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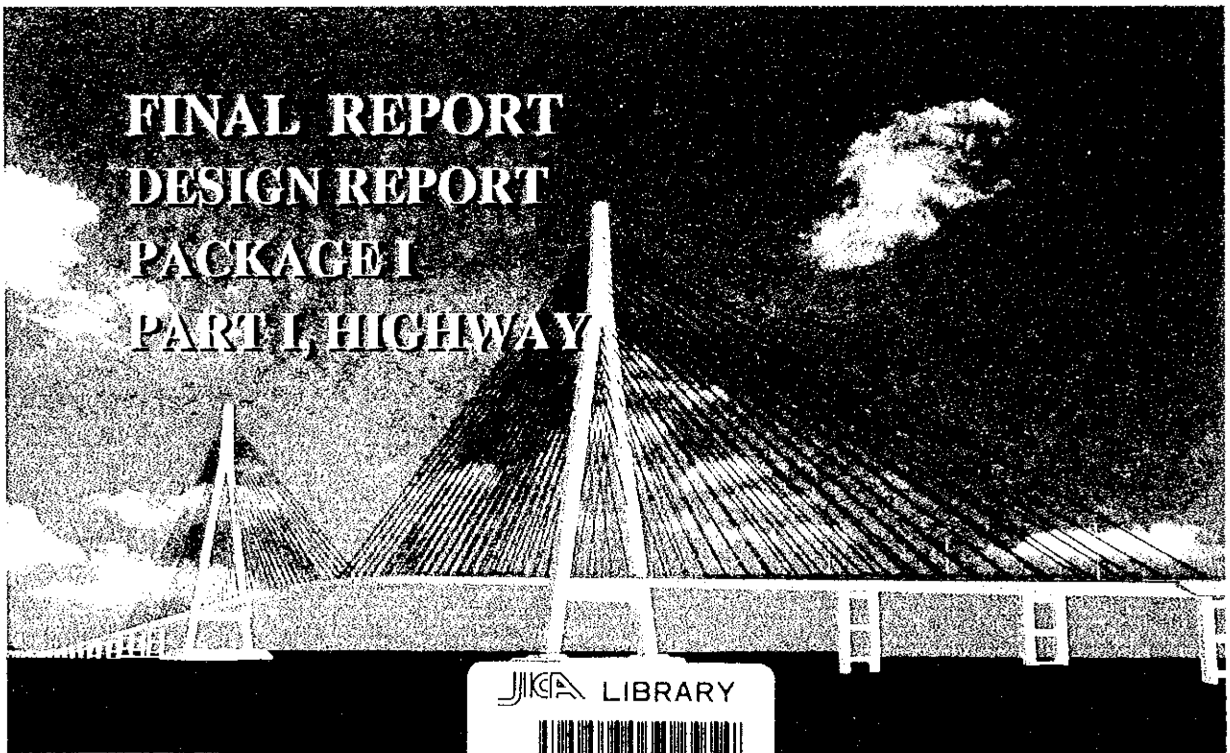
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF TRANSPORT
SOCIALIST REPUBLIC OF VIET NAM

THE DETAILED DESIGN ON THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM



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FINAL REPORT
DESIGN REPORT
PACKAGE I
PART I, HIGHWAY

OCTOBER 2000

NIPPON KOEI CO., LTD.

FINAL REPORT
ON
THE DETAILED DESIGN OF THE CAN THO BRIDGE CONSTRUCTION
IN
SOCIALIST REPUBLIC OF VIET NAM

DESIGN REPORT
PACKAGE-I
PART I, HIGHWAY

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Chapter 1

ALIGNMENT DESIGN

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CHARTER 1 ALIGNMENT DESIGN

CONTENTS

1-1. GENERAL

The project route was planned to connect two sides of Hau River at downstream distance of about 3.2km from the existing ferry.

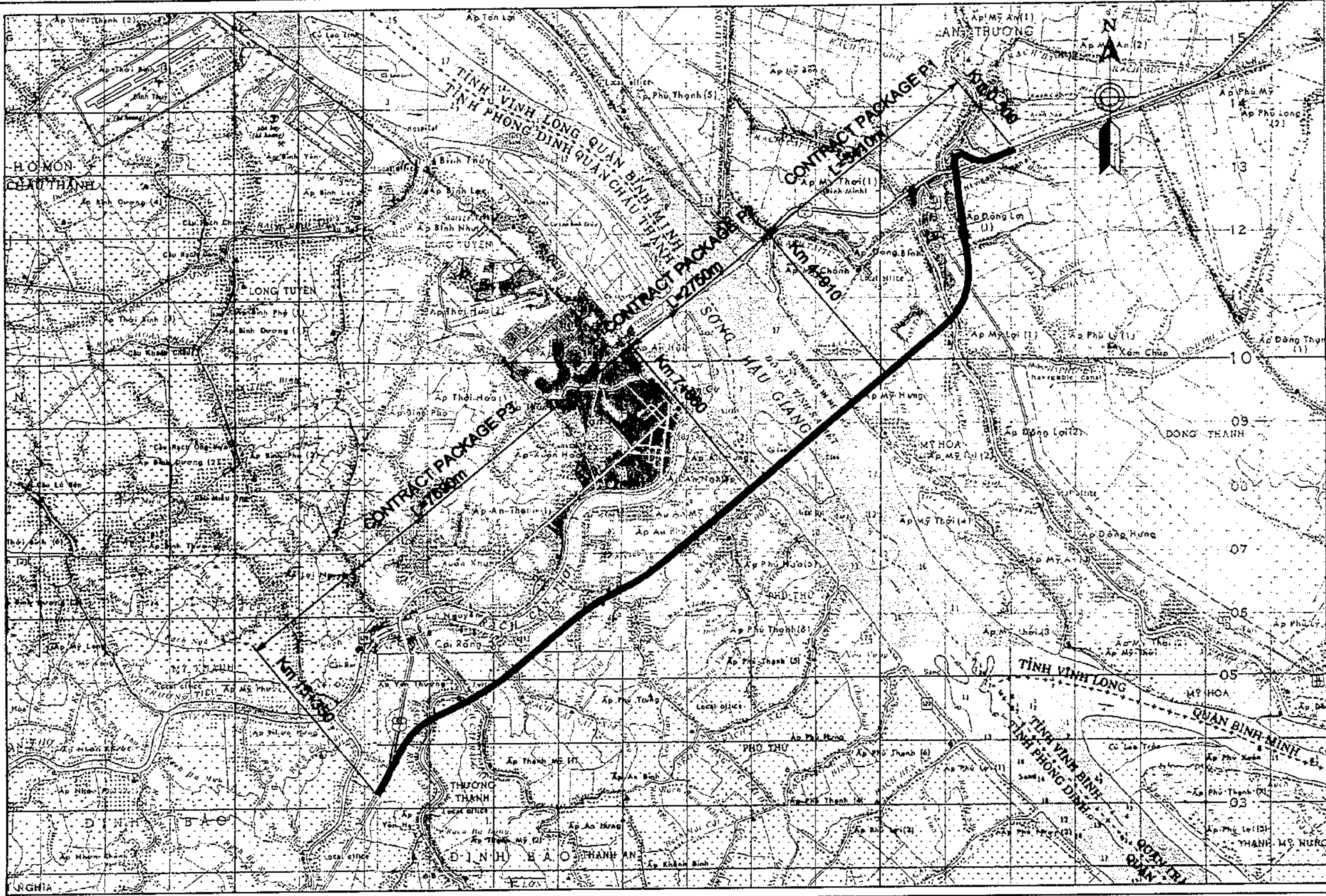
The starting point is at Km2061 on National highway No.1A of Binh Minh District in Vinh Long Province. The end is at Km2077 on National highway No.1A of Chau Thanh District, Can Tho Province.

The overall length of the project is 15 850m, including:

Total length of the approach road	:	13 100 m
Vinh Long side	:	5 410 m
Can Tho side	:	7 690 m
Length of the Can Tho bridge	:	2 750 m

Moreover, the project route is divided to 3 packages as below.

Package 1	Km 0-500	to	Km 4+910	5 410 m
Package 2	Km 4+910	to	Km 7+660	2 750 m
Package 3	Km 7+660	to	Km15+350	7 690 m



THE DETAIL DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPULIC OF VIETNAM	FIGURE 1. LOCATION MAP
	JAPAN INTERNATIONAL COOPERATION AGENCY

1-2. PRINCIPALS TO DETERMINE THE ALIGNMENT

In the Feasibility Study, the centerline of the project route was determined at the 2.9km downstream from the existing Can Tho ferry. To determine the final centerline for the Detailed Design, the following conditions were investigated and discussed with the related officers and people.

- Connecting point with the National Highway No.1
- Area and location of temples and tombs
- Public facilities such as hospitals, schools, and disposal sites
- Density of residential areas including markets
- Consistency with the Master Plans of Industrial Zone and City Development
- Future planning of roads and interchanges
- Dockyard Facilities and fuel stations for ships
- Confluence point of the stream and/or canal
- Influence of the ecosystem

Mainly due to the locations of temples and cemeteries, the centerline was finally shifted 220m to the downstream side from the centerline of the Feasibility Study.

1-3. GEOMETRIC DESIGN STANDARD

Vietnamese standard "TCVN 4054-1998" was mainly applied to highway design for the project.

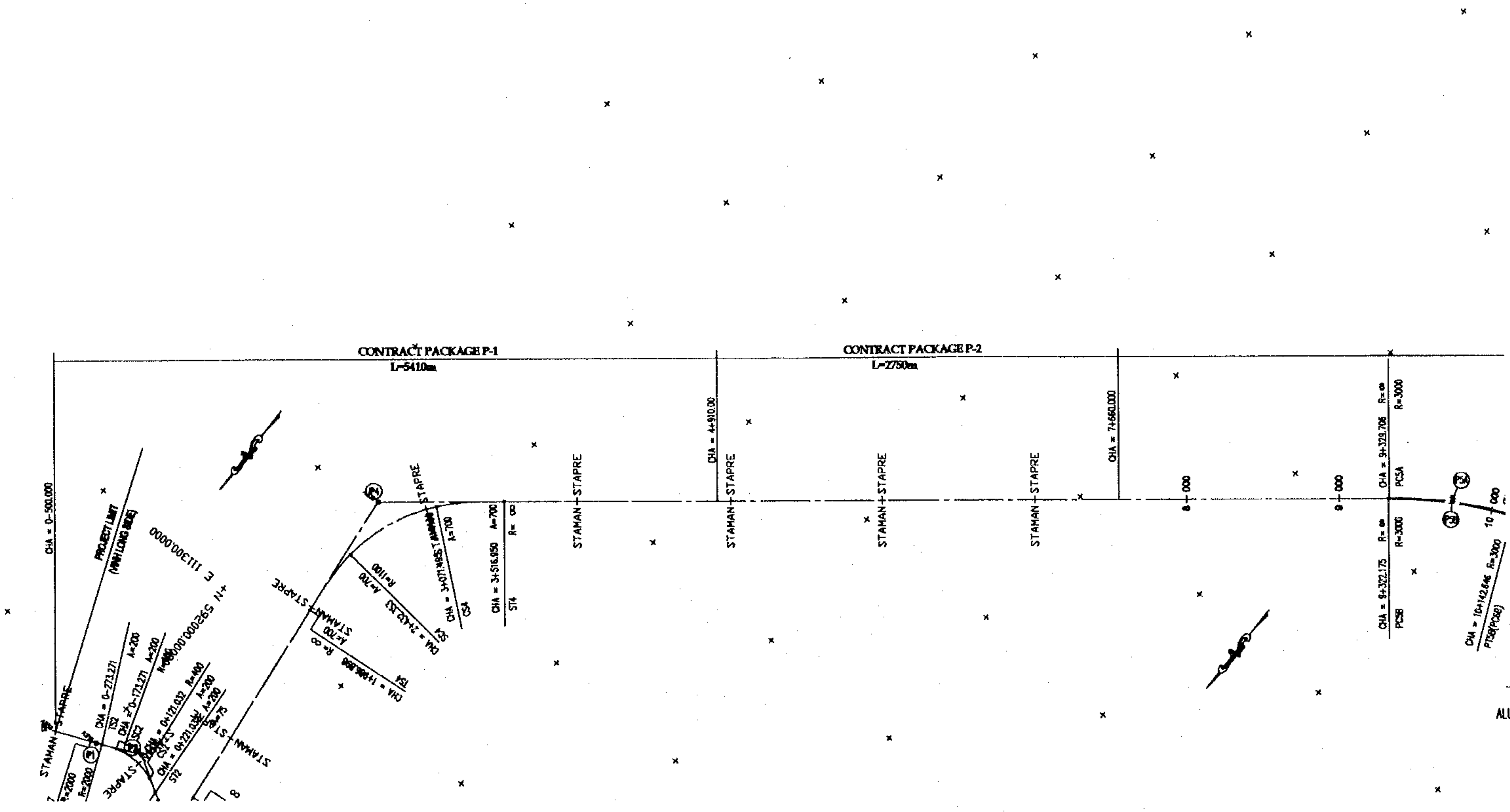
Where no provisions exist in TCVN4054, the relevant standards of AASHTO (A Policy on Geometric Design of Highways and Streets, 1994) of United States, JRSO (Japan Road Structure Ordinance, 1983) of Japan were referred.

The design standard and adopted values for the highway were summarized in Table 1.1.

Table 1.1 Geometric Design Standard and Adopted Values for Highway Design

No.	Items			Unit	Type/value: STANDARD		Type/value: DESIGN		Reference
1	Basic conditions	Class of Highway		-	80	60	80	60	TCVN4054
		Terrain		-	Plain		Plain		TCVN4054
		Design Speed		kph	80	60	80	60	TCVN4054
		Design Vehicles		-	Truck with Trailer				TCVN4054
2	Cross Section Elements	Total Width		m	24.1		24.1		
		Lane Number		-	4		4		
		Lane width	Right side lane width	m	3.5		3.5		
			Left side lane width	m	3.5		3.5		
		Median	Total width	m	2.6		2.6		
			Separator width	m	1.6		1.6		
			Safety portion	m	0.5		0.5		
		Sidewalk	Total width	m	2.75		2.75		
			Separator width	m	0.5		0.5		
		Shoulder	Earthen shoulder	m	0.5		0.5		
		Slop of embankment		-	V: H=1:2		V: H=1:2		
3	Horizontal Alignment	Minimum Radius	Super-elevation=6%	m	250	125	-	-	TCVN4054
			Super-elevation=4%	m	400	250	-	-	TCVN4054
		Minimum Radius with Normal Cross Slope		m	1000	500	1100	-	TCVN4054
		Transition Curve	Spiral type	-	Clothoid		Clothoid		TCVN4054
			Minimum length of transition	m	50	40	445.5	-	AASHTO
			Minimum radius w/o transition	m	2000	1300	1100	-	AASHTO
4	Vertical Alignment	Maximum gradient		%	6	7	4.35	-	TCVN4054
		Minimum Radius of Vertical Curve	Crest	m	4000	2500	4027	-	TCVN4054
			Sag	m	2000	1000	2027	-	TCVN4054
		Minimum Length of Vertical Curve		m	50	40	70	70	TCVN4054
		Critical length of grads	Less than 4.0%	m	No limit		-		TCVN4054
			For 4.0%	m	900	1000	-	-	TCVN4054
			For 5.0%	m	700	800	285	-	TCVN4054
			For 6.0%	m	500	600	-	-	TCVN4054
5	Cross slope	Normal Cross Slope		%	2		2		TCVN4054
		Maximum Superelevation		%	6	6	-	-	TCVN4054
6	Clearance	Lateral Clearance		m	All Paved Width				TCVN4054
		Vertical Clearance		m	4.5		4.5		TCVN4054

Note: The section at the interchange No.1 is temporarily designed with 40km/h speed to get a good condition for the improvement and connect to express way HO CHI MINH city - CAN THO in the future. (Regarding a letter No.61/QD-TTg)



NOTES :

ALL LENGTH UNITS ARE IN METERS .

