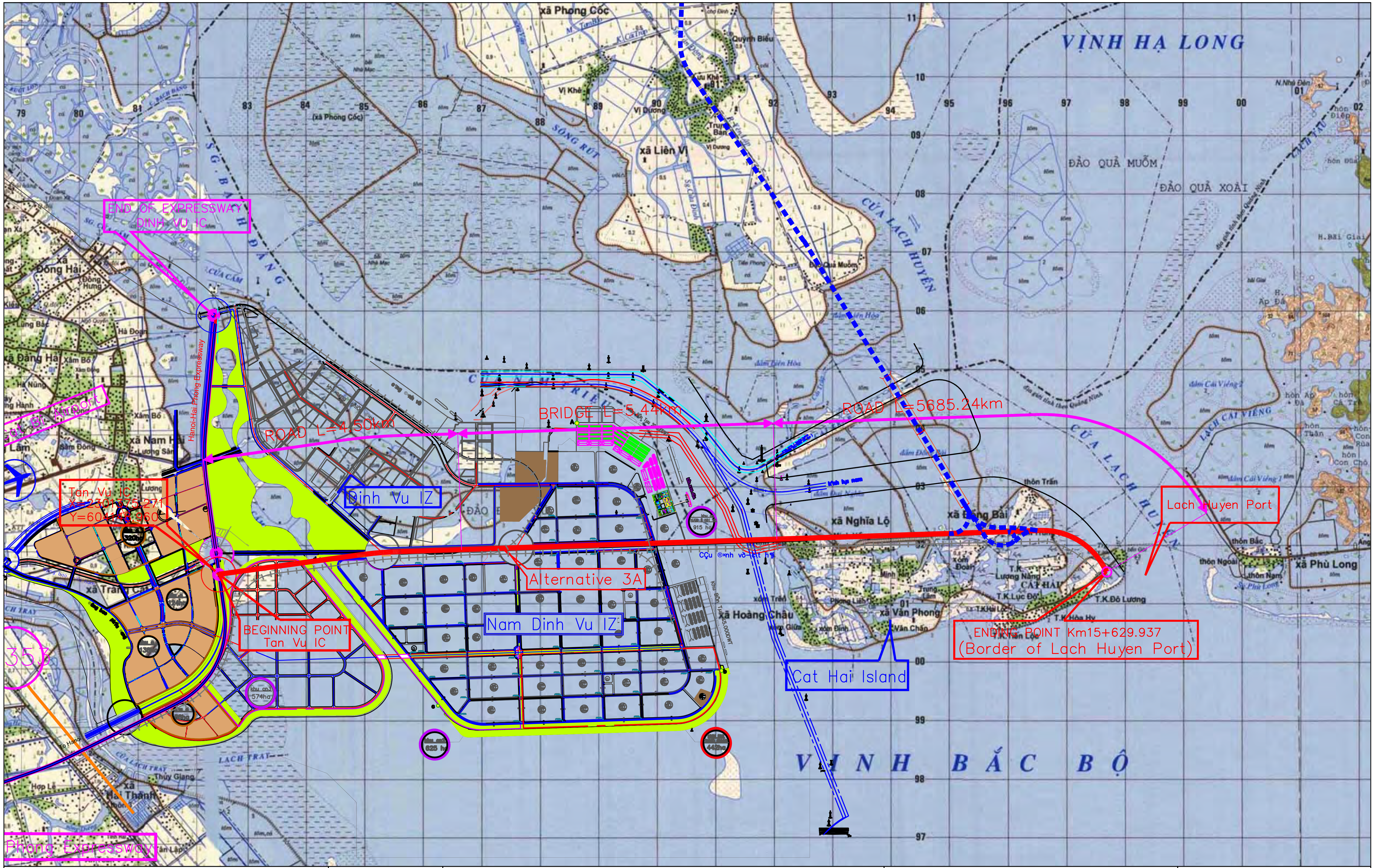
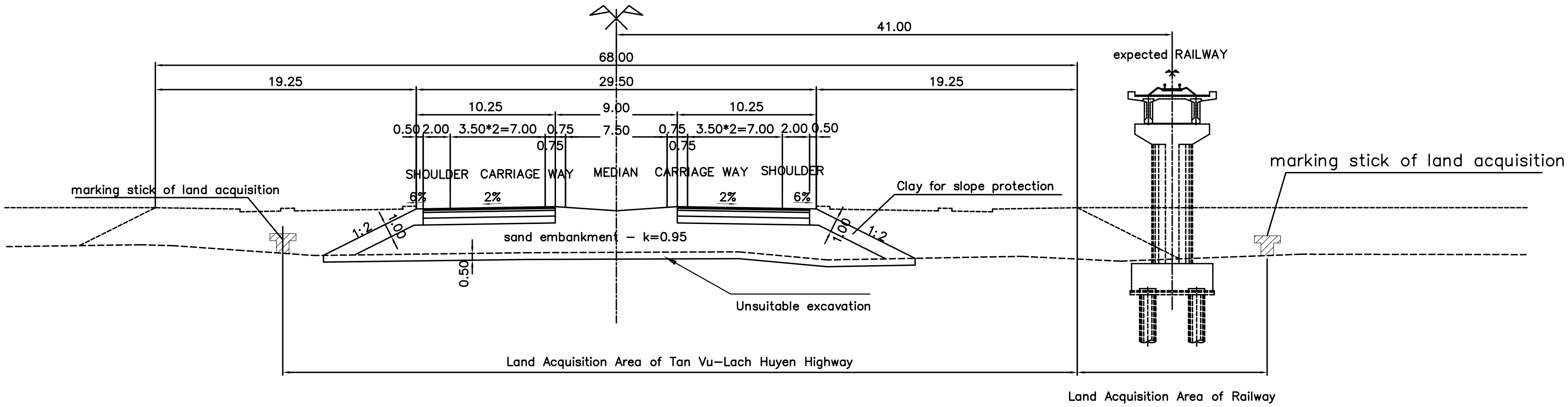
Appendix-1: Drawings

List of Drawings

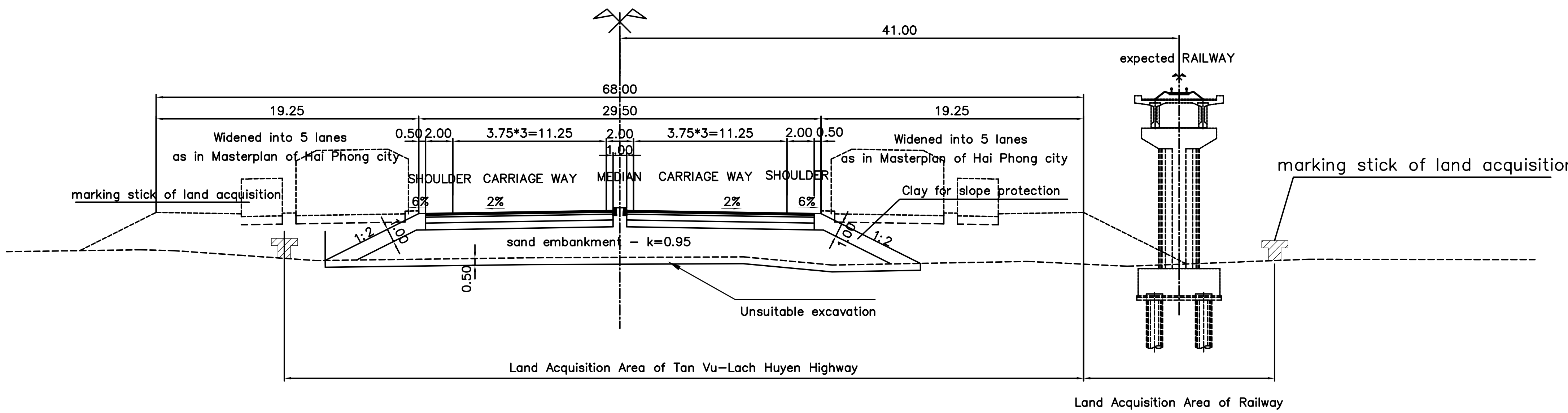


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Project Location Map	SCALE 1:60,000 NO. G-01

Typical Cross Section for First Stage 4-Lane

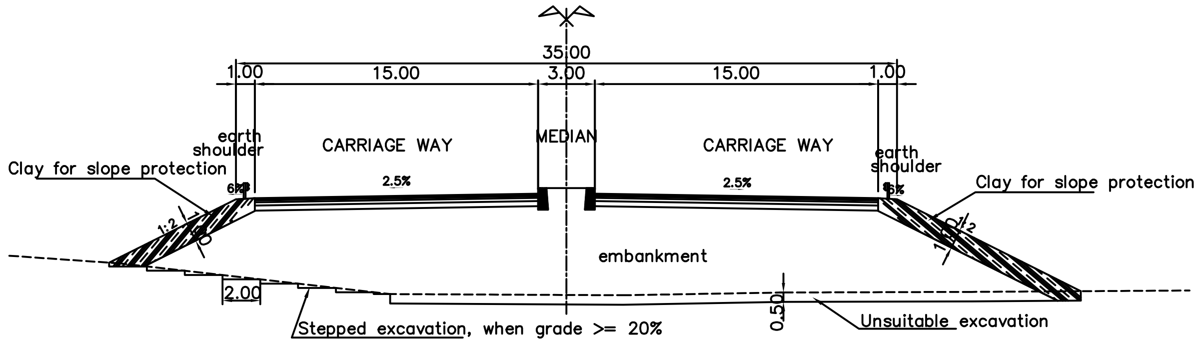


Typical Cross Section for second stage 6-Lane

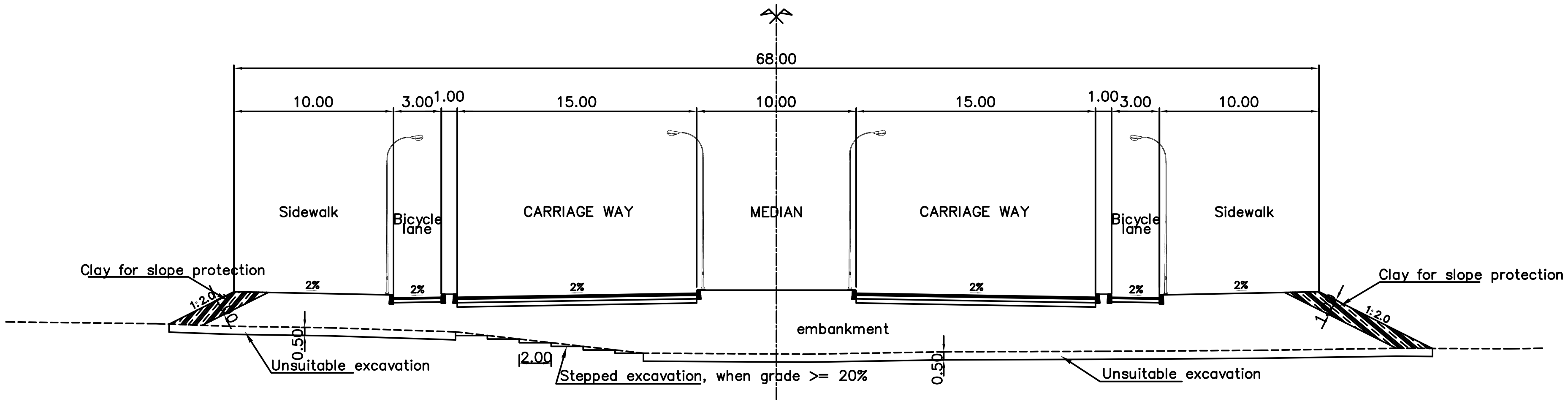


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)		JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Typical Cross Section(1) Project Highway	SCALE 1:40 NO. R-01-01

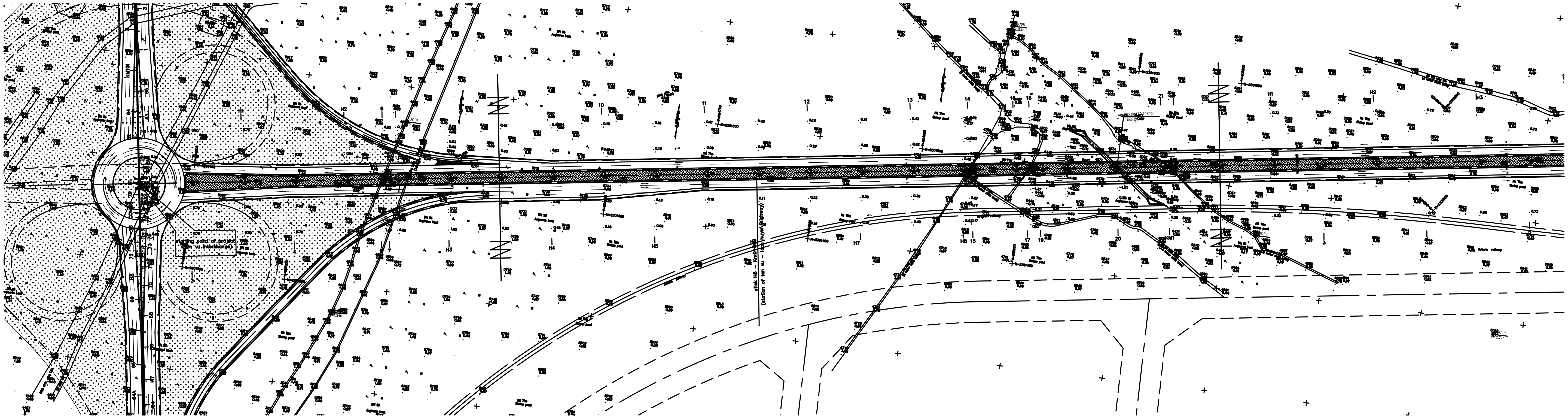
Ha noi – Hai Phong Expressway

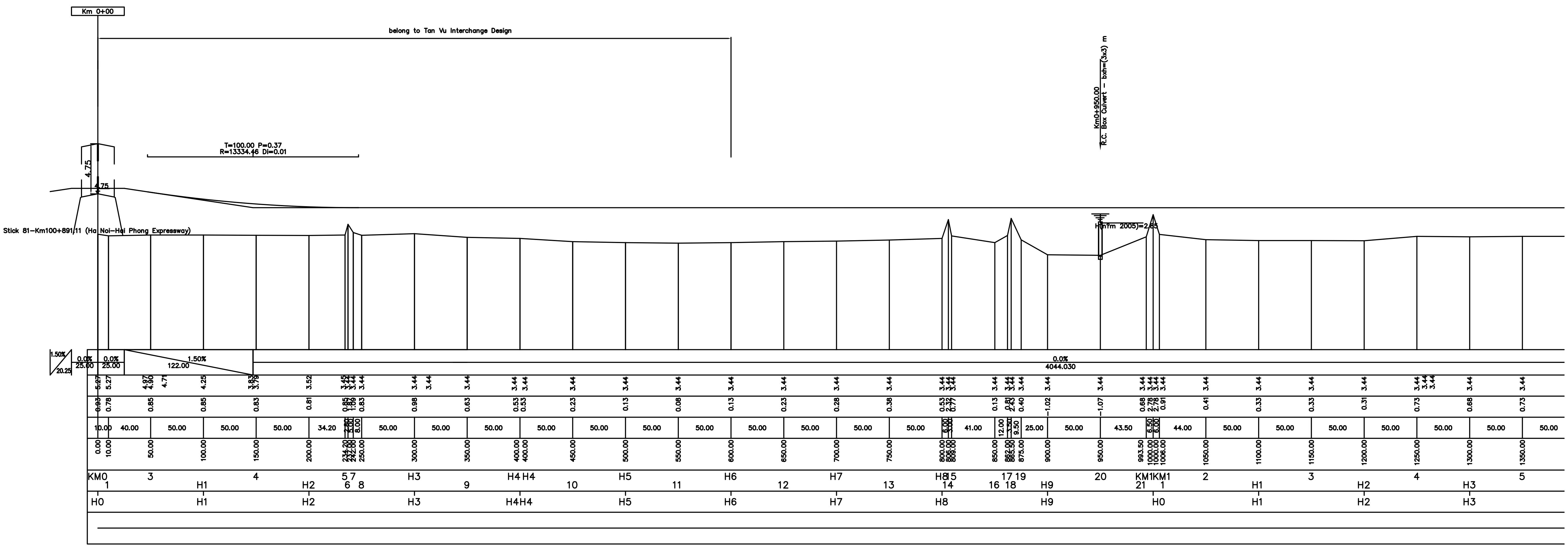


Third Ring Road as in Masterplan of Hai Phong City

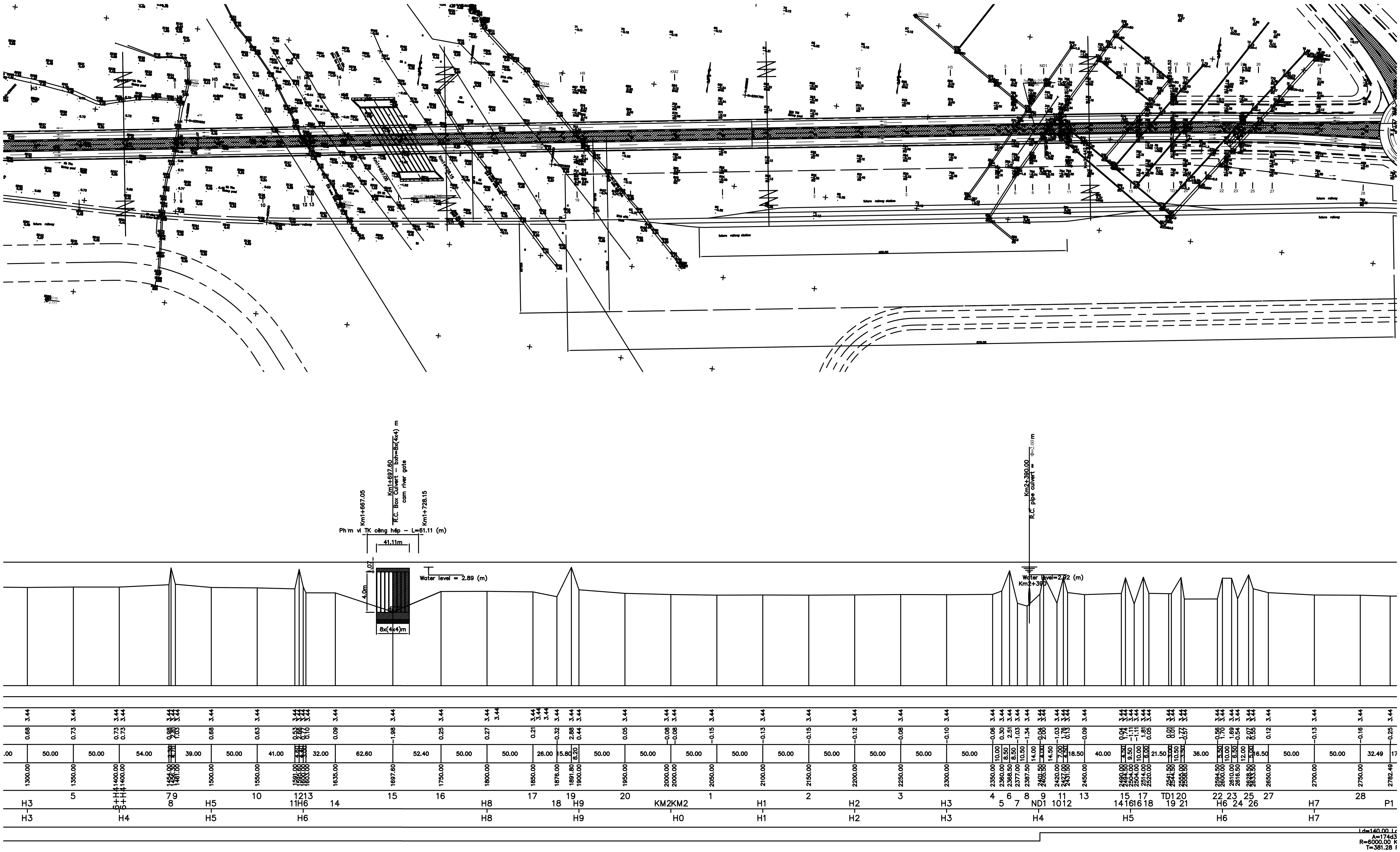


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Typical Cross Section(2) Crossing Roads	SCALE 1:40 NO. R-01-02

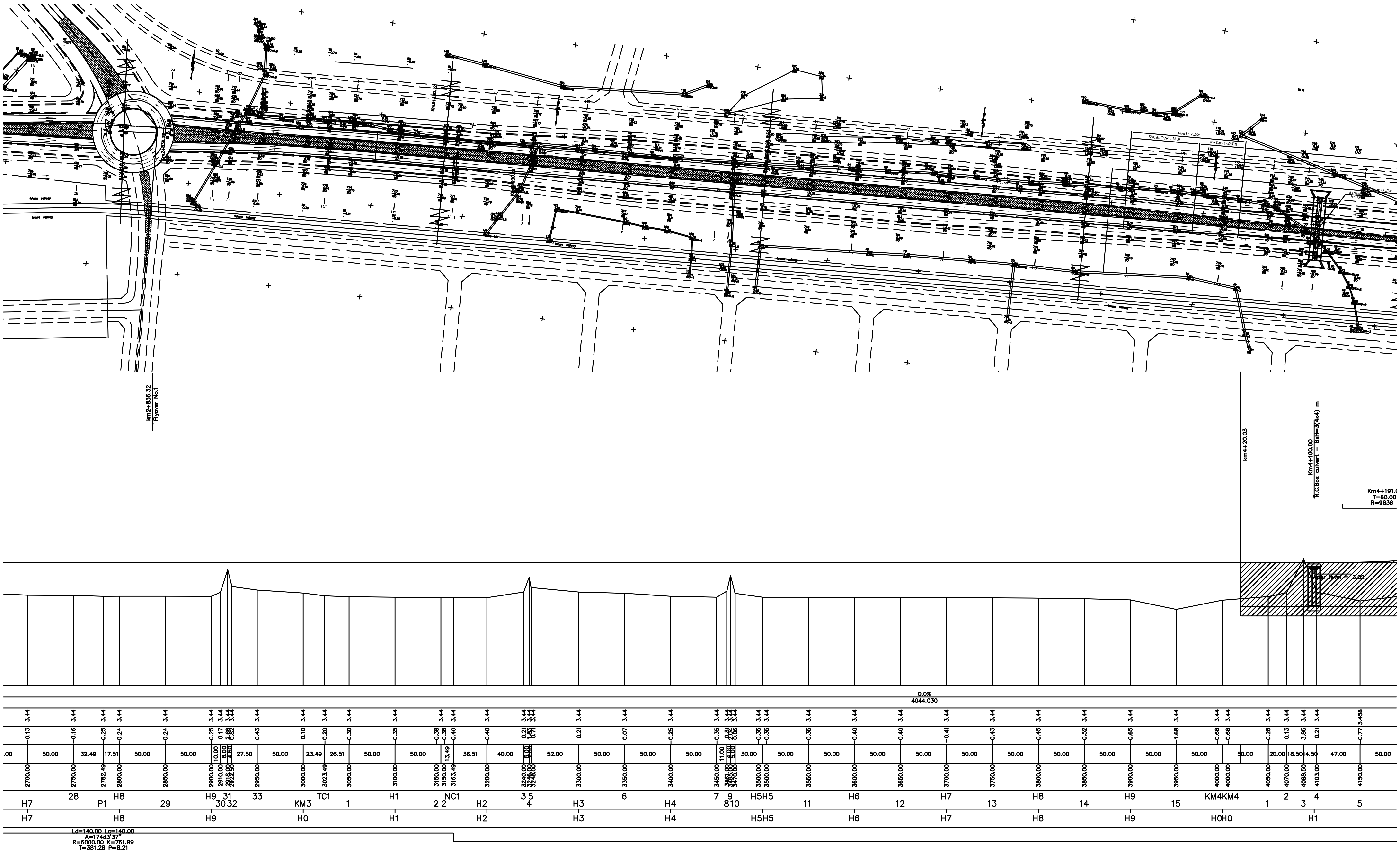




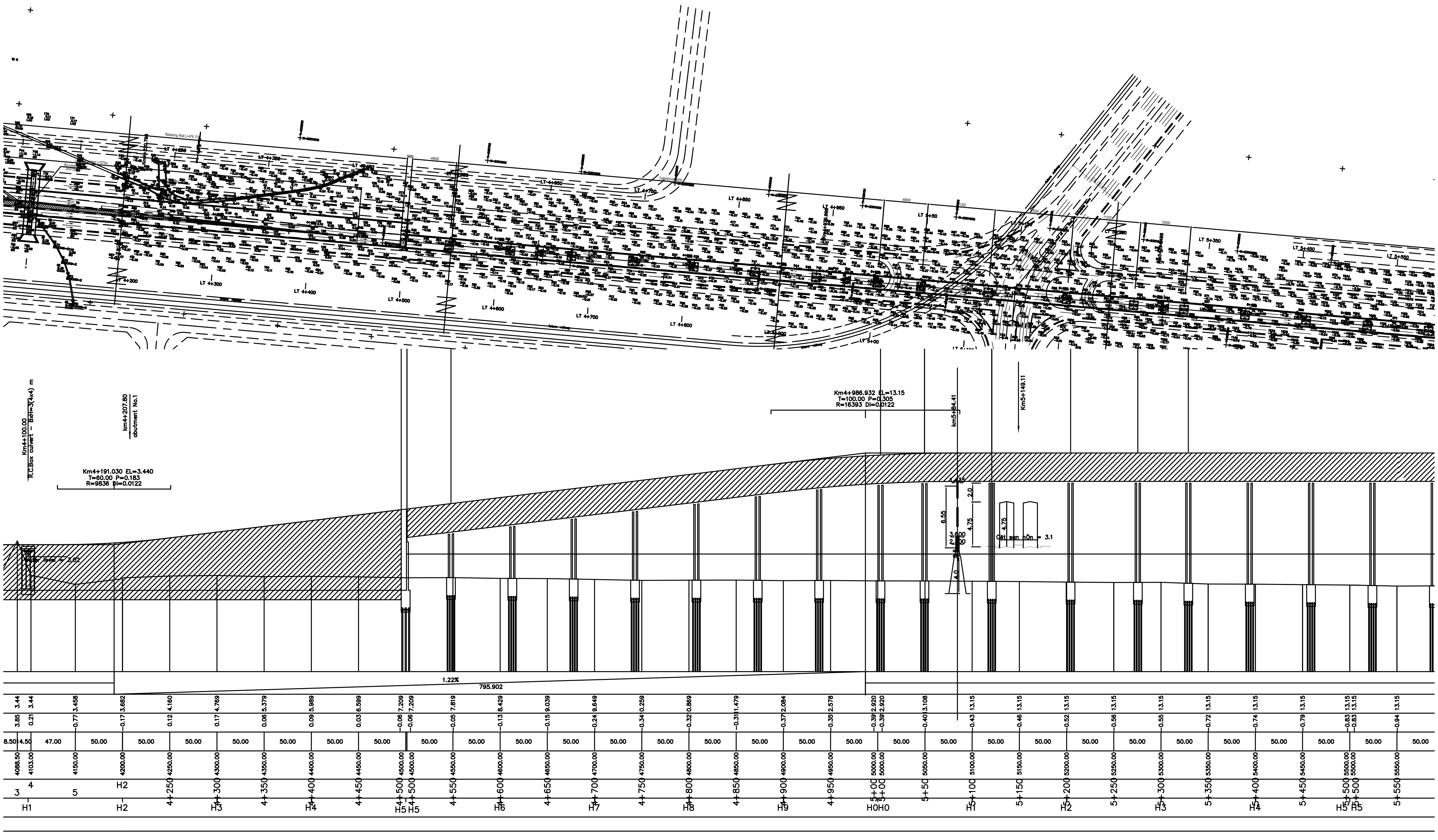
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-01



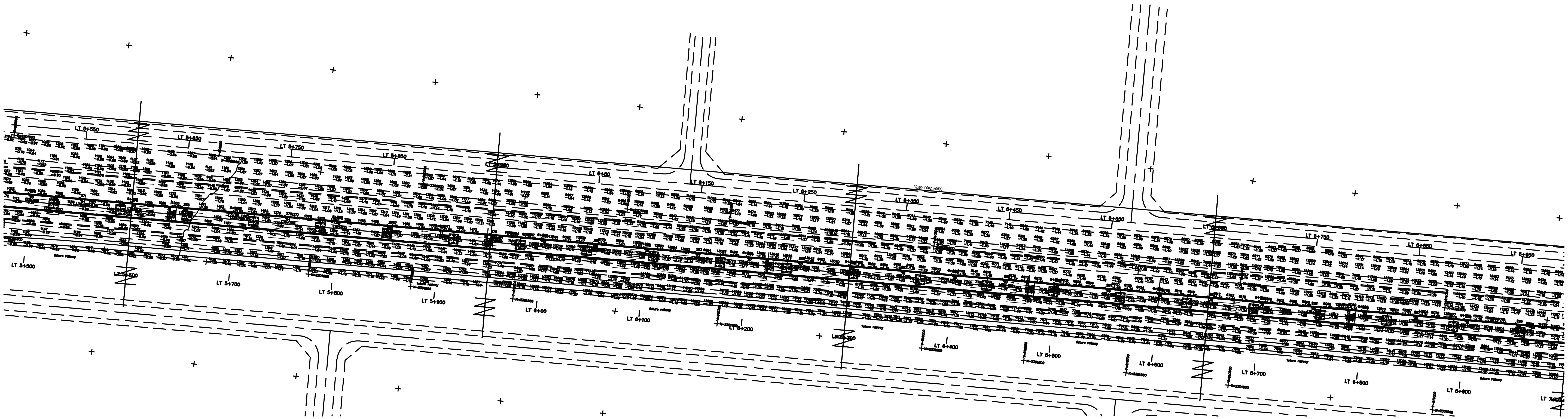
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-02

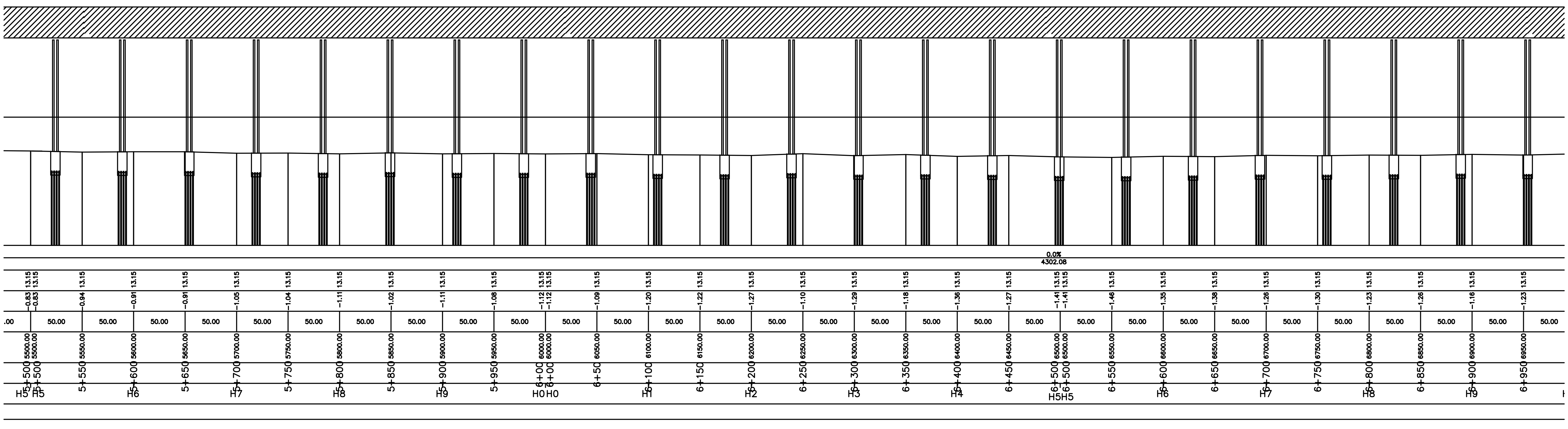


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-03

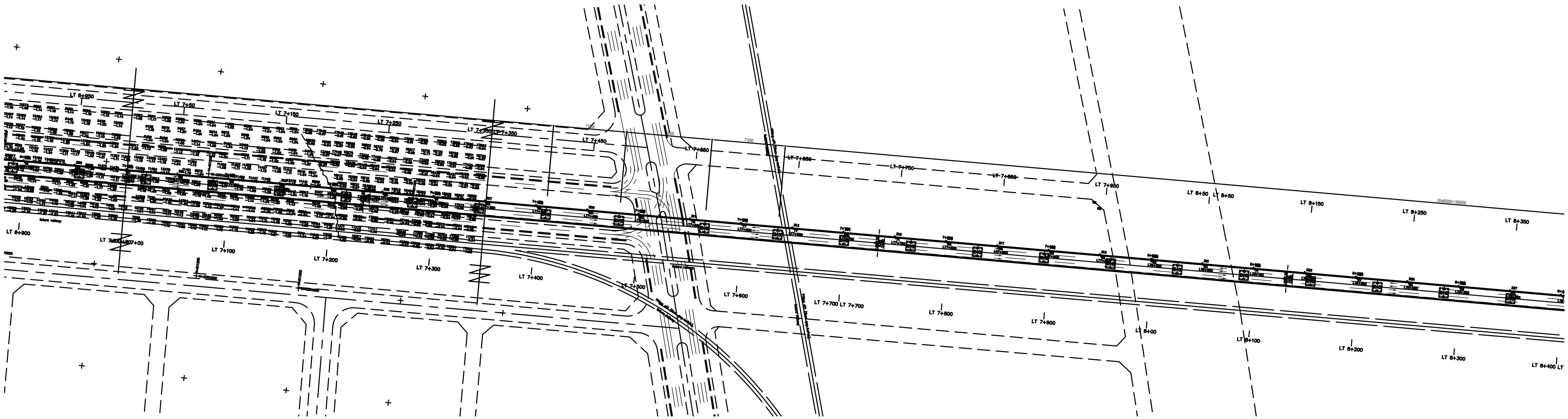


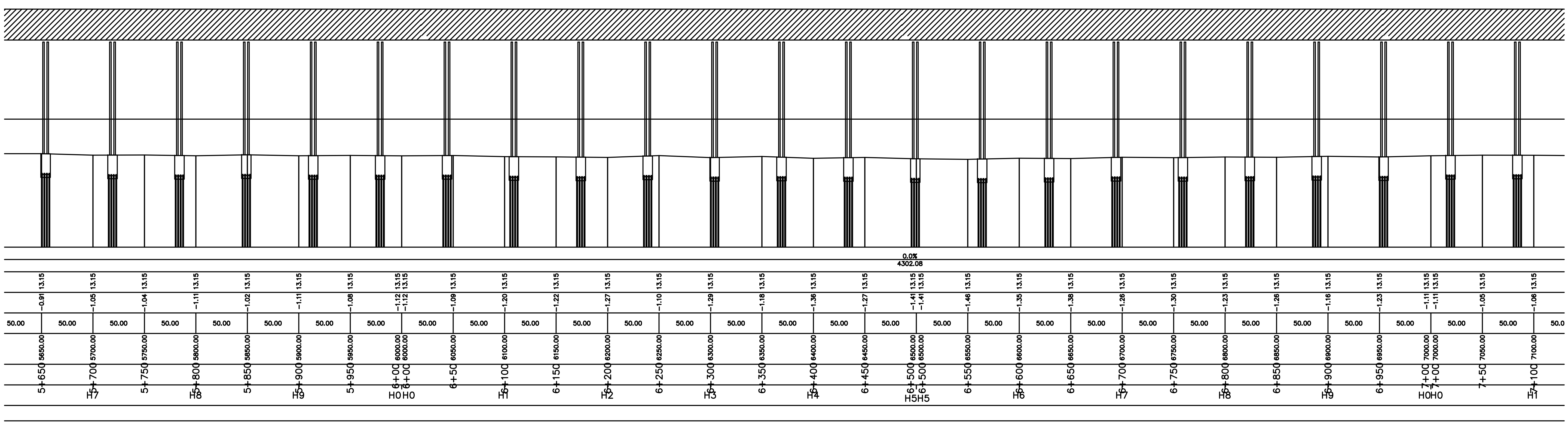
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-04



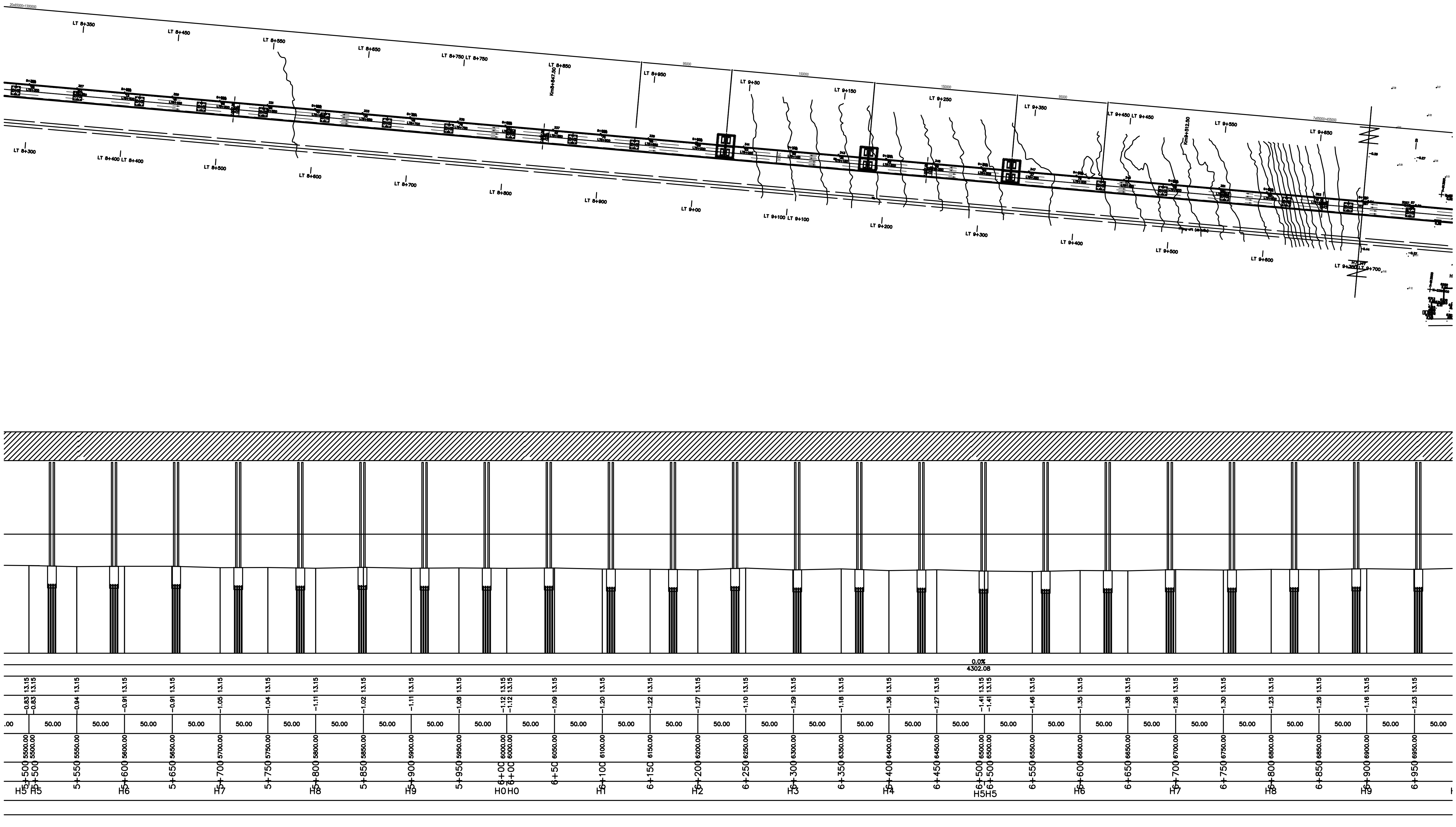


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-05

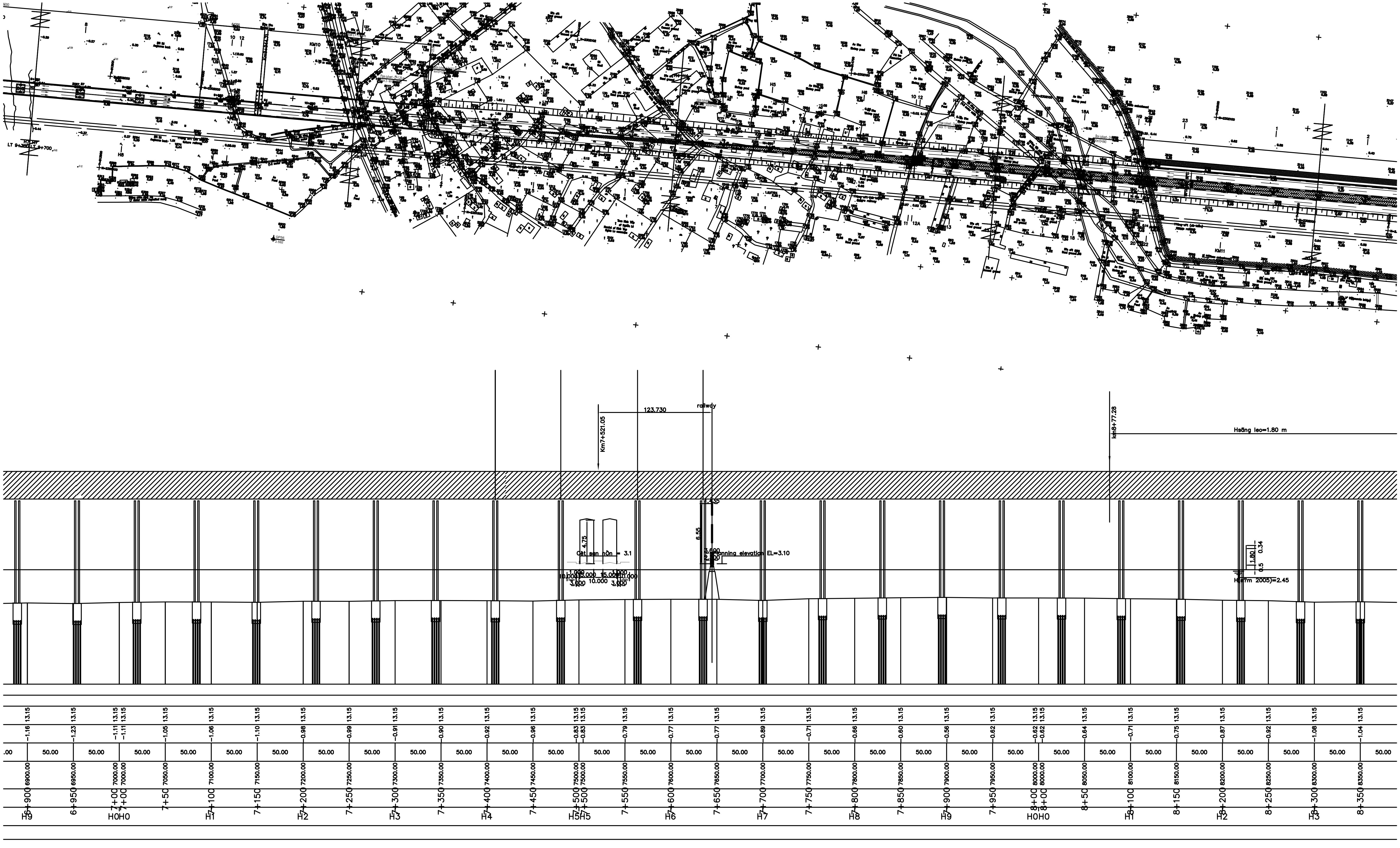




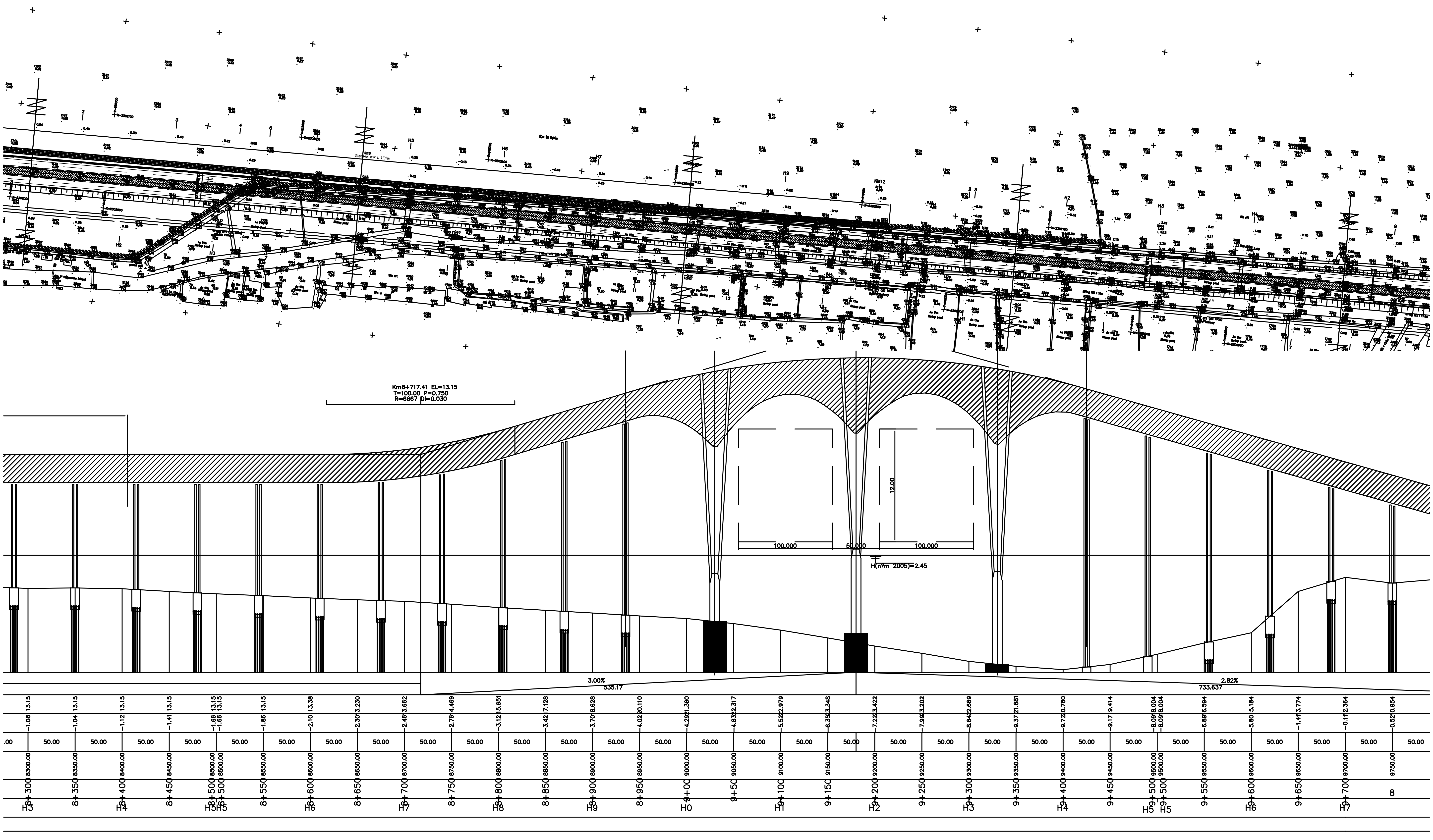
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-06



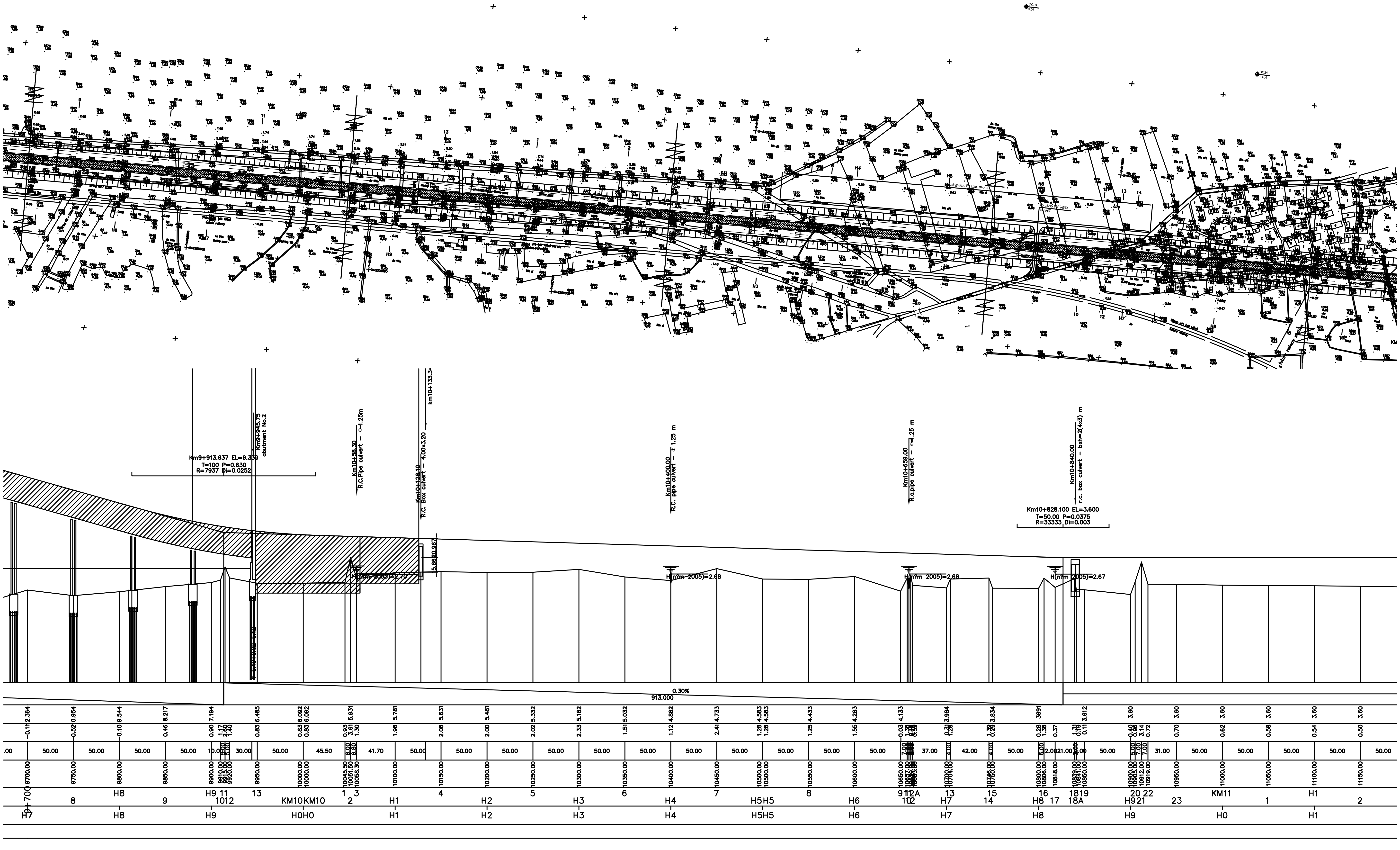
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-07



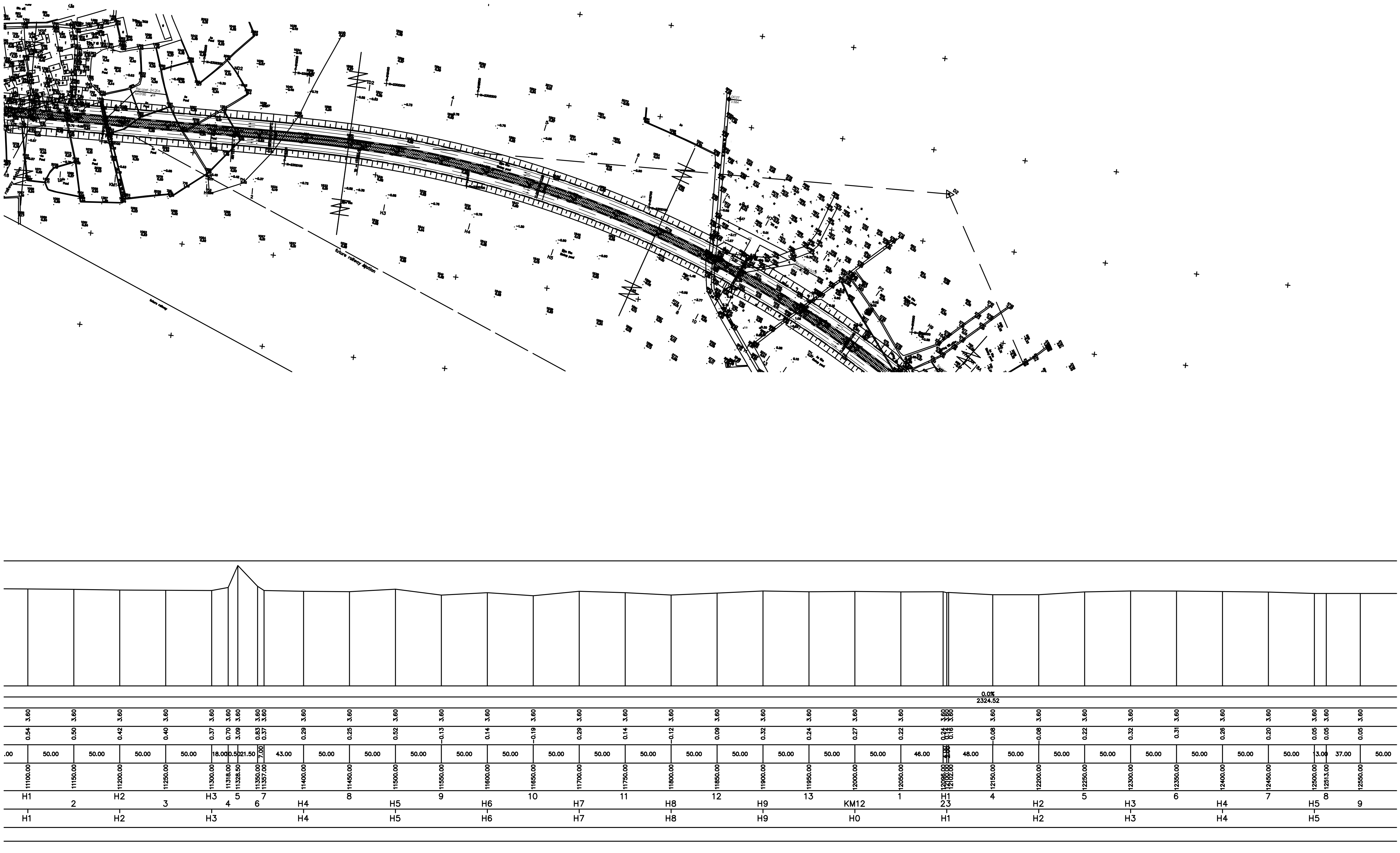
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-08



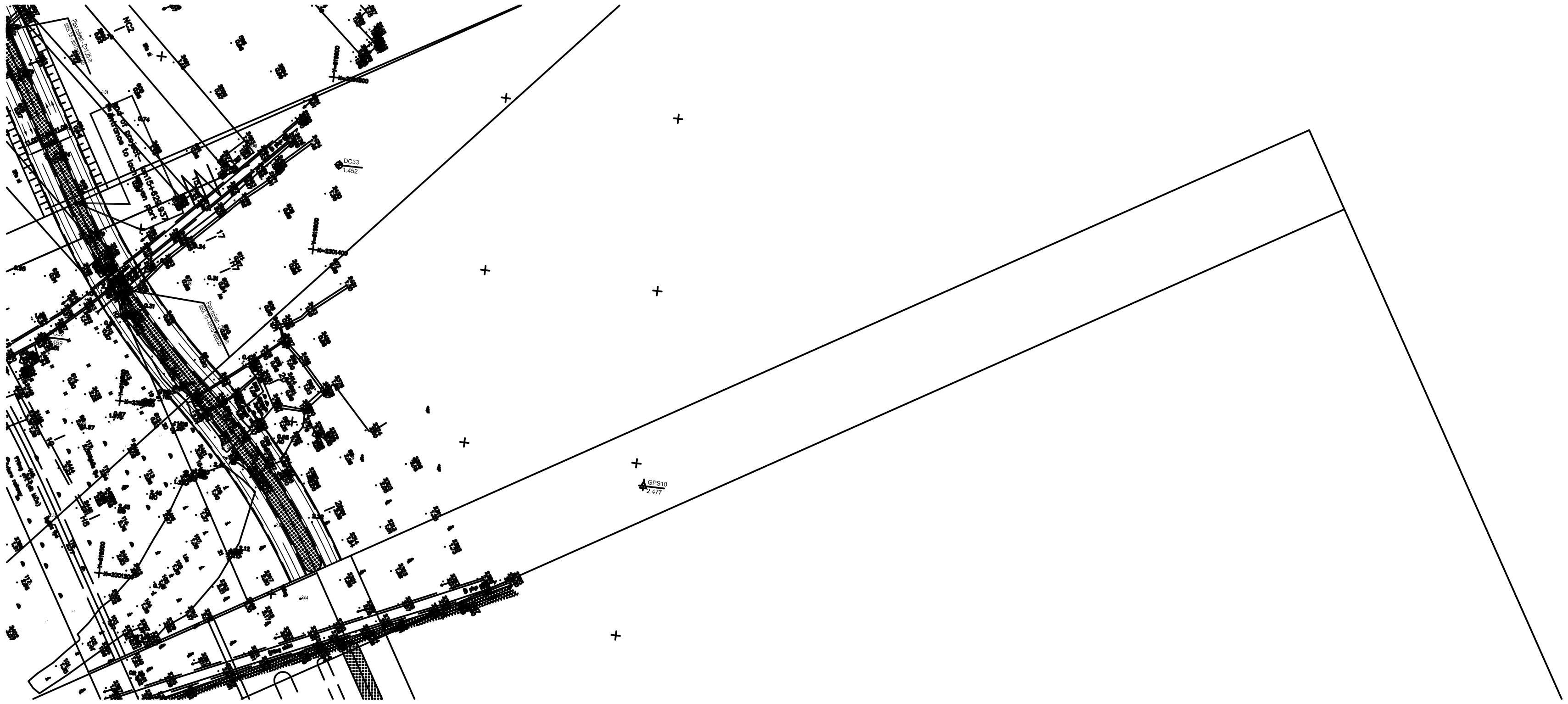
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-09

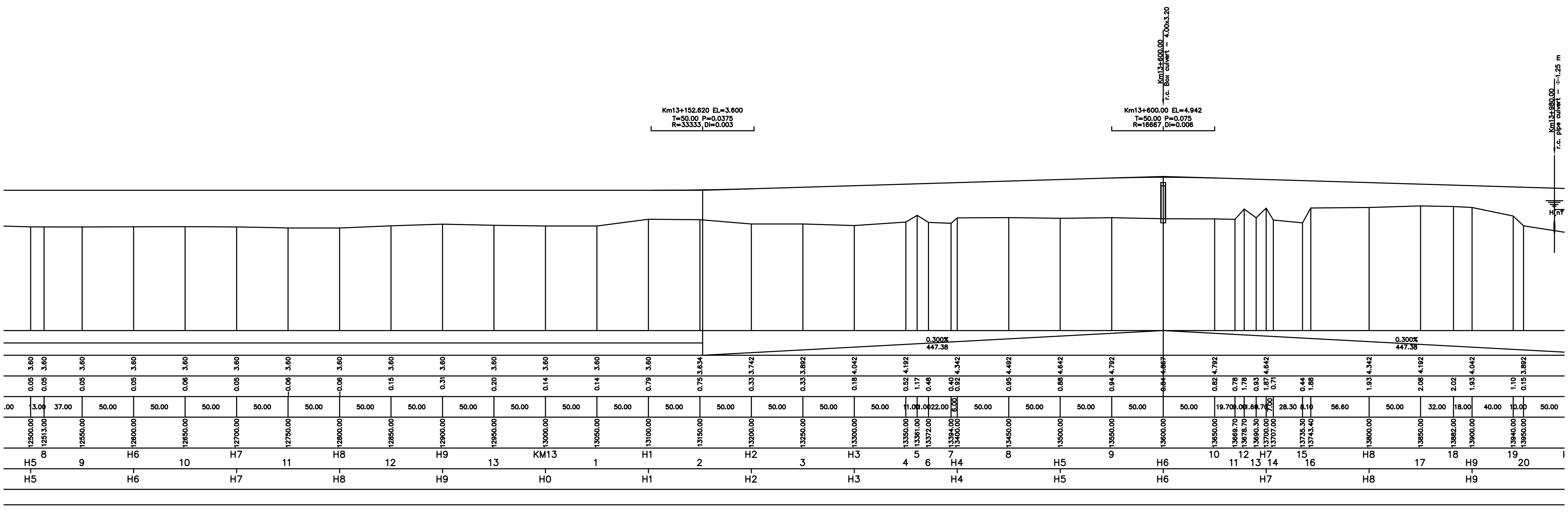


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-10

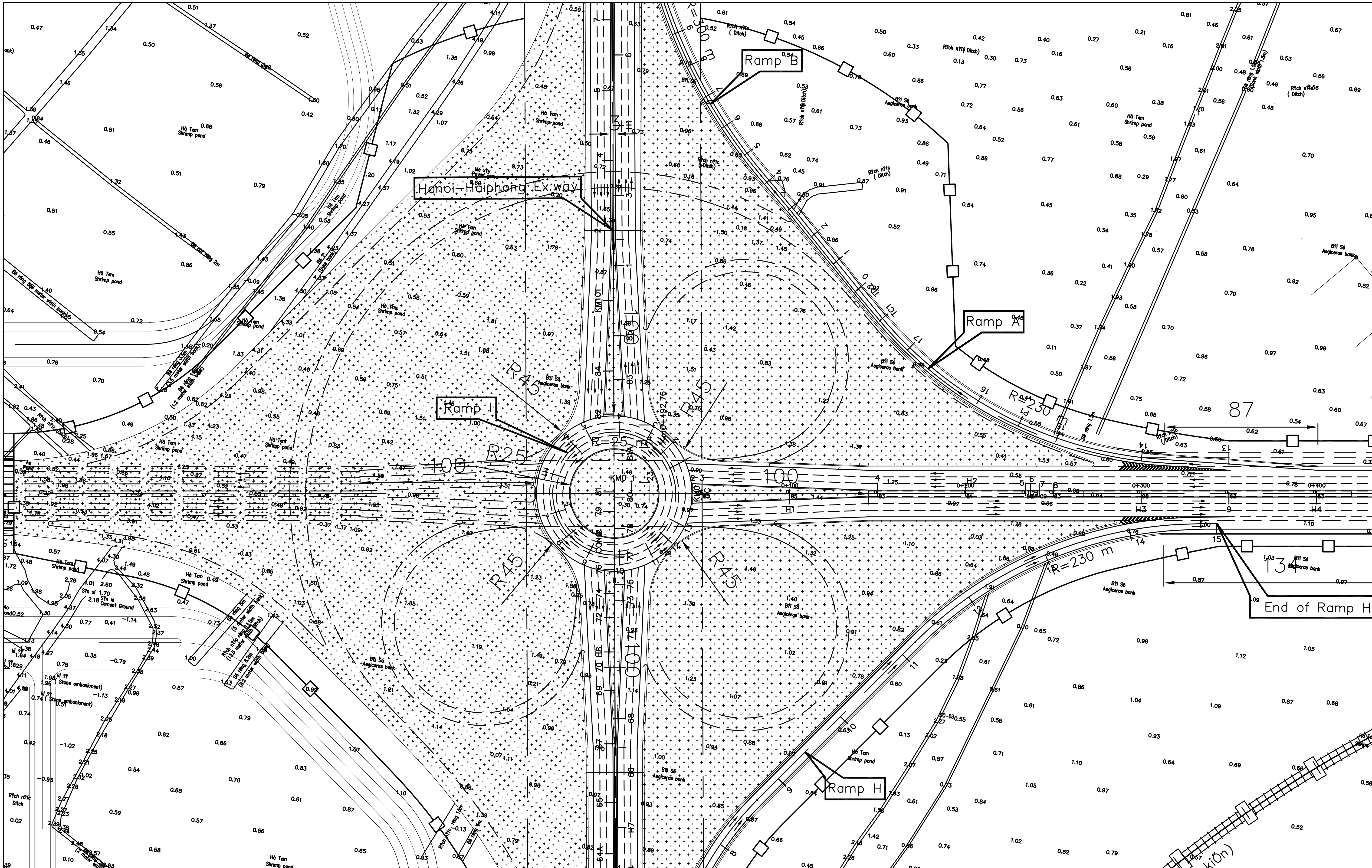


THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE: Plan and Profile	SCALE: 1:4000
	Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.		NO. R-02-11





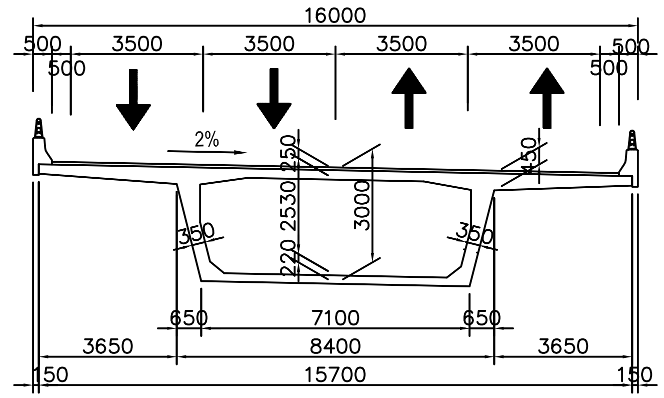
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Plan and Profile	SCALE 1:4000 NO. R-02-12



