社会開発調査部報告書

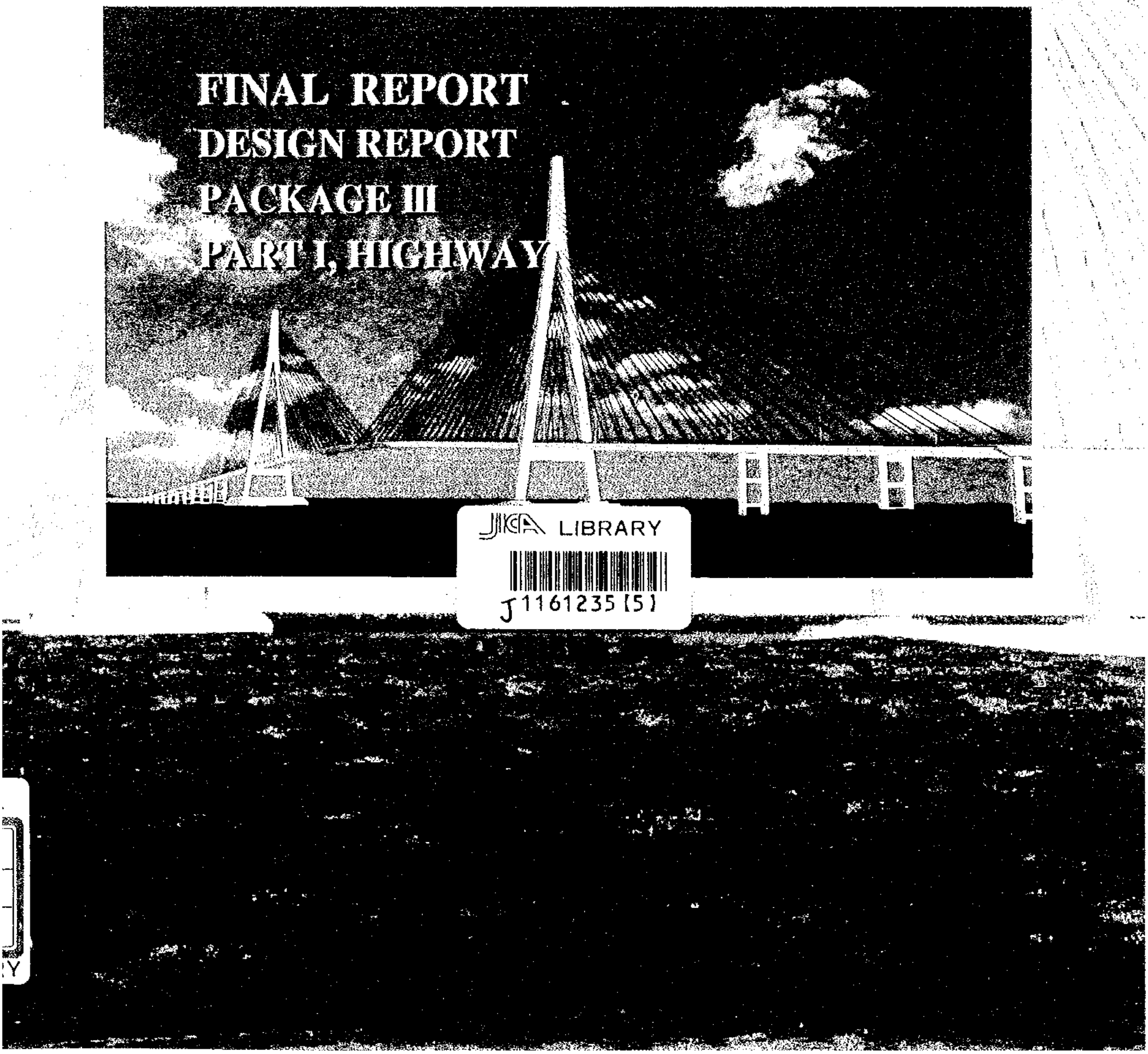
No. 32

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



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

FINAL REPORT
DESIGN REPORT
PACKAGE III
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 III, HIGHWAY

Table of Contents

Chapter 1

ALIGNMENT DESIGN

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.

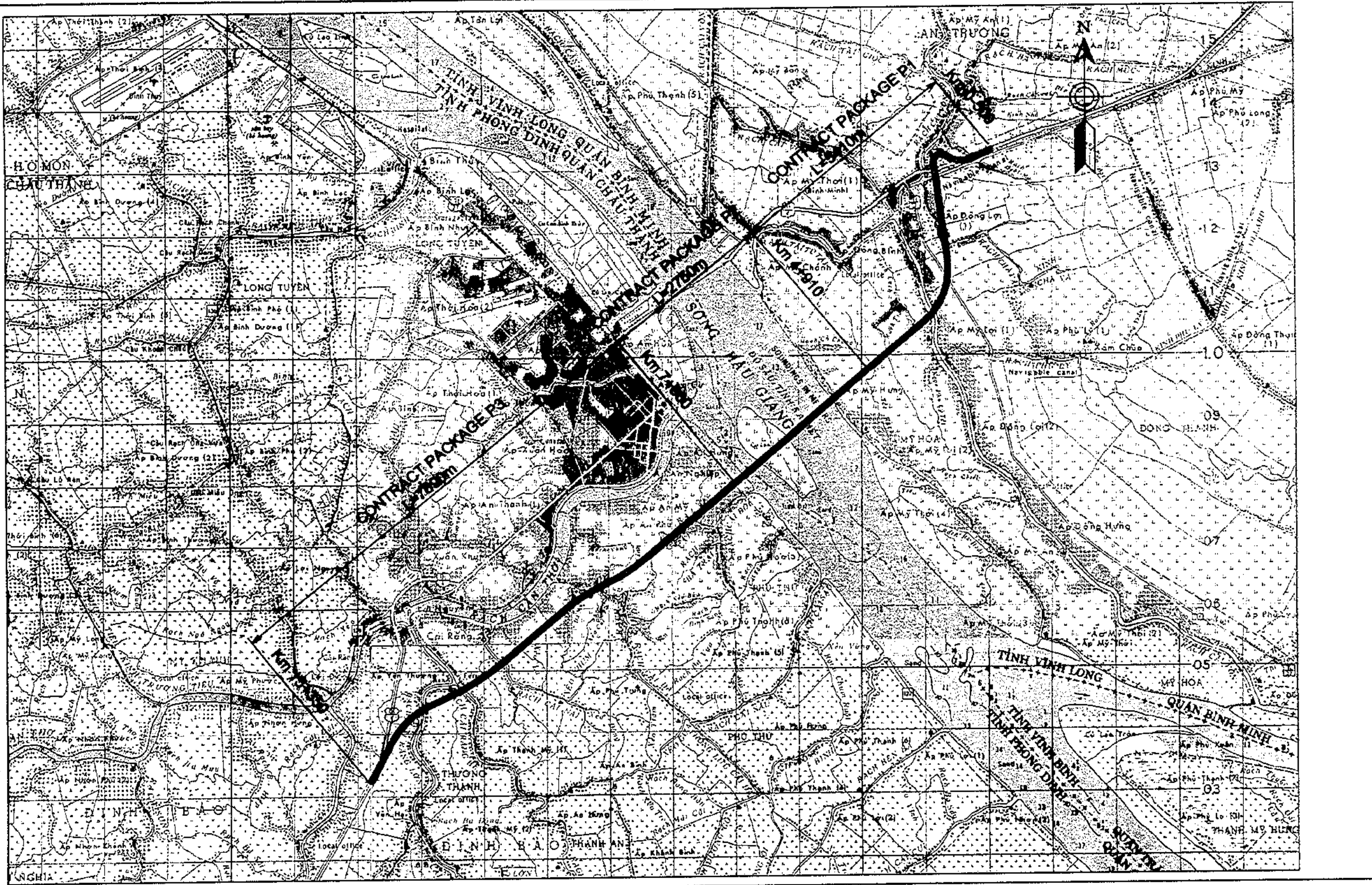
The starting point is at Km2061 on National highway No.1A of Binh Minh District in Vinh Long Province. The end is at Km2077 on National highway No.1A of Chau Thanh District, Can Tho Province.

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.

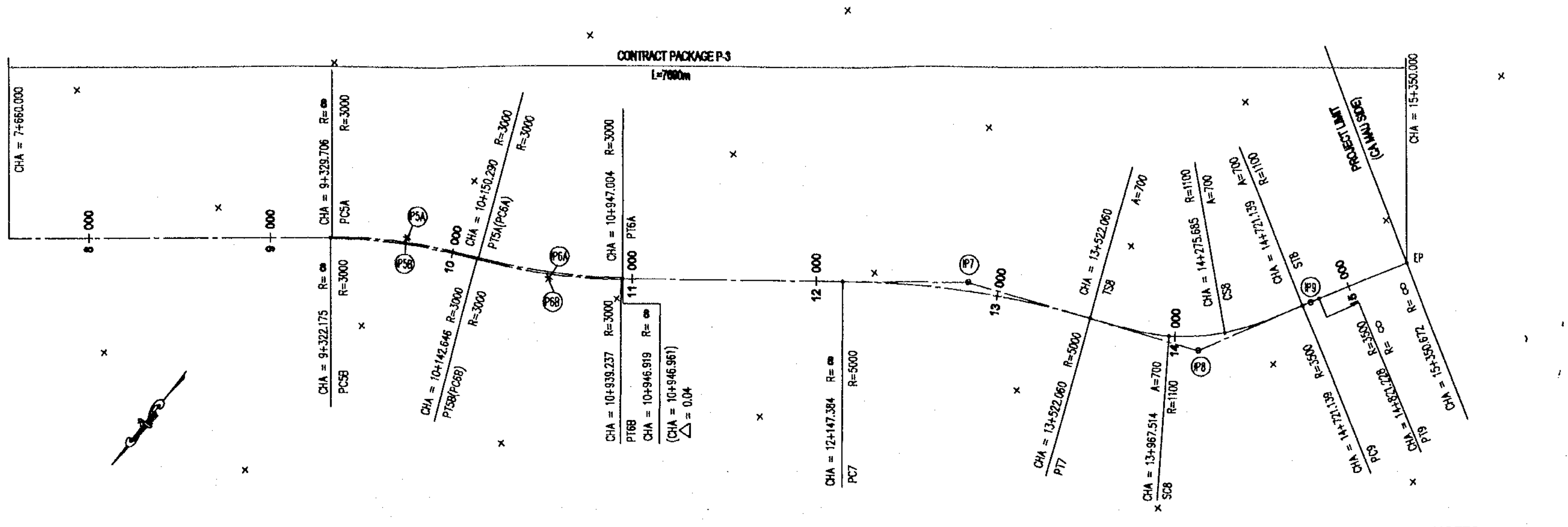
Where no provisions exist in TCVN4054, the relevant standards of AASHTO (A Policy on Geometric Design of Highways and Streets, 1994) of United States, JRSO (Japan Road Structure Ordinance, 1983) of Japan were referred.

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 .

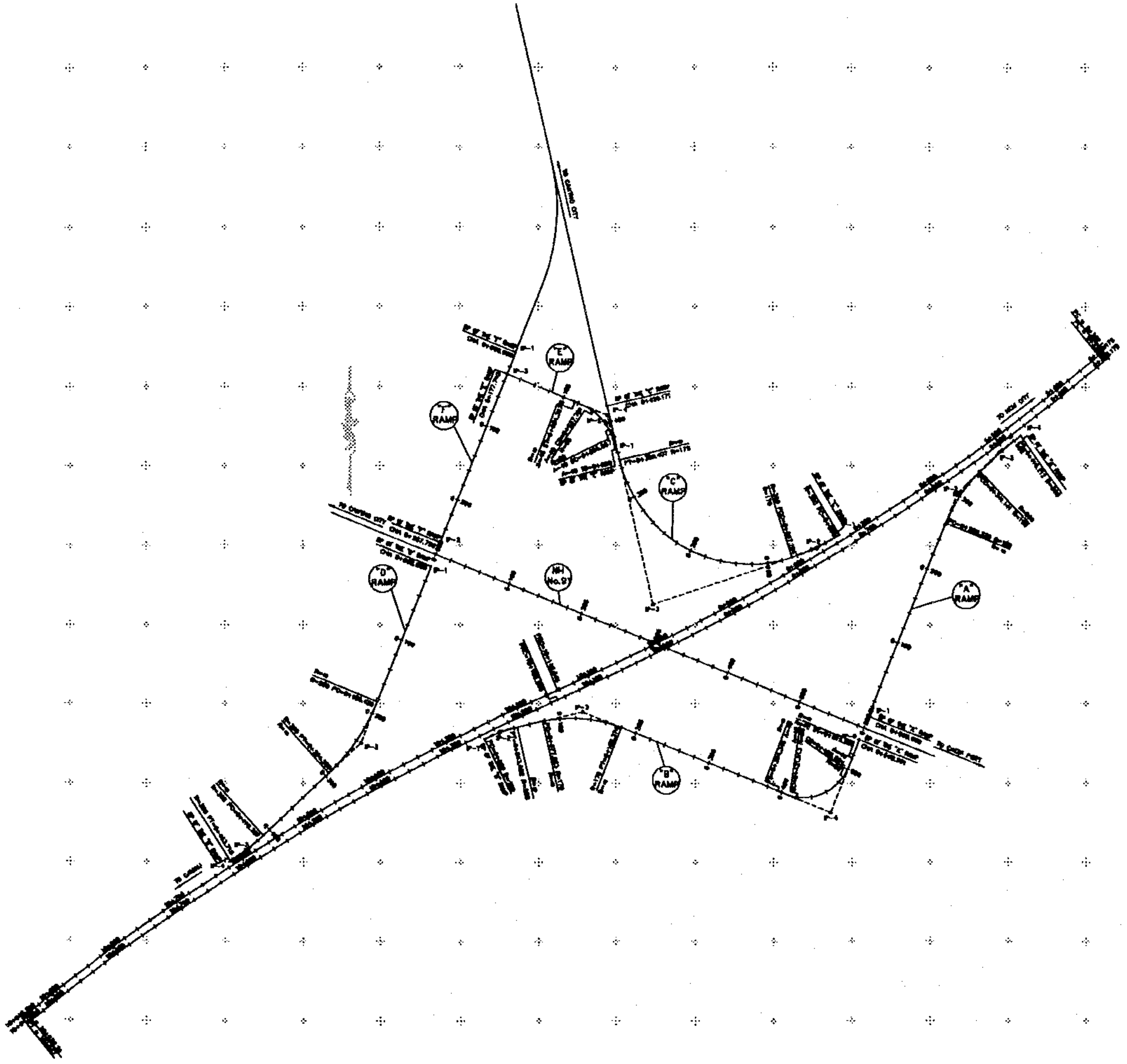
	IA	R	A1	A2	TL1	TL2	CL	L1	L2	LC	IP X	IP Y	PC X	PC Y	PC CHA	PT X	PT Y	PT CHA
IP-5A	15°40'19.23"	3000	-	-	412.86959	412.86959	820.58442	-	-	820.58442	1107469.90196	586103.72334	1107730.94313	586423.59645	9+329.70607	1107304.97264	585725.22682	10+150.29049
IP-6A	15°12'57.99"	3000	-	-	400.71469	400.71469	796.713520	-	-	796.713520	1107144.898864	585357.873270	1107304.97264	585725.22682	10+150.29049	1106894.02105	585045.41117	10+947.00401
IP-5B	15°40'11.42"	3000	-	-	412.81172	412.81172	820.47080	-	-	820.47080	1107482.13746	586103.53279	1107743.14203	586423.36105	9+322.17556	1107317.21693	585725.09558	10+142.64636
IP-6B	15°12'49.57"	3000	-	-	400.65237	400.65237	796.59116	-	-	796.59116	1107157.15412	585357.80518	1107317.21693	585725.09558	10+142.64636	1106906.31620	585045.39090	10+939.23752
IP-7	15°45'09.45"	5000	-	-	691.70053	691.70053	1374.67591	-	-	1374.67591	1105713.15088	583567.00000	1106146.20799	584106.36184	12+147.38450	1105442.78659	582930.32677	13+522.06041
IP-8	39°15'14.77"	1100	700.00000	700.00000	617.37700	617.37700	1199.07900	445.45455	445.45455	308.16990	1105201.47290	582362.06399	-	-	-	-	-	-
IP-9	01°38'18.54"	3500	-	-	50.04804	50.04804	100.08927	-	-	100.08927	1104610.74084	582051.43176	1104655.03790	582074.72506	14+721.13961	1104567.12792	582026.88141	14+821.22888
E.P	-	-	-	-	-	-	-	-	-	-	1104105.75918	581767.17016	-	-	-	-	-	-

	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)
IP-5A	-	-	-	-	-	-	-	-	-	-	-	-	230° 46' 58.43"	80	-	0
IP-6A	-	-	-	-	-	-	-	-	-	-	-	-	246° 27' 17.66"	80	-	0
IP-5B	-	-	-	-	-	-	-	-	-	-	-	-	230° 46' 58.43"	80	-	0
IP-6B	-	-	-	-	-	-	-	-	-	-	-	-	246° 27' 09.85"	80	-	0
IP-7	-	-	-	-	-	-	-	-	-	-	-	-	231° 14' 19.66"	80	-	0
IP-8	1105442.78659	582930.32677	13+522.06041	1105241.79231	582533.70472	13+967.51495	1105033.74028	582307.73205	14+275.68507	1104655.03790	582074.72506	14+721.13961	246° 59' 29.11"	80	-	0
IP-9	-	-	-	-	-	-	-	-	-	-	-	-	207° 44' 14.34"	80	-	0
E.P	-	-	-	-	-	-	-	-	-	-	-	-	209° 22' 32.88"	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



