3.2.3.2 Traffic Safety Control

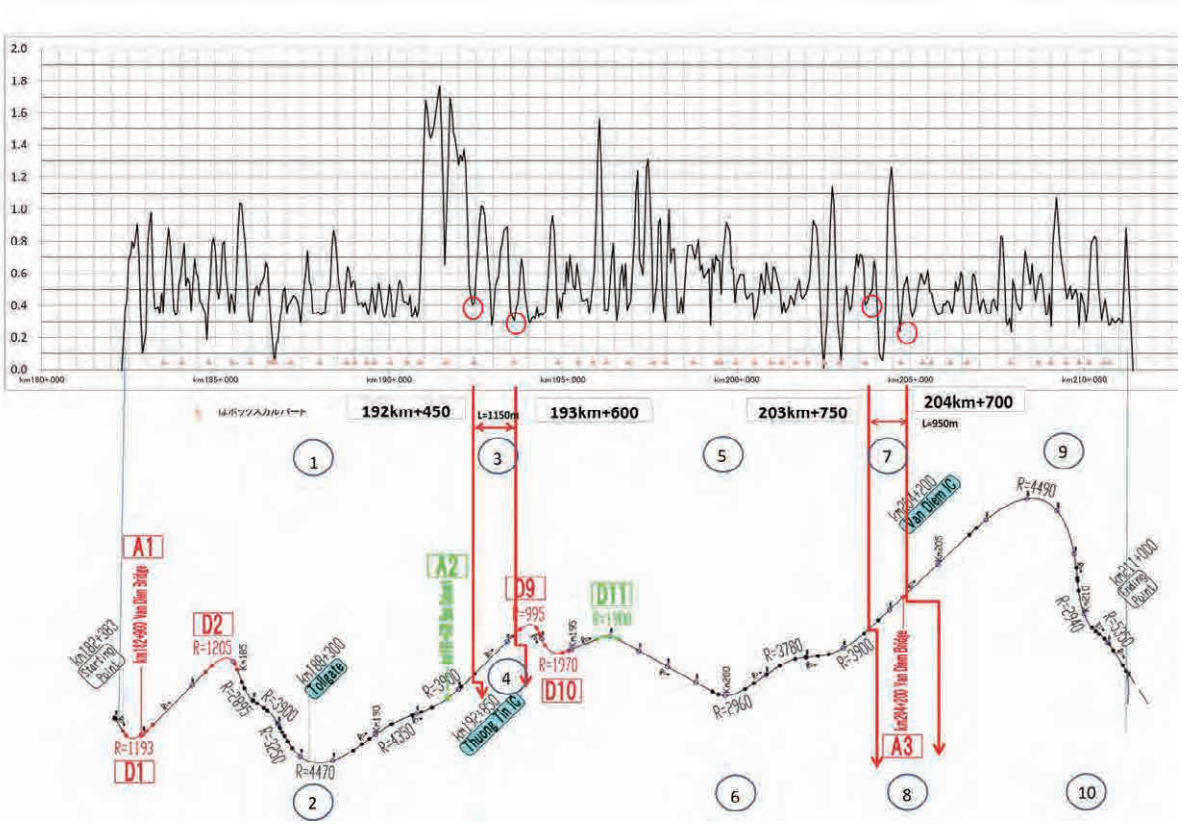
(1) Section of Traffic control

Section in upgrading of existing 4-lane road is shown below. At the upgrading of existing 4-lane road, planned pavement surface level after upgrading is higher than that of existing road by approx. 1.8m.

In addition, there are two Interchanges. Therefore, when deciding traffic control section, boundary of section is selected to the point where a relatively small difference in height between existing pavement and planned height (difference is 40cm or less). Inbound 2 lanes and outbound 2 lanes are constructed alternatively with two way traffic at the opposite side 2 lanes. For example construction of section ②, while two way traffic in section ①. Then construction of section ①, while two way traffic in section ②.

The following figure shows the division of section and raising height for upgrading. PV-CG road is divided into 5 sections (include two interchange) at one side, a total of 10 sections.

Figure 3.2.3-4 Raising Height and Sections for Traffic Control



1) ①、② Beginning Point - 192km+450 L=10,050m
2) ③、④ 192km+450 – 193km+600 L= 1,150m Thuong Tin IC
3) ⑤, ⑥ 193km+600 – 203km+750 L=10,150m
4) ⑦、⑧ 203km+750 – 204km+700 L= 950m Van Diem IC
5) ⑨、⑩ 204km+700 – Ending Point L= 6,300m

(2) Method of traffic control

Samples of Traffic control at Typical Sections and that for interchange section are shown below. At the construction stage, specifically for IC (interchange) section, the traffic control is to be reviewed and agreed by traffic administrator and relevant agencies. The speed limit for a section under construction is 50km / hour. Traffic signs used in these Samples are those in USA. The Contractor shall liaise with the relevant traffic Authority and agree the details of Traffic diversion including Traffic signs etc.

1) **Traffic control method at Typical Sections**

Traffic control at Typical Section is 2 lanes closed (inbound or outbound) and 2 lanes at the opposite side are utilized as two way traffic.

Basically gradient of a longitudinal slope is 4% or less.

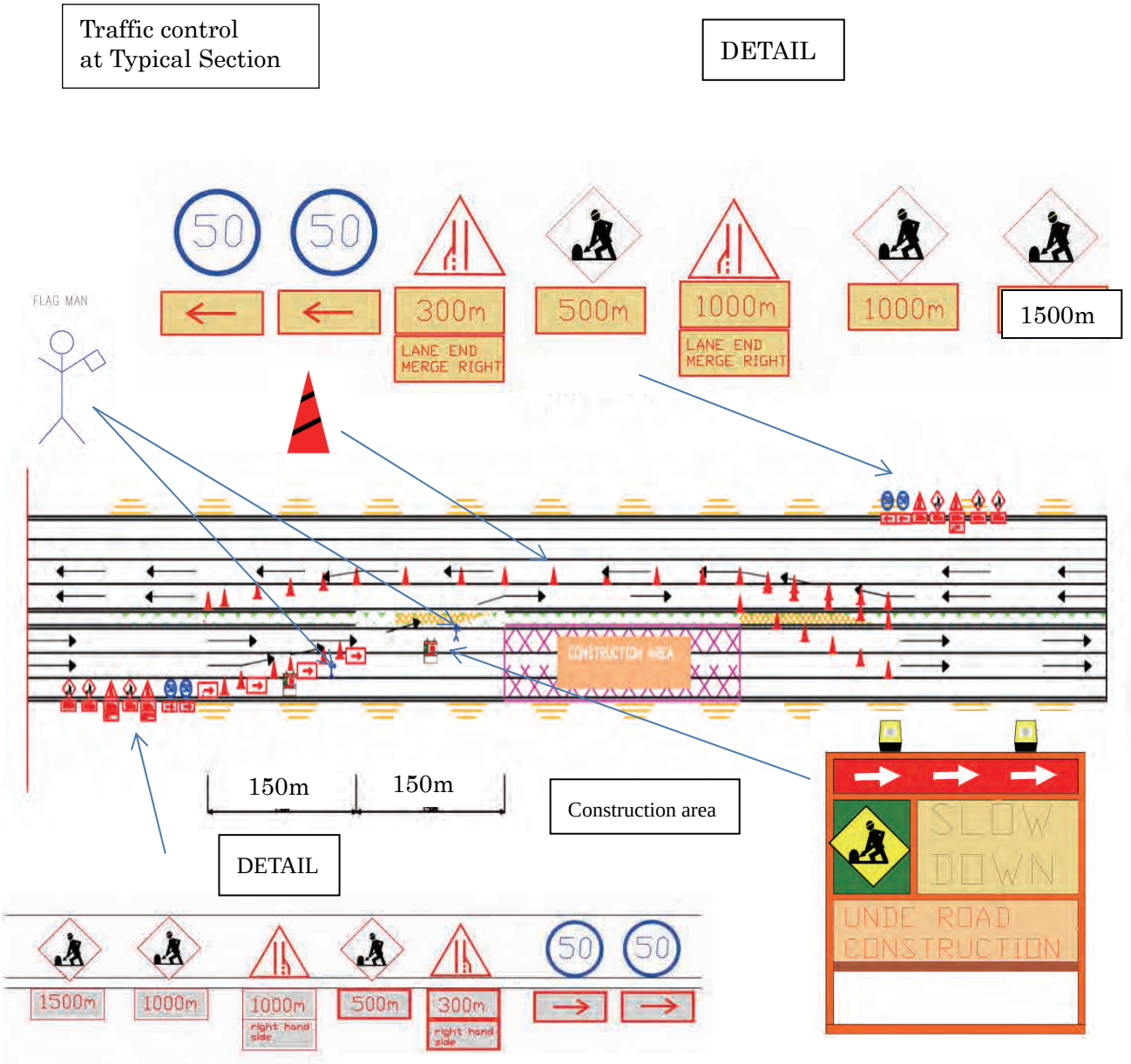


Figure 3.2.3-5 Traffic Control at Typical Sections

2) **Traffic control at IC (Interchange)**

(i) Traffic control at Thuong Tin IC

Traffic control method at Thuong Tin IC is shown below.

*Embankment of main road and IC (blue hating are) should be carried out prior to the construction of pavement at IC.

*Embankment of Shoulders is to be carried out repeatedly with pavement at main road in the same day.

*Raising height for one day is 30cm or less.

*The slope between the existing road and new pavement is 8% or less.

*Traffic control during shoulder construction is shown in Method of Traffic control at pavement at shoulder.

- Traffic control section at Thuong Tin IC is from station 192km +450 to 193km +600 and distance is 1,150 meter
- 1 way (2 lanes) is closed without shoulder (1 lane).
  Shoulder is used for entry/exit of IC.
  Opposite way (2 lanes) is used for two way traffic.
- 24 hours closed at one way of main road for construction.
  Traffic control at shoulder is controlled by flag man.
  Shoulder is opened after daily construction for exit and entrance of IC.
- Speed limit is 50km/hour.

Traffic control at main lanes is shown in below.

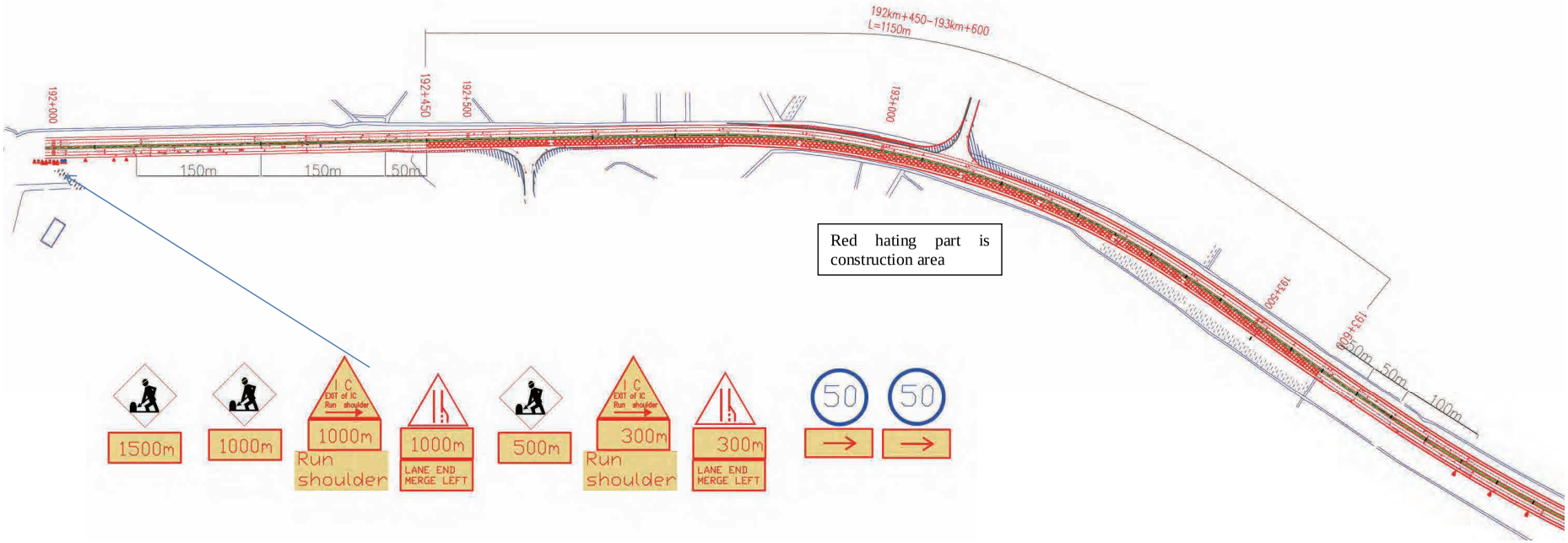


Figure 3.2.3-6 Traffic Control at Thuong Tin Interchange

Detail is shown in next page.

Detail of traffic control

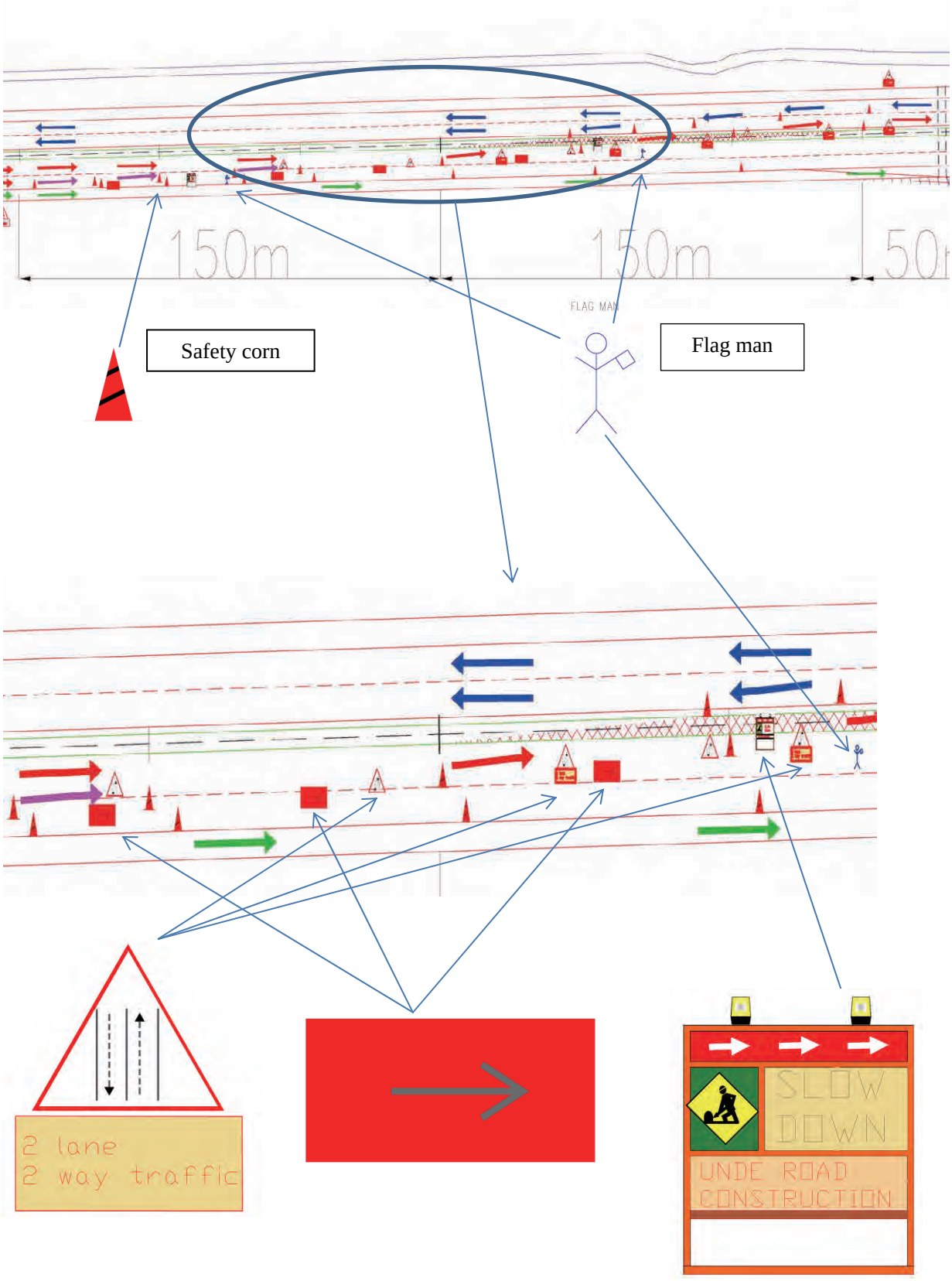


Figure 3.2.3-7 Traffic Control (Details)

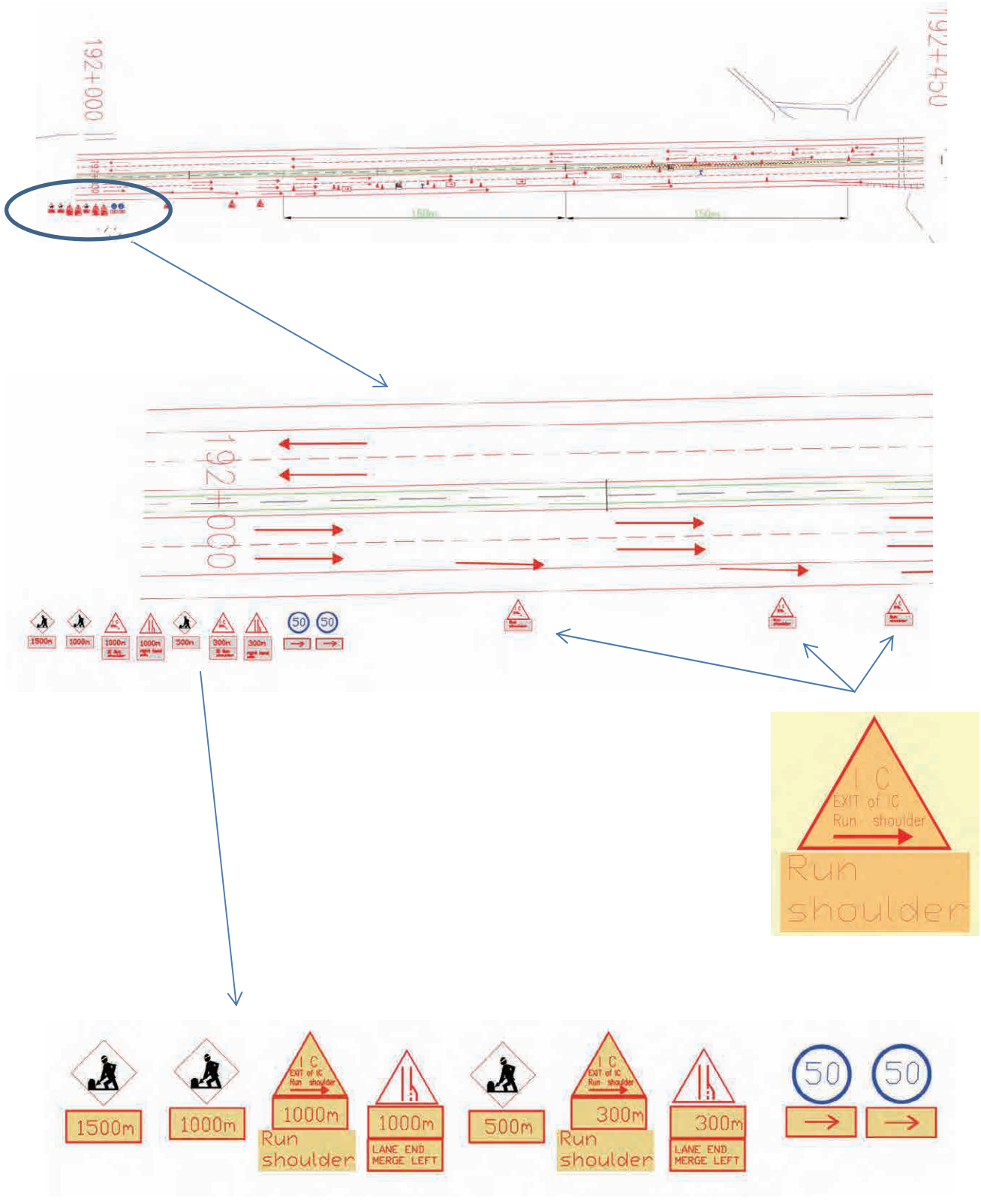


Figure 3.2.3-8 Traffic Control (Details)

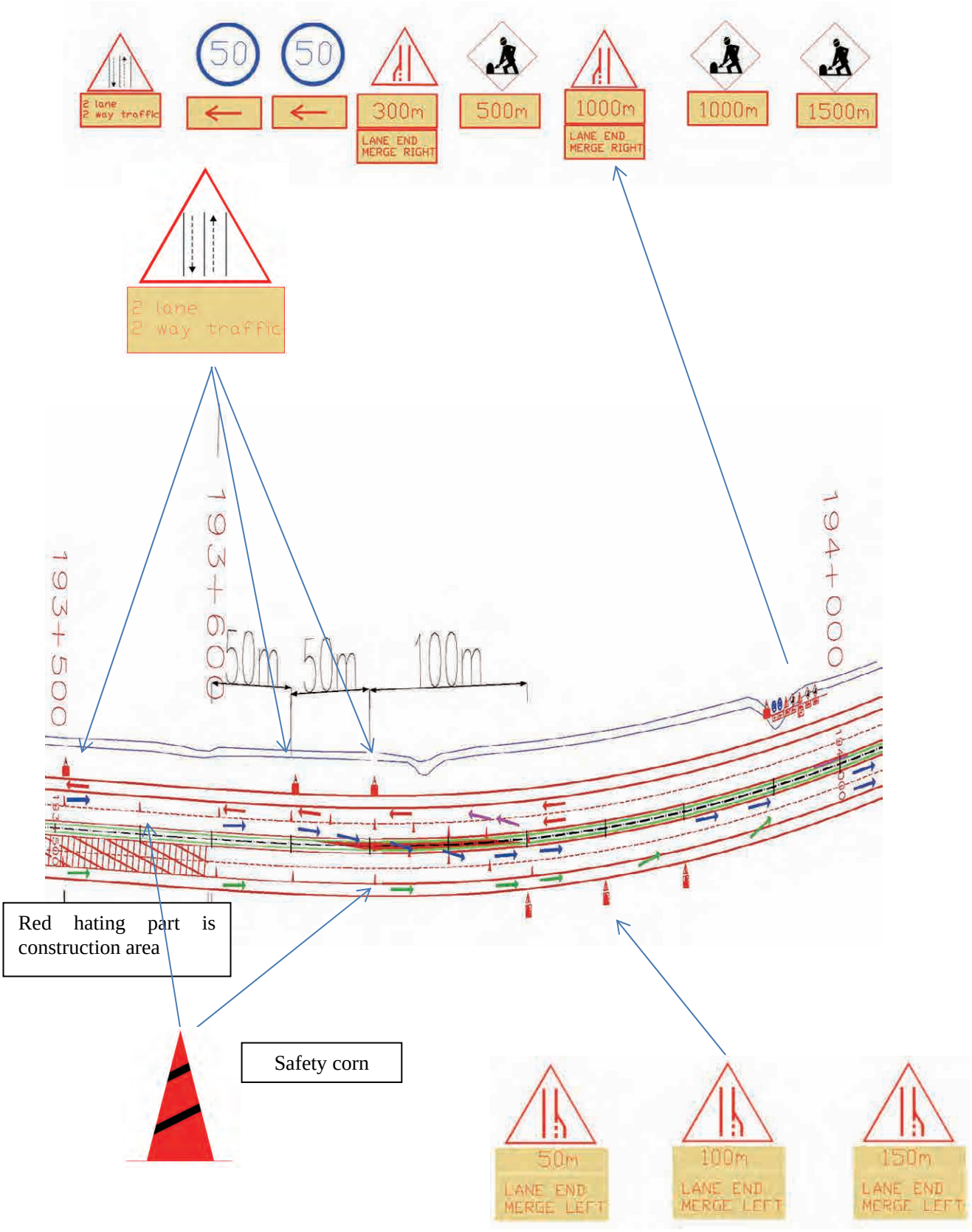


Figure 3.2.3-9 Traffic Control (Details)

(ii) Traffic control at Van Diem IC

Traffic control method at Van Diem IC is shown in below.

*Embankment of main road and IC (blue hating are) should be carried out prior to the construction of pavement at IC.

*Embankment of Shoulders to be carried out repeatedly with pavement at main road in the same day.

*Raising height for one day is 30cm or less.

*The gradient of slope between existing road and new pavement is 8% or less.

*Traffic control at shoulder is shown in Method of Traffic control at pavement at shoulder.

・Section of traffic control at Thuong Tin IC is from station 203km +750 to 204km +700 and distance is 950 meter

・1 way(2 lanes) closed without shoulder (1 lane).
Shoulder is used for entry/exit of IC.
Opposite way (2 lanes) is used for two way traffic.

・24 hours closed at one way of main road for construction.
Traffic control at shoulder is controlled by flag man.
Shoulder is opened after daily construction for exit and entrance of IC.

・Speed limit is 50km/hour.

Traffic control at main road is shown below. Detail is shown in Traffic control at Thuong Tin IC.

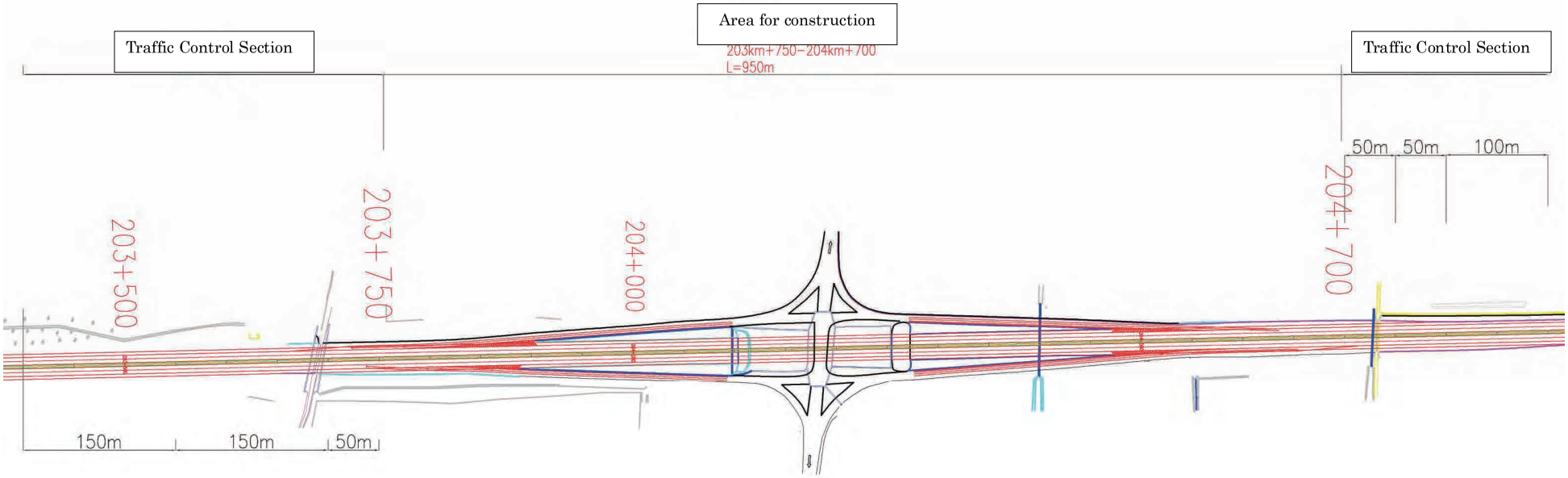


Figure 3.2.3-10 Traffic control at Van Diem Interchange

(iii) Traffic control at shoulder

Construction procedure is shown below.

*Overlay and longitudinal sloping at main road
*Sloping at exit and entrance of IC.
*Overlay at the shoulder

Detail procedure for Traffic Control at Thuong Tin Interchange is shown below.

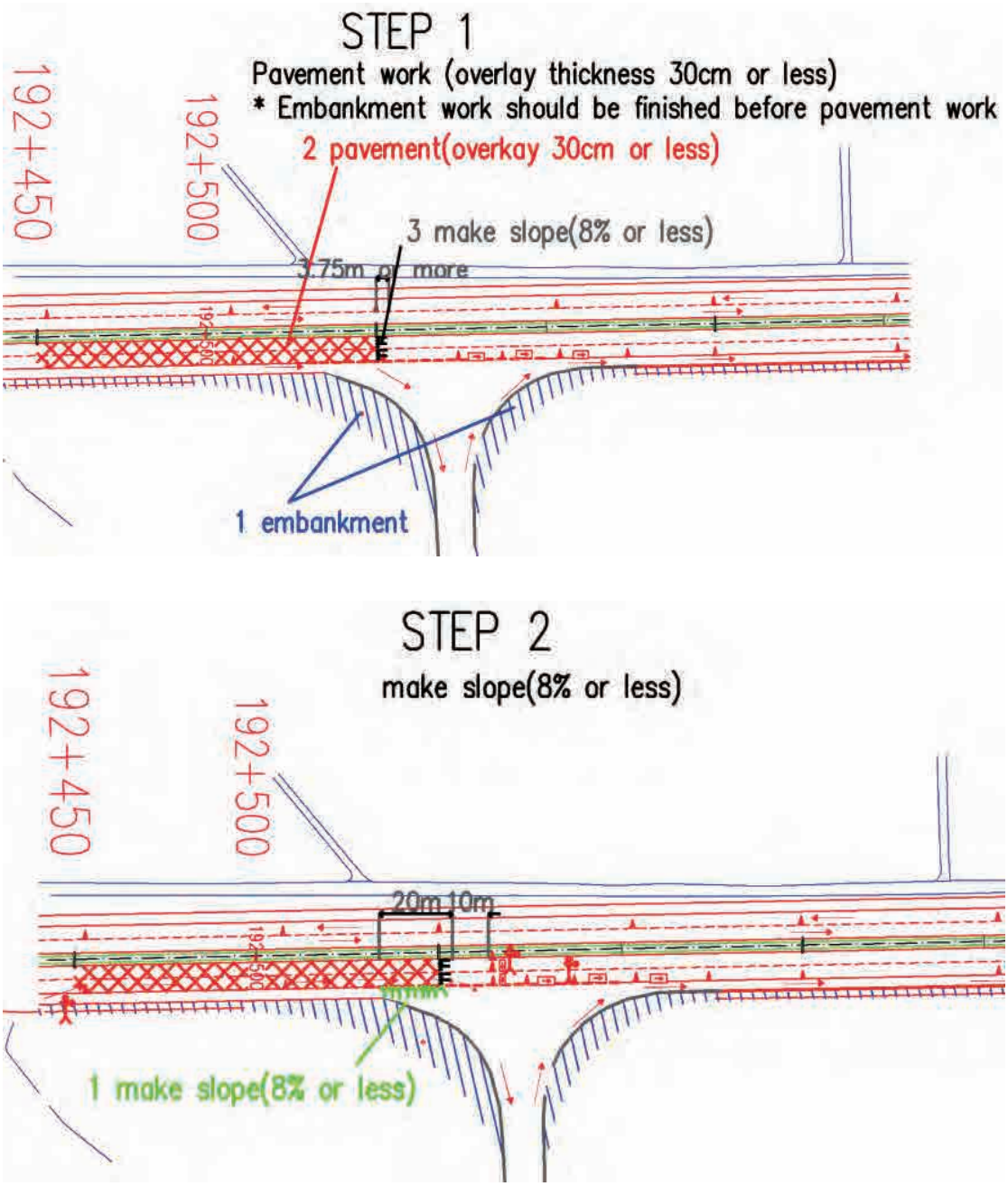


Figure 3.2.3-11 Traffic Control at shoulders (1)

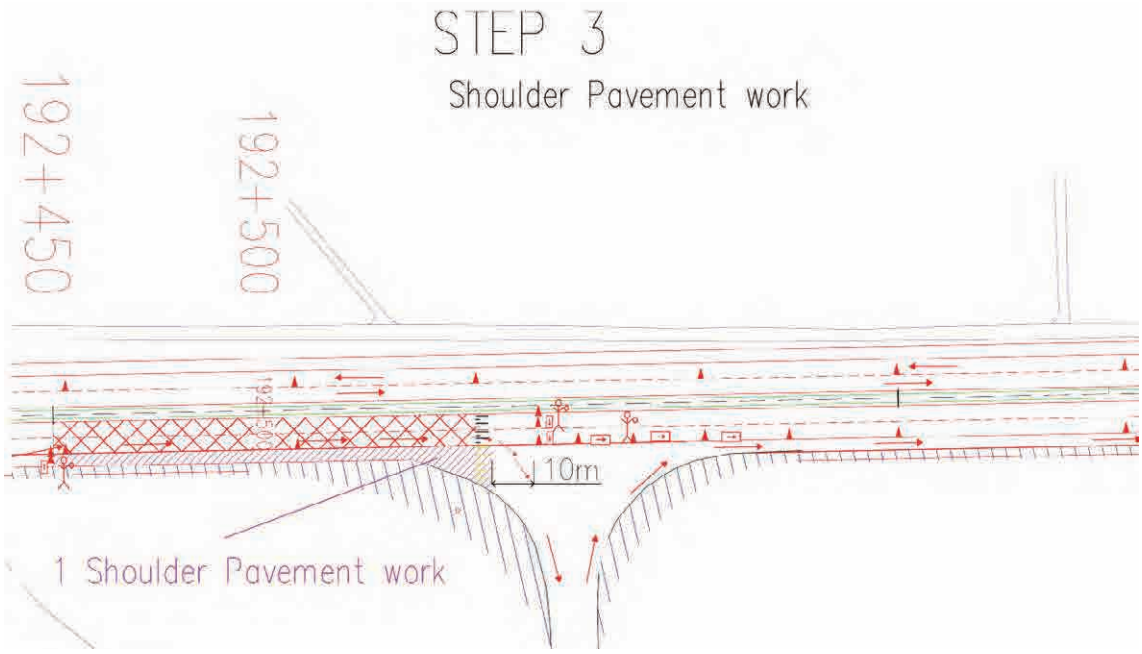


Figure 3.2.3-12 Traffic Control at shoulders (2)

3.2.3.3 Procurement of Construction Material

(1) Crushed Stones and Borrow Pit

Locations of Quarry and borrow pit for suitable material stated in VEC F/S are shown in Figure 3.2.3-13 Locations of Quarry and Borrow Pitand details are shown in Figure 3.2.3-14.

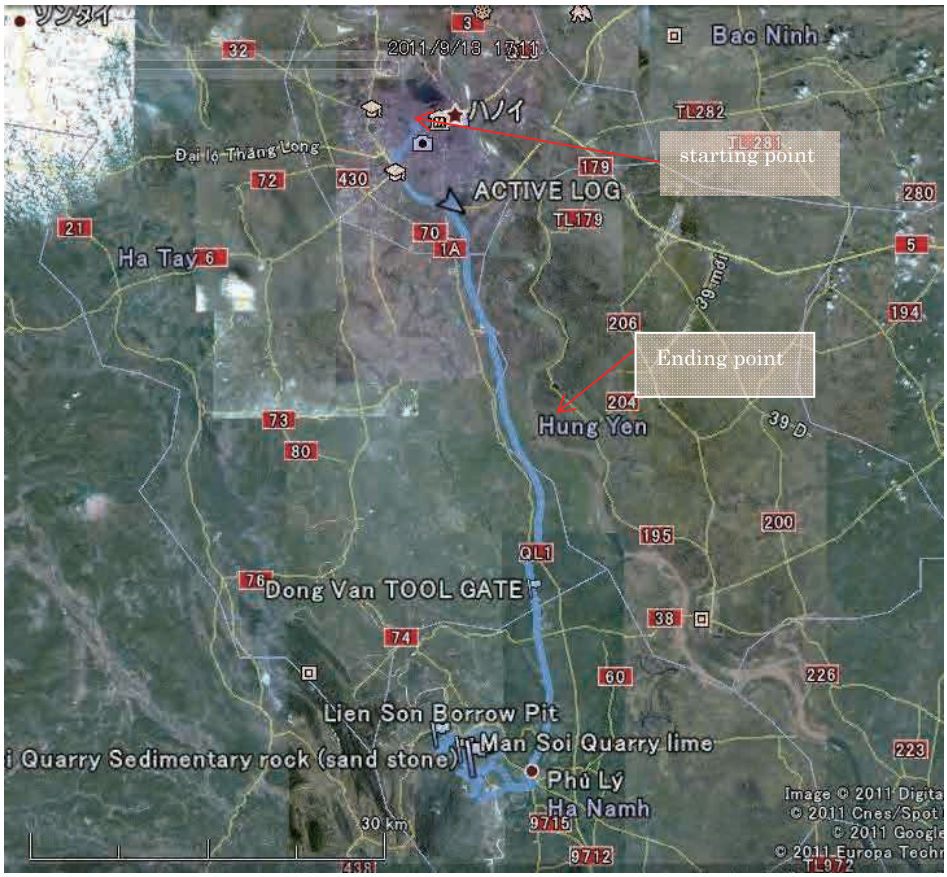


Figure 3.2.3-13 Locations of Quarry and Borrow Pit

Figure 3.2.3-14 Detailed map of Quarry and Borrow Pit

a. Borrow Pit for Suitable Material

Quantities of suitable material are enough for the Project and quality of material is suitable for slop tamping to the embankment slope.

b. Quarry

There are more than 5 quarries in MAM SOI district. Such quarries employ cone crushers for crushing. Some of them employs impact breaker.
Figure-CCC shows a quarry which employs impact breaker and Figure-DDD shows crushed stones (G1 size, 19mm or more).
Rocks before crushing are lime stones in most quarries. Also Sediment Rocks (sand stones) is also used.

Crushed stones can be used as normal base course or asphalt base course. However it is necessary to make additional tests, such as stripping test, Los Angeles machine test and stability test, in case that such crushed stones are used for permeable pavement.

Figure 3.2.3-15 Quarry using impact breaker

Figure 3.2.3-16 Crushed Stones (G1 size)

(2) Sand

Borrow pit for sand material designated in VEC F/S is shown below. Study team inspected THANH LONG companyand HUY HOANG company and checked material property and method of production of sand material.

Figure 3.2.3-17 Location for Sand Borrow Pit

a. THANH LONG company

Coarse sand produced at the borrow pit at upstream is transported by a barge and stok piled in the stock yard. There are two concrete batching plants near the borrow pit. Sand from borrow pit is used for coarce sand in fine aggregate. Coarse sand is well washed and, from quality point of view, it is considered suitable for coarse sand for embankment material and coarse sand in fine aggregate for asphalt concrete.

Figure 3.2.3-18 Detailed Location (THANH LONG company)

b. HUY HOANG company

Sand is dredged by a sand pump. At the time of Inspection in rainy season, fine sand was dredged. Fine sand is well washed and, from quality point of view, it is considered suitable for fine sand for embankment material and fine sand in fine aggregate for asphalt concrete.

Figure 3.2.3-19 Detailed Locations (HUY HOANG company)

3.2.3.4 Study for an introduction of Permeable Pavement

It is required that the surface of Expressways in Vietnam is paved by "roughness layer" as applied in the design of this time. Quality required for roughness layer is surface flatness (specified by International Roughness Index, IRI) and texture depth. Requirements for roughness layer are as follows:

Table 3.2.3-3 Requirements on Roughness Layer

Running Speed(Km/h) or Degree of Danger	Average depth of sand spreading H_{tb} (mm)
V< 60 60≤ V < 80 80 ≤ V ≤ 120	$H_{tb} \geq 0.25$ $H_{tb} \geq 0.35$ $H_{tb} \geq 0.45$
Difficult and dangerous road: ➢ winding road irrespective of speed limit ➢ road with curve radius not greater than 150m ➢ road with grade more than 5% and length longer than 100m.	$H_{tb} \geq 0.80$

Permeable Pavement improved and established by Japanese engineering technology can satisfy the standard for roughness described in the above Table (Permeable Pavement in Japan, Htb ≥ 0.9). Moreover, it has excellent features as follows:

- Upgrading of safety by preventing from hydroplaning
- Increasing of visibility by removing splash of water
- Improving of visibility during night
- Reducing of noise

Recently traffic accident has increased significantly in Vietnam in particular, thus Permeable Pavement may introduce many advantages on the highways there. However, in order to apply it as roughness layer, following issues of its material need to be addressed.