	IA	R	A1	A2	TL1	TL2	CL	L1	L2	LC	IP X	IP Y	PC X	PC Y	PC CHA	PT X	PT Y	PT CHA
B.P	–	–	–	–	–	–	–	–	–	–	1114395.90470	592300.00000	–	–	–	–	–	–
IP-1	2°13'55.64"	2000	–	–	38.96000	38.96000	77.915800	–	–	77.915800	1114290.56622	592042.92577	1114305.33946	592078.97925	0-351.18678	1114274.39998	592007.47504	0-273.27099
IP-2	56°28'46.96"	400	200.00000	200.00000	265.37000	265.37000	294.30276	100.00000	100.00000	494.30276	1114164.29429	591766.02573	–	–	–	–	–	–
IP-3	174°17'21.87"	125	75.00000	75.00000	278.31000	278.31000	233.54664	45.00000	45.00000	323.54664	1114452.12503	591304.78750	–	–	–	–	–	–
IP-4	56°29'36.56"	1100	700.00000	700.00000	817.42621	817.42621	1530.05170	445.45455	445.45455	639.14260	1111926.66483	591557.33352	–	–	–	–	–	–

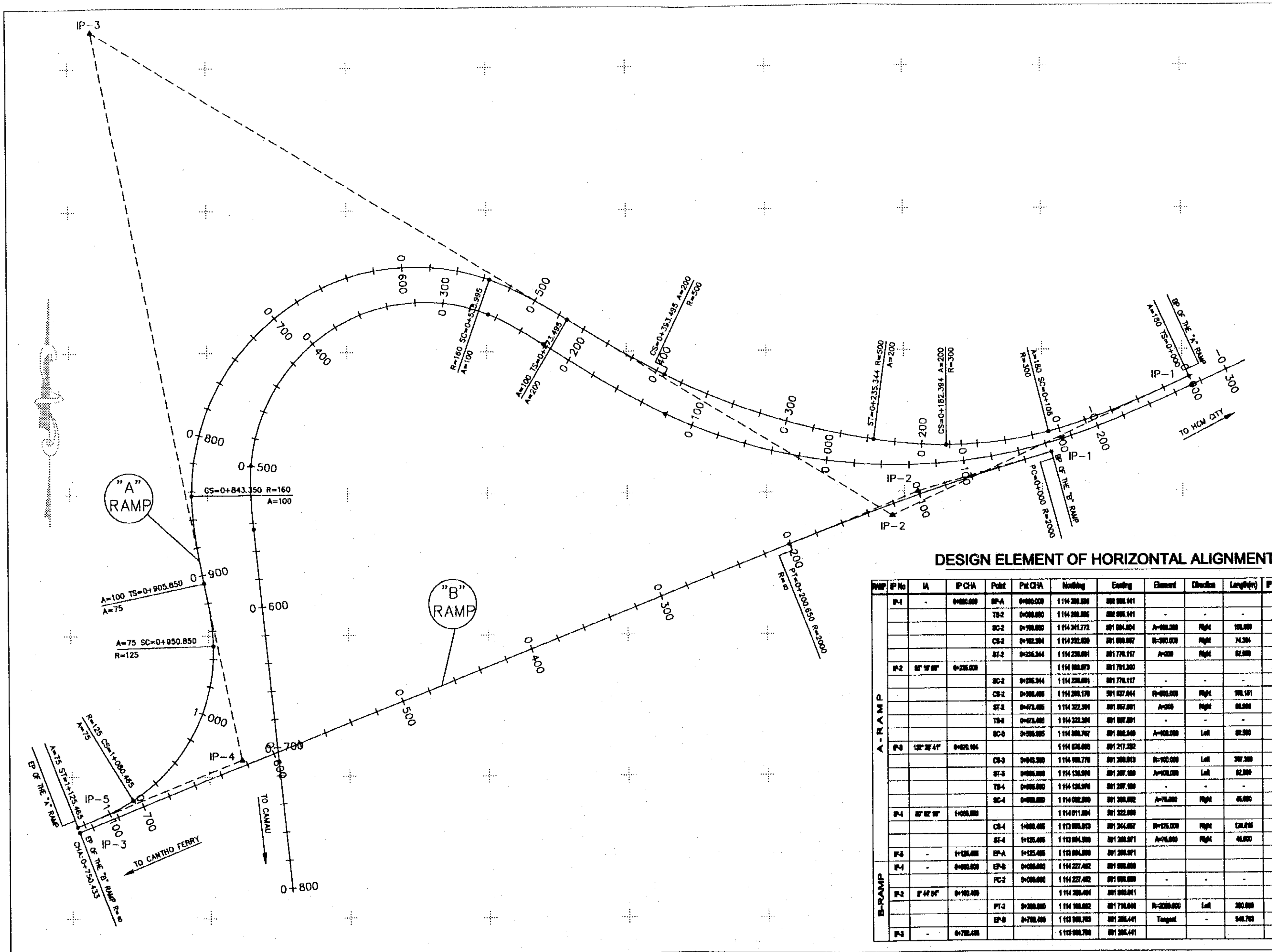
	TS X	TS Y	TS CHA	SC X	SC Y	SC CHA	CS X	CS Y	CS CHA	ST X	ST Y	ST CHA	AZIMUTH	V (KM/H)	SE (%)	W (M)
B.P	–	–	–	–	–	–	–	–	–	–	–	–	247° 43' 5.50"	40	–	0
IP-1	–	–	–	–	–	–	–	–	–	–	–	–	245° 29' 9.85"	40	–	0
IP-2	1114274.39998	592007.47504	0-273.27099	1114255.45663	591627.80299	0-173.27099	1114236.76018	591914.90418	0+121.03177	1114304.78433	591540.89558	0+221.03177	301° 57' 56.81"	40	–	0
IP-3	1114304.78433	591540.89558	0+221.03177	1114220.09634	591330.69756	0+266.03177	1114326.24554	591501.41658	0+499.57841	1114175.19649	591332.48035	0+544.57841	174° 17' 21.87"	40	2.0	0.8
IP-4	1112740.03432	591475.99657	1+986.89854	1112295.62139	591490.31116	2+432.35308	1111713.55431	591248.78069	3+071.49568	1111409.83844	590924.02783	3+516.95023	230° 46' 58.43"	80	–	0

THE DETAIL DESIGN OF
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPULIC OF VIETNAM

FIGURE 2. ALIGNMENT LAYOUT AND GEOMETRIC DATA

(THROUTHWAY)

JAPAN INTERNATIONAL COOPERATION AGENCY



DESIGN ELEMENT OF HORIZONTAL ALIGNMENT

RAMP	IP No	IA	IP CHA	Point	Pnt CHA	Northing	Easting	Element	Direction	Length(m)	IP Distance	Azimuth
A-RAMP	IP-1	-	0+000.000	BP-A	0+000.000	1 114 2[illegible]	[illegible] 141				-	245° 27' [illegible]
				TS-2	0+000.000	1 114 2[illegible]	[illegible] 141	-	-	-		
				SC-2	0+108.000	1 114 241.772	501 [illegible]	A=[illegible]	Right	108.000		
				CS-2	0+182.394	1 114 232.[illegible]	501 [illegible]	R=300.000	Right	74.394		
				ST-2	0+235.344	1 114 23[illegible]	501 776.117	A=200	Right	52.[illegible]		
	IP-2	55° 16' [illegible]	0+235.000			1 114 [illegible]	501 791.[illegible]				235.[illegible]	20[illegible]° 47' [illegible]
				SC-2	0+235.344	1 114 23[illegible]	501 776.117	-	-	-		
				CS-2	0+393.495	1 114 2[illegible].170	501 [illegible]	R=500.000	Right	158.151		
				ST-2	0+473.495	1 114 322.[illegible]	501 [illegible]	A=200	Right	80.000		
				TS-3	0+473.495	1 114 322.[illegible]	501 [illegible]	-	-	-		
				SC-3	0+523.995	1 114 [illegible]	501 [illegible]	A=100.000	Left	52.500		
	IP-3	132° 25' 41"	0+670.104			1 114 [illegible]	501 217.232				[illegible].440	10[illegible]° 22' 1[illegible]"
				CS-3	0+843.350	1 114 [illegible].770	501 [illegible]	R=160.000	Left	3[illegible]		
				ST-3	0+905.[illegible]	1 114 13[illegible]	501 2[illegible]	A=100.000	Left	62.[illegible]		
				TS-4	0+905.850	1 114 13[illegible]	501 2[illegible]	-	-	-		
				SC-4	0+950.850	1 114 0[illegible]	501 3[illegible]	A=75.000	Right	45.000		
	IP-4	[illegible]° 02' [illegible]"	1+0[illegible]			1 114 011.[illegible]	501 322.[illegible]				524.[illegible]	[illegible]° 2[illegible]' 32"
				CS-4	1+080.465	1 113 [illegible]	501 244.[illegible]	R=125.000	Right	1[illegible].615		
				ST-4	1+125.465	1 113 [illegible]	501 2[illegible]	A=75.000	Right	45.000		
	IP-5	-	1+125.465	EP-A	1+125.465	1 113 [illegible]	501 2[illegible]				-	[illegible]° 2[illegible]' 32"
B-RAMP	IP-1	-	0+000.000	BP-B	0+000.000	1 114 227.[illegible]	501 [illegible]				-	2[illegible]° 0[illegible]' [illegible]"
				PC-2	0+000.000	1 114 227.[illegible]	501 [illegible]	-	-	-		
	IP-2	[illegible]° 44' 54"	0+100.4[illegible]			1 114 2[illegible]	501 [illegible]				100.4[illegible]	[illegible]° 2[illegible]' 32"
				PT-2	0+200.650	1 114 1[illegible]	501 71[illegible]	R=2000.000	Left	200.[illegible]		
				EP-B	0+750.433	1 113 [illegible]	501 2[illegible].441	Tangent	-	5[illegible]		
	IP-3	-	0+750.433			1 113 [illegible]	501 2[illegible].441				[illegible].102	[illegible]° 2[illegible]' 32"

THE DETAIL DESIGN OF
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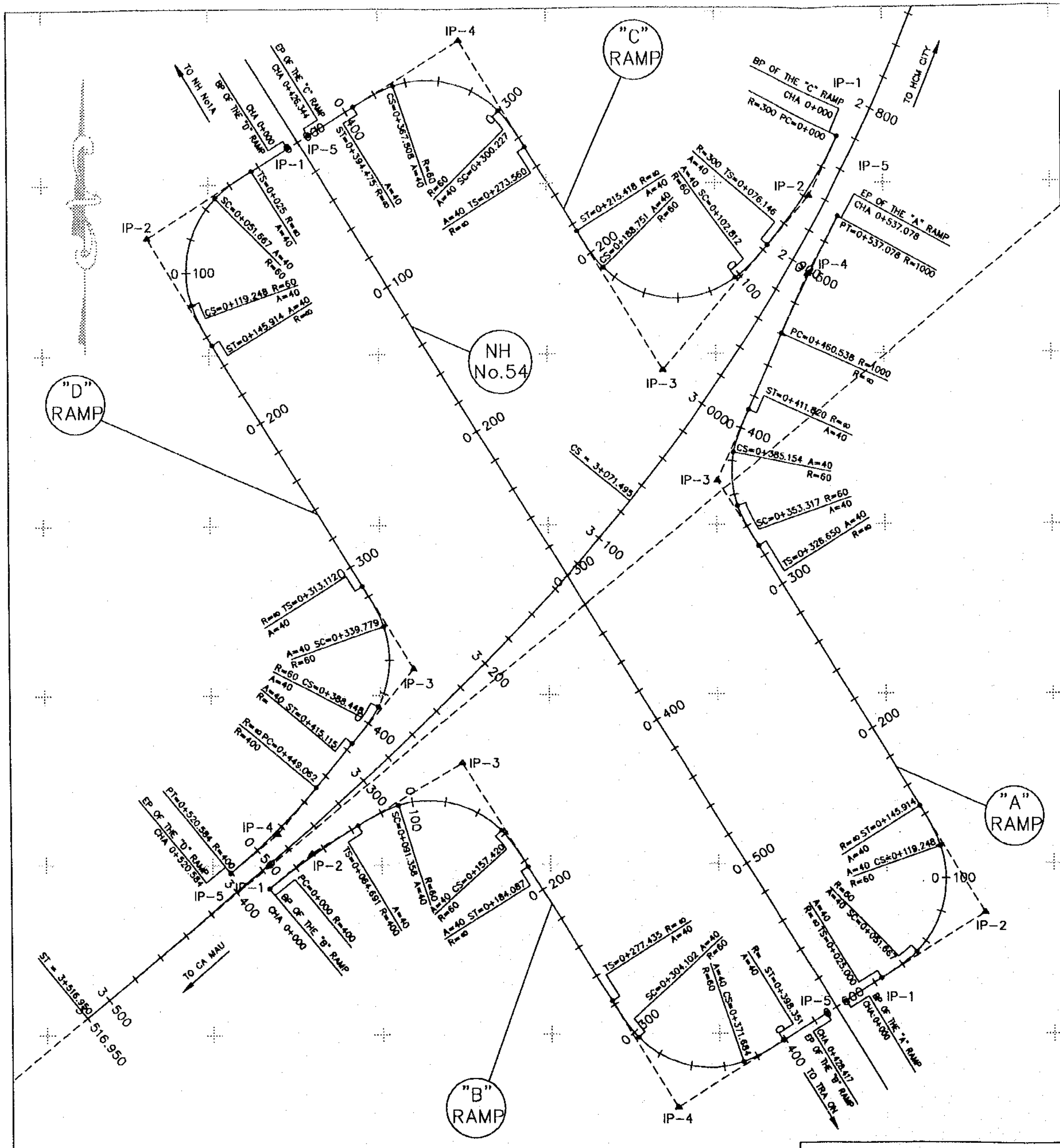
FIGURE 3. ALIGNMENT LAYOUT AND GEOMETRIC DATA
(INTERCHANGE 1)

JAPAN INTERNATIONAL COOPERATION AGENCY



DESIGN ELEMENT OF HORIZONTAL ALIGNMENT

RAMP	IP No	IA	IP CHA	Point	Pnt CHA	Northing	Easting	Element	Direction	Length(m)	IP Distance	Azimuth
A-RAMP	IP-1	-	0+000.000	BP-A	0+000.000	[illegible]	591 378.410				-	[illegible]
				TS-2	0+025.000	1 111 431.704	[illegible]	Tangent	-	25.000		
				SC-2	0+051.667	1 111 447.4[illegible]	591 416.140	A=40.000	Left	26.667		
	IP-2	90° 00' 00"	[illegible]			1 111 476.736	[illegible]				[illegible]	[illegible]
				CS-2	[illegible]	[illegible]	591 432.736	R=60.000	Left	67.581		
				ST-2	0+145.914	1 111 [illegible].431	591 430.307	A=40.000	Left	26.667		
				TS-3	0+320.000	[illegible]	[illegible]	Tangent	-	[illegible]		
				SC-3	0+353.317	1 111 710.637	591 312.709	A=40.000	Right	26.667		
	IP-3	[illegible]	0+372.[illegible]			1 111 726.811	[illegible]				[illegible]	[illegible]
				CS-3	0+385.154	1 111 741.[illegible]	[illegible]	R=60.000	Right	31.837		
				ST-3	0+411.820	1 111 7[illegible]	[illegible]	A=40.000	Right	26.667		
				PC-4	[illegible]	1 111 811.467	[illegible]	Tangent	-	48.718		
	IP-4	4° 22' 00"	[illegible]			1 111 [illegible]	591 354.671				132.383	[illegible]
				PT-4	0+537.078	1 111 [illegible].119	591 373.104	R=1000	Right	76.540		
	IP-5	-	0+537.078	EP-A	0+537.078	1 111 [illegible].119	591 373.104				[illegible]	[illegible]
B-RAMP	IP-1	-	0+000.000	BP-B	0+000.000	1 111 4[illegible].139	591 033.670				-	[illegible]
				PC-2	0+000.000	1 111 4[illegible].139	591 033.670	-	-	-		
	IP-2	9° 15' 00"	0+032.416			[illegible]	[illegible]				32.416	[illegible]
				PT-2	0+064.[illegible]	[illegible]	[illegible]	R=400.000	Right	64.691		
				TS-3	0+064.[illegible]	1 111 [illegible].230	[illegible]	-	-	-		
				SC-3	0+091.358	[illegible]	591 110.470	A=40.000	Right	26.667		
	IP-3	[illegible]	0+138.[illegible]			[illegible]	591 148.942				104.7[illegible]	[illegible]
				CS-3	0+157.420	1 111 510.[illegible]	591 171.413	R=60.000	Right	[illegible]		
				ST-3	0+184.087	1 111 4[illegible]	591 187.[illegible]	A=40.000	Right	26.667		
				TS-4	0+277.435	1 111 418.102	[illegible]	Tangent	-	93.348		
				SC-4	0+304.102	[illegible]	591 282.013	A=40.000	Left	26.667		
	IP-4	[illegible]	0+351.241	-		[illegible]	591 275.203				230.446	[illegible]
				CS-4	0+371.[illegible]	1 111 [illegible].021	[illegible]	R=60.000	Left	67.[illegible]		
				ST-4	0+398.351	1 111 395.3[illegible]	591 357.[illegible]	A=40.000	Left	26.667		
	IP-5	-	0+428.417	EP-B	0+428.417	1 111 411.215	[illegible]	Tangent	-	30.067	10[illegible].872	[illegible]
C-RAMP	IP-1	-	0+000.000	BP-C	0+000.000	1 111 [illegible].703	591 372.[illegible]				-	208° 04' 45"
				PC-2	0+000.000	1 111 [illegible].703	591 372.[illegible]	-	-	-		
	IP-2	14° 32' 34"	0+0[illegible].276			1 111 [illegible].221	591 3[illegible].125				38.276	2[illegible]° 37' [illegible]"
				PT-2	0+076.146	1 111 [illegible].267	591 391.305	R=300	Right	76.146		
				TS-3	0+076.146	1 111 [illegible].267	591 391.275	-	-	-		
				SC-3	0+102.812	1 111 [illegible].400	591 312.434	A=40.000	Right	26.667		
	IP-3	107° 31' 00"	0+172.[illegible]			1 111 7[illegible]	591 2[illegible].704				134.136	[illegible]
				CS-3	0+188.751	1 111 [illegible].404	591 2[illegible]	R=60.000	Right	[illegible]		
				ST-3	0+215.418	1 111 671.[illegible]	591 218.213	A=40.000	Right	26.667		
				TS-4	0+273.560	1 111 621.[illegible]	591 187.[illegible]	Tangent	-	58.142		
				SC-4	0+300.227	1 111 [illegible]	591 171.[illegible]	A=40.000	Left	26.667		
	IP-4	[illegible]	0+347.[illegible]			1 111 [illegible]	591 148.[illegible]				227.[illegible]	[illegible]
				CS-4	0+367.508	1 111 [illegible].465	591 109.475	R=60.000	Left	67.281		
				ST-4	0+394.475	1 111 [illegible]	[illegible]	A=40.000	Left	26.667		
	IP-5	-	0+426.344	EP-C	0+394.475	1 111 [illegible].240	[illegible]			31.[illegible]	105.873	[illegible]
D-RAMP	IP-1	-	000.000	BP-D	000.000	1 111 [illegible].872	[illegible]				-	[illegible]
				TS-2	0+025.000	1 111 [illegible].[illegible]	[illegible]	Tangent	-	25.000		
				SC-2	0+051.667	1 111 [illegible]	591 [illegible].104	A=40.000	Left	26.667		
	IP-2	90° 00' 00"	[illegible]			1 111 [illegible].737	[illegible]				[illegible]	14[illegible]° 00' 00"
				CS-2	0+119.248	1 111 [illegible].023	[illegible].017	R=60.000	Left	67.581		
				ST-2	0+145.914	1 111 [illegible].044	[illegible]	A=40.000	Left	167.198		
				TS-3	0+313.112	1 111 [illegible].017	591 [illegible].170	Tangent	-	26.667		
				SC-3	0+339.779	1 111 [illegible].430	591 102.400	A=40.000	Right	48.[illegible]		
	IP-3	71° [illegible]' 27"	0+370.[illegible]			1 111 [illegible].418	591 120.[illegible]				2[illegible].216	[illegible]
				CS-3	0+388.448	1 111 [illegible].214	[illegible]	R=60.000	Right	48.[illegible]		
				ST-3	0+415.115	1 111 [illegible].047	[illegible].011	A=40.000	Right	26.667		
				PC-4	0+449.062	1 111 [illegible].677	591 [illegible].040	Tangent	-	33.947		
	IP-4	10° 14' 41"	0+484.[illegible]			1 111 [illegible].367	[illegible]				127.[illegible]	[illegible]
				PT-4	0+520.584	1 111 4[illegible].301	[illegible].052	R=400.000	Right	71.522		
	IP-4	-	0+520.584	EP-D	0+520.584	1 111 4[illegible].301	[illegible].052	-	-	-	36.[illegible]	[illegible]
NH No1A	IP-1	-	0+000.000	BP-CR	0+000.000	1 111 [illegible]	591 [illegible].078	-	-	-	-	14[illegible]° 00' 00"
	IP-2	-	[illegible]	EP-CR	[illegible]	1 111 414.[illegible]	591 2[illegible].474	Tangent	-	[illegible]	[illegible]	14[illegible]° 00' 00"