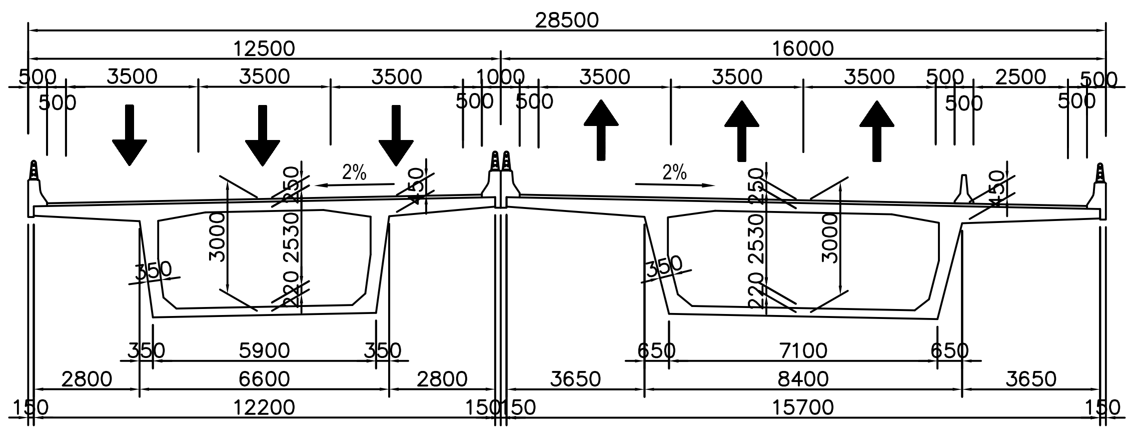
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Tan Vu Intersection (at grade)	SCALE 1:2000 NO. R-03

TYPICAL CROSS SECTIONS (Stage Construction, Full 6-lane)

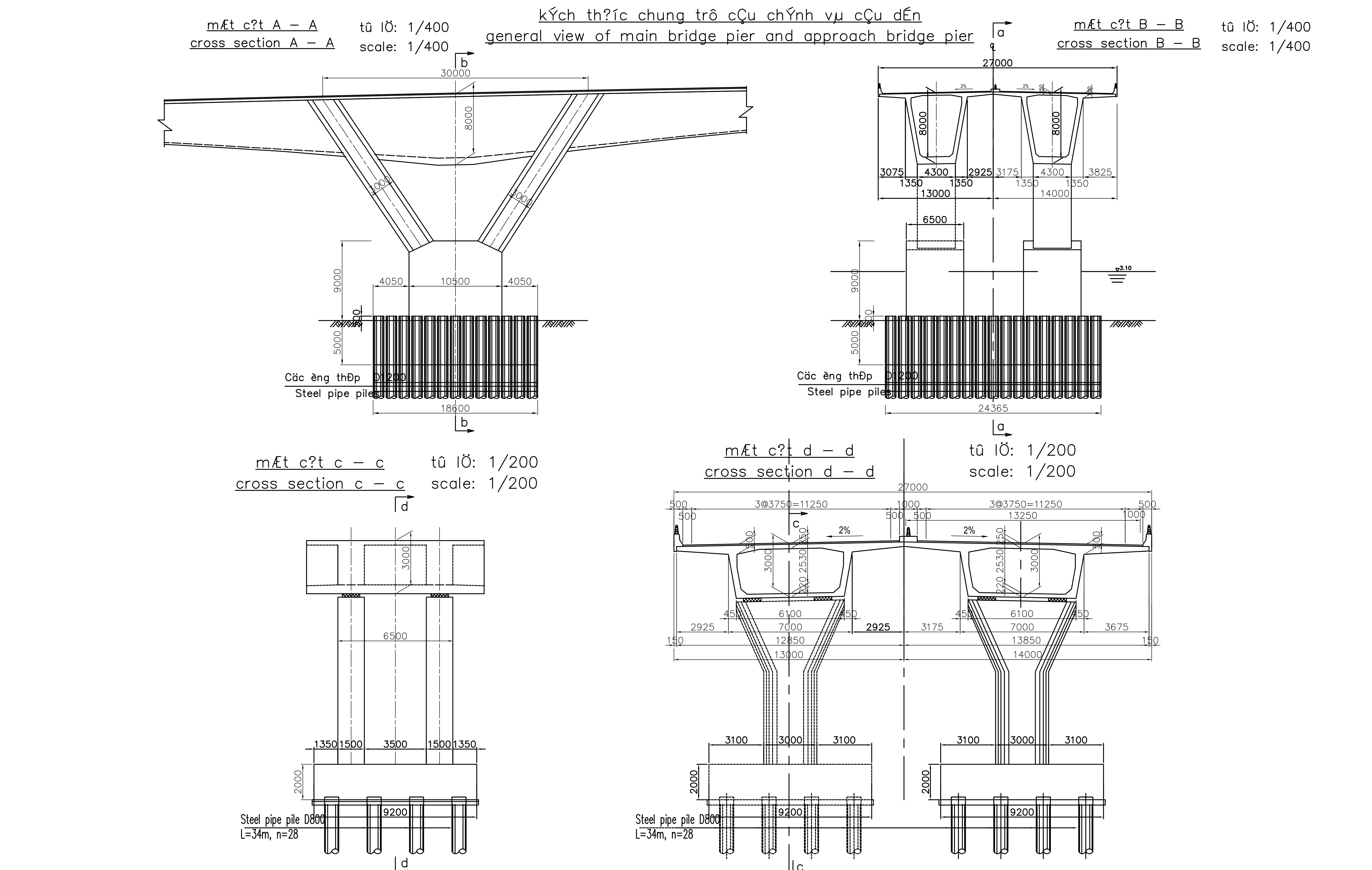
1st STAGE CONSTRUCTION, B_{bridge} = 16m
B_{lane} = 3.5m (4 LANES)



FULL SCALE CONSTRUCTION, B_{bridge} = 28.5m
B_{lane} = 3.5m (6 LANES)



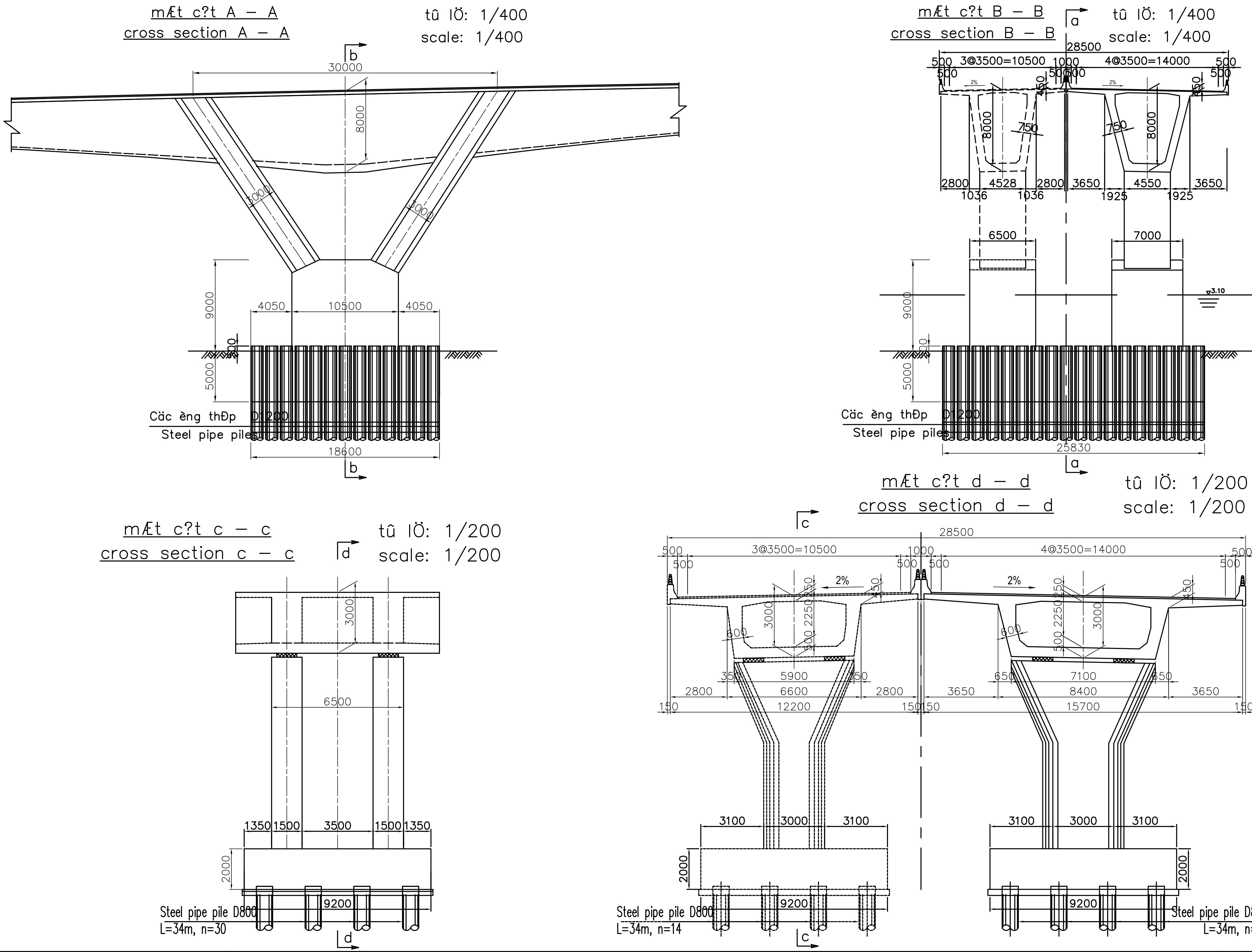
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE TYPICAL CROSS SECTIONS (Stage Construction,Full 6-lane)	SCALE 1:200 NO. B-01



THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE General View(1) Main Bridge	SCALE – NO. B-02

kÝch th?íc chung trô cÇu chÝnh vµ cÇu dÉn

general view of main bridge pier and approach bridge pier



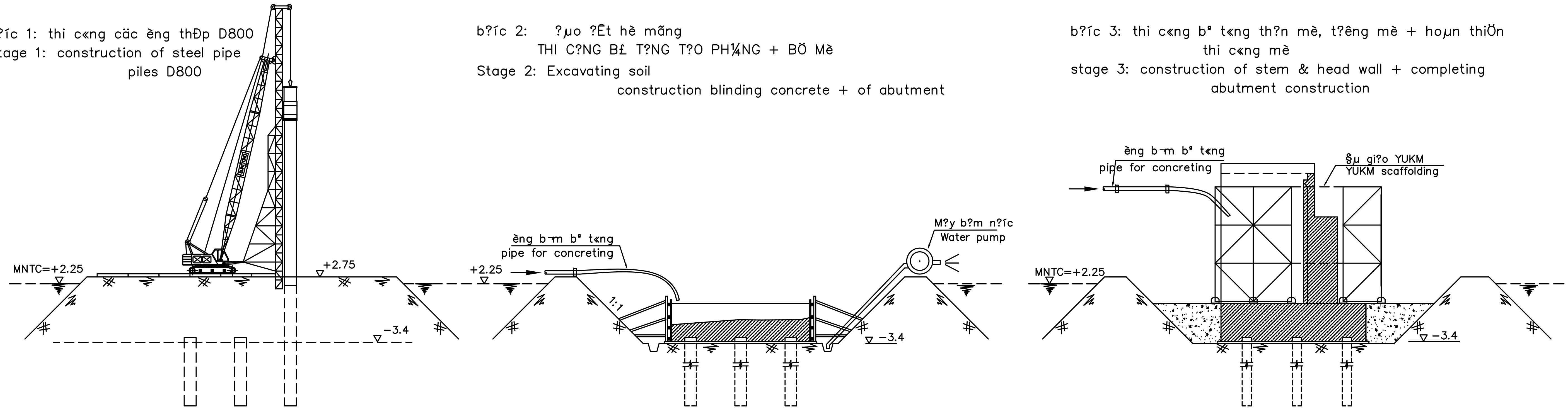
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE: General View(2) Approach Bridge
			SCALE: –
			NO. B-03

c?c b?íc thi c«ng mè – construction method of abutment

b?íc 1: thi c«ng cäc èng thÐp D800
Stage 1: construction of steel pipe piles D800

b?íc 2: ?µo ?Êt hè mãng
THI C?NG BÊ T?NG T?O PH¼NG + BÖ Mè
Stage 2: Excavating soil
construction blinding concrete + of abutment

b?íc 3: thi c«ng bª t«ng th?n mè, t?êng mè + hoµn thiÖn thi c«ng mè
stage 3: construction of stem & head wall + completing abutment construction

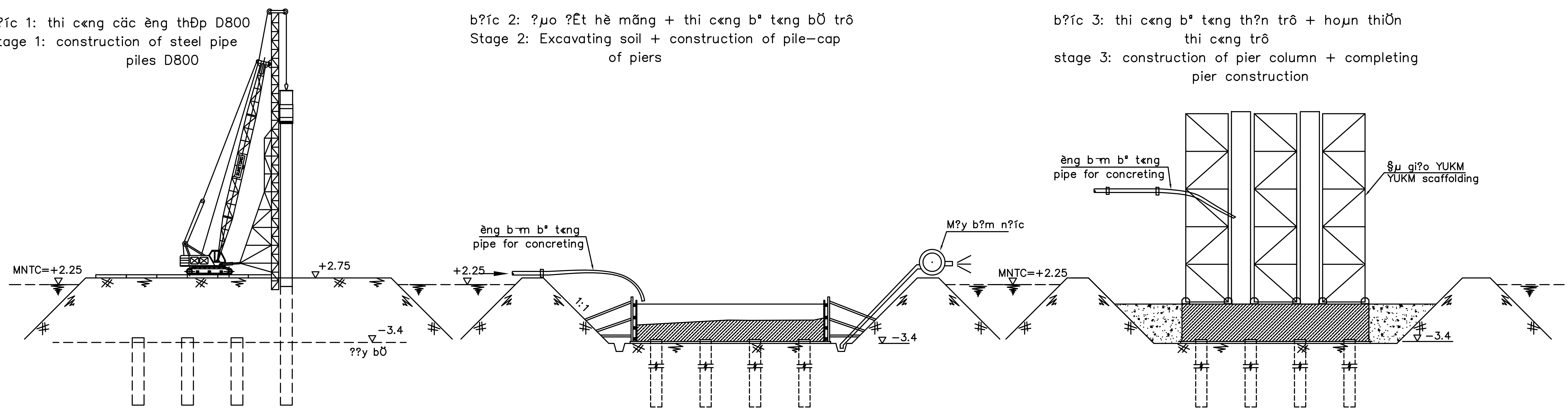


c?c b?íc thi c«ng trô cÇu dÉn – construction method of approach bridge pier

b?íc 1: thi c«ng cäc èng thÐp D800
Stage 1: construction of steel pipe piles D800

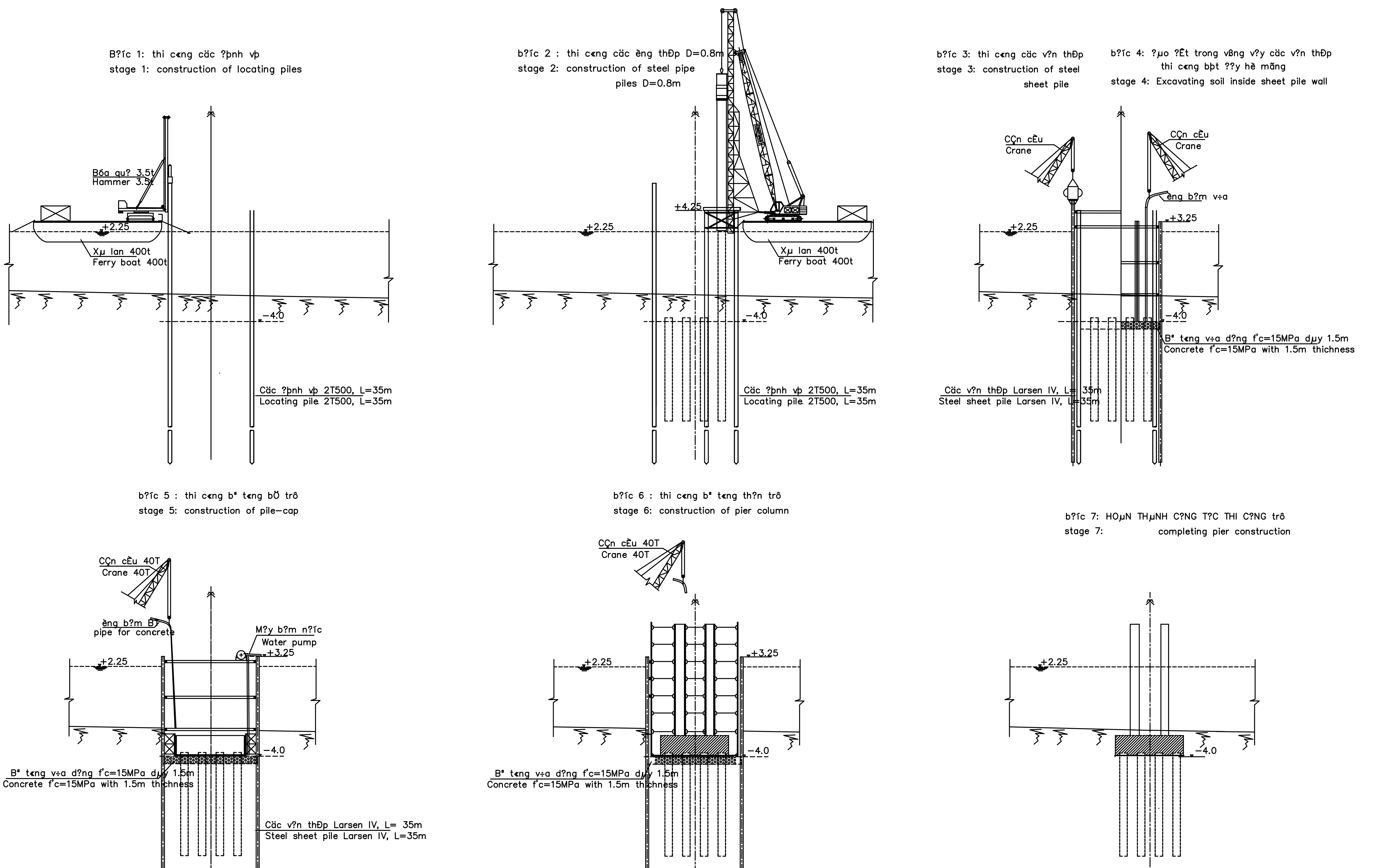
b?íc 2: ?µo ?Êt hè mãng + thi c«ng bª t«ng bÖ trô
Stage 2: Excavating soil + construction of pile-cap of piers

b?íc 3: thi c«ng bª t«ng th?n trô + hoµn thiÖn thi c«ng trô
stage 3: construction of pier column + completing pier construction



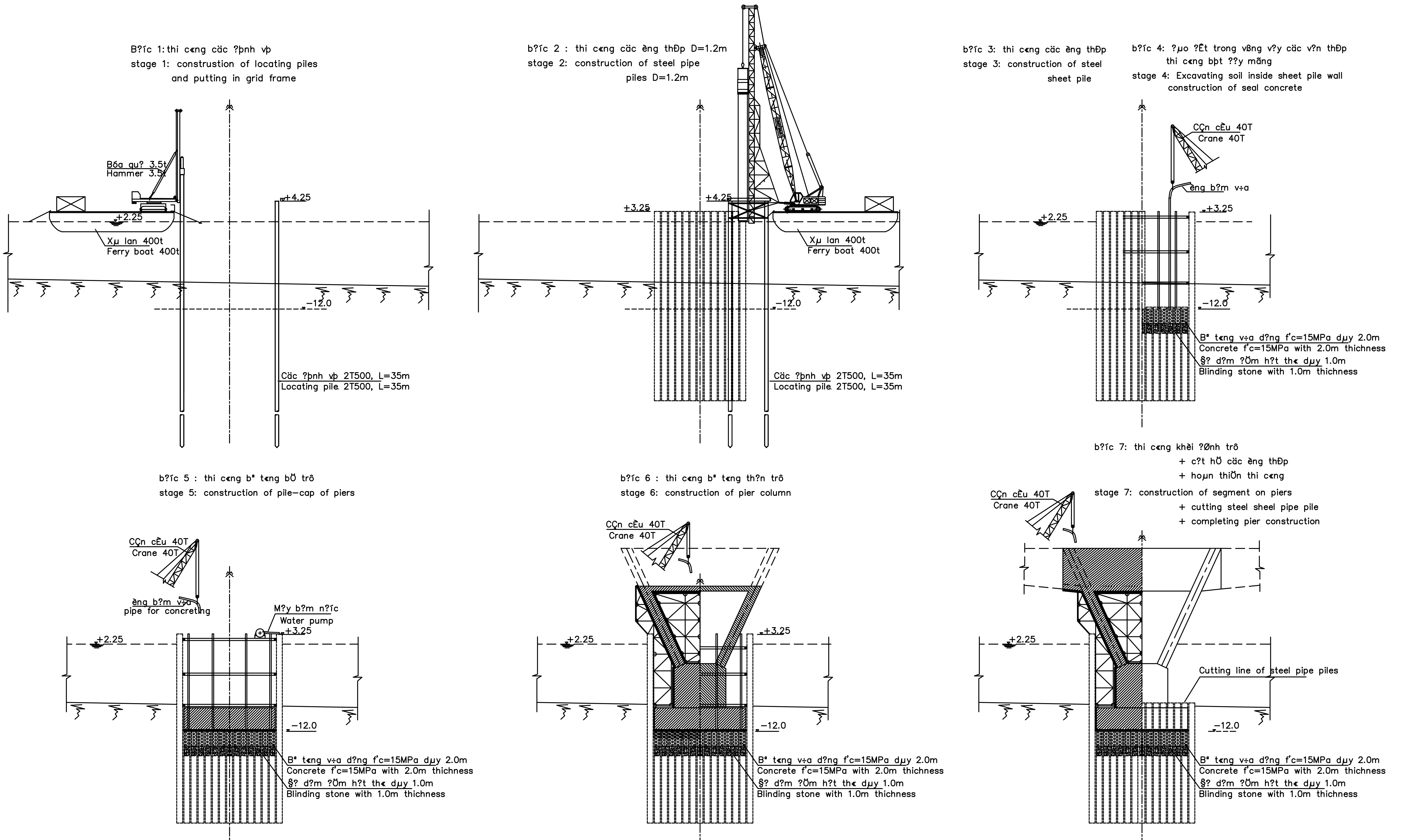
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Construction Method of Abutment and Approach Bridge Pier(On Land)	SCALE 1:1 NO. C-01

thi c«ng trô cÇu dÉn – construction method of approach bridge pier



THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Construction Method of Approach Bridge Pier (Off-shore)	SCALE 1:1 NO. C-02

thi c«ng trô cÇu chÝnh — construction method of main bridge pier



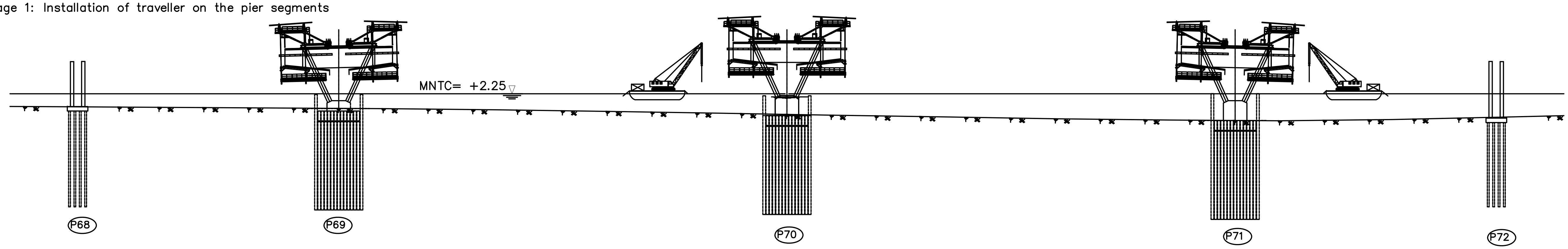
THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA ジャイカ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Ventuer of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Construction Method of Main Bridge Pier	SCALE 1:1 NO. C-03

?i T?n vð
to Tan vu

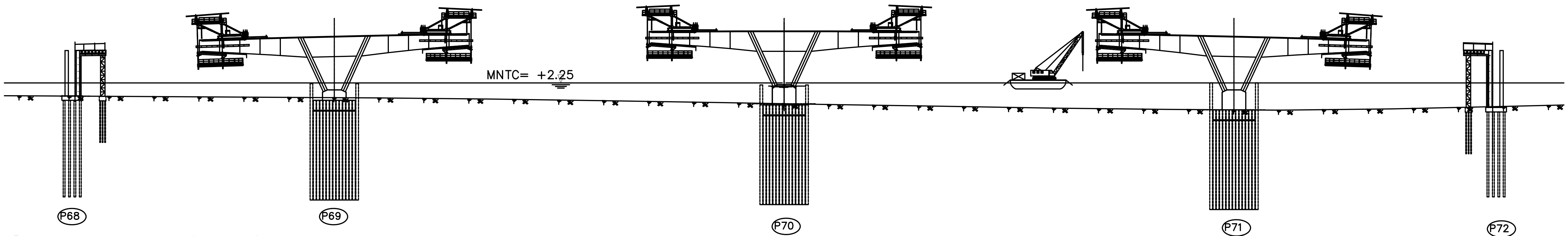
thi c«ng kÕt cÊu dÇm li°n tôc – construction method of main bridge superstructure

?i l?ch huyÖn
to lach huyen

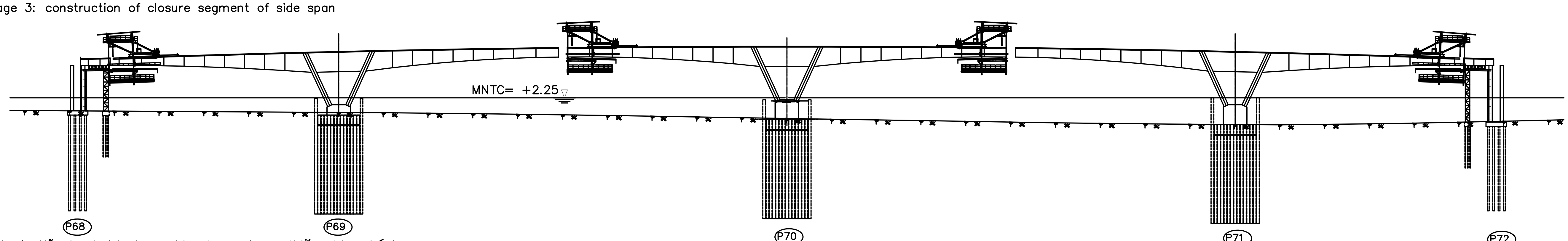
b?íc 1: l?p dùng xe ?óc t?i khèi tr°n ?Ønh trô
stage 1: Installation of traveller on the pier segments



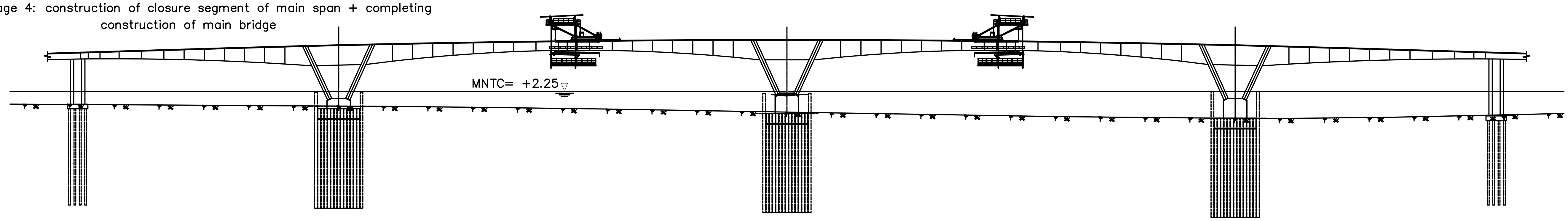
b?íc 2: thi c«ng c?c khèi theo ph??ng ph?p c?n b»ng ?èi xøng
stage 2: construction of segment by the balance cantilever method



b?íc 3: thi c«ng khèi hîp long cña nhip bi°n
stage 3: construction of closure segment of side span



b?íc 4: tiÕn hµnh hîp long nhip gi÷a + hoµn thiÖn nhþp chÝnh
stage 4: construction of closure segment of main span + completing construction of main bridge



THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Joint Venture of
Nippon Koei Co., Ltd. and
Japan Bridge & Structure Institute, Inc.

TITLE
Construction Method of Main Bridge Superstructure

SCALE 1:1000

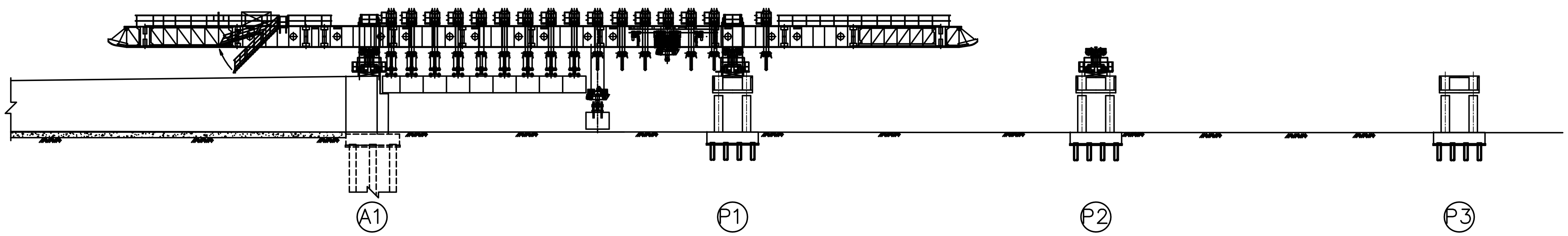
NO. C-04

?i T?n vò
to Tan vu

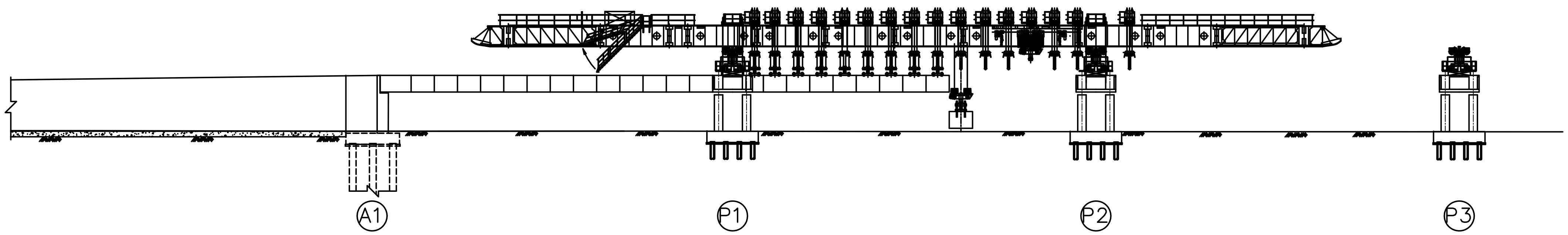
thi c«ng kÕt cÊu phÇn tr°n cña cÇu dÉn – construction method of approach bridge superstructure

?i l?ch huyÖn
to lach huyen

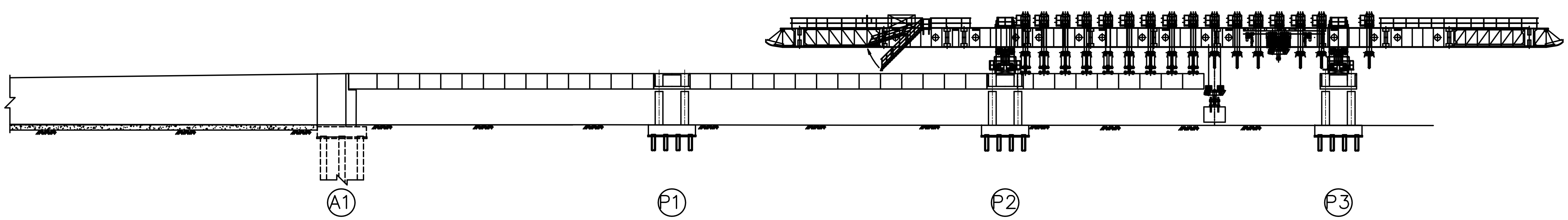
B?íC 1: THI C?NG nhþp 1
STAGE 1: CONSTRUCTION OF SPAN No.1



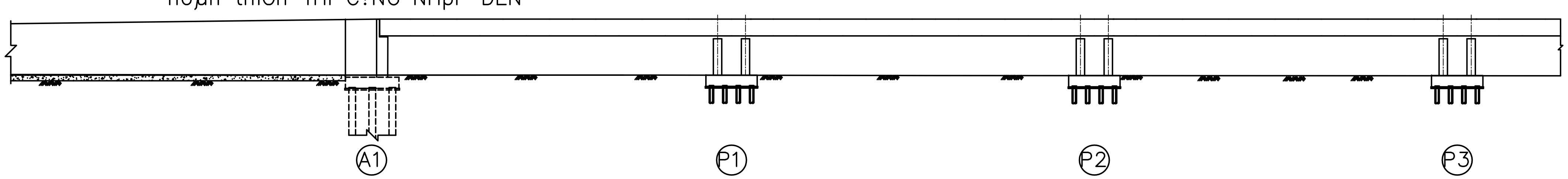
B?íC 2: THI C?NG nhþp 2
STAGE 2: CONSTRUCTION OF SPAN No.2



B?íC 3: THI C?NG nhþp 3
STAGE 3: CONSTRUCTION OF SPAN No.3

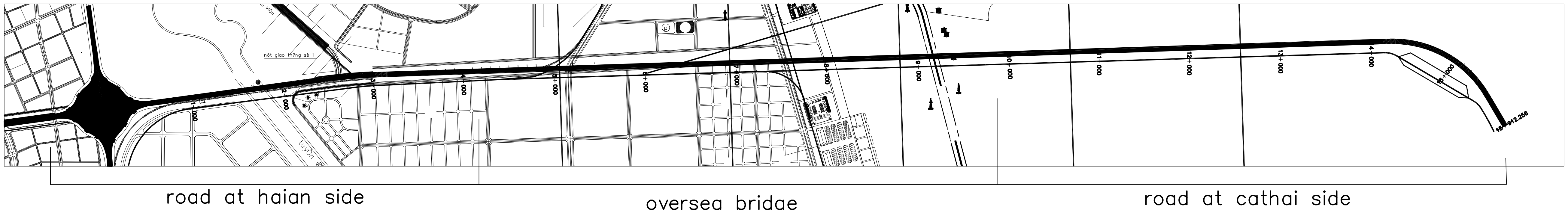


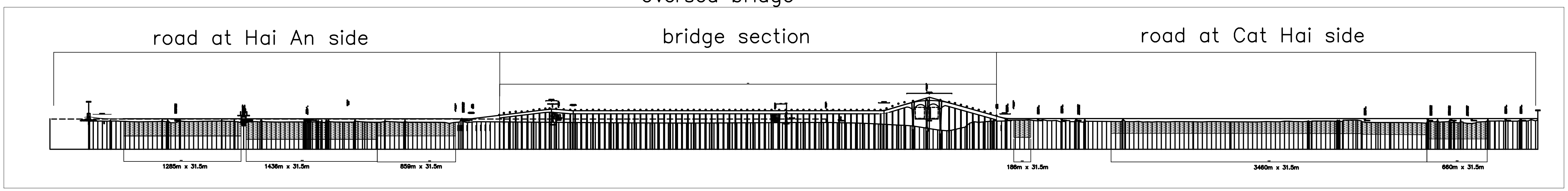
B?íC 4: – TIÕP TôC THI C?NG C?C NHþP DÉN KH?C t??ng tù
– hoµn thiÖn THI C?NG NHþP DÉN



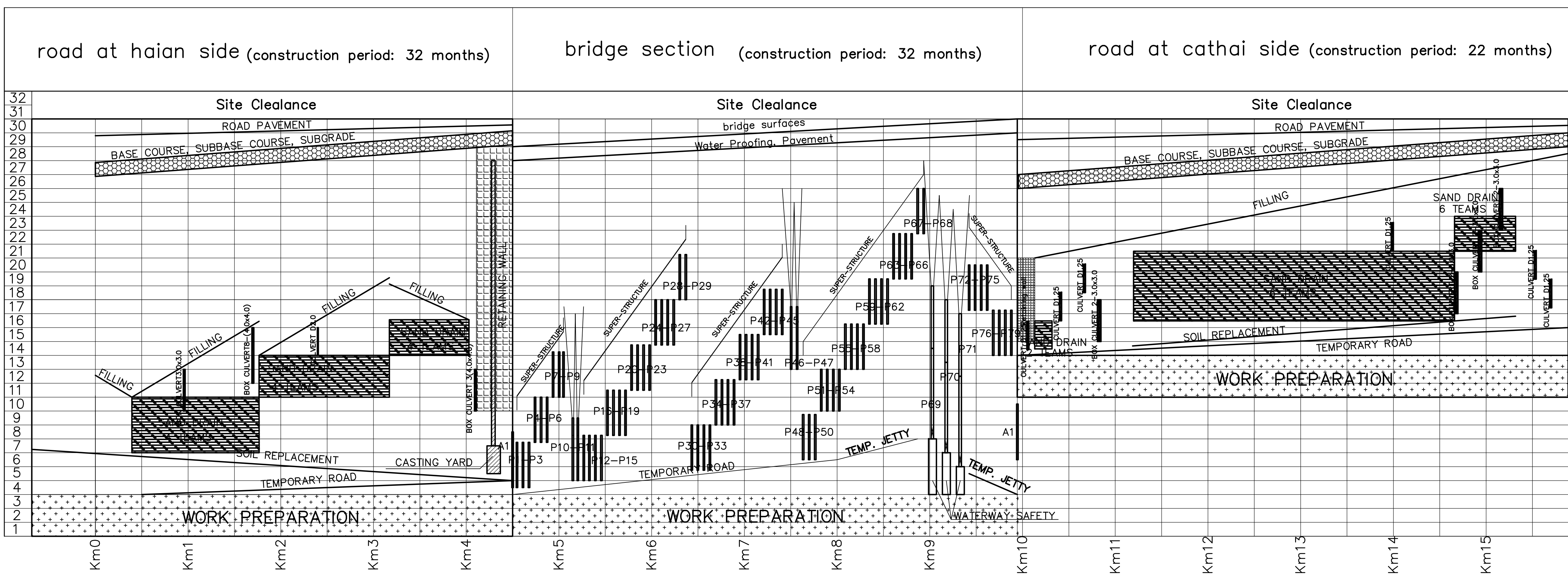
STAGE 4: – other spans are continue constructed as above stages
– CONSTRUCTION OF APPROACH SPANs IS COMPLETED

THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE Construction Method of Approach Bridge Superstructure	SCALE 1:1000 NO. C-05





construction schedule of alternative 3a



THE PREPARATORY SURVEY OF LACH HUYEN PORT CONSTRUCTION (ROAD AND BRIDGE PORTION)	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) Joint Venture of Nippon Koei Co., Ltd. and Japan Bridge & Structure Institute, Inc.	TITLE CONSTRUCTION SCHEDULE	SCALE 1:50 NO. C-06

Appendix-2: Traffic Data

Appendix-2-1: Traffic Count Data and Converted PCU

1. Summary of Counted Vehicles Number and PCU Number

Summary of Counted Vehicles Number

Unit: Vehicle

	Ninh Tiếp			Cat Hai			Ben Got		
Time	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total
6:00-7:00	12	89	101	66	76	142	47	72	119
7:00-8:00	85	53	138	84	45	129	62	21	83
8:00-9:00	31	21	52	42	40	82	36	35	71
9:00-10:00	53	16	69	72	34	106	45	31	76
10:00-11:00	31	11	42	47	21	68	19	18	37
11:00-12:00	23	21	44	32	19	51	24	39	63
12:00-13:00	0	15	15	28	34	62	9	0	9
13:00-14:00	46	28	74	56	79	135	26	53	79
14:00-15:00	28	35	63	45	35	80	18	19	37
15:00-16:00	27	28	55	69	47	116	53	24	77
16:00-17:00	23	40	63	67	61	128	32	38	70
17:00-18:00	86	0	86	76	54	130	24	30	54
12hr Total	445	357	802	684	545	1229	395	380	775

Summary of PCU Number

Unit: pcu

	Ninh Tiếp			Cat Hai			Ben Got		
Time	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total
6:00-7:00	3	24	27	22	31	53	12	31	43
7:00-8:00	55	33	88	53	10	63	39	7	46
8:00-9:00	20	6	26	29	12	41	17	10	27
9:00-10:00	18	5	23	30	11	41	15	9	24
10:00-11:00	25	5	30	27	10	37	8	7	15
11:00-12:00	11	21	32	11	12	23	20	30	50
12:00-13:00	0	9	9	7	11	18	3	0	3
13:00-14:00	23	18	41	25	26	51	13	26	39
14:00-15:00	27	17	44	19	12	31	5	7	12
15:00-16:00	14	21	35	30	27	57	34	20	54
16:00-17:00	15	29	44	21	25	46	8	18	26
17:00-18:00	23	0	23	31	14	45	17	8	25
12hr Total	234	188	422	305	201	506	191	173	364
24hr	281	226	507	366	241	607	229	208	437
D value	55.5%	44.5%		60.3%	39.7%		52.5%	47.5%	

2. Manual Classified Counts Vehicle and PCU

2.1. Ninh Tiep (Dinh Vu side ferry terminal)

DATE	27/04/2010							Investigator name					Dương Văn Tắc		
LOCATION		Ninh Tiếp													
Time	Counted Vehicle Number														
	To Cat Ba Direction							To Dinh Vu Direction							Total Movement
	1	2	3	4	5	6	Total	1	2	3	4	5	6	Total	
	0.2	0.3	1.0	2.0	2.5	4.0		0.2	0.3	1.0	2.0	2.5	4.0		
6:15							0	44	12		1			57	57
6:30	2	4					6		20					20	26
6:45		4					4		8					8	12
7:00		2					2		4					4	6
Hourly Total	2	10	0	0	0	0	12	44	44	0	1	0	0	89	101
pcu/hr	0	3	0	0	0	0	3	9	13	0	2	0	0	24	27
7:15		3					3	4	12		8	1		25	28
7:30	2	26	1	14			43	6	14					20	63
7:45	1	2					3	1	3		1			5	8
8:00	1	31	2	2			36		2	1				3	39
Hourly Total	4	62	3	16	0	0	85	11	31	1	9	1	0	53	138
pcu/hr	1	19	3	32	0	0	55	2	9	1	18	3	0	33	
8:15							0		4					4	4
8:30							0	1	13					14	14
8:45							0	1	1					2	2
9:00	4	21		5	1		31		1					1	32
Hourly Total	4	21	0	5	1	0	31	2	19	0	0	0	0	21	52
pcu/hr	1	6	0	10	3	0	20	0	6	0	0	0	0	6	
9:15							0		5					5	5
9:30							0		5					5	5
9:45							0		5					5	5
10:00	10	40	2	1			53		1					1	54
Hourly Total	10	40	2	1	0	0	53	0	16	0	0	0	0	16	69
pcu/hr	2	12	2	2	0	0	18	0	5	0	0	0	0	5	
10:15							0							0	0
10:30							0	1	6	1				8	8
10:45							0		1					1	1
11:00	3	18	1	9			31		1		1			2	33
Hourly Total	3	18	1	9	0	0	31	1	8	1	1	0	0	11	42
pcu/hr	1	5	1	18	0	0	25	0	2	1	2	0	0	5	
11:15							0		1	1	4	1		7	7
11:30							0		5	2				7	7
11:45	5	14	2	2			23		2		1			3	26
12:00							0		3		1			4	4
Hourly Total	5	14	2	2	0	0	23	0	11	3	6	1	0	21	44
pcu/hr	1	4	2	4	0	0	11	0	3	3	12	3	0	21	
12:15							0		6	1	2			9	9
12:30							0		5					5	5
12:45							0		1					1	1
13:00							0							0	0
Hourly Total	0	0	0	0	0	0	0	0	12	1	2	0	0	15	15
pcu/hr	0	0	0	0	0	0	0	0	4	1	4	0	0	9	
13:15							0		5	1	2			8	8
13:30	5	15		6			26	2	8		3			13	39
13:45							0		3					3	3
14:00	1	19					20	1	3					4	24
Hourly Total	6	34	0	6	0	0	46	3	19	1	5	0	0	28	74
pcu/hr	1	10	0	12	0	0	23	1	6	1	10	0	0	18	
14:15							0	1	18	2	1			22	22
14:30							0	1	5					6	6
14:45							0		4	1	1			6	6
15:00	3	15		9	1		28				1			1	29
Hourly Total	3	15	0	9	1	0	28	2	27	3	3	0	0	35	63
pcu/hr	1	5	0	18	3	0	27	0	8	3	6	0	0	17	
15:15							0	1	7		2			10	10
15:30	1	4		1	1		7		7		4	1		12	19
15:45		19		1			20		6					6	26
16:00							0							0	0
Hourly Total	1	23	0	2	1	0	27	1	20	0	6	1	0	28	55
pcu/hr	0	7	0	4	3	0	14	0	6	0	12	3	0	21	
16:15							0		3					3	3
16:30							0	1	14		1			16	16
16:45							0							0	0
17:00	2	16		5			23		12		9			21	44
Hourly Total	2	16	0	5	0	0	23	1	29	0	10	0	0	40	63
pcu/hr	0	5	0	10	0	0	15	0	9	0	20	0	0	29	
17:15							0							0	0
17:30							0							0	0
17:45	41	44		1			86							0	86
18:00							0							0	0
Hourly Total	41	44	0	1	0	0	86	0	0	0	0	0	0	0	86
pcu/hr	8	13	0	2	0	0	23	0	0	0	0	0	0	0	
Total	81	297	8	56	3	0	445	65	236	10	43	3	0	357	802
pcu/12hr	16	89	8	112	9	0	234	12	71	10	86	9	0	188	422

2.2. Cat Hai (Center of Cat Hai road)

DATE	27/04/2010							Investigator name					Nguyễn Minh Tài		
LOCATION	Cat Hai														
Time	Counted Vehicle Number														Total Movement
	To Cat Ba Direction							To Dinh Vu Direction							
	1	2	3	4	5	6	Total	1	2	3	4	5	6	Total	
	0.2	0.3	1.0	2.0	2.5	4.0		0.2	0.3	1.0	2.0	2.5	4.0		
6:15	15	9					24	11	8					19	43
6:30	11	8		1			20	18	6					24	44
6:45	5	5	1	1			12	8	9					17	29
7:00	5	4		1			10	4	5		6	1		16	26
Hourly Total	36	26	1	3	0	0	66	41	28	0	6	1	0	76	142
pcu/hr	7	8	1	6	0	0	22	8	8	0	12	3	0	31	53
7:15	21	8					29	16	4					20	49
7:30		14		7			21	2	5					7	28
7:45	5	6		7			18	4	3					7	25
8:00	7	5		4			16	5	5					10	26
Hourly Total	33	33	0	18	0	0	84	27	17	0	0	0	0	44	128
pcu/hr	7	10	0	36	0	0	53	5	5	0	0	0	0	10	63
8:15	1	4					5	3	1					4	9
8:30	2	1		1			4	1	5					6	10
8:45	6	7		3			16	6	13					19	35
9:00	4	7		6			17	6	4		1			11	28
Hourly Total	13	19	0	10	0	0	42	16	23	0	1	0	0	40	82
pcu/hr	3	6	0	20	0	0	29	3	7	0	2	0	0	12	41
9:15	5	7		1	1		14	4	7		1			12	26
9:30	6	2			1		9	3	5					8	17
9:45	15	4		2			21	3	4					7	28
10:00	9	16	3				28	1	6					7	35
Hourly Total	35	29	3	3	2	0	72	11	22	0	1	0	0	34	106
pcu/hr	7	9	3	6	5	0	30	2	7	0	2	0	0	11	41
10:15	6	6		1			13	1	3	1				5	18
10:30	5	6					11	4	1	1				6	17
10:45		8					8		5					5	13
11:00		5	5	5			15		3	1	1			5	20
Hourly Total	11	25	5	6	0	0	47	5	12	3	1	0	0	21	68
pcu/hr	2	8	5	12	0	0	27	1	4	3	2	0	0	10	37
11:15	6	8					14	5	6		2	1		14	28
11:30		2	1				3	2	1		1			4	7
11:45	2	5	2				9		1					1	10
12:00	4	1	1				6							0	6
Hourly Total	12	16	4	0	0	0	32	7	8	0	3	1	0	19	51
pcu/hr	2	5	4	0	0	0	11	1	2	0	6	3	0	12	23
12:15	1	3					4	1	3			1		5	9
12:30	4	4					8	1						1	9
12:45	1	2					3	1	4					5	8
13:00	4	9					13	12	11					23	36
Hourly Total	10	18	0	0	0	0	28	15	18	0	0	1	0	34	62
pcu/hr	2	5	0	0	0	0	7	3	5	0	0	3	0	11	18
13:15	10	10		2			22	13	13		3			29	51
13:30	4	10		3			17	14	5					19	36
13:45	2	4		1			7	17	5					22	29
14:00	3	7					10	2	6		1			9	19
Hourly Total	19	31	0	6	0	0	56	46	29	0	4	0	0	79	135
pcu/hr	4	9	0	12	0	0	25	9	9	0	8	0	0	26	51
14:15	5	3					8	5	2	2				9	17
14:30	5	4		1			10	6	1		1			8	18
14:45	6	9					15	4	3					7	22
15:00		8	1	3			12	5	6					11	23
Hourly Total	16	24	1	4	0	0	45	20	12	2	1	0	0	35	80
pcu/hr	3	7	1	8	0	0	19	4	4	2	2	0	0	12	31
15:15	4	9	1	4	1		19	2	4		6	1		13	32
15:30	5	1		1			7	6	6					12	19
15:45	18	4			1		23	7	11		1			19	42
16:00	14	6					20	1	2					3	23
Hourly Total	41	20	1	5	2	0	69	16	23	0	7	1	0	47	116
pcu/hr	8	6	1	10	5	0	30	3	7	0	14	3	0	27	57
16:15	10	4		1			15	6	6					12	27
16:30	24	8		1			33	8	10		1			19	52
16:45	2	12		1			15	6	10		1			17	32
17:00	1	3					4	1	7	3	2			13	17
Hourly Total	37	27	0	3	0	0	67	21	33	3	4	0	0	61	128
pcu/hr	7	8	0	6	0	0	21	4	10	3	8	0	0	25	46
17:15	9	5		2			16	9	5					14	30
17:30	14	14	1	3			32	5	8					13	45
17:45	8	7					15	7	7					14	29
18:00	2	10		1			13	4	9					13	26
Hourly Total	33	36	1	6	0	0	76	25	29	0	0	0	0	54	130
pcu/hr	7	11	1	12	0	0	31	5	9	0	0	0	0	14	45
Total	296	304	16	64	4	0	684	250	254	8	28	4	0	544	1228
pcu/12hr	59	92	16	128	10	0	305	48	77	8	56	12	0	201	506

2.3. Ben GOT (Cat Ba side ferry terminal)

DATE	27/04/2010							Investigator name					Phạm Đức Hoành		
LOCATION	Ben Got														
Time	Counted Vehicle Number														
	To Cat Ba Direction							To Dinh Vu Direction							Total Movement
	1	2	3	4	5	6	Total	1	2	3	4	5	6	Total	
	0.2	0.3	1.0	2.0	2.5	4.0		0.2	0.3	1.0	2.0	2.5	4.0		
6:15	13	4					17	28	9					37	54
6:30	2	16					18	4						4	22
6:45	1	6					7	2	2					4	11
7:00	1	4					5	7	12	1	6	1		27	32
Hourly Total	17	30	0	0	0	0	47	41	23	1	6	1	0	72	119
	3	9	0	0	0	0	12	8	7	1	12	3	0	31	43
7:15	5	10					15	3	11	1				15	30
7:30		9					9	1	3					4	13
7:45	2	12		10			24		2					2	26
8:00		10	2	2			14							0	14
Hourly Total	7	41	2	12	0	0	62	4	16	1	0	0	0	21	83
	1	12	2	24	0	0	39	1	5	1	0	0	0	7	46
8:15	1	19					20	3	21	1				25	45
8:30		5					5	1	1					2	7
8:45	3	2					5	2	4					6	11
9:00		2		4			6		2					2	8
Hourly Total	4	28	0	4	0	0	36	6	28	1	0	0	0	35	71
	1	8	0	8	0	0	17	1	8	1	0	0	0	10	27
9:15	1	3					4		2					2	6
9:30	1	8			1		10	2	21					23	33
9:45		1					1							0	1
10:00	13	16	1				30	3	3					6	36
Hourly Total	15	28	1	0	1	0	45	5	26	0	0	0	0	31	76
	3	8	1	0	3	0	15	1	8	0	0	0	0	9	24
10:15	4						4	1	8	2				11	15
10:30	1	1					2		3					3	5
10:45	1	2					3		1					1	4
11:00	1	7		2			10		3					3	13
Hourly Total	7	10	0	2	0	0	19	1	15	2	0	0	0	18	37
	1	3	0	4	0	0	8	0	5	2	0	0	0	7	15
11:15		1		5			6	3	16	2	2	5		28	34
11:30		2					2	1						1	3
11:45		4		1			5		9		1			10	15
12:00		7	4				11							0	11
Hourly Total	0	14	4	6	0	0	24	4	25	2	3	5	0	39	63
	0	4	4	12	0	0	20	1	8	2	6	13	0	30	50
12:15							0							0	0
12:30	3	1					4							0	4
12:45	1	4					5							0	5
13:00							0							0	0
Hourly Total	4	5	0	0	0	0	9	0	0	0	0	0	0	0	9
	1	2	0	0	0	0	3	0	0	0	0	0	0	0	3
13:15	1	2					3	14	9		6			29	32
13:30	2	6					8	2	9	1				12	20
13:45		2		2			4	1						1	5
14:00	1	9		1			11	1	9	1				11	22
Hourly Total	4	19	0	3	0	0	26	18	27	2	6	0	0	53	79
	1	6	0	6	0	0	13	4	8	2	12	0	0	26	39
14:15	1	4					5		1					1	6
14:30	2						2	1	4	2				7	9
14:45	3	1					4	2	2					4	8
15:00	2	5					7	5	2					7	14
Hourly Total	8	10	0	0	0	0	18	8	9	2	0	0	0	19	37
	2	3	0	0	0	0	5	2	3	2	0	0	0	7	12
15:15		5		6	2		13	2	15		6	1		24	37
15:30	1	7					8							0	8
15:45	1	14		1	1		17							0	17
16:00	7	8					15							0	15
Hourly Total	9	34	0	7	3	0	53	2	15	0	6	1	0	24	77
	2	10	0	14	8	0	34	0	5	0	12	3	0	20	54
16:15	2	2					4							0	4
16:30	5	3					8		4					4	12
16:45	5	1					6		1					1	7
17:00	8	6					14	2	25	3	3			33	47
Hourly Total	20	12	0	0	0	0	32	2	30	3	3	0	0	38	70
	4	4	0	0	0	0	8	0	9	3	6	0	0	18	26
17:15	1	6	2	3			12	1	1					2	14
17:30				1			1							0	1
17:45		3					3	5	23					28	31
18:00	3	4		1			8							0	8
Hourly Total	4	13	2	5	0	0	24	6	24	0	0	0	0	30	54
pcu/hr	1	4	2	10	0	0	17	1	7	0	0	0	0	8	25
Total	99	244	9	39	4	0	395	97	238	14	24	7	0	380	775
pcu/12hr	20	73	9	78	11	0	191	19	73	14	48	19	0	173	364

3. Speed Survey

Time	From Ninh Tiep to Cat Hai			From Cat Hai to Ninh Tiep		
	Departure time	Arrival time	Time required	Departure time	Arrival time	Time required
7:00	7h40'	8h01'	21'	7h11'	7h32'	21'
9:00	8h35'	8h54'	19'	8h05'	8h27'	22'
11:00	11h05'	11h25'	20'	11h40'	11h59'	19'
13:00	13h45'	14h06'	21'	14h20'	14h42'	22'
15:00	15h10'	15h30'	20'	16h15'	16h33'	18'
17:00	17h05'	17h26'	21'	17h35'	17h55'	20'

4. Ferry Track Record Survey

4.1. Summary of Dinh Vu-Cat Hai Ferry Track Record Survey

Year	Month	Type of vehicle							
		From Dinh Vu to Cat Hai and Cat Hai to Dinh Vu							
		1	2	3	4	5	6	Total	
		0.2	0.3	1.0	2.0	2.5	4.0		pcu/month
2002	Jan.								
	Feb								
	Mar								
	Apr								
	May	1,349	5,601	328	628	317		8,223	4,327
	Jun	4,173	15,827	1,365	2,242	1,373		24,980	14,864
	Jul	4,262	16,510	1,356	2,290	1,088		25,506	14,461
	Aug	4,180	16,520	821	1,500	485		23,506	10,826
	Sep	3,962	14,782	498	1,020	252		20,514	8,395
	Oct	3,728	12,467	506	1,145	226		18,072	7,847
	Nov	3,738	11,168	324	1,077	199		16,506	7,074
	Dec	3,030	10,696	294	1,171	217		15,408	6,993
	Total	28,422	103,571	5,492	11,073	4,157	-	152,715	74,787
	Total pcu/year	5,684	31,071	5,492	22,146	10,393	-	74,786	
	Average pcu/month	711	3,884	687	2,768	1,299	-	9,349	
	pcu/day	24	129	23	92	43	-	311	
2003	Jan.	4,239	12,280	281	1,050	222		18,072	7,468
	Feb	2,436	8,615	323	710	138		12,222	5,160
	Mar	2,949	8,081	400	1,212	210		12,852	6,363
	Apr	3,405	9,626	513	1,115	190		14,849	6,787
	May	2,728	10,288	661	1,281	322		15,280	7,660
	Jun	2,740	10,694	1,150	1,973	828		17,385	10,922
	Jul	2,098	9,858	1,049	1,966	698		15,669	10,103
	Aug	2,798	10,239	856	1,707	486		16,086	9,116
	Sep	2,689	9,744	422	966	192		14,013	6,295
	Oct	2,705	8,723	481	1,015	172		13,096	6,099
	Nov	3,049	9,796	381	821	192		14,239	6,052
	Dec	2,782	8,863	413	832	141		13,031	5,645
	Total	34,618	116,807	6,930	14,648	3,791	-	176,794	87,670
	Total pcu/year	6,924	35,042	6,930	29,296	9,478	-	87,670	
	Average pcu/month	866	4,380	866	3,662	1,185	-	10,959	
	pcu/day	29	146	29	122	40	-	366	
2004	Jan.	3,060	10,678	360	674	122		14,894	5,828
	Feb	2,595	7,335	508	779	136		11,353	5,126
	Mar	2,634	7,088	706	1,013	193		11,634	5,868
	Apr	3,157	11,500	628	1,133	202		16,620	7,480
	May	2,760	14,156	987	1,487	357		19,747	9,652
	Jun	2,488	10,841	1,194	2,197	956		17,676	11,728
	Jul	2,362	11,498	1,365	2,675	1,004		18,904	13,147
	Aug	2,406	10,586	906	2,244	695		16,837	10,789
	Sep	2,276	8,714	565	1,038	296		12,889	6,450
	Oct	2,249	8,904	479	947	232		12,811	6,074
	Nov	2,279	7,524	331	838	313		11,285	5,503
	Dec	1,950	7,454	447	974	222		11,047	5,576
	Total	30,216	116,278	8,476	15,999	4,728	-	175,697	93,221
	Total pcu/year	6,043	34,883	8,476	31,998	11,820	-	93,220	
	Average pcu/month	755	4,360	1,060	4,000	1,478	-	11,653	
	pcu/day	25	145	35	133	49	-	387	

Year	Month	Type of vehicle							
		From Dinh Vu to Cat Hai and Cat Hai to Dinh Vu							
		1	2	3	4	5	6	Total	
		0.2	0.3	1.0	2.0	2.5	4.0		pcu/month
2005	Jan.	1,968	6,794	456	1,003	199		10,420	5,391
	Feb	1,888	10,081	500	658	170		13,297	5,643
	Mar	2,026	8,409	709	1,189	268		12,601	6,685
	Apr	1,575	10,586	824	1,362	277		14,624	7,731
	May	1,591	11,449	1,074	1,698	559		16,371	9,620
	Jun	1,401	11,002	1,599	2,584	1,433		18,019	13,930
	Jul	1,851	10,996	1,678	3,009	1,455		18,989	15,003
	Aug	2,362	12,204	707	1,548	629		17,450	9,509
	Sep	1,990	10,082	520	1,156	304		14,052	7,015
	Oct	1,986	9,212	398	1,053	279		12,928	6,362
	Nov	1,767	8,598	319	999	227		11,910	5,817
	Dec	1,797	7,645	372	950	188		10,952	5,395
	Total	22,202	117,058	9,156	17,209	5,988	-	171,613	98,101
	Total pcu/year	4,440	35,117	9,156	34,418	14,970	-	98,101	
	Average pcu/month	555	4,390	1,145	4,302	1,871	-	12,263	
	pcu/day	19	146	38	143	62	-	408	
2006	Jan.	2,079	10,173	412	908	172		13,744	6,126
	Feb	1,429	9,604	401	730	183		12,347	5,486
	Mar	1,087	7,453	525	1,074	264		10,403	5,786
	Apr	1,308	9,356	767	1,617	319		13,367	7,867
	May	1,654	9,778	870	1,768	565		14,635	9,083
	Jun	1,701	8,847	1,128	2,963	1,809		16,448	14,571
	Jul	1,645	9,413	1,303	3,423	1,562		17,346	15,207
	Aug	1,355	6,531	607	1,503	631		10,627	7,421
	Sep	1,508	7,547	606	1,266	418		11,345	6,749
	Oct	1,484	6,834	477	1,137	335		10,267	5,936
	Nov	1,305	7,224	390	1,205	256		10,380	5,868
	Dec	1,621	8,273	540	1,301	282		12,017	6,653
	Total	18,176	101,033	8,026	18,895	6,796	-	152,926	96,753
	Total pcu/year	3,635	30,310	8,026	37,790	16,990	-	96,751	
	Average pcu/month	454	3,789	1,003	4,724	2,124	-	12,094	
	pcu/day	15	126	33	157	71	-	402	
2007	Jan.	1,603	6,708	400	1,047	189		9,947	5,300
	Feb	1,161	9,180	417	699	152		11,609	5,181
	Mar	1,034	6,511	440	1,074	204		9,263	5,258
	Apr	1,238	9,412	892	1,807	389		13,738	8,550
	May	1,101	8,032	655	1,639	539		11,966	7,910
	Jun	1,138	8,920	1,345	3,348	1,880		16,631	15,645
	Jul	1,814	8,929	1,458	3,972	1,741		17,914	16,796
	Aug	1,282	7,439	875	2,114	763		12,473	9,499
	Sep	1,167	6,984	610	1,577	362		10,700	6,998
	Oct	1,075	6,211	382	1,224	221		9,113	5,461
	Nov	1,042	6,731	443	1,253	216		9,685	5,717
	Dec	1,121	7,443	405	1,236	224		10,429	5,894
	Total	14,776	92,500	8,322	20,990	6,880	-	143,468	98,209
	Total pcu/year	2,955	27,750	8,322	41,980	17,200	-	98,207	
	Average pcu/month	369	3,469	1,040	5,248	2,150	-	12,276	
	pcu/day	12	116	35	175	72	-	410	

Year	Month	Type of vehicle							pcu/month
		From Dinh Vu to Cat Hai and Cat Hai to Dinh Vu							
		1	2	3	4	5	6	Total	
		0.2	0.3	1.0	2.0	2.5	4.0		
2008	Jan.	960	5,714	408	1,205	210		8,497	5,249
	Feb	814	9,073	380	950	177		11,394	5,607
	Mar	1,092	7,380	455	1,387	293		10,607	6,394
	Apr	766	8,553	594	1,786	323		12,022	7,693
	May	1,102	9,464	796	2,210	630		14,202	9,851
	Jun	1,255	8,631	1,052	3,330	1,458		15,726	14,197
	Jul	1,294	11,020	1,538	4,096	1,574		19,522	17,230
	Aug	1,196	8,619	718	2,049	638		13,220	9,236
	Sep	1,157	7,895	468	1,297	299		11,116	6,409
	Oct	1,571	7,284	300	1,286	244		10,685	5,981
	Nov	1,821	8,005	338	1,228	204		11,596	6,070
	Dec	1,750	7,932	347	1,179	196		11,404	5,925
	Total	14,778	99,570	7,394	22,003	6,246	-	149,991	99,842
	Total pcu/year	2,956	29,871	7,394	44,006	15,615	-	99,842	
	Average pcu/month	370	3,734	924	5,501	1,952	-	12,481	
	pcu/day	12	124	31	183	65	-	415	
2009	Jan.	996	10,604	415	978	184		13,177	6,211
	Feb	675	7,079	268	925	166		9,113	4,792
	Mar	772	7,940	490	1,406	242		10,850	6,443
	Apr	734	9,218	592	1,700	345		12,589	7,767
	May	859	9,934	774	2,108	705		14,380	9,905
	Jun	1,086	9,714	1,197	3,461	1,337		16,795	14,593
	Jul	838	10,545	1,366	3,912	1,201		17,862	15,524
	Aug	869	8,418	634	2,109	504		12,534	8,811
	Sep	1,238	8,282	379	1,288	300		11,487	6,437
	Oct	1,678	7,458	376	1,305	244		11,061	6,169
	Nov	2,007	7,198	400	1,208	215		11,028	5,914
	Dec	1,446	7,044	369	1,228	213		10,300	5,760
	Total	13,198	103,434	7,260	21,628	5,656	-	151,176	98,326
	Total pcu/year	2,640	31,030	7,260	43,256	14,140	-	98,326	
	Average pcu/month	330	3,879	908	5,407	1,768	-	12,292	
	pcu/day	11	129	30	180	59	-	409	

