Chapter 6 DESIGN

6.1 Road Design

6.1.1 Summary of Design

(1) Design Standard

Design conditions of each road is carried out based on the road classification type shown in contents 5.3.2 of Chapter 5.

(2) Future Traffic Volumes

Here shows the future traffic volumes for the study on pavement thickness. The 2035 traffic volume, after 15 years in service from the scheduled start 2020, is used for this study.

The details of the future traffic volume are mentioned in a separate chapter.

Table 6.1-1 2035 Traffic Volumes

Year	Nguyen Trai Bridge Avg. Daily Traffic (vehicles per day)								
	Bicycles	Automobiles	Cars	Microbuses	Motor Coaches	Single-unit Trucks	Combination Tracks (2-axis)	Combination Tracks (3-axis)	Trailers
2035	4,468	36,110	42,462	2,579	3,092	1,340	3,115	525	643

Year	The Northeast Section of Ring Road No. 3 Avg. Daily Traffic (vehicles per day)								
	Bicycles	Automobiles	Cars	Microbuses	Motor Coaches	Single-unit Trucks	Combination Tracks (2-axis)	Combination Tracks (3-axis)	Trailers
2035	658	13,308	8,254	579	1,125	99	1,460	398	1,211

Year	The North section of Ring Road No.3 (Include Vu Yen Bridge) Avg. Daily Traffic (vehicles per day)								
	Bicycles	Automobiles	Cars	Microbuses	Motor Coaches	Single-unit Trucks	Combination Tracks (2-axis)	Combination Tracks (3-axis)	Trailers
2035	945	12,936	6,468	599	1,162	96	1,403	382	1,164

In the view of safety, the values of the north east section are used for the study of Ring Road No.3's pavement thickness, most of which are larger than those of the north section.

(3) Restriction by the Site Condition and Terrain

- In the section crossing the existing roads, the main lines shall be the overpasses (No.1 IC, No.2 IC and No.3 IC).
- If there is long distance between the crossings above-mentioned, a box culvert (3.2m height and 4m width) shall be installed on the existing road for only motorbikes, bicycles and pedestrians crossing the RR3 (Box1, Box2).
- In the section passing over the river, the main lines shall be bridges (Ruot Lon Bridge and Vu Yen Bridge).
- Where the height of embankment is over 4m in the soft ground area of Vu Yen Island, the PVD technology shall be used.

(4) Crossing Facility

1) Road

- The existing Ring Road 3 (around No.0)
- The existing road (No4+90, No.1 IC) (No.55+0, No.2 IC) (No.81+0, BOX1)(NO.112+75, BOX2)
- VSIP planned road (around No.97+0, No.3 IC）
- The planned road L356 (around No.169+50, Vu Yen South IC）

2) River

- Ruot Lon River (No128+70, Ruot Lon Bridge)
- Vu Yen River (No159+20, Vu Yen Bridge)

3) Rail

No railway is crossing the roads.

(5) Typical Cross Section

The Typical cross section is shown in Figure 6.1-1.

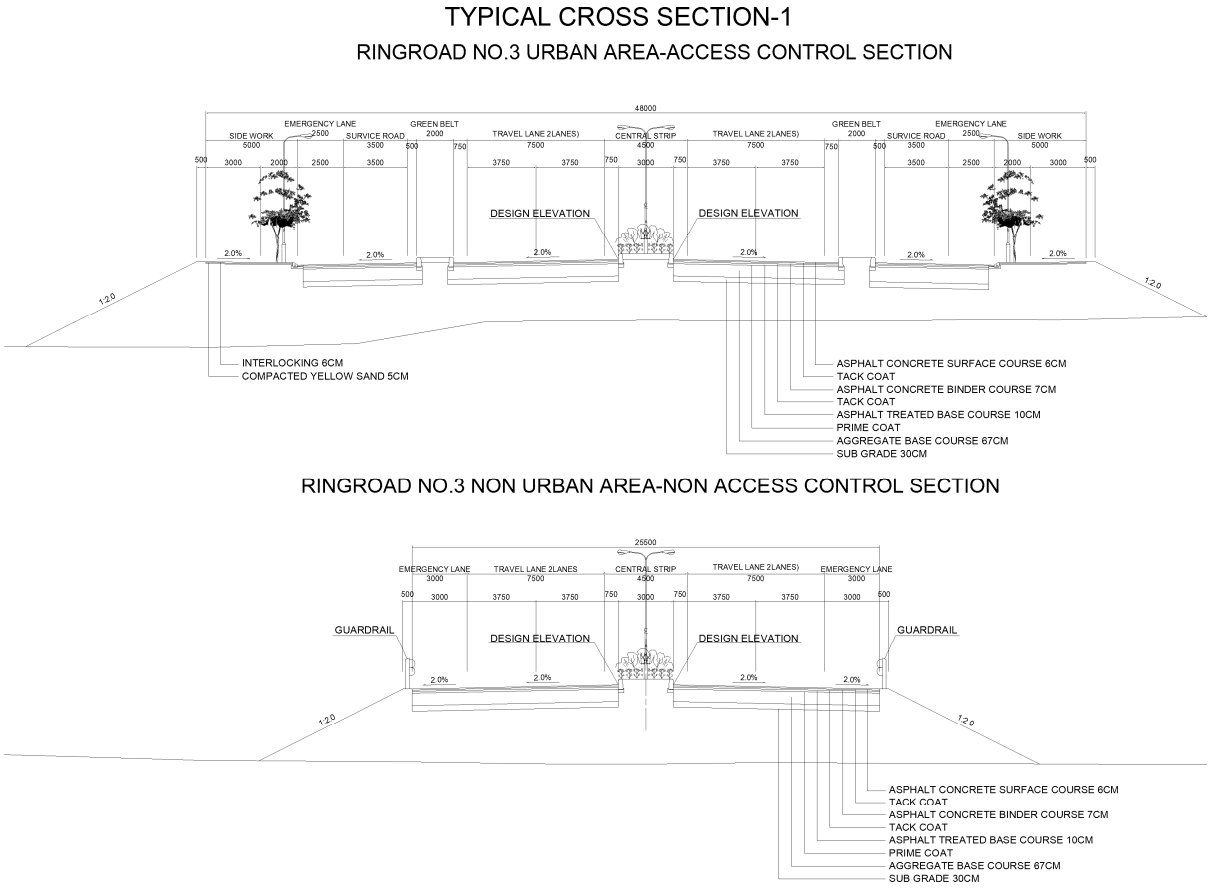


Figure 6.1-1 Standard Cross Section

(6) Geometric Design Standard

The geometric design standard is shown in Table 6.1-2 to 6.1-4.

Table 6.1-2 Geometric Design Standard of Interchange

(TCVN5729:2012, Ramp: V=40km/h)

		TCVN5729:2012 Expressway-Specifications for Design		
Road Type				
Design Speed of the Ramp	km	40		
				Ref.
Minimum Radius of Horizontal Curve	m	Standard	Exceptional	Table9
		60	45	
Minimum Parameter	m	35		Table10
Radius of No Need Transition Curve	m			
Lane-Carriageway Widening	m	1 lane	2 lanes	Table16
		Widening is necessary for R<72.	Widening is necessary for R<47.	
Maximum Superelevation	%	%		Table11
Superelevation	%	R(m)	%	Table13
		45～70	8	
		70～90	7～8	
		90～130	6～7	
		130～160	5～6	
		160～210	4～5	
		210～280	4	
		280～400	3	
		400～	2	
Radius of Superelevation Discontinuation	m	600		
Rate of Superelevation Transition		1 lane, lateral border	1 lane, center	Table14
		1/100	1/150	
		2 lanes, lateral border	2lanes, center	
		1/100	1/150	
Minimum Rate of Superelevation Transition		1 lane, lateral border	1 lane, center	Table15
		1/500	1/800	
		2lanes, center lateral border	2lanes, center	
		1/300	1/500	
Maximum longitudinal slope	%	6.0%		Table11
Minimum Radius of Vertical Curvature 凸	m	900	450	Table12
Minimum Radius of Vertical Curvature 凹	m	900	450	
Minimum Length of Vertical Curvature	m	40	35	
Combined Gradient	%			
Sight Distance	m	45		Table17

Table 6.1-3 Geometric Design Standard of Acceleration Lane

(TCVN5729:2012, Main Line: V=80km/h)

			TCVN 5792:2012 Expressway-Specifications for Design				
Road Type							
Design Speed of Main Line		km	80 (60)*				
							Ref
Taper Length		m	50 (40)				Table 18
Acceleration Lane Length	1 Lane Ramp	m	160 (120)				Table 21
	1 Lane Ramp		220 (160)				
Gradient Correction	Average Gradient of Main Line	%	0<i≦2	2<i≦3	3<i≦4	4<i≦6	
Correction factor of Upgrade Acceleration Lane Length			1.00	1.20	1.30	1.40	
Deceleration Lane Length	1 Lane Ramp	m	80 (70)				
	1 Lane Ramp		110 (90)				
Gradient Correction	Average Gradient of Main Line	%	0<i≦2	2<i≦3	3<i≦4	4<i≦6	
Correction factor of Upgrade Acceleration Lane Length			1.00	1.10	1.20	1.30	

*Note: 60km/h is applied for Nguyen Trai South IC as an exception.

Table 6.1-4 Geometric Design Standard of Main Line around Ramp Terminal
(TCVN5729:2012, Main Line: V=80km/h)

			TCVN5729:2012 Expressway-Specifications for Design		
Road Type					
Design Speed of the Main Line		km	80		
					Ref.
Minimum Radius of Horizontal Curve		m	Standard	Exceptional	Table7
			1100	700	
Maximum Longitudinal Slope		%	3.0	4.0	
Minimum Radius of Vertical Curvature	凸	m	12000	6000	
	凹		8000	4000	

(7) Earthwork Planning

By the study of section 6.1.6 “Soft ground treatment”, fill slope gradient shall be 1:2.0.

(8) Interchange Design

A full three-dimensional interchange shall be provided in the vicinity of No.169+50, where the designed road crosses with the main planned road L356.

6.1.2 Design of Ring Road No.3

(1) Horizontal Alignment

1) Elements of Horizontal Alignment

- The radius of horizontal curve shall be as much as possible more than R = 2500, the radius of superelevation discontinuation.
- If there is a restriction on the terrain, the minimum radius of horizontal curve shall be the standard value, R = 400 or more.
- In the vicinity of the interchange, the radius of horizontal curve shall be the standard value, R = 1100 or more.

2) Control Points on Horizontal Alignment

The each control points on the horizontal alignment are shown in Figure 6.1-2.

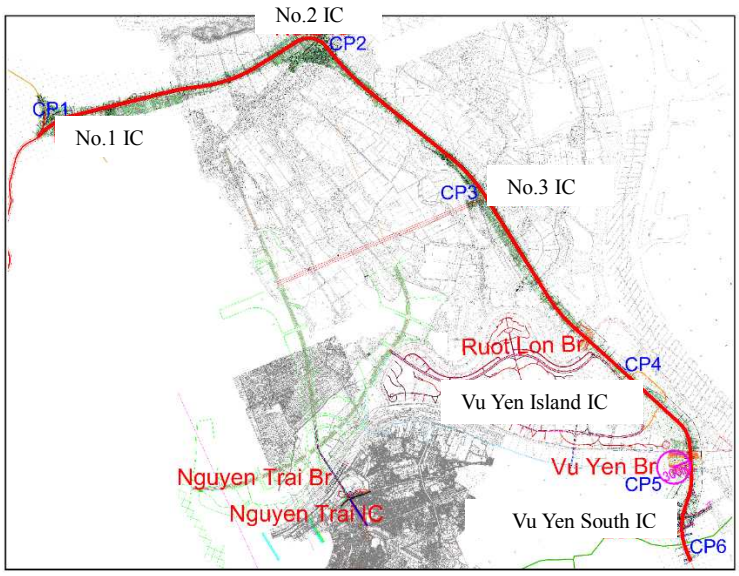


Figure 6.1-2 Control Points on Horizontal Alignment

Overall CP: Rivers and the power line towers in each location.

CP 1: Consistency with the existing Ring Road in the vicinity of the starting point No.0.

CP 2: In the vicinity of the No.57, the village boundary that this line passes through. JICA study team discussed with local community peoples and decided the position of alignment.

CP 3: Alignment with VSIP planned road in the vicinity of the No.97.

CP 4: The road alignment should be positioned abreast of the high power electrical line to avoid interference in Vu Yen Island.

CP 5: In the vicinity of No.160, linear to secure a distance of more than 300m from oil facilities.

CP 6: At the end part on the Vu Yen Island south, linear to reduce the influence on the planned road.

(2) Vertical Alignments

1) Elements of Vertical Alignment

- The planned height of the RR3 main line shall not be less than PH = 3.14m (5.0m from Marine level), which is separately determined.
- Maximum longitudinal slope shall be i= 4%, in consideration of the large trailer's climbing ability.
- The maximum section length of longitudinal slope i = 4%, shall be less than L = 900m by the criteria. The longitudinal slope of the subsequent sections shall not exceed i = 2.5% by the criteria.
- The minimum section length of the same longitudinal gradient shall not be less than L = 150m by the criteria.
- The minimum longitudinal gradient shall not be less than the standard value i = 0.5% by the criteria.

2) Control Points on Vertical Alignment

- In each of the bridges on land, the clearance value shall be more than the total value of PH = 3.14m + the clearance limit 4.75m + the structure height + the height down by crossfall.
- The planned heights of the river bridges shall be determined by the navigation vertical clearance and the structure height.
- For protecting the road structure from flooding in Vu Yen Island, the lowest planned height of the road shall be 4.2m.
- The north end of Nguyen Trai Bridge shall be the same height of VSIP road, PH = 2.34m (4.2m from marine level).
- The transition section shall be provided from the south end of Nguyen Trai Bridge to the existing road level.

The main control points on the horizontal alignment of RR3 are shown below.

CP 1: In the vicinity of the No.4+90, the route shall overpass the existing road (No.1 Inter section).

CP 2: In the vicinity of NO.55+00, the route shall overpass the existing road (No.2 Inter section).

CP 3: In the vicinity of the No.81, a box culvert shall be installed for crossing the existing road (No.1 Box).

CP 4: In the vicinity of the No.97+00, the route shall overpass VSIP planned road (No.3 Inter section).

CP 5: In the vicinity of the No.112+75, a box culvert shall be installed for crossing the existing road (No.2 Box).

CP 6: In the vicinity of No.128+70, a river bridge shall be built on Ruot Lon River in consideration

of the navigation vertical clearance (Ruot Lon Br.).

CP 7: In the vicinity of No.159+20, a river bridge shall be built on Vu Yen River in consideration of the navigation vertical clearance (Vu Yen Br.).

CP 8: In the vicinity of No.172+84, the planned street shall be moved to secure a distance to the clearance limit.

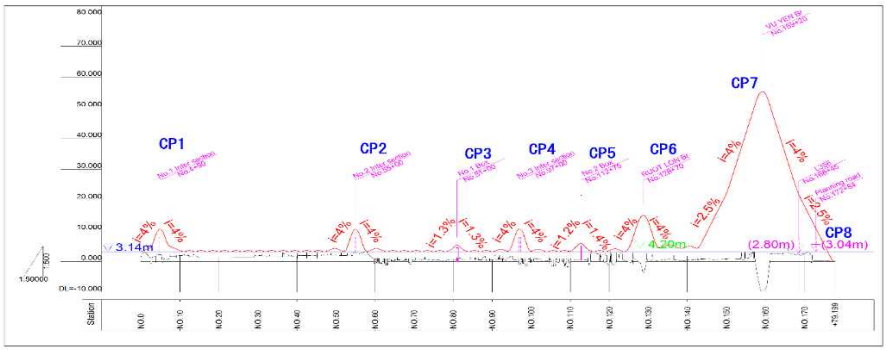


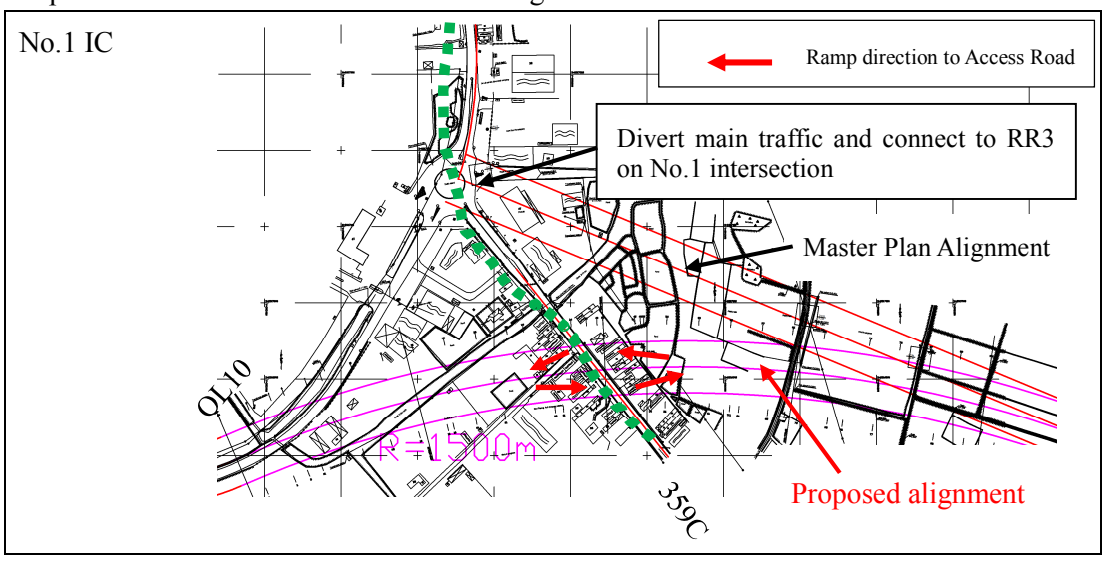
Figure 6.1-3 Control Points on Vertical Alignment

The road vertical alignment was safely and rationally designed on this project considering connection road. The vertical alignment plan should be arranged based on the letter issued by HPPI (No.: 162 CV/QH-KT2, 26th 11.2015) and discussion including plan of connection to existing road and box culvert with HPPC and related organization on Detailed Design stage.

(3) Intersection Design

1) Design of No.1 – No.3 IC

The plans of No.1 to No.3 IC are shown in Figure 6.1-4.



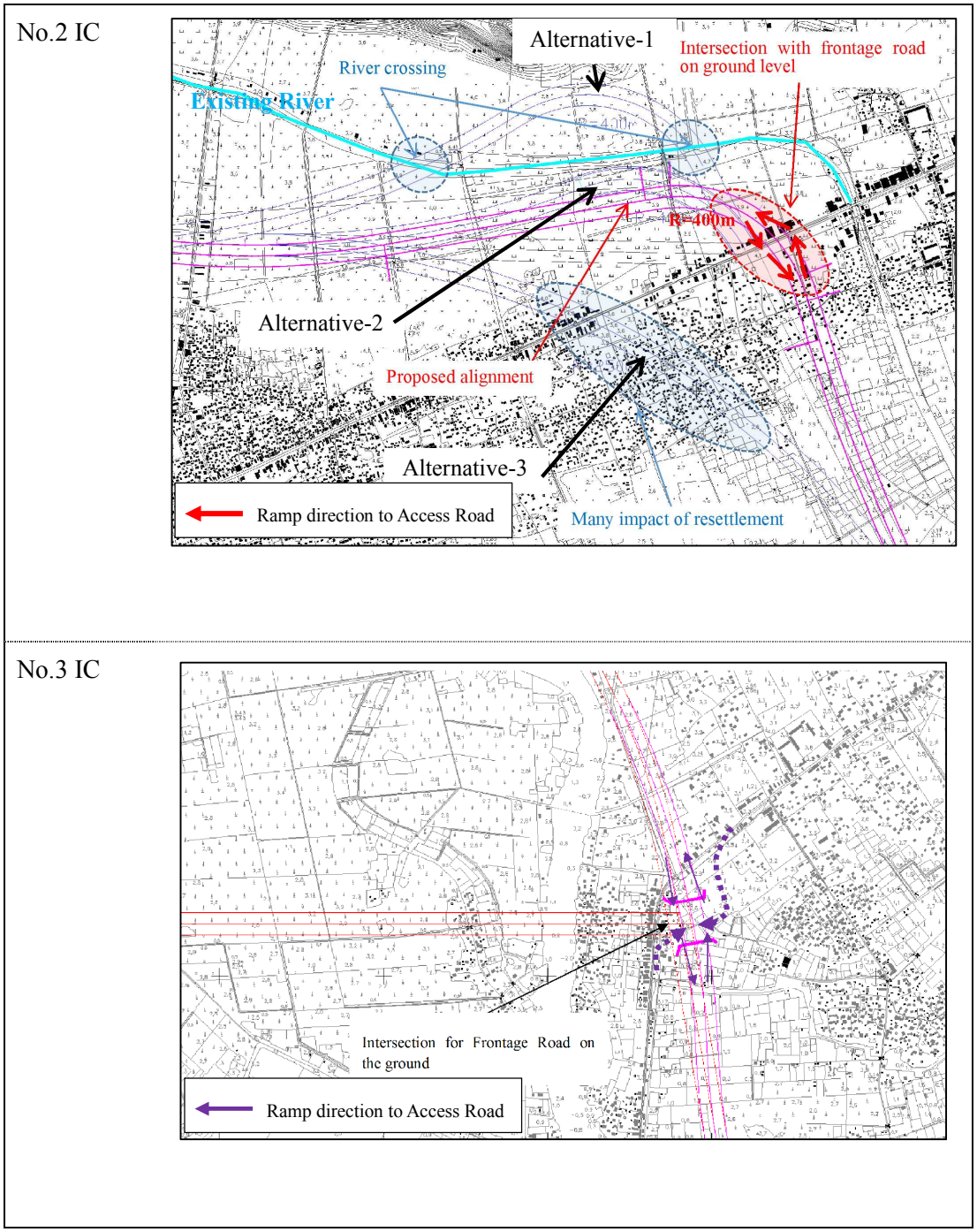


Figure 6.1-4 Plans of No.1- No.3 IC on RR3

2) Design of Vu Yen Island IC

In Vu Yen Island, omnidirectional IC shall be installed for connecting with the future planned road. It shall be built by "flat Y-type system" because the designed traffic volume is small. The acceleration and deceleration lane shall be provided in the earthwork section of the main line. East side lamp shall be built in the height of PH=4.2m under the Vu Yen Bridge.

The plan of Vu Yen Island IC is shown in Figure 6.1-5.

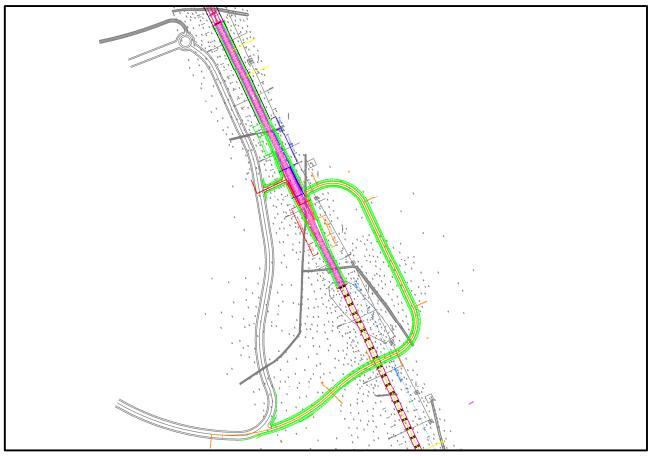


Figure 6.1-5 Plan of Vu Yen Island IC

3) Design of Vu Yen South IC (connect to L356)

In the south of Vu Yen Bridge, the four way IC shall be built for connecting to the road L356 (under construction). The longitudinal slope of the off ramp shall be i= 6% as well as the Master Plan. The longitudinal slope of the on ramp shall be restricted to i = 4%, in consideration of the large trailer's climbing ability.

This plan of Vu Yen South IC is compared with the Master Plan as shown in Figure 6.1-6.

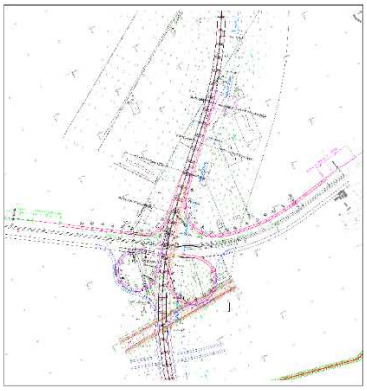
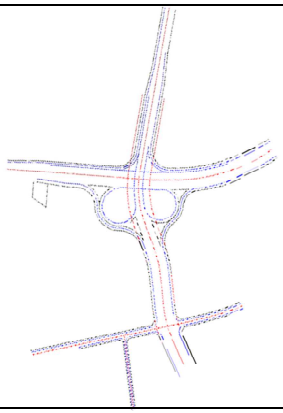
	
Jica Study Team	Master Plan of Hai Phong City
Off Ramp : R=60, i=6% On Ramp : R=70, 90, i=4%	Off Ramp : R=60, i=6% On Ramp : R=60, i=6%

Figure 6.1-6 Vu Yen South IC: Comparison with the Master Plan

6.1.3 Design of Nguyen Trai Road

(1) Nguyen Trai Road Widening

Two Nguyen Trai Road widening plans are shown in Figure 6.1-7 and 6.1-8. By conference with HPPC, the west side widening plan was adopted with less impact on the obstacles such as buildings.

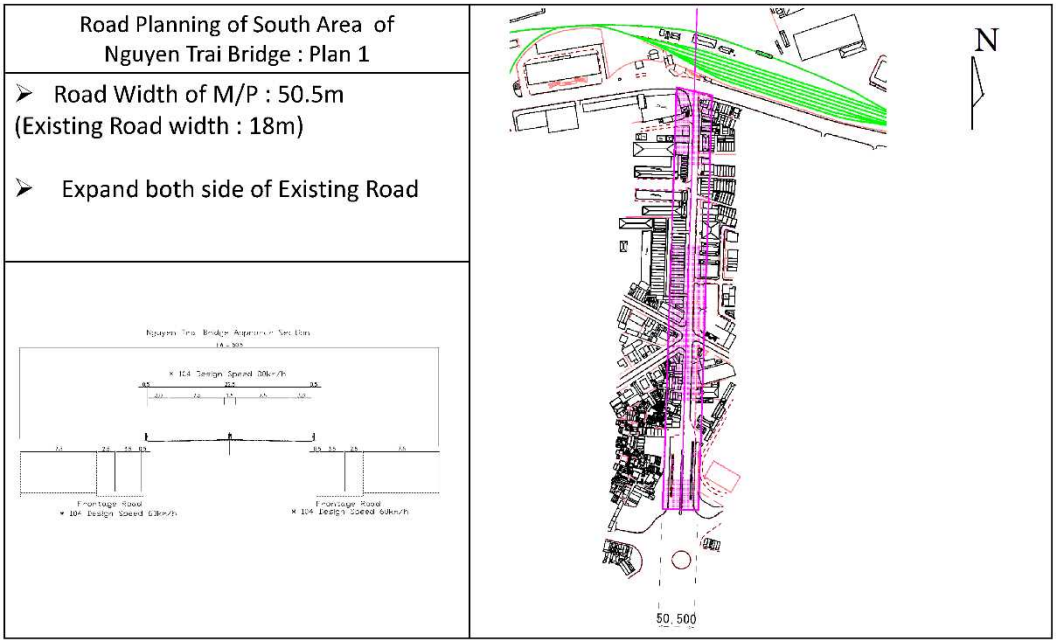


Figure 6.1-7 Both Sides of Nguyen Trai Road Widening Plan (W=50.5m)

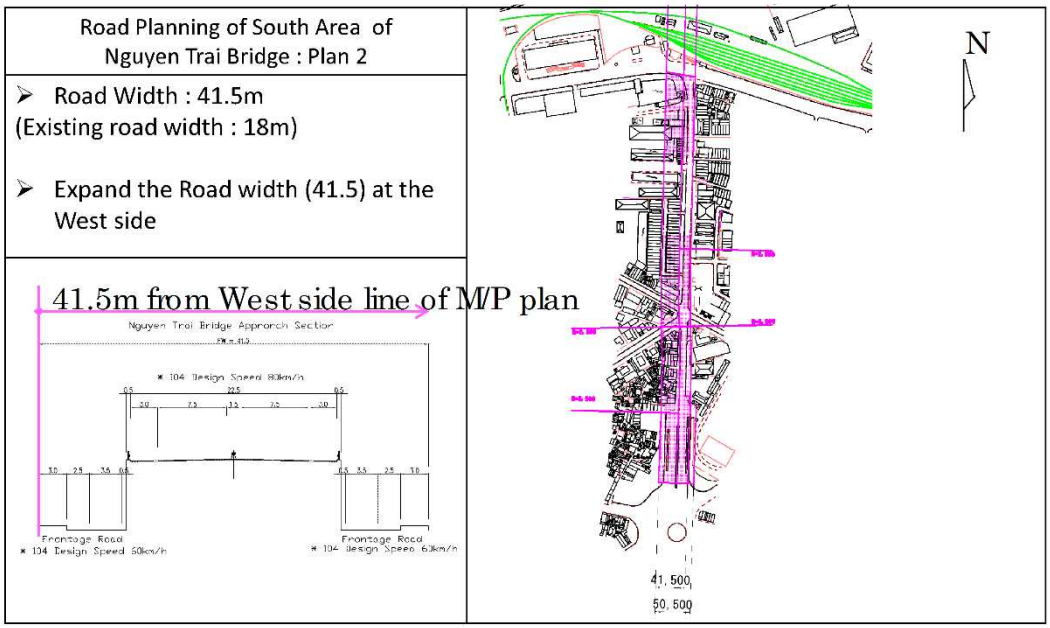


Figure 6.1-8 West Side of Nguyen Trai Road Widening Plan (W=41.5m)

(2) Northside Design of Nguyen Trai Bridge

- The starting point of the route shall be No.1+80.0 on the north side of Nguyen Trai Bridge.
- It is able to design VSIP planned road without changing the existing intersection plan.