THE DETAIL DESIGN OF THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPULIC OF VIETNAM	FIGURE 4. ALIGNMENT LAYOUT AND GEOMETRIC DATA (INTERCHANGE 2)
	JAPAN INTERNATIONAL COOPERATION AGENCY

1-5. COORDINATE LIST

1.5.1. COORDINATE LIST OF THROUGHWAY

No	Chainage			Coordinate				Remarks
				N		E		
BP1	0	K	-500	+	1114361.764	+	592216.681	
BP2	0	K	-450	+	1114342.806	+	592170.414	
BP3	0	K	-400	+	1114323.848	+	592124.148	
BP4	0	K	-350	+	1114304.889	+	592077.881	
BP5	0	K	-300	+	1114285.327	+	592031.868	
BP6	0	K	-250	+	1114264.792	+	591986.280	
BP7	0	K	-200	+	1114245.503	+	591940.159	
BP8	0	K	-150	+	1114230.470	+	591892.503	
BP9	0	K	-100	+	1114221.417	+	591843.362	
BP10	0	K	-50	+	1114218.562	+	591793.476	
BP11	0	K	0	+	1114221.949	+	591743.624	
BP12	0	K	50	+	1114231.524	+	591694.583	
BP13	0	K	100	+	1114247.139	+	591647.118	
BP14	0	K	150	+	1114268.461	+	591601.923	
BP15	0	K	200	+	1114293.683	+	591558.759	
BP16	0	K	250	+	1114319.501	+	591515.952	
BP17	0	K	300	+	1114334.362	+	591468.540	
BP18	0	K	350	+	1114329.708	+	591419.091	
BP19	0	K	400	+	1114306.165	+	591375.358	
BP20	0	K	450	+	1114267.451	+	591344.245	
BP21	0	K	500	+	1114219.676	+	591330.664	
BP22	0	K	550	+	1114169.802	+	591333.020	
BP23	0	K	600	+	1114120.050	+	591337.995	
BP24	0	K	650	+	1114070.298	+	591342.970	
BP25	0	K	700	+	1114020.546	+	591347.945	
BP26	0	K	750	+	1113970.794	+	591352.921	
BP27	0	K	800	+	1113921.043	+	591357.896	
12	0	K	850	+	1113871.291	+	591362.871	
13	0	K	900	+	1113821.539	+	591367.846	
14	0	K	950	+	1113771.787	+	591372.821	
15	1	K	0	+	1113722.035	+	591377.796	
16	1	K	50	+	1113672.283	+	591382.772	
17	1	K	100	+	1113622.531	+	591387.747	
18	1	K	150	+	1113572.779	+	591392.722	
19	1	K	200	+	1113523.028	+	591397.697	
20	1	K	250	+	1113473.276	+	591402.672	
21	1	K	300	+	1113423.524	+	591407.648	
22	1	K	350	+	1113373.772	+	591412.623	
23	1	K	400	+	1113324.020	+	591417.598	
24	1	K	450	+	1113274.268	+	591422.573	
25	1	K	500	+	1113224.516	+	591427.548	
26	1	K	550	+	1113174.765	+	591432.524	
27	1	K	600	+	1113125.013	+	591437.499	
28	1	K	650	+	1113075.261	+	591442.474	
29	1	K	700	+	1113025.509	+	591447.449	
30	1	K	750	+	1112975.757	+	591452.424	
31	1	K	800	+	1112926.005	+	591457.399	

No	Chainage			Coordinate				Remarks
				N		E		
32	1	K	850	+	1112876.253	+	591462.375	
33	1	K	900	+	1112826.502	+	591467.350	
34	1	K	950	+	1112776.750	+	591472.325	
35	2	K	0	+	1112726.998	+	591477.299	
36	2	K	50	+	1112677.238	+	591482.190	
37	2	K	100	+	1112627.447	+	591486.761	
38	2	K	150	+	1112577.607	+	591490.756	
39	2	K	200	+	1112527.708	+	591493.922	
40	2	K	250	+	1112477.753	+	591496.001	
41	2	K	300	+	1112427.760	+	591496.739	
42	2	K	350	+	1112377.770	+	591495.880	
43	2	K	400	+	1112327.847	+	591493.169	
44	2	K	450	+	1112278.083	+	591488.359	
45	2	K	500	+	1112228.588	+	591481.305	
46	2	K	550	+	1112179.464	+	591472.008	
47	2	K	600	+	1112130.813	+	591460.489	
48	2	K	650	+	1112082.736	+	591446.771	
49	2	K	700	+	1112035.332	+	591430.883	
50	2	K	750	+	1111988.699	+	591412.857	
51	2	K	800	+	1111942.933	+	591392.731	
52	2	K	850	+	1111898.129	+	591370.546	
53	2	K	900	+	1111854.380	+	591346.349	
	2	K	950	+	1111811.775	+	591320.188	
	3	K	0	+	1111770.402	+	591292.118	
	3	K	50	+	1111730.348	+	591262.198	
	3	K	100	+	1111691.690	+	591230.494	
	3	K	150	+	1111654.412	+	591197.177	
	3	K	200	+	1111618.407	+	591162.487	
	3	K	250	+	1111583.543	+	591126.650	
	3	K	300	+	1111549.666	+	591089.877	
	3	K	330	+	1111529.746	+	591067.445	
54	3	K	350	+	1111516.612	+	591052.362	
55	3	K	400	+	1111484.202	+	591014.290	
56	3	K	450	+	1111452.247	+	590975.833	
57	3	K	500	+	1111420.557	+	590937.159	
58	3	K	550	+	1111388.942	+	590898.422	
59	3	K	600	+	1111357.329	+	590859.685	
60	3	K	650	+	1111325.716	+	590820.947	
61	3	K	700	+	1111294.103	+	590782.209	
62	3	K	750	+	1111262.490	+	590743.471	
63	3	K	800	+	1111230.877	+	590704.733	
64	3	K	850	+	1111199.264	+	590665.996	
65	3	K	900	+	1111167.651	+	590627.258	
66	3	K	950	+	1111136.038	+	590588.520	
67	4	K	0	+	1111104.425	+	590549.782	
68	4	K	50	+	1111072.812	+	590511.044	
69	4	K	100	+	1111041.199	+	590472.307	
70	4	K	150	+	1111009.586	+	590433.569	
71	4	K	200	+	1110977.973	+	590394.831	

No	Chainage			Coordinate				Remarks
				N		E		
72	4	K	250	+	1110946.360	+	590356.093	
73	4	K	300	+	1110914.747	+	590317.355	
74	4	K	350	+	1110883.134	+	590278.618	
75	4	K	400	+	1110851.521	+	590239.880	
76	4	K	450	+	1110819.908	+	590201.142	
77	4	K	500	+	1110788.295	+	590162.404	
78	4	K	550	+	1110756.682	+	590123.667	
79	4	K	600	+	1110725.069	+	590084.929	
80	4	K	650	+	1110693.456	+	590046.191	
81	4	K	700	+	1110661.843	+	590007.453	
82	4	K	750	+	1110630.230	+	589968.715	
83	4	K	800	+	1110598.617	+	589929.978	
84	4	K	850	+	1110567.004	+	589891.240	
85	4	K	900	+	1110535.391	+	589852.502	
86	4	K	950	+	1110503.778	+	589813.764	

1.5.2. COORDINATE LIST OF INTERCHANGE No1

"A" RAMP

No	Chainage			Coordinate				Remarks
				N		E		
	0	+	0	+	1114280.533	+	592005.138	
	0	+	20	+	1114272.276	+	591986.922	
	0	+	40	+	1114264.245	+	591968.606	
	0	+	60	+	1114256.668	+	591950.097	
	0	+	80	+	1114249.782	+	591931.322	
	1	+	100	+	1114243.832	+	591912.230	
	1	+	120	+	1114239.063	+	591892.811	
	1	+	140	+	1114235.595	+	591873.118	
	1	+	160	+	1114233.446	+	591853.237	
	1	+	180	+	1114232.627	+	591833.258	
	2	+	200	+	1114233.118	+	591813.267	
	2	+	220	+	1114234.762	+	591793.337	
A-1	0	+	240	+	1114237.356	+	591773.507	
A-2	0	+	260	+	1114240.756	+	591753.800	
A-3	0	+	280	+	1114244.942	+	591734.244	
A-4	0	+	300	+	1114249.907	+	591714.872	
A-5	0	+	320	+	1114255.644	+	591695.716	
A-6	0	+	340	+	1114262.139	+	591676.799	
A-7	0	+	360	+	1114269.388	+	591658.160	
A-8	0	+	380	+	1114277.375	+	591639.826	
A-9	0	+	400	+	1114286.089	+	591621.825	
A-10	0	+	420	+	1114295.449	+	591604.152	
A-11	0	+	440	+	1114305.278	+	591586.734	
A-12	0	+	460	+	1114315.398	+	591569.483	
A-13	0	+	480	+	1114325.631	+	591552.300	
A-14	0	+	500	+	1114335.612	+	591534.969	
A-15	0	+	520	+	1114344.659	+	591517.137	
A-16	0	+	540	+	1114352.009	+	591498.548	
A-17	0	+	560	+	1114357.049	+	591479.207	
A-18	0	+	580	+	1114359.638	+	591459.389	
A-19	0	+	600	+	1114359.737	+	591439.402	
A-20	0	+	620	+	1114357.343	+	591419.559	
A-21	0	+	640	+	1114352.490	+	591400.157	
A-22	0	+	660	+	1114345.264	+	591381.535	
A-23	0	+	680	+	1114335.769	+	591363.948	
A-24	0	+	700	+	1114324.154	+	591347.682	
A-25	0	+	720	+	1114310.603	+	591332.991	
A-26	0	+	740	+	1114295.325	+	591320.104	
A-27	0	+	760	+	1114278.560	+	591309.222	
A-28	0	+	780	+	1114260.569	+	591300.515	
A-29	0	+	800	+	1114241.633	+	591294.119	
A-30	0	+	820	+	1114222.047	+	591290.135	
A-31	0	+	840	+	1114202.118	+	591288.622	
A-32	0	+	860	+	1114182.149	+	591289.530	
A-33	0	+	880	+	1114162.341	+	591292.262	
A-34	0	+	900	+	1114142.697	+	591296.015	

No	Chainage			Coordinate				No
				N		E		
A-35	0	+	920	+	1114123.090	+	591299.960	
A-36	0	+	940	+	1114103.315	+	591302.911	
A-37	0	+	960	+	1114083.342	+	591303.466	
A-38	0	+	980	+	1114063.533	+	591300.870	
A-39	1	+	0	+	1114044.390	+	591295.151	
A-40	1	+	20	+	1114026.403	+	591286.455	
A-41	1	+	40	+	1114010.032	+	591275.004	
A-42	1	+	60	+	1113995.693	+	591261.092	
A-43	1	+	80	+	1113983.754	+	591245.073	
A-44	1	+	100	+	1113974.321	+	591227.452	
A-45	1	+	120	+	1113966.515	+	591209.041	

"B" RAMP

No	Chainage			Coordinate				Remarks
				N		E		
	0	+	0	+	1114227.450	+	591906.599	
	0	+	20	+	1114221.894	+	591887.386	
	0	+	40	+	1114216.146	+	591868.230	
	0	+	60	+	1114210.207	+	591849.133	
	0	+	80	+	1114204.077	+	591830.095	
B-1	0	+	100	+	1114197.759	+	591811.127	
B-2	0	+	120	+	1114191.249	+	591792.216	
B-3	0	+	140	+	1114184.551	+	591773.371	
B-4	0	+	160	+	1114177.665	+	591754.594	
B-5	0	+	180	+	1114170.591	+	591735.887	
B-6	0	+	200	+	1114163.331	+	591717.252	
B-7	0	+	220	+	1114155.971	+	591698.655	
B-8	0	+	240	+	1114148.612	+	591680.058	
B-9	0	+	260	+	1114141.252	+	591661.462	
B-10	0	+	280	+	1114133.892	+	591642.865	
B-11	0	+	300	+	1114126.533	+	591624.268	
B-12	0	+	320	+	1114119.173	+	591605.672	
B-13	0	+	340	+	1114111.814	+	591587.075	
B-14	0	+	360	+	1114104.454	+	591568.478	
B-15	0	+	380	+	1114097.094	+	591549.882	
B-16	0	+	400	+	1114089.735	+	591531.285	
B-17	0	+	420	+	1114082.375	+	591512.688	
B-18	0	+	440	+	1114075.016	+	591494.092	
B-19	0	+	460	+	1114067.656	+	591475.495	
B-20	0	+	480	+	1114060.297	+	591456.898	
B-21	0	+	500	+	1114052.937	+	591438.302	
B-22	0	+	520	+	1114045.577	+	591419.705	
B-23	0	+	540	+	1114038.218	+	591401.108	
B-24	0	+	560	+	1114030.858	+	591382.511	
B-25	0	+	580	+	1114023.499	+	591363.915	
B-26	0	+	600	+	1114016.139	+	591345.318	
B-27	0	+	620	+	1114008.779	+	591326.721	
B-28	0	+	640	+	1114001.420	+	591308.125	
B-29	0	+	660	+	1113994.060	+	591289.528	
B-30	0	+	680	+	1113986.701	+	591270.931	
B-31	0	+	700	+	1113979.341	+	591252.335	
B-32	0	+	720	+	1113971.982	+	591233.738	
B-33	0	+	740	+	1113964.622	+	591215.141	

1.5.3. COORDINATE LIST OF INTERCHANGE No2

"A" RAMP

No	Chainage		Coordinate				Remarks
			N		E		
A-1	0 +	0	+	1111418.603	+	591375.410	
A-2	0 +	20	+	1111429.156	+	591392.400	
A-3	0 +	40	+	1111440.004	+	591409.197	
A-4	0 +	60	+	1111453.710	+	591423.660	
A-5	0 +	80	+	1111471.301	+	591432.979	
A-6	0 +	100	+	1111490.973	+	591436.030	
A-7	0 +	120	+	1111510.561	+	591432.476	
A-8	0 +	140	+	1111528.396	+	591423.499	
A-9	0 +	160	+	1111545.396	+	591412.964	
A-10	0 +	180	+	1111562.385	+	591402.411	
A-11	0 +	200	+	1111579.374	+	591391.858	
A-12	0 +	220	+	1111596.364	+	591381.305	
A-13	0 +	240	+	1111613.353	+	591370.752	
A-14	0 +	260	+	1111630.342	+	591360.198	
A-15	0 +	280	+	1111647.331	+	591349.645	
A-16	0 +	300	+	1111664.320	+	591339.092	
A-17	0 +	320	+	1111681.309	+	591328.539	
A-18	0 +	340	+	1111698.425	+	591318.198	
A-19	0 +	360	+	1111716.961	+	591310.867	
A-20	0 +	380	+	1111736.837	+	591309.762	
A-21	0 +	400	+	1111756.103	+	591314.902	
A-22	0 +	420	+	1111774.439	+	591322.885	
A-23	0 +	440	+	1111792.707	+	591331.026	
A-24	0 +	460	+	1111810.975	+	591339.166	
A-25	0 +	480	+	1111829.165	+	591347.480	
	0 +	500	+	1111847.185	+	591356.155	
	0 +	520	+	1111865.028	+	591365.189	

"B" RAMP

No	Chainage			Coordinate				Remarks
				N		E		
	0	+	0	+	1111486.139	+	591033.670	
	0	+	20	+	1111498.514	+	591049.380	
B-1	0	+	40	+	1111510.088	+	591065.688	
B-2	0	+	60	+	1111520.833	+	591082.554	
B-3	0	+	80	+	1111530.650	+	591099.973	
B-4	0	+	100	+	1111536.980	+	591118.865	
B-5	0	+	120	+	1111536.932	+	591138.772	
B-6	0	+	140	+	1111530.372	+	591157.568	
B-7	0	+	160	+	1111518.026	+	591173.185	
B-8	0	+	180	+	1111501.866	+	591184.923	
B-9	0	+	200	+	1111484.880	+	591195.482	
B-10	0	+	220	+	1111467.891	+	591206.035	
B-11	0	+	240	+	1111450.902	+	591216.588	
B-12	0	+	260	+	1111433.912	+	591227.141	
B-13	0	+	280	+	1111416.924	+	591237.695	
B-14	0	+	300	+	1111400.612	+	591249.231	
B-15	0	+	320	+	1111387.877	+	591264.534	
B-16	0	+	340	+	1111380.843	+	591283.157	
B-17	0	+	360	+	1111380.290	+	591303.057	
B-18	0	+	380	+	1111386.225	+	591322.067	
B-19	0	+	400	+	1111396.221	+	591339.379	
B-20	0	+	420	+	1111406.774	+	591356.368	

