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*Vietnam Expressway Corporation (VEC)*



*Project Management Unit No. 85 (PMU. 85)*



**THE WORLD BANK**

**IDA Credit No. / IDA tín dụng số : 4779-VN**

**Project ID No. / Mã dự án: P106235**

**Consulting Services for / Dịch vụ tư vấn**  
**Detailed Design for Da Nang - Quang Ngai Expressway Development Project**  
**/ Thiết kế kỹ thuật dự án Đường cao tốc Đà Nẵng – Quảng Ngãi**

**Detailed Engineering Design Report (Final)**

**Volume 2: Main Report (PKG3B)**

**Volume 2.1: Main Report (PKG3B, Road)**

**June 24, 2013**

**The Joint Venture of / Liên danh Tư vấn:**



**NIPPON KOEI CO.,LTD.**



**NIPPON ENGINEERING CONSULTANTS CO.,LTD.**



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(Báo cáo thiết kế kỹ thuật chi tiết)(Bản cuối cùng)**

**Volume 2: Main Report (PKG3B)  
(Tập 2: Thuyết minh chính (Gói thầu 3B))**

**Volume 2.1: Main Report (PKG3B, Road)  
(Tập 2.1: Thuyết minh chính (Gói thầu 3B, Đường))**

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**Đà Nẵng ngày 24 tháng 6 năm 2013**



Letter of Submission  
Project Location Map

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### List of Abbreviations

D/D	: Detailed Engineering Design
DHWL	: Design High Water Level
DQE	: Da Nang - Quang Ngai Expressway
F/S	: Feasibility Study
GOVN	: Government of Vietnam
IBRD	: The International Bank for Reconstruction and Development
MOT	: Ministry of Transport
NH	: National Highway
PC	: Pre-stressed Concrete
PKG	: Package
PMU	: Project Management Unit
QCVN	: Vietnamese National Standards
RNIP	: Road Network Improvement Project
TCN	: National Technical Regulations
TEDI	: Transport Engineering Design. Incorporated
TOR	: Terms of Reference
VEC	: Vietnam Expressway Corporation
WB	: The World Bank



## **1 GENERAL**

### **1.1 Composition of Detailed Engineering Design Report**

The design report consists of the following volumes;

#### **Basic Design Report**

**Volume 1 : Basic Design Report**

Volume 1.1 : Basic Design Report for Civil Works (Revision 3) (Whole Section of Expressway)

#### **Detailed Engineering Design Report**

**Volume 2 : Main Report (PKG3B)**

Volume 2.1 : Main Report (PKG3B, Road) – This Report

Volume 2.2 : Main Report (PKG3B, Bridge)

**Volume 3 : Drawings (PKG3B)**

Volume 3.1 : Road Works (PKG3B)

Volume 3.2 : Bridge Works (PKG3B)

**Volume 4 : Structural Calculation Report (PKG3B)**

Volume 4.1 : Road Works (PKG3B)

Volume 4.2 : Bridge Works (PKG3B)

**Volume 5 : Quantity Report (PKG3B)**

Volume 5.1 : Road Works (PKG3B)

Volume 5.2 : Bridge Works (PKG3B)

**Volume 6 : Hydrological and Hydraulic Calculation Report (PKG3B)**

### **1.2 Objective**

The objective of this report is to present the results of the detailed engineering design of roadworks for the construction of Package 3B.

### **1.3 Scope of Works and Work Demarcation**

The scope of works in the Contract Package 3B (Road Works) include the construction of the expressway from Km18+100 to Km21+500 of Da Nang – Quang Ngai Expressway, except Bridge Works. The work items related to the traffic safety, operation and maintenance, lighting and power supply and ITS are included in separate construction packages. The work demarcation is indicated in Table 1.1.

**Table 1.1 Work Demarcation of Construction Package 3B (Road Works)**

Item	PKG	PKG 3B (KM18+100-21+500)	PKG 13 (O&M / ITS)	PKG 14 (Traffic Safety / Lighting)
Road Works		X		
Traffic Safety on Expressway (guard rail, fence, road signs and markings)				X
Electrical System	Power Receiving System (Transformer)			X
	Power Cable			X (For lighting)
Road Lighting System	Lamp			X
	Lighting Pole			X
	Foundation for Lighting Pole	X		
	Control Panel			X
Communication System	Fibre Optic Cable		*1	
	Fibre Optic Connection & Terminal Box		*1	
Conduit System	HDPE Pipe for Electrical and Lighting Systems	X		
	HDPE Pipe for Communication System	*1		
	Manhole	X *1		
	Pull Box	X *1		

Note: \*1) The communication cable and conduits and pullbox for the communication cable are scheduled to invest by VNPT and those will be re-designed in the construction pahse.

## 2 LEGAL BASIS

- Decree 12/2009/NĐ - CP dated 12th February 2009 by Government on Management of Works Investment and Decree 83/2009/NĐ-CP dated 15th October 2009 of Government on revision and adjustment of some articles in Decree 12/2009/NĐ-CP;
- Decree 112/2009/NĐ-CP dated 14th December 2009 by Government on management of Works Investment;
- Decree 209/2004/NĐ-CP dated 16th December 2004 by Government regarding Construction quality management; and Decree No.49/2008/NĐ-CP dated 18th April 2008 regarding revision and addition of several articles of Decree No.209/2004/NĐ-CP;
- Decision No.362/QDD-BGTVT dated 20th February 2009 and Decision No.727/QĐ-BGTVT dated 6th April 2012 by MOT regarding approval for Technical standard list applied for DQEP;
- Decision 2656/QĐ-BGTVT dated 10th September 2010 of MOT on approval on Investment of Da Nang- Quang Ngai Expressway Project.
- Decision No. 265/QĐ-VEC dated 5th June 2013 with No. 175/BC-KTCNMT dated 27th May 2013 regarding Approval on Detailed Design of package 3B : Km18+100-Km21+500 under DQEP (phase 1) by VEC.
- Decision No. 1534/QĐ-BGTVT dated 5th June 2013 regarding Approving on Modification of Basic Design – Danang – Quang Ngai Expressway Project by Minister of MOT.

## 3 NATURAL CONDITION SURVEYS

### 3.1 Topographic Surveys

- See Topographic Surveys Report

### 3.2 Geotechnical and Geological Survey

- See Geotechnical and Geological Survey Report

### 3.3 Hydrological and Inundation Analysis

- See Hydrological and Inundation Analysis Report



Where, (applied values)

m – median width (1.5m)

S – median marginal strip width (0.75m)

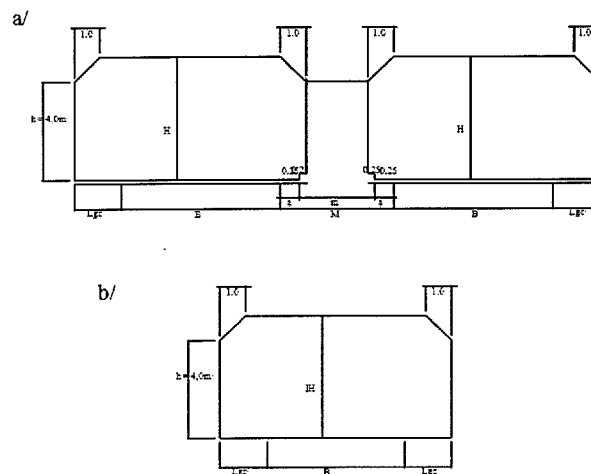
B – traveled way width (7.5m (initial stage), 11.25 (ultimate stage))

L – paved shoulder width (3.0m, the hunch width should be same as this value)

C – 0.3 m for Grade 120

## (2) TCVN4054-2005

The lateral and vertical clearances stipulated in TCVN4054-2005 are given in Figure 4.2. A 1.0m width is shown as hunch width at the top of envelop of corridor in the figure. However, dimension of hunch should be flexible because that the hunch is outside of travelled way space.



Note: a- Highways of  $V_{tk} \geq 80$  km/h with median, b- All types of highway without median;

**Figure 4.2 Lateral and Vertical Clearances in TCVN4054-2005**

Where,

B – Width of traveled way;

Lgc – Width of stabilized shoulder part;

m – Separated part;

s – Safety part (stabilized);

M – Width of separator;

M, m, s – Minimum values

H – Clearance height from the highest point of traveled lane (the height does not take into account of the reserved height for pavement raising when repairing or improvement);

h – Clearance height at the edge of stabilized shoulder

H = 4.75 m, h = 4.00 m for highway class I, II, III

H = 4.50 m, h = 4.00 m for remaining highway classes

## 4.4 Decision 315/QD-BGTVT

In consideration of clearance height specified in Decision 315/QD-BGTVT for each classification, lateral and vertical clearance of AH class follows criteria in TCVN4054-2005.

As for road classifications of A to C, lateral and vertical clearance is not specified in Decision 315/QD-BGTVT.

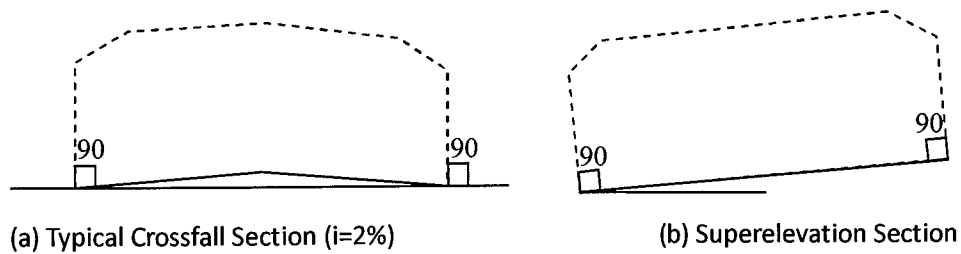
## 4.5 Setting of Lateral and Vertical Clearance

Setting of lateral and vertical clearance are developed as follows:

Ceiling line of the envelope is parallel with road surface.



Vertical edge lines are perpendicular to road surface. In case (a) normal cross fall, the vertical edge lines are plumb line, in case (b) super-elevated cross fall, the vertical edge lines are perpendicular to road surface shown in Figure 4.3. In case, the super-elevated value is smaller than the normal crossfall, which is 2%, plumb line is applied.



**Figure 4.3 Setting of Lateral and Vertical Clearances Lines**

#### **4.6 Geometric Design Criteria for Thruway**

Summary of geometric design criteria to be applied for the PKG3B for thruway with design speed of 120km/h is given in Table 4.2.

**Table 4.2 Geometric Design Criteria for Thruway (Initial Stage)**

Design Elements		Type/Value	Remarks	Reference
1	Expressway Classification	Grade 120	Type A	TCVN5729
2	Terrain	Flat		TCVN5729
3	Design Speed (km/h)	120		TCVN5729
4	Cross-Sectional Elements	Basic Lane Width (m)	3.75	TCVN5729
		Number of Lanes in each Traveled Way	2	F/S
		Number of Traveled Way	2	F/S
		Formation Width (m)	25.5	F/S
		Traveled Way Width(m)	2 x 7.5	TCVN5729
		Outer Shoulder Paved Width (m)	2 x 3.0	TCVN5729
		Outer Shoulder Earthen Width (m)	2 x 0.75	F/S
		Median Width (m)	1.5	F/S
		Median Marginal Strip (m)	2 x 0.75	TCVN5729
		Crossfall of Roadway (%)	2.0	TCVN5729
		Slope of Earthworks		
		Fill	V : H = 1:2.0	F/S
		Cut (soil)	V : H = 1:1.0	F/S
		Cut (stone Class 4)	V : H = 1:0.75	F/S
5	Sight Dist.	Stopping Sight Distance (m)	230	TCVN5729
		Driver's Eye Height (m)	1.2	TCVN5729
		Height of Object (m)	0.3	TCVN5729
6	Horizontal Alignment	Horizontal Curve		
		Absolute Minimum Radius of Horizontal Curve (m)	650	TCVN5729
		Desirable Minimum Radius of Horizontal Curve (m)	1000	TCVN5729
		Minimum Radius without Superelevation (m)	4000	TCVN5729
		Superelevation (Se)		TCVN5729
		Maximum Se for Absolute Minimum Radius (%)	7.0	TCVN5729
		Maximum Se for Desirable Minimum Radius (%)	5.0	TCVN5729
		Transition Curve		
		Minimum Length for Absolute Minimum Radius (m)	210	TCVN5729
7	Vertical Alignment	Minimum Length for Desirable Minimum Radius (m)	150	TCVN5729
		Minimum Length for Radius of 1125 m (m)	125	TCVN5729
		Minimum Length for Radius larger than 1125 m (m)	R/9	TCVN5729
		Vertical Gradient		
		Maximum Gradient		
		Maximum Grade-Up (%)	4.0	TCVN5729
		Maximum Grade-Down (%)	5.5	TCVN5729
		Critical Length for Maximum Grade of 4% (m)	600	
		Minimum Gradient		
		Minimum Grade for Cut Section (%)	0.5	TCVN5729
		Minimum Grade for Transition Section with Se<1% (%)	1.0	TCVN5729
		Minimum Grade for Tunnel Section (%)	0.3	TCVN5729
		Minimum Length of Grade (m)	300	TCVN5729
		Vertical Curve		
		Minimum Length of Vertical Curve (m)	100	TCVN5729
		Minimum Radius of Crest Curve (m)		
		Absolute Minimum Radius (m)	12000	TCVN5729
		Desirable Minimum Radius (m)	17000	TCVN5729
		Desirable Radius (m)	20000	TCVN5729
		Minimum Radius of Sag Curve (m)		
		Absolute Minimum Radius (m)	5000	TCVN5729
		Desirable Minimum Radius (m)	6000	TCVN5729
		Desirable Radius (m)	12000	TCVN5729
8	Lateral Clearance (m)	Traveled width		TCVN5729
	Vertical Clearance (m)	4.75		TCVN5729

## 5 TYPICAL CROSS SECTIONS

The cross sectional elements for PKG3B are proposed as shown in Table 5.1.

The expressway is designed with a staged construction approach by widening the road on both sides, maintaining the centerline in initial stage (Phase 1) as well as ultimate stage (Phase 2). However, for large scale bridge where PC Box culvert is designed, the total width in the initial and ultimate stage is 26m as shown in the table.

**Table 5.1 Proposed Cross Sectional Elements**

Cross Section Elements	D/D (Proposal)											
	Initial Stage						Ultimate Stage					
	Earthwork Section			Bridge Section			Earthwork Section			Bridge Section		
	Q'ty	Width (m)	Total (m)	Q'ty	Width (m)	Total (m)	Q'ty	Width (m)	Total (m)	Q'ty	Width (m)	Total (m)
Median	1	<u>1.50</u>	1.50	1	1.50	1.50	1	<u>1.50</u>	1.50	1	1.50	1.50
Marginal Strip (Inner)	2	0.75	1.50	2	0.75	1.50	2	0.75	1.50	2	0.75	1.50
Marginal Strip (Inner) Long Bridge (PC-Box)										2	0.50	1.00
Traveled Way	4	3.75	15.00	4	3.75	15.00	6	3.75	22.50	6	3.75	22.50
Traveled Way Long Bridge (PC-Box)										6	<u>3.50</u>	21.00
Paved Shoulder include Marginal Strip (Outer)	2	3.00	6.00	2	3.00	6.00	2	3.00	6.00	2	3.00	6.00
Paved Shoulder include Marginal Strip (Outer) Long Bridge (PC-Box)										2	<u>0.50</u>	1.00
Earthen Shoulder	2	<u>0.75</u>	1.50				2	<u>0.75</u>	1.50			
Parapet, Service Space				2	0.75	1.50				2	0.75	1.50
Parapet, Service Space Long Bridge (PC-Box)				2	1.00	2.00				2	0.75	1.50
Pedestrian way												
Total			25.50			25.50			33.00			33.00
				PC-Box		26.00				PC-Box		26.00

Note: Underlined values are proposed values by the Consultant

Total width of 25.5m for general section and 26.0m for PC-Box Bridge section are proposed in initial stage and the boundaries for land acquisition are 10m outer side from edge of embankment slopes on the general section of the expressway.

### 5.1 Typical Cross Section at Normal Embankment

Proposed typical cross section of the road on normal embankment is shown in Figure 5.1. When the embankment height is more than 10m, a berm is designed at a height of 6m having 2m width.

When the expressway passes through flat inundation sections, the embankment slopes are protected by mortared stonework to a height determined by the design high water level and a freeboard of 0.5m.

### 5.2 Typical Cross Section at Common Excavation

Proposed typical cross section of the road at common excavation is shown in Figure 5.2. Berms are designed at every excavation depth of 6m having width of 2m.

### 5.3 Typical Cross Section at Rock Excavation

Proposed typical cross section of the road at road excavation is shown in Figure 5.3. Berm ditches are designed with triangular shape in the rock area.

### 5.4 Typical Cross Section at Partial Excavation and Embankment

Proposed typical cross section of the road at partial excavation and embankment is shown in Figure 5.4. When the natural slope at embankment side is more than 20%, bench cutting at the slopes is required before the construction of embankment.

### **5.5 Typical Cross Section at Superelevated Sections**

Proposed typical cross section of the road at superelevated section is shown in Figure 5.5. Median drains are designed and are discharged by cross drainage.

### **5.6 Typical Cross Section at Deep Excavation**

Based on the Vietnamese Standard TCVN4054, when the depth of excavation exceeds 12m, it is defined as deep excavation. Along these sections, it will be difficult to widen the road in future for ultimate stage and hence the excavation is extended to a width required by the ultimate stage (6 traffic lanes). However, the pavement is constructed only to the width required for the initial stage, as shown in Figure 5.6. Along the deep excavation area with hard rock, the berms are designed at every 8m height. The slope of excavation depends on the type of material determined from the boring data.

### **5.7 Typical Cross Section of Expressway at Bridge Approach**

The concrete median barrier at the bridge has a total base width of 1m whereas, the concrete median barrier (New Jersey type) at the normal embankment section has a total base width of 0.82m. The median barrier is transitioned from 0.82m to 1.0m with a taper slope of 1:70. The typical cross section is shown in Figure 5.7.

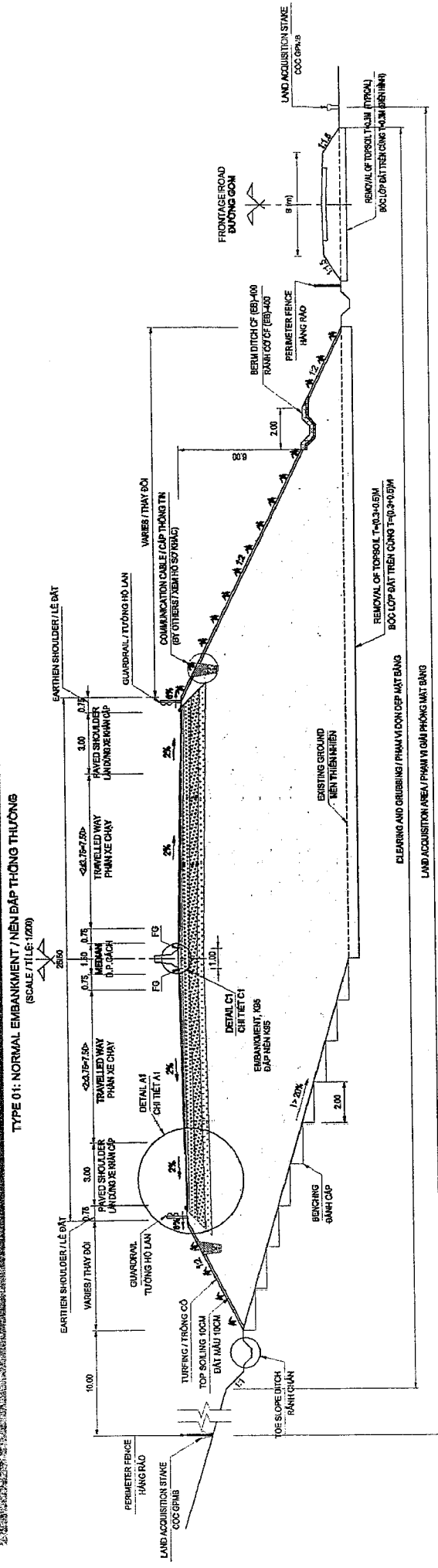
### **5.8 Typical Cross Section of Expressway at Flyover Location**

Typically, the expressway is designed with a median width of 1.5m and a New Jersey type concrete median barrier is installed. When a flyover is designed for the crossing road, a median width of 3.5m is required in order to accommodate the center pier of the flyover at the expressway median. The typical cross section is shown in Figure 5.8.

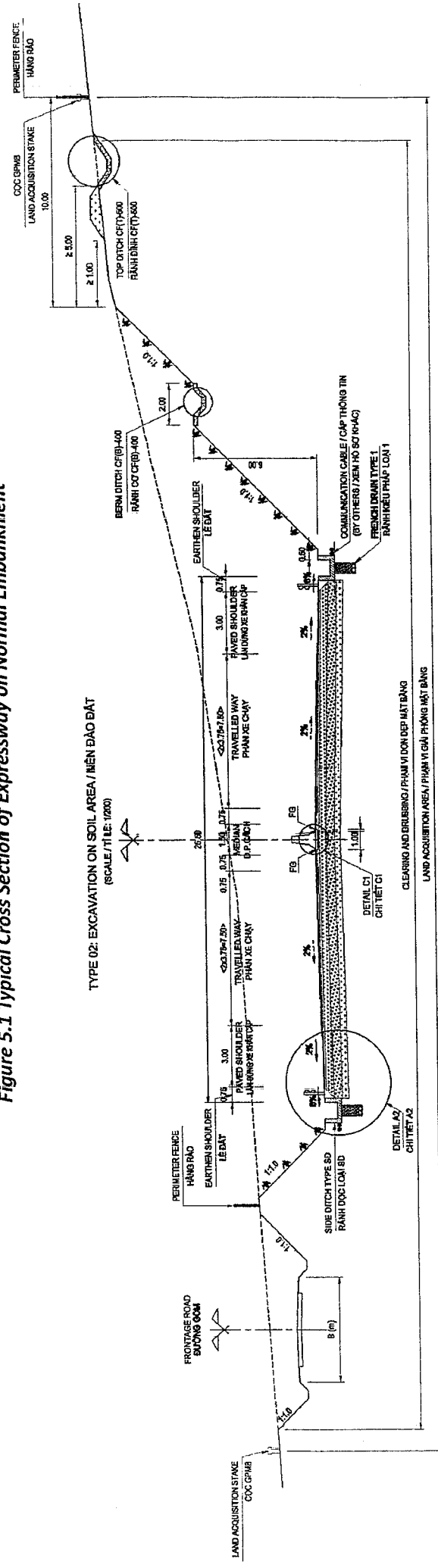
The median is transitioned from 1.5m to 3.5m within a length of 70m with taper (taper slope of 1:70 for 1m shift on each side).

### **5.9 Typical Cross Section of Expressway at Separated Alignment for Tunnel Approach**

The expressway alignments for inbound (Northbound) and outbound (Southbound) at the tunnel (Package 4) are separated at a distance of 40m (tunnel center to center), which is 36.588m between expressway centerlines of each direction. These two alignments at the tunnel are parallel to each other which need to be transitioned connecting to the normal cross section on both sides of the tunnel. Therefore, two separate alignments for Northbound and Southbound are defined starting from Km20+500. The two alignments start separating physically after the flyover at Km20+700. The typical cross section of expressway at separated alignment section is given in Figure 5.9.