The starting point plan on the northside of Nguyen Trai is shown in Figure 6.1-9.

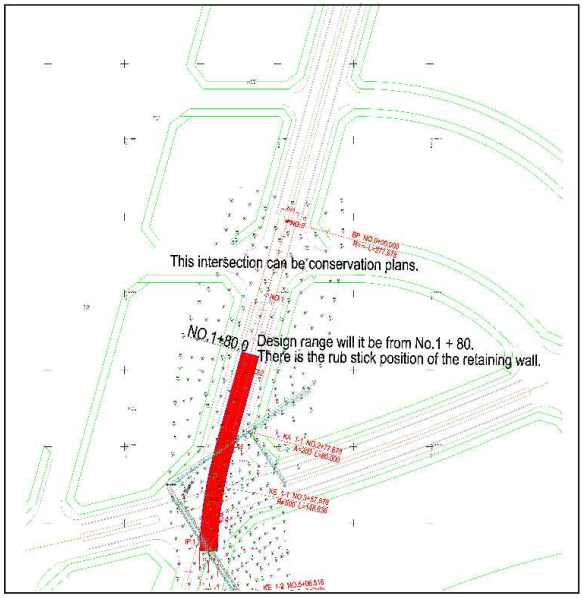


Figure 6.1-9 Starting Point Plan on the Northside of Nguyen Trai

- Passing position of the east-west highway in the most southern of VSIP moves in the vicinity of No4+55 to secure the clearance limit under Nguyen Trai Bridge.

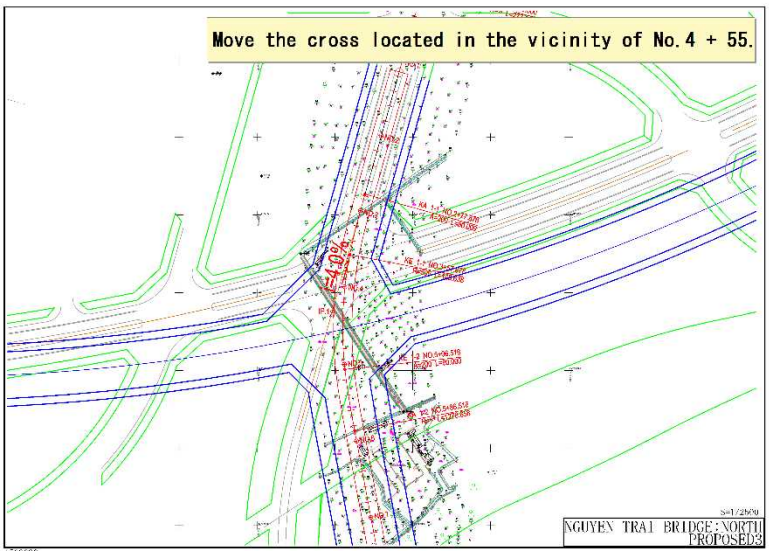


Figure 6.1-10 Movement Plan of VSIP East-West Highway

The longitudinal plan on the north side of Nguyen Trai is shown in Figure 6.1-11.

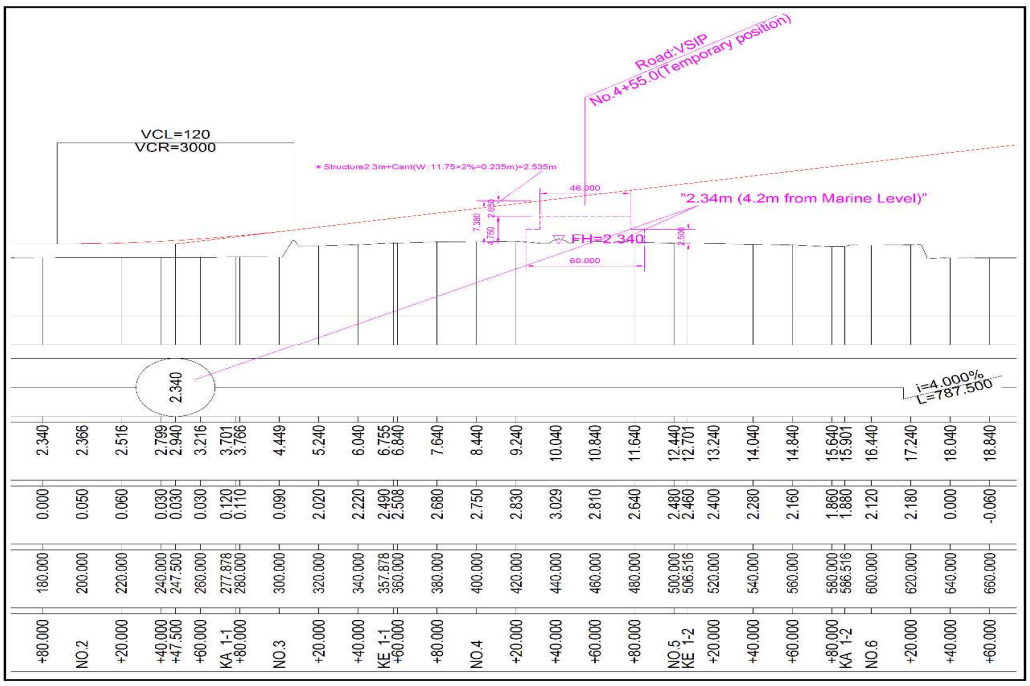


Figure 6.1-11 Longitudinal Plan on the Northside of Nguyen Trai

(3) Design of Nguyen Trai South IC

2) Study of alignment of ramp way

In the south of Nguyen Trai Bridge, the on ramp and the off ramp shall be set for the connection to Le Thanh Ton Street. Considering the traffic volume and the discussions with the related organizations, diverging/merging system, rather than intersection system, shall be adopted for making the inflow from the east to the street and the outflow from the street to the west.

In initial design, following to the precondition that railway will relocate based on masterplan, Road alignment which connects with Le Thanh Ton Street at the position near main route was designed as shown in Figure 6.1-12.

However, there was a change of precondition so that railway will not relocate in future, even if the port is relocated, at August 2016 after Pre-Final Report presentation. Therefore, the ramp way route was modified into which bypasses the railway area as Figure 6.1-14 on the condition that railway station and main route of railway area doesn't use.

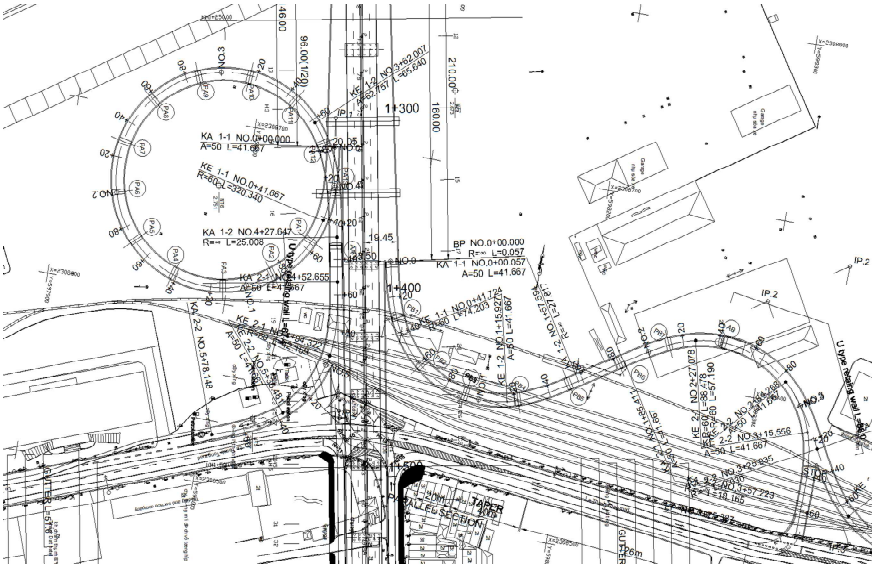


Figure 6.1-12 Nguyen Trai South IC, initial design

Modified alignment was decided from alternative plans of Figure 6.1-13, in consideration of the following point.

- The loop of on-lamp does not invade in the railway area. (Request from VNR)
- The design speed of Acceleration lane shall be 60 km/h that is the same as operation speed. Thereby, there is no widening into arch portion.
- Sidetrack of railway in west side of main route will relocate so that it cross by overpass.

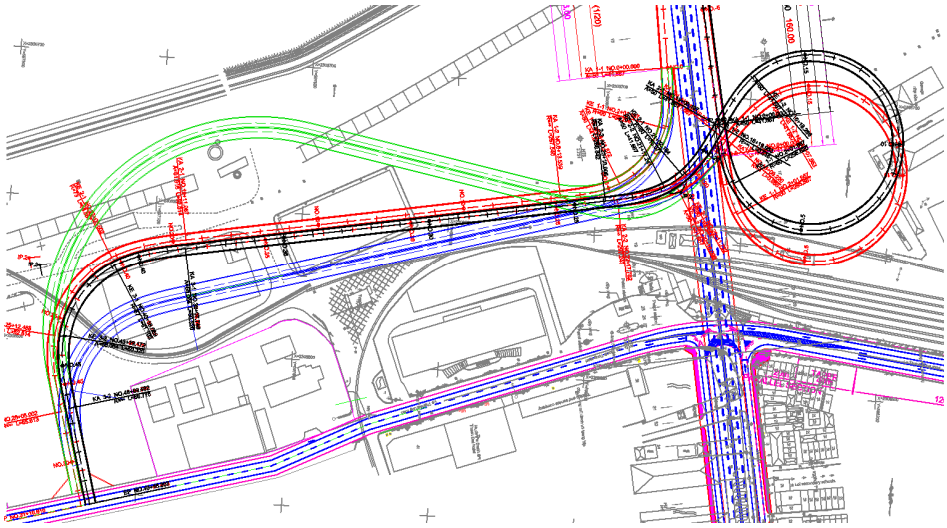


Figure 6.1-13 Nguyen Trai South IC, modified design (alternative)

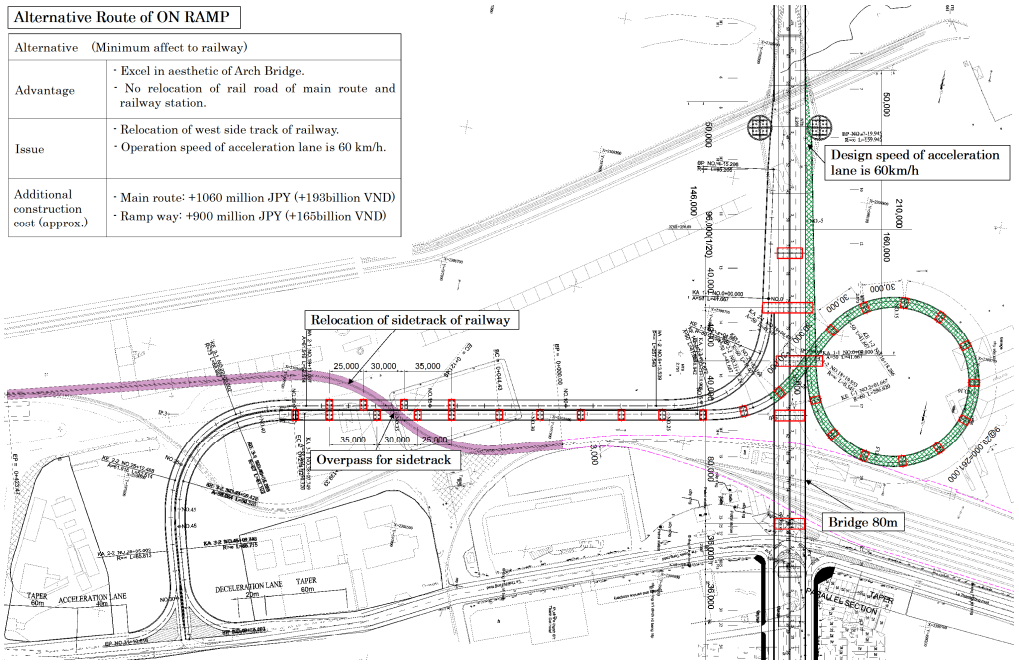


Figure 6.1-14 Nguyen Trai South IC, modified design (final alignment)

6.1.4 Pavement Design

By the assumed CBR value of the fill material and future traffic volume, the pavement thickness shall be set as shown below.

- RR3: assumed CBR value = 6, the total thickness 90cm

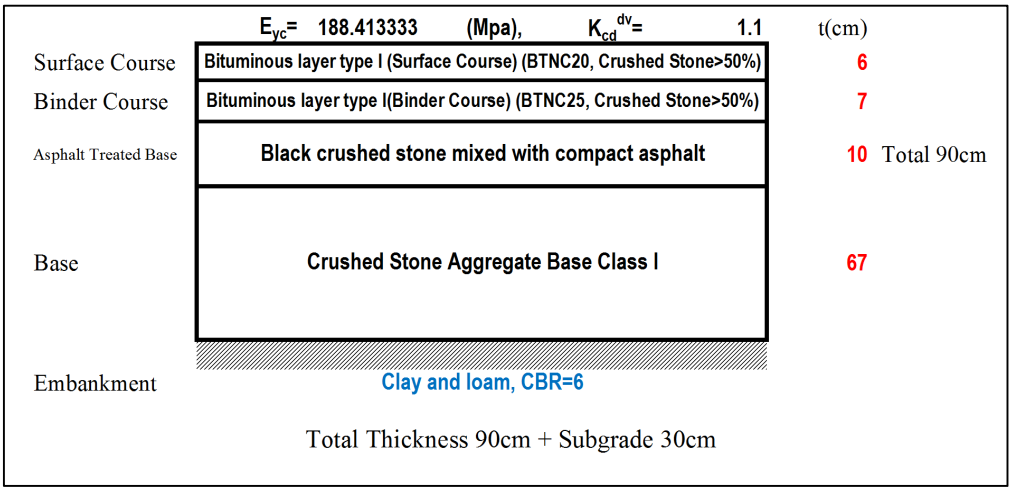


Figure 6.1-15 RR3 Thickness of Pavement

- Nguyen Trai Road: assumed CBR value = 8, the total thickness 91cm

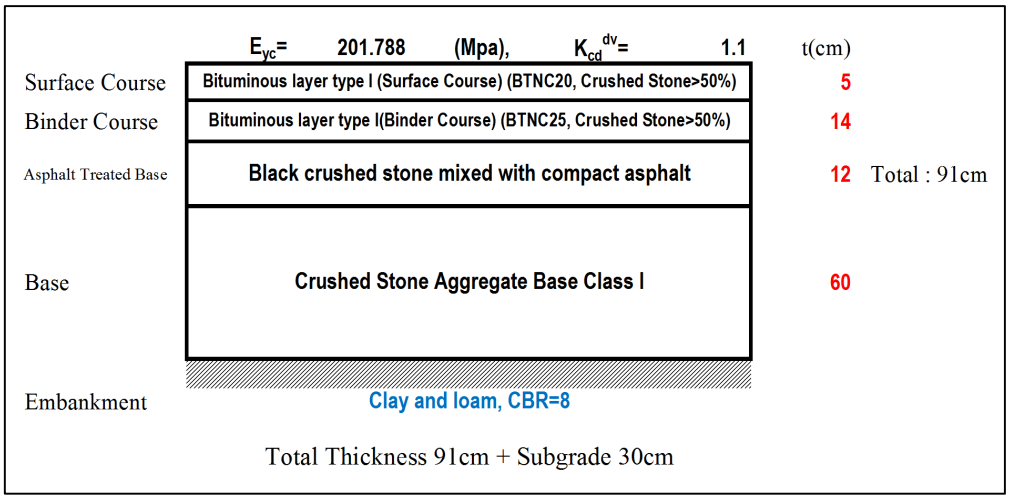


Figure 6.1-16 Nguyen Trai Road: Thickness of Pavement

6.1.5 Structure Design

The road structures, the retaining walls and the culverts shall be installed in this route.

- The L-shaped retaining walls shall be set for the bridge approach. The embedment of the retaining wall bottom slab shall be set 0.5m under the original ground that is normally the construction base. By the geological survey results, the lengths of piles shall be determined by the embedment made into a bearing layer at depth of 1m.
- The U-shaped retaining walls shall be set for the lamp of the bridge approach. The embedment of the retaining wall bottom and the lengths of piles shall be set in the same way as the L-shaped retaining walls.

The plan of the retaining walls is shown in Table 6.1-5.

Table 6.1-5 Schedule of Retaining Walls

	Place	Type	Width	Section			length	Location	Total length
							l*2		L
			m				m		m
1	No.1 IC A1 Side	L type retaing wall	26.5	No.2+30	-	No.3+10.35	80.35	Both sides	**80.35**
2	No.1 IC A2 Side	L type retaing wall	26.5	No.6+69.65	-	No.7+35	65.65	Both sides	**131.3**
3	No.2 IC A1 Side	L type retaing wall	26.5	No.52+00	-	No.53+60.35	160.35	Both sides	**320.7**
4	No.2 IC A2 Side	L type retaing wall	26.5	No.56+39.65	-	No.58+00	160.35	Both sides	**320.7**
5	No.3 IC A1 Side	L type retaing wall	26.5	No.94+00	-	No.95+40.35	140.35	Both sides	**280.7**
6	No.3 IC A2 Side	L type retaing wall	26.5	No.98+59.65	-	No.100+00	140.35	Both sides	**280.7**
7	Ruot Lon Bridge A1 Side	Embankment Construction	26.5						
8	Ruot Lon Bridge A2 Side	Embankment Construction	26.5						
9	Vu Yen Bridge A1 Side	Embankment Construction	23.5						
10	Vu Yen Bridge A2 Side	L type retaing wall	23.5	No.175+3.65	-	No.177+10	206.35	Both sides	**412.7**
11	Nguyen Trai Bridege A1 Side	L type retaing wall	23.5	No.1+80	-	No.3+35.35	155.35	Both sides	**310.7**
12	Nguyen Trai Bridege A2 Side	L type retaing wall	23.5	No.17+36.65	-	No.18+60	123.35	Both sides	**246.7**
13	Vu Yen South IC Ramp_A	U type retaing wall	7.5-8.0	No.2+34.394	-	No.3+30	95.61	-	**95.6**
14	Vu Yen South IC Ramp_B	U type retaing wall	7.5-8.0	No.2+94.830	-	No.3+61.972	67.14	-	**67.1**
15	Vu Yen South IC Ramp_C	U type retaing wall	7.5-8.0	No.4+94.000	-	No.6+15	121.00	-	**121.0**
16	Vu Yen South IC Ramp_D	U type retaing wall	7.5-8.0	No.2+93.294	-	No.4+10	116.71	-	**116.7**
17	Ngyen Trai South IC	U type retaing wall	15	No.40+6	-	No.49+9	183.00	-	**183.0**

	Maximum height	Minimum height	**Average height**	Pile			
	embedded depth=0.5m			**Average pile length**	Pile row	Pile column	**Number**
					R	C	R*L/C
	m	m	**m**	**m**	each	m	**each**
1	4.9	3.6					
2	5.9	4.5			2	2.5	**105**
3	5.6	1.6	**4.3**	**0.0**	2	2.5	**257**
4	5.2	0.5			2	2.5	**257**
5	6.2	2.7			2	2.5	**225**
6	8.7	3.2			2	2.5	**225**
7							
8							
9							
10	5.6	0.5	**3.1**	**0.0**	2	5.0	**165**
11	5.3	2.3	**3.4**	**0.0**	2	5.0	**124**
12	5.2	0.5			2	5.0	**99**
13	5.5	0.5			3	5.0	**57**
14	4.2	0.5			3	5.0	**40**
15	4.8	0.5	**2.9**	**0.0**	3	5.0	**73**
16	5.4	0.5			3	5.0	**70**
17	5.4	0.5			6	5.0	**220**

The general structural drawing of the retaining walls is shown in Figure 6.1-17.

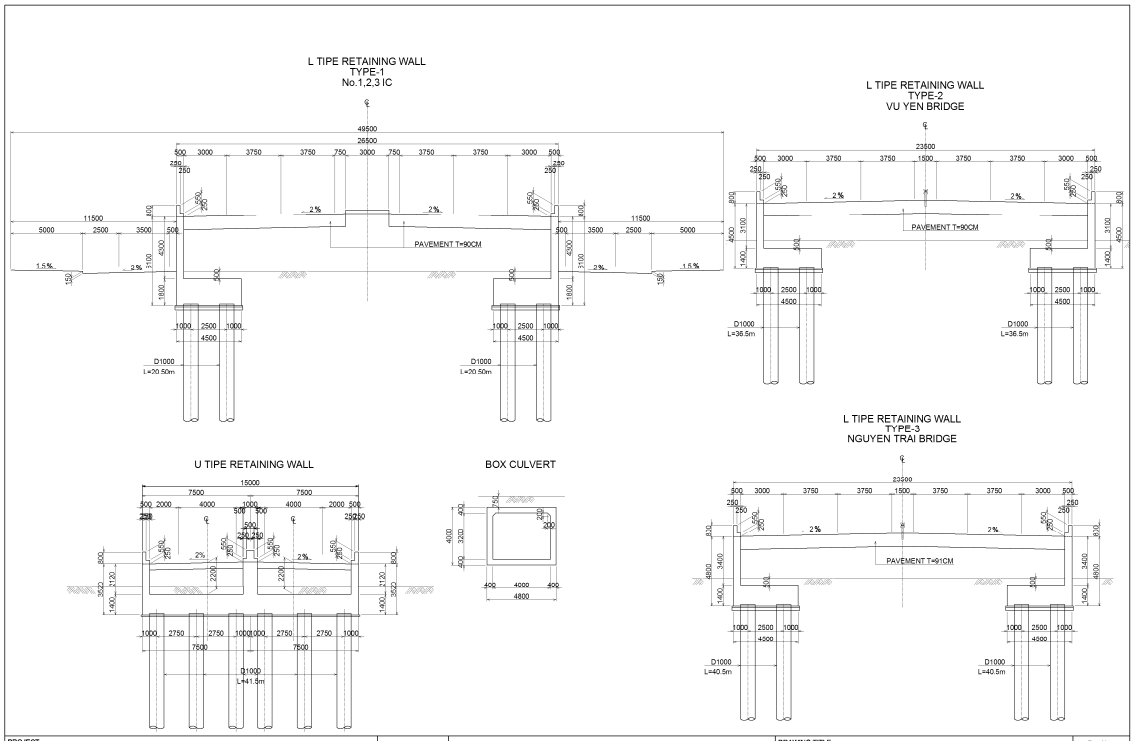


Figure 6.1-17 General Structural Drawing of Retaining Walls

Considering the convenience for cars, motorcycles and pedestrians to traffic, the culverts shall be 3.2m height and 4m width.

The plan of the culverts is shown in Table 6.1-6.

Table 6.1-6 Plan of Culverts

	Place	B - H - L
		m
1	No.81+00	4.0 - 3.2 - 26.5
2	No.122+75	4.0 - 3.2 - 26.5

6.1.6 Soft ground treatment

(1) Representative Sections for analysis

The representative sections for analysis are selected based on the height of embankment and results of geotechnical investigation.

Table 6.1-7 Sections for analysis

Section	Location	Height of embankment (m)	Borehole	Note
1	No 54 + 0.000	7.50	BH RR 04	
2	No 19 + 0.000	2.00	BH RR 02	No Undisturbed sample
3	Vu Yen Bridge No 135+0.000	4.5	BH VY 06	

(2) Design criteria

The adjustment of analysis follows Vietnam standard: "22TCN – 262 – Embankment Design on Soft Soil Foundation". Assuming the opening time for Project is 365 days after finishing the earthwork, the residual settlement at road center when opening shall be as follows:

Table 6.1-8 Residual Settlement at Road Center

Road Type	Location near Abutments	Location near drainage system	Normal Embankment
Expressway (V >80 m/h)	≤ 10 cm	≤ 20 cm	≤ 30 cm
Highway (V>60 km/h)	≤ 20 cm	≤ 30 cm	≤ 40 cm

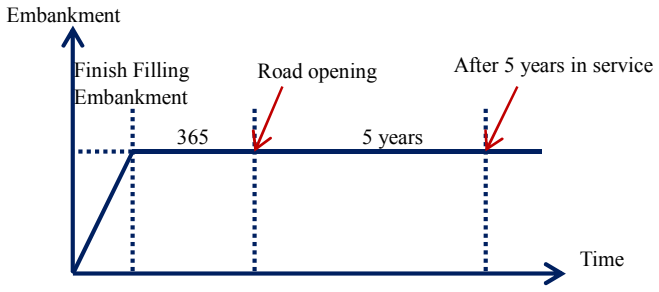


Figure 6.1-18 Residual Settlement at Road Center

(3) Outputs

Analysis results are presented in Table 6.1-9 including:

- Slope stability (Bishop) Min FS
- Residual settlement (Without PVD)
- Residual settlement (With PVD)

Table 6.1-9 Analysis Results

Embankment height (m)	Construction velocity (m/day)	Embankment Construction time (days)	No of Geotextile layer	Slope Stability Min FS	Output time (days)	Total settlement (m)	Allowable residual settlement (cm)	Without PVD	Adjustment
					Road opening			Residual settlement Road opening (cm)	
Section 1									
7.50	0.05	150	0	2.296	515	66.94	20.00	45.985	NG
Section 2									
2.00	0.05	40	0	2.083	405	33.54	30.00	24.492	OK
Section 3									
4.50	0.05	90	0	1.872	455	103.51	30.00	59.45	NG

Embankment height (m)	With PVD						Note
	PVD length (m)	Pattern	Pitch (m)	Construction time (days)	Residual settlement (m)	Degree of consolidation %	
Section 1							
7.50	9.00	Square	1.50	525	8.38	87.50	At road center
Section 2							
2.00	-	-	-	-	-	-	At road center
Section 3							
4.50	5.00	Square	1.50	525.00	14.23	86.25	At road center

(4) Conclusion

In case of embankment height is more than 5m, it is compulsory to apply soft soil treatment since the residual settlement at road center without improvement is more than 10 cm. The recommended method is Prefabricated Vertical Drain (PVD) with 9 m – 10 m in length depending on location and state of soft soil (from soft to very soft). The number of PVD installation for each section for a cross – section is shown in Table 6.1-10.

