38.1.3 Port facilities

(1) Design conditions

1) General conditions

From engineering point of view, general conditions related to port operations, which shall be considered in the preliminary design of the facilities, are summarized in **Table 38.1.2**.

Table 38.1.2 General Conditions of the Ports

Item	Hanoi	Khuyen Luong	N-North	N-East
Location	Right bank of the Red River	Left bank of the Red River		Right bank of the Duong River
Type	Passenger port[1)]	Cargo port	Cargo port	Cargo port
Handling Cargo	N.A.	General Container	General Container	General
Design Vessel	(fully boarded) L = 35 m B = 8.6 m D = 1.5 m	600 DWT (fully loaded) L = 50 m B = 11.0 m D = 2.1 m		
Required New Berth	100 m	120 m	240 m	240 m

Source) JICA Study Team

Note: 1) Technical Report on Construction Investment Project of Ha Noi Passenger Port, TEDIport, 2002

2) Load conditions

(a) Surcharge

In case of the cargo handling berths, the surcharge on the deck of pier structure is designed to be 30 kN/m^2, which includes load of temporally stock of handling cargos and possible cargo handling equipment.

In case of the passenger berth, the surcharge load on the deck of pier structure is assumed to be 20 kN/m^2, which includes the dead load of passenger terminal house and loads of expected vehicles for passenger transport and small trucks for maintenance works.

(b) Live load of cargo handling equipment

All cargos are assumed to be handled with truck cranes on the piers. Live load of the truck cranes will be considered in the detailed design of the facilities.

(c) Mooring force

Following the Japanese technical standard, mooring forces of vessels per one mooring bitt shown in **Table 38.1.3** are applied.

Table 38.1.3 Mooring Force

Item	Hanoi	Khuyen Luong	N-North	N-East
Design Vessel	Passenger (fully boarded)	600 DWT (fully loaded)		
Mf (kN)	150	250		

Source) JICA Study Team

(d) Berthing force

a) Berthing energy

The ship berthing energies of vessels are calculated as shown in **Table 38.1.4**.

$Ef = (Ms * V^2 / 2) * Ce * Cm * Cs * Cc$

Table 38.1.4 Berthing Energy

Item	Description	Passenger Vessel	Cargo Vessel 600 DWT
Ms	Water displacement of berthing ship (t)	300	1,100
V	Approach velocity of ship against the fender (m/s)	0.3	0.2
Ce	Eccentricity factor	0.5	0.5
Cm	Virtual mass factor	1.42	1.32
Cs	Softness factor	1.0	1.0
Cc	Shape factor of berth	1.0	1.0
Ef	Vessel's berthing energy (kJ)	9.6	14.5

Source) JICA Study Team

b) Reaction force of rubber fender

In case V-shaped rubber fenders are installed, the Reaction Forces (Rf) of the fender per one unit are estimated as shown in **Table 38.1.5**.

Table 38.1.5 Reaction Force of Rubber Fender

Vessel Type	Dimension of Rubber Fender	Ef (kJ)	Rf (kN)
Passenger	V shaped (H=25cm, L=100cm)	9.6	138
Cargo 600 DWT	V shaped (H=30cm, L=100cm)	14.5	166

Source) JICA Study Team

c) Loading conditions of mooring and berthing force

Taking account of mooring and berthing conditions illustrated in **Figure 38.1.6**, two times of calculated force (Mf and Rf) is considered.

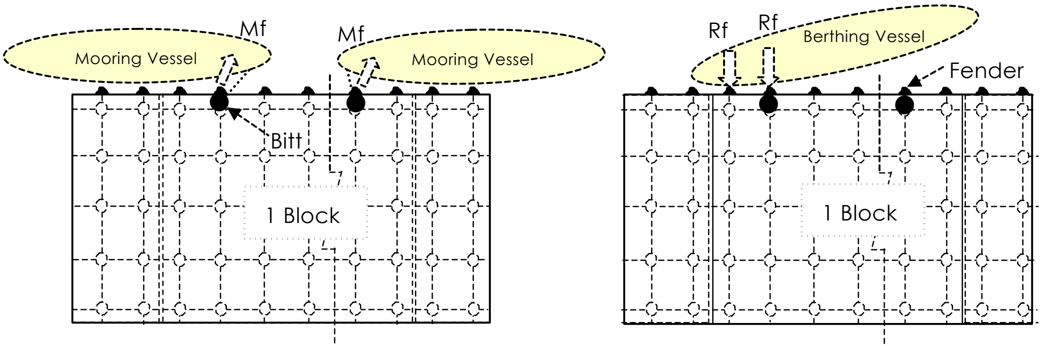


Figure 38.1.6 Loading Conditions to Bitt and Fender

4) Structural elevations

(a) Crown height of berth

Crown height of berth along its face lines are determined based on the following formula as summarized in **Table 38.1.6**.

Crown Height (m) = Warning Water Level (III) + α

Where: Passenger Berth $\alpha = 0.5m$
Cargo Berth $\alpha = 1.0m$

Table 38.1.6 Crown Height of Berths at Ports

(Unit: meter)

Elevation	Hanoi	Khuyen Luong	New North	New East
Warning Water Level (III)	+10.99	+10.59	+11.76	+10.50
Crown Height	+12.0	+11.1	+12.3	+11.0

Source) JICA Study Team

Note) Warning Water Levels (III) at each port are calculated based on the level at Hanoi, Thuong Cat and Ben Ho water gage stations, and the levels observed by the Study Team at each port in the rainy season.

(b) Minimum basin depth

Required minimum basin depths in front of berths along its face lines are determined based on the following formula as summarized in **Table 38.1.7**.

Minimum Front Depth (m) = Low Water Level (95%) + Required Water Depth

Table 38.1.7 Minimum Front Depths at Ports

(Unit: meter)

Elevation	Hanoi	Khuyen Luong	New North	New East
Low Water Level (95%)	+ 1.93	+ 1.77	+ 3.19	+ 2.45
Required Water Depth (Rw)	1.9	2.5		
Minimum Front Depth	0.0	-0.8	+0.6	-0.1

Source) JICA Study Team

Note) Low Water Levels (95%) at each port are calculated based on the level at Hanoi water gage station, and the levels observed by the Study Team at each port in the dry season.

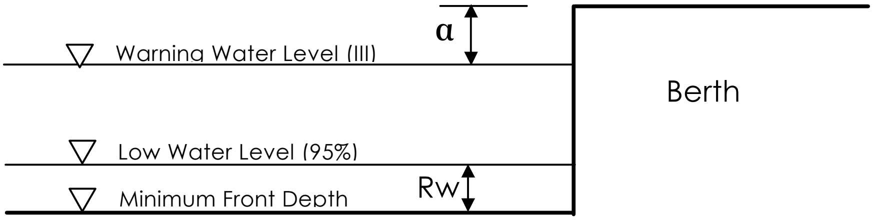


Figure 38.1.7 Image of Structural Elevations

5) Material conditions

Table 38.1.8 Design Criteria of Structural Materials

Material	Criteria
1 Concrete (1) Grade and Strength (kPa)	A(for ICB): 42.0, B(for PC): 34.5, C(for marine RC): 27.5, D(for on-land RC): 24.0, E(for plain concrete): 18.0, F(for lean concrete): 10.0
(2) Re-Bars (Grade, Allowable Stress Mpa)	SR295: fa=157 (Round Bar), SD345: fa=196 (Deformed Bar)
2 Steel Pipe Pile (Grade, Yield & Allowable Stress Mpa)	SKK400, SHK400, SKY400: fy=235, fa=140, SKK490, SHK490, SKY490: fy=315, fa=185
3 Steel Sheet Pile (Grade, Yield & Allowable Stress Mpa)	SY295: fy=295, fa=180, SY390: fy=390, fa=235
4 Corrosion of Steel	2 mm

Source) JICA Study Team

(2) Structural design

Structural design has been made considering following factors:

- Related design standards in Vietnam and Japan,
- Economical advantage,
- Construction efficiency,
- Environmental impacts,
- Safe operation, and
- Easy use.

