SOCIALIST REPUBLIC OF VIETNAM
VIETNAM EXPRESSWAY CORPORATION

PREPARATORY SURVEY REPORT
ON
Phap Van-Cau Gie EXPRESSWAY PROJECT
IN
SOCIALIST REPUBLIC OF VIETNAM

March 2012

JAPAN INTERNATIONAL COOPERATION AGENCY（JICA）

Katahira & Engineers International
Central Nippon Expressway Company Limited
ITOCHU Corporation

OPS
CR(10)
12-010

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Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Official
ADB	Asian Development Bank
BCR	Benefit Cost Ratio
BIDV	Bank for Investment and Development of Vietnam
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-Transfer
BT	Build-Transfer
BTO	Build-Transfer-Operate
CCTV	Closed-circuit television
DARD	Dept. Of Agriculture and Rural Development
DOE	Department of Environment
DRVN	Directorate of Road in Vietnam
DSCR	Debt Service Coverage Ratio
EC	Electric Conductivity
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
Equity IRR	Equity Internal Rate of Return
EPC	Environmental Protection Commitment
EMO	Expressway Management Office
EMP	Environmental Management Plan
FS	Feasibility Study
GDP	Gross Domestic Product
GNI	Gross National Income
GoV	Government of Vietnam
HOUTRANSS	The Study on the Urban Transport Master Plan and Feasibility Study in Hochiminh Metropolitan Area, JICA, 2004
IDC	Interest During Construction
IFC	International Finance Corporation
IOL	Inventory of Losses
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
LEP	Law on Environmental Protection
LLCR	Loan Life Coverage Ratio
LOS	Level of service
MARD	Ministry of Agriculture and Rural Development
METI	Ministry of Economy, Trade and Industry, JAPAN
MOC	Ministry of Construction
MOF	Ministry of Finance
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transport
MOU	Memorandum of Understanding
MPI	Ministry of Planning and Investment
NEXCO中日本	Central Nippon Expressway Company Limited
NEXI	Nippon Export and Investment Insurance
NH	National Highway
NPV	Net Present Value
OD	Origin and Destination
O&M	Operation and Maintenance
PAPs	Project Affected Persons
PCE	Passenger Car Equivalent
PCU	Passenger Car Unit
PDOT	People's Department of Transportation

PM	Particular Matter
PPP	Public-Private Partnership
PV-CG	Phap Van – Cau Gie
QCVN	Vietnam Technical Regulations
ROW	Right-of-Way
RAP	Resettlement Action Plan
SEA	Strategic Environmental Assessment
SOE	State- owned enterprise
SPC	Specific Purpose Company
SS	Suspended substance(solids)
TCVN	Vietnam Standards
TSP	Total Suspended Particle
TSS	Total Suspended Solids
TTC	Travel Time Cost
USD	United States Dollar
UXO	Unexploded Ordnance
VAT	Value Added Tax
VEC	Vietnam Expressway Cooperation
VITRANSS 2	The Comprehensive Study on the Sustainable Development of Transport System in Vietnam, JICA, 2010
VND	Vietnam Dong
VOC	Vehicle Operating Cost
WACC	Weighted average cost of capital

1. Introduction

1.1 Background and Objectives of the Study

1.1.1 Background of the Study

Ministry of Transport, Socialist Republic of Vietnam (hereinafter referred to as MOT) conducted the master plan entitled: "Expressway Network Master Plan in Vietnam (-2020)" in August 2005, and presented mid- & long-term Expressway Network Plan covering the period until 2025.
"Expressway Development Plan (Master Plan)," approved by the Prime Minister in December 2008, set the target for development of approximately 5,873km of expressways with 39 sections, and planned to develop 2,235km expressway by 2020. The Vietnam Expressway Corporation (hereinafter referred to as VEC), founded in 2004, is responsible for the development and investment in the expressways. VEC continues to pursue its development mandate.

Based on the Master Plan and VEC's mandate, the Prime Minister approved the detailed plan of North-South Expressway which connects Hanoi in Northern Vietnam and Canto in Southern Vietnam. The portion of Phap Van-Cau Gie (hereinafter referred to as PV-CG) is located with its starting point at the North-South Expressway in the southern part of Hanoi city. The project scope covers upgrading of the Bypass of National Route 1, which is currently in service and opened to the public - opened in 2002 with four-lanes and toll free. PV-CG Expressway project (hereinafter referred to as the Project) will involve the application of expressway standards and widening to six lanes. The list of Priority Projects listed in the road sectors identified in the attachment to the Prime Minister's Decision No. 05/2011/QD-TTg and as indicated in the Approval of the Transport Infrastructure Projects in Northern Economic Area, issued on 24 January 2011, includes PV-CG Expressway (32.3km, 6 lanes).

VEC was granted a right to implement the Project in April 2010 by MOT. Because VEC has been engaged in other expressway projects and this strained VEC's investment capacity, alternative implementation schemes, which utilize private-sector fund that would relieve excessive financial burden to VEC, were examined and evaluated.

1.1.2 Objectives of the Survey

The objectives of the Study are to formulate a basic infrastructure development plan as proposed by Private Sector proponents; and to verify its validity, effectiveness and efficiency. It is based on the following two conditions:
- Private sector undertakes to develop infrastructure project from design, construction, operation and to maintenance using equity or debt financed by ODA funds from public financial institutions, etc.; and
- In ODA funds, JICA Private Sector Investment Finance (PSIF) is considered as the prime source of funding .

1.2 Subject and Scope of Study

1.2.1 Survey Area

PV-CG Expressway is located with its starting point at the North-South Expressway in the southern part of Hanoi city as shown in the Figure 1.2.1-1 below.

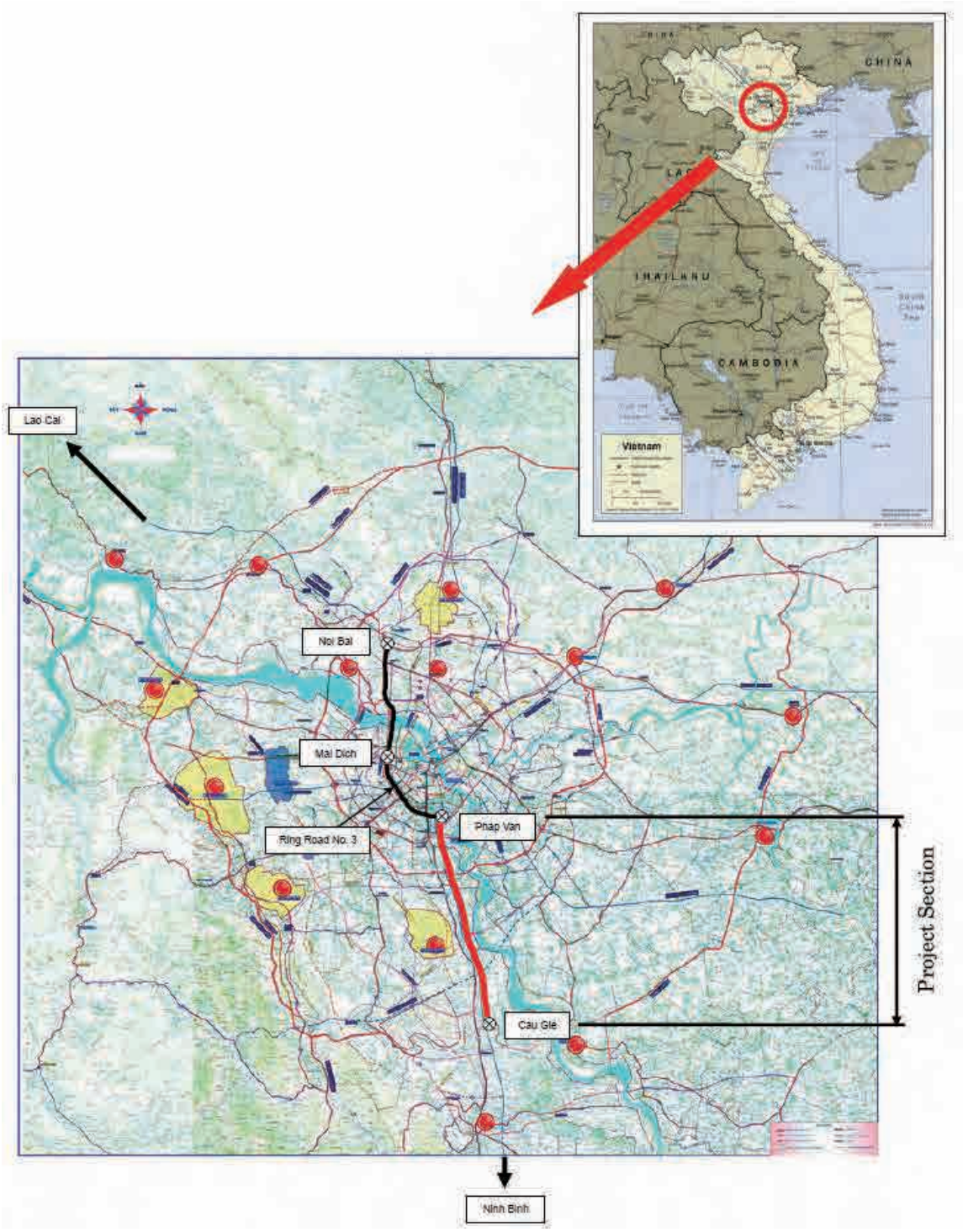


Figure 1.2.1-1 Survey Area

1.2.2 Scope and Contents of the Study

1.2.2.1 Scope of Study

The area to be studied covers an alignment that is 28.956 km in length on PV-CG Highway (Km182+300～Km211+248.96).

32.3km appears on the Prime Minister decision with the starting point at intersection of PV-CG Highway and Ring Road No.3 and the ending point at connection with the old NH No.1. Scope of study is between Phap Van IC at the starting point and Dai Xuyen IC at the ending point excluding these two ICs which are almost completed under the Cau Gie-Ninh Binh Project.

1.2.2.2 Contents of the Study

(1) Preparation for Project Implementation Program:

1) Study of Project Implementation Program

2) Formation of Project Implementing Organization

3) Preparation of Inception Report

(2) Project Proposal confirming the Project Background and its Necessity:

1) Current Status and Issues on Expressway Sector in Vietnam,

2) Policies and Government's Development Plan on Expressway Sector in Vietnam

3) Current and Prospective Situation of Project-related Legislation in Vietnam

4) Current and Prospective Situation of other Foreign Companies/Investors to the Project

5) Current Situation in the Project Areas including current and prospective business activities by other foreign Companies

6) Necessity of Project

7) Confirmation of Existing System on Environmental and Social Consideration and its mitigation measures

(3) Proposal of Project Implementation Program

1) Formulation of the Project

2) Outline Design

3) Economic and Financial Analysis

4) Environmental and Social Considerations and its mitigation measures

1.2.2.3 Project Outline

Construction of the Project will be carried out in two stages (Phase 1: Improvement of the existing 4-lanes plus land acquisition and Improvement of frontage road. Phase 2: Road widening to 6 lanes). In Phase 1, not only toll collection but also operation and maintenance of expressway will be carried out soon after the completion of the Project.

Acquisition of land required for frontage road improvement and widening to 6 lanes will be

carried out by the Government of Vietnam immediately after completion of required procedures in accordance with the Decree No. 69/2009/ND-CP for land acquisition.
It would be noted that the cost for this Right-of-Way acquisition shall be basically borne by the Government of Vietnam.
Table 1.2.2-1 enumerates the main works to be undertaken for the Project.

Table 1.2.2-1 Major Works

Phase	Contents of Main Works (Length of Road: 28km)
Phase 1	Before Land Acquisition ・Detailed Design ・Pavement Improvement of existing 4 lanes ・Repair of existing road structures (movement joints, cracks etc.) ・Road Operation and Maintenance
Phase 2	After Land Acquisition ・Detailed Design ・Construction of frontage roads ・Extension of drainage ・Road widening to 6 lanes ・Extension of culverts for traffic ・Counter measures for soft ground ・Road Operation and Maintenance

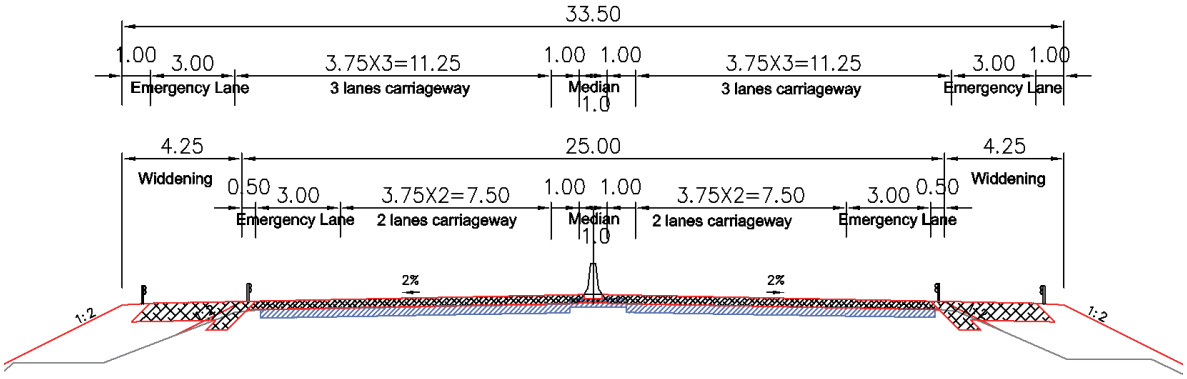


Figure 1.2.2-1 Widening to 6 Lanes Standard Cross Section

The project schedule is shown in Figure 1.2.2-2.

It is assumed that the completion of improvement of the existing road and the commencement of toll collection will be at the middle of 2014. Phase 2 is expected to be completed by the end of 2019. And the operation period will be 20 years from the commencement of toll collection (operation period will be completed at the middle of 2034.)

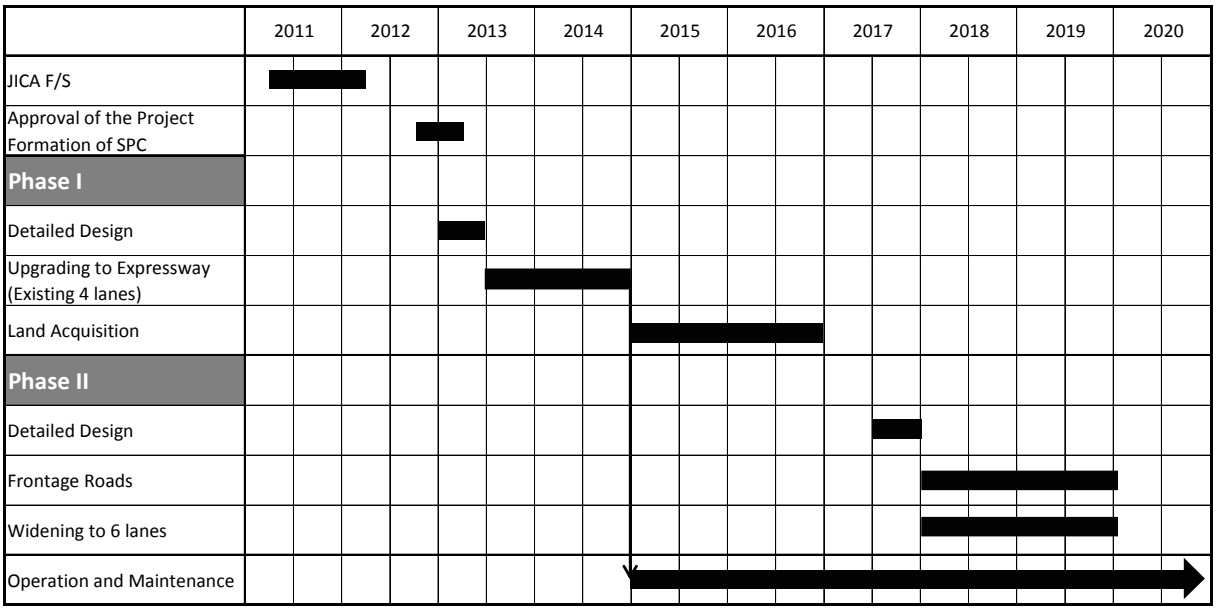


Figure 1.2.2-2 Current Project Schedule

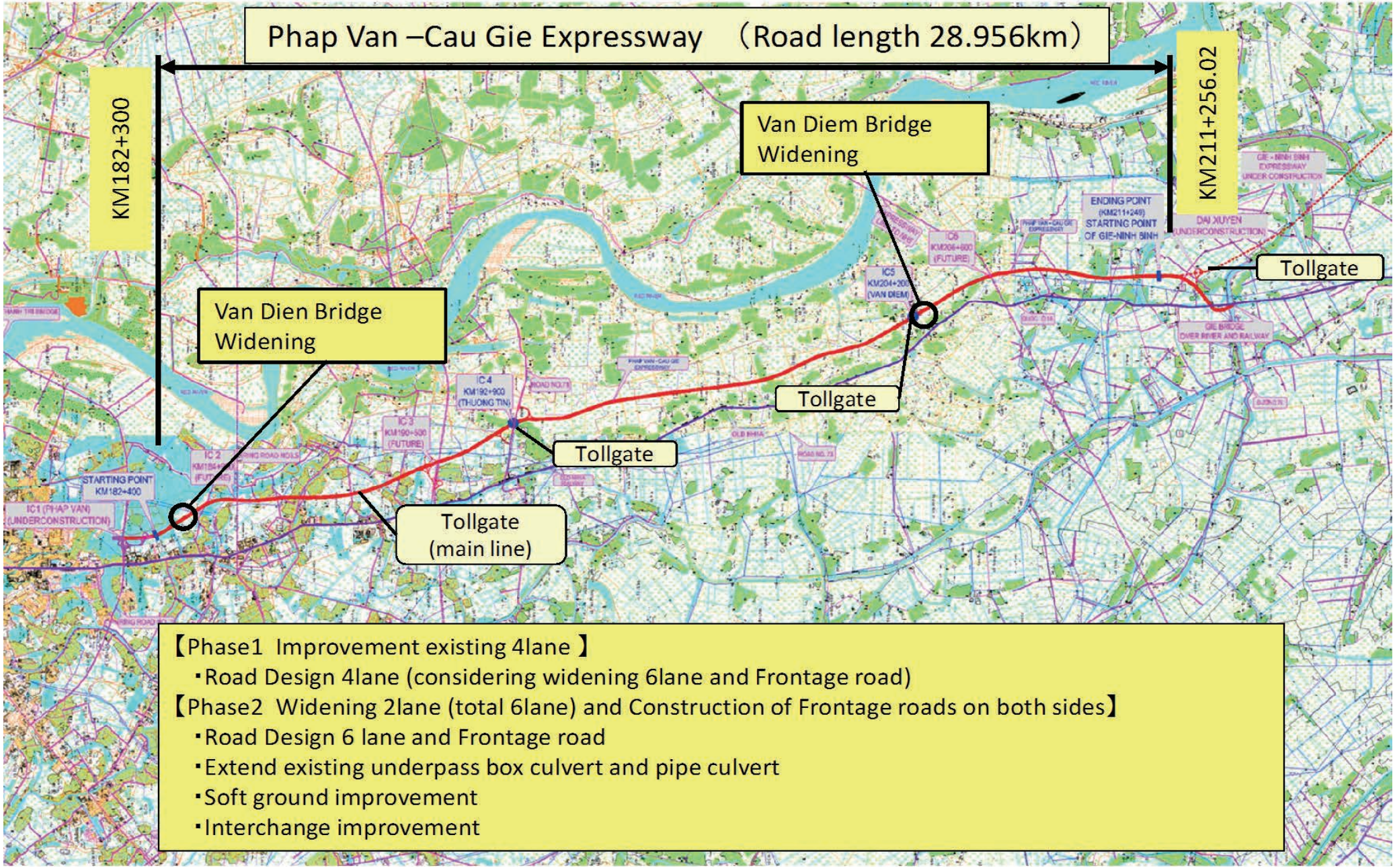


Figure 1.2.2-3 Major Design Items

1.3 Organization of Study Team

Organization of study team is shown in Figure 1.3.1-1 and study team members are shown in Table 1.3.1-1.

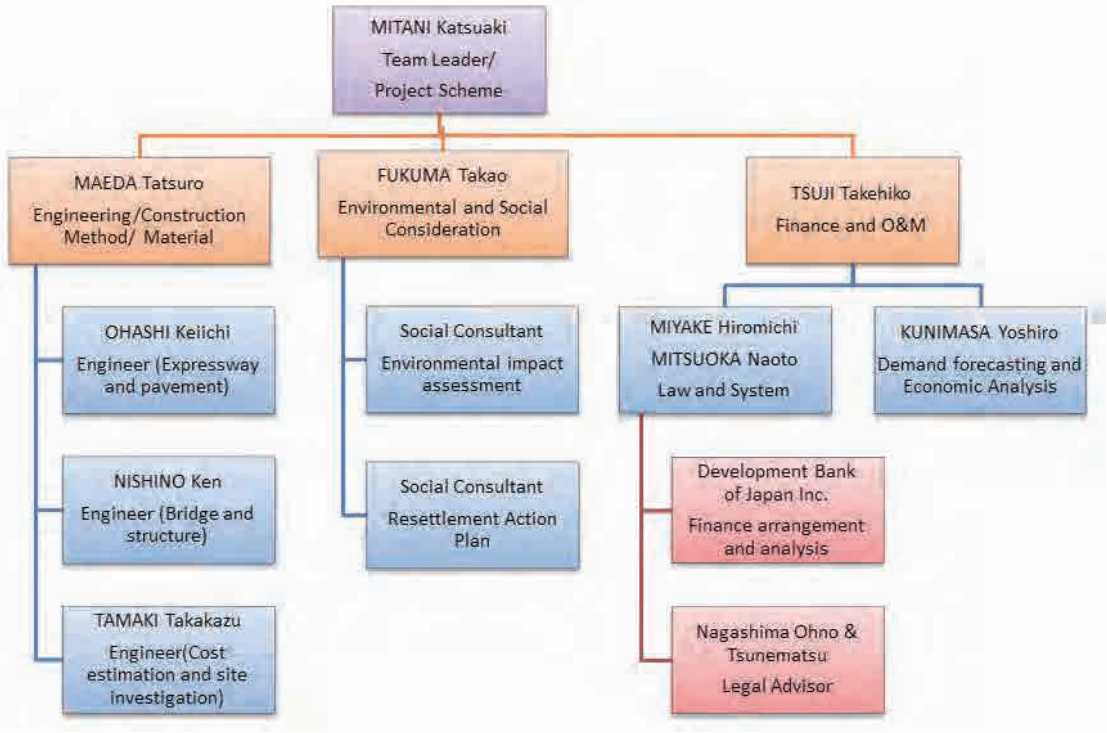


Figure 1.3.1-1 Organization of Study Team

Table 1.3.1-1 Study Team Member

Name	Role	Firm
MITANI Katsuaki	Team Leader／Project Scheme	KEI
MAEDA Tatsuro	Engineer／Construction method／Material	KEI
TSUJI Takehiko	Expressway Operation and Maintenance Specialist	C-NEXCO
MIYAKE Hiromichi	Law and System Specialist 1	C-NEXCO
MITSUOKA Naoto	Law and System Specialist 2	ITOCHU
KUNIMASA Yoshiro	Demand forecasting and Economic Analysis Specialist	KEI
OHASHI Keiichi	Design Engineer(Expressway and pavement)	KEI
NISHINO Ken	Design Engineer(bridge and structure)	KEI
TAMAKI Takakazu	Engineer(Cost estimation and site investigation)	KEI
FUKUMA Takao	Environmental and Social Consideration Expert	KEI

Note) KEI : Katahira & Engineers International
C-NEXCO : Central Nippon Expressway Company Limited
ITOCHU : ITOCHU Corporation

1.4 Study Schedule

Study schedule is shown in the chart, below.

Table 1.4.1-1 Study Schedule

Items	Progress Rate	2011 Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2012 Jan	Feb	Mar
1.Preparation of survey	100%												
2.Survey and Study of PPP project formulation													
(1) Demand forecasting for project	100%												
(2) Review of project	100%												
(3) Study of project enforcement system	100%												
(4) Establish project enforcement schedule	100%												
(5) Study of management and maintenance plan	100%												
3.Outline design													
(1) Outline design	100%												
(2) Planning of construction	100%												
(3) Planning of pavement	100%												
(4) Project Cost Estimation	100%												
4.Economic and financial analysis													
(1) Financial analysis of private sector	100%												
(2) Economic analysis of the whole project, Study on operation and effectiveness indicator.	100%												
5.Environmental and Social Consideration	100%												
6.Reports	80%												
7.Explanation,conference													
(1) Inception report	100%												
(2) Interim report	100%												
(3) Draft final report	0%												
(4) Final report	0%												

2. Background and Necessity of the Project

2.1 Current Status and Issues of Expressway in Vietnamese

2.1.1 Present Organization Structure concerning Expressway

This section clarifies present organization structure and its jurisdictions concerning Expressway in Vietnam.

(1) **Ministry of Transport (MOT)**

The Ministry of Transport (MOT) is a government agency in charge of state management of land transport (highways, railways), inland waterway transport and maritime transport across the country. There are 5 administrations under MOT.

Expressway Management Office (hereinafter referred to EMO) was established in accordance with Decision No.633/QD-BGTVT in April 2011. EMO has tasks of leading in researches and proposals for policies, regulations related to construction investment, management, operation, maintenance of expressway and to be a contact point assisting leaders of transport in relation with Ministries, calling for and promote investment. EMO will reorganize as Directorate of Expressway in Vietnam (DEVN) in the near future.

Table 2.1.1-1 Organization under jurisdiction of MOT

Organization	Jurisdiction
Directorate of Road in Vietnam (DRVN)	Road Transport and Traffic, but excluding Expressway
Expressway Management Office (EMO)	Expressway
Vietnam Inland Waterway Administration	Inland Waterway
Vietnam National Maritime Bureau	Maritime
Vietnam Register	Vehicle and Vessel Registration
Transport Construction Quality Control and Management Bureau	Construction Management

MOT is responsible for submitting Development Strategy and Implementation Plan of Expressway to the Prime Minister. In this regards, the Prime Minister approved Vietnam Expressway Network Developing and Planning until 2020 and the view for post 2020 (Decision No. 1734 / QD-TTg) in 1st December 2008 based on Submission No. 7056/TTr-BGTVT by MOT in May 2007.

MOT is also responsible for issuing construction standards and constructions standards for expressway. TCVN 5729-1997 is being under review from 2007, based on experiences obtained in design and construction of several expressways, to which TCVN 5729-1997 was applied. In the seminar on Expressway in Vietnam joint hosting by MOT and Ministry of Infrastructure, Land, Transport and tourism of JAPAN (MILT) held in August 2011, outline of revision to TCVN 5729-1997 was briefed. The objectives of revisions are as follows.

- To increase safety
- To save construction costs
- To reduce the area of land use
- To match with the complex terrain

(2) **Vietnam Expressway Cooperation (VEC)**

The Vietnam Expressway Cooperation (VEC) was established as State-owned Company under

MOT in 2004 for investment, development and management, maintenance of national expressway system. After reorganized as a holding company in July 2010, VEC at present is a one-member Ltd. Company owned by MOT. VEC has been frequently reorganized the structure to meet increasing task assignment for implementing projects and changing project stage such as investment, F/S, Design, Construction and operation of expressway. Present organization chart is shown in Figure 2.1.1-1Figure 2.1.1-1Figure 2.1.1-1

VEC is executing agency for following 6 expressways from 5,873km expressway M/P[1] at present.

(1) Cau Gie-Ninh Binh expressway: 56km, under construction with partial opening on Novemver2011, fully open in 2012.
(2) Noi Bai-Lao Cai expressway: 264km, under construction, open in 2014.
(3) HCM-Long Thanh-DauGuay expressway: 54.9km, under construction, open in 2014.
(4) Da Nang-Quang Ngai expressway: 139.5km, preparing for DD, open in 2014.
(5) Ben Luc- Long Thanh expressway: 57.8km, DD, open in 2017.
(6) Phap Van-Cau Gie expressway: 28km, F/S, This study.

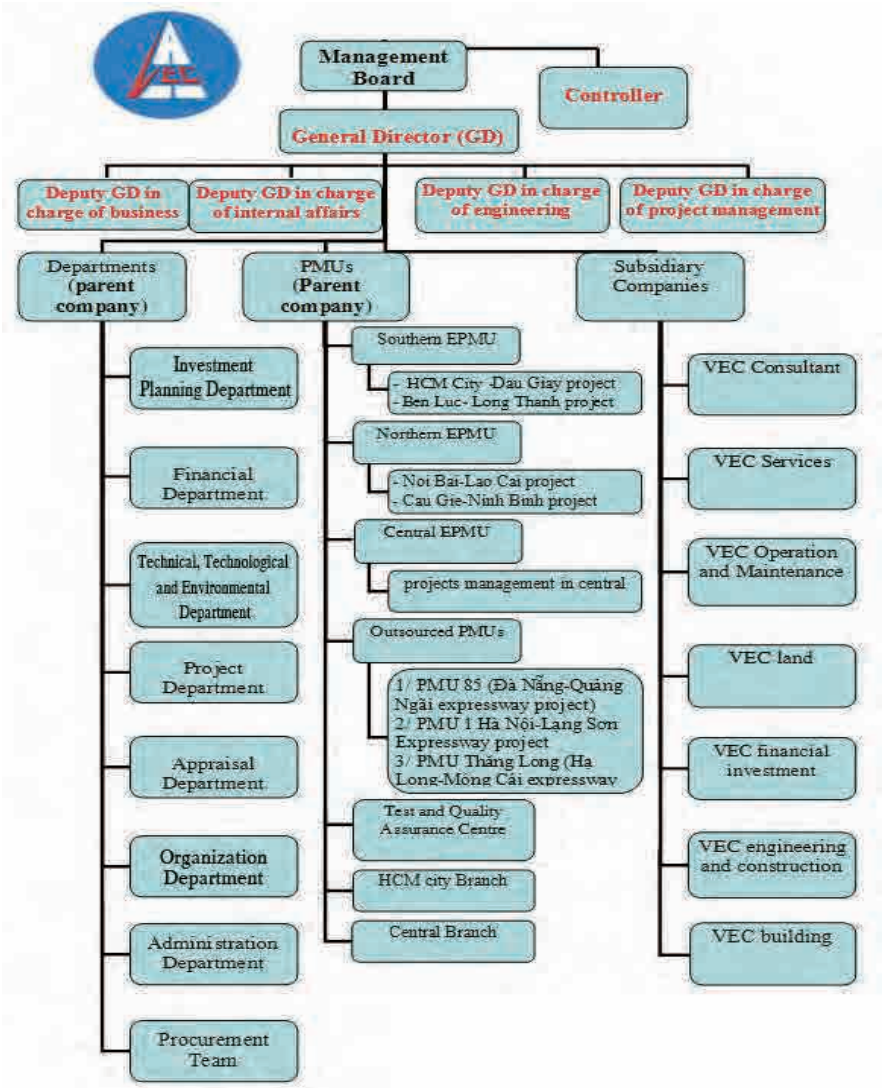


Figure 2.1.1-1 Organization Chart of VEC Source: VEC Web Site

[1] Decision1734/QD-TTg：Approval of Vietnam Expressway Network Developing and Planning until 2020 and the view for post-2020

(i) **Financial Situation**

Balance Sheets and Profit and Loss Statement from 2006 to 2010 of VEC is shown in the following **Table 2.1.1-2** and **Table 2.1.1-3**.

(a) At the macro level, the amount of Vietnam's public debt has exceeded 50% of GDP and is nearing to 60%.At the micro level, on the other hand, the total amount of VEC's debt consisting of ODA loans and bonds has exceeded US$3bil and is expected to reach US$5bil in 2011. It is desirable to formulate the project in such a manner as minimizing the financial burden to Vietnamese side.

(b) VEC totally depends on interest revenue accrued from bank deposit and working expenditure in the on-going projects allocated by ODA loans for their administrative costs. VEC opened one section in Cau Gie –Ninh Binh Expressway, or 23km between Cau Gie- Phu Ly, on November 13, 2011 and started its operation and maintenance. As the first repayment of its ODA loan is scheduled to begin in 2016, it is desirable that VEC starts soon the operation, or the collection of toll, of Phase I of Phap Van–Cau Gie Expressway just succeeding to the operation of the section mentioned above in order to secure the recurring cash flow.

(c) At present, the fixed assets of PV-CG Highway possessed by the DRVN are being assessed. Once the assessment is completed, balance sheet of VEC will be improved.

(d) The principal repayment for the loans for 5 expressways will commence from 2014 and the amount of repayment will keep increasing. According to ADB, depending upon the increase of traffic volume and toll revenue, VEC's financial position is expected to become stable after 2025. In this regard, VEC has no alternative but to apply a project scheme utilizing private sector fund such as BOT or PPP, as well as traditional procurement method like bonds or equity reinforcement.

Table 2.1.1-2 VEC's Balance Sheet

(Unit: USD)

ITEM	31/12/2006	31/12/2007	31/12/2008	31/12/2009	31/12/2010
A. SHORT-TERM ASSETS	**13,818,215**	**35,548,414**	**84,882,291**	**209,311,719**	**206,577,261**
I. Cash and Cash Equivalents	586,272	489,986	1,308,462	27,692,724	6,373,278
II. Short-term Financial Investment	526,316	13,343,684	22,684,211	0	1,730,029
III. Receivables	12,549,295	21,062,670	59,758,284	179,739,415	193,681,131
IV. Inventories	0	0	0	0	0
V. Other Short-term Assets	156,332	652,073	1,131,334	1,879,580	4,792,823
B. LONG-TERM ASSETS	**6,436,817**	**27,290,479**	**61,662,039**	**135,502,856**	**354,409,191**
I. Long-term receivable	0	0	0	0	0
II. Fixed assets	6,436,817	27,290,479	60,464,671	134,305,487	351,619,064
III. Long-term Investments	0	0	0	0	0
IV. Long-term Investments	0	0	1,197,368	1,197,368	2,790,126

ITEM	31/12/2006	31/12/2007	31/12/2008	31/12/2009	31/12/2010
V. Other Long-term Assets	0	0	0	0	0
TOTAL ASSETS	**20,255,032**	**62,838,893**	**146,544,330**	**344,814,575**	**560,986,452**
LIABILITIES AND EQUITY					
A. DEBTS	**125,232**	**23,131,459**	**93,514,889**	**291,043,008**	**513,348,642**
1. Short-term debts	123,176	2,073,914	7,522,483	46,498,977	79,614,985
II. Long-term debts	2,055	21,057,545	85,992,407	244,544,031	433,733,657
B. EQUITY	**20,129,800**	**39,707,434**	**53,029,441**	**20,129,800**	**47,637,810**
I. Equity	19,986,756	39,532,486	52,725,460	19,986,756	47,222,123
II. Others state-funded sources and funds	143,044	174,948	303,981	143,044	415,687
TOTAL LIABILITIES AND EQUITY	**20,255,032**	**62,838,893**	**146,544,330**	**344,814,575**	**560,986,452**

Source: figures in 2006, 2007, 2008 and 2009 from METI F/S 2010 version and those in 2010 from VEC

Table 2.1.1-3 VEC's Profit & Loss Statement

(Unit: USD)

ITEM	2006	2007	2008	2009	2010
Income from Sales & Services	253,516	0	0	0	0
Deduction of Revenue	0	0	0	0	0
Net income from Sales & Services	**253,516**	0	0	0	0
Cost of Goods Sold	253,516	0	0	0	0
Gross Incomes from Sales & Services	**0**	**0**	**0**	**0**	**0**
Income from Financial Activities	506,903	150,040	334,579	95,409	489,149
Financial Activities Expenses	0	0	0	0	0
Sales Cost	0	0	0	0	0
Administrative Cost	183,821	150,040	334,579	95,409	489,149
Net Profit from Business Activities	**323,082**	**0**	**0**	**0**	**0**
Other Income	0	0	0	0	0
Other Expenses	0	0	0	0	0
Other Profit	0	0	0	0	0
Gross Profit before Tax	**323,082**	**0**	**0**	**0**	**0**
Current Corporate Income Tax	0	0	0	0	0
Deferred Corporate Income Tax	0	0	0	0	0
Profit after Income Tax	**323,082**	**0**	**0**	**0**	**0**

Source: from 2006 to 2009 by 2010 version of METI F/S and 2010 by VEC

(ii) **Technical aspect**

VEC and NEXCO-Central (C-NEXCO) made a memorandum of agreement on exchanging

people and information, and strengthening relationship between the two entities in November 2007 and C-NEXCO opened his office in VEC's head office building in November 2008. Since both companies have kept good relationship through holding courses for education and training in Road Management etc.
At the request of VEC, C-NEXCO organized a working group to study a new scheme for PVCG Expressway project and has continued to do it.

VEC O&M, a 100% subsidiary of VEC, is now in charge of the operation and maintenance of the 23km section between Cau Gie-Ninh Binh opened in 2011. As of January, 2012, total enrollment in VEC is 127 who have already taken educational and training courses. In the final proposal from C-NEXCO to VEC, it is stipulated that VEC O&M shall be entrusted with operation and maintenance works of expressway so that C-NEXCO can transfer its technology and know-how to VEC.

2.1.2 Current Status and Government Policies for Expressway Sector

The following Items are pointed out in the fifth Seminar on Expressway in Vietnam (August 2011) for issues of Expressway Sector. Ultimately the issues can be traced to the fact that available Funds (State budget etc.) which Vietnamese Government can invest for Expressway construction are limited.

(a) Total capital source for land acquisition of Expressway projects only covers approx. 60% of the demand to 2020.

(b) The domestic bond market is undeveloped and international bond markets are still affected by the global economic crisis.

(c) As high as approx. 20 % of annual inflation affected investments.

(d) Only a very few expressways are understood to be financially viable, based on current toll level and projected traffic volume. The private sector is unlikely to step in, unless the regulations are changed and financial support system, such as a Viability Gap Funding, is established. A large portion of the capital costs of expressways will continue to require public sector funding.

(e) Most road projects in Vietnam are not built with toll collection as recovery mechanisms. The toll levels for any BOT projects are fixed at a maximum of twice the level of tolls for non-BOT projects; and these are sparingly low to allow investment recovery. There is no clarity on the Government's policy on toll rate adjustments or the mechanisms to put them into effect.

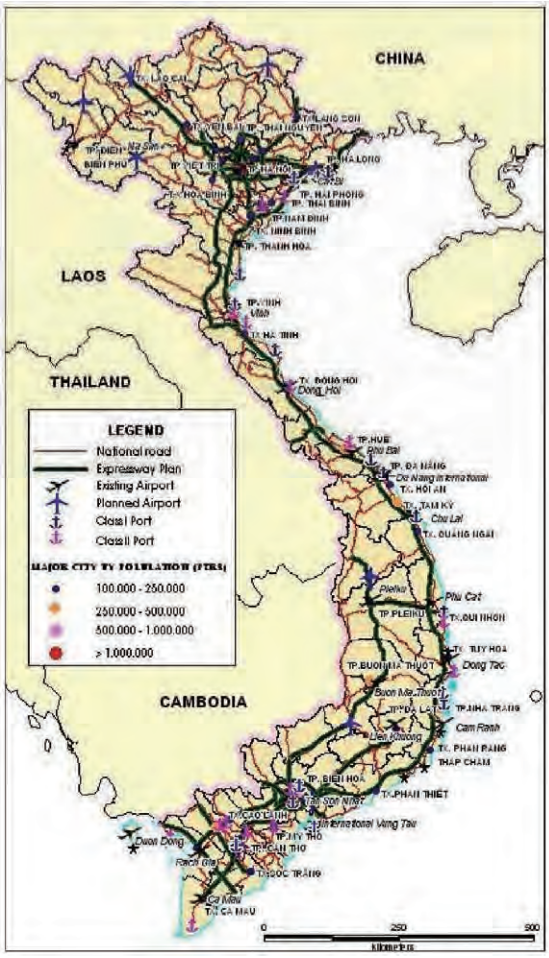
(f) Domestic commercial loans are limited by undeveloped capacity of domestic commercial banks and money markets, and cannot provide long-term capital.

2.1.2.1 Policy on Expressway Development

The Government is considering the BOT scheme based on a Toll Operating Concession with land development rights along the project alignment. Other PPP schemes that are for consideration are the Build-Transfer-&-Operate and the Build-Transfer. These PPP schemes face problems particularly because there are no standard contracts and financing structure that could be used for reference and also because of the inexperience of domestic private investors. The vast majority of road infrastructure BOT project have not been a pure private sector party since the 'Investor' has been a State Owned Enterprise (SOE) or a Joint Stock company with majority shareholding by the SOE's – essentially quasi government corporations.

2.1.2.2 Expressway Master Plan

The Prime Minister approved Expressway M/P (Decision1734/QD-TTg) for 5,873km. Approved expressway network is shown in figure 2.1.2-1.



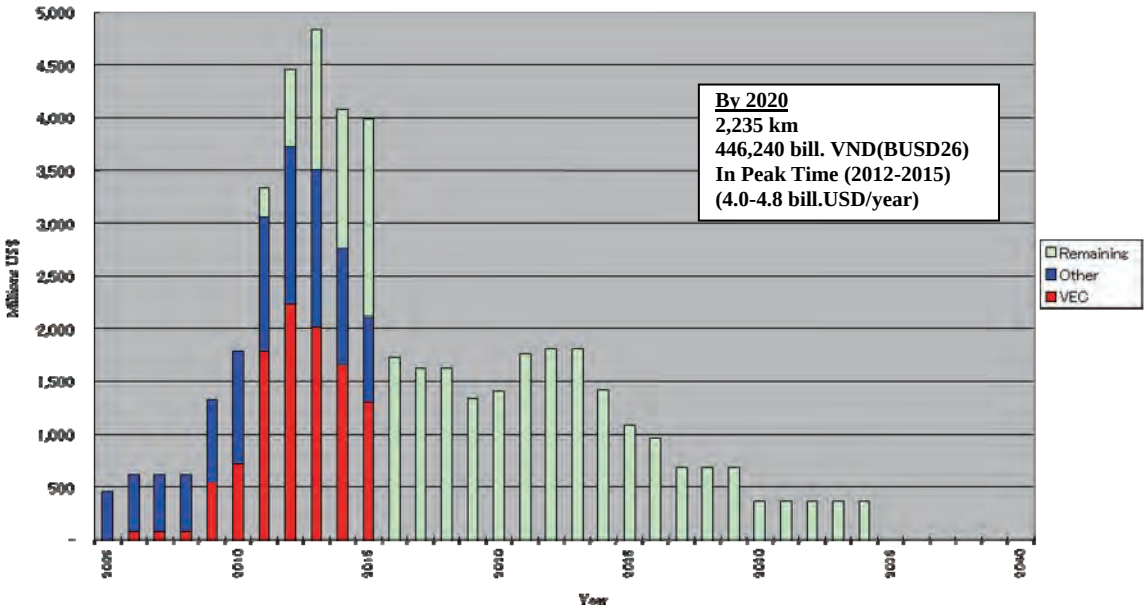
Source：MOT

	Section	Length	Lanes
North – South Expressway			
	East（Phap Van – Can Tho）	1,941Km	4-6
	West（Phu Tho – Pho Chau）	457Km	4-6
	West（Ngoc Hoi – Rach Gia）	864Km	4-6
North Expressway			
	Lang Son – Bac Ninh	130Km	4-6
	Hanoi – Hai Phong	105Km	6
	Hanoi – Lao Cai	264Km	4-6
	Hanoi – Mong Cai	294Km	4-6
	Hanoi – Bac Kan	90Km	4-6
	Hanoi – Hoa Binh	56Km	4-6
	Ninh Binh – Quang Ninh	160Km	4
	Hanoi Ring road No.3	56Km	4-6
	Hanoi Ring road No.4	125Km	6-8
Regional Central and Highland Expressway			
	Hong Linh – Huong Son	34Km	4
	Cam Lo – Lao Bao	70Km	4
	Quy Nhon – Pleiku	160Km	4
Southern Regional Expressway			
	Dau Giay – Da Lat	209Km	4
	Bien Hoa – Vung Tau	76Km	6
	Ho Chi Minh – Chon Thanh	69Km	6-8
	Ho Chi Minh – Moc Bai	55Km	4-6
	Chau Doc – Can Tho	200Km	4
	Ha Tien – Bac Lieu	225Km	4
	Can Tho – Ca Mau	150Km	4
	HCMC Ring road No.3	83Km	6-8
Total		5,873km	-

Figure 2.1.2-1 Expressway Master Plan

2.1.2.3 Capital Requirement for Expressway

Required annual investment for expressway is assumed to be as shown in Figure 2.1.2-2. Annual investment requirement in 2012-2015 is maybe 4.8 billion USD up to 8 times that of the average annual road investment in 2009.



Source："Seminar on Organizational Structure Orientation, Operation Mechanism and Business Development Plans for VEC", VEC, 5th November 2009 Legend: Red—VEC, Blue---Other, Aqua---Remaining

Figure 2.1.2-2 Capital requirement for Expressway Investment

A comparison between investment plan included in VEC seminar in November 2009 and that in Expressway Seminar in August 2011 is shown in the following Table.

Table 2.1.2-1 Comparison of Investment Plan

Description	Issue	Till 2020	After 2020
VEC Seminar	November 2009	A: Target construction length(km) 2,235 B: Necessary Funds (billion US$) 26	A: 3,635 B: 14.5
Expressway Seminar	August 2011	A: Target construction length(km) 1,870 B: Necessary Funds (billion US$) 19	A: 4,000 B: 21.5

Total investment amount for construction the 5,873km expressway network is estimated about 40.5 billion USD. By the year of 2020, total construction expenditure is to be about 19 billion USD for 1,870km and after 2020, to be about 21.5 billion USD for 4,000km. A delay in investment plan is observed compared to plan of 2009.

Up to now only 8 projects are under construction or preparation for construction. These projects are mainly funded by state budget capital, state owned enterprises on lending loan guaranteed by the Government, development investment capital of state owned enterprises and ODA loan. To realize investment on developing whole expressway network, the Government requires involvement of private sector for investment and has been engaged in developing legal system for PPP.

2.1.2.4 Current Status of Expressway Projects

Table 2.1.2-2 and 2.1.2-3 show expressway projects to be constructed by 2020 with status of open, under construction, under preparation of construction and under planning. Lang – Hoa Lac expressway is connecting Hanoi city and Hoa Lac High-tech park; free of charge. At present, HCM – Trung Luong expressway is the only approved toll expressway, however toll collection has not started yet as of September 2011. The investor, BIDV Expressway Development Company (BEDC), acquired a 25-year toll collection right to the HCM – Trung Luong expressway with the toll of 1,000 VND/km.

Table 2.1.2-2 Expressway projects to be completed by 2020

PROJECT NAME w/o Expressway Project	LENGTH (kM)	LANES	TOTAL INVESTMENT (Billion VND)	CONSTRUCTION PERIOD	STATUS
Lang – Hoa Lac	29.5	6	7.527	2005-2010	Completed and open to traffic. By VINACONEX with BT contract
HCM – Trung Luong	39.8	4-8	9.884	2004-2011	Open to traffic. Highly effective. Management by PMU My Thuan.
Cau Gie – Ninh Binh	50	4-6	8.974	2006-2011	Under construction. Management by VEC. Of 50km, 23km has completed. More than18 months behind the schedule. Refer to section 2.3.1.2.
Hanoi – Hai Phong	105	6	24.566	2008-2011	Under construction. Managed by VIDIFI. Late>20 months. Refer to Table 2.1.2-5and Table 2.1.2-6.
Hanoi – Thai Nguyen	62	2-4	8.104	2009-2013	Under construction. Managed by PMU2 -MOT
Noi Bai – Lao Cai	264	2-4	21.233	2010-2014	Under construction. Managed by VEC
HCM – LuongThanh – Dau Giay	54.9	4-6	16.340	2010-2014	Under construction. Managed by VEC
Trung Luong –My Thuan	54	6-8	20.000	200?-201?	In progress Investment by BIDV.
Da Nang – Quang Ngai	139.5	4	27.968	2011-2014	Detailed design about to commence, managed by VEC
Hoa Lac- Hoa Binh	30	6	6.000	2011-2016	In progress investment by Gelecimco
Ben Luc – Long Thanh	57.8	4-6	31.320	2012-2017	Detailed design ongoing, Managed by VEC
Hanoi Ring Road 3rd	56	4-6	17.990	2004-2018	Under construction, managed by PMU Thang Long – MOT

Source: EMO, MOT(Presentation Material for The 5th Expressway Seminar in Vietnam, August ,2011)

Table 2.1.2-3 Expressway projects to be completed by 2020, under study

PROJECT NAME w/o Expressway Project	LENGTH (kM)	LANES	TOTAL INVESTMENT (Billion VND)	CONSTRUCTION PERIOD	STATUS
PROJECTS under Study					
Phap Van – Cau Gie	**28**	**6**	**4.743**	**2012-2014**	**FS study ongoing by NEXCO Central – Japan, JICA (PSIF fund)**
Noi Bai – Ha Longt	196	4-6	20.800	2012-2015	Study investment by GITEC (China)
Dau Giay – Phan Thiet	98.7	4-6	18.388	2013-2016	Study investment by Bitexco. Refer to Table2.1.2-3.
My Thuan – Can Tho	24.5	6-8	15.000	–	Study investment by Cuu Long CIPM. Refer to Table 2.1.2-4.
Bien Hoa – Vung Tau	77.8	4-6	10.026	2013-2017	Investment study by BVEC, already first report study
Hanoi Ring Road No.4	136	6-8	72.000	2011-2020	Preparing investment
Ring Road 3rd - HCMC	90	6-8	43.000	2011-2020	Preparing investment
Ha Long – Mong Cai	130	4	19.000	–	Calling for investment PPP Pilot Project.
Hanoi – Lang Son	158.4	4-6	22.120	–	FS completed. Calling for investment.
Dau Giay – Da Lat	230	4	19.280	–	Calling for investment
Ninh Binh – Thanh Hoa	121	4-6	30.000	–	FS completed. Calling for investment. PPP Pilot Project.
Thanh Hoa – Ha Tinh	160	4-6	24.680	–	FS completed. Calling for investment. PPP Pilot Project.
Cam Lo – Tuy Loan	178	2-4	32.000	–	Calling for investment
Quang Ngai – Quy Nhon	108	4-6	26.654	–	Calling for investment

Source: EMO, MOT(Presentation Material for The 5th Expressway Seminar in Vietnam, August ,2011)

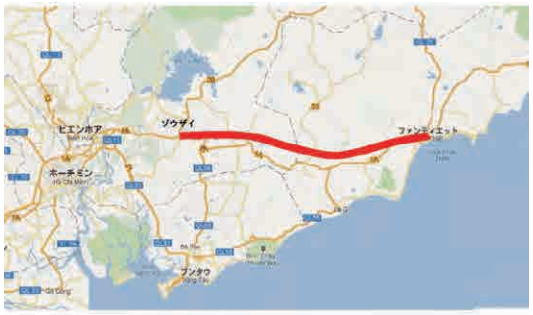
2.1.2.5 Public-Private Partnership (PPP) Expressway Projects in Vietnam

Precedent cases of expressway projects under PPP scheme are shown as below. The Dau Giay – Phan Thiet Expressway is the only 'PPP' project undertaken by the private company.

(1) DauGiay – PhanThiet Expressway

Vietnam government approved Dau Giay-Phan Theit Expressway project as the first PPP project in Vietnam[2]. The outline of the project is as follows:

Table 2.1.2-4 Outline of Dau Giay-Phan Thiet Expressway Project

Name of Project	**DauGiay-Phan Thiet Expressway**
Outline	The Project is important section in Southern Vietnam connecting Phan Thiet city and Dau Giay where it extends to National highway No.1 A . Total length is about 101km with 4 lanes in the 1st phase and 6 lanes in the 2nd phase at road grade A. Design speed is 100km/h- 120km/h There are 9 interchanges, 15 bridges traversing rivers, 19 flyovers and 12 over-bridges. ITS including ETC and traffic management system and service area are to be installed. 
Total Cost	**23.223billion VND** (5 billion VND increased from the previous total cost)
Executing Organization	Originally, investors were decided on No.1169/TTg-KTN dated July, 2010 as follows: The first investor : BITEXCO (Binh Minh Import-Export Co), The second investor: IFC (International Finance Corporation, The third investor : one selected through international competitive bidding However, due to Decision 1495/BGTVT dated July, 2011, they were changed as follows: The first investor: BITEXCO (Binh Minh Import-Export Co), The second investor: one selected through international competitive bidding
Implementing Scheme	As this is the first PPP project in Vietnam financed by WB, the final implementing scheme will be decided after the international consultant selected by WB reviewed it..
Funding	Investment from local and foreign investors. Loan from national budget and World Bank.
Construction Schedule	4 years of construction period after starting in 2012

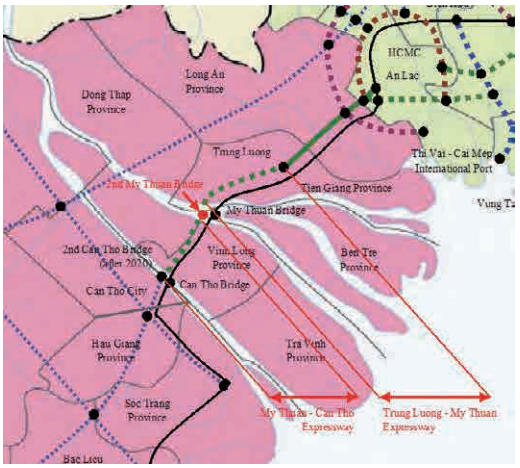
(2) My Thuan-Can Tho Expressway

Together with other Vietnamese corporations, Bank for Investment and Development of Vietnam established BIDV Expressway Development Company (BEDC) and acquired the business right of BOT for Trung Luong-My Thuan-Can Tho Expresway. However, due to the financial difficulty, the section between the second My Thuanb bridge and My Thuan-Can Tho was

[2]Mayer Brown Publications, 10 August 2010, "Vietnam's First Trial PPP Project"

transferred to PMU My Thuan in May, 2009. Latest outline of the Project is as follows:

Table 2.1.2-5 Outline of My Thuan-Can Tho Expressway Project

Name of Project	**My Thuan-Can Tho Expressway**	
Outline	The project is part of Trung Luong~My Thuan~Can Tho Expressway and connects My Thuan City and Can Tho City. About 32.3km of total length with 4 lanes and parking place for emergency at road standard A. Design speed is 100km/h- 120km/h There are 3 interchanges, 17 bridges traversing rivers and 3 over-pass. ITS including ETC and traffic management system and parking area are to be installed.	 source[3]
Total Cost	338 million USD (Of the total amount, it is reportedly said that Prime minister approved 350 billion VND or 18.3 million USD to be invested by the end of 2020)	
Executing Organization	Cuu Long Traffic Infrastructure Investment Development Management Corp (Cuu Long CIPM) under MOT establishes PPP company.	
Implementing Scheme	PPP Implementing agency：PMU My Thuan	
Funding	Using the right to collect toll fees at Can Tho bridge, CIPM invest 30% of total cost (upper limit is 83.35 billion VND). Investment from local and foreign investors. Vietnam government contributes the cost for land acquisition and part of compensation. ADB provide 175 million USD loan and technical assistance. 8 million USD will be disbursed in 2012.	
Construction Schedule	2 years of construction period after starting in 2012. People's committee in Dong Nai province and Binh Thuan province have expressed to undertake land acquisition and relocation of people.[4]	

(3) **Hanoi – Hai Phong Expressway**

Project outline, project scheme, fund procurement is shown in the next page.

[3] Study Report for Preliminary Study on Trung Luong - My Thuan - Can Tho Expressway Construction Project, March 2011, by Engineering and Consulting Firms Association, Japan and Nippon Koei Co., Ltd.

[4] Vietnam Investment Review, 15 November, 2010, "South Getting Connected"

<table>
<tr><td>Project</td><td colspan="3">Hanoi- Hai Phong Expressway</td></tr>
<tr><td>Project Outline</td><td colspan="2">Route:
Hanoi Ring Road No.3 ～ Hung Yen～Hai Duong ～Hai Phong
Road Length 105.5km
6-lane, Road Grade A
Design Speed 120km/h
Road width 100m
Interchange 7
ITS system and closed toll collection system will be introduced. Service area will be constructed.</td><td> 

Route Map</td></tr>
<tr><td>Total Project cost</td><td colspan="3">Approx. 1,722 million USD</td></tr>
<tr><td>Project Company</td><td colspan="3">VIDIFI (Vietnam Infrastructure Development and Finance Investment Joint Stock Company)。
Concession Contract is made with Ministry of Transport (MOT)
In order to compensate low commercial viability, the rights to develop the following:
i) Residential area in Gia Lam and Hanoi city (Total 400ha)
ii) New Urban development in Hai Phong and Hai Duong (150ha)</td></tr>
<tr><td>Project Scheme</td><td colspan="3">BOT (Concession Period 35 years)</td></tr>
<tr><td rowspan="3">Find Procurement</td><td colspan="2">Equity: approx. 250 million USD</td><td>Debt: approx. 1,472 million USD</td></tr>
<tr><td>Share holder</td><td>Ratio</td><td rowspan="2">Contracts Ex-3 and Ex-8 (Total 10 contracts)
Participation of Japanese Banks:
Sumitomo Mitsui Banking Corporation, The Sumitomo Trust & Banking Co.,Ltd , The Bank of Tokyo -Mitsubishi UFJ, Ltd and Citi Bank Japan Ltd
Loan Amount: 270 million USD
(16% of total project costs)
Finance Scheme: Above 4 banks lend US$ for expressway construction to Vietnam Development Bank (VDB) and VDB will VDB lend US$ to VIDIFI, a kind of 2 step loan. For other contracts, VDB and Vietcom Bank are main lenders.</td></tr>
<tr><td>Vietnam Development Bank : VDB
Others (Vietcom Bank Vinaconex, Sai Gon Invetment Group)</td><td>51%
49%
100%</td></tr>
<tr><td>Guarantee</td><td colspan="3">Vietnamese Government and Nippon Export and Investment insurance (NEXI) provide guarantee.
Vietnamese Government (VG) : When VDB is in default, VG unconditionally guarantee to repay the debt.
NEXI : Against Political Risk (restriction/prohibition of exchange dealings, raise in tariffs, restriction/prohibition of imports, acts by a third party other than the party concerned such as war or revolution, or natural disasters and extraordinary events) and Commercial Risk (Borrower, VDB, does not repay the loan) , Overseas United Loan Insurance are provided for 100% of loan amount for 15 years.</td></tr>
</table>

Consultants and Contractors

Contract	Length	Company name	Nationality
Ex-8	10km	Shandong Luqiao Group Co., Ltd	P.R. China
Ex-6	8.7km	GS Engineering & Construction Corporation	S. Korea
Ex-5	15.3km	- China Guangdong Provincial Changda Highway Engineering Co., Ltd - China Guangzhou International Economic and Technical Cooperation Co.	P.R. China
Ex-4	15km	PSJ	Czech
Ex-3	14km:	China Road & Bridge Corporation	P.R. China
Ex-2	12.8km	Namkwang Engineering and Construction Co., Ltd	S. Korea
Construction Supervision		Joint Venture of Meinhardt International Pte Ltd and Japan Engineering Consultants Co., Ltd	Singapore, Japan
Detailed Design		Joint Venture of Yooshin –KPT	S. Korea, Canada

Various source confirmed by MOT

2.1.2.6 Status of Foreign Company in Expressway Project

Figure 2.1.2-3 shows figure of sections by assigned investors and list of foreign companies implementing expressway projects, especially Hanoi – Hai phong, Noi Bai – Lao Cai, HCM – Long Than – Dau Giay expressways as they have many packages conducted by foreign companies. As shown in Table 2.1.2-, a lot of construction companies from South Korea and P. R. China.

Table 2.1.2-6 Presence of Foreign Companies in Expressway construction

Pro-ject	Package	Length	Contractor	Nation
Noi Bai – Lao Cai	1,2 & 3	48.7km	Posco E&C	S. Korea
	4 & 5	102.1km	Keangnam Enterprises Co., Ltd.	S. Korea
	6	39.5km	Doosan	S. Korea
	7	27.6km	Guangxi RBEC	P.R. China
	SV		Getinsa	Spain
	DD (TA, ADB)		PCI PCI Asia Apeco Hafico Groupe	Japan Philippines Vietnam Vietnam
HCM – Long – Dau Giay	1A	3.5km	China Road and Bridge Corp	P.R. China
	3	9.8km	Posco E&C	S. Korea
	5	3.9km:	Pumyang Construction Co., Ltd Sungjee Construction Co., Ltd	S. Korea
	6	17.1km of traffic road	Hashin Construction Co.	S. Korea
	SV(HCMC - Long Than)		Wilbur Smith Associates	USA
	SV (Long Than – Dau Giay)		Nippon Koei TEDI South	Japan Vietnam
	DD		Nippon Koei Hafico Groupe	Japan Vietnam

Various source confirmed by MOT

To see the investment plan, Dau Giay – Lien Khuong and Noibai – Halong expressway are listed. For Dau Giay – Lien Khuong expressway, South Korea's Incheon Urban Development

Corporation (IUDC) made a memorandum of understanding (MOU) with MOT for investment approx. 1 billion USD and plans to build and operate under BOT scheme.
For Noibai – Halong expressway, Economic and Technical Cooperation International Art Guangxi (GITEC) is conducting Feasibility study.

2.1.2.7 Position of the Project

The PV-CG section is located at the starting of the North-South Expressway, the project is to upgrade Bypass of National Route 1 currently in service; opening in 2002, four-lane, toll free; to the expressway standards and further widen to six lanes.
Road sector project priority list attached to the Prime Minister decision No. 05/2011/QD-TTg; Approval of the Transport Infrastructure Projects in Northern Economic Area issued on 24 January 2011, shows PC-CG Expressway (32.3km, 6 lanes).
In April 2011, the right of implement the Project was granted to VEC by MOT. Because of this fact, it is judged that neither New BOT Law nor PPP Piloting Regulation is applicable, because both Law and Regulations require tendering of right to implement the project. This Project will implement under the right granted to VEC and explore a new scheme of cooperation of Public Sector and Private Sector, respecting the intent of both Law and Regulations. If necessary, application for the Prime Minister's approval will be made.

2.2 Current Status and Future Prospects of Project-related Legislation in Vietnam

2.2.1 Legal Aspect regarding PPP

Decree 108 was taken effect on 15 January 2010. Degree 108 superseded Decree 78 that was issued in 2007. Regulation on Public-Private Partnership Investment Piloting (hereinafter referred to PPP Regulation) was issued on 9 November 2010 and it was enforced on January 15, 2011.

(1) Decision No. 71/2010/QD-TTg (PPP Piloting Regulation)

PPP Regulation is temporary regulation for making the Decree while 3 years or 5 years. Article 52 .2 includes the following provision.

> *"Matters not specified in this Regulation must comply with current law and international practices under the Prime Minister's decisions."*

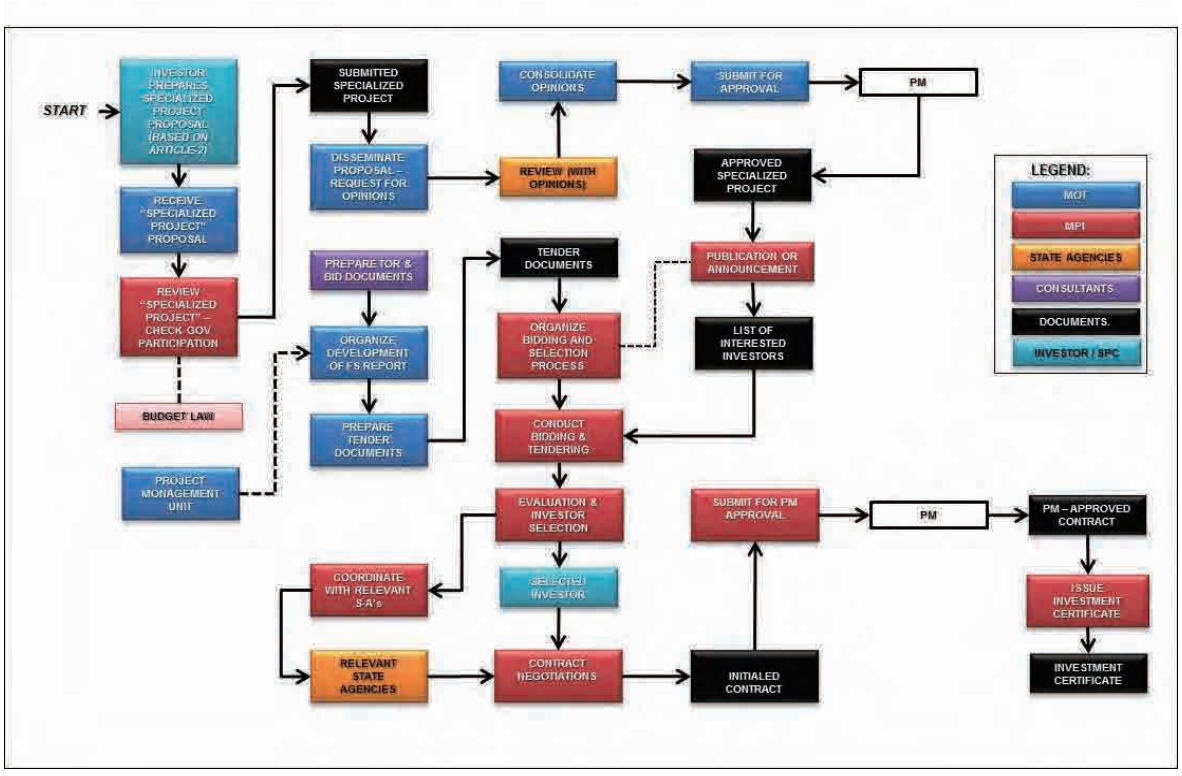
The following table summarizes characteristic points of this regulation.