"C" RAMP

No	Chainage			Coordinate				Remarks
				N		E		
	0	+	0	+	1111926.703	+	591372.954	
	0	+	20	+	1111909.045	+	591363.570	
	0	+	40	+	1111892.052	+	591353.030	
	0	+	60	+	1111875.799	+	591341.382	
	0	+	80	+	1111860.345	+	591328.691	
C-1	0	+	100	+	1111846.137	+	591314.652	
C-2	0	+	120	+	1111836.251	+	591297.372	
C-3	0	+	140	+	1111832.560	+	591277.810	
C-4	0	+	160	+	1111835.474	+	591258.117	
C-5	0	+	180	+	1111844.670	+	591240.461	
C-6	0	+	200	+	1111859.048	+	591226.668	
C-7	0	+	220	+	1111875.828	+	591215.795	
C-8	0	+	240	+	1111892.818	+	591205.242	
C-9	0	+	260	+	1111909.807	+	591194.688	
C-10	0	+	280	+	1111926.781	+	591184.112	
C-11	0	+	300	+	1111942.665	+	591172.019	
C-12	0	+	320	+	1111954.391	+	591155.931	
C-13	0	+	340	+	1111960.208	+	591136.892	
C-14	0	+	360	+	1111959.475	+	591116.998	
C-15	0	+	380	+	1111952.442	+	591098.353	
C-16	0	+	400	+	1111942.160	+	591081.203	
	0	+	420	+	1111931.607	+	591064.213	

"D" RAMP

No	Chainage		Coordinate				Remarks
			N		E		
D-1	0 +	0	+	1111920.872	+	591046.933	
D-2	0 +	20	+	1111910.319	+	591029.943	
D-3	0 +	40	+	1111899.471	+	591013.146	
D-4	0 +	60	+	1111885.765	+	590998.683	
D-5	0 +	80	+	1111868.174	+	590989.364	
D-6	0 +	100	+	1111848.501	+	590986.313	
D-7	0 +	120	+	1111828.914	+	590989.867	
D-8	0 +	140	+	1111811.079	+	590998.844	
D-9	0 +	160	+	1111794.079	+	591009.379	
D-10	0 +	180	+	1111777.090	+	591019.932	
D-11	0 +	200	+	1111760.101	+	591030.485	
D-12	0 +	220	+	1111743.111	+	591041.038	
D-13	0 +	240	+	1111726.122	+	591051.591	
D-14	0 +	260	+	1111709.133	+	591062.144	
D-15	0 +	280	+	1111692.144	+	591072.698	
D-16	0 +	300	+	1111675.155	+	591083.251	
D-17	0 +	320	+	1111658.148	+	591093.775	
D-18	0 +	340	+	1111640.228	+	591102.571	
D-19	0 +	360	+	1111620.586	+	591105.807	
D-20	0 +	380	+	1111600.965	+	591102.438	
D-21	0 +	400	+	1111583.435	+	591092.966	
D-22	0 +	420	+	1111567.910	+	591080.365	
D-23	0 +	440	+	1111552.610	+	591067.484	
D-24	0 +	460	+	1111537.407	+	591054.490	
	0 +	480	+	1111522.804	+	591040.828	
	0 +	500	+	1111508.901	+	591026.453	
	0 +	520	+	1111495.735	+	591011.401	

Chapter 2

NUMBER OF LANES OF INTERCHANGE

CHARTER 2 : NUMBER OF LANES OF INTERCHANGE

CONTENTS

2.1 *FORECASTING OF TRAFFIC VOLUME IN THE INTERCHANGE*

Proposed traffic volume at each direction in the interchange is affected by follow elements:

+ Annual rate of traffic growth

+ Distribution of traffic flows due to development of transport network.

+ Types of traffic flows

The above parameters are taken from the report of Feasibility Study.

The computation is used in Japan Software and its result is shown in table 2.1.

2.2 *CAPACITY OF TRAFFIC FLOW AT EVERY LANE*

Capacity of traffic flow at every lane is determined as follows:

$N_{capacity} = N_{max} \times Z$

Where :

N_{max}: Maximum capacity of traffic flow = 1500cpu/h (regarding TCVN 4054-98)

Z : coefficient of used companied capacity = 0.7 (regarding TCVN 4054-98)

2.3 *DETERMINATION OF REQUIRED LANES*

Under required lanes are determined:

$n_i = N_{peakhour} / N_{capacity}$

Where : $N_{peakhour}$: Traffic volume at peak hours is of 10% average annual traffic volume.

$N_{capacity}$: determination in accordance with item 2.2.

The result of required lanes at every direction in the interchange is summarized

in table 2.3.

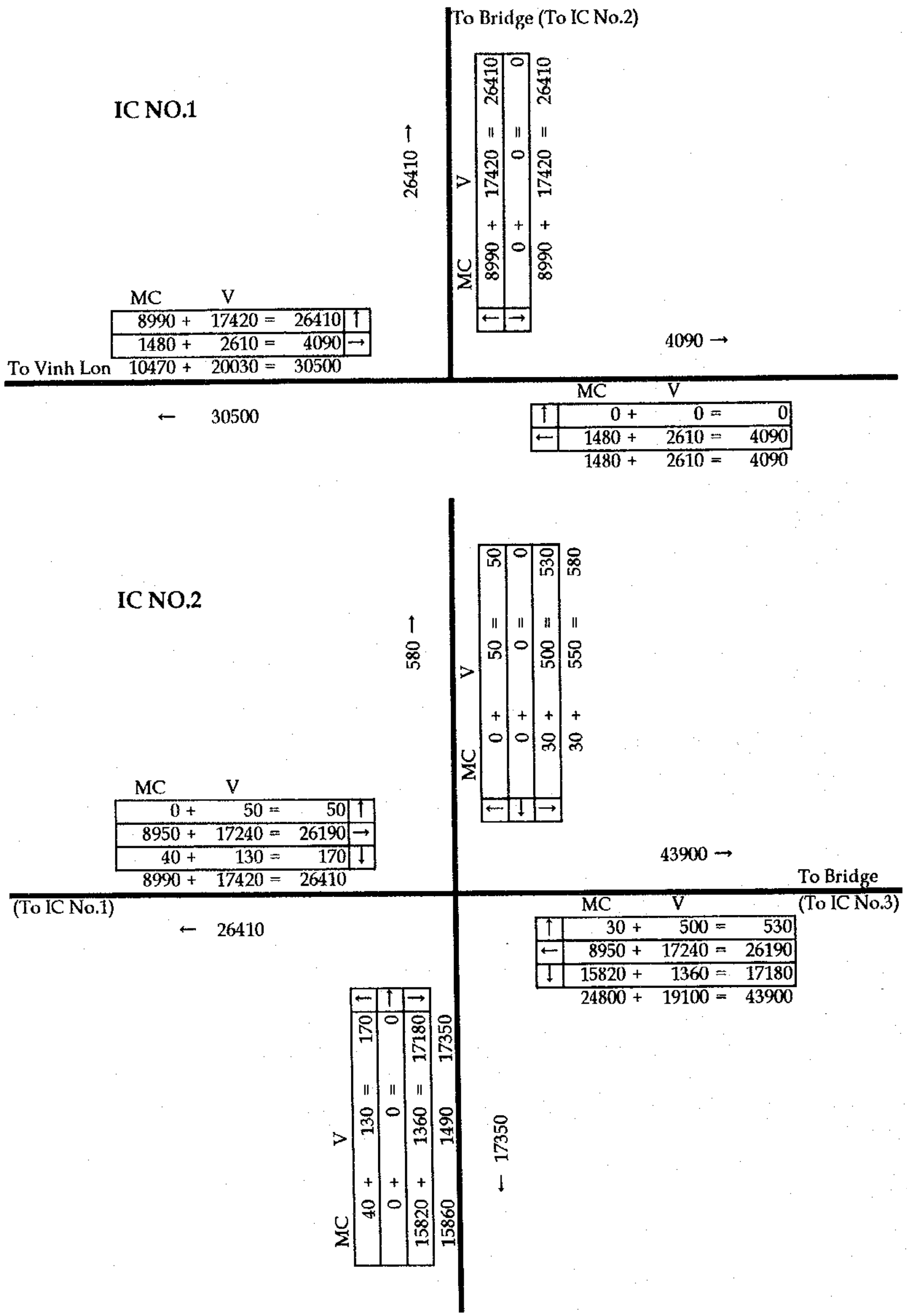


Fig. 2.1 Traffic Volume by Direction

Table. 2.1: Sectional Traffic Volume

Classification	Vehicle/day	Constitution ratio	Exchange coefficient	PCU/day	Classification	Vehicle/day	Constitution ratio	Exchange coefficient	PCU/day
Section 1 (NH.1-Vinh Long)					Section 4 (NH.54-Tra On)				
TOTAL	**59,960**			**79,885**	**TOTAL**	**1,160**			**2,045**
MC	**19,840**	-	0.3	5,952	**MC**	**60**	-	0.3	18
Vehicle	**40,120**	-	-	73,933	**Vehicle**	**1,100**	-		2,027
PC	14,664	36.55%	1.0	14,664	PC	402	36.55%	1.0	402
LB	4,641	11.57%	2.0	9,282	LB	127	11.57%	2.0	255
HB	1,926	4.80%	2.5	4,814	HB	53	4.80%	2.5	132
LT	5,206	12.98%	2.0	10,412	LT	143	12.98%	2.0	285
MT	12,577	31.35%	2.5	31,444	MT	345	31.35%	2.5	862
HT	1,106	2.76%	3.0	3,317	HT	30	2.76%	3.0	91
Section 2 (NH.1-Can Tho Ferry)					Section 5 (NH.54-Cai Von)				
TOTAL	**5,400**			**7,082**	**TOTAL**	**32,940**			**11,733**
MC	**1,860**	-	0.3	558	**MC**	**31,740**	-	0.3	9,522
Vehicle	**3,540**	-		6,524	**Vehicle**	**1,200**	-		2,211
PC	1,294	36.55%	1.0	1,294	PC	439	36.55%	1.0	439
LB	410	11.57%	2.0	819	LB	139	11.57%	2.0	278
HB	170	4.80%	2.5	425	HB	58	4.80%	2.5	144
LT	459	12.98%	2.0	919	LT	156	12.98%	2.0	311
MT	1,110	31.35%	2.5	2,774	MT	376	31.35%	2.5	940
HT	98	2.76%	3.0	293	HT	33	2.76%	3.0	99
Section 3 (Throughway-IC1-IC2)					Section 6 (Throughway-IC2-IC3)				
TOTAL	**54,560**			**72,803**	**TOTAL**	**87,780**			**85,299**
MC	**17,980**	-	0.3	5,394	**MC**	**49,560**	-	0.3	14,868
Vehicle	**36,580**	-		67,409	**Vehicle**	**38,220**	-		70,431
PC	13,370	36.55%	1.0	13,370	PC	13,969	36.55%	1.0	13,969
LB	4,232	11.57%	2.0	8,463	LB	4,421	11.57%	2.0	8,843
HB	1,756	4.80%	2.5	4,390	HB	1,835	4.80%	2.5	4,586
LT	4,747	12.98%	2.0	9,493	LT	4,960	12.98%	2.0	9,919
MT	11,468	31.35%	2.5	28,669	MT	11,982	31.35%	2.5	29,954
HT	1,008	2.76%	3.0	3,024	HT	1,053	2.76%	3.0	3,160

Table 2.2 :Traffic Volume by Direction (1/2)

Classification		Vehicle/day	Constitution ratio	Exchange coefficient	PCU/ day	Classification		Vehicle/ day	Constitution ratio	Exchange coefficient	PCU/ day
Interchange1 (NH.1-Can Tho)						Interchange2 (NH.54)					
Vinh Long to Bridge	TOTAL	27,280			36,403	Vinh Long to Cai Von	TOTAL	150			184
	MC	8,990	-	0.3	2,697		MC	60	-	0.3	18
	Vehicle	18,290	-	-	33,706		Vehicle	90	-	-	166
	PC	6,685	36.55%	1.0	6,685		PC	33	36.55%	1.0	33
	LB	2,116	11.57%	2.0	4,232		LB	10	11.57%	2.0	21
	HB	878	4.80%	2.5	2,195		HB	4	4.80%	2.5	11
	LT	2,373	12.98%	2.0	4,747		LT	12	12.98%	2.0	23
	MT	5,734	31.35%	2.5	14,335		MT	28	31.35%	2.5	71
	HT	504	2.76%	3.0	1,512		HT	2	2.76%	3.0	7
Vinh Long to Ferry	TOTAL	2,700			3,540	Vinh Long to Bridge	TOTAL	27,070			36,093
	MC	930	-	0.3	279		MC	8,940	-	0.3	2,682
	Vehicle	1,770	-	-	3,261		Vehicle	18,130	-	-	33,411
	PC	647	36.55%	1.0	647		PC	6,627	36.55%	1.0	6,627
	LB	205	11.57%	2.0	410		LB	2,097	11.57%	2.0	4,195
	HB	85	4.80%	2.5	212		HB	870	4.80%	2.5	2,176
	LT	230	12.98%	2.0	459		LT	2,353	12.98%	2.0	4,705
	MT	555	31.35%	2.5	1,387		MT	5,684	31.35%	2.5	14,209
	HT	49	2.76%	3.0	146		HT	500	2.76%	3.0	1,499
Ferry to Vinh Long	TOTAL	2,700			3,540	Vinh Long to Tra On	TOTAL	80			149
	MC	930	-	0.3	279		MC	0	-	0.3	0
	Vehicle	1,770	-	-	3,261		Vehicle	80	-	-	149
	PC	647	36.55%	1.0	647		PC	29	36.55%	1.0	29
	LB	205	11.57%	2.0	410		LB	9	11.57%	2.0	19
	HB	85	4.80%	2.5	212		HB	4	4.80%	2.5	10
	LT	230	12.98%	2.0	459		LT	10	12.98%	2.0	21
	MT	555	31.35%	2.5	1,387		MT	25	31.35%	2.5	63
	HT	49	2.76%	3.0	146		HT	2	2.76%	3.0	7
Bridge to Vinh Long	TOTAL	27,280			36,403	Cai Von to Vinh Long	TOTAL	150			184
	MC	8,990	-	0.3	2,697		MC	60	-	0.3	18
	Vehicle	18,290	-	-	33,706		Vehicle	90	-	-	166
	PC	6,685	36.55%	1.0	6,685		PC	33	36.55%	1.0	33
	LB	2,116	11.57%	2.0	4,232		LB	10	11.57%	2.0	21
	HB	878	4.80%	2.5	2,195		HB	4	4.80%	2.5	11
	LT	2,373	12.98%	2.0	4,747		LT	12	12.98%	2.0	23
	MT	5,734	31.35%	2.5	14,335		MT	28	31.35%	2.5	71
	HT	504	2.76%	3.0	1,512		HT	2	2.76%	3.0	7
						Cai Von to Tra On	TOTAL	0			0
							MC	0	-	0.3	0
							Vehicle	0	-	-	0
							PC	0	36.55%	1.0	0
							LB	0	11.57%	2.0	0
							HB	0	4.80%	2.5	0
							LT	0	12.98%	2.0	0
							MT	0	31.35%	2.5	0
							HT	0	2.76%	3.0	0
						Cai Von to Bridge	TOTAL	16,320			5,682
							MC	15,810	-	0.3	4,743
							Vehicle	510	-	-	939
							PC	186	36.55%	1.0	186
							LB	59	11.57%	2.0	118
							HB	24	4.80%	2.5	61
							LT	66	12.98%	2.0	132
							MT	160	31.35%	2.5	400
							HT	14	2.76%	3.0	42

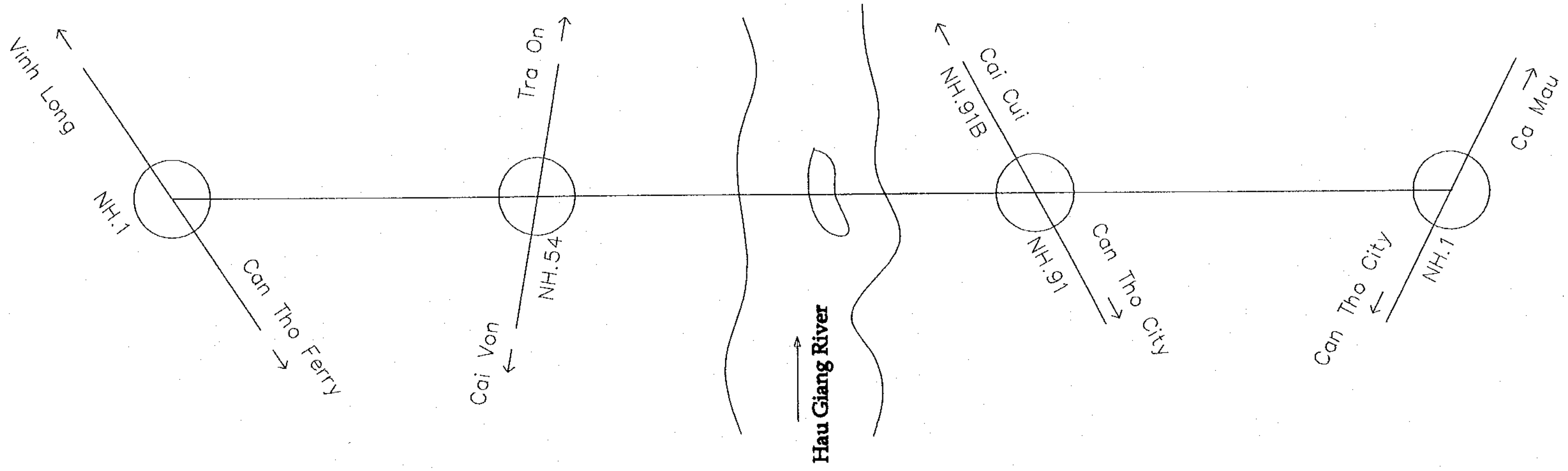
Table 2.2 :Traffic Volume by Direction (2/2)