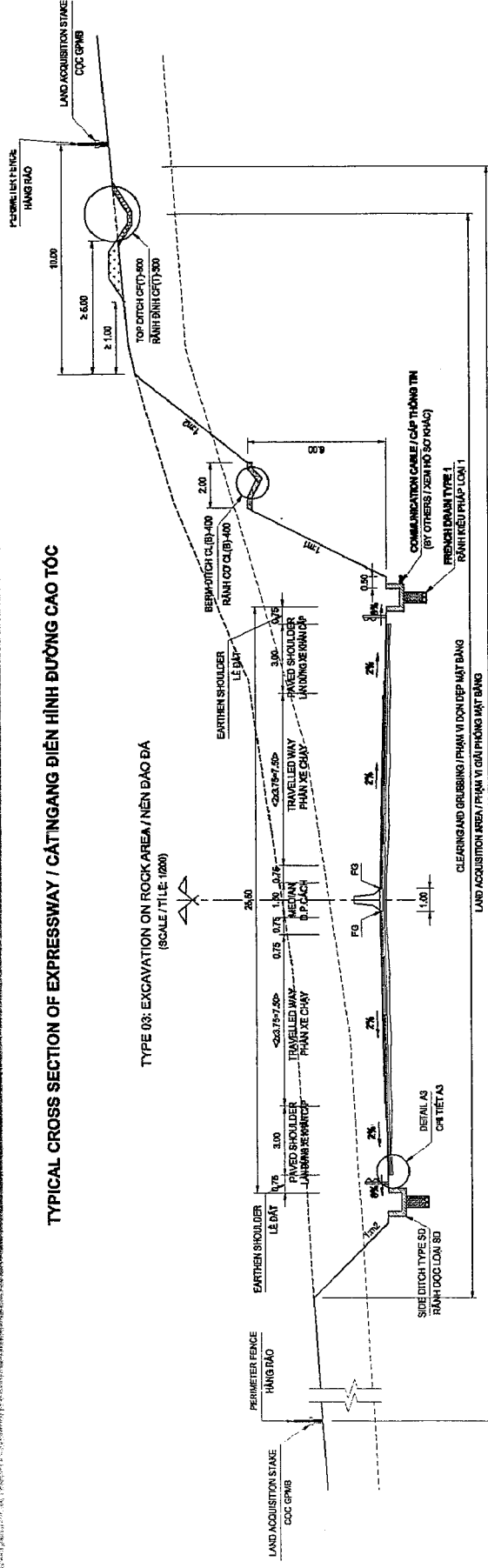
**Figure 5.1 Typical Cross Section of Expressway on Normal Embankment**



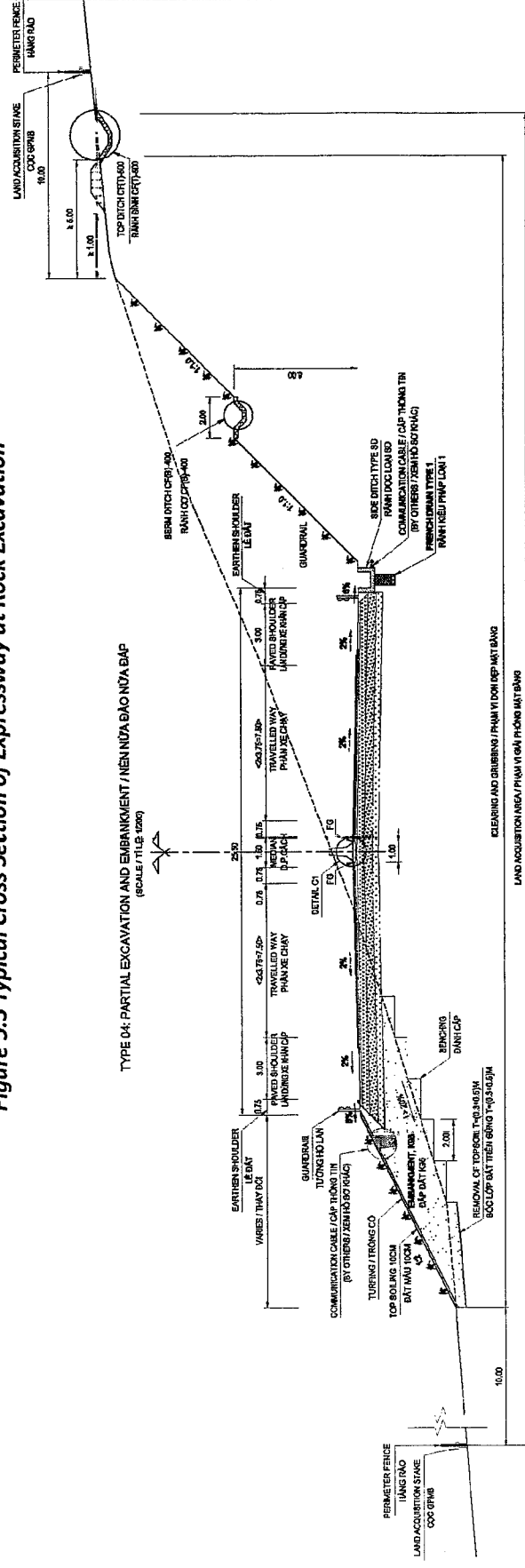
**Figure 5.2 Typical Cross Section of Expressway on Common Excavation**

**TYPICAL CROSS SECTION OF EXPRESSWAY / CÁTNGANG ĐIỆN HÌNH ĐƯỜNG CAO TỐC**

**TYPE 03: EXCAVATION ON ROCK AREA / NỀN ĐÀO ĐÁ**  
(SCALE / TỈ LỆ: 1/200)



**Figure 5.3 Typical Cross Section of Expressway at Rock Excavation**



**Figure 5.4 Typical Cross Section of Expressway at Partial Excavation and Embankment**

TYPE 05: EMBANKMENT WITH SUPERELEVATION / NỀN ĐẬP CÓ SIÊU CAO  
(SCALE/TITLE: 1/200)

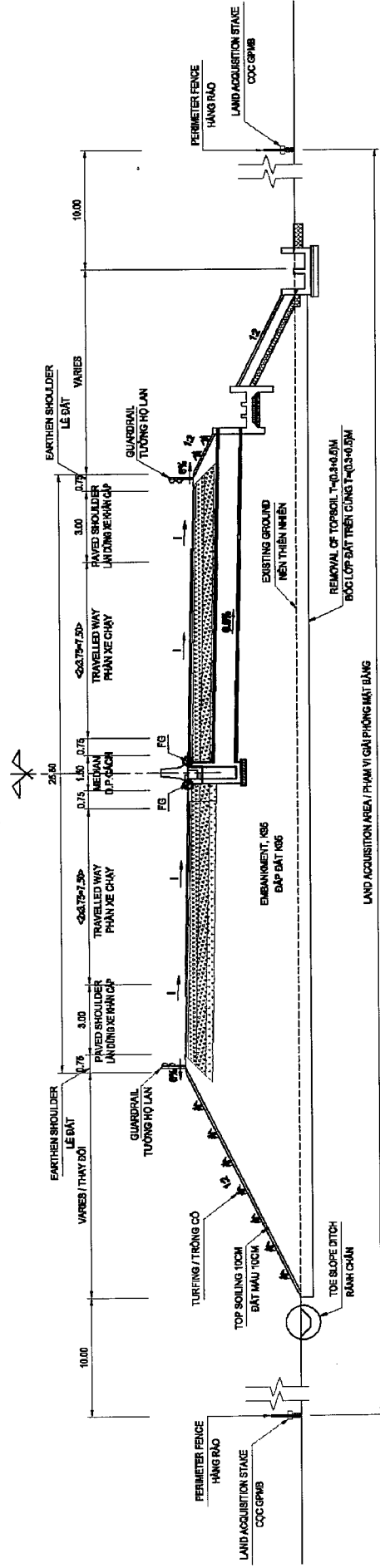


Figure 5.5 Typical Cross Section of Expressway at Superelevated Section

TYPE 06: DEEP EXCAVATION WITH 8 LANES AREA / NỀN ĐÀO SÂU 8 LÀN XE  
KM111+000.00-KM113+13.01, L = 2,033.01M  
(SCALE/TITLE: 1/200)

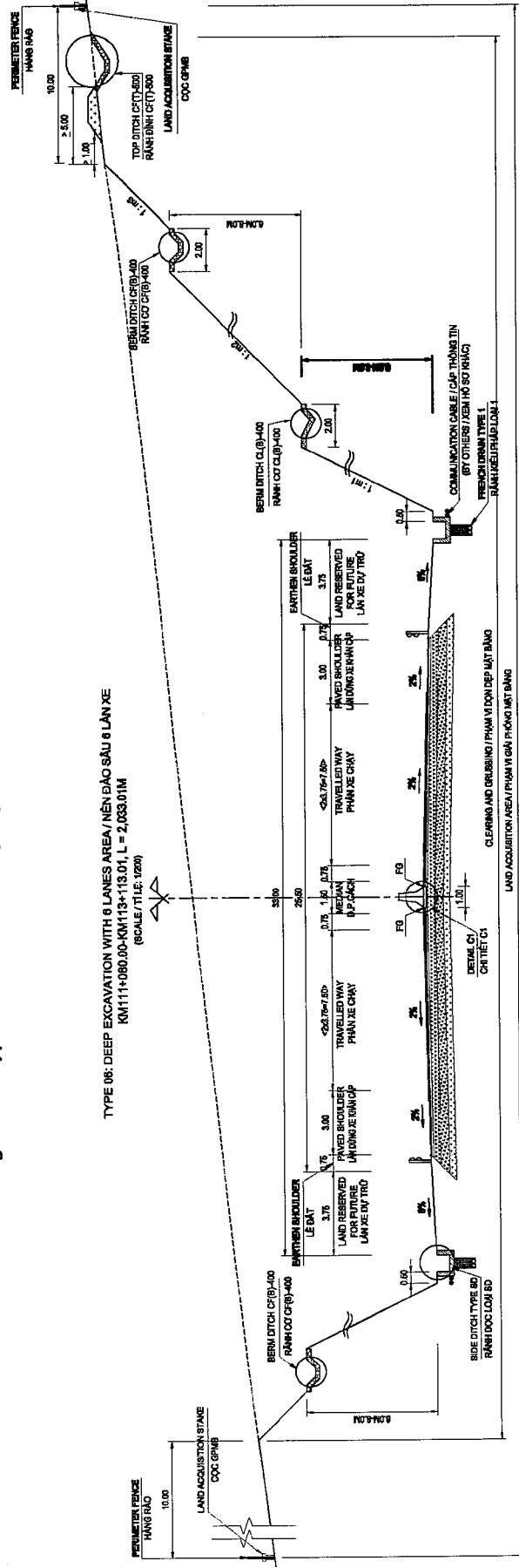
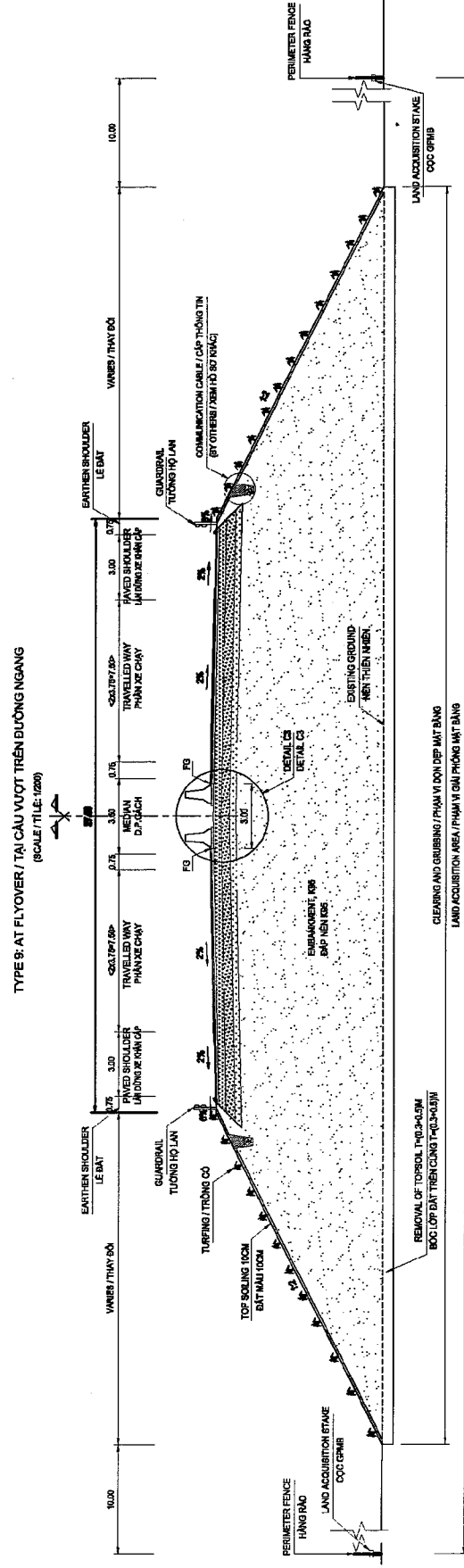
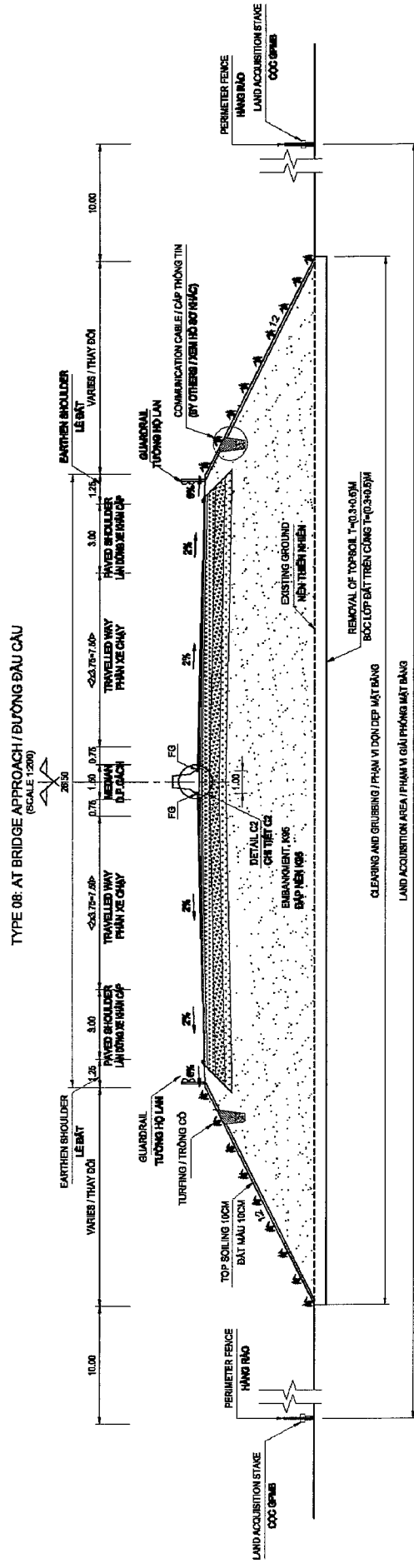


Figure 5.6 Typical Cross Section of Expressway at Deep Excavation





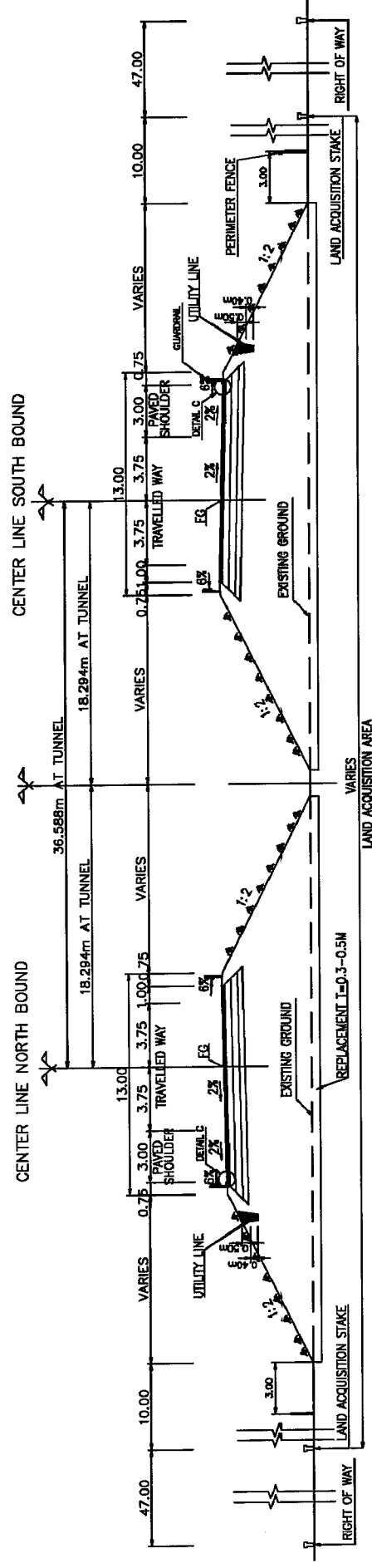


Figure 5.9 Typical Cross Section of Expressway at Separated Alignment for Tunnel Approach

## 6 DESIGNED ALIGNMENT

### 6.1 Horizontal Alignment of Expressway Centerline

The alignment in Package 3B starts in Dien Quang Commune of Dien Ban District in Quang Nam Province at Km18+100 of the expressway alignment.

The alignment in Package 3B ends in Duy Trinh Commune of Duy Xuyen District in Quang Nam Province at Km21+500.

The horizontal alignment for Package 3B is shown in Table 6.1.

**Table 6.1 Horizontal Alignment of Expressway Centerline**

IP	Station	Northing	Easting	Distance	Direction				Circular Curve		Spiral Length	
						D	M	S	L/R	Radius	In	Out
	16+170.183	1754935.629	519619.162	2617.303	S	22	24	0	E	Right	20000	
1	18+787.432	1752515.809	520616.534	2589.530	S	1	0	33	W	Right	2000	220
2	21+365.007	1749926.681	520570.930	2903.697	S	55	33	54	E	Left	1000	170
	24+158.817	1748284.730	522965.811	4915.164	S	70	26	54	E	Left	3000	333.333

Note: Package 3B is from Km18+100 to Km21+500

Station Break: Station Back=22+089.731, Station Ahead=22+070 (PKG4)

### 6.2 Horizontal Alignments of Separated Alignments for Tunnel and its Approaches

The horizontal alignments for Northbound and Southbound tunnels and their approaches are given in Table 6.2 and 6.3 respectively. In order to make the station inside the tunnel same for both Northbound and Southbound at the same Expressway Centerline, station breaks have been applied as shown below each respective tables.

**Table 6.2 Horizontal Alignment of Northbound Tunnel and its Approaches**

IP	Station	Northing	Easting	Distance	Direction				Circular Curve		Spiral Length	
						D	M	S	L/R	Radius	In	Out
	20+500.000	1750791.461	520591.413									
1	21+346.553	1749945.040	520576.504	846.553	S	1	0	33	W	Left	994.750	170.000
2	24+207.211	1748272.452	523016.071	2957.877	S	55	33	54	E	Left	2995.250	333.332
	25+247.788	1747922.619	524001.146	1045.350	S	70	26	54	E			

Note: Package 3B for this alignment is from Km20+500 to Km21+500

Station Break: Station Back=22+077.521, Station Ahead=22+070 (PKG4)

**Table 6.3 Horizontal Alignment of Southbound Tunnel and its Approaches**

IP	Station	Northing	Easting	Distance	Direction				Circular Curve		Spiral Length	
						D	M	S	L/R	Radius	In	Out
	20+500.000	1750791.646	520580.914									
1	21+383.461	1749908.322	520565.356	883.461	S	1	0	33	W	Left	1005.250	170.000
2	24+110.421	1748297.007	522915.552	2849.518	S	55	33	54	E	Left	3004.750	333.365
	25+253.925	1747912.725	523997.633	1148.291	S	70	26	54	E			

Note: Package 3B for this alignment is from Km20+500 to Km21+500

Station Break: Station Back=22+101.941, Station Ahead=22+070 (PKG4)

## 6.3 Vertical Alignment

### 6.3.1 Major Vertical Controls in Package 3B

Major vertical controls for the design of profile in Package 3B are generally,

1. Design High Water Level (DHWL)
2. Water crossing structures
  - i) Bridges
  - ii) Culverts (box and pipe)
3. Road crossing structures
  - i) Box for existing roads across expressway (box for road for expressway overpass)
  - ii) Bridges for existing roads across expressway (flyover for expressway underpass)
  - iii) Bridges on expressway across existing roads (bridge for road for expressway overpass)

### 6.3.2 Consideration to Phase 2 (Ultimate Stage)

At the initial stage (current stage Phase 1), the expressway is designed with a total of four lanes. At the ultimate stage (Phase 2) in future, the expressway is planned to be designed with six lanes by widening on both sides and adding one lane to each direction of traffic.

Design of vertical alignment considers the total width of expressway at the ultimate stage in the calculation of margins for vertical controls because the widened widths in future, otherwise, will be lower than the elevations from hydrological requirements.

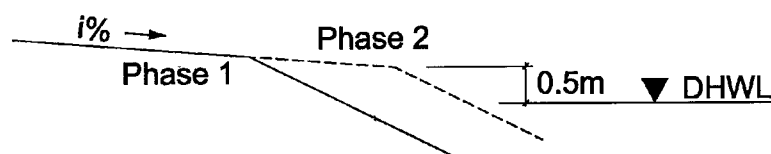


Figure 6.1 Required Margin for DHWL for Phase 2 Width

### 6.3.3 Designed Vertical Alignment for Expressway Centerline

The details of the designed vertical alignment in Package 3B is give in Table 6.4.

Table 6.4 Vertical Alignment in Package 3B for Expressway Centerline

PVI	Station	PVI Distance (m)	Elevation (m)	Grade-in (%)	Grade-out (%)	Curve Length (m)	Radius (m)	Remarks
	17+700.000		21.500		1.200			Continuation from PKG3A
1	18+188.782	488.782	12.213	1.200	0.300	198	9000	
2	19+138.000	949.218	15.061	0.300	-0.300	110	18333	
3	19+956.428	818.428	12.606	-0.300	0.750	100	9524	
4	20+329.000	372.572	15.400	0.750	-1.000	300	17143	
5	20+879.946	550.946	9.891	-1.000	0.950	230	11795	Refer Table 6.5, 6.6
	22+713.000	1833.054	27.492	0.950				Continuation to PKG4

### 6.3.4 Designed Vertical Alignments of Separated Alignmnets for Tunnel & its Approaches

The details of the designed vertical alignments of Northbound and Southbound tunnels and their approaches are given in Table 6.5 and 6.6 respectively.

**Table 6.5 Vertical Alignment for Northbound Tunnel and its Approaches**

PVI	Station	PVI Distance (m)	Elevation (m)	Grade-in (%)	Grade-out (%)	Curve Length (m)	Radius (m)	Remarks
	20+500.000		13.595		-1			
1	20+879.946	379.946	9.796	-1	0.95	230	11795	
2	22+713.000	1833.054	27.281	0.95	-2	510	17288	Continuation to PKG4

**Table 6.6 Vertical Alignment for Southbound Tunnel and its Approaches**

PVI	Station	PVI Distance (m)	Elevation (m)	Grade-in (%)	Grade-out (%)	Curve Length (m)	Radius (m)	Remarks
	20+500.000		13.595		-1			
1	20+879.946	379.946	9.796	-1	0.95	230	11795	
2	22+713.000	1833.054	27.513	0.95	-2	510	17288	Continuation to PKG4

## 7 GEOTECHNICAL DESIGN

### 7.1 General

Alignment of PKG 3B passes plane and mountainous sections. thus from the geotechnical aspects the section are divided into following sections.

#### 1) Normal Embankment Section

The section in which embankment height is under than 12m, and is about 1.7km. Major length of this package is either bridge or viaduct.

#### 2) Normal Excavation Section

The section in which slope height of the excavation is not deeper than 12m, short section at approaches of deep excavation section.

#### 3) Deep Excavation Section

The section in which slope height of the excavation is deeper than 12m, and is about 0.27km

At the deep excavation sections, the excavation width is extended up to a width required by Phase 2. However, the pavement is applied only for Phase 1 width. Moreover, when the excavation depth exceeds 12m only marginally for short length and when there is no hard rock (requiring blasting for excavation), excavation for Phase 2 width is not considered.

The study for each sections were conducted and are described below.

### 7.2 Normal Embankment Section

Embankment slope is designed with a value of 1:2 (1 vertical to 2 horizontal) when height of embankment is less than 10m. When the height of embankment is greater than 10m, a berm of 2m width is applied at a height of 6m.

In normal embankment, the embankment slopes are protected only by turfing. However, in the bridge approaches, 10m of approach road from the end of the bridge are protected with mortared stonework from top to the toe of embankment slope. Beyond the 10m of approach road, the embankment slopes are protected with mortared stonework to a height determined by the design high water level of 1% with additional marginal of 0.5m. The slope protection of embankment slope by mortared stonework is applied along inundation area only.

In this package no soft ground was observed. The maximum height of embankment is about 9.3m and the stability at this section was checked. The conditions for analysis are shown in Table 7.1 and the result is shown in Figure 7.1. Based on the analysis results it was concluded that there is no need for any treatment or countermeasure required in this section.

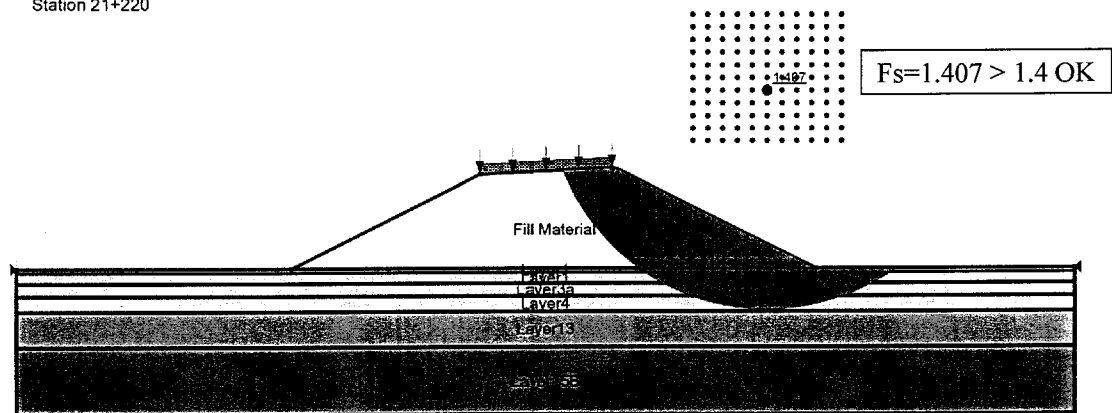
**Table 7.1 Conditions for Embankment Slope Stability Analysis at Km21+220**

Layer Name	Soil	SPT	Unit Weight (kN/m <sup>3</sup> )	Cohesion (kN/m <sup>2</sup> )	Angle (deg.)
Layer1	Plasticity clay		20.7	16	17
Layer3a	Plasticity clay	7~8	16.0	40	0
Layer4	Clayey sand	9	20.0	0	25
Layer13	Weathered madstone		20.0	24	24
Layer15b	Sand Stone		25.0	0	40
Fill Material	Borrow material		21.0	20	21

### 7.3 Normal Excavation Section

Normal excavation slope is designed with a value of 1:1 (1 vertical to 1 horizontal) when slope height is less than 12m. When the slope height is greater than 6m, a berm of 2m width is applied at a height of 6m. Generally, there are no rock section at normal excavation and hence slope gradient of 1:1 is generally applied. The cut slopes are protected by sodding.

Danang - Quangngai Expressway Project  
Package 3B  
Station 21+220



**Figure 7.1 Results of Embankment Slope Stability Analysis at KM21+220**

#### **7.4 Deep Excavation (Cut) Section**

##### **7.4.1 Deep Excavation (Cut) Sections in the Package**

PKG 3B includes cut and embankment slopes. In this package a deep cut section has slopes of higher than 12m as listed below;

KM20+500 – KM20+740 (L = 270m)

Not only the ordinary slope works complying with the Vietnamese technical design standards, the slope protection works which can address a large-scale cut slope shall be designed in these sections.

##### **7.4.2 Topographical and Geological Features in the Package**

Based on Atlas sheet of Hoi An Map (D-49-I) in the scale 1/200.000 of Published by Viet Nam Geology Bureau in 1995, the Package 3B is existed on Diluvia - Alluvial Epoch. The geological formations encountered in this section as follows:

- + Ai Nghia formations (N an): Glutenite, sandstone, siltstone, thickness > 300m.
- + Lower Pleistocene Q<sub>I</sub> (a): Gravel, cobble, thickness is 5m.
- + Middle – upper Pleistocene Q<sub>II-III</sub> (am): Sand, grit, clay, thickness is 30m.
- + Upper Pleistocene Q<sub>III</sub> (m): Sand, small gravel, silty clay, thickness is 15m.
- + Middle Holocene Q<sub>IV</sub><sup>2</sup> (a,am): Sand, clay, vegetable humus, thickness is 15m.
- + Undivided Holocene βQ<sub>IV</sub>: Olivine basalt, thickness is 50m.
- + Undivided Quaternary: Q (ad, ed, ap): Gravel, grit, sand, clay, thickness is 5m.

The topographic map and the geological map covering PKG3B are shown in Figure 7.2 and 7.3 respectively.



### 7.4.3 Design Policy

- Apply proper slope protection works which are suitable for the specific situations of the sites in consideration of the slope protection works widely used in Vietnam
  - Place emphasis on ensuring the stability in view of importance of the Expressway
- 1) Slope Protection Works Widely Applied in Vietnam

In order to grasp a general situation of slope protection in Vietnam, the slope protection works applied in national highways and provincial roads in the vicinity of the project site were studied.