(1) Aggregate

In order to find whether it is suitable for Permeable Pavement or not, it is necessary to inspect the validity of its resistance of rutting and void content through conducting the density testing, Los Angels abrasion testing (diminution of abrasion), peeling resistance testing etc.

(2) Asphalt

In order to lay Permeable Pavement in high quality, it is necessary to use special high viscous binders. However, they have now not been manufactured in Vietnam yet. They need to be imported from Japan or other neighboring countries.

(3) Quality Control

In addition to the preparation of high viscous binders which are used at the plant for asphalt mixture for Permeable Pavement (melting plant is necessary when binders are transported by drum), strict quality control such as material control and mixed temperature control is required during the production.

Each of those issues is possible to resolve, but it seems that applying Permeable Pavement for the first time in Vietnam to the Expressway project from the beginning of the Phase I is premature. It is recommended that pilot construction of using Permeable Pavement start during the Phase I or before the Phase II and its follow-up study be conducted after several years of service to check its quality.

Vietnam standard 22-TCN211-06 states that subject to confirmation of strength by various tests Permeable layer using polymer with15%-20% void can be regarded as structural component. Then, if Permeable Pavement can be used instead of roughness layer, a current standard structure of surface course and roughness layer will be substituted with one Permeable layer which is able to have same function and durability with structure as that of two layers. With economic advantage of one layer, Permeable Pavement is expected to become part of standard structure of expressways in Vietnam.

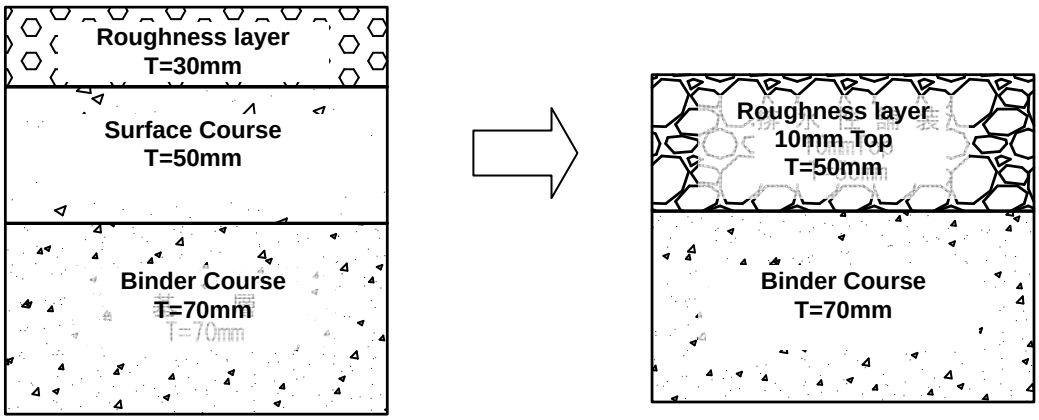


Figure 3.2.3-20 Decrease in Pavement thickness by Applying Permeable Pavement

At the construction stage, special skills and know-how may be required for the introduction of Permeable Pavement because of its complicated construction ways.

3.2.4 Outline Construction Costs

3.2.4.1 Scope of the Works in VEC FS

In VEC FS, there are only two estimates, namely (i) Upgrading existing 4-lane Highway to Expressway and (ii) Frontage Roads Construction. Cost Estimate for (iii) 6-lane widening is not included.

For Frontage Roads Construction, because works will be commenced for the areas where no land acquisition is required or where land acquisitions are completed, it is anticipated that commencement of works may not be the same as that for (i) Upgrading or will be delayed.

With this respect, in this study Item (i) above is regarded as Phase 1 and Item (ii) is regarded as Phase 1.5. The quantities for construction activities included in each Phase is calculated and compared to those in VEC FS. For Item (iii), it is regarded as Phase 2 and the construction cost a reference is calculated as at the same level as that in VEC FS by using the same construction activities.

The following Table shows construction activities identified for cost estimates.

Table 3.2.4-1 Construction Activities in Each Phase

Construction Stage	Location	Construction Activities
Phase I Upgrading existing 4-lane Highway to Expressway (review of VEC FS)	Main Lines	Earth works (Road way excavation and embankment) Slope treatment Pavement works (Overlay) Guard barriers and guard rails Road marking Ancillary works etc.
	Interchange	Earth works Slope treatment Pavement works Road marking etc.
Frontage Roads Construction (review of VEC FS)	Frontage Roads	Earth works (Road way excavation and embankment) Slope treatment Pavement works Drainage works Extension of existing Box or Pipe Culvert etc.
Phase 2 6-lane widening (Study Team based on VEC FS)	Main Lines	Earth works (Road way excavation and embankment) Slope treatment Pavement works (widening 2 lanes) Retaining walls Extension of underpass for traffic Guard rails Road marking Drainage works etc.
	Interchange	Earth works Slope treatment Pavement works Road marking Ancillary works etc.

Figure 3.2.4-1 shows typical cross section for Phase 2: 6-lane widening and Figure 3.2.4-1 shows a comparison of Phase 1 and Phase 2.

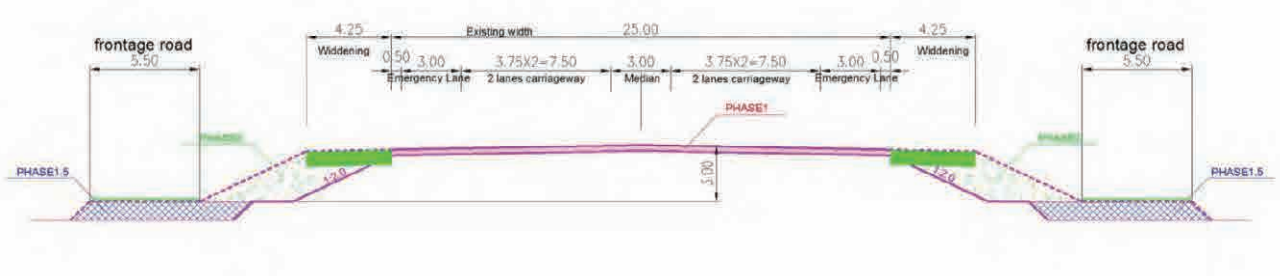


Figure 3.2.4-1 Typical Cross Section for Phase 2: 6-lane widening

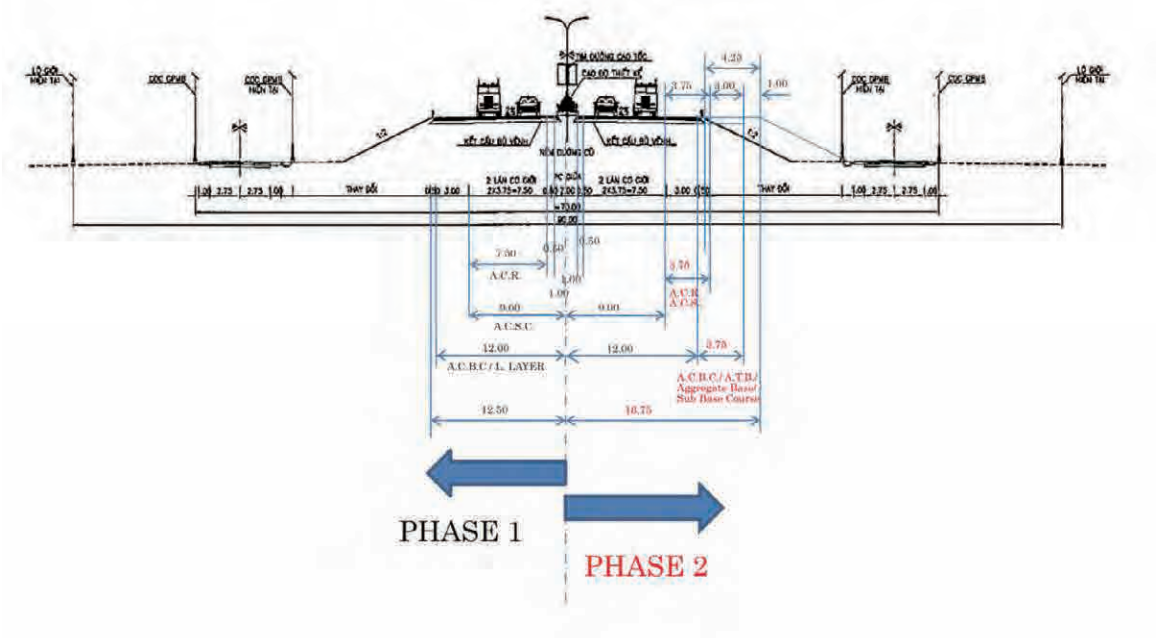


Figure 3.2.4-2 Comparison of Typical Sections for Phase 1 and Phase 2

3.2.4.2 Quantities for Major Construction Activities

Quantities for major construction activities are calculated based on the Figure 3.2.4-1 and 3.2.4-2.

Calculations are carried out as follows.

Site Clearance	: Surface area (slope etc.)×2×Length
Earth works	: Excavation Depth ×Width×2×Length
	Embankment (Phase 2)
	Widening Width× Height of Embankment ×2×Length
Slope Treatment	: Average Height of Embankment× Ratio of Gradient ×2×Length
Pavement	: Width of Pavement×2×Length

The basic design by phase was made as follows:

Phase 1 and the some portion of Phase I1 included in VEC FS;

-Quantities included in VEC FS are used without any change for construction activities whose quantities are not clear at present,

-Average height of frontage embankment is 0.8m

-Cost in VEC F/S are used for construction of interchange as its details are not clear

-Cost in VEC F/S are used for measures mitigating settlement as its details are not clear

Phase II not included in VEC F/S;

-Composition of pavement to be expanded

*Roughness layer	30mm
*Surface course	50mm

*Binder course	70mm
*Asphalt treatment base	100mm
*Road base	180mm
*Upper base	350mm
*Sub base	350mm

-Width of pavement for widening area is assumed to be +50cm

-An average embankment height for Main Lanes is assumed to be 3m.

3.2.4.3 Outline Construction Costs

Total Construction cost is 548.1 billion VND. It includes the costs of phase 1 construction and frontage road construction, phase 2 construction, design and supervision, contingency, VAT, but not land acquisition.

3.3 Study on new implementation scheme utilizing private sector finance

3.3.1 Review of the Scope of Project

3.3.1.1 Overview of the legal framework for BOT/PPP in Vietnam

3.3.1.2 Applicable Laws and Regulations for the Project Implementation Scheme

3.3.1.3 Schedule of Approval Process under Planned Scheme

3.3.1.4 Other Applicable Regulations concerning Project Implementation

Note: Chapter 3.3.1 (Page 3-79 to Page 3-85) in this report is not disclosed, because they contain relevant information such as confidentials on the commercial.

3.3.2 Structure of Implementing Operations and Maintenance

3.3.2.1 Roles of SPC

The concession for the PVCG expressway shall remain with VEC. SPC will sign a contract with VEC to take over the execution of the project on behalf of VEC. Based on this contract, SPC will be responsible for the total management of the PVCG expressway project, including the designing, ordering, construction, project management, operations and management. For the detailed design, construction management, construction, maintenance and toll collection, SPC will sign contracts with contractors specialized in each field of business.

While VEC still holds the concession, SPC will take over the actual execution of the project on behalf under the contract signed between the two. During the course of the project, VEC will monitor the SPC's implementation of the Project.

The following diagram shows the roles of SPC in construction, operations and maintenance.

(1) Construction Stage

Throughout the course of Phase 1 (improvement work) and Phase 2 (expansion to 6 lanes) of the PVCG expressway project, SPC will undertake the total management of the work, including designing, construction management and construction work.

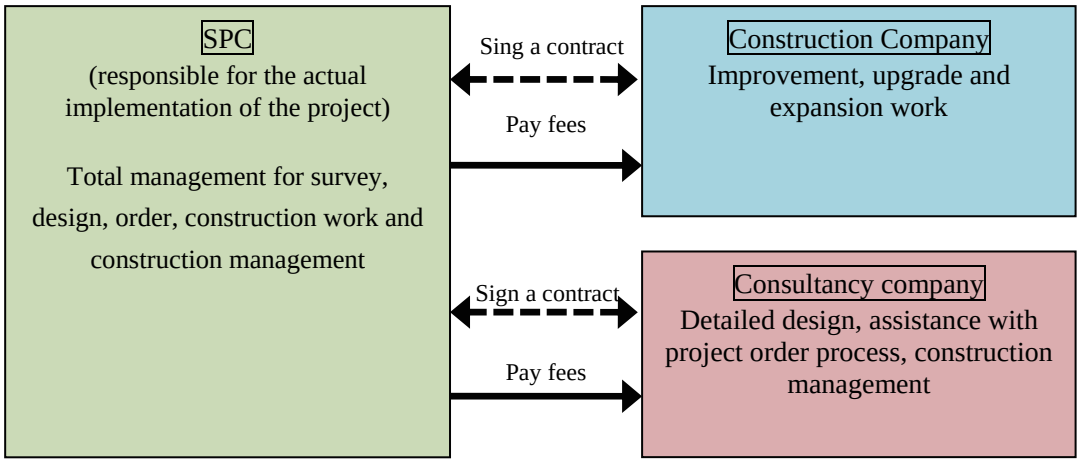


Figure 3.3.2-1 Roles of SPC during Construction

(2) Operations and Maintenance

While undertaking the operations and maintenance of the PVCG expressway project, SPC shall conduct operations and maintenance, toll collection, traffic control and asset management in an appropriate manner.

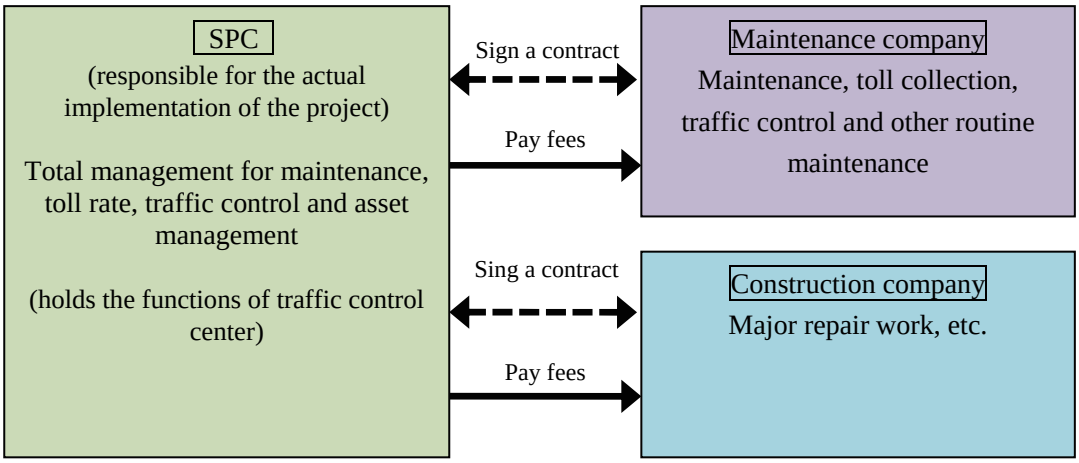


Figure 3.3.2-2 Roles of SPC during Operations and Maintenance

Roles of SPC and contractors are shown below:

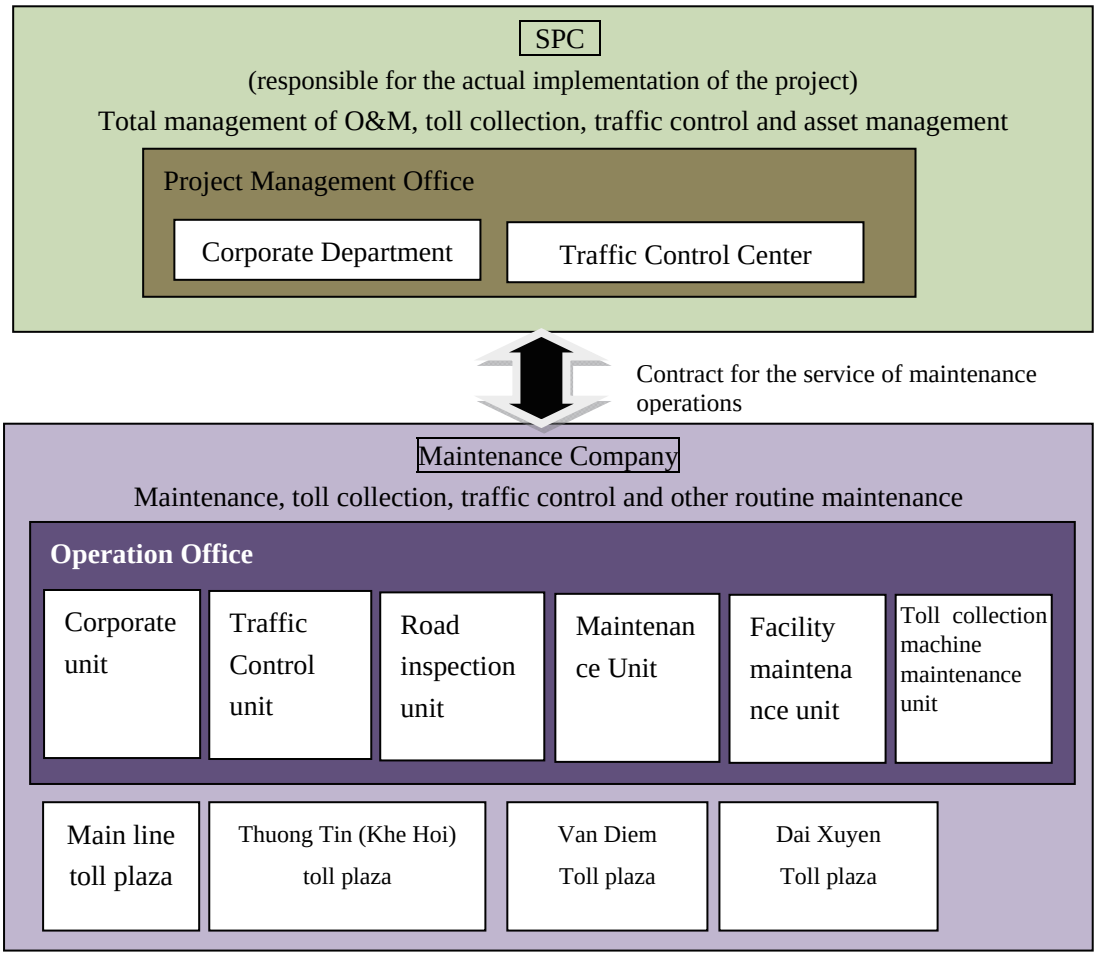


Figure 3.3.2-3 Roles of SPC and Contractor for Routine Maintenance

3.3.2.2 Organizational Design of SPC

As a current plan, SPC's Project Management Office will be organized as below. Traffic Control Center for the PV-CG Expressway will be established in the Project Management Office under

Road Traffic Control Department.

Table 3.3.2-1 Planned Organizational Structure of SPC's Project Management Office

[Phase 1: with 4 lanes in operation]

Department	No. of staff	Composition
Director (President of SPC)	1	
General Affairs Dept.	3	1 manager, 1 in charge of general affairs, 1 in charge of accounting
Toll Collection Dept.	1	1 manager
Traffic Control Dept.	7	1 manager, 1 in charge of traffic control, 5 operators for Traffic Control Center
Road Maintenance Dept.	4	1 manager, 1 in charge of construction project coordination, 1 in charge of asset management, 1 in charge of facility maintenance
Total	16	

[Phase 2: with 6 lanes in operation]

Department	No. of staff	Composition
Director (President of SPC)	1	
General Affairs Dept.	4	1 manager, 2 in charge of general affairs, 1 in charge of accounting
Toll Collection Dept.	1	1 manager
Traffic Control Dept.	9	1 manager, 1 in charge of traffic control, 7 operators for Traffic Control Center
Road Maintenance Dept.	5	1 manager, 1 in charge of construction project coordination, 1in charge of asset management, 1 in charge of repair work, and 1 in charge of facility maintenance
Total	20	

Source: JICA Study Team

Operation Office of a maintenance company will be organized as follows:

Table 3.3.2-2 Planned Organizational Structure of Operation Office

[Phase 1: with 4 lanes in operation]

Department	No. of staff	Composition
Director	1	
General Affairs Dept.	3	1 manager, 1 in charge of general affairs, 1 in charge of accounting
Toll collection Dept.	1	1 manager
Traffic Control Dept.	1	1 manager
Road Maintenance Dept.	4	1 manager, 1 in charge of construction project coordination, 1 in charge of asset management, 1 in charge of facility maintenance
Traffic Control Dept.	6	6 in charge of traffic patrol
Road Inspection Unit	2	2 in charge of road inspection

Department	No. of staff	Composition
Maintenance work unit	5	5 in charge of maintenance work
Facility maintenance unit	5	5 in charge of facility maintenance
Toll collection machine maintenance unit	2	2 in charge of maintenance of toll collection equipment
Total	30	

[Phase 2: with 6 lanes in operation]

Department	No. of staff	Composition
Director	1	
General Affairs Dpt.	3	1 manager, 1 in charge of general affairs, 1 in charge of accounting
Toll Collection Dpt.	1	1 manager
Traffic Control Dpt.	1	1 manager
Road Maintenance Dpt.	4	1 manager, 1 in charge of construction project coordination, 1 in charge of asset management, 1 in charge of facility maintenance
Traffic Control Unit	6	6 in charge of traffic patrol
Road Inspection Unit	2	2 in charge of road inspection
Maintenance Work Unit	20	20 maintenance workers
Facility Maintenance Unit	5	5 facility maintenance workers
Toll equipment maintenance unit	2	2 equipment maintenance workers
Total	45	

Source: JICA Study Team

The following is a list of toll plazas required for operators to collect tolls for this expressway:

Table 3.3.2-3 Plan for Toll Plaza Lanes

	Toll plaza	location	ETC lane		One-stop lane			Total
			entry	exit	entry	entry (with track scale)	exit (with no track scale)	
1	Toll Gate (Main Lane)	Km 188+300	1	1	5	7	4	18
2	Thuong Tin (Khe Hoi)	Km 192+865			4	3	1	8
3	Van Diem	Km 204+191			4	2	2	8
4	Dai Xuyen	Km 211+00			3	2	1	6
	Total		1	1	16	14	8	40

Source: VEC

Table 3.3.2-4 Plan for Staffing of Each Toll Plaza (Phase 1: with 4 lanes)

1) Toll Gate (Main Lane)

Positions	No. of staff	Shift arrangement
Toll office managers	3	1 x 3 teams
Toll management staff	6	2 x 3 teams
Toll collection managers	3	1 x 3 teams
Toll collectors	48	16 One-Stop Lanes x 3 teams
Total	60	

2) Thuong Tin (Khe Hoi)

Positions	No. of staff	Shift arrangement
Toll office managers	3	1 x 3 teams
Toll management staff	6	2 x 3 teams
Toll collection managers	3	1 x 3 teams
Toll collectors	24	8 One-Stop Lanes x 3 teams
Total	36	

3)Van Diem

Positions	No. of staff	Shift arrangement
Toll office managers	3	1 x 3 teams
Toll management staff	6	2 x 3 teams
Toll collection managers	3	1 x 3 teams
Toll collectors	24	8 One-Stop Lanes x 3 teams
Total	36	

4) Dai Xuyen

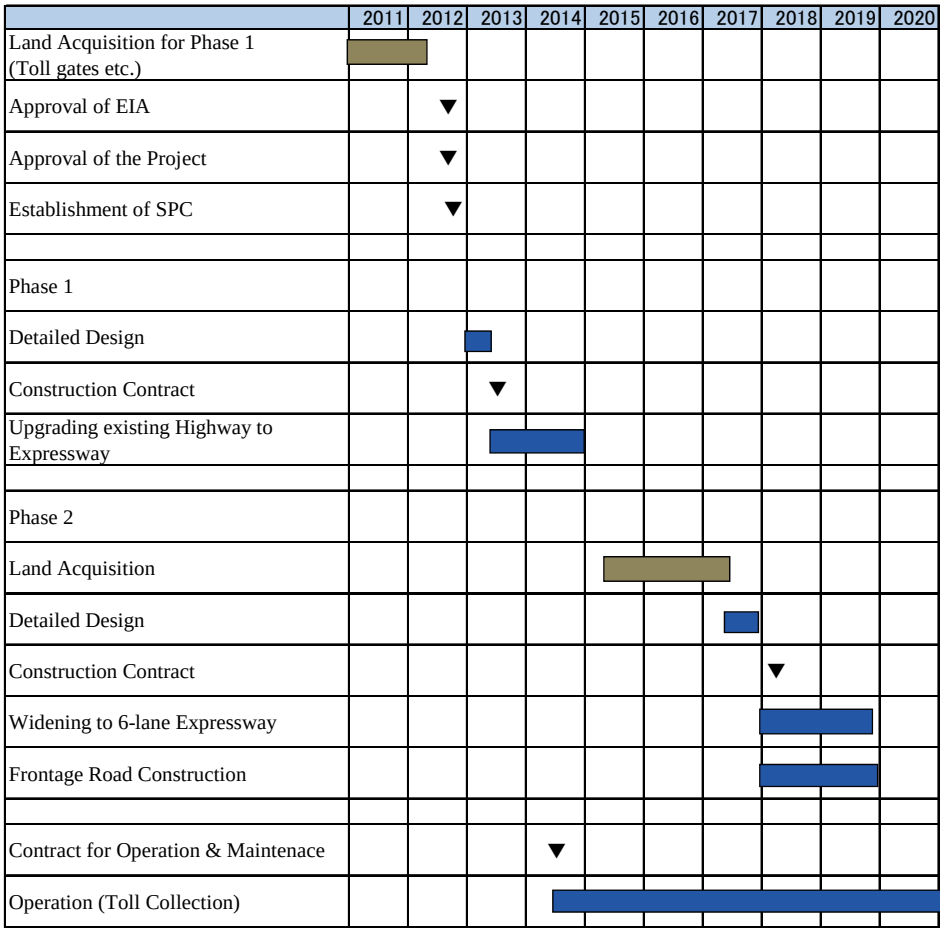
Positions	No. of staff	Shift arrangement
Toll office managers	3	1 x 3 teams
Toll management staff	6	2 x 3 teams
Toll collection managers	3	1 x 3 teams
Toll collectors	18	6 One-Stop Lanes x 3 teams
Total	30	

Source: JICA Study Team

3.3.3 Establishment of Project Implementation Schedule

In Phase 1 of the project, the existing road will be upgraded into 4-lane expressway, the required right of way will be acquired for the width of 6 lanes to be worked on in Phase 2. Because Frontage Roads construction can be commenced after Government acquires the necessary land, it is recognized as Phase 2 works. Land Acquisition can be commenced after EIA is corrected in JICA Environmental Advisory Committee and VEC submits corrected EIA to MONRE for approval, which calls EIA evaluation committee. In this regard, a schedule of Frontage Roads construction sets “at latest” commencement.

Table 3.3.3-1 Project Implementation Schedule



Source: JICA Study Team

3.3.4 Study on O&M Plan

In establishing the O&M Plan for the PV-CG Expressway, it shall be ensured that the plan would not contradict with the compliance to all relevant laws and regulations concerning the project implementation, operations and management of expressways in Vietnam. It is also important to establish an efficient Level of Service (LOS) that takes account of the characteristics of the expressway.

A local office will be established in Vietnam to provide the service and procure required facilities, equipment and tools. Necessary discussion and arrangement shall be made with relevant authorities, police and emergency aid services (fire trucks/ambulances) before the start of the operation.

3.3.4.1 Tasks involved in O&M

The tasks involved in the operations and maintenance of the expressway are shown in the table below:

Table 3.3.4-1 Tasks involved in O&M

No	Type of Work	Description
1	Maintenance (civil engineering work) ・pavement, bridges, embankment, drainage and other facilities 1) Routine maintenance, inspection 2) Repair 3) Upgrade	Inspection, cleaning, vegetation, road/lane closure, pavement repair, bridge repair, pavement replacement, bridge reinforcement, bridge accessory replacement
2	Maintenance (facilities) ・ITS facilities 1） Routine maintenance, inspection 2） Repair 3） Replacement	Facility inspection, repair and replacement of facility parts, upgrade or replacement of facilities
3	Traffic Control • Collection and dissemination of traffic information • Traffic patrol • Response to accidents and disasters • Clearing of disabled cars • Clearing of obstacles on road • Elimination of overloaded trucks • Management of traffic statistics	Central control of traffic information, regular/emergency patrol, lane/road closure, accident clearance, emergency response, clearing of disabled cars, clearing of obstacles on road, cleaning, inspection and enforcement with weight scale/vehicle height scale, data collection of traffic volume or traffic accidents
4	Road Management • Management of road asset • Management and update of road asset data	Monitoring of illegal occupancy of road, drawings, maintenance ledger
5	Toll Collection	Toll collection, maintenance of facilities and equipment used for toll collection
6	Others • Coordination with other roads and road projects nearby	Traffic information, traffic restriction, toll charges

Source: JICA Study Team

Note: In the event that Traffic control function is entrusted to the Northern Regional Main Center, the contents of the above table will be changed.

In order to regulate overloaded vehicles, it is necessary to provide a yard where inspection of overloaded vehicles including weighing the weight of a vehicle can be made. The location of such

yard is assumed to be the entrance of the Main Lanes Toll gates at Km 188+300. The detailed planning will be carried out in Detailed Design stage after co-ordination of VEC.

3.3.4.2 Determination of Level of Service for PVCG Expressway O&M

(1) Characteristics of PVCG Expressway

Forecasted traffic based on the current traffic demand forecast by JST is as follows:

Table 3.3.4-2 Result of Traffic Forecast of PVCG Expressway(ADT)

	Vehicles type＼year	2014	2020	2025	2030	2033
Number of cars	Cars, Pick-up & 4WD Truck	12,033	16,640	17,806	19,183	19,183
	Bus≤24 Seats, Medium Truck	4,157	7,592	10,975	16,460	16,460
	Bus≥25 Seats	3,142	3,831	4,033	4,245	4,245
	Heavy Truck	717	1,750	2,879	4,736	4,736
	Truck & Trailer	559	1,366	2,247	3,696	3,696
	Total	20,608	31,179	37,940	48,320	48,320
PCU converted		32,311	51,434	66,340	89,860	89,860
Remark		The first year of a 4-lane opened	The first year of a 6-lane opened			The final year of toll collection

Note: ADT is Average Daily Traffic

It is estimated that future traffic averaged in the whole sections is over 30,000 PCU/day from the first year that an expressway with 4- lane open to the public. With the steady increase in traffic volume thereafter, the expressway will be expanded to 6- lane in 2020 in response to its growing demand. As PV-CG expressway shares function of National Highway No.1A, on which many trucks for distribution of goods and long-distance buses travelled, a percentage of heavy vehicle traffic becomes high.

(2) Present situation of operation and maintenance

"Transportation facilities and construction management No.236 Inc." (No.236 Inc.) undertakes operation and maintenance of PVCG highway which is now used as a bypass of National road No.1A and administered by DRVN as the national road section.
Outline of No.236 Inc. and its operation and maintenance works are as follows:

1) O&M works undertaken

- National Road No.1 , Don Dang in Lan Son province(Chinese border)～Nhu Nguyet bridge in Bac Giang province, length: 132km
- National road No.1, Phap Van in Hanoi city～Tam Diep in Ninh Binh province, 115km
  For PhapVan and Cau Gie section, PVCG highway, a bypass to National road No.1A
- A national road toll gate in LanSon and BacGiang province border

2) Numbers of employees and organizational structure

6 Road Administration offices: about 30 staffs per office including about 20 workers
A national road tollgate: 83 staffs
Staff for machinery and materials, and electricity: about12 people
Stock share: 30% by the Government and 70% by employees and individuals from the outside
Capital: 11.23 billion VND (about 56million Yen）

3) Expenditure on operation and maintenance

Expenditure on operation and maintenance is fully met by State budget
Routin operation and maintenance cost: 50 million VND/km/year for high standard section in Phap Van-Cau Gie section
: 40 million VND/km/year for general section in Cau Gie - Ninh Binh section
Electricity cost: in addition to routin operation and maintenance cost above
: 400million VND/year (about 2 million yen) for high standard section in PhapVan-CauGie section
: Local People's Committee along the road bear the cost for general section

4) Level of Service in O&M

Budget for operation and maintenance is decided based on area characteristic along the road, mountainous or residential etc, traffic volume and road structure. Firstly budget is decided by DRVN in charge of budget allocation. Based on the budget allocated No.236 Inc. will make O&M plans for roads and submit it to DRVN. Then, after the plans are approved by DRVN, they will undertake operation and maintenance as per approved O&M plans.

Table 3.3.4-3 Frequency of major works

Work Items	Frequency
Cleaning on road surface by machinery	1time/2days
Pruning of planted trees	Every day (working capability is not clear)
Repairing works	Mainly for works leveling grade of structures
Regular maintenance works for Road lighting	Not carried out
Measures to recover from accidents	Cost is claimed against person concerned when they are identified

5) Vehicles for O&M

No.236 Inc. owns excavators, bulldozers, sprinklers, sweepers as well as liaison cars.

(3) Level of service in O&M when the same standard as that of Japan is applied

Traffic when PVCG Expressway with 4-lane opened its service is forecasted to be about 40,000 PCU per day. If the operation and maintenance standard in Japan is applied to this level of traffic, the following Level of services is assumed be applied:

Table 3.3.4-4 Assumed Operation and Maintenance Standard when based on that of Japan

Work Items	Frequency	Remarks
1. Cleaning		
Road surface cleaning with Machinery	45times/year	Frequency is determined according to clean conditions of road (Assuming the current road condition)
Road surface cleaning with man power	179times/year	Frequency is determined according to clean conditions of road (Assuming the current road condition)
Cleaning for Interchange area	1time/2days	Traffic volume: not less than 10,000 vehicles/day
Cleaning for drainage	1time/year	Mainly points where blockage is experienced
2. Inspection		
Safety Inspection	5days/2weeks	Checking safety by visual inspection from a car on the main line
Road structure inspection (Regular visual inspection)	1time/year	Checking damage condition by visual inspection on site
Road structure inspection (Detail inspection)	1time/5～10years	Detailed visual inspection on site and hammering
Maintenance inspection for Equipment (Routine inspection)	1time/1 month and 1time/3monthes	Visual checking for abnormality and light bulb replacement, etc.
Maintenance inspection for Equipment (Regular inspection)	1time/6 months and 1time/12monthes	Measurements using the instrument and operation check etc.
3. Traffic management (regular patrol)	10times/day	40,000vehcles/day ～ 50,000vecles/day

(4) Level of Service for PVCG Expressway in future

Judging from the current situation of PVCG highway, the following issues are identified in O&M aspect when compared with other National Roads in Vietnam.

- The highway has been stained by dust and dropped materials from vehicles.
- Road structures have been damaged by travelling of large heavy vehicles, especially overloaded vehicles.
- Because PVCG highway is located in the area with soft ground, it is expected that grade difference on the paved surface will occur by differential settlements.

As Level of service in O&M for PVCG Expressway, it is essential that safe and rapid travelling as well as efficient O&M is secured although private sector operates and maintains using private sector funds. On frequency of cleaning, it is required to decide efficiently the allocation between cleaning by machinery and by manpower. Its frequency will decide assessing how serious the dust and waste on the road are and considering how well operation and maintenance works will

be undertaken as a normal practice in Vietnam. For patrol for traffic management, it is efficient that the frequency and cycle of patrol in normal days are decided considering fluctuation of traffic volume by time and the situation where traffic accidents occur. Inspection of road structures and maintenance of ITS facility shall be held based on the quality of constructed road structures in Vietnam and the specifications of procured ITS facility. For road structures, it is necessary to inspect the soundness of those on how well its function is maintained taking traffic volume, weather conditions and geological situation near-by as well as its initial quality into account. In short, in order to decide Level of Service it is desirable not only to fix the optimum frequency of works considering the essential road features of the said Expressway but also to review it from time to time studying the change of the way how the Expressway is being used, such as traffic volume growth.

3.3.4.3 Tentative Regulations for the Ho Chi Minh-Trung Luon Expressway O&M

Tentative regulations currently exist for the Ho Chi Minh-Trung Luon Expressway, which opened to traffic in September 2010 in the southern part of Vietnam. These regulations lay basis on the O&M for Vietnam's expressways.

As shown in the evaluation table below, however, they do not specify any details about frequency and implementation methods, particularly on inspection, repair, cleaning, and traffic control.

Table 3.3.4-5 Evaluation of Tentative O&M Regulations

Evaluation item		Result
Inspection, evaluation	Type of inspection, evaluation	○
	Inspection/evaluation for each target structure	○
	Evaluation and implementation standard	Evaluation item: ○ Frequency: ×
Repair	Repair plan	○
	Frequency	○
Cleaning	Evaluation item, implementation standard	Evaluation item: ○ Frequency: ×
	Plan	○
	Frequency	Frequency and method: ×
Traffic control	Frequency	Detailed methods: ×
	Organizational structure	Evaluation item: ○ Frequency and method: ×
Facility maintenance, inspection	Type of inspection	○
	Regular maintenance, trouble shooting	○

Source: JICA Study Team

Legend: ○: Stated ×: Not stated

3.3.4.4 Plan of Operation Office Establishment

Although VEC-F/S has not determined its plan, the establishment of Operation Office is necessary to conduct operations and maintenance. As the PV-CG Expressway is 28km in length, it only takes 40 minutes to patrol the whole stretch, provided the driving speed is 80km/h. Therefore, even during the emergency dispatch to some accident site, the location of the operation office would not affect very much on the efficiency of the operation. However, it is important to bring the functions of the project management office, traffic control center and maintenance office into close proximity to each other for efficient operations. The area of the operation office will be leased to a contracted maintenance company, based on the service contract for the maintenance operations.

As a result of coordination with relevant Authority, traffic control for PV-CG Expressway may be entrusted to North District Traffic Control Center. Considering this possibility, traffic control room for the Project only equipped with a minimum function.

Table 3.3.4-6 Plan of Operation Office

Function	Example
Project Management Office	office, accommodation, space for construction materials/equipment/vehicles, staff room, parking
Traffic Control Center	office, traffic control system, communications facilities
Maintenance Office	office, staff accommodation, space for maintenance vehicles/equipment, staff room, parking

Source: JICA Study Team

3.3.4.5 Toll Collection

Toll collection for the PV-CG Expressway is planned as follows:

(1) Toll System

The distance-based toll system will be implemented; the distance between the interchanges of origin and destination will be calculated, and the rate in proportion to this distance will be charged.

(2) Collection Method

Tickets are issued upon the entry to the expressway, and the toll charges are collected from the drivers at the exit. When drivers get on the expressway through a toll booth, they are given toll tickets, which show the information about the point of entry. When they get off the expressway, the toll charges are calculated and charged to the drivers at the toll booth based on the information on the tickets. To ensure toll charges are collected from all expressway users, the Closed System will be applied, where toll collection facilities (i.e. toll booth) are located at every interchange.

(3) Construction of Toll Booth

According to the MOT Decision No. 232/2010/QD-BGTVT dated January 25, 2010, the construction of toll collection facilities on the PVCG Expressway is included in the Cau Gie-Ninh Binh (CGNB) Expressway project. The diagram and the table below show the location of each toll barrier and the lane allocation.

