SOCIALIST REPUBLIC OF VIETNAM
VIETNAM EXPRESSWAY CORPORATION

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

March 2012


JAPAN INTERNATIONAL COOPERATION AGENCY（JICA）

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Central Nippon Expressway Company Limited
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# 1. Introduction

## 1.1 Background and Objectives of the Study

"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.

In April 2010, Vietnam Expressway Cooperation (VEC) was granted a right by Ministry of Transport (MOT) to implement upgrading existing 4-lane Phap Van-Cau Gie (PV-CG) Highway to Expressway and Widening to 6-lane.(the Project)

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.

The objective of this Study is to formulate a basic infrastructure development plan as proposed by Private Sector proponents; and to verify its validity, effectiveness and efficiency.

## 1.2 Scope of the 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). Phap Van IC at the starting point and Dai Xuyen IC at the ending point are excluded because these two ICs which have been almost completed in the Cau Gie-Ninh Binh Project.

## 1.3 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 1.3-1 Major Works**

| Phase | Contents of Main Works (Length of Road: 29km) |
|---|---|
| Phase 1 | Before Land Acquisition<br>・Detailed Design<br>・Pavement Improvement of existing 4 lanes<br>・Repair of existing road structures (movement joints, cracks etc. )<br>・Road Operation and Maintenance |

| Phase | Contents of Main Works (Length of Road: 29km) |
|---|---|
| Phase 2 | After Land Acquisition<br>・Detailed Design<br>・Construction of frontage roads<br>・Extension of drainage<br>・Road widening to 6 lanes<br>・Extension of culverts for traffic<br>・Counter measures for soft ground<br>・Road Operation and Maintenance |

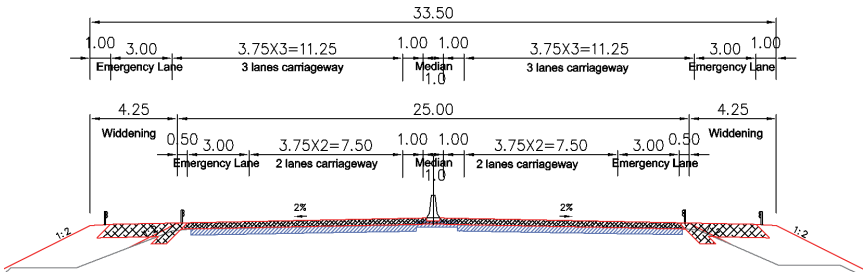



**Figure 1.3-1 Typical Cross Section for 6-lane widening**

Current Project Schedule is shown in the Figure below. 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.)

