2.3.3 Garang River

(1) Water Level Profile

Under the design flood condition (Q=790m^3/s), water level profile of Garang River was estimated by using non-uniform flow method. The results are shown in the following calculation sheets. It is compared with the design high water level as shown in the drawing. The calculation was done assuming that the initial water depth is equivalent to the uniform flow depth of channel at Simongan Weir.

The flow velocity, when the design flood discharge flows, was calculated as well, and is shown in the drawing.

(2) Water Level Rise by Bridge Pier

New Simongan Bridge is proposed at about 300 m upstream point from the weir. A pier is supposed to be built in the low water channel, which may affect the upstream water level. Then, the estimation was made regarding the water stage rise by using D'Aubuisson's formula. The result is presented in the table below together with calculation conditions.

Calculation Condition		Result
Q	790 m^3/s	$\Delta h = 0.26$ m
H_1, B	4.74 m *1, 3.0 m x 1	
b_1, b_2	55.0 m, 52.0 m	
C^2	0.81	

*1 : The water level is calculated based on non-uniform flow, using the critical water depth at the weir point.

It is estimated that the water stage in the upstream channel from the bridge is raised by 0.26 m due to the bridge pier. The water depth in the immediate upstream channel becomes 5.0 m, which is smaller than the design water depth of 6.5 m.

GARANG RIVER, FLOOD STAGE, (EL=1.50m),Rb1 = 35m, Rb2 = 35m, Rb3 = 40m
BASIC DATA

KUKAN-SU = 21 ALPHA = 1.00 QO = 790 M3/S HO = 5.300 M ZO = 1.500 M
JCO = 0 KEY = 0 IPT = 0
KUKAN DATA

	DANMEN NO.	BUNKATSU SUU	DANMEN KEIJYO	LOSS TYPE	SODO KEISU	KUKAN KYORI(M)	KASYO KOOBAI(1/I)	RAKUSA (M)	RYUNYU RYO(M3/S)
1	99+20-100	9	1 1	0	0.03	30	999999	0	0
2	100 - 101	9	2 1	0	0.03	49.82	1250	0	0
3	101 - 105	8	2 1	0	0.033	214.02	1250	0	0
4	105 - 106	1	2 1	0	0.033	47.42	1250	0	0
5	106 - 110	4	2 1	0	0.033	198.68	1250	0	0
6	110 - 111	1	2 1	0	0.033	48.32	1250	0	0
7	111 - 115	4	2 1	0	0.0333	137.84	1250	0	0
8	115 - 120	5	2 1	0	0.0333	195.72	1250	0	0
9	120 - 124	4	2 1	0	0.033	139.36	1250	0	0
10	124 - 127	3	2 1	0	0.0323	134.34	1250	1.5	0
11	127 - 133	6	2 1	0	0.0323	220.57	1250	0	0
12	133 - 135	2	2 1	0	0.0328	113.71	1250	0	0
13	135 - 142	7	2 1	0	0.0321	489.52	1250	0	0
14	142 - 148	6	2 1	0	0.0325	305.12	1250	0	0
15	148 - 152	4	2 1	0	0.0317	159.45	1250	0	0
16	152 - 155	3	2 1	0	0.0316	138.49	1250	0	0
17	155 - 165	10	2 1	0	0.0323	487.29	1250	0	0
18	165 - 170	5	2 1	0	0.0323	222.06	1250	0	0
19	170 - 174	4	2 1	0	0.0323	220.12	1250	0	0
20	174 - 176	2	2 1	0	0.0322	93.01	1250	0	0
21	176 - 179	3	2 1	0	0.0322	162.35	500	0	0

NO.	H	A	R	V	N	Q	DX	FROUD	IE	Z	H-Z
99+20-100	5.3	190	3.299	4.158	0.03	790	0	0.6813	3.17E-03	1.5	3.8
+ 3.33	5.283	187.06	3.281	4.223	0.03	790	3.33	0.6936	3.29E-03	1.5	3.783
+ 6.67	5.263	183.99	3.261	4.294	0.03	790	3.33	0.707	3.43E-03	1.5	3.763
+ 10.00	5.243	180.89	3.241	4.367	0.03	790	3.33	0.7211	3.58E-03	1.5	3.743
+ 13.33	5.22	177.72	3.219	4.445	0.03	790	3.33	0.7362	3.74E-03	1.5	3.72
+ 16.67	5.195	174.47	3.195	4.528	0.03	790	3.33	0.7525	3.92E-03	1.5	3.695
+ 20.00	5.166	171.1	3.169	4.617	0.03	790	3.33	0.7703	4.12E-03	1.5	3.666
+ 23.33	5.135	167.59	3.14	4.714	0.03	790	3.33	0.7898	4.35E-03	1.5	3.635
+ 26.67	5.098	163.9	3.107	4.82	0.03	790	3.33	0.8117	4.61E-03	1.5	3.598
+ 30.00	5.055	159.96	3.07	4.939	0.03	790	3.33	0.8368	4.92E-03	1.5	3.555
100 - 101	5.115	163.96	3.137	4.818	0.03	790	0	0.8127	4.55E-03	1.5	3.615
+ 5.54	5.147	164.45	3.178	4.804	0.03	790	5.54	0.8123	4.44E-03	1.504	3.642
+ 11.07	5.178	164.92	3.21	4.79	0.03	790	5.54	0.8122	4.36E-03	1.509	3.669
+ 16.61	5.208	165.38	3.233	4.777	0.03	790	5.54	0.8122	4.30E-03	1.513	3.695
+ 22.14	5.238	165.84	3.248	4.764	0.03	790	5.54	0.8123	4.25E-03	1.518	3.72
+ 27.68	5.268	166.33	3.256	4.75	0.03	790	5.54	0.8124	4.21E-03	1.522	3.746
+ 33.21	5.299	166.84	3.26	4.735	0.03	790	5.54	0.8124	4.18E-03	1.527	3.772
+ 38.75	5.329	167.38	3.259	4.72	0.03	790	5.54	0.8123	4.15E-03	1.531	3.798
+ 44.28	5.36	167.96	3.255	4.703	0.03	790	5.54	0.812	4.13E-03	1.535	3.824
+ 49.82	5.391	168.58	3.249	4.686	0.03	790	5.54	0.8116	4.11E-03	1.54	3.851
101 - 105	5.607	187.62	3.339	4.211	0.033	790	0	0.7234	3.87E-03	1.54	4.067
+ 26.75	5.755	192.99	3.423	4.093	0.033	790	26.75	0.6943	3.54E-03	1.561	4.194
+ 53.51	5.883	197.16	3.491	4.007	0.033	790	26.75	0.6727	3.30E-03	1.583	4.3
+ 80.26	5.996	200.53	3.548	3.94	0.033	790	26.75	0.6557	3.12E-03	1.604	4.392
+ 107.01	6.099	203.32	3.598	3.885	0.033	790	26.75	0.642	2.98E-03	1.625	4.474
+ 133.76	6.195	205.67	3.642	3.841	0.033	790	26.75	0.6306	2.87E-03	1.647	4.548
+ 160.51	6.285	207.66	3.682	3.804	0.033	790	26.75	0.6209	2.77E-03	1.668	4.616
+ 187.27	6.37	209.36	3.718	3.773	0.033	790	26.75	0.6127	2.69E-03	1.69	4.68
+ 214.02	6.451	210.82	3.751	3.747	0.033	790	26.75	0.6056	2.62E-03	1.711	4.74
105 - 106	6.386	201.87	3.747	3.913	0.033	790	0	0.6306	2.87E-03	1.711	4.675
+ 47.42	6.57	209.41	3.844	3.773	0.033	790	47.42	0.5998	2.57E-03	1.749	4.821
106 - 110	6.57	209.41	3.844	3.772	0.033	790	0	0.5998	2.57E-03	1.749	4.821
+ 49.67	6.736	215.97	3.928	3.658	0.033	790	49.67	0.5751	2.35E-03	1.789	4.947
+ 99.34	6.887	222.34	3.963	3.553	0.033	790	49.67	0.5952	2.19E-03	1.829	5.059
+ 149.01	7.027	228.44	3.963	3.458	0.033	790	49.67	0.5715	2.08E-03	1.868	5.159
+ 198.68	7.156	233.81	3.963	3.379	0.033	790	49.67	0.5518	1.98E-03	1.908	5.248
110 - 111	7.156	233.82	3.963	3.379	0.033	790	0	0.5518	1.98E-03	1.908	5.248
+ 48.32	7.324	251.32	3.923	3.143	0.033	790	48.32	0.5319	1.74E-03	1.947	5.377
111 - 115	7.324	251.32	3.923	3.143	0.0333	790	0	0.5319	1.77E-03	1.947	5.377
+ 34.46	7.446	269.27	3.923	2.934	0.0333	790	34.46	0.5556	1.54E-03	1.974	5.472
+ 68.92	7.557	290.45	3.923	2.72	0.0333	790	34.46	0.5553	1.33E-03	2.002	5.555
+ 103.38	7.653	313.43	3.923	2.521	0.0333	790	34.46	0.543	1.14E-03	2.029	5.624
+ 137.84	7.733	337.1	3.923	2.344	0.0333	790	34.46	0.5259	9.85E-04	2.057	5.676
115 - 120	7.787	374.61	4.009	2.109	0.0333	790	0	0.4558	7.74E-04	2.057	5.73
+ 39.14	7.814	371.86	4.009	2.124	0.0333	790	39.14	0.457	7.86E-04	2.088	5.726
+ 78.29	7.842	369.23	4.009	2.14	0.0333	790	39.14	0.4581	7.97E-04	2.12	5.722
+ 117.43	7.87	366.7	4.009	2.154	0.0333	790	39.14	0.4589	8.08E-04	2.151	5.719
+ 156.58	7.898	364.26	4.009	2.169	0.0333	790	39.14	0.4595	8.19E-04	2.182	5.716
+ 195.72	7.928	361.91	4.009	2.183	0.0333	790	39.14	0.4599	8.30E-04	2.213	5.714
120 - 124	7.868	324.28	3.923	2.436	0.033	790	0	0.5333	1.05E-03	2.213	5.654
+ 34.84	7.906	325.37	3.946	2.428	0.033	790	34.84	0.5131	1.03E-03	2.241	5.665
+ 69.68	7.943	326.13	3.968	2.422	0.033	790	34.84	0.4933	1.02E-03	2.269	5.674
+ 104.52	7.979	326.59	3.989	2.419	0.033	790	34.84	0.4735	1.01E-03	2.297	5.682
+ 139.36	8.015	326.81	4.009	2.417	0.033	790	34.84	0.4536	9.99E-04	2.325	5.69
124 - 127 **		SYUSO	KU SEZU **								

GARANG RIVER
BASIC DATA

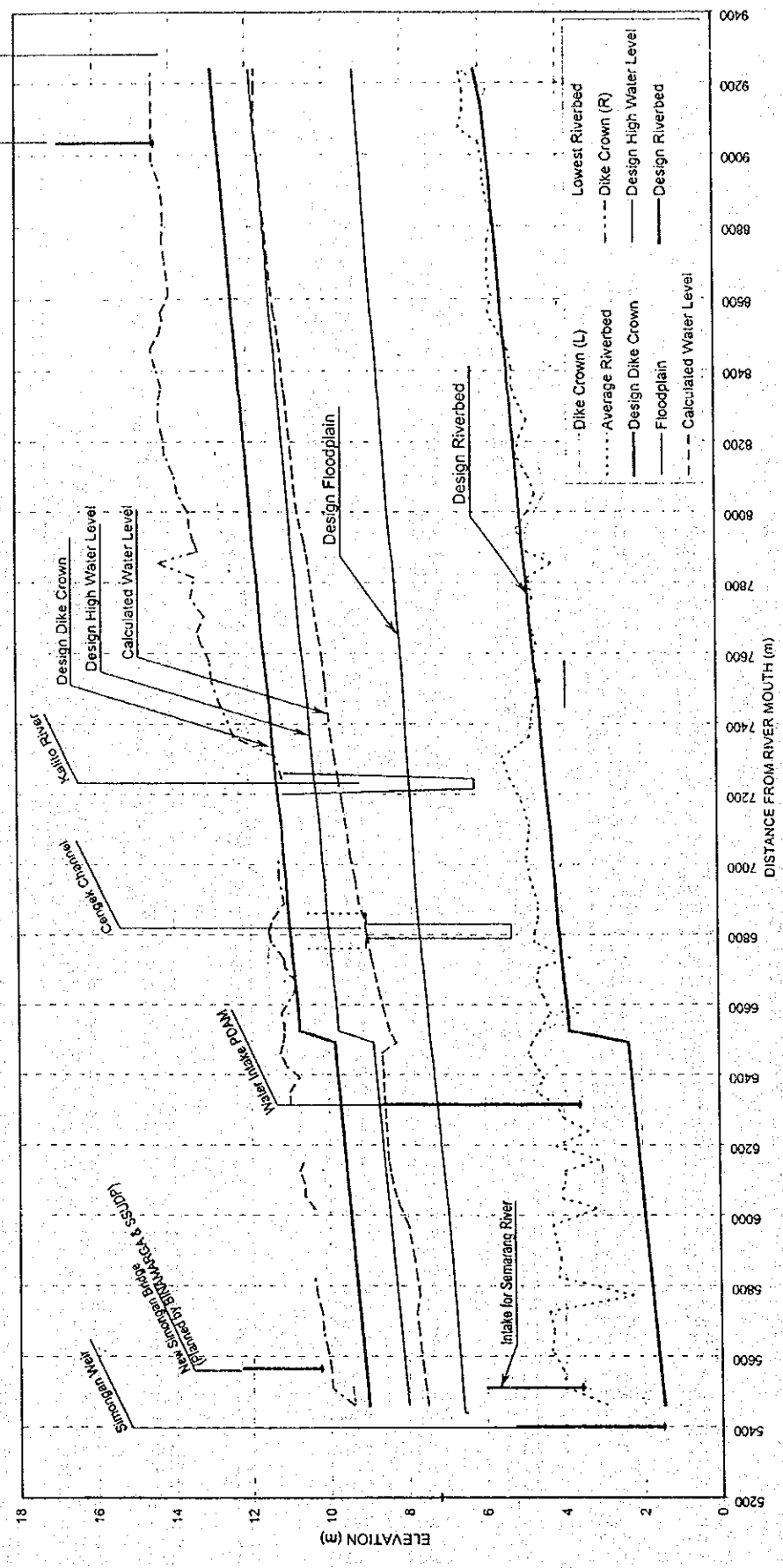
FLOOD STAGE, STEADY NON-UNIFORM FLOW (EL.=1.50m)

KUKAN-SU = 11:00 AM ALPHA = 1.0 QO =790.00 M3/S HO = 8.80 M ZO = 3.842 M
JCO = 0 KEY = 0 IPT = 0

	DANMEN NO.	BUNKATSU SUU	DANMEN KEIJYO	LOSS TYPE	SODO KEISU	KUKAN KYORI(M)	KASYO KOOBAI(1/I)	RAKUSA (M)	RYUNYU RYO(M3/S)
1	124 - 127	3	2 1	0	0.0323	134.34	1250	0	0
2	127 - 133	6	2 1	0	0.0323	220.57	1250	0	0
3	133 - 135	2	2 1	0	0.0328	113.71	1250	0	0
4	135 - 142	7	2 1	0	0.0321	489.52	1250	0	0
5	142 - 148	6	2 1	0	0.0325	305.12	1250	0	0
6	148 - 152	4	2 1	0	0.0317	159.45	1250	0	0
7	152 - 155	3	2 1	0	0.0316	138.49	1250	0	0
8	155 - 165	10	2 1	0	0.0323	487.29	1250	0	0
9	165 - 170	5	2 1	0	0.0323	222.06	1250	0	0
10	170 - 174	4	2 1	0	0.0323	220.12	1250	0	0
11	174 - 179	5	2 1	0	0.0322	255.36	1250	0	0