Table 2.2.1-1 Characteristic points of PPP Regulation

Item	Characteristic
Competitive Bidding of Investors (Concession right)	• Under the regulation, investors are elected by the bid. It is different from decree 108. Schedules are prescribed by the regulation. For example, after the election, the negotiations for right of investment are performed within 30 days, and details contents of the contract are agreed. It is pointed out that these schedules are too short for negotiation from international standard.
State Contribution	• Investments from the state are decreased from 49% to 30%, except for

Item	Characteristic
	exceptionally indication from government.
Equity capital	• It is prescribed that private investment share should be more than 30% and loan share should be under 70%. It is international custom that private investment share is from 10% to 15%.
Investment Incentives	• It is prescribed that reduction of corporation tax, reduction of tariff, and exemption from fixed property tax. Foreign contractor is exempted from some taxation under the low.
Selection of contractor	• Project Enterprise (SPC) has to select the contractor in accordance with Laws and Regulations
Land acquisition	• The Provincial People's Committee expropriates the land, under the project contract.
Security	• Project companies are permitted to pledge or mortgage assets and land use rights in accordance with Vietnam's laws, subject to the consent of the authorized state body and provided that any such pledge or mortgage must not "adversely affect the objectives, implementation progress and operations of the Project".
Exchange Risk	• Project enterprise and investor are given license to exchange VND to foreign currency for the project accomplishment and to send profit to foreign country, under the law.

Following Figure shows project procedure for proposal and contract.



Source : METI FS

Figure 2.2.1-1 The project procedure for proposal and contract (PPP Regulation)

Project outline nominated for pilot project under PPP Regulation is shown in next page. Projects drew a line under its name show that they are among 9 priority ones in the total 24 pilot projects.

Table 2.2.1-2 Outline of pilot projects under PPP Regulation

Projects	Preliminary Information
Highway Ninh Binh – Thanh Hoa	About 126,7km long with 6 lanes, the road passes Ninh Binh, Nam Dinh and Thanh Hoa provinces. The total investment is VND 33,000 billion. MOT approved the final report and project proposal is expected to be submitted in 2011. The WB is taking procedures for raising fund from The Public Private Infrastructure Advisory Fund (PPIAF) do the FS for the Ninh Bình- Thanh Hóa-Bãi Vot Highway Project under PPP form.
Highway Dau Giay – Lien Khuong	This is a category A-highway with designed speed 80-120km/h, about 200km long with 4 lanes. The road passes Dong Nai and Lam Dong provinces. The investment for the project is VND 48,324 billion. MOT approved interim report and its proposal is expected to be approved in 2011.
Highway Ha Long – Mong Cai	This is a category A-highway with designed speed 80-120km/h, about 128km long with 4-6 lanes. The road locates in Quang Ninh province. The investment for the projects is about VND 25,000 billion. At this moment, a technical assistance project has been carried out to set up investment project. MOT approved interim report of Technical Assistance Project.
Highway Ben Luc – Hop Phuoc	This is an urban highway with designed speed 80-100km/h, about 25km long with 4-6 lanes. The road connects Long An province and Ho Chi Minh City. Investment for the project is about VND 15,000 billion. MOT is studying the project and have already approved the initial report.
Highway Nghi Son (Thanh Hoa) – Bai Vot (Ha Tinh)	This is a category A- highway with designed speed 100-120km/h, about 93km long with 4-6 lanes. Investment is about VND 23,000 billion. MOT approved interim report and project proposal is expected to be approved in 2011. The WB is taking procedures for raising the fund from The Public Private Infrastructure Advisory Fund (PPIAF) to do the FS for the Ninh Bình- Thanh Hóa-Bãi Vot Highway Project under the PPP form.
Ho Chi Minh Highway, Cam Lo – La Son Section	This is a category B-highway, designed speed 80km/h, 103km with 4 lanes (2 lanes to be completed first), It locates in Quang Tri and Thua Thien Hue provinces. Investment is about VND 16,000 billion. MOT is studying the project and its approval is expected to be made in 2011.

(2) **Decree 108/2009/ND-CP (New BOT Law)**

On 27 November 2009, Decree 108/2009/ND-CP (Decree 108) was issued. Decree 108 superseded Decree 78/2007/ND-CP (Decree 78) and became effective from 15 January 2010. Decree78 contained key investor incentives and was implemented with the aim of providing a uniform

framework applicable to both Vietnamese and foreign investor.

There were notable revisions of Decree 78 that were addressed in Decree 108.

- Decree 108 continues to retain the 10% equity requirement for projects with investment capital greater than or equal to VND1,500 billion for the portion in excess of the threshold. It also stipulates a required equity ratio equal to 15 per cent in respect of the amount under VND1,500 billion. This would result in an increased overall equity requirement for large-scale projects compared to the position under Decree 78. The 30% equity requirement for projects under VND75 billion has been eliminated. Decree 108 now stipulates a 15 percent equity requirement for all projects under VND1,500 billion.

- Decree 108 specifies that the state-owned capital used to carry out a project must not exceed 4% of the "total investment capital" (comprising debt plus equity), of such project, whereas Decree No. 78 specified a limit of 49 per cent or less of the "required equity" of the investor. This potentially allows the state a greater participation in a project.

- Decree108 stipulates that ministries and local people's committees must make an annual announcement, on January 1, of the list of potential projects which require investment. This announcement must appear in three consecutive issues of the bidding process. Decree No. 108 limits a time to be 30 days from the last issued announcement published for investors to register their interest in certain projects.

- Both Decree 78 and Decree 108 force bidding for projects which are registered for implementation by two or more investors. However, both decrees also contain exceptions to this rule, where an investor may be appointed by the relevant authority without a competitive bid. Significantly, under Decree 108, any project proposed by an investor must in general be publicly tendered out.

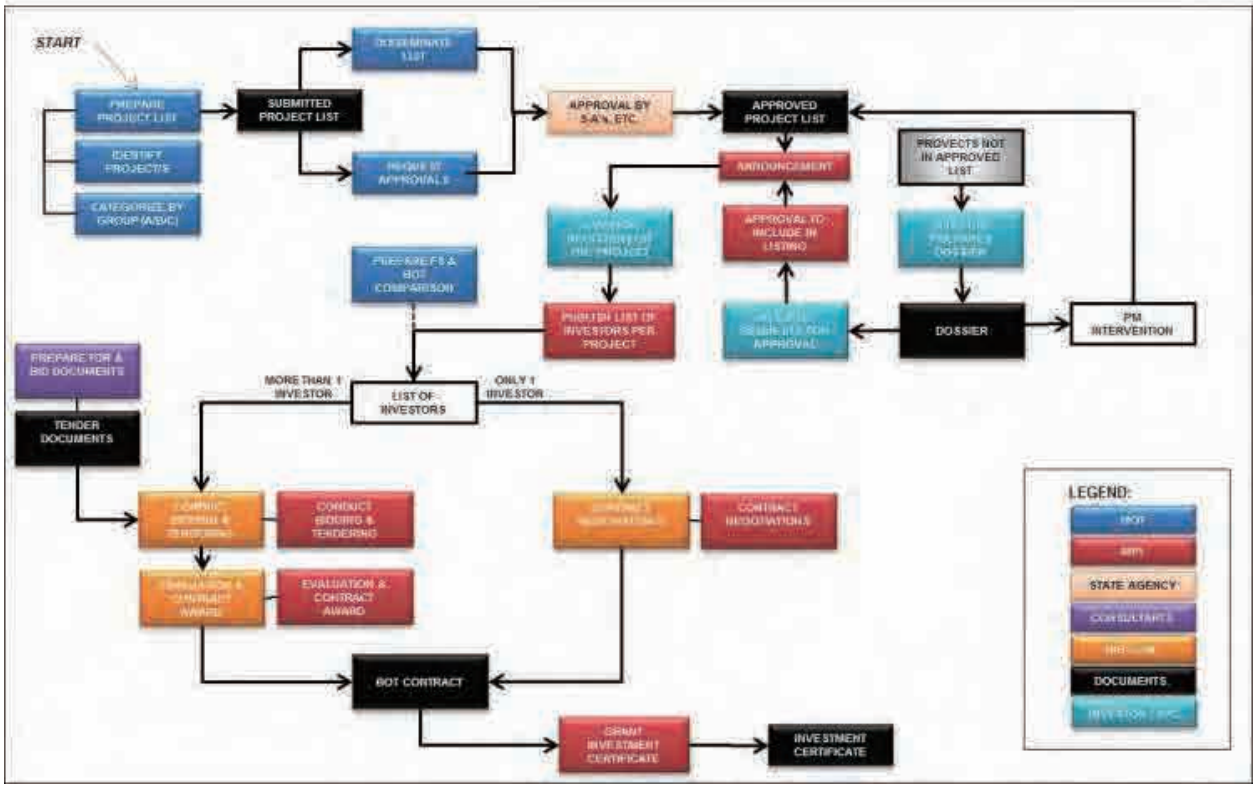
- Under Decree 108, the MPI is clearly authorized to issue investment certificates for projects of "national importance", projects for which a ministry, branch or a body delegated with authority by such ministry or branch is the authorized state body to enter into the project contract and projects which are to be implemented on an area covering a number of provinces or cities under central authority.

- Under Decree 108, all other projects must be licensed by the local people's committees. Investors are required to post a guarantee or security in respect of project performance. The amount of the security depends on the total invested capital of the relevant project. Under Decree108, a 2 per cent minimum deposit/guarantee is required for projects with investment capital equal to or less than VND1,500 billion. For projects with investment capital greater than VND1,500 billion, 1 per cent is required for the amount above VND1,500 billion and 2 per cent is required for the portion under VND1,500 billion.

- Decree108 provides generally that Corporate Income Tax (CIT) incentives for BOT, BTO

and BT projects are in accordance with the "applicable CIT regulations". This provides, for most infrastructure projects, that the 10 per cent preferential rate is available for only 15 years of operation. In addition, the CIT regulations state that the tax exemption and reductions will be applied from the fourth year of operation regardless of the project's profitability at that time.

Figure in the next page shows the process undertaken from Project Listing (by MPI) to Contract, under Decree 108.



Source: METI FS

Figure 2.2.1-2 Process: From Project Listing to Contract – Decree 108 (New BOT Law)

(3) Decree No.12/2009/ND-CP (On Management of Investment Projects on the Construction Works)

Decree No.12/2009/ND-CP was issued on 12 February 2009 and it superseded Decree No.16/2005/ND-CP and No.112/2006/ND-CP. It was taken effect on 2 April 2009. This Decree specifies the following:

(i) Depending on the charcteristic and scale of the project, the projects categorised as Group A, B and C. Group A is large. Authority who evaluates and approve Feasibility Study is specified. Some projects in Group A requires an approval of the Prime Minister.

(ii) Feasibility Study includes Basic Design and Environmental Impact Assessment (EIA) etc. (Article 6,7 and 8)

(iii) The evaluation of Basic Design shall be conducted simultaneously with but not separately from the evaluation of Feasibility Study (an investment project)

(4) **Decree No.29/2011/ND-CP (Providing Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment)**

Decree No.29/2011/ND-CP was issued on 18 April 2011 and it superseded a part of Decree No.80/2006/ND-CP and No.21/2008/ND-CP. It was taken effect on 5 June 2009. Previous Decree No.21/2008/ND-CP requires EIA only for the projects in the length not less than 50 km for upgrading or improving Expressway or Grade I, II or III of Highway. Decree No.29/2011/ND-CP, however, specifies that upgrading or improving Expressway or Grade I, II or III of Highway requires EIA irrespective of its length.

2.2.2 Toll Collection

A present flow of toll collection from planning to execution is as follows:

The Toll Collection Regime calls for the MOF to provide an operator with a set of Toll Reference Rates – the established precedent rates. The operator takes account of these reference rates and submits its Toll Collection Plan to be approved by the MOF. Once the operator-submitted Toll Collection Plan is approved by MOF, this is relayed to the Treasury and the Tickets (Couc Duong Bo) are printed and released to the operator. The operator then sells the Tickets to the Users at the Toll Selling Stations[5].

The User pays the toll by surrendering the Ticket to the toll collector who in turn sends the collected Tickets to the operator office. The operator reconciles and transfers the cash to the Treasury and finally endorses it to the MOF for disbursement to the operator after reconciliations with the operator collection accounts.

Currently, there is no regulation or law concerning toll collection for expressways in Vietnam; however, there are some existing regulations on charges and fees for toll roads:

(i) Ordinance on charges and fees No. 38/2001/PL-UBTVQH10 of August 28, 2001

(ii) Decree No. 57/2002/ND-CP of June 3, 2002 stipulating details in the implementation of the ordinance on charges and fees

(iii) Decree No. 24/2006/ND-CP of the Government on amendment and supplement to some articles of Decree No. 57/2002/ND-CP of the Government dated 03/06/2002 providing in detail the implementation of the Ordinance of Fees and Charges

(iv) Circular No 109/ 2002/TT-BTC of December 6, 2002 guiding the regime of collection, remittance, management and use of road tolls

(v) Circular No. 90/2004/TT-BTC of September 7, 2004 guiding the regime of collection, remittance, management and use of road tolls (replaces Circular No.

[5] At present, common Toll Selling Stations are the operative mode. However, this could be modified for the Private Enterprise (Sector) to have its Toll Selling Stations for its exclusive use.

109/2002/TT-BTC)

With this Circular No.90/2004/TT-BTC, Ministry of Finance stipulates the regulations on the charging and collection of tolls; and the payment, management and use of the collected tolls. It consists of 5 parts: (i) General Provision, (ii) Collection Level and Toll Management and Use Applicable to Each Kind of Road, (iii) Toll Collection Vouchers and Responsibilities of Road Toll Collecting Organizations, (iv) Handling of Violations, (v) Organization of Implementation, and the toll rate table for each vehicle type as Appendix

Some of the key points are as follows:

(i) Toll rates for roads invested with state budget capital shall uniformly apply to all toll booths according to the toll rate table attached to the Circular (refer to Table 3.1.3-3)

(ii) The par value of the single-trip ticket for a car under 12 seats is 10,000 VND per trip.

(iii) The minimum distance between two toll booths on a successive road must be 70 km or longer

(iv) The toll rates for roads invested for business (including BOT and other forms of business) shall not exceed twice the rates applicable to roads invested with state budget capital.

(v) Toll collection companies shall be entitled to deduct part of the collected toll amounts in percentages before remitting them to the state budget

(vi) Toll collection companies may deduct 20% of the collected toll amounts, 5% of which shall be paid to Vietnam Road Administration to invest in the modernization of toll-collection technology. The remaining 15% shall be used to cover the expenses required for toll collection operations.

Table 2.2.2-1 Toll Rate Table by Vehicle Type

Class	Vehicle Type	Toll Rate (VND/Trip)
1	Two wheelers, three wheelers	1,000
2	Tractors	4,000
3	Cars under 12 seats, trucks of a tonnage of under 2 tons, and mass transit buses	10,000
4	Cars with 12 to 30 seats, trucks of a tonnage of 2 to 4 tons	15,000
5	Cars with over 30 seats, trucks of a tonnage of 4 to 10 tons	22,000
6	Trucks of 10 to 18 tons, and 20ft container lorries	40,000
7	Trucks of over 18tons, and 40ft container lorries	80,000

Source: Circular 90/2004/TT-BTC, as of September 7 2004, Guiding the Regime of Road Toll Collection, Payment, Management and Use, MOF.

2.2.3 Legal and Financial Constraints

This project is based on the right to improve, construct and operate PV-CG Expressway granted

to VEC by MOT in April 2010 and a new scheme in which public sector and private sector shares risks is explored. Because the right has been granted to VEC, neither new BOT law nor PPP Piloting Regulation governs this Project. Project Implementation is to be carried out based on a new scheme under the Prime Minister's Decision in the same way as Hanoi-Hai Phong Expressway project which is currently under construction based on the Prime Minister's Decision No.1621/QD-TTg. (Implementation procedures will be decided by the report which will be submitted by MOT to the Prime Minister.)

(1) **Legal Constraints**

(a) As stated above, neither new BOT law nor PPP Piloting Regulation governs this Project. These two law and regulation do not impose direct limitations to the Project. However it is necessary to respect the intent of these two law and regulation and, where applicable, to preserve the intent of them.

(b) PPP Piloting regulation stipulates that the total value of the State contribution shall not exceed 30% of the total project investment except otherwise decided by the Government. In the light of the above stipulation, VEC's investment amount and method to the SPC and the costs of land acquisition, resettlement and compensation should be carefully studied.

(c) By the regulation, the tolls collected at the toll roads in Vietnam should be delivered to MOF before distribution. Whether or not it is possible to simplify and expedite the money flow from road users to the SPC should be examined.

(d) The toll rates for roads invested for business (including BOT and other forms of business) shall not exceed twice the rates applicable to roads invested with state budget capital. Despite as high as approx. 20% of inflation experienced in 2011, no revision is made regarding upper limit of tolls. As a minimum, it is necessary to agree a mechanism to revise tolls linked to inflation rates experienced in the previous period.

(e) According the Vietnamese regulations, the Basic Design for the large infrastructure projects, should be approved by the Prime Minister, for which their EIA should have been approved by MONRE's (or DONRE's) in advance. Without those approvals, the procedures including land acquisition and detailed design cannot be commenced. Since it is a time-consuming process, it is recommended that required procedures shall be practiced soonest possible.

(2) **Financial Constraints**

(a) At the macro level, the amount of Vietnam's public debt has exceeded 50% of GDP and is nearing to 60%. It is required to formulate the project without increasing public debt of Vietnamese Government.

(b) Under such financial situations, the MPI has consistently stated that viability gap funding or other forms of guarantees from the Government would be available for PPP pilot projects only in exceptional cases.[6]

(c) Conversion Risk is considerable risk for foreign investors from financial point of view. Inflation rate (CPI) in Vietnam in 2011 experienced as high as approx.20% compared to 2010. The tendency in which currency depreciation of Vietnam Dong against Japanese Yen continues. The same tendency is observed in other currency, such as US Dollar and Euro. Hedge of conversion risk is big issue and big financial constraint in case equity and debt is

[6] PPP Update: "Forget about past experience", Hogan Lovells, June 2011

provided in Japanese Yen or Yen-denominated base.

2.3 Situation and Trend of Foreign Companies, Current Status in Project Areas

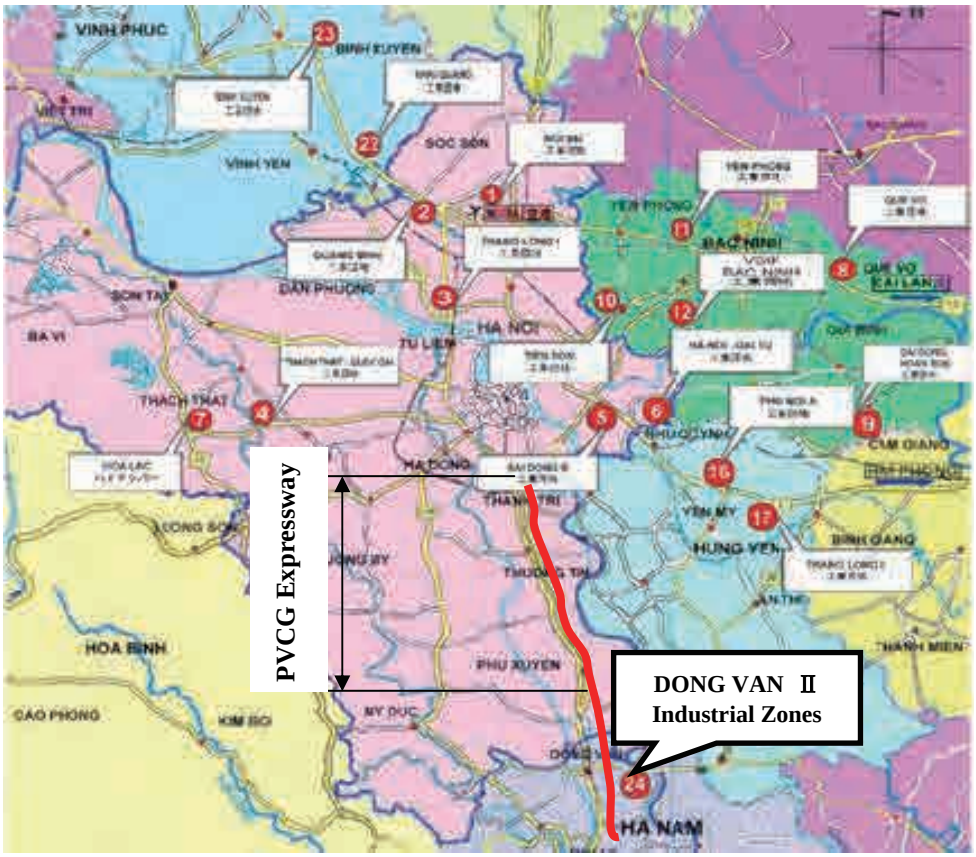
2.3.1 Outlines of the Project Area

2.3.1.1 Project Area

The location of industrial zones in Hanoi are Shown in the following Figure. Industrial zones are situated mainly along the main roads for highly convenient.

Major arterial road	Explanation
Than long－Noi bai	The highway linking Hanoi city (Thang Long bridge) and Noi Bai Airport.
Highway No.5	The highway linking Hanoi city and Hai Phong city.
Highway No.18	The highway linking Hanoi city (NoiBai Airport) and Cai Lan Port.

There is Dong Van II Industrial Zone (7 Lots out of total 11 Lots are Japanese-owned-companies which handle rare earth, motor bike parts, electronic parts, etc. for Exporting) in the south of PVCG highway. Therefore, future development along the “PVCG Expressway” as well as other industrial park is expected.



Source: Data Collection of Industrial Zone among south and middle Vietnam from JETRO

Figure 2.3.1-1 Location of Industrial Zones

2.3.1.2 Cau Gie - Ninh Binh Expressway

The Cau Gie–Ninh Binh Expressway is the first expressway that VEC has responsibility from construction to operation and maintenance. 56km long expressway is under construction. In the first phase, 4 lane expressway with 6 lane sub-grade will be constructed and carriageway will be

widen to 6 lanes in the second phase.

Total construction cost is estimated to be 8.9 trillion VND and funding sources are VEC's equity and Government Guaranteed Bond.

As of September 2011, 20km is completed. It is scheduled to partially open on November 2011. Progress of implementation is behind the schedule, however, 1.7 trillion VND project bond guaranteed by Government is approved by the Prime Minister, in addition to 5 trillion VND which has been approved by September 2011. Next year, remaining 2.2 trillion VND will be invested and expected to be fully open to traffic on September 2012.

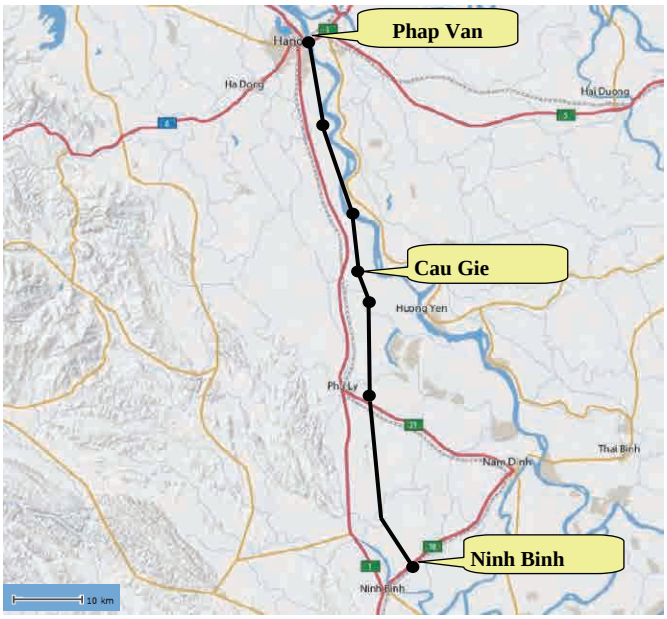
Basic design of Intelligent Transport System (ITS) on Cau Gie – Ninh Binh expressway was conducted by joint venture of CADPRO (Vietnam) and Guangxi (China), with technical review by Korean Expressway Corporation (KEC). After the completion of Basic design, MOT issued the letter to relevant agencies to apply RFID passive 860-960Mhz according to Standard ISO/IEC 18000-6C, generation 2 for no-stop automatic toll collection system for expressway project in Vietnam. Following that letter, CADPRO revised and resubmitted the basic design of ITS to MOT and it was approved. Detailed design was conducted by CADPRO and under examination at present. The ITS system applied to Cau Gie – Ninh Binh is also applied to PV-CG.

Table 2.3.1-1 Traffic Forecast of Cau Gie – Ninh Binh

Unit: PCU/day

Year	Cau Gie-Phu Ly	Phu Ly- Ninh Binh
2012	12,830	9,875
2015	24,293	20,184
2020	53,389	48,594
2025	87,034	82,621
2030	121,825	116,949

Source: August 2011 VEC HP (http://123.30.183.233:8080/popup.aspx/en/66/0/cid=330/nid/tempid=1）



Source：Study Team

Figure 2.3.1-2 Route from Phap Van to Ninh Binh

Table 2.3.1-2 Traffic Forecast of Phap Van– Cau Gie(VEC)

Unit: PCU/day

Year	Phap Van– Cau Gie	Remark
2015	19,802	Toll fee is 1,000VND/Km
2020	25,380	
2024	30,271	

Source: October 2011 VEC

Table 2.3.1-3 Traffic Forecast of Phap Van– Cau Gie(Study team)

Unit: PCU/day

Year	Phap Van– Cau Gie	Remark
2015	34,308（21,785）	Toll fee is 1500VND/km at the time of the year 2012 The value of brackets are vehicles / day
2020	51,434（31,179）	
2024	62,801（36,353）	

Source: Study team

Study team also carried out the Traffic Demand Forecast. The results are shown in Sub-Clause 3.1.2 Traffic Demand Forecasting.

2.4 Necessity of Project

Traffic congestion in Hanoi is getting worse year by year for its growing economy and increasing number of motorcycles and private cars. On March 2010, Hanoi city announced to construct promptly new viaduct roads on the heaviest congested 6 roads, as well as to enforce traffic regulation.

On the other hand, Master Plan of North – South Expressway, which connects Hanoi and Can Tho, was approved by prime minister on 21st January 2010. “PV-CG Expressway”, the starting point of North –South Expressway and the first road in the standard of expressway in Vietnam, is suffering from pavement deteriorations due to traffic loading and ground settlements. Upgrading of existing Highway to “PV-CG Expressway” and widening to 6-lane is required for coping with increasing traffic volumes. According to the traffic forecast of PVCG Expressway, there is 62,801PCU/day in 2024 and it is close to around 90% of 72,533PCU/day which is traffic capacity, so it is dispensable for widening to 6-lane.

Although the project was granted to VEC by Vietnamese Government via MOT in 2010, the project has not been implemented yet because of difficulty of financing.

All these condition indicate that the necessity of project implementation with utilizing private fund efficiently. This Project m

2.5 Basic Principles in the Proposal

This study is formulated based on the following principles:

(1) Early improvement of PV-CG Expressway

At Cau Gie, a gateway to Hanoi, the project connects with Cau Gie-Ninh Binh Expressway where its construction is now undergoing. Thus, it is necessary to improve the Project firmly and timely in consistent with the opening schedule of the said Expressway.

(2) Provision of funds for improvement of other Expressways by maximizing revenue of VEC

Expressways in Vietnam are valuable assets to the country and people. Thus the mechanism that the portion exceeding the reasonable profit corresponding to its investment will be effectively stocked by VEC and used for the improvement of other expressways in Vietnam, shall be built in as part of the Project.

(3) Maximum utilization of Japanese technology and know-how on Expressway operation

Expressway is not only one of the most important social infrastructures for the development of the nation but also requires substantial costs for its operation and maintenance for a longer period of time. Thus, it shall be secured that construction, operation and maintenance of Expressway will be undertaken considering the entire period in future as well as the period during collecting toll fees. Furthermore, by utilizing Japanese technology and know-how at its maximum, Expressway shall be improved and operated highly taking safety aspect into account.

(4) Close cooperation between Japan and Vietnam for Project formulation and implementation

The section to be improved is a part of the North-South Expressway which is one in the three strategic sectors Japan and Vietnam governments agreed to cooperate. Thus, it is significant that relevant Japanese and Vietnamese official institutions and private companies cooperate closely because this section is the most critical gateway to Hanoi.

3. Study and Proposal on Project Implementation Plan

3.1 Traffic Demand Forecasting

3.1.1 Traffic Demand Forecasting

Traffic demand has been estimated in this study according to the existing statistics and the latest data acquired during an onsite study.

(1) Summary

Traffic demand forecast had been estimated in both METI F/S and VEC F/S. There is large difference between traffic volume in METI F/S and traffic volume in VEC F/S, because data and calculation method applied in each existing study were different. OD in METI F/S was based on VITRANSS2 which data contain wide area, and OD in VEC F/S was based on traffic survey result. Thus VEC F/S does not take road network around PV-CG Expressway into account.

The Study Team calculated traffic demand forecast based on OD of METI F/S with revised road network and revised time cost. Following Items (3), (5) and (6) are extracted from METI F/S.

(2) Existing Study

1) METI F/S

The summary of the demand forecasting conducted as part of METI F/S is shown below:

Table 3.1.1-1 Summary of METI F/S's Demand Forecasting

Items	Summary
Zone classification	70 Zones in total (30 zones including the Hanoi City and Noi Bai International Airport; and 40 zones for outside the City, which follows the zones defined in VITRANSS2)
Current OD (Origin-Destination)	The data of interprovincial traffic determined by VITRANSS2 are used. Hanoi City is divided in zones according to the population. Inner-city traffic was determined through the result of interview-based survey.
Future OD	For interprovincial traffic, the OD data from the VITRANSS2 was used. For inner-city traffic, socioeconomic index for 2020 and 2030 was used to forecast the future OD.
Network	Hanoi City Master Plan
Service road	None
Toll rate	800VND/km

2) VEC F/S

The summary of the demand forecasting conducted as part of VEC F/S is shown below:

Table 3.1.1-2 Summary of VEC F/S's Demand Forecasting

Items	Summary
Zone classification	12 Zones in total (5 zones for the Hanoi City and 7 zones outside the City)
Current OD	Interview-based survey or traffic counts were used to determine the current OD data.
Future OD	Socioeconomic index was used to determine the future OD.
Network	Takes account of the current network and the future developments (PV-CG Expressway: 6 lanes, Ho Chi Minh Expressway: 4 lanes, North-South Express Railway, Ring Road No.3, 4, 5)
Service road	2-lane roads in both sides of the expressway will be constructed in parallel. For the purpose of traffic demand forecasting, the traffic volume of the expressway (excl. the service road) will be calculated, then certain percentage of each vehicle type will be assigned to the traffic volume of the service road
Toll rate	Free

3) Comparison of existing studies

The following tables show the comparison of the traffic volume estimates between the METI F/S's calculation and the VEC F/S's calculation (Passenger Car Unit/day). The estimates for Year 2020 or 2030 determined by the METI F/S are 1.1 to 1.2 times or 1.4 times higher respectively than those from VEC F/S.

Table 3.1.1-3 Comparison of Traffic Volume Forecasting for Year 2020

（PCU/day）

Type of vehicle	Phap Van - Thuong Tin		
	VEC FS (a)	METI FS (b)	(b)/(a)
Car	15,493	23,659	1.53
Small Bus	8,335	18,688	0.96
Large Bus	11,152		
Small Truck	9,238	13,653	1.34
Large Truck	929		
Total	45,147	56,000	1.24

Type of vehicle	Thuong Tin – Cau Gie		
	VEC FS (a)	METI FS (b)	(b)/(a)
Car	14,665	11,836	0.81
Small Bus	8,407	15,957	0.80
Large Bus	11,490		
Small Truck	8,434	24,907	1.96
Large Truck	4,288		
Total	47,284	52,700	1.11

Table 3.1.1-4 Comparison of Traffic Volume Forecasting for Year 2030

（PCU/day）

Type of vehicle	Phap Van - Thuong Tin		
	VEC FS (a)	METI FS (b)	(b)/(a)
Car	27,013	29,347	1.09
Small Bus	12,527	17,497	0.64
Large Bus	14,921		
Small Truck	10,709	48,226	4.13
Large Truck	977		
Total	66,147	95,070	1.44

Type of vehicle	Thuong Tin – Cau Gie		
	VEC FS (a)	METI FS (b)	(b)/(a)
Car	28,028	15,159	0.54
Small Bus	13,902	17,340	0.56
Large Bus	17,123		
Small Truck	10,687	73,054	4.92
Large Truck	4,163		
Total	73,903	105,553	1.43

(3) Methodology for Traffic Demand forecast

Traffic demand forecast was done in the following way:

<OD Matrix>

◇ Build the regression model from Socio Economic Indices until 2010 and volume of Generation and Attraction of Passengers and Freight in 2010.

◇ Estimate volume of Generation and Attraction of Passenger and Freight in 2020 and 2030 by Regression model and Socio Economic frame in 2020 and 2030.

◇ Build the Trip Assignment Model based on Generation and Attraction of Passenger and Freight in 2010 and their distribution.

◇ VITRANSS2 was comprehensive transport master plan covering from road, railway, aviation, inland waterway and to seaway. OD matrices developed in VITRANSS2 are passenger based on passenger OD and tonnage based on freight OD. Modal share was considered at the same time. In this regards, Study Team also developed OD based on passenger and OD based on tonnage, respectively, and then calculated OD based on trip by car type from share of car type and average occupancy for passenger car or average of loading for truck.

<Road Network>

◇ Establish road networks in 2020 and 2030 were based on Hanoi City Master Plan[1]

Based on the above, traffic forecast was done by conducting traffic assignment using OD matrices based on VITRANSS2and Networks in 2020 and 2030.

[1] Hanoi Construction Master Plan through 2030 with a Vision towards 2050, Hanoi City, 2010

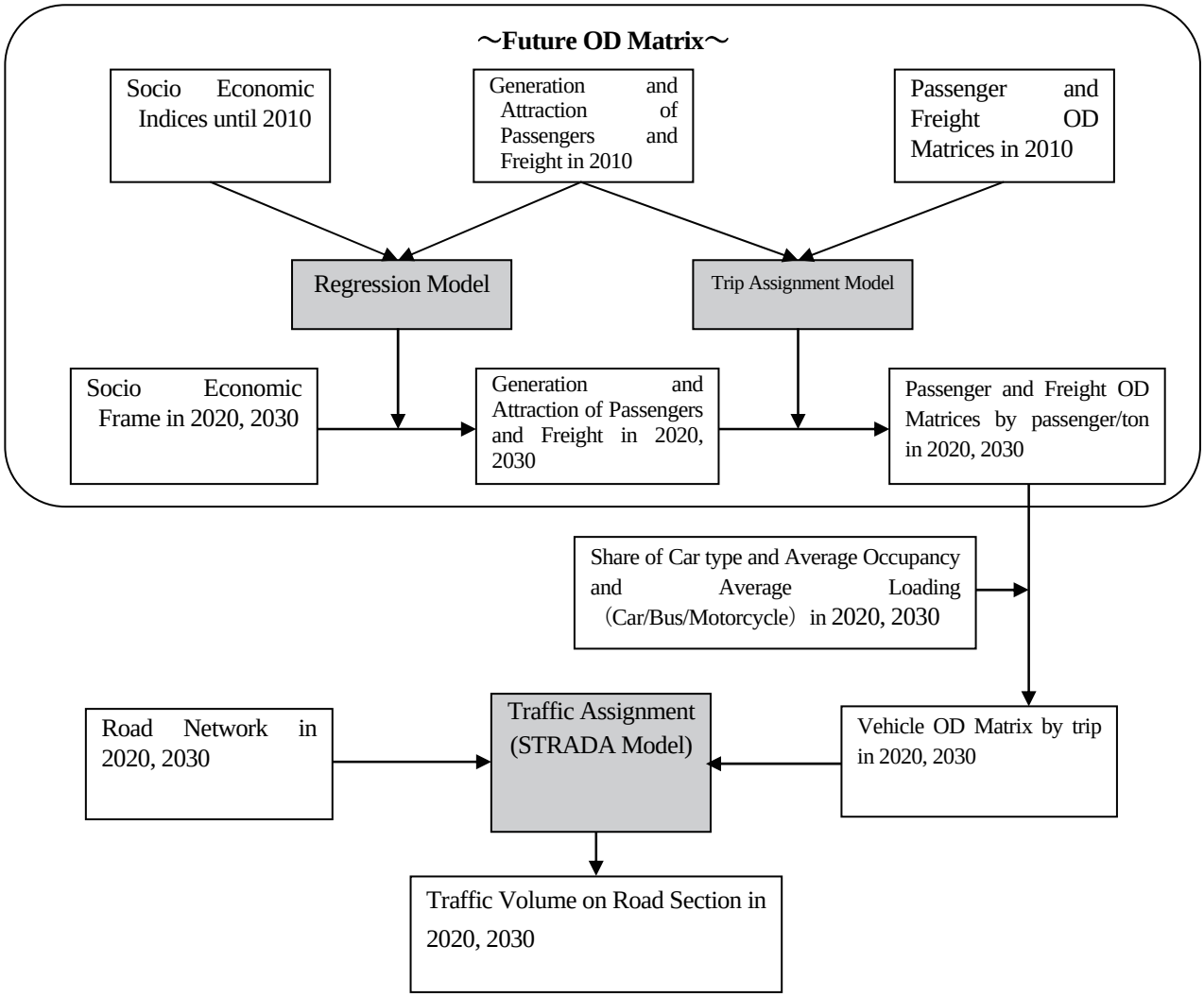


Figure 3.1.1-1 Flow of Estimating Future Traffic Demand Forecast

(4) Zoning

PV- CG is a link originating from the Ring Road 3 of Hanoi going parallel with NH1 and joining with NH1 at Cau Gie. Traffic demand on this road is mainly Interprovincial transport, which is very small and mainly long-distance trips. Cau Gie – Ninh Binh Expressway is under construction and expected to open in 2012. Urban traffic demand includes daily commune trips and short-distance trips using the NH1.

Traffic demand on two future expressways will consist of interprovincial traffic and through traffic of Hanoi and long-distance Inner-provincial traffic. In order to forecast the traffic demand on the expressways, the Study Team divides whole Hanoi city area into 29 traffic zones in accordance with 29 provinces of Hanoi. In Addition the Study Team divides Thanh Tri Province into 2 zones, and Thuong Tin Province into 4 zones, and Phu Xuyen Province into 3 zones. PV-CG Expressway located on these three provinces. As a result, 35 zones were finally studied. Thanh Tri, Thuong Tin and Phu Xuyen are divided accordance with each district. And OD is distributed in proportion to each zone's population.

Table 3.1.1-5 Traffic Zone in Thanh Tri、Thuong Tin、Phu Xuyen

Before divided (Province)	After divided（District）	Population (Person)
Thanh Tri	Van Dien, Dai ang, Huu Hoa, Lien Ninh, Ngoc Hoi, Ta Thanh Oai, Tam Hiep, Tan Trieu, Thanh Liet, Tu Hiep, Vinh Quynh	122,560
	Dong My, Duyen Ha, Ngu Hiep, Van Phuc, Yen My	36,190
Thuong Tin	Thuong Tin, Ha Hoi, Hien Giang, Hoa Binh, Khanh Ha, Nguyen Trai, Nhj Khe, Quat Dong, Tan Minh, Tien Phong, Van Binh, Van Phu	83,284
	Chuong Duong, Duyen Thai, Hong Van, Lien Phuong, Ninh So, Thu Phu, Tu Nhien, Van Tao	55,122
	Dung Tien, Minh Cuong, Nghiem Xuyen, Thang Loi, To Hieu, Van Tu	45,171
	Le Loi, Thong Nhat, Van Diem	18,993
Phu Xuyen	Phu Xuyen, Chau Can, Chuyen My, Dai Thang, Dai Xuyen, Hoang Long, Hong Minh, Phu Tuc, Phu Yen, Phuong Duc, Quang Trung, Son Ha, Tan Dan, Tri Trung, Van Hoang, Van Tu	106,450
	Phu Minh, Hong Thai, Nam Phong, Nam Trieu, Thuy Phu, Van Nhan	29,819
	Bach Ha, Khai Thai, Minh Tan, Phuc Tien, Quang Lang, Tri Thuy,	48,243

Source:

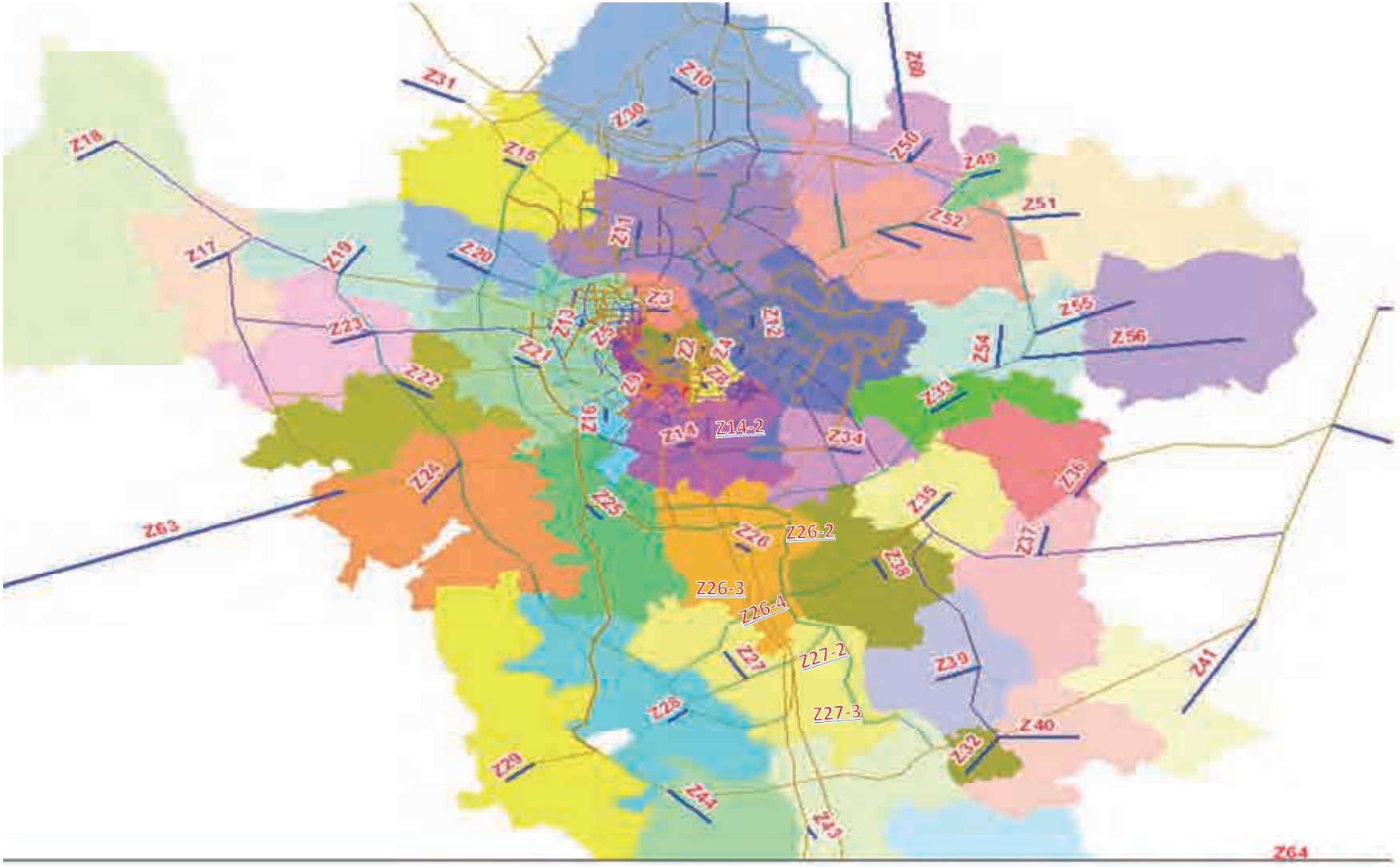


Figure 3.1.1-2 Traffic Zone

(5) Modal Share Settings

According to the transport development plan of Hanoi Capital to 2020, Hanoi will have a railway network with 5 lines, in which line 2 from Noi Bai to the city center is competing against "Mai Dich - Noi Bai". On the other hand, there is no railway line competing against "PV- CG". Therefore, modal share of railway was not set for "PV - CG".

1) Share of Passenger Vehicle

Share of passenger vehicles consisting of passenger car, bus and motorcycle are show in which are applied traffic survey result of locations 7, 9, 11, 13 and 15. Though share of motorcycle is 6.64%, future share had assumption to be decreased gradually.

Table 3.1.1-6 Share of Passenger Vehicle

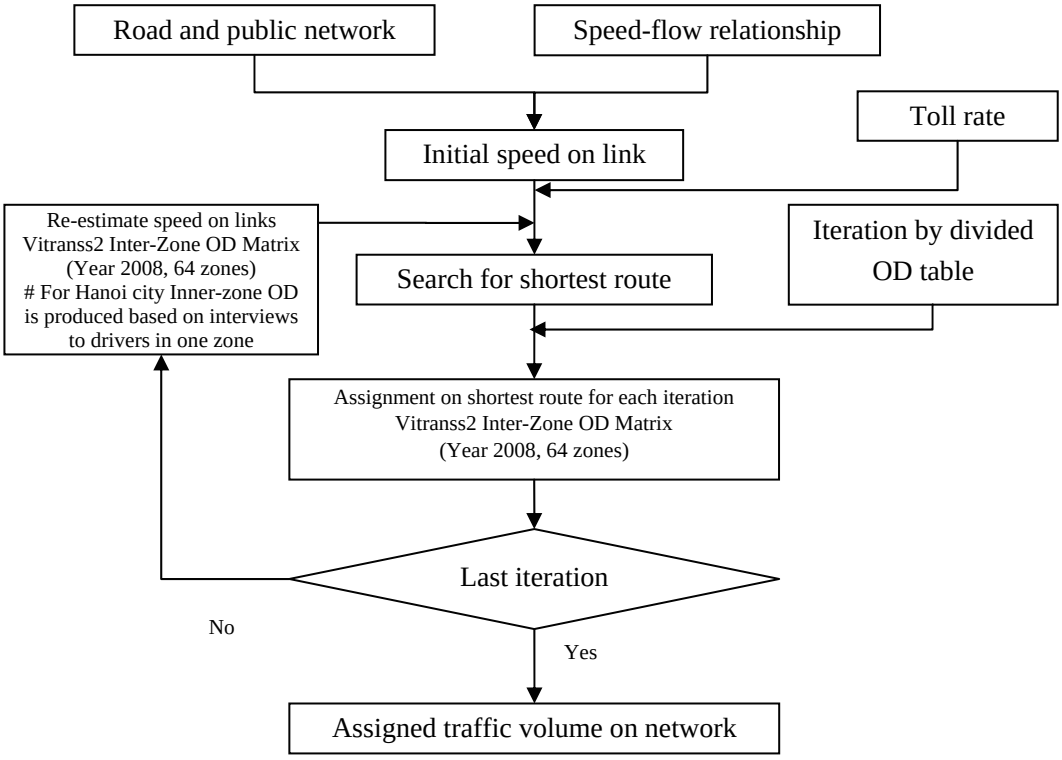
Unit : % of trips/ day

Year	Car	Bus	Motorcycle
2020	48.67%	45.34%	5.99%
2030	53.78%	41.26%	4.96%

Source: Study Team

(6) Conditions of Traffic Demand Forecast

In this study, capacity restraint assignment method, which was the most commonly used in network models, was applied. This assignment technique is based on the speed – flow relationship, and the flow chart of the applied methodology is shown in Figure 3.1.2-3. In this assignment technique, and by calculating the required travel time for each link according to its travel speed and road conditions, the program determines the fastest routes between each origin and destination by evaluating the consuming time on links, and assigns the trips between the given origin and destination to these routes starting to the destination and working back to the origins. As congestion increases till a certain level, alternative routes are introduced to handle the unassigned traffic. Zone-to-zone routing is built, which is the fastest path from each zone to any other, and all trips are assigned to these optimum routes.



Source: METI F/S

Figure 3.1.1-3 Traffic Assignment Flowchart

(7) Road Network

The Study Team make a road network include with Hanoi City Road at east side of PV-CG Expressway, because Hanoi City made construction plan of Hanoi City Road. The Study Team makes plan of frontage road on both side of PV-CG Expressway. But the Study Team is not include this frontage road in the network for traffic demand forecast, because this frontage road will be construct for residents who lived in around PV-CG Expressway and this traffic demand forecast handle long and middle range trip.

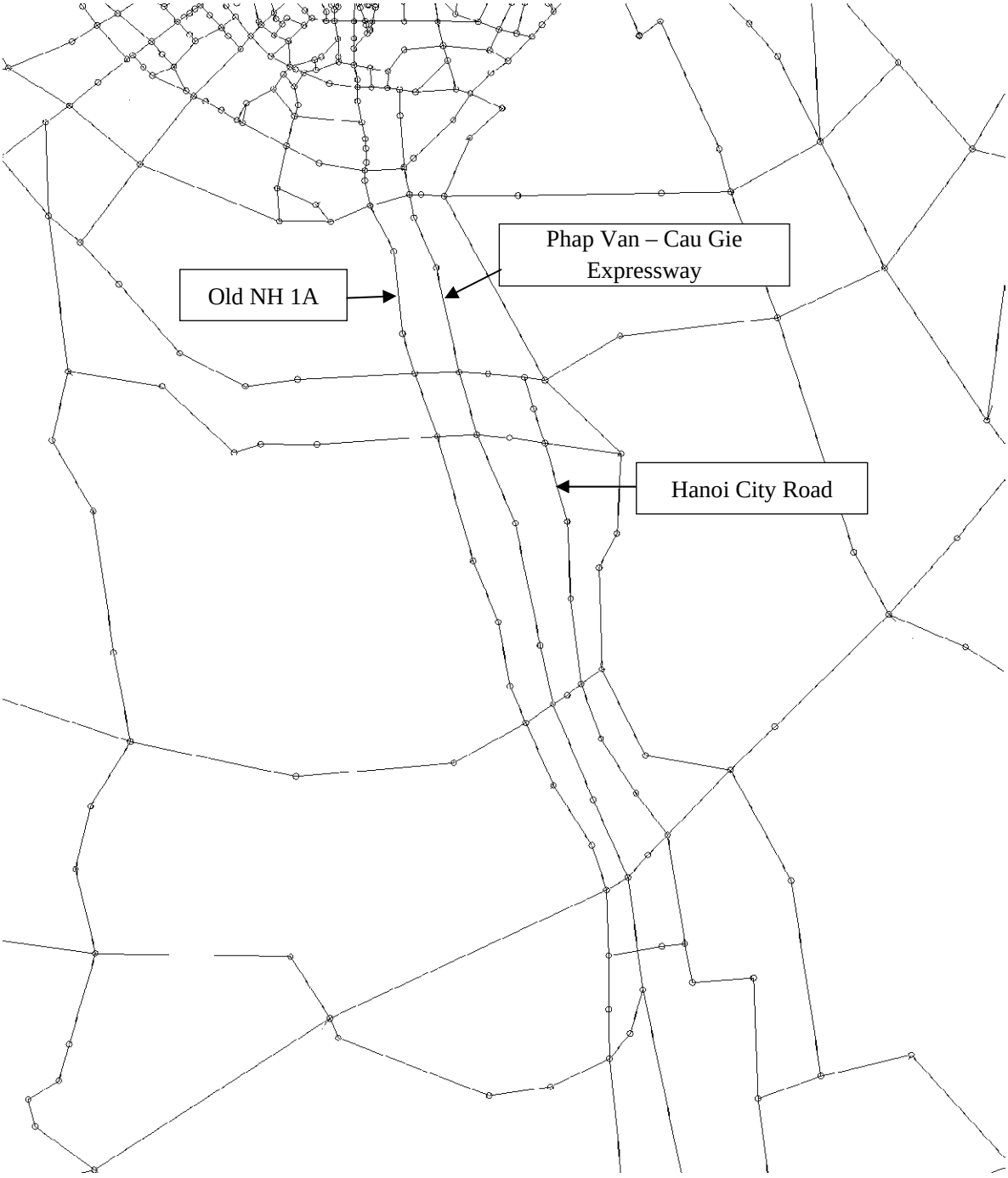


Figure 3.1.1-4 Road Network（2030）

(8) Conversion Factor

Passenger Car Equivalent (PCE) used is as shown in following table.

Table 3.1.1-7 Passenger Car Equivalent（PCE）

Car Type		Composition ratio	PCE	Aggregate PCE
Car/van		100.0%	1.0	1.0
Bus	Bus (≤ 24 seats)	40.0%	2.0	2.3
	Bus (> 24 seats)	60.0%	2.5	
Truck	4-wheel truck	4.5%	1.0	2.4
	2-axle, 6-wheel truck (Medium truck)	59.0%	2.0	
	3-axle truck (Heavy truck)	20.5%	3.0	
	Over 4-axle truck (Trailer)	16.0%	3.5	

(9) Time Evaluation Value

Time evaluation values are set as follows:

◇ Following the methodology applied to F/S on GMS Hanoi-Lang Son Expressway Project (ADB, June 2011)[2]

◇ Car and Bus: Based on time evaluation value used inVITRANSS2, price was updated with annual growth of socio economic framework.

◇ Truck : Applied truck ratio against private car of HOUTRANS, which is Urban transport master plan and FS in Ho Chi Minh

Table 3.1.1-8 Time evaluation Value by Vehicle Type

（unit：USD/h）

Vehicle Type	2010	2020	2030
Car	7.95	13.12	19.98
Bus	27.09	44.51	67.70
Truck	10.77	21.98	33.45

(10) Toll Rate

Toll rate for Expressway is not established in Vietnam. Toll rates are set as follows:

◇ Toll rate of car is set 1000VND/km(Closed toll system is applied)

◇ Toll rate ratio by vehicle type follows existing toll collection system as shown in Table 3.1.1-9. Car type for traffic assignment is 3 (car ,bus and truck) but existing toll collection system has 7 car types, thus, toll rate and traffic volume by 7 car type was weighted average into 3 types.

◇ Commuter ticket is not considered.

◇ Motor cycle is excluded as it is prohibited to run on expressway.

[2] F/S on GMS Hanoi-Lang Son Expressway Project (ADB, June 2011)

Table 3.1.1-9 Toll Rate Ratio

	Car	Bus		Truck			
		Bus≤24 Seats	Bus≥25 Seats	Pick-up & 4WD	Medium Truck	Heavy Truck	Truck & Trailor
Toll Rate Ratio (General Road)	1.0	1.5	2.2	1.0	2.2	4.0	8.0
Traffic volume	100%	40.0%	60.0%	4.5%	59.0%	20.5%	16.0%
Toll Rate Ratio	1.0	1.92		3.44			

（Source：Circular No.90/2004/TT-BTC, as of September 7, 2004, Guiding the Regime of Road Toll Collection, Payment, Management and Use, MOF）

(11) Validation of Present Traffic Assignment

OD in 2010 applied this time was validated whether it has enough reliability as the basis for calculating future OD.

Differences between traffic assignment and traffic Survey result in METI F/S are shown in following table and following figure. As shown in following figure, its result was proved that OD was adequate to become basis of future OD.

Table 3.1.1-10 Difference between Conducted Traffic Survey Result and Assigned Traffic

Location	Road Name	Total PCU in accordance with the counted traffic of two types of bus and dour types of truck	Total PCU assigned on the network	Difference
Location 07	PVCG	27,886	36,038	1.292
Location 09	PVCG	34,114	38,083	1.116
Location 11	PVCG	34,808	33,327	0.957
Location 12	Old NH1	4,917	5,601	1.139
Location 13	PVCG	32,034	33,306	1.040
Location 15	Old NH1	34,414	33,641	0.978

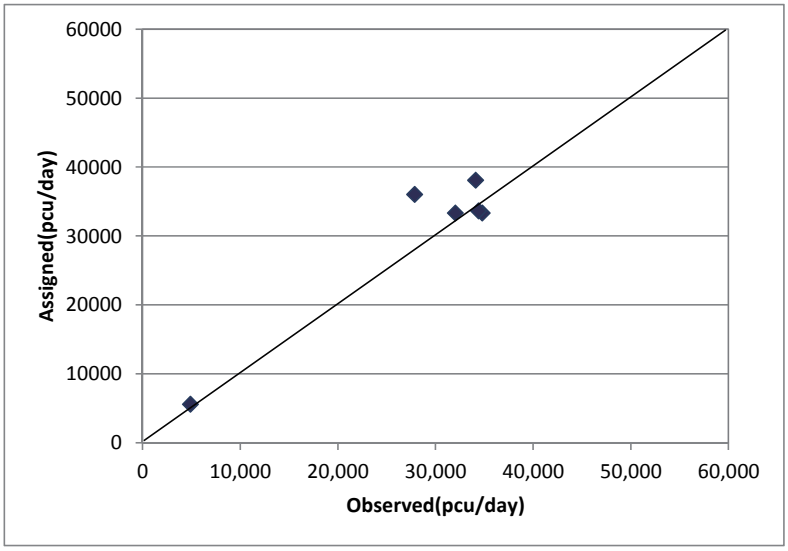


Figure 3.1.1-5 Comparison between Observed and Assigned Traffic at Individual Sites

(12) Traffic Demand

1) Traffic Volume inter IC

Traffic volume in 2020 and 2030 are shown in following table.

Table 3.1.1-11 Traffic Volume of PV– CG Expressway in 2020

unit：PCU/day

			Car	Bus	Truck	Total
Phap Van	～	Thuong Tin	19,725	14,706	19,710	54,140
Thuong Tin	～	Van Diem	20,932	15,723	16,037	52,692
Van Diem	～	Cau Gie	9,834	13,955	24,270	48,058

Table 3.1.1-12 Traffic Volume of PV–CG Expressway in 2030

unit：PCU/day

			Car	Bus	Truck	Total
Phap Van	～	Thuong Tin	22,043	14,675	52,784	89,502
Thuong Tin	～	Van Diem	21,054	16,044	55,829	92,927
Van Diem	～	Cau Gie	12,530	17,912	57,652	88,094

2) Change of future traffic volume

Change of future traffic volume is shown in following table. This traffic volume is calculated by a weighted average distance between the IC.

The Study Team assumed that 4 lanes Expressway will be opened at 2014, and 6 lanes Expressway will be opened at 2020, and project term is 20 years.

Table 3.1.1-13 Change of future traffic volume

unit：vehicle/day

Year	Car	Bus≤24 Seats	Bus≥25 Seats	Pick-up & 4WD	Medium Truck	Heavy Truck	Truck & Trailer	Total
2014	11,875	2,095	3,142	157	2,063	717	559	20,608
2015	12,453	2,163	3,245	177	2,315	804	628	21,785
2016	13,060	2,234	3,351	198	2,598	903	704	23,048
2017	13,696	2,307	3,460	222	2,915	1,013	791	24,404
2018	14,363	2,382	3,574	250	3,272	1,137	887	25,864
2019	15,062	2,460	3,691	280	3,671	1,276	996	27,436
2020	16,256	2,554	3,831	384	5,038	1,750	1,366	31,179
2021	16,436	2,580	3,870	424	5,565	1,934	1,509	32,318
2022	16,617	2,607	3,910	469	6,147	2,136	1,667	33,554
2023	16,801	2,634	3,951	518	6,791	2,359	1,842	34,895
2024	16,986	2,661	3,991	572	7,501	2,606	2,034	36,353
2025	17,174	2,688	4,033	632	8,286	2,879	2,247	37,940
2026	17,364	2,716	4,074	698	9,154	3,181	2,482	39,669
2027	17,556	2,744	4,116	771	10,112	3,513	2,742	41,554
2028	17,750	2,772	4,159	852	11,170	3,881	3,029	43,613
2029	17,946	2,801	4,202	941	12,339	4,287	3,346	45,861
2030	18,144	2,830	4,245	1,040	13,630	4,736	3,696	48,320
2031	18,344	2,859	4,289	1,148	15,056	5,231	4,083	51,012
2032	18,547	2,889	4,333	1,269	16,632	5,779	4,510	53,959
2033	18,752	2,918	4,378	1,401	18,373	6,384	4,982	57,188

3.2 Outline Design

After reviewing of VEC F/S Interim Report, the following problems and issues are taken into consideration and improvement measures are proposed in this Outline Design;

(i) Upgrading 4-lane Expressway from existing Bypass for National Road No.1 (Highway) and Widening 6-lane.
(ii) Role of PV-CG road in Vietnam (In providing reasonable quality and high-speed transport services as an arterial South-North Expressway in Vietnam and the gateway to the City of Hanoi)
(iii) Basic Policies of the Inception Report(Safety, Environment, Quality, Cost and Process)

The following standards and regulations are applied to the project to upgrade PV - CG Section.

- Process of topographical drawings -industry standard 96 TCN 43-90;
- Standard of measurement techniques and GPS data processing in works geodesy TCXDVN 364-2006;
- The highway survey process 22 TCN 263-2000;
- The process of works geological exploration 22 TCN 259-2000;
- Process of highway surveys on soft soil 22 TCN 262-2000;
- The process of testing and determining overall elastic module of soft pavement by Benkelman TCN251-98-22;
- Expressway - Design Requirements TCVN 5729-97;
- Highways - Design Requirements TCVN 4054-2005;
- Rural Roads - Design Standards 22TCN 210-92;
- Soft pavement - Requirements and guidelines designed 22 TCN 211-06;
- Design process of hard pavement 22 TCN 223-95;
- Bridge Design standards for 22 TCN, 272-05;
- Steel Structures - Design Standards TCXDVN 338-2005;
- Bored piles - construction standards and acceptance TCXDVN 326-2004;
- Design of earthquake resistant building TCXDVN 375:2006;
- Public transport projects in the earthquake region 22 TCN 211-95;
- Loading and Impact - Design standards TCVN 2737-1995;
- Road Signs Regulation 22 BC 237-01;
-Process of tree cost norm 529/BXD/VTK-1997 norms.

Reference Standard
- Road and Structure Ordinance, Japan;
- The Design Guidelines of AASHTO;
- The other standards or design guidelines of foreign countries such as Highway Capacity Manual 2000 and Geometric Design Standards for Motorways by AASHTO.

3.2.1 Design of Road and Structures

Based on the above, main design policies of road design items are as follows.

[Design policy]

(1) Design Standard

Basically the design standards are based on those in Vietnam. However where appropriate standard and/or items do not exist in Vietnam standards, applicable standards from other countries are referred to and adopted to supplement Vietnamese standards.

(2) Design Speed

Design Speed as high as 120km/h is considered necessary to provide high-speed transport service since the PV-CG Expressway is a part of South-North Expressway in Vietnam and the gateway to the city of Hanoi.

(3) Vertical Alignment

For purposes of minimizing the impact on consolidation settlements and the loads worked on existing crossing structures, the thickness of the overlay is reduced.

(4) Median Strip

The type of barriers is decided in consideration of user's safety, minimum maintenance costs, and improvement of safety of maintenance works.

Reduction of width of the road in order to Minimize land acquisition is considered.

(5) Interchange

Since the PV-CG Expressway provides 6lanes in its complete profile, major improvement works are not planned at the stage of the 4lane upgrade but will be carried out at the stage of the 6 lane widening as necessary.

(6) Frontage Road

Grade and Width of the Road, Design Speed are decided in order to improve convenience of the residents and ensure their safety.

3.2.1.1 Road Grade and Design Speed

Road Grade and Design Speed of Existing Road and Plan is as follow,

[Existing Road] Highway
Design Standard; TCVN4054:1985
Road Grade; Grade I Plane
Design Speed (V_{design}); 100km/h
Width of Road;

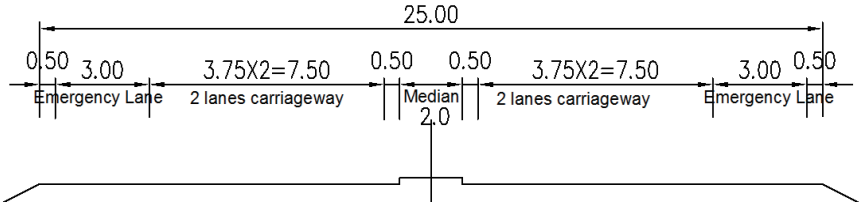


Figure 3.2.1-1 Width of Existing Road

[Plan] Expressway
Design Standard; TCVN5729:1997
Road Grade; Expressway Grade A
V_{design}; 100km/h or 120km/h

Scope of Design; Main line Km182+300～211+256 (L=28.956 Km)
Interchange Thuong Tin IC (approx. Km192+850),
Van Diem IC (approx. Km204+200)

Width of Road;
(4-lane)

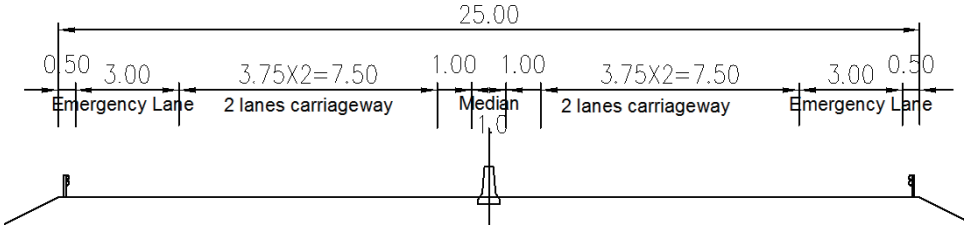


Figure 3.2.1-2 Width of Plan (Phase1:4-lane)

(6-lane)

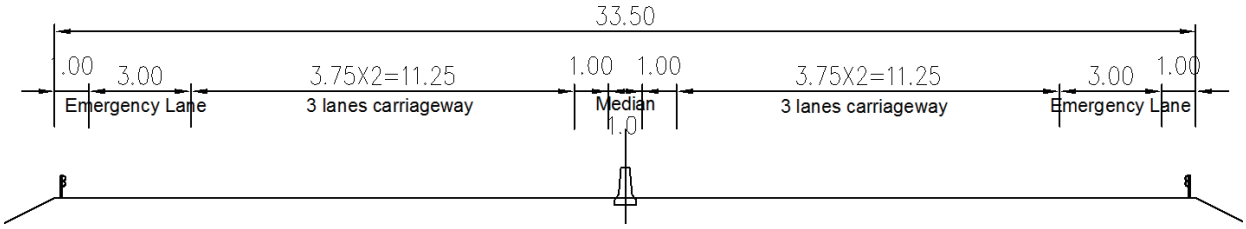


Figure 3.2.1-3 Width of Plan (Phase2:6-lane)

The PV-CG Expressway is aimed to provide high specification transport service because the PV-CG Expressway is an arterial South-North Expressway in Vietnam and the gateway to the city of Hanoi. Although Design Speed is considered to be V_{design}=120km/h, there are some locations to upgrade V_{design}=120km/h, where existing Bypass for National Road No.1 constructed as Highway with V_{design}=100km/h. In particular, vertical alignment has a problem. Because a radius of vertical curve of existing Van Diem Bridge (approx. Km204+200) is 6,000m, it is necessary to adjust the curve radius to 12,000m at V_{design}=120km/h by raising the surface by 30cm. Due to absorb an increase in dead load by raising surface, time and costs of the reinforcement works of the bridge. In the Outline Design, V_{design}=100km/h is applied to avoid significant modification works to minimize the effects to road users and to provide saving in time and costs.