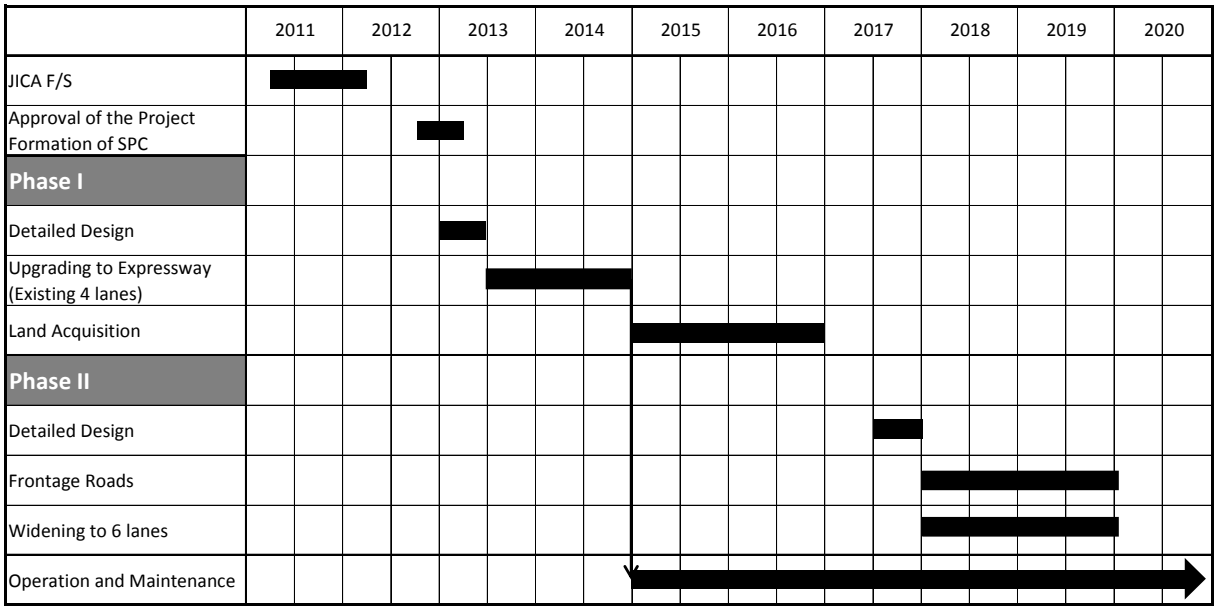



**Figure 1.3-2 Current Project Schedule**

### 1.4 Organization of the Study Team

Organization of study team is shown in Figure 1.4-1

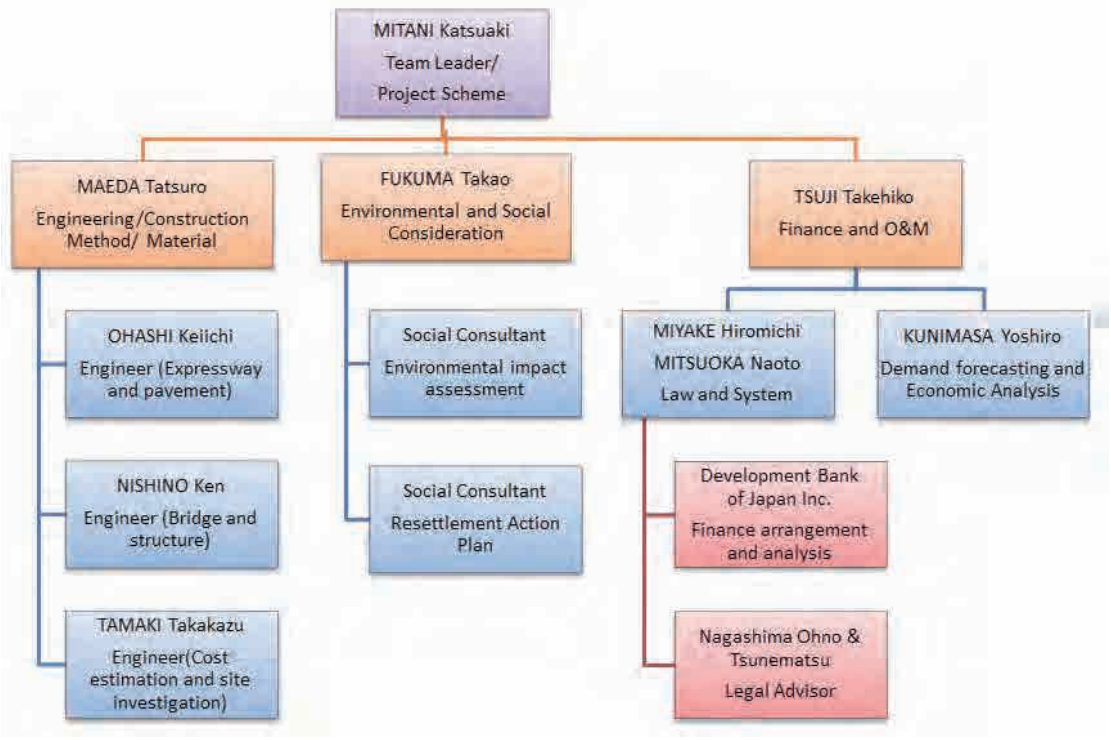



**Figure 1.4-1 Organization of the Study Team**

## 2. Background of the Project

### 2.1 Current Issues and Government Policies for Expressway Sector

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.

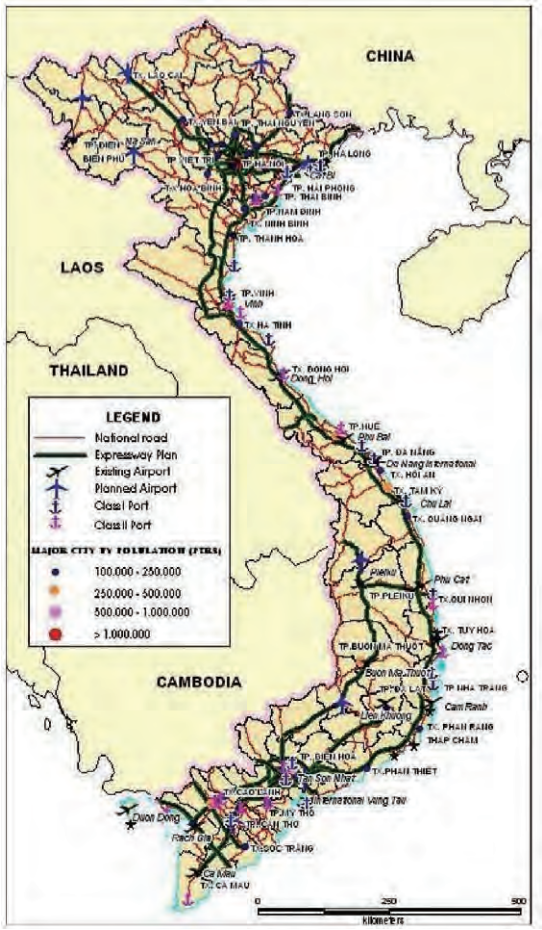
d. Only a very few expressways are understood to be financially viable, based on current toll level and projected traffic volume. The private sector is unlikely to step in, unless the regulations are changed and financial support system, such as a Viability Gap Funding, is established. A large portion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

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

## 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 2.2-1.




| | 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 |
| Sourthern 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 |
| | Ho Chi Minh Ring road No.3 | 83Km | 6-8 |
| Total | | 5,873km | - |

**Figure 2.2-1 Expressway Master Plan** Source: MOT

## 2.3 Capital Requirement for Expressway

Capital Requirement of Expressway is shown in Table below.

**Table 2.3-1 Capital Requirement for Expressway**

| Till 2020 | | After 2020 | |
|---|---|---|---|
| A. Target Construction Length (km): | 1,870 | A. | 4,000 |
| B. Necessary Funds (billion US$): | 19 | 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.

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.

### 2.4 Public-Private Partnership (PPP) Expressway Projects inVietnam

As a sample of Expressway Construction by PPP scheme in Vietnam, an outline of Hanoi-Hai Phong Expressway Project is stated. The project was implemented by the Prime Minister's Decision, dated 29 November 2007, No. 1621/QD-TTg on some pilot mechanisms and policies for the investment of the Hanoi - Hai Phong Expressway Project. Hanoi-Hai Phong Expressway connects Hanoi Ring Road No.3～Hung Yen～Hai Duong～Hai Phong total length of which is 105.5km and project cost of which is 1,722million USD. The Project company is VIDIFI (Vietnam Infrastructure Development and Finance Investment Joint Stock Company) with BOT franchise period of 35 years. Equity is 25 million USD and Debt is 1,472 million USD and Shareholder is Vietnam Development Bank (VDB) and others.

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

#### 2.5.1 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.

#### 2.5.2 Toll Collection

Currently, there is no regulation or law concerning toll collection for expressways in Vietnam. 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. Toll rate for passenger car is 1,000VND/trip. 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.

#### 2.5.3 Legal and Financial Constraints

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.

(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.[1]

(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. Currency depreciation of Vietnam Dong against Japanese Yen seems to continue. 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 provided in Japanese Yen or Yen-denominated base.