2) For normal excavation section, where excavation depth is less than 12m, excavation slope of 1:1 is applied and the slopes are protected by sodding.

3) For deep cut sections, slope design is conducted based on geological investigation results.

4) Measures for Ensuring Stability

In view of importance of the Expressway, the structural countermeasures at the lowest slope and the wide berms (w=2.0m) are applied.

Furthermore, phenomena to occur during and after construction were envisaged based on the site conditions and the plural countermeasure options were proposed.

### 7.4.4 Slope Design

1) Gradient and Height

It is assumed that sand rocks, alternate layers of sand rock and mud rock, granitic rocks would appear and they are evaluated based on the results of site survey and geological boring, as hard rocks under less weathered condition. Since land slide and rock slope failure are not confirmed at site, the slope gradients as recommended in Table 7.2 are applied in comparison to TCVN4054.

**Table 7.2 Slope of Cut Sections**

Type and Condition of Soil/Rock	Cut Slope Gradient TCVN4054		Cut Slope Gradient Recommended	
	<12m	>12m	<12m	>12m
Cohesive soil or incohesive soil with medium to high density	1:1.00	1:1.25	1:1.00	1:1.00
Granular soil	1:1.50	1:1.75	1:1.00	1:1.00
Lightly weathered rock	1:0.30	1:0.50	1:0.30	1:0.50/ 1:0.30
Heavily weathered rock	1:1.00	1:1.25	1:1.00	1:1.00
Lightly weathered soft rock	1:0.75	1:1.00	1:0.75	1:1.00
Heavily weathered soft rock	1:1.00	1:1.25	1:1.00	1:1.00

Note from TCVN4054: As for soil excavation, height of the slope should not be over 20m. As for soft rock excavation, if the surface of the rock layer slopes outward with the slope angle above 25°, the design slope should be as steep as the rock layer surface and the height of the slope should be limited less than 30m.

- When the cut height is less than 12m, slope gradient of 1:1.0 is recommended except for lightly weathered rock and are protected by sodding.
- When the cut height is more than 12m, slope gradient of 1:1.0 is recommended except for lightly weathered rock but are protected by other methods described below. Additionally, slope stability analysis is performed for the recommended slope gradient and height.

Type and condition of soil/rock in the above table and corresponding rock class and soil type determined by the geological survey conducted are shown in Table 7.3.



**Table 7.3 Type and Condition of Soil/Rock and Corresponding Rock Class and Soil Type**

Category of Rock/Soil Layer (PKG 5)			Rock and Type	Class Soil	Type and Condition of Soil/Rock
Layer f	Fill material	Rock, soil, organics		S	Cohesive soil or incohesive soil with medium to high density
Layer b	Boulder			S	
Layer 1	Cover soil	Mud, clay, sandy clay with organics		S	
Layer 2	Fine sand		sp	S	
Layer 3	Clayish sand		sc	S	
Layer 4	Low-plasticity clay		cl	C	
Layer 5	Low-plasticity clay		cl	C	Granular soil
Layer 6	Clayish sand		sc	S	
Layer 7	Poorly sorted sand		sp	S	
Layer 8	Clayish sand		sc	S	
Layer 9	Low-plasticity clay		cl	C	
Layer 10	Silty - Clayish sand		sc-sm	S	Heavily weathered soft rock
Layer 11	Silt rock, sand rock, heavily weathered soft rock		iv-2		
Layer 12	Silt rock, sand rock, lightly weathered soft rock		iv-1		
Layer 13	Granitic rock, heavily weathered hard rock		v-2		
Layer 14	Granitic rock, lightly weathered hard rock		v-1		Lightly weathered rock

Although the result of geological boring does not indicate the existence of soft rock or rock with well-developed discontinuous surface, in case where they appear on the surface of cut slope, the gradient shall be changed in consideration of the following note \*1).

\*1) As for soft rock excavation, if the surface of the rock layer slopes outward with the slope angle above 25°, the design slope should be as steep as the rock layer surface and the height should be limited less than 30m.

#### 2) Berm Width

The width of berm shall be 2.0m in the standard section and drainage shall be equipped.

### 7.4.5 Slope Protection Design

Slope protection works shall be selected in consideration of protection works widely applied in Vietnam. Table 7.4 shows selected slope protection works for the project.

Although many slopes are left untreated in Vietnam, a common issue found in the site is that the weathering of rocks exposed on the slope surface may cause rock fall, collapse, sediment discharge or functional deterioration of structures caused by them.

Therefore, the countermeasures against weathering of slopes are selected in principle. Furthermore, considering a huge amount of rainfall of over 700mm in a month in the rainy season, drainage shall be installed on the berm and every effort shall be made to decrease the flow speed of rain water on the slope surface.

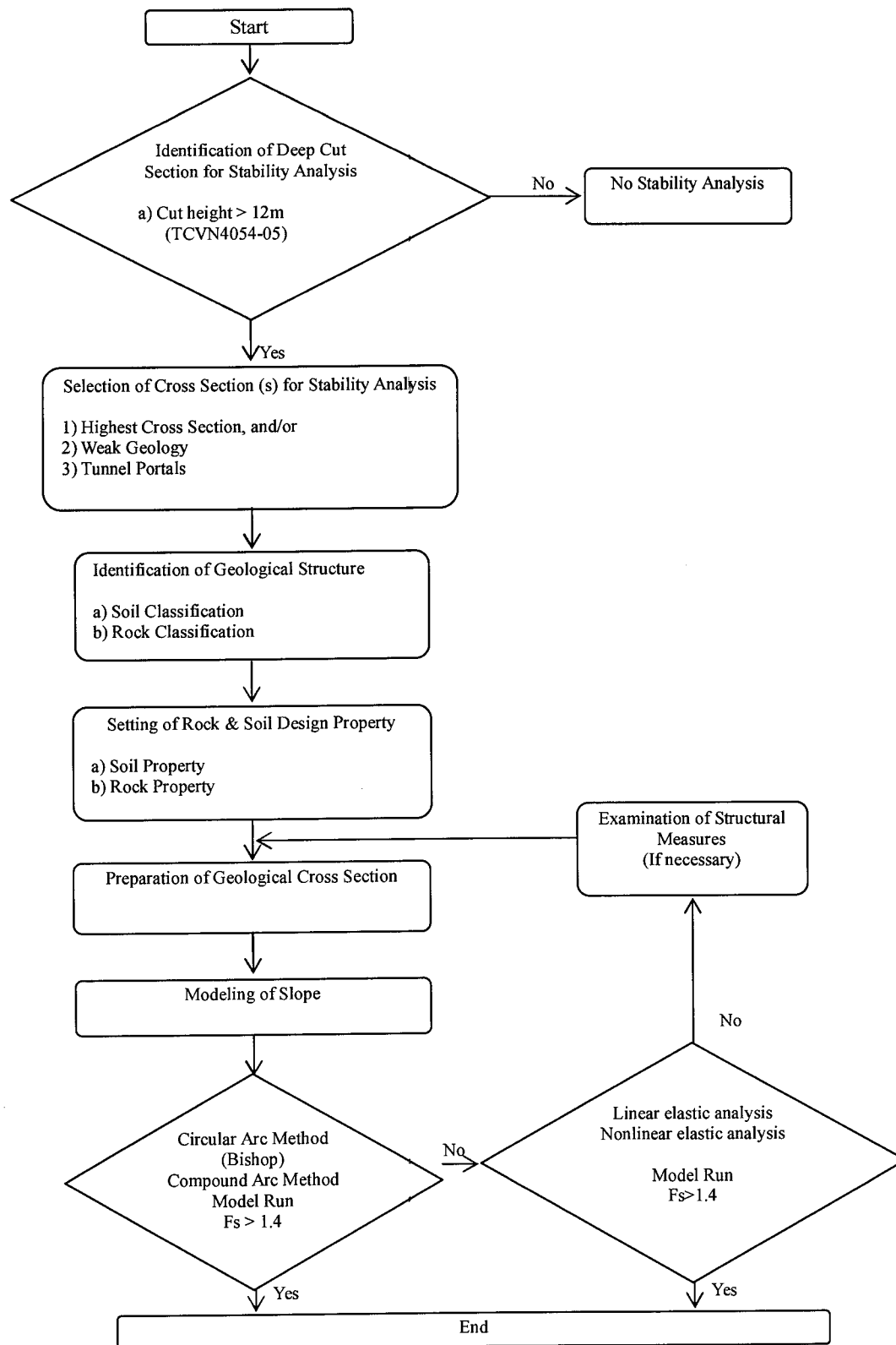
The basic patterns for specific slopes are shown in Table 7.4.

**Table 7.4 Basic Patterns of Slope Shape and Protection Works**

Type of Soil/Rock	Weathering Condition	Rock Grade	Recommended Slope Gradient		Condition of Cut Slope and Slope Protection Measure					
			h<12m	h>=12m	Symbol	a	b	c	d/e	*
Cohesive Soil			1:1.0	1:1.0	CS	Turfing	Turfing			UD,DS
			CS-h		Bl+PB	SF+SD			UD,DS	
Granular (Sandy) Soil			1:1.0	1:1.0	GS	Turfing	Turfing			UD,DS
			GS-h		PB	SF+SD			UD,DS	
Hard Rock (Granit)	Extremely (N>30)	V-3	1:1.0	1:1.0	RWg	Turfing	Turfing	--	--	UD,DP
					RWg-h	SF+PB	SF	Bl	An-a,b	UD
Soft Rock / Hard Rock	Moderately to Highly	IV-3, IV-2/ V-3, V-2	1:1.0	1:1.0	RW	Turfing	Turfing	--	--	UD,DP
					RW-h	SF+SC	SF	Bl	An-a,b	UD
Soft Rock	Fresh to Lightly	IV-1	1:0.75	1:1.0	SR	--	--	--	--	DP
					SR-h	SM	SF	Bl	An-a,b	UD,DP
Hard Rock	Fresh to Lightly	V-1	1:0.3	1:0.5/1:0.3	HR	--	--	--	--	DP
					HR-h	SF+SC	SC	Bl	An-a,b	UD,DS+DP
Item		Symbol	Description							
Symbol		CS	Cohesive Soil							
		GS	Granular Soil							
		RWg	Weathered Granitic Rock							
		RW	Weathered Rock							
		HR	Hard Rock							
		SR	Soft Rock							
Condition of Cut Slope		a	First Slope							
		b	No Joint is expected/observed							
		c	Small scale of slope falure along with joint (spacing <1.0m) is expected -> The final decision shall be made on actual geological condition of excavated cut slope.							
		d/e	The slope where more failure is expected than the above. -> The final decision shall be made on actual geological condition of excavated cut slope.							
		*	If much seepage water is expected/observed (surface, layer, piping hole, etc.)							
Structure of Slope Protection		SF	Cribwork with Shotcrete (B=200mm, 1500*1500 with anchor pin)							
		Bl	Anchor Rod + Cribwork with Shotcrete (B=200mm, 1500*1500, with steel bar L=2000)							
		An-a	Anchor Rod + Cribwork with Shotcrete (B=400mm, 2000*2000, with anchor bar L=100,000mm)							
		An-b	Anchor Rod + Cribwork with Shotcrete (B=500mm, 3000*3000, with anchor bar L=200,000mm)							
Structure of Surface Protection		PB	Precaset block facing							
		MS	Mortared Stone Works							
		SC	Shotcrete (t=10cm)							
		SD	Sodding							
Drainage Works		UD	French Drain (Wire Cylinder (Gabion), Perforated Drain Pipe, etc.)							
		DS	Geotextile Sheet							
		DP	Drain Pipe							

#### 7.4.6 Stability Analysis

Slope stability analysis for the deep excavation section were conducted for the critical sections. Work procedure of the slope stability analysis is proposed as shown in Figure 7.4. The results of the analysis are given in given in Figure 7.5 and Figure 7.6. The results of the analysis show that all the designed slopes are stable.



**Figure 7.4 Work Flow of Stability Analysis (Deep Cut)**

DA NANG - QUANG NGAI EXPRESSWAY PROJECT  
PACKAGE 3B  
STAGE: DETAIL DESIGN

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Last saved time: 1:42:26 PM  
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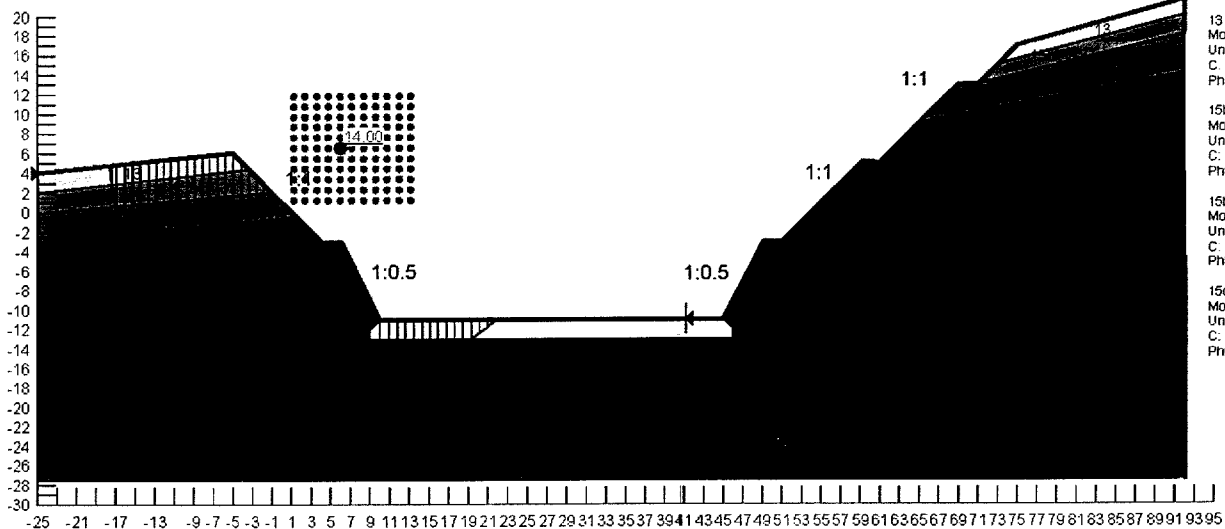
STABILIZATION TEST OF CUTTING SLOPE

KM 20+640

- Depth of Excavation: H=15.4-28.0m
- Load: q=13.0 kN/m<sup>2</sup>

- Fs>1.4 —> OK

None Treatment



Embank  
Model: MohrCoulomb  
UnitWeight: 18 kN/m<sup>3</sup>  
Phi: 30°  
13  
Model: MohrCoulomb  
UnitWeight: 18 kN/m<sup>3</sup>  
C: 0 kPa  
Phi: 25°  
15b(V-3)  
Model: MohrCoulomb  
UnitWeight: 25 kN/m<sup>3</sup>  
C: 100 kPa  
Phi: 30°  
15b(V-2)  
Model: MohrCoulomb  
UnitWeight: 25 kN/m<sup>3</sup>  
C: 100 kPa  
Phi: 30°  
15c(V-1)  
Model: MohrCoulomb  
UnitWeight: 27 kN/m<sup>3</sup>  
C: 1000 kPa  
Phi: 40°

Figure 7.5 Slope Stability Analysis at Deep Cut KM20+640 (Left)

DA NANG - QUANG NGAI EXPRESSWAY PROJECT  
PACKAGE 3B  
STAGE: DETAIL DESIGN

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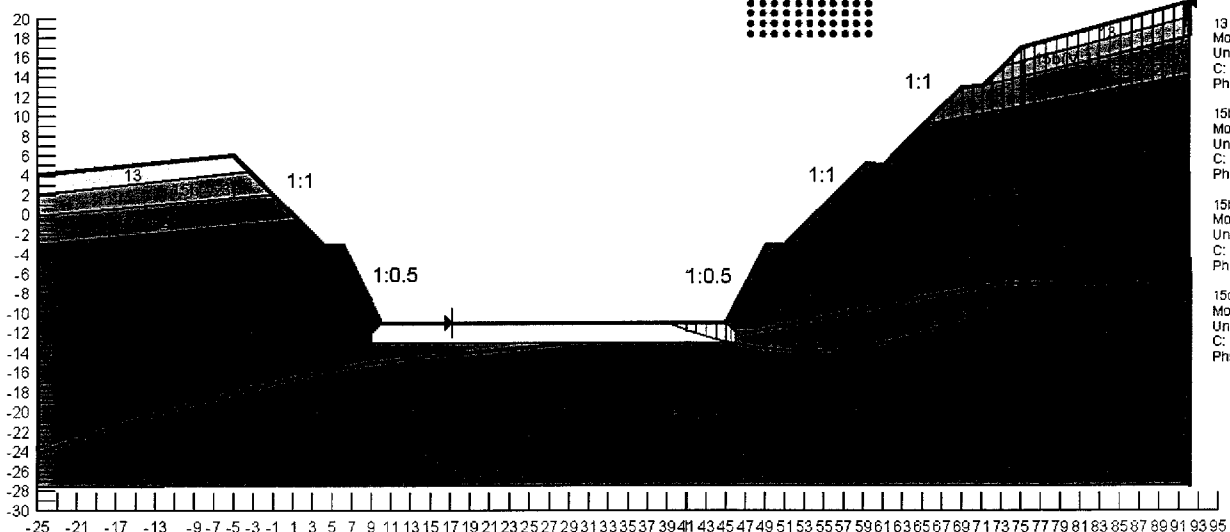
STABILIZATION TEST OF CUTTING SLOPE

KM 20+640

- Depth of Excavation: H=15.4-28.0m
- Load: q=13.0 kN/m<sup>2</sup>

- Fs>1.4 —> OK

None Treatment



Embank  
Model: MohrCoulomb  
UnitWeight: 18 kN/m<sup>3</sup>  
Phi: 30°  
13  
Model: MohrCoulomb  
UnitWeight: 18 kN/m<sup>3</sup>  
C: 0 kPa  
Phi: 25°  
15b(V-3)  
Model: MohrCoulomb  
UnitWeight: 25 kN/m<sup>3</sup>  
C: 100 kPa  
Phi: 30°  
15b(V-2)  
Model: MohrCoulomb  
UnitWeight: 25 kN/m<sup>3</sup>  
C: 100 kPa  
Phi: 30°  
15c(V-1)  
Model: MohrCoulomb  
UnitWeight: 27 kN/m<sup>3</sup>  
C: 1000 kPa  
Phi: 40°

Figure 7.6 Slope Stability Analysis at Deep Cut KM20+640 (Right)

## 7.4.7 Detailed Design

### 1) Typical Cross Section

Typical cross sections were prepared setting combination of slope gradient and protection works as shown in Figure 7.7.

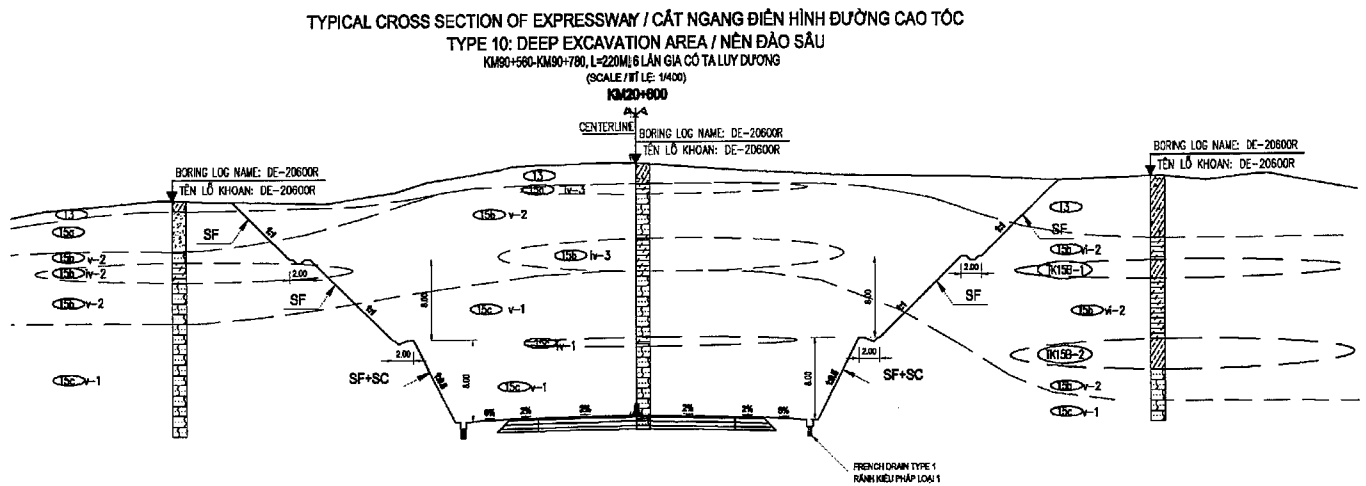


Figure 7.7 Typical Cross section

### 2) Arrangement of Protection Works for Each Cross Section

Based on the typical cross sections, slope gradient and protection works were arranged for each cross section. Arrangement plan with pitch of 40m is shown in Figure 7.8. Where the applied gradients significantly differ in consecutive two slopes, transition sections of slope gradient were arranged.

KM/	Slope	L5	L4	L3	L2	L1	R1	R2	R3	R4	R5	R6
	Berm	S4	S3	S2	S1		S1	S2	S3	S4	S5	
20+700	Slope condition											
	Gradient					1.0	1.0	1.0	1.0			
	Protection					--	SF+SC	SF	SF			
20+660	Slope condition											
	Gradient				1.0	0.75	0.75	1.0	1.0			
	Protection				SF	SF+SC	SF+SC	SF	SF			
20+620	Slope condition											
	Gradient			1.0	1.0	0.5	0.5	1.0	1.0	1.0		
	Protection			SF	SF	SF+SC	SF+SC	SF	SF	SF		
20+580	Slope condition											
	Gradient		1.0	1.0	1.0	0.5	0.5	1.0	1.0			
	Protection		SF	SF	SF	SF+SC	SF+SC	SF	SF			
20+540	Slope condition											
	Gradient			1.0	1.0	0.5	1.0					
	Protection			SF	SF	SF+SC	SF					
20+500	Slope condition											
	Gradient					1.0	1.0					
	Protection					SF	--					

- \* In case where more than one slope conditions are expected in a single step, the mildest gradient shall be applied.
- \* s1, s2, s3, s4 mean the wide berm (w=2.0m).
- \* The slopes are revised for better transitioning for each section in the design.

Figure 7.8 Arrangement plan of Slope Protection Works

## **8 PAVEMENT DESIGN**

### **8.1 Pavement Thickness in Normal Embankment of Expressway**

The designed pavement thickness in Package 3B for normal embankment of expressway mainline is given as;

#### **1) Normal Section**

Asphalt Concrete Anti-Skid	:	3cm (not applied in emergency shoulder lane)
Asphalt Concrete Surface	:	5cm
Asphalt Concrete Binder	:	8cm
Cement Treated Base	:	15cm
Aggregate Base Type-I	:	30cm
Aggregate Subbase Type-II	:	30cm
<b>TOTAL</b>	:	<b>91cm</b>

#### **2) Deep Cut (Rock) Sections**

Asphalt Concrete Anti-Skid	:	3cm (not applied in emergency shoulder lane)
Asphalt Concrete Surface	:	5cm
Asphalt Concrete Binder	:	7cm
Asphalt Treated Base	:	10cm
Aggregate Base Type-I	:	25cm

The pavement is designed for  $E_{yc} \geq 200\text{MPa}$  and the total thickness of the pavement is 91cm. The anti-skid asphalt concrete layer is not applied in the emergency shoulder lane. A minimum of 30cm of subgrade is designed with a compaction degree of 98%. The design CBR value of the subgrade is  $\geq 9\%$ .

### **8.2 Pavement Thickness in Excavation on Hard Rock**

The designed pavement thickness in excavation on hard rock, 15cm (along the cross section) of base course Type-I is recommended on top of a minimum 10cm of leveling base course Type-I. Asphalt concrete layers anti-skid, surface, binder and asphalt treated base of 3cm, 5cm, 7cm and 10cm respectively are applied. The construction of subgrade and subbase layers are not required at such locations, but shall be confirmed by the Engineer.

### **8.3 Pavement Thickness in Common Excavation**

In general, when the finished grade requires common excavation on hill, all the pavement layers from the 30cm of subgrade layers are recommended to be constructed. If the compaction requirement and CBR value of the existing road bed are confirmed to satisfy the design requirements, the construction of subgrade layer may be omitted, as directed by the Engineer.

### **8.4 Pavement Structure for Crossing Roads and Frontage Roads**

For Class AH road, bituminous surface treatment of 3cm thick is applied with 18cm of aggregate base (Type-I).

For rural Class A, B and C, cement concrete (C20) pavement of 18cm thick over 12cm of compacted sand is applied.

## **9 DRAINAGE DESIGN**

### **9.1 General**

Storm drainage design is an integral component in the design of expressway. Drainage design for expressway must strive to maintain compatibility and minimize interference with existing drainage patterns, control flooding of the roadway surface for design flood events, and minimize potential environmental impacts from expressway related storm water runoff.

Effective drainage of expressway pavements is essential to the maintenance of expressway service level and to traffic safety. Water on the pavement can interrupt traffic, reduce skid resistance, increase potential for hydroplaning, and limit visibility due to splash and spray, and cause difficulty in steering a vehicle when the front wheels encounter puddles. Pavement drainage requires consideration of surface drainage, gutter flow, and inlet capacity. The design of these elements is dependent on storm frequency and the allowable spread of storm water on the pavement surface.

For this Project, most of the drainage works shall be planned and designed in accordance with the following Standards and Specifications:

- TCVN 5729-1997 : Vietnamese Design Standards for Expressway;
- TCVN 4054-2005 : Vietnamese Design Standards for Highway;
- 22 TCN 273-2001 : Vietnamese Standard for Designing Highway;
- 22 TCN 272-2005 : Vietnamese Specification for Bridge Design (based on AASHTO LRFD Bridge Design Specifications, Second Edition, 1998);
- Other relevant Standards, design requirement and guidelines for highway drainage works.

The main river system in Package 3B is Chiem Son river. Details of Chiem Son river system is described in Hydrological and Inundation Reports.

### **9.2 Design Frequency and Design Spread**

Two of the more significant variables considered in the design of expressway pavement drainage are the frequency of the design rainfall and runoff event and the allowable spread of water on the pavement. A related consideration is the use of an event of lesser frequency to check the drainage design.

The objective of highway storm drainage design is to provide for safe passage of vehicles during the design storm event. The design of a drainage system for a curbed highway pavement section is to collect runoff in the gutter near the asphalt curb and convey it to pavement drainage inlets, provided at interval along the asphalt curb, and then discharge it through the connecting inclined drains (or vertical drain) into the longitudinal side ditch, generally located at or near the toe slope of the highway embankment (called a toe slope ditch) in a manner that will provide reasonable safety for traffic.