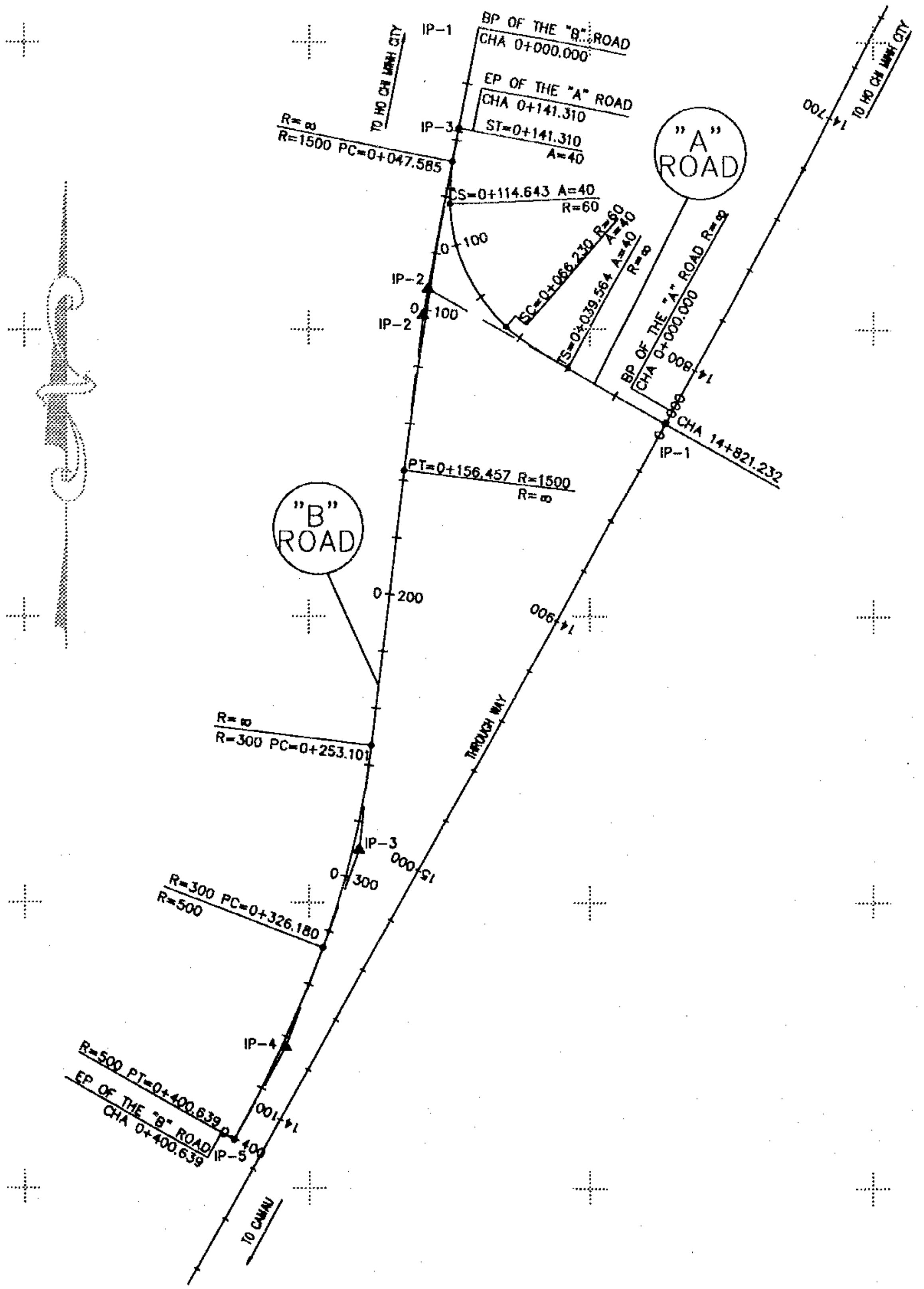
DESIGN ELEMENT OF HORIZONTAL ALIGNMENT

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	1 107 284.294	586 122.479				–	201° 48' 59"
				PC-2	0+262.333	1 107 527.839	586 219.971	Tangent	–	262.333		
	IP-2	23° 45' 54"	0+302.312			1 107 564.955	586 234.829				302.312	225° 34' 53"
				PT-2	0+341.141	1 107 592.935	586 263.384	R=190.000	Right	78.808		
				PC-3	0+341.141	1 107 592.935	586 263.384	–	–	–		
	IP-3	7° 54' 54"	0+375.732			1 107 617.145	586 288.090				74.569	233° 29' 47"
				PT-3	0+410.212	1 107 637.722	586 315.894	R=500.000	Right	69.071		
	IP-4	–	0+410.212	EP-A	0+410.212	1 107 637.722	586 315.894				34.591	233° 29' 47"
B-RAMP	IP-1	–	0+000.000	BP-B	0+000.000	1 107 255.599	585 631.599				–	244° 26' 04"
				PC-2	0+000.000	1 107 255.599	585 631.599	–	–	–		
	IP-2	12° 36' 00"	0+022.080			1 107 265.128	585 651.518				22.080	257° 02' 04"
				PT-2	0+043.982	1 107 270.082	585 673.035	R=200.000	Right	43.982		
				PC-3	0+077.223	1 107 277.540	585 705.428	Tangent	–	33.241		
	IP-3	34° 45' 56"	0+130.442			1 108 289.480	585 757.290				108.539	291° 48' 00"
				PT-3	0+180.374	1 107 269.717	585 806.703	R=170.000	Right	103.151		
				TS-4	0+394.346	1 107 190.254	586 005.372	Tangent	–	213.972		
				SC-4	0+421.013	1 107 182.228	586 030.741	A=40.000	Left	26.667		
	IP-4	90° 00' 00"	0+468.150			1 107 162.846	586 073.899				340.995	201° 48' 00"
				CS-4	0+488.594	1 107 207.465	586 089.625	R=60.000	Left	67.581		
				ST-4	0+515.261	1 107 231.372	586 101.307	A=40.000	Left	26.667		
				EP-B	0+540.261	1 107 254.584	586 110.591	Tangent	–	25.000		
	IP-5	–	0+540.261			1 107 254.584	586 110.591				98.804	201° 48' 00"
C-RAMP	IP-1	–	0+000.000	BP-C	0+000.000	1 107 512.765	586 085.056				–	58° 36' 52"
				PC-2	0+000.000	1 107 512.765	586 085.056	–	–	–		
	IP-2	12° 49' 58"	0+033.738			1 107 495.194	586 056.254				33.738	71° 26' 51"
				PT-2	0+067.194	1 107 484.460	586 024.269	R=300.000	Right	67.194		
				PC-3	0+067.194	1 107 484.460	586 024.269	–	–	–		
	IP-4	95° 27' 09"	0+254.193			1 107 424.962	585 846.988				220.738	166° 54' 00"
				PT-4	0+350.407	1 107 607.095	585 804.604	R=170.000	Right	283.213		
				EP-C	0+420.171	1 107 675.043	585 788.792	Tangent	–	69.764		
	IP-5	–	0+420.171			1 107 675.043	585 788.792				256.763	166° 54' 00"
D-RAMP	IP-1	–	0+000.000			1 107 473.134	585 564.178				–	21° 48' 00"
				PC-2	0+183.426	1 107 302.826	585 496.059	Tangent	–	183.426		
	IP-2	25° 27' 23"	0+239.895			1 107 250.395	585 475.088				239.895	47° 15' 23"
				PT-2	0+294.500	1 107 212.068	585 433.618	R=250.000	Right	111.074		
				PC-3	0+410.337	1 107 133.448	585 348.548	Tangent	–	115.837		
	IP-3	10° 11' 42"	0+437.098			1 107 115.284	585 328.894				199.067	57° 27' 05"
				PT-3	0+463.718	1 107 100.886	585 306.336	R=300	–	53.381		
	IP-4	–	0+463.718	EP-D	0+463.718	1 107 100.886	585 306.336				–	57° 27' 05"
E-RAMP	IP-1	–	0+000.000	BP-E	0+000.000	1 107 619.732	585 799.353				–	166° 54' 00"
				TS-2	0+000.000	1 107 619.732	585 799.353	–	–	–		
				SC-2	0+026.667	1 107 645.130	585 791.422	A=40.000	Left	26.667		
	IP-2	55° 06' 00"	0+044.869			1 107 663.433	585 789.183				44.869	111° 48' 00"
				CS-2	0+057.701	1 107 668.414	585 771.430	R=60.000	Left	31.034		
				ST-2	0+084.367	1 107 680.096	585 747.523	A=40.000	Left	26.667		
				EP-E	0+177.742	1 107 714.773	585 660.826	Tangent	–	93.375		
	IP-3	–	0+177.742			1 107 714.773	585 660.826				138.244	111° 48' 00"
F-RAMP	IP-1	–	0+000.000	BP-F	0+000.000	1 107 742.163	585 671.781				–	21° 48' 00"
	IP-2	–	0+257.750	EP-F	0+257.750	1 107 502.846	585 576.061				257.750	21° 48' 00"
NH No.91	IP-1	–	0+000.000	BP-OR	0+000.000	1 107 487.990	585 570.119				–	291° 48' 00"
	IP-2	–	0+588.500	EP-OR	0+288.500	1 107 269.440	586 116.533				288.500	291° 48' 00"

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

FIGURE 3. ALIGNMENT LAYOUT AND GEOMETRIC DATA
(INTERCHANGE 3)

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-ROAD	IP-1	-	0+000.000	BP-A	0+000.000	1 104 566.795	582 026.640				-	299° 20' 45"
				TS-2	0+039.564	1 104 586.185	581 992.153	Tangent	-	39.564		
				SC-2	0+066.230	1 104 600.905	581 969.988	A=40.000	Left	26.667		
	IP-2	71° 41' 44"	0+096.581			1 104 614.128	581 942.453				96.581	11° 02' 29"
				CS-2	0+114.643	1 104 643.668	581 950.222	R=60.000	Left	48.413		
				ST-2	0+141.310	1 104 670.089	581 953.373	A=40.000	Left	26.667		
	IP-3	-	0+141.310	EP-A	0+141.310	1 104 670.089	581 953.373				57.017	
B-ROAD	IP-1	-	0+000.000	BP-B	0+000.000	1 104 705.024	581 960.190				-	191° 02' 29"
				PC-2	0+47.585	1 104 658.319	581 951.076	Tangent	-	47.585		
	IP-2	4° 09' 31"	0+102.045			1 104 604.868	581 940.646				102.045	186° 52' 58"
				PT-2	0+156.457	1 104 550.801	581 934.120	R=1500	Left	108.871		
				PC-3	0+253.101	1 104 454.853	581 922.538	Tangent	-	96.645		
	IP-3	13° 57' 25"	0+289.822			1 104 418.396	581 918.137				187.825	200° 50' 23"
				PT-3	0+326.180	1 104 384.078	581 905.073	R=300	Right	73.079		
				PC-4	0+326.180	1 104 384.078	581 905.073	-	-	-		
	IP-4	8° 31' 57"	0+363.478			1 104 349.219	581 891.804				74.02	209° 22' 20"
				PT-4	0+400.639	1 104 316.715	581 873.510	R=500	Right	74.459		
	IP-5		0+400.639	EP-B	0+400.639	1 104 316.715	581 873.510				37.298	

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

FIGURE 4. ALIGNMENT LAYOUT AND GEOMETRIC DATA
(INTERSECTION 1)

JAPAN INTERNATIONAL COOPERATION AGENCY

1-5. COORDINATE LIST

1.5.1. COORDINATE LIST OF THROUGHWAY

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
165	7 K 790	+	1,108,708.157	+	587,613.457	
166	7 K 800	+	1,108,701.835	+	587,605.710	
167A	7 K 840	+	1,108,676.545	+	587,574.720	
	7 K 850	+	1,108,670.222	+	587,566.972	
168A	7 K 870	+	1,108,657.577	+	587,551.478	
	7 K 900	+	1,108,638.609	+	587,528.235	
168B	7 K 920	+	1,108,625.964	+	587,512.740	
169	7 K 950	+	1,108,606.996	+	587,489.497	
	7 K 980	+	1,108,588.028	+	587,466.254	
170	8 K 0	+	1,108,575.383	+	587,450.759	
171	8 K 50	+	1,108,543.770	+	587,412.021	
172	8 K 100	+	1,108,512.157	+	587,373.283	
173	8 K 150	+	1,108,480.544	+	587,334.546	
	8 K 160	+	1,108,474.221	+	587,326.798	
	8 K 180	+	1,108,461.576	+	587,311.303	
174	8 K 200	+	1,108,448.931	+	587,295.808	
	8 K 213.37	+	1,108,440.477	+	587,285.449	
175	8 K 250	+	1,108,417.318	+	587,257.070	
176	8 K 300	+	1,108,385.705	+	587,218.332	
	8 K 320	+	1,108,373.059	+	587,202.837	
	8 K 350	+	1,108,354.092	+	587,179.595	
177A	8 K 353	+	1,108,352.195	+	587,177.271	
178	8 K 400	+	1,108,322.478	+	587,140.857	
179	8 K 450	+	1,108,290.865	+	587,102.119	
	8 K 456.83	+	1,108,286.548	+	587,096.828	
	8 K 462.83	+	1,108,282.754	+	587,092.179	
	8 K 469.33	+	1,108,278.703	+	587,087.215	
	8 K 476.88	+	1,108,273.868	+	587,081.290	
180	8 K 500	+	1,108,259.252	+	587,063.381	1st CT Bridge
181	8 K 550	+	1,108,227.639	+	587,024.643	1st CT Bridge
182	8 K 600	+	1,108,196.026	+	586,985.906	1st CT Bridge
	8 K 606.73	+	1,108,191.768	+	586,980.688	
	8 K 612.50	+	1,108,188.123	+	586,976.221	
	8 K 616.22	+	1,108,185.773	+	586,973.342	

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
	8 K 625.00	+	1,108,180.220	+	586,966.536	
	8 K 637.50	+	1,108,172.316	+	586,956.852	
183	8 K 650	+	1,108,164.413	+	586,947.168	
184	8 K 700	+	1,108,132.800	+	586,908.430	
	8 K 723.65	+	1,108,117.848	+	586,890.108	
185A	8 K 748	+	1,108,102.452	+	586,871.242	
	8 K 750	+	1,108,101.187	+	586,869.692	
	8 K 772.22	+	1,108,087.136	+	586,852.475	
186	8 K 800	+	1,108,069.574	+	586,830.954	
	8 K 850	+	1,108,037.961	+	586,792.217	
187A	8 K 852	+	1,108,036.696	+	586,790.667	
	8 K 898.42	+	1,108,007.345	+	586,754.700	
	8 K 899.29	+	1,108,006.798	+	586,754.031	
188	8 K 900	+	1,108,006.348	+	586,753.479	
	8 K 902.16	+	1,108,004.982	+	586,751.000	
	8 K 941.53	+	1,107,980.092	+	586,721.305	
	8 K 950	+	1,107,974.735	+	586,714.741	
189A	8 K 960	+	1,107,968.412	+	586,706.993	
	9 K 0	+	1,107,943.122	+	586,676.003	
190A	9 K 11	+	1,107,936.167	+	586,667.481	
191A	9 K 40	+	1,107,917.832	+	586,645.013	
	9 K 50	+	1,107,911.509	+	586,637.265	
	9 K 80	+	1,107,892.541	+	586,614.023	
192	9 K 100	+	1,107,879.896	+	586,598.528	
193	9 K 150	+	1,107,848.283	+	586,559.790	
	9 K 166.44	+	1,107,837.892	+	586,547.057	
194	9 K 200	+	1,107,816.670	+	586,521.052	
195	9 K 250	+	1,107,785.057	+	586,482.314	
196	9 K 300	+	1,107,753.444	+	586,443.577	
197A	9 K 350	+	1,107,718.165	+	586,407.830	
	9 K 378.38	+	1,107,700.477	+	586,385.640	
198A	9 K 400	+	1,107,687.141	+	586,368.620	
199A	9 K 450	+	1,107,656.775	+	586,328.898	2sd CT Bridge
	9 K 500	+	1,107,627.074	+	586,288.676	
	9 K 521.66	+	1,107,614.419	+	586,271.101	
	9 K 550	+	1,107,598.049	+	586,247.964	IC91&91B
	9 K 587	+	1,107,568.600	+	586,205.110	
	9 K 600	+	1,107,569.705	+	586,206.774	IC91&91B

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
	9K 650	+	1,107,542.053	+	586,165.118	IC91&91B
	9K 700	+	1,107,515.098	+	586,123.006	IC91&91B
	9K 750	+	1,107,488.849	+	586,080.451	IC91&91B
	9K 800	+	1,107,463.312	+	586,037.465	IC91&91B
	9K 850	+	1,107,438.496	+	585,994.059	IC91&91B
	9K 900	+	1,107,414.407	+	585,950.245	IC91&91B
	9K 950	+	1,107,391.051	+	585,906.036	IC91&91B
	10K 0	+	1,107,368.435	+	585,861.444	IC91&91B
	10K 50	+	1,107,346.565	+	585,816.481	IC91&91B
	10K 100	+	1,107,325.448	+	585,771.160	IC91&91B
	10K 150	+	1,107,305.089	+	585,725.493	IC91&91B
	10K 200	+	1,107,284.739	+	585,679.822	IC91&91B
	10K 250	+	1,107,263.630	+	585,634.497	
216A	10K 300	+	1,107,241.769	+	585,589.530	
217A	10K 350	+	1,107,219.162	+	585,544.934	
218A	10K 400	+	1,107,195.814	+	585,500.720	
219A	10 K439	+	1,107,177.030	+	585,466.540	
	10K 450	+	1,107,171.733	+	585,456.902	
220A	10K 500	+	1,107,146.925	+	585,413.491	CD Bridge
221A	10K 550	+	1,107,121.397	+	585,370.499	
	10K 562	+	1,107,115.278	+	585,360.432	
222A	10K 600	+	1,107,095.156	+	585,327.939	
223A	10K 650	+	1,107,068.210	+	585,285.822	
224A	10K 700	+	1,107,040.565	+	585,244.161	
225A	10K 750	+	1,107,012.230	+	585,202.965	
226A	10K 800	+	1,106,983.212	+	585,162.248	
227A	10K 850	+	1,106,953.520	+	585,122.020	
228A	10K 900	+	1,106,923.161	+	585,082.292	
229B	9K 350	+	1,107,725.650	+	586,401.723	
	9K 378.15	+	1,107,708.158	+	586,379.666	
230B	9K 400	+	1,107,694.724	+	586,362.435	
231B	9K 450	+	1,107,664.458	+	586,322.637	2sd CT Bridge
232B	9K 500	+	1,107,634.858	+	586,282.340	
	9K 521	+	1,107,622.557	+	586,265.170	
233B	9K 550	+	1,107,605.935	+	586,241.556	
234B	9K 587	+	1,107,579.390	+	586,202.770	
	9K 600	+	1,107,577.695	+	586,200.295	
235B	9K 650	+	1,107,550.147	+	586,158.569	

