Ministry of Transport

Vietnam Expressway Corporation

Project Management Unit No. 85

THE WORLD BANK

IDA Credit No. : 4779-VN
Project ID No. : P106235

Consulting Services

for

Detailed Design for Da Nang - Quang Ngai Expressway Development Project

Basic Design Report for Civil Works (Final)

(Whole Section of Expressway)

(Based on Decision No. 1534/QD-BGTVT dated 5th June 2013)

Volume 1: Main Text

June 22, 2013

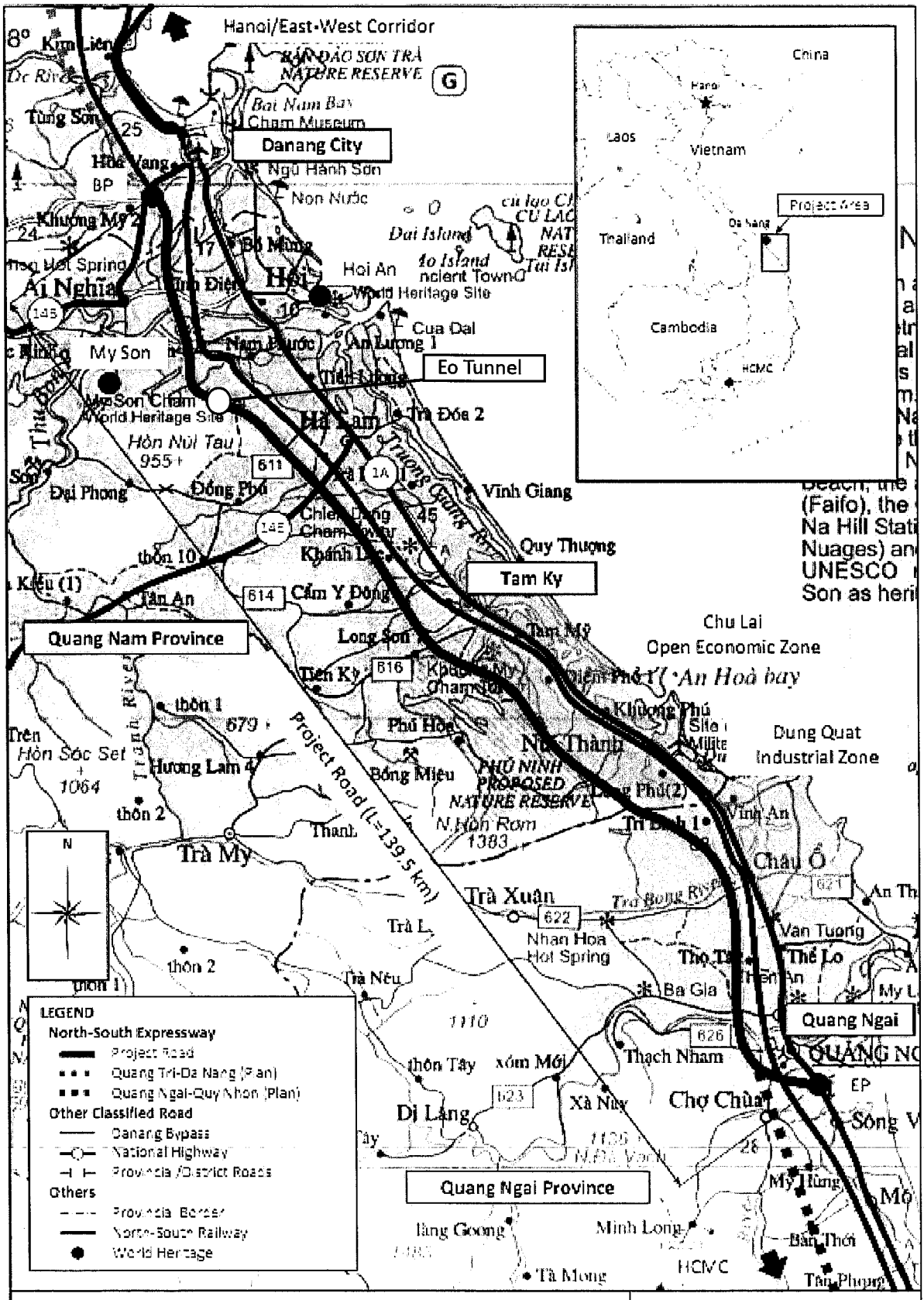
The Joint Venture of

NIPPON KOEI CO.,LTD.

NIPPON ENGINEERING CONSULTANTS CO.,LTD.

CHODAI CO.,LTD.

THAI ENGINEERING CONSULTANTS CO., LTD.



Consulting Services for Detailed Design for Danang Quang Ngai Expressway Development Project (DQEDP-DD)	Project Location Map

Letter of Submission
Project Location Map

Table of Contents

Appendices

Appendix 1 : Technical Standards to be applied to the Project
Appendix 2.1 : Review of Previous Studies (Expressway)
Appendix 2.2 : Typical Cross Sections (Report)
Appendix 2.3 : Typical Cross Sections (Drawings)
Appendix 2.4 : Technical Report "Finalization of Expressway Alignment"
Appendix 2.5 : Determination of Vertical Alignment (JICA Section)
Appendix 2.6 : Determination of Vertical Alignment (WB Section)
Appendix 3.1 : Review of Previous Studies (Interchange)
Appendix 4.1 : Discussion Paper "Alternative Study Report (Chiem Son Bridge)"
Appendix 4.2 : Discussion Paper "Alternative Study Report (Tra Khuc Bridge)"
Appendix 5.1 : List of Bridges in F/S
Appendix 5.2 : Main Bridge Structural Dimensions in Basic Design
Appendix 5.3 : Memorandum of Meeting (Basic Design of Other Bridges)
Appendix 5.4 : Letters from Vietnam Railways (Basic Design of Railway Overpasses)
Appendix 5.5 : Letter from PMU85 (Finalization of Basic Design of Other Bridges)
Appendix 6 : Review of Previous Studies (Tunnel)
Appendix 7 : Basic Layout Drawings of SA/PA
Appendix 8 : Review of Previous Studies (Social and Environmental)
Appendix 9 : List of Basic Documents for Cost Estimate

List of Figures

List of Tables

Abbreviations

AASHTO	:	American Association of State Highway and Transportation Officials
B/D	:	Basic Design
BP	:	Beginning Point
CBR	:	California Bearing Ratio
CL	:	Centerline
DARD	:	Department of Agriculture and Rural Development
D/D	:	Detailed Engineering Design
DPC	:	District People's Committee
DRC	:	District Resettlement Committee
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Plan
EP	:	Ending Point
ESCRD	:	Environmental and Social Considerations Review Division
ETC	:	Electric Toll Collection
EVN	:	Electricity of Vietnam
FG	:	Finished Grade
FO	:	Flyover
F/S	:	Feasibility Study
GOVN	:	Government of Vietnam
GPS	:	Global Positioning System
HCMC	:	Ho Chi Minh City
HIDO	:	Highway Industry Development Organization, Japan
HIV	:	Human Immunodeficiency Virus
HVL	:	High-voltage Line
IBRD	:	International Bank for Reconstruction and Development
IC	:	Interchange
ICB	:	International Competitive Bidding
ICR	:	Inception Report
ID	:	Identification
IDA	:	International Development Association
I/P	:	Implementation Program
IS	:	Intersection
ITR	:	Interim Report
ITS	:	Intelligent Transport Systems
JEHDRA	:	Japan Expressway Holding and Debt Repayment Agency
JICA	:	Japan International Cooperation Agency
JPY	:	Japanese Yen
JRSO	:	Japan Road Structure Ordinance
LRFD	:	Load and Resistance Factor Design
MEX	:	Metropolitan Expressway Co., Ltd., Japan
MLIT	:	Ministry of Land, Infrastructure, Transport and Tourism, Japan
MOM	:	Minutes of Meeting
MONRE	:	Ministry of Natural Resources and Environment
MOT	:	Ministry of Transport
MSEW	:	Mechanical Stabilized Earthen Wall
NEXCO	:	Nippon Expressway Company Limited, Japan
NH	:	National Highway
O&M	:	Operation and Maintenance
ORSE	:	Organization for Road System Enhancement, Japan
PA	:	Parking Area
PC	:	People's Committee
PC	:	Pre-stressed Concrete
PKG	:	Package
PMBOK	:	Project Management Body of Knowledge
PMU	:	Project Management Unit
PPC	:	Provincial People's Committee
P/Q	:	Pre-qualification
PTC2	:	Power Transmission Company No. 2
RAP	:	Resettlement Action Plan
RC	:	Reinforced Concrete
RFP	:	Request for Proposals
RP	:	Resettlement Plan
SA	:	Service Area
SAE	:	Social and Environmental
TMC	:	Traffic Management Center
TL	:	Test Level
TOR	:	Terms of Reference

USD	:	United States Dollars
VEC	:	Vietnam Expressway Corporation
VICS	:	Vehicle Information and Communication System
VIETTEL	:	Vietnam Military Electronics and Telecommunications Corporation
VND	:	Vietnamese Dong
VNPT	:	Vietnam Posts and Telecommunications Group
WB	:	The World Bank

5 Basic Design of Other Bridges

5.1 Summary

5.1.1 Objective

The objective of basic design of other bridges is to update the bridge plan in the F/S plan and obtain the agreement and approvals from the relevant organizations.

5.1.2 Bridges Subject to Other Bridges

The bridges in the Project were categorized as shown in Table 5.1-1.

The bridges subject to other bridges were all bridges in the Project other than four (4) major river bridges passing through the classified rivers on the Project road.

Table 5.1-1 Bridges Subject to Other Bridges

No.	Bridges				Subject to Other Bridges	Reference in This Report
	Road	Location	Bridge Category			
1	Expressway/ Linking Road	Thruway	Major River Bridges		----	Section 4 : Basic Design of Four (4) Major River Bridges
2			Other Bridges	Other Than IC Sections	●	Section 5.2 : Basic Design of Thruway Bridges (Other Than IC Sections)
3				IC Sections	●	Section 5.3 : Basic Design of Interchange (IC) Bridges
4		Interchange (IC)	IC Rampway Bridges		●	
5	Cross Road		Flyovers		●	Section 5.4 : Basic Design of Flyovers

●: Subject to Other Bridges

5.1.3 Principles of Basic Design

The following principles were established to the basic design of other bridges in consideration of the characteristics of expressway and site conditions of Project road.

(1) Common

- Adopted appropriate girder types to cope with skewed and curved bridges.
- Prioritized to adopt standard structure types.
- Not planned hauling of girders by access road conditions and high cost of temporary roads.
- Not adjusted to same girder length in a package to reduce surplus bridge length.
- Incorporated affection by inundation into bridge planning.
- Ensured appropriate span length in river bridges to secure smooth discharge of river flow.
- Ensured appropriate substructure locations in consideration of affection to crossing objects.
- Ensured appropriate substructure locations in consideration of future widening of thruway.

(2) Thruway Bridges Other Than IC Sections

- Standardized bridge planning to ensure efficiency and quality of design and construction works.
- Adopted joint-less structure in short length bridges to ensure flatness and structural durability.

(3) IC Bridges

- Ensured appropriate width of IC thruway bridges in initial stage in consideration of future widening of thruway with traffic operation.
- Ensured aesthetic view from thruway to IC rampway flyovers.

(4) Flyovers

- Ensured aesthetic view from thruway to flyovers.

5.1.4 Main Updates from Revision 2

The bridge plan of other bridges in the F/S plan was updated according to the updated alignment, profile, typical cross sections, cross structure plan, topographic survey and hydrological and inundation analyses and submitted as a part of B/D Reports in the following versions:

- B/D Report for Civil Works, DQEDD-PMU85-239-12, May 30, 2012
- B/D Report for Civil Works (Revision 1), DQEDD-PMU85-393-12, August 9, 2012
- B/D Report for Civil Works (Revision 2), DQEDD-PMU85-574-12, November 1, 2012

In this Revision 3, the basic design of other bridges was updated based on the following conditions:

- Revised alignment to avoid cemetery areas (see Table 5.1-2)
- Revised profile to reduce elevation at tunnel approach sections (see Table 5.1-2)
- Revised Binh Son IC plan (construct in ultimate stage) (see Table 5.1-2)
- Reflected the D/D results into this B/D Report Revision 3 (see Table 5.1-3)

Table 5.1-2 Main Updates in B/D Revision 3

No.	PKG	Station	Revision Item	Other Bridges Subject to Revision in This Report
1	1	KM000+518 - KM002+608	Revised alignment to avoid cemetery	FO01, OP00a, LRB01, LRB02
2	3b	KM019+990 - KM024+360	Revised alignment to avoid cemetery	FO03
			Revised profile by reason of modified Chiem Son Bridge (Super Tee Girder)	
3	4		Revised profile to reduce elevation at tunnel approach sections	ORB04, OP06
4		KM026+225 - KM031+698	Revised alignment to avoid cemetery	ORB06
5	A4	KM111+900 - KM113+010	Revised Binh Son IC plan (construct in ultimate stage)	OP22a, IRB05 (Deleted)
6	A5	KM124+450 - KM126+158	Revised profile by reason of modified Tra Khuc Bridge (Super Tee Girder)	OP24a

Table 5.1-3 Reflection of D/D Results into B/D Report Revision 3

No.	PKG	D/D Progress	Current Version		Reflection of D/D Results into This Report
			Alignment	Profile	
1	1	Not Commenced Yet	cl_7	pr_8 (121205)	----
2	2			pr_6 (121001)	
3	3b			pr_8 (121211)	
4	4			pr_8 (121211)	
5	5	Commenced		pr_7 (121213)	Followed Current Bridge Plan in D/D Stage
6	6	Completed Draft D/D		pr_6 (120912)	
7	7	Commenced		pr_8 (121213)	
8	A1	Not Commenced Yet		pr_6 (121031)	----
9	A2	Commenced		pr_8 (121214)	Followed Current Bridge Plan in D/D Stage
10	A3	Not Commenced Yet		pr_6 (120910)	----
11	A4	Completed Draft D/D		pr_6 (Draft D/D)	Followed Current Plan in D/D Stage
12	A5	Completed Draft D/D		pr_7 (121106)	

5.1.5 Summary of Basic Design Results

The summary of basic design results is shown in Table 5.1-4. The list of planned bridges and the location map of planned bridges are shown in Table 5.1-5 and Figure 5.1-1 in the next page, respectively.

The nos. of other bridges were reduced from 127 to 103 (bridge length: -3,740.4m) from the F/S plan.

The basic design results in comparison with the F/S plan are shown in Section 5.5.

Table 5.1-4 Summary of Basic Design Results (Other Bridges)

No.	Bridges				F/S		B/D (Rev. 2)[1]		Difference (B/D-F/S)	
	Road	Location	Bridge Category		Nos.	Bridge Length	Nos.	Bridge Length	Nos.	Bridge Length
1	Expressway/	Thruway	Thruway Bridges	Other Than IC Sections	96	8,902.6m	74	7,215.6m	-9	-963.5m (-10.8%)
2	Linking Road			IC Sections	-----	-----	13	723.5m		
3		Interchange (IC)	IC Rampway Bridges		12	1,662.3m	5	455.6m	-7	-1,206.7m (-72.6%)
4	Cross Road		Flyovers		19	2,252.0m	11	681.8m	-8	-1,570.2m (-69.7%)
Total					**127**	**12,816.9m**	**103**	**9,076.5m**	**-24**	**-3,740.4m (-29.2%)**

1) Counted average bridge length of bridges in independent alignment sections as one bridge

5.1.6 Next Steps

The following approvals and agreements will be obtained based on this basic design report.

- Agreements with relevant local governments
- Approvals by PMU85, VEC and MOT

The detailed engineering design works including geotechnical investigations will be commenced to the planned bridges immediately after obtaining the above approvals and agreements.

The substructure and foundation type was followed in the F/S plan in this basic design; however it will be updated in the D/D stage according to the geotechnical investigation results.

The following works will be conducted in the D/D stage.

- Replacement to Final Topographic Survey Data
- Geotechnical Investigation and Laboratory Test
- Definition of Final Profile
- Finalization of Substructure and Foundation Plan
- Revision of Bridge Width in SA/PA Sections
- Scouring Analysis at River Bridges
- Revetment and River Bed Protection Design

  (Review and update the river bed protection plan by River Engineer)
- Embankment Slope Design around Abutments
- Softground Treatment Design, if required
- Surface Drainage Design
- Other Ancillary Facilities Design
- Structural Design, Drawings and Quantity Taking-off

Table 5.1-5 List of Planned Bridges (Other Bridges)

Jurisdiction	Section	PKG	Station	Bridge Location: Expressway/Linking Road: Thruway	IC Section: Thruway	IC Section: Rampway	Cross Road	Bridge Nos.[1]	No.	Bridge Code[2]	Inbound/Outbound Line[3]	Bridge Station	Divided/Non-devided Road[4]	Characteristics: Alignment[5]	Separate Structure[6]	Alignment Horizontal: Curve Radius (m)	Clothoid Curve (m)	Vertical: Curve Radius (m)	Gradient (%)	Cross Sections Road Width: Initial (m)	Ultimate (m)	Cross Fall (%)
Danang	Expressway	PKG1	KM000+000 - KM008+000		●			8	1	ORB00a	I/O	-KM000+124	ND	P	NSS	Infinity	-----	-----	-----	19.0	56.840 to 52.252	-2.0
							●		2	FO01	I/O	KM000+578	ND	P	NSS	Infinity	-----	-----	-0.850	6.5	-----	-2.0
				●					3	OP00a	I/O	KM001+155	D	P	SS	2,000	-----	-----	1.100	25.5	33.0	3.0
				●					4	LRB01	I/O	KM001+597	D	P	SS	2,000	-----	17,000	-1.400	25.5	33.0	3.0
				●					5	LRB02	I/O	KM002+461	D	P	SS	2,000	678	-----	0.600	25.5	33.0	3.0 to -2.0
				●					6	OP00b	I/O	KM002+822	D	P	SS	Infinity	-----	12,442	-----	25.5	33.0	-2.0
				●					7	OP01	I/O	KM003+656	D	P	SAS	3,000	1,010	17,200	-----	25.5	33.0	2.0
				●					8	ORB00b	I/O	KM005+635	D	P	SS	Infinity	-----	23,333	-----	25.5	33.0	-2.0
QuangNam		PKG2	KM008+000 - KM016+880	●				15	9	CB02	I/O	KM009+373	D	P	SS	Infinity	-----	-----	0.500	25.5	33.0	-2.0
							●		10	FO02	I/O	KM009+619	ND	P	NSS	Infinity	-----	2,000	3.000	12.0	-----	-2.0
				●					11	LRB04	I/O	KM009+852	D	P	SS	Infinity	1,162	-----	-0.500	25.5	33.0	-2.0
				●					12	VD02	I/O	KM010+271	D	P	SS	4,500	-----	-----	0.300	25.5	33.0	-2.0
				●					13	LRB05	I/O	KM010+887	D	P	SS	Infinity	-----	-----	-0.500	25.5	33.0	-2.0
				●					14	LRB05a	I/O	KM011+924	D	P	SS	Infinity	-----	-----	0.500	25.5	33.0	-2.0
				●					15	LRB05b	I/O	KM012+644	D	P	SS	4,000	1,342	12,727	-0.300	25.5	33.0	-2.0
					●				16	VD02a	I/O	KM013+258	D	P	SS	4,000	-----	23,636	-0.300	29.642 to 33.112	33.394 to 36.862	-2.0
					●				17	OP03	I/O	KM013+628	D	P	SS	4,000	-----	-----	-0.300	42.453 to 40.999	-----	-2.0
						●			18	IRB00d	O	Ramp D, KM000+395	-----	-----	-----	102	91	2,020,537	-2.400	8.5	-----	-2.0
				●					19	LRB06	I/O	KM014+027	D	P	SS	4,000	-----	-----	-0.300	25.5	33.0	-2.0
				●					20	CB05	I/O	KM014+270	D	P	SS	4,000	-----	-----	-0.300	25.5	33.0	-2.0
				●					21	VD03	I/O	KM014+880	D	P	SS	Infinity	-----	-----	0.300	25.5	33.0	-2.0
				●					22	VD03a	I/O	KM015+340	D	P	SS	Infinity	-----	-----	-0.300	25.5	33.0	-2.0
				●					23	VD04	I/O	KM016+558	D	P	SS	Infinity	-----	17,000	0.500	25.5	33.0	-2.0
		PKG3a	KM016+880 - KM018+100																			
		PKG3b	KM018+100 - KM021+500	●				4	24	VD05	I/O	KM018+319	D	P	SS	2,000	-----	-----	0.300	25.5	33.0	-2.0 to 2.1
				●					25	VD06	I/O	KM018+607	D	P	SS	2,000	-----	-----	0.300	25.5	33.0	3.0
				●					26	VD07	I/O	KM019+252	D	P	SS	2,000	-----	18,332	0.300,-0.300	25.5	33.0	3.0 to -2.0
							●		27	FO03	I/O	KM020+720	ND	P	NSS	Infinity	-----	12,000	-----	6.5	-----	-2.0
		PKG4	KM021+500 - KM032+600	●				5	28	ORB04	I	KM023+371	D	I	IS	Infinity	-----	8,235	-0.300	13.0	16.75	-2.0
											O	KM023+411	D	I	IS	Infinity	-----	-----	-0.300	13.0	16.75	-2.0
				●					29	OP06	I	KM023+927	D	I	IS	2,995	999	-----	-0.300	13.0	16.75	-2.0
											O	KM023+943	D	I	IS	3,005	-----	-----	-0.300	13.0	16.75	2.0
							●		30	FO05	I/O	KM024+790	ND	P	NSS	Infinity	-----	600	5.000,-5.000	5.0	-----	-2.0
				●					31	ORB05	I/O	KM024+923	D	P	SS	Infinity	-----	-----	0.350	25.5	33.0	-2.0
				●					32	ORB06	I/O	KM029+510	D	P	SS	10,500	-----	-----	1.100	25.5	33.0	-2.0
		PKG5	KM032+600 - KM042+000	●				8	33	ORB07	I/O	KM034+151	D	P	SS	1,500	2,727	6,085	-----	25.5	33.0	3.5
				●					34	OP09	I/O	KM035+497	D	P	SS	Infinity	-----	23,256	-----	25.5	33.0	-2.0
				●					35	ORB08	I/O	KM036+432	D	P	SS	10,000	-----	-----	-1.220	25.5	33.0	-2.0
				●					36	ORB09a	I/O	KM038+377	D	P	SS	Infinity	-----	-----	0.600	25.5	33.0	-2.0
				●					37	LRB08	I/O	KM039+653	D	P	SAS	Infinity	-----	-----	0.300	25.5	33.0	-2.0
				●					38	CB09	I/O	KM040+110	D	P	SS	Infinity	-----	-----	0.300	25.5	33.0	-2.0
					●				39	OP09a	I/O	KM040+880	D	P	SS	Infinity	-----	23,636	-----	36.298 to 34.269	40.048 to 38.019	-2.0
					●				40	OP10	I/O	KM041+235	D	P	SS	Infinity	-----	-----	-0.800	33.616 to 31.806	37.366 to 35.556	-2.0
		PKG6	KM042+000 - KM052+000	●				9	41	OP11	I/O	KM042+723	D	P	SS	Infinity	-----	17,647	-----	25.5	33.0	-2.0
				●					42	CB11	I/O	KM043+655	D	P	SS	45,000	-----	17,000	-----	25.5	33.0	-2.0
				●					43	ORB11	I/O	KM044+440	D	P	SS	Infinity	-----	-----	-0.400	25.5	33.0	-2.0
				●					44	ORB12	I/O	KM045+438	D	P	SS	Infinity	-----	-----	0.350	25.5	33.0	-2.0
				●					45	CB12	I/O	KM045+540	D	P	SS	Infinity	-----	-----	0.350	25.5	33.0	-2.0
				●					46	ORB13	I/O	KM045+885	D	P	SS	Infinity	-----	25,316	-----	25.5	33.0	-2.0
				●					47	OP11a	I/O	KM047+136	D	P	SS	4,900	-----	17,742	-----	25.5	33.0	-2.0
				●					48	LRB09	I/O	KM047+911	D	P	SS	4,900	1,212	-----	0.820	25.5	33.0	-2.0
				●					49	CB13	I/O	KM048+390	D	P	SS	Infinity	-----	17,002	-----	25.5	33.0	-2.0
		PKG7	KM052+000 - KM065+000	●				10	50	ORB14	I/O	KM054+986	D	P	SS	Infinity	-----	-----	-0.500	25.5	33.0	-2.0
				●					51	LRB10	I/O	KM055+614	D	P	SAS	Infinity	-----	-----	0.300	25.5	33.0	-2.0
				●					52	ORB15	I/O	KM057+095	D	P	SS	Infinity	-----	-----	1.400	25.5	33.0	-2.0
				●					53	OP16	I/O	KM057+507	D	P	SS	Infinity	-----	17,000	-----	25.5	33.0	-2.0
				●					54	LRB11	I/O	KM058+244	D	P	SS	6,000	1,095	-----	-0.300	25.5	33.0	-2.0
				●					55	OP17a	I/O	KM060+043	D	P	SS	Infinity	-----	-----	-0.300	25.5	33.0	-2.0
				●					56	OP17b	I/O	KM060+958	D	P	SS	5,000	1,643	17,241	-----	25.5	33.0	-2.0
				●					57	ORB16	I/O	KM062+456	D	P	SS	5,000	-----	-----	-0.400	25.5	33.0	-2.0
				●					58	OP17c	I/O	KM063+786	D	P	SAS	5,000	-----	23,030	-----	25.5	33.0	-2.0
						●			59	IRB01	I/O	Ramp C1, KM000+450	D	P	NSS	Infinity	-----	1,833	-----	15.5	-----	-2.0
		PKGA1	KM065+000 - KM081+150	●				6	60	ORB17a	I/O	KM066+285	D	P	SS	Infinity	-----	17,126	-----	25.5	33.0	-2.0
				●					61	OP17d	I/O	KM066+463	D	P	SAS	Infinity	-----	17,126	-----	25.5	33.0	-2.0
				●					62	LRB12	I/O	KM068+456	D	P	SAS	Infinity	1,658	-----	-1.109	25.5	33.0	-2.0
				●					63	ORB21	I/O	KM075+184	D	P	SS	10,000	-----	17,273	-----	25.5	33.0	-2.0
							●		64	FO07	I/O	KM076+970	ND	P	NSS	Infinity	-----	-----	0.500	4.0	-----	-2.0
							●		65	FO08	I/O	KM078+640	ND	P	NSS	Infinity	-----	-----	3.000	4.0	-----	-2.0
		PKGA2	KM081+150 - KM099+500	●				9	66	CB23	I/O	KM081+364	D	P	SAS	Infinity	-----	-----	-0.673	25.5	33.0	-2.0
				●					67	ORB22	I/O	KM082+348	D	P	SS	Infinity	-----	12,077	-----	25.5	33.0	-2.0
					●				68	OP18a	I/O	KM082+986	D	P	SS	Infinity	-----	25,455	-----	35.990 to 34.136	39.740 to 37.886	-2.0
				●					69	OP19	I/O	KM085+751	D	P	SS	22,000	-----	17,059	-1.000	25.5	33.0	-2.0
				●					70	ORB23	I/O	KM087+710	D	P	SS	15,000	-----	-----	-0.341	25.5	33.0	-2.0
				●					71	LRB12a	I/O	KM087+970	D	P	SAS	15,000	-----	-----	-0.300	25.5	33.0	-2.0
							●		72	FO09	I/O	KM089+158	ND	P	NSS	Infinity	-----	1,000	-1.000	7.5	-----	-2.0
				●					73	ORB25a	I/O	KM091+140	D	P	SS	4,000	-----	-----	-0.700	25.5	33.0	-2.0
				●					74	CB25	I/O	KM092+360	D	P	SS	4,000	-----	12,500	-0.900	25.5	33.0	-2.0
QuangNgai		PKGA3	KM099+500 - KM110+100	●				13	75	OP20	I/O	KM099+543	D	P	SS	4,000	-----	17,442	-----	25.5	33.0	-2.0
				●					76	OP20a	I/O	KM100+846	D	P	SS	3,000	2,802	-----	0.300	25.5	33.0	2.0
					●				77	ORB26	I/O	KM101+445	D	P	SS	3,000	2,802	-----	0.300	43.888 to 45.757	-----	-2.0
					●				78	CB27	I/O	KM101+827	D	P	SS	3,000	2,802	-----	-0.300	34.371 to 34.004	38.121 to 37.754	-2.0
					●				79	ORB26a	I/O	KM102+055	D	P	SS	3,000	2,802	-----	-0.300	36.140 to 32.962	38.517 to 36.777	-2.0
						●			80	IRB02	I	Ramp B, KM000+409	-----	-----	-----	200	-----	-----	3.500	8.5	-----	-2.0
						●			81	IRB03	I/O	Ramp C1, KM000+980	D	P	NSS	Infinity	-----	1,857	4.000,0.500	15.500 to 16.825	-----	-2.0
						●			82	IRB04	I/O	Ramp C1, KM001+255	D	P	NSS	Infinity	73	2,667	0.500	15.5	-----	-2.0
				●					83	ORB26b	I/O	KM102+327	D	P	SS	3,000	2,802	-----	0.500	25.5	33.0	-2.0
							●		84	FO10	I/O	KM103+560	ND	P	NSS	Infinity	-----	-----	1.500	3.0	-----	-2.0
				●					85	ORB27	I/O	KM104+888	D	P	SS	4,850	-----	-----	0.450	25.5	33.0	-2.0
				●					86	VD09a	I/O	KM107+307	D	P	SS	Infinity	-----	17,000	-0.500	25.5	33.0	-2.0
				●					87	VD09b	I/O	KM107+829	D	P	SS	Infinity	-----	-----	0.523	25.5	33.0	-2.0
		PKGA4	KM110+100 - KM124+700				●	8	88	FO10a	I/O	KM111+720	ND	P	NSS	Infinity	-----	-----	-0.500	4.0	-----	-2.0
					●				89	OP22a	I/O	KM112+120	D	P	SS	Infinity	-----	15,000	-----	29.250	33.095 to 35.645	-2.0
				●					90	ORB28	I/O	KM115+999	D	P	SS	Infinity	-----	-----	-2.000	25.5	33.0	-2.0
							●		91	FO14	I/O	KM116+570	ND	P	NSS	Infinity	-----	400	4.000,-4.000	7.5	-----	-2.0
				●					92	CB30	I/O	KM118+050	D	P	SS	Infinity	-----	-----	-0.550	25.5	33.0	-2.0
							●		93	FO16	I/O	KM119+170	ND	P	NSS	Infinity	-----	2,500	-----	9.0	-----	-2.0
					●				94	OP23c	I/O	KM123+845	D	P	SS	10,000	2,915	-----	0.650	34.443 to 33.150	38.193 to 36.900	-2.0
					●				95	VD10a	I/O	KM124+117	D	P	SS	10,000	2,915	23,000	-----	37.013 to 30.387	39.280 to 34.109	-2.0
		PKGA5	KM124+700 - KM139+263	●				8	96	OP24a	I/O	KM124+899	D	P	SS	10,000	2,915	17,000	-----	25.5	33.0	-2.0
				●					97	VD12	I/O	KM126+882	D	P	SS	Infinity	-----	17,778	0.750,-0.600	25.5	33.0	-2.0
				●					98	VD13	I/O	KM127+761	D	P	SS	Infinity	663	-----	0.500	25.5	33.0	-2.0 to 2.61
				●					99	OP25	I/O	KM128+615	D	P	SAS	2,000	-----	17,000	-----	25.5	33.0	3.0
					●				100	ORB28a	I/O	KM130+174	D	P	SS	Infinity	-----	23,158	-----	25.5	41.764 to 44.019	-2.0
	Linking Road			●					101	ORB29	I/O	KM132+620	ND	P	NSS	Infinity	-----	5,000	-----	12.0	-----	-2.0
				●					102	OP27	I/O	KM134+953	ND	P	NSS	4,800	-----	5,250	-----	12.0	-----	-2.0
				●					103	CB38	I/O	KM138+284	ND	P	NSS	Infinity	-----	5,000	-----	12.0	-----	-2.0
		Total		74	13	5	11	103														