According to the Vietnamese Standards mentioned above, the longitudinal side ditch is not necessary to be provided at all sections. It shall be provided only on the cut section, the embankment fill with the height of 0.6 m or less, the residential section, the collector road section, the section closed to the existing stream (or river). Besides these sections, it is not necessary to provide the side ditch. And it should be noted that as spread from the curb increases, the risks of traffic accidents and delays also increase.

For this project, Design Frequency and Design Spread are as follows:

- Design frequency of pavement drainage is 4% (25 years return period);
- Design spread of pavement drainage is 3m (width of an emergency lane).

### **9.3 Storm Drainage System**

Storm drainage system shall include the following structures:

- i) Asphalt curb
- ii) Vertical drainage structure
- iii) Side ditch

### 9.3.1 Asphalt Curb

located along the lower edge of an emergency lane of the expressway. Height of the asphalt curb is 12 cm to prevent storm water on the pavement surface from discharging directly over the side slope. This structure is generally installed in all embankment sections, except for the elevated edge of a super elevation section (where the drainage system is provided at the median to collect and drain the storm water).

Spacing of the drainage inlets (L) along the asphalt curb is designed based on the design rainfall and the allowable spread of water on the pavement as previously mentioned. However, the maximum height of the surface water flowing along the gutter contacting with the asphalt curb on each side of the expressway is limited to 9 cm for calculation of the gutter flow rate and the spacing of the inlets to the vertical drains.

The Rational formula and the Manning equation are adopted to compute the flow rate of surface runoff and its cross-sectional area and flow rate of gutter flow for each trial value of distance between the drainage inlets (L) for a required discharge through each vertical drains. The data provided from the road design team included the longitudinal slope or the vertical profile slope (J) and the cross slope in different sections of the expressway are also adopted in the computation.

The designed spacing of the drainage inlets (L) for different ranges of the longitudinal slope (J) of portions of the expressway can be summarized as follows:

- If  $J \leq 0.4\%$   $L = 100\text{m}$ ;
- If  $0.4\% < J < 0.6\%$   $L = 125\text{m}$ ;
- If  $0.6\% \leq J < 0.8\%$   $L = 150\text{m}$ ;
- If  $0.8\% \leq J < 1.0\%$   $L = 175\text{m}$ ;
- If  $1.0\% \leq J$   $L = 200\text{m}$ .

### 9.3.2 Vertical Drainage Structure

located on the slope of the roadway embankment. It is functioned to collect water from the inlet along the asphalt curb and discharge to the side ditch or to the existing ground. This structure is made of mortared stone masonry and is an open channel with inclined bed or, in some special cases, with a step-type bed; connecting to catch basins without or with gabion at the end.

### 9.3.3 Side Ditch

located at the end of talus. It is functioned to collect water and discharge to proper locations and many types are designed according to the conditions as follows:

- Cut section: concrete type
- Embankment fill with height (H) = 0.6 m or less: concrete type
- Scouring/seepage protection section: mortared stone or concrete type
- Residential section: earth type
- Collector road section: earth type
- Nearby the rivers or streams: earth type (except where the irrigation canal joins to the side ditch, a concrete paved type shall be used)



In general, the side ditch will discharge the collected water to the existing stream, river, or to the existing ground. In case of discharging water to the existing ground, the catch basin with gabions shall be installed at the end or discharge location of the side ditch to protect the existing ground from scouring or erosion.

For high embankment (normally more than 3 m), an embankment berm ditch may be used to intercept and drain the excess water from embankment slopes in the same way like the side ditch. For high cut sections (normally more than 3 m), a top ditch and a cut berm ditch may also be used to intercept and drain the excess water from cut slopes in the same way like the side ditch and the embankment berm ditch. The water from these ditches mentioned above will be diverted and discharged directly to the existing streams, rivers and other receiving water sources (if it is possible).

#### 9.3.4 Surface Drainage at Super-elevated Sections

In super-elevated sections, the asphalt curb shall be installed only in lower shoulder side. The surface water from elevated side is collected by a U-shape median ditch, BxH = 0.35x0.40 m under the New Jersey barrier median. At the end of the median ditch, a D0.80 m pipe culvert is used to drain the collected water out to the road side.

#### 9.4 Runoff Discharge Calculation

One of the most commonly used equations for the calculation of peak flow from small areas (not more than 20 sq.km) is the Rational formula, given as:

$$Q = (CIA)/K_u$$

where:

- Q = Peak flow rate in cu.m/sec
- C = Dimensionless runoff coefficient
- I = Rainfall intensity (for a short period duration) in mm/hr
- A = Drainage area in hectares (ha)
- K<sub>u</sub> = Unit conversion factor equals to 360

The runoff coefficient C is a function of the ground cover and a host of other hydrologic abstractions. It relates the estimated peak discharge to a theoretical maximum of 100% runoff. Typical values for C are given in Table below. If the basin contains varying amounts of different land cover or other abstractions, a composite coefficient can be calculated through areal weighing.

**Table 9.1 Runoff Coefficients for Rational Formula**

Type of Drainage Area	Runoff Coefficient, C*
<b>Residential:</b>	
Single-family areas	0.30 - 0.50
Multi-units, detached	0.40 - 0.60
Multi-units, attached	0.60 - 0.75
Suburban	0.25 - 0.40
Apartment dwelling areas	0.50 - 0.70
<b>Industrial:</b>	
Light areas	0.50 - 0.80
Heavy areas	0.60 - 0.90
Parks, cemeteries	0.10 - 0.25
Playgrounds	0.20 - 0.40
Railroad yard areas	0.20 - 0.40
Unimproved areas	0.10 - 0.30
<b>Lawns:</b>	
Sandy soil, flat, 2%	0.05 - 0.10
Sandy soil, average, 2 - 7%	0.10 - 0.15
Sandy soil, steep, 7%	0.15 - 0.20
Heavy soil, flat, 2%	0.13 - 0.17

Type of Drainage Area	Runoff Coefficient, C*
Heavy soil, average, 2 - 7%	0.18 - 0.22
Heavy soil, steep, 7%	0.25 - 0.35
<b>Streets:</b>	
Asphaltic	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85

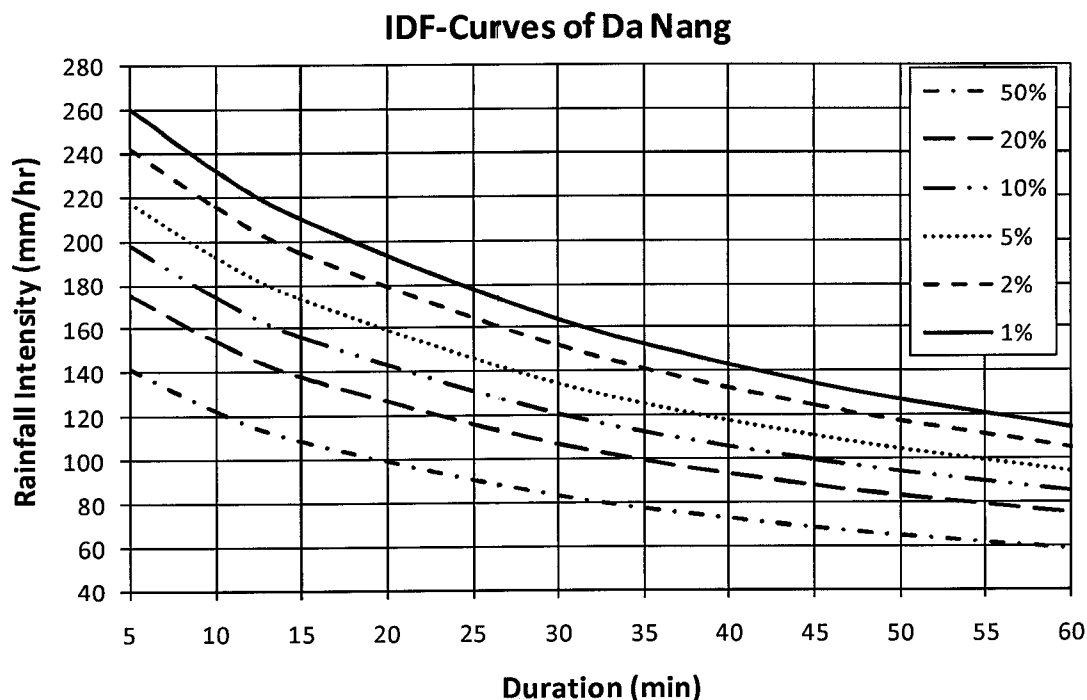
Rainfall intensity, duration, and frequency curves are needed data for the Rational method calculation. Rainfall IDF (Intensity-Duration-Frequency) curves at Danang previously prepared by our Hydrology study team are adopted in the calculation of the peak flows from small drainage areas. The result of rainfall IDF curve analysis and its values estimated for further uses are shown in the Tables and Figure below.

**Table 9.2 Rainfall IDF-Curve Constants**

Recurrence Probability		Constants		
% P	Year	n	a	b
50	2	0.8333	2667.313	14.992
33.3	3	0.8333	3068.609	15.497
20	5	0.9091	4804.695	23.028
10	10	0.9174	5684.649	24.372
5	20	0.9434	7097.925	28.096
4	25	0.9434	7325.981	28.200
2	50	0.9709	9050.138	32.677
1	100	0.9709	9812.921	32.926

**Table 9.3 Rainfall Intensity for Short Duration at Danang**

Duration	Rainfall Intensity (mm/hr)							
	50% P	33.3% P	20% P	10% P	5% P	4% P	2% P	1% P
5	142	159	176	198	217	224	242	260
10	122	138	154	174	192	198	215	232
15	109	123	138	156	173	178	194	210
30	83	94	107	121	134	138	151	163
45	69	78	88	99	110	114	124	134
60	59	67	75	85	94	97	105	114



**Figure 9.1 Rainfall IDF-Curves of Da Nang**

Based on the Tables and Figure shown above, short duration rainfall intensities of 5, 10, 15, 30, 45 and 60 min can be estimated for 1%, 2%, 4% and 5% probability levels from the IDF relations. For instance, 5-min design rainfall intensities are: 260 mm/hr (1%P), 242 mm/hr (2%P), 224 mm/hr (4%P) and 217 mm/hr (5%P). Similarly, 60-min design rainfall intensities are: 114 mm/hr (1%P), 105 mm/hr (2%P), 97 mm/hr (4%P) and 94 mm/hr (5%P).

In case the drainage area is larger than 20 sq.km, the Rational method should not be adopted because there will be higher errors in the calculation result. Most hydrologists are likely to use the other methods, for instance, Unit Hydrograph, Regional Flood Curves, etc., for the estimation of the peak flow rate for a specific region or drainage area.

More details on the hydrological analysis and the hydraulic calculation for the required opening areas and proposed sizes of all relevant drainage structures of the Project are presented in the Hydrological Report and Inundation Study Report of the Project prepared by the related study teams.

### **9.5 Calculation and Design of Drainage Channel and Structure**

The required opening area for a design discharge of the drainage structure can be calculated by using a hydraulic formula as shown below:

$$A = Q/V$$

Where,

A = Minimum opening area of the structure in sq.m

Q = Design discharge or flow rate in cu.m

V = Allowable velocity of flow in m/sec

To obtain the required opening area for a known design discharge of the drainage structure or channel by this formula, it needs to assume the allowable velocity of flow to be not more than 2.5 m/sec for the concrete or mortared stone ditch or culvert. For the earth ditch or channel which may be eroded easily from the flow, the design velocity of flow should not be more than the maximum permissible velocity for each type of its soil texture in the channel bed and side slopes as recommended in the

following section

The alternative approach to determine the flow velocity of an open channel or structure can be carried out by using the Manning equation as follows:

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

Where,

V = Velocity of flow in m/sec

n = Manning roughness coefficient

R = Hydraulic radius in m (where  $R = A/P$ , and P = Wetted Perimeter in m)

S = Slope of the channel

The Manning Roughness Coefficient (n) varies with the type of materials used for the drainage structure or ditch or channel. The values shown in the following Table are recommended to be adopted for calculation of its flow capacity.

Type of Material	Manning Roughness Coefficient (n)
PVC Pipe (for Storm & light Sewer Drains with Junctions & Joints, Open Channel Flow)*	0.012
Concrete Pipe or Box Culvert (pre-fab.)	0.013
Concrete Pipe or Box Culvert or Ditch	0.015
Rock-cut Ditch (smooth /uniform)	0.033
Mortared Stone Ditch	0.040
Earth Ditch (straight /uniform)	0.035

**Note:** \* For PVC Pipe (straight, smooth joints, ->full pipe flow), Manning "n" varies from 0.009 to 0.010.

Besides the formulae mentioned above, the following factors should also be considered in designing of appropriate sizes of the drainage channel, ditch or structure:

(i) **Tractive Force:** To check the possibility of erosion (scouring) and sedimentation on the designed open channel, particularly the earth channel or ditch, it is also necessary to determine the unit tractive force generated in the channel which can be calculated from the following formula:

$$T = WRS$$

Where

T = Unit tractive force in kg/sq.m

W = Unit weight of water = 1,000 kg/cu.m

R = Hydraulic radius in m

S = Slope of energy gradient = Slope of channel bed

The unit tractive force should be between 0.30 and 0.50 kg/sq.m which is the safe value that erosion and sedimentation will not occur in the designed open channel or drainage ditch (based on "Open Channel Hydraulics" by Ven Te Chow, 1959).

(ii) **Maximum Permissible Velocity:** Because the possibility of erosion (or scouring) on the designed open channel, particularly the earth channel or ditch, increases with the increased flow velocity, the design velocity should not be more than the maximum permissible velocity recommended by the U.S. Bureau of Reclamation. The maximum permissible velocity depends on the soil texture at the bed and side slopes of the earth channel as follows:

Soil Texture	Maximum Permissible Velocity (m/sec)
Stiff Clay	1.22
Sandy Loam	0.76
Fine Sand	0.46

To adopt the values shown above, the side slopes of the channel should be designed not to be so steep and they should be stable enough for slope stability. For instance, a side slope of 1 : 1.5 will be suitable for the cohesive sandy soil and sandy clay soil, while a side slope of 1 : 1 will be suitable for the stiff clay soil.

**(iii) Minimum Permissible Velocity:** Besides possibility of erosion (or scouring), sedimentation on the designed open channel should also be taken into account. Because the possibility of sedimentation increases with the decreased flow velocity, the design velocity should be more than the minimum permissible velocity recommended by the U.S. Bureau of Reclamation which is 0.30 m/sec to prevent sedimentation of silt and sand carried along the channel by the water.

**(iv) Freeboard:** In general, the freeboard for a drainage channel or ditch is the difference in elevations between the existing ground and the maximum designed water level. It is recommended that a minimum freeboard of 0.10 m should be provided. The maximum water level in the upstream branch should also be designed in such a way that the water can flow by gravity through its outlet to a downstream main drainage channel, stream, river or receiving water retention area.

## 9.6 Calculation and Design of Drainage Road Culvert

The required opening area for the drainage road culvert (box and pipe culverts), particularly the cross-drainage structure) is calculated based on the maximum peak flow that can pass through the expressway for the adopted design frequency without overtopping the traffic road surface. The detailed results are presented in the Hydrological Report and Inundation Study Report previously prepared by the Hydrological Study Team and the Inundation Study Team of this Project respectively.

Design of the road culvert for drainage purposes is carried out based mostly on the results of Hydrological study and Hydraulic calculation presented in the Reports referred above. Only some additional calculations are made for the other additional structures required for drainage works, such as the longitudinal drainage culvert along the road median, or are supplemental to the previously calculated results.

The following guidelines are adopted in the structural design of the box culverts for drainage purposes:

- 1) The calculation should be made for the condition: without water in the culvert.
- 2) The minimum depth of fill above the top of culvert should be 0.60 m for the traffic road, if it is applicable.
- 3) The guidelines for application of traffic loads on the culvert should be adopted in the structural analysis. The recommended guidelines are the 22 TCN 272-2005 Specification
- 4) In case that the fill above the top of culvert is less than 0.60 m, the wheel load should be applied directly on the culvert (not a distributed load).
- 5) In case that the fill above the top of culvert is more than 0.60 m, application of the wheel load on the culvert can be neglected.

But in general, structural calculation and reinforcement arrangement for detailed design of all culverts in this Project shall be carried out in accordance with the following Standards:

- TCXDVN 372-2006: Vietnamese Standard Specification for R.C. Pipe for Drainage (Revised Version) (for Precast Pipe Culvert from Commercial Factory; e.g. D0.80 in the Project vicinity)
- 22 TCN 159-1986: Vietnamese Standard Specification for R.C. Pipe Culvert (Old Version) (for Precast Pipe Culvert from Commercial Factory; e.g. D0.80 in the Project vicinity)
- 533-01-01 & 02-1988: Vietnamese Standard Drawings for R.C. Pipe Culvert under Road by TEDI for Nominal Sizes: D0.50, D0.75, D1.00, D1.25 & D1.50, D2.00, respectively (for Precast Pipe Culvert to be produced with quality control at Site by Construction Contractor); – *This one shall be applied for detailed design of the Precast Concrete Pipe Culvert for the Project*
- TCXDVN 392-2007: Vietnamese Standard Specification for Precast R.C. Box Culvert – Technical Requirements and Testing Methods (for Precast Box Culvert from Commercial Factory; e.g. up to Size 2.0x2.0 in the Project vicinity)
- 22 TCN 272-2005: Vietnamese Standard Specification for Bridge Design (based on AASHTO LRFD Bridge Design Specifications, Second Edition, 1998) – *This one shall be applied for detailed design of the Cast In-situ Concrete Box Culvert (and Underpass) for the Project*

Structural calculation and reinforcement arrangement for all Box Culverts (for Drainage, Waterway and Underpass) in this Package is presented and summarized separately in Volume 4.1: Structural Calculation Report (PKG3B, Box Culverts).

## **9.7 Drainage Design for Bridge, Overpass and Flyover**

### **9.7.1 Introduction**

Deck drain gutter and grate inlet type of catch pit will be used to capture pavement surface runoff occurred during a storm runoff event and divert it down via grate inlets installed at interval along the gutter on both edges of the bridge (or overpass) or flyover deck. From the inlet, the runoff will be discharged into a short vertical connecting pipe or directly discharged into a vertical leg of a T-shape pipe fitting and further drained into the collecting pipeline which is normally laid longitudinally under the bridge or flyover deck at the same designed slope as the bridge deck slope. Many inlets can be connected to the same collecting pipeline depending on the inlet spacing and inlet numbers required to drain the pavement surface runoff effectively. The end of the longitudinal pipeline will be connected with the vertical pipe laid along the exposed vertical wall of the bridge or flyover abutment (or in some cases, along the vertical wall of the bridge or flyover pier) before all of the collected runoff is drained through the inclined or vertical pipe outlet or down spout to the at-grade drain, ditch and/or catch basin which will further discharge the water to the nearby drainage system (or in some cases, drained directly into the existing swamp, stream or river under the bridge). The at-grade drain which is crossing under the bridge or flyover will further convey the runoff to the public waterways or the existing streams or rivers.

Besides, there is a suggestion that the proposed drainage outlet should be avoided to drain directly on the cross roads passing under the bridge or flyover. As for the canal or the main channel of river, the proposed drainage outlet should also be avoided to drain directly on it as much as applicable. And in some conditions for the bridge or flyover other than the major river bridge, installation of the inlets or catch pits on the bridge deck surface is not required. For example in the case that it is planned to install the expansion joint on the bridge or flyover, the catch pits may be installed at least in front of it only. But in the case that the portal rigid frame is planned to be used as the bridge or flyover structure, the catch pit is not required on the bridge deck surface, the deck drain will be joined to the road side ditches behind the abutments.

For all bridges and flyovers in this Project, except the Major River bridges, the catch pit with

grating at the inlet shall be a pre-fabricated Cast Iron type in accordance with AASHTO M105/ASTM A48M Standard. Such catch pit with grate inlet shall be strong enough to bear the design loads specified for the bridge or flyover (22 TCN 272-2005: Specification for Bridge Design). The round-shaped grate inlet is common in Vietnam. However, in consideration of the characteristics of heavy rain in the Project area, the rectangular-shaped type will be adopted to catch the surface water effectively. From the calculation, a 400 x 300 mm grate inlet for the catch pit is selected to be used for the other bridge and flyover in this Project.

The type of pipes to be used for such deck drainage purpose shall be a Polyvinyl Chloride (PVC) pipe in accordance with TCVN 6151-1996 or ASTM A53 Standards. The vertical pipe or T-shape fitting shall be fitted to the circular-shape outlet of the catch pit. The minimum diameter of the collecting pipe and down spout is calculated based on the pipe slope and the accumulated amount of runoff in the pipe from upstream to downstream sides. A nominal diameter of the collecting pipe and its vertical or inclined down-spout is determined to be 225 mm or 200 mm (minimum size) with the minimum inlet spacing (or interval) required varies from about 5 to 30 m, depending on the calculation for different sizes. However, a general minimum spacing of 15 m can be adopted for most of the bridge and flyover proposed for this Package.

In summary, for the drainage design of the bridge, overpass and flyover in this Package, a 400 x 300 mm grate inlet for the Cast Iron catch pit (470 mm total depth) shall be used to capture the pavement surface runoff. For the vertical or inclined down-spout pipe, and the longitudinal collecting pipe (if needed), a PVC pipe of 200 or 225 mm Nominal Diameter (DN) with allowable Nominal Pressure (PN) of 6.6 bar (or 0.66 Mpa) or PN6 class shall be used.

### **9.7.2 Design Criteria and Concepts**

#### **(1) Frequency of Rainfall and Rainfall Duration:**

The maximum rainfall intensity of frequency 25 years (probability = 4%) at a rainfall duration of 5 minute is adopted for design of the bridge deck drainage for the bridge and flyover in this Package. It is 224 mm/hr from the Danang Rainfall Intensity-Duration-Frequency (IDF) curves.

#### **(2) Peak Flow Calculation:**

One of the most commonly used equations for the calculation of peak flow from small areas (not more than 20 sq.km) is the Rational formula as given above.

A value of 'C' of 0.86 is adopted for the calculation of the deck drainage based on the type of the pavement and the deck surface.

As for the drainage area, 'A', in this formula, it is the result of different inundated widths on the sloped pavement surface multiplied by the trial value of inlet interval (or spacing). The inundated width is the allowable spread of water on the pavement. The design speed is important to the selection of the design criteria on this matter. At speeds greater than 75 km/hr, it has been shown that water on the pavement can cause hydroplaning which a risk of accident from uncontrollable driving will be higher.

Therefore, the spread of water is not allowed on the traffic lanes of the main road (thru-way) of expressway on which the maximum allowable speed is 120 km/hr, the spread will be allowed only on the emergency lane closing to the parapet, i.e. the maximum spread (inundated width) is 3.25 m for the main road (thru-way) of expressway and sometimes 2.75 m for one side of the overpass depending on the overpass design.

For the flyover and the bridge in the Interchange, the maximum allowable speed is generally less than 75 km/hr. The spread on traffic lanes can be tolerated to greater widths where traffic volumes and speeds are low. Spreads of one-half of a traffic lane or more are usually considered a minimum type design for low-volume local roads. This is also specified in a Vietnamese Standard: 22 TCN 273-2001, "Standard for Designing Highway (junctions)". Therefore, in this Project, the allowable spread of water will be extended from the inside edge of parapet to one-half of the traffic lane (normally without an emergency lane), i.e. the maximum spread (inundated width) is ranged from 1.00 - 3.25 m for the flyover in this Package depending on the flyover design.

### **(3) Calculation and Design of Drainage Pipe and Inlet Spacing:**

The required opening area for a design discharge of the drainage structure/pipe can be calculated by using a hydraulic formula as shown below:

$$A = Q/V$$

Where A = Minimum opening area of the structure/pipe in sq.m

Q = Design discharge or flow rate in cu.m

V = Allowable velocity of flow in m/sec

To obtain the required opening area for a known design discharge of the drainage structure/pipe or channel by this formula, it needs to assume the allowable velocity of flow to be not more than some values, e.g. a value of 2.5 m/sec for the concrete or asphaltic surface of the pavement on the bridge deck or a value of 3.0 m/sec for the PVC drainage pipe. For safety purposes, the maximum design flow in the longitudinal pipe shall be a value which is not more than 90% of the full-pipe capacity. In that case, the pipe flow will be likely an open-channel flow.

The alternative approach to determine the flow velocity of an open channel or structure can be carried out by using the Manning equation as provided before.

The Manning 'n' adopted for calculation of the surface runoff in this case is 0.013 which is suitable for the smooth surfaces of the surface water open channel flow or gutter flow closed to the parapet.

#### **9.7.3 Drainage Calculation method**

##### **(1) Deck Drainage**

###### **(a) On-Deck drainage**

The bridge, overpass and flyover in this Package: use rainfall intensity of frequency 25 years (probability = 4%) and rainfall duration equal to 5 minutes, which can obtain the rainfall intensity from the Danang IDF to be 224 mm/hr.

Determining the inlet overflow capacity by using overflow velocity equaled to the Critical Velocity ( $V_c$ ) which can be determined by this expression:

$$V_c = \sqrt{2gh}$$

Where g = acceleration due to gravity

h = average height of water when the width of ponding is equaled to the maximum allowable spread of water from the inside edge of the parapet as mentioned above

Then calculate inlet capacity by this expression

$$Q = VA$$

Where Q = Inlet capacity

V =  $V_c$  = Critical Velocity

A =  $L.Y_c$  = Overflow area, where

L = Overflow length,  $Y_c$  = Critical overflow depth, simplified to be  $2/3 h$

The applied size of catch pit (with grate inlet) shall have the capacity twice of the calculated size due to clogging. Therefore, the catch pit size for the bridge and flyover is 400 x 300 x 470 (depth) mm, spacing at a minimum acceptable value of 15 m. interval (in general case).



### **(b) Collecting pipeline**

Collecting Pipe (including connecting pipe): use PVC pipe in accordance with TCVN 6151-1996 or ASTM A53 Standards. The following requirements are also adopted:

the minimum pipe nominal diameter (DN) is 225 mm. (for vertical pipes, 200 mm is allowed).

The minimum longitudinal slope of pipe is 2% (preferable).

Full pipe flow velocity is calculated by using Manning formula from the pipe slope and pipe size selected by trial. The designed pipe size and slope shall be able to accommodate the accumulated runoff at all locations along the pipeline. However, such accumulated runoff at each location should not be larger than 90% of the pipe full flow capacity at the location. Therefore, Manning "n" used for the longitudinal PVC pipe is 0.012 (see Table of "n" in Sub-section 9.5).