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
236B	9K 700	+	1,107,523.298	+	586,116.390	
	9K 750	+	1,107,497.156	+	586,073.769	
	9K 800	+	1,107,471.727	+	586,030.719	IC91&91B
	9K 850	+	1,107,447.020	+	585,987.250	IC91&91B
	9K 900	+	1,107,423.041	+	585,943.376	IC91&91B
	9K 950	+	1,107,399.796	+	585,899.109	IC91&91B
	10K 0	+	1,107,377.292	+	585,854.460	IC91&91B
	10K 50	+	1,107,355.535	+	585,809.442	IC91&91B
	10K 100	+	1,107,334.532	+	585,764.068	IC91&91B
	10K 150	+	1,107,314.271	+	585,718.358	IC91&91B
	10K 200	+	1,107,293.803	+	585,672.740	IC91&91B
	10K 250	+	1,107,272.577	+	585,627.469	IC91&91B
	10K 300	+	1,107,250.600	+	585,582.559	IC91&91B
	10K 350	+	1,107,227.877	+	585,538.021	IC91&91B
	10K 400	+	1,107,204.416	+	585,493.868	IC91&91B
	10K 344	+	1,107,187.490	+	585,463.260	
	10K 450	+	1,107,180.221	+	585,450.112	IC91&91B
	10K 496	+	1,107,157.290	+	585,410.230	
	10K 500	+	1,107,155.301	+	585,406.766	IC91&91B
	10K 550	+	1,107,129.662	+	585,363.840	IC91&91B
254B	10K 600	+	1,107,103.311	+	585,321.348	
255B	10K 650	+	1,107,076.256	+	585,279.301	
256B	10K 700	+	1,107,048.504	+	585,237.711	
257B	10K 750	+	1,107,020.062	+	585,196.589	
258B	10K 800	+	1,106,990.939	+	585,155.947	
259B	10K 850	+	1,106,961.142	+	585,115.796	
260B	10K 900	+	1,106,930.681	+	585,076.147	
261	10K 950	+	1,106,895.862	+	585,040.037	
262	11K 0	+	1,106,864.558	+	585,001.049	
263	11K 50	+	1,106,833.254	+	584,962.061	
264	11K 100	+	1,106,801.950	+	584,923.073	
265	11 K 143	+	1,106,775.030	+	584,889.540	
	11K 150	+	1,106,770.646	+	584,884.084	
266	11 K 195	+	1,106,742.470	+	584,848.990	
	11K 200	+	1,106,739.343	+	584,845.096	
267	11K 250	+	1,106,708.039	+	584,806.108	
	11K 283.46	+	1,106,687.094	+	584,780.021	
268	11K 300	+	1,106,676.735	+	584,767.120	

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
	11 K 327.66	+	1,106,659.418	+	584,745.553	
269	11 K 350	+	1,106,645.431	+	584,728.132	
270	11 K 400	+	1,106,614.127	+	584,689.144	
	11 K 450	+	1,106,582.824	+	584,650.156	
271	11 K 455	+	1,106,579.690	+	584,646.260	
272	11 K 500	+	1,106,551.520	+	584,611.168	
273	11 K 550	+	1,106,520.216	+	584,572.180	
274	11 K 600	+	1,106,488.912	+	584,533.192	
275	11 K 650	+	1,106,457.608	+	584,494.203	
276	11 K 700	+	1,106,426.305	+	584,455.215	
277	11 K 750	+	1,106,395.001	+	584,416.227	
278	11 K 800	+	1,106,363.697	+	584,377.239	
279	11 K 850	+	1,106,332.393	+	584,338.251	
280	11 K 900	+	1,106,301.089	+	584,299.263	
281	11 K 950	+	1,106,269.786	+	584,260.275	
282	12 K 0	+	1,106,238.482	+	584,221.287	
283	12 K 40	+	1,106,200.920	+	584,174.500	
283	12 K 50	+	1,106,207.178	+	584,182.299	
284	12 K 100	+	1,106,175.874	+	584,143.310	
285	12 K 150	+	1,106,144.571	+	584,104.322	
286	12 K 200	+	1,106,113.483	+	584,065.162	
	12 K 214.78	+	1,106,104.377	+	584,053.524	
287	12 K 250	+	1,106,082.788	+	584,025.693	
288	12 K 300	+	1,106,052.490	+	583,985.918	
289	12 K 350	+	1,106,022.591	+	583,945.843	CN Bridge
	12 K 400	+	1,105,993.094	+	583,905.471	CN Bridge
290	12 K 390	+	1,105,987.280	+	583,897.340	
291	12 K 450	+	1,105,964.002	+	583,864.806	
292	12 K 500	+	1,105,935.318	+	583,823.852	
	12 K 550	+	1,105,907.045	+	583,782.614	
	12 K 551.94	+	1,105,905.963	+	583,781.000	
293	12 K 560	+	1,105,901.470	+	583,774.310	
294	12 K 600	+	1,105,879.187	+	583,741.094	
295	12 K 650	+	1,105,851.744	+	583,699.298	
296	12 K 697	+	1,105,826.340	+	583,659.750	
	12 K 700	+	1,105,824.721	+	583,657.230	
297	12 K 745	+	1,105,800.780	+	583,619.130	
	12 K 750	+	1,105,798.120	+	583,614.894	

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
298	12K 800	+	1,105,771.944	+	583,572.294	
299	12K 850	+	1,105,746.195	+	583,529.434	
300	12K 900	+	1,105,720.876	+	583,486.319	
301	12K 950	+	1,105,695.989	+	583,442.952	
	12K 979.18	+	1,105,681.669	+	583,417.533	
302	13K 0	+	1,105,671.537	+	583,399.339	
	13K 20.91	+	1,105,661.441	+	583,381.026	
303	13K 50	+	1,105,647.522	+	583,355.484	
304	13K 100	+	1,105,623.948	+	583,311.391	
	13K 107.34	+	1,105,620.532	+	583,304.893	
	13K 114.34	+	1,105,617.275	+	583,298.697	
	13K 121.34	+	1,105,614.022	+	583,292.499	
	13K 128.34	+	1,105,610.790	+	583,286.290	
	13K 135.64	+	1,105,607.422	+	583,279.820	
	13K 144.85	+	1,105,603.185	+	583,271.639	
305	13K 150	+	1,105,600.815	+	583,267.064	AM Bridge
	13K 200	+	1,105,578.127	+	583,222.508	
306	13 K 210	+	1,105,573.680	+	583,213.550	
	13K 214.50	+	1,105,571.638	+	583,209.542	
	13K 223.81	+	1,105,567.484	+	583,201.207	
	13K 232.00	+	1,105,563.849	+	583,193.870	
	13K 241.00	+	1,105,559.857	+	583,185.804	
307	13K 250	+	1,105,555.885	+	583,177.728	
308	13K 300	+	1,105,534.093	+	583,132.727	
	13K 322.27	+	1,105,524.534	+	583,112.611	
309	13K 350	+	1,105,512.751	+	583,087.511	
	13K 364.71	+	1,105,506.567	+	583,074.170	
310	13K 400	+	1,105,491.863	+	583,042.083	
311	13 K 453	+	1,105,470.230	+	582,993.700	
	13K 450	+	1,105,471.430	+	582,996.449	
312	13K 500	+	1,105,451.454	+	582,950.613	
313	13K 550	+	1,105,431.859	+	582,904.613	
	13K 600	+	1,105,412.174	+	582,858.651	
314	13 K 602	+	1,105,411.370	+	582,856.820	
315	13K 650	+	1,105,392.125	+	582,812.847	
316	13K 700	+	1,105,371.479	+	582,767.309	
	13K 733.40	+	1,105,357.226	+	282,737.103	

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
317	13 K 750	+	1,105,350.010	+	582,722.154	
	13 K 800	+	1,105,327.497	+	582,677.510	
318	13 K 804	+	1,105,325.600	+	582,673.990	
	13 K 807.88	+	1,105,323.815	+	582,670.544	
	13 K 815.88	+	1,105,320.077	+	582,663.472	
	13 K 823.88	+	1,105,316.297	+	582,656.421	
	13 K 831.88	+	1,105,312.473	+	582,649.393	
	13 K 841.91	+	1,105,307.655	+	582,640.592	
319	13 K 850	+	1,105,303.727	+	582,633.524	CR Bridge
320	13 K 880	+	1,105,288.590	+	582,607.630	
	13 K 900	+	1,105,278.500	+	582,590.358	CR Bridge
	13 K 950	+	1,105,251.627	+	582,548.198	CR Bridge
321	12 K 955	+	1,105,248.760	+	582,544.100	
322	14 K 0	+	1,105,222.949	+	582,507.245	CR Bridge
	14 K 29.24	+	1,105,205.293	+	582,483.942	
	14 K 39.01	+	1,105,199.298	+	582,476.231	
323	14 K 50	+	1,105,192.442	+	582,467.636	
	14 K 60	+	1,105,186.126	+	582,459.883	
	14 K 74.00	+	1,105,177.139	+	582,449.153	
324	14 K 100	+	1,105,160.166	+	582,429.454	
325	14 K 150	+	1,105,126.189	+	582,392.778	
	14 K 164.61	+	1,105,115.928	+	582,382.381	
326	14 K 200	+	1,105,090.580	+	582,357.684	
327	14 K 250	+	1,105,053.414	+	582,324.244	
328	14 K 300	+	1,105,014.769	+	582,292.524	
329	14 K 350	+	1,104,974.800	+	582,262.488	
	14 K 400	+	1,104,933.722	+	582,233.987	
330	14 K 403	+	1,104,930.780	+	582,232.090	
331	14 K 450	+	1,104,891.732	+	582,206.846	
332	14 K 500	+	1,104,849.006	+	582,180.877	
333	14 K 550	+	1,104,805.705	+	582,155.878	
334	14 K 600	+	1,104,761.974	+	582,131.640	
335	14 K 650	+	1,104,717.946	+	582,107.943	
336	14 K 695	+	1,104,678.170	+	582,086.900	
	14 K 700	+	1,104,673.747	+	582,084.567	
	14 K 750	+	1,104,629.550	+	582,061.188	
337	14 K 753	+	1,104,626.040	+	582,059.270	

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
	14K 786.02	+	1,104,597.587	+	582,043.762	
338	14 K 797	+	1,104,588.290	+	582,038.680	
	14K 800	+	1,104,585.659	+	582,037.239	I - EP
339	14K 850	+	1,104,542.056	+	582,012.768	I - EP
340B	14 K 894.30	+	1,104,498.485	+	581,988.241	I - EP
	14K 900	+	1,104,498.485	+	581,988.241	I - EP
341	14K 950	+	1,104,454.914	+	581,963.715	I - EP
342	15K 0	+	1,104,411.343	+	581,939.188	I - EP
343	15K 50	+	1,104,367.772	+	581,914.661	
344	15K 100	+	1,104,324.201	+	581,890.134	
345	15K 150	+	1,104,280.630	+	581,865.607	
346	15K 200	+	1,104,237.059	+	581,841.081	
347	15K 250	+	1,104,193.488	+	581,816.554	
348	15K 300	+	1,104,149.917	+	581,792.027	
349	15K 350	+	1,104,106.346	+	581,767.500	

1.5.2. COORDINATE LIST OF INTERCHANGE No3

A-RAMP

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
A - 1	0+0	+	1,107,284.294	+	586,122.479	
	0+9	+	1,107,292.658	+	586,125.828	
A - 2	0+20	+	1,107,302.862	+	586,129.912	
	0+25.4	+	1,107,307.874	+	586,131.918	
A - 3	0+40	+	1,107,321.429	+	586,137.345	
A - 4	0+60	+	1,107,339.997	+	586,144.777	
A - 5	0+80	+	1,107,358.564	+	586,152.210	
A - 6	0+100	+	1,107,377.132	+	586,159.643	
A - 7	0+120	+	1,107,395.700	+	586,167.076	
A - 8	0+140	+	1,107,414.267	+	586,174.508	
A - 9	0+160	+	1,107,432.835	+	586,181.941	
A - 10	0+180	+	1,107,451.402	+	586,189.374	
A - 11	0+200	+	1,107,469.970	+	586,196.806	
A - 12	0+220	+	1,107,488.538	+	586,204.239	
A - 13	0+240	+	1,107,507.105	+	586,211.672	
A - 14	0+260	+	1,107,525.673	+	586,219.104	
A - 15	0+280	+	1,107,543.912	+	586,227.289	
A - 16	0+300	+	1,107,561.196	+	586,237.333	
A - 17	0+320	+	1,107,577.330	+	586,249.137	
A - 18	0+340	+	1,107,592.134	+	586,262.571	
A - 19	0+360	+	1,107,605.877	+	586,277.099	
A - 20	0+380	+	1,107,619.027	+	586,292.167	
A - 21	0+400	+	1,107,631.564	+	586,307.748	

B-RAMP

No	Chainage	Coordinate of centerlines				Remarks
			N		E	
B - 1	0+0	+	1,107,255.599	+	585,631.599	
B - 2	0+20	+	1,107,263.314	+	585,650.042	
B - 3	0+40	+	1,107,269.150	+	585,669.163	
B - 4	0+60	+	1,107,273.676	+	585,688.644	
B - 5	0+80	+	1,107,278.141	+	585,708.139	
B - 6	0+100	+	1,107,281.150	+	585,727.900	
B - 7	0+120	+	1,107,281.819	+	585,747.877	
B - 8	0+140	+	1,107,280.139	+	585,767.795	
B - 9	0+160	+	1,107,276.133	+	585,787.378	
B - 10	0+180	+	1,107,269.855	+	585,806.355	
B - 11	0+200	+	1,107,262.428	+	585,824.925	
B - 12	0+220	+	1,107,255.001	+	585,843.494	
B - 13	0+240	+	1,107,247.574	+	585,862.064	
B - 14	0+260	+	1,107,240.146	+	585,880.634	
B - 15	0+280	+	1,107,232.719	+	585,899.204	
B - 16	0+300	+	1,107,225.291	+	585,917.773	
B - 17	0+320	+	1,107,217.864	+	585,936.343	
B - 18	0+340	+	1,107,210.437	+	585,954.913	
B - 19	0+360	+	1,107,203.009	+	585,973.483	
B - 20	0+380	+	1,107,195.582	+	585,992.052	
B - 21	0+400	+	1,107,188.172	+	586,010.629	
B - 22	0+420	+	1,107,182.396	+	586,029.742	
B - 23	0+440	+	1,107,182.227	+	586,049.649	
B - 24	0+460	+	1,107,188.581	+	586,068.515	
B - 25	0+480	+	1,107,200.758	+	586,084.264	
B - 26	0+500	+	1,107,217.348	+	586,095.299	
	0+513.4	+	1,107,229.667	+	586,100.625	
B - 27	0+520	+	1,107,235.773	+	586,103.067	
	0+532	+	1,107,246.649	+	586,107.417	
B - 28	0+540	+	1,107,254.342	+	586,110.495	

C-RAMP

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
C- 1	0+0	+	1,107,512.765	+	586,085.056	
C- 2	0+20	+	1,107,502.926	+	586,067.648	
C- 3	0+40	+	1,107,494.268	+	586,049.623	
C- 4	0+60	+	1,107,486.830	+	586,031.061	
C- 5	0+80	+	1,107,480.846	+	586,011.987	
C- 6	0+100	+	1,107,477.078	+	585,992.357	
C- 7	0+120	+	1,107,475.640	+	585,972.420	
C- 8	0+140	+	1,107,476.552	+	585,952.452	
C- 9	0+160	+	1,107,479.802	+	585,932.730	
C- 10	0+180	+	1,107,485.344	+	585,913.525	
C- 11	0+200	+	1,107,493.102	+	585,895.103	
C- 12	0+220	+	1,107,502.968	+	585,877.720	
C- 13	0+240	+	1,107,514.807	+	585,861.614	
C- 14	0+260	+	1,107,528.454	+	585,847.010	
C- 15	0+280	+	1,107,543.721	+	585,834.108	
C- 16	0+300	+	1,107,560.397	+	585,823.088	
C- 17	0+320	+	1,107,578.252	+	585,814.101	
C- 18	0+340	+	1,107,597.037	+	585,807.271	
C- 19	0+360	+	1,107,616.438	+	585,802.430	
C- 20	0+380	+	1,107,635.918	+	585,797.897	
C- 21	0+400	+	1,107,655.397	+	585,793.364	
C- 22	0+420	+	1,107,674.877	+	585,788.831	

D-RAMP

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
D- 1	0+0	+	1,107,473.134	+	585,564.178	
	0+8.92	+	1,107,464.851	+	585,560.864	
D- 2	0+20	+	1,107,454.565	+	585,556.750	
	0+26.98	+	1,107,448.084	+	585,554.158	
D- 3	0+40	+	1,107,435.995	+	585,549.323	
D- 4	0+60	+	1,107,417.425	+	585,541.895	
D- 5	0+80	+	1,107,398.855	+	585,534.468	
D- 6	0+100	+	1,107,380.286	+	585,527.041	
D- 7	0+120	+	1,107,361.716	+	585,519.613	
D- 8	0+140	+	1,107,343.146	+	585,512.186	
D- 9	0+160	+	1,107,324.576	+	585,504.759	
D- 10	0+180	+	1,107,306.007	+	585,497.331	
D- 11	0+200	+	1,107,287.652	+	585,489.399	
D- 12	0+220	+	1,107,269.980	+	585,480.046	
D- 13	0+240	+	1,107,253.112	+	585,469.310	
D- 14	0+260	+	1,107,237.156	+	585,457.261	Bridge
D- 15	0+280	+	1,107,222.213	+	585,443.975	Bridge
D- 16	0+300	+	1,107,208.335	+	585,429.579	Bridge
D- 17	0+320	+	1,107,194.761	+	585,414.891	Bridge
D- 18	0+340	+	1,107,181.187	+	585,400.203	Bridge
D- 19	0+360	+	1,107,167.612	+	585,385.515	
D- 20	0+380	+	1,107,154.038	+	585,370.827	
D- 21	0+400	+	1,107,140.463	+	585,356.139	
D- 22	0+420	+	1,107,127.004	+	585,341.347	
D- 23	0+440	+	1,107,114.424	+	585,325.804	
	0+460	+	1,107,102.906	+	585,309.458	