1) Berth

a) Structural alternatives

In order to construct the new ports in harmony with the effective channel stabilization works, any structural types of berth, which may interrupt trained river water flow, are not considered as sound alternatives. Therefore, the Study Team recommends permeable pier structures for the berths.

For all berths in the ports, comparative design in terms of pile materials (reinforced concrete and steel) has been made as shown in **Table 38.1.9**.

In order to make a realistic comparison on the pile materials, 40cm squared reinforced concrete pile, which is the most common one in Vietnam, was selected as a candidate of concrete material. In fact, the pier structures existing in the Study Area have been constructed with them. On the other hand, steel pipe pile was selected taking account of general corrosion rate of 2mm for the life span of the structures.

Steel sheet pile wall is necessary to keep stability of land behind the pier structures. The required driving depths of steel sheet piles are determined against circular failure of the land as shown in **Figure 38.1.8**.

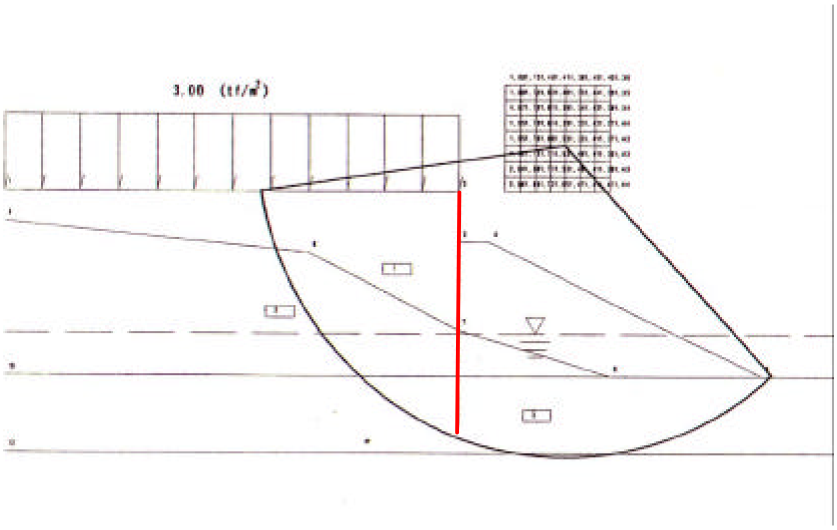


Figure 38.1.8 Required Driving Depth of Steel Sheet Piles (Khuyen Luong Port)

b) Advantageous structure

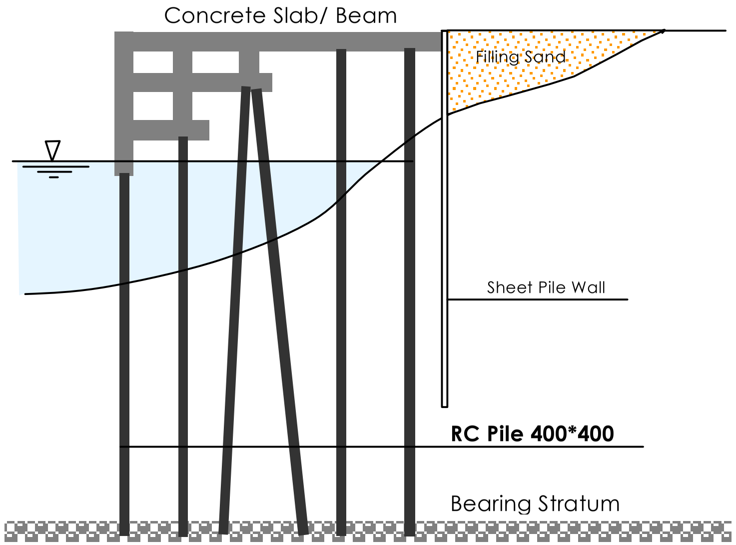
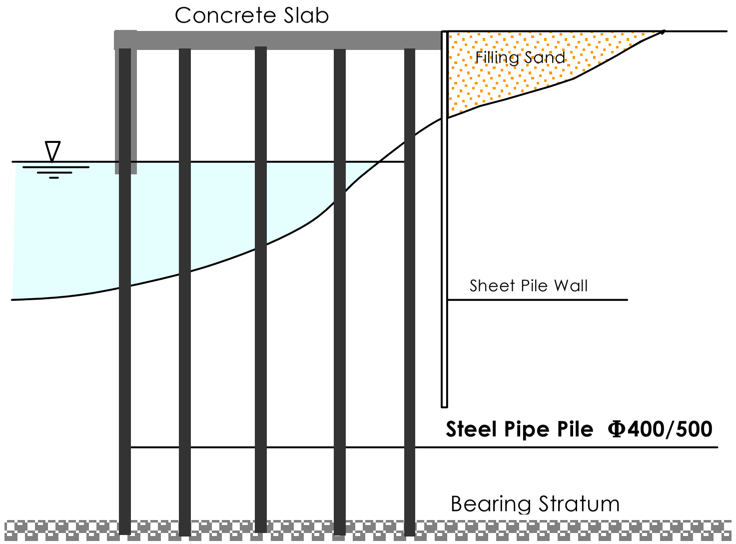
Table 38.1.9 shows advantages and disadvantages of steel / concrete structures.