NO.	H	A	R	V	N	Q	DX	FROUD	IE	Z	H-Z
124 - 127	8.8	337.88	3.012	2.338	0.0323	790	0	0.4258	1.31E-03	3.842	4.958
+ 44.78	8.861	339.65	3.043	2.326	0.0323	790	44.78	0.4214	1.28E-03	3.878	4.983
+ 89.56	8.92	341.2	3.072	2.315	0.0323	790	44.78	0.4174	1.25E-03	3.914	5.006
+ 134.34	8.978	342.56	3.1	2.306	0.0323	790	44.78	0.4139	1.23E-03	3.949	5.028
127 - 133	8.978	342.56	3.1	2.306	0.0323	790	0	0.4139	1.23E-03	3.949	5.028
+ 36.76	9.037	352.37	3.073	2.242	0.0323	790	36.76	0.4041	1.17E-03	3.979	5.058
+ 73.52	9.093	362.04	3.047	2.182	0.0323	790	36.76	0.395	1.13E-03	4.008	5.084
+ 110.29	9.145	371.57	3.02	2.126	0.0323	790	36.76	0.3865	1.08E-03	4.038	5.108
+ 147.05	9.196	380.95	3.001	2.074	0.0323	790	36.76	0.3785	1.04E-03	4.067	5.128
+ 183.81	9.243	390.15	3.001	2.025	0.0323	790	36.76	0.371	9.88E-04	4.097	5.146
+ 220.57	9.288	399.15	3.001	1.979	0.0323	790	36.76	0.364	9.44E-04	4.126	5.162
133 - 135	9.288	399.15	3.001	1.979	0.0328	790	0	0.364	9.74E-04	4.126	5.162
+ 56.85	9.313	369.03	3.097	2.141	0.0328	790	56.85	0.3841	1.09E-03	4.171	5.141
+ 113.71	9.335	339.3	3.298	2.328	0.0328	790	56.85	0.4047	1.19E-03	4.217	5.118
135 - 142	9.335	339.3	3.298	2.328	0.0321	790	0	0.4047	1.14E-03	4.217	5.118
+ 69.93	9.424	346.2	3.294	2.282	0.0321	790	69.93	0.3969	1.10E-03	4.273	5.151
+ 139.86	9.509	352.84	3.288	2.239	0.0321	790	69.93	0.3898	1.06E-03	4.329	5.18
+ 209.79	9.59	359.23	3.281	2.199	0.0321	790	69.93	0.3833	1.02E-03	4.385	5.206
+ 279.73	9.669	365.4	3.272	2.162	0.0321	790	69.93	0.3773	9.92E-04	4.441	5.228
+ 349.66	9.745	371.36	3.262	2.127	0.0321	790	69.93	0.3718	9.64E-04	4.497	5.248
+ 419.59	9.819	377.13	3.251	2.095	0.0321	790	69.93	0.3667	9.39E-04	4.553	5.266
+ 489.52	9.89	382.72	3.239	2.064	0.0321	790	69.93	0.362	9.16E-04	4.609	5.281
142 - 148	9.89	382.72	3.239	2.064	0.0325	790	0	0.362	9.39E-04	4.609	5.281
+ 50.85	9.929	374.81	3.293	2.108	0.0325	790	50.85	0.3664	9.58E-04	4.649	5.28
+ 101.71	9.968	366.96	3.352	2.153	0.0325	790	50.85	0.3708	9.76E-04	4.69	5.278
+ 152.56	10.008	359.15	3.416	2.2	0.0325	790	50.85	0.3751	9.93E-04	4.731	5.277
+ 203.41	10.048	351.37	3.486	2.248	0.0325	790	50.85	0.3793	1.01E-03	4.771	5.277
+ 254.27	10.088	343.61	3.562	2.299	0.0325	790	50.85	0.3834	1.03E-03	4.812	5.276
+ 305.12	10.128	335.85	3.645	2.352	0.0325	790	50.85	0.3875	1.04E-03	4.853	5.275
148 - 152	10.128	335.85	3.645	2.352	0.0317	790	0	0.3875	9.91E-04	4.853	5.275
+ 39.86	10.166	335.07	3.666	2.358	0.0317	790	39.86	0.3873	9.88E-04	4.884	5.282
+ 79.72	10.204	334.27	3.686	2.363	0.0317	790	39.86	0.3871	9.86E-04	4.916	5.288
+ 119.59	10.242	333.45	3.707	2.369	0.0317	790	39.86	0.3869	9.83E-04	4.948	5.294
+ 159.45	10.28	332.6	3.728	2.375	0.0317	790	39.86	0.3867	9.81E-04	4.98	5.299
152 - 155	10.28	332.6	3.728	2.375	0.0316	790	0	0.3867	9.75E-04	4.98	5.299
+ 46.16	10.351	349.62	3.604	2.26	0.0316	790	46.16	0.3746	9.23E-04	5.017	5.334
+ 92.33	10.416	366.53	3.498	2.155	0.0316	790	46.16	0.3631	8.74E-04	5.054	5.362
+ 138.49	10.475	383.28	3.406	2.061	0.0316	790	46.16	0.3522	8.28E-04	5.091	5.384
155 - 165	10.475	383.28	3.406	2.061	0.0323	790	0	0.3522	8.65E-04	5.091	5.384
+ 48.73	10.517	383.24	3.411	2.061	0.0323	790	48.73	0.3519	8.63E-04	5.13	5.387
+ 97.46	10.559	383.19	3.417	2.062	0.0323	790	48.73	0.3517	8.62E-04	5.169	5.39
+ 146.19	10.601	383.12	3.422	2.062	0.0323	790	48.73	0.3515	8.60E-04	5.208	5.393
+ 194.92	10.643	383.05	3.427	2.062	0.0323	790	48.73	0.3512	8.59E-04	5.247	5.396
+ 243.65	10.685	382.97	3.432	2.063	0.0323	790	48.73	0.3511	8.58E-04	5.286	5.399
+ 292.37	10.726	382.88	3.437	2.063	0.0323	790	48.73	0.3509	8.56E-04	5.325	5.401
+ 341.10	10.768	382.78	3.442	2.064	0.0323	790	48.73	0.3507	8.55E-04	5.364	5.404
+ 389.83	10.809	382.68	3.447	2.064	0.0323	790	48.73	0.3505	8.54E-04	5.403	5.406
+ 438.56	10.851	382.56	3.452	2.065	0.0323	790	48.73	0.3504	8.53E-04	5.442	5.409
+ 487.29	10.892	382.44	3.457	2.066	0.0323	790	48.73	0.3502	8.52E-04	5.481	5.411
165 - 170	10.892	382.44	3.457	2.066	0.0323	790	0	0.3502	8.52E-04	5.481	5.411
+ 44.41	10.931	383.58	3.454	2.06	0.0323	790	44.41	0.3493	8.48E-04	5.516	5.415
+ 88.82	10.97	384.7	3.452	2.054	0.0323	790	44.41	0.3485	8.43E-04	5.552	5.418
+ 133.24	11.009	385.8	3.449	2.048	0.0323	790	44.41	0.3476	8.40E-04	5.587	5.421
+ 177.65	11.047	386.89	3.446	2.042	0.0323	790	44.41	0.3468	8.36E-04	5.623	5.424
+ 222.06	11.085	387.95	3.443	2.036	0.0323	790	44.41	0.346	8.32E-04	5.658	5.427
170 - 174	11.085	387.95	3.443	2.036	0.0323	790	0	0.346	8.32E-04	5.658	5.427
+ 55.03	11.128	385.45	3.461	2.05	0.0323	790	55.03	0.3474	8.37E-04	5.702	5.426
+ 110.06	11.172	382.98	3.479	2.063	0.0323	790	55.03	0.3487	8.42E-04	5.746	5.425
+ 165.09	11.215	380.54	3.496	2.076	0.0323	790	55.03	0.35	8.48E-04	5.791	5.425
+ 220.12	11.259	378.13	3.512	2.089	0.0323	790	55.03	0.3513	8.53E-04	5.835	5.425
174 - 179	11.259	378.13	3.512	2.089	0.0322	790	0	0.3513	8.48E-04	5.835	5.425
+ 51.07	11.288	365.33	3.595	2.162	0.0322	790	51.07	0.3591	8.81E-04	5.875	5.412
+ 102.14	11.316	352.7	3.69	2.24	0.0322	790	51.07	0.3668	9.12E-04	5.916	5.4
+ 153.22	11.344	340.21	3.799	2.322	0.0322	790	51.07	0.3744	9.43E-04	5.957	5.387
+ 204.29	11.372	327.83	3.926	2.41	0.0322	790	51.07	0.3817	9.72E-04	5.998	5.374
+ 255.36	11.399	315.53	4.074	2.504	0.0322	790	51.07	0.3888	9.99E-04	6.039	5.36

LONGITUDINAL PROFILE OF WEST FLOODWAY CHANNEL



(3) Water Level Profile of Upper Semaran River

When the gates of Simongan Weir are totally open, the flow at the gate becomes a super critical flow. Using this water depth as a beginning condition on the calculation, the water level in the narrow channel section upstream from Simongan Weir was estimated by non-uniform flow method. The results are presented in the following calculation sheets.

SEMARANG RIVER (NON-UNIFORM STEADY FLOW)

CASE NO.1

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.264	4.55	0.6	0.094	5.8	0.897	0.035	0.5	0	9.33E-01	2.30E-02	212.16	14.566	
2	WF-265	5.182	5	0.646	7.5	0.1	0.035	0.5	51.1	3.99E-02	2.21E-05	1.4	1.184	
3	WF-266	5.184	4.6	0.445	10.8	0.108	0.035	0.5	52.1	5.15E-02	4.17E-05	1.82	1.348	
4	WF-267	5.186	4.3	0.457	9.6	0.117	0.035	0.5	52.5	5.53E-02	4.77E-05	2.13	1.461	
5	WF-268	5.188	5	0.458	10.8	0.099	0.035	0.5	50.5	4.67E-02	3.40E-05	1.53	1.236	
6	WF.268-	5.189	8.8	0.812	17.7	0.057	0.035	0.5	21.6	2.02E-02	5.23E-06	0.42	0.645	
7	WF.269	5.189	22.9	1.267	16.5	0.022	0.035	0.5	18.5	6.21E-03	4.28E-07	0.05	0.23	

CASE NO.2

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.264	4.6	0.9	0.136	6.2	0.582	0.035	0.5	0	5.04E-01	5.94E-03	79.18	8.898	
2	WF-265	4.777	2	0.284	7.1	0.245	0.035	0.5	51.1	1.47E-01	3.94E-04	10.96	3.311	
3	WF-266	4.854	1.3	0.134	9.5	0.392	0.035	0.5	52.1	3.43E-01	2.76E-03	36.13	6.011	
4	WF-267	4.945	2.1	0.236	8.7	0.243	0.035	0.5	52.5	1.60E-01	4.96E-04	11.48	3.388	
5	WF-268	4.965	2.7	0.267	10.1	0.182	0.035	0.5	50.5	1.13E-01	2.37E-04	6.2	2.489	
6	WF.268-	4.969	7.3	0.697	15.3	0.068	0.035	0.5	21.6	2.62E-02	9.27E-06	0.63	0.796	
7	WF.269	4.97	19.2	1.07	16.5	0.026	0.035	0.5	18.5	8.02E-03	7.55E-07	0.08	0.282	

CASE NO.3

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.264	4.65	1.2	0.18	6.5	0.424	0.035	0.5	0	3.20E-01	2.18E-03	38.31	6.19	
2	WF-265	4.728	1.7	0.245	6.9	0.294	0.035	0.5	51.1	1.90E-01	6.91E-04	16.59	4.073	
3	WF-266	4.84	1.1	0.123	9.2	0.437	0.035	0.5	52.1	3.98E-01	3.82E-03	46.05	6.786	
4	WF-267	4.959	2.2	0.248	8.7	0.23	0.035	0.5	52.5	1.48E-01	4.16E-04	10.09	3.176	
5	WF-268	4.976	2.9	0.277	10.1	0.175	0.035	0.5	50.5	1.06E-01	2.09E-04	5.66	2.379	
6	WF.268-	4.98	7.4	0.703	15.5	0.068	0.035	0.5	21.6	2.58E-02	9.00E-06	0.62	0.787	
7	WF.269	4.98	19.4	1.08	16.5	0.026	0.035	0.5	18.5	7.92E-03	7.34E-07	0.08	0.279	

CASE NO.4

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.264	4.7	1.5	0.223	6.7	0.331	0.035	0.5	0	2.24E-01	9.95E-04	21.73	4.661	
2	WF-265	4.742	1.8	0.256	6.9	0.279	0.035	0.5	51.1	1.76E-01	5.84E-04	14.67	3.831	
3	WF-266	4.844	1.2	0.125	9.3	0.426	0.035	0.5	52.1	3.84E-01	3.53E-03	43.45	6.591	
4	WF-267	4.955	2.1	0.244	8.7	0.233	0.035	0.5	52.5	1.51E-01	4.37E-04	10.47	3.236	
5	WF-268	4.973	2.8	0.274	10.1	0.177	0.035	0.5	50.5	1.08E-01	2.17E-04	5.81	2.411	
6	WF.268-	4.977	7.4	0.701	15.4	0.068	0.035	0.5	21.6	2.59E-02	9.08E-06	0.62	0.79	
7	WF.269	4.977	19.4	1.077	16.5	0.026	0.035	0.5	18.5	7.95E-03	7.40E-07	0.08	0.279	

CASE NO.5

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.264	4.75	1.9	0.265	7	0.27	0.035	0.5	0	1.68E-01	5.25E-04	13.63	3.692	
2	WF-265	4.774	2	0.282	7.1	0.248	0.035	0.5	51.1	1.49E-01	4.07E-04	11.22	3.35	
3	WF-266	4.853	1.3	0.133	9.5	0.395	0.035	0.5	52.1	3.46E-01	2.82E-03	36.76	6.063	
4	WF-267	4.946	2.1	0.237	8.7	0.242	0.035	0.5	52.5	1.59E-01	4.91E-04	11.4	3.377	
5	WF-268	4.966	2.7	0.267	10.1	0.182	0.035	0.5	50.5	1.12E-01	2.35E-04	6.17	2.484	
6	WF.268-	4.97	7.3	0.697	15.3	0.068	0.035	0.5	21.6	2.62E-02	9.26E-06	0.63	0.795	
7	WF.269	4.97	19.2	1.071	16.5	0.026	0.035	0.5	18.5	8.02E-03	7.54E-07	0.08	0.281	

CASE NO.6

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.264	4.8	2.2	0.308	7.1	0.227	0.035	0.5	0	1.31E-01	3.03E-04	9.15	3.025	
2	WF-265	4.815	2.3	0.316	7.2	0.217	0.035	0.5	51.1	1.23E-01	2.67E-04	8.27	2.875	
3	WF-266	4.869	1.4	0.146	9.7	0.353	0.035	0.5	52.1	2.95E-01	1.99E-03	28.39	5.328	
4	WF-267	4.939	2	0.231	8.6	0.249	0.035	0.5	52.5	1.66E-01	5.37E-04	12.17	3.488	
5	WF-268	4.96	2.7	0.263	10.1	0.185	0.035	0.5	50.5	1.16E-01	2.50E-04	6.45	2.539	
6	WF.268-	4.965	7.3	0.695	15.3	0.069	0.035	0.5	21.6	2.63E-02	9.39E-06	0.64	0.799	
7	WF.269	4.965	19.2	1.067	16.5	0.026	0.035	0.5	18.5	8.07E-03	7.65E-07	0.08	0.283	

(4) Water Level Profile of Upper Garang River

Water level profile was estimated to setup the design high water level under the design flood of 460 m^3/s. The existing channel cross sections were used in the non-uniform flow calculation. The results are shown below.

Flow velocity of upstream channel becomes rather high of 3.0 to 4.0 m/s.

GARANG RIVER (NON-UNIFORM STEADY FLOW)

CASE NO.1

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.180	11.800	194.1	2.417	101.2	2.369	0.035	460	0	4.87E-01	2.12E-03	502.19	22.41	
2	WF-181	11.866	191.5	3.195	70.6	2.402	0.035	460	41.4	4.29E-01	1.50E-03	470.33	21.687	
3	WF-182	11.760	151.9	3.242	47.1	3.029	0.035	460	44.1	5.37E-01	2.34E-03	743.95	27.275	
4	WF-183	11.792	139.5	3.379	45.6	3.298	0.035	460	51.3	5.73E-01	2.63E-03	870.32	29.501	
5	WF.184	11.573	106.5	2.972	33.1	4.318	0.035	460	47.1	8.00E-01	5.35E-03	1557.02	39.459	*
6	WF.185	12.187	138.1	3.309	40.3	3.33	0.035	460	46.8	5.85E-01	2.76E-03	893.27	29.888	
7	WF.186	12.803	101	3.311	28.3	4.555	0.035	460	47.4	8.00E-01	5.15E-03	1671.49	40.884	***
8	WF-186+29	13.767	109.9	2.794	37.1	4.186	0.035	460	27	8.00E-01	5.45E-03	1493.31	38.643	***

CASE NO.2

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.180	10.000	69.5	2.359	27.3	6.616	0.035	460	0	1.38E+00	1.71E-02	3947	62.825	
2	WF-181	10.656	115.6	2.525	46	3.978	0.035	460	41.4	8.00E-01	5.64E-03	1395.34	37.354	***
3	WF-182	10.931	114.4	2.578	43.3	4.019	0.035	460	44.1	8.00E-01	5.60E-03	1414.41	37.609	*
4	WF-183	11.202	115.3	3.036	36.8	3.989	0.035	460	51.3	7.31E-01	4.44E-03	1319.41	36.324	
5	WF.184	11.573	106.5	2.972	33.1	4.318	0.035	460	47.1	8.00E-01	5.35E-03	1556.87	39.457	**
6	WF.185	12.187	138.1	3.309	40.3	3.33	0.035	460	46.8	5.85E-01	2.76E-03	893.24	29.887	
7	WF.186	12.803	101	3.311	28.3	4.555	0.035	460	47.4	8.00E-01	5.15E-03	1671.49	40.884	***
8	WF-186+29	13.767	109.9	2.794	37.1	4.186	0.035	460	27	8.00E-01	5.45E-03	1493.31	38.643	***

CASE NO.3

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.180	10.500	89	2.028	50.2	5.171	0.035	460	0	1.16E+00	1.28E-02	2536.22	50.361	
2	WF-181	11.997	200.6	3.276	72.7	2.294	0.035	460	41.4	4.05E-01	1.32E-03	425.19	20.62	
3	WF-182	11.892	158.1	3.348	47.8	2.91	0.035	460	44.1	5.08E-01	2.07E-03	679.55	26.068	
4	WF-183	11.918	145.2	3.438	48.3	3.168	0.035	460	51.3	5.46E-01	2.37E-03	798.2	28.252	
5	WF.184	11.667	109.8	3.028	34.1	4.191	0.035	460	47.1	7.69E-01	4.91E-03	1457.23	38.174	
6	WF.185	12.220	139.5	3.335	40.3	3.298	0.035	460	46.8	5.77E-01	2.67E-03	873.93	29.562	
7	WF.186	12.803	101	3.311	28.3	4.556	0.035	460	47.4	8.00E-01	5.15E-03	1671.9	40.889	**
8	WF-186+29	13.767	109.9	2.794	37.1	4.186	0.035	460	27	8.00E-01	5.45E-03	1493.31	38.643	***

CASE NO.4

NO	D-NAME	H	A	R	B	V	N	Q	DX	FROUD	IE	TAU-0	U-*	HANT
1	WF.180	11.000	122.3	2.03	77.5	3.76	0.035	460	0	8.43E-01	6.74E-03	1340.34	36.611	
2	WF-181	11.568	170.8	3.009	65.7	2.694	0.035	460	41.4	4.96E-01	2.05E-03	603.31	24.562	
3	WF-182	11.468	138.3	3.007	45.6	3.327	0.035	460	44.1	6.13E-01	3.12E-03	920.6	30.341	
4	WF-183	11.519	127.1	3.252	39.7	3.621	0.035	460	51.3	6.41E-01	3.33E-03	1062.13	32.59	
5	WF.184	11.574	106.6	2.972	33.2	4.317	0.035	460	47.1	8.00E-01	5.34E-03	1555.97	39.446	*
6	WF.185	12.187	138.2	3.309	40.3	3.329	0.035	460	46.8	5.85E-01	2.75E-03	893.04	29.884	
7	WF.186	12.803	101	3.311	28.3	4.555	0.035	460	47.4	8.00E-01	5.15E-03	1671.49	40.884	***
8	WF-186+29	13.767	109.9	2.794	37.1	4.186	0.035	460	27	8.00E-01	5.45E-03	1493.31	38.643	***

2.3.4 By-pass Drainage Channel at River Mouth

The bypass channel is designed as follows.