No.	Skew Angle	Crossing Objects Cross Road: Road Class	Road Width (m)	Vertical Clearance (m)	Railway: Railway Width (m)	Vertical Clearance (m)	River: River Class	Freeboard (m)	Navigation Clearance (m)	Hydrological Requirements[7]: DHWL (I=1%) (m)	Required Bridge Opening Length (m)	Desirable Span Length (m)	DNWL (I=5%) (m)	Proposed Bridge Plan: Bridge Length[1]	Bridge Width	Bridge Skew Angle	Superstructure: Girder Type	Girder Arrange.	Substructure Abutment: Type	Height (m)	Pier: Type	Height (m)	Foundation: Type	Dia. (m)	Length (m)	Remark
1	90°	-----	-----	-----	-----	-----	-----	0.5	-----	6.71	20.7	-----	-----	38.1m	19.0m	90°	Slab Beam	1@24m	T	9.409	-----	-----	Driven Pile	0.35*0.35	15.2	Existing Bridge
2	90°	TypeA/Grade120	49.480	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	75.1m	6.5m	90°	Void Slab	2@30m	T	10.0	Wall	8.8	Bored Pile	1.0	14.0	
3	86°	Urban	16.5	4.5	-----	-----	-----	0.5	-----	6.71	-----	-----	-----	48.3m	25.5m	90°	IGirder	1@30m	T	13.6	-----	-----	Driven Pile	0.4*0.4	14.0	
4	80°,90°	Urban	26.5	4.5	-----	-----	V	1.0	4.0*20	6.74	130.0	32	1.84	223.8m	25.5m	80°,90°	IGirder	6@33m	T	13.9	Wall	16.9	Driven Pile	0.4*0.4	14.0	LRB+OP
5	80°	B	4.0	3.0	-----	-----	V	1.0	4.0*20	6.80	200.0	34	1.84	221.8m	25.5m	80°	IGirder	6@33m	T	11.3	Wall	20.7	Driven Pile	0.4*0.4	15.0	LRB+OP+CB
6	71°	Urban	34.0	4.5	-----	-----	-----	0.5	-----	6.84	-----	-----	-----	58.7m	25.5m	71°	IGirder	2@21m	T	13.0	Wall	8.0	Driven Pile	0.4*0.4	15.0	Connected Girder
7	43°	Urban	16.5	4.5	-----	-----	-----	0.5	-----	7.46	-----	-----	-----	58.9m	25.5m	70°	IGirder	1@40m	T	13.1	-----	-----	Driven Pile	0.4*0.4	15.0	
8	80°	B,Urban	4.0,16.5	3.0,4.5	-----	-----	-----	0.5	-----	7.24	43.7	21	-----	82.8m	25.5m	80°	IGirder	3@21m	T	10.2	Wall	12.9	Driven Pile	0.4*0.4	26.0	ORB+OP
9	67°	B,A	4.0,5.0	3.0,3.5	-----	-----	-----	0.5	-----	8.12	-----	-----	-----	45.1m	25.5m	70°	IGirder	1@27m	T	9.0	-----	-----	Driven Pile	0.4*0.4	15.0	CB+OP
10	70°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	60.3m	12.0m	70°	Void Slab	2@24m	T	10.0	Wall	9.0	Spread	-----	-----	
11	74°	B	4.0	3.0	-----	-----	-----	1.0	-----	8.23	126.0	30	-----	147.5m	25.5m	80°	IGirder	4@33m	T	8.9	Wall	16.7	Driven Pile	0.4*0.4	15.0	LRB+OP
12	90°	C	3.0	3.0	-----	-----	-----	0.5	-----	8.26	62.0	-----	-----	76.6m	25.5m	90°	IGirder	2@33m	T	7.8	Wall	8.4	Driven Pile	0.4*0.4	28.0	VD+OP
13	63°	A	5.0	3.5	-----	-----	-----	1.0	-----	8.38	88.0	25	-----	103.0m	25.5m	70°	IGirder	3@30m	T	8.7	Wall	11.4	Driven Pile	0.4*0.4	26.0	LRB+OP
14	90°	-----	-----	-----	-----	-----	-----	1.0	-----	8.52	128.0	25	-----	149.5m	25.5m	90°	IGirder	4@33m	T	9.3	Wall	11.8	Driven Pile	0.4*0.4	15.0	LRB+CB
15	90°	B	4.0	3.0	-----	-----	-----	1.0	-----	8.69	81.0	23	-----	105.4m	25.5m	90°	IGirder	3@30m	T	9.1	Wall	11.1	Driven Pile	0.4*0.4	15.0	LRB+OP
16	90°	Ramp C1	15.5	4.75	-----	-----	-----	0.5	-----	8.87	101.0	-----	-----	154.5m	33.0m	90°	IGirder	4@33m	T	11.9	Wall	13.9	Driven Pile	0.4*0.4	15.0	VD+OP
17	77°	Urban	16.5	4.5	-----	-----	-----	0.5	-----	8.87	-----	-----	-----	40.7m	42.040m	80°	IGirder	1@24m	T	11.2	-----	-----	Driven Pile	0.4*0.4	15.0	
18	-----	-----	-----	-----	-----	-----	-----	0.5	-----	8.87	101.0	-----	-----	142.0m	8.5m	90°	Void Slab	5@26m	T	10.7	Round	10.8	Driven Pile	0.4*0.4	15.0	IRB+VD
19	90°	A	5.0	3.5	-----	-----	-----	1.0	-----	9.09	87.0	26	-----	103.5m	25.5m	90°	IGirder	3@30m	T	9.0	Wall	15.0	Driven Pile	0.4*0.4	12.0	LRB+OP
20	65°	C	3.0	3.0	-----	-----	-----	0.5	-----	9.16	-----	-----	-----	33.1m	25.5m	70°	IGirder	1@21m	T	8.1	-----	-----	Driven Pile	0.4*0.4	12.0	CB+OP
21	90°	C	3.0	3.0	-----	-----	-----	0.5	-----	9.30	83.0	-----	-----	106.4m	25.5m	90°	IGirder	3@30m	T	9.6	Wall	11.0	Driven Pile	0.4*0.4	12.0	VD+OP
22	90°	-----	-----	-----	-----	-----	-----	0.5	-----	9.28	104.0	-----	-----	135.7m	25.5m	90°	IGirder	4@30m	T	8.6	Wall	9.3	Driven Pile	0.4*0.4	12.0	
23	90°	C	3.0	3.0	-----	-----	-----	0.5	-----	9.24	97.0	-----	-----	115.5m	25.5m	90°	IGirder	3@33m	T	9.7	Wall	10.7	Driven Pile	0.4*0.4	18.0	VD+OP
24	90°	A	5.0	3.5	-----	-----	-----	0.5	-----	9.20	83.0	-----	-----	107.3m	25.5m	90°	IGirder	3@30m	T	9.9	Wall	10.5	Driven Pile	0.4*0.4	8.0	VD+OP+CB
25	90°	-----	-----	-----	-----	-----	-----	0.5	-----	9.20	53.0	-----	-----	79.8m	25.5m	90°	IGirder	2@30m	T	11.5	Wall	12.1	Driven Pile	0.4*0.4	15.0	VD+CB
26	90°	IV,C,A,H,B	9.0,3.0,6.5,4.0	4.5,3.0,4.5,3.0	-----	-----	-----	0.5	-----	9.20	103.0	-----	-----	811.0m	25.5m	90°	IGirder	19@40m	T	12.2	Wall	16.0	Bored Pile	1.0	10.0	VD+OP+CB
27	70°	TypeA/Grade120	35.000	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	55.2m	6.5m	70°	Void Slab	2@24m	T	8.0	Wall	9.0	Bored Pile	1.0	10.0	
28	70°	-----	-----	-----	-----	-----	-----	1.0	-----	8.62	49.3	22	-----	72.2m	13.0m	70°	IGirder	2@27m	T	11.5	Wall	13.9	Bored Pile	1.0	12.0	
	70°	-----	-----	-----	-----	-----	-----	1.0	-----	8.62	49.3	22	-----	73.3m	13.0m	70°	IGirder	2@27m	T	11.7	Wall	14.0	Bored Pile	1.0	12.0	
29	70°	IV	9.0	4.5	-----	-----	-----	0.5	-----	8.62	-----	-----	-----	32.8m	13.0m	70°	IGirder	1@21m	T	11.1	-----	-----	Bored Pile	1.0	15.0	
	69°	IV	9.0	4.5	-----	-----	-----	0.5	-----	8.62	-----	-----	-----	31.5m	13.0m	70°	IGirder	1@21m	T	10.5	-----	-----	Bored Pile	1.0	15.0	
30	70°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	68.3m	5.0m	70°	Void Slab	2@27m	T	10.2	Wall	8.7	Bored Pile	1.0	10.0	
31	64°	-----	-----	-----	-----	-----	-----	1.0	-----	9.85	43.9	22	-----	57.4m	25.5m	70°	IGirder	2@24m	T	8.3	Wall	11.3	Bored Pile	1.0	15.0	
32	90°	-----	-----	-----	-----	-----	-----	1.0	-----	12.89	49.3	22	-----	70.3m	25.5m	90°	IGirder	2@30m	T	7.8	Wall	8.3	Bored Pile	1.0	10.0	
33	90°	B	4.0	3.0	-----	-----	-----	1.0	-----	20.46	29.6	-----	-----	51.1m	25.5m	90°	IGirder	1@33m	T	11.8	-----	-----	Driven Pile	0.4*0.4	15.0	ORB+OP
34	84°	IV	9.0	4.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	33.0m	25.5m	90°	IGirder	1@21m	T	10.9	-----	-----	Bored Pile	1.0	8.0	
35	74°	A	5.0	3.5	-----	-----	-----	1.0	-----	18.96	25.1	-----	-----	44.7m	25.5m	70°	IGirder	1@33m	T	9.7	-----	-----	Bored Pile	1.0	8.0	ORB+OP
36	70°	C	3.0	3.0	-----	-----	-----	1.0	-----	16.28	68.1	23	-----	87.1m	25.5m	70°	IGirder	3@24m	T	10.5	Wall	15.2	Bored Pile	1.0	17.0	ORB+OP
37	44°	C	3.0	3.0	-----	-----	-----	1.0	-----	17.73	148.0	26	-----	219.9m	25.5m	90°	IGirder	6@33m	T	11.1	Round	15.7	Spread	-----	-----	LRB+OP
38	81°	A	5.0	3.5	-----	-----	-----	0.5	-----	17.13	15.6	-----	-----	46.3m	25.5m	80°	IGirder	1@33m	T	11.2	-----	-----	Spread	-----	-----	CB+OP+VD
39	90°	Ramp C1	15.5	4.75	-----	-----	-----	0.5	-----	16.45	-----	-----	-----	43.1m	35.850m	90°	IGirder	1@27m	T	12.8	-----	-----	Bored Pile	1.0	6.0	
40	74°	II	12.0	4.75	-----	-----	-----	0.5	-----	16.39	-----	-----	-----	37.1m	32.940m	70°	IGirder	1@24m	T	11.3	-----	-----	Bored Pile	1.0	6.0	
41	70°	IV	9.0	4.5	-----	-----	-----	0.5	-----	15.18	-----	-----	-----	34.1m	25.5m	70°	IGirder	1@21m	T	9.916	-----	-----	Bored Pile	1.0	8.0	
42	83°	B	4.0	3.0	-----	-----	-----	0.5	-----	14.54	-----	-----	-----	39.1m	25.5m	80°	IGirder	1@27m	T	9.462	-----	-----	Bored Pile	1.0	17.5	CB+OP
43	90°	-----	-----	-----	-----	-----	-----	0.5	-----	14.22	42.9	22	-----	57.8m	25.5m	90°	IGirder	2@24m	T	7.196	Wall	14.596	Bored Pile/Spread	1.0	10.0	
44	89°	-----	-----	-----	-----	-----	-----	0.5	-----	13.53	26.4	-----	-----	44.1m	25.5m	90°	IGirder	1@30m	T	9.722	-----	-----	Bored Pile	1.0	9.5	
45	70°	A	5.0	3.5	-----	-----	-----	0.5	-----	13.17	-----	-----	-----	39.1m	25.5m	70°	IGirder	1@27m	T	9.978	-----	-----	Bored Pile	1.0	11.0	CB+OP
46	90°	-----	-----	-----	-----	-----	-----	0.5	-----	13.51	50.3	22	-----	74.8m	25.5m	90°	IGirder	2@27m	T	11.018	Wall	16.016	Bored Pile/Spread	1.2	8.0	
47	75°	IV	9.0	4.5	-----	-----	-----	0.5	-----	12.89	-----	-----	-----	33.9m	25.5m	70°	IGirder	1@21m	T	9.692	-----	-----	Bored Pile	1.0	9.0	
48	70°	-----	-----	-----	-----	-----	-----	1.0	-----	13.01	79.1	22	-----	112.2m	25.5m	70°	IGirder	3@33m	T	8.949	Wall	14.385	Bored Pile/Spread	1.0	10.0	
49	81°	V,C	7.5,3.0	4.5,3.0	-----	-----	-----	0.5	-----	13.90	-----	-----	-----	44.9m	25.5m	80°	IGirder	1@27m	T	10.091	-----	-----	Bored Pile	1.0	11.5	CB+OP
50	80°	B	4.0	3.0	-----	-----	-----	0.5	-----	8.27	30.9	-----	-----	40.7m	25.5m	80°	IGirder	1@33m	T	8.6	-----	-----	Spread	-----	-----	ORB+OP
51	46°	A	5.0	3.5	-----	-----	-----	1.0	-----	8.32	94.8	22	-----	150.0m	25.5m	90°	IGirder	4@33m	T	8.9	Round	13.9	Bored Pile	1.0	10.0	LRB+OP
52	70°	-----	-----	-----	-----	-----	-----	0.5	-----	8.27	16.0	-----	-----	37.7m	25.5m	70°	IGirder	1@30m	T	7.6	-----	-----	Spread	-----	-----	
53	80°	IV	9.0	4.5	-----	-----	-----	1.0	-----	9.72	-----	-----	-----	32.9m	25.5m	90°	IGirder	1@21m	T	10.2	-----	-----	Spread	-----	-----	
54	71°	-----	-----	-----	-----	-----	-----	1.0	-----	8.80	73.9	22	-----	144.1m	25.5m	70°	IGirder	4@33m	T	7.4	Wall	13.6	Spread	-----	-----	
55	80°	IV	9.0	4.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	39.7m	25.5m	80°	IGirder	1@21m	T	10.2	-----	-----	Spread	-----	-----	
56	82°	Urban	15.0	4.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	35.6m	25.5m	80°	IGirder	1@21m	T	9.1	-----	-----	Spread	-----	-----	
57	90°	-----	-----	-----	-----	-----	-----	0.5	-----	11.98	54.9	21	-----	70.4m	25.5m	90°	IGirder	2@30m	T	8.5	Wall	11.8	Spread	-----	-----	
58	46°	II	12.0	4.75	-----	-----	-----	0.5	-----	11.98	-----	-----	-----	51.5m	25.5m	70°	IGirder	1@33m	T	10.1	-----	-----	Spread	-----	-----	OP+CB
59	90°	TypeA/Grade120	40.234	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	70.2m	15.5m	90°	Void Slab	2@27m	T	10.5	Wall	9.9	Bored Pile	1.0	10.0	IRB+FO
60	70°	-----	-----	-----	-----	-----	-----	0.5	-----	8.87	20.1	-----	-----	38.8m	25.5m	70°	IGirder	1@24m	T	13.8	-----	-----	Bored Pile	1.0	10.0	
61	52°	III	21.0	4.75	-----	-----	-----	0.5	-----	8.87	-----	-----	-----	67.1m	25.5m	70°	IGirder	1@40m	Box	16.7	-----	-----	Bored Pile	1.5	10.0	
62	34°	IV	9.0	4.5	-----	-----	-----	1.0	-----	7.18	183.2	31	-----	304.6m	25.5m	70°	IGirder	7@40m	T	13.1	Round	23.7	Bored Pile	1.0	13.0	LRB+OP
63	90°	C	3.0	3.0	-----	-----	-----	0.5	-----	7.35	54.8	22	-----	81.1m	25.5m	90°	IGirder	2@33m	T	10.8	Wall	13.2	Bored Pile	1.0	15.0	ORB+OP
64	90°	TypeA/Grade120	33.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	55.8m	4.0m	90°	K-frame	12.4m+31m+12.4m	-----	-----	-----	-----	-----	-----	-----	
65	90°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	68.9m	4.0m	90°	Void Slab	2@27m	T	10.3	Wall	14.1	Spread	-----	-----	
66	52°	IV	9.0	4.5	-----	-----	-----	0.5	-----	12.60	-----	-----	-----	56.0m	25.5m	70°	IGirder	1@40m	T	11.1	-----	-----	Bored Pile	1.0	15.0	CB+OP
67	90°	C	3.0	3.0	-----	-----	-----	1.0	-----	6.97	53.1	21	-----	78.8m	25.5m	90°	IGirder	3@21m	T	10.6	Wall	13.7	Bored Pile	1.0	15.0	ORB+OP
68	82°	Ramp C1	15.5	4.75	-----	-----	-----	0.5	-----	9.66	-----	-----	-----	41.9m	35.8m	80°	IGirder	1@27m	T	11.8	-----	-----	Bored Pile	1.0	15.0	
69	85°	Urban	21.0	4.75	-----	-----	-----	0.5	-----	12.95	-----	-----	-----	45.4m	25.5m	90°	IGirder	1@27m	T	10.2	-----	-----	Bored Pile	1.0	15.0	
70	90°	B	4.0	3.0	-----	-----	-----	0.5	-----	4.00	32.2	-----	-----	46.5m	25.5m	90°	IGirder	1@33m	T	9.6	-----	-----	Bored Pile	1.0	15.0	ORB+OP
71	55°	-----	-----	-----	-----	-----	-----	1.0	-----	3.98	107.8	25	-----	144.6m	25.5m	90°	IGirder	4@33m	T	7.9	Round	10.2	Bored Pile	1.0	15.0	
72	70°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	56.6m	7.5m	70°	Void Slab	2@24m	T	8.0	Wall	8.5	Bored Pile	1.0	10.0	
73	90°	-----	-----	-----	-----	-----	-----	0.5	-----	3.27	18.0	-----	-----	28.7m	25.5m	90°	IGirder	1@21m	T	7.7	-----	-----	Bored Pile	1.0	15.0	
74	70°	-----	-----	-----	-----	-----	-----	0.5	-----	3.92	29.0	-----	-----	46.3m	25.5m	90°	IGirder	1@33m	T	9.1	-----	-----	Bored Pile	1.0	15.0	CB+VD
75	84°	IV	9.0	4.5	-----	-----	-----	0.5	-----	8.50	-----	-----	-----	35.8m	25.5m	90°	IGirder	1@21m	T	12.0	-----	-----	Bored Pile	1.0	15.0	
76	88°	C	3.0	3.0	-----	-----	-----	0.5	-----	4.34	9.0	-----	-----	29.8m	25.5m	90°	Portal	1@14m	T	8.6	-----	-----	Bored Pile	1.0	15.0	OP+VD
77	90°	-----	-----	-----	-----	-----	-----	0.5	-----	4.34	21.1	-----	-----	33.4m	45.530m	90°	IGirder	1@24m	T	9.2	-----	-----	Bored Pile	1.0	15.0	
78	90°	-----	-----	-----	-----	-----	-----	0.5	-----	4.34	16.6	-----	-----	37.7m	34.160m	90°	IGirder	1@21m	T	9.6	-----	-----	Bored Pile	1.0	15.0	CB+VD
79	90°	C	3.0	3.0	-----	-----	-----	0.5	-----	4.34	23.3	-----	-----	35.9m	35.700m	90°	IGirder	1@27m	T	7.6	-----	-----	Bored Pile	1.0	15.0	ORB+OP
80	58°	-----	-----	-----	-----	-----	-----	0.5	-----	4.34	19.6	-----	-----	47.5m	8.5m	70°	IGirder	1@30m	T	13.6	-----	-----	Bored Pile	1.0	15.0	IRB+CB+VD
81	78°,79°	II	23.5	4.75	4.88	6.55	-----	0.5	-----	4.34	-----	-----	-----	108.8m	15.960m	80°	IGirder	2@40m	Box	17.4	Wall	16.1	Bored Pile	1.5	15.0	IRB+OP
82	88°	TypeA/Grade120	41.043	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	87.1m	15.500m	90°	Void Slab	2@30m	Box	18.0	Wall	10.0	Bored Pile	1.5	12.0	IRB+FO
83	90°	-----	-----	-----	-----	-----	-----	0.5	-----	4.34	32.2	-----	-----	43.3m	25.5m	90°	IGirder	1@33m	T	8.3	-----	-----	Bored Pile	1.0	15.0	
84	90°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	53.7m	3.0m	90°	Void Slab	2@24m	T	7.4	Round	8.5	Spread	-----	-----	
85	90°	B	4.0	3.0	-----	-----	-----	0.5	-----	4.76	25.8	-----	-----	43.7m	25.5m	90°	IGirder	1@33m	T	9.0	-----	-----	Bored Pile	1.0	15.0	ORB+OP
86	90°	-----	-----	-----	-----	-----	-----	0.5	-----	7.01	24.9	-----	-----	38.5m	25.5m	90°	IGirder	1@30m	T	11.5	-----	-----	Bored Pile	1.0	15.0	
87	80°	A	5.0	3.5	-----	-----	-----	0.5	-----	7.01	24.9	-----	-----	42.9m	25.5m	90°	IGirder	1@30m	T	10.0	-----	-----	Bored Pile	1.0	15.0	VD+OP
88	90°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	53.7m	4.0m	90°	Void Slab	2@24m	T	5.318	Round	8.424	Spread	-----	-----	
89	90°	I	25.0	4.75	-----	-----	-----	0.5	-----	53.90	-----	-----	-----	50.7m	29.250m	90°	IGirder	1@40m	T	6.344	-----	-----	Spread	-----	-----	
90	70°	B	4.0	3.0	-----	-----	-----	0.5	-----	12.52	42.8	21	-----	61.9m	25.5m	70°	IGirder	2@24m	T	8.091	Wall	11.090	Bored Pile/Spread	1.0	6.0-9.0	ORB+OP
91	90°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	66.1m	7.5m	90°	Void Slab	2@27m	T	9.364	Wall	8.801	Bored Pile	1.0	11.5-18.5	
92	84°	B	4.0	3.0	-----	-----	-----	0.5	-----	13.74	15.1	-----	-----	46.1m	25.5m	90°	IGirder	1@33m	T	8.979	-----	-----	Bored Pile	1.0	1.0-8.0	CB+OP+VD
93	70°	TypeA/Grade120	35.0	4.75	-----	-----	-----	-----	-----	-----	-----	-----	-----	68.1m	9.0m	70°	Void Slab	2@27m	T	10.409	Wall	9.232	Bored Pile	1.0	14.0-15.5	
94	71°	Ramp C1	15.5	-----	-----	-----	-----	0.5	-----	12.32	-----	-----	-----	47.1m	34.340m	70°	IGirder	1@27m	T	12.021	-----	-----	Bored Pile	1.0	13.0-15.0	
95	59°	II	12.0	4.75	-----	-----	-----	0.5	-----	12.32	25.0	-----	-----	118.2m	36.015m	70°	IGirder	3@33m	T	11.272	Wall	13.721	Bored Pile	1.0	6.0-10.0	VD+OP+CB
96	76°	Urban	18.0	4.75	-----	-----	-----	0.5	-----	12.32	-----	-----	-----	47.1m	25.5m	80°	IGirder	1@27m	T	11.724	-----	-----	Bored Pile	1.2	24.0-29.5	
97	90°	B,V	4.0,7.5	3.0,4.5	-----	-----	-----	0.5	-----	12.32	680.0	-----	-----	692.4m	25.5m	90°	Super Tee	17@40m	T	10.050	Wall	13.351	Bored Pile	1.2	13.0-27.0	VD+OP+CB
98	90°	B	4.0	3.0	-----	-----	-----	0.5	-----	12.32	280.0	-----	-----	294.4m	25.5m	90°	Super Tee	7@40m	T	12.748	Wall	12.552	Bored Pile	1.2	11.5-23.0	VD+OP+CB
99	56°	III	12.0	4.75	-----	-----	-----	0.5	-----	12.28	-----	-----	-----	42.7m	25.5m	70°	IGirder	1@27m	T	10.243	-----	-----	Bored Pile	1.2	15.0	
100	90°	B	4.0	3.0	-----	-----	-----	0.5	-----	9.51	28.6	-----	-----	45.1m	25.5m	90°	IGirder	1@33m	T	9.420	-----	-----	Bored Pile	1.0	21.5-23.5	ORB+OP
101	90°	-----	-----	-----	-----	-----	-----	0.5	-----	8.70	34.5	-----	-----	54.1m	12.0m	90°	IGirder	1@40m	T	9.420	-----	-----	Bored Pile	1.2	13.0-16.0	
102	34°	-----	-----	-----	4.88	6.55	-----	0.5	-----	7.90	-----	-----	-----	138.1m	12.0m	70°	IGirder	3@40m	T	12.737	Wall	15.505	Bored Pile	1.5	27.5-35.5	
103	40°	-----	-----	-----	-----	-----	-----	0.5	-----	6.92	25.0	-----	-----	55.9m	12.0m	70°	IGirder	1@40m	T	11.180	-----	-----	Bored Pile	1.2	15.0	CB+VD
Total														9,076.5m												

1) Counted average bridge length of bridges in independent alignment sections as one bridge
2) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m≤L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover
3) I/O: Inbound and Outbound Lines, I: Inbound Line, O: Outbound Line (see 5.2.2(1)(a)(i))
4) D: Devided Road, ND: Non-devided Road (see 5.2.2(1)(a)(i))
5) P: Parallel Alignment, I: Independent Alignment (see 5.2.2(2)(b))
6) SS: Separate Structure, NSS: Non-separate Structure, SAS: Separate Abutment Structure, IS: Independent Structure (see 5.2.2(1)(a)(ii))
7) DHWL: Design High Water Level, DNWL: Design Navigation Water Level (see 5.2.4(3))

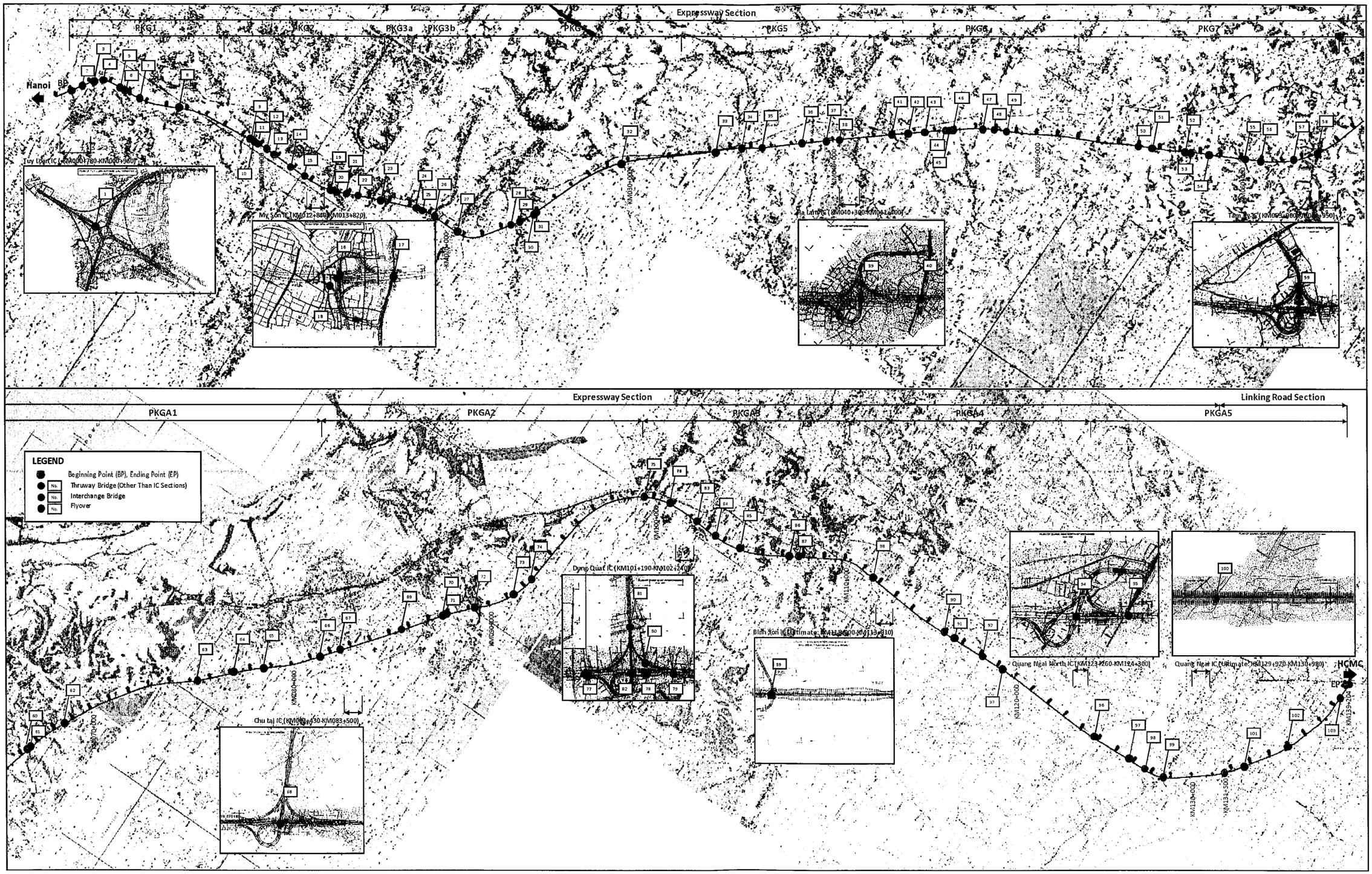


Figure 5.1-1 Location Map of Planned Bridges (Other Bridges)

5.2 Basic Design of Thruway Bridges (Other Than IC Sections)

5.2.1 General

(1) Objective

The objective of this section is to update the thruway bridge plan other than IC sections in the F/S plan and obtain the agreement and approvals from relevant organizations.

(2) Bridges Subject to Thruway Bridges

The bridges in the Project were categorized as shown in Table 5.2-1.

The bridges subject to this section were all of other bridges on the thruway except the IC sections.

Table 5.2-1 Bridges Subject to Thruway Bridges

No.	Bridges				Subject to Thruway Bridges	Reference in This Report
	Road	Location	Bridge Category			
1	Expressway/ Linking Road	Thruway	Major River Bridges		-----	Section 4 : Basic Design of Four (4) Major River Bridges
2			Other Bridges	Other Than IC Sections	●	This Section
3				IC Sections	-----	Section 5.3 : Basic Design of Interchange Bridges
4		Interchange (IC)	IC Rampway Bridges		-----	
5	Cross Road		Flyovers		-----	Section 5.4 : Basic Design of Flyovers

●: Subject to This Section

(3) Report Structure

The structure in this section is shown in Table 5.2-2.

Table 5.2-2 Report Structure

No.	Section	Main Contents
1	5.2.2 Definitions of Technical Terms	- Defined main terminologies for planning of bridge dimensions
2	5.2.3 Bridge Plan in F/S Stage	- Described main features of thruway bridge in the F/S plan
3	5.2.4 Bridge Planning Criteria and Conditions	- Described bridge planning criteria and conditions which were defined by standards or relevant decisions
4	5.2.5 Bridge Planning	- Determined principles of bridge planning which were not defined by standards or relevant decisions
5	5.2.6 Proposed Bridge Plan	- Proposed the updated thruway bridge plan and compared with F/S plan

(4) Principles of Basic Design

The following principles were adopted in the basic design of thruway bridges in consideration of the characteristic of expressway and site conditions of the Project road.

(a) Common

- Adopted appropriate girder types to cope with skewed and curved bridges.
- Prioritized to adopt standard structure types.
- Not planned hauling of girders by access road conditions and high cost of temporary roads.
- Not adjusted to same girder length in a package to reduce surplus bridge length.
- Incorporated affection by inundation into bridge planning.
- Ensured appropriate span length in river bridges to secure smooth discharge of river flow.
- Ensured appropriate substructure locations in consideration of affection to crossing objects.
- Ensured appropriate substructure locations in consideration of future widening of thruway.

(b) Thruway Bridges Other Than IC Sections

- Standardized bridge planning to ensure efficiency and quality of design and construction works.
- Adopted joint-less structure in short length bridges to ensure flatness and structural durability.

5.2.2 Definitions of Technical Terms

(1) Geometric Design

(a) Cross Section Elements

(i) Divided and Non-divided Roads

"Divided Road" was defined as the road with dual carriageways for traffic travelling in opposite directions divided by a median strip to ensure traffic safety with high speed limits as shown in Figure 5.2-1. "Non-divided Road" was defined as the road with one, two or more lanes arranged within a single carriageway with no median strip to divide opposing traffic flows as shown in Figure 5.2-1.

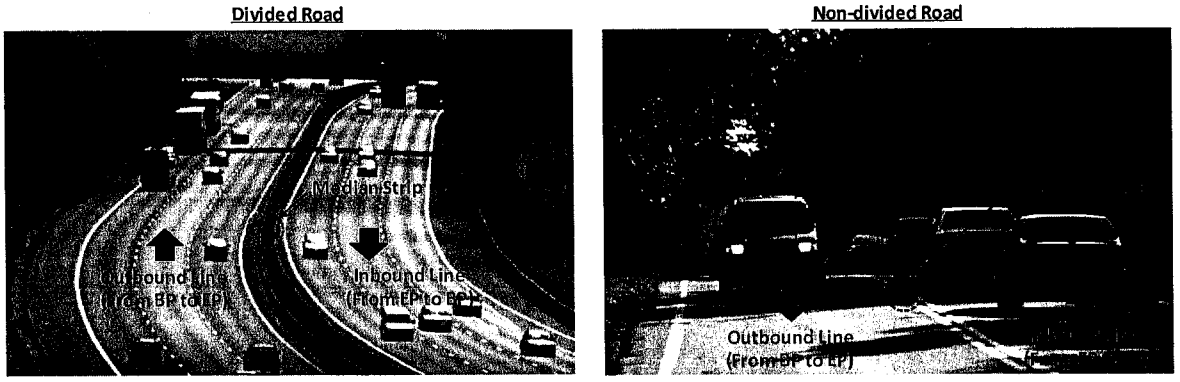


Figure 5.2-1 Image of Divided and Non-divided Roads

(ii) Inbound and Outbound Lines

"Inbound Line" was defined as the side of Divided or Non-divided Road towards the direction from ending point (EP) to beginning point (BP) as shown in Figure 5.2-1.

"Outbound Line" was defined as the opposite side of "Inbound Line" on the Divided or Non-divided Road towards the direction from BP to EP as shown in Figure 5.2-1.

(iii) Separate Structures

1: Separate and Non-separate Structures

"Separate Structure" was defined as the bridge structure which was separated the superstructure of Inbound and Outbound Lines as shown in Figure 5.2-2. In general, the bridges subject to "Separate Structure" is wide; however, it was limited to apply to the bridges on the Parallel Alignment (see 5.2.2(1)(b)(i)) in this report.

"Non-separate Structure" was defined as the bridge structure which was integrated the superstructure of Inbound and Outbound Lines on the Parallel Alignment as shown in Figure 5.2-2.

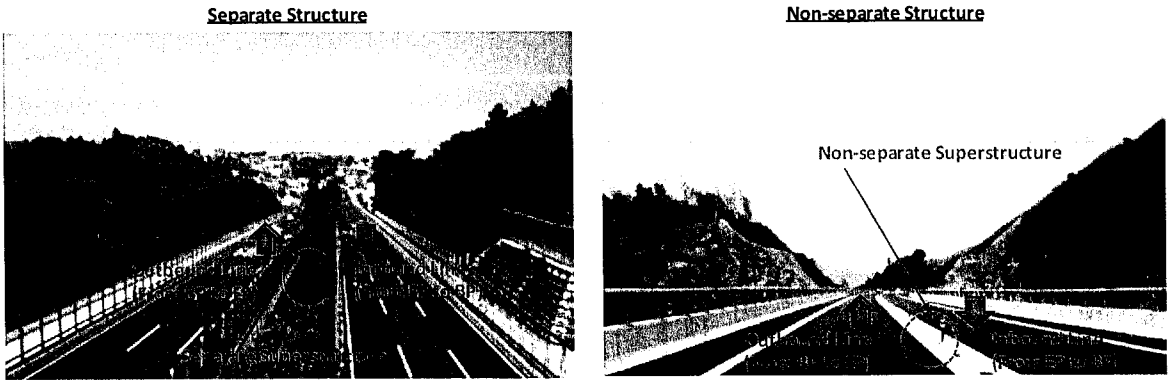


Figure 5.2-2 Image of Separate and Non-separate Structures

2: Separate Abutment Structure

"Separate Abutment Structure" was defined as the bridge structure which was separated the abutment structure of Inbound and Outbound Lines in the Separate Structure as shown in Figure 5.2-3.