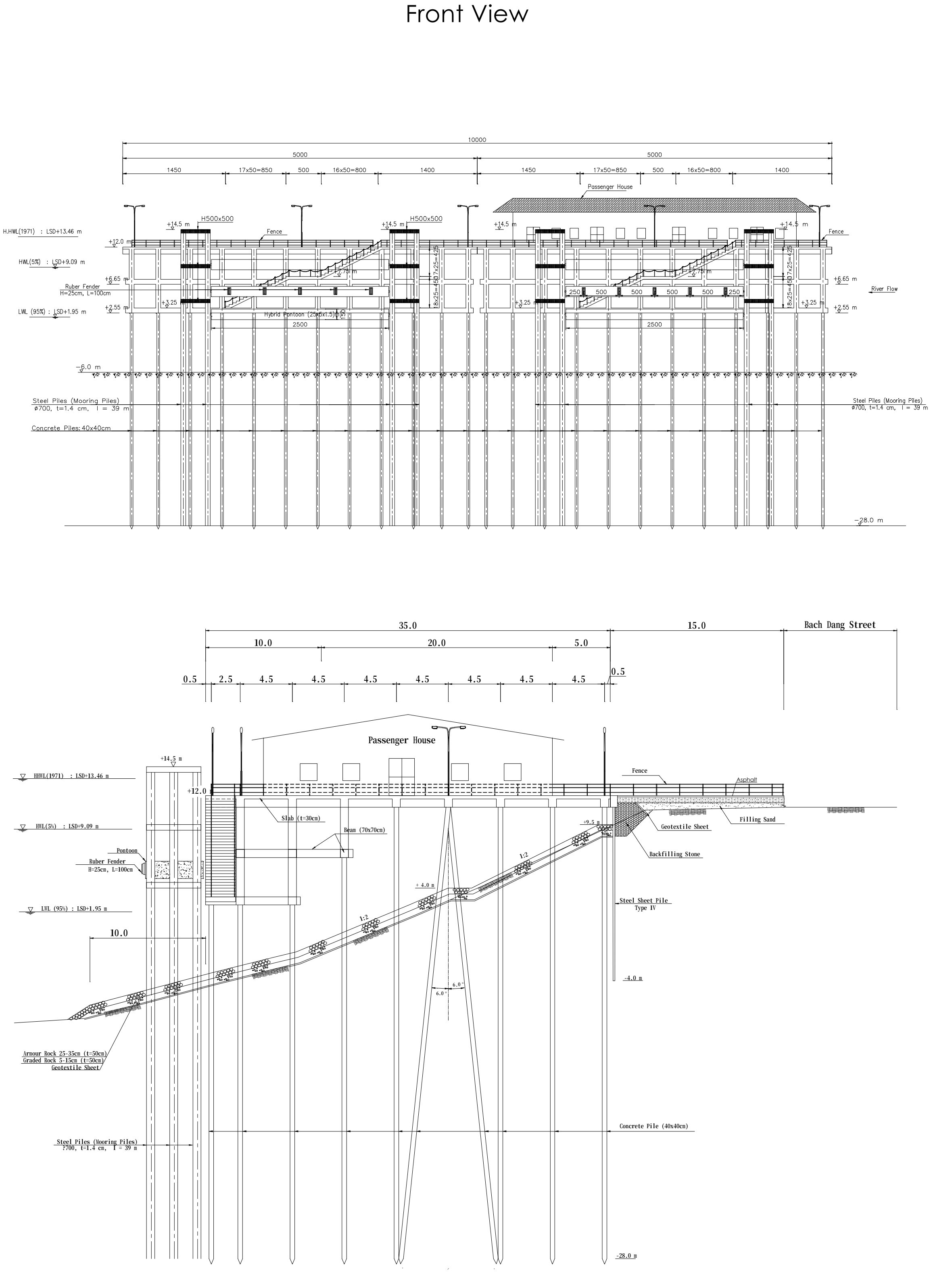
From overall viewpoint, Reinforce Concrete pier structure can be an advantageous structure. Because of complicated structure compare with steel pipe pile structure, however, construction schedule should be planned carefully taking account of the effect of high water level in the flood season (from July to September).

In addition, joint of pile top and horizontal beam can be a structural weak point brought about by inappropriate construction work. The results of the Deterioration Survey conducted by the Study Team (see **38.1.3(3)**) also show the serious damages (sharing and buckling) at that point.

The typical cross sections of advantageous structures are shown in **Figure 38.1.9**.

Table 38.1.9 Comparative Design of Pile Materials

	Coupled Reinforced Concrete Pile All Ports: 400mm * 400mm	Steel Pipe Pile Hanoi Port:φ500mm, Other Ports:φ400mm
Typical Cross Section		
Merit	• Displacement by horizontal force is smaller • Pile driving equipment is smaller • Pile material is available locally	• Structure is simple • Construction period is shorter • Suitable for hard pile driving
Demerit	• Structure is complicated • Construction period is longer • Not suitable for hard pile driving	• Maintenance against corrosion is necessary • Pile driving equipment is larger • Pile material will be imported
Cost	100 %	Hanoi Port: 121%, Khuyen Luong Port: 104%, New North Port: 106%, New East Port: 109%
Evaluation	Good	Fair



