ARAB REPUBLIC OF EGYPT
MINISTRY OF WATER RESOURCES AND IRRIGATION
RESERVOIR AND GRAND BARRAGES SECTOR

THE ARAB REPUBLIC OF EGYPT
THE PROJECT FOR CONSTRUCTION OF THE NEW DIROUT GROUP OF REGULATORS

DETAILED DESIGN STUDY

FINAL REPORT

Appendix (1/3)

May, 2017

JAPAN INTERNATIONAL COOPERATION AGENCY

SANYU CONSULTANTS INC.

RD
CR(2)
17-034

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DESIGN OF REGULAOTORS

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Hydraulic Calculation

SE=Sudden Expantion GE=Gradual Expantion

SC=Sudden Contraction GC=Gradual Contraction

IN=Inflow head loss

Non-uniform flow calculation table

Case [Bahr Yusef] **Necessary water level** **46.00m** < **46.30m** **OK**

№	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_b (a)+(b) (m)	Total head at Δx 2: Upstream Φ (a)+(b)+(c) (m)	Total head at Δx 2: Downstream Ψ (a)−(b)-(d) (m)
1	295.00		227.000	246.347	0.0250	3.877	0.921	5.020	40.800	45.820	0.050	0.001					45.870	45.871	
2	270.70	24.300	227.000	293.684	0.0250	3.925	0.773	4.738	41.100	45.838	0.034	0.001	0.001				45.872	45.873	45.871
3	246.90	23.800	227.000	292.094	0.0250	4.006	0.777	4.840	41.000	45.840	0.034	0.001	0.001				45.873	45.874	45.873
4	220.00	26.900	227.000	321.752	0.0250	4.147	0.706	5.647	40.200	45.847	0.028	0.000	0.001				45.875	45.875	45.874
5	202.70	17.300	227.000	345.837	0.0250	4.350	0.656	5.452	40.400	45.852	0.024	0.000	0.000				45.876	45.876	45.875
6	183.60	19.100	227.000	405.490	0.0250	4.591	0.560	7.557	38.300	45.857	0.019	0.000	0.000				45.876	45.876	45.876
7	166.00(+)	17.600	227.000	608.922	0.0250	6.591	0.373	10.168	35.700	45.868	0.008	0.000	0.000				45.876	45.876	45.876
														0.030	0.452	SE			
8	166.00(-)	0.000	227.000	199.718	0.0150	4.520	1.137	6.340	39.500	45.840	0.066	0.000	0.000				45.906	45.906	45.876
9	148.50(+)	17.500	227.000	199.736	0.0150	4.521	1.136	6.341	39.500	45.841	0.066	0.000	0.000				45.907	45.907	45.906
														0.007	0.059	SE			
10	148.50(-)	0.000	227.000	37.792	0.0150	2.032	1.502	6.299	39.500	45.799	0.115	0.001	0.000				45.914	45.915	45.907
11	135.75	12.750	227.000	37.807	0.0150	2.032	1.501	6.301	39.500	45.801	0.115	0.000	0.001				45.916	45.916	45.915
12	134.25	1.500	227.000	34.679	0.0150	1.975	1.636	5.780	40.000	45.780	0.137	0.001	0.000				45.916	45.917	45.916