Therefore there are two Design Speeds, such as V_{design}=120km/h and V_{design}=100km/h applied to the corresponding sections respectively. Following table shows Road Geometry specified in TCVN5729 : 1997, Expressway - Design Requirements, Vietnam, Road Structure Ordinance, Japan and AASHTO, USA.

Table Table 3.2.1-1 Road Geometry

		unit	Freeway/ Expressway Specification for Design TCVN5729		Road Structure Ordinance (JAPAN)						AASHTO(USA)		Remark
					Desirable	Ordinary	Relaxed	Desirable	Ordinary	Relaxed			
Design Speed		km/h	120	100	120			100			120	100	
Horizontal Alignment													
Min. Curve Radius		m	650	450	1,000	710	570	1,000	460	570	756	437	
Min. Curve Length		m	200.4	167		200			170		-	-	
Min.Transition Curve Length		m	125	100		100			85		-	-	
Vertical Alignment													
Max. Gradient	UP	%	4	5		2			3		-	-	
	Down	%	5,5	5,5		2			3		-	-	
Min. Curve Radius	crest	m	12,000	6,000	17,000	11,000		10,000	6,500		9,500	5,200	
	sag	m	5,000	3,000	6,000	4,000		4,500	3,000		6,300	4,500	
Min. Curve Length		m	100	85		100			85		-	-	
Min. Slope Length		m	300	140		-			-		-	-	
Stopping site distance		m	230	160		210			160		250	185	

A part of Table 7 Technical Standards for Expressway/Freeway Main lanes at the connecting elevated Interchange in TCVN 5729: 1997

			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

In this Outline Design, a study was made for selecting sections for V_{design}=120km/h and V_{design}=100km/h respectively. The same exercise was carried out in VEC F/S and only a minor difference is identified. In this regard, Detailed Design may be carried out based on the selection of sections in VEC F/S.

Table 3.2.1-2 Sections and Design Speed

	Design Speed (V_{design})	Section	Length	Remark
VEC F/S	100km/h	KM182+000～KM193+600	L=11.6km	
	120km/h	KM193+600～KM203+000	L=9.4km	【Enlargement for keeping sight distance】
	100km/h	KM203+00～KM211+000	L=8.0km	
JICA Study Team	100km/h	KM182+000～KM194+970	L＝12.970km	D1 : R=1193 ⊿W=0.675m,
	120km/h	KM194+970～KM201+670	L=6.7km	D2 : R=1205 ⊿W=0.648m
	100km/h	KM201+670～KM206+670	L=5.0km	D9 : R=995 ⊿W=1.206m
	120km/h	KM206+670～KM211+000	L=4.3km	D11 : R=1900 ⊿W=1.474m

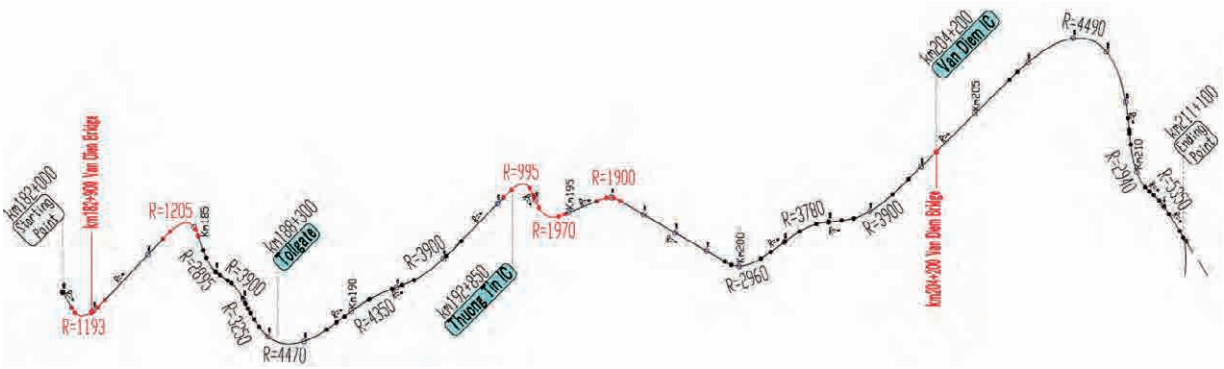


Figure 3.2.1-4 Horizontal Alignment

However it is noted that, from keeping traffic safety under standards in Japan, enlargements for keeping sight distance is required to apply alignments in VEC F/S. Details are shown in Attachment –Explanatory Note. Concept of sight distance is shown below.

[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.

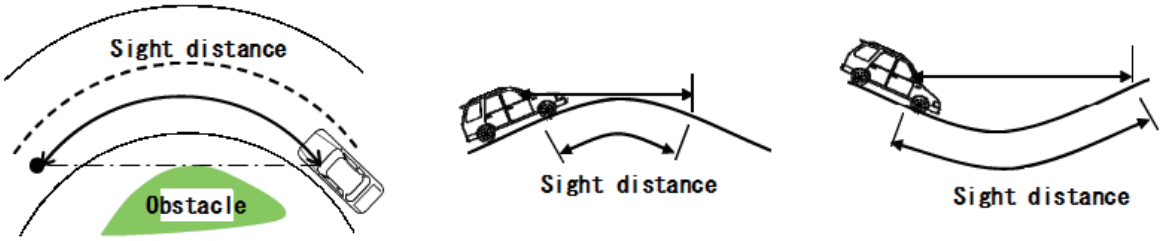


Fig. To ensure sight distance(Plan)

Fig. To ensure sight distance(Longitudinal)

Figure 3.2.1-5 Concept of Sight Distance

3.2.1.2 Vertical Alignment

The following items are taken into account for setting vertical alignment.

(i) Existing Bypass for NR-1 is to be upgraded to 4-lane Expressway and further extend to 6-lane in the near future

(ii) Typical section
Pavement strength represented by Elastic Modulus of existing Highway, obtained by Benkelman Tests, does not reach to the required strength calculated based on the traffic demand forecast. Remove and reconstruction of pavement gives considerable negative impact for existing traffic and it is not economical because strength of subgrade is less than that of the existing pavement. Overlay of required thickness to obtain the necessary pavement strength is to be carried out.
(Thickness of overlay is shown in Section 3.2.1.6 Pavement)

(iii) Bridges and Box culvert section
Because overlay increases overburden to the structures and reinforcement to those may become necessary, removal and reconstruction of pavement is carried out instead of overlay.

(iv) Because Highway locates on the soft ground, increase on overlay results in increase in overburden and induce further settlements. In this respect, it is required to minimize the thickness of overlay.

(v) TCVN5729:1997 Expressway - Design Requirements specifies Minimum Slope Length, a detail of which is shown in Table below and such provisions are neither included in Road Structure Ordinance, Japan nor in AASHTO, USA. Definition and provision of Minimum Slope Length is shown in Figure and Table below.

Table 3.2.1-3 Min. Slope Length

V_{design}	100km/h	120km/h
Min. Slope Length	250m	300m

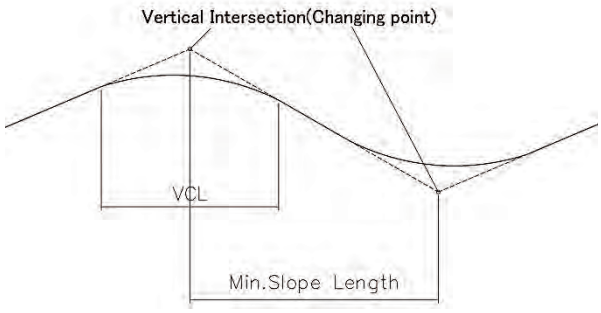


Figure 3.2.1-6 Definition of Min. Slope Length

(vi) Hanoi City experienced flooding damage frequently. With this respect, TCVN5729 : 1997 specifies pavement level of Expressway which is water level of 100 years return period, once per 100 years, plus 0.5m for an allowance. Also TCVN4054 : 2005 specifies that of frontage roads which is water level of 25 years return period, once per 25 years, plus 0.5m for an allowance. However pavement height of frontage roads become higher than the existing road and it is not convenient for neighborhood residents. The requirement of TCVN4054 : 2005 Highways - Design Requirements is not applied. Waters level for 100 years and 25 years return period are shown in the Table below.

Table 3.2.1-4 Design water level

No.	Station	Survey water level (m)			Design water level (m)	
		H_{1984}	H_{1994}	H_{2008}	$H_{1\%}$	$H_{4\%}$
1	Km182+000.00	5.42	5.2	5.29	5.51	5.33
2	Van Dien bridge Km182+926.99	5.72	5.30	5.12	5.34	5.16
3	Km184+500.00	5.53	5.33	5.24	5.46	5.28
4	Km185+448.58	5.61	5.51	5.32	5.54	5.36
5	Km186+651.42	5.58	5.28	5.13	5.35	5.17
6	Km187+616.40	5.77	5.37	5.07	5.29	5.11
7	Km188+000.00	5.78	5.37	5.03	5.25	5.07
8	Km189+388.23	5.37	5.08	4.91	5.13	4.95
9	Km190+884.85	5.49	5.24	5.10	5.32	5.14
10	Km192+349.27	5.60	5.35	5.10	5.32	5.14
11	Km193+600.00	4.52	4.34	4.13	4.30	4.16
12	Km194+858.55	4.67	4.57	4.08	4.25	4.11
13	Km196+000.00	4.65	4.43	4.40	4.57	4.43
14	Km196+909.49	4.73	4.54	4.40	4.57	4.43
15	Km197+259.00	4.10		4.00	4.32	4.03
16	Km198+500.00	4.03	3.69	3.70	3.87	3.73
17	Km199+560.00	4.50	4.32	4.25	4.42	4.28
18	Km200+528.92	4.28	4.03	4.10	4.27	4.13
19	Km201+514.12	4.42	4.11	4.17	4.34	4.20
20	Km202+526.56	4.15	3.90	3.97	4.14	4.00
21	Km204+185.00	4.20	3.99	4.05	4.22	4.08
22	Km205+850.00	3.95	3.76	3.81	3.98	3.84
23	Km207+850.00	3.60	3.50	3.45	3.62	3.48
24	Km207+931.38	4.10	3.88	3.90	4.07	3.93
25	Km209+468.20	3.30	3.12	3.10	3.27	3.13
26	Km211+149.14	2.64	2.40	2.45	2.62	2.48

Source : VEC F/S Final Report

Vertical Alignment included in VEC F/S Final Report considers all above requirement and becomes basis of the Detailed Design.

However because requirement of Min. Slope Length is included neither in standards of USA nor in those of Japan, such requirement may cause little adverse effect in travelling performance. In AASHTO and Road Structure Ordinance, there are provisions for maximum gradient, minimum radius of vertical curve and minimum length of vertical curve, which are so specified that required sight distance can be kept.

In the near future, there will be the same needs to upgrade existing highway to expressway like this project as the economy of Vietnam develops sustainably. Because funds for construction of expressway are not un-limited, it is necessary to save the construction cost by relaxing the requirements which have little adverse effects on travelling and safety performance. Saving will be utilized as a part of funds for construction of other Expressway.

Therefore further detailed study is to be carried out at Detailed Design stage regarding relaxation of the requirement of Min. Slope Length specifically for the sections which generate considerable saving by relaxation of such requirement. In this Outline Design, the following sections which have potential for saving, are identified.

Table 3.2.1-5 Recommendation of Min. Slope Length

	Standard	Relaxation(Recommendation)
V_{design}	100km/h	100km/h
Min. Slope Length	250m	200m

测点	区间长
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

Figure 3.2.1-7 Sections which needs relaxation of Min. Slope Length requirement is effective

3.2.1.3 Median

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 below Figure. 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}=100km or 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.

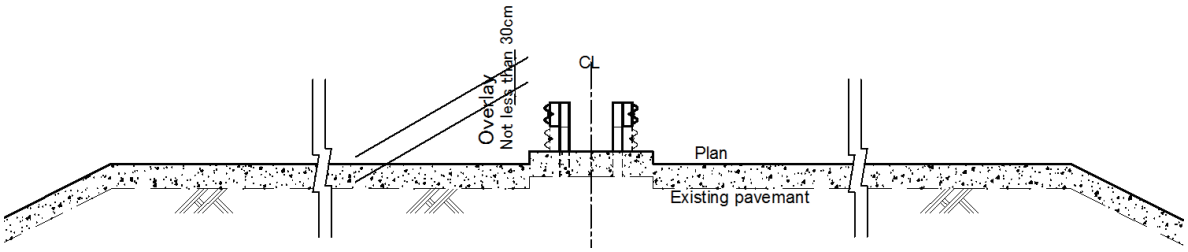


Figure 3.2.1-8 Concept of Overlay

(1)Condition of Study

TCVN5729:1997 Specification for Expressway in Vietnam specifies the width of median separator and safety strip as shown in Table3.2.1.6 corresponding to its design speed, i.e. V_{design}=100km/h and = V_{design} 120km/h.

Table 3.2.1-6 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 0.5m	not less than 1.0m

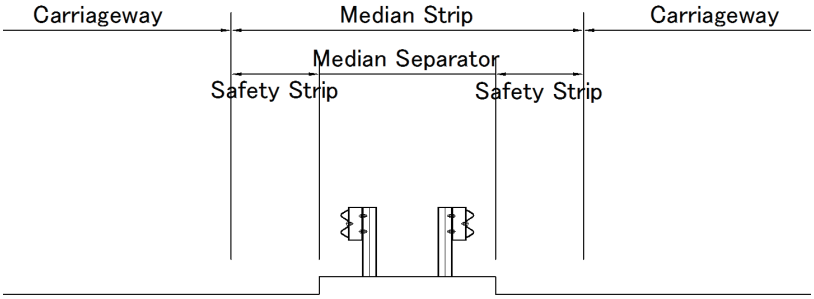


Figure 3.2.1-9 Definition of terms

(2) Selection criteria with regards to Median strip

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

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

* Safety
* Maintenance sufficiency
* Procurement of products
* Cost

A width of Median Strips shown in the above Figure is minimized considering the following two items.

(i) At the time of Phase I (4-lane) a total Road width is to be the same as that of existing highway

(ii) Continuity of Median Strips to Cau Gie- Ninh Binh Section, 1.0+3.0+1.0＝4.0m, at the connection point

At the same time, a rigid type concrete barrier is proposed for installation at the Median Separator. A comparison between a rigid type concrete barrier and a steel guard rail is shown in the Table 3.2.1-7 and further detailed study is shown in Attachment.

Table 3.2.1-7 Proposed Profile

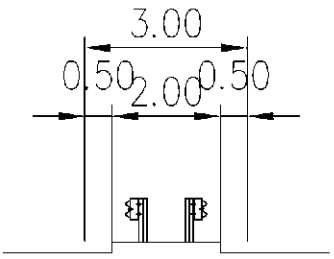
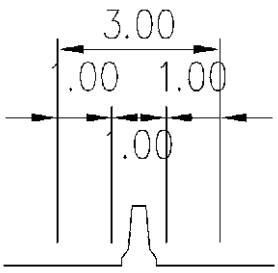
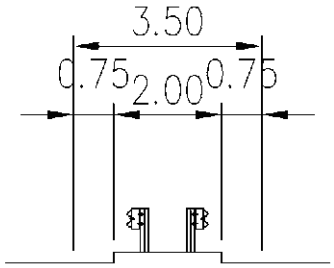
Existing profile (Typical section, Pier section)	Proposed profile：4 lane Carriageway・6 lane Carriageway	
	Typical section (Approx. 28.4km)	Pier section (Approx. 0.3km)
		

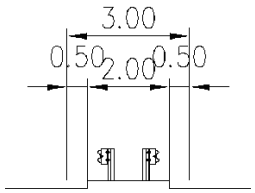
Table 3.2.1-8 Comparison of Safety Barriers

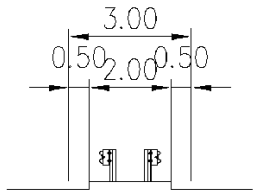
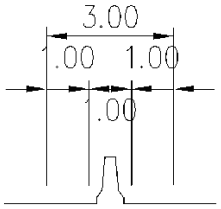
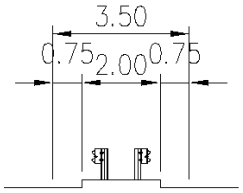
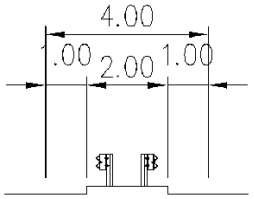
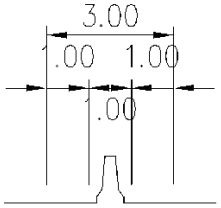
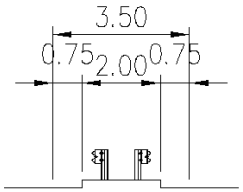
Comparison of Safety Barriers Rating: ◎: Excellent, ○:Good, △: Fair, ×: No Good

Item	Guard Rails×2	Rating	Rigid type Barriers	Rating	Remarks
Profile					
Safety Features	* Non-rigid type safety barrier is designed to absorb impact by its deflection. * It has the following functions (1) Preventing vehicle from crossing over a median and striking an on coming vehicle in a head-on crash (2) Ensuring passenger's safety (3) Redirecting vehicle into a path parallel to the barrier (4) Preventing barrier materials from fracturing	○	* Rigid barrier safety barrier is designed to resist an impact of crash without plastic deformation. *It has the following functions and good performance. (1) Preventing vehicle from crossing over a median and striking an on coming vehicle in a head-on crash (2) Ensuring passenger's safety (3) Redirecting vehicle into a path parallel to the barrier (4) Preventing barrier materials from fracturing	◎	
Durability	Fair durability	△	Excellent durability	○	
Estimated Cost (per M)	3,395,500VND/m * Reuse Guardrails	△	2,660,850VND/m	○	
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 less than 150kN/m2.	○	
Comprehensive Evaluation	△		○		

Table 3.2.1-9 Width of Median Strip

Width of Median Strip

	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	
						Typical section	Interchange/Pier section				
4 lane Carriage way	Expressway	 *1)	×	×	○	 *2)	 *3)	○ Not less than R=2100m	○	○	On bridge section, width of safety strip remains at 0.75m with shoulder width reduced by 0.25m
						Typical /Interchange section	Pier section				
6 lane Carriage way (Future)	Expressway		○	○	○	 *2)	 *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.

【Transition Section between PV-CG Expressway and Cau Gie - Nihn Binh Expressway】

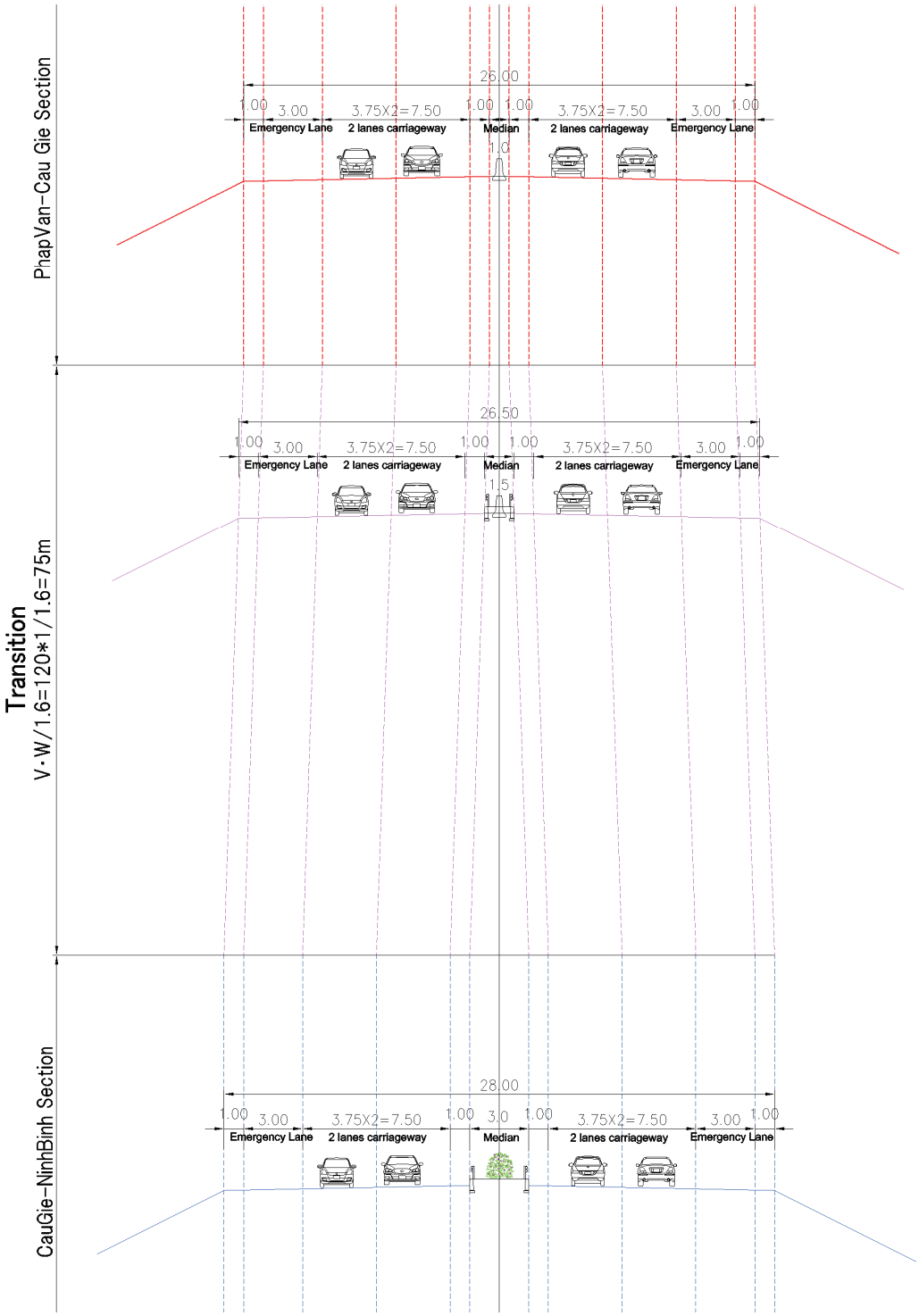


Figure 3.2.1-10 Transition Section for Median Strip continuity

3.2.1.4 Interchanges and Toll Gates

In PV-CG Expressway, there are two interchanges, ie Thuong Tin IC (Km192+850) and Van Diem IC (Km204+200). Phap Van IC at starting point of PV-CG Expressway was already completed and Dai Xuyen IC at the ending point will be constructed under the contract for the section of Cau Gie-Ninh Bin. All toll gates including that installed at Main Lanes of PV-CG Expressway will be constructed under the contract. Currently planning for tollgates and Interchanges are under review. There is no toll gate installed at Phap Van IC because toll gates at the Main Lanes will be installed between Phap Van IC and Thuong Tin Interchange.

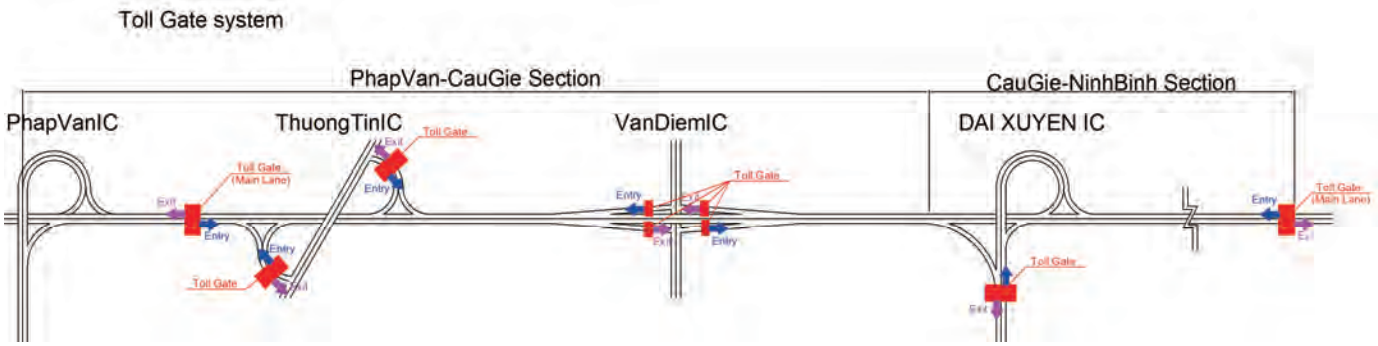


Figure 3.2.1-11 Location of Interchanges and Toll Gates

The following points are to be taken into consideration.

【Points to be considered for ICs and Toll Gates】

(i) It is important to keep smooth traffic at the Main Lanes of Expressway and access roads are to be constructed for entry to/exit from Expressway. No direct connection from Expressway to Frontage Road is entertained.

(ii) From operation point of view, Toll Gates are to be installed as close as possible to save time and cost for staff allocation, supervision and management.

(iii) Design is to be made with consideration of Phase II, 6-lane widening. Toll gates are so designed to minimize abortive costs incurred.

【Geometric Design】

Design Speed of Main Lanes : Thuong Tin IC 100km/h
Van Diem IC 100km/h

Table 3.2.1-10 Technical standards for freeway/expressway at the connecting elevated

The grades of expressway			120	100	80	60
The minimum radius of the horizontal curve		Normally	2,000	1,500	1,100	500
		Limited	1,500	1,000	700	350
The minimum radius of the vertical curve	Convex	Normally	45,000	25,000	12,000	6,000
		Limited	23,000	15,000	6,000	3,000
	Concave	Normally	16,000	12,000	8,000	4,000
		Limited	12,000	8,000	4,000	2,000
The largest longitudinal gradient, %		Normally	2	2	3	4.5
		Limited	2	2	4	5.5

Source: TCVN5729：1997 Table7

Table 3.2.1-11 The minimum length of the triangle lane-changing section (current separating or joining)

Grades of freeway/ expressway	120	100	80	60
L_n	75	60	50	40

Source: TCVN5729：1997 Table9

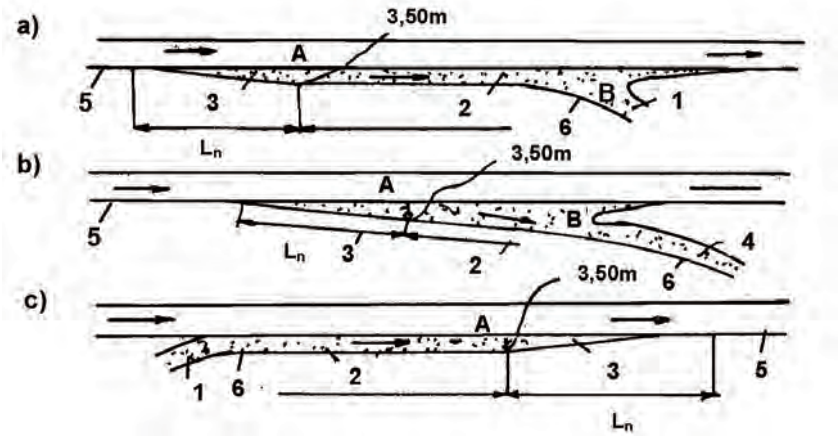


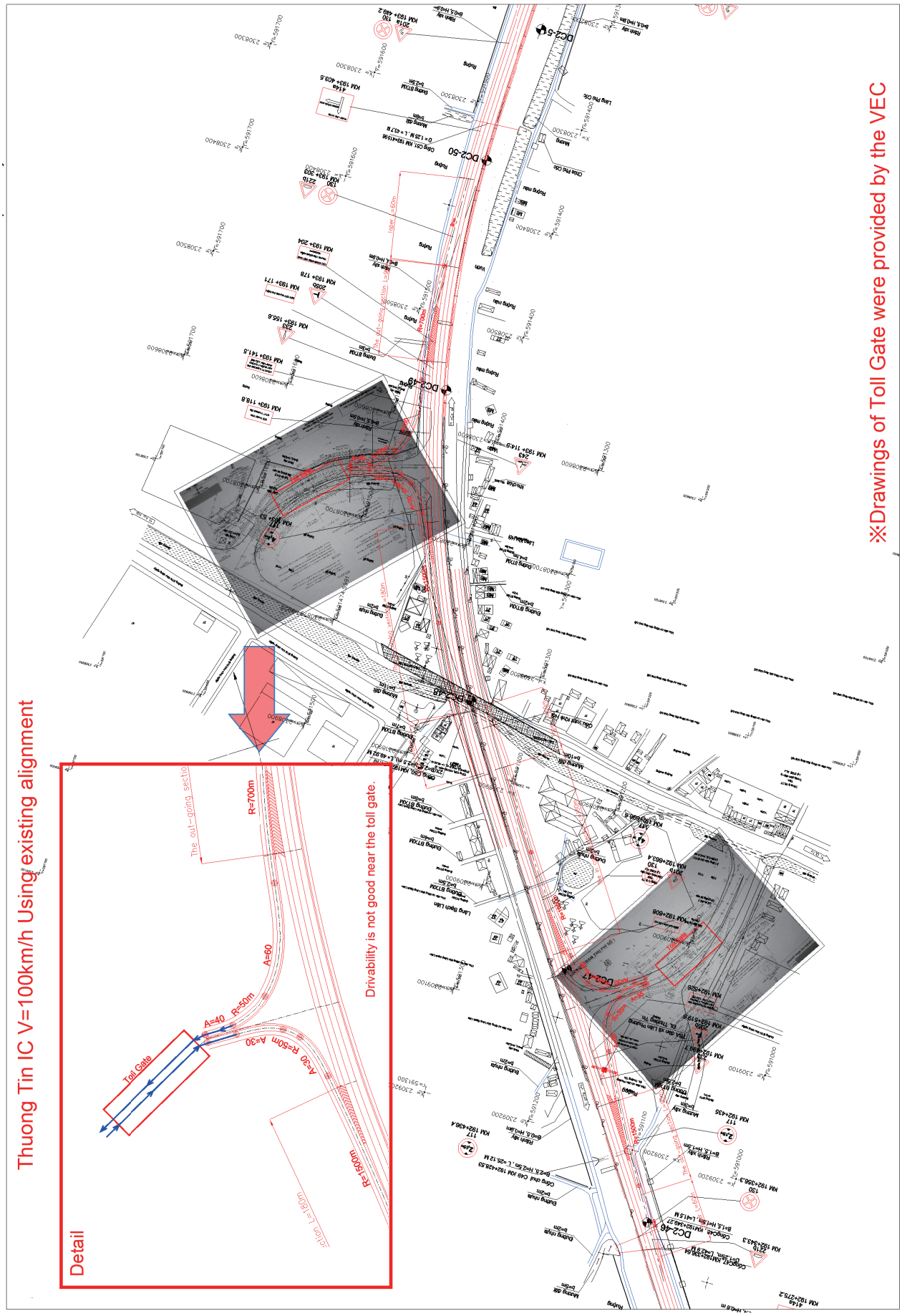
Figure 3.2.1-12 The ways of locating out-going and in-coming section (Source: TCVN5729：1997 Figure 5)

Table 3.2.1-12 The minimum value applied to the total length of the lane-changing section plus the speed-changing section.

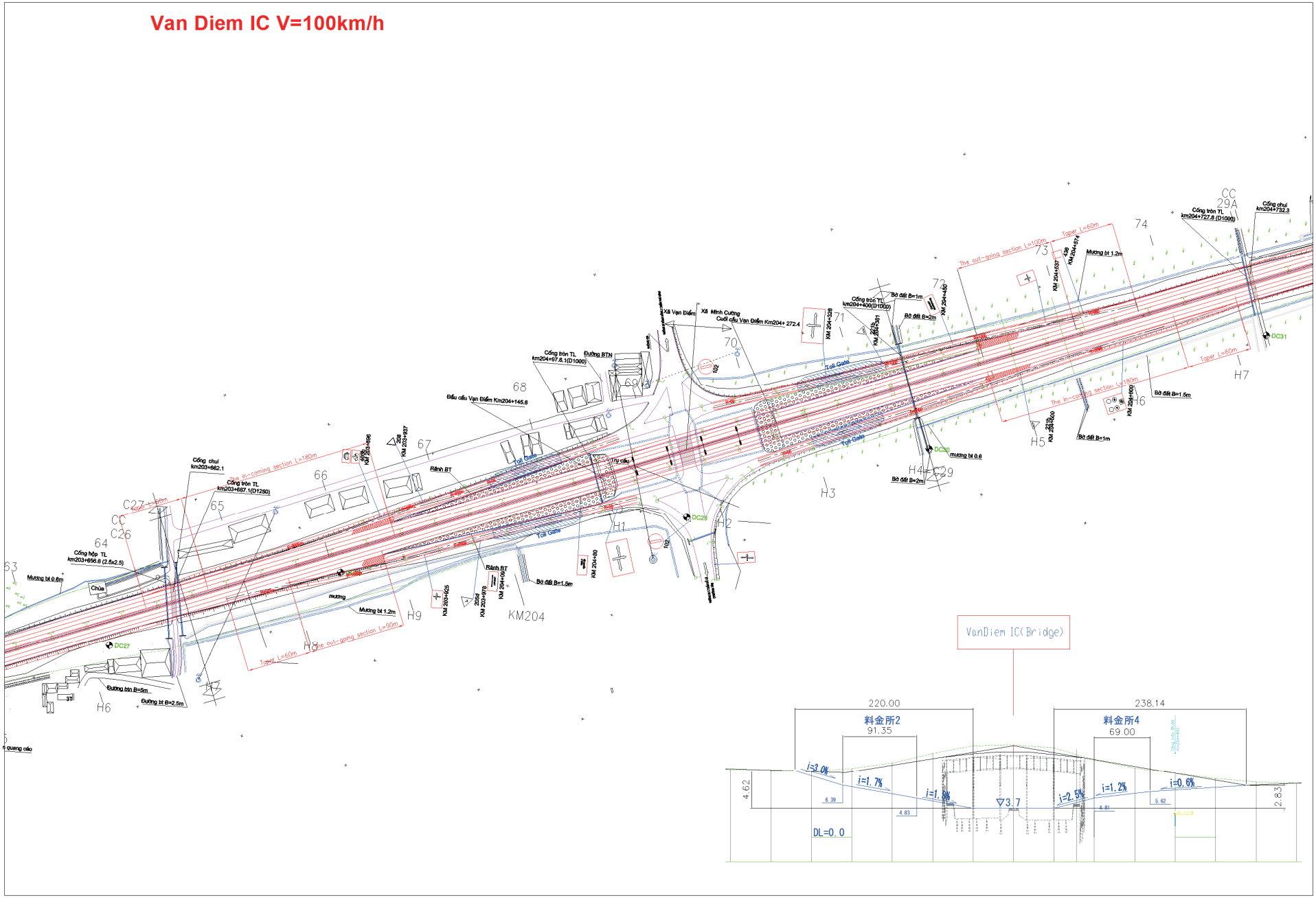
Grades of expressway	120	100	80	60
The minimum length at exit point (reducing speed) of one lane, m	100	90	80	70
The minimum length at entry point (increasing speed) of one lane, m	200	180	160	120

Source: TCVN5729：1997 Table12

As a reference, an Interchange Plan is attached to the next page.


Thuong Tin IC V=100km/h Using existing alignment
※Drawings of Toll Gate were provided by the VEC
Detail
Toll Gate
R=700m
A=60
A=40 R=50m
A=30 R=50m A=30
R=500m
Drivability is not good near the toll gate.

Van Diem IC V=100km/h



3.2.1.5 Frontage road

Along with the 6-lane widening of PV-CG Expressway, the existing frontage roads need to be moved. At the same time, discontinuous frontage roads need to be improved and to be raised for convenience of roadside residents.

Because motor bikes will not be allowed to drive in Main Lanes by upgrading Highway to Expressway, alternative roads for motor bikes are to be provided.

New roads a length of which is approx. 20km are planned to construct by Hanoi City at the east side and Cau Gie side of PV-CG Expressway.

Considering the above points, mainly its functions and roles, grade of road, design speed, road width and road formation level are designed.

(1) Basic design principle for Frontage Roads

(Existing) Width of Frontage Roads are narrow (approx. 2 to 3m) and they are not continued.
Frontage Roads may be covered by embankment for 6-lane widening.
(relocation is necessary)

(Design) Width of Frontage Roads is not less than 3.5m is to be kept
Frontage Roads are to be continued.

(2) Road Grade and Design Speed of Frontage Roads and Hanoi City Road

Road grade and design speed is shown in the Table below.

【Frontage Road】

Table 3.2.1-13 Road Specification

	VEC F/S	JICA Study Team
Design standard	TCVN4054：2005	
Road Grade	Grade V	Grade VI
Design Speed	V=40km/h	V=30km/h
Road configuration	W＝7.5m (Pavement Width, PW=5.5m)	W＝5.5m (PW=3.5m)

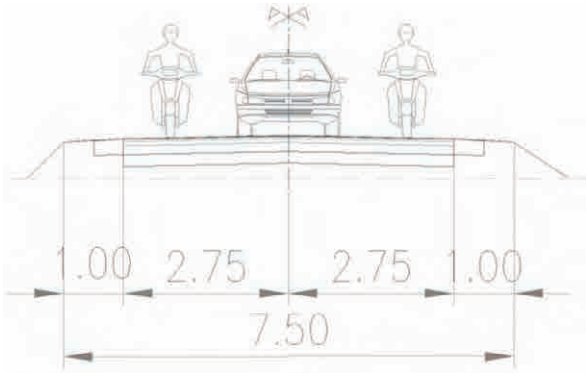


Figure 3.2.1-13 Frontage Road Configuration (VEC F/S)

Table 3.2.1-14 Highway Technical Classification according to function and design traffic volume

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

Source: TCVN4054：2005 Table 3

Table 3.2.1-15 Design speed of each road category

Design categories	I	II	III		IV		V		VI	
Topography	flat	flat	flat	mountain	flat	mountain	flat	mountain	flat	mountain
Design speed, V_{tk} (km/h)	120	100	80	60	60	40	40	30	30	20
NOTE: Classification of the terrain is based on common natural slope of the hill side and mountain side as follows: flat and rolling ≤ 30%; Mountain > 30%.										

Source: TCVN4054：2005 Table4

Table 3.2.1-16 Minimum width of cross-sectional elements applied for flat rolling terrain

Design categories	I	II	III	IV	V	VI
Design speed, (Km/h)	120	100	80	60	40	30
Minimum number of lanes for motorized vehicle,(nos)	6	4	2	2	2	1
Width of a lane, (m)	3.75	3.75	3.5	3.5	2.75	3.5
Width of traveled way for motorized vehicle, (m)	2 ×11.25	2 ×7.50	7.00	7.00	5.50	3.50
Width of median separator[1)], (m)	3.00	1.50	0	0	0	0
Width of shoulder and stabilized part of shoulder[2)], (m)	3.50 (3.00)	3.00 (2.50)	2.50 (2.00)	1.00 (0.50)	1.00 (0.50)	1.50
Width of roadbed, (m)	32.5	22.5	12.00	9.00	7.50	6.50

1) Width of median separator for each structure is defined in Article 4.4 and Figure 1. The minimum value is applied for separator made of pre-cast concrete or curb stone with cover and without constructing piers (poles) on separated bands. In other cases, separator width must comply with provisions in Article 4.4.

2) Number in the bracket is the minimum width of stabilized part of shoulder. If possible, it suggests to stabilize the whole shoulder width, especially when the highway without side lane for non-motorized vehicles.

Source: TCVN4054：2005 Table6

【Hanoi City Road】

Design standard：TCVN4054：2005

Road Grade：Grade III

Design Speed：V=80km/h

Road Width：W＝12.0m (PW=11.0m)

Number of lanes: Dual 2-lane

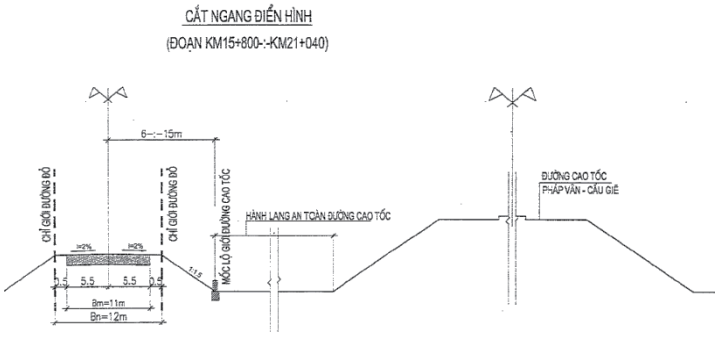


Figure 3.2.1-14 Hanoi City Road

Hanoi City Road is constructed in parallel to PV-CG Expressway and it connects Road No.71 to Cau Gie Interchange.

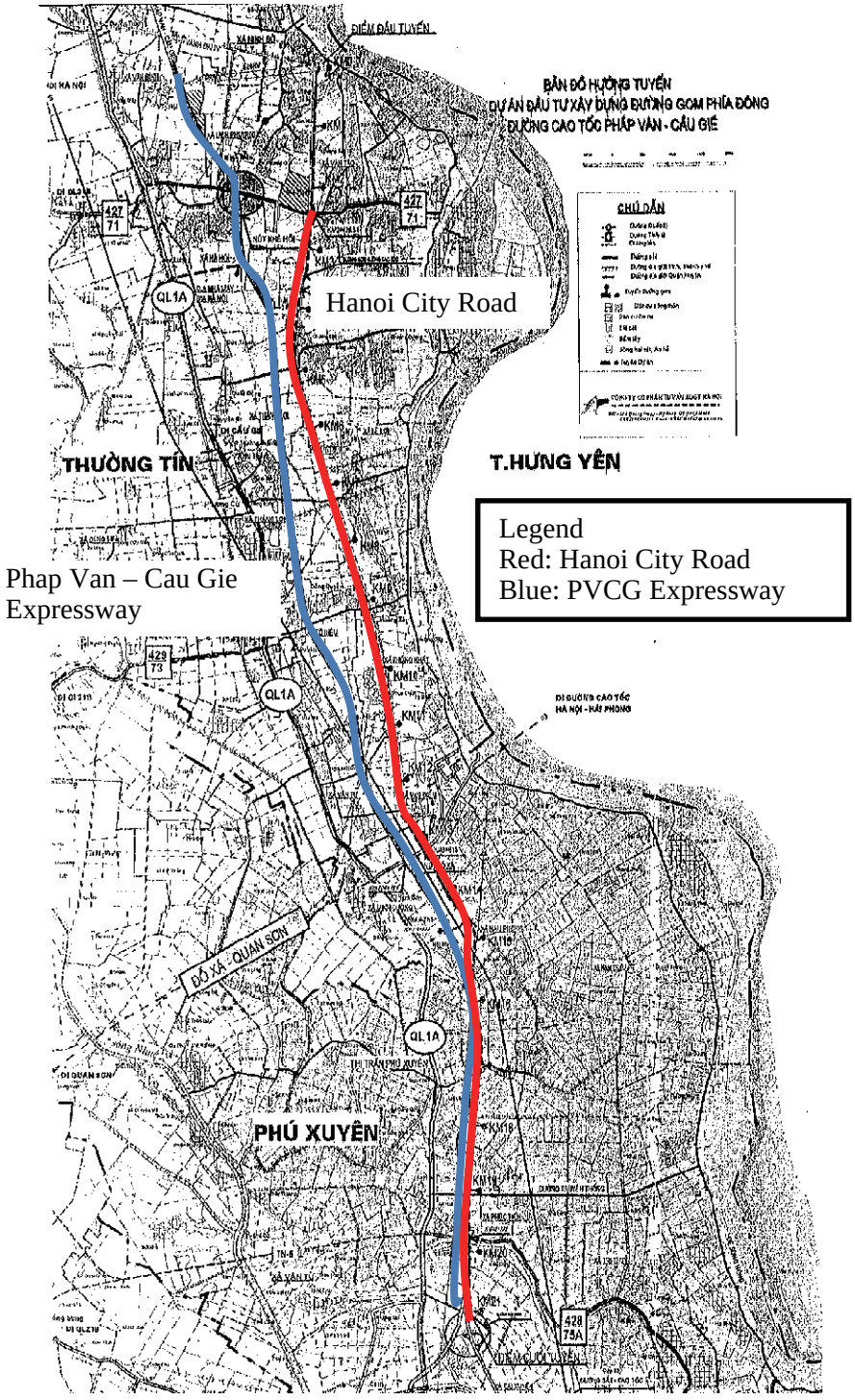


Figure 3.2.1-15 Plan of Hanoi City Road

(3) Pavement surface level of Frontage Roads

Pavement surface level of Main Lines of Expressway is decided at not less than flood level for 100 years return period plus 50 cm allowance as per TCVN 5729: 1997. In case that pavement surface level of Frontage Roads is decided at not less than flood level for 25 years return period

plus 50 cm allowance as per TCVN4054: 2005, such level is 1m or more higher than that of existing Frontage Road. The following problems are envisaged.

(i) Gradient to access part to the box culvert, which sits on piling foundation and level cannot be changed, becomes steep.

(ii) In residential area, level of roads becomes higher than that of housing land. It is inconvenient to the residence.

Therefore, considering convenience of residence and connection to the box culvert, the level of Frontage Road is decided at:

(i) not less than the level of existing road plus 10cm

(ii) not less than the level of 25 years return period

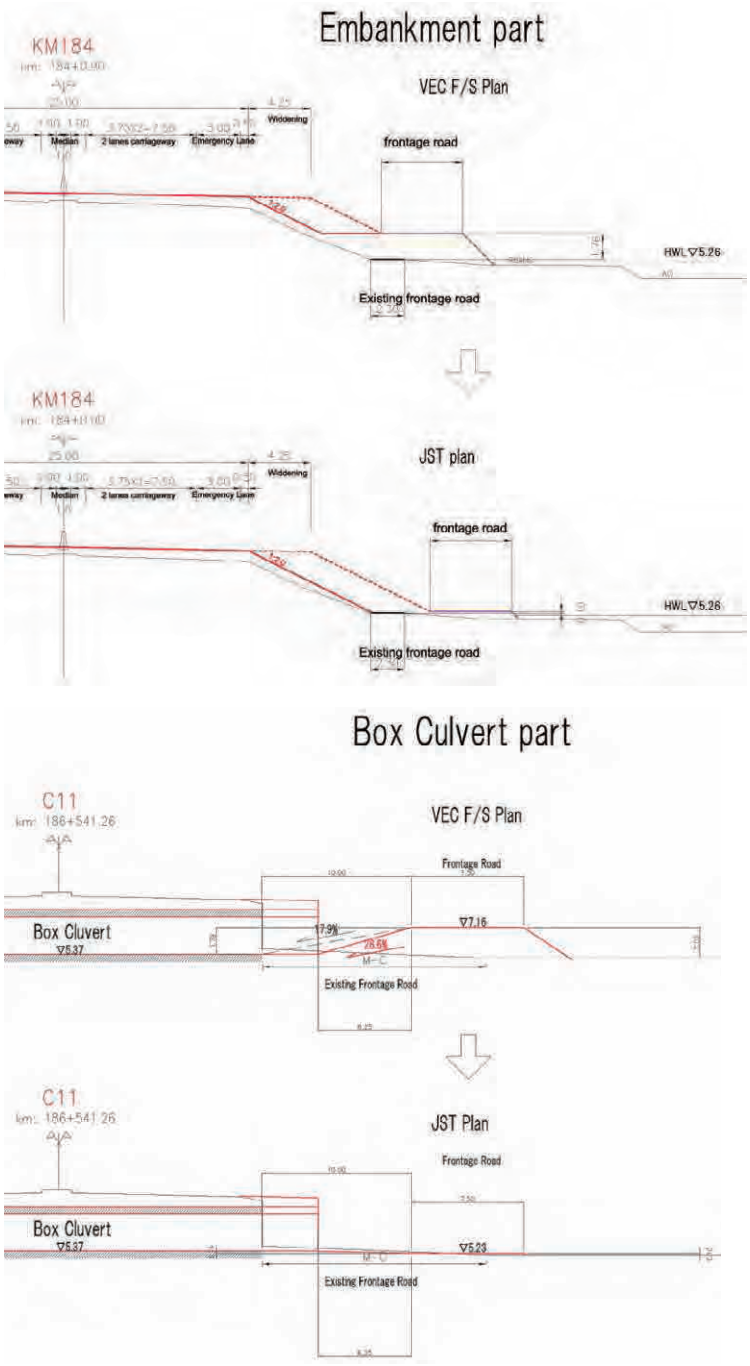


Figure 3.2.1-16 Level of Frontage Roads

3.2.1.6 Pavement

(1) Pavement Design

Following two cases of pavement design are made.

Table 3.2.1-17 Pavement Design cases

Timing / Locations	Phase I: Upgrade to Expressway (4lanes)	Phase II: Widening to 6 lanes
Typical sections, Existing 4 lanes	Overlay on existing pavement	same as on the left, if necessary
Adjacent sections of existing box culvert, Existing 4 lanes	Remove existing pavement and construct pavement onto subgrade	Ditto Case a
Sections for Widening two lanes (newly constructed)	Case b	construct pavement onto subgrade

VEC F/S (**PHAP VAN CAU GIE UPGRADING PROJECT, FEASIBILITY STUDY INTERIM REPORT August 2011**）was reviewed**.**

Vietnam pavement design is checked whether pavement strength E_{ch} (Elastic modulus) calculated from Elastic modulus of pavement component, such as surface course, binder course, road base, sub-base, sub-grade, exceeds required strength E_{yc} specified by road classification, traffic volume, considering reliability factor: K_{cd}^{dv}.

$$E_{ch} \geq K_{cd}^{dv} \times E_{yc}$$

The calculating method is multilayers (2 layers) elasticity theory. From E_1 for pavement excluding sub-grade and E_0 for sub-grade, E_{ch} can be calculated using nomograph.

In case of the improvement of existing 4 lanes that is overlay to existing road so instead of strength of subgrade (CBR) , strength(elastic modulus) of existing road was calculated by Benkelman beam test. Review was made in according with 22TCN251-98 (Benkelman beam test), 22TCN263-2000 (Road investigation) and 22TCN211-06 (Pavement thickness, traffic volume).

a) The improvement of existing 4 lanes （Overlay the existing pavement）

The flow of pavement design of improvement 4-lanes is shown in Figure 3.2.1-4.

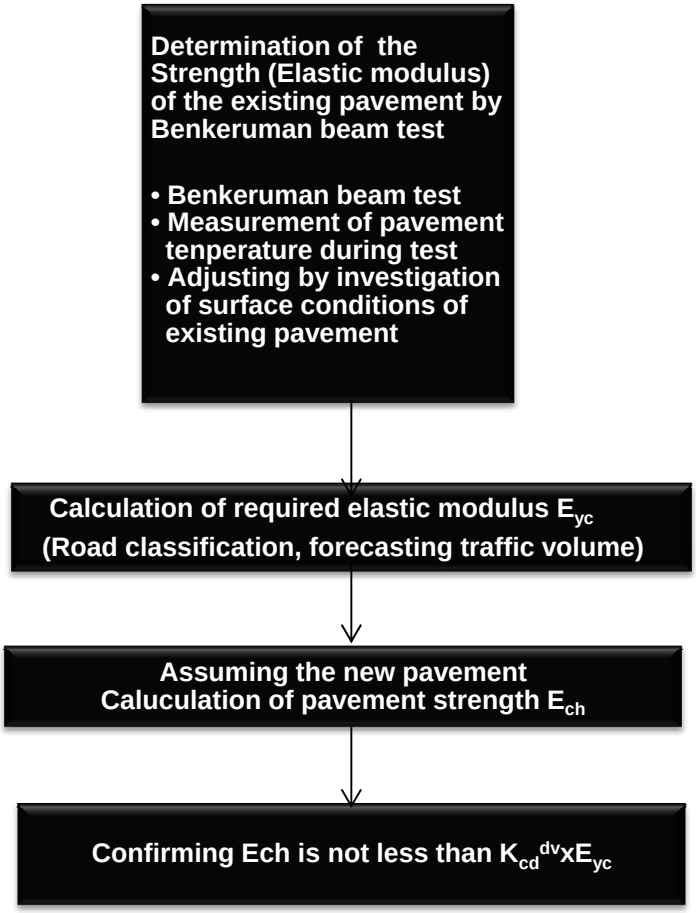


Figure 3.2.1-17 The flow of pavement design of improvement 4-lanes

i) Result of the Characteristic Elastic Module E_{dt} of existing pavement

The test result of Characteristic Elastic Module E_{dt} of existing pavement by VEC F/S and review by JST (JICA Study Team) is shown in Table 3.2.1-18. The test was performed each 200m.

Table 3.2.1-18 Result of the Characteristic Elastic Module E_{dt} of existing pavement

Unit: daN/cm^2

Lane	Starting point	Ending point	distance (m)	VEC FS E_{dt}	JST review E_{dt}
Right	Km181+600.00	Km182+700.00	1100	1023	1007
	Km182+700.00	Km185+300.00	2600	1189	1178
	Km185+300.00	Km191+900.00	6600	1201	1178
	Km191+900.00	Km197+300.00	5400	1387	1372
	Km197+300.00	Km200+700.00	3400	1665	1643
	Km200+700.00	Km207+500.00	6800	1301	1301
	Km207+500.00	Km212+200.00	2500	1601	1601
Left	Km180+700.00	Km181+800.00	1100	1125	1115
	Km181+800.00	Km188+400.00	6600	1146	1135
	Km188+400.00	Km191+600.00	3200	1403	1387
	Km191+600.00	Km198+400.00	6800	1328	1328
	Km198+400.00	Km206+000.00	7600	1343	1328
	Km206+000.00	Km211+300.00	5300	1601	1581

The result of PHAP VAN CAU GIE UPGRADING PROJECT Volume 1.2 Pavement Investigation Report, 10-TEDI-027-HD as basic data of VEC F/S can be considered generally valid.

ii) The traffic demand forecast

The comparison between Traffic volume demand forecast in 2030 by VEC FS and JST(JICA Study Team) is shown in Table 3.2.1.6-4 The comparison of the traffic volume demand forecast in 2030 between by VEC FS and JST.

Table 3.2.1-19 Traffic Demand Forecast in 2030 by VEC FS and JST

	VEC FS		JST	
Vehicle type	Phap van-Thuong Tin	Thuong Tin-Cau Ghe	Phap van-Thuong Tin	Thuong Tin-Cau Ghe
Passenger car	27,013	28,028	26,841	14,548
Small bus	6,264	6,951	2,977	3,205
Heavy bus	7,461	8,562	4,465	4,807
Small truck	4,284	4,275	1,363	1,371
Medium truck	1,071	1,069	17,868	17,979
Heavy truck	342	1,457	6,209	6,247
Heavy truck distance between rear axles is 3m or more	147	624	4,846	4,876
Total	46,582	50,966	64,569	53,033

iii) Required elastic modulus(E_{yc})

Review result of Required elastic modulus **(E_{yc})** is shown in Table 3.2.1.6-5 The comparison of Required elastic modulus (**E_{yc}**) between VEC FS and JST is shown in Table 3.2.1.6-6. Calculating method is followed 22 TCN211-06. However, both traffic surveys did not followed 22TCN211-06. That standard request the exact vehicle classification, so in the detailed design should be more detail studied.

Table 3.2.1-20 The comparison of Required elastic modulus (E_{yc}) between VEC FS and JST

(Unit: Mpa)

Station / Reviewed by	Phap van-Thuong Tin※	Thuong Tin※-Cau Gie
VEC FS	190	200
JST	226	227

※Thuong Tin (192km+900)

Minimum elastic modulus (**E_{yc}**) from 22TCN211-06 is shown in the table below.

Table 3-5: Minimum value of required elastic modulus (MPa)

Road type and class	Type of surface layer of design pavement structure		
	High-grade A1	High-grade A2	Low-grade B1
1. Highway/road			
- Expressways and Class I	180 (160)		
- Class II road	160 (140)		
- Class III road	140 (120)	120 (95)	
- Class IV road	130 (110)	100 (80)	75
- Class V road		80 (65)	Not stipulated
- Class VI road			
2. Urban road			
- Expressways and arterial road	190		
- Regional main road	155	130	
- Street	120	95	70
- Industrial road and warehouse	155	130	100
- Non-motorized road, lane	100	75	50

Note to Table 3-5:

- Values in parentheses are the minimum required elastic modulus for the structure of the hard shoulder.

Calculation cases, calculation method and way of determination of Ech

After determining the required elastic modulus value, it is probable that there are 2 calculation cases:

Recheck the proposed structural alternatives of pavement structure including material layers with the supposed thickness whether satisfactory to conditions (3.4) or not. In this case, Ech shall be calculated for the whole structure and then compared with a product K_{cd}^{dv}. Eyc for assessment. This is also the calculation case for assessing the strength of the existing pavement structure.

Knowing the product K_{cd}^{dv}. Eyc, carry out calculating the pavement thickness to satisfy the condition (3.4)

iv) Calculating result of necessary elastic modulus (K_{cd}^{dv} x E_{yc})

Table 3.2.1-21 The comparison of necessary elastic modulus (K_{cd}^{dv} x E_{yc})

	Phap van-Thuong Tin	Thuong Tin-Cau Gie
Required elastic modulus E_{yc}	226	227
Necessary elastic module K_{cd}^{dv} x E_{yc}	248.6	249.7

*Relaiability 90% is applied.

v) Review of pavement design(overlay)

JST used Aggregate type 1 with cement 6% instead of Aggregate type 1 applied in VEC FS for absorbing increase in thickness due to increase in required elastic modulus corresponding to traffic demand forecast by JST. Aggregate type 1 with cement 6% is the

same as that applied in VEC FS for pavement design (new 6 lanes).

Aggregate type 1 with cement 6% has greater strength than Aggregate type 1. Quality of another layers are same as that in VEC FS.

Table 3.2.1-22 Comparison of pavement design between VEC FS and JST

Locations			VEC FS							JST Review		
Lane	From (station)	To (station)	Length (m)	E_{dt} (daN/cm^2)	Rough-ness layer (cm)	Fine grain asphalt concrete (cm)	Coarse grained asphalt concrete (cm)	Aggregate type 1 (cm)	The total thickness increase (cm)	Aggregate type 1 with cement 6% (cm)	E_{ch}	$K^{dv}_{cd} \times E_{yc}$
Right lane	Km181+600	Km182+700	1100	1023	3	5	7	25	40	25	254.2	244.2
	Km182+700	Km185+300	2600	1189	3	5	7	20	35	20	260.7	244.2
	Km185+300	Km191+900	6600	1201	3	5	7	18	33	18	259.4	244.2
	Km191+900	Km197+300	5400	1387	3	5	7	15	30	15	254.1	246.4
	Km197+300	Km200+700	3400	1665	3	5	7	12	27	12	269.7	246.4
	Km200+700	Km207+500	6800	1301	3	5	7	20	35	20	254.2	246.4
	Km207+500	Km210+000	2500	1601	3	5	7	12	27	12	267.4	246.4
Left lane	Km180+700	Km181+800	1100	1125	3	5	7	20	35	20	256.3	244.2
	Km181+800	Km188+400	6600	1146	3	5	7	20	35	20	250.1	244.2
	Km188+400	Km191+600	3200	1403	3	5	7	10	25	10	252.9	244.2
	Km191+600	Km198+400	6800	1328	3	5	7	18	33	18	256.2	246.4
	Km198+400	Km206+000	7600	1343	3	5	7	15	30	15	265.3	246.4
	Km206+000	Km211+300	5300	1601	3	5	7	12	27	12	265.2	246.4

b) The improvement existing 4 lanes road (Reconstruction of the existing pavement) and new 2 lanes for 6 lanes widening (new construction)

(i) Design Method

Calculation method of The improvement existing 4 lanes road is using CBR value instead of i) elastic modulus of existing pavement (Characteristic Elastic Module) Edt. CBR value is using CENTRAL NEXCO Study of pavement by Japanese TA method**.** In this regard, CBR is 6%. A method in 22 TCN 211 – 06 B.4 is applied to convert CBR to elastic modulus method. Experimental correlation between elastic modulus E_o and load bearing ratio CBR is 3.4. Some experimental relations of Vietnam Types of soil (with a correlation coefficient R^2 =0.91) is as follows.

E_0 =4.68×CBR+12.48（filling sand） (MPa); B-5

E_0 of subgrade is ngiven 4.68*CBR+12.48＝4.68*6.0+12.48＝40.6(MPa). In case of H/D>2 formation is change to follows.

F.1 Approximate formula to calculate elastic module

$$E_{ch}=\frac{1+\frac{E_0}{E_1}}{\sqrt{1+4\left(\frac{H}{D}\right)^2\left(\frac{E_0}{E_1}\right)^{-0.67}}}$$

(ii) Review of Pavement design (6 lanes and new construction)

The comparison of the pavement design between VEC FS and JST is shown in Table 3.2.1-23.

Table 3.2.1-23 The comparison of the pavement design between VEC FS and JST

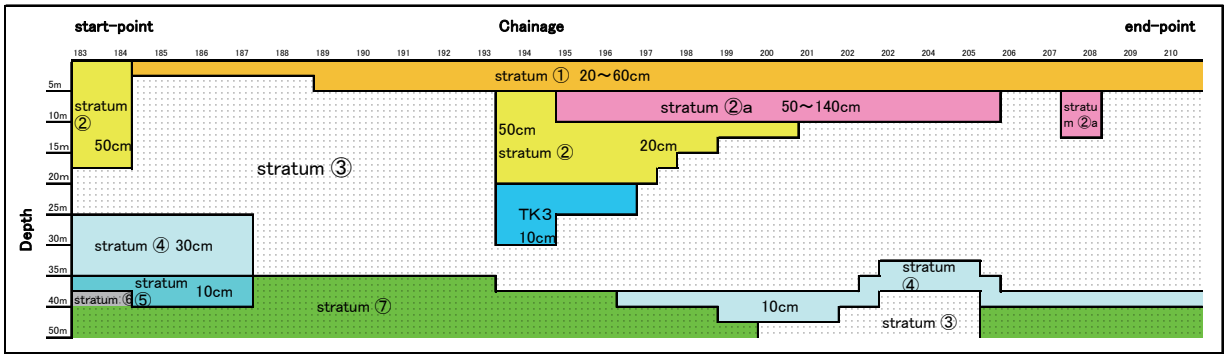
	VEC FS		JST	
SECTION / LAYER	Phap Van-Thuong Tin Thickness (cm)	Thuong Tin-Cau Gie Thickness (cm)	Phap Van-Thuong Tin Thickness (cm)	Thuong Tin-Cau Gie Thickness (cm)
Asphalt concrete Surface Course	5	5	5	5
Asphalt concrete Binder Course	7	7	7	7
Porous asphalt concrete	10	10	10	10
Macadam aggregate type1 with cement 6%	22	22	35	35
Macadam aggregate type2	25	30	35	35

Roughness Layer is added to the top layer as wearing layer (3cm). Roughness layer is not included as layer of pavement design because that is wearing course.

Due to the increase in traffic volume forecast, corresponding necessary elastic modulus also increases. It is understood that increase in aggregate layers for reconstruction or new construction is larger than those for overlay because overlay evaluates a strength of the existing pavement.

3.2.1.7 Counter measures for preventing settlements

PVCG Highway was constructed on the soft ground. Although approx. ten years have been past, consolidation settlements are observed. There are level differences at the boundary between Structures supported by piles, such as bridges or box culverts, and typical embankment section. While Structures supported by piles has little settlement, typical embankment section has at certain level of settlement in spite of countermeasures for settlements, ie. Prefabricated Vertical Drain (PVD). This uneven settlements cause level differences. In PV-CG Highway, there seems to be settlements as much as 1m. Soft layers which generate considerable consolidation settlements, such as layer 1, layer 2a and layer 2 shown in the following Figure, exist at the depth between 10m to 20m from the ground level.



No.	Outline of Stratum	No.	Outline of Stratum
Stratum ①	medium hard - hard clay	Stratum④	hard clay
Stratum②a	soft - very soft organic clay	Stratum⑤	hard - very hard clay
Stratum②	soft - very soft clay	Stratum⑥	moderate dense sand
Stratum③	medium dense sand	Stratum⑦	hard dense sand
TK3	very hard clay		

Source : GEOTECHNICAL ENGINEERING REPORT, August 1997

Figure 3.2.1-18 Geotechnical Longitudinal Section

In VEC FS, geological investigation was carried out and countermeasures were studied. Countermeasures included in VEC FS are introduced. As stated in VEC FS, the documents collected, such as detailed design drawing, as-built drawings and maintenance record, are not enough for studying countermeasures in detail. At the Detailed Design stage, it is necessary to re-study countermeasures in detail after collecting the documents mentioned above and carrying out an additional geological investigation. A Geological Longitudinal Section made from geological investigation ordered by C-NEXCO is attached to Attachment.

(1) Allowable residual settlements

Allowable residual settlements are shown in the following Table.

Table 3.2.1-24 Allowable residual settlements (Sr)

Location	Value
Typical Embankment Section	Sr≦30cm

Box Culvert Section	Sr≦20cm
Bridge Section	Sr≦10cm

(2) Countermeasures for Existing 4-lane

Design specifies Allowable residual settlements (Sr) is not greater than 10cm for Typical Embankment Section in order to minimize level differences at the connection part between existing 4-lane and widening part (one lane at each side), also standard specifies Sr is not greater than 30 cm. To achieve this target, Deep Mixing Method of Stabilization is applied to Box Culvert Section and Typical Embankment Section where Sr is greater than 10 cm.