In general, "Separated Abutment Structure" is applied to the bridge which is the different bridge locations (see 5.2.2(2)(a)) between Inbound/Outbound Lines on the Parallel Alignment (see 5.2.2(1)(b)(i)).

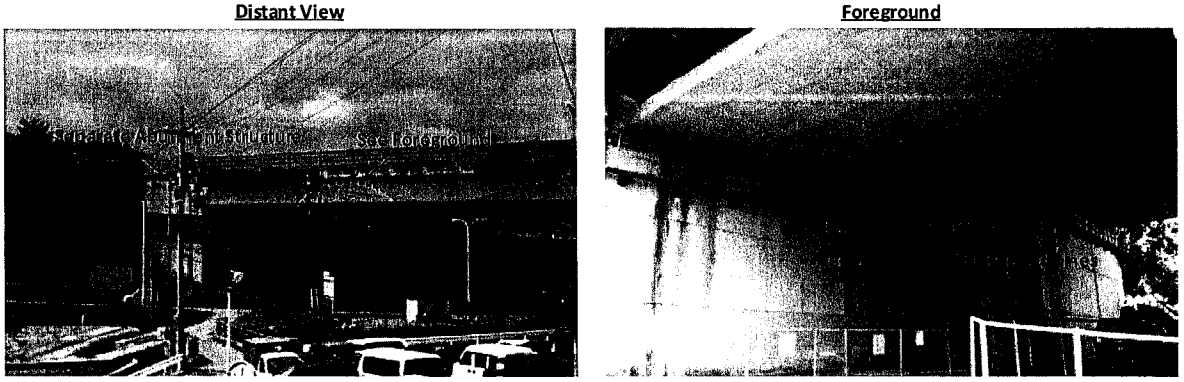


Figure 5.2-3 Image of Separate Abutment Structure

3: Independent Structure

"Independent Structure" was defined as the bridge structure which was separated all structures by Inbound/Outbound Lines on the Independent Alignment (see 5.2.2(1)(b)(iii)) as shown in Figure 5.2-4.

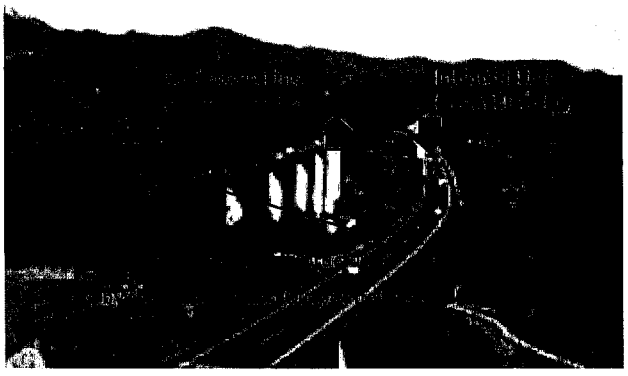


Figure 5.2-4 Image of Independent Structure

(b) Alignment

(i) Parallel Alignment

"Parallel Alignment" was defined as the road alignment which was applied the same horizontal and vertical alignment in the Inbound and Outbound Lines as shown in Figure 5.2-5.

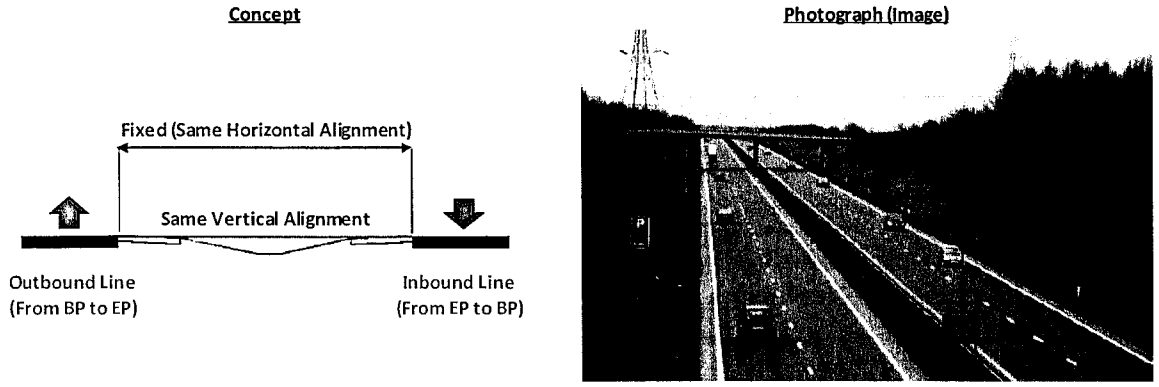


Figure 5.2-5 Image of Parallel Alignment

(ii) Independent Profile

"Independent Profile" was defined as the road alignment which was applied the same horizontal alignment with different vertical alignments in the Inbound and Outbound Lines as shown in Figure 5.2-6.

It is noted that "Independent Profile" was not applied to the bridges in the Project.

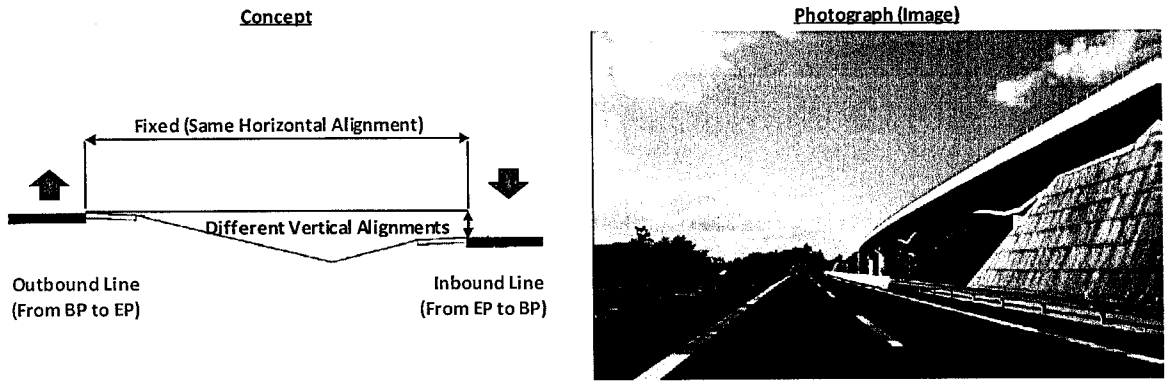


Figure 5.2-6 Image of Independent Profile

(iii) Independent Alignment

"Independent Alignment" was defined as the road alignment which was applied different horizontal and vertical alignments in the Inbound and Bound Lines with variable median strip or natural median width as shown in Figure 5.2-7.

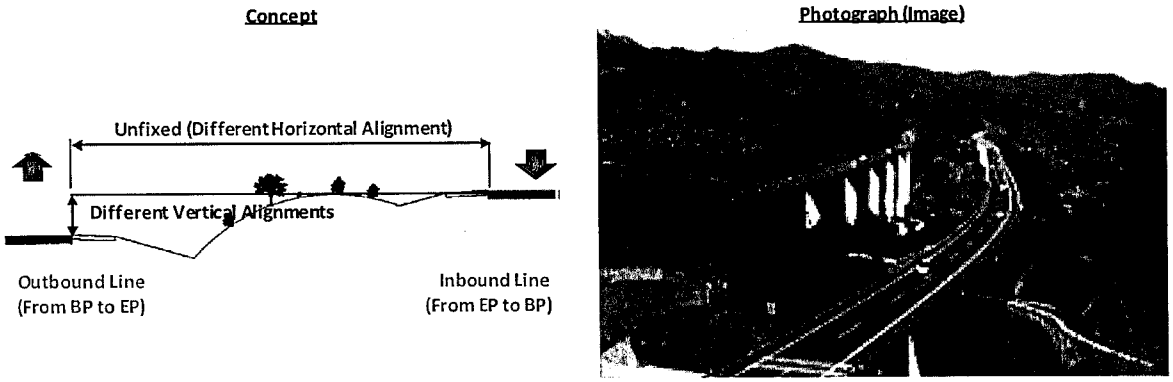


Figure 5.2-7 Image of Independent Alignment

(2) Bridge Planning

(a) Bridge Location

"Bridge Location" was defined as road station where the middle of Bridge Length (see 5.2.2(2)(b)) on the road centerline as shown in Figure 5.2-8 in the next page.

In case of the bridge structure was applied the Separate Abutment Structure or Independent Structure, "Bridge Location" was determined by the Inbound and Outbound Lines, respectively.

(b) Bridge Length

"Bridge Length" was defined as the horizontal distance between both ends of abutment wing wall on the road centerline as shown in Figure 5.2-8 in the next page.

In case of the bridge structure was applied the Separate Abutment Structure or Independent Structure, "Bridge Length" was determined by the Inbound and Outbound Lines, respectively.

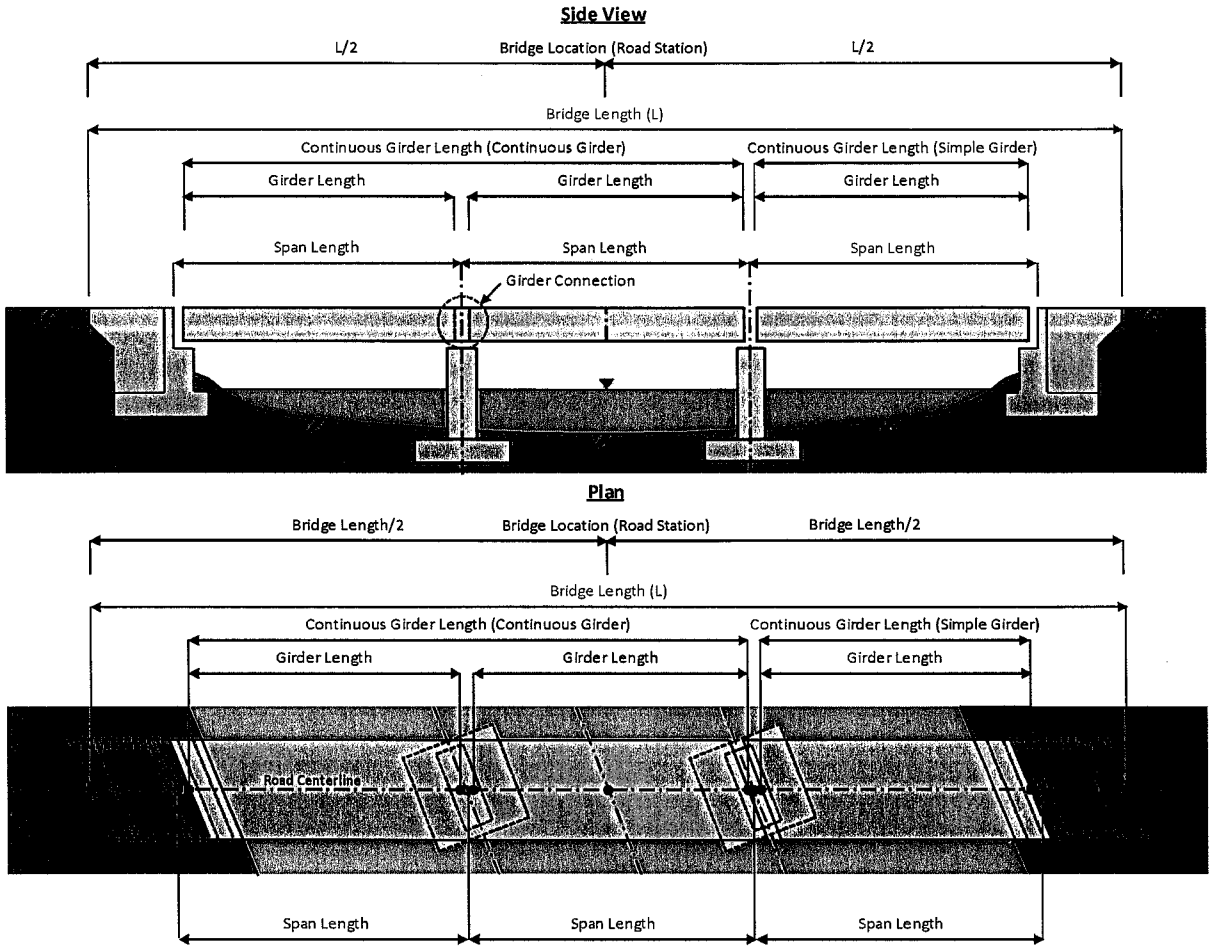


Figure 5.2-8 Definition of Bridge, Girder and Span Lengths

(c) Girder Length

(i) Girder Length

"Girder Length" was defined as the horizontal distance between both ends of the girder on the road centerline as shown in Figure 5.2-8.

In case of the girder was not arranged on the road centerline, the end of girder in the definition of "Girder Length" was defined as the intersection point between the road centerline and connecting line of girder ends on the transverse direction.

Furthermore, in case of bridge structure was applied the Separate Abutment Structure or Independent Structure, "Girder Length" was determined by the Inbound/Outbound Lines, respectively.

(ii) Continuous Girder Length

"Continuous Girder length" was defined as the horizontal distance between both ends of a simple girder or continuous girder on the road centerline as shown in Figure 5.2-8.

In case of the girder was not arranged on the road centerline, the end of girder in the definition of "Continuous Girder Length" was defined as the intersection point between the road centerline and connecting line of simple girder or continuous girder ends on the transverse direction.

Furthermore, in case of the bridge was applied the Separate Abutment Structure or Independent Structure, "Continuous Girder Length" was determined by the Inbound and Outbound Lines, respectively.

The types of continuous girder in the definition of "Continuous Girder Length" were included the following conditions of girder connection between adjacent piers at the intermediate piers.

- Linked Slab (connected only slab decks)
- Connected Girder and Continuous Girder (connected slab decks and girders)
- Rigid Frame Structure (connected slab decks, girders and piers rigidly)

(d) Span Length

"Span Length" was defined as the horizontal distance between the centers of adjacent pier on the road centerline as shown in Figure 5.2-8. As for the side span at the abutment, it was defined as the horizontal distance between the center of adjacent pier and face of parapet wall as shown in Figure 5.2-8.

In case of bridge structure was applied the Separate Abutment Structure or Independent Structure, "Span Length" was determined by the Inbound and Outbound Lines, respectively.

(e) Required Bridge Opening Length

"Required Bridge Opening Length" was one of requirements in the river bridges to secure smooth discharge of river flow and it was defined as the horizontal distance (subtracting pier widths) between both faces of abutment wall in case of projection on direction of river crossing as shown in Figure 5.2-9.

In case of bridge structure was applied the Independent Structure, "Required Bridge Opening Length" was determined by the Inbound and Outbound Lines, respectively.

In case of other bridge structures, "Required Bridge Opening Length" was determined as one bridge.

"Required Bridge Opening Length" was determined by hydrological and inundation analyses.

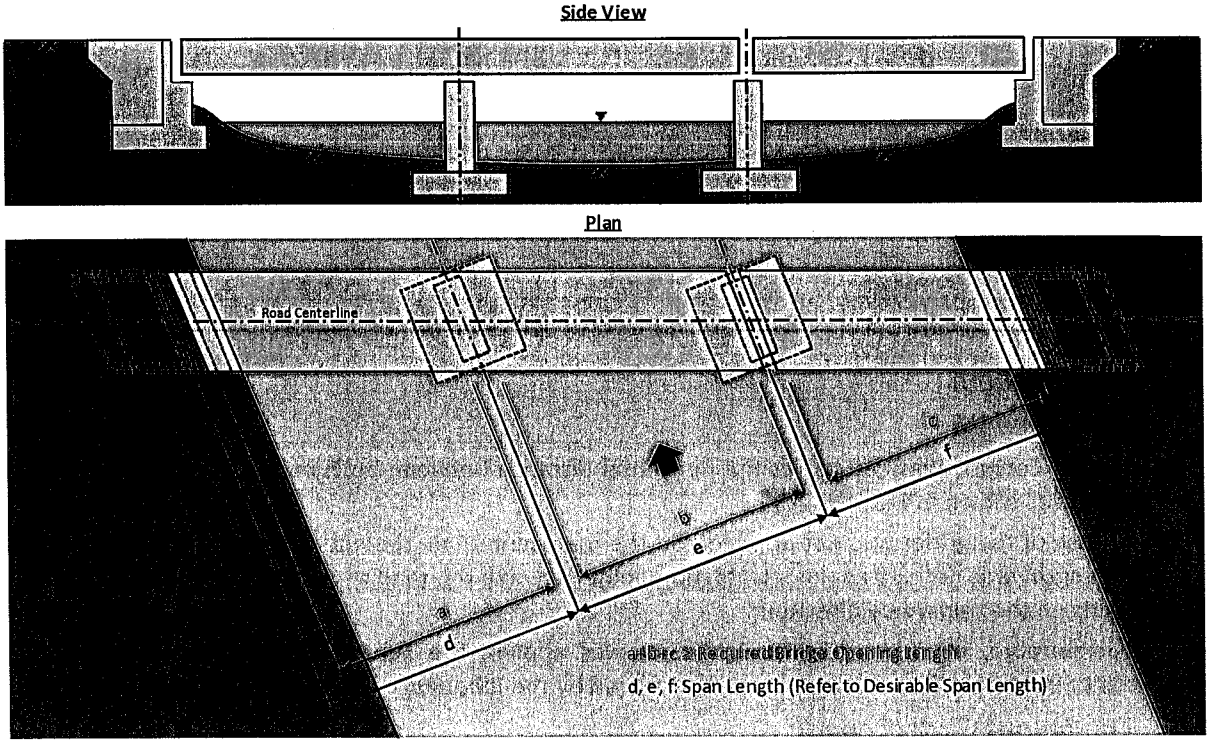


Figure 5.2-9 Definition of Required Bridge Opening and Desirable Span Lengths

(f) Desirable Span Length

"Desirable Span Length" was one of requirements in the river bridges to secure smooth discharge of water flow and it was defined as the horizontal distance between the centers of adjacent pier or between faces of abutment parapet wall and the center of adjacent pier in case of the projection on the direction of river crossing as shown in Figure 5.2-9.

In case of bridge structure was applied the Independent Structure, "Desirable Span Length" was determined by the Inbound and Outbound Lines, respectively.

In case of other bridge structures, "Desirable Span Length" was determined as one bridge.

"Desirable Span Length" was determined by hydrological and inundation analyses.

5.2.3 Bridge Plan in F/S Stage

(1) Main Features

The main features of thruway bridges in the F/S plan are shown in Table 5.2-3.

Table 5.2-3 Main Features of Thruway Bridges in F/S Plan

No.	Girder Type	Nos. of Bridge (By Girder Length[1])								Total	
		L≤24m				24m<L≤35m		L=40m[1]			
		L≤21m		L=24m							
		Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans
1	PC Slab Beam	30	3	2	-----	-----	-----	-----	-----	32	3
2	PC-I Girder	1	2	9	15	9	20	-----	-----	19	37
3	PC Super Tee Girder	-----	-----	-----	-----	-----	-----	-----	5	-----	5
Total		31	5	11	15	9	20	-----	5	51	45
		36		26		29		5		96	

1) L=40m in PC Super Tee Girder with is not girder length (38.3m) but span length (40m) in accordance with the Vietnamese standards

(2) Cross Section Elements

In the F/S plan, the cross section elements of thruway bridges on the expressway section was defined to be 26m with 4 lanes in the initial stage and will be widened to 6 lanes in the ultimate stage; however, the cross section elements in the ultimate stage were not mentioned.

According to the F/S Consultant, the widening of thruway bridges on the expressway section was not considered physically and it was planned to reduce the carriageway width from 3.75m to 3.5m without emergency lanes for ensuring 6 lanes in the ultimate stage as shown in Figure 5.2-10.

As for the thruway bridges on the linking road section, the cross section elements was defined to be 12m with complete 2 lanes in the initial stage as shown in Figure 5.2-10.

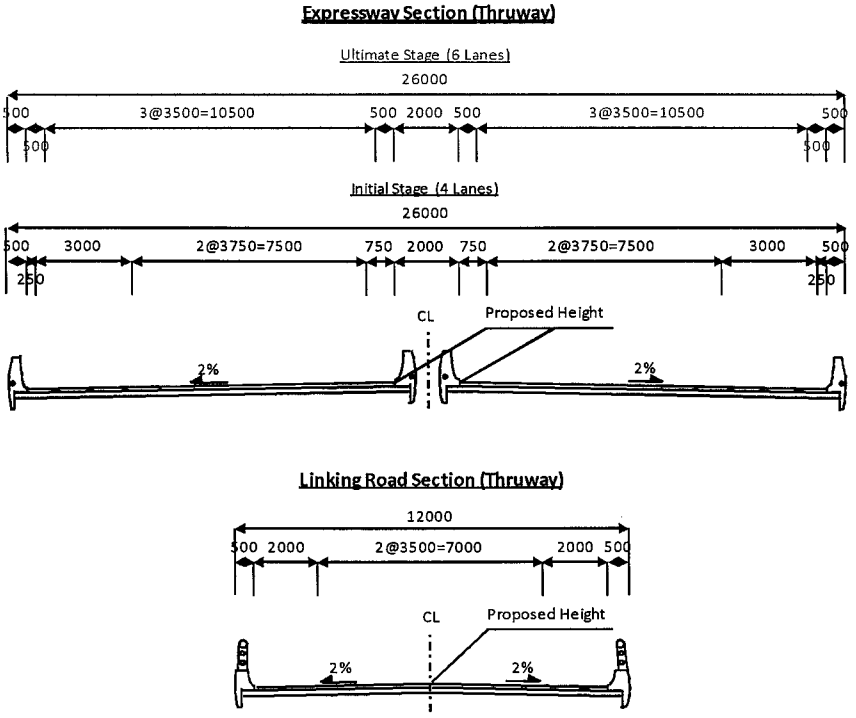


Figure 5.2-10 Cross Section Elements of Thruway Bridges in F/S Plan

(3) Typical Cross Sections

The typical cross sections of thruway bridges in the F/S plan are shown in Figure 5.2-11.

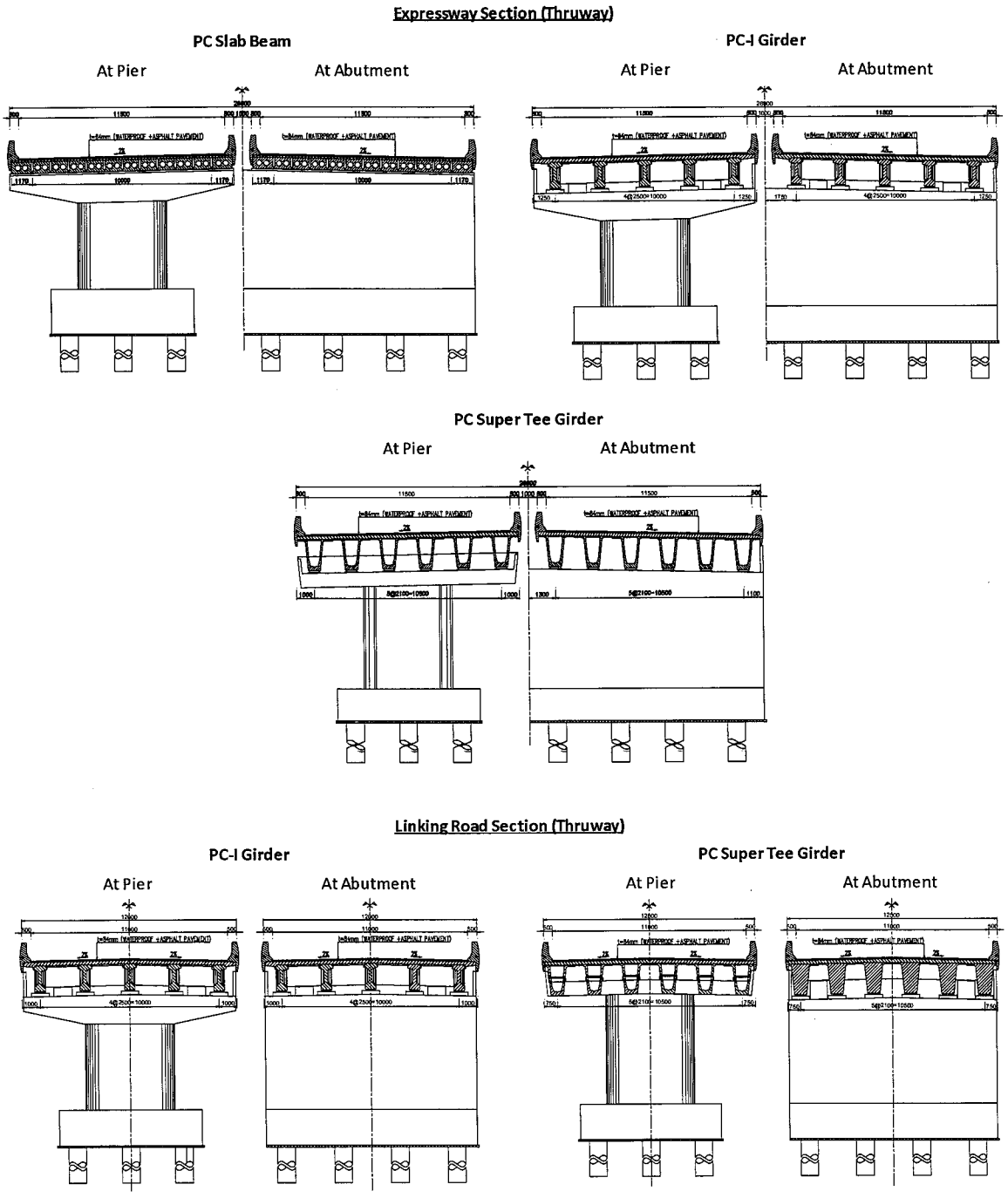


Figure 5.2-11 Typical Cross Sections of Thruway Bridges in F/S Plan

(4) List of Bridges

The List of bridges in the F/S plan is shown in Appendix 5.1, Volume 2.

5.2.4 Bridge Planning Criteria and Conditions

(1) Geometric Design Criteria

(a) Summary of Geometric Design Criteria

The geometric design criteria were established by the D/D Consultant mainly in accordance with the following design standards and submitted in Letters No. DQEDD-PMU85-49-12 dated on February 27, 2012 and No. DQEDD-PMU85-139-12 dated on April 18, 2012.

- Expressway Design Standards: TCVN 5729-97
- Highway Design Standards: TCVN 4054-05

The summary of geometric design criteria (thruway bridges, initial stage) are shown in Table 5.2-4, and the items which need further explanation, those are described in the subsequent sections.

Table 5.2-4 Summary of Geometric Design Criteria (Thruway Bridges, Initial Stage)

No.	Item		Type/Value		Reference in This Report
			Expressway Section	Linking Road Section	
1	Road Classification		Type A/Grade 120	Class III/Grade 80	
2	Terrain		Flat	Flat	
3	Design Speed		120km/hr	80km/hr	See 5.2.4(1)(c)
4	Design Vehicle		Semi-trailer	Semi-trailer	
5	Numbers of Lane		4	2	See 5.2.4(1)(b)
6	Cross Sections	Road Width	25.50m	12.00m	See 5.2.4(1)(e)
7		- Central Strip	3.00m	-----	
8		- Median Strip	1.50m	-----	
9		- Marginal Strip	2@0.75m	-----	
10		- Carriageway	4@3.75m	2@3.50m	
11		- Emergency Lane	2@3.00m	----	
12		- Paved Shoulder	-----	2@2.00m	
13		- Service Space	2@0.25m	-----	
14		- Railing, Outside	2@0.50m	2@0.50m	
15		Cross Fall	2.0%	2.0%	
16		Embankment Slope			
17		- Road Section	1:2	1:1.5	
18		- Bridge Section	1:1.25	1:1	
19	Horizontal Alignment	Horizontal Curve (R)			See 5.2.4(1)(d)
20		- Absolute Min Horizontal Curve Radius[1)]	Not Applied	Not Applied	
21		- Desirable Min. Horizontal Curve Radius	1,000m	Not Applied	
22		- Min. Curve Radius w/o Superelevation	4,000m	2,500m	
23		Superelevation		Not Applied	
24		- 1,000m≤R<1,100m	-5.0%	-----	
25		- 1,100m≤R<1,300m	-4.5%	-----	
26		- 1,300m≤R<1,500m	-4.0%	-----	
27		- 1,500m≤R<2,000m	-3.5%	-----	
28		- 2,000m≤R<2,500m	-3.0%	-----	
29		- 2,500m≤R<3,000m	-2.5%	-----	
30		- 3,000m≤R<4,000m	-2.0%	-----	
31		Transition Curve		Not Applied	
32		- Min. Length for Desirable Min. Curve Radius	150m	-----	
33		- Min. Length for R=1,125m	125m	-----	
34		- Min. Length for R>1,125m	R/9m	-----	
35	Vertical Alignment	Gradient			
36		- Max. Gradient-Upgrade	4.0%	4.0%[2)]	
37		- Max. Gradient-Downgrade	5.5%		
38		- Min. Gradient for Transition Section	1.0%	Not Applied	
39		- Critical Length for Max. Gradient-Upgrade	600m	900m	
40		- Min. Length for Gradient	300m	200m	
41		Vertical Curve			
42		- Min. Length for Vertical Curve	100m	70m	
43		- Desirable Min. Vertical Curve Radius	17,000m	5,000m	
44	Sight Distance	Stopping Sight Distance			
45		- Stopping Sight Distance	230m	100m	
46		- Stopping Sight Distance for Opposing Vehicle	-----	200m	
47		Overtaking Sight Distance	-----	550m	
48	Clearance	Expressway and Linking Road	4.75m	4.75m	See 5.2.4(1)(e)(v)(vi)

1) In case of satisfy the absolute min. horizontal curve radius, the widening of bridge is not required according to the relevant design standards.

2) All bridges on the linking road section were applied only parallel alignment and the gradient on inbound and outbound lines was same in a bridge (see 5.2.4(1)(d)).

(b) Numbers of Lane

The numbers of lane in the F/S plan were followed in the basic design as shown in Table 5.2-5.

The bridges on the expressway section were determined to be 4 lanes in the initial stage and will be widened to 6 lanes in the ultimate stage. As for the bridges on the linking road section, those were determined to be complete 2 lanes in the initial stage.

Table 5.2-5 Numbers of Lane

No.	Road	Location	Numbers of Lane	
			Initial Stage	Ultimate Stage
1	Expressway	Thruway	4 lanes	6 lanes
2	Linking Road		2 lanes	-----

(c) Design Speed

The design speed in the F/S plan was reviewed by the D/D Consultant according to the relevant design standards and determined the same values in the basic design as shown in Table 5.2-6.

The details were explained in Letter No. DQEDD-PMU85-139-12 dated on April 18, 2012.

Table 5.2-6 Design Speed

No.	Road	Location	Bridge Category	Bridge Type	Design Speed		Reference
					Initial Stage	Ultimate Stage	
1	Expressway	Thruway	Thruway Bridges	All Bridges	120km/hr	120km/hr	TCVN 5729-97
2	Linking Road			All Bridges	80km/hr	80km/hr	TCVN 4054-05

(d) Alignment

The design criteria for alignment design in the thruway bridges were summarized in Table 5.2-4.

In addition, the design conditions for alignment design were established as shown in Table 5.2-7.

Table 5.2-7 Design Conditions for Alignment Design

No.	Category	Item	Design Conditions for Alignment Design (Thruway Bridge Sections)	
			Expressway Section	Linking Road Section
1	Alignment Type	Parallel Alignment	Applied	Applied
2		Independent Profile	Not Applied	Not Applied
3		Independent Alignment	Applied	Not Applied
4	Sag Curve	Inflection Point	Not Applied	Not Applied

(e) Cross Sections

(i) Stage Construction

The stage construction in the F/S plan was updated by the D/D Consultant and submitted in Letter No. DQEDD-PMU85-139-12 dated on April 18, 2012 as shown in Table 5.2-8.

For minimizing the initial investment cost, the typical girder bridges on the expressway section were planned stage construction with 4 lanes in the initial stage and will be physically widened to 6 lanes in the ultimate stage.

Table 5.2-8 Stage Construction Plan

No.	Stage	Expressway Section		Linking Road Section
		Other Bridges		All Bridges
		Initial Stage	Ultimate Stage	Initial Stage
1	Superstructure	4 lanes	6 lanes	2 lanes
2	Substructure/Foundation		(Physically Widened)	

(ii) Divided and Non-divided Roads

The divided road in the F/S plan was followed in the basic design as shown in Table 5.2-9.

Table 5.2-9 Divided Road Plan

No.	Item	Expressway Section	Linking Road Section
1	Divided or Non-divided Road	Divided Road	Non-divided Road

(iii) Separate and Non-separate Structures

The separate structure in the F/S plan was followed in the basic design as shown in Table 5.2-10.

The separate structures were applied to the bridges on the expressway section in consideration of economy and effects on lateral load distribution of superstructure.

As for the bridges on the linking road section, those were applied the non-separate structures by reason of narrow bridge width with 12m.

Table 5.2-10 Separate Structure Plan

No.	Structure			Expressway Section		Linking Road Section
				Other Bridges		
				Parallel Alignment	Independent Alignment	
1	Superstructure			Separate Structure	Independent Structure	Non-separate Structure
2	Substructure	Abutment		Non-separate Structure/ Separate Abutment		
3		Pier	Wall/Column	Separate Structure		
4			Footing	Separate Structure		

(iv) Bridge Railings

The requirements for bridge railing are described in 22 TCN 272-05; however, those are referred to AASHTO LRFD 1998 and not matched with AASHTO LRFD 2007 which was proposed by the D/D Consultant to refer appropriately in Letter No. DQEDD-PMU85-12-12 dated on January 18, 2012.

In AASHTO, the requirements for bridge railing have been improved by experiments; therefore, AASHTO LRFD 2007 was proposed to apply in the basic design.

The expressway section was proposed to apply the New Jersey Barrier, TL-5 (h=1,070mm) as shown in Figure 5.2-12. Basically, TL-4 (h=810mm) is required for the expressway; however, the heavy vehicle traffic in the Project is expected to exceed 3,000 vehicle/day/direction; therefore, TL-5 is required.