Table 6.1-10 The Number of PVD Installation for Sections

Section	Pattern	Spacing (m)	Length (m)
Section 1	Square	1.5 x 1.5	10.0 (9.0)
Section 3 (Vu Yen Bridge)	Square	1.5 x1.5	5.0

For normal embankment (2m height in average), the residual settlement is less than 30 cm, soft soil treatment is not necessary to apply.

In Detailed Design Stage, soft soil improvement method should be re-evaluated based on the more fruitful data of geotechnical investigations.

(5) Schedule of soft ground treatment (PVD)

Table 6.1-11 Schedule of Soft Ground Treatment

	Main Location	Area		Length	PVD Pitch	PVD Depth	Height
1	Box1	No 80+17.000	No 81+50.000	133.000 m	1.5m x 1.5m	5m	4m < h < 5m
2	Box2	No 111+34.000	No 114+00.000	266.000 m	1.5m x 1.5m	5m	4m < h < 5m
3	RuotLon Br	No 124+75.000	No 125+15.000	40.000 m	1.5m x 1.5m	5m	4m < h < 5m
		No 125+15.000	No 125+80.350	65.350 m	1.5m x 1.5m	10m	5m < h
		No 131+59.650	No 132+06.660	47.010 m	1.5m x 1.5m	10m	5m < h
		No 132+06.660	No 132+55.000	48.340 m	1.5m x 1.5m	5m	4m < h < 5m
4	Vu Yen Island	No 132+55.000	No 143+56.500	1,101.500 m	1.5m x 1.5m	5m	4m < h < 5m

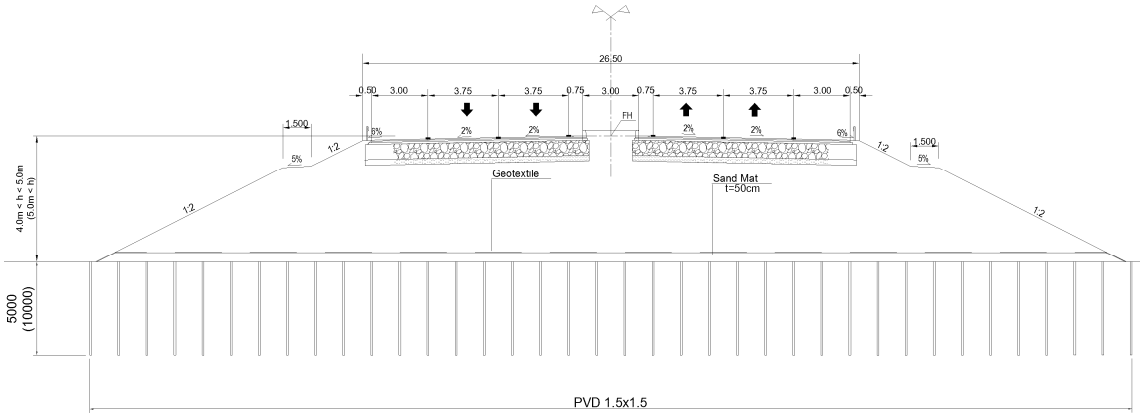


Figure 6.1-19 Typical Cross Section of Soft Ground Treatment

6.2 Bridge Design

6.2.1 Outline of Bridge Section

The bridge and viaduct lengths, locations and bridge types of each package are shown in following table.

Table 6.2-1 List of Bridges on Main Route of Nguyen Trai Bridge

	Name of Bridge	Chainage	L (m)	Span Arrangement or Unified Type	Type of Structure
1	North approach bridge	From KM0+332.35 to KM0+800.00	467.65	39.65+3@40+2@34+6@40	Super T Girder
2	Nguyen Trai Bridge	from KM0+800.00 to KM1+264.00	464.00	92+280+92	Arch bridge
3	South approach bridge	From KM1+264 to KM1+735.65	471.65	3@40+80+2@36+4@40+39.65	Super T Girder

Table 6.2-2 List of Bridges on Ramp Way South of Nguyen Trai Bridge

Ramp	Bridge Type	Span Arrangement	Width (m)	Connection Structure with Main line	Radius of Horizontal Curve
A	Hollow slab	2@30+32.755+6@30+35+30+25+2@30=422.755m	7	Deceleration	R=60
B	Hollow slab	10@29+2@30+30.322+9@30+25+30+35+30+28.889=799.221m	7	Acceleration	R=60

Table 6.2-3 List of Bridges on Main Route of Ring Road No. 3

	Name of Bridge	Chainage	L (m)	Span Arrangement or Unified Type	Type of Structure
1	JCT 1 overpass	From KM0+310.35 to KM0+669.65	359.30	39.65+7@40+39.65	Super T Girder
2	JCT 2 overpass	from KM5+360.35 to KM5+639.65	279.30	39.65+5@40+39.65	Super T Girder
3	JCT 3 overpass	From KM9+540.35 to KM9+859.65	319.30	39.65+6@40+39.65	Super T Girder
4	Ruot Lon Bridge	from KM12+580.35 to KM13+159.65	579.30	39.65+4@40+50+80+50 +4@40+39.65	Box girder Super T Girder
5	North approach	From KM14+356.35 to KM15+556.00	1199.65	39.65+29@40	Super T Girder
6	Vu Yen Bridge	from KM15+556.00 to KM16+284.00	728.00	40+154+340+154+40	Cable-stayed bridge
7	South approach	From KM16+284.00 to KM17+503.35	1219.65	13@40+4@35+13@40+ 39.65	Super T Girder

Table 6.2-4 List of Bridges on Ramp Way South of Vu Yen Bridge

Ramp	Bridge Type	Span Arrangement	Width (m)	Connection Structure with Main line	Radius of Horizontal Curve
A	Hollow slab	7@30=210m	7	Acceleration	R=60
B	Hollow slab	9@30=270m	7	Acceleration	R=60
C	Hollow slab	15@30=450m	7	Deceleration	R=90
D	Hollow slab	9@30=270m	7	Deceleration	R=70

6.2.2 Design Conditions

(1) General Information

General information on Nguyen Trai Bridge and Vu Yen Bridge and its cross-section are shown in Table 6.2-5 and Figure 6.2-1.

Table 6.2-5 General Information on Nguyen Trai Bridge

	Nguyen Trai Bridge	Vu Yen Bridge
Road standard	TCXDVN 104-2007 (Road Specifications for Urban Areas)	TCXDVN 4054-2005 (Highway Specifications)
Design speed	V=80km/h	V=80km/h, Grade III provincial road
Number of lanes	4 lanes, each 3.75m wide	4 lanes, each 3.75m wide
Longitudinal gradient	4% (specified for urban areas)	4% (specified for urban areas)
Span arrangement	L=92+280+92m=464m	L=40+159+340+159+40m=738m

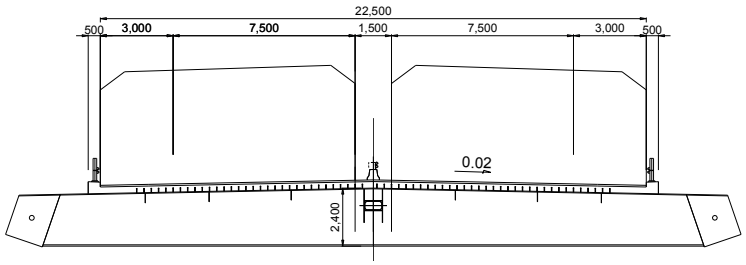


Figure 6.2-1 Road Width of Nguyen Trai Bridge

Source: Study Team

(2) Bridge Design Standards

Vietnamese standards, namely the SPECIFICATION BRIDGE DESIGN 22TCN-272-05, shall be applied for the bridge design.

Load factors and combinations shall be in accordance with Vietnamese standards (22 TCN-272-05), AASHTO LRFD, and PTI recommendations for stay cable design.

When checking the values, the following formula and parameters are used:

$$\sum \eta_i r_i Q_i \leq \varphi R_n = R_r$$

Where;

φ: Resistance Factor=0.9 (for checking cables and girders)

$\eta_i = \eta_D \eta_R \eta_I$: Load modifier=1.0 (for checking cables and girders)

(3) Live Load

The bridges have 3 notional lanes of traffic in each direction. Since these bridges have more than 3 lanes, the multiple presence factor is set at 0.65.

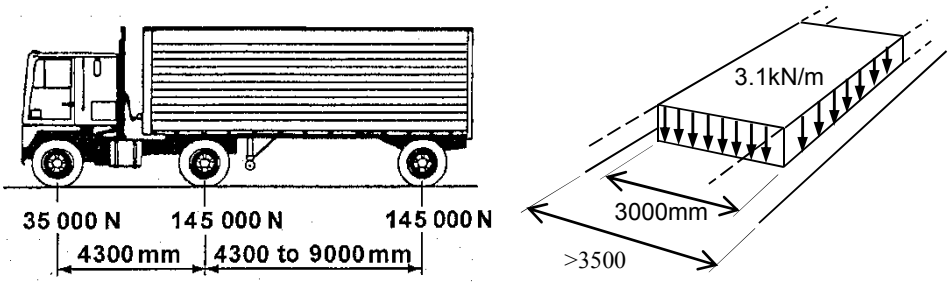


Figure 6.2-2 Design Truck and Lane Load

(4) Earthquake Load

Vietnamese standards (22TCN-272-05) are also applied for the seismic design of structures. Based on the horizontal seismic coefficients, the project area is classified as a Seismic Zone 2, as shown in Figure 6.2-3. The load factor design method is used to take into consideration the coefficients corresponding to the elastic wave velocity of the ground and the damping characteristics designated for each structure.

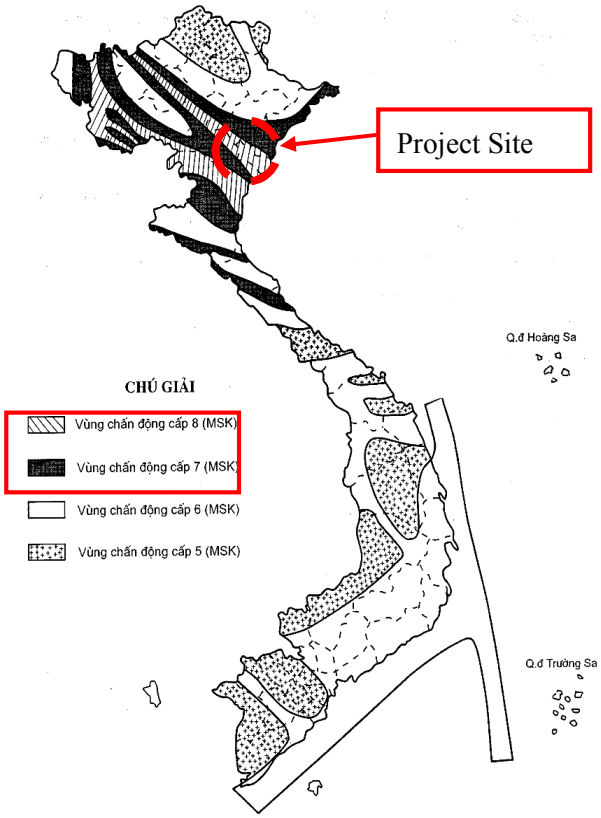


Figure 6.2-3 Earthquake Distribution Map

Source: Vietnamese standards – SPECIFICATION BRIDGE DESIGN 22 TCN-272-05

The acceleration coefficients are shown in Table 6.2-6, and the seismic zone is "2" in accordance with Article 3.10.4 of 22 TCN-272-05. Since the soil profile type at the site is "IV", the soil property coefficient is taken as "2.0" in accordance with Article 3.10.5.1 of 22TCN-272-05.

Table 6.2-6 Acceleration Coefficient (TCXDVN 375 2006)

Bridge name	District	Acceleration Return period 475 years
Nguyen Trai Bridge	Ngo Quyen District	A=0.1276
Vu Yen Bridge	Hai An District	A=0.1291

Table 6.2-7 Soil Property Coefficient

Soil property coefficient	Type of soil property			
	I	II	III	IV
S	1.0	1.2	1.5	2.0

A=0.1276 (Nguyen Trai Bridge)

Acceleration coefficient: A=0.1276 x 2.0= 0.2552

$$C_{sm} = \frac{1.2AS}{T_m^{2/3}} \le 2.5A \qquad (T \le 4.0)$$

$$= \frac{3AS}{T_m^{4/3}} \qquad (T \ge 4.0)$$

Where;

T_m = period of the m th mode of vibration in s.

(5) Wind Load

1) Design Wind Speed

a. The maximum wind speed obtained from the observed data and discussed in Chapter 3 is 47.2m/s (2min average wind speed, H=12m from land, land height is 115m). For design, wind speed is converted considering height and environment of site. Observed data and estimation of design wind speed is discrived in Appendix A3-2. The following equation is used for the design wind load for Nguyen Trai and Vu Yen Bridge.

$$p = 0.5\rho(V_d)^2 C_d G$$

Where:

p = wind pressure

ρ = mass density of air = 0.125 [kg s^2/m4]

C_d = drag coefficient

G = gust factor

V_d = design wind velocity 37.9 [m/s]

2) Gust factor and drag coefficient

The gust factor G is defined as the ratio of the peak gust to the mean wind speed, and the gust factor for each structure uses the default values of Japanese standards. Gust factor and drag coefficient shall be verified by gust analysis and wind tunnel test at the detailed design stage.

Assumed drag coefficient is shown in the drawings.

(6) Temperature Load (TU, TG)

1) Temperature Ranges

The temperature ranges (Article 3.12.2 of 22TCN-272-05) of each material are shown in the following table. The basic temperature (at the time of erection) is 23.2 degrees*.

*Average temperature from the Hai Phong Statistical Year Book 2012.

Table 6.2-8 Ambient Temperature of Steel and Concrete

Concrete	Concrete deck on steel girder	Steel deck on steel girder
+5 deg. to 47 deg. (-18.2, +23.8 deg.)	+1 deg. to 55 deg. (-22.2, +31.8 deg.)	-3 deg. to 63 deg. (-26.2, +39.8 deg.)

(7) Navigational Clearance of Nguyen Trai Bridge and Vu Yen Bridge

1) Ships on Cam River

According to Notification No.63/TB-UBND issued by the Hai Phong City People's Committee on 10 March 2015, the navigational clearance at Nguyen Trai Bridge is set at 25m. Hoang Dieu

Port which is currently located upstream of the bridge will be relocated downstream on the Cam River before construction of Nguyen Trai Bridge. The project will therefore use a navigational clearance of 25m for Nguyen Trai Bridge.

Based on records of ships that have sailed on the Cam River, the largest passing ship in 2014 was a 47,377 DWT bulk carrier based at Hai Phong Port (Hoang Dieu). Although the port is planned to be relocated in the future, there is still a large berth near Vu Yen Bridge and it is also unclear whether the port will have been relocated by the time bridge construction begins. Consequently, about 48,000 DWT ship based on the above-mentioned bulk carrier will be passed navigation.

As shown in Table 6.2-11, the largest ship which has sailed upstream of Hoang Dieu Port where Nguyen Trai Bridge is to be constructed was a 6,920 DWT ship.

The current 8 nautical miles/h (14.816 km/h) speed limit of the Cam River navigation channel will be used as the vessel speed.

Table 6.2-9 Largest Vessels on the Cam River in 2014

No.	Ship Name	LOA	Draught	GT	DWT	Date	Berth
1	Tai Shun Hai	189.9m	7.2m	27,598	47,378	29/7/2014	CANG HP
2	Tai Hua Hai	189.9m	6.7m	27,598	47,377	26/2/2014	CANG HP
3	Emerald	185.7m	6.9m	26,028	45,588	7/10/2014	CANG HP

* Record provided by the Hai Phong Marine Administration

Table 6.2-10 Record of Vessel Traffic Downstream of Hoang Dieu Port

Year	Vessel Weight <= 5,000 DWT (height clearance 12 - 25m)		Vessel Weight 5,000 DWT - 7,000 DWT (height clearance 25 - 30m)		Vessel Weight 7,000 DWT - 15,000 DWT (height clearance 30 - 45m)		Vessel Weight 15,000 DWT - 40,000 DWT (height clearance 45 - 75m)	
	Total trips	Total vessel weight (million ton)	Total trips	Total vessel weight (million ton)	Total trips	Total vessel weight (million ton)	Total trips	Total vessel weight (million ton)
2010	544	1.7	232	1.4	459	3.9	48	1.2
2011	467	1.4	205	1.3	465	4.0	64	1.5
2012	370	1.2	149	1.0	415	3.7	58	1.4
2013	267	0.9	109	0.7	351	3.2	62	1.7
2014	250	0.8	95	0.7	256	2.5	64	1.8
-03/2015	55	0.2	30	0.2	80	0.8	18	0.5

* Record provided by the Hai Phong Marine Administration

Table 6.2-11 Record of Vessel Traffic Upstream of Hoang Dieu Port

Year	Ship Name	DWT	No./year	Port
2014	(-5,000DWT)	4,000-5,000	38	Nam Ninh, Vat Cach, Quynh Cu
	Viet Thang 36	5,050	14	Nam Ninh, Vat Cach
	Thai Binh 88	5,200		

	Phu An 36	5,200		
	Phuong Nam 68	5,299		
	Nashico 08	5,374		
	Quang Minh 126	5,386		
	Royal 88	5,604		
2015-Mar	(-5,000DWT)	4,000-5,000	20	Nam Ninh, Vat Cach, Mipec, Tien Manh
	Phuong Nam 68	5,299		
	Victoria 01	5,200		
	Dai Tay Duong 36	5,164	10	Nam Ninh, Vat Cach
	Dai Tay Duong 25	5,173		
	Truong Minh Glory	6,920		

* Record provided by the Hai Phong Marine Administration

2) Bridge Design Elevation and Design Vessel

Nguyen Trai Bridge

a. Navigation Clearance

Based on Notification No.63/TB-UBND of HPPC notifying the conclusion of the HPPC Chairman in the meeting with the JICA study team about Nguyen Trai Bridge and Vu Yen Bridge, Nguyen Trai Bridge will be secured for navigation at a height of 25m from the 5% high water level, E+2.37m.

b. Navigation Width

The navigation width will comply with the latest navigation location provided by MA in drawings by the Hai Phong navigation party No.HP_122013_05_06, section from Km33+000 to Km42+000. (See Figure 6.2-4)

The navigation will keep a 30m safety distance from the navigation based on Decree No.109/2014/ND-CP, point d Clause 3 Article 5 Chapter II dated 20 November 2014 of the Vietnamese Government.

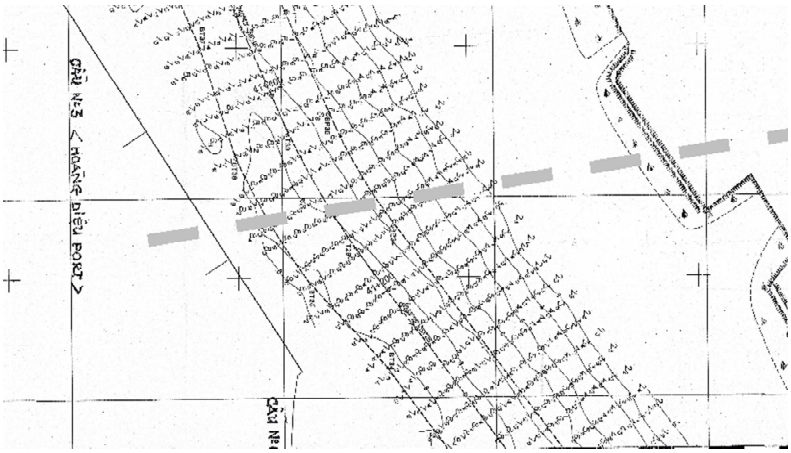


Figure 6.2-4 Navigational Clearance

Refer to the Hai Phong Marine Administration

c. Planning of Structure

Based on the letter no. 1126/SGTVT-TDXD dated 22 June 2015 of Hai Phong DOT, Letter no 1210/SXD-QLQH dated 23 June 2015 of Hai Phong DOC, a steel arch bridge is recommended for Nguyen Trai Bridge. Considering the above navigational conditions, the economics and natural condition, the span length is 280m. We have attached bridge planning drawings including the navigational conditions listed above.

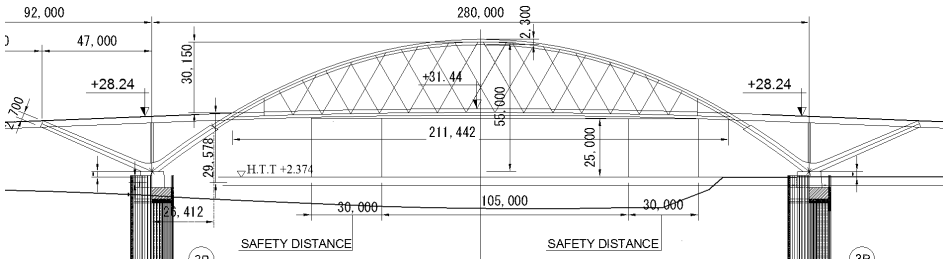


Figure 6.2-5 Conditions of Nguyen Trai Bridge

d. Collision resistance design for piers in the Cam River

For Nguyen Trai Bridge, the 25m navigational height will prevent vessels bigger than 7,000 DWT from passing and maximum ship was 6920 DWT in upstream of Hoang Dieu Port. Therefore 7,000 DWT vessel for the collision resistance design for piers in the Cam River.

Vu Yen Bridge

e. Navigational Clearance

Based on letter No. 2921/CHHVN-KHTC dated 23 October 2012 on the Bach Dang bridge location of the Vietnam Marine Administration (VMA) to the Quang Ninh PC and letter No. 2649/CHHVN-KHTC dated 14 November 2011 regarding the navigational clearance of VMA to TEDI, the designer of Bach Dang Bridge, the navigational height of Bach Dang bridge is 52m from the marine level considering the vessel height on the Cam River. According to the TEDI study, the marine level is 1.86m lower than the national level and the H5% high water level in the Bach Dang bridge area is 1.75m. Therefore, the navigation height of Bach Dang Bridge from the H5% high water level is: 52m – 1.86m – 1.75m = 48.39m, which TEDI has rounded up to 48.4m.

Vu Yen Bridge will use a 52m navigational clearance from the marine level so as not to disturb the ship navigation on the Cam River.

f. Navigation width

The navigation width will comply with the latest navigation location provided by MA in drawings by the Hai Phong navigation party No.HP_122013_05_06, section Km33+000 to Km42+000.

The navigation will keep a 30m safety distance from the navigation based on Decree No.109/2014/ND-CP, point d Clause 3 Article 5 Chapter II dated 20 November 2014 of the Vietnamese Government.

g. Planning of structure

Based on letter no. 1126/SGTVT-TDXD dated 22 June 2015 of Hai Phong DOT, letter no 1210/SXD-QLQH dated 23 June 2015 of Hai Phong DOC, a cable-stayed bridge is recommended for Vu Yen Bridge. Considering the above navigational conditions and navigational safety of the Cam River, we propose that the bridge foundations should be located cearly outside the navigation channel as in section 5.2.1(2) studied.

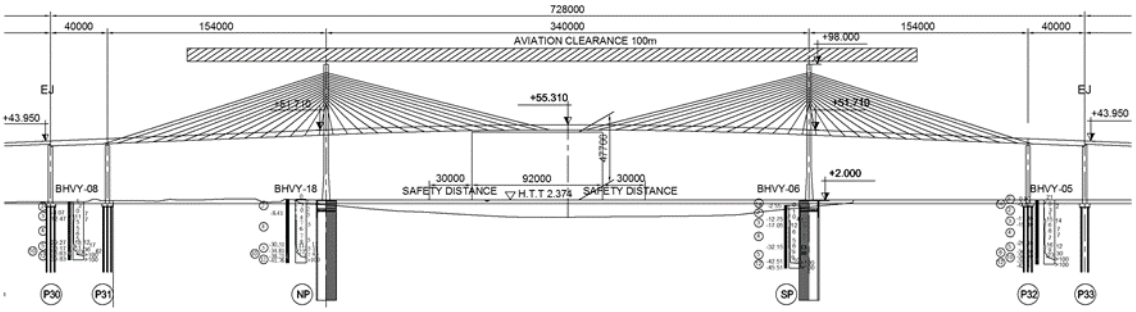


Figure 6.2-6 Conditions of Vu Yen Bridge

h. Collision resistance design for piers in the Cam river

The design for collision is also taken into account for piers in the Cam River of Vu Yen Bridge to minimize the possibility of damage from vessels to the bridge. Based on hydrological data collected from the site survey, the study team considers the critical case of a 5.7m high water level which consists of 2.37m HWL, 1m scour and 2.3m water depth at the location around the piers.

Regarding the statistical data such as name and DWT in the table below, with a high water level close to the tower of 5.7m, design vessel with a 4,000 DWT deadweight is used for the collision resistance design of the Vu Yen Bridge piers in the Cam River.

Table 6.2-12 Navigational Clearances in the Project

Bridge	Nguyen Trai Bridge	Vu Yen Bridge
Design Vessel	7,000 DWT	4,000DWT
Vessel Speed	8 knots (14.816 km/h)	8 knots (14.816 km/h)
Clearance (H)	Hmax5% (+2.37m) + 25.0m	Hmax5% (+2.37m) + 47.77m
Width (B)	80m + curve effect, and 30m safety zone on each side	80m + curve effect, and 30m safety zone on each side

Ruot Lon Bridge

The Ruot Lon River is currently a Class III river, but according to Circular No.36/2012/TT-BGTVT issued by MOT on 13 September 2012, it will become a Class II river in 2020. The navigational clearance in this Circular will thus be used for Ruot Lon Bridge.

Table 6.2-13 Navigational Clearance of Ruot Lon Bridge

	Class II (Ruot Lon, after 2020)	Class III (current)
Navigational width	>50m	>40m
Navigational clearance	9.5m	7m

(8) Air Space

According to Vietnamese regulations, Vu Yen Bridge is located inside the horizontal surface of Cat Bi Airport and therefore requires an air space of 45m. However, the Hai Phong People's Committee issued letter No.4531/TC-QC dated 24 December 2013 on this issue, which includes the following sentence from which the air space can be understood to actually be 100m:

"Department of Operations approves the maximum tower height of Vu Yen Bridge as 100 meters above sea level."

The letter also requires the adoption of an aviation alert system in accordance with the regulations in Appendix 4 of Decree 20.

For the above reason, the tower height is 98m which is the value of the aviation clearance minus 2m, the height of the lightning rod.

Table 6.2-14 Air Space Clearances in the Project

Bridge	Nguyen Trai Bridge	Vu Yen Bridge
Clearance (H)	145m	100m

(9) Distance from Oil Facilities

Decree No.13/2011/ND-CP regulates the distance from oil facilities.

The oil facilities which belong to the Military Petroleum Corporation (MIPECORP) and PITEC Petrol and affect the location of Vu Yen Bridge are shown in Table 6.2-15 and Figure 6.2-7.

In Japan, a 90m safety distance is required between bridges and oil facilities, and for example the Great Seto Bridge was constructed 230m from such facilities in the port.

Eventually, as examined in Chapter 5, the bridge location is planned 300m away from PETEC. The pier location is planned 30m away from the water's edge where ship collisions are not considered.

Table 6.2-15 Safety Distance from Oil Facilities

	MIPECORP	PETEC
Petrol port class	Class II	Class IV
Safety distance from port *	500m	300m
Size of docking vessels	About 15,000 DWT	About 8,000 DWT (4-10 ships/month)

*Decree No.13/2011/ND-CP

Figure 6.2-7 Oil Facilities near Proposed Location of Vu Yen Bridge

(10) Bearing Layer for Deep Foundations

1) Nguyen Trai Bridge

Soil composition at the bridge crossing location is distributed in the following order starting from the top layer: alluvial cohesive soil layer (Ac), alluvial sandy soil layer (As), diluvial sandy soil layer (Ds), and basement rock (mudstone, sandstone).