4.2. Summary of Cat Hai – Cat Ba Ferry Track Record Survey

Year	Month	Type of vehicle							pcu/month
		From Cat Hai to Cat Ba and Cat Ba Cat Hai							
		1	2	3	4	5	6	Total	
		0.2	0.3	1.0	2.0	2.5	4.0		
2002	Jan.								
	Feb								
	Mar								
	Apr								
	May	936	4,058	355	610	341		6,300	3,832
	Jun	2,172	10,875	1,118	1,893	1,263		17,321	11,758
	Jul	2,537	10,415	1,022	1,861	1,013		16,848	10,908
	Aug	2,192	9,985	553	1,304	508		14,542	7,865
	Sep	1,661	8,228	270	844	231		11,234	5,336
	Oct	1,180	5,936	283	911	215		8,525	4,659
	Nov	1,142	4,941	208	780	209		7,280	4,001
	Dec	1,528	5,338	156	885	229		8,136	4,406
	Total	13,348	59,776	3,965	9,088	4,009	-	90,186	52,765
	Total pcu/year	2,670	17,933	3,965	18,176	10,023	-	52,767	
	Average pcu/month	334	2,242	496	2,272	1,253	-	6,597	
	pcu/day	11	75	17	76	42	-	221	
2003	Jan.	2,000	6,651	149	837	236		9,873	4,808
	Feb	646	3,944	228	586	129		5,533	3,035
	Mar	463	3,606	259	955	198		5,481	3,838
	Apr	307	3,512	363	845	227		5,254	3,736
	May	133	2,700	549	957	320		4,659	4,100
	Jun	83	1,913	1,042	1,619	834		5,491	6,956
	Jul	37	1,279	843	1,489	616		4,264	5,752
	Aug	44	1,129	639	1,240	386		3,438	4,432
	Sep	35	621	268	686	121		1,731	2,136
	Oct	13	426	314	674	120		1,547	2,092
	Nov	16	417	209	522	187		1,351	1,849
	Dec	22	351	215	527	125		1,240	1,691
	Total	3,799	26,549	5,078	10,937	3,499	-	49,862	44,425
	Total pcu/year	760	7,965	5,078	21,874	8,748	-	44,425	
	Average pcu/month	95	996	635	2,734	1,094	-	5,554	
	pcu/day	3	33	21	91	36	-	184	
2004	Jan.	26	346	151	439	117		1,079	1,431
	Feb	12	287	232	516	132		1,179	1,683
	Mar	156	299	314	759	189		1,717	2,425
	Apr	113	1,180	443	800	184		2,720	2,880
	May	40	2,892	810	1,149	367		5,258	4,901
	Jun	37	1,477	917	1,778	907		5,116	7,191
	Jul	1,074	7,671	1,144	2,221	942		13,052	10,457
	Aug	1,171	6,468	679	1,589	592		10,499	7,512
	Sep	966	5,463	375	597	275		7,676	4,089
	Oct	754	5,684	268	578	238		7,522	3,875
	Nov	780	4,480	201	481	206		6,148	3,178
	Dec	980	4,234	237	462	184		6,097	3,087
	Total	6,109	40,481	5,771	11,369	4,333	-	68,063	52,709
	Total pcu/year	1,222	12,144	5,771	22,738	10,833	-	52,708	
	Average pcu/month	153	1,518	721	2,842	1,354	-	6,588	
	pcu/day	5	51	24	95	45	-	220	

Year	Month	Type of vehicle							pcu/month
		From Cat Hai to Cat Ba and Cat Ba Cat Hai							
		1	2	3	4	5	6	Total	
		0.2	0.3	1.0	2.0	2.5	4.0		
2005	Jan.	908	3,789	219	482	153		5,551	2,884
	Feb	1,041	5,428	201	327	141		7,138	3,044
	Mar	967	5,404	343	633	196		7,543	3,914
	Apr	976	7,070	508	856	242		9,652	5,141
	May	943	7,734	790	1,174	469		11,110	6,819
	Jun	1,031	7,226	1,065	1,948	1,158		12,428	10,230
	Jul	751	8,920	1,261	2,532	1,272		14,736	12,331
	Aug	1,071	9,058	558	1,233	597		12,517	7,448
	Sep	993	7,653	339	846	277		10,108	5,218
	Oct	928	7,110	214	679	228		9,159	4,461
	Nov	1,041	6,849	172	610	207		8,879	4,172
	Dec	1,109	5,610	162	639	175		7,695	3,782
	Total	11,759	81,851	5,832	11,959	5,115	-	116,516	69,444
	Total pcu/year	2,352	24,555	5,832	23,918	12,788	-	69,445	
	Average pcu/month	294	3,069	729	2,990	1,599	-	8,681	
	pcu/day	10	102	24	100	53	-	289	
2006	Jan.	1,273	6,812	193	536	160		8,974	3,963
	Feb	941	6,990	185	484	171		8,771	3,866
	Mar	776	5,543	269	770	230		7,588	4,202
	Apr	596	6,413	468	1,158	294		8,929	5,562
	May	895	6,304	538	1,297	492		9,526	6,432
	Jun	893	5,559	851	2,407	1,669		11,379	11,684
	Jul	852	5,762	1,009	2,814	1,413		11,850	12,069
	Aug	639	3,516	346	1,085	569		6,155	5,121
	Sep	544	4,389	382	826	346		6,487	4,325
	Oct	336	4,546	260	644	292		6,078	3,709
	Nov	450	4,412	178	573	226		5,839	3,303
	Dec	480	4,733	167	580	224		6,184	3,403
	Total	8,675	64,979	4,846	13,174	6,086	-	97,760	67,639
	Total pcu/year	1,735	19,494	4,846	26,348	15,215	-	67,638	
	Average pcu/month	217	2,437	606	3,294	1,902	-	8,456	
	pcu/day	7	81	20	110	63	-	281	
2007	Jan.	207	3,615	156	490	97		4,565	2,504
	Feb	328	5,140	135	330	23		5,956	2,460
	Mar	324	3,857	164	507	83		4,935	2,607
	Apr	210	5,119	527	1,119	296		7,271	5,083
	May	281	4,234	347	897	410		6,169	4,492
	Jun	557	6,418	1,169	3,090	1,969		13,203	14,308
	Jul	363	5,577	1,256	3,697	1,868		12,761	15,066
	Aug	138	4,366	811	2,019	854		8,188	8,321
	Sep	120	3,778	390	1,039	189		5,516	4,098
	Oct	132	3,086	200	697	184		4,299	3,006
	Nov	198	3,599	237	775	178		4,987	3,351
	Dec	103	3,503	201	732	198		4,737	3,232
	Total	2,961	52,292	5,593	15,392	6,349	-	82,587	68,528
	Total pcu/year	592	15,688	5,593	30,784	15,873	-	68,530	
	Average pcu/month	74	1,961	699	3,848	1,984	-	8,566	
	pcu/day	2	65	23	128	66	-	284	

Year	Month	Type of vehicle							pcu/month
		From Cat Hai to Cat Ba and Cat Ba Cat Hai							
		1	2	3	4	5	6	Total	
		0.2	0.3	1.0	2.0	2.5	4.0		
2008	Jan.	152	2,682	171	559	179		3,743	2,572
	Feb	44	4,610	155	454	166		5,429	2,870
	Mar	172	4,344	331	919	240		6,006	4,107
	Apr	87	4,768	463	1,324	349		6,991	5,431
	May	52	4,933	683	1,526	532		7,726	6,555
	Jun	40	4,751	1,113	2,888	1,441		10,233	11,925
	Jul	46	6,019	1,488	3,736	1,586		12,875	14,740
	Aug	42	4,615	657	1,716	692		7,722	7,212
	Sep	20	4,431	337	1,039	275		6,102	4,436
	Oct	22	4,244	256	994	232		5,748	4,102
	Nov	67	4,603	242	859	183		5,954	3,812
	Dec	73	4,325	236	870	192		5,696	3,768
	Total	817	54,325	6,132	16,884	6,067	-	84,225	71,530
	Total pcu/year	163	16,298	6,132	33,768	15,168	-	71,529	
	Average pcu/month	20	2,037	767	4,221	1,896	-	8,941	
	pcu/day	1	68	26	141	63	-	299	
2009	Jan.	23	4,663	231	698	193		5,808	3,513
	Feb	45	4,856	268	774	172		6,115	3,712
	Mar	42	4,937	397	1,213	244		6,833	4,923
	Apr	53	5,136	551	1,527	363		7,630	6,064
	May	47	6,163	796	1,991	742		9,739	8,491
	Jun	36	5,909	1,144	3,256	1,438		11,783	13,031
	Jul	62	6,238	1,325	3,562	1,290		12,477	13,558
	Aug	19	5,138	611	1,825	567		8,160	7,224
	Sep	23	4,236	325	1,038	303		5,925	4,434
	Oct	5	3,885	276	932	235		5,333	3,894
	Nov	1,231	4,128	223	883	189		6,654	3,946
	Dec	1,184	4,098	249	888	164		6,583	3,901
	Total	2,770	59,387	6,396	18,587	5,900	-	93,040	76,691
	Total pcu/year	554	17,816	6,396	37,174	14,750	-	76,690	
	Average pcu/month	69	2,227	800	4,647	1,844	-	9,587	
	pcu/day	2	74	27	155	61	-	319	

4.3. Ferry Track Record Survey Data (Dinh Vu-Cat Hai Ferry)

Year 2002

Order number	Type of vehicle	Unit	amount Month												Total	Total PCU	Average PCU/Mon.
			Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Passenger						11,663	30,900	32,007	26,834	19,660	15,116	14,106	13,565	163,851		
2	Bicycle						1,325	4,065	4,101	3,971	3,746	3,418	3,505	2,868	26,999	5,400	675
3	Bicycle with goods						6	61	110	179	194	291	201	141	1,183	237	30
4	Motorcycle						5,601	15,827	16,510	16,520	14,782	12,467	11,168	10,696	103,571	31,071	3,884
5	Cyclo						18	47	51	30	22	19	32	21	240	72	9
6	Car 4-6 seats						328	1,099	1,020	525	363	303	213	231	4,082	4,082	510
7	Bus						685	2,840	2,526	1,235	566	487	375	378	9,092	20,159	2,520
	< 9 seats						81	367	390	236	134	120	98	63	1,489	2,978	372
	9-24 seats						296	1,154	1,080	537	195	170	109	112	3,653	7,306	913
	24-32 seats						181	933	763	338	186	150	108	137	2,796	6,990	874
	< 32 seats						127	386	293	124	51	47	60	66	1,154	2,885	361
8	Truck						260	574	552	602	590	686	757	838	4,859	9,776	1,222
	< 1 ton																
	with goods						19	49	36	32	25	38	42	56	297	594	74
	non goods						16	60	30	33	34	29	37	43	282	564	71
	1 ton-3 ton																
	with goods						83	171	173	203	179	215	196	237	1,457	2,914	364
	non goods						71	118	117	145	132	150	155	190	1,078	2,156	270
	3 ton-5 ton																
	with goods						11	29	39	52	52	67	78	76	404	808	101
	non goods						13	38	46	47	36	44	62	81	367	734	92
	5 ton-10 ton																
	with goods						13	43	53	46	46	59	88	80	428	856	107
	non goods						25	46	48	37	74	65	70	65	430	860	108
	10 ton-13 ton																
	with goods						8	19	9	7	11	14	24	8	100	250	31
	non goods						1	1	1		1	5	5	2	16	40	5
9	Livestock																
10	Goods more 61 kg																
	Total Vehicles						8,223	24,513	24,870	23,062	20,263	17,671	16,251	15,173	150,026	70,797	8,850

Year 2003

Order number	Type of vehicle	Unit	amount Month												Total	Total PCU	Average PCU/Mon.
			Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Passenger		15,211	13,961	14,558	15,460	18,489	34,962	28,831	24,969	14,740	12,567	14,359	12,634	220,741		
2	Bicycle		4,068	2,436	2,937	3,405	2,724	2,738	2,098	2,793	2,686	2,703	3,049	2,782	34,419	6,884	574
3	Bicycle with goods		160		10		2	1		3		2			178	36	3
4	Motorcycle		12,280	8,615	8,081	9,626	10,288	10,694	9,858	10,239	9,744	8,723	9,796	8,863	116,807	35,042	2,920
5	Cyclo		11		2		2	1		2	3				21	6	1
6	Car 4-6 seats		225	251	330	425	581	986	821	634	280	338	272	293	5,436	5,436	453
7	Bus		358	267	480	510	779	2,065	1,707	1,391	484	424	372	319	9,156	20,027	1,669
	< 9 seats		51	48	133	132	153	309	250	316	122	109	78	71	1,772	3,544	295
	9-24 seats		114	107	180	212	346	938	822	613	188	169	132	133	3,954	7,908	659
	24-32 seats		130	47	84	101	172	580	441	335	73	54	63	34	2,114	5,285	440
	< 32 seats		63	65	83	65	108	238	194	127	101	92	99	81	1,316	3,290	274
8	Truck		819	468	816	657	674	513	586	631	575	689	607	614	7,649	15,431	1,286
	< 1 ton																
	with goods		27	24	43	42	43	28	35	38	34	40	18	43	415	830	69
	non goods		70	69	105	47	49	35	37	46	22	37	14	32	563	1,126	94
	1 ton-3 ton																
	with goods		215	116	214	172	163	140	157	138	165	177	171	151	1,979	3,958	330
	non goods		154	88	150	142	130	130	121	107	104	144	134	139	1,543	3,086	257
	3 ton-5 ton																
	with goods		70	32	70	64	80	56	61	83	73	96	84	72	841	1,682	140
	non goods		64	28	60	58	62	44	45	71	64	67	61	75	699	1,398	117
	5 ton-10 ton																
	with goods		101	51	72	57	59	42	62	76	51	51	48	44	714	1,428	119
	non goods		93	38	65	53	54	30	57	56	49	53	47	36	631	1,262	105
	10 ton-13 ton																
	with goods		20	9	22	14	16	7	4	7	6	10	20	14	149	373	31
	non goods		5	13	15	8	18	1	7	9	7	14	10	8	115	288	24
9	Livestock																
10	Goods more 61 kg			5	7	3	3	3		1	1				23		
	Total		17,921	12,037	12,656	14,623	15,050	16,998	15,070	15,693	13,772	12,879	14,096	12,871	173,666	82,862	6,905

Year 2004

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		13,503	11,305	10,346	18,079	25,293	33,932	36,249	24,890	11,615	11,165	9,468	9,046	214,891		
2	Bicycle		3,058	2,594	2,634	3,157	2,760	2,488	2,362	2,406	2,275	2,249	2,279	1,950	30,212	6,042	504
3	Bicycle with goods																
4	Motorcycle		10,678	7,335	7,088	11,500	14,156	10,841	11,498	10,586	8,714	8,904	7,524	7,454	116,278	34,883	2,907
5	Cyclo		2	1							1				4	1	0
6	Car 4-6 seats		280	340	358	477	847	964	1,178	728	458	389	302	379	6,700	6,700	558
7	Bus		319	372	402	590	1,066	2,371	2,785	1,823	629	476	429	408	11,670	25,373	2,114
	< 9 seats		106	151	145	186	335	481	605	380	188	142	110	110	2,939	5,878	490
	9-24 seats		105	111	140	230	408	995	1,222	835	193	149	153	126	4,667	9,334	778
	24-32 seats		29	47	52	75	182	613	720	377	119	53	144	54	2,365	5,913	493
	< 32 seats		79	63	65	99	141	282	238	231	129	132	122	118	1,699	4,248	354
8	Truck		460	505	599	721	722	662	713	926	659	670	610	755	8,002	16,204	1,350
	< 1 ton																
	with goods		25	23	38	34	44	42	41	74	45	40	46	46	498	996	83
	non goods		23	29	31	32	35	29	37	63	28	21	29	32	389	778	65
	1 ton-3 ton																
	with goods		143	117	164	200	185	156	186	242	163	140	106	171	1,973	3,946	329
	non goods		100	81	117	157	131	145	183	186	138	113	109	152	1,612	3,224	269
	3 ton-5 ton																
	with goods		58	85	78	98	96	74	72	97	65	100	69	68	960	1,920	160
	non goods		55	64	58	84	75	74	77	92	63	88	82	107	919	1,838	153
	5 ton-10 ton																
	with goods		23	44	38	47	70	55	58	64	56	68	59	62	644	1,288	107
	non goods		19	40	46	47	64	46	47	60	57	53	63	67	609	1,218	102
	10 ton-13 ton																
	with goods		6	13	15	12	15	26	8	26	22	18	21	27	209	523	44
	non goods		8	9	14	10	7	15	4	22	22	29	26	23	189	473	39
9	Livestock																
10	Goods more 61 kg				2	4				2	1				9		
	Total		14,797	11,147	11,081	16,445	19,551	17,326	18,536	16,469	12,736	12,688	11,144	10,946	172,866	89,203	7,434

Year 2005

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		7,188	11,576	11,605	15,298	22,316	37,165	44,919	28,703	16,900	11,927	11,670	9,581	228,848		
2	Bicycle		1,968	1,888	2,026	1,575	1,591	1,401	1,851	2,362	1,990	1,986	1,767	1,797	22,201	4,440	370
3	Bicycle with goods																
4	Motorcycle		6,794	10,081	8,409	10,586	11,449	11,002	10,996	12,204	10,082	9,212	8,598	7,645	117,058	35,117	2,926
5	Cyclo																
6	Car 4-6 seats		359	359	563	696	979	1,348	1,474	609	431	313	286	304	7,721	7,721	643
7	Bus		411	392	531	808	1,469	3,169	3,627	1,426	791	540	537	432	14,133	30,938	2,578
	< 9 seats		144	176	197	283	407	662	724	388	266	163	175	128	3,713	7,426	619
	9-24 seats		122	98	139	291	573	1,134	1,547	473	254	158	150	139	5,078	10,156	846
	24-32 seats		26	26	55	75	283	998	1,007	344	122	74	78	37	3,125	7,813	651
	< 32 seats		119	92	140	159	206	375	349	221	149	145	134	128	2,217	5,543	462
8	Truck		738	399	834	764	663	679	618	694	623	748	641	664	8,065	16,386	1,366
	< 1 ton																
	with goods		51	44	93	53	59	53	46	37	46	54	42	67	645	1,290	108
	non goods		47	40	68	47	53	40	41	47	31	45	40	58	557	1,114	93
	1 ton-3 ton																
	with goods		151	76	181	173	141	164	166	156	153	179	178	158	1,876	3,752	313
	non goods		152	79	167	149	117	134	121	112	109	147	142	125	1,554	3,108	259
	3 ton-5 ton																
	with goods		70	35	75	89	91	90	69	120	114	98	98	92	1,041	2,082	174
	non goods		77	21	73	83	61	70	65	76	82	87	65	64	824	1,648	137
	5 ton-10 ton																
	with goods		59	24	56	71	48	53	43	52	33	43	34	42	558	1,116	93
	non goods		77	33	59	57	38	50	32	30	25	35	27	36	499	998	83
	10 ton-13 ton																
	with goods		32	22	35	17	30	16	20	45	21	44	12	15	309	773	64
	non goods		22	25	27	25	25	9	15	19	9	16	3	7	202	505	42
9	Livestock																
10	Goods more 61 kg																
	Total		10,270	13,119	12,363	14,429	16,151	17,599	18,566	17,295	13,917	12,799	11,829	10,842	169,178	94,602	7,884

Year 2006

Order number	Type of vehicle	Unit	amount / Month: Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		10,685	13,708	11,713	17,971	24,283	52,596	50,926	18,975	14,090	9,664	8,244	9,591	242,446		
2	Bicycle		2,079	1,429	1,087	1,308	1,654	1,701	1,645	1,355	1,508	1,484	1,305	1,621	18,176	3,635	303
3	Bicycle with goods																
4	Motorcycle		10,173	9,604	7,453	9,356	9,778	8,847	9,413	6,531	7,547	6,834	7,224	8,273	101,033	30,310	2,526
5	Cyclo																
6	Car 4-6 seats		323	342	438	663	737	981	1,222	462	495	358	321	366	6,708	6,708	559
7	Bus		417	440	586	1,051	1,367	3,717	4,010	1,401	936	654	530	561	15,670	34,487	2,874
	< 9 seats		145	167	192	403	400	758	912	348	286	187	172	151	4,121	8,242	687
	9-24 seats		126	111	169	353	446	1,232	1,587	466	279	167	140	180	5,256	10,512	876
	24-32 seats		28	38	90	122	308	1,226	1,084	333	148	92	44	85	3,598	8,995	750
	< 32 seats		118	124	135	173	213	501	427	254	223	208	174	145	2,695	6,738	562
8	Truck		643	449	705	840	840	901	876	647	681	754	828	925	9,089	18,386	1,532
	< 1 ton																
	with goods		68	18	33	30	38	39	37	39	25	46	43	43	459	918	77
	non goods		61	19	40	30	32	31	26	26	22	35	37	63	422	844	70
	1 ton-3 ton																
	with goods		158	131	198	229	231	265	265	171	171	169	183	199	2,370	4,740	395
	non goods		153	99	156	167	157	172	155	120	145	143	190	219	1,876	3,752	313
	3 ton-5 ton																
	with goods		70	72	108	171	157	165	178	108	118	137	120	117	1,521	3,042	254
	non goods		59	43	73	105	114	89	78	60	93	99	110	135	1,058	2,116	176
	5 ton-10 ton																
	with goods		23	26	33	53	45	52	54	55	40	56	59	59	555	1,110	93
	non goods		26	22	25	32	33	40	36	35	28	34	58	43	412	824	69
	10 ton-13 ton																
	with goods		11	13	20	11	23	30	29	19	24	17	13	28	238	595	50
	non goods		14	6	19	12	10	18	18	14	15	18	15	19	178	445	37
9	Livestock																
10	Goods more 61 kg													1	1		
	Total		13,635	12,264	10,269	13,218	14,376	16,147	17,166	10,396	11,167	10,084	10,208	11,746	150,676	93,526	7,794

Year 2007

Order number	Type of vehicle	Unit	amount / Month: Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		7,154	8,827	7,648	16,713	17,848	56,431	59,014	27,058	16,463	9,231	9,595	10,376	246,358		
2	Bicycle		1,603	1,161	1,034	1,238	1,101	1,138	1,814	1,282	1,167	1,075	1,042	1,121	14,776	2,955	246
3	Bicycle with goods																
4	Motorcycle		6,708	9,180	6,511	9,412	8,032	8,920	8,929	7,439	6,984	6,211	6,731	7,443	92,500	27,750	2,313
5	Cyclo																
6	Car 4-6 seats		309	320	347	762	548	1,242	1,352	793	516	331	395	335	7,250	7,250	604
7	Bus		466	404	526	1,267	1,264	4,271	4,656	2,015	1,112	610	592	646	17,829	38,957	3,246
	< 9 seats		173	159	196	533	392	1,000	1,229	582	406	253	220	254	5,397	10,794	900
	9-24 seats		119	101	142	386	370	1,424	1,718	703	355	156	183	177	5,834	11,668	972
	24-32 seats		50	21	57	174	245	1,295	1,263	453	187	57	57	81	3,940	9,850	821
	< 32 seats		124	123	131	174	257	552	446	277	164	144	132	134	2,658	6,645	554
8	Truck		713	393	684	838	836	805	876	745	648	734	788	732	8,792	17,666	1,472
	< 1 ton																
	with goods		44	43	43	33	39	42	57	29	34	19	26	33	442	884	74
	non goods		43	29	27	30	34	36	41	36	29	22	32	44	403	806	67
	1 ton-3 ton																
	with goods		173	92	174	219	239	221	234	199	168	183	168	174	2,246	4,492	374
	non goods		189	93	130	180	119	172	206	188	134	153	178	151	1,893	3,786	316
	3 ton-5 ton																
	with goods		76	42	107	109	154	143	149	106	130	140	166	119	1,441	2,882	240
	non goods		85	36	91	113	88	81	89	82	81	107	117	76	1,046	2,092	174
	5 ton-10 ton																
	with goods		49	27	62	74	87	59	56	48	40	66	37	69	674	1,348	112
	non goods		39	25	41	56	44	44	37	38	26	33	42	59	484	968	81
	10 ton-13 ton																
	with goods		7	3	7	15	25	5	3	12	1	7	15	3	103	258	22
	non goods		6	3	2	9	7	2	4	7	5	4	7	4	60	150	13
9	Livestock																
10	Goods more 61 kg																
	Total		9,799	11,458	9,102	13,517	11,781	16,376	17,627	12,274	10,427	8,961	9,548	10,277	141,147	94,578	7,882

Year 2008

Order number	Type of vehicle	Unit	amount Month												Total	Total PCU	Average PCU/Mon.
			Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Passenger		7,445	11,583	11,908	14,822	24,192	46,400	61,829	27,636	14,790	10,699	11,317	10,190	252,811		
2	Bicycle		960	814	1,092	756	1,102	1,255	1,294	1,196	1,157	1,571	1,821	1,750	14,768	2,954	246
3	Bicycle with goods					10									10	2	0
4	Motorcycle		5,714	9,073	7,380	8,553	9,464	8,631	11,020	8,619	7,895	7,284	8,005	7,932	99,570	29,871	2,489
5	Cyclo																
6	Car 4-6 seats		342	317	394	529	740	998	1,480	655	407	278	306	319	6,765	6,765	564
7	Bus		563	551	727	1,014	1,592	3,567	4,536	1,896	824	577	586	568	17,001	36,914	3,076
	< 9 seats		229	229	274	487	618	1,064	1,363	642	284	218	246	272	5,926	11,852	988
	9-24 seats		139	162	204	258	419	1,100	1,646	638	258	145	164	119	5,252	10,504	875
	24-32 seats		36	34	105	133	324	964	1,082	369	123	65	55	49	3,339	8,348	696
	< 32 seats		159	126	144	136	231	439	445	247	159	149	121	128	2,484	6,210	518
8	Truck		760	485	836	1,012	1,158	1,132	1,011	700	654	876	743	741	10,107	20,347	1,696
	< 1 ton																
	with goods		43	24	41	40	43	32	53	36	29	48	26	43	458	916	76
	non goods		46	28	41	45	47	32	42	31	22	40	25	49	448	896	75
	1 ton-3 ton																
	with goods		148	110	170	197	266	226	246	161	162	217	176	168	2,247	4,494	375
	non goods		182	104	166	179	194	224	238	172	171	200	171	193	2,194	4,388	366
	3 ton-5 ton																
	with goods		135	89	132	141	160	128	152	102	109	130	116	107	1,501	3,002	250
	non goods		92	53	87	75	92	77	86	69	85	121	106	82	1,025	2,050	171
	5 ton-10 ton																
	with goods		60	37	83	220	215	277	120	61	37	52	59	53	1,274	2,548	212
	non goods		47	32	83	69	84	97	58	55	34	50	48	38	695	1,390	116
	10 ton-13 ton																
	with goods		6	3	20	38	39	23	13	11	4	10	15	4	186	465	39
	non goods		1	5	13	8	18	16	3	2	1	7	1	4	79	198	17
9	Livestock																
10	Goods more 61 kg				10							1			10		
	Total		8,339	11,240	10,429	11,874	14,056	15,583	19,341	13,066	10,937	10,586	11,461	11,310	148,221	96,853	8,071

Year 2009

Order number	Type of vehicle	Unit	amount Month												Total	Total PCU	Average PCU/Mon.
			Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Passenger		12,335	9,968	12,216	18,443	28,604	47,660	47,945	21,891	13,115	10,469	9,790	8,985	241,421		
2	Bicycle		996	675	772	734	859	1,086	838	869	1,238	1,678	2,007	1,446	13,198	2,640	220
3	Bicycle with goods																
4	Motorcycle		10,604	7,079	7,940	9,218	9,934	9,714	10,545	8,418	8,282	7,458	7,198	7,044	103,434	31,030	2,586
5	Cyclo																
6	Car 4-6 seats		387	252	452	567	747	1,160	1,324	597	371	340	338	346	6,881	6,881	573
7	Bus		543	482	747	1,079	1,836	3,628	3,822	1,520	729	599	559	510	16,054	34,761	2,897
	< 9 seats		283	228	358	472	667	1,213	1,288	550	292	274	250	255	6,130	12,260	1,022
	9-24 seats		89	95	167	291	507	1,123	1,371	480	166	113	125	92	4,619	9,238	770
	24-32 seats		35	41	78	173	412	863	843	304	126	81	58	37	3,051	7,628	636
	< 32 seats		136	118	144	143	250	429	320	186	145	131	126	126	2,254	5,635	470
8	Truck		578	583	842	890	888	1,061	1,137	1,040	823	880	783	877	10,382	20,898	1,742
	< 1 ton																
	with goods		40	27	49	63	56	52	44	45	40	55	28	42	541	1,082	90
	non goods		71	52	51	56	53	46	43	40	52	57	26	46	593	1,186	99
	1 ton-3 ton																
	with goods		118	113	208	215	212	254	276	258	205	198	208	238	2,503	5,006	417
	non goods		156	139	247	222	212	268	276	280	195	217	189	207	2,608	5,216	435
	3 ton-5 ton																
	with goods		56	89	79	111	94	140	159	120	80	98	104	92	1,222	2,444	204
	non goods		57	71	64	90	92	96	150	129	89	96	56	62	1,052	2,104	175
	5 ton-10 ton																
	with goods		38	43	70	62	74	98	89	84	70	64	75	69	836	1,672	139
	non goods		30	43	58	54	65	85	89	72	63	64	66	71	760	1,520	127
	10 ton-13 ton																
	with goods		8	2	7	10	22	14	8	9	25	20	19	43	187	468	39
	non goods		4	4	9	7	8	8	3	3	4	11	12	7	80	200	17
9	Livestock																
10	Goods more 61 kg																
	Total		13,108	9,071	10,753	12,488	14,264	16,649	17,666	12,444	11,443	10,955	10,885	10,223	149,949	96,210	8,018

4.4. Ferry Track Record Survey Data (Cat Hai – Cat Ba Ferry)

Year 2002

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger						14,342	47,522	44,075	25,636	13,739	9,178	7,203	7,660	169,355		
2	Bicycle						935	2,168	2,535	2,192	1,661	1,180	1,142	1,528	13,341	2,668	334
3	Bicycle with goods																
4	Motorcycle						4,058	10,875	10,415	9,985	8,228	5,936	4,941	5,338	59,776	17,933	2,242
5	Cyclo						1	4	2						7	2	0
6	Car 4-6 seats						355	1,058	918	489	258	254	159	146	3,637	3,637	455
7	Bus						728	2,616	2,327	1,206	560	468	317	369	8,591	19,085	2,386
	< 9 seats						76	274	325	210	157	116	72	66	1,296	2,592	324
	9-24 seats						321	1,124	1,009	521	181	157	77	101	3,491	6,982	873
	24-32 seats						201	852	692	359	173	148	106	132	2,663	6,658	832
	< 32 seats						130	366	301	116	49	47	62	70	1,141	2,853	357
8	Truck						223	323	315	426	448	553	582	681	3,551	7,148	894
	< 1 ton																
	with goods						16	15	12	18	14	17	19	26	137	274	34
	non goods						16	26	16	20	26	20	25	33	182	364	46
	1 ton-3 ton																
	with goods						68	108	98	150	148	173	165	206	1,116	2,232	279
	non goods						64	74	70	105	116	151	141	184	905	1,810	226
	3 ton-5 ton																
	with goods						8	20	31	35	29	53	39	62	277	554	69
	non goods						11	23	26	26	31	38	34	57	246	492	62
	5 ton-10 ton																
	with goods						10	27	32	34	42	57	69	52	323	646	81
	non goods						20	21	24	36	35	39	55	44	274	548	69
	10 ton-13 ton																
	with goods						5	4	5	2	5	3	31	15	70	175	22
	non goods						5	5	1		2	2	4	2	21	53	7
9	Livestock																
10	Goods more 61 kg																
	Total						6,300	17,044	16,512	14,298	11,155	8,391	7,141	8,062	88,903	50,473	6,309

Year 2003

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		8,648	7,917	7,675	8,887	10,287	23,187	17,977	13,617	4,028	2,673	2,144	1,660	108,700		
2	Bicycle		1,998	646	463	307	133	83	37	44	35	13	16	22	3,797	759	63
3	Bicycle with goods																
4	Motorcycle		6,651	3,944	3,606	3,512	2,700	1,913	1,279	1,129	621	426	417	351	26,549	7,965	664
5	Cyclo		2												2	1	0
6	Car 4-6 seats		121	200	249	352	527	1,004	799	600	256	304	202	195	4,809	4,809	401
7	Bus		300	230	431	507	718	2,008	1,517	1,179	384	302	303	253	8,132	17,830	1,486
	< 9 seats		49	39	124	118	113	278	177	247	95	80	52	50	1,422	2,844	237
	9-24 seats		70	79	146	191	317	915	778	567	181	132	100	103	3,579	7,158	597
	24-32 seats		114	44	72	109	176	585	414	300	70	41	48	22	1,995	4,988	416
	< 32 seats		67	68	89	89	112	230	148	65	38	49	103	78	1,136	2,840	237
8	Truck		625	357	674	533	506	375	307	343	374	434	375	345	5,248	10,636	886
	< 1 ton																
	with goods		20	20	39	34	39	25	24	22	21	22	7	16	289	578	48
	non goods		21	18	52	43	43	46	23	39	15	30	11	18	359	718	60
	1 ton-3 ton																
	with goods		177	95	191	150	125	95	84	81	93	101	94	89	1,375	2,750	229
	non goods		149	78	135	142	113	112	65	52	108	108	94	70	1,226	2,452	204
	3 ton-5 ton																
	with goods		48	32	73	48	54	27	29	34	28	43	41	51	508	1,016	85
	non goods		42	24	61	37	39	18	16	29	31	37	47	41	422	844	70
	5 ton-10 ton																
	with goods		57	33	43	28	31	23	33	40	29	29	22	19	387	774	65
	non goods		56	42	43	22	30	21	32	37	39	38	24	20	404	808	67
	10 ton-13 ton																
	with goods		43	7	25	14	12	6	1	4	5	15	30	13	175	438	37
	non goods		12	8	12	15	20	2		5	5	11	5	8	103	258	22
9	Livestock																
10	Goods more 61 kg									1					1		
	Total		9,697	5,377	5,423	5,211	4,584	5,383	3,939	3,295	1,670	1,479	1,313	1,166	48,537	42,000	3,500

Year 2004

Order number	Type of vehicle	Unit	amount												Total	Total PCU	Average PCU/Mon.
			Month														
			Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Passenger		1,374	1,943	2,199	5,344	12,946	24,428	33,590	20,067	9,913	9,589	7,456	7,181	136,030		
2	Bicycle		26	12	156	113	40	37	1,074	1,171	966	754	780	980	6,109	1,222	102
3	Bicycle with goods																
4	Motorcycle		346	287	299	1,180	2,892	1,477	7,671	6,468	5,463	5,684	4,480	4,234	40,481	12,144	1,012
5	Cyclo																
6	Car 4-6 seats		144	217	279	435	794	907	1,116	653	371	261	196	234	5,607	5,607	467
7	Bus		252	282	362	505	985	2,180	2,579	1,578	533	408	336	283	10,283	22,445	1,870
	< 9 seats		70	91	127	127	285	390	485	310	160	123	78	67	2,313	4,626	386
	9-24 seats		79	83	124	215	377	936	1,202	745	158	111	101	81	4,212	8,424	702
	24-32 seats		25	48	39	59	180	590	692	355	102	47	35	26	2,198	5,495	458
	< 32 seats		78	60	72	104	143	264	200	168	113	127	122	109	1,560	3,900	325
8	Truck		291	338	428	446	491	453	436	498	322	369	337	342	4,751	9,712	809
	< 1 ton																
	with goods		12	20	34	24	34	22	28	40	18	19	20	18	289	578	48
	non goods		14	27	29	17	23	20	26	41	18	15	22	14	266	532	44
	1 ton-3 ton																
	with goods		79	78	113	121	122	114	136	148	79	81	74	84	1,229	2,458	205
	non goods		70	63	88	115	93	98	106	99	60	59	62	68	981	1,962	164
	3 ton-5 ton																
	with goods		38	40	37	50	59	58	46	38	32	60	38	33	529	1,058	88
	non goods		43	39	38	45	48	39	33	35	16	35	27	29	427	854	71
	5 ton-10 ton																
	with goods		11	24	29	27	40	32	31	32	19	24	27	28	324	648	54
	non goods		10	24	29	29	37	29	17	25	22	19	22	25	288	576	48
	10 ton-13 ton																
	with goods		6	12	12	7	23	24	9	20	28	24	26	20	211	528	44
	non goods		8	11	19	11	12	17	4	20	30	33	19	23	207	518	43
9	Livestock																
10	Goods more 61 kg						3								3		
	Total		1,059	1,136	1,524	2,679	5,202	5,054	12,876	10,368	7,655	7,476	6,129	6,073	67,231	51,130	4,261

Year 2005

Order number	Type of vehicle	Unit	amount												Total	Total PCU	Average PCU/Mon.
			Month														
			Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
1	Passenger		6,628	10,410	9,588	15,015	21,392	36,067	48,788	29,051	18,022	13,798	13,104	10,175	232,038		
2	Bicycle		908	1,041	967	976	943	1,031	751	1,071	993	928	1,041	1,109	11,759	2,352	196
3	Bicycle with goods																
4	Motorcycle		3,789	5,428	5,404	7,070	7,734	7,226	8,920	9,058	7,653	7,110	6,849	5,610	81,851	24,555	2,046
5	Cyclo																
6	Car 4-6 seats		215	196	336	497	790	1,036	1,234	551	332	214	171	159	5,731	5,731	478
7	Bus		274	259	366	674	1,286	2,650	3,357	1,354	708	457	433	348	12,166	26,671	2,223
	< 9 seats		99	100	144	226	345	551	623	333	216	124	126	95	2,982	5,964	497
	9-24 seats		62	64	84	255	519	974	1,502	459	234	138	113	102	4,506	9,012	751
	24-32 seats		14	19	24	65	248	873	955	335	104	46	49	20	2,752	6,880	573
	< 32 seats		99	76	114	128	174	252	277	227	154	149	145	131	1,926	4,815	401
8	Truck		336	195	423	389	331	373	358	453	392	447	375	429	4,501	9,198	767
	< 1 ton																
	with goods		23	19	34	16	31	29	17	21	9	17	16	24	256	512	43
	non goods		22	14	45	16	35	27	20	28	17	27	22	41	314	628	52
	1 ton-3 ton																
	with goods		87	26	88	93	58	80	101	123	95	118	96	92	1,057	2,114	176
	non goods		57	31	79	72	47	80	67	88	83	85	81	85	855	1,710	143
	3 ton-5 ton																
	with goods		21	17	33	48	43	55	54	84	95	71	75	65	661	1,322	110
	non goods		25	7	34	31	26	30	26	42	43	43	42	40	389	778	65
	5 ton-10 ton																
	with goods		34	19	30	38	31	35	26	23	19	28	17	34	334	668	56
	non goods		27	16	26	28	13	25	20	11	16	25	13	24	244	488	41
	10 ton-13 ton																
	with goods		22	21	29	28	28	8	16	19	5	24	9	15	224	560	47
	non goods		18	25	25	19	19	4	11	14	10	9	4	9	167	418	35
9	Livestock																
10	Goods more 61 kg																
	Total		5,522	7,119	7,496	9,606	11,084	12,316	14,620	12,487	10,078	9,156	8,869	7,655	116,008	68,507	5,709

Year 2006

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		11,319	14,268	12,239	18,077	22,949	48,293	48,151	18,656	14,447	10,804	8,706	9,045	236,954		
2	Bicycle		1,273	941	776	596	895	893	852	639	544	336	450	480	8,675	1,735	145
3	Bicycle with goods																
4	Motorcycle		6,812	6,990	5,543	6,413	6,304	5,559	5,762	3,516	4,389	4,546	4,412	4,733	64,979	19,494	1,625
5	Cyclo																
6	Car 4-6 seats		192	182	261	467	531	844	996	337	366	237	162	154	4,729	4,729	394
7	Bus		324	337	463	890	1,222	3,398	3,684	1,243	747	532	383	368	13,591	30,007	2,501
	< 9 seats		95	105	155	316	362	663	811	302	208	145	112	75	3,349	6,698	558
	9-24 seats		99	87	113	304	401	1,136	1,498	414	225	122	81	112	4,592	9,184	765
	24-32 seats		15	18	50	108	262	1,088	972	299	125	67	21	35	3,060	7,650	638
	< 32 seats		115	127	145	162	197	511	403	228	189	198	169	146	2,590	6,475	540
8	Truck		365	312	511	542	528	604	513	390	365	363	369	400	5,262	10,297	858
	< 1 ton																
	with goods		22	16	25	21	39	20	21	25	14	23	19	27	272	544	45
	non goods		27	10	16	15	18	20	13	16	9	12	15	17	188	376	31
	1 ton-3 ton																
	with goods		91	105	126	131	118	151	137	82	78	74	89	86	1,268	2,536	211
	non goods		85	60	109	122	102	144	96	75	79	54	65	69	1,060	2,120	177
	3 ton-5 ton																
	with goods		44	42	86	100	96	106	99	66	73	70	72	60	914	1,828	152
	non goods		37	29	64	68	61	48	50	31	40	44	40	38	550	1,100	92
	5 ton-10 ton																
	with goods		14	13	28	34	39	42	38	33	30	35	28	39	373	746	62
	non goods		15	11	22	27	26	28	22	24	19	25	15	27	261	522	44
	10 ton-13 ton																
	with goods		15	14	20	15	17	28	22	20	11	14	15	19	210	525	44
	non goods		15	12	15	9	12	17	15	18	12	12	11	18	166	415	35
9	Livestock																
10	Goods more 61 kg																
	Total		8,966	8,762	7,554	8,908	9,480	11,298	11,807	6,125	6,411	6,014	5,776	6,135	97,236	66,262	5,522

Year 2007

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		7,284	9,247	7,785	15,229	14,396	58,478	58,381	26,912	13,881	6,394	6,161	6,515	230,663		
2	Bicycle		207	328	324	210	281	557	363	138	120	132	198	103	2,961	592	49
3	Bicycle with goods																
4	Motorcycle		3,615	5,140	3,857	5,119	4,234	6,418	5,577	4,366	3,778	3,086	3,599	3,503	52,292	15,688	1,307
5	Cyclo																
6	Car 4-6 seats		144	130	155	512	329	1,134	1,190	721	371	157	180	130	5,153	5,153	429
7	Bus		244	148	288	975	946	4,394	4,790	2,197	810	419	417	423	16,051	35,158	2,930
	< 9 seats		95	79	128	422	271	978	1,152	621	323	146	139	137	4,491	8,982	749
	9-24 seats		59	54	90	287	279	1,469	1,815	758	315	105	121	97	5,449	10,898	908
	24-32 seats		32	14	31	123	177	1,380	1,296	480	172	30	31	59	3,829	9,573	798
	< 32 seats		58	1	39	143	219	567	527	338		134	126	130	2,282	5,705	475
8	Truck		310	173	273	393	310	562	571	466	374	364	437	379	4,612	9,291	774
	< 1 ton																
	with goods		30	13	23	18	21	31	43	23	23	25	25	27	302	604	50
	non goods		11	10	9	13	12	21	24	15	15	12	20	20	182	364	30
	1 ton-3 ton																
	with goods		78	52	87	110	87	158	135	123	100	86	94	92	1,202	2,404	200
	non goods		71	30	41	87	38	110	127	116	76	61	78	55	890	1,780	148
	3 ton-5 ton																
	with goods		47	26	40	55	52	105	114	79	72	72	90	53	805	1,610	134
	non goods		28	12	23	34	29	56	49	39	40	43	51	37	441	882	74
	5 ton-10 ton																
	with goods		23	13	26	34	41	47	42	38	20	30	32	50	396	792	66
	non goods		15	10	15	25	18	31	30	22	14	17	27	36	260	520	43
	10 ton-13 ton																
	with goods		1	5	6	13	4	2	4	8	8	14	11	4	80	200	17
	non goods		6	2	3	4	8	1	3	3	6	4	9	5	54	135	11
9	Livestock																
10	Goods more 61 kg																
	Total		4,520	5,919	4,897	7,209	6,100	13,065	12,491	7,888	5,453	4,158	4,831	4,538	81,069	65,882	5,490

Year 2008

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		4,870	8,282	8,997	11,893	19,748	41,798	51,330	23,679	12,006	8,571	8,923	8,086	208,183		
2	Bicycle		152	44	172	87	52	40	46	42	20	22	67	73	817	163	14
3	Bicycle with goods																
4	Motorcycle		2,682	4,610	4,344	4,768	4,933	4,751	6,019	4,615	4,431	4,244	4,603	4,325	54,325	16,298	1,358
5	Cyclo																
6	Car 4-6 seats		118	108	246	398	593	970	1,326	572	256	182	173	174	5,116	5,116	426
7	Bus		338	328	553	903	1,383	3,567	4,388	1,899	801	548	467	460	15,635	34,088	2,841
	< 9 seats		115	98	227	404	539	1,056	1,307	583	294	202	197	195	5,217	10,434	870
	9-24 seats		57	78	114	241	363	1,122	1,570	638	245	141	117	98	4,784	9,568	797
	24-32 seats		15	25	66	115	261	958	1,043	424	88	52	27	37	3,111	7,778	648
	< 32 seats		151	127	146	143	220	431	468	254	174	153	126	130	2,523	6,308	526
8	Truck		324	233	492	634	507	479	564	395	388	561	456	492	5,525	11,193	933
	< 1 ton																
	with goods		28	18	41	37	28	21	33	22	19	33	24	37	341	682	57
	non goods		17	6	30	26	23	17	19	15	13	25	13	29	233	466	39
	1 ton-3 ton																
	with goods		70	53	101	149	126	114	142	97	90	145	105	100	1,292	2,584	215
	non goods		68	55	109	141	106	126	157	107	112	138	100	132	1,351	2,702	225
	3 ton-5 ton																
	with goods		41	39	81	77	91	93	74	46	62	80	69	76	829	1,658	138
	non goods		28	26	51	37	29	44	34	26	39	55	54	43	466	932	78
	5 ton-10 ton																
	with goods		34	12	30	47	41	35	53	37	26	34	35	29	413	826	69
	non goods		25	10	26	33	28	26	33	36	17	26	32	23	315	630	53
	10 ton-13 ton																
	with goods		7	8	10	74	20	2	15	7	8	19	23	14	207	518	43
	non goods		6	6	13	13	15	1	4	2	2	6	1	9	78	195	16
9	Livestock																
10	Goods more 61 kg																
	Total		3,614	5,323	5,807	6,790	7,468	9,807	12,343	7,523	5,896	5,557	5,766	5,524	81,418	66,858	5,572

Year 2009

Order number	Type of vehicle	Unit	amount Month Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Total PCU	Average PCU/Mon.
1	Passenger		8,516	9,965	10,382	14,171	25,119	43,405	4,114	18,035	9,713	7,362	6,687	6,382	200,851		
2	Bicycle		23	45	42	53	47	36	62	19	23	5	1,231	1,184	2,770	554	46
3	Bicycle with goods																
4	Motorcycle		4,663	4,856	4,937	5,136	6,163	5,909	6,238	5,138	4,236	3,885	4,128	4,098	59,387	17,816	1,485
5	Cyclo																
6	Car 4-6 seats		163	194	318	456	725	1,077	1,255	558	283	229	191	204	5,653	5,653	471
7	Bus		451	433	654	1,072	2,047	3,815	3,961	1,612	693	547	471	423	16,179	35,187	2,932
	< 9 seats		184	174	284	477	780	1,215	1,268	570	259	238	184	190	5,823	11,646	971
	9-24 seats		86	95	151	262	549	1,178	1,418	506	167	98	115	74	4,699	9,398	783
	24-32 seats		30	39	78	165	438	914	873	330	124	75	42	33	3,141	7,853	654
	< 32 seats		151	125	141	168	280	508	402	206	143	136	130	126	2,516	6,290	524
8	Truck		348	423	689	667	567	761	781	721	577	560	558	566	7,218	14,552	1,213
	< 1 ton																
	with goods		31	27	44	43	39	41	37	46	36	46	32	38	460	920	77
	non goods		53	44	44	46	29	29	28	45	42	34	21	38	453	906	76
	1 ton-3 ton																
	with goods		71	85	162	175	146	175	188	163	150	148	152	157	1,772	3,544	295
	non goods		71	90	210	179	154	188	199	152	132	144	126	147	1,792	3,584	299
	3 ton-5 ton																
	with goods		39	57	69	77	61	103	130	107	60	65	85	56	909	1,818	152
	non goods		30	45	51	52	49	78	76	65	52	41	42	44	625	1,250	104
	5 ton-10 ton																
	with goods		23	34	48	36	40	73	64	52	40	35	52	44	541	1,082	90
	non goods		18	33	38	31	29	60	46	60	29	23	31	37	435	870	73
	10 ton-13 ton																
	with goods		9	2	13	19	9	8	7	29	31	19	11	2	159	398	33
	non goods		3	6	10	9	11	6	6	2	5	5	6	3	72	180	15
9	Livestock																
10	Goods more 61 kg																
	Total		5,648	5,951	6,640	7,384	9,549	11,598	12,297	8,048	5,812	5,226	6,579	6,475	91,207	73,762	6,147

4.5. The total number of vehicles priority (Dinh Vu-Cat Hai Ferry)

Year	Month	Type of vehicle															
		Total	Car 4 seats	Car <9 seats	Bus 9<24	Bus 24<32	Bus more 32 seats	Truck <1 ton		Truck 1 -3 ton		Truck 3 -5 ton		Truck 5 -10 ton		Truck 10 -13 ton	
								with good	non goods	with good	non goods	with good	non goods	with good	non goods	with good	non goods
2002	Jan.																
	Feb																
	Mar																
	Apr																
	May																
	Jun	467	266	36	129	32	2	0	0	2	0	0	0	0	0	0	0
	Jul	636	336	30	248	22	0	0	0	0	0	0	0	0	0	0	0
	Aug	444	296	28	104	16	0	0	0	0	0	0	0	0	0	0	0
	Sep	251	135	9	104	3	0	0	0	0	0	0	0	0	0	0	0
	Oct	401	203	46	142	10	0	0	0	0	0	0	0	0	0	0	0
	Nov	255	111	42	100	2	0	0	0	0	0	0	0	0	0	0	0
	Dec	235	63	46	122	4	0	0	0	0	0	0	0	0	0	0	0
	Total	2689	1410	237	949	89	2	0	0	2	0	0	0	0	0	0	0
	Ave./Mon	384.1	201.4	33.9	135.6	12.7	0.3	-	-	0.3	-	-	-	-	-	-	-
2003	Jan.	151	56	22	69	4	0	0	0	0	0	0	0	0	0	0	0
	Feb	185	72	23	86	4	0	0	0	0	0	0	0	0	0	0	0
	Mar	196	70	28	92	2	4	0	0	0	0	0	0	0	0	0	0
	Apr	226	88	14	122	2	0	0	0	0	0	0	0	0	0	0	0
	May	230	80	22	120	8	0	0	0	0	0	0	0	0	0	0	0
	Jun	387	164	32	189	2	0	0	0	0	0	0	0	0	0	0	0
	Jul	597	228	66	231	50	2	0	0	8	0	10	0	4	0	0	0
	Aug	395	222	46	117	8	0	0	0	0	0	0	0	0	0	0	0
	Sep	239	142	15	78	3	2	0	0	1	0	0	0	0	0	0	0
	Oct	219	143	30	42	2	0	0	0	0	0	0	0	0	0	0	0
	Nov	143	109	4	28	0	0	0	0	1	1	0	0	0	0	0	0
	Dec	160	120	12	24	4	0	0	0	0	0	0	0	0	0	0	0
	Total	3128	1494	314	1198	89	8	0	0	10	1	10	0	4	0	0	0
	Ave./Mon	260.7	124.5	26.2	99.8	7.4	0.7	-	-	0.8	0.1	0.8	-	0.3	-	-	-
2004	Jan.	98	80	4	9	0	0	0	0	0	1	2	1	0	0	0	0
	Feb	206	168	13	21	2	2	0	0	0	0	0	0	0	0	0	0
	Mar	553	348	60	54	24	21	6	1	15	3	11	4	3	1	1	1
	Apr	175	151	4	14	4	2	0	0	0	0	0	0	0	0	0	0
	May	196	140	2	36	8	4	0	0	3	1	0	0	1	1	0	0
	Jun	350	230	44	50	16	4	0	0	4	0	0	0	1	1	0	0
	Jul	368	187	26	113	23	11	0	0	4	0	2	0	2	0	0	0
	Aug	368	178	52	81	32	7	0	0	2	0	2	0	14	0	0	0
	Sep	153	107	16	22	2	2	0	0	0	0	3	0	1	0	0	0
	Oct	123	90	14	18	0	0	0	0	1	0	0	0	0	0	0	0
	Nov	41	29	8	4	0	0	0	0	0	0	0	0	0	0	0	0
	Dec	101	68	14	17	0	0	0	0	1	0	1	0	0	0	0	0
	Total	2732	1776	257	439	111	53	6	1	30	5	21	5	22	3	1	1
	Ave./Mon	260.7	124.5	26.2	99.8	7.4	0.7	-	-	0.8	0.1	0.8	-	0.3	-	-	-
2005	Jan.	150	97	19	28	0	0	0	0	2	0	1	0	3	0	0	0
	Feb	178	141	11	17	2	3	0	0	0	0	0	0	4	0	0	0
	Mar	238	146	29	37	9	2	0	0	2	2	2	2	4	3	0	0
	Apr	195	128	30	27	1	0	0	0	1	0	2	2	1	3	0	0
	May	220	95	28	67	9	6	0	0	1	0	5	4	3	2	0	0
	Jun	420	251	45	77	14	21	0	0	2	0	3	1	3	3	0	0
	Jul	423	204	61	87	48	16	0	0	3	0	0	0	4	0	0	0
	Aug	155	98	29	26	0	0	0	0	0	0	0	0	2	0	0	0
	Sep	135	89	19	22	2	1	0	0	1	1	0	0	0	0	0	0
	Oct	129	85	20	15	0	0	0	0	3	2	0	0	2	2	0	0
	Nov	81	33	19	20	0	0	0	0	0	0	1	1	5	2	0	0
	Dec	110	68	12	16	0	1	0	0	2	0	5	2	2	2	0	0
	Total	2434	1435	322	439	85	50	0	0	17	5	19	12	33	17	0	0
	Ave./Mon	202.8	119.6	26.8	36.6	7.1	4.2	-	-	1.4	0.4	1.6	1.0	2.8	1.4	-	-
2006	Jan.	109	89	2	13	1	0	0	0	0	0	3	1	0	0	0	0
	Feb	83	59	8	12	2	0	0	0	0	0	1	1	0	0	0	0
	Mar	134	87	27	18	0	0	0	0	0	0	1	0	1	0	0	0
	Apr	149	104	23	12	1	0	0	0	3	1	2	2	0	1	0	0
	May	259	133	52	51	8	3	0	0	0	0	5	3	3	1	0	0
	Jun	301	147	34	62	23	11	0	0	0	0	0	1	14	9	0	0
	Jul	180	81	35	46	4	0	0	0	1	2	0	0	5	6	0	0
	Aug	231	145	29	34	11	0	0	0	4	2	3	3	0	0	0	0
	Sep	178	111	23	32	8	0	0	0	0	0	2	1	1	0	0	0
	Oct	183	119	37	23	0	0	0	0	0	0	0	0	4	0	0	0
	Nov	172	69	56	33	9	1	0	0	1	1	0	0	1	1	0	0
	Dec	271	174	40	44	5	0	0	1	2	3	0	0	1	1	0	0
	Total	2250	1318	366	380	72	15	0	1	11	9	17	12	30	19	0	0
	Ave./Mon	187.5	109.8	30.5	31.7	6.0	1.3	-	0.1	0.9	0.8	1.4	1.0	2.5	1.6	-	-

Year	Month	Type of vehicle															
		Total	Car 4 seats	Car <9 seats	Bus 9<24	Bus 24<32	Bus more 32 seats	Truck <1 ton with good	Truck <1 ton non goods	Truck 1 -3 ton with good	Truck 1 -3 ton non goods	Truck 3 -5 ton with good	Truck 3 -5 ton non goods	Truck 5 -10 ton with good	Truck 5 -10 ton non goods	Truck 10 -13 ton with good	Truck 10 -13 ton non goods
2007	Jan.	150	91	32	17	2	0	3	3	0	0	0	0	1	1	0	0
	Feb	151	97	22	24	2	0	0	0	2	2	1	1	0	0	0	0
	Mar	161	93	28	24	4	3	0	0	3	2	0	0	2	2	0	0
	Apr	221	130	35	35	11	6	0	0	1	1	1	1	0	0	0	0
	May	185	107	34	29	5	0	1	0	4	3	1	1	0	0	0	0
	Jun	255	103	57	67	21	5	0	0	1	1	0	0	0	0	0	0
	Jul	287	106	68	78	14	11	0	0	4	5	0	0	1	0	0	0
	Aug	199	82	40	58	9	5	0	0	5	0	0	0	0	0	0	0
	Sep	273	94	85	60	5	0	0	0	22	0	2	0	5	0	0	0
	Oct	152	51	46	35	5	0	0	0	0	0	4	5	2	0	4	0
	Nov	137	48	40	36	5	0	0	0	0	0	4	0	4	0	0	0
	Dec	152	70	43	23		0	0	0	1	0	13	0	0	0	2	0
	Total	2323	1072	530	486	83	30	4	3	43	14	26	8	15	3	6	0
	Ave./Mon	193.6	89.3	44.2	40.5	7.5	2.5	0.3	0.3	3.6	1.2	2.2	0.7	1.3	0.3	0.5	-
2008	Jan.	158	66	32	45	8	0	0	2	0	5	0	0	0	0	0	0
	Feb	154	63	34	41	9	0	0	0	0	7	0	0	0	0	0	0
	Mar	178	61	39	50	7	4	0	5	0	8	0	4	0	0	0	0
	Apr	148	65	25	40	8	0	0	6	0	1	0	3	0	0	0	0
	May	146	56	29	42	9	9	0	0	0	1	0	0	0	0	0	0
	Jun	143	54	23	49	14	2	0	1	0	0	0	0	0	0	0	0
	Jul	181	58	41	43	18	13	0	5	0	3	0	0	0	0	0	0
	Aug	154	63	34	41	9	0	0	0	0	7	0	0	0	0	0	0
	Sep	179	61	39	50	8	4	0	5	0	8	0	4	0	0	0	0
	Oct	100	22	29	27	13	0	0	5	0	0	0	2	2	0	0	0
	Nov	135	32	37	40	10	2	0	2	0	4	0	4	4	0	0	0
	Dec	94	28	14	36	11	0	2	0	0	0	2	1	0	0	0	0
	Total	1770	629	376	504	124	34	2	31	0	44	2	18	6	0	0	0
	Ave./Mon	147.5	52.4	31.3	42.0	10.3	2.8	0.2	2.6	-	3.7	0.2	1.5	0.5	-	-	-
2009	Jan.	69	28	19	16	1	0	0	0	2	0	1	0	2	0	0	0
	Feb	42	16	6	17	0	1	0	0	0	0	2	0	0	0	0	0
	Mar	97	38	17	34	4	0	0	0	3	0	1	0	0	0	0	0
	Apr	101	25	35	26	12	0	0	0	3	0	0	0	0	0	0	0
	May	116	27	38	36	12	1	0	0	0	0	2	0	0	0	0	0
	Jun	146	37	30	44	13	10	0	0	10	0	2	0	0	0	0	0
	Jul	196	42	82	40	23	4	0	0	3	0	2	0	0	0	0	0
	Aug	90	37	28	20	2	0	0	0	2	0	1	0	0	0	0	0
	Sep	44	8	11	9	0	0	0	0	0	0	2	0	14	0	0	0
	Oct	106	36	32	27	1	0	0	0	0	0	10	0	0	0	0	0
	Nov	143	62	42	30		0	0	0	5	0	2	0	2	0	0	0
	Dec	77	23	29	22		0	0	0	3	0	0	0	0	0	0	0
	Total	1227	379	369	321	68	16	0	0	31	0	25	0	18	0	0	0
	Ave./Mon	102.3	31.6	30.8	26.8	6.8	1.3	-	-	2.6	-	2.1	-	1.5	-	-	-

4.6. The total number of vehicles priority (Cat Hai – Cat Ba Ferry)

Year	Month	Type of vehicle															
		Total	Car 4 seats	Car <9 seats	Bus 9<24	Bus 24<32	Bus more 32 seats	Truck <1 ton		Truck 1 -3 ton		Truck 3 -5 ton		Truck 5 -10 ton		Truck 10 -13 ton	
								with good	non goods	with good	non goods	with good	non goods	with good	non goods	with good	non goods
2002	Jan.																
	Feb																
	Mar																
	Apr																
	May																
	Jun	585	368	60	119	34	2	0	0	2	0	0	0	0	0	0	0
	Jul	666	434	104	114	14	0	0	0	0	0	0	0	0	0	0	0
	Aug	393	213	64	81	19	12	0	0	4	0	0	0	0	0	0	0
	Sep	210	143	12	44	2	0	0	0	0	0	2	5	2	0	0	0
	Oct	296	191	29	56	12	3	0	0	2	0	3	0	0	0	0	0
	Nov	292	202	49	35	6	0	0	0	0	0	0	0	0	0	0	0
	Dec	171	107	10	39	2	8	0	0	0	2	0	0	0	3	0	0
	Total	2613	1658	328	488	89	25	0	0	8	2	5	5	2	3	0	0
	Ave./Mon	373.3	236.9	46.9	69.7	12.7	3.6	-	-	1.1	0.3	0.7	0.7	0.3	0.4	-	-
2003	Jan.	316	168	28	120	0	0	0	0	0	0	0	0	0	0	0	0
	Feb	284	156	28	98	2	0	0	0	0	0	0	0	0	0	0	0
	Mar	164	116	10	38	0	0	0	0	0	0	0	0	0	0	0	0
	Apr	131	99	11	21	0	0	0	0	0	0	0	0	0	0	0	0
	May	179	126	22	30	0	0	0	0	0	0	0	0	1	0	0	0
	Jun	207	137	38	21	10	1	0	0	0	0	0	0	0	0	0	0
	Jul	571	290	44	147	51	2	0	0	8	0	17	1	11	0	0	0
	Aug	237	133	39	46	7	5	0	0	0	0	5	2	0	0	0	0
	Sep	158	109	12	31	3	0	0	0	0	0	0	0	3	0	0	0
	Oct	162	104	10	44	2	2	0	0	0	0	0	0	0	0	0	0
	Nov	101	70	7	23	1	0	0	0	0	0	0	0	0	0	0	0
	Dec	124	70	20	30	4	0	0	0	0	0	0	0	0	0	0	0
	Total	2634	1578	269	649	80	10	0	0	8	0	22	3	15	0	0	0
	Ave./Mon	219.5	131.5	22.4	54.1	6.7	0.8	-	-	0.7	-	1.8	0.3	1.3	-	-	-
2004	Jan.	70	57	7	2	0	0	0	0	0	2	0	1	1	0	0	0
	Feb	136	108	15	12	1	0	0	0	0	0	0	0	0	0	0	0
	Mar	486	328	35	47	25	22	1	0	13	0	10	0	2	3	0	0
	Apr	132	99	8	22	1	2	0	0	0	0	0	0	0	0	0	0
	May	168	128	16	14	8	1	0	0	0	1	0	0	0	0	0	0
	Jun	255	203	10	26	5	7	1	0	2	0	0	0	1	0	0	0
	Jul	339	191	28	79	25	12	2	0	0	0	0	0	2	0	0	0
	Aug	255	150	26	36	23	6	0	0	1	0	6	7	0	0	0	0
	Sep	103	86	4	8	1	1	0	0	1	0	2	0	0	0	0	0
	Oct	119	80	7	21	7	0	0	0	0	0	0	0	4	0	0	0
	Nov	72	58	5	1	4	0	0	0	0	0	0	0	0	4	0	0
	Dec	137	116	3	8	6	0	0	0	0	0	0	0	4	0	0	0
	Total	2272	1604	164	276	106	51	4	0	17	3	18	8	14	7	0	0
	Ave./Mon	189.3	133.7	13.7	23.0	8.8	4.3	0.3	-	1.4	0.5	1.5	0.7	1.2	0.6	-	-
2005	Jan.	111	86	4	17	0	0	0	0	0	0	2	0	2	0	0	0
	Feb	98	84	5	7	0	0	0	0	2	0	0	0	0	0	0	0
	Mar	178	138	7	25	2	2	0	0	0	0	0	4	0	0	0	0
	Apr	179	144	11	16	2	0	0	0	2	0	2	0	2	0	0	0
	May	141	115	0	24	0	0	0	0	0	0	0	0	2	0	0	0
	Jun	316	233	29	25	12	9	0	0	3	0	0	0	5	0	0	0
	Jul	235	146	27	49	11	2	0	0	0	0	0	0	0	0	0	0
	Aug	67	44	7	14	2	0	0	0	0	0	0	0	0	0	0	0
	Sep	61	38	7	12	2	2	0	0	0	0	0	0	0	0	0	0
	Oct	31	28	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	Nov	37	28	1	4	0	0	0	0	2	2	0	0	0	0	0	0
	Dec	40	33	3	4	0	0	0	0	9	2	4	4	11	0	0	0
	Total	1494	1117	101	200	31	15	0	0	18	4	8	8	22	0	0	0
	Ave./Mon	124.5	93.1	8.4	16.7	2.6	1.3	-	-	1.5	0.6	0.7	0.7	1.8	-	-	-
2006	Jan.	47	40	1	5	0	0	0	0	0	0	0	0	1	0	0	0
	Feb	50	44	3	3	0	0	0	0	0	0	0	0	0	0	0	0
	Mar	83	59	8	9	0	0	0	0	2	0	2	2	3	0	0	0
	Apr	96	74	1	17	0	0	0	0	0	0	2	0	0	0	0	0
	May	169	130	7	28	2	2	0	0	0	0	0	0	0	0	0	0
	Jun	196	122	7	34	19	6	0	0	0	0	1	0	4	3	0	0
	Jul	76	46	13	16	1	0	0	0	0	0	0	0	0	0	0	0
	Aug	86	65	9	8	4	0	0	0	0	0	0	0	0	0	0	0
	Sep	146	86	16	32	9	0	0	0	0	0	2	0	1	0	0	0
	Oct	125	84	23	16	0	0	0	0	0	0	0	0	1	0	1	0
	Nov	114	67	16	18	8	0	0	0	3	0	0	0	0	0	2	0
	Dec	102	66	13	17	6	0	0	0	0	0	0	0	0	0	0	0
	Total	1290	883	117	203	49	8	0	0	5	0	7	2	10	3	3	0
	Ave./Mon	107.5	73.6	9.8	16.9	4.1	0.7	-	-	0.4	-	0.6	0.2	0.8	0.3	0.5	-