The linking road section is mixed traffic and proposed to apply the Combination Type of New Jersey Barrier, TL-4 (h=810mm) and Steel Railing with 1,070mm height in total as shown in Figure 5.2-12.

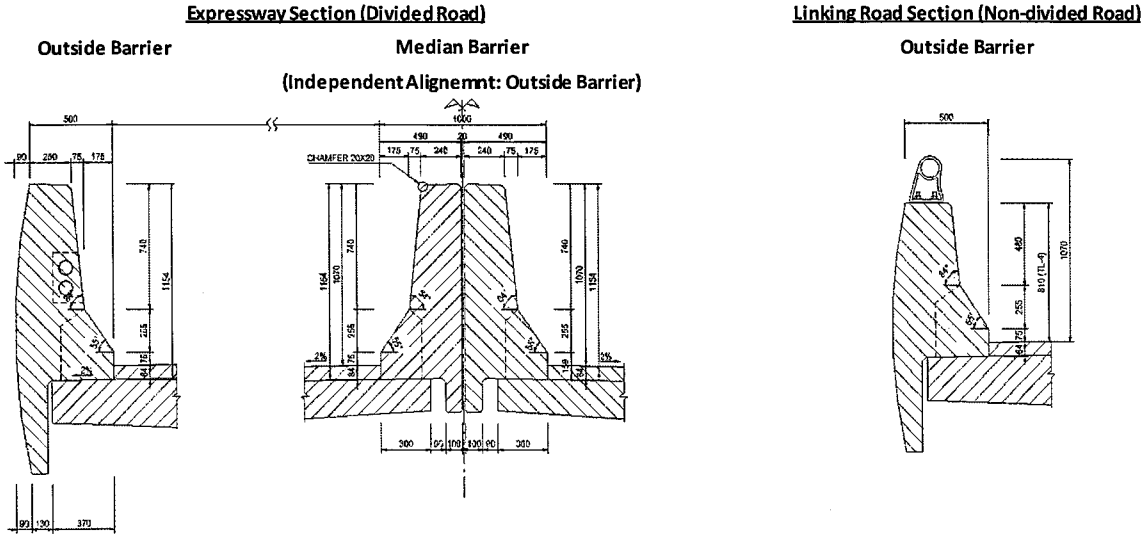


Figure 5.2-12 Bridge Railings

(v) Clearance

The clearance for thruway bridges was determined by the D/D Consultant in accordance with the following design standards and submitted in Letter No. DQEDD-PMU85-139-12 dated on April 18, 2012.

- Expressway Design Standards: TCVN 5729-97
- Highway Design Standards: TCVN 4054-05

The required clearance for thruway bridges is shown in Figure 5.2-13.

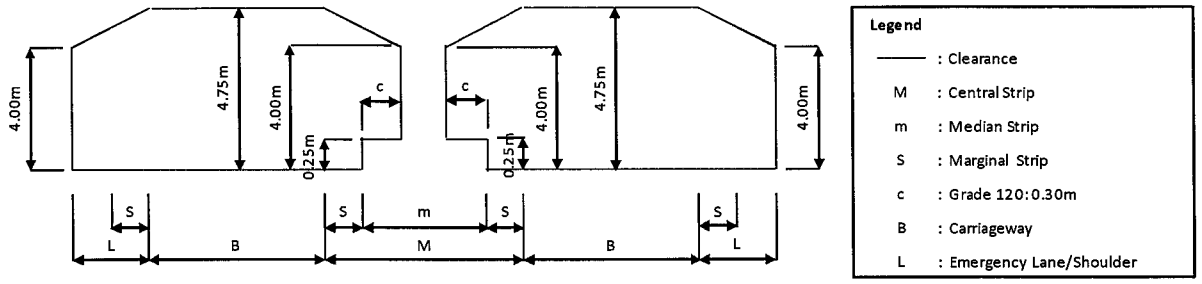


Figure 5.2-13 Required Clearance for Thruway Bridges

(vi) Cross Section Elements

The cross section elements of thruway bridges in the F/S plan are shown in Figure 5.2-10.

Since the commencement of basic design, several discussions on the cross section elements had been held among the relevant organizations. In order to reduce the initial investment cost, VEC instructed the D/D Consultant to examine the possibility for reducing the median strip width on the expressway section.

According to the instruction, the cross section elements including future widening were studied by the D/D Consultant and submitted in Letter No. DQEDD-PMU85-139-12 dated on April 18, 2012.

The gist of cross section elements on the expressway section is described below.

- Reduced the median strip width from 2.0m to 1.5m.
- Applied same cross section elements with road section in thruway bridges.

The cross section elements are shown in Table 5.2-11 and Figure 5.2-14, respectively.

Table 5.2-11 Cross Section Elements

No.	Item	Unit	Expressway				Linking Road
			Thruway Bridges				Thruway Bridges
			Parallel Alignment		Independent Alignment		Parallel
			Initial Stage	Ultimate Stage	Initial Stage	Ultimate Stage	Initial Stage
1	Numbers of Lane	lane	4	6	4	6	2
2	Road Width	m	25.50	33.00	13.00	16.75	12.00
3	- Central Strip	m	3.00	3.00	-----	-----	-----
4	- Median Strip	m	1.50	1.50	-----	-----	-----
5	- Marginal Strip	m	2@0.75	2@0.75	-----	-----	-----
6	- Railing, Inside	m	-----	-----	0.50	0.50	-----
7	- Service Space		-----	-----	0.25	0.25	-----
8	- Marginal Strip, Inside	m	-----	-----	1.00	1.00	-----
9	- Carriageway	m	4@3.75	6@3.75	2@3.75	3@3.75	2@3.50
10	- Emergency Lane	m	2@3.00	2@3.00	3.00	3.00	-----
11	- Paved Shoulder	m	-----	-----	-----	-----	2@2.00
12	- Marginal Strip, Outside	m	-----	-----	-----	-----	-----
13	- Service Space	m	2@0.25	2@0.25	0.25	0.25	
14	- Railing, Outside	m	2@0.50	2@0.50	0.50	0.50	2@0.50

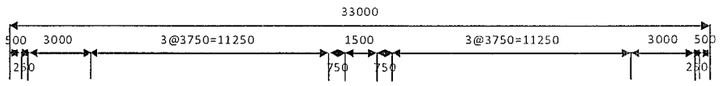
Expressway Section

Thruway Bridges

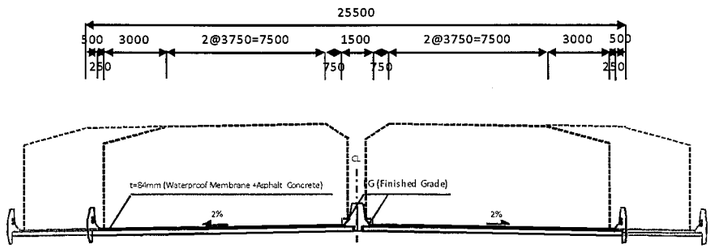
Parallel Alignment Section

Typical Section (R≥4,000m)

Ultimate Stage (6 Lanes)

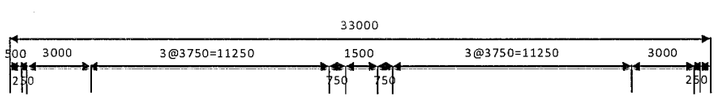


Initial Stage (4 Lanes)

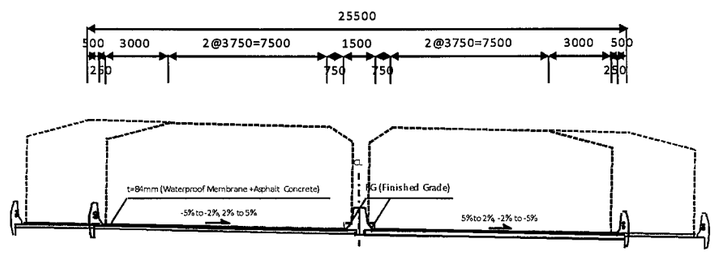


Superelevation Section (R<4,000m)

Ultimate Stage (6 Lanes)



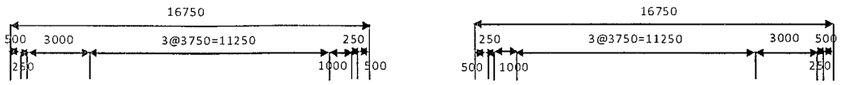
Initial Stage (4 Lanes)



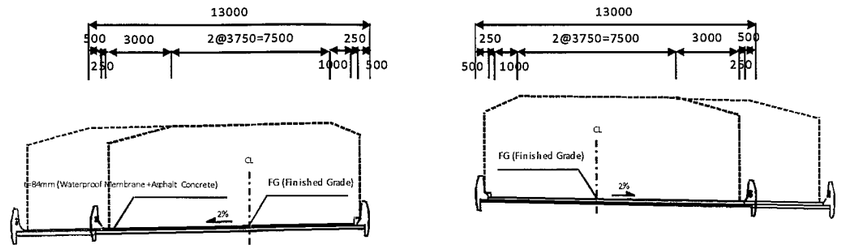
Independent Alignment Section

Typical Section (R≥4,000m)

Ultimate Stage (6 Lanes)

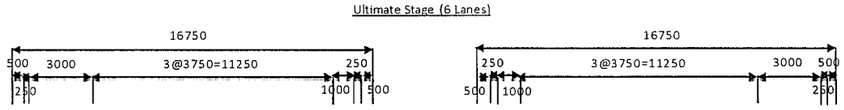


Initial Stage (4 Lanes)

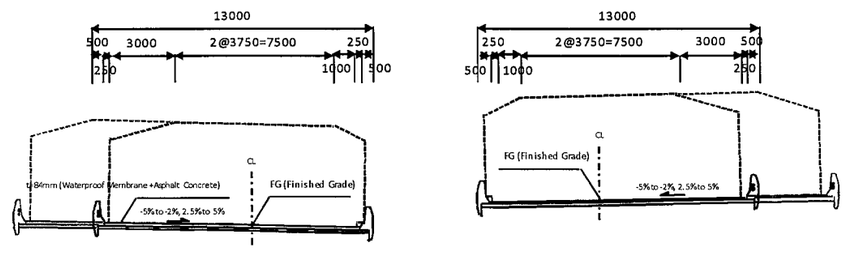


Superelevation Section (R<4,000m)

Ultimate Stage (6 Lanes)



Initial Stage (4 Lanes)

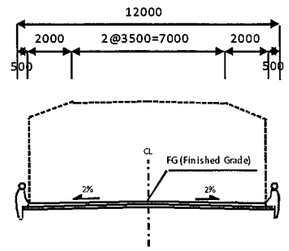


Linking Road Section

Thruway Bridges

Parallel Alignment Section

Typical Section (R≥4,000m)



Determination of Centerline and Finished Grade

Road	Alignment	Cross Section	Centerline	Finished Grade
Expressway	Parallel Alignment	Typical Section	Center of Cross Section	Edge of Median Barrier
		Superelevation Section		
	Independent Alignment	Typical Section	Center of Carriageway (Outside Edge of Inner Carriageway)	Same as Centerline
		Superelevation Section		
Linking Road	Parallel Alignment	Typical Section	Center of Cross Section	Center of Cross Section

Figure 5.2-14 Cross Section Elements and Clearance Requirements

(2) Clearance with Crossing Objects

(a) Clearance

(i) Cross Road

1: Cross Sections

The cross roads were classified by the relevant design standards as shown in Table 5.2-12.

Table 5.2-12 Classifications of Cross Road

No.	Crossing Objects		Design Standards
1	Highway	Class I, II, III, IV, V, VI	TCVN 4054-05: Highway Design Standards
2	Rural Road	Class AH (Terrain), AH (Mountain), A, B, C	Decision No.315/QD-BGTVT: Guidance on Rural Road Design

Based on the discussion with the relevant organizations, the cross sections of cross road in the thruway bridge planning were determined by the criteria as shown in Table 5.2-13.

Table 5.2-13 Cross Sections of Cross Road in Thruway Bridge Planning

No.	Existing Conditions			Cross Sections in Thruway Bridge Planning
1	Existing Road	With Approved Future Plan	With Approved Cross Sections	Followed Approved Cross Sections
2			Without Approved Cross Sections	Applied Standard Cross Sections (See Appendix 2.3)
3		Without Approved Future Plan		Followed Existing Cross Sections
4	New Road	With Approved Cross Sections		Followed Approved Cross Sections
5		Without Approved Cross Sections		Applied Standard Cross Sections (See Appendix 2.3)

2: Clearance

The clearance on cross roads was defined in the F/S plan; however, those were updated by the D/D Consultant according to the following items as shown in Figure 5.2-15 and Table 5.2-14, respectively.

- The clearance in the F/S plan was not defined in details.
- The clearance for rural roads should be updated based on Decision No. 315.

It is noted that the clearance on the cross roads was considered the future heightening in the relevant authorized development plan.

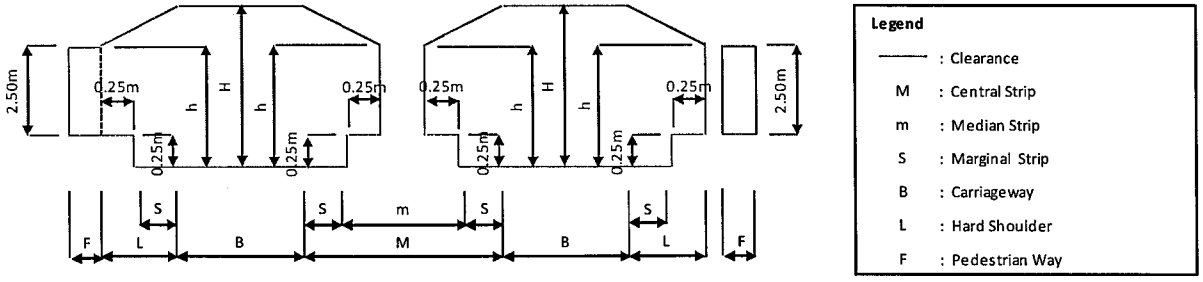


Figure 5.2-15 Clearance on Cross Roads

Table 5.2-14 Clearance on Cross Roads by Road Classifications

No.	Road Classifications		Clearance (See Figure 5.2-15)		Design Standards
			H	h	
1	Urban Road		4.75m (4.50m[1)])	4.00m	TCXDVN 104-2007: Urban Road Specifications for Design
2	Highway	Class I	4.75m	4.00m	TCVN 4054-05: Highway Design Standards
3		Class II	4.75m	4.00m	
4		Class III	4.75m	4.00m	
5		Class IV	4.50m	4.00m	
6		Class V	4.50m	4.00m	
7		Class VI	4.50m	4.00m	
8	Rural Road	Class AH (Terrain)	4.50m	4.00m[1)]	Decision No.315/QD-BGTVT: Guidance on Rural Road Design
9		Class AH (Mountain)	4.50m	4.00m[1)]	
10		Class A	3.50m	3.00m[1)]	
11		Class B	3.00m	2.50m[1)]	
12		Class C	3.00m	2.50m[1)]	

1) Exceptional value for improvement of existing street and tunnel and new construction of local street
2) Proposed by the D/D Consultant (not defined in the relevant design standards)

(ii) Railway

The clearance on North-South Railway (1435mm gauge) was determined in the F/S plan; however, it was not satisfied the requirements in Railway Law No. 35/2005/QH-11 dated on June 14, 2005.

Therefore, the clearance was updated in the basic design as shown in Figure 5.2-16.

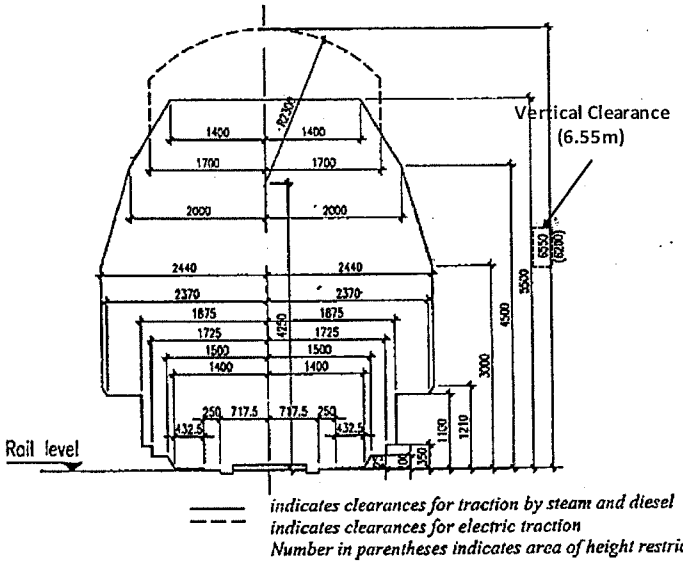


Figure 5.2-16 Clearance on North-South Railway (1435mm Gauge)

(iii) River

1: Freeboard

The freeboard which sets the clearance under the river bridges was not determined in the F/S plan.

The freeboard was determined in accordance with 22 TCN 272-05 and applied to not only river bridges and viaducts (discharge) but also other bridge categories in consideration of the flood conditions in the Project area as shown in Table 5.2-15.

Table 5.2-15 Freeboard

No.	Bridges	Freeboard
1	All Large River Bridges, Other River Bridges with Forest Area in Catchment Area	1.0m (with Driftwood Conditions)
2	Other Categories of Bridge except Flyovers	0.5m (Without Driftwood Conditions)

2: Navigation Clearance

The navigation clearance was determined to the bridges at the classified rivers in the F/S plan and it was determined in accordance with TCVN 5664-1992.

However, the current standards were updated to TCVN 5664-2009; therefore, the navigation clearance was updated by the D/D Consultant according to TCVN 5664-2009 as shown in Table 5.2-16.

Table 5.2-16 Navigation Clearance

No.	Category of Waterway[1)]	Clearance from Design Navigation Water Level (See 5.2.4(3)(d))	
		Horizontal	Vertical[2)]
1	North-Class I	>80m	11
2	North-Class II	>50m	9.5
3	North-Class III	>40m	9.5
4	North-Class IV	>30m	6 (5)
5	North-Class V	>20m	4 (3.5)
6	North-Class VI	>10m	3 (2.5)

1) North is applicable for cities and provinces in the northern and central regions which include Danang, Quang Nam and Quang Ngai.
2) Value in () is not in priority use.

(iv) High-voltage Lines

The vertical clearance for high-voltage lines was not clearly mentioned in the F/S plan; therefore, it was determined by the D/D Consultant in accordance with the current technical standards, Decree No. 81/2009/ND-CP dated on October 12, 2009 as shown in Table 5.2-17.

Table 5.2-17 Vertical Clearance (High-voltage Lines)

No.	Item	Vertical Clearance			
		Up to 35kV	110kV	220kV	500kV
1	Required Vertical Clearance from Top of Highest Vehicle on Thruway (4.5m)	2.5m (7.0m)	2.5m (7.0m)	3.5m (8.0m)	5.5m (10.0m)

1) Value in () is the required vertical clearance from the planned road surface.

(b) Minimum Requirements for Abutment Location

The minimum requirements for abutment location were not clearly determined in the F/S plan.

The requirements are not determined in the relevant Vietnamese regulations except the railway; therefore, those were established by the D/D Consultant based on the required space for operation of crossing objects as shown in Table 5.2-18 and Figure 5.2-17., respectively.

It is noted that the abutment locations were considered future widening (see 5.2.5(3)(a)).

Table 5.2-18 Minimum Requirements for Abutment Location

No.	Bridge Category		Minimum Requirements for Abutment Location	Remarks
1	River Bridge		- Existing river bank+3.5m (not allowed in river area)	- By river administration and embankment slope space
2	Viaduct	For Discharge	- No requirements	----
3		By Topography		
4	Canal Bridge	Embanked Type	- Edge of embankment slope+1.0m	- By pedestrian passage and drainage spaces
5		Trenched Type	- Edge of canal+3.0m	- By pedestrian and vehicle passage spaces
6	Overpass	For Cross Road	- Edge of embankment slope+1.0m	- By pedestrian passage and drainage spaces
7		For Railway	- Edge of embankment slope+5.0m	- Railway Law No. 35/2005/QH-11 dated on June 14, 2005
8	Multi-functioned Bridge		- Combination of the above requirements	----

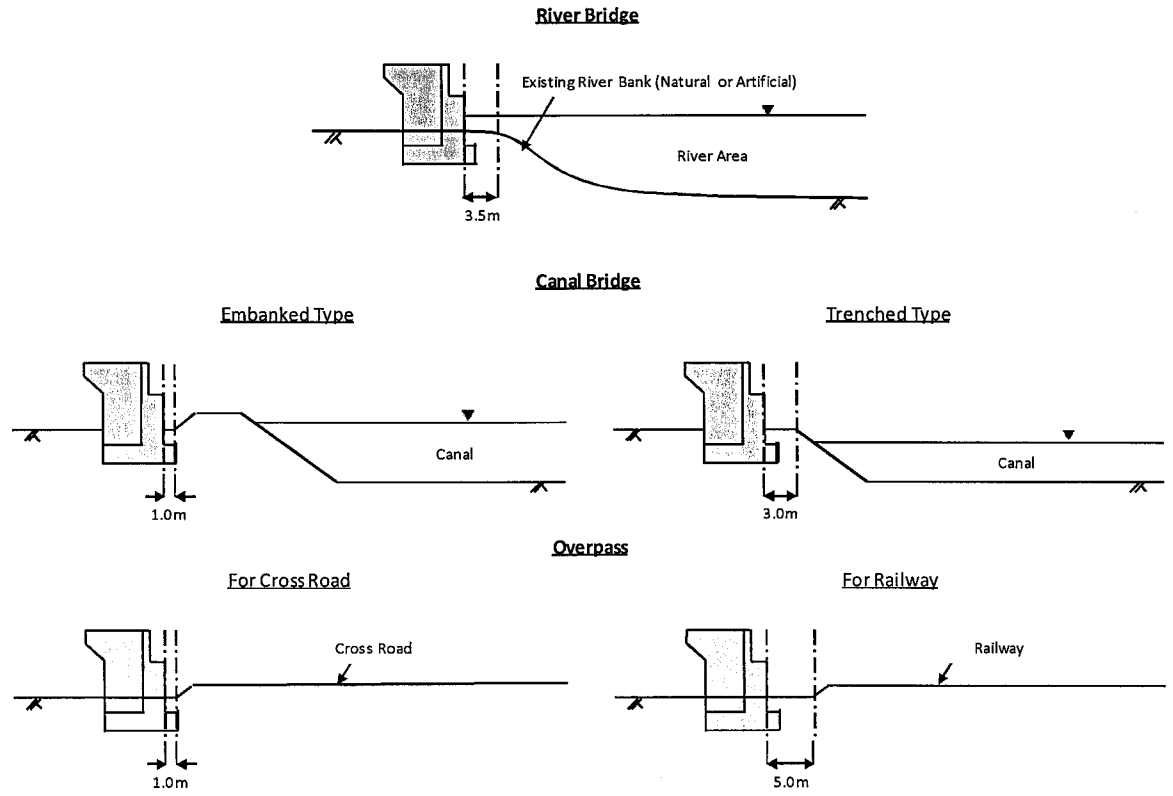


Figure 5.2-17 Minimum Requirements for Abutment Location

(3) Hydrological Requirements

(a) Design High Water Level

The frequencies of design high water level were determined in the F/S plan as shown in Table 5.2-19.

Those are satisfied the requirements in the current standards and applied in the basic design.

It is noted that the Project road is on inundation plains; then, the design high water levels were applied to not only river bridges and viaducts (discharge) but also other bridge categories in the Project.

Table 5.2-19 Frequencies for Design High Water Level

No.	Road	Bridge Length	Frequency	Design Standards
1	Expressway (Thruway)	All Bridges	1%	TCVN 5729-97: Expressway Design Standards
2	Linking Road	Large Bridges (L≥100m)	1%	TCVN 4054-05: Highway Design Standards
3		Medium Bridges (25m≤L<100m)	1%	
4		Small Bridges (L<25m)	4%	

(b) Required Bridge Opening Length

The required bridge opening length for river bridges was not determined in the F/S plan.

Those values were determined by hydrological and inundation analyses in the basic design under the conditions of design high water level (see 5.2.4(3)(a)).

The Project road is on inundation plain and all bridge categories shall be incorporated the affection by inundation into bridge planning. However, the required bridge opening length for other bridge categories cannot be determined by hydrological and inundation analyses, exactly. Therefore, the bridge opening length for other bridge categories were planned by the primary functions required in each bridge category and confirmed by inundation analyses quantitatively.

In case of required the extension of bridge opening length by the result of inundation analysis, it was extended in accordance with the instruction by the Senior Hydrologist.

(c) Desirable Span Length

The required span length for river bridges was not determined in the F/S plan.

The value of required span length cannot be determined by hydrological and inundation analyses and the technical standards are not existed in Vietnam. Therefore, the Japanese empirical formula in the followings was referred as the Desirable Span Length in the basic design.

$L_s=20+0.005Q$

Where: L_s = Desirable Span Length (l.m.)

Q = Peak Discharge (m^3/sec)

(Source: Government Ordinance for Structural Standard for River Administration Facilities, Japan)

(d) Design Navigation Water Level

The design navigation water level in the F/S plan was determined in accordance with TCVN 5664-1992; however, it is not matched with the current technical standards.

Therefore, it was updated by the D/D Consultant according to the current technical standards, TCVN 5664-2009 as shown in Table 5.2-20.

Table 5.2-20 Design Navigation Water Level

No.	Item	Original (F/S Plan)	Updated (D/D Stage)
1	Design Navigation Water Level	5% at yearly maximum water level (TCVN 5664-1992)	5% at hourly average water level for tidal area while daily average water level for non-tidal area (TCVN 5664-2009)

(e) Water Level during Construction

The water level during construction was not determined in the F/S plan.

It was applied 50% frequency according to 1.16, 22 TCN 266-2000 in the D/D stage.

(4) Other Requirements

(a) Surface Drainage

(i) Design Frequency

As mentioned in Section 1.5.1, the design frequency for surface drainage analysis was determined as 4% in accordance with Section 6.9, TCVN 4054-05.

(ii) Drainage Outlet

The requirements for drainage outlet were mentioned in Section 5.4.2.3 in the Supplemental EIA Report and approved by MONRE in Decision No. 2046/QD-BTNMT dated on October 29, 2010.

The four (4) major rivers belong to the main river systems in the Project area and the spill of fuel and chemical into the rivers by the traffic accident must be avoided in the Project. Therefore, the surface water was not allowed to drain into the rivers directly in the planning of 4 major river bridges.

As for the other bridges, the surface water was allowed to drain into the rivers directly.

(b) Road Lighting

The locations of road lighting in the F/S plan were mentioned in 2nd Para in MOT Decision No. 2656/QD-BGTVT dated on September 10, 2010 and revised it by VEC in Letter No. 2800/VEC-KTCNMT dated on October 19, 2012 as shown in Table 5.2-21.

It is noted that the preparation works for installation of road lighting by future urbanization were not considered in the basic design.

Table 5.2-21 Locations of Road Lighting

No.	Location	F/S (MOT Decision No. 2656/QD-BGTVT)	Revision (VEC Letter No. 2800/VEC-KTCNMT)
1	Thruway (other Than IC Sections)	Large Bridges (L>500m), Tunnel, Toll Barriers	Four Major River Bridges, Tunnel, Toll Barriers
2	Interchange	All Areas including Toll Gates and Plaza Offices	All Areas including Toll Gates and Plaza Offices
3	Cross Roads	Not Required	Not Required
4	Others	O&M Buildings (SA/PA, O&M Offices)	O&M Buildings (SA/PA, O&M Offices), Urbanized Areas

(c) Utility Lines

The requirements for public utility on the Project road were not mentioned in the F/S plan.

According to the F/S Consultant, the attachment of public utilities on the Project road was not required and it was confirmed with the relevant organizations in the F/S stage.

Therefore, the attachment of utilities on the thruway bridges was required the Project facilities only and it was limited to the communication cables.

5.2.5 Bridge Planning

(1) Basic Principles

The thruway bridges were deliberated to standardize the bridge planning to ensure efficiency and quality of design and construction works.

The basic principles of bridge planning in the thruway bridges are summarized in Table 5.2-22.

In case of the bridge did not apply to the basic principles, it was planned individually.

Table 5.2-22 Basic Principles of Bridge Planning in Thruway Bridges

No.	Item		Basic Principles	Reference
1	Planar Shape	Planar Shape	- Applied all types of planar shape (right, curved, skewed and combination bridges)	5.2.5(2)(a)
2			- Adjusted skew angles into 70, 80 and 90 degrees	
3		Adjustment of Skew Angle	- Ensured 70 degrees of skew angle by re-alignment of crossing object or setback of abutment	5.2.5(2)(b)
4			- Applied 90 degrees of skew angle to portal rigid frame bridge[1)]	
5		Substructure Arrangements	- Aligned pier of inbound and outbound lines	5.2.5(2)(c)
6			- Arranged substructures in parallel with the axis of crossing objects	
7	Bridge Length	Control of Abutment Location	- Controlled abutment locations in consideration of future widening	5.2.5(3)(a)
8		Adjustment of Bridge Length	- Allowed setback of abutment locations to incorporate the surplus length of typical girders	5.2.5(3)(b)
9	Span Arrangements		- Applied one type and length of girders in a bridge	5.2.5(4)
10			- Applied appropriate span arrangements in each category of bridge	
11	Typical Structure Plan	Superstructure	- Standardized bridge structures to ensure efficiency and quality of design and construction	5.2.5(5)(a)
12			- Adopted typical type of girders	
13			- Adopted suitable superstructure types to cope with skewed and curved bridges	
14			- Adopted joint-less structures to ensure flatness and structural durability (Portal Rigid Frame)	
15		Substructure and Foundation	- Adopted typical type of substructures and foundations	5.2.5(6)(a)(b)
16	Ancillary Works		- Ensured durability of equipment	5.2.5(6)
17			- Adopted typical type of equipment to maintain in operation phase	

1) Portal Rigid Frame Bridge was ensured 90 degree of skew angle to avoid unsymmetrical earth pressure behind the abutment walls.

(2) Planar Shape

(a) Planar Shape

The planar shape was applied all types (right, curved, skewed and combination bridges) and adjusted the skew angles into 70, 80 and 90 degrees as shown in Figure 5.2-18.

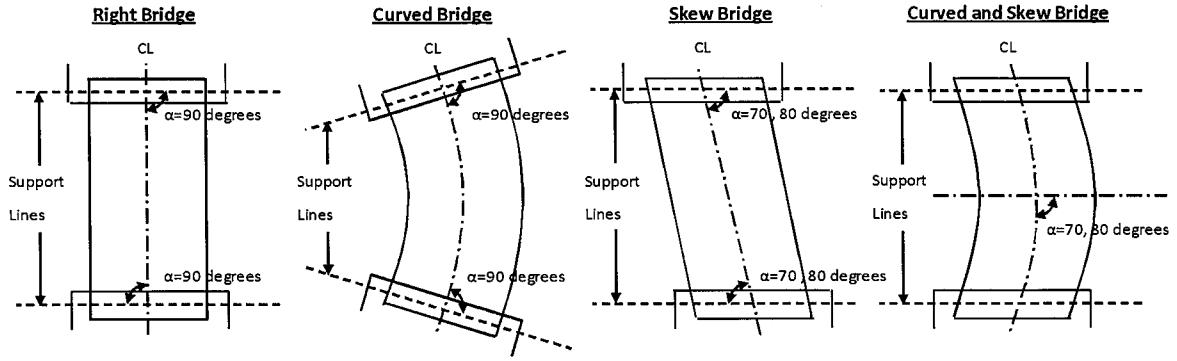


Figure 5.2-18 Applicable Planar Shapes and Skew Angles

(b) Adjustment of Skew Angle

The bridge location where the angle of road centerline and crossing object axis was less than 70 degrees, the angle was adjusted by re-alignment of crossing object in the Cross Structure Plan.

In case of the re-alignment of crossing objects was not appropriate, the skew angle of bridge was adjusted by the setback of abutment locations (see 5.2.5(2)(c)).

The Portal Rigid Frame Bridge (see 5.2.5(5)(a)(i)) was applied 90 degrees of skew angle to avoid unsymmetrical earth pressure behind the abutment walls.

(c) Substructure Arrangements

The separate structure plan was shown in Table 5.2-10 (see 5.2.4(1)(e)(iii)).

In principle, the angle of road centerline and crossing object axis was 70, 80 and 90 degrees.

In this case, the angle of substructures was arranged in parallel with the axis of crossing objects to minimize the obstructions to the crossing objects by the bridges and the piers on the parallel alignment section were aligned the inbound and outbound lines as shown in Figure 5.2-19 in the next page.

In case of the angle was less than 70 degrees and required the setback of abutment locations, the substructures were arranged in accordance with the followings.

(i) Parallel Alignment Section

Priority 1: Setback the Abutment Locations with Non-separate Abutment Structure

The skew angle of bridge was adjusted to 70 degrees by the setback of abutment locations with the non-separate abutment structure as shown in Figure 5.2-19 in the next page.

This adjustment was applied to the bridge types as shown in Table 5.2-23.

Table 5.2-23 Substructure Arrangements in Parallel Alignment Section (Priority 1)

No.	Nos. of Span	Bridge Category	Contents
1	Simple Span	All Bridges	- Allowed non-parallel arrangement of abutment and crossing object axis
2	Multiple Span	Viaduct (Topography)	- Not allowed non-parallel arrangement of pier and crossing object axis except viaduct (topography)

Priority 2: Setback the Abutment Locations with Separate Abutment Structure

The remaining bridges were adjusted to 70 degrees by the setback of abutment locations with the separate abutment structure and round-shaped pier shown in Figure 5.2-19 in the next page.

This adjustment was applied to the bridge types as shown in Table 5.2-24.

For the multiple span bridges, this adjustment was ensured to align the piers of inbound and outbound lines and arranged the angle of piers in parallel with the axis of crossing object.

Table 5.2-24 Substructure Arrangements in Parallel Alignment Section (Priority 2)

No.	Nos. of Span	Bridge Category	Contents
1	Simple Span	Overpass and Canal Bridges[1)]	- Allowed non-parallel arrangement of abutments in inbound and outbound lines
2	Multiple Span	All Bridges	- Aligned piers of inbound and outbound lines
3			- Arranged angle of piers in parallel with the axis of crossing object

1) In case of overpass and canal bridges were controlled by inundation, this adjustment was not also allowed to apply in those bridge types.