E/F-RAMP

No	Chainage	Coordinate of centerlines				Remarks
		N		E		
E- 1	0+0	+	1,107,619.732	+	585,799.353	
E- 2	0+20	+	1,107,638.992	+	585,794.016	
E- 3	0+40	+	1,107,656.390	+	585,784.332	
E- 4	0+60	+	1,107,669.682	+	585,769.512	
E- 5	0+80	+	1,107,678.466	+	585,751.575	
E- 6	0+100	+	1,107,685.902	+	585,733.008	
E- 7	0+120	+	1,107,693.329	+	585,714.439	
E- 8	0+140	+	1,107,700.757	+	585,695.869	
E- 9	0+160	+	1,107,708.184	+	585,677.299	
F- 1	0+0	+	1,107,742.163	+	585,671.781	
F- 2	0+20	+	1,107,723.593	+	585,664.354	
F- 3	0+40	+	1,107,705.024	+	585,656.927	
F- 4	0+60	+	1,107,686.454	+	585,649.499	
F- 5	0+80	+	1,107,667.884	+	585,642.072	
F- 6	0+100	+	1,107,649.314	+	585,634.645	
F- 7	0+120	+	1,107,630.745	+	585,627.217	
F- 8	0+140	+	1,107,612.175	+	585,619.790	
F- 9	0+160	+	1,107,593.605	+	585,612.362	
F- 10	0+180	+	1,107,575.036	+	585,604.935	
F- 11	0+200	+	1,107,556.466	+	585,597.508	
F- 12	0+220	+	1,107,537.896	+	585,590.080	
	0+232	+	1,107,526.340	+	585,585.458	
F- 13	0+240	+	1,107,519.326	+	585,582.653	
	0+248.8	+	1,107,511.163	+	585,579.388	

1.5.3. COORDINATE LIST OF INTERSECTION

No	Chainage	Coordinate of Centerlines				Remarks
		N		E		
A- 1	0+ 0	+	1104566.795	+	582026.640	
A- 2	0+ 20	+	1104576.597	+	582009.207	
A- 3	0+ 40	+	1104586.399	+	581991.773	
A- 4	0+ 60	+	1104596.957	+	581974.805	
A- 5	0+ 80	+	1104611.219	+	581960.911	
A- 6	0+ 100	+	1104629.229	+	581952.428	
A- 7	0+ 120	+	1104649.023	+	581950.288	
A- 8	0+ 140	+	1104668.804	+	581953.122	
B- 1	0+ 0	+	1104705.024	+	581960.190	
B- 2	0+ 20	+	1104685.394	+	581956.359	
B- 3	0+ 40	+	1104665.764	+	581952.529	
B- 4	0+ 60	+	1104646.125	+	581948.749	
B- 5	0+ 80	+	1104626.440	+	581945.212	
B- 6	0+ 100	+	1104606.710	+	581941.939	
B- 7	0+ 120	+	1104586.938	+	581938.928	
B- 8	0+ 140	+	1104567.128	+	581936.182	
B- 9	0+ 160	+	1104547.283	+	581933.695	
B- 10	0+ 180	+	1104527.427	+	581931.298	
B- 11	0+ 200	+	1104507.571	+	581928.902	
B- 12	0+ 220	+	1104487.716	+	581926.505	
B- 13	0+ 240	+	1104467.860	+	581924.108	
B- 14	0+ 260	+	1104448.014	+	581921.633	
B- 15	0+ 280	+	1104428.328	+	581918.122	
B- 16	0+ 300	+	1104408.920	+	581913.308	
B- 17	0+ 320	+	1104389.876	+	581907.212	
B- 18	0+ 340	+	1104371.231	+	581899.979	
B- 19	0+ 360	+	1104352.901	+	581891.982	
B- 20	0+ 380	+	1104334.905	+	581883.259	
B- 21	0+ 400	+	1104317.273	+	581873.823	

Chapter 2

TOLLGATE AND INTERCHANGE

CHARTER 2 TOLLGATE AND INTERCHANGE

CONTENTS

2.1. *NUMBER OF LANES OF TOLLGATE*

2.1.1 Basic data:

Traffic volume, traffic flows and rate of traffic growth are forecasted to be used from a report of Feasibility Study.

Table 2.1: Inventory of forecasted traffic volume in years of 2006, 2010 and 2015

	Traffic volume (nos/day)		
Type of vehicle/year	2006	2010	2015
Motorcycle	15165	22281	33248
Passenger car	2777	5139	8471
Light buses	1267	2051	3011
Heavy buses	566	898	1283
Light truck	918	1721	2921
Medium truck	2201	4175	7072
Heavy truck	185	397	647

2.1.2 Capacity of traffic flow at every lane:

Capacity of traffic flow at one lane (as per semi-automatic tollgate) is from 230pcu/h to 500pcu/h depending on number of lanes and levels of service in accordance with standard of Japanese road design and of 450pcu/h in local tollgate (tollgate No1 of NH No51).

However, traffic organization and traffic flow between Japan and Viet Nam are not the same. Therefore, capacity for traffic flow at every lane is proposed to take 450pcu/h.

2.1.3 Determination of required lanes:

Lanes of tollgate are determined as per below elements:

- Traffic volume for a design is converted at peak hours.

Including:

+ Years of design are 10 (regarding TCVN 5729-97)

+ Converted coefficient is taken from types of vehicles into cars (regarding TCVN 4054-98).

+ Traffic volume on peak hours is of 10% average annual traffic volume.

- Capacity of one lane (450pcu/h)

From the above elements, lanes of tollgate are determined of 12 ones as follow table:

Type of vehicle/year	Exchange Coefficient	Traffic volume (Nos/day)			pcu/day	pcu/h	Number of lanes of toll gate
		2006	2010	2015	2015	2015	2015
Motorcycle	0.3	15165	22281	33248	9974	997	2.2
Passenger car	1	2777	5139	8471	8471	847	1.9
Light buses	2	1267	2051	3011	6022	602	1.3
Heavy buses	2.5	566	898	1283	3208	321	0.7
Light truck	2	918	1721	2921	5842	584	1.3
Medium truck	2.5	2201	4175	7072	17679	1768	3.9
Heavy truck	3	185	397	647	1940	194	0.4
Total					53137	5314	12

2.2. *NUMBER OF LANES OF INTERCHANGE*

2.2.1 Forecasting of traffic volume at each direction 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 2.2.1, 2.2.2.

2.2.2 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)

2.2.3 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 2.2.2.

The result of required lanes at every direction in the interchange is summarized in table 2.2.3.

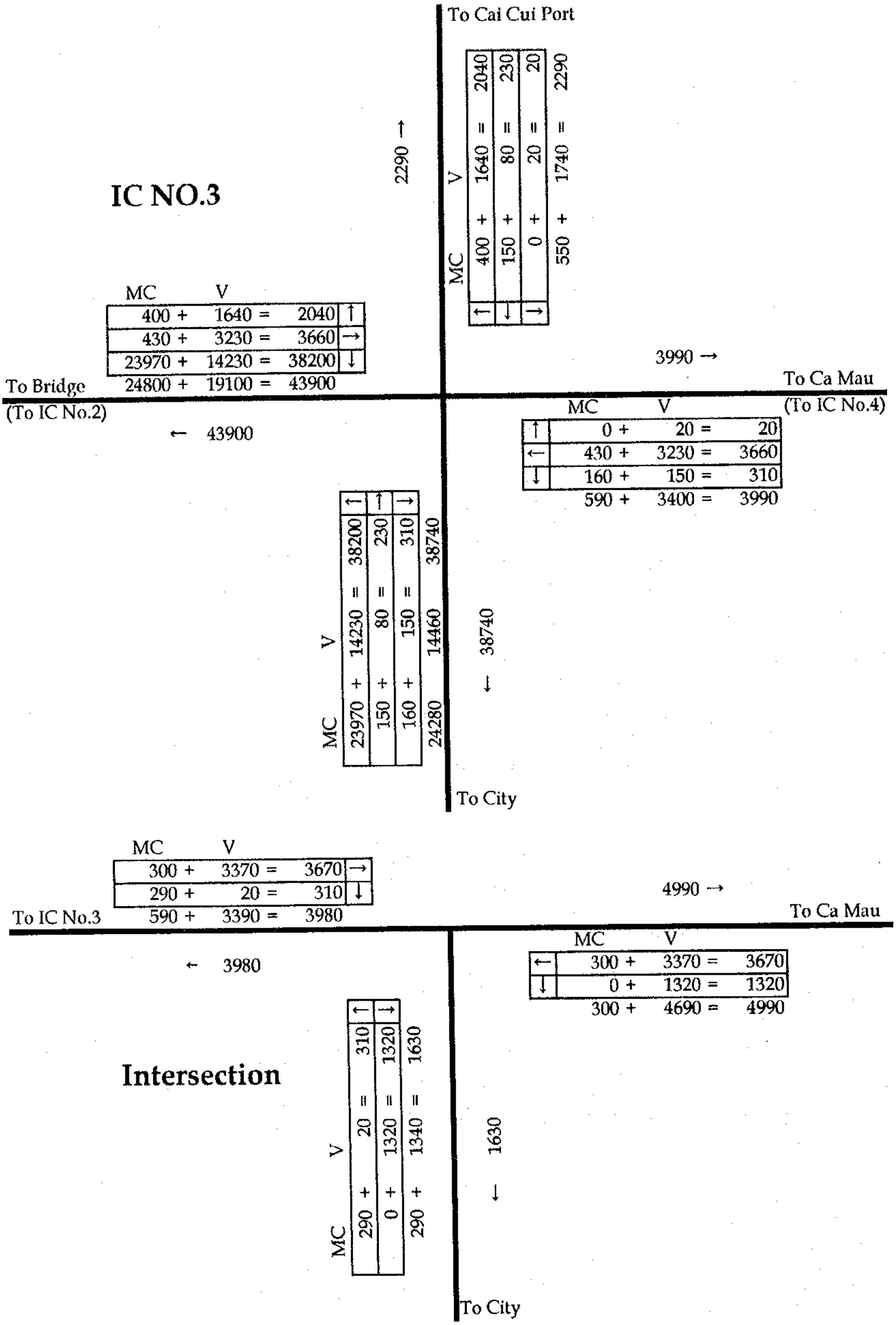


Fig. I-2-1 Traffic Volume by Direction

Table 2.2.1 Sectional Traffic Volume

Classification	Vehicle/day	Constitution ratio	Exchange coefficient	PCU/day	Classification	Vehicle/day	Constitution ratio	Exchange coefficient	PCU/day
Section 6 (Throughway-IC2-IC3)					Section 7 (NH.91B-Cai Cui)				
TOTAL	**87,780**	0	0	**85,299**	**TOTAL**	**4,540**			6,731
MC	**49,560**	-	0.3	14,868	**MC**	**1,060**	-	0.3	318
Vehicle	**38,220**	-	0	70,431	**Vehicle**	**3,480**	-		6,413
PC	13,969	36.55%	1.0	13,969	PC	1,272	36.55%	1.0	1,272
LB	4,421	11.57%	2.0	8,843	LB	403	11.57%	2.0	805
HB	1,835	4.80%	2.5	4,586	HB	167	4.80%	2.5	418
LT	4,960	12.98%	2.0	9,919	LT	452	12.98%	2.0	903
MT	11,982	31.35%	2.5	29,954	MT	1,091	31.35%	2.5	2,727
HT	1,053	2.76%	3.0	3,160	HT	96	2.76%	3.0	288
Section 10 (NH.1-Ca Mau)					Section 8 (NH.91B-Can Tho City)				
TOTAL	**12,440**			**20,794**	**TOTAL**	**50,020**			**39,352**
MC	**1,380**	-	0.3	414	**MC**	**34,240**	-	0.3	10,272
Vehicle	**11,060**	-		20,380	**Vehicle**	**15,780**	-		29,080
PC	4,042	36.55%	1.0	4,042	PC	5,768	36.55%	1.0	5,768
LB	1,279	11.57%	2.0	2,559	LB	1,825	11.57%	2.0	3,651
HB	531	4.80%	2.5	1,327	HB	757	4.80%	2.5	1,894
LT	1,435	12.98%	2.0	2,870	LT	2,048	12.98%	2.0	4,095
MT	3,467	31.35%	2.5	8,668	MT	4,947	31.35%	2.5	12,367
HT	305	2.76%	3.0	914	HT	435	2.76%	3.0	1,305
Section 11 (NH.1-Can Tho City)					Section 9 (IC3-IS)				
TOTAL	**23,840**			**22,179**	**TOTAL**	**35,120**			**40,837**
MC	**14,100**	-	0.3	4,230	**MC**	**15,480**	-	0.3	4,644
Vehicle	**9,740**	-		17,949	**Vehicle**	**19,640**	-		36,193
PC	3,560	36.55%	1.0	3,560	PC	7,178	36.55%	1.0	7,178
LB	1,127	11.57%	2.0	2,253	LB	2,272	11.57%	2.0	4,544
HB	468	4.80%	2.5	1,169	HB	943	4.80%	2.5	2,357
LT	1,264	12.98%	2.0	2,528	LT	2,549	12.98%	2.0	5,097
MT	3,053	31.35%	2.5	7,634	MT	6,157	31.35%	2.5	15,393
HT	268	2.76%	3.0	805	HT	541	2.76%	3.0	1,624

Table 2.2.2 Traffic Voulume by Direction (1/2)

Classification		Vehicle/ day	Constitu tion	Exchang e	PCU/ day	Classification		Vehicle/ day	Constitu tion	Exchang e	PCU/ day
Interchange3 (NH.91B)						Interchange3 (NH.91B)					
Bridge to Can Tho	TOTAL	**24,590**			**19,334**	E.P to Can Tho	TOTAL	**380**			**299**
	MC	**16,840**	-	0.3	5,052		MC	**260**	-	0.3	78
	Vehicle	**7,750**	-	-	14,282		Vehicle	**120**	-	-	221
	PC	2,833	36.55%	1.0	2,833		PC	44	36.55%	1.0	44
	LB	897	11.57%	2.0	1,793		LB	14	11.57%	2.0	28
	HB	372	4.80%	2.5	930		HB	6	4.80%	2.5	14
	LT	1,006	12.98%	2.0	2,011		LT	16	12.98%	2.0	31
	MT	2,430	31.35%	2.5	6,074		MT	38	31.35%	2.5	94
	HT	214	2.76%	3.0	641		HT	3	2.76%	3.0	10
Bridge to E.P	TOTAL	**17,140**			**20,061**	E.P to Bridge	TOTAL	**17,140**			**20,061**
	MC	**7,470**	-	0.3	2,241		MC	**7,470**	-	0.3	2,241
	Vehicle	**9,670**	-	-	17,820		Vehicle	**9,670**	-	-	17,820
	PC	3,534	36.55%	1.0	3,534		PC	3,534	36.55%	1.0	3,534
	LB	1,119	11.57%	2.0	2,237		LB	1,119	11.57%	2.0	2,237
	HB	464	4.80%	2.5	1,160		HB	464	4.80%	2.5	1,160
	LT	1,255	12.98%	2.0	2,510		LT	1,255	12.98%	2.0	2,510
	MT	3,031	31.35%	2.5	7,579		MT	3,031	31.35%	2.5	7,579
	HT	267	2.76%	3.0	800		HT	267	2.76%	3.0	800
Bridgeto Cai Cui	TOTAL	**2,190**			**3,266**	E.P to Cai Cui	TOTAL	**40**			**59**
	MC	**500**	-	0.3	150		MC	**10**	-	0.3	3
	Vehicle	**1,690**	-	-	3,116		Vehicle	**30**	-	-	56
	PC	618	36.55%	1.0	618		PC	11	36.55%	1.0	11
	LB	196	11.57%	2.0	391		LB	3	11.57%	2.0	7
	HB	81	4.80%	2.5	203		HB	1	4.80%	2.5	4
	LT	219	12.98%	2.0	439		LT	4	12.98%	2.0	8
	MT	530	31.35%	2.5	1,325		MT	9	31.35%	2.5	24
	HT	47	2.76%	3.0	140		HT	1	2.76%	3.0	2
Can Tho to Bridge	TOTAL	**24,590**			**19,334**	Cai Cui to Bridge	TOTAL	**2,190**			**3,266**
	MC	**16,840**	-	0.3	5,052		MC	**500**	-	0.3	150
	Vehicle	**7,750**	-	-	14,282		Vehicle	**1,690**	-	-	3,116
	PC	2,833	36.55%	1.0	2,833		PC	618	36.55%	1.0	618
	LB	897	11.57%	2.0	1,793		LB	196	11.57%	2.0	391
	HB	372	4.80%	2.5	930		HB	81	4.80%	2.5	203
	LT	1,006	12.98%	2.0	2,011		LT	219	12.98%	2.0	439
	MT	2,430	31.35%	2.5	6,074		MT	530	31.35%	2.5	1,325
	HT	214	2.76%	3.0	641		HT	47	2.76%	3.0	140
Can Tho to Cai Cui	TOTAL	**40**			**43**	Cai Cui to Can Tho	TOTAL	**40**			**43**
	MC	**20**	-	0.3	6		MC	**20**	-	0.3	6
	Vehicle	**20**	-	-	37		Vehicle	**20**	-	-	37
	PC	7	36.55%	1.0	7		PC	7	36.55%	1.0	7
	LB	2	11.57%	2.0	5		LB	2	11.57%	2.0	5
	HB	1	4.80%	2.5	2		HB	1	4.80%	2.5	2
	LT	3	12.98%	2.0	5		LT	3	12.98%	2.0	5
	MT	6	31.35%	2.5	16		MT	6	31.35%	2.5	16
	HT	1	2.76%	3.0	2		HT	1	2.76%	3.0	2
Can Tho to E.P	TOTAL	**380**			**299**	Cai Cui to E.P	TOTAL	**40**			**59**
	MC	**260**	-	0.3	78		MC	**10**	-	0.3	3
	Vehicle	**120**	-	-	221		Vehicle	**30**	-	-	56
	PC	44	36.55%	1.0	44		PC	11	36.55%	1.0	11
	LB	14	11.57%	2.0	28		LB	3	11.57%	2.0	7
	HB	6	4.80%	2.5	14		HB	1	4.80%	2.5	4
	LT	16	12.98%	2.0	31		LT	4	12.98%	2.0	8
	MT	38	31.35%	2.5	94		MT	9	31.35%	2.5	24
	HT	3	2.76%	3.0	10		HT	1	2.76%	3.0	2

