any livelihood recovery program for the APAs shall be fully compatible with the DCEZ master plan. In other words, assistance programs related to the existing agricultural or fishery based occupation will be out of its scopes. On the contrary, there are high demand for the livelihood recovery without drastic occupational changes in commune level officials and PAP, especially for elder persons that would hardly be able to adapt the industrialized economic activities even with full support of the vocational training.

ii) Education background in the potentially affected community

In order to consider the capability of the occupational change and practical vocational training methodology, trainees’ educational level is essential. Results of a survey on educational level of household heads in the project area are as follows. 20.8% of the household heads have primary school certificates or lower and 62.8% have secondary-school certificates or lower, 7.9% graduated high schools, and 1.1% does not have any schools education (Table 21.1.9).

Table 21.1.9 Education Background of Household Heads

Commune	Illiteracy	Primary not completed	Primary completed	Secondary not completed	Secondary completed	High school not completed	High school completed	Total
Hoang Chau	3.1	6.2	7.7	16.9	46.2	15.4	4.6	**100**
Nghia Lo	0.0	3.3	0.0	23.3	56.7	3.3	13.3	**100**
Van Phong	0.0	12.5	15.0	30.0	30.0	2.5	10.0	**100**
Dong Bai	2.9	5.7	25.7	28.6	20.0	5.7	11.4	**100**
Cat Hai town	0.8	9.6	11.2	48.8	15.2	6.4	8.0	**100**
Phu Long	0.0	11.7	15.0	25.0	36.7	6.7	5.0	**100**
Total	**1.1**	**8.7**	**12.1**	**32.7**	**30.1**	**7.3**	**7.9**	**100**

Source: Social environmental survey by JICA D/D Study team

In summary, education levels of the surveyed household heads in the project area are relatively low compared to other districts in Hai Phong. Lower education level may limit the applicability of some high level vocational training within limited timeframe and budget. Majority of the PAP has limited education and traditional salt/agricultural/fishery experiences in the past. These phenomena should be noted seriously considered during development of vocational training programs. Not only appropriate programs development but also effective monitoring mechanism shall be implemented to ensure the recovery of the PAHs' living standards and safeguard measures for those who are not suitable for the new occupation and need another means to recover the income level.

iii) Gender, ethnic minority, and poverty

Considering the suitable occupation and applicability of the income restoration programs, understanding of habitual practices in gender or minority issues is essential, especially in rural communities. In traditional agricultural communities in Vietnam, female contributions account for as same level as male's while compensation for female work are generally under estimated and low paid.

Table 21.1.10 Population and Labors by Gender

Commune	Total population	Male	%	Female	%	Total labor	Male	%	Female	%
Hoang Chau	311	157	50	155	50	158	86	54	72	46
Nghia Lo	146	70	48	76	52	74	35	47	39	53
Van Phong	188	93	49	95	51	114	61	54	53	46
Dong Bai	145	71	49	74	51	66	33	50	33	50
Cat Hai	514	275	54	232	45	291	174	60	117	40
Phu Long	263	129	49	134	51	139	75	54	64	46
Total	**1,567**	**795**	**51**	**766**	**49**	**842**	**464**	**55**	**378**	**45**

Source: Social environmental survey by JICA D/D Study team

Result of the male/female labor balance shows that population and labor force are equally distributed between men and women. Thus, income restoration program shall be equally addressed for both men and women. Since there are some differences such as physical strength between men and women, such difference shall be considered with expected income levels for the new occupations, which must be equal or higher than present level as long as high enough for the living standards in the DCEZ area. There is no ethnic group in the project affected communities. All the population in the project is Kinh people. Thus, there is no need for the special attentions to the ethnic groups.

Considering the poverty line in the project affected communities, the poverty line is defined by the GOV in the year 2011. The set poverty lines in urban area and rural area are less than VND 500,000/person/month and less than VND 400,000/person/month respectively (Decision No. 09/2011/QĐ-TTg dated 30/1/2011 of the Prime Minister). Based on the survey, there are 76 house holds are considered as poverty line households comprised of poor or/and social aided households (receiving livelihood assistance from the government). Among those 76 house holds, there are 4 house holds headed by women with dependents. Thus, it will not be critical matter to pay special attentions to those disadvantage groups.

Table 21.1.11 Disadvantageous Groups

Commune	Policy titled HH (%)	Poor HHs (%)
Hoang Chau	7.7	16.9
Nghia Lo	13.3	10.0
Van Phong	0.0	0.0
Dong Bai	17.1	8.6
Cat Hai	2.4	27.4
Phu Long	6.7	5.0

Source: Social environmental survey by JICA D/D Study team

c) PAP's General response for the Lach Huyen Gateway Port project

Since the project affected communities are not suitable for the farming, there are only limited income opportunities such as salt production, aquaculture, and coastal fishing. However, due to the unsuitable seawater and weather condition, productivity and quality of Cat Hai's sea salt is low. In addition, based on the survey, the coastal fish catch has been decreasing due to the least fish resource management and degradation of fish nursery area - mangrove forest in the region. As a result, it is hardly to improve the living standards with conventional economic activities except modernized aquaculture requiring big investments. Therefore, there are high expectations for new job opportunities and strong demand for necessary vocational training among the society.

i) PAP's recognition and opinion for the Lach Huyen Gateway Port project

Result of the social environmental survey found that recognition of the Lach Huyen Gateway Port project is relatively low though the project has been announced and continuously discussed throughout many media reports since 2008. Only 35% of 355 interviewed households had information of the either both Tan Vu-Lach Huyen Highway project and Lach Huyen Gateway Port project or one of two projects. Despite low recognition of the Lach Huyen Gateway Port project, 94% of interviewed households, which are most likely to be affected by the port project, have agreed with the project. With the trust of the government's decision, most of them have always followed the government's leadership. Majority of the interviewed PAP hope that the project will contribute to Vietnamese modernization in general and generate better job opportunities in the communities' particular, which would lead better living in the future. The remaining 6% disagreed with the project because of the serious concern to change the occupation. As majority of the interviewed PAP have limited educational opportunities and limited work experience in traditional agricultural activities, it is reasonable to seriously worry about the new occupation and security of the sustainable income.

Table 21.1.12 Knowledge/Recognition of the Lach Huyen Port Project and Opinion

Commune/Communities	**Information of the Port Development Project**		**Agree with the project construction**	
	Yes %	No %	Yes %	No %
Hoang Chau	44.6	55.4	95.4	4.6
Nghia Lo	23.3	76.7	100	0.0
Van Phong	15.0	85.0	97.5	2.5
Dong Bai	34.3	65.7	85.7	14.3
Cat Hai town	50.8	49.2	99.2	0.8
Phu Long	10.0	90.0	80.0	20.0
Total	**34.7**	**65.3**	**93.8**	**6.2**
Immigrant Fishermen in Ben Pha Got Harbor	33.3	66.7	100	0.0

Source: Social environmental survey by JICA D/D Study team

Summary of the PAP's expected impacts by the Lach Huyen Gateway Port project is shown in Table 21.1.13. Besides the expected benefits in the society, PAP has been concerned about the negative impacts to be appeared during construction and operation phases due to the drastic changes. Results of the survey indicate that majority of PAP believe that the Lach Huyen Gateway Port would impair the income level, job opportunity, environment (water, soil, air). In transportation, negative and positive impact level is same at 44%. Only positive impacts on market access (45%) are outweighed against negative impacts (24%).

Due to the lack of the detailed information for the DCEZ development and instruction for the occupational change and necessary vocational training by the government, 77% of PAP believe the income would be worse and 72% of PAP believe the job opportunity would be worse. Since there are neither traditional and unique handicraft practices nor productive agricultural land for alternative income sources, it is difficult to find alternative occupations in traditional practices, which are generally preferred by elder PAP. Unlike land clearance that causes direct impacts and is eligible for compensation, PAP are also concerned about the indirect impacts by the degradation of environmental condition that might lower the productivities of the traditional economic activities as well as value of the final products.

It is highly recommendable to disclose the development plan such as DCEZ in the community level to improve the public awareness of the Lach Huyen Gateway Port project as soon as possible. The fear of drastic changes in social system, particularly in occupational change and opportunity, shall be carefully considered and taken care of for the smooth implementation of the project and achievement of ambitious goals with sustainable way.

Table 21.1.13 PAP's Expected Impacts by the Lach Huyen Port Project (unit: %)

Impacts	Worse	Better	No Impacts	No Idea
Transportation	**44.4**	**44.4**	4.8	6.5
Market accessing	24.3	**45.2**	6.5	24.0
Income level	**77.1**	16.1	2.5	4.2
Job opportunity	**71.8**	18.6	4.2	5.4
Water	**63.0**	20.9	4.8	11.3
Soil	**93.2**	0.0	3.1	3.7
Air	**89.0**	0.0	6.8	4.2

Source: Social environmental survey by JICA D/D Study team

ii) PAP's preferable options for the occupational change

Summary of the PAP's preferable options for the occupational change is shown in Table 21.1.14. 59% of total interviewees in the project affected communes wish to continue their present work. The highest ratio is raised in Phu Long followed by Cat Hai town (61%), Nghia Lo (60%) and Hoang Chau (60%). The lowest ratio is raised in Van Phong, but it still accounts for 45%.

Construction worker is the 2nd preferable options and account for 27% in total. Although substantial TEMPORAL workers are required for the highway and port development projects, requirement for the unskilled workers may not be sufficient enough for the all PAP (cf. section 21.2.3). Even with skilled work with the vocational training, need for construction work relevant to the highway and port projects are only up to three years. Considering the sustainability of the occupational change and stable income sources, longer term solution shall be also considered for those who are willing to work as construction workers.

Other non-conventional options (small trade, animal breeding, and other new occupation) only account for 3%, 2%, and 6% respectively. Except for the animal breeding, such non-conventional options match the regional development plan and shall be the preferable options for the HPPC and Cat Hai District PC. The survey results clearly prove the need for good guidance for PAP to convert their occupation into non-conventional occupations.

Table 21.1.14 PAP's Preferable Options for the Occupational Change

Unit: %	**Hoang Chau**	**Nghia Lo**	**Van Phong**	**Dong Bai**	**Cat Hai town**	**Phu Long**	**Total**
1. Continue with present occupation	**60.0**	**60.0**	**45.0**	**57.1**	**60.5**	**65.0**	**59.0**
2. Handicraft	0.0	0.0	2.5	0.0	0.8	0.0	0.6
3. Restart business	0.0	0.0	2.5	2.9	0.0	0.0	0.6
4. Small trade or service activities	0.0	3.3	5.0	11.4	2.4	1.7	3.1
5. Animal breeding	0.0	3.3	0.0	11.4	0.0	3.3	2.0
6. Construction worker	35.4	26.7	12.5	17.1	36.3	11.7	26.6
8. Other New occupation	1.5	0.0	25.0	0.0	0.0	18.3	6.2
9. Aquaculture	0.0	0.0	2.5	0.0	0.0	0.0	0.3
10. Hired labor	0.0	3.3	0.0	0.0	0.0	0.0	0.3
11.Germents	0.0	0.0	2.5	0.0	0.0	0.0	0.3
12.No idea	3.1	3.3	2.5	0.0	0.0	0.0	1.1

Source: Social environmental survey by JICA D/D Study team

iii) PAP's preferable assistance for the income restoration program

Summary of the PAP's preferable assistance for the income restoration program is shown in Table 21.1.15. Financial assistance is exclusively high among all communes compared to other options. Among the interviewed PAHs, nearly 85% of the PAHs are currently engaged in some loans (average VND 20.0 million). 83% of the PAHs have borrowed money for salt production or aquaculture activities. The majority of remaining PAHs has borrowed money mainly for education and house construction.

Demand for conventional agriculture and fishery assistance is relatively high compared to other options except loans. Demand for non-conventional agriculture (livestock & crops) is also high in Van Phong and Phu Long commune. Sum of the technical training in non-conventional occupations is not as high as other conventional works at this moment. However, it could be much higher in the future if responsible authorities could give more clear visions for the modernized society and provide realistic options for the new occupations.

Table 21.1.15 Preferable Assistance for Income Restoration Programs

Unit: %*	**Hoang Chau**	**Nghia Lo**	**Van Phong**	**Dong Bai**	**Cat Hai town**	**Phu Long**	**Immigrant Fisherman Ben Pha Got**
1. Technical training for long term (not specific for the highway or port project)							
1. 1 agricultural/fishery training	3.3	3.2	13.6	13.4	0.6	26.6	
1.2 Mechanics	8.7	0.0	1.5	0.0	11.7	0.8	
1.3. Business/service	0.0	6.5	0.0	2.7	3.7	1.6	16.6
1.4 handicraft production	0.0	12.9	0.0	2.7	6.1	0.0	
1.5 Construction	8.7	6.5	0.0	2.7	3.7	0.0	
1.6. Restaurant/ hotel	0.0	0.0	0.0	0.0	0.6	0.0	

Unit: %*	**Hoang Chau**	**Nghia Lo**	**Van Phong**	**Dong Bai**	**Cat Hai town**	**Phu Long**	**Immigrant Fisherman Ben Pha Got**
2. Vocational training for construction worker for the highway/port project & skill worker in port operation	10.9	6.5	13.6	10.8	15.3	3.1	16.6
3. Livestock & crops	4.3	0.0	15.2	8.1	0.6	22.7	
4. Loan	**60.9**	**61.3**	**51.5**	**54.1**	**57.1**	**44.5**	66.6
5. Other assistance	0.0	0.0	0.0	0.0	0.0	0.0	66.6
6. No idea	2.2	0.0	4.5	5.4	0.6	0.8	

* multiple options could be chosen. Percentage were calculated from <chosen #>/<total interviewees in the commune>.
Source: Social environmental survey by JICA D/D Study team

2) Impacts of SS dispersion from dredging and dumping activities

As described in section 21.1.1, impacts by the dredging and dumping activities would be significantly higher than other sources. Since the smart choices of dredging methodologies and dumping site would be able to avoid unnecessary losses and expenditure for the compensation and counter measures, extent of the potential impacts are described below. SS dispersion from dredging and dumping activities will likely have significant impacts on the social environment without proper control measures as elevated levels of SS may cause degradation of existing economic activities including not only fishery but also salt production and aquaculture on land and beach resorts along the coast (Figure 21.1.9).

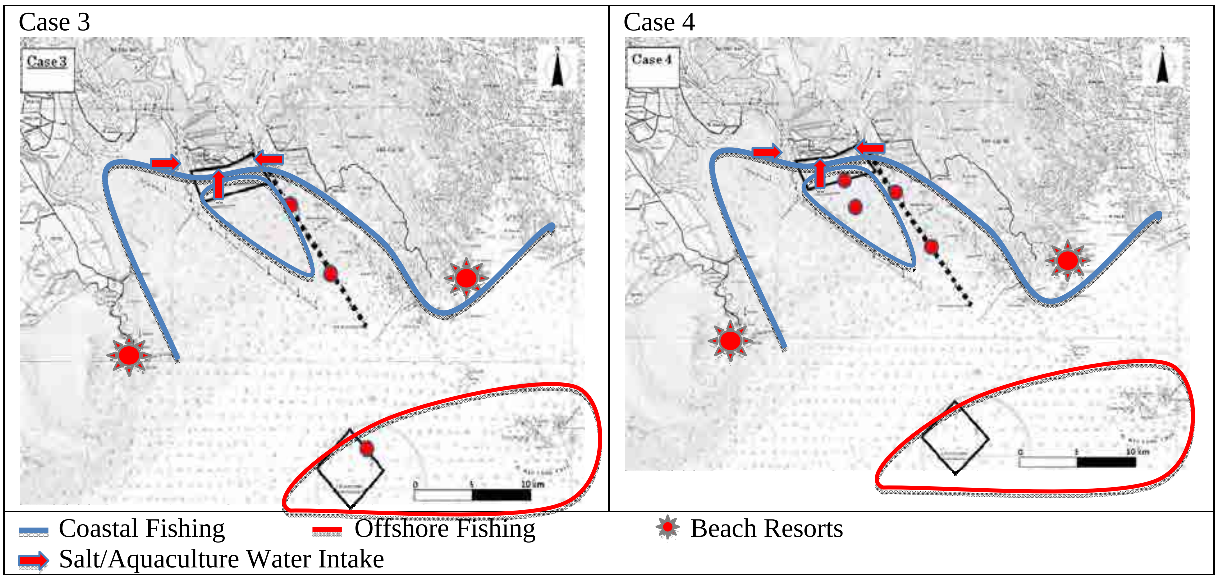


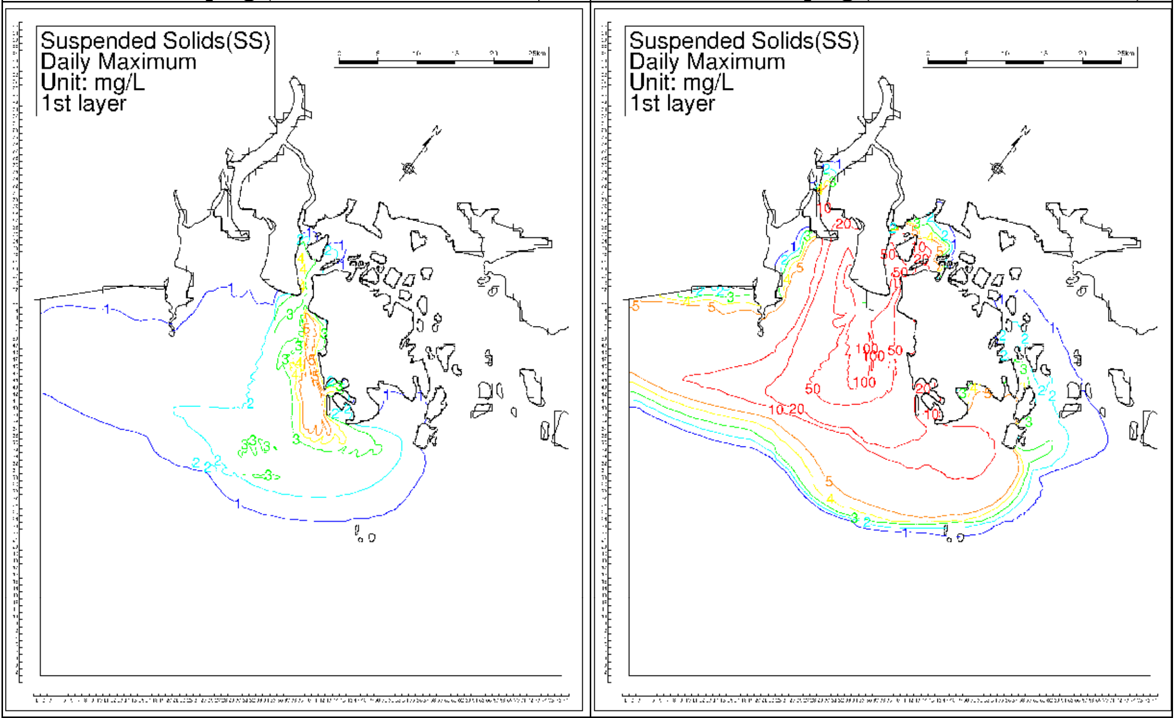
Figure 21.1.9 Representative Offshore and Near-shore Dumping Site and Socially Sensitive Area

a) Comparison of SS dispersion impacts

Since the mentioned economic activities are likely to be affected by surface water quality, expected daily maximum SS dispersion patterns on the surface water (0-2m) are compared between Offshore and Near-shore representative cases without any counter measures to lower the SS loads (Figure 21.1.10). Detailed dredging methodologies and SS dispersion results shall be conferred in Chapter 12.

As summarized in (Table 21.1.6), more than 5mg/l additional SS might seriously impact on present ecosystem. Although the existing fish's vulnerability of the sediment and applicability of Japanese or Canadian standards should be carefully examined, fish catch might significantly decrease within the red lined contour line (additional SS higher than 5mg/l).

Offshore dumping (Case 3, 0-2m/L-domain) | **Near-shore dumping (Case 4, 0-2m/L-domain)**



Offshore dumping (Case 3, 0-2m/M-domain) | **Near-shore dumping (Case 4, 0-2m/M-domain)**

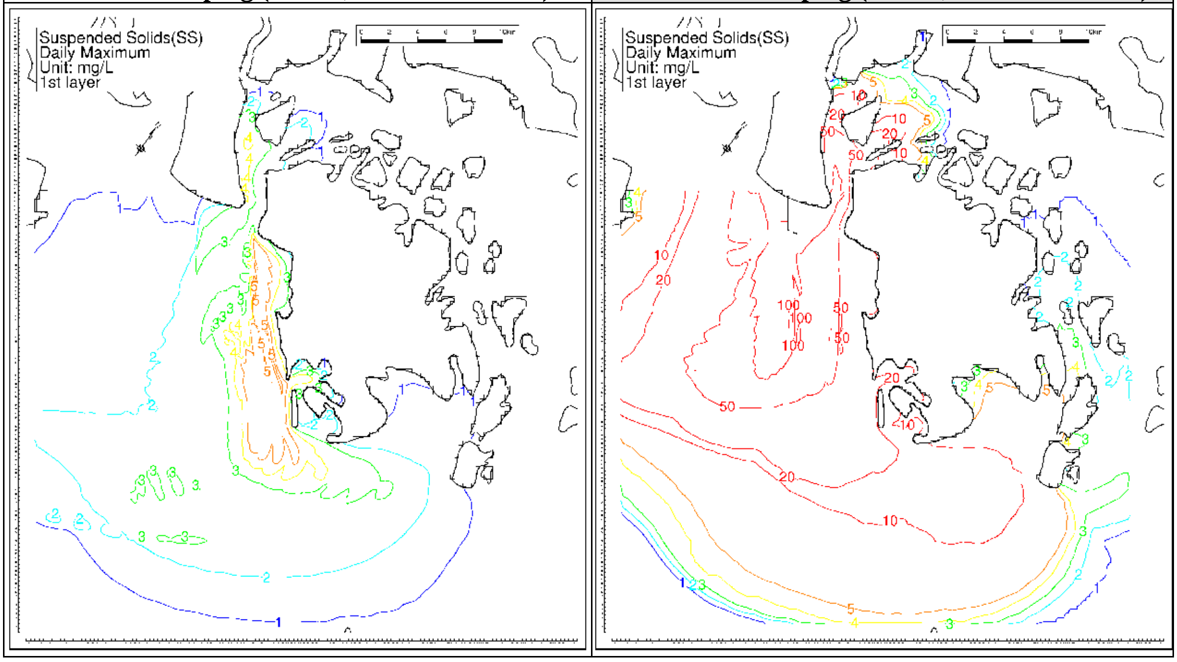
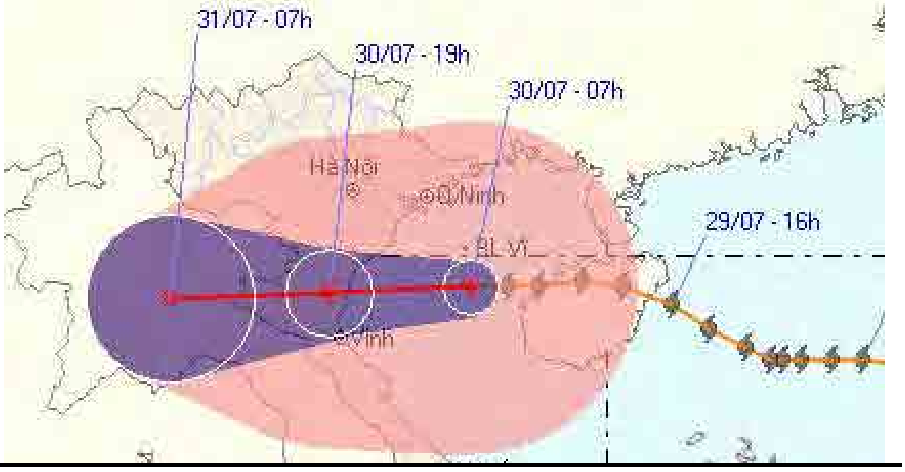


Figure 21.1.10 Comparison of Predicted Daily Maximum SS Dispersion Pattern on the Surface

Since those standards are also developed for recommendable aquaculture practices, the benchmark of 5mg/l shall be applicable for land based aquaculture’s potential impacts. Though there are no reference standards for salt production, any additional sediment in the intake water would likely to cause the degradation of final products or additional work to clean the final products.

In order to understand the circumstances after the tropical storm and consider the acceptable water quality level for the beach resorts, SS water samples were taken at Do Song beach on August/1/2011 and South of Cat Ba Island (WS12 in Figure 21.2.6) and Cat Ba Beach on Aug./2/2011 right after the strong cyclone No.3 (Bão số 3/2011). The results of the SS level clearly show that additional 5mg/l of SS is negligible in Do Song beaches while it is certainly recognizable in Cat Ba beaches. Such difference shall be carefully considered for the SS control measures.

Table 21.1.16 SS Level Right After the Storm at the Beach Resorts

Location	SS (mg/l)	Water color
Do Son Beach	77.2	
Cat Ba South	6.5	Not available
Cat Ba Beach	0.5	
Cyclone #3/2011		

Source: Social environmental survey by JICA D/D Study team

Based on the given facts and social environmental survey results, JICA study team had repeatedly consulted with each commune representatives and confirmed the number of PAP. Especially for the coastal and offshore fishing, it is hardly to clarify the each fishing household's fishing location and fish catch. Thus, the confirmed numbers shall be considered as the maximum number of potentially affected households. As the nature of the fishery, fishermen follow and catch the fish. Thus, loss of the present fishing location might not be linearly related to the loss of their income.

Offshore dumping

In the case of offshore dumping, PAHs by SS dispersion would be limited to offshore fishing households accounting for 386 households with 767 labors in interviewed six (6) communes (Table 21.1.17). Since it is required to have a large capacity boat for the offshore fishing, all fishing house holds in Hoang Chau and Majority of the Phu Long will be affected by the offshore dumping. Although the 100% of fishing households would be affected, the affected period shall be limited within the offshore fishing season between January and April. On the contrary, fishing households in Phu Long would be affected all year around. In addition, 53 out of 253 PAHs in Cat Hai town and 3 out of 76 PAHs in Dong Bai would be affecting and no households would be affected in Nghia Lo and Van Phong. Though the proposed offshore dumping are is not the popular/primary offshore fishing area, there are still some fishermen not only from surveyed communes also Cat Ba town, Do Song and other provinces. It is hardly evaluate the actual PAHs at the offshore dumping are with adjacent high SS dispersion area. Therefore, the above mentioned PAHs and labors shall be considered as “Minimum” and reference purpose only.

Near-shore dumping

In the case of near-shore dumping, PAHs by SS dispersion would be widely distributed to any conventional activity depending on coastal water (coastal fishing, salt production, aquaculture) accounting for 2,746 households with 4,907 labors, which is 68% of the total households in 6 communes (Table 21.1.18). Throughout the communication with commune PC officials, it is hardly to divide the potentially affected and unlikely affected households. Thus, the potentially affected number is equal to the number of officially registered/counted people engaged in potentially affected work. Considering the potential impacts on fishermen with large capacity boats by near-shore dumping, PAHs and commune authorities claimed certain impacts since they regularly fish around the coastal zone depending on the season and fish movement.

In addition to the fishing activities, salt production and aquaculture are likely to be affected by the near-shore dumping due to the degradation of productivities lead by higher concentration of SS in the intake water. Furthermore, beach resorts in Cat Ba Island are likely to be affected by the near-shore dumping due to the higher concentration of SS. On the contrary, beach resorts in Do Song may be affected only low turbidity seasons (September-April). As shown in Table 21.1.16, tolerance for SS concentration in Do Song should be higher than Cat Ba beaches. Although the beach resorts operate annually, the primary impacts on those businesses shall be limited to warmer seasons when people enjoy beaching.

Table 21.1.17 Number of PAHs and Labors by Offshore Dumping

Commune	Registered Coastal/Offshore Fishing		Potentially Affected Coastal/Offshore Fishing	
	Total household	Total Labor	Total household	Total Labor
Hoang Chau	186	367	186	367
Nghia Lo	37	76	0	0
Van Phong	50	89	0	0
Dong Bai	76	152	3	6
Cat Hai town	253	506	53	106
Phu Long	180	360	144	288
Total	**782**	**1,550**	**386**	**767**

Source: Social environmental survey by JICA D/D Study team

Table 21.1.18 Number of PAHs and Labors by Near-shore Dumping

Commune	Coastal/Offshore Fishing		Salt Production		Salt Production		Total	
	House hold	Labor	House hold	Labor	House hold	Labor	House hold	Labor
Hoang Chau	186	367	40	78	15	15	241	460
Nghia Lo	76	152	226	298	143	143	445	593
Van Phong	37	76	429	729	156	265	622	1,070
Dong Bai	50	89	400	815	110	185	560	1,089
Cat Hai town	253	506	226	391	69	138	548	1,035
Phu Long	180	360	0	0	150	300	330	660
Total	**782**	**1,550**	**1,321**	**2,311**	**643**	**1,046**	**2,746**	**4,907**

Source: Social environmental survey by JICA D/D Study team

For either offshore or near-shore dumping case, there are few specific and applicable safeguard policies for PAP though the potential impacts on conventional activities depending on seawater are certain and critical for those who partially or fully depend on such activities for income source. As mentioned above, the master plan on Dinh Vu – Cat Hai Economic Zone (2015-2030) is likely to be approved by GOV and implemented shortly. As a result, majority of residents on Cat Hai Island including PAP for the Lach Huyen Gateway Port project are required to relocate within the relocation site in Cat Hai Island and change the occupation. Therefore, responsible authorities shall seriously consider the actual action plans to realize the ambitious development plan. In order to make such action plans effective and realistic, it is highly recommendable to involve not only private businesses and investors, who would be the key component of the DCEZ and offer new jobs, but also affected people who need support for occupational change and would be the workforce for DCEZ.

b) Conclusion

Following are the main findings derived through the comparison of SS dispersion of near-shore and offshore dumping without any control measures.

- Near-shore dumping may cause more significant impacts on conventional occupations depending on seawater near-shore dumping led by the loss of fishing area and degradation of productivities by higher SS concentration.
- Near-shore dumping may cause more significant impacts on coastal tourism especially during the beaching seasons (late spring – early fall) led by the degradation of beaching attractiveness by higher SS concentration.
- Both dumping cases certainly cause negative impacts on local economy but there are few applicable safeguard policies to mitigate such impacts at this moment. With the smart integration of the DCEZ master plan, it is highly recommendable to get not only 1) key responsible authorities but also 2) businesses/investors and 3) PAP/potential labors involved in practical action plan and safeguard policy development.

In conclusion, near-shore dumping will be more significant impacts on social environment, and greater efforts would be required to mitigate such losses and impacts.

21.1.5 Summary and Recommended Dumping Site

Comparative summary of the environmental impact assessment for SS dispersion between near-shore and offshore dumping without SS control measures are shown in Table 21.1.19.

Table 21.1.19 Comparative Summary of the Environmental Impact Assessment

	Type of impact	**Near-shore**	**Offshore**
Permits	Requirement of authorization	- Officially approved by MOT (MOT Decision 476 QD-BGTVT 15//03/2011) - Officially approved by HPPC	- Need official approval by MOT - Need official approval by HPPC (at least 6 months)
Natural environment	Impact on water quality (i.e. SS)	- The upper layer SS dispersion range was more extensive compared to offshore dumping. - The upper layer SS concentration was significantly higher compared to offshore dumping. - Near-shore dumping may result in a maximum ten-fold increase in SS concentration from current levels.	- The upper layer SS dispersion range was less extensive compared to near-shore dumping. - The upper layer SS concentration was significantly lower compared to near-shore dumping.
Biological environment	Impacts by loss of existing benthic habitat	- The diversity and abundance of marine organisms was higher compared to offshore dumping area. - The near-shore area probably functions as a nursery ground for various species. - The near-shore area probably supports two fish species listed under Vietnam Red Book.	- The diversity and abundance of marine organisms was lower compared to near-shore dumping area. - No significant ecological function was identified. - No endangered species was identified.
	Impacts by SS dispersion	- Hard corals in Cat Ba Island and Long Chau Islands could be affected from SS dispersion. - Impacts on marine organisms will be greater compared to offshore dumping, as SS dispersion was predicted to be more significant than offshore dumping.	- Hard corals in Cat Ba Island and Long Chau Islands are unlikely to be affected from SS dispersion. - Impacts of SS dispersion on marine organisms will be less compared to offshore dumping, as SS dispersion was predicted to be less significant than near-shore dumping.
Social environment	Impacts by loss of existing fishing area & SS dispersion	- PAHs by loss of fishing area and SS dispersion would be **all existing/conventional** occupations depending on sea water (**up to** 2,746 HHs, 4,907 labors). - Impact on tourism//beach resorts would be moderate at Do Son beaches while it would be significant in Cat Ba beaches. - Additional safeguard policies for PAP/businesses are required, which shall be fully compatible with the DCEZ master plan 2015-2030.	- PAHs by loss of fishing area and SS dispersion would be limited to offshore fishing households only (**at least** 386 HHs, 767 labors). - Impact on tourism//beach resort would be negligible or minimal. - Additional safeguard policies for PAP/businesses are required, which shall be fully compatible with the DCEZ master plan 2015-2030.
Conclusion	Without SS control measures, either near-shore or offshore dumping would cause considerable impacts on natural, biological, and social environment. However, considering the environmental sustainability and avoidance and minimization of unnecessary environmental impacts, **offshore dumping** is the preferable option without SS control measures. Due to the higher extent of negative impacts, SS control measures for near-shore dumping would be technically difficult and costly to minimize and compensate the damages. Therefore, it is recommendable to dispose the dredged sediment at the offshore dumping site. Even with the offshore dumping, it is still required to apply SS control measures to minimize the impacts with effective, economical, and practical measures. However, in the case of solely near-shore dumping or combination of the offshore and near-shore dumping, GOV should carefully consider the tight schedule of the pot's inauguration, required time for the port construction, and costs & benefits of the mitigation measures to achieve the Vietnamese standard level.		

21.2 Primary environmental impacts and recommended mitigation measures and monitoring plan (dumping site: offshore)

Based on the environmental impact assessment above, this section summarizes the primary environmental impacts in the each project phase (pre-construction, construction, operation) and their mitigation measures and monitoring programs. As recommended in Table 21.1.19 above and designed dredging and dumping methodology in chapter 15, only offshore dumping is considered in this section.

In the case of near-shore dumping or combination of the offshore and near-shore dumping, the evaluation of the primary environmental impacts shall be reconsidered. As reconsideration of the impacts, mitigation measures and monitoring plan shall be also evaluated and revised. Especially for SS control measures, it would take extensive efforts to reduce SS level under the acceptable level. Thus, further comparative studies focusing on practical, effective, and financially reasonable counter measures shall be proposed in the FINAL D/D report.

21.2.1 Natural environment

In this section major concerned impact to natural environmental in construction phase and operation phase is discussed.

1) Major Impact

a) Construction phase

i) Air quality

Construction work (land and sea area) and construction-related traffic (land area) could cause adverse impact on the health of local residents and workers due to the generation of dust. Fine particulate dusts could affect the respiratory organs of laborers working in the project site and also could cause adverse effects to eyes, skin and digestion system.

ii) Noise and Vibration

Piling activity by pile-driving hammers, activities of reclamation for port facility portion, foundation/soil improvement activity and dredging activities at sea area will generate noise and vibration. Excessive noise and vibration will cause nuisance, interfere with hearing /conversation, cause fatigue, and reduce sleep quality and comfort of the laborers and local residents. During the construction phase, large noise and great vibration will be generated by the construction activities.

iii) Water quality

Dredging and dumping activities generate turbidity/suspended solid and cause adverse impact to natural environment such as undesirable water color and degradation of water quality by decomposition of excess nutrient supplied by suspended solid.

Increased nutrient level by dredging and dumping activity causes growth of phytoplankton leading the occurrence of red tide.

iv) Sediment quality

Suspended solids eventually settle down to sea bottom. Excessive accumulation of deposited solid in a location causes adverse impact to sediment quality by decomposition of nutrient in the deposited solids.

b) Operation phase

i) Air quality

Dust accumulated on the port area and exhausted gas from mooring cargo ships will be the main source of air pollution on operation phase as residential area is close to the port.

ii) Noise and Vibration

Law-frequency wave noise generated from mooring cargo ship is considered as adverse impact in operation phase. Law-frequency wave noise may cause annoyance or insomnia of local residents. As the port terminal is close to residential area, consideration to this matter is necessary.

iii) Water quality

Discharge of bilge water and deck washed water, which may contain oil, from cargo ships could cause water pollution of the sea area.

Impact by ballast water from international ships is getting serious worldwide from the viewpoint of undesirable immigration of alien species.

iv) Sediment quality

Antifouling paint on mooring ship bottom causes adverse impact to sediment quality by accumulating.

2) Measures for the impact

a) Construction phase

i) Air quality

Current dust concentration (TSP) in the proposed project area is 0.11 mg/m^3 and it does not exceed Vietnamese Standard (QCVN 05-2009/BTNMT, 0 .3 mg/m^3). However, this value may soon exceed the standard on construction activities. Therefore the following mitigation measures should be employed in construction phase.

- To use water sprays on the site clearance in dry days.
- To wash the wheels of vehicles to transport construction materials/machines.
- To use cover sheet for vehicles to transport the landfill materials.
- To provide workers with masks to prevent from dust nuisance.

ii) Sound and Vibration

Attenuation distance from sound/vibration source can be calculated by following equation.

$$L_2 = L_1 - 20 \times \log(d_2 \div d_1)$$

where:
L_1: Sound/Vibration Source level at d1 (dB)
L_2: Predicted sound/vibration level at d2 (dB)
d_1: distance from the sound/vibration source (m), 1m is used in this case
d_2: distance at predicted point from the sound/vibration source (m)

As a condition, both sound and vibration source is point source and predicted distance is more than 100m from the source.

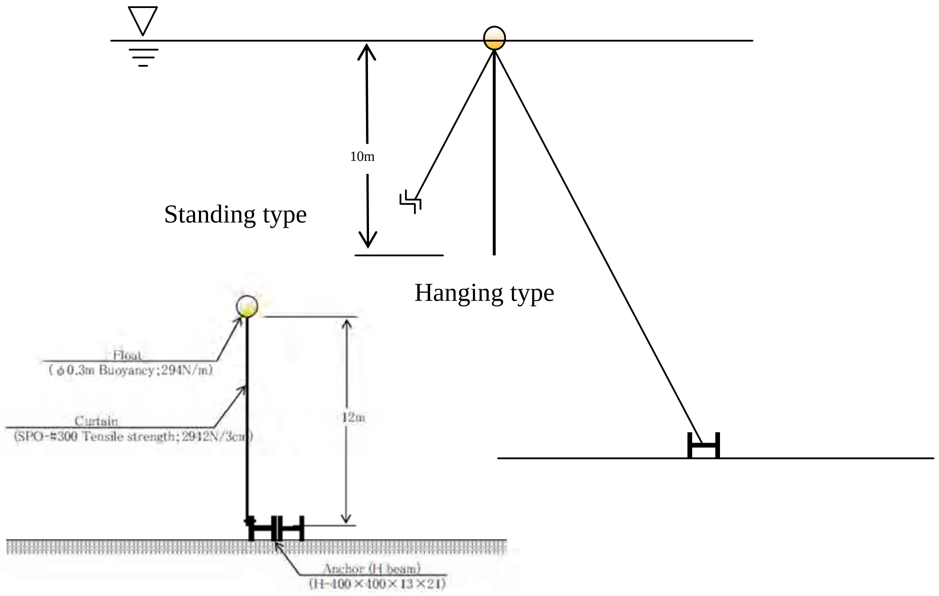
Table 21.2.1 shows the result of calculation using the data, 100 dB for sound and 80dB for vibration at 20m from the source respectively[3]. The resident households are located near to the construction site or port facility portion and may be located within 500m. Therefore construction activity on land should stop in the night time (21:00 – 6:00) to secure the Vietnamese Standard. Dredging activity should also pay attention when the target area is close to the land area.

Table 21.2.1 Attenuation of sound level from the sound source

		Distance from sound source (m)									
		20	100	200	300	400	500	750	1000	1500	2000
Sound Level (dB)		100	86	80	76	74	72	69	66	62	60
Vibration Level (dB)		80	66	60	56	54	52	49	46	42	40
Vietnamese Standard	Sound (QCVN26:2010/ BTNMT)	6:00 – 21:00: 70dB 21:00 – 6:00: 55dB									
	Vibration (QCVN27:2010/ BTNMT)	6:00 – 18:00: 75 dB 18:00 – 6:00: background value, 60dB is used based on the latest survey.									

iii) Water quality

As a measure to suspended solid dispersion, silt protector/silt curtain shown in Figure 21.2.1 is effective way to enhance the settlement of suspended solid and reduce the affected area. Figure 21.2.1 shows an image for installment of silt protector in offshore dumping site and near shore dumping site respectively.



Source: Taiyo Kogyo Corporation

Figure 21.2.1 Example of silt protector

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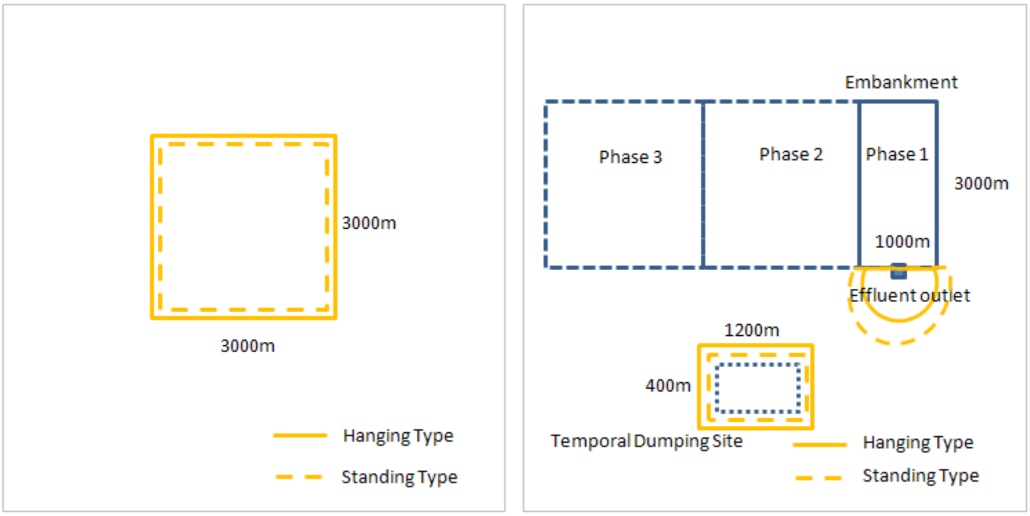
[3] Ambient Noise and Vibration of a Pile Driving Barge, Akizono. J et-al., Technical Note of the Port and Harbor Research Institute, Ministry of Transport, September 1980



Offshore dumping site Near shore dumping site

Figure 21.2.2 Measures for suspended solid dispersion

To determine the affected area by dredging and dumping activity, a study for suspended solid dispersion with countermeasure to SS dispersion by silt protector/curtain mentioned above was conducted using numerical simulation model. Input data such as tidal current was updated from the Outline Design Study using the results from the latest survey carried out from May to June 2011. Computation cases/ scenarios are summarized in Table 21.2.2. Other parameters such as construction load are not changed. (See section 12 for the details.) Details of the results are described in Appendix 21.1.

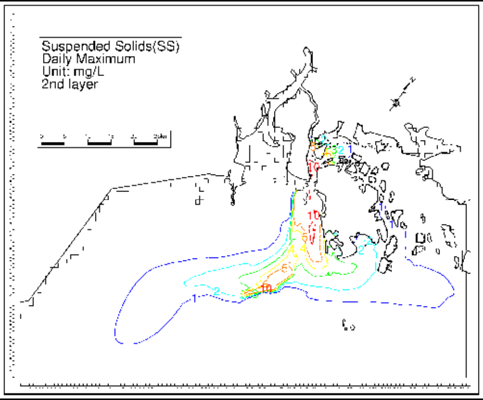
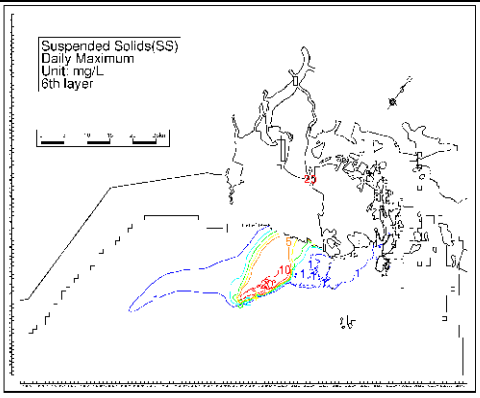
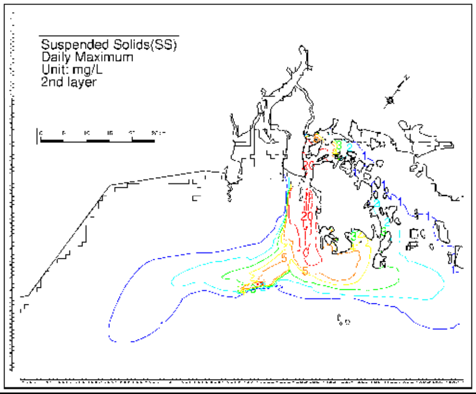
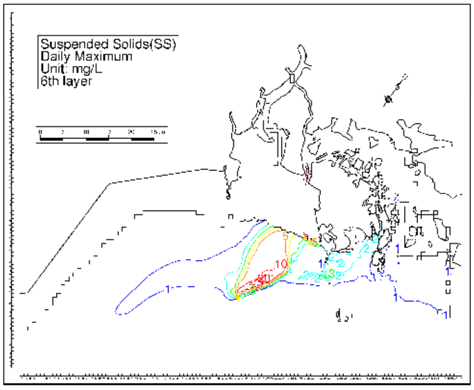
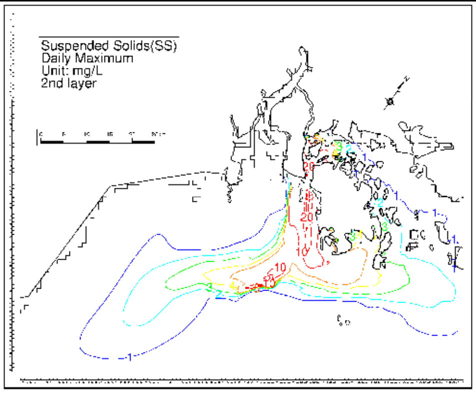
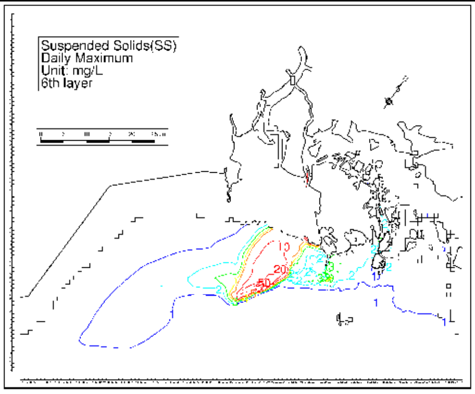
Table 21.2.2 Computation Cases for Simulation of Suspended Solid Dispersion

Case	Dredging		Dumping		Silt Protector	Season
	Case number in BDS	Overflow	Location	Embankment		
Case 6	Case 3	No	Offshore	-	Yes	Wet
Case 7	Case 3	Yes	Offshore	-	Yes	Wet
Case 8	Case 4	No	Near shore	Yes	Yes	Wet
Case 9	Case 4	Yes	Near shore	Yes	Yes	Wet
Case 10	Case 3	No	Offshore	-	Yes	Dry
Case 11	Case 3	Yes	Offshore	-	No	Wet

The case number is continued from Basic Design Study (BDS).

Out of the results, Case 6, 7 and 11 were compared in order to discuss the countermeasures to SS dispersion on dredging and offshore dumping (See Figure 21.2.3). Note that these figures show the worst scenario in the construction period (maximum dispersion in a day, wet season water flow regime which greatly flow out to offshore). Based on the figure, following findings are summarized.

- Dredging with overflow from barge vessels causes wider SS dispersion and greater SS concentration (Case 6 and Case 7).
- Countermeasures to SS dispersion by silt protector at offshore dumping site reduce the area and concentration of SS dispersion (Case 7 and Case 11).
- Thus dredging without overflow and dumping with countermeasure are preferable.
- As the SS dispersion is not able to prevent perfectly, other measures are also necessary and recommended.

Case	(2-4m)	(10-12m)
Case 6 Overflow: no Silt protector: yes		
Case 7 Overflow: yes Silt protector: yes		
Case 11 Overflow: yes Silt protector: no		

Dredging: 2 cutter suction dredgers
Dumping: hopper barges
Dumping site: offshore
Water flow regime: wet season

Figure 21.2.3 Comparison of SS dispersion pattern (daily maximum, large domain)

As shown in the figures SS dispersion is not perfectly controlled. Therefore daily SS monitoring to control SS dispersion actively is strongly recommended (refer to Section 21.1.13) a) ii) for the details of the monitoring). Based on the result of daily monitoring, work load of construction as well as overflow from barge vessels on dredging shall be controlled. Other measures as follows are also option.

- To consider appropriate timing of dredging base on the predicted tide table and tide direction.
- To minimize the duration of dredging, number of dredging vessels.
- To minimize the silt leakage by using seals on hopper doors, pumps and other equipment.
- To relocate the dredging to alternative areas in the event turbidity level exceeds the

management target level (refer to Section 21.1.13) a) ii) for the details of the monitoring).

iv) Sediment quality

Area of sedimentation of suspended solid can be reduced by silt protector (See Section 21.1.12) a) iii) for the details of the silt protector).

b) Operation phase

i) Air quality

Water spray on the port area shall be performed occasionally for the measures to dust form the port area. As for the measure to exhaust gas from moored vessels, introduction of high-combustion-efficiency diesel engine in the cargo vessels shall be accelerated.

ii) Noise and Vibration

Study of law-frequency wave noise shall be conducted regularly as well as interviews from local residents. And countermeasure such as sound insulting wall will be considered based on the result.

iii) Water quality

Management system for discharged water from mooring vessels should be established for less environmental load. Preservation and treatment system for waste water from mooring vessels is one of options.

Replacement of ballast water at offshore area, where the biodiversity is comparatively small, is recommended to reduce the possibility of immigration of invader species.

iv) Sediment quality

Monitoring survey covering wide area is recommended to confirm sediment quality is not changed.

3) Monitoring plan

a) Construction phase

i) Air quality, Noise and Vibration

Table 21.2.3 and Figure 21.2.4 show the outline and location for monitoring of air quality, noise and vibration, respectively.

Table 21.2.3 Outline for monitoring of air quality

Aim	To confirm any construction activities do not cause adverse impacts on the local community caused by air pollutants, noise and vibration.
Location	One (1) site on land (AQNV:20°47’47”N/106°53’36”E). See Figure 21.2.4 for the approximate location.
Frequency	Once a month
Parameters	Air quality: TSP (Total Suspended Particles), SO_2 (Sulfur Dioxide), NO_2 (Nitrogen Dioxide), CO (Carbon Monoxide), VOC (Volatile Organic Carbon) Noise level: L_{eq}, L_5, L_{95} Vibration level: L_{eq}, L_{10}, L_{90}
Method	Air quality shall be measured two (2) times a day once each during morning and afternoon. Noise and Vibration shall also be measured for 24 hours. (One (1) data each hour)
Reporting	Monitoring results shall be reported every month to the Engineer.

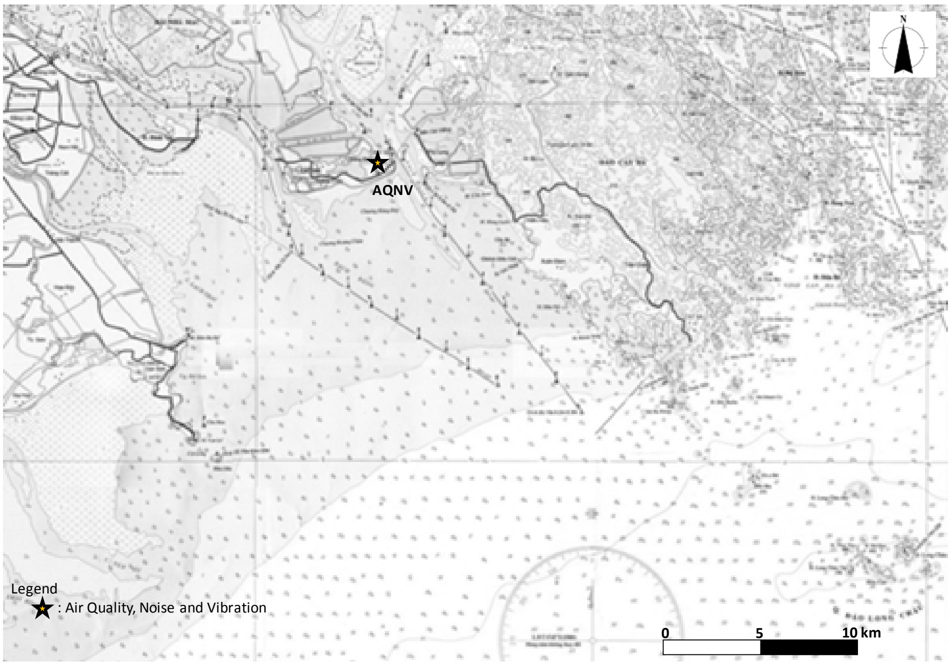


Figure 21.2.4 Location of air, noise and vibration monitoring site

ii) Suspended solid dispersion

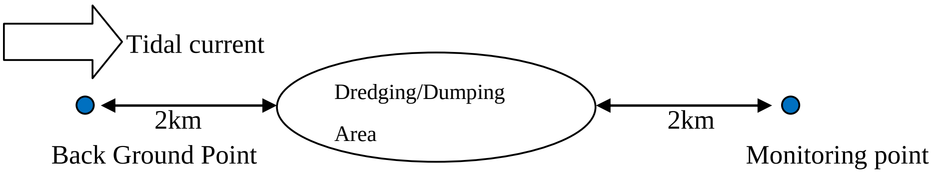
Daily-based monitoring is recommended to control the load of construction.

Table 21.2.4 and Figure 21.2.5 show the outline and location for monitoring of suspended solid dispersion.

Table 21.2.4 Outline of monitoring for suspended solid dispersion

Aim	To monitor whether dredging/dumping activities are not exceeding the pre-determined threshold value of Suspended Solid (SS), monitoring survey shall be carried out.
Location	Two (2) locations (Back Ground Point and Monitoring Point) in dredging area and dumping area respectively. Monitoring locations should be changed depending on the location of dredging and dumping. (See Figure 21.2.5)
Frequency	One time a day
Timing	Mid of ebb tide or flood tide is preferable
Parameters	Turbidity, measured by equipment Converted Suspended Solid (SS): refer to the 'Method'.
Method	1. Before daily monitoring is conducted, direction of tidal current at surface layer shall be confirmed. 2. Set the Back Ground Point (BG) at 2km upper stream from the edge of the dredging/dumping area. 3. Set the Monitoring Point (MP) at 2km downstream from the edge of the dredging/dumping area. 4. Measure turbidity three (3) times in fifteen (15) minutes at surface layer at both points. Handheld measurement equipment is preferable. 5. Average obtained three (3) data of each point, respectively. 6. Convert the turbidity values into SS values using following equation. SS (mg/L) = a x Turbidity (ppm) where: a: correlation between SS and Turbidity The constant 'a' shall be obtained by experimental study beforehand. Several concentration of turbid water shall be prepared using actual dredging sediment at several points alongside of dredging area. The turbid water, then, measured by turbidity meter and

	water sample shall be taken for SS analysis. Thus correlation can be obtained. 7. Evaluate the environmental condition of the day from following equation. SSMP - SSBG > 5mg/L: the monitoring value exceeds the monitoring value (Yellow condition) SSMP - SSBG <= 5mg/L: the monitoring value satisfies the monitoring value (Green condition) SSMP - SSBG > 10mg/L: the monitoring value extremely exceeds the monitoring value (Red condition) where: SSMP: SS value at Monitoring Point (mg/L) SSBG: SS value at Back Ground Point (mg/L) 8. If the Yellow condition continues three (3) days in a row, dredging/dumping strength shall be controlled from the fourth (4th) day until the condition recovers to Green condition. 9. If the Red condition is observed, dredging/dumping activity shall be stopped immediately to stabilize the turbid condition.
Reporting	Monitoring results shall be reported every day to the project management board to plan the construction schedule of following day.



Back Ground Point: 2km upper stream from the edge of the dredging/dumping area
Monitoring: 2km downstream from the edge of the dredging/dumping area

Figure 21.2.5 Distribution of monitoring location for suspended solid dispersion

iii) General environmental monitoring

This monitoring is conducted to know the general environment in the surrounded area of the project is not affected by the project. Table 21.2.5, Table 21.2.6 and Figure 21.2.6 show the outline, coordinates of the sites and location for general environmental monitoring.

Table 21.2.5 Outline for monitoring of general environment

Aim	To monitor whether dredging/dumping activities are not having any adverse impacts on the air quality, noise/vibration, water quality, and sediment quality and aquatic organisms at surrounding area of dredging/dumping sites.
Location	See Table 21.2.6 and Figure 21.2.6.
Frequency	Four (4) times a year
Parameters	Water Quality: Water temperature, pH, Salinity, BOD (Biological Oxygen Demand), DO (Dissolved Oxygen), TSS (Total Suspended Solid), Total phosphorus, Total Nitrogen, Cr^{6+} (Hexavalent Chromium), Zn (Zinc), Cd (Cadmium), Pb (Lead), Mn (Manganese), As (Arsenic), T-Hg (Total Mercury), Oil & Grease, Coliform Sediment Quality: Cr (Chromium), Cu (Copper), Pb (lead), Zn (Zinc), As (Arsenic), Hg (Mercury), Oil & Grease Aquatic Organisms: Zoobenthos, Demersal fish
Method	Water quality: Water sample shall be taken at tow (2) layers, surface and 1m above sea bottom, and analyzed. Sediment Quality: Sea bottom sediment shall be taken and analyzes.
Reporting	Monitoring results shall be reported to environmental authority.

Table 21.2.6 Coordinates of monitoring sites

Monitoring Point	Latitude	Longitude
WS03	106°49’30”E	20°48’55”N
WS05	106°48’10”E	20°47’06”N
WS06	106°50’50”E	20°47’06”N
WS08	106°56’04”E	20°47’06”N
WS09	106°57’28”E	20°45’31”N
WS11	106°54’16”E	20°43’49”N
WS12	106°59’17”E	20°43’29”N
WS13	106°58’46”E	20°40’50”N
WS16	107°02’00”E	20°36’00”N
WS17	106°54’00”E	20°36’00”N
WS18	106°58’00”E	20°36’00”N
WS20	106°50’03”E	20°40’27”E

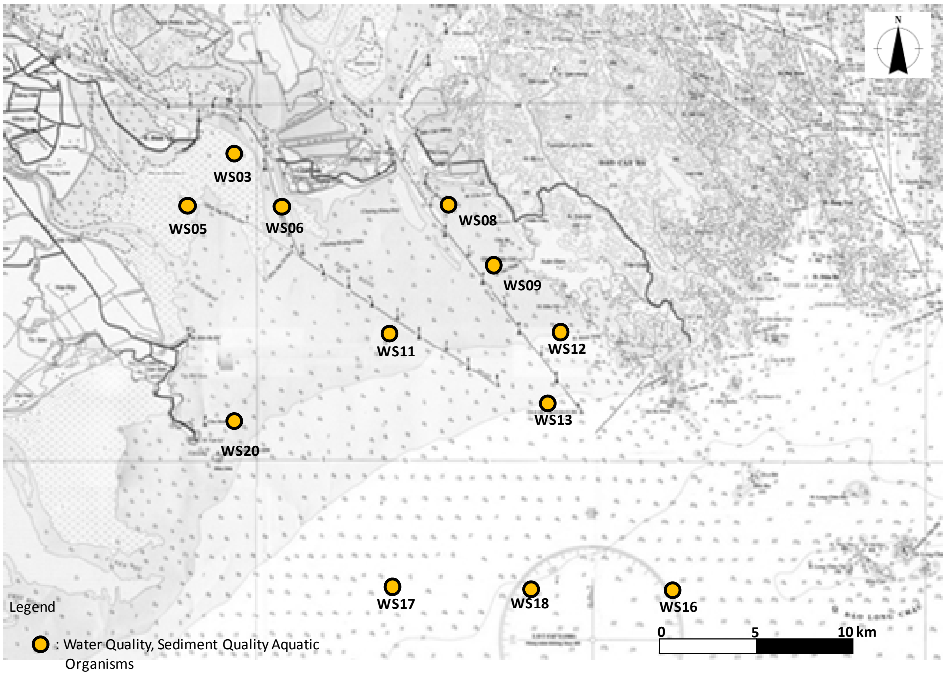


Figure 21.2.6 Location of general environmental monitoring site

b) Operation phase

This monitoring is conducted to know the general environment in the surrounded area of the project is not affected by the project. Table 21.2.7 and Figure 21.2.7 show the outline and location for general environmental monitoring.

Table 21.2.7 Outline for monitoring of general environment

Aim	To monitor whether general environment is not affected by the existence and activity of the new port.
Location	See Table 21.2.6 and Figure 21.2.7.
Frequency	Two (2) times a year
Parameters	Air quality: TSP (Total Suspended Particles), SO$_2$ (Sulfur Dioxide), NO$_2$ (Nitrogen Dioxide), CO (Carbon Monoxide), VOC (Volatile Organic Carbon) Noise level: L$_{eq}$, L$_5$, L$_{95}$ (For both general noise level and law-frequency noise level) Vibration level: L$_{eq}$, L$_{10}$, L$_{90}$ Water Quality: Water temperature, pH, Salinity, BOD (Biological Oxygen Demand), DO

	(Dissolved Oxygen), TSS (Total Suspended Solid), Total phosphorus, Total Nitrogen, Cr^{6+} (Hexavalent Chromium), Zn (Zinc), Cd (Cadmium), Pb (Lead), Mn (Manganese), As (Arsenic), T-Hg (Total Mercury), Oil & Grease, Coliform Sediment Quality: Cr (Chromium), Cu (Copper), Pb (lead), Zn (Zinc), As (Arsenic), Hg (Mercury), Oil & Grease Aquatic Organisms: Zoobenthos, Demersal fish
Method	Air quality shall be measured by equipment two (2) times a day, 7:00-8:00 and 15:00-16:00. Noise and Vibration shall also be measured by equipment for 24 hours. (One (1) data each hour) Water quality: Water sample shall be taken at tow (2) layers, surface and 1m above sea bottom, and analyzed. Sediment Quality: Sea bottom sediment shall be taken and analyzes. Aquatic Organisms: Sea bottom sediment shall be taken and sieved by 1mm mesh sieve for zoobenthos. Drag net shall be used for demersal fish.
Reporting	Monitoring results shall be reported to environmental authority.

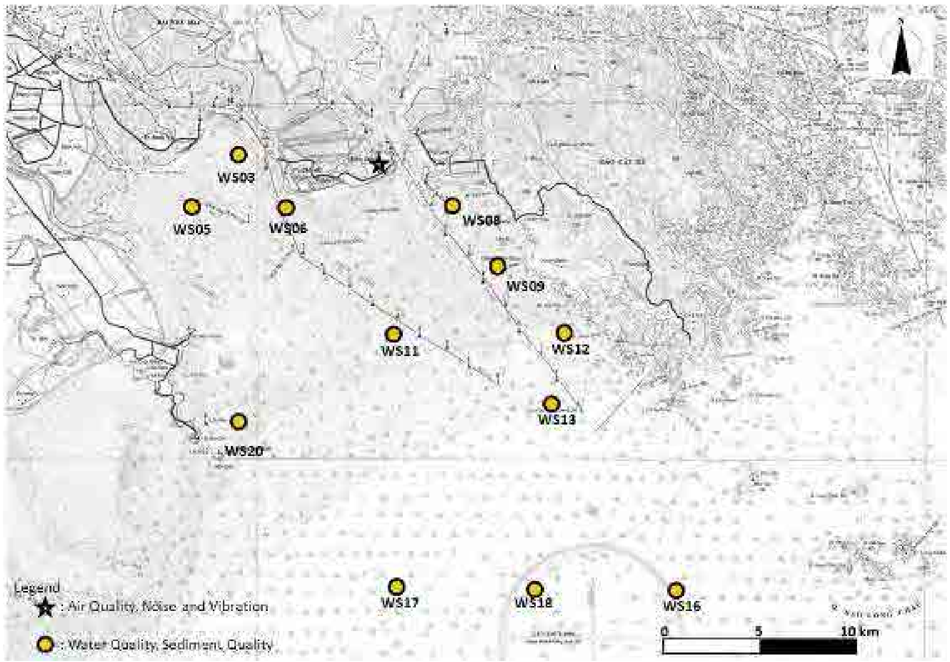
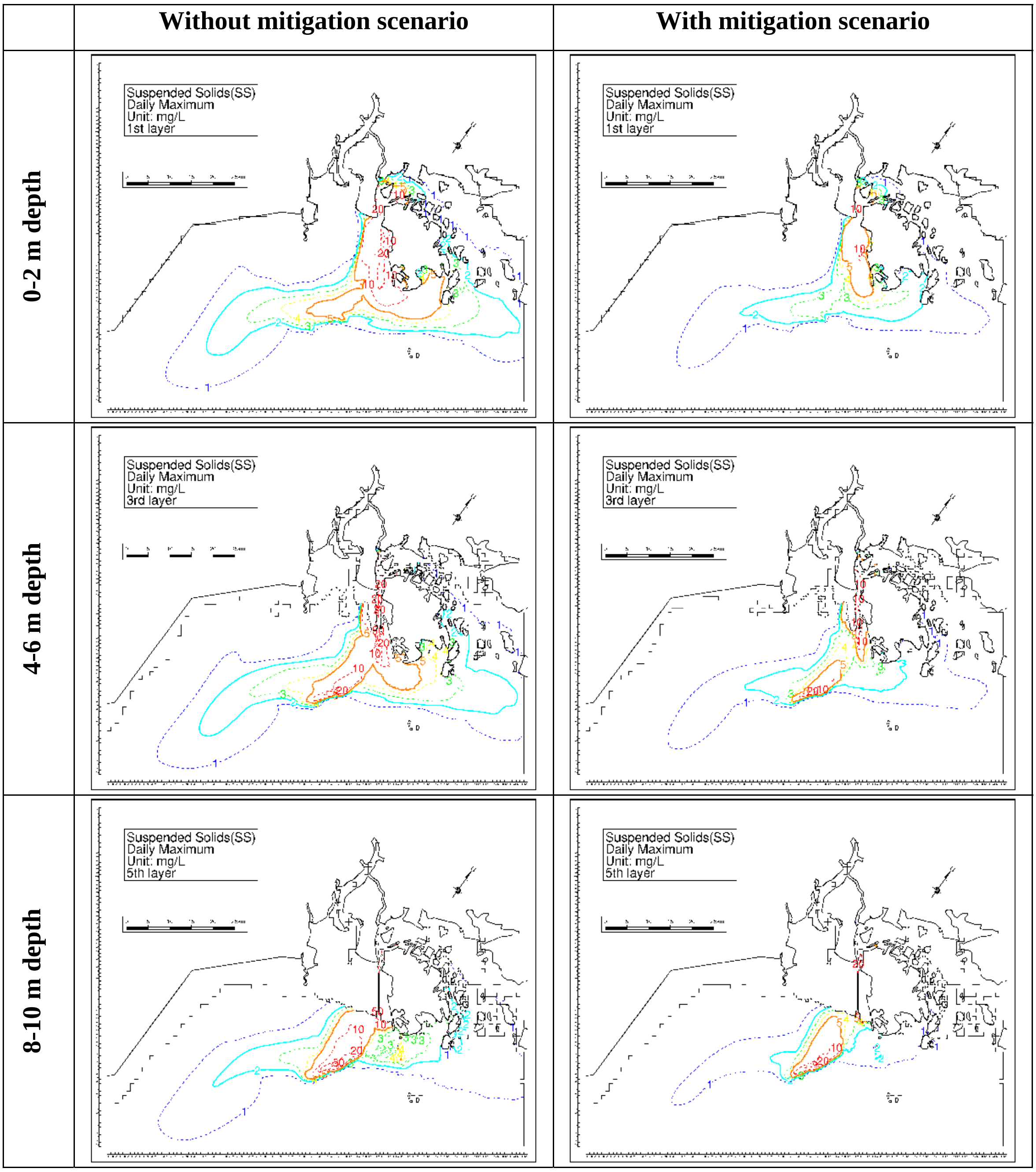


Figure 21.2.7 Location of general environmental monitoring site

21.2.2 Biological environment

1) Construction phase

During the construction phase, impacts on the biological environment will be most significant during dredging and dumping activities as these activities will disperse significant amount of SS into the water column. Although tolerance of marine organisms to SS elevation will vary with species and life stages, for the protection of marine organisms, the Japanese and Canadian guidelines recommends SS elevation to 2 and 5 mg/l from background levels respectively. Hence these values were applied to assess the impacts of dredging and dumping induced SS on the biological environment. Since the Japanese standard (2 mg/l) is stricter than the Canadian standard (5 mg/l), the Japanese standard was applied specifically to marine organisms that are sensitive to SS, which for this assessment was applied to the hard corals distributed in Cat Ba Island and Long Chau Islands. The Canadian standard on the other hand was applied to marine organisms that are relatively less sensitive to SS, which for this assessment was applied to marine organisms other than hard corals. The extent of SS elevation was predicted through SS dispersion simulation. Figure 21.2.8 shows the predicted daily maximum SS dispersion pattern at representative depths for two scenarios namely, without mitigation scenario (i.e. with overflow and no mitigation measures) and with mitigation scenario (i.e. without overflow and installation of silt curtain at dumping site). The light-blue and orange bold lines show the 2 and 5 mg/l contour lines respectively.



Note: The SS values do not include background SS concentration

Figure 21.2.8 Predicted daily maximum SS dispersion pattern at representative depths

Following are the main findings of the assessment (note that secondary impacts are not assessed):

<u>Impacts on hard corals</u>

- Without mitigation measures, SS generated from dredging and dumping activities are likely to have adverse impacts on the coral reefs in south/west of Cat Ba Island, as surface-middle layer SS elevation in these areas was predicted to be over 2 mg/l. However, with mitigation measures, the 2 mg/l range became limited to south of Cat Ba Island. Therefore, implementation of mitigation measures and monitoring are recommended.

- Coral reefs in Long Chau Island are unlikely to be affected even without mitigation measures, as SS elevation was predicted to be less than 1 mg/l at all layers. However, since the 2 mg/l range was relatively in close proximity, implementation of mitigation measures and monitoring is recommended.