Among these layers, the diluvial sandy soil layer (Ds, N>50) and the basement rock located under it can satisfy the requirements for the bridge's bearing layer in terms of hardness and thickness. In general, short piles are preferred to lower the cost and thus, Ds layer will be chosen for the bearing layer if it is properly distributed. However, at the moment geotechnical survey has only been conducted at a few locations, resulting in low accuracy for determining the bearing layer. Also, Ds layer's thickness and N value tend to scatter. For these reasons, basement rock was chosen to be the bearing layer and an embedded length no less than the pile diameter is assured. More detailed consideration will be conducted in the future survey.

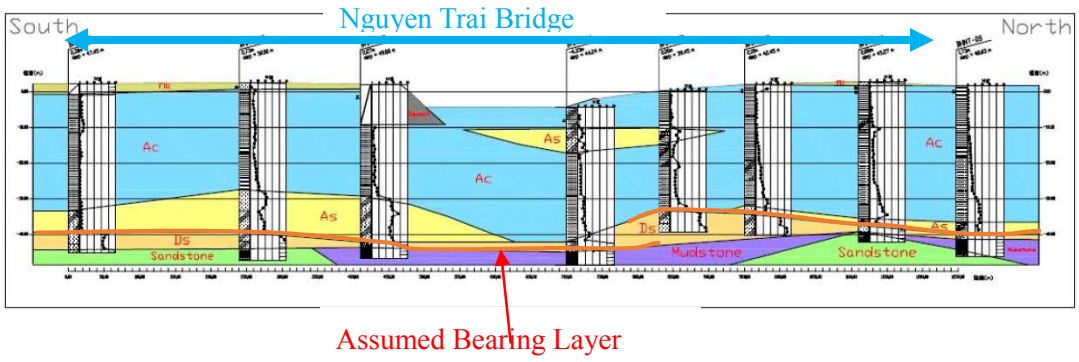


Figure 6.2-8 Soil Profile of Nguyen Trai Bridge Location

2) Vu Yen Bridge

Soil composition at the bridge crossing location is distributed in the following order starting from the top layer: alluvial cohesive soil layer (Ac), diluvial sandy soil layer (Ds), and basement rock (mudstone).

Among these layers, the basement rock can satisfy the requirements for the bridge's bearing layer in terms of hardness and thickness. On the other hand, Ds layer's thickness and N value tend to scatter. Also, geotechnical survey has only been conducted at a few locations, bringing in the issue regarding low accuracy for determining the bearing layer. For these reasons, Ds layer was not chosen for the bearing layer.

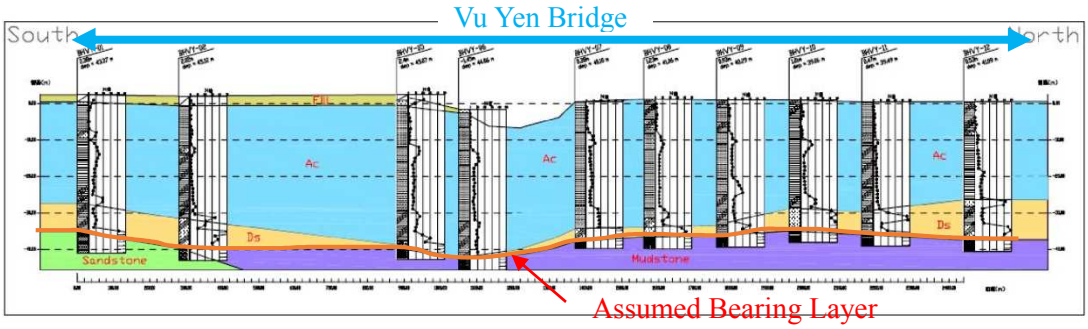


Figure 6.2-9 Soil Profile of Vu Yen Bridge Location

3) Ruot Lon Bridge and No.3 IC Overpass Bridge

Soil composition at the bridge crossing location is distributed in the following order starting from the top layer: alluvial cohesive soil layer (Ac), diluvial sandy soil layer (Ds), and basement rock (mudstone, sandstone). N value of Ds layer varies in the range of 20~50 or larger. At the vicinity of EL-30.0m at Ruot Lon Bridge, Ds layer's N value has an average value of more than 30; this layer also has enough thickness and thus is chosen to be the bearing layer. However, according to the boring survey at the location adjacent to the bridge crossing, there are locations under EL-30m where Ds layer has considerably small N value. Therefore, it is recommended to conduct geotechnical survey at each pier location to justify the adequacy of this bearing layer. On the other hand, basement rock was chosen to be the bearing layer at No.3IC.

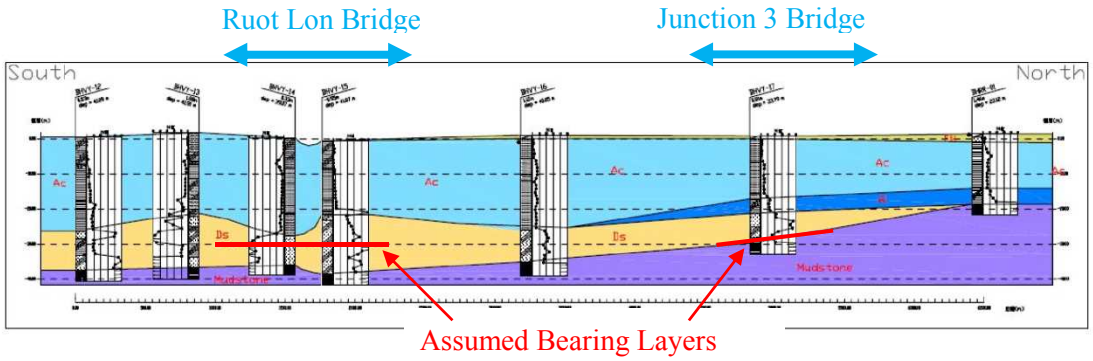


Figure 6.2-10 Assumed bearing layers of Ruot Lon Bridge and No.3IC

4) No.1IC Overpass Bridge and No.2IC Overpass Bridge

Soil composition at the bridge crossing location is distributed in the following order starting from the top layer: alluvial cohesive soil layer (Ac and Al) and basement rock (mudstone). Basement rock was chosen to be the bridges' bearing layer.

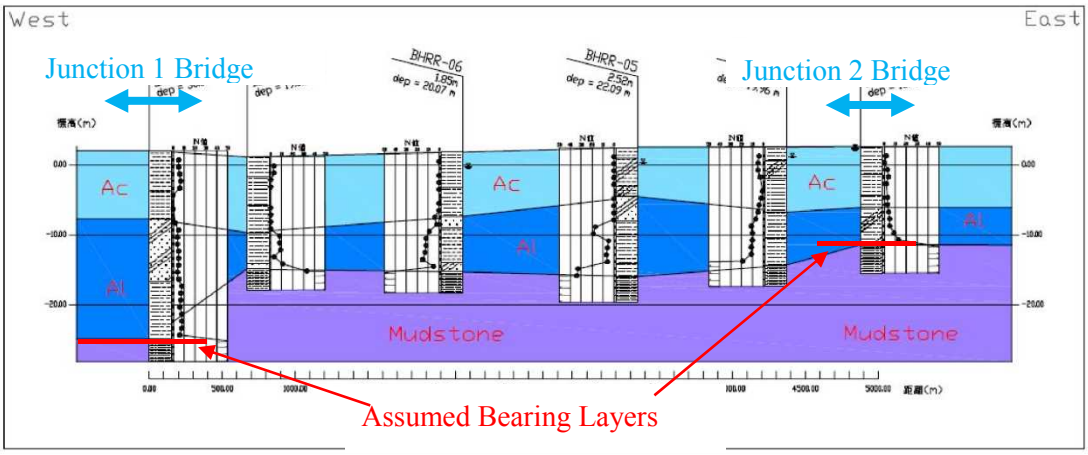


Figure 6.2-11 Assumed bearing layers of No.1&No.2 Overpass Bridge

(11) Elevation of Approach Bridge Abutment

The abutment elevation is determined by the stability of the embankment and the required minimum height at the maximum high water level.

As shown in Table 6.2-16 , the minimum bridge height is 5.2m. The abutment location is determined by finding the lowest embankment height which is more than the required minimum abutment height.

Table 6.2-16 Minimum Height of Abutment

	Height (m)
1% HWL	2.7m
Height margin	0.5m
Structure height	2.0m
Height of abutment	Higher than 5.2m

(12) Ground Elevation and Pile Cap Top Surface Bridges

A main bridge pier (tower) for Nguyen Trai Bridge and Vu Yen Bridge is proposed to be constructed at Hoang Dieu Terminal and Hai An Terminal, respectively. Not only the proposed pier locations, but also the elevations of the pile cap top surfaces (foundation top slabs) should be approved by the relevant authorities.

In the design, it is proposed to use a top surface elevation of EL+1.0m or deeper in order to reserve vertical space for pavement structures (top slabs), buried utility conduits, etc.

Table 6.2-17 Ground Elevation (Terminal Floors) and Foundation Top Slabs

Bridge	Terminal	Floor Elevation		Elevation of Foundation Top Slab
		Current	Future	
Nguyen Trai	Hoang Dieu Terminal	EL+2.30	EL+2.30	EL+1.00
Vu Yen	Hai An Terminal	EL+2.30	EL+2.30	EL+1.00

Notes:- The above floor elevations are based on the Study Team's assumptions.

- The proposed elevations of the foundation top slabs are subject to approval by relevant authorities.

In this Report, it is proposed to use a top surface elevation of pile cap by 2.0m below future ground elevation in order to reserve vertical space for pavement structures (top slabs), buried utility conduits, etc. where substructures to be located in urban area. Also, for substructures located non-urban area, the top surface elevation of pile cap will be 0.5m below current ground elevation.

Table 6.2-18 Ground Elevation and Foundation Top Slabs of main bridges

Location	Direction	Current Ground EL	Future Ground EL	Elevation of Foundation Top Slab
Nguyen Trai Route	North of Cam River	EL-1.50～EL+0.00m (fish farms, wetland)	EL+2.30m (future urban area)	2.0m below future ground EL
		EL+2.30m (reclaimed land)	EL+2.30m (future urban area)	
	South of Cam River	EL+2.30m (urban area)	EL+2.30m (urban area)	2.0m below future ground EL
Vu Yen Route	North of Cam River	EL+0.50 ~ EL+1.00m (fish farms, wetland)	EL+0.50 ~ EL+1.00m (non-urban area)	Set at current ground EL (0.5m below ground EL)
	South of Cam River	EL+2.30m (urban area)	EL+2.30m (urban area)	2.0m below future ground EL
		EL+0.50～EL+1.0m (fish farms, wetland)	EL+2.30m (urban area)	2.0m below future ground EL

Notes:- The above floor elevations are based on the Study Team's assumptions.

- Confirmation by relevant parties required.

Table 6.2-19 Ground Elevation and Foundation Top Slabs of Ring Road 3

Location	Current Ground EL	Future Ground EL	Elevation of Foundation Top Slab
Ruot Lon Bridge	EL0.00～EL+0.50m (fish farms, wetland)	EL+0.00 ~ EL+0.50m (non-urban area)	Set at current ground EL (0.5m below ground EL)
Overpass Bridge of TL359C	EL+1.40 ~ EL+2.30m (non-urban area)	EL+0.50 ~ EL+1.00m (non-urban area)	
Overpass Bridge of TL359	EL+1.80 ~ EL+2.70m (non-urban area)	EL+1.80 ~ EL+2.70m (non-urban area)	
Overpass Bridge of RR2	EL+0.40 ~ EL+0.60m (non-urban area)	EL+0.40 ~ EL+0.60m (non-urban area)	
L356 Ramp A~D	EL+2.10～EL+2.50m (reclaimed land)	EL+2.10～EL+2.50m (non-urban area)	

Notes:- The above floor elevations are based on the Study Team's assumptions.
- Confirmation by relevant parties required.

(13) Obstacles

Based on obstacle survey conducted by Study team, following item was confirmed on site and by hearing to administrators. Major obstacle is shown in Drawings. Bridge location is planned to avoid cross High Voltage Line. Minimum distance to bridge from High Voltage Line is 45m for Ruot Long Bridge.

Table 6.2-20 Checked Facilities of Obstacle Survey

Buried objects/Aerial lines
House, Building, Road, Fence, Temple, Cemetery area
Canal, Drain, Pavement structure
Medium and high Voltage line, On ground, Under ground utilities (fiber optic, telephone, water supply, electrical power)

6.2.3 Design of Nguyen Trai Bridge

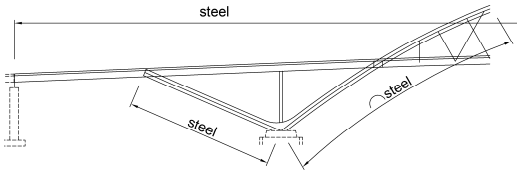
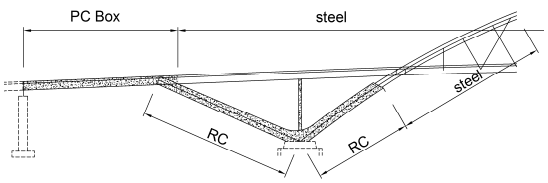
(1) Study of Superstructure Type

As a result of the comparison with the superstructure type of Nguyen Trai Bridge shown in Chapter 5, the arch type is selected as a suitable structure for Nguyen Trai Bridge.

Here, for the study of a suitable arch structure type, a comparison of two structure types is made: an all-steel bridge or a composite structure with concrete for the side span girders and the V-piers of the arch ribs. The results of the comparison are shown in Table 6.2-21.

As a result of this examination and from the viewpoint of economic efficiency and the efficiency of material use, steel structures are applied for the arch-ribs of the center span and girders in areas with large tensile force, and RC structures are applied for the side span girders and arch-ribs below the girders.

Table 6.2-21 Comparison of Structure Type for Arch Bridge

	Case 1 (Steel)		Case 2 (Steel + Concrete)	
Figure				
Structure outline	- Steel structures are applied for both main girders and V-piers. - Since the side spans are light, horizontal force will occur in the foundation.	○	- Concrete structures are applied for high compression members (V-piers) and side span girders for weight balance. Steel structures are applied for tension members. - The horizontal reaction force of the foundation which is located on soft ground is reduced compared with Case 1.	◎
Cost of super-structure	Steel = 4,984* Concrete = 0 Total = 4,984 (1.000) * million JPY	○	Steel = 3,758* Concrete = 344 Total = 4,102 (0.82) * million JPY	◎
Construction	- Member erection and large block erection can be applied. In case of large block erection, the construction period on site can be shortened.	◎	- Temporary pylons are used for V-pier construction to avoid using bents in the water. - The arch ribs shall be constructed at the same time with the fabrication of center span blocks. - Accurate construction is required for the connecting parts.	○
Appearance	- Structure has a smooth shape due to the continuous arch material.	◎	- Structure has a stable feel due to the concrete V-piers.	◎
Maintenance	- Steel structures require periodical inspection and re-painting.	○	- Steel structures require periodical inspection and re-painting. - Concrete members require periodical inspection.	○
Evaluation	Construction cost is higher than for Case 2	○	Economical and mechanically reasonable	◎

The following points are considered in the design of the bridge.

- The horizontal reaction force must be reduced because the bridge is located on soft ground. Therefore, a balanced arch type is applied and concrete side spans are used in order to counteract the horizontal force in the center span arch.
- Since the main span is long enough to satisfy the navigational clearance requirements, ship collisions will not occur at the bridge under normal conditions. However, since a collision may occur if a ship hits an arch rib during a typhoon, concrete structures which have good ductility are applied to increase the toughness of the structure.
- To reduce the large bending moment of the stiffening girders and arch ribs peculiar to long-span arch bridges, a Nielsen type cable system is applied.
- The center arch area is constructed using the large block erection method to minimize the

closure period of the navigation channel.

- In consideration of economical construction in Vietnamese conditions, PC slabs are applied whose span direction is set in the longitudinal axis because of the tension force of the stiffening girders.

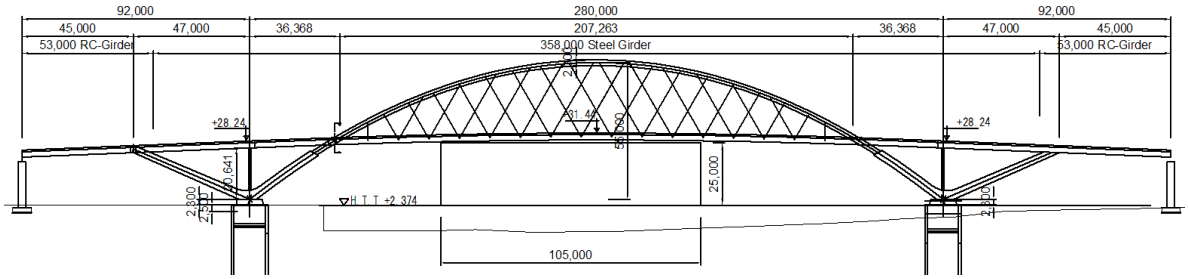


Figure 6.2-12 General View of Nguyen Trai Bridge

(2) Design Result of Nguyen Trai Bridge and Approach Bridge

Design and calculation results of Nguyen Trai Bridge are described in drawings.

For approach bridge of Nguyen Trai Bridge, Super-T girder and steel box girder with composite slab which were studied in Section 5.1.1 is arranged. Pier position along to railway should be examined in detail at detailed design stage in consideration of the influence on a railroad well. General view of steel box girder is shown in Figure 6.2-13.

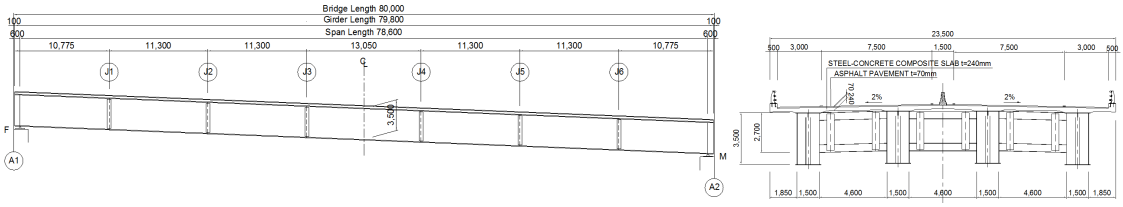


Figure 6.2-13 General View of Railway Overpass of South Approach Bridge

6.2.4 Design of Vu Yen Bridge

(1) Overview

As a result of the comparison with the structure type of Vu Yen Bridge, the cable-stayed bridge (hereafter referred to as CSB) type is selected. The bridge consists of a composite deck with steel I-girders, concrete H-shaped towers, and 52 high-strength cables.

Due to the strict aviation clearance requirement, the bridge needs a low-rise portion, approximately 0.15. Hence this bridge will have the below characteristics.

- The cable sectional area will be larger than for the ordinary low-rise portion of a CSB because the low cable angle makes the vertical component of the cable tension small.
- Since the bending moment at the center of the main span is larger than for an ordinary CSB,

a large sectional area at the main girders is needed not only close to the towers, but also at the center of the main span.

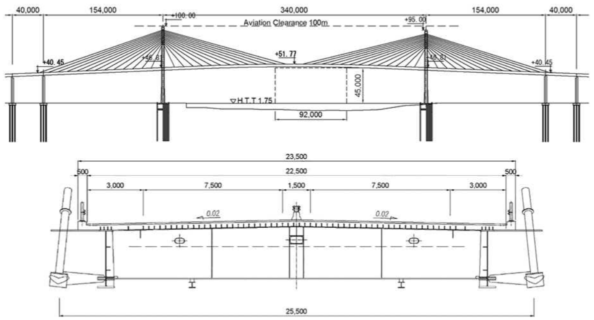
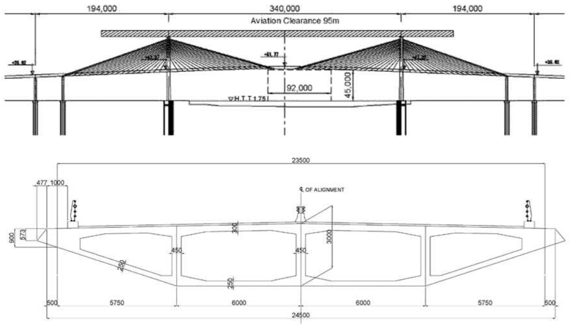
(2) Study of Superstructure Type

As a result of the comparison with the superstructure type of Vu Yen Bridge shown in Chapter 5, the Cable stayed bridge type is selected as a suitable structure for Vu Yen Bridge.

Here, for the study of a suitable Cable stayed bridge structure type, a comparison of two structure types is made: an Cable stayed Bridge with composite girders and Cable stayed Bridge with PC girders . The results of the comparison are shown below.

As a result of this examination and from the viewpoint of economic efficiency and applicability of low-rise cable stayed Bridge, composite girders are applied for the Vu Yen Bridge.

Table 6.2-22 Comparison composite girders vs PC girders

		Cable-stayed bridge with composite girders		Cable-stayed bridge with PC girders	
Bridge elevation and cross-section					
Structural comparison	Overview	Light-weight cable-stayed bridge with steel main girders. Economic design due to concrete deck. The bridge has a double-plane cable arrangement since the 2 main girders have combined composite girders.		Cable-stayed bridge with precast concrete girders. It is possible to achieve an economic design since the unit cost of girder manufacturing is low. The characteristics of the concrete material result in an unreasonable structure if the tensile force is large.	
	Track record	Binh Bridge (260m) Nhat Tan Bridge (300m) Can Tho Bridge (550m; steel box)	◎	Kien Bridge (200m) My Tuan Bridge (350m) Phu My Bridge (380m) Bai Chay Bridge (435m)	◎
	Construction cost	Main bridge superstructure (girders, cables, towers): 5.63 billion Main bridge substructure (piers, foundation): 2.28 billion } 7.91 billion (1.00)	◎	Main bridge superstructure (girders, cables, towers): 5.62 billion Main bridge substructure (piers, foundation): 2.59 billion Approach bridges } 8.21 billion (1.04)	○
	Appearance	･The bridge towers can be designed so that the bridge stands out as a landmark. ･The low bridge towers require a creative design solution.	○	･The bridge towers can be designed so that the bridge stands out as a landmark. ･The low bridge towers require a creative design solution.	○
	Applicability to low cable-stayed bridge	Application possible. The low cable angle increases the cable cost compared with ordinary cable-stayed bridges. Light composite girders have high applicability.	◎	The span centers of low cable-stayed bridges have large bending moments and therefore require PC steel. The bridge requires cables with the world's largest diameter since the dead load is large at locations where the cable angle is low. It is also necessary to provide sufficient reinforcement at the cable anchorages.	○
	Constructa-bility	･Girders are erected using the cantilever method. ･Navigation channel blocked for several hours during girder erection. ･Extensive construction track record, no particular problems.	◎	･Girders are erected using the cantilever method. ･Cable tension has to be repeatedly adjusted during erection. ･Extensive construction track record, no particular problems.	◎
	Construction period	･Using a slip form for the RC towers enables a shorter construction period. ･Since the main girders are pre-fabricated and the deck uses precast panels, the on-site construction time can be shortened. The construction period is thus shorter than for the PC cable-stayed bridge.	◎	･Using a slip form for the RC towers enables a shorter construction period. ･The cable spacing is narrower and the erection blocks shorter than for the composite girder bridge, and the construction period thus becomes longer.	○
	Maintenance	･The stiffening girders are made of steel and thus have to be periodically re-painted.	○	･ The cable anchorages inside the girders are made of steel and thus require periodic inspection. ･ The girders have to be periodically inspected for cracking.	○
	Overall evaluation	Recommended over the PC girder type because the cost is lower and the structure can be well applied to a low cable-stayed bridge.	◎		○

(3) Design result of Vu Yen Bridge

Design and calculation results of Vu Yen Bridge are described in drawings.

6.2.5 Design of JCT Bridge

(1) JCT of Nguyen Trai Bridge to Le Thanh Tong Street

1) Superstructure

2 ramp way bridges are planned on the south side of Nguyen Trai Bridge to access Le Thanh Tong Street.

There is a risk of delays to the construction work due to land acquisition delays on past projects in Vietnam. Considering this risk, the pier location at the node point of the ramp way is arranged as shown in the following figure. The detailed location will be studied at the detailed design stage.

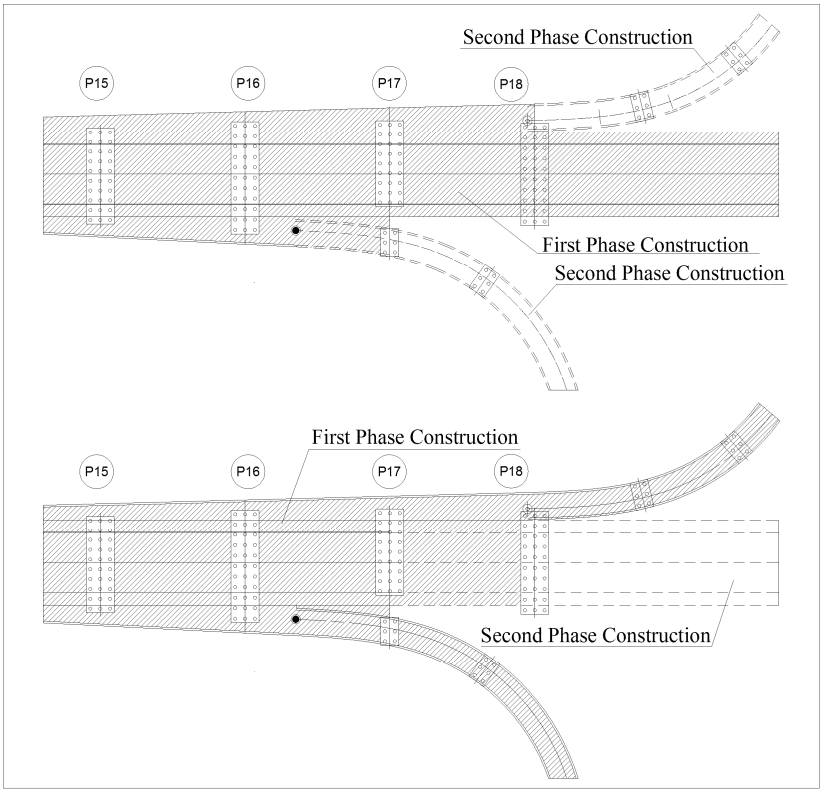


Figure 6.2-14 Arrangement of Node Points and Design Section of Bridge

The pier arrangement of the ramp way bridge is shown in Figure 6.2-15. The pier arrangement has been planned so as to avoid Le Thanh Tong Street and minimize influence of pier to existing railway. Since the ramp way bridge has a minimum radius of only 60m, hollow slab girders made of cast-in-place concrete which are applicable to the curved alignment are selected. The standard span length is 30m. To accommodate the eccentric load of the curved section, a rigid joint structure will be used and the ends equipped with 2 bearings. The girder cross-section is shown in Figure 6.2-16.