13	129.25	5.000	227.000	34.686	0.0150	1.975	1.636	5.781	40.000	45.781	0.137	0.001	0.001				45.918	45.918	45.917
14	124.25	5.000	227.000	34.693	0.0150	1.975	1.636	5.782	40.000	45.782	0.137	0.000	0.001				45.919	45.919	45.918
15	122.75	1.500	227.000	37.825	0.0150	2.033	1.500	6.304	39.500	45.804	0.115	0.000	0.000				45.919	45.919	45.919
16	121.50(+)	1.250	227.000	37.826	0.0150	2.033	1.500	6.304	39.500	45.804	0.115	0.000	0.000				45.919	45.919	45.919
														0.011	0.097	SC			
17	121.50(-)	0.000	227.000	200.491	0.0150	4.533	1.132	6.365	39.500	45.865	0.065	0.000	0.000				45.930	45.930	45.919
18	109.00(+)	12.500	227.000	200.504	0.0150	4.533	1.132	6.365	39.500	45.865	0.065	0.000	0.000				45.931	45.931	45.930
														0.022	0.336	SC			
19	109.00(-)	0.000	227.000	461.728	0.0250	4.992	0.492	7.139	38.800	45.939	0.014	0.000	0.000				45.952	45.953	45.931
20	84.80	24.200	227.000	406.592	0.0250	4.931	0.558	7.135	38.800	45.935	0.018	0.000	0.000				45.953	45.953	45.953
21	47.15(−)	37.650	227.000	230.696	0.0250	4.738	0.981	6.101	39.800	45.901	0.054	0.000	0.001				45.955	45.955	45.951
														0.001	0.015	SE			
22	47.15(-)	0.000	227.000	202.824	0.0150	4.985	1.119	6.182	39.700	45.882	0.074	0.001	0.000				45.956	45.956	45.955
23	15.00(−)	32.150	227.000	184.060	0.0150	4.674	1.233	6.165	39.700	45.865	0.092	0.000	0.001				45.957	45.957	45.956
														0.004	0.054	SC			
24	15.00(-)	0.000	227.000	222.588	0.0150	3.849	1.020	6.405	39.500	45.905	0.056	0.000	0.000				45.961	45.962	45.957
25	0.00(+)	15.000	227.000	222.606	0.0150	3.849	1.020	6.406	39.500	45.906	0.056	0.000	0.000				45.962	45.962	45.961
														0.013	0.110	SE			
26	0.00(-)	0.000	227.000	148.826	0.0150	1.656	1.525	6.333	39.500	45.833	0.142	0.002	0.000				45.975	45.977	45.962
27	-15.30(+)	15.300	227.000	148.924	0.0150	1.656	1.524	6.337	39.500	45.837	0.142	0.000	0.002				45.979	45.979	45.977
														0.021	0.200	IN			
28	-15.30(-)	0.000	227.000	1300.192	0.0150	6.104	0.175	6.501	39.500	46.001	0.002	0.000	0.000				46.003	46.003	45.979
29	-35.30	20.000	227.000	1300.192	0.0245	6.104	0.175	6.501	39.500	46.001	0.002	0.000	0.000				46.003	46.003	46.002
30	-115.30	80.000	227.000	649.670	0.0240	5.750	0.349	6.497	39.500	45.997	0.006		0.000				46.003		46.003