(3) Countermeasures for widening parts

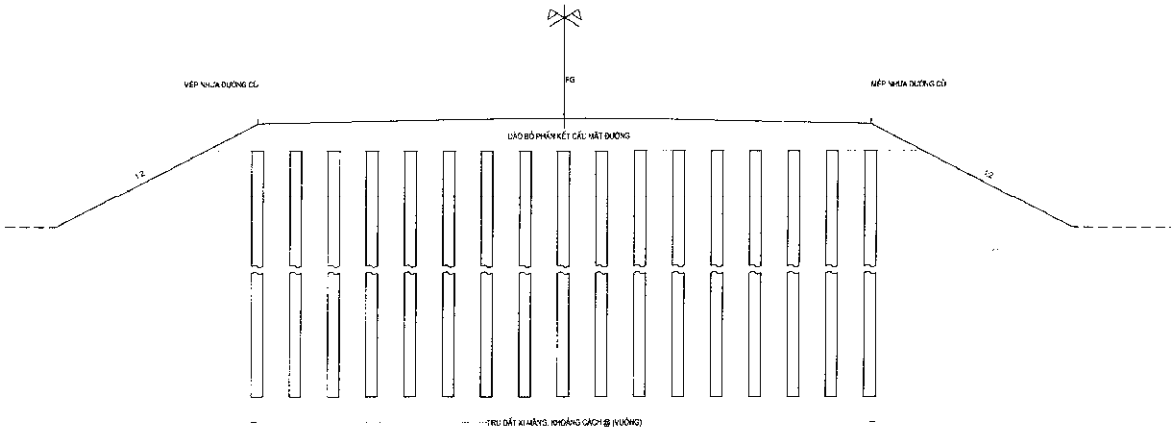
For widening part, most economical method, such as PVD plus surcharge, is designed. Thickness of surcharge is 60 cm and surcharge is to be made at 5cm/day.

Table 3.2.1-25 List of Box Culvert for Deep Mixing Method of Stabilization

No.	Station			No.	Station		
1	KM191+616.8	～	KM191+636.8	18	KM200+524.8	～	KM200+544.8
2	KM191+639.3	～	KM191+659.3	19	KM200+978.3	～	KM200+998.3
3	KM194+837.8	～	KM194+857.8	20	KM201+001.8	～	KM201+021.8
4	KM194+860.3	～	KM194+880.3	21	KM202+916.3	～	KM202+936.3
5	KM195+837.3	～	KM195+857.3	22	KM202+939.8	～	KM202+959.8
6	KM195+860.8	～	KM195+880.8	23	KM203+648.3	～	KM203+668.3
7	KM196+874.8	～	KM196+894.8	24	KM203+671.8	～	KM203+691.8
8	KM196+897.3	～	KM196+917.3	25	KM205+318.3	～	KM205+338.3
9	KM197+890.0	～	KM197+941.0	26	KM206+341.3	～	KM205+361.8
10	KM197+947.0	～	KM197+997.0	27	KM206+318.3	～	KM206+634.8
11	KM198+729.8	～	KM198+749.8	28	KM206+614.8	～	KM206+657.3
12	KM198+752.3	～	KM198+772.3	29	KM206+637.3	～	KM207+884.0
13	KM199+101.3	～	KM199+121.3	30	KM207+890.0	～	KM207+910.0
14	KM199+124.8	～	KM199+144.8	31	KM208+651.3	～	KM208+671.3
15	KM199+953.0	～	KM199+973.0	32	KM208+674.8	～	KM208+694.8
16	KM199+979.0	～	KM19+999.0	33	KM209+454.3	～	KM209+474.3
17	KM200+501.3	～	KM200+521.3	34	KM209+447.8	～	KM209+497.8

Table 3.2.1-26 List of PVD Sections (Typical Embankment)

TT	Lý trình	Cự ly (m)	Chiều cao đắp cạp (m)	Nội dung xử lý												
				Giếng cát (SD) hoặc Bấc thấm (PVD)			Chiều dày cát đệm (m)	Tiến trình đắp					Bệ phản áp bxh (m)	Độ cố kết U (%)	Độ lún còn lại Sr (m)	Chiều dày bù lún (m)
									Giai đoạn 1		Giai đoạn 2					
				SD/ PVD	Khoảng cách d (m)	Chiều sâu D (m)		Tốc độ đắp cm/ngày	Chiều cao (m)	Thời gian chờ cố kết T1 (ngày)	Chiều cao (m)	Thời gian đợi T2 (ngày)	Tổng thời gian thi công (ngày)			
1	KM 182+450.0 - KM 182+877.0	427	3.2	PVD	1.5	17.2	0.6	5	FG+0.5	210			288		91.1	0.05	0.67
	Cầu Vàn Điền																
2	KM 183+050.0 - KM 184+850.0	1800	3.2	PVD	1.5	17.7	0.6	5	FG+0.9	210			296		92.1	0.04	0.58
3	KM 184+850.0 - KM 189+650.0	4800	2.0	không xử lý													
4	KM 189+650.0 - KM 190+850.0	1200	2.4	PVD	1.5	15.8	0.6	5	FG+0.4	210			267		93.8	0.02	0.41
5	KM 190+850.0 - KM 191+450.0	600	2.7	PVD	1.5	15.8	0.6	5	FG+0.4	210			272		90.1	0.03	0.35
6	KM 191+450.0 - KM 192+000.0	550	3.5	PVD	1.5	16.0	0.6	5	FG+0.5	210			298		90.2	0.08	0.84
7	KM 192+000.0 - KM 192+861.0	861	1.2	không xử lý													
8	KM 193+200.0 - KM 194+350.0	1150	2.2	PVD	1.5	16.0	0.6	5	FG+0.5	210			262		91.1	0.03	0.38
9	KM 194+350.0 - KM 195+150.0	800	2.0	không xử lý													
10	KM 195+150.0 - KM 196+414.0	1264	2.2	PVD	1.5	13.0	0.6	5	FG+0.8	210			271		91.6	0.02	0.32
11	KM 196+414.0 - KM 198+550.0	2136	1.8	không xử lý													
12	KM 198+550.0 - KM 200+600.0	2050	3.0	PVD	1.5	17.0	0.6	5	FG+0.4	210			278		91.3	0.03	0.35
13	KM 200+600.0 - KM 202+031.0	1431	3.0	PVD	1.5	8.30	0.6	5	FG+0.3	210			294		97.1	0.01	0.21
14	KM 202+031.0 - KM 204+000.0	1969	2.5	không xử lý													
15	KM 204+000.0 - KM 204+110.0	110	6.0	PVD	1.5	7.00	0.6	5	3	90	FG+0.3	120	341	8x3	95.1	0.02	0.51
	Cầu Vạn Điểm																
16	KM 204+290.0 - KM 204+400.0	110	6.0	PVD	1.5	15.5	0.6	5	3	90	FG+0.3	120	351	8x3	97.0	0.03	1.02
17	KM 204+400.0 - KM 205+150.0	750	1.5	không xử lý													
18	KM 205+150.0 - KM 210+500.0	5350	3.0	PVD	1.5	13.5	0.6	5	FG+0.4	210			278		90.1	0.03	0.37
19	KM 210+500.0 - KM 211+256.0	756	4.0	không xử lý													



BẢNG TỔNG HỢP CÁC CỐNG HỘP CẦN XỬ LÝ PHẦN NỀN ĐƯỜNG ĐẦU CỐNG

Lý trình	
Cầu Vàn Điền	
CỐNG HỘP	KM 191+638.0
CỐNG HỘP	KM 195+857.0
CỐNG HỘP	KM 197+950.0
Cầu Vạn Điểm	
CỐNG HỘP	KM 208+680.0

SƠ ĐỒ BỐ TRÍ TRỤ ĐẤT XI MĂNG @=1.6

GHI CHÚ:

1. KÍCH THƯỚC GHI TRÊN BẢN VẼ ĐỀU ĐƠN VỊ LÀ MÉT, TRỪ KHI CÓ CHỈ ĐỊNH KHÁC;
2. CHIỀU SÂU PHỤ ĐẤT XI MĂNG CÓ THỂ THAY ĐỔI THEO SỰ PHÂN BỐ ĐẤT YẾU;
3. CỐNG RÃNH ĐƯỢC THI CÔNG SAU KHI TRỤ ĐẤT XI MĂNG ĐẠT YÊU CẦU;
4. FG: CAO ĐỘ THIẾT KẾ.
5. CÁC YÊU CẦU VỀ VẬT LIỆU, THI CÔNG TUÂN THỦ CHỈ DẪN KỸ THUẬT CỦA DỰ ÁN;
6. PHẠM VI XỬ LÝ CHO 1 BÊN CỐNG L=12M (ĐẤT ĐẮP TỪ SAU BẢN QUÁ ĐỘ);

Figure 3.2.1-19 Layout of Deep Mixing Method of Stabilization

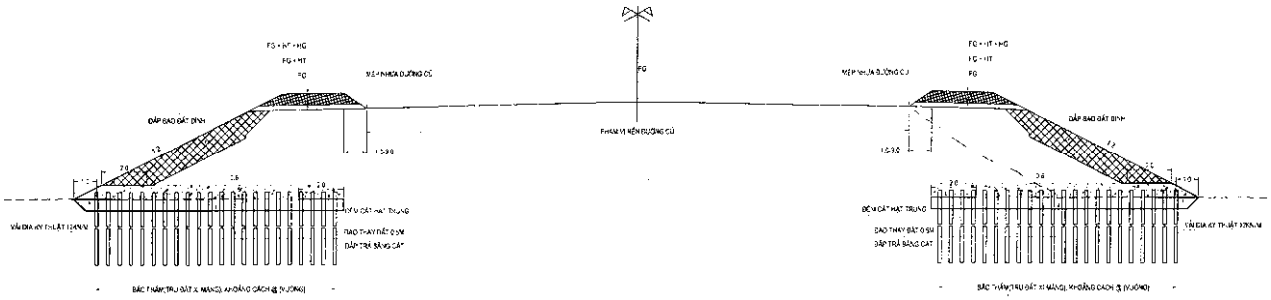


Figure 3.2.1-20 Layout of Prefabricated Vertical Drain (PVD)

3.2.2 Structure

In Study Area as main structure, there are 52 Box culverts for road, 105 Pipe culverts for drainage, 1 studying new bride for frontage road, 2 bridge for Expressway and 2 overpass bridge crossing Expressway.

Present Conditions and Design Policies for each structure are as follows.

3.2.2.1 Present Condition and Design Policy

(1) Box Culvert for Road (Phase Ⅰ)

a. Present Condition

Box culverts for road are 52 in Survey Area. Type of Inner size is 8 type, and Type of Inner size 2.5m square, the number of them is 19 and most common. Result in site survey, these Box culvert are good condition as non-damage. The list of Box culverts for road indicates in Appendix and the list of Type is as follows.

Table 3.2.2-1 The list of Box culverts for road

Size		The number of Box culverts
Inner width(m)	Inner height (m)	
2.5	2.5	19
3.5	2.5	15
3.5	3.2	3
3.5×2	3.2	2
4.0	2.5	1
4.0	3.2	3
5.0	3.6	2
6.0	3.6	7
Total		52

B2.5m,H2.5m

B3.5m×2,H3.2m

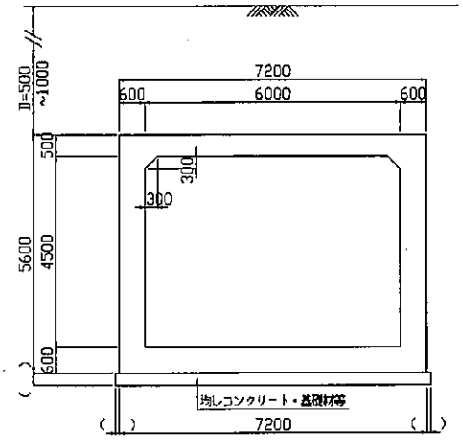
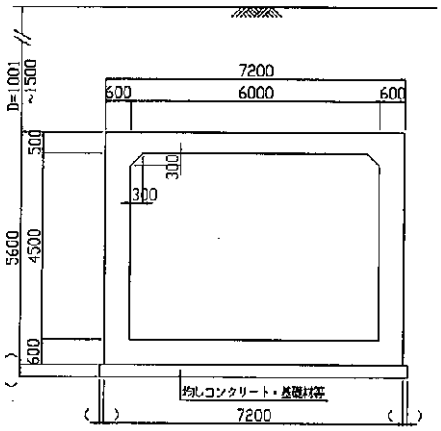
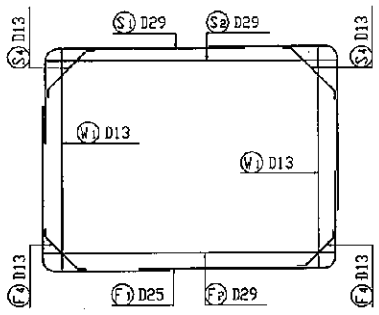
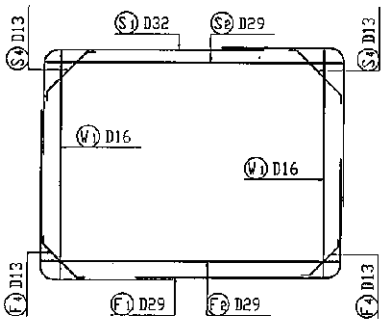
Figure 3.2.2-1 Existing Box culvert

b. Design Policy

The existing box culverts are made from reinforced concrete. The existing box culverts would need to be extended with the widening of PVCG Expressway and the additional extensions will be of the same inner size and shape with the existing structures.

Structure dimension and bar arrangement of the box culvert may be affected by the overburden as shown in Example. The vertical alignment of PVCG Expressway will be improved and the overburden on some box culvert will be deeper than that of existing one. Therefore structural soundness of the box culvert is checked. Checking Results shows that stress generated in the box culvert is within an allowable stress. Because increase in the overburden on box culvert may shorten its design life and may cause adverse effects by unexpected action of the load, it should be minimized. In the Detailed Design stage, decrease in overburden on the box culvert is to be studied by review of vertical alignment and pavement design, and structural soundness is to be checked.

Example: BOX 6.0×4.5, Extract from Japanese Standard Drawings

	Overburden D=500～1000	Overburden D=1001～1500
Size		
Placing Reinforcement		

(2) Box culvert for drainage (Phase Ⅰ)

a. Present Condition

It seems that Box culverts for drainage are 105 on survey area. But Site survey was tried, it was impossible we confirm them account for growing thick plants. So location and size of Box culvert for drainage are confirmed by plan and parts of drawings provided from Vietnamese government.

They are divided 16 type by different of shape Type of Inner diameter is1.25m and the number of them is 19 and most common. The list of Pipe culverts for road indicates Appendix and the list of Type is as follows.

Table 3.2.2-2 The list of Pipe culverts for road

Size			The number of Box culverts
Box Culvert		Pipe Culvert	
Inner width(m)	Inner height (m)	Inner Diameter(m)	
-	-	1.00	18
-	-	1.20	3
-	-	1.25	52
-	-	1.30	1
-	-	1.50	2
-	-	1.50×2	1
1.5	1.5	-	12
1.5	2.0	-	1
1.5×2	1.5	-	3
2.0	2.0	-	1
2.0×2	2.0	-	2
2.5	2.5	-	1
2.5×2	2.5	-	3
3.0	3.0	-	2
3.0×2	3.0	-	2
3.5×2	3.0	-	1
Total			105

	
ϕ 1.25m	B2.5m×2,H2.5m

Figure 3.2.2-2 Existing Pipe culvert for drainage

b. Design policy

Pipe culvert is reinforced concrete structure. According to widening PVCG road, these need to be extended at existing inner size and shape.

(3) Frontage Road Bridge (Phase Ⅰ)

a. Present Condition

Frontage road is planned to be constructed between km182+800 and km211+300 west and between km182+950 and km206+60 east. On west sides the bridge is needed because of crossing over To Lich River(nearby km182+900). Main line of expressway crosses over To Lich River, so bridge of frontage road will be planned to parallel to the bridge of expressway and to cross over To Lich River.

	
Looking from south west (end-point side)	Administrative way from south (end-point side)

Figure 3.2.2-3 Van Dien Bridge

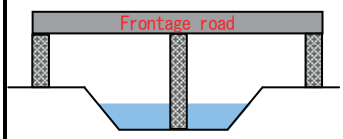
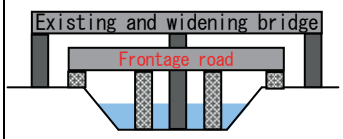
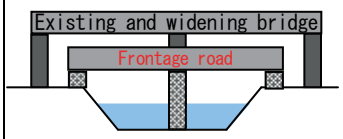
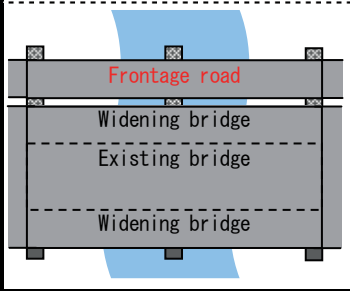
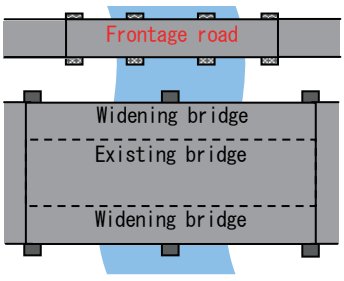
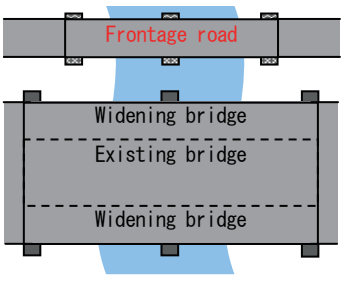
b. Design Policy

Design Policy of Frontage Road Bridge is as follow.

- The type of structure is decided in considering harmonious with nearby landscape.
- The type of structure is decided in considering maintenance
- Bridge design is conducted considering keeping administrative way's space.
- The type of structure is decided in considering an estimated high level water level of To Lich River.

Types of superstructures are compared as shown below. Type of superstructure is to be of PC-I girder, which was determined to be optimum in landscape and land acquisition.

Table 3.2.2-3 Comparison of type of superstructure

Type of superstructure	PC-I girder bridge	RC slab bridge	Plate girder bridge
The length of bridge	Approx.65m	Approx.50m	Approx.50m
Span	2span	3span	2span
Outline	Form and location of this bridge are same form, construction adjacent positions respectively.	Bridge length will be shorter and construction cost will to be reduced. Construction position of this bridge is offset from expressway at a certain distance because space of administrative road is obstructed by this bridge	Bridge length will be shortest and construction cost will to be reduced. Construction position of this bridge is offset from expressway at a certain distance because space of administrative road is obstructed by this bridge
Advantage	Landscape is better than others because this bridge is parallel to expressway. Land acquisition is controlled minimal scope.	Bridge length can be shorter than the steel construction and maintenance costs are reduced.	The burden of substructure can be reduced because weight of superstructure is light compare to other proposal.
Disadvantage	Construction costs are higher compared to other proposals for a longer bridge length.	Landscape is worse than others because of difference of height of bridge and difference of bridge form Because offset from expressway to frontage road expand, land acquisition is also expanded. Because bridge pier is many, so there is a risk of adverse effects on river flows down.	Landscape is worse than others because of difference of height of bridge and difference of bridge form Because offset from expressway to frontage road expand, land acquisition is also expanded. Because metal bridge is required periodic painting, maintenance cost is increase.
Figure of Vertical image			
Figure of plane image			

(4) Bridge(Phase Ⅱ)

a. Present Condition

PVCG road has two bridges, Van Dien Bridge and Van Diem Bridge. As a result of site survey, they are non-damage and good condition.

Table 3.2.2-4 Outline of Expressway bridge

The name of Bridge	Station	Length	Superstructure	Span	The length of span	The Width of road
Van Dien Bridge	Km182+920	66.15m	PC-I girder	2span	32.2m	12.0m one side
Van Diem Bridge	Km204+191	165.30m	PC-I girder	5span	32.2m	12.0m one side

Figure 3.2.2-4 Van Dien Bridge

b. Design Policy

It is confirmed that design load of Van Dien Bridge is H30-XB80(HS20-44×1.25) form as-built drawing.so it is considered that Existing Van Dien Bridge were adopted for Vietnam Standard. And it is considered that Van Dien Bridge was built as design condition. So on this time survey, checking existing structure don't be conducted and only study on widening is conducted.

Widening parts are widened 4.25m, and the type of superstructure is decided PC-I girder considering workability, economy and ease of maintenance and being same superstructure of existing Van Dien Bridge.(comparison of superstructure from the report of past survey are conducted.)

Table 3.2.2-5 Outline of widening Expressway bridge

The name of bridge	Superstructure	Length	The length of widening
Van Dien Bridge	PC-I girder	66.15m	4.75m
Van Diem Bridge	PC-I girder	165.30m	4.75m

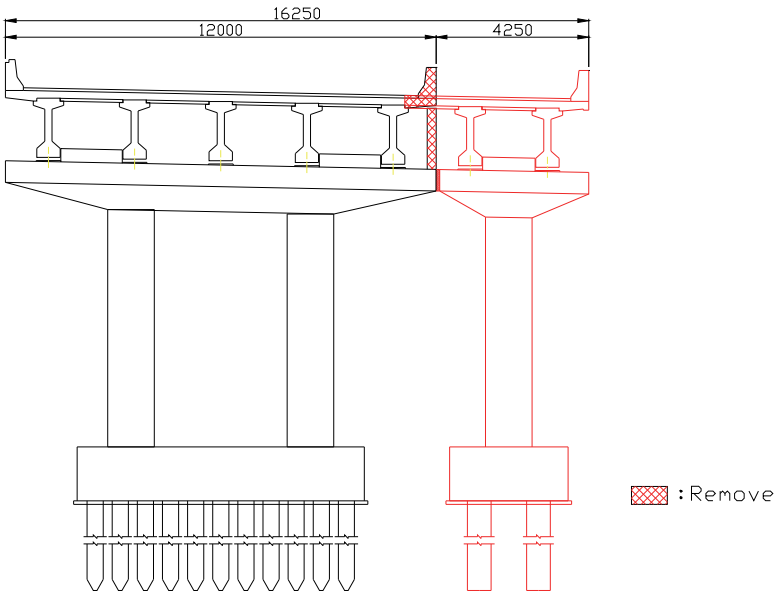


Figure 3.2.2-5 Cross section

(5) Over pass (Phase Ⅱ)

a. Present Condition

Crossing expressway Overpass on survey site is two bridge, Tu Khoat Flyover and Khe Hoi Flyover

As a result of site survey, these bridges are confirmed that main girder was lightly damaged and drainage was deteriorated. These injuries are not urgent, but thought to be repaired at the time of four-lane highway.

Table 3.2.2-6 List of overpass

The name of bridge	Station	Superstructure	Span
Tu Khoat Flyover	km186+720	PC-I girder	8span
Khe Hoi Flyover	km192+873	PC-I girder	6span

	
Tu Khoat Flyover (km186+720)	Khe Hoi Flyover(km192+873)
	
Chipped main girder(Tu Khoat Flyover)	Aging drainage(Khe Hoi Flyover)

Figure 3.2.2-6 Present condition of flyovers

b. Design Policy

The results of the investigations show that the clearances under the girder of Tu Khoat Flyover Bridge and Khe Hoi Flyover Bridge are within standards; with clearances of 4.25m. These clearances will be kept sufficient when road is overlaid and upgraded, when additional widening to 6 lanes will be undertaken. So the Study Team does not carry out any design for these Flyovers.

3.2.3 Construction Method Statement

3.2.3.1 Sequence of Construction

The project for Phase I is to upgrade existing 4-lane Highway to Expressway. To satisfy the standard of Expressway, planned level of pavement surface is raised by maximum 1.8m due to vertical alignment improvement. Embankment is to be made as per new planned level. Paving and installation of guard rails follows.

Construction sequence is as shown in the following flow chart.

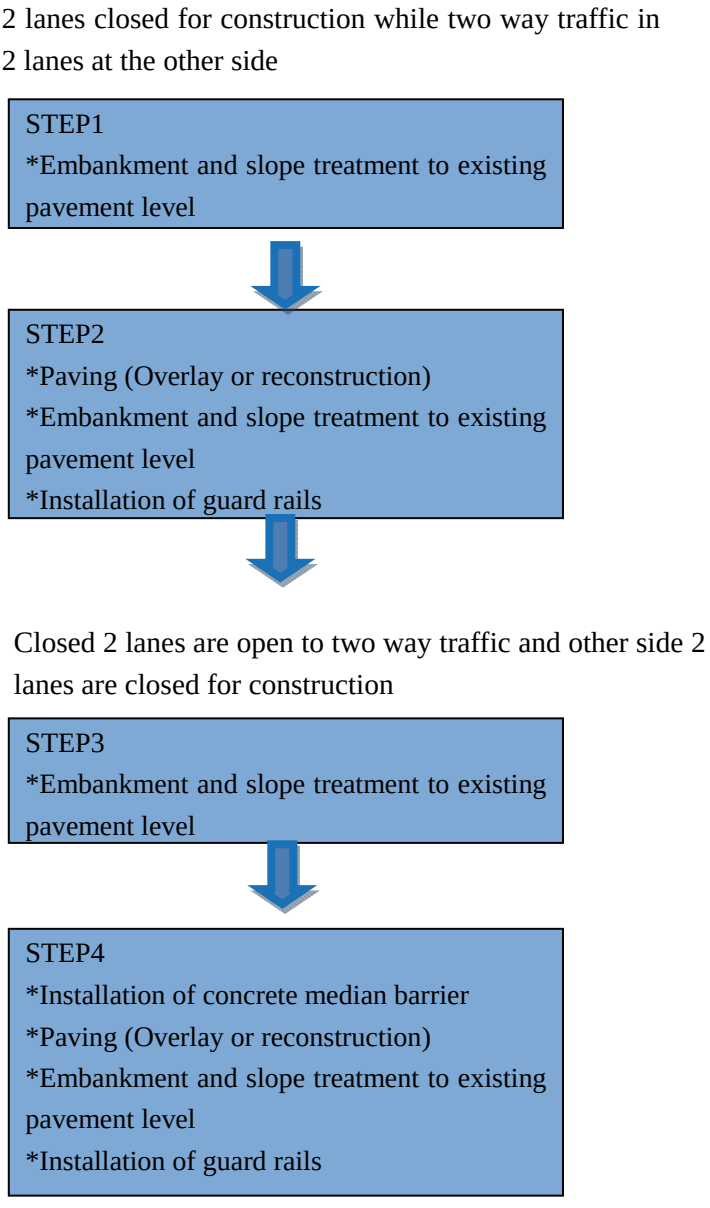
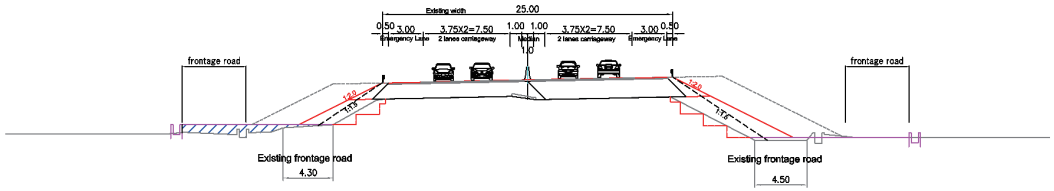


Figure 3.2.3-1 Sequence of Construction

Sequence of construction, construction mashine list and outline construction schedule for Phase I are shown in the next page onwards.

Construction process: Embankment, Slope protection are implemented on one side. after that , Pavement is implemented. And then same processes are conducted on an another side.

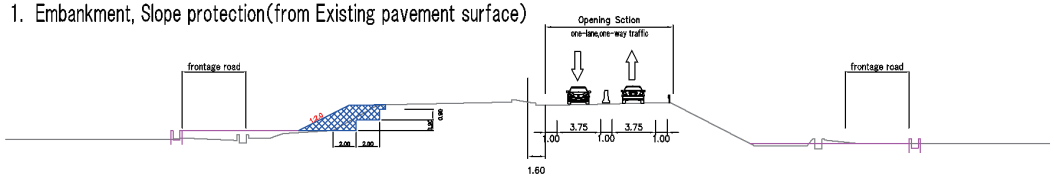
Complete cross-section(STEP5)



STEP1

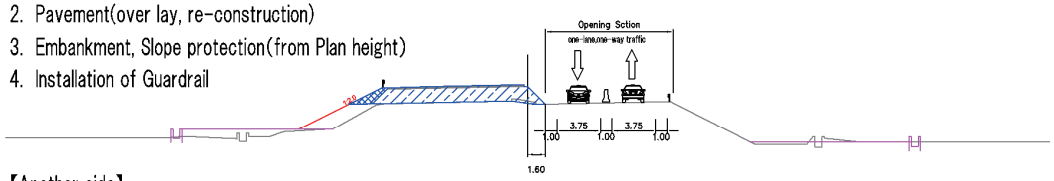
【One side】

1. Embankment, Slope protection(from Existing pavement surface)



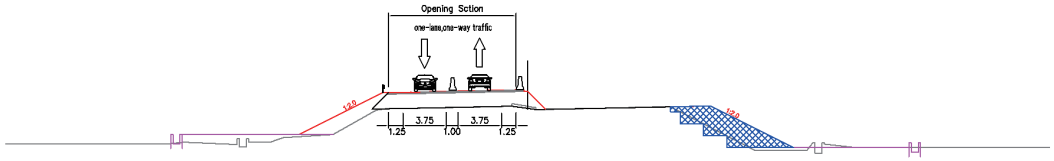
STEP2 【One side】

2. Pavement(over lay, re-construction)
3. Embankment, Slope protection(from Plan height)
4. Installation of Guardrail



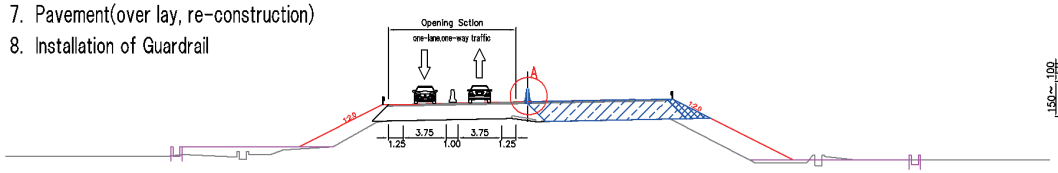
STEP3 【Another side】

5. Embankment, Slope protection(from Existing pavement surface)



STEP4

6. Installation of Concrete Barriers
7. Pavement(over lay, re-construction)
8. Installation of Guardrail



A(Concrete barriers)part Detail

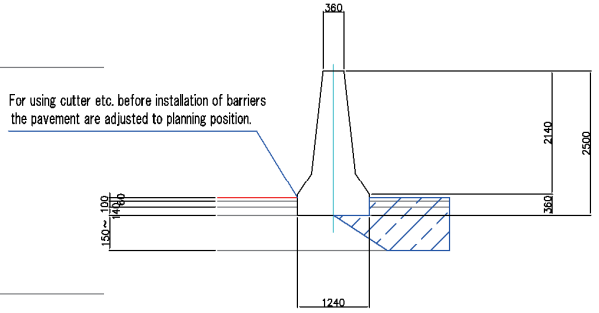


Figure 3.2.3-2 Construction Process (Phase I)

Construction process：Installation PVD and surcharge for widening part, standing for a period, after that, doing Excavation and Removable Surcharge, Pavement, Installation of Guardrail

Complete cross-section(STEP5)

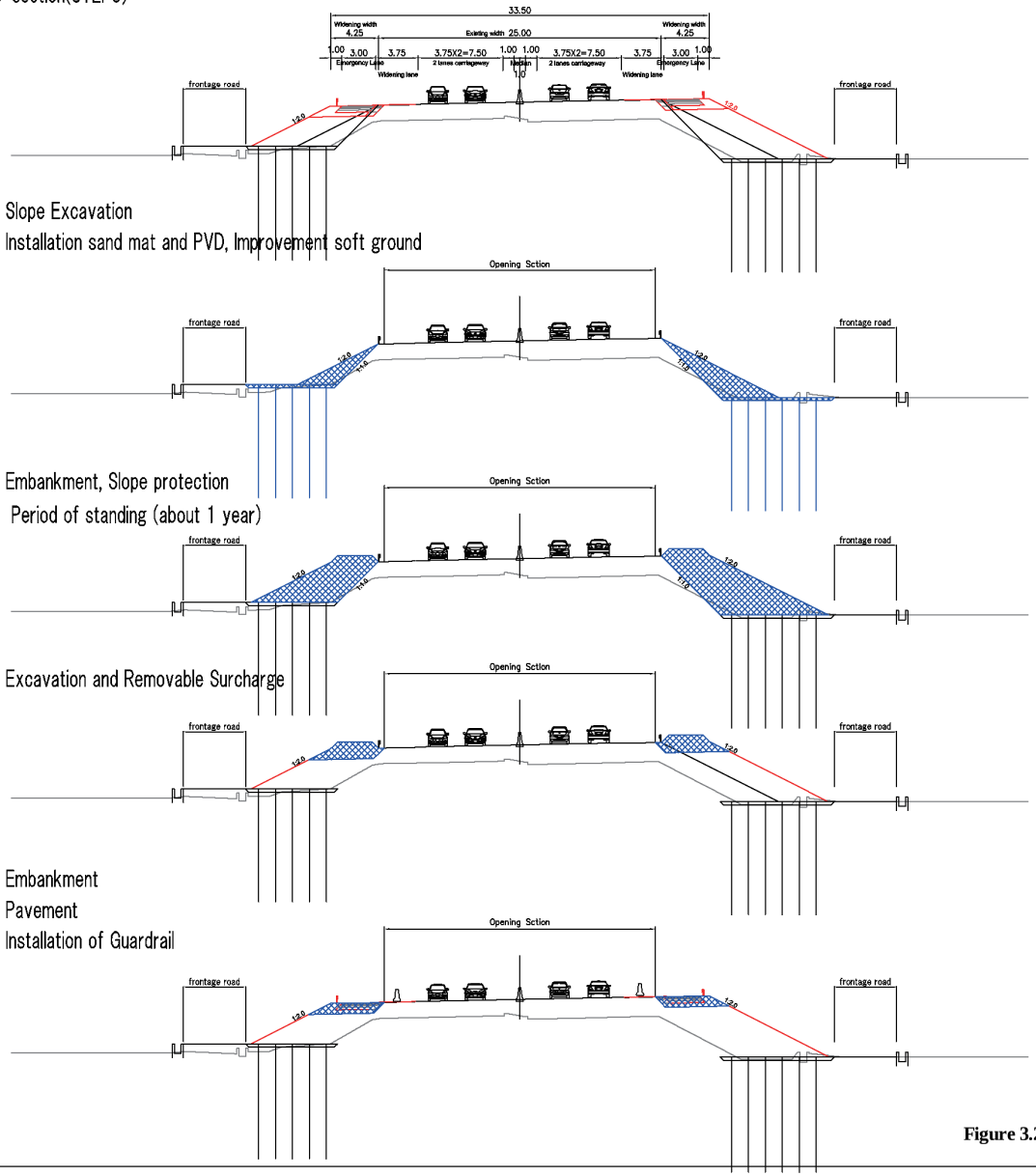


Figure 3.2.3-3 Construction Process (Phase II)

Table 3.2.3-1 Outline Construction Schedule (Phase I)

Area	Unit Price Code	Norm Code	Description	unit	Total Quantity	Work Rate (8 Hours)	Workable Weather Rate (%)	Work Duration per 1set (days)	Work Party (Set)	Work Duration (days)	Year 1 M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	Year 2 M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	Remarks
SECTION 1～ SECTION 6			A MAIN ROAD								SECTION 1			SECTION 2			SECTION 3		SECTION 4		SECTION 5			SECTION 6											
			A MAIN ROAD																																
			I EMBANKMENT																																
	ĐG1		Site clearing	m2	220,395	1,500	74%	199	4	50																									
	TH- 1		Road Excavation	m3	**32,176**	1,500	74%	29	4	7																									
	TH- 2		Embankment K95	m3	**168,873**	300	74%	761	8	95																									
	ĐG9		Embankment K98	m3	3,450	300	74%	16	4	4																									
	ĐG104		Embankment K98 (not including material)	m3	**9,609**	300	74%	43	4	11																									
	ĐG11	AL 17111	Grasses for slope protection	m2	**217,480**	500	83%	524	5	105																									
	TH- 31		Excavation of existing road	m3	8,426	200	74%	57	4	14																									
	II		PAVEMENT																																
	TH- 3		Asphalt Concrete Roughness Layer-thickness 3cm	m2	**388,162**	3,500	74%	150	4	37																									
	TH- 4		Asphalt Concrete Surface Course-thickness 5cm	m2	**509,836**	3,500	74%	197	4	49																									
	TH- 5		Asphalt Concrete Binder Course-thickness 7cm	m2	**514,182**	3,500	74%	199	4	50																									
	TH- 6		Porous Asphalt Concrete-thickness 10cm	m2	**12,250**	1,225	74%	14	4	3																									
	ĐG34		Base course (Aggregate type 1 + 6%cement)	m3	**82,437**	600	74%	186	2	93																									
	ĐG33	AD 11212	SubBase course (Aggregate type 2)	m3	4,428	225	74%	27	2	13																									
	ĐG29	AD 24211	Bituminous Tack Coat 0.6kg/m2	m2	**388,162**	3,500	74%	150	4	37																									
	ĐG30	AD 24213	Bituminous Tack Coat 1.0kg/m2	m2	**509,836**	3,000	74%	230	4	57																									
	ĐG31	AD 24214	Bituminous Prime Coat 1kg/m2	m2	**514,182**	3,500	74%	199	4	50																									
	III		TREATED SOFT SOIL																																
			Soil cement columns	m	39,498	45	83%	1,057	5	211																									
	IV		MISCELLANEOUS																																
	TH- 10		Removal of Median strip	m	43,240	1,500	74%	39	2	19																									
	TH- 48		Proposed Concrete Median	each	**4,271**	15	83%	343	5	69																									
	TH- 12		Removal of existing Guardrail	m	86,481	300	83%	347	5	69																									
	TH- 47		Reinstallation of 30% existing guardrail after repair	m	25,944	200	83%	156	4	39																									
	TH- 8		Installation of Guardrail	m	**17,828**	200	83%	107	4	27																									
	ĐG94	AA 21511	Removal of Boundary barbed wire Fence	m2	43,240	200	83%	260	5	52																									
	ĐG103		Removal of Trees	each	**10,677**	10	83%	1,286	10	129																									
	TH- 28		Shrubs for Outer separation (additional)	each	4,325	10	83%	521	10	52																									
			Shoulder Retaining Wall	m	3,300	30	83%	133	2	66																									
	V		TRAFFIC ORGANIZATION																																
	ĐG38	AK.91131	Reflective Road Marking	m2	29,984	400	74%	101	2	51																									
	ĐG40	AD 32421	Circle Guide Sign D1.26m	each	2	10	83%	0	1	0																									
	ĐG39	AD 32421	Circle Guide Sign D0.7m	each	63	10	83%	8	2	4																									
	ĐG41	AD 32431	Triangle Warning Signs 0.7m	each	131	10	83%	16	2	8																									
	ĐG43	AD 32441	Rectangular Sign	m2	95	10	83%	11	2	6																									
	ĐG45	AD 32131	Steel post for Guide Sign 3.4m	each	54	10	83%	6	2	3																									
	ĐG44	AD 32131	Steel post for Guide Sign 3.7m	each	84	10	83%	10	2	5																									
		TT	Removal of Traffic Sign	each	458	10	83%	55	2	28																									
		TT	Removal of Advertisement Board	each	92	10	83%	11	2	6																									
	B		INTERCHANGE																																
	II		PAVEMENT																																
	TH- 4		Asphalt Concrete Surface Course-thickness 5cm	m2	4,779	1,500	74%	4	1	4																									
	ĐG30	AD 24213	Bituminous Prime Coat 1kg/m2	m2	4,779	1,500	74%	4	1	4																									
	IV		TRAFFIC ORGANIZATION																																
	ĐG38	AK.91131	Reflective Road Marking	m2	1,120	200	74%	8	2	4																									
	ĐG40	AD 32421	Circle Guide Sign D1.26m	each	6	10	83%	1	2	0																									
	ĐG39	AD 32421	Circle Guide Sign D0.7m	each	10	10	83%	1	2	1																									
	ĐG41	AD 32431	Circle Guide Sign D0.7m	each	4	10	83%	0	2	0																									
	ĐG42	AD 32431	Triangle Warning Signs 1.26m	each	1	10	83%	0	2	0																									
	ĐG43	AD 32441	Rectangular Sign	m2	99	10	83%	12	2	6																									
	ĐG45	AD 32131	Steel post for Guide Sign 3.4m	each	7	10	83%	1	2	0																									
	ĐG44	AD 32131	Steel post for Guide Sign 3.7m	each	11	10	83%	1	2	1																									
		TT	Steel sign post D200, L=6.2m	each	10	10	83%	1	2	1																									
		TT	Overhead Gantry	each	2	0.1	83%	24	1	24																									
		TT	cantilever arm	each	4	0.1	83%	48	2	24																									
SECTION 7～ SECTION 10			A MAIN ROAD								SECTION 10			SECTION 9			SECTION 8		SECTION 7																
			A MAIN ROAD																																
			I EMBANKMENT																																
	ĐG1		Site clearing	m2	**74,782**	1,500	74%	67	3	22																									
	TH- 1		Road Excavation	m3	**10,918**	1,500	74%	10	3	3																									
	TH- 2		Embankment K95	m3	**38,452**	300	74%	173	3	58																									
	ĐG9		Embankment K98	m3	2,070	300	74%	9	3	3																									
	ĐG104		Embankment K98 (not including material)	m3	**3,261**	300	74%	15	3	5																									
	ĐG11	AL 17111	Grasses for slope protection	m2	**73,793**	500	77%	192	5	38																									
	TH- 31		Excavation of existing road	m3	5,055	200	74%	34	3	11																									
	II		PAVEMENT																																
	TH- 3		Asphalt Concrete Roughness Layer-thickness 3cm	m2	**131,706**	3,500	74%	51	3	17																									
	TH- 4		Asphalt Concrete Surface Course-thickness 5cm	m2	**172,992**	3,500	74%	67	3	22																									
	TH- 5		Asphalt Concrete Binder Course-thickness 7cm	m2	**174,466**	3,500	74%	67	3	22																									
	TH- 6		Porous Asphalt Concrete-thickness 10cm	m2	**7,350**	1,225	74%	8	3	3																									
	ĐG34		Base course (Aggregate type 1 + 6%cement)	m3	**28,621**	600	74%	64	1	64																									
	ĐG33	AD 11212	SubBase course (Aggregate type 2)	m3	2,657	225	74%	16	1	16																									
	ĐG29	AD 24211	Bituminous Tack Coat 0.6kg/m2	m2	**131,706**	3,500	74%	51	3	17																									
	ĐG30	AD 24213	Bituminous Tack Coat 1.0kg/m2	m2	**172,992**	3,000	74%	78	3	26																									
	ĐG31	AD 24214	Bituminous Prime Coat 1kg/m2	m2	**174,466**	3,500	74%	67	3	22																									
	III		TREATED SOFT SOIL																																
			Soil cement columns	m	23,699	45	83%	634	5	127																									
	IV		MISCELLANEOUS																																
	TH- 10		Removal of Median strip	m	14,672	1,500	74%	13	2	7																									
	TH- 48		Proposed Concrete Median	each	**1,449**	15	83%	116	5	23																									
	TH- 12		Removal of existing Guardrail	m	29,344	300	83%	118	5	24																									
	TH- 47		Reinstallation of 30% existing guardrail after repair	m	8,803	200	83%	53	4	13																									
	TH- 8		Installation of Guardrail	m	**6,049**	200	83%	36	4	9																									
	ĐG94	AA 21511	Removal of Boundary barbed wire Fence	m2	14,672	200	83%	88	5	18																									
	ĐG103		Removal of Trees	each	**3,623**	10	83%	436	10	44																									
	TH- 28		Shrubs for Outer separation (additional)	each	1,467	10	83%	177	10	18																									
			Shoulder Retaining Wall	m	3,050	30	83%	122	2	61																									
	V		TRAFFIC ORGANIZATION																																
	ĐG38	AK.91131	Reflective Road Marking	m2	10,174	400	74%	34	2	17																									
	ĐG40	AD 32421	Circle Guide Sign D1.26m	each	2	10	83%	0	1	0																									
	ĐG39	AD 32421	Circle Guide Sign D0.7m	each	21	10	83%	3	2	1																									
	ĐG41	AD 32431	Triangle Warning Signs 0.7m	each	45	10	83%	5	2	3																									
	ĐG43	AD 32441	Rectangular Sign	m2	32	10	83%	4	2	2																									
	ĐG45	AD 32131	Steel post for Guide Sign 3.4m	each	18	10	83%	2	2	1																									
	ĐG44	AD 32131	Steel post for Guide Sign 3.7m	each	29	10	83%	3	2	2																									
		TT	Removal of Traffic Sign	each	156	10	83%	19	2	9																									
		TT	Removal of Advertisement Board	each	31	10	83%	4	2	2																									
	B		INTERCHANGE																																
	II		PAVEMENT																																
	TH- 4		Asphalt Concrete Surface Course-thickness 5cm	m2	4,779	1,500	74%	4	1	4																									
	ĐG30	AD 24213	Bituminous Prime Coat 1kg/m2	m2	4,779	1,500	74%	4	1	4																									
	IV		TRAFFIC ORGANIZATION																																
	ĐG38	AK.91131	Reflective Road Marking	m2	1,120	200	74%	8	2	4																									
	ĐG40	AD 32421	Circle Guide Sign D1.26m	each	6	10	83%	1	2	0																									
	ĐG39	AD 32421	Circle Guide Sign D0.7m	each	10	10	83%	1	2	1																									
	ĐG41	AD 32431	Circle Guide Sign D0.7m	each	4	10	83%	0	2	0																									
	ĐG42	AD 32431	Triangle Warning Signs 1.26m	each	1	10	83%	0	2	0																									
	ĐG43	AD 32441	Rectangular Sign	m2	99	10	83%	12	2	6																									
	ĐG45	AD 32131	Steel post for Guide Sign 3.4m	each	7	10	83%	1	2	0																									
	ĐG44	AD 32131	Steel post for Guide Sign 3.7m	each	11	10	83%	1	2	1																									
		TT	Steel sign post D200, L=6.2m	each	10	10	83%	1	2	1																									
		TT	Overhead Gantry	each	2	0.1	83%	24	1	24																									
		TT	cantilever arm	each	4	0.1	83%	48	2	24																									

Table 3.2.3-2 List of Construction Machinery

Period: Month 1 to Month 9

Area	Item	Type of Machine	Capacity	Unit	Quantity	Remarks
Plant	Asphalt Paving	Asphalt Plant (Batching Type)	120ton/hour	UN	7	
		Wheel Loader	2-3m3	UN	7	
	Cement Treated Base Course	Soil Mix Plant (Cement Treated Base)	250-300ton/hour	UN	3	
		Excavator	0.7m3-1.0m3	UN	6	
Site	Clearing & Earth Work	Bulldozer	15ton	UN	11	
		Excavator	0.7m3-1.0m3	UN	11	
		Motor Grader	3.7m	UN	11	
		Single Drum Vibration Roller	10 ton	UN	11	
		Tire Roller	10 ton	UN	11	
		Water Tanker	10,000litter	UN	11	
		Dump Track	10 ton	UN	44	
	Sub base	Motor Grader	3.7m	UN	3	
		Single Drum Vibration Roller	10 ton	UN	3	
		Tire Roller	10 ton	UN	3	
		Water Tanker	10,000litter	UN	3	
		Dump Track	10 ton	UN	12	
	Cement Treated Base Course	Asphalt Paver	2.5m - 6.0m	UN	3	
		Tandem Steel Vibration Roller	8 ton	UN	3	
		Tire Roller	10 ton	UN	3	
		Water Tanker	10,000litter	UN	3	
		Dump Track	10 ton	UN	18	
	Prime & Tack Coat	Tractor	80 hp	UN	7	
		Mechanical Broom	2.0m	UN	7	
		Asphalt Distributor	6,000litter	UN	7	
		Water Tanker	10,000litter	UN	7	
	Asphalt Paving	Asphalt Paver	2.5m - 6.0m	UN	7	
		Tandem Steel Vibration Roller	8 ton	UN	7	
		Tire Roller	10 ton	UN	7	
		Water Tanker	10,000litter	UN	7	
		Dump Track	10 ton	UN	42	
	Soil Cement Column	Boling Machine	-	UN	10	
		Jet Grout Pump	-	UN	10	
	Concrete Barrier	Track Crane	25ton	UN	10	
		Trailer	10ton	UN	10	
	Signboard & Gantry	Track Crane	25ton	UN	4	
		Flat Body Track with Crane	4ton	UN	4	

Period: Month 10 to Month 3 in Year 2

Area	Item	Type of Machine	Capacity	Unit	Quantity	Remarks
Plant	Asphalt Paving	Asphalt Plant (Batching Type)	120ton/hour	UN	4	
		Wheel Loader	2-3m3	UN	4	
	Cement Treated Base Course	Soil Mix Plant (Cement Treated Base)	250-300ton/hour	UN	2	
		Excavator	0.7m3-1.0m3	UN	4	
Site	Clearing & Earth Work	Bulldozer	15ton	UN	8	
		Excavator	0.7m3-1.0m3	UN	8	
		Motor Grader	3.7m	UN	8	
		Single Drum Vibration Roller	10 ton	UN	8	
		Tire Roller	10 ton	UN	8	
		Water Tanker	10,000litter	UN	8	
		Dump Track	10 ton	UN	32	
	Sub base	Motor Grader	3.7m	UN	2	
		Single Drum Vibration Roller	10 ton	UN	2	
		Tire Roller	10 ton	UN	2	
		Water Tanker	10,000litter	UN	2	
		Dump Track	10 ton	UN	8	
	Cement Treated Base Course	Asphalt Paver	2.5m - 6.0m	UN	2	
		Tandem Steel Vibration Roller	8 ton	UN	2	
		Tire Roller	10 ton	UN	2	
		Water Tanker	10,000litter	UN	2	
		Dump Track	10 ton	UN	12	
	Prime & Tack Coat	Tractor	80 hp	UN	4	
		Mechanical Broom	2.0m	UN	4	
		Asphalt Distributor	6,000litter	UN	4	
		Water Tanker	10,000litter	UN	4	
	Asphalt Paving	Asphalt Paver	2.5m - 6.0m	UN	4	
		Tandem Steel Vibration Roller	8 ton	UN	4	
		Tire Roller	10 ton	UN	4	
		Water Tanker	10,000litter	UN	4	
		Dump Track	10 ton	UN	24	
	Soil Cement Column	Boling Machine	-	UN	5	
		Jet Grout Pump	-	UN	5	
	Concrete Barrier	Track Crane	25ton	UN	5	
		Trailer	10ton	UN	5	
	Signboard & Gantry	Track Crane	25ton	UN	2	
		Flat Body Track with Crane	4ton	UN	2	

3.2.3.2 Traffic Safety Control

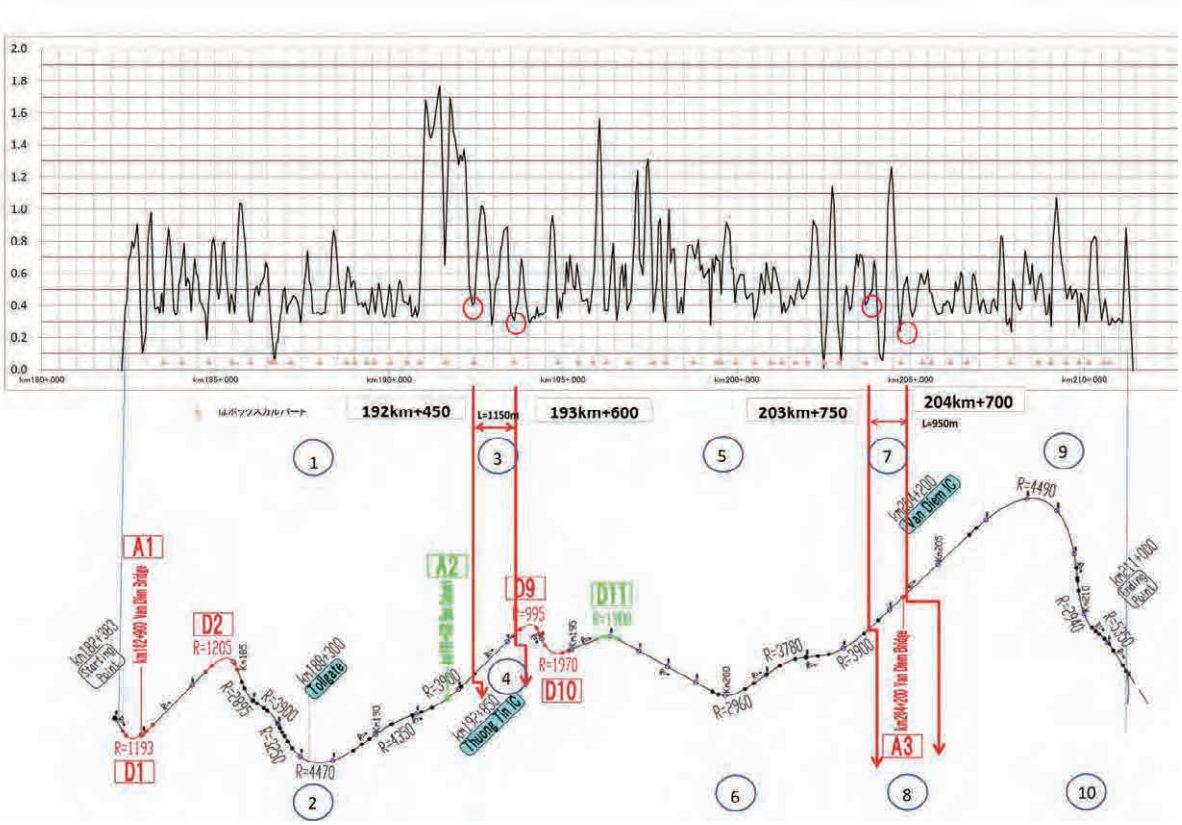
(1) Section of Traffic control

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.

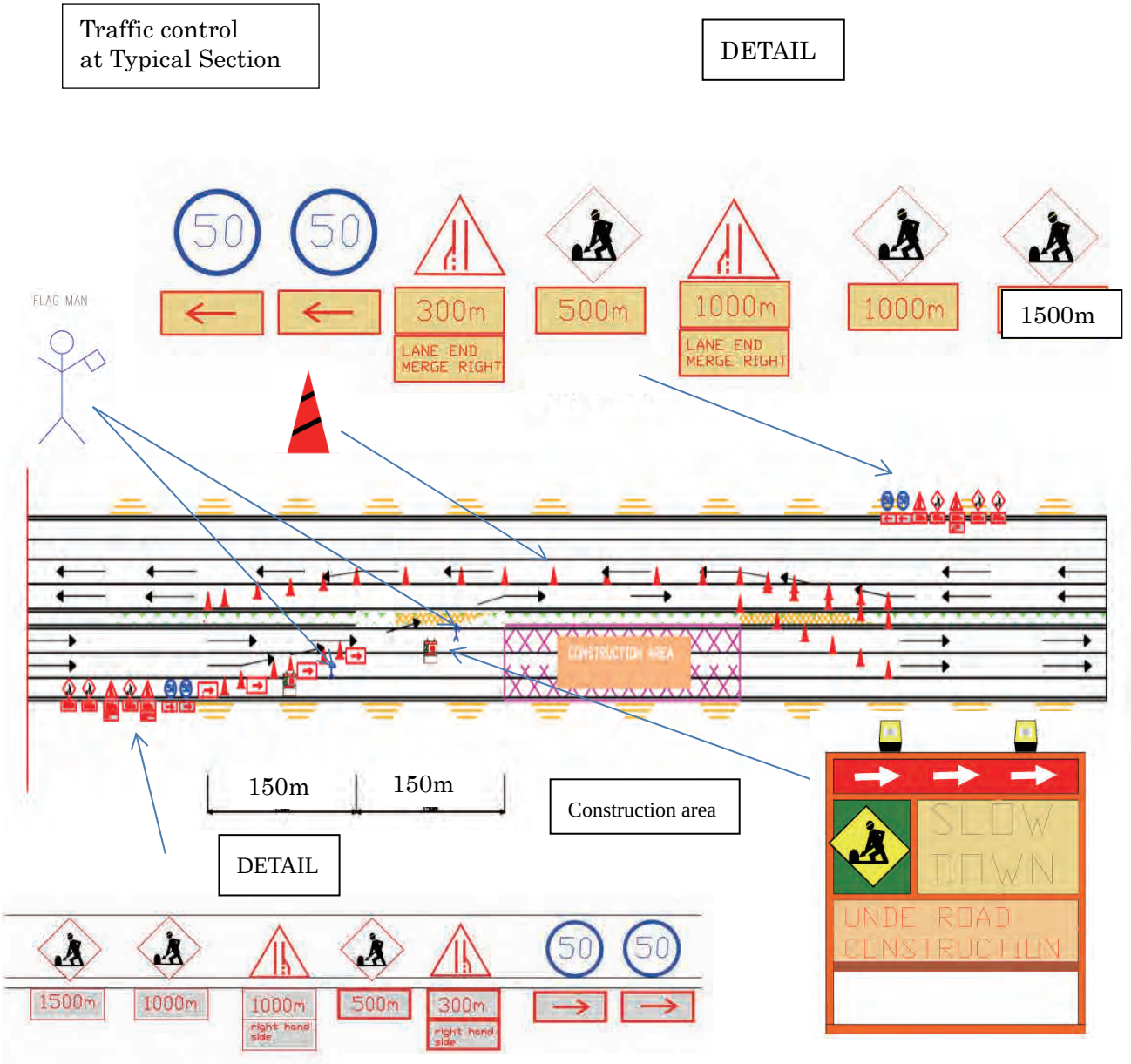


Figure 3.2.3-5 Traffic Control at Typical Sections

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.

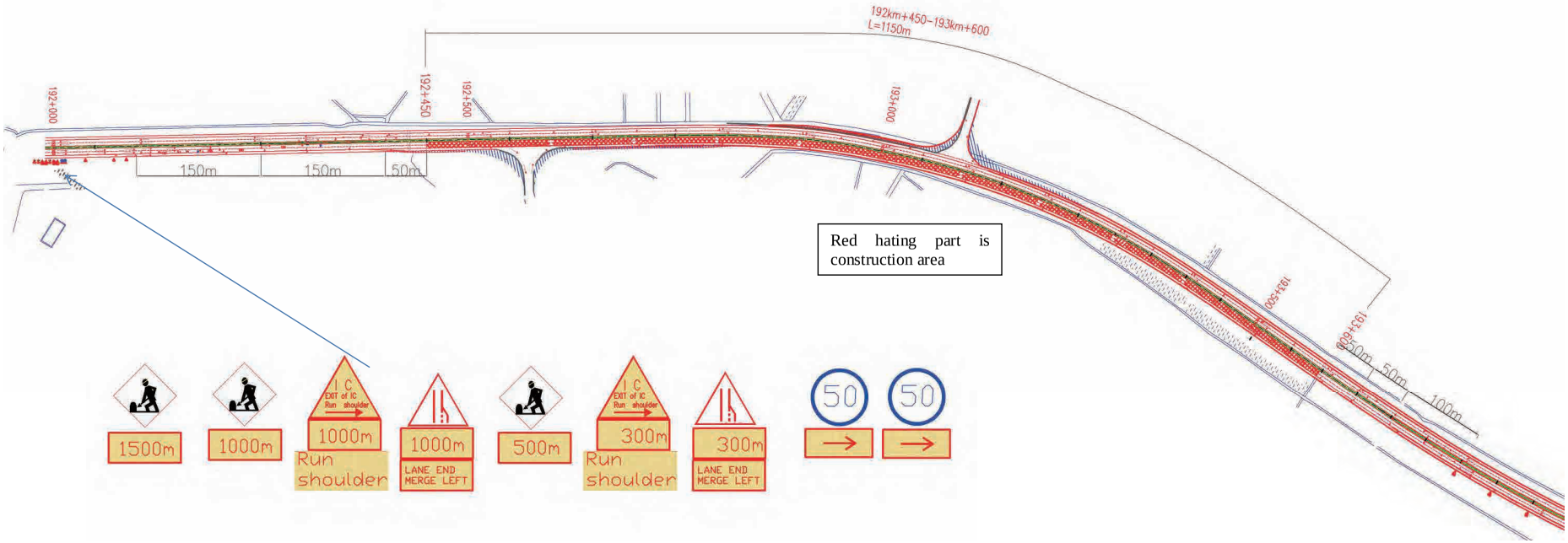


Figure 3.2.3-6 Traffic Control at Thuong Tin Interchange

Detail is shown in next page.