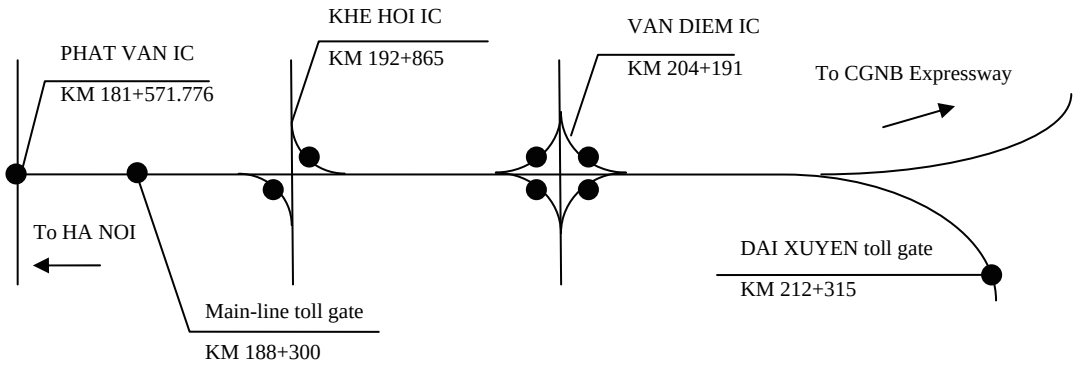


Figure 3.3.4-1 Planned Locations of Interchanges and Toll Gates on PV-CG Expressway

Table 3.3.4-7 Lane Arrangement at Toll Barrier

	Name of toll gate	Location	ETC lane		One-stop lane			Total
			entry	exit	entry	exit (with track scale)	exit (with no track scale)	
1	Main-line toll gate	Km 188+300	1	1	5	7	4	18
2	Thuong Tin (Khe Hoi)	Km 192+865			4	3	1	8
3	Van Diem	Km 204+191			4	2	2	8
4	Dai Xuyen	Km 211+00			3	2	1	6
	Total		1	1	16	14	8	40

Source: VEC

(4) Issues in Toll System

For the CG-NB Expressway, which will be connected to the PV-CG Expressway, distance-based toll charges will be applied. A reliable toll system is critical for the stable operations of these two expressways. The following two plans are proposed as to how the tolls are collected from drivers travelling across these two expressways managed by different operators.

1） Individual collection method; a main-line toll gate will be set up at the point of connection between these two expressways. When drivers travel from the PV-CG Expressway to the CG-NB Expressway, they pay for the PV-CG at the toll gate before entering the CG-NB, and vice versa.

2） Combined collection method; there will be no toll gate at the point of connection between two expressways. Drivers are charged for the distance of the consecutive sections according to the toll rate matrix used for both expressways. All the collected tolls and the traffic data are later processed and paid out to each expressway operator.

The operators of the PV-CG and CG-NB (managed by VEC) shall discuss further to determine a

practical and efficient toll collection system.

3.3.4.6 ITS Development Plan (Traffic Control)

SPC will undertake the operations of the traffic control center for the PV-CG Expressway. The contracted maintenance company will undertake routine patrol, emergency patrol (as required from Traffic Control Center), accident clearance and other traffic management operations.

The PV-CG Expressway will have its own traffic control system. ITS technologies will be implemented in stages in accordance with an increase in traffic volume and the number of traffic accidents.

In early stages where the traffic volume is still low, the number of traffic accidents or the frequency of traffic congestion is naturally low. The traffic information will be collected through the routine or emergency traffic patrol, communication from toll booths or information from road users. As the traffic volume grows and the frequency of accidents and congestion becomes higher in the future, ITS facilities will be implemented. The level of traffic control system expected in the early stages and the future is shown in the following table:

Table 3.3.4-8 Traffic Control level

Items	Early Stages	Future
Concept	Minimum level of ITS required	Higher level of ITS facilities to accommodate higher frequency of traffic incidents
ITS technology	Establishment of Traffic Control Center, Patrol by Traffic Control Unit, Appropriate response to incidents	All items mentioned above, plus Installation of cameras and signboards, Establishment of an ITS-driven system
Method	Collection of information through routine patrol, emergency patrol or communication from toll booths, Traffic monitoring, Clearing of accidents and disabled cars based on the information from road users => time lag is inevitable	Remote monitoring system, Real-time information collection (incl. information from patrol, toll booths and users)
Interoperability with other road operators' systems	Independent traffic control system, not connected to other road operators' systems.	Sharing of information on a real-time basis with other road operators
Cost of installation and maintenance	Low	High
Ease of maintenance	Easy to maintain	Highly technical skills are required for maintenance
Required skill	No special skill is required to operate the system	Highly technical skills are required
Information delivery	Lacks speed and details	Real-time information delivery using signboards

Source: JICA Study Team

Currently VEC has already make contract for ITS package installation. Although the details are not yet disclosed, the contract includes toll collecting equipment, communication lines, CCTV and vehicle detector etc., which are mainly focused for toll collection.

At the same time, "Preliminary Study on Freeway Traffic Management Systems in Hanoi Metropolitan Area, Vietnam" under JICA Grant Aid is ongoing by a JV of Oriental Consultants and Metropolitan Expressway Company Limited. In this study, there is a plan to install equipment for informing traffic information in Hanoi city in PV-CG Expressway. VEC and relevant Authority make coordination in this respect. Therefore a policy of the Project for traffic control and provision of traffic information will be made in the Detailed Design stage.

3.3.4.7 Coordination on ITS Development Plan (Traffic Control)

An implementation policy for traffic control of ITS package designed by CADPRO contacted by VEC is as follows.

Table 3.3.4-9 The Contents of ITS package by VEC (Traffic Control)

Item	Contents
Section	Phap Van-Cau Gie-Ninh Binh Section
Implementation policy	Installation of Traffic Control Equipment and ETC equipment for Cau Gie-Ninh Binh Expressway
Equipment installed for Traffic Control	Traffic Monitoring camera, Vehicle Detecting camera, Event Detecting camera, Variable Message Sign Board, Movable Message Sign Board, Changeable Speed Limit Sign Board, Weather Monitoring Equipment, Communication cable (Optical fiber), IP Telephone, Uninterrupted Power Supply
Traffic Control Center function	Vuc Vong Interchange in Cau Gie-Ninh Binh Expressway VEC Road Management and Traffic Control Center ※to be competed in June 2012

As an operator, VEC will carry out traffic monitoring and traffic regulation for Cau Gie-Ninh Binh Expressway and existing PV-CG highway in Traffic Control Center in Vuc Vong Interchange. By upgrading PV-CG highway to Expressway by SPC, authority for traffic control of PV-CG Expressway is assumed to be transferred to SPC by VEC. SPC has the following two options for traffic control.

- Option A: SPC will construct Traffic Control Center for PV-CG Expressway and install equipment for the same.
- Option B: SPC will utilize Traffic Control Center in Vuc Vong Interchange and make joint operation for traffic control from Phap Van to Ninh Binh.

Because Option B allows joint operation for traffic control from Phap Van to Ninh Binh easily, Option B is attractive. Also because existing equipment in Traffic Control Center can be utilized, saving cost of additional investment by SPC is expected.

As roadside equipment, a policy is adopted that Traffic flow will be monitored by CCTV cameras

for traffic monitoring and Vehicle detection, which will be installed through whole line. Road users, whose car has a trouble, can contact road operator by mobile phone. The same procedure has been applied in Ho Chi Minh-Trung Luong Expressway which was in operation from September 2010.

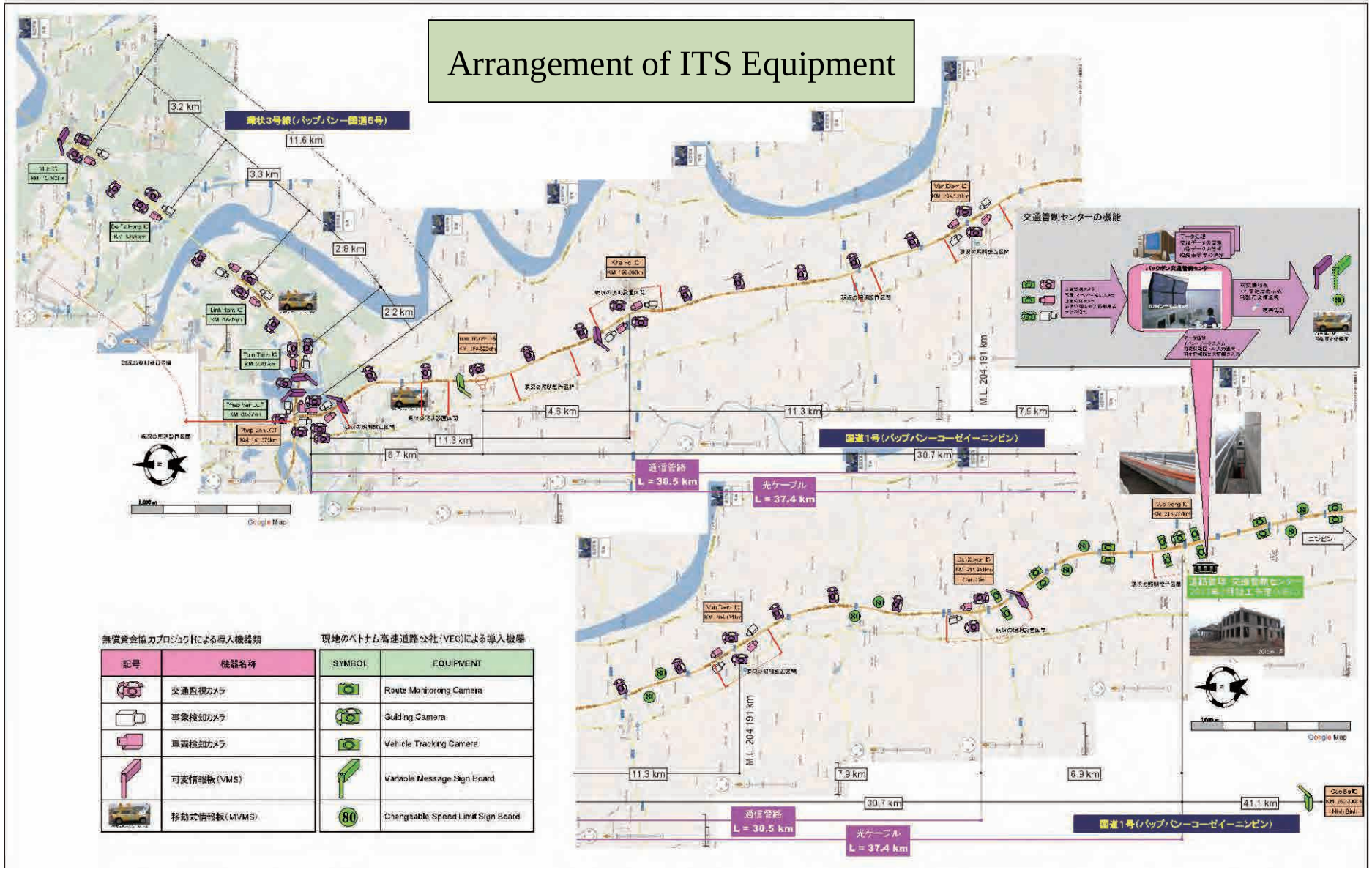
Currently JICA Preparatory Survey on the project for Development of Traffic Control System for Expressway in Hanoi under Japan's Grant Aid is on-going in parallel with installation of ITS package by VEC. ITS equipment for the section from Ring Road No.3 (from Phap Van Interchange to National Highway No.5) to PV-CG highway will be installed under Japan's Grant. In this regard, roadside equipment and communication cable in PV-CG highway section included in ITS package to be installed by VEC will be installed under Japan's Grant with co-ordination of VEC and JICA. Arrangement of ITS equipment, Pattern Diagram for equipment location and Functions of Traffic Control Center are attached from page 3-101 to 3-103 by the courtesy of the Grant Survey Team.

There will be no significant increase in initial investment unless quantities of equipment are increased and/or specifications of equipment are graded up, although procurement method of ITS package is changed from procurement by VEC using State budget to that under Japan's Grant Aid through JICA. Also appropriate function and quality of equipment is procured, there will be no increase in replacement and/or repair costs. The precondition of the above statement is that authority to own, maintain, operate and replace equipment is to be assigned to SPC, as a road operator.

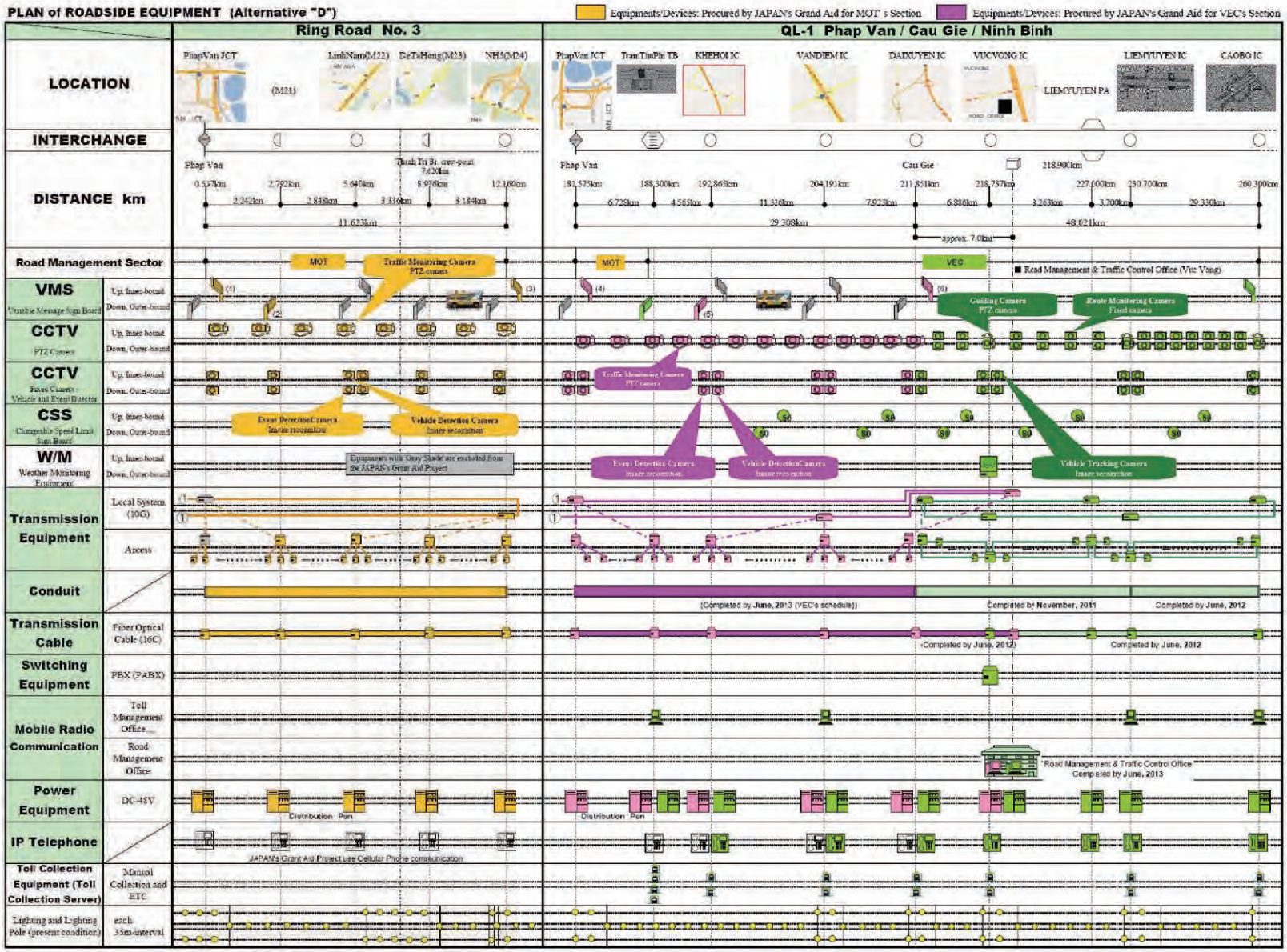
In the other hand, Vietnamese Government has a concept that traffic control of Expressway network in Hanoi will be managed in integrated manner by installation and operation of Regional Main Center with help of JICA Special Assistance for Project Implementation (SAPI), Study for Assistance of its Integration Project Implementation over National Highway No.3 & Hanoi Metropolitan Area. However there are agendas that the following items are still not clear between an operator of such Regional Main Center and each road operators.

- Responsibility and authority
- Actual Implementation procedure
- Cost Allocation

Because the above agendas are not solved at this moment, in Project plan of PV-CG Expressway, SPC holds authority as road administrator and also holds Traffic Control function, Regulation of Traffic, such as Road closure, and Traffic Control, such as exclusion of traffic violator.



Source：Source：Preparatory Survey on the Project for Development of Traffic Control System for Expressway in Ha Noi (JICA)



Source：Source：Preparatory Survey on the Project for Development of Traffic Control System for Expressway in Ha Noi (JICA)

Function of Traffic Control Center

Source：Preparatory Survey on the Project for Development of Traffic Control System for Expressway in Ha Noi (JICA)
Translated and Redrawn by Study Team

*Data Processing
*Traffic data management
*Traffic event data management
*Decision of priority display items

*CCTV Camera
*Event detection camera
*Vehicle Detection camera
*Warning by Road Operator or Road User

Back Bone Traffic Control Center

*Various Message Sign Board (VMS)
*Event detection camera
*Vehicle Detection camera
*Warning by Road Operator or Road User

*Data Processing
*Event data Input
*Selection of information to VMS
*Input of information to VMS

Equipment to be supplied by JICA Grant

Equipment to be procured by VEC

3.4 Financial and Economic Analysis

3.4.1 Study of Financial Scheme and Analysis
3.4.1.1 Composition of Funding
3.4.1.2 Project Costs
3.4.1.3 Tax and other assumptions
3.4.1.4 Policy for dividend to Investors
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3.4.2 Risks for project implementation and operation and Study of Security Package
3.4.2.1 Outline of Risks
3.4.2.2 Sensitivity Analysis
3.4.2.3 Comparative Analysis of Project Schemes
3.4.2.4 Summary of Financial Analysis

3.4.3 Study on risk and security package in general project

3.4.4 Security Package for Lender
3.4.4.1 Overview of Security Package
3.4.4.2 Layer1: Arrangements for the SPC's Viability
3.4.4.3 Layer2: Arrangements for Lender's Asset Control

3.4.5 Legal updates regarding security package of this project
3.4.5.1 New regulations on government guarantee for foreign loans
3.4.5.2 Agent bank in syndicated credit facilities in Vietnam

Note: Chapter from 3.4.1 to 3.4.5 (Page 3-105 to Page 3-147) in this report is not disclosed, because they contain relevant information such as the detailed project cost and confidential on the commercial.

3.4.6 Economic Analysis for this project, Study for index of operate and effect

(1) Economic Evaluation

1) **Methodology**

The economic evaluation is to examine the economic viability of project by comparing economic cost of the projects and economic return (so-called social benefit) to be generated in the regional or national economy. Evaluation indicators are Net Present Value (NPV), Economic Internal Rate of Return (Economic IRR) and Benefit Cost Ratio (BCR). The economic evaluation method is used the standard discount cash flow comparing by cost and benefit.

2) **General Condition**

Benefit of project is measured through "with" and "without" comparison. Using the results of traffic assignment to a network with a project subject to evaluate and also to the same network but without the project, total VOC (Vehicle Operation Cost) and TTC (Travel Time Cost) of each case are calculated. And then benefit is obtained as the difference of them between "with" and "without" cases.

3) **Project Cost**

Project costs, which are shown in Sub-Clause 3.2.4 Outline Cost Estimate, are presented in the financial price. For Economic analysis, costs and benefits are analyzed form the point of view of society, which means interest on borrowing, taxes, direct or indirect subsidies should be excluded. In this regard, for this study, conversion rate 0.85 from financial cost which is used in VITRANSS2 is applied. Economic Cost is shown in following table.

4) **Benefit Estimate**

Benefits of this study are consist of the following two savings,

- Savings the Travel Time Cost (TTC)
- Savings the Vehicle Operating Cost (VOC)

Table 3.4.6-1Travel Time Costs (TTC) by Vehicle Category

Vehicle Type	Motor-cycle	Car	Small-Medium Bus	Large Bus	Pick-Up & 4WD Truck	Medium Truck	Heavy Truck	Truck & Trailer
Driver Monthly Wage ('000VND)		3,500	4,500	5,500	3,500	4,000	5,000	6,500
Assistants Monthly Wage('000VND)			2,500	3, 000	1,750	3,000	3,500	4,500
Driver + Assistant Hourly Rate (VND/h)	0	21,875	43,750	53,125	32,813	43,750	53,125	68,750
Passenger Monthly Wage (7000VND)	3,500	10,000	6,500	6,500				
Hourly Wage Rate (VND/h)	21,875	62,500	40,625	40,625				
Percentage Work Time Passengers	40%	40%	40%	40%				
Passenger Time	8,750	25,000	16,250	16,25				

Vehicle Type	Motor-cycle	Car	Small-Medium Bus	Large Bus	Pick-Up & 4WD Truck	Medium Truck	Heavy Truck	Truck & Trailer
Cost (VND/h)				0				
Vehicle Occupancy	1.75	5.2	18	36				
Freight Volume (Tonne)					1.2	3.4	12.6	26.5
Freight Value per tonne hour (VND/tonne)					3,247	3,247	4,202	5,730
Time Cost per Hour by Vehicle Type (VND/h)	15,313	151,875	336,250	638,125	113,271	156,873	230,029	381,012

Note: Vehicle Occupancy and Freight Volume are Calculated Based on Traffic Survey Result Conducted for METI F/S.
Source: F/S on GMS Hanoi-Lang Son Expressway Project (ADB, June 2011)

Table 3.4.6-2 Vehicle Operating Cost (VOC) following speed by Vehicle Category

Unit: VND

(km/h)	Motor-cycle	Car		Bus		Truck		
		Car	Pick-Up & 4WD Truck	Small-Medium Bus	Large Bus	Medium Truck	Heavy Truck	Truck & Trailer
10	1,008	8,008		12,125		14,274		
15	947	7,874		11,518		13,236		
20	893	6,977		10,911		12,357		
25	853	6,503		10,415		11,541		
30	819	6,113		9,973		10,776		
35	792	5,723		9,642		10,175		
40	783	5,388		9,311		9,628		
45	778	5,109		9,035		9,224		
50	783	4,859		8,870		8,863		
55	792	4,636		8,759		8,590		
60	812	4,468		8,704		8,481		
65	846	4,357		8,704		8,426		
70	886	4,273		8,759		8,464		
75	934	4,247		8,870		8,590		
80	994	4,245		9,035		8,809		
85	1,062	4,273		9,311		9,136		
90	1,142	4,368		9,642		9,574		

Source: “Nhat Tan Bridge to Noi Bai Airport Connecting Road Construction Project Feasibility Study”, TEDY, MOT PMU 85, Oct 2008.

5) **Cost Benefit Analysis**

Based on the estimated economic cost and benefit described in the previous sections, cost benefit analysis was calculated. The result is shown in following table.

Table 3.4.6-3 Summary of Cost Benefit Analysis

Evaluation indicators	Result
EIRR	20.6%
NPV (Mil. VND, Discount rate12%)	3,462,221 (approx. 13,800mil JPY)
BCR (Discount rate12%)	2.0

(2) Operation and Performance Indicator

Operation and performance indicator for expressway that can be quantified is traffic volume and time required. In this project construction have two stages that improve the existing road (Phase 1) and six-lane widening (Phase 2). The travelling velocity on PV– CG Expressway will be increased form 80km/h to 100km/h in phase1, and traffic capacity will be increased in phase2. The study team set operation indicator as per the following table and the target year is set two years after completion of phase2.

Table 3.4.6-4 Operation indicator for PV–CG Expressway

Indicator name	Standard value (actual result in 2010)	Target value(2020) (two years after completion of phase2)
Average traffic volume(PCU/Day)	34,000	60,000
Time required between PhapVan to Cau Gie (minute)	22minutes (80km/h)	17minutes (100km/h)

3.5 Environmental and Social Consideration

3.5.1 EIA System in Vietnam

3.5.1.1 Procedure for obtaining an approval on EIA

In accordance with the Appendix attached to the Government's Decree No. 29/2011/ND-CP of June 05 2011, the Project falls on the following provisions, and obtaining an approval on EIA is required.

1) Ordinal No. 24: Project on upgrading expressway, highways from grade I to III, and railway

To obtain an approval on EIA from Ministry of Natural Resources and Environment (MONRE), VEC as a project proponent shall prepare both EIA report and project investment report (Feasibility Study report) and submit to MONRE. The submitted report subjects to review and approval procedure by EIA Assessment Board and will be approved when it satisfies the requirements.

The required procedure is presented in **Figure 3.5.1-1**.

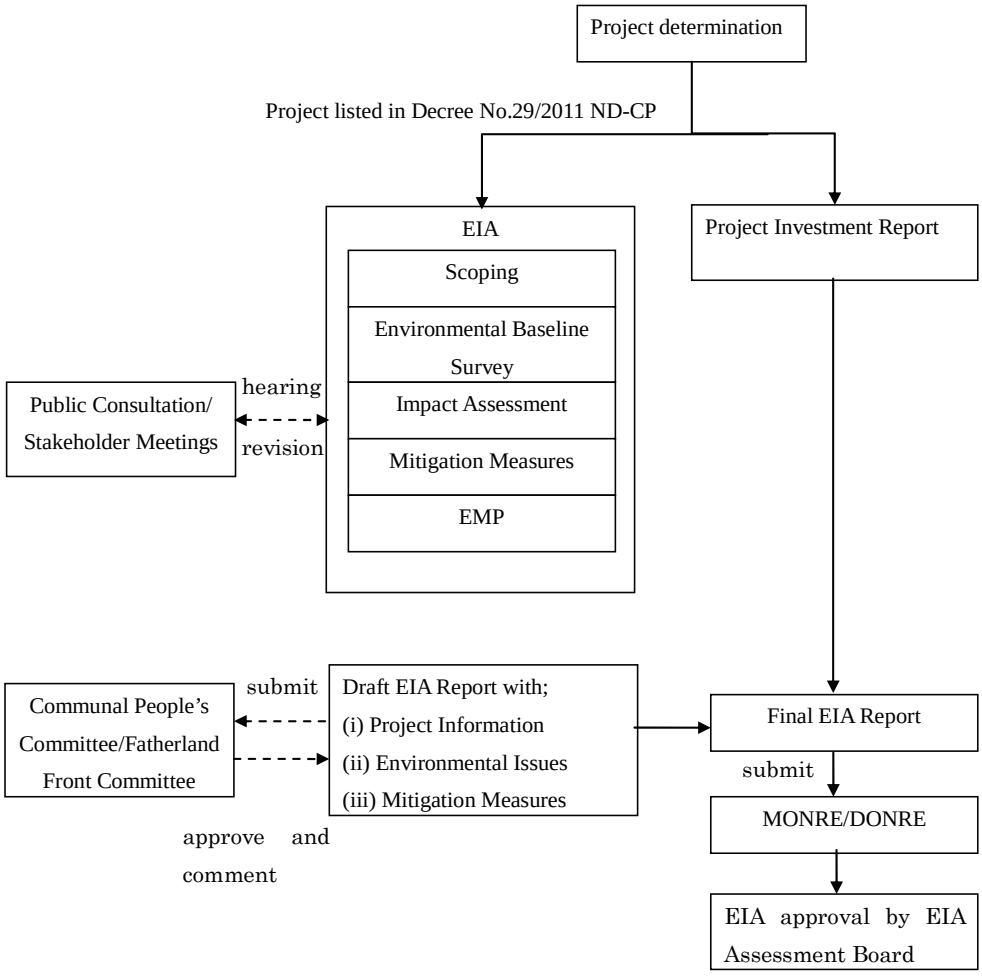
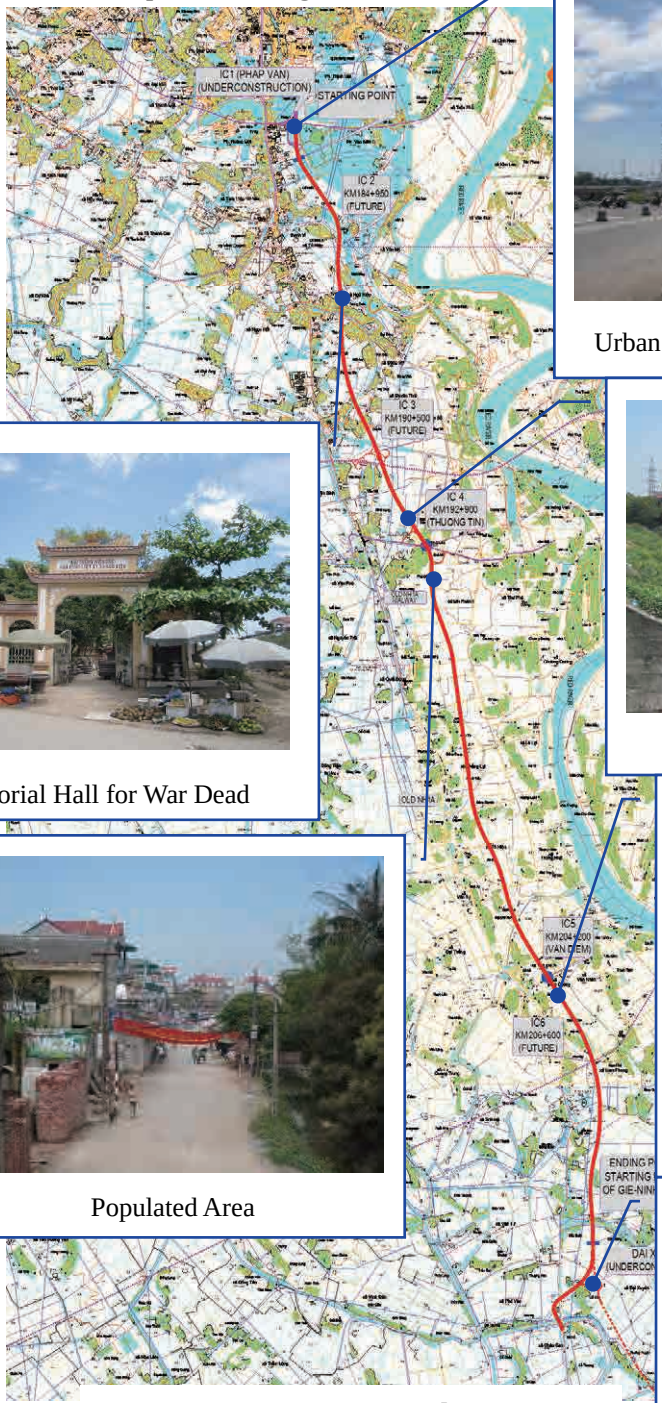


Figure 3.5.1-1Procedure for Obtaining Approval on EIA

3.5.2 Environmental Characteristic of the Project site

The existing Phap Van – Cau Gie Expressway was built on a delta area by embankment method in early 2000, and runs parallel with National Road No.1 which runs the west of the project road. Phap Van where begins the Expressway is connected to the Hanoi Ring Road No.3, and urban development such as constructing high-rise buildings is active. Cau Gie where ends the project it is connected to National Road No.1. Paddy cultivation and field are main land use, and agro-type villages are scattering along the project road. The present land use is expressed in **Figure 3.5.2-1**.



Urban Development in Phap Van

Memorial Hall for War Dead

Populated Area

Populated Area

Populated Area

Rural Area

Figure 3.5.2-1 Land Use

3.5.3 Scoping of the Environmental Impacts

3.5.3.1 Scoping matrix of environmental impacts

The scoping matrix which was prepared before starting the natural and social environmental condition survey is presented in the **Table 3.5.3-1(1)**. Another scoping matrix on environmental impacts in accordance with the result of survey is expressed in the **Table 3.5.3-1(2)** and reason of assumed magnitude of impacts are shown in the context of anti-pollution measures, natural environment, social environment and others point of view.

Table 3.5.3-1 (1) Scoping Matrix of the Project before Starting Survey

			Factor of adverse inpact																Factor of positive impact		
			Total Assessment			Planning Stage		Construction Stage							Operation Stage				Operation Stage		
			Planning stage	Construction stage	Operation stage	Land acquisition and loss of architectures	Deterioration of living environment due to resettlement	Change of plowland	Change of landscape	Operation of vehicles and heavy equipments for construction	Constructing activity on extending the carriage way, culvert boxes and providing toll plaza and frontage road	Traffic jam	Inflow of construction workers and set up of construction bases	Increase of traffic capacity	Entity of the expressway and increase of the related facilities	Making toll free road to pay	Enhance the economic activity along the Project road	Increase of traffic capacity	Shorten the travel time	Enhance the economic activity along the Project road
Anti-pollution measures	1	Air pollution		-B	+B/-B					-B	-B	-B		-B		-B			+B	
	2	Water pollution		-B	-D					-B	-B		-B		-D					
	3	Soil pollution		-B						-B	-B		-B							
	4	Waste		-B	-B					-B	-B		-B				-B			
	5	Noise and vibrations		-B	-B					-B	-B		-B	-B		-B				
	6	Ground subsidence		-A	-A						-A				-A					
	7	Offensive odors		-B	-B					-B		-B	-B	-B						
	8	Global warming		-B	+B/-B					-B	-B	-B		-B		-B	-B		+B	
Natural environment	1	Topography and geology		-D	-D				-D		-D		-D		-D					
	2	Bottom sediment		-D	-D				-D		-D		-D		-D					
	3	Biota and ecosystem		-B				-B												
	4	Hydrology		-D	-D				-D		-D		-D		-D					
	5	Protected areas		-D							-D									
Social environment	1	Involuntary resettlement	-A			-A														
	2	Local economies, such as employment, livelihood, etc.	-A		+B/C		-A									C				+B
	3	Land use and utilization of local resources			+B/C											C				+B
	4	Social institutions such as social infrastructure and local decision-making institutions, Existing social infrastructures		-B	+B/C					-B	-B	-B				C		+B		+B
	5	Poor, indigenous or ethnic minority people	-A		-A		-A									-A				
	6	Misdistribution of benefits and damages	-A		-A		-A									-A				
	7	Local conflicts of interest			-B										-B					
	8	Gender	-B			-B	-B													
	9	Children's rights	-B				-B													
	10	Cultural heritage	-D	-D		-D					-D									
	11	Infectious diseases such as HIV/AIDS		-B									-B							
	12	Landscape		-D	-D				-D		-D				-D					
	13	Working conditions		-B						-B	-B	-B	-B							
	14	Social Consensus	-A	-A/-B	+B/-A	-A	-A	-A		-B	-A		-A		-A	-A				+B
Others	1	Accidents		-B	-B					-B	-B	-B	-B	-B		-B				

Table 3.5.3-1 (2) Scoping Matrix of the Project based on Survey Result

			Factor of adverse inpact															Factor of positive impact		
			Total Assessment			Planning Stage		Construction Stage						Operation Stage				Operation Stage		
			Planning stage	Construction stage	Operation stage	Land acquisition and loss of architectures	Deterioration of living environment due to resettlement	Change of plowland	Change of landscape	Operation of vehicles and heavy equipments for construction	Constructing activity on extending the carriageway, culverts, bones and paving toll way plaza and frontage	Traffic jam	Inflow of construction workers and set up of construction bases	Increase of traffic capacity	Entity of the expressway and increase of the related facilities	Making toll free road to pay	Enhance the economic activity along the project road	Increase of traffic capacity	Shorten the travel time	Enhance the economic activity along the Project road
Anti-pollution measures	1	Air pollution		-B	+B/-B					-B	-B	-B		-B		-B			+B	
	2	Water pollution		-B	-D					-B	-B		-B		-D					
	3	Soil pollution		-B						-B	-B		-B							
	4	Waste		-B	-B					-B	-B		-B				-B			
	5	Noise and vibrations		-B	-B					-B	-B		-B	-B		-B				
	6	Ground subsidence		-B	-B						-B				-B					
	7	Offensive odors		-B	-B					-B		-B	-B	-B						
	8	Global warming		-B	+B/-B					-B	-B	-B		-B		-B	-B		+B	
Natural environment	1	Topography and geology		-D	-D				-D		-D		-D		-D					
	2	Bottom sediment		-D	-D				-D		-D		-D		-D					
	3	Biota and ecosystem		-B	-B			-B						-B						
	4	Hydrology		-D	-D				-D		-D		-D		-D					
	5	Protected areas		-D							-D									
Social environment	1	Involuntary resettlement	-A			-A														
	2	Local economies, such as employment, livelihood, etc.	-A		+B/C		-A									C				+B
	3	Land use and utilization of local resources			+B/C											C				+B
	4	Social institutions such as social infrastructure and local decision-making institutions, Existing social infrastructures		-B	+B/C					-B	-B	-B				C		+B		+B
	5	Poor, indigenous or ethnic minority people	-A		-A		-A									-A				
	6	Misdistribution of benefits and damages	-A		-A		-A									-A				
	7	Local conflicts of interest			-B										-B					
	8	Gender	-B			-B	-B													
	9	Children's rights	-B				-B													
	10	Cultural heritage	-D	-D		-D					-D									
	11	Infectious diseases such as HIV/AIDS		-B									-B							
	12	Landscape		-D	-D				-D		-D				-D					
	13	Working conditions		-B						-B	-B	-B	-B							
	14	Social Consensus	-A	-A/-B	+B/-A	-A	-A	-A		-B	-A		-A		-A	-A				+B
Others	1	Accidents		-B	-B					-B	-B	-B	-B	-B		-B				
	2	Sunshading, Living environment			-D										-D					

Notes: assessment A: Significant impact is assumed,
B: Impact is assumed but less than A,
C: Impact is not clear because the design is not finished and further survey is needed to confirm,
D: Impact is little and further survey is not needed.
+: Positive impact is assumed
- : Negative impact is assumed
The scoping items are referred from JICA and JBIC guidelines

3.5.3.2 Impacts assessed as *A*

The items assessed as **A** which may have significant adverse impacts are presented in the Table below.

Table 3.5.3-2 Significant Adverse Impacts Assumed

Social Environment	
Items of Impact	**Reason of Assessment**
Involuntary resettlement	According to METI F/S, it was assumed that 289 households might be resettled. However, the number of affected households decreased to 35 after the careful review of ROW and the decision providing retaining walls at some areas though 770 households will still lose more than 10% of their own land.
Local economies, such as employment, livelihood, etc.	It is anticipated that 770 households will lose more than 10% of their own land and business of shops along the road will be affected. In addition, negative impact relating to the current legal system in Vietnam as shown below is also anticipated: i. Compensation to illegal settlers ii. Way how to compensate to relocation
Poor, indigenous or ethnic minority people	Impact on the poor from the involuntary resettlement is anticipated. The change of road from free to charging toll will also affect the poor. Neither indigenous nor minority people is identified in the area nearby.
Misdistribution of benefits and damages	In the current legal framework on compensation, legitimate dwellers can receive the full amount of compensation while some illegitimate ones cannot. Also, it is worried about that benefit will be distributed unevenly: one can enjoy receiving benefit from toll road but some cannot for losing the opportunity of using bus services in future.
Social consensus	It would affect badly if project started without getting mutual understanding between the Project owner and the people concerned living along the Expressway.

3.5.3.3 Impacts assessed other than *A*

Items with less impact are presented in the Table below**.**

Table 3.5.3-3 Less Significant Adverse Impact

(1) Items certain impact assumed to be affected

Anti-pollution Measures	
Items of Impact	**Reason of Assessment**
Air pollution	It is assumed that more exhausted gas caused by traffic congestion and operation of heavy equipment and vehicles during the construction may come out temporarily. In addition, increase in exhausted gas with increasing traffic after the opening of the Expressway is expected not only in the Expressway but also in National Highway No.1 running along with it and Hanoi City roads.
Water pollution	Earthworks including excavation for road crossing facility may generate turbid water. Again, widening of bridge may cause turbid water to the river temporarily. Effluent from drainage facility will cause turbid water but it may be short period until grass can cover the filled slope in operation stage.
Soil Pollution	It is assumed that present soil condition may be deteriorated by excavation activity or land use as temporary yards while in construction stage.
Waste	It is assumed that waste may be generated in construction stage. In addition, enhancement of economic activity along the project road will generate waste in operation stage.
Noise and vibration	Operation of heavy equipment and vehicle may generate noise and vibration level while in construction stage. Increase of noise and vibration level is envisaged due to the increased traffic and improved travel speed in operation stage. In addition, it might be envisaged as well as in National Highway No.1 and Hanoi City Road.
Ground Subsidence	It was worried that soft soil layers which exists below the project site will cause the long consolidation settlement due to the additional embankment. However, it is ascertained the affected area are limited within road embankment in accordance with the soil investigation result which was by VEC.
Offensive odors	Increase of exhausted gas is assumed caused by traffic congestion, heavy equipment and vehicles while in the construction stage.