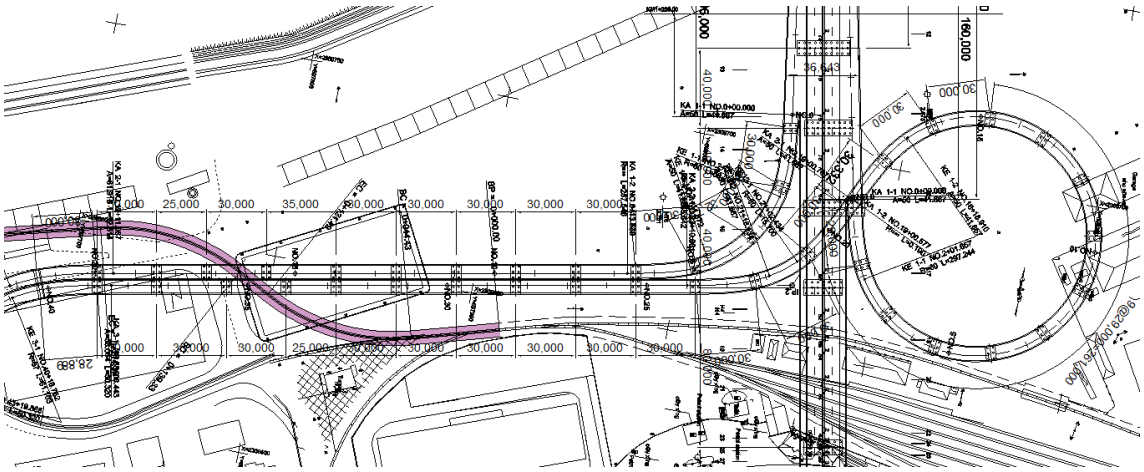


Figure 6.2-15 Span arrangement of JCT of Nguyen Trai South

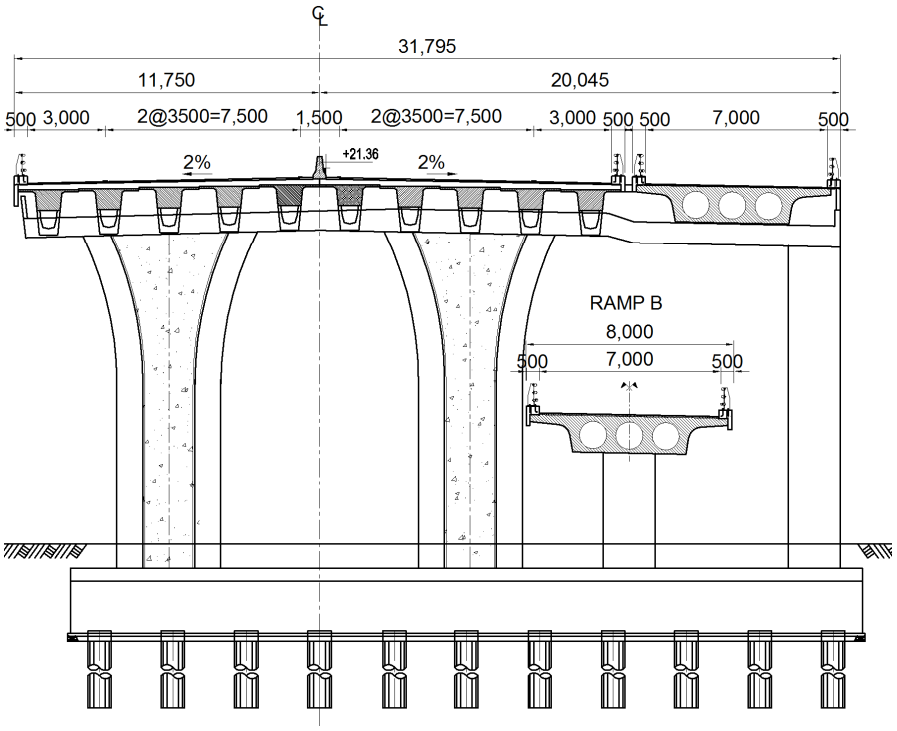


Figure 6.2-16 Cross-section of Ramp Way Bridge (PB13)

(2) JCT of Vu Yen Bridge to TL356

4 ramp way bridges are planned on the south side of Vu Yen Bridge to access TL356. Since the ramp way bridge has a minimum radius of only 60m, hollow slab girders made of cast-in-place concrete which are applicable to the curved alignment are selected.

6.2.6 Planning of Bridge on Ring Road 3

Three overpass bridges and one bridge on the Ruot Lon River on Ring Road No.3 are planned as listed in Table 6.2-3.

(1) Ruot Lon Bridge

1) Span Arrangement

A cantilever PC box girder bridge with an 80m center span is selected for Ruot Lon Bridge to pass the 50m x 9.5m navigation clearance.

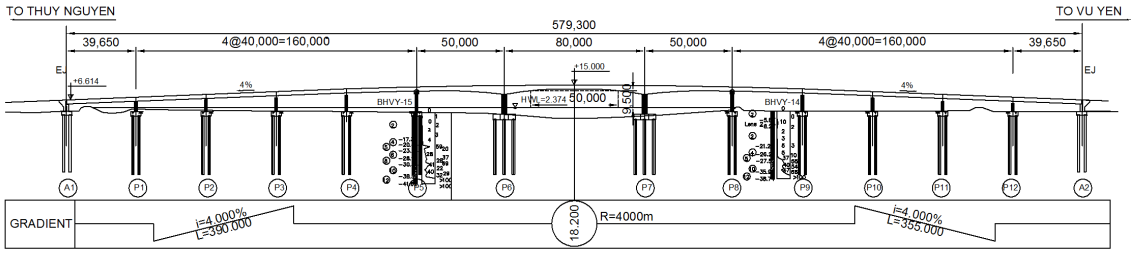
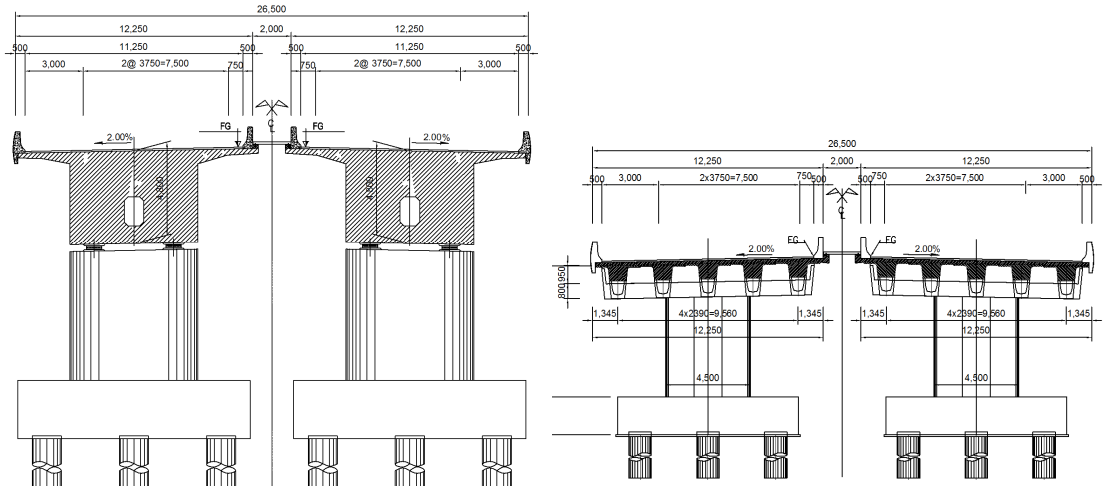


Figure 6.2-17 Ruot Lon Bridge



Box girder bridge Approach bridge, Overpass bridge

Figure 6.2-18 Typical Cross-section

2) Dimensions of Box Girder Section

Girder Height

Referring to Figure 6.2-17, the girder height on the pier and central/side span is determined as 4.8m (on the pier) and 2.1m (central/side span).

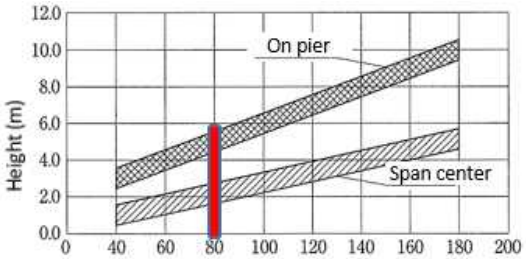


Figure 6.2-19 Girder Height for Continuous PC Box Girder Bridge

Number of box cells

Considering the width of the bridge deck (12.25m) and referring to Table 6.2-23 below, the

number of box cells is determined as one box with PC slab.

Bottom slab width

Following the above ratio 0.50 to 0.60, the bottom slab width is determined as 6.0m.

Table 6.2-23 Standard PC box dimensions

Box type	Slab type	Total width of deck (m) 5 10 15	Ratio of bottom & top slab width
1 cell	RC		0.55~0.65
	PC		0.50~0.60

Thickness of each member

Considering the above dimensions and referring to similar experience of PC box girders, the thickness of the top slab, bottom slab and web are determined as shown below:

- Cantilever slab: 250 to 600mm
- Top slab on box cell: 250 to 600mm
- Bottom slab: 250 to 800mm
- Web: 450mm

(2) JCT Overpass Bridge

All three JCT on Ring Road No. 3 have overpass bridges. JCT1 overpass crosses over TL359C, JCT2 overpass crosses over TL359, and JCT3 overpass provides access to the trunk line of the VSIP road.

Economical Super-T girders are applied for the JCT overpass bridges.

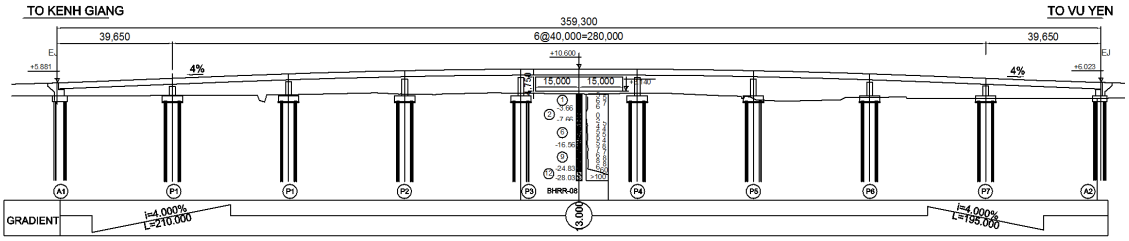


Figure 6.2-20 JCT Overpass Bridge (JCT1)

6.3 Study of Overloaded Vehicles

Overloaded vehicles seem to cause pavement damage in Vietnam as can be observed on Kien Bridge. Many overloaded vehicles are observed on the roads near the port, and the Survey Team will carry out axle weight tests for heavy vehicles and suggest countermeasures to control the damage caused by overloaded vehicles.

6.3.1 Investigation of Present Condition of Bridges

(1) Binh Bridge

Binh Bridge which is maintained by the Hai Phong Bridge Projects Management Department (HPBMD hereinafter) was investigated at the site and the results are shown below. At present there are not any maintenance problems. The pavement over the bridge is in good condition, partly due to the lower traffic volume compared to Kien Bridge. Pavement Photo is shown in Figure 6.3-1.

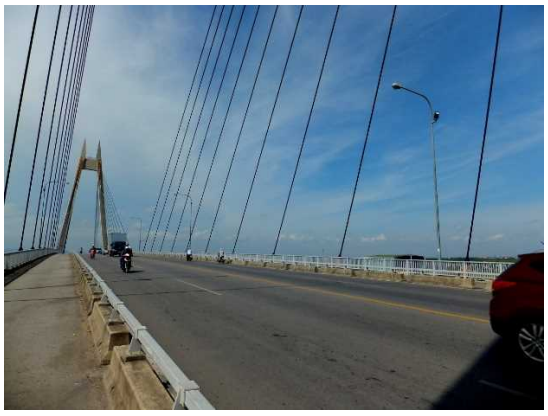
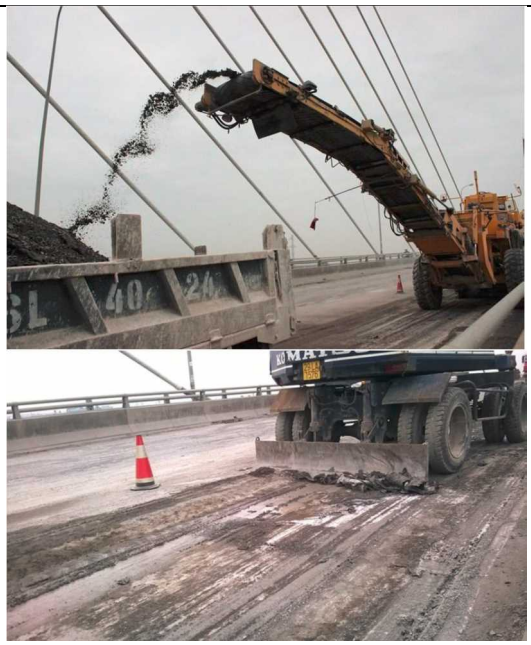
	
Center span At about 4:00 PM, the bridge was not congested. Pavement is good condition.	The south approach of Binh Bridge. The vertical gradient is 4%, which is the same as Kien Bridge.

Figure 6.3-1 Pavement condition of Binh Bridge

(2) Kien Bridge

The present condition of Kien Bridge on QL10 was investigated on site. The approach gradient of the bridge is 4% which is the same as that of Binh Bridge. Kien Bridge has only two lanes and a large number of heavy vehicles pass the bridge every day. The vehicles always run over the same part of the bridge because it only has two lanes. Since the vehicles are heavier and always run over the same part, the conditions for the pavement are much harsher than those of Binh Bridge. This is probably one of the reasons for the more rapid deterioration of the pavement of Kien Bridge. After Kien Bridge was opened in September 2003, the pavement deteriorated rapidly. In November 2014, the road surface of the bridge was repaved. When the bridge was inspected in June 2015 by the study team, the pavement conditions were still good. However, the heavy traffic concentrated on one lane may result in earlier deterioration of the pavement. The inspection results are shown below.

Pavement conditions of Kien Bridge in September 2014. Source: http://www.baohaiphong.com.vn/ <03/09/2014>



Repavement of Kien Bridge, November 2014 Source: http://www.baohaiphong.com.vn/ <03/09/2014>

As heavy trucks are slower, traffic congestion is common. The vertical gradient of the bridge is 4%.

Unevenness has already appeared after repavement about 6 months earlier.

Figure 6.3-2 Pavement condition of Kien Bridge

(3) Cause of Pavement Damage

1) Characteristics of heavy vehicle on Kien Bridge

At Station 2, near the Kien Bridge and at Station 3 near the Binh Bridge, axle weights of trucks and busses were measured. At Station 2, 347 trucks & buses, which is 10.3% of the average daily volume of heavy vehicle (i.e. trucks & buses), were measured. At Station 3, 154 trucks & buses, which is 11.4% of the average daily volume of heavy vehicle (i.e. trucks & buses), were measured. This means that the closely same amount of heavy vehicles of each bridge was measured. The result of axle weight distribution is shown below. From Figure 6.3-3, it is quite obvious that the larger amount of heavy vehicles pass through the Kien Bridge than the Binh Bridge.

Maximum axial weight is 15.81ton for Kien Bridge and 15.60 ton for Binh Bridge.

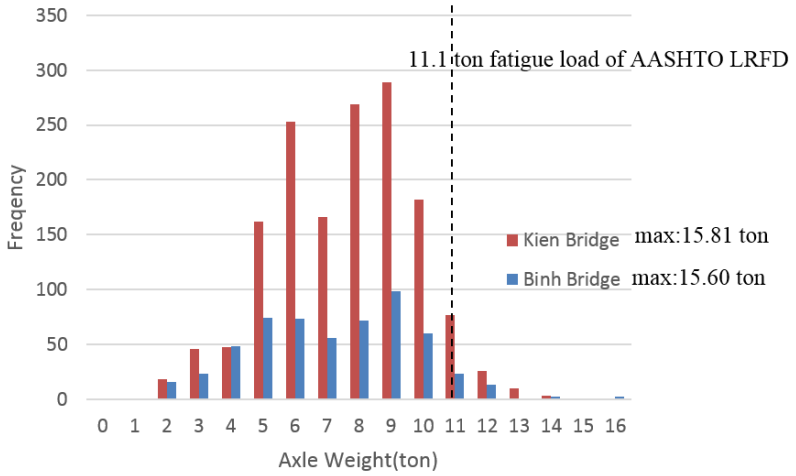


Figure 6.3-3 Axle Weight Distribution of Trucks & Buses

If these two distributions are compared for one lane of the bridge, the frequency of the Binh Bridge needs to be halved because the Binh Bridge has 2 lanes in each direction.

2) Potential cause of pavement damage

About 6 months after Kien Bridge was repaved, the pavement condition were still good on the whole, however it has already deteriorated and surface unevenness has appeared partially. This is probably due to the following reasons:

- Because Kien Bridge is steep, heavy and often overloaded trucks climb up the bridge at a very low speed which often results in congestion.
- Many heavier trucks run through the Kien Bridge but for the Binh Bridge, heavier trucks seldom pass through. As the gradient of the Kien Bridge is steep, heavier trucks need to climb the bridge with a large friction force. Consequently the pavement surface of the Kien Bridge is always pulled downward with a larger friction force.

Result of axial survey will clarify the very severe loading condition of the Kien Bridge compared to the Binh Bridge. If the overloading is defined as more than 10t axle weight, the number of overloading vehicles is comparatively smaller. But the loading condition of the Kien Bridge is very severe, it is recommended to install a weighing station to eliminate overloading vehicles.

- The road of Binh Bridge is wide and has 4 lanes, but Kien Bridge is narrow with only 2 lanes (one in each direction). Therefore, heavy trucks always use the same lane and almost the same part of the lane. This results in very harsh conditions for the pavement.
- The summer temperature in Hai Phong is sometimes more than 40℃. The surface

temperature of the pavement may rise more than this which is very harsh on the pavement.

- The combined effects of the above conditions will influence the pavement and the pavement of the Kien Bridge may therefore deteriorate faster than the pavement of Binh Bridge.
- Although many heavy trucks could be observed, it is not clear whether they were overloaded or not because the axle weights were not measured.
- In this inspection, no deterioration of the concrete bridge decks was found.

6.3.2 Possible Countermeasures

(1) Elimination of Overloaded Vehicles

1) Installation of Check Points for Overloaded Vehicles

Vu Yen Bridge is on the circumferential road around Hai Phong City and large vehicles may pass on the bridge because Lach Huyen Port is currently under construction. Therefore it is recommended to install check points for overloaded vehicles before and after the bridge. (Refer to Figure 6.3-4)

On the other hand, Nguyen Trai Bridge is on the road which connects the old and new city areas, and it is thus expected that fewer large trucks will pass on the bridge. But overloaded trucks may still utilize the bridge and should therefore be checked by daily patrols. If overloaded trucks are found, they should be directed to the check points at Vu Yen Bridge to check their weight.

●Existing locations with axle load meters

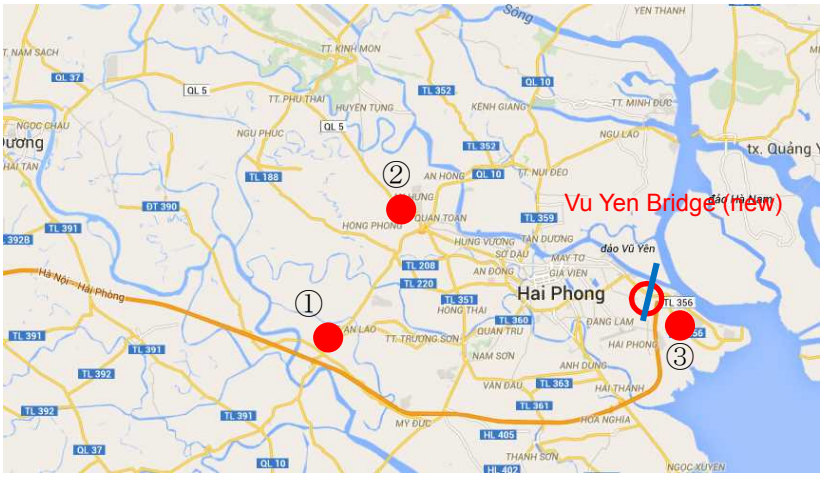
① For QL5: Quan Toan

② For QL10: AnLao

③ For the port: Along TL356

●New locations with axle load meters

④ Kien Bridge: Near the vacant area of National Highway Route 10 (Xa An Hong)



Existing locations with axle load meters:

① For National Highway Route 5: QuanToan
② For National Highway Route 10: AnLao
③ For the port: Prefectural Road 356

New locations with axle load meters:

④ Vu Yen Bridge

Figure 6.3-4 Check point of axial load

2) Education of Transportation Administrators and Road Administrators

Damaged pavements caused by overloaded vehicles may not only deteriorate the safety of pedestrians but also affect the bridge structures. Rain water may seep into the concrete bridge

decks and the rebars inside may rust and increase in volume. This will damage the concrete bridge deck even further. If this situation is left untreated, the concrete bridge deck may deteriorate further and need to be repaired or replaced.

The photos show the damaged pavement of Kien Bridge (Figure 6.3-4). It is difficult for motorbikes to run safely, and even locations without pavement can be identified. The bridge was already repaved in 2014, but if this situation continues, the actual bridge structure may finally be affected.

It is therefore recommended to educate Transportation Administrators and Road Administrators by holding seminars on the fact that the overloaded vehicles can considerably damage pavements and structures.

(2) Adoption of Abrasion Resistant and Flow Resistant Pavement

1) Concept of pavement on bridge

Abrasion resistant and flow resistant pavement is effective against overloaded vehicles. But at the same time, this kind of pavement is less flexible in following the deflection of the bridge deck. As long span bridges tend to have larger deflection, this pavement is difficult to follow the deflection and tends to peel apart from the bonding layer. As the pavement on the bridge deck is so thin that it cannot support the vehicle weight by itself, instead the pavement together with the bridge deck can support the vehicle weight. The bonding between the pavement and the bridge deck is therefore very important. When highly abrasion resistant and flow resistant pavement is adopted, the bonding between the pavement and the bridge deck including the deflection characteristics of the bridge need to be investigated carefully, and the best bonding method needs to be selected.

2) Highly Abrasion Resistant and Flow Resistant Pavement on Bridge Deck

Pavement in which coarse aggregates are fixed by fiber reinforced asphalt mortar is called Stone Mastic Asphalt (SMA).

Resin Asphalt employs resin to fix the coarse aggregates. This pavement is suitable for bridge deck pavements.

Resin asphalt shows excellent characteristics in the laboratory but site mixture control and temperature control are very difficult and the paving work is very difficult and consequently very expensive. This pavement is applied only on special locations and there are only a few examples of actual use.

SMA pavement can be applied with conventional machines and no special machines are needed. Thus this pavement is comparatively cheaper. Since this pavement has some water tightness, it has been applied to orthotropic steel decks. However, it was later revealed that the water tightness was not sufficient, the flexibility was inadequate and significant damage was found. This pavement is thus not applied to orthotropic steel decks anymore.

For concrete bridge decks which are less flexible, SMA is still suitable. SMA is highly abrasion resistant and flow resistant and can withstand overloaded vehicles to some extent. The general

composition of SMA pavement is shown below.

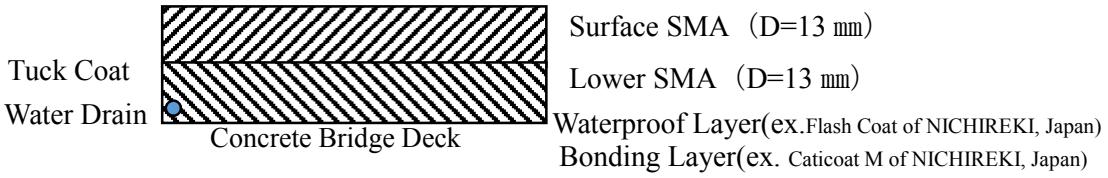


Figure 6.3-5 SMA Pavement over Bridge Deck

3) Important points for the application of SMA Pavement

- SMA Pavement is highly abrasion resistant and flow resistant. But it is at the same time hard and less flexible in following deflection, and therefore not suitable for structures with large deflection.
- The pavement over the bridge deck is thin and not strong enough. The pavement and the bridge deck work together to withstand the vehicle weight, and bonding between them is therefore very important.
- Laitance, dust and sand on the bridge deck needs to be removed completely and the flatness of the surface needs to be ensured. A good quality bonding layer then needs to be applied on the surface.
- The run-ability over SMA pavement is slightly inferior compared to conventional pavement as it is harder.
- SMA pavement itself is not completely watertight. To prevent deterioration due to rainwater seepage, water drains need to be installed inside the pavement so that water can be drained smoothly.

4) Bridge deck pavements other than SMA pavement

Conventional modified asphalt pavement is applied over the bridge deck.

To increase abrasion resistance and flow resistance, the amount of asphalt binder can be reduced to a minimum. But any pavement methods do not account for illegally overloaded vehicles. It should be noted that the application of modified asphalt is the international standard.

Pavement quality often depends on the quality of the site execution work rather than the quality of the blend design. These specification should be described clearly in construction specification in tender document.

5) Waterproof on the deck

Water proofing on the deck has 3 types: Membrane type, painted type and spray type. There is conflict between reliability and workability.

- Reliability: Membrane type > painted type > spray type
- Workability: Membrane type < painted type < spray type

Sheet waterproof and coated waterproof are required edhesion layer, but membrane waterproof is

not required edhesion layer by spraying permeation.

In Vietnam, to avoid occurring blisters due to lack of construction technology, coated waterproof or membrane waterproof is recommended.

Chapter 7 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

7.1 Basic Policy on Environmental and Social Considerations

The Project is anticipated to have a significant impact on the natural environment on a large area around the project sites. Hundreds of households would be affected by land acquisition for the Project, and a number of local communities around the project sites will be affected during the planning, construction, and operation phases of the Project. In addition, the Project may have an impact on the natural eco-system of Vu Yen Island.

The EIA study and reporting shall be undertaken in accordance with the following guidelines, laws and regulations.

(1) Japan International Cooperation Agency Guidelines for Environmental and Social Considerations, April 2010, (hereinafter referred to as "JICA Environmental Guidelines"), especially Appendix 2. EIA Reports for Category A Projects (http://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf)

(2) World Bank Operational Policies, OP 4.01 Annex B

(3) Relevant laws, guidelines, regulations, etc. of the Government of the Socialist Republic of Vietnam

The JICA Survey Team will assist the Vietnamese authorities to carry out the studies on environmental and social considerations (including the stakeholder consultation meetings), and prepare drafts of the EIA and RAP reports to submit to the competent Vietnamese authorities and JICA for approval.

7.2 Environmental and Social Considerations in Project Preparation Procedures

Because of revisions of major laws and regulations on public investment and environmental issues in recent years, legal procedures to prepare an ODA project has been changed in terms of environmental and social considerations, especially in the field of environmental impact assessment and land acquisition. The most important laws form ground of legal procedures for ODA projects are as follows;

(1) Public Investment Law (2014)

(2) Environment Protection Law (2014)

(3) Land Law (2013)

Figure 7.2-1 shows major laws on procedures of environmental and social considerations with their supporting lower legal documents, such as Decree and Circular.

1. Overall Procedures

No. 49/2014/QH13

Public Investment Law (Luật đầu tư công)

Stipulates general procedures, documents, and authorities in charge based on project classification

[Hai Phong Arterial Road]
- *Group A using ODA as main capital*
- *Pre-FS for Investment Policy Approval by PM*
- *FS for Project Investment Decision by Hai Phong PC*

* Legal gaps are observed between Public Investment Law and Decree 38 (HPPC requested guidelines from MPI)

No. 38/2013/ND-CP

Decree on Management and Utilization of Official Development Assistance (ODA) and Concessional Loans from Donors (Quy định về quản lý và sử dụng nguồn hỗ trợ phát triển chính thức (ODA) và nguồn vốn vay ưu đãi của các nhà tài trợ)

- Formulation and submission to competent agencies for approval of the resettlement policy framework (Khung chính sách tái định cư) prior the program or project documents are appraised and approved (Article 17, b)
- In cases where there is discrepancy between provisions of Vietnamese law and international treaties, such international treaties shall take precedence (regarding resettlement, Article 46, 1.)

2. Environmental Impact Assessment

No. 55/2014/QH13

Environmental Protection Law

(Luật Bảo vệ Môi tường)

Stipulates general procedures, documents, and authorities in charge based on project classification

[Hai Phong Arterial Road]

- Investment Policy Approval requires EIA certification with other necessary documents such as Pre-FS report

No. 18/2015/ND-CP

Decree on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (Quy định về quy hoạch bảo vệ môi trường, đánh giá môi trường chiến lược, đánh giá tác động môi trường và kế hoạch bảo vệ môi trường)

Stipulates project classification

[Hai Phong Arterial Road]

- MONRE approve EIA Report (Appendix III)

No. 27/2015/TT-BTNMT

Circular on Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (Thông tư về đánh giá môi trường chiến lược, đánh giá tác động môi trường và kế hoạch bảo vệ môi trường)

Stipulates necessary procedures for EIA approval

3. Land Acquisition and Resettlement

No.45/2013/QH13

Land Law (Luật đất đai)

Stipulates general procedures, documents, and authorities in charge for land acquisition and resettlement including resettlement policy framework.