Non-uniform flow calculation table

Case [Ibrahimia] **Necessary water level** **45.22m** < **46.30m** **OK**

SE=Sudden Expantion GE=Gradual Expantion
SC=Sudden Contraction GC=Gradual Contraction
IN=Inflow head loss

№	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m/s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_b (a)+(b) (m)	Total head at Δx 2: Upstream Φ (a)+(b)+(c) (m)	Total head at Δx 2: Downstream Ψ (a)−(b)-(d) (m)
1	243.30		186.000	286.448	0.0250	4.618	0.649	5.730	39.400	45.130	0.023	0.000					45.153	45.154	
2	225.40	17.900	186.000	290.626	0.0250	4.752	0.640	5.831	39.300	45.131	0.023	0.000	0.000				45.154	45.154	45.153
3	203.00	22.400	186.000	295.571	0.0250	4.586	0.629	5.932	39.200	45.132	0.022	0.000	0.000				45.154	45.155	45.154
4	181.60	21.400	186.000	328.244	0.0250	5.020	0.567	5.838	39.300	45.138	0.018	0.000	0.000				45.155	45.155	45.155
5	166.00(+)	15.600	186.000	288.988	0.0250	4.601	0.644	5.832	39.300	45.132	0.024	0.000	0.000				45.156	45.156	45.155
														0.009	0.151	SE			
6	166.00(-)	0.000	186.000	176.641	0.0150	4.135	1.053	5.608	39.500	45.108	0.057	0.000	0.000				45.164	45.165	45.156
7	148.50(+)	17.500	186.000	176.659	0.0150	4.136	1.053	5.608	39.500	45.108	0.057	0.000	0.000				45.165	45.165	45.164
														0.006	0.059	SE			
8	148.50(-)	0.000	186.000	33.432	0.0150	1.950	1.391	5.572	39.500	45.072	0.099	0.001	0.000				45.171	45.172	45.165
9	135.75	12.750	186.000	33.446	0.0150	1.950	1.390	5.574	39.500	45.074	0.099	0.000	0.001				45.173	45.173	45.172
10	134.25	1.500	186.000	30.320	0.0150	1.882	1.534	5.053	40.000	45.053	0.120	0.001	0.000				45.173	45.174	45.173
11	129.25	5.000	186.000	30.326	0.0150	1.883	1.533	5.054	40.000	45.054	0.120	0.001	0.001				45.174	45.175	45.174
12	124.25	5.000	186.000	30.333	0.0150	1.883	1.533	5.055	40.000	45.055	0.120	0.000	0.001				45.175	45.176	45.175
13	122.75	1.500	186.000	33.462	0.0150	1.951	1.390	5.577	39.500	45.077	0.099	0.000	0.000				45.176	45.176	45.175
14	121.50(+)	1.250	186.000	33.463	0.0150	1.951	1.390	5.577	39.500	45.077	0.099	0.000	0.000				45.176	45.176	45.176
														0.010	0.097	SC			
15	121.50(-)	0.000	186.000	177.311	0.0150	4.147	1.049	5.629	39.500	45.129	0.056	0.000	0.000				45.185	45.185	45.176
16	109.00(+)	12.500	186.000	177.326	0.0150	4.147	1.049	5.629	39.500	45.129	0.056	0.000	0.000				45.186	45.186	45.185
														0.004	0.064	SC			
17	109.00(-)	0.000	186.000	218.917	0.0250	3.447	0.850	5.847	39.300	45.147	0.042	0.002	0.000				45.189	45.191	45.185
18	61.20	47.800	186.000	239.387	0.0250	4.516	0.777	5.758	39.400	45.158	0.034	0.001	0.001				45.192	45.193	45.191
19	27.00(−)	34.200	186.000	242.031	0.0250	4.293	0.768	5.761	39.400	45.161	0.033	0.000	0.001				45.194	45.194	45.193
														0.001	0.017	SE			
20	27.00(-)	0.000	186.000	210.266	0.0150	3.845	0.885	5.153	40.000	45.153	0.042	0.000	0.000				45.195	45.195	45.194
21	15.35(−)	11.650	186.000	210.278	0.0150	3.845	0.885	5.153	40.000	45.153	0.042	0.000	0.000				45.195	45.195	45.195
														0.001	0.029	SC			
22	15.35(-)	0.000	186.000	242.302	0.0150	3.788	0.768	5.355	39.810	45.165	0.031	0.000	0.000				45.196	45.196	45.195
23	0.00(+)	15.350	186.000	242.314	0.0150	3.788	0.768	5.355	39.810	45.165	0.031	0.000	0.000				45.196	45.196	45.196
														0.009	0.125	SE			
24	0.00(-)	0.000	186.000	156.684	0.0150	1.484	1.187	5.311	39.810	45.121	0.084	0.001	0.000				45.206	45.207	45.197
25	-15.30(+)	15.300	186.000	156.769	0.0150	1.484	1.186	5.314	39.810	45.124	0.084	0.000	0.001				45.208	45.208	45.207
														0.011	0.200	IN			
26	-15.30(-)	0.000	186.000	2861.186	0.0150	5.594	0.065	5.722	39.500	45.222	0.000		0.000				45.223		45.208

Non-uniform flow calculation table

Case [Badraman] **Necessary water level 45.96m < 46.30m OK**

SE=Sudden Expantion GE=Gradual Expantion
SC=Sudden Contraction GC=Gradual Contraction
IN=Inflow head loss