Anti-pollution Measures	
Items of Impact	**Reason of Assessment**
Global warming	It is assumed that exhausted gas by heavy equipment and vehicles may increase green house gas temporarily in the construction stage. In operation stage, it is assumed that the increase of traffic will generate the green house gas.

Natural Environment	
Items of Impact	**Reason of Assessment**
Biota and ecosystem	It is worried that the existing fauna and flora in paddy/vegetable field to be expropriated may be affected. Furthermore, in cases fields are used as temporary yard or level of air pollution and noise/vibration increased more than expected after the opening, certain impact will be affected.

Social Environment	
Items of Impact	**Reason of Assessment**
Social institutions for local infrastructure and decision making Existing social infrastructure and services	Box culvert and drainage pipe will be restricted for its use during the construction by expanding the road. Affect to some local clinics and educational facilities might not be avoidable.
Local conflicts of interest	Widening is considered both right and left side evenly. The magnitude of impact may be limited because frontage road and access to the expressway will be provided, thus habitants split by expressway may receive even benefits.
Gender	It is assumed that the opportunity such as joining the local stakeholder meeting or statement is under developing to the women group.
Children's right	It is assumed that the access to the school or hospital may be affected due to the resettlement.
Infectious diseases such as HIV/AIDS	It is assumed that the risk by infection disease may increase caused by the project employees.
Working conditions	It is assumed that the safety/health condition to project employee may worsen when the safety facility/training/management and sanitation are not provided properly.

Others	
Items of Impact	**Reason of Assessment**
Accidents	It is worried that the accident of vehicles those engaged in the project might be generated in construction stage and accident due to the travelling traffic might be generated both in National Highway No.1 and Hanoi City Road in operation stage.

(2) Impact is little and further survey is not needed

Natural Environment	
Items of Impact	**Reason of Assessment**
Topography and geology	No cutting work is anticipated and the height of filling is low. Soil condition which may cause a collapse or landslide is not envisaged along the project road.
Bottom sediment	Project road runs away from rivers, lakes, seashores, therefore adverse impact may not be anticipated.
Hydrology	Impact to surface water or ground water may be little because significant change of topography or tunneling work or deep excavation is not anticipated. Also, there is no change of catchment area or runoff because the existing discharge facility shall be extended in accordance with road widening plan.
Protected area	There is no protected area along the project road

Social Environment	
Items of Impact	**Reason of Assessment**
Cultural heritage	There are 12 cultural heritages designated by Hanoi City, Those will not be affected because all them are several hundred meters away from the project road.
landscape	Project is limited to extend the existing carriageway only and adverse significant impacts might be not assumed. However, it is worried that the newly built toll plaza fails to harmonize the local landscape when proper consideration is not taken.

Others	
Items of Impact	**Reason of Assessment**
Sun shading, Living environment	Impact on sun shading might be little because retaining walls are to be provided along north –south direction and frontage roads are to be constructed. It is difficult to assess the living environment at this moment how it will change.

(3) Impact is not clear and further survey is needed to confirm

Social Environment	
Items of Impact	**Items of Impact**
Local economies such as employment, livelihood, etc.	It might be difficult to envisage the impact due to "making toll free road to pay" at the preparatory survey stage, therefore, it is recommended to carry out the survey and assess it in operation stage.
Land use and utilization of local resources	It might be difficult to envisage the impact due to "making toll free road to pay" at the preparatory survey stage, therefore, it is recommended to carry out the survey and assess it in operation stage.
Social institutions such as social infrastructures and decision-making institutions Existing social infrastructures and services	It might be difficult to envisage the impact at the preparatory survey stage, therefore, it is recommended to carry out the survey and assess it in operation stage.

3.5.4 Environmental Impact Assessment Survey

3.5.4.1 Outline of field survey for Environmental Impact Assessment

As for the scoping of this project prior to start the survey, it was assumed that the significant adverse impacts might be induced in terms of local economies such as employment, livelihood, etc., vulnerable group such as poor, misdistribution of benefits and damages those related to involuntary resettlement of dwelling houses/shops.

Moreover, some adverse impacts are assumed in terms of air pollution, water pollution, noise and vibration, existing infrastructures and services, local conflicts of interest, gender, children's right, infectious diseases such as HIV/AIDS and accidents.

Therefore, the EIA survey is split into two; one is social environmental condition survey which treats involuntary resettlement, local economies such as employment and livelihood etc., another is natural environmental condition survey which treats air quality, noise and vibration level, and fauna & flora etc.

Although VEC carried out the soil investigation adjacent to the project road and it was made clear that significant ground settlement had occurred, however, its impact is confined only to the road range. Thus, it is not necessary required by the EIA study to cover this settlement issue since it will not affect living and land of the people who stay along the project road. And this issue is analyzed from the engineering point of views and presented in **Sub-clause 3.2.1.7 Treatment of Soft Ground.**

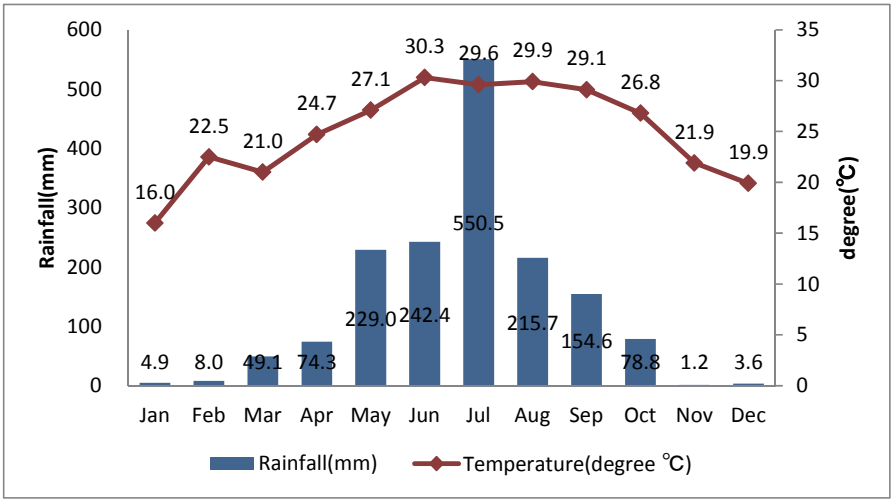
For preservation of natural environment, Vietnam has ratified World Heritage

Convention, Ramsar Convention, and proclaimed laws on other protected areas. Furthermore, Vietnam government addresses to public nuisances such as air pollution and water pollution by preparing the relevant standard matching international one through legislating laws and ordinances.

3.5.4.2 Natural characteristic

(1) Climate

Under the Koppen climate classification, Hanoi has a tropical monsoon climate with an annual average temperature of 24 degree Celsius, 83 % of average humidity and rainfall of about 1,700 mm. The climate is divided into "hot and rainy season" from May to September, "cool and dry season" from October to April. About 90% of the annual rainfall occurs from May to September.



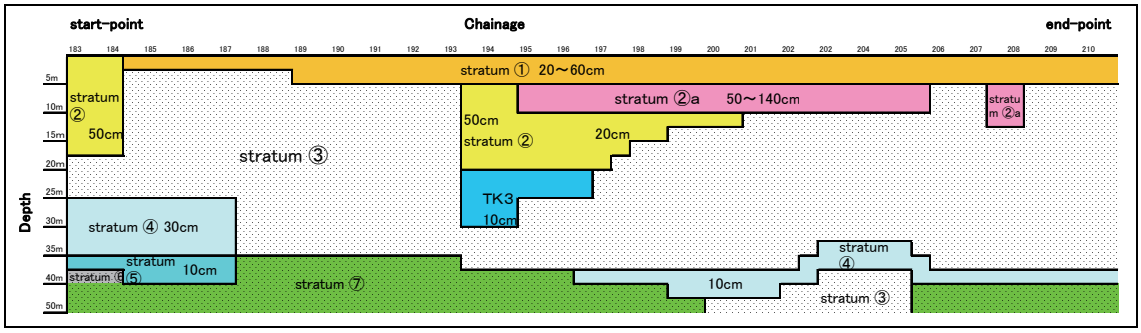
Source : http//www.worldclimate.com/

Figure 3.5.4-1 Monthly Average Rainfall and Temperature of Hanoi

(2) Topography and geology

Project road is running through flat plain where numerous rivers and streams flew in the past tome. Thus, alluvial deposits such as soft and moderate hard organic/inorganic clay, medium dense sand and hard clay/hard dense fragment with the depth of 40m are accumulated and distributed intricately as presented in **Figure 3.5.4-2**

Presently, small canals, streams, reservoirs and paddy fields and villages are spread out along the Project road.



No.	Outline of Stratum	No.	Outline of Stratum
Stratum ①	medium hard-hard clay	Stratum ④	hard clay
Stratum ②a	soft-very soft organic clay	Stratum ⑤	hard-very hard clay
Stratum ②	soft-very soft clay	Stratum ⑥	moderate dense sand
Stratum ③	medium dense sand	Stratum ⑦	hard dense sand
TK3	very hard clay		

Source：GEOTECHNICAL ENGINEERING REPORT, August 1997

Figure 3.5.4-2 Geological Longitudinal Section

(3) Air quality

The main air pollutants in Hanoi are Nitrogen Oxides (NOx), Sulfur Dioxide (SO_2), Particulate Matter (PM, usually expressed as PM with diameter of 10 microns or smaller: PM10, or 2.5 microns or smaller: PM2.5), TSP and Pb. The motor vehicles and traditional brick kilns contribute predominantly to the air pollution (about 70%). Air quality in urban centers throughout Vietnam has been deteriorating in recent years in line with increasing urbanization and industrialization.

Air quality in Hanoi:

1) The main issue of concern in relation to air quality is particular matter (PM), particularly PM10 and fine particular matter with an aerodynamic diameter less than 2.5 microns (PM2.5). PM2.5 results from combustion of fossil fuels in transport and industry. Measured PM concentrations in Vietnamese cities are one to five times higher than allowed by TCVN (Vietnam standards) and recent monitoring in Hanoi suggests TCVN are exceeded by six to seven times over the majority of the road network. Particulate matter levels are elevated in the dry season when there is less rain.

2) Sulfur dioxide (SO2) levels are usually below the relevant TCVN criteria in urban areas, although levels exceed TCVN criteria by two to three times can occur near major intersections (Hanoi DONRE, 2005). Diesel powered vehicles are the major source of SO2 in urban areas, together with coal burning for domestic use.Nitrogen oxides (NOx) result from fuel combustion and are usually found at levels below

TCVN criteria in urban areas. Elevated levels, however, are increasingly observed at major urban intersections (Hanoi DONRE, 2005).

3) Carbon monoxide (CO) levels commonly exceed TCVN at major intersections in urban areas and along major thoroughfares, but are generally within standards in other areas. Mobile emission sources such as vehicles are the main generators of CO.

4) Benzene levels are above EU recommended levels in many locations with the highest level has found at traffic intersections and along major roads.

5) Soil from construction activities and road surfaces are the major sources of total suspended particulates (TSP). During 2005, Hanoi DONRE conducted monitoring for TSP along side of major roads in a number of districts. Those that indicated concentration exceeding permitted levels of 300 mg/m^3 regulated by TSVN:QCVN (National Technical Regulation) 05:2009/BTNMT, came up to 83% of that of samples taken from six monitoring points (Ex. Hoan Kiem district 77.7%, Ba Dinh district 61%, Dong Da district 80.5%, Cau Gie district 66.8%, Tu Liem district 66.7%).

Air quality is monitored and analyzed on June of 2011 at five positions along the PV-CG expressway. The results are presented in the Appendix 1 and in **Table 3.5.4-1**. Analyzed results show that TSP at three of five positions are higher that VN standard (TCVN) and the others as NOx and SO_2 are quite high but still lower that standards at TCVN.

Table 3.5.4-1 Result of Air Quality Analysis

No	*Location & Date*	*Ambient Air Pollutants Concentration (micro gram/m3)*						
		TSP	*PM10*	*PM2.5*	*SO_2*	*NOx*	*CO*	*Pb*
1	*Dai Xuyen Interchange (km211 + 150)*	**204**	*144*	*114*	*113*	*87*	*3555*	*0.13*
2	*Van Diem Interchange (km204 + 190)*	*148*	*116*	*94*	*94*	*75*	*3441*	*0.13*
3	*Position of Km199 + 00.00 (belongs to Ha Vi village, Le Loi Commune, Thuong tin District)*	*165*	*101*	*73*	*75*	*67*	*3050*	*0.13*
4	*Thuong Tin Interchange – Khe Hoi over bridge (km192 + 870)*	**218**	*126*	*83*	*123*	*90*	*2962*	*0.13*
5	*Starting point of the route (km182 + 100)*	**275**	*148*	*103*	*99*	*72*	*3038*	*0.16*
Duration (hour)		*24*	*24*	*24*	*24*	*24*	*24*	*24*
QCVN 05:2008/BTNMT: National Technical Standard on Ambient Air Quality		*200*	*150*	*-*	*125*	*100*	*5000*	*1.5*

(4) Water quality

Water quality of Hanoi is very bad and contaminated. Since Hanoi does not have any drainage treatment facilities, and industrial wastewater and household wastewater are discharged directly into surrounding waters (rivers, lakes and coast). In rainy seasons, drainage systems are filled with water, and with mixture of industrial wastewater and household wastewaters, overflows by inundation occur in the city.

Surface water quality is monitored at 5 places along the road on July 2011. Monitoring results showed that pH values at the five observation points meet environmental standards for surface water quality; 4/5 observation positions have DO value does not meet the requirement of oxygen soluble in water; There is only 1/5 sample does not meet the specified requirement of the content of solids suspended in surface water. The following Table presents the result of surface water quality analysis.

Table 3.5.4-2 Result of Surface Water Quality Analysis

(Rainy season)

No.	*Paramete*	*Surface Water 1 – Lake*	*Surface Water 2 – Canal*	*Surface Water 3- Canal*	*Surface Water 4 – Lake*	*Surface Water 5 - Pond*	*Vietnam Standard 08/2008/ MONRE column B1*
1	*Position*	*Km201 + 600m*	*Km201 + 700m*	*Km198 + 00m*	*Km188 + 800m*	*Km185+ 000m*	
2	*pH*	*8.8*	*7.1*	*6.9*	*7.2*	*8.2*	*5.5 - 9*
3	*T^o (^oC)*	*34.1*	*32.5*	*28.9*	*30.3*	*30.9*	-
4	*EC (mS/m)*	*29.0*	*32.1*	*25.1*	*30.8*	*37.5*	-
5	*DO (mg/l)*	*4.7*	**2.3**	**0.9**	**3**	**3.6**	*≥ 4*
6	*Turbidity (NTU)*	*25*	*28*	*47*	*21*	*232*	-
7	*Smell*	*KM*	*KM*	*KM*	*KM*	*KM*	-
8	*Colour (Pt-Co)*	*18*	*30*	*41*	*33*	*26*	-
9	*TSS (mg/l)*	*24*	*34*	*43*	*31*	**177**	*50*

Monitoring result in December shows that analyzed results are within tolerance. Thus, quality of surface water varies between rainy season and dry season.

(Dry season)

No.	*Paramete*	*Surface Water 1 – Lake*	*Surface Water 2 – Canal*	*Surface Water 3- Canal*	*Surface Water 4 – Lake*	*Surface Water 5 - Pond*	*Vietnam Standard 08/2008/ MONRE column B1*
1	*Position*	*Km201 + 600m*	*Km201 + 700m*	*Km198 + 00m*	*Km188 + 800m*	*Km185+ 000m*	
2	*pH*	*7.2*	*7.4*	*7.6*	*7.8*	*7.5*	*5.5 - 9*
3	*T^o (^oC)*	*22.7*	*22.8*	*23.1*	*23.2*	*23.3*	-
4	*EC (mS/m)*	*28.5*	*29.2*	*28.7*	*31.1*	*29.3*	-
5	*DO (mg/l)*	*5.2*	*5.2*	*5.6*	*5.8*	*6.1*	*≥ 4*
6	*Turbidity (NTU)*	*20*	*22*	*30*	*35*	*27*	-
7	*Smell*	*odorless*	*odorless*	*Odorless*	*odorless*	*odorless*	-
8	*Colour (Pt-Co)*	*31*	*38*	*40*	*36*	*34*	-
9	*TSS (mg/l)*	*30*	*35*	*32*	*31*	**34**	*50*

The groundwater capacity is not high. The depth of wells ranged from 28 - 43m. At present, the groundwater mainly serves domestic use of the local people living along the proposed highway and in some places for watering vegetables and fruit trees.

Water from drilled well in the project area is mainly untreated or only pre-treated by sand tank. According to the initial assessment, water well of the household is colorless but iron smelly. Consultative results of affected households showed that all households evaluated water resource to be good and used for living purposes. **Table 3.5.4-3** presents the result of ground water analysis conducted at the 5 same places in July and December, 2011. Observational results show that all samples were within tolerance except TTS.

Table 3.5.4-3 Result of Ground Water Quality Analysis

(Rainy season)

No	Sample	T^o (^oC)	pH	EC (ms/m)	DO (mg/l)	Turbid-ity (NTU)	Odor	Color (Pt-Co)	TSS (mg/l)	Depth (m)	Coliform (MPN/ 100ml)	BOD_5 (mg/l)
1	NN1	26.3	6.1	95	0.9	4	Odor-less	0	**214**	30	81	3.5
2	NN2	27.8	6.7	111	1.2	12	ditto	2	**76**	40	56	3.2
3	NN3	27	6.5	124	1.8	3	ditto	0	**11**	35	45	3.3
4	NN4	27.5	7.1	56	3.1	3	ditto	0	**7**	28	10	6.2
5	NN5	28.3	7	53	1	2	ditto	0	**38**	43	91	5.1
Vietnam Standard 02-MOHP: The quality of domestic water		-	6.0 – 8.5	-	-	-	Odor-less	15	5	-	150	-

(Dry season)

No	Sample	T^o (^oC)	pH	EC (ms/m)	DO (mg/l)	Turbid-ity (NTU)	Odor	Color (Pt-Co)	TSS (mg/l)	Depth (m)	Coliform (MPN/ 100ml)	BOD_5 (mg/l)
1	NN1	25.5	6.6	102	1.2	4	Odor-less	0	**14**	37	4	2.6
2	NN2	23.4	6.7	103	1.4	5	ditto	0	**17**	45	5	3.2
3	NN3	23.5	6.9	99	1.6	5	ditto	0	**19**	40	6	2.8
4	NN4	23.6	7.1	83	2.5	5	ditto	0	**18**	36	6	2.9
5	NN5	23.4	6.8	97	1.4	6	ditto	0	**16**	49	5	3.1
Vietnam Standard 02-MOHP: The quality of domestic water		-	6.0 – 8.5	-	-	-	Odorless	15	5	-	150	-

(5) Noise

The acoustic environment in Hanoi is characterized by high noise levels arising from transport movements, construction activities, industry and daily activities. Noise levels are elevated throughout the day and night. Noise monitoring results at 16 locations on major roads in Hanoi in 2010 indicate that average noise levels during the daytime vary from 64.4 - 80.5dB (A), and during the evening from 67.3 - 73.0dB (A). Most locations had noise levels exceeding the maximum TCVN limits for mixed development areas (the most noise tolerant category) during the daytime and night time.

The result of noise level is presented in the following Table. The result shows the noise level exceeds at all monitored locations.

Table 3.5.4-4 Result of Noise Level along the Project Site

Samples	*Location*	*Noise Level (Equivalent sound level in dB)*	
		Day (6.00 ~ 21.00)	*Night (21.00 ~ 6.00)*
N1	*Dai Xuyen interchages (km211 + 150)*	*70*	**71**
N2(Special areas)	*Van Diem Interchanges (km204 + 190)*	**73**	**72**
N3	*Position at Km199 + 00.00 (Ha Vi Village, Le Loi commune, Thuong Tin District)*	**71**	**70**
N4(Special areas)	*Interchange at Thuong Tien – Khe Hoi over bridge (km192 + 870)*	**77**	**76**
N5	*Starting point of the route (km182 + 100)*	**77**	**76**
VietNam Standards for Noise (QCVN 26:2011/BTNMT) (Day time : 06.00 to 21.00) (Nigh time : 21.00 to 06.00)	*Special areas (Hospital, Library, School, Shrine and pagoda)*	*55*	*45*
	Normal areas (Residential Area, Hotel and Offices)	*70*	*55*

(6) Biota and ecosystem

Vietnam is the world's 16th richest country of biodiversity in the world sharing 6.5% of biodiversity index and the project area is located in the delta area where many development projects have been completed and undergoing. There is no natural forest nearby.

There is a designated natural reserve to 77 km north from this Project area and many under developed areas in Route C regions specified in Figure II: Comparison of Alternatives of EIA report and along the Red River may possibly hold rich biodiversity worth to be reserved.

For a new acquisition of land for road widening of 10m each at the both side of the Expressway, 310,831 ㎡ of farm land 14,224 ㎡ of nursery land will be affected. Thus, fauna-flora and endangered-rare species survey was carried out at the both side within 200m from the existing road center.

Farm lands are mainly used for raising one or two rice crop a year but such crops as peanuts, corn, beans, vegetables, sweet potatoes and sugar cane are sols being cultivated.

Impact on farm land will be little because the land width to be expropriated is limited only to10m excluding the site of temporary stock yards for construction. Furthermore, impact on aquaculture will also be slight if fish in aquaculture farm are moved to other places in the same premises of the farm.

Along the project area, birds like bats, pigeons, sparrows and ibis, and livestock like chickens and ducks are found. Mammal is rare but rats inhabiting in residential areas and field are confirmed. Together with house lizard, lizard and water snake, many kinds of frogs in amphibian are frequently observed. Although those animals will move to other areas and be affected less just after the relevant land was acquired, they would be affected if the level of air pollution, noise and vibration increased more than expected after the opening of the Expressway.

Water quality at the site bridges are to be expanded are deteriorating due to the increase in water drained without being trated which will be severe environmentally especially to living creatur in water. They will be affected for a short period of time during the construction but might be very limited.

As a result of a survey, it was made clear that there are no rare species in the flora-fauna recorded in Vietnam Red Book in 2007.

3.5.4.3 Social environmental impact survey

(1) Outline of the survey

Socio-economic condition survey was carried out with the presence of TEDI in accordance with the following **Figure 3.5.4-4** and **Figure 3.5.4-5** those will satisfy the

width required improving to six lanes, extending box culvert and providing frontage roads from Km 181+361.156 where project will start to Km 211+500 where project will end. However, ramps of interchange which will connect to the next project section had not designed yet, therefore it was exempted from survey in accordance with the direction made by TEDI.

Prior to start the survey, local stakeholder meetings were carried out from June to August 2011.

There are seventeen communes those involved in four districts such as Hoag Mai District, Thanh Tri District, Thuong Tin District and Phu Xuyen District. The coverage communes are resented following **Figure 3.5.4-3.**

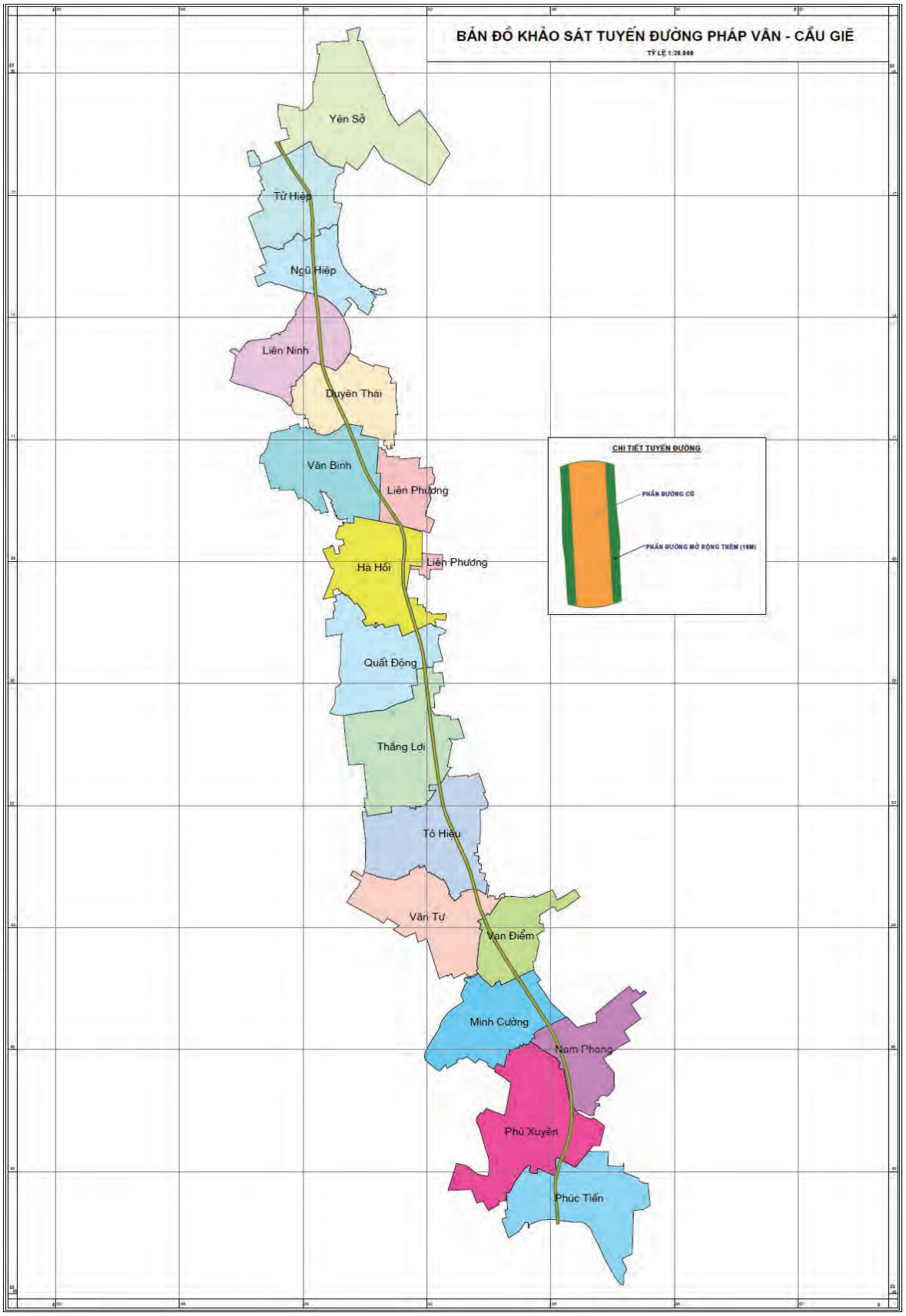


Figure 3.5.4-3 Coverage Commune

The survey includes;

1) Census of anticipated households, his family and physical units (shops and tenants);
2) Socio-economic condition of anticipated PAHs;
3) Surveys for valuation of land and other assets;
4) Photos of affected assets; and
5) Stakeholder meetings by anticipated commune.

The survey identifies the land-user, households, commercial and business enterprises, common property and other facilities those locating within the Right of Way (ROW) of the project as shown in **Figure 3.5.4-4** and **3.5.4-5**. And the results are presented by every commune basis.

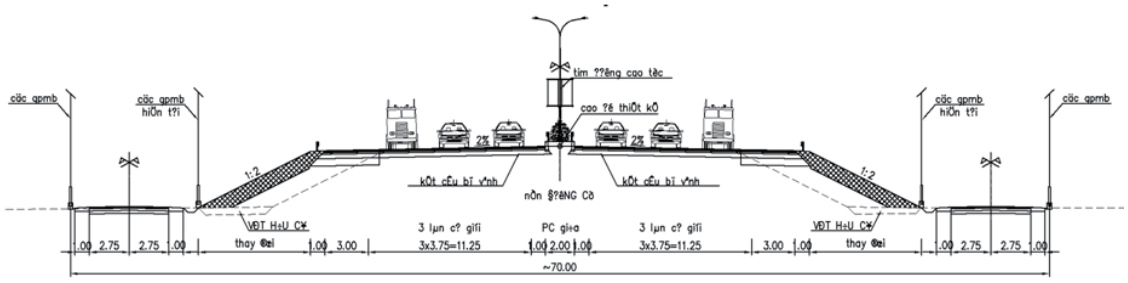


Figure 3.5.4-4 Typical Cross Section of Embankment Section (ROW=70 m)

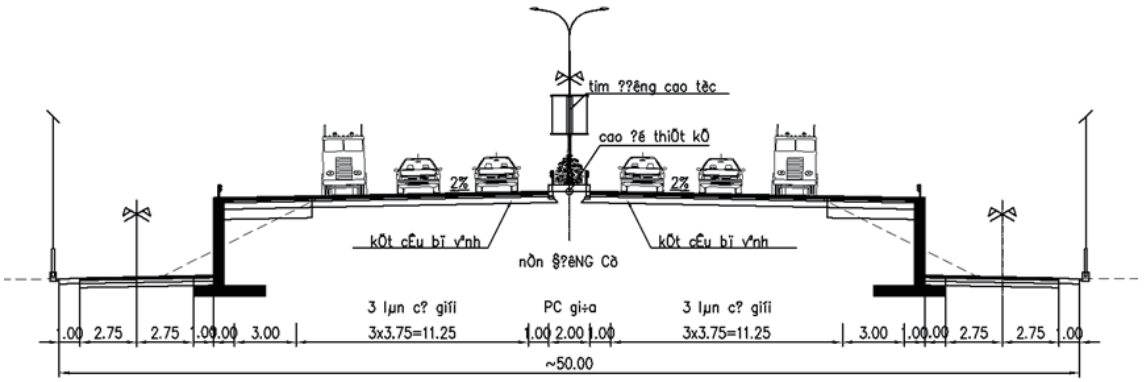


Figure 3.5.4-5 Typical Cross Section of Retaining Wall Section (ROW=50 m)

(2) Project affected households (PAHs), PAPs and population by sex

The following Table presents the number of PAHs, PAPs and populations by sex on commune basis.

Table 3.5.4-5 Number of PAHs, PAPs and populations by sex

No.	*Commune*	*Number of PAHs*	*Number of PAPs*	*Male*		*Female*	
				Number	*%*	*Number*	*%*
1	*Phuc Tien*	*244*	*960*	*238*	*24.8*	*722*	*75.2*
3	*Phu Xuyen Town*	*76*	*323*	*155*	*48.1*	*168*	*51.9*
2	*Nam Phong*	*125*	*518*	*253*	*48.8*	*265*	*51.2*
4	*Minh Cuong*	*235*	*963*	*408*	*42.4*	*555*	*57.6*
5	*Van Diem*	*181*	*787*	*271*	*34.4*	*516*	*65.6*
6	*Van Tu*	*67*	*276*	*96*	*34.9*	*180*	*65.1*
7	*To Hieu*	*239*	*1,036*	*408*	*39.4*	*628*	*60.6*
8	*Thang Loi*	*378*	*1,678*	*1,052*	*62.7*	*626*	*37.3*
9	*Quat Dong*	*347*	*1,491*	*580*	*38.9*	*911*	*61.1*
10	*Ha Hoi*	*297*	*1,274*	*410*	*32.2*	*864*	*67.8*
16	*Lien Phuong*	*110*	*466*	*171*	*36.6*	*295*	*63.4*
11	*Van Binh*	*245*	*1,036*	*492*	*475*	*544*	*52.5*
12	*Duyen Thai*	*127*	*597*	*297*	*49.8*	*300*	*50.2*
13	*LienNinh*	*87*	*388*	*181*	*46.6*	*207*	*53.4*
14	*Ngu Hiep*	*160*	*633*	*311*	*49.1*	*322*	*50.9*
15	*Tu Hiep*	*347*	*1,425*	*747*	*52.4*	*678*	*47.6*
17	*Le Loi*	*1*	*4*	*4*	*100.0*	*0*	*0*
	Total	***3,266***	***13,855***	***6,074***	***43.8***	***7,781***	***56.2***

(3) Features of severely affected PAHs

According to IOL results, 770 PAHs will have over 10% of their total existing land acquired and 35 PAHs will be resettled. The socio-economic condition survey on the severely affected households is presented in **Table 3.5.4-6.**

Table 3.5.4-6 Features of Severely Affected Households

Male headed HHs	*Percentage (%)*	*Female headed HHs*	*Percentage (%)*
Severely affected households			
532	*69.09*	*238*	*30.91*
Resettled households			
26	*74.3*	*9*	*25.7*

According to the result of IOL, there are 35 PAHs who will have to resettle and their distribution is presented in the following Table.

Table 3.5.4-7 Distribution of Resettled PAHs

No.	*Commune*	*Number of HH*	*Number of people*
1	*Phuc Tien*	*-*	*-*
2	*Phu Xuyen Town*	*-*	*-*
3	*Nam Phong*	*2*	*8*
4	*Minh Cuong*	*-*	*-*
5	*Van Diem*	*-*	*-*
6	*Van Tu*	*-*	*-*
7	*To Hieu*	*1*	*4*
8	*Thang Loi*	*-*	*-*
9	*Quat Dong*	*-*	*-*
10	*Ha Hoi*	*9*	*38*
11	*Lien Phuong*	*3*	*12*
12	*Van Binh*	*-*	*-*
13	*Duyen Thai*	*7*	*36*
14	*Ngu Hiep*	*6*	*26*
15	*Tu Hiep*	*-*	*-*
16	*Lien Ninh*	*7*	*28*
17	*Le Loi*	*-*	*-*
Total		***35***	***152***

(4) Impacts on business

According to the result of IOL, 21 business households of which most of them are

wooden furniture shops and retail shops will be affected as presented in the following Table.

Table 3.5.4-8 Number of Business Affected Households

No.	*Commune*	*Number of affected business households*	*No.*	*Commune*	*Number of affected business households*
1	*Phuc Tien*	*-*	*10*	*Ha Hoi*	*2*
2	*Phu Xuyen Town*	*-*	*11*	*Lien Phuong*	*5*
3	*Nam Phong*	*1*	*12*	*Van Binh*	*-*
4	*Minh Cuong*	*-*	*13*	*Duyen Thai*	*7*
5	*Van Diem*	*4*	*14*	*Lien Ninh*	*-*
6	*Van Tu*	*-*	*15*	*Ngu Hiep*	*1*
7	*To Hieu*	*1*	*16*	*Tu Hiep*	*-*
8	*Thang Loi*	*-*	*17*	*Yen So*	*-*
9	*Quat Dong*	*-*	*18*	*Le Loi*	*-*
Total		***21***			

(5) Income and poverty dimension of PAHs

The average income of affected households is 71.7 million/household/year (4.24 members). Besides the main occupation, the members of the affected households also do other secondary occupations in their free time such as retail trade, masonry and being employed as hired labor. In some communes, the people combine cultivation with traditional industries such as embroidery industry in Thang Loi commune and carpentry in Van Diem and Van Tu. The wage per workday of masons or engravers is from 120,000 to 150,000 VND/person/day and from 50,000 to 80,000 VND for the assistants or unskilled labor.

According to the results of the socio-economic survey for affected households, the income of affected households is presented in the following Table.

Table 3.5.4-9 Annual Income of Affected Households

Commune	*< 50 millions*	*50 - 75 millions*	*76-100 millions*	*>100 millions*	*Total*
Phuc Tien	*97*	*69*	*45*	*33*	***244***
Phu Xuyen Town	*22*	*20*	*22*	*12*	***76***
Nam Phong	*32*	*39*	*25*	*29*	***125***
Minh Cuong	*81*	*66*	*43*	*45*	***235***
Van Diem	*57*	*41*	*46*	*37*	***181***
Van Tu	*38*	*11*	*11*	*7*	***67***

Commune	*< 50 millions*	*50 - 75 millions*	*76-100 millions*	*>100 millions*	*Total*
To Hieu	*97*	*65*	*37*	*40*	***239***
Thang Loi	*111*	*117*	*95*	*55*	***378***
Quat Dong	*83*	*88*	*83*	*93*	***347***
Ha Hoi	*84*	*55*	*52*	*106*	***297***
Lien Phuong	*33*	*36*	*23*	*18*	***110***
Van Binh	*84*	*79*	*34*	*48*	***245***
Duyen Thai	*23*	*36*	*35*	*33*	***127***
Lien Ninh	*78*	*7*	*0*	*2*	***87***
Ngu Hiep	*77*	*42*	*30*	*11*	***160***
Tu Hiep	*197*	*69*	*46*	*35*	***347***
Le Loi	*0*	*1*	*0*	*0*	***1***
Total	***1,194***	***841***	***627***	***604***	***3,266***

In accordance with Decision 01/2011/QĐ-UBND of Hanoi city is less than 520,000 VND/person/month is categorized as poor. The numbers of vulnerable households such as poor, female headed, disabled, wounded soldier who are entitled to receive the social subsidies are presented in the following Table.

Table 3.5.4-10 Vulnerable Households

Type of household	*Number*
Poor HH	*101*
Woman headed HH (Need to be assisted)	*1,015*
Other households in preferential social policies	*101*

3.5.5 Mitigation Measures

Mitigation measures on environmental impacts are summarizes in **Table 3.5.5-1** by magnitude impact basis while in planning, construction and operation phases, respectively.

Table 3.5.5-1 Mitigation Measures

(1) Planning Phase

No.	Item of Impacts	Magnitude of adverse Impact	Mitigation Measures
1	Involuntary resettlement	**A**	・Conduct census survey and local stakeholder meeting. ・Prepare RAP involving the following measures. - PAPs must be acknowledged as an eligible for compensation. - Identify the eligibility of non-titled people at the census survey intended to PAPs and ensure the compensation and support. - Refer the previous/on-going projects by other donors, determine the requirement for social vulnerability and compensate to them. - Resettlement site must be prepared when PAPs need it. ・Establish external monitoring committee consists of the third party.
2	Local economies such as employment, livelihood, etc	**A**	・ Prepare RAP involving the following measure. - Measure to restore PAPs' livelihood must be secured. ・Enhance the orderly development along expressway and employ PAPs on priority basis.
3	Poor, indigenous or ethnic minority people	**A**	・Prepare RAP involving the following measure. - Define the displaced persons and criteria for determining their eligibility for compensation. ・Establish external monitoring committee consists of the third party.
4	Misdistribution of benefits and damages	**A**	・Prepare RAP involving the following measure. - Assessed compensation will base on the market price. - Cover the difference between market price and assessed price - Payment will be carried out before resettlement. - Establish external monitoring committee consists of the third party.
5	Gender	**B**	・ Feminine gender will be invited and join local stakeholder as well as male gender. ・Interview to feminine gender while in census survey will be considered.
6	Children's right	**B**	・Secure the accessibility to go to school/hospital when select resettlement sites.
7	Social consensus	**A**	・Hold sufficient local stakeholder meetings in every stage and establish mutual understanding.

(2) Construction Phase

No.	Item of Impacts	Magnitude of adverse Impact	Mitigation Measures
1	Air pollution	**B**	・Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions. ・ Regular preventive maintenance service of construction equipment and machineries will strictly comply with. ・The proper work schedules should be considered not to concentrate the construction equipment at a certain point for long time. ・To reduce the dust, periodical water spray should be taken. ・If the residents and pedestrians complain about the dust and gas, the consultant of the supervision and contractors should reconsider the construction technique. ・ When the air pollution levels exceeds significantly the environmental standards, the regulation on fuel quality, importing old cars and emission gas control should be prepared on necessity.
2	Water pollution	**B**	・Concrete poring and road surfacing will be closely supervised to prevent spillage. ・All formworks will be secured prior to pouring to ensure failure will not occur. ・Temporary sanitation facilities such as portable toilets and garbage bins will be provided by the contractors to ensure that the domestic wastes to be generated by the construction personals are properly handled and not thrown into the drainage to prevent further pollution. ・Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions. ・ Regular preventive maintenance service of construction equipment and machineries will strictly comply with. ・Contractors will be prohibited from washing the construction tools along the waters to prevent further pollution. ・ In construction works near water bodies the consultant of supervision and contractor should monitor and control the turbid water as necessary.
3	Soil pollution	**B**	・Contractor will be required to facilitate proper re-use and disposal plan, and manage the construction waste. ・The surplus soil should be properly hauled and filled in accordance with the local regulation/rule. To prevent the impact, proper disposal site should be selected in the next detailed design stage. ・The consultant of supervision should monitor the waste disposal.