Year	Month	Type of vehicle															
		Total	Car 4 seats	Car <9 seats	Bus 9<24	Bus 24<32	Bus more 32 seats	Truck <1 ton		Truck 1 -3 ton		Truck 3 -5 ton		Truck 5 -10 ton		Truck 10 -13 ton	
								with good	non goods	with good	non goods	with good	non goods	with good	non goods	with good	non goods
2007	Jan.	86	53	12	9	0	0	0	0	6	0	6	0	0	0	0	0
	Feb	94	62	5	6	1	0	0	0	2	0	16	0	2	0	0	0
	Mar	111	82	9	10	4	0	0	0	0	0	2	0	4	0	0	0
	Apr	162	115	15	18	6	7	0	0	0	0	1	0	0	0	0	0
	May	178	127	18	21	2	0	0	0	2	0	8	0	0	0	0	0
	Jun	232	129	35	46	13	6	0	0	2	0	1	0	0	0	0	0
	Jul	374	170	66	91	22	16	0	0	7	0	2	0	0	0	0	0
	Aug	313	103	90	81	18	7	0	0	8	4	1	1	0	0	0	0
	Sep	89	45	19	17	3	0	0	0	0	0	5	0	0	0	0	0
	Oct	185	83	43	32	0	0	0	0	19	0	0	0	6	0	2	0
	Nov	179	80	57	28	1	0	0	0	8	0	4	0	1	0	0	0
	Dec	192	64	71	26	0	0	0	0	23	0	6	0	2	0	0	0
	Total	2195	1113	440	385	70	36	0	0	77	4	52	1	15	0	2	0
	Ave./Mon	182.9	92.8	36.7	32.1	5.8	3.0	-	-	6.4	0.6	4.3	0.1	1.3	-	0.3	-
2008	Jan.	124	48	53	13	0	0	0	0	1	0	3	0	6	0	0	0
	Feb	91	32	47	6	0	0	0	0	0	0	3	3	0	0	0	0
	Mar	183	69	85	14	5	0	0	0	0	0	6	0	4	0	0	0
	Apr	239	103	65	61	4	0	0	0	1	0	2	0	3	0	0	0
	May	231	63	90	57	12	4	0	0	0	0	4	1	0	0	0	0
	Jun	359	76	143	83	42	7	0	0	3	4	1	0	0	0	0	0
	Jul	478	108	162	144	45	11	0	0	0	0	2	1	4	1	0	0
	Aug	183	69	85	14	5	0	0	0	0	0	6	0	4	0	0	0
	Sep	178	53	81	39	3	0	0	0	0	0	0	0	2	0	0	0
	Oct	147	30	74	38	2	0	0	0	1	0	2	0	0	0	0	0
	Nov	166	47	69	33	6	0	0	0	0	0	5	1	4	1	0	0
	Dec	173	63	62	32	2	0	0	0	0	0	10	1	2	1	0	0
	Total	2552	761	1016	534	126	22	0	0	6	4	44	7	29	3	0	0
	Ave./Mon	212.7	63.4	84.7	44.5	10.5	1.8	-	-	0.5	0.6	3.7	0.6	2.4	0.3	-	-
2009	Jan.	118	26	68	11	0	0	0	0	6	5	0	0	2	0	0	0
	Feb	124	34	74	16	0	0	0	0	0	0	0	0	0	0	0	0
	Mar	148	34	79	24	2	0	6	1	0	0	0	0	2	0	0	0
	Apr	186	35	95	38	2	0	0	0	16	0	0	0	0	0	0	0
	May	172	53	71	35	4	0	0	0	9	0	0	0	0	0	0	0
	Jun	167	49	67	49	2	0	0	0	0	0	0	0	0	0	0	0
	Jul	193	83	70	30	2	0	0	0	7	1	0	0	0	0	0	0
	Aug	99	40	53	6	0	0	0	0	0	0	0	0	0	0	0	0
	Sep	106	35	42	5	0	0	0	0	10	0	0	0	7	7	0	0
	Oct	98	38	47	9	0	0	0	0	4	0	0	0	0	0	0	0
	Nov	76	33	32	7	0	0	0	0	4	0	0	0	0	0	0	0
	Dec	82	19	45	12	0	0	0	0	1	5	0	0	0	0	0	0
	Total	1569	479	743	242	12	0	6	1	57	11	0	0	11	7	0	0
	Ave./Mon	130.8	39.9	61.9	20.2	1.0	-	0.5	0.2	4.8	1.7	-	-	0.9	0.6	-	-

APPENDIX 2 -2: TRAFFIC DEMAND FORECSAST CALCULATION

1. Summary of Peak Hour Trip Generation (pcu/hr)

Position	Year	AM Peak		PM Peak	
		Generation (outbound)	Attraction (inbound)	Generation (outbound)	Attraction (inbound)
Dinh Vu	2015	349	394	200	198
	2020	654	706	353	379
	2030	2,138	2,618	1,141	1,770

Position	Year	AM Peak		PM Peak	
		Generation (outbound)	Attraction (inbound)	Generation (outbound)	Attraction (inbound)
Cat Hai	2015	792	307	307	792
	2020	1,309	686	686	1,309
	2030	1,846	1,300	1,300	1,846

Position	Year	AM Peak		PM Peak	
		Generation (outbound)	Attraction (inbound)	Generation (outbound)	Attraction (inbound)
Cat Ba	2015	135	43	43	135
	2020	185	59	59	185
	2030	156	50	50	156

2. Summary of Future Traffic Demands

Section	Peak Hour	Direction	Year			
			2015	2020	2025	2030
Tan Vu IC - Dinh Vu	AM	To Tan Vu Interchange	1,276	2,149	3,145	4,140
		From Tan Vu Interchange	745	1,451	2,709	3,967
	PM	To Tan Vu Interchange	550	1,098	1,794	2,490
		From Tan Vu Interchange	1,125	1,874	2,823	3,772
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	927	1,494	1,748	2,002
		Dinh Vu to Cat Hai	351	745	1,047	1,350
	PM	Cat Hai to Dinh Vu	351	745	1,047	1,350
		Dinh Vu to Cat Hai	927	1,494	1,748	2,002

3. Forecasted Traffic Demands on Dinh Vu Industrial Zone

Dinh Vu Industrial Zone 2015 (Without Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Industrial Zone	($100m^2$)	($100m^2$)	($pcu/hr/100m^2$)		($pcu/hr/100m^2$)		(pcu/hr)		(pcu/hr)	
		16,375	4,913	0.110	0.150	0.060	0.040	238	324	130	86
		16375*30%						4913*0.11*0.44	4913*0.15*0.44	4913*0.06*0.44	4913*0.04*0.44
II	Dinh Vu Port Area	(tons /yr)	(tons /yr)	(pcu/ton)		(pcu/ton)		(pcu/ton)		(pcu/ton)	
		4,500,000	616	0.082	0.082	0.082	0.082	51	51	51	51
		4500000/365*5%						616*0.082	616*0.082	616*0.082	616*0.082
III	Appartment block for resident	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		162,500	406	0.250	0.080	0.080	0.250	61	19	19	61
		162500/1000*50%*5						406*0.25*0.6	406*0.08*0.6	406*0.08*0.6	406*0.25*0.6
							TOTAL	**349**	**394**	**200**	**198**

Dinh Vu Industrial Zone 2020 (Without Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Industrial Zone	($100m^2$)	($100m^2$)	($pcu/hr/100m^2$)		($pcu/hr/100m^2$)		(pcu/hr)		(pcu/hr)	
		32,750	9,825	0.110	0.150	0.060	0.040	432	590	236	157
		32750*30%						9825*0.11*0.4	9825*0.15*0.4	9825*0.06*0.4	9825*0.04*0.4
II	Dinh Vu Port Area	(tons /yr)	(tons /yr)	(pcu/ton)		(pcu/ton)		(pcu/ton)		(pcu/ton)	
		6,000,000	822	0.082	0.082	0.082	0.082	67	67	67	67
		6000000/365*5%						822*0.082	822*0.082	822*0.082	822*0.082
III	Appartment block for resident	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		325,000	813	0.250	0.080	0.080	0.250	154	49	49	154
		325000/1000*50%*5						813*0.25*0.76	813*0.08*0.76	813*0.08*0.76	813*0.25*0.76
							TOTAL	**654**	**706**	**353**	**379**

Dinh Vu Industrial Zone 2030 (With Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Industrial Zone	($100m^2$)	($100m^2$)	($pcu/hr/100m^2$)		($pcu/hr/100m^2$)		(pcu/hr)		(pcu/hr)	
		97,680	29,304	0.110	0.150	0.060	0.040	1,805	2,462	985	656
		97680*30%						29304*0.11*0.56	29304*0.15*0.56	29304*0.06*0.56	29304*0.04*0.56
II	Dinh Vu Port Area	(tons /yr)	(tons /yr)	(pcu/ton)		(pcu/ton)		(pcu/ton)		(pcu/ton)	
		10,000,000	890	0.082	0.082	0.082	0.082	73	73	73	73
		10000000/365*0.65*5%						890*0.082	890*0.082	890*0.082	890*0.082
III	Appartment block for resident	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		650,000	1,625	0.250	0.080	0.080	0.250	260	83	83	1,040
		650000/1000*50%*5						1625*0.25*0.64	1625*0.08*0.64	1625*0.08*0.64	1625.25*0.64
							TOTAL	**2,138**	**2,618**	**1,141**	**1,770**

4. Forecasted Traffic Demands on Cat Hai Island

Cat Hai Island 2015 (Without Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Population	$(100m^2)$	$(100m^2)$	$(pcu/hr/100m^2)$		$(pcu/hr/100m^2)$		(pcu/hr)		(pcu/hr)	
		19,000	4,750	0.250	0.080	0.080	0.250	713	228	228	713
		19000*1/4						4750*0.25*0.6	4750*0.08*0.6	4750*0.08*0.6	4750*0.25*0.6
II	Lach Huyen Port Area	(tons /yr)	(tons /yr)	(pcu/ton)		(pcu/ton)		(pcu/ton)		(pcu/ton)	
		5,394,000	739	0.082	0.082	0.082	0.082	61	61	61	61
		5394000/365*0.05						739*0.082	739*0.082	739*0.082	739*0.082
III	Tourists	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		500,000	62	0.400	0.400	0.400	0.400	19	19	19	19
		500000/365*0.76*0.06						62*0.4*0.76	62*0.4*0.76	62*0.4*0.76	62*0.4*0.76
							TOTAL	792	307	307	792

Cat Hai Island 2020 (Without Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Population	$(100m^2)$	$(100m^2)$	$(pcu/hr/100m^2)$		$(pcu/hr/100m^2)$		(pcu/hr)		(pcu/hr)	
		19,300	4,825	0.250	0.080	0.080	0.250	917	293	293	917
		19300*1/4						4825*0.25*0.76	4825*0.08*0.76	4825*0.08*0.76	4825*0.25*0.76
II	Lach Huyen Port Area	(tons /yr)	(tons /yr)	(pcu/ton)		(pcu/ton)		(pcu/ton)		(pcu/ton)	
		29,525,000	4,045	0.082	0.082	0.082	0.082	332	332	332	332
		29525000/365*0.05						4045*0.082	4045*0.082	4045*0.082	4045*0.082
III	Tourists	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		1,600,000	200	0.400	4.000	0.400	4.000	61	61	61	61
		1600000/365*0.76*0.06						200*0.4*0.76	200*0.4*0.76	200*0.4*0.76	200*0.4*0.76
							TOTAL	1,309	686	686	1,309

Cat Hai Island Zone 2030 (With Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Population	$(100m^2)$	$(100m^2)$	$(pcu/hr/100m^2)$		$(pcu/hr/100m^2)$		(pcu/hr)		(pcu/hr)	
		20,100	5,025	0.250	0.080	0.080	0.250	804	257	257	804
		20100*1/4						5025*0.25*0.64	5025*0.08*0.64	5025*0.08*0.64	5025*0.25*0.64
II	Lach Huyen Port Area	(tons /yr)	(tons /yr)	(pcu/ton)		(pcu/ton)		(pcu/ton)		(pcu/ton)	
		120,000,000	11,507	0.082	0.082	0.082	0.082	944	944	944	944
		120000000/365*0.7*0.05						11507*0.082	11507*0.082	11507*0.082	11507*0.082
III	Tourists	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		2,600,000	325	0.400	0.400	0.400	0.400	99	99	99	99
		2600000/365*0.76*0.06						325*0.4*0.76	325*0.4*0.76	325*0.4*0.76	325*0.4*0.76
							TOTAL	1,846	1,300	1,300	1,846

5. Forecasted Traffic Demands on Cat Ba Island

Cat Ba Island 2015 (Without Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Population	$(100m^2)$	$(100m^2)$	$(pcu/hr/100m^2)$		$(pcu/hr/100m^2)$		(pcu/hr)		(pcu/hr)	
		12,000	900	0.250	0.080	0.080	0.250	135	43	43	135
		12000/4*0.3						900*0.25*0.6	900*0.08*0.6	900*0.08*0.6	900*0.25*0.6
III	Tourists	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		500,000	----	0.400	0.400	0.400	0.400	0	0	0	0
							TOTAL	**135**	**43**	**43**	**135**

Cat Ba Island 2020 (Without Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Population	$(100m^2)$	$(100m^2)$	$(pcu/hr/100m^2)$		$(pcu/hr/100m^2)$		(pcu/hr)		(pcu/hr)	
		13,000	975	0.250	0.080	0.080	0.250	185	59	59	185
		13000/4*0.3						975*0.25*0.76	975*0.08*0.76	975*0.08*0.76	975*0.25*0.76
III	Tourists	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		348,700	----	0.400	0.400	0.400	0.400	0	0	0	0
							TOTAL	**185**	**59**	**59**	**185**

Cat Ba Island 2030 (With Railway)

No.	Item	Amount		Trip Generation Rate				Trip Generation (pcu/hr)			
				AM		PM		AM		PM	
				Genaration	Attraction	Genaration	Attraction	Genaration	Attraction	Genaration	Attraction
I	Population	$(100m^2)$	$(100m^2)$	$(pcu/hr/100m^2)$		$(pcu/hr/100m^2)$		(pcu/hr)		(pcu/hr)	
		13,000	975	0.250	0.080	0.080	0.250	156	50	50	156
		13000/4*0.3						975*0.25*0.64	975*0.08*0.64	975*0.08*0.64	975*0.25*0.64
III	Tourists	(m2)	(units)	(pcu/hr/unit)		(pcu/hr/unit)		(pcu/hr)		(pcu/hr)	
		2,600,000	----	0.400	0.400	0.400	0.400	0	0	0	0
							TOTAL	**156**	**50**	**50**	**156**

6. Revised FS Daily Traffic Volume (Tan Vu – Dinh Vu)

Revised FS Peak Hour Traffic Volume (Tan Vu - Dinh Vu)

Unit: pcu/peak hour

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
To Tan Vu Interchange	1,276	1,451	1,625	1,800	1,974	2,149	2,348	2,547	2,746	2,945	3,145	3,344	3,543	3,742	3,941	4,140	4,380	4,619	4,858	5,098	5,337
Bicycle 1	268	296	322	346	367	387	392	392	387	377	362	341	315	284	248	207	193	176	155	133	107
Motorcycle 2	623	676	723	761	794	816	850	876	895	907	912	910	900	883	859	828	841	850	855	856	854
Car 3	125	168	218	274	336	404	467	535	604	680	761	846	935	1025	1123	1226	1318	1412	1508	1607	1708
Trucks of 2 axles and mini bus with less than 25 seats 4	110	129	150	169	191	215	244	275	308	342	377	415	454	494	536	580	635	693	753	816	881
Truck of more than 3 axles and large bus 5	138	167	198	230	266	305	371	441	519	604	695	789	893	1003	1115	1238	1328	1420	1514	1610	1708
Trailer and bus with trailer 6	13	15	16	18	20	21	26	28	33	35	41	43	50	52	59	62	66	69	73	76	80
Total	1277	1451	1627	1798	1974	2148	2350	2547	2746	2945	3148	3344	3547	3741	3940	4141	4381	4620	4858	5098	5338
The percent of heavy vehicles	25.9%	26.9%	27.9%	28.7%	29.7%	30.7%	32.7%	34.5%	36.5%	38.2%	40.0%	41.5%	43.2%	44.8%	46.3%	47.8%	48.4%	49.1%	49.8%	50.4%	51.0%

From Tan Vu Interchange	745	886	1,028	1,169	1,310	1,451	1,703	1,955	2,206	2,458	2,709	2,961	3,213	3,464	3,716	3,967	4,394	4,821	5,248	5,674	6,101
Bicycle 1	156	181	204	224	244	261	284	301	311	315	312	302	286	263	234	198	193	183	168	148	122
Motorcycle 2	364	413	457	494	527	552	616	673	719	757	786	805	816	818	810	793	844	887	924	953	976
Car 3	73	103	138	178	223	273	339	411	485	568	656	749	848	949	1059	1174	1322	1473	1629	1788	1952
Trucks of 2 axles and mini bus with less than 25 seats 4	64	79	95	110	127	145	177	211	247	285	325	367	411	457	505	555	637	723	813	908	1007
Truck of more than 3 axles and large bus 5	80	102	125	150	177	206	269	338	417	504	599	699	810	928	1052	1186	1332	1482	1635	1792	1952
Trailer and bus with trailer 6	7	9	10	12	13	15	19	22	26	29	35	38	45	48	56	60	66	72	79	85	92
Total	744	887	1029	1168	1311	1452	1704	1956	2205	2458	2713	2960	3216	3463	3716	3966	4394	4820	5248	5674	6101
The percent of heavy vehicles	25.7%	26.9%	27.9%	28.8%	29.7%	30.7%	32.7%	34.5%	36.4%	38.2%	39.9%	41.5%	43.2%	44.8%	46.3%	47.8%	48.4%	49.1%	49.7%	50.4%	51.0%

Revised FS Daily Traffic Volume: Tan Vu-Dinh Vu

Unit: vehicles/day

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Bicycle 1	42,400	47,700	52,600	57,000	61,100	64,800	67,600	69,300	69,800	69,200	67,400	64,300	60,100	54,700	48,200	40,500	38,600	35,900	32,300	28,100	22,900
Motorcycle 2	65,800	72,600	78,667	83,667	88,067	91,200	97,733	103,267	107,600	110,933	113,200	114,333	114,400	113,400	111,267	108,067	112,333	115,800	118,600	120,600	122,000
Car 3	3,960	5,420	7,120	9,040	11,180	13,540	16,120	18,920	21,780	24,960	28,340	31,900	35,660	39,480	43,640	48,000	52,800	57,700	62,740	67,900	73,200
Trucks of 2 axles and mini bus with less than 25 seats 4	1,243	1,486	1,750	1,993	2,271	2,571	3,007	3,471	3,964	4,479	5,014	5,586	6,179	6,793	7,436	8,107	9,086	10,114	11,186	12,314	13,486
Truck of more than 3 axles and large bus 5	1,246	1,537	1,846	2,171	2,531	2,920	3,657	4,451	5,349	6,331	7,394	8,503	9,731	11,034	12,383	13,851	15,200	16,583	17,994	19,440	20,914
Trailer and bus with trailer 6	71	86	93	107	118	129	161	179	211	229	271	289	339	357	411	436	471	504	543	575	614
Total	114,720	128,829	142,076	153,978	165,267	175,160	188,278	199,588	208,704	216,132	221,619	224,911	226,409	225,764	223,337	218,961	228,490	236,601	243,363	248,929	253,114
The percent of heavy vehicles	3.5%	3.8%	4.1%	4.4%	4.7%	5.1%	5.7%	6.2%	6.9%	7.5%	8.2%	9.0%	9.8%	10.6%	11.6%	12.5%	13.0%	13.6%	14.1%	14.6%	15.2%

PCU Daily Traffic Volume: Tan Vu-Dinh Vu

Unit: PCU/day

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Bicycle 1	8,480	9,540	10,520	11,400	12,220	12,960	13,520	13,860	13,960	13,840	13,480	12,860	12,020	10,940	9,640	8,100	7,720	7,180	6,460	5,620	4,580
Motorcycle 2	19,740	21,780	23,600	25,100	26,420	27,360	29,320	30,980	32,280	33,280	33,960	34,300	34,320	34,020	33,380	32,420	33,700	34,740	35,580	36,180	36,600
Car 3	3,960	5,420	7,120	9,040	11,180	13,540	16,120	18,920	21,780	24,960	28,340	31,900	35,660	39,480	43,640	48,000	52,800	57,700	62,740	67,900	73,200
Trucks of 2 axles and mini bus with less than 25 seats 4	2,486	2,972	3,500	3,986	4,542	5,142	6,014	6,942	7,928	8,958	10,028	11,172	12,358	13,586	14,872	16,214	18,172	20,228	22,372	24,628	26,972
Truck of more than 3 axles and large bus 5	3,115	3,843	4,615	5,428	6,328	7,300	9,143	11,128	13,373	15,828	18,485	21,258	24,328	27,585	30,958	34,628	38,000	41,458	44,985	48,600	52,285
Trailer and bus with trailer 6	284	344	372	428	472	516	644	716	844	916	1,084	1,156	1,356	1,428	1,644	1,744	1,884	2,016	2,172	2,300	2,456
Total	38,065	43,899	49,727	55,382	61,162	66,818	74,761	82,546	90,165	97,782	105,377	112,646	120,042	127,039	134,134	141,106	152,276	163,322	174,309	185,228	196,093

7. Revised FS Daily Traffic Volume (Dinh – Cat Hai)

Revised FS Peak Hour Traffic Volume (Dinh Vu - Cat Hai)

Unit: pcu/peak hour

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Cat Hai to Dinh Vu	927	1,040	1,154	1,267	1,381	1,494	1,545	1,596	1,647	1,697	1,748	1,799	1,850	1,900	1,951	2,002	2,055	2,108	2,161	2,214	2,267
Bicycle 1	195	212	228	243	257	269	258	246	232	217	201	183	165	144	123	100	90	80	69	58	45
Motorcycle 2	452	485	512	536	555	568	559	549	537	523	507	489	470	448	425	400	395	388	380	372	363
Car 3	91	121	155	193	235	281	307	335	362	392	423	455	488	521	556	593	618	644	671	698	725
Trucks of 2 axles and mini bus with less than 25 seats 4	80	93	106	119	134	149	161	172	184	197	210	223	237	251	265	280	298	316	335	354	374
Truck of more than 3 axles and large bus 5	100	120	141	162	186	212	244	276	311	348	386	425	466	509	552	599	623	648	673	699	725
Trailer and bus with trailer 6	9	10	12	13	14	15	17	18	20	20	23	23	26	27	29	30	31	32	32	33	34
Total	927	1041	1154	1266	1381	1494	1546	1596	1646	1697	1750	1798	1852	1900	1950	2002	2055	2108	2160	2214	2266
The percent of heavy vehicles	25.8%	26.9%	28.0%	28.7%	29.7%	30.7%	32.8%	34.5%	36.4%	38.2%	40.0%	41.5%	43.2%	44.8%	46.3%	47.8%	48.4%	49.1%	49.7%	50.4%	51.0%

Dinh Vu to Cat Hai	351	430	508	587	666	745	806	866	927	987	1,048	1,108	1,169	1,229	1,290	1,350	1,428	1,506	1,584	1,662	1,740
Bicycle 1	74	88	101	113	124	134	135	133	131	126	121	113	104	93	81	68	63	57	51	43	35
Motorcycle 2	171	200	226	248	268	283	292	298	302	304	304	301	297	290	281	270	274	277	279	279	278
Car 3	34	50	68	89	113	140	160	182	204	228	254	280	309	337	368	400	430	460	492	524	557
Trucks of 2 axles and mini bus with less than 25 seats 4	30	38	47	55	65	75	84	94	104	114	126	137	150	162	175	189	207	226	246	266	287
Truck of more than 3 axles and large bus 5	38	49	62	75	90	106	127	150	175	202	232	261	295	329	365	404	433	463	494	525	557
Trailer and bus with trailer 6	4	4	5	6	7	7	9	10	11	12	14	14	16	17	19	20	21	23	24	25	26
Total	351	429	509	586	667	745	807	867	927	986	1051	1106	1171	1228	1289	1351	1428	1506	1586	1662	1740
The percent of heavy vehicles	26.0%	26.7%	27.9%	28.8%	29.8%	30.8%	32.7%	34.6%	36.4%	38.1%	40.0%	41.5%	43.2%	44.8%	46.3%	47.8%	48.4%	49.1%	49.8%	50.4%	51.0%

Daily Traffic Volume: Dinh Vu-Cat Hai

Unit: vehicles/day

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Bicycle 1	26,900	30,000	32,900	35,600	38,100	40,300	39,300	37,900	36,300	34,300	32,200	29,600	26,900	23,700	20,400	16,800	15,300	13,700	12,000	10,100	8,000
Motorcycle 2	41,533	45,667	49,200	52,267	54,867	56,733	56,733	56,467	55,933	55,133	54,067	52,667	51,133	49,200	47,067	44,667	44,600	44,333	43,933	43,400	42,733
Car 3	2,500	3,420	4,460	5,640	6,960	8,420	9,340	10,340	11,320	12,400	13,540	14,700	15,940	17,160	18,480	19,860	20,960	22,080	23,260	24,440	25,640
Trucks of 2 axles and mini bus with less than 25 seats 4	786	936	1,093	1,243	1,421	1,600	1,750	1,900	2,057	2,221	2,400	2,571	2,764	2,950	3,143	3,350	3,607	3,871	4,150	4,429	4,721
Truck of more than 3 axles and large bus 5	789	966	1,160	1,354	1,577	1,817	2,120	2,434	2,777	3,143	3,531	3,920	4,349	4,789	5,240	5,731	6,034	6,349	6,669	6,994	7,326
Trailer and bus with trailer 6	46	50	61	68	75	79	93	100	111	114	132	132	150	157	171	179	186	196	200	207	214
Total	72,554	81,039	88,874	96,172	103,000	108,949	109,336	109,141	108,498	107,311	105,870	103,590	101,236	97,956	94,501	90,587	90,687	90,529	90,212	89,570	88,634
The percent of heavy vehicles	3.6%	3.8%	4.1%	4.4%	4.7%	5.1%	5.7%	6.2%	6.8%	7.5%	8.2%	9.0%	9.8%	10.6%	11.5%	12.6%	13.0%	13.6%	14.1%	14.6%	15.2%

PCU Daily Traffic Volume: Dinh Vu-Cat Hai

Unit: PCU/day

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Bicycle 1	5,380	6,000	6,580	7,120	7,620	8,060	7,860	7,580	7,260	6,860	6,440	5,920	5,380	4,740	4,080	3,360	3,060	2,740	2,400	2,020	1,600
Motorcycle 2	12,460	13,700	14,760	15,680	16,460	17,020	17,020	16,940	16,780	16,540	16,220	15,800	15,340	14,760	14,120	13,400	13,380	13,300	13,180	13,020	12,820
Car 3	2,500	3,420	4,460	5,640	6,960	8,420	9,340	10,340	11,320	12,400	13,540	14,700	15,940	17,160	18,480	19,860	20,960	22,080	23,260	24,440	25,640
Trucks of 2 axles and mini bus with less than 25 seats 4	1,572	1,872	2,186	2,486	2,842	3,200	3,500	3,800	4,114	4,442	4,800	5,142	5,528	5,900	6,286	6,700	7,214	7,742	8,300	8,858	9,442
Truck of more than 3 axles and large bus 5	1,973	2,415	2,900	3,385	3,943	4,543	5,300	6,085	6,943	7,858	8,828	9,800	10,873	11,973	13,100	14,328	15,085	15,873	16,673	17,485	18,315
Trailer and bus with trailer 6	184	200	244	272	300	316	372	400	444	456	528	528	600	628	684	716	744	784	800	828	856
Total	24,069	27,607	31,130	34,583	38,125	41,559	43,392	45,145	46,861	48,556	50,356	51,890	53,661	55,161	56,750	58,364	60,443	62,519	64,613	66,651	68,673

8. Daily Traffic Volume Based on Traffic Survey (Dinh – Cat Hai) Unit:pcu/day

Year	Dinh Vu-Cat Hai Ferry and Ninh Tiep Ferry terminal									
	1	2	3	4	5	6	Port	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	33	192	22	237	22	0		506	278	228
2011	36	207	24	256	24	0		547	301	246
2012	39	224	26	276	26	0		591	325	266
2013	42	242	28	298	28	0		638	351	287
2014	45	261	30	322	30	0		688	378	310
2015	49	282	32	348	32	0	3,170	3,913	2,152	1,761
2016	53	305	35	376	35	0	5,658	6,462	3,554	2,908
2017	57	329	38	406	38	0	8,158	9,026	4,964	4,062
2018	62	355	41	438	41	0	10,678	11,615	6,388	5,227
2019	67	383	44	473	44	0	13,205	14,216	7,819	6,397
2020	72	414	48	511	48	0	15,748	16,841	9,263	7,578
2021	77	443	51	547	51	0	21,863	23,032	12,668	10,364
2022	82	474	55	585	55	0	26,035	27,286	15,007	12,279
2023	88	507	59	626	59	0	30,513	31,852	17,519	14,333
2024	94	542	63	670	63	0	35,315	36,747	20,211	16,536
2025	101	580	67	717	67	0	40,433	41,965	23,081	18,884
2026	108	621	72	767	72	0	32,103	33,743	18,559	15,184
2027	116	664	77	821	77	0	36,130	37,885	20,837	17,048
2028	124	710	82	878	82	0	40,378	42,254	23,240	19,014
2029	133	760	88	939	88	0	44,843	46,851	25,768	21,083
2030	142	813	94	1,005	94	0	49,555	51,703	28,437	23,266
2031	151	862	100	1,065	100	0	53,685	55,963	30,780	25,183
2032	160	914	106	1,129	106	0	58,048	60,463	33,255	27,208
2033	170	969	112	1,197	112	0	62,410	64,970	35,734	29,237
2034	180	1,027	119	1,269	119	0	66,768	69,482	38,215	31,267
2035	191	1,089	126	1,345	126	0	71,130	74,007	40,704	33,303

Year	Cat Hai Road									
	1	2	3	4	5	6	Port	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	129	202	29	221	26	0		607	334	273
2011	139	218	31	239	28	0		655	360	295
2012	150	235	33	258	30	0		706	388	318
2013	162	254	36	279	32	0		763	420	343
2014	175	274	39	301	35	0		824	453	371
2015	189	296	42	325	38	0	3,170	4,060	2,233	1,827
2016	204	320	45	351	41	0	5,658	6,619	3,640	2,979
2017	220	346	49	379	44	0	8,158	9,196	5,058	4,138
2018	238	374	53	409	48	0	10,678	11,800	6,490	5,310
2019	257	404	57	442	52	0	13,205	14,417	7,929	6,488
2020	278	436	62	477	56	0	15,748	17,057	9,381	7,676
2021	297	467	66	510	60	0	21,863	23,263	12,795	10,468
2022	318	500	71	546	64	0	26,035	27,534	15,144	12,390
2023	340	535	76	584	68	0	30,513	32,116	17,664	14,452
2024	364	572	81	625	73	0	35,315	37,030	20,367	16,664
2025	389	612	87	669	78	0	40,433	42,268	23,247	19,021
2026	416	655	93	716	83	0	32,103	34,066	18,736	15,330
2027	445	701	100	766	89	0	36,130	38,231	21,027	17,204
2028	476	750	107	820	95	0	40,378	42,626	23,444	19,182
2029	509	803	114	877	102	0	44,843	47,248	25,986	21,262
2030	545	859	122	938	109	0	49,555	52,128	28,670	23,458
2031	578	911	129	994	116	0	53,685	56,413	31,027	25,386
2032	613	966	137	1,054	123	0	58,048	60,941	33,518	27,423
2033	650	1,024	145	1,117	130	0	62,410	65,476	36,012	29,464
2034	689	1,085	154	1,184	138	0	66,768	70,018	38,510	31,508
2035	730	1,150	163	1,255	146	0	71,130	74,574	41,016	33,558

Year	Ben Got Ferry Terminal and Cat Hai-Cat Ba Ferry								
	1	2	3	4	5	6	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	47	176	28	152	36		439	241	198
2011	51	190	30	164	39	0	474	261	213
2012	55	205	32	177	42	0	511	281	230
2013	59	221	35	191	45	0	551	303	248
2014	64	239	38	206	49	0	596	328	268
2015	69	258	41	222	53	0	643	354	289
2016	75	279	44	240	57	0	695	382	313
2017	81	301	48	259	62	0	751	413	338
2018	87	325	52	280	67	0	811	446	365
2019	94	351	56	302	72	0	875	481	394
2020	102	379	60	326	78	0	945	520	425
2021	109	406	64	349	83	0	1,011	556	455
2022	117	434	68	373	89	0	1,081	595	486
2023	125	464	73	399	95	0	1,156	636	520
2024	134	496	78	427	102	0	1,237	680	557
2025	143	531	83	457	109	0	1,323	728	595
2026	153	568	89	489	117	0	1,416	779	637
2027	164	608	95	523	125	0	1,515	833	682
2028	175	651	102	560	134	0	1,622	892	730
2029	187	697	109	599	143	0	1,735	954	781
2030	200	746	117	641	153	0	1,857	1,021	836
2031	212	791	124	679	162	0	1,968	1,082	886
2032	225	838	131	720	172	0	2,086	1,147	939
2033	239	888	139	763	182	0	2,211	1,216	995
2034	253	941	147	809	193	0	2,343	1,289	1,054
2035	268	997	156	858	205	0	2,484	1,366	1,118

9. Daily Traffic Volume Based on Traffic Survey (Dinh – Cat Hai) Unit: Vehicles/day

Unit: Vehicles/day

Year	Dinh Vu-Cat Hai Ferry and Ninh Tiep Ferry terminal									
	1	2	3	4	5	6	Port	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	165	640	22	119	9	0		954	525	429
2011	178	691	24	128	10	0		1,031	567	464
2012	192	746	26	138	11	0		1,113	612	501
2013	207	806	28	149	12	0		1,202	661	541
2014	224	870	30	161	13	0		1,298	714	584
2015	242	940	32	174	14	0	1,268	2,670	1,469	1,202
2016	261	1,015	35	188	15	0	2,263	3,777	2,077	1,700
2017	282	1,096	38	203	16	0	3,263	4,898	2,694	2,204
2018	305	1,184	41	219	17	0	4,271	6,037	3,320	2,717
2019	329	1,279	44	237	18	0	5,282	7,189	3,954	3,235
2020	355	1,381	48	256	19	0	6,299	8,358	4,597	3,761
2021	380	1,478	51	274	20	0	8,745	10,948	6,021	4,927
2022	407	1,581	55	293	21	0	10,414	12,771	7,024	5,747
2023	435	1,692	59	314	22	0	12,205	14,727	8,100	6,627
2024	465	1,810	63	336	24	0	14,126	16,824	9,253	7,571
2025	498	1,937	67	360	26	0	16,173	19,061	10,484	8,577
2026	533	2,073	72	385	28	0	12,841	15,932	8,763	7,169
2027	570	2,218	77	412	30	0	14,452	17,759	9,767	7,992
2028	610	2,373	82	441	32	0	16,151	19,689	10,829	8,860
2029	653	2,539	88	472	34	0	17,937	21,723	11,948	9,775
2030	699	2,717	94	505	36	0	19,822	23,873	13,130	10,743

Unit: Vehicles/day

Year	Cat Hai Road									
	1	2	3	4	5	6	Port	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	645	673	291	111	10	0		1,730	952	779
2011	697	727	314	119	11	0		1,868	1,027	841
2012	753	785	339	129	12	0		2,018	1,110	908
2013	813	848	366	139	13	0		2,179	1,198	981
2014	878	916	395	150	14	0		2,353	1,294	1,059
2015	948	989	427	162	15	0	1,268	3,809	2,095	1,714
2016	1,024	1,068	461	175	16	0	2,263	5,007	2,754	2,253
2017	1,106	1,153	498	189	17	0	3,263	6,226	3,424	2,802
2018	1,194	1,245	538	204	18	0	4,271	7,470	4,109	3,362
2019	1,290	1,345	581	220	19	0	5,282	8,737	4,805	3,932
2020	1,393	1,453	627	238	21	0	6,299	10,031	5,517	4,514
2021	1,491	1,555	671	255	22	0	8,745	12,739	7,006	5,733
2022	1,595	1,664	718	273	24	0	10,414	14,688	8,078	6,610
2023	1,707	1,780	768	292	26	0	12,205	16,778	9,228	7,550
2024	1,826	1,905	822	312	28	0	14,126	19,019	10,460	8,559
2025	1,954	2,038	880	334	30	0	16,173	21,409	11,775	9,634
2026	2,091	2,181	942	357	32	0	12,841	18,444	10,144	8,300
2027	2,237	2,334	1,008	382	34	0	14,452	20,447	11,246	9,201
2028	2,394	2,497	1,079	409	36	0	16,151	22,566	12,411	10,155
2029	2,562	2,672	1,155	438	39	0	17,937	24,803	13,642	11,161
2030	2,741	2,859	1,236	469	42	0	19,822	27,169	14,943	12,226

Unit: Vehicles/day

Year	Ben Got Ferry Terminal and Cat Hai-Cat Ba Ferry								
	1	2	3	4	5	6	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	235	587	28	76	14		940	517	423
2011	254	634	30	82	16	0	1,016	559	457
2012	274	685	32	89	17	0	1,097	603	494
2013	296	740	35	96	18	0	1,185	652	533
2014	320	799	38	104	19	0	1,280	704	576
2015	346	863	41	112	21	0	1,383	761	622
2016	374	932	44	121	23	0	1,494	822	672
2017	404	1,007	48	131	25	0	1,615	888	727
2018	436	1,088	52	141	27	0	1,744	959	785
2019	471	1,175	56	152	29	0	1,883	1,036	847
2020	509	1,269	60	164	31	0	2,033	1,118	915
2021	545	1,358	64	175	33	0	2,175	1,196	979
2022	583	1,453	68	187	35	0	2,326	1,279	1,047
2023	624	1,555	73	200	37	0	2,489	1,369	1,120
2024	668	1,664	78	214	40	0	2,664	1,465	1,199
2025	715	1,780	83	229	43	0	2,850	1,568	1,283
2026	765	1,905	89	245	46	0	3,050	1,678	1,373
2027	819	2,038	95	262	49	0	3,263	1,795	1,468
2028	876	2,181	102	280	52	0	3,491	1,920	1,571
2029	937	2,334	109	300	56	0	3,736	2,055	1,681
2030	1,003	2,497	117	321	60	0	3,998	2,199	1,799

Unit: Vehicles/day

Year	Ben Got Ferry Terminal and Cat Hai-Cat Ba Ferry								
	1	2	3	4	5	6	Total	To Tan Vu IC Direction	To Cat Ba Direction
2010	235	587	28	76	14		940	517	423
2011	254	634	30	82	16	0	1,016	559	457
2012	274	685	32	89	17	0	1,097	603	494
2013	296	740	35	96	18	0	1,185	652	533
2014	320	799	38	104	19	0	1,280	704	576
2015	346	863	41	112	21	0	1,383	761	622
2016	374	932	44	121	23	0	1,494	822	672
2017	404	1,007	48	131	25	0	1,615	888	727
2018	436	1,088	52	141	27	0	1,744	959	785
2019	471	1,175	56	152	29	0	1,883	1,036	847
2020	509	1,269	60	164	31	0	2,033	1,118	915
2021	545	1,358	64	175	33	0	2,175	1,196	979
2022	583	1,453	68	187	35	0	2,326	1,279	1,047
2023	624	1,555	73	200	37	0	2,489	1,369	1,120
2024	668	1,664	78	214	40	0	2,664	1,465	1,199
2025	715	1,780	83	229	43	0	2,850	1,568	1,283
2026	765	1,905	89	245	46	0	3,050	1,678	1,373
2027	819	2,038	95	262	49	0	3,263	1,795	1,468
2028	876	2,181	102	280	52	0	3,491	1,920	1,571
2029	937	2,334	109	300	56	0	3,736	2,055	1,681
2030	1,003	2,497	117	321	60	0	3,998	2,199	1,799

Appendix-3: Standard and Criteria for Bridge Design

1. Design Standards

Basically, the bridges and structures in this project shall be designed with the Vietnamese Design Standard (22 TCN 272-05) and AASHTO-LRFD (Load and Resistance Factor Design, 3rd Edition 2004). However, the some items shall be considered in accordance with the other international standards.

The adopted items for this project are summarized in Table 1.

Table 1 Adopted Items for this Project

Item	Specification	Standard
Design Method	Limit State Design	Vietnamese
Design Life	100 years	Vietnamese
Design Lane Width	3600 mm or 3750 mm	Vietnamese
Load Combination		Vietnamese
Live Load	HL-93	Vietnamese
Dynamic Load Allowance, IM	0.25 for main part of bridge	Vietnamese
Wind Load	Depend on the site	Vietnamese
Vessel Collision Force	Depend on the site	Vietnamese
Earthquake	Depend on the site	Vietnamese/Japanese
Seismic Earth Pressure	Depend on the site	Vietnamese/Japanese
Stress Loss in Tendons		Vietnamese/Japanese
Creep & Shrinkage		Vietnamese/Japanese /CEB-FIP
Pile Foundation Analysis	Displacement Method	Vietnamese/Japanese
Train Load	T-26	Vietnamese

The items not fit for these standards, shall be determined referring to AASHTO (Allowable stress design method, 17th Edition 2002) or Japanese Standard of Highway Bridge (JSHB-96).

The highway cum railway bridge is planned in this project. The clause 1.1 of 22 TCN 272-05 described that " It is envisaged that a supplement on the design of railway bridges will be produced in the future." Accordingly, the design concept of the highway cum railway bridge will be established in accordance with AASHTO. The train load shall be taken from Vietnamese standards, which the Railway Projects Management Unit (RPMU) has applied for Hanoi - Ho Chi Minh City Railway Bridge Rehabilitation Project. Since the load combination is not specified in these standards, the Consultant will establish the load combination and load factors.

1.1. Limit State Design

The bridge and structures shall be designed for specified limit states in the Vietnamese Standard (22 TCN 272-05) to achieve the objectives of constructability, safety, and serviceability with due regard to issues of inspectibility, economy, and aesthetics in considering with the design life of bridge and structures shall be 100 years.

1.1.1. Limit States

The bridge and structures shall be verified under the following limit states. And all limit states shall be considered of equal importance.

- Strength Limit State
- Extreme Event Limit State
- Service Limit State
- Fatigue Limit State

Each component and connection shall satisfy the following equation for service limit, fatigue and fracture limit, strength limit and extreme event limit states.

$$Q = \Sigma \eta_i \gamma_i Q_i \leq \phi R_n = R_r$$

where:

Q = factored load
Q_i = force effect
R_n = nominal resistance
R_r = factored resistance
γ_i = load factor
φ = resistance factor
η_i = load modifier

(1) Load Modifier (η_i)

The load modifier for strength limit state is calculated by the following equation. Besides the load modifier for the other limit state should be 1.0.

$$\eta_i = \eta_D * \eta_R * \eta_I$$

where:

η_D = a factor relating to ductility
η_R = a factor relating to redundancy
η_I = a factor relating to operational importance

Table 2 Load Modifier

Factor	Category	Strength Limit State
η_D	For nonductile components and connections	>= 1.05
	For conventional designs and details complying with TVCN 22 TCN-272-05	1.00
	For components and connections for which additional ductile-enhancing measures have been specified beyond those required by TVCN 22 TCN-272-05	>= 0.95
η_R	For nonredundant members	>= 1.05
	For conventional levels of redundancy	1.00
	For exceptional levels of redundancy	>= 0.95
η_I	For important bridges	>= 1.05
	For typical bridges	1.00
	For relatively less important bridges	>= 0.95

(2) Limit States for the bridge and structures

The limit states for the bridge and structures are shown in Table 3.

Table 3 Limit States for the bridge and structures

Limit State	Outline of Limit State
Strength-I	Basic load combination relating to the normal vehicular use of the bridge without wind.
Strength-II	Load combination relating to the bridge exposed to wind velocity exceeding 25 m/s without live load.
Strength-III	Load combination relating to normal vehicular use of the bridge with wind of 25 m/s velocity.
Extrem Event	Load combination relating to earthquake, collision by vessels and vehicles, and certain hydraulic events with a reduced live load other than that which is part of the vehicular collision load, CT.
Service	Load combination relating to the normal use of the bridge with a 25 m/s wind and all loads taken at their normal values, to control deflections, crack width in RC and PC structure, yielding of steel structures and slip of slip critical connections due to vehicular live load, and to investigate slope stability.
Fatigue	Fatigue and fracture load combination relating to repetitive gravitational vehicular live load and dynamic responses under a single design truck.

1.2. Load Factor and Combination

1.2.1. Loads

The following permanent and transient loads shall be considered.

Table 4 Permanent and Transient Loads

Permanent Loads	DD = Downdrag DC = Dead load of structural components and nonstructural attachment DW = Dead load of wearing surfaces and utilities EH = Horizontal earth pressure load EL = Accumulated locked-in force effects resulting from the construction process, including the secondary forces from post-tensioning ES = Earth surcharge load EV = Vertical pressure from dead load of earth fill
Transient Loads	BR = Vehicular braking force CE = Vehicular centrifugal force CR = Creep CT = Vehicular collision force CV = Vessel collision force EQ = Earthquake FR = Friction IM = Vehicular dynamic load allowance LL = Vehicular live load LS = Live load surcharge PL = Pedestrian live load SE = Settlement SH = Shrinkage TG = Temperature gradient TL = Train Load TU = Uniform temperature WA = Water load and stream pressure WL = Wind on live load WS = Wind load on structure

1.2.2. Load Factor and Combination

The total factored force effect shall be taken as:

$$Q = \Sigma \eta_i * \gamma_i * Q_i$$

where:

Q_i = force effects from loads

γ_i = load factors specified in Tables 5 to 7

Table 5 Load Combinations and Factors

Load Combination / Limit State	DC DD DW EH EV ES	LL IM CE BR PL LS EL	TL	WA	WS	WL	FR	TU CR SH	TG	SE	Use One of These At a Time		
											EQ	CT	CV
Strength-I	γ_p	1.75	1.75	1.00	-	-	1.00	0.50/1.20	γTG	γSE	-	-	-
Strength-II	γ_p	-	-	1.00	1.40		1.00	0.50/1.20	γTG	γSE	-	-	-
Strength-III	γ_p	1.35	1.35	1.00	0.40	1.00	1.00	0.50/1.20	γTG	γSE	-	-	-
Extreme	γ_p	0.50	0.50	1.00	-	-	1.00	-	-	-	1.00	1.00	1.00
Service	1.00	1.00	1.00	1.00	0.30	1.00	1.00	1.00/1.20	γTG	γSE	-	-	-
Fatigue-LL,	-	0.75	0.75	-	-	-	-	-	-	-	-	-	-
IM&CE only													

Note: For checking crack widths in prestressed concrete structures at the service limit state, the load factor for live load may be reduced to 0.80

Table 6 Load Factors for Permanent Loads, γ_p

Type of Load			Load Factor	
			Maximum	Minimum
DC	:	Component and Attachments	1.25	0.90
DD	:	Downdrag	1.80	0.45
DW	:	Wearing Surfaces and Utilities	1.50	0.65
EH	:	Horizontal Earth Pressure		
		Active	1.50	0.90
		At Rest	1.35	0.90
EL	:	Locked-in Erection Stress	1.00	1.00
EV	:	Vertical Earth Pressure		
		Overall Stability	1.00	N/A
		Retaining Structures	1.35	1.00
		Rigid Buried Structures	1.30	0.90
		Rigid Frames	1.35	0.90
		Flexible Buried Structures other than Metal Box Culverts	1.95	0.90
		Flexible Metal Box Culverts	1.50	0.90
ES	:	Earth Surcharge	1.50	0.75

Table 7 Load Factor for Temperature Gradient, γ_{TG}

γ_{TG}	Conditions
0.00	at the strength and extreme event limit states
1.00	at the service limit state when live load is not considered
0.50	at the service limit state when live load is considered

1.3. Design Load

1.3.1. Dead Load: DC, DW and EV

Dead loads shall include the weight of all components of the structure, appurtenances and utilities attached thereto, earth cover, wearing surface and future overlays.

The following densities specified in Table 8 for each material is used for dead loads. And the weight of utilities shall be decided due to the site investigations.

Table 8 Densities

Material		Density (kg/m^3)
Aluminum Alloys		2800
Bituminous Wearing Surfaces		2250
Cinder Filling		960
Compacted Sand, Silt or Clay		Due to soil investigation
Concrete	Low-density	1775
	Sand-low-density	1925
	Normal	2400
Loose Sand, Silt or Gravel, Soft Clay		Due to soil investigation
Rolled Gravel, Macadam or Ballast		2250
Steel		7850
Stone Masonry		2725
Water	Fresh	1000
	Salt	1025

1.3.2. Live Loads

(1) <u>Vehicular Live Load: LL</u>

1) Number of Design Lanes

The number of design lanes should be determined by taking the integer part of the ratio w/3600, where w is the clear roadway width in mm between curbs and/or barriers.

2) Multiple Presence Factor

The extreme live load force effect shall be determined by considering each possible combination of number of loaded lanes multiplied by a corresponding multiple presence factor to account for the probability of simultaneous lane occupation by the HL-93 design live load. The multiple presence factors are shown in Table 9.

For the purpose of determining the number of lanes when the loading condition includes the pedestrian loads combined one or more lanes of the vehicular live load, pedestrian loads may be taken to be one loaded lane.

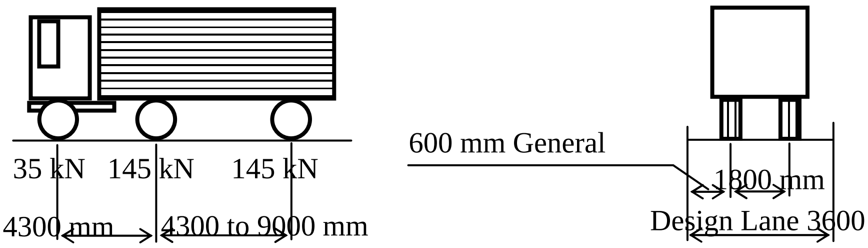
Table 9 Multiple Presence factors "m"

Number of Loaded Lanes	1	2	3	> 3
Multiple Presence Factors "m"	1.20	1.00	0.85	0.65

3) Design Vehicular Live Load

Vehicular live loading (HL-93) shall consist of a combination of the followings:

- Design Truck
- Design Tandem
- Design Lane Load



Note: For fatigue load, the distance between 145 kN axles shall be constant of 9000 mm

Figure 1 Design Truck

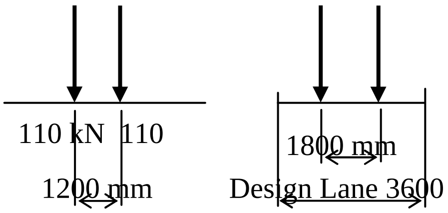


Figure 2 Design Tandem

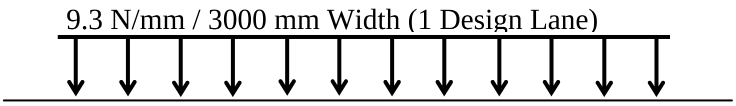


Figure 3 Design Lane Load

The extreme force effect shall be taken as the larger of the followings:

- The effects of Design Tandem and Design Lane Load
- The effects of Design Truck with variable axle spacing and Design Lane Load
- For both negative moment between points of contra flexure under a uniform load on all spans, and reaction at interior pier, 90% of the effect of two design trucks spaced a minimum 15000 mm between the lead axle of one truck and the rear axle of the other truck, combined with 90 % of the effect of the design lane load. The distance between the 145000 N axles of each truck shall be 4300 mm

And the extreme force effect shall be considered as follows:

- Longitudinally, the axles that do not contribute to the extreme force effect under consideration shall be neglected
- Transverse, both the design lanes and the 3000 mm loaded width in each lane shall be positioned to produce extreme force effects

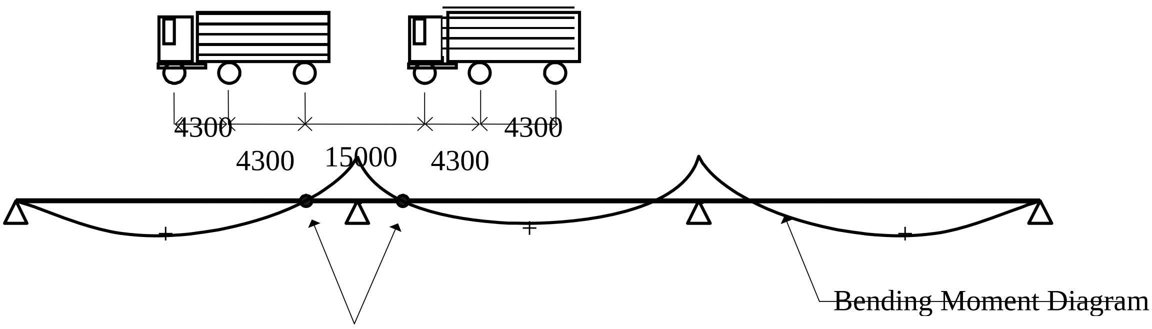


Figure 4 Two Design Trucks Loadings for Negative Moment and Reaction at Intrior Pier

(2) Pedestrian Loads: PL

A pedestrian load of 3×10^{-3} MPa shall be applied to all sidewalks wider then 600mm and considered simultaneously with the vehicular design live load.

(3) Dynamic Load Allowance: IM

In case of the both of the design truck and tandem, the static effects shall be increased by the percentage specified in Table 10 for dynamic load allowance.

Table 10 Dynamic Load Allowance, IM

Component	Deck Joints - All Limit States	All Other Components	
		Fatigue and Fracture Limit State	All Other Limit States
IM	75 %	15 %	25 %

Dynamic load allowance need not be applied to:

- Retaining walls not subject to vertical reactions from the superstructure
- Foundation components that are entirely below ground level

For buried structures such as culverts, IM shall be taken as:

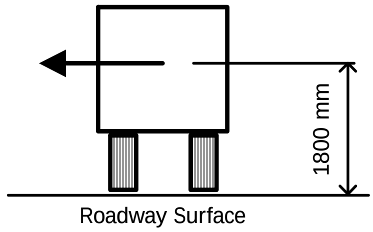
$IM = 33*(1.0-4.1*10^{-4}*DE) >= 0\ \%$

Where;

DE = Minimum depth of earth cover above the structure (mm).

(4) Centrifugal Forces: CE

Centrifugal forces, which is to be applied horizontally at a distance 1800 mm above the roadway surface, shall be taken as the product of the axle weights of the design truck or tandem and the factor C, taken as:



Centrifugal Force

$$C = \frac{4}{3}\frac{v^2}{gR}$$

where:

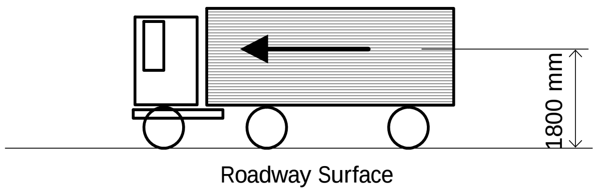
v = highway design speed (m/s)
g = gravitational acceleration: 9.807 (m/s^2)
R = radius of curvature of traffic lane (m)

The multiple presence factors shall apply.

(5) Braking Force: BR

The braking forces shall be taken as 25% of the axle weights of the design truck or tandem per lane placed in all design lanes which are carrying traffic headed in the same direction. Besides all design lanes shall be simultaneously loaded for bridges likely to become one-directional in the future.

These forces shall be assumed to act horizontally at a distance of 1800 mm above the roadway surface in either longitudinal direction to cause extreme force effects.



Braking Force

The multiple presence factors shall apply.

(6) Vehicular Collision Force: CT

Unless protected as followings, abutments and piers located within a distance of 9000 mm to the edge of roadway, shall be designed for an equivalent static force of 1800 kN, which is assumed to act in any direction in a horizontal plane, at a distance of 1200 mm above ground.

- An embankment;
- A structurally independent, crashworthy ground mounted 1370 mm high barrier, located within 3000 mm from the component being protected
- A 1070 mm high barrier, located at more than 3000 mm from the component being protected

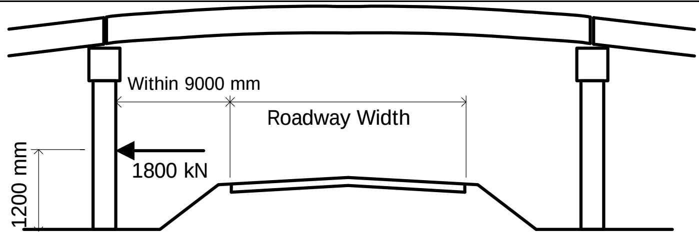


Figure 5 Vehicular Collision Force

(7) ***Train Live Load: TL***

Train Load

A train load of T-26 shall be applied and considered simultaneously with the vehicular design live load. The train load is shown in Figure 6.

Train Load (T-26)

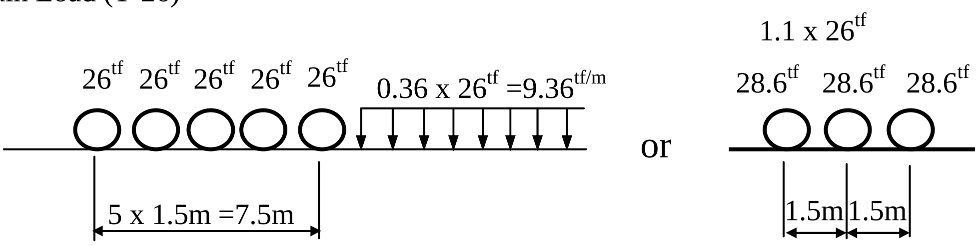


Figure 6 Train Load of T-26

Centrifugal Load

The Centrifugal Load shall act at right angles and horizontally to the truck at the center of gravity of the train load.

Centrifugal Load = Train Load x α (tf)

$$\alpha = \frac{v2}{127R}$$

where:
α = Factor of train load
v = Maximum speed (km/h) of the train traveling on the curved track (m/s) : **to be specified.**
R = Radius of the curve (m)

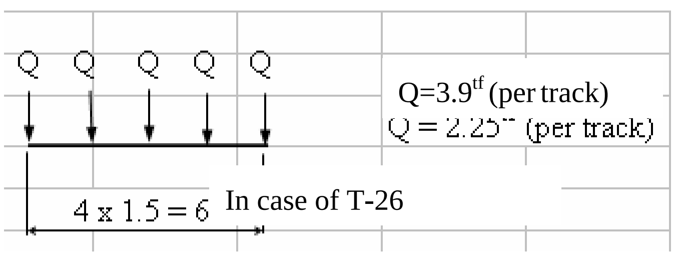
Long Rail Longitudinal Load

Long Rail Longitudinal Load = 1.0tf/m/truck x the overall length of the member (tf/truck)

This value shall not exceed 200tf/truck.

Rolling Stock Lateral Load

The rolling stock lateral load shall act at right angle and horizontally to the rail surface height.



Breaking Load and Starting Load

The breaking load and starting load shall act on the track at the center of gravity height of the train load.

Breaking Load	25% of the characteristic value of train load
Starting Load	25% of the drive wheel axle weight constituting the characteristic value of train load

Note: Loading length of train load shall be within the range of maximum effect on the member

1.3.3. Water Loads: WA

For bridges over water way, the water loads as static pressure, buoyancy and stream pressure shall be adopted with following considerations;

Strength and Service Limit State

The consequences of changes in foundation conditions resulting from the design flood for scour shall be considered.

Extreme Event Limit State (with EQ, CT and CV)

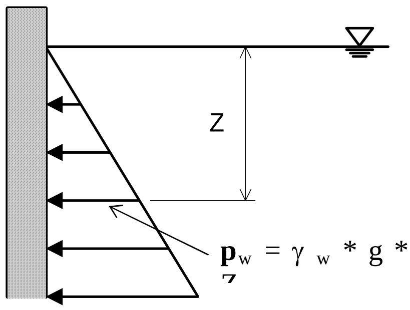
The water loads and scour depths may be based on the mean annual discharge.

Extreme Event Limit State (without EQ, CT and CV)

The structure shall be checked for the consequences of changes in foundation conditions resulting from the check flood for scour.

(1) Static Pressure

Static pressure of water shall be assumed to act perpendicular to the surface that is retaining water. Pressure shall be calculated as the product of height (Z) of water above the point of consideration, the density of water (γ_w), and g (the acceleration of gravity).



Static Water Pressure

(2) Buoyancy

Buoyancy shall be considered to be an uplift force, taken as the sum of the vertical components of static pressures acting on all components below the design water level.

(3) Stream Pressure

1) Longitudinal

The pressure of flowing water acting in the longitudinal direction of substructure shall be taken as:

$$p = 5.14 * 10^{-4} C_D V^2$$

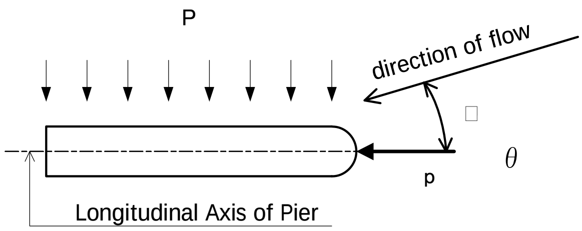
where:
p = pressure of flowing water (MPa)
C_D = drag coefficient for piers as specificed in Table 11
V = velocity of water for the design flood for scour in strength and service limit states and for the check flood for scour in the extreme event limit state (m/s)

Table 11 Drag Coefficient

Type	C_D
Semicircular-nosed Pier	0.70
Square-ended Pier	1.40
Debris lodges against the Pier	1.40
Wedge-nosed Pier with Nose Angle 90o or less	0.80

2) Transverse

The lateral, uniformly distributed pressure on a substructure due to water flowing at an angle, θ, to the longitudinal axis of the pier shall be taken as:



TTransverse Water Pressure

$$p = 5.14 * 10^{-4} C_L V^2$$

where:
p = lateral pressure (MPa)
C_L = lateral drag coefficient specified in Table 12

Table 12 Lateral Drag Coefficient

Angle, θ, between direction of flow and longitudinal axis of the pier	C_L
0^o	0.0
5^o	0.5
10^o	0.7
20^o	0.9
>= 30^o	1.0

(4) Wave load

Wave load on the bridge structures shall be considered for exposed where the development of significant wave forces may occur.

1.3.4. Wind Load

(1) Horizontal Wind Load

1) General

This Article provides design wind loads for conventional bridge structures. For long span, specific wind climate studies should be carried out to determine the wind effects.

The design wind velocity, V, shall be determined from:

$V = V_B * S$ where:

V_B = basic 3 second gust wind velocity with 100 years return period appropriate to the Wind Zone in which the bridge is located, as specified in Table 13

S = correction factor for upwind terrain and deck height, as specified in Table 14

Figure 7 Wind Zone Map in Vietnam

Table 13 Values of V_B for Wind Zones in Vietnam

Wind zone (TCVN2737-1995)	V_B (m/s)
I	38
II	45
III	53
IV	59

Table 14 Values of S

Height of bridge deck above surrounding ground or water level (m)	Open country or open water	Wooded country or built-up areas, with trees or buildings up to a maximum height of about 10 m	Built-up areas with buildings predominantly over 10 m high
10	1.09	1.00	0.81
20	1.14	1.06	0.89
30	1.17	1.10	0.94
40	1.20	1.13	0.98
50	1.21	1.16	1.01

2) Wind Load on Structures: WS

Transverse Wind Load

The transverse wind load, P_D, shall be taken as acting horizontally at the centroids of the appropriate areas, and shall be calculated as:

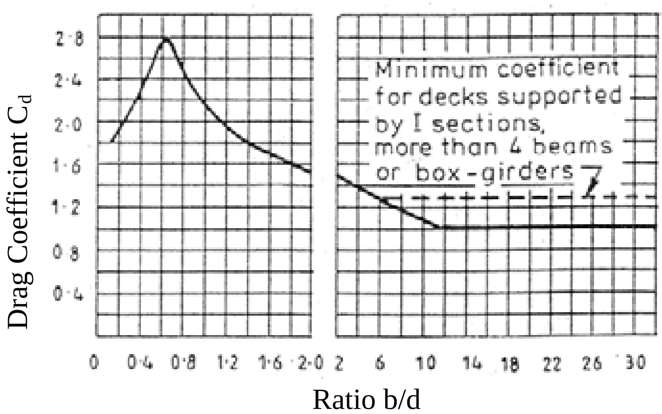
$$P_D = 0.0006V^2 A_t C_d \geq 1.8A_t \quad \text{(kN)}$$

where:

V = design wind velocity (m/s)

A_t = solid area of the structure or element for calculation of transverse wind load (m^2)

C_d = drag coefficient specified in Figure 8



b=overall width of bridge between outer faces of parapets(mm)
d=depth of superstructure including solid parapets if applicable(mm)

Figure 8 Drag Coefficient Cd for Superstructures with Solid Elevation

The area of the structure or element under consideration A_t, shall be the solid area in normal projected elevation, without live load, subjected the following provisions;

For superstructures with solid parapets:	The area of superstructure shall include the area of the solid windward parapet, but the effect of the leeward parapet need not be considered.
For superstructures with open parapets:	The area of superstructure shall include both windward and leeward parapets separately considered. Where there are more than two parapets, only those two having the greatest unshielded effect shall be considered.
For truss girder superstructures:	The wind force shall be calculated for each component separately, both windward and leeward, without considering shielding.
For piers:	Shielding shall not be considered

Longitudinal Wind Load

The longitudinal wind load shall be considered as follows;

For piers, abutments, truss girder superstructures and other superstructure forms which represent a significant surface area to wind loads parallel to longitudinal centerline similar way to those for transverse wind loads

For superstructure with solid elevation: 0.25 times the transverse wind load

Longitudinal and transverse wind loads shall be applied as separate load cases and, where appropriate, the structure shall be checked for the effect of intermediate angles of wind by resolution of forces.