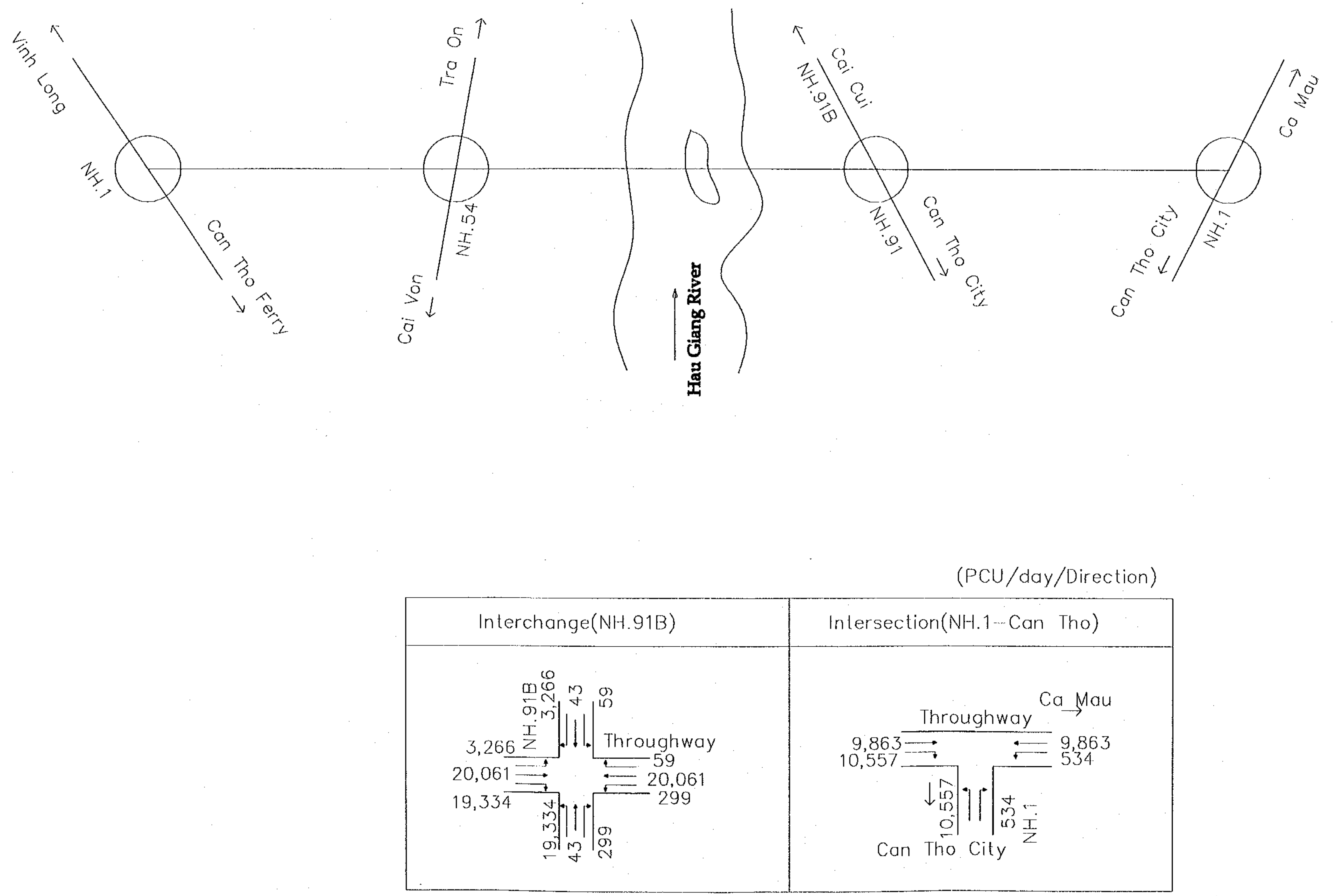
Table 2.2.2 Traffic Voulume by Direction (2/2)

Classification		Vehicle/day	Constitution	Exchange	PCU/day	Classification		Vehicle/day	Constitution	Exchange	PCU/day
Intersection (NH.1-Can Tho)											
IC.3 to Can Tho	**TOTAL**	**11,630**			**10,557**						
	MC	**7,050**	-	0.3	2,115						
	Vehicle	**4,580**	-	-	8,442						
	PC	1,674	36.55%	1.0	1,674						
	LB	530	11.57%	2.0	1,060						
	HB	220	4.80%	2.5	550						
	LT	594	12.98%	2.0	1,189						
	MT	1,436	31.35%	2.5	3,590						
	HT	126	2.76%	3.0	379						
IC.3 to Ca Mau	**TOTAL**	**5,930**			**9,863**						
	MC	**690**	-	0.3	207						
	Vehicle	**5,240**	-	-	9,656						
	PC	1,915	36.55%	1.0	1,915						
	LB	606	11.57%	2.0	1,212						
	HB	252	4.80%	2.5	629						
	LT	680	12.98%	2.0	1,360						
	MT	1,643	31.35%	2.5	4,107						
	HT	144	2.76%	3.0	433						
Can Tho to IC.3	**TOTAL**	**11,630**			**10,557**						
	MC	**7,050**	-	0.3	2,115						
	Vehicle	**4,580**	-	-	8,442						
	PC	1,674	36.55%	1.0	1,674						
	LB	530	11.57%	2.0	1,060						
	HB	220	4.80%	2.5	550						
	LT	594	12.98%	2.0	1,189						
	MT	1,436	31.35%	2.5	3,590						
	HT	126	2.76%	3.0	379						
Can Tho to Ca Mau	**TOTAL**	**290**			**534**						
	MC	**0**	-	0.3	0						
	Vehicle	**290**	-	-	534						
	PC	106	36.55%	1.0	106						
	LB	34	11.57%	2.0	67						
	HB	14	4.80%	2.5	35						
	LT	38	12.98%	2.0	75						
	MT	91	31.35%	2.5	227						
	HT	8	2.76%	3.0	24						
Ca Mau to Can Tho	**TOTAL**	**290**			**534**						
	MC	**0**	-	0.3	0						
	Vehicle	**290**	-	-	534						
	PC	106	36.55%	1.0	106						
	LB	34	11.57%	2.0	67						
	HB	14	4.80%	2.5	35						
	LT	38	12.98%	2.0	75						
	MT	91	31.35%	2.5	227						
	HT	8	2.76%	3.0	24						
Ca Mau to IC.3	**TOTAL**	**5,930**			**9,863**						
	MC	**690**	-	0.3	207						
	Vehicle	**5,240**	-	-	9,656						
	PC	1,915	36.55%	1.0	1,915						
	LB	606	11.57%	2.0	1,212						
	HB	252	4.80%	2.5	629						
	LT	680	12.98%	2.0	1,360						
	MT	1,643	31.35%	2.5	4,107						
	HT	144	2.76%	3.0	433						

Table 2.2.3 : Lane Number of Rampway

Name of Intersection	Direction	PCU/day	$N_{peakhour}$	Nmax	Z	ni		Remarks
IC 1	Vinh Long→Ferry	3,540	319	1,500	0.55	0.4→	1.0	
(NH.1 Vinh Long)	Ferry→Vinh Long	3,540	319	1,500	0.55	0.4→	1.0	
IC 2	Vinh Long→NH.54	333	30	1,800	0.55	0.1→	1.0	
(NH.54)	NH.54→Vinh Long	333	30	1,800	0.55	0.1→	1.0	
	Bridge→NH.54	6,557	590	1,800	0.55	0.6→	1.0	
	NH.54→Bridge	6,557	590	1,800	0.55	0.6→	1.0	
IC 3	Bridge --> NH.91	22,600	2,260	1,500	0.70	2.16-->	2.0	
(NH.91,91B)	NH.91B-->Bridge	22,600	2,260	1,500	0.70	2.16-->	2.0	
	Ca Mau-->NH.91	358	36	1,500	0.70	0.04-->	1.0	
	NH.91B-->Ca Mau	358	36	1,500	0.70	0.04-->	1.0	
Intersection	Can Tho-->Bridge	10,557	1,056	1,500	0.70	1.01-->	1.0	
(NH.1-Can Tho)	Bridgesy-->Can Tho	10,557	1,056	1,500	0.70	1.01-->	1.0	
	Can Tho-->Ca Mau	534	53	1,500	0.70	0.06-->	1.0	
	Ca Mau-->Can Tho	534	53	1,500	0.70	0.06-->	1.0	

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



Chapter 3

SERVICE AREA

CONTENTS I-3-1

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.

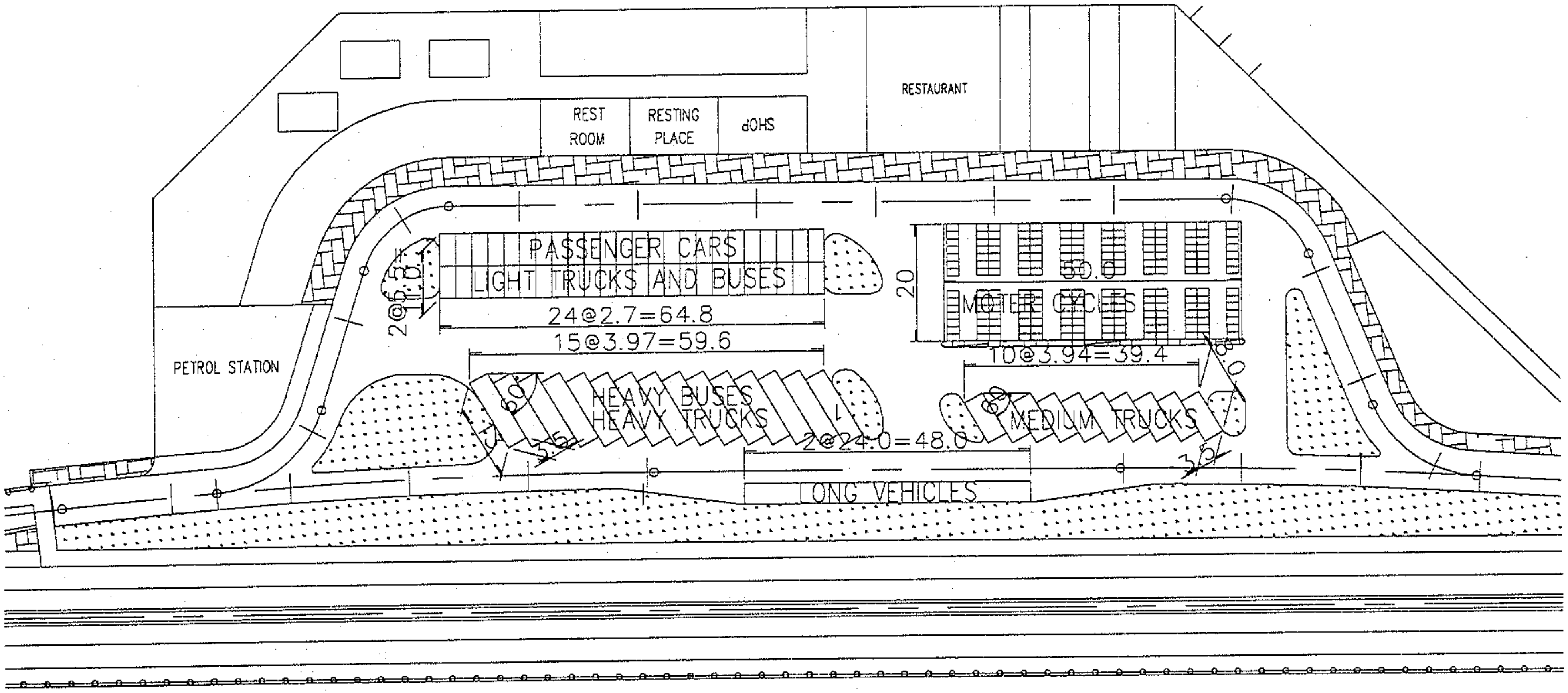
Peak rate: The ratio of the traffic density that uses the service area at the time of traffic congestion

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.)

CAN THO 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 = A1 + 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	(a) Intensities, I (mm/h) Average Recurrence Interval						
(min)	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)
			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	0.0162		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	2.2728	m/s	
7. Discharge Max $Q = A \times V$	0.4463	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	0.0292		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1/2}$	3.0514	m/s	
7. Discharge Max $Q = A \times V$	0.5991	m^3/s	

COMPUTING HYDRAULIC CHARACTERISTICS OF THE SECTONAL AREA

2. DITCH

HYDRAULIC CHARACTERISTICS OF THE SECTONAL ARE			W (mm) H (mm)
			500 x 500
1. Area of ditch A = W x H	0.2500	m^2	
2. Perimeter of ditch X = W + 2 x H	1.5000	m	
3. Hydraulic radius R = A/X	0.1667	m	
4. Roughness factor n :	0.0140		
5. Hydrawlic gradient i :	0.0020		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1}$	0.9674	m/s	
7. Discharge Max Q = A x V	0.2419	m^3/s	

HYDRAULIC CHARACTERISTICS OF THE SECTONAL ARE			W (mm) H (mm)
			500 x 1000
1. Area of ditch A = W x H	0.5000	m^2	
2. Perimeter of ditch X = W + 2 x H	2.5000	m	
3. Hydraulic radius R = A/X	0.2000	m	
4. Roughness factor n :	0.0140		
5. Hydrawlic gradient i :	0.0020		
6. Velocity of flow in ditch $V=(1/n) \times R^{2/3} \times i^{1}$	1.0925	m/s	
7. Discharge Max Q = A x V	0.5462	m^3/s	

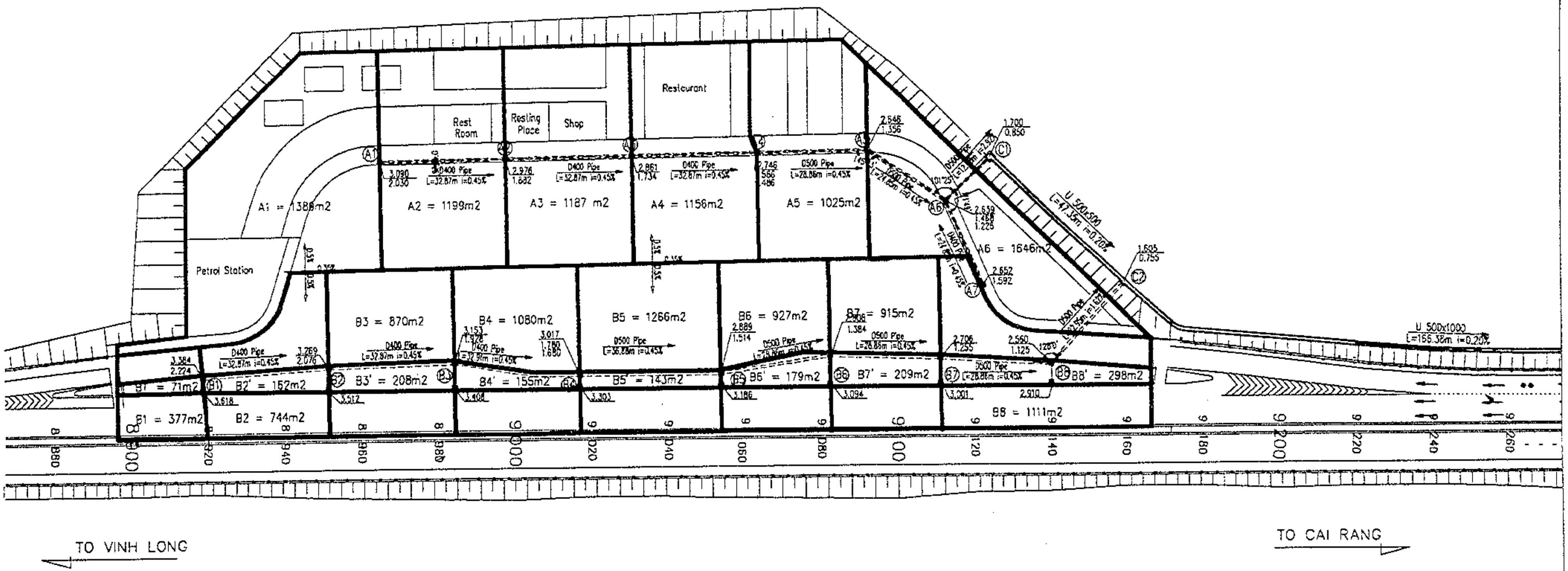
COMPUTING HYDROLOGY & HYDRAULIC OF DRAINAGE SYTEM

Start	End	Symbol (Computed areas)	Check Point	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
				(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	376.55	70.55	0.90	0.15	0.012		0.012	400	0.45	0.130	1.032
Start	**B2**	**B1+B2**	**B2**	2.0	1353.20	1120.30	232.90	0.90	0.15	0.035		0.035	400	0.45	0.130	1.032
Start	**B3**	**B1+B2+B3**	**B3**	2.0	2431.00	1989.85	441.15	0.90	0.15	0.062		0.062	400	0.45	0.130	1.032
Start	**B4**	**B1+B2+B3+B4**	**B4**	2.0	3666.05	3069.35	596.70	0.90	0.15	0.095		0.095	400	0.45	0.235	1.198
Start	**B5**	**B1+B2+B3+B4+B5**	**B5**	2.0	5074.50	4335.00	739.50	0.90	0.15	0.134		0.134	500	0.45	0.235	1.198
Start	**B6**	**B1+B2+B3+B4+B5+B6**	**B6**	2.0	6180.35	5261.50	918.85	0.90	0.15	0.162		0.162	500	0.45	0.235	1.198
Start	**B7**	**B1+B2+B3+B4+B5+B6+B7**	**B7**	2.0	7304.05	6176.10	1127.95	0.90	0.15	0.191		0.191	500	0.45	0.235	1.198
Start	**B8**	**B1+B2+B3+B4+B5+B6+B7+B8**	**B8**	2.0	8712.50	7287.05	1425.45	0.90	0.15	0.226		0.226	500	1.62	0.446	1.198

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	1388.90	1388.90		0.90		0.042	0.005	0.0467	400	0.45	0.130	1.032
Start	**A2**	**A1+A2**	**A2**	2.0	2588.25	2588.25		0.90		0.078	0.005	0.0826	400	0.45	0.130	1.032
Start	**A3**	**A1+A2+A3**	**A3**	2.0	3774.85	3774.85		0.90		0.113	0.003	0.1162	400	0.45	0.130	1.032
Start	**A4**	**A1+A2+A3+A4**	**A4**	2.0	4930.85	4930.85		0.90		0.148	0.003	0.1509	500	0.45	0.235	1.198
Start	**A5**	**A1+A2+A3+A4+A5**	**A5**	2.0	5955.95	5955.95		0.90		0.179	0.003	0.1817	500	0.45	0.235	1.198
Start	**A6**	**A1+A2+A3+A4+A5+A6**	**A6**	2.0	7602.40	7602.40		0.90		0.228	0.003	0.2311	500	2.92	0.599	3.051
Start	**C1**	**A1+A2+A3+A4+A5+A6**	**C1**	2.0	7602	7602		0.90		0.228	0.003	0.2311	500X550	0.20	0.242	0.967
Start	**C1**	**TOTAL : (A+B)**	**C2**	2.0	16315	14889		0.90		0.454	0.022	0.4568	500X1000	0.20	0.546	1.092

PLAN LAYOUT OF DRAINAGE SYSTEM

SCALE 1:1500



Chapter 4

EMBANKMENT AND SOFT GROUND TREATMENT

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.