Impacts on marine organisms (other than hard corals)

- Without mitigation measures, the 5 mg/l range was extensive particularly in the surface layer, and even extended towards sensitive ecosystems such as the nursery grounds east of Cat Hai Island. With mitigation measures, the 5 mg/l range was reduced to more than half, but still extended towards the nursery grounds east of Cat Hai Island, especially in the surface layer. Since these nursery grounds support juveniles of various species, implementation of mitigation measures and monitoring are recommended to minimize impacts.
- The seabed inside the 5 mg/l range was primarily comprised of silty-sandy habitat. Typical marine organisms that inhabit these areas are crustaceans (e.g. crabs, prawns, and mantis shrimp), polychaetes (e.g. worms), gastropods (e.g. sea snails), bivalves (e.g. clams) and demersal fish (e.g. flounders, croakers, flatheads). While mobile species may be able to migrate to less impacted areas, certain impacts will be unavoidable for immobile or low-mobility species. Possible adverse impacts may include:
  - Physiological damage (e.g. clogging of gills)
  - Growth hindrance (e.g. physiological stress, reduction in foraging success due to reduced visibility, reduction of food source)
  - Reduced reproductive success
  - In extreme cases mortality

In order to minimize the risks of such impacts, implementation of mitigation measures and monitoring are recommended.

a) Recommended mitigation measures

The most effective solution to minimize SS dispersion and hence impact on the biological environment will be to prohibit overflow from cutter-suction dredger. Installation of silt curtain at the dumping site will also be effective but its effectiveness will be more spatially limited compared to overflow prohibition (see Section 21.2.1 for more details on mitigation measures against SS dispersion). Reactive monitoring should also be conducted to check the effectiveness of mitigation measures. Mitigation measures should be strengthened if excessive values or adverse impacts are identified (see the ensuing section for details on the recommended monitoring plan).

b) Recommended monitoring plan

The recommended monitoring plan consists of the following components:

- Water quality monitoring at ecologically sensitive sites
- Coral health monitoring
- Demersal fish/macrozoobenthos monitoring

Details of each monitoring plan are described below.

i) Water quality monitoring at ecologically sensitive sites

Aim: To monitor whether dredging/dumping activities are not having any adverse impacts on the water quality around sensitive sites (e.g. fish nursery ground, coral reef)

Location: Three (3) sites:

- Coral reef in Long Chao Islands (W1: 20°37'28"N / 107°09'35"E)
- Coral reef in Cat Ba Island (W2: 20°45'39"N / 107°04'27"E)
- Fish nursery ground (W5: 20°49'46"N / 106°53'44"E)

See Figure 21.2.9 for the approximate location.

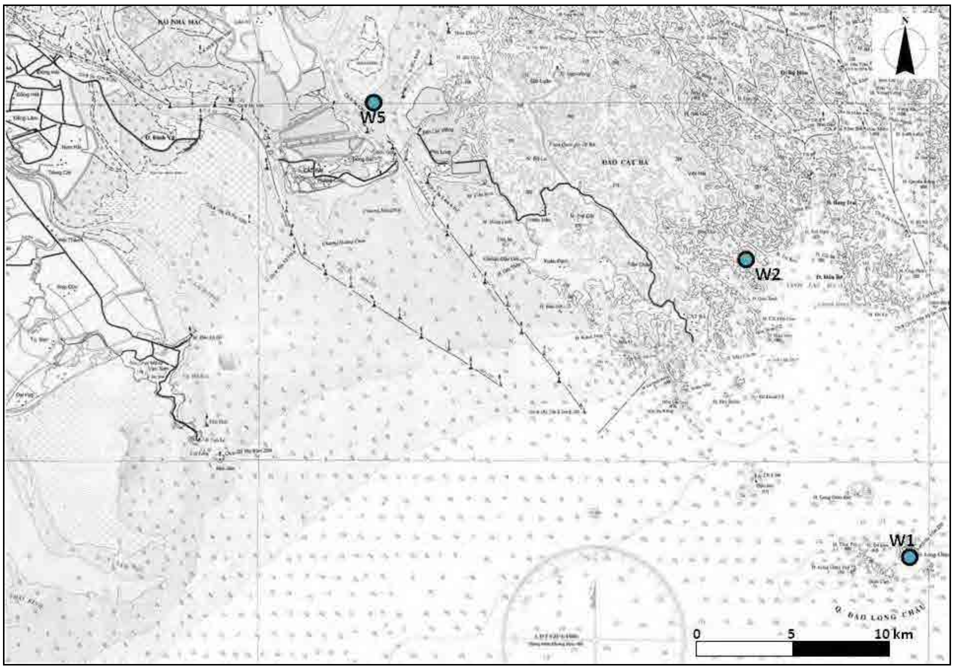


Figure 21.2.9 Approximate location of water quality monitoring sites

Method:

Pre-dredging survey

Prior to the start of dredging, the surface suspended solid (SS) concentration and turbidity levels at the monitoring sites shall be measured once per day for 14 days. The aim is to understand the background SS concentration and correlation between SS and turbidity. This survey shall be conducted for both rainy during and dry seasons.

Monitoring survey

Throughout the dredging period, surface turbidity levels shall be monitored daily at the monitoring sites. The use of water quality data logger is recommended to obtain continuous data and to avoid daily travelling to the monitoring sites. The turbidity values shall be converted into SS by using the pre-identified correlation between SS and turbidity. The dredging/dumping methods and countermeasures shall be reconsidered if SS concentration is above 2 mg/l (at sites W1 and W2) or 5 mg/l (at site W5) above respective seasonal background levels for 7 out of 14 days.

Reporting: Every fortnight

Implementing organization: Construction contractor

ii) Coral health monitoring

Aim: To monitor whether dredging/dumping activities are not having any adverse impacts on the health of the local coral community

Location: Two (2) sites: Coral reef in Long Chao Islands (C1: 20°37'28"N / 107°09'35"E) and coral reef in Cat Ba Island (C2: 20°45'39"N / 107°04'27"E). See Figure 21.2.10 for the approximate location.

Frequency: Once a month

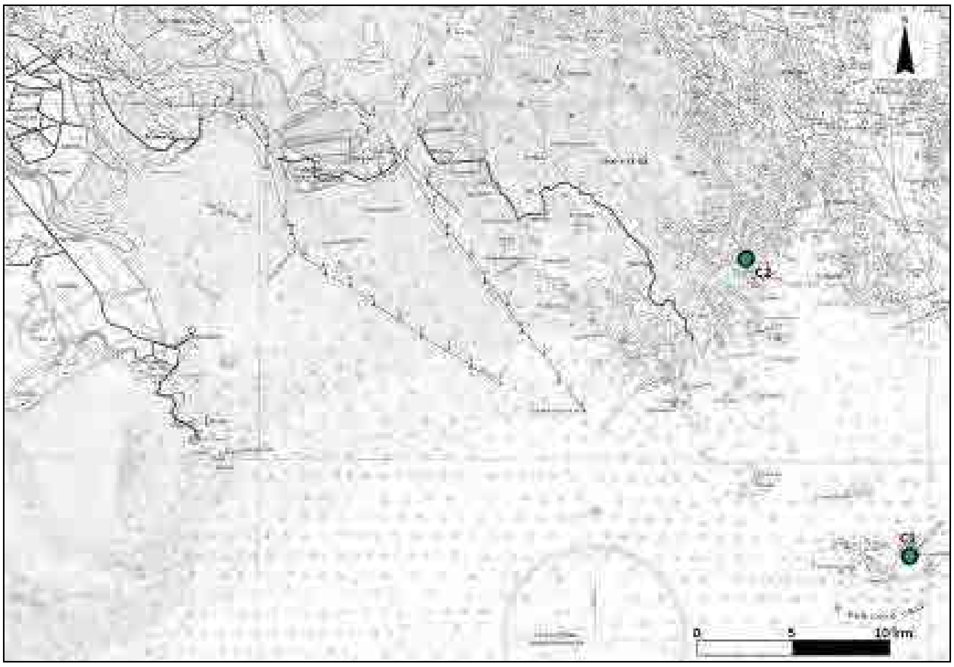


Figure 21.2.10 Approximate location of coral health monitoring sites

Method:

Pre-dredging survey

Prior to the start of dredging, a permanent monitoring quadrat (e.g. 2 m x 2 m) shall be set at 5 sites per monitoring location. The quadrat shall be set by targeting coral species that are vulnerable to turbidity/sedimentation and species listed under Vietnam Red Book. For site C1, monitoring of plating/encrusting corals of *Montipora* spp., *Pavona* spp. and *Acropora* spp. are recommended. *Acropora aspera*, *Acropora formosa*, *Acropora nobilis* and *Porites lobata* shall also be monitored as they are classified as “Vulnerable” in Vietnam Red Book. For site C2, monitoring of *Agariciidae* spp. and *Pectiniidae* spp. are recommended. *Porites lobata* shall also be monitored as it is classified as “Vulnerable” in Vietnam Red Book. At each quadrat, information such as percent live coral coverage and percent bleaching shall be recorded. Underwater photographs shall also be taken for record.

Monitoring survey

Throughout the dredging period, the status of the corals shall be monitored at the set monitoring quadrants. Underwater photographs shall also be taken for record. Monitoring parameters include:

- Sediment accumulation
- Percent live coral coverage
- Percent bleaching
- Other health indicators (e.g. coral color, mucus production)

Monitoring shall be conducted once per month. If adverse impacts from dredging/dumping activities are identified, the dredging/dumping methods and countermeasures shall be reconsidered. Frequency of monitoring shall be increased to every fortnight until adverse impacts are no longer confirmed.

Post-dredging survey

Within two weeks after the completion of the dredging works, the status of the corals shall be surveyed at the two monitoring locations and compared with the pre-dredging survey. Underwater photographs shall also be taken for record.

Implementing organization: Construction contractor

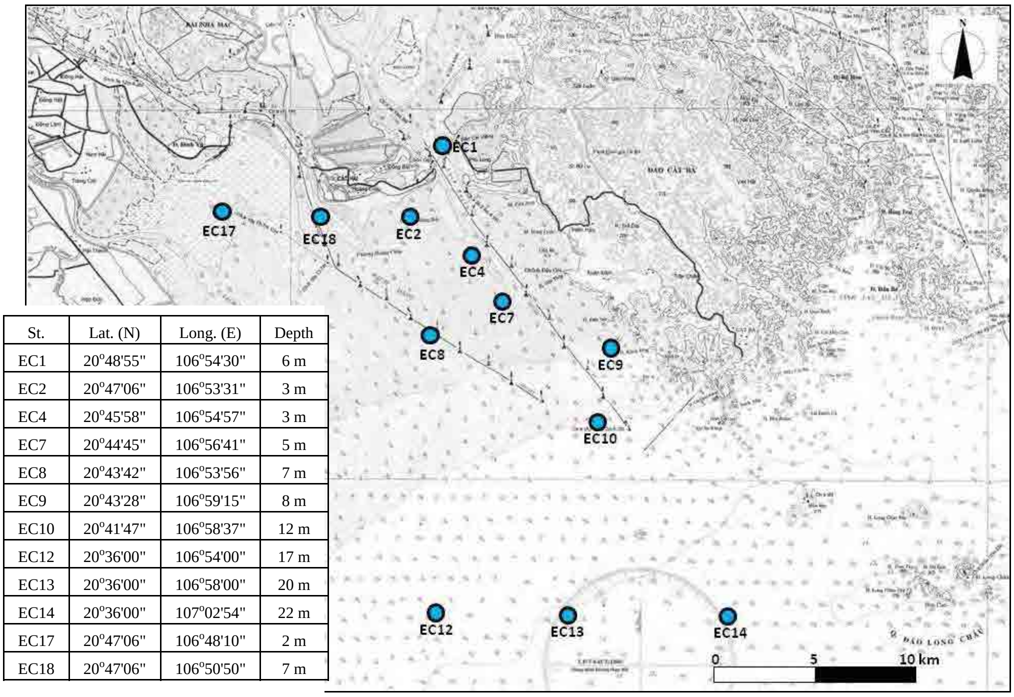
Reporting: Once per month

Monitoring team: Monitoring shall be conducted by qualified experts in coral monitoring.

iii) Demersal fish/macrozoobenthos monitoring

Aim: To understand how the diversity and abundance of local demersal fish/macrozoobenthos changes during the construction period

Location: Twelve (12) sites. See Figure 21.2.11 for the approximate location.



St.	Lat. (N)	Long. (E)	Depth
EC1	20°48'55"	106°54'30"	6 m
EC2	20°47'06"	106°53'31"	3 m
EC4	20°45'58"	106°54'57"	3 m
EC7	20°44'45"	106°56'41"	5 m
EC8	20°43'42"	106°53'56"	7 m
EC9	20°43'28"	106°59'15"	8 m
EC10	20°41'47"	106°58'37"	12 m
EC12	20°36'00"	106°54'00"	17 m
EC13	20°36'00"	106°58'00"	20 m
EC14	20°36'00"	107°02'54"	22 m
EC17	20°47'06"	106°48'10"	2 m
EC18	20°47'06"	106°50'50"	7 m

Figure 21.2.11 Approximate location of the demersal fish/macrozoobenthos monitoring sites

Frequency: 2 times/year (once each in the wet and dry seasons) throughout the construction period

Method: Demersal fish and macrozoobenthos shall be collected by trawling survey (mesh size: #15, width: 5 m). Each trawl shall be conducted for 15-20 minutes at a speed of 1.5-2 miles/hour. All collected species shall be identified to the species level. The total length and weight of each individual shall also be measured.

Reporting: 2 times/year (once each in the wet and dry seasons)

Implementing organization: Project owner

2) Operation phase

The type of impacts on the biological environment will be similar to the construction phase due to the requirement of maintenance dredging. However, the significance of the impacts should be less severe due to the smaller dredging volume. Further assessment was not possible as the specification of the maintenance dredging was not available at the time of this reporting. Nevertheless, implementation of mitigation measures and monitoring similar to the construction phase is recommended.

21.2.3 Social environment

1) Major Impact

a) Pre-Construction phase

i) Land acquisition for public related facilities

As shown in the section 3.4.3 (Status of the Land Clearance for the Lach Huyen Gateway Port Project), acquired land for component A (public facilities/ODA portion) would be 23ha including a relatively large cemetery, salt pan, abandoned aquaculture pond, pine forest, residential and public service office area, road, and sea dyke. Number of PAP for 1) salt production, 2) residential land and 3) residential houses are 49 (persons), 7 (households) and 2 (households) respectively. All detailed losses would be surveyed and confirmed by district PC after the final approval of the master plan on Dinh Vu-Cat Hai Economic Zone (DCEZ) by GOV (expected to be in October 2011).

ii) Clearance of offshore dumping area and near-shore fishing area

Though it is hardly to confirm the actual number of fishing PAHs by the clearance of proposed offshore dumping area, PAHs by clearance of offshore dumping area would be limited to offshore fishing households only accounting for 386 households with 767 labors in interviewed six (6) communes (Table 21.1.17). The impacts of such households shall be carefully examined by the compensation authorities since not all offshore fishermen go fishing in the area annually (cf. seasonally in Hoang Chau and annually in Phu Long). It would be also necessary to consider the potential impacts for some fishermen out of surveyed six (6) communes such as Cat Ba town, Do Song and other provinces.

In order to implement the construction work safely and smoothly, all construction area including actual construction sites and safety buffer zone would be secured and all fishing activities in the clearance area would be prohibited. Clearance of near-shore fishing area would potentially affect up to 787 households with 1,550 labors including above mentioned offshore households. The dependency of fish catch in the clearance area is hardly evaluated, but it is certain that majority of the fishing households would be affected by actual loss of fishing area. As the nature of the fishing, fishermen could move around and maintain the fish catch, but the accessible coastal fishing area with economical fuel cost is limited for mentioned coastal fishing households. On the contrary, potential impact by the accessibility between Cat Hai and Cat Ba would be minimal since it is accessible for small draft boats to cross the sand training protection dike roughly at 1.0-2.0 km (crest height would be -1.5m from) from the south end of the Lach Huyen Gateway port's break waters.

b) Construction phase

In order to summarize the potential impacts on surface water-most likely affecting socioeconomic activities by different dredging methodologies, SS control measure, and seasons, following four cases are summarized in Figure 21.2.12. Detailed cases differences are summarized in Table 21.2.2 and all simulated results are shown in Appendix 21.1.

i) Decrease in salt and aquaculture productivities

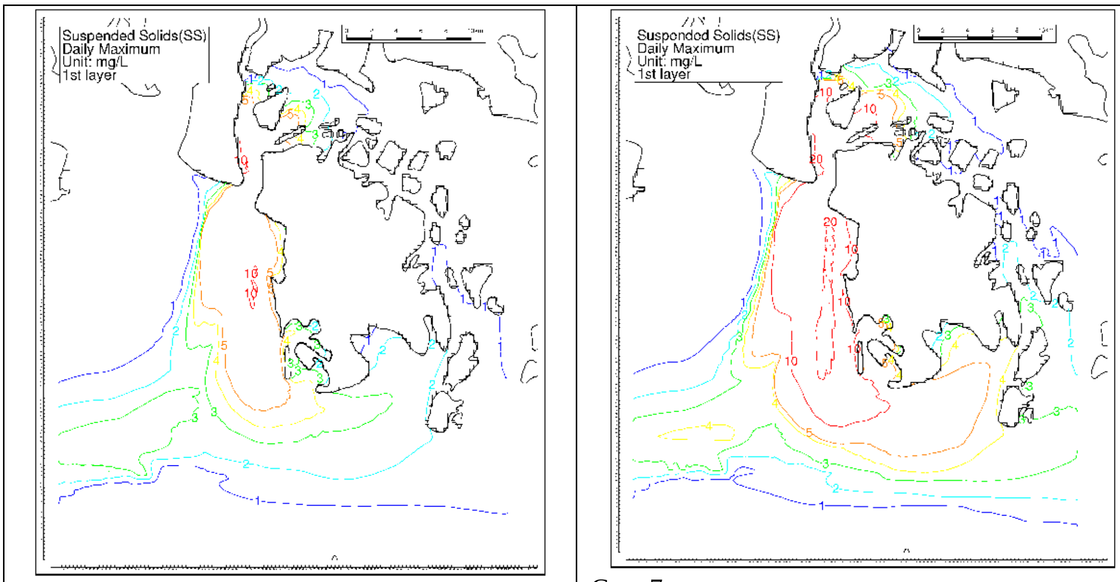
Based on the simulation results shown in Figure 21.2.12 and recommended SS limitation standards in Table 21.1.6, over flow cases (case 7 and 11) are likely to increase the concentration of SS more than 5 mg/l in the intake water for both salt production and aquaculture and likely to decrease the productivities of the salt production and aquaculture. With no over flow cases, the expected SS level would be less than 5mg/l in the intake water, and there are no significant difference between dry (case 10) and wet (case 6) seasons. Since the SS standards for salt production is unknown, potential impacts on salt production shall be carefully examined even for no over flow cases. In the worst cases, 1,321 house holds with 2,311 labors in Salt production and 643 households with 1,046 labors would be affected by the degradation of intake water quality (Table 21.1.18).

ii) Decrease in offshore fish catch

Based on the simulation results shown in Figure 21.2.12 and recommended SS limitation standards in Table 21.1.6, over flow cases (case 7 and 11) are likely to increase the concentration of SS more than 5 mg/l in the southwest of Cat Ba fishing area out of secured construction area accounted and deducted in the pre-construction phase. With no over flow cases, the excess of 5mg/l area would be smaller than over flow cases, but both dry and wet season cases are likely to increase the concentration of SS more than 5 mg/l in the southwest of Cat Ba fishing area. However, majority of common fish in this area are likely to have high tolerance to higher SS so that addition of 5mg/l may not be the appropriate guideline to evaluate the potential impacts. Potential impacts for offshore fishing shall be carefully examined by Cat Hai district authorities with the consultation with biological experts and experienced fishermen in the region. In the worst cases, 386 fishing households with 767 labors in interviewed six (6) communes (Table 21.1.17) and some other fishermen coming from other area would be affected.

iii) Degradation of water quality in beach resorts

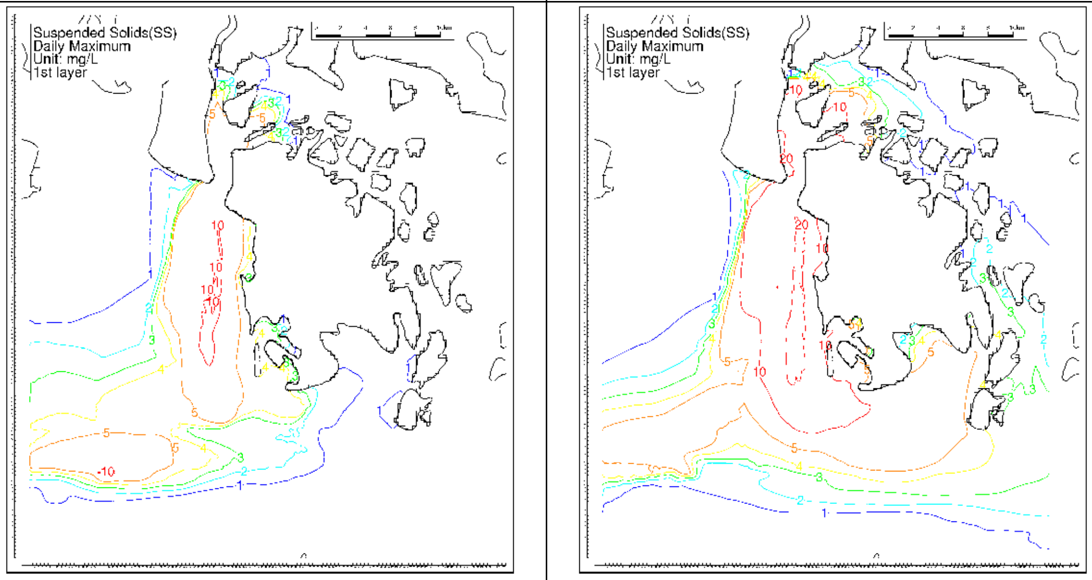
Based on the simulation results shown in Figure 21.2.12. offshore dumping may not affect the beaches in Do Song in any cases. On the contrary, over flow cases (case 7 and 11) may affect beach resorts in Cat Ba beaches since SS level in the Cat Ba beaches are very low even after the strong storm event (cf. Table 21.1.16). In the case of the no over flow case in the wet season (case 6), addition of 2-3 mg/l would be recognizable at the beaches, but such degradation level may not significantly impact beach resorts compared to other coastal beaches in the region. Considering the expected absolute level of the SS, the SS level in the Cat Ba beaches may reach 2-4 mg/l, which is far below the 50 mg/l (water standard for beaches or water sports: National Technical Regulation on Coastal Water Quality QCVN 10: 2008/BTNMT).



Case 6 (base case):
- dredging without overflow
- SS control measures by silt protector
- wet seasons

Case 7
(cf. with overflow impacts vs. case 6):
- dredging with overflow
- SS control measures by silt protector

wet seasons



Case 10
(cf. seasonal difference vs. case 6):
- dredging without overflow
- SS control measures by silt protector
- dry seasons

Case 11
(cf. overflow and no SS control vs. case 6 or cf. no SS control vs. case 7):
- dredging with overflow
- no SS control measures
- wet seasons

Figure 21.2.12 Comparison of SS Dispersion Pattern by Dredging, SS Control Measures, and Seasons on the Surface Water (daily maximum SS/medium domain)

iv) Traffic accident

Due to the limited capacity of the ferry between Dinh Vu-Cat Hai and road system in Cat Hai Island, most of the construction materials would be carried by ships without passing through the Cat Hai Island. However, daily commodities and construction workers' transferal will significantly increase. Due to the low transferal capacity of Cat Hai Island's road system, it is likely to cause traffic jam and accidents.

v) Socioeconomic impacts in Cat Hai Island by radical changes

Based on the JICA D/D Study experts' assumption, total number of construction workers for the Lach Huyen Gateway port project would be up to 700 and that of Tan Vu-Lach Huyen Highway project would be 1,200 (Table 21.2.8). Not all construction workers are required during the construction period (36 months for port and 30 months for highway). Due to the two separated construction sites for the highway project, not all construction workers for the highway would stay in Cat Hai Island. In addition, some labors are likely to be hired in the local communities. However, considering the net increase of residents in Cat Hai Island, it would be significant change compared to the total population of Cat Hai Island (14,000 residents: Table 3.4.5)

Table 21.2.8 Expected Number of Construction Workers (Port vs. Highway)

Job title	Expected workers in port # of workers, working/construction months		Expected workers in highway # of workers, working/construction months	
Form Worker (Concrete)	**80**	**22/36**	**246**	**18/30**
Concrete Worker	**80**	**18/36**	**328**	**18/30**
Rebar Worker	**80**	**18/36**	**109**	**18/30**
General Worker	**300**	**36/36**	**300**	**27/30**
Steel Worker	**20**	**20/36**	**50**	**on demand/30**
Dump Truck Driver	**80**	**18/36**	**20**	**25/30**
Construction Machine Operator	**40**	**29/36**	**60**	**25/30**
Mechanic	**20**	**36/36**	**40**	**25/30**
Marine worker*	**30**	**29/36**	**30**	**28/30**
Office cleaning	**10**	**36/36**	**10**	**30/30**
Security	**20**	**36/36**	**20**	**30/30**
Total	**700**	**-**	**1,213**	**-**

***** boat operator/other offshore general work
Source: JICA D/D Study team (port and highway portion)

Based on the JICA D/D Study experts' assumption, expected monthly wages of the construction workers would be between 3 and 6 million VND/person-month (cf. Chapter 23 Detailed Cost Estimation), which is as same level as net income (actual income after deduction of income tax) of PAH/month (Table 3.4.11). In general, the numbers of labors in PAH are more than two (2), so there would be clear difference between PAHs without additional income and PAHs with additional income by construction work or immigrant construction workers staying in the Cat Hai.

Since there are not many higher income opportunities in Cat Hai Island at this moment, there are not significant income differences among PAP. However, the time limited construction work might give an opportunity to make a gap between conventional work households and construction work household. Since there are not enough labor needs for the construction work for the PAP as well as not all PAP are suitable for the construction work, construction work might lead imbalance in the present community. In addition to the direct impacts by construction work, there are also good income opportunities in indirect sectors such as grocery, food, and accommodation services for construction workers. However, it highly depends on the capability of the PAP as well.

As described above, except Phu Long commune in Cat Ba Island, all residents on Cat Hai Island will be fully affected by the DCEZ development 2015-30 including most residents' relocation and occupational change. If the land clearance for the DCEZ is implemented as its plan, not only PAP of Lach Huyen Gateway port project but also all residents of Cat Hai

Island will be required to move to the designated relocation sites in Cat Hai island or other resettlement sites in Hai Phong city and to make efforts to adapt the new occupations.

c) Operation phase

i) Socioeconomic impacts in the case of oil spill accidents

Though it is hardly to predict the time, frequency, and scale of the oil spill accidents, the potential impacts in the local economy would be significant. Major oil spill accidents in Vietnam and their losses are summarized in Table 21.2.9. The table shows that the volume of oil spill does not linearly link to the losses in economy and environment. Since the project area would be high productive area in both economic activities and ecosystem, losses would be significant if the counter measures to stop the oil spill and clean the environment are not efficiently implemented.

Table 21.2.9 Oil spill accidents in Vietnam (1993-2005)

No	Name of ship	Timing	Location	Causes	Type of oil	Volume of oil spill	Losses	
							Economy	Environment
1	Pan Harves (Taiwan)	20/09/93	Offshore of Vung Tau	Ship crash		300 ton		
2	Humanity (Taiwan)	08/05/94	Can Gio, HCM	Ship crash	FO	130 ton	200,000 USD	400,000 USD
3	Neptune Aries - Singapore	03/10/94	Cai Lat, HCM	Hit to Quay	DO	1.700 ton	4,200,000 USD	
4	Promex Cita Cabvan (Malaysia)	04/12/97	Bien Ly Son	Drown	FO DO	300 ton FO 30 ton DO		
5	Gemini (Singapore)	27/01/96	Cai Lat, HCM	Hit to Quay	Crude oil	32 ton	600,000 USD	
7	Sokimex (Vietnam)	16/08/98	Can Gio, HCM	Hit the barge	DO	41 ton	500 million VND	
8	Nhat Thuan 1 and Hoa Hiep 2	1999	Saigon river	Ship crash		113 ton		
9	Sunny (Hong Kong)	2000	Phu Yen sea	Accident	DO	300 ton		
10	Barge	02/06/01	Da Nang	Hit the rock	TC-1 oil	30 - 40 m^3		
11	Formosa One (Liberia)	07/09/01	Gang Rai, Vung Tau	Ship crash	DO	900 m^3	17,200,000 USD	
12	Bach Dang Giang (Vietnam)	06/02/02	Hai Phong	Hit the rock	DO	2,500 m^3		
13	My Dinh (Vietnam)	15/02/05	Hai Phong	Hit the rock	DO	300 ton		
14	KASCO	21/01/05	District 12, HCMC	Hit the Quay	DO	100 ton	14,300 million VND	
15	Ham Luong 5	06/04/05	Saigon port	Hit the ship	DO	40 m^3		
16	La Palmas	24/8/06	Saigon port	Hit the Quay	DO	1,500 ton		
17	New Oriental	10/2007	Phu Yen	Accident	DO	500 ton		
18	Duc Tri BWEG	2/3/08	Binh Thuan	Accident	DO	1,700 ton		
19	Nhật Thuần	6/2009	Ba ria – Vung tau	Accident	DO	1,795 m^3		
20	Huỳnh Nhi 01	23/6/10	Kinh Sang river	Accident	DO	250 ton		
21	Bien Dong 50	27/4/10	Vung Tau	Accident	DO	370 ton		

2) Measures for the impact

a) Pre-Construction phase

i) Land acquisition for public related facilities

Based on the continuous discussion with responsible authorities-Cat Hai district PC for the compensation, it is clear that all losses are accounted and compensated by the land law and HPPC's compensation policies including the support for the income restoration. Though the detailed compensation plan has not been completed by Cat Hai district PC, it is likely to comply with the master plan on DCEZ. JICA Study team's and local experts' proposal for the income restoration plan shall refer to the following mitigation measures for the clearance of offshore dumping area and near-shore fishing area.

ii) Clearance of offshore dumping area and near-shore fishing area

As stated above, there are few applicable safeguard policies to assist project affected fishing households. Based on the social environmental survey results identifying the preferable income restoration options by the PAP (section 21.1.4), JICA D/D Study experts have prepared a draft income restoration programs (IRP) and repeatedly communicate with directly affected six (6) communes PD and the Cat Hai district PC for the potential development of safeguard policies for those who would critically face the difficulties to continuously depend on the present fishing activities in the future.

The draft IRP proposal was comprised of 1) Extension of traditional/conventional occupation training and technical & financial support, 2) Off-farm vocational training for contemporary economic or business activities, and 3) Financial support with capacity development of households' capital/financial management. Due to the lack of information on expected job opportunities in DCEZ and other capable job opportunities as well as the fear of occupational change, extension of traditional/conventional work related assistance was included.

<Commune PC's Initial response to the draft IRP> Summaries of the commune PC's responses in September 2011 for the draft IRP proposal is shown in Table 21.2.10. Though there are some preferences among communes due to the present economical activities and geological characteristics, all IRP options were generally accepted by all commune PCs except baby shrimp aquaculture. All communes have high interests in new occupational options including livestock (pig, cow, goat, chicken, and others), farming, and off-farm-contemporary economic activities or SME business activities. Due to the necessity of support for elder PAP who will have difficulty to adapt contemporary work but need income to sustain their daily life, assistance for the improved salt production was generally accepted but not high interests. Although the financial support was the most preferred option by PAP, financial support is medium to low interests by commune PCs except Dogn Bai commune. All communes recognized and recommended the training program for the capacity development of households' financial/capital management with a set of financial support. Considering the Off-farm vocational training for contemporary economic or SME business activities, all options received high interests among all communes. Since there are not many off-farm occupations at this moment, all commune PCs are willing to ask District PC and privates' assistance to secure such occupational s for the job transferred PAP.

<District PC's Initial response to the draft IRP> Despite the PAP and commune PC's medium to high interests in extension of traditional/conventional occupation training and technical & financial support, they would be minimum options only for those who are not capable to change the present occupation and are not going to extend such activities for long time. Since land use for the proposed traditional/conventional work does not comply with the master plan of DCEZ 2015-30 promoting and allocating land for only industrial or contemporary economic activities, it is not acceptable for the Cat Hai district to consider such mitigation programs in parallel.

Table 21.2.10 Commune PCs' Responses for JICA D/D Team's Draft IRP Proposal

Proposed Activity	Cat Hai town	Dong Bai	Hoang Chau	Nghia Lo	Van Phong	Phu Long	Total	Remarks
Extension of traditional/conventional occupation training and technical & financial support								
1. Livestock								Generally constraint in land allocation
Pig	1	3	3	3	2	3	15	Preferably individual, little intention for commercial firms
Cow, goat, chicken or other livestock	0	3	3	3	2	3	14	Interested but not feasible for Cat Hai due to the land constraint
Big shrimp,	2	3	2	2	2	3	14	Need assistance for good market access too
Baby shrimp	0	0	0	0	0	0	0	Higher risk than big shrimp
2. Framing	1	3	2	2	2	2	12	Generally interested but no specific idea, except Dong Bai (mushroom)
3. Improved salt production	2	2	2	2	2	0	10	Still concerning low price, Need assistance for higher value market access, Need technical & financial support, no land for Phu Long
Off-farm vocational training for contemporary economic or SME business activities								Workforce supply for DCEZ, potential needs in services, and other business opportunities
1. Driver, construction, mechanics	3	3	3	3	3	3	18	Especially suitable for younger generation, highest interest
2. Services, handicraft	3	3	3	3	3	3	18	Generally interested, Need specific idea
3. Trading, SME business	3	3	3	3	3	3	18	Generally interested, Good practice is available in the communities
Credit/loan with capacity development of households' financial/capital management	2	3	2	1	2	2	12	Highest interests by PAP, Need assistance for effective and sustainable management

Score of the proposed IRP demands: 3: high, 2: medium, 1: low, 0: no demand

<Recommendable IRP> As Cat Hai district PC is appointed by HPPC for development, approval, and implementation of the mitigation programs for the Lach Huyen Gateway port project's PAP, it is reasonable to address the district PC's vision and propose practical mitigation measure for both PAP and district PC. It will require substantial efforts to change the majority of Cat Hai residents' occupations by 2015 as planned. However, it would be good opportunities for Cat Hai district PC to take advantage of Lach Huyen port project's IRP as the good practices with limited numbers for the shortly followed DCEZ's IRP development. Though the expected job opportunities in DCEZ are not clear at this moment, such workforce demand could be assumed from the similar cases in the coastal economic zones in southern regions or preceding economic zone projects in Hai Phong region such as South Dinh Vu Industrial Zone.

One of the critical concerns for those who are required to change their occupations is ACTUAL job opportunities for them and SECURITY of their employment in such new work field. In order to encourage the occupational change and smooth transition of DCEZ development, it is highly recommendable to get not only 1) Cat Hai District PC/responsible authorities but also 2) businesses/investors and 3) PAP/potential labors involved in practical vocational training and safeguard policy development. It is also necessary for PAP to maintain the income level and stabilize the life before working in DCEZ or other location so that IRP followed by the basic vocational training shall consider a paid training or so called on the job training (OJT) for limited time until privates start hiring PAP in the DCEZ. Cat Hai District PC has been preparing for the career change programs for DCEZ and requested HPPC to secure the budget for the job training center development in Cat Ba Island and a branch center in Cat Hai Island as well as vocational training fee (IRP discussion on 15/9/2011 at Cat Hai District PC office).

In the case of occupational change, the district PC and maybe HPPC as well should assist PAP to sell or abandon traditional/conventional work related tools such as fishing boat and nets, or a wheelbarrow. Since there would be little need for such tools in Cat Hai Island after the DCEZ development, there would be few market values for such tools. In order to accelerate the process of transition and encourage PAP to participate vocational trainings in the same time, it is recommendable for responsible authorities to evaluate the value of such facilities and tools and compensate such losses with reasonable prices.

In the case of no occupational change such as offshore fishing, their present income shall be carefully evaluated and mitigation measures during the construction and operation phases shall be prepared to ensure their income level. Also, in the case of continuous work in traditional salt production or aquaculture for short term (up to 2015 or permitted period) for those who will be affected by the land clearance for public port facilities and hardly adapt the new occupations, assistance for those PAP shall be considered with the participation of PAP, IRP experts, and responsible officials of Cat Hai district PC. Though the district PC is not willing to promote any IRP for extension of traditional work, it also recognizes the difficulties for some PAP, especially for elder PAP, to adapt the new occupations even with vocational training and other support. If the PAP is agreeable to continue traditional work within limited time before the DCEZ’s land clearance, it could be possible to apply the initially proposed IRP that was developed by JICA D/D experts and local experts for the PAP and commune PC’s demands (Appendix 21-2).

<IRP Policy and Proposed Budget for Vocational Training> As described previously, there are few applicable safeguard policies for non-land related PAP at this moment. However, under the Japanese ODA policy (JBIC Guideline 2002), borrower - GOV is responsible to sufficiently mitigate ANY negative impact and secure the PAP’s livelihood and living standard at least as same level as pre-project condition (Part 2. 1. Environmental and Social Considerations Required for Funded Projects (Involuntary Resettlement), JBIC Guideline 2002, cf. V. ITEMS CONSIDERED IN APPRAISAL 5. Project Cost and Financing Plan (3) Fixed-Percentage Financing Criteria, Operational Guidance on the Preparation for Japan’s ODA Loan Project/JBIC).

Therefore, as the responsibility of GOV for the Lach Huyen Gateway port development with Japanese ODA and a preceding efforts of DCEZ development, it is recommendable to integrate the IRP for DCEZ and apply such policies and programs for any PAP including non-land related PAP. Based on the local expert’s experiences and observation of the present status in the project affected communities, it is recommendable as follows. Each member at labor age of seriously affected households will receive one vocational training card/right costing 200 USD and an additional allowance of 100 USD for one course for 3 to 6 months. Table 21.2.11 shows the rough estimation of the vocational training and temporal allowance costs

JBIC Guidelines for Confirmation of Environmental and Social Considerations, 2002

Part 2.
1.Environmnetal and Social Considerations Required for Funded Projects
(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.

JBIC Operational Guidance on the Preparation for Japan's ODA Loan Project

V. ITEMS CONSIDERED IN APPRAISAL
5. Project Cost and Financing Plan
(3) Fixed-Percentage Financing Criteria

Developing countries often find it difficult to make public investment due to their domestic budgetary constraints. As a means to financing part of domestic currency component, JBIC introduced fixed-percentage financing criteria in fiscal 1989.

The criteria set a certain percentage of the total project cost as the upper limit for ODA loan financing regardless of the distinction between foreign and domestic currency components in the total project cost. The percentage may vary depending on per capita GNI in the borrowing country.
Items such as land acquisition and compensation, taxes and duties, administration costs of the Executing Agency are not eligible to ODA loan financing. These items, however, can be included in the total project cost based on which the maximum amount of an ODA loan is calculated.

Table 21.2.11 Estimated Budget for Career Change and Vocational Training

- Offshore dumping case-

No.	Training	Unit	Price unit (1000 VND)
I	*Driver (B1 & B2 classes) : (3 months)*		
1	Training fee	Person	4,300
	Allowance subsistence	Person	2,000
II	*Career group I* **-** *(650,000VND/month x 3 months or 6 months as required but maximum is equivalent to 300USD): electric welding, electricity, electronic, lathe, ...*		
1	Training fee	Person	1,950
2	Subsistence (pers./course)		2,000
III	*Career group II* **-** *600,000VND/month x 3 months or 6 months as required but maximum is equivalent to 300USD): cooking, motorbike, sewing machine, & mobile phone repairs, tailor, construction, hair maker*		
1	Training fee	Person	1,800
2	Subsistence (pers./course)		2,000
IV	*Career group III* **-** *(500,000VND/month x 3 months or 6 months as required but maximum is equivalent to 300USD): Office informatics, handicraft (bamboo, embroidering...), hotel, restaurant services; housework assistant, selling*		
1	Training fee	Person	1,500
2	Subsistence (pers./course)		2,000

Estimated by JICA D/D Study Experts as of September 2011

b) Construction phase

i) Decrease in salt and aquaculture productivities

Since the master plan on the DCEZ is expected to be approved by the GOV in October 2011, there is no land allocation for salt production and aquaculture on Cat Hai Island after 2015. Preparation of career change program shall be initiated by Cat Hai district PC by the time of construction work so that it is recommendable to adapt the district PC's IRP for DCEZ implementation. The proposed income restoration program is briefly described in the Pre-construction phase. As Cat Hai District PC is the solely response agency to develop, authorize, and implement the career change program/IRP, it is recommendable for the district PC to collaborate with expected investors and businesses as well as potential labors/workforce-PAP for the development of practical and meaningful assistance programs.

In the cease of the mitigation for the aquaculture in Phu Long commune, it is recommendable to maintain the intake water quality for the aquaculture with necessary counter measures such as silt protector proposed in 21.2.1. It is also recommendable to monitor the negative impacts by the higher concentration of SS in the intake water. If the monitoring proves the negative impact by project related activities, the district PC should take necessary actions to secure the pre-construction income level.

ii) Decrease in offshore fish catch

As same as the mitigation measures for salt and aquaculture activities, it is recommendable to adapt the career change program for DCEZ and encourage PAP to participate such programs. However, if APA is willing to continue the offshore fishing, the negative impacts shall be carefully monitored. If the monitoring proves the negative impact by project related activities, the district PC should take necessary actions to secure the pre-construction income level.

iii) Degradation of water quality in beach resorts

The mitigation measures shall be provided by the SS control measures mentioned above. Although the tourism shall be higher tolerance than biological tolerance (less than 5mg/l), it is recommendable to monitor the negative impact by the project related activities with the collaboration of local businesses. If the monitoring proves the negative impact by project related activities, the district PC should take necessary actions to secure the pre-construction income level.

iv) Traffic accident

It is hardly to prevent traffic accidents under very limited road system on Cat Hai Island, it is recommendable to allocate at least one primary road to handle expected traffic during the construction, which could also contribute to the construction of the Tan Vu – Cat Hai highway on Cat Hai island. Since the master plan on the DCEZ is expected to be approved by the GOV in October 2011, it is highly recommendable to integrate such plan and the primary road development before the construction.

v) Socioeconomic impacts in Cat Hai Island by radical changes

Though the many changes in local communities, especially in Cat Hai Island, led by the Lach Huyen port project would be substantial, complete land use change by the DCEZ would alter any potential impact by the port construction projects. It is hardly mitigate expected changes with conventional counter measures. Thus, it is highly recommendable to address such impacts by integration of DCEZ's new society development as recommended above. Since the district PC is the primary response authority for both DCEZ and Lach Huyen port allocation and implement mitigation measures for such development activities, district PC would be the only capable authority to integrate such mitigation measures.

c) Operation phase

i) Socioeconomic impacts in the case of oil spill accidents

The port authority of Lach Huyen Gateway port shall carefully examine the worst case scenarios and prepare for such disaster. Preparation shall include the necessary capacity development of the port authority's disaster management skills, necessary materials such as oil fence and detergent compound, hazard mapping, and networking among public and private organizations capable of handling oil spill accident immediately. Since north-east-south coast of the Cat Ba Island is one of the most precious natural reserves in Vietnam as well as the UNESCO world heritage site, such disaster management plan shall consider such special circumstances.

3) Monitoring plan

a) Pre-Construction phase

Although Cat Hai District is responsible for the certainty of avoiding and minimizing the social impacts and effectiveness of mitigation measures for such negative impacts, VINAMARINE and MPMU II are also responsible to monitor such social impacts for the compliance of Japanese ODA policy – JBIC Guideline 2002 as the responsible project owner and implementation agency of borrower. If the monitoring proves the negative impact by project related activities, the VINAMARINE and MPMU II should collaborate with HPPC and district PC to have them take necessary actions to avoid and compensate the negative impacts. Table 21.2.12 shows the outline of the social environmental monitoring.

Table 21.2.12 Outline of Monitoring for Social Environment (pre-construction)

Aim	To confirm the recovery of PAP's livelihood and living standard in new career or recovered occupation. To identify difficulties for PAP's adaptation and consider follow up program if it's necessary. To modify career change programs/IRP to address the raised problems and adapt necessary needs.
Location	Project affected six (6) communes (Hoang Chau, Nghia Lo, Van Phong, Dong Bai, Cat Hai town, Phu Long) and any other if it's necessary
Frequency	Two (2) times a year (when the general monitoring is conducted)
Parameters & Methods	i) Land acquisition: ii) Clearance of offshore dumping area and near-shore fishing area: - financial (income and expenditure), - household structure - opinions for the new career - any complaint to improve IRP/Career Change Program - unemployment rate - Selective consumer price index Cf. Table 3.4.3 Survey Item and Methods
Reporting	Monitoring results shall be reported to Cat Hai district PC and HP DONRE. MPMU II is required to prepare for quarterly monitoring report for JICA as well.

b) Construction phase

As same as pre-construction, VINAMARINE and MPMU II are also responsible to monitor such social impacts for the compliance of Japanese ODA policy. If the monitoring proves the negative impact by project related activities, the VINAMARINE and MPMU II should collaborate with HPPC and district PC to have them take necessary actions to avoid and compensate the negative impacts. Table 21.2.13 shows the outline of the social environmental monitoring.

Table 21.2.13 Outline of Monitoring for Social Environment (construction)

Aim	To follow up the mitigation measures during the pre-construction To confirm the recovery of PAP's livelihood and living standard in new career or recovered occupation. To identify difficulties for PAP's adaptation and consider follow up program if it's necessary. To modify career change programs/IRP to address the raised problems and adapt necessary needs.
Location	Project affected six (6) communes (Hoang Chau, Nghia Lo, Van Phong, Dong Bai, Cat Hai town, Phu Long) and any other if it's necessary
Frequency	Two (2) times a year (when the general monitoring is conducted)
Parameters & Methods	Follow-up (same items as monitor) i) Land acquisition: ii) Clearance of offshore dumping area and near-shore fishing area: Monitor i) Decrease in salt and aquaculture productivities: ii) Decrease in offshore fish catch: - financial (income and expenditure), - household structure - opinions for the new career - any complaint to improve IRP/Career Change Program - unemployment rate - Selective consumer price index Cf. Table 3.4.3 Survey Item and Methods iii) Degradation of water quality in beach resorts - Number of tourist in major beaches in Northern region - any complaint iv) Traffic accident - Number of traffic accident and location - Traffic jam information in Cat Hai Island - any complaint v) Socioeconomic impacts in Cat Hai Island by radical changes - any complaint from commune PC representative and local representatives such as unions or fatherland front committee
Reporting	Monitoring results shall be reported to Cat Hai district PC and HP DONRE. MPMU II is required to prepare for quarterly monitoring report for JICA as well.

c) Operation phase

Once the port starts operation, the port authority shall take over any responsibility of VINAMARINE and MPMU II during the pre-construction and construction phases. As long as specified in the loan agreement, the port authority would be responsible to monitor the potential impacts during the operation phase and follow up the status of the mitigation measures for pre-construction and construction phases. If the monitoring proves the negative impact by project related or operation activities, the port authority should collaborate with HPPC and district PC to have them take necessary actions to avoid and compensate the negative impacts. Table 21.2.14 shows the outline of the social environmental monitoring.

Table 21.2.14 Outline of Monitoring for Social Environment (operation)

Aim	To follow up the mitigation measures during the pre-construction To confirm the recovery of PAP's livelihood and living standard in new career or recovered occupation. To identify difficulties for PAP's adaptation and consider follow up program if it's necessary. To modify career change programs/IRP to address the raised problems and adapt necessary needs.
Location	Project affected six (6) communes (Hoang Chau, Nghia Lo, Van Phong, Dong Bai, Cat Hai town, Phu Long) and any other if it's necessary
Frequency	Two (2) times a year (when the general monitoring is conducted)
Parameters & Methods	Follow-up (same items as monitor) i) Land acquisition: ii) Clearance of offshore dumping area and near-shore fishing area: iii) Decrease in salt and aquaculture productivities: iv) Decrease in offshore fish catch: - financial (income and expenditure), - household structure - opinions for the new career - any complaint to improve IRP/Career Change Program - unemployment rate - Selective consumer price index Cf. Table 3.4.3 Survey Item and Methods v) Degradation of water quality in beach resorts - Number of tourist in major beaches in Northern region - any complaint
Reporting	Monitoring results shall be reported to Cat Hai district PC and HP DONRE. The port authority would be required to prepare for quarterly monitoring report for JICA as well.

21.3 Recommended Environmental Management Plan

This section (21.3) aims to summarize the potential impacts on environment and their mitigation measures and monitoring programs recommended in section 21.2 above. In order to clarify the responsibilities of the implementation and monitoring of the recommended programs, recommended organization structure of Environmental Management Plan (EMP) is also provided.

21.3.1 Organizational Structure of Environmental Management Plan

Proposed organization structure of environmental management plan (EMP) is considered based on 1) new environmental legislations (decree #29/2001/NDCP and circular # 26/2011/TT-BTNMT), 2) Environmental Impact Assessment Report/ Lach Huyen Gateway Port Construction Project 2010-2015 (October 2008), and 3) Supplemental Report – Environmental Impact Assessment Report for Lach Huyen Gateway Port Construction Project 2010-2015(May 2010 by JICA SAPROF study). Due to the different responsibilities in phases and project components, the organization structure and expected responsibilities are separately proposed before the port operation and after the port operation as summarized in Table 21.3.1.

Table 21.3.1 Proposed Organization Structure for EMP

Component	Pre-Construction/Construction	Port Operation
Lach Huyen Gate Way Port	Supervision: VINAMARINE	Supervision: The Lach Huyen Gateway Port Authority
- Component A	Designated responsible entity for EMP: MPMU II	Designated responsible entity for EMP: The Lach Huyen Gateway Port Authority
- Component B (private portion)	Designated responsible entity for EMP: joint stock company (VINALINE and other private stakeholders)	Designated responsible entity for EMP: joint stock company (VINALINE and other private stakeholders)

1) EMP structure for the preparation and construction phase

As component B (private portion) is separate owner and responsibility, this section only addresses the component A. EMP of the private portion shall be defined by joint stock company-the owner of the component A, but the structure of the EMP shall be similar to component A and supervised by VINAMARINE or MOT.

Before the construction of the port project, Maritime Project Management Unit II (MPMU II) shall establish environmental monitoring and safety of contractors, subcontractors and suppliers during construction period. Monitoring focuses on the compliance of contractors and suppliers in the implementation of measures to minimize environmental impacts, safety measures as committed and approved in the EIA report. MPMU II shall designate a Project Management Consultant (PMC) and Independent Supervision of safety and environment Consultant (ISSEC) to perform the tasks above.

Specific responsibilities of the stakeholders in the environmental management of project preparation and construction are shown in Table 21.3.2. Recommended structure of the EMP is shown in Figure 21.3.1.

Table 21.3.2 Responsibilities of the Primary Stakeholders under EMP during Pre-Construction and Construction Phase

Units	Main Responsibilities
VINAMARINE	- Supervise the EMP for both component A and B - Based on the monitoring reports prepared by MPMU II (component A) and (component B), periodical report to the Department of Natural Resources and Environment of Hai Phong city, MOT, and JICA - Assign the Independent Supervision of Safety and Environment Consultants (ISSEC) on the overall environmental impact assessments of the project.
MPMU II (component A) / Joint Stock Company (Component B)	- Monitor the project performance indicators related to environmental issues - Perform checks of contractors performance and progress of the mitigation measures stated in the contract - Assign project management consultant (PMC) and guide PMC for the preparation of periodical monitoring reports to ensure compliance and implementation of mitigation measures - Consult with ISSEC and review the periodical reports of ISSEC - Coordinate with the Community Supervision Board (CSB)
Independent Supervision of Safety and Environment Consultant (ISSEC)	- To conduct an independent supervision on issues related to safety and the environment in preparation and construction periods. - Supporting and coordinating with PMC to establish, collect the information necessary environmental norms. - Coordinating with the community supervisory board (CSB) to ensure community participation in monitoring the implementation of environmental management plans - Update and advice environmental knowledge for MPMU II, the contractors,

Units	Main Responsibilities
	workers and communities, CSB. - Prepare and periodically report to the MPMU II of the overall environmental impacts of the project
Project Management Consultant (PMC)	- Coordinate with the ISSEC in establishing, gathering information on the environmental criteria required - Conduct environmental monitoring - Supervise the implementation of mitigation measures by contractors and timely proposals and implementation of additional interventions to improve the mitigation measures to meet the requirements of environmental protection - Monitor that construction work is conducted in full compliance with environmental management plan has been approved and the other provisions mentioned in the EIA report - Develop and recommend further mitigation measures for environmental problems, the emergency situations that may be occur during the construction period. - Write recommendations for MPMU II suspend part or all of the construction work if the contractor does not meet the requirements of occupational safety and environmental protection have agreed or stated contract. - Organize meetings and exchanges between related parties, receive and deliver the necessary information on project implementation plans to increase public awareness and identification of sensitive issues may occur in the community to promptly treated before implementation of the Project. - Prepare and periodically report to MPMU II of monitoring report
Community Supervisory Board (CSB)	- Supporting the dissemination of information on the project, raising awareness to the community. - Reflecting the opinions, complaints, questions of government and community to the MPMU II of the environmental impacts and mitigation measures. - Support the implementation of the mitigation measures required for the environmental impacts associated with project - Collecting and supporting the work of collecting data, observatory - Coordinate with ISSEC deployed environmental monitoring on the basis of the EMP approved - Participating the training capacity of environmental monitoring and dissemination of knowledge and training for local communities.
Department of Environment-Ministry of Transport (DE/MOT)	- Coordinate with the Hai Phong Department of Natural Resources and Environment and CSB to monitor and supervise the implementation of the contents of the report on environmental impact assessment has been approved and request of approval
Hai Phong Department of Natural Resources and Environment (DONRE)	- Coordinating with the DE/MOT and CSB management and supervising the implementation of measures to minimize environmental impacts of the project. - Receiving and responding to environment reports of the project.

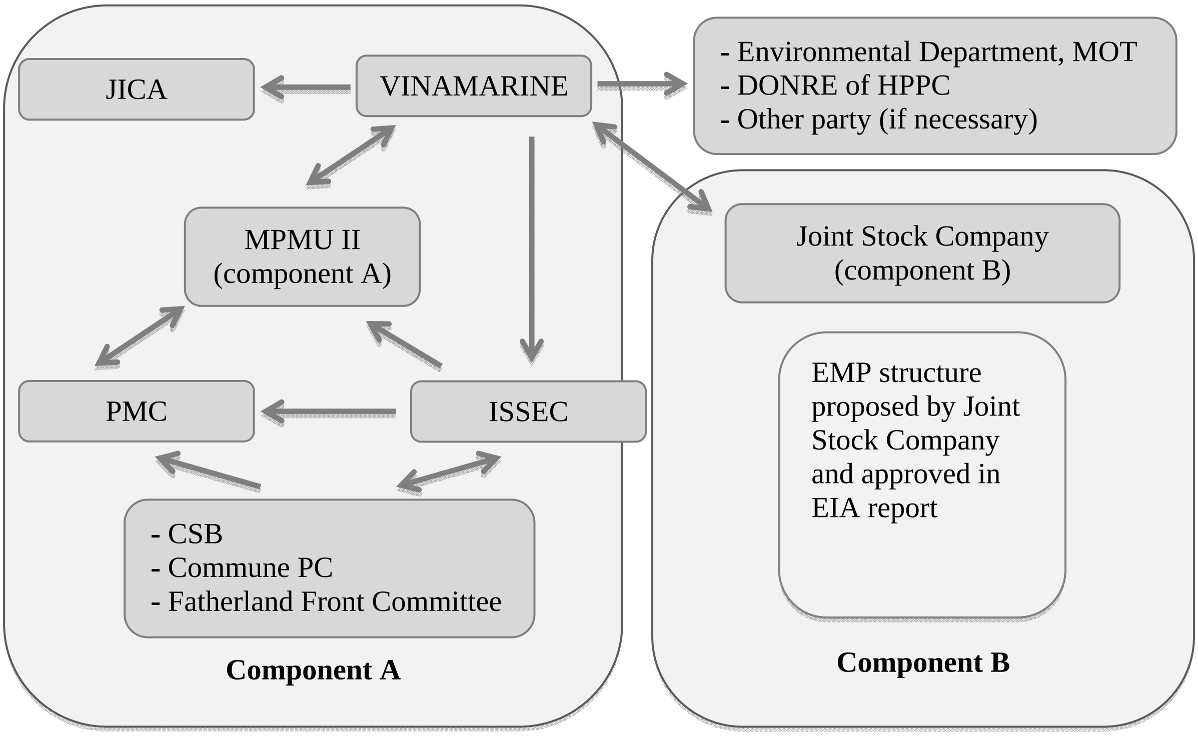


Figure 21.3.1 Organization Structure of EMP for Pre-Construction and Construction Phase

2) EMP structure in operation phase

After the inauguration of the port, the port authority of the Lach Huyen Gateway port shall be the solely responsible entity to supervise the EMP including the follow-up of the EMP during the pre-construction and construction phases. Each port operator of component A and B shall be responsible for ensuring the EMP. Specific responsibilities of the stakeholders in the environmental management of project preparation and construction are shown in Table 21.3.3. Recommended structure of the EMP is shown in Figure 21.3.2.

Table 21.3.3 Responsibilities of the Primary Stakeholders under EMP during Operation Phase

No	Units	Main Responsibilities
1	Lach Huyen Gateway Port Authority	- Appointed department responsible for environment issues project. - Financial guarantee for environmental protection activities in operation period - Receiving and handling of environmental issues arising during project implementation - Checking the operation of environmental monitoring unit. - Conducting inspection, periodic testing of compliance with the requirements of environmental protection facilities in the port construction zone - Approving the plans and measures to minimize environmental impact adjusted / added (if necessary) - Conduct inspection, periodic testing of compliance with the requirements of environmental protection facilities in the port construction
2	Environmental Management Division of Port Operator (component A/B)	- Implementing, monitoring and evaluating work related to environmental issues and safety in the Port. - Reporting to the Port Management Board and the Department of Natural Resources and Environment of Hai Phong City, Natural Resources and Environment office Cat Hai district
3	Independent Supervision of Safety and	- To monitor and assess environmental quality based on monitoring parameters proposed in the report covers the construction and operation period. - Implementation of community consultation meetings to acknowledge the

No	Units	Main Responsibilities
	Environment Consultant (ISSEC)	feedback and assessment of local people on environmental management plan of the project. - Report to the Safety and Environmental supervising department. - Perform additional measurements upon request from the Board of Port Construction.
4	DONRE	- Manage and supervise compliance with the mitigation measures proposed environmental impact assessment report of the Executive Board projects and actual test results

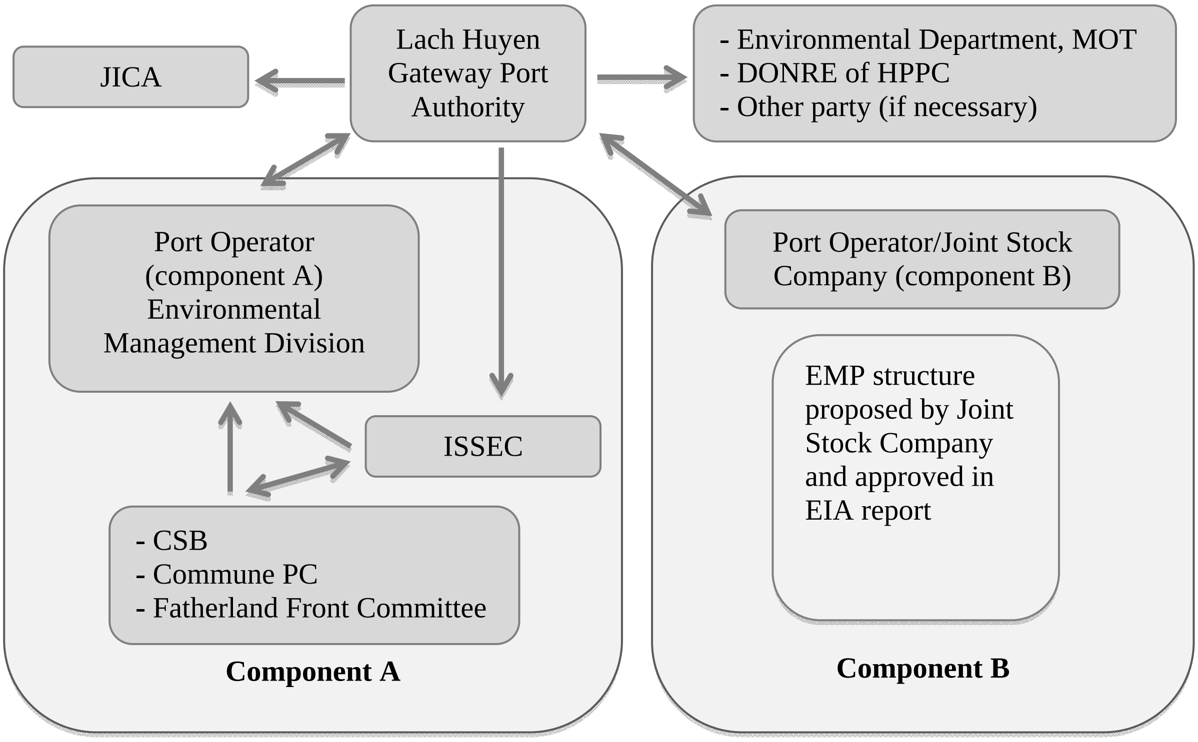


Figure 21.3.2 Organization Structure of EMP for Pre-Construction and Construction Phase

21.3.2 Recommended Mitigation Measures

Recommended mitigation measures are summarized in Table 21.3.4.

Table 21.3.4 Recommended Mitigation Measures

Phase	Category	Impact factor	Mitigation measure	Implementing organization	Cost (USD)
Pre-Construction phase	Social environment	Land acquisition	Land for Land/Cash & IRP by Land law And/or Career change program or IRP by DCEZ' safety guard policy	Cat Hai District PC	Shall be defined by Cat Hai District PC for the DCEZ's safety guard policies
		Clearance of construction area (port & dumping site)	Career change program or IRP by DCEZ' safety guard policy		
Construction phase	Natural environment	Dust	Water spray, etc.	Construction contractor	-
		Noise/Vibration	Securing distance	Construction contractor	-
		Suspended solid	Silt curtain	Construction	36,000,000/3years

Phase	Category	Impact factor	Mitigation measure	Implementing organization	Cost (USD)
			Overflow prohibition	contractor	
		Sediment degradation	Silt curtain	Construction contractor	
	Biological environment	Impact on hard corals and other marine organism due to SS dispersion from dredging and dumping activities	- Prohibition of overflow from dredger. - Installation of silt curtain around the dumping site - Implementation of reactive monitoring	Construction contractor	Refer to the cost above.
	Social environment	Degradation of water quality by SS for salt/aquaculture/beach resorts/fishery	DCEZ' safety guard policy (career change program or other mitigation/compensation measures)	Cat Hai District PC	Shall be defined by Cat Hai District PC for the DCEZ's safety guard policies.
Operation phase	Natural environment	Dust, Exhaust gas	Water spray High-combustion-efficiency engine	Port Operators	-
		Noise/Vibration	Monitoring, Interview	Port Operators	3,000/year
		Discharged water	Discharge water management	Port Operators	-
		Ballast water	Offshore replacement	Port Operators	-
		Antifouling paint, Sediment quality	Regular monitoring	Port Operators	37,500/year
	Biological environment	Any of impacts in Natural environment	Any of measures in Natural environment	Port Operators	Refer to the cost above.
	Social environment	Oil Spill Accident	- Capacity development of authority's disaster management skills - Preparation of disaster management materials and implementation structure	Lach Huyen Gateway Port Authority	Shall be defined by Lach Huyen Gateway Port Authority

21.3.3 Recommended Environmental Monitoring Plan

Recommended environmental monitoring plans are summarized in Table 21.3.5.

Table 21.3.5 Recommended Environmental Monitoring Plan

Phase	Category	Impact factor	Monitoring method	Implementing organization	Cost (USD)
Pre-Construction phase	Social environment	Land acquisition	2 time/year Standard methods for involuntary resettlement monitoring	Cat Hai District PC (legally responsible) with Collaboration of MPMU II	- Mandatory cost shall be defined by Cat Hai District PC - MPMU II's monitoring cost shall be 50,000/year
		Clearance of construction area (port & dumping site)	2 time/year Standard methods for involuntary resettlement monitoring		
Construction phase	Natural environment	Air quality, Noise, Vibration	1 time/month	Construction contractor	9,160/3years
		Suspended solid	Daily	Construction contractor	9,400/ 3years

Phase	**Category**	**Impact factor**	**Monitoring method**	**Implementing organization**	**Cost (USD)**
		General environment	4 times/year	Project owner	375,000/year
	Biological environment	Impact on hard corals and other marine organism due to SS dispersion from dredging and dumping activities	**[Water quality monitoring]** - Daily monitoring of turbidity/SS levels at environmentally sensitive sites (3 sites) **[Coral health monitoring]** - Monthly monitoring of coral health at 2 hard coral sites (Cat Ba Island and Long Chau Island)	Construction contractor	130,000/3 years
		Impact on demersal fish/macrozoobenthos due to construction works	**[Demersal fish/macro zoobenthos monitoring]** - Seasonal monitoring of fish/macrozoobenthos status through trawling survey	Project owner	The cost is included in the cost for General environment of natural environment.
	Social environment	Degradation of water quality by SS for salt/aquaculture/beach resorts/fishery	2 time/year Standard methods for involuntary resettlement monitoring	Cat Hai District PC (legally responsible) with Collaboration of MPMU II	- Mandatory cost shall be defined by Cat Hai District PC - MPMU II's monitoring cost shall be 50,000/year including follow-up monitoring for pre-construction
Operation phase	Natural environment Biological environment	General environment	2 times/year	Port Operators	187,500/year
	Social environment	Follow-up monitoring for PAP	2 time/year Standard methods for involuntary resettlement monitoring	Cat Hai District PC (legally responsible) with Collaboration of the LH Gateway Port Authority	- Mandatory cost shall be defined by Cat Hai District PC - Port Authority's monitoring cost shall be 50,000/year

22. HIV / AIDS PREVENTION PROGRAM

22.1 Introduction

Lach Huyen Port Infrastructure Construction Project (the Project), consists of two portion – the constructions of access roads/bridge to Lach Huyen port (Road & Bridge portion) and the civil works and constructions for soil improvement, and reclamation for terminal area, protection facility, dredging etc. (Port portion) has potential social risks for the increase of HIV infection and vulnerability against AIDS among staff and labor in construction sites and to the immediate local communities.

In August 2006, Japan International Cooperation Agency (JICA) signed a joint initiative together with five other donor agencies to commit to reducing HIV vulnerabilities associated with infrastructure projects through targeted interventions and supporting the HIV and AIDS response of partner countries. Since then, JICA has been incorporating HIV prevention programs targeting construction workers and the local communities they interact with into the design of its large scale infrastructure projects. In this context, JICA and Socialist Republic of Vietnam agreed on the inclusion of a plan to implement a prevention program against HIV/AIDS (Minuets of Discussion, 18 June 2010).

This chapter is to present draft HIV/AIDS prevention program for the Project, which will be reflected into general requirements of the tender documents for construction. HIV/AIDS prevention program will include such prevention/care activities and monitoring scheme to take care of the Contractor’s personnel and workers from incident of infection of HIV/AIDS. The proposed drafted program is the product after discussion with Hai Phong City Health Department, Hai An district, and Cat Hai district, based on core components recommended in “Practice guidelines for harmonizing HIV prevention initiatives in the infrastructure sector” and past similar program in Vietnam.

22.1.1 Situation in Vietnam

The HIV epidemic in Vietnam continued to rise in all 64 provinces and cities until 2000, but incidence (new cases) has declined from 67 per 100,000 adults (15-49 age group) in 2000 to 39 in 2007. Meanwhile, the number of people living with HIV (PLHIV) is estimated 243,000 cases (0.41% of the Population) in 2009, and it is predicted that the number will have reached at 280,000 by the end of 2012(0.47%). In Vietnam, an estimated one in five males who inject drugs was living with HIV in 2009. For men who have sex with men, the infection level is also very high – at 16.7%. There has been progress in reducing the risk of HIV infection for female sex workers. National prevalence for this group was reported 3.2% in 2009. But hotspots of high prevalence still occur, such as in Hai Phong where HIV prevalence among street-based female sex workers in 2009 was 8.5%.

In 2004, The Government of Vietnam formulated “The National Strategy on HIV/AIDS Prevention and Control in Vietnam for 2004–2010 with a Vision to 2020”, and in 2006, passed “The Law on Prevention and Control of HIV/AIDS (No. 64/2006/QH11)”. This law prohibits terminating an employee, denying medical care, and refusing an employment based on HIV status, guarantees the right to have HIV status kept confidential as well as encouraging the employment of PLHIV. The law also provides for access to medical insurance and coverage for treatment expenses as well as free treatment for children living with HIV and other PLHIV living in difficult circumstances. In 2007, “Detailing the implementation of a number of articles of the law on Prevention and Control of HIV/AIDS (Decree No. 108/2007/ND-CP) defines target groups of harm reduction intervention measures in the prevention of HIV transmission, competency criteria of agency that provide such a program, and mandate on integration of HIV/AIDS prevention and control into social development program

While Vietnam Administration for AIDS Control (VAAC), Ministry of Health is the major stakeholder of HIV/AIDS prevention program, the Ministry of Transport (MOT) also has taken part in the response to HIV prevention. MOT set out a HIV Action Plan to respond the prevention of HIV risk in transportation sector in 2009. The overall objective of the Action Plan is to reduce the vulnerability to HIV and AIDS of those who are working in the transport sector, with a focus on staff and workers of the sea ports, waterways and civil construction sub-sectors in a period 2009-2013. The plan consists of the five (5) specific objectives such as "(1) To strengthen the committees for HIV/AIDS prevention and control", "(2) To improve the legislation for HIV/AIDS prevention and control, "(3) To improve capacity of staff of the MOT's health system", (4) "To raise awareness and reduce discrimination against PLHIV", and "(5) To improve the monitoring and evaluation system related to HIV/AIDS prevention and control"(Presentation at ICAAP-9 on 12 August 2009).

22.1.2 Situation in the Project Sites

Construction works will take place in two districts- Hai An district and Cat Hai district in Hai Phong City. The access roads which start from Tan Vu inter-change of Hanoi - Hai-Phong expressway in Hai An district via 5.44km bridge between the main land and Cat Hai Island will connect to Lach Huyen port terminal that stands out to the sea from Cat Hai Island of Cat Hai district. Japanese ODA loan finances the construction works for 15.63km Tan Vu- Lach Huyen highway and Lach Huyen port, and private investments are expected to fulfill the provision of Lach Huyen port facilities.

Hai Phong City is considered one of Vietnam's highest HIV epidemic areas. According to VAAC's data, more than 0.4% of the adult population in Hai Phong City is HIV positive, while it is estimated to be 1% in urban and 0.3% in rural. Vietnam's epidemic has mostly been driven by Injecting Drug Use (IDU) and its association with sex work.

Since the first case had been found in 1993, the total number of HIV positive has reached to 9,901 in Hai Phong City as of September 2011, in which 5,673 of AIDS. During past 18 years, 3,154 people died from AIDS or AIDS related diseases. Therefore, the number of people living with HIV/AIDS in Hai Phong City now is 6,747. In Hai Phong City, 64% of IDUs are PLHIV, and HIV prevalence among Female Sex Workers (FSWs) is 9.5% while the prevalence of street FSWs are 7.2%. An age group from 30 years old to 39 years old accounts for 54% of PLHIV. HIV Prevalence of Cat Hai district is now 3rd highest district among 15 districts of Hai Phong City while Hai An district is 8th among them. Ngo Quyen district, neighboring to Hai An district, is the first, and the districts where entertainment establishments are prospering.