### 2.5.4 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

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

be fully open to traffic on September 2012.

### 2.5.5 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. Traffic demand forecast shows that traffic volume will become 62,801PCU/day in 2024 and because it reaches 90% of capacity, 72,533PCU/day, of 4-lane, 6-lane widening will be indispensable.

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.

## 3. Study and Proposal of Project Implementation Plan

### 3.1 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) Traffic Volume between Interchange

The results of traffic Demand forecasting at year 2020 and 2030 are shown below.

**Table 3.1-1Traffic Volume between Interchanges in PV-CG Expressway (Year 2020)**

Unit: PCU/day

| Sections | | | 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 3.1-2 Traffic Volume between Interchanges in PV-CG Expressway (Year 2030)**

Unit：PCU/day

| Sections | | | 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 |

## 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)

### 3.2.1 Road Grade and Design Speed

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

[Existing Road] Highway

Design Standard; TCVN4054:1985

Road Grade; Grade I Plane

Design Speed ($V_{design}$); 100km/h

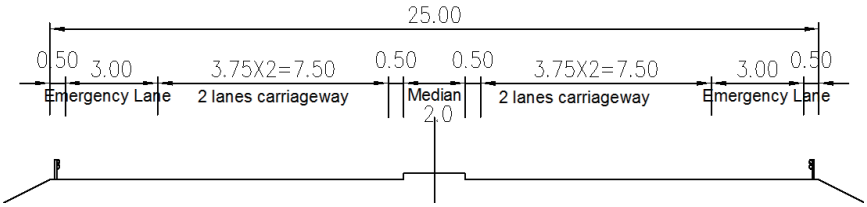



**Figure 3.2-1 Configuration of Existing Road**

[Plan] Expressway

Design Standard; TCVN5729:1997

Road Grade; Expressway Grade A

$V_{design}$; 100km/h or 120km/h

Scope of Design; Main lines Km182+300～211+256 (L=28.956 Km)

Interchange: Thuong Tin IC (approx. Km192+850), Van Diem IC (approx. Km204+200)

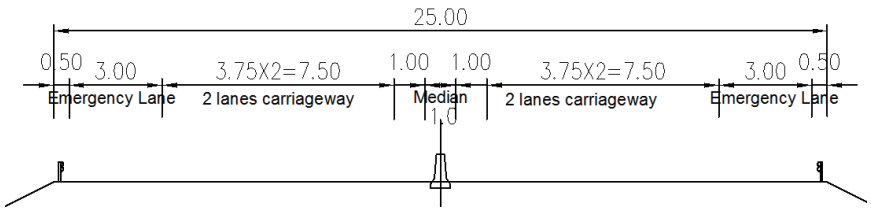



**Figure 3.2-2 Configuration of PV-CG Expressway (Phase I, 4-lane)**

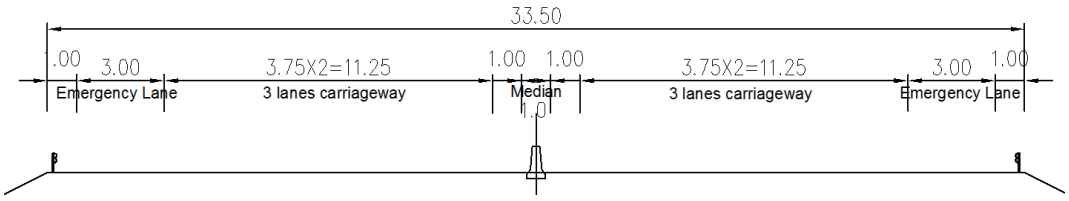



**Figure 3.2-3 Configuration of PV-CG Expressway (Phase II, 6-lane)**

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 practically impossible to upgrade $V_{design}$=120km/h, where existing Bypass for National Highway No.1 constructed as Highway with $V_{design}$=100km/h.

**Table 3.2-1 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 | |

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.

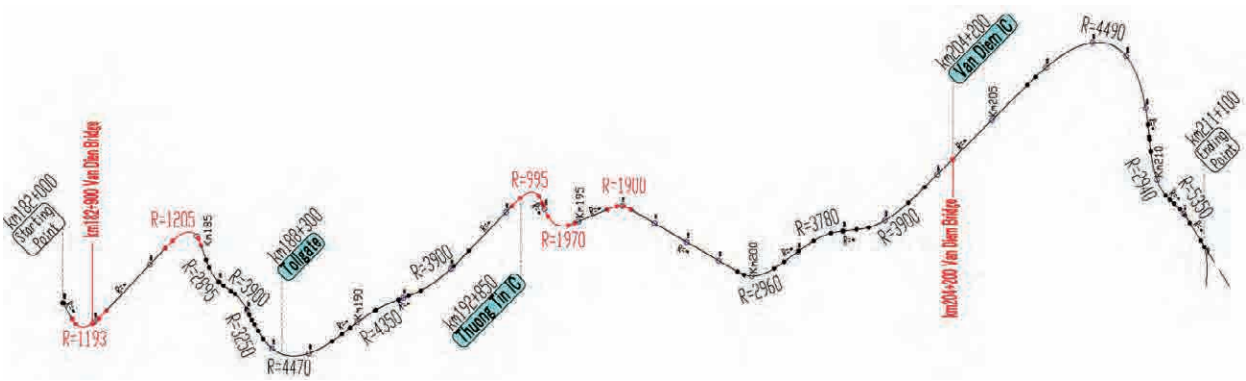



**Figure 3.2-4 Horizontal Alignment**

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.