Front View

Figure 38.1.9 (1) Typical Cross Section of Hanoi Port Passenger Berth

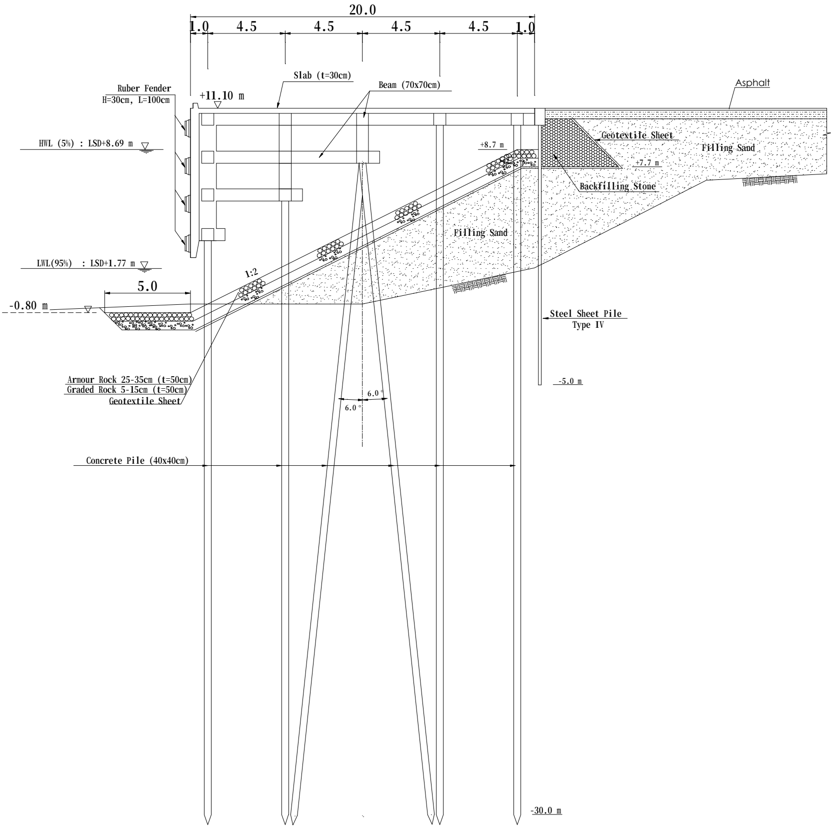


Figure 38.1.9 (2) Typical Cross Section of Khuyen Luong Port Cargo Berth

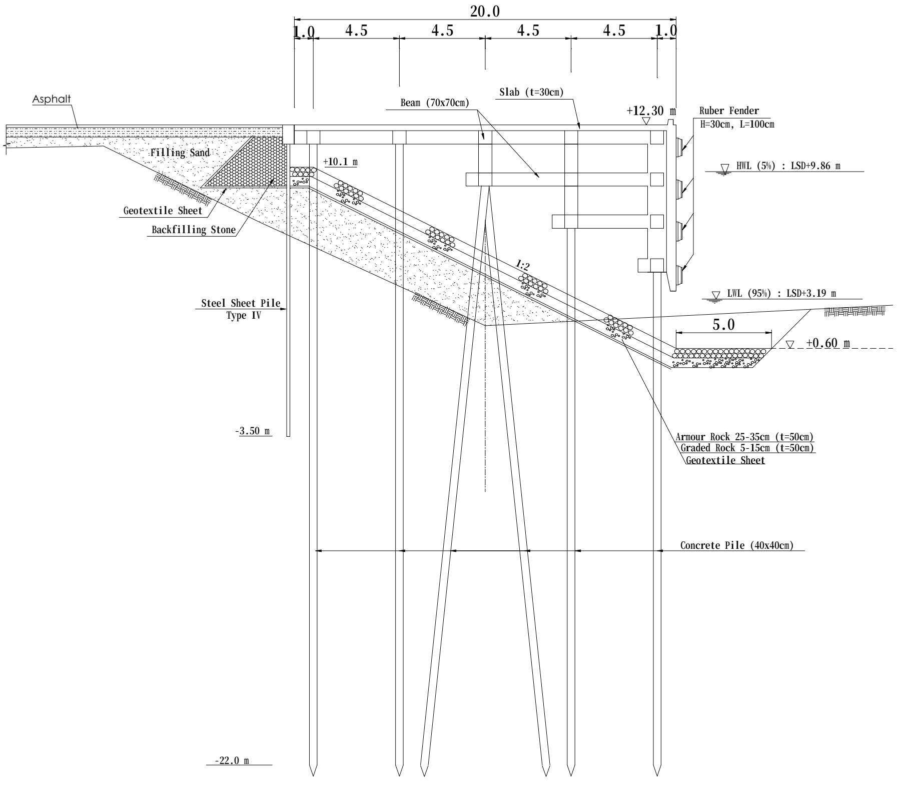


Figure 38.1.9 (3) Typical Cross Section of New North Port Cargo Berth

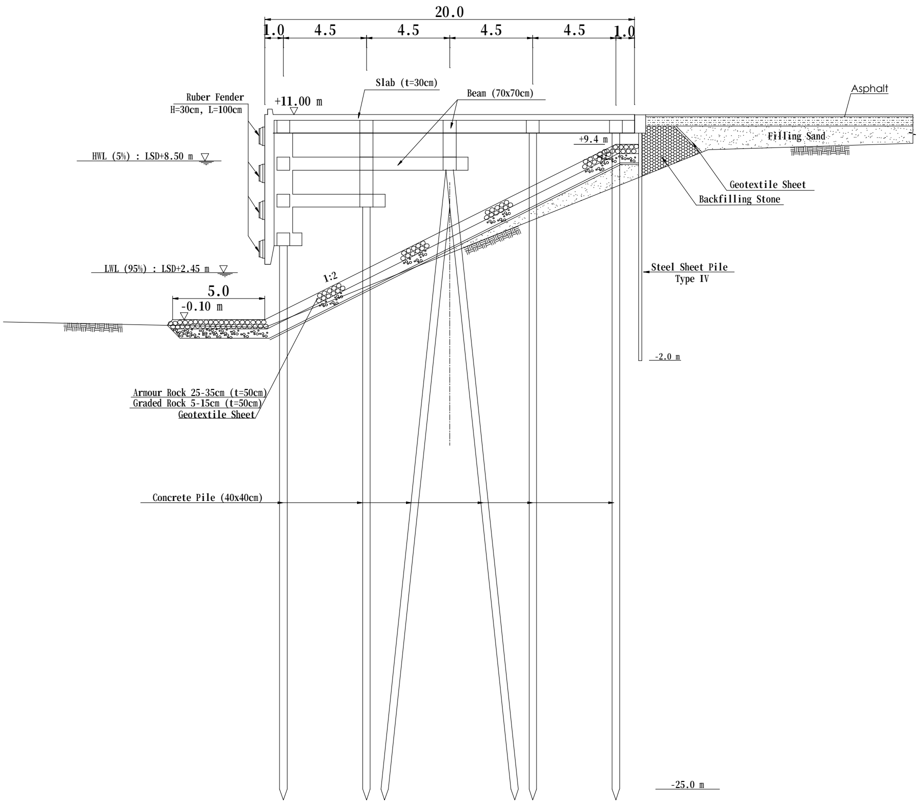
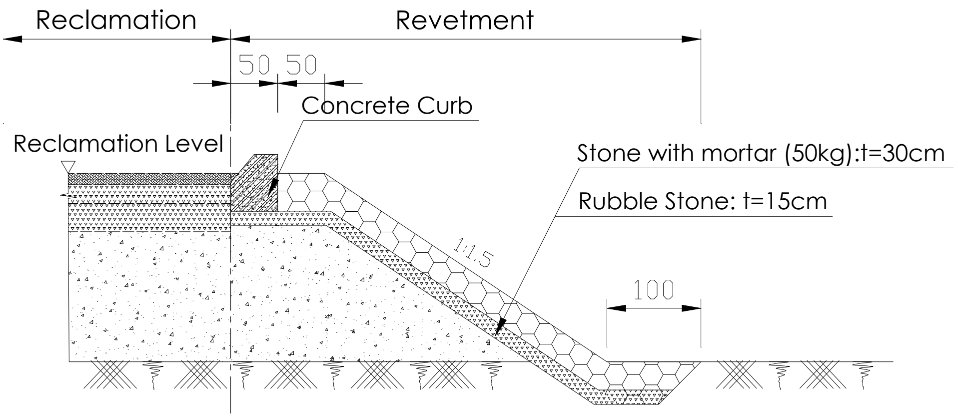


Figure 38.1.9 (4) Typical Cross Section of New East Port Cargo Berth

2) Revetment

Along the boundary between port area and neighboring areas, revetment structure is employed as shown in **Figure 38.1.10**. According to the topographic map surveyed by the Study Team, average height of revetment (reclamation height) is approximately 2m. In order to avoid the collapse of bank slopes during the flood season, amour stone layers are placed on the slopes, the base of which is constructed by compacted sand.

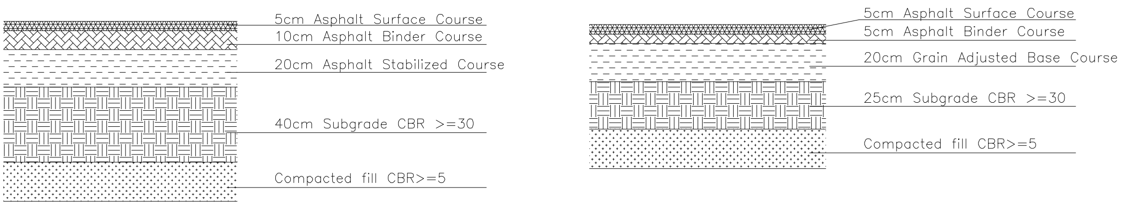


Note: all dimensions are in centimeter

Figure 38.1.10 Typical Cross Section of Revetment

3) Terminal pavement

In order to maintain the high efficiency of cargo handling and storm drainage function, the areas, such as open storage yard, road and utility areas should be paved with asphalt concrete as shown in **Figure 38.1.11**.