Along with the national strategy and program of actions, Hai Phong City executes nine (9) HIV/AIDS programs. Nine programs are (1) HIV Prevention through Information, Education and Communication (IEC) and Behavior Change Communication (BCC), (2) Harm Reduction Prevention targeting high risk populations including Injection Drug User(IDU), (3) Care and Support for People Living with HIV (4) HIV Surveillance and Monitoring and Evaluation (M&E),(5) Access to HIV/AIDS Treatment Program, (6) Prevention of Mother to Child Transmission (PMTCT),(7) Management and Treatment of Sexually Transmitted Infections (STI), (8) Safe Blood Transfusion, and (9) Capacity Building and International Cooperation Enhancement.

Through those programs, Hai Phong City controls 100% of blood transfusions, assures that 80% of children living with HIV/AIDS access ART, and introduced methadone treatment program for IDUs. Hai Phong City operates 5 Voluntary Counseling and Testing (VCT) centers and one counseling center with the initiation of U.S. President's Emergency Plan for AIDS Relief (Emergency Plan/PEPFAR), and launched 100% condom use program through social marketing approach to entertainment establishment. In Hai Phong City, a HIV Legal Clinic is available since 2008, which provides face to face consultation and HIV hotline national free telephone (1800 1521). The hotline is one of five Legal Clinics (Hanoi, Quang Ninh, An Giang, Hai Phong, and Ho Chi Minh) in the country. The Hai Phong City has been involved in the national leading pilot program such as Anti-retroviral therapy (ART) and methadone treatment for people who inject drugs. Prevalence is decreasing 5-7% every year, and new cases remains 100 cases per a year. Hai Phong City intensively carries out HIV/AIDS program through the collaboration with13-14 international organizations.

The location of Hai An district is close to the center of Hai Phong City. Hai An district consists of 8 communes with population of 103,000. The size of population increase 3-4,000 people every year. Hai An district health center has 8 workers, and four (4) of them are designated as staff for HIV/AIDS program operation.

In addition, the center accommodated eleven (11) persons who work for World Bank's program. The number of PLHIV counts 513 in the district, which consists of 436 men and 78 women. Seven (7) of them are children. All PLHIV receive ART service and other medical care. The Hai An district has one VCT center on the premise of Hai An district hospital and one methadone treatment center for IDUs. The number of IUDs who receive the service is 92, and it will be expected to reach 145 in October 2011. HIV positive IDUs among the clients are 41 (45%), and the clients with Hepatitis B positive is 13 and with Hepatitis C positive is 61.

The methadone treatment center is expected to expand its capacity up to 200. In order to cope with the increasing needs for health service including ART and VCT, new district hospital and district health center are under construction. Hai An receive financial support from Center for Disease Control (CDC), Family Health International (FHI), and World Bank (WB). Every commune operates health station with 4-6 health staff who engaged in primary health care including STI syndromic diagnosis and community mobilizations about HIV awareness in their spare time.

Despite its operation efforts, Hai An district concerns post operation of program after the expiration of support from international organization (e.g.WB's support to methadone treatment program), continues education of HIV for staff, insufficient resources for community mobilization, and enhancement of network among self-help groups.

Cat Hai Island, where is the center of the Port construction site, consist Cat Hai district with Cat Ba Island where the district administration office and the general hospital are located. Cat Hai district consists of 10 communes with the population of 29,800. The population of all five (5) communes in Cat Hai Island is around 14,100, where sixty-nine (69) cases are registered as PLHIV.

Furthermore, some immigrant fishermen inhabit Ben Pha Got Harbor of Cat Hai Island. Meanwhile, Cat Ba Island is commonly used as an overnight hotel stop on tours to Ha Long Bay run by travel agents from Hanoi. Hotels located in Cat Ba Island count around 40, and they accommodate 700 tourists. Cat Hai district administration office and the district hospital are located in Cat Ba Island. The general hospital provides VCT service.

22.2 Issues

The linkages between migration, mobility, and the spread of HIV are well documented. Increases in HIV prevalence have been observed along major transport routes, cross-border areas and in economic growing regions experiencing high seasonal and long-term population mobility. Large infrastructure projects offer economic opportunities that attract migrant workers, commercial retailers, and entertainment industries to previously remote and isolated communities. The interaction among the construction workforce, local communities, and sex workers can create a potentially high-risk environment for the spread of HIV and other STIs through unprotected sex and/or injecting drug use. Mobile and migrant workers, including construction workers, are highly vulnerable since their prolonged separation from family and communities, access to disposable income, and lack of alternative sources for rest and recreation can lead them to adopt high-risk behaviors. Other vulnerable groups include truck drivers and their helpers, commercial retailers, and seamen and common carriers who are involved in deliveries to the site.

While construction workers are considered higher at-risk to HIV epidemic, recent research in Vietnam shows that construction workers have general knowledge regarding HIV transmission and benefits of condom use, though the knowledge about STI/STD is rather low and certain percent of men practice multiple partners.

The experience and the practice of program implementation were taken into policy progress and other program design and implementation, then main stream of HIV prevention in infrastructure sector gradually change the policy environments. The followings are the issues in current policy environment.

(1) Large scale construction projects that seek to mitigate the spread of HIV must align their program to fit within existing national HIV responses and local programs. The sector interventions must also be linked to the various local health services delivery mechanisms, including local implementation units such as NGOs that are most effective for providing HIV services. Likewise, a number of ministries of transport have established their own HIV/AIDS plans and workplace policies, which can serve as good practice examples for the sector to address the threat posed by the epidemic. An important ingredient for success will be the working relationship that must be established between transport staff, health staff and local partners. The sector should also rely on existing best practice and supporting tools created by partners such as the International Labor Organization and the International Transport Workers Federation for implementing workplace HIV strategies and for influencing behavior change among transport workers. In Hai Phong City, various partners such International NGO takes different role with its own coverage area in different time schedule. The issue is how the Program will formulate a mechanism that coordinates continuously synergetic enjoyment with the partners in the area.

(2) HIV clause under construction contracts is effective for the staff and labor to acquire certain level of knowledge about HIV/AIDS as indicated in the monitoring and evaluation reports of similar programs. However, IEC activities that is run by construction companies tend to be passive, and they cannot grab the interest of individuals. In addition, it is pointed out that IEC and mass media fostered stigma and discrimination unintentionally while the law on Prevention and Control of HIV/AIDS has been in place. The issue is how the Program tackles on stigma and discrimination other than HIV awareness and their protection to the epidemic, how the Program integrate HIV/AIDS aspects into “health and safety” of each companies.

(3) While construction workers know certain level of knowledge regarding to HIV/AIDS including protection method, the proportion of workers who know STI is lower, and most of them do not know their sero-status of HIV. If diagnosis and treatment service for STI are integrated into company health service, workers would not use them partly out of stigma and possibly because having an STI could be evidence of ‘social evils’ and grounds for dismissal. Workers do not use VCT even the services attached to worksites or those that are likely to give test results to employers due to fear of dismissal if HIV positive. The issue is how the Program sorts out the roles of service provider and construction contractor so that the site staff and labor can participate in the Program without fear and distrust.

(4) If the prevalence of Hai Phong City will be applied to the number of site staff and labor, there will be several PLHIVs in the face of statistics. Attitudes and beliefs are a barrier to reflection on HIV, actual risk, self protection and protection of families. The issues are how the Program establishes the environment that enable all site staff and labor participate in voluntary testing or STI/STD service without fear and prejudices, and how the Program enable the site staff and labor utilize VCT and ART service provided by local health providers if they require.

(5) Several international NGOs and organization operate their programs in Hai Phong City where the Program will be implemented, therefore, the Program continuously needs fine tuning with those partners during the Program period. In addition, situational change along with private investment may lead the Program framework revised. Furthermore, it is far more difficult to predict what the measure should be taken at the end of Program. The issue is how the Program institutionalizes a modifiable adjustment mechanism in monitoring, and how the evaluation can be utilized for the future.

(6) The Vietnam law - Circular No.14/1998/TTLT-BLDTBXH-BYT imposes enterprise set up health station with one doctor and one practitioner if the enterprise has 501 – 1000 workers. For

enterprise having less than 300 workers needs to have a clinic with at least one nurse; Enterprise with 300 – 500 workers needs at least one nurse and one practitioner. In case, lack of qualified health professionals, enterprises can make a contract with local health center to get services. The clinic is responsible for providing health care services for all kind of sickness, initial treatment for accidents during the work, control of contaminated foods, and provision of periodical health check including HIV/AIDS prevention. When the most of site staff and labor are assumed as temporary employed workers and engaged in short period of time by smaller enterprise, they may not be fully covered as expected.

22.3 Design and Implementation Strategy

The HIV/AIDS prevention program should be a single program that complies with the national and local framework. However, operationally, the Program will be divided into two portions: (1) Port potion and (2) Roads & Bridge portion, under project management unit respectively. In other words, the Program implementation should be controlled by PMU2 and MPMU II as a part of the construction project management. However, due to limited human resource and technical capability, the PMU2 and MPMU II should employ HIV management specialist as a consultant respectively. The appointed consultants will control quality of the Program through participating in the preparation of HIV clause for the contracts, monitoring and evaluation of the Program. Based on the contract between a prime contractor and Service Provider, the Service Provider operates the Program on site. Service Provider means an entity approved to provide the HIV/AIDS Prevention Program. The followings are the detailed strategy for design and implementation of the Program.

(1) It is required to set up a mechanism that Service Providers, Hai Phong City authority, Hai Phong City Health department, representatives from Hai An district health center and Cat Hai district health center will be able to discuss the direction of the Program. The Program appoints Service Provider who shall attend quarterly HIV and Social Crime Steering Committee meeting for the purpose of reporting and coordination among stakeholders. Service Provider also attends the similar regular meeting held in Hai An district and Cat Hai district. In addition, the Program will organize the Program Management Coordinating Committee meeting, chaired by a member of HIV and Social Crime Steering Committee at the commencement of the Program, one year after, at the time of mid-term evaluation, 2 years after, and at the final evaluation. Participants of the meeting will be representatives from PMU2, MPMU II, construction contractors, Hai An district, Cat Hai district etc.

(2) The Program will support executives, human resource manager, and health personal in site clinic, if it is set up, to create better HIV and workplace in the context of health and safety. Advocacy should focus on building company support for integration of the prevention program, and all employers should receive information to promote uptake of company run prevention activities and, where needed, changes in workplace policy. This work policy will cover anti-discrimination and elimination of stigma in workplace. The Program will extend the advocacy activities, if Ca Hai district and Hai An district agree, to owners of hotels, entertainment establishments, transport business in surrounding area.

(3) Response to HIV/AIDS should focus on the both organization and individuals. In principle, construction contractors are responsible for HIV/AIDS prevention activities clarified by the HIV sub-clause under health and safety clause along with Vietnamese law. The Program support this principle though, Service Provider with its specialty and skills will access individual site staff and labor through BCC approach. Further, with the collaboration with local authority, the Service Provider will provide BCC approach to social groups and business communities where the local health authority cannot reach in general social campaigns.

(4) Service providers will establish a mechanism that mediates and promotes VCT, STI/STD treatment, and access to ART if required, through collaboration with site clinic (if it is set up) and health centers in Hai An district and Cat Hai district. The Service Provider will control the budget for this service within the Program cost.

The Program should include analyzing stakeholders and partners to find out priority activities and problems, and conducting baseline survey including behavior change and situation analysis at the time of the Project commencement. In order to reflect the change occurred during the implementation, it is required to conduct mid-term evaluation so that the Program will be able to re-design. The Program will need to conduct the evaluation together with an exit survey so that the results will reflect recommendations into the HIV/AIDS program in the post-construction period.

The Program should be implemented to involve in health staff of site clinic as much as possible as they are responsible health and safety including HIV prevention.

22.4 Scope of the Program

22.4.1 Program Title

HIV/AIDS Prevention Program for Lach Huyen Port Infrastructure Construction Project (the Program)

22.4.2 Outline of the Program Objectives and Outputs

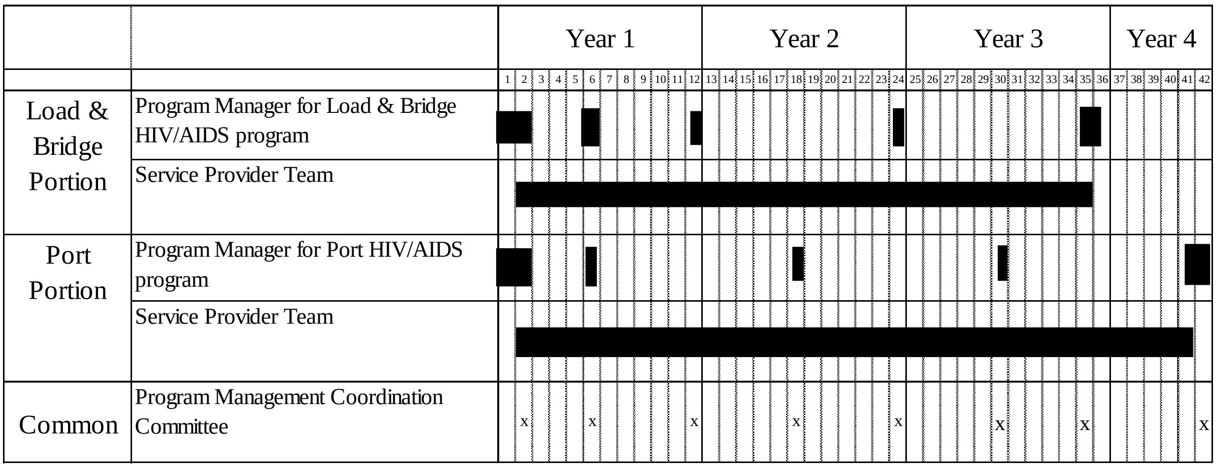
The overall goal of the Program is to reduce potential negative social impacts associated with the implementation and operation of the Lach Huyen Infrastructure Construction Project (Roads/Bridge and Port) in an HIV/AIDS prevalent area). In order to achieve the overall goal, the Program will mitigate HIV risks and vulnerability to HIV/AIDS at the construction Sites and surrounding communities by the following outputs.

- Functioned management body and coordinating structure for the HIV/AIDS prevention program through proper implementation arrangement.
- Increased awareness about, and capacity to address HIV, drug, stigma, and HIV resilient communities among key partners such as entertainment establishment, transportation business and local communities through advocacy and capacity building
- Increased awareness and positive behavior change among Site staff and labor and local communities through IEC and BCC
- Secured access to quality HIV, STI and other health service including VCT and ARV, if necessary, through linking to other components and existing local resources
- Secured performance of the Program through institutionalized monitoring and evaluation mechanism

22.4.3 The Program Period and Schedule

The Program covers 42 months (3 years and 6 months). However, the Program will be managed by two management bodies due to the nature of construction plan and supervision. The program for the road & bridge portion ends 6 months earlier that the program for the port portion while the port Program covers full period of the Program. Therefore, the Program consists of two parts- the program for the road & bridge portion and the program for the port portion.

Table 22.4.1 Program Schedule



22.4.4 Supervision, Implementing Agencies, and Manager/Service Providers

The Program implementation should be controlled by PMU2 and MPMU II as a part of the construction project management. However, due to limitation of human resource and technical specialty, PMU2 and MPMU II should employ a consultant as a HIV management specialist respectively. The consultants control quality of the Program through preparation of contracts for HIV clause, monitoring and evaluation of the Program. Based on the contract between a prime contractor and service provider, the service provider operates the Program on site. The Program requires setting up Program Management Coordinating Committee (PMCC) which directs and controls the Program,

The PMCC meetings are expected to have every 6 months by the attendance of representatives from local authorities (Hai Phong City HIV and Social Crime Steering Committee and Cat Hai HIV and Social Crime Committee and Hai An HIV and Social Crime Committee), and representatives from PMU2 and MPMU II, and program managers for respective portion of the Program.

The both PMU2 (Roads & Bridge portion) and MPMU II (Port portion) are expected to assign focal persons or a task team within their project management body respectively. Actual work and management of the Program will be assisted by prime contractors (consulting agency). An implementing guide including the recommended implementing structure is attached in this chapter as Annex-3 Implementation Guide.

Each prime contractor assigns a manger who is an expert on HIV/AIDS prevention program and, contract out the most of work to a service provider. The each prime contractor and the assigned manager control respective portion of the Program through HIV clause in contract of construction contractors and supervision and monitoring on the service provider. Sample TORs for program management and monitoring consultant and Service Provider are attached in this chapter as Annex 4 Sample TOR for Management and Monitoring Consultant and Annex-5 TOR for Service Provider.

In order to secure the all site staff and labor participate in the Program, each prime contractor imposes construction contractor the obligation through HIV sub-clause under “Health and Safety” clause of contract. Sample HIV clause for inclusion in construction contract is attached as Annex-6 in this chapter. However, this sample only cover general condition, and it requires negotiation on specific conditions before the commencement of the Program. For instance, it may be possible for Service Provider to cover “Health and Safety” by assigning additional qualified personals and by setting up required facility on site.

22.4.5 Site and the Immediate Community

The number and type of the site staff and labor will vary accordingly with the actual condition of construction work. Given information from similar construction work and construction plan of the Project, the best estimated number of workers for the Roads & Bridge construction will be 1,500 and the best estimated number of workers for the Port construction will be 600 at the peak construction period.

The Program encompasses managers of business community related to the construction works, entertainment establishment and local social groups in surrounding area. It is also expected to provide training to pharmacies, health staff of local health facilities, and health staff of site clinic in surrounding area.

The table below shows expected participants in the Program by output. It is difficult to get exact number of each group including business sector in immediate community but it is assumed that four times per a year workshop and capacity training cover all participants for Advocacy and Capacity Building; bi-monthly Peer Educator training cover all peer educators for IEC/BBC in both site and immediate community; twice a year technical training cover the technical need of health staff for Access to Health Service. However, this assumption also include that participants can have opportunity to utilize trainings planned by the both Road & Bridge program and Port program.

Table 22.4.2 Expected Participants in the Program

	Participants	
	site staff and labor	Immediate community
(1) Implementation Arrangement	MPMU II, PMU2, Management and monitoring consultants, Service Providers, Major sub-contractors	Hai Phong City Health Department, Hai Phong City HIV/AIDS prevention center, Hai An district health center, Cat Hai district health center
(2) Advocacy and Capacity Building	Responsible persons from Sub-contractors and business community directory associated with the construction works and workers' transfer (Truck Station Owners, Bus Station Owners, Dock Owners, Registration Authorities, General carriers' owner, motorcycle taxi owner etc.)	Through coordination with local partners, the following can be participants: Mangers of entertainment establishments (Fishermen, Seafarers, Youth union, Women's union) and representatives from local communities (bia hoi, karaoke clubs, and night clubs. Guest houses and small hotels)
(3) IEC /BBC	Sub-contractors and business community directory associated with the construction works and workers' transfer (Truck Station Owners, Bus Station Owners, Dock Owners, Registration Authorities, General carriers' owner, motorcycle taxi owner etc.)	Through coordination with local partners, the following can be participants: Fishermen, Seafarers, Youth union, Women's union, sex workers
(4) Access to Health Service	All the staff and labor who voluntary seek the STI/STD and HIV/AIDS related service including VCT, ART, and methadone treatment.	Training of local partners who provide health service(including pharmacies) and community mobilization, health personal in site clinic
(5) Monitoring Evaluation	Management and monitoring consultants, Service Providers, Major sub-contractors	Local authorities and local partners

22.5 Expected Activities

22.5.1 Implementation Arrangement

The expected output is to establish functioned management body and coordinating structure for the HIV/AIDS prevention program through proper implementation arrangement among major sub-contractors, Hai Phong City Health Department, Hai Phong City HIV/AIDS prevention center, Hai An district health center, Cat Hai district health center, Service Provider, and the Project management unit. Activities are as follows.

(1) To establish management body such task team in MPMU II and PMU2 in order to accommodate supervision mechanisms for the Program among key stakeholders

(2) To revise the draft Program frame work and plan of operation, and to prepare TORs of the Program implementation that Service Providers undertake and HIV clause in contracts with Contractors.

(3) To conduct a Management Coordinating Committee Meeting chaired by the member of Hai Phong City HIV and Social Crime Steering Committee every year on discussing annual plans and midterm and final evaluation. Representative from Service Provider attend quarterly Hai Phong City HIV and Social Crime Steering Committee and relevant regular meeting in other places.

22.5.2 Advocacy and Capacity Building

The expected output is to gain increased awareness about, and applied workplace policy to address HIV, drug, stigma, and HIV resilient communities to sub-contractors and key partners including entertainment establishments, transportation business and local communities. Activities are as follows.

(1) To plan and conduct regular workshops that advocate HIV/AIDS awareness, overcome of social stigma, confidentiality obligation, and privacy protection for each potential participating group of local communities, entertainment establishment, and business communities involved in the Project

(2) To plan and conduct "HIV and workplace" training program (workplace policy) for responsible person in contractors and business community that are interested in.

(3) To facilitate voluntary participants for introducing work place policy in their companies and local communities

(4) To monitor and support participants of the training and workshop program.

22.5.3 Information, Education, and Communication (IEC) and Behavior Change Communication (Peer Education)

The expected output is to achieve the status of increased awareness and positive behavior change among site staff and labor and local communities through IEC and BCC. Activities are as follows.

<IEC and condom distribution>

(1) To regularly collect information on composition of site staff and labor in designated construction area for ICE approaches and Peer Education program.

(2) To select effective, locally acceptable, and IEC approaches for each group of the participants in the program with relevant local materials.

(3) To disseminate HIV/AIDS and STI information among site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to site for construction activities.

(4) To ensure the availability of condoms with free of charge during first implementation year; afterwards condoms made available at affordable costs.

(5) To cover or complement the community mobilization activities together with local health staff based on the method applied to the Program.

<Peer Education Part>

(6) To prepare Peer Education Program including curriculum and materials linking to other services such as access to condoms, medical care and voluntary HIV counseling and testing.

(7) To select Peer Educators from site staff and labor including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to site for construction activities) and to the immediate local communities.

(8) To plan and conduct training program for Peer Educators so that the ratio of Peer Educator become one for every fifteen (15) or less of site staff and labor including identified groups in the local communities. The number of Peer Educator for trainings are assumed to be 150-200 (Roads & Bridge portion: 250-350) including turnover of participants and coverage of new recruits.

(9) To support and monitor Peer Educators.

22.5.4 Provision of Health Service and Counseling

The expected output is to secure the access to quality HIV, STI and other health services including Voluntary Counseling and Testing and antiretroviral therapy (ART) for all site staff and labor with trust and confidentiality, through linking to other components and existing local resources.

(1) To plan and prepare guidance and materials for Staff and labor who seek for STI/HIV prevention and treatment service on site or linking to local services. Although the use of local resources are free of charge in most cases, the plan should at least includes cost estimation of VCT use and Injection Drug User treatment center based on projected both prevalence and incidence of HIV/AIDS in the area.

(2) To support site staff and labor to secure the access to STI/HIV prevention and treatment services linking private and public health services or/and entities where he/she can protect privacy and human rights(i.e. establishment of a confidential referral system and/or voluntary self referral system is in place for the site staff and labor) .

(3) To plan and conduct training program for health workers in STI/STD management and VCT in order to ensure efficient, quality, confidential, and client-friendly services in site or /and surrounding communities.

(4) To monitor and evaluate the provision of access to HIV/AIDS related health service and counseling.

22.5.5 Monitoring and Evaluation

The expected output is to secure performance of the Program through institutionalized monitoring and evaluation mechanism. Activities are as follows.

(1) To review the draft Program frame work and set indicators of the objectives in the Program based on baseline survey and situation analysis at the time of the Project commencement.

(2) To outline coordination, monitoring and evaluation mechanism processes to ensure that the Program is relevant to the overall goal and the program goal of the Program, and sufficiently flexible to revise the Program when it is necessary and approved by PMCC. The mechanism should include the linkage with Vietnam’s National Monitoring and Evaluation framework for HIV prevention and control programs and local monitoring system.

(3) To prepare monitoring and evaluation plan together with monitoring tools including formats for Service Providers.

(4) To design baseline and exit survey for the Program evaluation including sentinel behavior surveillance, complying Ministry of Health’s questionnaire and analysis method.

(5) To conduct monitoring and evaluation by a planned schedule. The results of monitoring and evaluation are compiled as reports and to submit them to the executing agencies and associated entities.

22.6 Notes for Design Adjustment and Implementation

Notes for design adjustment and implementation of the draft Program are as follows.

(1) Management Coordinating Meeting revises the Draft Framework of Program before the commencement of the Program. Performance indicators for the objectives in the prevention program should be concretely developed, but those indicators should be always reviewed to match with the available human resources and the time of the Program implementation.

(2) Collaboration among implementation teams of the both Roads & Bridge program and the Port program, supporting agencies such local health providers, and local authorities are key to success to the program implementation. Especially, the Roads & Bridge program and the Port program should tightly coordinate to eliminate duplication and shortfall in the affected area. It may be useful to prepare HIV/AIDS terminology list including words and phrases used in the community or certain group.

(3) PLHIV should be involved as much as possible in providing communication to dispel fear, stigma, and discrimination. For instance, Service Provider is expected to ensure the involvement of PLHIV in the delivery of workshop/trainings.

(4) Service Provider applies Participatory Learning Action to workshop/trainings as much as possible, and provokes interaction among different sub-groups. However, some of the training session may require gender responsive, culturally and linguistically appropriate, work classification responsive, and work time adapted curriculum.

(5) Many similar materials and tools for IEC and BCC have been developed and used under HIV prevention program in Vietnam. In Hai Phong City, relevant and useful HIV prevention, care, and support program are carried out by different organizations. Development of IEC/BCC program is not issue since those programs in both local and national level produced a number of useful materials and tools. However, Service Provider may apply a few innovative approaches. For instance, use of mobile phone or hotline information on a small card can be tested. IEC materials for people in rural settings may need adequate pre-test to avoid wrong message and stigma.

(6) BCC through peer education program should be integrated into company structures and social systems. Peer educators should be selected among, and by, staff and labor with attention to potential for coverage. Training courses for new peer educators should be planned due to the high turnover rate to maintain regular operation. When peer education is applied in the community setting, use the name – peer communicator instead of peer educator.

(7) The Manager and Service Provider monitor the change of gender or culture related situation during every phase of the Program implementation so that gender-responsive and socially inclusive approach can be adapted to the situation.

22.7 Cost Estimates

The total cost of the additional scope of the Program is estimated at $866,900. The cost for the Roads & Bridge program is estimated $464,500, and the cost for the Port program is estimated $ 402,400 as shown in the table below. Some components of the Port program is estimated to require 60% of the Roads & Bridge Program since the estimated number of site staff and labor under the Port program would be less than 600 persons per a day in maximum. The detailed cost estimates are shown in this chapter as Annex- 7 Cost estimates.

Table 22.7.1 Summary Table for Cost Estimates

No	Item	Service Provider (USD)	Management Consultants (USD)	Cost (USD)	Cost ('000VND)
1	Road & Bridge potion	324,500	140,000	464,500	9,582,000
2	Port portion	446,400	140,000	586,400	12,097,000
	Total	770,900	280,000	1,050,900	21,679,000

22.8 Annexes

22.8.1 Annex-1: Draft Program Design and Monitoring Framework

Name of program: HIV/AIDS prevention program for Lach Huyen Infrastructure Construction Project
Period: 42 months
Construction Sites: Lach Huyen port construction site in the Cat Hai Island and access roads and a bridge from Tan vu to Lach Huyen port
Target groups and program area: Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to Site for construction activities) and to the immediate local communities in Cat Hai district and Hai An district of Hai Phong City

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions and Risks
Overall Goal : 1 Potential negative social impacts associated with the implementation and operation of the Lach Huyen Infrastructure Construction Project (Roads/Bridge and Port) in an HIV/AIDS prevalent area) are reduced	1 HIV and sexually transmitted infection (STI) prevalence rate among target groups not higher than 2011 rates 2 Environment and land acquisition etc.	1 Health Department of Hai Phong City's serological surveillance and health information data 2 Social indicators and other mitigation measures to be monitored under the Project	
Program Objective : 1 HIV risks and vulnerability to HIV/AIDS at the construction sites and surrounding communities are mitigated	1-1 30% increase in HIV and STI testing at Cat Hai and Hai An district 1-2 60% increase in positive behavior change among construction workforce and local communities affected by the Project	1-1 Hai Phong City HIV and STI sentinel surveillance 1-2 The Program final report including baseline and end line data	
Outputs : Implementation Arrangement 1. Functioned management body and coordinating structure for the HIV/AIDS prevention program through proper implementation arrangement among major sub-contractors, Hai Phong City Health Department, Hai Phong City HIV/AIDS prevention center, Hai An district health center, Cat Hai district health center, service provider, and the Project management unit.	1-1 Established the Program Management and Coordinating Committee(PMCC) and attendance rate 1-2 Hold meetings once every 6 months to secure the progress of the Program	1-1 Role and function of Program Management and Coordinating Committee are signed among stakeholders 1-2 Minutes of Meeting (M/M) of Program Management Coordinating Committee and availability of quarterly progress report.	· Timely implementation of the HIV/AIDS and STI prevention program · Commitment of the Hai Phong City, MUMP2/PMU2, and Contractors. · Social disturbance or natural disasters do not affect the project areas. · Social stigma and

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions and Risks
Advocacy and Capacity Building 2. Increased awareness about, and applied workplace policy to address HIV, drug, stigma, and HIV resilient communities to sub-contractors and key partners including entertainment establishments, transportation business and local communities through advocacy and capacity building	2-1 Development of HIV/AIDS workplace policy 2-2 Number of workshops and capacity building for workplace policy. 2-3 Four times per a year workshop for business /entertainment establishment community over the 3–year implementation period.	2-1 Participation level of target groups by Consultant Annual reports 2-2 Management Consultant Annual reports 2-3 Management Consultant Annual reports	discrimination do not prevail · Increased awareness translates into attitudinal changes. · Selected peer educators are welcomed by the target groups.
Information, Education, and Communication (IEC) and Behavior Change Communication(Peer Education) 3. Increased awareness and positive behavior change among site staff and labor and local communities through IEC and BCC	3-1 100% coverage of site staff and labor 3-2 60% increase in positive behavior change among site staff and labor and other groups in local communities 3-3 One peer educator for every fifteen site staff and labor 3-4 100% of the workers and CSWs know the benefit of use of condoms.	3-1 Quarterly Service Provider report 3-2 Quarterly Service Provider report 3-3 Quarterly Service Provider Report 3-4 100% of the workers and participants of the Program know the benefit of use of condoms.	· Construction companies facilitate information sessions at worksites and allow selected workers to attend training courses. · Trained health workers are engaged in STI treatment.
Provision of Health Service and Counseling 4. Secured access to quality HIV, Sexual Transmitted Infection (STI) and other health services including Voluntary Counseling and Testing (VCT) and antiretroviral therapy (ART) for all site staff and labor with trust and confidentiality, through linking to other components and existing local resources.	4-1 50 health workers receive continuous training in STI management and HIV voluntary testing and counseling including fear and stigma reduction and human rights. 4-2 50% increase in reported capacity among City and district health workers to diagnose and treat STI and VCT.	4-1 Quarterly Service Provider Report 4-2 Quarterly Service Provider Report	· Provided material is used properly. · Increased awareness translates into attitudinal changes.
Monitoring and Evaluation 5. Reliable performance of the Program through institutionalized monitoring and evaluation mechanism	5-1 80% of the Contractor meets the requirements in contracts.	5-1 Annual Service Provider Report	
Activities : Implementation Arrangement 1-1 To establish management body such task team in MPMU II and PMU2 in order to accommodate			

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions and Risks
supervision mechanisms for the Program among key stakeholders 1-2 To revise the draft Program frame work and plan of operation, and to prepare TORs of the Program implementation that Service Providers undertake and HIV clause in contracts with Contractors. 1-3 To conduct a Management Coordinating Committee Meeting chaired by the member of Hai Phong City HIV and Social Crime Steering Committee every year on discussing annual plans and midterm and final evaluation. Advocacy and Capacity Building 2-1 To plan and conduct regular workshops that advocate HIV/AIDS awareness, overcome of social stigma, confidentiality obligation, and privacy protection for each potential participating group of local communities, entertainment establishment, and business communities involved in the Project 2-2 To plan and conduct "HIV and workplace" training program (workplace policy) for responsible person in contractors and business community that are interested in. 2-3 To facilitate voluntary participants for introducing work place policy in their companies and local communities 2-4 To monitor and support participants of the workshop and training program. Information, Education, and Communication(IEC) and Behavior Change Communication(BCC) 3-1 To project composition of site staff and labor in designated construction area for ICE approaches and Peer Education program. 3-2 To select effective, locally acceptable, and IEC approaches for each group of the participants in			

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions and Risks
the program with relevant local materials. 3-3 To disseminate HIV/AIDS and STI information among site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to site for construction activities. 3-4 To ensure the availability of condoms with free of charge during first implementation year; afterwards condoms made available at affordable costs. 3-5 To cover or complement the community mobilization activities together with local health staff based on the method applied to the Program. <Peer Education Part> 3-6 To prepare Peer Education Program including curriculum and materials linking to other services such as access to condoms, medical care and voluntary HIV counseling and testing 3-7 To select Peer Educators from site staff and labor including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to site for construction activities and to business communities closely associated with construction works. 3-8 To plan and conduct training program for Peer Educators so that the ratio of Peer Educator become one for every fifteen (15) or less of site staff and labor including identified groups in the local communities 3-9 To support and monitor Peer Educators and beneficiaries of Peer Education program. Securing confidentiality and access to HIV/AIDS related Health Service and Counseling in collaboration with			

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions and Risks
local authority and front line communities. 4-1 To plan and prepare guidance and materials for Staff and labor who seek for STI/HIV prevention and treatment service on site or linking to local services. Although the use of local resources are free of charge in most cases, the plan should at least includes cost estimation of VCT center and Injection Drug User treatment center based on projected both prevalence and incidence of HIV/AIDS in the area. 4-2 To support site staff and labor to secure the access to STI/HIV prevention and treatment services linking private and public health services or/and entities where he/she can protect privacy and human rights. 4-3 To plan and conduct training program for health workers in STI/STD management and VTC in order to ensure efficient, quality, confidential, and client-friendly services in surrounding communities. 4-4 To monitor and evaluate the provision of access to HIV/AIDS related health service and counseling. Monitoring and Evaluation 5. Regular execution of monitoring and reporting, and evaluation 5-1 To review the draft Program frame work and set indicators of the objectives in the Program based on baseline survey and situation analysis at the time of the Project commencement. 5-2 To outline coordination, monitoring and evaluation mechanism processes to ensure that the Program is relevant to the overall goal and the program goal of the Program, and sufficiently flexible to revise the Program when it is necessary and approved by PMCC.			

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions and Risks
5-3 To prepare monitoring and evaluation plan together with monitoring tools including formats for Service Providers. 5-4 To design baseline and exit survey for the Program evaluation including sentinel behavior surveillance, complying Ministry of Health's questionnaire and analysis method. 5-5 To conduct monitoring and evaluation by a planned schedule.			

Note

The Project : Lach Huyen Infrastructure Construction Project
The Program : HIV/AIDS prevention program for Lach Huyen Infrastructure Construction Project
M/M : Minutes of Meeting
VCT : Voluntary Counseling and Testing
STI/ STD : Sexual Transmitted Infection / Sexual Transmitted Disease
PMCC : Program Management Coordinating Committee
ART : Antiretroviral therapy
Workplace policy: Referred to ILO Code of Practice on HIV/AIDS and the World of Work
Business community: Truck Station Owners, Bus Station Owners, Dock Owners, Registration Authorities, General carriers, motorcycle taxi drivers, tourist agent, etc.
Local community: Fishermen, Seafarers, Youth union, Women's union, self-help group such People Living with HIV (PLHIV), Injection Drug User etc.
Entertaining Establishments: These are often places where contacts for sex can be made, and in some instances, where sex can take place such as bia hoi, karaoke clubs, and night clubs. Guest houses and small hotels are generally included

22.8.2 Annex-2: Tentative Plan of Operation

	Port Portion Roads & Bridge Portion																																										
	Activities	year 1												year 2												year 3												year 4					
		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	32	33	34	35	36	37	38	39	40	41	42
1. Implementation Arrangement		1	0.5										0.5						1						0.5							0.5					1						
1-1	To establish management body such task team in MPMU2 and PMU2 in order to accommodate supervision mechanisms for the Program among key stakeholders	x																																									
1-2	To prepare TORs of the Program implementation that Service Providers undertake and HIV clause in contracts with Contractors	x																																									
1-3	To coordinate a Management Coordinating Committee Meeting chaired by the member of Hai Phong city HIV and Social Crime Steering Committee every year on discussing annual plans and midterm and final evaluation. Representative from Service Provider will att		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2. Advocacy and Capacity Building				1	1			3	1	3	1		3		1		3		1		3		1		3		1		3		1	2	1		1		1		1		1		1
2-1	To plan and conduct regular workshops that advocate HIV/AIDS awareness, overcome of social stigma, confidentiality obligation, and privacy protection for each potential participating group of local communities, entertainment establishment, and business co			x	x			w		w			w				w				w				w				w			w											
2-2	To plan and conduct "HIV and workplace" training program (workplace policy) for responsible person in contractors and business community that are interested in.			x	x			t		t			t				t				t				t				t			t											
2-3	To facilitate voluntary participants for introducing work place policy in their companies and local communities									x	x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x
2-4	To monitor and support participants of the workshop and training program.									x	x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x
3. Information, Education, and Communication (IEC) and Behavior Change			1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	1	2	1	2	1	1	1	2	1	1	1	1	1	1	1	1	0	0
3-1	To project composition of Site staff and labor in designated construction area for ICE approaches and Peer Education program			x	x																																						
3-2	To select effective, locally acceptable, and IEC approaches for each group of the participants in the program with relevant local materials			x	x																																						
3-3	To disseminate HIV/AIDS and STI information among Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to Site for construction activiti			x	x	x	x	x	x		x		x		x		x		x		x		x		x		x		x		x		x		x		x						
3-4	To ensure the availability of condoms with free of charge during first implementation year; afterwards condoms made available at affordable costs			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x		x		x		x		x		x										
3-5	To cover or complement the community mobilization activities together with local health staff based on the method applied to the Program		x	x	x			x						x					x						x						x												
3-6	3-6 To prepare Peer Education Program including curriculum and materials linking to other services such as access to condoms, medical care and voluntary HIV counseling and testing		x	x	x																																						
3-7	To select Peer Educators from Site staff and labor including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to Site for construction activities) and to the immedi		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x								
3-8	To plan and conduct training program for Peer Educators so that the ratio of Peer Educator become one for every fifteen (15) or less of Site staff and labor including identified groups in the local communities and to business communities closely associate			x	t	t	t	t	t	t	t	t	t	t	t	t	t	t	t		t		t		t		t		t				t					t					
3-9	To support and monitor Peer Educators and beneficiaries of Peer Education program			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		

	Port Portion Roads & Bridge Portion																																										
	Activities	year 1												year 2												year 3												year 4					
		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	32	33	34	35	36	37	38	39	40	41	42
4. Provision of Health Service and Counseling			1	1	1	2	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1
4-1	To plan and prepare a guidance and materials for Staff and labor who seek for STI/HIV prevention and treatment service on Site or linking to local services. Although the use of local resources are free of charge in most cases, the plan should at least inc		x	x																																							
4-2	To support Site staff and labor to secure the access to STI/HIV prevention and treatment services linking private and public health services or/and entities where he/she can protect privacy and human rights.			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4-4	To plan and conduct training program for health workers in STI/STD management and VTC in order to ensure efficient, quality, confidential, and client-friendly services in surrounding communities.			x		t			t								t				t																						
4-3	To monitor and evaluate the provision of access to HIV/AIDS related health service and counseling.						x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		x		
5. Monitoring and Evaluation		1	1	1			1						1						1	1					1						1						1				1	1	1
5-1	To review the Program frame work and set indicators of the objectives in the Program based on baseline survey and situation analysis at the time of the Project commencement.	x																																									
5-2	To outline coordination, monitoring and evaluation mechanism processes to ensure that the Program is relevant to the overall goal and the program goal of the Program, and sufficiently flexible to revise the Program when it is necessary and approved by PMC	x	x				x						x						x						x						x						x						x
5-3	To prepare monitoring and evaluation plan together with monitoring tools including formats for Service Providers.		x	x									x												x												x						
5-4	To organize baseline and exit survey for the Program evaluation including behavior sentinel survey, complying Ministry of Health's questionnaire and analysis method.		x	x															x	x																					x	x	
5-5	To conduct monitoring and evaluation by a planned schedule.						x						x							x					x						x						x						x

w: workshop t: training x: activities

22.8.3 Annex-3: Sample Implementation Guide

1) Objectives of the Meetings

<Program Management Coordination Committee Meetings>

1.2.1. The aim of the Program Management Coordination Committee is to consult with the Hai Phong City and designated district governments for coordinating HIV/AIDS initiatives and program within the entire infrastructure project.

1.2.2 The representatives from the Port and the Roads & Bridge Working Groups, the both program mangers, MPMU II and PMU2, together with representatives from the Hai Phong City HIV and Social Crime Committee and Cat Hai district and Hai An district will meet jointly on a half-year basis to review and monitor progress of activities and necessary coordination with city and local on-going HIV/AIDS program.

1.2.3. The PMCC meetings will result in the identification of any problems or issues concerning the Program implementation, revision of the Program including indicators and recommend necessary collective/advocacy action. The PMCCC meetings will also confirm the direction of the implementation of each activity for the next half year.

<Bi-Monthly Working Group Meetings>

1.2.4 The Port Program Working Group and the Roads & Bridge program Working Group as well as the construction Contractor will meet jointly on a bi-monthly basis to review and monitor progress of activities including:

- peer education activities including; peer education sessions, meeting of peer supporters and the number of site staff and other beneficiaries reached by the peer education program;
- social marketing/IEC activities including; condom distribution and educational events, IEC materials, and distribution of promotional materials;
- First aid/STI Clinic operation including clinical services and HIV/AIDS and STI prevention education activates if the Clinic is set up; adherence to obligations by the construction Contractor concerning housing and recreational facilities for site staff and labor

1.2.5 The Bi-Monthly Working Group meetings will result in the identification of any problems or issues concerning program implementation, and recommend necessary collective/advocacy action and those responsible for taking action.

2) Membership

<Bi-Monthly Working Group Meetings>

2.1.1. Membership in the Bi-Monthly Working Group meetings will include the following:

Port Program Working Group

- Port program manager
- Leader of port program

- Focal person in construction contractor
- Local authority or others

Roads & Bridge Program Working Group

- Leader and sub-leader of port program
- Focal person in construction contractor
- Local authority or others (to be listed)

2.2. Program Management Coordination Committee Meetings

2.2.1. Membership in the PMCC meetings will include the followings:

- Representative from Hai Phong City HIV and Social Crime Committee
- Representative from Cat Hai district(HIV and Social Crime Committee)
- Representative from Hai An district(HIV and Social Crime Committee)
- Focal person from MPMU II
- Focal person from PMU2
- Program manager for the Port program
- Program manager for the Roads and Bridge program
- Representative from Port Working Groups
- Representative from Roads & Bridge Working Groups

3) Schedule

3.1. Bi-Monthly Working Group Meetings

3.1.1. The following tentative schedule is recommended for holding Bi-Monthly Working Group Meetings. The Roads and Bridge Working Group will inform the stakeholders once meeting dates are confirmed.

3.2. PMCC Meetings

3.2.1. The following tentative schedule is recommended for holding PMCC Meetings. The Roads and Bridge Working Group will inform the stake-holders once meeting dates are confirmed.

The commencement of the Program, one year after, at the time of mid-term evaluation, 2 years after, and at the final evaluation

4) Venue

4.1. Bi-Monthly Working Group Meetings

4.1.1. Bi-Monthly Working Group meetings will be held at:

4.2. PMCC Meetings

4.2.1. PMCC t meetings will be held at:

5) Roles and Responsibilities

5.1.Manager and Service Provider for the Roads & Bridge program — The Roads & Bridge Program Working Group(RPWG), which consists of program manager and service provider team will be responsible to take the lead in overall management and monitoring of the Roads & Bridge program to be carried out on site and near the site communities. The RPWG will serve as the link between the construction Contractor and key stakeholders in the communities.

In addition, the RPWG will cooperate with the Port Program Working Group (PPWG) for monitoring the Program.

The RPWG will convene Bi-Monthly Working Group and PMCC meetings. The RPWG will serve as the Secretariat for these meetings in turn with PPWG. The RPWG will issue invitations to participants and set meeting agendas. In addition, the RPWG will be responsible for collecting and compiling monitoring data and information based on monitoring formats and preparing brief summary reports.

The RPWG may arrange additional meetings (other than the Bi-Monthly Working Group) with stakeholders to ensure the smooth implementation of activities when necessary.

5.2. Manager and Service Provider for the Port Portion of the Program — The Port Portion Program Working Group(PPWG), which consists of program manager and service provider team will be responsible to take the lead in overall management and monitoring of the port portion of the Program to be carried out on site and near the site communities. The PPWG will serve as the link between the construction Contractor and key stakeholders in the communities.

In addition, the PPWG will cooperate with the RPWG for monitoring the Program.

The PPWG will convene Bi-Monthly Working Group and PMCC meetings. The PPWG will serve as the Secretariat for these meetings in turn with RPWG. The PPWG will issue invitations to participants and set meeting agendas. In addition, the PPWG will be responsible for collecting and compiling monitoring data and information based on monitoring formats and preparing brief summary reports.

The PPWG may arrange additional meetings (other than the Bi-Monthly Working Group) with stakeholders to ensure the smooth implementation of activities when necessary.

5.3. Construction Contractor — The construction Contractor will be responsible for providing the Bi-Monthly Working Group with the progress of the activities on HIV/AIDS/STI and prevention under the HIV clause. In addition, the construction Contractor will provide statistical information on site staff and labor including the number of construction workers, truck drivers and staff by work type and nationality, etc. Further, the construction Contractor will provide statistical information on the First aid/STI clinic including the number of visitors for first aid services, the number of distributed condoms, the number of workers for counseling and STI/STD service.

5.4. Cat Hai district and Hai An district — At least one representative from each district will attend the PMCC. The representative from each district may provide guidance to coordinate activities of the Program and local activities carried out by each district.

5.5. Chairpersons

5.5.1. Representative form Hai Phong City HIV and Social Crime Committee will serve as a Chair-person for PMCC. When he is not available, either representative of the designated districts will be replaced.

5.6. Taking of Minutes

5.6.1. The RPWG and PPWG will assign two staff (one from the RPWG and one from the PPWG) to take minutes for the Bi-Monthly Working Group meetings and PMCC meetings. In order to ensure continuity in minute taking/recording, these two staff should remain the same throughout the life of the Program. These two staff will be responsible for working together to compile minutes for both the Bi-Monthly Working Group and PMCC meetings.

5.6.2. Outline/Format of Minutes — Minutes should provide adequate detail regarding the reports/presentations of meeting participants, issues and concerns discussed, and recommended further actions.

5.7. Distribution of Minutes

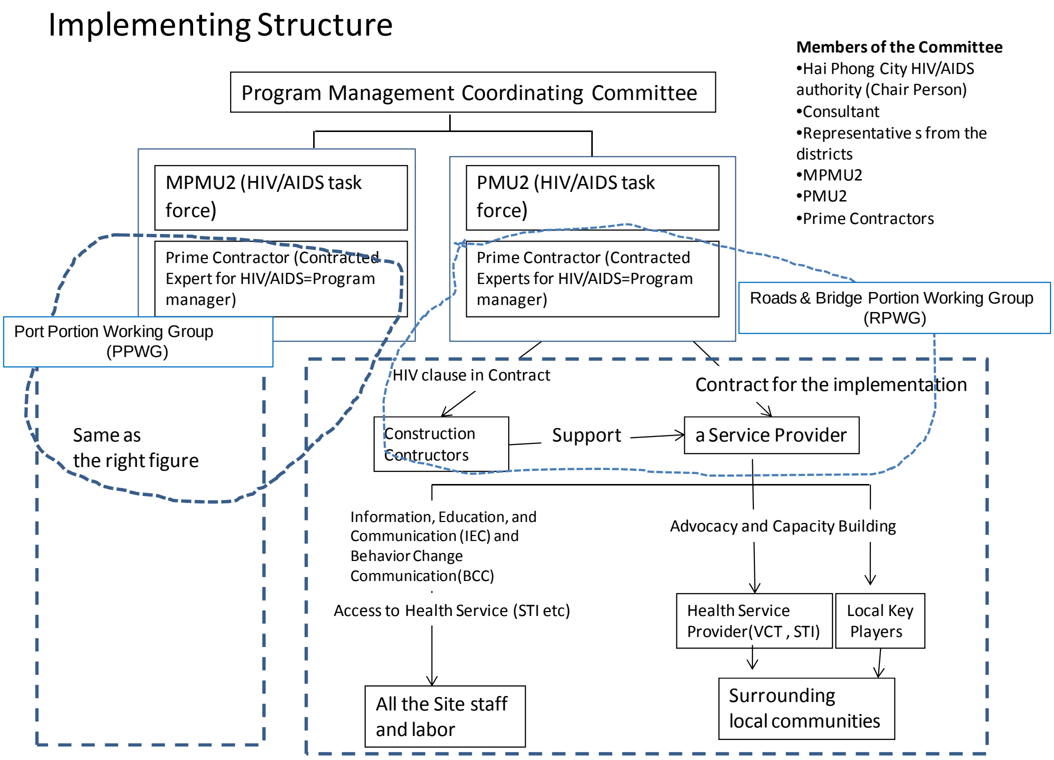
5.7.1. The two staff responsible for taking and compiling minutes for the Bi-Monthly Working Group and PMCCC meetings will be responsible for distributing minutes to all participants and the MPMU II and PMU2.

5.8. Record Keeping

5.8.1. The two staff responsible for taking, compiling and distributing minutes for the Bi-Monthly Working Group and PMCC meetings will be responsible for maintaining a file of all minutes, reports, correspondence and other documents relating to program activities.

6) Management Structure and Reporting

The following diagram outlines structure of the Program management and reporting requirements of Bi-Monthly Working Group and PMCC meetings.



22.8.4 Annex-4: TOR for Management and Monitoring Consultants (Port program)

1. The objectives of the Program Management Team (PMT) are to (1) develop a HIV/AIDS prevention program and a plan of operation associated with the port construction from the master Program (Annex 1 Draft Program Design and Monitoring Framework, i.e. the Program) and Tentative Plan of Operation(Annex 2 Plan of Operation), (2) organize and coordinate the management system of the Program from draft Implementation Guide(Annex 3 draft implementation guide) ,(2) assess the progress of the Program associated with the Port Project in a timely fashion, (3) enable appropriate adjustment of the Port program activities during the construction period through monitoring verifiable indicators, and (4) evaluate the impacts of the Program .

2. The Port program management unit will consist of one international and one national specialist. The international specialist will be required for a total input of 5 person-months, while the national specialist will be required for a total of 5 person-months. The consulting firm/organization will be highly qualified in program management, with recognized experience in monitoring and evaluating HIV prevention programs in Vietnam. The consulting services will be intermittently conducted over a period of 3 years and 6 months.

3. The Port program manager, i.e., an international specialist will have at least 13 years of public health experience in prevention programs of HIV. Some experience in Vietnam along with the prevention programs in non-health sectors would be beneficial. The program manager will be responsible for overall supervision, implementation, and report preparation for the Port program.

In coordination with focal person for the Port program, the program manager will undertake the following tasks but will not be limited to them:

(1) Report to the manger of the Project supervision consultant, focal person of MPUM2 for the Program, and Program Management Coordinating Committee.

(2) Manage the administration and implementation of the Program.

(3) Guide the team member of Service Provider and national specialist, and ensure that the Port program is implemented according to the terms of reference for the Service Provider.

(4) Take responsibility for preparing a Plan of Operation and budget for the Port program The plan must be submitted for approval at Program Management Coordination Committee.

(5) Develop and ensure the overall implementation of an effective system for internal monitoring of the Port program implementation and outcomes, in collaboration with the Road & Bridge Program,

(6) Take responsibility for facilitating the Program Management Coordinating Committee, and ensuring that regular monitoring meetings (Working Group Meeting) are conducted with the Service Provider.

(7) Prepare minutes of meetings and contracts required to implement the approved Program design, and financial and reporting requirements and to ensure formal and documented approval of the Port program

(8) Ensure complete and on-time submission of formal written reports, including the quarterly report, mid-term evaluation report, and completion report including an evaluation part. The evaluation part should include lessons for HIV/AIDS program for infrastructure projects and recommendations for future program in the affected area by the Project.

(9) Help fine-tune prevention programs associated with large infrastructure projects and post-HIV/AIDS programs in local communities.

4. The Port program coordinator, i.e., a national specialist, who is fluency in both English and Vietnamese, will have at least 5 years of public health experience in prevention programs of HIV.

Some experience in Vietnam along with the prevention programs in non-health sectors would be beneficial. The program coordinator will be responsible for support the work of the Port program manager, and coordinate relationship among key stakeholders of the Port program for smooth implementation.

5. The Port program management unit will undertake the following tasks together with a selected Service Provider but will not necessarily be limited to them:

Implementation Arrangement

(1) To support establishing management body or personal in MPMU II in order to accommodate supervision mechanisms for the Program among key stakeholders

(2) To revise the draft Program frame work and plan of operation, and to prepare TORs of the Program implementation that Service Providers undertake and HIV clause in contracts with Contractors.

(3) To support and participate a management coordinating committee meeting chaired by Hai Phong City HIV and Social Crime Committee every 6 months

(4) To create a working group among Service Provider and construction contractors for the Port program refer to Sample Operation Guide for Program (Annex 3)

Regular execution of monitoring and reporting, and evaluation

(1) To review the draft Program frame work and set indicators of the objectives in the Program based on baseline survey and situation analysis at the time of the Project commencement.

(2) To outline coordination, monitoring and evaluation mechanism processes to ensure that the Program is relevant to the overall goal and the program goal of the Program, and sufficiently flexible to revise the Program when it is necessary and approved by Program Management Coordinating Committee.

(3) To prepare monitoring and evaluation plan together with monitoring tools including formats for Service Providers.

(4) To design baseline and exit survey for the Program evaluation including behavior survey, complying Ministry of Health’s questionnaire and analysis method.

(5) To conduct monitoring and evaluation by a planned schedule. The results of monitoring and evaluation will be compiled as reports and to submit them to the executing agencies and associated entities including national supervising agency.

22.8.5 Annex-5: Sample TOR for Service Provider

1. The Service Provider will be responsible for the effective and efficient implementation of the following four components of the HIV/AIDS Prevention Program (the Program): (1) Increased awareness about, and capacity to address HIV, drug, stigma, and HIV resilient communities among key partners among entertainment establishment, transportation business and local communities through advocacy and capacity building, (2) Increased awareness and positive behavior change among site staff and labor and local communities through Information, Education, and Communication (IEC) and Peer Education, (3) Secured access to quality HIV/AIDS, STI/STD and other health service including VCT and ARV, through linking other the program components and existing local resources. (4)Monitoring and reporting.

The project supervision consultant, who will be selected by Maritime Project Management Unit 2 (MPMU II), Vietnam National Maritime Bureau (VINAMARINE) to supervise consulting service for Lach Huyen Port Infrastructure Construction Project – port portion (the Project), will make a subcontract with the selected organization / consulting firm for the port portion of the Program(the Port program).

2. The selected Service Provider shall have demonstrated competence and experience in implementing an HIV/AIDS prevention programs or similar programs, preferably in the infrastructure projects. The Service Provider team should consist of one team leader (17 person-months), and two national officers (a total of 72 person months).

3. Team Leader (17 person-months, national)

The team leader will have at least 13 years of public health experience, including at least 3 years in Asia, in prevention programs for HIV/AIDS including workshop/training design, and as team leader of projects. Some experience in Vietnam along with HIV-prevention programs in non-health sectors would be beneficial. The team leader will be responsible for overall coordination, implementation, and report preparation. Under the supervision of the management unit, the team leader will undertake the following tasks but will not be limited to them:

(1) Report to the Port program manager of the Project supervision consultant, member of focal person for the Program, and other agencies as requested by the Port program manager.

(2) Manage the administration and implementation of the Port program.

(3) Guide the working group members, ensure that the Port program is implemented according to the TOR for the supervisory consultant and any subsequent instructions or guidance from the Port program manager.

(4) Ensure regular liaison with Port program management team, Hai Phong authority for HIV/ AIDS in the Project area, other ministries, development partners, and civil society.

(5) Take responsibility for preparing a detailed implementation and budget for the above four (4) components of the program through a participatory planning process (including consultations, task forces, field visits, and workshops) with the member of working group and groups from local communities. The plan should comprise the port part of Plan of Operation, budget, and a performance monitoring system from each component. The plan must be approved by the Port program Management Team (PPMT) who assigned by the supervise consultant, not later than 1.5 months after civil works commence.

(6) Develop and ensure the overall implementation of an effective system for internal monitoring of the program implementation and outcomes, in collaboration with the PPMT. The scope of the internal monitoring system will include (a) maintaining baseline data for benefit evaluation purposes as developed by the port PMT team, and (b) tracking of resources, activities, and schedules related to the Port program.

(7) Support the PPMT in developing indicators and targets that are adequate for detailed planning, monitoring, and evaluation of the Port program using updated information on HIV/AIDS, sexually transmitted infections (STIs), transport settings, commercial and entertainment settings, mobility and migration patterns, ethnic minority settings, health systems, among others.

(8) Ensure that extensive consultation with the representatives of civil works contractors and subcontractors, transport companies, commercial and entertainment establishments, and local communities.

(9) Appoint a focal section/person from the above associated groups and initiate them as a port working group to active actors for the Port program.

(10) Take responsibility for facilitating the working group meetings, and ensuring that those meetings are conducted with representatives from construction and transport companies, and local community representatives.

(11) Prepare minutes of meetings /contracts required to implement the approved program design, and financial and reporting requirements and to ensure formal and documented approval of the program at provincial and district levels.

(12) Ensure complete and on-time submission of formal written reports, including the bi-monthly report, quarterly report, and completion report.

(13) Ensure the activities described under the implementation guide.

4. Program Officers (72 person-months, national)

The program officers will have a bachelor’s degree in public health, social service, psychology or related field and at least 5 years of work experience in project implementation and/or provision of technical services. The Program Officers will consist of following technical field:

- IEC and social marketing / Peer education program with quality assurance
- Occupational health, STI/STD and HIV/AIDS management

5. The Service Provider team will undertake the following tasks together with the port working group:

<Implementation Arrangement>

(1) To coordinate a Management Coordinating Committee Meeting chaired by the member of Hai Phong City HIV and Social Crime Steering Committee every year on discussing annual plans and midterm and final evaluation. Representative from Service Provider will attend quarterly Hai Phong City HIV and Social Crime Steering Committee and relevant regular meeting in other places.

<Advocacy and Capacity Building>

(1) To plan and conduct regular workshops that advocate HIV/AIDS awareness, overcome of social stigma, confidentiality obligation, and privacy protection for each potential participating group of local communities, entertainment establishment, and business communities involved in the Project. Participants of HIV prevention advocacy workshops can be manager and responsible person for “Health and Safety” of consultants, contractors, subcontractors; local government authorities (e.g., immigration, customs, and border police);local community leaders; director of local public and private health providers and pharmacies; commercial and entertainment establishment owners and controllers; hotel and tourist owners. The workshops will contain the issues indicated in ten key principles of the ILO Code of Practice on HIV/AIDS and the World of Work (incl. its education and training manual) in local context.

(2) To plan and conduct training program of HIV workplace policy for responsible person who

engaged in “Health and Safety” among consultants, contractors, sub-contractors, and local government. Trainings encompass steps to initiate a workplace policy and its management for HIV and STI prevention; advocacy; counseling; diagnosis and treatment; culture, power, and gender consideration among workers; HIV and STI confidential counseling and testing, treatment and care, available support and use of local resources; and the establishment of referral to the local resources etc.

(3) To facilitate voluntary participants for introducing work place policy in their companies and local communities.

(4) To monitor and support participants of the workshop and training program.

< IEC and condom distribution >

(1) To project composition of site staff and labor in designated construction area for ICE approaches and Peer Education program.

(2) To select effective, locally acceptable, and IEC approaches for each group of the participants in the program with relevant local materials.

(3) To disseminate HIV/AIDS and STI information among site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to site for construction activities.

(4) To ensure the availability of condoms with free of charge during first implementation year; afterwards condoms made available at affordable costs.

(5) To cover or complement the community mobilization activities together with local health staff based on the method applied to the Program.

<Peer Education>

(1) To prepare Peer Education Program including curriculum and materials linking to other services such as access to condoms, medical care and voluntary HIV counseling and testing.

(2) To select Peer Educators from site staff and labor including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers, mariners, and crew making deliveries to site for construction activities) and to the immediate local communities.

(3) To plan and conduct training program for Peer Educators so that the ratio of Peer Educator become one for every fifteen (15) or less of site staff and labor including identified groups in the local communities. The number of Peer Educator for trainings are assumed to be 150-200 (Roads & Bridge portion: 250-350) including turnover of participants and coverage of new recruits.

(4) To support and monitor Peer Educators.

Provision of Access to HIV/AIDS related Health Service and Counseling

(1) To plan and prepare guidance and materials for Staff and labor who seek for STI/HIV prevention and treatment service on site or linking to local services. Although the use of local resources are free of charge in most cases, the plan should at least includes cost estimation of VCT center and Injection Drug User treatment center based on projected both prevalence and incidence of HIV/AIDS in the area.

(2) To support site staff and labor to secure the access to STI/HIV prevention and treatment services linking private and public health services or/and entities where he/she can protect privacy and human rights(i.e. establishment of a confidential referral system and/or voluntary self referral system is in place for the site staff and labor).

(3) To plan and conduct training program for health workers in STI/STD management and VTC in

order to ensure efficient, quality, confidential, and client-friendly services in surrounding communities. Training program include reproductive health, preparation of STI diagnostic tools, and drug treatments in the project-affected districts, and it also include preventing HIV screening for employment, ensuring confidentiality of medical records and medical status, provision of a non discriminatory work environment, and promotion of workers' rights to continue employment if tested positive for HIV and other STIs.

(4) To plan and conduct training program for health workers in STI/STD management and VTC in order to ensure efficient, quality, confidential, and client-friendly services in surrounding communities.

<Program Monitoring>

(1) To prepare monitoring and evaluation plan together with monitoring tools including formats for Service Providers.

(2) To organize baseline and exit survey for the Program evaluation including sentinel behavior surveillance, complying Ministry of Health's questionnaire and analysis method.

(3) To conduct monitoring and evaluation by a planned schedule. The results of monitoring and evaluation will be compiled as reports and to submit them to the executing agencies and associated entities. To prepare monitoring plan together with monitoring tools the program manager team.

(4) To organize baseline and exit survey for the Program evaluation including sentinel behavior surveillance, complying Ministry of Health's questionnaire and analysis method.

(5) To conduct monitoring by a planned schedule. The results of monitoring will be compiled as reports and to submit them to the program manager, executing agencies and associated entities along with the implementation guide.

22.8.6 Annex-6: Sample HIV Clause for Inclusion in Construction Contracts

1. For the Purpose of this Clause:

“Service Provider” means a person or entity approved to provide the HIV-Awareness and Prevention Program; “the Contractor’s Employees” means, without prejudice to any other definition contained in the Contract, any workers who are under the Contractor’s control and on the Site in connection with the Contract, including any workers who are under the control of any person or entity to whom the Contractor has subcontracted any its obligations under the Contract other than those responsibilities set out in this Clause); “the HIV Prevention Program” means HIV/AIDS prevention Program for Lach Huyen Infrastructure Construction Project”;

1.2. It shall be a Condition of the Contract that the Contractor:

1.2.1 subcontracts with a Service Provider to implement an HIV-prevention program among the Contractor’s Employees for the duration of the Contractor’s contract and commencing as soon as practicable after the Contractor’s Employees arrive at the Site/s;

1.2.2 gives any representative of the Service Provider, and the Employer all reasonable access to the Site in connection with the HIV-prevention program;

1.2.3 instructs the Contractor’s Employees to participate in the HIV -Prevention Program in the course of their employment and during their normal working hours or any period of overtime provided for in the relevant employment contracts and uses all reasonable endeavors to ensure this instruction is followed;

1.2.4 does nothing to dissuade the Contractor’s Employees from participating in the HIV-Awareness and Prevention Program.

1.3 The Contractor shall be entitled to be reimbursed by the Employer for any payments made under a subcontract made for the purpose of Clause 1.2.1 in accordance with the relevant provisions in the Contract.

1.4 Where the Contract does not provide for reimbursement of named costs, the amount paid by the Contractor to the Service Provider shall be added to any lump sum to be paid by the Employer to the Contractor under the Contract and, before such lump sum is paid, the Contractor shall provide to the Employer evidence of:

1.4.1 payment of the amount claimed to the Service Provider; and

1.4.2 provision of the HIV-Prevention Program (e.g., a certificate issued by the Service Provider).

1.5 Where a clinic is provided on behalf of the Contractor on Site, the Contractor shall ensure that such clinic provides to the Contractor’s Employees, on request and without charge:

1.5.1 confidential counseling and advice on HIV/AIDS and

1.5.2 Condoms that comply with the WHO/UNAIDS Specification and for Condoms 1998 or any more recent equivalent publication to a maximum of [number] per member of the Contractor’s Employees per year.

1.6 Where the Contractor subcontracts any of its obligations under the Contract, it shall require any subcontractor to comply with sub clauses [1.2.2–1.2.6] of the Contract as if it were the Contractor.

22.8.7 Annex-7: Cost estimates

1) Cost estimates for the Roads and Bridge portion

No	Item	Unit	A. Unit Cost(USD)	B. Road & Bridge Potion (Quantity)	Cost(USD)
Cost for Service Provider					
1	Team Leader	MM	3,200	17	54,400
2	Officers	MM	600	72	43,200
3	Travel Cost	lump	20,000	1	20,000
4	Office and equipment	lump	25,000	1	25,000
5	Advocacy and cpacity building	lump	30,000	1	30,000
6	Information Education, and Communication and Peer Education including condom distribution	lump	70,000	1	70,000
7	Secure access to STI/STD,HIV/AIDS and counseling including local health staff trainings	3) Cost estimates for Healtrh Service			49,923
8	Baseline survey and mid-term situation analysis	lump	20,000	1	20,000
9	Endline survey, and situation analysis at the end of the Porgram	lump	20,000	0	0
10	Monitoring and reporting including coordination of working group meetings and Program Management Coordinating Committee	month	12,000	1	12,000
					324,523

Cost for Management Consultant				0	
11	International Consultant (Manager)	MM	20,000	5	100,000
12	National Coordinator	MM	3,000	6	18,000
13	International and Local Travel	lump	15,000	1	15,000
14	Review of the Program design,and supervise Service Provider and consturction contractor	lump	2,000	1	2,000
15	Monitoring and evaluation(Reporting)	lump	5,000	1	5,000
	Subtotal (2)				140,000
	Grand total (sub 1 + sub 2)				464,523

2) Cost estimates for the Port portion

No	Item	Unit	Unit Cost(USD)	Quantity	Cost(USD)
Cost for Service Provider					
1	Team Leader	MM	3,200	17	54,400
2	Officers	MM	600	72	43,200
3	Travel Cost	lump	30,000	1	30,000
4	Office and equipment	lump	25,000	1	25,000
5	Advocacy and cpacity building	lump	15,000	1	15,000
6	Information Education, and Communication and Peer Education including condom distribution	lump	35,000	1	35,000
7	Secure access to STI/STD,HIV/AIDS and counseling including local health staff trainings	3) Cost estimates for Healtrh Service			27,849
8	Baseline survey and mid-term situation analysis	lump	20,000	0	0
9	Endline survey, and situation analysis at the end of the Porgram	lump	20,000	1	20,000
10	Monitoring and reporting including coordination of working group meetings and Program Management Coordinating Committee	month	12,000	1	12,000
11	Program Management				
a	Program Manager (International expert)	MM	20,000	8	160,000
b	International and Local Travel	lump	18,000	1	18,000
c	Monitoring and evaluation(Reporting)	lump	6,000	1	6,000
	Subtotal (1)				446,449

Cost for Management Consultant of MPMU2					
1	International Consultant (Manager)	MM	20,000	5	100,000
2	National Coordinator	MM	3,000	6	18,000
3	International and Local Travel	lump	15,000	1	15,000
4	Review of the Program design,and supervise Service Provider and consturction contractor	lump	2,000	1	2,000
5	Monitoring and evaluation(Reporting)	lump	5,000	1	5,000
	Subtotal (2)				140,000
	Grand total (sub 1 + sub 2)				586,449

3) Cost estimates for Health Service - "8 Secure access to STI/STD/HIV/AIDS and counseling including local heath staff training".

		A	**B**	**C**	**D**	**E**	
No	**Interventions**	**Median unit cost($US)**	**Road & Bridge**	**Port**	**Years**	**Cost for Approach**	**Caliculation**
8-1	Outreach and needle/syringe exchange for IDU (Per IDU Reached)	24.49	750	300	3	3,857	A x (B+C) x 0.02(%) x D
8-2	Methadone treatment (Per IDU Reached)	1008	750	300	3	15,876	A x (B+C) x 0.005(P) x D
8-3	Couseling and Testing	14.66	400	200	3	26,388	A x (B+C) x D
8-4	ART	181	750	300	3	2,851	A x (B+C) x 0.005(P) x D
8-5	Reflesh training for Health staff	200	27	21	3	28,800	A x (B+C) x D
total						77,772	
Road & Bridge						49,923	
Port						27,849	

8-1 Assumption: (%) Percentage of IDU among the median number of site staff and labor is 5 % (2)

8-2 Assumption: (%) Percentage of IDU among the medican number of site staff and labor is 5 %(2), among them, one tenth receive the tretment

8-3 Asumption: During the Program period, 1800 person utlize VCT in total

8-4 Assumption: (%) Percentage of PLHIV among the median number of site staff and labor is 0.5 % (2)

8-5 Assumption: During the Program period, 48 health professional have reflesh trainings

The unit cost for the table above is based on the following documents .

(1) Supplementary webappendix to: Schwartländer B, Stover J, Hallett T, et al, on behalf of the Investment Framework Study Group. Towards an improved investment approach for an effective response to HIV/AIDS. Lancet 2011; published online June 3. DOI:10.1016/S0140-6736(11)60702-2.

The variables such as HIV incident rate and prevalence used for the cost estimates are drawn from the following documents.

(2) Vietnam HIV/AIDS estimates and projections 2007 – 2012

22.8.8 Annex-8: Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
BBC	Behavior Change Communication
CDC	Centers for Disease Control and Prevention
FSW	Female Sex Worker
HIV	Human Immunodeficiency Virus
IDU	Injecting Drug User
IEC	Information, Education, and Communication
ILO	International Labor Organization
JICA	Japan International Cooperation Agency
MOH	Ministry of Health
MOT	Ministry of Transport
MPMU2	Maritime Project Management Unit 2
MSM	Men who have Sex with Men
NGO	Nongovernmental Organization
PLHIA	People living with HIV
PMCC	Program Management Coordinating Committee
PMTCT	Prevention of Mother to Child Transmission
PMU2	Project Management Unit 2
STD	Sexually-Transmitted Diseases
STI	Sexually Transmitted Infection
TOR	Terms of Reference
VAAC	Vietnam Administration for AIDS Control
VCT	Voluntary Counseling and Testing
VINAMARINE	Vietnam National Maritime Bureau
WB	World Bank

23. DETAILED COST ESTIMATION

23.1 Premises of Cost Estimates

In this project cost estimates, basically Vietnamese method is adopted. Only for Japanese procurement portion, Japanese method is applied.