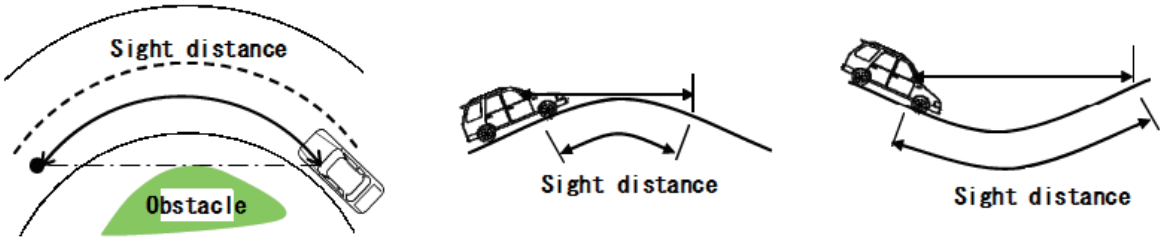



Fig. To ensure sight distance (Plan)　　Fig. To ensure sight distance (Longitudinal)

**Figure 3.2-5 Concept of Stopping Sight Distance**

### 3.2.2 Vertical Alignment

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

(i) Existing Bypass for NH-1 is to be upgraded to 4-lane Expressway and further extended 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.

(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.

**Table 3.2-2 Min. Slope Length**

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

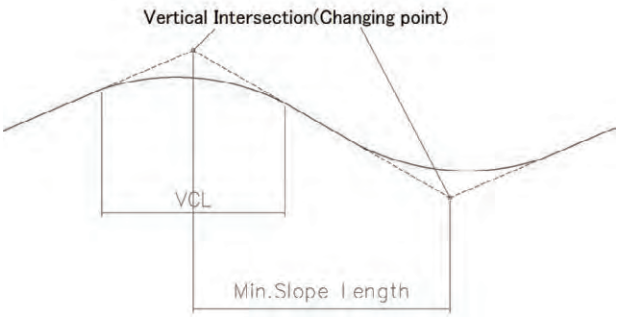



**Figure 3.2-6 Definition of Min. Slope Length**

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.

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

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 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.

**Table 3.2-3 Recommendation of Min. Slope Length**

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

### 3.2.3 Median Strip

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. 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.

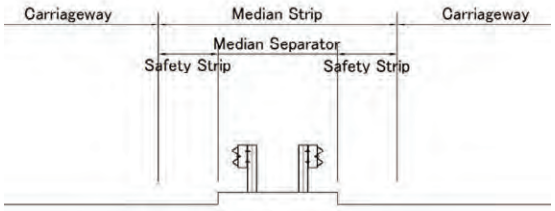



**Figure 3.2-7 Configuration of Median Strip**

[Selection criteria with regards to Median strip]

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

[Comparison criteria with regards to Safety barriers in Attachment ]

* Safety
* Maintenance sufficiency
* Procurement of products
* Cost

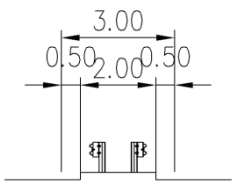
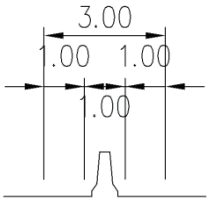
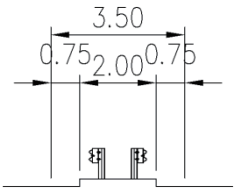
A width of Median Strips shown in the above Figure is minimized considering the following two items.

(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 3.2-4 and further detailed study is shown in Attachment.

**Table 3.2-4 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) |
|   |   |   |

### 3.2.4 Interchange and Toll Gates

In PV-CG Expressway, there are two interchanges, ie Thuong Tin IC (Km192+850) and Van Diem IC (Km204+200). PhapVan 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 toll gates and Interchanges are under review.

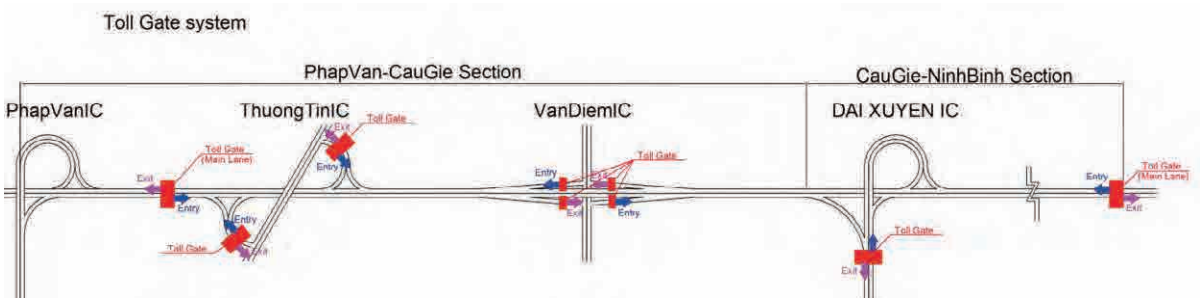



**Figure 3.2-8 Location of Interchanges and Toll Gates**

【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

### 3.2.5 Frontage Roads

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.

**Table 3.2-5 Road Specification**

| Items | 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) |

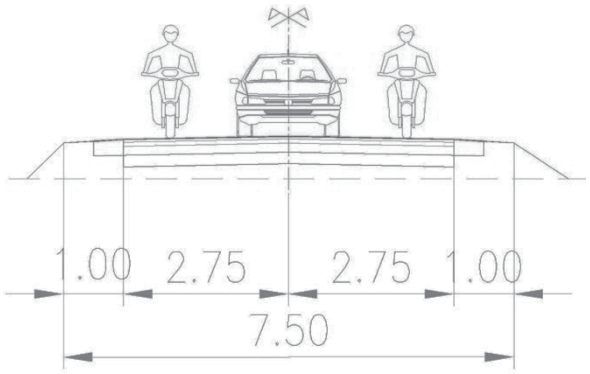



**Figure 3.2-9 Frontage Road Configuration (VEC F/S)**

### 3.2.6 Pavement

(1) **Pavement Design**

Following two cases of pavement design are made. VEC F/S is reviewed.

**Table 3.2-6 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<br>Case a |
| Sections for Widening two lanes (newly constructed) | Case b | construct pavement onto subgrade |

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).