Summary of Designed Collecting Pipe (including connecting pipe):

Pipe material: PVC (conforming to TCVN 6151-1996, ASTM A53 Standards)

Nominal Pressure: PN6 (= 0.66 MPa)

Nominal Diameter: DN 200 and DN 225 (outside diameters = 200.0 and 225.3 mm, respectively)

### **(c) Summary of the calculation**

Summary of the calculation includes surface runoff, spacing of inlets (inlet interval), sizes of pipe, etc. are shown in Volume 6.

## **9.8 Designed Cross Drainage Structures**

Cross drainage structures comprise culverts and approached canals, streams or rivers. For the expressway, the minimum size of pipe culvert adopted is D1.50 m. In case the approached canal, stream or river needs to be relocated, its minimum size will be designed to be equaled or larger than the existing one and should follow requirements of the managing agencies.

The designed cross drainage pipe culverts and box culverts in this Package (in Mainline and IC of the expressway) are given in Table 9.4 and Table 9.5 respectively.

**Table 9.4 Designed Cross Drainage Pipe Culverts in Package 3B**

SN	Station	Pipe Dia. (m)	Angle (degree)	Length (m)	Flow Direction	Function	Remarks
1	21+295.00	1-D1.50	R70	70.12	R->L	Irrig. Canal	
2	21+365.00	1-D1.50	90	61.00	L>R	Topo	Added

**Table 9.5 Designed Cross Drainage Box Culverts in Package 3B**

SN	Station	Size (m)	Angle (degree)	Covering (m)	Length (m)	Flow Direction	Function	Remarks
1	20+900.00	3-(3.0x3.0)	90	4.23	43.83	R->L	Basin	Adj.fr.Sta.20+860
2	21+150.00	1-(3.0x3.0)	90	5.55	56.75	R->L	Basin	Adj.fr.Sta.21+000

## 10 DESIGN OF CROSSING ROADS AND FRONTAGE ROADS

### 10.1 Design of Crossing Roads

The locations, where crossing facilities are designed for the existing local roads crossing the expressway, are given in Table 10.1. The approach roads are also included in the design of crossing roads.

**Table 10.1 List of Crossing Roads in Package 3B**

Proposed Locations and Class					Clearance		Pavement Type	Remarks
SN	Station	Class	Type	Angle	Horizontal	Vertical		
1	18+282.25	Rural A	Under Bridge	90	5.0	3.5	Cement concrete	Diverted under the bridge
2	18+907.50	Rural C	Under Bridge	90	3.0	3.0	Cement concrete	Diverted under the bridge
3	19+092.00	Rural B	Under Bridge	90	4.0	3.0	Cement concrete	Diverted under the bridge
4	19+578.35	Rural B	Under Bridge	90	4.0	3.0	Cement concrete	Diverted under the bridge
5	19+636.09	Rural C	Under Bridge	90	3.0	3.0	Cement concrete	Diverted under bridge at Km19+334
6	20+700.00	Class AH (VI)	Flyover	R70	6.5	4.5	Bituminous surf.treatment	

### 10.2 Design of Frontage Roads

Frontage roads are designed at locations where the crossing facilities are not designed for the crossing roads and are diverted to nearest crossing facility.

The frontage roads are designed with the same road classification as the respective road of concern. The list of frontage roads designed in Package 3B is given in Table 10.2.

**Table 10.2 List of Frontage Roads in Package 3B**

S.N.	Station		Side	Class	Length	Type of pavement
	From	To				
1	18+081.12	18+678.30	Left	Rural A	1511.90	Cement concrete
2	18+068.80	18+346.25	Right	Rural A	277.34	Cement concrete
3	19+636.09	19+732.66	Right	Rural C	181.01	Cement concrete

### 10.3 Design of Evacuation Area during Flood

An evacuation space during flood with an area of 1000sq.m has been designed at the east side edge of the embankment at about Km18+700. The width of the space is 10m and is designed with stairs. It was designed as per the request from the local authority.

## 11 MISCELLANEOUS DESIGN

### 11.1 Provision for Emergency Opening of Median

Each unit of the median concrete barrier is normally designed with a length of 4m. Based on the Vietnamese Standard TCVN5729-1997, the expressway is required to be designed with a provision of emergency opening of median at every 2km to 4km and near the tunnel and major bridges. Based on the same standard, the length of the opening provision shall be 25m to 30m. Therefore, the unit of median concrete barrier is designed with a length of 1m at every 4km for this project, so that the median can be easily moved during emergency. The length of the opening provision is designed for a length of 28m, which is 7 units of normal median concrete barrier.

### 11.2 Traffic Safety Design

#### 11.2.1 Traffic Sign

Basically there are 4 types of traffic signs as given below;

- Kilometer Station
- Bridge Name
- Traffic signs at interchange
- Traffic signs at parking area

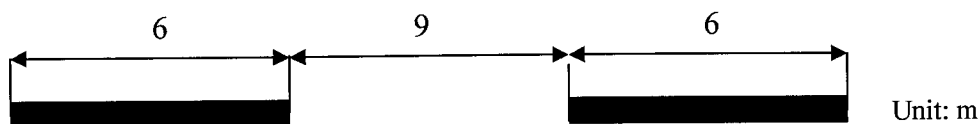
The design of traffic sign is based on Vietnamese Standards 22TCN 237-01 and TCVN5729-97.

Kilometer stations are provided at an interval of 1km, on both sides of the expressway. The sign posts of bridge names, interchange and parking are installed at the respective locations.

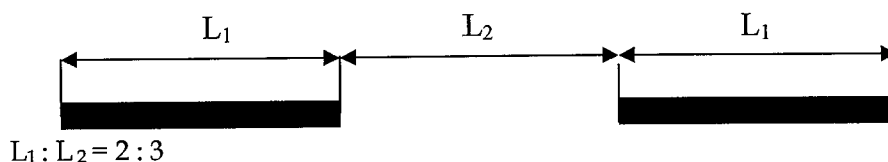
#### 11.2.2 Road Markings

In general, two types of road markings are applied. One is white interruptive lane marking (Type 2) and the other is yellow continuous lane marking (Type 4). Both of these markings are also based on the Vietnamese Standards QCVN41-2012. Additionally, there are road markings at merging and diverging noses of the interchange rampways and directional arrow markings etc.

The white interruptive lane markings stipulated in the Vietnamese Standard QCVN41-2012, as shown below,



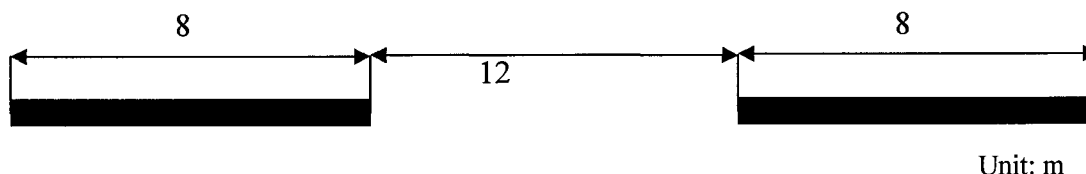
has shorter interval compared to the Expressway Standards in Japan. Shorter lengths as shown above are suitable only for national highways with lower design speeds such as 50-60km/h. In case of expressway, with design speed as high as 120km/h, shorter lane marking may cause flickering effect to drivers. Japanese standards recommend the following lengths;



The length of  $L_1$  is decided based on the design speed, as follows;

Design Speed (km/h)	Below 40	50 ~ 60	Above 80
Length (m)	4	6	8

Applying the above recommended values, the lengths for lane markings in this project can be drawn as follows;



From the driver's visual point of view, the latter values for lane markings will provide more comfortable driving and will reduce driver's stress from flickering effect. In this context, the Consultant would like to recommend the values recommended by Japanese standard regarding lane marking in order to enhance traffic safety, which is the same applied in Ho Chi Minh – Long Thanh – Dau Giay Expressway.

### 11.3 Electrical / Lighting / Communication Design

#### 11.3.1 Power Supply System

##### (1) Power Receiving Point

Power supply system will be fed from medium voltage distribution line of 22 kV. Voltage of received power will be stepped down to low voltage by transformer and distributed to each facility and/or equipment. The power supply facility in PKG 3B section will be placed at following place.

- Chiem Son Bridge

##### (2) Design Standards

Followings are reference standards for the electrical facility.

- Vietnamese sectorial standard 11TCN 18,19,20:2006: Norm of electrical equipment part I, II, III.
- Vietnamese construction standard TCXD 4756-89: Specification on grounding for electrical equipment
- Technical Regulation on Rural Electric Power Grid by Ministry of Industry 57/2000/QĐ-BCN
- IEC-62271-1: High voltage switchgear and control gear, common specifications
- IEC-62271-200: AC metal-enclosed switchgear and control gear
- IEC-62271-201: Insulation -enclosed switchgear and control gear
- IEC-60076: Power transformers
- IEC-61439 Standard: Low voltage switchgear and control gear
- Other relevant standards

##### (3) Power Demand Load

The power supply system shall feed power to various facilities and equipment such as road lighting, building facilities and ITS equipment. The power supply system must have enough capacity to supply power all electrical equipment. The table below shows the estimated power demand load at Chiem Son Bridge.

**Table 11.1 Estimated Power Demand Load**

No.	Station No.	Location	Estimated Demand Load
1	KM 20+450	Chiem Son Bridge	4.8 kVA

Source: Consultant

##### (4) Transformer

Rated capacity of transformer is determined by the estimated power demand load shown in Table 11.1 above and rounded up to the nearest rated capacity used in Vietnam.

Following are technical requirements of transformer installed in the house building.

**[Chiem Son Bridge]**

Type	Outdoor, Oil immersed, ONAN
Rated Capacity	10 kVA
Number of Phases	1
Rated primary voltage	12.7 kV
Rated secondary voltage	0.23 kV
Frequency	50 Hz
Connection	I/Io
Off-loaded Tap Changer	12.7kV+-2x2.5% - 8.66/2x0.23kV

### 11.3.2 Lighting Facility

#### (1) Required Lighting Area

Road lighting system improves a capacity of traffic volume of expressway. Requirements to the road lighting are ensured the smooth traffic flow with safely in the conditions of night time or bad weather situations. The lighting system should be a high quality of lighting and low running cost in operation stage. Major principles of the design should be:

- To keep driver's visibility guiding continuously by a lines of lighting at tollgate areas, interchanges, etc.,
- To install sufficient lighting level for finding out disabled car, stack-up, or obstructions, and
- To provide sufficient light for identification of roadside facilities

The road lightings in PKG 3B will be placed at Chiem Son Bridge section.

#### (2) Design Standards

Followings are reference standards for the road lighting.

- TCXDVN 333: 2005 Design Standard of Artificial Outdoor Lighting for Public Buildings and Urban Infrastructure
- TCXDVN 259: 2001 Standard for Design of Urban Streets and Square Lighting
- TCVN 5729: 2007 Expressway Standard for Design
- Other relevant standards

#### (3) Design Conditions and Calculation Results

##### 1) Lighting Source

The road lighting is recently being developed high efficiency lighting source with more efficient lighting distribution characteristics in the world. One of famous technical revolution in this sector is an application of LED (light-emitting diode). The LED lighting source has various advantages such as low power consumption, high color rendering properties, long lifecycle, less CO<sub>2</sub> emission, etc. Table below shows lighting source comparison between LED and high-pressured sodium lamp which has been generally used for road lighting in Vietnam.

**Table 11.2 Comparison of Lighting Source**

Item \ Lighting	High-Pressure Sodium (HPS) Lamp	LED Lamp	Remarks
Output Power	150W, 250W, 400W, 1000W, etc.	Up to 160W	
Color Rendering Properties	Average (Ra25)	Excellent (Ra65)	Ra100: natural sunlight
Lamp Lifetime	6 years	15 years	
Power Consumption (Relative, HPS Lamp = 100)	100	70	
Initial Cost (Relative, HPS Lamp = 100)	100	160	
Running Cost (Relative, HPS Lamp = 100)	100	45	
Lifecycle Cost (Relative, HPS Lamp = 100)	100	98	15 years

Source: Consultant

In this project, LED lamp instead of HPS lamp is proposed as a road lighting source for bridge due to lower lifecycle cost and other various advantages.

## 2) Required Luminance and Illuminance Levels

Required luminance and illuminance levels at each lighting area are set as follows by referring to relevant standards.

**Table 11.3 Required Luminance and Illuminance Levels**

Lighting Area	Average Luminance/ Illuminance Level	Remarks
Main Carriageway	2.0 cd/m <sup>2</sup> = 35 lux	

Source: Consultant

## 3) Calculation results

The lighting calculation using program software was carried out in this design. The selected lamp, height of lighting pole, etc. based on the calculation is summarized as follows.

**Table 11.4 Lighting Calculation Results**

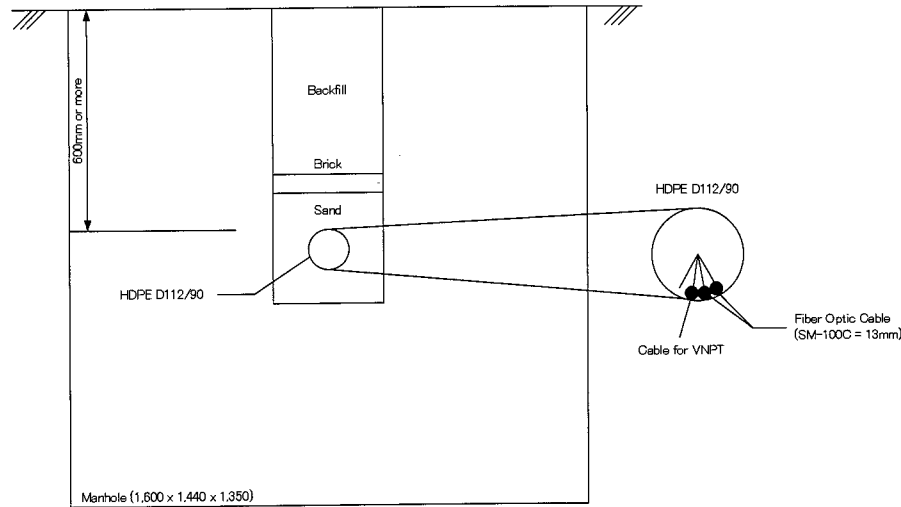
Items \ Lighting Area	Main Carriageway (Including Bridge)
Adopted Lamp	LED Lamp 160W
Height of Lighting Pole	12m
Arrangement of Pole	Both sided
Calculated Pole Distance	40m
Size of Lighting Pole Foundation	1,000m(W) x 1,000mm(D) x 1,200mm(H)

Source: Consultant

### 11.3.3 Communication Facility

#### (1) Conduit for Communication Cable

Though any ITS and communication equipment is not planned to be installed in PKG 3B section, the conduit for communication cable, which connects ITS roadside equipment placed in other expressway sections with Main Management Center located at Sta. 4+100, must be provided along the expressway in this section. Typical section of conduit for communication cable at grade-section is illustrated in the figure below.



Source: Consultant

**Figure 11.1 Typical Section of Conduit Installation**

One (1) HDPE pipe of which diameter are 112/90mm will be laid along left side of expressway. The pipe must be buried at least 600 mm from surface. Manhole with the size of 1,516 mm length x 1,336 mm width x 925 mm or 1,820 mm height shall be installed for pulling and connecting/diverging the cable. Interval of manhole must be less than 250m to reduce cable laying tension.

#### 11.3.4 Conduit Plan

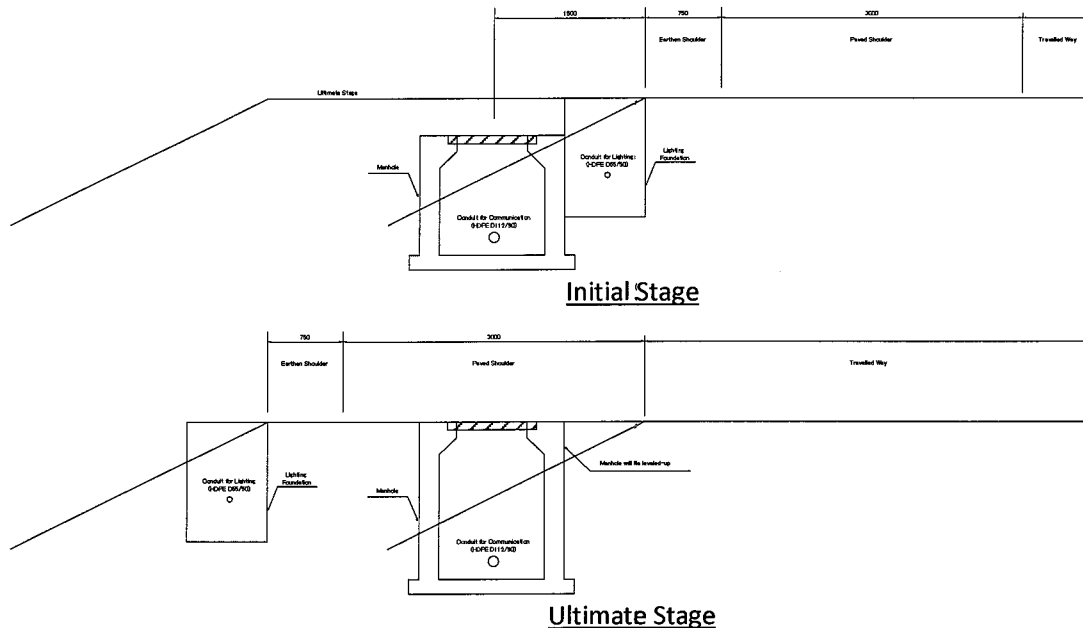
The basic requirements of conduit system are shown in table below.

**Table 11.5 Basic Requirements of Conduit System**

Item		Requirements
Location	Road Section	Under side slopes, 600mm depth from the surface
	Bridge Section	In concrete barriers
Conduit	Nos.	For Communication: 11 nos. (left side) For Power for Lighting: 1 nos.
	Type and Size	HDPE $\phi$ 112/90mm x 1 : Communication HDPE $\phi$ 65/50mm x 1 : Power for Lighting
	Min. Curve Radius	Communication Cable: $R \geq 300$ mm ( $R \geq 20D$ , D: expected 15mm) Electric Cable: $R \geq 600$ mm ( $R \geq 20D$ , D: expected 30mm)
Manhole: MH-C	Size	L: 1,600mm x W: 1,440 mm x D: 1,350 mm
	Interval	Communication Cable: 250m pitch Power Cable: 50m pitch
Pull Box : PB-E	Size	L: 1,200 mm x W: 350mm x D: 200mm
	Interval	Communication Cable: 250m pitch Power Cable: 50m pitch
Pull Box : PB-B	Size	L: 1,200 mm x W: 339mm x D: 185mm (min)
	Interval	Communication Cable: 250m pitch Power Cable: 50m pitch

Source: Consultant

Conduit transition plan to ultimate stage is summarized in figure below.



Source: Consultant

**Figure 11.2 Conduit Transition Plan**

In the ultimate stage, the number of lanes will be expanded to 6 lanes. Conduit plan is proposed taking into consideration the following conditions for future road widening.

- Communication conduit is proposed at location where 1.5 m away from edge of earthen shoulder of initial stage. Even in ultimate stage, the conduit is not necessary to be relocated since communication cable is still under the paved shoulder and maintenance work of the cable can be carried out without interruption to traffic flow in case of cable trouble. Manhole height will be leveled up to meet the surface of pavement at the time of road widening. This location can also minimize the interference of flooding.
- Lighting system including lighting foundation, cable and conduit must be replaced or relocated at ultimate stage since the required lighting output is varied depending on road width to keep luminance level required. An implementation of lighting arrangement considering future widening at initial stage is not economical in both implementation cost and running cost. Thus, the Consultant recommends to install lighting pole at outer edge of earthen shoulder.

### 11.3.5 Work Demarcation with other Packages

Work demarcation with other packages is proposed in the table below.



**Table 11.6 Proposed Work Demarcation with Other Packages**

Item		PKG	PKG 3B (KM18+100-21+ 500)	PKG 13 (O&M / ITS)	PKG 14 (Traffic Safety / Lighting)
Electrical System	Power Receiving System (Transformer)				X
	Power Cable				X (For lighting)
Road Lighting System	Lamp				X
	Lighting Pole				X
	Foundation for Lighting Pole		X		
	Control Panel				X
Communication System	Fibre Optic Cable			*1	
	Fibre Optic Connection & Terminal Box			*1	
Conduit System	HDPE Pipe for Electrical and Lighting Systems		X		
	HDPE Pipe for Communication System		*1		
	Manhole		X *1		
	Pull Box		X *1		

Note: \*1) The communication cable and conduits and pullbox for the communication cable are scheduled to invest by VNPT and those will be re-designed in the construction pahse.

Source: Consultant

The proposed work demarcation is set up based on the following considerations.

- To avoid the double construction works such as excavation, backfill and pavement, the installation works of conduit system for power and communication cables shall be included in scope of PKG 3B.
- The foundation for lighting pole must be constructed at a same timing with power cable conduit installation, because the PVC pipe protecting the power cable to feed the power to lamp must be buried in the concrete foundation for lighting pole. Thus, the construction work of foundation for lighting pole shall be also included in PKG 3B.
-

## **12 CONSTRUCTION PLAN**

- See Method Statement Report for Package 3B

**APPENDIX 1: AGREEMENTS ON CROSS STRUCTURE PLAN WITH LOCAL AUTHORITIES (DIEN BAN  
DISTRICT, DUY XUYEN DISTRICT – QUANG NGAI PROVINCE )**

## **13 STATUS OF AGREEMENT WITH LOCAL AUTHORITIES**

### **13.1 Basic Policy for Cross Structure Plan**

The expressway is crossing many local roads. In principle, cross road shall be reinstalled and possess the existing function by providing appropriate cross structures (i.e. underpass, overpass or flyover).

Following planning policies are applied to culvert box (cross road) plan:

- Dimension of inner space of the culvert box (cross road) shall be maintained those of existing road, as well as complying with the standard value in TCVN4054-05 and 315/QD-BGTVT
- Location and classification of planned / ongoing road projects crossing the expressway shall be confirmed, and be incorporated into the cross structure plan
- To ensure efficiency of the design and construction of the culvert box, standardization of structure type is applied. Crossing angle of the culvert box for the expressway are categorized 90 degrees, 80 degrees, and 70 degrees

### **13.2 Status of Agreement with Local Authorities**

During basic design and detailed design of PKG-3B, the Consultant has discussed with local authorities and irrigation management agencies, as followings:

#### **(1) Cross Structure Plan (Roadway)**

- On 08/02/2012, the Consultant and PMU85 had a meeting with the People's Committee of Dien Ban District. Proposed cross structure plan including location, cross structure type, road classification, and dimentions, and frontage road plan are basically agreed by the People's Committee of Dien Ban District and the minutes of agreement was signed by participated parties on 08/02/2012.
- On 16/04/2012, the Consultant and PMU85 had a meeting with the People's Committee of Duy Xuyen District. Cross structure plan including location, cross structure type, road classification, and dimentions, and frontage road plan are basically agreed by the People's Committee of Duy Xuyen District. Through subsequent discusstions between both partys, the minutes of agreement was signed by participated parties on 12/06/2012.

#### **(2) Cross Structure Plan (Waterway)**

- On 08/02/2012, Consultant and PMU85 had a meeting with the People's Committee of Dien Ban district and Quang Nam DOT (Department of Transport). The two parties have confirmed on number, location and dimension of cross structures for residents and waterways.
- On 14/04/2012, Consultant and PMU85 had a meeting with the People's Committee of Duy Xuyen district. After site checking, the two parties have confirmed on number, location and dimension of cross structures for residents and waterways.

The main conclusions of those meetings are as follows (detailed are shown in appendices):

- Cross drainage structures are culverts and approached canal, river, stream.
- For the expressway, the minimum size of culvert is pipe D1.50.
- In case, the approached canal, stream, river need to relocate, the minimum size of relocate canal, stream, and river is equal or larger than existing and follows the requirements of management agencies.

**APPENDIX 1: AGREEMENTS ON CROSS STRUCTURE PLAN WITH LOCAL AUTHORITIES (DIEN BAN  
DISTRICT, DUY XUYEN DISTRICT – QUANG NGAI PROVINCE )**



THE SOCIALIST REPUBLIC OF VIETNAM  
Independence – Freedom – Happiness

**MINUTES OF MEETING**

on

**Adoption of related structures in Design of Da Nang – Quang Ngai  
Expressway Project, section of Dien Ban District**

Time and venue: 7.30am, February 08, 2012, office of Dien Ban PC;

Participants are as follows:

**1. Dien Ban District:**

- Mr. Tran Uc (Presider)
- Mr. Nguyen Duc Choi
- Mr. Pham Ngoc Anh
  
- Mr. Nguyen Khoan
- Mr. Le Thuong
  
- Mr. Vo Ngoc A
- Mr. Nguyen Viet Long

Position: Vice Chairman of DPC  
Position: Chief of Planning & Investment Dept.  
Position: Vice chief of Natural Resources &  
Environment Dept.  
Position: Vice chief of Financial & Planning Dept.  
Position: Vice Director of Land Source  
Development Center  
Position: Vice Director of Management Unit  
Position: Vice Director of Dien Ban  
Irrigation Branch

**2. Dien Tien Commune**

- Mr. Do Dien
- Mr. Van Kim Trong
- Mr. Tran Da

Position: Chairman of CPC  
Position: Leader of hamlet  
Position: Leader of hamlet

**3. Dien Tho Commune**

- Mr. Le Van Cam
- Mr. Nguyen Hanh
- Mr. Lu Văn Tuấn
- Mr. Phan Minh Hoa
- Mr. Phan Minh Mai
- Mr. Tran Minh Vu
- Mr. Phan Tan Nhanh
- Mr. Le Quang Vinh
- Mr. Nguyen Dinh Tam

Position: Chairman of CPC  
Position: Land survey & Construction officer  
Position: Leader of hamlet  
Position: Leader of hamlet  
Position: Leader of hamlet  
Position: Leader of hamlet  
Position: Leader of hamlet  
Position: Leader of hamlet  
Position: Leader of hamlet

**4. Dien Quang Commune**

- Mr. Ha Van Minh
- Mr. Phan Van Sinh
- Mr. Vo Viet Tam
- Mr. Trinh Xuan Duc
- Mr. Tran Kiet

Position: Vice Chairman of CPC  
Position: Land survey & Construction officer  
Position: Leader of hamlet  
Position: Leader of hamlet  
Position: Leader of hamlet

- |    |   |                           |
|----|---|---------------------------|
| 5. | <b>Quang Nam DOT</b><br>- Mr. Tran Thanh An | Position: Vice Director   |
| 6. | <b>PMU85</b><br>- Mr. Le Trong Do           | Position: Vice Director   |
| 7. | <b>Design Consultant</b><br>- Mr. Ishimoto  | Position: Project Manager |

**Discussion contents:**

Mr. Tran Uc, Vice Chairman of Dien Ban PC presides the meeting. He states that the construction of Da Nang – Quang Ngai Expressway Project is social-economic strategy for the development of central part. In entire Project's alignment, there are local communities cut through by the Project and their infrastructure systems are affected by Project also. During design preparation, the Consultant have studied and surveyed the site to propose the proper technical design suitable with local living and social-economic development.