23.1.1 Cost Estimations Standards in Vietnam

1) Decrees/ Circulars related to Cost Estimates in Vietnam

There are various Decrees/ Circulars related to cost estimation for construction works issued by the government of Socialist Republic of Vietnam and Ministry of Construction in Vietnam. Adopted standards, Lows, Decrees and Circulars for the detailed cost estimates as of September 2011 are listed in the following table. Based on these, necessary on-time updates are done based on the instruction by Vietnamese counterparts.

Table 23.1.1 Decrees/ Circular relayed to Cost Estimates in Vietnam (as of September 2011)

No	Name of document
1	Construction Law No. 16/2003/QH11 dated 26 December 2003.
2	Law No. 38/2009/QH12 dated 19 June 2009 amending and supplementing a number of articles of the Laws concerning capital construction investment.
3	Decree No. 131/2006/ND-CP dated 09 November 2006 of the Government on Issuance of Regulation on Management and Utilization of Official Development Assistance.
4	Decree No. 12/2009/ND-CP dated 10 February 2009 of the Government on Management of Construction Investment Projects (CIPs)
5	Decree No. 83/2009/ND-CP dated 15 October 2009 of the Government on Amending and supplementing a number of Articles of Decree No. 12/2009/ND-CP dated 10 February 2009 of Government on Management of Construction Investment Projects.
6	Decree No. 112/2009/ND-CP dated 19 December 2009 of the Government on Management of work Construction Investment expenses.
7	Decree No. 209/2004/ND-CP dated 16 December 2004 of Government on quality management of construction works.
8	Decree No. 49/2008/ND-CP dated 18 April 2008 of the Government on Amending and supplementing a number of Articles of Decree No. 209/2004/ND-CP dated 16 December 2004 of the Government on quality management of construction works.
9	Decree No. 123/2008/ND-CP dated 08 December 2008 of the Government detailing and guiding the implementation of a number of articles of the Low on Value-Added Tax.
10	Circular No. 04/2010/TT-BXD dated 26 May 2010 of the Ministry of Construction on guiding the marking and Management of work Construction Investment expenses.
11	Circular No. 129/2008/TT-BTC of December 26, 2008, guiding the implementation of a number of articles of the Value-Added Tax Law and guiding the implementation of the Government's Decree No. 123/2008/ND-CP of December 8, 2008, detailing and guiding the implementation of a number of articles of the Value-Added Tax Law.
12	Decree No. 87/2010/ND-CP of August 13, 2010, detailing a number of articles of the Law on Import Duty and Export Duty.
13	Construction Quantum - Construction Part in the announcement of the document No. 1776/BXD-VP dated 16 August 2007 of the Ministry of Construction.
14	Construction Quantum - Installation Part in the announcement of the document No. 1777/BXD-VP dated 16 August 2007 of the Ministry of Construction.
15	Construction Quantum - The waste material in the publication of the document No. 1784/BXD-VP dated 16 August 2007 of the Ministry of Construction.
16	Construction Quantum on Sea and Inland following Decision No. 19/2000/QD-BXD dated 19 October 2000 of the Ministry of Construction.

Source: JICA D/D Study Team Note: Some items are revised and compared to basic design stage.

2) Unit Price

The following table shows references of unit prices calculation for Lach Huyen Port Infrastructure Project issued by the government of the Socialist Republic of Vietnam, Ministry of Construction in Vietnam and Hai Phong city.

Table 23.1.2 Unit Price Documents

No	Name of document
17	Decree No. 205/2004/ND-CP dated 14 December 2004 of the Government on decision salary grade systems in Vietnamese.
18	Decree No. 70/2011/ND-CP dated 22 August 2011 of the Government on decision minimum wage with the Vietnamese labor working in the foreign-Invested enterprise.
19	Decision No. 131/QD-UBND dated 26 January 2011 of Hai Phong Committee on contraction equipment unit price (working shift) in Hai Phong province.
20	Material unit price Quotation of Hai Phong City Constructional - Financial Service at the present;

Source: JICA D/D Study Team Note: Some items are revised and compared to basic design stage.

a) Unit Price of Construction Material

For the purpose of detailed cost estimates, unit prices of construction materials were revised based on the price indexes in Vietnam and as requested by the Project Owner. Almost all prices are increased compared to Basic Design stage. As for important materials, the prices were fixed by price quotations.

Table 23.1.3 Unit Price of Construction Material (Price in VND)

Unit: VND

No.	Material Items	The Study of PROJECT Team (Review)										
		Source location	Unit	Productivity	Distance from Hai Phong center	Material Unit Price at Mar.2010 (No. 41/2010/ CBG-SXD dated 26 May 2010	Material Unit Price at Mar.2011 (No. 44/2011/ CBG-SXD dated 13 Apr. 2011	Material Unit Price at April.2012 (No. 31/2012/ CBG-SXD dated 10 May 2012	Balance (Comp. of quoitation of Mar.2010 with Mar.2011)	Balance (Comp. of quotation of Mar.2011 with April.2012)	Escalation Factor (Comp. of quoitation of Mar.2010 with Mar.2011)	Escalation Factor (Comp. of quotation of Mar.2011 with April.2012)
1	2	3	4	5	6	7	8	9	10=8-7	11=9-8	12=8/7	13=9/8
1	Filling sand	Cong Hoa mine, Dai Dong mine - Hai Duong Province (Material Unit Price at the Site_Included supply and transportation)	m3	1000m3/day	70 km	125,000	125,000	159,500	0	34,500	1.00	1.28
2	Coarse sand	- Viet Tri city - Vinh Phu Province (Supply Material at the site)	m3	many	200 km	330,000	275,000	352,000	-55,000	77,000	0.83	1.28
		- Yen Lap - Quang Ninh Province (Supply Material at the site)	m3	many	60 km	154,000	198,000	209,000	44,000	11,000	1.29	1.06
3	Rubble stone, Armour Stone	Thong Nhat mine, Kinh Mon mine - Hai Duong province, Phi Liet, Minh Duc mine - Hai Phong city (At the site)	m3	500m3/day	40 km	165,000	187,000	187,000	22,000	0	1.13	1.00
4	Crushed stone	Thong Nhat mine, Kinh Mon mine - Hai Duong province, Phi Liet, Minh Duc mine - Hai Phong city (Supply material at the site)	m3	500m3/day	40 km							
	0.5 x 1		m3			242,000	253,000	253,000	11,000	0	1.05	1.00
	1 x 2		m3			242,000	253,000	253,000	11,000	0	1.05	1.00
	2 x 4		m3			220,000	253,000	253,000	33,000	0	1.15	1.00
	4 x 6		m3			198,000	209,000	209,000	11,000	0	1.06	1.00
5	Cement	Chin-Fong factory - Hai Phong city; Hai Phong factory - Hai Phong city (at the Hai Phong center)	ton	PCB40_many	25 km - 30 km	950,000	1,040,000	1,280,000	90,000	240,000	1.09	1.23
			ton	PCB30_many		920,000	1,010,000	1,250,000	90,000	240,000	1.10	1.24
6	Re-bar, steel prod.		ton									
	D 10	Viet - Uc, See - Steel factory - Hai Phong city (at the factory)	ton	many	30 km	14,575,000	18,315,000	18,260,000	3,740,000	-55,000	1.26	1.00
	D12		ton			14,520,000	18,150,000	18,260,000	3,630,000	110,000	1.25	1.01
	D14-32		ton			14,410,000	18,040,000	18,260,000	3,630,000	220,000	1.25	1.01
	Plate steel	Hai Phong city	ton	many	30 km	13,772,000	18,150,000	19,030,000	4,378,000	880,000	1.32	1.05
	Shaped steel		ton			13,772,000	18,150,000	19,030,000	4,378,000	880,000	1.32	1.05
7	Structural Steel	Japan		many	not yet		not yet	not yet				
8	Concrete Pile	Dinh Vu Industrial Park	m	many	20 km							
	Pile 400x400		m			510,000	600,000	667,700	90,000	67,700	1.18	1.11
	Pile 500x500		m			740,000	850,000	946,000	110,000	96,000	1.15	1.11
9	Concrete Batching Plant	Thanh Hung concrete station - Hai Phong city; Dinh Vu Industrial Park	m3	50m3/h	30 km							
	M200					800,800	986,150	870,100	185,350	-116,050	1.23	0.88
	M250					840,400	1,029,710	928,400	189,310	-101,310	1.23	0.90
	M300					882,200	1,074,480	997,700	192,280	-76,780	1.22	0.93
	M350					931,700	1,145,870	1,067,000	214,170	-78,870	1.23	0.93
	M400					992,200	1,245,200	1,112,100	253,000	-133,100	1.25	0.89
10	Asphalt	Hoang Truong concrete station - Hai Phong city	ton	25m3/h	30 km							
	Cooarse Asphalt		ton			1,120,000	1,240,000	1,450,000	120,000	210,000	1.11	1.17
	Semi-Coarse Asphalt		ton			1,180,000	1,295,000	1,510,000	115,000	215,000	1.10	1.17
	Fine Asphalt		ton			1,260,000	1,390,000	1,630,000	130,000	240,000	1.10	1.17

11	Form wood	Hai Phong city	m3	many	30 km	2,970,000	2,970,000	3,080,000	0	110,000	1.00	1.04
12	Fuel	Hai Phong city	liter	many								
	Mogas 92		liter	many	30 km	16,990	21,300	23,300	4,310	2,000	1.25	1.09
	Gasoil 0.05S		liter	many	30 km	14,600	21,100	21,600	6,500	500	1.45	1.02
	Kero		liter	many	30 km	15,000	20,800	21,400	5,800	600	1.39	1.03
									Average Escalation Factor		**1.17**	**1.06**

Source: JICA D/D Study Team

Note: For packages 8, 9 & 10, Prices of same materials are updated from above table.

b) Unit Price of Construction Labor

Normally, unit price indexes of construction labors in Vietnam are updated in every October. In this year, it was updated as of October 5, 2011 based on Decree No. 205/2004/ND-CP dated 14 December 2004 of the Government on decision salary grade systems in Vietnamese and Decree No. 70/2011/ND-CP dated 22 August 2011 of the Government on decision minimum wage with the Vietnamese labor working in the foreign-Invested enterprise. Therefore, the unit prices of labors in Basic Design stage were revised and updated prices were incorporated into detailed cost estimates. Unit prices of construction labors in Vietnam are categorized into three (3) Groups. Basically, Group I means for building construction, Group II means for road construction, and Group III means for port and bridge construction. Each group is divided into seven (7) grades, and furthermore, each grade is divided into nine (9) smaller levels. In this report, only major labor wages in each group are shown in the following tables respectively.

Table 23.1.4 Unit Price of Construction Labor (Group I: Building Construction)

No.	Labor Items	Decree 107/2010/ND-CP dated 29 Oct.2010 of Government	Decree 70/2011/ND-CP dated 22 Aug.2011 of Government	Balance	Escalation Factor
1	2	3	4	5=4-3	6=4/3
I	Minimum Wage (per month)	1,170,000	1,780,000	610,000	1.521
II	Sumary of Main Grade Wages (Group I_per month)				
1	Grade 1	2,519,010	3,832,340	1,313,330	1.521
2	Grade 2	2,931,786	4,460,324	1,528,538	1.521
3	Grade 3	3,418,272	5,200,448	1,782,176	1.521
4	Grade 4	3,993,210	6,075,140	2,081,930	1.521
5	Grade 5	4,671,342	7,106,828	2,435,486	1.521
6	Grade 6	5,482,152	8,340,368	2,858,216	1.521
7	Grade 7	6,425,640	9,775,760	3,350,120	1.521

Source: JICA D/D Study Team

Table 23.1.5 Unit Price of Construction Labor (Group II: Road Construction)

No.	Labor Items	Decree 107/2010/ND-CP dated 29 Oct.2010 of Government	Decree 70/2011/ND-CP dated 22 Aug.2011 of Government	Balance	Escalation Factor
1	2	3	4	5=4-3	6=4/3
I	Minimum Wage (per month)	1,170,000	1,780,000	610,000	1.521
II	Sumary of Main Grade Wages (Group II_per month)				
1	Grade 1	2,695,914	4,101,476	1,405,562	1.521
2	Grade 2	3,123,432	4,751,888	1,628,456	1.521
3	Grade 3	3,639,402	5,536,868	1,897,466	1.521
4	Grade 4	4,229,082	6,433,988	2,204,906	1.521
5	Grade 5	4,936,698	7,510,532	2,573,834	1.521
6	Grade 6	5,747,508	8,744,072	2,996,564	1.521
7	Grade 7	6,720,480	10,224,320	3,503,840	1.521

Source: JICA D/D Study Team

Table 23.1.6 Unit Price of Construction Labor (Group III: Port and Bridge Works)

No.	Labor Items	Decree 107/2010/ND-CP dated 29 Oct.2010 of Government	Decree 70/2011/ND-CP dated 22 Aug.2011 of Government	Balance	Escalation Factor
1	2	3	4	5=4-3	6=4/3
I	Minimum Wage (per month)	1,170,000	1,780,000	610,000	1.521
II	Sumary of Main Grade Wages (Group III_per month)				
1	Grade 1	2,961,270	4,505,180	1,543,910	1.521
2	Grade 2	3,447,756	5,245,304	1,797,548	1.521
3	Grade 3	4,007,952	6,097,568	2,089,616	1.521
4	Grade 4	4,671,342	7,106,828	2,435,486	1.521
5	Grade 5	5,452,668	8,295,512	2,842,844	1.521
6	Grade 6	6,381,414	9,708,476	3,327,062	1.521
7	Grade 7	7,457,580	11,345,720	3,888,140	1.521

Source: JICA D/D Study Team

As a result of price comparison between last year and this latest version, all of the construction labor wages rose by 52%. Compared with the ratio in last year as 15%, it is considerably higher and the result influences to increasing of total project cost.

c) Unit Price of Construction Equipment

Above-mentioned labor price surging influences equipment prices as well because those prices are combined prices with labor costs according to the calculation method of Vietnamese norm. In this Detail Design stage, many kinds of equipment unit prices were computed not only for detailed cost estimates but also comparative studies and decision of construction method. In this chapter, main items are listed to recognize price growth within a study period.

Table 23.1.7 Unit Price of Construction Equipment

No.	Name of equipment	Unit Price of Construction Equipment_ Working shift (May 2010)	Unit Price of Construction Equipment_ Working shift (May 2011)	Unit Price of Construction Equipment_ Working shift (April 2012)	Balance (May 2011 with May 2010)	Balance (April 2012 with May 2011)	Escalation Factor (May 2011 with May 2010)	Escalation Factor (April 2012 with May 2011)
1	2	3	4	5	6=4-3	7=5-4	8=4/3	9=5/4
1	Excavator 1.0 m3	2,623,895	3,273,973	3,509,596	650,079	235,623	1.248	1.072
2	Excavator 1.25 m3	3,235,028	3,969,041	4,208,529	734,012	239,488	1.227	1.060
3	Excavator 1.6 m3	3,921,402	4,883,264	5,137,357	961,862	254,093	1.245	1.052
4	Excavator 2.0 m3	4,723,576	5,822,446	6,102,865	1,098,869	280,419	1.233	1.048
5	Excavator 3.5 m3	7,680,745	9,369,984	9,683,264	1,689,239	313,279	1.220	1.033
6	Grab crane 0.65 m3	2,269,364	2,833,548	3,036,448	564,184	202,900	1.249	1.072
7	Grab crane 1.00 m3	3,147,706	3,876,790	4,116,269	729,084	239,479	1.232	1.062
8	Grab crane 1.60 m3	4,569,200	5,659,579	5,939,998	1,090,379	280,419	1.239	1.050
9	Grab crane 2.30 m3	5,871,357	7,258,243	7,555,940	1,386,887	297,696	1.236	1.041
10	Back hoe 1.0 m3	1,450,404	1,789,119	1,892,422	338,715	103,303	1.234	1.058
11	Back hoe 1.65 m3	2,486,293	3,127,265	3,335,148	640,973	207,883	1.258	1.066
12	Back hoe 2.3 m3	3,005,028	3,801,124	4,046,354	796,096	245,230	1.265	1.065
13	Bulldozer 110 cv	1,736,825	2,156,169	2,350,192	419,344	194,023	1.241	1.090
14	Bulldozer 180 cv	2,918,097	3,585,055	3,793,110	666,958	208,055	1.229	1.058
15	Bulldozer 320 cv	4,990,847	6,085,111	6,352,417	1,094,265	267,306	1.219	1.044
16	Tamping roller 8.5 ton (steel whell)	805,467	1,014,485	1,098,919	209,018	84,434	1.259	1.083
17	Tamping roller 9.0 ton	1,255,441	1,328,264	1,672,120	72,823	343,855	1.058	1.259
18	Tamping roller 10.0 ton (steel whell)	963,556	1,198,710	1,296,114	235,154	97,404	1.244	1.081
19	Tamping roller 15.5 ton steel whell)	1,438,619	1,795,324	1,900,987	356,704	105,664	1.248	1.059
20	Truck 5.0 ton	852,788	1,073,467	1,171,680	220,679	98,214	1.259	1.091
21	Truck 7.0 ton	1,083,909	1,355,872	1,462,271	271,964	106,399	1.251	1.078
22	Truck 10.0 ton	1,294,349	1,623,017	1,741,921	328,668	118,904	1.254	1.073

23	Dump truck 5.0 ton	1,107,183	1,438,146	1,543,758	330,963	105,611	1.299	1.073
24	Dump truck 7.0 ton	1,365,309	1,666,960	1,774,301	301,651	107,341	1.221	1.064
25	Dump truck 10.0 ton	1,641,954	2,105,913	2,233,742	463,959	127,829	1.283	1.061
26	Agitator truck 5.0 m3	1,666,824	2,021,798	2,224,255	354,974	202,457	1.213	1.100
27	Agitator truck 6.0 m3	1,891,919	2,302,760	2,508,559	410,841	205,798	1.217	1.089
28	Water tank truck 5.0 m3	951,811	1,165,506	1,277,012	213,695	111,506	1.225	1.096
29	Water tank truck 6.0 m3	1,041,945	1,269,917	1,382,139	227,972	112,222	1.219	1.088
30	Truck crane 5.0 ton	1,472,416	1,779,539	1,968,965	307,123	189,427	1.209	1.106
31	Truck crane 10.0 ton	2,020,876	2,401,535	2,604,470	380,660	202,935	1.188	1.085
32	Truck crane 16.0 ton	2,308,740	2,753,438	2,946,888	444,698	193,450	1.193	1.070
33	Crawler crane 5.0 ton	1,622,158	1,943,872	2,130,880	321,715	187,007	1.198	1.096
34	Crawler crane 10.0 ton	1,863,733	2,226,691	2,415,846	362,958	189,155	1.195	1.085
35	Crawler crane 25.0 ton	2,863,568	3,355,862	3,578,350	492,294	222,488	1.172	1.066
36	Crawler crane 40.0 ton	4,249,392	4,844,309	5,068,826	594,918	224,516	1.140	1.046
37	Winch 3.0 ton	177,766	204,501	278,370	26,735	73,869	1.150	1.361
38	Winch 5.0 ton	135,223	222,822	296,913	87,599	74,092	1.648	1.333
39	Concrete mixer 250L	209,307	237,777	311,646	28,469	73,869	1.136	1.311
40	Concrete mixer 500L	308,809	348,114	435,686	39,305	87,572	1.127	1.252
41	Mortar mixer 80L	158,950	183,966	257,380	25,016	73,414	1.157	1.399
42	Mortar mixer 110L	165,812	191,504	265,116	25,692	73,612	1.155	1.384
43	Con. mixer station 30m3/h	1,941,623	2,562,727	2,821,817	621,104	259,090	1.320	1.101
44	Con. mixer station 50m3/h	3,332,327	3,699,945	3,961,210	367,618	261,265	1.110	1.071
45	Concrete pump truck 50m3/h	3,773,975	4,350,371	4,571,193	576,395	220,822	1.153	1.051
46	Concrete pump truck 60m3/h	4,147,302	4,790,016	5,014,275	642,714	224,259	1.155	1.047
47	Concrete pump machine 40-60 m3/h	1,838,512	1,998,963	2,185,890	160,451	186,927	1.087	1.094
48	Concrete pump machine 60-90 m3/h	2,415,560	2,639,742	2,843,931	224,182	204,189	1.093	1.077
49	Vibrator driver 0,8KW	144,666	168,687	241,963	24,021	73,276	1.166	1.434
50	Vibrator driver 1,0KW	148,568	172,916	246,266	24,348	73,350	1.164	1.424
51	Concrete vibrator 0,8KW	145,867	169,956	243,232	24,089	73,276	1.165	1.431
52	Concrete vibrator 1,0KW	146,618	170,859	244,209	24,241	73,350	1.165	1.429
53	Concrete vibrator 1,5KW	151,016	175,777	249,312	24,761	73,535	1.164	1.418
54	Concrete vibrator 2,8KW	162,034	188,128	262,145	26,094	74,017	1.161	1.393
55	Asphalt station 60T/h (216T/shift)	10,619,603	11,646,930	12,973,767	1,027,327	1,326,837	1.097	1.114
56	Bitumen pump 190CV	2,793,700	3,341,114	3,553,594	547,414	212,480	1.196	1.064
57	Asphalt finish 65T/h	2,748,836	3,145,564	3,333,573	396,728	188,009	1.144	1.060
58	Asphalt finish 100T/h	3,347,565	3,881,592	4,077,620	534,028	196,028	1.160	1.051
59	Asphalt finish 130CV - 140CV	5,345,751	6,067,954	6,269,995	722,203	202,041	1.135	1.033
60	Paint machine YHK10A	225,305	255,846	340,650	30,541	84,804	1.136	1.331
61	Paint boil machine YHK3A	703,404	825,719	915,554	122,316	89,834	1.174	1.109
62	Bitumen boil machine 500 liter	235,077	266,154	350,958	31,078	84,804	1.132	1.319
63	Water pump 50KW, Electric	376,121	429,850	524,541	53,730	94,691	1.143	1.220
64	Water pump 75KW, Electric	479,083	545,923	645,558	66,840	99,634	1.140	1.183
65	Water pump 75CV, diezel	978,205	1,273,482	1,375,442	295,277	101,961	1.302	1.080
66	Water pump 100CV, diezel	1,108,120	1,466,774	1,573,056	358,654	106,281	1.324	1.072
67	Water pump 150CV, diezel	1,478,045	1,971,905	2,100,967	493,861	129,062	1.334	1.065
68	Air Compressor 75m3/h	282,548	352,021	439,574	69,473	87,553	1.246	1.249
69	Air Compressor 102m3/h	412,683	535,533	626,637	122,850	91,104	1.298	1.170
70	Air Compressor 360m3/h	901,341	1,183,765	1,285,064	282,424	101,298	1.313	1.086
71	Air Compressor 600m3/h	1,167,028	1,487,921	1,591,052	320,893	103,131	1.275	1.069
72	Air Compressor 1200m3/h	2,267,137	2,875,911	2,996,510	608,773	120,599	1.269	1.042
73	Welding machine 23kw	226,467	263,067	351,850	36,600	88,783	1.162	1.337
74	Welding machine (water)	1,107,076	1,220,270	1,464,668	113,194	244,399	1.102	1.200
75	Sand pump machine	153,784	177,860	250,840	24,076	72,979	1.157	1.410
76	Borer (stand) 4,5KW	195,915	223,482	297,239	27,567	73,758	1.141	1.330
77	Steel borer 13mm	140,237	163,698	236,763	23,461	73,066	1.167	1.446
78	Cutter steel 1,0KW	153,179	177,482	250,634	24,303	73,152	1.159	1.412
79	Cutter steel 1,7KW	154,729	179,255	252,498	24,526	73,243	1.159	1.409
80	Concrete borer 1,5KW	158,607	183,228	256,393	24,621	73,165	1.155	1.399
81	Brick cutter 1,7KW	152,461	176,844	250,076	24,383	73,231	1.160	1.414
82	Concrete cutter 1,5KW	154,942	179,417	252,619	24,475	73,202	1.158	1.408
83	Concrete cutter 7,5KW	185,836	213,015	286,884	27,179	73,869	1.146	1.347
84	Air-compressor hammer 1,5m3/ph	165,006	192,231	277,034	27,225	84,804	1.165	1.441
85	Air-compressor hammer 3,0m3/ph	167,653	195,023	279,827	27,370	84,804	1.163	1.435
86	Scrolling machine 2,8 KW	157,884	182,812	256,206	24,927	73,394	1.158	1.401

87	Pipe cutter 5,0KW	162,219	187,875	261,596	25,656	73,721	1.158	1.392
88	Steel plate cutter 15KW	297,837	333,188	408,391	35,351	75,204	1.119	1.226
89	Cutter (and stick) 2,8KW	170,466	196,086	269,480	25,620	73,394	1.150	1.374
90	Bending machine 5KW	151,963	177,055	250,776	25,093	73,721	1.165	1.416
91	Diezel pile hammer 1,8T	2,512,943	3,070,801	3,361,411	557,858	290,610	1.222	1.095
92	Diezel pile hammer 3,5T	3,659,712	4,312,685	4,667,360	652,974	354,675	1.178	1.082
93	Diezel pile hammer 4,5T	4,080,781	4,775,550	5,131,656	694,769	356,106	1.170	1.075
94	Vibrating hammer 50KW	579,769	662,180	831,086	82,411	168,906	1.142	1.255
95	Vibrating hammer 170KW	952,639	1,083,113	1,270,309	130,474	187,196	1.137	1.173
96	Diezel pile hammer 3,5T with floating	4,866,005	5,611,804	6,129,125	745,799	517,321	1.153	1.092
97	Pilling ship <=7,5T	13,229,637	15,181,386	15,967,880	1,951,749	786,494	1.148	1.052
98	PVD Driver	1,805,934	2,548,656	2,743,466	742,722	194,810	1.411	1.076
99	Pile borer VRM1500/800HD	9,242,213	10,145,146	10,515,788	902,933	370,642	1.098	1.037
100	Pile borer VRM2000	11,840,827	12,938,869	13,313,520	1,098,041	374,651	1.093	1.029
101	Barge 200T	842,366	895,956	1,034,228	53,590	138,272	1.064	1.154
102	Barge 250T	988,683	895,956	1,188,593	-92,727	292,637	0.906	1.327
103	Barge 400T	1,221,583	1,296,030	1,434,302	74,446	138,272	1.061	1.107
104	Barge 800T	1,847,171	1,956,026	2,094,298	108,855	138,272	1.059	1.071
105	Barge 1000T	2,127,778	2,252,066	2,390,339	124,288	138,272	1.058	1.061
106	Ferry boat 250T	2,043,337	2,115,692	2,549,467	72,355	433,775	1.035	1.205
107	Ponton 10T	59,246	62,505	62,505	3,259	0	1.055	1.000
108	Ponton 60T	122,152	128,871	128,871	6,719	0	1.055	1.000
109	Ponton 250T	223,331	235,614	235,614	12,283	0	1.055	1.000
110	Canoe 23CV	369,424	389,611	433,740	20,187	44,129	1.055	1.113
111	Canoe 30CV	395,967	426,748	517,516	30,781	90,767	1.078	1.213
112	Canoe 55CV	606,514	729,607	918,426	123,093	188,818	1.203	1.259
113	Canoe 75CV	703,167	853,942	1,044,479	150,775	190,537	1.214	1.223
114	Canoe 90CV	798,527	971,320	1,163,145	172,793	191,825	1.216	1.197
115	Tug boat 150CV	3,031,321	3,890,679	4,543,303	859,358	652,625	1.283	1.168
116	Tug boat 360CV	4,817,621	6,506,022	7,242,281	1,688,402	736,258	1.350	1.113
117	Tug boat 600CV	7,289,688	9,968,525	11,084,561	2,678,837	1,116,036	1.367	1.112
118	Tug boat 1200CV	20,556,494	26,785,285	28,261,438	6,228,792	1,476,153	1.303	1.055
119	Cutter suction 1200CV	30,341,332	38,087,235	40,173,546	7,745,903	2,086,311	1.255	1.055
120	Cutter suction 4170CV	109,691,720	135,164,685	138,568,912	25,472,964	3,404,227	1.232	1.025
121	Trailing suction hopper dredger 5945CV	124,271,305	163,975,079	168,191,382	39,703,774	4,216,303	1.319	1.026
122	Diver's equipment	663,447	752,242	996,641	88,796	244,399	1.134	1.325
					Average Equipment Factor		**1.189**	**1.169**

Source: JICA D/D Study Team

Note: Above prices are not considered increase of fuel price as of November 2012 however, cost estimates for packages 8,9&10 are considered the increase.

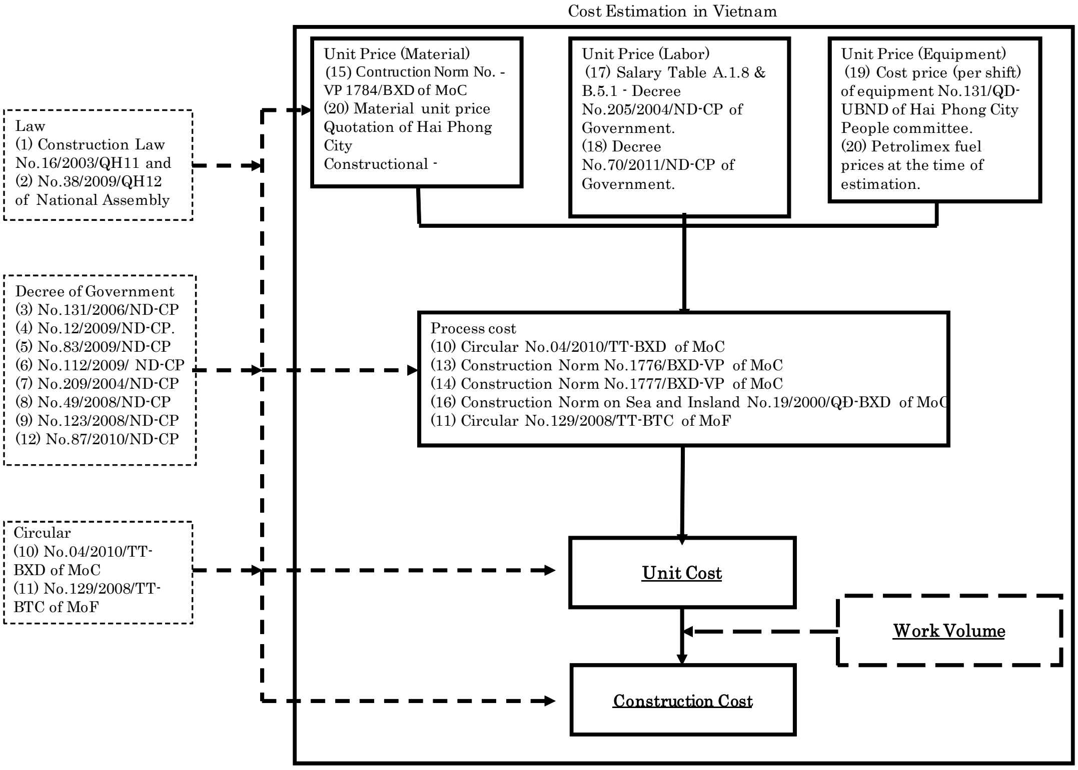
As shown in the above table, price growth ratio is approximately 17% on average among listed items and smaller equipment, which has a large proportion of labor cost, indicates relatively higher growth.

As for marine construction equipment, the growth ratio is relatively lower, less than 10%, because those cost components are relied on mainly equipment depreciation. However, considering massive work volume, the increase amounts are highly influence to the calculation of total project cost.

Due to the extension of DD study based on the request from Vietnamese Government, further updating of unit prices & the related cost estimates beyond the May 2012 were done timely. The newest unit prices are used in the final cost estimates and the list is shown together with the documents of cost estimates.

3) Flow chart of Cost Estimation method in Vietnam

In previous chapter 14, flow chart of cost estimation method in Vietnam was shown. However, some circular and decision are updated. Therefore, the revised flow chart is shown in the following Figure.



Source: JICA Study Team Note: Number shown in ( ) is related to the Table 23.1.1

Figure 23.1.1 Flow Chart of Cost Estimation Method in Vietnam

23.1.2 Cost Estimates Standards in Japanese Portion

Since the Project is assumed as Special Terms for Economic Partnership (STEP) loan scheme, at least 30% of total project cost should be comprised as Japanese procurement. As for the cost estimates of Japanese portion, Japanese Standards are complied with. Applied standards and reference are listed in the following.

Table 23.1.8 Applied Standards for Cost Estimates

No	Name of Standards	
1	Cost estimation standards for ports and harbors constructions(2011), issued by The Ports & Harbors Association of Japan	Supervised by Port Authority of Ministry of Land, Infrastructure, Transport and Tourism. The most widespread standards among Japanese marline civil works.
2	Supplemental manual for cost estimation and design (civil work) (March 2009)	Issued by JICA.
3	Standards for depreciation cost estimation for vessels and equipment (2008), The Ports & Harbors Association of Japan (*note: issued in 2008 but the latest version)	Supervised by Port Authority of Ministry of Land, Infrastructure, Transport and Tourism. The most widespread standards among Japanese marline civil works.
4	Monthly price indexes of Construction material (Sep. 2011), Construction Research Institution	The most widespread price indexes among Japanese construction.
5	List of miscellaneous expense ratio (version 13), Construction Research Institution	The most well-known reference for calculation of expenses ratio in Japanese construction field.
Reference		
1	Cost standards for dredging equipment (2005), Authored by RN Bray, CIRA, London, UK	Reference for cost estimation of TSHD.
2	Dredging, a handbook for Engineer, authored by RN Bray, AD Bates & JM Land, BH	Reference for cost estimation of TSHD.

Source: JICA D/D Study Team

1) Difference on Calculation Method of Dredging Unit Cost between Vietnamese and Japanese

As our investigation results, it is clarified that there is differences on calculation method of dredging unit cost between Vietnamese and Japanese. Generally, Japanese calculation method asks to consider more detail about each site conditions than Vietnamese, that is, Japanese method requires stepping in closer to assume practical works especially on the aspect of relation between work time and site conditions. In this chapter, major deferent items are described. First, calculation process of Vietnamese dredging cost and Japanese is shown in Figure 23.1.2.

a) Unit Price

As for unit labor wage calculation, Vietnamese norm requires much more detailed categorizations than Japanese standard. It affects equipment price calculation therefore price calculations of Vietnamese equipment are also more complicated than Japanese.

b) Equipment Depreciation

In Vietnamese cost estimation, the unit of equipment depreciation is prescribed as “SHIFT”. The SHIFT contains 8 hours working time including time for equipment idling, preparation, and maintenance, and decided by the referring Vietnamese norm. On the other hand, the calculation of Japanese equipment depreciation is comprised of 2 items, working depreciation and service depreciation. The former means only for dreading works and the latter is for equipment idling, preparation, and maintenance. Those are decided by referring Japanese standard and its calculation way is similar to Vietnamese.

c) Productivity based on Work Efficiency

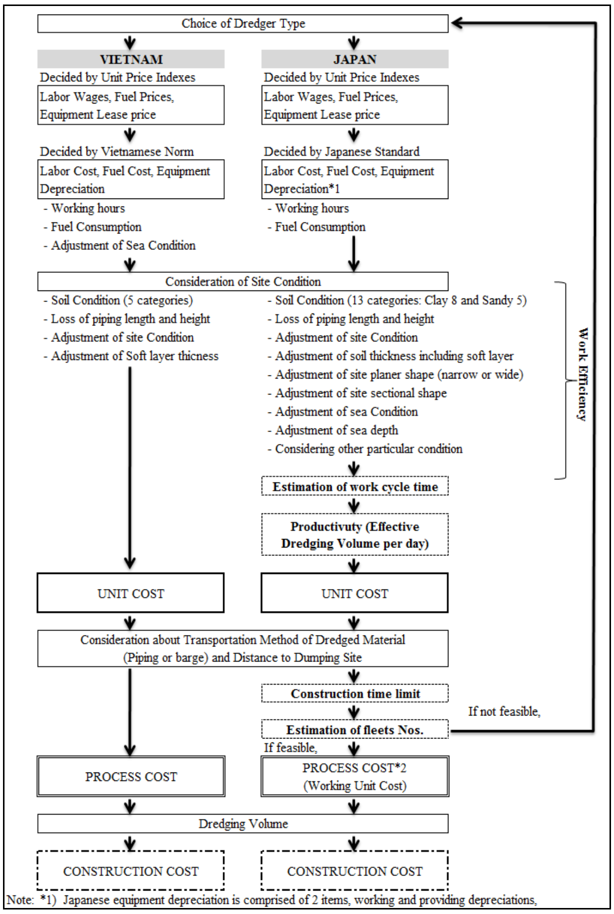
As an important factor for Japanese unit cost estimates, “Productivity” is calculated. The productivity means effective dredging volume within a time and it is decided based on construction schedule assuming work cycle time according to each site characteristics. Concretely, geological condition, dredging method, shape of the site, sea depth, current direction & strength, seabed condition and so on, are considered as factor for cost decision and those are figured out as “Work efficiencies”. Considering these work efficiencies, the productivity is estimated. Table 23.1.9 shows items to be considered for cost calculation in Vietnam and in Japan.

Table 23.1.9 Items Considered for Cost Calculation (Dredging work)

No.	Items	Japanese	Vietnamese
1	Work Efficiencies		
a)	Soil Categorization	○ (13 categories based on N-value)	○ (5 categories)
b)	Losses related to dredged material pipe-transportation	○	○
c)	Site Condition	○	○
d)	Sea depth	○	○
e)	Superficial soft layer	○	○
f)	Sea condition	○	○
g)	Site planner and sectional shape	○	N/A
h)	Estimated actual dredging volume (mud-content)	○	N/A
i)	Other particular conditions	○	N/A
2	Work cycle time	○	N/A
3	Productivity (Effective dredging volume per day)	○	N/A
4	Construction time limit	○	N/A

Source: JICA Study Team Note: 2, 3, 4 are estimated and calculated based on 1. Work efficiencies.

As is obvious from the above table, the items related to time are not considered in Vietnamese cost estimation method.



Note: *1) Japanese equipment depreciation is comprised of 2 items, working and providing depreciations,

Figure 23.1.2 Flow Chart of Calculation Process of Dredging Cost

d) Unit Cost Comparison by Dredger Type

Many discussions about dredging methodology with considering cost comparison between MPMUII and JICA study team were held during study period. As one of the discussions, unit cost comparison by dredger type was examined in early August 2011. Two common major types, Cutter Suction dredger (CSD) 4,000ps class and Trail Suction Hopper Dredger (TSHD) 3,500m^3 class, were chosen and calculated by Vietnamese method and Japanese individually, and finally, the costs are compared on a same basis. The result is shown in the following table.

Table 23.1.10 Unit Cost Comparison by Dredger Type

No.	Items	Unit	Japanese calculation	Vietnamese calculation
	CSD 4,000ps class *1	M3	VND 158,333	VND 148,918
	TSHD 3,500m3 class *2	M3	VND 248,674	VND 139,183
Exchange rate: VND1=JPY0.00528				

Source: JICA Study Team

Note *1 assumptions: Site: Lach Huyen port, soil category: plastic clay, piping length=1.6km

*2 assumptions: Site: Lach Huyen port, soil category: plastic clay, transportation distance 16km

*3 above costs are only for comparative study purpose, not for the Project cost estimates.

In Japanese domestic dredging, TSHD is not major so JICA study team had calculated the unit cost with referring European standard (Cost Standards for Dredging Equipment and Dredging, a handbook for Engineers), Japanese technical books and hearing results from major Japanese marine contractors. As for CSD comparison, both results are similar. On the other hand, big difference is happened about TSHD. Probably, the reason is caused on the different approach of mud content in the initial dredging and its related transportation time. Actually it is very difficult to estimate the actual mud content because it depends on existing soil condition and too sensitive to estimate based on geological result only. In this comparison, JICA study team concluded lower productivity. On the other hand, Vietnamese norm has no consideration about work time as mentioned in previous chapter therefore, it seems that such a big difference occurred.

23.1.3 Basic Condition of Cost Estimates

In order to calculate cost estimates in Detail Design stage, the following conditions are taken into consideration.

1) Exchange Rate

Exchange rate for the cost estimates is set in the following.

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

Above-mentioned exchange rates are same as the time of SAPROF Study.

2) Assumed Price Escalation Rate

Assumed price escalation rates for both local and foreign currency portions are in the following. Price escalation is calculated for both local and foreign currency portion 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 estimates	: September 2011

3) Physical Contingency (5%)

A rate of physical contingency is set as 5 % which is same as the one used in the SAPROF study. Physical contingency is obtained by multiplying the rate by the total of:

- Construction Cost
- Price Escalation

4) General Expenses

In general expenses, costs for site office & related facilities, cars & motor bikes, monitoring surveys, and other necessary items are allocated. Temporary yard and its related facilities are allocated in direct cost due to the amount is not small.

5) Land Acquisition Cost

Land acquisition cost is considered in the cost estimates. The amount is assumed from the result of social environmental study.

- Land acquisition cost only for ODA portion: **VND 40, 377,634,000.00**

including income restoration support for the affected labors.

6) Administration Cost (5%)

Assumed administration cost is set 5%. Administration cost is obtained by multiplying the rate by the local currency portion of:

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

7) Value Added Tax (10%)

Value added tax (VAT) is set 10%. VAT is calculated by multiplying the rate by the total of:

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

8) Imported Tax (10%)

Imported tax is set 10%. Import tax is applied only to the materials that are procured by the foreign country portion, and used for the permanent structure for the Project. The detail of this taxation is based on Decree on Custom Valuation of Imported and Exported Goods issued by the government of socialist republic of Vietnam (Decree No. 87/2010/ND-CP of August 13, 2010,). In this study, it is calculated by multiplying the rate by the total of:

- Permanent material cost in 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 interests are considered during construction:

For Construction cost	0.2% per annum
For Consultancy service	0.01% per annum

The interest during construction is estimated based on the disbursement schedule.

10) Commitment Charge (0.1% per annum)

Commitment charge is the charge for holding available undisturbed balance of a loan commitment after effective date of Loan Agreement (L/A). It is a fixed-rate charge of 0.1 % a year calculated on the basis of undisturbed balance. This is also followed as SAPROF result.

11) Expenses

According to the cost estimation method in Vietnam, there are four (4) kinds of expenses. Three of four are applied to the stage of unit cost calculation:

- Other direct expenses : 2.0 % of sum of unit prices
- General expenses : 5.5% of sum of unit prices including other direct expenses
- Pre-Determined taxable income : 6.0% of sum of unit prices considered general expenses

After summing up the cost, “cost of setting up tents at site” is usually considered in Vietnam. It meets a part of site management cost in the standard of Japanese cost estimation, and it is applied 1.0% of sum of construction cost excluding VAT to each package.

12) Conditions for STEP application

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 is also requires the following conditions:

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 estimates, the following construction works / materials are considered to be procured from Japan:

- Procurement of CDM special ships & related equipment, skilled labors for CDM, that is, cost for simple labor & cement as main material belongs to local procurement.
- Procurement of steel sheet piles, sheet piles, shaped steel, tie-rod, fender, and bollard. Those are material procurement only, installation cost is based on Vietnamese Norm.
- Procurement of navigation light (material procurement only, installation is by Vietnamese)
- Procurement of Japanese dredgers, related satellite vessels, and skilled marine labors.

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

The Whole Project is divided into four (4) packages. The packaging is;

(1) Package 6: Infrastructure Construction Behind the Container Terminal

(2) Package 8: Channel Dredging and Disposal Works Part A

(3) Package 9: Channel Dredging and Disposal Works Part B

(4) Package 10: Breakwater and Sand Protection Dyke Works

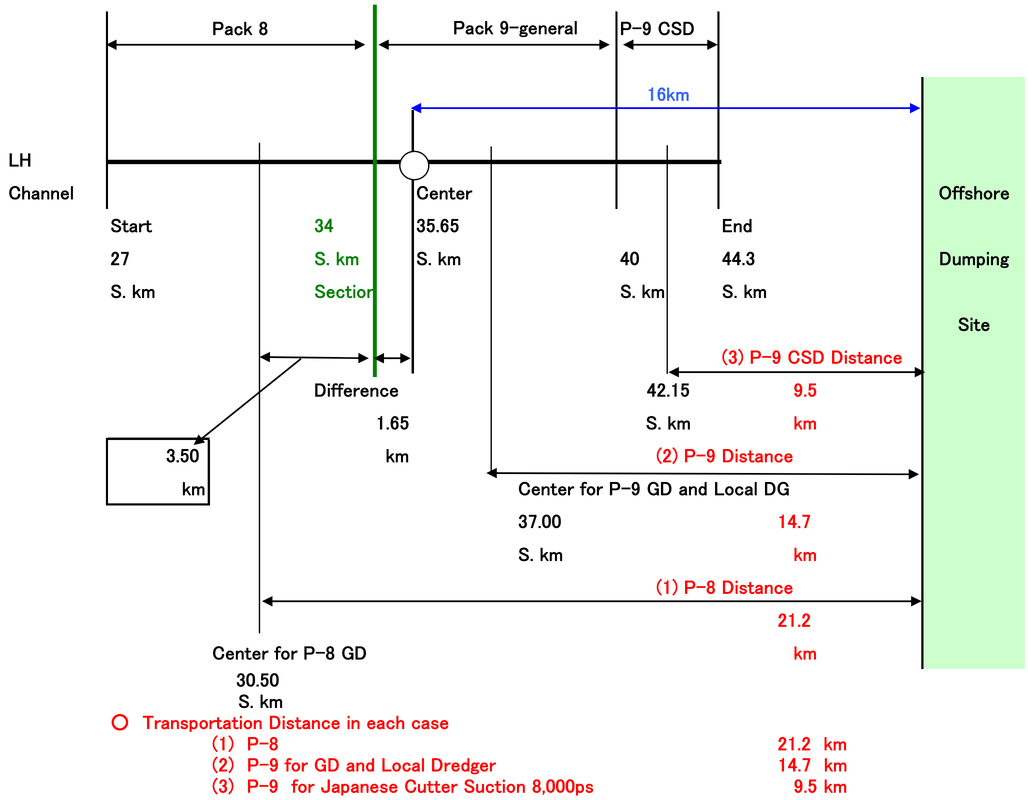
14) Cost Estimates Conditions

As assumptions, cost estimates conditions are set in the following.

- Time schedule is based on the DD schedule shown in the Chapter 20.
- Price fluctuation compared to SAPROF study is considered.
- Exchange rate is set as same as the time of SAPROF study.

The followings are particularly for dredging packages, Packages 8 & 9.

- Cost estimates for Package 8& 9 cover cost for main channel dredging & dumping and other related works.
- Dredging volume for Package 8 is 16,693,927 m^3 and Package 9 is 21,285,780 m^3. So total volume is 37,979,707 m^3.
- Above volumes are calculated based on the result of Detailed Design. The channel depth is set as -14m and the width as 160m all along the line. The slope of the channel is 1:10 from channel beginning point to CD -10m and it changes 1:15 from CD -10m to deeper. Besides, extra volume and expected sediment volume are considered into cost estimates.
- Cost for diversion channel and/ or other temporary channel are not considered.
- Main dredgers are Grub dredger 23m3, TSHD 16,000 m^3 & Cutter Suction dredger 8,000 ps as described in Chapter 15. And those are categorized as Japanese procurement portion therefore those cost estimates are based on the Japanese Standards introduced in previous section.
- However, cost for satellite ships, fuel and a part of common labors is calculated based on the Vietnamese prices.
- All dredged soil is transported by barge and the dumping is at off shore only.
- The cost for dumping facilities like perimeter dyke & temporary access trench are not considered.
- Each distance from packaged channel center to the off shore dumping site is;
- Package 8: 21.2km, Package 9: 14.7km (9.5km for CSD dredging area from 40km to 44km +300m) *See the next figure.
- Disbursement schedule is calculated based on the project schedule in previous chapter.
- Price fluctuation compared to SAPROF study is considered.
- Exchange rate is set as same as the time of SAPROF study



Source: JICA Study Team

Figure 23.1.3 Flow Chart of Calculation Process of Dredging Cost

23.1.4 Package 6: Infrastructure Construction Behind the Container Terminal

This package for Terminal area is comprised of mainly local currency portions except three (3) major items. The first exclusion is that procurement of particular steel materials likewise steel pipe sheet-pile, tie-rod and shaped steel. The second is that procurement of marine construction material likewise bollard and Fender. The third is that applying soil improvement method that is Cement Deep Mixing (CDM) method. The first and the second contain material procurement costs from Japan or Japanese company in Vietnam including transportation cost and its related expenses. The third means to apply this method as Japanese portion, concretely, cost for special equipment including transportation and its related expenses and supervising belong to Japanese Portion. The main material for the method is cement and it is easily procured in Vietnam so the material procurement is planned as local currency portion. Those Japanese procurements are applied to Japanese cost estimation method. Material prices of Japanese procurement are decided by referring Monthly Price Indexes of Construction Material (Sep. 2011) issued by Construction Research Institution, which is the most popular indexes in Japan and cost for equipment transportation and its related costs are according to Japanese Standards.

In SAPROF, Outer Revetment B was proposed to belong into Terminal package. However, as the result of DD study, it was decided that Outer Revetment B and Sand Protection Dyke are in one package because on the view of cost balance compared to other packages and request from Vietnam.

There are three type of revetment, Outer Revetment A, Inner Revetment at Terminal Area and Inner Revetment at Public Related Area. Outer revetment A is located behind of access load and the length is 750m. The structure is conventional compound type. The foundation is rubble mound foundation over PVD improved soil, and cooping concrete is mounted on top of the foundation. Finally, the structure is armed by wave dispatching blocks. Inner revetment at Terminal Area is L=750m and structural component is similar to the outer revetment but a little righter. Inner Revetment at Public Related Area is quite small compared to another 2 revetments and the structure is simple rubble mound type. Those are planned to be constructed mainly as local marine civil work.

Soil improvement is one of key work and it is on the critical pass of the Project schedule. In this project, two (2) methods are applied, PVD and CDM. As for PVD in terminal area, its interval varies from 1.1m to 2.2 m depend on existing soil condition. By the same token, the length varies from 30.5m to 36m. Those are driven as on-land work after the first reclamation. CDM method is sometimes applied in Vietnam but only smaller diameter like less than 400 m/m. However, the planned CDM for the Project has much bigger diameter, 1,300m/m and it is not listed in Vietnamese Norm. This is a reason that the method is categorized into Japanese portion. CDM is planned to apply just behind of terminal structure to acquire the space for private portion. The length of CDM varies from 23.5m to 25.5m depend on existing soil condition and the variation is considered into cost estimates carefully. The construction method is on-sea method in this cost estimates. Considering the time schedule and productivity, two working vessels are necessary.

Reclamation for terminal, container storage and access road will be completed after the soil improvement. Material for the reclamation is planned to be procured from approximately 60km river distance from the Project site. Considering necessary of total volume as over 3 million m3 including surcharge material, the transportation method has to be relied on river/ marine transportation. The top level of reclamation is planned as CD+4.0m, however, surcharge is planned for the acceleration of consolidation. Therefore the material volume for the surcharge is also considered into cost estimates.

As a sample, Cost estimates premises for CDM method (Part a) are show in the following.

Table 23.1.11 Cost Estimates Premises of CDM (Part a)

Cost Estimation Premises		**CDM (on-sea, Part a)**	**CEP- 12**
1. Work volume and period			
1	Construction level (Mean sea level: CDL)	1.9 m	
2	Existing seabed elevation (Average: CDL)	-1.0 m	
3	Pile top elevation (CDL)	-2.0 m	
4	Pile toe elevation (CDL)	-25.0 m	
5	Main Pile (Length and diameter):	**23.0 m**	dia.1,000 mm
6	Pile Number (2 axis)	**2,485**	Nos.
7	Construction period (months):	**3.4 months**	
8	Construction period (days)	**102 days**	Improved Volume
9	Work area (m2):	**9,536.3 m2**	**146,316.8 m3**
	Equipment component:	CDM ship 809kw class 2.2 m2	
		with Anchor boar D15ton class (284kw=389ps)	
2. Productivity			
10	Material extra ratio:	15%	(poor soil, off shore)
	t= 2 x (a x H + b x L') +c		
	t: Time to complete a pile(min/ pile)		
11	H: Sea depth (from average sea surface to seabed):	3.0 m	
12	a: coefficient according to H:	0.12	
13	b: Coefficient according to H:	1	
14	c: Coefficient according to H:	15	
15	L': Distance from seabed to pile toe (m): 25(24.5)m	24.0	
16	Therefore, time to complete a pile (t) is;	63.72	min.
	N=60 x T/ t x E1 x E2 x E3 x E4		
	N: Pile Numbers (per day)		
17	T: Work time (hour):	14	hours
18	E1: Sea condition:	0.75	
19	E2: Planer shape coefficient:	1	(normal)
20	E3: Middle layer influence:	1	(normal)
21	E4: Improvement type:	1	(normal)
22	Therefore, Productivity (pile numbers per day: N) is;	**10**	Nos. per day
23	Therefore, Required days for the work is (6/22);	**249**	days
24	Therefore, Required sets of the equipment:	**2**	sets
3. Material consumption			
25	Mixing proportion for main pile:	0.2 ton/ m3	for Main Pile
26	W= N x (L+0.5) x q x w/ 1,000 x (1+r)		
	W: required cement volume (per day)		
27	N: Pile Numbers (per day):	10	
28	L: Pile length (m):	23.0 m	
29	w: Mix proportion: 200 kg per cubic meter	200	kg/ m3
30	q: Objective soil volume (m3 per meter)	2.56	
31	r: Material extra ration (%):	15%	
32	Therefore, Required cement volume (W) is;	**138.4**	ton per day
33	Therefore, Total required cement volume (V) is;	**34,384.4**	ton

Source: JICA Study Team

The result of construction costs for Package6: Terminal area comprised of Revetment, Service Road, Service Berth, Reclamation and Soil Improvement at the Detail Design stage is shown in the following table.

Table 23.1.12 Cost Estimates for Package 6: Infrastructure Construction Behind the Container Terminal

Exchange Rate: 1VND = JPY0.00528

BILL NO	DESCRIPTION	LOCAL CURRENCY (VND) GIÁ TR? N?I T? (VND)	FOREIGN CURENCY (J.YEN) GIÁ TR? NGO?I T? (J.YEN)	TOTAL AMOUNT IN (J.YEN) T?NG GIÁ QUY V? (J.YEN)
DIVISION 1	**GENERAL COST**			
Bill No. 1A	GENERAL PROVISION	3,554,938,202	275,254,914	294,024,987
Bill No. 1B	SITE ESTABLISHMENT AND TEMPORARY WORKS	126,597,871,364	0	668,436,761
Bill No. 1C	SURVEY AND INVESTIGATION	35,696,128,677	0	188,475,559
	SUB TOTAL OF DIVISION 1	**165,848,938,243**	**275,254,914**	**1,150,937,308**
DIVISION 2	**TERMINAL AREA AND PUBLIC AREA**			
Bill No. 2A	RETAINING WALL AT CONTAINER TERMINAL	97,285,943,836	759,029,674	1,272,699,458
Bill No. 2B	RECLAMATION FOR TERMINAL AREA	507,696,037,439	0	2,680,635,078
Bill No. 2C	SOIL IMPROVEMENT	946,794,458,085	2,730,055,446	7,729,130,185
Bill No. 2D	PORT PROTECTION FACILITIES	137,323,406,866	0	725,067,588
Bill No. 2E	ACCESS ROAD BEHIND PORT	75,739,939,321	0	399,906,880
Bill No. 2F	PUBLIC RELATED FACILITIES	203,293,253,634	266,762,445	1,340,150,824
	SUB TOTAL OF DIVISION 2	**1,968,133,039,179**	**3,755,847,566**	**14,147,590,012**
DIVISION 3	**PROVISIONAL SUM**			
Bill No. 3A	SOIL INVESTIGATION AT TERMINAL AREA	3,539,470,325	0.00	18,688,403
Bill No. 3B	HIV PREVENTION PROGRAM	0	20,000,000	20,000,000
	SUB TOTAL OF DIVISION 3	**3,539,470,325**	**20,000,000**	**38,688,403**
(I)	**CONSTRUCTION COST (SUM OF DIV 1 TO DIV 3)**	**2,137,521,447,748**	**4,051,102,479**	**15,337,215,723**
(II)	**CONTINGENCY**	**756,015,570,526**	**505,236,824**	**4,496,999,037**
(1)	CONTINGENCY FOR ARISE QUANTITY (5% of sum of Div. 1 to Div. 3)	**106,876,072,387**	**202,555,124**	**766,860,786**
(2)	PRICE ESCALATION (Foreign 3.1% per year , Local 10.3% per year)	**649,139,498,138**	**302,681,700**	**3,730,138,251**
(III)	**TOTAL CONSTRUCTION COST (EXCLUDE TAX) [(I) + (II)]**	**2,893,537,018,273**	**4,556,339,303**	**19,834,214,760**
(IV)	**VALUE ADDED TAX (VAT) [10% OF (III)]**	**375,648,006,817**	**0**	**1,983,421,476**
(V)	**IMPORT TAX**	**7,657,028,181**	**0**	**40,429,109**
(VI)	**TOTAL CONSTRUCTION COST (INCLUDE TAX) [(III)+(IV)+(V)]**	**3,276,842,053,271**	**4,556,339,303**	**21,858,065,345**

Source: JICA Study Team

23.1.5 Package 8 and 9: Channel Dredging and Disposal Works

Channel dredging & dumping is highlight of the Project. The total share of Channel dredging cost occupies almost a half of the total Project cost. Channel dredging spans 17.4km length and the width is 160m all along the line. Turning basin is planned in front of terminal with single circle designed.

Assumed dredging volume is 37,979,707 m^3 in total of Package 8 & 9, and the estimated work period is within 36 months only. The required dredging volume is quite huge within a short period as 36 months, it means procurement of higher productive dredgers is essential to achieve on time competition. Concretely, it deserves that Grab Dredger 23m^3 (GD), Trailer Suction Hopper Dredger 16,000m^3 (TSHD), and Cutter Suction Dredger 8,000ps (CSD) classes have to be procured. Such big work ships are not registered in Vietnam but there are in Japan, and, considering STEP loan scheme is applied to the Project, those big dredgers are set as Japanese procurement. However, mainly for project cost saving, satellite vessels like anchor boats and soil barges for GDs are estimated as local portion in this cost estimates. Barge size for CSD8,000ps is chosen as 5,000m^3 class based on the Japanese Standards and the size is not common in Vietnam so this procurement is also set from Japan. Needless to say, cost for fuel, a part of common marine workers for the vessels are estimated based on the official Vietnamese prices because those are easily procured in Vietnamese domestic. Dredged soil is planned to be disposed at designated off shore dumping site which is located 16 km offshore from the channel center. The dumping site is distant so method for conveying soil is by barge transportation. Related to the disposal, there is no additional temporary facility in this cost estimates except costs for safety management.

In the basic design stage, geological survey was conducted all along proposed new channel line and terminal area. According to the results in channel area, most of all objective soil is relatively soft, clayey with N value<5, and partially harder clayey 5<N<15 and sandy soil 5<N<10 exist especially around CD-10m from km 0 to km 8. It is therefore, existing soil characters will not result difficulty to dredgers. However, on the view point of work efficiency, there is a concern that it will be not effective because the dredged material will become very slimy like flaccidity mud especially by CSD dredging, because CSD dredges with cutter spinning and it disturbs existing soil totally together with sea water mixing. As the result, initial mud content in barge tank will be lower and most of the tank will be filled by seawater, that is, it causes lower work efficiency. Assumed the above worse case, dredging efficiency will get lower than estimates in DD study and it will bring higher cost than this estimates. Also, this characteristic of the dredged material will be more SS dispersion so it needs with care on environmental aspect.

Although the dredging volume is a quite huge within a short period, the dredging methodology has no diversion channel and the dredging work have to be done within the existing channel. Therefore, it will bring not only lower work efficiency but also necessity of highly attention to public vessel navigations. Basically the safety vessel management is under Vietnamese responsibility but some costs for the work safety and a special insurance cost are calculated in this cost estimates.

As the result of many discussions through DD study, the dredging & dumping works are divided into 2 packages, closer to land side is as Package 8 and off shored side is as Package 9. The border line between package 8 and 9 is set at 34km post which means Package 8 covers basin dredging with 7km length of channel dredging, and Package 9 has 10.3km of off shored channel dredging. As the result of this packaging, Package 8 has 16,693,927m^3 of dredging volume and Package 9 has 21,285,780m^3. Dredging wok is planned within existing channel as mentioned before, that is, the first step of the dredging will be executed to expand & deepen of adjacent of existing channel with avoiding public vessels navigation. After the completion of the half, navigation of public vessels will shift to the completed space and remained half will be dredged. This method is, of course, applied to all along the channel for both Package 8 and 9, that is, shifting channel of both Packages has to be done at the same time. Considering different dredging condition and volume, it is easy to imagine that adjusting the timing to shift channel is very difficult if each package hires different contractor. However, related to such a difficulty, this cost estimates could not consider anything because there is no step in the Vietnamese/Japanese cost estimation Standard, so it is another potential risk on over budgeting.

As a sample, the calculation manners on major Japanese dredger are shown in the following table.

Table 23.1.13 Cost Estimates Premise in the case of GD 23m3 (Package 8)

Cost Estimation Premises **P-8 Grab GD 23m3, Dumping at Offshore, Local Barge** CEP- 30

1. Work volume and period			
1	Dredged volume (m3):	10,529,500	m3
2	Dredging period (months):	**38 months**	
3	Dredging period (days)	**1,151 days**	
4	Dumping method of dredged soil:	Offshore 21.2km	
2. Fleet component			
5	Ship providing coefficient: α=	1.3889	
6	Maritime providing coefficient: β=	1.21	
7	Watch:	2	
8	Working time (hours per day): *1	16	hours per day
9	Providing time (hours per day):*1	20	hours per day
10	Fleet component:	GD 23m3	Local barge1,000m3
	(decided by the Standard and use local barge)	Anchor boat D15t	Tag 1,200PS
3. Estimation of dredging productivity (work efficiencies)			
	Q=q x E1 x E2 x E3 x E4 x E5 x E6 x T x D		
	Q: Dredging productivity (m3/ day)		
11	q : Basic productivity of CSD (m3/ hour) *1	787	m3
12	E1: Thickness of objective layer:	0.85	(normal)
13	E2: Sea condition:	0.95	(normal)
14	E3: Sea depth consideration:	1	(<15m)
15	T: Time for genuine dredging work (hours per day):	16	
16	D: Work abeyance:	0.9	(=27/30, 30days/ month)
17	Therefore, dredging productivity(Q) is;	**9,151.24**	m3 per day
18	q0: Estimated dredged volume (=Q)	**571.95**	m3 per hour
4. Transportation of dredged material			
	N=qo/ f x (0.2 + 2 x d/ v)/ B		
	N: Required numbers of hopper barge (ship/ day)		
19	q0: Estimated dredged volume (=Q)	571.95	m3 per hour
20	f: Change ratio of dredged soil volume:	0.87	
21	d: Average round trip distance (km):	47.4	km (=21.2km x 2 +5km, 5km=distance in dumping site)
22	v: Average transportation speed (km/ hour):	5.5	km/ hour (considering lower speed in/ around dumping site)
23	B: Official capacity of hopper (m3):	1,000	m3
24	Therefore, Required umbers of hopper barge (N) is;	12	Nos.
5. Binding days for dredging fleets			
	BD=PD+CD		
	BD: Biding days		
25	PD: Preparation days for dredging works	15	
26	CD: Stand-by days after dredging completion	30	
27	Therefore, BD=	45	days

Note *1: The Standard has only 8 hours working therefore it doubles and makes as 16 hours working

*2: Feasible productivity is decided by the Standard with considering losses, not by manufacturer catalogue

Source: JICA Study Team

Cost estimates for Package 8 & 9 are shown in the following.

Table 23.1.14 Cost Estimates for Package 8

BILL NO	DESCRIPTION	LOCAL CURRENCY (VND) GIÁ TRỊ NỘI TỆ (VND)	FOREIGN CURENCY (J.YEN) GIÁ TRỊ NGOẠI TỆ (J.YEN)	TOTAL AMOUNT IN (J.YEN) TỔNG GIÁ QUY VỀ (J.YEN)
DIVISION 1	**GENERAL COST**			
Bill No. 1A	GENERAL PROVISION	111,479,083,824	525,885,344	1,114,494,907
Bill No. 1B	SURVEY WORKS	191,063,971,934	0	1,008,817,772
	SUB TOTAL OF DIVISION 1	**302,543,055,759**	**525,885,344**	**2,123,312,678**
DIVISION 2	**CHANNEL DREDGING AND DISPOSAL**			
Bill No. 2A	CHANNEL DREDGING FROM KM26+930 TO KM34 (1ST PERIOD)	541,041,619,254	3,724,644,009	6,581,343,759
Bill No. 2B	CHANNEL DREDGING FROM KM26+930 TO KM34 (2ND PERIOD)	879,984,909,543	4,564,110,392	9,210,430,714
	SUB TOTAL OF DIVISION 2	**1,421,026,528,797**	**8,288,754,401**	**15,791,774,473**
DIVISION 3	**PROVISION SUM**			
Bill No. 3A	HIV PREVENTION PROGRAM		5,000,000	5,000,000
Bill No. 3B	MARITIME LIABILITY INSURANCE		107,520,000	107,520,000
	SUB TOTAL OF DIVISION 3	**0**	**112,520,000**	**112,520,000**
(I)	**CONSTRUCTION COST (SUM OF DIV 1 TO DIV 3)**	**1,723,569,584,556**	**8,927,159,745**	**18,027,607,151**
(II)	**CONTINGENCY**	**584,719,702,964**	**1,149,302,161**	**4,236,622,193**
(1)	CONTINGENCY FOR ARISE QUANTITY (5% of sum of Div. 1 to Div. 3)	**86,178,479,228**	**446,357,987**	**901,380,358**
(2)	PRICE ESCALATION (Foreign 3.1% per year , Local 10.3% per year)	**498,541,223,736**	**702,944,174**	**3,335,241,835**
(III)	**TOTAL CONSTRUTION COST (EXCLUDE TAX) [(I) + (II)]**	**2,308,289,287,520**	**10,076,461,906**	**22,264,229,344**
(IV)	**VALUE ADDED TAX (VAT) [10% OF (III)]**	**421,671,010,307**	**0**	**2,226,422,934**
(V)	**TOTAL CONSTRUCTION COST (INCLUDE TAX) [(III)+(IV)]**	**2,729,960,297,828**	**10,076,461,906**	**24,490,652,279**

Table 23.1.15 Cost Estimates for Package 9

Exchange Rate: 1VND = JPY0.00528

BILL NO	DESCRIPTION	LOCAL CURRENCY (VND) GIÁ TRỊ NỘI TỆ (VND)	FOREIGN CURENCY (J.YEN) GIÁ TRỊ NGOẠI TỆ (J.YEN)	TOTAL AMOUNT IN (J.YEN) TỔNG GIÁ QUY VỀ (J.YEN)
DIVISION 1	**GENERAL COST**			
Bill No. 1A	GENERAL PROVISION	126,384,991,893	1,465,534,608	2,132,847,365
Bill No. 1B	SURVEY WORKS	179,315,677,294	0	946,786,776
	SUB TOTAL OF DIVISION 1	**305,700,669,188**	**1,465,534,608**	**3,079,634,142**
DIVISION 2	**CHANNEL DREDGING AND DISPOSAL**			
Bill No. 2A	CHANNEL DREDGING FROM KM34 TO KM40 (1ST PERIOD)	388,798,449,055	3,461,264,110	5,514,119,921
Bill No. 2B	CHANNEL DREDGING FROM KM34 TO KM40 (2ND PERIOD)	839,642,581,074	4,590,046,763	9,023,359,591
Bill No. 2C	CHANNEL DREDGING FROM KM40 TO KM44+300 (2ND PERIOD)	241,141,150,918	3,320,122,358	4,593,347,635
	SUB TOTAL OF DIVISION 2	**1,469,582,181,047**	**11,371,433,232**	**19,130,827,147**
DIVISION 3	**PROVISION SUM**			
Bill No. 3A	HIV PREVENTION PROGRAM		5,000,000	5,000,000
Bill No. 3B	MARITIME LIABILITY INSURANCE		107,520,000	107,520,000
	SUB TOTAL OF DIVISION 3	**0**	**112,520,000**	**112,520,000**
(I)	**CONSTRUCTION COST (SUM OF DIV 1 TO DIV 3)**	**1,775,282,850,235**	**12,949,487,840**	**22,322,981,289**
(II)	**CONTINGENCY**	**666,612,272,887**	**1,852,643,139**	**5,372,355,940**
(1)	CONTINGENCY FOR ARISE QUANTITY (5% of sum of Div. 1 to Div. 3)	**88,764,142,512**	**647,474,392**	**1,116,149,064**
(2)	PRICE ESCALATION (Foreign 3.1% per year , Local 10.3% per year)	**577,848,130,375**	**1,205,168,747**	**4,256,206,875**
(III)	**TOTAL CONSTRUCTION COST (EXCLUDE TAX) [(I) + (II)]**	**2,441,895,123,122**	**14,802,130,979**	**27,695,337,229**
(IV)	**VALUE ADDED TAX (VAT) [10% OF (III)]**	**524,532,902,057**	**0**	**2,769,533,723**
(V)	**TOTAL CONSTRUCTION COST (INCLUDE TAX) [(III)+(IV)]**	**2,966,428,025,178**	**14,802,130,979**	**30,464,870,951**

Source: JICA Study Team

23.1.6 Package 10: Breakwater and Sand Protection Dyke

Package 10 includes construction of Sand Protection Dyke and Outer Revetment B. All construction of this package is categorized into local currency portion except light beacons procurement therefore Vietnamese cost estimation method is applied.

The sand protection dike spans L=7.88km along Lach Huyen channel to diminish influence of sedimentation. The basic structure is rubble mound foundation and cooping concrete is surmounted it. The cooping structure is mainly as cellular block type that is reinforced concrete structure with hollow shape and only top is opened. The cellular blocks are planned to manufacture in temporary yard in advance of installation. Those manufactured blocks are carried to the place where is planned to be installed by way of barge transportation. After the installation by lifting crane barge, appropriate size and weight of stones are filled into the hollow, and top cover concrete blocks are installed on it. As a final stage of dyke construction, armor blocks are installed by crane barge according to the designed sectional profile. In detailed design stage, cost comparative study among four (4) types of the dykes was conducted and the most appropriate design was proposed in DF/R. Also, alignment of the dyke was discussed many times through DD study. The DD team alignment was bent type closer to channel to reduce influence of sedimentation and it contributed to be lower construction cost due to shorten length and smaller section. Although these merits are key point for the Project forming, Vietnamese side insists to construct it with a straight alignment. According to Vietnamese side, the straight alignment will bring lower cost for future Terminal construction because the sand dyke will be a role of revetment for future terminals. Considering the long time cost management including maintenance cost, it seems not to come true but finally the alignment is changed based on their opinion. Through those processes, the final design was determined as shown in previous chapter.

Outer Revetment B is located from the south end of Revetment A to off shore direction and it spans 2.48km. The structure is conservative compound type. The foundation is rubble mound foundation over replaced soil foundation, and cooping concrete is mounted on top of the foundation. Finally, the structure is armed by wave dispatching blocks.