[Hai Phong Arterial Road]
For projects using loans from international or foreign organizations for which Vietnam has committed to a policy framework for compensation, support and resettlement (Khung chính sách về bồi thường, hỗ trợ, tái định cư), that framework policy shall be applied (Article 87, 2.)

No. 43/2014/ND-CP
Decrees on Detailing a Number of Articles of the Land Law
Stipulates implementation of land acquisition

No. 44/2014/ND-CP
Regulations on Land Prices
Stipulates land pricing rules and methodology

No. 47/2014/ND-CP
Regulations on Compensation, Support, and Resettlement upon Land Expropriation by the State
Stipulates supplemental method for resettlement compensation and assistance

Figure 7.2-1 Major Laws and its lower legal documents

According to the major laws and regulations, an ODA project shall commonly go through the following procedures:

(1) To be classified into project category, namely; (a) national important project, (b) group A project, (c) group B project (according to Public Investment Law)
(2) Depending on the above classification, an ODA Project shall require several survey reports and documents, such as EIA report, pre-FS report, and etc., to get investment policy approval (phê duyệt chủ trương đầu tư) from certain authority, such as national assembly, prime minister, etc..
(3) After obtaining the investment policy approval, depending on its category, a project may require an FS report to get a decision of project investment (quyết định đầu tư). Usually, the project investment is decided by an authority in a level lower than the authority who approved the investment policy.
(4) After the project investment decision, concrete plans are established to implement the project at sites.

7.3 Confirmation of Relevant Vietnamese Laws, Regulations and Institutions on EIA

7.3.1 Main laws and regulations on environmental protection

Table 7.3-1 lists the main laws and regulations on environmental protection in Vietnam.

Table 7.3-1 Main Laws and Regulations on Environmental Protection in Vietnam

Date of Issuance	Code/Number	Title
2000/08/08	Circular No. 10/2000/TT-BXD	Guiding the formulation of EIA report for a construction project
2002/06/26	Decision No. 82/2002/QD-TTg	Establishment, Mandate and Operations of the Vietnam Environment Protection Fund
2002/07/16	Decision No. 53/2002/QD-BKHCNMT	Promulgating the Organization and Operation Charter of Vietnam Environmental Protection Fund (expired)
2002/08/09	Decision No. 62/2002/QD-BKHCNMT	Promulgating the Regulation on the Protection of the Environment in Industrial Parks
2002/11/11	Decree No. 91/2002/ND-CP	Prescribing the Functions, Tasks, Powers and Organizational Structure of the Ministry of Natural Resources and Environment
2003/04/02	Decision No. 45/QD-TTg	Establishment of provincial Department of Natural Resources and Environment.
2003/05/08	Decision No. 600/2003/QD-BTNMT	Specifying mandates, responsibilities; powers and organizational structure of the Department of Water Resources Management
2003/06/23	Decision No. 782/2003/QD-BTNMT	Promulgating the Charter on organization and operation of Vietnam Environment Protection Fund

Date of Issuance	Code/Number	Title
2005/12/12	Order No. 29/2005/L-CTN	Law on Environmental Protection
2005/12/12	Decision No. 328/2005/QD-TTg	Approving the state plan on environmental pollution control till 2010
2006/06/23	Decree No. 65/2006/ND-CP	Organization and Operation of the Natural Resources and Environment Inspectorate
2006/08/09	Decree No. 80/2006/ND-CP	Providing detailed guidelines for Implementation of a Number of Articles of the Law on Environmental Protection (Note *)
2006/08/09	Decree No. 81/2006/ND-CP	Sanctioning of Administrative Violation in the Domain of Environmental Protection
2006/09/08	Circular No. 13/2006/TT-BTNMT	Stipulation of organizations and operation of the assessment board for reports on Strategic Environmental Assessment (SEA) and EIA
2006/09/09	Circular No. 08/2006/TT-BTNMT	Guiding the preparation of Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment
2006/11/22	Decree No. 140/2006/ND-CP	Providing for the Environmental Protection at Stages of Elaboration, Evaluation, Approval and Implementation of Development Strategies, Planning, Plans, Programs and Projects
2007/08/27	Circular No. 06/TT-BKH	On environmental protection in appraising and approving programs and projects
2007/08/27	Decision No. 1281/QD-BTNMT	Authorizing directors of departments to review and approve the EIA reports
2007/11/26	Decision No. 19/2007/QD-BTNMT	Promulgating the Regulation on the conditions for and provision of the service of appraising environmental impact assessment reports
2008/02/28	Decree No. 21/2008/ND-CP	Amending and supplementing a number of articles of the Government's Decree No. 80/2006/ND-CP of August 9, 2006, detailing and guiding the implementation of a number of articles of the Law on Environmental Protection (Note *)
2008/07/15	Circular No. 03/2008/TTLT-BTNMT- BNV	Guiding the functions, tasks, powers and organizations of the natural resources and environment related specialized units under the people's committees at all levels
2008/09/15	Decree No. 102/2008/ND-CP	On the collection, management, exploitation and use of natural resources and environmental data
2008/09/18	Circular No. 04/2008/TT-BTNMT	Guiding the formulation and approval or certification of environmental protection schemes and the examination and inspection of implementation of environmental protection schemes
2008/09/30	Decision No. 132/2008/QD-TTg	On function, tasks, responsibilities, and organization structure of Vietnam Environmental Protection Administration under MONRE
2008/12/08	Circular No. 05/2008/TT-BTNMT	Replace Circular 08/2006/TT-BTNMT on Guiding the preparation of Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment
2009/11/16	Circular No. 25/2009/TT-BTNMT	On the promulgation of National Technical Regulations on Environment.

Date of Issuance	Code/Number	Title
	Circular No. 39/2010/TT-BTNMT	National Technical Regulations on Environment.
	Circular No. 09/2010/TT-BTNMT	On environmental protection in developing transport infrastructure
2010/03/18	Circular No. 08/2010/TT-BTNMT	Stipulation on the preparation of national environmental report, sectorial environmental situation report, and provincial environmental status report
2010/04/06	Circular No. 09/2010/TT-BGTVT	Stipulation on environmental protection for transportation infrastructure development projects
2011/04/14	Circular No. 12/2011/TT-BTNMT	On management codes of harmful wastes
2011/04/18	Decree No. 29/2011/ND-CP	Stipulation on strategic environmental assessment (SEA), environmental impact assessment (EIA), and environmental protection commitment (EPC) (Replaced by Decree 18/2015/ND-CP)
2011/07/18	Circular No. 26/2011/TT-BTNMT	Guiding in detail numbers of articles of Decree No. 29/2011/ND-CP dated 18 April 2011 on strategic environmental assessment (SEA), environmental impact assessment (EIA) and environment protection commitment (EPC). (Note *)
2012/03/16	Circular No. 01/2012/TT-BTNMT Replaces Circular No. 04/2008/TT-BTNMT	Regulation on setting-up, assessment, approval, inspection and certification of the implementation of detailed environmental protection project; setting-up and registration of simple environmental protection project
2013/11/14	Decree No. 179/2013/ND-CP	Decree on the sanction of administrative violations in the domain of environmental protection
2014/03/25	Decision No.25/2014/QD-TTg	Stipulation on function, responsibility, right, and organization structure of Vietnam Environmental Administration (VEA)
2014/04/29	Decree No. 35/2014/ND-CP (came into effect on 15 June 2014)	Amending and supplementing a number of articles of the Government's Decree No. 29/2011/ND-CP of stipulation on strategic environmental assessment (SEA), environmental impact assessment (EIA), and environmental protection commitment (EPC). (Replaced by Decree 18/2015/ND-CP))
2014/05/05	Circular No. 22/2014/TT-BTNMT	Providing regulations and guidelines on the implementation of Decree No. 35/2014/ND-CP dated 29 April 2014 amending and supplementing a number of articles of Decree No.29/2011/ND-CP dated 18 April 2011 providing for the strategic environmental assessments, environmental impact assessments and environmental protection commitments
2014/06/23	**Law No.55/2014/QH13**	**Law on Environmental Protection (2nd revision) (Note*)**
2014/08/28	Circular No.50/2014/TTLT-BTNMT-BNV	On function, responsibility, right, and organization structure of agency in charge of natural resources and environment in provinces, cities, districts.
2015/01/06	Decree No.03/2015/ND-CP	Stipulations on confirmation of damages to environment

Date of Issuance	Code/Number	Title
2015/02/14	**Decree No.18/2015/ND-CP**	**Stipulations on environmental protection master plan, strategic environmental assessment, environmental impact assessment, and environmental protection plan. (Note *)**
2015/02/14	**Decree No.19/2015/ND-CP**	**Stipulations on the implementation of several articles of Environmental Protection Law. (Note *)**
2015/05/29	**Circular 27/2015/BTNMT**	**Providing guidance on a number of articles of Law on Environmental Protection 2014 and Decree 18/2015/ND-CP on strategic environmental assessment, environmental impact assessment, and environmental protection plan. (Note *)**

Note *: Law or regulation which should be especially considered for the EIA of the Project.

The Government of Vietnam has so far signed 32 international environmental conventions/ agreements/ treaties, and is currently considering to join another six (refer to the document "Register of International Treaties and Other Agreements in the Field of the Environment", published by UNEP in 2005, and the website of the Vietnam Environmental Protection Agency). Table 7.3-2 lists the main international conventions/ agreements/ treaties related to environmental protection which Vietnam has signed.

Table 7.3-2 List of International Environmental Conventions/ Agreements/ Treaties signed by Vietnam

No.	Name	Effective Date in Vietnam	Manage-ment Body
1.	Cartagena Protocol on Biosafety	2004 Ac	VEPA, MONRE
2.	Kyoto Protocol on Climate Change	2002 R	GDMH, MONRE
3.	Stockholm Convention on Persistent Organic Pollutants (POPs)	05/2001 R	VEPA, MONRE
4.	UN's International Declaration on Cleaner Production	22/9/1999	MPI
5.	UN Convention to Combat Desertification	23/11/1998 Ac	MARD
6.	Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal	13/03/1995 Ac	VEPA, MONRE
7.	Agreement on Cooperation for the Sustainable Development of the Mekong River Basin	1995 S	MFA
8.	United Nations Convention on the Law of the Sea (UNCLOS)	25/07/1994 R	MFA
9.	Vienna convention for the protection of the ozone layer including the Montreal Protocol on Substances that Deplete the Ozone Layer	26/01/94 Ac	GDMH
10.	United Nations framework Convention on Climate Change	16/11/1994 R	MONRE
11.	Convention on Biological Diversity (CBD)	16/11/1994 R	VEPA, MONRE
12.	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	20/01/1994 R	MARD
13.	MARPOL International Convention for the Prevention of Pollution from Ships	29/08/1991 S	VNMB, MOT
14.	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar)	20/9/1988	MONRE, MARD
15.	Convention Concerning the Protection of the World Cultural and Natural Heritage	10/10/1987 At	MOCI
16.	Convention on the Conservation of Migratory Species of Wild Animals (CMS)	Under discussion	
17.	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction	1998 R	NP
18.	Agreement on the Network of Aquaculture Centres in Asia and the Pacific	1989	MONRE
19.	Agreement for the Establishment of the Asia-Pacific Fishery Commission	1995 At	MOF
20.	Agreement on the Conservation of Nature and Natural Resources	Under discussion	

Legend: DMH: General Department of Meteorology and Hydrology, MOF: Ministry of Fisheries, VNMB: Vietnam Marine Bureau, MFA: Ministry of Foreign Affairs, MOT: Ministry of Trade, MONRE: Ministry of Natural Resources and Environment, MARD: Ministry of Agriculture and Rural Development, MPI: Ministry of Planning and Investment, MOH: Ministry of Health, MOST: Ministry of Sciences and Technologies, MOT: Ministry of Transportation, MOCI: Ministry of Culture and Information (now the Ministry of Culture, Sport and Tourism), NP: National President.;
S: Signed, R: Ratified, At: Accepted, Ap: Approved, Ac: Accession

7.3.2 Law on Environmental Protection

In Vietnam, the Law on Environmental Protection (LEP) is the umbrella law and the most comprehensive legal base related to environmental protection. Its first version was approved in 1993, and it was first amended in 2005 and then again in 2014. The Law on Environmental Protection amended in 2014 (hereinafter referred to as "LEP amended in 2014") was passed on 23 June 2014 by the XIIIth National Assembly (with law code 55/2014/QH13), and became effective on January 1, 2015.

In addition, the Government of Vietnam has also issued Decree 18/2015/ND-CP and then Decree 19/2015/ND-CP to provide instruction and guidance for the implementation of the LEP.

Circulars to provide detailed guidance for the implementation of the LEP may be under preparation by MONRE. However, the procedure to prepare, apply, appraise, and approve EIA reports may not be different from the current procedure as shown in Figure 7.3-1.

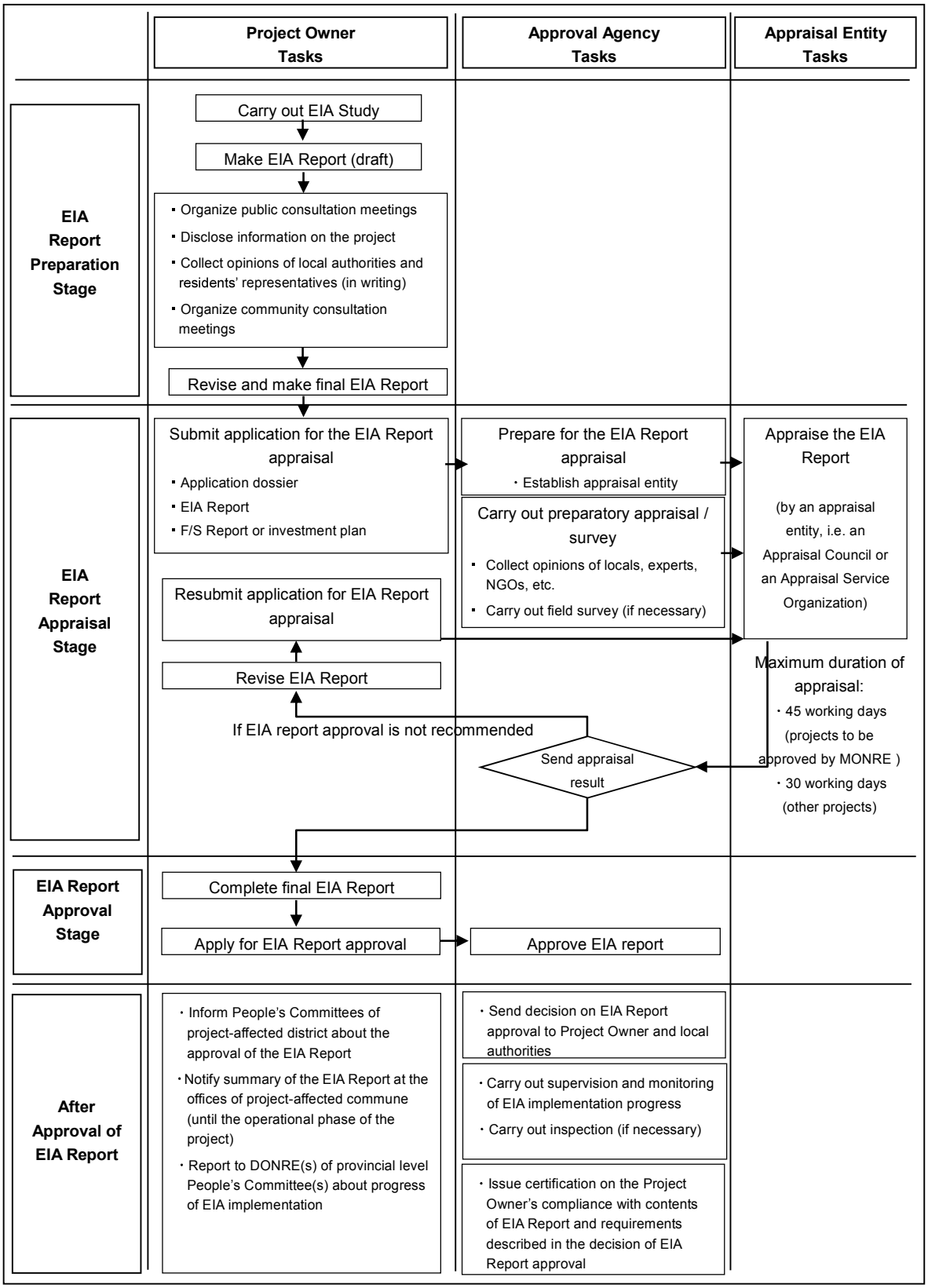


Figure 7.3-1 Flow-chart with Procedure for Preparation, Appraisal and Approval of EIA Report

7.3.3 Policy gap

Table 7.3-3 summarizes the gaps between JICA Environmental Guidelines and Vietnam regulation on EIA.

Table 7.3-3 Gaps between JICA Environmental Guidelines and Vietnam regulations on EIA

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
Underlying principles		
1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.(Appendix 1, 28p)	According to the new Law on Environmental Protection, implementation of strategic environment assessment (SEA) is required before stage of F/S, for general strategy and planning for socio-economic development of keys regions, centrally-governed cities, industrial zones, etc. Only for the project which causes significant impacts (as listed up in Appendix II of Decree 18/2015/ND -CP), implementation of EIA is required during F/S stage.	In this Preparatory Survey, the environmental assessment is carried out based on the framework of EIA report stated in JICA Environmental Guidelines and World Bank OP. In addition, during the EIA implementation for this project, the SEA report prepared for the master plan of the Dinh Vu-Cat Hai Economic Zone Development Project is reviewed and referred to.
2. Such examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects. (Appendix 1, 28p)	There is no particular provision on this item in the legal framework on EIA in Vietnam.	Analysis of alternatives and mitigation measures is carried out in the most quantitative terms possible. Particularly, mitigation measures for impacts of air pollution and noise are examined and assessed quantitatively based on results of traffic volume forecast, etc.
3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures, and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts. (Appendix 1, 28p)	A project that may cause significant adverse environmental impacts should prepare an EIA report as stipulated in the new Law on Environmental Protection (Article 19) and Decree 18/2015/ND-CP.	In this Preparatory Survey, an EIA report is prepared based on both legal framework on EIA in Vietnam and in conformity with requirements of JICA Environmental Guidelines.
4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability. (Appendix 1, 28p)	There is no particular provision on this item in the legal framework on EIA in Vietnam.	The Study Team intends to monitor and confirm the accountability of the project activities, during its implementation process, through the local stakeholder consultation meetings and other on-site studies. If it observes any identified critical problem, then proper solutions will be examine.

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
5. When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country. (Appendix 2, 30p)	According to the new Law on Environmental Protection and Decree 18/2015/ND-CP, the Hai Phong Arterial Road Construction Project should prepare an EIA report and obtain the approval by MONRE.	During the Preparatory Survey, the JICA Study Team will assist the Vietnam counterpart agencies in preparing an EIA report in accordance with Vietnam regulations, and submitting it to MONRE for approval.
Examination of Measures		
1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures. (Appendix 1, 28p)	Examination of alternatives on the project location was stipulated in Circular 26/2011/ TT-BTNMT. But, such examination is not mentioned in the recently- issued Circular 27/2015/TT-BTNMT. It seems that alternatives for a road construction project are examined only during the establishment of the socio-economic development masterplan and the transportation masterplan of the province, or region, or transportation sector. However, the suitability of the project location should be assessed and described in the EIA report, taking into account the natural environment and socio-economic condition of the project area, according to Circular 27/2015/TT-BTNMT.	In the Preparatory Survey, several alternatives including zero-option, alternatives on road alignment, means and types of river crossings, bridge structures, etc., are examined. In particular, alternatives on road alignment are carefully examined with aim to avoid impacts of land acquisition, resettlement, and split of community. Measures to minimize/mitigate impacts are examined only when these impacts cannot be avoided. And road structures such as viaducts, bridges, culverts, etc., are designed to the extent possible to mitigate impacts to the ecosystems of mangrove forests and wetlands.
2. Appropriate follow-up plans and systems, such as monitoring plans and environmental management plans, must be prepared; the costs of implementing such plans and systems, and the financial methods to fund such costs, must be determined. Plans for projects with particularly large potential adverse impacts must be accompanied by detailed environmental management plans. (Appendix 1, 28p)	The structure and content of and EIA report are stated in detail in Appendix 2.3 of Circular 27/2015/TT-BTNMT issued by MONRE on May 29, 2015. According to this Circular, an environmental management plan and an environmental monitoring program should be described in detail in Chapter 5 of an EIA report.	In the Preparatory Survey, an environmental management plan and an environmental monitoring program are prepared and described in the EIA report in conformity with Vietnam regulations on EIA.
Impacts to be assessed.		
1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as	According to Appendix 2.3 of Circular 27/2015/TT-BTNMT (stipulating in detail a number of articles of Law on Environmental Protection and Decree 18/2015/ND-CP), impacts in pre-construction phase, construction phase, and operation phase should be anticipated and assessed. In pre-construction phase, the suitability of the project location should be assessed.	It can say that in Vietnam, stipulations on impact assessment for items such as natural environment and pollution are relatively well prepared. There are many detailed provisions, technical specifications, standards, etc. relating to ambient air, water quality, noise, vibration, soil pollution, etc. But it can say that stipulations on

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. (Appendix 1, 29p)	In construction phase and operation phase, all project activities should be identified and impacts caused by these activities should be anticipated and assessed while taking into considerations the source of impact, subject of impact, extent of impact, occurrence frequency of impact, recovering possibility, etc. Major impacts which need to be assessed as listed in Appendix 2.3 of Circular 27/2015/TT-BTNMT are: (1) impacts to natural environment; (2) impacts to biodiversity; (3) impacts to public health; and (4) impacts to climate change. Considerations to vulnerable people such as the poor, woman headed-households, etc. are discussed in the "*plan of compensation, supports, and resettlement"* as measures to mitigate impacts to people directly affected by the land acquisition.	assessment of impacts to social environment of the communities around the project area are not properly mentioned. Under this situation, the following environmental factors will be particularly considered by the JICA Study Team during the Preparatory Survey: (1) local economy (employment, livelihood, etc.); (2) utilization of land, etc.; (3) local resources, social institutions, local decision-making institutions; (4) vulnerable social groups (the poor, indigenous peoples, etc.); (5) equality of benefits and losses; (6) equality in the development process; (6) gender, children's rights; and (7) local conflicts of interest.
2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project. (Appendix 1, 29p)	There is no particular provision on this item in the legal framework on EIA in Vietnam.	In addition to the direct and immediate impacts of the project, the derivative, secondary and cumulative impacts as well as the impacts of projects that are indivisible from the project are also examined and assessed in this Preparatory Survey.
Compliance with Laws, Standards, and Plans		
1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction. (Appendix 1, 29p)	According to Appendix 2.3 of Circular 27/2015/TT-BTNMT, all laws and regulations that form the basis of the EIA study should be listed up in the preface of an EIA report.	The Preparatory Survey is planned in conformity with the Law on Environmental Protection and other regulations, technical specifications, standards, etc., on EIA in Vietnam.
2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of	Any project that requires to use the land of national parks, wildlife sanctuary, world heritage sites, biosphere reserved, historic	There is no designated protection area or historic-cultural heritage around the project area.

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas. (Appendix A7)	-cultural sites, or national scenic beauties should prepare an EIA report as stipulated in Appendix II of Decree 18/2015/ ND-CP. Development project in these areas/sites is not strictly forbidden, but an EIA report should be prepared and approved.	
Social Acceptability		
1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans. Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared. (Appendix 2, 31p) In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared. (Appendix A7)	According to Decree 18/2015/ ND-CP (Article 12), consultation with affected people is carried out through the following methods: (1) Consultation with the People's Committee of communes (commune PCs) where the project is carried out, and with organizations or community under the direct impact of the project; (2) Consultation with the community under the direct impact of the project, in the form of community meeting co-chaired by project owner and the commune PC where the project is carried out together with the participation of representatives of Vietnamese Fatherland Front of communes, socio-political organizations, socio-professional organizations, neighborhoods, villages convened by the commune PC. All opinions of delegates attending the meeting must be sufficiently and honestly stated in the meeting minutes.	In Vietnam, requirement of carrying out consultation meeting with the project-affected community during the EIA implementation is stipulated by law. However, there is no clear provision which states that project-affected people should be invited to the consultation meetings. The concept of "local stakeholders" is not commonly recognized in Vietnam. And the main objective of the consultation in the communes is just to check whether the communes agree with the project or not. In this Preparatory Survey, the following efforts are paid with aim to improve local residents' awareness about the project and promote their participation into the project activities: (1) Printing and distribution of a leaflet introducing the outline of the project; (2) Carrying out a socio-economic survey (household survey); (3) Organization of a number of local stakeholder consultation meetings subject directly to project-affected people; (4) Carrying out the meetings, group discussions with local key persons whenever possible.
2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.	There is no particular provision on this item in the legal framework on EIA in Vietnam.	Comments, requests, etc., of vulnerable social groups are collected through the SHMs, socio-economic surveys (household surveys), group discussions, etc., and are reflected in RAP and other plans prepared during the project implementation.

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
Information disclosure		
- JICA discusses frameworks with project proponents etc. in order to ensure information disclosure, and comes to an agreement in an early stage of cooperation projects. (Section 2.1, 12p) - Project proponents etc. disclose scoping drafts, which consist of project name, countries, locations, project outlines, categorizations and the reasons behind them, alternatives, impacts, and contents. Project proponents etc. also consult with local stakeholders reflecting stakeholder analysis for Category A projects and, if necessary, for Category B projects. (Section 3.1, 20p) - EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.(Appendix 2, 32p)	In Vietnam, there is no comprehensive regulation on information disclosure. There is no regulation or law on the compulsory disclosure of EIA report for the development project widely to the people. In Decree 18/2015/ND-CP (Article 16), there is a statement saying: (after obtained the EIA approval), the project owner should make an environmental management plan (EMP) on the basis of program for environmental management and monitoring suggested in the EIA report, and posted it at the premises of the commune PC where the consultation is taken place when implementing EIA. However, at the present time, there is no concrete guidance on this provision, and on the penalties should be done in cases of default. In the new Law on Environmental Protection (Article 131 stating the publishing of environmental information), the "environmental reports" are referred to as the information to be made known in the public. However, concrete provisions on how to disclose these information have not been issued. And in actuality, people may only see a copy of the decision to approve the EIA report at the office of the commune PC.	It is commonly known that people in Vietnam do not easily access to information, documents, etc., relating to the development projects. Awareness on the need to disclosure these information, documents, etc., is different among local authorities. In actuality, it is commonly seen that the local authorities have no incentive to disclose such information widely to the public. Under such condition, the JICA Study Team is paying efforts to discuss with Hai Phong City PC and PMU on any possibility to disclose information on the project through mass media, to print a leaflet introducing the outline of the project and distribute it widely to people, etc. and particularly assist Vietnam authorities in organizing a number of local stakeholder consultation meetings in the project-affected communes.
Ecosystem and Biota		
1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests. (Appendix 1, 30p)	An EIA report should be prepared and approved by competent authority for any project that requires deforestation, change in forest land uses, and change in paddy land uses, as stipulated in Appendix II of Decree 18/2015/ ND-CP.	There is no valuable natural habitats or critical forest observed around the project area.
2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way to ensure the prevention of illegal logging. (Appendix 1, 30p)	Activities that cause damages to natural resources and illegal exploitation of natural resources are prohibited (Article 7 of Law on Environmental Protection).	The project should have permission from competent agency to cut down the mangrove trees in the areas planned for the bridge piers in the next stages of project preparation.