**(i) Results of pavement Cross Sections**

A comparison is shown in Table Table **3.2-7** in the next page.
JST proposes that, in order to reduce overlay thickness due to an increase in $E_{yc}$, Aggregate type1 with cement 6% which VEC FS applied in the widening sections (new construction) is to be used for overlay in substitution of Aggregate typa 1 which VEC FS applied in overlay sections. Thickness for other layer is the same as that applied in VEC FS.

| |
|---|
| Asphalt Concrete Roughness Layer t=3cm |
| Asphalt Concrete Surface Course t= 5cm |
| Asphalt Concrete Binder Course-t=7cm |
| Base course (Aggregate type 1 + 6%cement), t=15cm to 21cm |

**b) Review of Pavement design(6 lanes and new construction)**

**Table 3.2-7 The comparison of the pavement design between VEC FS and JST**

(Unit: cm)

| | VEC FS | | JST | |
|---|---|---|---|---|
| Section / Layer | Phap Van-Thuong Tin | Thuong Tin-Cau Gie | Phap Van-Thuong Tin | Thuong Tin-Cau Gie |
| Asphalt concrete Surface Course | 5 | 5 | 5 | 5 |
| Asphalt concrete Binder Course | 7 | 7 | 7 | 7 |
| porous asphalt concrete | 10 | 10 | 10 | 10 |

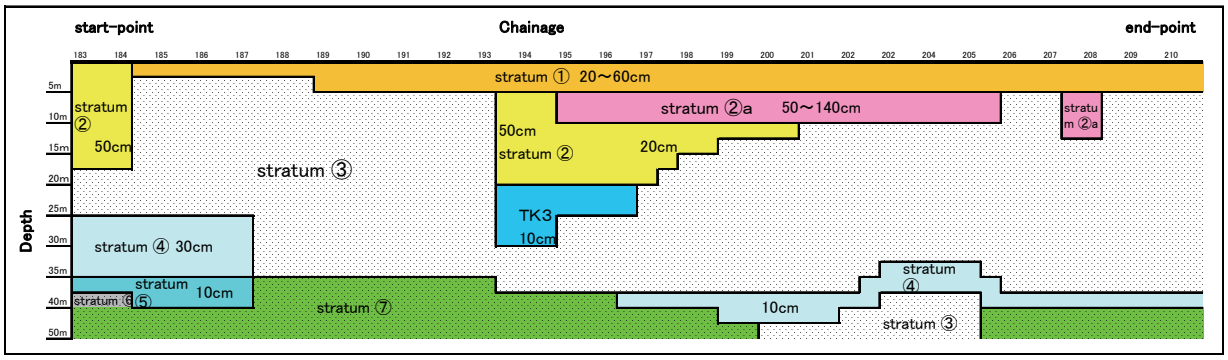
| | VEC FS | | JST | |
|---|---|---|---|---|
| macadam aggregate type1 with cement 6% | 22 | 22 | 35 | 35 |
| macadam aggregate type2 | 25 | 30 | 35 | 35 |

※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.

### 3.2.7 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 | | |

出典:GEOTECHNICAL ENGINEERING REPORT, August 1997 をもとに作成

**Figure 3.2-10 Geotechnical Longitudinal Section**

#### (1) Allowable residual settlements

Allowable residual settlements are shown in the following Table.

**Table 3.2-8 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.

### 3.2.8 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.

(1) **Box Culverts for Roads (Phase Ⅰ)**

**1) Current Conditions**

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 no-damage.

| | |
|---|---|
|  |  |
| **B2.5m,H2.5m** | **B3.5m×2,H3.2m** |

**Figure 3.2-11 Existing Box culvert**

**2) Design Policy**

The existing box culvert are made from reinforced concrete. The existing box culverts would need to

be extended with the widening of PVCG road 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 is affected by the depth of the earth covering. PVCG Expressway will be improved the alignment, and the depth of the earth covering on some box culvert will be deeper than existing earth covering. 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.

(2) **Box Culvert for drainage (Phase Ⅰ)**

**1) Present Conditions**

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.

**2) 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)**

**1) Present Conditions**

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.

**2) 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.

### (4) Bridges in Main Lines (Phase Ⅱ)

#### 1) Present Conditions

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 3.2-9 Outline of Existing 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 |

| | |
|---|---|
|  |  |
| Van Dien Bridge | Van Diem Bridge |

**Figure 3.2-12 Existing Van Dien Bridge and Van Diem Bridge**

#### 2) Design Policy

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 3.2-10 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 |

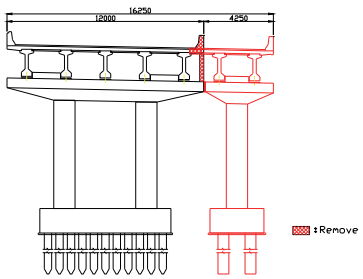



**Figure 3.2-13 Typical Cross Section**

(5) **Overpass (Phase Ⅱ)**

**1) Present Conditions**

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 slightly damaged and drainage was deteriorated. Repair of these damages are not urgent, but thought to be repaired at the time of four-lane highway.