In SAPROF, Outer Revetment B was proposed to belong into Terminal package. However, as the result of DD study, it was decided that Outer Revetment B and Sand Protection Dyke were in one package. The main reason is on the view point of cost balance compared to other packages and request from Vietnam. This is a reason why the total cost of this package is bigger than SAPROF.

Cost estimation for Package 10 is shown in the following.

Table 23.1.16 Cost Estimates for Package 10: Breakwater and Sand Protection Dyke

Exchange Rate: 1VND = JPY0.00528

BILL NO	DESCRIPTION	LOCAL CURRENCY (VND) GIÁ TRỊ NỘI TỆ (VND)	FOREIGN CURENCY (J.YEN) GIÁ TRỊ NGOẠI TỆ (J.YEN)	TOTAL AMOUNT IN (J.YEN) TỔNG GIÁ QUY VỀ (J.YEN)
DIVISION 1	**GENERAL COST**			
Bill No. 1A	GENERAL PROVISION	15,303,411,706	0	80,802,014
Bill No. 1B	SITE ESTABLISHMENT AND TEMPORARY WORKS	83,589,449,603	0	441,352,294
Bill No. 1C	SURVEY WORKS	39,531,153,950	0	208,724,493
	SUB TOTAL OF DIVISION 1	**138,424,015,259**	**0**	**730,878,801**
DIVISION 2	**SAND PROTECTION DIKE AND OUTER REVETMENT -B**			
Bill No. 2A	OUTER REVETMENT -B	976,548,114,164	0	5,156,174,043
Bill No. 2B	SAND PROTECTION DIKE	978,514,231,990	0	5,166,555,145
Bill No. 2C	LIGHT BEACON	342,827,394	30,797,982	32,608,111
	SUB TOTAL OF DIVISION 2	**1,955,405,173,548**	**30,797,982**	**10,355,337,298**
DIVISION 3	**PROVISION SUM**			
Bill No. 3A	HIV PREVENTION PROGRAM	0	10,000,000	10,000,000
	SUB TOTAL OF DIVISION 3	**0**	**10,000,000**	**10,000,000**
(I)	**CONSTRUCTION COST (SUM OF DIV 1 TO DIV 3)**	**2,093,829,188,807**	**40,797,982**	**11,096,216,099**
(II)	**CONTINGENCY**	**715,493,048,465**	**8,088,218**	**3,785,891,514**
(1)	CONTINGENCY FOR ARISE QUANTITY (5% of sum of Div. 1 to Div. 3)	**104,691,459,440**	**2,039,899**	**554,810,805**
(2)	PRICE ESCALATION (Foreign 3.1% per year , Local 10.3% per year)	**610,801,589,025**	**6,048,319**	**3,231,080,709**
(III)	**TOTAL CONSTRUCTION COST (EXCLUDE TAX) [(I) + (II)]**	**2,809,322,237,272**	**48,886,200**	**14,882,107,613**
(IV)	**IMPORT TAX**	**521,232,181**	**0**	**2,752,106**
(V)	**VALUE ADDED TAX (VAT) [10% OF (III)+(IV)]**	**281,910,221,943**	**0**	**1,488,485,972**
(VI)	**TOTAL CONSTRUCTION COST (INCLUDE TAX) [(III)+(IV)+(V)]**	**3,091,753,691,396**	**48,886,200**	**16,373,345,690**

Source: JICA Study Team

23.2 Summary of Project Cost Estimate

As a final result regarding cost estimates in Detail Design stage, summary of project cost is estimated. The construction cost is computed as:

VND 7,730,203,071,345 for local currency portion, and,

JPY 25,968,548,046 for foreign currency portion

As the result, the total amount in the VND currency is:

VND 18,654,951,471,477

It is equivalent to:

JPY 98,498,143,769

As for the percentage of Japanese procurement (as foreign currency portion) in the total project cost, it is calculated for:

- Construction cost
- Price escalation
- Physical contingency

The result is shown in the following section.

23.3 Summary of Japanese Procurement Cost and Comparison to SAPROF

The total project cost and Japanese procurement portion is wrapped up in the following table.

Table 23.3.1 Total Project Cost and Japanese Procurement Portion

VND1=JPY 0.00528

Package No.		Item	VND Portion	JPY Portion	Total in JPY	Contents of JP Portion
Package 6		Terminal	2,893,537,018,273	4,556,339,303	19,834,214,760	-Steel pipe pile and tie-rod
			77.03%	22.97%	100%	and related structural steels
Dredging	Package 8	Channel Dredging	2,308,289,287,520	10,076,461,906	22,264,229,344	- Cost for procurement huge dredgers except
			54.74%	45.26%	100%	fuel, satellite ships and common labor
	Package 9	Channel Dredging	2,441,895,123,122	14,802,130,979	27,695,337,229	- Cost for procurement huge dredgers except
			46.55%	53.45%	100%	fuel, satellite ships and common labor
	Sub-total	Package 8 + 9	4,750,184,410,642	24,878,592,885	49,959,566,573	
			50.20%	49.80%	100%	
Package 10		Sand Dyke and Revetment B	2,809,322,237,272	48,886,200	14,882,107,613	- Light beacon
			99.67%	0.33%	100%	
TOTAL			10,453,043,666,187	29,483,818,388	84,675,888,945	Exchange rate: 1VND=0.00528
			65.18%	**34.82%**	100%	

Note:
Above cost is comprised of (a) direct cost (b) indirect cost based on VN norm (c) Price escalation (foreign 3.1%, local 10.3%) and physical contingency 5%.

Source: JICA Study Team

The total of Japanese procurement portion for whole project is 34.82%

Breakdown of cost estimates for the Project compared with the result of SAPROF study is shown in the following Table.

Table 23.3.2 Breakdown of the whole Project Cost Compared with SAPROF Results

Exchange Rate (as of Mar 2010) 1 USD= JPY 89.60
1 VND= JPY 0.00528

Exchange Rate : 1 USD= JPY 89.60
1 VND= JPY 0.00528

A. SAPROF STUDY									B. DETAILED DESIGN (AS NOVEMBER 2012)									BALANCE (B - A)				Remarks
No.	Item	Unit	Quantity	Local Currency Portion (in VND)		Foreign Currency Portion (in JPY)		Total Amount	No.	Item	Unit	Quantity	Local Currency Portion (in VND)		Foreign Currency Portion (in JPY)		Total Amount	Local Currency Portion (in VND)		Foreign Currency Portion (in JPY)		
				Unit Price	Amount	Unit Price	Amount	(in JPY)					Unit Price	Amount	Unit Price	Amount	(in JPY)	Unit Price	Amount	Unit Price	Amount	
I	Construction Cost								I	Construction Cost												
1	Package 1: Channel Dredging and Disposal				2,058,210,799,200		16,473,438,600	27,340,791,620	1	Package 8 &9: Channel Dredging and Disposal				3,498,852,434,791		21,876,647,585	40,350,588,440		1,440,641,635,591		5,403,208,985	(VN 44 : JP 56)
	a General Cost	L.S.	1.0		0		0	0	1	General Cost				608,243,724,946		1,991,419,952	5,202,946,820		608,243,724,946		1,991,419,952	
									1.1	General Cost of Package 8	L.S.	1.0		302,543,055,759		525,885,344	2,123,312,678					
									1.2	General Cost of Package 9	L.S.	1.0		305,700,669,188		1,465,534,608	3,079,634,142					
									2	Provision Sum				0		225,040,000	225,040,000		0		225,040,000	
									1.1	Provision Sum of Package 8	L.S.	1.0		0		112,520,000	112,520,000					
									1.2	Provision Sum of Package 9	L.S.	1.0		0		112,520,000	112,520,000					
	b Channel Dredging	m3	32,300,860.0	159,300	2,058,210,799,200	850	16,473,438,600	27,340,791,620	3	Channel Dredging and Disposal (Dumping at Offshor	m3	37,977,503		2,890,608,709,845		19,660,187,632	34,922,601,620		832,397,910,645		3,186,749,032	(VN 43 : JP 57)
									3.1	Channel Dredging of Package 8	m3	16,693,928		1,421,026,528,797		8,288,754,401	15,791,774,473					
										a From Km 26+930 To Km 34 (1st Period_East half)	m3	7,303,678	74,078	541,041,619,254	510	3,724,644,009	6,581,343,759					
										b From Km 26+930 To Km 34 (2nd Period_West half)	m3	9,390,250	93,713	879,984,909,543	486	4,564,110,392	9,210,430,714					
									3.2	Channel Dredging of Package 9	m3	21,283,575		1,469,582,181,047		11,371,433,232	19,130,827,147					
										a From Km 34 To Km 40 (1st Period_East half)	m3	6,783,046	57,319	388,798,449,055	510	3,461,264,110	5,514,119,921					
										b From Km 34 To Km 40 (2nd Period_West half)	m3	9,887,190	84,922	839,642,581,074	464	4,590,046,763	9,023,359,591					
										c From Km 40 To Km 44+300 (2nd Period_Whole Are	m3	4,613,339	52,270	241,141,150,918	720	3,320,122,358	4,593,347,635					
2	Package 2: Revetment, Breakwater, Service Road, Service Berth, Reclamation and Soil Improvement				2,112,506,638,862		4,922,555,845	16,076,590,898	2	Package 6: Land Reclamation, Soil Improvement, Revetment/Breakwater and Public Related Area Works				2,137,521,447,748		4,051,102,479	15,337,215,723		25,014,808,886		-871,453,366	JICA Portion
2-1	a Cost of Setting Up Tents at Site	L.S.	1.0		0		0	0	2-1	a General Cost	L.S.	1.0		66,932,252,156		275,254,914	628,657,205		66,932,252,156		275,254,914	
	b Temporary Yard	m2	28,000.0	0	0	0	0	0		b Temporary Yard	m2	28,000.0	1,336,510	37,422,280,292	0	0	197,589,640		37,422,280,292		0	
										c Temporary Dike	m	1,758.0	34,979,753	61,494,405,794	0	0	324,690,463		61,494,405,794		0	
										d Provision Sum	L.S.	1.0		3,539,470,325		20,000,000	38,688,403		3,539,470,325		20,000,000	
2-2	Container Terminal				79,073,459,100		2,350,001,970	2,767,509,834	2-2	Container Terminal				97,285,943,836		759,029,674	1,272,699,458		18,212,484,736		-1,590,972,296	JICA Portion
	a Berth Structure	L.S	1.0	N.A.	0	N.A.	0	0		a Berth Structure	L.S	1.0	N.A.	0	N.A.	0	0	0	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	2,678,353,829		b Retaining Wall Behind Container Berth	m	722.0	109,196,391	78,839,794,507	855,285	617,515,751	1,033,789,866	6,141,573	1,548,681,007	-2,171,724	-1,652,740,999	
	c Earth Retaining Wall for Barge Berth	m	180.0	9,901,920	1,782,345,600	443,029	79,745,220	89,156,005		c Retaining Wall Behind Barge Berth	m	180.5	102,194,733	18,446,149,329	784,011	141,513,923	238,909,592	92,292,813	16,663,803,729	340,982	61,768,703	
2-3	Reclamation				600,087,179,286		0	3,168,460,307	2-3	Reclamation				507,696,037,439		0	2,680,635,078		-92,391,141,847		0	JICA Portion
	a Terminal Area	m3	2,955,483.0	203,042	600,087,179,286	0	0	3,168,460,307		a Terminal Area	m3	2,200,428.0	230,726	507,696,037,439	0	0	2,680,635,078	27,684	-92,391,141,847	0	0	
2-4	Soil Improvement				1,004,710,309,560		2,100,315,625	7,405,186,059	2-4	Soil Improvement				946,794,458,085		2,730,055,446	7,729,130,185		-57,915,851,475		629,739,821	JICA Portion
	a Terminal Area	m2	366,625.0	1,261,246	462,404,314,750	4,665	1,710,305,625	4,151,800,407		a Terminal Area and Access Road Areas	m2	552,327.5	1,325,042	731,857,111,013	4,943	2,730,055,446	6,594,260,992					
	b Barge Berth Area	m2	5,000.0	3,373,909	16,869,545,000	78,002	390,010,000	479,081,198														
	c Inner Revetment	m2	4,550.0	2,324,418	10,576,101,900	0	0	55,841,818		c Inner Revetment	m2	26,919.6	3,575,101	96,240,151,271	0	0	508,147,999					
	d Outer Revetment A	m2	13,104.0	2,094,872	27,451,202,688	0	0	144,942,350		d Outer Revetment A	m2	28,625.3	4,146,578	118,697,195,801	0	0	626,721,194					
	e Outer Revetment B	m2	52,459.0	5,019,258	263,305,255,422	0	0	1,390,251,749														
	f Access Road	m2	192,900.0	1,161,762	224,103,889,800	0	0	1,183,268,538														
2-5	Port Protection Facilities				169,579,987,320		0	895,382,333	2-5	Port Protection Facilities				137,323,406,866		0	725,067,588		-32,256,580,454		0	JICA Portion
	a Inner Revetment	m	750.0	40,162,324	30,121,743,000	0	0	159,042,803		a Inner Revetment	m	709.0	33,949,067	24,069,888,718	0	0	127,089,012	-6,213,257	-6,051,854,282	0	0	
	b Outer Revetment-A	m	720.0	193,692,006	139,458,244,320	0	0	736,339,530		b Outer Revetment-A	m	750.0	151,004,691	113,253,518,147	0	0	597,978,576	-42,687,315	-26,204,726,173	0	0	
2-6	Access Road behind Port				62,027,985,000		0	327,507,761	2-6	Access Road behind Port				75,739,939,321		0	399,906,880		13,711,954,321		0	JICA Portion
	a Access Road	m	1,000.0	62,027,985	62,027,985,000	0	0	327,507,761		a Access Road behind Port	m	1,000.0	75,739,939	75,739,939,321	0	0	399,906,880	13,711,954	13,711,954,321	0	0	
2-7	Public Related Facilities (CIQ)				197,027,718,596		472,238,250	1,512,544,604	2-7	Public Related Facilities (CIQ)				203,293,253,634		266,762,445	1,340,150,824		6,265,535,038		-205,475,805	JICA Portion
	a Reclamation	m3	344,131.0	203,042	69,873,046,502	0	0	368,929,686		a Reclamation	m3	205,362.0	223,007	45,797,202,571	0	0	241,809,230	19,965	-24,075,843,931	0	0	
	b Dredging	m3	103,897.0	223,127	23,182,225,919	0	0	122,402,153		b Dredging	m3	160,698.5	222,726	35,791,771,546	0	0	188,980,554	-401	12,609,545,627	0	0	
	c Quay wall	m	375.0	237,948,361	89,230,635,375	1,259,302	472,238,250	943,376,005		c Service Boat Berth	m	347.0	319,570,793	110,891,065,283	768,768	266,762,445	852,267,270	81,622,432	21,660,429,908	-490,534	-205,475,805	
	d Soil Improvement	m2	23,600.0	624,653	14,741,810,800	0	0	77,836,761		d Soil Improvement	m2	23,600.0	0	0	0	0	0	-624,653	-14,741,810,800	0	0	
										e Revetment	m	966.0	10,559,848	10,200,813,220	0	0	53,860,294	10,559,848	10,200,813,220	0	0	
										f Ship Hydrant	L.S.	1.0	612,401,014	612,401,014	0	0	3,233,477	612,401,014	612,401,014	0	0	
3	Package 3: Training Dyke and Outer Revetment -B				2,443,708,647,466		18,126,764	12,920,908,423	3	Package 10: Sand Protection Dike and Outer Revetment -B				2,093,829,188,807		40,797,982	11,096,216,099		-349,879,458,659		22,671,218	JICA Portion
3-1	a General Cost	L.S.	1.0		0		0	0	3-1	a General Cost	L.S.	1.0		94,059,328,150		0	496,633,253		94,059,328,150		0	
	b Temporary Yard	m2	32,000.0	4,356,402	139,404,864,000	0	0	736,057,682		b Temporary Yard	m2	32,000.0	1,386,396	44,364,687,109	0	0	234,245,548		-95,040,176,891		0	
										c Provision Sum	L.S.	1.0		0		10,000,000	10,000,000		0		10,000,000	
3-2	Training Dyke and Outer Revetment -B				2,304,303,783,466		18,126,764	12,184,850,741	3-2	Sand Protection Dike and Outer Revetment -B				1,955,405,173,548		30,797,982	10,355,337,298		-348,898,609,918		12,671,218	
	a Training Dike-1	m	3,110.0	119,133,461	370,505,063,710	0	0	1,956,266,736		a Sand Protection Dike	m	7,600.0	128,493,173	976,548,114,164	0	0	5,156,174,043					
	b Training Dike-2	m	3,290.0	307,135,810	1,010,476,814,900	0	0	5,335,317,583		b Outer Revetment -B	m	2,480.0	394,562,190	978,514,231,990	0	0	5,166,555,145					
	c Training Dike-3	m	1,200.0	354,387,901	425,265,481,200	0	0	2,245,401,741		c Light Beacon	nos	6.0	57,137,899	342,827,394	5,132,997	30,797,982	32,608,111					
	d Outer Revetment-B	m	2,510.0	198,346,558	497,849,860,580	0	0	2,628,647,264														
	e Light Beacon for Training Dyke	nos	4.0	51,640,769	206,563,076	4,531,691	18,126,764	19,217,417														
	Total of Construction Cost				6,614,426,085,528		21,414,121,209	56,338,290,941		Total of Construction Cost				7,730,203,071,345		25,968,548,046	66,784,020,262		1,115,776,985,817		4,554,426,837	
II	Price Escalation (Foreign 3.1% Local 10.3%)				2,687,374,729,306		2,423,685,463	16,613,024,034	II	Price Escalation (Foreign 3.1% Local 10.3%)				2,336,330,441,274		2,216,842,940	14,552,667,670		-351,044,288,032		-206,842,523	
III	Physical Contingency (5%)				465,090,040,742		1,191,890,334	3,647,565,749	III	Physical Contingency (5% of Total of Construction Cost)				386,510,153,567		1,298,427,402	3,339,201,013		-78,579,887,174		106,537,069	
	Percentage of Japan Portion						32.68%	76,598,880,723		Percentage of Japan Portion						34.82%	84,675,888,945					
IV	Consulting Service				58,071,069,646		645,546,327	952,161,575	IV	Consulting Service				57,758,561,225		946,224,342	1,251,189,545		-312,508,421		300,678,015	
V	Land Acquisition Cost				7,481,807,000		0	39,503,941	V	Land Acquisition Cost				40,377,634,000		0	213,193,908		32,895,827,000		0	
VI	Administration Cost				491,622,186,611		0	2,595,765,145	VI	Administration Cost				527,558,993,071		0	2,785,511,483		35,936,806,459		0	
VII	VAT				1,468,769,740,492		0	7,755,104,230	VII	VAT				1,627,406,789,595		0	8,592,707,849		158,637,049,103		0	
VIII	Import Tax				476,795,603,307		0	2,517,480,785	VIII	Import Tax				8,194,418,560		0	43,266,530		-468,601,184,747		0	
IX	Interest During Construction				0		467,740,070	467,740,070	IX	Interest During Construction				0		671,691,202	671,691,202		0		203,951,132	
X	Commitment Charge				0		313,826,010	313,826,010	X	Commitment Charge				0		264,694,307	264,694,307		0		-49,131,703	
	Total Project Cost				12,269,631,262,632		26,456,809,413	91,240,462,479		Total Project Cost				12,714,340,062,638		31,366,428,239	98,498,143,769		444,708,800,006		4,909,618,826	
					−①		−②							-③		−④						
		Total Amount in VND			17,280,390,621,089									18,654,951,471,477					1,374,560,850,388			
		Total Amount in JPY					91,240,462,479									98,498,143,769					7,257,681,290	
					−⑤									- ⑥								

Notes:

Above-mentioned Total as SAPROF results are slightly different from the ones shown in SAPROF report. The reasons are:

1. In the SAPROF report, the items of New navigation channel buoy, Replacement of existing buoy, and Pilot assistance system were taken into consideration. However, these are confirmed as out of scope of JICA portion.
2. Round Difference in small digit numbers.

Result :

	Variation in VND Portion (Total Construction cost: DD Result/ SAPROF)	1.04
	Variation in JPY Portion (Total Construction cost: DD Result/ SAPROF)	1.19
	Variation in Total (Total Construction cost: DD Result/ SAPROF)	1.08
Reference	Total in JPY with Considering Present Exchange Rate (1VND= 0.0037JPY)	0.86

24. FINANCIAL ANALYSIS

24.1 Methodology and Assumption on Financial Analysis

24.1.1 Financial model

Financial model, which is called “OCDI-Ides financial model”, is composed of financial model for Container Terminal (CNT) and Consolidated Financial Statements of terminal using excel program.

The model is for port lease (concession) and is applied to estimate the financial conditions of private operator (Terminal Operating Company: represented by the name TOC) and public sector (Port Management Body: represented by the name PMB[1]) during the project life under the lease (concession) scheme.

Financial statements are based on Vietnamese GAAP (GAAP: Generally Accepted Accounting Principle) and calculated automatically by inputting investment costs, throughput container at the terminal, vessels (type, size, number), itemized operating expenses and maintenance expenses etc.

The model consists of following sheets;

- Risk Analysis: inputting lease (concession) conditions and get the financial indicators corresponding to input lease (concession) conditions for various cases each of which linked with sensitivity analysis sheet.
- Sensitivity: comprehensive table for sensitivity analysis showing major input data and outputs for each case.
- TOC: estimated financial statements (income statement, cash flow statement and balance sheet) of TOC for each year of lease (concession) period.
- PMB: estimated financial statements of PMB
- all: consolidated financial statements of PMB and TOC
- Reinvestment & Repayment: itemized reinvestment & repayment schedule for equipment of TOC
- Depreciation: calculation of itemized depreciation cost during lease (concession) period
- Operating Cost: calculation of operating cost both for TOC and PMB during lease (concession) period
- Port Demand: estimation of container & vessel demand during the lease (concession) period for the item corresponding to each item of port tariff and port charge
- Port Charge: calculation of fee during lease (concession) period corresponding to each item of charge
- Port Tariff: calculation of fee during lease (concession) period corresponding to each item of port due
- Local Loan Repayment: repayment schedule of loans for local portion
- Foreign Loan Repayment: repayment schedule of JICA loan (PMB) and JBIC loan (TOC) corresponding to respective loan conditions
- Cost Allocation: construction cost and disbursement schedule corresponding to work schedule of PMB
- Add. Invest: construction and procurement cost and disbursement schedule corresponding to work schedule of TOC

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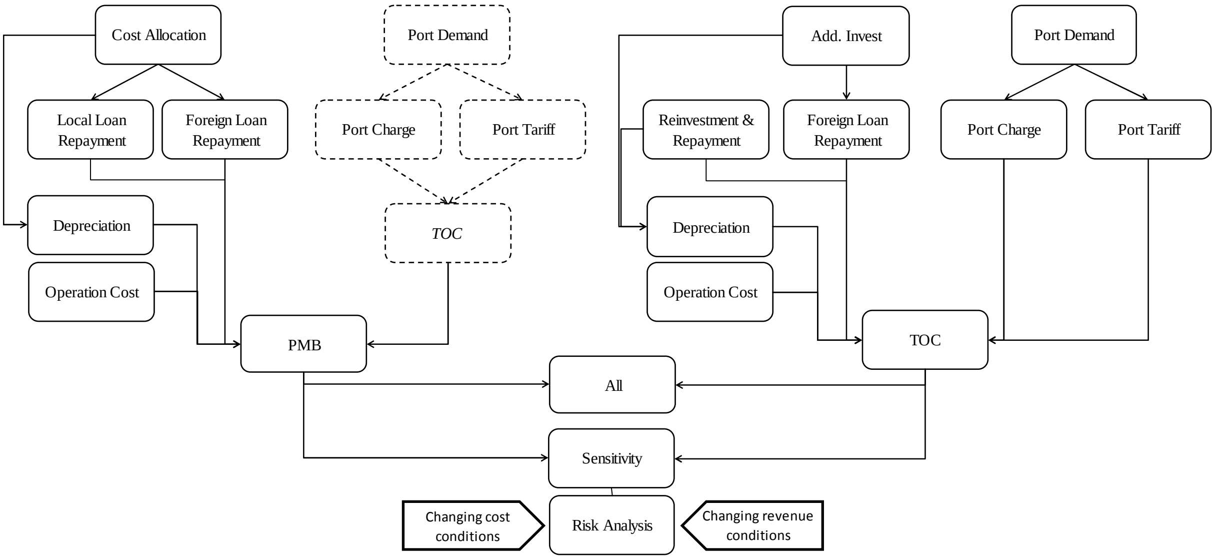
[1] PMB in this Chapter is imaginary entity for convenience. Revenue and expenditure of PMB is limited only to those directly related with terminal.

These 15 sheets are linked together to get the estimated financial statements and sensitivity sheet based on the calculation steps shown in below figure.



Source: JICA Study Team

Figure 24.1.1 Procedure of Financial Analysis

24.1.2 Methods of financial evaluation

1) FIRR

Financial feasibility of the container berth No. 1 and No. 2 is to be analyzed through an estimated FIRR (Financial Internal Rate of Return), the indicator is to assess the financial soundness by indicating a discount rate which leads discounted cost and revenue to be equivalent through the project life.

$$\sum(B_i - C_i)/(1+r)^{i-1} = 0$$

Where,
B_i : revenue of i-th year,
C_i : cost of i-th year
r : discount rate

In this calculation, revenue from financing activity is excluded from total revenue, and depreciation cost and repayment of loan are excluded from cost.

Weighted average interest of various loan used for the Project is used as a criteria.

2) Financial efficiency

Financial efficiency is to be analyzed through evaluation of following financial indicators besides FIRR during the lease (concession) period;

- Return on Net Fixed Asset
  Net operating income/net fixed asset (%)

This indicator is to evaluate the profitability of TOC and PMB, and it is necessary to maintain the value over weighted average interest of loans used for the Project.

- Operating Ratio & Working Ratio
  Operating cost/operating revenue (%) (O.R)
  (Operating cost – depreciation cost)/operating revenue (%) (W.R)

These indicators are to evaluate the effectiveness of the business operation and in case of port business, under 70~75% for O.R and under 50~60% for W.R are said to be necessary for effective organization.

- Debt Service Coverage Ratio (DSCR)
  (Operating revenue +depreciation cost)/total repayment amount for long term loan

This indicator is to evaluate whether operating revenue can cover the necessary repayment amount for long term loan and is necessary to be over 1.0 and desirably over 1.75.

24.1.3 Premise for financial analysis

1) Project life

Considering the service lives of the port facilities, the project life in the financial analysis is assumed to be 35 years from the year 2013 and the terminal operation will start in 2017. We call the year 2017 as the ‘Base Year’. Neither inflation nor an increase in nominal wages is considered during an operation period in the project life.

All costs and revenues are indicated in price as of 2012, when the price survey was conducted (US$ 1.00 = JPY 89.60, VND 1.00 = 0.00528).

2) Cash flow

The GOV implements initial investment of infrastructure for container berth No. 1 & 2 funded by JICA and PMB receives lease (concession) fees from TOC for repayment of JICA loan. Revenue of PMB related to the berth No. 1 & 2 is only assumed the lease (concession) fees.

TOC carries out yard pavement and quay wall construction, etc. of container berth No. 1 & 2 and procures equipment to handle containers. After completion of the works, TOC starts the container terminal operation and earns revenues by handling and storage of containers and so on.

Revenues from tonnage due and navigation safety fee etc. and costs of initial investment/maintenance of channel, training dyke and public related facilities are separated from the financial analysis because these costs will be covered used by all the vessels using all the terminals in Lach Huyen and Hai Phong area and not by only users of the berth No. 1 & 2 terminals. In addition, channel and training dyke will be managed another state owned company (Maritime Safety Company No. 1) not only by fees nor charges from users but also by the GOV budget, in accordance with Decision No. 26/2009/QQ-TTg dated Feb. 20, 2009.

3) Revenue

Assuming container handling charge at berth No.1 & 2 is shown in Table 24.1.1 on the basis of information of a container terminal operation company and a container carrier in Vietnam.

Port tariff applying to the financial model is only wharfage, and it is summarized as Table 24.1.2in accordance with Decision No. 98/2008/QD-BTC.

Table 24.1.1 Container Handling Charge

Container Handling Charge	Unit	
20-feet container (Laden)	USD/con.	76.70
20-feet container (Empty)	USD/con.	53.69
40-feet container (Laden)	USD/con.	112.09
40-feet container (Empty)	USD/con.	78.46
Over-40-feet container (Laden)	USD/con.	150.00
Over-40-feet container (Empty)	USD/con.	105.00
Reefer 20-feet container	USD/con.	76.70
Reefer 40-feet container	USD/con.	112.09

Charge for Storage (Box-days)	Unit	
20-feet container (Laden)	USD/con.-day	1.45
20-feet container (Empty)	USD/con.-day	0.73
40-feet container (Laden)	USD/con.-day	2.18
40-feet container (Empty)	USD/con.-day	1.09
Over-40-feet container (Laden)	USD/con.-day	3.27
Over-40-feet container (Empty)	USD/con.-day	1.73
Reefer 20-feet container	USD/con.-hour	1.63
Reefer 40-feet container	USD/con.-hour	2.45

Others	Unit	
CFS charge: Import	USD/RT	7.14
CFS charge: Export	VND/RT	71,429
PTI for Reefer container	USD/con.	22.73
Mooring/Unmrg (10,001<GRT<15,000)	USD/each	66.00
Mooring/Unmrg, 15,001<GRT	USD/each	83.00

Source: JICA Study Team

Table 24.1.2 Port Tariff

Wharfage		
For transport means	98/2008/QD-BTC	
Stay at wharf	0.0031	USD/GT-hour
Stay at buoy	0.0013	USD/GT-hour
For cargoes		
Handling at wharfage	98/2008/QD-BTC	
Conventional cargoes	0.180	USD/ton
20-feet container	1.600	USD/con.
40-feet container	3.200	USD/con.
Over-40-feet container	4.000	USD/con.
Handling at buoy	0.090	USD/ton

The JICA Study team estimated future average size of vessel, the calls and GT-hour as follows.

Table 24.1.3 Call Ships of Container and Total GT-hour

Size of Vessel (GRT) (A)	No. of Call (2017~) (B)	Total GT (C)=(AxB)	Berthing Hour per Vessel (D)	Total GT-hour (CxD)	Remarks DWT
16,000	156	2,496,000	19.30	48,166,603	20,000
38,000	156	5,928,000	17.60	104,342,772	50,000
72,000	104	7,488,000	29.91	223,955,592	80,000
82,000	52	4,264,000	29.47	125,670,857	100,000
			TOTAL	502,135,825	

Source: JICA Study Team

Regarding container handling, a capacity of the container terminal of the berth No. 1 & 2 is estimated around 900,000 TEU, so demand volume reaches its capacity as of 2017.

Table 24.1.4 Calculated Container Volume including Empty Container

			2017	2018	2019	2020	2021
Total Container Volume at Terminal		TEUs	**806,000**	**900,000**	**900,000**	**900,000**	**900,000**
Container Volume by Each Type							
20-feet container (Laden)	20 feet	Box	174,096	194,400	194,400	194,400	194,400
20-feet container (Empty)	20 feet	Box	75,227	84,000	84,000	84,000	84,000
40-feet container (Laden)	40 feet	Box	168,525	188,179	188,179	188,179	188,179
40-feet container (Empty)	40 feet	Box	72,819	81,312	81,312	81,312	81,312
Over-40-feet container (Laden)	Over-40	Box	6,190	6,912	6,912	6,912	6,912
Over-40-feet container (Empty)	Over-40	Box	2,407	2,688	2,688	2,688	2,688
Reefer 20-feet container	20 feet	Box	19,344	21,600	21,600	21,600	21,600
Reefer 40-feet container	40 feet	Box	18,725	20,909	20,909	20,909	20,909
TOTAL		Box	537,333	600,000	600,000	600,000	600,000

Note: TEU/ Box rate is set at 1.50
Source: JICA Study Team

4) Covered components and cost

The scope of the financial analysis covers the container berth No. 1 & 2 of the Project. Major components both of PMB/GOV and TOC, their work periods and the capital cost are summarized as follows:

Table 24.1.5 Development Schedule and Capital Cost of PMB/GOV

	Executed by	Work period (yr)	Cost (000 Yen / %)	
Temporary Yard Construction Works	PMB	2013~2013	1,189,626	88% (incl. TAS: 1%)
Container Terminal Civil Works	PMB	2014~2014	1,272,699	
Reclamation Works	PMB	2013~2016	2,680,635	
Soil Improvement Works	PMB	2013~2016	7,729,130	
Port Access Road	PMB	2016~2017	399,907	
Escalation & P. Contingency* (EPC)	PMB	2013~2017	3,555,653	
Tender Assistance and Supervision*(TAS)	PMB	2013~2017	248,649	
Interest During Construction* (IDC)	PMB	2013~2017	72,596	
Commitment Charge* (CC)	PMB	2013~2017	50,912	
PMB Initial Investment			17,199,808	
*Administration Cost, VAT, etc. * (AC)*	*GOV*	2013~2015	2,303,979	12%
Total Project Cost of Container Berth No. 1 & 2			19,503,788	100%

* Figures of EPC, TAS, IDC, CC and AC mentioned above are calculated by using an allocation rate between the amount of the berth No. 1 & 2 and that of other components of the Project
Source: JICA Study Team

Table 24.1.6 Development Schedule and Capital Cost of TOC

Unit: million US$

	2014	2015	2016	2017	Total
Total Cost	12.7	27.7	73.5	217.8	331.7

Source: Figures of Capital Cost is cited in “Revised F/S for Component B of Hai Phong International Gateway Port Construction Investment Project”, but the disbursement is rescheduled to match the construction schedule of D/D report by the JICA Study Team.

From the start of an operation and through the project life, container handling equipment that is procured by TOC in the initial stage will be renewed to avoid decreases profitability when its depreciation period expires. The shorter ones are 4 to 10 years. The longer lives are 15 to 25 years.

It is assumed that the GOV will establish management office at Lach Huyen Port and the office has 18 staffs for management and supervision of a lease (concession) contract. Below table shows annual personnel cost and number of staff by position.

Table 24.1.7 Manning schedule and Wage of PMB

Category	Nos	Salary M. VD/M	14Mo (30% O/H) M. VD/yr	Remark
General Manager	1	18.0	327.6	
D. General Manager	1	14.0	254.8	
Secretary	2	8.0	291.2	
Manager	2	11.0	400.4	
Assist. Manager	4	9.0	655.2	
Staff	8	7.0	1,019.2	
Total	18		2,948.4	
Total US$			$173,742	

Source: JICA Study Team

TOC's annual personnel cost and number of staff by position are shown in the below:

Table 24.1.8 Manning schedule and Wage of TOC

Personnel Organization(Office)-Lach Huyen

Category	Nos	Salary/Mo	Salary/yr	Add. manning		Remark
		(M.VD)	(Incl. 30% O/H)	Yr. 2017		
CEO (G. Manager)	1	140.0	2,548.0	0	1	
CFO (treasurer)	1	100.0	1,820.0	0	1	
Corporate Secretary	1	80.0	1,456.0	0	1	
Operation Staff						
Manager	2	15.0	546.0	add. 1	3	
Assist. Manager	13	12.0	2,839.2	add. 4	17	Incl.CFS Manager
Maintenance & Repair						
Manager	1	15.0	273.0	0	1	
Assist. Manager	2	12.0	436.8	0	2	
Accounting						
Manager	1	15.0	273.0	0	1	
Staff	6	7.5	819.0	add. 1	7	
General Affair & Personnel						
Manager	1	15.0	273.0	0	1	
staff	7	7.5	955.5	add. 2	9	Incl.CPU Operator
	36		12,239.5		44	
	1$=	16,970	$721,243			

Labor

Category	Nos	Salary/Mo	Salary/yr	Add. manning		Remark
		(M.VD)	(Incl. 30% O/H)	Yr. 2017		
Ship,Yard Operation						
Boss	16	10.8	3,145.0	add. 6	22	D. & N.
G.C.Operator	24	9.0	3,931.2	add. 8	32	D. & N.
RTG & Heavy Lift Equip. Operator	45	8.1	6,633.9	add. 15	60	D. & N.
Tractor Driver	35	7.2	4,586.4	add. 10	45	D. & N.
Longshore Worker	100	6.3	11,466.0	add. 40	140	D. & N.
Marine Clerk	45	9.0	7,371.0	add. 15	60	D. & N.
M&R						
Boss	4	10.8	786.2	add. 2	6	D. & N.
Mechanic	35	7.2	4,586.4	add. 15	50	D. & N.
Electrician	6	8.1	884.5	add. 2	8	D. & N.
CFS Operation						
Boss	1	10.8	196.6	add. 1	2	
Driver & Worker	33	7.2	4,324.3	add. 18	51	Subject to Vol.
Clerk	13	7.2	1,703.5	add. 6	19	Incl. office clerk
	357		49,615.0		495	
	1$=	16,970	$2,923,690			

Source: JICA Study Team

Other operating cost of the berth No. 1 & 2 is shown in Table 24.1.9.

Table 24.1.9 Other Operating Cost

	PMB	**TOC**
Administration and Other Cost	-	100% of Personnel cost
Maintenance Dredging	(by port authority)	Approx. 132,000m^3/year
Maintenance Cost	Infrastructure: 0.2% of the total cost of berth No. 1 & 2 Equipment: 1% of the equipment cost Electric, fuel & utilities: 2% of the equipment cost	
Depreciation	Civil structure (Port facilities): 40 years, Equipment: 4 - 25 years	

Source: JICA Study Team

5) Tax system

Basic corporate income tax (CIT) of TOC at 25% will be imposed, but following tax incentive will be given according to Circular No.130/2008/TT-BTC because the project site of berth No. 1 & 2 is located in Din Vu-Cat Hai economic zone.

- Tax exemption for 4 years and reduction to 5% for 9 years and incentive of 10% for 2 years (Clause II 1.3 and Clause III 1.3)

As to the VAT, 10% will be imposed. (Circular No. 129/2008/TT-BTC)

Import Tax (10%) will be exempted on equipment to form fixed asset of the foreign invested Terminal Operating Company. (Decrees No. 87/2010/ND-CP)

Below table shows the summary of applicable tax and duty incentives to the financial model.

Table 24.1.10 Applicable Tax and Duty Incentives

	CIT	**VAT**	**Import Tax**
PMB	0%	0%	0%
TOC	25%	10%	0%
CIT incentive: 1-4yr	0%		
CIT Incentive: 5-13yr	5%		
CIT Incentive: 14-15yr	10%		

Source: JICA Study Team

6) Conditions of fund raising

a) PMB and GOV

Main conditions of the loan are summarized as follows:

- JICA STEP Loan
  Amount 1 : 16,951 million JPY (0.87 of the capital cost for berth No. 1 & 2)
  Interest rate 1 : 0.2% for construction
  Amount 2 : 249 million JPY (0.01 of the capital cost for berth No. 1 & 2)
  Interest rate 2 : 0.01% for tender assistance
  Loan period : 40 years, including a grace period of 10 years

The GOV is required to bear a local portion of the project cost such as administration cost and taxes. The JICA Study Team makes an assumption of financing conditions as follows:

- General Account Budget of GOV
  Amount : 2,304 million JPY (0.12 of the capital cost for berth No. 1 & 2)
  Discount Rate : 13.00% (929/QD-NHNN on 29 April 2011)

b) TOC

Regarding construction works and equipment procurement as initial investment, it is assumed that TOC raises funds by debt: JBIC syndicate with private banks, and by equity. Conditions of the loan and equity on the basis of SAPROF Study are shown in below:

- JBIC and Private Bank
  Amount : 0.70 of TOC's capital cost
  Loan period : 17 years, including a grace period of 5 years
  Interest rate : 5.0%
  Income tax : 15.4% (weighted average rate for 30 years)
  Repayment : Fixed amount repayment of principal
- Equity of TOC
  Amount : 0.30 of TOC's capital cost
  Cost of Capital : 15.0%

As to drawdown of the loan, proceeds of the loan are withdrawn in accordance with the progress of the capital investment after the total equity is invested

7) Weighted average cost of capital (WACC)

a) PMB and GOV

Weighted average cost of capital (PMB/GOV)

$$1.74\% \approx 0.2\% \times 0.87 + 0.01\% \times 0.01 + 13.0\% \times 0.12$$

b) TOC

Weighted average cost of capital (TOC)

$$7.47\% \approx 5.0\% \times 0.70 \times (1 - 0.154) + 15.0\% \times 0.30$$

8) Lease (Concession) fee/Land use fee

As for revenue of PMB (expenditure of TOC), the JICA Study Team gave due consideration to the following matters regarding lease (concession) fixed and variable fee;

- TOC pays a fixed fee to PMB as a lease fee of facilities of the project. The amount is equivalent to the necessary level for repayment of the GOV to JICA. It is assumed to be US$ 6.7 million per annum during lease (concession) term: repayment period is from 2017 to 2046, and
- TOC pays a variable fee to PMB every year. The amount will be subject to share of TOC's revenue as follows;
  5% of gross annual returns during years one to five,
  10% of gross annual returns during years six to the end of lease (concession) period.

In addition, it is assumed that TOC also have to pay a land lease fee of US$ 600 thousand per year to Hai Phong People's Committee based on information of SAPROF report.

24.2 Evaluation of the Project

24.2.1 FIRR

As a base case under above-mentioned premises, the FIRR for financial analysis are conducted and in order to see if the project is still financially viable when some factors vary, the following cases are examined as sensitivity analyses:

- Case A: The initial investment cost both of PMB/GOV and TOC increases by 10%
- Case B: The handling container volume decreases by 10%
- Case C: The initial investment cost both of PMB/GOV and TOC increases by 10% and the handling container volume decreases by 10% (Worst scenario)

Table 24.2.1 FIRR of both parties

	Threshold level	Base case	Case A	Case B	Case C
FIRR: PMB	*1.74%*	3.63%	3.60%	3.39%	3.37%
FIRR: TOC	*7.47%*	8.93%	8.67%	6.80%	6.53%

Source: JICA Study Team

The results of FIRRs of PMB on base case and sensitivity case are exceeding the weighted average interest rate of the loans as threshold level. On the other hand, those of TOC, especially case B and C, are fallen below the threshold level. These results mean that a decreasing of handling container volume is more adverse element on TOC's financial soundness than an increase of the initial investment cost. It is suggested that both parties should pay attentions to acquire clients as well as to manage each initial capital cost.

24.2.2 Financial efficiency

Below table shows the summary of financial indicators.

Table 24.2.2 Financial indicator of both parties

PMB	ave. ROA	max OR	max WR	min DSCR	TOC	ave. ROA	max OR	max WR	min DSCR
Base Case	4.89%	0.55	0.08	1.57	Base Case	10.33%	0.65	0.44	1.16
Case A	4.66%	0.52	0.08	1.52	Case A	10.00%	0.66	0.45	1.14
Case B	4.51%	0.57	0.09	1.49	Case B	7.67%	0.71	0.47	0.97
Case C	4.33%	0.53	0.08	1.45	Case C	7.35%	0.72	0.48	0.95

Source: JICA Study Team

1) Return on Net Fixed Asset

Return on Net Fixed Asset of PMB is high because the lease (concession) fixed fee is set to cover the project cost including loan interest. That of TOC is fallen below the criteria in case C because revenue of TOC decreases for cost growth and decline in demand.

2) Operating Ratio & Working Ratio

O.R and W.R both of PMB and TOC are under 70~75% and 50~60%, respectively over the project life.

3) Debt Service Coverage Ratio (DSCR)

DSCR of PMB is higher than 1.0 through the project life. That of TOC is fallen below the criteria in case B & C the same as the reason of Return on Net Fixed Asset.

These results mean that a decreasing of handling container volume is more adverse element on TOC's financial soundness than an increase of the initial investment cost. It is suggested that both parties should pay attentions to acquire clients as well as to manage each initial capital cost.

24.2.3 Profit share

As a result of financial analysis, both of the GOV/PMB and TOC will be able to share reasonable profit, and retained earnings at the end of the lease (concession) period is almost equal in reinvesting the same investment under the assumption of exchange rate of US$1.00=JP¥89.60 as is shown in below table.

Table 24.2.3 Comparison of Retained Earnings vs. Initial Investment on base case

Unit: 1,000

	JICA (JPY)	GOV (JPY)	Total (JPY)	**Total (USD)**	**R/E (USD)**
PMB	17,187,672	2,236,059	19,423,731	**216,783**	**199,765**

	JBIC (USD)	Equity (USD)	**Total (USD)**	**R/E (USD)**
TOC	240,274	99,524	**339,798**	**405,020**

Source: JICA Study Team

It can be said that desired performance level of 900,000 TEUs/year can maintain sound financial condition during the lease (concession) period under the condition mentioned above.

However, the Project should be reviewed and reevaluated from time to time, in particular when the financial environment is expected to drastically change. It is also recommendable that a New Port Management Body and a TOC should make continuous efforts to improve the quality of the service and cargo handling efficiency, to secure the expected cargo volume.

Table 24.2.4 Estimated Financial Indices on Base Case

Concession Fee	1st Prd	2nd Prd	3rd Prd
Fixed	6,651	6,651	6,651
Variable	2,935	5,871	5,871

		1000$
	Land Use Fee (Lease Fee)	600
		0

TOC			Financial Indicators									2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	PROFITABILITY (Net Operating Income/ Net Fixed Assets)																						
		Rate of Return on Net Fixed Assets (Criterion		7.47%								5.92%	7.61%	7.94%	8.31%	8.66%	7.94%	8.36%	8.39%	8.85%	8.95%	9.46%	10.04%
	OPERATIONAL EFFICIENCY																						
		Operating Ratio (Criterion: under 0.7– 0.75)										0.64	0.60	0.60	0.60	0.60	0.65	0.65	0.65	0.65	0.65	0.65	0.65
		Working Ratio (Criterion: under 0.5– 0.6)										0.40	0.39	0.39	0.39	0.39	0.44	0.44	0.44	0.44	0.44	0.44	0.44
	LOAN REPAYMENT CAPACITY																						
		Debt Service Coverage Ratio (Criterion: over 1.0)										0.00	1.16	1.20	1.24	1.28	1.21	1.25	1.30	1.24	1.30	1.25	1.31
			concessionn fee rate (fixed)									100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
			concession fee rate (variable)									0%	0%	0%	0%	0%	10%	10%	10%	10%	10%	10%	10%
			total concession fee/revenue									19%	17%	17%	17%	17%	22%	22%	22%	22%	22%	22%	22%
		MAXIMUM CONCESSION FE	NPV(Profit/Reven	75.21%																			
			Financial Indicators			2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
	PROFITABILITY (Net Operating Income/ Net Fixed Assets)																						
		Rate of Return on Net Fixed Assets (Criterion		7.47%		10.69%	11.44%	9.26%	9.30%	9.86%	10.49%	11.21%	11.28%	12.12%	13.09%	14.23%	14.33%	10.60%	11.34%	12.19%	13.15%	14.30%	10.50%
	OPERATIONAL EFFICIENCY																						
		Operating Ratio (Criterion: under 0.7– 0.75)				0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
		Working Ratio (Criterion: under 0.5– 0.6)				0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
	LOAN REPAYMENT CAPACITY																						
		Debt Service Coverage Ratio (Criterion: over 1.0)				1.37	2.46	9.86	2.56	2.30	2.42	2.81	2.97	2.88	3.05	3.24	3.45	2.99	2.05	2.33	2.44	2.57	2.71
	FINANCIAL INTERNAL RATE OF RETURN				8.9%																		
			concessionn fee rate (fixed)			100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
			concession fee rate (variable)			10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
			total concession fee/revenue			22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
		MAXIMUM CONCESSION FEE RATE	NPV(Profit/Revenue	75.21%																			
			Retained Earnings Total		405,020	($1,000)																	
PMB			Financial Indicators									2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	PROFITABILITY (Net Operating Income/ Net Fixed Assets)																						
		Rate of Return on Net Fixed Assets (Criterion		1.74%								1.96%	2.14%	2.19%	2.24%	2.29%	3.88%	3.97%	4.06%	4.16%	4.27%	4.38%	4.49%
	OPERATIONAL EFFICIENCY																						
		Operating Ratio (Criterion: under 0.7– 0.75)										0.55	0.53	0.53	0.53	0.53	0.41	0.41	0.41	0.41	0.41	0.41	0.41
		Working Ratio (Criterion: under 0.5– 0.6)										0.08	0.08	0.08	0.08	0.08	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	LOAN REPAYMENT CAPACITY																						
		Debt Service Coverage Ratio (Criterion: over 1.0)										8.32	7.27	7.27	7.27	2.02	1.57	1.57	1.57	1.57	1.58	1.58	1.58
			Financial Indicators			2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
	PROFITABILITY (Net Operating Income/ Net Fixed Assets)																						
		Rate of Return on Net Fixed Assets (Criterion		1.74%		4.61%	4.74%	4.88%	5.02%	5.17%	5.33%	5.50%	5.69%	5.88%	6.09%	6.32%	6.56%	6.83%	7.11%	7.42%	7.76%	8.13%	8.53%
	OPERATIONAL EFFICIENCY																						
		Operating Ratio (Criterion: under 0.7– 0.75)				0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
		Working Ratio (Criterion: under 0.5– 0.6)				0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	LOAN REPAYMENT CAPACITY																						
		Debt Service Coverage Ratio (Criterion: over 1.0)				1.59	1.59	1.59	1.59	1.60	1.60	1.60	1.60	1.61	1.61	1.61	1.61	1.62	1.62	1.62	1.63	1.63	1.63
			Retained Earnings Total		199,765	($1,000)																	
	FINANCIAL INTERNAL RATE OF RETRUN				3.6%																		

Table 24.2.5 Estimated Income Statement of PMB on Base Case

Income Statement of the Lach Huyen Project ($'000s)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
REVENUE																																		
Concession Fixed Fee (from TOC)					6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651
Concession Variable Fee (from TOC)					2,630	2,935	2,935	2,935	2,935	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871
TOTAL REVENUE					9,281	9,586	9,586	9,586	9,586	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522	12,522
EXPENSE																																		
DIRECT EXPENSE																																		
Maintenance of equipment (for PMB asset)					167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167
Fuel & Utilities (for PMB)					167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167
Maintenance of infrastructures (PMB: major repairs)					280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280
Total Direct Expense					613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613	613
INDIRECT EXPENSE																																		
Depreciation (infrastructures)					3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781
Depreciation (Consulting service)					56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Depreciation (PMB Local Portion)					499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499
Total Indirect Expense					4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336
GENERAL & ADMINISTRATIVE																																		
PMB Lach Huyen Port Office Administration					174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174
Total General & Administrative					174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174
TOTAL EXPENSE					5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123	5,123
OPERATING INCOME					4,158	4,463	4,463	4,463	4,463	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399
OTHER INCOME/(EXPENSE)																																		
Repayment of Interest on Initial Loans (PMB)					189	378	378	378	378	369	357	344	332	319	307	295	282	270	257	245	233	220	208	195	183	171	158	146	133	121	109	96	84	71
TOTAL OTHER					189	378	378	378	378	369	357	344	332	319	307	295	282	270	257	245	233	220	208	195	183	171	158	146	133	121	109	96	84	71
EARNINGS before TAXES					3,968	4,085	4,085	4,085	4,085	7,029	7,042	7,054	7,067	7,079	7,091	7,104	7,116	7,129	7,141	7,154	7,166	7,178	7,191	7,203	7,216	7,228	7,240	7,253	7,265	7,278	7,290	7,302	7,315	7,327
INCOME TAX (for PMB)					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	0	0
NET INCOME after tax					3,968	4,085	4,085	4,085	4,085	7,029	7,042	7,054	7,067	7,079	7,091	7,104	7,116	7,129	7,141	7,154	7,166	7,178	7,191	7,203	7,216	7,228	7,240	7,253	7,265	7,278	7,290	7,302	7,315	7,327
Retained Earnings					3,968	8,053	12,138	16,223	20,307	27,337	34,379	41,433	48,500	55,579	62,670	69,774	76,890	84,019	91,160	98,314	105,479	112,658	119,848	127,052	134,267	141,495	148,735	155,988	163,253	170,531	177,821	185,123	192,438	199,765

Table 24.2.6 Estimated Cash Flow Statement and Balance Sheet of PMB on Base Case

Statement of Cash Flows ($'000s) of Lach Huyen	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
Cash Beginning	0	0	0	0	0	7,472	15,061	22,650	30,239	34,684	38,928	43,184	47,453	51,735	56,029	60,335	64,654	68,985	73,328	77,684	82,052	86,433	90,826	95,232	99,650	104,080	108,523	112,978	117,445	121,925	126,418	130,922	135,440	139,969
Cash Inflow	43,969	69,386	48,868	48,712	14,342	8,799	8,799	8,799	8,799	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735
CASH FLOWS FROM OPERATING ACTIVITIES	0	0	0	0	8,494	8,799	8,799	8,799	8,799	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735	11,735
Operating Income	0	0	0	0	4,158	4,463	4,463	4,463	4,463	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399	7,399
Depreciation Expense (Infrastructures)	0	0	0	0	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781	3,781
Depreciation (Consulting Service)	0	0	0	0	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
Depreciation (PMB Local Portion)	0	0	0	0	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	499
[Total No cash Items included in Net Income (Depreciation)]	0	0	0	0	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336
CASH FLOWS FROM FINANCING ACTIVITIES	43,969	69,386	48,868	48,712	5,848	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	0
Initial Long-Term Loans (PMB)	38,736	61,024	42,959	42,773	5,659	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	0
Long-Term Loans (PMB Local Portion)	5,194	8,197	5,789	5,776	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	0	0
Capitalized Interest (Long-term: Government)	38	166	120	162	189																													
Cash Outflow	43,969	69,386	48,868	48,712	6,869	1,210	1,210	1,210	4,355	7,490	7,478	7,466	7,453	7,441	7,428	7,416	7,404	7,391	7,379	7,366	7,354	7,341	7,329	7,317	7,304	7,292	7,279	7,267	7,255	7,242	7,230	7,217	7,205	7,193
CASH FLOWS FROM INVESTING ACTIVITIES	43,969	69,386	48,868	48,712	5,848	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	0
Construction in Progress (PMB)	38,736	61,024	42,959	42,773	5,659	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	0
Capitalized Interest (Long-term: Government)	38	166	120	162	189	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	0
Assets Acqired Local Portion (PMB)	5,194	8,197	5,789	5,776	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	0	0
CASH FLOWS FROM FINANCING ACTIVITIES	0	0	0	0	1,021	1,210	1,210	1,210	4,355	7,490	7,478	7,466	7,453	7,441	7,428	7,416	7,404	7,391	7,379	7,366	7,354	7,341	7,329	7,317	7,304	7,292	7,279	7,267	7,255	7,242	7,230	7,217	7,205	7,193
Repayment of Initial Loan Principal (PMB)	0	0	0	0	0	0	0	0	3,145	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289	6,289
Repayment of Interest on Initial Loans (PMB)	0	0	0	0	189	378	378	378	378	369	357	344	332	319	307	295	282	270	257	245	233	220	208	195	183	171	158	146	133	121	109	96	84	71
Repayment of Lon-Term Loan Principal (PMB Local Portion)	0	0	0	0	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832	832
Cash Inflow - Cash Outflow	0	0	0	0	7,472	7,589	7,589	7,589	4,444	4,244	4,257	4,269	4,281	4,294	4,306	4,319	4,331	4,343	4,356	4,368	4,381	4,393	4,406	4,418	4,430	4,443	4,455	4,468	4,480	4,492	4,505	4,517	4,530	4,542
Cash Ending	0	0	0	0	7,472	15,061	22,650	30,239	34,684	38,928	43,184	47,453	51,735	56,029	60,335	64,654	68,985	73,328	77,684	82,052	86,433	90,826	95,232	99,650	104,080	108,523	112,978	117,445	121,925	126,418	130,922	135,440	139,969	144,511

Balance Sheet ($'000s)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
CURRENT ASSETS	0	0	0	0	7,472	15,061	22,650	30,239	34,684	38,928	43,184	47,453	51,735	56,029	60,335	64,654	68,985	73,328	77,684	82,052	86,433	90,826	95,232	99,650	104,080	108,523	112,978	117,445	121,925	126,418	130,922	135,440	139,969	144,511
Cash and Cash Equivalent Investments	0	0	0	0	7,472	15,061	22,650	30,239	34,684	38,928	43,184	47,453	51,735	56,029	60,335	64,654	68,985	73,328	77,684	82,052	86,433	90,826	95,232	99,650	104,080	108,523	112,978	117,445	121,925	126,418	130,922	135,440	139,969	144,511
PROPERTY, PLANT AND EQUIPMENT	43,969	113,355	162,223	210,935	212,447	208,111	203,775	199,438	195,102	190,766	186,430	182,094	177,758	173,422	169,086	164,750	160,414	156,078	151,742	147,406	143,070	138,734	134,398	130,062	125,726	121,389	117,053	112,717	108,381	104,045	99,709	95,373	91,037	86,701
Construction in Progress (PMB)	38,775	61,190	43,079	42,936	5,848	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	0
Fixed Assets (PMB)	38,775	99,964	143,043	185,979	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827	191,827
Accumulated Depreciation (PMB)	0	0	0	0	3,837	7,674	11,511	15,348	19,185	23,022	26,859	30,695	34,532	38,369	42,206	46,043	49,880	53,717	57,554	61,391	65,228	69,065	72,902	76,739	80,576	84,413	88,250	92,086	95,923	99,760	103,597	107,434	111,271	115,108
Net Fixed Assets (PMB)	38,775	99,964	143,043	185,979	187,990	184,153	180,316	176,479	172,642	168,805	164,968	161,131	157,294	153,457	149,620	145,783	141,947	138,110	134,273	130,436	126,599	122,762	118,925	115,088	111,251	107,414	103,577	99,740	95,903	92,066	88,229	84,393	80,556	76,719
Fixed Assets (PMB Local Portion)	5,194	13,391	19,180	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956	24,956
Accumulated Depreciation (PMB Local Portion)	0	0	0	0	499	998	1,497	1,996	2,496	2,995	3,494	3,993	4,492	4,991	5,490	5,989	6,489	6,988	7,487	7,986	8,485	8,984	9,483	9,982	10,482	10,981	11,480	11,979	12,478	12,977	13,476	13,975	14,474	14,974
Net Fixed Assets (PMB Local Portion)	5,194	13,391	19,180	24,956	24,457	23,958	23,459	22,960	22,460	21,961	21,462	20,963	20,464	19,965	19,466	18,967	18,467	17,968	17,469	16,970	16,471	15,972	15,473	14,974	14,474	13,975	13,476	12,977	12,478	11,979	11,480	10,981	10,482	9,982
TOTAL ASSETS	43,969	113,355	162,223	210,935	219,919	223,172	226,425	229,678	229,786	229,694	229,615	229,548	229,493	229,451	229,421	229,404	229,399	229,406	229,426	229,458	229,503	229,560	229,629	229,711	229,806	229,912	230,031	230,163	230,307	230,463	230,632	230,813	231,006	231,212
LONG-TERM LIABILITIES	43,969	113,355	162,223	210,935	215,951	215,119	214,287	213,455	209,479	202,357	195,236	188,115	180,994	173,872	166,751	159,630	152,509	145,387	138,266	131,145	124,023	116,902	109,781	102,660	95,538	88,417	81,296	74,175	67,053	59,932	52,811	45,690	38,568	31,447
Long-Term Borrowings (PMB from JBIC)	38,775	99,964	143,043	185,979	191,827	191,827	191,827	191,827	188,682	182,393	176,103	169,814	163,524	157,235	150,946	144,656	138,367	132,077	125,788	119,499	113,209	106,920	100,630	94,341	88,052	81,762	75,473	69,183	62,894	56,605	50,315	44,026	37,736	31,447
Long-Term Borrowings (PMB Local Portion)	5,194	13,391	19,180	24,956	24,124	23,292	22,460	21,629	20,797	19,965	19,133	18,301	17,469	16,637	15,805	14,974	14,142	13,310	12,478	11,646	10,814	9,982	9,151	8,319	7,487	6,655	5,823	4,991	4,159	3,327	2,496	1,664	832	0
CAPITAL	0	0	0	0	3,968	8,053	12,138	16,223	20,307	27,337	34,379	41,433	48,500	55,579	62,670	69,774	76,890	84,019	91,160	98,314	105,479	112,658	119,848	127,052	134,267	141,495	148,735	155,988	163,253	170,531	177,821	185,123	192,438	199,765
Retained Earnings	0	0	0	0	3,968	8,053	12,138	16,223	20,307	27,337	34,379	41,433	48,500	55,579	62,670	69,774	76,890	84,019	91,160	98,314	105,479	112,658	119,848	127,052	134,267	141,495	148,735	155,988	163,253	170,531	177,821	185,123	192,438	199,765
TOTAL LIABILITIES AND CAPITAL	43,969	113,355	162,223	210,935	219,919	223,172	226,425	229,678	229,786	229,694	229,615	229,548	229,493	229,451	229,421	229,404	229,399	229,406	229,426	229,458	229,503	229,560	229,629	229,711	229,806	229,912	230,031	230,163	230,307	230,463	230,632	230,813	231,006	231,212

Table 24.2.7 Estimated Income Statement of TOC on Base Case

Income Statement of the Lach Huyen Project ($'000s)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
REVENUE																																		
Wharfage for Vessels					1,407	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557
Wharfage for Cargo					1,206	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346
Charge for mooring/unmooring					78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78
Charge for handling container					46,760	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213	52,213
Charge for storage of Container					2,169	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422	2,422
Charge for CFS					653	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730	730
Charge for PTI (Pre Trip Inspection) of Reefer Container					324	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362	362
TOTAL REVENUE					52,597	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708	58,708
EXPENSE																																		
DIRECT EXPENSE																																		
Lobour Cost (Concessionaire)					2,924	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046	4,046
Maintenance of equipment (Concessionaire)					1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501
Fuel & Utilities (for Concessionaire)					3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169	3,169
Maintenance of infrastructures (Concessionaire: minor repaires)					653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653	653
Maintenance dredging					818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818	818
Total Direct Expense					9,064	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187	10,187
INDIRECT EXPENSE																																		
Depreciation (equipment) (Concessionaire)					8,790	8,790	8,790	8,729	8,722	8,722	8,722	8,716	8,716	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636
Depreciation (S/S of TOC)					3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928
Insurance & Claims (??% of Revenue)					789	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881	881
Bad Debt (0.5% of Revenue)					263	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294	294
Concession Fixed Fee (to PMB)					6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651	6,651
Concession Variable Fee (to PMB)					2,630	2,935	2,935	2,935	2,935	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871	5,871
Land Lease Fee (to HPPC)					600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Total Indirect Expense					23,651	24,078	24,078	24,018	24,011	26,946	26,946	26,940	26,940	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860	26,860
GENERAL & ADMINISTRATIVE																																		
Administrative Personnel (Concessionaire)					721	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813	813
Others (Personnel Cost x 40%)					288	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325
Total General & Administrative					1,010	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
TOTAL EXPENSE					33,725	35,403	35,403	35,343	35,336	38,271	38,271	38,265	38,265	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185	38,185
OPERATING INCOME					18,872	23,304	23,304	23,365	23,371	20,436	20,436	20,443	20,443	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522
OTHER INCOME/(EXPENSE)																																		
Repayment of Interest on Long-Term Loans (Concessionaire)					0	11,773	10,812	9,851	8,910	8,054	7,080	6,107	6,062	4,995	4,813	3,658	2,522	1,365	929	5,124	5,431	4,716	4,001	3,378	3,668	3,043	2,418	1,795	2,101	6,414	5,634	4,947	4,279	3,591
TOTAL OTHER					0	11,773	10,812	9,851	8,910	8,054	7,080	6,107	6,062	4,995	4,813	3,658	2,522	1,365	929	5,124	5,431	4,716	4,001	3,378	3,668	3,043	2,418	1,795	2,101	6,414	5,634	4,947	4,279	3,591
EARNINGS before TAXES					18,872	11,531	12,492	13,514	14,462	12,382	13,356	14,336	14,381	15,527	15,709	16,864	18,000	19,157	19,594	15,398	15,091	15,806	16,521	17,144	16,854	17,479	18,104	18,727	18,421	14,108	14,888	15,575	16,243	16,932
INCOME TAX (from Concessionaire only)					0	0	0	0	723	619	668	717	719	776	785	843	900	1,916	1,959	3,850	3,773	3,952	4,130	4,286	4,214	4,370	4,526	4,682	4,605	3,527	3,722	3,894	4,061	4,233
NET INCOME after tax					18,872	11,531	12,492	13,514	13,739	11,763	12,688	13,620	13,662	14,750	14,924	16,021	17,100	17,242	17,634	11,549	11,318	11,855	12,391	12,858	12,641	13,109	13,578	14,045	13,816	10,581	11,166	11,681	12,182	12,699
Retained Earnings					18,872	30,403	42,895	56,408	70,147	81,910	94,598	108,217	121,879	136,630	151,553	167,575	184,675	201,916	219,551	231,099	242,418	254,272	266,663	279,521	292,162	305,271	318,849	332,894	346,710	357,291	368,457	380,139	392,321	405,020

Table 24.2.8 Estimated Cash Flow Statement and Balance Sheet of TOC on Base Case

Statement of Cash Flows ($'000s) of Lach Huyen	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
Cash Beginning	0	0	0	0	360	33,781	38,807	44,795	51,744	58,887	63,920	69,878	76,761	82,524	89,296	95,137	102,075	110,067	127,812	155,585	171,920	186,863	202,343	219,520	237,165	254,557	272,419	290,773	309,595	327,025	340,422	355,565	371,224	387,359
Cash Inflow	43	12,717	27,687	73,835	251,244	36,022	36,022	36,265	37,367	33,087	33,087	44,705	33,087	44,139	33,087	33,330	33,087	33,087	87,954	44,705	33,087	33,087	33,087	44,484	33,087	33,087	33,087	44,705	95,944	33,087	33,087	33,330	33,087	97,661
CASH FLOWS FROM OPERATING ACTIVITIES	0	0	0	0	31,590	36,022	36,022	36,022	36,022	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087	33,087
Operating Income	0	0	0	0	18,872	23,304	23,304	23,365	23,371	20,436	20,436	20,443	20,443	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522	20,522
Depreciation (equipment) (Concessionaire)	0	0	0	0	8,790	8,790	8,790	8,729	8,722	8,722	8,722	8,716	8,716	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636	8,636
Depreciation (S/S of TOC)	0	0	0	0	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928	3,928
[Total No cash Items included in Net Income (Depreciation)]	0	0	0	0	12,718	12,718	12,718	12,657	12,651	12,651	12,651	12,644	12,644	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565	12,565
CASH FLOWS FROM FINANCING ACTIVITIES	43	12,717	27,687	73,835	219,654	0	0	243	1,345	0	0	11,618	0	11,052	0	243	0	0	54,867	11,618	0	0	0	11,397	0	0	0	11,618	62,857	0	0	243	0	64,574
Long -Term Loan (Concessionaire) incl. IDC of JBIC loan		0	0	14,759	219,654	0	0	243	1,345	0	0	11,618	0	11,052	0	243	0	0	54,867	11,618	0	0	0	11,397	0	0	0	11,618	62,857	0	0	243	0	64,574
Cash from Equity	43	12,717	27,687	59,076																														
Cash Outflow	43	12,717	27,687	73,475	217,824	30,995	30,034	29,316	30,224	28,054	27,129	37,822	27,324	37,366	27,246	26,392	25,094	15,342	60,181	28,370	18,144	17,607	15,909	26,840	15,694	15,225	14,732	25,883	78,514	19,690	17,943	17,671	16,952	81,009
CASH FLOWS FROM INVESTING ACTIVITIES	43	12,717	27,687	73,475	217,824	0	0	243	1,345	0	0	11,618	0	11,052	0	243	0	0	54,867	11,618	0	0	0	11,397	0	0	0	11,618	62,857	0	0	243	0	64,574
Assets Acquired (Concessionaire) incl. IDC of JBIC loan	43	12,717	27,687	73,475	217,824	0	0	243	1,345	0	0	11,618	0	11,052	0	243	0	0	54,867	11,618	0	0	0	11,397	0	0	0	11,618	62,857	0	0	243	0	64,574
CASH FLOWS FROM FINANCING ACTIVITIES	0	0	0	0	0	30,995	30,034	29,073	28,879	28,054	27,129	26,204	27,324	26,314	27,246	26,149	25,094	15,342	5,314	16,751	18,144	17,607	15,909	15,442	15,694	15,225	14,732	14,265	15,657	19,690	17,943	17,428	16,952	16,435
Repayment of Long-Term Loan Principal (Concessionaire)	0	0	0	0	0	19,222	19,222	19,222	19,246	19,381	19,381	19,381	20,543	20,543	21,648	21,648	21,672	12,061	2,426	7,778	8,940	8,940	7,778	7,778	7,813	7,813	7,788	7,788	8,950	9,749	8,587	8,587	8,612	8,612
Repayment of Interest on Long-Term Loans (Concessionaire)	0	0	0	0	0	11,773	10,812	9,851	8,910	8,054	7,080	6,107	6,062	4,995	4,813	3,658	2,522	1,365	929	5,124	5,431	4,716	4,001	3,378	3,668	3,043	2,418	1,795	2,101	6,414	5,634	4,947	4,279	3,591
Income Tax (Concessionaire only)	0	0	0	0	0	0	0	0	723	619	668	717	719	776	785	843	900	1,916	1,959	3,850	3,773	3,952	4,130	4,286	4,214	4,370	4,526	4,682	4,605	3,527	3,722	3,894	4,061	4,233
Cash Inflow - Cash Outflow	0	0	0	360	33,421	5,027	5,988	6,949	7,143	5,033	5,958	6,883	5,763	6,772	5,841	6,938	7,993	17,745	27,773	16,335	14,943	15,479	17,178	17,644	17,393	17,861	18,354	18,822	17,430	13,397	15,143	15,659	16,135	16,652
Cash Ending	0	0	0	360	33,781	38,807	44,795	51,744	58,887	63,920	69,878	76,761	82,524	89,296	95,137	102,075	110,067	127,812	155,585	171,920	186,863	202,343	219,520	237,165	254,557	272,419	290,773	309,595	327,025	340,422	355,565	371,224	387,359	404,010

Balance Sheet ($'000s)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
CURRENT ASSETS	0	0	0	360	33,781	38,807	44,795	51,744	58,887	63,920	69,878	76,761	82,524	89,296	95,137	102,075	110,067	127,812	155,585	171,920	186,863	202,343	219,520	237,165	254,557	272,419	290,773	309,595	327,025	340,422	355,565	371,224	387,359	404,010
Cash and Cash Equivalent Investments	0	0	0	360	33,781	38,807	44,795	51,744	58,887	63,920	69,878	76,761	82,524	89,296	95,137	102,075	110,067	127,812	155,585	171,920	186,863	202,343	219,520	237,165	254,557	272,419	290,773	309,595	327,025	340,422	355,565	371,224	387,359	404,010
PROPERTY, PLANT AND EQUIPMENT	43	12,761	40,448	113,923	319,029	306,311	293,593	281,179	269,873	257,223	244,572	243,546	230,903	229,390	216,826	204,504	191,940	179,375	221,678	220,731	208,167	195,602	183,038	181,870	169,306	156,741	144,177	143,230	193,523	180,958	168,394	156,072	143,508	195,517
Fixed Assets (Concessionaire)	43	12,761	40,448	113,923	331,747	331,747	331,747	331,990	333,335	333,335	333,335	344,953	344,953	356,005	356,005	356,248	356,248	356,248	411,115	422,733	422,733	422,733	422,733	434,130	434,130	434,130	434,130	445,749	508,606	508,606	508,606	508,849	508,849	573,423
Accumulated Depreciation (Concessionaire)	0	0	0	0	12,718	25,436	38,154	50,811	63,462	76,112	88,763	101,407	114,050	126,615	139,179	151,744	164,309	176,873	189,438	202,002	214,567	227,131	239,696	252,260	264,825	277,389	289,954	302,518	315,083	327,647	340,212	352,776	365,341	377,906
Net Fixed Assets (Concessionaire)	43	12,761	40,448	113,923	319,029	306,311	293,593	281,179	269,873	257,223	244,572	243,546	230,903	229,390	216,826	204,504	191,940	179,375	221,678	220,731	208,167	195,602	183,038	181,870	169,306	156,741	144,177	143,230	193,523	180,958	168,394	156,072	143,508	195,517
TOTAL ASSETS	43	12,761	40,448	114,283	352,810	345,118	338,388	332,923	328,761	321,143	314,450	320,307	313,426	318,686	311,962	306,579	302,007	307,187	377,263	392,652	395,030	397,945	402,558	419,035	423,863	429,160	434,950	452,825	520,547	521,380	523,959	527,296	530,866	599,527
LONG-TERM LIABILITIES	0	0	0	14,759	234,413	215,191	195,970	176,991	159,090	139,709	120,328	112,566	92,023	82,533	60,885	39,480	17,808	5,747	58,188	62,028	53,089	44,149	36,371	39,990	32,177	24,365	16,576	20,406	74,313	64,564	55,977	47,633	39,021	94,984
Long-Term Borrowings (Concessionaire)	0	0	0	14,759	234,413	215,191	195,970	176,991	159,090	139,709	120,328	112,566	92,023	82,533	60,885	39,480	17,808	5,747	58,188	62,028	53,089	44,149	36,371	39,990	32,177	24,365	16,576	20,406	74,313	64,564	55,977	47,633	39,021	94,984
Equity	43	12,761	40,448	99,524	118,396	129,927	142,419	155,932	169,671	181,434	194,122	207,742	221,403	236,154	251,077	267,099	284,199	301,440	319,075	330,623	341,942	353,796	366,187	379,045	391,686	404,795	418,373	432,419	446,234	456,815	467,981	479,663	491,845	504,544
Retained Earnings	0	0	0	0	18,872	30,403	42,895	56,408	70,147	81,910	94,598	108,217	121,879	136,630	151,553	167,575	184,675	201,916	219,551	231,099	242,418	254,272	266,663	279,521	292,162	305,271	318,849	332,894	346,710	357,291	368,457	380,139	392,321	405,020
Capital	43	12,761	40,448	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524	99,524
TOTAL LIABILITIES AND CAPITAL	43	12,761	40,448	114,283	352,810	345,118	338,388	332,923	328,761	321,143	314,450	320,307	313,426	318,686	311,962	306,579	302,007	307,187	377,263	392,652	395,030	397,945	402,558	419,035	423,863	429,160	434,950	452,825	520,547	521,380	523,959	527,296	530,866	599,527

25. ECONOMIC ANALYSIS

25.1 Methodology and Assumption on Economic Analysis

25.1.1 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. In 2010, “The Preparatory Survey on Lach Huyen Port Infrastructure Construction in Viet Nam” was conducted, including economic analysis for the Project. In this study, economic analysis is conducted utilizing the same methodology used in the survey and updated information.