Channel section	Right bank, WF0 to North Ring Road Bridge	
Length	770 m	
Hydraulic data - Design discharge - Freeboard - Roughness coefficient	 11.0 m^3/s 0.3 m 0.030	 Flow capacity of the existing channel is considered.
Longitudinal profile - Design high water level - Riverbed elevation (lowest end) - Riverbed slope	 EL +0.50 m (level) EL –1.850 m 1 / 1,650	 H.H.W.L (Tide) +0.05 m 0.6 m higher than the riverbed elevation of Floodway.
Cross section - Width of riverbed - Side slope	 5.00 m 1 : 2	 Same as the existing channel Stable slope
Small dike	2.5 m wide about 0.5 m high	For inspection

Water level of the channel was calculated by non-uniform flow calculation method. The calculation results are shown in the following tables.

1
0 INPUT-DATA LIST

NALTER	NDHIN	NHQIN	NSQCAL	NHCAL	NJYO	NHARB	NCHECK	NFROUD	NTOKUS	NENERG	NPOUT	NBK	NBLOCK	NSCAL	LINEMA
0	0	0	0	1	0	0	0	0	0	0	4	0	0	0	90

Right Tributary

IMAX	KARA	MADE	KEY	ALPH	EPSL	FROUD	FROUD1	ETA	DH	IIDA	NSENDA	IYOKO	ISLP
9	1	8	0	1.0000	.0005	.8000	.8000	.0005	.5000	0	0	0	0	0

0 ** Existing Right Tributary DAN ******1998.6.22 MODIFY**

KIND= 4

IRTYPE 1 0 1 0 0 0 0 0 0

1

Right Tributary
CALCULATION CASE = 1

NO	Section	ｽｲｲ H(M)	ﾘｭｳｾｷ A(M2)	ｹｲｼﾝ R(M)	ｽｲﾒﾝﾊﾊﾞ B(M)	ﾘｭｳｿｸ V(M/S)	ｿﾄﾞ N	ﾘｭｳﾘｮｳ Q(M3/S)	ｸｶﾝｷｮﾘ DX(M)	ﾌﾙｰﾄﾞｽｳ FR	ｴﾈﾙｷﾞｰｺｳﾊﾞｲ IE	ｿｳﾘｭｳﾘｮｸ TAUO	ﾏｻﾂｿｸﾄﾞ U*	ﾊﾝﾃｲ
1	WF.6	.250	12.8	1.074	11.0	.390	.0330	5.0	.00	.1201E+00	.1504E-03	15.83	3.979	
2	WF.7	.257	13.6	1.135	11.0	.367	.0330	5.0	45.20	.1102E+00	.1242E-03	13.81	3.716	
3	WF.8	.264	16.1	1.282	11.4	.311	.0330	5.0	52.40	.8788E-01	.7588E-04	9.53	3.087	
4	WF.9	.267	15.2	1.267	10.8	.329	.0330	5.0	47.10	.9331E-01	.8588E-04	10.66	3.265	
5	WF.10	.271	12.0	1.085	10.0	.416	.0330	5.0	50.40	.1276E+00	.1691E-03	17.98	4.240	
6	WF.11	.280	14.7	1.263	10.4	.340	.0330	5.0	47.90	.9657E-01	.9208E-04	11.40	3.376	
7	WF.12	.286	20.1	1.131	16.8	.249	.0330	5.0	51.30	.7467E-01	.5711E-04	6.33	2.516	
8	WF.13	.289	21.3	1.355	14.6	.235	.0330	5.0	51.70	.6434E-01	.3992E-04	5.30	2.303	

Right Tributary
ｹｲｻﾝ ｹｰｽ= 2

NO	ﾀﾞﾝﾒﾝ	ｽｲｲ H(M)	ﾘｭｳｾｷ A(M2)	ｹｲｼﾝ R(M)	ｽｲﾒﾝﾊﾊﾞ B(M)	ﾘｭｳｿｸ V(M/S)	ｿﾄﾞ N	ﾘｭｳﾘｮｳ Q(M3/S)	ｸｶﾝｷｮﾘ DX(M)	ﾌﾙｰﾄﾞｽｳ FR	ｴﾈﾙｷﾞｰｺｳﾊﾞｲ IE	ｿｳﾘｭｳﾘｮｸ TAUO	ﾏｻﾂｿｸﾄﾞ U*	ﾊﾝﾃｲ
1	WF.6	.250	12.8	1.074	11.0	.780	.0330	10.0	.00	.2403E+00	.6016E-03	63.34	7.958	
2	WF.7	.279	13.8	1.148	11.1	.722	.0330	10.0	45.20	.2153E+00	.4727E-03	53.16	7.291	
3	WF.8	.306	16.5	1.307	11.4	.605	.0330	10.0	52.40	.1691E+00	.2789E-03	35.74	5.978	
4	WF.9	.318	15.7	1.298	10.9	.635	.0330	10.0	47.10	.1781E+00	.3104E-03	39.47	6.283	
5	WF.10	.329	12.6	1.122	10.1	.793	.0330	10.0	50.40	.2392E+00	.5877E-03	64.63	8.039	
6	WF.11	.362	15.6	1.316	10.5	.641	.0330	10.0	47.90	.1785E+00	.3103E-03	40.02	6.326	
7	WF.12	.385	21.8	1.194	17.2	.458	.0330	10.0	51.30	.1341E+00	.1808E-03	21.15	4.599	
8	WF.13	.394	22.8	1.426	14.9	.438	.0330	10.0	51.70	.1171E+00	.1300E-03	18.17	4.263	

Right Tributary
ｹｲｻﾝ ｹｰｽ= 3

NO	ﾀﾞﾝﾒﾝ	ｽｲｲ H(M)	ﾘｭｳｾｷ A(M2)	ｹｲｼﾝ R(M)	ｽｲﾒﾝﾊﾊﾞ B(M)	ﾘｭｳｿｸ V(M/S)	ｿﾄﾞ N	ﾘｭｳﾘｮｳ Q(M3/S)	ｸｶﾝｷｮﾘ DX(M)	ﾌﾙｰﾄﾞｽｳ FR	ｴﾈﾙｷﾞｰｺｳﾊﾞｲ IE	ｿｳﾘｭｳﾘｮｸ TAUO	ﾏｻﾂｿｸﾄﾞ U*	ﾊﾝﾃｲ
1	WF.6	.250	12.8	1.074	11.0	1.169	.0330	15.0	.00	.3604E+00	.1354E-02	142.51	11.938	
2	WF.7	.316	14.3	1.170	11.2	1.052	.0330	15.0	45.20	.3107E+00	.9776E-03	112.11	10.588	
3	WF.8	.374	17.3	1.351	11.6	.867	.0330	15.0	52.40	.2381E+00	.5474E-03	72.49	8.514	
4	WF.9	.398	16.7	1.351	11.0	.901	.0330	15.0	47.10	.2475E+00	.5914E-03	78.33	8.850	
5	WF.10	.418	13.5	1.178	10.2	1.112	.0330	15.0	50.40	.3272E+00	.1081E-02	124.89	11.175	
6	WF.11	.480	16.9	1.391	10.8	.889	.0330	15.0	47.90	.2407E+00	.5539E-03	75.52	8.690	
7	WF.12	.523	24.2	1.281	17.8	.621	.0330	15.0	51.30	.1751E+00	.3013E-03	37.84	6.152	
8	WF.13	.538	25.0	1.528	15.1	.601	.0330	15.0	51.70	.1552E+00	.2231E-03	33.41	5.780	

Right Tributary
ｹｲｻﾝ ｹｰｽ= 4

NO	ﾀﾞﾝﾒﾝ	ｽｲｲ H(M)	ﾘｭｳｾｷ A(M2)	ｹｲｼﾝ R(M)	ｽｲﾒﾝﾊﾊﾞ B(M)	ﾘｭｳｿｸ V(M/S)	ｿﾄﾞ N	ﾘｭｳﾘｮｳ Q(M3/S)	ｸｶﾝｷｮﾘ DX(M)	ﾌﾙｰﾄﾞｽｳ FR	ｴﾈﾙｷﾞｰｺｳﾊﾞｲ IE	ｿｳﾘｭｳﾘｮｸ TAUO	ﾏｻﾂｿｸﾄﾞ U*	ﾊﾝﾃｲ
1	WF.6	.250	12.8	1.074	11.0	2.339	.0330	30.0	.00	.7208E+00	.5415E-02	570.03	23.875	
2	WF.7	.543	16.8	1.322	11.6	1.783	.0330	30.0	45.20	.4952E+00	.2385E-02	309.01	17.579	
3	WF.8	.697	21.2	1.572	12.1	1.415	.0330	30.0	52.40	.3606E+00	.1194E-02	183.89	13.561	
4	WF.9	.749	20.7	1.590	11.5	1.452	.0330	30.0	47.10	.3679E+00	.1238E-02	192.86	13.887	
5	WF.10	.787	17.3	1.410	10.9	1.733	.0330	30.0	50.40	.4662E+00	.2068E-02	285.77	16.905	
6	WF.11	.916	21.6	1.670	11.6	1.390	.0330	30.0	47.90	.3437E+00	.1063E-02	173.87	13.186	
7	WF.12	1.012	33.1	1.640	19.3	.906	.0330	30.0	51.30	.2259E+00	.4618E-03	74.22	8.615	
8	WF.13	1.033	32.6	1.909	15.7	.920	.0330	30.0	51.70	.2127E+00	.3891E-03	72.78	8.531	

Right Tributary
ｹｲｻﾝ ｹｰｽ= 5

NO	ﾀﾞﾝﾒﾝ	ｽｲｲ H(M)	ﾘｭｳｾｷ A(M2)	ｹｲｼﾝ R(M)	ｽｲﾒﾝﾊﾊﾞ B(M)	ﾘｭｳｿｸ V(M/S)	ｿﾄﾞ N	ﾘｭｳﾘｮｳ Q(M3/S)	ｸｶﾝｷｮﾘ DX(M)	ﾌﾙｰﾄﾞｽｳ FR	ｴﾈﾙｷﾞｰｺｳﾊﾞｲ IE	ｿｳﾘｭｳﾘｮｸ TAUO	ﾏｻﾂｿｸﾄﾞ U*	ﾊﾝﾃｲ
1	WF.6	.250	12.8	1.074	11.0	3.898	.0330	50.0	.00	.1201E+01	.1504E-01	1583.42	39.792	
2	WF.7	1.200	24.7	1.848	12.1	2.028	.0330	50.0	45.20	.4765E+00	.1974E-02	357.58	18.910	
3	WF.8	1.343	29.1	2.088	12.6	1.715	.0330	50.0	52.40	.3792E+00	.1201E-02	245.68	15.674	
4	WF.9	1.391	28.3	2.098	12.0	1.769	.0330	50.0	47.10	.3902E+00	.1269E-02	261.00	16.156	
5	WF.10	1.428	24.9	1.800	12.1	2.007	.0330	50.0	50.40	.4779E+00	.2004E-02	353.44	18.800	
6	WF.11	1.565	29.7	2.073	12.8	1.682	.0330	50.0	47.90	.3731E+00	.1165E-02	236.71	15.385	
7	WF.12	1.691	46.2	2.289	19.3	1.082	.0330	50.0	51.30	.2284E+00	.4223E-03	94.73	9.733	
8	WF.13	1.704	43.3	2.507	15.9	1.154	.0330	50.0	51.70	.2329E+00	.4261E-03	104.68	10.231	

Right Tributary
ｹｲｻﾝ ｹｰｽ= 6

NO	ﾀﾞﾝﾒﾝ	ｽｲｲ H(M)	ﾘｭｳｾｷ A(M2)	ｹｲｼﾝ R(M)	ｽｲﾒﾝﾊﾊﾞ B(M)	ﾘｭｳｿｸ V(M/S)	ｿﾄﾞ N	ﾘｭｳﾘｮｳ Q(M3/S)	ｸｶﾝｷｮﾘ DX(M)	ﾌﾙｰﾄﾞｽｳ FR	ｴﾈﾙｷﾞｰｺｳﾊﾞｲ IE	ｿｳﾘｭｳﾘｮｸ TAUO	ﾏｻﾂｿｸﾄﾞ U*	ﾊﾝﾃｲ
1	WF.6	.250	12.8	1.074	11.0	7.796	.0330	100.0	.00	.2403E+01	.6016E-01	6333.68	79.584	
2	WF.7	4.600	65.9	4.937	12.1	1.518	.0330	100.0	45.20	.2183E+00	.2986E-03	144.48	12.020	
3	WF.8	4.629	70.4	5.044	12.6	1.420	.0330	100.0	52.40	.2020E+00	.2538E-03	125.47	11.201	

4	WF. 9	4.633	67.5	4.969	12.1	1.482	.0330	100.0	47.10	.2124E+00	.2821E-03	137.39	11.721
5	WF. 10	4.654	69.4	4.342	14.2	1.441	.0330	100.0	50.40	.2209E+00	.3193E-03	135.85	11.655
6	WF. 11	4.675	71.8	4.762	13.6	1.393	.0330	100.0	47.90	.2040E+00	.2640E-03	123.18	11.098
7	WF. 12	4.737	105.1	5.201	19.3	.952	.0330	100.0	51.30	.1333E+00	.1095E-03	55.81	7.470
8	WF. 13	4.729	91.5	5.279	15.9	1.093	.0330	100.0	51.70	.1519E+00	.1414E-03	73.18	8.554

1

******** Right Tributary ********

*** H-Q ﾋｮｳ *** PAGE 2

NO	D-NAME	H	Q	NO	D-NAME	H	Q	NO	D-NAME	H	Q
		.250	.0			.250	.0			.250	.0
+ 1	WF. 6			2	WF. 7			3	WF. 8		
		.250	5.0			.257	5.0			.264	5.0
		.250	10.0			.279	10.0			.306	10.0
		.250	15.0			.316	15.0			.374	15.0
		.250	30.0			.543	30.0			.697	30.0
		.250	50.0			1.200	50.0			1.343	50.0
		.250	100.0			4.600	100.0			4.629	100.0
		.250	.0			.250	.0			.250	.0
+ 4	WF. 9			5	WF. 10			6	WF. 11		
		.267	5.0			.271	5.0			.280	5.0
		.318	10.0			.329	10.0			.362	10.0
		.398	15.0			.418	15.0			.480	15.0
		.749	30.0			.787	30.0			.916	30.0
		1.391	50.0			1.428	50.0			1.565	50.0
		4.633	100.0			4.654	100.0			4.675	100.0
		.250	.0			.250	.0				
+ 7	WF. 12			8	WF. 13						
		.286	5.0			.289	5.0				
		.385	10.0			.394	10.0				
		.523	15.0			.538	15.0				
		1.012	30.0			1.033	30.0				
		1.691	50.0			1.704	50.0				
		4.737	100.0			4.729	100.0				

1

******** Right Tributary ********

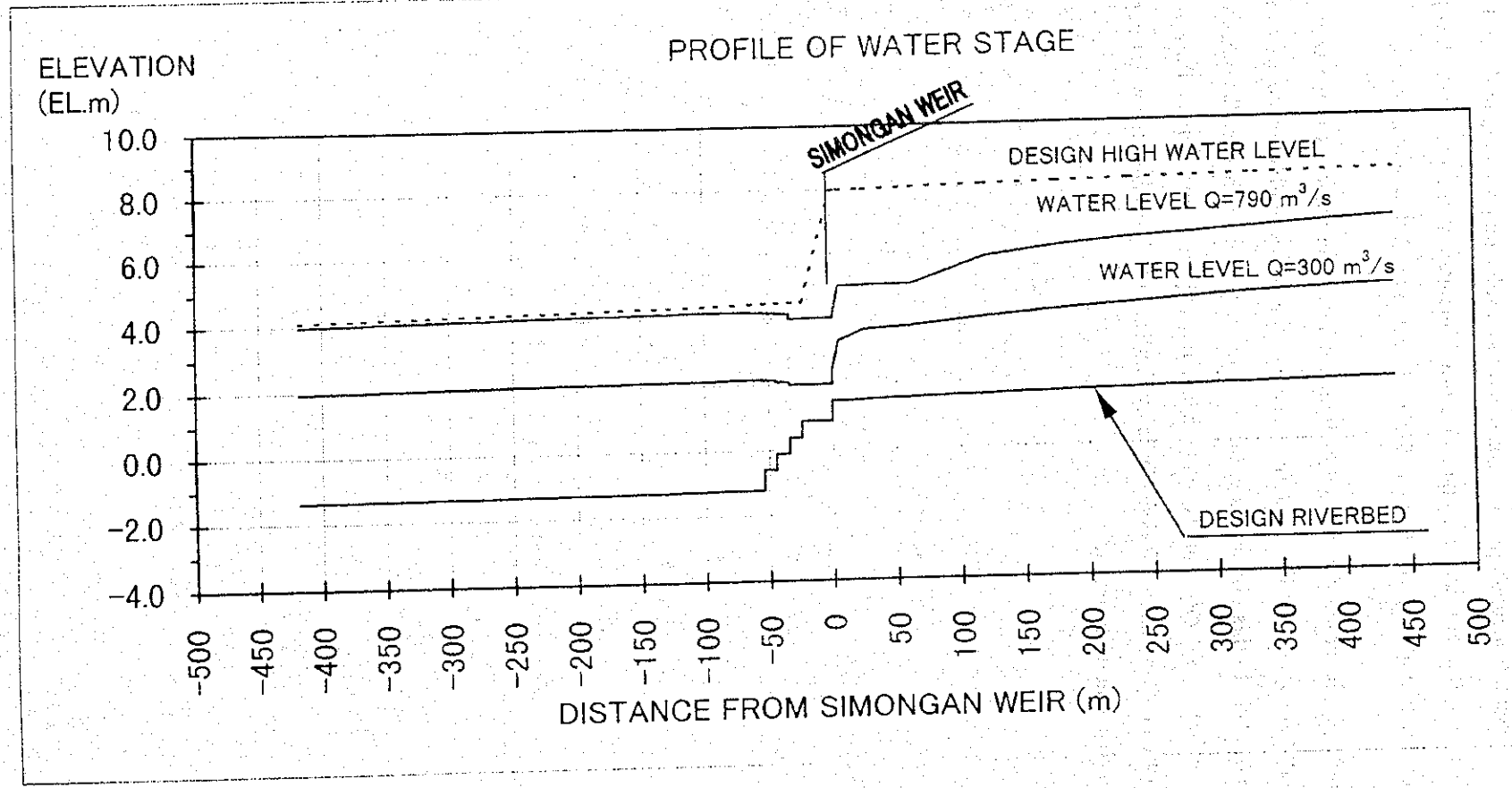
*** ﾘｭｳｶ ﾉｳﾘｮｸ ﾋｮｳ *** Existing Ground PAGE 3

NO	D-NAME	H	Q	NO	D-NAME	H	Q	NO	D-NAME	H	Q
1	WF. 6	.450	********								
2	WF. 7	.440	22.5								
3	WF. 8	.340	12.4								
4	WF. 9	.320	10.1								
5	WF. 10	.620	22.6								
6	WF. 11	.400	11.5								
7	WF. 12	.910	26.4								
8	WF. 13	.480	12.9								

2.4 Hydraulics on Simongan Weir

To know the water level profile of immediate downstream and upstream channels, detail hydraulic calculations were done, and the results are presented in the following figures. For the downstream channel from Simongan Weir, the water levels are caluclated by non-uniform flow method as shown in the following table.