**2) 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.

### 3.2.9 Construction Method Statement

#### 3.2.9.1 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 Figure .


**Figure 3.2-14 Sequence of Construction**

#### 3.2.9.2 Traffic Safety Control

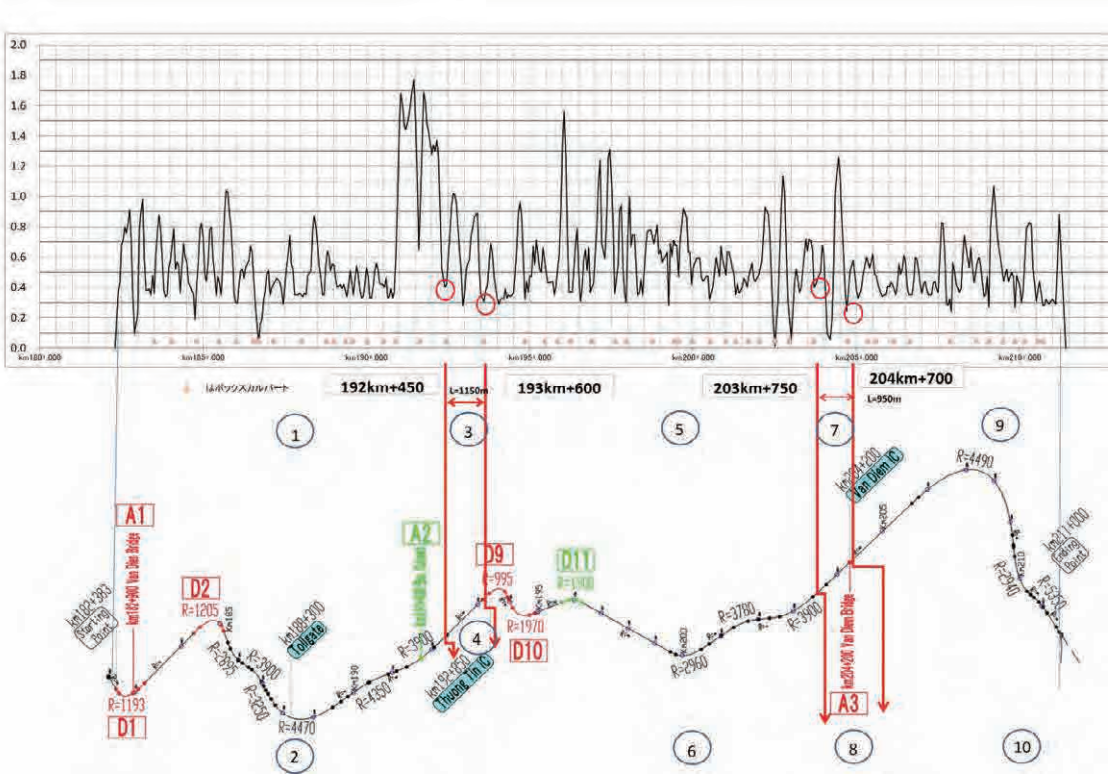
(1) **Section of Traffic Control**

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 traffics 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.




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

**Figure 3.2-15 Raising Height and Sections for Traffic Control**

(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.

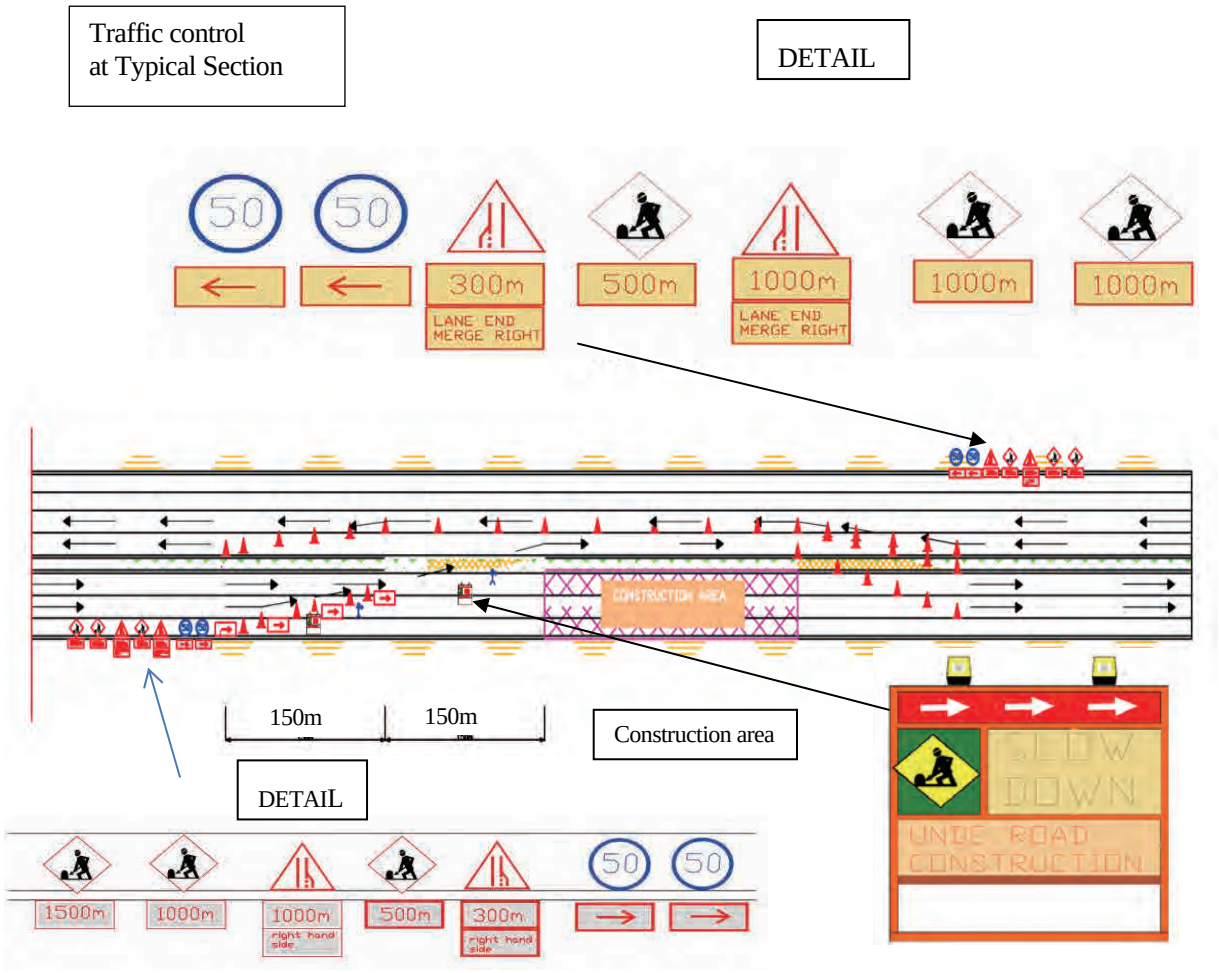



**Figure 3.2-16 Traffic Control at Typical Sections**

### 3.2.9.3 Outline Construction Costs

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

### 3.3 Study on new implementation scheme utilizing private sector finance

#### 3.3.1 Structure of Implementing Operations and Maintenance

##### 3.3.1.1 Role 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.

(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.