No.	Item of Impacts	Magnitude of adverse Impact	Mitigation Measures
4	Waste	**B**	・Contractor will be required to facilitate proper re-use and disposal plan, and manage the construction waste. ・The surplus soil should be properly hauled and filled in accordance with the local regulation/rule. To prevent the impact, proper disposal site should be selected in the next detailed design stage. ・The consultant of supervision should monitor the waste disposal.
5	Noise and vibrations	**B**	・The proper work schedules should be considered not to concentrate the construction equipment at a certain point for long time. ・Noise suppressors such as mufflers will be installed whenever deemed necessary to maintain the noise generated by the various heavy equipment and other construction machinery within permissible limits. ・Temporary noise barriers such as corrugated metal sheets will be installed around the construction sites to maintain noise level within permissible level if necessary. ・High noise generating construction activities will be scheduled during daytime only (06:00-18:00) to avoid noise disturbance to adjacent residential and commercial areas, and other noise-sensitive areas. ・Contractors will be required to use low-noise equipped machinery whenever it is necessary (sensitive area <55 dB, commercial area <70 dB). ・To identify impact on the surrounding buildings, the vibration level and condition of the buildings should be monitored. ・The explanation and consultation to the affected persons prior to the construction should be conducted to obtain the understanding about the potential impacts including information of the positive impacts such as promotion of the local socio-economic activity. If the local people complain about noise and vibration, the consultant of the supervision and the contractors should reconsider the construction technique.
6	Ground Subsidence	**B**	・Ground subsidence might be cause by the consolidation settlement. When appropriate method is applied to accelerate the most of anticipated settlement within a construction period, then the residual settlement may not affect the expected function of expressway. ・The consultant of supervision and contractor should monitor the ground subsidence. If the ground subsidence occurs, the consultant and contractors should reconsider the construction method.

No.	Item of Impacts	Magnitude of adverse Impact	Mitigation Measures
7	Offensive odors	**B**	・Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions. ・ Regular preventive maintenance service of construction equipment and machineries will strictly comply with. ・The proper work schedule should be considered not to concentrate the construction equipment at a place for long time.
8	Global warming	**B**	・Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions. ・ Regular preventive maintenance service of construction equipment and machineries will be strictly conducted.
9	Biota and ecosystem	**B**	・ Contractor should prevent oil/fuel at temporary stockyard from outflowing and restore to original form when the project is completed.
10	Existing social infrastructures and services	**B**	・Social service utilities such as power, water, drainage and communication line will be diverted before starting the construction activity.
11	Infectious diseases such as HIV/AIDS	**B**	・Contactor will be required to conduct a periodical health education to his personnel. ・ Local public health center will conduct health education to new settlers.
12	Working conditions	**B**	・Construction personnel shall be provided with the necessary safety gears such as protective hard hat and safety belt. ・First aid stations supervised by the safety health officer of the contractor shall be located within the construction site office. ・Emergency vehicles shall be on stand-by within the construction site.
13	Social consensus	**A**	・Contractor must provide counter man who will receive the complaint from inhabitants. ・Supervision consultant shall supervise the daily activity by the contractor to minimize the adverse impacts to the inhabitants.
14	Accidents	**B**	・A sound traffic management and detour plans duly approved by the concerned agency will strictly implemented to minimize traffic congestions. ・Traffic enforcers and flagmen will be designated along these area to assist in directing traffic flow. ・Parking time of construction equipment such as dump track and agitator car along the major thoroughfare must be limited.

(3) Operation Phase

No.	Item of Impacts	Magnitude of adverse Impact	Mitigation Measures
1	Air pollution	**B**	・ When the air pollution levels exceeds significantly the environmental standards, the regulation on fuel quality, importing old cars and emission gas control should be prepared on necessity.
2	Waste	**B**	・VEC will provide proper number of garbage bins in every parking lot for Expressway users. ・The waste in the operation stage should be properly collected and disposed or recycled in compliance with rules in Vietnam.
3	Noise and vibrations	**B**	・ The proper countermeasures to reduce noise and vibration such as slow speed in curve sections, installation of sound barrier and adoption of expansion and contraction joint should be included in the plan and design. ・In residential area, the noise along the expressway should be periodically monitored. If the noise level reaches a significant level such as far exceeding the environmental standard, the mitigation measures on noise control should be conducted.
4	Ground Subsidence	**B**	・VEC shall monitor the residual settlement and take countermeasures when un-expected settlement confirmed.
5	Offensive odors	**B**	・The regulation on fuel quality, importing old cars and emission gas control should be prepared on necessity.
6	Global warming	**B**	・The regulation on fuel quality, importing old cars and emission gas control should be prepared on necessity.
7	Biota and ecosystem	**B**	・Refer to the mitigation measures those presented in “Air pollution, and Noise and vibrations”. ・Same species of trees shall be provided as compensatory planting along shoulder/slope of embankment/frontage road when those in median strip will be removed.
8	Local economies such as employment, livelihood, etc	**C**	・The magnitude of impact will be assessed by the external monitoring committee which consists of third party in the future.
9	Land use and utilization of local resources	**C**	・The magnitude of impact will be assessed by the external monitoring committee which consists of third party in the future.
10	Existing social infrastructures and services	**C**	・The magnitude of impact will be assessed by the external monitoring committee which consists of third party in the future.
11	Poor	**A**	・Monitor by the external monitoring committee which consists of the third party and take counter measures on necessity.

No.	Item of Impacts	Magnitude of adverse Impact	Mitigation Measures
12	Misdistribution of benefits and damages	**A**	・Monitor by the third party to confirm whether compensation for those who relocated and land owners was properly implemented.
13	Local conflicts of interest	**B**	・Monitor the convenience of frontage road and its related facility at both of the west and east side of the expressway.
14	Accidents	**B**	・Establish a road maintenance and management system to keep road facilities such as road surface in good condition. ・Educational campaign which aims at traffic safety of road users and inhabitants shall be considered to enhance the prevention of traffic accidents.

3.5.6 Stakeholder Meeting

3.5.6.1 Stakeholder meeting with relevant agencies

17 Stakeholder meetings with relevant agencies involving People's Committee, land officials, Fatherland Front Woman's Union and Farmer's Union was held in all affected communes from 2nd of June 2011 to 31st of July 2011. 290 peoples joined the meeting and main opinions are;

1) Agree with the project plan in the commune area
2) Announce the plan and content of the project for the local communities
3) The acquisition of land must ensure the rights of local people
4) Do not affect the local people's production capacity
5) Perform the land clearance well to create favorable conditions for construction to ensure the schedule
6) Revert used local road (if any) during the construction period
7) Manage the workforce well, do not ruin the security and spiritual life of local people
8) Install the traffic signs during the construction
9) Fully perform the environmental mitigations measures and periodic environmental supervision
10) Establish rules and regulations for the construction units during the construction period in order to preserve environmental sanitation and security in the local area
11) Create jobs for local employees those must be relocated and resettled due to the project
12) Coordinate with local authorities in environmental protection work. When here are any reflections of the community about environmental pollution, it is needed to quickly check and have the solutions

3.5.6.2 Stakeholder meeting with local stakeholder

Except Le Loi (there is only one PAH) and Yen So (PAH is nil) local stakeholder meetings were carried out from 25th of June 2011 to 25th of July 2011 in the 16 communes. The number of participants was 893 (398 females) their concern and opinions are;

(1) **Regarding the potential impact of the project on the environment**

The project acquires agricultural land area, which put the households' livelihood in difficult situation. Dust, noise, waste during the construction will cause environmental pollution affecting people's health. In addition, the concentration of construction workers will affect the local security and increase the risk of social evils. The construction will also cause damage to public assets such as frontage road system, irrigation system, historical and cultural works.

(2) **The measures to mitigate the environmental impacts**

Residents near the construction site required the contractors not to work after 21h00 to avoid noise impact on their living; the contractors also should regularly water the road to reduce dust emissions in the air. The contractor should closely coordinate with the local authorities to manage the construction workers. The community wants the environmental management plan to be broadly public to people; in case the EMP is not well complied, there will have the punishment.

(3) **The participation of the people**

The people totally agreed and supported the participation in the implementation of mitigation measures of impacts on the environment. The community will establish the supervision team to monitor the construction process and the implementation of environmental management plan. The Investor should have a mechanism to ensure the supervision of the people in implementing the above plans. In particular, the mechanism for grievance redress must be clear and transparent.

(4) **Other opinions:**

The community hoped to contribute the comments and opinions during the design of the frontage roads and box culverts in order to match with the characteristics of regional activities. The design of roads and ancillary works should be in detail informed to people.

The 2nd stake holder meetings were held in 16 communes from 12th to 30th of December,

2011. The total number of participants was 2,521(including 1,221 of females) and their main concerns and opinions are summarize as follows.

(1) **Potential impact on Environment**

Results of IOL are agreeable. However, it was reported that residents along the road were suffered from noise and stagnant water and waste in box culvert during the construction of the PV-CG Highway Construction Project.

(2) **Mitigation measures on potential Impact**

The proposed mitigation measures seem to be appropriate. However, measures explained in the previous construction time were presented but not implemented. It is necessary for local official institutions and local residents that they can participate in the monitoring of the construction and of the situation of dust, noise and accidents after the opening of the Expressway.

(3) Policy on compensation, assistance and resettlement

Frame of compensation price is reasonable but representative from local villages and affected households shall be participated when to determine the market price.

Proposed assistance packages are reasonable but income restoration program for severely affected households must be designed considering the situation and productivity in each area. Beside, in order to avoid bury newly at cemetery to be affected, information on relocation shall be informed of as early as possible.

(4) **Disclosure of Information**

The implementation plan must be made public and informed to local residents soon in order to keep transparency. The “cut-off date” must be announced publicly and posted at public places.

(5) Participation to the survey

Participation in a survey on DMS, determination of market price, payment of compensation and one at various stages including monitoring shall be encouraged and accelerated.

(6) Grievance redress mechanism

Name of agencies and organizations in charge of receiving and resolving grievance shall be made clear so that affected people can conclude the contract earlier. The grievance redress must be processed accurately and timely strictly in line with the proposed plan.

3.5.6.3 Consultation with Affected Institutions and Enterprises

(1) Opinions of affected schools: The project owner must take efforts to minimize the adverse impacts due to the dust, noise/vibration those anticipated while in construction and operation phase, and secure the safety of students then take measures to prevent the increase of traffic accident those anticipated while in construction phase.

(2) Opinions of health center: A small area of the health center might be acquired. The work of health care for people will be interrupted or difficult during construction process due to the impacts of dust, noise/vibration. Therefore, project owner must take countermeasures to minimize those adverse impacts.

(3) Opinions of industrial zones and enterprises along the route: The acquired area might be not large and will not affect the architecture. However, the project owner take adequate countermeasures to solve the problems arising during construction process such as gathering of construction materials, noise and air pollution.

3.5.7 Resettlement Action Plan

3.5.7.1 Proposed gap filling measures to comply with JICA Guideline

Table 3.5.7-1 presents gaps on the policy of involuntary resettlement between JICA guideline and related rules in Vietnam, and proposed gap filling measures.

Table 3.5.7-1 GAP between JICA Guideline and related Rules in Vietnam

	Item	JICA guideline	Related Rules in Vietnam	Proposed Measure
1	**Acknowledgement as an eligible for compensation**	All of the project affected persons (PAPs), whether legally residing or not, must be acknowledged as an eligible for compensation.	If households, individuals those use the land without the legal papers have used land and have certification issued by People's Committee (PC) of the commune-level that they have not violated any planning, have not encroached upon the corridor, then they shall be compensated. For the houses and structures on the non-eligible-for –compensation land, which have not violated announced land use plans or the right of way, will be assisted 80 % of replacement cost. Houses and structures on non-eligible for compensation land, which have violated announced land use plans or the right of way, will not compensated but assisted.	Apply the cut-off date method to determine and acknowledgement of eligibility: Any persons who settle in the project area before cut-off date will be acknowledged as eligible for compensation and assistance disregarding that they have or have not legal paper on the affected land and asset upon the land. The cut-off date must be widely and publicly announced by local authorities for the local communes in the project area.

	Item	JICA guideline	Related Rules in Vietnam	Proposed Measure
2	**Support for non-titled people**	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner.	Person whose main income is derived from agricultural production and he cannot satisfy the legal papers when his land is acquired by the Government, the Provincial Peoples' Committee (PPC) will consider the level of assistance to be provided in conformity with the locality's actual conditions.	When the cut-off date is applied and announced widely, persons who settle before the cut-off date would be eligible and acknowledged as eligible people. After the announcement of cut-off date any persons who encroaches the project area shall be considered as non-eligible people and no support should be provided as they violate the land use plan.
3	**Construction of support system for vulnerable social groups**	Appropriate considerations must be given to vulnerable social group which may have little access to decision making process within society.	Vulnerable is defined as poor household only. Woman headed, aged, handicapped households are not involved in this category. The actual amount and time of assistance will be decided by the Provincial People's Committee but the time might not less than 3 years and must not exceed 10 years.	Adopt a definition of vulnerable group which includes not only poor but also landless, elderly, woman heads of household. The particular households to support are subjects to be discussed between District Compensation, Assistance and Resettlement Committee (DCARC) with the related PC.

	Item	JICA guideline	Related Rules in Vietnam	Proposed Measure
4	**Land acquisition against PAPs**	Government of Vietnam must make efforts to enable people affected by projects and to improve their standard of living, income opportunities and production levels or at least to restore these to pre-project levels.	Government administrates the land as a representative of ownership of land by the entire people and Provincial/Municipal People's Committee administrate the land practically. People are granted the land use rights but not the individual ownership. When Government decide a land acquisition for national development purpose, peoples those are granted their land use rights should discharge the rights	Necessity or not-necessity to secure the alternative land must be confirmed from affected people when the Inventory Loss Survey is carried out and all affected people must be acknowledged as eligible regardless of title holder or not.
5	**Offering measure to the recovery of livelihood to PAPs**	Government of Vietnam must make efforts to enable people affected by projects and to improve their standard of living, income opportunities and production levels or at least to restore these to pre-project levels.	A person is entitled to receive the livelihood/vocational training support in accordance with the loss ratio of his productive land and whether they will resettle or not.	Prepare practical measures pursuant to related rules.

	Item	JICA guideline	Related Rules in Vietnam	Proposed Measure
6	**Formulation of Resettlement Action Plan and promotion of citizen's participation in the project implementation stage**	Promote the participation of affected people and their community and their opinion must be incorporated into the decision making process.	The Resettlement Action Plan only mentions the compensation and resettlement plan rather than the income restoration, and allowances for recovery and moving. No later than ninety (90) days with respect to agricultural land and one hundred and eighty (180) days with respect to non-agricultural land prior to recovery of land, the appropriate State body must notify the person having the land to be recovered of the reason for recovery of the land, the time-limit and plan for removal, and the general plan for compensation, site clearance and resettlement.	RAP must have a chapter on Information Disclosure, Consultation and Local Participation, specifying the consultation activities and how the opinions, suggestions, concerns of the affected persons have been addressed. Participation during the implementation and monitoring program should be indicated. Host communities should also be included in the participation process.

	Item	JICA guideline	Related Rules in Vietnam	Proposed Measure
7	**Compensation for house loss at full replacement cost**	Compensation rate must be at full replacement cost as possible and must be paid before relocate the house.	Persons who have land recovered shall be compensated with new land having the same use purpose; if there is no land for compensation, they shall receive compensation equal to the value of land use right which is calculated based on land price at the time of issuance of recovery decisions. The compensation rates for land shall be determined by the PPC in accordance with the Government regulations for the type of land which has been used for at the time of land acquisition. Compensation shall be based on market prices. Where there is a difference between acquired price and market value, PPC will decide the compensation rate for each specific case. With regard to house and structure, it will be compensated equivalent to the value of the newly-constructed ones those having the same technical standards. When the land is used by registered economic organization, production household, business household, then the business and production must be suspended. Loss of business is compensated with 30 % (highest) of the after tax income in one year which subjects to averaged income in the last 3 continuous year certified by the tax department.	Compensation rate must be at full replacement cost as practically as possible. It is the market price including materials and labor cost, plus all costs required to transfer the assets, plus any cost of any registration and transfer taxes.

	Item	JICA guideline	Related Rules in Vietnam	Proposed Measure
8	**Grievance committee**	Grievance committee must be established so that PAPs will not suffer a loss due to resettlement	Citizens are entitled to complain to the District Peoples' Committee. There is no Grievance Committee system which consists of representative of citizens, project proponent, agency for land acquisition/resettlement and the third party.	The grievance redress mechanism is available. It would be more effective to solve the issues when the executing agency (EA) and implementing agency (IA) are closely and actively engaged in the grievance redress process.
9	**Implementation of monitoring**	A monitoring plan must be implemented so that people can monitor whether environmental and social considerations are undertaken during the project	Internal monitoring: the Department of Finance (Provincial and district level) and financial auditing agencies will monitor the compensation amounts paid for the households. But there is no internal monitoring system on progress or the process of implementing compensation/assistance or resettlement. There is no indicator and procedure for the usage of independent monitors to evaluate whether the project has achieved resettlement objectives or not.	The EA and IA should set out principles, requirements and indicators of internal compensation, assistance and resettlement monitoring. The EA should appoint an 1ndependent external monitoring consultant.

3.5.7.2 Outline of prepared RAP

The RAP of the Project is prepared in accordance with principle measure which copes with the result of socio-economic condition survey and local stakeholder meeting as presented in the following Table.

The RAP, after receiving the advice by JICA Advisory Committee, VEC must submit the RAP to MOT for the purpose of discussion and approval.

Table 3.5.7-2 Outline of prepared RAP

No.	Item	Prepared Measure
1	**Acknowledgement as an eligible for compensation**	Apply the cut-off date method to determine acknowledgement of eligibility: Any persons who settle in the project area before cut-off date will be acknowledged as eligible for compensation and assistance irrespective of whether they have legal papers on the affected land and asset upon the land. The cut-off date must be publicly announced by local authorities for the local communes in the project area when Detailed Measurement Survey is completed.
2	**Support for non-titled people**	When the cut-off date is applied and made public, persons who settle before the cut-off date would be eligible and acknowledged as titled people. After the announcement of the cut-off date any person who encroaches on the project area shall be considered as non-eligible people and no support should be provided as they violate the land use plan.
3	**Construction of support system for vulnerable social groups**	Adopt a definition of vulnerable group which includes not only poor but also landless, elderly, woman heads of household.
4	**Land acquisition against PAPs**	Monetary compensation will be applied to the loss of agriculture/aquaculture land those difficult to provide the alternative lands and land for resettlement must be considered when PAPs request to provide it.
5	**Offering measure to the recovery of livelihood to PAPs**	Support of monetary-level will be applied. When livelihood of a person depends on production from land, but no land allocation of land is available, in addition to monetary support, he is entitled to be supported for stabilizing his livelihood by training for conversion of occupations and render him new employment.
6	**Formulation of Resettlement Action Plan and promotion of citizen's participation in the project**	RAP has referred the consultation activities and how the opinions, suggestions, concerns of the affected persons have been addressed. Participation during the implementation and monitoring program has required to be guaranteed.

No.	Item	Prepared Measure
	implementation stage	
7	**Compensation for house loss at full replacement cost**	Compensation must be at market price with full replacement cost. Pursuant to Decree No. 69 and Decision 108/2009/QD cash compensation equivalent to 5 times of compensation price of official agricultural land for the affected area will be assessed. For agricultural land in residential area: cash compensation of 20-50% of current market price based on the price of residential land in the area will be assessed. DCARC which consists of DPC, Departments of Finance, Natural Resources and Environment, Agriculture and Rural Development, representative of affected commune and representative of affected households will determine the market price. Since the RAP preparation and implementation is long enough, the market rates may fracture. At the time of compensation, when market price is increased, DCARC should prepare the proposal to adjust the unit rates to ensure that the compensation unit rates are close to the current market price.
8	**Grievance committee**	The grievance redress mechanism will be implemented in accordance with the following four stages. Stage 1-Commune People's Committee Stage 2- District People's Committee Stage 3- Hanoi People's Committee Stage 4- District People's Committee Prior to go to Stage 1, the DCARC which consists of the representative of PAH plays a role to settle a grievance.
9	**Implementation of monitoring**	Steering Committee for Compensation and Site Clearance Board will play a role to carry out the internal monitoring, and VEC will hire an external monitoring consultant.

3.5.7.3 Implementation of RAP

The roles of concerned agencies in related to the implementation of RAP are as follows.

(1) Vietnam Expressway Corporation (VEC)

VEC is the project proponent of "Phap Van - Cau Gie Upgrading" Project and is the unit which will prepare and approve the Resettlement Plan then submit it to the funder (Japanese side) for consideration and approval.

1) Contract with the Steering Committee for Compensation and Site Clearance of Hanoi city or directly contract with DCARC for planning (a detailed compensation, assistance and resettlement plan) and will implement compensation, assistance and resettlement activities.
2) Provide necessary instructions concerning compensation, assistance and

resettlement for the Steering Committee for Compensation and Site Clearance Board of Hanoi City or the DCARC (agreements with the donor related to compensation, assistance and resettlement; provisions of the VEC on safety corridor etc.)

3) Regularly coordinate with the agency which will directly implement compensation, assistance and resettlement to monitor the implementation in order to ensure compliance with the provisions of the approved Resettlement Plan.
4) Coordinate with the agency who will directly implement compensation, assistance and resettlement to handle problems that arise during the implementation of compensation, assistance and resettlement as well as the recommendations from executive agencies.
5) Transfer funds directly to the compensation unit, support and resettlement.
6) Update progress of the Project and issues related to the implementation of compensation, assistance and resettlement activities and report to the donor. VEC will recruit an external monitoring unit to monitor the implementation of compensation, assistance and resettlement.
7) Coordinate with other units who implement compensation, assistance and resettlement to redress grievances of affected households, if any.

(2) Hanoi People's Committee and relevant departments and boards

Hanoi People's Committee and relevant departments and boards directly under the city

Hanoi People's Committee will be responsible for compensation, assistance and resettlement activities. Hanoi People's Committee will:

1) Establish the DCARC or authorize District People's Committee to establish the DCARC.
2) Provide instructions and direction for the DCARC to implement compensation, assistance and resettlement activities.
3) Consider and adjust unit price of compensation and assistance for land and on-land assets if the District People's Committees require it.
4) Guide on dealing with difficulties during the implementation of compensation, assistance and resettlement activities.

(3) Steering Committee for Compensation and Site Clearance Board of Hanoi City

1) Provide guidance to the DCARC on planning and implementing of compensation, assistance and resettlement.
2) Provide budget sufficiently and in a timely manner to the DCARC to implement compensation, assistance and resettlement.
3) Discuss with VEC, different city and district's relevant agencies, and with the DCARC to solve issues during compensation, assistance and resettlement.
4) Carry-out internal resettlement supervisions.

(4) District Compensation, Assistance and Resettlement Committee (DCARC)

The DCARC headed by DPC Vice-chairman will consist of leaders of Departments of Finance, Natural Resources and Environment, Transport, Agriculture and Rural Development, CPC Chairman of affected communes and authorized representatives of affected households in the province. Responsibility of the District People's Committee has been clearly defined in Decree 197/2004 and 84/2008. The main responsibilities of the DCARC include:

1) Update loss inventory based on the DMS.
2) Prepare updated Resettlement Plan to submit to DPC for approval.
3) Implement community consultation and information dissemination with affected people, design and implement income restoration programs. Coordinate with relevant agencies such as Department of Finance, Department of Natural Resources and Environment to fix compensation price for land and on-land assets.
4) Determine, construct resettlement area and allocate land for affected households who are eligible.
5) Implement compensation, assistance and resettlement activities for affected households.
6) Coordinate with other agencies and boards to redress grievance of affected households. Prepare reports on the progress of compensation and site clearance quarterly.
7) Allocate acquired land for VEC to implement construction activities.

(5) District People's Committee (DPC)

1) District People's Committees will be responsible for the following activities:

Consider and approve the compensation, assistance and resettlement options submitted by the DCARC.

2) Monitor the implementation of compensation, assistance and resettlement activities to ensure that activities are done in accordance with the options already approved by the DPC.
3) Settle grievance of affected households, if any

(6) Commune People's Committee (CPC)

Commune People's Committees will support the DCARC in implementation of compensation assistance and resettlement activities. Specifically, Commune People's Committees will be responsible for the following activities.

1) Arrange officers to support the DCARC in cadastral map updating, option planning and implementing compensation, assistance and resettlement activities.
2) Co-sign the minutes of DMS for compensation with the affected households.
3) Implement community consultation and provide information for affected households.
4) Settle grievances and complaints at commune level.

3.5.7.4 Grievance redress measures

Grievances and complaints related to any issue in implementation of compensation, assistance and resettlement in PCVG project will be settled through negotiation to achieve consensus of the two parties. Then the grievance resolution process will be made in accordance with Article 138 of the 2003 Land Law, Decree 197/2004/ND-CP on compensation, assistance and resettlement in the event of land acquisition by the State (Article 63 and Article 64) and provisions on grievance resolution in Decree 136/2006/ND-CP. The affected households will be exempt from all grievance fees. Grievance redress mechanisms will be implemented in accordance with the following four stages.

(1) Stage 1- Commune People's Committee

Affected households will directly submit their grievance or send in writing to any member of the Commune/Ward People's Committee who has the responsibility to inform the CPC of the grievances. The Commune/Ward People's Committee will hold a private meeting with the households to resolve

grievances within 15 days after the submission. Office of the Commune/Ward People's Committee is responsible for recording and storing and managing all received grievances.

(2) Stage 2- District People's Committee (DPC)

If after 15 days, affected households do not receive any response from the Commune/Ward People's Committee or their grievance is not settled satisfactorily, they will submit the grievance (sent in writing or directly reported) to any member of the DPC. The DCARC will advise the District People's Committee to resolve grievances and complaints. District People's Committee will respond to grievances and complaints of affected households within 15 days after the submission. The DCARC is responsible for recording and storing and managing all grievances received and settled by the DPC.

(3) Stage 3- Hanoi People's Committee

If after 15 days, affected households do not receive any response from the DPC or they are not satisfied with the decision on grievance resolution of the DCARC, they will have two options: (i) submit their complaint to the District People's Court, or (ii) submit the complaint (sent in writing or directly reported) to any member of Hanoi People's Committee. The Hanoi People's Committee will have 15 days to resolve complaints. The Office of the Hanoi People's Committee is responsible for recording and storing and managing all grievances and grievance resolutions of the Hanoi People's Committee

(4) Final Stage- District People's Court

If after 15 days, affected households do not receive any response from the DPC or they are not satisfied with the decision on grievance resolution of the DPC; or 15 days after submitting the complaint to Hanoi People's Committee, affected households do not receive any response from Hanoi People's Committee or they are not satisfied with the decision on grievance resolution of Hanoi People's Committee, they will submit their complaint to the District People's Court to be processed and settled in accordance with regulations of Vietnamese law.

Appendix

Study on Design Speed and Stopping Sight Distance

In the meeting held on 27 May 2011 with attendance of MOT/VEC/TEDI/NEXCO and JICA Study Team("ST"), ST proposed that Design Speed of Phap Vam-Cau Gie ("PV-CG") Expressway in 4 lane operation is to be 100km/h because stopping sight distance ("sight distance") of 230m corresponding to Design Speed of 120km/h is not kept throughout PV-CG Expressway. This note includes the study what kind of activities are needed to keep sight distance of 230m, which corresponds to Design Speed of 120km/h basically. Conditions of study are stated as below.

1. Sight Distance

Stopping sight distance is the distance traveled while the vehicle driver perceives a situation requiring a stop, realizes that stopping is necessary, applies the brake, and comes to a stop.

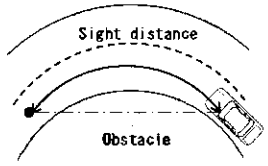


Fig. To ensure sight distance(Plan)

Fig. To ensure sight distance(Longitudinal)

2. Design Standard(Alignment/Sight Distance)

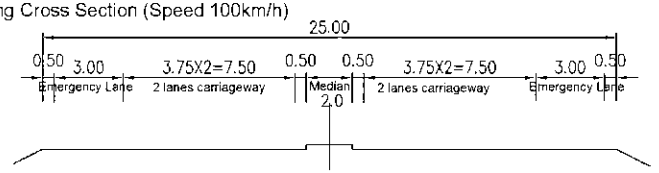
Table-1 Design Standard applied to this note

Items		unit	Freeway/ Expressway Specification for Design TCVN5729	Road Structure Ordinance (JAPAN) Desirable	Ordinary	Relaxed	AASHTO (USA)	Applied standard (based on TCVN5729)	Remark	Applied standard (100km/h)
Design Speed		km/h	120					**120**		100
Horizontal Alignment										
Min. Curve Radius		m	**650**	1,000	710	570	460	**650**		450
Min. Curve Length		m	**200.4**		200		170	**200.4**		167
Min.Transition Curve Length		m	125		**100**		85	**100**	Relaxed to100m	100
Vertical Alignment										
Max. Gradient	UP	%	**4**		2		-	**4**		5
	Down	%	**5.5**		2		-	**5.5**		5.5
Min. Curve Radius	crest	m	**12,000**	17,000	11,000		9,500	**12,000**	relates to sight distance	6,000
	sag	m	**5,000**	6,000	4,000		6,300	**5,000**		3,000
Min. Curve Length		m	**100**		100		-	**100**		85
Min. Slope Length		m	300		-		-	**140**		140
Stopping site distance		m	**230**		210		250	**230**		160

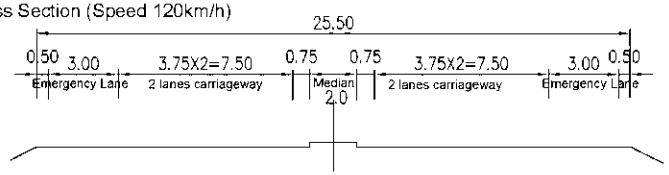
Technical Standards for Expressway/Freeway Main lanes at the connecting portion of Interchange

			120		100	
			Ordinary	Relaxed	Ordinary	Relaxed
Main lanes in the vicinity of Interchange	Min. Horizontal curve radius		2,000	1,500	1,500	1,000
	Min. Vertical curve radius	crest	45,000	23,000	25,000	15,000
		sag	16,000	12,000	12,000	8,000
	Max. Vertical gradient		2	–	2	3

Existing Cross Section (Speed 100km/h)



Cross Section (Speed 120km/h)



In order to identify the necessary activities to apply Design Speed 120km/, standard shown in table-1 is applied this study. Standard applied is based on TCVN5729:1997 Freeway/Expressway Specification for Design with the following two relaxations. (It is noted that standard applied satisfies "Ordinary Value" of Road Structure Ordinance in Japan, at Design Speed of 120km/h.)

i. Min. Transition Curve Length: Ordinary value of 100m in Road Structure Ordinance is applied.

ii. Min. Slope Length: From the following reasons, 140m is applied.

- There are similar items neither in Road Structure Ordinance nor in AASHTO
- In case Min. vertical curve radius and curve length satisfies the requirement, sight distance can be kept.
- By relaxation of this item, overlay thickness can be reduced and loads, it induces further settlement to existing PV-CG Highway, are also reduced.

3. Other Conditions for studying Vertical Alignment

Control points, required overlay thickness calculated from pavement design and other conditions are the same as those set out in Interim Report compiled by TEDI.

4. Result of Study

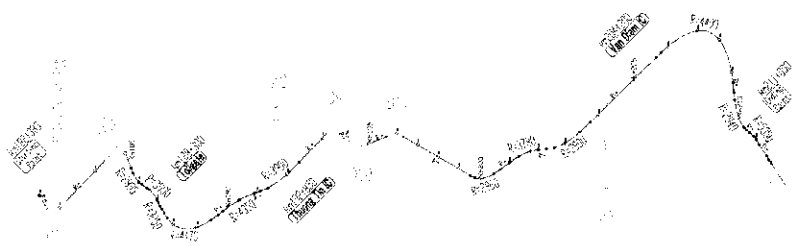
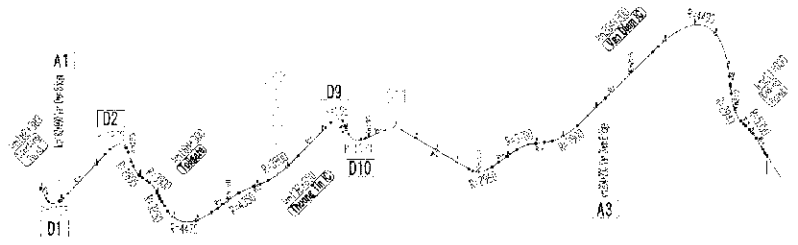
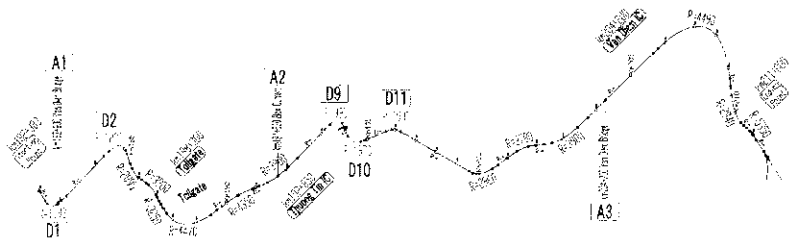
Because the existing PV-CG highway was constructed with Design Speed of 100km/h, there would not be significant problems. However to upgrade existing PV-CG Highway to Expressway with design Speed of 120km/h in full section, in Horizontal Alignment, 5 sections and in Vertical Alignment, 3 sections are required to be improved. Most of improvement requires modification of structure or significant improvement of Main lanes and Interchange, which requires considerable Land Acquisition.

However Design Speed of the connecting Expressway Cau Gie-Nin Binh is 120km/h and PV-CG Expressway should improve travelling performance and provide reasonable service.

As a conclusion of the Study, ST proposes No.2 in the next page. Design Speed 120km/h is applied to PV-CG Expressway except the sections, where improvement is difficult and design Speed of which will be restricted to 100km/h.

Traffic safety measures, such as securing the length of sections with different design speed taking speed change into account, are needed in order to ensure the safety and smooth traffic flow.