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
Concern about Social Environment and Human Rights		
JICA respects the principles of internationally established human rights standards such as the International Convention on Human Rights, and gives special attention to the human rights of vulnerable social groups including women, indigenous peoples, persons with disabilities, and minorities when implementing cooperation projects. (Section 2.5, 15p)	In Article 4 (Principles of environ-mental protection) of the new Law on Environmental Protection, there is a statement saying: *"Environmental protection must harmonize with the economic growth, social security, assurance about the children's right, promotion of gender equality, development and conservation of biodiversity, response to climate changes, in order to ensure the human right to live in a pure environment"*. However, there is no concrete guidance on how to realize this principle.	Through the local stakeholder consultation meetings, the socio-economic surveys, the focus group meetings, etc., the needs of vulnerable social groups, such as fatherless family, persons with disabilities, elderly, poor, etc., is confirmed, and measures to support them are discussed and reflected in the RAP.
Indigenous Peoples		
1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses. (Appendix 1, 30p)	There is no particular provision on indigenous peoples in legal framework on EIA in Vietnam.	Indigenous peoples are not observed in the project area.
2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation. (Appendix 1, 30p)	- ditto -	- ditto -
3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held,	- ditto -	- ditto -

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B. (Appendix 1, 30p)		
Monitoring		
1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring. (Appendix 1, 31p)	Article 22 of the Law on Environmental Protection stipulates that a chapter on environmental management plan and environmental monitoring program should be prepared as a part of the EIA report.	There is not gap between JICA Environmental Guidelines and Vietnam regulations on EIA about the need to formulate the environmental monitoring program.
2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans. (Appendix 1, 31p)	- ditto -	In the stage of F/S or D/D of the project, the environmental management plan (EMP) and the environmental monitoring program (EMoP) should be prepared (or updated) and incorporated in the EIA report (or the updated EIA report). In addition, it needs to confirm the organizational capacity of the entities in charge of implementation of EMP and EMoP, and provide them with capacity strengthening in case of necessary.
3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders. (Appendix 1, 31p)	In Decree 18/2015/ND-CP (Article 16), there is a statement saying: "(... after obtained the EIA approval), the project owner should make an environmental management plan (EMP) on the basis of program for environmental management and monitoring suggested in the EIA report, and posted it at the premises of the commune PC where the consultation is taken place when implementing EIA." However, in the legal framework on impact assessment in Vietnam, there is no provision on the project owner's obligation to publicize results of monitoring process, and the procedure to settle complaints raised by the public on environmental issues relating to the project.	JICA shall discuss with the project proponent (Hai Phong City PC) about the framework to disclose results of environmental monitoring.

JICA Environmental Guidelines	Vietnam Regulations on EIA	Measures to fulfil gaps
4. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems. (Appendix 1, 31p)	In actuality, when local residents find out that impacts of air pollution, dust, noise, vibration, etc., are intolerable, the only way they can do is sending the complaints to the head of residential block. But it is very rare for the complaints being forwarded to the contractors and properly treated by the contractors.	In the construction phase, it needs to establish and enforce a system that can appropriately disclose information on monitoring results to local residents, and can get local residents' participation into the tasks to monitor the obligation of contractors.

7.4 Current Environmental Conditions of the Study Area

7.4.1 Collection and Review of Existing Reports

The following reports have been collected and used to initially confirm the current environmental conditions of the project area.

1) Strategic Environmental Impact Assessment (Chapter 8 - Master Plan of Dinh Vu – Cat Hai Economic Zone, Hai Phong City up to 2025, HEZA & Nikken Sekkei Civil Engineering, July 2012)
2) Environmental Impact Assessment Report for Hai Phong Ring Road No. 3 Construction Project, West Section the Urban Area and Ben Rung Industrial Zone – Hai Phong Economic Zones PMU, October 2014 (in Vietnamese).
3) Preliminary Environmental Impact Assessment (Chapter 5 - Pre-Feasibility Study for the Nguyen Trai Bridge Project at Thuy Nguyen District in Hai Phong, Vietnam, Final Report, VSIP & AECOM, April 10, 2013).
4) Study on the Highway Bridge in the New Urban Area of Hai Phong, the Socialist Republic of Vietnam, Final Report, February 2014, Chodai Co., Ltd., IHI Infrastructure Systems Co., Ltd., Mitsubishi Corporation, Nippon Steel & Sumitomo Metal Corporation, February 2014 (in Japanese).
5) Environmental impacts assessment for Bac Son - Nam Hai East-West Arterial Road, Hai Phong Urban Road Construction Project, World Bank, December 2010.
6) Environmental Impact Assessment Report for Lach Huyen Port Construction Project (Road Portion), May 2010.

7.4.2 Current natural environment

Figure 7.4-1 shows location of sites for environmental quality survey which was carried out in August 2015. Center for Training and Consultation on Environmental Technique and Conservation (Trung tâm Đào tạo và Tư vấn KHCN Bảo vệ Môi trường Thủy, Trường Đại Học Hàng Hải Việt Nam) and Environmental Center of TEDI were entrusted to carry out the survey under the JICA Study Team's supervision.

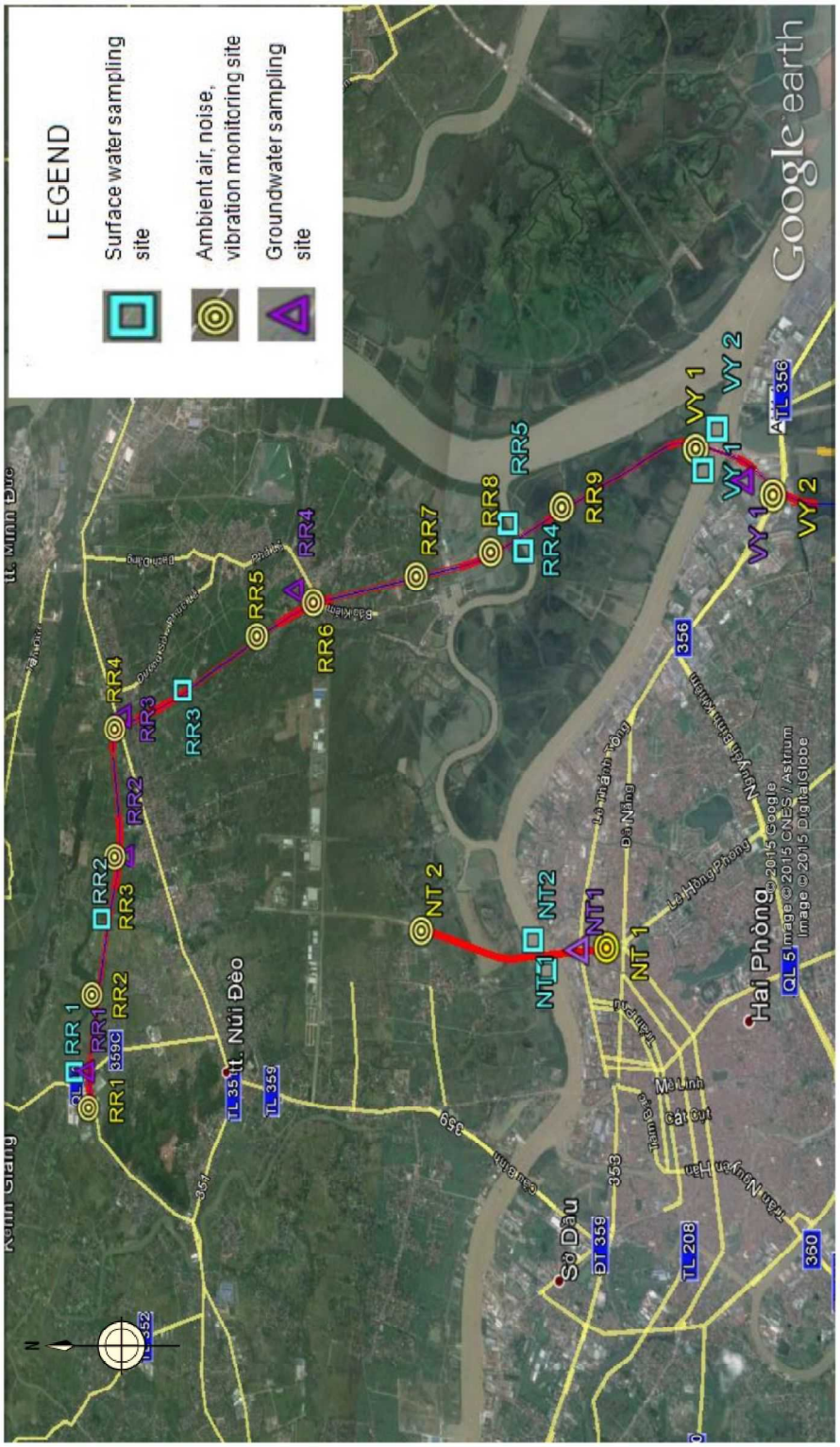


Figure 7.4-1 Location map of environmental quality survey sites in August 2015

(1) Current ambient air quality

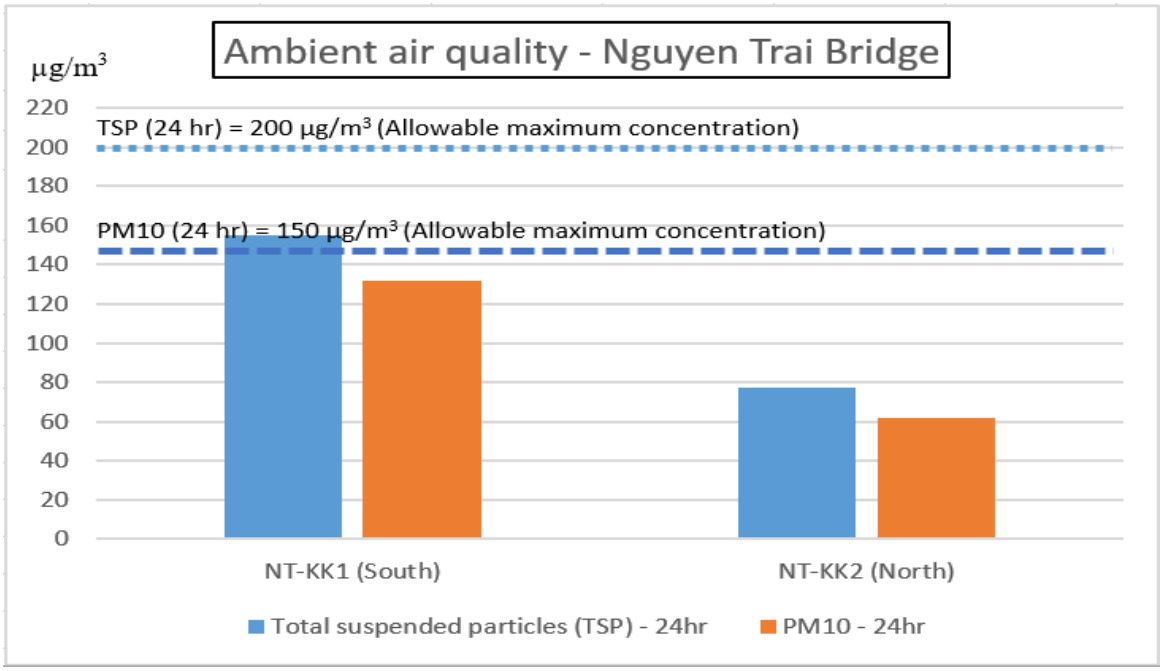
Table 7.4-1 and Figure 7.4-2 show results of survey on current ambient air quality.

Table 7.4-1 Results of survey on current ambient air quality

No.	Sign	Location	TB	Content (µg/m3)				
				TSP	PM10	SO_2	NO_2	CO
I	**Nguyen Trai bridge**							
1	NT-KK1	The start point of Nguyen Trai bridge (6-way intersection - May To ward)	24h	155	132	73	94	1,938
2	NT-KK2	The finish point of Nguyen Trai bridge (at the connection to current VSIP road No.	24h	77	62	24	31	952
II	**Vu Yen bridge**							
3	VY-KK1	Northern bank of Cam river at Km15+560	24h	91	56	23	35	885
4	VY-KK2	Intersection of Vu Yen bridge and provincial road No. 356	24h	421	388	148	171	2,280
III	**Ring road No. 3**							
5	RR-KK1	The start point of ring road No. 3 (intersection with national road No. 10)	24h	144	37	20	19	682
6	RR-KK2	Intersection of ring road No. 3 and the road in the residential area – Ha Luan village, Hoa Binh comm (Km1+500)	24h	50	42	38	55	891
7	RR-KK3	Intersection of ring road No. 3 and the road in the residential area (Km3+620)	24h	77	60	44	64	926
8	RR-KK4	Intersection of ring road No. 3 and provincial road No. 359 (Km5+500)	24h	247	205	70	93	1,154
9	RR-KK5	Intersection of ring road No. 3 and crossing road (Km7+940)	24h	82	68	43	31	958
10	RR-KK6	Intersection of ring road No. 3 and crossing road (Km9+500)	24h	106	68	45	55	1,120
11	RR-KK7	Intersection of ring road No. 3 and Cap village's road. (Km11+300)	24h	61	56	48	54	1,310
12	RR-KK8	Northern bank of Ruot Lon river (Km12+200)	24h	71	56	22	34	940
13	RR-KK9	Southern bank of Ruot Lon river (Km13+650)	24h	68	55	20	34	867
	QCVN 05:2013/BTNMT		**24h**	**200**	**150**	**125**	**100**	**-**

Note*): Contents which exceed the allowable limits are marked by yellow color.

24-hour average concentration of CO is not stipulated in QCVN 05:2013/BTNMT



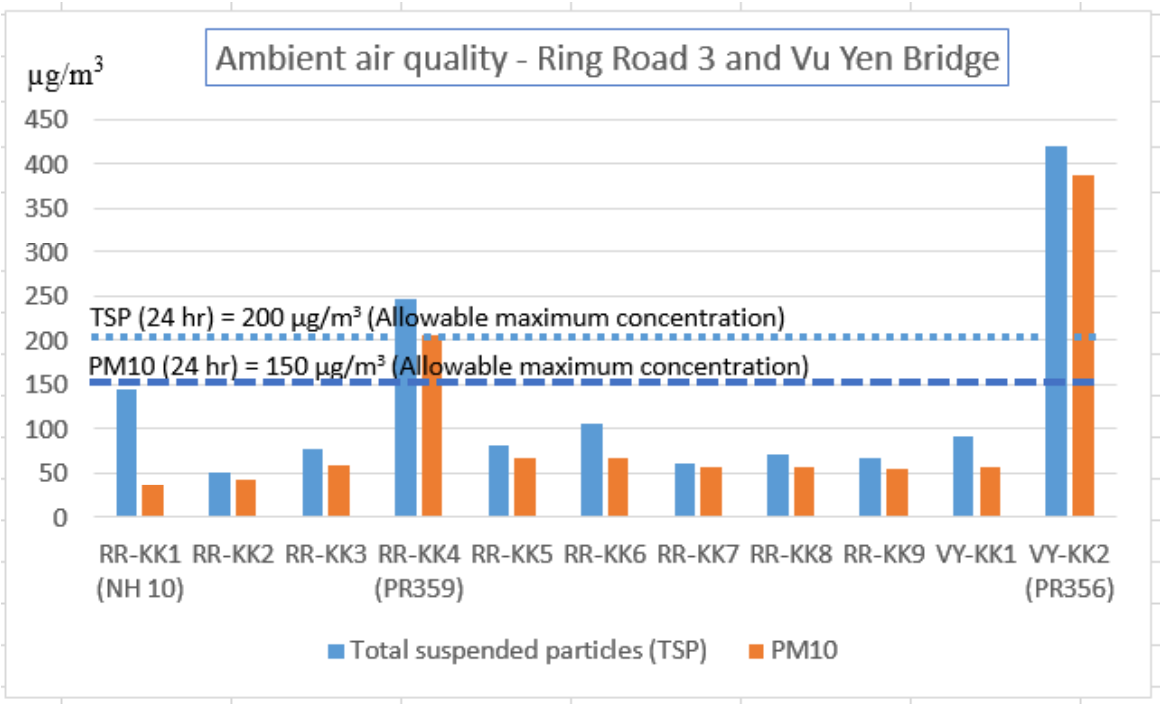


Figure 7.4-2 Observed TSP and PM10 concentrations along the project route

Comparing to the QCVN 05:2013/BTNMT, it is found that:

- Total suspended particulates (TSP) and PM10:
  These measured parameters exceeded allowable limits at the following sites: (1) Intersections of Ring Road No. 3 and Provincial Road No. 359 (RR-KK4). Heavy traffic volume on the provincial road may be considered as main contributor to these high concentrations of TSP and PM10.
  (2) Intersection of Vu Yen Bridge and Provincial Road No. 356 (VY-KK2). Heavy traffic volume with many container trailers on Provincial Road No. 356 at the section near Nam Dinh Vu Port may be considered as main contributor to these high concentrations of TSP and PM10.
  (3) At the start point of Nguyen Trai Bridge (NT-KK1) these parameters almost reaches the allowable limit. Heavy traffic volume on Le Thanh Ton Street may be considered as main contributor to these high concentrations of TSP and PM10.
- Concentrations of SO_2, NO2:
  These measured parameters exceeded allowable limit at the intersection of Vu Yen Bridge and Provincial Road No. 356. Heavy traffic volume with many container trailers on Provincial Road No. 356 at the section near Nam Dinh Vu Port may be considered as main contributor to these high concentrations of SO2 and NO2.
- Concentration of CO:
  In QCVN 05/2013/BTNMT, the average concentration of CO in 24 hours is not stipulated. However, according to the previous QCVN 05:2009/BTNMT issued on October 7, 2009, the maximum allowable average concentration of CO in 24 hours is stipulated as 5000 $\mu g/m^3$. The observed concentrations of CO in August 2015 at all sites along the project route are lower than this allowable limit.

(2) Current noise levels

Table 7.4-2 Measured noise levels

No	Sign	Location	Average value	L_{Aeq}
I	**Nguyen Trai bridge**			
1	NT-O1	The finish point of Nguyen Trai bridge (6-way intersection - May To ward)		67,8
2	NT-O2	The start point of Nguyen Trai bridge (at the connection to existing VSIP road)		58,9
II	**Vu Yen bridge**			
3	VY-O1	Northern bank of Cam river at Km15+560		52,1
4	VY-O2	Intersection of Vu Yen bridge and provincial road No. 356		75,5
III	**Ring road No. 3**			
5	RR-O1	The start point of ring road No. 3 (intersection with national road No. 10)	**6h – 21h**	72,8
6	RR-O2	Intersection of ring road No. 3 and the road in the residential area – Ha Luan village, Hoa Binh commune (Km1+500)		54,3
7	RR-O3	Intersection of ring road No. 3 and the road in the residential area (Km3+620)		57,4
8	RR-O4	Intersection of ring road No. 3 and provincial road No. 359 (Km5+500)		69,3
9	RR-O5	Intersection of ring road No. 3 and crossing road (Km7+940)		55,4
10	RR-O6	Intersection of ring road No. 3 and crossing road (Km9+500)		63,1
11	RR-O7	Intersection of ring road No. 3 and Cap village's road. (Km11+300)		54,2
12	RR-O8	Northern bank of Ruot Lon river (Km12+200)		51,3
13	RR-O9	Southern bank of Ruot Lon river (Km13+650)		51,6
	QCVN 26:2010/BTNMT			**70**

Note*): Contents which exceed the allowable limits are marked by yellow color.

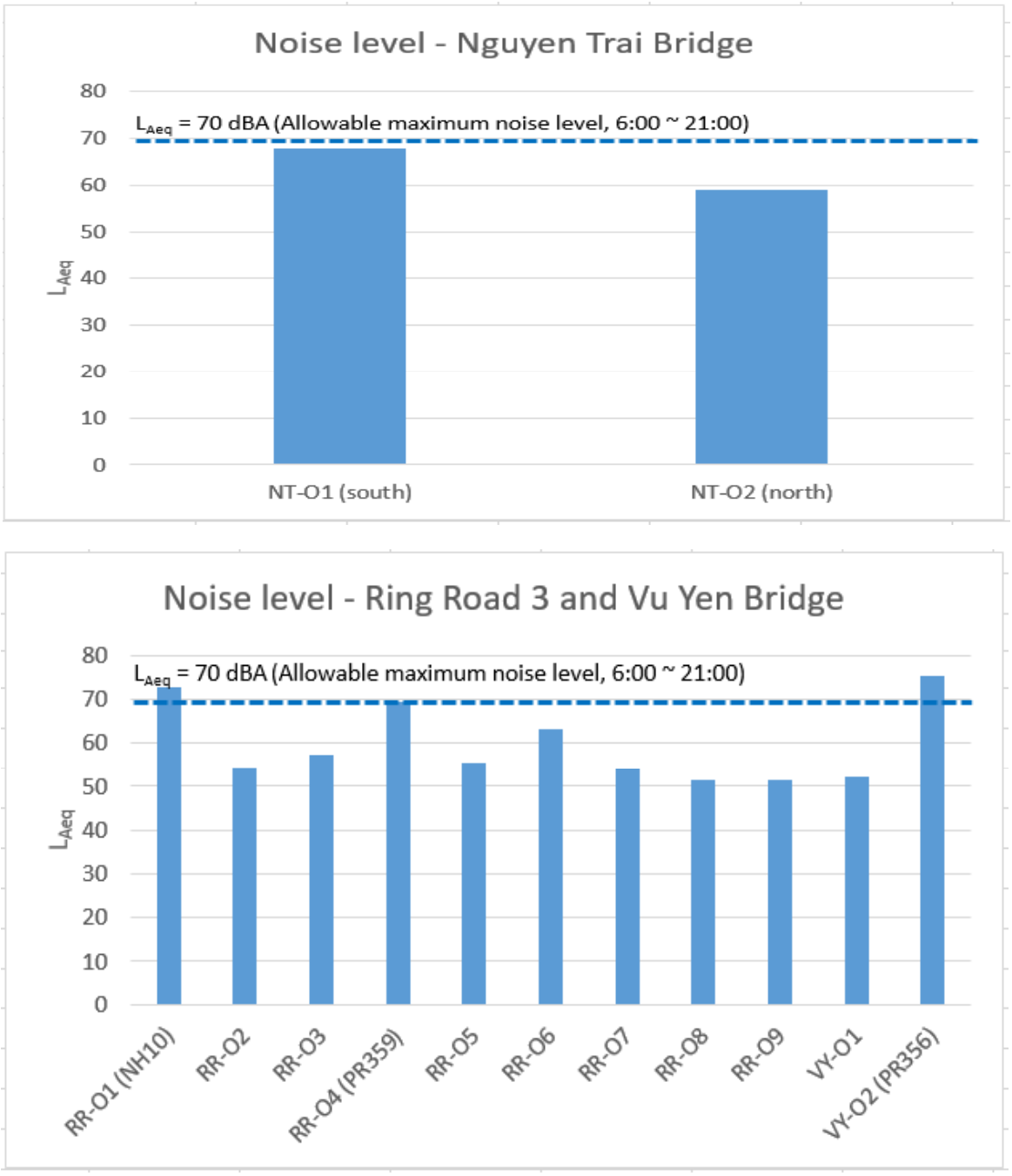


Figure 7.4-3 Observed noise levels along the project route

Measured noise levels exceeded allowable limit at the following sites:

(1) At the intersection of Ring Road 3 and National Road No. 10 (RR-O1). Heavy traffic volume on National Road No. 10 may be considered as main contributor to this excessive noise level.

(2) At the intersection of Vu Yen Bridge and Provincial Road 356 (VY-O2). Heavy traffic volume with many container trailers on Provincial Road No. 356 at the section near Nam Dinh Vu Port may be considered as main contributor to this excessive noise level.

And noise levels almost reach the allowable limit at the following sites:

(1) At the intersection of Ring Road 3 and Provincial Road No. 359 (RR-O4), where there is heavy traffic volume on Provincial Road No. 359.

(2) At the start point of Nguyen Trai Bridge (NT-O2). Heavy traffic volumes on Le Thanh Ton Street, and on other surrounding roads may be considered as main contributors to this excessive noise level.

(3) Current vibration level

Table 7.4-3 Summary of vibration level measurement results (dB)

TT	Sign	Location	Average value	L_{10}
I	**Nguyen Trai bridge**		**6h – 21h**	
1	NT-R1	The finish point of Nguyen Trai bridge (6-way intersection - May To ward)		63,0
2	NT-R2	The start point of Nguyen Trai bridge (at the connection to existing VSIP road)		56,1
II	**Vu Yen bridge**			
3	VY-R1	Northern bank of Cam river at Km15+560		42,1
4	VY-R2	Intersection of Vu Yen bridge and provincial road No. 356		69,9
III	**Ring road No. 3**			
5	RR-R1	The start point of ring road No. 3 (intersection with national road No. 10)		62,0
6	RR-R2	Intersection of Ring Road No. 3 and a rural road in Ha Luan village, Hoa Binh commune (Km1+500)		52,6
7	RR-R3	Intersection of ring road No. 3 and the road in the residential area (Km3+620)		48,0
8	RR-R4	Intersection of ring road No. 3 and provincial road No. 359 (Km5+500)		60,8
9	RR-R5	Intersection of ring road No. 3 and crossing road (Km7+940)		53,9
10	RR-R6	Intersection of ring road No. 3 and crossing road (Km9+500)		50,7
11	RR-R7	Intersection of ring road No. 3 and Cap village's road. (Km11+300)		44,7
12	RR-R8	Northern bank of Ruot Lon river (Km12+200)		42,5
13	RR-R9	Southern bank of Ruot Lon river (Km13+650)		42,2
	QCVN 27:2010/BTNMT			**75**

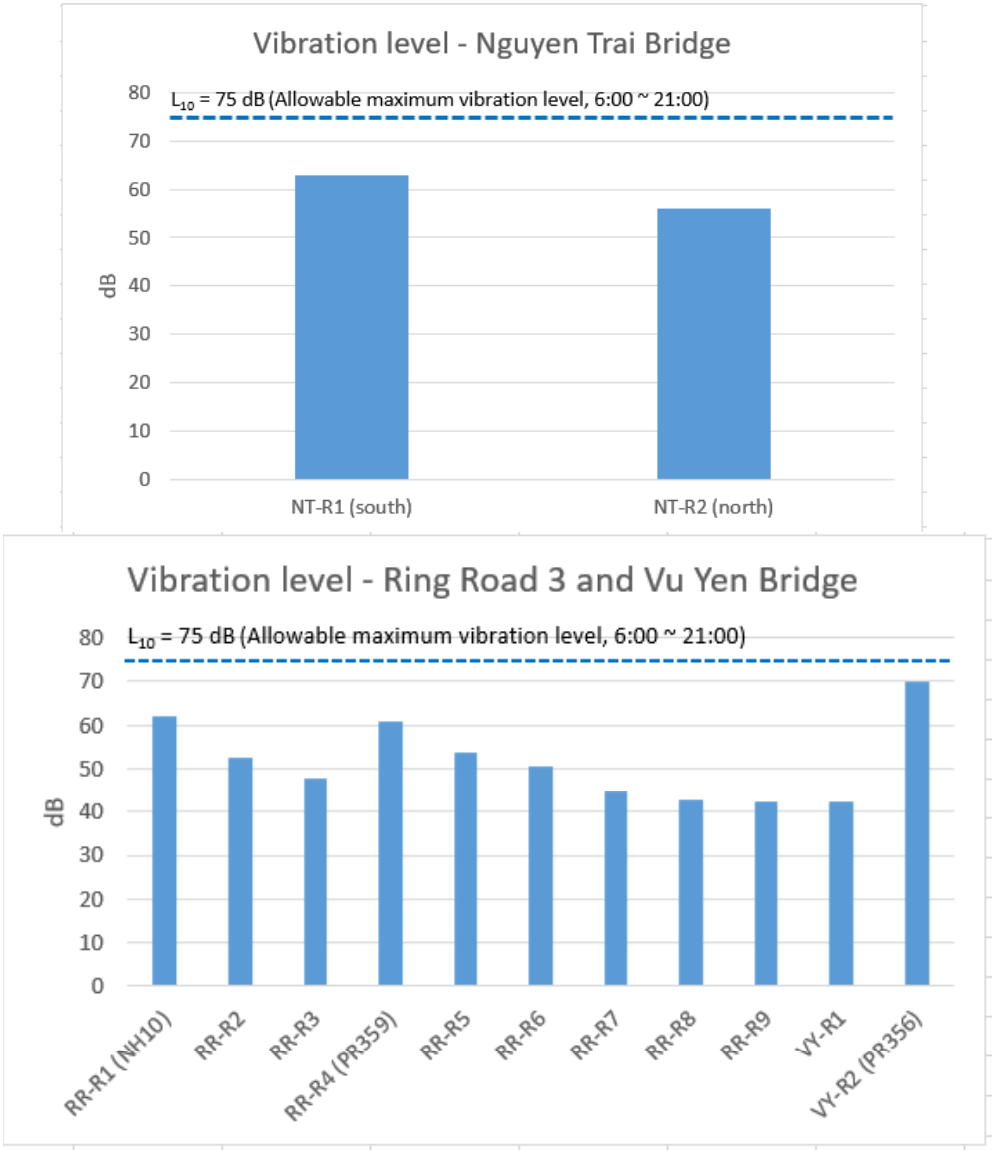


Figure 7.4-4 The current status of vibration at the project area

All vibration levels measured in the project area are lower than the allowable limit stated in QCVN 27:2010/BTNMT.