Classification		Vehicle/ day	Constitution ratio	Exchange coefficient	PCU/ day	Classification		Vehicle/ day	Constitution ratio	Exchange coefficient	PCU/ day
Interchange2 (NH.54)											
Bridge to Cai Von	TOTAL	16,320			5,682	Tra On to Bridge	TOTAL	500			875
	MC	15,810	-	0.3	4,743		MC	30	-	0.3	9
	Vehicle	510	-	-	939		Vehicle	470	-	-	866
	PC	186	36.55%	1.0	186		PC	172	36.55%	1.0	172
	LB	59	11.57%	2.0	118		LB	54	11.57%	2.0	109
	HB	24	4.80%	2.5	61		HB	23	4.80%	2.5	56
	LT	66	12.98%	2.0	132		LT	61	12.98%	2.0	122
	MT	160	31.35%	2.5	400		MT	147	31.35%	2.5	368
	HT	14	2.76%	3.0	42		HT	13	2.76%	3.0	39
Bridgeto Ving Long	TOTAL	27,070			36,093	Tra On to Cai Von	TOTAL	0			0
	MC	8,940	-	0.3	2,682		MC	0	-	0.3	0
	Vehicle	18,130	-	-	33,411		Vehicle	0	-	-	0
	PC	6,627	36.55%	1.0	6,627		PC	0	36.55%	1.0	0
	LB	2,097	11.57%	2.0	4,195		LB	0	11.57%	2.0	0
	HB	870	4.80%	2.5	2,176		HB	0	4.80%	2.5	0
	LT	2,353	12.98%	2.0	4,705		LT	0	12.98%	2.0	0
	MT	5,684	31.35%	2.5	14,209		MT	0	31.35%	2.5	0
	HT	500	2.76%	3.0	1,499		HT	0	2.76%	3.0	0
Bridge to Tra On	TOTAL	500			875	Tra On to Ving Long	TOTAL	80			149
	MC	30	-	0.3	9		MC	0	-	0.3	0
	Vehicle	470	-	-	866		Vehicle	80	-	-	149
	PC	172	36.55%	1.0	172		PC	29	36.55%	1.0	29
	LB	54	11.57%	2.0	109		LB	9	11.57%	2.0	19
	HB	23	4.80%	2.5	56		HB	4	4.80%	2.5	10
	LT	61	12.98%	2.0	122		LT	10	12.98%	2.0	21
	MT	147	31.35%	2.5	368		MT	25	31.35%	2.5	63
	HT	13	2.76%	3.0	39		HT	2	2.76%	3.0	7

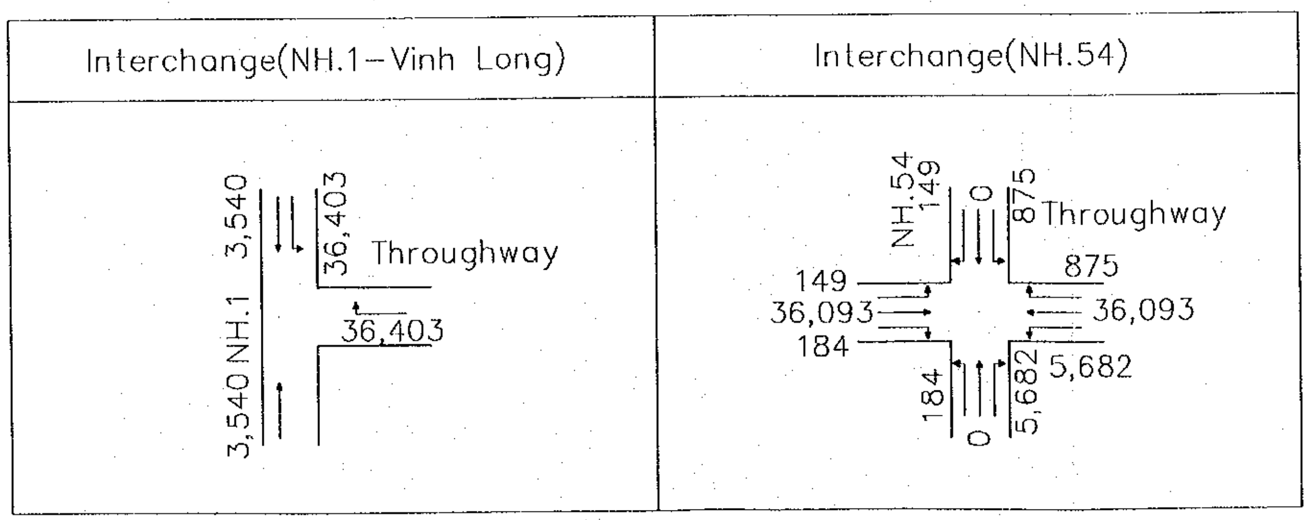
Table 2.3 : Lane Number of Rampway

Name of Interchange	Direction	PCU/day	$N_{peakhour}$	$N_{capacity}$	Z	ni	Remarks
IC 1	Vinh Long to Ferry	3,540	354	1,500	0.70	0.4--> 1.0	
(NH.1 Vinh Long)	Ferry to Vinh Long	3,540	354	1,500	0.70	0.4--> 1.0	
IC 2	Vinh Long to NH.54	333	33	1,500	0.70	0.1--> 1.0	
(NH.54)	NH.54 to Vinh Long	184	18	1,500	0.70	0.1--> 1.0	
	Bridge to NH.54	6,557	656	1,500	0.70	0.7--> 1.0	
	NH.54 to Bridge	5,682	568	1,500	0.70	0.6--> 1.0	

Fig. I-2-2 : TRAFFIC VOLUME BY DIRECTION **(Year:2020)**



(PCU/day/Direction)



Chapter 3

SERVICE AREA

CHARTER 3 SERVICE AREA.

CONTENTS

3.1 *ARRANGEMENT AND LAYOUT OF SERVICE AREA*

3.1.1 ARRANGEMENT OF SERVICE AREA

The service area was planned to both sides of the HAU River in consideration of the move of the store, which is doing business with the ferry platform periphery of established.

The execution position of the service area was selected in consideration of the following items.

- Security of sufficient distance with the interchange.
- Selection of the section of a fine horizontal and vertical alignment of throughway.
- Avoid the Area and location of temples and tombs, Public facilities such as hospital, school and disposal sites and density of residential areas including markets
- Consistency with the master plans for Industrial Zones and City Development
- Confluence point of the stream and/or canal
- Influence to ecosystem

3.1.2 STYLE AND LAYOUT

The service area is composed of the parking lot, throughway, ramp-way, and institutions for the user, garden ground and control institutions.

As for the institutions for the user, there is petrol station, stands, resting-places, restaurant, toilets, information office etc; and the size and fundamental arrangement of these outlines were planned with the design in this time.

Table 3.1.1 Standard scale of an architecture institution (sq.m)

Public toilet	Restaurant	Free resting-place	Stands	Petrol station	Subsidiary equipment
180	500	170	170	550	2070

Ramp-ways of service area conforms as ramp-way of the interchange and were designed.

3.2 NUMBER OF PARKING LOT

3.2.1 DIMENSION OF PARKING SPACE FOR VEHICLE

Dimension of the parking space of each vehicle shows below was adopted.

Table 3.2.1 Traffic Volume for Design

Type of Vehicle	Length (m)	Width (m)
Heavy bus and Truck	13.0	3.5
Medium bus and Truck	8.0	3.5
Light bus and Truck	5.5	2.7
Passenger car	5.5	2.7
Motor Cycle	2.0	1.25
Long Vehicle	17.0	3.5

3.2.2 NUMBER OF PARKING LOT

Number of parking lot is determined based on standard of Japanese road design.

Table 3.2.2 Traffic Volume for Design

Type of a car	Prediction number of units (2020)	Exchange rate	Conversion number of units	Total
Motor Cycle	49,612	0.30	14,884	14,884
Passenger Car	13,965	1.00	13,965	
Light Bus	4,420	2.00	8,840	
Light Truck	4,958	2.00	9,916	32,721
Medium Truck	11,978	1.00	11,978	11,978
Heavy Bus	1,834	1.00	1,834	
Heavy Truck	1,053	1.00	1,053	2,887
Total	87,820			62,470

Table 3.2.3 Calculation Table of Parking Lot Number

Item	Symbol	Motorcycle	Passenger Car	Medium Truck	Heavy Bus Heavy Truck
Traffic volume (2020)	Q	14,884	32,721	11,978	2,887
Holiday service coefficient	s	1.15			
Design traffic volume	q=Q*s/2	8,558	18,815	6,887	1,660
Application ratio	v	0.500	0.100	0.100	0.250
Peak rate	r	0.100	0.100	0.100	0.100
Circulation ratio	c	4.000	4.000	4.000	3.000
Number of parking lot (calculate)	n=q*v*r/c	107	47	17	14
Number of parking lot (design)		196	48	10	15

Note

Holiday service coefficient : Increasing coefficient that makes 90% or more of application passable efficiency of the service area.

Application rate : The ratio of the traffic density that flows in the service area in throughway traffic density.

Peak rate: The ratio of the traffic density that uses the service area at the time of traffic congestion

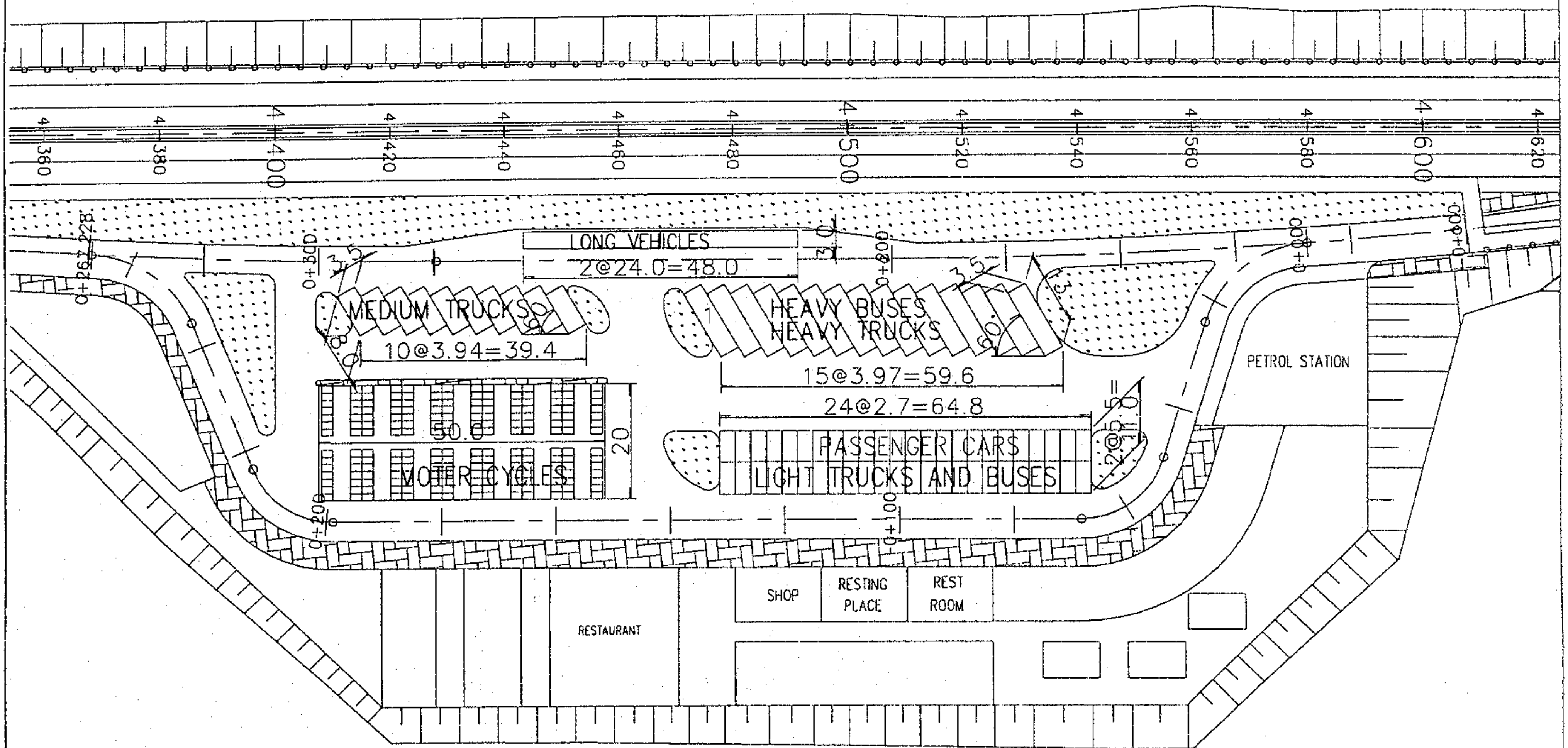
Circulation rate: The application number of parking space of in one hour.

(These coefficients were calculated from the traffic actual condition survey result in 4 main expressways of Japan except for motorcycle.)

VINH LONG SERVICE AREA

PARKING LOT LAYOUT

SCALE 1:1000



3.3. DESIGN OF THE STORM DRAINAGE & SEWAGE SYSTEMS

3.3.1. THE BASIC DATA

1) The general plan layout of Can Tho service area. (See Drawings)
2) The general arrangement of structural objects in service area.
3) The record of rainfall intensity of the Can Tho region.

3.3.2. THE PRINCIPLES TO ARRANGE THE DRAINAGE SYSTEMS

1) The drainage system will be designed gravity flow.
2) The drainage systems are to be installed under ground of sidewalk and clearance is 2-3m far from foundation of buildings; 1- 2m far from street lighting pole foundation.
3) The gradient of drainage structures might be followed to the gradient of road.
4) Dividing the flowing areas based on the general plan layout and the general arrangement of structural objects in studying area.

3.3.3 CALCULATING THE HYDROLOGIC AND THE HYDRAULIC CONDITIONS.

The peak runoff discharge of storm water is determined by following equation

Based on Viet Nam Standard "Design of standard drainage out side system and works" 20 TCN-51-84.

Q1= C x q1 x A (l/sec)

where:

A: Area of watershed = AI + A2 (ha)
A1: Sidewalk (concrete), AC pavement & House: (ha)
A2: Grass area (ha)

C: Runoff coefficient = (C1xA1 + C2xA2)/ (A1 + A2)

C1: Runoff coefficient of House, Sidewalk or Ac pavement.
C2: Runoff coefficient of grass

C: Average Runoff Coefficient. It reflects the portion under the total water discharge flowing into the drainage system. It is depended on characteristics of surface area, for example:

- If surface area is concrete, asphalt: C = 0.90

- If surface area is aggregate, stone: C = 0.40-0.60

- If surface area is natural ground: C = 0.15

q_1 = 166.7 x q (l/sec/ha)

q : Rainfall intensity is determined by statistic data of rainfall in every region and design frequency.

Where:
10-year frequency return period for pipes .
2-year frequency return period for ditches .

Table 3.3.1 Rainfall Intensity in Can Tho region

Duration (min)	(a) Intensities, I (mm/h) Average Recurrence Interval						
	1	2	5	10	20	50	100
5	105	140	175	200	215	240	250
6	102	136	171	194	209	234	245
7	99	132	167	188	203	228	240
8	96	128	163	182	197	222	235
9	93	124	159	176	191	216	230
10	90	120	155	170	185	210	225
15	85	108	135	150	162	172	185
20	76	95	122	133	143	158	165
30	58	76	100	110	120	137	145
60	42	54	72	81	90	110	105

The discharge of sewage:

Q2 = (Number of house in watershed area) x 0.001 m3/sec/house

Total discharge:

Q = Q1 + Q2 (m3/sec)

Hydraulic Computation

$Q_{max.} = A . V$

V= 1/n x R0.67 x I0.5

Where:

A = the sectional area of pipe or ditch (m2)
V = Mean velocity (m/sec)
R = Hydraulic radius (m)
I = Hydraulic gradient or slope of pipe (%)
n = roughness coefficient

Table 3.3.2 Rough coefficient for material of drainage system

Surface	Rough coefficient		
	Min	Normal	Max
1. Pipes			
- Steel			
• Welding joints	0.010	0.012	0.014
• Mechanical joints	0.013	0.016	0.017
- Cast iron			
• With the bitumen surface	0.010	0.013	0.014
• Without the bitumen surface	0.011	0.015	0.016
Concrete Pipe	0.012	0.014	0.016
2. Ditch			
- Earth, straight and uniform	0.016	0.018	0.020
- Rock cut, smooth and uniform	0.025	0.030	0.033
- Ground with dense grass	0.030	0.035	0.040
- Cement-lined channels	0.012	0.014	0.016
- Ground with gravel	0.022	0.027	0.033
- Steel with paint surface	0.012	0.013	0.017
- Steel with non-paint surface	0.011	0.012	0.014
- Concrete with flat surface	0.017	0.020	-
- Concrete with non-flat surface	0.022	0.027	-

COMPUTING HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA

1. DRAINPIPE

HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA :			D (mm)
			400
1. Area of ditch $A = (p \times D^2)/4$	0.1257	m^2	
2. Perimeter of ditch $X = p \times D$	1.2566	m	
3. Hydraulic radius $R = A/X$	0.1000	m	
4. Roughness factor n	0.0140		
5. Hydraulic gradient i	0.0045		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	1.0323	m/s	
7. Discharge Max $Q = A \times V$	0.1297	m^3/s	

HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA :			D (mm)
			400
1. Area of ditch $A = (p \times D^2)/4$	0.1257	m^2	
2. Perimeter of ditch $X = p \times D$	1.2566	m	
3. Hydraulic radius $R = A/X$	0.1000	m	
4. Roughness factor n	0.0140		
5. Hydraulic gradient i	0.0058		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	1.1720	m/s	
7. Discharge Max $Q = A \times V$	0.1473	m^3/s	

HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA :			D (mm)
			500
1. Area of ditch $A = (p \times D^2)/4$	0.1963	m^2	
2. Perimeter of ditch $X = p \times D$	1.5708	m	
3. Hydraulic radius $R = A/X$	0.1250	m	
4. Roughness factor n	0.0140		
5. Hydraulic gradient i	0.0045		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	1.1979	m/s	
7. Discharge Max $Q = A \times V$	0.2352	m^3/s	

HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA :			D (mm)
			500
1. Area of ditch $A = (p \times D^2)/4$	0.1963	m^2	
2. Perimeter of ditch $X = p \times D$	1.5708	m	
3. Hydraulic radius $R = A/X$	0.1250	m	
4. Roughness factor n	0.0140		
5. Hydraulic gradient i	0.0088		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	1.6751	m/s	
7. Discharge Max $Q = A \times V$	0.3289	m^3/s	

HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA : D (mm) 500

1. Area of ditch $A = (p \times D^2)/4$	0.1963	m^2
2. Perimeter of ditch $X = p \times D$	1.5708	m
3. Hydraulic radius $R = A/X$	0.1250	m
4. Roughness factor n	0.0140	
5. Hydraulic gradient i	0.0160	
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	2.2588	m/s
7. Discharge Max $Q = A \times V$	0.4435	m^3/s

HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA : D (mm) 500

1. Area of ditch $A = (p \times D^2)/4$	0.1963	m^2
2. Perimeter of ditch $X = p \times D$	1.5708	m
3. Hydraulic radius $R = A/X$	0.1250	m
4. Roughness factor n	0.0140	
5. Hydraulic gradient i	0.0261	
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	2.8849	m/s
7. Discharge Max $Q = A \times V$	0.5665	m^3/s

COMPUTING HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA

1. DITCH

HYDRAULIC CHARACTERISTICS OF THE SECTONAL ARE	W (mm) H (mm)	
		500 x 550
1. Area of ditch A = W x H	0.2750	m^2
2. Perimeter of ditch X = W + 2 x H	1.6000	m
3. Hydraulic radius R = A/X	0.1719	m
4. Roughness factor n :	0.0140	
5. Hydrawlic gradient i :	0.0020	
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1}$	0.9875	m/s
7. Discharge Max Q = A x V	0.2716	m^3/s

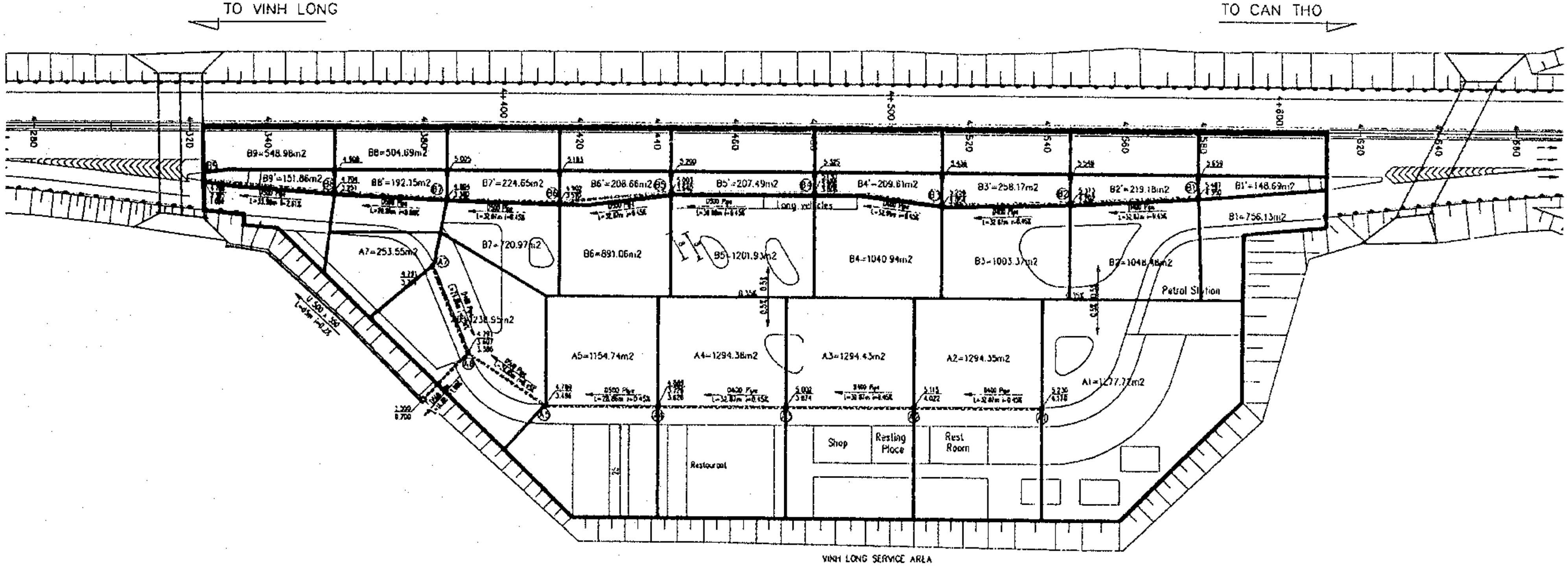
COMPUTING HYDROLOGY & HYDRAULIC OF DRAINAGE SYTEM

Start	End	Symbol	Check	Computing hydrology									Computing hydraulic			
				Storm water							Sewage	Discharge	Sectional of ditch			
				q (50%)	A	A1	A2	C1	C2	Q_1	Q_2	Q	(W x H)	I	Q	V
		(Computed areas)	Point	(mm/min)	m^2	m^2	m^2			m^3/s	m^3/s	m^3/s	mm	o/o	m^3/s	m/s
1	2		3	5	8	7	8	9	10	11	12	13	14	15	16	17
Start	B1	B1	B1	2.0	526.00	756.13	148.69	0.90	0.15	0.023		0.023	400	0.45	0.130	1.032
Start	B2	B1+B2	B2	2.0	2172.48	1804.61	367.87	0.90	0.15	0.056		0.056	400	0.45	0.130	1.032
Start	B3	B1+B2+B3	B3	2.0	3434.02	2807.98	626.04	0.90	0.15	0.087		0.087	400	0.45	0.130	1.032
Start	B4	B1+B2+B3+B4	B4	2.0	4684.57	3848.92	835.65	0.90	0.15	0.120		0.120	500	0.45	0.235	1.198
Start	B5	B1+B2+B3+B4+B5	B5	2.0	6093.98	5050.84	1043.14	0.90	0.15	0.157		0.157	500	0.45	0.235	1.198
Start	B6	B1+B2+B3+B4+B5+B6	B6	2.0	7193.70	5941.91	1251.79	0.90	0.15	0.185		0.185	500	0.45	0.235	1.198
Start	B7	B1+B2+B3+B4+B5+B6+B7	B7	2.0	8139.32	6662.88	1476.44	0.90	0.15	0.207		0.207	500	0.88	0.329	1.675
Start	B8	B1+B2+B3+B4+B5+B6+B7+B8	B8	2.0	8836.16	7167.57	1668.59	0.90	0.15	0.223		0.223	500	2.61	0.566	2.885

Start	End	Symbol	Check	Computing hydrology									Computing hydraulic			
				Storm water							Sewage	Discharge	Sectional of ditch			
				q (50%)	A	A1	A2	C1	C2	Q_1	Q_2	Q	(W x H)	I	Q	V
		(Computed areas)	Point	(mm/min)	m^2	m^2	m^2			m^3/s	m^3/s	m^3/s	mm	o/o	m^3/s	m/s
1	2		3	5	8	7	8	9	10	11	12	13	14	15	16	17
Start	A1	A1	A1	2.0	1277.72	1277.72		0.90		0.038	0.005	0.0433	400	0.45	0.130	1.032
Start	A2	A1+A2	A2	2.0	2572.07	2572.07		0.90		0.077	0.005	0.0822	400	0.45	0.130	1.032
Start	A3	A1+A2+A3	A3	2.0	3866.50	3866.50		0.90		0.116	0.003	0.1190	400	0.45	0.130	1.032
Start	A4	A1+A2+A3+A4	A4	2.0	5160.88	5160.88		0.90		0.155	0.003	0.1578	500	0.45	0.235	1.198
Start	A5	A1+A2+A3+A4+A5	A5	2.0	6315.62	6315.62		0.90		0.189	0.003	0.1925	500	0.45	0.235	1.198
Start	A6	A1+A2+A3+A4+A5+A6	A6	2.0	7552.57	7552.57		0.90		0.227	0.003	0.2296	500	1.60	0.444	2.259
Start	C1	A1+A2+A3+A4+A5+A6	C1	2.0	7553	7553		0.90		0.227	0.003	0.2296	500X550	0.20	0.272	0.987

PLAN LAYOUT OF DRAINAGE SYSTEM

SCALE 1:1500



Chapter 4

EMBANKMENT AND SOFT GROUND TREATMENT

CONTENTS *I-4-1*

CHAPTER 4 EMBANKMENT AND SOFT GROUND TREATMENT

CONTENTS

APPENDICES

4-1. Design Concepts

- For embankment stability measure shall adopt the methods of Surcharge and Slow Banking and Settlement Promotion method (PVD) for increase the strength of subsoil.
- Sand Compaction Pile Method (SCP) shall adopt in the case that is not able to secure stability with the above method.
- Execution of embankment makes the information processing construction method by movement observation a principle.
- The degree of consolidation makes 90% or more or the remaining settlement quantity 10 or less cm a target at the time of the surcharge removing.
- Furthermore, the settlement quantity per the year after the road opening was prescribed to 2 or less cm.
- The surcharge method shall be adopted in general section in order that reduces remaining settlement. Also Pre-loading method should be adopted in structural section in order that reduces remaining settlement.
- Detainment period of surcharge and pre-load shall be secured at least 6 months without being related to the calculation result in consideration of the reduction of the settlement by secondary consolidation.
- The factor of safety to the slide of embankment shall be secured 1.10 or more at the time of surcharge/pre-load completion.

4-2. *Design Condition*

4.2.1 Design Section

The design section of the soft ground treatment was divided to 4 segments by mainly subsoil condition as below.

Segment 1; Km -0+500 - Km 4+910 (Package 1)
Segment 2; Km 4+910 - Km 7+660 (Main bridge section) (Package 2)
Segment 3; Km 7+600 - Km 11+000 (Package 3)
Segment 4; Km 11+000 - Km 15+350 (Package 3)

Segment 1,3 and 4 will be concerned for soft ground treatment.

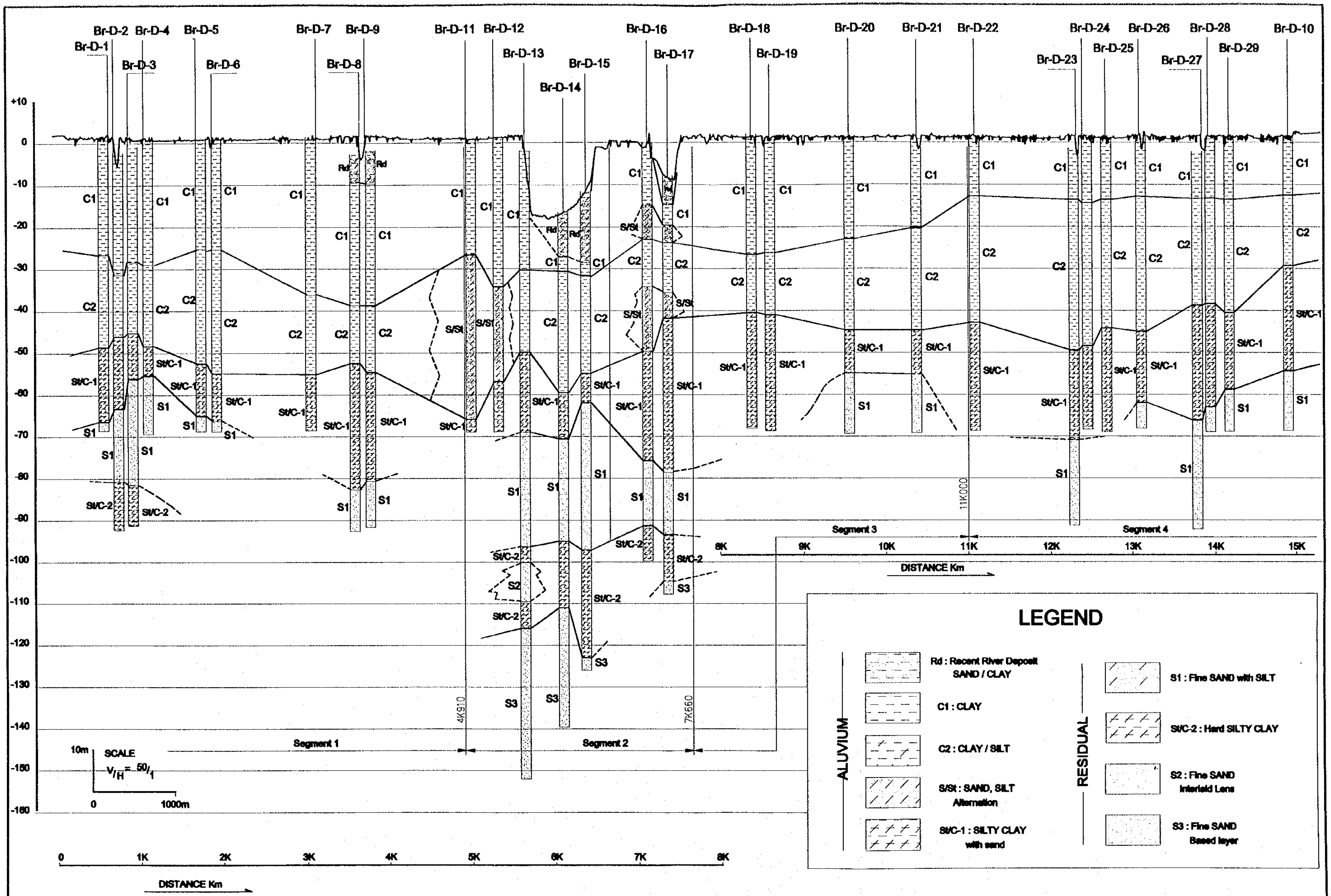


Fig I-4-1. Design Segment of Soft Ground Treatment

4.2.2 Design Formula

(1) Settlement

$$S = Sc + Sl$$

$$Sc = \frac{e0 - e1}{1 + e0} \cdot Hi$$

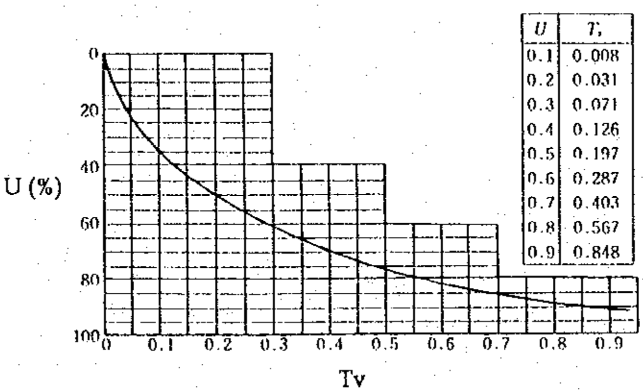
$$U = Si / Sc$$

$$t = \frac{(H_0/2)^2}{Cv_0} \cdot Tv$$

$$t = \frac{Th}{Ch} \cdot de^2$$ This formula applies to SD and PVD.

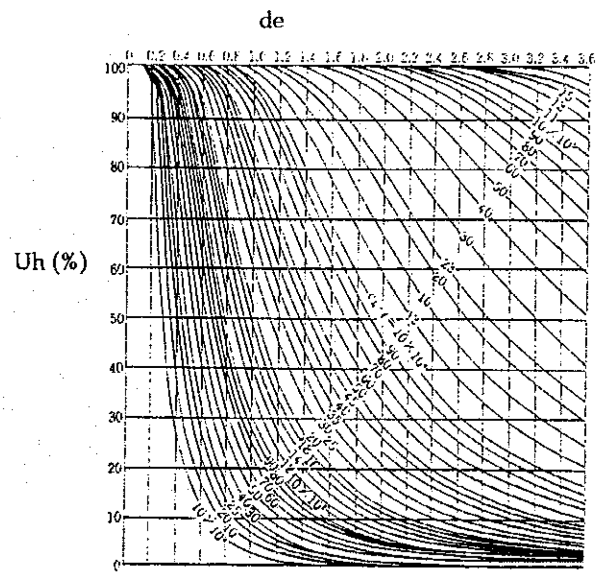
Where				
	S	:	Total quantity of settlement	cm
	Sc	:	Settlement quantity due to consolidation	cm
	Sl	:	Settlement quantity in the long term	cm
	Si	:	Settlement of consolidation quantity in optional time	cm
	U	:	Degree of consolidation	
	e0	:	Initial void ratio of a consolidation layer	
	e1	:	Void ratio after the consolidation of a consolidation layer	
	Hi	:	Thickness of a consolidation layer	cm
	t	:	Time for consolidation	
	H_0	:	Thickness of conversion consolidation layer	cm
	Cv_0	:	Vertical consolidation coefficient	cm^2/s
	Tv	:	Coefficient of consolidation time	
	Th	:	Coefficient of horizontal consolidation time	cm
	Ch	:	Horizontal consolidation coefficient	cm^2/s
	de	:	Effective diameter of vertical discharge material	cm

Settlement quantity in the long term (Sl) is the value that is calculated by movement observation with construction stage and 20 cm are applied in the design stage.