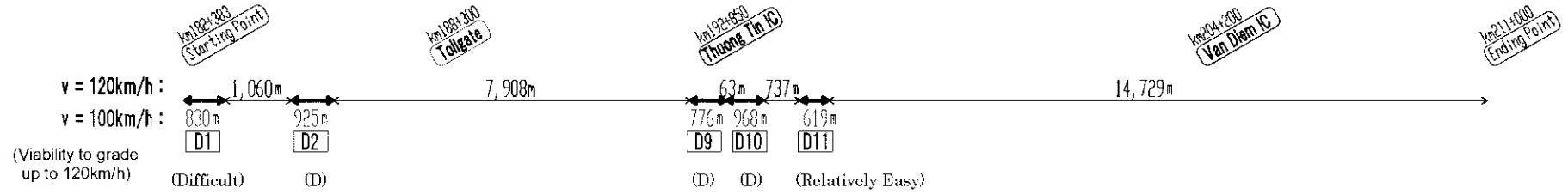
Necessary Activities for upgrading existing 4 lanes PV-CG highway to Expressway with Design Speed of 100km/h and/or 120km/h

No	Design Criteria and Upgrading policy	Sections to be upgraded	Assessment	Planning Outline	Evaluation
1	Design Speed 120km/h Standard applied Standard stated in page 1 Upgrading Policy Upgrading is to be carried out to allow Design Speed of 120km/h throughout PV-CG Expressway	Upgrade the sections which does not comply the requirement of Design Speed of 120km/h. Following 5 sections in horizontal alignment and 3 sections in Vertical alignment are identified. ・D1, D9: Upgrading to satisfy the requirement of Horizontal Alignment in the vicinity of IC ・D2,D10,D11: widening for keeping sight distance ・A1,A2,A3 : Sections overlay thickness of which exceeds 0.9m . (Refer to attachment 1)	Following 4 sections requires modification on structures or large widening and those will give considerable impact on Schedule and Land Acquisition. ・D1, D9: Considerable Land Acquisition is needed. ・D2: Extension of existing culvert is needed. ・A3: Modification on Van Diem Bridge is needed.	 — : Upgrade to Design Speed 120km/h, — : Design Speed 120km/h in existing PV-CG Highway	—
2	Design Speed 100km/h to 120km/h Standard applied Standard stated in page 1 Upgrading Policy Design Speed 120km/h is basically applied to PV-CG Expressway except the following three sections, design Speed of which will be restricted to 100km/h 1. Starting Point to Toll Plaza on Main lanes 2. Thuong Tin Interchange 3. Van Diem Interchange	Considering impact on Schedule and Land Acquisition, the following two easy improvements are to be upgraded to Design Speed 120km/h. ・D11: Widening for keeping sight distance ・A2: Improvement of Vertical alignment by 1.6m thick overlay	PV-CG Expressway has sections with Design Speed 100km/h to 120km/h considering traffic safety, although it would be desirable to have unified design speed throughout PV-CG Expressway.	 (Length) D1 (830m) D2 (1,060m) (925m) (7,908m) D9 (776m) D10 (63m) (968m) (9,035m) A3 (600m) (6,450m) (Design Speed)----(12,617m)----(6,700m)----(5,000m)----(4,300m)---- — : Upgrade to Design Speed 120km/h, Design Speed, — : 100km/h and — : 120km/h in existing PV-CG Highway	○
3	Design Speed 100km/h Standard applied Standard stated in page 1 Upgrading Policy Upgrading is to be carried out to improve only vertical alignment of existing PV-CG Highway with Design Speed of 100km/h	In respect of existing Horizontal Alignment, no significant improvement is to be carried out. Min. slope length:140 (Min. curve radius Crest 6,000, sag 3,000)	Because major activity is upgrading for vertical alignment, construction management on schedule and cost is relatively easy.	 Design Speed, — : 100km/h and — : 120km/h in existing PV-CG Highway	—

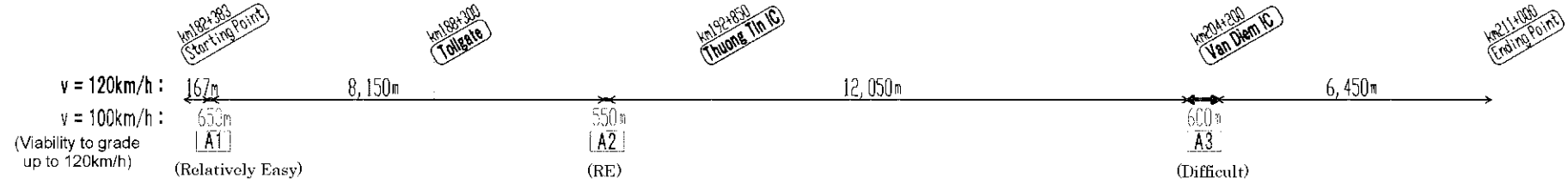
Appendix-2

Design Speed of existing Phap Van-Cau Gie Highway

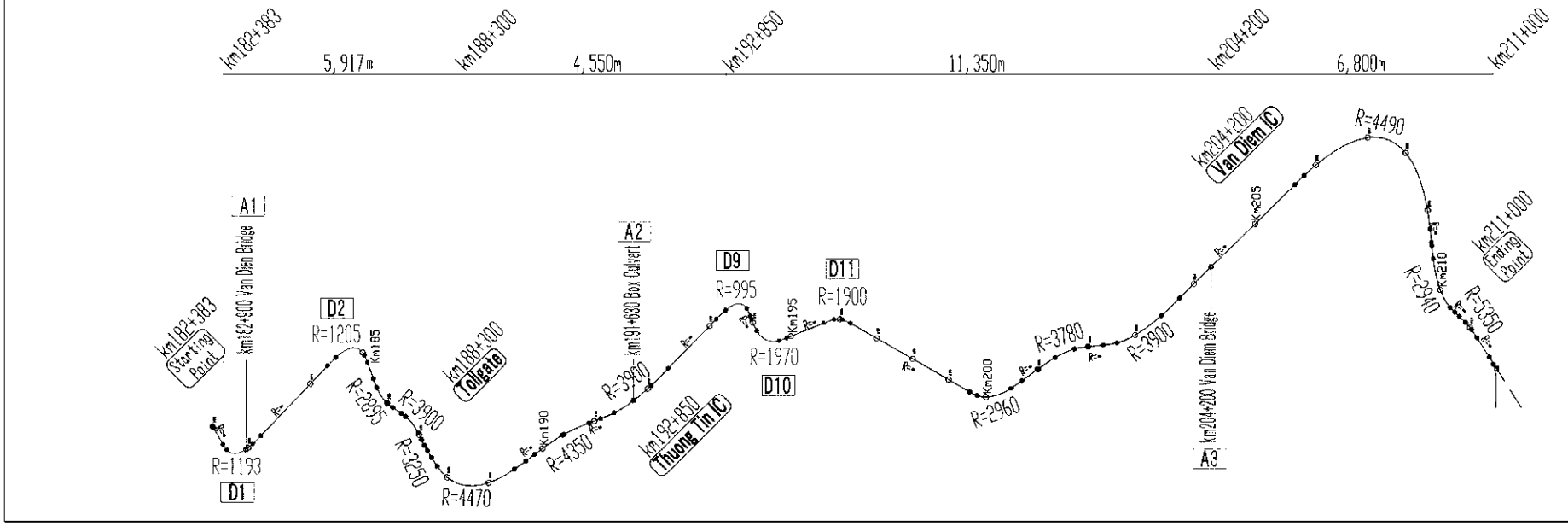
Design Speed corresponding to the existing Horizontal alignment



Design Speed corresponding to the existing Vertical alignment (Longitudinal Profile)



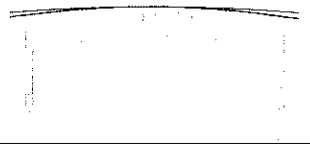
PLAN



Appendix-3

Evaluation of necessary Activities for Upgrading to Expressway with Design Speed of 120km/h

Vertical Alignment (Major Items only, Attachment -2 to refer)

No.	Station	Description of place	Overlay thickness (m)	Viability	Evaluation (E)
A1	km182+900	Near Van Dien Bridge	0.9	Because vertical alignment is flat for Van Dien Bridge, no modification is necessary for the Bridge. By installing retaining walls at the center of the road, upgrading can be made lanes by lanes for both approach to the Bridge	○
A2	km191+630	Near Box Culvert	1.6	Because vertical alignment is flat for Box culvert, no modification is necessary for the culvert. By installing retaining walls at the center of the road, upgrading can be made lanes by lanes for both sides of the culvert	○
A3	km204+200	Near Van Diem Viaduct	1.0	Because vertical alignment includes R=6,000m curve in Van Diem Bridge, it should be upgrade to R=12,000m. In this upgrading, as shown in the figure in right hand, approx. 40cm of overlay is needed. Modification of Bridges structure is required. 	×

Horizontal Alignment (Attchment-3 and Attachment-4 to refer)

		A. Widening: widening of main lane(s) for keeping sight distance				B. Re-alignment: Re-alignment of main lanes for keeping sight distance				
Curve No.	Station	Widening width ΔW(m)	Widening Length L (m)	Viability	E	Section to be re-aligned	Curve Radius after re-alignment R (m)	Max. distance of two center lines, re-aligned and existing (m)	Viability	E
D1	km182+406, R=1,193m Phap Van IC	2.8	830	Sight distance for main lanes can be kept. However requirement of Horizontal Alignment of main lanes un the vicinity of IC remains unfulfilled	×	km182+177～km183+405 L=1,228m	2100	50	Land recovery (acquisition) for re-alignment route is required.	×
D2	km184+344, R=1,205m	3.2	925	Extension of box culvert is required	×	km184+020～km185+400 L=1,380m	2100	40	Ditto	×
D9	km193+102, R=995m Thuong Tin IC	4.2	776	Sight distance for main lanes can be kept. However requirement of Horizontal Alignment of main lanes un the vicinity of IC remains unfulfilled	×	km191+260～km195+320 L=4,063m	2100	152	Ditto	×
D10	km194+073, R=1,970m	0.43	968	Widening is to be within median separator (w=2.0m)	○	km191+260～km195+320 L=4,063m	2100	152	Ditto	×
D11	km195+569, R=1,900m	0.55	619	Widening is to be within median separator (w=2.0m)	○	Re-alignment is not necessary. Widening can be applied.	–	–	–	

Interchange

IC No.	Name of IC	Viability			Evaluation
		Horizontal Alignment of Mane lanes	Vertical Alignment of Main lanes	Speed change lanes (SCL)	
IC1	Phap Van	It does not comply with the requirement of minimum R=1,500 for Design Speed of 120km/h	Upgrading can be made	No SCL are installed.	×
IC2	Thuong Tin	Presumably, existing alignment applies relaxed value R=1,000m due to the existence of many residences. Improvement to minimum R=1,500m seems to be practicably impossible.	Upgrading can be made	No SCL are installed.	×
IC3	Van Diem	Horizontal alignment complies with requirement of Design Speed of 120km/h.	Modification on Bridge structure is required. Refer to No. A3 in Vertical Alignment.	SCL are designed with Design Speed 100km/h, considerable modification is required.	×

Appendix-4

Attachment-1

Comparison of Planned Height in Vertical Alignment (Longitudinal Profile)

A comparison of Planned Height(P.H.) is made between a plan included in Interim Report of VEC F/S and two plans, one for Design Speed of 100km/h and the other is for 120km/h, of JICA Study Team (ST).

Section compared: from km182+300 to Km211+200, L=28.9km

Differences between P.H. and existing Ground Height(G.H.), included in files received from TEDI via. VEC in April 2011, are shown below.

Table Difference between P.H. and G.H. (Average of the Section)

VEC Plan	ST Plan(V=120km/h)	ST Plan(V=100km/h)
0.66m	0.43m	0.42m

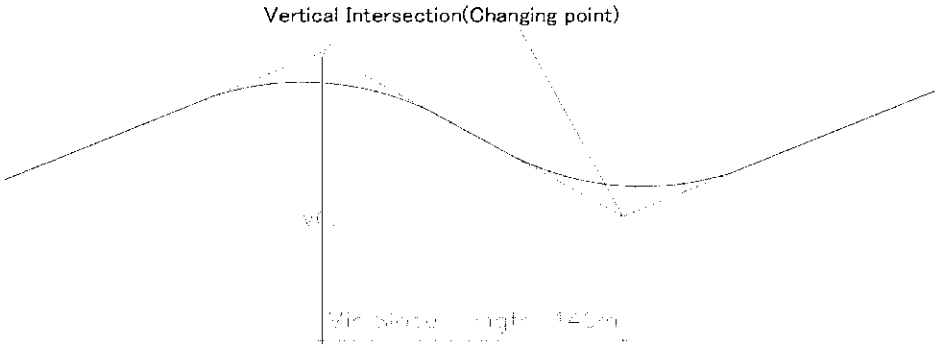


Figure Min.Slope Length

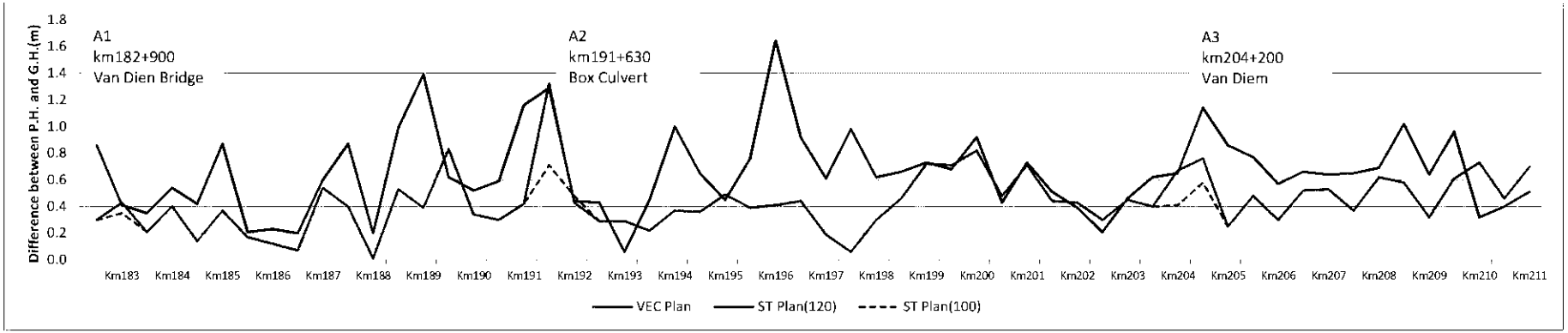
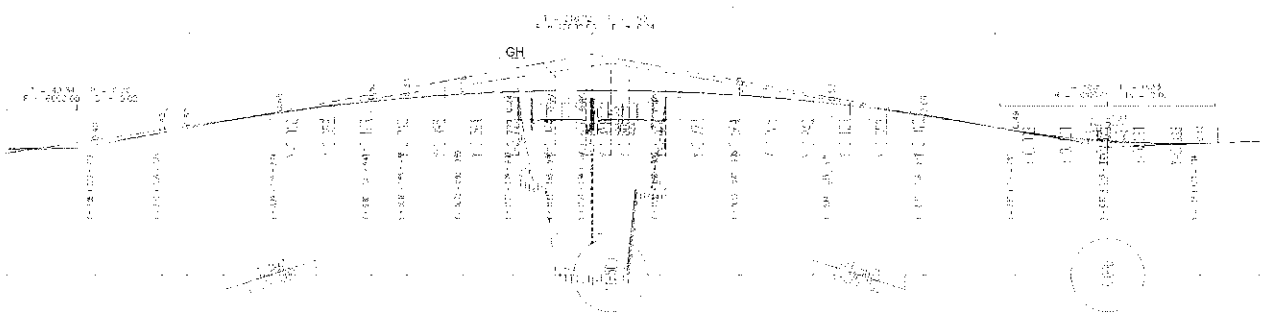


Table Difference between P.H. and G.H.

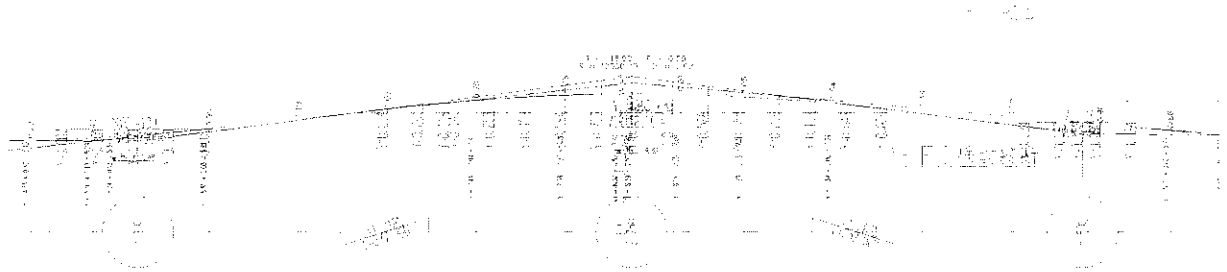
Appendix-5

Attachment-2 Vertical Alignment Improvement

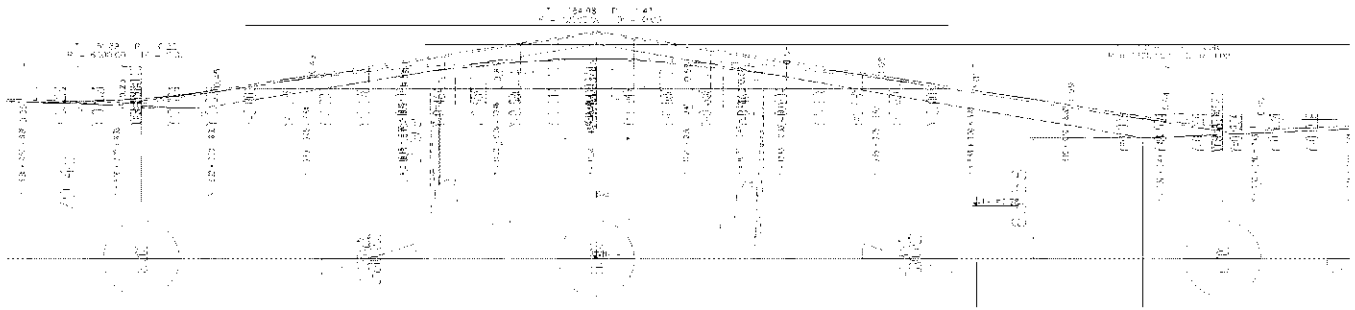
km182+900, in the vicinity of Van Dien Bridge



km191+630, in the vicinity of Box Culvert



km204+200, in the vicinity of Van Diem Interchange

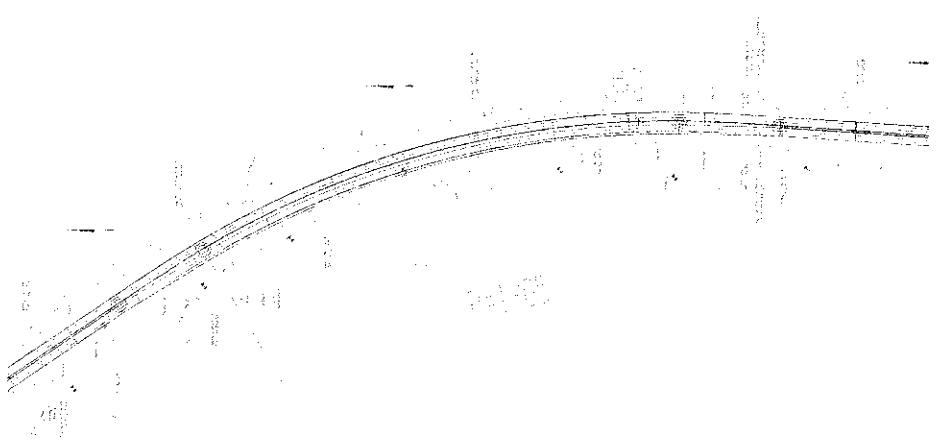


Appendix-6

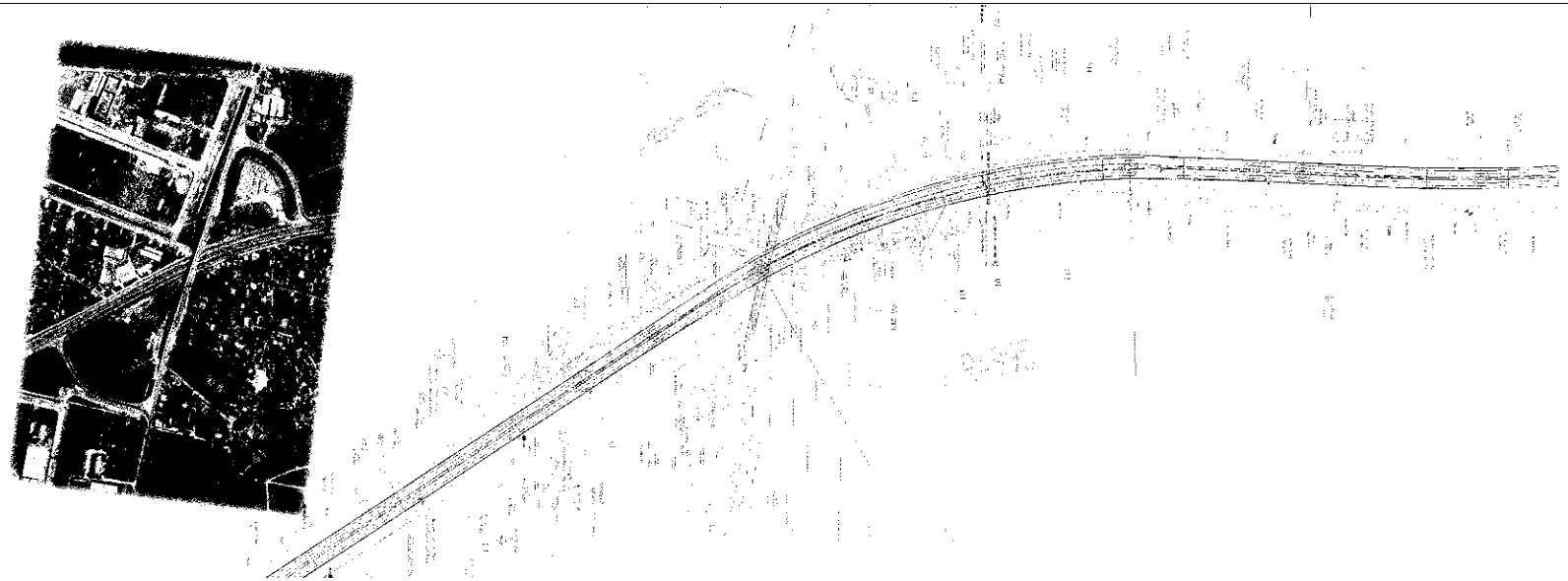
Attachment-3 Horizontal Alignment Improvement—Widening for keeping sight distance

Widening for Curve D1

Widening for Curve D2

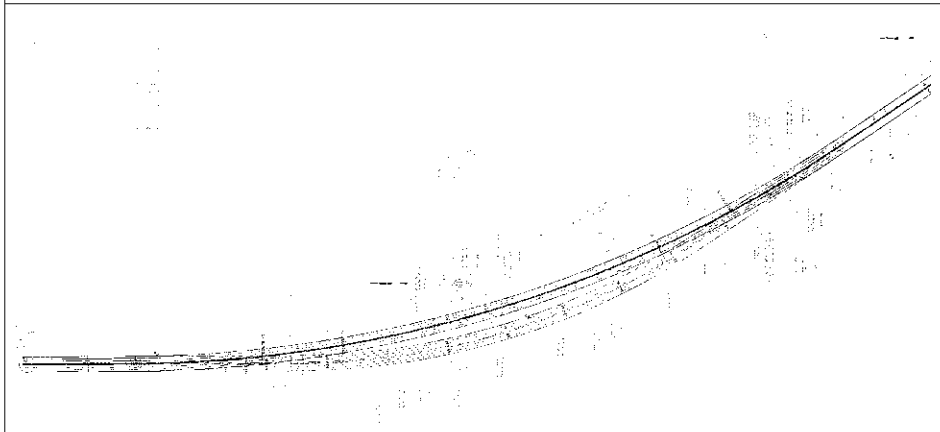


Widening for Curve D9, in the vicinity of Thuong Tin Interchange

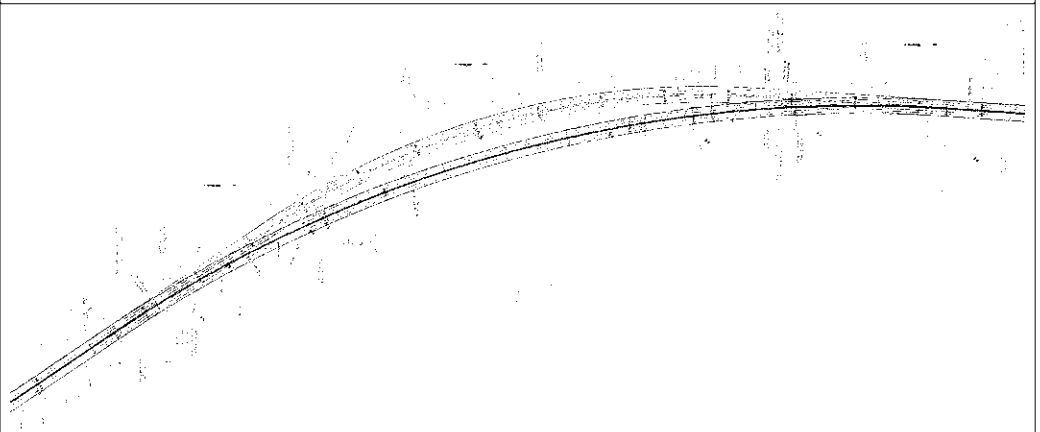


Attachment-4 Horizontal Alignment Improvement—Re-alignment

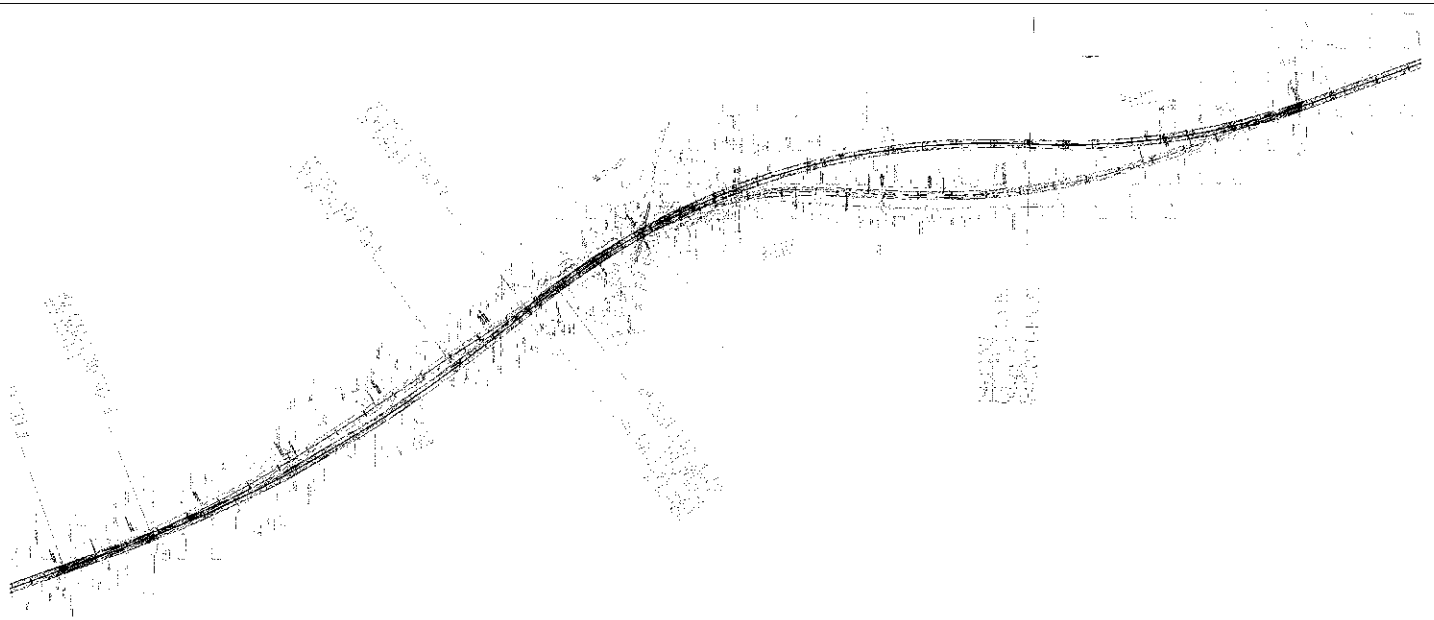
Re-alignment for Curve D1



Re-alignment for Curve D2



Re-alignment for D9, in the vicinity of Thuong Tin Interchange



Study on Vertical Alignment

The purpose of previous study of Vertical alignment (Longitudinal Profile) included in Explanatory Note-No.1 (EN-No.1) was to minimize the thickness of overlay, i.e. Volume of overlay. As a result, Min. Slope Length in our plan was 140m.

On the other hand, requirement for Min. Slope Length at V_{design}=100km/h in TCVN5729:1997 "Freeway/Expressway Specification for Design" is 250m. By complying with this requirement, the thickness of overlay, as shown in VEC F/S, becomes larger than that of our plan.

This study is conducted again based on our proposal for relaxation of the requirement that Min. Slope Length is reduced from 250m to 200m, included in our report submitted for MOT on 27 May 2011.

In order to avoid significant change in the overlay thickness included in our EN-No.1, a review of Min. Slope Length is conducted and confirmed that Min. Slope Length=200m can be accommodated. A case for Min. Slope Length 250m is not reviewed because it was carried out in VEC F/S Plan.

Difference in figures between this study and VEC F/S Plan on 5 sections (total 5.3km) is shown in Attachment 1. In comparison of the result, volume of overlay, i.e. volume of Leveling layer, for sections of 5.3km can be reduced to one-third of VEC F/S Plan. Corresponding cost saving is approx. 18 billion VND. In addition, it is possible to reduce the impact on consolidation settlements and the loads on the crossing structure, i.e. Box culverts.

i. For a comparison of Longitudinal Profile of whole sections of PV-CG Expressway, the attachment of Vertical alignment (Longitudinal Profile) included in EN-No.1 is updated. (Attachment 2)
ii. A comparison of the total cost for pavement is carried out. For V_{design} =120km/h, a case for Min Slope Length=200m saves approx. 50 billion VND compared to VEC F/S, in which Min Slope Length=250m is applied. (Attachment 3)
iii. Longitudinal Profile for above 5 sections is attached as reference (Attachment 4)

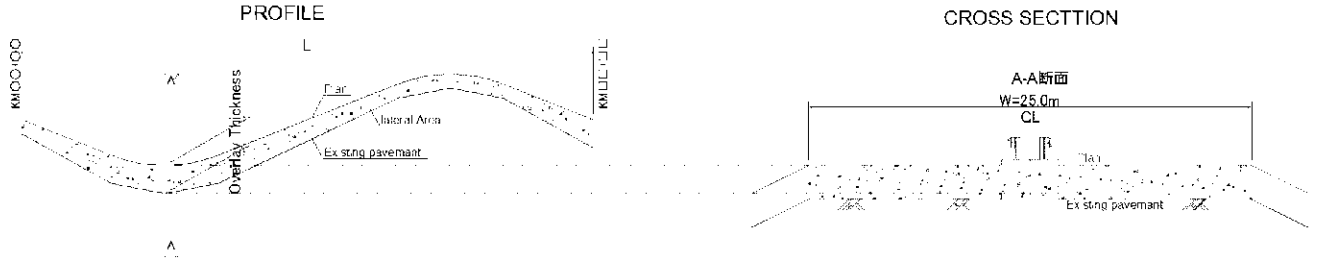
Attachment 4-1 shows the locations of the above 5 sections and sections where Min Slope Length is less than 250m.

Attachment 1

Comparison of result of Min. Slope Length

Section	Station	Length (m)	VEC F/S Min. Slope Length L=250m						ST ope Length L=200m						A-B *) (m)
			Lateral Area (m2)	Width of pavement (W)	Volume of overlay (m3) (A)	(P.H.)-(Height of Median Strip) (Lateral Area/Length) (m)	Height of Median Strip (m)	Thickness of overlay (m)	Lateral Area (m2)	Width of pavement (W)	Volume of overlay (m3) (B)	(P.H.)-(Height of Median Strip) (Lateral Area/Length) (m)	Height of Median Strip (m)	Thickness of overlay (m)	
1	187+150～189+356.37	2,206	1,318.53	26	34,282	0.600	0.20	0.800	378.65	26	9,845	0.172	0.20	0.372	
2	193+050～194+050	1,000	590.97	26	15,365	0.590	0.20	0.790	133.86	26	3,480	0.134	0.20	0.334	
3	195+825～196+850	1,025	715.15	26	18,594	0.700	0.20	0.900	259.09	26	6,736	0.253	0.20	0.453	
4	196+900～197+500	600	370.96	26	9,645	0.620	0.20	0.820	118.09	26	3,070	0.197	0.20	0.397	
5	202+500～203+000	500	378.10	26	9,831	0.760	0.20	0.960	106.57	26	2,771	0.213	0.20	0.413	
	Total	5,331	3,373.71	26	87,716	0.630	0.20	0.830	996.27	26	25,903	0.187	0.20	0.387	61,813

*A-B = difference of volume of overlay between VEC F/S plan and ST plan. It stands for deference of volume of Leveling layer.



Estimated cost saving

Item	Volume	Unit	
Volume of pavement	61,813	m3	
Unit price	286,000	VND/m3	Leveling layer Macadam Type I
amount cost saving	17,678,651,276	VND	
per meter	3,316,198	VND/m	
Length	5,331	m	
Width of pavement (W)	26	m	
Thickness of overlay	0.446	m	

*The price of aggregate type 1 is one-ninth of macadam type 1. Aggregate type 1 was recommended by VEC F/S.

Attachment 2

Comparison of Planned Height Alignment (longitudinal Profile)

A comparison of Planned Height(P.H.) was made between the plan included in the Interim Report of VEC F/S and two plans by JICA Study Team (ST). one is V_{design}=100km/h and the other is V_{design}=120km/h(Min. Slope Length L=200m)

Sections compared: from km182+300 to Km211+200, L=28.9km

Differences between P.H. and existing Ground Height(G.H.), included in the files received from TEDI through VEC in April 2011, are shown below.

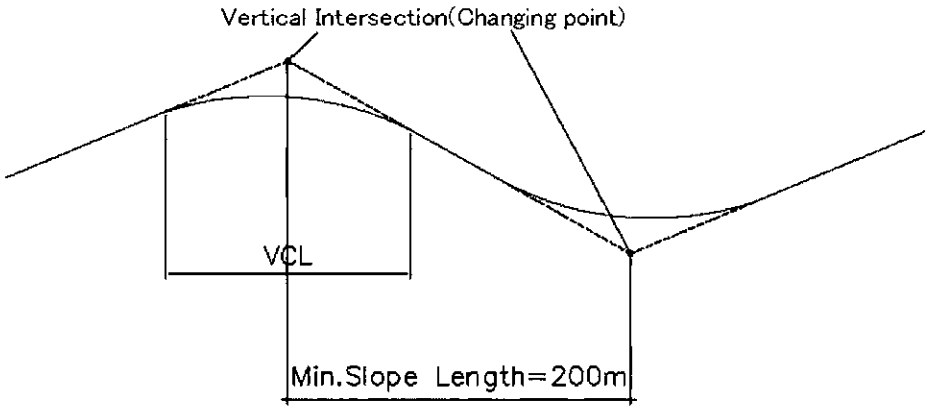


Table Difference between P.H. and G.H.,volume of overlay (Average of the Section)

	VEC Plan(A)	ST Plan (V_{design}=120km/h) Min. Slope Length L=200m(B)	ST Plan (V_{design}=100km/h)
Difference between P.H. and G.H	0.66m	0.44m	0.42m
Volume of overlay	498,663m3	331,344m3	313,195m3

※Volume of overlay is calculated as width of pavement is 26m

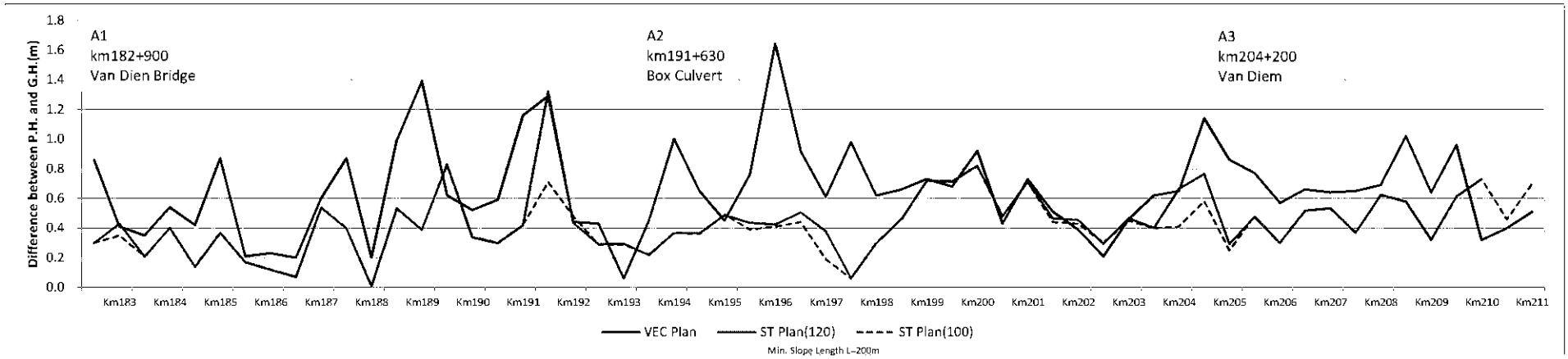


Table Difference between P.H. and G.H.

Appendix-11

Attachment 3
Comparison of the cost on each plan

It carrying out the comparison of the cost for each plan in which the vertical alignment were studied. The cost of pavement in VEC F/S confirms 543B VND.
As results of comparison, in case of Min. Slope Length of 200m on V_{design}=120km/h, the costs of pavement can be less than VEC F/S by 47B VND.
And in case of V_{design}=100km/h, the cost of pavement can be less than VEC F/S by 51B VND.
the rate of Cost reduction on V_{design}=120km/h and V_{design}=100km/h compare with VEC F/S is 8.7%, 9.5% respectively.

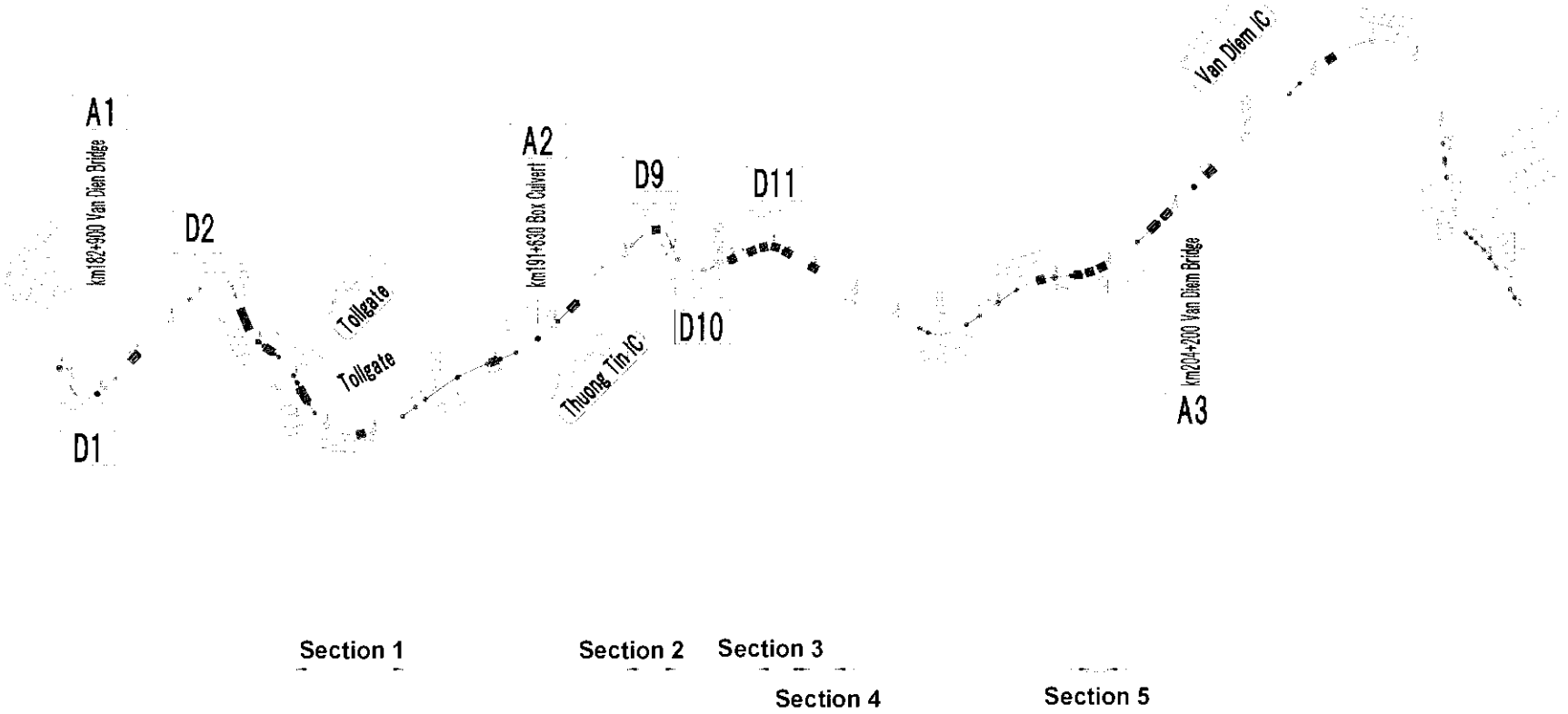
Calculation of height and Comparison of cost on Leveling layer

	VEC Plan	ST Plan(V_{design}=120km/h)	ST Plan(V_{design}=100km/h)
thickness of overlay (m)	0.66	0.44	0.42
Amount thickness of Asphalt	0.15	0.15	0.15
Leveling layer (n	0.51	0.29	0.27
Cost (VND)	543,190,239,000	495,912,151,000	491,614,143,000
Cost reduction (VND)	-	47,278,088,000	51,576,096,000
Rate of Cost reduction	-	8.7%	9.5%

SHDG	MHDM	PROJECT ITEMS	UNIT	Computation	QUANTITY	GENERAL APPLICATION RATES (VND)	INTO CASH (VND)
	VEC Plan(A)		**m**		28,900		**543,190,239,000**
TH- 7		Asphalt Concrete Roughness	m2	17.5m×28.9km	505,750	158,100	79,959,075,000
TH- 8		Asphalt Concrete Surface Course 5cm	m2	18.0m×28.9km	520,200	208,300	108,357,660,000
TH- 9		Asphalt Concrete Binder Course	m2	25.0m×28.9km	722,500	278,000	200,855,000,000
A48	AD.11222	Leveling layer Macadam Type I	m3	26.0m×0.51m×28.9km	383,214	286,000	109,599,204,000
A45	AD.24211	Tac Coat 0.6kg/m2	m2	17.5m×28.9km	505,750	16,000	8,092,000,000
A46	AD.24213	Tac Coat 1kg/m2	m2	18.0m×28.9km	520,200	24,000	12,484,800,000
A47	AD.24214	Prime coat 1.5 kg/m3	m2	25.0m×28.9km	722,500	33,000	23,842,500,000
	ST Plan(V=120km/h)(B)		**m**		28,900		**495,912,151,000**
TH- 7		Asphalt Concrete Roughness	m2	17.5m×28.9km	505,750	158,100	79,959,075,000
TH- 8		Asphalt Concrete Surface Course 5cm	m2	18.0m×28.9km	520,200	208,300	108,357,660,000
TH- 9		Asphalt Concrete Binder Course	m2	25.0m×28.9km	722,500	278,000	200,855,000,000
A48	AD.11222	Leveling layer Macadam Type I	m3	26.0m×0.29m×28.9km	217,906	286,000	62,321,116,000
A45	AD.24211	Tac Coat 0.6kg/m2	m2	17.5m×28.9km	505,750	16,000	8,092,000,000
A46	AD.24213	Tac Coat 1kg/m2	m2	18.0m×28.9km	520,200	24,000	12,484,800,000
A47	AD.24214	Prime coat 1.5 kg/m3	m2	25.0m×28.9km	722,500	33,000	23,842,500,000
	ST Plan(V=100km/h)(C)		**m**		28,900		**491,614,143,000**
TH- 7		Asphalt Concrete Roughness	m2	17.5m×28.9km	505,750	158,100	79,959,075,000
TH- 8		Asphalt Concrete Surface Course 5cm	m2	18.0m×28.9km	520,200	208,300	108,357,660,000
TH- 9		Asphalt Concrete Binder Course	m2	25.0m×28.9km	722,500	278,000	200,855,000,000
A48	AD.11222	Leveling layer Macadam Type I	m3	26.0m×0.27m×28.9km	202,878	286,000	58,023,108,000
A45	AD.24211	Tac Coat 0.6kg/m2	m2	17.5m×28.9km	505,750	16,000	8,092,000,000
A46	AD.24213	Tac Coat 1kg/m2	m2	18.0m×28.9km	520,200	24,000	12,484,800,000
A47	AD.24214	Prime coat 1.5 kg/m3	m2	25.0m×28.9km	722,500	33,000	23,842,500,000
(A)-(B)							47,278,088,000
(A)-(C)							51,576,096,000