(ii) Independent Alignment Section

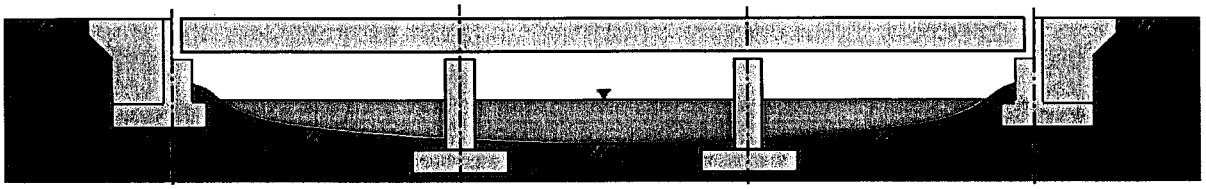
The bridges on the independent alignment section were applied independent structures; therefore, the substructures in inbound and outbound lines were separately arranged.

The skew angle of bridge was adjusted 70 degrees as shown in Table 5.2-25.

Table 5.2-25 Substructure Arrangements in Independent Alignment Section

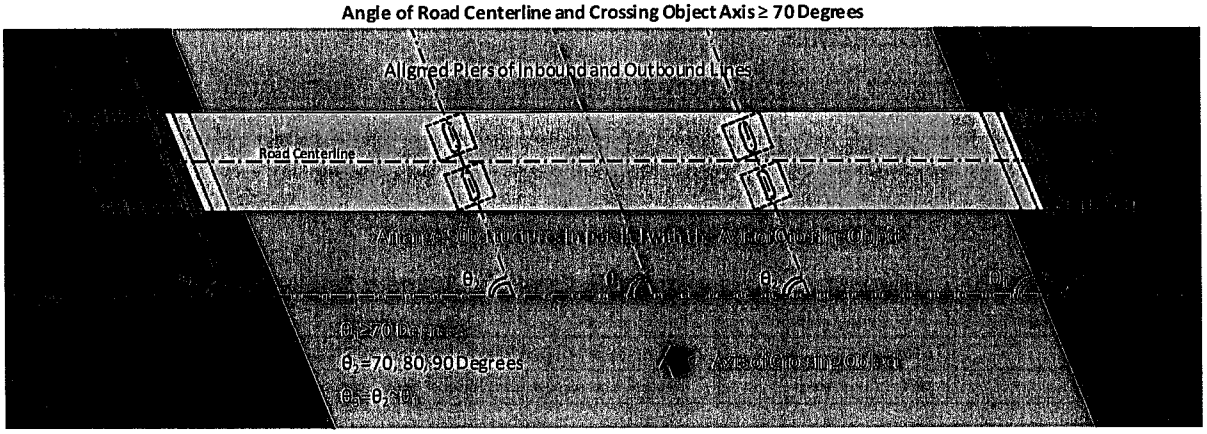
No.	Nos. of Span	Bridge Category	Contents
1	Simple Span	All Bridges	- Adjusted by setback of abutment locations
2	Multiple Span	Viaduct (Topography)	- Adjusted by setback of abutment locations
3		Other Bridges	- Adjusted by setback of abutment locations with round-shaped pier

Side View



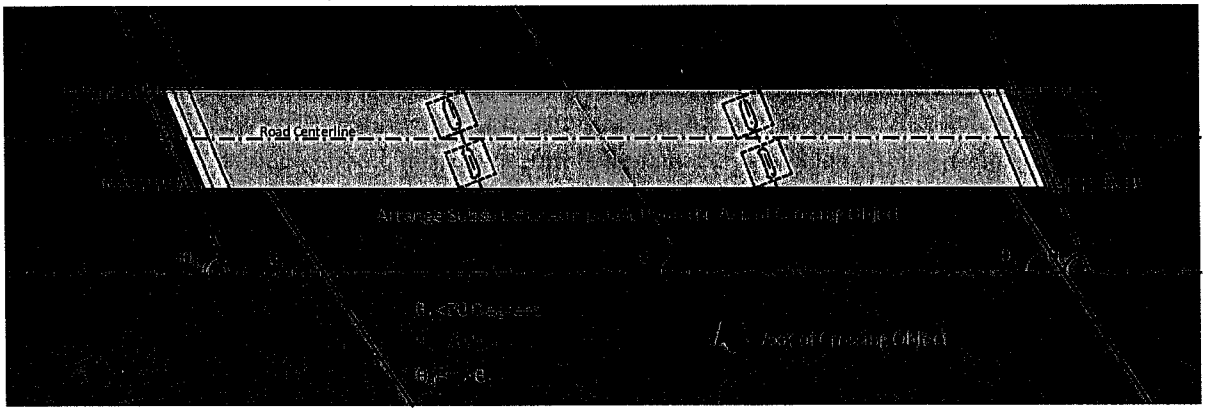
Plan

Angle of Road Centerline and Crossing Object Axis ≥ 70 Degrees



Angle of Road Centerline and Crossing Object Axis < 70 Degrees

Priority 1: Setback the Abutment Locations with Non-separate Abutment Structure



Angle of Road Centerline and Crossing Object Axis < 70 Degrees

Priority 2: Setback the Abutment Locations with Separate Abutment Structure

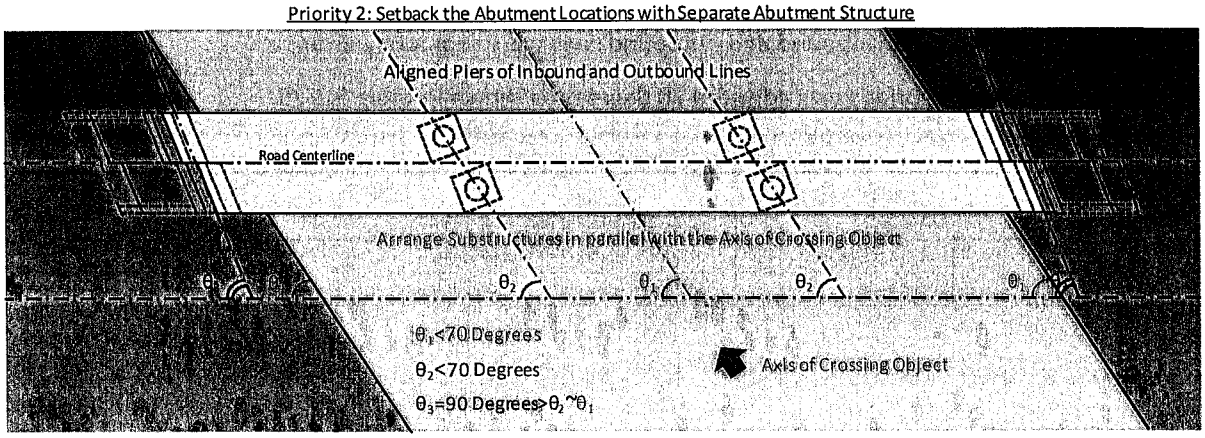


Figure 5.2-19 Substructure Arrangements

(3) Bridge Length

(a) Control of Abutment Location

In case of skew angle of bridge was different from the angle of road centerline and crossing object axis, the control of abutment location was controlled in consideration of the future widening in the ultimate stage as shown in Figure 5.2-20.

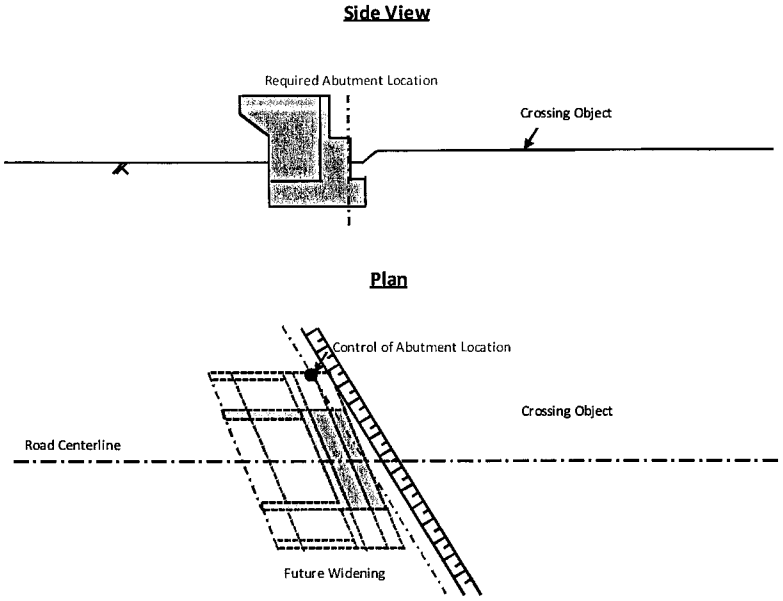


Figure 5.2-20 Control of Abutment Location

(b) Adjustment of Bridge Length

The typical girders were applied in the thruway bridges (see 5.2.5(5)(a)); therefore, the surplus length of girders was occurred by the applicable girder lengths.

In this case, the bridge length was adjusted by the setback of abutment locations to incorporate the surplus length of typical girders as shown in Figure 5.2-21.

In addition, the Portal Rigid Frame Bridge (see 5.2.5(5)(a)) was applied in the Project and it was planned as the cast in place concrete. Therefore, the bridge length of this bridge type was adjusted by each 1m unit in the Project.

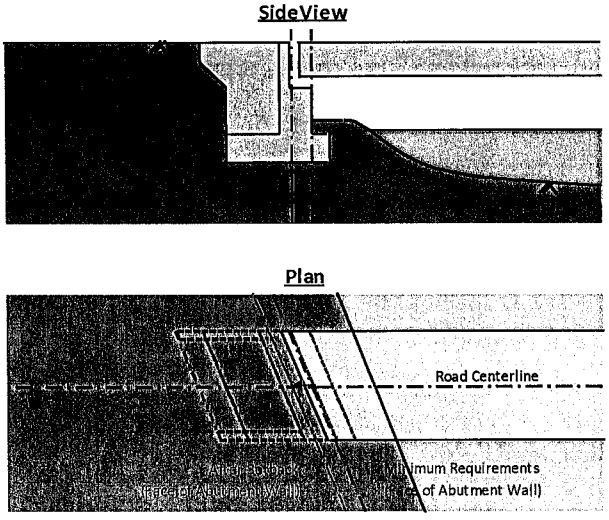


Figure 5.2-21 Adjustment of Bridge Length

(4) Span Arrangements

The required span arrangements are not clearly defined in relevant technical standards; therefore, the required span arrangements were established by the D/D Consultant as shown in Table 5.2-26.

In principle, the span arrangements were applied same span lengths in a bridge.

The river bridges were referred to the desirable span length (see 5.2.4(3)(c)) and prioritized simple span arrangement up to 40m length. In case of required multiple span arrangements, the pier locations were avoided near the center of river flow.

The viaducts for discharge were prioritized 40m girder length to ensure smooth discharge of water flow; however, in case of not economical, it was allowed to shorten up to 30m. As for the viaducts by topography, the span arrangements were prioritized 40m girder length to minimize the nos. of pier; however, it was allowed to shorten the girder length in case of nos. of pier were not increased.

The canal bridges/overpasses were applied simple span to avoid the obstacles on crossing objects.

The multi-function bridges were followed the above requirements, respectively.

Table 5.2-26 Required Span Arrangements

No.	Bridge Category			Required Span Arrangements
1	Principles			- Applied same span lengths in a bridge
2	By Bridge Type	River Bridge		- Referred to the desirable span length (see 5.2.4(3)(c))
3				- Prioritized simple span arrangement up to 40m girder length
4				- Avoided the pier locations near the center of river flow in case of multi-span arrangements
5		Viaduct	For Discharge	- Prioritized 40m girder length to ensure smooth discharge of water flow
6				- Allowed to shorten the girder length up to 30m in case of not economical
7			By Topography	- Prioritized 40m girder length to minimize the nos. of pier
8				- Allowed to shorten the girder length in case of nos. of pier were not increased
9		Canal Bridge		- Applied simple span
10		Overpass		- Applied simple span
11	Multi-function Bridge			- Followed the above requirements, respectively

(5) Typical Structure Plan

The typical structure plan was established in accordance with the following basic principles.

1: Standardization

The numbers of other thruway bridge were huge; therefore, the bridge plan was standardized to ensure the efficiency and quality of design and construction works.

2: Typical Girders

The typical girders were adopted to ensure standardization and economical structures.

3: Flexibility of Superstructure

The Project road is an expressway and the geometric design is severer than other road classes; therefore, the flexible types of superstructure were adopted to cope with skewed and curved bridges.

4: Flatness and Structural Durability

The advantage of expressway shall not be impaired; therefore, the simple span with short length bridges was adopted the joint-less structures by the following reasons.

- The simple span with short length bridges is not possible to install the durable expansion joints; therefore, the economic loss due to the punctuality by the replacement of expansion joints shall be eliminated by applying the joint-less structures.
- The expansion joints between the abutments in the simple span with short length bridges are extremely near; therefore, the economic loss due to losses the surface flatness shall be eliminated by applying the joint-less structures.

(a) Superstructure Plan

(i) Review of Previous Studies

The superstructure plan in the F/S plan is summarized in Table 5.2-27.

The review of superstructure plan in the F/S plan was conducted by dividing into the 3 ranges of girder length, (i) L≤24m, (ii) 24m<L≤33m, (iii) L=40m below.

Table 5.2-27 Summary of Superstructure Plan in F/S Plan

No.	Girder Type	Nos. of Bridge (By Girder Length[1])								Total	
		L≤24m				24m<L≤33m		L=40m[1]			
		L≤21m		L=24m							
		Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans
1	PC Slab Beam	30	3	2	-----	-----	-----	-----	-----	32	3
2	PC-I Girder	1	2	9	15	9	20	-----	-----	19	37
3	PC Super Tee Girder	-----	-----	-----	-----	-----	-----	-----	5	-----	5
Total		31	5	11	15	9	20	-----	5	51	45
		36		26		29		5		96	

1) L=40m in PC Super Tee Girder with is not girder length (38.3m) but span length (40m) in accordance with the Vietnamese standards

1: Girder Length: L≤24m

The superstructure plan (L≤24m) in the F/S and alternative plan is shown in Table 5.2-28.

PC-I Girder is possible in L≥21m and is flexible to cope with the skewed and curved bridges. The durable expansion joints are possible to install in case of the continuous girder length is more than 21m; therefore, PC-I Girder was adopted in L≥21m both of simple and multiple spans. In addition, the linked slab were adopted the same structure type with PC Super Tee Girder in consideration of the large impact force on the Project road as shown in Figure 5.2-22 in the next page.

As for the simple span with L<21m, PC Slab Beam was adopted in the F/S plan; however, it is not suitable to cope with skewed and curved bridges. In addition, the expansion joints between abutments are extremely near and not possible to install the durable expansion joints. Therefore, Portal Rigid Frame was adopted in the Project. The comparison study is shown in Table 5.2-31 in the next page.

Table 5.2-28 Typical Superstructure Plan in F/S and Alternative Plan (L≤24m)

No.	Nos. of Span	Girder Length	Original Plan (F/S)	Alternative Plan (B/D)
1	Simple Span	L<21m	PC Slab Beam	Portal Rigid Frame[1]
2		21m≤L≤24m	PC Slab Beam/PC-I Girder	PC-I Girder
3	Multiple Span	21m≤L≤24m	PC-I Girder (Linked Slab)	PC-I Girder (Linked Slab (PC Super Tee Girder Type))

1) In case of required Portal Rigid Frame (skew angle=90 degrees) with L≥21m, PC-I Girder with L≥21m was applied by the setback of abutment locations (see 5.2.5(3)(b))

2: Girder Length: 24m<L≤33m

The superstructure plan (24m<L≤33m) in the F/S and alternative plan is shown in Table 5.2-29.

The F/S plan is appropriate and followed in the basic design.

Table 5.2-29 Typical Superstructure Plan in F/S and Alternative Plan (24m<L≤33m)

No.	Nos. of Span	Girder Length	Original Plan (F/S)	Alternative Plan (B/D)
1	Simple Span	24m<L≤33m	PC-I Girder	PC-I Girder
2	Multiple Span	24m<L≤33m	PC-I Girder (Linked Slab)	PC-I Girder (Linked Slab (PC Super Tee Girder Type))

3: Girder Length: L=40m

The superstructure plan (L=40m) in the F/S and alternative plan is shown in Table 5.2-30.

Based on the review of previous studies, the following issues were identified in the F/S plan.

- PC Super Tee Girder is not economical in case of few nos. of girder in a bridge.
- PC-I Girder is flexible to cope with skewed and curved bridges.

Therefore, PC-I Girder with L=40m was adopted in the simple span. As for the multiple span, PC Super Tee Girder was prioritized; however, under the conditions of less than 4 spans or superelevation section, PC-I Girder was adopted to reduce construction cost and cope with curves.

Table 5.2-30 Typical Superstructure Plan in F/S and Alternative Plan (L=40m)

No.	Nos. of Span	Girder Length	Conditions	Original (F/S)	Alternatives (B/D)
1	Simple Span	L=40m	All Conditions	Not Planned	PC-I Girder
2	Multiple Span		Less Than 4 Spans or Superelevation Section	PC Super Tee Girder	PC-I Girder (Linked Slab (PC Super Tee Girder Type))
3			More Than 4 Spans and Non-superelevation Section		PC Super Tee Girder (Linked Slab)

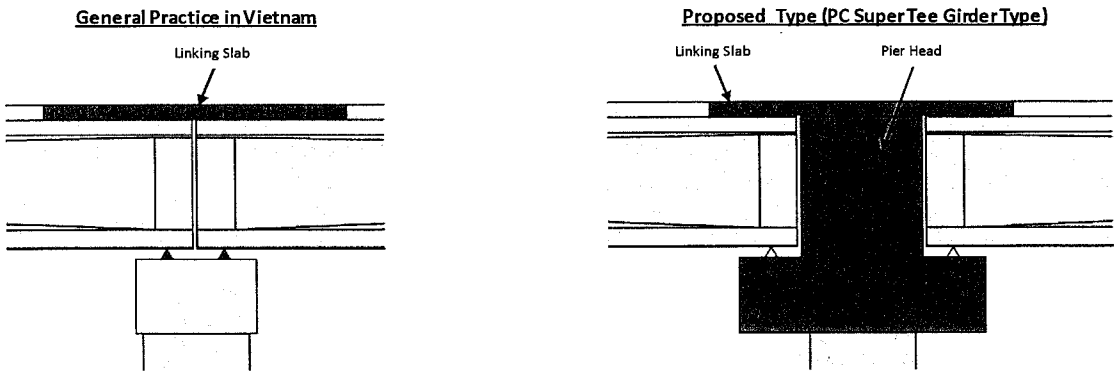
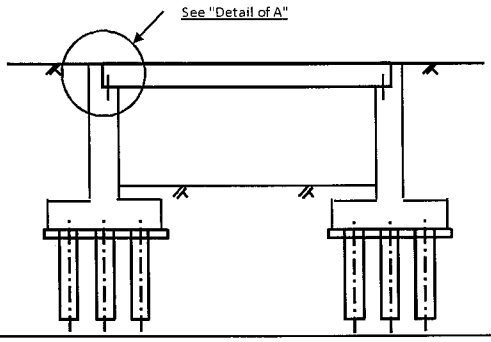
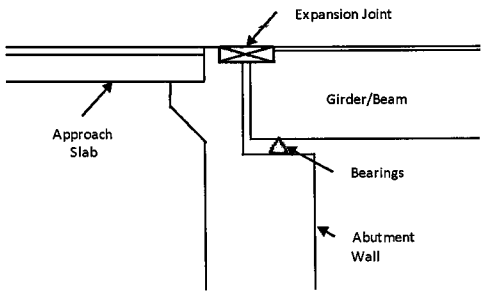
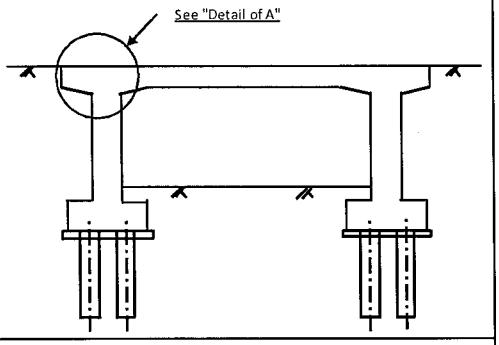
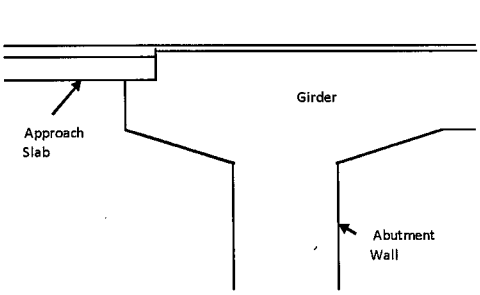


Figure 5.2-22 Image of Linked Slab (PC-I Girder)

Table 5.2-31 Comparison of Typical Superstructure Plan (Simple Span, L<21m)

No.	Item	Original Plan (F/S)	Alternative Plan (B/D)
1	Drawings	**Side View**  **Detail of A**  	**Side View**  **Detail of A** 
2	Flatness	- Impair flatness by short distance between expansion joints **(Inappropriate)**	- Ensure high flatness by joint-less structures **(Excellent)**
3	Durability	- Require replacement of bearings and non-durable expansion joints (Not possible to install durable expansion joints) **(Inappropriate)**	- Ensure high durability by joint-less structures (Not required expansion joints and bearings) **(Excellent)**
4	Constructability	- Ensure high constructability with short construction period (Adopt pre-cast beams with crane construction method) **(Excellent)**	- Require construction period slightly longer than the F/S plan (Adopt cast in place girders with stationary support method) **(Fair)**
5	Economy	- Ensure low initial investment cost - Require high maintenance cost in operation phase - Suffer economic loss by low punctuality/high vehicle operation cost **(Fair)**	- Ensure low initial investment cost equivalent to the F/S plan (Cast in place girder: higher than the F/S plan) (Joint-less structure/less nos. of foundation: lower than the F/S plan) - Ensure low maintenance cost in operation phase - Minimize economic loss by high flatness and structural durability **(Excellent)**
6	Overall Evaluation	The initial cost is slightly lower than alternative plan; however, life cycle cost and economic loss are higher than the alternative plan. **Inappropriate**	The initial cost is equivalent to the F/S plan; however, life cycle cost and economic loss can be minimized. **Good**

(ii) Proposed Superstructure Plan

1: Typical Girder Plan

The proposed typical girder plan in the basic design is shown in Table 5.2-32.

Table 5.2-32 Proposed Typical Girder Plan

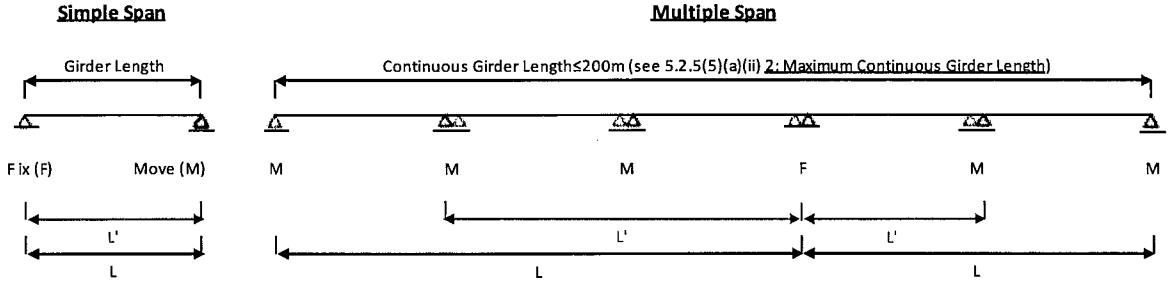
No.	Nos. of Span	Conditions	Girder Length		
			L<21m	21m≤L≤33m	L=40m
1	Simple Span	All Conditions	Portal Rigid Frame	PC-I Girder	PC-I Girder
2	Multiple Span	Less Than 4 spans or Superelevation Section	Not Applied	PC-I Girder (Linked Slab (PC Super Tee Girder Type))	PC-I Girder (Linked Slab (PC Super Tee Girder Type))
3		Other Conditions			PC Super Tee Girder (Linked Slab)

2: Maximum Continuous Girder Length

The continuous girder length (see 5.2.2(2)(c)(ii)) was determined max. 200m in consideration of the volume of expansion and contraction to apply the appropriate size of expansion joints.

3: Support Conditions

The supporting conditions were followed the general practice in Vietnam and one fixed support shall be arranged at the center pier or the nearest pier from center to minimize the volume of expansion and contraction as shown in Figure 5.2-23.



Note: One fixed support shall be arranged at the center pier or the nearest pier from center to minimize the volume of expansion and contraction

L: Expansion length for volume of expansion and contraction

L': Base length for estimating the expansion and girder connection spaces (see 5.2.5(5)(a)(ii) 4: Expansion and Girder Connection Spaces)

Figure 5.2-23 Support Conditions

4: Expansion and Girder Connection Spaces

Based on 22 TCN 272-05, the contraction volume is larger than the expansion volume; therefore, the expansion and girder connection spaces were determined based on the contraction volume at the nearest pier from the end of continuous girder as shown in Table 5.2-33.

Table 5.2-33 Expansion and Girder Connection Spaces

No.	Nos. of Span	Expansion Space (see Figure 5.2-24)	Girder Connection Space (see Figure 5.2-24)
1	Simple Span	50mm	----
2	Multiple Span	Maximum base length (see Figure 5.2-23) in a bridge, L'<50m: 50mm (applied same value in a bridge) L'≥50m: 100mm (applied same value in a bridge)	

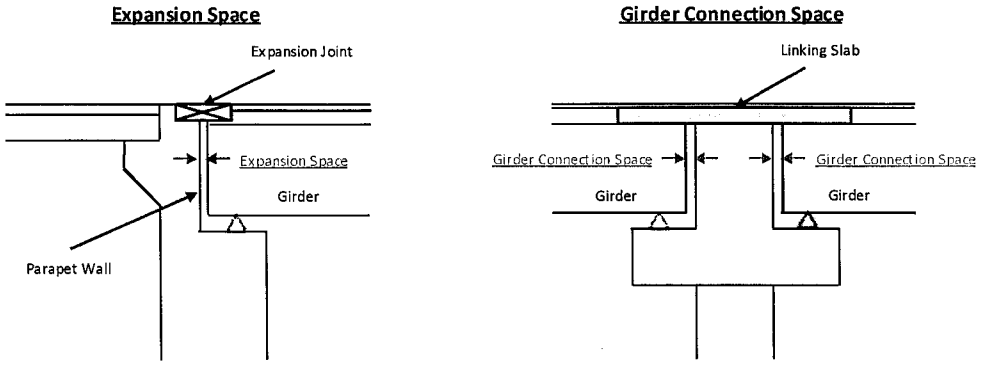


Figure 5.2-24 Expansion and Girder Connection Spaces

(b) Substructure Plan

(i) Review of Previous Studies

The substructure types adopted in the F/S plan are summarized below.

- Abutment: Inverted T-shaped Abutment
- Pier: Wall-shaped Pier

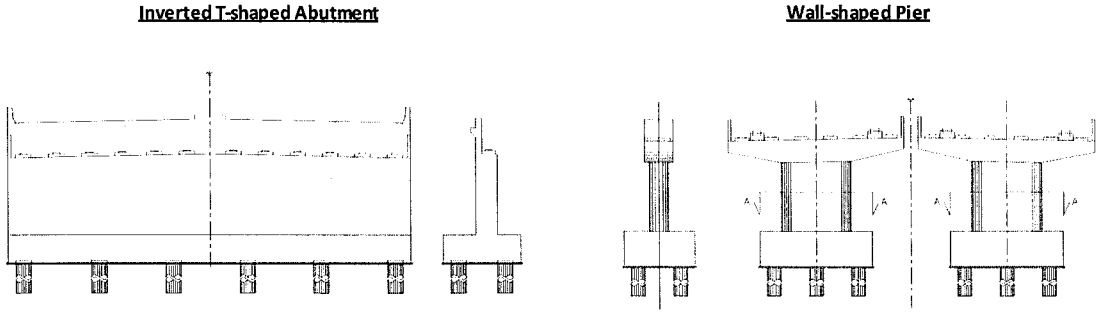


Figure 5.2-25 Image of Substructure Types in F/S Plan

The substructure types in the F/S plan were basically appropriate; however, other substructure types were also adopted by the D/D Consultant at the following locations.

The height of inverted T-shaped abutment is depended on the geotechnical conditions at the site and the maximum height is generally applied up to 15m. However, some locations in the Project road, especially mountainous area, the abutment heights were exceeded more than 15m. In such locations, the abutment type was adopted the box type abutment as shown in Figure 5.2-26. The maximum height of inverted T-shaped abutment is depended on the geotechnical conditions and some of bridge locations may be not adoptable. In such locations, the abutment type will be revised in the D/D stage.

The wall-shaped pier is not appropriate at the locations where the angle of crossing object is less than 70 degrees (see 5.2.5(2)(c)). In such locations, the pier type was adopted the round-shaped pier as shown in Figure 5.2-26.

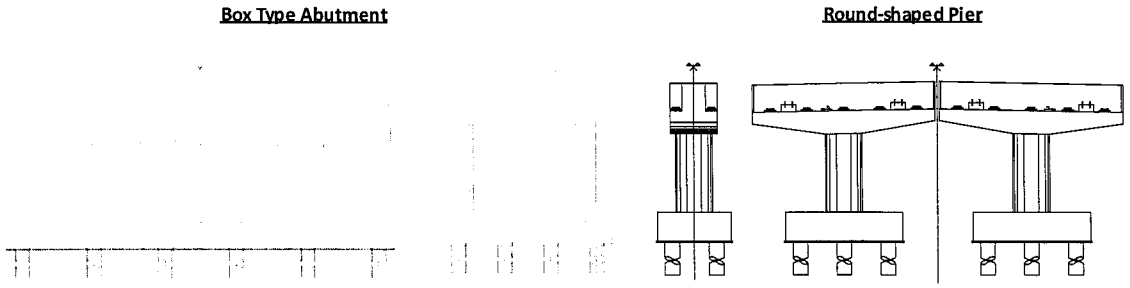


Figure 5.2-26 Image of Box Type Abutment and Round-shaped Pier

(ii) Proposed Substructure Plan

1: Typical Substructure Plan

The proposed typical substructure plan in the basic design is shown in Table 5.2-34.

Table 5.2-34 Proposed Typical Substructure Plan

No.	Structure		Structure Type
1	Abutment	Abutment Height≤15m[1)]	Inverted T-shaped Abutment
2		Abutment Height>15m[1)]	Box Type Abutment
3	Pier	Angle of Road Centerline and Crossing Object <70 Degrees (except Viaduct (Topography))	Round-shaped Pier
4		Other Locations	Wall-shaped Pier

1) In case of not adoptable with the result of geotechnical investigation, the abutment type will be revised in the D/D stage.

2: Embankment Slope and Embedding of Abutment

The requirements for embankment slope and embedding of abutment are not clearly defined in Vietnamese design standards. Therefore, the requirements were established by the D/D Consultant based on the general practice of relevant projects in Vietnam and other countries.

2.1: Embankment Slope with Stone Masonry (Typical Type)

The stone masonry was adopted as the typical type of embankment slope in the basic design.

The requirements including the embedding of abutment are shown in Table 5.2-35 and Figure 5.2-27.

It is noted that the grade and protection of embankment slope below will be revised in the D/D stage in accordance with 2.7(3), Appendix 5.3 in Volume 2.

Table 5.2-35 Requirements for Embankment Slope and Embedding of Abutment

No.	Road	Bridge Category	Embankment Slope				Embedding	Bank Protection
			Grade	Top of Slope	Bottom of Slope	Protection	(Top of Pile Cap)	
1	Expressway	River Bridge	1:1.25	750mm From	2500mm From	Stone Masonry	0m	Not Required
2	(Thruway)	Viaduct (for Discharge)		End of Wing Wall	Face of Abutment Wall		0m	-----
3		Viaduct (by Topography)			Same Location at		1m	-----
4		Canal Bridge			Face of Abutment Wall		1m	-----
5		Overpass					1m	-----
6		Multi-function Bridge	Follow the above requirements respectively					
7	Linking Road	River Bridge	1:1	750mm From	2500mm From	Stone Masonry	0m	Not Required
8		Viaduct (for Discharge)		End of Wing Wall	Face of Abutment Wall		0m	-----
9		Viaduct (by Topography)			Same Location at		1m	-----
10		Canal Bridge			Face of Abutment Wall		1m	-----
11		Overpass					1m	-----
12		Multi-function Bridge	Follow the above requirements respectively					

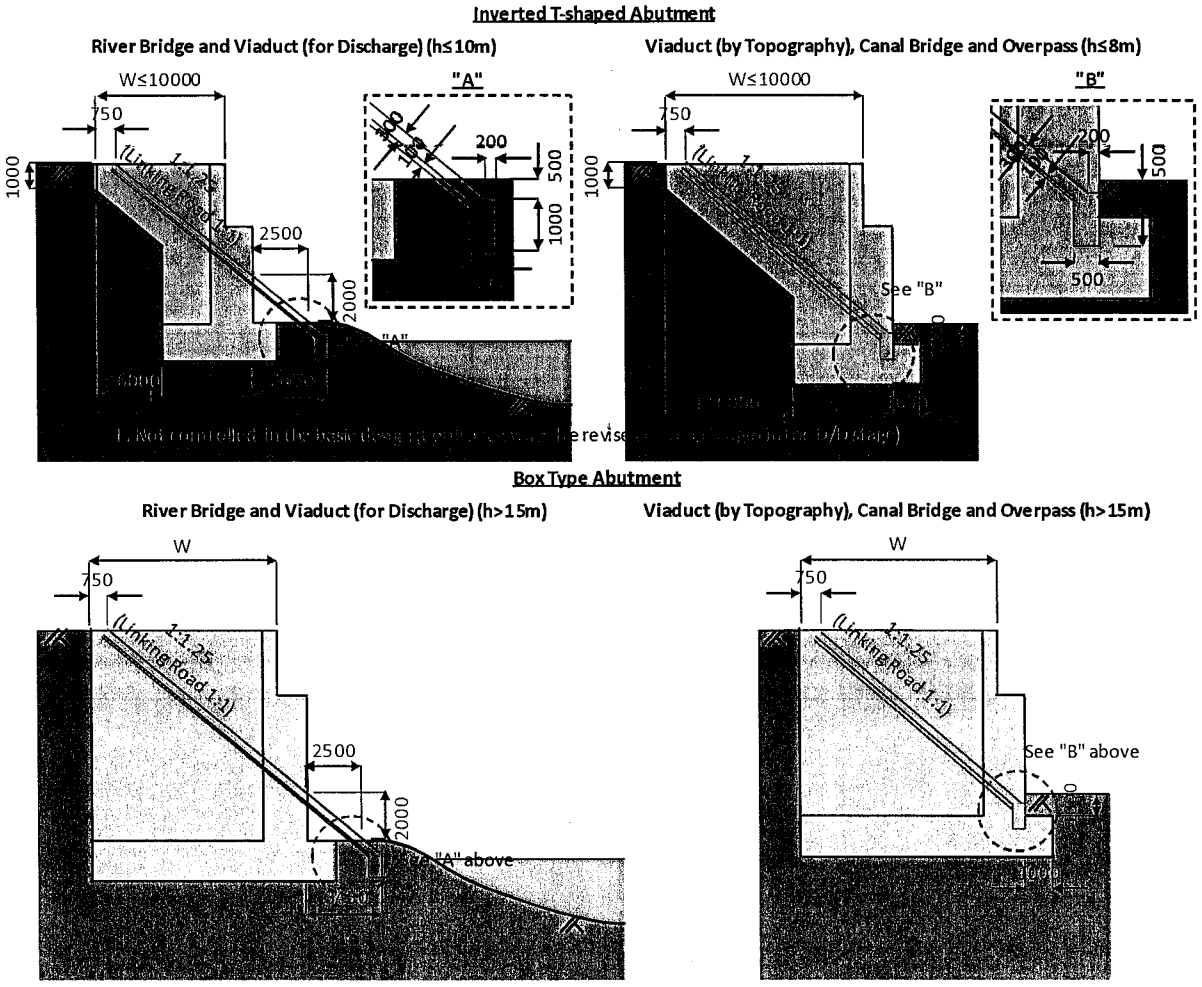


Figure 5.2-27 Requirements for Embankment Slope and Embedding of Abutment

2.2: Retaining Wall (Block Type)

The retaining wall (block type) was adopted at the following locations.