“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.

In this analysis, Economic Internal Rate of Return (EIRR) is utilized to evaluate the Project economically. 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 this study, EIRR based on cost-benefit analysis is adopted in order to appraise the feasibility of project.

25.1.2 “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. The following conditions are assumed in this economic analysis.

1) “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, 3 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.

2) “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.

25.1.3 Prerequisites of Economic Analysis

In order to estimate costs and benefits of projects, the following requisites are assumed for analysis.

(1) Project Period

- Taking the depreciation period of main port facilities into account, the period of calculation for the economic analysis (project life) is assumed to be from 2012, when the construction of the port starts, to 2047, 30 years after port starts the operation.

(2) Foreign Exchange Rate

- Foreign exchange rate adopted for this analysis is US$1.00= JPY 89.60= VND16,970, the same rate as used in the cost estimation.

25.2 Economic Cost

25.2.1 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 land acquisition 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. SCF is calculated by following formula.

$$SCF = \frac{(X + M)}{(X + M + D)}$$

Where:
X: Commodity exports
M: Commodity imports
D: Import duty and taxes

In the recent F/S study of Vietnam’s transport sector and the preparatory survey, SCF applied 0.85 in the economic analysis. Therefore, in this study, 0.85 use for SCF in the economic analysis.

25.2.2 Cost of Projects

Components of project cost are tabulated in the Table 25.2.1. 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 25.2.2.

Table 25.2.1 Components of Project Costs

<table>
<tr><th>Components of Project Costs</th><th>Definition of Components of Project Costs</th></tr>
<tr><td>Construction Cost</td><td>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.</td></tr>
<tr><td>Maintenance Cost</td><td>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 0.2% of construction cost and 1.0% of equipment cost.</td></tr>
<tr><td>Maintenance Dredging Cost</td><td>Based on the results of simulation for maintenance dredging, yearly maintenance dredging volume applied as follows.
1’st year : 1.60 million m^3
After 2’nd year: 2.30 million m^3</td></tr>
<tr><td>Operation Cost</td><td>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.
<table>
<tr><th>Operation and Management Body</th><th>Number of Staffs</th></tr>
<tr><td>Project Management Body</td><td>36</td></tr>
<tr><td>Terminal Operating Company</td><td>110</td></tr>
<tr><td>Labor for 5 Container Berths</td><td>1,237</td></tr>
<tr><td>Labor for 3 Multi Purpose Berths</td><td>3,640</td></tr>
</table>
As for the other operation cost, it is assumed that 2.0% of equipment cost is necessary for electricity, fuel, and utilities every year.</td></tr>
<tr><td>Refurbishment of equipment</td><td>Considering the life time of equipment, cost for refurbishment of equipment is estimated year by year during project life.</td></tr>
</table>

Table 25.2.2 Economic Price of Project Costs for Medium Term Port Development Project including Access Bridge and Road (2020)

Initial Investment	Economic Price (1,000 USD)
2 Container Berth, Channel, & Dyke	1,051,051
Additional 3 Container Berths & 3 General Cargo Berths for Medium Term Development	1,945,993
Access Bridge & Road	397,180
Total	***3,394,224***
Total O/M Cost (2012- 2047)	**Economic Price (1,000 USD)**
Maintenance Dredging	305,378
O/M Cost for Container & General Cargo Berths	2,208,233
O/M Cost for Access Bridge & Road	35,634
Total	***2,549,244***

25.3 Economic Benefits

25.3.1 Benefit Items

Among the various benefit of the Project, following 2 items, whose impact are huge and can be recognized quantitatively, are considered in this analysis.

(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

25.3.2 Calculation of Benefits

In the container demand forecast, "With" and "Without" case are applied in Figure 25.3.1.

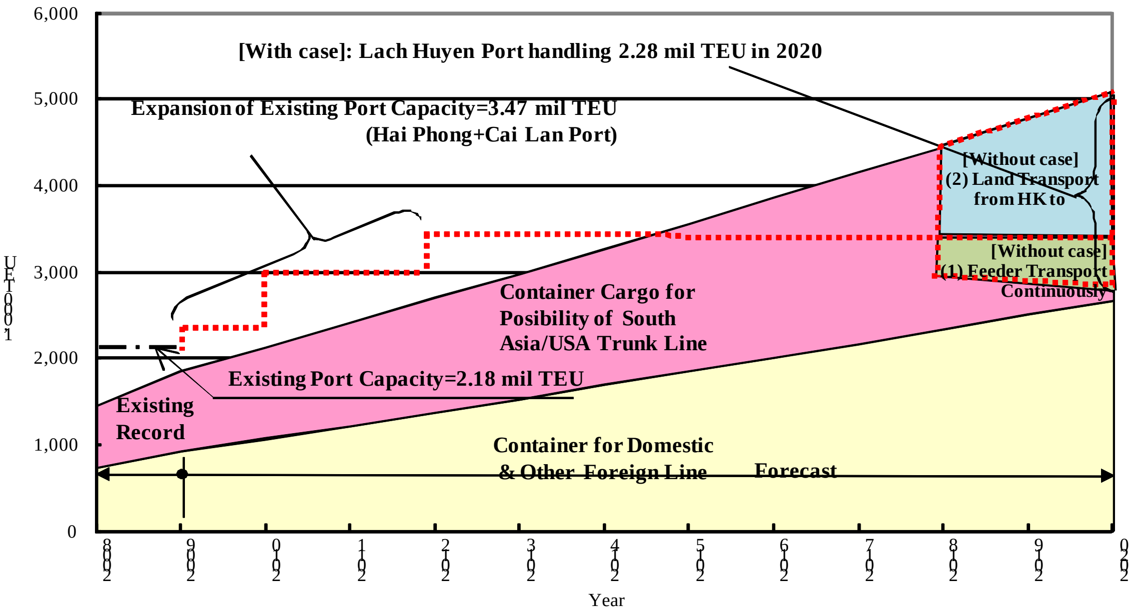


Figure 25.3.1 Container Cargo Demand of "With" and "Without" case

"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.

In estimating benefit, following operation schedule is assumed.

Table 25.3.1 Expected Operation Start Year

Container Terminal (No.1&2)	Middle of 2018
Container Terminal (No.3&4)	Beginning of 2018
Container Terminal (No.5)	Beginning of 2020
3 Multi Purpose Berths	Beginning of 2020

Capacity of container terminal No.1 and 2 is assumed to be 900,000TEU and capacity of container terminal No. 3, 4 and 5 is assumed to be 1,384,000 TEU.

"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 25.3.2 was described transport route and system for “With” and “Without” case.

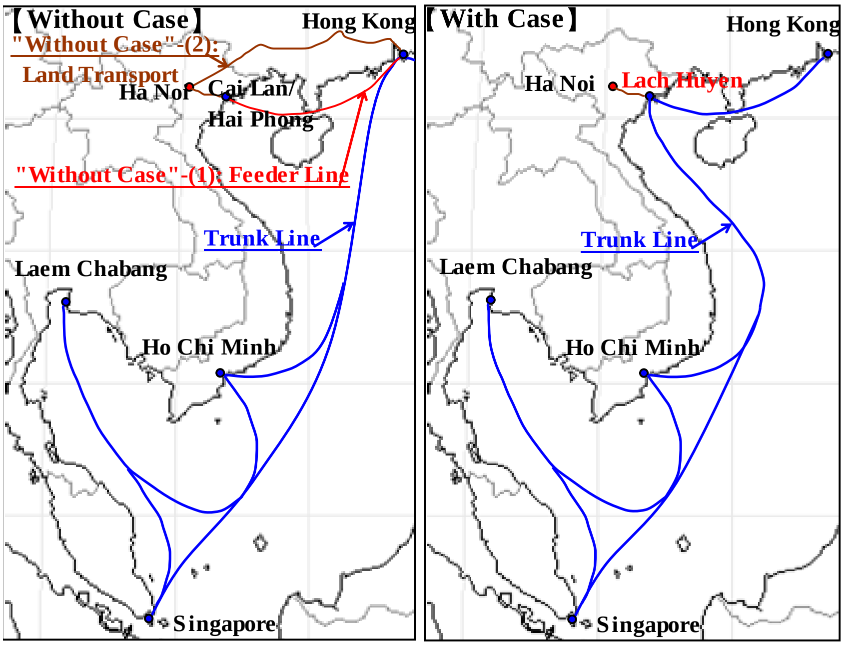


Figure 25.3.2 Transport System between “With” and “Without” Case

1) “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) = $S1_{Tl/m}$
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)

$S1_{Tl/m}$ = 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

$S2_{HK}$ x 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 25.3.2 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, 65USD per TEU can applied as reduction transport cost by transshipment cargo handling.

The difference of transport distance between “With” case and “Without” case is shown in Table 25.3.3.

Table 25.3.3 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 25.3.4.

Table 25.3.4 Transport Cost by Container Vessel Size

Vessel	**Lease Cost** USD/day/vessel	**Container Cost** USD/day/vessel	**Fuel Cost** USD/day/vessel	**Total** USD/day/vessel	**Total** USD/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 USD1.2/TEU
2. Fuel cost is the price of bunker oil as USD 528/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 98 per TEU is estimated for forecast container cargo volume until the existing port capacity.

2) "Without Case"-(2)

The reduction benefits of cargo transport cost can be assumed as follows.

RCL = CL(WO) - CL(W)
CL(W) = $S1_{\mathrm{T}l\mathrm{m}}$+ SL1
CL(WO) = $S2_{\mathrm{T}l'\mathrm{m}}$ + 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)
$S1_{\mathrm{T}l\mathrm{m}}$ = 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)

$S2_{\mathrm{T}l'\mathrm{m}}$ = 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 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.

SL2 = 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.

Consequently, based on the above formula, in the consideration of 1.5 in TEU/Box ratio, USD 1084.08 per TEU in economic price is estimated for forecast container cargo volume in "Without Case"-(2).

3) Container for benefit estimation

In "With" case, it is assumed that 70% of total trunk liner services gradually converted to South East Asia/USA trunk liner through Lach Huyen Port, considering the current liner service operation in northern Vietnamese ports. Vessels more than 50,000 DWT account for 80% of total vessels in the liner service. Furthermore, container handled for import or export will account for 95% of total container in Lach Huyen Port. Benefit of this project can be applied to container for export or import carried by large-scale vessel in South East Asia/USA trunk liner. Therefore, among difference between "With" and "Without" case in container cargo, it is assumed that 53.2% (=0.7 x 0.95 x 0.8) of total difference of container can be considered in benefit estimation.

25.4 Summary of Economic Analysis

25.4.1 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

25.4.2 EIRR Results

EIRR of the base case of the Lach Huyen Port project with Tan Vu-Lach Huyen Highway Project is estimated at 20.2%, 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.

25.4.3 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 25.4.1)

Table 25.4.1 Sensitivity Analysis of EIRR for Medium-term Development Project in 2020 (5 Container Terminals and 3 Multi Purpose Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	20.2%	18.4%	16.6%
	10% up	18.4%	16.9%	15.1%
	20% up	16.6%	15.6%	13.9%

25.4.4 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 25.4.2 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 0.2% of construction cost and 1.0% 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 : 1.60million m^3 After 2'nd year: 2.30 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: Project Management Body: 18 Terminal Operating Company: 44 Labor for 5 Container Berths: 495 As for the other operation cost, it is assumed that 2.0% of equipment cost is necessary for electricity, fuel, and utilities every year.
Refurbishment of equipment	Considering the life time of equipment, cost for refurbishment of equipment is estimated year by year during project life.

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 900,000TEU per year. And the period of calculation for the economic analysis (project life) is assumed to be from 2012, when the construction of the port starts, to 2047, 30 years after port starts the operation.

EIRR for the Short-term Project (2 Container Terminals) are also estimated at 21.0%/annum. Therefore, the project is economically feasible for both short-term and medium-term development project

Table 25.4.3 Sensitivity Analysis of EIRR for Short-term Development Project (2 Container Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	21.0%	19.4%	17.8%
	10% up	19.4%	18.1%	16.5%
	20% up	17.8%	16.9%	15.4%

Reference: EIRR only for Port Project

EIRR for Port Project without Road & Bridge construction cost is as follow:

Table 25.4.4 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	24.3%	22.1%	19.9%
	10% up	22.1%	20.3%	18.1%
	20% up	19.9%	18.7%	16.6%

26. TENDER DOCUMENTS

26.1 General

The Tender Document was prepared in accordance with the relevant regulations, guidelines and procedures of the Government of the Socialist Republic of Vietnam and JICA based on the understanding that the project is implemented under Terms and Conditions for Special Terms of Economic Partnership "STEP" by Japanese ODA Yen Loan. A series of latest Sample Documents prepared by JICA was used in the preparation

26.2 Basic Principle in Preparation of Tender Documents

(1) Guidelines for Procurement under Japanese ODA Loans dated March 2009

The "Guidelines for Procurement under Japanese ODA Loans dated March 2009" was used as general principles to be followed by Borrowers in order to consider the economical, efficiency and transparency in the procurement process among bidders in carrying out the procurement of Works for the LACH HUYEN PORT INFRASTRUCTURE CONSTRUCTION PROJECT.

(2) Sample Prequalification and Bidding Documents under Japanese ODA Loans

The "Sample Prequalification and Bidding Documents under Japanese ODA Loans" dated April 2010 and June 2009 respectively was used for preparation of the tender documents. These documents are consistent with Guidelines for Procurement under Japanese ODA Loans dated March 2009 and based on the July 2004 version of the Master Bidding Documents for Procurement of Works, prepared by the Multilateral Development Banks and Financial Institutions. These Sample documents reflect the structure and the provisions of the Master Bidding documents, except where specific considerations within JICA have required a change e.g. as STEP loan terms and condition provisions.

(3) Law on Tendering of Vietnam

Law on Tendering – National Assembly of the Socialist Republic of Vietnam, Legislature XI, Session 8 (from 18 October until 29 November 2005) as amended by Resolution 51-2001-QH10 passed by Legislature X of the National Assembly at its 10th Session on 25 December 2001 is considered as applicable for preparation of the tender documents.

26.3 Structure of Tender Documents

In reference to JICA ODA Guidelines, Sample Tender Documents and governing laws of the government of the Socialist Republic of Vietnam, the Structure of Tender documents were considered in detail under two stages as follows:

Ref. JICA guidelines	**Component**	**Detailed Contents**
- STAGE ONE -		
Section 3.02	Prequalification of Tenderers	
		- Invitation for Prequalification - Instructions to Applicants - Prequalification Data Sheet - Qualifications Criteria and requirements - Application Forms - List of Eligible Countries of Japanese ODA Loans

Ref. JICA guidelines	**Component**	**Detailed Contents**
	- STAGE TWO - Tendering Stage	
Section 4.01	Tender Documents for the Qualified Contractors	
		- Invitation to Bid Volume I Section I - Instructions to Bidders Section II - Bid Data Sheet Section III - Evaluation and Qualification Criteria Section IV - Bidding Forms Section V - List of Eligible Countries of Japanese ODA Loans Section VI - Works Requirements Section VII - General Condition Section VIII - Particular Condition Section IX - Annex to the Particular Condition, Contract Forms Volume II Section I - General Requirements Section II - Technical Specifications Volume III Section I - Preamble Section II - Measurement and Payment Section III - Summary of Bill of Quantities Section IV - Detailed Bill of Quantities Volume IV Bid and Contract Drawings

26.4 Methods of Bidding

26.4.1 Prequalification

The prequalification is in principle required in advance of bidding for large scale or complex civil works contracts or specialized services to ensure that only firms with appropriate experience, a proven track record and necessary annual turnover, which are free of any major pending litigation are invited to submit bids taking into account the following criteria:

(1) Eligibility

- Nationality
- Conflict of Interest
- JICA Ineligibility

(2) Historical Contract Non-Performance

- History of Non-Performing Contracts
- Pending Litigation

(3) Financial Situation

- Financial Performance
- Average Annual Construction Turnover

(4) Experience

- General Construction Experience
- Specific Construction experience

All Applicants must meet all the requirements specified in the above qualification criteria. The prequalification evaluation criteria will be carried out by two major important factors based on the submitted documents by the Bidders as follows:

1) Preliminary Examination

The purpose of the "Preliminary Examination" is to assess the document formality required in the Prequalification Documents for each applicant with ***PASS or FAIL*** criteria. Each applicant shall fully satisfy the requirements of the Prequalification Documents in respect of the basic formalities for submission and the completeness of the submitted documentation.

Where required documents deemed as important are missing, the Applicant will be disqualified at this stage

2) Qualification Evaluation

The purpose of the "Qualification Evaluation" is to examine whether submitted documents comply with the qualification requirements by using ***PASS or FAIL*** criteria. The Prequalification flow chart is shown in Figure 26.4.1.

26.4.2 Bidding

Following Prequalification, the Invitation to Bid shall be issued to all applicants who passed the prequalification stage. All bidders shall submit the bid documents in accordance with requirements before the closing date and shall be opened publicly immediately after the deadline for closing tender. One Envelope Type Bidding procedures will be adopted for this project. If no clarification of the tender documents, evaluation will be conducted based on the Bidders submitted documents in accordance with ITB and other relevant documents will be the primary source of information to be used in evaluating their respective capabilities in the Technical and Financial aspects to undertake the proposed works. The evaluation will be carried out in ***PASS or FAIL*** criteria. Consideration for recommendation to the winning responsive bidder as follows:

(1) Having a valid tender, e.g. securities provided, document properly signed, document are in order, etc.

(2) Conformance to the Technical Specifications

(3) Technical and Financial Capabilities

(4) Lowest responsive bidder

(5) Contract sum not exceed the approved tender package cost.

(6) Duration of the implementation of the project.

(7) Other addendum or requirements.

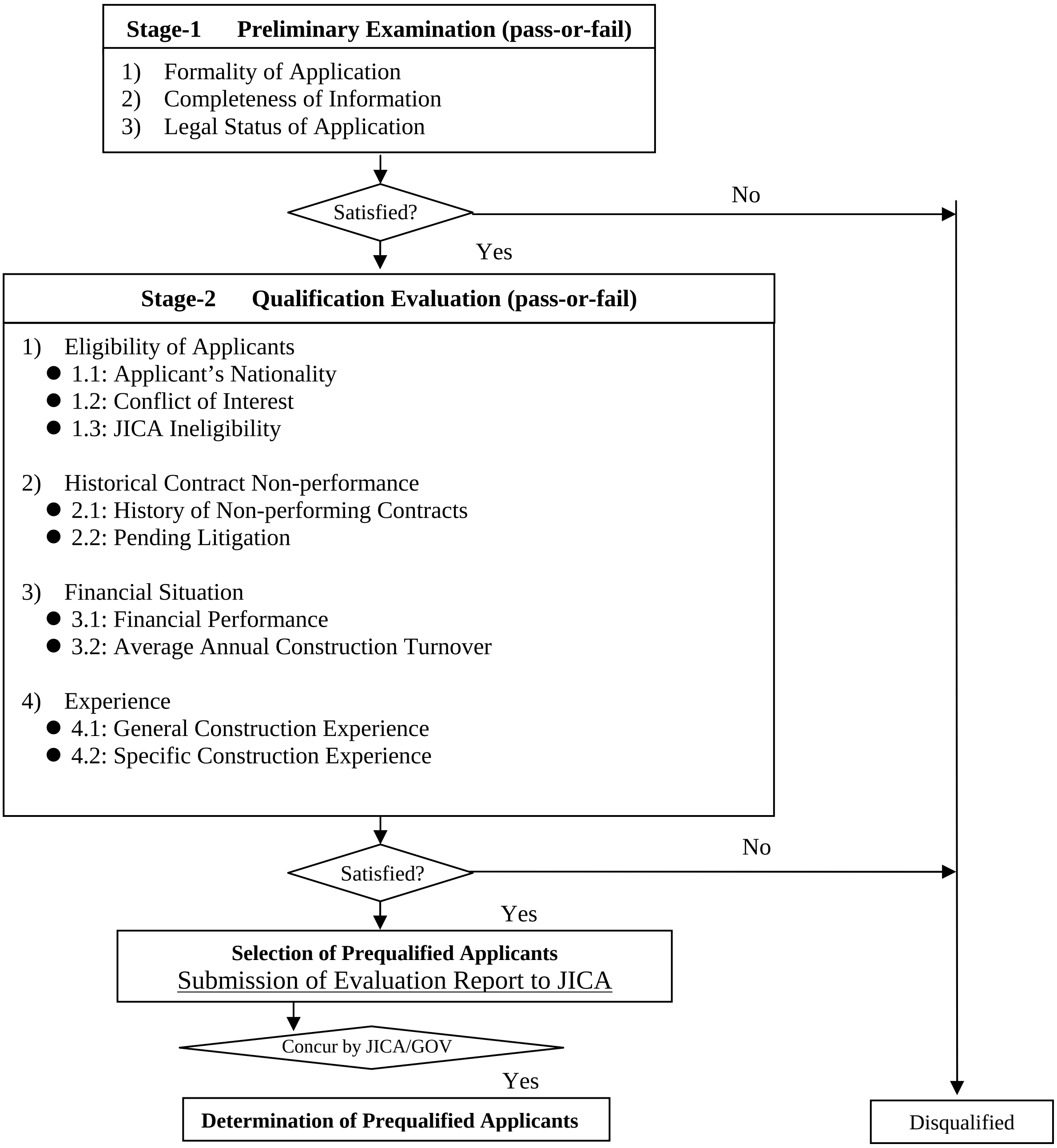


Figure 26.4.1 Prequalification flow chart

26.5 Bid Time Frame

The time bid frame was formulated in accordance with the provisions of Guidelines for Procurement under Japanese ODA Loans, March 2009 and Vietnam Law on Tendering, No. 61-2005-QH11 in order to satisfy both requirements. The time limit for selection of contractors will be in two stages as shown in Figure 26.5.1.

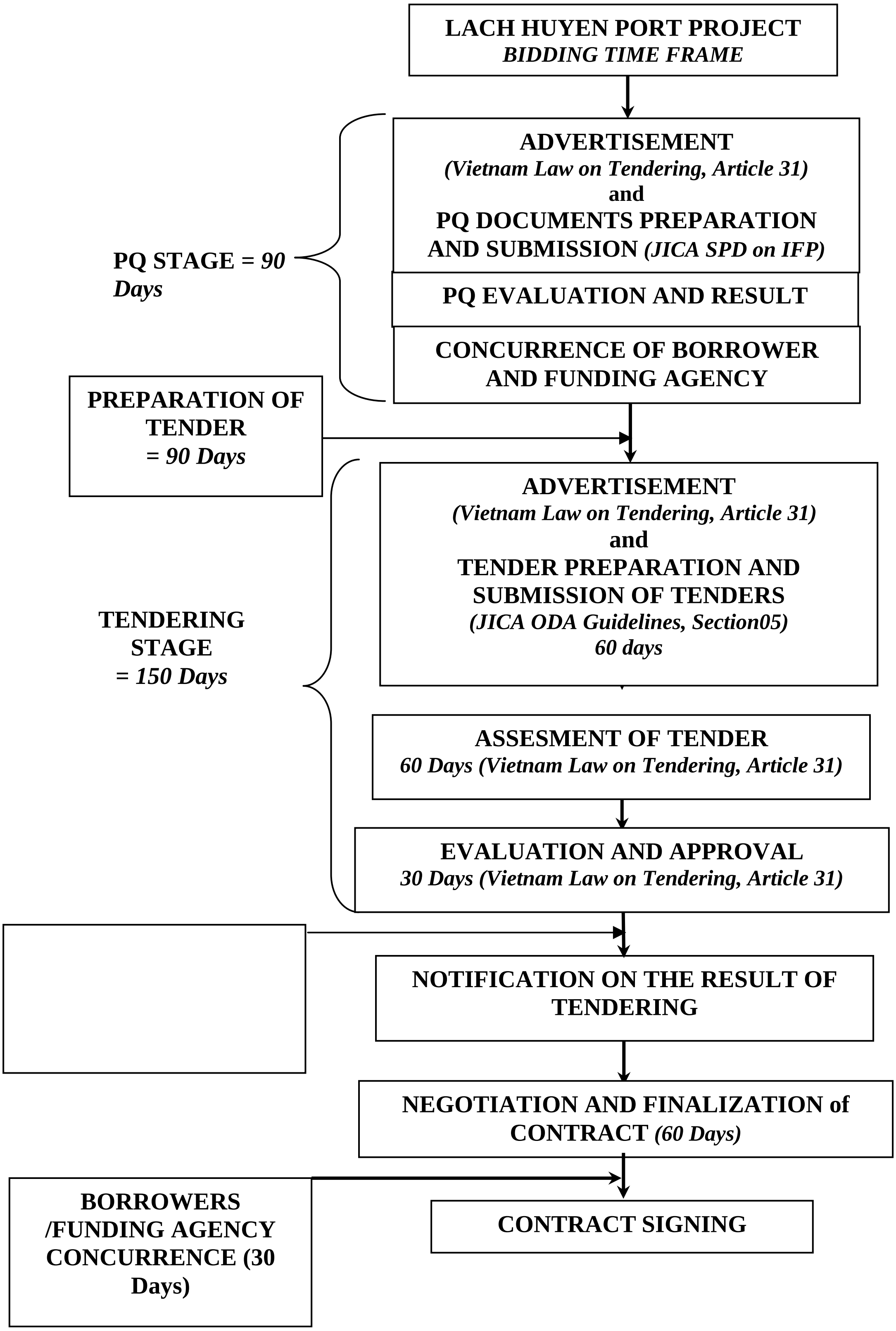


Figure 26.5.1 Bid Time Frame

26.6 Condition of Contract

The General Conditions used in the Documents are the Bank Harmonized Edition of the General Conditions of Contract for Construction, MDB harmonized edition 2005 prepared by the International Federation of Consulting Engineers (*Fédération Internationale des Ingénieurs-Conseils*, or FIDIC), Part A – General Conditions and Part B- Particular Conditions.

Also, the terms and condition of STEP loan package comprise of the procurement ratio, eligible source of origin, etc.

DIVISION – V

MANAGEMENT AND MAINTENANCE

27. OPERATION AND MANAGEMENT

27.1 Port Administration System in Vietnam

27.1.1 Legal System of Administration and Management of Seaports in Vietnam

Administration and management of seaports in Vietnam is legally governed by Maritime Code of Vietnam (hereinafter referred to as "VMC") and its related Decrees and Decisions of Prime Minister and other Ministers.

As to the port affairs, VMC Chapter IV defines administration and management. Major decrees and decisions are shown in Figure 27.1.1.

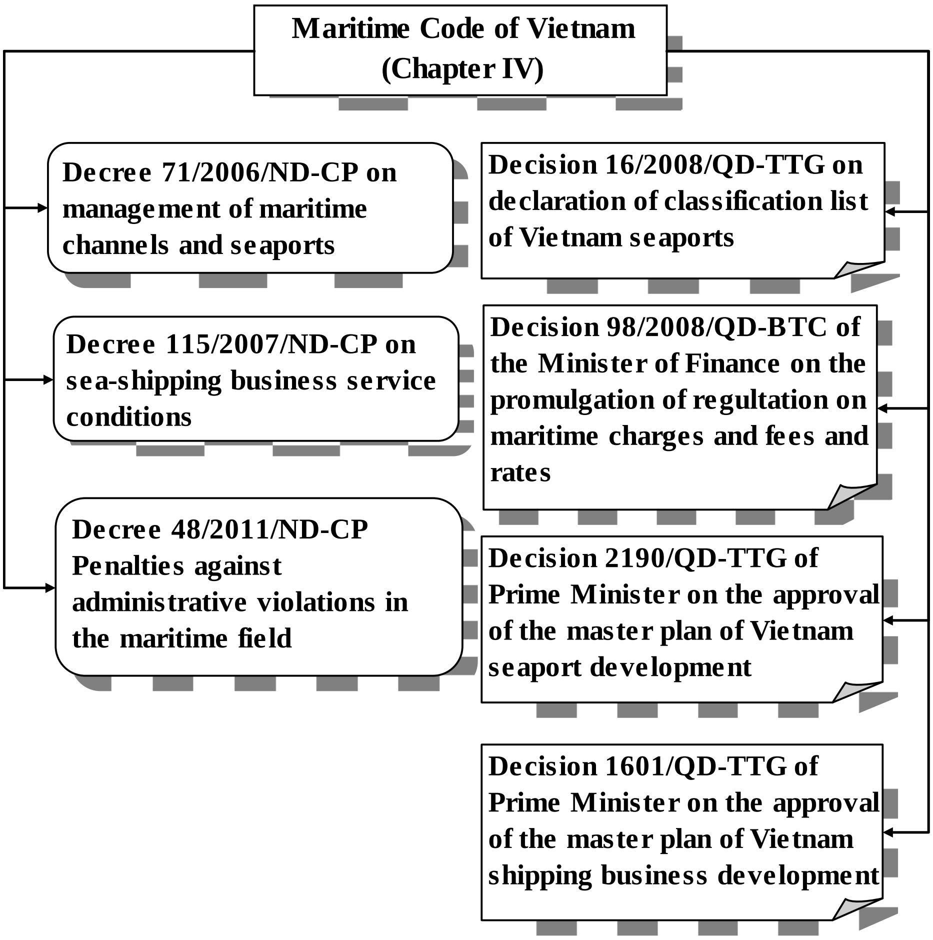


Figure 27.1.1 Legal Framework on Administration and Management of Seaports

27.1.2 Basic Organizational Structure

The key organization in administration and management in Vietnam is Ministry of Transport, Vietnam Maritime Administration and Maritime Port Authority and operation of port is conducted mainly by state own companies.

The whole institutional structure under the Ministry of Transport is shown in Figure 27.1.2.

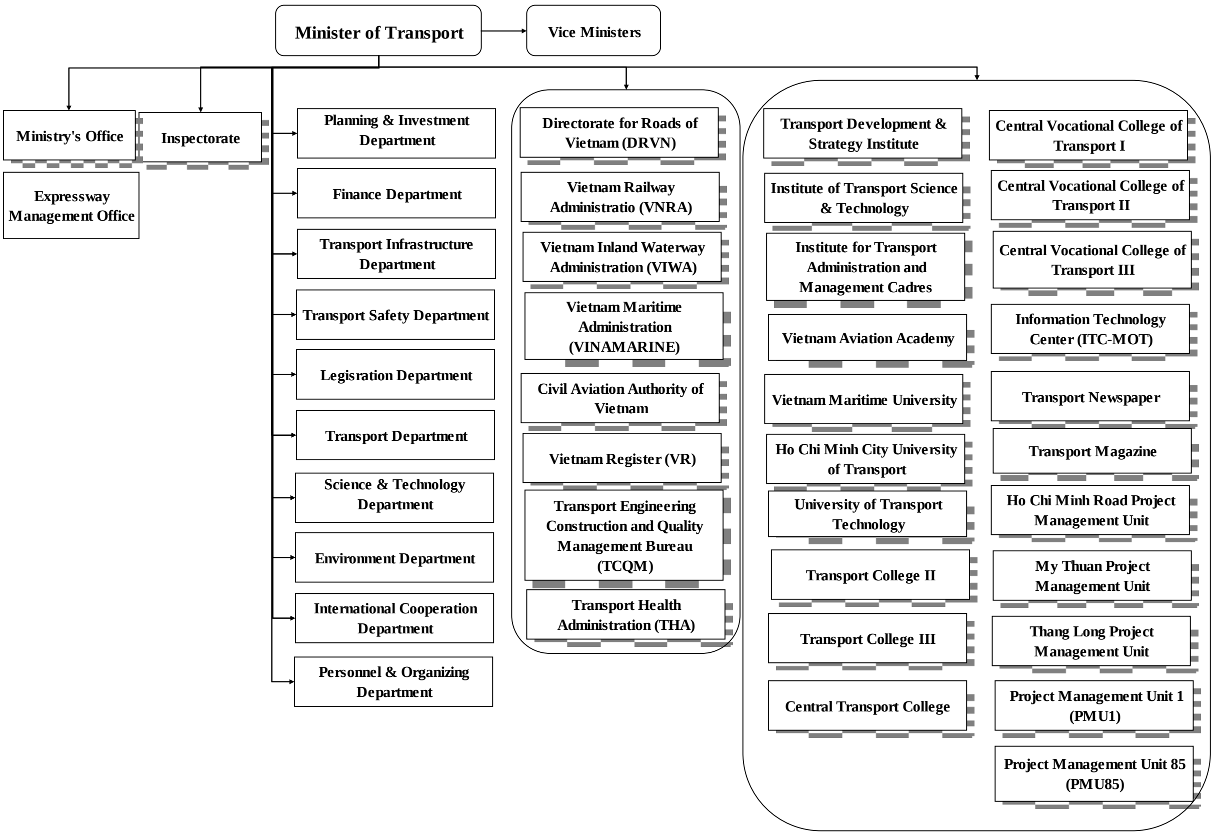


Figure 27.1.2 Organization of Ministry of Transport (Decree No.34/ND-CP)

1) Vietnam Maritime Administration

According to the Prime Minister's Decision No.26/2009/QD-TTg defining the functions, tasks, powers and organizational structure of Vietnam Maritime Administration, functions and powers of VINAMARINE in relation with port affairs are defined as follows;

a) Position and Functions (Article 1)

- The Vietnam Maritime Administration (VINAMARINE) is an entity under the Ministry of Transport (MOT) with the functions of consulting, supporting the Minister of Transport in administration of maritime sector and undertaking state administration in maritime sector nationwide.
- The Vietnam Maritime Administration enjoys the status of a legal person, owns the seal with the National Emblem and is financed from the state budget. It is authorized to open an account at the State Treasury in Hanoi.

b) Tasks and Powers (Article 2)

- To preside over the development of strategies, development plans, annual/five year/ and long term plans, programs, and projects for the national maritime industry to submit to the Minister of Transport;
- To preside over the developing and drafting of legal regulatory documents in appropriate maritime areas to submit to the Minister of Transport;
- To preside over the development of national standards, technical regulations, maritime economic-technical standards to submit to the Minister of Transport for promulgation under his power or forwarded to by the Minister of Transport to other competent authorities for appraisal, promulgation; to organize the development and appraisal and publication of

fundamental standards in maritime sector;

- To organize the implementation of maritime legal regulatory documents, strategies, plans, programs, standards, procedures, and economic-technical standards issued by authorized levels; within VINAMARINE's management competence to regulate certain technical standards and procedures applying to organizations operating in the maritime field in conformity with the maritime law;
- To organize the dissemination, promotion and education of maritime laws;

c) Management of the Sea-ports System, Channels and Anchorage Areas, Management of Development Plans of Ship Repair, Ship Building Factories

- To organize the management of maritime activities at seaports;
- To organize the monitoring of implementation of plans for developing seaports, navigation channels, anchorage areas, ship repair and ship building factories in conformity with approved plans and ensuring maritime safety; organize tendering for leasing ports, terminals under its management as regulated by the laws;
- To submit orders to the Minister of Transport concerning the closing and opening of sea ports, seaport water areas, maritime channels and management area of Maritime Administrations;
- Decide to put ports, terminals, transshipment areas into operation as regulated by the laws;

d) Management of Sea-Going Vessels, Seafarers and Other Maritime Human Resources

- Develop regulations on registration, management on purchase, sale of sea-going vessels, titles, title standards of seafarers and manning scale of sea-going vessel in Vietnam;
- To organize the registering of sea-going vessels, seafarers, as regulated by the laws;
- To issue and withdraw certificates of competency, seaman passports, seaman books and other documents relating to the maritime activities in accordance with the provisions of laws;
- To organize the training, drills for seafarers, maritime pilots, port security officers, and other maritime human resources in accordance with the provisions of Vietnam laws and concerned international conventions that Vietnam signed or participated;

e) Maritime Transport and Services

- To draft legal regulatory documents on development of maritime transport, ancillary services, conditions for providing maritime transport services;
- To provide guidelines on implementing legal regulations on maritime transport and services;
- To organize the implementation of statistics, research, forecast on maritime development and assessment of maritime services;

f) Maritime Safety, Security and Prevention of Environmental Pollution

- To draft regulatory documents on maritime safety and security and submit to the Minister of Transport; join the drafting of regulatory documents on prevention of environment pollution in maritime sector;
- To organize the ensuring of maritime safety and security for vessels operating at seaports, navigation channels and sea waters of Vietnam in accordance with the provisions of laws;
- To organize the implementation of reporting, investigation and handling of maritime accidents and violations against maritime safety and security in accordance with the provisions of Vietnam laws and concerned international conventions that Vietnam signed or participated;
- To coordinate with functional agencies in the prevention of pollution of the marine environment at seaports and navigation channels;
- To act as a focal agency to coordinate with the National Committee for Search and Rescue; to organize maritime search and rescue activities at sea in conformity with provisions of the

laws;

- To manage the maritime navigation information system, and the vessel traffic services system and other navigation-aid systems; to organize the provision of information and documents to ensure maritime safety in accordance with provisions of the laws;
- To organize the approval of seaport security plans in Vietnam in accordance with the provisions of Vietnam laws and concerned international conventions that Vietnam signed or participated;
- To organize the receiving and transmitting of maritime security information in accordance with the provisions of the laws.

g) Management of Investment, Construction Projects

- To undertake the obligations, power of investment decision makers, project owner of projects assigned under its decentralized competence;
- To draft regulations on investment, construction, management on operation of seaports, navigation channels and management of maritime activities at seaports in Vietnam
- To submit to Minister of Transport for promulgation or forwarded by the Minister of Transport to competent authorities for promulgation.

h) Other Tasks and Powers

- To participate in the resolution of maritime claims and disputes; to confirm the submission of maritime protests in conformity with provisions of the Vietnam laws;
- To develop international cooperation plan, program and submit to Minister of Transport for approval or for him to submit to competent authorities for approval of proposal on signing or participation in international maritime conventions; to preside over the drafting of international maritime cooperation agreement and submit to Minister of Transport; to join in negotiation in order to submit to competent authorities for approval the signing and participating of international maritime conventions and organizations; to organize the implementation of international maritime conventions, agreements and cooperation in maritime sector within its decentralized power; to act as focal agency with international maritime organizations.
- To organize the implementation of science research, development and application and transfer of technologies in maritime sector; to develop, implement IT application programs, projects; develop database, information services to serve for the management and operation in maritime sector.
- To guide and facilitate non-government organizations to participate in maritime sector.
- To inspect, check organizations, agencies, individuals in the whole country regarding the implementation of maritime laws; to investigate, control and deal with claims and denunciations, oppose corrupt and negative situations, practice economy and fight against waster and respond to and resolve legal violations in the maritime industry, within its competence.
- To develop and conduct its administrative reform program based on goals and contents of state administrative reform of MOT.
- To manage its organization, staff and labors using approved personnel by the laws; to implement the salary system and systems and policies on the treatment, remuneration and discipline, to organize training and strengthening of professional skills of staff, officials, workers and laborers in accordance with provisions of the laws.
- VINAMARINE can enjoy budget allocated from the state budget, incomes from charges and fees to undertake assigned obligations, and shall manage its finance, assigned properties in accordance with provisions of the laws.
- To preside over the drafting of maritime charges and fees, unit price of public services in maritime sector and submit to competent authorities for decision in accordance with

provisions of the laws.

- To tender, reserve or order the provision of public utilities in maritime sector in accordance with provisions of the laws.
- To directly contact to concerned state agencies to implement assigned functions, obligations and power in accordance with provisions of the laws.
- To carry out other tasks assigned by the Minister of Transport and in accordance with provisions of the laws.

i) Organization Structure (Article 3)

In order to execute tasks under its jurisdiction, VINAMARINE has 11 departments, Standing Office of the Vietnam IMO Secretariat and Administrative Office in its headquarter and 3 regional offices in Hai Phong City, in Da Nang City (currently vacant) and in Ho Chi Minh City, and 24 Maritime Administrations as well.

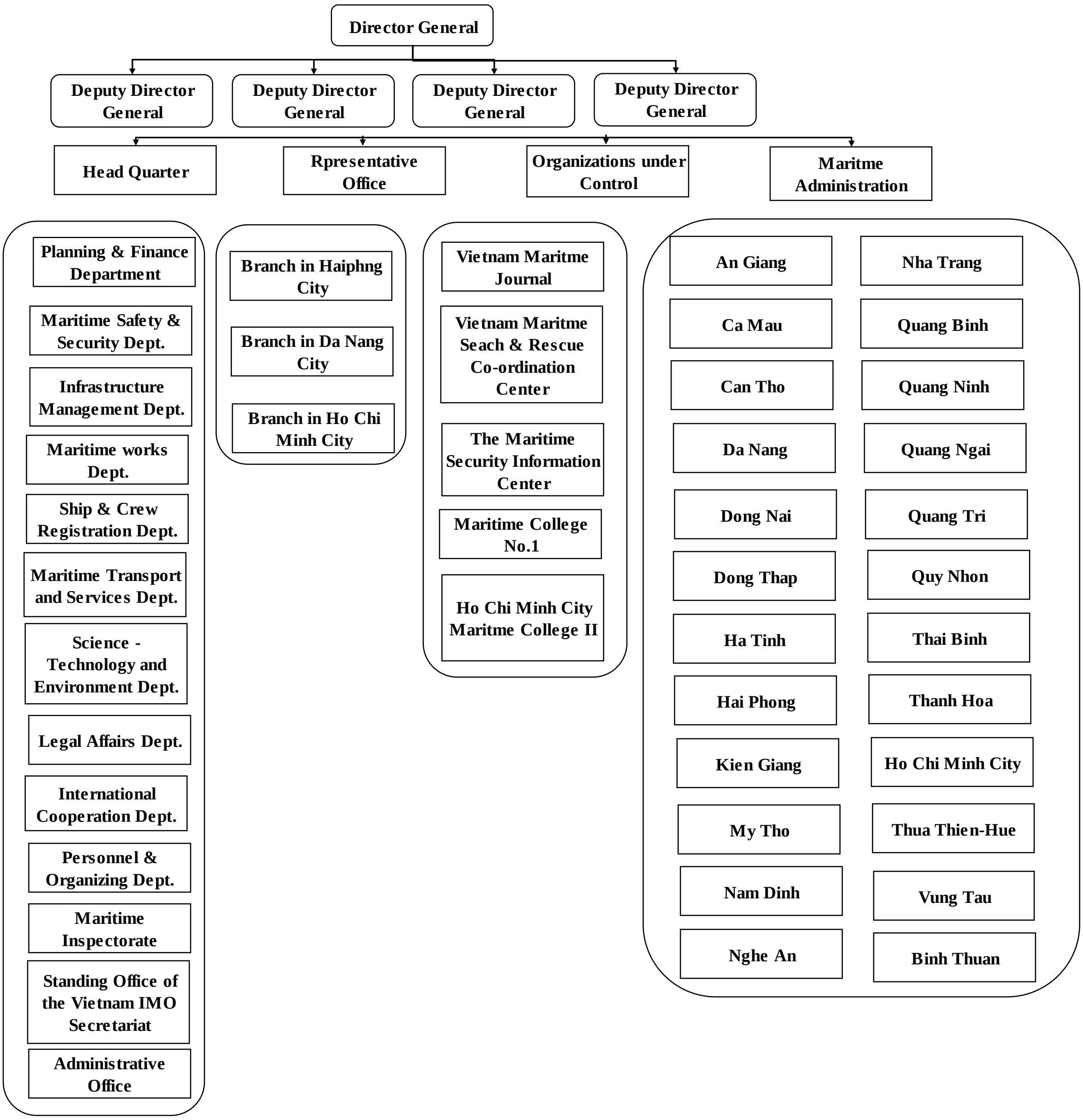


Figure 27.1.3 Organization Chart of VINAMARINE

2) Roles and Functions of Maritime Administration

Organization of Maritime Administration is stipulated by Article 5 of the decision 57/2005/QD-BGTVT as is shown in Figure 27.1.4.

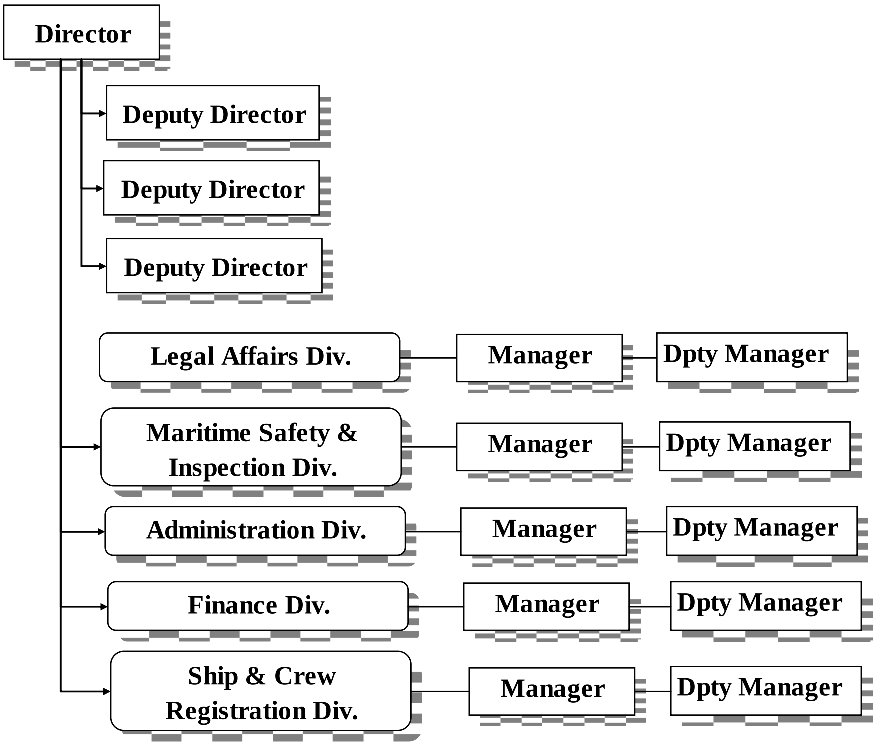


Figure 27.1.4 Organization Chart of Maritime Port Authority

Maritime Administration’s power is stated as follows; (Article 66, VMC)

- The Maritime Port Authority is the body to carry out the State administration on maritime affairs at seaports and port water areas.
- Director of the Maritime Port Authority is the person who exercises the highest command of the Maritime Port Authority.

Duties and powers of Director of the Maritime Port Authority are as follows; (Article 67, VMC)

- To take part in making the Master plan and plans for port development within his responsible area and to organize supervising their implementation after the approval by the competent authorities.
- To organize the implementation of regulations on the management of maritime activities at the seaport and the area under his management; to inspect and supervise the port access channel and the navigation aids system; to inspect maritime activities of organizations and individuals at the seaport and the area under his management.
- To permit and supervise ships’ entering and leaving and operations during their stay in the seaport; not to permit ships to enter or to leave the seaport if they are not seaworthy in respect of maritime safety and security and prevention of environmental pollution.
- To perform a writ to arrest of sea-going ships at the request by the competent authorities.
- To exercise the detention of sea-going ships in conformity with the provisions of Article 68 of this Code.
- To organize search and rescue of persons in distress in the port water area; to mobilize all human resources and appropriate facilities to carry out the search and rescue or to solve the

environmental pollution incidents.

- To exercise the implementation of the registration of sea-going ships and crew; to carry out the collection, management and use of all port charges and fees in accordance with the provisions of the laws and regulations.
- To carry out maritime safety inspection; to investigate and handle within his power marine accidents at the seaport and the area under his management.
- To chair and run the co-ordination of activities between the State Authorities at the seaport.
- To impose, within his power and responsibilities, maritime administrative fines.
- To carry out other duties and powers in conformity with the provisions of law.

In addition to these stipulations of VMC, Decision 57 also stipulates the obligations and powers of MA as follows;

- Develop and submit financial plan to Chairman of VINAMARINE, and actualize approved plan.
- Develop personnel plan for Chairman of VINAMARINE to submit to Minister of Transport for approval; employ, deploy and manage officers in accordance with regulations of the Ordinance on Civil Servants; provide professional training for officers under their management.
- Propagandize, examine, and monitor the implementation of maritime laws.
- Perform activities as authorized by State competence authorities regarding the lease of port infrastructure, which are developed by state budget or state-budget-generated funds, for management and operation.
- Manage properties, finance in accordance with legal regulations; produce reports, statistics and perform other obligations, power as regulated.
- Allowed to directly connect with domestic/international organizations, individuals to perform assigned obligations.

27.1.3 Administration System of Seaports

As to the administration system of seaports, clauses related with announcement of closure and opening of seaports and port water areas, planning for seaport development and investments in construction, management and operation of seaport and port access channels are provided in the VMC.

1) Announcement of Closure and Opening of Seaports and Port Water Areas (Article 62)

As to the closure and opening of seaports and port water areas, VMC stipulates as follows;

- The Government shall provide for conditions and procedures for closure and opening of seaports and port water areas, and for management of maritime access channel and maritime activities at seaports.
- The Minister of Transport, in consultation with the People Committee of the Province or the City under the central government where the port exists, shall make public closure and opening of seaports, port water areas and areas under the management of the Maritime Port Administration.
- Director of the Maritime Port Administration shall determine temporary suspension of port entry or departure of ships.

2) Planning for Seaport Development (Article 63)

As to the development of seaport, VMC also stipulates as follows;

- Master plan for seaport development shall proceed from the strategy of national socio-economic development, the national defense and security and the Master plans for transport development, other sectors and localities, and trend of international maritime development.

- When sectors and localities work out their sectoral or local Master plans for developing works and facilities in connection with seaports, they shall have to obtain written comments from the Ministry of Transport.
- The Prime Minister shall approve the Master Plan for development of the seaport system.
- The Minister of Transport shall approve the detailed plans for development of the seaport system.

Summary of the planning system is shown in Figure 27.1.5.

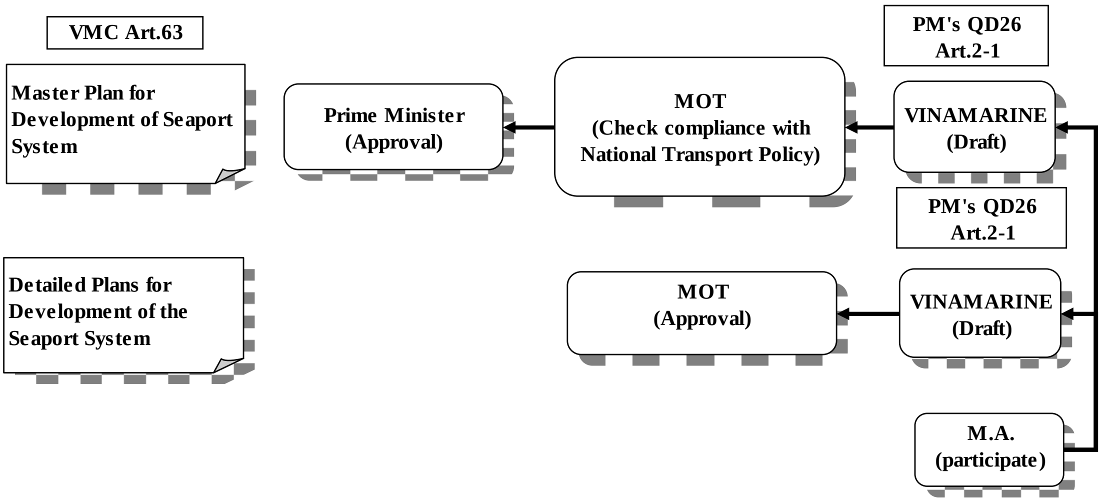


Figure 27.1.5 Planning Procedure

3) Investments in Construction, Management and Operation of Seaports and Port Access Channels (Article 64)

- Investment in construction of seaports and port access channels must be in compliance with the Master plan for development of the seaport and port access channel system and provisions of the laws and regulations on investment and construction and other relevant legislations.
- Local organizations and individuals, and foreign organizations and individuals shall be entitled to invest in construction of seaports and port access channels in accordance with the existing laws and regulations.
- The organizations and individuals who invest in construction of seaports and port access channels shall determine modalities of managing and operating the seaports and port access channels.
- The Government shall provide in detail for construction investment, management and operation of seaports and port access channels.

Apart from the VMC, construction and investment of major seaport projects have to comply with the Decree No.12/2009/ND-CP on management of investment projects on the construction of works as well as the Decree No.108/2006/ ND-CP providing detailed provisions and guidelines for implementation of a number of articles of Law on Investment and Law on Investment. According to these Decrees, investment decision/approval is conducted either by the Prime Minister or ministers, head of ministerial –level agencies or president of People’s Committees. In the former decree No.52, investment license is issued by Ministry of Planning and Investment But in the Decree No.12 replaced with Decree 52, there is no stipulation on investment license. The role of the Ministry of Transport is stipulated as follows;

(Art.79)

Ministries and ministerial equivalent bodies shall, within the scope of their respective duties and powers, be responsible for exercising State administration of investment within the sectors delegated to them, specifically as follows;

- Co-ordinating with the Ministry of Planning and Investment and relevant ministries and branches in the formulation of laws and policies relating to investment activities;
- Presiding over co-ordination with relevant ministries and branches in formulation and promulgation of laws, policies, standards and technical regulations and providing guidelines for their implementation.
- Submitting to the Government for promulgation conditions for investment in sectors in which investment is conditional within the technological-economic branch.
- Preparing master plans, plans and lists of projects calling for capital within branches; organization of encouragement and promotion of investment in their specialized branches.
- Announcing publicity the master plan. Plans, technical criteria, investment conditions and list of projects calling for capital within the branch.
- Evaluating and giving their opinions in writing on the ability to satisfy conditions which projects must satisfy in respect of projects falling within the approval authority of the Prime Minister of the Government and projects in sectors in which investment is conditional.
- Carrying out specialized examination, inspection and supervision of the satisfaction of conditions for investment and State administration in respect of investment projects falling within their authority.
- Presiding over co-ordination with relevant ministries, branches and provincial people’s committee to deal with difficulties and problems of investment projects relating to fields falling within their specialized administration.

Competent authorities for the decision of port investment are summarized in Figure 27.1.6 and detailed procedure for investment is shown in Figure 27.1.7.

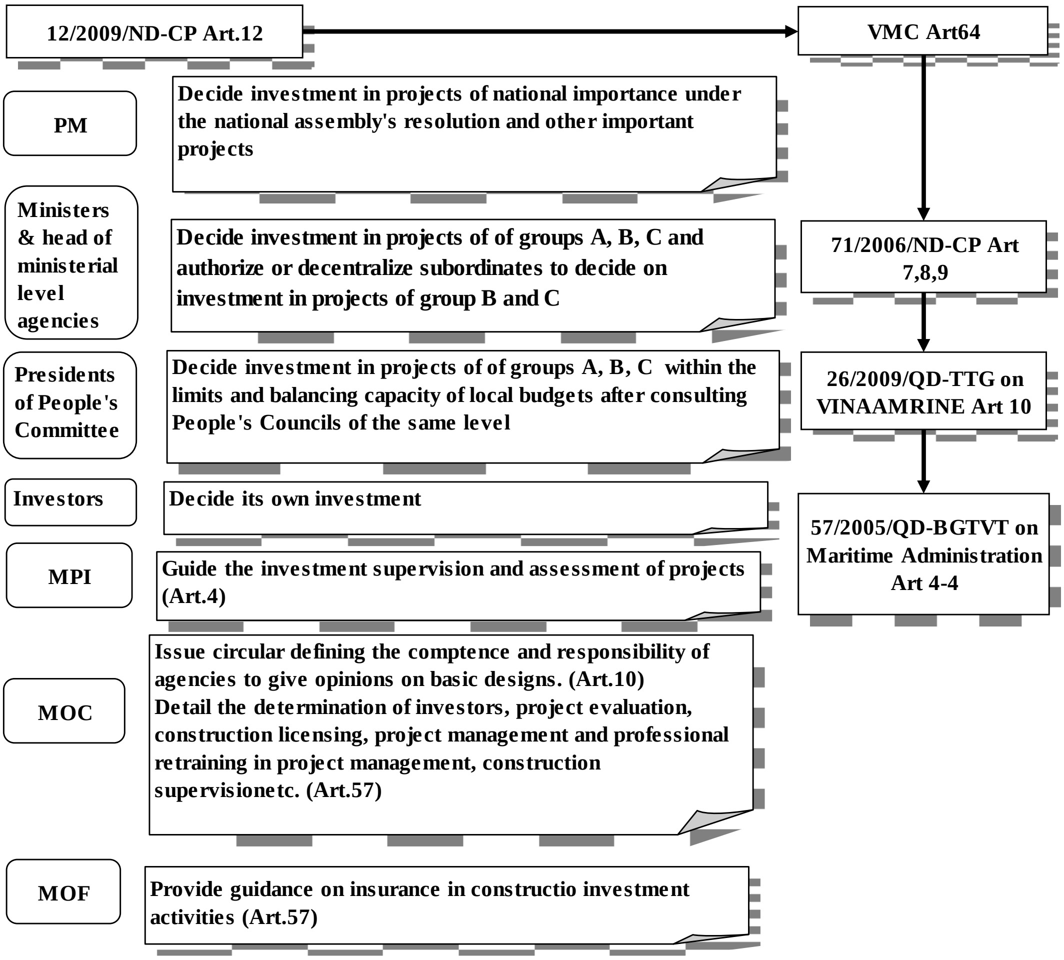


Figure 27.1.6 Authority on Decision of Investment on Port

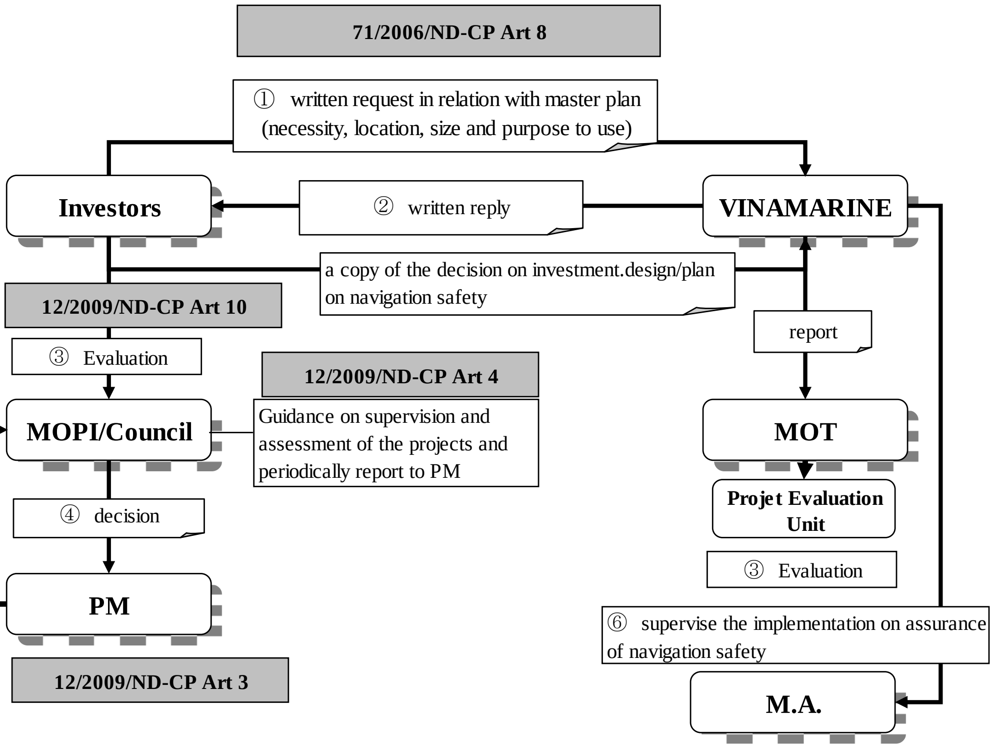


Figure 27.1.7 Detailed Procedure for Investment

4) Closure and Opening of Seaports and Wharves

According to the Decree No.160/2003/ND-CP on the control of maritime activities in seaports and the maritime area of Viet Nam, it is obligated that the investors shall obtain comments of the Ministry of Transport, Ministry of National Defense and Ministry of Public Security when they are preparing investments for development of seaport with the documents showing the necessity, place and scope of the proposed seaport, intended pilot boarding area, access channel and the purpose of port usage, and before carrying out the construction of a seaport, the investors shall submit to the Viet Nam Maritime Administration under the Ministry of Transport a copy of the Decision approving the technical design of the seaport, and the Viet Nam Maritime Administration shall be responsible for supervising the construction of the seaport by the investors in accordance with the approved master plan and maritime safety in that area. (Article 6)

Similar procedures are provided as to the opening of wharves and transshipment areas, but application shall be submitted to Viet Nam Maritime Administration in this case. (Article 7)

As to the construction of other works such as bridges, tunnels, ferry terminals, cables, underground cables and other similar works not under the project of construction of a wharf or a transshipment area in the seaport areas, similar procedure is regulated under the jurisdiction of Viet Nam Maritime Administration, and Maritime Port Authority and Maritime Safety Agency at the works' area (inform prior to putting the works into operation) (Article 8)

5) Pilotage

In the Viet Nam seaports, pilotage is compulsory for all types of foreign vessels regardless of size and Vietnamese vessels of 2000GT and over by Vietnamese pilots on entry into, departure from the port, maneuver in the waters of the port or in other compulsory pilotage areas of Viet Nam under the control and supervision of the Maritime Port Authority.

6) Coordination of Administration

In organizing the coordination of administration between the line State administration agencies in seaports, the Maritime Port Authority shall have the following responsibilities: (Article 51, ibid)

- Presiding and coordinating administration between the line State administration agencies in the seaports;
- Organizing and presiding meetings with the line State administration agencies or with other relevant organizations, agencies and enterprises in the port area to exchange ideas on settlement of problems;
- Requesting the other line State administration agencies in the seaport to timely notify the outcomes of formality clearance and measures to solve the problems, if arising; requesting the port enterprise, the ship-owners, vessels and other relevant agencies and organizations to supply data and information on maritime activities at the seaport;
- Recommending to Chairman of the People's Committee of the province or the city under the central control in the area to timely solve problems within the jurisdiction of the province or the city in connection with the line State administration at the seaport.

27.2 Proposed Management System of Lach Huyen Port under Current Regulatory System

27.2.1 Current System of Port Management under PPP Scheme in Vietnam

In the year of 2004, first scheme for leasing state own port facility to SOE was implemented under the lease contract between VINAMARINE and Quang Ninh Port Company for Cai Lan Port infrastructure financed by JICA (former JBIC).

Under this scheme, port infrastructure including berths, yards, buildings, utility facilities except equipment are leased to Quang Ninh Port Company for 25 years and equipment is assigned to Quang Ninh Port Company.

As to the maintenance of facilities, under this lease contract, VINAMARINE takes the responsibility of maintenance of channel and basin, sudden repair of lease properties' damage caused by force majeure or latent defects, and repair of lease properties' damage that is not caused by Quang Ninh Port Company's fault during the guaranteed period.

Quang Ninh Port Company is obliged to plan, implement and notify in paper to VINAMARINE about periodical repairs, annual maintenance of lease properties to ensure proper operation and repair, maintenance shall be done pursuant to legal regulations. Further it is obligated that before implementing periodical repair or maintenance of lease properties Quang Ninh Port Company shall have notification to VINAMARINE so that VINAMARINE can send staff to observe these works if necessary.

Quang Ninh Port Company is also obligated to dredge and maintain waterfront of terminals 5, 6, 7 at its own expense to guarantee the safe depth for vessels' navigation as announced by the competent authority.

Other than Cai Lan Port Lease Contract, there is no other contract on PPP scheme than Cai Mep-Thi Vai International Port which is currently under preparation.

During the technical assistance program conducted by JICA for the implementation of PPP scheme for Cai Mep-Thi Vai International Port, VINAMARINE drafted the Decree on Management of Seaport Infrastructure Operation which is not provided in the current regulations related to VMC.

In this draft regulation, the lessee is obligated to do periodic repairs and regular maintenance as regulated and lessor is obligated to do unscheduled repairs as regulated in leasing contract.

The draft regulation also stipulates the obligations and powers of Port Management Body as follows;

- To participate in the formulation of Vietnam seaport development plan
- To set up seaport infrastructure operation business strategy and business plan for the length of one year, five year and for a long-term
- To build up rules and regulations for management, investigation, repair supervision, improvement and development of seaports
- To formulate technical standards for seaport infrastructure operation and utilization
- To set up income-expense plan on the basis of seaport operation revenue
- To organize the collection of leasing and purchasing fees of seaport infrastructure and extract a part of revenue into Port Development Funds as regulated
- To organize regular and periodic investigation and supervision over operation of seaport infrastructure to ensure appropriate utilization of that infrastructure in accordance with technical standards

- To require operators to obey the approved technical procedures and standards for utilization and operation of seaport infrastructure
- To coordinate with the operators to deal with damages to seaport infrastructure and to organize the repair and rectification of those damages in the agreed period by both sides
- To report timely to specialized state administration agency when discovering that channel depth, turning basins, and maritime signal systems do not conform to design approved by competent authority
- To receive and propose plans for port improvement, expansion, and development when required by operators or specialized state administration agency
- To require operators to carry out plans and exercise measures to prevent calamity, fires and to protect environment under relevant regulations and laws
- To implement other assigned duties and powers

27.2.2 Proposed Management System of Lach Huyen Port

Considering the powers and authorities of Maritime Port Authority (former Maritime Administration) stipulated in Decision 57 and VMC and draft regulation on seaport management and operation, it is recommended to attach the function of port management body stipulated and expected for management of Lach Huyen Port in the draft regulation to existing Maritime Port Authority (Maritime Administration) of Hai Phong under VINAMARINE.

1) Proposed Institutional Setting

As to the implementation of PPP project, hierarchical relations of powers and authorities among related institutions based on the existing laws and regulations and draft decree on management of seaport infrastructure operation is shown in Figure 27.2.1.

In order to manage the concession and implement the maintenance obligation of the Government, it is necessary to modify the institutional organization of Hai Phong Maritime Port Authority (Maritime Administration) as shown in Figure 27.1.2.