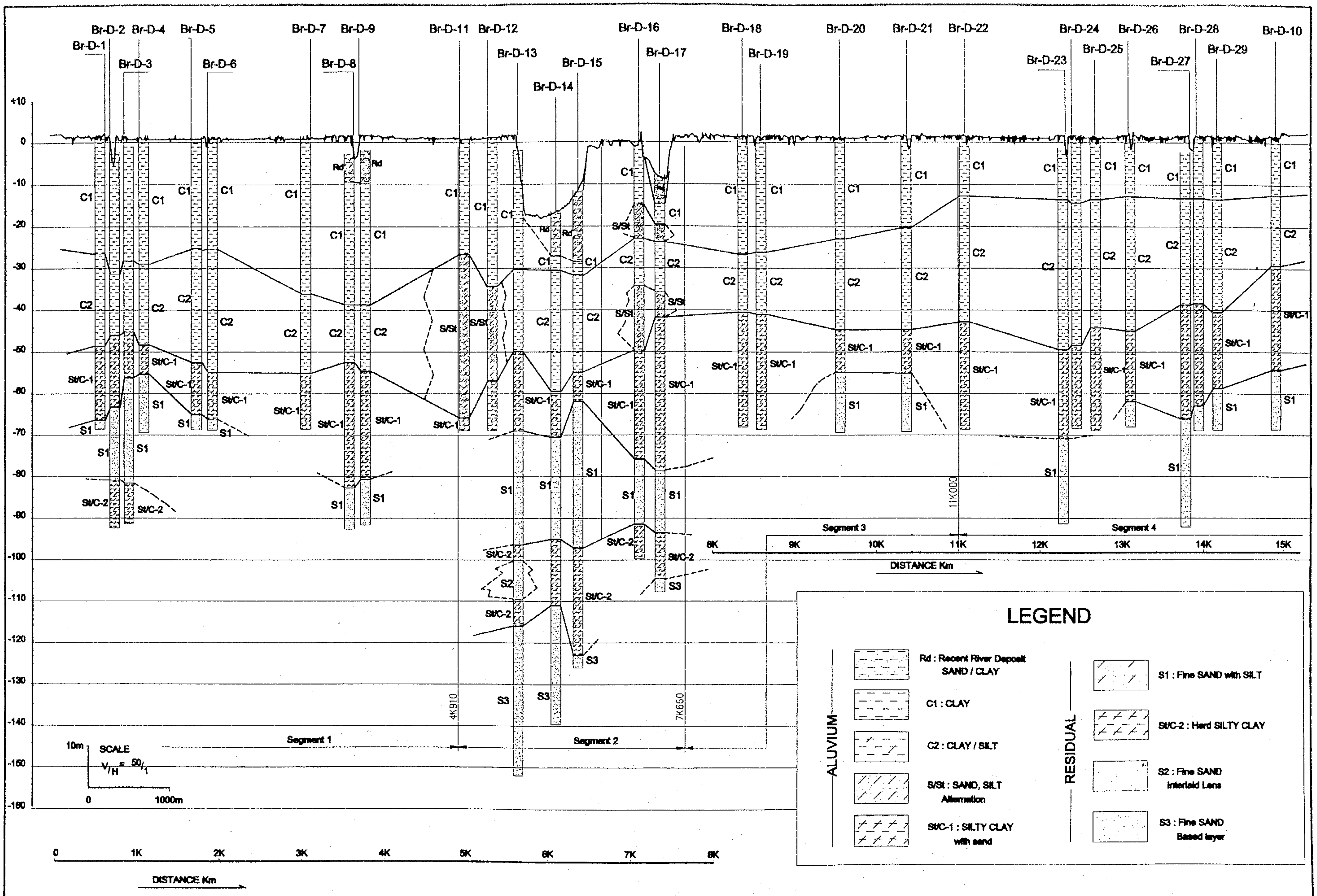


Fig I-4-1. Design Segment of Soft Ground Treatment

4.2.2 Design Formula

(1) Settlement

$$S = Sc + Sl$$

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

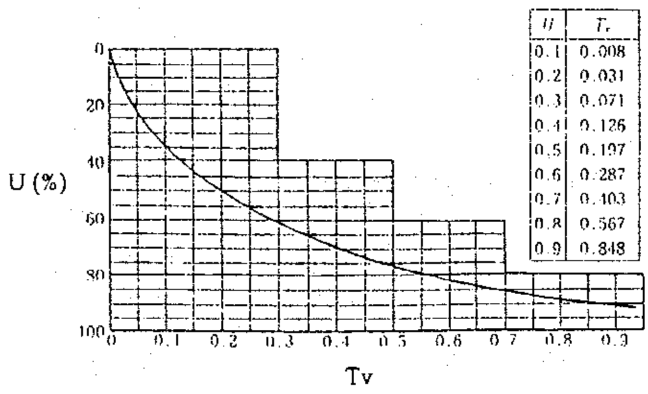
$$U = Si / Sc$$

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

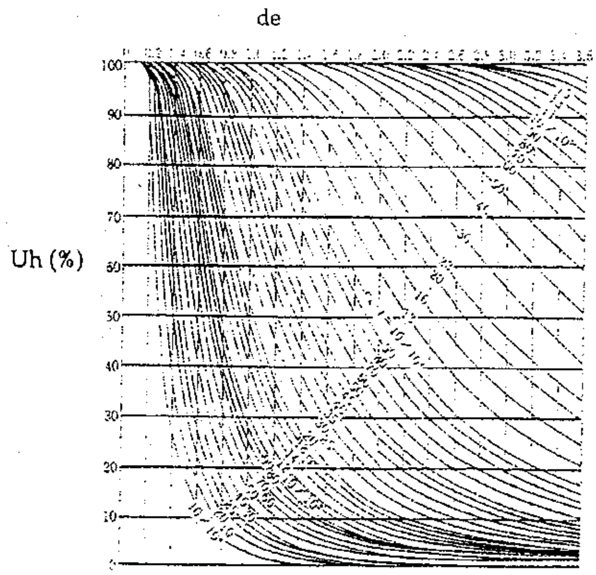
$$t = \frac{Th}{Ch} \cdot de^2$$ This formula applies to SD and PVD.

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 Curve



U-de Curves

(2) Slope Stability

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

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

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

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
	$\varDelta P$	:	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.

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

Where				
	τl	:	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

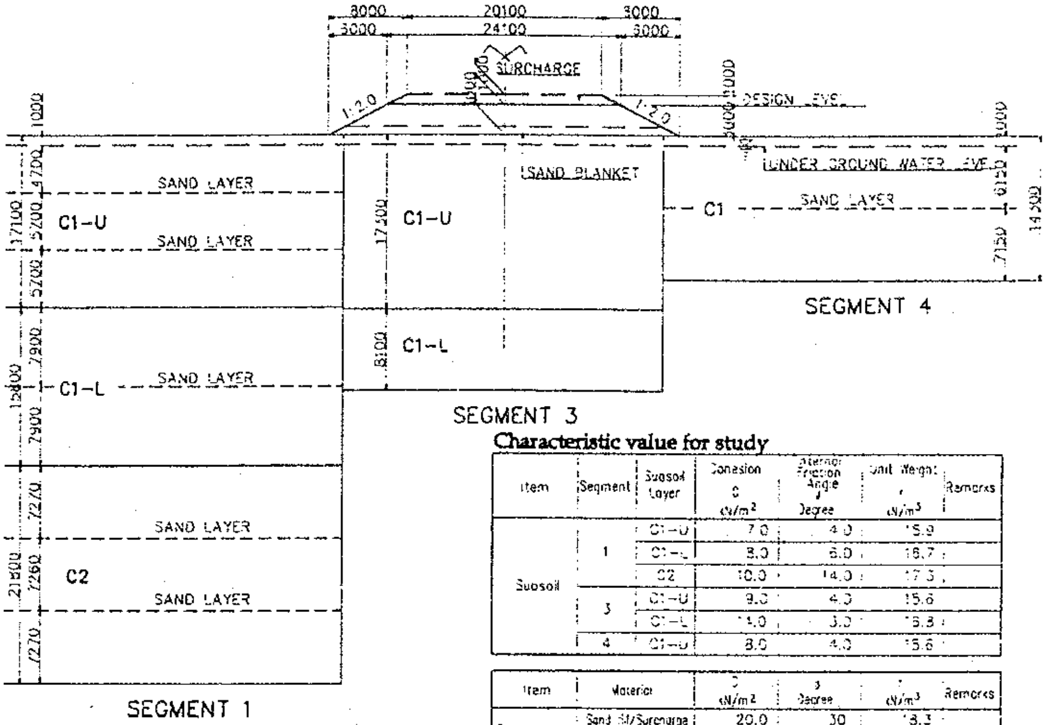
Thickness of surcharge shall be applied 0.3 H basically. (H; Height of Embankment).
Actual thickness of surcharge adopted the following table.

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

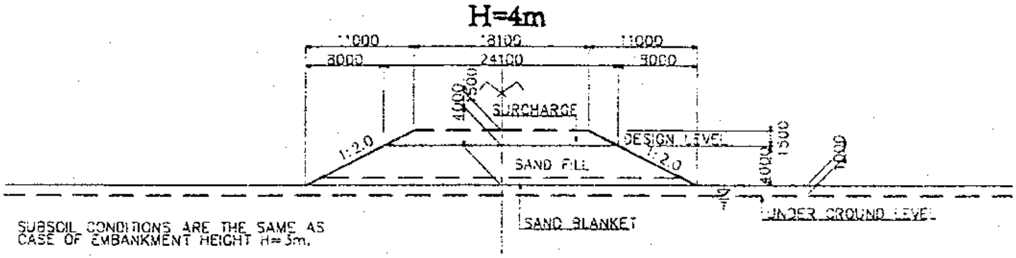


Characteristic value for study

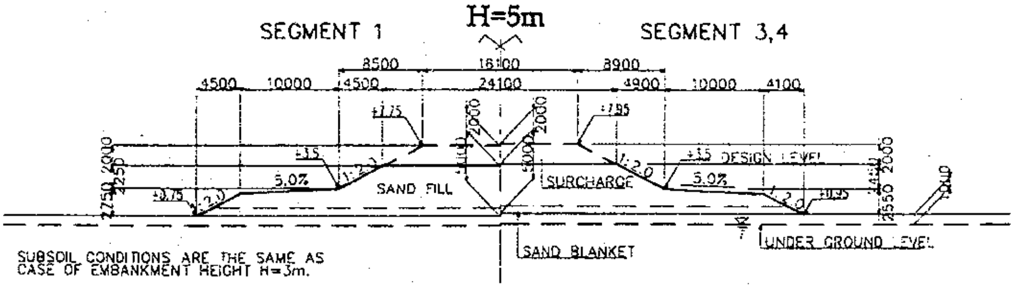
Item	Segment	Subsoil Layer	Cohesion c kN/m²	Internal Friction Angle φ Degree	Unit Weight γ kN/m³	Remarks
Subsoil	1	C1-U	7.0	4.0	15.9	
		C1-L	8.0	6.0	16.7	
		C2	10.0	14.0	17.3	
	3	C1-U	9.0	4.0	15.6	
		C1-L	14.0	3.0	16.8	
	4	C1-U	8.0	4.0	15.6	

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	18.5	

H=4m



H=5m



H=6m

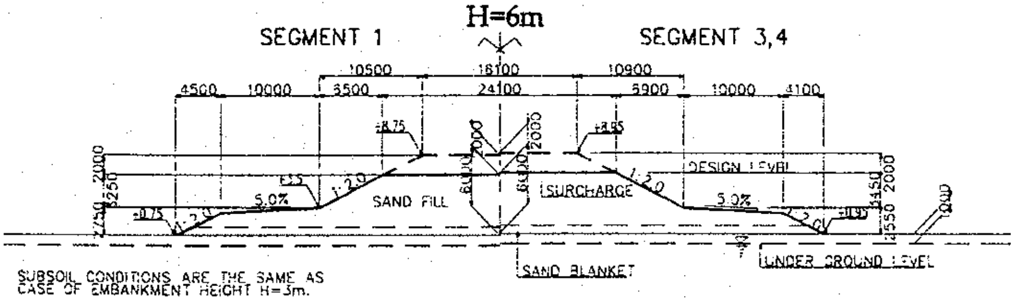
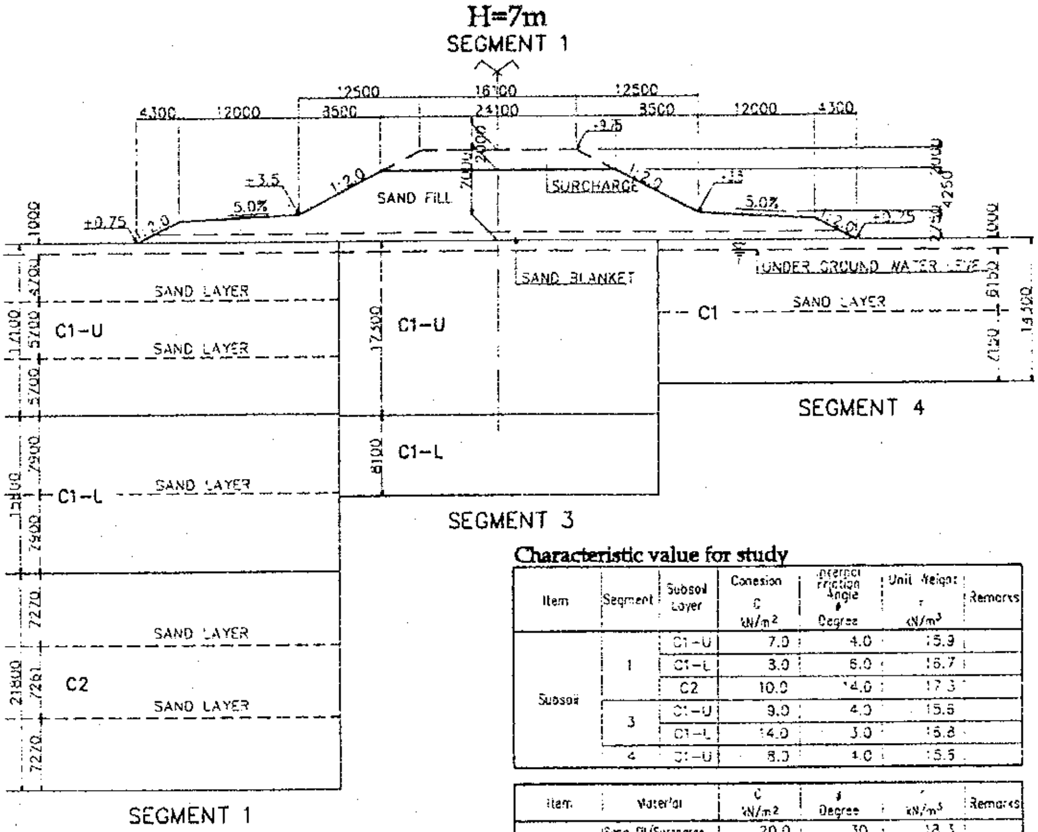


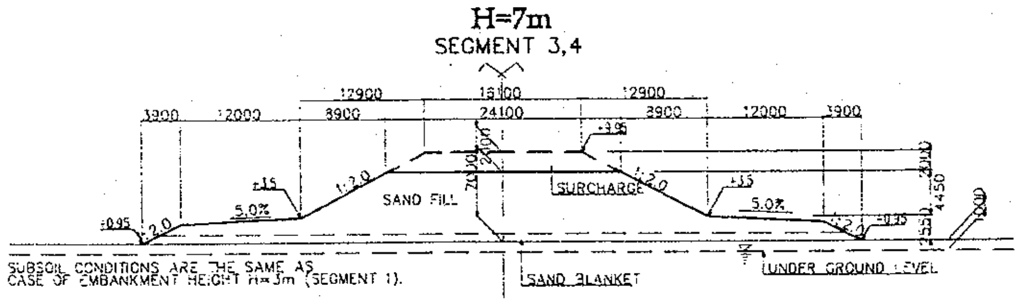
Fig-I-4-2. Design Section-1

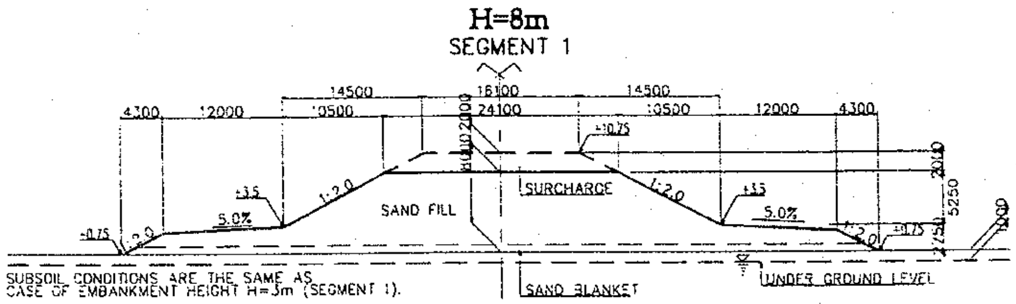


Characteristic value for study

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	3.0	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	15.5	

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	18.3	





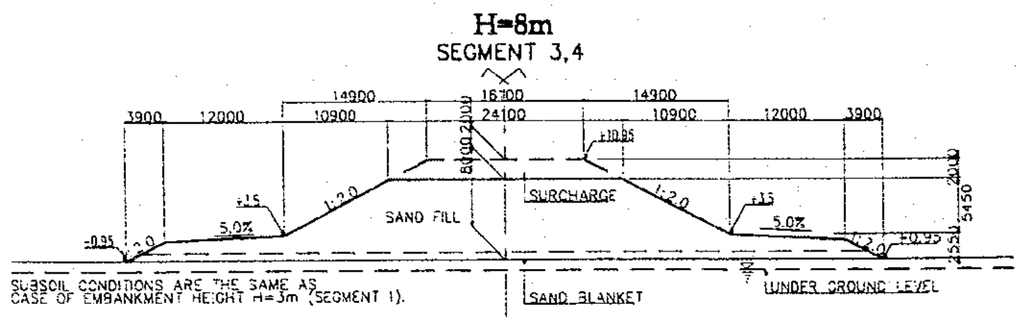


Fig-I-4-2. Design Section-2

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/m^2)

qd = 5.1 x Cu Cu; Cohesion in undrained condition test (kN/m^2)

γ_E; Unit Weight of Embankment (kN/m^3)

4.3.3 The Calculation Result and Conclusion

Segment	Cu	qd	γ_E	H_{EC}	Remarks
	kN/m^2	kN/m^2	kN/m^3	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.