- At inverted T-shaped abutment where the slope was obstructed to the crossing objects.
- At inverted T-shaped abutment where L>6m in Figure 5.2-28 (considered in the D/D stage)

It is noted that the grade and protection of embankment slope below will be revised in the D/D stage in accordance with 2.7(3), Appendix 5.3 in Volume 2.

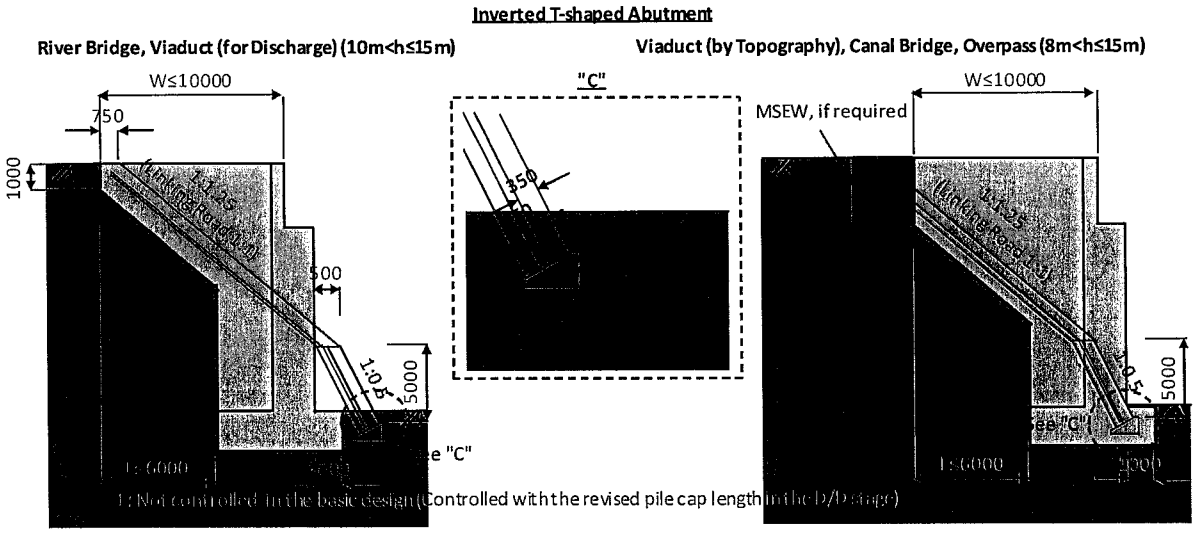


Figure 5.2-28 Requirements for Retaining Wall (Block Type)

3: Embedding and River Bed Protection of Pier

The requirements for embedding and river bed protection of pier are not defined in Vietnamese standards. Therefore, the requirements were established by the D/D Consultant referred to the general practice of relevant projects in Vietnam and other countries shown in Table 5.2-36 and Figure 5.2-29.

It is noted that the required locations of river bed protection below will be reviewed and updated in the D/D stage in accordance with the scouring analysis results.

Table 5.2-36 Requirements for Embedding and River Bed Protection of Pier

No.	Road	Bridge Category	Pier Location	Embedding (Top of Pile Cap)	River Bed Protection
1	Expressway (Thruway)/ Linking Road	River Bridge	Main Channel	2m	Required (Gabion Type)
2			Others	1m	
3		Viaduct (for Discharge)	All Locations	1m	
4		Viaduct (by Topography)	All Locations	1m	Not Required

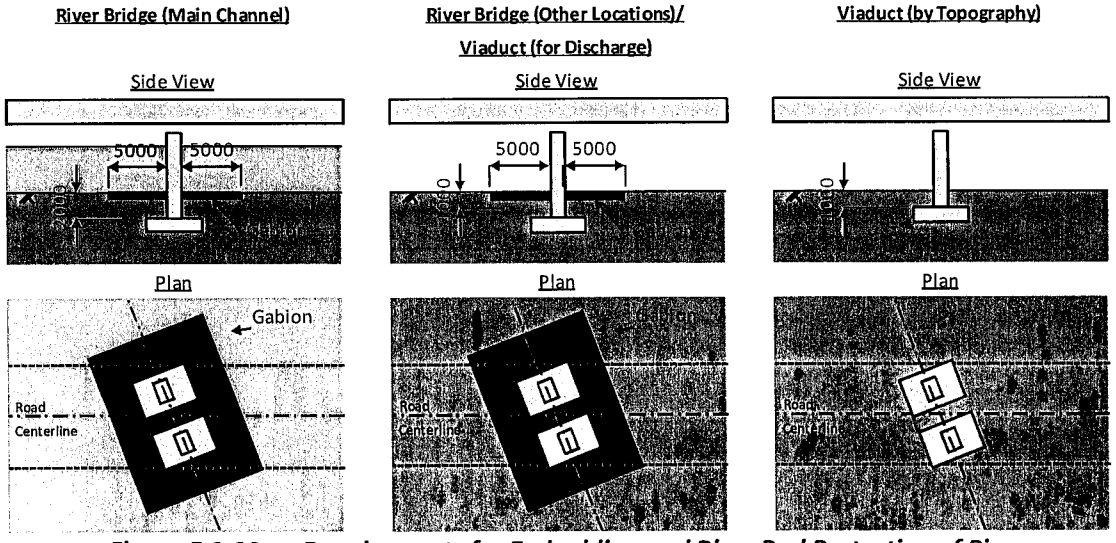


Figure 5.2-29 Requirements for Embedding and River Bed Protection of Pier

(c) Foundation Plan

(i) Review of Previous Studies

The foundation types adopted in the F/S plan are summarized below.

- Spread Foundation
- Bore RC Pile (Diameter: 1.0m)
- Precast RC Pile (Dimension: 0.4m*0.4m)

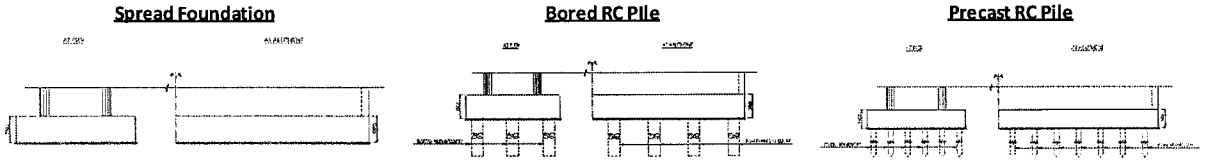


Figure 5.2-30 Image of Foundation Types in F/S Plan

The foundation types in the F/S plan were basically appropriate; however, the following issues were identified by the D/D Consultant.

- The geotechnical data was limited in the F/S plan.
- The selection criteria of foundation type were not clearly mentioned in the F/S plan.
- The caisson pile may be required at some locations of mountainous slope (see Figure 5.2-31).

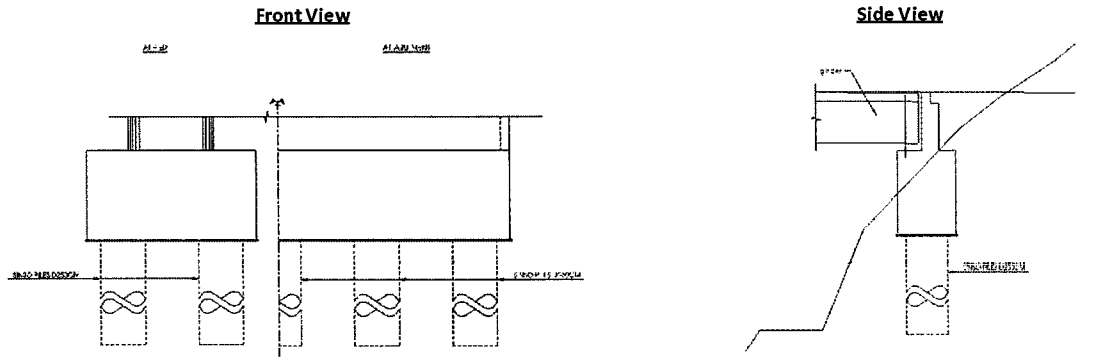


Figure 5.2-31 Image of Caisson Pile

(ii) Proposed Foundation Plan

The foundation plan in the basic design stage was followed the F/S plan as shown in Table 5.2-37.

The foundation plan will be updated with the boring data in the D/D stage in accordance with the foundation plan as shown in Table 5.2-38.

Table 5.2-37 Foundation Plan (B/D)

No.	Foundation Type	Foundation Plan
1	Spread Foundation (embedded Depth in Bearing Layer: 0.3m)	Referred and followed the foundation type in the F/S plan (Bridges with Box Abutment: Bored RC Pile (Diameter: 1.5m))
2	Bored RC Pile (Diameter: 1.0m)	
3	Pre-cast RC Pile (Dimension: 0.4m*0.4m)	

Table 5.2-38 Proposed Typical Foundation Plan (D/D)

No.	Principle Conditions	Foundation Type	Size and Embedding Depth
1	Location: Not at River Bridge, Not Near House Soil Conditions: No Soft and Hard Soil Layers Pile Nos.: Not Increase Significantly (In Consideration of Economy) Pile Length: Max. 70*Diameter (Special Conditions: 100*Diameter)	Pre-cast RC Pile	Dimension: 0.4m*0.4m
2	Pile Length: Less Than 6*Diameter	Spread Foundation	Embedding Depth in Bearing Layer: 0.3m
3	Location: At Mountainous Slope, if Required	Caisson Pile	To be studied in the D/D Stage
4	Other Conditions Above (Min. 6*Diameter, Max. 50*Diameter)	Bored RC Pile	Precast Girders : Girder<40m, Embankment Heights≤8m : Diameter 1.0m Girder<40m, Embankment Heights≤12m: Diameter 1.2m Girder<40m, Embankment Height>12m: Diameter 1.5m Girder=40m, Embankment Heights≤12m: Diameter 1.2m Girder=40m, Embankment Height>12m: Diameter 1.5m Void Slab : Examined bridge by bridge (Diameter 1.0m, 1.2m, 1.5m) Box Abutment : Diameter 1.5m (Applied to all piles in a bridge)

(6) Ancillary Works

(a) Bearings

The bearing type in the F/S plan was adopted the pot bearing in the rubber type.

The rubber type was appropriate in consideration of durability; however, the pad bearing in the rubber type was adopted in the basic design to ensure the economy as shown in Figure 5.2-32. In case of exceeded the capacity of pad bearing, the pot bearing was adopted.

The details of bearing will be decided in the D/D stage.

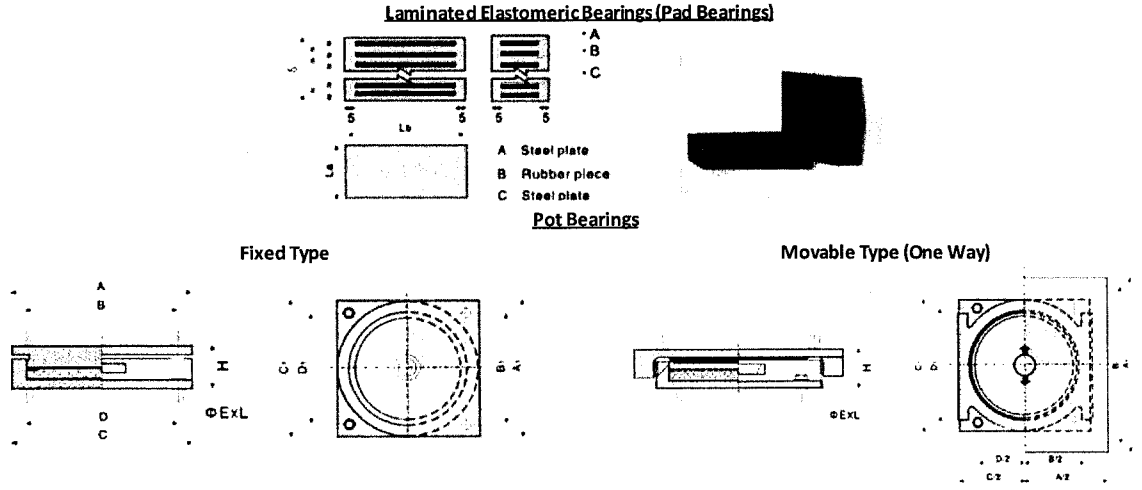


Figure 5.2-32 Images of Bearings

(b) Expansion Joints

The expansion joints in the F/S plan was adopted the low-bedding type and comb type.

As explained in the beginning of 5.2.5(5), the simple span with short length bridges was adopted the joint-less structures; therefore, the low-bedding type was not adopted in the basic design.

For other bridges, with expansion joints, the comb type in the F/S plan was appropriate in consideration of durability; therefore this type of expansion joints was adopted in the basic design.

The details of expansion joint will be decided in the D/D stage.

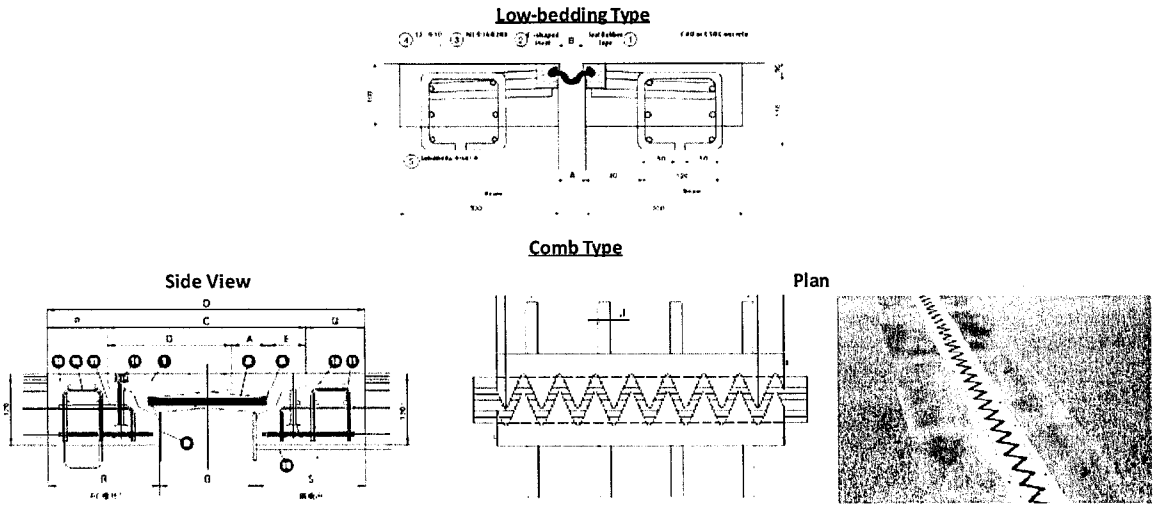


Figure 5.2-33 Images of Expansion Joints

(c) Surface Drainage

The surface water was basically allowed to drain into the crossing objects by catch basins installed on the bridge surfaces; however, some requirements were established as shown in Table 5.2-39.

The catch basin was considered to bear the design loads. In this case, the round-shaped type is common in Vietnam; however, in consideration of the characteristics of heavy rain in the Project area, the square-shaped type was adopted to catch the surface waters efficiently as shown in Figure 5.2-34.

The details of surface drainage will be decided in the D/D stage.

Table 5.2-39 Proposed Drainage Outlet

No.	Drainage Analysis	Proposed Drainage Outlet
1	Required to install catch basins	- Avoid to drain to the cross roads
2	on bridge surfaces	- Avoid to drain to the canals and main channel of rivers as can as possible
3	Not required to install catch basins	- Install the catch basins at least in front of expansion joints in case of plan the expansion joints on bridge
4	on bridge surfaces	- Not install the catch basin on bridge surface and join to the road side ditches behind the abutments in case of portal rigid frame

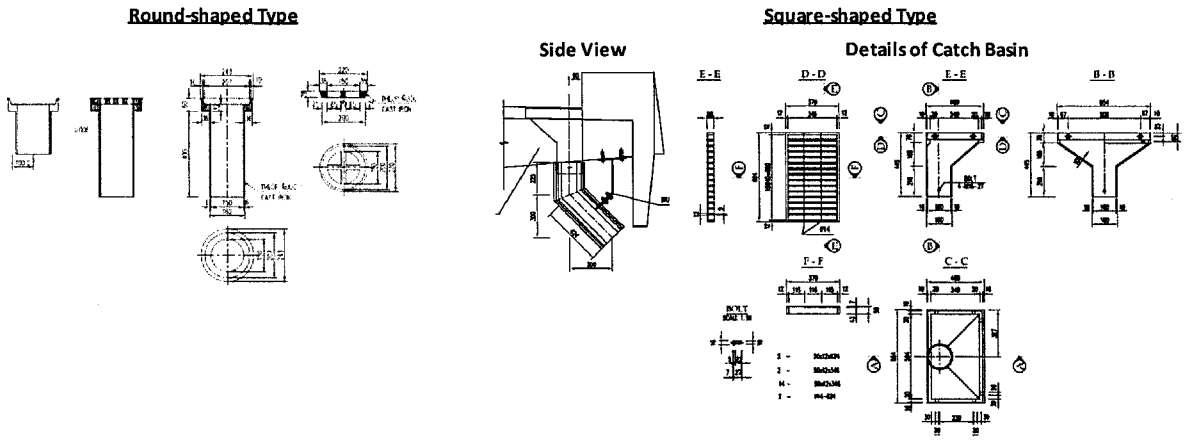


Figure 5.2-34 Images of Catch Basins

(d) Bridge Railing (including Space of Utility Lines)

The bridge railings were adopted the concrete barrier as shown in Figure 5.2-12 (see 5.2.5(1)(e)(iv)).

In Figure 5.2-12, it is also mentioned the spaces for communication cables which are required in the concrete barriers (outside) on the expressway section (see 5.2.4(4)(c)).

Based on the preliminary study by the D/D Consultant, the requirements for communication cable spaces are as shown in Table 5.2-40.

The details of concrete barrier including the spaces for communication cable spaces will be decided in the D/D stage.

Table 5.2-40 Proposed Requirements for Communication Cable Spaces

No.	Item		Proposed Requirements
1	Location	Bridge Section	Outside Concrete Barriers
2		Road Section	Under Shoulder (600mm depth from the surface)
3	Communication Cable Spaces	Nos.	2 nos./barrier
4		Size	ϕ110mm
5	Others	Min. Curve Radius	R≥300mm (R≥20D, D: expected 15mm)
6		Pull Box (Bridge Section)	Communication Cable: 250m pitch on bridge section, boundary between bridge and road sections
7			Pull Box Length: More than 1,200mm
8		Covering (Bridge and Road Sections)	Polyvinyl Chloride Pipe

(e) Anti-glare Screen

The cross section elements on the thruway bridges are shown in Figure 5.2-14 (see 5.2.4(1)(e)(vi)).

In consideration of design speed, height of median barrier and close distance between inbound and outbound lines, anti-glare screen may be required on the expressway section shown in Figure 5.2-35.

The details of anti-glare screen will be decided in the D/D stage.

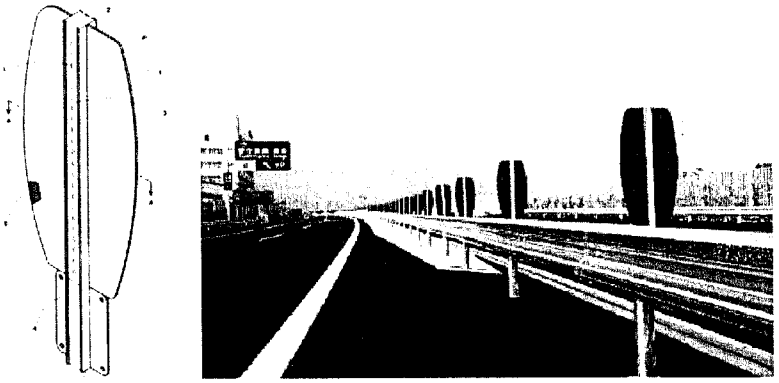


Figure 5.2-35 Images of Anti-glare Screen

(f) Inspection Way

The inspection way on the bridge structure was not planned in the F/S plan.

Based on the overseas practices, the main purposes of inspection way are in the followings.

- Periodic Inspection for Bearings
- Emergency Inspections for Bearings

The emergency inspections are expected at the time of large-scale earthquake and flood with high velocity and required to inspect all bridges at the same time. However, those cases are not expected at the Project site, therefore, it was not considered to inspect all bridges at the same time.

In addition, many bridges on the Project road are not possible to access on land and required to install the inspection ways at the substructures a shown in Figure 5.2-36. However, the inspection ways are obstructed to the crossing objects; therefore, the inspection ways were not planned in the basic design and planned to introduce the bridge inspection vehicle as shown in Figure 5.2-36.

The details of bridge inspection plan will be studied in the O&M plan.

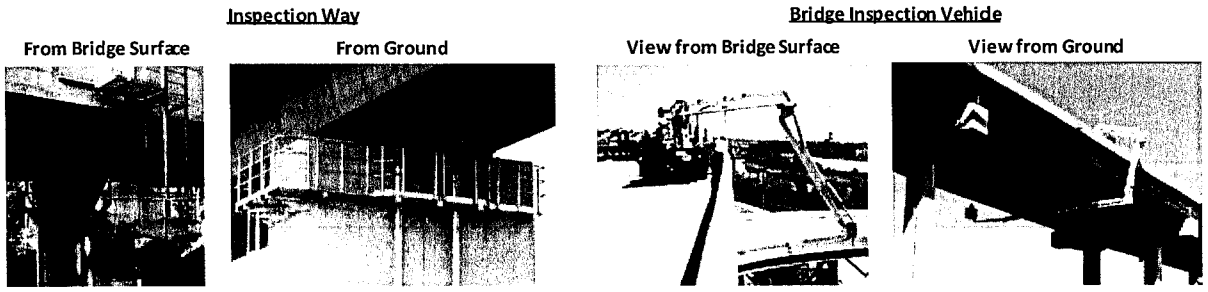


Figure 5.2-36 Images of Inspection Way and Bridge Inspection Vehicle

(g) Revetment

The revetment at the river bridges was not studied in the basic design.

The scouring and revetment structure at the river bridges will be studied in the D/D stage.

(h) Anti-Noise Barrier

The anti-noise barrier was not considered in the F/S plan.

Based on the environmental assessment by the D/D Consultant, some road sections on the thruway may be required to install the anti-noise barriers to protect the houses, hospitals and schools; however, those are not located on the crossing objects at the bridge sections.

Therefore, the anti-noise barrier was not planned in the basic design.

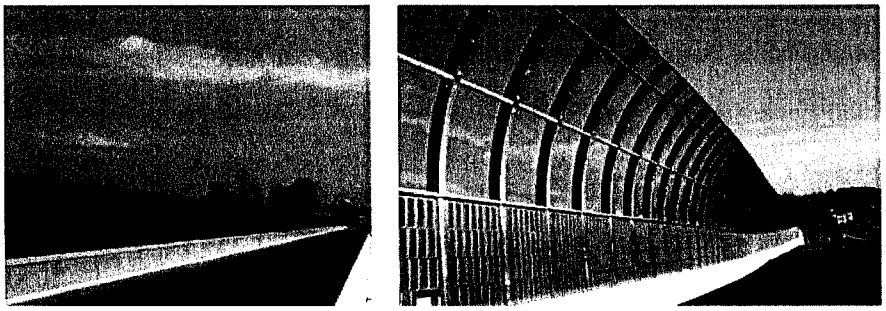


Figure 5.2-37 Images of Anti-noise Barrier

(i) Protection Fence

The protection fence was not considered in the F/S plan.

Based on the practices in other countries, the protection fence is installed at the overpasses and flyovers where cross the roads and railways to protect the freight falling into the crossing objects in case of the traffic accidents.

For the thruway bridges, the protection fence was planned on the overpasses where locate at the railway crossing or superelevation section as shown in Table 5.2-41 and Figure 5.2-38.

Table 5.2-41 Proposed Protection Fence Plan on Thruway Bridges

No.	Road	Bridge Location	Bridge Category	Conditions	Width	Proposed Protection Fence Plan	
					(Emergency Lane or Shoulder)	Location	Height
1	Expressway	Thruway	Overpass (Road)	Superelevation	3.0m	Outside Barrier	2.0m
2	Linking Road				2.0m	(Both Sides)	(From Bridge Surface)
3			Overpass (Railway)	All Conditions			

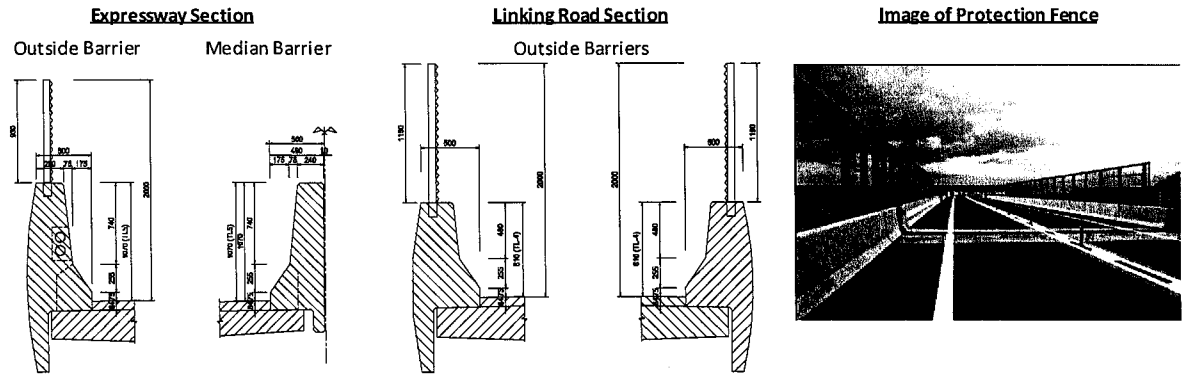


Figure 5.2-38 Protection Fence

(7) Main Bridge Structural Dimensions in Basic Design

The following main bridge structural dimensions in the basic design are shown in Appendix 5.2, Volume 2.

- Structural Heights of Superstructure
- Pier Head Widths at Linking Slab
- Structural Heights and Widths of Substructure

5.2.6 Proposed Bridge Plan

(1) Proposed Bridge Plan

The plan of thruway bridges in the F/S plan was updated according to the updated alignment, typical cross sections, cross structure plan, topographic survey and hydrological and inundation analyses.

The following bridge design results are shown in this report, respectively.

- List of Planned Bridges: Section 5.1.5 (Table 5.1-5)
- Location Map of Planned Bridges: Section 5.1.5 (Figure 5.1-1)
- Comparison between F/S and Proposed Bridge Plan: Section 5.5 (Tables 5.5-1 to 5.5-12)

(2) Bridges Out of Principles

Most of thruway bridges were planned in accordance with the basic principles as determined in Table 5.2-22 (see 5.2.5(1)) except the bridges as shown in Table 5.2-42.

Table 5.2-42 Bridges Out of Principles

No.	Planned Bridges (B/D)					Out of Basic Principles
	Bridge Code[1)]	Station (PKG)	Bridge Length	Girder Type	Girder Arrange.	
1	OP00a	KM001+155 (PKG1)	48.3m	I Girder	1@30m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The abutments were allowed on the embankment slope to minimize the bridge length (No. 6, Table 5.2-18).
2	LRB01	KM001+597 (PKG1)	223.8m	I Girder	6@33m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The substructures were allowed on the embankment slope to apply 33m of PC-I Girder (No. 6, Table 5.2-18). The required bridge skew angles are different with the cross road (80°) and river (90°). The valuable bridge skew angles (80° and 90°) were applied in a bridge to cope with required crossing conditions. (Varied bridge skew angle at P1 pier by adjusting width of pier head)
3	OP00b	KM002+822 (PKG1)	58.7m	I Girder	2@21m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The abutments were allowed on the embankment slope to minimize the bridge length (No. 6, Table 5.2-18). The pier on the median of cross road was allowed by DOT-Danang to reduce the elevation (No. 10, Table 5.2-26). The connected PC-I Girder was applied to reduce the girder height (No.2, Table 5.2-32). The bridge skew angle was applied 71 degrees to ensure the clearance of cross road (5.2.5(2)(c)).
4	OP01	KM003+656 (PKG1)	58.9m	I Girder	1@40m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The abutments were allowed on the embankment slope to minimize the bridge length (No. 6, Table 5.2-18).
5	OP17b	KM060+958 (PKG7)	35.6m	I Girder	1@21m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The reduced width of sidewalks on the cross road was allowed by DOT-Quang Nam to minimize the bridge length. The abutments were allowed on the edge of reduced sidewalks to minimize the bridge length (No. 6, Table 5.2-18).
6	OP17d	KM066+463 (PKGA1)	67.1m	I Girder	1@40m	The abutments were allowed on the embankment slope by DOT-Quang Nam to apply typical type of girder. (No. 6, Table 5.2-18 and No. 12, Table 5.2-22)
7	LRB12	KM068+456 (PKGA1)	304.6m	I Girder	7@40m	PC Super Tee Girder is appropriate as an individual bridge by reason of right alignment (No. 3, Table 5.2-32). PC-I Girder was applied to ensure constructability and economy in the package.
8	OP19	KM085+751 (PKGA2)	45.4m	I Girder	1@27m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The abutments were allowed on the embankment slope to minimize the bridge length (No. 6, Table 5.2-18).
9	CB30	KM118+050 (PKGA4)	46.1m	I Girder	1@33m	The abutments were allowed on the embankment slope to apply 33m of PC-I Girder (.No. 6, Table 5.2-18).
10	OP24a	KM124+899 (PKGA5)	46.1m	I Girder	1@27m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The abutments were allowed on the embankment slope to minimize the bridge length (No. 6, Table 5.2-18).
11	VD13	KM127+760 (PKGA5)	291.4m	Super Tee	7@40m	PC-I Girder is appropriate as an individual bridge by reason of clothoid curve (No.2, Table 5.2-32). PC Super Tee Girder was applied in consideration of constructability and economy in the package.
12	OP27	KM134+953 (PKGA5)	143.7m	I Girder	3@40m	The piers were allowed within 5m from the edge of railway embankment slope by Vietnam Railways to apply typical type of girder (No. 12, Table 5.2-22). The multi-span was applied by reason of near the railway embankment slope (No. 10, Table 5.2-26).
13	CB38	KM138+284 (PKGA5)	54.5m	I Girder	1@40m	The pedestrian and vehicle passage spaces could not be ensured at A2 abutment side to apply typical type of girder. (No. 5, Table 5.2-18 and No. 12, Table 5.2-22)

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass

5.3 Basic Design of Interchange (IC) Bridges

5.3.1 General

(1) Objectives

The objective of basic design of IC bridges is to update the bridge plan in the F/S plan and obtain the agreement and approvals from the relevant organizations.

(2) Bridges Subject to IC Bridges

The bridges in the Project were categorized as shown in Table 5.3-1.

The bridges subject to IC bridges were all bridges on the expressway in the IC sections.

Table 5.3-1 Bridges Subject to IC Bridges

No.	Bridges				Subject to IC Bridges	Reference in This Report
	Road	Location	Bridge Category			
1	Expressway/ Linking Road	Thruway	Major River Bridges		-----	Section 4 : Basic Design of Four (4) Major River Bridges
2			Other Bridges	Other Than IC Sections	-----	Section 5.2 : Basic Design of Thruway Bridges (Other Than IC Sections)
3				IC Sections	●	This Section
4		Interchange (IC)	IC Rampway Bridges		●	
5	Cross Road		Flyovers		-----	Section 5.4 : Basic Design of Flyovers

●: Subject to IC Bridges

(3) Report Structure

The structure in this section is shown in Table 5.3-2.

Table 5.3-2 Report Structure

No.	Section	Main Contents
1	5.3.2 Definitions of Technical Terms	- Defined main terminologies for planning of bridge dimensions
2	5.3.3 Bridge Plan in F/S Stage	- Described main features of IC bridge in the F/S plan
3	5.3.4 Bridge Planning Criteria and Conditions	- Described bridge planning criteria and conditions which were defined by standards or relevant decisions
4	5.3.5 Bridge Planning	- Determined principles of bridge planning which were not defined by standards or relevant decisions
5	5.3.6 Proposed Bridge Plan	- Proposed the updated IC bridge plan and compared with F/S plan

(4) Principles of Basic Design

The following principles were established to the basic design of IC bridges in consideration of the characteristic of expressway and site conditions of the Project road.