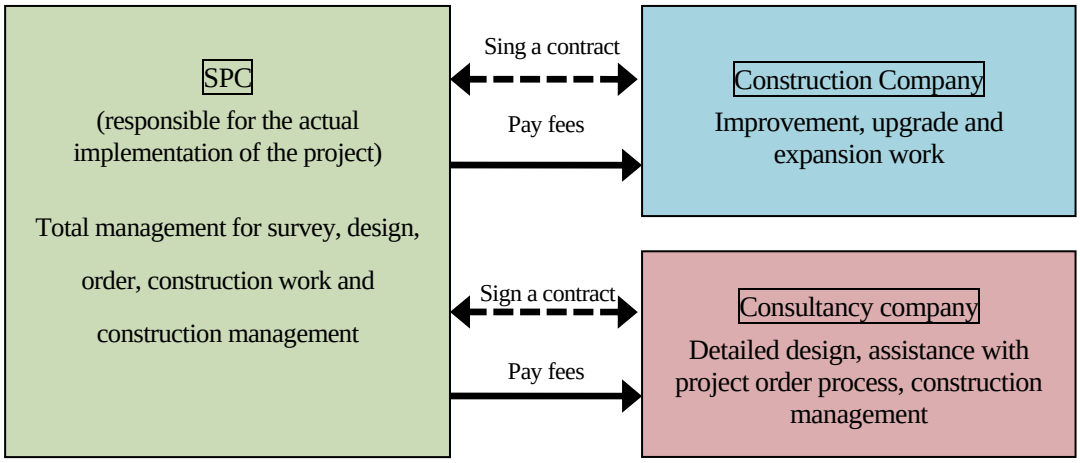



**Figure 3.3-1 Roles of SPC during Construction**

(2) **Operation and maintenance Stage**

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.

Until coordination with the North Regional Traffic Control Center is completed, traffic control functions of SPC operation office will limit to the extent that SPC operation office can control traffics which pass through PV-CG Expressway. After coordination is made, it is assumed that a part of functions in SPC operation office is to be entrusted to the North Regional Traffic Control Center.

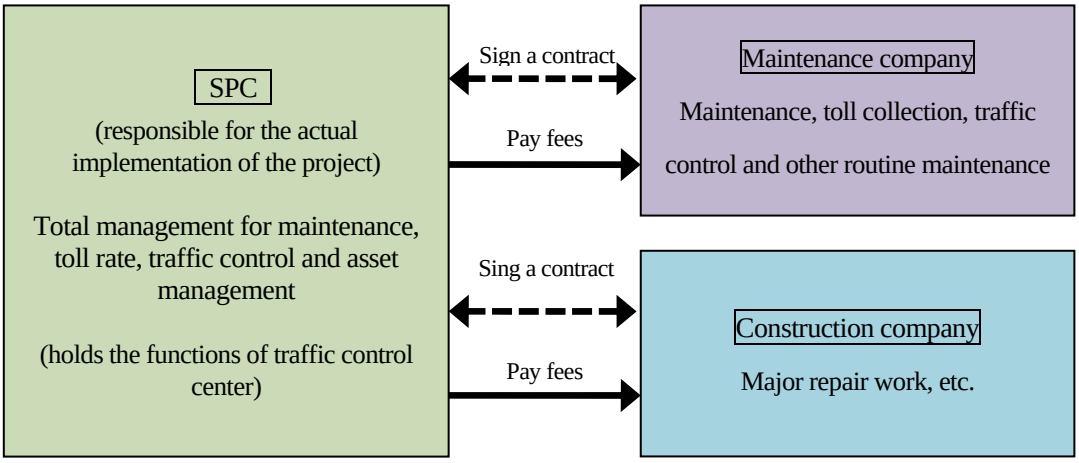



**Figure 3.3-2 Role of SPC during Operation and Maintenance**

## 3.4 Financial and Economic Analysis

### 3.4.1 Economic Analysis for this project and Study for index of operate and effect

#### (1) Economic Analysis

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

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

##### 1) 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 3.4-1 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 3.4-2 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, 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.