Accordingly, it turned out that the hydraulic control section arises at the weir when the gates are open. The flow pattern is a super critical flow with the velocity of about 4.2 m/s. Due to this critical flow, the velocity of upstream channel becomes rather high of 3.0 to 4.0 m/s. On the other hand, the impact of the critical flow on the downstream river channel is considered hydraulically less, because the water depth is bigger than that of upstream.


PROFILE OF WATER STAGE
ELEVATION
(EL.m)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
SIMONGAN WEIR
DESIGN HIGH WATER LEVEL
WATER LEVEL Q=790 m3/s
WATER LEVEL Q=300 m3/s
DESIGN RIVERBED
-500
-450
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300
350
400
450
500
DISTANCE FROM SIMONGAN WEIR (m)

WESTFLOODWAY, STEADY NON-UNIFORM FLOW (LEVEL, 2.5,1/2650) b = 50 WF.75-UP

Downstream

BASIC DATA

KUKAN-SU =19 ALPHA = 1.00 QO = 300.00 M3/S HO = .250 M ZO = -2.500 M

	KUKAN DATA DANMEN NO.	BUNKATSU SUU	DANMEN KEIJYO	LOSS TYPE	SODO KEISU	KUKAN KYORI(M)	KASYO KOOBAI(1/I)	RAKUSA (M)	RYUNYU RYO(M3/S)
1	WF-9 -WF0	9	2 1	0	0.0324	413.7	999999	0	0
2	WF0 - WF5	5	2 1	0	0.031	258.96	999999	0	0
3	WF5 - WF14	9	2 1	0	0.0307	442.71	999999	0	0
4	WF14 -WF21	7	2 1	0	0.0306	371.14	999999	0	0
5	WF21 -WF30	9	2 1	0	0.0306	454.32	999999	0	0
6	WF30 -WF39	9	2 1	0	0.0304	456.73	2650	0	0
7	WF39 -WF42	3	2 1	0	0.0303	150	2650	0	0
8	WF42 -WF47	5	2 1	0	0.03	249.23	2650	0	0
9	WF47 -WF59	12	2 1	0	0.03	600.23	2650	0	0
10	WF59 -WF63	4	2 1	0	0.03	200.01	2650	0	0
11	WF63 -WF69	6	2 1	0	0.03	300.9	2650	0	0
12	WF69 -WF75	6	2 1	0	0.03	305.77	2650	0	0
13	WF75 -WF95	20	2 1	0	0.03	1006.84	2650	0	0
14	WF95 -WF98	4	2 1	0	0.03	149.6	2650	0	0
15	WF98-1	1	1 0	0	0.03	10	99999	0.6	0
16	WF98-2	1	1 0	0	0.03	10	99999	0.5	0
17	WF98-3	1	1 0	0	0.03	10	99999	0.5	0
18	WF99-1	1	1 0	0	0.03	27	99999	0.5	0
19	WF99-2	1	1 0	0	0.03	17	99999	0.5	0
20	WF100-101	1	1 1	0	0.03	5	1250	0	0
21	101 - 105	4	2 1	0	0.0305	236.01	1250	0	0
22	105 - 106	1	2 1	0	0.03	47.42	1250	0	0
23	106 - 110	4	2 1	0	0.03	198.68	1250	0	0
24	110 - 111	1	2 1	0	0.0302	48.32	1250	0	0
25	111 - 115	4	2 1	0	0.0333	137.84	1250	0	0
26	115 - 120	5	2 1	0	0.0333	195.72	1250	0	0
27	120 - 124	4	2 1	0	0.033	139.36	1250	0	0
28	124 - 127	3	2 1	0	0.0323	134.34	1250	1.5	0
29	127 - 133	6	2 1	0	0.0323	220.57	1250	0	0
30	133 - 135	2	2 1	0	0.0328	113.71	1250	0	0
31	135 - 142	7	2 1	0	0.0321	489.52	1250	0	0
32	142 - 148	6	2 1	0	0.0325	305.12	1250	0	0
33	148 - 152	4	2 1	0	0.0317	159.45	1250	0	0
34	152 - 155	3	2 1	0	0.0316	138.49	1250	0	0
35	155 - 165	10	2 1	0	0.0323	487.29	1250	0	0
36	165 - 170	5	2 1	0	0.0323	222.06	1250	0	0
37	170 - 174	4	2 1	0	0.0323	220.12	1250	0	0
38	174 - 176	2	2 1	0	0.0322	93.01	1250	0	0
39	176 - 179	3	2 1	0	0.0322	162.35	500	0	0

NO.	H	A	R	V	N	Q	DX	FROUD	IE	Z	H-Z
WF-9 -WF0	.250	427.63	2.635	0.702	0.0324	300	0	0.1375	1.42E-04	-2.5	2.75
+ 45.97	.257	428.68	2.641	0.7	0.0324	300	45.97	0.137	1.41E-04	-2.5	2.757
+ 91.93	.263	429.74	2.647	0.698	0.0324	300	45.97	0.1365	1.40E-04	-2.5	2.763
+ 137.90	.270	430.78	2.653	0.696	0.0324	300	45.97	0.136	1.39E-04	-2.5	2.77
+ 183.87	.276	431.81	2.659	0.695	0.0324	300	45.97	0.1356	1.38E-04	-2.5	2.776
+ 229.83	.283	432.84	2.665	0.693	0.0324	300	45.97	0.1351	1.37E-04	-2.5	2.782
+ 275.80	.289	433.86	2.67	0.691	0.0324	300	45.97	0.1346	1.36E-04	-2.5	2.789
+ 321.77	.295	434.87	2.676	0.69	0.0324	300	45.97	0.1342	1.35E-04	-2.5	2.795
+ 367.73	.302	435.87	2.682	0.688	0.0324	300	45.97	0.1337	1.34E-04	-2.5	2.801
+ 413.70	.308	436.87	2.688	0.687	0.0324	300	45.97	0.1333	1.33E-04	-2.5	2.807
WF0 - WF5	.308	436.87	2.688	0.687	0.031	300	0	0.1333	1.21E-04	-2.5	2.807
+ 51.79	.314	437.89	2.693	0.685	0.031	300	51.79	0.1328	1.20E-04	-2.5	2.814
+ 103.58	.320	438.9	2.699	0.684	0.031	300	51.79	0.1324	1.20E-04	-2.499	2.82
+ 155.38	.327	439.9	2.705	0.682	0.031	300	51.79	0.1319	1.19E-04	-2.499	2.826
+ 207.17	.333	440.9	2.71	0.68	0.031	300	51.79	0.1315	1.18E-04	-2.499	2.832
+ 258.96	.339	441.89	2.716	0.679	0.031	300	51.79	0.131	1.17E-04	-2.499	2.838
WF5 - WF14	.323	340.51	2.668	0.881	0.0307	300	0	0.1714	1.98E-04	-2.499	2.822
+ 49.19	.333	341.76	2.677	0.878	0.0307	300	49.19	0.1705	1.95E-04	-2.499	2.832
+ 98.38	.343	343	2.686	0.875	0.0307	300	49.19	0.1696	1.93E-04	-2.499	2.842
+ 147.57	.353	344.22	2.694	0.872	0.0307	300	49.19	0.1687	1.91E-04	-2.499	2.852
+ 196.76	.362	345.43	2.703	0.868	0.0307	300	49.19	0.1679	1.89E-04	-2.499	2.861
+ 245.95	.372	346.62	2.711	0.865	0.0307	300	49.19	0.167	1.87E-04	-2.499	2.871
+ 295.14	.381	347.8	2.72	0.863	0.0307	300	49.19	0.1662	1.85E-04	-2.499	2.88
+ 344.33	.390	348.97	2.728	0.86	0.0307	300	49.19	0.1654	1.83E-04	-2.499	2.889
+ 393.52	.400	350.13	2.736	0.857	0.0307	300	49.19	0.1646	1.81E-04	-2.499	2.898
+ 442.71	.409	351.28	2.744	0.854	0.0307	300	49.19	0.1638	1.79E-04	-2.499	2.908
WF14 -WF21	.409	351.28	2.744	0.854	0.0306	300	0	0.1638	1.78E-04	-2.499	2.908
+ 53.02	.418	352.49	2.753	0.851	0.0306	300	53.02	0.163	1.76E-04	-2.499	2.917
+ 106.04	.428	353.69	2.761	0.848	0.0306	300	53.02	0.1622	1.74E-04	-2.499	2.927
+ 159.06	.437	354.87	2.77	0.845	0.0306	300	53.02	0.1614	1.72E-04	-2.499	2.936
+ 212.08	.447	356.05	2.778	0.843	0.0306	300	53.02	0.1606	1.70E-04	-2.499	2.945
+ 265.10	.456	357.21	2.786	0.84	0.0306	300	53.02	0.1599	1.69E-04	-2.499	2.954
+ 318.12	.465	358.36	2.794	0.837	0.0306	300	53.02	0.1591	1.67E-04	-2.499	2.963
+ 371.14	.474	359.5	2.802	0.835	0.0306	300	53.02	0.1584	1.65E-04	-2.499	2.972
WF21 -WF30	.474	359.5	2.802	0.834	0.0306	300	0	0.1584	1.65E-04	-2.499	2.972
+ 50.48	.482	360.57	2.81	0.832	0.0306	300	50.48	0.1577	1.64E-04	-2.498	2.981
+ 100.96	.491	361.63	2.817	0.83	0.0306	300	50.48	0.157	1.62E-04	-2.498	2.989
+ 151.44	.499	362.69	2.825	0.827	0.0306	300	50.48	0.1563	1.61E-04	-2.498	2.998
+ 201.92	.507	363.89	2.827	0.824	0.0306	300	50.48	0.1708	1.59E-04	-2.498	3.006
+ 252.40	.516	365.15	2.827	0.822	0.0306	300	50.48	0.1704	1.58E-04	-2.498	3.014
+ 302.88	.524	366.42	2.827	0.819	0.0306	300	50.48	0.17	1.57E-04	-2.498	3.022
+ 353.36	.532	367.7	2.827	0.816	0.0306	300	50.48	0.1695	1.56E-04	-2.498	3.03
+ 403.84	.540	368.98	2.827	0.813	0.0306	300	50.48	0.1691	1.55E-04	-2.498	3.038
+ 454.32	.548	370.26	2.827	0.81	0.0306	300	50.48	0.1686	1.54E-04	-2.498	3.046

WF30 -WF39	.548	370.26	2.827	0.81	0.0304	300	0	0.1686	1.52E-04	-2.498	3.046
+ 50.75	.556	368.51	2.827	0.814	0.0304	300	50.75	0.1713	1.53E-04	-2.479	3.034
+ 101.50	.563	366.71	2.827	0.818	0.0304	300	50.75	0.174	1.55E-04	-2.46	3.023
+ 152.24	.571	364.86	2.827	0.822	0.0304	300	50.75	0.1768	1.56E-04	-2.441	3.011
+ 202.99	.578	362.96	2.826	0.827	0.0304	300	50.75	0.1562	1.58E-04	-2.421	3
+ 253.74	.586	361.51	2.816	0.83	0.0304	300	50.75	0.1571	1.60E-04	-2.402	2.988
+ 304.49	.594	360.08	2.806	0.833	0.0304	300	50.75	0.158	1.62E-04	-2.383	2.977
+ 355.23	.602	358.67	2.796	0.836	0.0304	300	50.75	0.1589	1.64E-04	-2.364	2.966
+ 405.98	.610	357.26	2.786	0.84	0.0304	300	50.75	0.1598	1.66E-04	-2.345	2.955
+ 456.73	.618	355.88	2.777	0.843	0.0304	300	50.75	0.1607	1.68E-04	-2.326	2.944
WF39 -WF42	.619	358.9	2.779	0.836	0.0303	300	0	0.1593	1.64E-04	-2.326	2.945
+ 50.00	.627	357.51	2.769	0.839	0.0303	300	50	0.1602	1.66E-04	-2.307	2.934
+ 100.00	.635	356.13	2.759	0.842	0.0303	300	50	0.1611	1.68E-04	-2.288	2.923
+ 150.00	.643	354.77	2.75	0.846	0.0303	300	50	0.162	1.70E-04	-2.269	2.912
WF42 -WF47	.642	351.78	2.748	0.853	0.03	300	0	0.1635	1.70E-04	-2.269	2.912
+ 49.85	.643	316.52	2.716	0.948	0.03	300	49.85	0.1826	2.13E-04	-2.25	2.894
+ 99.69	.643	281.58	2.68	1.065	0.03	300	49.85	0.2065	2.74E-04	-2.231	2.875
+ 149.54	.642	246.94	2.639	1.215	0.03	300	49.85	0.2372	3.64E-04	-2.213	2.855
+ 199.38	.637	212.49	2.589	1.412	0.03	300	49.85	0.278	5.05E-04	-2.194	2.831
+ 249.23	.625	178.08	2.525	1.685	0.03	300	49.85	0.3355	7.43E-04	-2.175	2.8
WF47 -WF59	.625	178.1	2.525	1.684	0.03	300	0	0.3354	7.43E-04	-2.175	2.8
+ 50.02	.664	179.47	2.542	1.672	0.03	300	50.02	0.3317	7.25E-04	-2.156	2.82
+ 100.04	.702	180.79	2.557	1.659	0.03	300	50.02	0.3283	7.09E-04	-2.137	2.839
+ 150.06	.739	182.04	2.572	1.648	0.03	300	50.02	0.3251	6.94E-04	-2.118	2.857
+ 200.08	.775	183.24	2.586	1.637	0.03	300	50.02	0.3221	6.80E-04	-2.1	2.875
+ 250.10	.810	184.39	2.6	1.627	0.03	300	50.02	0.3192	6.67E-04	-2.081	2.891
+ 300.11	.845	185.48	2.612	1.617	0.03	300	50.02	0.3165	6.54E-04	-2.062	2.907
+ 350.13	.879	186.53	2.625	1.608	0.03	300	50.02	0.314	6.43E-04	-2.043	2.922
+ 400.15	.912	187.54	2.637	1.6	0.03	300	50.02	0.3116	6.32E-04	-2.024	2.936
+ 450.17	.945	188.51	2.648	1.591	0.03	300	50.02	0.3094	6.22E-04	-2.005	2.95
+ 500.19	.977	189.43	2.659	1.584	0.03	300	50.02	0.3072	6.13E-04	-1.986	2.964
+ 550.21	1.009	190.33	2.669	1.576	0.03	300	50.02	0.3051	6.04E-04	-1.967	2.976
+ 600.23	1.040	191.21	2.679	1.569	0.03	300	50.02	0.3032	5.95E-04	-1.949	2.989
WF59 -WF63	1.040	191.22	2.679	1.569	0.03	300	0	0.3031	5.95E-04	-1.949	2.989
+ 50.00	1.071	192.06	2.688	1.562	0.03	300	50	0.3256	5.87E-04	-1.93	3
+ 100.00	1.101	192.98	2.688	1.555	0.03	300	50	0.3208	5.82E-04	-1.911	3.012
+ 150.01	1.131	193.86	2.688	1.548	0.03	300	50	0.3163	5.77E-04	-1.892	3.023
+ 200.01	1.161	194.67	2.688	1.541	0.03	300	50	0.3119	5.72E-04	-1.873	3.034
WF63 -WF69	1.161	194.68	2.688	1.541	0.03	300	0	0.3119	5.72E-04	-1.873	3.034
+ 50.15	1.190	195.12	2.722	1.537	0.03	300	50.15	0.3109	5.60E-04	-1.854	3.044
+ 100.30	1.219	195.77	2.732	1.532	0.03	300	50.15	0.2932	5.53E-04	-1.835	3.054
+ 150.45	1.247	196.44	2.74	1.527	0.03	300	50.15	0.2917	5.48E-04	-1.816	3.063
+ 200.60	1.275	197.08	2.747	1.522	0.03	300	50.15	0.2904	5.42E-04	-1.797	3.072
+ 250.75	1.303	197.71	2.754	1.517	0.03	300	50.15	0.2891	5.37E-04	-1.778	3.081
+ 300.90	1.330	198.31	2.761	1.513	0.03	300	50.15	0.2878	5.32E-04	-1.76	3.09
WF69 -WF75	1.330	198.32	2.761	1.513	0.03	300	0	0.2878	5.32E-04	-1.76	3.09
+ 50.96	1.353	194.45	2.758	1.543	0.03	300	50.96	0.2937	5.54E-04	-1.74	3.094
+ 101.92	1.377	190.65	2.755	1.574	0.03	300	50.96	0.2996	5.77E-04	-1.721	3.098
+ 152.88	1.402	186.89	2.753	1.605	0.03	300	50.96	0.3057	6.01E-04	-1.702	3.104
+ 203.85	1.428	183.19	2.752	1.638	0.03	300	50.96	0.3119	6.26E-04	-1.683	3.111
+ 254.81	1.455	179.54	2.75	1.671	0.03	300	50.96	0.3182	6.52E-04	-1.663	3.118
+ 305.77	1.483	175.93	2.75	1.705	0.03	300	50.96	0.3247	6.79E-04	-1.644	3.127
WF75 -WF95	1.483	175.94	2.75	1.705	0.03	300	0	0.3247	6.79E-04	-1.644	3.127
+ 50.34	1.519	176.97	2.763	1.695	0.03	300	50.34	0.322	6.67E-04	-1.625	3.144
+ 100.68	1.554	177.97	2.775	1.686	0.03	300	50.34	0.3195	6.56E-04	-1.606	3.16
+ 151.03	1.588	178.93	2.787	1.677	0.03	300	50.34	0.3171	6.45E-04	-1.587	3.175
+ 201.37	1.622	179.85	2.798	1.668	0.03	300	50.34	0.3148	6.35E-04	-1.568	3.19
+ 251.71	1.655	180.73	2.81	1.66	0.03	300	50.34	0.3126	6.26E-04	-1.549	3.204
+ 302.05	1.687	181.59	2.82	1.652	0.03	300	50.34	0.3105	6.17E-04	-1.53	3.217
+ 352.39	1.719	182.41	2.83	1.645	0.03	300	50.34	0.3086	6.08E-04	-1.511	3.23
+ 402.74	1.751	183.2	2.84	1.638	0.03	300	50.34	0.3067	6.00E-04	-1.492	3.243
+ 453.08	1.782	183.96	2.85	1.631	0.03	300	50.34	0.3049	5.93E-04	-1.473	3.255
+ 503.42	1.813	184.7	2.859	1.624	0.03	300	50.34	0.3032	5.85E-04	-1.454	3.267
+ 553.76	1.843	185.41	2.867	1.618	0.03	300	50.34	0.3015	5.78E-04	-1.435	3.278
+ 604.10	1.873	186.1	2.876	1.612	0.03	300	50.34	0.3	5.72E-04	-1.416	3.289
+ 654.45	1.903	186.77	2.884	1.606	0.03	300	50.34	0.2985	5.66E-04	-1.397	3.3
+ 704.79	1.932	187.42	2.892	1.601	0.03	300	50.34	0.297	5.60E-04	-1.378	3.31
+ 755.13	1.961	188.04	2.9	1.595	0.03	300	50.34	0.2956	5.54E-04	-1.359	3.32
+ 805.47	1.989	188.65	2.907	1.59	0.03	300	50.34	0.2943	5.49E-04	-1.34	3.33
+ 855.81	2.018	189.24	2.914	1.585	0.03	300	50.34	0.293	5.43E-04	-1.321	3.339
+ 906.16	2.046	189.81	2.921	1.581	0.03	300	50.34	0.2918	5.38E-04	-1.302	3.348
+ 956.50	2.073	190.36	2.928	1.576	0.03	300	50.34	0.2906	5.34E-04	-1.283	3.357
+ 1,006.84	2.101	190.9	2.935	1.572	0.03	300	50.34	0.2894	5.29E-04	-1.264	3.365
WF95 -WF98	2.101	190.9	2.935	1.571	0.03	300	0	0.2894	5.29E-04	-1.264	3.365
+ 37.40	2.121	191.28	2.939	1.568	0.03	300	37.4	0.2886	5.26E-04	-1.25	3.371
+ 74.80	2.141	191.66	2.944	1.565	0.03	300	37.4	0.2878	5.23E-04	-1.236	3.377
+ 112.20	2.161	192.04	2.949	1.562	0.03	300	37.4	0.287	5.20E-04	-1.222	3.383
+ 149.60	2.181	192.4	2.953	1.559	0.03	300	37.4	0.2863	5.17E-04	-1.208	3.389
WF98-1	2.139	166.14	2.469	1.806	0.03	300	0	0.3635	8.79E-04	-0.608	2.746
+ 10.00	2.149	166.83	2.478	1.798	0.03	300	10	0.3614	8.68E-04	-0.608	2.756
WF98-2	2.083	141.04	2.021	2.127	0.03	300	0	0.4744	1.59E-03	-0.108	2.191
+ 10.00	2.103	142.41	2.038	2.107	0.03	300	10	0.4679	1.55E-03	-0.108	2.211
	WF98-3 ** SYUSO KU SEZU **										