Open Storage Yard

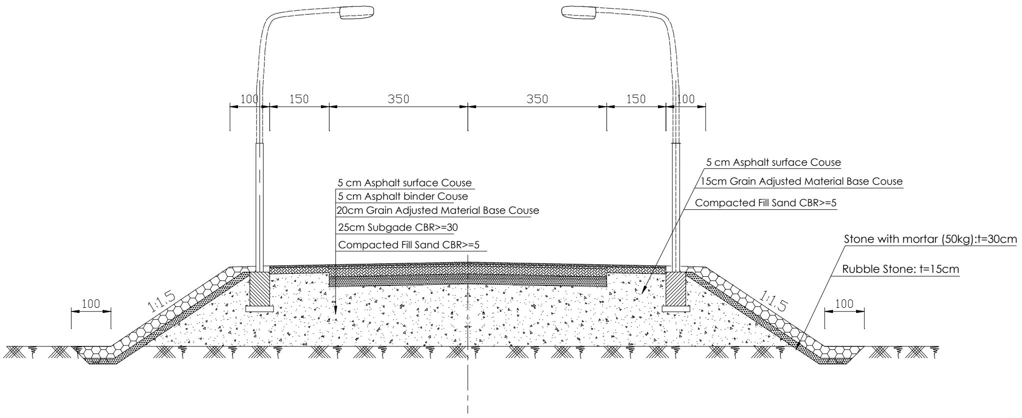
Other Areas

Figure 38.1.11 Typical Type of Pavement

4) Access road

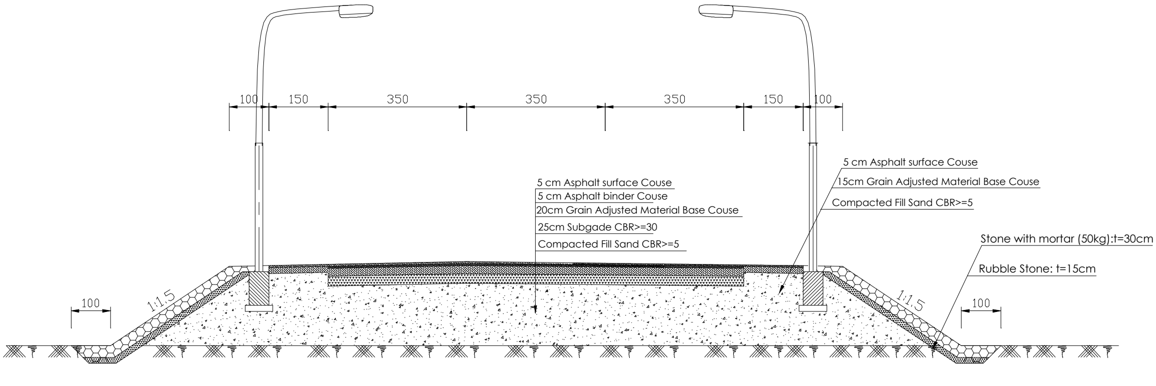
Sections of access road have been designed as shown in **Figure 38.1.12**, based on the required number of traffic lanes to cope with access of port related traffic to the ports. The same reason with revetment, amour stone layers are placed on the slopes constructed by compacted sand.

Box culverts should be build-in at appropriate intervals to allow flood flow through the road.



Note: all dimensions are in centimeter

Figure 38.1.12 (1) Typical Cross Section of Access Road – 2 Lanes



Note: all dimensions are in centimeter

Figure 38.1.12 (2) Typical Cross Section of Access Road – 3 Lanes

(3) Deterioration survey

1) Outline

Simple survey on the present degree of deteriorations of the pier structures has been conducted by the Study Team, in order to obtain the information on the durability of the structures in the future.

The structures listed up in **Table 38.1.10** are surveyed by means of visual inspection and measurement of concrete strength, using the Schmidt Concrete Testing Hammer.

Table 38.1.10 Surveyed Pier Structures

Location	Pier Structure	Year Built
Hanoi Port	Berth No. 1,2,3	1980
	Berth No. 4,5,6	1984
	Berth No. 7	1996
	Berth No. 8	1989
Khuyen Luong Port	Berth No. 2	1996

2) Visual inspection

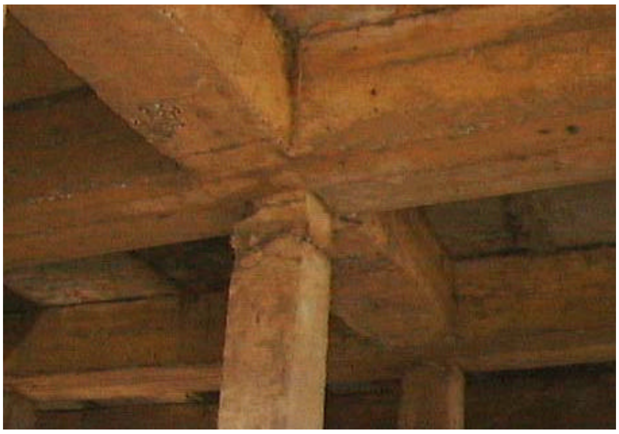
(a) Hanoi Port

a) Berth No. 1,2,3

Gap between pier and access bridge

Damaged lower slab (spalling) due to thin covering and punching share

b) Berth No. 4,5,6



Damaged concrete pile due to buckling

Damaged concrete pile due to excessive horizontal force

Crack and spalling of canti-lever beam between pier and access bridge

Crack and gap on upper slab between pier segments

c) Berth No. 7

Side view of pier structure

Beam, column with no serious damage

d) Berth No. 8

Side view of pier structure

Beam, column without serious damage

(b) Khuyen Luong Port

a) Berth No. 2

Side view of pier structure

Deterioration of cross beam under slab

Evaluating the condition of existing pier structures in the ports, the degree of deterioration ranks higher for Hanoi B-4,5,6; Khuyen Luong B-2; Hanoi B-1,2,3; Hanoi B-8; and Hanoi B-7.

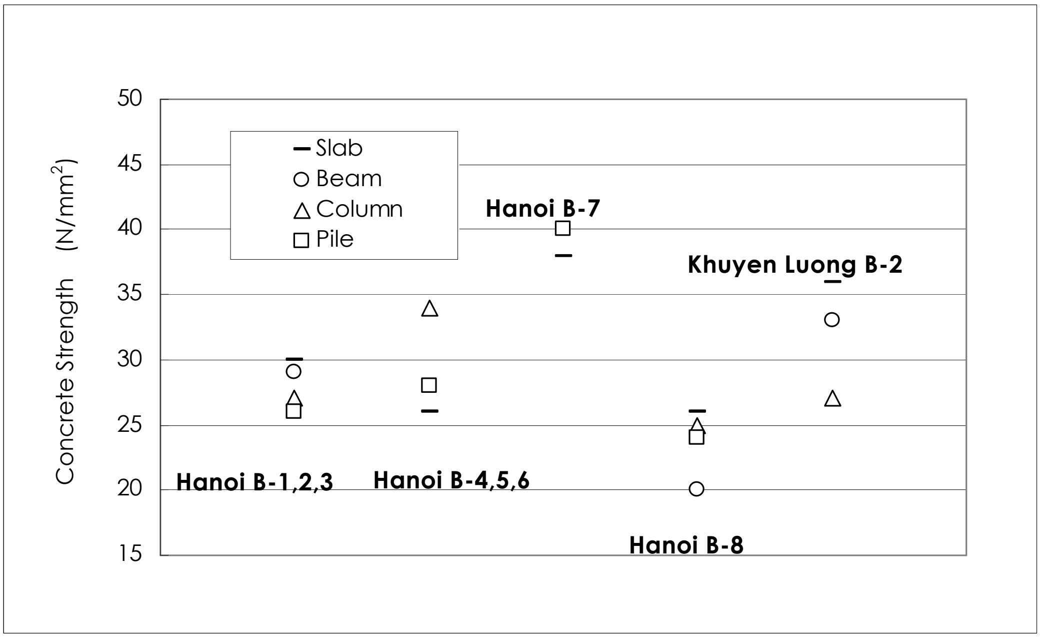
3) Measurement of concrete strength

The Study Team has estimated the concrete strength of pier structures by means of Schmidt Concrete Testing Hammer as shown in Photograph below.

Schmidt Concrete Testing Hammer

Measured values in the field have been converted into the concrete strength taking account of age of concrete after casting.

The estimated concrete strengths of each piers and members are indicated in **Figure 38.1.13**.



Source) JICA Study Team

Figure 38.1.13 Estimated Concrete Strengths

The deterioration survey of the existing pier structures can be concluded that, judging from the above figure:

- Strengths of concrete are ranging from 20 N/mm^2 (200kg/cm^2) to 40 N/mm^2 (400kg/cm2). Most of the structures have still enough strength except the beam of B-8 in Hanoi port, of which strength is barely enough compaired with the ordinary design strength.

- Generally speaking, the newer the age of concrete, the higher the strength of concrete.