(a) Common

- Adopted appropriate girder types to cope with skewed and curved bridges.
- Prioritized to adopt standard structure types.
- Not planned hauling of girders by access road conditions and high cost of temporary roads.
- Not adjusted to same girder length in a package to reduce surplus bridge length.
- Incorporated affection by inundation into bridge planning.
- Ensured appropriate span length in river bridges to secure smooth discharge of river flow.
- Ensured appropriate substructure locations in consideration of affection to crossing objects.
- Ensured appropriate substructure locations in consideration of future widening of thruway.

(b) IC Bridges

- Ensured appropriate width of IC thruway bridges in initial stage in consideration of future widening of thruway with traffic operation.
- Ensured aesthetic view from thruway to IC rampway flyovers.

5.3.2 Definition of Technical Terms

The definition of technical terms in the IC bridges was same as Section 5.2.2

5.3.3 Bridge Plan in F/S Stage

(1) Main Features

(a) Thruway Bridges in IC Sections

The thruway bridges were not planned in the IC sections in the F/S plan.

(b) IC Rampway Bridges

The main features of IC rampway Bridges in the F/S plan are shown in Table 5.3-3.

Table 5.3-3 Main Features of IC Rampway Bridges in F/S Plan

No.	Girder Type	Nos. of Bridge											
		By Girder Length						By Bridge Width					
		24m		35m		Total		7.5m	10..5m	12.0m	13.5m	17.5m	22.5m
		Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans						
1	PC Slab Beam	2	1	-----	-----	2	1	-----	2	1	-----	-----	-----
2	PC Void Slab	-----	-----	1	8	1	8	2	-----	2	2	2	1
Total		2	1	1	8	3	9	2	2	3	2	2	1
		3		9		12		12					

(2) Cross Section Elements

The cross section elements of IC rampway bridge were not mentioned in the F/S plan.

(3) Typical Cross Sections

The typical cross sections of IC rampway bridge were not mentioned in the F/S plan.

(4) List of Interchange Bridges

The List of bridges in the F/S plan is shown in Appendix 5.1, Volume 2.

5.3.4 Bridge Planning Criteria and Conditions

(1) Summary

The summary of bridge planning criteria and conditions are shown in Table 5.3-4 in the next page.

Most of items were referred to the other sections in this report; however, the items which need further explanation, those are described in 5.3.4(2).

Table 5.3-4 Summary of Bridge Planning Criteria and Conditions (IC Sections)

No.	Items (Based on Section 5.2.4)	Bridge Planning Criteria and Conditions (IC Sections)			
		Thruway Bridges in IC Sections		IC Rampway Bridges	
		References (Other Sections)	Remark	References (Other Sections)	Remark
1	(1) Geometric Design Criteria	-----	-----	-----	-----
2	(a) Summary of Geometric Design Criteria	3.4.2, 5.2.4(1)(a)	-----	3.4.3, 3.4.4	-----
3	(b) Numbers of Lane	5.2.4(1)(b)	Initial Stage: 4 lanes Ultimate Stage: 6 lanes	3.4.3	No Future Widening
4	(c) Design Speed	5.2.4(1)(c)	120km/hr	3.4.1, 3.4.3	40km/hr
5	(d) Alignment	5.2.4(1)(d)	Parallel Alignment	-----	Parallel Alignment
6	(e) Cross Sections	-----	-----	-----	-----
7	(i) Stage Construction	5.2.4(1)(e)(i)		3.4.3	One Stage Construction
8	(ii) Divided and Non-divided Roads	5.2.4(1)(e)(ii)	Divided Road	3.4.3, 3.5.1	Divided Road
9	(iii) Separate and Non-separate Structures	5.2.4(1)(e)(iii)	Separate Structure	-----	Non-separate Structure
10	(iv) Bridge Railings	5.2.4(1)(e)(iv)	See 5.3.4(2)(a)	-----	See 5.3.4(2)(b)
11	(v) Clearance	5.2.4(1)(e)(v)	-----	5.2.4(1)(e)(v)	-----
12	(vi) Cross Section Elements	3.4.3, 3.5.1, 5.2.4(1)(e)(vi)	Necessary Widening (at IC Rampway Terminal) Pavement: 84mm	3.4.3, 3.5.1	Necessary Widening (at Small Horizontal Curve Radius) Pavement: 74mm (See 5.3.4(2)(b))
13	(2) Clearance with Crossing Objects	-----	-----	-----	-----
14	(a) Clearance	-----	-----	-----	-----
15	(i) Cross Road	-----	-----	-----	-----
16	1: Cross Sections	5.2.4(2)(a)(i)	-----	5.2.4(2)(a)(i), 5.2.4(1)(e)(vi)	-----
17	2: Clearance			5.2.4(2)(a)(i), 5.2.4(1)(e)(v)	-----
18	(ii) Railway	5.2.4(2)(a)(ii)	-----	5.2.4(2)(a)(ii)	-----
19	(iii) River	-----	-----	-----	-----
20	1: Freeboard	5.2.4(2)(a)(iii)	-----	5.2.4(2)(a)(iii)	-----
21	2: Navigation Clearance				
22	(iv) High-voltage Lines	5.2.4(2)(a)(iv)	-----	5.2.4(2)(a)(iv)	-----
23	(b) Minimum Requirements for Abutment Location	5.2.4(2)(b)	-----	5.2.4(2)(b)	IC Rampway Flyovers: See 5.3.4(2)(c)
24	(3) Hydrological Requirements	-----	-----	-----	-----
25	(a) Design High Water Level	5.2.4(3)(a)	-----	5.2.4(3)(a)	-----
26	(b) Required Bridge Opening Length	5.2.4(3)(b)	-----	5.2.4(3)(b)	-----
27	(c) Desirable Span Length	5.2.4(3)(c)	-----	5.2.4(3)(c)	-----
28	(d) Design Navigation Water Level	5.2.4(3)(d)	-----	5.2.4(3)(d)	-----
29	(e) Water Level during Construction	5.2.4(3)(e)	-----	5.2.4(3)(e)	-----
30	(4) Other Requirements	-----	-----	-----	-----
31	(a) Surface Drainage	-----	-----	-----	-----
32	(i) Design Frequency	5.2.4(4)(a)(i)	-----	5.2.4(4)(a)(i)	-----
33	(ii) Drainage Outlet	5.2.4(4)(a)(ii)	-----	5.2.4(4)(a)(ii)	-----
34	(b) Road Lighting	5.2.4(4)(b)	See 5.3.4(2)(d)	5.2.4(4)(b)	See 5.3.4(2)(d)
35	(c) Utility Lines	5.2.4(4)(c)	See 5.3.4(2)(e)	5.2.4(4)(c)	See 5.3.4(2)(e)

(2) Additional Bridge Planning Criteria and Conditions

(a) Bridge Railings

The bridge railings for thruway bridge other than IC sections are described in 5.2.4(1)(e)(iv) and the thruway bridges in IC sections were also applied TL-5 (h=1,070mm).

As for the IC rampway bridges, TL-4 (h=810mm) was applied in consideration of design speed (40km/hr).

The bridge railings IC sections are shown in Figure 5.3-1.

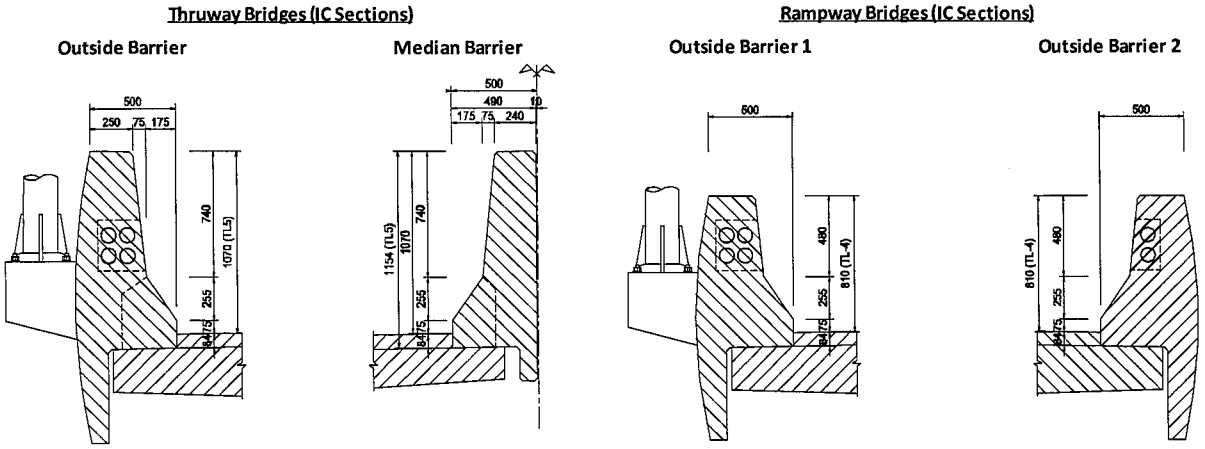


Figure 5.3-1 Bridge Railings in IC Sections

(b) Cross Section Elements

The pavement thickness on the IC rampway bridges was followed the F/S plan in the followings.

- Asphalt Concrete Pavement (70mm)+Waterproof Membrane (4mm)

(c) Minimum Requirements for Abutment Location

The minimum requirements for abutment locations in thruway bridges are described in 5.2.4(2)(b).

As for the IC rampway flyovers, the minimum requirements for substructure arrangement were established as shown in Figure 5.3-2. For adopting the typical type of girders, the pier locations were allowed at the thruway median strip with the widening to 3.5m.

In case of passing through cross roads (not expressway), the minimum requirements for substructure arrangement were followed 5.2.4(2)(b).

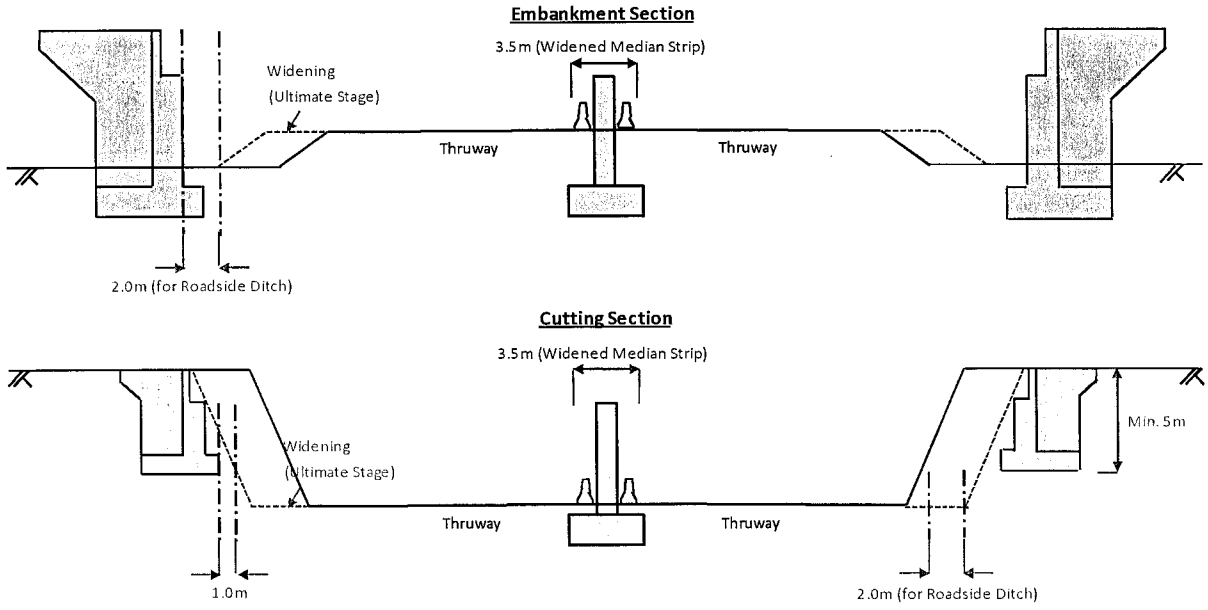


Figure 5.3-2 Minimum Requirements for Abutment Location (IC Rampway Flyovers)

(d) Road Lighting

The required locations of road lighting are described in 5.2.4(4)(b).

In IC sections, the road lighting was required on all thruway and rampway bridges.

(e) Utility Lines

The required public utilities on the Project road are described in 5.2.4(4)(c).

In addition to the communication cables, the electric cables for road lighting were also required to attach on all thruway and rampway bridges in the IC sections.

5.3.5 Bridge Planning

(1) Summary

The bridge planning in thruway bridges is described in 5.2.5 and it was also applied in IC sections.

However, some items were modified as described in 5.3.5(2).

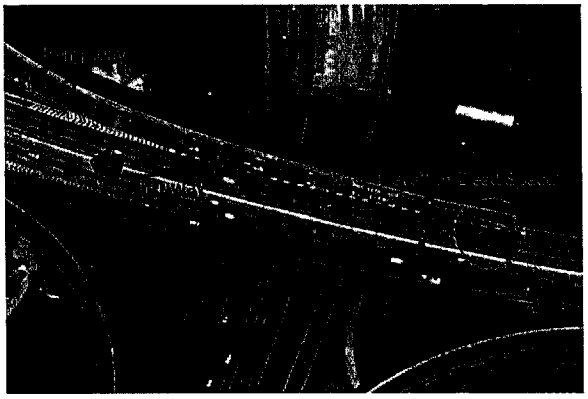
(2) Additional Bridge Planning

(a) Dead Spaces (Thruway Bridges)

The dead space on the thruway bridges was allowed by widening at the rampway terminal in the IC sections to cope with the variable bridge width by the typical type of girders as shown in Figure 5.3-3.

In this case, the constant bridge width and parallel girder layout in a bridge can be ensured and it is advantaged in consideration of the future widening of thruway bridges.

Thruway Bridge with Rampway Terminal in IC Section



Detail of Dead Space

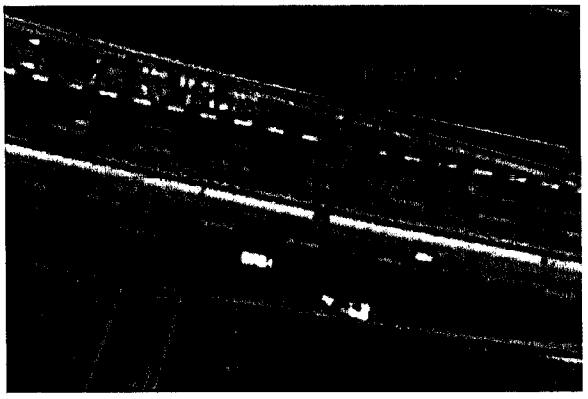


Figure 5.3-3 Image of Dead Spaces (Thruway Bridges in IC Sections)

(b) Typical Structure Plan (IC Rampway Bridges)

The superstructure type of IC rampway bridges were applied PC Void Slab in the F/S plan.

Based on the hearing from the F/S Consultant, the reasons were in the followings.

- Appropriate to cope with the small horizontal curve radius.
- Appropriate to ensure the aesthetic view from the thruway.

The F/S plan is appropriate and followed in the basic design.

The applicable girder length was typicalized in the followings to ensure efficiency and quality of design and construction works.

- Simple or 2 Spans Bridge: 24m, 27m and 30m
- More Than 3 Spans Bridges: 24m, 27m, 30m and 35m

The support conditions on the thruway bridges are described in Figure 5.2-23 (see 5.2.5(5)(a)(ii)); however, it was adopted the rigid frame at piers in the IC rampway flyovers in consideration of narrow width of pier head.

(c) Bridge Railing (including Space of Utility Lines)

The bridge railings were adopted the concrete barrier types as shown in Figure 5.3-1 (see 5.3.4(2)(a)).

In Figure 5.3-1, it is also mentioned the spaces for communication and electric cables which are required in the concrete barriers in the IC sections (see 5.3.4(2)(e)).

Based on the preliminary study by the D/D Consultant, the requirements for communication and electric cable spaces are as shown in Table 5.3-5.

The details of concrete barrier including the spaces for communication and electric cable spaces will be decided in the D/D stage.

Table 5.3-5 Proposed Requirements for Communication and Electric Cable Spaces (IC Sections)

No.	Item		Proposed Requirements	
			Thruway	Rampway
1	Location	Bridge Section	Outside Concrete Barriers	
2		Road Section	Under Shoulder (600mm depth from the surface)	
3	Cable Spaces	Nos.	4 nos./barrier	Side 1 (w/ electric cable): 4 nos./barrier Side 2 (w/o electric cable): 2 nos./barrier
4		Size	ϕ110mm	
5	Others	Min. Curve Radius	Communication Cable: R≥300mm (R≥20D, D: expected 15mm) Electric Cable: R≥600mm (R≥20D, D: expected 30mm)	
6		Pull Box (Bridge Section)	Communication Cable: 250m pitch on bridge section, boundary between bridge and road sections	
7			Electric Cable: 50m pitch on bridge section, boundary between bridge and road sections	
8			Pull Box Length: More than 1,200mm	
9		Covering (Bridge and Road Sections)	Polyvinyl Chloride Pipe	

(d) Protection Fence and Road Lighting

The protection fence and road lighting on IC bridges was planned as shown in Table 5.3-6 and Figure 5.3-4.

Table 5.3-6 Proposed Protection Fence Plan on IC Bridges

No.	Road	Bridge Location	Bridge Category	Conditions	Protection Fence (Both Outsides)	Road Lighting	Drawings (Figure 5.3-4)
1	Expressway (IC Sections)	Thruway	Overpass	Superelevation	2.0m	Both Outsides at Piers	1
2				Other Conditions	-----		2
3		Rampway	Flyovers	Shoulder Width ≥ 1.0m	2.0m	One Side (at Piers)	3
4				Other Conditions	3.0m		4
5			Other Bridges	Superelevation, Shoulder Width ≥ 1.0m	2.0m		3
6				Superelevation, Shoulder Width < 1.0m	3.0m		4
7				Other Conditions	-----		5

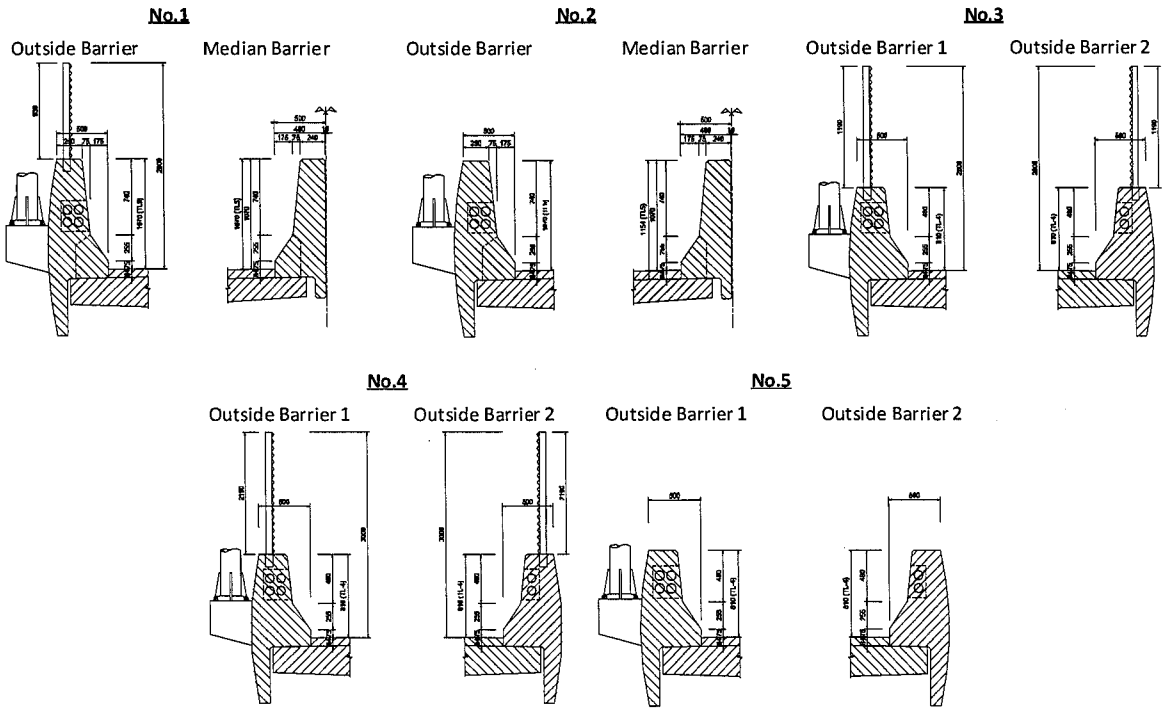


Figure 5.3-4 Protection Fence

5.3.6 Proposed Bridge Plan

(1) Proposed Bridge Plan

The plan of interchange bridges in the F/S plan was updated according to the updated alignment, typical cross sections, cross structure plan, topographic survey and hydrological and inundation analyses.

The following bridge design results are shown in this report, respectively.

- List of Planned Bridges: Section 5.1.5 (Table 5.1-5)
- Location Map of Planned Bridges: Section 5.1.5 (Figure 5.1-1)
- Comparison between F/S and Proposed Bridge Plan: Section 5.5 (Tables 5.5-1 to 5.5-12)

(2) Bridges Out of Principles

Most of IC bridges were planned in accordance with the basic principles as determined in Section 5.3.5 except the bridges as shown in Table 5.3-7.

Table 5.3-7 Bridges Out of Principles

No.	Planned Bridges					Out of Basic Principles
	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
1	ORB00a	-KM000+124, Tuy Loan IC (PKG1)	38.1m	Slab Beam	1@24m	It was planned to utilize the existing bridge on Danang Bypass (KM18+156) as existing conditions in the initial stage. The bracket on outer barrier was planned in the initial stage to install electrical lines. The widening in the ultimate stage was planned by reconstruction (superstructure) and widening (substructure and foundation).
2	OP03	KM013+628, My Son IC (PKG2)	40.7m	I Girder	1@24m	The cross road is planned as an urban road and the road side ditch at the edge of embankment slope is not required. The abutments were allowed on the embankment slope to minimize the bridge length (No. 6, Table 5.2-18).
3	IRB00d	Ramp D, KM000+395, My Son IC (PKG2)	142.0m	Void Slab	5@26m	The span arrangement was applied 5@26m by reason of restriction of abutment locations (5.3.5(2)(b)).
4	IRB02	Ramp B, KM000+409, Dung Quat IC (PKGA3)	47.5m	I Girder	1@30m	The aesthetic view from thruway is not required by reason of canal bridge (5.3.5(2)(b)). PC-I Girder was applied by reason of non-small curve radius at the bridge (5.3.5(2)(b).
5	IRB03	Ramp C1, KM000+980, Dung Quat IC (PKGA3)	108.8m	I Girder	2@40m	The aesthetic view from thruway is not required by reason of passing NH1A and Railway (5.3.5(2)(b)). The alignment is right at the bridge (5.3.5(2)(b)). PC-I Girder with 2@40m was applied by reason of crossing conditions (No. 6 and 7, Table 5.2-18).
6	IRB04	Ramp C1, KM001+255, Dung Quat IC (PKGA3)	87.1m	Void Slab	2@30m	The aesthetic view from thruway is required by reason of flyover (5.3.5(2)(b)). PC-I Girder cannot be applied by reason of restriction of thruway profile, high embankment and bridge location in IC. PC Void Slab with 2@30m was applied with the retaining wall at the thruway embankment slope (Figure 5.3-2).

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge

5.4 Basic Design of Flyovers

5.4.1 General

(1) Objectives

The objective of basic design of flyover plan is to update the bridge plan in the F/S plan and obtain the agreement and approvals from the relevant organizations.

(2) Bridges Subject to Flyovers

The bridges in the Project were categorized as shown in Table 5.4-1.

The bridges subject to this section were all of flyovers on the cross roads.

Table 5.4-1 Bridges Subject to Flyovers

No.	Bridges				Subject to IC Bridges	Reference in This Report
	Road	Location	Bridge Category			
1	Expressway/ Linking Road	Thruway	Major River Bridges		-----	Section 4 : Basic Design of Four (4) Major River Bridges
2			Other Bridges	Other Than IC Sections	-----	Section 5.2 : Basic Design of Thruway Bridges (Other Than IC Sections)
3				IC Sections	●	Section 5.3 : Basic Design of Interchange (IC) Bridges
4		Interchange (IC)	IC Rampway Bridges		●	
5	Cross Road		Flyovers		-----	This Section

●: Subject to Flyovers

(3) Report Structure

The structure in this section is shown in Table 5.4-2.

Table 5.4-2 Report Structure

No.	Section	Main Contents
1	5.4.2 Definitions of Technical Terms	- Defined main terminologies for planning of bridge dimensions
2	5.4.3 Bridge Plan in F/S Stage	- Described main features of flyovers in the F/S plan
3	5.4.4 Bridge Planning Criteria and Conditions	- Described bridge planning criteria and conditions which were defined by standards or relevant decisions
4	5.4.5 Bridge Planning	- Determined principles of bridge planning which were not defined by standards or relevant decisions
5	5.4.6 Proposed Bridge Plan	- Proposed the updated flyover plan and compared with F/S plan

(4) Principles of Basic Design

The following principles were established to the basic design of flyovers in consideration of the characteristic of expressway and site conditions of the Project road.

(a) Common

- Adopted appropriate girder types to cope with skewed and curved bridges.
- Prioritized to adopt standard structure types.
- Not planned hauling of girders in consideration of high cost of access and temporary roads.
- Not adjusted into same girder length in a package to reduce surplus bridge length.
- Incorporated affection by inundation into bridge planning.
- Ensured appropriate span length in river bridges to secure smooth discharge of river flow.
- Ensured appropriate substructure locations in consideration of affection to crossing objects.
- Ensured appropriate substructure locations in consideration of future widening of thruway.

(b) Flyovers

- Ensured aesthetic view from thruway.

5.4.2 Definition of Technical Terms

The definition of technical terms in the flyover was same as Section 5.2.2.

5.4.3 Flyover Plan in F/S Stage

(1) Main Features

The main features of flyovers in the F/S plan are shown in Table 5.4-3.

Table 5.4-3 Main Features of Flyovers in F/S Plan

No.	Girder Type	Nos. of Bridge											
		By Girder Length						By Bridge Width			By Bridge Length		
		24m		35m		Total		7.5m	9.0m	12.0m	L<50m	50m<L<100m	L>100m
		Simple Span	Multi Spans	Simple Span	Multi Spans	Simple Span	Multi Spans						
1	PC Void Slab	-----	-----	5	14	5	14	10	2	7	5	-----	14
Total		-----	-----	5	14	5	14	10	2	7	5	-----	14
		-----		19		19		19			19		

(2) Cross Section Elements

Refer to Section 5.4.3(3).

(3) Typical Cross Sections

The typical cross sections of flyovers in the F/S plan are shown in Figure 5.4-1.

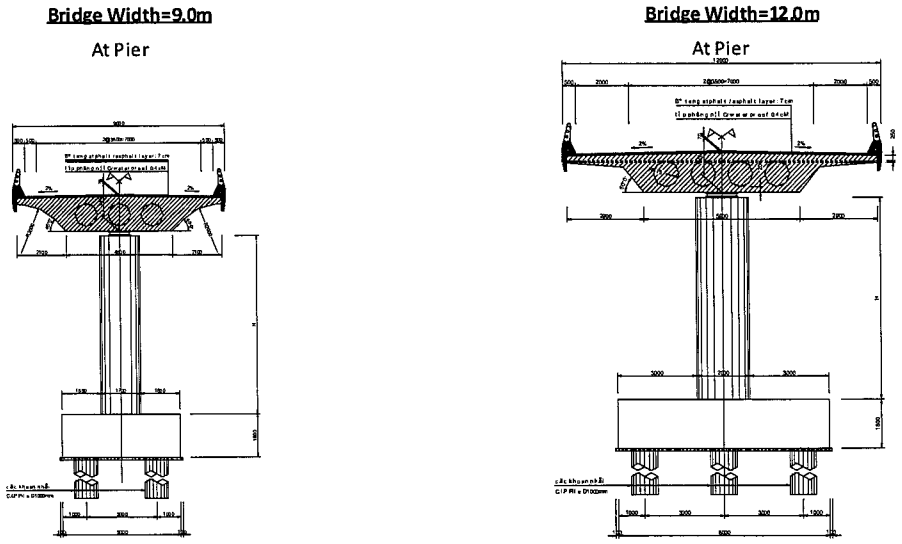


Figure 5.4-1 Typical Cross Sections of Flyovers in F/S Plan

(4) List of Flyovers

The List of bridges in the F/S plan is shown in Appendix 5.1, Volume 2.

5.4.4 Bridge Planning Criteria and Conditions

(1) Summary

The summary of bridge planning criteria and conditions are shown in Table 5.4-4.

Most of items were referred to the other sections in this report; however, the items which need further explanation, those are described in 5.4.4(2).

Table 5.4-4 Summary of Bridge Planning Criteria and Conditions (Flyovers)

No.	Items (Based on Section 5.2.4)	Flyovers	
		References (Other Sections)	Remark
1	(1) Geometric Design Criteria	-----	-----
2	(a) Summary of Geometric Design Criteria	2.4	-----
3	(b) Numbers of Lane	2.4, 2.5	No Future Widening
4	(c) Design Speed	2.4	-----
5	(d) Alignment	-----	Parallel Alignment
6	(e) Cross Sections	-----	-----
7	(i) Stage Construction	-----	One Stage Construction
8	(ii) Divided and Non-divided Roads	2.4, 2.5	-----
9	(iii) Separate and Non-separate Structures	-----	-----
10	(iv) Bridge Railings	-----	See 5.4.4(2)(a)
11	(v) Clearance	5.2.4(2)(a)(i)	-----
12	(vi) Cross Section Elements	2.4, 2.5	See 5.4.4(2)(b)
13	(2) Clearance with Crossing Objects	-----	-----
14	(a) Clearance	-----	-----
15	(i) Cross Road	-----	-----
16	1: Cross Sections	2.4, 2.5, 5.2.4(1)(e)(vi)	-----
17	2: Clearance	2.4, 2.5, 5.2.4(1)(e)(v)	-----
18	(ii) Railway	5.2.4(2)(a)(ii)	-----
19	(iii) River	-----	-----
20	1: Freeboard	5.2.4(2)(a)(iii)	-----
21	2: Navigation Clearance	-----	-----
22	(iv) High-voltage Lines	5.2.4(2)(a)(iv)	-----
23	(b) Minimum Requirements for Abutment Location	5.2.4(2)(b)	See 5.4.4(2)(c)
24	(3) Hydrological Requirements	-----	-----
25	(a) Design High Water Level	5.2.4(3)(a)	-----
26	(b) Required Bridge Opening Length	5.2.4(3)(b)	-----
27	(c) Desirable Span Length	5.2.4(3)(c)	-----
28	(d) Design Navigation Water Level	5.2.4(3)(d)	-----
29	(e) Water Level during Construction	5.2.4(3)(e)	-----
30	(4) Other Requirements	-----	-----
31	(a) Surface Drainage	-----	-----
32	(i) Design Frequency	5.2.4(4)(a)(i)	-----
33	(ii) Drainage Outlet	5.2.4(4)(a)(ii)	-----
34	(b) Road Lighting	5.2.4(4)(b)	-----
35	(c) Utility Lines	5.2.4(4)(c)	See 5.4.4(2)(d)

(2) Additional Bridge Planning Criteria and Conditions

(a) Bridge Railings

The bridge railings for flyovers on the cross roads are shown in Table 5.4-5 and Figure 5.4-2.

The test class was adopted TL-2 (h=685mm) to TL-4 (h=810mm) on the Road Classes I to A in consideration of design vehicles and speeds.

As for the Road Classes B and C, the typical type of concrete barrier was adopted in consideration of light design vehicle and low design speed.

Table 5.4-5 Proposed Bridge Railings and Protection Fence Plan on Flyovers

No.	Road	Bridge Location	Bridge Category	Conditions	Protection Fence (Both Outsides)	Road Lighting	Drawings (Figure 5.4-2)
1	Cross Road		Flyovers	Road Class I, II, III	2.0m	Not required	1
2				Road Class IV	3.0m		2
3				Road Class V, VI, AH, A	3.0m		3
4				Road Class B, C	3.0m		4

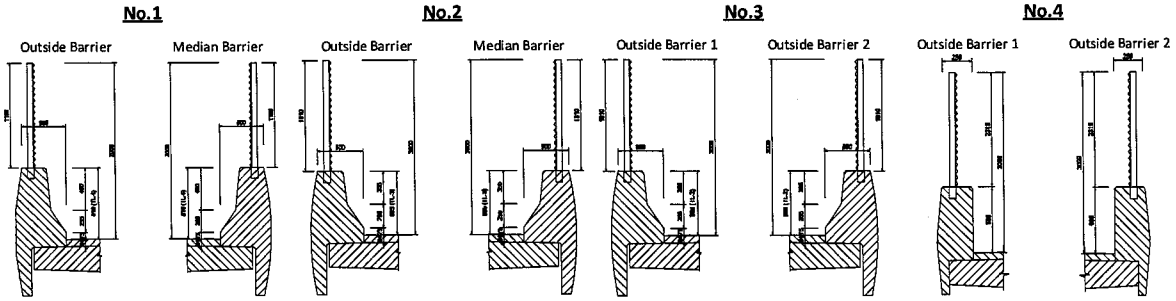


Figure 5.4-2 Protection Fence

(b) Cross Section Elements

The pavement thickness on the flyovers was followed the F/S plan in the followings.

- Asphalt Concrete Pavement (70mm)+Waterproof Membrane (4mm)

(c) Minimum Requirements for Abutment Location

Refer to Figure 5.3-2 (see 5.3.4(2)(c)).

(d) Utility Lines

The utility lines are not required to attach on the flyovers.

5.4.5 Bridge Planning

(1) Summary

The bridge planning in thruway bridges is described in 5.2.5 and it was also applied in the flyovers. However, some items were modified as described in 5.4.5(2).

(2) Additional Bridge Planning

(a) Typical Structure Plan

Refer to Section 5.3.5(2)(b).

(b) Expansion Joints

The expansion joints for flyovers were adopted the low-bedding type as shown in Figure 5.2-33 in consideration of small traffic volume on the cross roads.

(c) Protection Fence

Refer to Section 5.4.4(2)(a) (Table 5.4-5 and Figure 5.4-2).

5.4.6 Proposed Bridge Plan

(1) Proposed Bridge Plan

The plan of flyovers in the F/S plan was updated according to the updated alignment, typical cross sections, cross structure plan, topographic survey and hydrological and inundation analyses.