3) Wind Load on Vehicles: WL

When considering STRENGTH III load combination, the design wind load shall be applied to both structure and vehicles. And longitudinal and transverse wind loads shall be applied as separate load cases and, where appropriate, the structure shall be checked for the effect of intermediate angles of wind by resolution of forces.

Transverse

The transverse wind load on vehicles shall be represented by a line load of 1.50 kN/m acting horizontally, transverse to the longitudinal centerline of the structure and 1800 mm above the roadway.

Longitudinal

The longitudinal wind load on vehicles shall be represented by a line load of 0.75 kN/m acting horizontally, parallel to the longitudinal centerline of the structure and 1800 mm above the roadway.

(2) Vertical Wind Load

In case the angle of inclination of the wind to the structure less than 5 degrees, a vertical wind load, Pv, shall be taken as acting at the centroid of the appropriate area, and shall be calculated as:

$$P_v = 0.00045V^2 A_v \text{ (kN)}$$

where:
V = design wind velocity (m/s)
A_v= plan area of the bridge deck or element for calculation of vertical wind load (m^2)

This load shall be applied only for limit states that do not involve wind on live load, and only when the direction of wind is taken to be perpendicular to the longitudinal axis of the bridge.

1.3.5. Earthquake Effects: EQ

Earthquake loads shall be taken to be horizontal force effects for rigid-frame superstructures, substructures, foundations and connections between superstructures and substructures.

Seismic effects for box culverts and buried structures need not be considered, except where they cross active fault.

These loads are determined based on the following items.

- Acceleration Coefficient (AC) at each bridge
- Importance Categories (IC) for each bridge
- Seismic Zone based on AC for each bridge
- Site Effects (S) based on soil profile type
- Period of Vibration of the m-th mode (Tm) for the structure
- Response Modification Factor (R) for the substructures and connections

(1) Analysis for Earthquake Loads

The minimum analysis requirements for seismic effects shall be as specified in Table 15 depend on structural type, seismic zone, importance category, and part of the structure.

The connections between the superstructure and substructure shall be designed for the minimum force requirements.

Also the minimum seat width requirement shall be satisfied.

- UL = uniform load elastic method
- SM = single-mode elastic method
- MM = multimode elastic method
- TH = time history method

Table 15 Minimum Analysis Requirements for Seismic Effects

Seismic Zone	Single- Span Bridges	Multi-span Bridges					
		Other Bridges		Essential Bridges		Critical Bridges	
		Regular	Irregular	Regular	Irregular	Regular	Irregular
1	No need	No need	No need	No need	No need	No need	No need
2	No need	SM/UL	SM	SM/UL	MM	MM	MM
3	No need	SM/UL	MM	MM	MM	MM	TH

(2) Acceleration Coefficients (AC) and Seismic Zone

The seismic zone of each bridge shall be determined base on the acceleration coefficient using following table:

Table 16 Seismic Zones

Acceleration coefficients	Seismic zone	MSK – 64 class
A <= 0.09	1	Class <= 6.5
0.09 < A <= 0.19	2	6.5 < Class <= 7.5
0.19 < A < 0.29	3	7.5 < Class <= 8

According to the Vietnamese Design Code TCXDVN 375:2006 "Design of Structures with Seismic Isolation", project site is located on the seismic zone 7, acceleration coefficient A=0.1291.

(3) Importance Categories

The Owner shall classify the bridge one of three Importance Categories as follows;

- Critical Bridges
- Essential Bridges
- Other Bridges

(4) Site Effects

Based on the soil profile at each bridge site, site effects shall be included in the determination of seismic loads for bridges. The site coefficients are shown in Table 17.

Table 17 Site Coefficients

Site Coefficient	Soil Profile Type			
	I	II	III	IV
S	1.00	1.20	1.50	2.00

Where the soil profiles are follows;

Soil Profile Type I

Rock of any description, either shale - like or crystalline in nature, or Stiff soils where the soil depth is less than 60 m, and the soil types overlying rock are stable deposits of sands, gravels, or stiff clays

Soil Profile Type II

Stiff cohesive or deep cohesionless soils where the soil depth exceeds 60 m and the soil types overlaying the rock are stable deposits of sands, gravels, or stiff clays

Soil Profile Type III

Soft to medium-stiff clays and sands, characterized by 9 m or more of soft to medium-stiff clays

Soil Profile Type IV

Soft clays or silts greater than 12 m in depth

(5) *Elastic Seismic Response Coefficient*

The elastic seismic response coefficient, C_{sm} for the m^{th} mode of vibration shall be taken as :

$C_{sm} = 1.2\ AS / T_m^{2/3}$
$<= 2.5A$

where :
T_m = period of vibration of the mth mode (s); based on the nominal unfactored
Mass of the component or structure.
A = acceleration coefficient
S =site coefficient

For soil profiles Ⅲ and Ⅳ, and for modes other than the fundamental mode that have periods less 0.30s, C_{sm} shall be taken as:

- $C_{sm} = A(0.8+4.0\ T_m)$

If the period of vibration for any mode exceeds 4.0s, the value of C_{sm} for that mode shall be taken as;

- $C_{sm} = 3.0\ AS / T_m^{4/3}$

(6) *Response Modification Factors*

Seismic design force effects for substructures and the connections between parts of structure, shall be determined by dividing the force effects resulting from elastic analysis by the appropriate response modification factor, R.

Table 18 Response Modification Factors-Substructures

Substructure	Importance category		
	Critical	Essential	Other
Wall-type piers larger dimension	1.5	1.5	2.0
Reinforced concrete pile bents			
- Vertical piles only	1.5	2.0	3.0
- With batter piles	1.5	1.5	2.0
Single columns	1.5	2.0	3.0
Steel or composite steel and concrete pile bents			
- Vertical piles only	1.5	3.5	5.0
- With batter piles	1.5	2.0	3.0
Multiple column bents	1.5	3.5	5.0

Table 19 Response Modification Factors-Connections

Connection	All importance categories
Superstructure to abutment	0.8
Expansion joints within a span of the superstructure	0.8
Columns, piers, or pile bents to cap beam or superstructure	1.0
Columns or piers to foundations	1.0

If an inelastic time history method of analysis is used, the response modification factors, R, shall be taken as 1.0 for all substructure and connections.

(7) Combination of Seismic Force Effects

The following two load cases combining elastic member forces resulting from earthquakes to the longitudinal and transverse axes of the bridge, should be considered.

Load Case 1: 1.0 FL+ 0.3 FT
Load Case 2: 0.3 FL+ 1.0 FT

where:
FL= absolute elastic member forces due to an earthquake to the longitudinal axis
FT= absolute elastic member forces due to an earthquake to the transverse axis

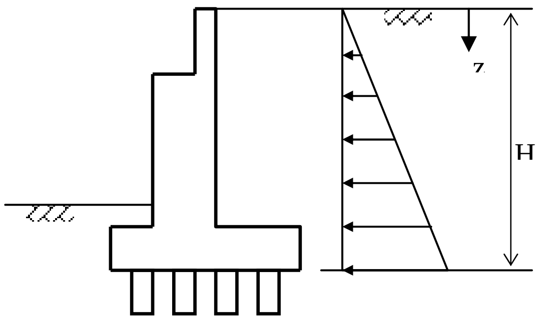
1.3.6. Earth Pressure: EH

Earth pressure shall be considered as a function of the:

- Type and density of soil,
- Water content,
- Soil creep characteristic,
- Degree of compaction,
- Location of groundwater table,
- Earth-structure interaction,
- Amount of surcharge,
- Earthquake effects.

(1) Basic Earth Pressure

Basic earth pressure shall be assumed to be linearly proportional to the depth of earth and taken as:



Earth Pressure

$p = K\gamma_s\, g\, z\ (*10^{-9})$

where:
p = basic earth pressure (MPa)
K = coefficient of lateral earth pressure
γ_s = density of soil (kg/m^3)
z = depth below the surface of earth (mm)
g = gravitational acceleration (m/s^2)

The resultant lateral earth load due to the weight of the backfill shall be assumed to act at a height of 0.4H above the base of the wall, where H is the total wall height, measured from the surface of the ground to the bottom of the footing.

(2) At-Rest Lateral Earth Pressure Coefficient, Ko

$Ko = 1 - \sin\varphi_f$

: for normally consolidated soils

$Ko = (1 - \sin\varphi_f)(OCR)^{\sin\varphi f}$

: for overconsolidated soils

where:

φ_f = effective friction angle of soil

Ko = coefficient of earth pressure at rest

OCR = overconsolidation ratio (refer to Table 20)

Table 20 Typical Coefficient of Lateral Earth Pressure At-Rest

Soil Type	Coefficient of Lateral Earth Pressure, Ko			
	OCR=1	OCR=2	OCR=5	OCR=10
Loose Sand	0.45	0.65	1.10	1.60
Medium Sand	0.40	0.60	1.05	1.55
Dense Sand	0.35	0.55	1.00	1.50
Silt (ML)	0.50	0.70	1.10	1.60
Lean Clay (CL)	0.60	0.80	1.20	1.65
Highly Plastic Clay (CH)	0.65	0.80	1.10	1.40

(3) Active Lateral Earth Pressure Coefficient, Ka

$$Ka = \frac{\cos^2(\phi-\theta)}{\Gamma_1\left[\cos^2\theta\cos(\theta+\delta)\right]}$$

$$\Gamma_1 = \left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\alpha)}{\cos(\theta+\delta)\cos(\theta-\alpha)}}\right]^2$$

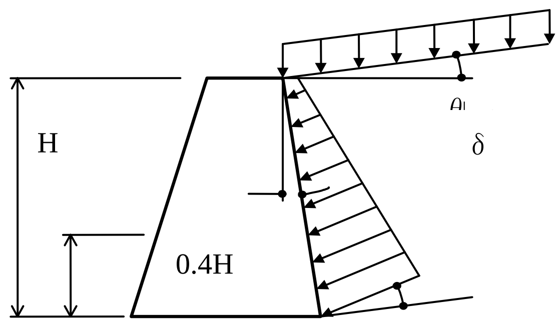
where:

δ = friction angle between fill and wall (deg)

α = angle of fill to the horizontal (deg)

θ = angle of back face of wall to the vertical (deg)

ϕ = effective angle of internal friction (deg)



Earth Pressure

(4) Passive Lateral Earth Pressure Coefficient, Kp

For noncohesive soils, values of the coefficient of passive lateral earth pressure Kp may be taken from Figure 1 of Specification 22 TCN 272-05 for the case of a sloping or vertical wall with a horizontal backfill or from 3.11.5.4-2 of Specification 22 TCN 272-05 for the case of a vertical wall and sloping backfill.

For conditions that deviate from those described in Figures 1 and 2, the passive pressure may be calculated by using a trial procedure based on wedge theory. When wedge theory is used, the limiting value of the wall friction angle should not be taken larger than one-half the angle of internal friction, φ.

For cohesive soils, passive pressures may be estimated by:

pp= $K_p * \gamma_s * g * z * 10^{-9} + 2c\sqrt{Kp}$

where:
pp = lateral earth pressure (MPa)
γ_s = density of soil (kg/m^3)
z = depth below the surface of soil (mm)
c = unit cohesion (MPa)
K_p = coefficient of passive lateral earth pressure

(5) Seismic Active Earth Pressure Coefficient Kae:

Seismic active earth pressure Pae shall be taken as:

Pae= $\frac{1}{2} g\gamma H^2 (1-k_v) K_{ae} \times 10^{-9}$

for which:

Kae = $\frac{\cos^2(\phi-\theta_o-\theta)}{\Gamma_2 \cos\theta_o \cos^2\theta \cos(\delta+\theta+\theta_o)}$

Γ_2 = $\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\theta_o-\alpha)}{\cos(\delta+\theta+\theta_o)\cos(\alpha-\theta)}}\right]^2$

where:

θ_0 = arc tan (kh/(1-kv)) (deg)
kh = horizontal acceleration coefficient
kv = vertical acceleration coefficient

(6) 4Seismic Passive Earth Pressure Coefficient Kpe:

Seismic active earth pressure Pae shall be taken as:

Ppe = $\frac{1}{2} g\gamma H^2 (1-k_v) K_{pe} \times 10^{-9}$

for which:

Kpe = $\frac{\cos^2(\phi-\theta_o+\theta)}{\Gamma_3 \cos\theta_o \cos^2\theta \cos(\delta-\theta+\theta_o)}$

Γ_3 = $\left[1-\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\theta_o+\alpha)}{\cos(\delta-\theta+\theta_o)\cos(\alpha-\theta)}}\right]^2$

where:

θ_0 = arc tan (kh/(1-kv)) (deg)

kh = horizontal acceleration coefficient

kv = vertical acceleration coefficient

1.3.7. Force Effects due to Superimposed Deformations: TU, TG, SH, CR, SE

(1) Uniform Temperature: TU

The maximum and minimum average bridge temperature specified in TVCN are shown in Table 21. The difference between the maximum and minimum average bridge temperature and the base construction temperature assumed in the design shall be used to calculate thermal deformation effects. These are based on shade air temperature ranges of 0 ^oC to +45 ^oC north of latitude 16^o N (Hai Van Pass) and +5 ^oC to +45 ^oC south of latitude 16^o N.

The setting temperature of the bridge shall be taken as the actual air temperature averaged over the 24-hour period immediately preceding the setting event.

These temperatures should be reviewed in considering with the meteorological data of the site.

Table 21 Bridge Temperature Ranges

Climate Zone	Concrete superstructure	Concrete deck on steel girders or box	Steel deck on steel girders or box
North of Latitude 16 Deg. N (Hai Van Pass)*	+5 ^oC to +47 ^oC	+1 ^oC to +55 ^oC	-3 ^oC to +63 ^oC
South of Latitude 16 Deg. N (Hai Van Pass)	+10 ^oC to +47 ^oC	+6 ^oC to +55 ^oC	+2 ^oC to +63 ^oC

*: For sites north of latitude 16^o N and at an elevation above sea level greater than 700 m, the minimum temperature in the Figure 9 shall be reduced by 5 ^oC.

(2) Temperature Gradient: TG

The effect of vertical differential temperature gradients through a bridge superstructure shall be derived for both positive temperature differential conditions (top surface hotter) and negative temperature differentials (top surface cooler). Dimension "A" in Figure 9 shall be taken as;

For concrete superstructures that are 400 mm or more in depth ----- A = 300 mm:

For concrete sections shallower than 400 mm ----- A = 100 mm less than actual depth

For steel/concrete composite superstructures ----- t = depth of concrete deck

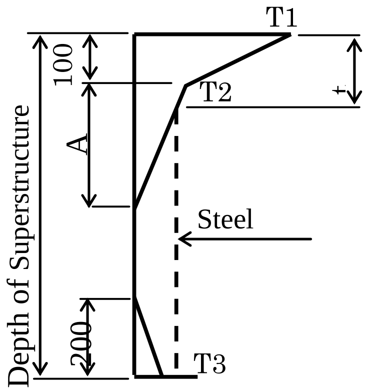


Figure 9 Vertical Temperature Gradient

The temperature gradients given in Table 22 apply to bridge decks with 100 mm thickness of surfacing. Where a different surfacing thickness is used, the values should be adjusted accordingly.

Table 22 Temperature Gradient (^oC)

	T1	T2	T3
Positive	+23	+6	+3
Negative	-7	-1	0

(3) Creep and Drying Shrinkage

Influences of creep and drying shrinkage are varied from condition of the land, quality of the materials, dimension of the members, the ages, and the erection methods. To evaluate the differences of the ages varied from the erection methods accurately have to consider not only the amount of the final creep drying shrinkage but also the erection order and progress of the creep drying shrinkage. In this project, the regulations for creep drying shrinkage of CEB-FIP model code (MC78) mentioned in AASHTO 5.4.2.3.1 is applied.

1) Creep Coefficient

According to MC78, the total strain related the stress at t when the fixed continue stress is acted by t0 is shown in the following equation as the sum of elastic strain occurred at t0 and creep strain occurred from between t_0 and t.

$$\Sigma\ \varepsilon\ (t, t_0) = (\sigma_0)/Ec(t_0) + (\sigma_0)/Ec,28 * \phi\ (t, t_0)$$

Where,
- $Ec(t_0)$: Elastic modulus for concrete of the age t_0
- Ec,28: Elastic modulus for concrete of the age for 28days.
- $\varphi(t, t_0)$: Creep strain progress between from t0 to t given in MC78.

According to the equation, elastic modulus for concrete decided the creep strain by MC78 have to use the elastic modulus for concrete of the age for 28days all the time.

The creep coefficient is decided by the following equation:

$$\phi i = \phi d_0 * \beta_d\ (t'i - t'i\text{-}1) + \phi f_0\ \{\beta f\ (t'i) - \beta f\ (t'i\text{-}1)\}$$

where,
- $\Delta\varphi i$: Creep coefficient progress between ti-1 and ti.
- φd_0: Basic creep coefficient 0.4 against late elastic strain.
- φf_0: Using the number of Table 23 according to the environmental condition by basic creep coefficient against the flow.
- $\beta_d(t'i - t'i\text{-}1)$: Using the number of the Table 24 by the coefficient for the changes with times of late elastic strain.
- $\beta f\ (t'i)$: Using the number of Table 24 according to the theoretical thickness of materials by the coefficient for the changes with times of flow.
- t i : The ages of concrete after loading.
- t'i : Effective age fixed by the kinds of cement and surround average temperature during concrete hardening. $=\alpha/30\Sigma ti\ (T\ (ti) + 10) * ti$
- α : Using the coefficient related the hardening speed of concrete. normal concrete: 1.0, high speed concrete: 2.0
- T(t i) : Average temperature of t i days.
- hth : $\lambda * Ao / u$ (theoretical thickness)
- λ : Using the number of Table 23 by coefficient related the environmental condition.

A_o : Sectional area of the materials.

u : Circumference length(m) of the connected section to the air of material section.

Table 23 φf_0, εs_0 and λ

Environment Condition		φf_o	εs_o (×10−6)	λ
Relative Humidity (%)	100（Underwater）	0.8	−100	60
	90	1.3	100	10
	70	2.0	250	3
	40	3.0	400	2

Table 24 Coefficient βd(ti) and Coefficient βf(t'i)

Effective Age (Day)	βd(t'i-t'-1)	βf(t'i) against hth (cm)					
		<=5	10	20	40	80	>=160
1	0.280	-	-	-	-	-	-
2	0.300	-	-	-	-	-	-
3	-	0.240	0.210	0.190	0.170	0.155	0.140
5	0.350	0.345	0.310	0.270	0.235	0.210	0.185
10	0.400	0.505	0.440	0.380	0.328	0.280	0.235
20	0.465	0.685	0.575	0.500	0.420	0.350	0.280
30	0.580	—	—	—	—	—	—
50	—	0.964	0.810	0.690	0.562	0.443	0.330
100	0.700	1.195	1.025	0.850	0.680	0.52	0.375
200	0.830	1.395	1.215	1.020	0.800	0.603	0.435
500	0.945	1.600	1.413	1.208	0.980	0.750	0.566
1000	0.985	1.698	1.514	1.320	1.107	0.884	0.703
2000	1.000	1.762	1.589	1.416	1.217	1.010	0.842
5000	1.000	1.820	1.660	1.510	1.330	1.148	1.000
10000	1.000	1.846	1.695	1.545	1.383	1.225	1.085
20000	1.000	1.850	1.700	1.500	1.400	1.250	1.120
∞	1.000	1.850	1.700	1.550	1.400	1.250	1.120

2) Drying Shrinkage

Drying shrinkage is decided by the following equation,

εcs i =εso (βs (t''i) –βs (t''i – 1))

where,

△εcs,i: Drying shrinkage which progress during ti – 1 to ti

εso :Using the number of Table 23 according to the basic drying shrinkage strain and environmental condition.

βs(t''i) :Using the number of Table 25 according to the theoretical thickness of materials by the coefficient for the changes with times of drying shrinkage.

t''i :Effective age fixed by the surrounding average temperature during concrete hardening.

=1/30Σti (T (ti) + 10)*ti

Table 25 Coefficient βs(t''i)

Effective Age (Day)	Coefficient βs(t''i) against hth (cm)					
	<=5	10	20	40	80	>=160
1	0.110	0.040	0.010	0.0	0.0	0.0
2	0.170	0.080	0.020	0.0	0.0	0.0
5	0.290	0.160	0.055	0.005	0.005	0.0
10	0.420	0.240	0.100	0.005	0.020	0.0
20	0.560	0.340	0.160	0.060	0.030	0.0
50	0.760	0.510	0.270	0.120	0.055	0.010
100	0.900	0.650	0.375	0.185	0.085	0.020
200	1.020	0.780	0.490	0.260	0.120	0.045
500	1.100	0.910	0.660	0.410	0.210	0.090
1000	1.160	0.980	0.770	0.550	0.340	0.175
2000	1.190	1.040	0.840	0.660	0.500	0.310
5000	1.200	1.050	0.885	0.750	0.660	0.510
10000	1.200	1.050	0.895	0.790	0.725	0.640
20000	1.200	1.050	0.900	0.800	0.750	0.700
∞	1.200	1.050	0.900	0.800	0.750	0.700

(4) Friction Forces: FR

Forces due to friction on the sliding or rotating surface shall be considered. The value of friction coefficients are depend on the specification of each product. Based on the former projects in Vietnam, the friction coefficients of elastmetric bearing shall be as 0.15.

(5) Vessel Collision: CV

All bridges crossing navigable waterways shall be designed for vessel collision with the substructure and, where appropriate, the superstructure.

The Owner shall establish and/or approve the design vessel(s), design velocity, and any specific requirements for the bridge in consideration with the Vietnam Inland Waterways Bureau or the Vietnam Marine Authority, as appropriate.

1) Design Vessel

The design vessels and their dimensions are given for various classes of navigable waterway shown in Table 26 and Table 27.

Table 26 Design Vessels for Classes of Navigable Waterway

Class of navigable waterway	Design vessel tonnage (dwt)	
	Self-propelled vessel	Towed barge
I	2000	500
II	1000	500
III	300	400
IV	200	400
V	100	100
VI	40	100

Table 27 Dimensions of Design Vessels

	Self-propelled vessel						Towed barge		
	2000	1000	300	200	100	40	500	400	100
Maximum Length (LOA) (m)	90	75	38	34	15	8	40	41	27
Maximum Breadth (m)	12.0	10.5	7.0	6.6	5.0	3.0	10.0	11.2	6.4
Laden draught (m)	3.5	2.8	2.2	1.7	1.0	0.8	1.7	1.3	1.0

(6) Design Collision Velocity

The recommended design impact velocity, V, to be used with each design vessel shall be as given in Table 28, where:

Vs = mean annual stream velocity adjacent to the bridge element under consideration (m/s)

Table 28 Design Impact Velocity for Desian Vessels

Design vessel	Design impact velocity, V (m/s)
Self-propelled Vessel >= 1000 DWT	3.3 + Vs
Self-propelled Vessel < 1000 DWT	2.5 + Vs
Towed Barge	1.6 + Vs

(7) Vessel Collision Energy

The kinetic energy of a moving vessel to be absorbed during a non-eccentric collision with a bridge pier shall be taken as:

$KE = 500CHMV^2$ where:

KE = Vessel collision energy (joule)

M = Vessel displacement tonnage (Mg)

The vessel mass, M, shall be based on the loading condition of the vessel and shall include the empty mass of the vessel, plus consideration of the mass of cargo, for loaded vessels, or the mass of water ballast for vessels transiting in an empty or lightly loaded conditions.

CH = Hydrodynamic mass coefficient

= 1.05 Underkeel clearance >= 0.5*draft

= interpolate

= 1.25 Underkeel clearance <= 0.1*draft

V = Vessel impact velocity (m/s)

(8) Ship Collision Force on Pier

The head-on ship collision impact force on a pier shall be taken as:

$PS = 1.2*10^5 V(DWT)^{0.5}$ where;

PS = Equivalent static vessel impact force

DWT = Deadweight tonnage of vessel

V = Vessel impact velocity

(9) Barge Collision Force on Pier

The collision impact force, N, on a pier for a standard hopper barge shall be taken as:

$PB = 6.0*10^4 aB$	$aB < 100$ mm	where;
$= 6.0*10^6 + 1600aB$	$aB >= 100$ mm	PB = Equivalent static barge impact force (N)
		aB = Barge bow damage length specified in the following equation (mm)
		$aB = 3100 [(1 + 1.3*10^{-7}KE)^{0.5} - 1]$

The impact force for design barges larger than the standard hopper barge shall be determined by increasing the standard hopper barge impact force by the ratio of the larger barge's width to the width of the standard hopper barge.

(10) Application of Impact Forces

1) Substructure Design

For substructure design, equivalent static force, parallel and normal to the centerline of the navigable channel, shall be applied separately as follows;

* Parallel to the alignment of the centerline of the channel: 100% of the design impact force

* Normal to the alignment of the centerline of the channel: 50% of the design impact force

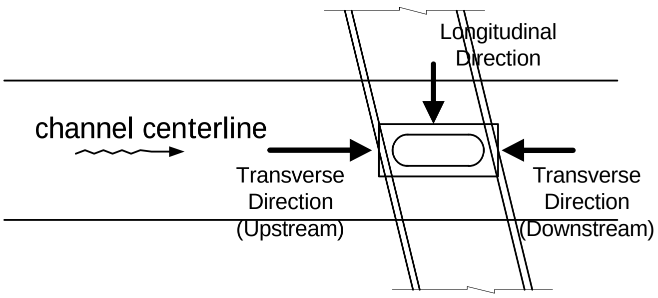


Figure 10 Application of Vessel Collision Force on Pier

The impact force shall be applied to a substructure in accordance with the following criteria:

* For overall stability, design impact force is applied as a concentrated force on the substructure at the mean annual high water level of the waterway, as shown in Figure 11.

* For local collision forces, design impact force is applied as a vertical line load equally distributed on the depth of the head block (HL), as shown in Figure 12.

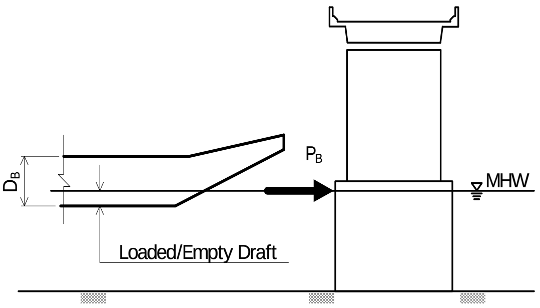


Figure 11 Load Application for Overall Stability

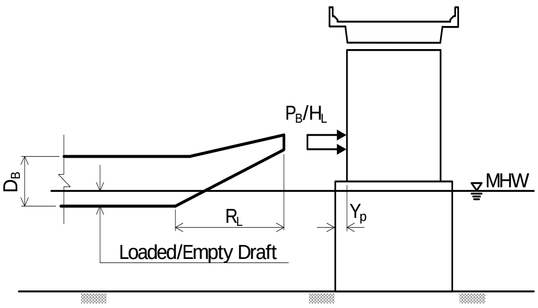


Figure 12 Load Application for Local Collision

2) Superstructure

For superstructure design, design impact force may be applied as an equivalent static force transverse to the superstructure component in a direction parallel to the centerline of navigable channel, if necessary.

1.3.8. Prestress Force

The Prestressing force shall be computed using the equation as bellow.

$$P(x) = Pi - [\triangle Pi(x) + \triangle Pt(x)]$$

where,

P(x) :Prestressing force of cross section under consideration

Pi :Prestressing force at prestressing work at the tensioning end of tendon

△Pi(x) :Loss of prestressing force immediately after prestressing to be computed considering the following effects

Elastic deformation of concrete

Friction between tendon and duct

Anchorage seating loss, or set loss

Others

△Pt(x) :Loss of prestress force over time to be computed considering the following effects

Relaxation of prestressing steel

Creep of concrete

Shrinkage of concrete

To calculate the indeterminate forces at the serviceability or the fatigue limit state, the prestress force may be taken to be the characteristic value of the prestressing force.

[Commentary] (1) The following effects shall be considered when calculating the prestress losses, namely △Pi(x) and △Pt(x).

(1) Elastic deformation of concrete

The prestress loss due to elastic deformation of concrete shall always be considered for the pre-tensioning system. When post-tensioning tendons are tensioned one by one, the prestress loss due to elastic deformation of concrete shall be calculated, and the average prestress loss may be computed.

for pre-tensioning system △pEs = np*f'cpg

for post-tensioning system △σp = 1/2np*f'cpg(N-1)/N

where, △σp : Prestress loss in prestressing tendon

np :Young' modulus ratio of prestressing tendon to concrete = Ep / Ec

f'cpg :Concrete compassive stress due to prestressing at the centroid of prestressing tendons

N :Number of tensioning times (number of groups of the tendon)

(2) Friction between prestressing tendon and duct

The prestress loss in prestressing tendon due to friction varies considerably on condition of the inner surface of the duct and type, degrees of rusting, and alignments of the prestressing tendon.

Loss of prestressing tendon force due to friction can generally be separated into two terms – one related to the angular change of the centroid line of the prestressing tendons, and the other related to length of the prestressing tendon. tension in the prestressing tendon at cross section under consideration can be expressed by following equation.

Px = Pi*e(μα+λx) where,

Px:Tension force of tendon at considered cross section
Pi:Tension force at the tensioning end of tendon
μ:Friction coefficient for angular change of 1 radian
α:Angular change of the tendon in radian
λ:Friction coefficient per unit length
χ:Length from the end of the tendon to the considered cross section

Though, μ and λ should be determined by site measurement, but values shown in next table may generally be used for calculation for prestressing force in a tendon encased in a sheath.

Table 29 Friction Coefficient

	μ	λ
Prestressing wire, Prestressing wire strand	0.3	0.004
Prestressing steel bar	0.3	0.003

Because external tendons are arranged outside of the concrete and are free from friction except at anchorages or deviators, friction loss at a section may not be considered. Depending on the material of the duct, the value of the coefficient of friction at anchorages or deviators given in following table may be used.

Table 30 Friction coefficient between prestressing wire strand and duct

	μ	λ
Steel Polyethylene	0.30 0.15	0.004 0.004
(for prestressing wire and prestressing wire strand)		

The wobble coefficient may be determined on the basis of prior experimental or other data in case a special sheath or spacer is used in order to reduce the friction, or the prestressing steel is specially processed, or the friction is reduced by giving impact to the prestressing bar.

(3) <u>Anchorage seating, or set</u>

If during the anchoring of the tendon 'set' occurs, the ensuing loss in prestress shall be taken into account. Especially in the case of a wedge-type anchorage system, since the amount of set is relatively large, the loss of prestress and the affected length, shall be determined prior to tensioning on the basis of previous experience or available data. The "set" refers to the pulling in of a prestressing tendon at the anchoring device during anchoring. As the actual amount of set varies depending on the anchoring device used, the actual amount corresponding for each device shall be determined (See "Guidelines for Design and Construction of Prestressed Concrete Structures", 1991, JSCE).

When there is no friction between the prestressing tendon and duct, loss of the prestressing tendon force due to set may be calculated using the following equation;

$\triangle P = (\triangle \iota)/\iota A_P E_P$ where,

$\triangle P$:Loss of tension force due to set of tendon
$\triangle \iota$:Setting length
ι :Length of tendon
A_P :Area of tendon
E_P :Young's modulus of tendon

1.4. Pile Foundation Design

The bridge is located in the soft ground area, which bearing stratum is about -50 m. Therefore, the pile foundation shall be adopted for foundation type.

Pile foundation design shall be made for service limit states, strength limit states and extreme event limit states respectively. Each limit state include the followings:

Table 31 Verification Items for Limit States

	Verification Items	Remark
Service Limit States	Adequate Bearing resistance	Allowable Bearing Resistance
	Structural Resistance	Control of Cracking
	Tolerable Settlement	Considered Bridge Performance
	Tolerable Horizontal Displacement	
Strength Limit States	Adequate Bearing Resistance	Considered punching failure
	Structural Resistance	
	Horizontal Displacement	P-Y curve
Extreme Event Limit States	Bearing Resistance	
	Structural Resistance	
Service Limit state	Overall stability	Considered Lateral Flow

1.4.1. Transverse Spring Coefficients of Pile

Transverse Spring Coefficients of Pile for the analysis are shown in Table 32.

Table 32 Transverse Spring Coefficients of Pile

	$h \neq 0$	$h = 0$	$h \neq 0$	$h = 0$
K1	$\dfrac{12EI\beta^3}{(1+\beta h)^3+2}$	$4EI\beta^3$	$\dfrac{3EI\beta^3}{(1+\beta h)^3+0.5}$	$2EI\beta^3$
K2, K3	$K_1 \dfrac{\lambda}{2}$	$2EI\beta^2$	0	0
K4	$\dfrac{4EI\beta}{1+\beta h} \dfrac{(1+\beta h)^3+0.5}{(1+\beta h)^3+2}$	$2EI\beta$	0	0

where: Kv = $a\dfrac{A_p E_p}{L}$ (kN/m)	= characteristic value of a pile $\beta = \sqrt[4]{\dfrac{k_H D}{4EI}}$ (1/m)
γ =	$h + \dfrac{1}{\beta}$
kH =	coefficient of lateral ground spring (kN/m^3)
D =	pile diameter (m)
EI =	flexure rigidity of a pile ($kN.m^2$)
h =	axial length of a pile above the ground level (m); if h < 0, h = 0
a =	0.014(L/D) + 0.72 for driven pile by percussion 0.017(L/D) - 0.014 for driven pile by vibro hammer 0.031(L/D) – 0.15 for cast-in-place conrete pile
Ap =	net area of a pile (mm^2)
Ep =	modulus of elasticity of a pile (kN/mm^2)
L =	pile length (m)
D =	pile diameter (m)

1.5. Materials

In this section, the specified values for the concrete, reinforcing bar and prestressing tendon on the TVCN and AASHTO are described. In the detail design, these values should be reviewed and modified if necessary.

1.5.1. Concrete

Although concrete strength for each structural element shall basically follow the Vietnamese Standard considering local conditions, they may be modified based on the AASHTO LRFD and Japanese Specifications for reasons of required properties. The followings are concrete strengths for each structural element to be used in this Project.

Table 33 Concrete Strength by Structural Member

Compressive Strength at 28 days (MPa) (Cylinder Specimen)	Structural Member	Remarks
50	Pretensioned Slab/Girder	During design period, these may be modified due to requirements.
45	Free Cantilever PC Girder	
40	Post-tensioned PC I-Girder Cast-in-situ PC Slab/Girder	
35	Cast-in-situ PC Slab Cast-in-situ PC Crossbeam	
28	RC Girder Diaphragm (Crossbeam) RC Deck Slab Substructure (Pier, Abutment, Pile Caps, Wingwall) Retaining Wall, Box Culvert Precast Reinforced Concrete Plate Precast Pile Precast Parapet	
21	Approach Slab Pipe Culvert Precast Concrete Curb	
30	Cast-in-situ Bored Pile	
18	Non-reinforced Concrete Structure Lean Concrete	

In this project, only normal density concrete shall be used. The properties of concrete are as shown below.

Table 34 Concrete Properpies

Modulus of Elasticity (MPa)	Poisson's Ratio	Modulus of Rupture (MPa)
Ec = $0.043\gamma_c^{1.5}\sqrt{f'_c}\quad(1440 \le \gamma_c \le 2500)$	0.20	f r = $0.63\sqrt{f'_c}$
γc = density of concrete (kg/m^3) f' c = specified strength of concrete (MPa)		flexure tensile stress

Stress limits for concrete in Service Limit State in PC are shown in Tables 35 and 36. For RC, as the width of flexure cracks is controlled by distributing the reinforcement over the region of maximum concrete tension, stress limit for concrete is not described.

Table 35 Temporary Tensile Stress Limits in PC before Losses

Bridge Type	Location		Stress Limit (MPa)
Other Than Segmentally Constructed Bridges	*	In precompressed tensile zone without bonded reinforcement	Not Applicable
	*	In areas other than the precompressed tensile zone and without bonded reinforcement	$0.25\sqrt{f'_{ci}} \leq 1.38$
	*	In areas with bonded reinforcement (reinforcing bars or prestressing steel) sufficient to resist the tensile force in the concrete computed assuming an uncracked section, where reinforcement is proportioned using a stress of 0.5 fy, not to exceed 210 MPa.	$0.63\sqrt{f'_{ci}}$
	*	For handling stresses in prestressed piles	$0.415\sqrt{f'_{ci}}$

Table 36 Compressive Stress Limits in PC at Service Limit State after Losses

Location		Stress Limit (MPa)
*	In other than segmentally constructed bridges due to the sum of effective prestress and permanent loads	0.45 f'c
*	In other than segmentally constructed bridges due to live load and one-half the sum of effective prestress and permanent loads	0.40 f'c
*	Due to the sum of effective prestress, permanent loads, and transient loads and during shipping and handling	0.60 φw f'c

Table 37 Tensile Stress Limits in PC at Service Limit State after Losses

Bridge Type	Location		Stress Limit (MPa)
Other Than Segmentally Constructed Bridges	Tension in the Precompressed Tensile Zone Bridges, assuming uncracked sections		
	*	For components with bonded prestressing tendons or reinforcement that are subjected to not worse than moderate corrosion conditions	$0.50\sqrt{f'_{ci}}$
	*	For components with bonded prestressing tendons or reinforcement that are subjected to severe corrosive conditions	$0.25\sqrt{f'_{ci}}$
	*	For components with unbonded prestressing tendons	No tension

1.5.2. Reinforcing Bar

Two types of Grade 300 and Grade 420 shall be used. The properties and strength are as shown below.

Table 38 Properties and Stress Limit of Reinforcing Bars

Type	Yield Strength f y (MPa)	Tensile Strength f u (MPa)	Modulus of Elasticity (MPa)
Grade 300	300	500	200,000
Grade 420	420	620	200,000

1.5.3. Prestressing Steel

Uncoated, stress-relieved or low-relaxation, seven-wire strand, or uncoated plain or deformed, high-strength bars, shall have the following properties and strength as shown in Table 39.

Table 39 Properties of Prestressing Strand and Bar

Material	Grade or Type	Diameter (mm)	Tensile Strength fpu (MPa)	Modulus of Elasticity Ep (MPa)	Yield Strength fpy (MPa)
Strand	1725 MPa (Grade 250)	6.35 – 15.24	1725	197,000	0.85 f pu for stress-relieved 0.90 f pu for low-relaxation
	1860 MPa (Grade 270)	9.53 – 15.24	1860		0.90 f pu
Bar	Type 1, Plain	19 – 35	1035	207,000	0.85 f pu
	Type 2, Deformed	16 – 35	1035		0.80 f pu

Stress limits for each tendon type are as shown in Table 40.

Table 40 Stress Limits for Prestressing Tendons

	Tendon Type		
	Stress-relieved Strand / Plain high-strength bars	Low Relaxation Strand	Deformed High-strength Bars
Pretensioning			
* Immediately prior to transfer (f pt + Δf pES)	0.70 f pu	0.75 f pu	-
* At service limit state after all losses (f pe)	0.80 f py	0.80 f py	0.80 f py
Post-tensioning			
* Prior to seating–short-term fs may be allowed	0.90 f py	0.90 f py	0.90 f py
* At anchorages and couplers immediately after anchor set (f pt + Δf pES + Δ fpA)	0.70 f pu	0.70 f pu	0.70 f pu
* At end of the seating loss zone immediately after anchor set (f pt + Δf pES + Δ fpA)	0.70 f pu	0.74 f pu	0.70 f pu
* At service limit state after all losses (f pe)	0.80 f py	0.80 f py	0.80 f py

1.5.4. Durability of Concrete

(1) <u>Environmental condition</u>

It is considered extremely severe environment for a concrete structure that a region where saline moisture, seawater etc., are splashed or sprayed constantly, such as a location for pier at the coast.

It is because the increment of the density of salinity occurs in such a region where supply and dry of salt water being repeated.

It seems appropriate to take some counter measures, considering the following conditions;

The bridge crosses the sea.

It is an especially important structure.

The design service life shall be 100 years.

(2) Proposal of counter measure concerning durability of bridge structurres

We would propose to provide following counter measures as recommendable.

1) The cover of the reinforcing bar of main girder is to be 45mm that is 10mm more than the designed cover.

2) The cover of the reinforcing bar of pier & abutment is to be 40mm when the structure is under water, and is to be 60mm when the structure is at elevations of tidal water.

3) Painted reinforcing bars, performance of which is equal to or greater than that of epoxy painted reinforcing bars, shall be used for the reinforcing bars at the most outside perimeter of structure, excluding that of upper slab structure.

Regarding 1)

The standard cover is 35mm according to the Specifications for Highway Bridges of the Japan Road Association.

Here, 45mm cover would be proposed with additional thickness of 10mm, in consideration of a margin for the construction error etc.

Regarding 2)

The standard cover is 40mm and 60mm according to the Vietnamses standard TCXDVN 327:2004.

Regarding 3)

It was anticipated from the beginning stage that the structure would be affected by saline splash. As for the Dinh Vu-Cat Hai Bridge, it would be proposed to adopt the painted reinforcing bars for the most outside perimeter bars so as to secure the durability which is equal to or greater than that of above-mentioned bridge.

The bars painted with "Magne line", which is categorized as polyacrylic ester paint, may be adopted as the said painted reinforcing bar.

Regarding "Magne line"

This material is widely adopted as coating material on the surface of concrete and rust prevention material for steel material, and it retains the following features;

Certain rust prevention action

The salt water atomization tests have been performed by official body for the steel material painted with the said material.

The result is obtained as "Rust will not be generated after 4000 hours of the salt water atomization".

This result excels the required standard of the epoxy painting reinforcing bars to the same tests, which is "Rust shall not be generated by 1000 hours or more and within 1100 hours under the salt water atomization "

Therefore, it could be expected that the performance of reinforcing bars painted with the said material would be more than that of the epoxy painted reinforcing bars for the rust prevention of the steel material when the said material is applied and spread on to steel surface.

Excellent adhesion strength

The adhesive pulling out test also have been performed by the official body, for the reinforcing bars painted with Mange line and for the reinforcing bars without paint.

Result shows, the reinforcing bars painted with Magne Line has approximately 1.4 times larger adhesive strength comparing to bare reinforcing bars.

Therefore, it could be expected that the reinforcing bar painted with this material has more than or the equal adhesion strength to bare reinforcing bar.

Mechanism of rust prevention

The epoxy painted reinforcing bar secures the effect of rust prevention by intercepting salinity. Therefore, there is no effect of rust prevention, once salinity invades from the pinhole etc. In addition, once rust would be generated, it is considered that behavior to pull the epoxy painting apart from the inside of the paint will occur.

On the other hand, as for the mechanism of the rust prevention of reinforcing bar painted with Magne-Line, the stable rust formed on the surface of the reinforcing bar secures rust prevention effect. Therefore, if salinity invades from the pinhole and rust is generated, it is less likely to extend its surrounding part. Thus, it can be said that reinforcing bar painted with Magne-Line has grater performance against the unanticipated scratch comparing than the epoxy painted reinforcing bar.

It is therefore considered that the durability of a main girder can be secured by applying the counter measures of 1), 2) & 3) as stated above

(3) Regarding execution management

It is necessary to provide the construction management standard, since the said material shall be applied at the site. For this purpose, the quality standard of the epoxy painting reinforcing bars specified by Japan Society of Civil Engineers shall be adopted.

And that can be defined by "The number of pinholes in 1 m shall be no more than 5 for D19 or smaller diameter, and no more than 8 for D22 or bigger diameter.” The standard for D19 refers to D20.

< Reference literature >

"Concrete and reinforced concrete structures – Requirements of Protection from Corrosion in Marine Environment" TCXDVN 327:2004.

"Preliminarily design & construction guideline for the reinforced concrete which utilize epoxy resin painting " Japan Society of Civil Engineers: November, 2003

1.5.5. Steel Pipe

Two types of steel pipe Grade SKK400 and Grade SKK 490 based on the Japanese Standard JIS 5525 or equivalent international standard shall be used. The properties and strength are as shown below.

Table 41 Properties and Stress Limit of Steel Pipe

Type	Yield Strength f y (MPa)	Tensile Strength f u (MPa)	Modulus of Elasticity (MPa)
Grade SKK 400	235	400	200,000
Grade SKK 490	315	490	200,000

Appendix 4: List of Construction Equipment

For reference, list of construction equipment for the smooth implementation of the construction works are as follows but not limited to. Number, capacity and specifications of each equipment will be optimized when the scale of contract package is finalized.

1. General

   Air Compressor

   Bar Bending Machine

   Cargo Truck

   Center Hole Jack

   Forklift

   Four Wheel Drive Car (Jeep)

   Fuel Truck

   Generator

   High Pressure Pump

   Lighting Tower

   Material Testing Laboratory

   Submergible Pump

   Truck Crane

   Vehicle

   Water Tanker

   Welding Generator

   Welding Machine

2. Road Works

   Backhoe

   Bulldozer

   Dump Truck

   Motor Grader

   Wheel Loader

   Tired Roller

3. Bridge Works (On Land)

Clamshell
Concrete Batching Plant
Concrete Pump
Concrete Pump Truck
Concrete Vibrator
Crawler Crane
Diesel Hammer
Engine Welder
Erection Girder
Form & Fabrication Facility for PC-BOX Segment
Gantry Crane
PC Grout Mixer
PC Grout Pump
Piling Machine
Post Tensioning Stressing Jacks & Pump
Steel Launching Girder or Overhead Gantry Crane with Legs
Strand Pushing Machine for PC Cables
Trailer Segment Transport
Vibration Hammer

4. Offshore Work

Barge
Crawler Crane
Diesel Hammer
Passenger Boat
Speed Boats
Tug Boat
Vibration Hammer

5. Softground Works

Boring Machine
Crawler Crane

6. Pavement Works

Asphalt Plant

Asphalt Paver / Finisher

Asphalt Distributer

Pneumatic Tired Roller

Tamper (Plate Compactor)

Three Wheel Roller

Traffic Lane Marker

Vibrating Roller

Wheel Loader

Appendix-5: Annual Fund Requirement

The disbursement schedule has been prepared as shown in Table 1, in accordance with the implementation program of the project, described in Section 2.9.

Table 1 Annual Fund Requrement

(1) Eligible Portion

(F/C&Total+ Million JPY, L/C: Billion VND)

Item	Yearly Cost during Construction Period																					Total (Million JPY)		
	2011			2012			2013			2014			2015			2016			2017					
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
(1) Construction Cost	0	0	0	1,064	759	5,104	3,192	2,278	15,311	1,064	759	5,104	0	0	0	0	0	0	0	0	0	5,320	3,797	25,518
(2) Price Contingency = (1) x {Yearly Price index}	0	0	0	39	164	914	175	779	4,319	79	365	2,018	0	0	0	0	0	0	0	0	0	293	1,308	7,251
(3) Physical contingency = {(1)+(2)} x 5%	0	0	0	55	46	301	168	153	981	57	56	356	0	0	0	0	0	0	0	0	0	281	255	1,638
sub-total = (1)+(2)+(3)	0	0	0	1,158	970	6,318	3,536	3,210	20,611	1,200	1,180	7,478	0	0	0	0	0	0	0	0	0	5,893	5,360	34,407
(4) Consulting Services for Construction Supervision	0	0	0	156	18	249	467	53	747	156	18	249	0	0	0	0	0	0	0	0	0	779	88	1,245
(5) Interest during Consturction	0	0	0	12	10	64	29	26	166	8	7	47	0	0	0	0	0	0	0	0	0	48	43	277
(6) Commitment Charge	36	0	36	36	0	36	36	0	36	36	0	36	36	0	36	36	0	36	36	0	36	251	0	251
Total = (1)+(2)+(3)+(4)+(5)+(6)	36	0	36	1,361	997	6,666	4,067	3,288	21,560	1,399	1,205	7,810	36	0	36	36	0	36	36	0	36	6,972	5,490	36,180

(2) Non Eligible Portion (For Reference Only)

Item	Yearly Cost during Construction Period																					Total (Million JPY)		
	2011			2012			2013			2014			2015			2016			2017					
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
(7) Environmental Management and Monitoring Cost	0	140	745	0	146	777	0	22	117	0	6	32	0	0	0	0	0	0	0	0	0	0	314	1,671
(8) Administration Cost	0	21	112	0	49	261	0	210	1,120	0	70	373	0	0	0	0	0	0	0	0	0	0	351	1,866
(9) Value Added Tax (VAT)	0	0	0	0	123	657	0	401	2,136	0	145	773	0	0	0	0	0	0	0	0	0	0	670	3,565
(10) Import Tax	0	0	0	0	20	106	0	60	319	0	20	106	0	0	0	0	0	0	0	0	0	0	100	532
Total = (7)+(8)+(9)+(10)	0	161	857	0	339	1,801	0	694	3,692	0	241	1,284	0	0	0	0	0	0	0	0	0	0	1,435	7,634
Grand Total Annual Requrement = sum{(1):(10)}	36	161	893	1,361	1,336	8,468	4,067	3,982	25,251	1,399	1,446	9,094	36	0	36	36	0	36	36	0	36	6,972	6,925	43,814

Note:

1) Exchange rate: USD1=VND 17,002 = JPY 90.50
VND1=JPY 0.00532

2) Price escalation Rate:
*Detailed information is to be referred to Sectıse Year: 2010
F/C portion: 1.8% per year
L/C portion: 10.3% per year

Yearly Price Index (Index2010=100)

Year	2010		2011		2012		2013		2014	
F/C, L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	LC
Price Index	100	100	101.8	110.3	103.63	121.66	105.50	134.19	107.40	148.01

3) Physical Contingency Rate: 5.0%

4) Interest during Construction Construction Cost: 0.2% per year
Consulting Services 0.01% per year

5) Commitment Charge Loan Amount x number of years of the disbursement period x 0.1%

6) Environmental Management and Monitoring Cost includes land acquisition and resettlement, livelihood restoration plan, HIV prevention program, environmental management program, environmental monitoring program.
*Detailed information is to be referred to Section 3.4.3

7) Administration Cost 5 % of the sum of construction cost, price contingency, physical contingency, consulting services and environmental management and monitoring cost

8) Value Added Tax 10 % of amount of JICA loan eligible portion was estimated as value added tax (VAT) in this Study.

9) Import Tax 10 % in average (assumed average rate; the rates of import tax are different item by item.)

Appendix-6: Cost Data

(Reference Only)

The construction cost estimated in this study, as approximately JPY 25.5 Billion, is tentative and subject to update.

1. BREAKDOWN OF CONSTRUCTION COST

The breakdown of the construction cost is shown in the tables hearafter.

Table 1 Breakdown of Construction Cost (Total)

Section	Construction Works		Construction Cost (in VND)	Other construction Cost(2%)	Total Amount (VND)	Construction Cost (in JP¥)
Tempo-rary works	Other Cost(Temporary houses for managemen		103,455,267,757	--		550,382,024
	Temporary road(Embankment)		273,200,373,348	5,464,007,467		1,453,425,986
	Temporary Jetty		97,857,000,000	1,957,140,000		520,599,240
	Temporary Road for Hai An side Road Work		78,303,298,368	1,566,065,967		416,573,547
	Temporary works Subtotal=		552,815,939,473	8,987,213,434	561,803,152,907	2,940,980,798
Road Hai An Side	Embankment		74,714,931,346	1,494,298,627		397,483,435
	Approach Road (Soft Soil Treatment)		415,169,708,824	8,303,394,176		2,208,702,851
	Pavement		56,495,133,094	1,129,902,662		300,554,108
	Traffic Safety		11,427,717,516	228,554,350		60,795,457
	Culvert		19,071,956,260	381,439,125		101,462,807
	Cam box culvert		22,171,111,326	443,422,227		117,950,312
	Tan Vu Interchange		268,618,947,329	5,372,378,947		1,429,052,800
	Hai An side road works TOTAL=		867,669,505,695	17,353,390,114	885,022,895,809	4,616,001,770
Bridge Hai An Side	Approach Bridge(1)(2)(3)	Superstructure	928,244,566,180	18,564,891,324		4,938,261,092
		Substructure	776,661,624,819	15,533,232,496		4,131,839,844
	Flyover Bridge(1)(2)	Superstructure	140,910,008,951	2,818,200,179		749,641,248
		Substructure	105,492,692,744	2,109,853,855		561,221,125
	Approch Bridge+Flyover Bridge TOTAL=		1,951,308,892,695	39,026,177,854	1,990,335,070,549	10,380,963,309
	Approach Road to the end of behind abutment		16,423,668,452	328,473,369		87,373,916
	Retaining Wall		212,289,351,224	4,245,787,024		1,129,379,349
	Retaining Wall+App.Road TOTAL=		228,713,019,676	4,574,260,394	233,287,280,069	1,216,753,265
	Bridge+Retaining wall=		2,180,021,912,370	43,600,438,247	2,223,622,350,618	11,597,716,574
Main Bridge		Superstructure(PC-BOX)	175,550,168,179	3,511,003,364		933,926,895
		Substructure	484,533,313,527	9,690,666,271		2,577,717,228
		Subtotal(3)=	660,083,481,706	13,201,669,634	673,285,151,340	3,511,644,123
Bridge Cat Hai Side	Approach Bridge	Superstructure	120,899,219,631	2,417,984,393		643,183,848
		Substructure	122,443,344,242	2,448,866,885		651,398,591
	Sub Total(4)=		243,342,563,873	4,866,851,277	248,209,415,150	1,294,582,440
	Approach Road to the end of behind abutment		6,625,654,160	132,513,083		35,248,480
	Retaining Wall		84,302,380,353	1,686,047,607		448,488,663
	Approach Bridge Total=		90,928,034,513	1,818,560,690	92,746,595,203	483,737,144
	Cat Hai Side Total=		334,270,598,386	6,685,411,968	340,956,010,354	1,778,319,583
Bridge Total=			3,174,375,992,463	63,487,519,849	3,237,863,512,312	16,887,680,280
Road Cat Hai Side	Embankment		141,290,225,418	2,825,804,508		751,663,999
	Approach Road (Soft Soil Treatment)		356,657,461,383	7,133,149,228		1,897,417,695
	Pavement		116,207,888,267	2,324,157,765		618,225,966
	Traffic Safety		17,768,417,889	355,368,358		94,527,983
	Culvert		49,433,224,998	988,664,500		262,984,757
	TOTAL=		681,357,217,955	13,627,144,359	694,984,362,314	3,624,820,400
GRAND TOTAL=			5,276,218,655,586	103,455,267,757	5,276,218,655,586	28,069,483,248
Exclude VAT=			4,796,562,414,169			25,517,712,043

Table 2 Breakdown of Construction Cost (Temporary Works)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	UNIT PRICE	Quantites	Amount (VND)
	TEMPORARY WORKS						
			Other Cost	LS	Calculated in the TOTL sheet		
			Fill of Stone	m^3	299,236	248,688.0	74,416,402,368
			Crushed stone 2*4	m^3	404,885	9,600.0	3,886,896,000
			Temporary road for Road Hai An Side				78,303,298,368
			Temporary Jetty	m^2	4,500,000	21,746.0	97,857,000,000
			Embankment	m^3	299,236	912,993.0	273,200,373,348

Note: VAT is included

Table 3 Breakdown of Construction Cost (Road Portion in Hai An Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	UNIT PRICE	Quantites	Amount (VND)
	HAI AN side ROAD						**599,050,558,367**
A	**1.1EMBANKMENT**						**74,714,931,346**
	15-HA		Ecavation of soil	m^3	59,987	2,375.2	142,481,122
	17-HA		Excavetion of organic soil	m^3	42,867	88,406.2	3,789,708,575
	20-HA		Embankment of sand, K=0.95	m^3	136,637	357,207.2	48,807,720,186
	22-HA		Embankment of sand, K=0.98	m^3	140,617	63,716.1	8,959,566,834
	23-HA		Embankment of Clay (Slope Protection)	m^3	263,825	46,708.3	12,322,817,248
	51-HA		Sodding (Slope Protection)	m^3	14,829	46,708.3	692,637,381
A	**1.2APPROACH ROAD (Soft Soil Treatment)**						**415,169,708,824**
	28-HA		Geotextile Filter Fabric (non-woven)	m^2	18,536	259,178.3	4,804,128,969
	30-HA		Geotextile Filter Fabric (woven)	m^2	57,870	93,390.8	5,404,525,596
	21-HA		Sand Blancket (medium sand)	m^3	383,737	266,363.9	102,213,683,894
	27-HA		Sand Drain (D400)	m	141,774	1,798,841.4	255,028,940,644
	20-HA		Embankment of sand for compensation	m^3	136,637	251,710.5	34,392,967,589
	20-HA		Embankment of sand for compensation	m^3	136,637	179,569.8	24,535,878,763
	18-HA		Removal of surcharge	m^3	8,481	179,569.8	1,522,931,474
	31-HA		Settlement Plate by steel 0.8*0.8*	each	2,355,676	105.0	247,345,980
	32=HA		Wooden Pile 10*10*170cm	each	25,162	280.0	7,045,360
			Piezometer,observation well, inc	set	85,000,000	6.0	510,000,000
			Reusable sand (surcharge)	m^3	83,519	-161,612.8	-13,497,739,443
A	**1.3 PAVEMENT**						**56,495,133,094**
	33-HA		Fine Asphalt Concrete -5cm	m^2	156,560	72,421.8	11,338,362,325
	39-HA		Tack Coat 0.5kg/m2	m^2	10,351	72,421.8	749,638,403
	35-HA		Medium Asphalt Concrete-7cm	m^2	205,245	72,421.8	14,864,219,312
	38-HA		Prime Coat 1.0kg/m2	m^2	18,340	72,421.8	1,328,216,435
	36-HA		Aggregate Base-15cm	m^3	451,362	15,151.4	6,838,766,207
	37-HA		Aggregate Subbase-43cm	m^3	403,549	43,434.0	17,527,747,266
	28-HA		Geotextile Filter Fabric (non-woven, 25kn/m)	m^2	36,642	105,021.1	3,848,183,146
A	**1.4 TRAFFIC SAFETY**						**11,427,717,516**
	45-HA		Guide Posts	each	118,088	823.0	97,186,424
	46-HA		Kilometer Posts	each	394,478	3.0	1,183,434
	43-HA		Regulatory Signs	each	1,563,626	6.0	9,381,756
	41-HA		Information and Guidance signs	each	5,493,688	6.0	32,962,128
	40-HA		Area Reflection Pavement Marking	each	260,842	5,738.4	1,496,815,733
	3-HA		Guardrail	m	1,270,022	748.8	950,992,474
	49-HA		Reflectorized Pavement Stud	each	68,702	1,099.0	75,503,498
	2-HA		Concrete curb	m	175,009	8,208.1	1,436,491,373
	50-HA		Planting	each	278,300	1,369.0	380,992,700
			Lighting Pole-Single Arms	pole	30,000,000	216.0	6,480,000,000
	51-HA		Sodding	m^2	14,829	2,626.6	38,949,851
	23-HA		Embankment of clay	m^3	263,825	1,179.9	311,287,118
	19-HA		Organic soil	m^3	100,347	1,155.7	115,971,028
A	**1.5 Culvert**						**19,071,956,260**
	5-HA		RC Pipe Culvert-D2.0m	m	12,488,327	43.0	536,998,061
			RC Box Culvert-3m*3m(Km0+950)	m	144,690,939	46.6	6,742,597,757
			RC Box Culvert-3*4m*4m(Km4+100)	m	405,235,754	29.1	11,792,360,441
A	**1.6 Cam Box Culvert**		**BTCT 8*(4*4)m (Km1+697.6)**				**22,171,111,326**
	102-HA		Concrete of box culvert, wall 28MPa	m^3	2,652,255	1,912.0	5,071,111,560
	100-HA		Reinforcement of box culvert, wall	ton	19,769,693	315.8	6,244,059,837
	106-HA		Lean Concrete	m^3	1,723,811	144.0	248,228,784
	63-HA		Billing Stone	m^3	672,724	119.0	80,054,156
	65-HA		Masonry	m^3	1,036,880	44.0	45,622,720
	72-HA		Concrete of approach slab, 28MPa	m^3	2,232,178	38.0	84,822,764
	73-HA		Reinforcement of approach slab	ton	20,878,827	4.7	98,339,275
	34-HA		Pavement(Fine,asphalt concrete-7cm)	m^2	218,252	1,360.0	296,822,720
	97-HA		Water proofing layer	m^2	222,000	1,360.0	301,920,000
	21-HA		Embankment of drainage material	m^3	383,737	2,120.0	813,522,440
	107-HA		Excavation of soil for foundation pit	m^3	68,819	1,770.0	121,809,630
	164-HA		Drive test pile 35*35cm (2piles)	m	1,439,008	80.0	115,120,640
	164-HA		Drive test pile 35*35cm	m	1,351,512	6,400.0	8,649,676,800

Note: VAT is included

Table 4 Breakdown of Construction Cost (Tan Vu Interchange)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	UNIT PRICE	Quantites	Amount (VND)
	TAN VU INTERCHANGE						268,618,947,329
B	2.1EMBANKMENT						43,242,017,435
	17-HA		Excavetion of organic soil	m^3	42,867	38,797.7	1,663,141,006
	20-HA		Embankment of sand, K=0.95	m^3	136,637	194,954.9	26,638,052,671
	22-HA		Embankment of sand, K=0.98	m^3	140,617	21,467.9	3,018,751,694
	23-HA		Embankment of Clay (Slope Protection)	m^3	263,825	42,784.5	11,287,620,713
	51-HA		Sodding (Slope Protection)	m^3	14,829	42,784.5	634,451,351
B	2.2 Soft Soil Treatment						191,356,707,790
	28-HA		Geotextile Filter Fabric (non-woven 12kN/m)	m^2	18,536	190,356.2	3,528,442,523
	21-HA		Sand Blancket (medium sand)	m^3	383,737	145,959.0	56,009,868,783
	27-HA		Sand Drain (D400)	m	141,774	758,248.4	107,499,908,662
	20-HA		Embankment of sand for compensation	m^3	136,637	132,795.8	18,144,819,725
	20-HA		Embankment of sand for compensation	m^3	136,637	76,882.3	10,504,966,825
	18-HA		Removal of surcharge	m^3	8,481	76,882.3	652,038,786
	31-HA		Settlement Plate by steel 0.8*0.8*	each	2,355,676	153.0	360,418,428
	32=HA		Wooden Pile 10*10*170cm	each	25,162	408.0	10,266,096
			Piezometer,observation well, inc	set	85,000,000	5.0	425,000,000
			Reusable sand (surcharge)	m^3	83,519	-69,194.1	-5,779,022,038
B	1.3 PAVEMENT						28,800,925,874
	1-HA		Pavement areas	m^2	631,726	42,935.7	27,123,598,018
	28-HA		Geotextile Filter Fabric (non-woven, 25kn/m)	m^2	36,642	45,776.1	1,677,327,856
B	1.4 TRAFFIC SAFETY						5,219,296,230
	45-HA		Guide Posts	each	118,088	220.0	25,979,360
	43-HA		Regulatory Signs	each	1,563,626	17.0	26,581,642
	41-HA		Information and Guidance signs	each	5,493,688	6.0	32,962,128
	40-HA		Area Reflection Pavement Marking	each	260,842	2,293.3	598,188,959
	3-HA		Guardrail	m	1,270,022	946.9	1,202,583,832
	49-HA		Reflectorized Pavement Stud	each	68,702	524.0	35,999,848
	2-HA		Concrete curb	m	175,009	1,700.3	297,567,803
	50-HA		Planting	each	278,300	611.0	170,041,300
			Lighting Pole-Single Arms	pole	30,000,000	69.0	2,070,000,000
	51-HA		Sodding	m^2	14,829	5,497.7	81,525,393
	23-HA		Embankment of clay	m^3	263,825	1,649.3	435,126,573
	19-HA		Organic soil	m^3	100,347	2,419.0	242,739,393