U	Tv
0.1	0.008
0.2	0.031
0.3	0.071
0.4	0.126
0.5	0.197
0.6	0.287
0.7	0.403
0.8	0.567
0.9	0.848

U-Tv Curve



U-de Curves

(2) Slope Stability

Stability of embankment and cohesive of subsoil are calculated with formula as below.

$$K = \frac{\Sigma(Cu \cdot l + W \cdot \cos\alpha \cdot \tan\phi u)}{\Sigma W \cdot \sin\alpha}$$

$$Cu = Cu_0 + m \cdot (P_0 - Pc + \Delta P) \cdot U$$

Where	K	:	Safety factor of slope stability	
	Cu	:	Cohesion of subsoil after consolidation	kN/m^2
	l	:	Length of a sliding surface of the small piece of a circular slip	m
	W	:	Weight of the small piece of a circular slip	kN/m^3
	α	:	Average angle of slope of the small piece of a circular slip	kN/m^2
	ϕu	:	Undercharge angle of shearing resistance that does not consider consolidation	Degree
	Cu_0	:	Cohesion of subsoil before consolidation	kN/m^2
	m	:	Ratio of strength increase of subsoil	
	P_0	:	Overburden pressure before banking	kN/m^2
	Pc	:	Consolidation yield stress (= P_0/m)	kN/m^2
	ΔP	:	Increase stress by a banking load	kN/m^2
	U	:	Degree of consolidation	

Also, the average shear strength of the ground that established SCP in the special section was calculated with the following formula.

$$\tau 1 = l \cdot [a_s\{\gamma_s Z \cdot \frac{\sigma}{1+(n-1)\cdot a_s}\} \cos^2\alpha \cdot \tan\phi_s + (1-a_s) \cdot \{Cu_0 + m\,(P_0 - Pc + \frac{\sigma}{1+(n-1)\cdot a_s})U\} + (1-a_s) \cdot \{\gamma' Z \frac{\sigma}{1+(n-1)\cdot a_s}\} \cos^2\alpha \cdot \tan\phi u]$$

Where	$\tau 1$	:	Average shearing strength of the ground that established SCP	kN/m^2
	a_s	:	Replacement rate of SCP ($=0.907(ds/d)^2$)	
	ds	:	Diameter of SCP	m
	d	:	Spacing of SCP	m
	σ	:	Average increase load by embankment	
	γ'	:	Unit weight of subsoil	kN/m^3
	γs	:	Unit weight of SCP	kN/m^3
	Z	:	Depth of the small piece of a circular slip	m
	n	:	Stress share ratio (SCP/Subsoil)	
	ϕs	:	Internal friction angle of SCP	Degree

4.2.3 Characteristic Value of Subsoil

(1) Layer Constitution and C, ϕ, γ

The constitution of subsoil and characteristic value of the layer of each segment was summarized as the table shown below from the geographic survey and lab-test result.

C2 layer of segment 3 and 4 shall not include to this study by result of confirming of characteristic value.

Segment	Subsoil Layer		Cohesion	Internal Friction Angle	Unit Weight	Ratio of Strength Increase
	Layer Name	Thickness	C	ϕ	γ	m
		m	kN/m²	Degree	kN/m³	-
1	C1-U	17.1	7.0	4.0	15.9	0.35
	C1-L	15.8	8.0	6.0	16.7	0.35
	C2	21.8	10.0	14.0	17.3	0.35
3	C1-U	16.3	9.0	4.0	15.6	0.35
	C1-L	8.1	14.0	3.0	16.8	0.35
4	C1	14.3	8.0	4.0	15.6	0.35

Note C1-U; Layer C1-Upper, C1-L; Layer C1-Lower

(2) e-Log-P curves and Log P-Log Cv curves

e-Log P curves

P (kPa)			0	10	20	50	100	200	400	800
e	1	C1-U	1.625	1.583	1.552	1.477	1.379	1.245	1.082	-
		C1-L	1.306	1.278	1.255	1.201	1.131	1.013	0.847	-
		C2	1.132	1.092	1.076	1.046	0.999	0.932	0.841	0.761
	3	C1-U	1.740	1.707	1.677	1.590	1.451	1.252	1.032	
		C1-L	1.295	1.265	1.242	1.189	1.123	1.038	0.933	
	4	C1	1.624	1.579	1.548	1.469	1.350	1.187	1.009	

Log P-Log Cv curves

Average P (kPa)			5	15	35	75	150	300	600
Log Cv cm²/s	1	C1-U	1.172	1.053	1.016	0.864	0.799	0.730	
		C1-L	1.085	0.901	0.869	0.774	0.640	0.605	
		C2	1.386	1.393	1.486	1.434	1.439	1.422	
	3	C1-U	0.963	0.771	0.685	0.488	0.435	0.406	
		C1-L	0.830	0.834	0.820	0.775	0.712	0.645	
	4	C1	1.058	0.948	0.905	0.751	0.681	0.659	

Note P; Pressure, e; Void ratio, Cv; Consolidation coefficient

4.2.4 Characteristic value of embankment material used for study

Material	Location of dredging	Lab No.	C kN/m²	ϕ Degree	γ kN/m³
Embankment	1 Km downstream of proposed bridge	912	20	30	18.6
	5 Km downstream of proposed bridge	913	14	30	18.3
Sand Blanket	Dai Ngai sand	46	20	30	18.6

- Characteristic value of embankment material use for study ware applied Lab No. 913 due to safety design.

4.2.5 Minimum Safety Factor of Sliding "K"

At the time of surcharge completion. 1.10

4.2.6 Embankment Speed

Embankment speed shall be applied less than 5 cm/day in average.

4.2.7 Thickness of Surcharge

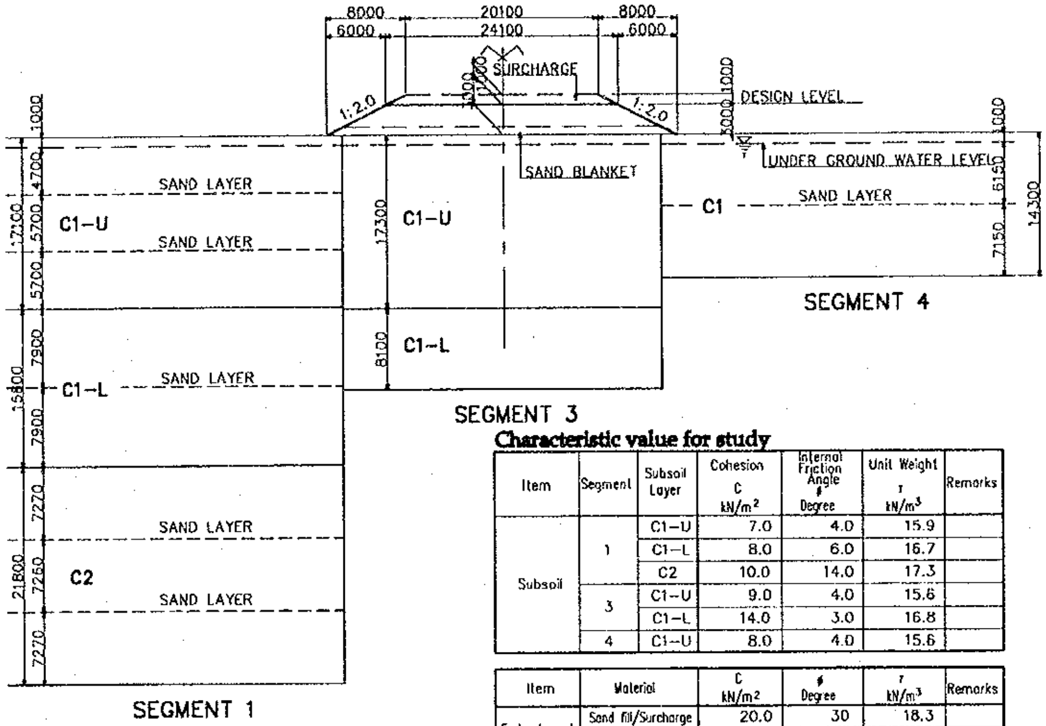
Thickness of surcharge shall be applied 0.3 H basically. (H; Height of Embankment). Actual thickness of surcharge adopted the following table.

Height of Embankment; m	<3.0	3.0-4.0	4.0-5.0	5.0<
Height of Surcharge; m	0	1.0	1.5	2.0

4.2.8 Typical Cross Section for Study

Typical cross sections for soft ground analysis are shown in next pages.

H=3m

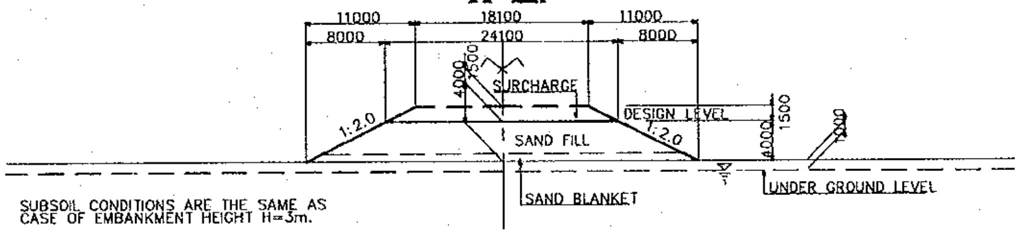


Characteristic value for study

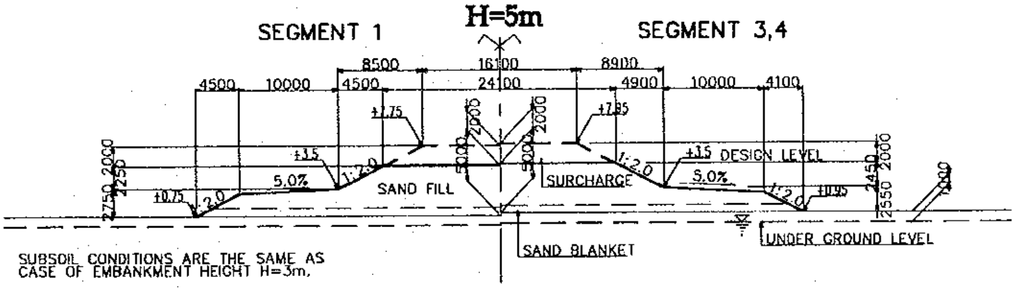
Item	Segment	Subsoil Layer	Cohesion C kN/m²	Internal Friction Angle φ Degree	Unit Weight γ kN/m³	Remarks
Subsoil	1	C1-U	7.0	4.0	15.9	
		C1-L	8.0	6.0	16.7	
		C2	10.0	14.0	17.3	
	3	C1-U	9.0	4.0	15.6	
		C1-L	14.0	3.0	16.8	
	4	C1-U	8.0	4.0	15.6	

Item	Material	C kN/m²	φ Degree	γ kN/m³	Remarks
Embankment	Sand fill/Surcharge	20.0	30	18.3	
	Sand Blanket	14.0	30	18.6	

H=4m



H=5m



H=6m

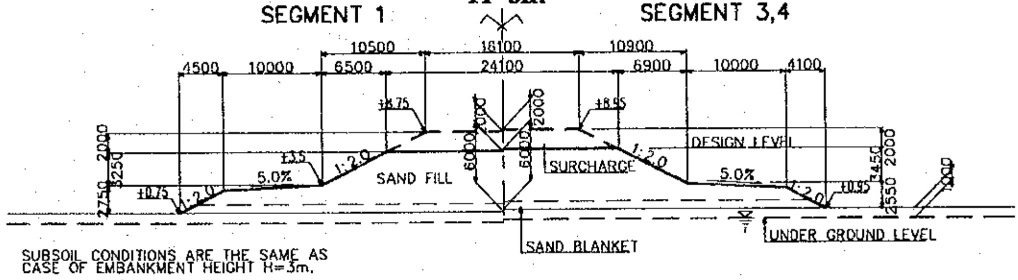
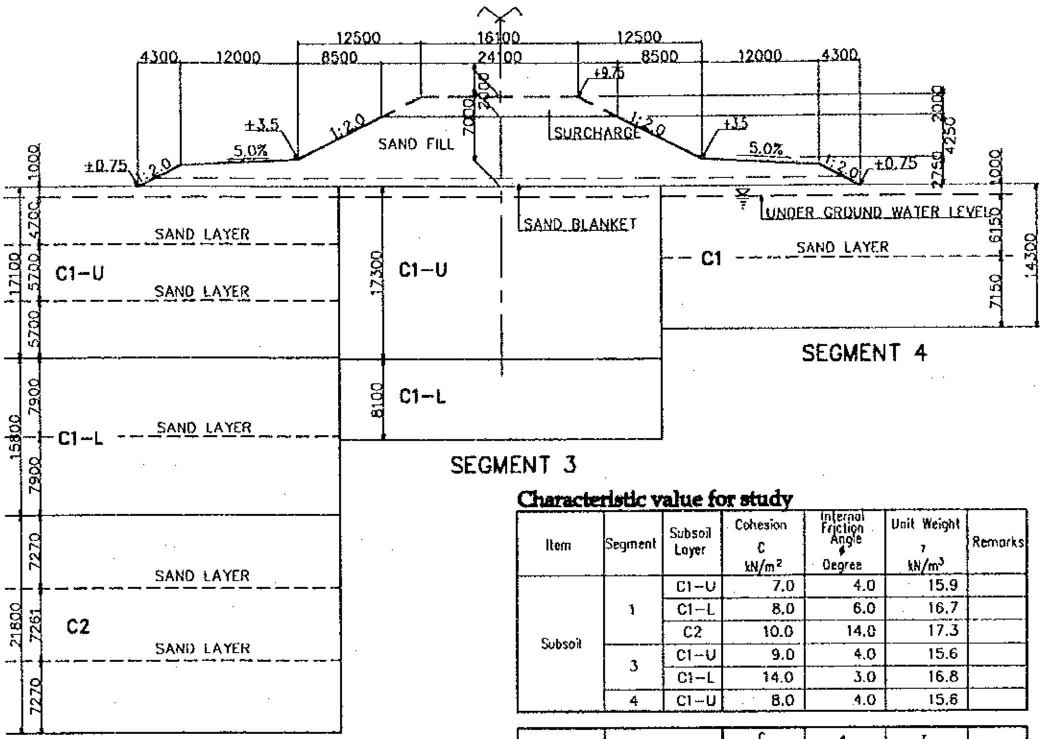


Fig-I-4-2. Design Section-1

H=7m
SEGMENT 1

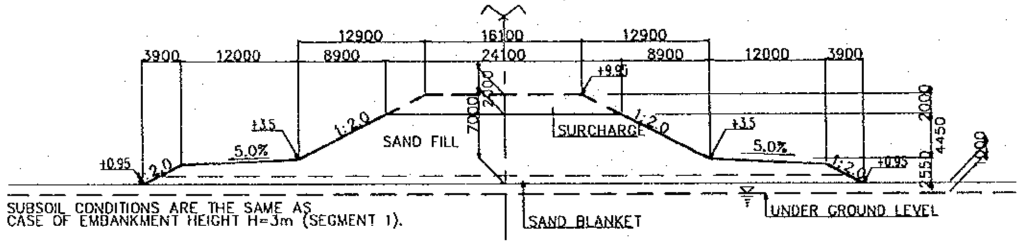


Characteristic value for study

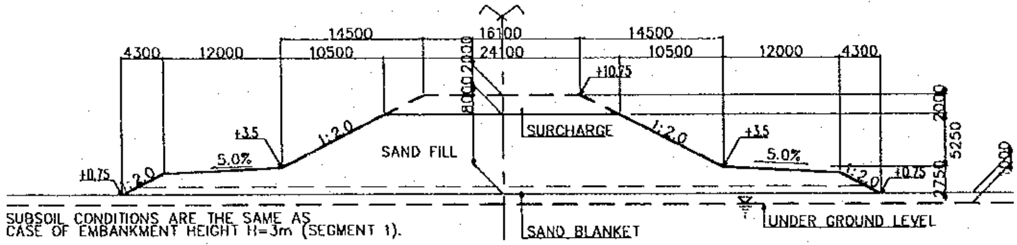
Item	Segment	Subsoil Layer	Cohesion C kN/m²	Internal Friction Angle φ Degree	Unit Weight γ kN/m³	Remarks
Subsoil	1	C1-U	7.0	4.0	15.9	
		C1-L	8.0	6.0	16.7	
		C2	10.0	14.0	17.3	
	3	C1-U	9.0	4.0	15.6	
		C1-L	14.0	3.0	16.8	
	4	C1-U	8.0	4.0	15.6	

Item	Material	C kN/m²	φ Degree	γ kN/m³	Remarks
Embankment	Sand fill/Surcharge	20.0	30	18.3	
	Sand Blanket	14.0	30	18.6	

H=7m
SEGMENT 3,4



H=8m
SEGMENT 1



H=8m
SEGMENT 3,4

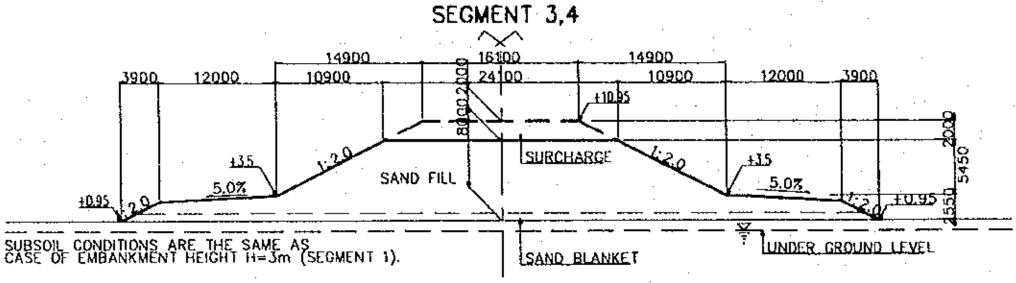


Fig-I-4-2. Design Section-2

4-3. Limit Height of Embankment

4.3.1 Description

Limit embankment height is maximum height in the case that it does not consider strength increase of the subsoil by the embankment load. This value is applied to the rough estimate of counter berm style and the study of stage construction.