Upstream

*** GARANG RIVER , FLOOD STAGE , (EL=1.50 m) , Rb1=35m, Rb2=35, Rb3=40m

** INPUT DATA **

* BAISIC DATA *

KUKAN-SU = 21 ALPHA = 1.00 QO = 790.00 M3/S HO = 5.300 M ZO = 1.500 M

JCO = 0 KEY = 0 IPT = 0

* KUKAN DATA *

	DANMEN NO.	BUNKATSU SUU	DANMEN KEIJYO		LOSS TYPE	SODO KEISU	KUKAN KYORI (M)	KASYO KOOBAI (1/1)	RAKUSA (M)	RYUNYU RYO (M3/S)
1	99+20~100	9	1	1	0	.0300	30.00	999999.00	.000	.00
2	100 - 101	9	2	1	0	.0300	49.82	1250.00	.000	.00
3	101 - 105	8	2	1	0	.0330	214.02	1250.00	.000	.00
4	105 - 106	1	2	1	0	.0330	47.42	1250.00	.000	.00
5	106 - 110	4	2	1	0	.0330	198.68	1250.00	.000	.00
6	110 - 111	1	2	1	0	.0330	48.32	1250.00	.000	.00
7	111 - 115	4	2	1	0	.0333	137.84	1250.00	.000	.00
8	115 - 120	5	2	1	0	.0333	195.72	1250.00	.000	.00
9	120 - 124	4	2	1	0	.0330	139.36	1250.00	.000	.00
10	124 - 127	3	2	1	0	.0323	134.34	1250.00	1.500	.00
11	127 - 133	6	2	1	0	.0323	220.57	1250.00	.000	.00
12	133 - 135	2	2	1	0	.0328	113.71	1250.00	.000	.00
13	135 - 142	7	2	1	0	.0321	489.52	1250.00	.000	.00
14	142 - 148	6	2	1	0	.0325	305.12	1250.00	.000	.00
15	148 - 152	4	2	1	0	.0317	159.45	1250.00	.000	.00
16	152 - 155	3	2	1	0	.0316	138.49	1250.00	.000	.00
17	155 - 165	10	2	1	0	.0323	487.29	1250.00	.000	.00
18	165 - 170	5	2	1	0	.0323	222.06	1250.00	.000	.00
19	170 - 174	4	2	1	0	.0323	220.12	1250.00	.000	.00
20	174 - 176	2	2	1	0	.0322	93.01	1250.00	.000	.00
21	176 - 179	3	2	1	0	.0322	162.35	500.00	.000	.00

* KEIJYO DATA *

KUKAN	KEIJYO		BO(R)	M1	N1	B1	B2	HP(B3)	M2	N2
1	1	1	50.000	.000	.000	.000	.000	.000	.000	.000
			45.000	.000	.000	.000	.000	.000	.000	.000
2	2	1	45.000	.100	.100	.500	.500	5.000	2.000	2.000
			38.000	1.500	1.500	4.000	7.000	5.000	2.000	2.000
3	2	1	38.000	2.000	2.000	4.000	7.000	5.000	2.000	2.000
			35.000	2.000	2.000	4.000	4.000	5.000	2.000	2.000
4	2	1	35.000	2.000	1.500	4.000	4.000	5.000	2.000	.500
			35.000	2.000	1.500	4.000	5.000	5.000	2.000	.500
5	2	1	35.000	2.000	1.500	4.000	5.000	5.000	.500	2.000
			35.000	2.000	1.500	4.000	4.000	5.000	2.000	.500
6	2	1	35.000	2.000	1.500	4.000	4.000	5.000	.500	2.000
			35.000	2.000	2.000	4.000	10.000	5.000	2.000	2.000
7	2	1	35.000	2.000	2.000	4.000	10.000	5.000	2.000	2.000
			35.000	2.000	2.000	105.000	5.000	5.000	.001	2.000
8	2	1	40.000	2.000	2.000	105.000	5.000	5.000	.001	2.000
			40.000	2.000	2.000	90.000	6.000	5.000	.001	2.000
9	2	1	35.000	2.000	2.000	90.000	6.000	5.000	.001	2.000
			40.000	2.000	2.000	15.000	35.000	5.000	2.000	2.000
10	2	1	40.000	2.000	2.000	15.000	35.000	4.000	2.000	2.000
			40.000	2.000	2.000	5.000	45.000	4.000	1.500	2.000
11	2	1	40.000	2.000	2.000	5.000	45.000	4.000	1.500	2.000
			40.000	2.000	2.000	30.000	45.000	4.500	2.000	.001
12	2	1	40.000	2.000	2.000	30.000	45.000	4.500	2.000	.001
			40.000	2.000	2.000	25.000	15.000	4.000	2.000	2.000
13	2	1	40.000	2.000	2.000	25.000	15.000	4.000	2.000	2.000
			40.000	2.000	2.000	5.000	40.000	4.500	2.000	1.000
14	2	1	40.000	2.000	2.000	5.000	40.000	4.500	2.000	1.000
			40.000	2.000	2.000	4.000	10.000	4.500	2.000	1.000
15	2	1	40.000	2.000	2.000	4.000	10.000	4.500	2.000	1.000
			40.000	2.000	2.000	4.000	4.000	3.500	2.000	1.000
16	2	1	40.000	2.000	2.000	4.000	4.000	3.500	2.000	1.000
			40.000	2.000	2.000	30.000	8.000	4.000	2.000	1.000
17	2	1	40.000	2.000	2.000	30.000	8.000	4.000	2.000	1.000
			40.000	2.000	2.000	5.000	20.000	4.500	2.000	1.000
18	2	1	40.000	2.000	2.000	5.000	20.000	4.500	2.000	1.000
			40.000	2.000	2.000	15.000	15.000	4.500	2.000	1.000
19	2	1	40.000	2.000	2.000	15.000	15.000	4.500	2.000	1.000
			40.000	2.000	2.000	5.000	10.000	4.500	1.000	2.000
20	2	1	40.000	2.000	2.000	5.000	10.000	4.500	1.000	2.000
			40.000	2.000	2.000	5.000	10.000	4.000	1.000	2.000
21	2	1	40.000	2.000	2.000	5.000	10.000	4.000	1.000	2.000
			30.000	2.000	2.000	5.000	10.000	4.000	1.000	1.000

* LOSS DATA *

KUKAN	LOSS TYPE	FL1	FL2

NO.	H	A	R	V	N	Q	DX	FROUD	IE	Z	H-Z
99+20-100	5.300	190.00	3.299	4.158	.0300	790.00	.00	.6813	.3169E-02	1.500	3.800
+ 3.33	5.283	187.06	3.281	4.223	.0300	790.00	3.33	.6936	.3292E-02	1.500	3.783
+ 6.67	5.263	183.99	3.261	4.294	.0300	790.00	3.33	.7070	.3431E-02	1.500	3.763
+ 10.00	5.243	180.89	3.241	4.367	.0300	790.00	3.33	.7211	.3579E-02	1.500	3.743
+ 13.33	5.220	177.72	3.219	4.445	.0300	790.00	3.33	.7362	.3742E-02	1.500	3.720
+ 16.67	5.195	174.47	3.195	4.528	.0300	790.00	3.33	.7525	.3922E-02	1.500	3.695
+ 20.00	5.166	171.10	3.169	4.617	.0300	790.00	3.33	.7703	.4123E-02	1.500	3.666
+ 23.33	5.135	167.59	3.140	4.714	.0300	790.00	3.33	.7898	.4350E-02	1.500	3.635
+ 26.67	5.098	163.90	3.107	4.820	.0300	790.00	3.33	.8117	.4611E-02	1.500	3.598
+ 30.00	5.055	159.96	3.070	4.939	.0300	790.00	3.33	.8368	.4921E-02	1.500	3.555
100 - 101	5.115	163.96	3.137	4.818	.0300	790.00	.00	.8127	.4549E-02	1.500	3.615
+ 5.54	5.147	164.45	3.178	4.804	.0300	790.00	5.54	.8123	.4444E-02	1.504	3.642
+ 11.07	5.178	164.92	3.210	4.790	.0300	790.00	5.54	.8122	.4362E-02	1.509	3.669
+ 16.61	5.208	165.38	3.233	4.777	.0300	790.00	5.54	.8122	.4297E-02	1.513	3.695
+ 22.14	5.238	165.84	3.248	4.764	.0300	790.00	5.54	.8123	.4246E-02	1.518	3.720
+ 27.68	5.268	166.33	3.256	4.750	.0300	790.00	5.54	.8124	.4207E-02	1.522	3.746
+ 33.21	5.299	166.84	3.260	4.735	.0300	790.00	5.54	.8124	.4175E-02	1.527	3.772
+ 38.75	5.329	167.38	3.259	4.720	.0300	790.00	5.54	.8123	.4149E-02	1.531	3.798
+ 44.28	5.360	167.96	3.255	4.703	.0300	790.00	5.54	.8120	.4127E-02	1.535	3.824
+ 49.82	5.391	168.58	3.249	4.686	.0300	790.00	5.54	.8116	.4107E-02	1.540	3.851
101 - 105	5.607	187.62	3.339	4.211	.0330	790.00	.00	.7234	.3869E-02	1.540	4.067
+ 26.75	5.755	192.99	3.423	4.093	.0330	790.00	26.75	.6943	.3537E-02	1.561	4.194
+ 53.51	5.883	197.16	3.491	4.007	.0330	790.00	26.75	.6727	.3302E-02	1.583	4.300
+ 80.26	5.996	200.53	3.548	3.940	.0330	790.00	26.75	.6557	.3123E-02	1.604	4.392
+ 107.01	6.099	203.32	3.598	3.885	.0330	790.00	26.75	.6420	.2982E-02	1.625	4.474
+ 133.76	6.195	205.67	3.642	3.841	.0330	790.00	26.75	.6306	.2867E-02	1.647	4.548
+ 160.51	6.285	207.66	3.682	3.804	.0330	790.00	26.75	.6209	.2772E-02	1.668	4.616
+ 187.27	6.370	209.36	3.718	3.773	.0330	790.00	26.75	.6127	.2692E-02	1.690	4.680
+ 214.02	6.451	210.82	3.751	3.747	.0330	790.00	26.75	.6056	.2623E-02	1.711	4.740
105 - 106	6.386	201.87	3.747	3.913	.0330	790.00	.00	.6306	.2866E-02	1.711	4.675
+ 47.42	6.570	209.41	3.844	3.773	.0330	790.00	47.42	.5998	.2573E-02	1.749	4.821
106 - 110	6.570	209.41	3.844	3.772	.0330	790.00	.00	.5998	.2573E-02	1.749	4.821
+ 49.67	6.736	215.97	3.928	3.658	.0330	790.00	49.67	.5751	.2351E-02	1.789	4.947
+ 99.34	6.887	222.34	3.963	3.553	.0330	790.00	49.67	.5952	.2192E-02	1.829	5.059
+ 149.01	7.027	228.44	3.963	3.458	.0330	790.00	49.67	.5715	.2077E-02	1.868	5.159
+ 198.68	7.156	233.81	3.963	3.379	.0330	790.00	49.67	.5518	.1982E-02	1.908	5.248
110 - 111	7.156	233.82	3.963	3.379	.0330	790.00	.00	.5518	.1982E-02	1.908	5.248
+ 48.32	7.324	251.32	3.923	3.143	.0330	790.00	48.32	.5319	.1739E-02	1.947	5.377
111 - 115	7.324	251.32	3.923	3.143	.0333	790.00	.00	.5319	.1771E-02	1.947	5.377
+ 34.46	7.446	269.27	3.923	2.934	.0333	790.00	34.46	.5556	.1543E-02	1.974	5.472
+ 68.92	7.557	290.45	3.923	2.720	.0333	790.00	34.46	.5553	.1326E-02	2.002	5.555
+ 103.38	7.653	313.43	3.923	2.521	.0333	790.00	34.46	.5430	.1139E-02	2.029	5.624
+ 137.84	7.733	337.10	3.923	2.344	.0333	790.00	34.46	.5259	.9845E-03	2.057	5.676
115 - 120	7.787	374.61	4.009	2.109	.0333	790.00	.00	.4558	.7744E-03	2.057	5.730
+ 39.14	7.814	371.86	4.009	2.124	.0333	790.00	39.14	.4570	.7858E-03	2.088	5.726
+ 78.29	7.842	369.23	4.009	2.140	.0333	790.00	39.14	.4581	.7971E-03	2.120	5.722
+ 117.43	7.870	366.70	4.009	2.154	.0333	790.00	39.14	.4589	.8081E-03	2.151	5.719
+ 156.58	7.898	364.26	4.009	2.169	.0333	790.00	39.14	.4595	.8190E-03	2.182	5.716
+ 195.72	7.928	361.91	4.009	2.183	.0333	790.00	39.14	.4599	.8297E-03	2.213	5.714
120 - 124	7.868	324.28	3.923	2.436	.0330	790.00	.00	.5333	.1045E-02	2.213	5.654
+ 34.84	7.906	325.37	3.946	2.428	.0330	790.00	34.84	.5131	.1030E-02	2.241	5.665
+ 69.68	7.943	326.13	3.968	2.422	.0330	790.00	34.84	.4933	.1017E-02	2.269	5.674
+ 104.52	7.979	326.59	3.989	2.419	.0330	790.00	34.84	.4735	.1007E-02	2.297	5.682
+ 139.36	8.015	326.81	4.009	2.417	.0330	790.00	34.84	.4536	.9992E-03	2.325	5.690
124 - 127	** SYUSOKU SEZU **										

CHAPTER 3 PROTECTION WORKS FOR RIVERBANK AND RIVERBED

3.1 Slope Stability of Riverbank

For the design of riverbanks and dikes, stability of slope and dike against circular slip/sliding was confirmed.