Note: VAT is included

Table 5 Breakdown of Construction Cost (Approache Road in Hai An Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	UNIT PRICE	Quantites	Amount (VND)
	APPROACH ROAD & RETAINING WALL HAI AN SIDE						228,713,019,676
	2.1EMBANKMENT						16,423,668,452
	20-HA		Embankment of sand, K=0.95	m^3	136,637	52,024.0	7,108,403,288
	22-HA		Embankment of sand, K=0.98	m^3	140,617	6,296.0	885,324,632
	23-HA		Geotextile Fillter Fabric (non-woven, 25kN/m	m^2	36,642	12,970.0	475,246,740
			Pavement Structure	m^2	631,726	12,592.0	7,954,693,792
	2.2 RETAINING WALL						212,289,351,224
			Concrete of Retainingwall, 28MPa	m^3	2,240,947	22,012.0	49,327,725,364
			Reinforcement of retaining wall	ton	18,021,434	1,761.0	31,735,006,395
			Lean Concrete	m^3	1,723,811	1,269.0	2,187,516,159
			RC Piles 35*35cm	m	1,351,512	81,198.0	109,740,071,376
			Auxiliary	%	192,990,319,294	0.1	19,299,031,929

Note: VAT is included

Table 6 Breakdown of Construction Cost (Approache Bridge (1) in Hai An Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)
	Hai An Side APPROACH BRIGE (1) L=548.2m (on Shore)					(VND)	(JP¥)	(VND)	(JP¥)	**0.00532**	**1,350,411,935**
A	**Super Structure**							**113,707,323,365**	**81,055,296**	**128,943,281,260**	685,978,256
			Box girder 45MPa for Box Girder bridge	m^3	5,040.0	16,382,949	13,402	82,570,062,960	67,546,080	95,266,694,539	506,818,815
			High Strength cable, transverse	ton	27.0	46,998,431		1,268,957,637	0	1,268,957,637	6,750,855
			Transverse Anchor	set	730.0	1,146,867		837,212,910	0	837,212,910	4,453,973
	72-HA		Concrete of deck, curb 28MPa	m^3	394.0	2,232,178		879,478,132	0	879,478,132	4,678,824
			Reinforcement of deck, curb	ton	39.0	22,546,530		879,314,670	0	879,314,670	4,677,954
	34-HA		Asphalt concrete of bridge deck	m^2	6,853.0	228,603		1,566,616,359	0	1,566,616,359	8,334,399
	96-HA		Metal Railing	m	1,096.0	2,058,567		2,256,189,432	0	2,256,189,432	12,002,928
			Bearing	each	38.0	5,516,875		209,641,250	0	209,641,250	1,115,291
			Water proofing layer	m^2	6,853.0	436,000		2,987,908,000	0	2,987,908,000	15,895,671
			Bridge name sign	each	1.0	1,366,116		1,366,116	0	1,366,116	7,268
			Expansion Joint	m	27.0	15,862,554		428,288,958	0	428,288,958	2,278,497
			Lighting Pole -Single Arms	each	27.0	30,000,000		810,000,000	0	810,000,000	4,309,200
	98-HA		Cast iron drain pipe D150	set	137.0	445,740		61,066,380	0	61,066,380	324,873
			Auxiliary (20%)	%	0.2	94,756,102,804		18,951,220,561	13,509,216	21,490,546,877	114,329,709
A	**Substructure**							**58,249,868,254**	**354,544,379**	**124,893,548,555**	664,433,678
	102-HA		Concrete of Abutment, pier, 28MPa (Under W	m^3	2,913.0	2,652,255		7,726,018,815		7,726,018,815	41,102,420
	59-CH		Reinforcement of abutment, pier	ton	259.0	21,437,396		5,552,285,564		5,552,285,564	29,538,159
	62-CH		Lean Concrete	m^3	89.0	1,723,811		153,419,179		153,419,179	816,190
	81-CH		Blinding stone	m^3	179.0	696,000		124,584,000		124,584,000	662,787
			Steel Pipe Pile	ton	1,436.0	1,785,438	224,452	2,563,888,968	322,313,072	63,149,052,878	335,952,961
	63-CH		Foundation Excavation	m^3	3,512.0	318,066		1,117,047,792		1,117,047,792	5,942,694
	80-CH		Embankment of drainage material	m^3	1,529.0	382,355		584,620,795		584,620,795	3,110,183
			Auxiliary (10%)	%	0.1			1,782,186,511	32,231,307	7,840,702,902	41,712,539
	86-CH		Sheet Pile (=11.12%)	ton	1,017.0	24,798,638		25,220,214,846		25,220,214,846	134,171,543
	87-CH		Driving steel sheet pile	m	9,683.0	416,961		4,037,433,363		4,037,433,363	21,479,145
	88-CH		Pulling sheet pile	m	9,683.0	205,276		1,987,687,508		1,987,687,508	10,574,498
	84-CH		Face timpering (=19.0%)	ton	203.0	22,206,791		4,507,978,573		4,507,978,573	23,982,446
	84-CH		Manufacture of Face Timperring	ton	203.0	7,034,461		1,427,995,583		1,427,995,583	7,596,937
	85-CH		Installation and Removal of Face timpering	ton	203.0	7,214,319		1,464,506,757		1,464,506,757	7,791,176

Note: VAT is included

Table 7 Breakdown of Construction Cost (Flyover Bridge (1) in Hai An Side)

No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)	Check
Hai An Side FLYOVER BRIDGE (1) L=226.0m (on shore)					(VND)	(JP¥)	(VND)	(JP¥)	**0.00532**	**655,539,833**	
Super Structure							**70,455,004,476**	0	**70,455,004,476**	374,820,624	374,820,624
12-HA		Box girder 45MPa for Box Girder bridge	m^3	2,105.0	20,979,943		44,162,780,015	0	44,162,780,015	234,945,990	234,945,990
75-HA		High Strength cable, transverse	ton	11.0	46,998,431		516,982,741	0	516,982,741	2,750,348	2,750,348
79-HA		Transverse Anchor	set	300.0	1,146,867		344,060,100	0	344,060,100	1,830,400	1,830,400
72-HA		Concrete of deck, curb 28MPa	m^3	163.0	2,232,178		363,845,014	0	363,845,014	1,935,655	1,935,655
		Reinforcement of deck, curb	ton	16.0	22,546,530		360,744,480	0	360,744,480	1,919,161	1,919,161
34-HA		Asphalt concrete of bridge deck	m^2	2,825.0	228,603		645,803,475	0	645,803,475	3,435,674	3,435,674
96-HA		Metal Railing	m	452.0	2,058,567		930,472,284	0	930,472,284	4,950,113	4,950,113
		Bearing 9000kN	each	0.0	499,200,000		0	0	0	0	0
		Bearing 5000kN	each	12.0	277,400,000		3,328,800,000	0	3,328,800,000	17,709,216	17,709,216
		Water proofing layer	m^2	2,825.0	436,000		1,231,700,000	0	1,231,700,000	6,552,644	6,552,644
		Expansion Joint	m	14.0	139,683,000		1,955,562,000	0	1,955,562,000	10,403,590	10,403,590
		Lighting Pole -Single Arms	each	11.0	30,000,000		330,000,000	0	330,000,000	1,755,600	1,755,600
		Naigation light	set	0.0	4,845,000,000		0	0	0	0	0
98-HA		Cast iron drain pipe D150	set	57.0	445,740		25,407,180	0	25,407,180	135,166	135,166
		Auxiliary (30%)	%	0.3			16,258,847,187	0	16,258,847,187	86,497,067	86,497,067
										0	0
Substructure							**25,199,675,352**	**146,656,937**	**52,766,768,736**	280,719,210	280,719,210
63-CH		Concrete of Abutment, pier, 28MPa (Under W)	m^3	1,180.0	2,652,255		3,129,660,900	0	3,129,660,900	16,649,796	16,649,796
59-CH		Reinforcement of abutment, pier	ton	104.0	21,437,396		2,229,489,184	0	2,229,489,184	11,860,882	11,860,882
62-CH		Lean Concrete	m^3	35.0	1,723,811		60,333,385	0	60,333,385	320,974	320,974
81-CH		Blinding stone	m^3	71.0	696,000		49,416,000	0	49,416,000	262,893	262,893
		Steel Pipe Pile	ton	594.0	1,785,438	224,452	1,060,550,172	133,324,488	26,121,544,157	138,966,615	138,966,615
63-CH		Foundation Excavation	m^3	1,405.0	318,066		446,882,730	0	446,882,730	2,377,416	2,377,416
80-CH		Embankment of drainage material	m^3	622.0	382,355		237,824,810	0	237,824,810	1,265,228	1,265,228
		Auxiliary (10%)	%	0.10			721,415,718	13,332,449	3,227,515,117	17,170,380	17,170,380
86-CH		Sheet Pile (=11.12%)	ton	454.0	24,798,638		11,258,581,652	0	11,258,581,652	59,895,654	59,895,654
87-CH		Driving steel sheet pile	m	4,320.0	416,961		1,801,271,520	0	1,801,271,520	9,582,764	9,582,764
88-CH		Pulling sheet pile	m	4,320.0	205,276		886,792,320	0	886,792,320	4,717,735	4,717,735
84-CH		Face timpering (=19.0%)	ton	91.0	22,206,791		2,020,817,981	0	2,020,817,981	10,750,752	10,750,752
84-CH		Manufacture of Face Timperring	ton	91.0	7,034,461		640,135,951	0	640,135,951	3,405,523	3,405,523
85-CH		Installation and Removal of Face timpering	ton	91.0	7,214,319		656,503,029	0	656,503,029	3,492,596	3,492,596

Note: VAT is included

Table 8 Breakdown of Construction Cost (Approache Bridge (2) in Hai An Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)
	Hai An Side APPROACH BRIGE (2) L=2133.5m (on shore)					(VND)	(JP¥)	(VND)	(JP¥)	**0.00532**	**4,804,916,723**
A	**Super Structure**							**437,987,587,494**	**312,786,598**	**496,782,060,727**	**2,642,880,563**
			Box girder 45MPa for Box Girder bridge	m^3	19,449.0	16,382,949	13,402	318,631,975,101	260,655,498	367,627,369,462	1,955,777,606
			High Strength cable, transverse	ton	104.0	46,998,431		4,887,836,824	0	4,887,836,824	26,003,292
			Transverse Anchor	set	2,844.0	1,146,867		3,261,689,748	0	3,261,689,748	17,352,189
	72-HA		Concrete of deck, curb 28MPa	m^3	1,534.0	2,232,178		3,424,161,052	0	3,424,161,052	18,216,537
			Reinforcement of deck, curb	ton	153.0	22,546,530		3,449,619,090	0	3,449,619,090	18,351,974
	34-HA		Asphalt concrete of bridge deck	m^2	26,669.0	228,603		6,096,613,407	0	6,096,613,407	32,433,983
	96-HA		Metal Railing	m	4,267.0	2,058,567		8,783,905,389	0	8,783,905,389	46,730,377
			Bearing	each	132.0	5,516,875		728,227,500	0	728,227,500	3,874,170
			Water proofing layer	m^2	26,669.0	436,000		11,627,684,000	0	11,627,684,000	61,859,279
			Bridge name sign	each	0.0	1,366,116		0	0	0	0
			Expansion Joint	m	41.0	15,862,554		650,364,714	0	650,364,714	3,459,940
			Lighting Pole -Single Arms	each	107.0	30,000,000		3,210,000,000	0	3,210,000,000	17,077,200
	98-HA		Cast iron drain pipe D150	set	533.0	445,740		237,579,420	0	237,579,420	1,263,923
			Auxiliary (20%)	%	0.2			72,997,931,249	52,131,100	82,797,010,121	440,480,094
											0
A	**Substructure**							**200,526,349,674**	**1,095,235,979**	**406,397,774,335**	**2,162,036,159**
	102-HA		Concrete of Abutment, pier, 28MPa (Under W	m^3	9,327.0	2,652,255		24,737,582,385		24,737,582,385	131,603,938
	59-CH		Reinforcement of abutment, pier	ton	833.0	21,437,396		17,857,350,868		17,857,350,868	95,001,107
	62-CH		Lean Concrete	m^3	283.0	1,723,811		487,838,513		487,838,513	2,595,301
	81-CH		Blinding stone	m^3	566.0	696,000		393,936,000		393,936,000	2,095,740
			Steel Pipe Pile	ton	4,436.0	1,785,438	224,452	7,920,202,968	995,669,072	195,076,043,570	1,037,804,552
	63-CH		Foundation Excavation	m^3	11,239.0	318,066		3,574,743,774		3,574,743,774	19,017,637
	80-CH		Embankment of drainage material	m^3	4,974.0	382,355		1,901,833,770		1,901,833,770	10,117,756
			Auxiliary (10%)	%	0.1			5,687,348,828	99,566,907	24,402,932,888	129,823,603
	86-CH		Sheet Pile (=11.12%)	ton	3,629.0	24,798,638		89,994,257,302		89,994,257,302	478,769,449
	87-CH		Driving steel sheet pile	m	34,560.0	416,961		14,410,172,160		14,410,172,160	76,662,116
	88-CH		Pulling sheet pile	m	34,560.0	205,276		7,094,338,560		7,094,338,560	37,741,881
	84-CH		Face timpering (=19.0%)	ton	726.0	22,206,791		16,122,130,266		16,122,130,266	85,769,733
	84-CH		Manufacture of Face Timperring	ton	726.0	7,034,461		5,107,018,686		5,107,018,686	27,169,339
	85-CH		Installation and Removal of Face timpering	ton	726.0	7,214,319		5,237,595,594		5,237,595,594	27,864,009

Note: VAT is included

Table 9 Breakdown of Construction Cost (Flyover Bridge (2) in Hai An Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)
	Hai An Side FLYOVER BRIDGE (2) L=226.0m (on shore)					(VND)	(JP¥)	(VND)	(JP¥)	**0.00532**	**655,322,540**
A	**Super Structure**							**70,455,004,476**	**0**	**70,455,004,476**	**374,820,624**
	12-HA		Box girder 45MPa for Box Girder bridge	m^3	2,105.0	20,979,943		44,162,780,015	0	44,162,780,015	234,945,990
	75-HA		High Strength cable, transverse	ton	11.0	46,998,431		516,982,741	0	516,982,741	2,750,348
	79-HA		Transverse Anchor	set	300.0	1,146,867		344,060,100	0	344,060,100	1,830,400
	72-HA		Concrete of deck, curb 28MPa	m^3	163.0	2,232,178		363,845,014	0	363,845,014	1,935,655
			Reinforcement of deck, curb	ton	16.0	22,546,530		360,744,480	0	360,744,480	1,919,161
	34-HA		Asphalt concrete of bridge deck	m^2	2,825.0	228,603		645,803,475	0	645,803,475	3,435,674
	96-HA		Metal Railing	m	452.0	2,058,567		930,472,284	0	930,472,284	4,950,113
			Bearing 9000kN	each	0.0	499,200,000		0	0	0	0
			Bearing 5000kN	each	12.0	277,400,000		3,328,800,000	0	3,328,800,000	17,709,216
			Water proofing layer	m^2	2,825.0	436,000		1,231,700,000	0	1,231,700,000	6,552,644
			Expansion Joint	m	14.0	139,683,000		1,955,562,000	0	1,955,562,000	10,403,590
			Lighting Pole -Single Arms	each	11.0	30,000,000		330,000,000	0	330,000,000	1,755,600
			Naigation light	set	0.0	4,845,000,000		0	0	0	0
	98-HA		Cast iron drain pipe D150	set	57.0	445,740		25,407,180	0	25,407,180	135,166
			Auxiliary (30%)	%	0.3	54,196,157,289		16,258,847,187	0	16,258,847,187	86,497,067
											0
A	**Substructure**							**25,158,830,625**	**146,656,937**	**52,725,924,009**	**280,501,916**
	63-CH		Concrete of Abutment, pier, 28MPa (Under W)	m^3	1,166.0	2,652,255		3,092,529,330	0	3,092,529,330	16,452,256
	59-CH		Reinforcement of abutment, pier	ton	104.0	21,437,396		2,229,489,184	0	2,229,489,184	11,860,882
	62-CH		Lean Concrete	m^3	35.0	1,723,811		60,333,385	0	60,333,385	320,974
	81-CH		Blinding stone	m^3	71.0	696,000		49,416,000	0	49,416,000	262,893
			Steel Pipe Pile	ton	594.0	1,785,438	224,452	1,060,550,172	133,324,488	26,121,544,157	138,966,615
	63-CH		Foundation Excavation	m^3	1,405.0	318,066		446,882,730	0	446,882,730	2,377,416
	80-CH		Embankment of drainage material	m^3	622.0	382,355		237,824,810	0	237,824,810	1,265,228
			Auxiliary (10%)	%	0.10	32,238,019,596		717,702,561	13,332,449	3,223,801,960	17,150,626
	86-CH		Sheet Pile (=11.12%)	ton	454.0	24,798,638		11,258,581,652	0	11,258,581,652	59,895,654
	87-CH		Driving steel sheet pile	m	4,320.0	416,961		1,801,271,520	0	1,801,271,520	9,582,764
	88-CH		Pulling sheet pile	m	4,320.0	205,276		886,792,320	0	886,792,320	4,717,735
	84-CH		Face timpering (=19.0%)	ton	91.0	22,206,791		2,020,817,981	0	2,020,817,981	10,750,752
	84-CH		Manufacture of Face Timperring	ton	91.0	7,034,461		640,135,951	0	640,135,951	3,405,523
	85-CH		Installation and Removal of Face timpering	ton	91.0	7,214,319		656,503,029	0	656,503,029	3,492,596

Note: VAT is included

Table 10 Breakdown of Construction Cost (Approache Bridge (3) in Hai An Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)
	Hai An Side APPROACH BRIGE (3) L=1300m (off shore)					(VND)	(JP¥)	(VND)	(JP¥)	0.00532	2,914,772,279
A	Super Structure							266,720,769,156	190,447,781	302,519,224,194	1,609,402,273
			Box girder 45MPa for Box Girder bridge	m^3	11,842.0	16,382,949	13,402	194,006,882,058	158,706,484	223,838,927,923	1,190,823,097
			High Strength cable, transverse	ton	63.0	46,998,431		2,960,901,153	0	2,960,901,153	15,751,994
			Transverse Anchor	set	1,733.0	1,146,867		1,987,520,511	0	1,987,520,511	10,573,609
	72-HA		Concrete of deck, curb 28MPa	m^3	935.0	2,232,178		2,087,086,430	0	2,087,086,430	11,103,300
			Reinforcement of deck, curb	ton	94.0	22,546,530		2,119,373,820	0	2,119,373,820	11,275,069
	34-HA		Asphalt concrete of bridge deck	m^2	16,250.0	228,603		3,714,798,750	0	3,714,798,750	19,762,729
	96-HA		Metal Railing	m	2,600.0	2,058,567		5,352,274,200	0	5,352,274,200	28,474,099
			Bearing	each	78.0	5,516,875		430,316,250	0	430,316,250	2,289,282
			Water proofing layer	m^2	16,250.0	436,000		7,085,000,000	0	7,085,000,000	37,692,200
			Bridge name sign	each	0.0	1,366,116		0	0	0	0
			Expansion Joint	m	27.0	15,862,554		428,288,958	0	428,288,958	2,278,497
			Lighting Pole -Single Arms	each	65.0	30,000,000		1,950,000,000	0	1,950,000,000	10,374,000
	98-HA		Cast iron drain pipe D150	set	325.0	445,740		144,865,500	0	144,865,500	770,684
			Auxiliary (20%)	%	0.2			44,453,461,526	31,741,297	50,419,870,699	268,233,712
											0
A	Substructure							116,601,514,485	685,049,949	245,370,301,929	1,305,370,006
	102-HA		Concrete of Abutment, pier, 28MPa (Under W	m^3	5,721.0	3,564,274		20,391,211,554		20,391,211,554	108,481,245
	59-CH		Reinforcement of abutment, pier	ton	512.0	21,966,562		11,246,879,744		11,246,879,744	59,833,400
	62-CH		Lean Concrete	m^3	168.0	1,741,595		292,587,960		292,587,960	1,556,568
	81-CH		Blinding stone	m^3	336.0	737,139		247,678,704		247,678,704	1,317,651
			Steel Pipe Pile	ton	2,654.0	1,785,438	224,452	4,738,552,452	595,695,608	116,711,411,099	620,904,707
	63-CH		Foundation Excavation	m^3	6,673.0	318,747		2,126,998,731		2,126,998,731	11,315,633
	80-CH		Embankment of drainage material	m^3	2,953.0	389,875		1,151,300,875		1,151,300,875	6,124,921
			Auxiliary (15%)	%	0.15			6,029,281,503	89,354,341	22,825,210,300	121,430,119
	86-CH		Sheet Pile (=11.12%)	ton	2,155.0	24,798,638		53,441,064,890		53,441,064,890	284,306,465
	87-CH		Driving steel sheet pile	m	2,052.0	376,297		772,161,444		772,161,444	4,107,899
	88-CH		Pulling sheet pile	m	2,052.0	205,330		421,337,160		421,337,160	2,241,514
	84-CH		Face timpering (=19.0%)	ton	431.0	22,206,791		9,571,126,921		9,571,126,921	50,918,395
	84-CH		Manufacture of Face Timperring	ton	431.0	7,077,157		3,050,254,667		3,050,254,667	16,227,355
	85-CH		Installation and Removal of Face timpering	ton	431.0	7,241,480		3,121,077,880		3,121,077,880	16,604,134

Note: VAT is included

Table 11 Breakdown of Construction Cost (Main Bridge)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)
	MAINBRIGE L=490.0m (off shore)					(VND)	(JP¥)	(VND)	(JP¥)	0.00532	3,511,644,123
A	Super Structure							175,550,168,179	0	175,550,168,179	933,926,895
	12-HA		Box girder 45MPa for Box Girder bridge	m^3	5,504.0	20,979,943		115,473,606,272	0	115,473,606,272	614,319,585
	75-HA		High Strength cable, transverse	ton	33.0	46,998,431		1,550,948,223	0	1,550,948,223	8,251,045
	79-HA		Transverse Anchor	set	653.0	1,146,867		748,904,151	0	748,904,151	3,984,170
	72-HA		Concrete of deck, curb 28MPa	m^3	352.0	2,232,178		785,726,656	0	785,726,656	4,180,066
			Reinforcement of deck, curb	ton	35.0	22,546,530		789,128,550	0	789,128,550	4,198,164
	34-HA		Asphalt concrete of bridge deck	m^2	6,125.0	228,603		1,400,193,375	0	1,400,193,375	7,449,029
	96-HA		Metal Railing	m	980.0	2,058,567		2,017,395,660	0	2,017,395,660	10,732,545
			Bearing 9000kN	each	4.0	499,200,000		1,996,800,000	0	1,996,800,000	10,622,976
			Bearing 5000kN	each	0.0	277,400,000		0	0	0	0
			Water proofing layer	m^2	6,125.0	436,000		2,670,500,000	0	2,670,500,000	14,207,060
			Expansion Joint	m	14.0	139,683,000		1,955,562,000	0	1,955,562,000	10,403,590
			Lighting Pole -Single Arms	each	25.0	30,000,000		750,000,000	0	750,000,000	3,990,000
			Naigation light	set	1.0	4,845,000,000		4,845,000,000	0	4,845,000,000	25,775,400
	98-HA		Cast iron drain pipe D150	set	123.0	445,740		54,826,020	0	54,826,020	291,674
			Auxiliary (30%)	%	0.3			40,511,577,272	0	40,511,577,272	215,521,591
											0
A	Substructure							158,573,069,292	1,734,108,499	484,533,313,527	2,577,717,228
	63-CH		Concrete of Abutment, pier, 28MPa (Under W)	m^3	10,161.0	3,564,274		36,216,588,114	0	36,216,588,114	192,672,249
	59-CH		Reinforcement of abutment, pier	ton	912.0	21,966,562		20,033,504,544	0	20,033,504,544	106,578,244
	62-CH		Lean Concrete	m^3	2,610.0	1,741,595		4,545,562,950	0	4,545,562,950	24,182,395
	81-CH		Blinding stone	m^3	1,331.0	737,139		981,132,009	0	981,132,009	5,219,622
			Steel Pipe Sheet Pile(Exteria)	ton	4,725.7	2,308,090	221,786	10,907,340,913	1,048,094,100	207,917,510,124	1,106,121,154
			Steel Pipe Sheet Pile(Bulk Head)	ton	1,575.0	2,339,460	226,478	3,684,649,500	356,702,850	70,734,057,395	376,305,185
			Steel Pipe Pile	ton	317.0	1,785,438	224,452	565,983,846	71,151,284	13,940,285,350	74,162,318
			Reinforcing Bar Stud SM490A-SD	ton	7.8	1,331,000	4,099,000	10,381,800	31,972,200	6,020,193,830	32,027,431
			Bottom slab concrete	m^3	2,592.0	1,741,595		4,514,214,240	0	4,514,214,240	24,015,620
			PDA test on 1.2m Dia. Steel Pipe Sheet Pile	Nos.	3.0	15,000,000		45,000,000	0	45,000,000	239,400
			Mortar Filling to Steel Pipe Joint	ton	68.0	1,507,799		102,530,332	0	102,530,332	545,461
	63-CH		Foundation Excavation	m^3	1,729.9	318,747		551,400,435	0	551,400,435	2,933,450
	80-CH		Embankment of drainage material	m^3	13,361.4	389,875		5,209,275,825	0	5,209,275,825	27,713,347
			Structurel Excavation Inside Piles and joint pi	m^3	10,368.0	454,571		4,712,992,128	0	4,712,992,128	25,073,118
			Auxiliary (15%)	%	0.15			13,812,083,495	226,188,065	56,328,637,091	299,668,349
	86-CH		Sheet Pile (=11.12%)	ton	1,377.0	24,798,638		34,147,724,526	0	34,147,724,526	181,665,894
	87-CH		Driving steel sheet pile	m	13,115.0	376,297		4,935,135,155	0	4,935,135,155	26,254,919
	88-CH		Pulling sheet pile	m	13,115.0	205,330		2,692,902,950	0	2,692,902,950	14,326,244
	84-CH		Face timpering (=19.0%)+Tie Rod	ton	298.6	22,206,791		6,629,837,453	0	6,629,837,453	35,270,735
	84-CH		Manufacture of Face Timperring + Tie Rod	ton	298.6	7,077,157		2,112,885,222	0	2,112,885,222	11,240,549
	85-CH		Installation and Removal of Face timpering+Ti	ton	298.6	7,241,480		2,161,943,854	0	2,161,943,854	11,501,541

Note: VAT is included

Table 12 Breakdown of Construction Cost (Approache Bridge in Cat Hai Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	Quantites	UNIT PRICE	UNIT PRICE	Amount	Amount	Amount (in VND)	Amount (in JP¥)
	Cat Hai Side APPROACH BRIGE L=519.2m (off shore)					(VND)	(JP¥)	(VND)	(JP¥)	0.00532	1,294,582,440
A	Super Structure							106,597,371,060	76,085,834	120,899,219,631	643,183,848
			Box girder 45MPa for Box Girder bridge	m^3	4,731.0	16,382,949	13,402	77,507,731,719	63,404,862	89,425,938,862	475,745,995
			High Strength cable, transverse	ton	25.0	46,998,431		1,174,960,775	0	1,174,960,775	6,250,791
			Transverse Anchor	set	692.0	1,146,867		793,631,964	0	793,631,964	4,222,122
	72-HA		Concrete of deck, curb 28MPa	m^3	373.0	2,232,178		832,602,394	0	832,602,394	4,429,445
			Reinforcement of deck, curb	ton	37.0	22,546,530		834,221,610	0	834,221,610	4,438,059
	34-HA		Asphalt concrete of bridge deck	m^2	6,490.0	228,603		1,483,633,470	0	1,483,633,470	7,892,930
	96-HA		Metal Railing	m	1,038.0	2,058,567		2,136,792,546	0	2,136,792,546	11,367,736
			Bearing	each	32.0	5,516,875		176,540,000	0	176,540,000	939,193
			Water proofing layer	m^2	6,490.0	436,000		2,829,640,000	0	2,829,640,000	15,053,685
			Bridge name sign	each	1.0	1,366,116		1,366,116	0	1,366,116	7,268
			Expansion Joint	m	14.0	15,862,554		222,075,756	0	222,075,756	1,181,443
			Lighting Pole -Single Arms	each	26.0	30,000,000		780,000,000	0	780,000,000	4,149,600
	98-HA		Cast iron drain pipe D150	set	130.0	445,740		57,946,200	0	57,946,200	308,274
			Auxiliary (20%)	%	0.2			17,766,228,510	12,680,972	20,149,869,939	107,197,308
											0
A	Substructure							56,603,387,738	350,268,569	122,443,344,242	651,398,591
	102-HA		Concrete of Abutment, pier, 28MPa (Under W	m^3	2,741.0	3,564,274		9,769,675,034		9,769,675,034	51,974,671
	59-CH		Reinforcement of abutment, pier	ton	244.0	21,966,562		5,359,841,128		5,359,841,128	28,514,355
	62-CH		Lean Concrete	m^3	81.0	1,741,595		141,069,195		141,069,195	750,488
	81-CH		Blinding stone	m^3	161.0	737,139		118,679,379		118,679,379	631,374
			Steel Pipe Pile	ton	1,357.0	1,785,438	224,452	2,422,839,366	304,581,364	59,674,975,456	317,470,869
	63-CH		Foundation Excavation	m^3	3,161.0	318,747		1,007,559,267		1,007,559,267	5,360,215
	80-CH		Embankment of drainage material	m^3	1,374.0	389,875		535,688,250		535,688,250	2,849,861
			Auxiliary (15%)	%	0.15			2,903,302,743	45,687,205	11,491,123,156	61,132,775
	86-CH		Sheet Pile (=11.12%)	ton	903.0	24,798,638		22,393,170,114		22,393,170,114	119,131,665
	87-CH		Driving steel sheet pile	m	8,603.0	416,961		3,587,115,483		3,587,115,483	19,083,454
	88-CH		Pulling sheet pile	m	8,603.0	205,276		1,765,989,428		1,765,989,428	9,395,064
	84-CH		Face timpering (=19.0%)	ton	181.0	22,206,791		4,019,429,171		4,019,429,171	21,383,363
	84-CH		Manufacture of Face Timperring	ton	181.0	7,034,461		1,273,237,441		1,273,237,441	6,773,623
	85-CH		Installation and Removal of Face timpering	ton	181.0	7,214,319		1,305,791,739		1,305,791,739	6,946,812

Note: VAT is included

Table 13 Breakdown of Construction Cost (Approache Road in Cat Hai Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	UNIT PRICE	Quantites	Amount (VND)
	APPROACH ROAD & RETAINING WALL CAT HAI SIDE						90,928,034,513
	2.1EMBANKMENT						6,625,654,160
			Embankment of sand, K=0.95	m^3	190,170	15,117.0	2,874,799,890
			Embankment of sand, K=0.98	m^3	194,243	2,500.0	485,607,500
			Geotextile Fillter Fabric (non-woven, 25kN/m	m^2	36,659	5,149.0	188,757,191
			Pavement Structure	m^2	615,421	4,999.0	3,076,489,579
	2.2 RETAINING WALL						84,302,380,353
			Concrete of Retainingwall, 28MPa	m^3	2,248,743	8,492.0	19,096,325,556
			Reinforcement of retaining wall	ton	18,025,372	679.3	12,245,031,758
			Lean Concrete	m^3	1,741,595	504.0	877,763,880
			RC Piles 35*35cm	m	1,353,921	32,234.0	43,642,289,514
			Metal Railing	m	2,061,318	377.0	777,116,886
			Auxiliary	%	76,638,527,594	0.1	7,663,852,759

Note: VAT is included

Table 14 Breakdown of Construction Cost (Road work in Cat Hai Side)

BILL ITEM	No. of UNIT Price	Code of Norm	Item	UNIT	UNIT PRICE	Quantites	Amount (VND)
	CAT HAI Side ROAD WORKs						**681,357,217,955**
A	1.1EMBANKMENT						**141,290,225,418**
			Ecavation of soil	m^3	60,030	2,659.5	159,649,785
			Excavetion of organic soil	m^3	42,794	134,312.5	5,747,769,125
			Embankment of sand, K=0.95	m^3	190,170	509,403.3	96,873,225,561
			Embankment of sand, K=0.98	m^3	194,243	94,735.6	18,401,727,151
			Embankment of Clay (Slope Protection)	m^3	229,903	82,125.5	18,880,898,827
			Sodding (Slope Protection)	m^3	14,940	82,125.5	1,226,954,970
A	1.2APPROACH ROAD (Soft Soil Treatment)						**356,657,461,383**
			Excavation of unsuitable soil	m^3	52,395	107,107.7	5,611,907,942
			Embankment of sand, K=0.95	m^3	190,170	107,107.7	20,368,671,309
			Geotextile Filter Fabric (non-woven)	m^2	18,553	378,043.9	7,013,848,477
			Geotextile Filter Fabric (woven)	m^2	57,887	221,355.8	12,813,623,195
			Sand Blancket (medium sand)	m^3	391,215	188,786.2	73,855,993,233
			Sand Drain (D400)	m	142,919	1,313,630.9	187,742,814,597
			Embankment of sand for compensation by Sa	m^3	190,170	173,682.3	33,029,162,991
			Embankment of sand for compensation by Pa	m^3	190,170	171,021.8	32,523,215,706
			Removal of surcharge	m^3	8,478	171,021.8	1,449,922,820
			Settlement Plate by steel 0.8*0.8*	each	2,359,416	180.0	424,694,880
			Wooden Pile 10*10*170cm	each	25,203	480.0	12,097,440
			Piezometer,observation well, inc	set	85,000,000	1.0	85,000,000
			Reusable sand (surcharge)	m^3	118,721	-153,919.6	-18,273,491,206
A	1.3 PAVEMENT						**116,207,888,267**
			Fine Asphalt Concrete -5cm	m^2	159,415	135,847.3	21,656,093,419
			Tack Coat 0.5kg/m2	m^2	10,352	135,847.3	1,406,290,996
			Medium Asphalt Concrete-7cm	m^2	209,184	135,847.3	28,417,076,472
			Prime Coat 1.0kg/m2	m^2	18,340	135,847.3	2,491,439,032
			Aggregate Base-15cm	m^3	553,398	28,420.7	15,727,958,539
			Aggregate Subbase-43cm	m^3	482,571	81,472.6	39,316,314,055
			Geotextile Filter Fabric (non-woven, 25kn/m)	m^2	36,659	196,206.0	7,192,715,754
A	1.4 TRAFFIC SAFETY						**17,768,417,889**
			Guide Posts	each	119,005	1,380.0	164,226,900
			Kilometer Posts	each	400,726	6.0	2,404,356
			Regulatory Signs	each	1,567,972	10.0	15,679,720
			Information and Guidance signs	each	5,499,512	6.0	32,997,072
			Area Reflection Pavement Marking	each	261,074	8,598.6	2,244,870,896
			Guardrail	m	1,278,433	480.0	613,647,840
			Reflectorized Pavement Stud	each	68,780	1,842.0	126,692,760
			Concrete curb	m	176,176	13,779.7	2,427,652,427
			Planting	each	278,416	2,298.0	639,799,968
			Lighting Pole-Single Arms	pole	30,000,000	361.0	10,830,000,000
			Sodding	m^2	14,940	4,409.5	65,877,930
			Embankment of clay	m^3	229,903	1,980.8	455,391,862
			Organic soil	m^3	76,887	1,940.2	149,176,157
A	1.5 Culvert						**49,433,224,998**
			RC Pipe Culvert-D1.25m	m	8,514,271	258.0	2,196,681,918
			RC Box Culvert-2*4m*3m(Km10+818)	m	246,545,728	31.5	7,765,450,795
			RC Box Culvert-2*4m*3.2m(Km10+128.1)	m	262,982,110	29.5	7,757,972,245
			RC Box Culvert-4m*3.2m((Km13+600)	m	262,982,110	29.5	7,757,972,245
			RC Box Culvert-1.5*3m(Km14+669)	m	142,359,293	31.6	4,494,282,880
			RC Box Culvert-3m*3m(Km 14+926)	m	161,191,286	31.8	5,125,399,321
			RC Box Culvert-3*4m*4m (Km 15+150)	m	449,754,207	31.9	14,335,465,594

Note: VAT is included

Appendix-7: Prediction of Impact on Ambient Air Quality and Impact of Noise during Operation Phase

1. Impact on Ambient Air Quality during Operation Phase

1.1. Pollutant emission source intensity of automobile tail gas

a) Pollutant emission source intensity of automobile tail gas

Sources of air pollution during operation phase are mainly from emission of vehicle engines, emission of friction between vehicle tires and road pavement.

The following formula is used to calculate gaseous pollutant (SO2, NOx, CO, and TSP) discharge source intensity of the planned highway[1].

$$Q_t = V_w \times \frac{1}{3600} \times \frac{1}{1000} \times \sum_{i=1}^{2} (N_{it} \times E_i)$$

In which, Q_t : discharge intensity of gaseous pollutant (ml/m･s (or mg/m･s))
E_i : air emission coefficient of i type vehicle (g/km･vehicle)
N_{it} : hour traffic volume by i type vehicle (vehicle/h)
V_w : conversion coefficient (ml/g (or mg/g))

Regarding the air emission coefficient E_i , the following formulation is used[1].

$$Ei = a/x + bx + cx^2 + d$$

In which, x is vehicle average hour speed (km/h), and a, b, c, d are regression parameters.

Table 1 shows the results of calculation of E_i in cases of x= 50km/h, 60km/h and 80km/h for small car and big car.

[1] Referred to "道路環境影響評価の技術手法（Technical Handbook for Environmental Impact Assessment of Roads）", 2007 Revision, Japan Highway Environment Research Institute (HERI).

Table 1 Air emission coefficients of vehicles

(Unit: g/km per vehicle unit)

Pollutants	Vehicle size	a	b	c	d	Average speed of vehicle 50km/h	60km/h	80km/h
NOx	Small car	-0.902	-0.00578	4.39E-05	0.261	0.0637	0.0572	0.0683
	Big car	-7.12	-0.0895	0.000735	3.93	1.1501	1.0873	1.3850
SPM	Small car	-0.0687	-0.000385	2.87E-06	0.017	0.0036	0.0031	0.0037
	Big car	0.0318	-0.0031	2.27E-05	0.158	0.0604	0.0543	0.0557
CO	Small car	-12.5	-0.0559	0.000448	2.2	0.2750	0.2505	0.4390
	Big car	10.9	-0.0168	0.000115	1.19	0.8555	0.7777	0.7183
SO2	Small car	0.0783	-0.000162	1.31E-06	0.0112	0.0079	0.0075	0.0076
	Big car	0.0411	-0.000699	5.51E-05	0.0424	0.1460	0.1995	0.3396

Source of data: Technical Handbook for Environmental Impact Assessment of Roads, 2007 Revision, HERI

Table 2 Daily traffic volume - TanVu-DinhVu Section

(Unit: vehicle /day)

Year	2015	2020	2030
(a) Bicycle	42,400	64,800	40,500
(b) Motorcycle	65,800	91,200	108,067
(c) Car	3,960	13,540	48,000
(d) Trucks of 2 axles and mini bus with less than 25 seats 4	1,243	2,571	8,107
(e) Truck of more than 3 axles and large bus	1,246	2,920	13,851
(f) Trailer and bus with trailer	71	129	436
Total	114,720	175,160	218,961
Small car [(b) + (c)]	69,760	104,740	156,067
Big car [(d)+(e)+(f)]	2,560	5,620	22,394

Source of data: JICA Preparatory Survey Team, May 2010

Table 3 Daily traffic volume – DinhVu-Cat Hai Section

(Unit: vehicle /day)

Year	2015	2020	2030
(a) Bicycle	26,900	40,300	16,800
(b) Motorcycle	41,533	56,733	44,667
(c) Car	2,500	8,420	19,860
(d) Trucks of 2 axles and mini bus with less than 25 seats 4	214	536	1,350
(e) Truck of more than 3 axles and large bus	789	1,817	5,731
(f) Trailer and bus with trailer	46	79	179
Total	71,982	107,885	88,587
Small car [(b) + (c)]	44,033	65,153	64,527
Big car [d)+(e)+(f)]	1,049	2,432	7,260

Source of data: JICA Preparatory Survey Team, May 2010

Table 4 Tan Vu - Dinh Vu Section, forecasted air pollutant emission

(Unit: g/km ·day)

Year	2015	2020	2030
SO2	927.7	897.8	8,791.5
NOx	7,388.7	12,102.6	41,672.7
CO	21,374.1	30,604.4	84,590.1
TSP	402.3	628.2	1,825.7

Source of data: JICA Preparatory Survey Team, May 2010

Table 5 Dinh Vu – Cat Hai Section, forecasted air pollutant emission

(Unit: g/km ·day)

Year	2015	2020	2030
SO2	502.8	537.2	2,956.1
NOx	4,011.8	6,371.6	14,461.3
CO	13,006.5	18,209.9	33,538.6
TSP	219.7	333.1	643.6

Source of data: JICA Preparatory Survey Team, May 2010

1.2. Ambient air pollutant diffusion model

To predict air pollutants emitted by moving vehicles during operation phase (with wind velocity > 1.0m/s) , the following Plume Model is used (Source: Technical Handbook for Environmental Impact Assessment of Roads, 2007 Revision, HERI).

$$C(x,y,z) = \frac{Q}{2\pi \cdot u \cdot \sigma_y \cdot \sigma_z} \exp(-\frac{y^2}{2\sigma y^2})[\exp\{-\frac{(Z-H)^2}{2\sigma_z^2}\}+\exp\{-\frac{(Z+H)^2}{2\sigma_z^2}\}]$$

In which,

C(x,y,z) : air pollutant concentration at survey site (x,y,z) (ppm or mg/m^3)
Q : air pollutant emission rate (ml/s or mg/s)
u : vehicle average speed (m/s)
H : height of source of emission (m)
σ_y, σ_z : diffusion coefficient toward y dimension and z dimension (m)
x : distance from emission point source to survey site along the wind direction (m)
y : horizontal distance from survey point to x axis (m)
z : vertical distance from survey point to x axis (m)

σ_y, σ_z are calculated by the following formulations:
$\sigma_y = W/2 + 0.46 L^{0.81}$ (in case of $x<W/2$: $\sigma_y = W/2$) (m)
$\sigma_z = \sigma_{z0} + 0.31 L^{0.83}$ (in case of $x<W/2$: $\sigma_z = \sigma_{z0}$) (m)
In which,

L : distance from the survey point to the road side = x-W/2 (m)
x : distance from emission point source to survey site along the wind direction (m)
W : road width (m)
σ_{z0} : initial vertical diffision coefficient (m)
in case of no existing of noise barrier : $\sigma_{z0} = 1.5$
in case of existing of noise barrier : $\sigma_{z0} = 4.0$

Based on result of the EIA study relating to meteorological conditions of the Project area, input data using to predict ambient air quality for the Project are setting as following.

Table 6 Input data for prediction of ambient air quality

Z (m)	h (m)	Summer				Winter			
		Wind direct-ion	Wind velocity (m/s)	Temper-ature (℃)	Atmos-phere stability	Wind direct-ion	Wind velocity (m/s)	Temper-ature (℃)	Atmos-phere stability
1	Note*)	SE	2.5	28.2	C	NE	1.7	16.7	B

Data source: EIA Report of Tan Vu – Lach Huyen Highway Construction Project, Hanoi May 2010, Section 2.1.4

Since the wind velocity in winter (1.7m/s) is lower than the one in summer (2.5m/s), the wind velocity in winter is selected for obtaining more conservative prediction results. In this case, predicted air pollutant concentrations (with lower wind speed) may present higher values than it is in case of summer.

And, to convert the concentration of NOx to NO_2, the following formulation is applied (Source: Technical Handbook for Environmental Impact Assessment of Roads, 2007 Revision, HERI).

$$[NO_2]_R = 0.0683[NO_x]_R^{0.499} \quad x \quad \{1-\{[NO_x]_{BG}/([NO_x]_R + [NO_x]_{BG})\}\}^{0.507}$$

In which,

$[NO_2]_R$: NO_2 contributed by the road (ppm)
$[NO_x]_R$: NO_x contributed by the road (ppm)
$[NO_x]_{BG}$: background NO_x (ppm)

The following data described in the report of the study “Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam” (Prepared by Multi-sectoral Action Plan Group, and chaired by Viet Nam Register, March 2002) are referred to for $[NO_x]_{BG}$.

Hanoi City (Nga Tu Vong Road Intersection), [NOx] = 0.13 mg/m^3 (in 1999).

1.3. Prediction results

Results of prediction of pollutants in ambient air in one hour in a winter day of the years 2015, 2020 and 2030 are described in the following tables.

In addition, the following background air pollutant concentrations are included to the predicted air pollutants emitted by vehicles.

Table 7 Background air pollution concentration (unit: μg/m^3)

Survey site	Survey day	SO2	NO2	SPM	CO
A1	10-Aug-08	50	42	130	3,448
	12-Aug-08	52	42	131	3,497
	Average	**51**	**42**	**131**	**3,473**
A2	10-Aug-08	46	51	93	4,019
	12-Aug-08	46	49	91	4,035
	Average	**46**	**50**	**92**	**4,027**
A3	10-Aug-08	47	35	92	3,786
	12-Aug-08	48	36	88	3,899
	Average	**48**	**36**	**90**	**3,843**
A4	10-Aug-08	62	45	119	4,128
	12-Aug-08	61	44	120	4,227
	Average	**62**	**45**	**120**	**4,178**

Data source: EIA Report of Tan Vu – Lach Huyen Highway Construction Project, Hanoi May 2010.

Table 8 Predicted air pollutant concentrations
in winter at A1 (K1) survey point (h =3.3m, with background concentration added)

(unit: µg/m3)

Year	2015				2020				2030			
Distance (m)	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP
10	52.0	44.1	3,496	130.9	53.1	45.4	3,506	131.2	60.7	52.7	3,566	132.5
20	51.8	43.7	3,491	130.8	52.6	44.7	3,499	131.0	58.6	50.6	3,546	132.1
30	51.7	43.4	3,488	130.8	52.4	44.2	3,494	130.9	57.3	49.2	3,533	131.8
40	51.6	43.2	3,486	130.7	52.2	43.9	3,491	130.9	56.4	48.3	3,524	131.6
50	51.5	43.0	3,484	130.7	52.0	43.7	3,489	130.8	55.7	47.5	3,518	131.5
70	51.4	42.8	3,482	130.7	51.8	43.3	3,485	130.8	54.7	46.4	3,508	131.3
100	51.3	42.6	3,479	130.6	51.6	43.0	3,482	130.7	53.7	45.3	3,499	131.1
TCVN 5937-2005	350	200	30,000	300	350	200	30,000	300	350	200	30,000	300

Table 9 Predicted air pollutant concentrations
in winter at A2 (K3) survey point (h =2.3m, with background concentration added)

(unit: µg/m3)

Year	2015				2020				2030			
Distance (m)	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP
10	46.6	51.3	4,043	92.3	47.2	52.0	4,049	92.4	49.6	54.5	4,068	92.8
20	46.5	51.0	4,039	92.2	46.9	51.5	4,044	92.3	48.7	53.4	4,058	92.6
30	46.4	50.8	4,037	92.2	46.7	51.3	4,041	92.2	48.2	52.8	4,052	92.5
40	46.3	50.7	4,035	92.1	46.6	51.1	4,039	92.2	47.9	52.4	4,048	92.4
50	46.3	50.6	4,034	92.1	46.5	50.9	4,037	92.2	47.6	52.1	4,045	92.4
70	46.2	50.5	4,033	92.1	46.4	50.7	4,035	92.1	47.3	51.6	4,042	92.3
100	46.2	50.3	4,031	92.1	46.3	50.5	4,033	92.1	46.9	51.2	4,038	92.2
TCVN 5937-2005	350	200	30,000	300	350	200	30,000	300	350	200	30,000	300

Table 10 Predicted air pollutant concentrations
in winter at A3 (K4) survey point (h =3.4 m, with background concentration added)

(unit: μg/m3)

Year	2015				2020				2030			
Distance (m)	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP
10	48.0	36.6	3,857	90.2	48.6	37.3	3,862	90.4	50.7	39.5	3,879	90.7
20	47.9	36.4	3,854	90.2	48.3	36.9	3,858	90.3	50.0	38.7	3,871	90.6
30	47.9	36.3	3,852	90.2	48.2	36.7	3,855	90.2	49.6	38.2	3,866	90.5
40	47.8	36.1	3,850	90.1	48.1	36.5	3,854	90.2	49.3	37.8	3,863	90.4
50	47.8	36.1	3,849	90.1	48.0	36.4	3,852	90.2	49.1	37.5	3,860	90.3
70	47.7	35.9	3,848	90.1	47.9	36.2	3,850	90.1	48.7	37.1	3,857	90.3
100	47.7	35.8	3,846	90.1	47.8	36.0	3,848	90.1	48.4	36.7	3,853	90.2
TCVN 5937-2005	350	200	30,000	300	350	200	30,000	300	350	200	30,000	300

Table 11 Predicted air pollutant concentrations
in winter at A4 (K5) survey point (h =4.2 m, with background concentration added)

(unit: μg/m3)

Year	2015				2020				2030			
Distance (m)	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP	SO2	NO2	CO	TSP
10	62.0	45.6	4,191	119.7	62.5	46.2	4,196	119.8	64.5	48.2	4,211	120.1
20	61.9	45.4	4,188	119.7	62.3	45.9	4,192	119.8	63.9	47.5	4,205	120.0
30	61.8	45.2	4,186	119.7	62.2	45.6	4,190	119.7	63.5	47.1	4,200	119.9
40	61.8	45.1	4,185	119.6	62.1	45.5	4,188	119.7	63.2	46.7	4,197	119.9
50	61.8	45.0	4,184	119.6	62.0	45.4	4,187	119.7	63.0	46.4	4,195	119.8
70	61.7	44.9	4,183	119.6	61.9	45.2	4,185	119.6	62.7	46.1	4,191	119.8
100	61.7	44.8	4,181	119.6	61.8	45.0	4,183	119.6	62.4	45.6	4,188	119.7
TCVN 5937-2005	350	200	30,000	300	350	200	30,000	300	350	200	30,000	300

2. Impact of Noise during Operation Phase

2.1. Prediction model

Road traffic noise prediction model "ASJ RTN-Model 2003" developed by the Acoustical Society of Japan is used to predict impact of noise caused by the Project during operation phase.

The mathematical calculation equation is as follow:

$$LAeq = 10\log_{10}(\sum_{i=1}^{k} 10^{LAi/10} *\Delta t*N/t)$$

where

LAi = Lw – 8 – 20log $_{10}$(r) + ΔLd + ΔLg + ΔLm
Lw : the A-weighted sound power level of a single running vehicle at the i^{th} source position (dB)
r : the direct distance from the i^{th} source position to the prediction point (m)
ΔLd : correction for diffraction (dB),
ΔLg : correction for the ground effect (dB)
ΔLm : correction for atmospheric absorption (dB)
N : predicted traffic volume (unit/hr)
Δt : passing time = ΔD/V
ΔD : distance berween noise source (m)
V : average vehicle speed (m/s)

The A-weighted sound power level of a road vehicle is given by:

$$Lw= r_1 + r_2*\log_{10} (V) +C$$

where Lw is the sound power level [dB], V is the vehicle speed [km/h], r_1 and r_2 are regression coefficients, and C is the correction term from a reference value (the power level when the vehicle runs on a dense asphalt pavement constructed within the last several years).

For the Project, to simplify the calculation, C is intentionally obmissed, and Lw is calculated as follow:

$$Lw \text{ (big car)} = 53.2 + 30 \log_{10}(v)$$
$$Lw \text{ (small car)} = 46.7 + 30 \log_{10}(v)$$

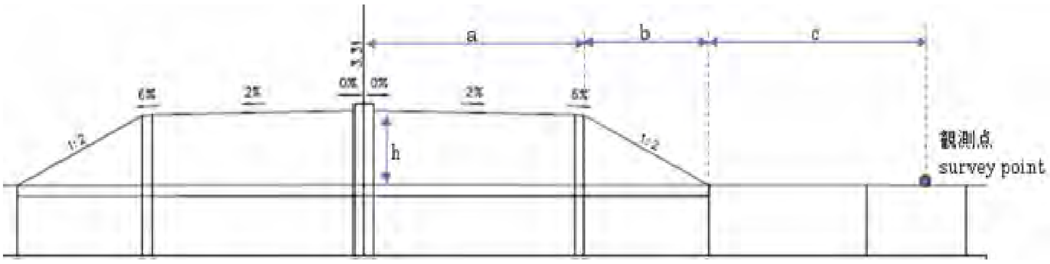
2.2. Input data

Table 12 shows the location, height of road surface, distance from the center of the road to the road side of the road section at the survey sites (A1~A4).

Table 12 Dimension of road cross-sections

(unit=m)

No.	Section	h	a	b	a+b
A1	0+600	3.3	14.75	6.2	21.35
A2	10+500	2.3	14.75	4.6	19.35
A3	12+000	3.4	14.75	6.8	21.55
A4	14+000	4.2	14.75	8.4	23.15



The distances (c) from the survey point are set as 10m. 20m, 30, 40m, 50, 70m, and 100m from the road embankment side (at the distance a+b from the road center), at 1.2 m high from the land surface.

Table 13 Hour Traffic Volume at Section of Tan Vu – Dinh Vu

(Unit: vehicles/hr)

Year	At day time (6am~18pm)			At night time (18pm~22pm)			At midnight (22pm~6am)		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
Motorcycle	5,483	7,600	9,006	2,303	3,192	3,782	494	684	811
Small car	330	1,128	4,000	139	474	1,680	30	102	360
Big car	214	468	1,866	90	197	784	19	42	168

Table 14 Hour Traffic Volume at Section of Dinh Vu – Cat Hai

(Unit: vehicles/hr)

Year	At day time (6am~18pm)			At night time (18pm~22pm)			At midnight (22pm~6am)		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
Motorcycle	3,461	4,728	3,722	1,454	1,986	1,563	311	425	335
Small car	208	702	1,655	88	295	695	19	63	149
Big car	88	203	606	38	86	254	8	19	54

2.3. Prediction results

Table 15 Predicted Noise Level at Survey Site A1 (K1)

(Unit: dBA)

Distance c (m)	In day-time (6am~18pm)			In night-time (18pm~22pm)			In midnight (22pm~6am)		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
10	61.9	65.5	71.0	58.1	61.8	67.2	51.5	55.1	60.5
20	61.7	65.3	70.8	58.0	61.6	67.0	51.3	54.9	60.3
30	61.3	65.0	70.4	57.6	61.2	66.7	50.9	54.5	60.0
40	60.9	64.6	70.0	57.2	60.8	66.2	50.5	54.1	59.6
50	60.6	64.2	69.6	56.8	60.4	65.9	50.1	53.7	59.2
70	59.8	63.4	68.9	56.1	59.7	65.1	49.4	53.0	58.4
100	58.9	62.5	68.0	55.1	58.8	64.2	48.4	52.1	57.5
TCVN5949-1998*	75 dBA			70 dBA			50 dBA		

**Note: Allowable maximum noise level at business-service-shopping-industrial mixed residential area*

Table 16 Predicted Noise Level at Survey Site A2 (K3)

(Unit: dBA)

Distance c (m)	In day-time (6am~18pm)			In night-time (18pm~22pm)			In midnight (22pm~6am)		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
10	61.4	64.9	68.5	57.6	61.1	64.7	50.9	54.5	58.0
20	60.8	64.3	67.9	57.1	60.6	64.1	50.4	53.9	57.4
30	60.2	63.7	67.3	56.5	60.0	63.5	49.8	53.3	56.8
40	59.7	63.2	66.7	55.9	59.4	63.0	49.2	52.7	56.3
50	59.1	62.7	66.2	55.4	58.9	62.4	48.7	52.2	55.7
70	58.3	61.8	65.3	54.5	58.0	61.6	47.8	51.3	54.9
100	57.2	60.7	64.3	53.4	56.9	60.5	46.7	50.3	53.8
TCVN5949-1998	60 dBA			55 dBA			50 dBA		

Table 17 Predicted Noise Level at Survey Site A3 (K4)

(Unit: dBA)

Distance c (m)	In day-time (6am~18pm)			In night-time (18pm~22pm)			In midnight (22pm~6am)		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
10	59.5	63.2	66.6	55.8	59.3	62.8	49.1	52.6	56.1
20	59.4	62.9	66.5	55.6	59.1	62.7	48.9	52.5	56.0
30	59.0	62.5	66.1	55.3	58.8	62.3	48.6	52.1	55.6
40	58.6	62.2	65.7	54.9	58.4	61.9	48.2	51.7	55.2
50	58.3	61.8	65.3	54.5	58.0	61.6	47.8	51.3	54.9
70	57.5	61.1	64.6	53.8	57.3	60.8	47.1	50.6	54.1
100	56.6	60.2	63.7	52.9	56.4	59.9	46.2	49.7	53.2
TCVN5949-1998	60 dBA			55 dBA			50 dBA		

Table 18 Predicted Noise Level at Survey Site A4 (K5)

(Unit: dBA)

	In day-time (6am~18pm)			In night-time (18pm~22pm)			In midnight (22pm~6am)		
Distance c (m)	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**	**2015**	**2020**	**2030**
10	58.5	62.0	65.6	54.7	58.3	61.8	48.0	51.6	55.1
20	58.5	62.0	65.6	54.8	58.3	61.8	48.1	51.6	55.1
30	58.3	61.8	65.4	54.5	58.1	61.6	47.8	51.4	54.9
40	58.0	61.5	65.1	54.3	57.8	61.3	47.6	51.1	54.6
50	57.7	61.2	64.8	53.9	57.4	61.0	47.2	50.8	54.3
70	57.1	60.6	64.2	53.3	56.8	60.4	46.6	50.2	53.7
100	56.3	59.8	63.3	52.5	56.0	59.6	45.8	49.4	52.9
TCVN5949-1998	60 dBA			55 dBA			50 dBA		

Appendix-8: Environmental Checklist for Tan Vu - Lach Huyen Highway Construction Project

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	1) Have EIA reports been officially completed? 2) Have EIA reports been approved by authorities of the host country's government? 3) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? 4) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	1) In 2009, the EIA report was submitted by VIDIFI (the former Project proponent) to Hai Phong City People's Committee for approval. However, in December 2009, The Prime Minister decided to transfer the Project Proponent title from VIDIFI to MoT. Therefore, under the VN regulations, it is MoT who is authorized entity to approve the EIA report. The PMU 2 under MoT revised the EIA report due to changing the Project Proponent and to be accordance with JBIC Guidelines. 2) The revised EIA report was approved by MoT on May 27, 2010 (Decision 1420/QD-BGTVT). 3) The EIA report was approved with a list of requirements. 4) Only the EIA report approval is required. No other environmental permit is required.
	(2) Explanation to the Public	1) Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? 2) Are proper responses made to comments from the public and regulatory authorities?	1) Contents of the project, and potential impacts and proposed mitigation measures have been explained to the public, especially to five communes in the project site, under the procedure specified in the Vietnamese regulations. In addition, a consultation meeting was organized on April 28, 2010. Approximately 80 local residents and representatives of local authorities of Cat Hai District, Cat Hai Townlet, Nghia Lo Commune and Dong Bai Commune have participated the meeting. Participants

<table>
<tr>
<td></td>
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<td>hade raised many comments and recommendations during the meeting. It seems that residents have been informed about outlines of the project through many formal and informal channels including hearing surveys carried out during F/S study.

2) Comments raised by local residents in the public consultation meeting had been recorded and carefully considered during the revision of EIA Report and RAP Report.</td>
</tr>
<tr>
<td>2 Mitigation Measures</td>
<td>(1) Air Quality</td>
<td>1) Is there a possibility that air pollutants emitted from various sources, such as vehicle traffic will affect ambient air quality? Does ambient air quality comply with the country’s ambient air quality standards?

2) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?</td>
<td>1) Yes. The following table shows predicted data on ambient air quality.

Predicted ambient quality (unit: μg/m^3) at the survey point 10m from the road embarkment side.

<table>
<tr><th></th><th></th><th>A1</th><th>A2</th><th>A3</th><th>A4</th><th>Standard*)</th></tr>
<tr><td rowspan="3">TSP</td><td>2015</td><td>19</td><td>45</td><td>10</td><td>2</td><td rowspan="3">300μg/m^3 (1 hour average)</td></tr>
<tr><td>2022</td><td>31</td><td>71</td><td>16</td><td>3</td></tr>
<tr><td>2032</td><td>72</td><td>108</td><td>24</td><td>5</td></tr>
<tr><td rowspan="3">SO2</td><td>2015</td><td>112</td><td>254</td><td>56</td><td>11</td><td rowspan="3">350μg/m^3 (1 hour average)</td></tr>
<tr><td>2022</td><td>207</td><td>460</td><td>102</td><td>20</td></tr>
<tr><td>2032</td><td>535</td><td>783</td><td>173</td><td>34</td></tr>
<tr><td rowspan="3">NO2</td><td>2015</td><td>154</td><td>354</td><td>78</td><td>15</td><td rowspan="3">200μg/m^3 (1 hour average)</td></tr>
<tr><td>2022</td><td>275</td><td>620</td><td>137</td><td>27</td></tr>
<tr><td>2032</td><td>758</td><td>1134</td><td>250</td><td>49</td></tr>
<tr><td rowspan="3">CO</td><td>2015</td><td>2864</td><td>6622</td><td>1460</td><td>284</td><td rowspan="3">30,000 μg/m^3 (1 hour)</td></tr>
<tr><td>2022</td><td>4205</td><td>9468</td><td>2088</td><td>405</td></tr>
<tr><td>2032</td><td>6205</td><td>8818</td><td>1944</td><td>378</td></tr>
</table>
*) TCVN 5937:2005 Ambient air quality standard

Proposed mitigation measures described in the EIA Report:

- Planting trees at the road sides near the populous residential areas;
- Strictly control exhaust gas and dust emission during construction</td>
</tr>
</table>

			- Forbid trucks with over exhaust gas to use the road during operation phase. - Carry out regular maintenance of road and bridge pavement. Spray water regularly on road surface at least 10 days/time in dry season; - Take care of trees and landscape along the road. - Carry out monitoring of ambient air quality; 2) At present, industrial areas are not yet developed along the road. However, in the near future, in the west side (Dinh Vu peninsula) the Dinh Vu Industrial Zone will be expanded and in the east side (Cat Hai Island) the Lach Huyen International Port will be developed. There is a possibility that the project will make air pollution worse.
	(2) Water Quality	1) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? 2) Is there a possibility that surface runoff from roads will contaminate water sources, such as surface water, seawater, and groundwater? 3) Do effluents from various facilities, such as toll gate and parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas that do not comply with the country's ambient water quality standards?	1) Yes. Mitigation measures: - At the start of site establishment, perimeter cut-off drains to direct off-site water around the site shall be constructed and internal temporary drainage works and erosion and sediment control facilities implemented. - The Contractor shall plan his works to minimize surface excavation works during the rainy season where practicable. - Channels, earth bunds, netting, tarpaulin and or sand bag barriers shall be used on site to manage surface water runoff and minimize erosion - All exposed earth areas shall be completed and re-vegetated as soon as possible after earthworks have been completed.

		4) Is there a possibility that oceanographic changes, such as alteration of ocean currents, and reduction in seawater exchange rates (deterioration of seawater circulation) due to modification of water areas, such as shoreline modifications, reduction in water areas, and creation of new water areas will cause changes in water temperature and water quality? 5) In the case of the projects including land reclamation, are adequate measures taken to prevent contamination of surface water, seawater, and groundwater by leachates from the reclamation areas?	2) Yes. However the following mitigation measures will be included in the bidding documents and contracts, and would be carried out by contractors under supervision of General Consultant. - Drainage system and retention ponds will be constructed to collect and treat surface runoff from road prior to discharge to the local surface water bodies. A reservoir (200 ha) will be planned near the Tan Vu Interchange to collect and regulate runoff water from road on the Dinh Vu side, and other two retention ponds will be planned on the Cat Hai side (one near Ninh Tiep Hamlet, and one near Trung Hamlet) with similar functions . 3) Once the proposed mitigation measures to be strictly applied and well controlled, there is not a possibility. Sewerage from parking areas/ service areas shall be collected and treated by specified processes prior to discharge. 4) No. 5) For the land reclamation and other earthworks, the following measures are proposed. - Material stockpile sites, earthwork sites, and other construction sites where exposed land surface is vulnerable to runoff, etc. should be consolidated and/or covered; - The material stockpile site should be far away from surface water body and the area prone to surface run-off. The loose materials should be bagged and covered. Open ditch should be built around the stockpile site to intercept wastewater;

			- Construction wastes should be collected and re-used wherever possible, otherwise should be disposed in the small deposit area invulnerable to surface run-off, along with soil erosion prevention measures; - Prevent the oil leak from the operation of the machinery by the regular check; - Utilize excavated soil through recycling within the project; - Contract out treatment / dumping / recycling fo residual soil depending on soil quality.
	(3) Wastes	1) Is offshore dumping of dredged materials and soils properly performed in accordance with the country's standards to prevent impacts on the surrounding waters? 2) Are adequate measures taken to prevent discharge or dumping of hazardous materials to the surrounding water areas?	1) The sites and methods to dump dredged materials and soils will be examined carefully in the D/D stage. 2) The following measures are proposed. - Carry out analysis of toxic components of soil to be excavated; - Prohibit dumping of hazardous soils and wastes. - Obligate contractors to segregate construction wastes on-site to facilitate re-use, recycling and proper disposal; - Obligate contractors to contract out treatment/ dumping/ recycling of construction wastes to competent companies. - Waste oils, chemicals, paints and other materials used for machinery maintenance and construction shall be collected and stored in bunded areas on-site for resale/re-use or managed disposal without resulting in damage or pollution of the environment. Waste storage sites shall be located away from water areas. Designated waste storage areas shall be well maintained and cleaned regularly.

	(4) Noise and Vibration	1) Do noise and vibrations from vehicle comply with the country's standards?	1) The predicted noise level do not comply with the Vietnam country's standards.