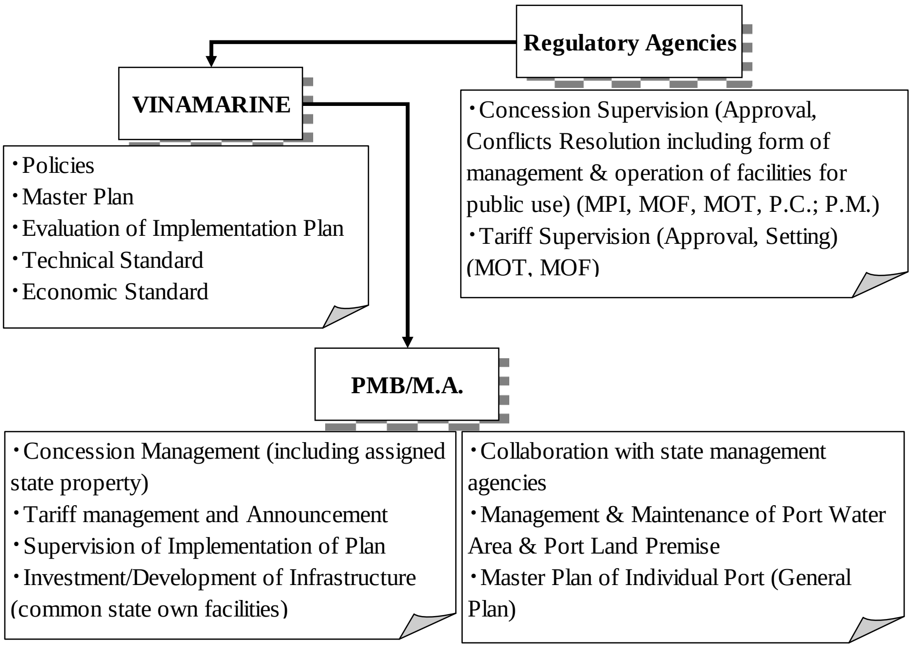


Figure 27.2.1 Hierarchical Relations of Related Institutions

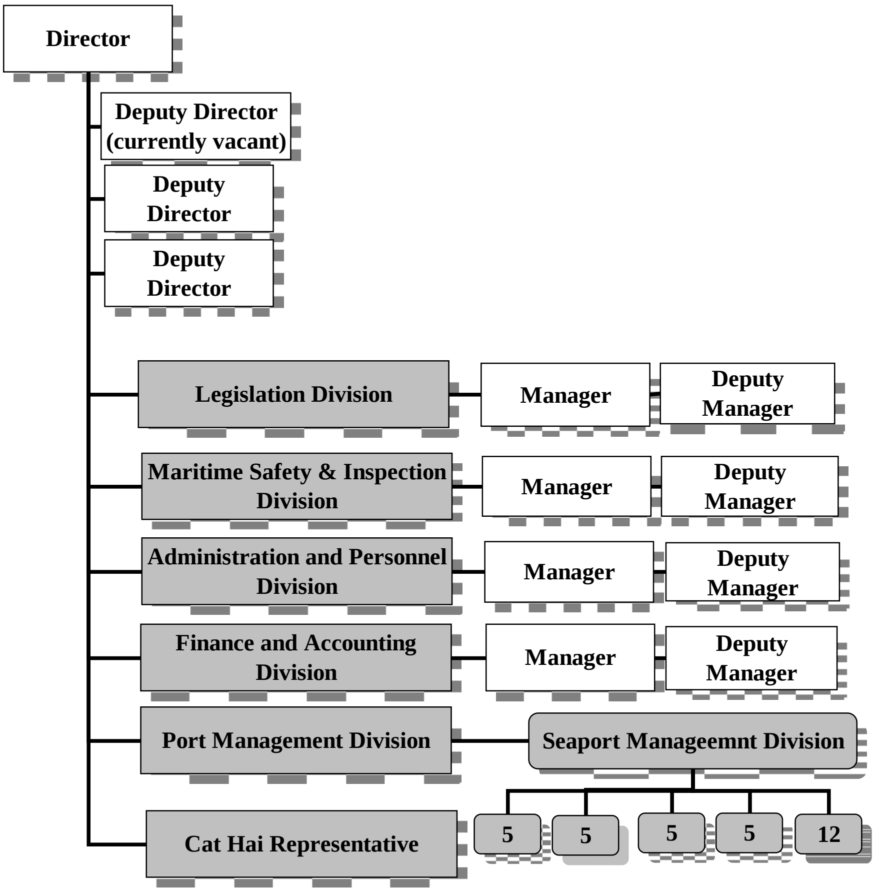


Figure 27.2.2 Modified Organization of Hai Phong Maritime Port Authority

Newly attached seaport management division is assumed to consist of 5 departments which are real estate, business development, procurement & accounting, marketing and engineering.

Responsibility of each department is as follows;

a) Department of Real Estate

- Responsible for maintaining and making public a revolving 1-month tickler log of all agreements showing their expiration dates and renegotiation dates and a comprehensive port-wide lease map indicating leased and unleased properties
- Responsible for reviewing the log and lease map on a regular basis to determine when leases will expire, minimizing properties under holdover, and when unleased properties are available to market and take necessary action
- Responsible for recommending several alternate uses for the property

b) Department of Business Development

- Responsible for setting business conditions for the concessionaire and/or lessee
- Responsible for financial management
- Responsible for permission for investment in the port area
- Responsible for economic regulations

c) Department of Marketing

- Responsible for concession process
- Responsible for port sales

- Responsible for tariff setting and supervision

d) Department of Procurement & Accounting

- Responsible for the procurement of all the requirement for operation of the Maritime Port Authority
- Responsible for accounting of the Maritime Port Authority

e) Department of Engineering

- Responsible for planning and statistics
- Responsible for IT management
- Responsible for construction supervision and maintenance
- Responsible for technical regulations

Detailed structure of sections in each department and necessary number of staffs are as shown in Figure 27.2.3.

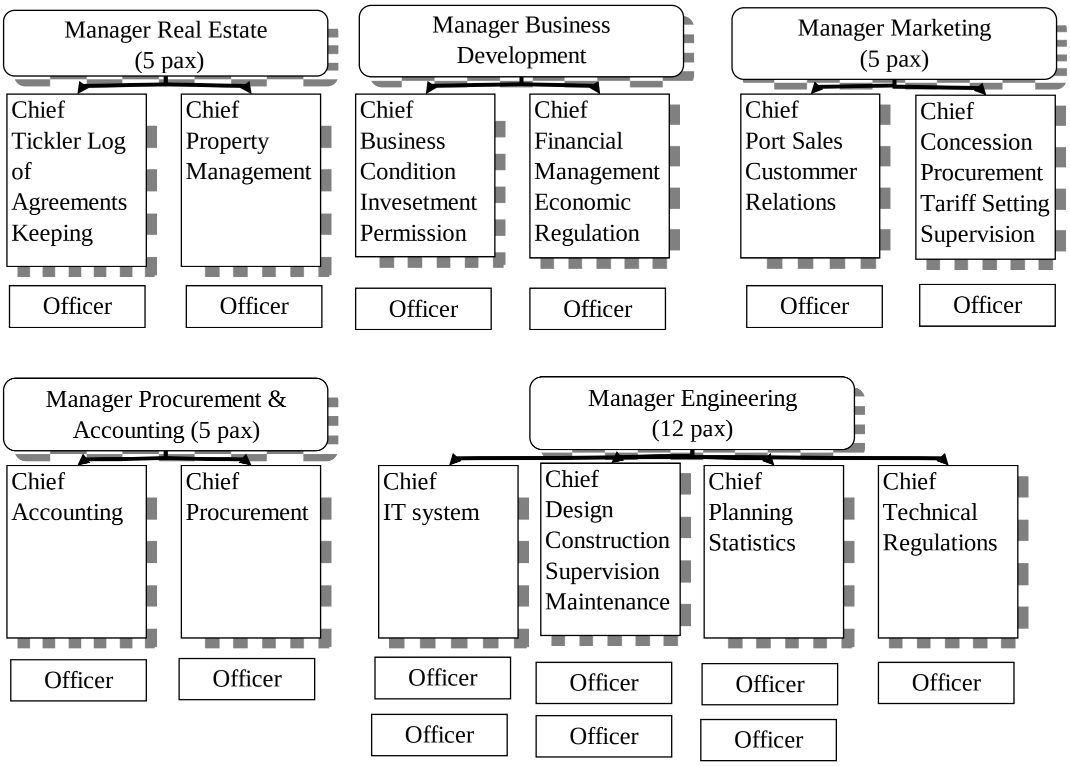


Figure 27.2.3 Detailed Organization of Departments

2) Inspection and Maintenance Plan of Port Facilities

Under the PPP scheme applied for Lach Huyen New Port, especially for Phase I development in which construction of channel, groin, access bridge and road and land reclamation is conducted by the Government and other terminal facilities including quay wall are constructed by concessionaire (Terminal Operator), basic principles for inspection and maintenance of the port facilities should be clearly defined in the concession contract.

As to the navigation facilities including channel and navigation aids and possibly including groin shall be constructed for the use of vessels to not only the one terminal operator but also to other terminal operators and capital cost and maintenance cost shall be expensed from the revenue from tonnage due, navigation safety fee and procedure fee.

It is, therefore, rational to bear the responsibility of maintenance of these facilities by VINAMARINE/Maritime Port Administration.

Other terminal facilities including quay wall and alongside basin shall be maintained by the terminal operator at its own cost.

Based on the above mentioned principle, followings should be stipulated in the concession contract;

a) Obligation of VINAMARINE/Maritime Administration

- Maintain the depth of the port entrance/exit channels, basin to ensure the safe operation depth by each period in accordance with channel design approved by the competent authority
- Take charge of sudden repair of lease properties' damage caused by force majeure or latent defects of reclaimed land.
- Take charge of repair of conceded properties' damage that is not caused by terminal operator's fault during the concession period.
- Inspect, monitor the management, operation, repair, maintenance of conceded properties to concessionaire to ensure that the conceded properties are utilized for appropriate purposes and in accordance with their technical functions.

b) Obligation of Concessionaire/Terminal Operator

- Responsible for damages, losses of conceded properties caused by the concessionaire/terminal operator's faults or any third party and also notify the situation to Maritime Port Authority.
- Plan, implement and notify in written form to Maritime Port Authority about periodical repairs, annual maintenance of conceded properties to ensure proper operation. The repair, maintenance shall be done pursuant to legal regulations. Before implementing periodical repair or maintenance of conceded properties, concessionaire/terminal operator shall notify to Maritime Port Authority so that he can send staff to observe these works if necessary.
- Dredge, maintain along side basin at concessionaire's own expense to guarantee the safe depth for vessels' navigation as announced by the competent authority.

27.3 Guideline for Establishing the Independent Regional Port Authority

27.3.1 Basic Consideration for the Reform of Port Management System in Vietnam

It is necessary for Vietnam to focus its effort to develop and strengthen the major port infrastructure to sustain its economic development for the nation as a whole at least for coming decade. In this context, it is necessary to avoid duplicated investment by different agencies including foreign direct investment and to guide them to invest in port in line with well elaborated port sector development plan.

Former centralized development system for major port projects based on Decree No. 52 and Foreign Investment Law together with its related Decrees No.24 and No.27 has been changed and decentralized in the new Decree No.12/2009/ND-CP and Decision No.108/2006/ND-CP. It is, however, necessary to make more clearly define the procedure of investment decision and its criteria together with establishment of planning standard for port development for Master Plan and Detailed Plan specialized in the port sector.

It is also necessary to establish more fair, transparent and clear condition for the port operation to encourage market oriented competition among the operators. For this purpose, currently practiced cross subsidy system of the SOEs should be abolished and establish level playing field with non-state sector operators. Hence, it is also necessary to reform the SOEs currently participating in the port operation to the status of private entities.

In order to more effectively work the current system of infrastructure development, especially in port sector, responsible port management bodies are necessary to be established and clear redefinition of roles and functions together with powers and authorities of VINAMARINE, Port Authority, port management body and operators is necessary.

27.3.2 Three Tiered Organizational Structure

Considering the current legal system on port development and administration system of Vietnam of which main players are VINAMARINE, Maritime Administration and Provincial People’s Committee, landlord port system with three tiered administration structure which is composed of VINAMARINE, Regional Port Authority and Local Port Authority is recommended.

Within the landlord port system, terminal operation is the responsibility of private operators under concession/lease contract and port management body, which is the owner of infrastructure and a party of the contract, has a responsibility to administer the contract and to observe the public interest.

When the port management body is a party of the concession contract, it is natural to get terminal more profitable to increase the concession fee revenue and thus it will cause a conflict of interest against users of the terminal. To avoid such a situation, neutral supervisory function is attached to VINAMARINE independent from the port management body.

Considering the operational situation of Vietnamese ports, where the port authority under VINAMARINE is controlling the navigation of the area covering a number of ports/terminals and administration system by VINAMARINE which classifies ports of the nation into 8 groups based on which national policy and plans are established, Regional Port Authorities (Regional Port Management Bodies) are to be established corresponding to representative office of VINAMARINE and considering the group of ports.

Regional Port Authorities are the owner of the infrastructure and a party of concession/lease contract and executes some parts of obligation of a party of contract including major maintenance work of the infrastructure and planning of ports under its ambit, while Local Port Authority executes daily management and operation works of individual port and supervision of the performance of the operator.

In order to maintain the status of public interest oversight and provision of level playing field to operators, Port Authority should refrain from conducting the business in terminal operation in the major port competing with private/state-own companies unless it is approved by VINAMARINE as a special case.

Considering the powers and authorities on investment license, land lease and state administration attached to each entities, Local Port Authority is better to be established by reforming the current port authority to expand its function involving the port management function and directors of the local port authority are composed of representatives of provincial level people's committee, current port authority, VINAMARINE, Ministries of Finance and Ministry of Planning and Investment.

In order to reflect the opinions of interest groups on port planning and policy making of the local port authority, Port Planning Committee is recommended to be established and attached to Regional Port Authority and VINAMARINE to deliberate the important issues on port management and operation.

Hence, major role of VINAMARINE is the state administration in port affairs (policy, plan and regulation) and regulator for the concession contract as well. Regional Port Authority is to implement the regulation and administer the concession contract as a party of concession contract. Private entities including SOEs play the role of terminal operator under concession contract.

27.3.3 Regulatory Framework

In order to realize the system mentioned above, regulatory framework for administration and management of the ports should be restructured. Current legal system is established to develop major industries and infrastructures under centrally licensed investment system and under business license system lacking of regulatory framework for port management including coordination among the operators and economic and technical regulatory system.

Such a port management function should be rendered to newly established Port Management Body with clear definition of legal status. Physical development of port infrastructure as well as its location should be planned reflecting the local situation of economic development and business environment of maritime sector as well, and transport network connecting hinterland and ports. Well coordinated plan and investment are achieved through three tiered administration system to implement policies and plans of the State by regional/local administration entities and reporting the local situation to the central organization both of which has sectoral expertise.

Especially in the port sector, ports can achieve their role well coordinated developments both of maritime/port business and infrastructure. Hence, licenses of maritime/port business and infrastructure development should be under the same organization with unified sectoral policy.

As to the financial and monetary policy of the State, it is necessary to control foreign investment and domestic investment as well under the unified financial and monetary policy. The function and role of the Ministry of Planning and Investment should be limited to control and supervise the allocation of financial resources and investment amount.

Decentralization of powers and authorities among the ministries are necessary as the economic scale expands to avoid the over-capacity of one ministry and mislead of administration.

1) Investment and Construction License

In line with the framework mentioned above, investment and construction license of Group A, B and C has become under Ministry of Transport/VINAMARINE in its decentralized authority in consultation with Ministry of Planning and Investment. The form of investment and construction is usually the matter of proposed plan of concession including the form of management and operation and business license of the project, it is necessary to discuss and negotiate with the potential bidders for the concession under the single responsible administration in order to smooth implementation of contract agreement. Ministry of Planning and Investment should assess the project only from the view point of financial and monetary policy.

According to Article 3 of Decree No. 12, investors for the state budget-funded projects may be ministerial level agencies. Therefore, without changing the laws and decrees, the above mentioned powers can be rendered to the Ministry of Transport.

2) Business Condition

It is reasonable for the enterprises engaging in terminal operation to register its business in compliance with the business conditions set forth in Decree No.115/2007/ND-CP rather than to apply licensing system. It is, however, necessary to loose the condition that for enterprises with foreign investment capital, the capital contributed by the Vietnamese party must not be lower than 51%, since 100% foreign capital enterprise has already been operating the terminal in Vietnam in reality.

3) Port Water Area and Port Land Premise

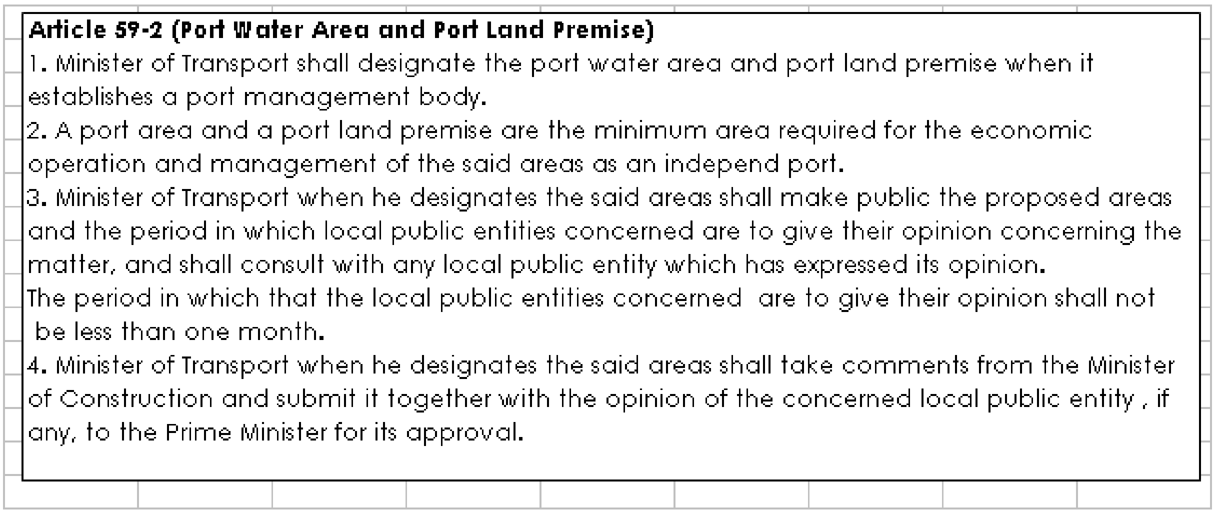
New Maritime Code of Vietnam defines Port Water Area and Port Land Premise as restrictive areas. There is, however, neither clear description of their objective, nor the procedure to designate these areas.

It is necessary to designate certain restrictive zones both for water area and land area of the port which are under jurisdiction of Port Management Body to restrict the acts which may seriously impede the development, utilization or preservation of the port and acts of the nature which seriously impede the utilization of the port, or obstructs seriously the implementation of the port and harbor plan, or interferes considerably with the development and progress of the port.

Hence, article 59 of the new Maritime Code of Vietnam needs additional provisions on the restrictive measures of port water area and port land premise together with the procedure of designation.

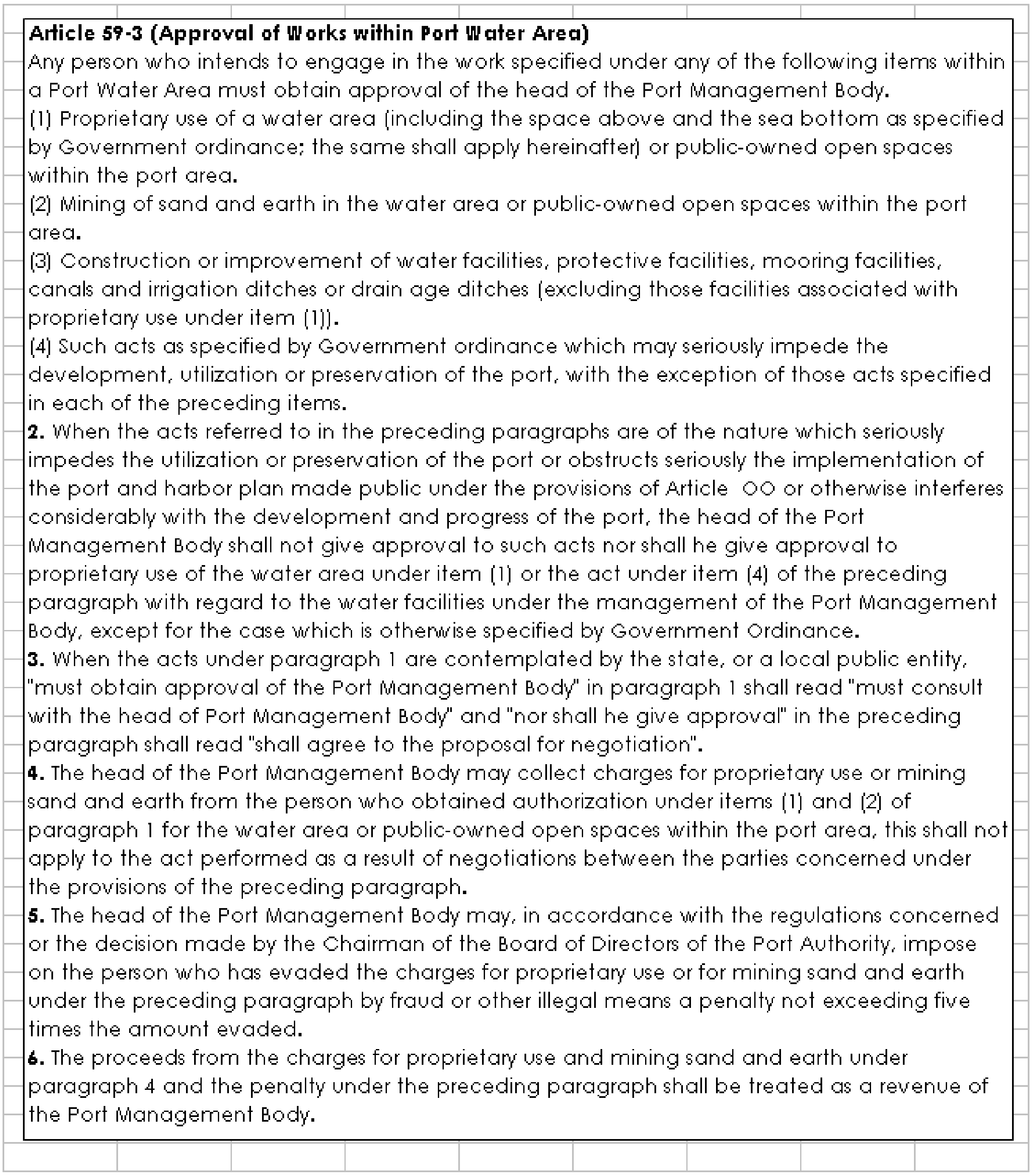
Sample provisions are shown in Box 27.3.1 through Box 27.3.6.

Box 27.3.1



Article 59-2 (Port Water Area and Port Land Premise)
1. Minister of Transport shall designate the port water area and port land premise when it establishes a port management body.
2. A port area and a port land premise are the minimum area required for the economic operation and management of the said areas as an independ port.
3. Minister of Transport when he designates the said areas shall make public the proposed areas and the period in which local public entities concerned are to give their opinion concerning the matter, and shall consult with any local public entity which has expressed its opinion.
The period in which that the local public entities concerned are to give their opinion shall not be less than one month.
4. Minister of Transport when he designates the said areas shall take comments from the Minister of Construction and submit it together with the opinion of the concerned local public entity , if any, to the Prime Minister for its approval.

Box 27.3.2



Article 59-3 (Approval of Works within Port Water Area)

Any person who intends to engage in the work specified under any of the following items within a Port Water Area must obtain approval of the head of the Port Management Body.

(1) Proprietary use of a water area (including the space above and the sea bottom as specified by Government ordinance; the same shall apply hereinafter) or public-owned open spaces within the port area.

(2) Mining of sand and earth in the water area or public-owned open spaces within the port area.

(3) Construction or improvement of water facilities, protective facilities, mooring facilities, canals and irrigation ditches or drain age ditches (excluding those facilities associated with proprietary use under item (1)).

(4) Such acts as specified by Government ordinance which may seriously impede the development, utilization or preservation of the port, with the exception of those acts specified in each of the preceding items.

2. When the acts referred to in the preceding paragraphs are of the nature which seriously impedes the utilization or preservation of the port or obstructs seriously the implementation of the port and harbor plan made public under the provisions of Article OO or otherwise interferes considerably with the development and progress of the port, the head of the Port Management Body shall not give approval to such acts nor shall he give approval to proprietary use of the water area under item (1) or the act under item (4) of the preceding paragraph with regard to the water facilities under the management of the Port Management Body, except for the case which is otherwise specified by Government Ordinance.

3. When the acts under paragraph 1 are contemplated by the state, or a local public entity, "must obtain approval of the Port Management Body" in paragraph 1 shall read "must consult with the head of Port Management Body" and "nor shall he give approval" in the preceding paragraph shall read "shall agree to the proposal for negotiation".

4. The head of the Port Management Body may collect charges for proprietary use or mining sand and earth from the person who obtained authorization under items (1) and (2) of paragraph 1 for the water area or public-owned open spaces within the port area, this shall not apply to the act performed as a result of negotiations between the parties concerned under the provisions of the preceding paragraph.

5. The head of the Port Management Body may, in accordance with the regulations concerned or the decision made by the Chairman of the Board of Directors of the Port Authority, impose on the person who has evaded the charges for proprietary use or for mining sand and earth under the preceding paragraph by fraud or other illegal means a penalty not exceeding five times the amount evaded.

6. The proceeds from the charges for proprietary use and mining sand and earth under paragraph 4 and the penalty under the preceding paragraph shall be treated as a revenue of the Port Management Body.

Box 27.3.3

Article 59-4 (Port Land Premise)

ARTICLE 38-2 (Reporting of Acts Performed in Port Land Premise)

Any person who intends to engage in any of the following acts within a port land premise shall report that effect to the head of the port Management Body concerned not later than sixty (60) days prior to the start of the said work in accordance with the provisions of Ministry of Transport Ordinance. Provided that this shall not apply when a person or persons granted permission under the provisions of Article 59-3 paragraph 1 are engaged in the work authorized or when a person or persons referred to in paragraph 3 of the same article are engaged in work which is agreed upon by the head of the Port Management Body under the provisions of the same paragraph.

(1) Construction or improvement of water facilities, canals, irrigation ditches or drainage ditches.

(2) Construction or improvement of waste disposal facilities specified by Government Ordinance other than those provided in the premises of factories and others specified in the following item (limited to those facilities which are used specifically for the treatment of waste generated in the said factories and others).

(3) Construction or extension of a factory or a business establishment in which the total floor area of the work shops or the total ground area of the factory or the business establishment (hereinafter referred to as factories and others) located with in one industrial complex exceed the standard specified by Government Ordinance (hereinafter referred to as factories and others).

(4) Construction or improvement of such facilities as specified by Government Ordinance which may cause a major obstruction to the development, utilization or preservation of the port, except for those facilities specified in the preceding three items.

2. Any person who intends to make a report in accordance with the provisions of the preceding paragraph must submit a report containing the following information to the head of the Port Management Body.

(1) Name or title and address of a person concerned or name of the representative of a corporation concerned.

(2) Such information as described below in the case of works specified in items (1) and (2) of the preceding paragraph.

a. Location, type and design of the facilities concerned.

b. Plans for use of the facilities concerned

(3) Such information as specified below in the case of works given under item (3) of the preceding paragraph.

a. Location, type and ground area of factories and others and floor area of work shops.

b. Approximate quantity of incoming and outgoing cargo associated with the operation of factories and others and transport plan thereof.

c. Other matters specified by Ministry of Transport Ordinance.

(4) Other matters specified by Ministry of Transport Ordinance.

3. The report under the preceding paragraph must be accompanied by work specifications and other documents specified by Ministry of Transport Ordinance.

4. Any person who has made a report under the provisions of paragraph 1, when intending to make changes in the matters referred to in items (2) through (4), paragraph 2 in relation to the work for which he has made a report, must notify the head of the Port Management Body of the effect not later than sixty (60) days prior to the start of the work necessitated by the said changes, in accordance with the Ministry of Transport Ordinance.

5. Any person who has made a report under the provisions of paragraph 1, in the event of any change in the matters referred to in item (1), paragraph 2 while the said work is in progress, shall report that effect to the head of the Port Management Body without delay.

6. The provisions of paragraph 3 shall apply mutatis mutandis to the reporting under the provisions of paragraph 4.

7. The head of the Port Management Body may, when he considers, upon receipt of a report under the provisions of paragraph 1 or 4, that the work being reported is not in conformity with the standards specified in the following items (Items (3) and (4) in the case of the work described in items (1), (2) and (4) of paragraph 1; the same shall apply to the following paragraph and paragraph 10), recommend, within sixty (60) days from the date on which the report is received, the person who made the report to change the plan or take necessary steps in relation to the said work.

(1) That the transport plan for cargo to be transported to and from the factories and others scheduled for construction or extension as a result of the operation thereof is appropriate upon comparison with the capabilities of port facilities in the said port or the port and harbor plan made public under the provisions of paragraph 7 or 8, Article XX.

(2) That the quantity or the type of waste materials to be disposed of within the said port area or waterfront area (excluding the premises of the factories and others) out of the waste materials to be generated as a result of the operation of the factories and others scheduled for construction or extension is appropriate upon comparison with the plan for disposal of waste materials worked out under the port and harbor plan which was made public under the provisions of paragraphs 7 or 8, Article XX.

(3) That the said work will not be a major obstruction to the implementation of the port and harbor plan made public under the provisions of paragraph 7 or 8, Article XX.

(4) That the said work is not likely to become a major obstruction to the utilization and preservation of the port.

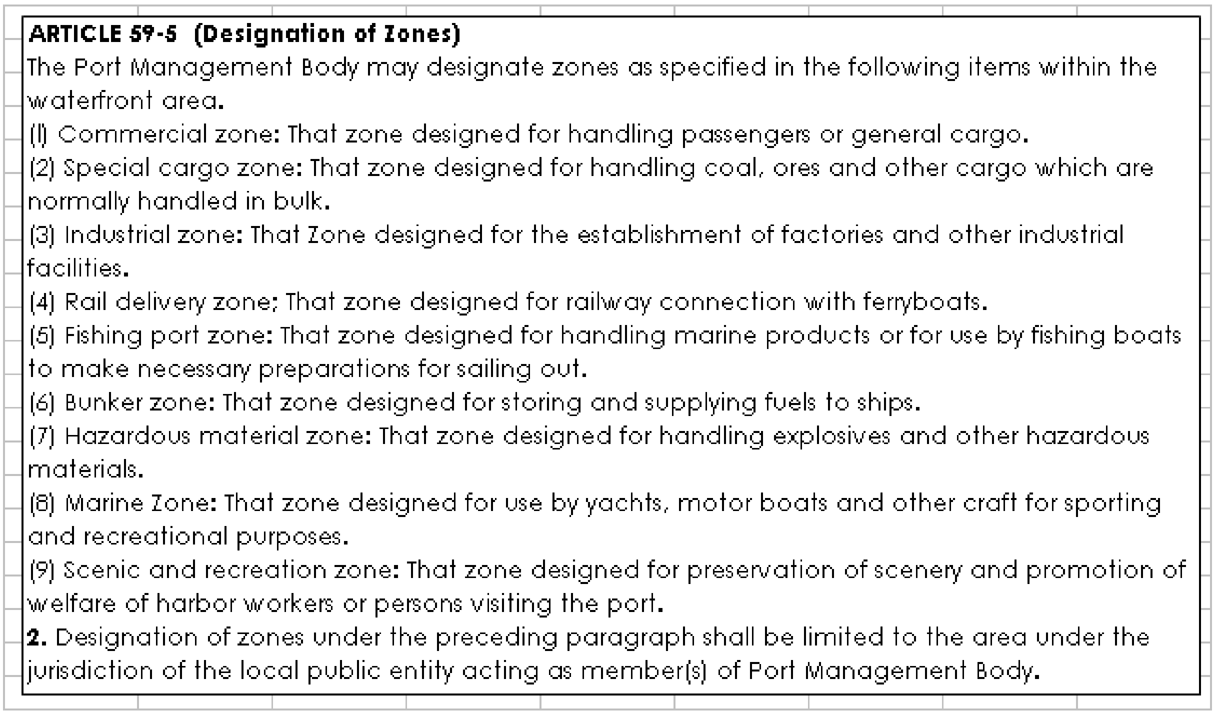
8. The head of the Port Management Body may, when he considers, upon receipt of a report under the provisions of paragraph 1 or 4, that the work being reported (excluding the works referred to in items (2) and (4), paragraph 1) is not in conformity with the requirements specified in each item of the preceding paragraph and that, unless major changes are made in the port and harbor plan for water facilities, protective facilities, mooring facilities or port transport facilities, the execution of the said work will make the operation and management of the port extremely difficult, order the person making the report, within sixty (60) days from the date on which the report is received, to change the plan for the said work.

9. When the person referred to in Article 59-3 paragraph 3 intends to engage in the work specified in any of the items of paragraph 1 (excluding works specified in the provision to the same paragraph), he must report that effect to the head of the Port Management Body according to the formalities required for reporting specified in the same paragraph and when intending to make changes in the matters already reported, must report that effect to the head of the Port Management Body according to the formalities required for reporting specified by the provisions of paragraph 4.

10. The head of the Port Management Body may, when he considers, upon receipt of a notification under the provision of the preceding paragraph, that the work for which the notification was made is not in conformity with the standards specified in each of the items of paragraph 7, request the person who has made notification, within sixty (60) days from the date on which the notification is made, to change the plan or take necessary steps for the said work.

Continuation of Box 27.3.3

Box 27.3.4



ARTICLE 59-5 (Designation of Zones)

The Port Management Body may designate zones as specified in the following items within the waterfront area.

(l) Commercial zone: That zone designed for handling passengers or general cargo.

(2) Special cargo zone: That zone designed for handling coal, ores and other cargo which are normally handled in bulk.

(3) Industrial zone: That Zone designed for the establishment of factories and other industrial facilities.

(4) Rail delivery zone; That zone designed for railway connection with ferryboats.

(5) Fishing port zone: That zone designed for handling marine products or for use by fishing boats to make necessary preparations for sailing out.

(6) Bunker zone: That zone designed for storing and supplying fuels to ships.

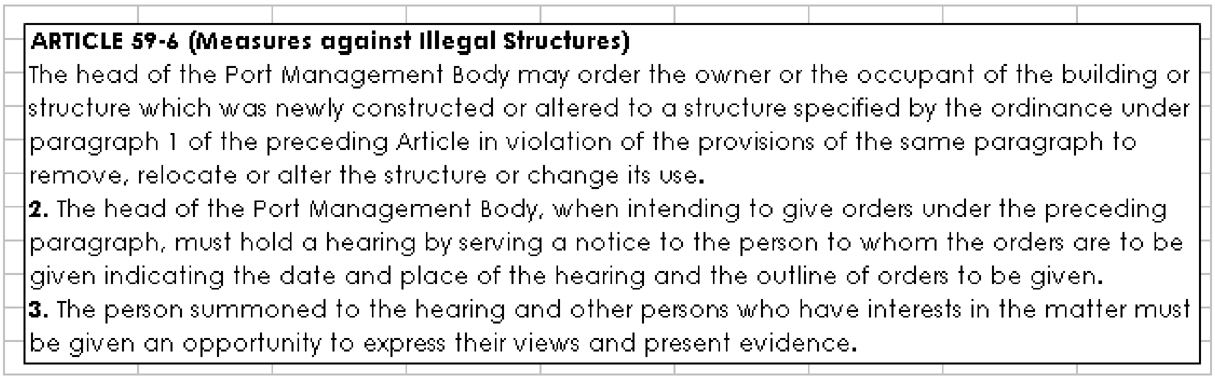
(7) Hazardous material zone: That zone designed for handling explosives and other hazardous materials.

(8) Marine Zone: That zone designed for use by yachts, motor boats and other craft for sporting and recreational purposes.

(9) Scenic and recreation zone: That zone designed for preservation of scenery and promotion of welfare of harbor workers or persons visiting the port.

2. Designation of zones under the preceding paragraph shall be limited to the area under the jurisdiction of the local public entity acting as member(s) of Port Management Body.

Box 27.3.5



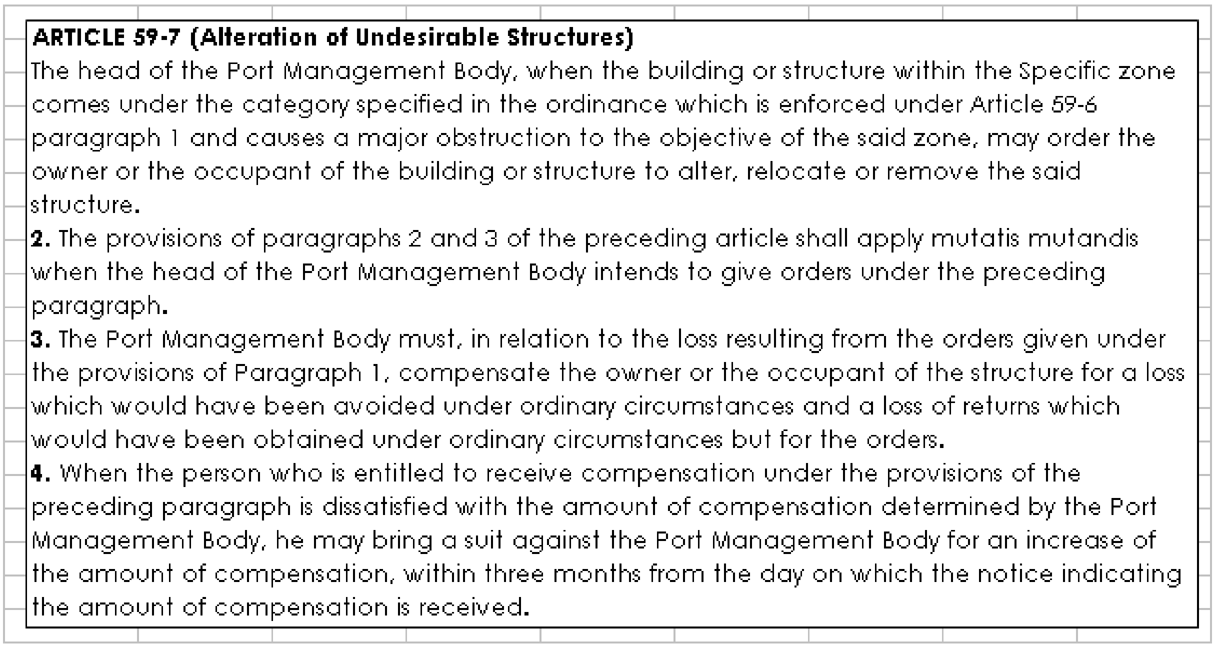
ARTICLE 59-6 (Measures against Illegal Structures)

The head of the Port Management Body may order the owner or the occupant of the building or structure which was newly constructed or altered to a structure specified by the ordinance under paragraph 1 of the preceding Article in violation of the provisions of the same paragraph to remove, relocate or alter the structure or change its use.

2. The head of the Port Management Body, when intending to give orders under the preceding paragraph, must hold a hearing by serving a notice to the person to whom the orders are to be given indicating the date and place of the hearing and the outline of orders to be given.

3. The person summoned to the hearing and other persons who have interests in the matter must be given an opportunity to express their views and present evidence.

Box 27.3.6



ARTICLE 59-7 (Alteration of Undesirable Structures)

The head of the Port Management Body, when the building or structure within the Specific zone comes under the category specified in the ordinance which is enforced under Article 59-6 paragraph 1 and causes a major obstruction to the objective of the said zone, may order the owner or the occupant of the building or structure to alter, relocate or remove the said structure.

2. The provisions of paragraphs 2 and 3 of the preceding article shall apply mutatis mutandis when the head of the Port Management Body intends to give orders under the preceding paragraph.

3. The Port Management Body must, in relation to the loss resulting from the orders given under the provisions of Paragraph 1, compensate the owner or the occupant of the structure for a loss which would have been avoided under ordinary circumstances and a loss of returns which would have been obtained under ordinary circumstances but for the orders.

4. When the person who is entitled to receive compensation under the provisions of the preceding paragraph is dissatisfied with the amount of compensation determined by the Port Management Body, he may bring a suit against the Port Management Body for an increase of the amount of compensation, within three months from the day on which the notice indicating the amount of compensation is received.

4) Planning for Seaport Development

It is specified in new Maritime Code of Vietnam that master plan for seaport development shall proceed from the strategy of national socio-economic development, the national defense and security and the master plan for transport development, other sectors and localities, and trend of international maritime development, and when sectors and localities work out their sectoral or local master plans for developing works and facilities in connection with seaports, they shall have to obtain written comments from the Ministry of Transport, and the Prime Minister shall approve the master plan for development of the seaport system.

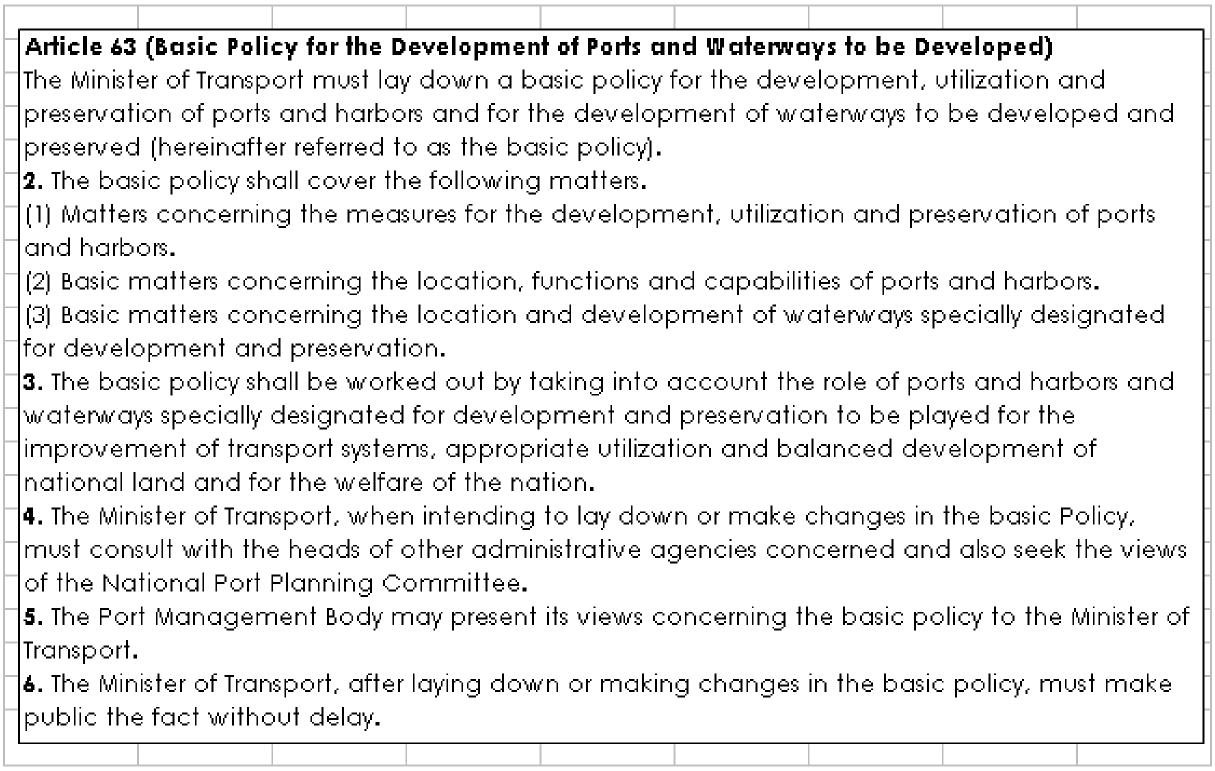
This specification for planning procedure is corresponding to the procedures specified for investment and construction project in Decree No.12/2009/ND-Cp.

It is, however, necessary to coordinate the individual project to match with the master plan of individual port as a whole to secure the orderly development of the port which is also appropriate for the port sector development of the nation as a whole.

Therefore, individual port development master plan should be formulated by the Port Management Body which has legal power to approve the acts within the port as is mentioned in preceding section.

Therefore, article 63 and 64 of new Maritime Code of Vietnam should be amended as in the Box 27.3.7 and Box 27.3.8.

Box 27.3.7



Article 63 (Basic Policy for the Development of Ports and Waterways to be Developed)

The Minister of Transport must lay down a basic policy for the development, utilization and preservation of ports and harbors and for the development of waterways to be developed and preserved (hereinafter referred to as the basic policy).

2. The basic policy shall cover the following matters.

(1) Matters concerning the measures for the development, utilization and preservation of ports and harbors.

(2) Basic matters concerning the location, functions and capabilities of ports and harbors.

(3) Basic matters concerning the location and development of waterways specially designated for development and preservation.

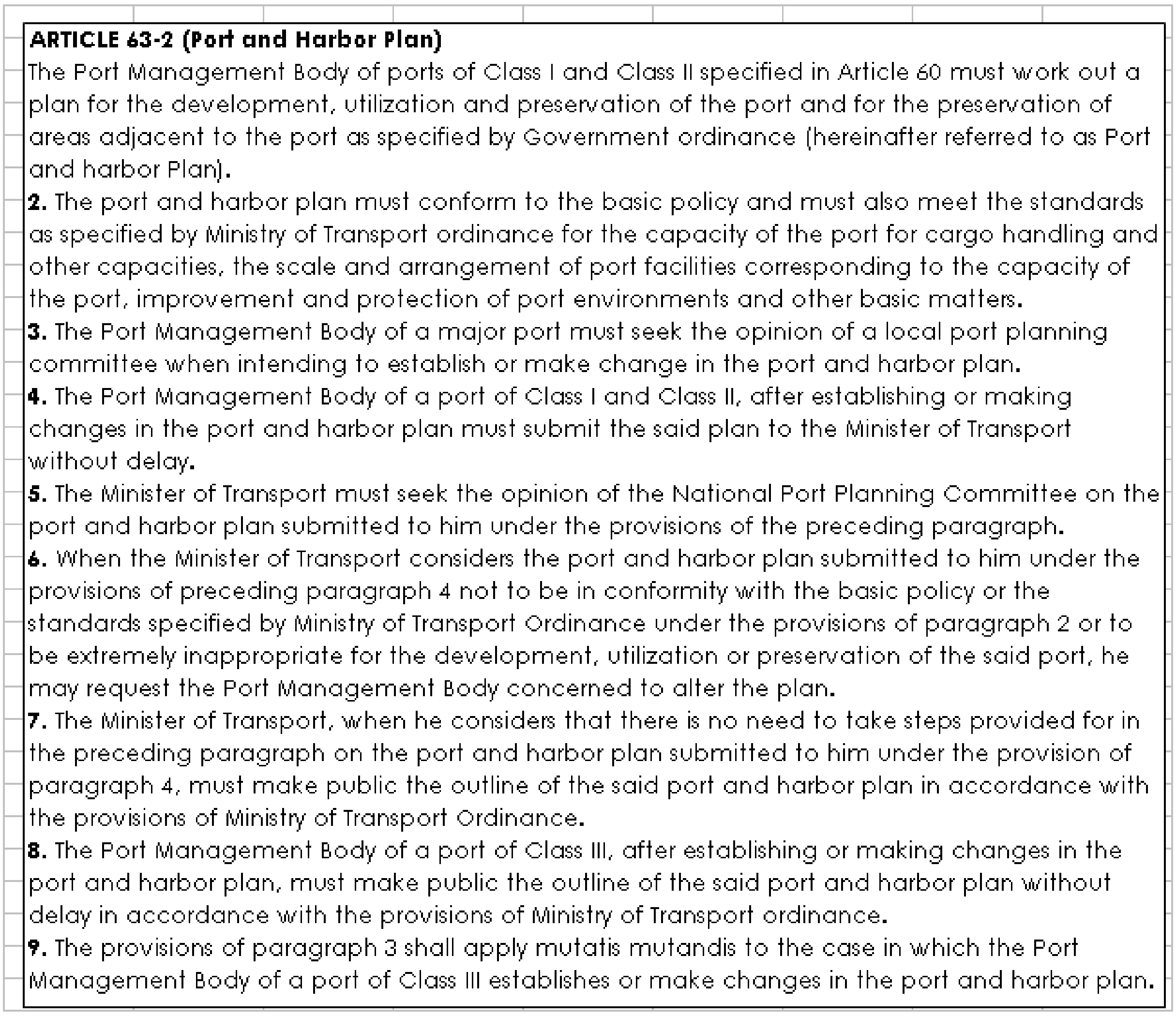
3. The basic policy shall be worked out by taking into account the role of ports and harbors and waterways specially designated for development and preservation to be played for the improvement of transport systems, appropriate utilization and balanced development of national land and for the welfare of the nation.

4. The Minister of Transport, when intending to lay down or make changes in the basic Policy, must consult with the heads of other administrative agencies concerned and also seek the views of the National Port Planning Committee.

5. The Port Management Body may present its views concerning the basic policy to the Minister of Transport.

6. The Minister of Transport, after laying down or making changes in the basic policy, must make public the fact without delay.

Box 27.3.8



ARTICLE 63-2 (Port and Harbor Plan)

The Port Management Body of ports of Class I and Class II specified in Article 60 must work out a plan for the development, utilization and preservation of the port and for the preservation of areas adjacent to the port as specified by Government ordinance (hereinafter referred to as Port and harbor Plan).

2. The port and harbor plan must conform to the basic policy and must also meet the standards as specified by Ministry of Transport ordinance for the capacity of the port for cargo handling and other capacities, the scale and arrangement of port facilities corresponding to the capacity of the port, improvement and protection of port environments and other basic matters.

3. The Port Management Body of a major port must seek the opinion of a local port planning committee when intending to establish or make change in the port and harbor plan.

4. The Port Management Body of a port of Class I and Class II, after establishing or making changes in the port and harbor plan must submit the said plan to the Minister of Transport without delay.

5. The Minister of Transport must seek the opinion of the National Port Planning Committee on the port and harbor plan submitted to him under the provisions of the preceding paragraph.

6. When the Minister of Transport considers the port and harbor plan submitted to him under the provisions of preceding paragraph 4 not to be in conformity with the basic policy or the standards specified by Ministry of Transport Ordinance under the provisions of paragraph 2 or to be extremely inappropriate for the development, utilization or preservation of the said port, he may request the Port Management Body concerned to alter the plan.

7. The Minister of Transport, when he considers that there is no need to take steps provided for in the preceding paragraph on the port and harbor plan submitted to him under the provision of paragraph 4, must make public the outline of the said port and harbor plan in accordance with the provisions of Ministry of Transport Ordinance.

8. The Port Management Body of a port of Class III, after establishing or making changes in the port and harbor plan, must make public the outline of the said port and harbor plan without delay in accordance with the provisions of Ministry of Transport ordinance.

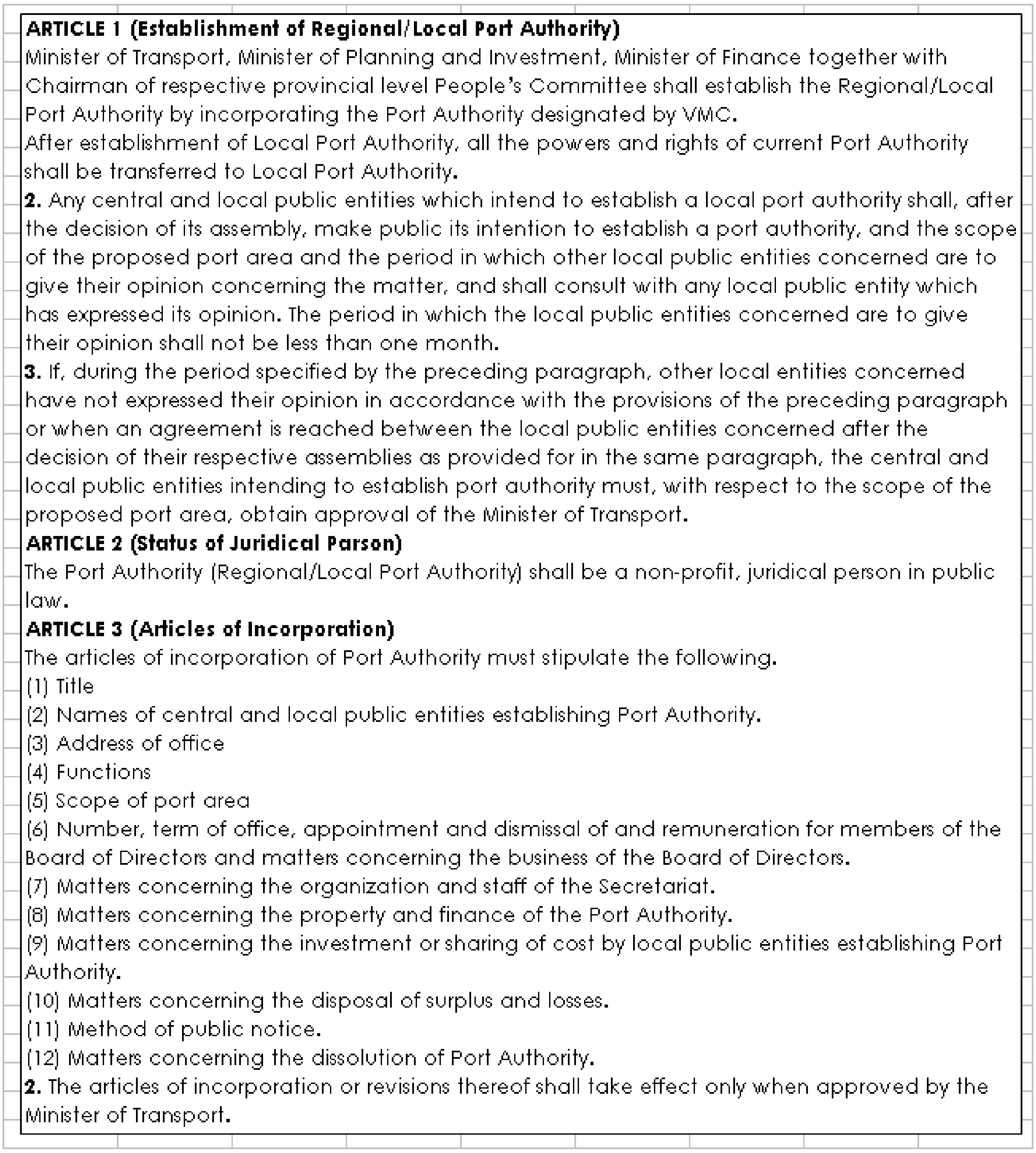
9. The provisions of paragraph 3 shall apply mutatis mutandis to the case in which the Port Management Body of a port of Class III establishes or make changes in the port and harbor plan.

5) Legal Status of Port Management Body

There is no definition of Port Management Body in the laws of Vietnam. It is necessary to establish responsible organization to manage and operate the port in an orderly manner.

It should also be established under the Prime Minister’s Decree or the Port Law as a public legal entity. Sample provisions are shown in the Box 27.3.9 and Box 27.3.10.

Box 27.3.9



ARTICLE 1 (Establishment of Regional/Local Port Authority)

Minister of Transport, Minister of Planning and Investment, Minister of Finance together with Chairman of respective provincial level People's Committee shall establish the Regional/Local Port Authority by incorporating the Port Authority designated by VMC.

After establishment of Local Port Authority, all the powers and rights of current Port Authority shall be transferred to Local Port Authority.

2. Any central and local public entities which intend to establish a local port authority shall, after the decision of its assembly, make public its intention to establish a port authority, and the scope of the proposed port area and the period in which other local public entities concerned are to give their opinion concerning the matter, and shall consult with any local public entity which has expressed its opinion. The period in which the local public entities concerned are to give their opinion shall not be less than one month.

3. If, during the period specified by the preceding paragraph, other local entities concerned have not expressed their opinion in accordance with the provisions of the preceding paragraph or when an agreement is reached between the local public entities concerned after the decision of their respective assemblies as provided for in the same paragraph, the central and local public entities intending to establish port authority must, with respect to the scope of the proposed port area, obtain approval of the Minister of Transport.

ARTICLE 2 (Status of Juridical Parson)

The Port Authority (Regional/Local Port Authority) shall be a non-profit, juridical person in public law.

ARTICLE 3 (Articles of Incorporation)

The articles of incorporation of Port Authority must stipulate the following.

(1) Title
(2) Names of central and local public entities establishing Port Authority.
(3) Address of office
(4) Functions
(5) Scope of port area
(6) Number, term of office, appointment and dismissal of and remuneration for members of the Board of Directors and matters concerning the business of the Board of Directors.
(7) Matters concerning the organization and staff of the Secretariat.
(8) Matters concerning the property and finance of the Port Authority.
(9) Matters concerning the investment or sharing of cost by local public entities establishing Port Authority.
(10) Matters concerning the disposal of surplus and losses.
(11) Method of public notice.
(12) Matters concerning the dissolution of Port Authority.

2. The articles of incorporation or revisions thereof shall take effect only when approved by the Minister of Transport.

ARTICLE 4 (Registration)

The Port Authority must register its establishment, changes in the address of its main office and other matters specified by Government Ordinance in accordance with the formalities specified by Government Ordinance.

2. Any matter required to be registered in relation to the Port Authority shall not have effect against a third party until it has been registered.

ARTICLE 5 (Establishment)

Establishment of Port Authority shall be effected when its establishment is registered.

ARTICLE 6 (Public Notice on Port Area)

The Port Authority shall, immediately after coming into being, give a public notice concerning its establishment and the scope of port area. The same shall apply when changes are made in the scope of port area.

2. The provisions of paragraph 2 and paragraph 3 of Article 1 shall apply mutatis mutandis to the case in which the port Authority intends to change the scope of port area.

ARTICLE 7 (Provisions for Dissolution)

Central and local public entities which established the port authority shall obtain approval of the Minister of Transport for dissolution of the said port authority.

2. The central and local public entities which established the Port Authority shall, when there is any obligation on the bonds or any other liabilities specified by Government Ordinance at the time of dissolution of the Port Authority, perform their obligation jointly in accordance with the provisions of the articles of incorporation.

ARTICLE 8 (Application of Civil Code and Other Laws)

The provisions of Articles 44, 50, 54, 57, Article 68 paragraph 1, Article 72 through Article 80, Articles 82 and 83 of the Civil Code (Law No. 89 of 1896) and the provisions of Articles 35, 37 and 37b of the Law of Non-Legal Case Proceedings (Law No. 14 of 1898) shall apply mutatis mutandis to Port Authority.

ARTICLE 9 (Functions)

Functions of Port Authority shall be as follows. (box 2.3.3-10)

ARTICLE 10 (Regulations)

The port authority may establish regulations concerning the matters within its authority insofar they do not conflict with laws, ordinances or regulations of the local public entities which established the Port Authority.

ARTICLE 11 (Non-intervention with Private Enterprises)

The Port authority must not obstruct or interfere with the fair activities of private enterprises in port transportation business, warehousing business and other businesses related to transportation and storage of goods or must not operate business in competition with therewith.

2. The Port Authority must not give discriminatory treatment to any party with respect to the use of facilities and the operation and management of the port.

Continuation of Box 27.3.9

Organization of Port Authority

ARTICLE 12 (Board of Directors)

The Port Authority shall have a Board of Directors.

ARTICLE 13 (Authority and Responsibilities of Board of Directors)

The Board of Directors shall be responsible for the formulation of policies of Port Authority and shall direct and regulate the administration of Port Authority.

ARTICLE 14 (Organization of Board of Directors and Appointment of Members)

The Board of Directors shall be composed of members less than eight in number in accordance with the articles of incorporation.

2. The number of members may be increased up to eleven (11) for the Board of Directors of the Port Authority which is established by more than three local public entities, regardless of the provisions of the preceding paragraph.

3. The members of the Board of Directors under the preceding two paragraphs shall be appointed from among persons with an extensive knowledge and wide experience in the matters relating to ports and harbors or persons of high reputation, by the heads of local public entities establishing the Port Authority with the consent of their respective assemblies.

ARTICLE 15 (Persons not Eligible as Members)

Any persons coming under any of the following items shall not be eligible as a member of the Board of Directors.

(1) Member of the National Assembly.

(2) Member of the assembly of a local public entity.

(3) A contractor for the work of the Port Authority or in case the contractor is a corporation, an officer of the corporation or any person, regardless of his title, who has authority or power equivalent to or exceeding that of the officer (including those who fell under this category during the period of one year prior to the date of appointment under consideration).

(4) An officer of an organization of contractors specified in the preceding paragraph or any person, regardless of his title, who has authority or power equivalent to or exceeding that of the officer (including those who fell under this category during the period of one year prior to the date of appointment under consideration).

2. Any member of the Board of Directors who, during his term of office, has fallen under any of the items of the preceding paragraph must resign from the Board of Directors.

ARTICLE 16 (Term of Office for Members)

The term of office of a member of the Board of Directors shall not exceed three years: the term of office of a member who has filled a vacancy shall be for the remainder of his predecessor's term of office.

2. A member of the Board of Directors shall not be precluded from being reappointed.

3. The term of office of the members first taking office following the establishment of the Port Authority shall be determined by the heads of local public entities establishing the Port Authority at the time of their appointment in such a manner as to prevent the expiration of the term of office of many members at the same time.

ARTICLE 17 (Dismissal of Members)

The Minister of Transport may dismiss any member of the Board of Directors with the consent of its assembly when he considers the said member is unable to perform his duties owing to physical or mental disabilities or when he considers the said member has acted contrary to his duties or the behavior of the said member is not acceptable as a member of the Board of Directors.

Continuation of Box 27.3.9

ARTICLE 18 (Chairman)

The Board of Directors shall have a chairman who shall be elected from among the members.

2. The chairman shall preside over the meetings of the Board of Directors.

ARTICLE 19 (Method of Decision-making)

All decisions of the Board of Directors shall be made by a majority vote of the members of the Board of Directors.

2. No member of the Board of Directors shall exercise his vote in a decision of the Board of Directors on the matters in which he has special interests as determined by the Board of Directors.

ARTICLE 20 (Auditors)

The Port Authority may have an auditor or auditors in accordance with the provisions of the articles of incorporation.

2. The provisions of Article 14, paragraph 3 and Articles 15 and 17 shall apply mutatis mutandis to the appointment and dismissal of auditors.

ARTICLE 21 (Duties and Authority of Chairman)

The chairman, as a representative of the Port Authority, shall preside over the functions of the Port Authority as the head thereof and shall conduct business related to the development, utilization, preservation and management of the port placed under his authority.

2. A member of the Board of Directors other than chairman, as a representative of the Port Authority, shall assist the Chairman in directing the functions of the Port Authority, act on behalf of the chairman in his absence and perform the duties of the chairman when the post is vacant in accordance with the provisions of the articles of incorporation.

3. The auditor shall audit the business of the Port Authority.

ARTICLE 22 (Secretariat)

The Port Authority shall have a Secretariat with a necessary staff to perform administrative works, in accordance with the provisions of the articles of incorporation.

ARTICLE 23 (Local Port Planning Committee)

A local port planning committee shall be established within the Regional Port Authority for the purpose of investigating and deliberating important matters related to each port upon inquiries by the chairman of the Board of Directors.

2. The matters concerning the title, organization and management of the local port planning committee shall be stipulated by the provisions of Article 10.

ARTICLE 24 (Remuneration for Chairman and Others)

The Port Authority must pay salary to the members of the Board of Directors, Auditors and its employees who are in full-time service.

2. The amount of salary under the preceding paragraph shall be determined in proportion to the nature and responsibilities of the assignment and on the same level as that for persons engaged in similar works in the district concerned, provided that it shall not exceed the amount of salary of whichever the higher remuneration the head of central and local public entities establishing the Port Authority.

3. The members of the Board of Directors and the Auditors who receive salary under the preceding paragraph shall not engage in any work for remuneration.

ARTICLE 25 (Status as Public Service Personnel)

The members of the Board of Directors, the Auditors and employees of the Port Authority shall be regarded as public service personnel in accordance with law insofar as the application of penal laws is concerned.

Continuation of Box 27.3.9

ARTICLE 26 (Investment)

No person other than the central and the local public entities establishing the Port Authority shall be entitled to invest in the said Port Authority.

ARTICLE 27 (Principles of Finance)

All expenses incurred by the Port Authority for the performance of its functions (excluding the cost of port and harbor works) shall be covered by charges and rent/concession fees of port facilities under its management, charges for such services as water supply provided by the Port Authority and other revenues derived from the operation and management of the port.

ARTICLE 28 (Issuance of Bonds)

The Port Authority may issue bonds to raise funds to be appropriated for construction, improvement or rehabilitation of port facilities.

2. The provisions of Article 250 of the Local Autonomy Law (Law No. 67 of 1947) shall apply mutatis mutandis to the case under the preceding paragraph.

3. The Port Authority must, in accordance with the provisions of the articles of incorporation, put aside in each fiscal year as a reserve to be appropriated for redemption of bonds issued under the provisions of paragraph 1.

4. The reserve for redemption under the preceding paragraph shall not be used for any purpose other than for redemption of bonds.

ARTICLE 29 (Disposition of Profit and Loss)

When there is still a balance after appropriation of surplus for reserve for redemption as stipulated in the preceding paragraph and for loss compensation, the Port Authority must transfer the balance to the central and local public entities establishing the Port Authority in accordance with the provisions of the articles of incorporation.

2. When a loss incurred by the Port Authority cannot be covered adequately by the reserve referred to in the preceding paragraph, the central and local public entities establishing the Port Authority must make up the deficiency in accordance with the provisions of the articles of incorporation.

ARTICLE 30 (Inventory of Property)

The Port Authority must prepare an inventory of property, a balance sheet and a statement of profit and loss and submit them to the central and local public entities establishing the Port Authority within two months following the end of each fiscal year.

Continuation of Box 27.3.9

Box 27.3.10

Regional Port Authority

a) Implement the national policy for port and maritime development

b) Implement the national plans for the port and maritime sub-sector and their legal standards.

c) Dictate the sector's technical regulations.

d) Promote the participation of the social and private sectors, and the municipalities in operating ports, terminals, marinas and port installations.

e) Authorize maritime works and the dredging of ports and access canals while observing the applicable environmental norms.

f) Exercise the authority to apply sanctions according to the principles of this law and the regulations.

g) Apply sanctions to concessionaires or providers of maritime and port services in accordance with the obligations that each had assumed under contract.

h) Attend to the claims made by all the users of the maritime and port services provided in the ambit of the Socialist Republic of Vietnam.

i) Formulate port plans in the region

Local Port Authority

a) Supervise and control the fulfillment of the concession contracts that are entered into with concessionaires, and private operators of ports and all the agents that participate in maritime activity.

b) Control the functioning of ports in accordance with the commitments assumed by the respective concessionaires and operators, and applying control to fulfill legal standards and port regulations.

c) Control and supervise the activities developed in ports, insure the protection and maintenance of the port installations supervising everything that affects the conservation and improvement of public areas and access ways.

d) Control the fulfillment of the works realized in the ports.

e) Control the services rendered by concessionaires, operators, and service providers to ships and cargo, insuring that the users of port services receive efficient, fair and egalitarian treatment.

f) Exercise the rights corresponding to the State, as established in the respective laws, to control and inspect for the fulfillment of the obligations assumed by the concessionaires and operators of ports and of maritime activity.

g) Control the proper functioning of the different maritime and port services concerning navigation that are rendered by individuals to ships and cargo, especially the essential services of towing, maneuvering, piloting and communications for navigation safety.

h) Dictate regulations to insure that the holders of concessions and usage-permits establish plans and procedures for maintaining the goods used for the services in good condition during the period of said concessions and permits, and to make periodic reports to the Commission, which allow it to determine the level of fulfillment of said plans and procedures.

i) Resolve claims made by users of port and maritime activity because of the poor quality of the services they receive and/or all matters concerning complaints about their operation.

j) Provision of ancillary services not provided by the concessionaire/private provider

k) Authorize the arrival and departure of ships and naval artifacts.

l) Supervise and control navigation within the port area and its access canals stoppage of ships, piloting and towing services, and assistance to navigation.

m) Control the conditions for the safety of canals, access ways and depth of the respective piers.

n) Register all the statistical information regarding the port or ports included in its delegation.

o) Formulate master plan of seaport of its ambit

27.3.4 Institutional Arrangement for Lach Huyen International Port and Process to the Independent Regional Port Authority

1) Presumption

For coming 5 years, Maritime Port Authority plays the role mainly of the local port authority and major role expected by regional port authority except for concession contract will be played by VINAMRINE. Lac Huyen terminal shall have a branch office with the purpose of supervising performance and communication with users and engineering.

a) Tentative allocation of functions between VINAMARINE and Port Authority

Among the functions to be executed by the Regional Port Authority, followings shall be executed by VINAMARINE till the regional port authority is established.

Regional Port Authority shall be established after experimental period of the system of Maritime Port Authority of Hi Phong.

Hence, like Cai Lan Lease Project, evaluation committee for the Maritime Port Authority shall be established within VINAMARINE and prepare for the further reform of the function of Maritime Port Authority/Local Port Authority (LPA) aiming at the establishment of Regional Port Authority.

(a) Implement the national policy for port and maritime development (regional affairs) ⇒ VINAMARINE
(b) Implement the national plans for the port and maritime sub-sector and their legal standards ⇒VINAMARINE
(c) Dictate the sector’s technical regulations ⇒VINAMARINE
(d) Promote the participation of the social and private sectors, and the municipalities in operating ports, terminals and port installations.⇒LPA
(e) Authorize maritime works and the dredging of ports and access canals while observing the applicable environmental norms ⇒LPA
(f) Exercise the authority to apply sanctions according to the principles of the decree and the regulations ⇒LPA
(g) Apply sanctions to concessionaires or providers of maritime and port services in accordance with the obligations that each had assumed under contract ⇒LPA
(h) Attend the claims made by all the users of the maritime and port services provided in the ambit of the Social Republic of Vietnam ⇒VINAMARINE
(i) Formulate port plans in the region/the port ⇒VINAMARINE/LPA

b) Function of current Maritime Port Authority (Harbor Master Function)

Current Hi Phong Maritime Port Authority is presumed to merge into newly established Port Authority (Port Management Body) and forms one department with all the currently executing function.

2) Organization of Hai Phong Port Authority (Port Management Body)

In order to have the independent power to contract with concessionaire on the conceded facilities and business of the operator of the Lac Huyen terminals, Hi Phong Port Authority has to be transferred the authority on land, water area and facilities under Government and the people’s committee of Hi Phong Province, and the necessary permits and licenses should be issued autonomously by the Port Authority for smooth implementation of concession contract.

Hence, under the condition that related authority shall be transferred from current entities of authority to Hi Phong Port Authority, Executive Directors shall be selected from these entities.

Most important functions of the Port Authority are to implement the concession contract and promote fair competition among the operators while maintaining the orderly use of port area within the port (newly defined port).

Hence, organization of Hi Phong Port Authority is composed of the following departments;

a) Office of Secretary: (VINAMARINE)

- Responsible for general affairs and personal relations
- Responsible for personnel management
- Responsible for legal affairs

b) Department of Real Estate: (People's Committee)

- Responsible for maintaining and making public a revolving 1-month tickler log of all agreements showing their expiration dates and renegotiation dates and a comprehensive port-wide lease map indicating leased and unleased properties
- Responsible for reviewing the log and lease map on a regular basis to determine when leases will expire, minimizing properties under holdover, and when unleased properties are available to market and take necessary action
- Responsible for recommending several alternate uses for the property

c) Department of Business Development: (Ministry of Planning & Investment)

- Responsible for setting business conditions for the concessionaire and/or lessee
- Responsible for financial management
- Responsible for permission for investment in the port area
- Responsible for economic regulations

d) Department of Procurement and Accounting: (Ministry of Finance)

- Responsible for the procurement of all the requirements for the operation of the Port Authority
- Responsible for accounting of the Port Authority

e) Department of Harbor Master: (Maritime Port Authority)

- Responsible for navigation control
- Responsible for environmental management
- Responsible for port security and fire-fighting

f) Department of Marketing: (VINALINES ?)

- Responsible for Concession Process
- Responsible for Port Sales
- Responsible for tariff setting and supervision

g) Department of Engineering: (VINAMARINE)

- Responsible for planning & statistics
- Responsible for IT management
- Responsible for construction supervision and maintenance
- Responsible for technical regulations

28. FACILITY MAINTENANCE PLAN

28.1 Preliminary Discussion on Facility Maintenance Plan

This Project has construction of terminal structure including public related facilities and sand protection dyke. The former includes reclamation, revetment structure and earth retaining wall. Berth structure is demarcated from this Project and it belongs to private potion. The latter is constructed to reduce sedimentation in main channel spanned 17.4km from the edge of terminal to south offshore. After completion of the Project, each facility need appropriate maintenance to sustain each function.