Attachment 4-1

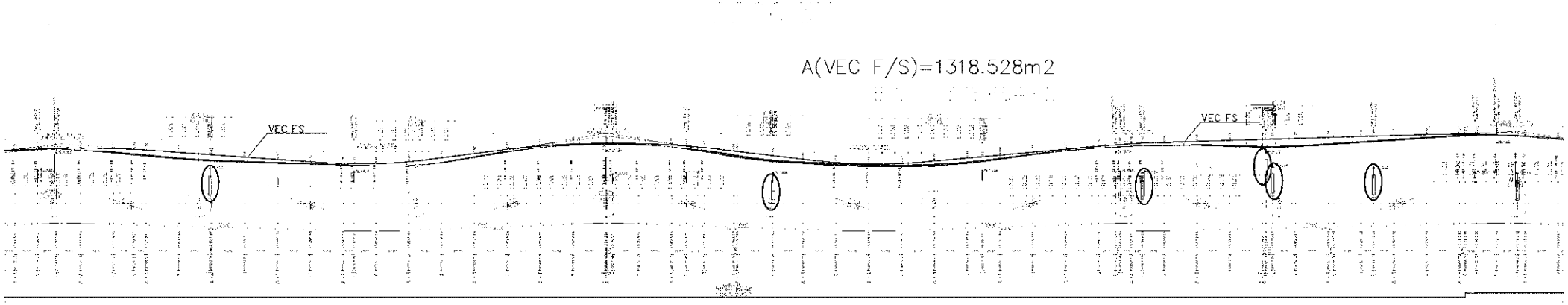
Deployment Status of Min.Slope Length L=200m of ST Plan



Station		Length
183+468	183+695	227
185+495	185+730	235
186+330	186+566	236
187+157	187+380	223
188+790	189+025	235
190+865	191+065	200
192+180	192+395	215
193+600	193+840	240
195+175	195+410	235
195+825	196+030	205
196+030	196+235	205
196+235	196+440	205
196+440	196+640	200
196+917	197+150	233
201+780	201+980	200
202+326	202+530	204
202+530	202+750	220
202+750	202+950	200
203+715	203+960	245
203+960	204+200	240
204+530	204+730	200
206+160	206+380	220

Attachment 4-2

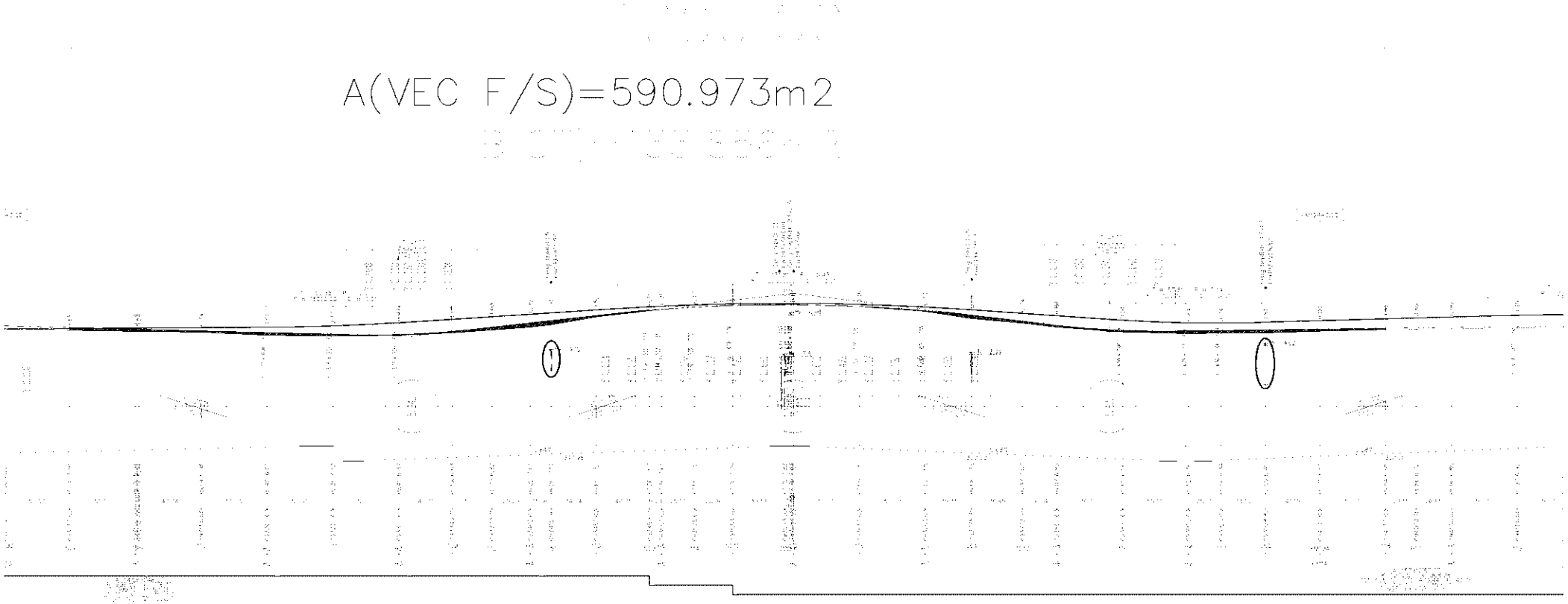
Section 1:KM187+150～KM189+356.37



Crossing structure which applied an increasing load on plan of VEC FS

Attachment 4-3

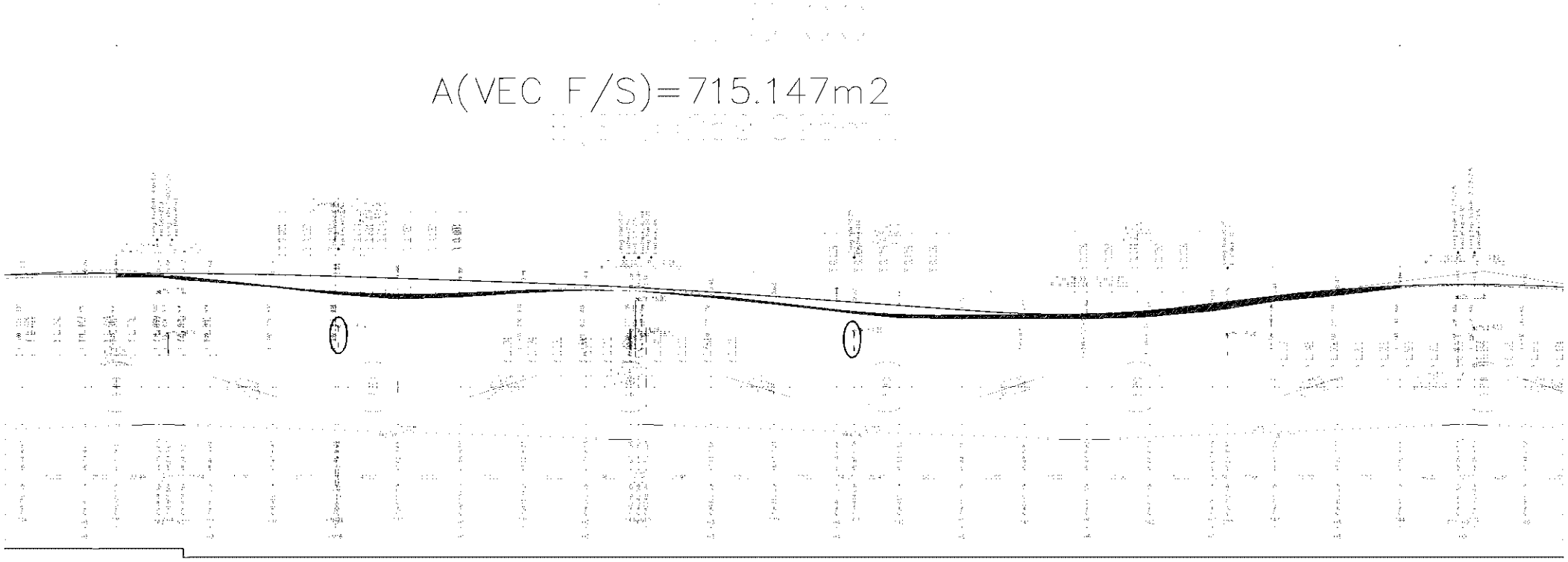
Section 2:KM193+050～KM194+050



○ Crossing structure which applied an increasing load on plan of VEC FS

Attachment 4-4

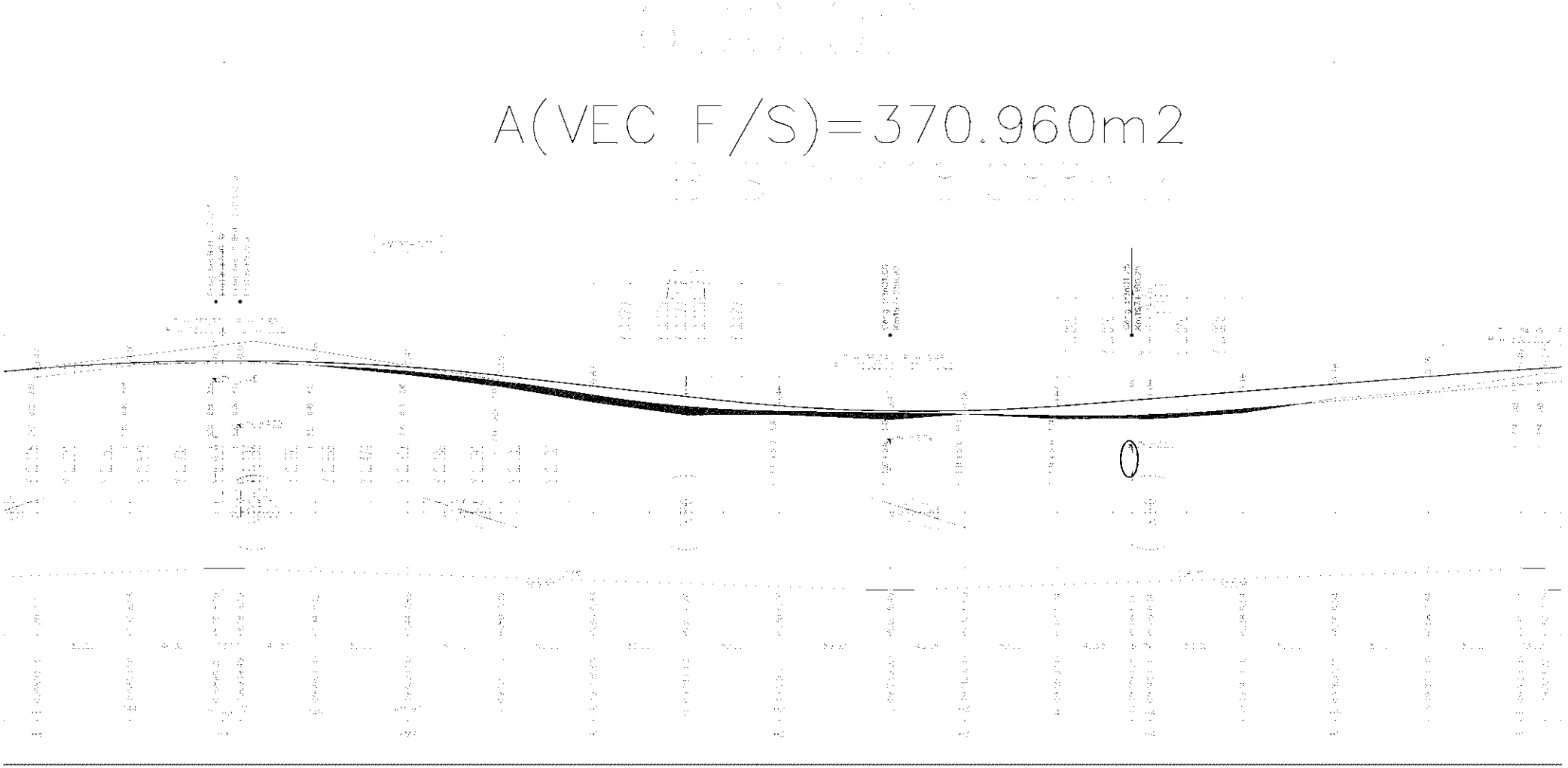
Section 3:KM195+825～KM196+850



Crossing structure which applied an increasing load on plan of VEC FS

Attachment 4-5

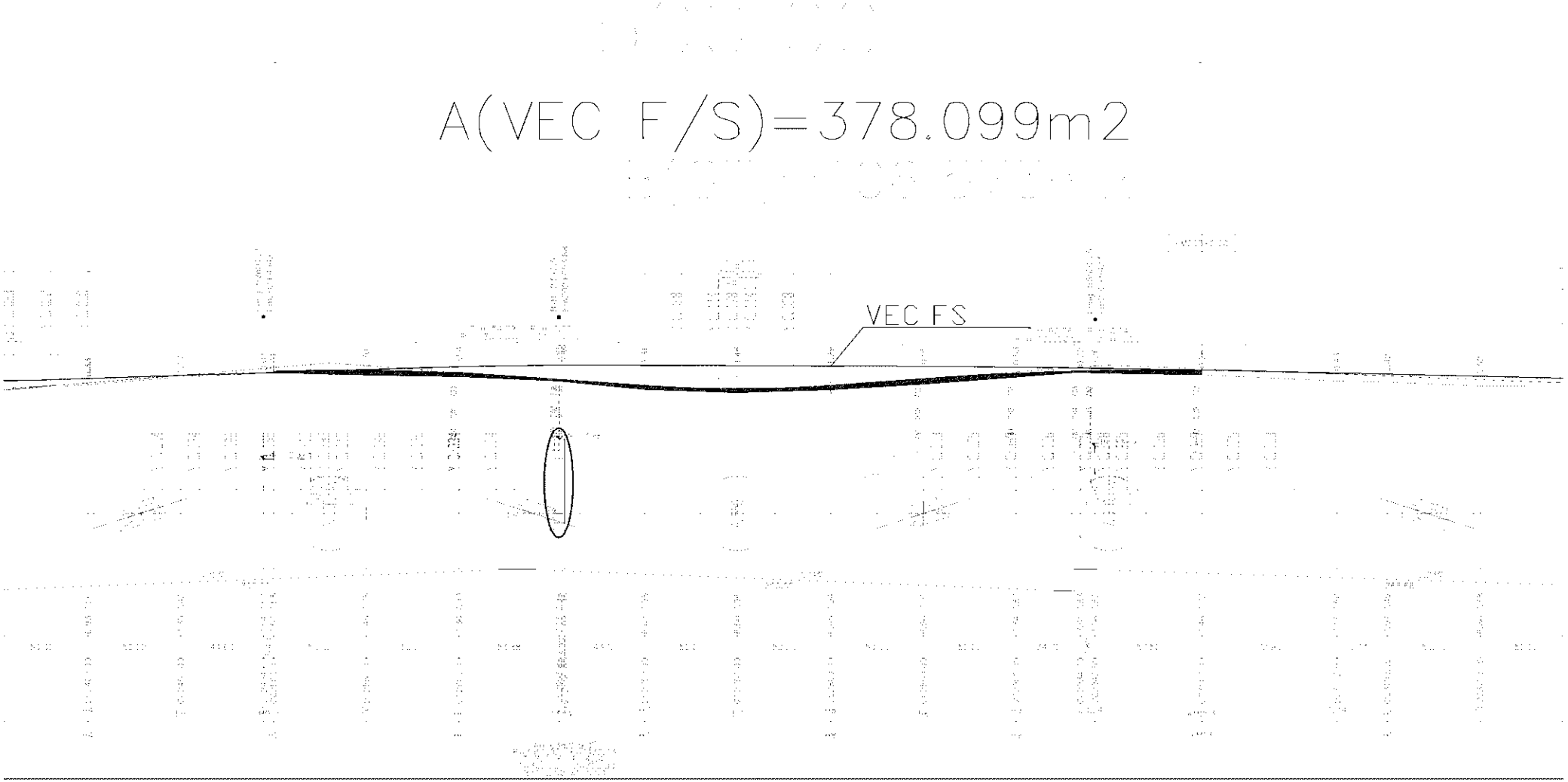
Section 4:KM196+900～KM197+500



Crossing structure which applied an increasing load on plan of VEC FS

Attachment 4-6

Section 5:KM202+500～KM203+000



Crossing structure which applied an increasing load on plan of VEC FS

Explanatory Note-No.3: JUNE 2011

Study on specification of frontage road

1. Features of surrounding existing roads

There are several roads in the same direction in the vicinity of the designated Phap Van-Cau Gie expressway as shown in Figure 1-1. Features and functions of these roads are shown in the following Table 1-1.

Table 1-1 Feature and function of roads in surrounding areas

Road name	Grade	Number of lanes	Function	
			Service for Through traffic	Provision of access to the residence
PhapVan-Cau Gie	Expressway	6	◎	×
Old NR1	III	2-4	○	△
NR21B	IV	2	○	△
NR39	III-V	2	○	△
Hanoi City Road	III	4	○	○
PR1	III-V	2	△	◎
PR2	III-V	2	△	◎
Frontage Road	Under study	Under study	×	◎

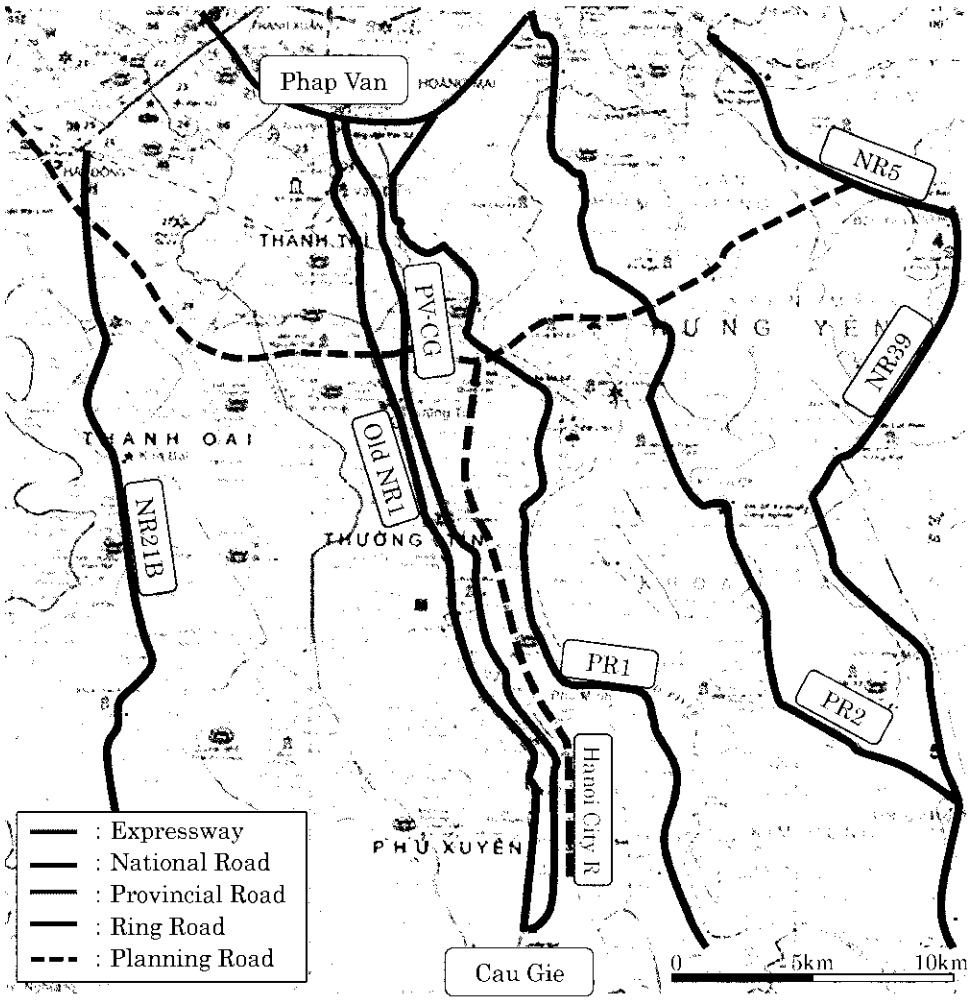


Figure1-1 Roads in surrounding areas

2. Traffic demand on the frontage road

According to the VEC F/S Interim Report, traffic volume on the frontage road in 2030 is estimated at 7,102(PCU/day) as shown in Table 2-1. With assumption of 0.13 for the peak ratio, peak hour traffic volume is estimated at 923(PCU/hour). Although any information of the traffic volume on every road in the surrounding areas is not presented in the VEC F/S Interim Report, it is possibly considered that the estimated traffic volume on the frontage road can be distributed to these roads and consequently, practical traffic volume on the frontage road becomes lesser than so estimated.

Table 2-1 Summary of traffic demand on the frontage road

Unit: car conversion/day night

Type of vehicle	Cau Gie – Thuong Tin			Thuong Tin – Phap Van		
	2015	2020	2030	2015	2020	2030
Car	1,047	1,630	3,114	1,047	1,722	3,001
Small Bus	217	260	430	217	258	387
Large Bus	367	479	713	367	465	622
Small Truck	1,412	2,108	2,672	1,374	2,309	2,677
Large Truck	170	179	173	141	39	41
Total	3,213	4656	7,102	3,146	4,793	6,728
Motorcycle	4,917	5,904	7,243	3,235	3,885	4,766

These data are excerpted from VEC F/S Interim Report.

3. Suitable features for frontage road

According to TVCN4054-2005 Highway - Specifications for Design, a main function of the frontage road is to improve the convenience of the roadside residence by providing them with the minimum access to the nearby trunk roads. The function of the frontage road need to be focused more on the convenience for the residence than the through traffic itself. Taking the convenience and safety of the residence into account, the frontage road for light traffic demands with lower travelling speed satisfies the requirement practicably. As described in the preceding paragraph, it is assumed that even without the frontage roads, the existing roads in the surrounding areas are considered capable to accomodate the estimated traffic volume in 2030. Therefore, the lower road grade of VI is recommended, which does not need a function for the through traffic but for the convenience of the residence in their daily movement. A comparison of ordinary frontage roads in Japan, Grade VI frontage road and frontage roads of Cau Gie-Ninh Binh expressway in Vietnam is presented in the following Table 3-1.

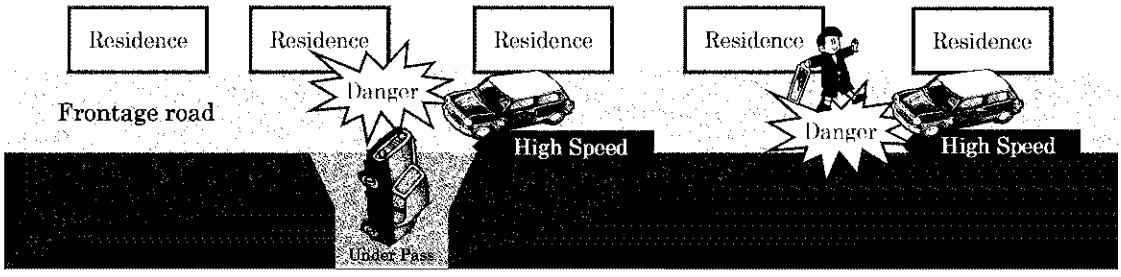


Figure3-1 Image of the frontage road in residential areas

Table 3-1 Standard of frontage road

	Japanese frontage road[1)]	**GradeⅥ**	**Frontage road of Cau Gie–Ninh Binh expressway**
Road Grade	Grade III ClassV	VI	VI
Design Speed	30km/h	30km/h	30km/h
Number of lanes	1	1	1
Width of lane	3.0m~4.0m	3.5m	3.5m
Width of shoulder	0.5m	1.5m	1.0m

1) Road Structure Ordinance (Japan)

4. Design policy

As stated above, the grade VI is adopted for the frontage road in the designated section as shown in Table 4-1 bellow. This grade has similar standards to the frontage roads of Cau Gie–Ninh Binh expressway and provides the uniformity of standard and profiles for frontage roads in the continuous expressway networks across the country. Cross-sectional elements of frontage road of Cau Gie–Ninh Binh expressway, which are pavement width of 3.5m, shoulder width of 1.0m and a total width of 5.5m, are applied to the designated section as well as shown in Figure 4-1. In designing, the passing places (bays) on the frontage road are considered to be placed for smooth and safe traffic.

The frontage roads at the Van Dien Bridge are considered not necessary for the local residence and traffic. Installation of two (2) frontage bridges at the both sides may induce significant traffic congestion around the area and result in negative effect to the roadside residence. However, installing a frontage road bridge only on one side is still considered necessary in terms of the continuation of frontage roads with similar profiles in the expressway networks over the country. This bridge needs to be built at the west side of the existing bridge taking into account of convenience for significant number of the residence in the areas.

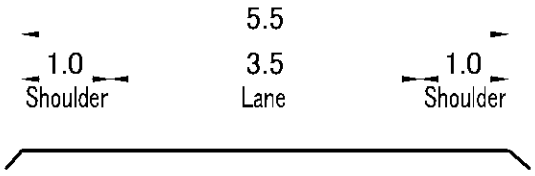


Figure4-1 Cross section of the frontage road

Table 4-1 Length of the frontage road

	Right(West side)	**Left(East side)**	**Total**
Starting Point	km182+800	km182+950	—
Ending Point	km211+300	km206+600	—
Length	28,500m	23.650m	52.150m

5. Cost

A comparison of the construction cost will be made and submitted after details of Basic Design for Frontage Roads, to be submitted to VEC by TEDI at the end of JUNE 2011, are received by JICA Study Team. Difference in width of Frontage Roads will generate the savings in construction costs and land acquisition (recovery) costs.

Quoted from *TVCN4054:2005 Highway - Specifications for Design*

3.1.3 In principles, high- class highways (of category I, II and III) shall not be planned running through urban centers. When designing, following considerations should be made:

- connection between the road with the urban area especially large urban area
- method for separation of the local traffic, particular from high- class highway in order to ensure mobility of the traffic.

The highway shall ensure two functions, these are:

- mobility presenting by high speed, cut-down of travel time and safety during traveling
- accessibility i.e. vehicle can reach the destination favorably.

These two functions are incompatible. Therefore, it's necessary to limit accessibility of the high-level highway with high traffic volume and long distance in order to ensure mobility; **in contrast for the low-level highway (of category IV, V, VI) the accessibility shall be ensured.**

For the high- level highway, it's necessary to ensure:

- separation of the local traffic from the through traffic on the high-level highway.
- detour residential area, but taking into consideration of the connection with the urban area especially large urban area requiring radial traffic

3.4.2 Technical classification is based on function and design traffic volume of the highway in the network and stipulated in the Table 3

Table 3 – Highway Technical Classification according to function and design traffic volume

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

4.6 Frontage road

4.6.1 Frontage road is the auxiliary road arranged along both sides of the road class I and II, has following functions:

- To prevent traffic (motorized, non-motorized vehicles and pedestrians) from accessing freely the road class I and II;
- **To meet the traveling demand of the cited vehicles in local scope (local traffic)** in one-way or two- way (in the scope between the permitted accesses to the road class I and II)

4.6.2 **On the road class I and II, frontage road shall be arranged on the sections having significant local traffic such as sections through residential areas, industrial zones, tourism landscape, forestry and agricultural farm etc.** When it's impossible to arrange frontage road (in staged construction, or having difficulties etc.) provisions in Article 4.6.6 shall be applied.
Determination of above-mentioned local traffic demand is required surveying, forecasting by socio-cultural- economic development plan for each section to be arranged frontage road.

4.6.3 Frontage road shall be arranged separately from the main roadway of the road class I and II. Length of each frontage road (i.e. interval between permitted accesses to the road class I and II) is equal or larger than 5 km. Frontage roads can be arranged at both sides of the main line and it can be one-way or two-way road each side (**in order to facilitate the local traffic**). If there are frontage roads at both sides of the main line, it's possible to organize traffic from frontage roads by grade-separated underpass or overpass structures (do not cross the main line) at the locations of the permitted accesses to the main line only when it's really necessary.

4.6.4 Frontage road can be arranged right at the right-of-way of the main road class I and II. In this case the ROW shall be in compliance with the existing regulations taking account of the boundary of the edge side structure of the frontage road.

4.6.5 Frontage road is designed by category V and VI (for flat or rolling terrain) but its roadbed width can be reduced minimally to 6.0m (if two-way frontage road) and 4.5m (if one-way frontage road). Cross-sectional arrangement of the frontage road shall be selected by Design consultant depending on the actual requirements.

4.6.6 As for sections without frontage road, on the road class I and II it's necessary to arrange bicycle and non-motorized vehicles lane on the stabilized part which is separated by guardrail with height of at least 0.80m from the road surface.

-End-

Study of Interchange for 6-lane wideing

In the report which was submitted to MOT on 27 May 2011, the following design options for upgrading 4-lane highway to the expressway were proposed.

A) Installation of speed change lanes and improvement of the rampway alignment for 4-lane carriageway at V_{design}=100km/h for the Thuong Tin IC.

B) Installation of speed change lanes for the Van Diem IC (R429)

Above two improvements of IC are not considered in the upgrading of the 4-lane highway to the expressway, because necessary improvement is facilitated for the stage of the 6-lane widening

For the 6-lane widening planned in the future, optional designs for the profiles of the Phap Van IC, Thuong Tin IC and Van Diem IC are presented as follows for reference.

1. Thuong Tin IC

The plans at V_{design}=100km/h including speed change lanes for the 6-lane carriageway and toll gates are prepared in consideration of;

A) Horizontal alignment with R=995m of the existing highway seems to be designed applying a relaxation of the requirement of Table 7 in TCVN5729:1997 "Technical standerd for freeway / expressway at the connecting elevated interchange".

B) Speed change lanes are not provided currently.

2. Van Diem IC

The plans at V_{design}=100km/h and 120km/h are prepared respectively for the 6-lane carriageway.

Corresponding attachments (for 6-lane widening)

	ThuongTin IC	VanDiem IC
Option 1	Attachment 1 V_{design}=100km/h Using existing alignment	Attachment 3 V_{design}=100km/h
Option 2	Attachment 2 V_{design}=100km/h Considering alignment of Toll Gate	Attachment 4 V_{design}=120km/h
Remark	・Confirmation on current status of ROW (right of way) is required	* By installing a retaining wall, Land Acquisition is not required. *In order to operate the expressway with V_{design}=120km/h will be installed, improvement of the vertical alignment of the carriageway and reinforcement to the Van Diem Bridge are required.

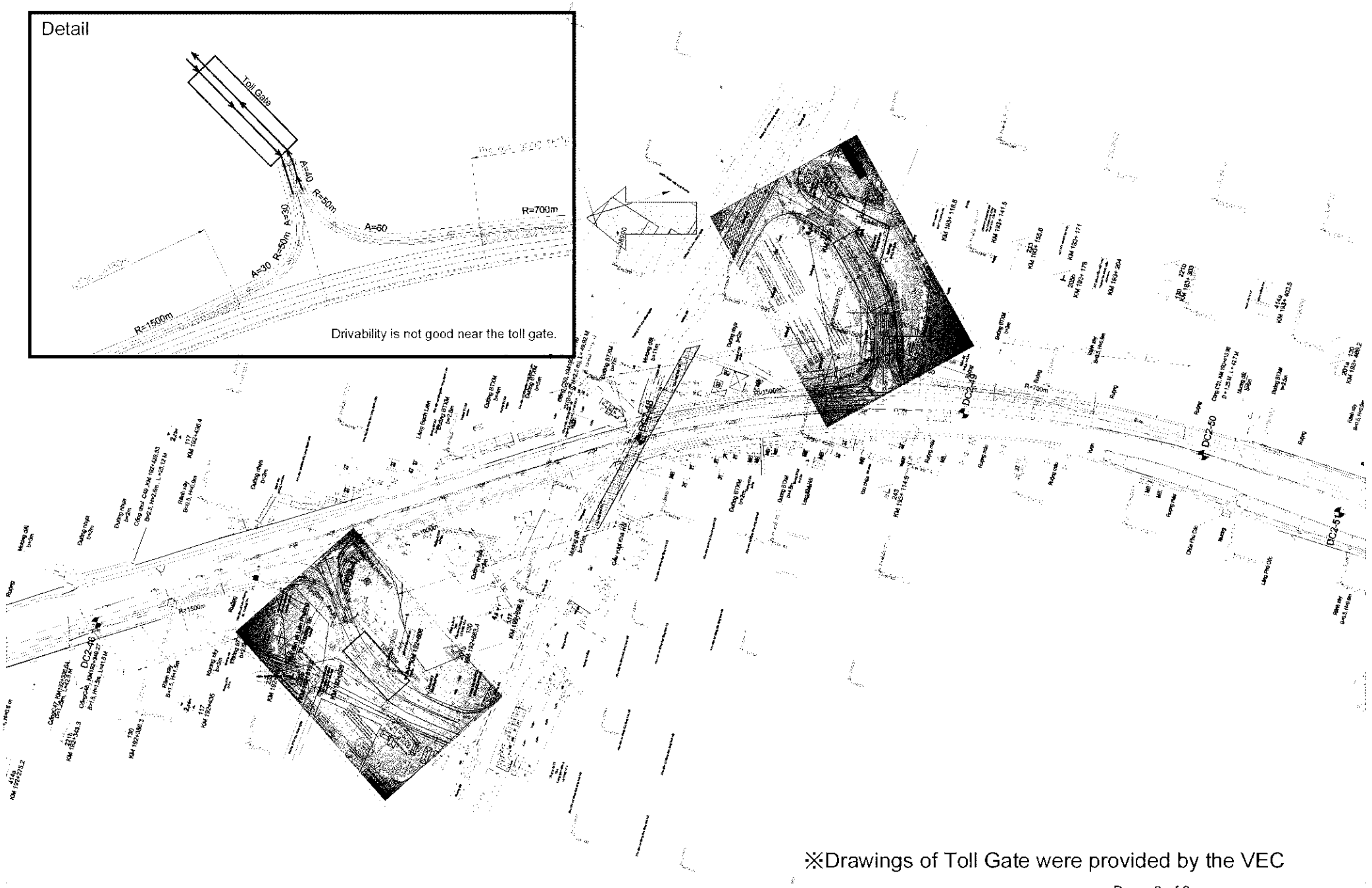
3. Phap Van IC

The toll gates are not necessary because a toll gate will be installed on the Main Line at Km188+300 . Therefore, a plan in the VEC F/S is recommended for the 4-lane carriageway. A plan for the 6-lane carriageway describing the merging traffic of a 2-lane ramp way of the Ring Road No.3 and 1-lane from other roads with the PVCG Expressway is proposed

Corresponding attachments Phap Van IC

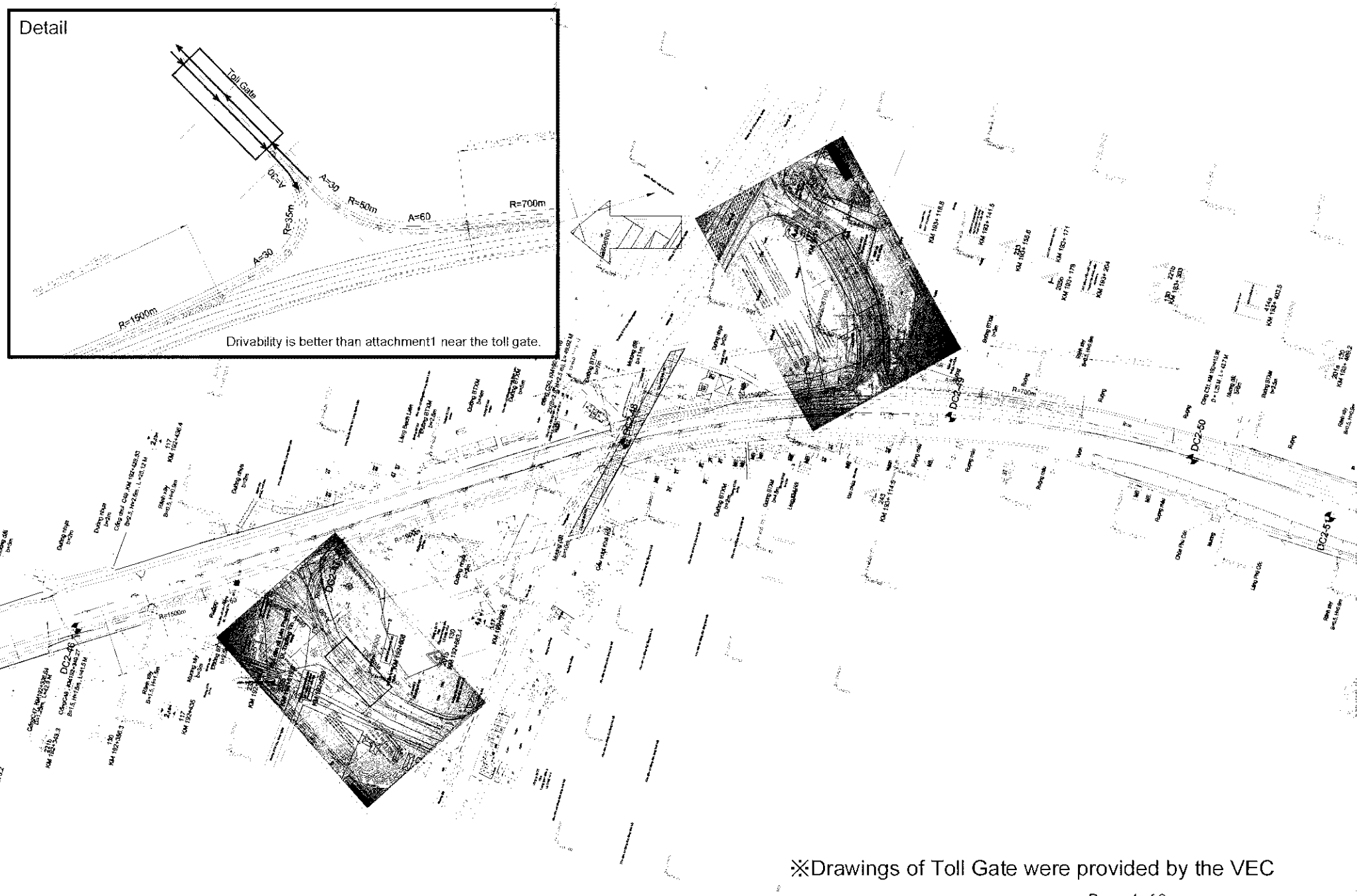
No. of Lane	Number of Attachment	Design Speed	Remark
4-lane	Attachment 5	V_{design}=100km/h	VEC F/S
6-lane	Attachment 6	V_{design}=100km/h	2-lane Rump of Ring Road No.3+ 1lane of other Road = 3 lanes. 3 lanes×2 directions=6 lanes