Design Consultant and PMU85 report the design solutions for affected structures in Dien Tien, Dien Tho, Dien Quang. Parties are discussing and commenting on Consultant's Design for proper adjustments, modifications and additions.

After discussion, PMU85 and meeting Chairman come to the following conclusions:

- In principle: It is basically agreed with proposal of Design Consultant regarding design solution for structures crossing expressway. Besides, PMU85 will be responsible for instructing the Design Consultant to perform supplement and adjustment as follows:

**1. Dien Tien Commune**

- Pavement of road and underpass under the Project is minimum 5m wide in accordance with Decision No. 315/QD-BGTVT dated 23 Feb 2011.
- It is requested to provide the underpass (along the drainage ditch of Dien Tien) of 9m wide to connect PR605 to residential area at the foot of Bo Bo Hill.

**2. Dien Quang Commune**

- For the section via Dien Quang commune, it is proposed the Employer (MOT) to construct the viaduct as proposed by localities to ensure the living condition of the area between railway and expressway. Also the minimization of flood level at the upstream and erosion in downstream is requested.
- Pavement of road and underpass should be designed in line with approved master planning of Dien Quang commune.
- 01 more underpasses should be provided for North of PR610B (Xuan Dai hamlet) for farming activities.



- It is requested to reinstate the irrigation and drainage system to ensure the irrigation at the upstream and downstream of the expressway.
- It is requested to provide an emergency road (just in case).

### **3. Dien Tho Commune**

- Road and underpass should be designed in line with approved master planning of Dien Tho commune.
- Church at Duc Ky Bac hamlet is requested to be maintained.
- It is requested to reinstate the irrigation canal to ensure the irrigation at the upstream and downstream of the expressway.
- PR609 to Ben Huc is requested to widen as 9m as designed subject to commune planning.
- Relocation of 100% households in the area of downstream of underpass into resettlement areas will be taken into consideration.

### **4. Dien Ban Irrigation Branch**

- It is requested to reinstate the affected channel systems as well as to design the curve radius of channel  $R \geq 120^0$ . On the completion of irrigation system design, the Employer is requested to provide the design document for Local Management Unit for reporting to authorized level.
- It is requested ensure the irrigation capacity of crossing culvert.

### **5. Other issues**

- It is requested to improve the downstream structures for erosion protection within the energy consumption area of flow.
- It is requested to confirm the crossing point between district road 8 and expressway and the underpass should be designed with pavement width as same as district road 8.
- The navigation clearance should meet the requirement plus 0.3-0.5m upon certain locations.
- Dien Tien, Dien Quang, Dien Tho communes are requested to prepare the site for receiving the excavated soil.
- For the provincial roads, PMU85 and Consultant are requested to work directly with Quang Nam DOT on design matters.

### **6. Provision of documents**

The District Department of Economy & Infrastructure is requested to provide Design Consultant with the following documents:

- + Decision 315/QD-BGTVT dated 23 Feb 2011;
- + Document relating to district road 8 project;
- + Approved new rural planning of Dien Quang, Dien Tho communes.

*(After the meeting, the above documents were delivered to Mr. Pham Viet Hung, design consultant of Project)*

During the implementation, in case of other issues PMU85 will inform to Dien Ban PC for resolution.

The Minutes is signed by related parties and prepared in 10 sets and kept by concerned parties, *namely Dien Ban PC, Quang Nam DOT, Dien Ban Department of Economy & Infrastructure, CPCs of Dien Tien, Dien Tho, Dien Quang, PMU85 and Design Consultant.*

Meeting finishes on the same day.

<b>Representative of PMU85</b> (signed)  Mr. Nguyen Tien Ha	<b>Representative of Dien Ban PC</b> (signed)  Mr. Tran Uc
<b>Representative of Design Consultant</b> (signed)  Mr. Ishimoto	<b>Representative of Quang Nam DOT</b>  Mr. Tran Thanh An
<b>Representative of Dien Ban Irrigation Branch</b> (signed)  Mr. Nguyen Viet Long	<b>Representative of Dien Tien PC</b> (signed)  Mr. Do Dien
<b>Representative of Dien Tho PC</b> (signed)  Mr. Le Van Cam	<b>Representative of Dien Quang PC</b> (signed)  Mr. Ha Van Minh
<b>Representative of Dien Ban Electricity Company</b>  Mr. Tran Phuoc Mot	

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM  
Độc lập – Tự do – Hạnh phúc

**BIÊN BẢN**

**Họp thông qua các công trình liên quan đến thiết kế đường cao tốc  
Đà Nẵng - Quảng Ngãi đi qua địa phận huyện Điện Bàn**

Hôm nay, vào lúc 7 giờ 30, ngày 08 tháng 02 năm 2012, tại phòng họp UBND huyện Điện Bàn, thành phần tham dự gồm có:

**1. Huyện Điện Bàn:**

- |                          |                                  |
|--------------------------|----------------------------------|
| - Ông: Trần Úc (Chủ trì) | Chức vụ: Phó Chủ tịch huyện      |
| - Ông: Nguyễn Đức Chơi   | Chức vụ: Trưởng Phòng KT&HT      |
| - Ông: Phạm Ngọc Anh     | Chức vụ: Phó Trưởng Phòng TN&MT  |
| - Ông: Nguyễn Khoan      | Chức vụ: Phó Trưởng Phòng TC-KH  |
| - Ông: Lê Thương         | Chức vụ: Phó GD Trung tâm PTQĐ   |
| - Ông: Võ Ngọc A         | Chức vụ: Phó GD Ban quản lý      |
| - Ông: Nguyễn Việt Long  | Chức vụ: Phó GD CN thủy lợi ĐBàn |

**2. Xã Điện Tiến:**

- |                      |                      |
|----------------------|----------------------|
| - Ông: Đỗ Diên       | Chức vụ: Chủ tịch xã |
| - Ông: Văn Kim Trọng | Chức vụ: Trưởng thôn |
| - Ông: Trần Đá       | Chức vụ: Trưởng thôn |

**3. Xã Điện Thọ:**

- |                        |                       |
|------------------------|-----------------------|
| - Ông: Lê Văn Cẩm      | Chức vụ: Chủ tịch xã  |
| - Ông: Nguyễn Hạnh     | Chức vụ: Địa chính xã |
| - Ông: Lưu Văn Tuấn    | Chức vụ: Trưởng thôn  |
| - Ông: Phan Minh Hòa   | Chức vụ: Trưởng thôn  |
| - Ông: Phan Minh Mai   | Chức vụ: Trưởng thôn  |
| - Ông: Trần Minh Vũ    | Chức vụ: Trưởng thôn  |
| - Ông: Phan Tấn Nhanh  | Chức vụ: Trưởng thôn  |
| - Ông: Lê Quang Vinh   | Chức vụ: Trưởng thôn  |
| - Ông: Nguyễn đình Tám | Chức vụ: Trưởng thôn  |

**4. Xã Điện Quang:**

- |                       |                          |
|-----------------------|--------------------------|
| - Ông: Hà Văn Minh    | Chức vụ: Phó Chủ tịch xã |
| - Ông: Phan Văn Sinh  | Chức vụ: Địa chính XD xã |
| - Ông: Võ Việt Tám    | Chức vụ: Trưởng thôn     |
| - Ông: Trịnh Xuân Đức | Chức vụ: Trưởng thôn     |
| - Ông: Trần Kiệt      | Chức vụ: Trưởng thôn     |

**5. Đại diện Sở Giao thông - Vận tải tỉnh Quảng Nam:**

- |                      |                       |
|----------------------|-----------------------|
| - Ông: Trần Thanh An | Chức vụ: Phó Giám đốc |
|----------------------|-----------------------|





**6. Đại diện BQL dự án 85:**

- Ông: Lê Trọng Độ

Chức vụ: Phó Giám đốc BDH

**7. Đại diện đơn vị thiết kế:**

- Ông: Ishimôtô

Chức vụ: Giám đốc dự án

**Nội dung làm việc:**

Ông: Trần Úc – Phó Chủ tịch UBND huyện Điện Bàn chủ trì cuộc họp, nêu lên vấn đề xây dựng đường cao tốc Đà Nẵng - Quảng Ngãi là chiến lược phát triển kinh tế - xã hội khu vực miền trung. Các địa phương có trên tuyến cao tốc đi qua, bị ảnh hưởng đến hệ thống hạ tầng kỹ thuật. Trong quá trình thiết kế, đơn vị tư vấn đã nghiên cứu, khảo sát đưa ra phương án thiết kế nhằm đáp ứng phù hợp cho đời sống nhân dân, phát triển kinh tế - xã hội địa phương.

Đơn vị tư vấn thiết kế, đại diện BQL dự án 85 báo cáo phương án thiết kế các công trình bị ảnh hưởng của đường cao tốc đi qua xã Điện Tiến, Điện Thọ, Điện Quang. Trên cơ sở đó, các thành phần dự họp góp ý và đưa ra đề xuất để đơn vị tư vấn xem xét cập nhật cho phù hợp.

Qua các kiến nghị của thành phần dự họp, chủ trì cuộc họp và BQL dự án 85 thống nhất những nội dung sau:

- Về mặt nguyên tắc: Cơ bản thống nhất đề xuất của tư vấn thiết kế về giải pháp thiết kế các công trình giao cắt với tuyến đường cao tốc. Ngoài ra, BQL dự án 85 sẽ chỉ đạo đơn vị tư vấn thiết kế bổ sung, điều chỉnh như sau:

**1. Xã Điện Tiến:**

- Tất cả đường và cống chui qua đường cao tốc có mặt nền rộng nhỏ nhất là 5 mét theo Quyết định số 315/QĐ-BGTVT ngày 23/02/2011.

- Bố trí đường chui (dọc kênh tiêu nước Điện Tiến) nền đường rộng 9m để nối từ đường ĐT605 vào khu dân cư dưới chân núi Bồ Bồ.

**2. Xã Điện Quang:**

- Đoạn tuyến đường cao tốc đi qua xã Điện Quang sẽ đề xuất chủ đầu tư (Bộ Giao thông - Vận tải) làm cầu cạn theo kiến nghị tham vấn cộng đồng và nhằm đảm bảo đời sống dân sinh cho các hộ nằm giữa đường cao tốc và đường sắt, đồng thời giảm chiều cao mực nước lũ phía thượng lưu và giảm xói lở hạ lưu.

- Tất cả đường và cống chui qua đường cao tốc có mặt nền rộng theo đề án phát triển nông thôn mới của xã Điện Quang đã phê duyệt.

- Phía Bắc đường ĐT610B (thuộc thôn Xuân Đài) bố trí 01 đường chui để phục vụ nhân dân sản xuất.

- Hoàn trả toàn bộ lại hệ thống kênh tưới và kênh tiêu nhằm đảm bảo tưới tiêu phía thượng lưu và hạ lưu đường cao tốc.

- Mở đường dẫn lên đường cao tốc để cứu nạn khi cần thiết.

**3. Xã Điện Thọ:**

- Tất cả đường và cống chui qua đường cao tốc có mặt nền rộng theo đề án phát triển nông thôn mới của xã Điện Thọ đã phê duyệt.

- Nhà thờ tại khu vực thôn Đức Ký Bắc: Tư vấn xem nên xem xét giữ lại.
- Hoàn trả toàn bộ lại hệ thống kênh tưới và kênh tiêu nhằm đảm bảo tưới tiêu phía thượng lưu và hạ lưu đường cao tốc.
- Đường ĐT609 đi Bến Húc: Mở rộng nền đường rộng 9m, theo định hướng phát triển của xã.
- Sẽ xem xét di dời 100% các hộ nằm phía hạ lưu các cống chui về các khu tái định cư.

#### **4. Chi nhánh thủy lợi Điện Bàn:**

- Hoàn trả lại hệ thống kênh bị ảnh hưởng. Thiết kế bán kính cong thủy lực của kênh  $R \geq 120^0$ . Khi thiết kế xong hệ thống kênh, chủ đầu tư đường cao tốc cung cấp hồ sơ thiết kế cho đơn vị, để chi nhánh thủy lợi báo cáo cơ quan chủ quản;
- Cống tưới qua đường thiết kế đảm bảo lưu lượng tưới.

#### **5. Một số nội dung khác:**

- Gia cố chống xói lở các công trình phía hạ lưu đường cao tốc mà nằm trong phạm vi tiêu năng dòng chảy lũ;
- Trên cơ sở bản vẽ thiết kế cơ sở của dự án đường ĐH8, đơn vị thiết kế đường cao tốc xác định vị trí giao cắt giữa đường cao tốc với tuyến đường ĐH8. Tại điểm giao này, bố trí cống chui có mặt nền rộng phù hợp với chiều rộng nền đường ĐH8;
- Khoảng tính không các cống, cầu bản chui qua đường cao tốc, đảm bảo theo quy định và cộng thêm từ 0,3m đến 0,5m tùy theo vị trí;
- Xã Điện Tiến, Điện Quang, Điện Thọ chuẩn bị mặt bằng để tiếp nhận khối lượng đất hữu cơ và đất thải của dự án.
- Các tuyến đường ĐT, tư vấn thiết kế và BQL dự án 85 sẽ làm việc với Sở Giao thông - Vận tải Quảng Nam.

**6. Cung cấp tài liệu:** Phòng Kinh tế và Hạ tầng huyện sẽ cung cấp cho đơn vị tư vấn các hồ sơ sau:

- + Quyết định số 315/QĐ-BGTVT ngày 23/02/2011;
- + Dự án tuyến đường ĐH8;
- + Đề án nông thôn mới đã phê duyệt của xã Điện Quang, Điện Thọ.

(Sau cuộc họp, anh: Phạm Việt Hùng – tư vấn thiết kế đường cao tốc đã tiếp nhận tài liệu trên).

Trong quá trình thực hiện, nếu có ý kiến khác thì BQL dự án 85 thông báo cho UBND huyện Điện Bàn để giải quyết.

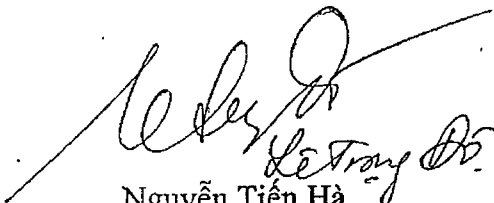
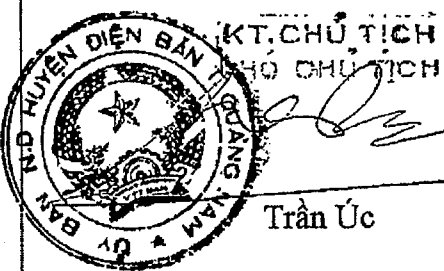
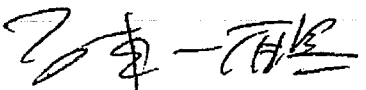

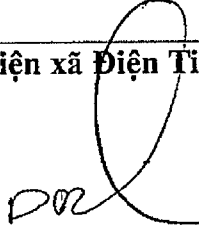
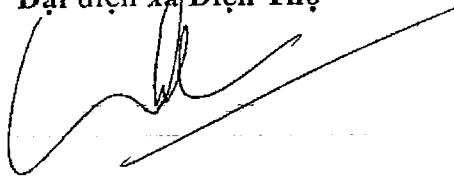
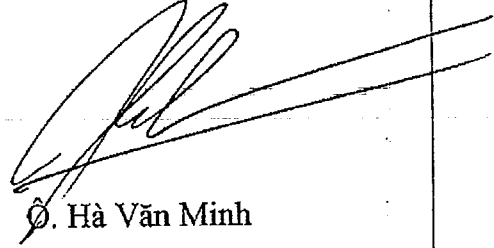
Biên bản cuộc họp lập thành 10 bản, có nội dung như nhau và được các đơn vị sau đây lưu giữ: Văn phòng UBND huyện Điện Bàn; Sở Giao thông - Vận tải Quảng Nam; Phòng Kinh tế và Hạ tầng huyện Điện Bàn; Văn phòng UBND các xã: Điện Tiến, Điện Thọ, Điện Quang; Ban QL dự án 85; Tư vấn thiết kế đường cao tốc.

Nội dung biên bản đọc lại các bên cùng nghe và thống nhất ký biên bản. Biên bản kết cùng ngày./.

**Consulting Services for  
Detailed Design for Danang - Quang Ngai Expressway Development  
Project**

IDA Credit No. 3843-VN

Biên bản được lập thành 10 bản có giá trị pháp lý như nhau. Mỗi bên liên quan giữ 01 bản.

<p><b>Đại diện Ban QLDA 85</b></p>  <p>Nguyễn Tiến Hà</p>	<p><b>Đại diện huyện Điện Bàn</b></p>  <p>Trần Úc</p>
<p><b>Đại diện Tư vấn thiết kế</b></p>  <p>Ô. Ishimoto</p>	<p><b>Đại diện Sở GTVT Quảng Nam</b></p> <p>Ô. Trần Thanh An</p>
<p><b>Đại diện Thủy nông Điện Bàn</b></p>  <p>Ô. Nguyễn Viết Long</p>	<p><b>Đại diện xã Điện Tiến</b></p>  <p>Ô. Đỗ Diên</p>
<p><b>Đại diện xã Điện Thọ</b></p>  <p>Ô. Lê Văn Cẩm</p>	<p><b>Đại diện xã Điện Quang</b></p>  <p>Ô. Hà Văn Minh</p>
<p><b>Đại diện Điện lực Điện Bàn</b></p> <p>Ô. Trần Phước Một</p>	





*Duy Xuyen, 12 June, 2012*

**MINUTES OF MEETING**  
**DA NANG – QUANG NGAI EXPRESSWAY PROJECT**  
**Stage: Detailed Design**  
**Duy Xuyen district (Km20+200 – Km29+465)**

**TIME AND PLACE:**

1. **Time:** 13h30 – 17h00, 16 April 2012;
2. **Place:** Meeting room – Duy Xuyen DPC;
3. **Meeting chairman:** Mr. Nguyen Cong Dung – Chairman of Duy Xuyen DPC.

**PARTICIPANTS:**

**1. Representative of Project Owner – PMU85**

- 1.1. Mr. Le Trong Do – Deputy Project Manager;

**2. Representative of Duy Xuyen DPC**

- 2.1. Mr. Nguyen Cong Dung – Chairman of DPC;
- 2.2. Mr. Nguyen Viet Dong – Deputy Head of Economy – Infrastructure Division;
- 2.3. Mr. Pham Van Sang – Head of Land Acquisition and Resettlement Board;
- 2.4. Mr. Tran Dinh Phuc – Deputy Head of Land Acquisition and Resettlement Board;
- 2.5. Mr. Luu Cong Ca – Chairman of Duy Trinh CPC;
- 2.6. Mr. Phan Ho – Chairman of Duy Son CPC;
- 2.7. Mr. Nguyen Nhu Tien – Chairman of Duy Trung CPC;
- 2.8. Mr. Nguyen The Hoi – Head of Resources and Environment Division;
- 2.9. Mr. Lam Quang Minh – Specialist of Duy Xuyen DPC;
- 2.10. Mr. Nguyen Phuoc Minh – Land Official of Duy Son commune;
- 2.11. Mr. Dang Cang – Land Official of Duy Trinh commune;
- 2.12. Mr. Nguyen Thanh Tam – Land Official of Duy Trung commune;
- 2.13. Mrs. Duong Thi My Lang – Director of Da Nang Price Valuation and Financial Services Limited Company.
- 2.14. Mrs. Dang Thi An Thinh – Deputy Director of Da Nang Price Valuation and Financial Services Limited Company.

### **3. Representative of Design Consultant**

- 3.1. Mr. Takayasu Nagai – Deputy Project Manager/ Road Design Team Leader;
- 3.2. Mr. Doan Van Thang – Co-Project Manager/ Highway Engineer;

### **DISCUSSION CONTENTS:**

- Alignment of the Expressway in Duy Xuyen section follows the alignment approved by MOT in Decision No.2656/QD-BGTVT dated 10 September 2010 and Document No. 1619/BGTVT-CQLXD dated 9 March 2012. The total length of Duy Xuyen section is approximately 9.265km;
- Residential structures: Underpass (or overpass) shall be basically provided at the positions where the Expressway crosses existing roads. For some locations without underpass (or overpass), frontage roads shall be provided at the both side of Expressway to lead to the suitable underpass/ overpass;
- Drainage structures include bridges, drainage/irrigation culverts, relocation canals along the expressway and side ditches, etc...Dimension of these structures are determined in accordance with hydrological calculation results and current situation of local irrigation system;  
Results of structures in Duy Xuyen section are shown in Appendix 1~5 (see attachments)

### **CONCLUSION:**

After discussion, the followings are agreed among the parties:

- The location and opening of structures as shown in Appendix 1~5 (see attachments) proposed by Consultant are basically agreed;
- During construction, the Project Owner is requested to direct involved agencies to provide temporary reinstatement methods and to agree with the local authority to ensure the continuity of local drainage/ irrigation.

### **RECOMMENDATIONS OF LOCAL AUTHORITY:**

- Duy Xuyen district is in flood area, drainage direction is from the West to the East. Therefore, Consultant is requested to carry out flood survey and hydrological calculation carefully to give out design plan ensuring the drainage.
- Underpass B=3-4m is smaller than one in local planning, Consultant is requested to review and double check.
- Consultant is requested to cooperate with Economy-Infrastructure Divisions of Districts and Communes, where Expressway will pass through to carry out Site checking at each crossing location between Expressway with bridges, drainage culverts...
- Economy-Infrastructure Division provides planning information of district roads and commune roads so that Consultant can update on scale.

This minute is prepared into 5 copies with equal legal value. Each related party keeps one copy.

<b>Representative of PMU85</b>	<b>Representative of Duy Xuyen DPC</b>
<b>Le Trong Do</b>	<b>Nguyen Cong Dung</b>
	<b>Representative of Consultant</b>
	<b>Takayasu Nagai</b>

**Appendix 1 List of roadway cross structures**

No.	Station	Commune	Existing width (m)	Expected Road Classification	Cross structure type	Expected dimension (m)	Remark	Recommendations of locality
1	Km20+400.0	Duy Trinh	7	IV			Province road 610 is passing under Chiem Son bridge	
2	Km20+735.0		4	AH (VI)	Flyover	B=6,5m	District road 9 leads to Vinh Trinh dam.	
3	Km021+620.0		2.5	A	Underpass	BxH=5.0x3.5	in Chiem Son hamlet	
4	Km022+252.0		3.5	A	Underpass	BxH=5.0x3.5	From hamlet 1 to mountain	Underpass BxH=4.0x3.5
5	Km023+243.0	Duy Son	3.0	A	Underpass	BxH=5.0x3.5	From hamlet 1 to hamlet 6, hamlet 7	To be commune road according to planning, proposed dimension BxH=5.5x3.0m
6	Km23+547		2.0	C	Underpass	BxH=3.0x3.0		
7	Km023+935		4	IV	Overpass	L=21m	District road 08	
8	Km024+150		3	A	Underpass	BxH=5.0x3.5	From hamlet East Phu Nham to mountain	To be commune road according to planning, proposed dimension B=5.5m
9	Km024+790		2.5	A	Flyover	B=5m	From hamlet Chiem Son to hamlet East Phu Nham	To be commune road according to planning, proposed dimension B=5.5m
10	Km025+373		6	IV	Underpass	BxH=2x(4.5x4.5)	District road 02 to Duy Xuyen 2 Hydroelectric Plant	

No.	Station	Commune	Existing width (m)	Expected Road Classification	Cross structure type	Expected dimension (m)	Remark	Recommendations of locality
11	Km026+003.0		2.5	B	Underpass	BxH=4.0x3.0	From hamlet West Tra Kieu to hamlet Chiem Son	
12	Km026+520		2	B	Flyover	B=4m	To graveyard +stone-pit	
13	Km026+806	Duy Trung	3	A	Flyover	B=5m	To graveyard +stone-pit	
14	Km027+660		3	C	Underpass	BxH=3.0x3.0		
15	Km028+080		3	C	Underpass	BxH=3.0x3.0		
16	Km028+935		4	V	Underpass	BxH=6.5x4.5	From hamlet Nam Thanh to hamlet 1	

#### Appendix 2 List of drainage culverts

No.	Commune	Station	Type	Dimension (m)	Remark, recommendations of locality
1	Duy Trinh	Km020+860.0	Box culvert	BxH=3(3.0x3.0)	
2		Km021+060.0	Box culvert	BxH=3.0x3.0	
3		Km021+240.0	Pipe culvert	D1.5	
4		Km021+730.0	Box culvert	BxH=2(3.0x3.0)	
5		Km021+755.0	Box culvert	D1.5	
6		Km022+246.0	Pipe culvert	D1.5	
7		Km022+380.0	Pipe culvert	D1.5	
8		Km023+720.0	Box culvert	BxH=2x2m	
9		Km023+820.0	Box culvert	BxH=2(3.0x3.0)	
10		Km024+080.0	Pipe culvert	D1.5	
11		Km024+340.0	Pipe culvert	D1.5	
12		Km024+550.0	Pipe culvert	D1.5	
13		Km024+750.0	Pipe culvert	D1.5	
14		Km025+200.0	Pipe culvert	D1.5	
15		Km025+450.0	Pipe culvert	D1.5	
16		Km025+716.5	Box culvert	BxH=2(2.5x2.5)	
17		Km025+971.0	Pipe culvert	D1.5	
18		Km026+159.0	Box culvert	BxH=2.5x2.5	
19		Km026+323.0	Box culvert	BxH=2x(2.5x2.5)	
20		Km026+442.0	Pipe culvert	D1.5	
21	Duy Trung	Km026+621.5	Pipe culvert	D1.5	

No.	Commune	Station	Type	Dimension (m)	Remark, recommendations of locality
22		Km026+840.0	Pipe culvert	D1.5	
23		Km027+082.0	Box culvert	BxH=2x(2.5x2.5)	
24		Km027+340.0	Pipe culvert	D1.5	
25		Km027+620.0	Box culvert	BxH=2.0x2.0	
26		Km027+700.0	Box culvert	D1.5	
27		Km028+010.0	Box culvert	BxH=3.0x3.0	
28		Km028+330.0	Box culvert	BxH=2.0x2.0	
29		Km028+464.0	Pipe culvert	D1.5	
30		Km028+654.0	Box culvert	BxH=2.5x2.5	
31		Km029+060.0	Pipe culvert	D1.5	
32			Km029+146.0	Box culvert	BxH=2.0x2.0
33	Km029+365.0		Box culvert	BxH=2(3.0x3.0)	
34	Km029+435.0		Pipe culvert	D1.5	
	Total	Pipe culvert		19	
		Box culvert		15	

### Appendix 3 List of frontage roads

STT	Commune	Station		Length (m)	Side	Remark
		From	To			
1	Duy Trinh	Km021+100.0	Km021+240.0	140.00	Left	
2		Km021+550.0	Km021+610.0	80.00	Left	
3		Km021+320.0	Km021+630.0	310.00	Right	
		<b>Total</b>		<b>530.00</b>		
4	Duy Son	Km023+180.0	Km023+330.0	150.00	Right	
5		Km023+921.0	Km024+150.0	229.00		
6		Km025+927.0	Km026+049.0	122.00	Right	
		<b>Total</b>		<b>501</b>		
7	Duy Trung	Km027+658.5	Km027+820.5	162.00	Left	
8		Km028+78.5	Km028+214.5	136.00	Right	
9		Km028+745.0	Km028+934.0	189.00	Right	
		<b>Total</b>		<b>189.00</b>		

### Appendix 4 List of relocation canals

STT	Commune	Station		Length (m)	Side	Remark
		From	To			
1	Duy trinh	Km021+090.0	Km021+235.0	145.0		
		<b>Total length (m)</b>		<b>145.0</b>		
2	Duy Son	Km023+343.0	Km023+376.0	33.0	Left	
3		Km023+180.0	Km023+412.0	232.0	Right	
4		Km025+190.0	Km025+235.0	45.0	Left	
5		Km025+430.0	Km025+475.0	45.0	Left	
6		Km026+110.0	Km026+160.0	50.0	Right	

STT	Commune	Station		Length (m)	Side	Remark
		From	To			
7		Km026+295.0	Km026+315.0	20.0	Left	
8		Km026+330.0	Km026+360.0	30.0	Right	
		<b>Total length (m)</b>		<b>455.0</b>		
9	Duy Trung	Km028+320.0	Km028+387.0	67.0	Right	
10		Km028+985.0	Km029+050.0	65.0	Left	
		<b>Total length (m)</b>		<b>132.0</b>		

#### Appendix 5 River bridge / stream bridge

No.	Commune	Station		Length (m)	Remark
		From	To		
1	Duy Trinh	Km021+832.0	Km021+862.0	30.00	Vinh Trinh canal bridge
2	Duy Son	Km023+368.0	Km023+422.0	54.00	Duy Loc river bridge
3		Km024+900.0	Km024+935.0	35.00	Duy Son river bridge





Duy Xuyên, ngày 12 tháng 6 năm 2012

**BIÊN BẢN THỎA THUẬN**  
**DỰ ÁN ĐƯỜNG CAO TỐC ĐÀ NẴNG - QUẢNG NGÃI**  
Giai đoạn: Thiết kế kỹ thuật  
Đoạn qua huyện Duy Xuyên (Km20+200 – Km29+465)

**THỜI GIAN, ĐỊA ĐIỂM:**

1. Thời gian họp: 13h30 – 17h00, ngày 16/4/2012;
2. Địa điểm họp: Phòng họp – UBND huyện Duy Xuyên;
3. Chủ trì cuộc họp: Ông Nguyễn Công Dũng – Chủ tịch huyện Duy Xuyên.