Following table shows predicted data on noise level (at the survey site located 10m from the road embankment side):

		A1	A2	A3	A4	Standard*)
6am ~ 18pm	2015	95	92	89	87	60 dBA
	2020	104	100	98	96	
	2030	115	109	106	104	
18pm ~22pm	2015	78	75	72	70	55 dBA
	2020	87	83	81	79	
	2030	98	92	89	87	
22pm ~6am	2015	70	67	65	63	50 dBA
	2020	79	76	73	71	
	2030	91	85	82	80	

*) TCVN-5949-1998

Proposed mitigation measures described in the EIA Report:

- Plant trees along sections of road near the populous residential areas in Thon Hamlet and Ninh Tiep Hamlet, to mitigate impacts of noise, exhaust gas and dust to local residents;
- Take care of trees planted along the road, and grasses planted at the road slope surfaces;
- Install warning signs on road for horning bans and speed control at the road sections close to residential areas of Trung Hamlet and Ninh Tiep Hamlet;
- Respond to monitoring results which show higher noise than projected by the EIA;
- Regular maintenance on road to keep good road surface condition.

			- Carry out monitoring of noise.
3 Natural Environment	(1) Protected Areas	1) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	1) No.
	(2) Ecosystem	1) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? 2) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? 3) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? 4) Is there a possibility that the project will adversely affect aquatic organisms? If significant impacts are anticipated, are adequate protection measures taken to reduce the impacts on aquatic organisms? 5) Is there a possibility that the project will adversely affect vegetation and wildlife of coastal zones? If significant impacts are anticipated, are adequate measures taken to reduce the impacts on vegetation and wildlife?	1) The project area does not encompass primeval forests, tropical rain forests, ecologically valuable habitats. It will encompass tidal flats. However, the impact is not significant. 2) No. 3) It is anticipated that the ecological impacts are not significant 4) It is anticipated that impacts to aquatic organisms are not significant 5) It is anticipated that impacts to vegetation and wildlife of coastal zones are not significant 6) There is not any valuable forest, wetland, fauna species, flora species in the project area. 7) A part of the planned highway is located in the under-developing Dinh Vu Industrial Zone. However, there is not any possibility that the highway will result in extensive loss of natural environments.

		6) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? 7) In cases where the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	
	(3) Hydrology	1) Is there a possibility that alteration of topographic features and installation of structures will adversely affect surface water and groundwater flows on the land? 2) Is there a possibility that alteration of topographic features and installation of structures, such as piers and guide posts will cause oceanographic changes and adversely affect oceanographic conditions, such as induced currents, waves, and tidal currents?	1) Impact caused by the planned highway to the rivers, canals, and other surface water system and groundwater flows in the project area is anticipated not significant. 2) Impact caused by the planned bridge piers to the river flows and current oceanographic conditions is anticipated not significant.
	(4) Topography and Geology	1) Is there a soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? 2) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	1) The project area is generally flat. Slope failures or landslides are not likely to be induced. However, the highway is planned on soft ground of Cat Hai Island and Dinh Vu Peninsula. There would be possibility of land subsidence if proper measures to treat soft ground are not carried out appropriately. 2) The highway is planned in the plain coastal areas, and therefore, occurrence of large-scale slop failures or landslides are not

		3) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff? 4) Is there a possibility that installation of structures, such as piers and guide posts will cause a large-scale alteration of topographic and geologic features in the surrounding areas or elimination of natural beaches?	anticipated. 3) The following measures are proposed to prevent soil runoff from earthwork sites, waste soil disposal sites, and borrow sites: - Contractors will be obligated to minimize exposition of soil surface caused by excavation works during the rainy season where practicable. - The material stockpile sites, the earthwork sites where exposed land surface is vulnerable to runoff, etc. should be consolidated and/or covered; - The material stockpile sites should be far away from surface water bodies and areas prone to surface run-off. Loose materials should be bagged and covered. Open ditch should be built around the stockpile sites to intercept wastewater. Channels, earth bunds, netting, tarpaulin and/or sand bag barriers shall be used on site to manage surface water runoff and minimise erosion; - All exposed earth areas shall be completed and re-vegetated as soon as possible after completion of earthworks. 4) No.

4 Social Environment	(1) Resettlement	1) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? 2) Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? 3) Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? 4) Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? 5) Are agreements with the affected persons obtained prior to resettlement? 6) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? 7) Is a plan developed to monitor the impacts of resettlement?	1) The Project would acquire some lots of residential land, especially in Cat Hai Island. This will cause the need of involuntary resettlement. In the D/D stage, efforts should be made to minimize scale of land acquisition and involuntary resettlement, through the careful examination of route alignment, particularly at the section near the Trung Hamlet in Cat Hai Island. 2) At present time, the Project have not been formally approved, and impacts caused by the land acquisition for the Project have not been identified clearly yet. Therefore, PMU2 and local authorities can provide residents living in the affected areas with only limited explanations on resettlement and compensation. 3) The detailed socio-economic survey has not been carried out yet. A Pre-RAP had been prepared as a part of the F/S report prepared in July 2009 by VIDIFI. This Pre-RAP includes legal and policy framework for compensation and resettlement. Policy on restoration of livelihoods and living standards of PAP is described briefly in this Pre-RAP. 4) A section in the Pre-RAP describes the compensation policy which includes several statements on particular considerations to the poors. However, a detailed socio-economic survey should be carried out in the D/D stage, to identify characteristics and living conditions of the poors. the elderly, the children, as well as other vulnerable groups in the Project area. And a detailed RAP should be prepared in the D/D stage, which should take into considerations particular measures to assist vulnerable residents in restoring their livelihoods and living

			standards. 5) At this present time, PAP have not been formally identified yet, and negotiations on compensation and relocation have not been carried out yet. 6) According to Vietnam regulations on compensation and resettlement in case of development project, a formal declaration on land acquisition will be done after the approval of the F/S and investment license. Organizational framework for implementation of compensation and resettlement will be established after such formal declaration on land acquisition. 7) The Pre-RAP prepared by VIDIFI in July 2009 includes a section describing outline of a system proposed for monitoring the implementation of the RAP. However, it is recommended that a RAP Monitoring Plan should be prepared in detail in the D/D stage.
	(2) Living and Livelihood	1) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts? 2) Is there a possibility that changes in water uses (including fisheries and recreational uses) in the surrounding areas due to project will adversely affect	1) At present time, the main mean of transportation of residents in Cat Hai Island is motorbike and ferry (Dinh Vu Ferry). The Project may contribute to the improvement of residents' accessibility to other cities the main land. However, it may cause the termination of Dinh Vu Ferry. Workers of the Ferry as well as shopkeepers, peddlers, etc. who have means of livelihood in relation with the Ferry should lose income, and should be supported to change occupation. In addition, aquaculture and salt production which are main means of livelihood of local residents, would be significantly affected by the Project. Therefore, it is recommended that a proper Livelihood Restoration Program should be prepared and implemented in the D/D

		the livelihoods of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? 3) Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? 4) Is there a possibility that the project will adversely affect the existing water traffic and road traffic in the surrounding areas (e.g., by causing increases in traffic congestion and traffic accidents)? 5) Is there a possibility that roads will cause impede the movement of inhabitants? 6) Is there a possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	stage. It also recommends to construct a parking area/ service zone in the area near the Cat Hai side- terminal of Got Ferry in order to facilitate the implementation of Livelihood Restoration Program for PAP. There is a plan to relocate all residents in the southern part of the Cat Hai Island to develop an industrial zone in connecting with the international port. However, detailed information about this plan are unknown. 2) As mentioned above, aquaculture and salt production would be significantly affected by the Project. 3) It is estimated that about 400 immigrant construction workers may come to work in and around the Project area. The EIA report identifies organic waste which affects human health, water-transmitted diseases and social evil activities as the negative impacts on health condition. In addition, possibility of outbreaks of infectious diseases from such workers such as malaria, dengue and HIV cannot be neglected. It is recommended to prepare a proper HIV/AIDS Prevention Program in the D/D stage, and duly carry out this Program during construction phase. 4) During construction phase, traffic congestions and accidents may occurred frequently on the roads near Cat Hai City, due to the concentration of construction vehicles using these roads to access to construction sites. Several mitigation measures are recommended in the EIA Report such as the followings.

			- Carefully prepare the construction plan in order to minimize the area and period of road occupation / closure, and avoid concentration of construction vehicles; - Prior notice local residents on the road occupation / closure through sign boards and mass media; - Allocate personnel at place vulnerable to traffic congestion to instruct detour. 5) The highway will cause split of the Ninh Tiep Hamlet and Trung Hamlet, and would impede residents' movement in these hamlets. Therefore, it is recommended to construct several underpass routes at road sections near these hamlets to mitigate such impedance.. 6) For the road section in Cat Hai Island, the heights of the road embankment are planned about 1~4 meters from the existing land level. A few number of houses in Ninh Tiep Hamlet may be affected by sun shading. However, impact of radio interference is unlikely anticipated.
	(3) Heritage	1) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	1) No.
	(4) Landscape	1) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	1) No.

	(5) Ethnic Minorities and Indigenous Peoples	1) Where ethnic minorities and indigenous peoples are living in the rights-of-way, are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples? 2) Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples?	1) The Project area is far away from the living habitats of ethnic minorities. There are no indigenous people in the Project area. 2) Not applicable
5 Others	(1) Impacts during Construction	1) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? 2) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? 3) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? 4) If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	1) Measures described in the following annex are recommended to mitigate impacts during construction. However, an EMP (Environmental Management Program) should be prepared and implemented duly to ensure the implementation of these measures. 2) Similar to Paragraph 1) 3) Similar to Paragraph 1) 4) The health and safety education (e.g., traffic safety, public health) will be provided for project personnel, including workers.
	(2) Monitoring	1) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? 2) Are the items, methods and frequencies included in the monitoring program judged to be appropriate? 3) Does the proponent establish an adequate monitoring	1) An environmental monitoring plan is described briefly in the EIA Report. 2) Items, methods and frequencies included in the environmental monitoring plan described in the EIA Report are judged not appropriate. In the D/D stage, a detailed Environmental Management Program (EMP) which includes a concrete environmental monitoring

		framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? 4) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	plan should be prepared. 3) Establishment of an adequate monitoring framework should be examined and described in the EMP to be prepared in the D/D stage. 4) The EIA report does not show any regulatory requirements on reporting monitoring results. However, the project proponent will have a responsibility for reporting periodically to the relevant governmental agencies as well as public. Besides, the Pre-RAP describes briefly about the need of monitoring of the RAP implementation, but does not go into detail about the organizational framework for the monitoring, and the systematical reporting process. It is recommended to examine this issue in more detail in the RAP to be prepared in the D/D stage.
6 Note	Note on Using Environmental Checklist	1) Where necessary, impacts on groundwater hydrology (groundwater level drawdown and salinization) that may be caused by alteration of topography, such as land reclamation and canal excavation should be considered, and impacts, such as land subsidence that may be caused by groundwater uses should be considered. If significant impacts are anticipated, adequate mitigation measures should be taken. 2) If necessary, the impacts on transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	1) Not applicable. 2) Not applicable.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.

In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Annex- Proposed mitigation measures in construction phase

A. AIR QUALITY CONTROL

1) Construction materials are supplied only from the quarries that have exploitation license and operated under a good environmental management

2) The Contractor shall not burn debris, construction wastes, vegetation or other materials on the site.

3) Specific mitigation measures to control air quality impacts arising from implementing the earthworks are as follows:

- to minimize dust emissions, the amount of spoil exposed shall be kept as low as possible and
- the dust generation potential shall be kept as low as possible, this can be accomplished by surface compaction, temporary fabric covers, minimizing the extent of exposed soil and the prompt re-vegetation of completed earthworks;

4) In transportation of earth and construction materials:

- Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin in good condition.
- The Contractor shall be responsible for ensuring that no earth, rock or debris is deposited on public or private right of way as a result of his operations, including any deposits arising from the movement of Construction Plant or vehicles.

- Wheel washing facilities shall be provided at the exit of all construction sites to prevent dusty material from being carried off-site on vehicles and deposited on public roads. Wash-water shall have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of wheel wash operations.
- The Contractor shall spray all roads within the construction sites and roads leading to the sites to control dust.
- The Contractor shall require that all vehicles, while parked on the site have their engines turned off.
- On site vehicle speeds shall be restricted to a maximum of 15km/hour to reduce dust resuspension and dispersion by traffic within sites;
- Areas within the Site where there is a regular movement of vehicles shall have a hard surface and be kept clear of loose surface material
- During breaking/crushing or demolition works watering shall be implemented to control dust. Water sprays shall be used during the handling of excavated material and at active cuts, excavation and fill sites. Excessive watering should be avoided.

5) Heights from which excavated materials are dropped shall be controlled to the minimum practical to limit the fugitive dust generation from unloading.

6) Specific mitigation measures to control air quality impacts arising from concrete batching plant operation are as follows:

- Cement and other such fine-grained materials delivered in bulk shall be stored in closed silos fitted with a high-level alarm indicator. All air vents on cement silos shall be fitted with suitable fabric filters provided with either shaking or pulse-air cleaning mechanisms.
- The Contractor shall frequently clean and water the concrete batching plant and crushing plant sites and ancillary areas to minimize any dust emissions.
- Where dusty materials are being discharged to vehicles from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system;
- All stockpiles of sand and aggregate within the batching plant site which are greater than 50m3 shall be enclosed on three sides with walls extending above the stockpile and 2000mm beyond the front of the stockpile.

B. NOISE AND VIBRATION CONTROL

1) Construction works within 100 meters of residential areas and hospitals, shall be restricted to daytime hours 0600 to 1800, to minimise noise disturbance at night.

2) The Contractor shall select equipment with considerations for using equipment with lowest noise levels;

3) Positioning air compressors for various construction plant on rubber sheets;

4) Sitting of mobile plant as far away from NSRs as possible. Orientation of plant known to emit noise strongly in one direction such that the noise is directed away from nearby SRs.

C. EROSION CONTROL

1) At the start of site establishment, perimeter cut-off drains to direct off-site water around the site shall be constructed and internal temporary drainage works and erosion and sediment control facilities implemented.

2) The Contractor shall plan his works to minimize surface excavation works during the rainy season (April to September) where practicable.

3) Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms shall be developed by the Contractor. Particular attention shall be paid to the control of surface runoff during storm events, especially for sites located near steep slopes.

If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces shall be protected by temporary drainage measures as detailed above.

4) Channels, earth bunds, netting, tarpaulin and or sand bag barriers shall be used on site to manage surface water runoff and minimize erosion. Failure to provide temporary drainage measures can result in considerable storm damage during the wet season to the site works as well as considerable water quality impacts.

5) All exposed earth areas shall be completed and revegetated as soon as possible after earthworks have been completed.

6) The overall slope of the works areas and construction yards shall be kept to a minimum to reduce the erosive potential of surface water flows

D. WATER POLLUTION CONTROL

1) The Contractor shall ensure that all temporary construction facilities are located at least 50 meters away from any waterbody.

The Contractor shall ensure that no tools or machinery are washed in any water source or areas that drain into an existing watercourse or to the marine environment.

2) The Contractor shall ensure that rain run-off from the construction sites is not deposited directly into any watercourse or the marine environment.

Drainage from vehicle maintenance areas, plant servicing areas and vehicle wash bays shall be passed via a petrol interceptor prior to discharge.

Wastewater shall be collected and disposed of off-site after oil/grease removal and settlement of suspended solids.

Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6-8m3 capacity shall be used at all sites for settling waste-waters prior to disposal. Wastewater arising from excavation works shall be discharged to storm drains via sediment tanks.

3) All drainage facilities and erosion and sediment control structures shall be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms.

4) The Contractor shall weekly check all equipment for prevention of oil and or lubrication leaks and ensure that all equipment oil and lubrication replacements are performed only in bunded maintenance and repair areas.

5) The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to, the Site are kept safe and free from any debris and any excavated materials arising from the Works.

E. WASTE MANAGEMENT

1) Raw material requirements shall be planned at the outset of each construction activity to avoid excess material storage and wastage on-site.

Fill required for site formation of construction yards shall be sourced from cuttings required within the works areas only.

2) No burning of debris, construction wastes or vegetation shall be allowed on-site.

3) The Contractor shall segregate construction waste materials on-site to facilitate re-use, recycling and waste disposal practice in accordance with the best available technology, as follows:

- For construction waste deemed by the Engineer to be suitable for reclamation or land formation: the Contractor shall liaise with the Municipal Environmental Company of Hai Phong City to determine the appropriate location for reuse. Reuse shall not have a detrimental impact on the environment.
- For construction waste deemed by the Engineer to be unsuitable for reclamation or land formation: the Contractor shall classify wastes on-site with dedicated areas for each waste stream including but not limited to: wood/timber, metals and plastics.

4) Wastes shall be stored and handled in dedicated areas with bunded sides such a way as to avoid loss or leakage and subsequent pollution. Waste storage sites shall be located away from sensitive areas such as: residential, surface/groundwater. Designated waste storage areas shall be well maintained and cleaned regularly.

5) The Contractor shall enter into a contract with the Municipal Environment Company of Hai Phong City for the collection of domestic refuse. To facilitate waste collection the Contractor is required to designate locations on-site shielded from wind and rain.

The Contractor shall enter into a contract with the Municipal Environment Company of Hai Phong City or similar approved company for the collection of asbestos waste arising from demolition works. The Contractor shall employ within his team a specialist in the identification of asbestos containing material (ACM). On removal ACM shall not be broken, shall be kept dampened and shall be stored in a dedicated enclosed area on-site.

6) Waste oils, chemicals, paints and other such materials used for machinery maintenance and construction shall be collected and stored in bunded areas on-site for resale/re-use or managed disposal without resulting in damage or pollution of the environment.

4) In locations remote from the site offices the Contractor shall provide latrine pits in suitable locations for the convenience of the construction workforce. If any office, site canteen or toilet facilities are erected foul water effluent shall be directed to a sewage treatment facility either directly or indirectly by pumping.

7) All water and liquid waste products arising on the site shall be collected and removed from Site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance.

Sewage from site toilets, kitchens and similar, shall be discharged to a septic tank and soak-away system. Grease traps shall be installed where canteen waste is collected and shall be capable of providing at least 20 minutes retention during peak flow, prior to discharge.

F. ECOLOGY AND LANDSCAPE

1) No vegetation of any type shall be removed from lands outside the works boundary.

2) The Contractor shall preserve all trees within the works boundaries if they are outside the permanent works areas and do not interfere with construction or operation of the project. During site clearance the Contractor shall minimize loss of mature trees, particularly those on the downward slope of the road;

3) Site fencing shall be erected on the border of all construction sites, storage areas etc. to avoid unnecessary off-site damage to vegetation, trees and the landscape generally. Construction personnel, equipment, and vehicles shall be confined to the works areas as defined by site fences/hoardings erected at the works boundary.

4) Exposed slopes created during the works shall be stabilized by planting grass, trees to minimize erosion.

All cut slopes, embankments and cleared areas shall be planting grass immediately after works to provide a greening effect to mitigate visual appearance of cuttings and shall be subsequently planted with trees; Native species shall be used in replanting schemes to increase potential ecological value of these restored areas; Cut and fill areas subject to erosion are to be covered with organic, biodegradable, erosion-control mats after planting.

G. CONSTRUCTION WORKFORCE

1) In order to minimize impacts of an influx of new people into the local community, wherever possible, suitable local companies and organizations should be involved. For unskilled manual labour, men and women from Dinh Vu and Cat Hai should be employed.

2) Should there be a large influx of new people, then they are likely to be housed on the site. Adequate living standards with suitable services (water supply, sanitation and power supplies) should be provided for these temporary housing areas. Effluents discharged from these premises should employ mitigation measures discussed under wastes and water quality above.

3) Opportunities to use local services (e.g. for food supplies etc) should also be encouraged so that the local population benefits from an influx of new people.

Appendix-9: Comparison Study on Investment Timing for Tan Vu - Lach Huyen Highway Project

The JICA Follow-up Mission was carried out from 7 June to 18 June 2010. During said period, a discussion paper was prepared by the Study Team as guide for discussion between JICA and MOT. The discussion results were summarized in the Minutes of Discussion (M/D) dated 18 June 2010.

This Appendix-9 contains the discussion paper submitted to JICA on 11 June 2010.

1. Alternatives

1.1. Parameters

The following parameters were considered in the comparison study on cross section elements for optimum investment.

- Number of lanes (4, 6)
- Width of lane (3.0 m, 3.5 m, 3.75 m)
- Timing of investment (2011, 2024[1])

1.2. Alternatives

The following four alternatives are considered for the comparison study.

Table 1 List of Alternatives

No.	Alternative Code	Number of Lanes	Lane Width (m)	Investment Timing	
				1st	2nd
1	4-3.0	4	3.0	2011	2024
2	4-3.5	4	3.5	2011	2024
3	6-3.5	6	3.5	2011	-
4	6-3.75	6	3.75	2011	-

1.3. Road Classification

In the F/S, the project road was classified as "Expressway", while in this Study, it is classified as "Highway".

Standard lane width for "Expressway" is different from that of "Highway" which is 3.75 m and 3.50 m, respectively.

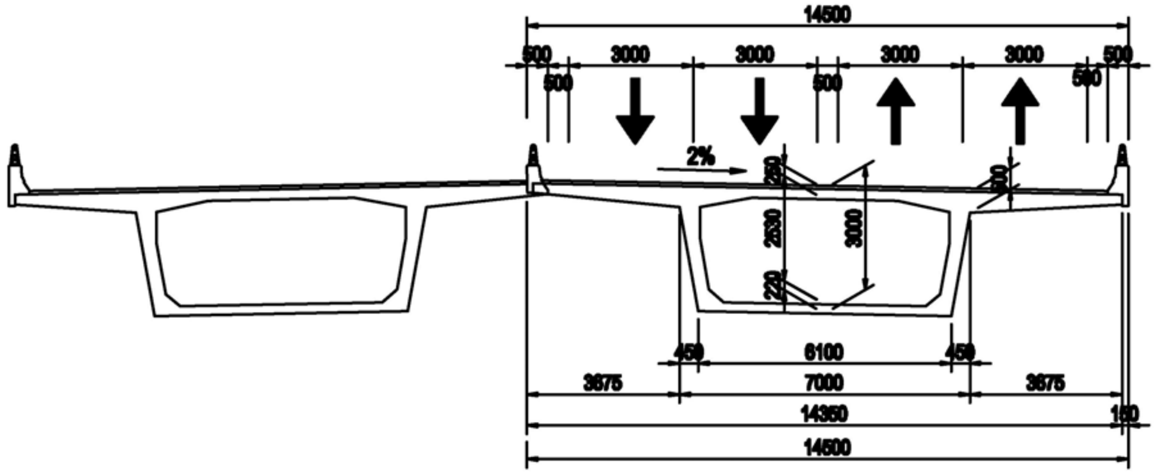
[1] Investment in 2024: Assumed that 2nd stage would open in 2027. Start investment in 2024.

Table 2 Road Classification (as per F/S)

Geometric Items	UNIT	TCVN 4054-98	TCVN 4054-2005	TCVN5729-97
Road classification		Technical class 80	Design category III	Class B-grade 80
		Highway	Highway	Expressway
Minimum of Design Volume PCU	PCU/day	≧3000	≧3000	10,000≧V≧5,000
Design speed	km/h	80	80	80
Cross Section				
Carriageway	m	2 x 3.50	2 x 3.50	**4 x 3.75**
Shoulder	m	2 x 3.00	2 x 2.50	**2 x 3.25**
Paved portion	m	2 x 2.50	2 x 2.00	**2 x 2.50**
Minimum width of Road bed	m	13.00	12.00	23.00
Median Separator(arranged for the 4 lane highway upward)				
Separetor	m	———	———	0.50
Safety part	m	———	———	2 x 0.50
Minimum Width of Median	m	———	———	1.50

Typical cross sections of the alternatives are shown in Figures 1-4.

LIMITED 4-LANE, B_{bridge} = 14.5m
B_{lane} = 3.00m (DESIGN SPEED: 60km/h)
STAGE CONSTRUCTION: 1st stage - B_{lane} = 3.0m
2nd stage - B_{lane} = 3.75m



FULL SCALE 6-LANE, B_{bridge} = 27.0m
B_{lane} = 3.75m (DESIGN SPEED: 100km/h)
STAGE CONSTRUCTION: 1st stage - B_{lane} = 3.0m
2nd stage - B_{lane} = 3.75m

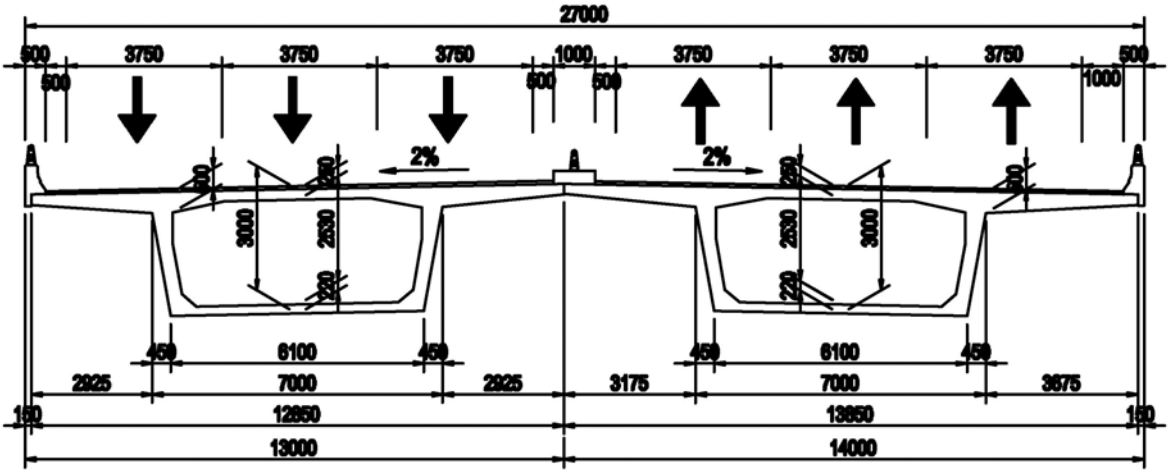


Figure 1 Typical Cross Sections of Alternative (1), Case 4-3.0

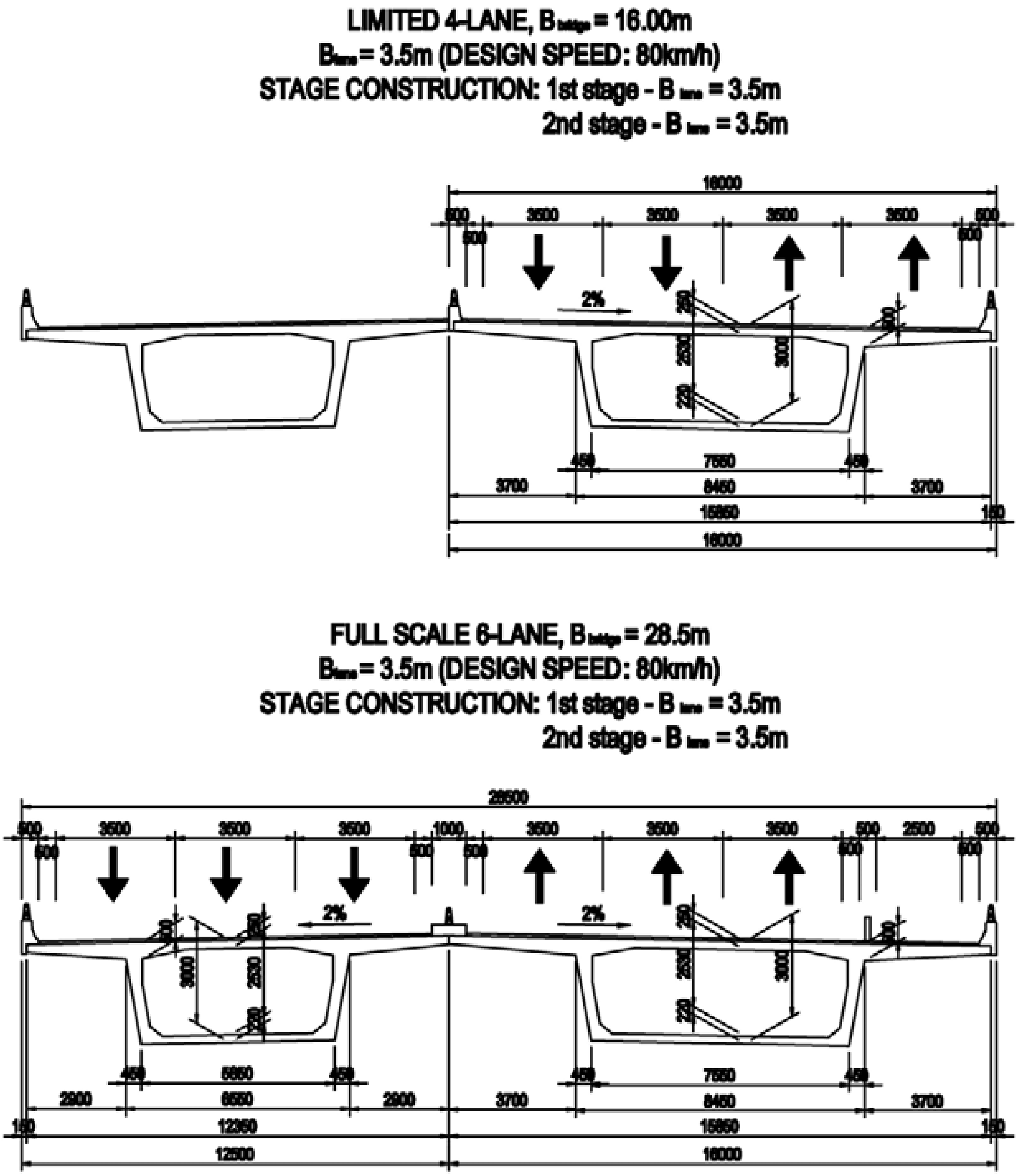


Figure 2 Typical Cross Sections of Alternative (2), Case 4-3.5

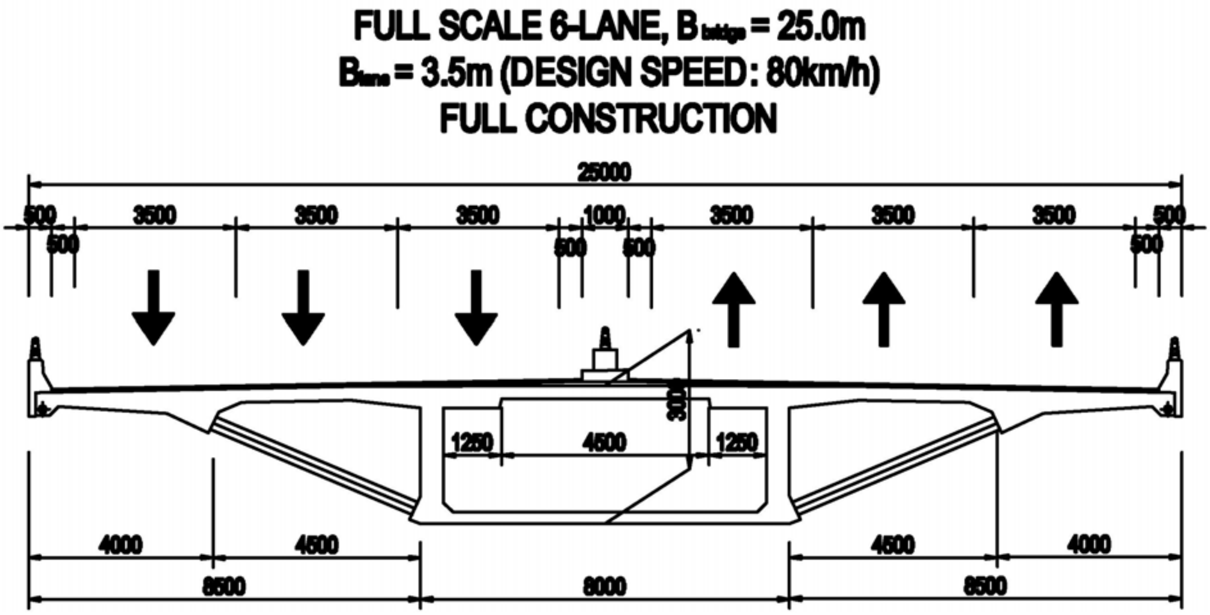


Figure 3 Typical Cross Sections of Alternative (3), Case 6-3.5

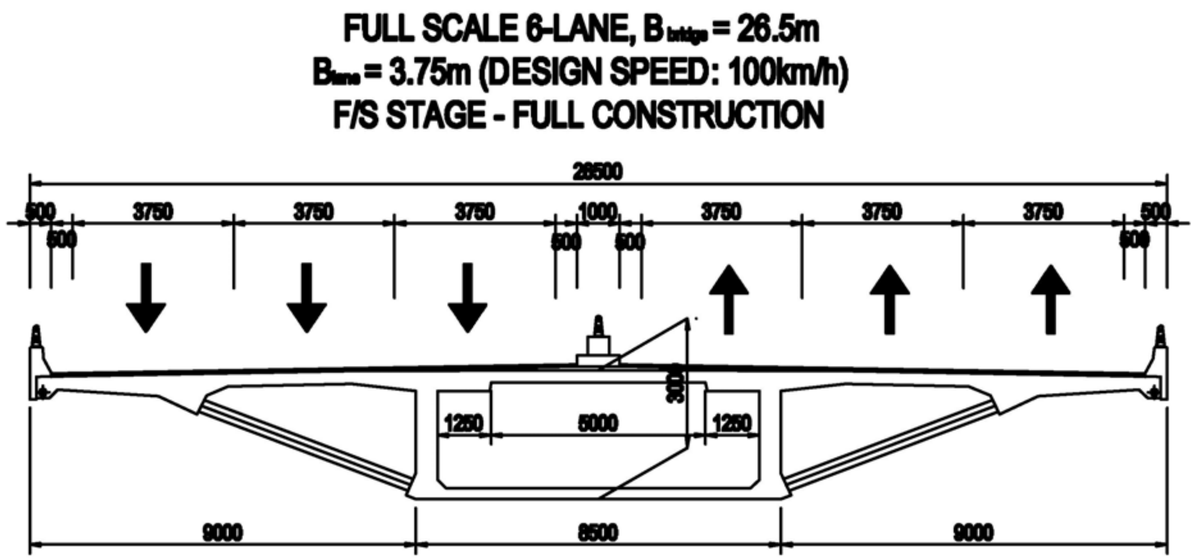


Figure 4 Typical Cross Sections of Alternative (4), Case 6-3.75

2. Future Lane Requirement

2.1. Update Base Data from the F/S

Table 3 shows the comparison between the F/S and this Study.

Table 3 Comparison of Input Data between the F/S and this Study

ITEM	FS Study	This Study
Traffic forecast method	➢ Use generation rate	➢ Use generation rate ➢ Prediction using a GDP rate of growth was carried out based on the traffic census as the abovementioned verification.
Analysis fiscal year	➢ 2015-2032	➢ 2015-2020 (First target) ➢ 2020-2030 (Second target)
Assumptions		
Conversion ratio of generating traffic	➢ Dinh Vu IZ:100%	➢ Dinh Vu IZ:50% ➢ Nam Dinh Vu IZ:80%
Development process	➢ Dinh Vu IZ: 2015(50% of 2020) 2020(100%) 2030(add 20%)	➢ Dinh Vu IZ: same as FS ➢ Nam Dinh Vu IZ: 2015(0%) 2020(0%) 2030(50%)
Population	➢ Cat Hai : 2015(31,000) 2020(33,000) 2030(38,500) ➢ Cat Ba : 2015(12,000) 2020(14,500) 2030(16,500) Based on statistical yearbook 2006	➢ Cat Hai : 2015(19,000) 2020(19,300) 2030(20,100) ➢ Cat Ba : 2015(12,000) 2020(13,000) 2030(14,600) Based on statistical yearbook 2008
Lach Huyen Port	Based on MOT Decision No.501	Based on result of Lach Huyen Port Preparatory Study

It is observed that:

- **<u>Conversion ratio was too high in the F/S</u>** considering the number of people from the industrial zone willing to use the project road. In the F/S, said ratio was 100%, which seems unrealistic. People working in the northern area of Dinh Vu Industrial Zone (IZ) will take TL356 and move to the city of Hai Phong. In this Study, the conversion rate was revised to 50% for Dinh Vu IZ and 80% for Nam Dinh Vu IZ.

- **<u>Population in Cat Hai Island was counted twice</u>**. In this Study, all socio-economic data was updated based on Statistical Yearbook 2008. It seems that population in Cat Hai Island indicated in the F/S was counted twice.

2.2. Future Lane Requirement

In this Study, future lane requirement was calculated in accordance with Section 4.2.2 of TCVN4054-2005.

Table 4 Future Lane Requirement (as per this Study)

Section	Peak Hour	Direction	Year							
			2015		2020		2025		2030	
Tan Vu IC - Dinh Vu	AM	To Tan Vu Interchange	1,276	2	2,149	3	3,145	4	4,140	5
		From Tan Vu Interchange	745	1	1,451	2	2,709	3	3,967	5
	PM	To Tan Vu Interchange	550	1	1,098	2	1,794	2	2,490	3
		From Tan Vu Interchange	1,125	2	1,874	2	2,823	3	3,772	4
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	927	1	1,494	2	1,748	2	2,002	3
		Dinh Vu to Cat Hai	351	1	745	1	1,047	2	1,350	2
	PM	Cat Hai to Dinh Vu	351	1	745	1	1,047	2	1,350	2
		Dinh Vu to Cat Hai	927	1	1,494	2	1,748	2	2,002	3

Table 5 shows the future lane requirement in the F/S while the text box in the next page presents the capacity assumptions in the F/S.

Table 5 Future Lane Requirement (as per the F/S)

Section	Peak Hour	Direction	Year					
			2015		2022		2032	
			Future Traffic Demands	Lane Requirement	Future Traffic Demands	Lane Requirement	Future Traffic Demands	Lane Requirement
Tan Vu IC - Dinh Vu	AM	To Tan Vu Interchange	2,272	2	4,242	3	5,195	3
		From Tan Vu Interchange	1,304	2	2,751	3	3,949	3
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	1,680	2	3,143	3	3,459	3
		Dinh Vu to Cat Hai	583	2	1,450	3	1,826	3

<BOX: Extraction from the F/S>

Capacity Assumptions

For a two-lane highway (i.e., two lanes in one direction), the current Vietnamese code of practice recommends a daily "Design Capacity" of 25,000 pcu/hr. If a peak hour factor of 12% is used, the "Design Capacity" will be about 3,000 pcu/hr. However, it is also understood that a capacity of 3,600 pcu/hr has been regarded and used as the "Practical Capacity" of a two-lane highway in the F/S. As a matter of fact, much higher capacity and traffic flows (i.e., about 4,800 pcu/hr) were commonly observed on many expressways and freeways around the world. For this analysis, **a capacity of 1800 pcu/hr per lane for expressway (3,600 for 2 lanes)** was assumed. For directional ramps, the practical capacity would be around 800-1000 pcu/hr/lane depending on the ramp design standards.

It is observed that

- **Too much traffic capacity was applied**. In Vietnamese expressway design standards, it is stipulated that the maximum traffic capacity is 2,000 pcu/hr/lane and Z-value, factor of using traffic capacity, is defined as Z = 0.55 for plain and hilly terrains (Section 4.5.3 of TCVN5729-2007). This results to 2,000*0.55 = 1,100 pcu/hr/lane. It seems that traffic volume forecasted was too high. Therefore, **the traffic capacity was increased from 1,100 to 1,800**.

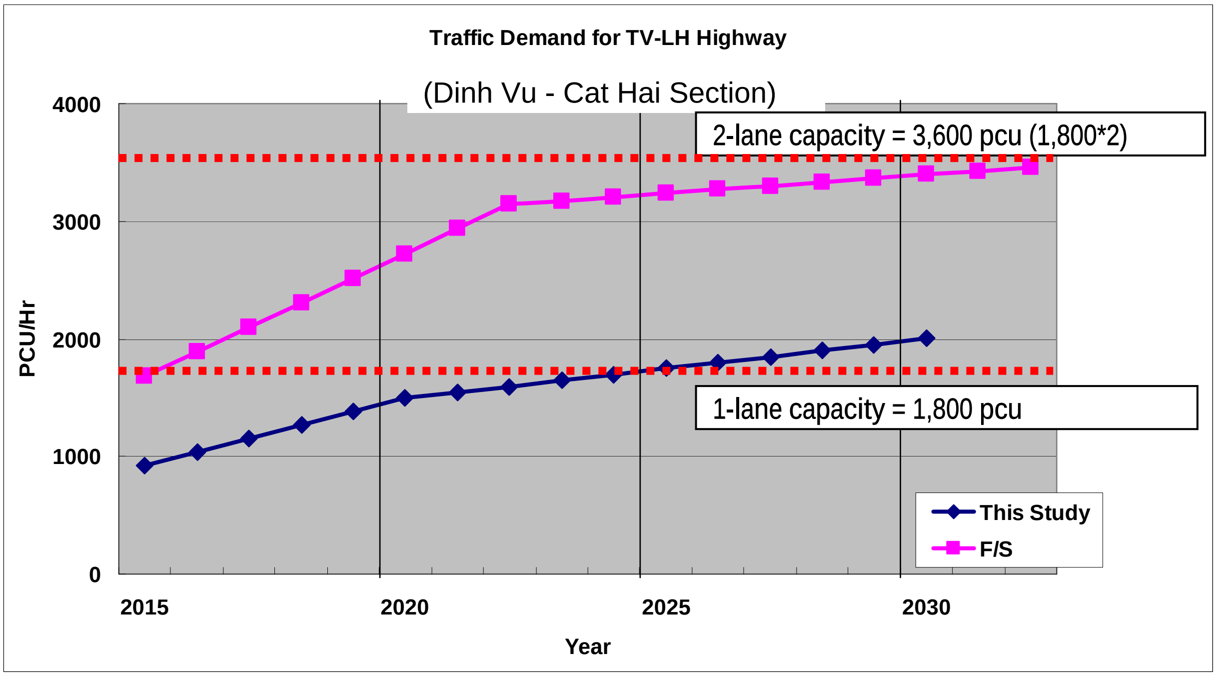


Figure 5 Future Lane Requirement (as per the F/S)

- In case 1,800 pcu/hr/lane is adopted to determine the required number of lanes as shown in Figure 5, **two-lane carriageway for one direction will still be sufficient in 2032 for Dinh Vu - Cat Hai Section, where a bridge structure is required.**

- In case 1,800 pcu/hr/lane is adopted as a result of traffic demand forecast in the F/S, the correct lane requirement should be as shown in Table 6. Hence, **three-lane expressway will not be necessary in 2032**.

Table 6 Future Lane Requirement (as per the F/S)

Section	Peak Hour	Direction	Year					
			2015		2022		2032	
			Future Traffic Demands	Lane Requirement	Future Traffic Demands	Lane Requirement	Future Traffic Demands	Lane Requirement
Tan Vu IC - Dinh Vu	AM	To Tan Vu Interchange	2,272	2	4,242	3	5,195	3
		From Tan Vu Interchange	1,304	**1**	2,751	**2**	3,949	3
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	1,680	**1**	3,143	**2**	3,459	**2**
		Dinh Vu to Cat Hai	583	**1**	1,450	**2**	1,826	**2**

- In case TCVN4054 (990 pcu/hr/lane) is adopted as traffic volume in the F/S, **four-lane carriageway in one direction is required in 2022,** based on the number of lanes determined from Figure 5.

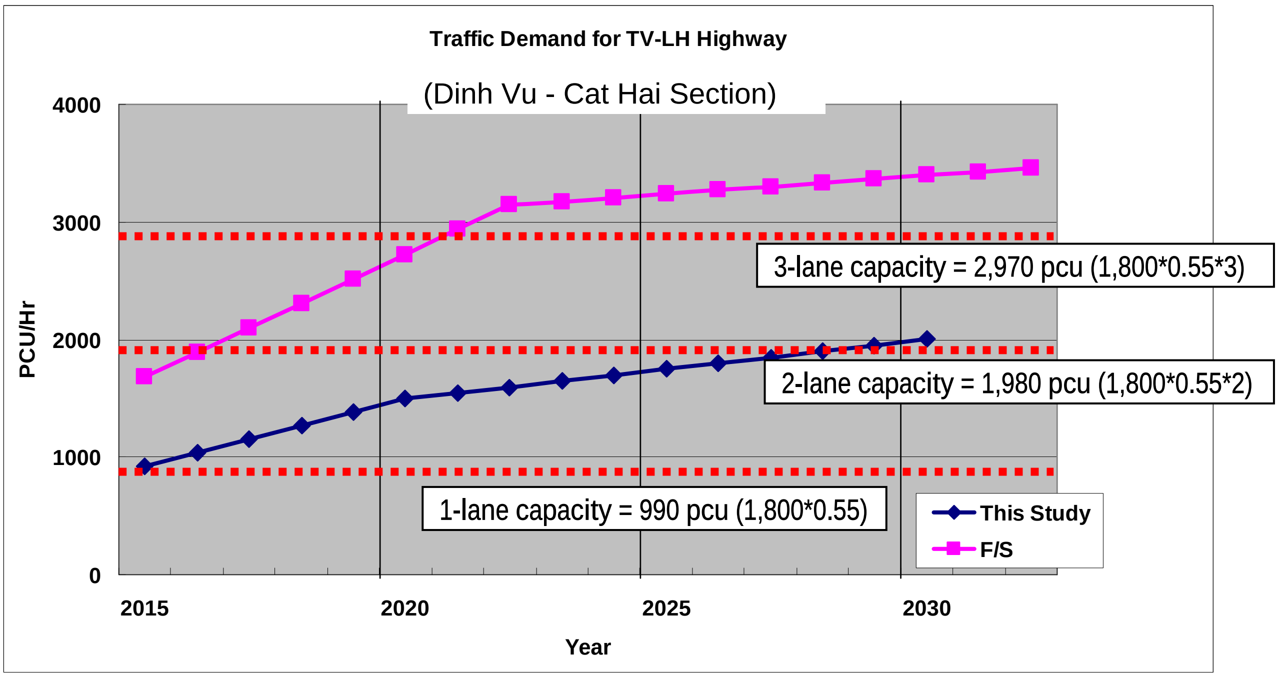


Figure 6 Future Lane Requirement (TCVN4054-2005)

2.3. Conclusion of Review of the Traffic Forecast in the F/S

In conclusion of the review of the F/S, the following are observed:

- Input data in the F/S was not correctly selected, and hence, the traffic volume forecasted is excessive.
- Traffic capacity in the F/S was set at 1,800 pcu/hr/lane, although this capacity does not meet the technical standards (TCVN5729-2007).
- In case this criterion is adopted, Dinh Vu - Cat Hai Section will not require three-lane per direction even in 2032.

2.4. Recommendation on Traffic Demand Capacity and Lane Requirement

- Traffic demand forecast was reviewed and updated in this Study.
- In this Study, TCVN4054 was applied to determine the required number of lanes.
- In this Study, it is concluded that **<u>two-lane per direction could sufficiently accommodate traffic capacity until 2027.</u>**
- This updated and technically correct determination of required number of lanes should be subject to further discussion.

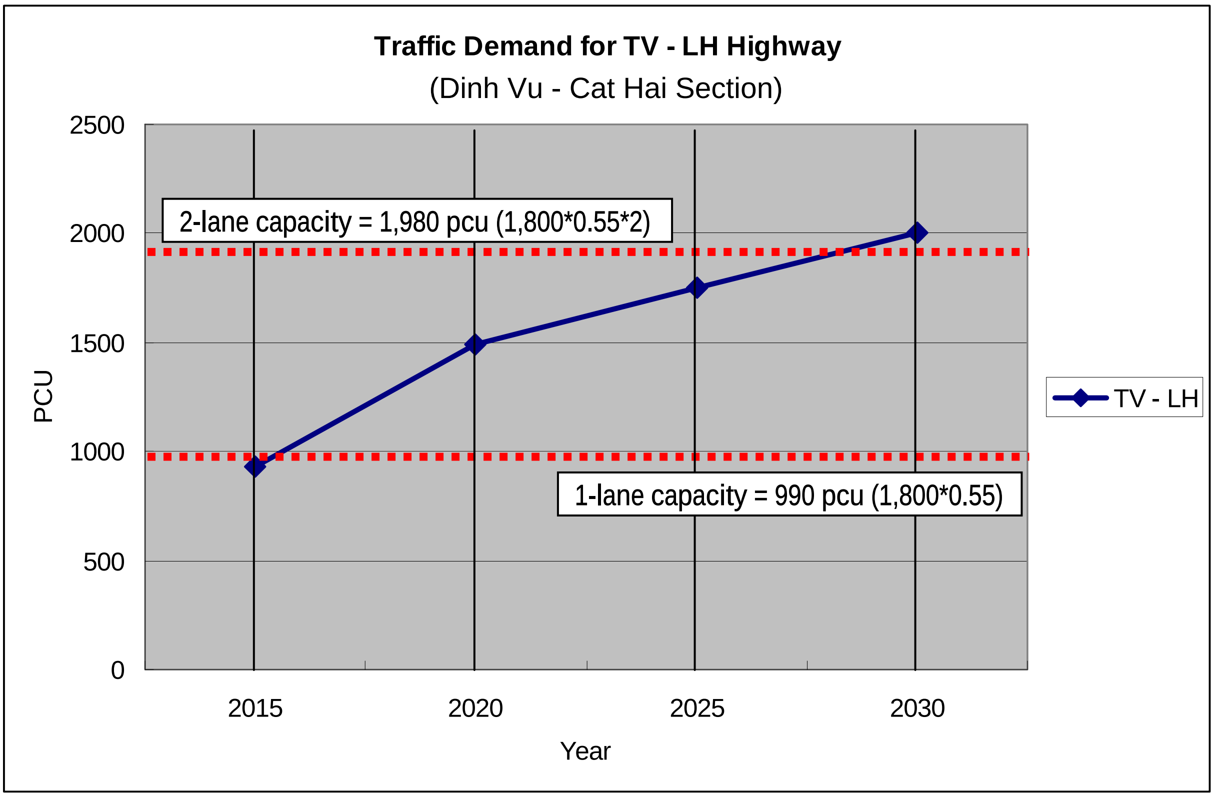


Figure 7 Future Lane Requirement

3. Project Cost

3.1. Premise and Conditions for Rough Cost Estimates

In order to compare the project benefit of each alternative, the following premises and conditions are considered.

<u>Road Works</u>

Table 7 Premises and Conditions for Cost Estimates of Road Works

No.	Alternative	Number of Lanes	Premise and Conditions
1	4-3.0	4	<1st Stage> • Complete 6-lane embankment. • Complete 4-lane, 3.5 m wide pavement <2nd Stage> • Complete 6-lane embankment. • Complete 6-lane, 3.75 m wide pavement
2	4-3.5	4	
3	6-3.5	6	<1st Stage> • Complete 6-lane embankment. • Complete 6-lane, 3.75 m wide pavement
4	6-3.75	6	

<u>Bridge Works</u>

Table 8 Premises and Conditions for Cost Estimates of Bridge Works

No.	Alternative	Number of Lanes	Premise and Conditions
1	4-3.0	4	• Estimated cost based on quantities
2	4-3.5	4	• Above estimated cost of (Alt. Code 4-3.0) multiply bridge area ratio [(4-3.5)/(4-3.0)]
3	6-3.5	6	• Below estimated cost of (Alt. Code 6-3.75) multiply bridge area ratio [(6-3.5)/(6-3.75)]
4	6-3.75	6	• Estimated cost based on quantities

3.2. Project Cost

In accordance with the above premises and conditions, the project cost is updated for each alternative as estimated below:

Table 9 Project Cost

No.	Code	Investment from 2011				Investment from 2024				Total				Rate (No.1 = 100)
		Project Cost (by Currency)		Project Cost (Total)		Project Cost (by Currency)		Project Cost (Total)		Project Cost (by Currency)		Project Cost (Total)		
		F/C (Mil.JPY)	L/C (Bil.VND)	F/C (Mil.JPY)	L/C (Bil.VND)	F/C (Mil.JPY)	L/C (Bil.VND)	F/C (Mil.JPY)	L/C (Bil.VND)	F/C (Mil.JPY)	L/C (Bil.VND)	F/C (Mil.JPY)	L/C (Bil.VND)	
1	4-3.0	6,734	6,838	43,110	8,103	3,981	3,714	23,739	4,462	10,715	10,551	66,849	12,566	100
2	4-3.5	7,295	7,125	45,202	8,497	3,851	3,616	23,088	4,340	11,146	10,741	68,289	12,836	102
3	6-3.5	5,248	10,002	58,460	10,989					5,248	10,002	58,460	10,989	87
4	6-3.75	5,483	10,352	60,555	11,382					5,483	10,352	60,555	11,382	91

4. Assumed Annual Disbursement

The following annual disbursement is assumed for comparison study. Commencement of works starting with land acquisition is assumed to be in 2011.

Table 10 Assumed Annual Disbursement

No.	Alternative	Construction Period	2011	2012	2013	2014	2015	2024	2025	2026
1	4-3.0	30 months	2%	18%	60%	20%	-	30%	40%	30%
2	4-3.5	30 months	2%	18%	60%	20%	-	30%	40%	30%
3	6-3.5	36 months	2%	18%	40%	30%	10%	-	-	-
4	6-3.75	36 months	2%	18%	40%	30%	10%	-	-	-

5. Economic Evaluation

5.1. Method of Evaluation

The evaluation is undertaken based on the following conditions:

- Project costs are converted into economic prices by applying a Standard Conversion Factor (SCF) of 0.85 to non-traded goods and services, and eliminating transfer payment such as tax and duty.
- Discount rate of 12% is applied.
- Evaluation period of 2011-2030 is assumed.
- For Alternative 4-3.0 and 4-3.5, the project costs are allocated to 1st stage during 2011-2014, and 2nd stage during 2024-2026, according to the above disbursement schedule.
- For Alternative 6-3.5 and 6-3.75, the project costs are allocated immediately during 2011-2015, according to the above disbursement schedule.

5.2. EIRR

Based on the above project costs and annual disbursement, EIRR and NPV for each alternative are calculated as follows:

Table 11 Comparison of EIRR and NPV among Alternatives

No.	Alternative	EIRR	NPV (Bil. VND)
1	4-3.0	39.1%	21,911
2	4-3.5	38.2%	21,738
3	6-3.5	30.9%	17,083
4	6-3.75	30.3%	16,914

5.3. Selection of Optimum Investment in terms of Economic Evaluation

As indicated above, Alternative 4-3.0 presents the highest EIRR and NPV, followed by Alternative 4-3.5. On the other hand, relatively greater amount of investment from year 2011 (Alternative 6-3.5 and 6-3.75) would result in much lower EIRRs as compared with stage construction scenarios. Although the overall project costs of four-lane alternatives are higher than those of six-lane alternatives, the present value of investment in the 2nd Stage from year 2024 would be discounted to a minimum. This results in less present value of investment costs and higher EIRRs.

Therefore, Alternative 4-3.0 (4 lanes with 3.0 m width, stage construction) is the most efficient and economically reasonable investment alternative among others.

6. Conclusion and Recommendation

a) It was confirmed that six-lane highway is not required until 2027 based on traffic demand forecast.

b) Four alternatives are developed for the comparison of number of lanes, lane width and investment timings in order to evaluate investment efficiency.

c) Based on economic aspects, Alternative 1, four 3.0 m-wide lanes exhibits the best rating among the alternatives.

Table 12 Results of Economic Evaluation in EIRR and NPV

No.	Alternative	EIRR	NPV (Bil. VND)
1	4-3.0	39.1%	21,911
2	4-3.5	38.2%	21,738
3	6-3.5	30.9%	17,083
4	6-3.75	30.3%	16,914

Appendix-10:
Updates in Accordance with Minutes of Discussion dated 18 June 2010

The JICA Follow-up Mission was carried out from 7 June to 18 June 2010. During said period, a discussion paper was prepared by the Study Team as guide for discussion between JICA and MOT. The discussion results were summarized in the M/D dated 18 June 2010.

This Appendix-10 contains updates of the Study in accordance with the M/D.

1. Items Updated during the Discussion between JICA and MOT

The following items were updated during the discussion between JICA and MOT.

Table 1 List of Items Updated in the JICA Mission in June 2010

No.	Items	**Updated in JICA Mission**	Study Team Proposed
1	Target Year of Traffic Forecast	**2035**	2030
2	Typical Cross Section 1st Stage of Bridge Section	**4-lanes, 3.5m/lane**	4-lanes, 3.0m/lane
3	Construction Period	**Aug 2012 – Mar 2015 (32 Months)**	Jun 2012 – Dec 2014 (30 Months)
4	Implementation Program	**Aug 2012 – Mar 2015 (32 Months)**	Jun 2012 – Dec 2014 (30 Months)

2. Traffic Demand Forecast

In accordance with the above updates realized during the discussion between JICA and MOT, the following were also updated concerning the target year of the traffic demand forecast.

2.1. Future Traffic Demands

The traffic in 2035 was calculated by extrapolation from traffic volume of 2020-2030 with 85% growth rate, which is 6%.

Table 2 Summary of Future Traffic Demands (Updated after JICA Mission)

Section	Peak Hour	Direction	Year			
			2015	2020	2030	**2035**
Tan Vu IC - Dinh Vu	AM	To Tan Vu IC	1,276	2,149	4,140	**5,337**
		From Tan Vu IC	745	1,451	3,967	**6,101**
	PM	To Tan Vu IC	550	1,098	2,490	**3,534**
		From Tan Vu IC	1,125	1,874	3,772	**5,086**
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	927	1,494	2,002	**2,267**
		Dinh Vu to Cat Hai	351	745	1,350	**1,740**
	PM	Cat Hai to Dinh Vu	351	745	1,350	**1,740**
		Dinh Vu to Cat Hai	927	1,494	2,002	**2,267**

2.2. Forecast of Transport Growth

It was assumed that the growth rate of 2031-2035 is 6% which is 85% of the previous period.

Table 3 Forecast of Transport Growth Rate (Updated after JICA Mission)

Stage	2010-2015	2016-2020	2021-2025	2026-2030	**2031-2035**
Nationwide	7.0%	6.5%	6.5%	6.0%	---
Hanoi-Haiphong Expressway	7.67%	7.67%	6.67%	6.67%	---
Preparatory survey on Lach Huyen Port (Road and Bridge portion)	8.00%	8.00%	7.00%	7.00%	**6.00%**

2.3. Traffic Demand Forecast for Comparison of Updated Traffic

It was assumed that the growth rate of 2031-2035 is 6% which is 85% of the previous period.

Table 4 Traffic Demand Forecast Based on Socio-economic Data (Updated after JICA Mission)

Year	Dinh Vu-Cat Hai Ferry and Ninh Tiep Ferry terminal			Cat Hai Roa			Ben Got Ferry Terminal and Cat Hai-Cat Ba Ferry		
	Total (pcu/day-night)	To Tan Vu IC Direction (pcu/peak hr)	To Cat Ba Direction (pcu/peak hr)	Total (pcu/day-night)	To Tan Vu IC Direction (pcu/peak hr)	To Cat Ba Direction (pcu/peak hr)	Total (pcu/day-night)	To Tan Vu IC Direction (pcu/peak hr)	To Cat Ba Direction (pcu/peak hr)
2010	506	28	23	607	33	27	439	24	20
2011	547	30	25	655	36	29	474	26	21
2012	591	33	27	706	39	32	511	28	23
2013	638	35	29	763	42	34	551	30	25
2014	688	38	31	824	45	37	596	33	27
2015	3,913	215	176	4,060	223	183	643	35	29
2016	6,462	355	291	6,619	364	298	695	38	31
2017	9,026	496	406	9,196	506	414	751	41	34
2018	11,615	639	523	11,800	649	531	811	45	36
2019	14,216	782	640	14,417	793	649	875	48	39
2020	16,841	926	758	17,057	938	768	945	52	43
2021	23,032	1,267	1,036	23,263	1,279	1,047	1,011	56	45
2022	27,286	1,501	1,228	27,534	1,514	1,239	1,081	59	49
2023	31,852	1,752	1,433	32,116	1,766	1,445	1,156	64	52
2024	36,747	2,021	1,654	37,030	2,037	1,666	1,237	68	56
2025	41,965	2,308	1,888	42,268	2,325	1,902	1,323	73	60
2026*	33,743	1,856	1,518	34,066	1,874	1,533	1,416	78	64
2027*	37,885	2,084	1,705	38,231	2,103	1,720	1,515	83	68
2028*	42,254	2,324	1,901	42,626	2,344	1,918	1,622	89	73
2029*	46,851	2,577	2,108	47,248	2,599	2,126	1,735	95	78
2030*	51,703	2,844	2,327	52,128	2,867	2,346	1,857	102	84
2031	**55,963**	**3,078**	**2,518**	**56,413**	**3,103**	**2,539**	**1,968**	**108**	**89**
2032	**60,463**	**3,325**	**2,721**	**60,941**	**3,352**	**2,742**	**2,086**	**115**	**94**
2033	**64,970**	**3,573**	**2,924**	**65,476**	**3,601**	**2,946**	**2,211**	**122**	**99**
2034	**69,482**	**3,822**	**3,127**	**70,018**	**3,851**	**3,151**	**2,343**	**129**	**105**
2035	**74,007**	**4,070**	**3,330**	**74,574**	**4,102**	**3,356**	**2,484**	**137**	**112**

Source: Study Team
2026*-2030*: Railway transportation is taken into consideration.
The traffic in 2031-2035 was calculated based on 85% of the growth rate for 2020-2030, which is 6%.

Table 5 Estimated Cargo Volume and Container Vehicles (Updated after JICA Mission)

	Cargo	TEU	Truck of more than 3 axles			
	1000ton/Year	1000TEU	Vehicle/Year	Vehicle/day	pcu/day	pcu/peak hr
2015	5,394	463	463,000	1,268	3,170	317
2016	9,607	826	826,000	2,263	5,658	566
2017	14,962	1,191	1,191,000	3,263	8,158	816
2018	19,816	1,559	1,559,000	4,271	10,678	1,068
2019	24,671	1,928	1,928,000	5,282	13,205	1,321
2020	29,525	2,299	2,299,000	6,299	15,748	1,575
2021	37,061	3,192	3,192,000	8,745	21,863	2,186
2022	44,126	3,801	3,801,000	10,414	26,035	2,604
2023	51,726	4,455	4,455,000	12,205	30,513	3,051
2024	59,863	5,156	5,156,000	14,126	35,315	3,532
2025	68,536	5,903	5,903,000	16,173	40,433	4,043
2026	54,421	4,687	4,687,000	12,841	32,103	3,210
2027	61,243	5,275	5,275,000	14,452	36,130	3,613
2028	68,439	5,895	5,895,000	16,151	40,378	4,038
2029	76,011	6,547	6,547,000	17,937	44,843	4,484
2030	84,000	7,235	7,235,000	19,822	49,555	4,956
2031	**91,001**	**7,838**	**7,838,000**	**21,474**	**53,685**	**5,369**
2032	**98,393**	**8,475**	**8,475,000**	**23,219**	**58,048**	**5,805**
2033	**105,786**	**9,112**	**9,112,000**	**24,964**	**62,410**	**6,241**
2034	**113,178**	**9,748**	**9,748,000**	**26,707**	**66,768**	**6,677**
2035	**120,571**	**10,385**	**10,385,000**	**28,452**	**71,130**	**7,113**

Source: Study Team
2026*-2030*: Railway transportation is taken into consideration.
The traffic of 2031-2035 was calculated based on 85% of the growth rate of 2020-2030, which is 6%.

Table 6 Traffic Forecast between Revised F/S and Traffic Survey Basis (Updated after JICA Mission)

Forecast Method	Peak Hour	Direction	Year				
			2015	2020	2025	2030	**2035**
Revised FS Traffic Forecast	AM	Cat Hai to Dinh Vu	927	1,494	1,748	2,002*	**2,267**
		Dinh Vu to Cat Hai	351	745	1,047	1,350*	**1,740**
	PM	Cat Hai to Dinh Vu	351	745	1,047	1,350*	**1,740**
		Dinh Vu to Cat Hai	927	1,494	1,748	2,002*	**2,267**
Based on Traffic Survey in Cat Hai	AM	Cat Hai to Dinh Vu	215	926	2,308	2,844*	**4,070**
		Dinh Vu to Cat Hai	176	758	1,888	2,327*	**3,330**
	PM	Cat Hai to Dinh Vu	176	758	1,888	2,327*	**3,330**
		Dinh Vu to Cat Hai	215	926	2,308	2,844*	**4,070**

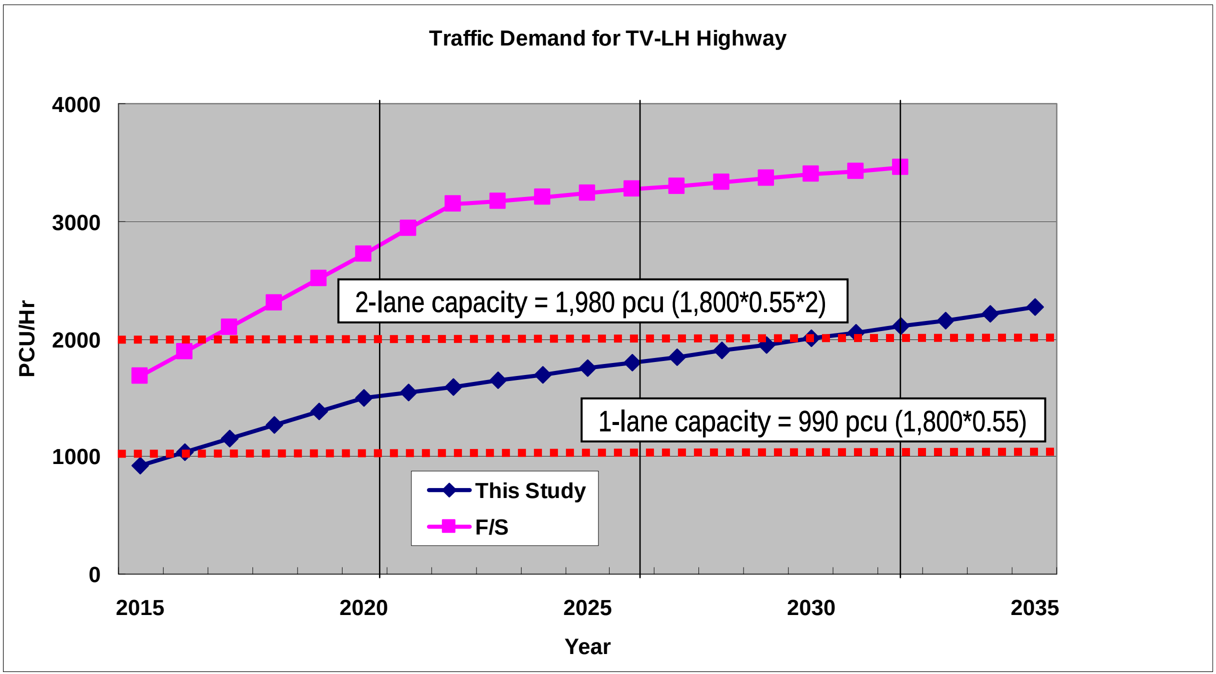
Source: Study Team
2030: Railway transportation is taken into consideration.