Detail of traffic control

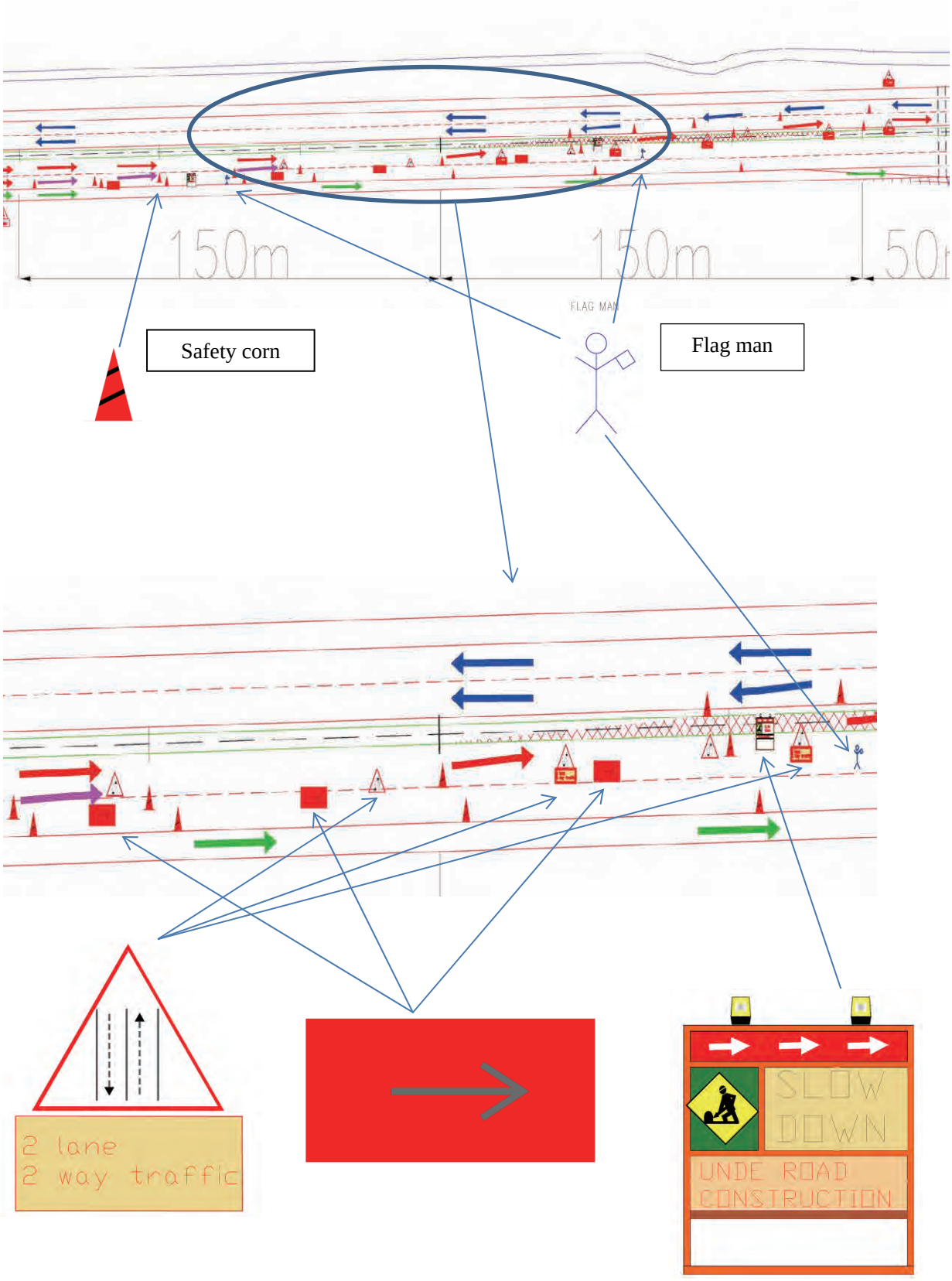


Figure 3.2.3-7 Traffic Control (Details)

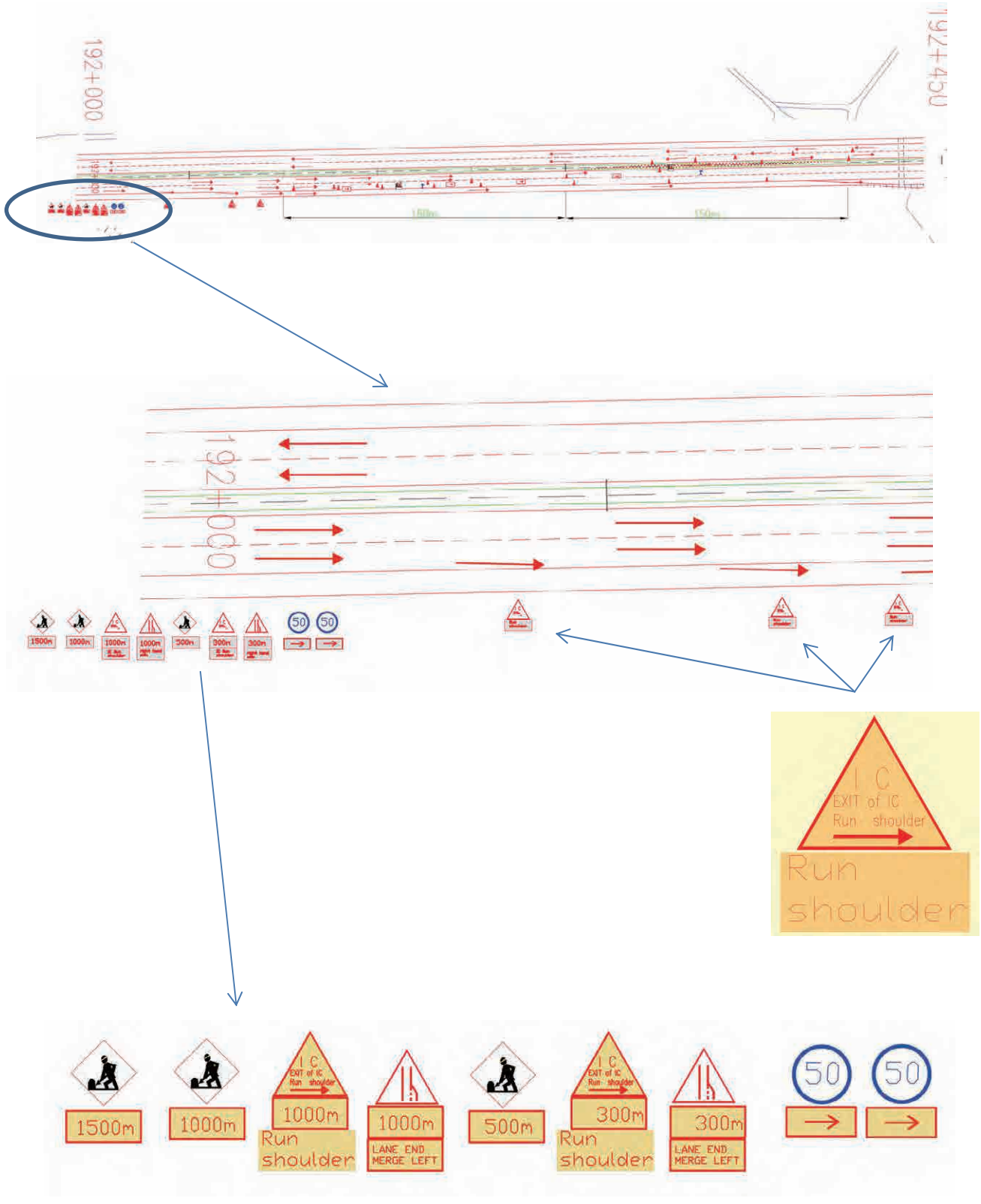


Figure 3.2.3-8 Traffic Control (Details)

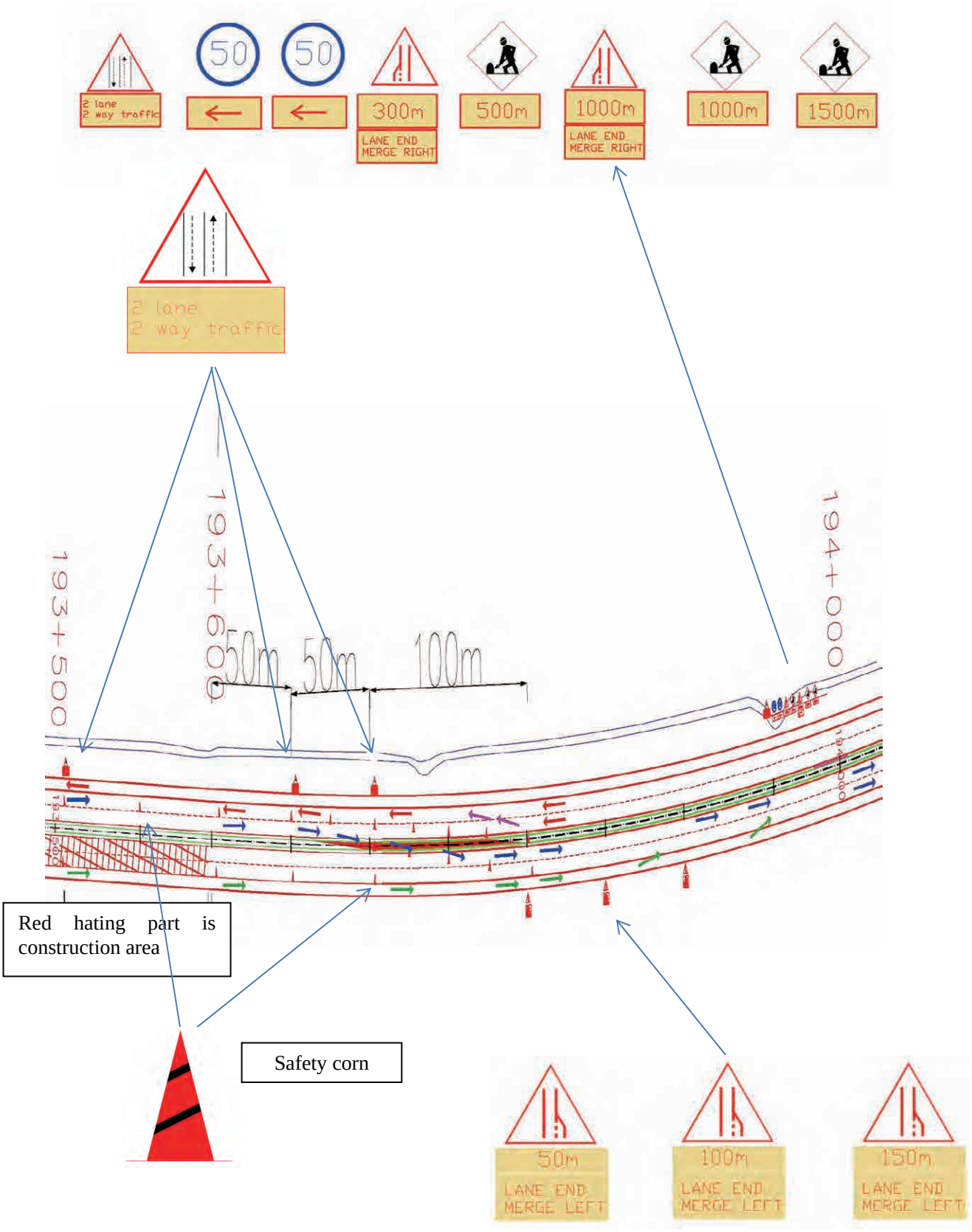


Figure 3.2.3-9 Traffic Control (Details)

(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.

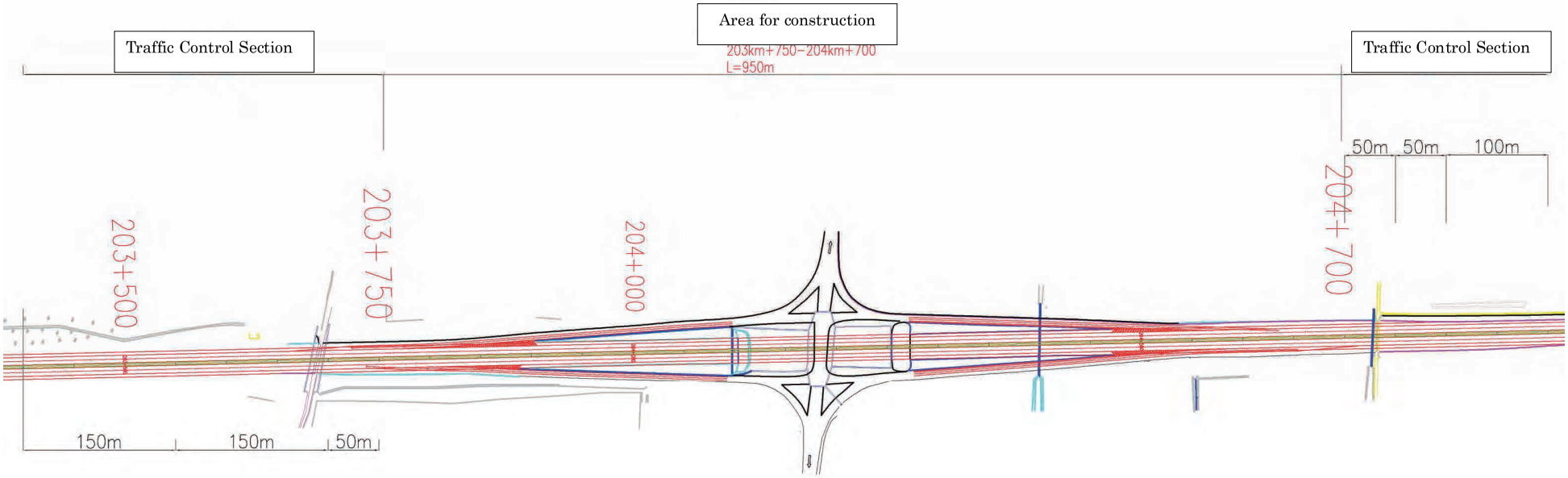


Figure 3.2.3-10 Traffic control at Van Diem Interchange

(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.

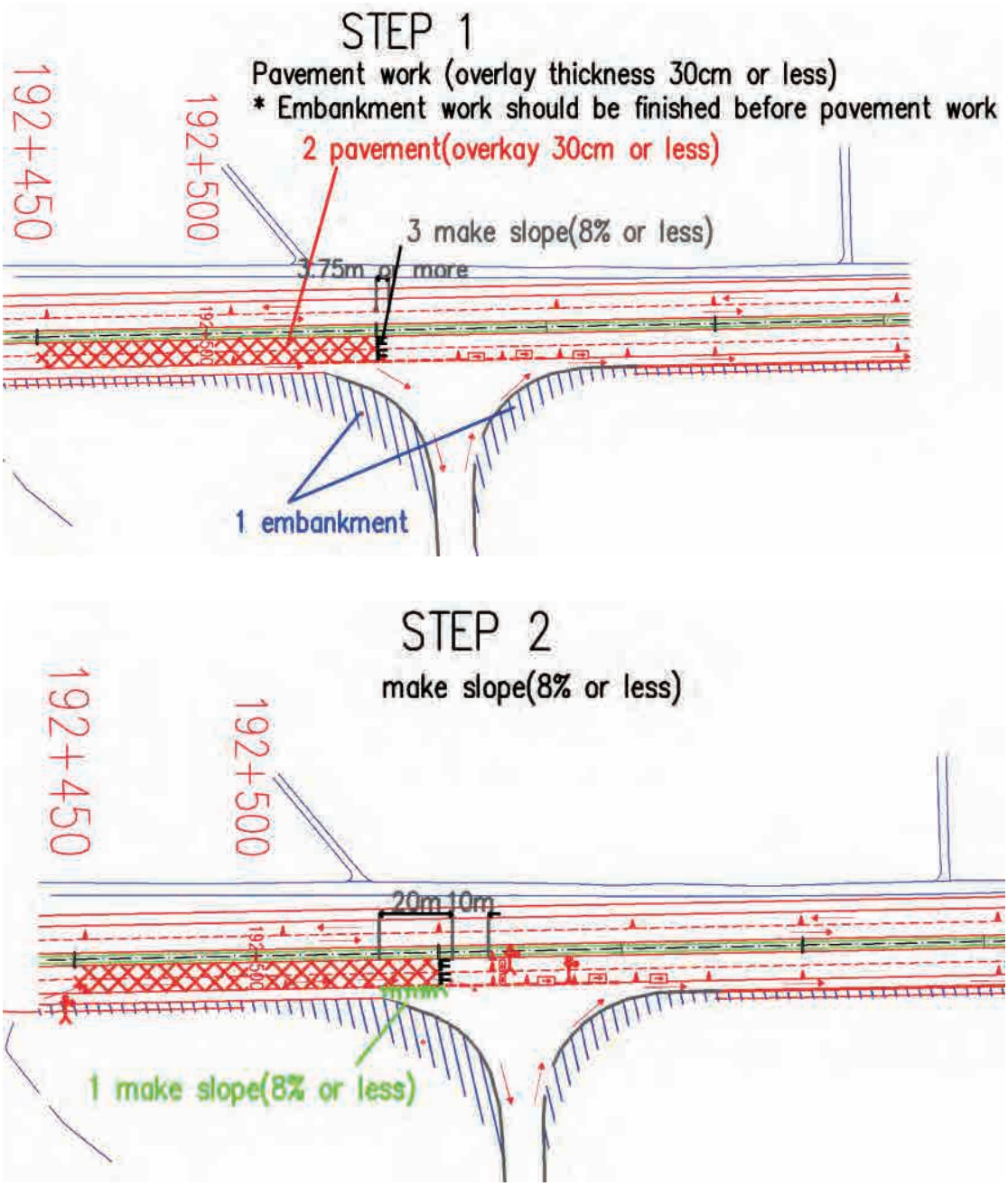


Figure 3.2.3-11 Traffic Control at shoulders (1)

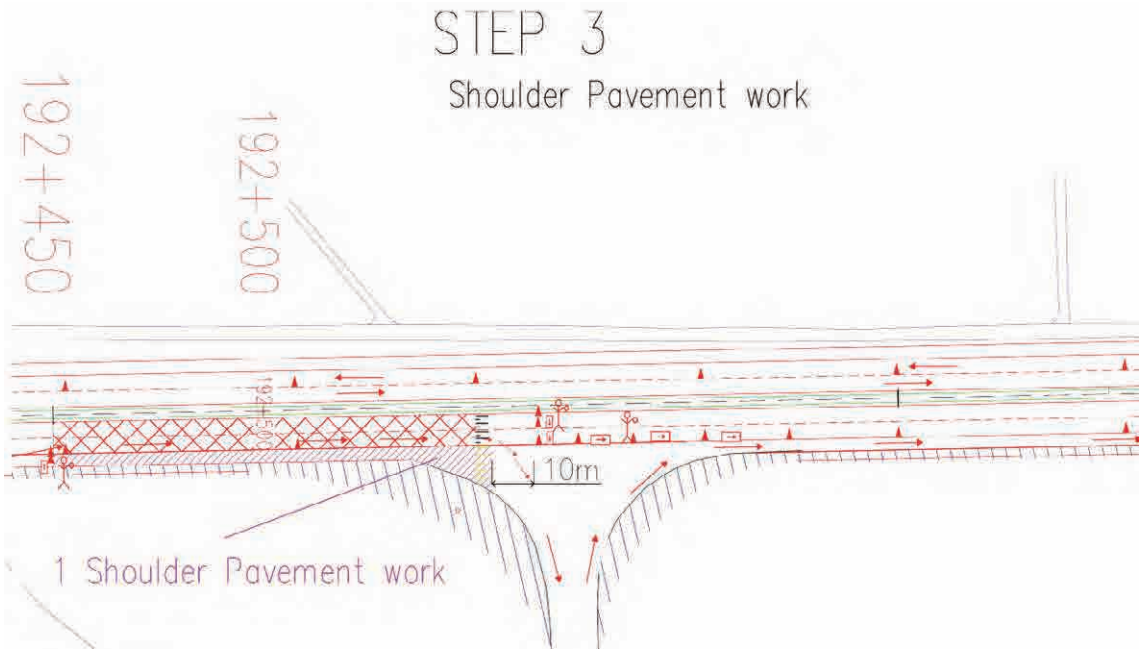


Figure 3.2.3-12 Traffic Control at shoulders (2)

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.

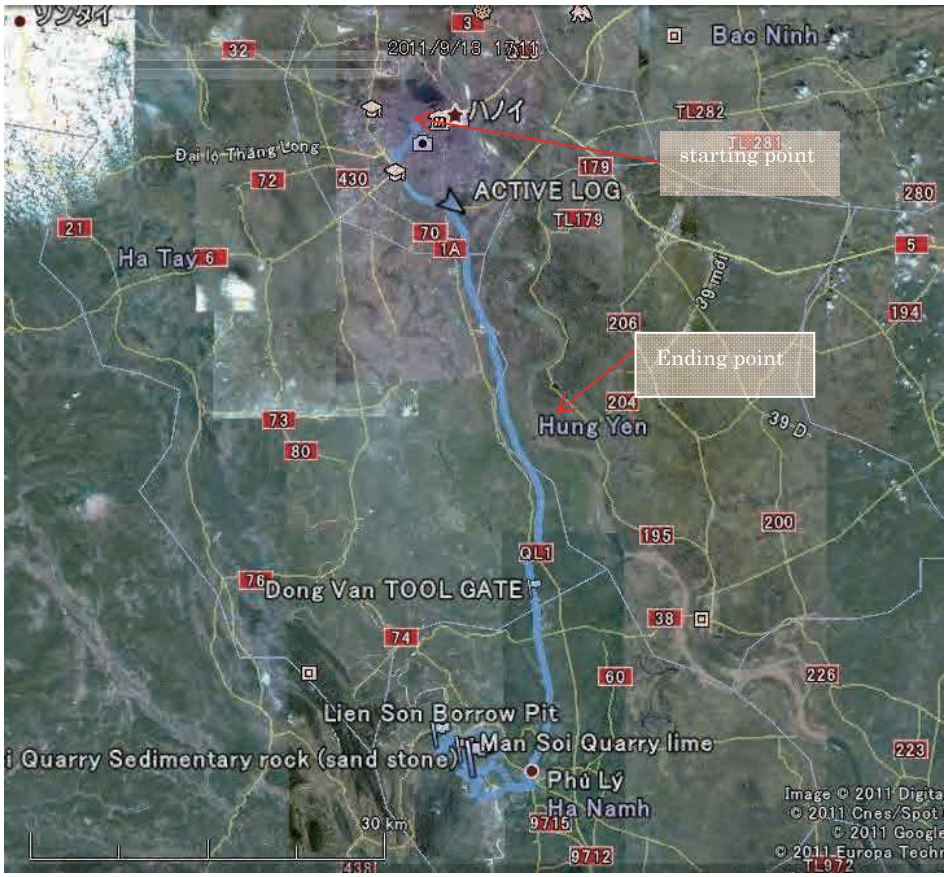


Figure 3.2.3-13 Locations of Quarry and Borrow Pit

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.

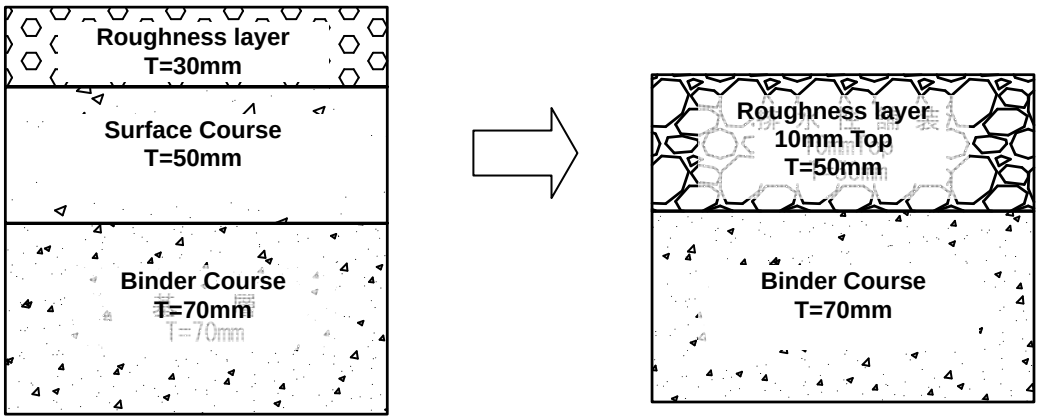


Figure 3.2.3-20 Decrease in Pavement thickness by Applying Permeable Pavement

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.

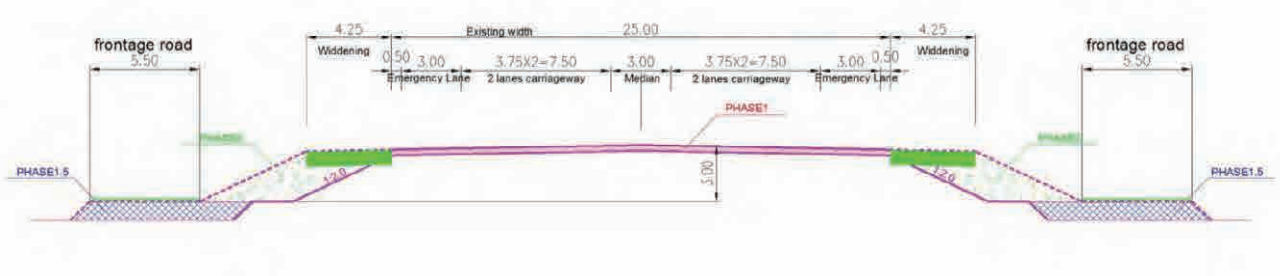


Figure 3.2.4-1 Typical Cross Section for Phase 2: 6-lane widening

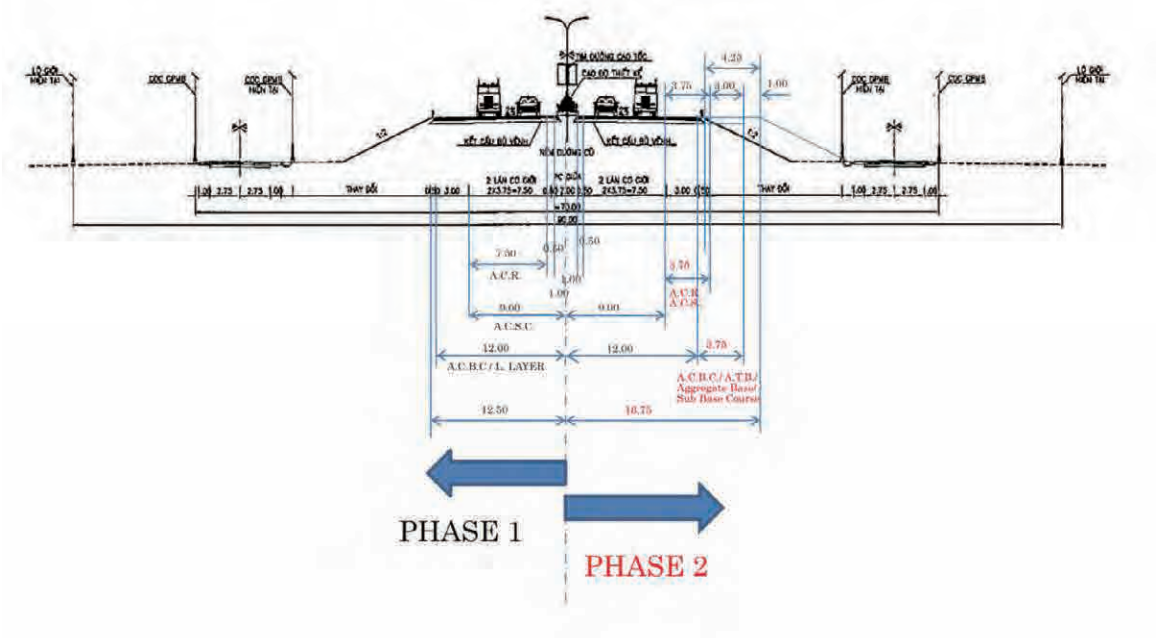


Figure 3.2.4-2 Comparison of Typical Sections for Phase 1 and Phase 2

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

Outline Construction Cost for the basic case are shown in Table 3.2.4-2 .

Table 3.2.4-2 Construction Cost

Items	Amount (billion VND)			
	Phase 1	Frontage roads	Phase 2	Total
Estimated Construction Cost	**1,105.83**	**374.43**	**1,457.53**	**2,937.79**
Earth works	186.75	179.42	743.10	1,109.27
Pavement works	540.66	72.39	302.22	915.27
Drainage works	0.00	67.15	136.38	203.53
Operation Equipment	149.22	0.00	36.15	185.37
Operation office	96.88	7.47	54.68	159.03
Maintenance Vehicles	20.32	0.00	0.00	20.32
Design and supervision	112.00	48.00	185.00	345.00
Physical contingency (10%)	**110.58**	**37.44**	**145.75**	**293.78**
Price contingency (Varies)	**194.21**	**337.43**	**1,219.27**	**1,750.92**
VAT	**141.06**	**74.93**	**282.26**	**498.25**
Total	**1,551.69**	**824.24**	**3,104.81**	**5,480.74**

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

(1) BOT Law

The Vietnamese Government issued Decree No.78 in 2007 on infrastructure projects built under build-operate-transfer (BOT), build-transfer-operate (BTO) and build-transfer (BT) contracts (or BOT Law for short).

This Decree No.78 stipulates the forms of investments agreed between investors and the Vietnamese Government. It applies to the infrastructure projects for roads, ports, airports, railways, bridges, water/electricity supplies.

The forms of contracts shall be classified into 3 types: BOT, BTO or BT contracts as shown in Table 2, depending on when the constructed infrastructure shall be transferred to the Government or how it shall be operated after the transfer.

Table 3.3.1-1 Differences between BOT, BTO and BT Contracts

Form of Contract		Description
BOT	Build-Operate-Transfer	Investors undertake construction and operation of an infrastructure work for a certain period of time. Upon the end of this period, the work shall be transferred to the Vietnamese Government without compensation.
BTO	Build-Transfer-Operate	After completing its construction, investors shall transfer an infrastructure work to the Government, which then grant the investors the right to operate the work for a certain period of time to efficiently recover investment capital and earn profits
BT	Build-Transfer	After completing its construction, investors shall transfer an infrastructure work to the Government, which shall create conditions for the investors to execute other projects to efficiently recover investment capital and earn profits, or shall make payment to the investors as agreed in the BT contract.

Decree No.78, however, contained some ambiguities particularly in terms of the procedures for project implementation or the regulations concerning government assistance. In 2009, the Vietnamese Government issued Decree No.108 (New BOT Law) to stipulate further details, for example on the project scheme, procedures and roles.

(2) PPP Piloting Regulation

Although the Vietnamese Government, at times, has difficulty in securing adequate Government funding for the development of public infrastructure projects, the infrastructure development in the country is becoming increasingly critical. Against such backdrop, the Government has identified the need to encourage the private sector to invest in infrastructure development. The Government has now started clarifying the legislation concerning the PPP project implementation scheme. As part of this initiative, Prime Minister's Decision No.71 was issued in 2010 on the Pilot Public Private Partnerships.

3.3.1.2 Applicable Laws and Regulations for the Project Implementation Scheme

The BOT law and the PPP law mentioned above may not apply to the PVCG Expressway Project because VEC already has the concession rights.

The following 2 types of project implementation schemes, In-kind Investment and Contract Fee, are proposed for this Project in this study assuming that operation and maintenance works under the two schemes will be sublet to VEC O&M from SPC:

(1) Scheme X: In-kind Investment Scheme

In this scheme, investors including VEC and C-NEXCO establish the Special Purpose Company (SPC) for the Project and this SPC is responsible for finance, construction, operation and maintenance. VEC only makes In-kind Investment and other investors including C-NEXCO make cash investment. Dividends are distributed by SPC to all investors including VEC and C-NEXCO depending on investment ratio and investors recover their investments.

Because SPC newly established will be the concessionaire, it is probable that new BOT Law or PPP Piloting Regulation is applied and authority to which assets of SPC is determined by new BOT Law or PPP Piloting Regulation.

(2) Scheme Y: Contract Fee Scheme

In this scheme, the concessionaire, VEC for this project, and other investors including C-NEXCO jointly establish a SPC and SPC, Investors, Lenders and Public Authorities including Vietnamese Government will make an umbrella agreement. Each party performs his roles in accordance with the contract. This scheme is based on the form of the Business Cooperation Contract (BCC). Because foreign companies, financial institutions and domestic state owned companies are included, the agreement is recognized as an International Contract. Practically it is a type of BCC.

BCC is a common type of method for investment projects in Vietnam. Foreign companies and domestic companies do not establish a new company in Vietnam and share profits, liabilities and assets by the contract. Specifically, both parties shall agree on the purpose and nature of the project; particulars on investments; schedule; contract term; each party's rights and responsibilities; and financial or accounting matters, all of which shall be clearly stated in the contract. This means each contract signing party is directly accountable for tax obligations and other legal responsibilities stated in the contract.

There are some advantages to this form of contract; it is possible to establish any terms and conditions flexibly (eg. how long the contract is valid, who actually controls the project management, etc.) as long as they are stated in the contract. Another advantage is that it does not specify the restrictions and regulations concerning the withdrawal from the project or the transfer of money to investors' own countries. On the other hand, this form of contract entails some risks in that investors are directly accountable for the legal responsibilities of this project.

This method has been increasingly common when investing on short-term projects or government-regulated industries (eg. telecommunication), or when conducting joint operation for oil or other natural resource development.

In either scheme, this Project will be a new model of project implementation as the Japanese party and VEC, will work in partnership for investment and development of an Expressway project in Vietnam, which goes beyond the conventional framework of the existing new BOT laws and PPP Piloting Regulation. If there are any particulars not covered by the existing laws, VEC and the Japanese party shall determine the additional particulars and submit them to the Government for permission as required while conforming to the existing laws and regulations concerning investment, new BOT law and PPP Piloting Regulation.

(3) Scheme X: Details of In-Kind Investment Scheme

1) Overview of the Scheme (In-Kind Investment of Road Asset)

VEC currently holds the concession for the Project. With the in-kind investment scheme, however, SPC shall have the concession. Accordingly, VEC shall return the concession to the Vietnamese government first, then SPC shall acquire it back later. SPC shall undertake construction, operations and management based on this concession.

VEC shall provide SPC with road asset as a form of in-kind investment. To do so, the existing road asset has to be transferred from the government to VEC.

Once the duration of the project is over, SPC will be dissolved and the road asset previously owned by SPC will be handed over to the Vietnamese government at no cost. The government shall decide whether the transferred road asset is to be operated as a toll road or not. If it is operated as a toll road, it needs to be decided who holds the concession for the road. The following diagram shows this scheme.

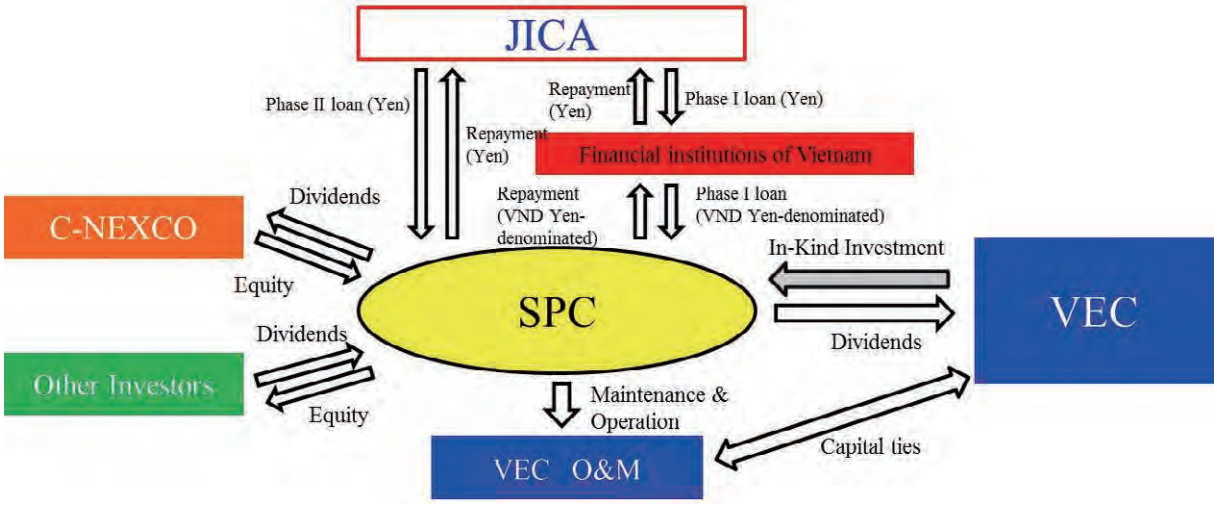


Figure 3.3.1-1 Project Scheme (with In-Kind Investment)

2) Asset Allocation (with In-Kind Investment Scheme)

The owners of the assets for this project will be as follows:

(a) The existing roads shall be provided from VEC to SPC as a form of in-kind investment. After the duration of the project, they shall be returned to the Vietnamese Government.

(b) The roads to be expanded in this project fall under SPC's assets, but they shall be returned to the Government after the duration of the project on the conditions that its depreciation is completed by that time.

(c) The proprietary right of the land currently belongs to the Government and will remain so.

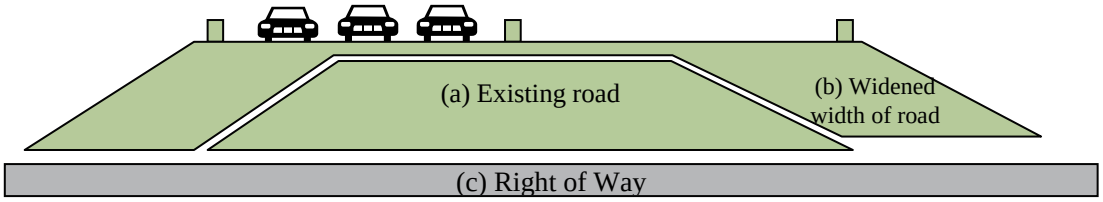


Figure 3.3.1-2 Asset Allocation (with In-Kind Investment Scheme)

(d) Scheme X: Valuation of existing Road Asset

Value of existing road asset used in analysis is 4,000billion VND which was obtained by hearing from VEC. Official asset evaluation will be carried out by VEC and analysis is to be made again after official value is determined.

3) Dividends for the Duration of the Project (with In-Kind Investment Scheme)

The amount of the dividends payable to the investors shall be the remaining toll revenues after the deduction of such expenses as administrative costs (maintenance cost, overhead cost, corporate tax, etc.) and financial expenses (interests, amortization of capital). If the toll revenue goes above the expected amount, dividends increase in proportion. If it goes below the expected amount, dividends decrease accordingly.

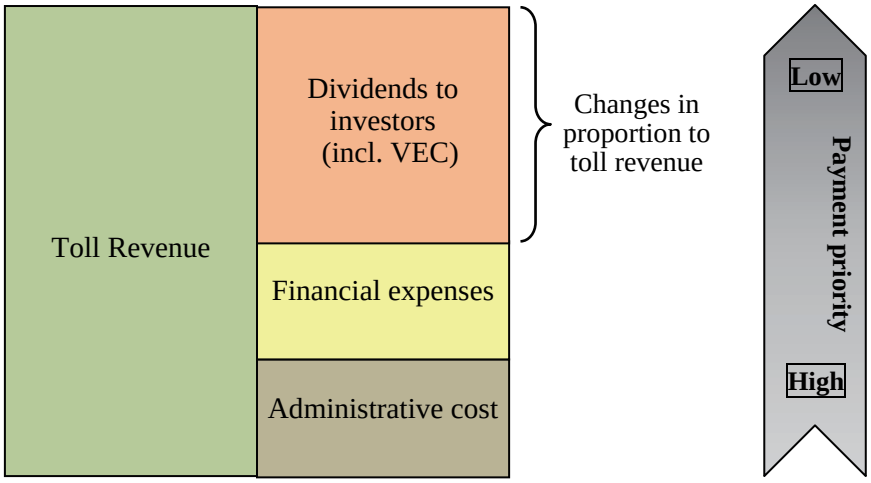


Figure 3.3.1-3 Payment of Dividends (with In-Kind Investment Scheme)

(4) Scheme Y: Detail of Contract Fee Scheme

1) Overview of the Scheme (Contract Fee)

VEC currently holds the concession for this expressway project. The concession will remain with VEC. In this scheme, the concessionaire, VEC for this project, and other investors including C-NEXCO jointly establish a SPC and SPC, Investors, Lenders and Public Authorities including Vietnamese Government will make an umbrella agreement. Each party performs his roles in accordance with the contract. Figure 3.3.1-4 shows the scheme of the project implementation.

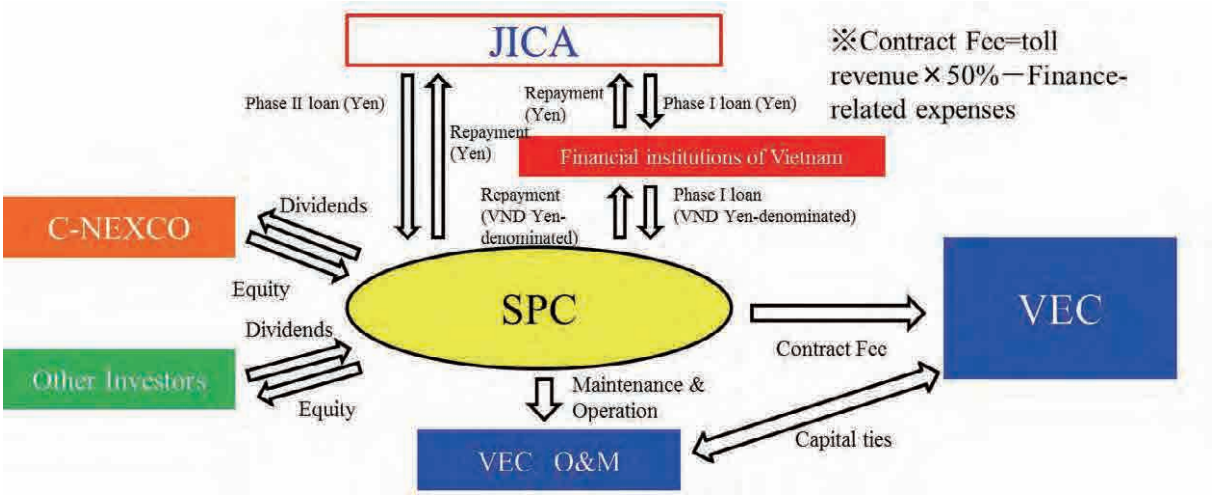


Figure 3.3.1-4 Project Scheme (with Contract Fee)

The roles to be specified in the contract are assumed to be as follows.

Table 3.3.1-2 Roles of Stakeholders

Authority	Major Roles
VEC	➢Allow for SPC to use the existing Highway to upgrade to Expressway. ➢Bear the costs for land acquisition for toll gates etc. necessary for Phase 1 and coordinate with relevant Authority for land acquisition.
SPC	➢Construction and Operation & Maintenance for PV-CG Expressway ➢Regular payment to VEC of Contract Fee specified in the contract ➢Transfer of Road assets to VEC after concession period ends
Equity Investors including C-NEXCO	➢Provision of equity in cash ➢Support to SPC other than cash ➢Coordination with relevant Authority
Lenders	➢Provision of Debt on project finance base ➢Bank Credit Facility Management for SPC cash flow, bank credit and security
Vietnamese Government	➢Land acquisition necessary for Phase 2 including costs ➢Provide Government guarantee regarding toll revision linked to Inflation (CPI) , currency conversion from VND to hard currency and remittance to abroad

2) Assets Allocation (Contract Fee)

Owners of the assets for this Project will be as follows:

(a) Assuming that the existing roads will be transferred to VEC, it holds the assets and will keep these even for the duration of the Project.

(b) The roads expanded in this Project are owned by SPC and both of the existing and expanded roads shall be handed over to VEC after the completion of the project duration

(c) The proprietary right of the land currently belongs to the Vietnamese Government and will remain so.

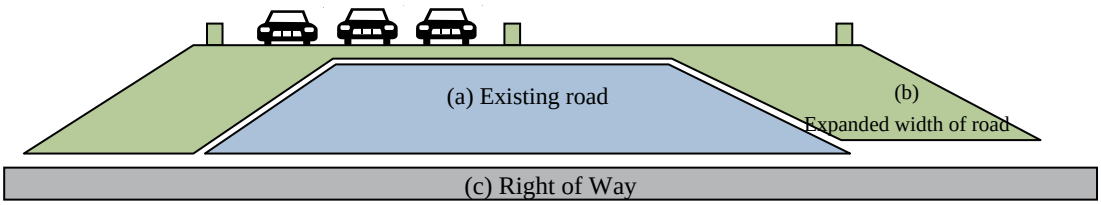


Figure 3.3.1-5 Asset Allocation (with Contract Fee Scheme)

3) Dividends for the Duration of the Project (with Contract Fee scheme)

Contract fee is to be regarded as cost under Taxation Law. However taking a practice in Vietnam into consideration, Contract fee is regarded as distribution of net profit under Taxation Law in this financial analysis. Contract Fee is calculated using the following formula.

Contract fee=Toll Revenue ×50% - financial expense (repayment of principle + Interest + Insurance fee + loan management fee + other financial expense)

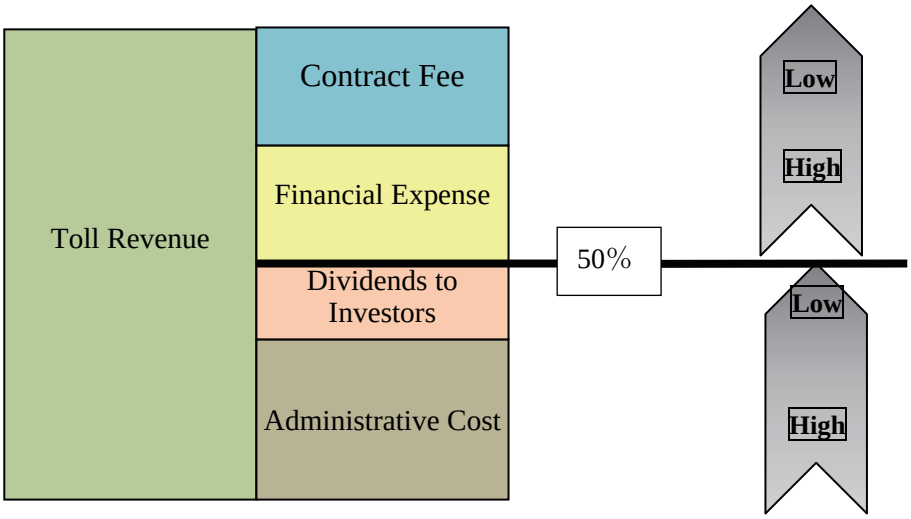


Figure 3.3.1-6 Payment of Dividends (with Contract Fee Scheme)

Table 3.3.1-3 Comparison of Project Scheme

Items		In-Kind Investment Scheme	Contract Fee Scheme
Overview		Investors including VEC and C-NEXCO establish the Special Purpose Company (SPC) for the Project and this SPC is responsible for finance, construction, operation and maintenance.	SPC which is established by investors, Investors, Lenders and Public Authorities including Vietnamese Government will make an umbrella agreement. Each party performs his roles in accordance with the contract.
Concession Right holder		SPC	VEC
Project Investor		SPC	SPC
Assets	Existing Road	In-Kind Investment from VEC to SPC	Owned by VEC

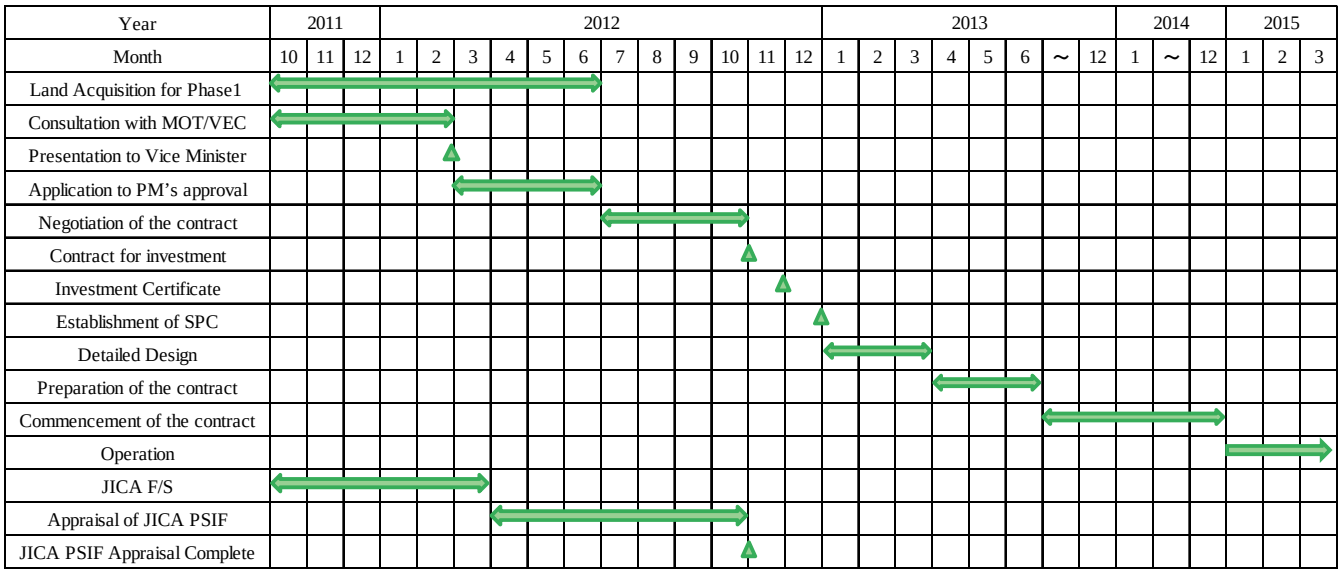
Items		In-Kind Investment Scheme	Contract Fee Scheme
	Widening Portion	Owned by SPC	Owned by SPC
	Land	Owned by Vietnamese Government	Owned by Vietnamese Government
Revenue to equity Investors		Dividend depending on Investment Ratio	Based on the contract
Laws and Regulation imposed		Existing laws and regulations is not imposed. However it is probable to apply new BOT Law or PPP piloting Regulation.	Existing laws and regulations is not imposed. Where applicable intent of new BOT Law or PPP piloting Regulation is respected. Where necessary, after consultation with relevant authorities, the Prime Minister's approval is sought.
Merit Demerit		Table 3.4.2-11 Comparison of Project Scheme is to be referred to.	

Source: JICA Study Team

3.3.1.3 Schedule of Approval Process under Planned Scheme

The following chart shows a schedule of approval process for planned project scheme. This schedule has been determined through the discussion between MOT's EMO and VEC, and it has been shared and understood by all relevant organizations and parties.

Table 3.3.1-4 Schedule of Project Approval Process



Note: PSIF is Private Sector Investment Finance.

JICA's PSIF has not been committed. It will be determined after the necessary appraisal procedures.

3.3.1.4 Other Applicable Regulations concerning Project Implementation

(1) Toll Collection of Expressways

Refer to Sub-Clause 2.2.1.(5) Toll Collection.

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.

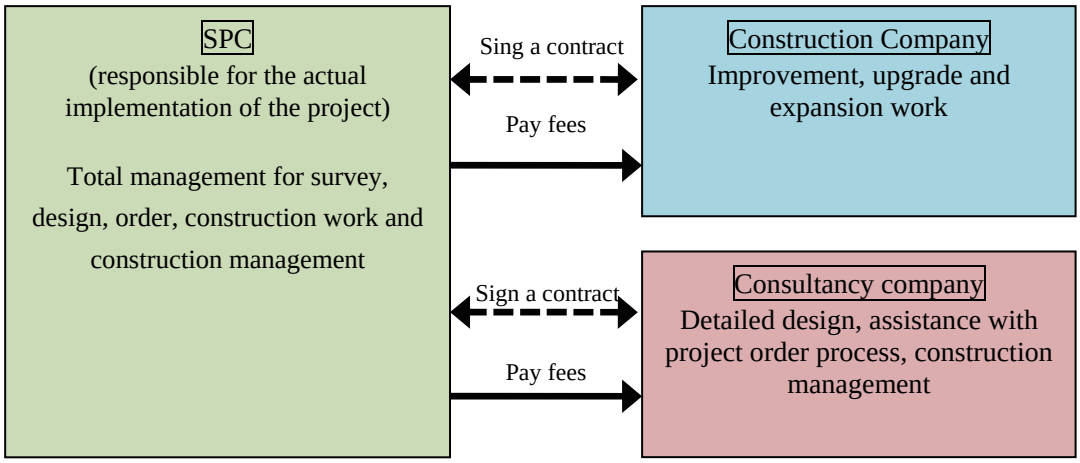


Figure 3.3.2-1 Roles of SPC during Construction

(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.

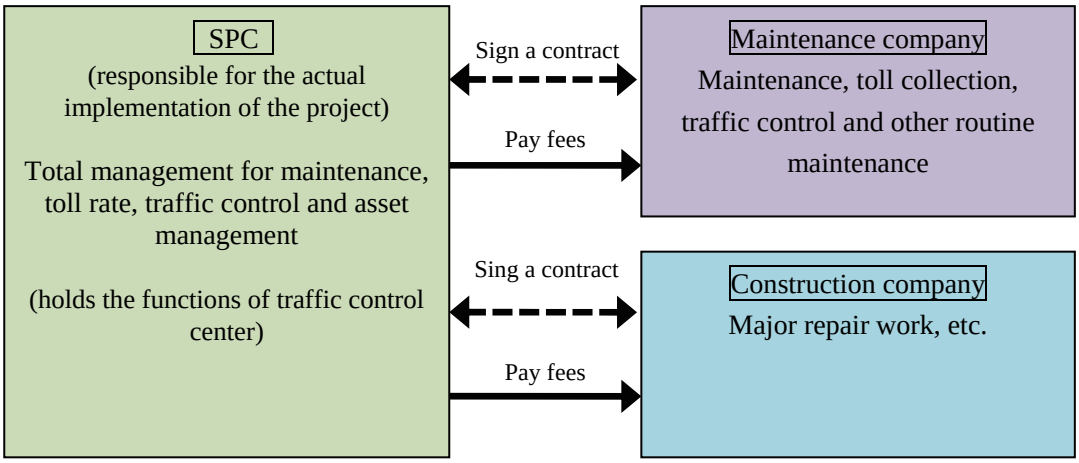


Figure 3.3.2-2 Roles of SPC during Operations and Maintenance

Roles of SPC and contractors are shown below:

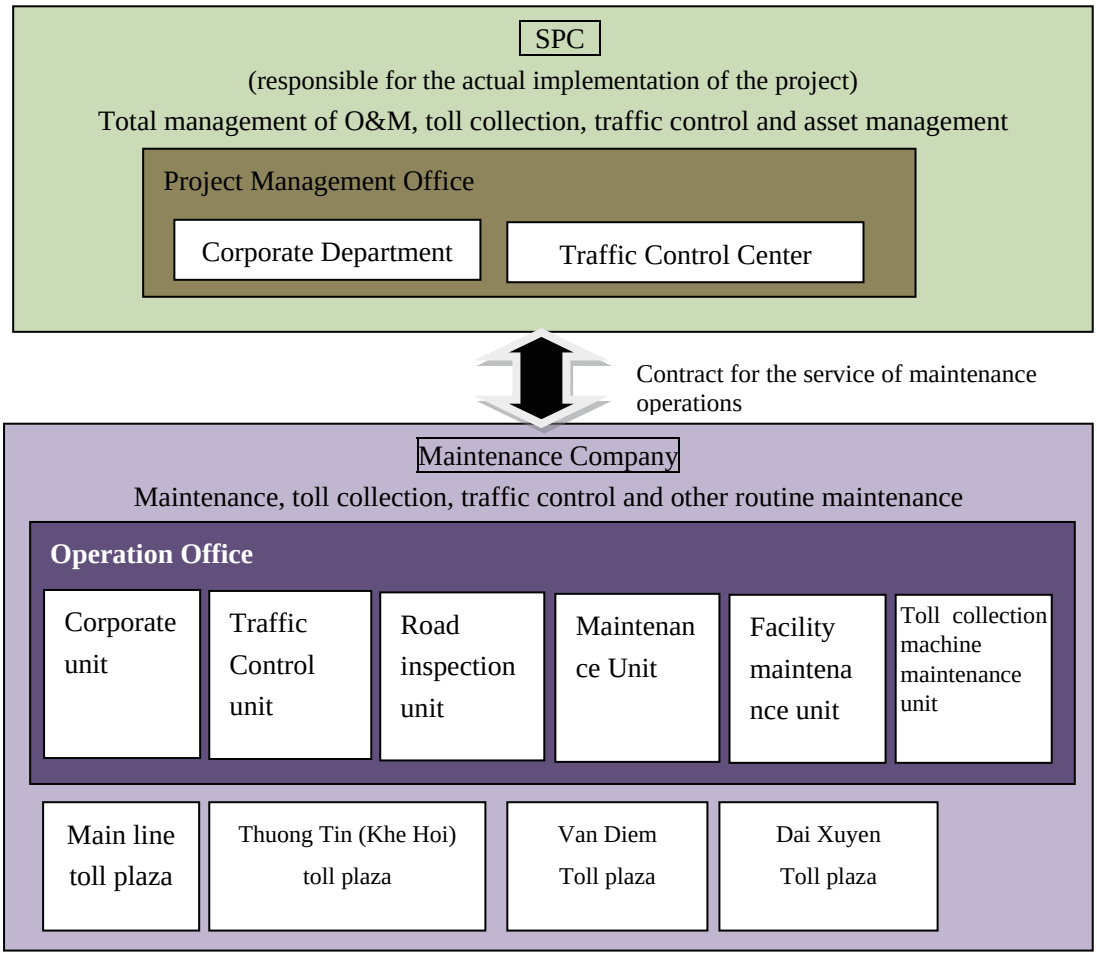


Figure 3.3.2-3 Roles of SPC and Contractor for Routine Maintenance

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

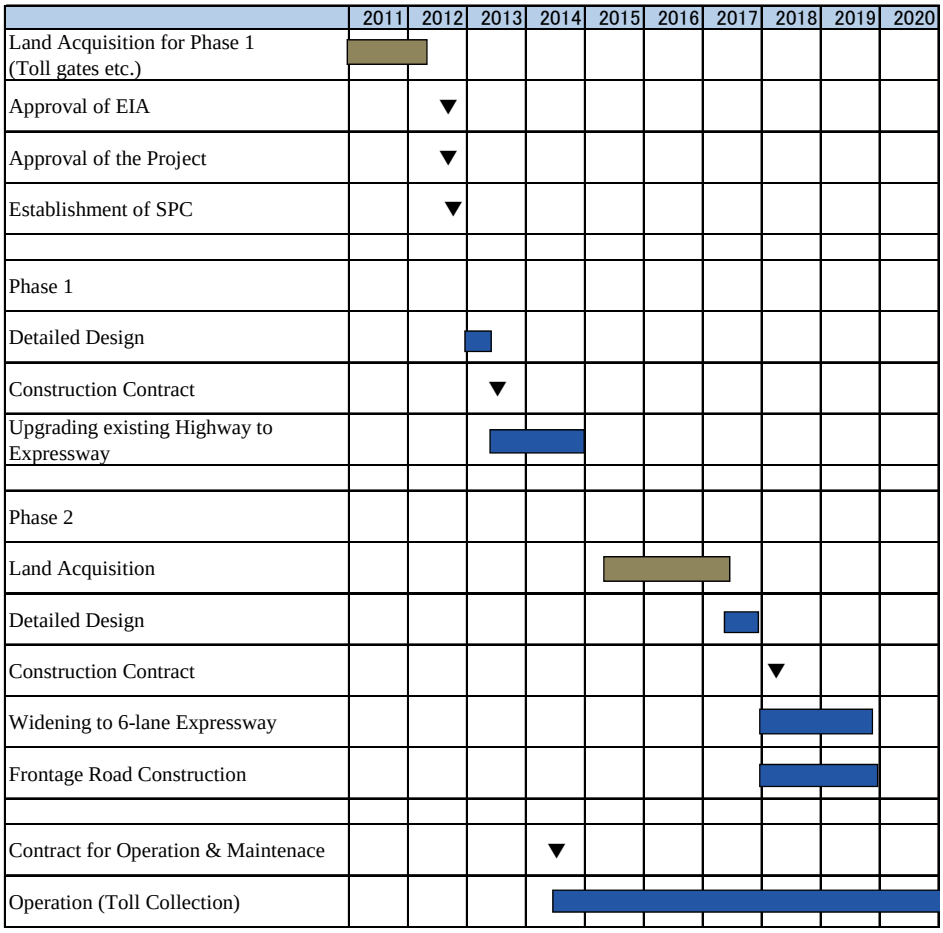
Positions	No. of staff	Shift arrangement
Toll office managers	3	1 x 3 teams
Toll management staff	6	2 x 3 teams
Toll collection managers	3	1 x 3 teams
Toll collectors	18	6 One-Stop Lanes x 3 teams
Total	30	

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.

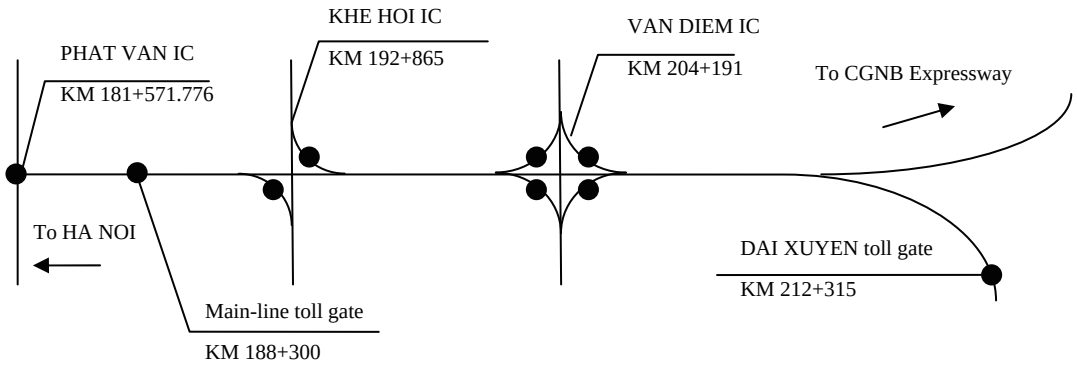


Figure 3.3.4-1 Planned Locations of Interchanges and Toll Gates on PV-CG Expressway

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.

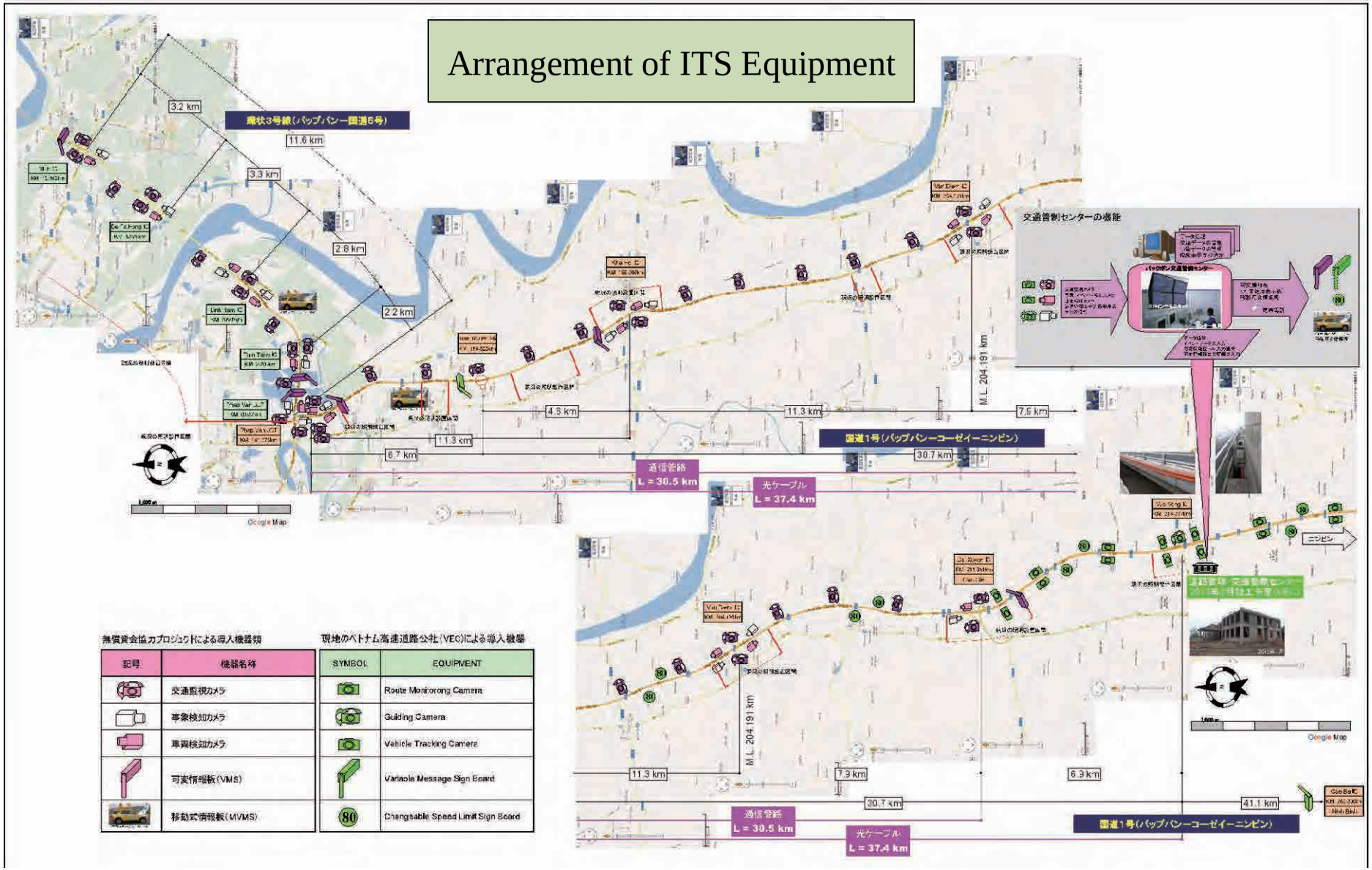
Currently JICA Preparatory Survey on the project for Development of Traffic Control System for Expressway in Hanoi under Japan's Grant Aid is on-going in parallel with installation of ITS package by VEC. ITS equipment for the section from Ring Road No.3 (from Phap Van Interchange to National Highway 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.

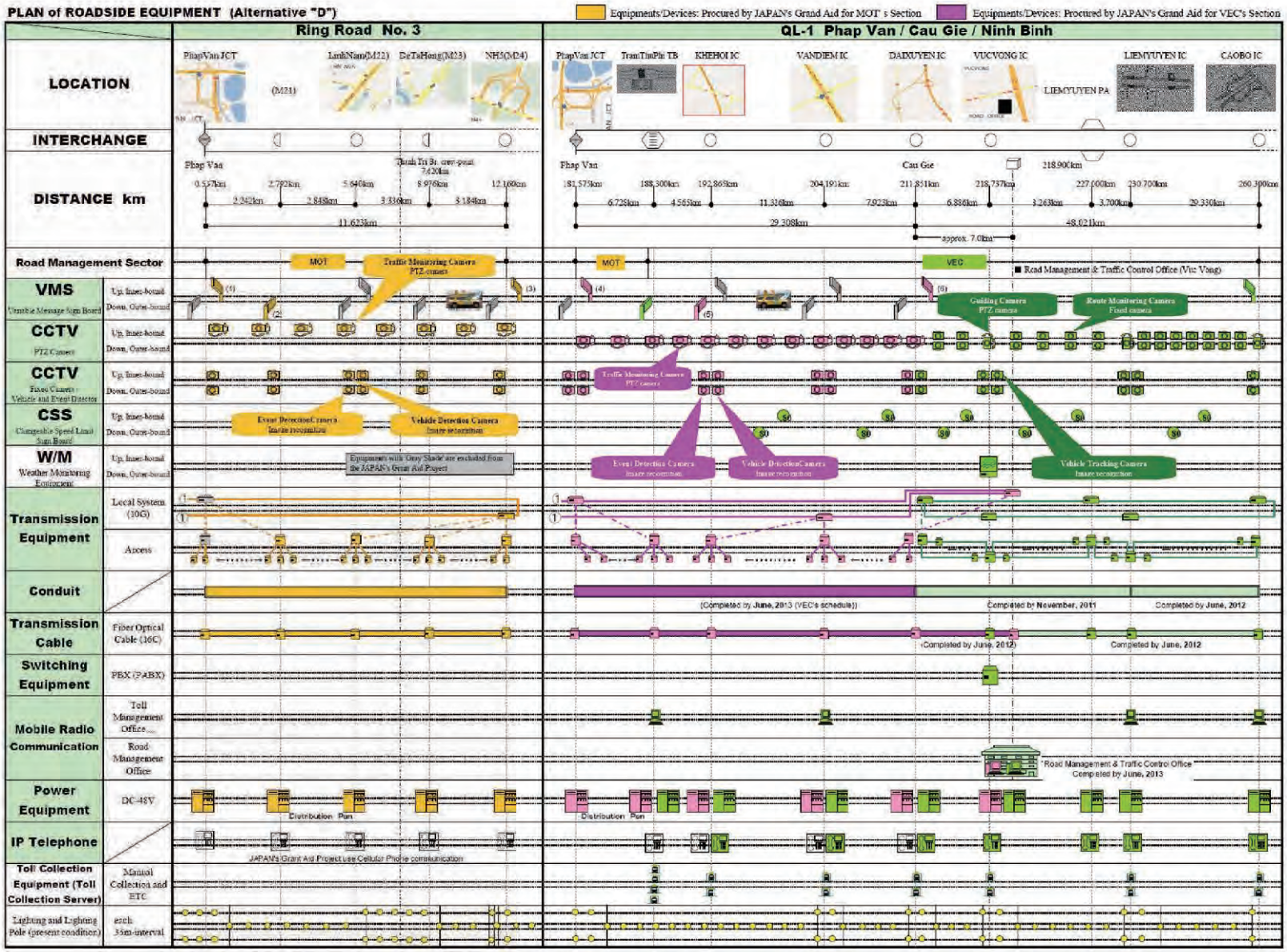
In the other hand, Vietnamese Government has a concept that traffic control of Expressway network in Hanoi will be managed in integrated manner by installation and operation of Regional Main Center with help of JICA Special Assistance for Project Implementation (SAPI), Study for Assistance of its Integration 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

For estimating the fund to be raised, ratio between loan and investment (D/E Ratio) was fixed as below. Although D/E ratio in the interim report was fixed to be 50:50, the one in this report was changed to 70:30 because of the increased profit on the Project and expected increase in net profit to VEC.