(1) Location for Calculation

The following river cross sections were selected for calculation.

- Right River Bank at WF.1 including Dike Embankment
- Right River Bank at WF.75 including Leaning Wall
- Right River Bank at WF.110 including Leaning Wall
- Left River Bank at WF. 110 including Leaning Wall
- Right River Bank at WF.154 including Revetment and Dike

(2) Calculation Method

Circular slip method with effective stress of soil is used. The calculation was done only for ordinary case.

(3) Ground Condition and Soil Property

Setting of soil layer and soil property of each layer is presented in the calculation charts.

(4) Loading Condition and Ground Water Level

A distributed load of 1.0 tf/m^2 is placed on the ground behind the riverbank as the surcharge composed of traffic load, houses and others. The ground water line is shown on the calculation chart.

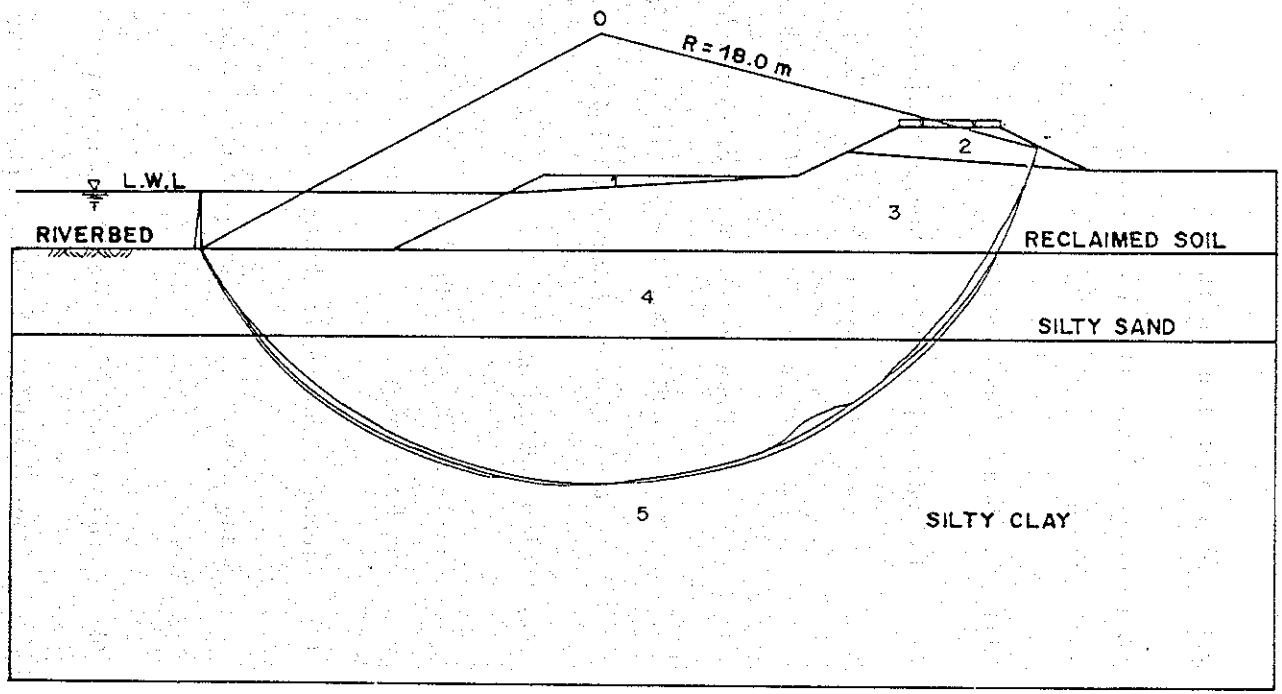
(5) Calculation Results

The calculation results are shown in the form of safety factor (Fs). As shown in the calculation charts, all safety factors are bigger than the allowable safety factor of 1.20. Therefore, it ca be said that the objective riverbank slopes and dike are safe enough against circular sliding.

RIVER MOUTH DIKE WF. 1

MINIMUM SAFETY FACTOR (FS)		1.48
COORDINATE	X (m)	8.14
	Y (m)	6.21
RADIUS OF ARC	R (m)	18.00
RESISTANT MOMENT	(tf.m)	1817.90
SLIPPING MOMENT	(tf.m)	1448.23

NO	NAME OF BLOCK	t (tf/m^3)	Co (tf/m^2)	Ø(DEGREE)
1	m1	1.80	0.00	30.00
2	m2	1.80	0.00	30.00
3	m3	1.80	0.00	30.00
4	g1	1.60	0.50	25.00
5	g2	1.50	2.00	0.00



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.

Calculation : Circular Slip
Location : Right Riverbank in Mouth Dike

《 Input Data 》 Number of Coordinators = [12]

Embankment and Ground

x (m)	y (m)
-15.000	-2.500
0.000	-2.500
4.540	-0.230
6.000	0.500
16.000	0.500
18.000	1.500
20.000	2.500
24.000	2.500
27.400	0.800
27.400	0.800
35.000	-20.000
-15.000	-20.000
-15.000	-2.500

Block of Soil [1]

x (m)	y (m)
4.540	-0.230
6.000	0.500
16.000	0.500
4.540	-0.230

Block of Soil [2]

x (m)	y (m)
18.000	1.500
20.000	2.500
24.000	2.500
27.400	0.800
18.000	1.500

Block of Soil [3]

x (m)	y (m)
0.000	-2.500
4.540	-0.230
16.000	0.500
18.000	1.500
27.400	0.800
35.000	0.800
35.000	-2.500
0.000	-2.500

Block of Soil [4]

x (m)	y (m)
-15.000	-2.500
35.000	-2.500
35.000	-6.000
-15.000	-6.000
-15.000	-2.500

Block of Soil [5]

x (m)	y (m)
-15.000	-6.000
35.000	-6.000
35.000	-20.000
-15.000	-20.000
-15.000	-6.000

Block of Soil [6]

x (m)	y (m)

Water Level

x (m)	y (m)
-15.000	-0.230
4.540	-0.230
16.000	0.500
18.000	1.500
27.400	0.800
35.000	0.800

Target Range for Center of Circle

x (m)	y (m)
2.000	12.000
12.000	12.000
12.000	2.000
2.000	2.000
2.000	12.000

Lines not to be cut

x (m)	y (m)
-15.000	-2.500
-15.000	-20.000
35.000	-20.000
35.000	0.800

Lines to be cut

No	x (m)	y (m)
1	-15.000	-4.000
2	35.000	-4.000

Center of Circle

x (m)	y (m)
4.000	11.000

Distribution of Load

No	x (m)	y (m)
1	20.000	2.500
1	24.000	2.500

《 Data on Soil 》

γ_t = Unit weight of partially saturated soil (tf/m^3)

γ_{sat} = Unit weight of saturated soil (tf/m^3)

γ' = Unit weight of saturated soil considering up-lift (tf/m^3)

C = Cohesion under effective stress (tf/m^2)

k = Increase rate of cohesion

φ = Internal friction angle (effective stress) (degree°)

y_0 = Base elevation when calculating cohesion (m)

r_u = Void ratio (after embankment)

U = Degree of consolidation

β = Correction coefficient of seismic intensity

Block Number = [5]

	1	2	3	4	5
Name of Block	C	m2	m3	g1	g2
γ_t (tf/m^3)	1.80	1.80	1.80	1.60	1.50
γ_{sat} (tf/m^3)	2.00	2.00	2.00	1.70	1.60
γ' (tf/m^3)	1.00	1.00	1.00	0.70	0.60
γ_w (tf/m^3)	1.000	1.000	1.000	1.000	1.000
C (tf/m^2)	0.00	0.00	0.00	0.50	2.00
k (tf/m^3)	0.00	0.00	0.00	0.00	0.00
φ (degree°)	30.00	30.00	30.00	25.00	0.00
y_0 (m)	0.0	0.0	0.0	0.0	0.0
r_u	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000
β	1.0	1.0	1.0	1.0	1.0

Distributed Load

Number = [1]

No	Stress at Right End (tf/m^2)	Stress at Left End (tf/m^2)	Acting Angle (degree)	Dispersive Angle (degree)
1	1.00	1.00	0.0	0.0

《 Calculation of Safety Factor 》

$$Fs = \frac{MR}{MD}$$

MR : Resisting moment (tf·m / m)

MD : Sliding moment (tf·m / m)

《 Sliding Force 》

$$S = \Sigma\{(1 + kv)\cdot Wi\cdot \sin\alpha i + kh\cdot Wi\cdot \cos\alpha i\} + Sp$$

$$MD = \Sigma\{(1 + kv)\cdot Wi\cdot \Delta xi + kh\cdot Wi\cdot \Delta yi\} + Mp + Mw$$

Wi : Total weight of sliced block (using γ_t & γ_{sat}) (tf /m)

αi : Sliding angle of sliced block (degree°)

Δxi : Horizontal distance between centers of circle and sliced block(=xg–xo) (m)

Δyi : Vertical distance between centers of circle and sliced block (=yg-yo) (m)

kv, kh : Design seismic intensity

Sp : Sliding force by loads (tf / m)

Mp : Sliding moment by loads (tf·m /m)

Mw : Sliding moment by horizontal water pressure (tf·m /m)

Mw = Pw·(yo–yg)

Pw : Total water pressure (tf)

Yo : Y-coordinate of center of sliding circle

Yg : Y-coordinate of acting point of total water pressure

《 Simplified Slice Method 》

$$T = \Sigma[Ci\cdot Li + \{(Wi' + kv\cdot Wi)\cdot \cos\alpha i - kh\cdot Wi\cdot \sin\alpha i - Ui - \Delta Ui\}\cdot \tan\phi i]$$

Ci, ϕi : Strength of soil (tf /m^2, degree°)

Li : Sliding length of slice block (m)

αi : Sliding angle of sliced block (degree°)

Wi' : Soil weight of slice block (tf / m)

Ui : Power water pressure (tf / m)

ΔUi : Corrected number for estimating excess hydrostatic pressure (tf / m)

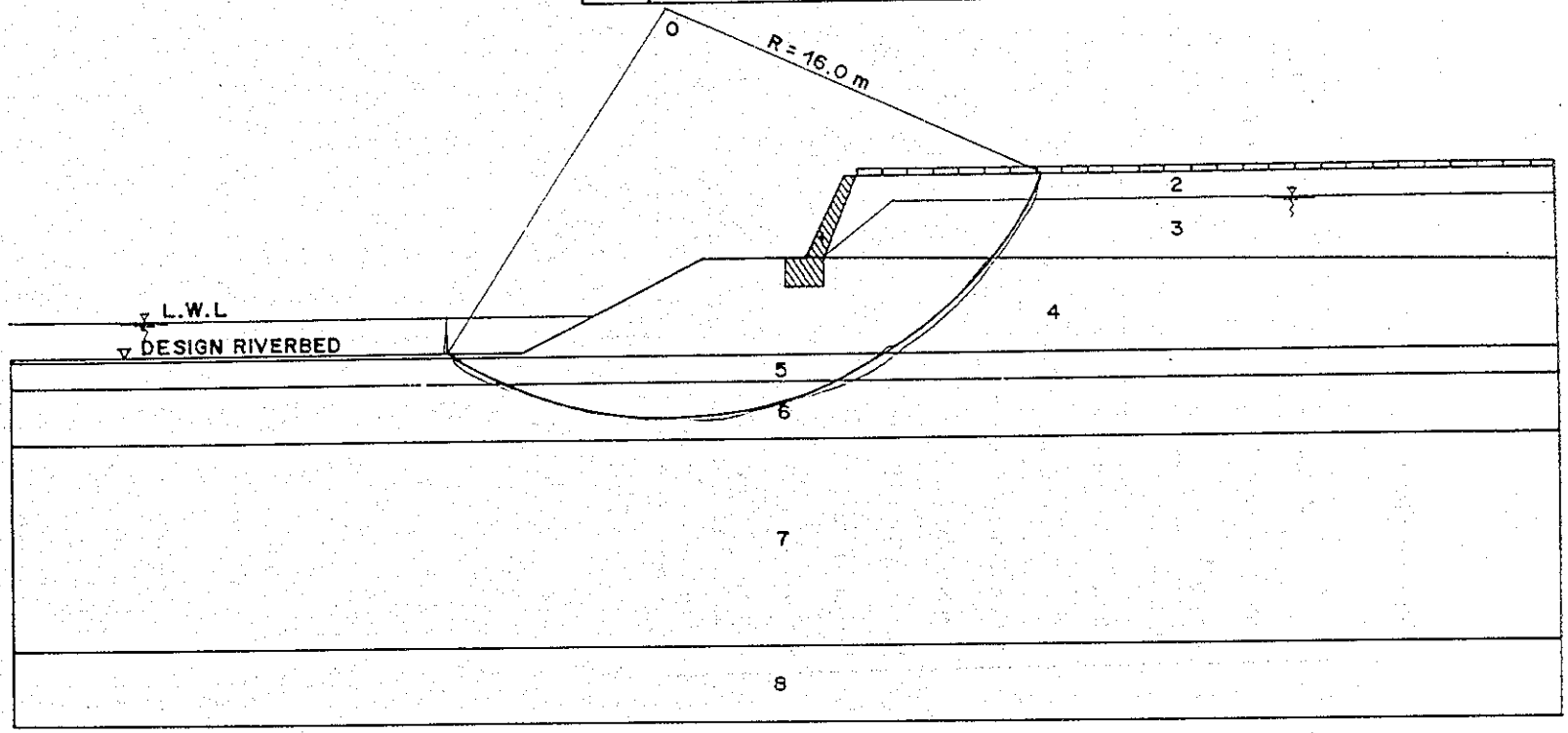
Calculation Results

Method of Analysis	Fellenius method
Rupture Standard	Effective stress method
State of Water	Partially submerged
Sliding shape	Arc
Allowable Safety Factor	1.20
X-Coordinate of Center of Circle (m)	8.14
Y-Coordinate of Center of Circle (m)	6.21
Radius of Arc (m)	18.00
Minimum Safety Factor	1.48
Resistant Force (tf)	72.11
Resistant Moment (tf·m)	1297.98
Sliding Force (tf)	53.93
Sliding Moment (tf·m)	879.51

CALCULATION SECTION : WF 75 R

MINIMUM SAFETY FACTOR (Fs)		1.27
COORDINATE		
	X (m)	5.76
	Y (m)	11.76
RADIUS OF ARC	(m)	16.00
RESISTANT MOMENT	(tf.m)	1023.06
SLIPPING MOMENT	(tf.m)	802.58

NO	NAME OF BLOCK	t (tf/m3)	Co (tf/m2)	Ø (DEGREE)
1	C1	2.50	20.00	0.00
2	M1	1.70	1.00	25.00
3	M2	1.70	1.00	25.00
4	M3	1.60	2.50	0.00
5	M4	1.70	4.00	0.00
6	M5	1.80	0.00	30.00
7	M6	1.65	3.00	0.00
8	M7	1.80	0.00	36.00



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JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.