- Strengths of deteriorated piers tend to have wider variation of strength than those of less-deteriorated ones.

38.2 Cost estimation

As shown in the bottom of **Table 38.2.1**, total cost of Short Term Project (2010) is estimated to be 149 million USD, including 10% of Contingency, 7% of Engineering Service Cost, Survey and Analysis Cost, and 5% of Value Added Tax.

Table 38.2.1 Summary of Cost Estimate for Short Term Project (2010)

Item	2010	
	Million US$	Share
A. Port	**46.8**	**39%**
1. Hanoi Port	8.0	7%
2. Khuyen Luong Port	8.9	7%
3. New North Port	10.8	9%
4. New East Port	19.1	16%
B. Channel Stabilization	**63.3**	**53%**
C. Navigation Channel	**9.8**	**8%**
D. Duong Bridge Improvement	**0.0**	**0%**
Direct Cost (A+B+C+D)	119.9	100%
Contingency (10% of Direct Cost)	12.0	
Engineering Service (7% of Direct Cost)	8.4	
Survey and Analysis	1.5	
VAT (5% of D.C+Cont.+Eng.+S.&A.)	7.1	
Ground Total	**148.9**	

Note) Excluding operation & maintenance costs Source) JICA Study Team

The above costs are estimated by means of Unit Rate Method as shown in **Table 38.2.3**. The bases of unit costs in the table are presented in **Table A38.2.1,2,3,** and **4**.

Some of the quantities, which were used for the cost estimation, contain a certain amount of allowance taking into consideration of the nature of the works, as shown in **Table 38.2.2**.

Table 38.2.2 Allowance Rate for Quantity

Quantity Item	Allowance Rate
Sand Filling Graded Rock Quarry Run Armour Stone	20% of calculated Volume
Geo-textile Sheet Scour protection Mat	10% of calculated Volume

Table 38.2.3 Cost Estimation Sheet (1)

Source) JICA Study Team

Short Term Project (2010)

Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
A. Port				**46,827**	
1. Hanoi Port				**8,034**	
(1) New Passenger Terminal				**2,722**	
1) Main Passenger Berth				**2,560**	
a) Pier	m	10,182	100.0	1,018	
b) Sheet Pile Wall	m	2,855	100.0	286	
c) Back Filling	m	546	100.0	55	
d) Slope Protection	m	1,601	100.0	160	
e) Pontoon	unit	520,693	2.0	1,041	
2) Passenger House	m^2	120	1,000.0	**120**	
3) Utilities	set	41,937	1.0	**42**	Fence, Lighting, etc.
(2) New Cargo Terminal				**2,703**	
1) Cargo handling equipment				**2,703**	
a) Quay-side crane	unit	984,000	0	0	30t
b) Quay-side crane	unit	380,000	5	1,900	8t
c) Grab Bucket	unit	17,000	3	51	
d) Forklift	unit	380,000	0	0	37t
e) Forklift	unit	20,000	6	120	3t
f) Shovel Loader	unit	47,000	2	94	
g) Bulldozer	unit	150,000	1	150	
h) Dump Truck	unit	50,000	5	250	
I) Truck	unit	30,000	4	120	
j) Tractor+Trailer	unit	76,000	0	0	
k) Pallet	unit	25	700	18	
(3) Bank Protection 7-2	m	1,392	800.0	**1,114**	
(4) Road Elevation Improvement	ha	250,000	2.6	**650**	Asphalt Pavement
(5) New Satellite Passenger Berth	m	10,000	80.0	**800**	20m x 4 locations
(6) Management Information System	set	45,000	1.0	**45**	
2. Khuyen Luong Port				**8,886**	
(1) New Cargo Terminal				**7,621**	
1) Cargo Berth				**2,834**	
a) Pier	m	13,183	160.0	2,109	
b) Sheet Pile Wall	m	2,872	160.0	460	
c) Back Filling	m	425	160.0	68	
d) Slope Protection	m	1,234	160.0	197	
2) Cargo Terminal				**1,490**	
a) Revetment	m	151	400.0	60	
b) Land Reclamation	m^3	2	63,000.0	126	
c) Storage Yard	ha	250,000	1.5	375	Asphalt Pavement
d) Warehouse	ha	1,200,000	0.43	516	
e) Utilities	set	82,600	1.0	83	
f) Terminal Pavement	ha	150,000	2.2	330	Asphalt Pavement

Table 38.2.3 Cost Estimation Sheet (2)

Short Term Project (2010) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
3) Cargo handling equipment				**3,297**	
a) Quay-side crane	unit	984,000	0	0	30t
b) Quay-side crane	unit	380,000	6	2,280	8t
c) Grab Bucket	unit	17,000	4	68	
d) Forklift	unit	380,000	0	0	37t
e) Forklift	unit	20,000	6	120	3t
f) Shovel Loader	unit	47,000	3	141	
g) Bulldozer	unit	150,000	1	150	
h) Dump Truck	unit	50,000	8	400	
I) Truck	unit	30,000	4	120	
j) Tractor+Trailer	unit	76,000	0	0	
k) Pallet	unit	25	700	18	
(2) Access Road				**1,220**	
1) 2 lanes	m	642	1,900.0	1,220	
2) 3 lanes	m	797	0.0	0	
(3) Management Information System	set	45,000	1.0	**45**	
3. New North Port				**10,801**	
(1) New Cargo Terminal				**8,959**	
1) Cargo Berth				**4,781**	
a) Pier	m	12,837	280.0	3,594	
b) Sheet Pile Wall	m	2,872	280.0	804	
c) Back Filling	m	226	280.0	63	
d) Slope Protection	m	1,142	280.0	320	
2) Cargo Terminal				**1,222**	
a) Revetment	m	151	300.0	45	
b) Land Reclamation	m^3	2	96,600.0	193	
c) Storage Yard	ha	250,000	1.5	375	Asphalt Pavement
d) Warehouse	ha	1,200,000	0.21	252	
e) Utilities	set	72,200	1.0	72	
f) Terminal Pavement	ha	150,000	1.9	285	Asphalt Pavement
3) Cargo handling equipment				**2,956**	
a) Quay-side crane	unit	984,000	0	0	30t
b) Quay-side crane	unit	380,000	5	1,900	8t
c) Grab Bucket	unit	17,000	5	85	
d) Forklift	unit	380,000	0	0	37t
e) Forklift	unit	20,000	3	60	3t
f) Shovel Loader	unit	47,000	3	141	
g) Bulldozer	unit	150,000	2	300	
h) Dump Truck	unit	50,000	8	400	
I) Truck	unit	30,000	2	60	
j) Tractor+Trailer	unit	76,000	0	0	
k) Pallet	unit	25	400	10	
(2) Access Road				**1,477**	
1) 2 lanes	m	642	2,300.0	1,477	
2) 3 lanes	m	797	0.0	0	
(3) Management Information System	set	45,000	1.0	**45**	
(4) Capital Dredging	m^3	2	160,000.0	**320**	Basin

Source) JICA Study Team

Table 38.2.3 Cost Estimation Sheet (3)