Table 3.4.1-1 D/E Ratio

Classification	Loan(Debt)	Investment(Equity)
Phase 1	70%	30%
Phase 2	70%	30%

1) **Equity Composition**

New BOT Law (No.108/2009/ND-CP) specifies that the project cost of which is more than 1.5 trillion equity ratio is to be more than 15% for the portion not less than 1.5 trillion and that is to be more than 10% for the other portion more than 1.5 trillion. Equity ratio in Table 3.4.1-2 Equity Investor List satisfies this requirement. Assumed investment ratio is shown below.

Table 3.4.1-2 Equity Investor List

Equity Investor	Capital contribution Ratio (%)
NEXCO Central Company Limited	50.1
Other Investors (Japan or Vietnam)	49.9
Total	100.0

2) **Lenders and loan conditions**

Debt portion is to be procured by non-recourse project finance. Currently available Options are as follows.

(1) JICA Direct (JPY-base)
(2) JICA 2step (JPY-base)
(3) JICA 2step (VND-base)
(4) Finance institution in Vietnam (VND-base)

Based on hearing of finance institution etc. loan conditions in each financial institution is assumed as shown in the following Table. The optimum option to be adopted may be finalized depending on the result of the financial analysis.

Table 3.4.1-3 Loan conditions of Finance Institutions

Currency	Loan Package	Loan Conditions	At Phase 1	At Phase 2
JPY base	JICA Provides PSIF to SPC	Grace Period (Year)	1	2
		Annual Interest (%)	2.0	2.0
		Repayment Period (Year including Grace Period)	20	15
		Upfront Fee	0.3	0.3
		Commitment Fee	0.0	0.0
	JICA 2 step loan JICA provides PSIF to SPC via Vietnamese Financial Institution (JPY→JPY)	Grace Period (Year)	1	2
		Annual Interest (%)	5.0	5.0
		Repayment Period (Year including Grace Period)	15	15
		Upfront Fee	2.0	2.0
		Commitment Fee	0.5	0.5
VND base	JICA 2 step loan JICA provides PSIF to SPC via Vietnamese Financial Institution (JPY→VND)	Grace Period (Year)	1	2
		Annual Interest (%)	13	11
		Repayment Period (Year including Grace Period)	15	15
		Upfront Fee	2.0	2.0
		Commitment Fee	0.5	0.5
	Vietnamese Financial Institution provides commercial loan to SPC	Grace Period (Year)	0	0
		Annual Interest (%)	15	13
		Repayment Period (Year including Grace Period)	5	5
		Upfront Fee	2.0	2.0
		Commitment Fee	0.5	0.5

Note: Unit of Upfront Fee and Commitment Fee is % of Total Loan Amount committed.

JICA's PSIF has not been committed. It will be determined after the necessary appraisal procedures.

※Repayment period of JICA PSIF is max. 20 years and Grace period is max. 5 years. Repayment period and Grace period are decided based on the characteristic of the project.

※Interest of 2 step loan is regarded as an interest which SPC pays to a financial institution in Vietnam. The financial institution pays lower interest to JICA.

3.4.1.2 Project Costs

1) Construction Costs

Construction costs are the current estimated construction costs plus Value Added Tax and Contingencies. Vehicles necessary for operation and maintenance after completion of Phase 1is added to Project costs of Phase 1. Land Acquisition costs are borne by Government of Vietnam and the Project costs do not include such costs. A breakdown of the Construction costs is shown in the following Table.

Table 3.4.1-4 Construction Costs

Items	Amount (billion VND)			
	Phase 1	Phase 1.5	Phase 2	Total
Estimated construction cost	1,105.83	374.43	1,457.53	2,937.79
Physical Contingency	110.58	37.44	145.75	293.78
Price Contingency	194.21	337.43	1,219.27	1,750.92
VAT	141.06	74.93	282.26	498.25
Total	1,551.69	824.24	3,104.81	5,480.74

Physical Contingency is calculated as 10% of estimated construction cost as per Circular No. 04/2010/TT-BXD dated 26/5/2010 by Ministry of Construction on guidance and management of construction costs. VEC F/S also applied the same 10% for calculation of Physical Contingency.

2) **Operation management Expense**

Annual operation management expense was calculated based on such cost as maintenance, road patrol and toll collection & management while considering VAT, physical contingency and price escalation.

Table 3.4.1-5 Operation Management Expense

Year	2015	2020	2025	2030	2034
Operation management Expense (billion VND)	45	85	117	142	160

3) **General Administration costs**

Annual general and administration costs consists of running costs of SPC itself and costs for periodic check of equipment and machinery while considering price escalation.

Table 3.4.1-6 General Administration Cost

Year	2015	2020	2025	2030	2034
General Administration costs (billion VND)	7	13	17	21	24

4) **Capital Expense after opening**

Capital Expense after opening, such as removal and reconstruction of pavement, replacement of equipment and machinery, extensive repair works, is allocated considering price escalation, when depreciation period of those equipment and machinery are expired.

5) **Depreciation**

Depreciation is calculated by fixed amount method depending on the type of assets. In case that depreciation period is longer than concession period, then depreciation period is shortened so that a book value at the end of concession period becomes ZERO.

6) **Project Cost**

Project cost is as follows:

Table 3.4.1-7 Project Cost

	Total	1st Stage	2nd Stage	Frontage Road
Revenue				
Equity Funding	1,812.0	564.3	995.5	252.2
Debt Funding	4,229.5	1,316.7	2,323.1	589.7
Total	6,041.5	1,881.0	3,318.6	841.9
Expenditure				
Construction cost	5,480.7	1,551.7	3,104.8	824.2
G&A cost during construction	6.8	6.8	0.0	0.0
Other cost (Agency fee & Insurance)	47.3	22.1	18.3	6.9
Interest during construction	207.6	136.5	62.1	9.0
Commitment fee during construction	0.0	0.0	0.0	0.0
Upfront fee	35.1	26.3	7.0	1.8
Reserve fund	264.0	137.6	126.4	0.0
Total	6,041.5	1,881.0	3,318.6	841.9

3.4.1.3 Tax and other assumptions

1) **Corporate Income Tax**

Taxation rate of corporate income tax is normally 25% of earnings. Because this Project is categorized as Infrastructure improvement, it falls within the special incentive project under Taxation Law and preferential taxation is assumed to be applied.

2) **Value Added Tax (VAT)**

Value Added Tax Law with effect on 1 January 2009 will be applied and 10% of all expenditure of the Project excluding contingency will be imposed as VAT. Toll fee is assumed to be taxed (VAT is included in it).

3) **Toll rate (fare)**

Distance based Toll is assumed based on toll systems applied by other Expressway operators in Vietnam. Level of toll is the same as that applied in Cau Zie- Ninh Binh Expressway operated by VEC and partially open to the public in November 2011, which is 1,500VND/km for car at the beginning of 2012. Toll ratio between various car type is also the same as that for Cau Zie- Ninh Binh Expressway.

For setting toll in this study, increase in base toll by inflation from base 2012 to Phase 1 open 2014 is considered. (Toll for opening is 1,798 VND/km) Also toll revision per 2 years linked to inflation rate in past two years is considered.

Table 3.4.1-8 Toll Fare Schedule

(Unit: VND/km)

	2012	2014	2020	2025	2030	2033
Car/Small Truck	1,500	1,960	2,667	3,946	4,660	5,245
Small Bus/Medium Truck	1,750	2,287	3,111	4,603	5,437	6,119
Large Bus	2,250	2,940	4,000	5,918	6,990	7,867
Large Truck	3,500	4,574	6,222	9,206	10,873	12,238
Trailer etc.	7,000	9,147	12,445	18,412	21,747	24,476
Remarks	Base Toll	Phase 1 open	Phase 2 open			End of Concession

4) **Traffic**

Based on the data provided by TEDI in VEC FS and the data in METI FS in 2010, traffic volume was estimated by making such necessary modifications as changing a price elasticity in response to the revised toll fee system after the opening of the section between Cau Gie-Ninh Binh Expressway as follows:

Table3.4.1-9 Traffic Volume (per day)

	Type of Vehicle＼Year	2015	2020	2025	2030	2034
Number of Vehicles	Car/Small Truck	12,630	16,640	17,806	19,183	19,183
	Small Bus/Medium Truck	4,478	7,592	10,975	16,460	16,460
	Large Bus	3,245	3,831	4,033	4,245	4,245
	Large Truck	804	1,750	2,879	4,736	4,736
	Trailer etc.	628	1,366	2,247	3,696	3,696
	Remarks	21,785	31,179	37,940	48,320	48,320
PCU converted		34,308	51,434	66,340	89,860	89,860

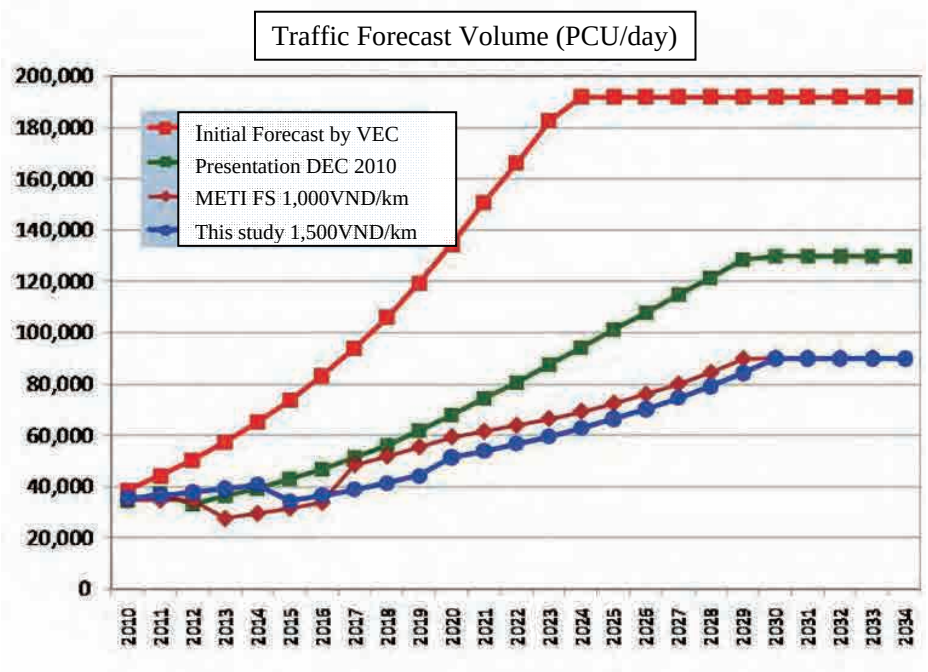
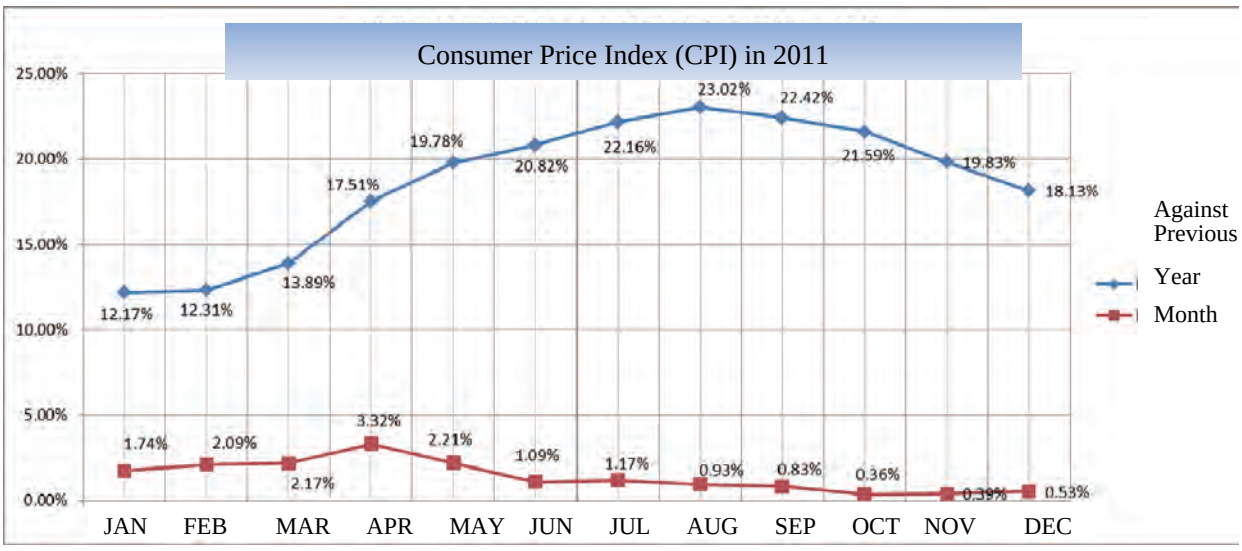


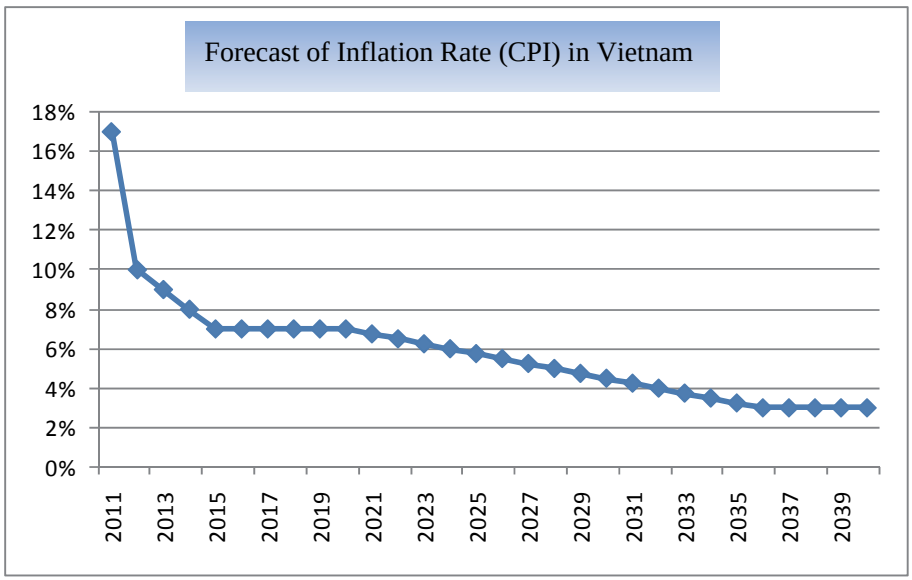
Figure 3.4.1-1 Traffic Forecast (Average PCU/day)

5) **Inflation Rate (CPI)**

Inflation rate (CPI) in Vietnam 2011 recorded as high as 18.5% but this is considered transitory event. In this study, it is assumed that CPI will be drop rapidly down to 8% which is equivalent to the average of consumer price index in Vietnam for the past decade and this rate will continue till 2020 by when high economic growth rate is planned. Then inflation rate will be lowered down to 3% which is nearly the same level as that of developed countries. Forecasted inflation rate is shown as below.



Source：Directorate of statistics, Vietnam



Source: JST

Figure 3.4.1-2 Actual Inflation rate Year 2011 and future forecast

6) **Exchange Rate**

Exchange rate between Japanese Yen and VND is estimated based on the current rate and will fluctuate in response to the difference in price increase between the two countries. Annual price inflation rate in Japan was assumed to be 1%.

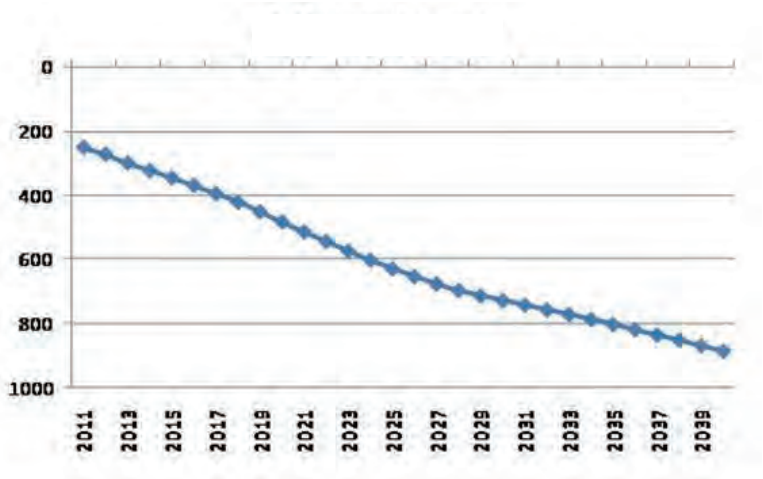


Figure 3.4.1-3 Exchange Rate

3.4.1.4 Policy for dividend to Investors

Dividend paid every year by SPC to investors will be the total of whichever is smaller of the following two:

i. Amount that was calculated by deducting required minimum cash to be reserved from the annual cash balance before dividend at the end of a term (10 billion BND is assumed at this moment)
ii. Amount that was calculated by adding the profit surplus in the previous term to the net profit after tax deduction in current term

3.4.1.5 Project Scheme

Two Project Schemes, such as Scheme X and Scheme Y, are analyzed. Details are explained in Clause 3.3.1.2 (3) Scheme X: Details of In-kind Investment Scheme and (4) Scheme Y: Details of Contract Fee Scheme.

In financial analysis, the following items are handled with the assumption stated below.

(1) Toll revenue before commencement of and during Phase I works

There is a probability that toll may be collected before commencement of Phase I works or during Phase I works, depending on the progress of land acquisition and installation of toll gates. However there are the following uncertainties.

- Schedule for land acquisition and construction of toll gates
- Possibility for toll collection during construction of Phase I
- Level of toll

Because it is too risky for investors to make business plan with assumptions that toll revenue is generated before commencement and/or during construction of Phase I, a generation of toll revenue is assumed after completion of Phase I works and operation by SPC is commenced.

(2) Toll gate and ITS Package

Toll gates and ITS Package will be installed by VEC using the budget for Cau Gie- Ninh Binh. It is necessary to make clear demarcation for ownership because PV-CG Expressway is constructed by SPC. For solving ownership, there are two methods, i) VEC will provide them to SPC as

In-kind Investment, ii) SPC will procure them from VEC. Item ii) is considered as practicable. The book value of them is used for procurement price. For ITS Package, in case that ITS Package will be installed under Japan's Grant Aid and/or Yen Loan,

3.4.1.6 Items to be analyzed

1) **Project IRR, Equity IRR (Profitability)**

IRR (Internal Rate of Return) is an index which evaluates viability of the Project throughout the Project period. By Project IRR pre-evaluation at the time investment decision is made using expected cash flow income expected throughout the Project period and Initial Investment. While cash flow for discounting is "Free Cash Flow" is Project IRR, it is "Equity Cash Flow" is Equity IRR.

IRR is a discount rate which gives that total of Net Present Value (NPV) of income cash flow during the Project period equals to total NPV of Initial Investment. IRR is an average investment return and calculated by the following formula.

$$\sum_{i=0}^{N} \frac{Cash\ flow\ of\ year\ i}{(1 + discount\ rate)^i} = 0\ (NPV)$$

Cash flow by which Project IRR and Equity IRR is calculated is different. As shown below, Cash flow for calculating Equity IRR is that for calculating Project IRR minus Equity, Debt Repayment and Financial costs.

Table 3.4.1-10 Project IRR and Equity IRR

Project IRR	Equity IRR
Operating profit after tax payment	Free Cash Flow
＋） Depreciation	－） Equity
－） Project Costs	－） Debt Repayment
－） Equipment Investment	－） Financial costs
Free Cash Flow	Equity Cash Flow

2) **DSCR**

DSCR (Debt Service Coverage Ratio) is a ratio which is calculated by the following formula. Minimum DSCR during the Project period is evaluated.

DSCR = (Cash flow before repayment of capital and interest in current year) / (Amount of Repayment in the same year)

DSCR is an index for a financial safety margin how stable the repayment to the lenders is made by cash flow generated by the Project operation. Many Financial Institutions impose a financial restriction condition, that a minimum DSCR is not less than the certain value, in Loan Agreement.

Generally Financial Institutions requires minimum DSCR of 1.2.

3.4.1.7 Flow of Financial Analysis

Flow of Financial Analysis is shown below. Because a project costs differs in combination of

scope of works and timing of commencement, the construction plan matching the project objectives is regarded as base plan for financial analysis. In the same way, financial arrangement suitable for the project is regarded as base arrangement. Based on the base plan and base arrangement, project scheme is studied and optimum project scheme is identified through financial analysis.

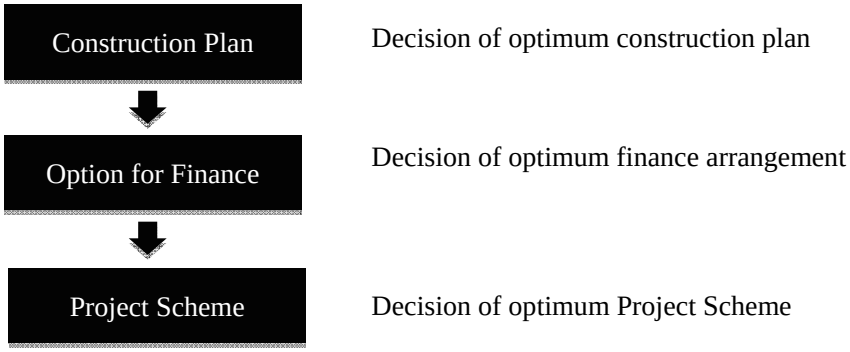


Figure 3.4.1-4 Flow of Financial Analysis

3.4.1.8 Construction Schedule

Project costs considerably deviate by the scope of the works of each Phases, ie policy or contents of Main Lines works and timing of construction of the Frontage Roads. Several options are studied regarding Main Lines works and Frontage Roads works.

1) **Main Lanes Works**

Main Lanes works are fundamentally divided into Phase 1 (Upgrading existing 4-lane Highway to Expressway) and Phase 2 (Widening to 6-lane) and several types of scope of works are examined. Among the following three options, the optimum one will be selected depending on a result of financial analysis. Project costs for each option are as follows.

Construction of Phase I will start in 2013 and collect toll fees in 2015 after the completion of widening to 4 lanes in 2014. Construction of Phase II will start in 2018 and be completed in 2020.

Table 3.4.1-11 Options for scope of works for Main Lanes works

Option	Contents	Phase	Construction Costs (billion VND)
A	Phase 1: Upgrading of vertical alignment and lane configuration to Expressway Standard (ES) Phase 2: Widening to 6-lane	Phase 1	1,552
		Phase 2	3,105
		Total	4,657
B	Phase 1: Upgrading of lane configuration to ES Phase 2: Upgrading of vertical alignment and Widening to 6-lane	Phase 1	1,515
		Phase 2	3,388
		Total	4,903
C	Phase 1: Upgrading of lane configuration to ES Smoothing of big level difference Phase 2: Widening to 6-lane	Phase 1	1,254
		Phase 2	3,957
		Total	5,211

2) **Frontage Roads Works**

Regarding the timing of commencement of frontage roads work, two options are set considering the progress of Main Lanes Works. Option is to be selected by a result of financial analysis. Project costs for each option are as follows.

Table 3.4.1-12 Options for timing of Frontage Roads Works

Option	Contents	Construction Costs (billion VND)
A	After completion of Phase 1 works, Frontage Road Construction starts immediately. (Construction: 2015～2016)	663
B	Frontage Road Construction starts at the same time of Phase 2. (Construction: 2014～2015)	824

※Estimated Construction costs for Frontage Roads may deviate according to the timing of commencement of such works. For simplicity, the same amount is used.

3) **Land Acquisition Costs**

There are considerable risks for the actual costs to exceed the budgeted amount by sharp rise of acquisition costs and/or resettlement costs. Because to bear the land acquisition costs is big hazard for SPC, it is the conditions precedent that the Project costs for neither Phase 1 nor Phase 2 includes Land Acquisition Costs.

4) **Financial Analysis and Evaluation of Construction Plans**

As stated in 1) Main Lanes Works (3 options) and 2) Frontage Roads Works (2 options), there are 6 options for construction plans when combined Main Lanes options and Frontage Roads options. Financial Analyses are carried out for all 6 options to check validity of each construction scheme. Project IRR, that is affected neither by loan conditions nor project scheme, is selected as an objective indicator for evaluation.

Based on the above policy of financial analysis, results of financial analysis are shown in the following Table.

Table 3.4.1-13 Results of Comparison on 6 construction plans

Plan	Main Lanes Works	Frontage Roads Works	Project IRR (%)
Aα	A：Phase 1: Upgrading of vertical alignment and lane configuration to Expressway Standard (ES) Phase 2: Widening to 6-lane	α： After completion of Phase 1 works, Frontage Road Construction starts immediately.	21.8
Aβ		β： Frontage Road Construction starts at the same time of Phase 2.	23.2
Bα	B：Phase 1: Upgrading of lane configuration to ES Phase 2: Upgrading of vertical alignment and Widening to 6-lane	α： After completion of Phase 1 works, Frontage Road Construction starts immediately.	21.4
Bβ		β：Frontage Road Construction starts at the same time of Phase 2.	22.8

Plan	Main Lanes Works	Frontage Roads Works	Project IRR (%)
Cα	C : Phase 1: Upgrading of lane configuration to ES Smoothing of big level difference Phase 2: Widening to 6-lane	α : After completion of Phase 1 works, Frontage Road Construction starts immediately.	22.2
Cβ		β : Frontage Road Construction starts at the same time of Phase 2.	23.9

※For calculating Project IRR, there are possibilities that Project IRR may slightly affected by project scheme and/or loan conditions. The same conditions for loan conditions and project scheme are applied for calculation.

Based on the above results, the following evaluations are made.

【Evaluation】

- Regarding 3 options for Main Lanes Works, if the same option for Frontage Roads Works is taken, Option C in which lane configuration is upgraded to Expressway Standards (ES) gives highest Project IRR. However the difference between A and B is only 0.7%. For Option B, there are many abortive works and it gives lower Project IRR than Option A. Therefore Option A, in which both vertical alignment and lane configuration are upgraded to ES, is evaluated as excellent because it improves service to the road users and gives the highest Project IRR.

- For Frontage Roads Works, if the same option for Main Lanes Works is taken, there is maximum difference of 1.1%, which is considered relatively large. However, considering the merit which can provide a resident nearby with community roads in early stage, Option α is preferable if the project is commercially viable.

- In order to carry out the project based on Option α, frontage roads construction has to be included in part of Phase I because it is not practical to raise funding exclusively for frontage roads construction. However, it may be difficult to get loan commitment from financial institutions as long as there is no telling when the land acquisition will be completed before SPC is established in Phase I (assumed to be within 2012).

As a conclusion, the following Option Aβ is to be taken up for most valid.

Main Lanes: Phase 1: Upgrading of vertical alignment and lane configuration to Expressway Standard (ES)
Phase 2: Widening to 6-lane
Frontage Roads: Frontage Road Construction starts at the same time of Phase 2.

However in order to provide residents to community roads, study of early commencement of Frontage Roads Works is to be initiated by SPC with financial institutions and investors after completion of Phase 1 Works and procedures necessary for land acquisition has been completed.

Construction Cost for Option Aβ is shown in the following Table.

Table 3.4.1-14 Construction Cost

Phase	Construction Cost including contingency and VAT (billion VND)
Phase 1	1,552
Phase 2(including frontage roads)	3,929
Total	5,481

For implementation schedule, please refer Sub-clause 3.3.4.

3.4.1.9 Option for Loan Conditions

Regarding 4 options for loan conditions, Equity IRR (in VND and in JPY) and Minimum DSCR are calculated through financial analysis. Validity of 4 options is verified.

Because the above two indicators may varied when the project scheme differs, strictly speaking, financial analyses are to be carried out for all combination of project schemes and loan conditions. However it requires many complicated analyses and it is inefficient. Therefore a scheme which gives highest Equity IRR, such as without payment of Contract Fee and without investment in kind by VEC, is used for evaluation with different loan conditions. Options with commercial viability are identified.

Regarding Equity IRR, there are two kinds of calculation methods. One is dividend plus retained earnings and others only dividend actually paid to the investors. Generally projects for construction of infrastructures in Vietnam are considered as high risk. Because it is required to keep considerable retained earnings and dividend is deferred, there is a big difference between dividend plus retained earnings and others only dividend. In this regard, Equity IRR calculated by only dividend is calculated.

Based on the above analysis policy, the following results are obtained.

Table 3.4.1-15 Results of analysis for loan conditions (Equity IRR and DSCR)

Option for Loan Conditions		Equity IRR (VND base)	Equity IRR (JPN base)	Minimum DSCR
JPY Base	JICA Direct (lend JPY directly to SPC)	30.6%	22.7%	1.79
	JICA 2 step (JPY→JPY)	25.5%	18.3%	1.23
VND base	JICA 2 step (JPY→VND)	23.3%	16.3%	1.00
	Financing Institution in Vietnam	21.6%	14.8%	0.28

*Equity IRR includes price escalation in both of VND and JPN base.

Based on the results obtained from the above calculation, following evaluation was made:

【Evaluation】

- Because interest rate of loans or its related fees by Private Financial Institutions in Vietnam and Japan are rather high, it is difficult to keep a reasonable Equity IRR corresponding to high rate of price escalation in Vietnam. In addition, their lending term is so short that risk for default (unable to repay) of SPC is high under the current project scheme. This option is considered not to be appropriate.

- JICA 2 step loan in which JICA lends JPY to Financial Institution in Vietnam (FIV) and FIV lend VND to SPC has a merit for SPC because conversion risks can be mitigated. However Minimum DSCR is 1.00 and there are possibilities, difficult to repay. This option transfers conversion risk to FIV. Considering the current situation in Vietnam where high inflation rate and lowering conversion rate of VND against other currencies continue, there is little possibility for FIV to accept this loan option.

- From the results of financial analysis, option for JICA Direct is most attractive. However JICA Private Sector Investment Finance (PSIF) seems not to be applied to this Project for some time because JICA finds it very difficult to carry out loan and security management in Vietnam by himself. Thus, even if this option may become available from financing to Phase II but at least not from Phase I.

- Although JICA 2 step loan in which JICA lends JPY to FIV and FIV lends JPY to SPC can keep a certain level of Equity IRR, it may not be enough in order to respond to high rate of price escalation in Vietnam. Since there may be a problem for commercial viability depending on the project scheme, it is not suitable to apply this option to all.

Based on the above study, the following loan conditions are selected to be practical and commercially viable:

Phase 1: JICA 2 step loan (JPY→JPY)
Phase 2: JICA Direct

3.4.1.10 Financial Analysis by Project Scheme

Based on the lending options described above, Financial Analyses are carried out for 2 options, (X) Investment in kind by VEC and (Y) Paying Contract fee about Equity IRR expressed in VND and JPY and net profit of VEC during the period collecting the toll . Results are shown below.

Table 3.4.1-16 Results of comparison of project scheme (Equity IRR and Net Profit of VEC)

Project Scheme	Equity IRR VND base (%)	Equity IRR JPY base (%)	Net Profit of VEC (20 years, in billion VND)	Ratio of VEC Equity in Phase I (%)
X: Investment in kind (existing road Only)	9.7	3.9	9,662.8	87.6
Y: Paying Contract Fee(amount deducted loan handling charges from certain portion of toll revenue)	23.3	16.0	8,682.4	0.0

*Net income of VEC includes no toll revenue likely to be obtained from PV-CG Expressway before and during the construction of Phase I

* VEC investment is assumed to be only investment in kind

Based on the above results, evaluation is as follows:

【Evaluation】

- Option X cannot keep the sufficient Equity IRR that would satisfy the need of investors in Japan and Vietnam and cannot be found the commercial viability from the beginning.
- Although Option X seems to be better that option Y in terms of net profit of VEC for 20 years, the actual differences between the two schemes is little.
- In Option X, VEC is supposed to invest nearly 90% of the total equity of Phase I which will raise the problem of a conflict of interests.

From the above evaluation it is concluded that Option Y will be judged to be feasible for both of the investors in Japan and Vietnam and it is regarded as a standard model in the following study.

3.4.2 Risks for project implementation and operation and Study of Security Package

3.4.2.1 Outline of Risks

The following Table shows risks in Sensitivity Analysis. Analysis of (4) listed below, however, is not needed as the standard model assumes that contract fee is not treated as cost.

Table 3.4.2-1 Item List in Sensitivity Analysis

Symbol	Items	Content	Range
(1)	Deviation Risk for Traffic Demand Forecast	Impact on dividend to investors and net profit of VEC when actual traffic volume deviates from forecast	Traffic Volume Maximum ±30%
(2)	Inflation (Price fluctuation) Risk	Ditto when actual inflation rate deviates from assumed value	Maximum 30%

Symbol	Items	Content	Range
(3)	Exchange Rate Fluctuation Risk	Impact on dividend to investors and net profit of VEC when actual exchange rate between Yen and Dong deviates from forecast	Exchange Rate Maximum ±30%
(4)	Risk for accounting interpretation of Contract fee	Ditto when contract fee is not treated as cost	Contract Fee paid to VEC by SPC is not treated as cost

3.4.2.2 Sensitivity Analysis

Based on the standard model, sensitivity analysis is carried out by using various parameters and stress-tested against expected risks of each scheme.

1) **Risk for Traffic Volume Deviation**

In 3.1.2 Traffic Demand Forecast, a forecast is carried out and the traffic volume thus calculated is used as base case. Traffic volume is forecasted based on information available at the time of forecasting, there might be a difference between forecasted traffic volume and actual traffic volume due to changes of socioeconomic situation in the future. And tolls paid by road users are the only one source of revenue of SPC. Deviation in traffic volume has great impact on the commercial viability of the Project. The stress test of each scheme when actual traffic volumes fluctuated more than forecasted (±30%) is conducted.

i) Equity IRR (in VND)

Table 3.4.2-2 Result of Sensibility Analysis (Traffic Volume Deviation and Equity IRR, in VND)

Deviation range from the expected traffic volume	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	9.7%	23.3%
Increased by 30%	13.4%	31.0%
-ditto- by 20%	12.2%	28.6%
-ditto- by 10%	11.0%	26.0%
Decreased by 10%	8.5%	20.2%
-ditto- by 20%	7.2%	16.7%
-ditto- by 30%	5.4%	12.7%

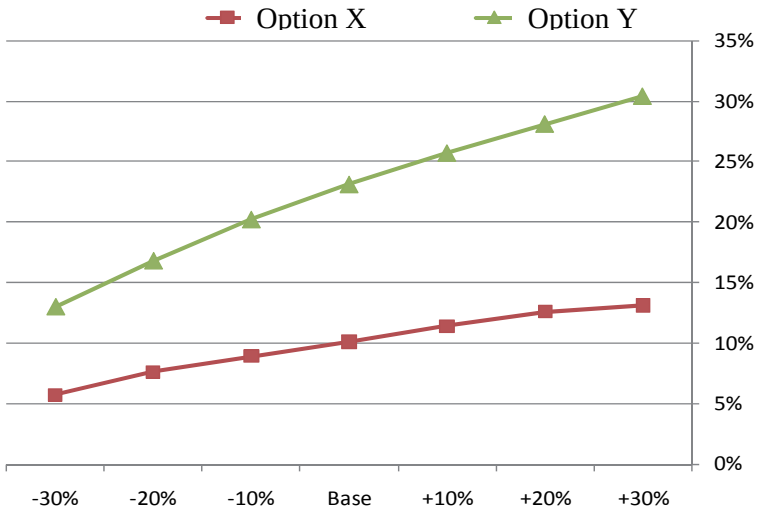


Figure 3.4.2-1 Risk of Traffic Volume Deviation and Equity IRR, in VND

ii) Equity IRR (in JPY)

Table 3.4.2-3 Result of Sensibility Analysis (Traffic Volume Deviation and Equity IRR, in JPY)

Variation range from the expected traffic volume	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	3.9%	16.0%
Increased by 30%	7.2%	22.8%
-ditto- by 20%	6.1%	20.7%
-ditto- by 10%	5.1%	18.4%
Decreased by 10%	2.9%	13.2%
-ditto- by 20%	1.8%	10.2%
-ditto- by 30%	0.1%	6.7%

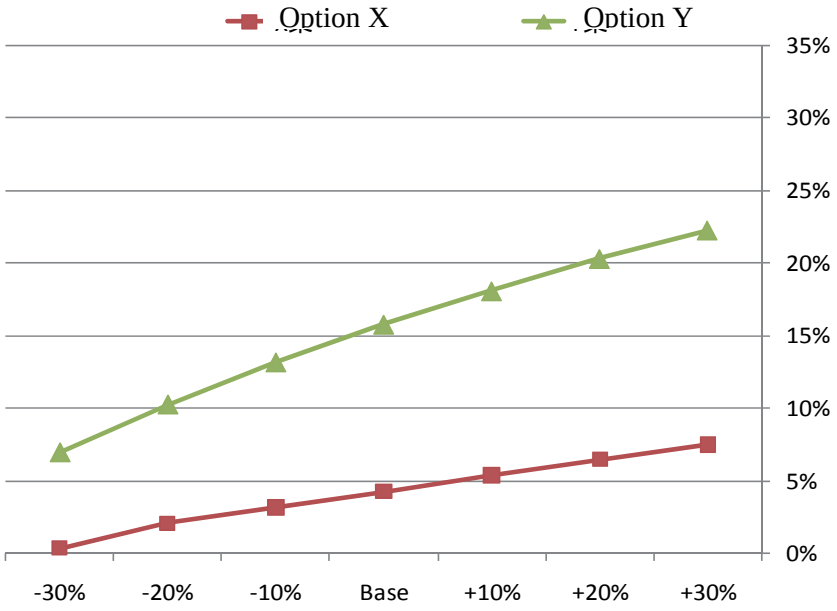


Figure 3.4.2-2 Risk of Traffic Volume Deviation and Equity IRR, in JPY

iii) Net profit of VEC

Table 3.4.2-4 Result of Sensibility Analysis (Risk of Traffic Volume Deviation and Net Profit of VEC, in billion VND

Variation range from the expected traffic volume	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	9,663	8,682
Increased by 30%	16,500	13,733
-ditto- by 20%	14,266	12,012
-ditto- by 10%	12,006	10,324
Decreased by 10%	7,847	7,122
-ditto- by 20%	6,051	5,720
-ditto- by 30%	3,490	4,459

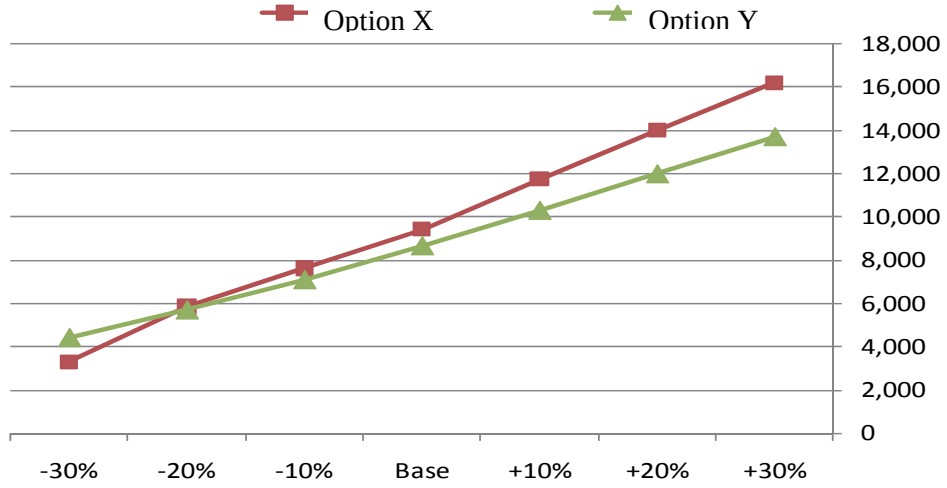


Figure 3.4.2-3 Risk of Traffic Volume Deviate and Net Profit of VEC, billion VND

iv) Evaluation

Evaluation based on the study above is as follows:

- Sensibility Analysis of Equity IRR shows that Option Y is always advantageous to both of the investors in Japan and Vietnam even if traffic volumes fluctuate.
- Net profit of VEC for 20 years shows that there is a case Option Y is rather advantageous when traffic volumes decrease more that estimated while Option X is advantageous when traffic volumes increase more that estimated. In other words, Option X may carry a high risk but Option Y a low.

2) **Risk for Inflation (risk for conversion rate)**

Recently CPI (Consumer Price Index) in Vietnam becomes high and CPI target in Fiscal Year 2011 is 17%. The difference of inflation rates in Vietnam and Japan is one of the reasons why generating a variation in conversion rate. As Japanese and other foreign investors are expected to participate in this Project, inflation rate causing variation in conversion rate has a great impact on dividend to foreign investors. The stress test of each scheme when actual consumer price fluctuated more than forecasted (±30%) is conducted.

i) Equity IRR in VND

Table 3.4.2-5 Result of Sensibility Analysis (Risk of Price escalation and Equity IRR, in VND)

Variation range from the expected price escalation	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	9.7%	23.3%
Increased by 30%	11.7%	24.2%
-ditto- by 20%	11.0%	23.9%
-ditto- by 10%	10.4%	23.6%
Decreased by 10%	9.0%	23.0%
-ditto- by 20%	8.3%	22.4%
-ditto- by 30%	7.7%	22.3%

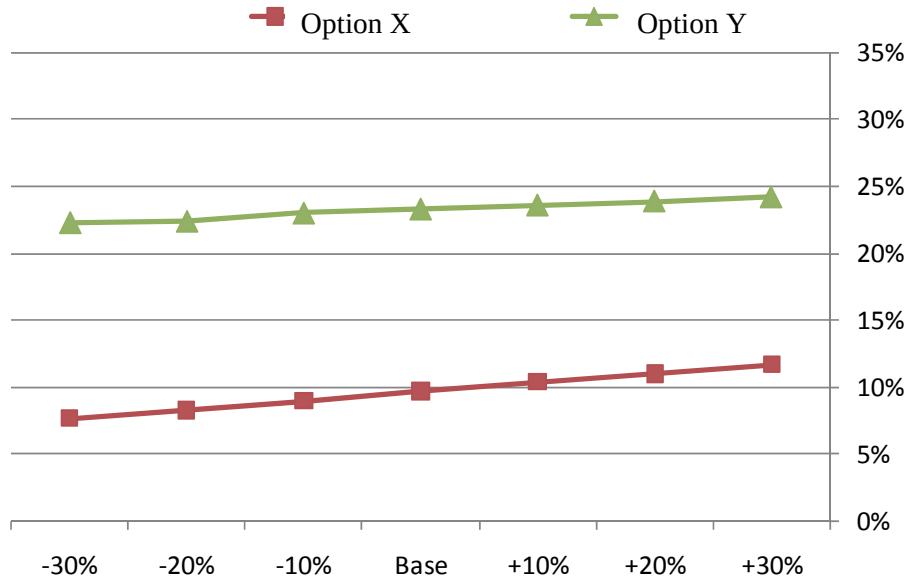


Figure 3.4.2-4 Risk of price escalation and Equity IRR, in VND

ii) Equity IRR in JPY

Table 3.4.2-6 Result of Sensibility Analysis (Risk of Price escalation and Equity IRR, in JPY)

Variation range from the expected price escalation	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	3.9%	16.0%
Increased by 30%	3.9%	14.7%
-ditto- by 20%	3.9%	15.1%
-ditto- by 10%	3.9%	15.5%
Decreased by 10%	3.9%	16.4%
-ditto- by 20%	4.0%	16.7%
-ditto- by 30%	4.0%	17.3%

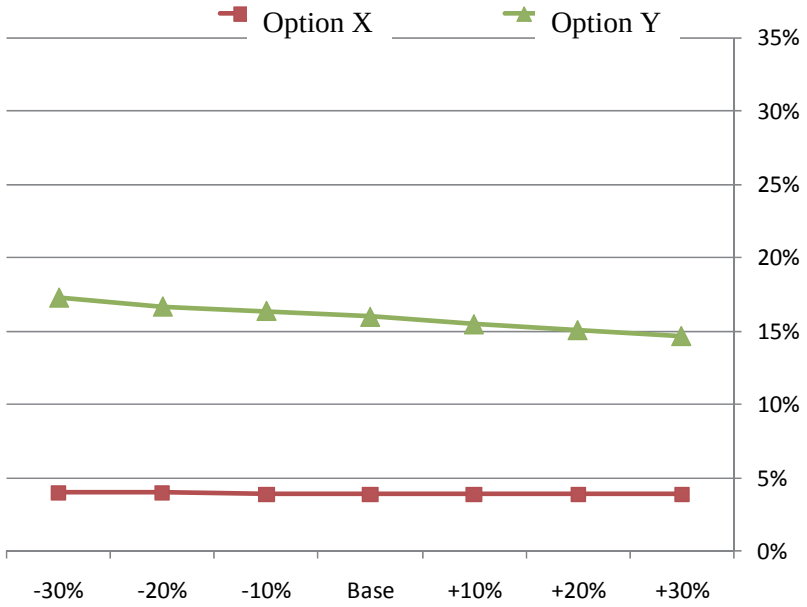


Figure 3.4.2-5 Risk of Price Escalation and Equity IRR, in JPY

iii) Net Profit of VEC

Table 3.4.2-7 Result of Sensibility Analysis
(Risk of Price Escalation and Net Profit of VEC, in billion VND)

Variation range from the expected price escalation	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	9,663	8,682
Increased by 30%	14,429	12,437
-ditto- by 20%	12,708	11,041
-ditto- by 10%	11,123	9,793
Decreased by 10%	8,328	7,685
-ditto- by 20%	7,101	6,801
-ditto- by 30%	5,988	6,015

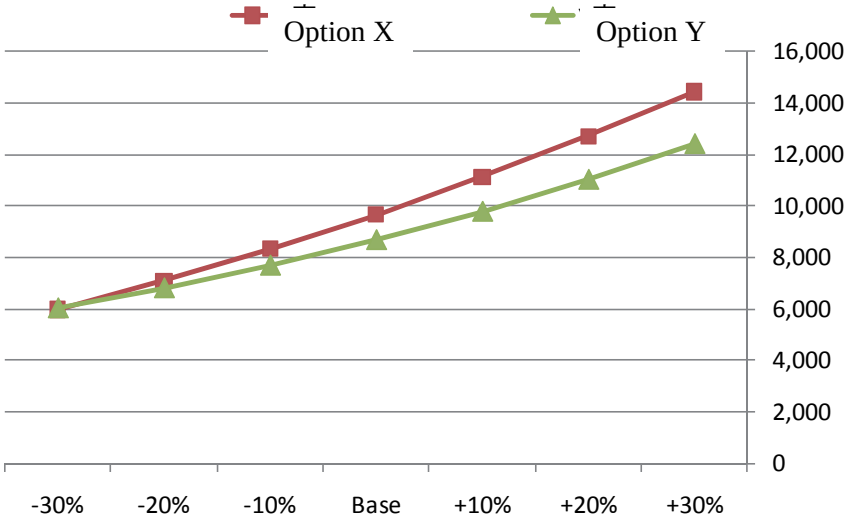


Figure 3.4.2-6 Risk of Price Escalation and Net Profit of VEC, in billion VND)

iv) Evaluation

Evaluation based on the study above is as follows:

- Sensibility Analysis of Equity IRR shows that both of the Option X and Y are the project scheme resilient to risk of price escalation.
- From the point of profitability, Option Y is always advantageous to both of the investors in Japan and Vietnam when rate of price escalation fluctuated.
- Net profit of VEC for 20 years shows there is a case Option Y is rather advantageous when rate of price escalation decreases more than estimated while Option X is advantageous when rate of price escalation increases more than estimated. In other words, Option X may carry a high risk but Option Y a low.

3) **Risk for Fluctuation of Exchange Rate**

The stress test of each scheme when actual exchange rate between JPY and VND fluctuated more than forecasted (±30%) is conducted. It is quite natural that foreign investors normally take much interest in exchange rate risk. Vietnamese investors and financial institutions, however, may also take much interest in it this time, because in principle Yen loan through JICA (2step loan and direct loan) is assumed to be applied to this loan scheme.

i) Equity IRR in VND

Table 3.4.2-8 Risk of Exchange rate fluctuation and Equity IRR in VND

Variation range from the expected price escalation	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	9.7%	23.3%
Increased by 30%	9.5%	22.6%
-ditto- by 20%	9.5%	22.8%
-ditto- by 10%	9.5%	23.0%
Decreased by 10%	9.8%	23.6%
-ditto- by 20%	9.8%	23.8%
-ditto- by 30%	9.9%	24.1%

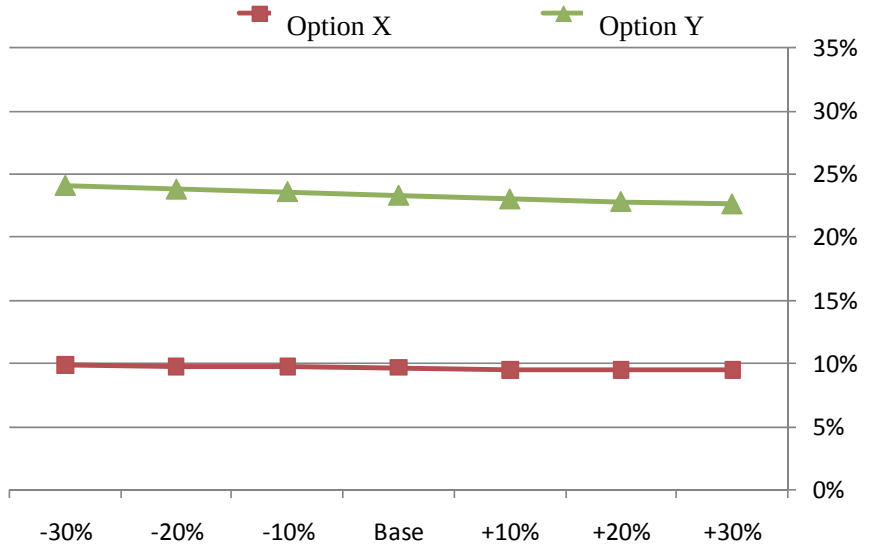


Figure 3.4.2-7 Risk of Exchange Rate Fluctuation and Equity IRR in VND

ii) Equity IRR in JPY

Table 3.4.2-9 Risk of Exchange Rate Fluctuation and Equity IRR, in JPY

Variation range from the expected price escalation	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	3.9%	16.0%
Increased by 30%	2.9%	14.4%
-ditto- by 20%	3.2%	14.9%
-ditto- by 10%	3.6%	15.4%
Decreased by 10%	4.3%	16.6%
-ditto- by 20%	4.7%	17.3%
-ditto- by 30%	5.2%	18.0%

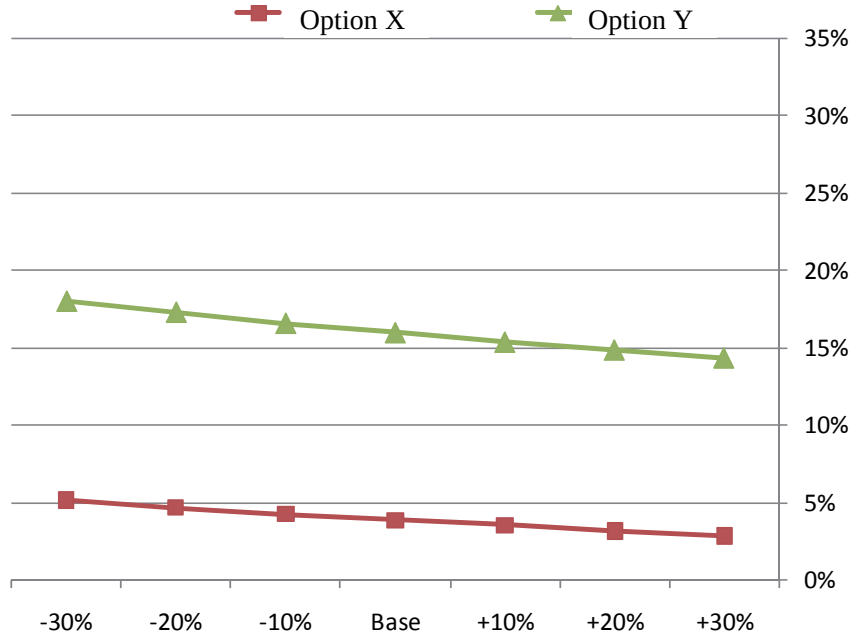


Figure 3.4.2-8 Risk of Exchange Rate Fluctuation and Equity IRR in JPY)

iii) Net Profit of VEC

Table 3.4.2-10 Result of Sensibility Analysis (Risk of Exchange Rate Fluctuation and Net Profit of VEC, in billion VND)

Variation range from the expected price escalation	Option X Investment in kind (Only Existing Road)	Option Y Paying Contract Fee
Base case	9,663	8,682
Increased by 30%	9,423	8,313
-ditto- by 20%	9,499	8,429
-ditto- by 10%	9,579	8,553
Decreased by 10%	9,751	8,818
-ditto- by 20%	9,845	8,970
-ditto- by 30%	9,947	9,146

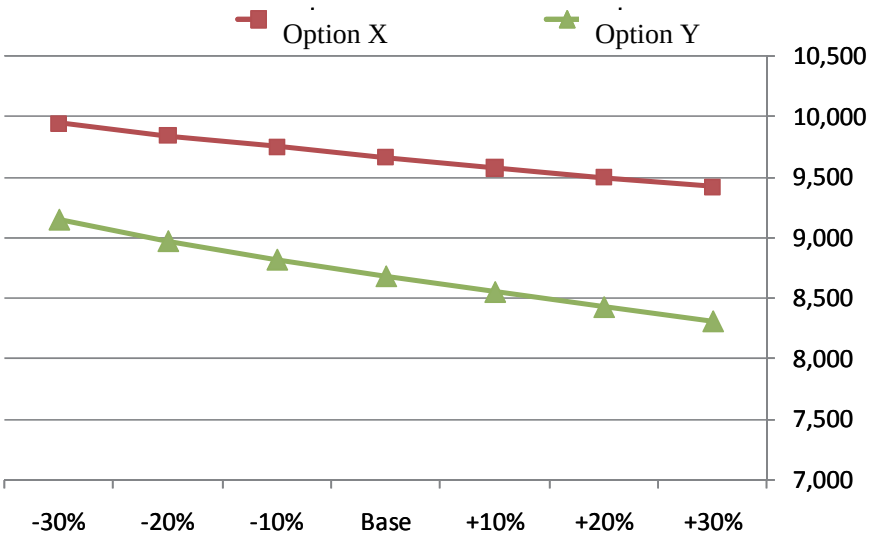


Figure 3.4.2-9 Risk of Exchange Rate Fluctuation and Net Profit of VEC, in billion VND

iv) Evaluation

Evaluation based on the study above is as follows:

- Result of sensibility analysis of Equity IRR shows that both of the Option X and Y are the project scheme resilient to risk of price escalation. However this model of sensibility analysis assumes that higher or lower exchange rate than estimated will consistently continue until future. Thus, it is not the model that can respond to the case that exchange rate was extremely high when decision on investment or loan was accommodated but it became extremely lower when the repayment of loan started, taking for example.
- From the point of profitability, Option Y is always advantageous to both of the investors in Japan and Vietnam when rate of price escalation fluctuated.
- Net profit of VEC for 20 years shows that Option X is advantageous. However, there is little difference between the two in terms of net profit and it is so even in terms of degree of risk .

3.4.2.3 Comparative Analysis of Project Schemes

Based on the result of quantitative study referred above and other qualitative issues, advantages and disadvantages of each project scheme are summarized as follows and as Project scheme of this time Option Y (Paying Contract Fee Method) seems to be feasible, which is the same conclusion with the paper , No.18/TB-BGTVT dated January 24, 2011 :

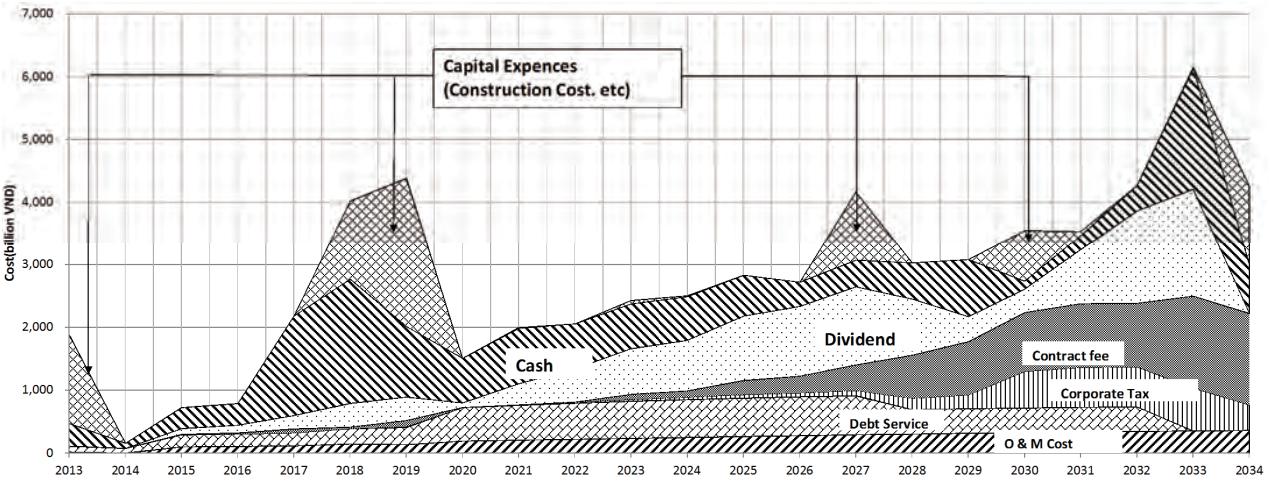
Table 3.4.2-11 Comparison between Project Schemes

Evaluation	Option X (Investment in Kind)	Option Y (Paying Contract Fee)
Advantage	・ Japanese technology and knowhow are expected to be transferred and used to the coming improvement of expressways in Vietnam through participation by VEC to a member of SPC. ・VEC can anticipate high return though high risk might be accompanied by.	・It is most likely that investors from Japan and Vietnam will participate in the Project because Equity IRR in JPY and VND is high to a certain extent and its risk is comparatively small. Project is expected to be carried out without fail and promptly. ・No need to care for conflict of interests. ・ It is expected that management and operation capability on Expressways in Vietnam will be enhanced through the transfer of Japanese Technology and know-how from SPC to VEC O&M because the former is going to train directly the latter in that field. ・Provided that VEC is granted conseccion right in this scheme, procedures to change it when starting the Project not seem to be required.
Disadvantage	・It may be difficult to invite investors from Japan and Vietnam and implement the Project because of low Equity IRR in JPY and VND. ・Need to care for conflict of interests because VEC holds high share of investment. ・ There is a possibility that concession right shall be passed to others due to the fact that VEC changes its status from a Project owner to a member of investors and instead SPC becomes a Project owner. If so, VEC has to obtain concession right again after contract duration expired.	・ VEC cannot anticipate high return comparing to Option X (Investment in kind) but risk is also low.

3.4.2.4 Summary of Financial Analysis

As a result of financial analysis, JICA 2 step loan (Yen→Yen) is selected for Phase 1 and JICA Direct loan is selected for Phase 2. Project scheme is option Y Paying Contract fee .Cash flow and results of Financial Analysis are shown below.

Table 3.4.2-12 Cash flow Diagram



	Year	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020	2,021	2,022	2,023
1	Equity	566	-	-	-	1,248	-	-	-	-	-	-
2	Debt	1,318	3	-	-	-	1,037	1,876	-	-	-	-
3	Toll Revenue	-	-	501	534	664	709	883	1,033	1,258	1,321	1,585
4	Reversal of Reserve account	1	0	6	7	27	7	57	14	14	15	18
5	O&M cost	20	6	101	109	118	150	140	193	208	222	238
6	Repayment	92	71	191	198	205	242	270	534	554	572	588
7	Income Tax	-	-	-	-	-	-	15	-	7	19	33
8	Contract Fee	-	-	9	14	63	25	95	-	-	-	79
9	Dividends	-	-	91	127	215	376	372	75	337	529	724
10	Capital Expense	1,411	-	-	-	-	1,257	2,372	-	14	-	54
11	Reserve account	362	82	334	342	1,581	1,972	1,124	708	880	715	713

	Year	2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	Total
1	Equity	-	-	-	-	-	-	-	-	-	-	-	1,814
2	Debt	-	-	-	-	-	-	-	-	-	-	-	4,234
3	Toll Revenue	1,671	1,975	2,090	2,433	2,586	2,964	3,163	3,356	3,356	3,560	3,560	39,201
4	Reversal of Reserve account	19	22	23	1,212	23	24	375	55	768	1,895	-	4,580
5	O&M cost	252	267	280	295	307	319	330	340	349	355	365	4,962
6	Repayment	601	610	617	620	387	390	390	390	390	-	-	7,913
7	Income Tax	39	57	64	81	180	219	584	633	634	685	403	3,653
8	Contract Fee	100	222	263	409	684	847	932	1,015	1,011	1,458	1,454	8,680
9	Dividends	805	1,025	1,111	1,243	895	396	374	864	1,478	1,713	-	12,750
10	Capital Expense	15	-	-	1,094	-	-	813	69	-	20	1,260	8,379
11	Reserve account	692	647	384	423	576	910	124	224	404	1,922	775	15,896

Table 3.4.2-13 Results of Financial Analysis

Unit is billion VND unless state otherwise.

Items	Contents		Remarks
Construction Costs	Phase 1 (incl. contingency, VAT)	1,552	Land acquisition costs not included
	Phase 2 (incl. contingency, VAT)	3,929	Ditto Costs for Frontage Roads included
	Total	5,481	
D/E Ratio	Phase 1	70 : 30	
	Phase 2	70 : 30	
Equity required	Phase 1	568	NEXCO50.1% VEC has nonvoting share
	Phase 2	1,248	NEXCO50.1% VEC has nonvoting share
	Total	1,815	
Debt required	Phase 1	1,319	100%, JICA 2 step (JPY→JPY)
	Phase 2	2,913	100%, JICA Direct
	Total	4,232	
Project scheme	Paying Contract fee Scheme. Contract fee=Toll revenue×50%-Finance related expense (repayment of principle + interest + insurance +loan management fee+ other expenses)		
Investment Indicators (Sub-clause 3.4.1.6 is to be referred to)	Project IRR	24.0%	IRR on Free cash flow
	Equity IRR (VND)	23.3%	IRR on Equity cash flow in VND
	Equity IRR (JPY)	16.0%	IRR on Equity cash flow in JPY
	Net profit for VEC	8,682	By a provisional formula stated above
	Minimum DSCR	1.45	
Toll level	At the beginning of 2012 Car 1,500VND/km At the opening of PVCG Car 1,960VND/km		Revision of tolls will be made once per two years at the same rate as CPI
Construction Programme	Phase 1 Commencement: 2013 Open to public : 2015		
	Phase 2 Commencement : 2018 Open to public : 2020		Frontage Roads Construction is included. Construction of them should be commenced as early as possible.

3.4.3 Study on risk and security package in general project

One of the fundamental elements for private investors and lenders to assess the project feasibility is to analyze the risks involved in the project. General categorization of risks in large infrastructure projects is described in the following table.

Table 3.4.3-1 Name of risks and the detail

Name of Risks			Detail
Project Risks	Environmental Risks	Land acquisition risks	Delay of land acquisition, increase in the acquisition cost, etc.
		Environment / Social risks	Effect on the environment / local community, protest movement, etc.
	Finance Risks	Equity financing risks	Lack of enough commitment of capital contribution / contributors
		Loan financing risks	Lack of loan financing / financiers
	Commercial Risks	Construction risks	Delay in completion, increase in construction costs, etc.
		Technical risks	Technical defect, increase in costs, etc.
		O & M risks	Additional investment in equipments, increase in O&M costs, etc.
		Supply risks (raw materials)	－（None in the road projects）
		Market demand risks	Volatility of demand, absence of toll fee revision, failure of assumed network scenario, etc.
		Macroeconomic risks	Inflation, Volatility of FX rate, interest rate, etc.
	Political Risks	Breach of contract risks	Breach of contract by the other parties
		Change in law / Regulation risks	Change in law, requirement of another permission
		Currency conversion /Transfer risks	Restrictions of currency conversion / transfer
		Expropriation, nationalization risks	Expropriation of the project or interests in it by hosting government
	Force Majeure	Political Force Majeure	War, civil war, strikes, etc.
		Natural Force Majeure	Natural disaster, etc.

Table 3.4.3-2 describes common measures of the risk mitigation. These arrangements need to be stipulated in the project documents or in the finance documents. They are described in the "3.4.4 Security package for lender" in detail.

Table 3.4.3-2 Measures of risk mitigation

Name of Risks			Issues / Notes
Project Risks	Project Environmental Risks	Land acquisition risks	● Government guarantees against land acquisition / land use
		Environment / Social risks	● Government guarantees against project environment (implement action of EIA, observation of the guideline process of JICA, etc.)
	Finance Risks	Equity financing risks	● Appropriate government guarantee and preferential treatment to investors ● Analysis and disclosure
		Loan financing risks	● Appropriate government guarantee and preferential treatment to loan financiers ● Appropriate sponsor support
	Commercial Risks	Construction risks	● Fixed completion date, fixed price by EPC contract
		Technical risks	● Guarantee against defects by EPC contractors, risk pass-through to the contractor, etc.
		O & M risks	● Long term repair plan by reliable contractor / operator ● Fixed OM price in the OM contract, etc.
		Supply risks (raw materials)	－（None in the road projects）
		Market demand risks	● Minimum revenue guarantee by the government ● Stipulation of scheduled tariff adjustment formula ● Government guarantee against implementation of such tariff adjustment ● Compensation by the government in case of failure of the road network development, etc.
		Macroeconomic risks	● Reflection to the tariff adjustment formula （inflation, FX rate） ● Hedging with interest rate swap （interest rate） ● Extended political risk insurance / guarantee if government guarantee or obligations exist

Name of Risks				Issues / Notes
		Extended Political Risks	Breach of contract risks	● Government guarantee against the contract parties' performance under project contract ● Extended political risk insurance if government guarantee or obligations exist
		Political Risks	Change in law / Regulation risks	● Stipulation of compensation by the government against change in law in IC / GGU ● Extended political risk insurance if government guarantee or obligations exist
			Currency conversion /Transfer risks	● Political risk insurance / guarantee ● Stipulation of government guarantee against currency transfer / conversion ● Offshore banking account
			Expropriation, nationalization risks	● Political risk insurance / guarantee ● Stipulation of compensation by the government against expropriation in IC / GGU
		Force Majeure	Political Force Majeure	● Political risk insurance / guarantee
			Natural Force Majeure	● Stipulation of buy-out the project by the government in IC / GGU ● Construction insurance, insurance on assets, third party liability insurance

Although the table above shows common measures of the risk mitigation for each risk category, it should be noted that some of the items including government guarantees or support, might be affected by the policy of the hosting government. Measures of the risk mitigation should be discussed and agreed by the government prior to the establishment of SPC, as mentioned later. Sponsors should negotiate as much as possible in advance of the establishment of SPC, considering political situation of the country.