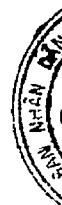
**THÀNH PHẦN THAM DỰ:**

**1. Đại diện Chủ đầu tư – Ban QLDA 85**

- 1.1. Ông: Lê Trọng Độ – Phó Giám đốc Ban điều hành;

**2. Đại diện UBND huyện Duy Xuyên**

- 2.1. Ông: Nguyễn Công Dũng – Chủ tịch UBND huyện;
- 2.2. Ông: Nguyễn Viết Đông – Phó trưởng Phòng Kinh tế và Hạ Tầng;
- 2.3. Ông: Phạm Văn Sang – Trưởng ban đền bù GPMB và tái định cư
- 2.4. Ông: Trần Đình Phúc – Phó trưởng ban đền bù GPMB và tái định cư
- 2.5. Ông: Lưu Công Cả – Chủ tịch UBND xã Duy Trinh;
- 2.6. Ông: Phan Hộ – Chủ tịch UBND xã Duy Sơn;
- 2.7. Ông: Nguyễn Như Tiền – Chủ tịch UBND xã Duy Trung;
- 2.8. Ông: Nguyễn Thế Hời – Trưởng phòng TNMT ;
- 2.9. Ông: Lâm Quang Minh – Chuyên viên VPHĐ ND-UBND Duy Xuyên
- 2.10. Ông: Nguyễn Phước Minh – Cán bộ địa chính xã Duy Sơn
- 2.11. Ông: Đặng Cang – Cán bộ địa chính xã Duy Trinh
- 2.12. Ông: Nguyễn Thanh Tâm – Cán bộ địa chính xã Duy Trung
- 2.13. Bà: Dương Thị Mỹ Lạng – Giám đốc CT TNHH thẩm định giá và dịch vụ tài chính Đà Nẵng;
- 2.14. Bà: Đặng Thị Ân Thịnh – Phó Giám đốc CT TNHH thẩm định giá và dịch vụ tài chính Đà Nẵng;





### 3. Đại diện Tư vấn thiết kế

- 3.1. Ông: Takayasu Nagai – Phó Giám đốc dự án/Trưởng nhóm thiết kế đường;  
3.2. Ông: Đoàn Văn Thắng – Đồng Giám đốc dự án/Kỹ sư đường cao tốc;

#### NỘI DUNG THẢO LUẬN:

- Hướng tuyến đường cao tốc trong phạm vi huyện Duy Xuyên tuân theo hướng tuyến đã được Bộ GTVT phê duyệt tại Quyết định số 2656/QĐ-BGTVT ngày 10/9/2010 và văn bản số 1619/BGTVT-CQLXD ngày 9/3/2012. Tổng chiều dài đoạn tuyến qua địa phận huyện Duy Xuyên khoảng 9.265km;
- Các công trình dân sinh: về cơ bản các vị trí đường cao tốc cắt đường hiện tại sẽ bố trí các công trình công chui (hoặc cầu vượt). Một số vị trí không bố trí công chui (hoặc cầu vượt) sẽ thiết kế đường gom hai bên đường cao tốc để thu gom về các vị trí chui/vượt phù hợp;
- Các công trình thoát nước: gồm cầu, cống tưới/tiêu, hệ thống mương cải dọc theo đường cao tốc, các tuyến rãnh dọc... Kích thước các công trình được thiết kế theo kết quả tính toán thủy văn và các điều kiện hiện trạng của hệ thống thủy lợi địa phương;  
Kết quả thiết kế các công trình trong phạm vi huyện Duy Xuyên được thống kê theo các phụ lục từ 1 – 4 (kèm theo biên bản);

#### KẾT QUẢ THỐNG NHẤT:

Sau khi các thành viên dự họp thảo luận nội dung liên quan, Hội nghị đi đến thống nhất một số nội dung như sau:

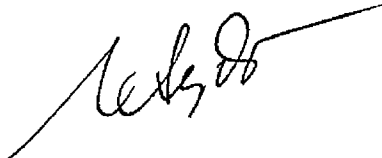


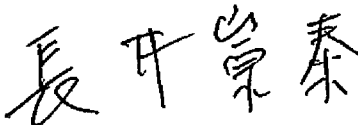
- Cơ bản thống nhất với những đề xuất của Tư vấn thiết kế về vị trí, khẩu độ các công trình theo các phụ lục từ 1 – 5 (kèm theo biên bản);
- Trong quá trình thi công đề nghị Chủ đầu tư chỉ đạo các đơn vị liên quan đưa ra các biện pháp hoàn trả tạm thời và thống nhất với địa phương để đảm bảo các công trình phục vụ tưới tiêu của địa phương không bị gián đoạn;

#### ĐỀ XUẤT CỦA ĐỊA PHƯƠNG:

##### Ý kiến của Chủ tịch UBND huyện Duy Xuyên

- Huyện Duy Xuyên là vùng lũ, hướng thoát nước từ phía Tây về phía Đông, đề nghị TVTK khảo sát kỹ lũ lụt và tính toán thủy văn để đưa ra phương án thiết kế đảm bảo thoát nước.
- Cống chui B=3-4m là nhỏ so với quy hoạch của địa phương, đề nghị TVTK xem xét và kiểm tra lại.
- TVTK phối hợp với phòng KT&HT huyện và các xã trong phạm vi tuyến ĐCT cắt qua kiểm tra hiện trường từng vị trí đường giao cắt với đường cao tốc, cầu, cống thoát nước...
- Phòng KT&HT cung cấp thông tin quy hoạch các vị trí đường huyện đường xã để TVTK cập nhật quy mô.

Biên bản được lập thành 5 bản có giá trị pháp lý như nhau. Mỗi bên liên quan giữ 01 bản.

<p><b>Đại diện Ban QLDA 85</b></p>  <p><b>Lê Trọng Độ</b></p>	<p><b>Đại diện UBND huyện Duy Xuyên</b></p>   <p><b>Nguyễn Công Dũng</b></p>
	<p><b>Đại diện Tư vấn thiết kế</b></p>  <p><b>Takayasu Nagai</b></p>

**Phụ lục 1 Danh sách các kết cấu ngang đường**

TT	Lý trình	Xã	Chiều rộng hiện có (m)	Phân loại đường dự kiến	Loại kết cấu ngang	Kích thước dự kiến (m)	Ghi chú	Đề xuất địa phương
1	Km20+400.0	Duy Trinh	7	IV			ĐT610 chui dưới cầu Chiêm Sơn	
2	Km20+735.0		4	AH (VI)	Cầu đường ngang vượt đường cao tốc	B=6,5m	ĐH 9 đi vào Đập Vĩnh Trinh	
3	Km021+620.0		2.5	A	Cống chui	BxH=5.0x3.5	Thuộc thôn Chiêm Sơn	
4	Km022+252.0		3.5	A	Cống chui	BxH=5.0x3.5	Từ thôn 1 đi vào núi	Cống chui BxH=4.0x3.5
5	Km023+243.0	Duy Sơn	3.0	A	Cống chui	BxH=5.0x3.5	Từ thôn 1 đi thôn 6, thôn 7	QH là ĐX đề xuất BxH=5.5x3.0 m
6	Km23+547		2.0	C	Cống chui	BxH=3.0x3.0		
7	Km023+935		4	IV	Cầu ĐCT vượt đường ngang	L=21m	ĐH 08	
8	Km024+150		3	A	Cống chui	BxH=5.0x3.5	Từ thôn Phú Nham đồng vào núi	QH là ĐX đề xuất B=5.5m
9	Km024+790		2.5	A	Cầu đường ngang vượt cao tốc	B=5m	Từ thôn Chiêm Sơn sang thôn Phú Nham Đông	QH là ĐX đề xuất B=5.5m
10	Km025+373		6	IV	Cống chui	BxH=2x(4.5x4.5)	ĐH02, vào thủy điện Duy Xuyên 2	
11	Km026+003.0		2.5	B	Cống chui	BxH=4.0x3.0	Từ thôn Trà Kiệu Tây sang thôn Chiêm Sơn	
12	Km026+520		2	B	Cầu đường ngang vượt cao tốc	B=4m	Vào khu nghĩa địa+mỏ đá	

TT	Lý trình	Xã	Chiều rộng hiện có (m)	Phân loại đường dự kiến	Loại kết cấu ngang	Kích thước dự kiến (m)	Ghi chú	Đề xuất địa phương
13	Km026+806	Duy Trung	3	A	Cầu đường ngang vượt cao tốc	B=5m	Vào khu nghĩa địa+mô đá	
14	Km027+660		3	C	Cống chui	BxH=3.0x3.0		
15	Km028+080		3	C	Cống chui	BxH=3.0x3.0		
16	Km028+935		4	V	Cống chui	BxH=6.5x4.5	Từ thôn Nam Thành sang thôn I	

### Phụ lục 2 Danh sách cống thoát nước

STT	Xã	Lý trình	Loại	Kích thước (m)	Ghi chú, đề xuất của địa phương
1	Duy Trinh	Km020+860.0	Cống hộp	BxH=3(3.0x3.0)	
2		Km021+060.0	Cống hộp	BxH=3.0x3.0	
3		Km021+240.0	Cống tròn	D1.5	
4		Km021+730.0	Cống hộp	BxH=2(3.0x3.0)	
5		Km021+755.0	Cống hộp	D1.5	
6		Km022+246.0	Cống tròn	D1.5	
7		Km022+380.0	Cống tròn	D1.5	
8		Km023+720.0	Cống hộp	BxH=2x2m	
9		Km023+820.0	Cống hộp	BxH=2(3.0x3.0)	
10		Km024+080.0	Cống tròn	D1.5	
11		Km024+340.0	Cống tròn	D1.5	
12		Km024+550.0	Cống tròn	D1.5	
13		Km024+750.0	Cống tròn	D1.5	
14		Km025+200.0	Cống tròn	D1.5	
15		Km025+450.0	Cống tròn	D1.5	
16		Km025+716.5	Cống hộp	BxH=2(2.5x2.5)	
17		Km025+971.0	Cống tròn	D1.5	
18		Km026+159.0	Cống hộp	BxH=2.5x2.5	
19		Km026+323.0	Cống hộp	BxH=2x(2.5x2.5)	
20		Km026+442.0	Cống tròn	D1.5	
21	Duy Trung	Km026+621.5	Cống tròn	D1.5	
22		Km026+840.0	Cống tròn	D1.5	
23		Km027+082.0	Cống hộp	BxH=2x(2.5x2.5)	
24		Km027+340.0	Cống tròn	D1.5	
25		Km027+620.0	Cống hộp	BxH=2.0x2.0	
26		Km027+700.0	Cống hộp	D1.5	
27		Km028+010.0	Cống hộp	BxH=3.0x3.0	
28		Km028+330.0	Cống hộp	BxH=2.0x2.0	

STT	Xã	Lý trình	Loại	Kích thước (m)	Ghi chú, đề xuất của địa phương
29		Km028+464.0	Cống tròn	D1.5	
30		Km028+654.0	Cống hộp	BxH=2.5x2.5	
31		Km029+060.0	Cống tròn	D1.5	
32		Km029+146.0	Cống hộp	BxH=2.0x2.0	
33		Km029+365.0	Cống hộp	BxH=2(3.0x3.0)	
34		Km029+435.0	Cống tròn	D1.5	
	Tổng cộng	Cống tròn		19	
		Cống hộp		15	

### Phụ lục 3 Danh sách đường gom

STT	Xã	Lý trình		Chiều dài (m)	Bên	Ghi chú
		Từ	Đến			
1	Duy Trinh	Km021+100.0	Km021+240.0	140.00	Trái	
2		Km021+550.0	Km021+610.0	80.00	Trái	
3		Km021+320.0	Km021+630.0	310.00	Phải	
		<b>Tổng cộng</b>		<b>530.00</b>		
4	Duy Sơn	Km023+180.0	Km023+330.0	150.00	Phải	
5		Km023+921.0	Km024+150.0	229.00		
6		Km025+927.0	Km026+049.0	122.00	Phải	
		<b>Tổng cộng</b>		<b>501</b>		
7	Duy Trung	Km027+658.5	Km027+820.5	162.00	Trái	
8		Km028+78.5	Km028+214.5	136.00	Phải	
9		Km028+745.0	Km028+934.0	189.00	Phải	
		<b>Tổng cộng</b>		<b>189.00</b>		

### Phụ lục 4 Danh sách cải mương

STT	Xã	Lý trình		Chiều dài (m)	Bên	Ghi chú
		Từ	Đến			
1	Duy Trinh	Km021+090.0	Km021+235.0	145.0		
		<b>Tổng chiều dài (m)</b>		<b>145.0</b>		
2	Duy Sơn	Km023+343.0	Km023+376.0	33.0	Trái	
3		Km023+180.0	Km023+412.0	232.0	Phải	
4		Km025+190.0	Km025+235.0	45.0	Trái	
5		Km025+430.0	Km025+475.0	45.0	Trái	
6		Km026+110.0	Km026+160.0	50.0	Phải	
7		Km026+295.0	Km026+315.0	20.0	Trái	
8		Km026+330.0	Km026+360.0	30.0	Phải	
		<b>Tổng chiều dài (m)</b>		<b>455.0</b>		
9	Duy Trung	Km028+320.0	Km028+387.0	67.0	Phải	
10		Km028+985.0	Km029+050.0	65.0	Trái	
		<b>Tổng chiều dài (m)</b>		<b>132.0</b>		

**Phụ lục 5 Cầu vượt sông suối**

STT	Xã	Lý trình		Chiều dài (m)	Ghi chú
		Từ	Đến		
1	Duy Trinh	Km021+832.0	Km021+862.0	30.00	Cầu vượt kênh Vĩnh Trinh
2	Duy Sơn	Km023+368.0	Km023+422.0	54.00	Cầu vượt sông Duy Lộc
3		Km024+900.0	Km024+935.0	35.00	Cầu vượt sông Duy Sơn



## **APPENDIX 2: RESULTS OF STABILITY ANALYSIS AT EMBANKMENT SECTIONS**



# SLOPE/W Analysis

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## Project Settings

Length(L) Units: meters  
Time(t) Units: Seconds  
Force(F) Units: kN  
Pressure(p) Units: kPa  
Strength Units: kPa  
Unit Weight of Water: 9.807 kN/m<sup>3</sup>  
View: 2D

## Analysis Settings

### SLOPE/W Analysis

Kind: SLOPE/W  
Method: Bishop  
Settings  
PWP Conditions Source: Piezometric Line  
Apply Phreatic Correction: No  
Use Staged Rapid Drawdown: No

#### Slip Surface

Direction of movement: Left to Right  
Use Passive Mode: No  
Slip Surface Option: Grid and Radius  
Critical slip surfaces saved: 1  
Optimize Critical Slip Surface Location: No  
Tension Crack  
Tension Crack Option: (none)

#### F of S Distribution

F of S Calculation Option: Constant

#### Advanced

Number of Slices: 30  
F of S Tolerance: 0.001  
Minimum Slip Surface Depth: 0.1 m  
Optimization Maximum Iterations: 2,000  
Optimization Convergence Tolerance: 1e-007  
Starting Optimization Points: 8  
Ending Optimization Points: 16  
Complete Passes per Insertion: 1  
Driving Side Maximum Convex Angle: 5 °  
Resisting Side Maximum Convex Angle: 1 °

## Materials

### Fill Material

Model: Mohr-Coulomb  
Unit Weight: 21 kN/m<sup>3</sup>



Cohesion': 20 kPa  
Phi': 21 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

**Layer1**

Model: Mohr-Coulomb  
Unit Weight: 20.7 kN/m<sup>3</sup>  
Cohesion': 16 kPa  
Phi': 17 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

**Layer3a**

Model: Mohr-Coulomb  
Unit Weight: 16 kN/m<sup>3</sup>  
Cohesion': 40 kPa  
Phi': 0 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

**Layer4**

Model: Mohr-Coulomb  
Unit Weight: 20 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 25 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

**Layer13**

Model: Mohr-Coulomb  
Unit Weight: 20 kN/m<sup>3</sup>  
Cohesion': 24 kPa  
Phi': 24 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

**Layer15B**

Model: Mohr-Coulomb  
Unit Weight: 25 kN/m<sup>3</sup>  
Cohesion': 0 kPa  
Phi': 40 °  
Phi-B: 0 °  
Pore Water Pressure  
Piezometric Line: 1

**Slip Surface Grid**

Upper Left: (14, 28) m



Lower Left: (28, 28) m  
 Lower Right: (28, 16) m  
 Grid Horizontal Increment: 10  
 Grid Vertical Increment: 10  
 Left Projection Angle: 0 °  
 Right Projection Angle: 0 °

## Slip Surface Radius

Upper Left Coordinate: (5, 4) m  
 Upper Right Coordinate: (36, 4) m  
 Lower Left Coordinate: (5, -6) m  
 Lower Right Coordinate: (36, -6) m  
 Number of Increments: 20  
 Left Projection: No  
 Left Projection Angle: 135 °  
 Right Projection: No  
 Right Projection Angle: 45 °

## Slip Surface Limits

Left Coordinate: (-50, 3.9) m  
 Right Coordinate: (50, 3.9) m

## Piezometric Lines

### Piezometric Line 1

#### Coordinates

	X (m)	Y (m)
Coordinate 1	-50	3.9
Coordinate 2	-24	3.9
Coordinate 3	25.6	3.9
Coordinate 4	50	3.9

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 15.7 kN/m<sup>3</sup>  
 Direction: Vertical

#### Coordinates

	X (m)	Y (m)
	-6.2	12.8
	-6.2	13.8
	6.3	14.4
	6.3	13.4





## Points

	X (m)	Y (m)
Point 1	-50	3.9
Point 2	50	3.9
Point 3	-50	3.5
Point 4	50	3.5
Point 5	-50	2.5
Point 6	50	2.5
Point 7	-50	1.3
Point 8	50	1.3
Point 9	-50	-0.2
Point 10	50	-0.2
Point 11	-50	-3.6
Point 12	50	-3.6
Point 13	-24	3.9
Point 14	-6.2	12.8
Point 15	6.3	13.4
Point 16	6.9	13.3
Point 17	25.6	3.9
Point 18	-50	-10
Point 19	50	-10

## Regions

	Material	Points	Area (m <sup>2</sup> )
Region 1	Layer13	9,11,12,10	340
Region 2	Layer4	7,9,10,8	150
Region 3	Layer3a	5,7,8,6	120
Region 4	Layer1	3,4,6,5	100
Region 5	Layer1	1,3,4,2,17,13	40
Region 6	Fill Material	14,13,17,16,15	287.77
Region 7	Layer15B	11,12,19,18	640

## Current Slip Surface

Slip Surface: 1,290

F of S: 1.407

Volume: 174.43981 m<sup>3</sup>

Weight: 3,537.7656 kN

Resisting Moment: 32,840.922 kN-m

Activating Moment: 23,339.491 kN-m

F of S Rank: 1

Exit: (33.125593, 3.9) m

Entry: (1.6473546, 13.176673) m

Radius: 20.8 m

Center: (21, 20.8) m



## Slip Slices

	X (m)	Y (m)	PWP (kPa)	Base Normal Stress (kPa)	Frictional Strength (kPa)	Cohesive Strength (kPa)
Slice 1	2.2289352	11.943967	- 78.887181	7.6431319	2.9339235	20
Slice 2	3.3920966	9.7818471	- 57.683275	46.001073	17.658158	20
Slice 3	4.555258	8.0994029	- 41.183544	78.975678	30.315922	20
Slice 4	5.7184193	6.7153669	- 27.610304	108.09673	41.494448	20
Slice 5	6.6	5.7964306	- 18.598295	114.91558	44.111957	20
Slice 6	7.3936018	5.0812301	- 11.584324	125.4709	48.163767	20
Slice 7	8.3808054	4.2769806	- 3.6970484	134.90701	51.785949	20
Slice 8	9.1633401	3.7	1.9614	147.84956	44.602487	16
Slice 9	9.8674897	3.2368129	6.5038763	152.50118	44.635854	16
Slice 10	10.697923	2.7368129	11.407376	156.88525	44.477049	16
Slice 11	11.554601	2.274912	15.937238	166.35943	0	40
Slice 12	12.437523	1.850348	20.100937	165.48067	0	40
Slice 13	13.320445	1.475436	23.777699	163.70628	0	40
Slice 14	14.300002	1.1168365	27.294484	156.55365	60.274541	0
Slice 15	15.376192	0.78249812	30.573341	154.88564	57.967778	0
Slice 16	16.452382	0.51071516	33.238716	151.73199	55.254318	0
Slice 17	17.528572	0.29899167	35.315089	147.13175	52.140963	0
Slice 18	18.604763	0.14547511	36.820626	141.10735	48.629696	0
Slice 19	19.680953	0.048869932	37.768033	133.6658	44.717864	0
Slice 20	20.757144	0.0083806593	38.165111	124.79912	40.3981	0
Slice 21	21.833334	0.023678321	38.015087	114.48388	35.657985	0
Slice 22	22.909524	0.094886903	37.316744	102.68007	30.479419	0
Slice 23	23.985715	0.22258844	36.064375	89.328844	24.83763	0



Slice 24	25.061905	0.40784723	34.247542	74.349139	18.699682	0
Slice 25	26.039682	0.62486136	32.119285	64.349578	15.029232	0
Slice 26	26.919047	0.8652434	29.761858	59.832639	14.022236	0
Slice 27	27.798411	1.1478971	26.989873	54.358128	12.762027	0
Slice 28	28.679555	1.475436	23.777699	56.664587	0	40
Slice 29	29.562477	1.850348	20.100937	52.213275	0	40
Slice 30	30.445399	2.274912	15.937238	47.068718	0	40
Slice 31	31.302077	2.7368129	11.407376	33.267776	6.6833951	16
Slice 32	32.13251	3.2368129	6.5038763	23.235213	5.115283	16
Slice 33	32.83666	3.7	1.9614	13.784563	3.6147036	16



### APPENDIX 3 : TECHNICAL STANDARDS LIST APPLIED IN DQEP





### Appendix 3: Technical Standards to be applied to the Project

Update: 25 April 2013

According to the Decision No. 362/QD-BGTVT dated on 20 February 2009, Decision No. 727/QD-BGTVT dated 6/4/2012, Decision No.270/QD-BGTVT dated 29 January 2013, Decision No. 994/QD-BGTVT dated 16 April 2013, the following technical standards are to be applied to the Project. .