(4) Current surface water quality

Table 7.4-4 Current surface water quality

No.	Locations	Sign	Tide	t^0C	pH	DO	BOD5 (mg/L)	SS (mg/L)	Coliform (MPN/100mL)
I	**Nguyen Trai bridge**								
(1)	Upstream of Nguyen Trai bridge (on the Cam river)	NT-Nm1	Up	30,5	7,3	4	10	3	1,000
(2)	Downstream of Nguyen Trai bridge (on the Cam river)	NT-Nm2	Up	30,1	7,1	5	6	3	800
(3)	Upstream of Nguyen Trai bridge (on the Cam river)	NT-Nm3	Down	31,2	7,3	5	9	4	900
(4)	Downstream of Nguyen Trai bridge (on the Cam river)	NT-Nm4	Down	30,8	7,2	5	5	4	700
II	**Vu Yen bridge**								
(5)	Upstream of Vu Yen bridge (on the Cam river)	VY-Nm1	Up	30,6	7,3	5	9	4	900
(6)	Downstream of Vu Yen bridge (on the Cam river)	VY-Nm2	Up	30,7	7,3	4	8	3	800
(7)	Upstream of Vu Yen bridge (on the Cam river)	VY-Nm3	Down	31,1	7,4	4	7	3	800
(8)	Downstream of Vu Yen bridge (on the Cam river)	VY-Nm4	Down	30,9	7,3	4	8	3	800
III	**Ring road No. 3**								
(9)	Kenh Giang river	RR-Nm1		31,2	7,1	2	7	4	900
(10)	The river at Km2+600	RR-Nm2		31,4	7,0	2	6	4	900
(11)	The river at Km6+900	RR-Nm3		30,9	6,9	3	7	3	900
(12)	Upstream of Ruot Lon river	RR- Nm4		30,7	7,1	4	6	3	800
(13)	Downstream of Ruot Lon bridge	RR- Nm5		30,8	7,3	4	6	3	800
QCVN 08:2008/BTNMT (B1)				**-**	**5,5 ~ 9**	**> 4**	**15**	**50**	**7,500**
QCVN 08:2008/BTNMT (B2)				**-**	**5,5 ~ 9**	**> 2**	**25**	**100**	**10,000**

Note: QCVN 08:2008/BTNMT- National Technical Regulations on Surface Water Quality; Type B1: For irrigation purpose or other purposes requiring the same water quality or the purposes such as for type B2; B2: Waterway traffic and other purposes requiring low quality of water

Contents which do not meet the allowable limits are marked by yellow color.

- DO values of water took from 3 canals along RR3 (i.e. Kenh Giang Canal RR-Nm1, canal at km2+600 RR-Nm1, and canal at km6+900 RR-Nm3) do not meet water standards for surface water type B1 (water usable for irrigation). Domestic wastewater from the surrounding residential areas and polluted water generated from agricultural activities are considered main contributors to this water pollution at these canals.

- Other parameters are within the allowable limit of surface water type B1

In general, the quality of surface water in the project area is good, and is usable for irrigation.

(5) Current ground water quality

Table 7.4-5 Summary of underground water quality analysis results

No.	Location	Sample sign	Temp (^{0}C)	pH	Conductivity (ms/m)	BOD (mg/l)	Coliform (100ml)	Depth of well (m)
I.	**Nguyen Trai bridge**							
(1)	Residential area of May Chai ward, near the finishing point of Nguyen Trai street	NT-Nn1	28.5	6.7	23.4	4	Un-detected	6
II.	**Vu Yen bridge**							
(2)	Intersection of route centerline and provincial road No. 356	VY-Nn1	28.7	6.7	27.2	5	Un-detected	10
III.	**Ring road 3**							
(3)	Residential area at Ha Luan, Hoa Binh commune, Thuy Nguyen district	RR-Nn1	29.2	6.9	23.8	4	Un-detected	10
(4)	Residential area at Trai village, Trung Ha commune, Thuy Nguyen district	RR-Nn2	29.0	6.7	25.4	3	3	30
(5)	Residential area at Trung Son village, Ngu Lao commune, Thuy Nguyen district (intersection of ring road No. 3 and provincial road No. 359)	RR-Nn3	27.6	6.8	20.9	2	3	5
(6)	Residential area at Bao Kiem village, Lap Le commune, Thuy Nguyen district	RR-Nn4	28.1	6.7	22.7	2	3	6-7
QCVN 09:2008			**-**	**5.5 – 8.5**	**-**		**3**	

Microbiological factors (Coliform) were found in underground water took from the wells in the residential areas in Hoa Binh Commune, Trung Ha Commune, Ngu Lao Commune, and Lap Le Commune. Other parameters met allowable limits stated in QCVN 09:2008

7.4.3 Ecological resources

The study on biological resources was conducted in two stages. In the first stage, a literature review was carried out by the ecological experts to grasp the overall condition of biological resources in a large area covering about 2.5 km ~ 3.0 km around the project area. In the second stage, during July and August 2015, a number of field surveys were carried out by a survey team led by an ecological expert to collect samples on sites, identify species of flora and fauna, etc., along the project area including Nguyen Trai Bridge, Vu Yen Bridge, and Ring Road 3. In addition to the field surveys, the survey team also carried out the hearings to local residents, fishermen, owners of the aquaculture ponds, along the project area in order to collect supplemental information on the local biodiversity.

The objects of the survey and data collection consists of (1) Coastal natural mangrove vegetation and species of wild plants, crops and food crops; (2) Groups of natural animals like birds, mammals, reptiles, and amphibians; (3) Groups of aquatic organisms like plankton, benthos and fish.

Survey method and result of the survey are summarized and described in a report attached to the EIA Report for the Project (Appendix 1 – Report of Ecosystem Survey). Only essential parts of the survey are described in this section.

(1) Mangrove vegetation (mangrove ecosystem)

The study area is an alluvial area formed by Thai Binh River and Bach Dang River. Although these rivers bring to the area a large amount of alluvium and nutrient, the natural mangrove forests in the area cannot grow densely due to the strong wind and strong wave on the land characterized by vacant terrain. Main vegetation communities include as follows:

- *Sonneratia caseolaris (Bần Chua)* dominates in the community of brackish water plants, with the height of 8 - 10 meters, diameter at breast height of 9 - 12 cm and density of 3,850 plants/ha (154 *Sonneratia caseolaris* in a sample plot: 20mx20m). *Acanthus ilicifolius (Ô Rô)* is usually found under the canopy of *Sonneratia caseolaris*. *Sonneratia caseolaris* can be found growing on the banks of Ruot Lon River, Cam River, and other rivers, even at the location about 30 km far away from the seashore.

Mangrove trees *(Sonneratia caseolaris)* on the north bank of Ruot Lon River.

Acanthus ilicifolius (Ô Rô), and Acromstichum aureum (Ráng Biển)

Figure 7.4-5 Mangrove Vegetation (1)

- *Avicennia marina (Mắm Biển)*, *Sonneratia caseolaris (Bần), Kandelia candel (Trang),* and *Aegiceras corniculatum (Sú)* can be found growing along the mudflats near the estuaries.

- Mixed community of *Rhizophora stylosa (Đước Vòi), Kandelia obovata (Trang)* and other species like *Bruguiera gymnorrhiza (Vẹt)*, and *Aegiceras corniculatum (Sú)*.

- *Aegiceras corniculatum (Sú)* dominates in the low shrub community, with other secondary species including *Bruguiera gymnorrhiza (Vẹt Dù)*, and *Avicennia marina (Mắm Biển)*.

Kandelia obovata, Sonneratia caseolaris.

Rhizophora stylosa.

Figure 7.4-6 Mangrove Vegetation (2)

No precious and rare plant species listed in Vietnam's Red Data Book 2007 was found in the surveyed area.

(2) Phytoplankton

Based on the analysis results of samples collected from Ruot Lon and Cam rivers and bridge construction areas, 95 species of phytoplankton falling into 4 algae divisions are identified including: *Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta*. Among Phytoplankton, *Bacillariophyta* has the highest number of species (41 species, accounting for 43%), followed by *Chlorophyta* (29 species, accounting for 30%), *Euglenophyta* (14 species, accounting for 15%), and finally *Cyanophyta* (11 species, accounting for 12%).

In the area around Nguyen Trai Bridge, 87 species of phytoplankton were found. The number of phytoplankton found in the area around Vu Yen Bridge was 82 species. And around the site planned for the bridge crossing Ruot Lon River, 72 species of phytoplankton were found. Most of the phytoplankton are common and widespread species, which are frequently seen in natural freshwater areas in coastal and estuarine regions, among which *Bacillariophyta* group accounts for the highest rate in terms of composition and quantity density.

The density of phytoplankton in the area around Nguyen Trai Bridge ranges from 1,417.5 Tb/l to 4,422.6 Tb/l (i.e. 2,721.6 Tb/l on average). *Bacillariophyta* has the highest average density of phytoplankton (41%), followed by *Cyanophyta* (31%), *Chlorophyta* (23%) and finally *Euglenophyta* (5%).

The density of phytoplankton in the area around Vu Yen Bridge ranges from 1,190.7 Tb/l to 4,536.0 Tb/l (i.e. 2,891.7 Tb/l on average). *Bacillariophyta* has the highest average density of phytoplankton (41%), followed by *Cyanophyta* (30%), *Chlorophyta* (25%) and finally *Euglenophyta* (4%).

The density of phytoplankton in the area planned for the bridge crossing at Ruot Lon River ranges between 1,417.5 Tb/l and 4,422.6 Tb/l (i.e. 2,721.2 Tb/l on average). *Bacillariophyta* has the highest average density of phytoplankton (39%), followed by *Cyanophyta* (32%), *Chlorophyta* (25%) and finally *Euglenophyta* (4%). The density of phytoplankton in the surveyed area shows no abnormality and significant difference from the results of previous surveys conducted in Hai Phong estuarine areas.

(3) Zooplankton

It has been identified 62 species and species groups of zooplankton belonging to *Copepoda, Cladocera, Rotatoria* and other groups such as *Crustacea, Mollusca, Ostracoda* and *Polychaete,* etc. Among them, *Cladocera* has the highest number of species (27 species, accounting for 44%), followed by *Copepoda* (18 species, accounting for 29%), *Rotatoria* (13 species, accounting for 21 %), and other groups (4 species, taking 6%).

The area of Nguyen Trai Bridge rooms the highest number of species with 54 species of zooplankton, followed by Vu Yen Bridge area with 50 species and finally Ruot Lon Bridge area with 44 species. Most of the zooplankton in the surveyed area is widely distributed in natural water areas in the North of Vietnam. *Cladocera* has the highest number of species; meanwhile *Copepoda* has the highest density of quantity.

The density of zooplankton in the area around Nguyen Trai Bridge ranges from 29 to 7.694 zooplankton/m^3 (i.e. 1,464.2 zooplankton/m^3 on average). *Copepoda* has the highest average density of zooplankton (43%), followed by *Cladocera* (25%), *Rotatoria* (28%) and other groups (4%).

The observed density of phytoplankton and zooplankton were relatively high, due to the fact that the survey was carried out in the summer season (July and August 2015) where the river water temperature was high. Besides, the eutrophication may occurred in the river water due to a large volume of domestic wastewater discharged from many populous residential areas located in the upstream of Cam River and Ruot Lon River.

(4) Zoobenthos

30 species of zoobenthos and insect groups of *Mollusca, Arthropoda (Crustacea - Decapoda)* were identified in the area around Nguyen Trai Bridge, Similarly, in the areas around Vu Yen Bridge and Ruot Lon Bridge, there are 25 species and 20 species were identified, respectively. Among them, *Mollusca, Bivalvia, and Gastropoda* have highest number of species (25 species, accounting for 61%). *Arthropoda, Crustacea* and insect groups have 16 species, accounting for 39% of the total.

The density of zoobenthos in the area around Nguyen Trai Bridge ranges from 5 to 48 zoobenthos/m^2, i.e. 21.9 zoobenthos/m^2 on average. Zoobenthos biomass ranges from 4.15 to 16.96 g/m^2, i.e. 18.04 g/m^2 on average. *Gastropoda* and *Bivalvia* have the highest average density among zoobenthos. Other groups have insignificant density.

The density of zoobenthos in the area round Vu Yen Bridge ranges from 7 to 28 zoobenthos/m^2, i.e. 18.44 zoobenthos/m^2 on average. Zoobenthos biomass ranges between 7.2 and 44.6 g/m^2, averagely 18.9 g/m^2. *Gastropoda* and *Bivalvia* have the highest average density of zoobenthos. Other groups have insignificant density.

The identified density of zoobenthos in the area around Ruot Lon Bridge ranges between 3 and 88 zoobenthos/m^2, averagely 35.7 zoobenthos/m^2. Zoobenthos biomass ranges from 6.1 to 28.7 g/m^2, i.e. 14.5 g/m^2 on average. *Gastropoda* and *Bivalvia* have the highest average density of zoobenthos. Other groups have insignificant density.

These identified zoobenthos are commonly and widely distributed in many areas in the Northern Region of Vietnam. No typical or endemic species in the area was found during the survey.

(5) Fish and fishery

In the survey area, there are identified 61 species of 22 families of orders of freshwater fish species (wild and farm-raised fish). These include A*nguilliformes*; *Clupeiformes*; *Osmeriformes*; *Characiformes*; *Cypriniformes; Siluriformes; Synbranchiformes; Perciformes; Cyprinodontiformes* and *Pleuronectiformes*. In particular, *Cyprinidae (Cá Chép)* is the highest in number of species. *Cyprinidae* is a kind of farmed fish with high economic value (37

species, accounting for 59%), followed by *Perciformes* (10 species, accounting for 17%). Other orders have low number of species (1 to 4 species, accounting for 2 to 6%).

There are 3 precious and rare species of fish which are listed in Vietnam's Red Data Book with EN grade (Endangered), namely *Clupanodon thrissa (Chinese gizzard shad, Cá Mòi Cờ Hoa), Tenualosa reevesii (Reeves shad, Cá Cháy), Elopichthys bambusa (Yellowcheek, Cá Măng)*. These species were identified in some coastal and estuarine areas in the Northern Region of Vietnam, and sometimes were found habitat in the brackish- seawater-mixed water of Ruot Lon, Cam and Bach Dang Rivers.

Since aquaculture is well developed on Vu Yen Island and in the area on the northern side of Ruot Lon River, then fishing is not common in the area.

Figure 7.4-7 Mangrove trees (*Sonneratia caseolaris)* along the banks of Ruot Lon River

(6) Fauna

Animals in the survey area include groups of birds, mammals, amphibians, and reptiles, commonly seen in the northern delta provinces; nonetheless, there are few species and low density of quantity. Apart from wild animals, some animal species are raised for food or ornament.

According to several existing reports, one species of *Lutra lutra (Eurasian Otter, rái cá)*, and two species of reptiles - *Gekko gecko (Tokay Gecko, tắc kè)* listed in Vietnam's Red Data Book in 2007 were observed mainly in the areas with many wild plants along unfrequented dyke, marshes, and ponds, especially in the mangrove areas along Cam and Ruot Lon rivers and adjacent areas. However, according to the hearings to local residents during the survey, they were not observed in the area recently.

7.4.4 Socio-economic conditions

(1) Thuy Nguyen District

1) Population and Labor

Thuy Nguyen District is home to about 320,000 people, of which about 49.3% is male and 50.7% is female. Natural population growth rate accounts for about 0.99%. Population density reaches about 1,215 people/km^2. Working-age population accounts for 50.6%, of which 41% are working in district's economic sector. Currently, labor force is mainly engaged in farming accounting for 78% of the total employees working in economic sector.

2) Economy

In 2014, Thuy Nguyen District's total production value of all sectors reached 12,865.9 billion VND. Agriculture - fisheries sector accounted for 20.1%, industry & construction sector - 46.4%, service sector - 33.5%.

For agriculture – fisheries sector, rice-cultivated area in 2014 reached 13,121 ha with productivity of 63.32 quintals/ha. Aquaculture area reached 1,887 ha with breeding yield of 7,614 tons, and catching yield of 23,314 tons. Construction and improvement of irrigation systems have been performed regularly to ensure sufficient water supply and drainage.

For industry – construction sector, production value reached 5,964.2 billion VND, of which industry accounted for 2,787.5 billion VND, and construction – 3,176.7 billion VND. The main products include stones of all types, lime, metal casting, textiles, cement.

Service sector reached 4,309.7 billion VND, of which transport service accounted for 1,604 billion VND, trade – service – 1,926.7 billion VND, and other services - 779 billion VND.

3) Infrastructure

National Road No.10 is the main route connecting National Road No.5 and National Road No.18. Besides, Provincial Roads No.351, 352, and 359 have been completed. In addition, many inter-village and inter-commune roads have been concretized under the National Target Program for New Rural Construction.

The district has 84km of inland waterway, mainly for transport of building materials. There are river ports such as Da Bac, Xuan Lai, Kien, Minh Duc, Cong Son and Lap Le river wharves.

National electric grid has currently installed in all communes and towns of Thuy Nguyen district. The district also has 282 substations with 373 km high-voltage and low-voltage transmission lines. Maintenance and repair of transmission lines and substations have been maintained regularly.

Around 80% of the population in communes and town of Thuy Nguyen district is provided with clean water, the rest uses groundwater resources. More than 30 small water plants are available in many different communes and towns.

4) Environmental sanitation

Regular waste collection unit is established in each communes and towns. All households are using septic tank toilet. Waste treatment system is also installed in breeding farm.

5) Culture – society

In terms of education and training, district's system of vocational schools and centers have been upgraded to meet training requirements. There are 37 kindergartens, 38 primary schools, 37 secondary schools, and 7 high schools in the district, of which 35 schools meet national standards.

In terms of health, healthcare quality has been improved; doctors and nurses have been trained to improve proficiency. Health care service in all communes and towns in the district meets national standards. There are 1 hospital, 4 general clinics and 37 communal health stations with a total of 474 beds and 378 medical workers. Currently, all grassroot-level health units have 1-2 doctors.

(2) Ngo Quyen district

1) Population and Labor

Ngo Quyen District is home to around 158,674 people, of which about 49.3% is male and 50.7% is female. Natural population growth rate accounts for about 0.62%. Population density reaches about 14,165 people/km^2.

2) Economy

Ngo Quyen District is the center of economy, industry and services of Hai Phong City. Economic activities in the district are dynamically carried out. In 2014, total production value of all sectors in Ngo Quyen District reached 3,220 billion VND. In particular, industry accounted for 1,082 billion VND, trade-service - 2,138 billion VND. There are more than 2,000 enterprises and more than 8,000 business households, and several commercial centers and large wholesale markets such as Big C supermarket, Intimex supermarket, TD Plaza, Cat Bi Plaza in the district.

3) Infrastructure

Road traffic in the district is relatively fully worked-out system with urban roads. All roads have been equipped with drainage system and lighting system. Currently, the district continues

to develop road traffic system through projects of interchange construction and route expansion.

Cam River is the major waterway route playing very important role in economic activities and seaport services. This is the main circulation route for vessels and boats to land Hoang Dieu Port and Hai An Port for trading purpose.

Electric network for domestic use and for business purpose is installed in all residential areas in the district

All residential areas in the district are provided with piped water

4) Environmental sanitation

Regular waste collection unit is established in the district. All households are using septic tank toilet

5) Culture - society

Education and training quality has been improved; there are 02 schools that meets standard of level 2 among 08 schools.

National target programs of health, population, family and children have been fully implemented. All children are fully immunized.

(3) Hai An District

1) Population and Labor

Hai An District is home to about 77,600 people, of which about 49.6% is male and 50.4% is female. Natural population growth rate accounts for about 0.61%. Population density reaches about 739.6 people/km^2.

2) Economy

Total production value of economic sectors in the district is 25,377.6 billion VND. Total production value of the sectors managed by Hai An District reaches 3,819.1 billion VND. Industry - handicraft makes up 7.5%, construction - 48.2%, trade-service - 41.7%, and agriculture-fisheries - 2.6%.

3) Infrastructure

Road traffic in the Project location is relatively fully worked-out system with urban roads. All roads have been equipped with drainage system and lighting system. Currently, the district continues to develop road traffic system through projects of interchange construction and route expansion.

Cam River is the major waterway route playing very important role in economic activities and seaport services. This is the main circulation route for vessels and boats to land Hai An and Dinh Vu ports for trading purpose.

Electric network for domestic use and for business purpose is installed in all residential areas in the district

All residential areas in the district are provided with piped water.

4) Environmental sanitation

Regular waste collection unit is established in the district. All households are using septic tank toilet

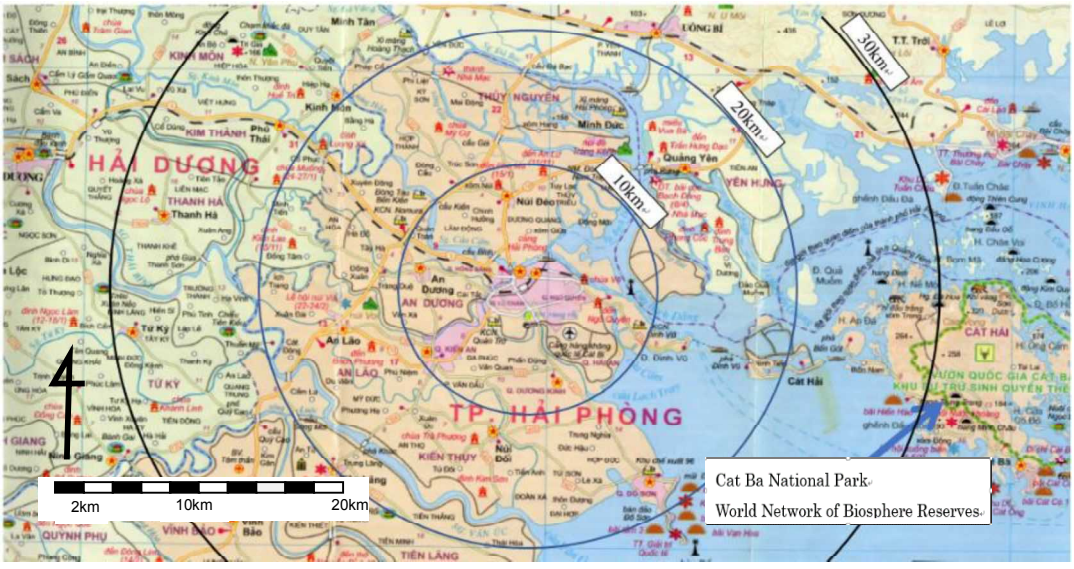
5) Culture – society

There are 20 schools; of which 18 schools meet standard according to criteria of Ministry of Education and Training.

National target programs of health, population, family and children have been fully implemented. All children are fully immunized.

7.4.5 Sensitive receptors along the project sites

No national parks or protected areas exist in or around the project area. The Cat Ba Archipelago, which in 2004 was designated by UNESCO as a biosphere reserve, is located 30km east of the project area (see Figure 7.4-8). The central area of Cat Ba Island (15,331 ha surface area) is designated by the Government of Vietnam as a national park.



Source: Study Team

Figure 7.4-8 Location Map of the Project Area and Cat Ba Archipelago

The project area is an intensively developed economic focal zone in the north of Vietnam where many economic activities can be observed. A large part of the natural land has been converted to urban and residential areas and agricultural land. Poorly-grown natural mangrove

trees spread out in thin belt-like forests along the river banks near river mouths, and it seems that these mangrove forests are not properly protected by effective regulations.

In the project area, relatively dense mangrove forests are observed near the site planned for the bridge crossing of the Ruot Lon River on the north side in Lap Le Commune of Thuy Nguyen District. The width of the mangrove forest belt here is about 200m.

Figure 7.4-9 shows the distribution and general condition of the mangrove forests in the project area near the sites planned for Vu Yen Bridge and the bridge crossing of the Ruot Lon River.

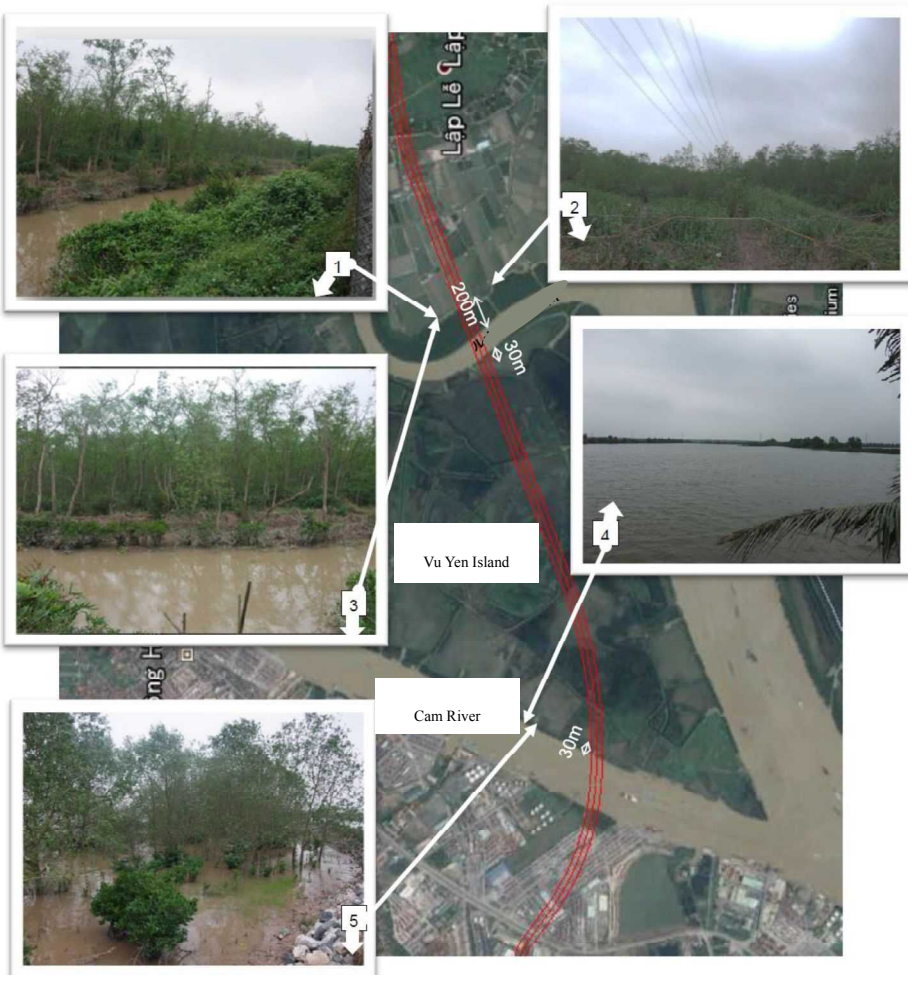


Figure 7.4-9 Distribution of Mangrove Forests near Planned Bridge Construction Sites

Located next to these mangrove forests is land where mangrove trees were probably grown for a long time in the past, but which has since been converted into aquaculture ponds. There are also many paddy fields distributed in the project area beside mangrove forests and aquaculture ponds. The current existing ecosystem observed in the project area is likely made up mainly of plants and animals which coexist with humans.