3.4.4 Security Package for Lender

3.4.4.1 Overview of Security Package

Security package is considered as a set of various arrangements for protecting lender's loan by enhancing the SPC's financial viability by allocating and sharing project risks appropriately among project stakeholders and setting lender's security interests over the SPC's asset or other items. "Security package for lender" is defined in this report as a set of arrangements described below both in Layer1 and Layer2. Details of the proposed arrangements are written in the following sections.

Layer1: the SPC's viability arrangements (Section 3.4.4.2)

This includes various government guarantees, incentives, subsidies, sponsor guarantees and robust bankable major project agreements (including arrangements with respect to EPC, O&M, cash collections and currency conversion and project insurance). The objective is to generate positive operating cash flow for the SPC, which in return will be the fundamental security for lender's debt service. Typically, the basic contents of all forms of government support (i.e. items stated in the Government Guarantee and Undertaking (GGU), the BOT Agreement (BOTA) and the Investment Certificate (IC)) for the project should be discussed and agreed before the establishment of the SPC (which occurs upon the issue of the IC).

Again, typically, the elements described for layer 1 which are stipulated in major project contracts are discussed and agreed during the period between the establishment of the SPC and financing as these documents form part of the lender's due diligence.

The loan agreement and any political risk insurance provided to the lenders (such insurance can be obtained by the SPC or the sponsors but is less common) is part of the financing package itself and would be the last element of layer 1 to be put in place.

Sponsor support can come in a number of forms such as shareholder loan or capital contribution obligations. These supports might form a part of an agreement between multiple sponsors and would be put in place early (before the establishment of the SPC), but any capital contribution support agreement or completion guarantee required by the lenders would be part of the financing package.

Note that we have seen these steps conducted in various sequences and there is some flexibility – though settling the agreed government support before expending significant capital is usually the best policy.

Layer2: lender's asset control arrangements (Section 3.4.4.3)

In the unfortunate event of the SPC's poor performance/default, lender should be in a position to control the assets of the SPC. This includes mortgage of the shares in the SPC, security over all material contract agreements, securities over on-shore and off-shore accounts and mortgage over fixed assets. Lender's asset control arrangements would be not only mortgage and security, but also include approval from SBV, some arrangements in loan agreement (e.g. cash waterfall, accounting structure, financial covenants). Typically, arrangements for layer 2 would be put in

place as part of the financing package – with the exception of the account and currency conversion arrangements which we be put in place earlier together with the main project contracts.

3.4.4.2 Layer1: Arrangements for the SPC's Viability

(1) Overview of the Layer1

Overview of the arrangements in the layer1 is shown below.

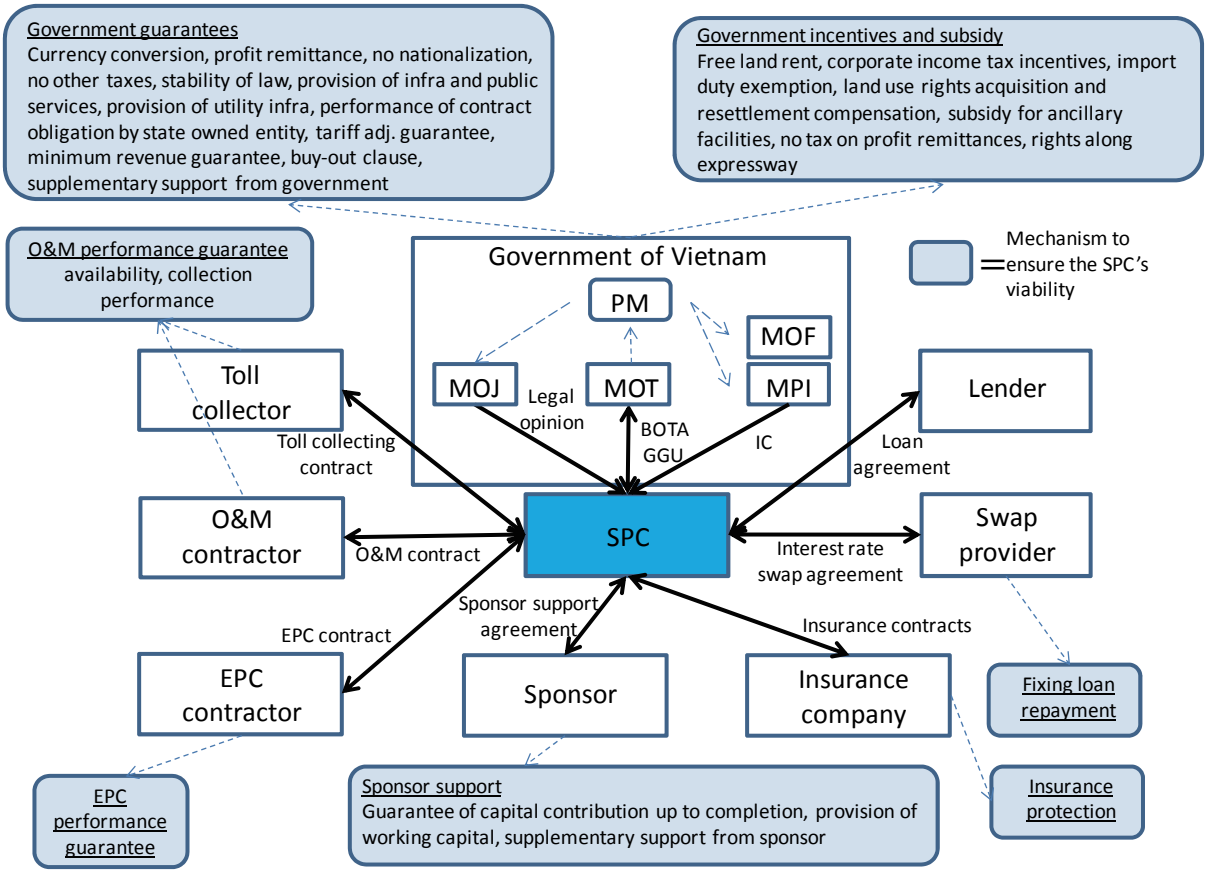


Figure 3.4.4-1 Layer1: Arrangements for the SPC's Viability

(2) Details of each arrangements *

Detailed Arrangements are shown in the following Table.

Table 3.4.4-1 Details of Arrangements (Layer 1)

Type	Contract	Description	Issues/Notes
Government guarantees			
• Currency conversion	GGU	The SPC's right to make currency conversion from VND based toll revenue to USD or JPY.	Due to scarcity of foreign reserves, Vietnam government has imposed an upper limit of 30%[1] conversion of revenue

[1] Article 2(dd) of Official Letter 1604/TTg-KTN of the Prime Minister providing a number of basic contents of BOTA and

Type	Contract	Description	Issues/Notes
			for any government guarantee. The Government has been firm on this policy in recent project negotiations. Government would like to ensure the convertibility of foreign currency in the market and not to provide guarantee.
• Profit remittance	GGU or BOTA**	The SPC's right to remit profits overseas.	
• No nationalization	GGU or BOTA	Assets of the SPC will not be nationalized. Full compensation will be paid if such case occurs.	
• No other taxes	GGU or BOTA	The SPC will not be affected by negative tax changes and has the right to receive benefits from positive changes.	Government may not give positive benefits but open to negotiation.
• Stability of law	GGU or BOTA	The SPC has the right to enjoy favorable changes in law and receive compensation when there are unfavorable changes in law. Specific mechanism on compensation to be stated in GGU or BOTA.	
• Provision of infrastructure and public services	GGU or BOTA	Authorized body shall provide feeder roads and other public facilities critical to traffic demand, according to mutually agreed schedule. The SPC receives compensation from government if authorized body fails to provide agreed infrastructure. Specific mechanism on compensation to be stated in GGU or BOTA.	Vietnam government may resist responsibility for feeder roads built by private sector. Causes of delay or failure of the provision of the infrastructure may need to be specified.
• Provision of utility infrastructures	GGU or BOTA	Basic utility infrastructures have to be provided to or available at the project site such as electricity and water.	
• Performance of	GGU or BOTA	The SPC may have the right to	This performance clause is

of GGU applicable to thermal power plant projects in the BOT investment form.

Type	Contract	Description	Issues/Notes
contract obligation by state owned entity		receive benefits from state owned entity actions stated in contract. The SPC receives compensation from government if government and/or state owned entity fails to comply with such contractual obligations. Specific mechanism on compensation to be stated in GGU or BOTA.	typical for state enterprises selling raw material or purchasing products and services. It has not yet expanded to state owned sponsor obligations. In any case, it is now Government policy to reduce exposure under these sorts of guarantees.
• Tariff adjustment guarantee	GGU or BOTA	Authorized body shall adjust tariff according to mutually agreed adjustment mechanism. Mechanisms of reflecting changes of inflation rate and foreign currency exchange rate should be incorporated. The SPC receives compensation on loss portion if authorized body fails to comply.	Upfront discussion necessary. Explanation of project importance to be emphasized.
• Minimum revenue guarantee	GGU or BOTA	Government guarantees a minimum level of traffic demand converted into revenue. This applies for the initial 10years of operation when the traffic could be volatile and well below forecast. Minimum level is set to allow the SPC to stay afloat, without additional capital injection. In addition, upper limit of the SPC's revenue would be set and the SPC would pay government for the amount beyond the limit.	Upfront discussion necessary. Explanation of project importance to be emphasized.
• Buy-out clause	GGU or BOTA	Government's guarantee to buy-out the project, in the event of breach of contract by government (e.g. no tariff adjustment) and natural force majeure event which is not cured within agreed cure	Similar clause has been successfully negotiated in other Vietnam infrastructure project.

Type	Contract	Description	Issues/Notes
		period. Method of buy-out to be specified in GGU or BOTA.	
• Supplementary support from government		Supplementary support to other risk mitigation mechanisms could be required such as foreign exchange rate change.	Discussion with government required.
Government Incentives and Subsidy			
• Free land rent	IC	The SPC is exempt from the land use fee or land rent with respect to the land on which the toll road is built. This is automatic if the project is a BOT project as stated in the Decree 108/2009[2] (Article 38) and has to be negotiated in other cases.	
• Corporate income tax incentives	IC and GGU or BOTA	Exemption from corporate income tax for a period of four years commencing from the first year in which the SPC starts to generate taxable income. A 50% reduction of tax rate for the subsequent nine years. Tax losses to be carried over for a period of up to five years. Permitted to accelerate depreciation of fixed assets up to twice the rate of depreciation as stipulated by law.	Considered for preferential investment sectors and granted on a case-by-case basis. Note there has not been much recent relevant experience on this.
• Import duty exemption	IC and GGU or BOTA	Exemption from import duties for goods and services imported for the construction, operation and maintenance (subject to some conditions).	
• Initial land use rights acquisition and	IC and GGU or BOTA	Authorized body will be responsible for all costs related to initial land rights acquisition	Decree 108/2009 states that cost of compensation, site clearance and resettlement

[2] Decree 108/2009/ND-CP "Decree on Investment in the Form of Build-Operate-Transfer, Build-Transfer-Operate or Build-Transfer Project"

Type	Contract	Description	Issues/Notes
resettlement compensation		and resettlement compensation costs. Authorized body will ensure that regional people's committee will execute on schedule and within guidelines set by the sponsor/lender.	shall basically be paid by SPC and that exception is limited to projects of urgent need and importance. (Article 6.2 and 30.2)
• Subsidy for ancillary facilities	GGU or BOTA	Authorized body will provide ancillary facilities in relation to the toll road project. This includes service area (SA), parking area (PA), interchange and surrounding facilities, toll booth and information systems.	In case of asking these to the Government, upfront discussion required. Emphasize project importance.
• No tax on profit remittances	IC and GGU or BOTA	Supplementing the right to remit.	
• Rights along expressway	GGU or BOTA	Advertising business rights and other development rights along expressway can be provided to the SPC or sponsor as an incentive. Specific conditions to be specified in GGU or BOTA.	
Sponsor support			
• Guarantee of capital contribution up to completion	Sponsor support agreement	Sponsor guarantees to provide required capital up to completion. This type of contribution might be provided by subordinated loan.	
• Provision of working capital	Sponsor support agreement	Senior lender would provide working capital facility as well in common, if required. However, when senior lenders are not able to provide this as part of the senior debt package, the sponsors might provide the working capital with subordination to the senior debt.	
• Supplementary support from sponsor		Supplementary support to other risk mitigation mechanisms could be required	Discussion with sponsor required.

Type	Contract	Description	Issues/Notes
		such as inflation and foreign exchange rate change and currency convertibility.	
Fixing loan repayment			
• Interest swap	Interest rate swap agreement	In order to avoid risk of interest rate fluctuation, the SPC will enter into interest rate swap agreement with swap provider.	
Insurance protection			
• Insurances	Insurance contracts	Protection from several risks, including additional cost or damage caused by natural force majeure event, should be provided by insurances, such as construction insurance, property damage insurance, third-party liability insurances, etc.	
Contractor obligation			
• EPC performance obligation	EPC contract, completion bond	The EPC contract would have to include bankable provisions dealing with a number of issues including completion risk, bonds, retentions and liquidated damages regimes.	
• O&M performance obligation	O&M contract	O&M contractor fee would be paid based on tightly defined key performance indicators on toll road availability.	
• Toll collection obligation	Toll collecting contract	Toll collecting fee will be coupled with toll collection leakage.	Cash collection performance is difficult to control. Mechanism for cash flow transparency will be required.

* Statements here represent the approach generally taken as modified by current circumstances. In reality, each project will be approached and documented somewhat differently.

** Where the project has a BOTA, most provisions will be contained in the BOTA and the GGU will be a shorter document covering headline issues such as government guarantees of state entities involved in the project and currency availability and conversion. Where there is no BOTA, all issues normally located in the BOTA have to be relocated to a longer GGU.

Although common arrangements for ensuring SPC's viability are mentioned in the table above, they

might be affected by the host country, sector of the project, policy of the government, etc. It is necessary to figure out the policy of Vietnamese Government, government guarantee for projects of the same kind and attitude toward government support at that time. With respect to the arrangements below, Vietnamese Government so far is not positive for providing them or provides them in limited manner.

Table 3.4.4-2 Arrangements with special attention

Type		Contract	Description
Government guarantees	• Currency conversion	GGU	The SPC's right to make currency conversion from VND based toll revenue to USD or JPY.
	• No other taxes	GGU or BOTA	The SPC will not be affected by negative tax changes and has the right to receive benefits from positive changes.
	• Provision of infrastructure and public services	GGU or BOTA	Authorized body shall provide feeder roads and other public facilities critical to traffic demand, according to mutually agreed schedule. The SPC receives compensation from government if authorized body fails to provide agreed infrastructure. Specific mechanism on compensation to be stated in GGU or BOTA.
	• Performance of contract obligation by state owned entity	GGU or BOTA	The SPC may have the right to receive benefits from state owned entity actions stated in contract. The SPC receives compensation from government if government and/or state owned entity fails to comply with such contractual obligations. Specific mechanism on compensation to be stated in GGU or BOTA.
	• Minimum revenue guarantee	GGU or BOTA	Government guarantees a minimum level of traffic demand converted into revenue. This applies for the initial 10years of operation when the traffic could be volatile and well below forecast. Minimum level is set to allow the SPC to stay afloat, without additional capital injection. In addition, upper limit of the SPC's revenue would be set and the SPC would pay government for the amount beyond the limit.
Government Incentives and Subsidy	• Corporate income tax incentives	IC and GGU or BOTA	Exemption from corporate income tax for a period of four years commencing from the first year in which the SPC starts to generate taxable income. A 50% reduction of tax rate

Type		Contract	Description
			for the subsequent nine years. Tax losses to be carried over for a period of up to five years. Permitted to accelerate depreciation of fixed assets up to twice the rate of depreciation as stipulated by law.
	• Subsidy for ancillary facilities	GGU or BOTA	Authorized body will provide ancillary facilities in relation to the toll road project. This includes service area (SA), parking area (PA), interchange and surrounding facilities, toll booth and information systems.

3.4.4.3 Layer2: Arrangements for Lender's Asset Control

(1) Overview of the Layer2

Overview of the arrangements in the layer2 is shown below.

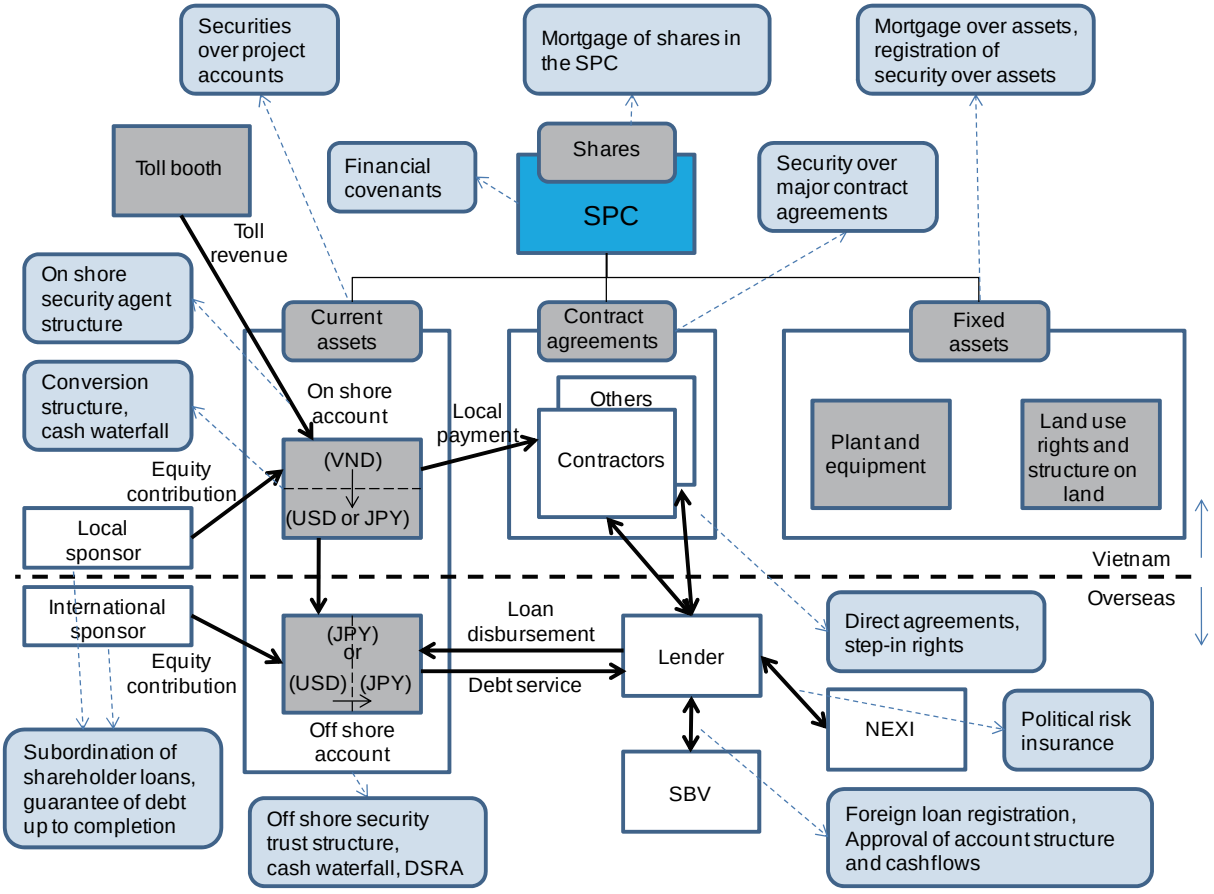


Figure 3.4.4-2 Layer2: Arrangements for Lender's Asset Control

(2) Details of each arrangements *

Detailed arrangements are shown in the Table in next page.

Table 3.4.4-3 Details of Arrangements (Layer 2)

Type	Contract	Description	Issues/Notes
Cash control mechanism			
• Foreign loan registration	State Bank of Vietnam(SBV) registration	Foreign loans of more than 12months must be registered with SBV[3]. This will be required for remitting the proceeds of security enforcement out of the country.	
• Approval of account structure and cash flows	BOTA or GGU and SBV approval	The SPC will want to receive foreign currency receipts (of loans, equity, insurance proceeds etc.) into an off-shore account. It will also want to be able to pay foreign currency outgoings (including dividends, debt service and payments to foreign contractors) from this account. It will want to be able to remit revenue generated on-shore into the off-shore account (after allowing for local payments). Local VND and foreign currency accounts will also be required. Any local payments in VND will be managed from the VND account. This includes VND debt service payments to local banks and/or dividend payments to local sponsors, upon instruction from overseas offshore account waterfall account manager.	This will require a detailed step by step plan be agreed as part of the BOTA or the GGU as currently, SBV regulation will not support these arrangements without an agreed exemption[4]. SBV may want foreign currency receipts (of loans, equity, insurance proceeds etc.) into an on-shore account in the aspect of keeping foreign currency reserves in Vietnam. In relation to the relevant laws such as Ordinance on Foreign Exchange Control, the SPC is required to obtain approvals from SBV.
• Conversion structure	Conversion bank agreement	Mechanisms and conditions for currency conversion of VND to USD or JPY within onshore account would be agreed.	The effect of PM's instruction to guarantee conversion limited to only 30% [5] of the revenue should be monitored closely.
• Onshore security agent structure	Agent agreement with local bank	A designated security agent will hold the security in onshore assets on behalf of the lenders. Lender syndication should ideally include local bank that will also play this	Unlike trust structure, this agent structure cannot cope with changes in lender syndicate, and requires

[3] Article 30.2 of the Decree 134/2005/ND-CP providing Control of Foreign Loan and Loan Repayments

[4] Article 23.3 of the Ordinance on Foreign Exchange and Article 31.1(b) of Decree 160/2006/ND-CP providing detailed guidance for implementation of Ordinance of Foreign Exchange, and Decision 218/2001/QD-NHNN on procedures for conversion of Vietnamese Dong to USD and for overseas remittance in projects with Government Guarantee and Undertakings

[5] The footnote 1 is to be referred to

Type	Contract	Description	Issues/Notes
		agent role. If not, it is still possible to convince a local bank to play the role, if they are given some incentive (such as that the local accounts are to be opened with them). Some foreign banks which have their branch office in Vietnam are playing this role in existing projects.	changes to the documents and registrations every time such changes occur.
• Offshore security trust structure	Agreement with offshore security trustee	A designated offshore security trustee will hold the security in offshore assets on behalf of the lenders. Ideally, security trustee should be designated from one of the overseas lender syndicates. If not, it is still possible to convince a foreign bank to play the role, if they are given some incentive.	Should discuss with potential lenders how they plan to manage this.
• Cash waterfall	Loan agreement	The loan agreement will include provisions of cash waterfall. This will detail prioritized order of cash allocation among the project accounts and what may be withdrawn from those accounts.	
• Debt service reserve account	Loan agreement	The SPC will establish an offshore debt service reserve account (DSRA), which must be funded before lower ranking payments (such as profits remittance) from cash waterfall.	
• Financial Covenants	Loan agreement	Loan agreement will include financial covenants such as keeping a certain number of Debt Service Coverage Ratio (DSCR) or Debt/Equity Ratio. If the SPC cannot keep these covenants, lenders can stop dividend distribution to the sponsors or announce the event of default according to the provisions of the loan agreement.	
• Subordination of shareholder loans	Shareholder loan agreement	To the extent shareholder loans to the SPC compete with the senior debt, they would have to be subordinated.	
• Guarantee of debt up to completion	Loan agreement or separate Completion Guarantee Agreement	Sponsor guarantees the debt until financial completion (generating stable operational cash flow satisfying financial covenants) occurs.	

Type	Contract	Description	Issues/Notes
Mortgage and Security			
• Registration of security over assets	National Register of Security Interests	Security over assets in Vietnam should be registered with the National Register of Security Interests, to ensure priority.	
• Mortgage of shares in the SPC	Mortgage agreement between lender and each shareholder	Lender's right to retain ownership of shares in the SPC in the event of the SPC default.	In Vietnam, approval by government on shift in ownership must be obtained [6] on enforcement in addition to corporate approvals from the SPC and waivers from the sponsors. It is not possible to achieve these approvals up front and so, upon enforcement, hurdles remain. This may especially be the case if sponsor is state-owned or if there is some dispute with government (e.g. no adjustment to tariff).
• Mortgage over plant and equipment	Mortgage agreement with the SPC	Lender's right to retain ownership of plant and equipment (e.g. O&M equipment for toll road) in the event of the SPC default.	The relevant equipment in this case may be limited and difficult to transfer.
• Mortgage of land use rights and structure on land	Mortgage agreement with the SPC	Lender's right to retain control of land use rights and structures on land during the course of concession period, in the event of the SPC default.	While Decision on PPP Piloting states "Project enterprises shall be permitted to pledge and/or mortgage assets and land use rights in accordance with the laws" [7], another law prohibits the grant of mortgages over land to foreigners[8]. There have, in the past, been exceptions granted for

[6] Article 41 and Article 42 of Decree 43/2010/ND-CP of the Government on Enterprises Registration

[7] Article 43 of Decision 71/2010/QD-TTg

[8] Article 119.2 of the Law on Land where the project is not in an industrial zone or economic zone. Article 120 of the Law on Land where the project is in an industrial zone or economic zone. Also see Article 111a.1(3) of Decree 181-2004-ND-CP (as amended by Decree 17-2006-ND-CP), and Article 1(d) of Official Letter 1604-TTg-KTN of the Prime Minister providing a number of basic contents of BOTA and of GGU applicable to thermal power plant projects in the BOT investment form.

Type	Contract	Description	Issues/Notes
			projects of national importance. However, recently, government has shown reluctance. In the context of toll road, the focus should be to ensure that land use rights are not transferred to other entity (negative protection). This will allow the operational cash flow to continue to flow in, which is the most important to protect since these assets cannot be liquidated.
• Security over major contract agreements	Mortgage Agreement	Lender's right to retain security over contract. In the toll road project, Toll Colleting Contract is also important in the aspect of maintaining cash flow.	
• Direct Agreements with all major project counterparties	Direct Agreement	Each mortgage of a project contract (including the GGU and the BOTA) would be accompanied by a direct agreement, including assurance not to change or terminate contract without lender's consent.	
Step-in rights	Mortgage Agreements and Direct Agreements	Lender's right to step-in and control the SPC management, in the event of non-performance or default.	In reality, most lenders prefer not to step-in because they don't want to be held responsible. Also, since the authorities will only recognize the legal representatives of the SPC, step-in rights may not be effective. Nevertheless, there is no downside in including in the contract. It is important to note, however, that control and continuity of operational cash flow from toll booth is the most important factor

Type	Contract	Description	Issues/Notes
			and not necessarily management of the SPC entity itself.
Political risk			
• Political risk insurance	NEXI insurance package (if required by overseas lenders)	NEXI provides Overseas Untied Loan Insurance which will guarantee the payment of debt, in the case of the SPC's poor performance/default caused by political changes that negatively affect the basic operations of the SPC. Such political changes include breach of contractual obligation risk, change in law/permission risk, remittance and conversion of foreign currency risk, expropriation/nationalization risk and political force majeure (war, civil war, terrorism, strike, etc.)	This is not required if loan is provided by JICA only.

* Statements here represent the approach generally taken as modified by current circumstances. In reality, each project will be approached and documented somewhat differently. Actual conditions in various contracts are determined based on the negotiations among the contracting parties. It should be noted that not all of the items above are absolute of necessity for the project feasibility.

3.4.5 Legal updates regarding security package of this project

3.4.5.1 New regulations on government guarantee for foreign loans

It is noted that there are regulations in which the ratio of the Government guarantee to the loan in the company held by foreign investors is restricted. New regulations are in Decree 15 recently issued by the Government on 16 February 2011 regarding the issuance and management of Government guarantee (“Decree 15”). Decree 15 took effect from 5 April 2011 and replaced Decision 272 of the Prime Minister dated 28 November 2006 promulgating the Regulations on the issuance and management of Government guarantee for foreign loans (“Decision 272”).

Although Decision 272 did not include a restriction on a ratio of Government guarantees for loans borrowed by project enterprises by a ratio of equity share of foreign company(ies), Decree 15 now clearly states that the Government will only guarantee the Vietnamese liability portion of the loan (Article 8). Practically, Decree 15 simply put what has always been the practice into statutory form. In the past, before the issuance of Decree 15, there were presidents the Government guaranteed some joint venture debts in proportion to the equity of State owned enterprises in the joint venture companies.

Table 3.4.5-1 Comparison between Decision 272 and Decree 15

	Decision 272	Decree15
Date of enforcement	・2006/12/28	・2011/4/5
Legal classification	・Decision of the Prime Minister	・Decree
Restrictions in government guarantee for the loan by a ratio of equity share of foreign company (ies)	・none	・The loan's portion corresponding to the equity interests held by foreign party(ies) in the borrowing entity shall not be covered by the Government
Scope of application	・Foreign loans	・Domestic and foreign loans ・Bonds issued in Vietnam and in the international markets
Financial requirement for obtaining the Government guarantee	・The equity contribution by the project owner must be at least 20% of the total investment amount of the project ・The borrower did not suffer losses in the latest 3 consecutive years prior to the application for the Government guarantee	・none
Conditions for the loan	・The amount of the loan must be at least USD10 million ・The term of the loan must be at least 10 years	・none

3.4.5.2 Agent bank in syndicated credit facilities in Vietnam

According to Circular No. 42/2011/TT-NHNN, issued by the State Bank of Vietnam ("SBV") on and being effective from 15 December 2011, offshore credit institutions which grant syndicated credit facilities in Vietnam are not permitted to take roles as below;

- Syndicated lead lender (facility agent)
- Payment coordinating member (paying agent)
- Coordinating member of receiving security assets (security agent)

Additionally, Circular No. 42 requires that the syndicated credit-granting coordinating member takes responsibility for making and filing reports with the SBV on a quarterly basis by the 14th day of the first month of the subsequent quarter at the latest.

This project is planning to be financed by JICA 2 Step Loan in the 1st phase, and by JICA Direct Loan in the 2nd phase. Finance by JICA alone would not be regarded as the "syndicated" credit facilities, thus Circular 42 would not apply in this project.

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**.

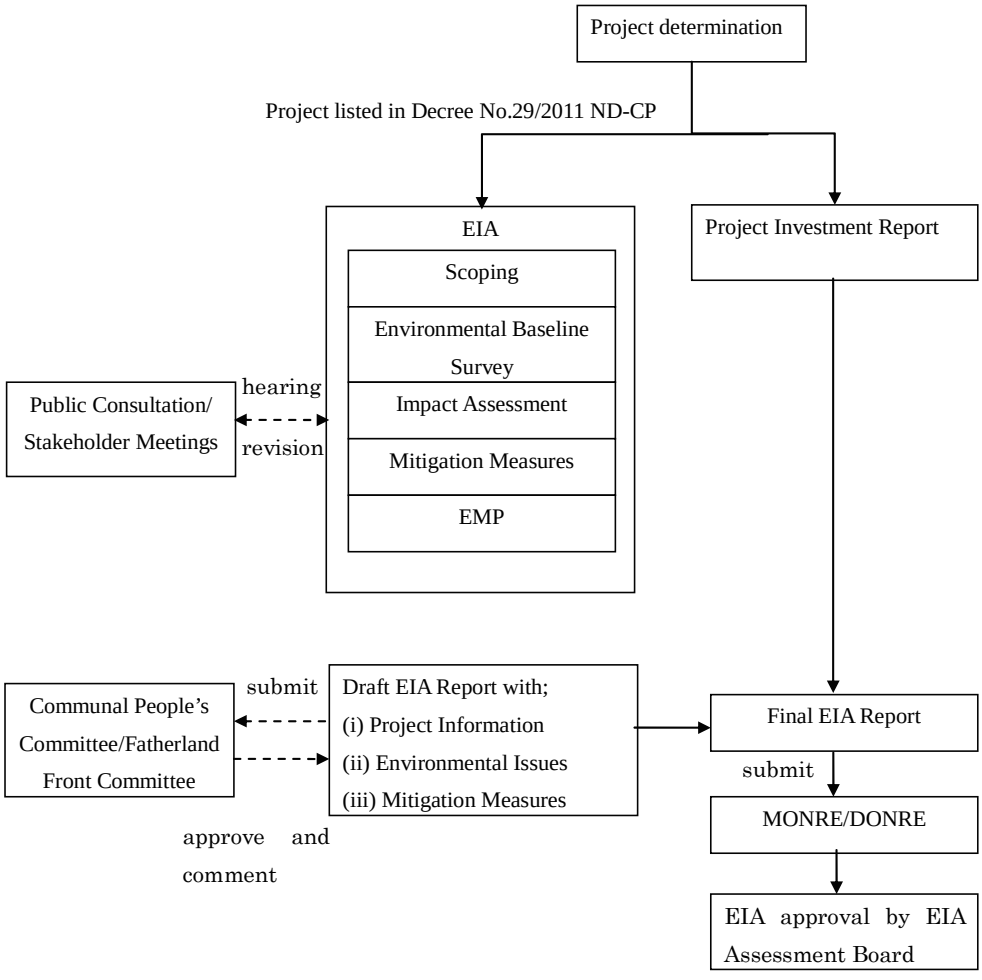
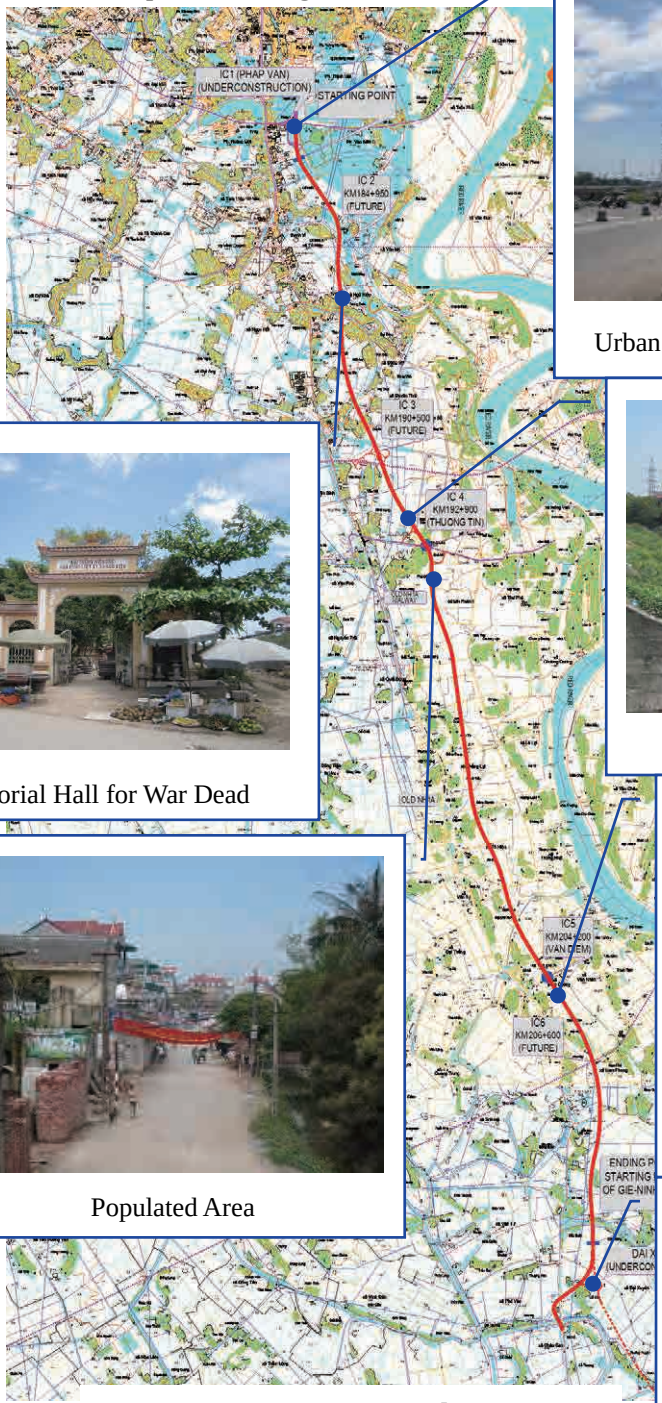


Figure 3.5.1-1Procedure for Obtaining Approval on EIA

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.**

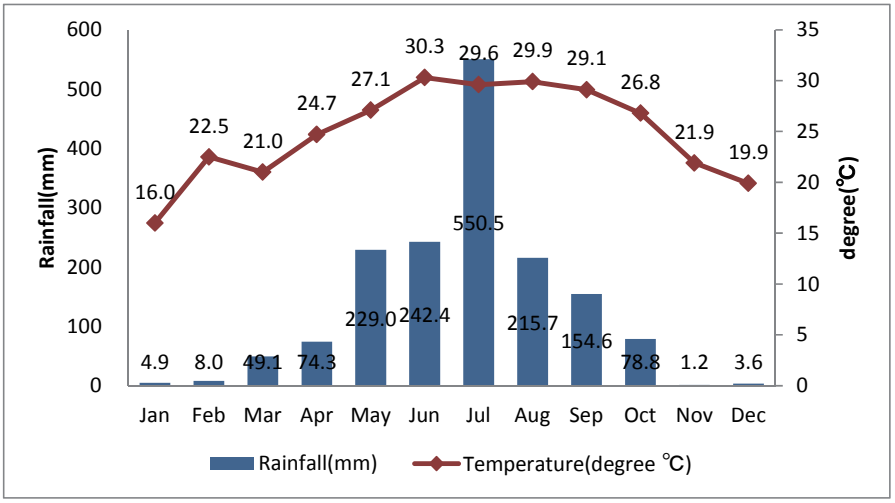
For preservation of natural environment, Vietnam has ratified World Heritage

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.



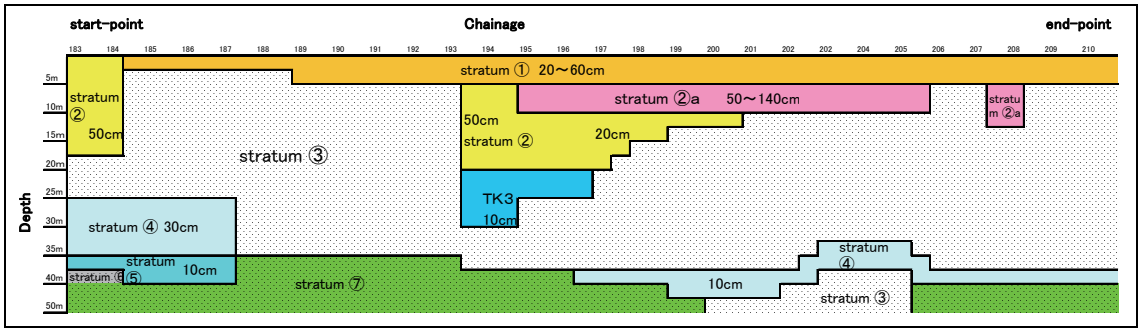
Source : http//www.worldclimate.com/

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.**

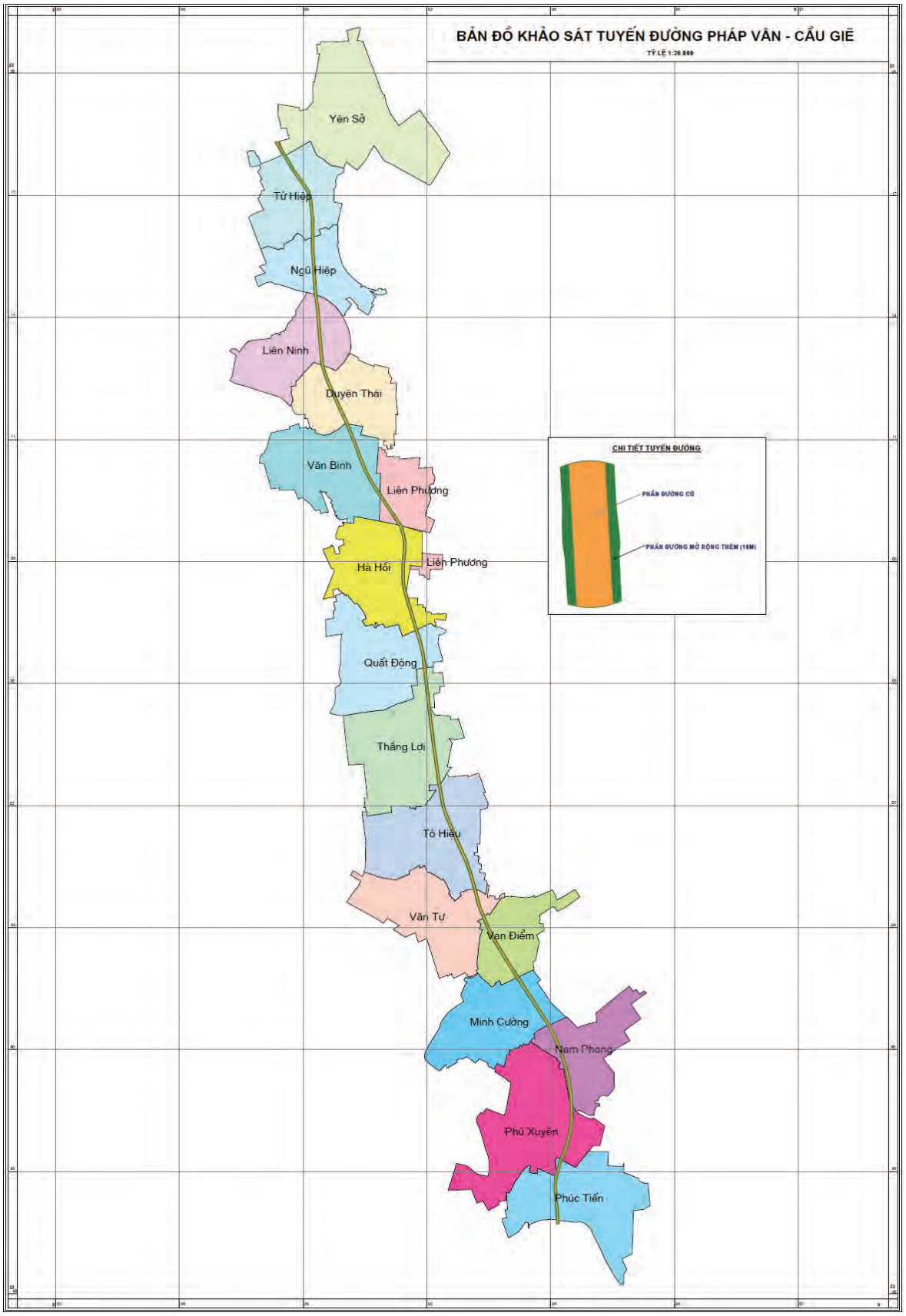


Figure 3.5.4-3 Coverage Commune

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.

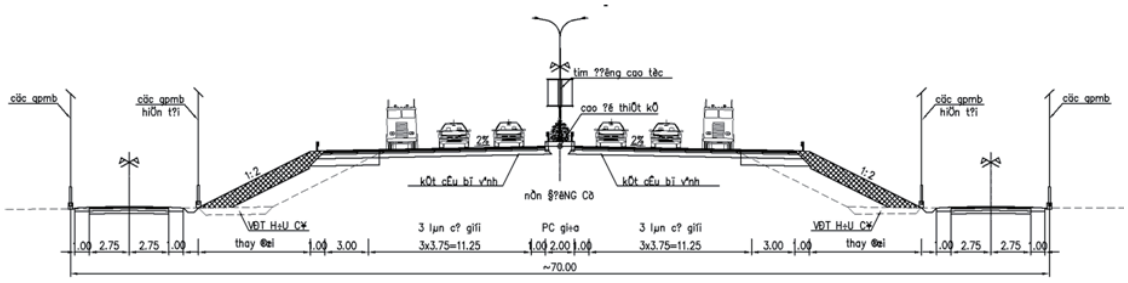


Figure 3.5.4-4 Typical Cross Section of Embankment Section (ROW=70 m)

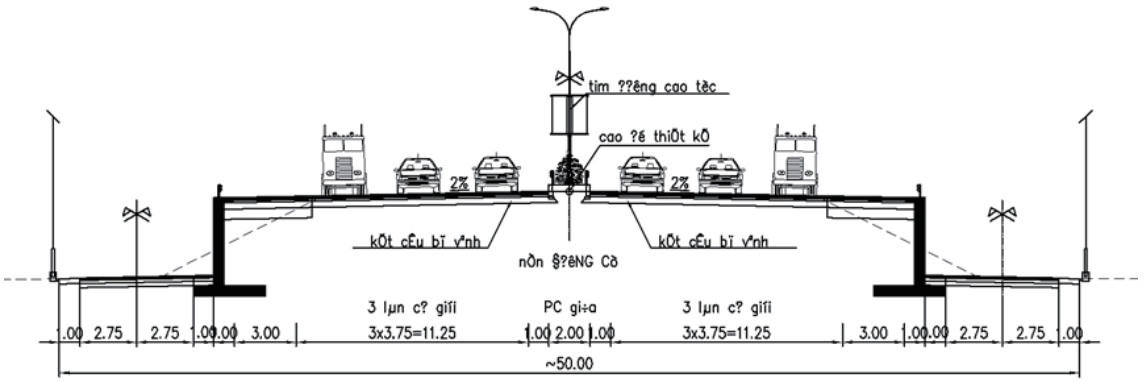


Figure 3.5.4-5 Typical Cross Section of Retaining Wall Section (ROW=50 m)

(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.

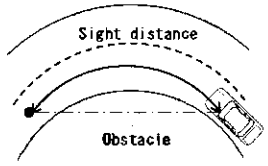


Fig. To ensure sight distance(Plan)

Fig. To ensure sight distance(Longitudinal)

2. Design Standard(Alignment/Sight Distance)

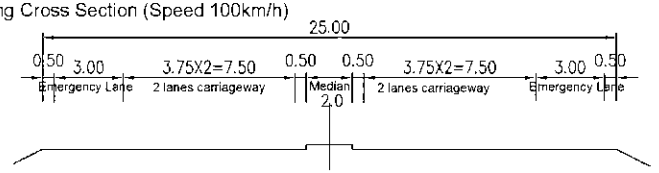
Table-1 Design Standard applied to this note

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

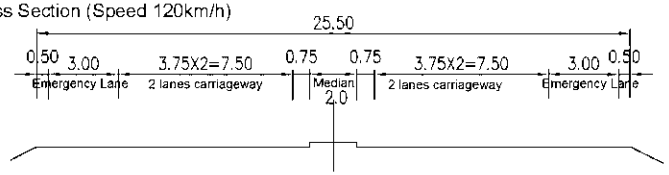
Technical Standards for Expressway/Freeway Main lanes at the connecting portion of Interchange

			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

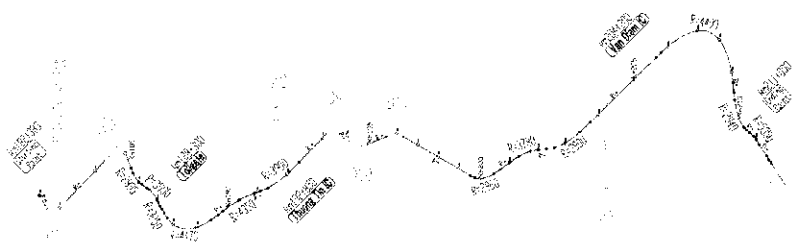
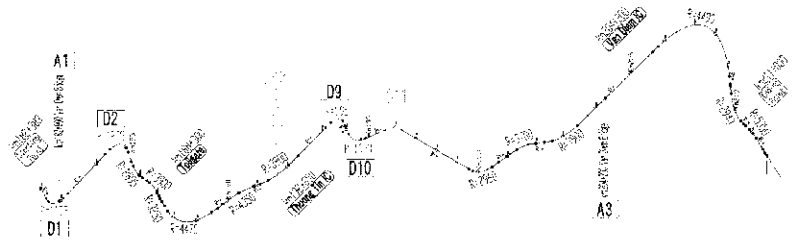
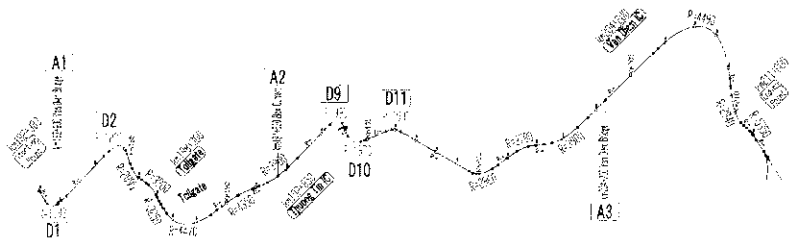
Because the existing PV-CG highway was constructed with Design Speed of 100km/h, there would not be significant problems. However to upgrade existing PV-CG Highway to Expressway with design Speed of 120km/h in full section, in Horizontal Alignment, 5 sections and in Vertical Alignment, 3 sections are 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.

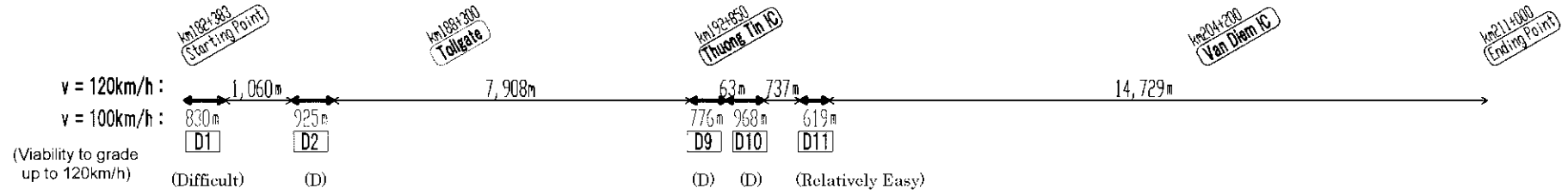
Necessary Activities for upgrading existing 4 lanes PV-CG highway to Expressway with Design Speed of 100km/h and/or 120km/h

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	—

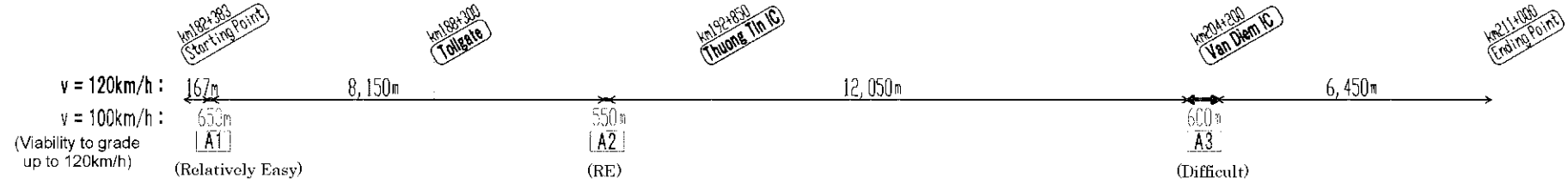
Appendix-2

Design Speed of existing Phap Van-Cau Gie Highway

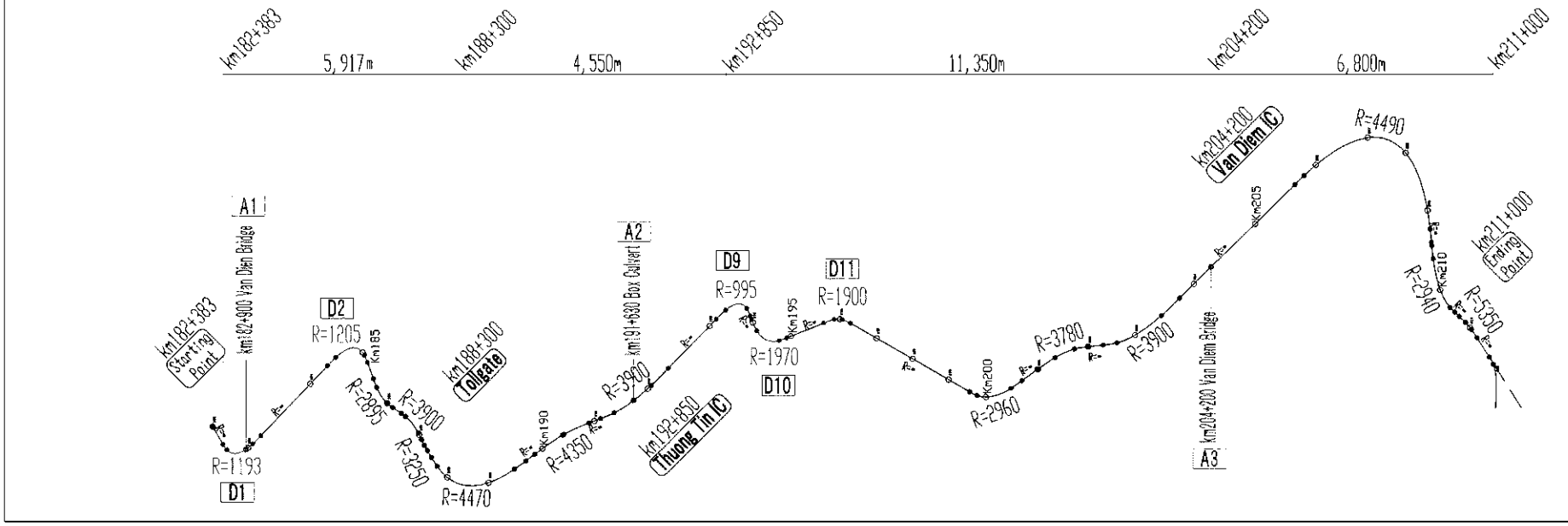
Design Speed corresponding to the existing Horizontal alignment



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



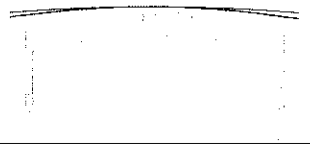
PLAN



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

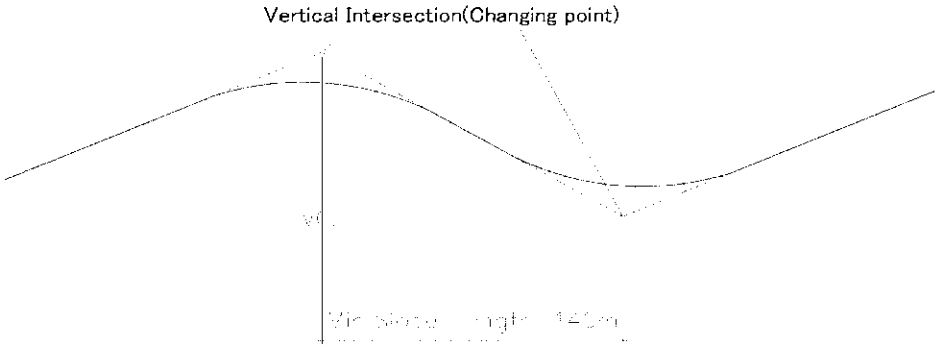


Figure Min.Slope Length

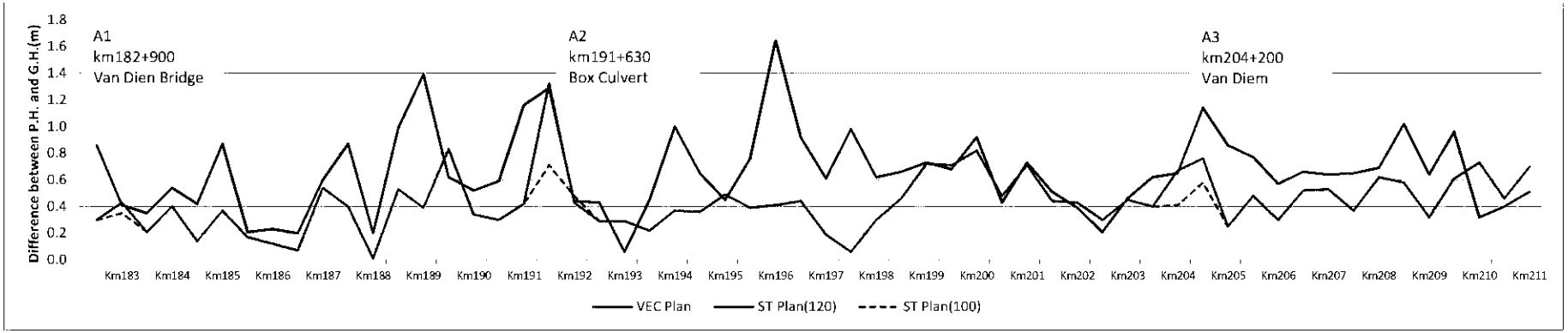
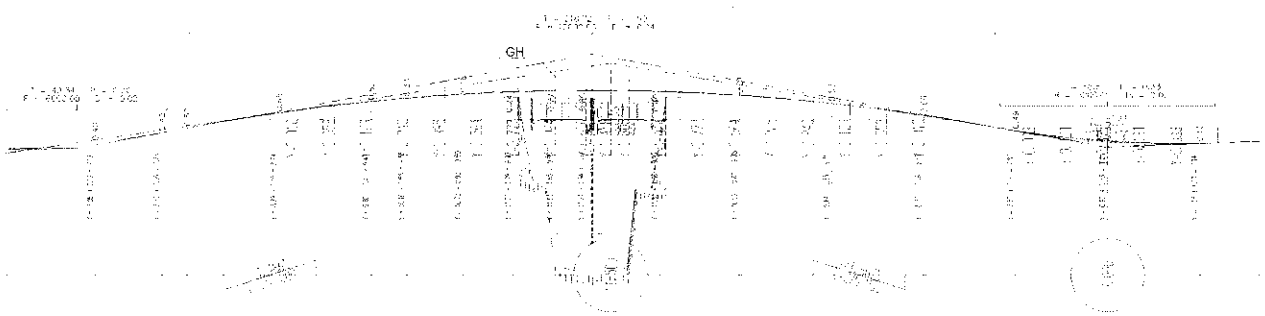


Table Difference between P.H. and G.H.

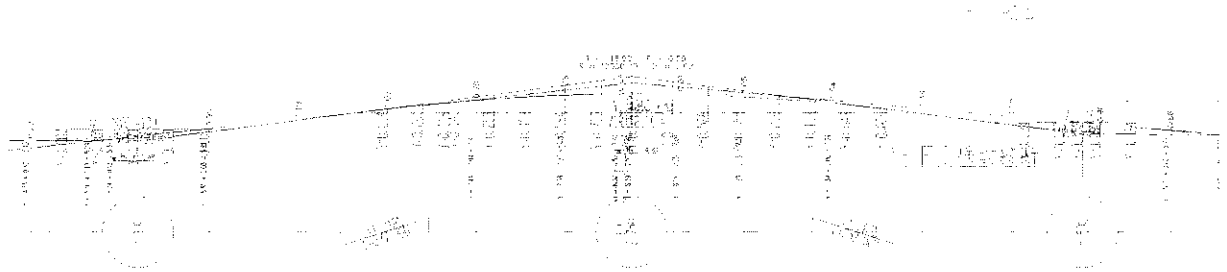
Appendix-5

Attachment-2 Vertical Alignment Improvement

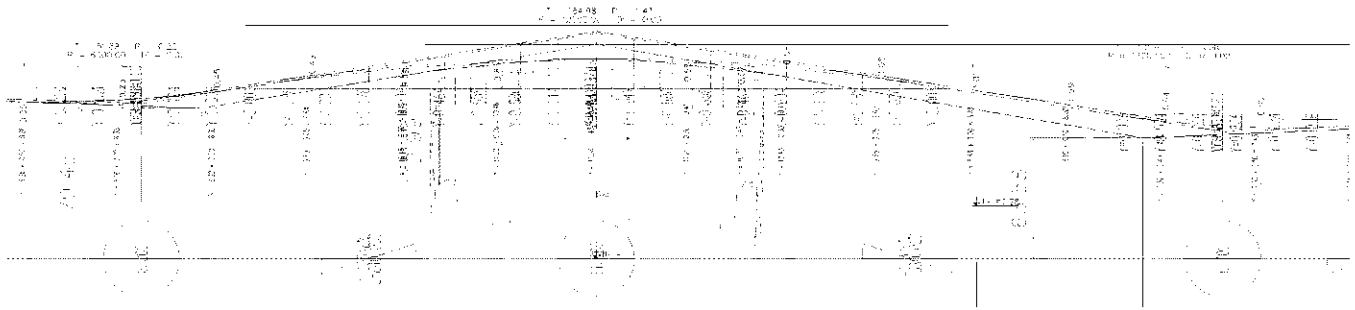
km182+900, in the vicinity of Van Dien Bridge



km191+630, in the vicinity of Box Culvert



km204+200, in the vicinity of Van Diem Interchange

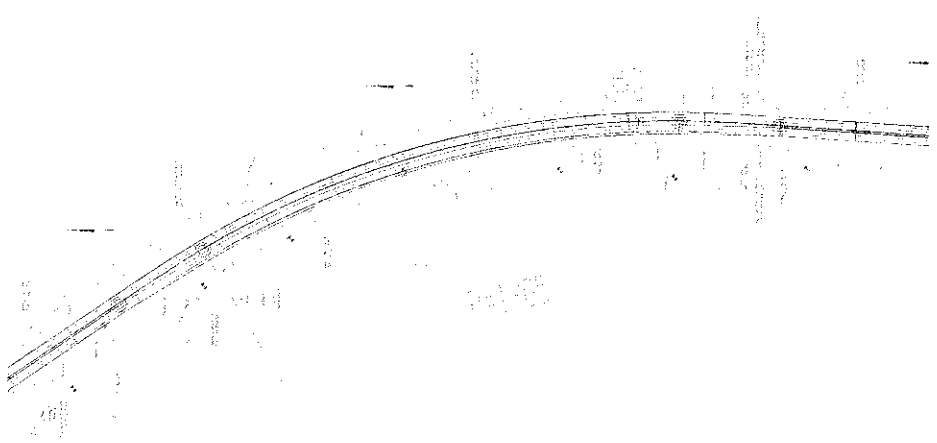


Appendix-6

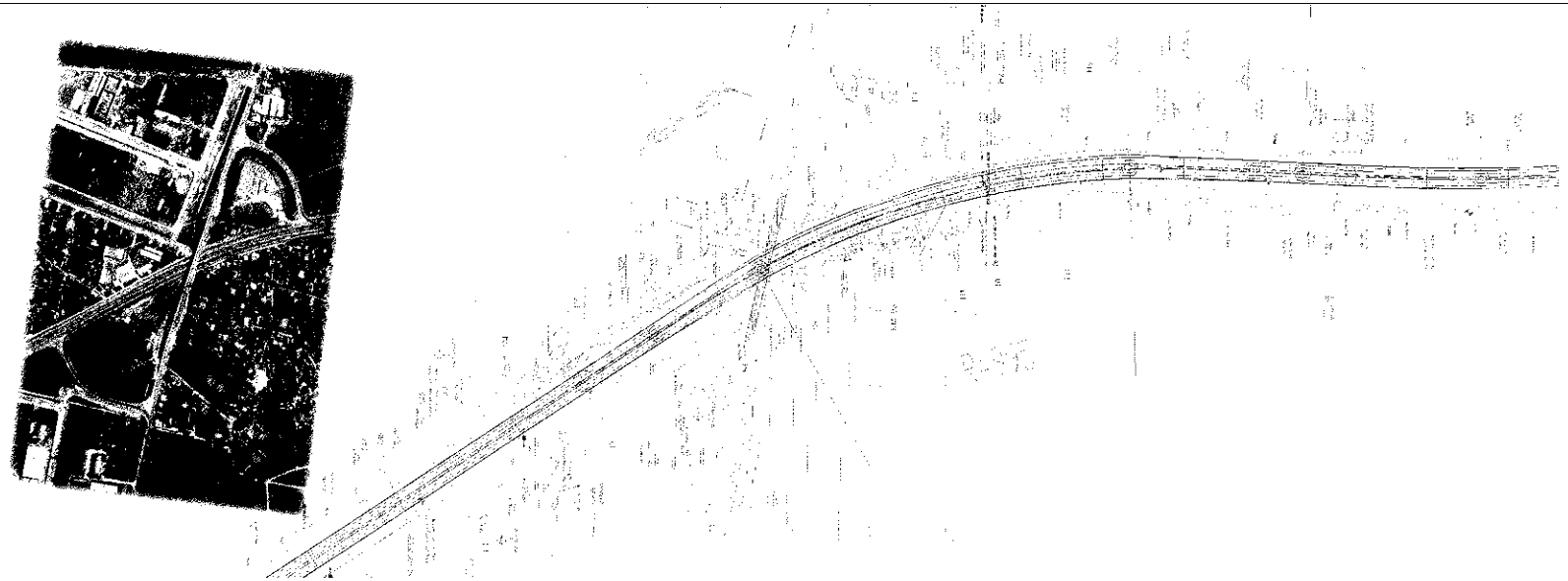
Attachment-3 Horizontal Alignment Improvement—Widening for keeping sight distance

Widening for Curve D1

Widening for Curve D2

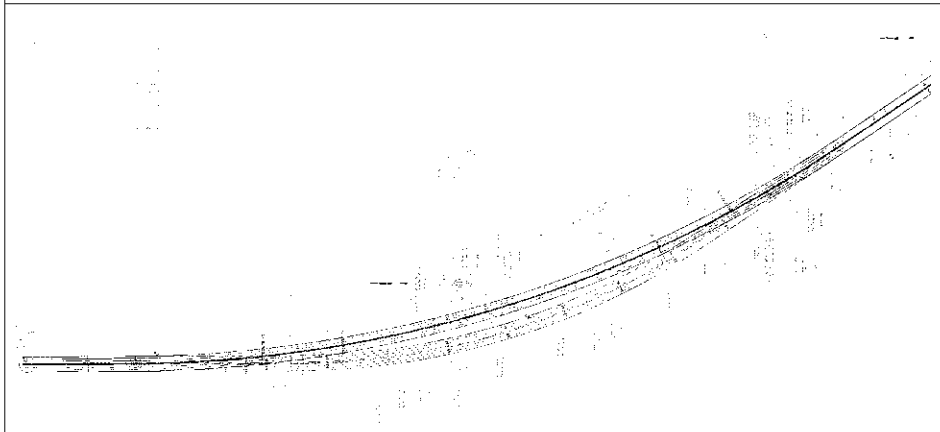


Widening for Curve D9, in the vicinity of Thuong Tin Interchange

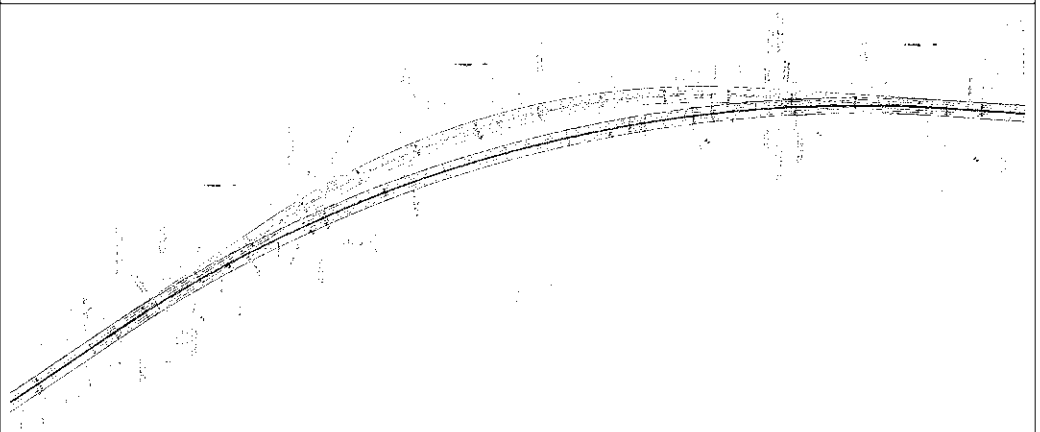


Attachment-4 Horizontal Alignment Improvement—Re-alignment

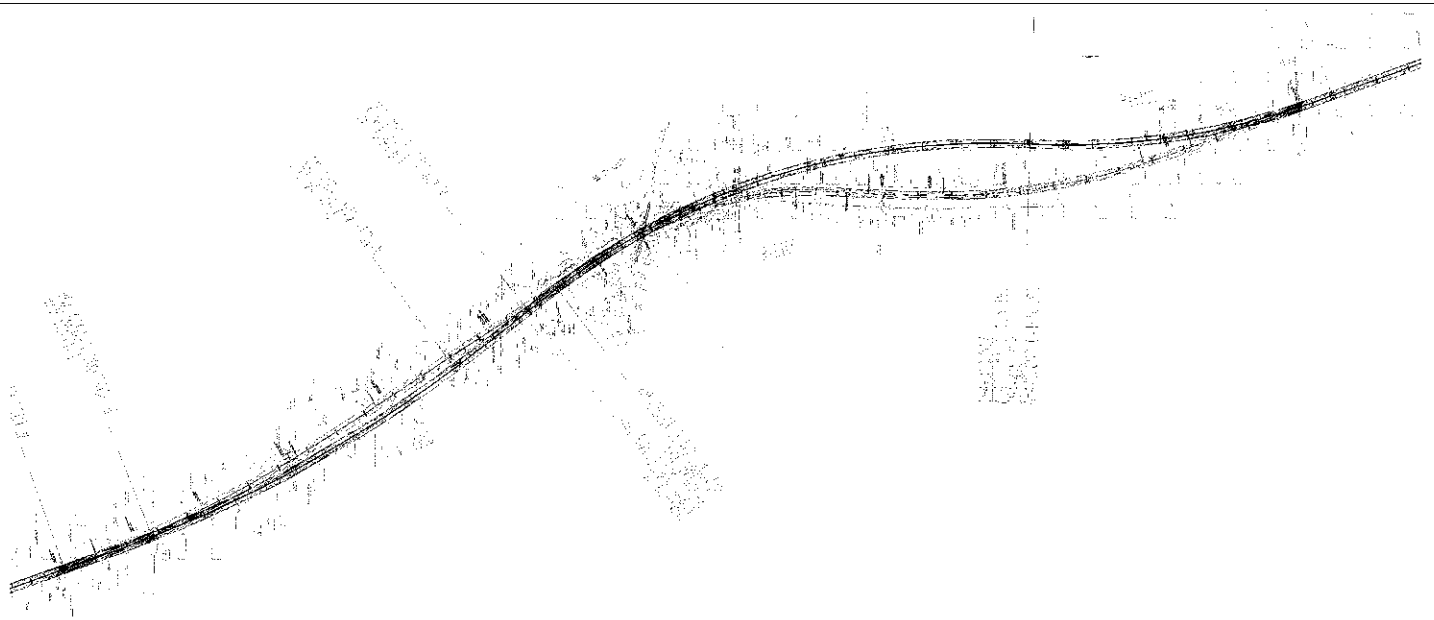
Re-alignment for Curve D1



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)

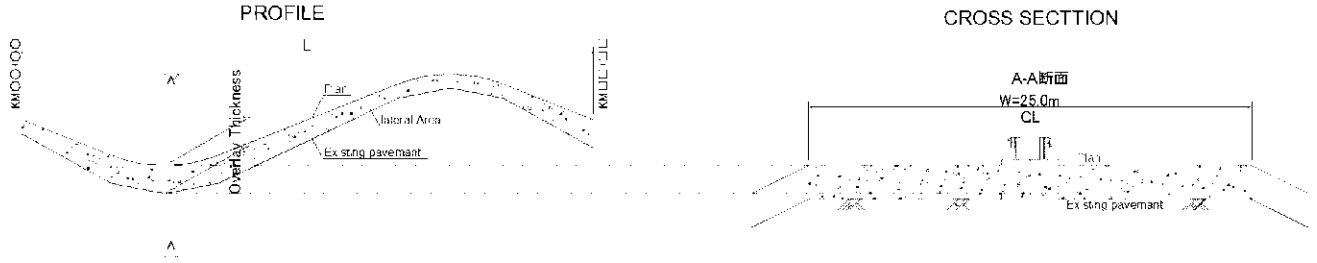
Attachment 4-1 shows the locations of the above 5 sections and sections where Min Slope Length is less than 250m.