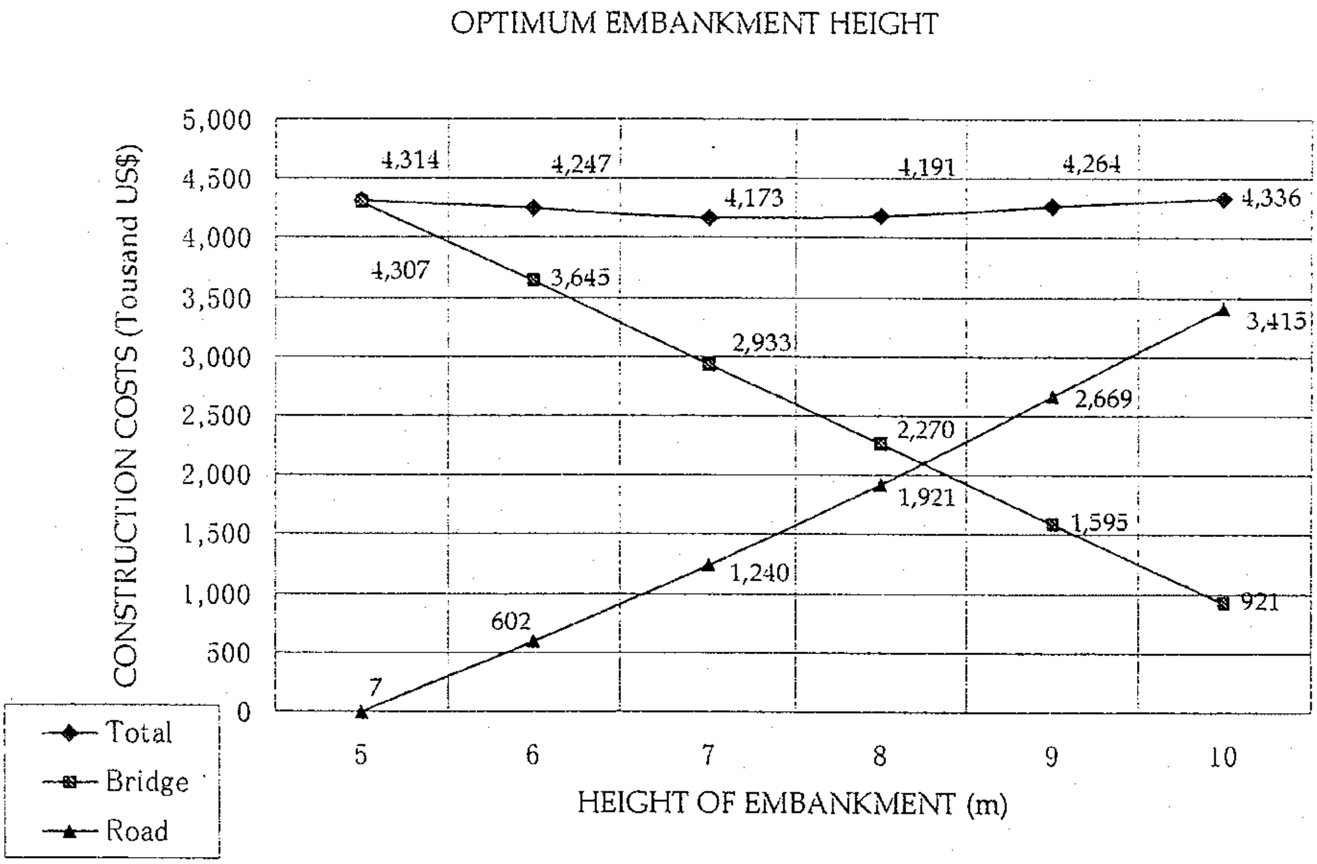


Figure I-4- 4 Cost Comparisons by Embankment Height

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.

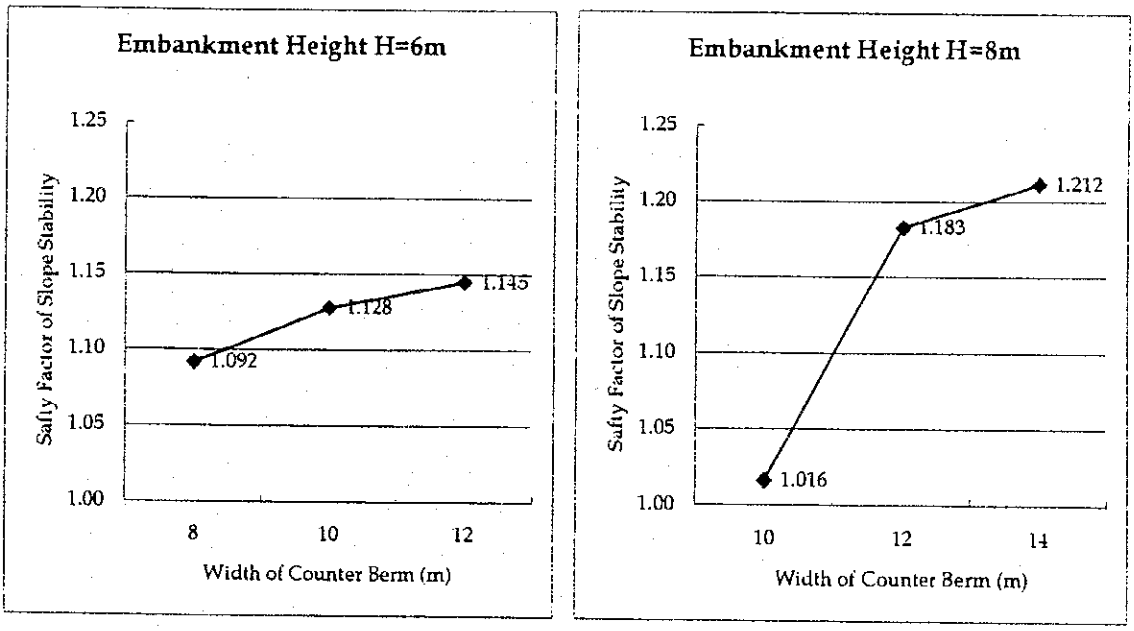


Figure I-4-5. Study Result of Counter Berm Width

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.

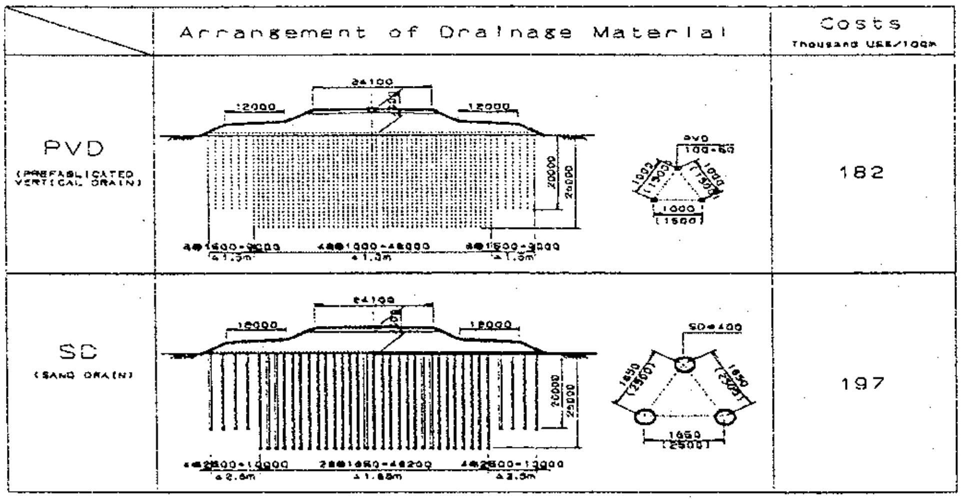


Figure I-4-6. Cost Comparison of SD and PVD

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.

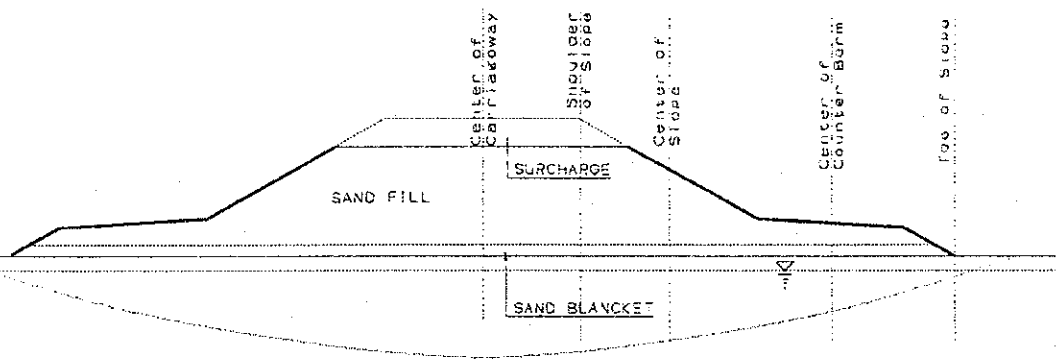


Figure I-4-7. Section of Settlement Calculation

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.

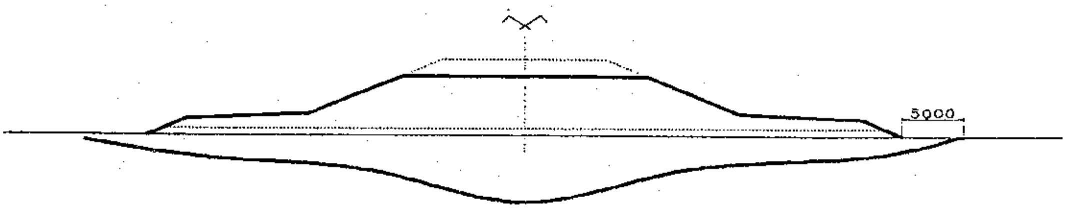


Figure I-4-8. Cross-Section of Settlement

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

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

4-10. Study of Thickness of Sand Blanket

4.10.1 Description

The thickness of the sand blanket was calculated in consideration of contact pressure of construction machine.

Dai Nai sand was selected for the material of sand blanket based on the test result.

4.10.2 Design formula

The calculation method of the sand blanket thickness is used according to Porando & Raysne formula as follows:

$$\frac{K \cdot P}{(B+2 \cdot h \cdot \tan a) \cdot (L+h \cdot \tan a)} < (\gamma \cdot h + C \cot\phi) \cdot \frac{1+\sin\phi}{1-\sin\phi} \cdot e^{\pi \cdot \tan\phi} \cdot C \cdot \tan\phi$$

Where:

Left side of formula is the live load pressure.

Right side of formula is the capacity of the soft ground.

P:	Weight of one vehicle wheel	
K:	Safety factor in construction process	1.1
B, L:	Sizes of vehicle wheel	
a :	Angle of pressure distribution =	30degree
γ:	Dry unit weight of sand blanket=	18.6KN/cm³
h:	Thickness of sand blanket	
C:	Cohesion of soft ground=	7.0kN/m²
ϕ:	Internal friction angle of soft ground=	4.0degree

4.10 3 Determination of sand blanket thickness

Vehicle	B (cm)	L (cm)	P (kN)	h (m)
16 T	20	60	56.0	60
21 T	20	60	73.5	70
30 T	20	60	60.0	65

As for the thickness of sand blanket 70 cm are applied.

4-11. Study of Lateral Movement of Abutment

4.11.1 Description

The lateral movement is the ground deformation the phenomenon that results to level direction by the embankment load.

As for the occurrence mechanism of this phenomenon, there is much problem that is not clarified and the measure method is not established in a present stage.

However, the ground that was consolidated sufficiently with the pre-load or surcharge be that there is little occurrence of this phenomenon is confirmed in the execution of work achievement of Japan.

The abutment is displaced and the expansion spacing of rail joint of an abutment and girder disappear and the bearing and parapet and girder fail is a big problem by lateral movement.

In this Chapter, the determination of the risk of the occurrence of lateral movement is confirmed by using determination formula that is adopted generally in Japan.

4.11.2 Determination of lateral movement

(1) Determination formula

$$I = \mu 1 \times \mu 2 \times \mu 3 \times \gamma (h - h_w)/C$$

$$\mu 1 = D/L,\ \mu 2 = \Sigma b/B,\ \mu 3 = D/A\ (=<3.0)$$

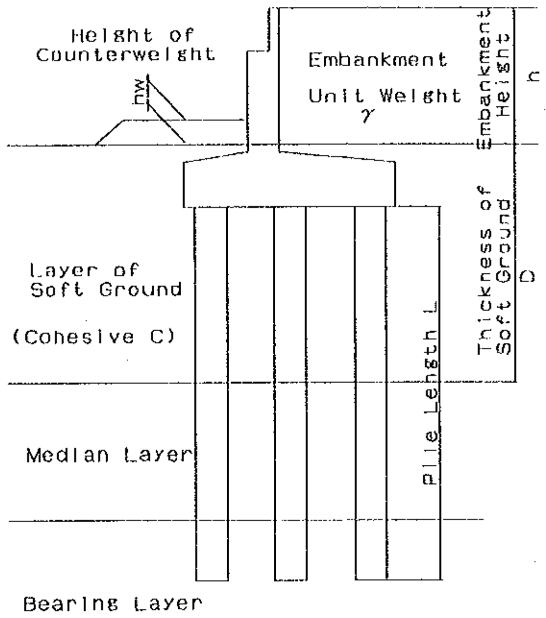
Where

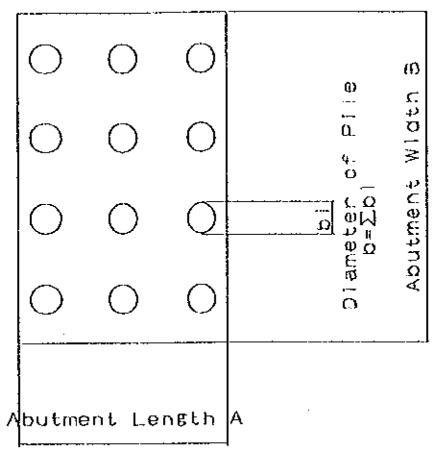
I	:	Later Lateral Movement Determination Index	Non Dimension
γ	:	Unit Weight of Embankment	kN/m^3
h	:	Height of Embankment	m
h_w	:	Height of Counterweight	m
C	:	Cohesion of Subsoil	kN/m^2
D	:	Thickness of Soft Ground <3x (h-hw)	m
L	:	Length of Foundation Pile	m
b	:	Diameter of Foundation Pile	m
B	:	Width of Pile Cap	m
A	:	Length of Pile Cap	m

(2) Conclusion

Occurrence probability of the lateral movement occurrence of the abutment will be little. The calculation result is shown to the next page.