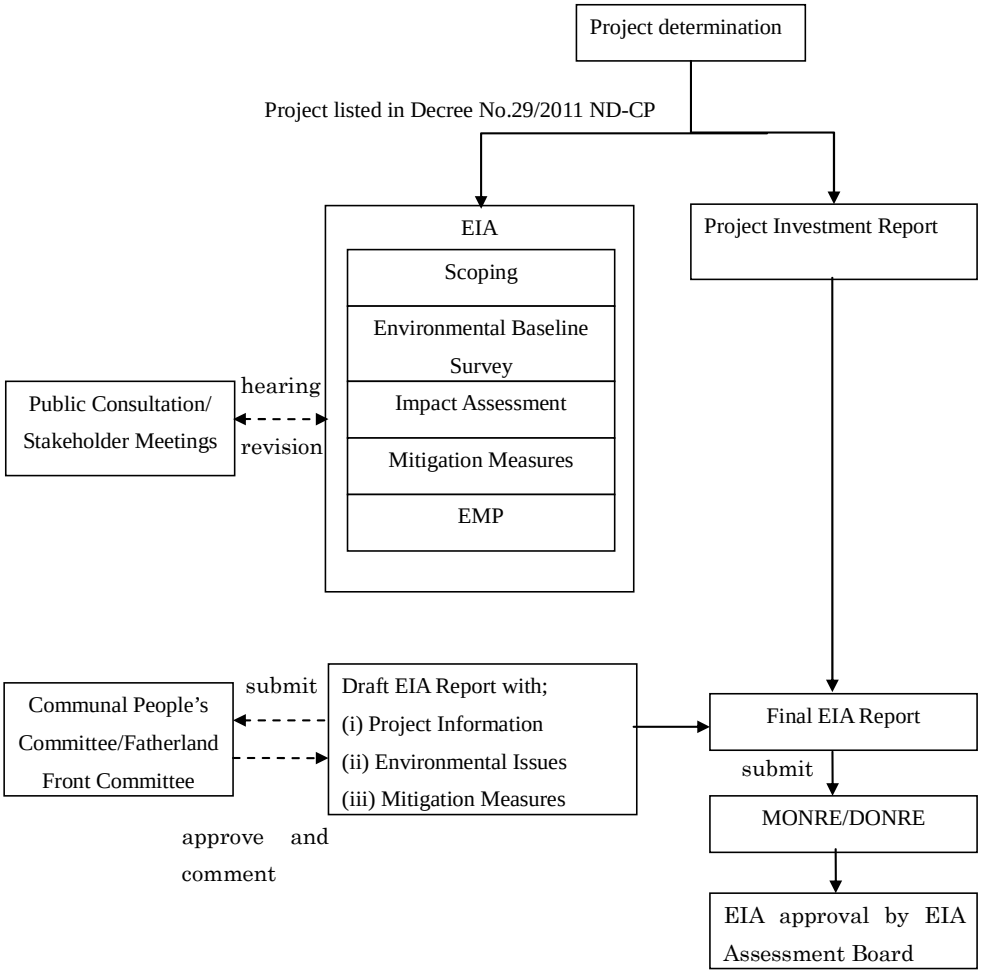



**Figure 3.5-1 Procedure for Obtaining Approval on EIA**

### 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.**

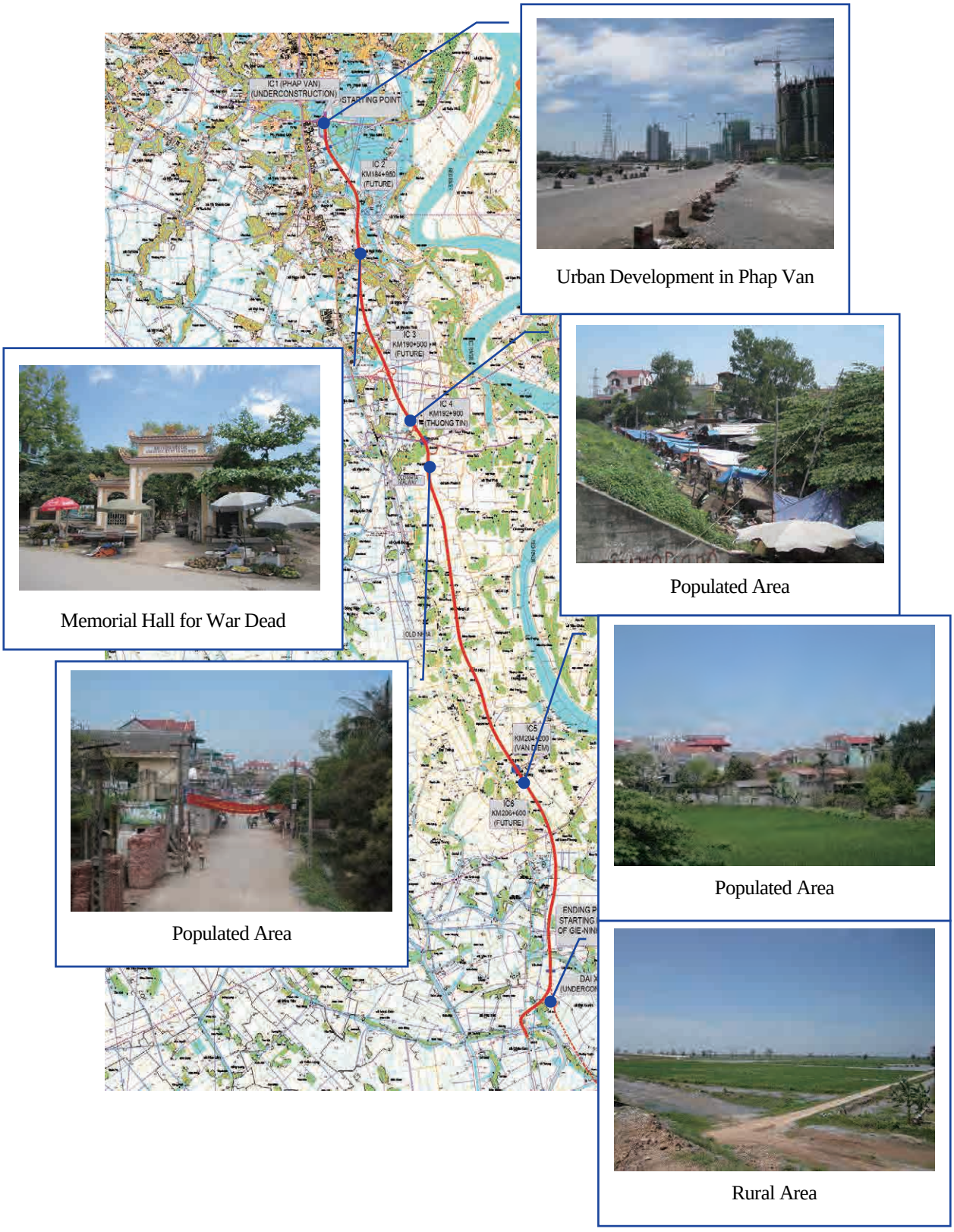



**Figure 3.5-2 Land Use along PV-CG Expressway**

**Table 3.5-1 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:<br>i. Compensation to illegal settlers<br>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.<br>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.<br>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. |