3. Typical Cross Section of Bridge Section

In accordance with the above updates, the typical cross section for the bridge section was updated during the discussion between JICA and MOT, as follows:

3.1. Updated Traffic Demand Forecast

In accordance with the updated traffic forecast, the required traffic lane is revised as follows:



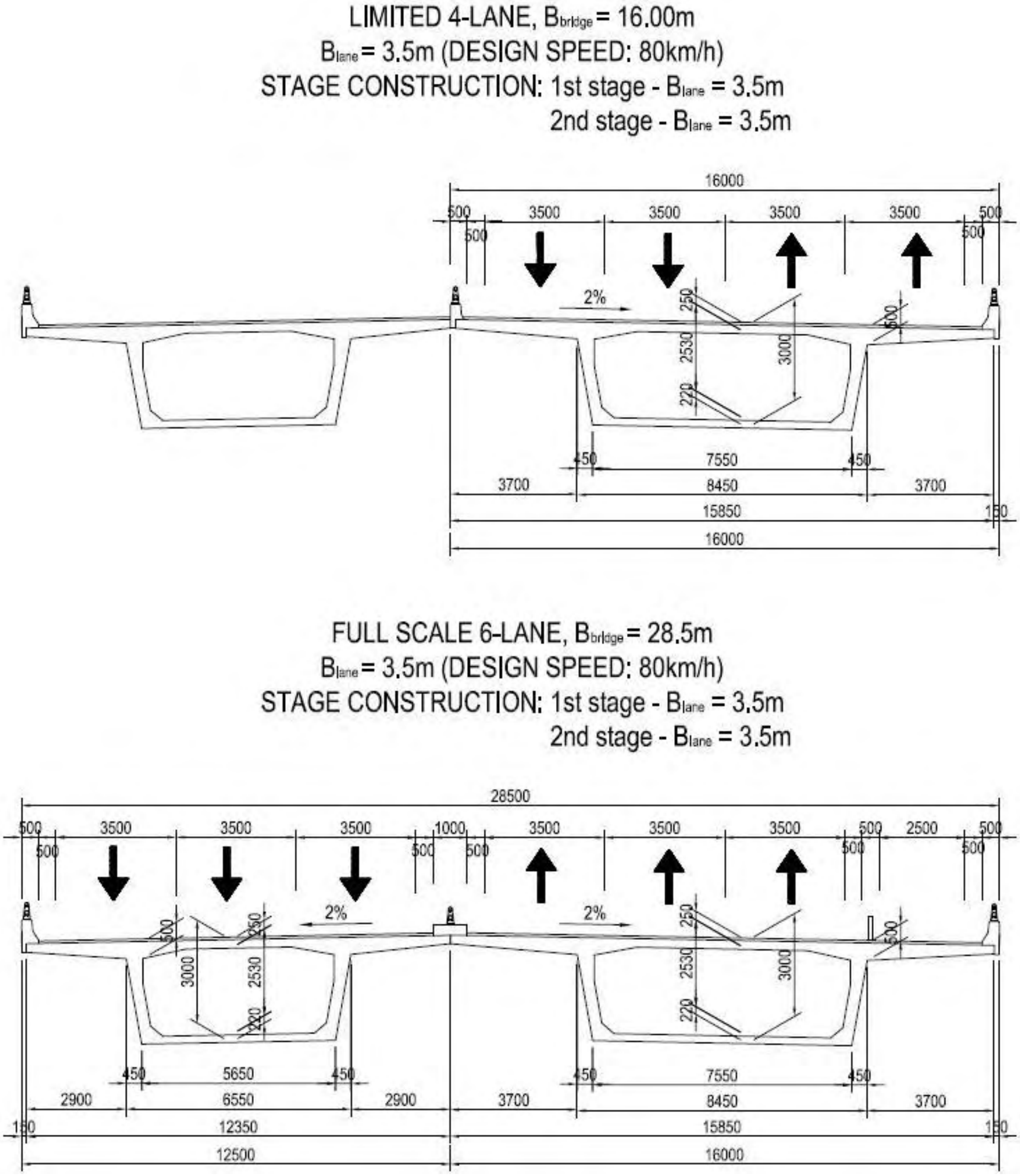
Source: Study Team

Figure 1 Updated Traffic Demand and Future Lane Requirement

- Traffic demand forecast is updated by extending the target year to 2035, which is 20 years after the highway is opened to the public.
- In this Study, it is concluded that two lanes per direction could sufficiently accommodate traffic capacity until 2027.

3.2. Updated Typical Cross Section of the Bridge

Typical cross section of the bridge during the first stage was updated as shown in figure below.



Source: Study Team

Figure 2 Updated Typical Cross Section of Bridge Section

4. Updated Project Cost Estimate

4.1. Project Cost

The following tables were updated considering 1) revision of the typical cross section of the bridge and 2) construction period of 32 months.

Table 7 Summary of Estimated Project Cost

Cost Items		Project Cost (by Currency)		Project Cost (Currency Exchange)	
		F/C (Mil.JPY)	L/C (Mil.VND)	F/C (Mil.JPY)	L/C (Mil.VND)
Total Project Cost		7,773	7,384,236	47,057	8,845,326
I	JICA Loan Eligible Portion (STEP Scheme)	7,773	5,925,775	39,298	7,386,865
1	Construction Cost	5,390	3,954,100	26,426	4,967,258
2	Price Contingency	337	1,602,431	8,862	1,665,777
3	Physical Contingency	286	277,827	1,764	331,586
4	Consulting Services	1,115	91,417	1,601	301,003
5	Interest during Construction	333	0	333	62,594
6	Commitment Charge	312	0	312	58,647
II	State Budget Portion	0	1,458,461	7,759	1,458,461
7	Environmental Management and Monitoring Cost	0	304,424	1,620	304,424
8	Administration Cost	0	378,506	2,014	378,506
9	Value Added Tax (VAT)	0	741,622	3,945	741,622
10	Import Tax	0	33,909	180	33,909

Source: Study Team

4.2. Procurement Ratio from Japan

Table 8 shows the procurement ratio from Japan.

Table 8 Procurement ratio from Japan

Unit:Yen

Construction Cost		26,426,000,000	
Goods procured from Japan			
1	Erection Girder	662,445,651	2.5%
2	Steel Pipe Pile	2,488,599,940	9.4%
3	Steel Pipe Sheet Pile	1,834,987,272	6.9%
4	PC Strand	678,996,366	2.6%
5	Reinforcement Steel	1,168,310,556	4.4%
6	Cement	368,364,482	1.4%
7	Steel Sheet Pile for Cofferdam	1,717,440,239	6.5%
8	H-shaped Steel for Jetty	429,413,302	1.6%
9	Japanese Engineer	315,061,980	1.2%
10	Japanese Skilled Labor	187,174,300	0.7%
11	Administration Overhead	1,770,202,690	6.7%
Total		11,620,996,780	44.0%

Source: Study Team

The contents and cost of major goods expected to be procured from Japan are shown in the Table 9.

Table 9 Goods expected to be Procured from Japan

Supplier	Item	Unit	Qty	Unit Price (JPY)	Amount(JPY)
Japanese Firm	Erection Girder	m^3	45,310	14,620	662,445,651
	Steel Pipe Pile	ton	11,087	224,452	2,488,599,940
	Steel pipe Sheet Pile	ton	6,961	263,606	1,834,987,272
	PC Strand	ton	2,716	250,032	678,996,366
Japanese Firm in Vietnam	Reinforcement Bar	ton	15,313	76,251	1,168,310,556
	Cement	ton	67,290	5,474	368,364,482
	Steel Sheet Pile	ton	11,404	131,929	1,504,533,710
	Equipment for Steel Sheet Pile	m	90,489	2,353	212,906,530
	H-shaped Steel	ton	3,367	99,102	333,711,630
	Equipment for Driving/Extracting H-shaped Steel	m	52,273	1,831	95,701,672

Source: Study Team

5. Project Evaluation

5.1. Estimated Project Benefit

The project benefit is re-estimated with the design speed of 80km/hr under the condition where the road width is set at 3.5m per lane. Assumed transportation routes and conditions as well as comparison with "With Project Case" are presented in Figure 3. The general conditions for benefit calculation are shown in Table 10.

Table10 General Conditions for Benefit Calculation

General Conditions for Passengers Traffic - **Without Project Case**

Without Project	Tan Vu IC-Dinh Vu	Dinh Vu-Ninh Tiep (Ferry)	Ninh Tiep-Ben Got	Total
Distance (km)	15	--	7.7	22.7
Travel Time (min)	45	90	20	155.0
Ave. Speed (km/hr)	20.0	--	23.1	

General Conditions for All Traffic - **With Project Case**

With Project	Tan Vu IC-Dinh Vu	Dinh Vu - Ben Got	Total
Distance (km)	4.50	11.37	15.9
Travel Time at 50km/hr speed (min)	5.4	13.6	19.0
Travel Time at 80km/hr speed (min)	3.4	8.5	11.9

Source: Study Team

Based on the above conditions, travel times by type of vehicle for "With" and "Without" project cases were estimated in Table 11. Daily values for VOC and TTC per vehicle were also computed in Table 11 in which detailed calculations for each unit by road sections are noted under each table for explanation. For the "With Project Case", according to the four numbers of lanes and the road width of 3.5 m per lane, design speed of 80 km per hour is applied for VOC and TTC calculation. The same VOC and TTC units and formula presented in the main text Section 3.2.2 (3) and (4) are applied for the calculation.

Table 11 Travel Time by Type of Vehicle – With and Without Project Cases

Travel Time by Type of Vehicles and of Container Transportation - **With and Without Project Cases**

Route	**Without Project**	Tan Vu-Dinh Vu (15km)	Dinh Vu-Ninh Tiep (Ferry)	Ninh Tiep-Ben Got (7.7km)	Total
Route 2	Bicycle (min.)	90	90	40	220
	Motorcycle, Car, Bus (min.)	45	90	20	155

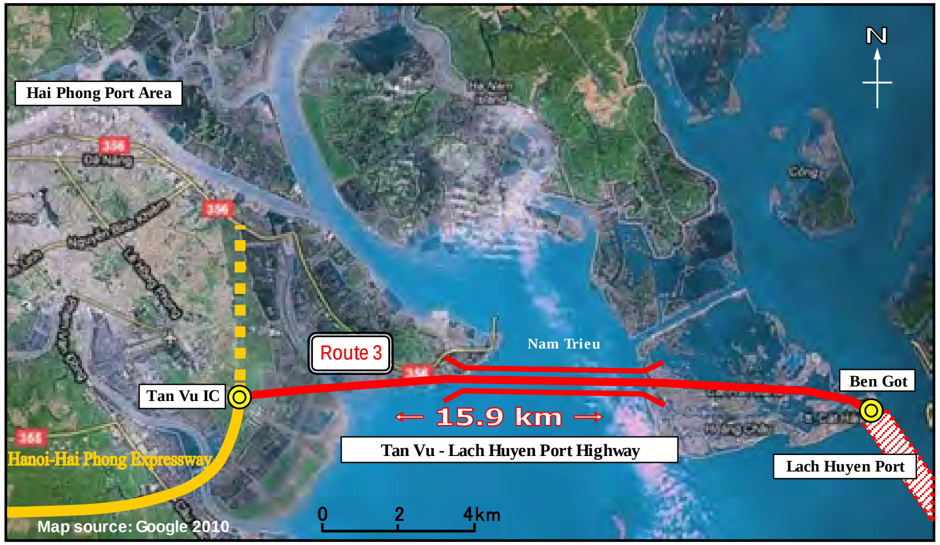
Route	**Without Project**	Port handling (transshipping)	Transport (Lach Huyen - Hai Phong)	Transport (Hai Phong - Tan Vu IC: 8km)	Total
Route 1	Container transport (Maritime)	24 hrs / 90TEU barge	120		1,560
	Container transport (Ground Transport by Trailers) at average 40km/hr speed			12	12

Route	**With Project**	Tan Vu IC - Dinh Vu (4.5km)	Dinh Vu - Ben Got (11.4km)	Tan Vu - Ben Got (15.9km)	Remarks
Route 3	Bicycle (min.)	27	68	95	Average 10km/hr speed
	Motorcycle, Car, Bus, Trailer* (min.)	5	14	19	Design speed: 50km/hr
		3	9	12	Design speed: 80km/hr

*For benefit calculation, the design speed at 80 km / hr is adapted.

Source: Study Team

With Project Case

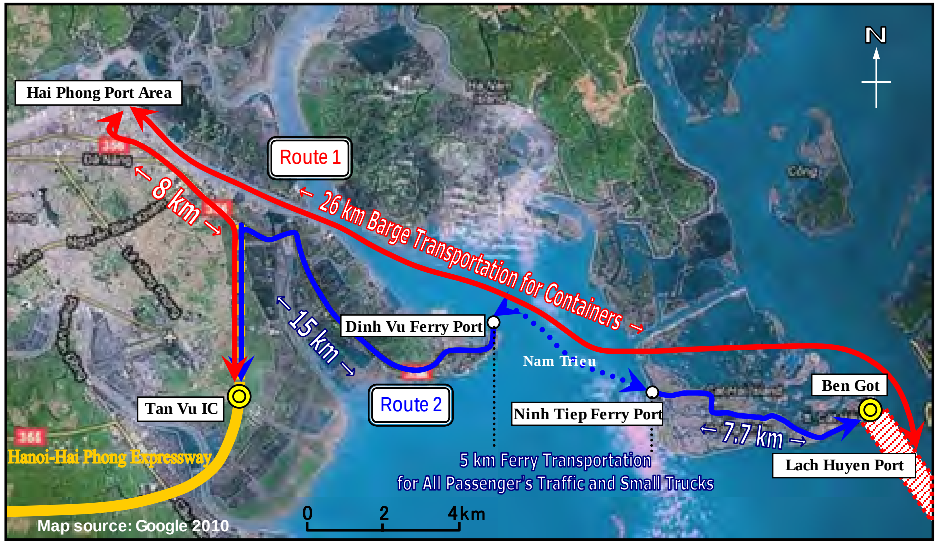


Conditions:

<u>Route 3: Tan Vu-Lach Huyen Highway</u>

- All traffic goes through the Tan Vu-Lach Huyen Highway smoothly without disturbance and congestion.
- Containers are smoothly transported by trucks or trailers from and to the Lach Huyen port, enhancing trading and marketing activities.
- Port capacity and function will be fully utilized.
- There is no congestion in maritime transportation and maritime safety, and fishing boats are more secured as well.

Without Project Case



Conditions:

<u>Route 1: Container Transport</u>

- Daily required no. of barges (90 TEU): 5 vessels in 2015, 52 in 2025, 91 in 2035.
- Daily required no. of RoRo ships: 3 vessels in 2015, 32 in 2025, 55 in 2035.
- Daily required no. of trips between Lach Huyen and Hai Phong Ports: 15 in 2015, 180 in 2030, 317 in 2035.
- Cost of transports: VND 2.0 billion/day in 2015, VND 25.3 billion/day in 2025, VND 44.6 billion/day in 2035.

<u>Route 2: Passenger Traffic</u>

- Daily required no. of trips between Dinh Vu and Ninh Tiep ferry ports: 18 trips in 2015, 36 trips in 2025, 70 trips in 2035
- Daily required no. of ferries: 3 in 2015, 6 in 2025, 12 in 2035.
- Cost of transport: ferry fees are assumed to be financial cost. Therefore it is assumed that ferry fees are not counted for cost of transportation in economic analysis. But TTC is accounted for economic cost.

Source: Study Team

Figure 3 Comparison of the "With" and "Without" Project Cases

Table 12 Values of VOC and TTC per Vehicle per Day – With and Without Project Cases

Unit VOC for Passengers' Traffic (per vehicle per day) - **With and Without Project Cases** (Unit: 1000VND/vehicle/day)

Route	Condition	Motorcycle	Car	Mini Bus	Large Bus	Motorcycle	Car	Mini Bus	Large Bus	Motorcycle	Car	Mini Bus	Large Bus
Route 2	**Without Project***	Tan Vu IC - Dinh Vu (15km)				Ninh Tiep - Ben Got (7.7km)				Tan Vu IC - Ben Got			
		15.2	41.2	56.6	56.6	7.2	19.8	27.2	27.2	22.3	61.0	83.8	83.8
Route 3	**With Project****	Tan Vu IC - Dinh Vu (4.5km)				Dinh Vu - Ben Got (11.4km)				Tan Vu IC - Ben Got			
		2.0	6.4	9.0	9.0	5.1	16.2	22.6	22.6	7.1	22.6	31.6	31.6
									Unit VOC Saving =	15.2	38.4	52.2	52.2

*Ex.): Motorcycle VOC for Tan Vu IC - Dinh Vu Section under Without Project Case = 5909 x $20km/hr^{-0.589}$ x 15km = 15,181 VND/vehicle/day

**Ex): Motorcycle VOC for Tan Vu IC - Dinh Vu Section under With Project Case = 5909 x $80km/h^{r-0.589}$ x 4.5km = 26,548 VND/vehicle/day

Unit TTC for Passengers' Traffic (per vehicle per day) - **With and Without Project Cases** (Unit: 1000VND/vehicle/day)

Route	Condition	Bicycle	Motorcycle	Car	Mini bus	Large bus	Bicycle	Motorcycle	Car	Mini bus	Large bus	Bicycle	Motorcycle	Car	Mini bus	Large bus
Route 2	**Without Project***	Tan Vu IC - Dinh Vu including 90 min. ferry (15km)					Ninh Tiep-Ben Got (7.7km)					Tan Vu IC - Ben Got				
		43.8	32.9	155.7	328.5	887.0	9.7	4.9	23.1	48.7	131.4	53.5	37.7	178.8	377.2	1,018.4
Route 3	**With Project****	Tan Vu IC - Dinh Vu (4.5km)					Dinh Vu - Ben Got (11.4km)					Tan Vu IC - Ben Got				
		6.6	0.8	3.9	8.3	22.3	16.5	2.1	9.8	20.7	55.8	23.1	2.9	13.7	29.0	78.2
											Unit TTC Saving =	30.4	34.8	165.0	348.2	940.2

*Ex.): Bicycle TTC for Tan Vu IC - Dinh Vu Section under Without Project Case = (90min. + 90min.)/60 x 14,600 = 43,800 VND/vehicle/day
Car TTC for Tan Vu IC - Dinh Vu Section under Without Project Case = (45min. + 90min.)/60 x 69,200 = 155,700 VND/vehicle/day

**Ex): Bicycle TTC for Tan Vu IC - Dinh Vu Section under With Project Case = 27min./60 x 14,600 = 6,570 VND/vehicle/day
Car TTC for Tan Vu IC - Dinh Vu Section under With Project Case = 3.4min./60 x 69,200 = 3,921 VND/vehicle/day

VOC and TTC for Container Transportation by Trailers - **With and Without Project Cases**

Route	Conditions	VOC (1000VND / vehicle / day)	TTC (1000VND / vehicle / day)	Remarks
Route 1	**Without Project**	38.5	5.8	Hai Phong-Tan Vu IC: 8km section only
Route 3	**With Project**	53.1	5.8	Tan Vu IC-Ben Got: 15.9km whole section
	Unit Saving =	-14.6	0.0	

*Ex): VOC under Without Project Case = 33065 x $40km/hr^{-0.5227}$ x 8km = 38,465 VND/vehicle/day
TTC under Withiout Project Case = 29,200 x 12min./60 = 5,840 VND/vehicle/day

**Ex): VOC under With Project Case = 33065 x $80km/hr^{-0.5227}$ x 15.9km = 53,113 VND/vehicle/day
TTC under With Project Case = 29,200 x 12min./60 = 5,791 VND/vehicle/day

Note: VOC and TTC savings associated with container transport can not be simply compared due to difference in the travel distances between With and Without Project Cases.

Source: Study Team

The following table presents the traffic demand forecast used for VOC and TTC calculations. It is basically the same as presented in Table 3.2-7 of the main text.

Table 13 Traffic Demand Forecast Used for Benefit Calculation

Daily Traffic Volume - Without Project Case (Unit: Vehicle/day)

Year	Tan Vu IC - Dinh Vu						Ninh Tiep - Ben Got					
	Bicycle	Motorcycle	Car	Minibus	Large Bus	Trailer	Bicycle	Motorcycle	Car	Minibus	Large Bus	Trailer
2010	165	640	22	119	9	0	645	673	291	111	10	0
2011	178	691	24	128	10	0	697	727	314	119	11	0
2012	192	746	26	138	11	0	753	785	339	129	12	0
2013	207	806	28	149	12	0	813	848	366	139	13	0
2014	224	870	30	161	13	0	878	916	395	150	14	0
2015	242	940	32	174	14	1,268	948	989	427	162	15	0
2016	261	1,015	35	188	15	2,263	1,024	1,068	461	175	16	0
2017	282	1,096	38	203	16	3,263	1,106	1,153	498	189	17	0
2018	305	1,184	41	219	17	4,271	1,194	1,245	538	204	18	0
2019	329	1,279	44	237	18	5,282	1,290	1,345	581	220	19	0
2020	355	1,381	48	256	19	6,299	1,393	1,453	627	238	21	0
2021	380	1,478	51	274	20	8,745	1,491	1,555	671	255	22	0
2022	407	1,581	55	293	21	10,414	1,595	1,664	718	273	24	0
2023	435	1,692	59	314	22	12,205	1,707	1,780	768	292	26	0
2024	465	1,810	63	336	24	14,126	1,826	1,905	822	312	28	0
2025	498	1,937	67	360	26	16,173	1,954	2,038	880	334	30	0
2026	533	2,073	72	385	28	12,841	2,091	2,181	942	357	32	0
2027	570	2,218	77	412	30	14,452	2,237	2,334	1,008	382	34	0
2028	610	2,373	82	441	32	16,151	2,394	2,497	1,079	409	36	0
2029	653	2,539	88	472	34	17,937	2,562	2,672	1,155	438	39	0
2030	699	2,717	94	505	36	19,822	2,741	2,859	1,236	469	42	0
2031	741	2,880	100	535	38	21,474	2,905	3,031	1,310	497	45	0
2032	785	3,053	106	567	40	23,219	3,079	3,213	1,389	527	48	0
2033	832	3,236	112	601	42	24,964	3,264	3,406	1,472	559	51	0
2034	882	3,430	119	637	45	26,707	3,460	3,610	1,560	593	54	0
2035	935	3,636	126	675	48	28,452	3,668	3,827	1,654	629	57	0

Daily Traffic Volume - With Project Case (Unit: Vehicle/day)

Year	Tan Vu IC - Dinh Vu						Dinh Vu - Ben Got					
	Bicycle	Motorcycle	Car	Minibus	Large bus	Trailer	Bicycle	Motorcycle	Car	Minibus	Large bus	Trailer
2015	42,400	65,800	3,960	534	234	1,791	26,900	41,533	2,500	338	148	1,135
2016	47,700	72,600	5,420	652	277	2,180	30,000	45,667	3,420	411	174	1,367
2017	52,600	78,667	7,120	784	319	2,586	32,900	49,333	4,460	490	201	1,624
2018	57,000	83,667	9,040	911	360	3,000	35,600	52,267	5,640	568	225	1,872
2019	61,100	88,067	11,180	1,058	402	3,459	38,100	54,867	6,960	662	251	2,160
2020	64,800	91,200	13,540	1,221	447	3,952	40,300	56,733	8,420	760	278	2,458
2021	67,600	97,733	16,120	1,458	538	4,829	39,300	56,733	9,340	849	312	2,803
2022	69,300	103,267	18,920	1,718	628	5,755	37,900	56,467	10,340	941	343	3,150
2023	69,800	107,600	21,780	2,002	722	6,800	36,300	55,933	11,320	1,039	375	3,531
2024	69,200	110,933	24,960	2,307	823	7,909	34,300	55,133	12,400	1,144	409	3,926
2025	67,400	113,200	28,340	2,632	924	9,122	32,200	54,067	13,540	1,260	441	4,362
2026	64,300	114,333	31,900	2,994	1,020	10,364	29,600	52,667	14,700	1,378	470	4,775
2027	60,100	114,400	35,660	3,380	1,119	11,750	26,900	51,133	15,940	1,512	500	5,251
2028	54,700	113,400	39,480	3,790	1,214	13,180	23,700	49,200	17,160	1,646	527	5,723
2029	48,200	111,267	43,640	4,231	1,313	14,686	20,400	47,067	18,480	1,788	555	6,210
2030	40,500	108,067	48,000	4,702	1,413	16,279	16,800	44,667	19,860	1,943	585	6,732
2031	38,600	112,333	52,800	5,379	1,490	17,888	15,300	44,600	20,960	2,135	591	7,100
2032	35,900	115,800	57,700	6,109	1,559	19,533	13,700	44,333	22,080	2,338	597	7,481
2033	32,300	118,600	62,740	6,891	1,619	21,213	12,000	43,933	23,260	2,556	600	7,862
2034	28,100	120,600	67,900	7,733	1,672	22,924	10,100	43,400	24,440	2,781	601	8,247
2035	22,900	122,000	73,200	8,645	1,736	24,634	8,000	42,733	25,640	3,026	608	8,627

Source: Study Team

The major project benefit from barge transportation cost under "Without" Project Case is calculated based on Table 14 below. These comprise port handling charges, economic costs of ship hiring, and fuel costs based on the container demand forecast at Lach Huyen Port.

Table 14 Benefit Calculation for Barge Transportation of Containers under "Without" Project Case

Port Handling Charge for Transshipment

	Port	US$/TEU	VND/TEU
(I)	Lach Huyen	40	680,080
(II)	Hai Phong	40	680,080

Source: Data from existing Hai Phong - Cai Lan maritime transportation

Economic Prices Estimate for Lach Huyen-Hai Phong Barge Transport

	Item	Value	Remarks
(a)	Ship hiring cost (RoRo ship)(VND/day/ship)	13,812,500	414 mil.VND per month hiring basis
(b)	Barge hiring cost (90TEU equivalent) (VND/day/ship)	9,668,800	290 mil.VND per month hiring basis
(c)	Diesel gasoline requirement* (liter/hr)	540	120 liter/hr x 90TEU/20TEU
(d)	Fuel cost (VND/ship/trip)	13,500,000	(c) x (g) x (i)
(e)	Distance (km) (Lach Huyen-Hai Phong)	26.0	
(f)	Speed at full container (km/hr)	14.8	8 knot x 1.852
(g)	Time required per trip (hr)	2.0	(e) / (g)
(h)	Marine Diesel Oil Price** ($US/MT)	587	
(i)	Liter equivalent of Marine Diesel Oil Price (VND/liter)	12,500	(h) / 1,000kg x 0.8 x VND17,002

*Based on the data of barge transportation Hai Phong-Cai Lan (48km) at 20 million VND/month for 20TEU barge,
120 liter/hr of diesel fuel requirement, 8 knot ave. speed.

**As of May 25 at Singapore MDO price (Source: http://www.bunkerworld.com/markets/prices/sg/sin/)

Cost Estimation for the Barge Transportation of Containers under **Without Project Case**

	(1)	(2)	(3)	(4)	(5)	(6)
Year	Container Demand TEU/day	No. Trips/day	No. Barge/day	No. RoRo Ship/day	Costs of Daily Transports* (Mil.VND/day)	Costs of Annual Transports** (Mil.VND/year)
2015	1,268	15	5	3	2,017	736,192
2016	2,263	26	8	5	3,575	1,305,041
2017	3,263	37	11	7	5,141	1,876,372
2018	4,271	48	14	9	6,717	2,451,675
2019	5,282	59	17	11	8,297	3,028,468
2020	6,299	70	20	12	9,872	3,603,197
2021	8,745	98	28	17	13,723	5,008,945
2022	10,414	116	34	21	16,350	5,967,570
2023	12,205	136	39	24	19,145	6,988,048
2024	14,126	157	45	27	22,141	8,081,521
2025	16,173	180	52	32	25,373	9,261,016
2026	12,841	143	41	25	20,138	7,350,387
2027	14,452	161	46	28	22,662	8,271,647
2028	16,151	180	52	32	25,343	9,250,093
2029	17,937	200	58	35	28,141	10,271,618
2030	19,822	221	64	39	31,102	11,352,260
2031	21,474	239	69	42	33,682	12,293,875
2032	23,219	258	74	45	36,402	13,286,587
2033	24,964	278	80	48	39,145	14,287,756
2034	26,707	297	85	51	41,862	15,279,476
2035	28,452	317	91	55	44,618	16,285,687

*Costs of Daily Transportation (5) = (1)x((I) + (II)) + (4)x(a) + (3)x(b) +(2)x(d)

**Costs of Annual Transportation (6) = (5) x 365

Source: Study Team

Estimated project benefit of all items (VOC/TTC savings and barge transportation) is summarized as shown in Table 15.

Table 15 Summary of Project Benefit

Without Project Case

Year	VOC (1000VND/day)										Total VOC (1000VND/day)	(A) Annual Total VOC (Mil.VND/yr)	TTC (1000VND/day)	
	Tan Vu IC - Dinh Vu					Ninh Tiep-Ben Got							Tan Vu IC - Dinh Vu	
	Motorcycle	Car	Mini Bus	Large Bus	Trailer	Motorcycle	Car	Mini Bus	Large Bus	Trailer			Bicycle	Motorcycle
2015	14,270	1,319	9,847	792	48,773	7,080	8,439	4,404	408	0	95,333	34,796	10,600	30,879
2016	15,409	1,443	10,639	849	87,045	7,646	9,111	4,757	435	0	137,334	50,127	11,432	33,343
2017	16,638	1,567	11,488	905	125,510	8,254	9,842	5,138	462	0	179,805	65,629	12,352	36,004
2018	17,974	1,690	12,394	962	164,283	8,913	10,633	5,546	489	0	222,883	81,352	13,359	38,894
2019	19,416	1,814	13,412	1,019	203,170	9,629	11,483	5,981	516	0	266,440	97,251	14,410	42,015
2020	20,965	1,979	14,488	1,075	242,289	10,402	12,392	6,470	571	0	310,630	113,380	15,549	45,366
2021	22,437	2,103	15,506	1,132	336,373	11,132	13,262	6,932	598	0	409,475	149,458	16,644	48,552
2022	24,001	2,268	16,581	1,188	400,571	11,912	14,190	7,421	652	0	478,786	174,757	17,827	51,936
2023	25,686	2,432	17,770	1,245	469,461	12,743	15,179	7,938	707	0	553,160	201,904	19,053	55,582
2024	27,477	2,597	19,015	1,358	543,352	13,637	16,246	8,481	761	0	632,925	231,018	20,367	59,459
2025	29,405	2,762	20,373	1,471	622,089	14,590	17,392	9,080	816	0	717,978	262,062	21,812	63,630
2026	31,470	2,968	21,788	1,585	493,925	15,613	18,617	9,705	870	0	596,541	217,737	23,345	68,098
2027	33,671	3,175	23,316	1,698	555,891	16,709	19,922	10,384	924	0	665,690	242,977	24,966	72,861
2028	36,024	3,381	24,957	1,811	621,243	17,875	21,325	11,118	979	0	738,713	269,630	26,718	77,953
2029	38,544	3,628	26,711	1,924	689,940	19,128	22,827	11,907	1,060	0	815,671	297,720	28,601	83,406
2030	41,247	3,875	28,579	2,037	762,446	20,467	24,428	12,749	1,142	0	896,971	327,394	30,616	89,253
2031	43,721	4,123	30,277	2,150	825,990	21,698	25,891	13,511	1,223	1	968,585	353,533	32,456	94,608
2032	46,347	4,370	32,088	2,264	893,111	23,001	27,452	14,326	1,305	2	1,044,265	381,157	34,383	100,291
2033	49,126	4,618	34,012	2,377	960,231	24,383	29,092	15,196	1,386	3	1,120,424	408,955	36,442	106,303
2034	52,071	4,906	36,049	2,547	1,027,275	25,843	30,832	16,120	1,468	4	1,197,115	436,947	38,632	112,676
2035	55,198	5,195	38,200	2,716	1,094,396	27,397	32,689	17,099	1,549	5	1,274,444	465,172	40,953	119,443

Year	TTC (1000VND/day)										Total TTC (1000VND/day)	(B) Annual Total TTC (Mil.VND/yr)	(C) Cost of Barge Transports (Mil.VND/yr)	(D) Total Cost (A+B+C) (Mil.VND/yr)
	Tan Vu IC - Dinh Vu				Ninh Tiep-Ben Got									
	Car	Mini bus	Large bus	Trailer	Bicycle	Motorcycle	Car	Mini bus	Large bus	Trailer				
2015	4,982	57,159	12,417	7,405	9,227	4,813	9,849	7,884	1,971	0	157,187	57,373	736,192	828,362
2016	5,450	61,758	13,304	13,216	9,967	5,198	10,634	8,517	2,102	0	174,920	63,846	1,305,041	1,419,014
2017	5,917	66,686	14,191	19,056	10,765	5,611	11,487	9,198	2,234	0	193,500	70,627	1,876,372	2,012,629
2018	6,384	71,942	15,078	24,943	11,622	6,059	12,410	9,928	2,365	0	212,983	77,739	2,451,675	2,610,767
2019	6,851	77,855	15,965	30,847	12,556	6,546	13,402	10,707	2,497	0	233,649	85,282	3,028,468	3,211,000
2020	7,474	84,096	16,852	36,786	13,559	7,071	14,463	11,583	2,759	0	255,557	93,278	3,603,197	3,809,856
2021	7,941	90,009	17,739	51,071	14,512	7,568	15,478	12,410	2,891	0	284,814	103,957	5,008,945	5,262,361
2022	8,564	96,251	18,626	60,818	15,525	8,098	16,562	13,286	3,154	0	310,644	113,385	5,967,570	6,255,712
2023	9,186	103,149	19,513	71,277	16,615	8,663	17,715	14,211	3,416	0	338,380	123,509	6,988,048	7,313,460
2024	9,809	110,376	21,287	82,496	17,773	9,271	18,961	15,184	3,679	0	368,661	134,561	8,081,521	8,447,100
2025	10,432	118,260	23,061	94,450	19,019	9,918	20,299	16,255	3,942	0	401,078	146,394	9,261,016	9,669,471
2026	11,210	126,473	24,835	74,991	20,352	10,614	21,729	17,374	4,205	0	403,227	147,178	7,350,387	7,715,303
2027	11,989	135,342	26,609	84,400	21,773	11,359	23,251	18,591	4,468	0	435,608	158,997	8,271,647	8,673,621
2028	12,767	144,869	28,382	94,322	23,302	12,152	24,889	19,905	4,730	0	469,989	171,546	9,250,093	9,691,270
2029	13,702	155,052	30,156	104,752	24,937	13,004	26,642	21,316	5,125	0	506,693	184,943	10,271,618	10,754,280
2030	14,636	165,893	31,930	115,760	26,679	13,914	28,510	22,825	5,519	0	545,535	199,120	11,352,260	11,878,775
2031	15,570	175,748	33,704	125,408	28,275	14,751	30,217	24,187	5,913	1	580,838	212,006	12,293,875	12,859,414
2032	16,504	186,260	35,478	135,599	29,969	15,637	32,040	25,647	6,307	2	618,116	225,612	13,286,587	13,893,357
2033	17,438	197,429	37,252	145,790	31,770	16,576	33,954	27,205	6,701	3	656,861	239,754	14,287,756	14,936,465
2034	18,528	209,255	39,913	155,969	33,677	17,569	35,984	28,859	7,096	4	698,160	254,829	15,279,476	15,971,252
2035	19,618	221,738	42,574	166,160	35,702	18,625	38,152	30,611	7,490	5	741,070	270,490	16,285,687	17,021,349

With Project Case

Year	VOC (1000VND/day)										Total VOC (1000VND/day)	(E) Annual Total VOC (Mil.VND/yr)	TTC (1000VND/day)		
	Tan Vu IC - Dinh Vu					Dinh Vu - Cat Hai							Tan Vu IC - Dinh Vu		
	Motorcycle	Car	Mini Bus	Large Bus	Trailer	Motorcycle	Car	Mini Bus	Large Bus	Trailer			Bicycle	Motorcycle	Car
2015	132,444	25,353	4,791	2,100	26,977	136,807	40,442	7,654	3,359	43,178	423,104	154,433	278,568	54,439	15,528
2016	146,131	34,701	5,847	2,480	32,831	152,572	55,324	9,305	3,938	52,026	495,156	180,732	313,389	60,064	21,254
2017	158,343	45,585	7,027	2,862	38,941	167,321	72,148	11,089	4,545	61,784	569,645	207,920	345,582	65,084	27,920
2018	168,407	57,877	8,163	3,230	45,178	181,052	91,236	12,864	5,090	71,241	644,341	235,184	374,490	69,220	35,449
2019	177,264	71,578	9,485	3,607	52,098	193,767	112,589	14,996	5,678	82,196	723,259	263,990	401,427	72,861	43,841
2020	183,570	86,688	10,946	4,004	59,519	204,955	136,207	17,211	6,296	93,533	802,929	293,069	425,736	75,453	53,095
2021	196,720	103,206	13,071	4,818	72,727	199,870	151,090	19,221	7,057	106,646	874,427	319,166	444,132	80,858	63,212
2022	207,859	121,133	15,399	5,625	86,676	192,750	167,266	21,299	7,772	119,877	945,656	345,165	455,301	85,436	74,192
2023	216,580	139,443	17,942	6,472	102,412	184,612	183,119	23,524	8,490	134,376	1,016,972	371,195	458,586	89,021	85,407
2024	223,289	159,803	20,675	7,377	119,117	174,441	200,590	25,903	9,253	149,379	1,089,826	397,787	454,644	91,779	97,876
2025	227,852	181,443	23,593	8,284	137,387	163,761	219,032	28,534	9,995	165,971	1,165,852	425,536	442,818	93,654	111,131
2026	230,133	204,235	26,836	9,145	156,079	150,538	237,796	31,208	10,653	181,684	1,238,306	451,982	422,451	94,592	125,091
2027	230,267	228,308	30,294	10,030	176,960	136,807	257,855	34,239	11,326	199,812	1,315,898	480,303	394,857	94,647	139,835
2028	228,255	252,765	33,974	10,879	198,492	120,532	277,591	37,278	11,930	217,779	1,389,474	507,158	359,379	93,820	154,814
2029	223,961	279,399	37,923	11,765	221,182	103,749	298,944	40,500	12,579	236,314	1,466,314	535,205	316,674	92,055	171,127
2030	217,520	307,313	42,144	12,663	245,170	85,440	321,268	44,002	13,238	256,186	1,544,945	563,905	266,085	89,407	188,224
2031	226,107	338,045	48,210	13,351	269,407	77,812	339,062	19,828	13,391	237,147	1,582,361	577,562	253,602	92,937	207,046
2032	233,085	369,416	54,753	13,971	294,180	69,675	357,180	22,077	13,515	250,665	1,678,517	612,659	235,863	95,805	226,261
2033	238,721	401,684	61,759	14,515	319,475	61,029	376,268	24,510	13,592	264,217	1,775,772	648,157	212,211	98,122	246,024
2034	242,747	434,720	69,312	14,984	345,244	51,366	395,357	27,021	13,621	278,024	1,872,396	683,425	184,617	99,776	266,259
2035	245,565	468,653	77,480	15,558	370,992	40,686	414,769	29,758	13,770	291,783	1,969,013	718,690	150,453	100,935	287,042

Note: Design speed of 80km/hr is applied for "With Project Case".

Year	TTC (1000VND/day)									Total TTC (1000VND/day)	(F) Annual Total TTC (Mil.VND/yr)	(G) Total Cost (E+F) (Mil.VND/yr)	(H) Total VOC Saving (A-E) (Mil.VND/yr)	(I) Total TTC Saving (B-F) (Mil.VND/yr)	(J) Annual Incremental Benefit (D-G, or H+I+C) (Mil.VND/yr)
	Tan Vu IC - Dinh Vu			Dinh Vu - Cat Hai											
	Mini bus	Large bus	Trailer	Bicycle	Motorcycle	Car	Mini bus	Large bus	Trailer						
2015	4,422	5,233	2,964	445,105	85,904	24,508	1,903	8,284	3,345	930,203	339,524	487,396	-113,075	-282,151	340,966
2016	5,397	6,180	3,607	496,400	94,455	33,527	2,461	9,710	4,112	1,050,557	383,453	556,590	-123,010	-319,608	862,423
2017	6,486	7,134	4,278	544,385	102,037	43,723	3,113	11,207	4,988	1,165,938	425,567	624,881	-133,684	-354,940	1,387,748
2018	7,535	8,050	4,964	589,061	108,106	55,291	3,715	12,552	5,835	1,274,268	465,108	690,671	-144,211	-387,369	1,920,096
2019	8,756	8,989	5,724	630,428	113,483	68,231	4,472	14,003	6,821	1,379,036	503,348	756,554	-155,955	-418,066	2,454,447
2020	10,104	9,980	6,539	666,831	117,343	82,544	5,266	15,525	7,857	1,476,272	538,839	819,972	-167,753	-445,561	2,989,883
2021	12,066	12,008	7,990	650,284	117,343	91,563	6,019	17,404	9,144	1,512,022	551,888	858,218	-156,871	-447,931	4,404,143
2022	14,215	14,019	9,523	627,119	116,793	101,366	6,870	19,166	10,464	1,534,463	560,079	891,595	-156,759	-446,694	5,364,118
2023	16,562	16,131	11,252	600,644	115,688	110,974	7,761	20,936	11,917	1,544,878	563,880	920,556	-154,772	-440,372	6,392,904
2024	19,084	18,385	13,087	567,551	114,033	121,561	8,671	22,818	13,416	1,542,905	563,160	945,479	-151,301	-428,599	7,501,621
2025	21,778	20,646	15,095	532,803	111,829	132,737	9,773	24,649	15,095	1,532,007	559,182	968,313	-147,069	-412,789	8,701,158
2026	24,771	22,793	17,148	489,781	108,933	144,109	10,853	26,269	16,695	1,503,486	548,773	983,441	-216,931	-401,595	6,731,861
2027	27,963	24,998	19,442	445,105	105,760	156,265	12,117	27,930	18,549	1,467,468	535,626	997,622	-219,019	-376,629	7,675,999
2028	31,360	27,113	21,808	392,156	101,762	168,225	13,353	29,419	20,396	1,413,605	515,966	1,003,847	-218,251	-344,420	8,687,423
2029	35,005	29,321	24,301	337,552	97,350	181,166	14,711	31,019	22,314	1,352,595	493,697	1,008,667	-217,250	-308,754	9,745,614
2030	38,902	31,559	26,937	277,984	92,386	194,694	16,195	32,645	24,375	1,279,393	466,979	1,009,628	-215,255	-267,858	10,869,147
2031	44,502	33,275	29,599	253,164	92,248	205,478	18,110	33,023	25,780	1,288,763	470,399	1,047,960	-224,029	-258,393	11,811,453
2032	50,541	34,821	32,321	226,689	91,695	216,458	20,163	33,329	27,250	1,291,195	471,286	1,083,945	-231,503	-245,675	12,809,410
2033	57,008	36,175	35,100	198,560	90,868	228,026	22,386	33,519	28,723	1,286,722	469,654	1,117,810	-239,203	-229,900	13,818,653
2034	63,979	37,346	37,932	167,121	89,766	239,593	24,679	33,590	30,224	1,274,882	465,332	1,148,757	-246,479	-210,505	14,822,492
2035	71,519	38,776	40,760	132,373	88,386	251,357	27,179	33,957	31,720	1,254,457	457,877	1,176,567	-253,520	-187,388	15,844,779

Source: Study Team

5.2. Economic Evaluation

(1) *General Conditions for the Evaluation*

The following conditions are assumed for the purpose of the economic evaluation:

- Price level is adapted to 2010 constant prices
- Economic project life is set for 2012-2035.
- Standard Conversion Factor (SCF) at 0.85 is applied for non-traded goods and services in the project costs, benefits and O&M costs
- Major rehabilitation works are assumed every seven years after the opening
- Procurement costs for O&M equipment and materials are assumed at 5% of the construction costs
- Opportunity cost of capital (discount rate) is set at 12%.
- Construction period is assumed at 32 months during 2012-2015

(2) *Economic Project Cost and Investment Schedule*

All the costs and benefits, estimated from market prices, need to be converted into economic terms in the economic analysis by excluding price escalation and transfer items such as taxes and subsidies. In this study, the Standard Conversion Factor (SCF) is at 0.85, which is generally used in the recent studies in Vietnam's transport sector, is applied to the construction costs in order to obtain the economic prices. The obtained economic project cost is presented in Table 16.

Table 16 Economic Project Cost

	Item	Local Currency (in VND)	Foreign Currency (in JPY)	Economic Project Cost in VND
I	Construction Expenses	3,360,985,000,000	5,390,000,000	4,374,142,894,737
II	Price Escalation (I×10.3%(L), I×1.8%(F))	-	-	-
III	Physical Contingency ((I+II)×5%)	168,049,250,000	269,500,000	218,707,144,737
IV	Cosulting Service	77,704,450,000	1,115,000,000	287,290,916,165
V	Land Acquisition, HIV/AIDS prevension	258,760,400,000	-	258,760,400,000
VI	Administration Cost ((I+II+III+Ⅳ+Ⅴ)×5%)	193,274,955,000	338,725,000	256,945,067,782
VII	VAT ((I+II+III+Ⅳ)×10%)	-	-	-
VIII	Import Tax (10%)	-	-	-
IX	Interest during Construction (Temporary)	-	-	-
X	Commitment Charge	-	-	-
	Total Economic Cost	4,058,774,055,000	7,113,225,000	5,395,846,423,421

Source: Study Team

The economic project costs are allocated according to the implementation schedule as shown in Table 17 below.

Table 17 Disbursement Schedule of Economic Project Cost

(Unit: Mil. VND)

Year	Costs	
	Mil.VND	%
2012	809,377	15%
2013	2,428,131	45%
2014	1,888,546	35%
2015	269,792	5%
Total	5,395,846	100%

Source: Study Team

(3) *Evaluation Indicators and Cost-Benefit Streams*

The following three kinds of evaluation indicators are calculated:

- Economic Internal Rate of Return (EIRR)
- Net Present Value (NPV)
- Benefit/Cost Ratio (B/C)

The cost and benefit streams and the results of evaluation are presented in Table 18 below.

Table 18 Results of Economic Evaluation

(Unit: Million VND)

Year	Initial Investment Cost	Routine/Repair Works*	Major Replacement	Annual Total Cost	Annual Incremental Benefit**	Annual Net Benefit
2012	809,377			809,377	0	-809,377
2013	2,428,131			2,428,131	0	-2,428,131
2014	1,888,546			1,888,546	0	-1,888,546
2015	269,792	218,707		488,499	249,042	-239,458
2016		15,522		15,522	852,061	836,539
2017		15,522		15,522	1,375,950	1,360,428
2018		15,522		15,522	1,906,845	1,891,323
2019		15,522		15,522	2,439,524	2,424,002
2020		15,522		15,522	2,973,288	2,957,766
2021		15,522	63,776	79,298	4,386,202	4,306,904
2022		15,522		15,522	5,344,939	5,329,417
2023		15,522		15,522	6,372,393	6,356,871
2024		15,522		15,522	7,479,653	7,464,131
2025		15,522		15,522	8,677,732	8,662,210
2026		15,522		15,522	6,706,991	6,691,469
2027		15,522		15,522	7,649,543	7,634,021
2028		15,522	63,776	79,298	8,659,396	8,580,098
2029		15,522		15,522	9,716,015	9,700,493
2030		15,522		15,522	10,837,866	10,822,344
2031		15,522		15,522	11,811,453	11,795,931
2032		15,522		15,522	12,809,410	12,793,888
2033		15,522		15,522	13,818,653	13,803,131
2034		15,522		15,522	14,822,492	14,806,970
2035		15,522	63,776	79,298	15,844,779	15,765,481

EIRR =	32.1%
NPV =	19,858,215
B/C =	5.5
Discount rate =	12%

Note: * Procurement cost for O&M equipment is included as 5% of construction cost before opening.
** Benefit in the first year (2015) is adjusted by deduction of the first quarter benefit (original x 3/4).

Source: Study Team

The above results indicate that implementation of the project is economically feasible with values of EIRR sufficiently higher than the opportunity cost of capital (>12%), B/C ratio higher than unity (>1), and positive NPV (>0).

(4) *Economic Evaluation under the Different Condition regarding Container Transportation*

In the above analysis, all containers are assumed to be transported between Tan Vu IC and Lach Huyen port. In this alternative case, it is assumed that 50% of the projected containers be transported between Hai Phong port and Lach Huyen port, while holding all other conditions at the same as the above analysis in order to see the impact on how EIRR would change. This implies that, under "Without Project Case" 50% of the containers would not transferred to Tan Vu IC, while under "With Project Case" 50% of container traffic would need to go beyond Tan Vu IC toward Hai Phong port, which would require extending the travel distance by 8km (refer to Figure 3).

With such condition, the cost and benefit streams and the results of evaluation are presented in Table 19 below.

Table 19 Results of Economic Evaluation under the Different Condition

(Unit: Million VND)

Year	Initial Investment Cost	Routine/Repair Works*	Major Replacement	Annual Total Cost	Annual Incremental Benefit**	Annual Net Benefit
2012	809,377			809,377	0	-809,377
2013	2,428,131			2,428,131	0	-2,428,131
2014	1,888,546			1,888,546	0	-1,888,546
2015	269,792	218,707		488,499	230,490	-258,010
2016		15,522		15,522	816,137	800,615
2017		15,522		15,522	1,328,660	1,313,138
2018		15,522		15,522	1,848,056	1,832,534
2019		15,522		15,522	2,368,846	2,353,324
2020		15,522		15,522	2,890,403	2,874,881
2021		15,522	63,776	79,298	4,276,448	4,197,150
2022		15,522		15,522	5,214,201	5,198,679
2023		15,522		15,522	6,218,726	6,203,204
2024		15,522		15,522	7,301,484	7,285,962
2025		15,522		15,522	8,473,203	8,457,681
2026		15,522		15,522	6,519,368	6,503,846
2027		15,522		15,522	7,437,684	7,422,162
2028		15,522	63,776	79,298	8,422,239	8,342,941
2029		15,522		15,522	9,452,236	9,436,714
2030		15,522		15,522	10,545,966	10,530,444
2031		15,522		15,522	11,493,183	11,477,661
2032		15,522		15,522	12,463,732	12,448,210
2033		15,522		15,522	13,445,285	13,429,763
2034		15,522		15,522	14,421,196	14,405,674
2035		15,522	63,776	79,298	15,415,550	15,336,252
					EIRR =	31.6%
					NPV =	19,196,701
					B/C =	5.3
					Discount rate =	12%

Note: * Procurement cost for O&M equipment is included as 5% of construction cost before opening.
** Benefit in the first year (2015) is adjusted by deduction of the first quarter benefit (original x 3/4).

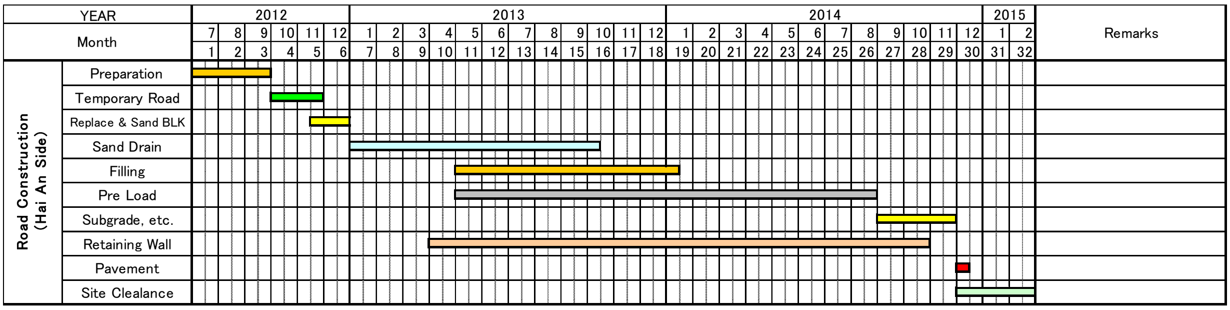
Source: Study Team

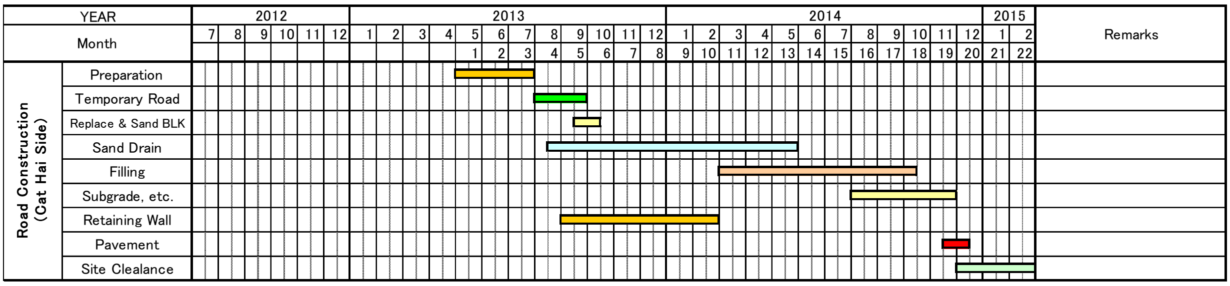
The result shows that the annual incremental benefits have slightly decreased and resulted in 0.5% reduction in EIRR from 32.1% to 31.6%.

6. Construction Schedule

The following tables were updated considering 1) revision of the typical cross section of the bridge and 2) construction period of 32 months.

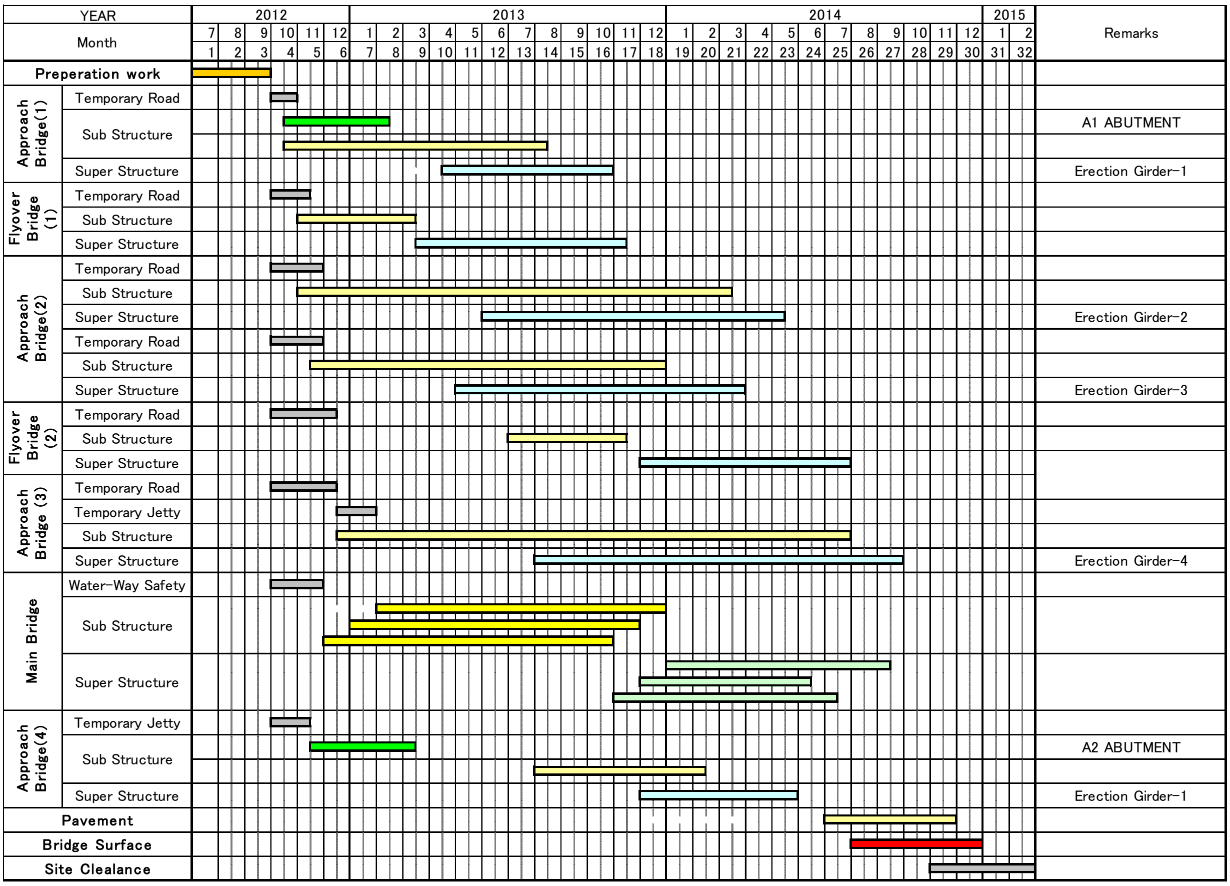
Table 20 Construction Schedule (Road Section)





Source: Study Team

Table 20 Construction Schedule (Bridge Section, 32 months)



Source: Study Team

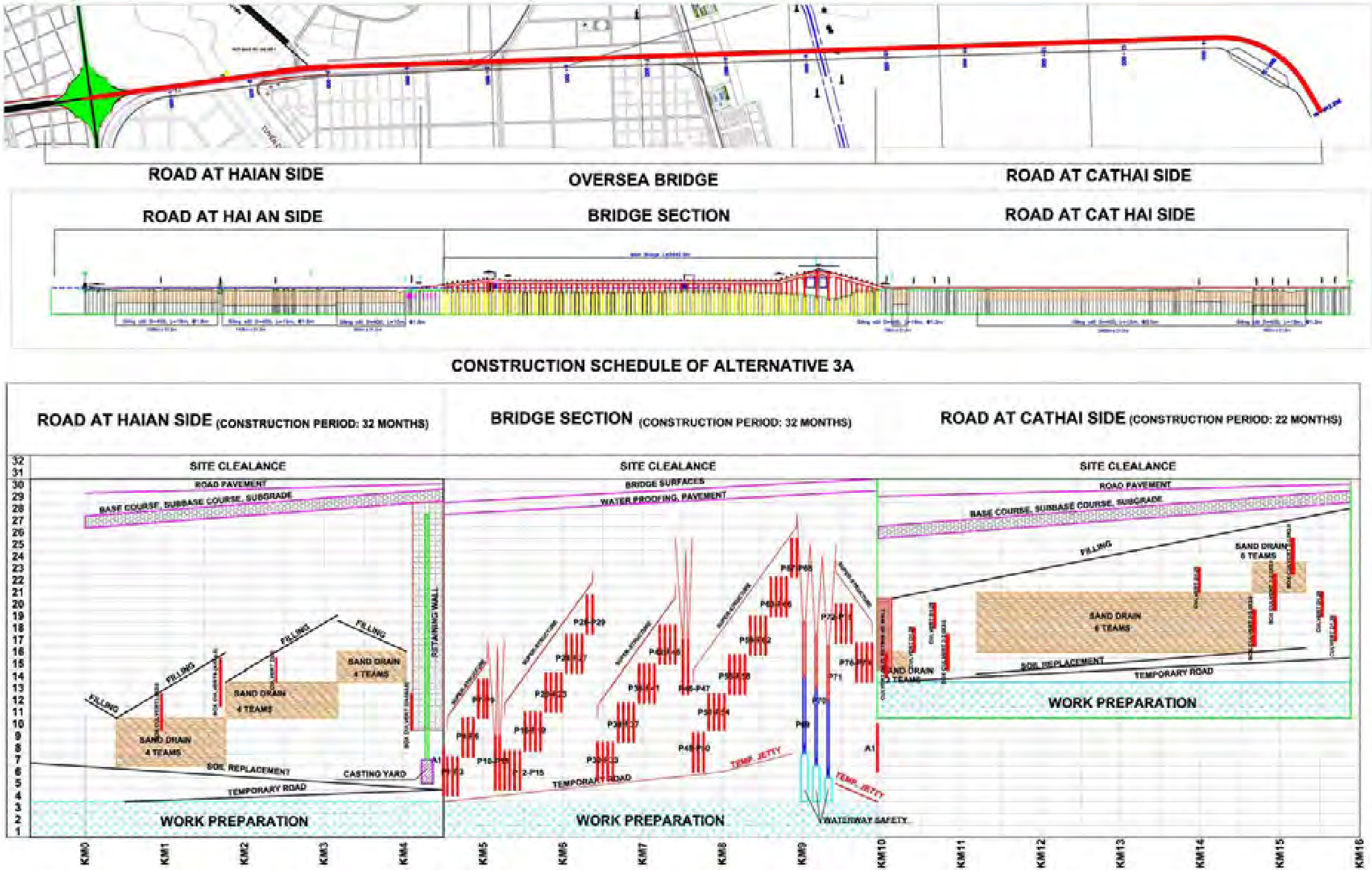


Figure 4 Construction Schedule (32 Months)

7. Implementation Agency and Implementation Program

The implementation program (I/P) in this Study is established based on following assumptions,

- STEP scheme of Japanese ODA Loan is applied,
- Consulting services of Detail Design and Tender Assistance are supported by Japanese Grant,
- Loan Agreement is signed in September 2010, and,
- Construction period is 32 months.

The implementation program (I/P) is as follows and shown in Table 20, assuming the common practice.

Table 21 Implementation Milestones (After JICA Follow-up Mission in June 2010)

Event/ Milestone	Time/ Period
Preparatory Stage	
SAPROF Study	: April 2010 to July 2010
JICA Follow-up Mission	: Jun 2010
Pledge by Japanese Government	: August 2010
Exchange Note & Loan Agreement	: September 2010
Procurement of D/D consultant	: August 2010 to October 2010
Detail Design	: October 2010 to August 2011
Procurement of C/S Consultant	: November 2010 to August 2011
P/Q Period	: May 2011 to July 2011
Bidding Time	: August 2011 to July 2012
Land Acquisition	: January 2011 to July 2012
Construction	: August 2012 to March 2015
Defect Liability Period	: March 2015 to February 2017

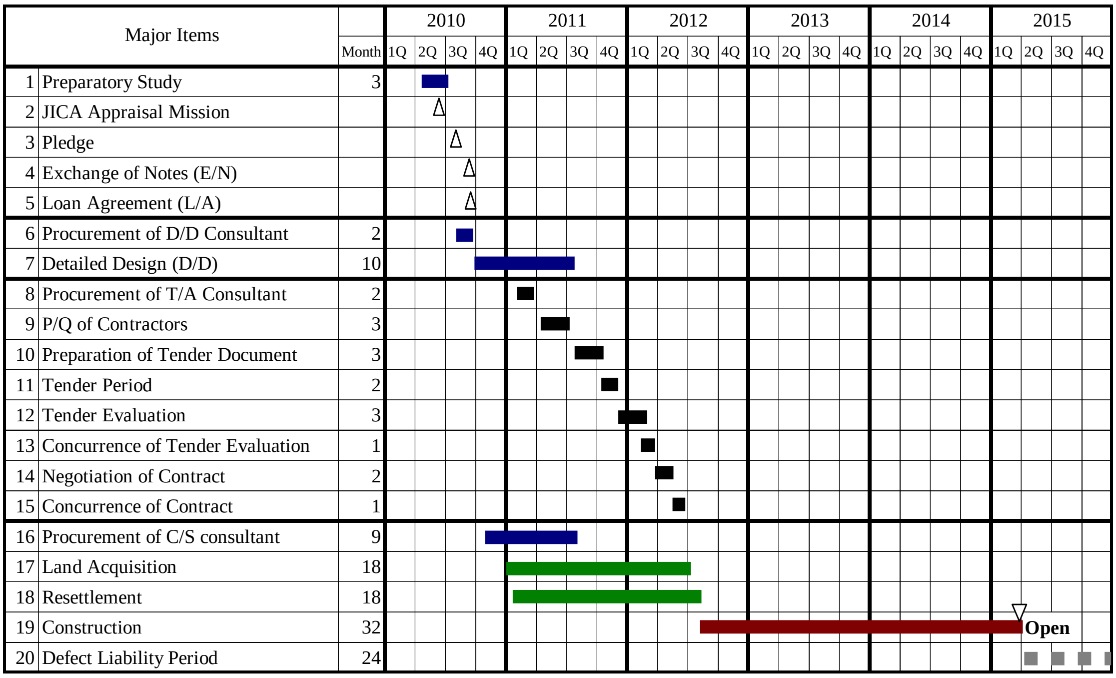


Figure 5 Proposed Implementation Program

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