As described in other chapters, these facilities are constructed under responsibility of Vietnamese government by PPP ODA project, however, the operation and management will be by international private operator, it is therefore, these two bodies has responsibility to make and execute facility maintenance. As of now, concrete demarcation of facilities maintenance is not decided yet, however, normally the body that uses the facility frequently shall have responsibility of the maintenance. In this chapter, JICA study tem lists major items to be maintained in the following Table 28.1.1

Table 28.1.1 Major Items to be Maintained

No.	Facility	Expected Defect
1	**Terminal Area including Public Related Facilities**	
	- Reclamation	Settlement
	- Revetment	Settlement
	- Earth Retaining Wall Steel pipe pile	 corrosion
	- Barge berth Steel pipe pile Structural Concrete Fender Bollard Water depth of Berth	 Corrosion Broken, Damage Broken, Damage Broken, Damage Sedimentation
	- Pavement for Access Road	Settlement, Damage
	- Drainage for Access Road	Settlement, Damage
	- Traffic Markings / Guide	Erased
	- Landscaping for Public Area	Settlement
2	**Sand Protection Dyke**	
	- Ruble mound	Settlement
	- Super structure concrete	Damage, corrosion (inner Re-bar)
	- Navigation light	Damage

28.2 Terminal Area including Public Related Facilities

1) Reclamation

Reclamation area has anxiety about settlement caused by mainly traffic loads, therefore, JICA study team recommend that maintenance body shall keep periodical settlement survey. In case superficial undulation happened, the body has to rehabilitate, overlay, it immediately not to expand the damage but also prevention of trailers and other vehicles entered in the area.

2) Revetment

PVD sol improvement will be applied for foundation of revetment. In detail design stage, interval and length of the PVD are decided based on detailed examinations and the surcharge period is sufficiently secured. However, anxiety about undulation is remained. So, as same as reclamation, maintenance body has to periodical settlement survey.

3) Steel Pipe Piles

The steel sheet pipe piles above low water level are protected against corrosion by mortar lining which is durable for long time. However, if cover is damaged by some reasons, the durability of mortar lining will decrease considerably. Therefore, visual inspection for soundness of the covers should be carried out regularly, at least once a year.

4) Structural Concrete

The concrete of quay structure are affected by salt water all the time and therefore the concrete coverage of re-bars was designed thicker than normal concrete structures.

Some part of concrete are inevitable cause of tide, however, to maintain proper condition, visual inspection should be at least once a year and if any evidence for cracks of concrete or corrosion of re-bars is found, suitable remedial measures should be taken as soon as possible.

5) Rubber Fender

The rubber fenders are designed for the berthing energy caused by vessels. It must be monitored during the berthing operation that all vessels should keep these berthing conditions.

The rubber fender is a consumable good and its service life is expected to be around 10 years. Therefore, visual inspection for soundness of these rubber fenders should be carried out every day and if damaged by some reasons, it should be repaired or replaced as soon as possible. And after 10 years, most of these rubber fenders would be replaced by new one.

6) Bollard

The bollard materials are protected against corrosion by painting but the durability of paint is not so long. Thus periodical repainting will be inevitable.

Concrete curbs and traffic markings on the apron also have possibility to get damages by the normal cargo handling operation. Therefore, immediate repair works are required if damaged.

7) Water Depth of Berth

The water depth in front of barge berth should be kept to be CDL-14m. In accordance with the Vietnamese regulation, the maintenance of water depth in front of quay is the responsibility of terminal owner/operator.

Therefore, the sounding survey of berthing basin should be conducted at least once a year and if water depth is shallower than -14.0m, the maintenance dredging should be conducted considering the amount of sedimentation for the period until next maintenance dredging by the owner/operator.

8) Pavement and Drainage for Access Road

Terminal area will settle about 20cm for twenty years after starting operation as mentioned in the above chapter. The uneven settlement will much affect the operation of cargo handling such as handling of containers by RTG, etc. Therefore, regular maintenance for the pavement is strictly required.

The following items for maintenance are recommended to be carried out regularly. In case that the uneven settlement affected to the operation would happen, which could be an order of a few cm from the designed elevation, the repairing works should be required.

Table 28.2.1 Maintenance Plan for Pavement and Drainage

	Maintenance Item	Recommendable Frequency
Pavement	Visual Inspection for Damage, Crack, Uneven Settlement	Weekly
	Survey for Checking Elevation of Surface	Monthly (the first year after staring operation) Quarterly (from the second year)
Drainage	Visual Inspection for Damage of Top of Culvert and Grating Cover	Weekly
	Cleaning of Sedimentation in Man-hole and Culvert	Quarterly
	Survey for Checking Elevation of Bottom of Culvert	Quarterly

It is generally said that life time of asphalt pavement is 5-10 years and life time of concrete pavement is 20 years. The repair works of pavement in a large scale such as re-installation of ICB pavement, re-casting of RTG Lane, overlay of asphalt pavement, etc. will be required approximately every 20 years.

In this section, a tentative plan for road maintenance and rehabilitation has been prepared for an analysis period of 50 years. The main items and respective periods for application have been defined as follows:

a) Routine Maintenance

Performed in monthly basis, consisted of the following activities:

- Site inspection (performed by one engineer or a technician with adequate experience in pavement maintenance, and one assistant).
- Minor works for cleaning of the road surface, side ditches, inlets, culverts, etc. when so required by the inspection team.
- Minor works for repairing damages observed of the road, signals, boards, etc. when so required by the inspection team.
- Inspection of the joints installed for differential settlement due to soft soil consolidation.
- Monitoring of settlement rates along the road where soft soil improvement has been implemented.
- Reports and updating of Data Base for maintenance.

b) Periodic Maintenance

Performed in quarterly basis for minor repairs and yearly for works of medium scale, consist of the following activities:

- Site inspection (performed by one engineer, two assistants and required inspectors) [once every three months]. This inspection requires of more detail on measurements and some testing for evaluation (if needed).
- Minor to medium scale of works for repairing of the road surface (patching, etc.), side ditches, inlets, culverts, signs, road marking, etc. (Performed when required, and if so identified during inspection, or if so required on the records of Routine Maintenance inspections).
- Sealing and re-painting of the whole road surface (cold slurry seal or hot seal could be considered) (once per year).
- Repairs of the joins installed for differential settlement due to soft soil consolidation.
- Inspection and minor repairs of the joints installed for differential settlement due to soft soil consolidation.
- Monitoring of settlement rates along the road where soft soil improvement has been

implemented.

- Reports and updating of Data Base for maintenance.

c) Surface Rehabilitation

Performed once every 5 years and consists of the following activities:

- Removal of Asphalt Concrete wearing surface (5cm).
- Cleaning of the remaining surface (hard brush or sand blasting should be applied).
- Tack coat (leveling A/C or prime coat should be recommended if the remaining surface presents not recommendable roughness).
- New Asphalt Concrete (A/C) wearing surface (5cm) in accordance with the original technical specifications (recycling could be allowed if properly implemented upon the review and approval by a consultant in behalf of the Client).
- Re-painting and repairs on the road signs for safety.
- Inspection and repairs of the joints installed for differential settlement due to soft soil consolidation.
- Repairs of the transversal and longitudinal drainage.
- Monitoring of settlement rate.
- Reports and updating of Data Base for maintenance.

d) Structural Rehabilitation

Performed once every 10 years and consists of the following activities:

- Removal of Asphalt Concrete wearing surface (5cm).
- Milling of damaged surface of the Binder Course (approximately ranging since 3cm to 5cm).
- Cleaning of the remaining surface (hard brush or sand blasting should be applied).
- Leveling A/C and prime coat.
- New Asphalt Concrete (A/C) Binder Course (5cm) in accordance with the original technical specifications (recycling could be allowed if properly implemented upon the review and approval by a consultant in behalf of the Client. In this case, thicker layer should be required).
- Tack coat
- New Asphalt Concrete (A/C) Surface Course (5cm) in accordance with the original technical specifications.
- Re-painting and repairs on the road signs for safety.
- Repairs of the joins installed for differential settlement due to soft soil consolidation.
- Repairs of the transversal and longitudinal drainage.
- Inspection and repairs of the joints installed for differential settlement due to soft soil consolidation.
- Monitoring of settlement rate.
- Reports and updating of Data Base for maintenance.

e) Reconstruction

Performed once every 20 years and consists of the following activities:

- Removal of Asphalt Concrete wearing surface and binder course until to find a healthy aggregate base course layer.
- Additional Crushed Stone aggregate base course up to its level determined to make even the

surface after settlement due to soft soil consolidation (recycling of the removed A/C and aggregate base course could be allowed if properly treated in a plant and upon the review and approval by a consultant in behalf of the Client).

- Prime coat.
- New Asphalt Concrete (A/C) Binder Course (10cm) in accordance with the original technical specifications.
- Tack coat.
- New Asphalt Concrete (A/C) Surface Course (5cm) in accordance with the original technical specifications.
- Re-painting and repairs on the road signs for safety.
- Repairs of the joins installed for differential settlement due to soft soil consolidation (if needed according to the settlement records)
- Repairs of the transversal and longitudinal drainage.
- Reconstruction of the joints installed for differential settlement due to soft soil consolidation.
- Monitoring of settlement rate.
- Reports and updating of Data Base for maintenance.

28.3 Sand Protection Dyke

Cooping structure of sand protection dyke is cellular brook type and therefore it contains Re-bars. During construction stage, concrete cover will be secured by appropriate construction but anxiety of which less cover is remained. Needless to say, Re-bars affect chloride damage easily and it caused structural defect. Therefore, periodical inspection is necessary.

As for foundation, there is a concern of settlement as same as revetment structure. So settlement survey has to be planned periodically. As for ground deformation monitoring program, refer to section 16.3.

Navigation lights are scheduled to be installed on the dyke. The lights work by the source of electric battery and solar assistant system. The maintenance manner shall be according to the manufacturer’s manual.

DIVISION – VI

CONCLUSION AND RECOMMENDATIONS

29. CONCLUSION AND RECOMMENDATIONS

29.1 General

29.1.1 Solution for Major Subjects on JICA Detailed Design Study

The following solutions on major subjects for the port portion of the Project were offered by JICA Study Team for conclusion of the Study and were incorporated in this Final Report:

1) Access Channel

a) Channel Depth

MOT Decision No 476/QD-BGTVT dated March 15, 2011 specifies a staged development that the Lach Huyen Channel is scheduled to dredge at the depth of CD-13m in 2015 and CD-14m in 2020. But, the channel of CD-13m can not serve for larger size of container vessels since Panamax class of 50,000DWT ship has 12.7m full draft and 100,000dwt class container ships must reduce a load temporarily or wait for high tide.

There is observed the current upward trend in container seaborne transportation and the steady increase of container cargo demand in this region. In addition, in this Lach Huyen channel case, it is recognized through the channel sedimentation simulation analysis that the difference in sedimentation volume between CD-13m and -14m depth of channel is minimum and, therefore, the cost difference for channel maintenance dredging is very small while the larger size ship waiting cost for high tides is so remarkable for 50,000 DWT vessel in full draft or 100,000 DWT partially loaded. In this regard, the staged development for channel dredging has no advantage for Lach Huyen channel and, therefore, it was recommended that the channel be dredged to CD-14m by the initial capital dredging so as for 50,000DWT fully loaded and 100,000 DWT partially loaded to use the dredged channel without any waiting for high tides from the initial stage of the port development.

b) Channel Width

The channel section is designed to be 160 m (=3.5B for 100,000DWT class of vessel) in width. This is determined based on PIANC/IAPH Guide for Design of Approach Channel and its suitability is confirmed by ship maneuvering simulation study in this DD Study.

c) Side Slope

Based on the Vietnamese standard, the side slope of dredged channel is basically designed in a slope of 1(V):10 (H). But upper subsurface deposits may not be fully unconsolidated and relatively low density and therefore the design dredged slope may not be stable during extremely high wave actions in particular. The stable side slope to repose is dependent primary upon the nature of the materials on the side slope, marine condition of channel and the manner in slope dredging, and there may be resulted in side slope slumping down over time to gradual slope to repose of more than 1(V) to 10 (H). Therefore, the dredged slope in 1 (H) to 15 (V) for capital dredging is applied for the channel section part shallower than CD-10m in order to minimize future recurrent maintenance dredging.

2) Ship Passageway to and from Haiphong Port during Construction Work

Lach Huyen channel has to be dredged giving priority to the existing ship traffic of the present channel. Marine navigation safety for existing ship passage in the channel as well as dredging operation for construction has to be maintained. JICA Study Team carried out alternative cases of study on the channel dredging plan with provision of ship passageway inside or outside of the present channel. JICA Study concluded that the dredging plan with provision of diversion channel east outside the present channel was recommended in view of marine safety and economy in construction.

In MOT Notice No. 306/TB-BGTVT dated September 5 2011, Vietnamese side opined that the marine traffic safety could be secured while keeping continuous dredging operation in the present channel during construction period without any interruption under proper marine traffic control and management which shall be borne by local counterpart fund for the Project. Based on MOT Notice, therefore, it is concluded that the method of channel dredging with the provision of ship passageway inside the present channel is applied in this Study.

3) Dumping Site of Channel Dredged Soil

Capital channel dredging volume is estimated 38 million m^3 including extra depth for sedimentation and the likely channel sedimentation which may occur during 3-year dredging work period.

JICA Study Team carried out a comparative study on potential dumping sites for channel dredged soil among such 4 alternative sites as Dinh Vu South Industrial Zone, Cat Hai Island South Coastal area, future logistic park development area along the west of future terminal expansion, and deep sea offshore. The study covered several cases of alternative way of dumping dredged soil in combination of disposal at coastal reclamation and offshore as well.

The above series of studies indicate that, among other alternative sites, deep sea offshore dumping is most practical for JICA ODA Project in view of economy in construction, time duration for construction and environmental aspect as follows:

a) Disposal into Coastal Reclamation

In case of dumping Dinh Vu South IZ or Cat Hai South coastal area, discharging into reclamation area requires

1) Additional dredging of shallow water access trench and temporary dumping basin for access of hopper barge to temporally dumping,

2) Secondary discharging for reclamation, and

3) Pipeline arrangement for discharging into reclamation area.

In addition, the reclamation area must be properly protected by peripheral dyke for receiving very weak dredged soil for purpose of environmental protection during dumping operation and proper protection of the reclaimed land from sea water and wave actions. Because the dyke construction may include peripheral dyke (outer seawall), inner partition dyke for phased reclamation by working lot, bund for pipeline support and excess water flow control, and excess water outlet pond, etc., these works related to land reclamation including dyke construction is very costly. It is roughly estimated that the cost is around 30 to 40 billion Japanese Yen. The time spending for construction of such peripheral dyke is estimated 3 to 4 years period to complete, though it may depend on the volume of dredged soil disposal to the reclamation area and, in case of Cat Hai South area in particular, the basic development plan of reclamation area must be established by GOV as sooner as possible.

b) Expectation for use of dredged soil as Reclamation Fill

There may be great expectation that the channel dredged soil could be used for land reclamation work at Dinh Vu South IZ, or Cat Hai Island coastal area for future land-use development. But, unfortunately, the dredged soil from Lach Huyen channel is not sandy material and is mostly soft clayey soil (estimated content of mud N<5: 71%, clayey soil 5<N<15: 14%, and sand: 14%) and will be weakened by mixing with large amount of water during dredging and discharging operation into reclamation area. Since the soil is very weak and has a nature of very high compressibility, it decisively requires pre- or post treatment for soil improvement once such dredged soil shall be used as fill materials for land reclamation. Such soil improvement measure is relatively costly and the land developer must bear considerable amount of additional cost spending in the succeeding works for land-use development.

c) Environmental Impact on Water Contamination

Since dredging and dumping operation may cause water contamination in adjacent marine environment at the site, the likely extent and degree of water contamination by suspended solid (SS) diffusion for the cases of dumping at South Dinh Vu IZ, Cat Hai Island coastal area and deep sea offshore area was studied by the use of numerical computer simulation. The results of numerical simulation study shows that the case of South Dinh Vu IZ or Cat Hai Island dumping causes wider range and more intensive water contamination than the case of offshore dumping. This is due to the double handling operation of dredged soil at temporally dumping basin for 2nd discharging to land fill and huge volume of discharging excess water in high SS density from reclamation area.

d) Disposal Site in Combination

There may be an expectation for alternative way of dumping dredged soil under the condition to minimize offshore dumping, for example, dumping in combination of land reclamation at Cat Hai South or SDVIZ and deep sea offshore. The study indicates that this combination method of dumping results in serious delay in construction time schedule of JICA ODA Project for 2-3 years. In addition, it roughly requires about 30 billion Japanese Yen for any works related to reclamation including peripheral dyke construction for reclamation area.

e) Volume of Disposal for Land Reclamation

As an alternative way of dumping, there may be the case that offshore dumping is allowed in initial stage of channel dredging work till the partial completion of peripheral dyke construction for receiving dredged soil. But, about 1/2 of total volume of channel dredged soil may be dumped at offshore so as to maintain the construction time schedule of JICA ODA Project as originally planned. This might be small amount for land reclamation, unlike expectation by Vietnamese side. In addition, even in this case, it still requires costly expenses for works related to land reclamation and no significant saving of extra cost is expected substantially.

In the course of DD Study, the Vietnamese government expressed the final remark in MOT reply letter to JICA dated September 26, 2011 that the channel dredged soil is used for the reclamation fill for Dinh Vu South or Cat Hai South areas in minimizing the dredged soil dumping to offshore. The followings are a brief summary on the results of additional study on the case of coastal dumping at Cat Hai and South Dinh Vu IZ.

(Additional Study on Dumping at Cat Hai Coastal Area)

In response to the remark, further study was carried out for channel dredged soil dumping at coastal area and JICA Study Team came to a solution that all the dredged soil could be used for reclamation for Cat Hai South coastal area (in view of economy in construction rather than the case of Din Vu South may be) under the following assumption.

- Construction of whole peripheral dyke for Cat Hai South area (assumed to be done by others) is estimated 3 to 4 years period to complete (JICA Study Team Estimate),
- Initial stage of peripheral dyke construction will be completed within 15-month period for receipt of dredged soil in applying phased construction (JICA Study Team Estimate),
- Simultaneously, access trench and temporary dumping basin is dredged (assumed to be done by others) and the dredged soil will be disposed offshore or other designated area (=about 5.5 million m^3). This dredging must be finished until the completion of the 1st stage dyke construction to be provided at Cat Hai reclamation area and the temporary dumping basin shall be ready for 2nd discharging operation of channel dredged soil for reclamation,
- Thereafter, channel dredging work could be started and the channel dredged soil is discharged into Cat Hai Island south for use as reclamation fill material (Net volume =29 million m^3), and
- Channel dredging will require 33 month period and will be completed within 49 month from the commencement of dyke construction at Cat Hai south reclamation area.

The above method of dredging and disposal of channel dredging work decisively requires time extension of the JICA ODA Project. The overall construction time framework for the Project shall be extended for a certain period of time for commencement of container terminal operation and the completion of the Project. The budget for JICA ODA loan Project is <u>limited</u> and, <u>in the present framework of JICA ODA loan finance for the Project,</u> it may be understood that the scope of the JICA ODA loan Project only covers the channel dredging work and its disposal (at designated temporary dumping site for land filling or offshore dumping), and the JICA Project <u>may not include</u> any work related to reclamation.

In the case of dumping at Cat Hai Coastal area, it is recommended that necessary source of fund arrangement is raised for Cat Hai South reclamation development plan ant the design work for reclamation work is initiated as sooner as possible so that the construction of reclamation dyke at Cat Hai south area as well as the JICA ODA Project could be started in time as expected without any further delay.

(Additional Study on Dumping at South Dinh Vu IZ)

Additional study on the case of dumping at South Dinh Vu IZ was carried out based on the request by Vietnamese Side. Several cases were studied on changing possible amount of dredged soil dumping at South Dinh Vu IZ for comparison in terms of cost and construction time and the results of these studies is summarized as follows:

a. 100% offshore dumping is better option in view of the following reasons:

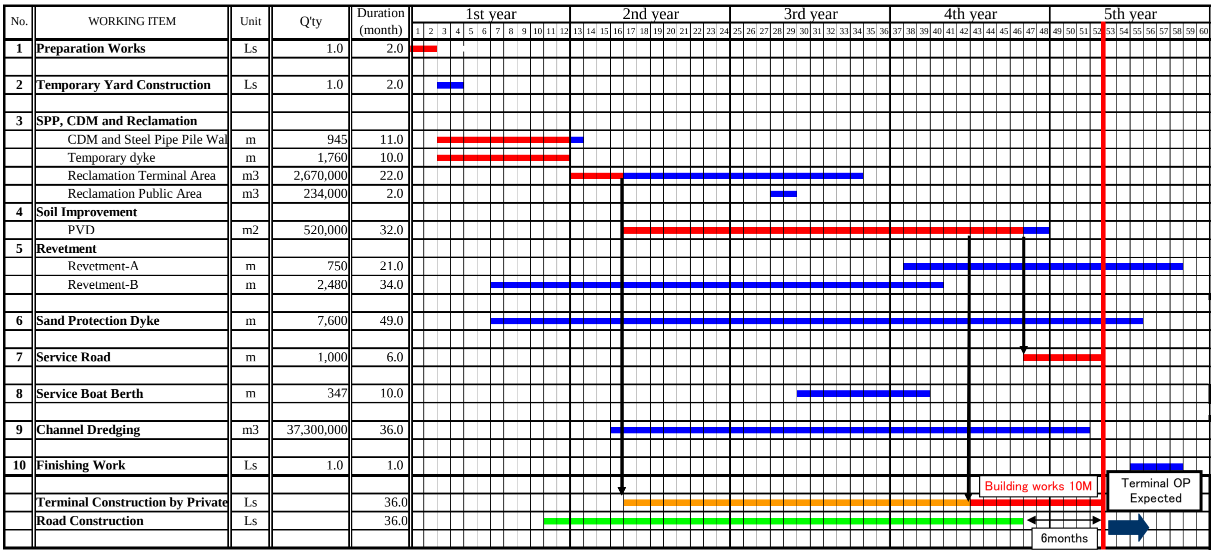
- Dredged soil is not suitable for reclamation
- Project cost is lower (about 6,000 billion VND cheaper)
- Environmental impact is smaller

b. 50% South Dinh Vu dumping is technically possible but with risk of:

- Cost of surface soil improvement is high
- Coordination of schedule with IZ Developer will not be easy
- Additional L/A is required
- Additional EIA is necessary

4) Construction Time Schedule and Opening of Container Terminal

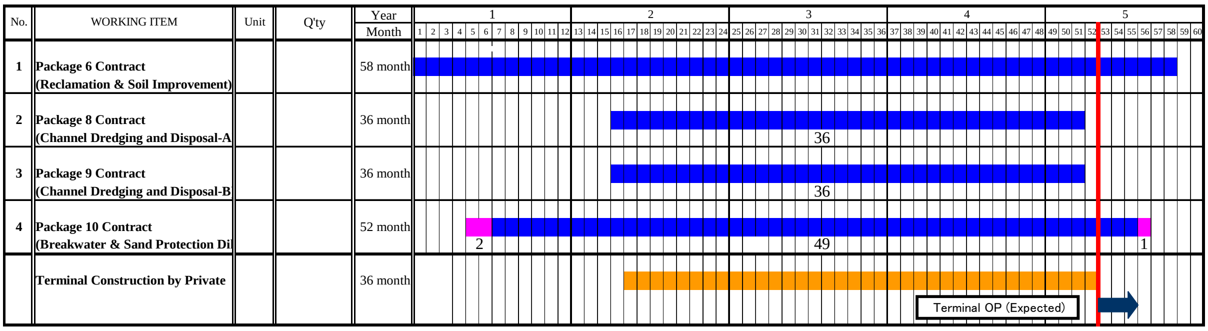
The Project is expected to complete as sooner as possible so that the first container terminal operation under PPP program could be started earlier to carter for strong demand of increase of container cargoes in coming years. But, soil improvement by PVD method in combination with preloading needs sufficient time of construction to complete. Therefore, it is estimated that overall construction period for the Project requires 58 months and the container terminal construction may be complete in 52 months period from the commencement of the Works. The overall construction time schedule for the Project is shown in the following table.



No.	WORKING ITEM	Unit	Q'ty	Duration (month)
1	**Preparation Works**	Ls	1.0	2.0
2	**Temporary Yard Construction**	Ls	1.0	2.0
3	**SPP, CDM and Reclamation**			
	CDM and Steel Pipe Pile Wal	m	945	11.0
	Temporary dyke	m	1,760	10.0
	Reclamation Terminal Area	m3	2,670,000	22.0
	Reclamation Public Area	m3	234,000	2.0
4	**Soil Improvement**			
	PVD	m2	520,000	32.0
5	**Revetment**			
	Revetment-A	m	750	21.0
	Revetment-B	m	2,480	34.0
6	**Sand Protection Dyke**	m	7,600	49.0
7	**Service Road**	m	1,000	6.0
8	**Service Boat Berth**	m	347	10.0
9	**Channel Dredging**	m3	37,300,000	36.0
10	**Finishing Work**	Ls	1.0	1.0
	Terminal Construction by Private	Ls		36.0
	Road Construction	Ls		36.0

Note:
1) Dredging schedule is shown in Chapter 15.
2) JICA study team recommends that 58 months for construction period except channel dredging.

Construction Period by Contract Package



No.	WORKING ITEM	Unit	Q'ty	Year / Month
1	**Package 6 Contract (Reclamation & Soil Improvement)**			58 month
2	**Package 8 Contract (Channel Dredging and Disposal-A**			36 month
3	**Package 9 Contract (Channel Dredging and Disposal-B**			36 month
4	**Package 10 Contract (Breakwater & Sand Protection Di**			52 month
	Terminal Construction by Private			36 month

Figure 29.1.1 Construction Schedule Overall (Normal Schedule)

In reply to strong requests from Vietnamese side to shorten the construction schedule, a conditional time schedule is proposed, i.e., 6 months shorter than the above normal schedule proposed by JICA Study Team. This schedule is expected to complete the reclamation work in 52 months period, which may enable the completion of container terminal construction within 46 months period for terminal operation. The conditions of this schedule are:

- Preparatory work which may normally required 2 to 3 months period for site delivery of steel pipe pile, piling equipment, CDM ships from Japan is not considered in the construction schedule.
- Reclamation work starts 4 months earlier under partial completion of temporary dyke under the condition that the acceptance by HPPC and the approval by MONRE are obtainable in view of environmental protection.
- Time for terminal operation is dependent upon the detailed time schedule for construction of container terminal to be prepared by private operator.

No.	WORKING ITEM	Unit	Q'ty	Duration (month)
1	**Preparation Works**	Ls	1.0	2.0
2	**Temporary Yard Construction**	Ls	1.0	2.0
3	**SPP, CDM and Reclamation**			
	CDM and Steel Pipe Pile Wal	m	945	11.0
	Temporary dyke	m	1,760	10.0
	Reclamation Terminal Yard	m3	2,670,000	22.0
	Reclamation Public Area	m3	234,000	2.0
4	**Soil Improvement**	m2	520,000	32.0
5	**Revetment**			
	Revetment-A	m	750	21.0
	Revetment-B	m	2,480	34.0
6	**Sand Protection Dyke**	m	7,600	49.0
7	**Service Road**	m	1,000	6.0
8	**Service Boat Berth**	m	347	10.0
9	**Channel Dredging**	m3	37,300,000	36.0
10	**Finishing Work**	Ls	1.0	1.0
	Terminal Construction by Private	Ls		36.0
	Road Construction	Ls		36.0

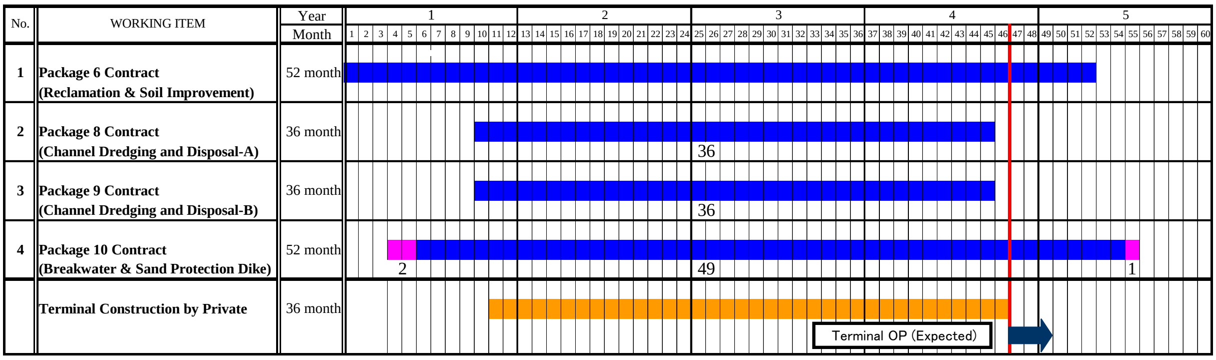
Note:

1) Dredging schedule is shown in Chapter 15.
Above schedule is conditional. This schedule is 6 months shorter than the schedule proposed by JICA DD Team under the Conditions:-
Condition 1(2 months shorter): Preparation works shown in above 1 dose not include procurement of Piling equipment, Steel Pipe Piles, CDM equipment from Japan and cement.
Condition 2(4 months shorter): Reclamation works can start 4 months earlier if Vietnamese side take responsibility and approve the work commencement upon about 60% progress of temporary dyke as scheduled above.

2) For Condition 2, Vietnamese side have to accept the condition especially on the aspect of Environment. (MONRE and HPC should approve the work procedure.)

3) Further discussions with private sector are necessary for Container Terminal construction time schedule if this schedule is adopted.

Construction Period by Contract Package



No.	WORKING ITEM	Year / Month
1	**Package 6 Contract (Reclamation & Soil Improvement)**	52 month
2	**Package 8 Contract (Channel Dredging and Disposal-A)**	36 month
3	**Package 9 Contract (Channel Dredging and Disposal-B)**	36 month
4	**Package 10 Contract (Breakwater & Sand Protection Dike)**	52 month
	Terminal Construction by Private	36 month

Figure 29.1.2 Conditional Construction Schedule Overall (Earlier Schedule)

5) Construction Package

In considering the financial scale, technical requirement and qualification of work, interface between works of each package, the port portion of JICA ODA Project was divided into following four (4)-packages for construction.

Package 6	: Infrastructure Construction Behind the Container Terminal
Package 8	: Channel Dredging and Disposal Works Part A
Package 9	: Channel Dredging and Disposal Works Part B
Package 10	: Breakwater and Sand Protection Dyke Works

6) EIA for the Project

JICA DD Team prepared draft EIA report for the case of channel dredged soil dumping at offshore and submitted to the Project Owner for his application to EIA approval. The Draft EIA report covers the project component A by Public Sector and Component B by Private Sector.

7) UXO's Survey and Clearance

Due to the Vietnamese regulation that the Project Owner shall execute UXO's survey and clearance which only specifically authorized organization is allowed to carry out, the field survey work for UXO's was deleted from the scope of this JICA DD Study. It is expected that the UXO's survey and clearance for the Project is performed under the responsibility of the MPMUII in due course till the commencement of the construction. Once there may be encountered UXO's in the Project site during construction period, the clearance must be done by the Project Owner and the Contractor is entitled to claim for any stand-by cost for such case.

29.1.2 Basic Principles of Detailed Design Study

1) Standards Applied for Design, Materials and Testing

In executing JICA DD Study, the Vietnamese standards listed in the MOT Decision No. 1386/QD-BD-BGTVT dated May 19, 2008 are applied to JICA ODA portion of Lach Huyen Gateway Port Construction Investment Project for survey work, design of port facilities, standard for materials and testing (refer to the listing summarized in Chapter 1 of this report). Additionally foreign standards such as Japanese Technical Standards and Commentaries for Port and Harbor Facilities (OCDI, 2002) for design of marine structure, and JIS, BS, ASSHTO and ASTM for materials and testing are also applied as reference standards to supplement Vietnamese standards.

2) STEP ODA Loan by GOJ

The Project will be executed under ODA soft loan finance by GOJ in the scheme of Special Terms for Economic Partnership (STEP) Loan. Loan Agreement for Port portion (I) was signed on November 2, 2011. The amount of the STEP Loan for Port (I) is JPYen of 11,924 million under the terms and condition of the interest rate of 0.2 % per annum for construction works to cover 100% of the Project cost., repayment period 30 years and grace period of 10 years. The total cost of goods and services to be procured from Japan must be not less than 30% of the total amount of contracts excluding consulting services under the terms and conditions of STEP loan. These conditions are taken into consideration for design, construction planning, cost estimate and economic and financial analysis in DD Study work.

3) PPP Project, Demarcation of Work between Public and Private Sector

The initial development of container terminal (Berth No1 & 2) is implemented under PPP (Public-Private Partnership) scheme. Basically, the construction of container berth, onshore terminal yard facilities and cargo-handling equipment is allocated to private sector (Component B) and such basic port infrastructure as channel/port basin, sand protection dyke, reclamation and inner/outer revetment, public related facilities with service boat berth belongs to public sector (Component A). However, MOT decision No. 475/QD-BQTVT dated 15 March 2011 approved two optional scenario of investment cost sharing between public and private sectors in which the one scenario allocates the reclamation of container terminal, terminal yard revetment, soil improvement into private sector (Items marked with yellow color hatching in Table 29.1.1).

In the course of JICA DD study, the reclamation and soil improvement with revetment and earth retaining wall (immediately behind the berth construction) is included in Component A to be done by Public sector under the JICA ODA loan finance. In addition, the barge berth construction (Open type piled construction) is allocated into the component B to be implemented by private sector while the earth retaining wall behind barge berth construction by public sector in accord with the MOT notice No. 306/TB-BGTVT dated September 5, 2011. It was recommended that the financial arrangement for each share of investment cost burden should be settled and confirmed between Public and Private sector.

4) Planned Size of Container Vessel

The objectives of JICA detailed design work for port facilities is to provide necessary basic infrastructures of Lach Huyen Port Infrastructure Project which is able to accommodate design container vessel designed of 50,000 DWT (fully loaded) and 100,000 DWT (partially loaded) to cater for the expected cargo demand for the container berth to be constructed by private operator.

Table 29.1.1 Demarcation of Scope of Works between Public and Private Sector

No.	Work Item	MOT Decision		JICA DD Study	
		Public	Private	Public	Private
I	Construction Part				
1	Berth				
1.1	Container berth		●		●
1.2	Service berth	●		●	
1.3	Barge berth		●*		●
2	Dyke				
2.1	Container berth(behind container berth)		●	●	
2.2	Reclamation yard(South side of yard)		●	●	
2.3	Public related facility	●		●	
2.4	Access road to the port	●		●	
3	Weak soil treatment (Soil improvement)				
3.1	Port area		●	●	
3.2	Public related facility	●		●	
3.3	Access road to the port	●		●	
4	Reclamation				
4.1	Port area		●	●	
4.2	Public related facility	●		●	
4.3	Access road to the port	●		●	
5	Yard Road (Pavement)				
5.1	Port area		●		●
5.2	Public related facility	●		●	
5.3	Access road to the port	●		●	
6	Breakwater (Outer revetment)	●		●	
7	Sand training dyke	●		●	
8	Dredging ship anchoring area		●		●
9	Architecture building and technical network				
9.1	Public related facility	●		●	
9.2	Port area		●		●
10	Ship passage (Channel and turning basin)	●		●	
II	Equipment Cost				
1	Port equipment		●		●
2	Public related facility	●		●	
3	Architecture equipment		●		●

Remark as regards Barge Barth structure (*): Steel sheet pipe piled (SSPP) structure, which functions as berth as well as earth retaining wall, is adopted for barge berth construction in the approved MOT Decision.

29.2 Detailed Design of Port Facilities

Utmost effort was exerted in the course of this Detailed Design work to perform technically sound and cost-effective design of basic infrastructures for the Project. Various series of numerical simulation study were adopted for careful review on planning, laying out and design of port facilities. In this DD Study, the following numerical simulation was carried out:

- Channel Sedimentation analysis to estimate possible degree of channel sedimentation since Lach Huyen channel is subjected to possible sedimentation.
- Wave Hind-casting to establish design waves for designing such port protective facilities as inner/outer revetment, sand protection dyke

- Wave Deformation Analysis to confirm harbor calmness in front of berth structure
- Real-Time Visual Ship Maneuvering Simulation to confirm safety of ship navigation and ship maneuverability along channel and in ship turning basin to berth or de-berth of a ship
- Suspended Solid (SS) Dispersion Simulation to study the likely extent and degree of water contamination by channel dredging, dumping dredging soil offshore and excess water discharging from Cat Hai South reclamation work.

The following summarizes the outline of port facilities designed in this JICA Study in comparison with those determined by MOT Decision No.476/QD-BGTVT dated March 15, 2011.

Table 29.2.1 Outline of Detailed Design of Port Facilities

A. Dredging

Facility	Item	MOT Decision	JICA DD Study
Access Channel	Side Slope	1:10	1:15 for depth shallower than CD-10m and 1:10 for depth deeper than CD -10m by channel section
	Water Depth	CD-13.0m in 2015 &CD-14.0m in 2020	CD-14.0m
	Width	160m	160m
Vessel Turning Basin	Area	660m	660m
	Water Depth	na	CD-14.0m

B. Reclamation and Revetment

Facility	Item	MOT Decision	JICA DD Study
Reclamation for Conainer Terminal and Access Road Area	Elevation	CD+4.5m	CD+4.5m
	Soil Improvement by CDM	1) 50m width behind container berth 2) 30m width behind barge berth	1) about 34 to 40m width behind container berth
	Soil Improvement by PVD	Area other than above	Area other than above
Earth Retaining Wall behind container berth	Structure	Steel Sheet Pipe Piled Wall D500mm supported by battered piles D700mm at interval of 6m	Steel Sheet Pipe Piled Wall D800mm with anchored system by tension tie rope and precast concrete anchore wall
Earth Retaining Wall/Barge Berth	Structure	Earth Retaining Wall/Barge Berth: Steel Sheet Pipe Piled Wall D500mm with anchor system by tension bar and wall	Earth Retaining Wall behind barge berth: Steel Sheet Pipe Piled Wall D800mm with anchored system by tension tie rope and precast concrete anchore wall
Inner Revetment	Structure	na	Sloped Revetment
	Armour Stone		100-500kg Armour Stone
	Crown Height		CD+5.5m（1:3 Gently sloped
	Soil Improvement		PVD
Acess Road	Width	na	53.5m
	Nr of lane	na	2-Passing lane in One way and 2-Parking lane at terminal side
	Elevation	na	CD+5.5m
	Pavement	Soft Road Cover	Flexible Asphalt Pavement
Service Boat Berth	Berth Top El	CD+5.5m	CD+5.5m
	Water Depth	CD-5m	CD-5m
	Structure	Steel Sheet Pipe Piled Wall D500mm with anchor system	Steel Sheet Piled Wall of Type V-L with relieving platform supported by PHC foundation piles
Reclamation of Public Related Area	Elevation	CD+4.5m	CD+4.5m with sloped periphral revetmen

C. Protective Facility

Facility	Item	MOT Decision	JICA DD Study
Outer Revetment A & B (Breakwater)	Structure	Sloped Rubble Mound with Wave Breaking Work	1) Outer A: Sloped revetement protected with wave breaking work of 2.0t/pc with subsoil improvement by PVD 2) Outer B: Vertical concrete retaining wall on rubble mound protected with wave breaking work of 3.2 to 4.0t/pc with subsoil improvement by sand replacement to depth of CD-7.5 to -9.5m
	Length	3,230m	3,230m
	Crown Height	CD+6.5m proteced by wave breaking work	CD+6.5m proteced by wave breaking work
	Soil Improvement	PVD	Outer A:PVD Outer B: Sand Replacement to depth of CD-7.5 to -9.5m
Sand Protection Dyke	Structure	Rubble Mound Non-Permeable Dyke	Cellular block on rubble mound base
	Armour Stone	4 to 8 t/pc Wave breaking work	None
	Length	7,600m	7,880m
	Alignment	About 1,000m apart from channel	About 1,000m apart from channel
	Crown Height	CD+2.0m	CD+2.0m
	Soil Improvement	No Improvement	No Improvement

Special remarks for conclusion and recommendation will be given as follow:

1) Reclamation and Revetment Work

a) Supply of Fill and Rock Materials

The filling soil for reclamation is about 3 million m^3 and the reclaimed fill must be properly protected by peripheral revetment for which rock materials is used. It is estimated that the delivery rate of fill sand and rock material is about 10,000 m^3 and 1,000 m^3 maximum per day respectively to the Project, which is deemed critical component of work for construction time schedule.

The specifications stipulate fill materials obtainable from either dredged materials or fill materials other than dredged materials. In case of the use of dredged materials for reclamation fill, both river sand and sea sand are acceptable once such materials shall meet the quality requirements.

Both river and sea sand is naturally deposited soil and therefore the quality of the material decisively differs by places of the dredged area and is not controllable. The work for the project requires a large amount of reclamation fill material to supply in relatively shorter period. Reclamation fill material must be obtained at reasonable price at in-time rate of supply schedule without any delay for the project demand. In technical view of judgment, the contract specifications require normally obtainable quality of river or sea sand material for reclamation fill soil in order to preclude drastic increase of the unit price offered by the Bidder in the contract bidding and likely delay in the construction time schedule for completion.

b) Ground Elevation

Reclamation for Container Terminal area is executed up to the finish level of CD+4.5m while the peripheral revetment is elevated at the elevation of CD+5.5m under JICA ODA Project based on MOT Decision No. 476/QD-BGTVT. Access Road area is finished at the elevation of CD+5.5m.

2) Subsoil Improvement

The underlying sandy/silty clay deposits at the reclamation area for container terminal construction are soft to firm with an N-value of 0 to 5 for upper clay or 5-15 for lower layers. These soils are classified as clay or silt having plastic and cohesive character. The deposits are of a relatively low strength and decisively exhibit moderate compressibility once the reclamation fill and/or surcharges are loaded onto the reclamation fill for its intended use. Therefore, soil improvement is necessary in order for the underlying clayey subsoil to accelerate the process of consolidation which is caused by reclamation fill and operation surcharge loading.

The objectives of soil improvement at this site are to accelerate the consolidation and to reduce the residual consolidation settlement occurred by reclamation and the port operation load. Comparative study was carried out on the method of soil improvement among Plastic Board Vertical Drain (PVD), PVD+ vacuum method and CDM for whole terminal area. Considering the natural conditions and objectives and in view of cost performance, it is recommended that the best method of soil improvement is Plastic Board Vertical Drain (PVD) method in combination preloading since it is easy for work, low construction cost, and no hazardous impact for natural and social environment.

PVD method in combination with Preloading is basically carried out within the reclamation area for container terminal and access road in order to accelerate and complete the consolidation during construction period. The reclamation area may be divided into several zones for reclamation fill and preloading. Other than PVD subsoil improvement, it was scheduled that Cement Deep Mixing Method (CDM) is applied for the area of about 35 to 40m wide right behind the container berth and barge berth to make the wall construction stable. Since these areas are intended for use as temporally yard for construction of berth structure by Private Sector, it is recommended that these areas are handed over to Private Sector to initiate and complete terminal construction as earlier as practically possible.

One of important issues for design of subsoil improvement is the ground settlement and deformation to occur under subsoil improvement process. Especially horizontal deformation of container berth and revetment cannot be analyzed by ordinary design method to calculate future settlement and slope stability.

In this Detailed Design Study, the soil/water coupled Elasto-Visco-Plastic FEM analysis (code name is DACSAR that can calculate vertical and horizontal displacement by two dimensional analyses) is conducted in order to predict the container berth and revetment deformation and to confirm the stability of revetment structure during construction period. Totally 4 locations (1 location at Terminal Berth, 2 locations at Inner Revetment, 1 locations at Outer Revetment A) are selected to analyze those deformation under subsoil improvement process with consolidation progress.

3) Capital Channel Dredging and Disposal of Dredged Soils

It is estimated that the capital dredging volume is about 38 million m^3, which is derived from:

Net Volume	: 29.8 million m^3
Extra Dredging	: 1.9 million m^3 to cover the likely sedimentation due to two (2) times of storm weather and normal waves for one year period, and
Sedimentation Volume	: 6.3 million m^3 to cover the likely sedimentation during 3 years initial dredging period

The capital dredging works will be executed in 36 months period by Grab Dredger (GD) with 23 m^3 grab capacity for 16 hours/day or TSHD (Trailing Suction Hopper Dredger) with a hopper capacity of 16,000 m^3 to operate 24 hours/day. Cutter Suction Dredger (CSD) may not be allowed in view of safety of navigation except for channel sections from STA40 to offshore end where Cutter Suction Dredger (CSD) of 8,000 ps may be used for dredging along present navigation channel.

It is assumed that the works covered by JICA ODA Project is channel dredging and dumping (dumping offshore area).

4) Work at Public Related Area

Record of Discussion between GOV and JICA exchanged in June 2010 indicates that:

> *"The both side agreed that the work for the public related facilities would be limited to the most urgent component. It was thus agreed that, except for the service boat berth, soil improvement and construction of building and utilities in the public related facilities area would not be included in the scope of the ODA loan, as organization that would use the area would be responsible for such works. As for the service boat berth, all the necessary work to set up is included in the scope."*

Based on the above agreement on the scope of work for the Public related area, JICA DD Study Team designed reclamation, revetment and Service Boat Berth with its related facilities to be included in JICA ODA loan Project as follows:

a) Reclamation and Revetment

Reclamation is executed up to the finish level of CD+4.5m while the peripheral inner and outer revetment is elevated at the elevation of CD+5.5m and CD+6.5m respectively under the JICA ODA Loan Project.

b) Service Boat Berth

Service Boat Berth is included in JICA ODA Loan Project and was designed in conformity with MOT Decision No. 476/QD-BGTVT which stipulates berth top elevation of +5.5m and berth bottom elevation of -5.0m.

c) Water Supply System

Water supply piping work to service boat berth should be developed in the total system of water supply in Public Related Area. The work included in JICA DD Study is:

- Ship hydrant (Underground water supply piping and outlet) at berth apron area to Service Boat Berth

No water piping connection from the above connection pipe to underground water supply pipe at service boat berth in Public related area is covered in JICA ODA Loan Project since the land is reclaimed to the finished level of CD+4.5m under the Project. Electric supply work to service boat berth should be developed in the total system of electric supply in Public Related Area

External lighting system (Lighting pole and electric cabling) behind Service Boat Berth area was not included in JICA ODA Loan Project since the land immediately behind the berth area is reclaimed to the finished level of CD+4.5m under the Project. No electric supply cable connection from the above connection pit to service boat berth in Public related area is covered in JICA ODA Loan Project since the land is reclaimed to the finished level of CD+4.5m under the

Project.

Other than the water hydrant to service boat berth, such utilities to and/or in the Public Related Area as waste water treatment, fire fighting, telephone, internet, and electric power supply with connection to mains, etc., shall be developed by the Project Owner.

5) Earth Retaining Wall Construction

The earth retaining wall behind container berth and barge berth structure (to be constructed by private operator) was designed steel sheet pipe piled structure. Anti-corrosion measures was provided with concrete lining cover for the splash zone of external face of sheet piles.

Since the berth construction is scheduled to succeed to the construction of the earth retaining wall after handing-over the part of the reclamation area to the private sector, the pile driving work for berth construction shall be carefully executed as lightly as possible so as to eliminate any damages or deformation to the earth retaining wall in complete..

Harbor calmness in front of the proposed container berth was examined for normal and abnormal wave condition. The results of the study show that the calmness of the wharf is sufficient with more than 97.5 % of the rate of effective working days for normal wave condition. But the wave condition in front of the wharf for abnormal conditions is estimated to be less than 1.5 m in wave height, which should be considered in designing container berth structure.

6) Inner/Outer Revetment

Outer revetment A and B (West side revetment “Breakwater” along access road) was designed to be stable for any wave actions at the site as originally planned. It is recommended that any excess preload fill soil are temporary stockpiled in front of Inner Revetment A to protect the terminal yard from possible wave attack during terminal operation period till the commencement of the succeeding next terminal expansion work.

7) Prediction of Channel Sedimentation

The likely rate of channel sedimentation was accessed by means of numerical simulation study in this DD study. The estimated rate of sedimentation with provision of sand protection dyke is in an order of:

- Due to normal waves: about 1.3 million m^3/year in normal marine conditions
- Due to extreme high waves: about 0.48 million m^3 per one time once extreme high waves shall intrude into channel in rough weather.

8) Sand Protection Dyke

Based on the numerical simulation study for channel sedimentation, the detailed design of sand protection dyke was revised. In this DD Study, several cases of numerical simulation study on channel sedimentation were done to predict the annual sedimentation volume with and without sand protection training dyke in alternative layouts and different crown height. Through the simulation study, the layout plan for Sand Protection Dyke was determined as the most cost-effective countermeasures against channel sedimentation considering the certain amount in port operational period as follows:

- Proposed location of the structure: about 1,000m south–west from centerline of channel (about 800m from the edge of channel)
- Crown height: CDL +2.0m, and
- Location of Offshore Tip of the Dyke: extended to a water depth of CD.-5.00m

Alternative types of structure for the Dyke were studied to seek most cost-effective type of structure and the layout were determined and cellular type of concrete box filled with rock on ruble mound base is applied. No soil improvement for seabed ground was used for countermeasure to minimize future settlement in consideration of the magnitude of the future settlement and the uncertainty inherent with the results of numerical simulation of channel sedimentation prediction which was the basis for the determination of the crown height and the layout of the structure.

9) Utility Supply

It was confirmed that Cat Hai Electricity will supplied 20MVA through power supply line of 110KV/35-10kV from the existing Cat Hai substation for the initial stage of consumption in container terminal and public related area. Water supply main pipe is scheduled to be provided by Hai Phong City. Follow-up actions for electric and water supply for the Project is highly recommended to be taken by MPMU2 for smooth implementation of the Project.

It is also understood that any utility facilities inside the fence of the container terminal will be developed by the terminal operator, while those situated up to the fence of the container terminal will be developed by the Vietnamese Government.

29.3 Project Implementation

1) Preparatory Work

a) Location of the Contractor’s Temporary Yard

There are two (2) alternative sites proposed for construction of the contractor’s temporary yard, Dinh Vu district and Cat Hai land acquisition area for the Project. It seems that temporary construction yard at Dinh Vu district may be preferable in view of easy access from Hai Phong City, availability of concrete batching plant and asphalt mixing plant, and short distance from the site. But, through the discussion between DD team and Vietnamese side, it is concluded that Cat Hai land acquisition area is used for the contractor’s temporary yard in the purpose of construction planning and cost estimate in this DD study.

Temporary yard is constructed under the responsibility of the construction contractor under the construction contract. The required area is estimated to be about 6 Ha. Some reclamation work will be required for yard construction. The yard will be provided with fabrication and stockpile yard and temporary jetty for river transportation of equipment and materials to the Site, etc. It is additionally required to install concrete batching plant with provision of material stockpile yard in case of Cat Hai acquisition area.

Since Employer wish to provide the contractor’s temporary yard at Cat Hai Island project site, any discussion may be necessary in initial stage of construction to make consensus between the Employer and the Contractor for programming the contractor’s temporary yard for the Project construction.

b) Land Acquisition of Cat Hai Project Area

Land acquisition for Cat Hai Island project site shall be done in time for commencement of the construction work by the Project Owner. Cat Hai Island project site of about 20ha area is recommended by the Employer to set up the contractor’s temporary yard for construction. In order to smoothly initiate preparatory work by the contractor, it is necessary for the Project consultants to thoughtfully monitor the progress of land acquisition to be done by the Project Owner. It is schedule that the contractor is given the access right to site in two steps procedure, i.e., Step 1 for the specified area at public related area upon the commencement of the work, and Step 2 for the remaining area in 10 month period after the Step 1. The area for the contractor access to site in Step 2 is the land lot behind the access road at public related area where the temple and its cemetery exists.

c) UXO's Clearance

UXO's survey and clearance in and around project site area is also the responsibility of the Project Owner. Site access by the contractor should be done after confirmation, declaration and guarantee for full site clearance of UXO's in compliance with legal procedures by the relevant authority.

d) Mobilization

In case of application of earlier construction time schedule for the construction, the contractor to must initiate necessary administrative procedure for construction in proper assistance and coordination with the Employer immediately after signing into the contract. In addition, it is mandatory for the contractor

- To systematically mobilize construction materials and equipment to site because of no time allowance for preparatory work in the schedule which normally require 2-3 months,
- To initiate preparatory work to commence temporary dyke, earth retaining wall and CDM work as quickly as possible as scheduled in early case of construction schedule.

e) Supply of Reclamation Fill Materials

Supply demand for Reclamation Fill is estimated as follows as derived from the BOQ and Construction Time Schedule established for Package 6 Contract.

Table 29.3.1 Estimated Supply Requirement based on the BOQ and Construction Time Schedule

Fill Category	Estimated Quantity (m^3)	Construction Period for Supply
1. Reclamation Fill (so called Black Sand)	2,700,000	22 months
2. Surcharge Fill (so called Black Sand)	800,000	15 months
For Reference: Sand Mat Fill (so called Yellow Sand)	640,000	13 months

In results of SAPROF study, it is scheduled that the reclamation fill materials are obtainable from two (2) potential rivers, Thai Binh river and Kinh Thay River, for sand dredging site at Hai Duong Province (about 70km distance by river from the Project site). But according to the latest information, river sand dredging operation is allowed only for supply of sand to road construction project and the river dredged sand from these sources are prohibited to use for land reclamation work such as seaport construction like Lach Huyen project. Therefore, it is mandatory for the Contractor to gather latest information on availability of river as well as sea sand sources in the bidding stage to determine possible source of reclamation fill materials for the Project use.

2) Additional Soil Investigation to supplement boring works done by JICA DD Study

In response to MOT Notice No. 306/TB-BGTVT dated September 5, 2011, the construction contract specified pre-construction soil investigation work to be executed by the Contractor so that the boring numbers as a whole could satisfy the Vietnamese Standard 22TCN260-2000 to cover the area for construction of outer breakwater, sand protection dyke and navigation channel/turning basin.

As being provided provisional sum item in the Bill of Quantities, a series of soil investigation work is scheduled to execute so as to effectively carry out soil improvement by PVD method while confirming the degree and effects of subsoil consolidation during preloading period.

3) Soil Improvement

PVD method required proper horizontal drain of water by the use of good quality of sand, for which so-called yellow sand or Sand Drain Mat is recommended to use for the upper layer of reclamation for drain.

The effects of soil improvement by PVD methods must be carefully evaluated by predicting future's settlement during a construction period based on the monitored data on settlement. Therefore, it is quite important that high quality of PVD technique and work control must be exercised to perform the targeted settlement during preloading period under proper supervision of work supported by ground settlement and movement monitoring program. Ground Deformation Monitoring Program proposed in this Study is recommended to apply during construction stage for the settlement control to monitor settlement and groundwater systematically, and for lateral displacement monitoring for the stability examination at toe lines of preload embankment and face lines of terminal berth and revetments during construction.

Flexible implementation and strict work control and management may be required in response to the results of ground settlement and lateral displacement monitoring survey. In particular, due care to avoid possible collapse or excess movement of peripheral revetment is also paid for during reclamation and soil improvement in line with ground displacement monitoring survey.

Soil improvement in combination of PVD and reloading is required about 32 month period to complete. Reclamation fill and preload soil must be properly protected by temporary peripheral dike from the offshore waves which may directly intrude to the reclamation area during the construction period.

Upon the completion of preloading, surcharge fill for preloading must be removed and become excess soil materials to be temporary stockpiled near the project site. Excess soil is estimated considerable amount of volume to 740 thousand m3 in total. It is recommended to temporary stockpile this excess soil in front of Inner Revetment A so that terminal yard could be protected from the likely wave action in the operation stage till the commencement of the next terminal construction.

4) Monitoring of Channel Sedimentation and Flexible Implementation of Maintenance Dredging Work

The channel depth monitoring survey is scheduled to be done monthly and at each interval of construction period as indicated Tables hereunder.

Table 29.3.2 Schedule of Dredging Works and Monitoring

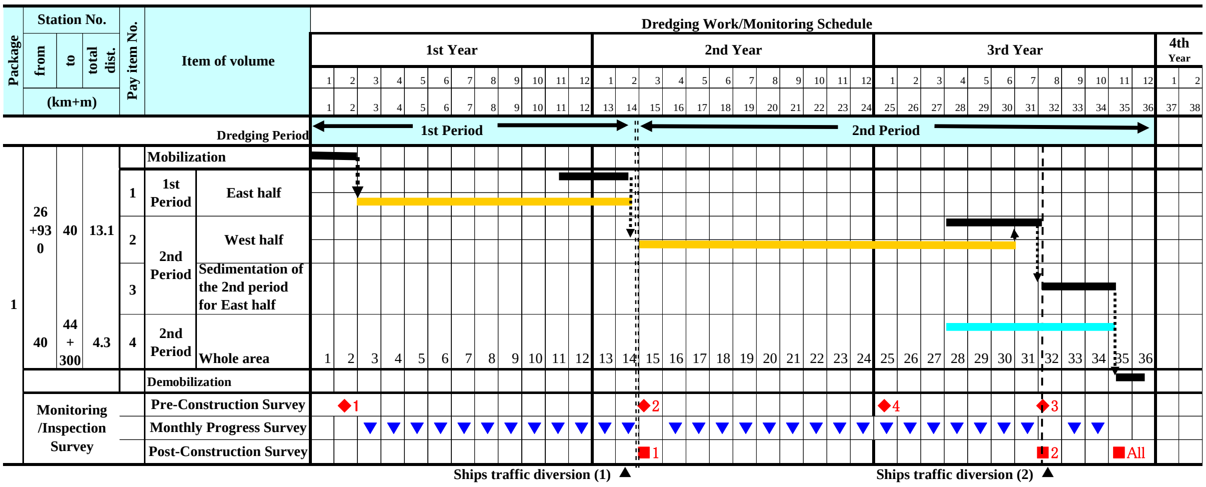


Table 29.3.3 Channel Dredging area monitoring Hydro Survey Requirement

Monitoring Survey Item	Symbol	Hydro-Survey Area				Survey output
		Cross Sectional Survey line Intervals	Cross section Width		Longitudinal Survey line	
			The Channel area	Turning Basin		
		(m)	(m)	(m)	(m)	(Within: days)
Pre-Construction Survey	◆1	25	1,000	400 m from slope bottom	1) Channel Center line 2) Channel slope bottoms 3) 100 m intervals for slope and outside area	30 days
Monthly Progress Survey	▼	50	500	300 m from slope bottom		10 days
Post-Construction Survey	■1	25	1,000	400 m from slope bottom		30days
Special Survey after rough weather (typhoon)	–	50	500	300 m from slope bottom		10 days

5) Environmental Protection

Either near-shore or offshore dumping would cause considerable impacts on natural, biological, and social environment without SS control measures during dredging and dumping operation. However, in view of environmental sustainability and avoidance and minimization of unnecessary environmental impacts, offshore dumping is preferable option (with or without SS control measures) rather than near shore dumping which would cause higher extent of negative impacts

But even in case of offshore dumping, it is recommended to apply SS control measures to minimize the impacts with effective, economical and practical measures. Environmental monitoring plan shall be carried out in each stage of the Project implementation for pre-construction, construction and operation. It is specifically identified herein that the major subjects of the Environmental Mitigation Measures in the Construction Stage are as follows:

- Prohibition of overflow from dredger and installation of silt curtain around dumping site and implementation of reactive monitoring,
- Monitoring of dredging and dumping works at the access channels to minimize their effects on natural, biological and social environment.

6) HIV/AIDS Protection

HIV/AIDS Protection Program was established to reduce potential negative social impacts associated with the implementation and operation of Port portion of Lach Huyen Infrastructure Construction Project. In order to achieve the overall goal, the Program is intended to mitigate HIV risks and vulnerability to HIV/AIDS at the construction sites and surrounding communities.

It is recommended that the Program implementation is controlled by MPMU2 as a part of the construction project management and MPMU2 employs HIV management specialist as a consultant respectively. The appointed consultants control quality of the Program through participating in the preparation of HIV clause for the contracts, monitoring and evaluation of the Program. Based on the contract between a prime contractor and Service Provider, the Service Provider operates the Program on site.

The Program design also requires setting up Program Management Coordinating Committee which directs the Program and harmonizes the roles of stakeholders. It is expected that the program for the port portion of the Project covers all the staff including the entire contractor's employees, all sub-contractors and consultants' employees, and all truck drivers, mariners, and crew making deliveries to sites for construction activities and labor in construction sites and to the immediate local communities in Cat Hai district.

7) Construction Safety

The contractors are required to prepare and submit a Safety Management Plan for the review and acceptance by the Project Safety Committee and necessary measures for construction safety are considered to be taken by the Contractor in the implementation of the Project as for:

- Safety and Security measures, Safety monitoring and patrol, Training workers on safety, Fire detection and protection, and actions to be taken for explosives and other dangerous material handling and stockpiling
- Safety measures for Marine Works, Maritime accidents prevention, Diver’s work and Refuge location and evacuation of work vessels in case of adverse weather and sea conditions,
- General Protection and Contingency measures against natural disasters, and
- Other matters such as UXO detection and settlement procedure, Emergency case communication and action plan, and Preliminary Risk Analysis and Prevention Plan for respective work components and activities

29.4 Operation and Management

1) Channel Maintenance and Monitoring

Careful regular monitoring survey on water depth of channel is recommended to carry out regularly to monitor the rate of sedimentation by channel section. After the Channel dredging works were turned over to the Employer, the channel monitoring survey has to be conducted by the Project Owner based on the recommendation as indicated in the Table below.

Table 29.4.1 Channel Dredging Area Monitoring Hydro Survey during the Post Construction Period

Monitoring Survey Item	Hydro-Survey Area				Timing of survey
	Cross Sectional Survey line Intervals	Cross section Width		Longitudinal Survey line	
		The Channel area	Turning Basin		
	(m)	(m)	(m)	(m)	(days)
Periodical Survey	**50**	**500**	**300 m from slope bottom**	**1) Channel Center line 2) Channel slope bottoms 3) 100 m intervals for slope and outside area**	**Once in every two (2) months for the 1st year. Once in every six (6) monthe for the 2nd year.**
Annual Survey	**50**	**1,000**	**400 m from slope bottom**		**Once in every year**
Special Survey after rough weather (typhoon)	**50**	**500**	**300 m from slope bottom**		**Immediately after typhoon**

The annual rate of channel sedimentation is discussed in Chapter. 5. For the bases of the determination of the maintenance dredging program for the post construction period, annual maintenance volume of 3.39 million m^3 under the conditions of 1): the provision of sand dyke, 2): the occurrence of the highest waves 4 times in a year, and 3): tolerance factor of 1.50 is applied based on the prediction given in Chapter 5. Figures below show the distribution of the annual sediment volume by every 500 m longitudinal section and relevant thickness of the sediment.

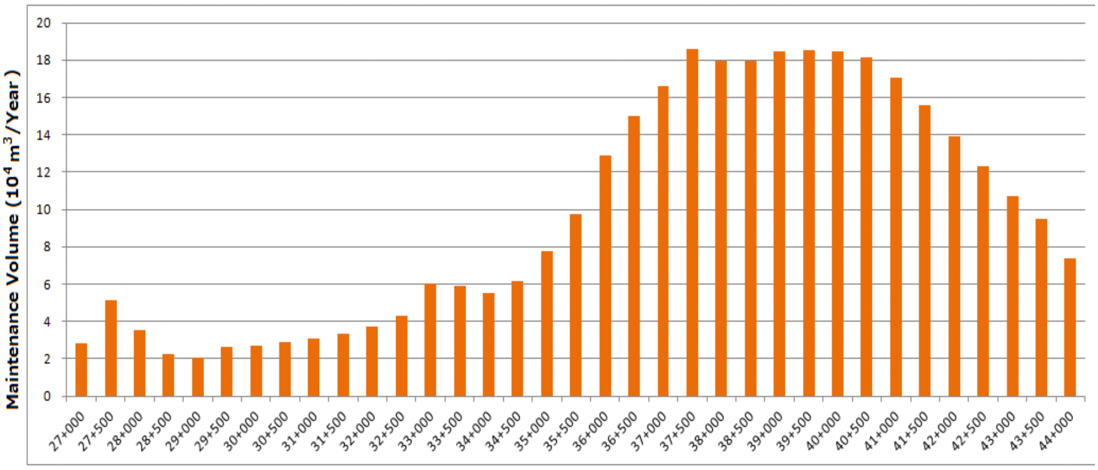


Figure 29.4.1 Maintenance Volume by Section (Chap 5, Figure 5.10.1)

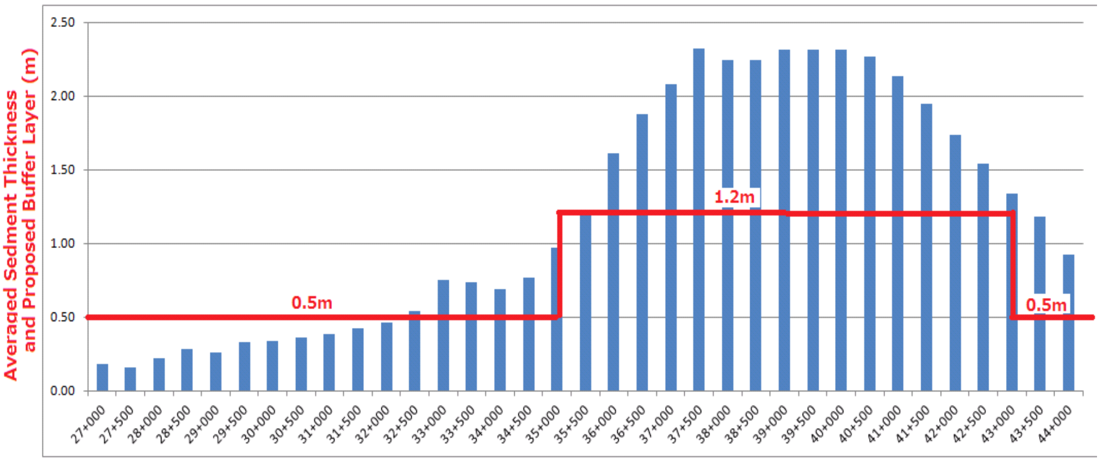


Figure 29.4.2 Proposed Buffer Layer for Infill (Chap 5, Figure 5.10.2)

But sedimentation or siltation is a very sensitive phenomenon depending upon marine conditions. Therefore, it is better to understood that the figures derived from the above estimate just figure out an order of extent occurred in future and therefore maintenance dredging program should be executed flexibly in response to the actual phenomenon of channel sedimentation.

Available local dredgers in combination of TSHD and small size GD may be deployed for the channel main portion and for the Channel side slope area. The dumping site for the maintenance dredged soil will be either at Dinh Vu or Off shore. Considering the necessity of continuous maintenance dredging activity, the provision of one (1) TSHD for exclusive use for the Lach Huyen Channel maintenance dredging is recommendable.

Table 29.4.2 Maintenance Dredging Program

Station No.			Type of dredger	Productivity	No of dredging fleet	Total Duration		Dredging volume	1 Year											
from	to	total dist.		(m3/day/ fleet)					1	2	3	4	5	6	7	8	9	10	11	12
(km+m)						(day)	Unit-month	(m3)												
27 km + 000	44 km + 300	17 km + 300	TSHD 3,250 m3	2,977	1	300	10.0	893,100	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪		
					1	300	10.0	893,100			🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪
					1	163	5.4	485,251	🟪	🟪	🟪	🟪	🟪						🟪	🟪
				Sub total	3		25.4	2,271,451												
			GD 2.5 m3	746	1	300	10.0	223,800	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨		
					1	300	10.0	223,800		🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	
					1	300	10.0	223,800			🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
					1	300	10.0	223,800	🟨			🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
					1	300	10.0	223,800	🟨	🟨			🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨
				Sub total	5		50.0	1,119,000												
Total								3,390,451												

2) Settlement Monitoring at Reclamation Area

Even through the subsoil is subjected to soil improvement during construction period, a certain degree of secondary settlement of reclamation area is inevitably occurred after handing-over to private operator in case of PVD soil improvement with Preloading method. In this DD Study, PVD with Preloading method is designed for residual settlement criteria as follows:

Container Terminal Area:	Spr=0 (100% of Primary Consolidation Settlement for Reclamation and Operation load
Access Road Area:	Spr=300mm within 15 years for Reclamation and Operation load including secondary settlement

It is recommended to carry out recurrent monitoring for settlement of ground surface throughout construction and operation stage.

3) Recurrent Maintenance of Civil Facilities

Recurrent maintenance of all civil works is recommended to carry out in order to maintain its intended function and to prolong its service life. In particular, anti corrosion provision for steel foundation must be carefully surveyed to detect any fault and maintained properly its effectiveness.

4) Port Administration System

For more effective administration and management of seaport, function of regulator and policy making as the nation as a whole become more important and the role of VINAMARINE will become heavy. Currently, administration and management (especially, tariff setting, infrastructure management and lease contract on the public port infrastructure) function is centralized to MOT and VINAMARINE.

Hence it becomes necessary to separate the function of regulator and operator under the scheme of Public Private Partnership so as to establish the port management body to dictate the regulations and to implement and coordinate the management of each port on site. For the management of Lach Huyen International Port including existing ports in Hai Phong, it is recommended that supervision of terminal operators which operates the infrastructure by the state budget or state budget generated funds is entrusted to Hai Phong Maritime Administration and some part of planning of regional seaports and to dictate of the regulations on seaport management is entrusted to regional office of VINAMARINE in Hai Phong. For this purpose, it is proposed that the Port Management Division of Hai Phong Maritime Administration is strengthen to be able to supervise the daily work of Lach Huyen terminal operators and implement the necessary maintenance work to be born by VINAMARINE attaching five (5) new department under Port Management Division, namely, real estate, business development, marketing, procurement and accounting, engineering.

5) Channel Navigation Aids

Through real-time ship maneuvering simulation, it was confirmed that the large vessel was possible to sail in the channel of 160m wide under the one way condition. However, the one way ship traffic control needs to be strictly controlled in ship traffic more than an hour in the channel to enter to and depart from the port.

It deems that the channel navigation aids along new channel are established by the Vietnamese side. It is recommended that Vietnamese Government should replace channel buoys from the existing floating buoys to Spar Buoys and should provide the pilot office with pilot assistance system to display own ship position at real time (semi-automatic control based on PC).

29.5 Financial and Economic Viability of the Project

The results of economic and financial analysis indicated that the return of the Project is sufficient for the implementation of the Project. The Project is considered viable from the view of national economy as well as the financial view point.

(Financial Viability)

FIRR for financial analysis are conducted and in order to see if the project is still financially viable when some factors vary:

- Case A: The initial investment cost both of PMB/GOV and TOC increases by 10%
- Case B: The handling container volume decreases by 10%
- Case C: The initial investment cost both of PMB/GOV and TOC increases by 10% and the handling container volume decreases by 10% (Worst scenario)

Table 29.5.1 FIRR of both parties

	Threshold level	Base case	Case A	Case B	Case C
FIRR: PMB	*1.74%*	3.63%	3.60%	3.39%	3.37%
FIRR: TOC	*7.47%*	8.93%	8.67%	6.80%	6.53%

Source: JICA Study Team

The results of FIRRs of PMB on base case and sensitivity case are exceeding the weighted average interest rate of the loans as threshold level. On the other hand, those of TOC, especially case B and C, are fallen below the threshold level. These results mean that a decreasing of handling container volume is more adverse element on TOC’s financial soundness than an increase of the initial investment cost. It is suggested that both parties should pay attentions to acquire clients as well as to manage each initial capital cost.

(Economic Viability)

EIRR of the base case of the Lach Huyen Port project with Tan Vu-Lach Huyen Highway Project is estimated at 20.2%, 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.

EIRR for the Short-term Project (2 Container Terminals) are also estimated at 21.0%/annum. Therefore, the project is economically feasible for short-term development project

Table 29.5.2 Sensitivity Analysis of EIRR for Short-term Development Project (2 Container Terminals)

		Benefits		
		Base case	10% down	20% down
Project Cost	Base case	21.0%	19.4%	17.8%
	10% up	19.4%	18.1%	16.5%
	20% up	17.8%	16.9%	15.4%