Attachment 1 Thuong Tin IC V=100km/h Using existing alignment



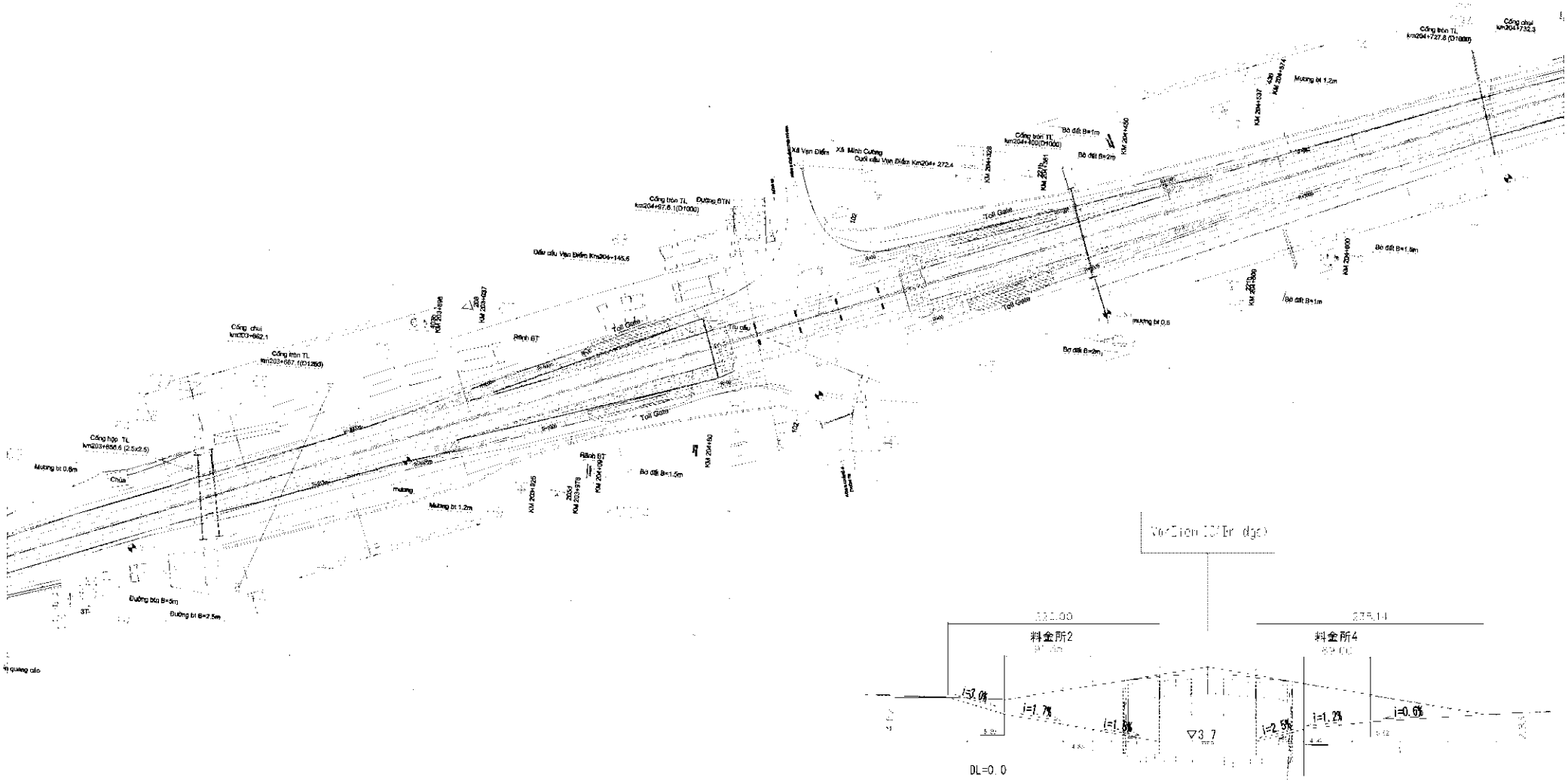
※Drawings of Toll Gate were provided by the VEC

Attachment 2 Thuong Tin IC V=100km/h Considering alignment of Toll Gate

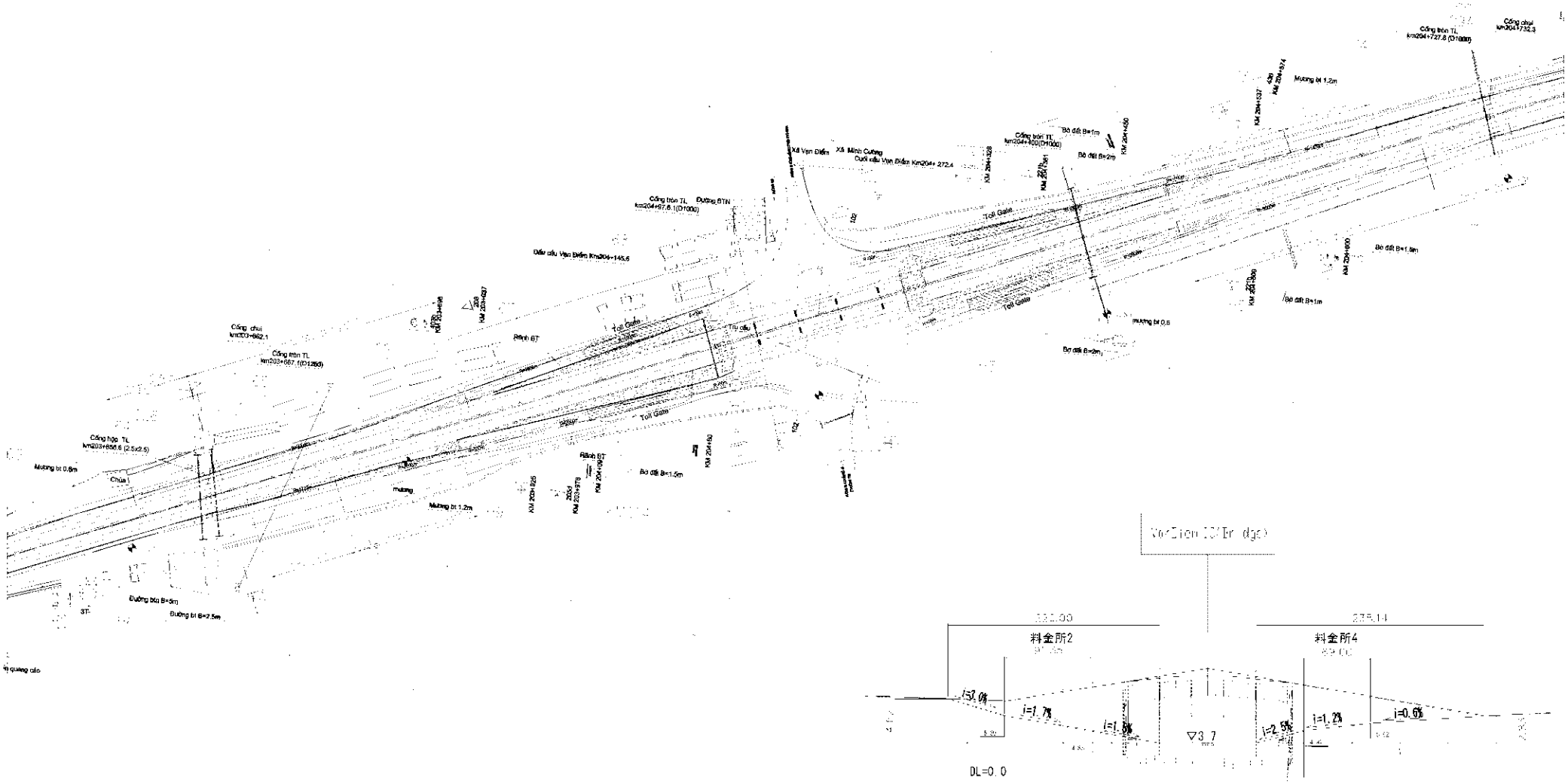


※Drawings of Toll Gate were provided by the VEC

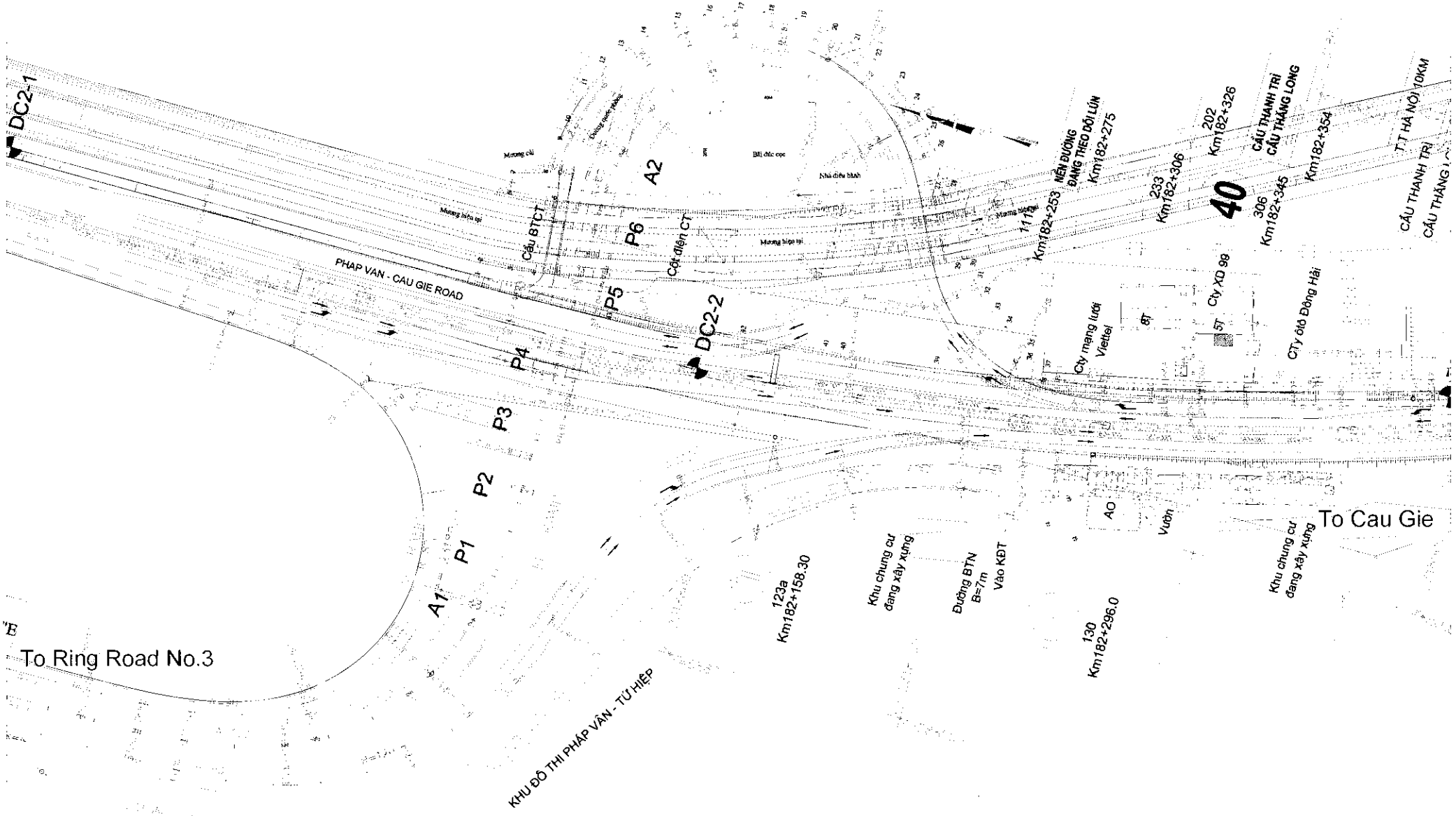
Attachment 3 Van Diem IC V=100km/h



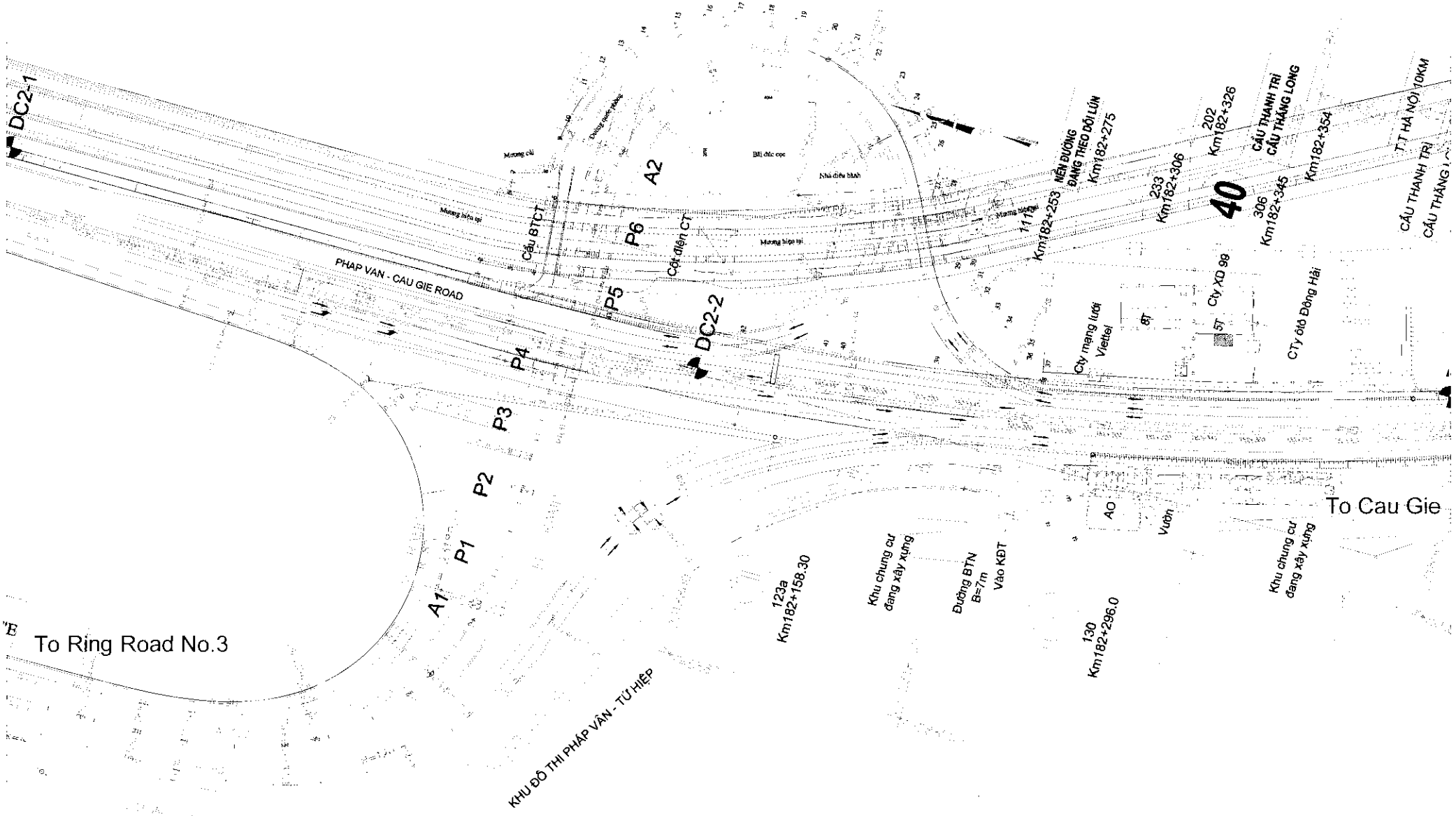
Attachment 4 Van Diem IC V=120km/h



Attachment 5 PhapVan IC 4-lane carrigeway



Attachment 6 PhapVan IC 6-lane carrigeway



Appendix-33

Study on Median Strip and Safety Barrier

1. Subject of Study

In order to upgrade the existing highway to the expressway, pavement needs to be strengthened by carrying out overlay with thickness not less than 30cm, as shown in Fig.1 below. In this regard, median strip and safety barrier (guard facility) are required to be re-constructed. Because specification applied to median strip and safety barrier is changed to TCVN: 1997 Specification for Expressway in Vietnam, design of median strip and safety barrier should be reviewed considering design speed of the expressway, where V_{design}=120km will be applied in general. The following conditions and items are taken into account for selection of the width of median strip and type of safety barriers.

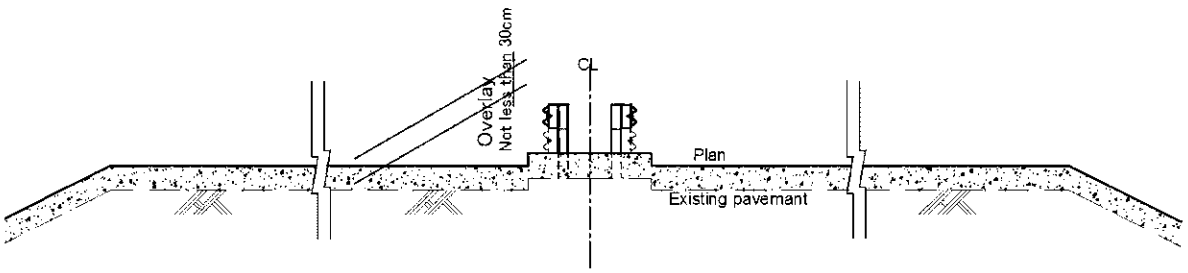


Fig.1 Concept of Overlay

2. Condition of Study

TCVN5729:1997 Specification for Expressway in Vietnam specifies the width of median separator and safety strip as shown in Table 1 corresponding to its design speed, i.e. V_{design}=100km/h and = V_{design} 120km/h.

Table-1 Width of median separator and safety strip

	V_{design}=100km/h	V_{design} 120km/h
Width of Safety strip:	not less than 0.75m	not less than 0.75m
Width of Median separator:	not less than 1.0m	not less than 1.0m

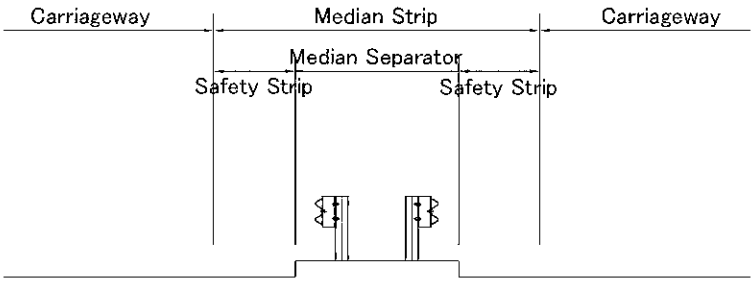


Fig. 2 Definition of terms

(1) Selection criteria with regards to Median strip

* Required area for median strip is minimized as practically as possible.

(2) Comparison criteria with regards to Safety barriers in Attachment 3

* Safety
* Maintenance sufficiency
* Procurement of products
* Cost

3. Result of Study

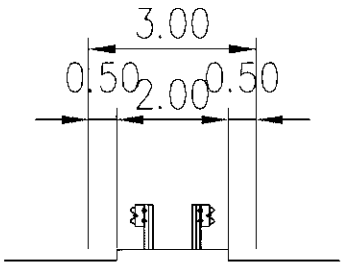
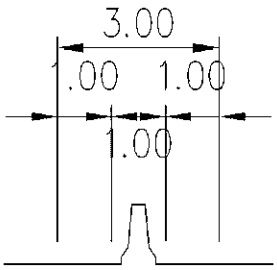
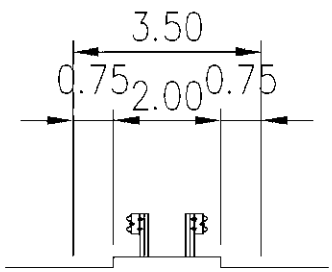
Our proposal is shown in Table-2 below. The widths of median strip are minimized in consideration of the following aspects.

(1) For upgrading of the existing highway to 4 lanes expressway, the total width of the road will not be changed to avoid an additional land acquisition.

(2) The width of safety strip of 1.0m in the Cau Gie-Ninh Binh expressway is to be applied in general to keep continuity of expressway.

In addition, the rigid type concrete safety barrier is proposed.

Table-2 proposed Profile

Existing profile (Typical section, Pier section)	Proposed profile : 4 lane Carriageway・6 lane Carriageway	
	Typical section (Approx. 28.4km)	Pier section (Approx. 0.3km)
		

For the study and comparison for median strip and safety barriers, the following attachment is to be referred to.

List of Attachment

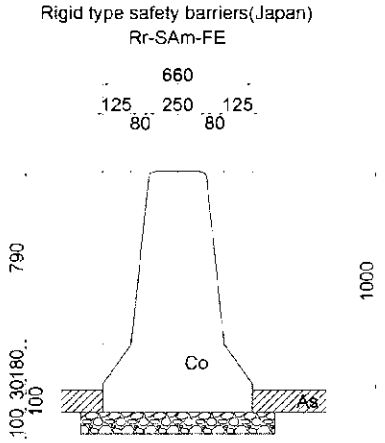
Item of Study	Number of Attachment	Remark
Example of installation of the rigid type concrete safety barrier Typical of sizes and shapes of the rigid type safety barrier (In Japan)	Attachement1	
Width of Median Strip	Attachement2	
Comparison of Safety Barriers	Attachement3	
Comparison on Element of Median Strip	Attachement4	

Attachment 1

Actual implementation of the rigid type safety barrier

HCM Expressway（Ho Chi Minh - Trung Luong section）

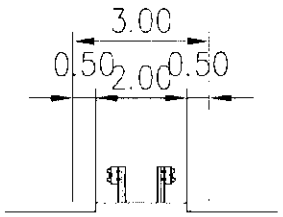
Typical of sizes and shapes of the rigid type safety barrier (In Japan)

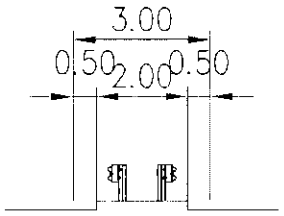
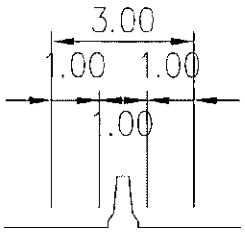
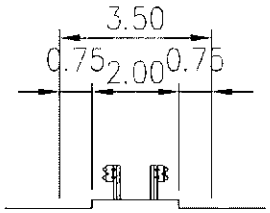
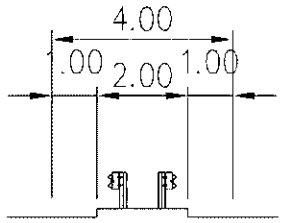
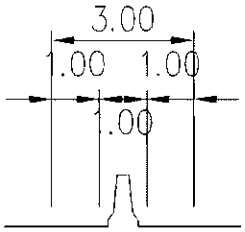
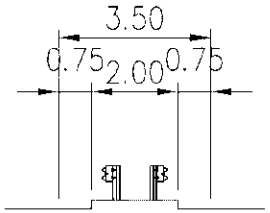


Attachment2

Width of Median Strip

Attachment 8.0 in the report of JICA study team(ST) submitted on 27 May 2011,with amendment as an Explanation Note-No.5 in June 2011

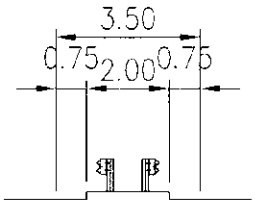
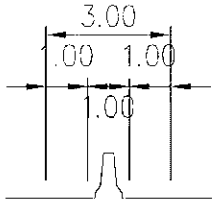
	Category of Road	Sectional profile	120km/h	100km/h	80km/h
Existing	National Road		Standard for National Road ○	Standard for National Road ○	○

	Category of Road	VEC-FS				ST Proposal				Remarks
		Sectional profile	120km/h	100km/h	80km/h	Sectional profile		120km/h	100km/h	80km/h	
4 lane Carriage way	Expressway	 *1)	×	×	○	Typical section  *2)	Interchange/Pier section  *3)	○ Not less than R=2100m	○	○	On bridge section, width of safety strip remains at 0.75m with shoulder width reduced by 0.25m
6 lane Carriage way (Future)	Expressway		○	○	○	Typical /Interchange section  *2)	Pier section  *3)	○ Not less than R=2100m	○	○	

*1) While PVCG is 4 lane carriageway with V=100km/h, it is operated provisionally with width of median strip indicated.
*2) In case of installing Kilo meter post/Street light, Kilo meter post/Street light are placed on both sides.(For example, refer to attachment1)
*3) Typical and particular section are to be connected smoothly.

Attachment 3

Comparison of Safety Barriers

Item	Guard Rails×2	Rating	Rigid type Barriers	Rating	Remarks
Profile					
Safety Features	* Non-rigid type to absorb impact * Performance for preventing vehicle's deviation, for passenger's safety, for safety direction to vehicles and for antiscattering assembled parts	○	* Rigid barrier against impact * Performance for preventing vehicle's deviation, for passenger's safety, for safety direction to vehicles and for antiscattering assembled parts	◎	
Durability	Fair durability	△	Excellent durability	○	
Estimated Cost (per M)	US$55 (Cost for new installation)	△	US$34	○	Unit cost of Guard Rail 546,683VND/m Concre, Height=0.85m 552,585VND/m(0.254m3) Including footing 683,116VND/m(0.314m3)
Maintenance	* Replacement required for damaged area. * Maintenance necessary for planting and trees. * Unsafe work at the middle of median strip when pruning.	△	* Maintenance free.	○	
Procurement of Materials	* Imported materials	△	* Locally procured materials (Reinforced concrete)	○	
Road Width and Sight Distance	Compared with Rigid type Barriers, * Wider median strips and width of the road by 0.5m for 4-lane carriageway and by 1.0m for 6-lane carriageway respectively. * Wider width of the road for sight distance by 0.25m.	△	Compared with Guard Rails, * Narrower median strips and width of the road by 0.5m for 4-lane carriageway and by 1.0m for 6-lane carriageway respectively. * Narrower width of the road for sight distance by 0.25m.	○	
Others	・Area available for street light installation.	○	* Area for street light not available but only beside road shoulder. * Interlocked barriers in 50m length sufficient against impact. * Allowable bearing capacity of the ground needs not more than 150kN/m2.	○	
Comprehensive Evaluation	△		○		

Attachment4

Comparison on Elements of Median Strip

With rigid type safety barriers, median strips and width of the road are reduced by 0.5m for 4-lane carriageway and by 1.0m for 6-lane carriageway respectively.

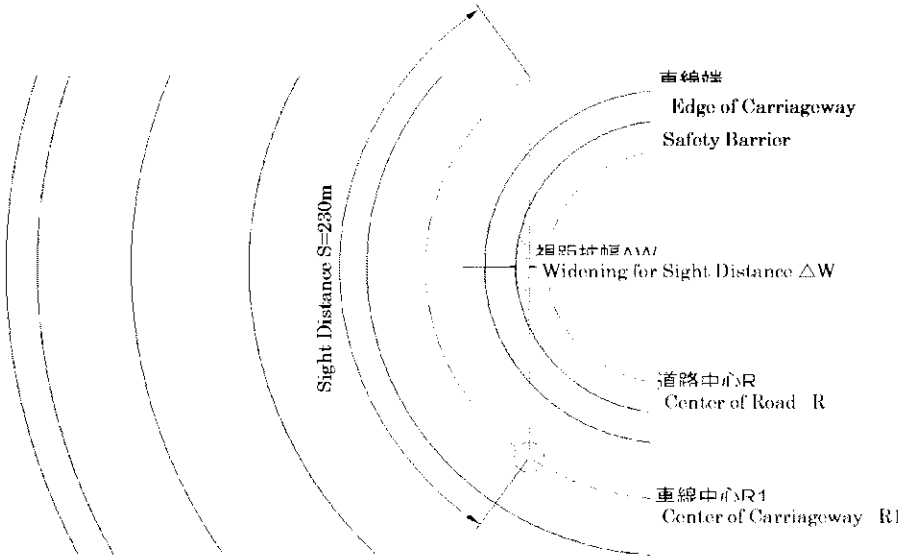
(1) Width

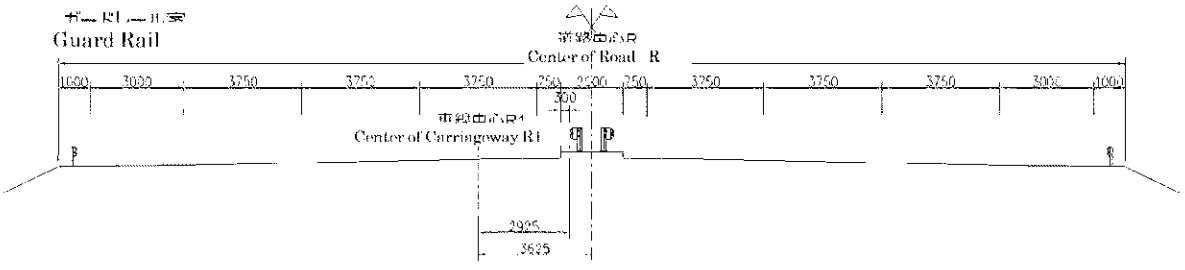
		4-lane carriageway					6-lane carriageway				
		Median strip (m)				Total width of road (m)	Median strip (m)				Total width of road (m)
		Safety strip	Median separator	Safety strip	Total		Safety strip	Median separator	Safety strip	Total	
A	Guard rails	0.75	2.00	0.75	3.50	25.50	1.00	2.00	1.00	4.00	34.50
B	Rigid type safety barrier	1.00	1.00	1.00	3.00	25.00	1.00	1.00	1.00	3.00	33.50
	Difference(A-B)	-0.25	1.00	-0.25	0.50	0.50	0.00	1.00	0.00	1.00	1.00

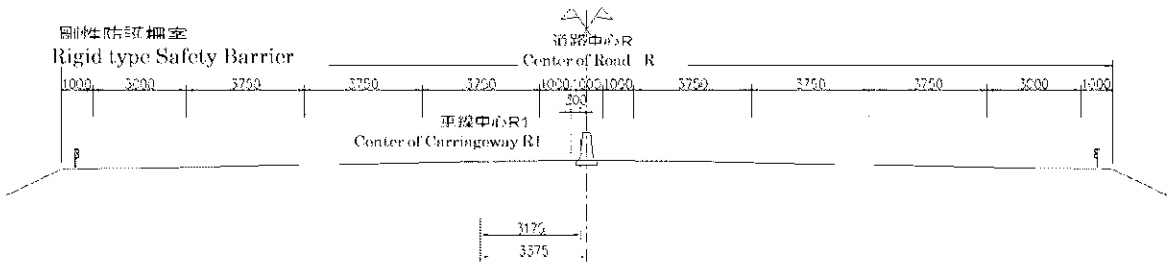
(2) Sight Distance

$$R1 = \frac{S^2}{8W} \qquad W = \frac{S^2}{8R1}$$

Center line radius R(m)	Standard inner width Y(m)	Curve radius at center line of carriageway R1(m)	Sight distance S(m)	Width necessary for sight distance W(m)	Widening for sight distance ΔW(m)	Deference in comparison with guard rail (m)		Length of Widening L (incl. transition) (m)	Area required L×ΔW/2 (m2)	Deference in comparison with guard rail (m2)
Guard rails										
D1 1193	2.925	1195.925	230	5.529	2.604			830	1080.66	
D2 1205	2.925	1207.925	230	5.474	2.549			925	1178.91	
D9 995	2.925	997.925	230	6.626	3.701			776	1435.99	
D1(1970	2.925	1972.925	230	3.352	0.427			968	206.668	
D1' 1900	2.925	1902.925	230	3.475	0.55			619	170.225	
Rigid type safety barrier										
D1 1193	3.175	1196.175	230	5.528	2.353	-0.251		830	976.495	-104.165
D2 1205	3.175	1208.175	230	5.473	2.298	-0.251		925	1062.83	-116.088
D9 995	3.175	998.175	230	6.625	3.45	-0.251		776	1338.6	-97.388
D1(1970	3.175	1973.175	230	3.351	0.176	-0.251		968	85.184	-121.484
D1' 1900	3.175	1903.175	230	3.474	0.299	-0.251		619	92.541	-77.684
										-516.809







Appendix6

Box Culvert for Road

No.	Station	**Width (m)**	**Height (m)**	Angle (°)
1	km183+496.88	2.50	2.50	90
2	km184+045.91	5.00	3.60	36
3	km184+803.53	2.50	2.50	89
4	km185+488.58	2.50	2.50	90
5	km186+014.41	4.00	3.20	95
6	km186+541.13	2.50	2.50	68
7	km186+624.12	3.5×2	3.20	68
8	km186+700.75	2.50	2.50	71
9	km187+163.17	4.00	2.50	131
10	km188+002.04	4.00	3.20	90
11	km188+776.36	2.50	2.50	124
12	km189+005.03	2.50	2.50	52
13	km189+356.35	3.5×2	3.20	90
14	km189+576.03	2.50	2.50	89
15	km190+026.02	2.50	2.50	55
16	km190+515.92	2.50	2.50	61
17	km190+889.87	2.50	2.50	62
18	km191+637.79	2.50	2.50	63
19	km192+428.44	2.50	2.50	90
20	km193+598.01	2.50	2.50	90
21	km194+858.55	2.50	2.50	66
22	km195+448.95	2.50	2.50	89
23	km195+858.99	4.00	3.20	95
24	km196+242.12	2.50	2.50	90
25	km196+896.33	2.50	2.50	97
26	km197+613.22	2.50	2.50	90
27	km197+943.55	5.00	3.60	80
28	km198+751.48	3.50	2.50	75
29	km199+123.40	3.50	2.50	78
30	km199+550.53	3.50	2.50	90
31	km199+975.67	6.00	3.60	90
32	km200+521.32	3.50	3.20	79
33	km200+996.66	3.50	2.50	78
34	km201+302.03	3.50	2.50	83
35	km201+693.94	3.50	2.50	90
36	km202+031.55	3.50	3.20	73
37	km202+499.56	3.50	2.50	114
38	km202+934.66	3.50	2.50	61
39	km203+689.53	6.00	3.60	75
40	km204+732.29	3.50	2.50	90
41	km205+345.85	3.50	2.50	89
42	km205+590.49	6.00	3.60	71
43	km206+137.12	3.50	2.50	90
44	km206+635.81	6.00	3.60	90
45	km207+873.66	6.00	3.60	124
46	km208+673.36	3.50	2.50	90
47	km209+056.32	3.50	2.50	75
48	km209+476.10	3.50	3.20	80
49	km209+850.18	6.00	3.60	90
50	km210+133.33	3.50	2.50	84
51	km210+559.91	6.00	3.60	90
52	km210+701.27	3.50	2.50	73
53	Km211+556.68	3.50	3.20	90
54	Km212+144.60	3.50	2.50	72

Appendix7

Culvert for drainage

	Station	Length (m)	Width (m)	Height (m)	Diameter (m)	Angle (°)
1	km183+393.05	30.00	1.50	1.50	-	90
2	km183+717.95	44.50	1.50	1.50	-	125
3	km184+447.00	37.69	-	-	1.25	90
4	km184+789.17	44.50	-	-	1.25	90
5	km185+211.81	36.00	1.50	1.50	-	115
6	km185+480.54	44.33	-	-	1.30	90
7	km185+785.39	38.00	-	-	1.25	90
8	km186+024.68	55.00	-	-	1.25	90
9	km186+651.42	44.00	3.5×2	3.00	-	71
10	km186+708.49	46.40	-	-	1.25	70
11	km187+134.57	44.00	-	-	1.25	90
12	km187+397.14	42.80	-	-	1.25	62
13	km187+616.40	36.00	-	-	1.50	90
14	km188+010.49	50.50	-	-	1.25	87
15	km188+122.87	48.85	-	-	1.25	74
16	km188+254.19	45.00	-	-	1.00	103
17	km188+573.15	40.80	-	-	1.25	108
18	km188+783.45	55.90	-	-	1.20	124
19	km188+816.68	51.00	3.00	3.00	-	120
20	km189+015.24	52.50	1.50	1.50	-	53
21	km189+169.12	69.30	-	-	1.20	137
22	km189+325.32	79.20	-	-	1.00	63
23	km189+388.23	91.40	-	-	1.50	49
24	km189+542.99	77.30	-	-	1.25	138
25	km189+987.11	44.20	3.00	3.00	-	59
26	km190+131.25	49.40	-	-	1.20	60
27	km190+251.66	51.00	-	-	1.00	60
28	km190+572.26	41.00	-	-	1.25	107
29	km190+574.91	41.00	-	-	1.25	107
30	km190+884.85	45.80	1.50	1.50	-	63
31	km191+130.13	68.24	1.5×2	1.50	-	150
32	km191+347.16	42.00	-	-	1.25	71
33	km191+630.52	49.20	1.50	1.50	-	61
34	km191+970.35	52.00	1.50	2.00	-	142
35	km192+336.64	42.90	-	-	1.25	84
36	km192+349.27	41.50	1.50	1.50	-	92
37	km192+861.10	49.92	2.5×2	2.50	-	47
38	km193+415.96	43.70	-	-	1.25	88
39	km193+593.09	43.60	-	-	1.25	90
40	km193+735.31	43.20	-	-	1.25	86
41	km193+958.82	35.30	1.50	1.50	-	86
42	km194+456.05		-	-	1.25	71
43	km194+864.85	47.60	1.50	1.50	-	66
44	km195+279.79	40.70	-	-	1.25	93
45	km195+454.81	43.20	-	-	1.25	90
46	km195+869.59	48.50	-	-	1.25×2	96
47	km196+002.47	43.00	-	-	1.25	91
48	km196+236.02	42.80	-	-	1.25	90
49	km196+248.09	43.00	-	-	1.25	90
50	km196+414.03	36.70	-	-	1.25	88
51	km196+712.34	38.10	-	-	1.25	87

	Station	Length (m)	Width (m)	Height (m)	Diameter (m)	Angle (°)
52	km196+909.49	36.90	2.5×2	2.50	-	95
53	km197+259.92	34.50	1.5×2	1.50	-	69
54	km197+390.25	34.00	-	-	1.00	81
55	km197+689.37	45.80	-	-	1.00	88
56	km197+979.22	51.50	-	-	1.00	90
57	km198+232.86	32.00	-	-	1.00	101
58	km198+259.70	34.00	-	-	1.00	74
59	km198+630.9	40.00	-	-	1.00	73
60	km198+869.40	40.60	-	-	1.25	77
61	km199+078.00	42.00	-	-	1.00	83
62	km199+250.54	41.50	1.50	1.50	-	84
63	km199+550.00	40.00	-	-	1.25	90
64	km199+986.30	40.00	-	-	1.25	90
65	km200+516.42	49.56	-	-	1.25	79
66	km200+528.92	50.00	-	-	1.25	79
67	km200+761.80	44.80	-	-	1.25	80
68	km200+938.87	43.00	-	-	1.25	79
69	km201+203.20	40.40	-	-	1.25	82
70	km201+464.30	32.40	-	-	1.00	84
71	km201+714.70	37.50	-	-	1.25	86
72	km201+722.50	38.00	-	-	1.25	86
73	km202+038.30	44.50	-	-	1.25	79
74	km202+235.97	37.50	2.00	2.00	-	90
75	km202+494.60	49.00	-	-	1.00	115
76	km202+653.88	35.30	3.0×2	3.00	-	90
77	km202+942.50	44.00	-	-	1.25	66
78	km203+269.70	36.70	-	-	1.25	85
79	km203+682.92	66.40	2.50	2.50	-	77
80	km203+695.02	68.50	-	-	1.25	78
81	km204+097.62		-	-	1.00	88
82	km204+400	71.63	-	-	1.00	87
83	km204+727.80		-	-	1.00	86
84	km204+962.64				1.25	93
85	km205+340.50	38.80	-	-	1.25	92
86	km205+582.05	48.30	1.50	1.50	-	73
87	km205+805.24	44.50	-	-	1.25	102
88	km206+130.78	41.62	-	-	1.25	110
89	km206+478.45	39.58	2.0×2	2.00	-	119
90	km206+662.10	61.63	-	-	1.25	88
91	km207+234.50	38.64	-	-	1.00	81
92	km207+534.00	34.35	1.50	1.50	-	93
93	km207+886.17	47.33	3.0×2	3.00	-	123
94	km208+006.43	52.03	-	-	1.25	124
95	km208+355.75	51.10	-	-	1.00	133
96	km208+651.72	38.28	2.5×2	2.50	-	103
97	km209+050.79	42.26	-	-	1.25	77
98	km209+233.90	47.70	-	-	1.00	60
99	km209+468.21	47.51	-	-	1.25	82
100	km209+840.03	45.21	1.5×2	1.50	-	90
101	km210+127.41	41.55	-	-	1.25	83
102	km210+379.92	44.20	-	-	1.25	85
103	km210+647.97	39.14	2.0×2	2.00	-	87
104	km211+025.78	52.24	-	-	1.25	73
105	km211+219.35	30.47	-	-	1.25	61