Calculation : Circular Slip
Location : Right Riverbank at WF.75

《 Input Data 》 Number of Coordinators = [15]

Embankment and Ground

x (m)	y (m)
-20.000	-1.649
-15.000	-1.649
0.000	-1.649
7.000	1.851
10.200	1.851
11.000	1.851
12.600	5.051
13.050	5.051
40.000	5.051
40.000	-16.000
-20.000	-16.000
-20.000	-1.649

Block of Soil [1]

x (m)	y (m)
10.200	1.851
11.000	1.851
12.600	5.051
13.050	5.051
11.700	1.851
11.700	0.750
10.200	0.750
10.200	1.851

Block of Soil [2]

x (m)	y (m)
11.700	1.851
13.050	5.051
40.000	5.051
40.000	4.000
14.416	4.000
11.700	1.851

Block of Soil [3]

x (m)	y (m)
11.700	1.851
14.416	4.000
40.000	4.000
40.000	1.500
11.700	1.851

Block of Soil [4]

x (m)	y (m)
-20.000	-1.649
0.000	-1.649
2.838	-0.230
7.000	1.851
10.200	1.851
10.200	0.750
11.700	0.750
11.700	1.851
40.000	1.500
40.000	-1.800
-20.000	-1.800
-20.000	-1.649

Block of Soil [5]

x (m)	y (m)
-20.000	-2.800
-20.000	-1.800
40.000	-1.800
40.000	-2.800
-20.000	-2.800

Block of Soil [6]

x (m)	y (m)
-20.000	-5.000
-20.000	-2.800
40.000	-2.800
40.000	-5.000
-20.000	-5.000

Block of Soil [7]

x (m)	y (m)
-20.000	-13.000
-20.000	-5.000
40.000	-5.000
40.000	-13.000
-20.000	-13.000

Block of Soil [8]

x (m)	y (m)
-20.000	-16.000
-20.000	-13.000
40.000	-13.000
40.000	-16.000
-20.000	-16.000

Water Level

x (m)	y (m)
-20.000	-0.230
2.838	-0.230
7.000	1.851
10.200	1.851
11.000	1.851
11.700	1.851
14.416	4.000
40.000	4.000

Lines not to be cut

x (m)	y (m)
-20.000	-13.000
40.000	-13.000

Lines to be cut

No	x (m)	y (m)
1	-15.000	-1.649
1	0.000	-1.649
2	0.000	-1.649
2	7.000	1.851

Target Range for Center of Circle

x (m)	y (m)
2.000	18.000
12.000	18.000
12.000	6.000
2.000	6.000
2.000	18.000

Distribution of Load

No	x (m)	y (m)
1	13.050	5.051
1	40.000	5.051

《 Data on Soil 》

γ_t = Unit weight of partially saturated soil (tf/m^3)

γ_{sat} = Unit weight of saturated soil (tf/m^3)

γ' = Unit weight of saturated soil considering up-lift (tf/m^3)

C = Cohesion under effective stress (tf/m^2)

k = Increase rate of cohesion

φ = Internal friction angle (effective stress) (degree°)

y_0 = Base elevation when calculating cohesion (m)

r_u = Void ratio (after embankment)

U = Degree of consolidation

β = Correction coefficient of seismic intensity

Block Number = [8]

	1	2	3	4	5
Name of Block	C1	M1	M2	M3	M4
γ_t (tf/m^3)	2.50	1.70	1.70	1.60	1.70
γ_{sat} (tf/m^3)	2.50	1.90	1.90	1.70	1.80
γ' (tf/m^3)	1.00	0.90	0.90	0.70	0.80
γ_w (tf/m^3)	1.000	1.000	1.000	1.000	1.000
C (tf/m^2)	20.00	1.00	1.00	2.50	4.00
k (tf/m^3)	0.00	0.00	0.00	0.00	0.00
φ (degree°)	0.00	25.00	25.00	0.00	0.00
y_0 (m)	0.0	0.0	0.0	0.0	0.0
r_u	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000
β	1.0	1.0	1.0	1.0	1.0

	6	7	8
Name of Block	M5	M6	M7
γ_t (tf/m^3)	1.80	1.65	1.80
γ_{sat} (tf/m^3)	2.00	1.70	2.00
γ' (tf/m^3)	1.00	0.70	1.00
γ_w (tf/m^3)	1.000	1.000	1.000
C (tf/m^2)	0.00	3.00	0.00
k (tf/m^3)	0.00	0.00	0.00
φ (degree°)	30.00	0.00	36.00
y_0 (m)	0.0	0.0	0.0
r_u	0.000	0.000	0.000
U	0.000	0.000	0.000
β	1.0	1.0	1.0

Distributed Load

Number = [1]

No	Stress at Right End (tf/m^2)	Stress at Left End (tf/m^2)	Acting Angle (degree)	Dispersive Angle (degree)
1	1.00	1.00	0.0	0.0

《 Calculation of Safety Factor 》

$$Fs = \frac{MR}{MD}$$

MR : Resisting moment (tf·m / m)

MD : Sliding moment (tf·m / m)

《 Sliding Force 》

$$S = \Sigma\{(1 + kv)\cdot Wi\cdot \sin\alpha i + kh\cdot Wi\cdot \cos\alpha i\} + Sp$$

$$MD = \Sigma\{(1 + kv)\cdot Wi\cdot \Delta xi + kh\cdot Wi\cdot \Delta yi\} + Mp + Mw$$

- Wi : Total weight of sliced block (using γ_t & γ_{sat}) (tf /m)
- αi : Sliding angle of sliced block (degree°)
- Δxi : Horizontal distance between centers of circle and sliced block (=xg-xo) (m)
- Δyi : Vertical distance between centers of circle and sliced block (=yg-yo) (m)
- kv, kh : Design seismic intensity
- Sp : Sliding force by loads (tf / m)
- Mp : Sliding moment by loads (tf·m /m)
- Mw : Sliding moment by horizontal water pressure (tf·m /m)
  - Mw = Pw·(yo-yg)
  - Pw : Total water pressure (tf)
  - Yo : Y-coordinate of center of sliding circle
  - Yg : Y-coordinate of acting point of total water pressure

《 Simplified Slice Method 》

$$T=\Sigma[Ci\cdot Li + \{(Wi' + kv\cdot Wi)\cdot \cos\alpha i - kh\cdot Wi\cdot \sin\alpha i - Ui - \Delta Ui\}\cdot \tan\phi i]$$

- Ci, ϕi : Strength of soil (tf /m^2, degree°)
- Li : Sliding length of slice block (m)
- αi : Sliding angle of sliced block (degree°)
- Wi' : Soil weight of slice block (tf / m)
- Ui : Power water pressure (tf / m)
- ΔUi : Corrected number for estimating excess hydrostatic pressure (tf / m)

Calculation Results

Method of Analysis	Fellenius method
Rupture Standard	Effective stress method
State of Water	Partially submerged
Sliding shape	Arc
Allowable Safety Factor	1.20
X-Coordinate of Center of Circle (m)	5.76
Y-Coordinate of Center of Circle (m)	11.76
Radius of Arc (m)	16.00
Minimum Safety Factor	1.27
Resistant Force (tf)	63.94
Resistant Moment (tf·m)	1023.06
Sliding Force (tf)	53.76
Sliding Moment (tf·m)	802.58
Preventive Force (tf)	0.57

CALCULATION SECTION : WF 110R

MINIMUM SAFETY FACTOR (FS)		1.38
COORDINATE		
	X (m)	3.38
	Y (m)	19.22
RADIUS OF ARC	R (m)	18.00
RESISTANT MOMENT	(tf.m)	1642.92
SLIPPING MOMENT	(tf.m)	1187.00

NO	NAME OF BLOCK	γ (tf/m^3)	Co (tf/m^2)	Ø(DEGREE)
1	L1	1.70	5.00	0.00
2	C	2.50	20.00	0.00
3	L2	1.70	5.00	0.00
4	L3	1.70	5.00	0.00
5	L4	1.80	0.00	36.00
6	L5	1.80	0.00	40.00

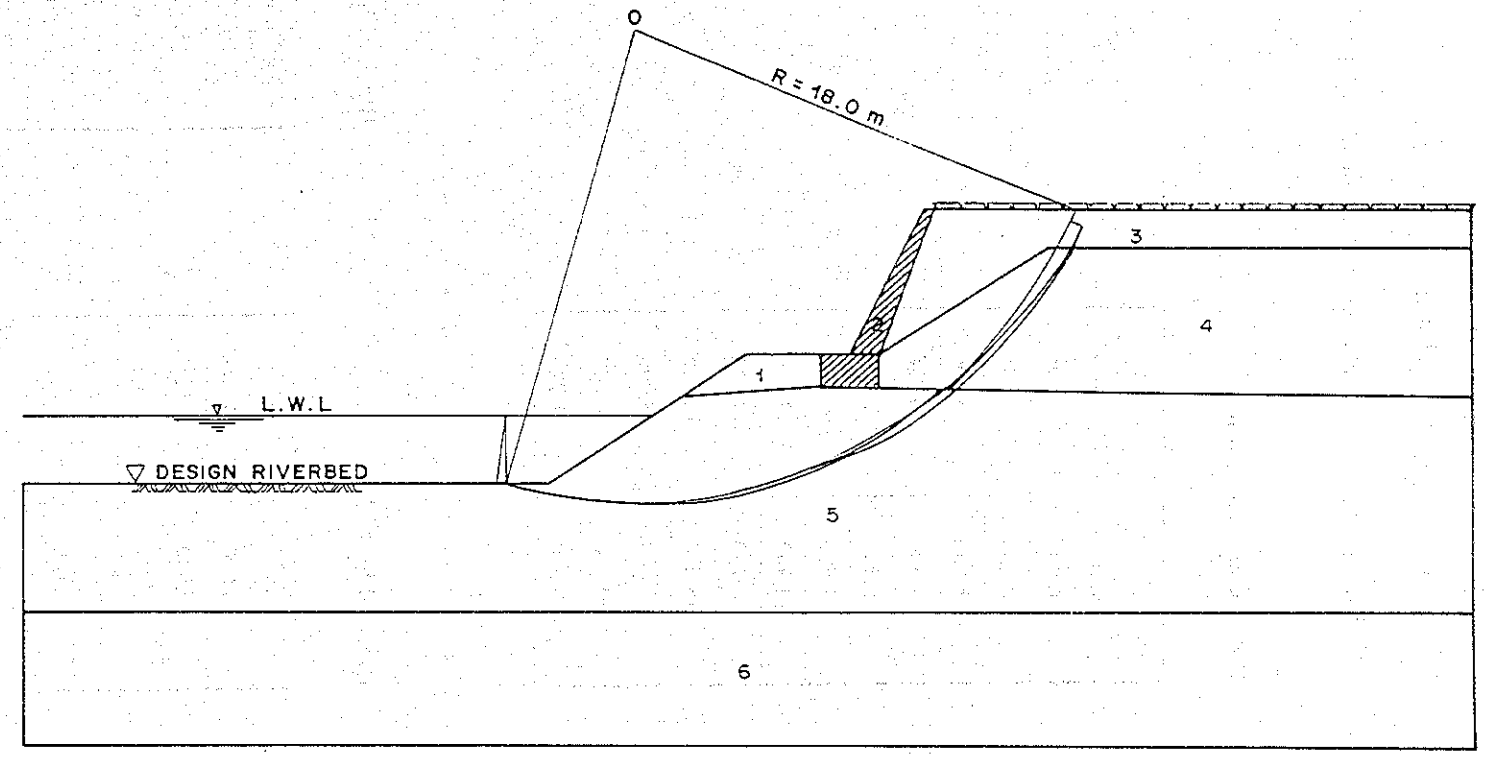


Fig.

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Calculation : Circular Slip
Location : Right Riverbank at WF.110

《 Input Data 》 Number of Coordinators = [13]

Embankment and Ground

x (m)	y (m)
-20.000	1.926
0.000	1.926
4.000	4.575
5.000	5.266
7.500	6.926
10.359	6.926
11.500	6.926
14.300	12.526
14.750	12.526
35.000	12.526
35.000	-8.000
-20.000	-8.000
-20.000	1.926

Block of Soil [1]

x (m)	y (m)
5.000	5.266
7.500	6.926
10.359	6.926
10.359	5.626
5.000	5.266

Block of Soil [2]

x (m)	y (m)
10.359	6.926
11.500	6.926
14.300	12.526
14.750	12.526
12.603	6.926
12.603	5.626
10.359	5.626
10.359	6.926

Block of Soil [3]

x (m)	y (m)
12.603	6.926
14.750	12.526
35.000	12.526
35.000	11.000
18.991	11.000
12.603	6.926

Block of Soil [4]

x (m)	y (m)
12.603	5.626
12.603	6.926
18.991	11.000
35.000	11.000
35.000	5.266
12.603	5.626

Block of Soil [5]

x (m)	y (m)
-20.000	1.926
0.000	1.926
4.000	4.575
5.000	5.266
10.359	5.626
12.603	5.626
35.000	5.266
35.000	-3.000
-20.000	-3.000
-20.000	1.926

Block of Soil [6]

x (m)	y (m)
-20.000	-3.000
35.000	-3.000
35.000	-8.000
-20.000	-8.000
-20.000	-3.000

Block of Soil [7]

x (m)	y (m)

Block of Soil [8]

x (m)	y (m)

Water Level

x (m)	y (m)
-20.000	4.575
4.000	4.575
5.000	5.266
7.500	6.926
10.359	6.926
11.500	6.926
12.603	6.926
18.991	11.000
35.000	11.000

Lines not to be cut

x (m)	y (m)
10.359	6.926
11.500	6.926
14.300	12.526
14.750	12.526

Lines to be cut

No	x (m)	y (m)
1	0.000	1.926
1	7.500	6.926
2	-5.000	1.926
2	0.000	1.926

Target Range for Center of Circle

x (m)	y (m)
0.000	25.000
8.000	25.000
8.000	15.000
0.000	15.000
0.000	25.000

Distribution of Load

No	x (m)	y (m)
1	14.750	12.526
1	35.000	12.526

《 Data on Soil 》

γ_t = Unit weight of partially saturated soil (tf/m^3)

γ_{sat} = Unit weight of saturated soil (tf/m^3)

γ' = Unit weight of saturated soil considering up-lift (tf/m^3)

C = Cohesion under effective stress (tf/m^2)

k = Increase rate of cohesion

φ = Internal friction angle (effective stress) (degree°)

y_0 = Base elevation when calculating cohesion (m)

r_u = Void ratio (after embankment)

U = Degree of consolidation

β = Correction coefficient of seismic intensity

Block Number = [6]

	1	2	3	4	5
Name of Block	L1	C	L2	L3	L4
γ_t (tf/m^3)	1.70	2.50	1.70	1.70	1.80
γ_{sat} (tf/m^3)	1.80	2.50	1.80	1.80	2.00
γ' (tf/m^3)	0.80	1.50	0.80	0.80	1.00
γ_w (tf/m^3)	1.000	1.000	1.000	1.000	1.000
C (tf/m^2)	5.00	20.00	5.00	5.00	0.00
k (tf/m^3)	0.00	0.00	0.00	0.00	0.00
φ (degree°)	0.00	0.00	0.00	0.00	36.00
y_0 (m)	0.0	0.0	0.0	0.0	0.0
r_u	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000
β	1.0	1.0	1.0	1.0	1.0

	6
Name of Block	L5
γ_t (tf/m^3)	1.80
γ_{sat} (tf/m^3)	2.00
γ' (tf/m^3)	1.00
γ_w (tf/m^3)	1.000
C (tf/m^2)	0.00
k (tf/m^3)	0.00
φ (degree°)	40.00
y_0 (m)	0.0
r_u	0.000
U	0.000
β	1.0

Distributed Load

Number = [1]

No	Stress at Right End (tf/m^2)	Stress at Left End (tf/m^2)	Acting Angle (degree)	Dispersive Angle (degree)
1	1.00	1.00	0.0	0.0

《 Calculation of Safety Factor 》

$$Fs = \frac{MR}{MD}$$

MR : Resisting moment (tf·m / m)

MD : Sliding moment (tf·m / m)

《 Sliding Force 》

$$S = \Sigma\{(1 + kv)\cdot Wi\cdot \sin\alpha i + kh\cdot Wi\cdot \cos\alpha i\} + Sp$$

$$MD = \Sigma\{(1 + kv)\cdot Wi\cdot \Delta xi + kh\cdot Wi\cdot \Delta yi\} + Mp + Mw$$

Wi : Total weight of sliced block (using γ_t & γ_{sat}) (tf /m)

αi : Sliding angle of sliced block (degree°)

Δxi : Horizontal distance between centers of circle and sliced block (=xg-xo)(m)

Δyi : Vertical distance between centers of circle and sliced block (=yg-yo) (m)

kv, kh : Design seismic intensity

Sp : Sliding force by loads (tf / m)

Mp : Sliding moment by loads (tf·m /m)

Mw : Sliding moment by horizontal water pressure (tf·m /m)

Mw = Pw·(yo-yg)

Pw : Total water pressure (tf)

Yo : Y-coordinate of center of sliding circle

Yg : Y-coordinate of acting point of total water pressure

《 Simplified Slice Method 》

$$T = \Sigma[Ci\cdot Li + \{(Wi' + kv\cdot Wi)\cdot \cos\alpha i - kh\cdot Wi\cdot \sin\alpha i - Ui - \Delta Ui\}\cdot \tan\phi i]$$

Ci, ϕi : Strength of soil (tf /m^2, degree°)

Li : Sliding length of slice block (m)

αi : Sliding angle of sliced block (degree°)

Wi' : Soil weight of slice block (tf / m)

Ui : Power water pressure (tf / m)

ΔUi : Corrected number for estimating excess hydrostatic pressure (tf / m)

Calculation Results

Method of Analysis	Fellenius method
Rupture Standard	Effective stress method
State of Water	Partially submerged
Sliding shape	Arc
Allowable Safety Factor	1.20
X-Coordinate of Center of Circle (m)	3.38
Y-Coordinate of Center of Circle (m)	19.22
Radius of Arc (m)	18.00
Minimum Safety Factor	1.28
Resistant Force (tf)	91.27
Resistant Moment (tf·m)	1642.92
Sliding Force (tf)	67.98
Sliding Moment (tf·m)	1187.00

CALCULATION SECTION : WF 110 L

MINIMUM SAFETY FACTOR (FS)		1.26
COORDINATE		
	X (m)	3.39
	Y (m)	19.24
RADIUS OF ARC	(m)	18.00
RESISTANT MOMENT	(tf.m)	1817.90
SLIPPING MOMENT	(tf.m)	1448.23

NO	NAME OF BLOCK	t (tf/m^3)	Co (tf/m^2)	Ø(DEGREE)
1	C	2.50	20.00	0.00
2	L 1	1.70	5.00	0.00
3	L 2	1.70	5.00	0.00
4	L 3	1.80	0.00	36.00
5	L 4	1.80	0.00	40.00

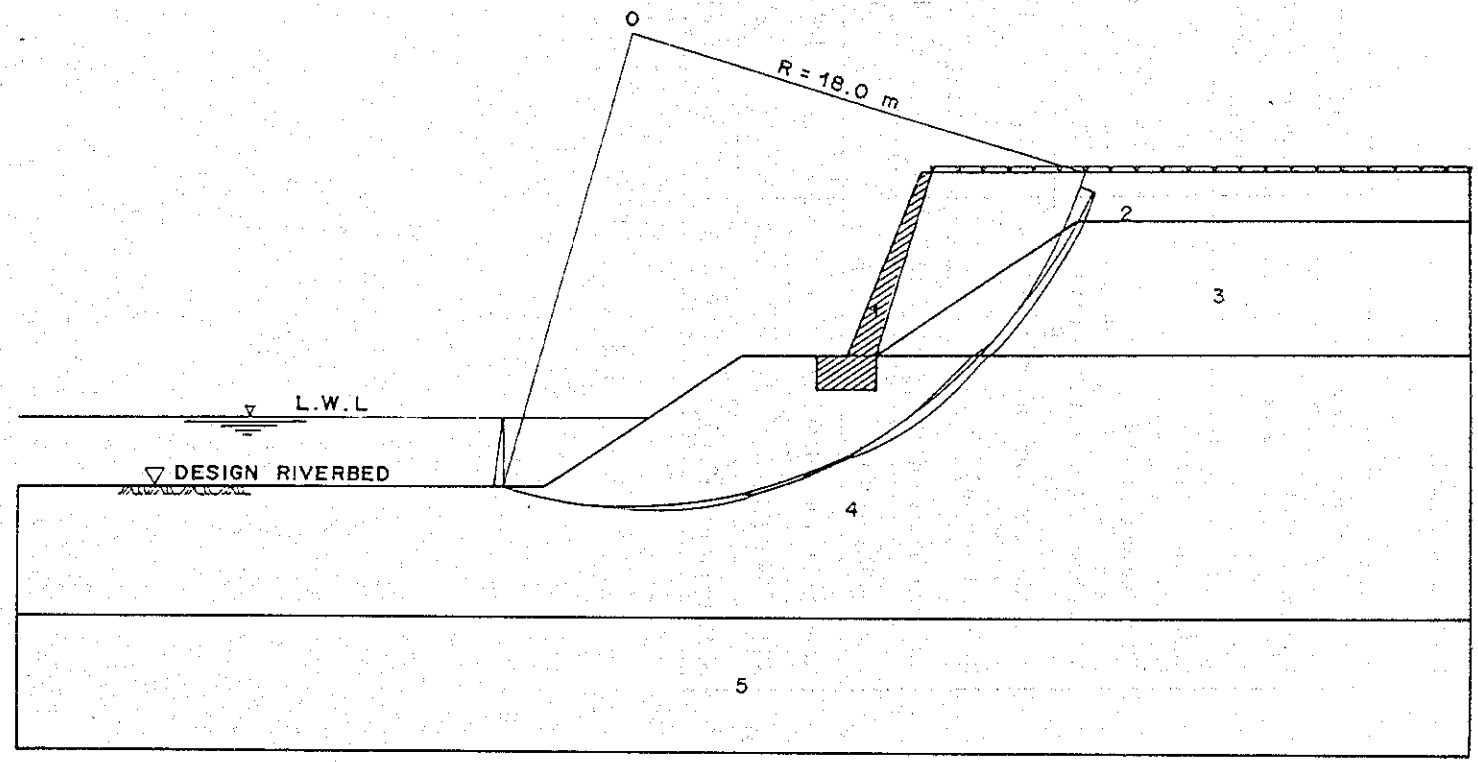


Fig.