Short Term Project (2010) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
4. New East Port				**19,106**	
(1) New Cargo Terminal				**18,084**	
1) Cargo Berth				**5,870**	
a) Pier	m	12,867	360.0	4,632	
b) Sheet Pile Wall	m	2,399	360.0	864	
c) Back Filling	m	123	360.0	44	
d) Slope Protection	m	918	360.0	330	
2) Cargo Terminal				**6,936**	
a) Revetment	m	151	700.0	106	
b) Land Reclamation	m^3	2	341,000.0	682	
c) Storage Yard	ha	250,000	0.7	175	Asphalt Pavement
d) Warehouse	ha	1,200,000	1.06	1,272	
e) Distribution Center / CFS	ha	1,300,000	3.20	4,160	
f) Utilities	set	151,200	1.0	151	
g) Terminal Pavement	ha	150,000	2.6	390	Asphalt Pavement
3) Cargo handling equipment				**5,278**	
a) Quay-side crane	unit	984,000	1	984	30t
b) Quay-side crane	unit	380,000	6	2,280	8t
c) Grab Bucket	unit	17,000	2	34	
d) Forklift	unit	380,000	2	760	37t
e) Forklift	unit	20,000	15	300	3t
f) Shovel Loader	unit	47,000	1	47	
g) Bulldozer	unit	150,000	1	150	
h) Dump Truck	unit	50,000	3	150	
I) Truck	unit	30,000	10	300	
j) Tractor+Trailer	unit	76,000	3	228	
k) Pallet	unit	25	1,800	45	
(2) Access Road				**977**	
1) 2 lanes	m	642	900.0	578	
2) 3 lanes	m	797	500.0	399	
(3) Management Information System	set	45,000	1.0	**45**	
B. Channel Stabilization				**63,251**	
(1) Groin				**5,614**	
1) Groin 1	m	2,794	1,500	4,191	
2) Groin 2	m	2,372	600	1,423	
3) Groin 3	m	1,800	0	0	
(2) Training Wall				**32,528**	
1) Training Wall 1	m	3,000	4,300	12,900	
2) Training Wall 2-1	m	2,816	4,500	12,672	
3) Training Wall 2-2	m	4,016	1,000	4,016	
4) Earth Work	m^3	3	980,000	2,940	$100m^3$ / m

Source) JICA Study Team

Short Term Project (2010) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	**Unit**	**Unit Cost (USD)**	**Quantity**	**Cost (Thou. USD)**	**Remarks**
(3) Bank Protection				**23,267**	
1) Bank Protection 1	m	2,300	0	0	
2) Bank Protection 2	m	1,349	800	1,079	
3) Bank Protection 3	m	1,349	500	675	
4) Bank Protection 4	m	2,000	0	0	
5) Bank Protection 5	m	1,992	1,000	1,992	
6) Bank Protection 6	m	3,034	4,500	13,653	
7) Bank Protection 7-1	m	3,082	1,500	4,623	
8) Bank Protection 8	m	2,000	0	0	
9) Earth Work	m^3	3	415,000	1,245	$50m^3$ / m
(4) Structural Maintenance	set	1,842	1.0	1,842	3% of (1),(2),(3)
C. Navigation Channel				**9,810**	
(1) Capital Dredging	m^3	2	3,500,000.0	7,000	
(2) Main Navigation Aids	set	976,000	1.0	976	
(3) Management Equipment	set	770,000	1.0	770	
(4) Information Service System				**1,064**	
1) Observation Equipment	set	487,000	1.0	487	
2) Information Service Center	set	577,000	1.0	577	
Direct Cost	A+B+C			119,888	
Contingency	10% of Total			11,989	
Engineering Service	7% of Total			8,392	
Survey and Analysis				1,500	
VAT	5% of (D+C+E+S)			7,088	
Grand-total	D + C + E + S + V			**148,900**	

Table 38.2.3 Cost Estimation Sheet (4)

Source) JICA Study Team

38.3 Construction schedule

Aiming at commencement of the port operation in the planned ports at the beginning of 2010, a construction schedule is presented as shown in **Figure 38.3.1**.

As indicated in the figure, the regular flood season in the Study Area (from July to September) is disregarded from the construction period.

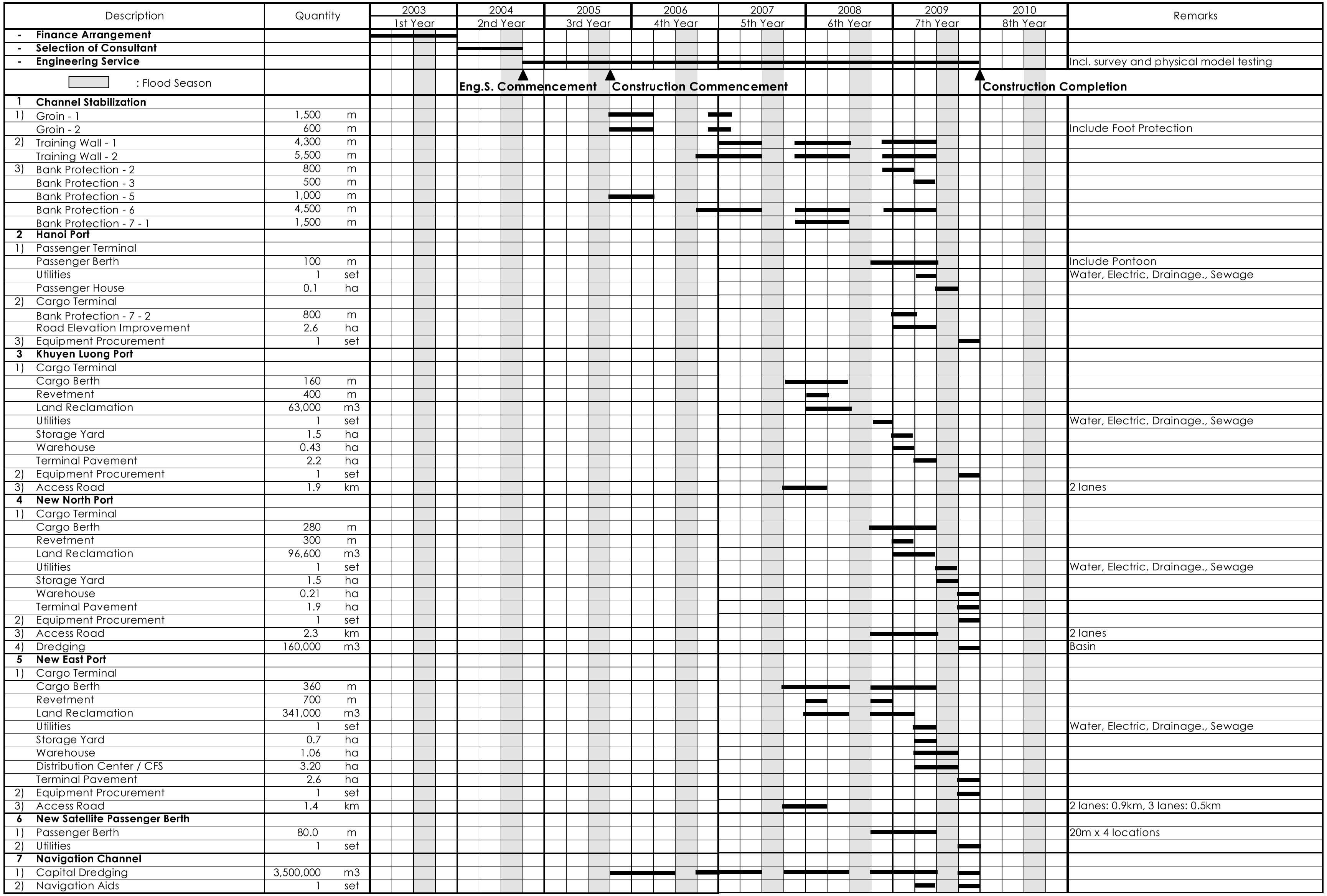
In the schedule, basically, constructions of the ports facilities start following the ones for the channel stabilization in order to avoid excessive change in water current and morphology of riverbed around the port facilities.