#### Decision No. 362/QD-BGTVT dated 20 February 2009

No.	Standards to be applied	Code
I.	TO BE APPLIED FOR SURVEY	
1	Specification for measuring and drawing topography	96TCN43-1990
2	Specification for drawing topographical maps with scale 1:500 1:1000 1:2000 1:5000 1:10000 1:25000	96TCN42-1990
3	Geodesy works in engineering - general requirements	TCXDVN309-2004
4	Specification for measuring and analyzing GPS data	TCXDVN364-2006
5	Specification for boring survey	22TCN259-2000
6	Specification for geotechnical investigation of marine works	22TCN260-2000
7	Specification for surveying and designing the highway embankment on the soft ground	22TCN262-2000
8	Specification for surveying highway	22TCN263-2000
9	Specification for geotechnical investigation and design solution for roads in land sliding areas	22TCN171-1987
10	Specification for Static Penetration Test (CPT and CPTU)	22TCN317-2004
11	Specification for site shearing test	22TCN355-2000
12	Construction soil site testing method SPT	TCXD226-1999
13	Construction soil-physic-mechanical test	TCVN4195-4202-1995
14	Surveying works for design and construction of pile foundation	20TCN160-1987
15	Construction soil exploiting packing transporting and maintaining samples	TCXD2683-1991
16	Specification for checking bridge on highway technical requirements	22TCN243-1998
17	Specification for testing elastic modulus of the pavement by deflection measurement Benkelman beam	22TCN251-1998
18	Specification for testing and evaluating pavement strength and flexible pavement of highway by FWD	22TCN335-2006
19	Specification for analyzing water used in transport constructions	22TCN61-1984
20	Specification for geotechnical investigation for constructions in Karst area	TCXDVN366-2006
II.	TO BE APPLIED FOR DESIGN	
1	Expressway highway design requirements	TCVN5729-1997
2	Highway Design Requirements	TCVN4054-2005

No.	Standards to be applied	Code
3	Standard for designing highway (junctions)	22 TCN273-2001
4	Soft soil treatment with wick drains	22TCN244-1998
5	Geotextile applying for embankment of soft soil ground	22TCN248-1998*
6	Specification for designing of flexible pavement	22TCN211-2006
7	Specification for rigid pavement design	22TCN223-1995
8	Standard of bridge design	22TCN272-2005
9	Standard for design culverts with limit state (applying for culvert design and auxiliaries)	22TCN18-1979
10	Pile foundation design standard	TCXDVN205-1998
11	PC concrete nail T13 T15 & D13 D15	22TCN267-2000
12	Rubber bearings	AASHTO M251-06-UL, ASTM D4014-03(2007)
13	Standard for expansion joints	AASHTO M297-96, AASHTO M183-96
14	Specification for design of bridges and auxiliaries for bridges	22TCN200-1989
15	Calculation of flood flow features	22TCN220-1995
16	Transport works in earthquake zone design standard	22TCN221-1995
17	Regulations of traffic signals on highway	22TCN237-2001*
18	Guiding board on expressway	22TCN331-2005*
19	Drainage design standard	22TCN51-1984
20	Standard for design lighting of roads and squares in urban	TCXDVN259-2001
21	Lighting outdoor of public works and infrastructure in urban construction design standards	TCXDVN333-2005
22	Specification for environment impact assessment in preparing FS and design for transport works	22TCN242-1998
23	Design earthquake bearing facilities	TCXDVN375-2006
24	Concrete and reinforced concrete	TCXDVN356-2005
III.	TO BE APPLIED FOR CONSTRUCTION AND ACCEPTANCE	
1	Block bricks, construction and acceptance	TCVN 4085-1985
2	Specification for construction and acceptance of culverts and bridges	22TCN 266-2000
3	Specification for testing CBR for crush stones and sand in lab	22 TCN 332-2006
4	Specification for compaction of crushed stone and soil in lab	22 TCN 333-2006
5	Specification construction and acceptance of crushed stone layers in highway pavement	22 TCN 334-2006
6	Specification for checking compaction of embankment by priming funnel	22 TCN 346-2006
7	Specification for measuring the smoothness of pavement by 3m ruler	22 TCN 16-1979

No.	Standards to be applied	Code
8	Specification for checking and evaluating roughness by IRI	22 TCN 277-2001
9	Specification for testing roughness of pavement by sand sprinkling	22 TCN 278-2001
10	Painting traffic signals in liquidity on concrete cement pavement and asphalt pavement	22 TCN 282-285
11	Specification for checking compaction of embankment in transport works	22 TCN 02-1971 and Decision 4313/2001/QĐ-BGTVT
12	Construction soil - construction and acceptance specification	TCVN 4447-1987
13	Specification for construction and acceptance of AC pavement	22 TCN 249-1998
14	Standard for construction and acceptance of bituminous surface pavement	22 TCN 271-2001
15	Concrete drainage pipe	TCXD VN 372:2006
16	Aggregates used for concrete and mortar	TCVN 7572:2006
17	Specification for taking samples of asphalt applying for road, airport	22 TCN 321-2006
18	Specification for testing AC	22 TCN 62-1984
19	Dense asphalt - technical requirements and testing method	22 TCN 279-2001
20	Specification for testing mineral powder used for ETN	22 TCN 58-1984
21	Bored piles - specification for construction and acceptance	TCXDVN 326-2004
22	Bored piles - sonic logging method to test the homogene of concrete	TCXDVN 358-2005
23	Portland cement - methods of determining physio-mechanical criteria	TCVN -4029-1985 TCVN-4030-2003
24	Portland cement - technical requirements	TCVN-2682-1999
25	Mixed Portland cement - technical requirements	TCVN-6260-1997
26	Aggregates for concrete and mortar - technical requirements	TCVN-7570-2006
27	Water for concrete and mortar - technical requirements	TCVN 4506 - 1987
28	Heavy concrete - method testing physio-mechanical criteria	TCVN 3105-3120:1993
29	Heavy concrete - Method of testing cylinder strength and elastic modulus of static compression	TCXD 171-1989
30	Heavy concrete - method of nondestructive sonic logging and rebound hammer to check the compressive strength	TCVN 2576-1993
31	Specification for construction and acceptance of PC beam	22 TCN 247-1998
32	Specification for construction and acceptance asphalt pavement using polime asphalt.	22 TCN 356-2006
33	Specification for construction and acceptance asphalt pavement with high roughness cover layer	22 TCN 345-2006
34	Temporary specification for construction and acceptance of super thin cover layer for roughness n highway	QĐ 3287/QĐ-BGTVT of 29 Oct 2008
35	Finishing works - construction and acceptance	TCXD 305-2004
36	Mass concrete, specification of construction and acceptance	TCXDVN 305-2004
37		

No.	Standards to be applied	Code
38	Specification of construction and acceptance of wick drain in soft soil pavement	22TCN 236-1997
39	Specification for testing bridges	22TCN 170-1987
40	Specification of testing density by sand pouring	22TCN 13-1979
41	Specification of construction and acceptance of crushed stone layers	22TCN 252-1998
42	Technical requirements and testing method for polime asphalt	22TCN 319-2004
43	Acceptance of construction quality	TCXDVN 371-2006

### Decision No. 727/QĐ-BGTVT dated 6 April 2012

No.	Standards to be applied	Code
I.	TO BE APPLIED FOR SURVEY	
1	British Practical standard of soil and other reinforced materials	BS8006-1995
2	Paint traffic signals: Solvent road marking paint – Specification and testing method	22TCN 283-2002
II.	TO BE APPLIED FOR DESIGN	
3	Hazardous solid waste landfills – Design standard	TCXDVN320-2004
4	Load and Effect	TCVN 2737-1995
5	Steel bridges and steel structures	TCXDVN 338-2005
6	Guidance for determination of dynamic component of the wind load under TCVN 2737-1995	TCXD 229-1999
7	Standard for railway tunnel and highway tunnel	TCVN4527-1988
8	Tunnel Design Standard: Mountain Tunnel	JSC 2007
9	Navigation clearance requirements of rivers	TCVN 5664-2009
10	Regulation on navigation aids of Vietnam inland waterways	22TCN 269-2000
11	Drainage & Sewerage – External Network & Facilities – Design Standard	TCVN7957-2008
12	Standard for design of rural roads	22TCN 210-1992
13	Office buildings – Design standard	TCVN 4601-1988
14	Dwellings – Design standard	TCVN 353-2004
IV.	TO BE APPLIED FOR CONSTRUCTION AND ACCEPTANCE	
15	Specification for High-Strength Bolts for Structural Steel Joints	AASHTO M164
16	Standard for construction and acceptance of cement consolidated stones sub- grade in highway pavement structure	22TCN 245-1998
17	Cement - Classification	TCVN 5439-2004
18	Mortar – Technical specifications	TCVN 4314-2003
19	Concrete - Requirement for natural moist curing	TCXDVN 391-2007
20	Chemical admixtures for concrete	TCXDVN 325-2004
21	Steel scaffolding	TCVN 6052-1995
22	Scaffolding-Safety Requirements	TCXDVN 296-2004
23	Pre-cast reinforced concrete box culvert technical requirements and testing method	TCXDVN 392-2007
24	Monolithic concrete and reinforced concrete structures – Codes for construction, check and acceptance	TCVN 4453-1995

No.	Standards to be applied	Code
25	Specification for underwater concrete construction by cavity-fill method	22TCN 209-1992
26	Precast pre-stressed concrete products - Technical requirements and acceptance	TCXDVN 389-2007
27	Assembled Concrete and reinforced Concrete Structures - Code of Practice for construction and acceptance	TCXDVN 390-2007
28	Concrete and Reinforced concrete structures-Guide on technical measures for prevention of cracks occurred under the action of local hot humid climate	TCXDVN 313-2004
29	Welding specifications for steel bridge and steel structure	22TCN 280-01
30	Pile driving and static jacking works - Standard for construction, check and acceptance	TCVN 286-2003
31	Protection against corrosion in construction. Concrete and reinforced concrete structures. Classification of corrosive medium	TCVN 3994-1985
32	Specification for construction and acceptance of paint used for steel bridge and steel structures	22TC 253-98
33	Piles - Standard test method for piles under axial compressive load	TCXDVN 269-2002
34	Foundation Piles - Method of detection of defects by dynamic low-strain testing	TCXDVN 359-2005
35	Standard Test Method for High-Strain Dynamic Testing of Deep Foundations	ASTM D4945
36	Standard Specification for Steel Strand Uncoated Seven-Wire for Pre-stressed Concrete	ASTM A416
37	Standard Specification for Uncoated High-Strength Steel Bars for Pre-stressing Concrete	ASTM A722
38	Steel for reinforcement of concrete	TCVN 1651-2008
39	Paint for construction – Classification	TCXDVN 321-2004
40	Paint used for steel bridges and steel structures – Technical requirements and testing method	22TCN 235-97
41	Paint and metal protective coating	22TCN 300-02
42	Bridge construction specification	TCCS 02:2010/TCDBVN
43	Specification for construction and acceptance of pavement structure by natural grading	22TCN 304-2003
III.	TO BE APPLIED FOR ELECTRICAL SURVEY and DESIGN	
44	Standard for electric system- electric line system	11TCN 19-2006
45	Specification for lighting	TCXDVN 259-2001
V.	TO BE APPLIED FOR BUILDING SURVEY and DESIGN	
46	Toll station	TCCS 01-2008/VRA
47	Electric distribution network in dwellings and public building – Design standard	TCXD 27-1991
48	Installation of electric wire in dwellings and public buildings – Design standard	TCXD 25-1991
49	Protection of Structures Against Lightning - Guidance for design, inspection and maintenance	TCXDVN 46-2007
VI.	TO BE APPLIED FOR OPERATION and MAINTENANCE (O&M) of ROADS	
50	Concrete and Reinforced concrete Structures - Guide on Maintenance	TCXDVN 318-2004

### Decision No. 270/QD-BGTVT dated 29 January 2013

No.	Standards to be applied	Reference
I	TO BE APPLIED FOR TRAFFICE MANAGEMENT SYSTEM	
1	Reference model architecture for the ITS sector	ISO 14813

No.	Standards to be applied	Reference
2	Transport information and control systems – Requirements for ITS/TICS central data registry and ITS/TICS data dictionaries	ISO 14817:2002
3	Transport information and control systems – Data interfaces between centers for transport information and control system – Part1: message definition requirements	ISO 14827-1:2005
4	Transport information and control systems – Data interfaces between centers for transport information and control systems – Part 2: DATEX-ASN	ISO 14827-2:2005
5	Intelligent transport systems (ITS) – Data exchange involving roadside modules communication Part1: General principles and documentation framework of application profiles	ISO 15784-1:2008
6	Intelligent transport systems (ITS) – Data exchange involving roadside modules communication Part2:Application Profile-SNMP	ISO 15784-2:2008
7	Intelligent transport systems (ITS) – Data exchange involving roadside modules communication --- Part3: Application profile-data exchange (AP-DATEX)	ISO 15784-3:2008
II	<b>TO BE APPLIED FOR TOLL COLLECTION SYSTEM</b>	
1	Information technology – specification and standardization of data elements	ISO/IEC 11179
2	ITS – Dedicated Short Range Communication (DSRC) at 5.8GHz	ITU-R M.1453-2
3	Road transport and traffic telematics – Dedicated Short Range Communication (DSRC) – Application Layer	ISO 15628
4	DSRC System	ARIB STD-T75
5	Road transport and traffic telematics – Electronic fee collection Application	ISO 14906
6	Electronic fee collection -- Interface Definition for on-board account using	ISO/TS 25110
7	Road transport and traffic telematics – Electronic fee collection (EFC) – systems	ISO 17573
8	Identification cards – Contactless integrated circuit cards – Proximity cards –	ISO/IEC 14443-1
9	Identification cards – Contactless integrated circuit cards – Proximity cards – Part 2: Radio frequency power and signal interface	ISO/IEC 14443-2
10	Identification cards – Contactless integrated circuit cards – Proximity cards – Part 3: Initialization and anticollision	ISO/IEC 14443-3
11	Identification cards – Contactless integrated circuit cards – Proximity cards – Part 4: Transmission protocol	ISO/IEC 14443-4
12	Identification cards – Integrated circuit cards – Part 4: Organization, security and commands for interchange	ISO/IEC 7816-4
13	Information technology – Telecommunication and information exchange between systems – Near Field Communication – Interface and Protocol (NFCIP-1)	ISO/IEC 18092
14	Classification of environment conditions – Part 3 : Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations	IEC 60721-3-4

No.	Standards to be applied	Reference
15	Classification of environment conditions – Part 3 : Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations	IEC 60721-3-5
16	Road transport and traffic telematics – Automatic vehicle and equipment identification –System specifications	ISO 14815
17	Environmental testing. Part 1: General and guidance	IEC 60068-1
18	Road transport and traffic telematics – Electronic fee collection – Test procedures for user and fixed equipment – Part 1: Description of test	ISO/TS 14907-1
19	Road transport and traffic telematics – Electronic fee collection – Test procedures for user and fixed equipment – Part 2: Conformance test for the onboard unit application interface	ISO/TS 14907-2
III	TO BE APPLIED FOR COMMUNICATION SYSTEM	
1	<ul style="list-style-type: none"> <li>8802-3: 2000 (ISO/IEC) (ANSI/IEEE Std 802.3 2000 Edition): Information Technology – Telecommunications and information exchange between systems – Local and Metropolitan area networks – Specific equipment -- Part3: Carrier sense multiple access with collision detection (CAMA/CD) access method and physical layer specifications.</li> </ul>	Ethernet
2	<ul style="list-style-type: none"> <li>IEEE 802.3u-1995 IEEE Standards for Local and metropolitan area networks: Supplement to Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications: Media access control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100Mb/s Operation, Type 100BaseT (Clauses 21-30) (ANSI)</li> <li>EIA/TIA568B (AT and T-258A) Commercial Building Telecommunications Wiring Standard, 1991</li> </ul>	Fast Ethernet
3	<ul style="list-style-type: none"> <li>IEEE 802.3ab : Physical coding sublayer (PCS), physical medium attachment (PMA) sublayer and baseband medium, type 1000BASE-T</li> <li>IEEE 802.3z : Media Access Control(MAC) Parameters, Physical Layer, Repeater and Management Parameters for 1000 Mb/s Operation</li> </ul>	Gigabit Ethernet
4	<ul style="list-style-type: none"> <li>RFC 959 File Transfer Protocol, J. Postel, J.K. Reynolds, Oct-01-1985</li> <li>RFC 1350 The TFTP Protocol (Revision 2), K. Sollins, July 1992 (TFTP)</li> </ul>	FTP
5	<ul style="list-style-type: none"> <li>RFC 1945 Hypertext Transfer Protocol -- HTTP/1.0. R. Fielding, H. Frystyk, T. Berners-Lee</li> <li>RFC 2068 Hypertext Transfer Protocol -- HTTP/1.1. R. Fielding, J. Gettys, J. Mogul, H. Frystyk, T. Berners-Lee, January 1997 (Status: PROPOSED STANDARD)</li> <li>RFC 2616 Hypertext Transfer Protocol /1.1 June 1999</li> <li>RFC 2617 HTTP Authentication: Basic and Digest Access Authentication, June 1999</li> </ul>	HTTP
6	<ul style="list-style-type: none"> <li>RFC 791 Internet Protocol. J. Postel. Sep-01-1981</li> </ul>	IP
7	<ul style="list-style-type: none"> <li>RFC 1661 The Point-to-Point Protocol (PPP), W. Simpson, July 1994</li> </ul>	PPP

No.	Standards to be applied	Reference
8	<ul style="list-style-type: none"> <li>RFC 1157 Simple Network Management Protocol (SNMP), J.D. Case, M. Fedor, M.L.Schoffstall, C. Davin, May-01-1990</li> </ul>	SNMP
9	<ul style="list-style-type: none"> <li>RFC 793 Transmission Control Protocol. J. Postel. Sep-01-1981</li> </ul>	TCP
10	<ul style="list-style-type: none"> <li>RFC 768 User Datagram Protocol. J. Postel. Aug-28-1980</li> </ul>	UDP
11	<ul style="list-style-type: none"> <li>ISO/IEC 144916-1:1999 Information technology -- Coding of audio visual objects -- Part 1: Systems</li> <li>ISO/IEC 144916-2:1999 Information technology -- Coding of audio-visual objects -- Part 2: Visual</li> <li>ISO/IEC 144916-2:1999 Information technology -- Coding of audio-visual objects -- Part 3: Audio</li> <li>ISO/IEC 14496-10:2003: Information technology -- Coding of audio-visual objects -- Part 10: Advanced Video Coding</li> </ul>	MPEG4
12	<ul style="list-style-type: none"> <li>ITU-T G 652: Characteristics of a single-mode optical fiber and cable</li> <li>ITU-T G 655: Characteristic of a non-zero dispersion-shifted single-mode optical fiber and cable</li> </ul>	FOC
13	Telecom Peripheral Construction – Technical regulations	TCN 68-254:2006
14	Cable duct and cable connected box - Technical requirements	TCN 68-153:1995
15	Rigid PVC pipes for underground cables - Technical standards	TCN 68-144:1995
16	Rigid PVC pipes for underground cables - Technical standards	TC.VNPT-06:2003
17	Code of practice for the construction for optical fiber communication system	TCN 68-178:1999

**Decisions No. 994/QD-BGTVT dated 16 April 2013**

**List of Additional / Updated Technical Standards Applied to DQEP**

**A. UPDATED STANDARDS**

No	Technical Standard	Standards approved in Decision No.362/QD-BGTVT dated 20/2/2009 and No. 727/QD-BGTVT dated 6/4/2013 by MOT	Updated/Approved Standards
1	Asphalt Concrete Pavement – Specification for Construction and Acceptance	22TCN 249-1998	TCVN 8819:2011



No	Technical Standard	Standards approved in Decision No.362/QĐ-BGTVT dated 20/2/2009 and No. 727/QĐ-BGTVT dated 6/4/2013 by MOT	Updated/Approved Standards
2	Graded Aggregate Base and Subbase Pavement - Specification for Construction and Acceptance	22TCN 334-2006	TCVN 8859:2011
3	Bituminous Surface Treatment – Specification for Construction and Acceptance	22TCN 271-2001	TCVN 8863:2011
4	Standard Test Method for Measuring Road Pavement Surface Roughness Using a 3m Straight Edge	22TCN 16-1979	TCVN 8864:2011
5	Method for Measuring and Assessment Roughness by International Roughness Index (IRI)	22TCN 277-2001	TCVN 8865:2011
6	Standard Test Method for Measuring Pavement Macrottexture Depth Using a Volumetric Technique	22TCN 278-2001	TCVN 8866:2011
7	Flexible Pavement – Standard Test Method for Determination of Elastic Modulus of Pavement Structure Using Benkelman beam	22TCN 251-1998	TCVN 8867:2011
8	National Technical Regulation on Road Signs and Signals	22TCN 237-2001	QCVN 41:2012/BGTVT
9	Soil - Methods laboratory of determination of specific weight	TCVN4195:1995	TCVN4195:2012
10	Soil - Methods laboratory of determination of volume weight	TCVN4202:1995	TCVN4202:2012
11	Soils - Sampling, packing, transportation and curing of samples	TCVN2683:1991	TCVN2683:2012
12	Bored Piles- Construction, check and acceptance	TCXDVN 326:2004	TCVN 9395:2012
13	Bored piles – Determination of homogeneity of concrete - sonic pulse method	TCXDVN 358:2005	TCVN 9396:2012
14	Piles - standard test method in situ for piles under axial compressive load	TCXDVN 269:2002	TCVN 9393:2012
15	Cement Treated Aggregate Base for Road Pavement – Specification for Construction and Acceptance	22TCN 245-1998	TCVN 8858:2011
16	Painting Traffic signal – Road marking by thermoplastic reflective material – Specification, testing method, construction and acceptance.	22TCN 283-2002	TCVN 8791:2011
17	Painting for protection of steel structure – Specification and testing method	22TCN 235-97	TCVN8789:2011
18	Painting for protection of steel structure – Construction and acceptance	22TCN 253-98	TCVN8790:2011
19	Paint and metal covering – Testing method in natural conditions	22TCN 300-02	TCVN8785-1:2011 TCVN8785-14:2011
20	Concrete structure and precast reinforced concrete	TCXDVN 390:2007	TCVN 9115:2012

No	Technical Standard	Standards approved in Decision No.362/QĐ-BGTVT dated 20/2/2009 and No. 727/QĐ-BGTVT dated 6/4/2013 by MOT	Updated/Approved Standards
21	Drainage reinforced concrete culvert pipe	TCXDVN 372:2006	TCVN 9113:2012
22	Reinforced concrete box culvert	TCXDVN 392:2007	TCVN 9116:2012
23	Product of pre-stressed concrete – Technical specification and acceptance	TCXDVN 389:2007	TCVN 9114:2012
24	Bored pile – Specification for construction and acceptance	TCXDVN 326:2004	TCVN 9395:2012
25	Bored pile – Ultrasonic impulse method for determining the uniform of concrete	TCXDVN 358:2005	TCVN 9396:2012
26	Cement – Testing method – Determination of durability	TCVN 6016:1995	TCVN 6016:2001
27	Portland cements – Specifications	TCVN 2682 – 1999	TCVN 2682 - 2009
28	Portland blended cements – Specifications.	TCVN 2660 – 1987	TCVN 6260 - 2009
29	Water for mixing concrete and mortar – Technical Specification	TCVN 4506:1987	TCXDVN 4506:2012
30	Heavy concrete – Nondestructive method by using both ultrasonic counter and rebound hammer for determining compressive strength	TCXD 171-1989	TCVN 9335:2012
31	The finalization works in construction – Construction and acceptance	TCXD 303-2006	TCVN 9397-2:2012 TCVN 9397-3:2012
32	Mass concrete – Specification for construction and acceptance	TCXDVN 305-2004	TCVN 9395-2012
33	Bitumen – Testing method for physico-mechanical characteristic	22TCN 279-01	TCVN 7493:2005 ÷TCVN 7405:2005
34	Bitumen –Method for sampling	22TCN 231-96	TCVN 7494:2005
35	Installation of conduct line in house and public works – Design specification	TCXD25:1991	TCVN 9207:2012
36	Installation of electric facilities in house and public works – Design specification	TCXD27:1991	TCVN 9206:2012
37	Anti-lightning for civil works – Instruction of design, inspection and maintenance for its system	TCXDVN 46:2007	TCVN 9385:2012
38	Chemical admixture for concrete	TCXDVN 325-2004	TCVN 8826:2011
39	Concrete – Requirements on natural moisture curing	TCXDVN 391:2007	TCVN 8828:2011
40	Structure of concrete and reinforced concrete – Technical instruction on preventing cracks under impact of hot- moist climate	TCXDVN 313:2004	TCVN 9345:2012

No	Technical Standard	Standards approved in Decision No.362/QD-BGTVT dated 20/2/2009 and No. 727/QD-BGTVT dated 6/4/2013 by MOT	Updated/Approved Standards
41	Structure of concrete and reinforced concrete – Instruction on maintenance works.	TCXDVN 318:2004	TCVN 9343

## B. ADDITIONAL STANDARDS

No	Technical Standard	Code
1	Standard test method for CBR (California Bearing Ratio) of soils and unbound roadbase in place	TCVN 8821-2011
2	Steel for the reinforcement of concrete – Threaded coupler splice	TCVN 8163:2009
3	Water-stop membrane used in construction joints - Requires in using	TCXDVN 290:2002
4	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)	ASTM C1107
5	Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets - Evaluation of Rubber for Bridge bearing.	ASTM D3182+D3190; D3192
6	Reflective membrane for road signalling	TCVN 7887:2008
7	Temporary regulation on normal cement concrete formation with joint in construction of traffic works.	Decision No.3230/QD-BGTVT dated 14/12/2012.
8	Temporary regulation on construction engineering and acceptance for cement concrete pavement in construction of traffic works.	Decision No.1951/QD-BGTVT dated 17/08/2012.
9	Flexible pavement – Determination of elastic modul of ground base and pavement structure courses by using hard steel plates	TCVN 8861:2001
10	Water supply – Network of pipe and structures – Specification for design	TCXDVN 33:2006
11	National technical codes on safety for fire for house and structures	QCVN 06:2010/BXD
12	Regulations on earthing connection and neutral connection for electric facilities	TCVN 4756:1989
13	Geotextile fabric – Testing method	TCVN 8871-1:2011-TCVN 8871-6:2011
14	Painting for traffic signal	TCVN 8786:2011 TCVN 8788:2011
15	Structure of stone brick – Regulations on construction and acceptance	TCVN 4085:2011
16	Asphalt concrete – Testing method	TCVN 8860-1:2011-TCVN 8860-12:2011
17	Hot asphalt concrete mixing plant – Specification and checking method	22TCN 255-99
18	Pavement for highway – Construction and acceptance	TCVN 9436-2012

No	Technical Standard	Code
19	Polymer Modified Cationic Emulsified Asphalt	TCVN 8816:2011
20	Cationic Emulsified Asphalt	TCVN 8817-1:2011 - TCVN 8817-15:2011
21	Cut-back asphalt	TCVN 8818-1:2011 - TCVN 8818-5:2011