Study of Lateral Movement





Determination formula of Japan Road Association

I= μ1 x μ2 x μ3 x γ (h-hw)/C

μ1=D/L , μ2= Σb/B , μ3=D/A(=<3.0)

I : Lateral movement determination Index

(I < 1.2 ; There is little probability of the occurrence of Lateral Movement)

Classification	Bridge Name		Embankment Factor				Thickness of	Soft Ground Factor		Structural Factor						Lateral Movement Determination Index					Remarks
			h(m)	hw(m)	h-hw(m)	γ(kN/m³)	C1Layer	D(m)	C(kN/m²)	A	B	L	n	bi	Σb	μ1	μ2	μ3	I	Judgment	
Vinh Long	Large Tra Va	A1	8.01	3.05	4.96	18.30	26.00	14.90	12.4	9.20	24.10	70.00	6	1.50	9.00	0.21	0.37	1.62	0.94	OK	
Vinh Long	Large Tra Va	A2	8.33	3.48	4.85	18.30	29.00	14.60	12.4	9.20	24.10	70.00	6	1.50	9.00	0.21	0.37	1.59	0.88	OK	
Vinh Long	Small Tra Va	A1	7.53	2.50	5.03	18.30	25.70	15.10	12.4	8.50	24.10	70.00	5	1.50	7.50	0.22	0.31	1.78	0.89	OK	
Vinh Long	Small Tra Va	A2	8.75	3.75	5.00	18.30	24.50	15.00	12.4	8.50	24.10	70.00	5	1.50	7.50	0.21	0.31	1.76	0.87	OK	
Vinh Long	Tra On	A1	8.77	3.20	5.57	18.30	36.00	16.70	12.4	9.20	24.10	79.00	6	1.50	9.00	0.21	0.37	1.82	1.18	OK	
Vinh Long	Tra On	A2	8.58	3.20	5.38	18.30	36.00	16.10	12.4	9.20	24.10	79.00	6	1.50	9.00	0.20	0.37	1.75	1.06	OK	
Vinh Long	Can Tho (Main Bridge)	A1	6.60	2.60	4.00	18.30	29.00	12.00	12.4	7.00	23.10	59.00	6	1.50	9.00	0.20	0.39	1.71	0.80	OK	
Can Tho	Can Tho (Main Bridge)	A2	5.70	2.55	3.15	18.30	16.00	9.50	15.9	7.00	23.10	62.00	6	1.50	9.00	0.15	0.39	1.36	0.29	OK	
Can Tho	Cai Tac 1	A1	4.47	0.00	4.47	18.30	26.20	13.40	15.9	7.50	24.10	66.00	6	1.50	9.00	0.20	0.37	1.79	0.70	OK	
Can Tho	Cai Tac 1	A2	6.88	2.69	4.19	18.30	26.90	12.60	15.9	9.20	24.10	66.00	6	1.50	9.00	0.19	0.37	1.37	0.47	OK	
Can Tho	Cai Tac 2	A1	6.30	3.00	3.30	18.30	23.30	9.90	15.9	7.00	31.36	55.00	8	1.20	9.60	0.18	0.31	1.41	0.30	OK	
Can Tho	Cai Tac 2	A2	6.30	3.00	3.30	18.30	23.30	9.90	15.9	7.00	31.45	55.00	8	1.20	9.60	0.18	0.31	1.41	0.30	OK	
Can Tho	Cai Da	A1	4.65	0.00	4.65	18.30	19.80	14.00	15.0	7.50	25.35	55.00	6	1.50	9.00	0.25	0.36	1.87	0.96	OK	
Can Tho	Cai Da	A2	4.65	0.00	4.65	18.30	19.80	14.00	14.2	7.50	25.10	55.00	6	1.50	9.00	0.25	0.36	1.87	1.02	OK	
Can Tho	Ba Mang	A1	4.50	1.76	2.74	18.30	13.60	8.20	14.2	7.50	24.10	40.00	13	0.45	5.85	0.21	0.24	1.09	0.19	OK	
Can Tho	Ba Mang	A2	4.50	1.76	2.74	18.30	13.60	8.20	14.2	7.50	24.10	40.00	13	0.45	5.85	0.21	0.24	1.09	0.19	OK	
Can Tho	Cai Nai	A1	5.55	2.38	3.17	18.30	12.30	9.50	14.2	7.50	24.10	40.00	13	0.45	5.85	0.24	0.24	1.27	0.30	OK	
Can Tho	Cai Nai	A2	5.67	2.38	3.29	18.30	14.70	9.90	14.2	7.50	24.10	40.00	13	0.45	5.85	0.25	0.24	1.32	0.34	OK	
Can Tho	Ap My	A1	7.24	2.55	4.69	18.30	12.10	12.10	14.2	7.50	24.10	40.00	15	0.45	6.75	0.30	0.28	1.61	0.83	OK	
Can Tho	Ap My	A2	7.24	2.55	4.69	18.30	12.10	12.10	14.2	7.50	24.10	40.00	15	0.45	6.75	0.30	0.28	1.61	0.83	OK	
Can Tho	Cai Rang	A1	7.64	2.46	5.18	18.30	11.00	11.00	14.2	7.50	24.10	40.00	15	0.45	6.75	0.28	0.28	1.47	0.75	OK	
Can Tho	Cai Rang	A2	7.46	2.46	5.00	18.30	13.00	13.00	14.2	7.50	24.10	40.00	15	0.45	6.75	0.33	0.28	1.73	1.02	OK	
Over Br	NH.54	A1	7.35	2.38	4.97	18.30	36.80	14.90	12.4	9.50	14.00	70.00	4	1.50	6.00	0.21	0.43	1.57	1.05	OK	
Over Br	NH.54	A2	7.35	2.38	4.97	18.30	36.80	14.90	12.4	9.50	14.00	70.00	4	1.50	6.00	0.21	0.43	1.57	1.05	OK	
Over Br	NH.91B	A1	8.27	3.43	4.84	18.30	19.80	14.50	15.9	10.50	45.63	57.00	9	1.50	13.50	0.25	0.30	1.38	0.58	OK	
Over Br	NH.91B	A2	8.27	3.43	4.84	18.30	19.80	14.50	15.9	10.50	45.68	57.00	9	1.50	13.50	0.25	0.30	1.38	0.58	OK	
Ramp Br	IC NH.91B Rampway D	A1	4.19	0.00	4.19	18.30	19.80	12.60	15.9	5.40	7.50	40.00	6	0.45	2.70	0.32	0.36	2.17	1.19	OK	
Ramp Br	IC NH.91B Rampway D	A2	4.16	0.00	4.16	18.30	19.80	12.50	15.9	5.40	7.50	40.00	6	0.45	2.70	0.31	0.36	2.16	1.16	OK	

4-12. The Plan of Movement Observation and Execution Management

4.12.1 Description

The construction work of the soft ground section should adopt the information processing construction method by movement observation.

The execution management item by the movement observation is shown below.

(1) Control of banking speed.
(2) Stable evaluation of banking.
(3) Prevention of the displacement of the rupture and periphery of banking.
(4) Confirmation of settlement quantity.
(5) Decision in the removal time of surcharge and the pre-load.
(6) Decision of the establishment height of crossing structure.
(7) Prediction of future settlement quantity.

In this chapter, selection of movement observation devices, arrangement of instruments, Execution management method by observation result are entered.

4.12.2 Item of movement observation

(1) Settlement of ground surface and subsoil layer.
(2) Deformation of the surface of the periphery ground by banking.
(3) Horizontal deformation of subsoil.
(4) Fluctuation of pore water pressure of subsoil.
(5) Fluctuation of a groundwater level.

4.12.3 Arrangement of devices for movement observation

Surface Settlement Plate	SSP	Each pre-load, 60m intervals in general section.
Deep Settlement Plate	DSP	Pre-load of high embankment section
Alignment Stakes	AS	Each pre-load, 60m intervals in general section.
Electrical Piezometer	EP	Pre-load of high embankment section
Inclinometer	INC	Pre-load of high embankment section
Observation Well	OW	1 or 2 unit to the each segment section

The detailed establishment position is shown to the Drawings. Also the standard establishment figure is attached in the next pages.

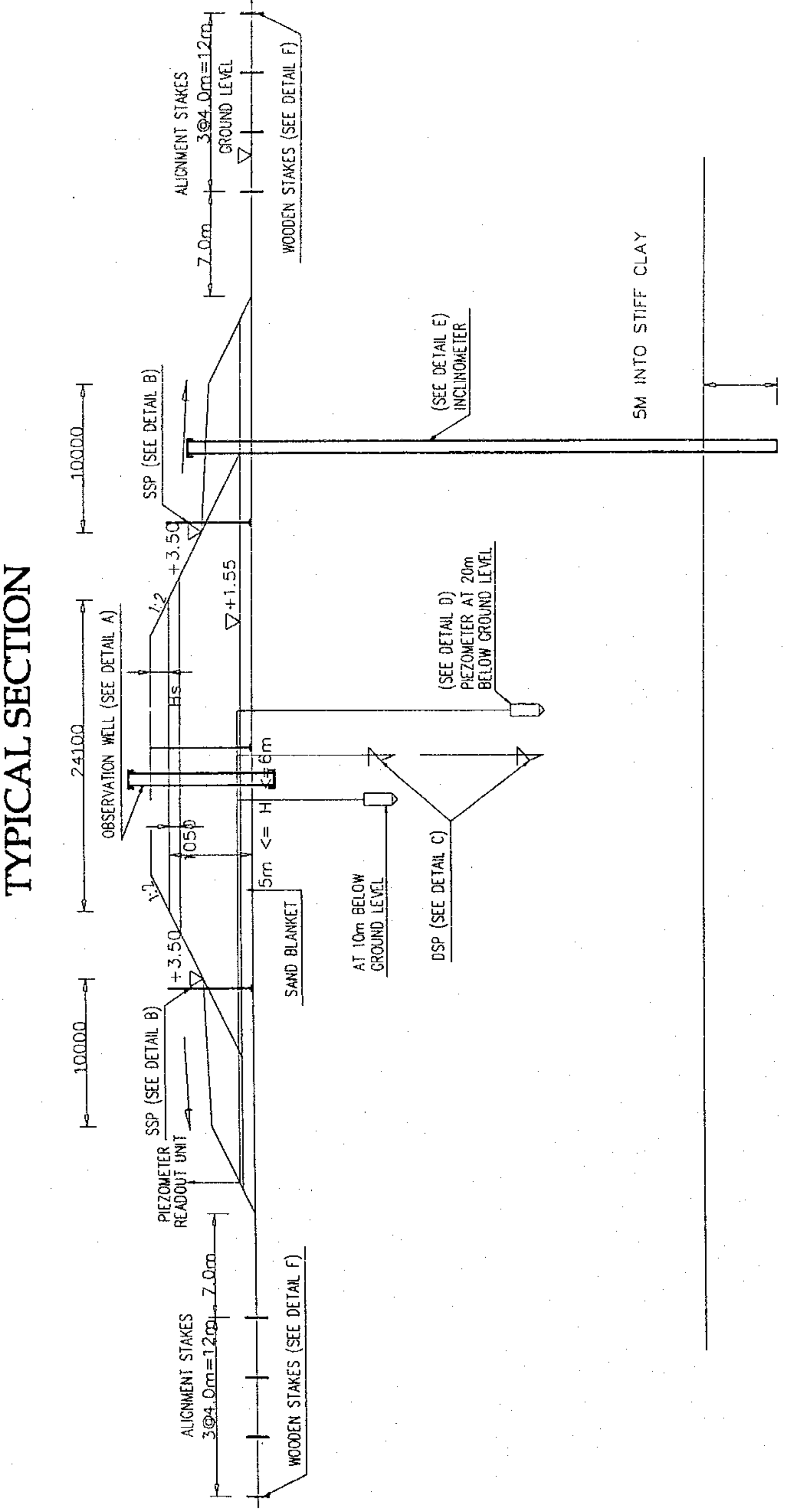
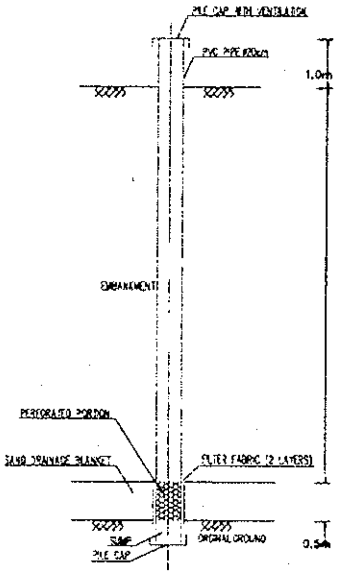
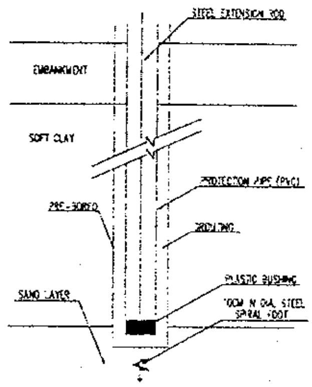


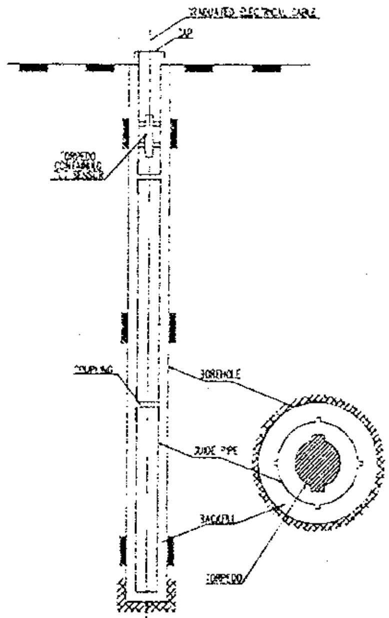
Fig-I-4-9 Details of Moving Observation Devices



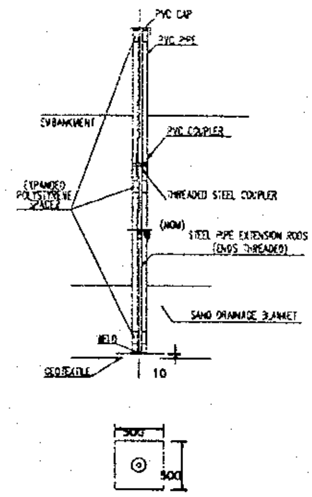
OBSERVATION WELL



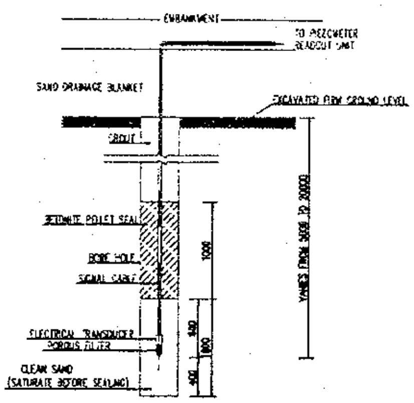
DEEP SETTLEMENT PLATE (DSP)



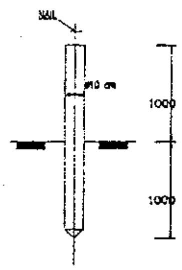
INCLINOMETER



SURFACE SETTLEMENT PLATE



ELECTRICAL PIEZOMETER



WOODEN STAKE

Fig-I-4-10 Details of Moving Observation Devices

4.12.4 Frequency of observation

Name of Devices	Symbol	Through Banking period	Period from banking completion until pavement construction work start
Surface Settlement Plate	SSP	Measuring/day	Measuring/week
Deep Settlement Plate	DSP	- a a -	- a a -
Alignment Stakes	AS	- a a -	- a a -
Electrical Piezometer	EP	- a a -	- a a -
Inclinometer	INC	- a a -	- a a -
Observation Well	OW	- a a -	- a a -

4.12.5 Application to execution management of the observation result

(1) Application purpose of the observation result

- Measured value of *SSP* and *DSP* are used to the confirmation of settlement quantity and, the stability control of banking with the measured value of deformation quantity and the confirmation of the progress situation of consolidation.

- Measured value of *AS* and *INC* are used to the stability control of banking with the measured value of settlement.

- Measured value of *EP* and *OW* are used to the confirmation of the progress situation of consolidation and the stability control of banking.

(2) Stability control method of embankment

There are several methods in the stability control method of embankment.
In this paragraph, quantitative stability control methods are chosen to esteem simplicity of the control and shown as below.

Name of Method	Data that uses it for stability control
S-δ method	S: Settlement quantity δ: Lateral movement quantity
$\Delta\delta/\Delta t$ method	$\Delta\delta/\Delta t$: Lateral movement quantity per day
S-δ/S method	S: Settlement quantity δ: Lateral movement quantity

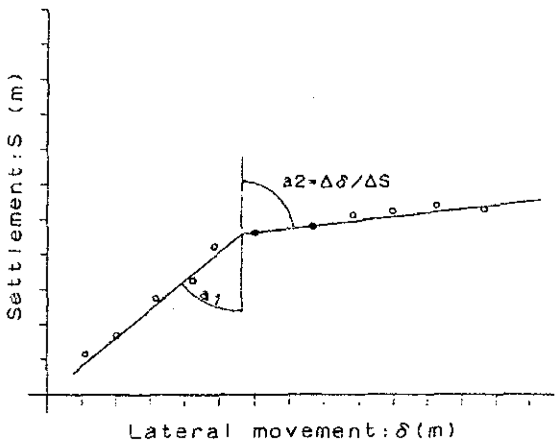
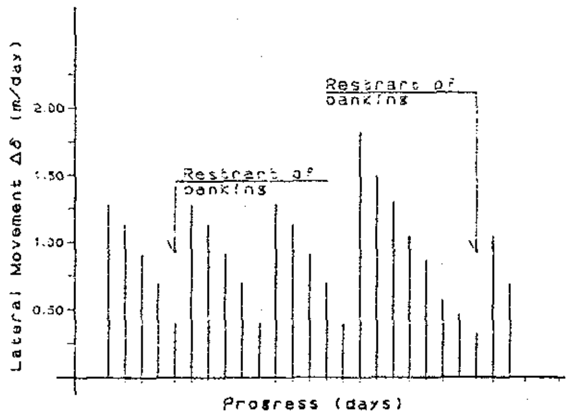
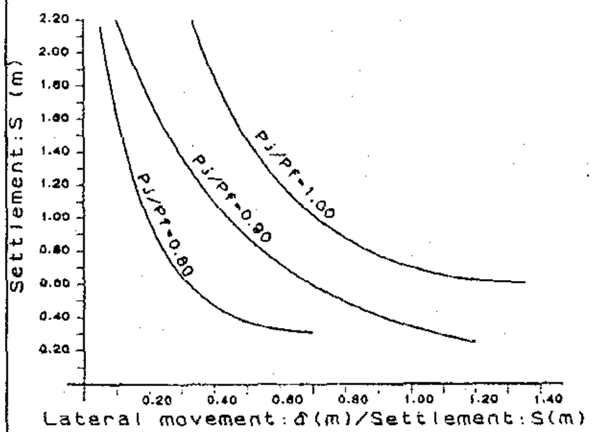
<table>
<tr><th>Name of Method</th><th>Control chart</th><th>Control Limit</th></tr>
<tr><td>S-δ method</td><td>
</td><td>a2=> a1+0.5
a2=> 0.7</td></tr>
<tr><td>Δδ / Δt method</td><td>
</td><td>Δδ / Δt =>1.5 cm/day</td></tr>
<tr><td>S-δ /S method</td><td>
</td><td>(1) δ /S >0.1, pj/pf=>0.95
(2) δ /S >0.8, -1=<a3=<1
(3) δ /S >0.6</td></tr>
</table>

Figure I-4-11. Control Chart of Slope Stability