The surveys and analysis are necessary during the implementation of the Project include bathymetric, topographic, hydrographic, and geographical surveys. At the early stage, in-depth numerical simulations and hydrographic model tests are prerequisite with movable bed. These items are listed up in **Table 38.3.1**.

Table 38.3.1 Necessary Surveys and Analysis during Implementation Stage

Item	Place / Area	Frequency
1. Surveys		
(1) Bathymetric survey	All the segment	Once a year
(2) Cross-sectional survey	Fixed 20 sections	Twice a year
(3) Topographic survey	Flood plain and some bars	Once a year
(4) Hydrographic survey	Fixed 20 sections	Twice a year
1) Current		
2) Suspended solid		
(5) Geotechnical survey	Planned ports, location of channel stabilization facilities, and channel to be dredged	Once in the Project
1) Soil boring		
2) Laboratory tests		
2. Analysis		
(1) Morphological analysis	All the plain and cross-sections	Twice a year
(2) Numerical simulations	All the segment	4 times during the Project
1) Current		
2) Riverbed variation		
(3) Hydraulic model tests	Upper half of the segment	Twice during the project
1) Current		
2) Riverbed variation		
3. Environmental Monitoring		
(1) Air quality, noise, vibration	Planned ports	Once 3 months
(2) Water quality	Dredging site	When dredging work is done

Source) JICA Study Team



Description		Quantity		Remarks
-	**Finance Arrangement**			
-	**Selection of Consultant**			
-	**Engineering Service**			Incl. survey and physical model testing
▭	: Flood Season			
1	**Channel Stabilization**			
1)	Groin - 1	1,500	m	
	Groin - 2	600	m	Include Foot Protection
2)	Training Wall - 1	4,300	m	
	Training Wall - 2	5,500	m	
3)	Bank Protection - 2	800	m	
	Bank Protection - 3	500	m	
	Bank Protection - 5	1,000	m	
	Bank Protection - 6	4,500	m	
	Bank Protection - 7 - 1	1,500	m	
2	**Hanoi Port**			
1)	Passenger Terminal			
	Passenger Berth	100	m	Include Pontoon
	Utilities	1	set	Water, Electric, Drainage., Sewage
	Passenger House	0.1	ha	
2)	Cargo Terminal			
	Bank Protection - 7 - 2	800	m	
	Road Elevation Improvement	2.6	ha	
3)	Equipment Procurement	1	set	
3	**Khuyen Luong Port**			
1)	Cargo Terminal			
	Cargo Berth	160	m	
	Revetment	400	m	
	Land Reclamation	63,000	m3	
	Utilities	1	set	Water, Electric, Drainage., Sewage
	Storage Yard	1.5	ha	
	Warehouse	0.43	ha	
	Terminal Pavement	2.2	ha	
2)	Equipment Procurement	1	set	
3)	Access Road	1.9	km	2 lanes
4	**New North Port**			
1)	Cargo Terminal			
	Cargo Berth	280	m	
	Revetment	300	m	
	Land Reclamation	96,600	m3	
	Utilities	1	set	Water, Electric, Drainage., Sewage
	Storage Yard	1.5	ha	
	Warehouse	0.21	ha	
	Terminal Pavement	1.9	ha	
2)	Equipment Procurement	1	set	
3)	Access Road	2.3	km	2 lanes
4)	Dredging	160,000	m3	Basin
5	**New East Port**			
1)	Cargo Terminal			
	Cargo Berth	360	m	
	Revetment	700	m	
	Land Reclamation	341,000	m3	
	Utilities	1	set	Water, Electric, Drainage., Sewage
	Storage Yard	0.7	ha	
	Warehouse	1.06	ha	
	Distribution Center / CFS	3.20	ha	
	Terminal Pavement	2.6	ha	
2)	Equipment Procurement	1	set	
3)	Access Road	1.4	km	2 lanes: 0.9km, 3 lanes: 0.5km
6	**New Satellite Passenger Berth**			
1)	Passenger Berth	80.0	m	20m x 4 locations
2)	Utilities	1	set	
7	**Navigation Channel**			
1)	Capital Dredging	3,500,000	m3	
2)	Navigation Aids	1	set	

Figure 38.3.1 Construction Schedule for Short Term Project (2010)

38.4 Foreign / local currency portions of project cost and investment schedule

Based on the above construction schedule, required project costs by currency in each year are summarized in **Table 38.4.2**.

As shown in the table, the foreign currency portion (including latent foreign currency cost) shares 66% of the total project cost in this project.

For the estimation of figures in the table, the currency-wise ratios of major construction works and materials are set as shown in the **Table 38.4.1**, taking account of availability of construction recourses in Vietnam.

Table 38.4.1 Currency-wise Ratios of Major Construction Items

Item	Local (%)	Foreign (%)	Remarks
Excavation	20	80	
Dredging	20	80	
Asphalt Pavement	40	60	Incl. Base
RC Concrete	50	50	Incl. Casting, Form
Steel Sheet Pile	10	90	Incl. Driving
Fender	10	90	Incl. Setting
Stone	70	30	Incl. Place, Trimming
Geo Textile Sheet	20	80	Incl. Placing
Equipment	2	98	
Engineering Service	20	80	

Source) JICA Study Team

Table 38.4.2 Investment Schedule by Currency

Unit: Local - Billion VND, Foreign – Million USD

Currency	2004 2nd Year	2005 3rd Year	2006 4th Year	2007 5th Year	2008 6th Year	2009 7th Year	**Total**
Local	5.0	31.6	88.7	158.8	198.8	284.7	**767.6 (34%)**
Foreign	1.3	3.6	8.6	16.0	23.4	44.6	**97.5 (66%)**

Source) JICA Study Team

The detail calculation sheet for each project item in each year is attached as **Table A38.4.1**.

38.5 Recommendations

The engineering studies were conducted based on the available data, both existing and investigated ones by the Study Team, at the moment. Considering flow condition in the river as well as economic circumstances in Vietnam, which change from time to time, following conditions should be reviewed in the Detailed Design Stage of the structures.

- Topography and Bathymetry around the structures should be surveyed to scrutinize design condition of flood plane, riverbank, and riverbed. Tendency of their changes should be evaluated carefully, especially in the construction sites which were pointed out that erosion and accumulation are likely to occur in the channel stabilization analysis. The changes of the profiles will greatly affect on the arraignment of facilities, type of structures, and construction costs.
- Soil conditions around the structures, especially of channel stabilization facilities, should be surveyed more in detail. The driving depth of piles of structures should be adjusted to the actual undulation of bearing stratum or probable depth of erosion.
- Considering recent tendency of deviation of mainstream, construction of channel stabilization structures, especially Groin-1 & 2, should be started as soon as possible in order to avoid additional construction periods and costs.
- Basically, construction of the proposed channel stabilizing facilities will induce changes in river flow character considerably. In order to avoid adverse effects of the channel stabilization facilities to the other facilities, construction works of port-related structures should be planned to start after channel stabilization structures and realization of the stable riverbed.
- Due to high water level during the flood season, the construction schedule was planned in limited workable days excluding the flood season. Under this condition, the proposed construction schedule should understood to be quite tight, specifically that of pier structure in New North port and training walls. In case of the training walls, it is indispensable that provision of large amount of quarry should be enough and stable.
- The project costs estimated in the Study should be reviewed, reflecting the latest conditions, including costs of materials, manpower, equipment, etc. In consideration of these conditions, the structural type and its material should be reviewed appropriately.