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.

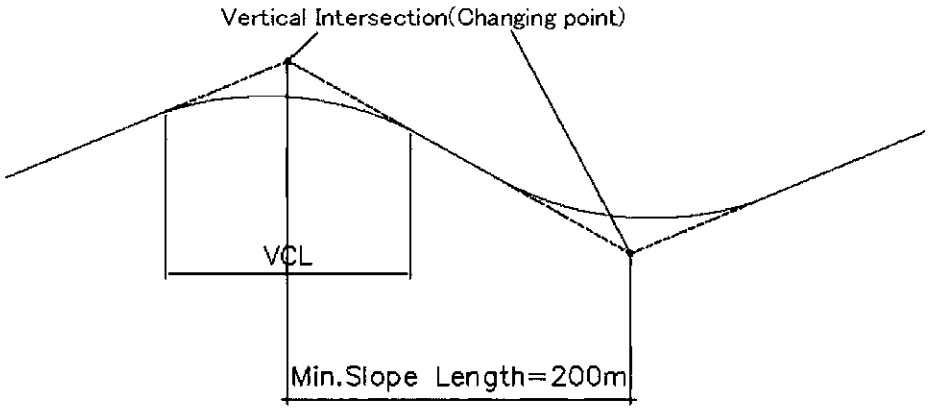


Table Difference between P.H. and G.H.,volume of overlay (Average of the Section)

	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

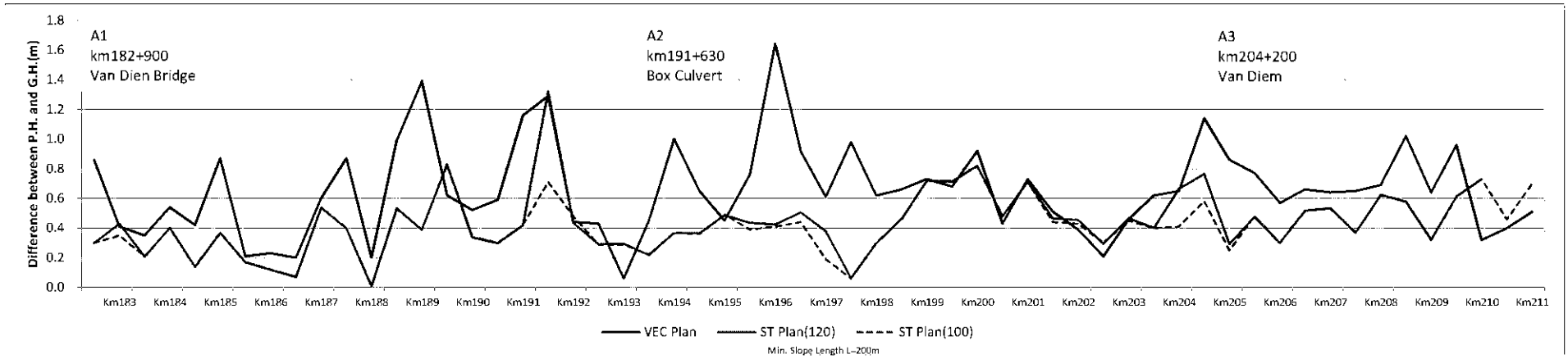


Table Difference between P.H. and G.H.

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.

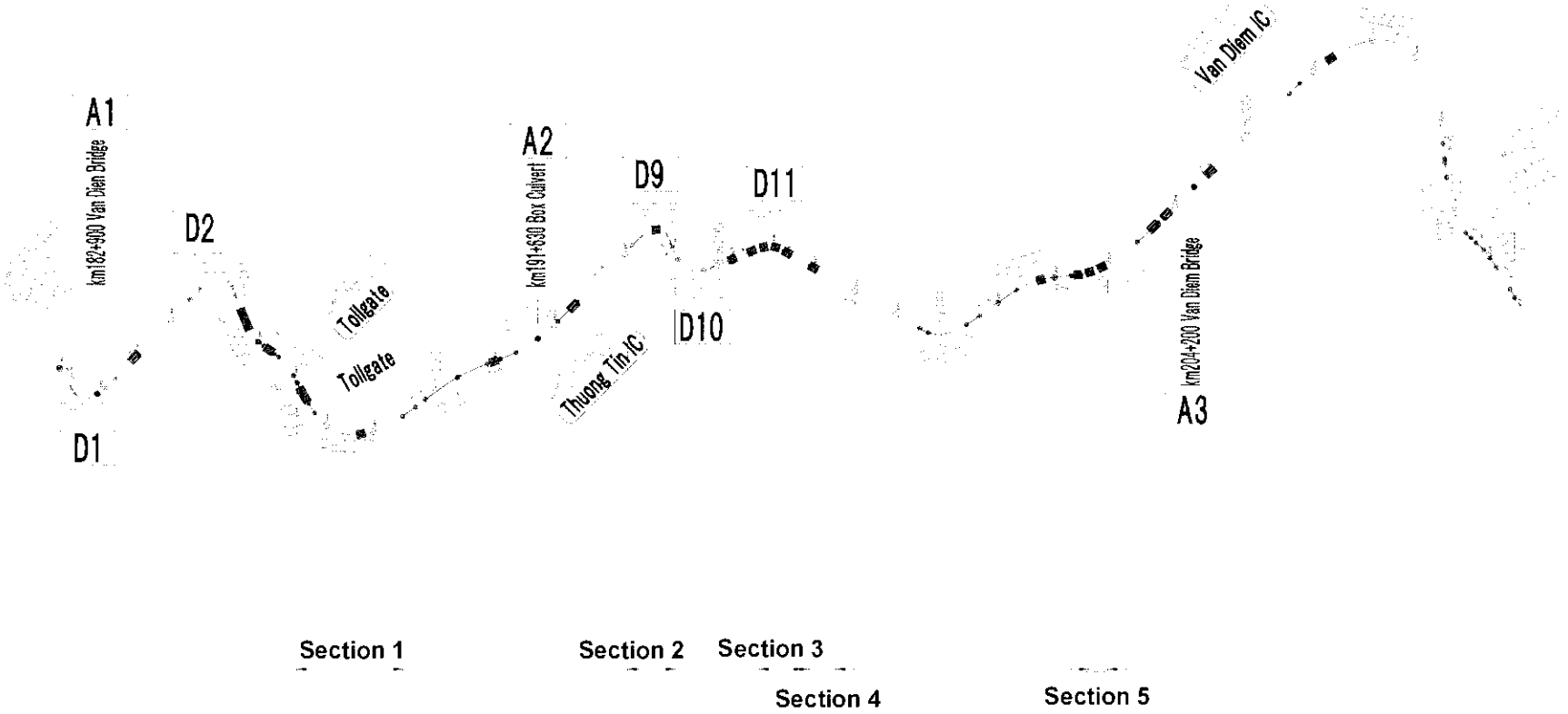
Calculation of height and Comparison of cost on Leveling layer

	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

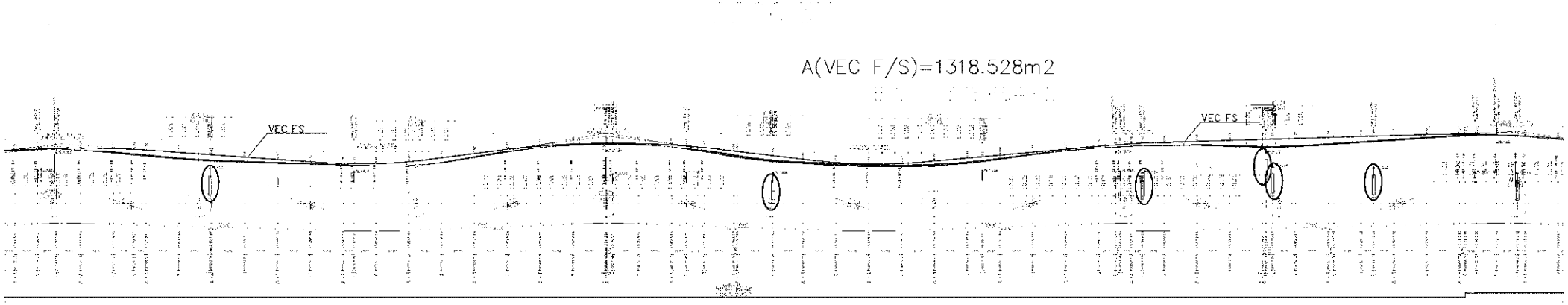
Deployment Status of Min.Slope Length L=200m of ST Plan



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

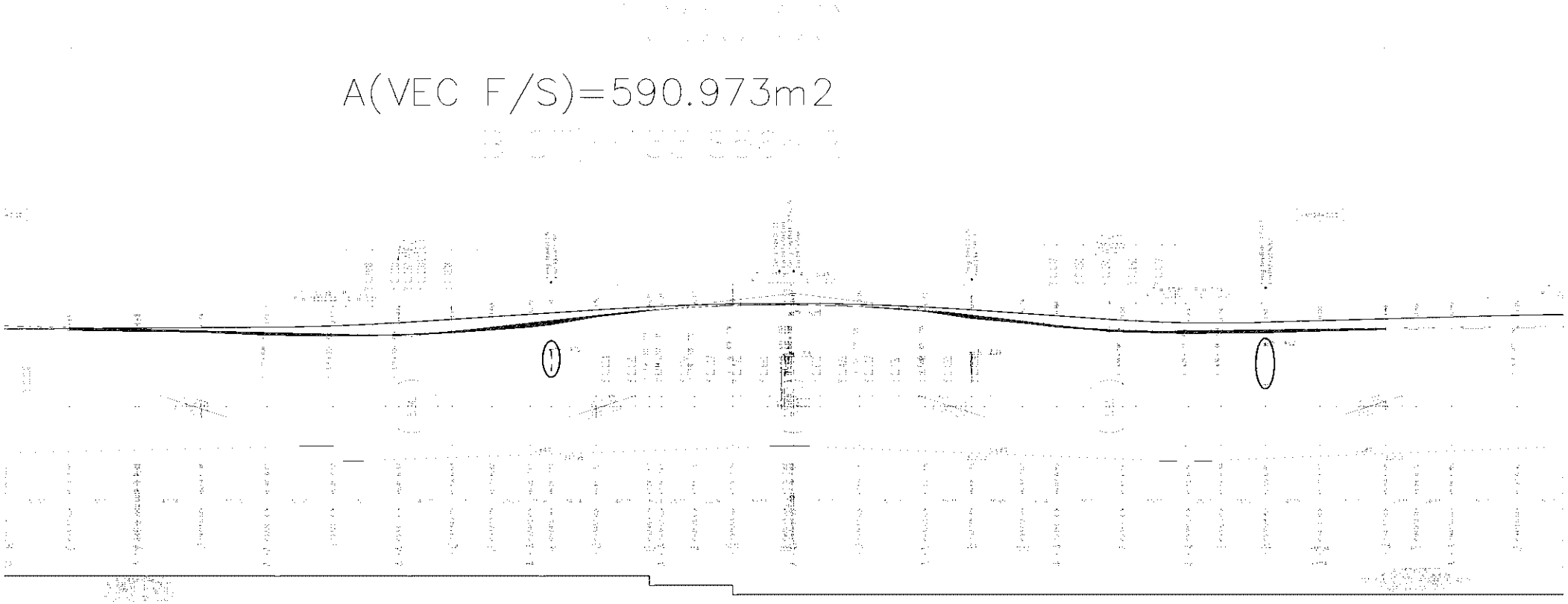
Section 1:KM187+150～KM189+356.37



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

Attachment 4-3

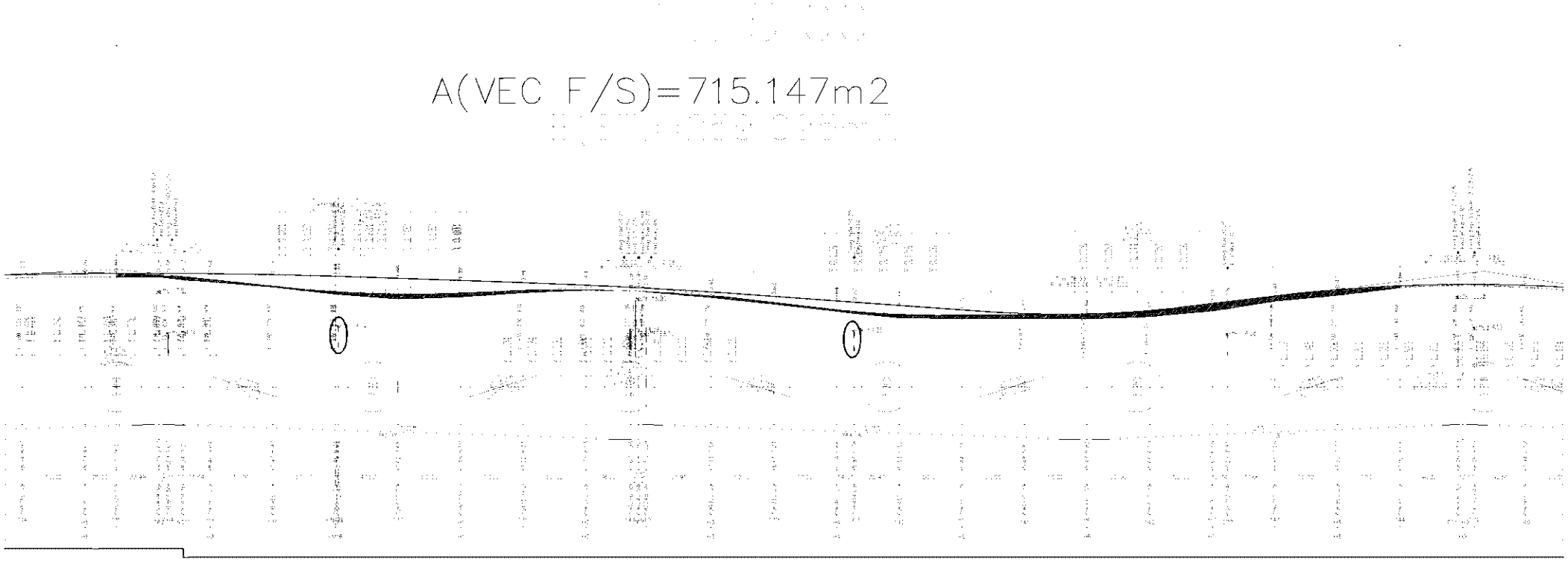
Section 2:KM193+050～KM194+050



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

Attachment 4-4

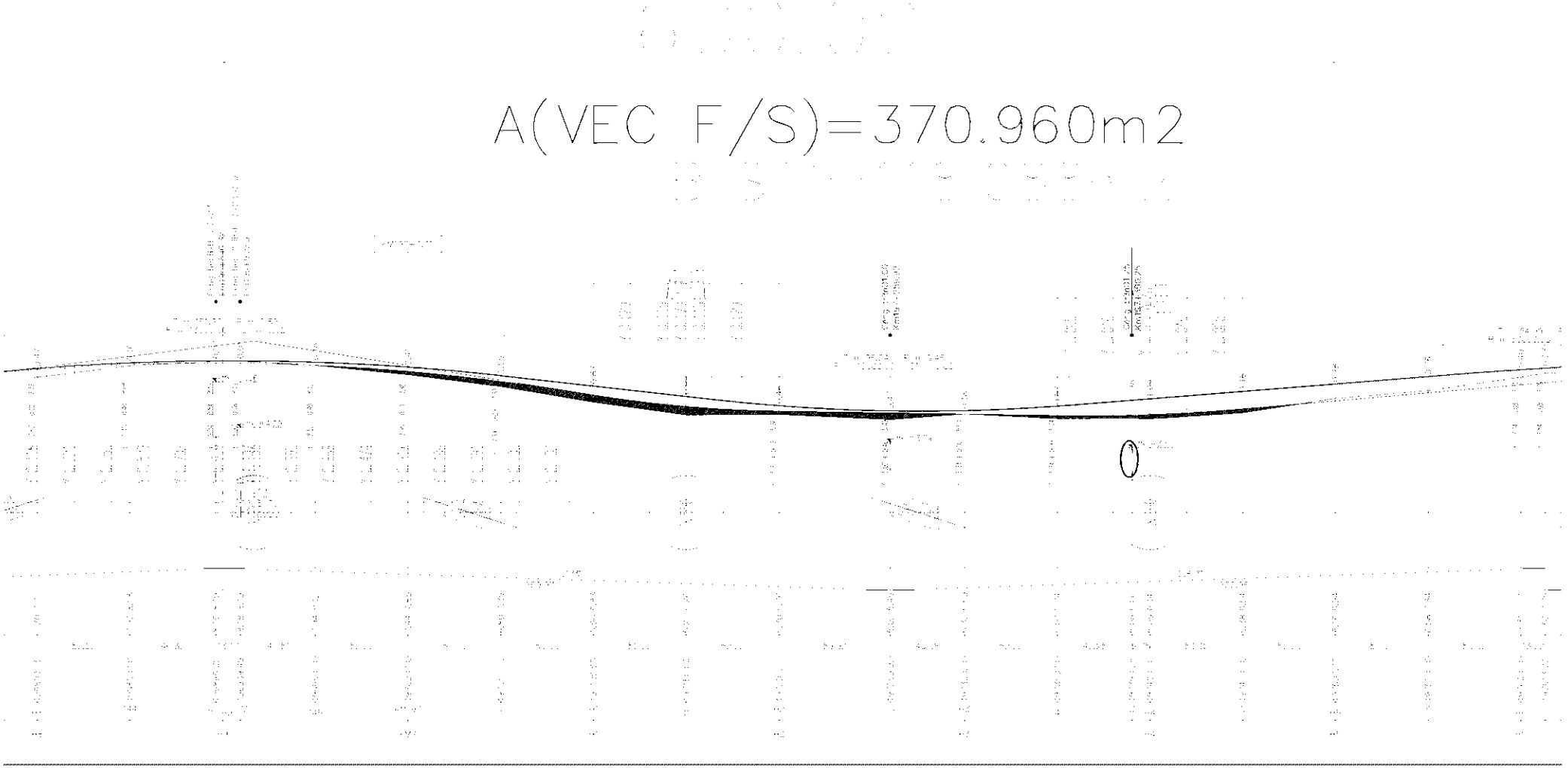
Section 3:KM195+825～KM196+850



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

Attachment 4-5

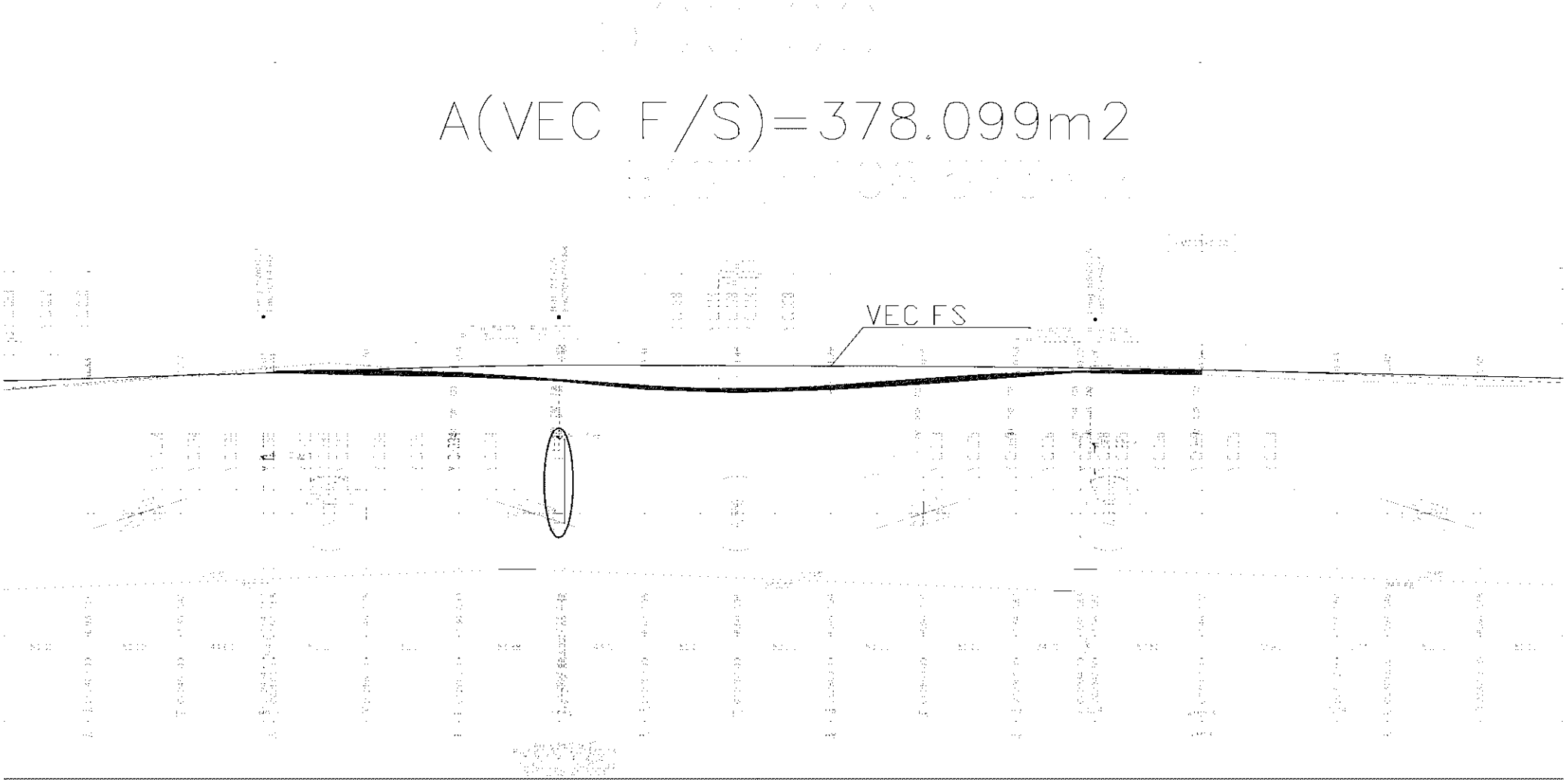
Section 4:KM196+900～KM197+500



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	×	◎

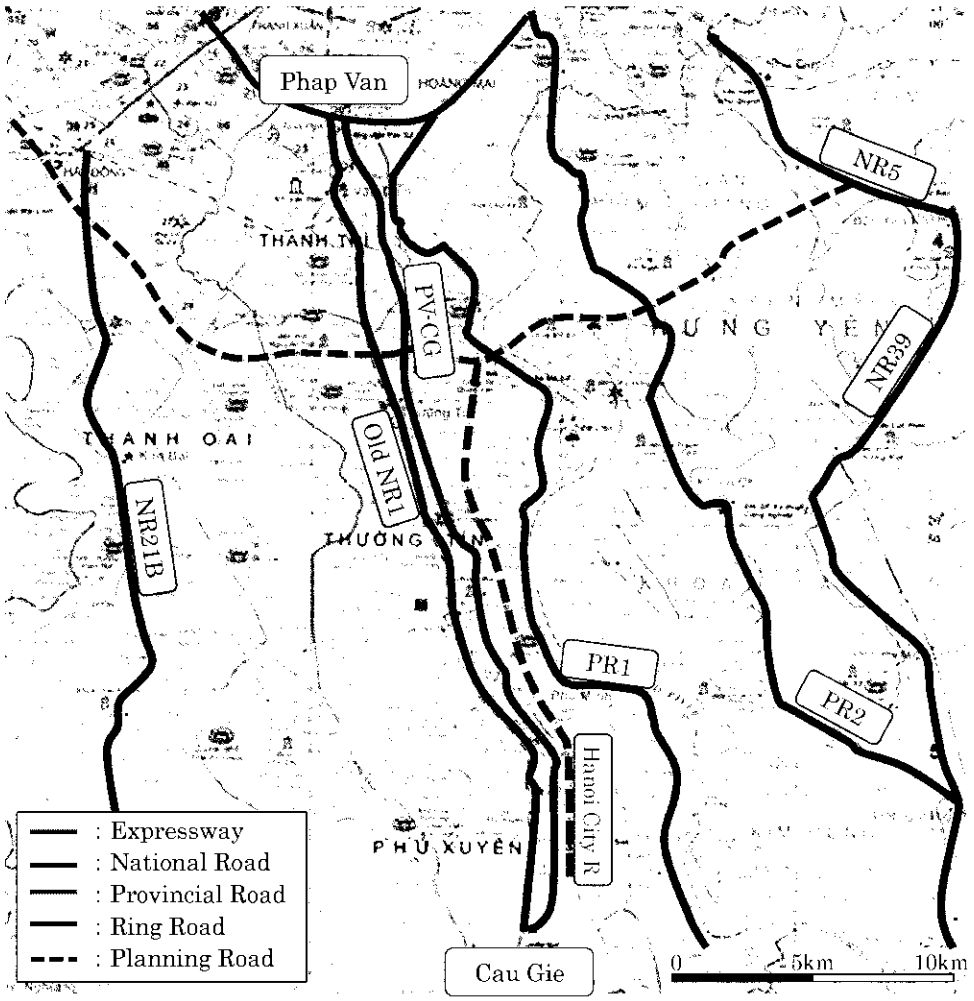


Figure1-1 Roads in surrounding areas

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.

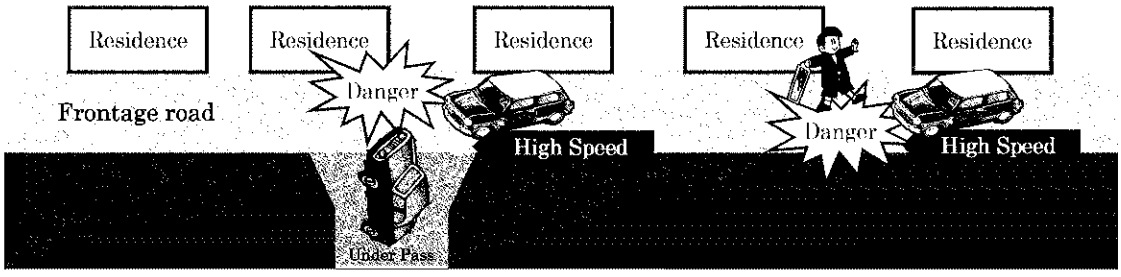


Figure3-1 Image of the frontage road in residential areas

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.

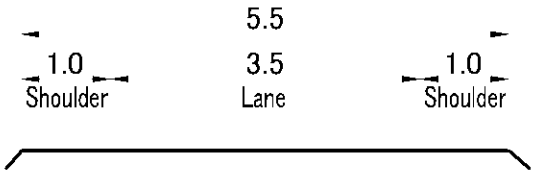


Figure4-1 Cross section of the frontage road

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.

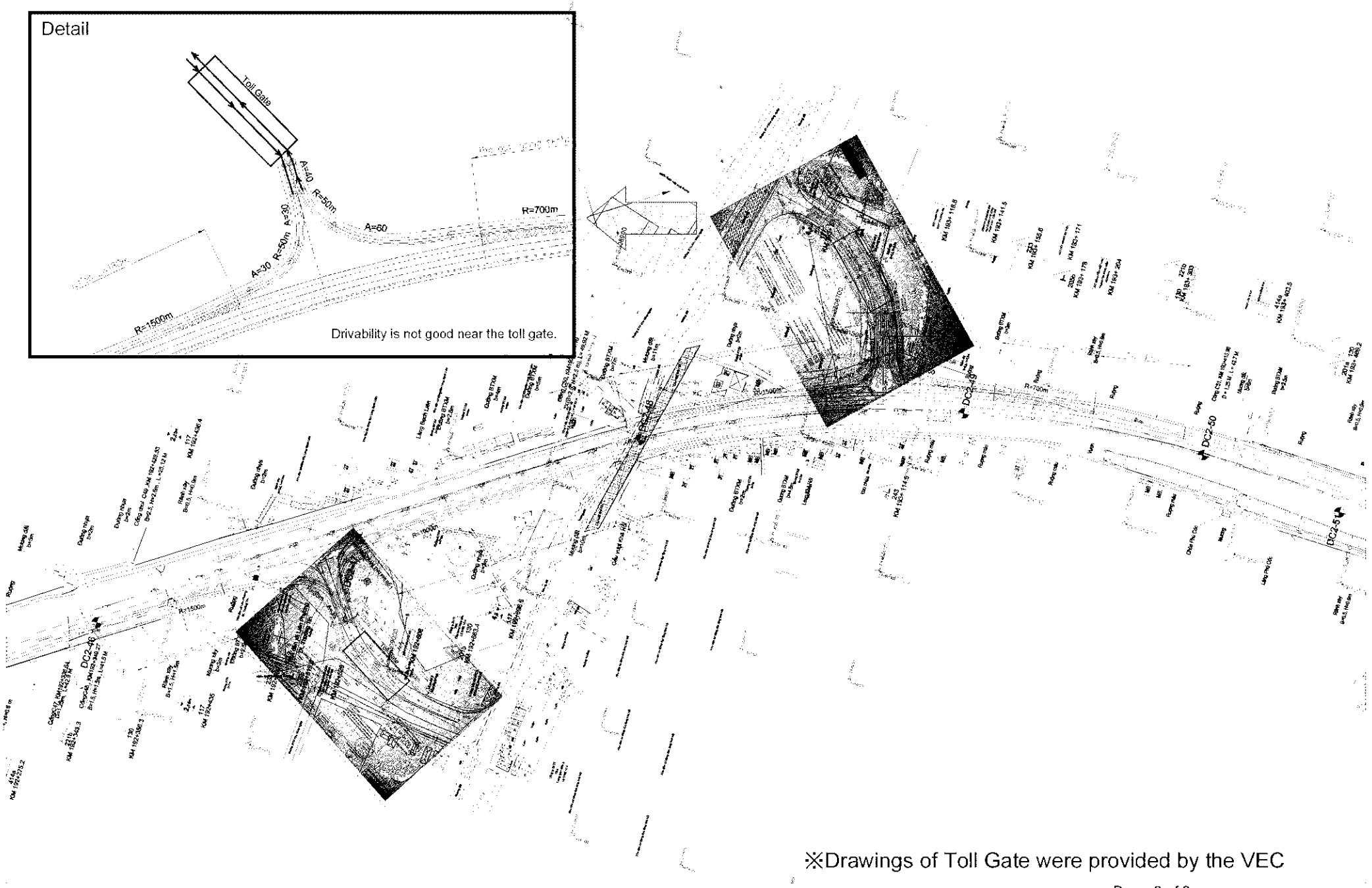
3. Phap Van IC

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

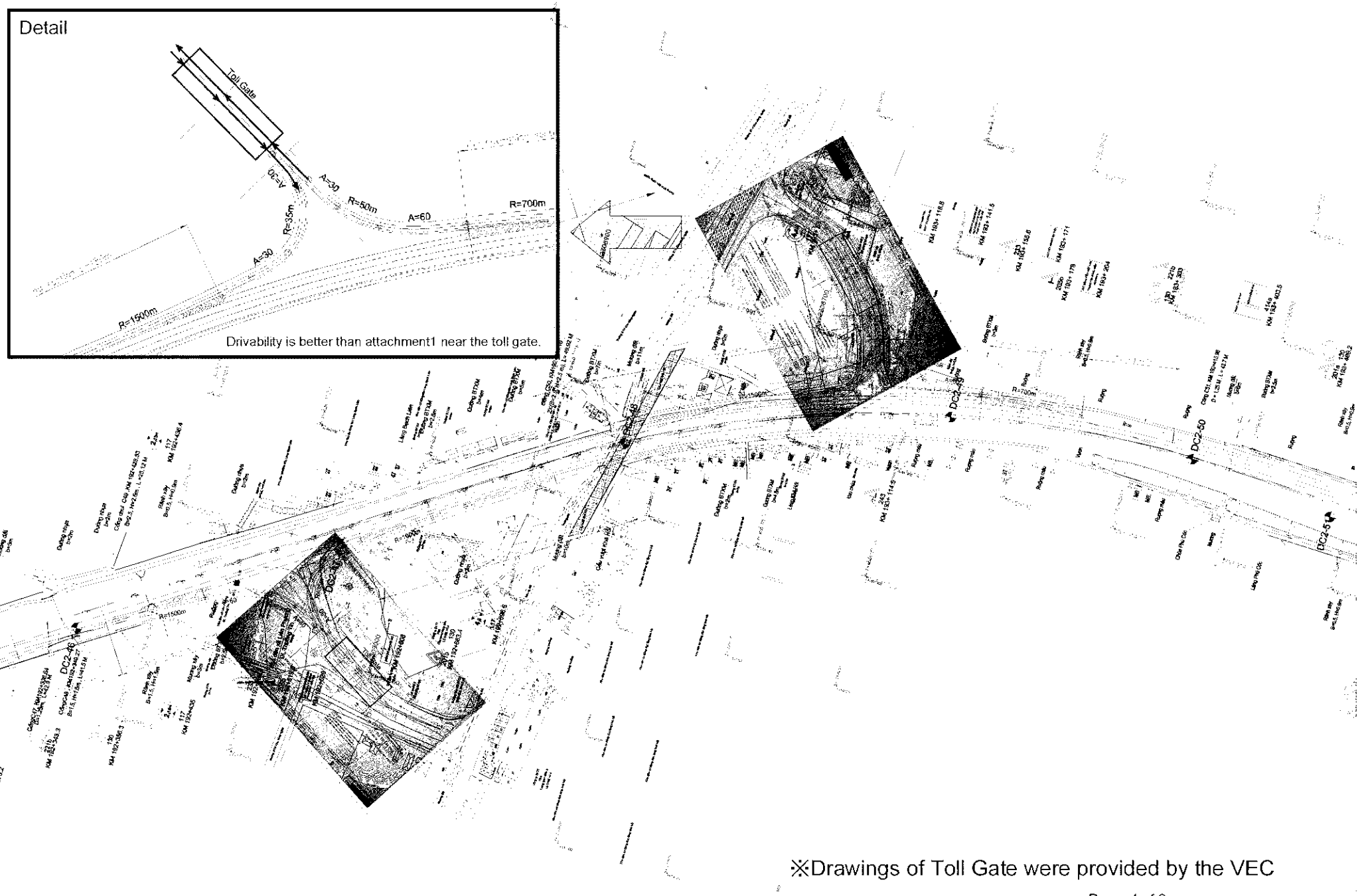
No. of Lane	Number of Attachment	Design Speed	Remark
4-lane	Attachment 5	V_{design}=100km/h	VEC F/S
6-lane	Attachment 6	V_{design}=100km/h	2-lane Rump of Ring Road No.3+ 1lane of other Road = 3 lanes. 3 lanes×2 directions=6 lanes

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



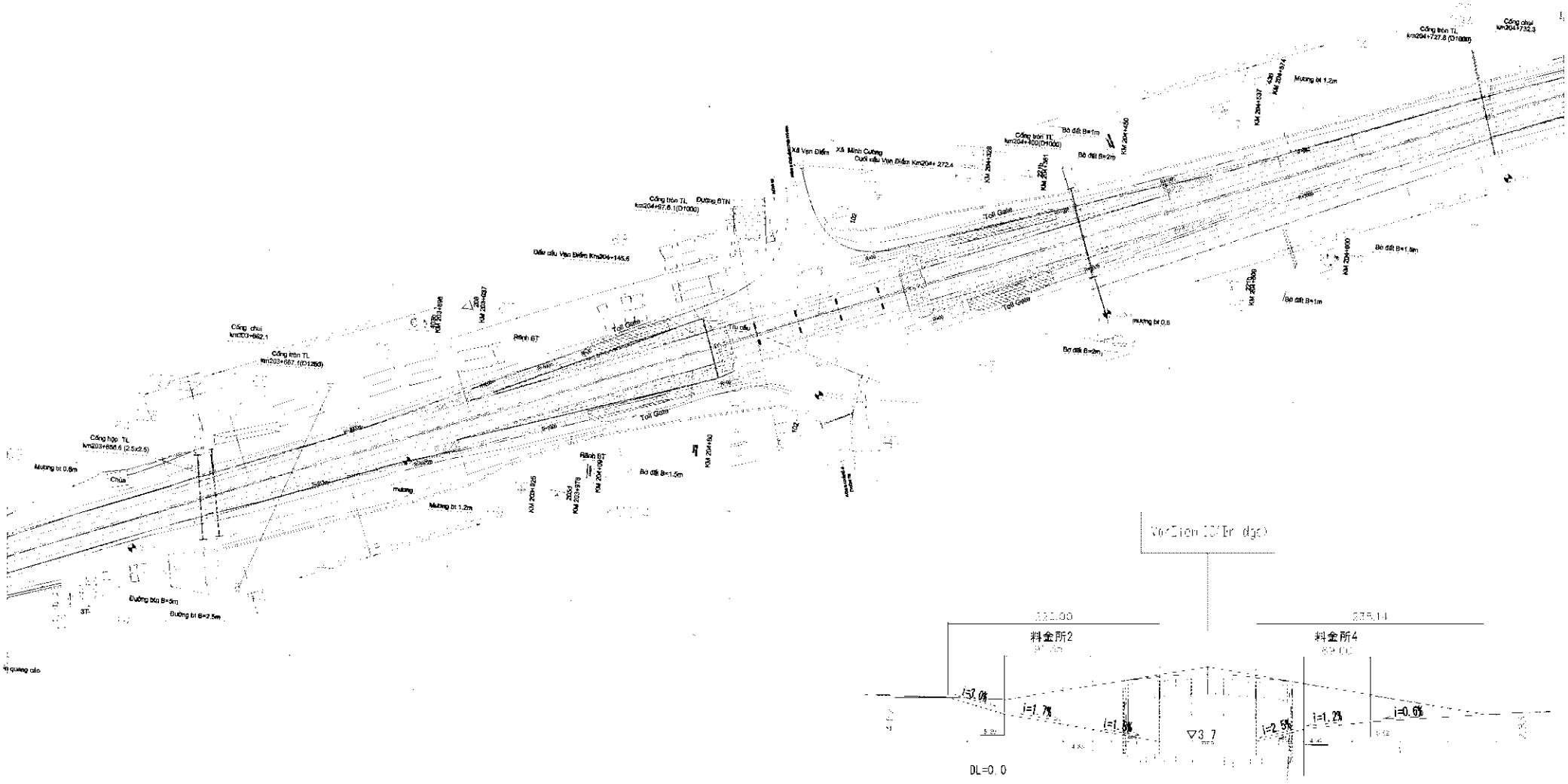
※Drawings of Toll Gate were provided by the VEC

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

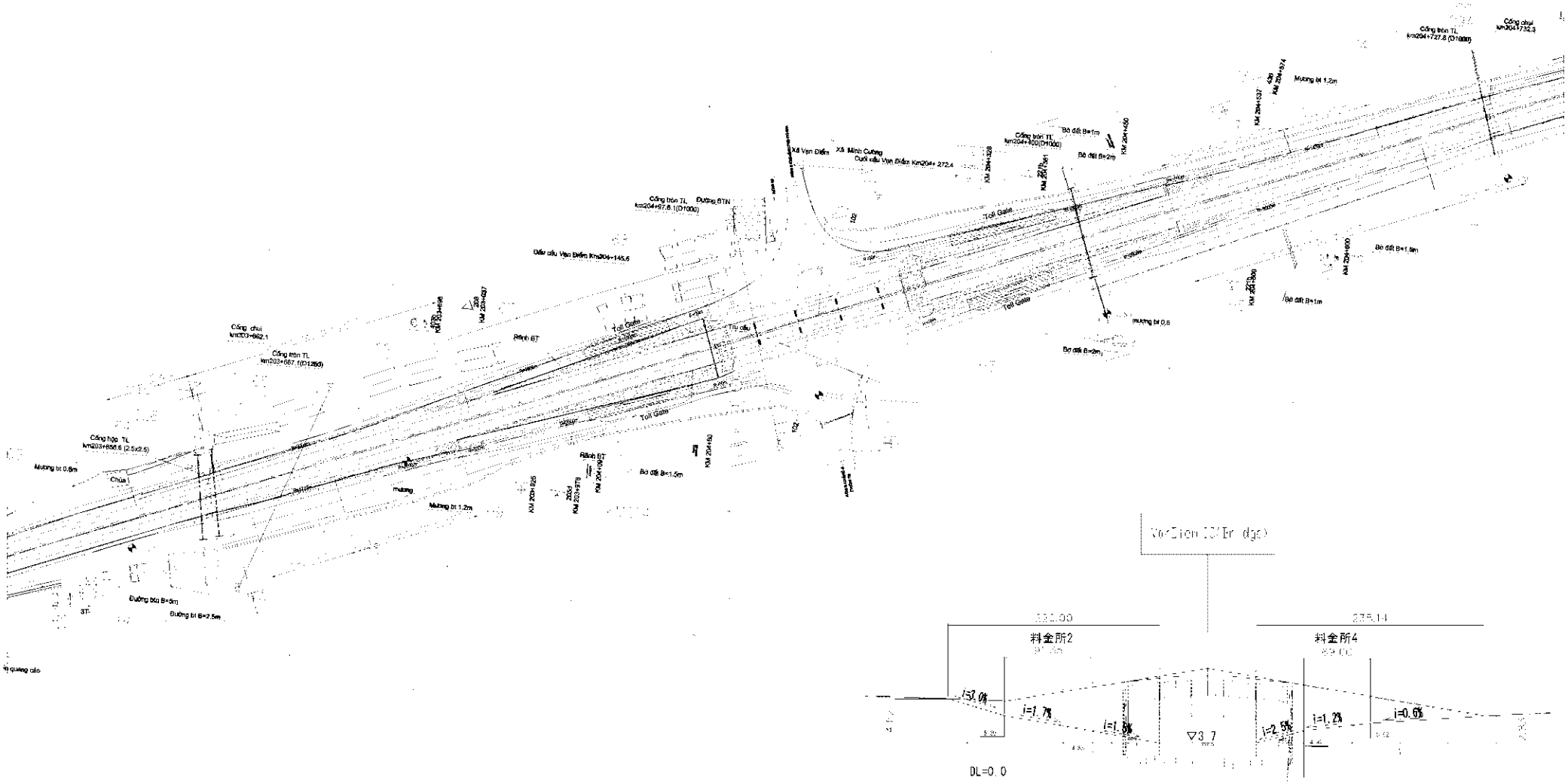


※Drawings of Toll Gate were provided by the VEC

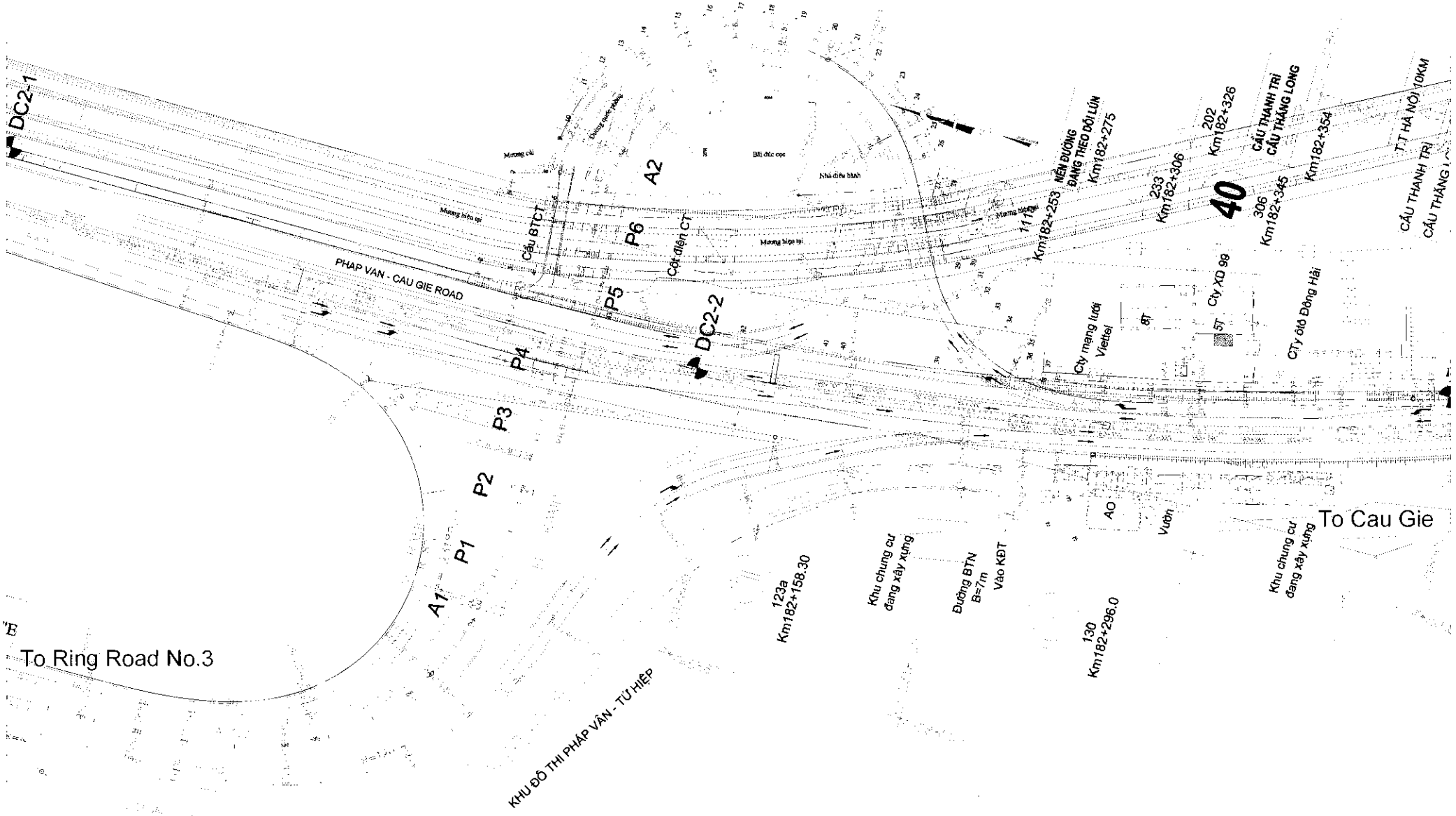
Attachment 3 Van Diem IC V=100km/h



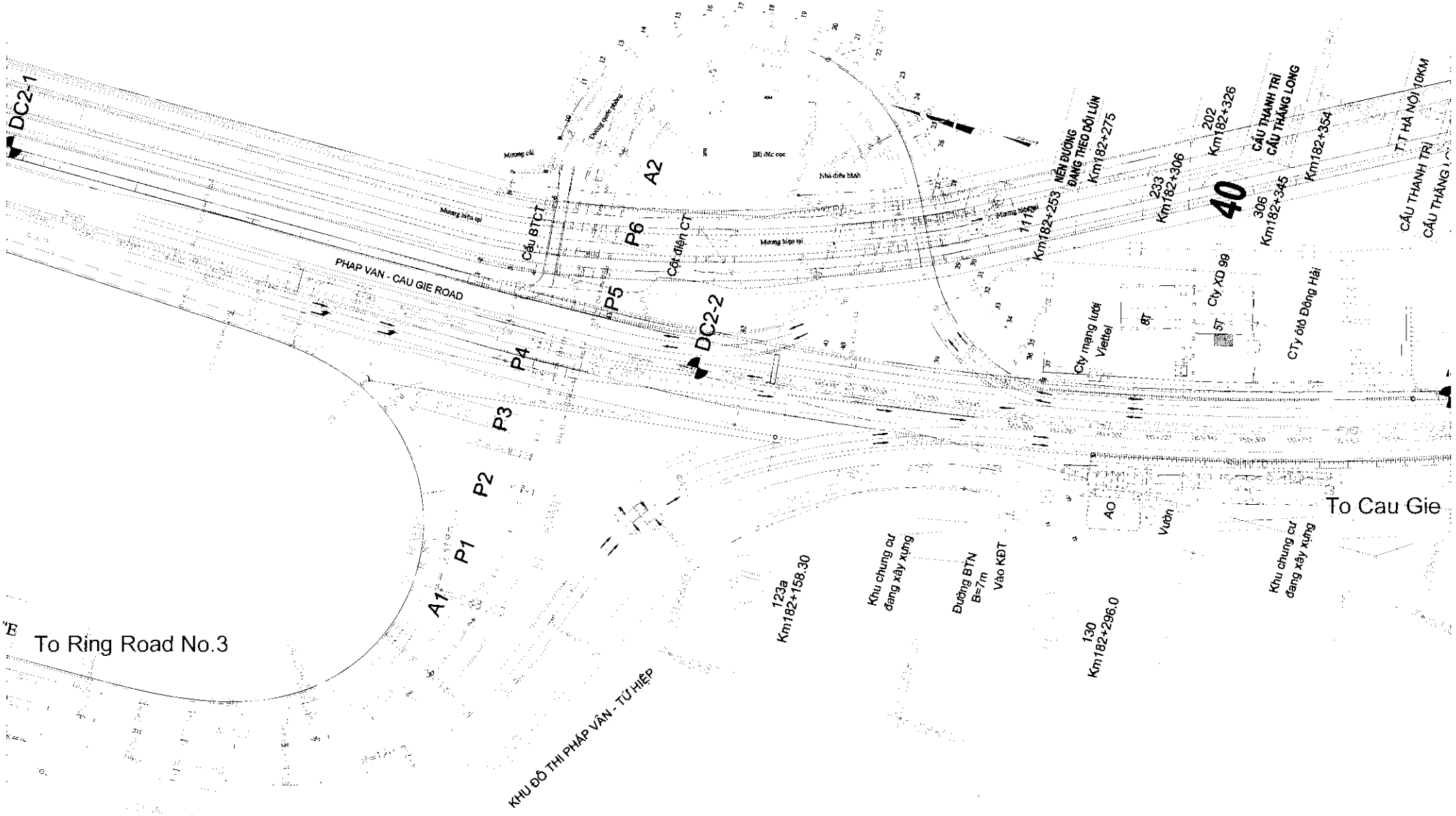
Attachment 4 Van Diem IC V=120km/h



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.

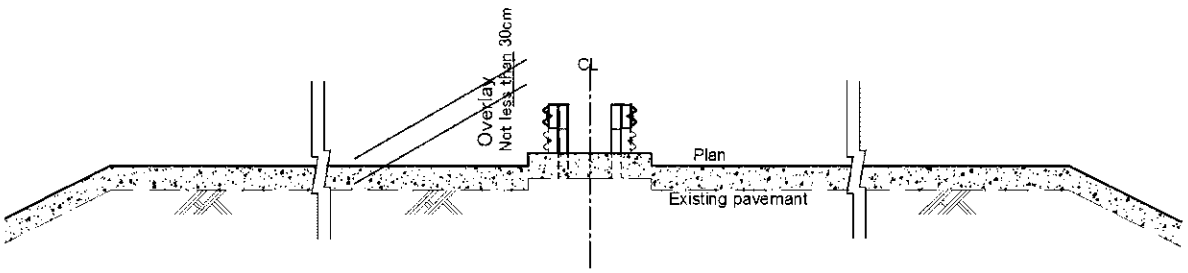


Fig.1 Concept of Overlay

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

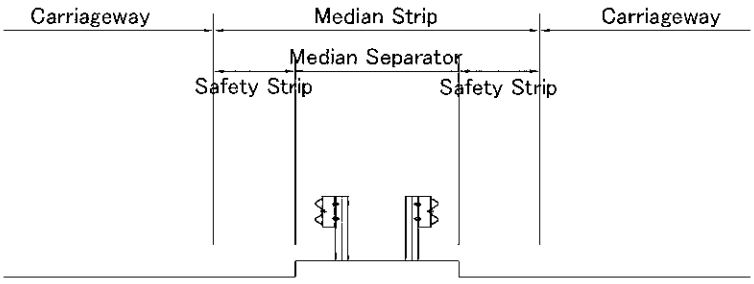


Fig. 2 Definition of terms

(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

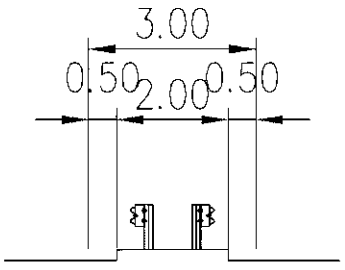
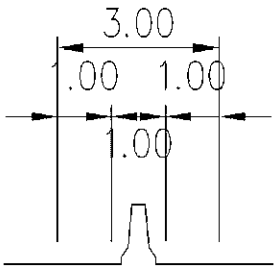
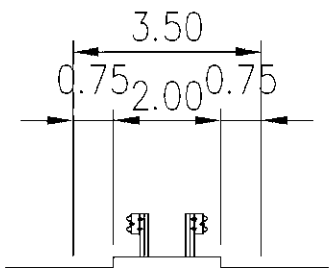
Our proposal is shown in Table-2 below. The widths of median strip are minimized in consideration of the following aspects.

(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

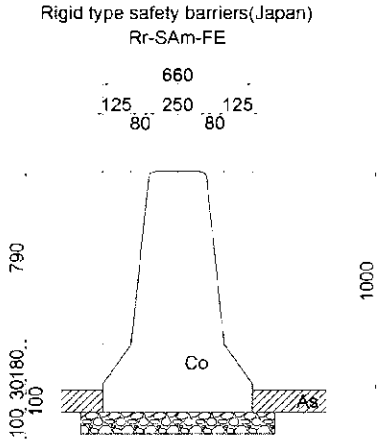
Item of Study	Number of Attachment	Remark
Example of installation of the rigid type concrete safety barrier Typical of sizes and shapes of the rigid type safety barrier (In Japan)	Attachement1	
Width of Median Strip	Attachement2	
Comparison of Safety Barriers	Attachement3	
Comparison on Element of Median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

Attachment 1

Actual implementation of the rigid type safety barrier

HCM Expressway（Ho Chi Minh - Trung Luong section）

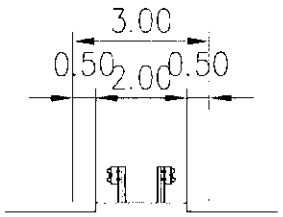
Typical of sizes and shapes of the rigid type safety barrier (In Japan)

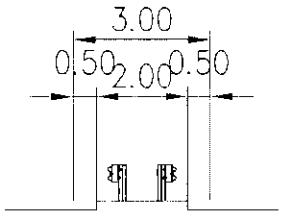
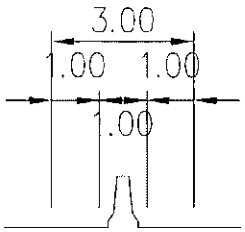
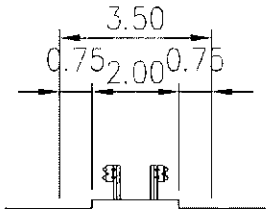
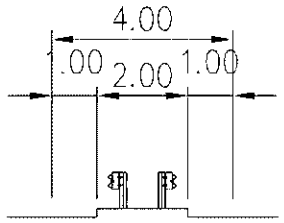
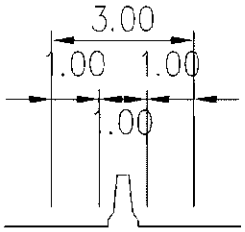
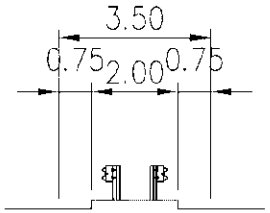


Attachment2

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

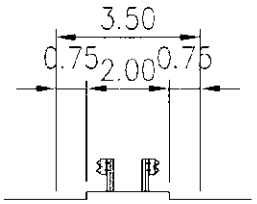
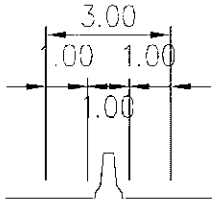
	Category of Road	Sectional profile	120km/h	100km/h	80km/h
Existing	National Road		Standard for National Road ○	Standard for National Road ○	○

	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.

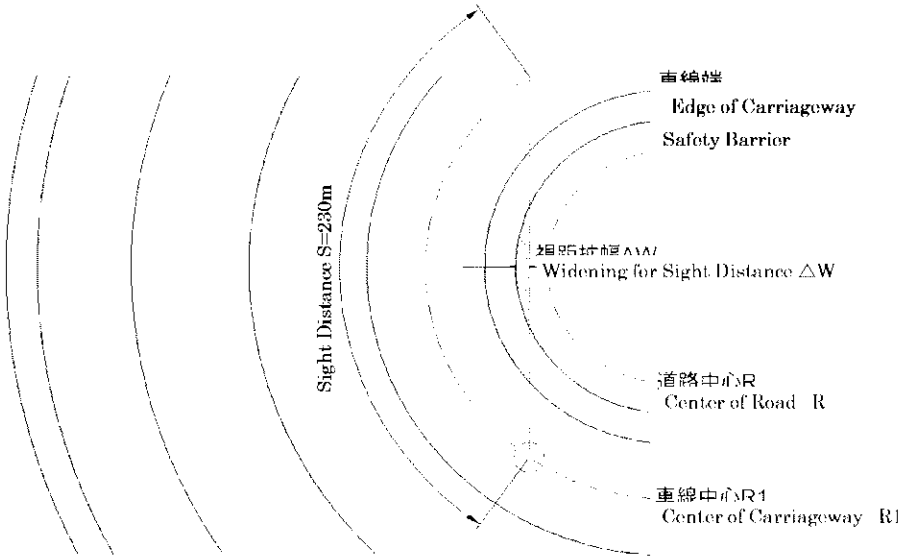
(1) Width

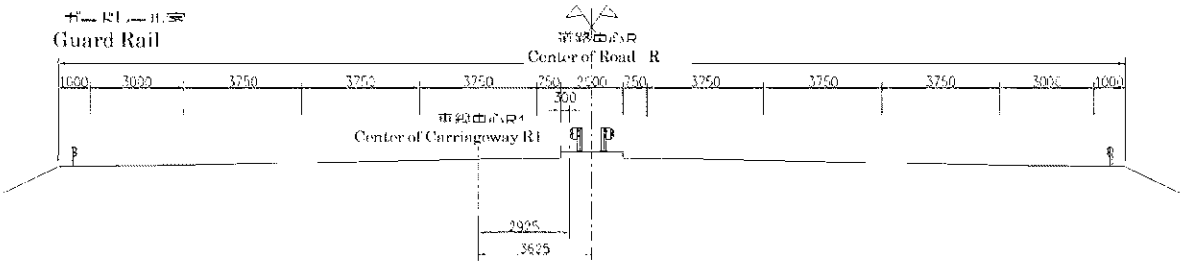
		4-lane carriageway					6-lane carriageway				
		Median strip (m)				Total width of road (m)	Median strip (m)				Total width of road (m)
		Safety strip	Median separator	Safety strip	Total		Safety strip	Median separator	Safety strip	Total	
A	Guard rails	0.75	2.00	0.75	3.50	25.50	1.00	2.00	1.00	4.00	34.50
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

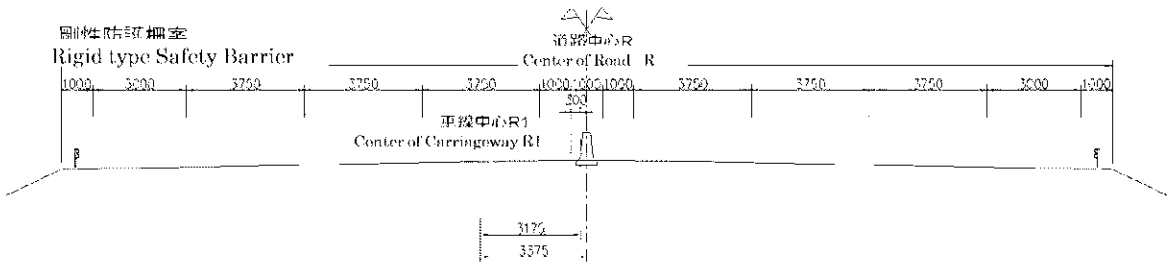
(2) Sight Distance

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

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