Calculation : Circular Slip
Location : Left Riverbank at WF.110

《 Input Data 》 Number of Coordinators = [12]

Embankment and Ground

x (m)	y (m)
-20.000	1.926
0.000	1.926
4.000	4.575
5.000	5.266
7.500	6.926
10.359	6.926
11.500	6.926
14.300	13.900
14.750	13.900
35.000	13.900
35.000	-8.000
-20.000	-8.000
-20.000	1.926

Block of Soil [1]

x (m)	y (m)
10.359	6.926
11.500	6.926
14.300	13.900
14.750	13.900
12.603	6.926
12.603	5.626
10.359	5.626
10.359	6.926

Block of Soil [2]

x (m)	y (m)
12.603	6.926
14.750	13.900
35.000	13.900
35.000	12.000
20.212	12.000
12.603	6.926

Block of Soil [3]

x (m)	y (m)
12.603	6.926
20.212	12.000
35.000	12.000
35.000	6.926
12.603	6.926

Block of Soil [4]

x (m)	y (m)
-20.000	-3.000
-20.000	1.926
-8.000	1.926
0.000	1.926
4.000	4.575
5.000	5.266
7.500	6.926
10.359	5.626
10.359	5.626
12.603	6.926
35.000	6.926
35.000	-3.000
-20.000	-3.000

Block of Soil [5]

x (m)	y (m)
-20.000	-8.000
-20.000	-3.000
35.000	-3.000
35.000	-8.000
-20.000	-8.000

Block of Soil [6]

x (m)	y (m)

Block of Soil [7]

x (m)	y (m)

Block of Soil [8]

x (m)	y (m)

Water Level

x (m)	y (m)
-20.000	4.575
4.000	4.575
5.000	5.266
7.500	6.926
10.359	6.926
11.500	6.926
12.603	6.926
20.212	12.000
35.000	12.000

Lines not to be cut

x (m)	y (m)
4.000	4.575
5.000	5.266
7.500	6.926
10.359	6.926
11.500	6.926
14.300	13.900

Lines to be cut

No	x (m)	y (m)
1	0.000	1.926
1	4.000	4.575
2	-8.000	1.926
2	0.000	1.926

Target Range for Center of Circle

x (m)	y (m)
0.000	25.000
8.000	25.000
8.000	15.000
0.000	15.000
0.000	25.000

Distribution of Load

No	x (m)	y (m)
1	14.750	13.900
1	35.000	13.900

《 Data on Soil 》

γ_t = Unit weight of partially saturated soil (tf/m^3)

γ_{sat} = Unit weight of saturated soil (tf/m^3)

γ' = Unit weight of saturated soil considering up-lift (tf/m^3)

C = Cohesion under effective stress (tf/m^2)

k = Increase rate of cohesion

φ = Internal friction angle (effective stress) (degree°)

y_0 = Base elevation when calculating cohesion (m)

r_u = Void ratio (after embankment)

U = Degree of consolidation

β = Correction coefficient of seismic intensity

Block Number = [5]

	1	2	3	4	5
Name of Block	L1	C	L2	L3	L4
γ_t (tf/m^3)	2.50	1.70	1.70	1.80	1.80
γ_{sat} (tf/m^3)	2.50	1.80	1.80	2.00	2.00
γ' (tf/m^3)	1.50	0.80	0.80	1.00	1.00
γ_w (tf/m^3)	1.000	1.000	1.000	1.000	1.000
C (tf/m^2)	20.00	5.00	5.00	0.00	0.00
k (tf/m^3)	0.00	0.00	0.00	0.00	0.00
φ (degree°)	0.00	0.00	0.00	36.00	40.0
y_0 (m)	0.0	0.0	0.0	0.0	0.0
r_u	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000
β	1.0	1.0	1.0	1.0	1.0

Distributed Load

Number = [1]

No	Stress at Right End (tf/m^2)	Stress at Left End (tf/m^2)	Acting Angle (degree)	Dispersive Angle (degree)
1	1.00	1.00	0.0	0.0

《 Calculation of Safety Factor 》

$$Fs = \frac{MR}{MD}$$

MR : Resisting moment (tf·m / m)

MD : Sliding moment (tf·m / m)

《 Sliding Force 》

$$S = \Sigma\{(1 + kv)\cdot Wi\cdot \sin\alpha i + kh\cdot Wi\cdot \cos\alpha i\} + Sp$$

$$MD = \Sigma\{(1 + kv)\cdot Wi\cdot \Delta xi + kh\cdot Wi\cdot \Delta yi\} + Mp + Mw$$

Wi : Total weight of sliced block (using γ_t & γ_{sat}) (tf /m)

αi : Sliding angle of sliced block (degree°)

Δxi : Horizontal distance between centers of circle and sliced block (=xg−xo)(m)

Δyi : Vertical distance between centers of circle and sliced block (=yg−yo) (m)

kv, kh : Design seismic intensity

Sp : Sliding force by loads (tf / m)

Mp : Sliding moment by loads (tf·m /m)

Mw : Sliding moment by horizontal water pressure (tf·m /m)

Mw = Pw·(yo−yg)

Pw : Total water pressure (tf)

Yo : Y-coordinate of center of sliding circle

Yg : Y-coordinate of acting point of total water pressure

《 Simplified Slice Method 》

$$T = \Sigma[Ci\cdot Li + \{(Wi' + kv\cdot Wi)\cdot \cos\alpha i - kh\cdot Wi\cdot \sin\alpha i - Ui - \Delta Ui\}\cdot \tan\phi i]$$

Ci, ϕi : Strength of soil (tf /m^2, degree°)

Li : Sliding length of slice block (m)

αi : Sliding angle of sliced block (degree°)

Wi' : Soil weight of slice block (tf / m)

Ui : Power water pressure (tf / m)

ΔUi : Corrected number for estimating excess hydrostatic pressure (tf / m)

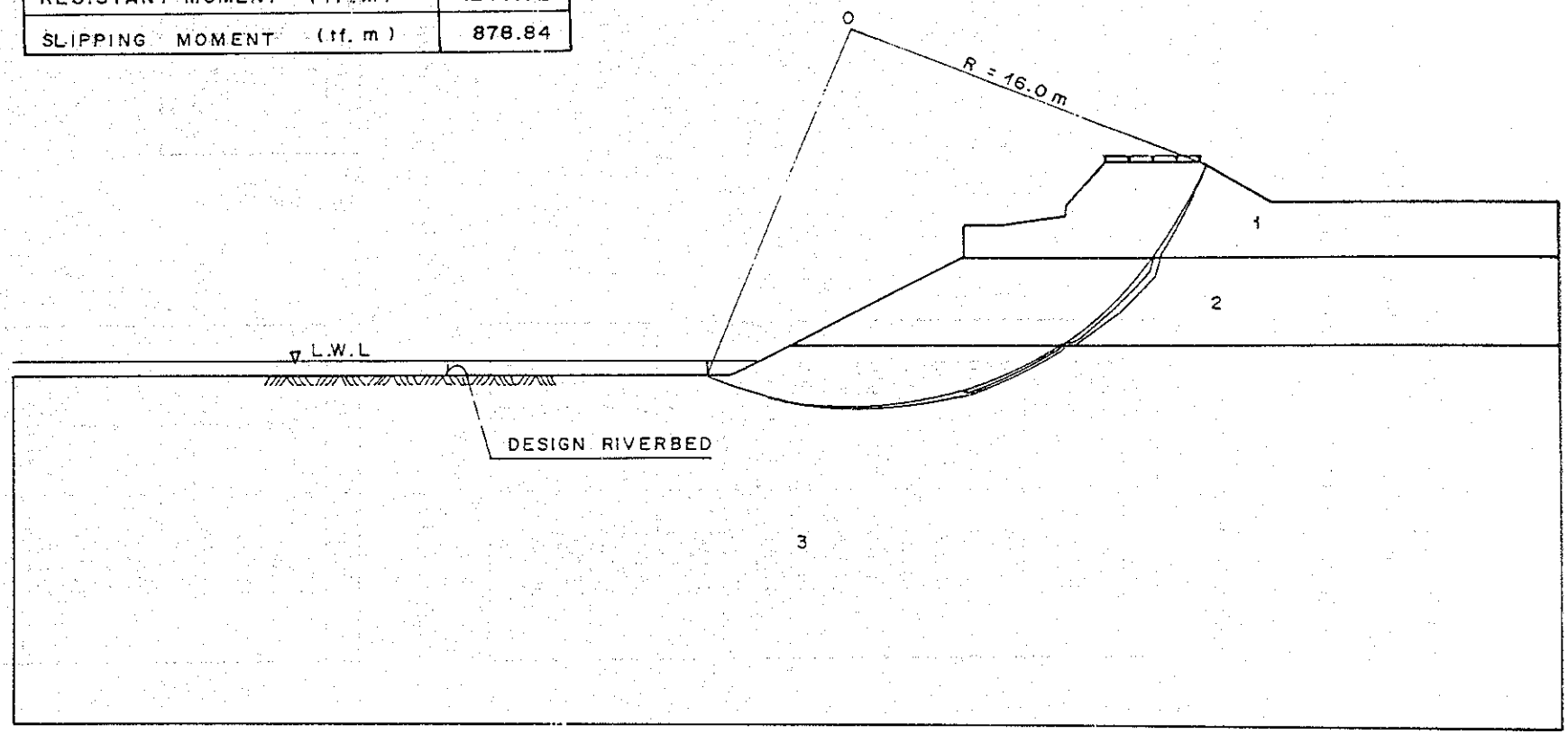
Calculation Results

Method of Analysis	Fellenius method
Rupture Standard	Effective stress method
State of Water	Partially submerged
Sliding shape	Arc
Allowable Safety Factor	1.20
X-Coordinate of Center of Circle (m)	3.39
Y-Coordinate of Center of Circle (m)	19.24
Radius of Arc (m)	18.00
Minimum Safety Factor	1.26
Resistant Force (tf)	100.99
Resistant Moment (tf·m)	1817.90
Sliding Force (tf)	82.58
Sliding Moment (tf·m)	1448.23

CALCULATION SECTION : WF 154 R

MINIMUM SAFETY FACTOR (Fs)		1.41
COORDINATE :		
	X (m)	5.40
	Y (m)	19.33
RADIUS OF ARC	(m)	16.00
RESISTANT MOMENT	(tf.m)	1240.92
SLIPPING MOMENT	(tf.m)	878.84

NO	NAME OF BLOCK	t (tf/m^3)	Co (tf/m^2)	Ø (DEGREE)
1	L1	1.70	0.00	30.00
2	L2	1.55	6.00	0.00
3	L3	1.80	0.00	40.00



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.

Calculation : Circular Slip
Location : Right Riverbank at WF.153

《 Input Data 》 Number of Coordinators = [9]

Embankment and Ground

x (m)	y (m)
-30.000	4.650
-10.000	4.650
0.000	4.650
1.300	5.300
2.700	6.000
10.000	9.650
10.000	10.950
11.500	10.950
14.300	11.300
14.400	11.800
16.000	13.600
20.000	13.600
23.000	11.900
35.000	11.900
35.000	9.650
35.000	6.000
35.000	-10.000
-30.000	-10.000
-30.000	4.650

Block of Soil [1]

x (m)	y (m)
10.000	9.650
10.000	10.950
11.500	10.950
14.300	11.300
14.400	11.800
16.000	13.600
20.000	13.600
23.000	11.900
35.000	11.900
35.000	9.650
10.000	9.650

Block of Soil [2]

x (m)	y (m)
2.700	6.000
10.000	9.650
35.000	9.650
35.000	6.000
2.700	6.000

Block of Soil [3]

x (m)	y (m)
-30.000	4.650
-10.000	4.650
0.000	4.650
1.300	5.300
2.700	6.000
35.000	6.000
35.000	-10.000
-30.000	-10.000
-30.000	4.650

Block of Soil [4]

x (m)	y (m)

Water Level

x (m)	y (m)
-30.000	5.300
1.300	5.300
2.700	6.000
10.000	9.650
35.000	9.650

Lines not to be cut

x (m)	y (m)

Lines to be cut

No	x (m)	y (m)
1	0.000	4.650
1	10.000	9.650
2	-10.000	4.650
2	0.000	4.650

Target Range for Center of Circle

x (m)	y (m)
0.000	25.000
9.000	25.000
9.000	14.000
0.000	14.000
0.000	25.000

Distribution of Load

No	x (m)	y (m)
1	16.000	13.600
1	20.000	13.600

《 Data on Soil 》

γ_t = Unit weight of partially saturated soil (tf/m^3)

γ_{sat} = Unit weight of saturated soil (tf/m^3)

γ' = Unit weight of saturated soil considering up-lift (tf/m^3)

C = Cohesion under effective stress (tf/m^2)

k = Increase rate of cohesion

φ = Internal friction angle (effective stress) (degree)

y_0 = Base elevation when calculating cohesion (m)

r_u = Void ratio (after embankment)

U = Degree of consolidation

β = Correction coefficient of seismic intensity

Block Number = [3]

	1	2	3
Name of Block	L1	L2	L3
γ_t (tf/m^3)	1.70	1.55	1.80
γ_{sat} (tf/m^3)	1.90	1.65	2.00
γ' (tf/m^3)	0.90	0.70	1.00
γ_w (tf/m^3)	1.000	1.000	1.000
C (tf/m^2)	0.00	6.00	0.00
k (tf/m^3)	0.00	0.00	0.00
φ (degree)	30.00	0.00	40.00
y_0 (m)	0.0	0.0	0.0
r_u	0.000	0.000	0.000
U	0.000	0.000	0.000
β	1.0	0.0	0.0

Distributed Load

Number = [1]

No	Stress at Right End (tf/m^2)	Stress at Left End (tf/m^2)	Acting Angle (degree)	Dispersive Angle (degree)
1	1.00	1.00	0.0	0.0

《 Calculation of Safety Factor 》

$$Fs = \frac{MR}{MD}$$

MR : Resisting moment (tf·m / m)

MD : Sliding moment (tf·m / m)

《 Sliding Force 》

$$S = \Sigma\{(1 + kv)\cdot Wi\cdot \sin\alpha i + kh\cdot Wi\cdot \cos\alpha i\} + Sp$$

$$MD = \Sigma\{(1 + kv)\cdot Wi\cdot \Delta xi + kh\cdot Wi\cdot \Delta yi\} + Mp + Mw$$

Wi : Total weight of sliced block (using γ_t & γ_{sat}) (tf /m)

αi : Sliding angle of sliced block (degree)

Δxi : Horizontal distance between centers of circle and sliced block (=xg-xo) (m)

Δyi : Vertical distance between centers of circle and sliced block (=yg-yo) (m)

kv, kh : Design seismic intensity

Sp : Sliding force by loads (tf / m)

Mp : Sliding moment by loads (tf·m /m)

Mw : Sliding moment by horizontal water pressure (tf·m /m)

Mw = Pw·(yo-yg)

Pw : Total water pressure (tf)

Yo : Y-coordinate of center of sliding circle

Yg : Y-coordinate of acting point of total water pressure

《 Simplified Slice Method 》

$$T=\Sigma[Ci\cdot Li + \{(Wi' + kv\cdot Wi)\cdot \cos\alpha i - kh\cdot Wi\cdot \sin\alpha i - Ui - \Delta Ui\}\cdot \tan\phi i]$$

Ci, ϕi : Strength of soil (tf /m^2, degree)

Li : Sliding length of slice block (m)

αi : Sliding angle of sliced block (degree)

Wi' : Soil weight of slice block (tf / m)

Ui : Power water pressure (tf / m)

ΔUi : Corrected number for estimating excess hydrostatic pressure (tf / m)

Calculation Results

Method of Analysis	Fellenius method
Rupture Standard	Effective stress method
State of Water	Partially submerged
Sliding shape	Arc
Allowable Safety Factor	1.20
X-Coordinate of Center of Circle (m)	5.40
Y-Coordinate of Center of Circle (m)	19.38
Radius of Arc (m)	16.00
Minimum Safety Factor	1.41
Resistant Force (tf)	77.56
Resistant Moment (tf·m)	1240.92
Sliding Force (tf)	57.20
Sliding Moment (tf·m)	878.84