The following bridge design results are shown in this report, respectively.

- List of Planned Bridges: Section 5.1.5 (Table 5.1-5)
- Location Map of Planned Bridges: Section 5.1.5 (Figure 5.1-1)
- Comparison between F/S and Proposed Bridge Plan: Section 5.5 (Tables 5.5-1 to 5.5-12)

(2) Bridges Out of Principles

Most of flyovers were planned in accordance with the basic principles as determined in Section 5.4.5 except the bridges as shown in Table 5.4-6.

Table 5.4-6 Bridges Out of Principles

No.	Planned Bridges					Out of Basic Principles
	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
1	FO07	KM076+970 (PKGA1)	55.8m	K-frame	12.4+31+12.4m	K-frame bridge was applied to introduce a new technology (2.6(2), Appendix 5.3, Volume 2).

1) FO: Flyover

5.5 Comparison between F/S and Proposed Bridge Plan

The bridge plan of other bridges in the F/S plan was updated in this report.

The comparison between F/S and proposed bridge plan is shown in Tables 5.5-1 to 5.5-12.

Table 5.5-1 Comparison between F/S and Proposed Bridge Plan (PKG1)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station	Bridge Length	Girder Type	Girder Arrange.	
1	VD01	-KM000+120	49.10m	I Girder	1@33m	1	ORB00a	-KM000+124	38.1m	Slab Beam	1@24m	Existing bridge on Danang Bypass (No. 1, Table 5.3-7)
3	IRB01	KM000+000	66.15m	Slab Beam	2@24m	-----						Revised interchange plan
4	IRB02	KM000+000	40.15m	Slab Beam	1@24m	-----						Revised interchange plan
2	FO01	KM000+000	220.00m	Void Slab	6@35m	-----						Revised interchange plan
5	FO02	KM000+590	45.00m	Void Slab	1@35m	2	FO01	KM000+578	75.1m	Void Slab	2@30m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
-----						3	OP00a	KM001+155	48.3m	I Girder	1@30m	Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-42
6	LRB01	KM001+619	743.15m	I Girder	22@33m	4	LRB01	KM001+597	223.8m	I Girder	6@33m	Required bridge opening length: 130m Desirable span length: 32m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Applied variable bridge skew angles (No.2, Table 5.2-42) Planned urban road (A1 side) A1 and P1 Locations: No.2, Table 5.2-42 A2 Location: No.1, Table 5.2-18
7	LRB02	KM002+510	181.30m	I Girder	5@33m	5	LRB02	KM002+461	221.8m	I Girder	6@33m	Required bridge opening length: 200m Desirable span length: 34m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross roads ~~Abutment Locations: No. 1, Table 5.2-18~~
-----						6	OP00b	KM002+822	58.7m	I Girder	2@21m	Revised from culvert to OP in cross structure plan Applied same span length in a bridge (No. 1, Table 5.2-26) Other Bridge Planning: No. 3, Table 5.2-42
-----						7	OP01	KM003+656	58.9m	I Girder	1@40m	Newly added in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 4, Table 5.2-42 Applied separate abutment structure (No. 1, Table 5.2-24 and Figure 5.2-19)
8	LRB03	KM005+623	113.20m	I Girder	3@33m	8	ORB00b	KM005+635	82.8m	I Girder	3@21m	Required Bridge Opening Length: 43.7m Desirable Span Length: 21m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of river and cross roads (Cross road on A2 side: future plan (from KM005+750)) A1 Location: No. 1, Table 5.2-18 A2 Location: No. 6, Table 5.2-18
9	OP01	KM005+750	26.10m	Slab Beam	1@12m	-----						Revised to culvert in cross structure plan
10	OP02	KM007+926	23.10m	Slab Beam	1@9m	-----						Revised to culvert in cross structure plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-2 Comparison between F/S and Proposed Bridge Plan (PKG2)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1)]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
-----						9	CB02	KM009+373	45.1m	I Girder	1@27m	Revised from culvert to CB in cross structure plan Applied simple span bridge (No. 9, Table 5.2-26) Planned re-alignment of canal and cross roads Abutment Locations: No. 5, Table 5.2-18
11	FO03	KM009+585	45.00m	Void Slab	1@35m	10	FO02	KM009+619	60.3m	Void Slab	2@24m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
12	LRB04	KM009+870	183.30m	I Girder	5@33m	11	LRB04	KM009+852	147.5m	I Girder	4@33m	Required Bridge Opening Length: 126m Desirable Span Length: 30m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
13	VD02	KM010+271	90.20m	I Girder	3@24m	12	VD02	KM010+271	76.6m	I Girder	2@33m	Bridge Opening Length (Inundation Analysis) : 62m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of cross roads
14	LRB05	KM010+882	117.20m	I Girder	3@33m	13	LRB05	KM010+887	103.0m	I Girder	3@30m	Required Bridge Opening Length: 88m Desirable Span Length: 25m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
15	LRB06	KM011+904	150.25m	I Girder	4@33m	14	LRB05a	KM011+924	149.5m	I Girder	4@33m	Required Bridge Opening Length: 128m Desirable Span Length: 25m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
16	ORB01	KM012+639	86.20m	I Girder	3@24m	15	LRB05b	KM012+644	105.4m	I Girder	3@30m	Required Bridge Opening Length: 81m Desirable Span Length: 23m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross roads Abutment Locations: No. 1, Table 5.2-18
17	CB01	KM013+210	138.30m	I Girder	5@24m	16	VD02a	KM013+258	154.5m	I Girder	4@33m	Newly added VD02a in cross structure plan Combined CB01 to VD in cross structure plan Required Opening Length (Inundation Analysis): 101m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26

18	OP03	KM013+626	42.10m	Slab Beam	1@24m	17	OP03	KM013+628	40.7m	I Girder	1@24m	Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 2, Table 5.3-7
-----						18	IRB00d	Ramp D, KM000+395	142.0m	Void Slab	5@26m	Revised IC location and plan Required Opening Length (Inundation Analysis): 101m Applied same span length in a bridge (No. 1, Table 5.2-26) Other Bridge Planning: No. 3, Table 5.3-7
19	LRB07	KM014+027	117.20m	I Girder	3@33m	19	LRB06	KM014+027	103.5m	I Girder	3@30m	Required Bridge Opening Length: 87m Desirable Span Length: 26m Avoid pier locations at near river center (No.4, Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A2 side) Abutment Locations: No. 1, Table 5.2-18
-----						20	CB05	KM014+270	33.1m	I Girder	1@21m	Revised from culvert to CB in cross structure plan Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 5, Table 5.2-18 Applied setback of abutment location (Note1, Table 5.2-28)
20	VD03	KM014+873	117.2m	I Girder	3@33m	21	VD03	KM014+880	106.4m	I Girder	3@30m	Bridge Opening Length (Inundation Analysis) : 83m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of cross roads
21	VD04	KM015+171	117.2m	I Girder	3@33m	22	VD03a	KM015+340	135.7m	I Girder	4@30m	Bridge Opening Length (Inundation Analysis) : 104m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26
22	VD05	KM016+497	117.2m	I Girder	3@33m	23	VD04	KM016+558	115.5m	I Girder	3@33m	Bridge Opening Length (Inundation Analysis) : 97m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of cross road (A2 side)

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-3 Comparison between F/S and Proposed Bridge Plan (PKG3b)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station	Bridge Length	Girder Type	Girder Arrange.	
24	VD06	KM018+319	86.20m	I Girder	3@24m	24	VD05	KM018+319	107.3m	I Girder	3@30m	Bridge Opening Length (Inundation Analysis) : 83m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of cross road (A1 side)
25	VD07	KM018+612	62.15m	I Girder	2@24m	25	VD06	KM018+607	79.8m	I Girder	2@30m	Bridge Opening Length (Inundation Analysis) : 53m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26
26	VD08	KM018+831	86.20m	I Girder	3@24m	26	VD07	KM019+252	811.0m	I Girder	19@40m	Bridge Opening Length (Inundation Analysis) : 103m Combined to one bridge in cross structure plan (Based on request from local government) Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 5, Table 5.2-26 Planned re-alignment of cross roads
27	OP04	KM019+209	26.10m	Slab Beam	1@12m							
28	VD09	KM019+350	47.10m	I Girder	1@33m							
-----						27	FO03	KM020+720	55.2m	Void Slab	2@24m	Revised from culvert to FO in cross structure plan Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
30	IRB03	KM020+805	255.00m	Void Slab	7@35m	-----						Revised interchange plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-4 Comparison between F/S and Proposed Bridge Plan (PKG4)

F/S (Original Plan)						Updated (Proposed Plan)							Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station		Bridge Length	Girder Type	Girder Arrange.	
31	ORB02	KM021+900	47.10m	I Girder	1@33m	-----							Revised to culvert in cross structure plan
32	ORB03	KM023+350	62.15m	I Girder	2@24m	28	ORB04	Inbound	KM023+371	72.2m	I Girder	2@27m	Required Bridge Opening Length: 49.3m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26)
								Outbound	KM023+411	73.3m	I Girder	2@27m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
33	OP05	KM024+430	26.1m	Slab Beam	1@12m	29	OP06	Inbound	KM023+927	32.8m	I Girder	1@21m	Applied simple span bridge (No. 10, Table 5.2-26) Planned re-alignment of cross road
								Outbound	KM023+943	31.5m	I Girder	1@21m	Abutment Locations: No. 6, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
-----						30	FO05	KM024+790		68.3m	Void Slab	2@27m	Revised from culvert to FO in cross structure plan Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, embankment section
34	ORB04	KM024+648	77.65m	I Girder	2@33m	31	ORB05	KM024+923		57.4m	I Girder	2@24m	Required Bridge Opening Length: 43.9m Desirable Span Length: 22m Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
35	OP06	KM025+062	26.10m	Slab Beam	1@12m	-----							Revised to culvert in cross structure plan
36	ORB05	KM025+720	36.10m	I Girder	1@24m	-----							Revised to culvert in cross structure plan
37	VD10	KM027+000	34.10m	I Girder	1@24m	-----							Revised to embankment in cross structure plan
38	VD11	KM027+900	26.10m	Slab Beam	1@12m	-----							Revised to embankment in cross structure plan
39	OP07	KM028+778	26.10m	Slab Beam	1@12m	-----							Revised to culvert in cross structure plan
40	ORB06	KM029+500	77.65m	I Girder	2@33m	37	ORB06	KM029+510		70.3m	I Girder	2@30m	Required Bridge Opening Length: 52.4m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of river Abutment Locations: No. 1, Table 5.2-18
41	OP08	KM031+950	26.10m	Slab Beam	1@12m	-----							Revised to culvert in cross structure plan
42	VD12	KM032+440	26.10m	Slab Beam	1@12m	-----							Revised to embankment in cross structure plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-5 Comparison between F/S and Proposed Bridge Plan (PKG5)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1)]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
43	ORB07	KM034+120	70.15m	I Girder	2@24m	33	ORB07	KM034+151	51.1m	I Girder	1@33m	Required Bridge Opening Length: 29.6m Planned re-alignment of cross road (A2 side) Abutment Locations: No. 1, Table 5.2-18
44	OP09	KM035+353	35.00m	Slab Beam	1@21m	34	OP09	KM035+497	33.0m	I Girder	1@21m	Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
45	ORB08	KM036+200	60.00m	I Girder	2@24m	35	ORB08	KM036+432	44.7m	I Girder	1@33m	Required Bridge Opening Length: 25.1m Planned re-alignment of river Planned re-alignment of cross road (A2 side) Abutment Locations: No. 1, Table 5.2-18
46	ORB09	KM036+780	24.00m	Slab Beam	1@12m	-----						Revised to culvert in cross structure plan
47	LRB08	KM038+287	142.00m	I Girder	4@33m	36	ORB09a	KM038+377	87.1m	I Girder	3@24m	Required Bridge Opening Length: 68.1m Desirable Span Length: 23m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
48	OP10	KM038+787	19.00m	Slab Beam	1@9m	-----						Revised to culvert in cross structure plan
49	LRB09	KM039+550	176.00m	I Girder	5@33m	37	LRB08	KM039+653	219.9m	I Girder	6@33m	Required Bridge Opening Length: 148m Desirable Span Length: 26m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A2 side) Abutment Locations: No. 1, Table 5.2-18 Applied separate abutment structure/round-shaped pier (No. 3, Table 5.2-24 and Figure 5.2-19)
50	CB02	KM039+995	22.00m	Slab Beam	1@12m	38	CB09	KM040+110	46.3m	I Girder	1@33m	Bridge Opening Length (Inundation Analysis). 15.6m Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 4, Table 5.2-18
51	IRB04	KM040+776	38.00m	Slab Beam	1@24m	39	OP09a	KM040+880	43.1m	I Girder	1@27m	Revised to OP in interchange plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18
52	OP11	KM041+121	38.00m	Slab Beam	1@24m	40	OP10	KM041+235	37.1m	I Girder	1@24m	Revised to IC bridge in IC plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-6 Comparison between F/S and Proposed Bridge Plan (PKG6)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1)]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
53	ORB10	KM042+058	58.00m	I Girder	2@24m	-----						Revised to culvert in cross structure plan
54	OP12	KM042+596	34.0m	Slab Beam	1@21m	41	OP11	KM042+723	34.1m	I Girder	1@21m	Applied simple span bridge (No. 10, Table 5.2-26) Planned re-alignment of cross road Abutment Locations: No. 6, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
55	CB03	KM043+520	23.00m	Slab Beam	1@12m	42	CB11	KM043+655	39.1m	I Girder	1@27m	Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 4, Table 5.2-18
56	ORB11	KM044+300	58.00m	I Girder	2@24m	43	ORB11	KM044+440	57.8m	I Girder	2@24m	Required Bridge Opening Length: 42.9m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
57	ORB12	KM045+306	21.00m	Sla Beam	1@9m	44	ORB12	KM045+438	44.1m	I Girder	1@30m	Required Bridge Opening Length: 26.4m Planned re-alignment of river Abutment Locations: No. 1, Table 5.2-18
58	CB04	KM045+525	25.00m	Slab Beam	1@15m	45	CB12	KM045+540	39.1m	I Girder	1@27m	Applied simple span bridge (No. 9, Table 5.2-26) Planned re-alignment of canal and cross roads Abutment Locations: No. 4, Table 5.2-18
59	LRB10	KM045+775	142.00m	I Girder	4@33m	46	ORB13	KM045+885	74.8m	I Girder	2@27m	Required Bridge Opening Length: 50.3m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
60	OP13	KM046+121	19.00m	Slab Beam	1@9m	-----						Revised to culvert in cross structure plan
61	ORB13	KM046+750	25.00m	Slab Beam	1@15m	-----						Revised to culvert in cross structure plan
62	OP14	KM047+012	19.00m	Slab Beam	1@9m	47	OP11a	KM047+136	33.9m	I Girder	1@21m	Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
63	LRB11	KM047+850	142.00m	I Girder	4@33m	48	LRB09	KM047+911	112.2m	I Girder	3@33m	Required Bridge Opening Length: 79.1m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
-----						49	CB13	KM048+390	44.9m	I Girder	1@27m	Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 4, Table 5.2-18
64	OP15	KM051+120	19.00m	Slab Beam	1@9m	-----						Revised to culvert in cross structure plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-7 Comparison between F/S and Proposed Bridge Plan (PKG7)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1)]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
65	OP16	KM054+222	19.00m	Slab Beam	1@9m	-----						Revised to culvert in cross structure plan
66	ORB14	KM054+783	45.00m	I Girder	1@33m	50	ORB14	KM054+986	40.7m	I Girder	1@33m	Required Bridge Opening Length: 30.9m Planned re-alignment of river and cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
67	LRB12	KM055+500	142.00m	I Girder	4@33m	51	LRB10	KM055+614	150.0m	I Girder	4@33m	Required Bridge Opening Length: 94.8m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18 Applied separate abutment structure/round-shaped pier (No. 3, Table 5.2-24 and Figure 5.2-19)
68	CB05	KM056+300	22.00m	Slab Beam	1@12m	-----						Revised to culvert in cross structure plan
69	OP17	KM056+370	19.00m	Slab Beam	1@9m	-----						Revised to culvert in cross structure plan
70	ORB15	KM056+950	45.00m	I Girder	1@33m	52	ORB15	KM057+095	37.7m	I Girder	1@30m	Required Bridge Opening Length: 16.0m Abutment Locations: No. 1, Table 5.2-18
71	OP18	KM057+378	32.00m	Slab Beam	1@21m	-----						Revised to culvert in cross structure plan
-----						53	OP16	KM057+507	32.9m	I Girder	1@21m	Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
72	LRB13	KM058+120	142.00m	I Girder	4@33m	54	LRB11	KM058+244	144.1m	I Girder	4@33m	Required Bridge Opening Length: 73.9m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
73	OP19	KM059+167	22.00m	Slab Beam	1@12m	-----						Revised to culvert in cross structure plan
-----						55	OP17a	KM060+043	39.7m	I Girder	1@21m	Revised from culvert to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Planned re-alignment of cross road Abutment Locations: No. 6, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
-----						56	OP17b	KM060+958	35.6m	I Girder	1@21m	Revised from culvert to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 5, Table 5.2-42
74	ORB16	KM062+337	73.00m	I Girder	3@21m	57	ORB16	KM062+456	70.4m	I Girder	2@30m	Required Bridge Opening Length: 54.9m Desirable Span Length: 21m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of river Abutment Locations: No. 1, Table 5.2-18
-----						58	OP17c	KM063+786	51.5m	I Girder	1@33m	Revised from culvert to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18 Applied separate abutment structure (No. 1, Table 5.2-24 and Figure 5.2-19)
75	IRB05	KM064+200	290.00m	Void Slab	8@35m	59	IRB01	Ramp C, KM000+450	70.2m	Void Slab	2@27m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, embankment section

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-8 Comparison between F/S and Proposed Bridge Plan (PKGA1)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station	Bridge Length	Girder Type	Girder Arrange.	
76	CB06	KM066+200	73.00m	I Girder	3@21m	60	ORB17a	KM066+285	38.8m	I Girder	1@24m	Required Bridge Opening Length: 20.1m Planned re-alignment of river Abutment Locations: No. 1, Table 5.2-18
77	FO04	KM066+334	185.00m	Void Slab	5@35m	61	OP17d	KM066+463	67.1m	I Girder	1@40m	Revised from FO to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Planned re-alignment of river Abutment Locations: No. 6, Table 5.2-42 Applied separate abutment structure (No. 1, Table 5.2-24 and Figure 5.2-19)
78	LRB14	KM068+308	307.00m	I Girder	9@33m	62	LRB12	KM068+456	304.6m	I Girder	7@40m	Required Bridge Opening Length: 183.2m Desirable Span Length: 31m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18 Applied separate abutment structure/round shaped pier (No. 3, Table 5.2-24 and Figure 5.2-19) Other Bridge Planning: No. 7, Table 5.2-42
79	CB07	KM071+000	25.00m	Slab Beam	1@15m	-----						Revised to culvert in cross structure plan
80	LRB15	KM074+312	144.00m	I Girder	4@33m	-----						Revised to culvert in cross structure plan
81	CB08	KM074+879	24.00m	Slab Beam	1@12m	-----						Revised to culvert in cross structure plan
-----						63	ORB21	KM075+184	81.1m	I Girder	2@33m	Revised from culvert to ORB in cross structure plan Required Bridge Opening Length: 54.8m Desirable Span Length: 22m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18
-----						64	FO07	KM076+970	55.8m	K-frame	12.4m +31m +12.4m	Revised from culvert to FO in cross structure plan Bridge Planning: No. 1, Table 5.4-6
82	FO05	KM078+481	187.00m	Void Slab	5@35m	65	FO08	KM078+640	68.9m	Void Slab	2@27m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
83	CB09	KM079+212	33.00m	I Girder	1@21m	-----						Revised to culvert in cross structure plan
84	FO06	KM080+071	117.00m	Void Slab	3@35m	-----						Revised to culvert in cross structure plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-9 Comparison between F/S and Proposed Bridge Plan (PKGA2)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1)]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1)]	Station	Bridge Length	Girder Type	Girder Arrange.	
85	CB10	KM081+556	45.00m	I Girder	1@33m	66	CB23	KM081+364	56.0m	I Girder	1@40m	Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 7, Table 5.2-42 Applied separate abutment structure (No. 1, Table 5.2-24 and Figure 5.2-19)
86	ORB17	KM082+527	84.00m	I Girder	3@24m	67	ORB22	KM082+348	78.8m	I Girder	3@21m	Required Bridge Opening Length: 53.1m Desirable Span Length: 21m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of cross roads Abutment Locations: No. 1, Table 5.2-18
87	IRB06	KM083+800	119.00m	Void Slab	3@35m	68	OP18a	KM082+986	41.9m	I Girder	1@27m	Revised from IRB to OP18 in interchange plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18
88	CB11	KM085+316	24.00m	Slab Beam	1@12m	-----						Revised to culvert in cross structure plan
89	FO07	KM085+940	117.00m	Void Slab	3@35m	69	OP19	KM085+751	45.4m	I Girder	1@27m	Revised from FO to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 8, Table 5.2-42
90	ORB18	KM087+892	36.00m	I Girder	1@24m	70	ORB23	KM087+710	46.5m	I Girder	1@33m	Required Bridge Opening Length: 32.2m Planned re-alignment of river and cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
91	LRB16	KM088+180	108.00m	I Girder	4@24m	71	LRB12a	KM087+970	144.6m	I Girder	4@33m	Required Bridge Opening Length: 107.8m Desirable Span Length: 25m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: No. 1, Table 5.2-18 Applied separate abutment structure/round shaped pier ~~(No. 3, Table 5.2-24 and Figure 5.2-19)~~
92	FO08	KM089+335	47.00m	Void Slab	1@35m	72	FO09	KM089+158	56.6m	Void Slab	2@24m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
93	ORB19	KM090+660	60.00m	I Girder	2@24m	-----						Revised to culvert in cross structure plan
-----						73	ORB25a	KM091+140	28.7m	I Girder	1@21m	Required Bridge Opening Length: 18m Abutment Locations: No. 1, Table 5.2-18
94	CB12	KM092+658	84.00m	I Girder	3@24m	74	CB25	KM092+360	46.3m	I Girder	1@33m	Bridge Opening Length (Inundation): 29m Applied simple span bridge (No. 9, Table 5.2-26) Planned re-alignment of canal Abutment Locations: No. 5, Table 5.2-18
95	CB13	KM094+318	36.00m	I Girder	1@24m	-----						Revised to culvert in cross structure plan
96	CB14	KM095+718	36.00m	I Girder	1@24m	-----						Revised to culvert in cross structure plan
97	FO09	KM099+710	47.00m	Void Slab	1@35m	-----						Revised to culvert in cross structure plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-10 Comparison between F/S and Proposed Bridge Plan (PKGA3)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station	Bridge Length	Girder Type	Girder Arrange.	
-----						75	OP20	KM099+543	35.8m	I Girder	1@21m	Newly added OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-42 Applied setback of abutment location (Note1,Table 5.2-28)
98	CB15	KM100+300	36.00m	PC-I Girder	1@24m	-----						Revised to culvert in cross structure plan
-----						76	OP20a	KM100+846	29.8m	Portal	1@14m	Revised from culvert to OP in cross structure plan Bridge Opening Length (Inundation Analysis): 9m Planned Opening Length: 9.0m+5.0m (Cross Road) Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-42
-----						77	ORB26	KM101+445	33.4m	I Girder	1@24m	Revised from culvert to ORB in cross structure plan Required Bridge Opening Length: 21.1m Planned re-alignment of river Abutment Locations: No. 1, Table 5.2-18
-----						78	CB27	KM101+827	37.7m	I Girder	1@21m	Revised from culvert to CB in cross structure plan Required Bridge Opening Length: 16.6m Applied simple span bridge (No. 9, Table 5.2-26) Re-alignment of canal Abutment Locations: No. 5, Table 5.2-18 Applied setback of abutment location (Note1,Table 5.2-28)
-----						79	ORB26a	KM102+055	35.9m	I Girder	1@27m	Revised from culvert to ORB in cross structure plan Required Bridge Opening Length: 23.3m Planned re-alignment of river and cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
102	IRB10	KM102+255	119.00m	Void Slab	3@35m	80	IRB02	Ramp B, KM000+409	47.5m	I Girder	1@30m	Required Bridge Opening Length: 19.6m Applied simple span bridge (No. 9, Table 5.2-26) Planned re-alignment of canal Abutment Locations: No. 5, Table 5.2-18 Other Bridge Planning: No. 4, Table 5.3-7
99	IRB07	KM102+255	154.00m	Void Slab	4@35m	81	IRB03	Ramp C1, KM000+980	108.8m	I Girder	2@40m	Abutment Locations: No. 6 and 7, Table 5.2-18 Other Bridge Planning: No. 5, Table 5.3-7
100	IRB08	KM102+255	224.00m	Void Slab	6@35m	82	IRB04	Ramp C1, KM001+255	87.1m	Void Slab	2@30m	Applied same span length in a bridge (No. 1, Table 5.2-26) Other Bridge Planning: No. 6, Table 5.3-7
101	IRB09	KM102+255	119.00m	Void Slab	3@35m	-----						Revised interchange plan
-----						83	ORB26b	KM102+327	43.3m	I Girder	1@33m	Revised from culvert to ORB in cross structure plan Required Bridge Opening Length: 32.2m Abutment Locations: No. 1, Table 5.2-18
103	OP20	KM103+254	66.00m	Slab Beam	3@18m	-----						Revised to culvert in cross structure plan
-----						84	FO10	KM103+560	53.7m	Void Slab	2@24m	Newly added FO in cross structure plan Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
104	ORB20	KM105+328	36.00m	I Girder	1@24m	85	ORB27	KM104+888	43.7m	I Girder	1@33m	Required Bridge Opening Length: 25.8m Planned re-alignment of river and cross road (A2 side) Abutment Locations: No. 1, Table 5.2-18
105	OP21	KM106+709	66.00m	Slab Beam	3@18m	-----						Revised to culvert in cross structure plan
-----						86	VD09a	KM107+307	38.5m	I Girder	1@30m	Newly added VD in cross structure plan Bridge Opening Length (Inundation Analysis): 24.9m
-----						87	VD09b	KM107+829	42.9m	I Girder	1@30m	Newly added VD in cross structure plan Bridge Opening Length (Inundation Analysis): 24.9m
106	FO10	KM108+478	117.00m	Void Slab	3@35m	-----						Revised to culvert in cross structure plan
107	ORB21	KM109+000	36.00m	I Girder	1@24m	-----						Revised to culvert in cross structure plan
109	OP22	KM110+128	66.00m	Slab Beam	3@18m	-----						Revised to culvert in cross structure plan

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-11 Comparison between F/S and Proposed Bridge Plan (PKGA4)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station	Bridge Length	Girder Type	Girder Arrange.	
110	VD13	KM111+120	492.00m	Super Tee	12@40m	-----						Revised to embankment in cross structure plan
----						88	FO10a	KM111+720	53.7m	Void Slab	2@24m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
111	FO11	KM112+411	49.00m	Void Slab	1@35m	89	OP22a	KM112+120	50.7m	I Girder	1@40m	Revised from FO to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: Figure 5.3-2, cutting section
112	IRB11	KM112+615	49.00m	Void Slab	1@35m	-----						Binh Son IC: Construct in ultimate stage
113	FO12	KM114+755	117.00m	Void Slab	3@35m	-----						Revised to culvert in cross structure plan
114	FO13	KM115+242	117.00m	Void Slab	3@35m	-----						Deleted in cross structure plan
115	ORB22	KM116+326	32.00m	Slab Beam	1@20m	90	ORB28	KM115+999	61.9m	I Girder	2@24m	Required Bridge Opening Length: 42.8m Desirable Span Length: 21m Avoid pier locations at near river center (No.4,Table 5.2-26) Applied same span length in a bridge (No. 1, Table 5.2-26) Planned re-alignment of river and cross road (A1 side) Abutment Locations: No. 1, Table 5.2-18
116	FO14	KM116+888	117.00m	Void Slab	3@35m	91	FO14	KM116+570	66.1m	Void Slab	2@27m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, embankment section
117	FO15	KM118+065	117.00m	Void Slab	3@35m	-----						Revised to culvert in cross structure plan
118	CB16	KM118+373	45.00m	I Girder	1@33m	92	CB30	KM118+050	46.1m	I Girder	1@33m	Bridge Opening Length (Inundation Analysis): 15.1m Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 9, Table 5.2-42
119	FO16	KM119+508	187.00m	Void Slab	5@35m	93	FO16	KM119+170	68.1m	Void Slab	2@27m	Applied same span length in a bridge (No. 1, Table 5.2-26) Abutment Locations: Figure 5.3-2, embankment section
120	FO17	KM120+316	117.00m	Void Slab	3@35m	-----						Revised to culvert in cross structure plan
121	FO18	KM122+568	117.00m	Void Slab	3@35m	-----						Revised to culvert in cross structure plan
122	IRB12	KM123+915	189.00m	Void Slab	5@35m	94	OP23c	KM123+845	47.1m	I Girder	1@27m	Revised from IRB to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18
123	VD14	KM124+400	412.00m	Super Tee	10@40m	95	VD10a	KM124+117	118.2m	I Girder	3@33m	Bridge Opening Length (Inundation Analysis) : 25m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of canal

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

Table 5.5-12 Comparison between F/S and Proposed Bridge Plan (PKGA5)

F/S (Original Plan)						Updated (Proposed Plan)						Main Reasons to Update
No.	Bridge Code[1]	Bridge Station	Bridge Length	Girder Type	Girder Arrange.	No.	Bridge Code[1]	Station	Bridge Length	Girder Type	Girder Arrange.	
-----						96	OP24a	KM124+899	47.1m	I Girder	1@27m	Revised from culvert to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 10, Table 5.2-42
125	VD15	KM127+200	652.00m	Super Tee	16@40m	97	VD12	KM126+882	692.4m	Super Tee	17@40m	Required Opening Length (Inundation Analysis): 680m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of canal and cross roads
126	VD16	KM128+180	292.00m	Super Tee	7@40m	98	VD13	KM127+761	294.4m	Super Tee	7@40m	Required Opening Length (Inundation Analysis): 280m Applied same span length in a bridge (No. 1, Table 5.2-26) Span Arrangement: No. 6, Table 5.2-26 Planned re-alignment of canal and cross roads Other Bridge Planning: No. 11, Table 5.2-42
127	FO19	KM128+948	187.00m	Void Slab	5@35m	99	OP25	KM128+615	42.7m	I Girder	1@27m	Revised from FO to OP in cross structure plan Applied simple span bridge (No. 10, Table 5.2-26) Abutment Locations: No. 6, Table 5.2-18 Applied separate abutment structure (No. 1, Table 5.2-24 and Figure 5.2-19)
-----						100	ORB28a	KM130+174	45.1m	I Girder	1@33m	Revised from culvert to ORB in cross structure plan Required Bridge Opening Length: 28.6m Planned re-alignment of river and cross road (A2 side) Abutment Locations: No. 1, Table 5.2-18
128	ORB23	KM132+934	42.00m	I Girder	1@33m	101	ORB29	KM132+620	54.1m	I Girder	1@40m	Required Bridge Opening Length: 34.5m Abutment Locations: No. 1, Table 5.2-18
129	VD17	KM134+726	42.00m	I Girder	1@33m	-----						Revised to culvert in cross structure plan
130	OP24	KM135+270	492.0m	Super Tee	12@40m	102	OP27	KM134+953	138.1m	I Girder	3@40m	Revised from OP to culvert at District Road No. 59B Applied same span length in a bridge (No. 1, Table 5.2-26) Other Bridge Planning: No. 12, Table 5.2-42
131	CB17	KM138+599	33.00m	I Girder	1@24m	103	CB38	KM138+284	55.9m	I Girder	1@40m	Required Opening Length (Inundation Analysis): 25m Applied simple span bridge (No. 9, Table 5.2-26) Abutment Locations: No. 13, Table 5.2-42

1) LRB: Large River Bridge (L≥100m), ORB: Other River Bridge (Medium River Bridge (25m<L<100m) and Small River Bridge (L≤25m)), CB: Canal Bridge, VD: Viaduct, OP: Overpass, IRB: Interchange Rampway Bridge, FO: Flyover

5.6 Conclusions

The bridge plan of other bridges was updated in accordance with the updated alignment, typical cross sections, cross structure plan, topographic survey and hydrological and inundation analyses.

The summary of basic design results is shown in Table 5.6-1.

The nos. of other bridges were reduced from 127 to 103 (bridge length: -3,740.4m) from the F/S plan.

Table 5.6-1 Summary of Basic Design Results (Other Bridges)

No.	Bridges				F/S		B/D (Rev. 2)[1)]		Difference (B/D-F/S)	
	Road	Location	Bridge Category		Nos.	Bridge Length	Nos.	Bridge Length	Nos.	Bridge Length
1	Expressway/	Thruway	Thruway Bridges	Other Than IC Sections	96	8,902.6m	74	7,215.6m	-9	-963.5m (-10.8%)
2	Linking Road			IC Sections	-----	-----	13	723.5m		
3		Interchange (IC)	IC Rampway Bridges		12	1,662.3m	5	455.6m	-7	-1,206.7m (-72.6%)
4	Cross Road		Flyovers		19	2,252.0m	11	681.8m	-8	-1,570.2m (-69.7%)
Total					**127**	**12,816.9m**	**103**	**9,076.5m**	**-24**	**-3,740.4m (-29.2%)**

1) Counted average bridge length of bridges in independent alignment sections as one bridge

The following approvals and agreements will be obtained based on this basic design report.

- Agreements with relevant local governments
- Approvals by PMU85, VEC and MOT

The detailed engineering design works including geotechnical investigations will be commenced to the planned bridges immediately after obtaining the above approvals and agreements.

The substructure and foundation type was followed in the F/S plan in this basic design; however it will be updated in the D/D stage according to the geotechnical investigation results.

The following works will be conducted in the D/D stage.

- Replacement to Final Topographic Survey Data
- Geotechnical Investigation and Laboratory Test
- Definition of Final Profile
- Finalization of Substructure and Foundation Plan
- Revision of Bridge Width in SA/PA Sections, if required
- Scouring Analysis at River Bridges
- Revetment and River Bed Protection Design

  (Review and update the river bed protection plan by River Engineer)
- Embankment Slope Design around Abutments
- Softground Treatment Design, if required
- Surface Drainage Design
- Other Ancillary Facilities Design
- Structural Design, Drawings and Quantity Taking-off