4.3.2 Design Formula

Limit embankment height is calculated by the formula as below.

$$H_{EC} = qd / \gamma_E$$

Where, H_{EC} ; Limit embankment height (m)

qd ; Limit bearing capacity of subsoil (kN/m²)

qd = 5.1 x Cu Cu; Cohesion in undrained condition test (kN/m²)

γ_E; Unit Weight of Embankment (kN/m³)

4.3.3 The Calculation Result and Conclusion

Segment	Cu	qd	γ_E	H_{EC}	Remarks
	kN/m²	kN/m²	kN/m³	m	
1	7.0	35.7	18.3	2.0	
2	9.0	45.9	18.3	2.5	
3	8.0	40.8	18.3	2.2	

Limit embankment height adopts 2.0 m to all segments due considering the safety design.

4-4. Maximum Embankment Height

The maximum height of the road embankment greatly influences the bridge length and the degree of soft-ground treatment, included in the construction costs of the approach roads. The limitation height can be concluded from the result of optimization study based on the sub soils survey including the laboratory testing results. As illustrated in the following diagrams, the limiting embankment height was 7.0m from existing ground level, after consideration of embankment stability and minimizing cost of construction.

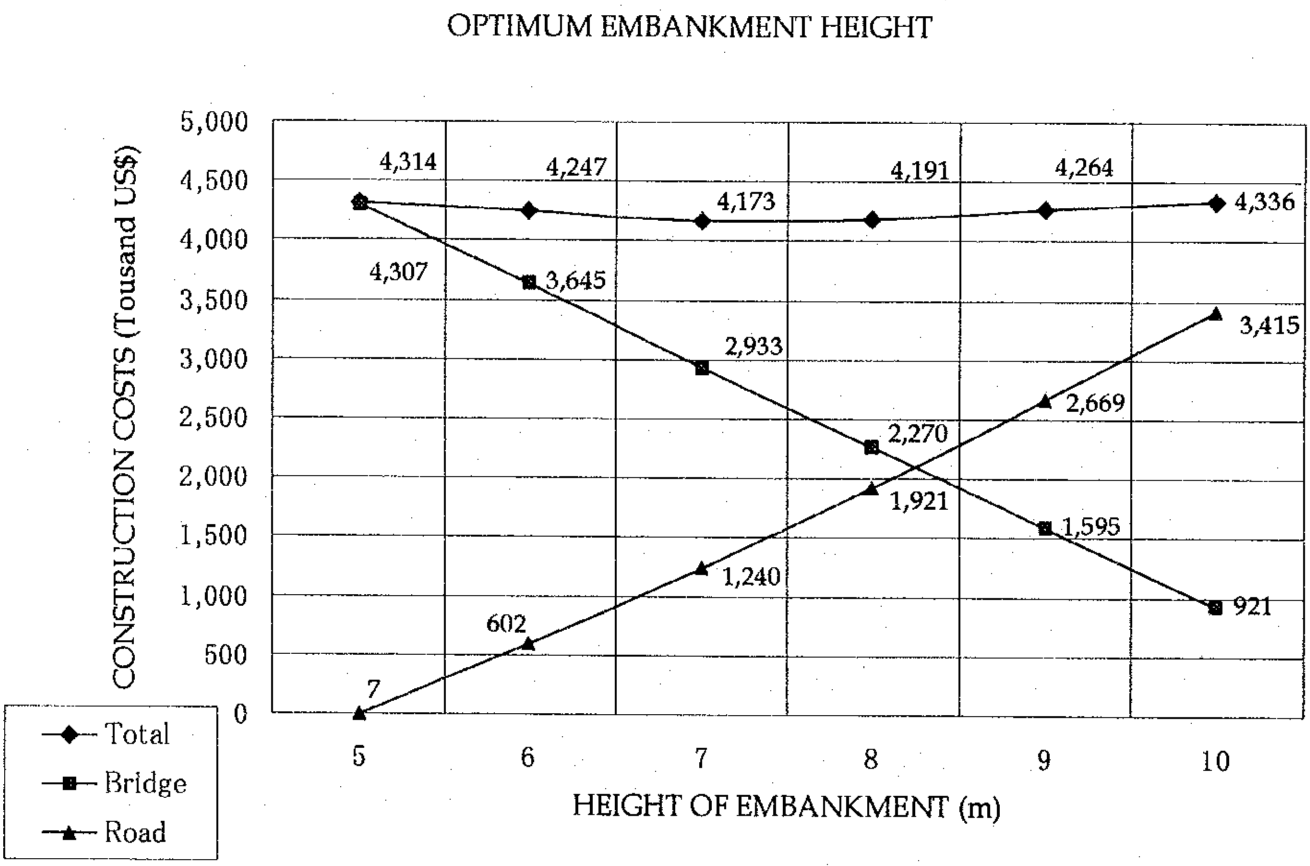


Figure I-4- 4 Cost Comparisons by Embankment Height

4-5. Form of Counter Berm

4.5.1 Description

The Counter Berm is one of the soft ground treatment methods that placing the embankment as weight to foot of slope to improve the stability of embankment. This method is an effective method in the case that security of land acquisition and embankment material is easy.

The form of the counter berm was decided with the following manner.

- The height of counter berm is applied the limit banking height that expressed in Chapter 4.3.
- The width of counter berm is decided with the calculation result of slope stability.

4.5.2 Design formula

The design formula of the slope stability is explained on Chapter 4.2.2.

4.5.3 Conclusion

The study of the form of the counter berm was carried out with 6 m embankment height and also 8 m. The result of the stability calculation is shown to the graph as below. The width of counter berm adopts 10 m in the case of 6 m or less embankment height and adopts 12 m in the case of 8 m or less embankment height.

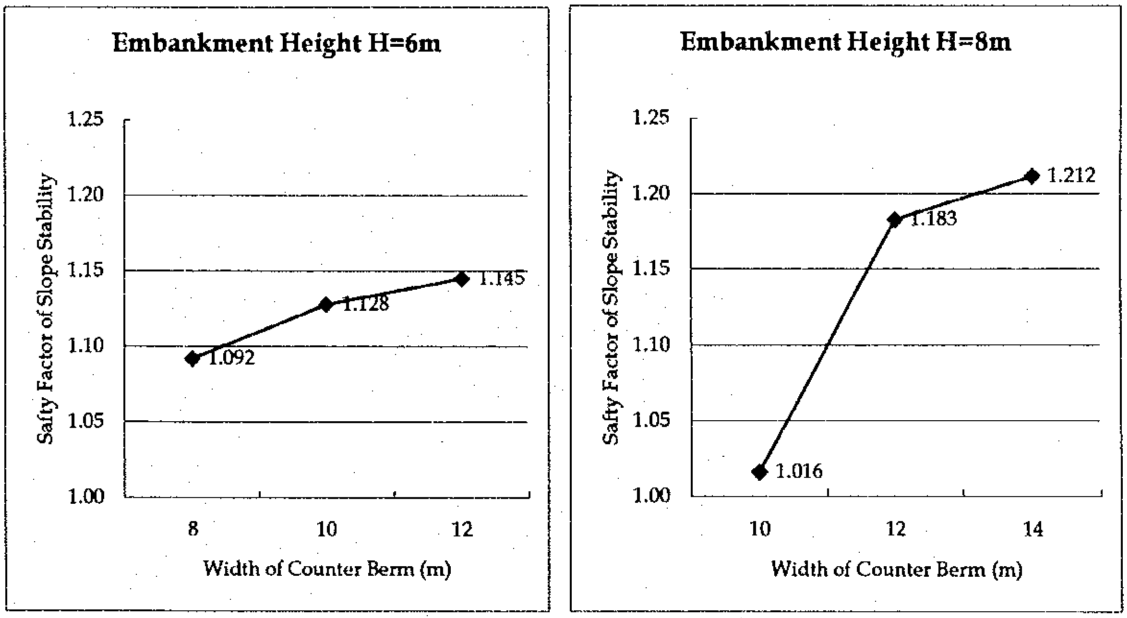


Figure I-4-5. Study Result of Counter Berm Width

4-6. Design of Construction Method for Settlement Promotion

4.6.1 Description

The consolidation of subsoil is promoted by discharge of underground water. Accordingly the selection of the high discharge method of efficiency will be contributed to the strength increase of subsoil, and the shortening of the construction period.

Sand drain method (SD) and pre-fabricated vertical drain method (PVD) are acknowledged the effective discharge method as soft ground treatment method generally, and the selection of the method suitable for the Project is carried out in this chapter.

4.6.2 Selection of the material for settlement promotion

Adaptability to the Projects of both methods SD and PVD are summarized as below.

SD	• This method is effective in the thick homogeneous clay stratum. • As for SD the discharge ability is high because the diameter is big. • There is the fear that the semantic differentials easy to disturb the subsoil and decrease the strength of subsoil and increase deformation. • The drainage ability of SD relies on the material of sand. Accordingly the acquisition of the fine material is the condition that selects this method.
PVD	• This method is cheaper in comparison with SD and the execution of work is early and also there is little fear that disturbs the subsoil.

And comparison table of construction costs of both methods SD and PVD are shown as below.

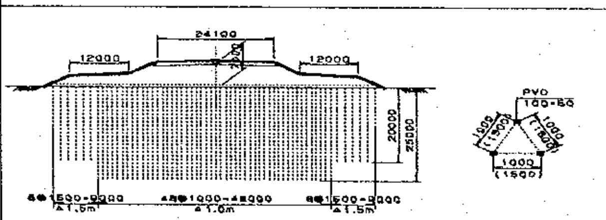
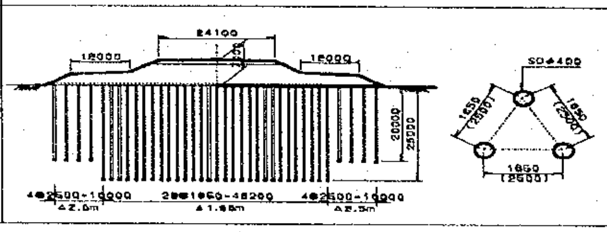
	Arrangement of Drainage Material	Costs Thousand US$/100m
PVD (PREFABLICATED VERTICAL DRAIN)		182
SD (SAND DRAIN)		197

Figure I-4-6. Cost Comparison of SD and PVD

4.6.3 Conclusion

PVD should be applied to the Project as for the settlement promotion method of subsoil by the above study result.

4-7. Arrangement Design of PVD

4.7.1 Description

As expressed with the design concept, PVD should arranged to secure the degree of consolidation at the time of removing surcharge becomes 90% or more.

Also, PVD should place from ground surface to the bottom of high compressible C1 layer by the result of settlement analysis.

4.7.2 PVD arrangement study result of the main body of embankment

The arrangement study of PVD was carried out embankment height 4 m and 7 m as the representative case, and result of comparative study was summarized in the table as below.

	Embankment Height 4m				Embankment Height 7m			
Segment 1	Spacing	0.8 m	***1.0 m***	1.2 m	Spacing	0.8 m	***1.0 m***	1.2 m
	Sf (cm)	159.5			Sf (cm)	243.7		
	Sr (cm)	147.0	145.7	140.4	Sr (cm)	221.9	220.4	213.9
	U (%)	92.2	***91.3***	88.0	***U (%)***	91.1	***90.4***	87.8
Segment 3	Spacing	0.9 m	***1.1 m***	1.3 m	Spacing	0.9 m	***1.1 m***	1.3 m
	Sf (cm)	156.6			Sf (cm)	228.6		
	Sr (cm)	152.9	141.3	123.8	Sr (cm)	225.2	212.0	189.8
	U (%)	97.6	***90.2***	79.1	***U (%)***	98.5	***92.7***	83.7
Segment 4	Spacing	1.1 m	***1.3 m***	1.5 m	Spacing	1.1 m	***1.3 m***	1.5 m
	Sf (cm)	110.4			Sf (cm)	155.8		
	Sr (cm)	107.4	100.6	90.7	Sr (cm)	152.9	145.2	132.9
	U (%)	97.3	***91.1***	82.2	***U (%)***	98.1	***93.2***	85.3

Note Sf: Final Settlement Sr: Settlement at the time of removing surcharge
U; Degree of Consolidation (=Sr/Sf x 100%)

4.7.3 PVD arrangement of the counter berm

The spacing of PVD of counter berm makes about 1.5 times of the spacing of the main body for economize.

4-8. Study of Slope Stability

4.8.1 Description

Stability calculation was carried out separately general section and special section.

(1) General Section

Slope stability of embankment was confirmed every 2 m from 4 m to 8 m of design embankment height of each design segment.

(2) Special Section

The establishment position of the abutment was considering even the execution of the pre-load for the abutment and was selected. As a result, most of the abutments were secured the stability with only Slow banking method. However, Sand Compaction Pile (SCP) was necessary for the pre-load of only Small Tra Va Bridge and Cai Nai Bridge.

(3) Design formula and software used for study

The factor of stability was calculated by both formula of Fillenius and Bishop's. And Japanese software COSTANA and Australian software PCSTABL5M was used for the calculation.

4.8.2 Slope Stability Calculation Result of General Section

Embankment Height		4m	6m	8m
Safety Factor of sliding K	Segment 1	1.16	1.13	1.18
	Segment 3	1.11	1.13	1.20
	Segment 4	1.22	1.13	1.23

Note K: Safety Factor of sliding (>=1.10)

4.8.3 Slope Stability Calculation Result of Special Section

Bridge Name	Small Tra Va Bridge	Cai Nai Bridge
Safety Factor of sliding K	1.193	1.105

Note: Gravel should use to SCP for pre-load of Cai Nai bridge abutment. And Dai Ngai sand should use to embankment for Cai Nai Bridge.

4-9. Calculation of Settlement

4.9.1 Description

Settlement quantity was calculated every 1 m from 1 m to 8 m of design embankment height of each design segment. And settlement quantity of 5 points was calculated to every 1 section as also, shown in the rough sketch.

Japanese software DECALTO was used for calculation of settlement and Vietnamese software was used for checking. Both soft wear was calculated by using same formula shown in Chapter 4.2.2.

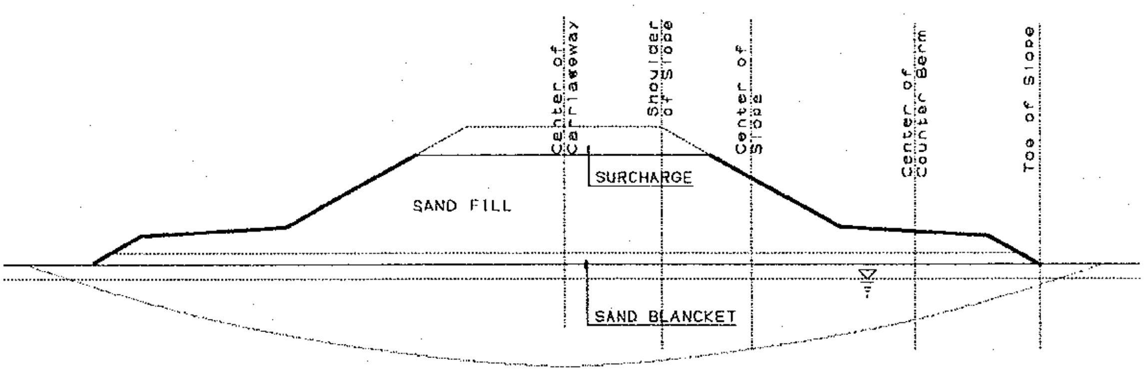


Figure I-4-7. Section of Settlement Calculation

4.9.2 Calculation Result of Settlement

Item/ Segment	Height of Embankment	Toe of Slope	Center of Counter Berm	Center of Slope	Shoulder of Slope	Center of Carriage way
	m	m	m	m	m	m
Segment 1	1.0	0.19	-	0.27	0.27	0.38
	2.0	0.38	-	0.66	0.76	0.92
	3.0	0.54	-	1.04	1.27	1.44
	4.0	0.64	-	1.31	1.64	1.80
	5.0	0.58	1.36	1.88	2.06	2.18
	6.0	0.61	1.41	2.05	2.30	2.43
	7.0	0.62	1.41	2.21	2.53	2.64
	8.0	0.63	1.45	2.37	2.76	2.87
Segment 3	1.0	0.20	-	0.24	0.27	0.41
	2.0	0.35	-	0.61	0.74	0.95
	3.0	0.46	-	0.97	1.23	1.44
	4.0	0.53	-	1.22	1.59	1.77
	5.0	0.43	1.20	1.76	1.96	2.09
	6.0	0.43	1.23	1.90	2.17	2.30
	7.0	0.42	1.23	2.05	2.37	2.49
	8.0	0.43	1.22	2.16	2.56	2.67
Segment 4	1.0	0.12	-	0.18	0.21	0.31
	2.0	0.19	-	0.45	0.57	0.70
	3.0	0.24	-	0.71	0.93	1.06
	4.0	0.27	-	0.89	1.19	1.30
	5.0	0.22	0.85	1.27	1.43	1.51
	6.0	0.22	0.86	1.37	1.56	1.64
	7.0	0.21	0.84	1.45	1.69	1.76
	8.0	0.21	0.84	1.52	1.79	1.86

Note: Displayed settlement quantity was added 20 cm as settlement quantity for long-term settlement quantity. (Toe of Slope was not added 20cm.)
The settlement area was calculated on the basis of the assumption that settlement converges with the point of 5 m from toe of slope.

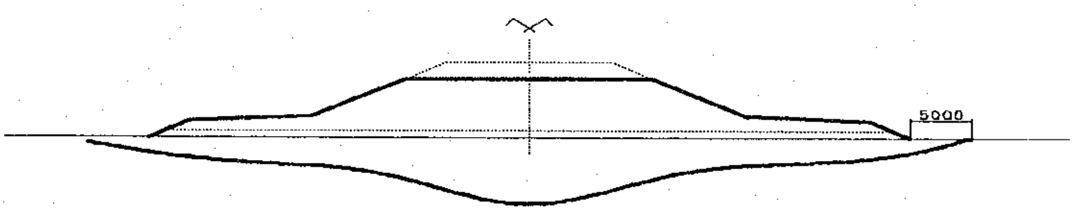


Figure I-4-8. Cross-Section of Settlement

Settlement of embankment height 1 m and 2 m was calculated with the proportional distribution method as below.

$$S_n = (S_{n+1}/S_{n+2})^2 \times S_{n+1}$$