No	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m/s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_2 (a)+(b) (m)	Total head at Δx/2: Upstream Φ (a)+(b)+(c) (m)	Total head at Δx/2: Downstream Ψ (a)+(b)-(d) (m)
1	-150.75(-)		9.00	23.78	0.03	1.63	0.38	2.65	43.25	45.90	0.01	0.000					45.91	45.91	
														0.01	0.34	SE			
2	-150.75(−)	0.00	9.00	1.96	0.02	0.71	0.91	2.48	43.10	45.88	0.04	0.002	0.000				45.92	45.92	45.91
3	-136.90	13.85	9.00	4.97	0.02	0.71	0.91	2.48	43.40	45.88	0.04	0.000	0.002				45.93	45.93	45.92
														0.01	0.20	GE			
4	-135.90	1.00	9.00	3.93	0.02	0.66	1.15	1.96	43.90	45.86	0.07	0.002	0.000				45.93	45.93	45.93
5	-128.40	7.50	9.00	3.94	0.02	0.66	1.14	1.97	43.90	45.87	0.07	0.000	0.002				45.93	45.94	45.93
														0.00	0.10	GC			
6	-127.40	1.00	9.00	4.99	0.02	0.71	0.90	2.50	43.40	45.90	0.04	0.000	0.000				45.94	45.94	45.94
7	-126.05(-)	1.35	9.00	4.99	0.02	0.71	0.90	2.50	43.40	45.90	0.04	0.000	0.000				45.94	45.94	45.94
														0.01	0.36	SC			
8	-126.05(−)	0.00	9.00	24.74	0.03	2.16	0.36	2.95	42.99	45.94	0.01	0.001	0.000				45.95	45.95	45.94
9	-30.00(-)	96.05	9.00	27.64	0.03	2.35	0.33	3.15	42.80	45.95	0.01	0.000	0.001				45.96	45.96	45.95
														0.00	0.00	SE			
10	-30.00(+)	0.00	9.00	83.36	0.02	3.22	0.11	5.95	40.00	45.95	0.00	0.000	0.000				45.95	45.95	45.96
11	-12.00(-)	18.00	9.00	83.36	0.02	3.22	0.11	5.95	40.00	45.95	0.00	0.000	0.000				45.95	45.95	45.96
														0.00	0.29	SE			
12	-12.00(+)	0.00	9.00	38.69	0.02	2.10	0.23	5.95	40.00	45.95	0.00	0.000	0.000				45.96	45.96	45.96
13	-4.85	7.15	9.00	38.69	0.02	2.10	0.23	5.95	40.00	45.95	0.00	0.000	0.000				45.96	45.96	45.96
														0.00	0.20	GE			
14	-2.45	2.40	9.00	17.84	0.02	1.20	0.50	5.95	40.00	45.95	0.01	0.000	0.000				45.96	45.96	45.96
15	15.35(-)	17.80	9.00	17.84	0.02	1.20	0.50	5.95	40.00	45.95	0.01	0.000	0.000				45.96	45.96	45.96
														0.00	0.10	IN			
16	15.35(+)	0.00	9.00	595.99	0.03	5.33	0.02	5.96	40.00	45.96	0.00		0.000				45.96		45.96

Non-uniform flow calculation table

Case [Diroutiah] **Necessary water level 45.95m < 46.30m OK**

SE=Sudden Expantion GE=Gradual Expantion
SC=Sudden Contraction GC=Gradual Contraction
IN=Inflow head loss

No	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m/s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_2 (a)+(b) (m)	Total head at Δx/2: Upstream Φ (a)+(b)+(c) (m)	Total head at Δx/2: Downstream Ψ (a)+(b)-(d) (m)
1	-150.75(-)		9.00	30.24	0.03	1.71	0.30	2.40	43.50	45.90	0.00	0.000					45.90	45.90	
														0.01	0.32	SE			
2	-150.75(−)	0.00	9.00	1.38	0.02	0.69	0.69	2.19	43.70	45.89	0.02	0.001	0.000				45.91	15.91	15.91
3	-136.90	13.85	9.00	4.32	0.02	0.68	1.04	2.16	43.70	45.86	0.06	0.000	0.003				45.92	45.92	45.91
														0.01	0.20	GE			
4	-135.90	1.00	9.00	3.26	0.02	0.62	1.38	1.63	44.20	45.83	0.10	0.003	0.000				45.93	45.93	45.92
5	-128.40	7.50	9.00	3.27	0.02	0.62	1.38	1.63	44.20	45.83	0.10	0.000	0.003				45.93	45.93	45.93
														0.00	0.10	GC			
6	-127.40	1.00	9.00	4.36	0.02	0.69	1.03	2.18	43.70	45.88	0.05	0.000	0.000				45.94	45.94	45.93
7	-126.05(-)	1.35	9.00	4.43	0.02	0.69	0.68	2.21	43.70	45.91	0.02	0.000	0.000				45.94	45.94	45.94
														0.01	0.33	SC			
8	-126.05(−)	0.00	9.00	29.61	0.03	1.99	0.30	2.35	43.59	45.94	0.01	0.001	0.000				45.94	45.95	45.94
9	-30.00(-)	96.05	9.00	31.12	0.03	2.01	0.26	2.39	43.55	45.94	0.00	0.000	0.001				45.95	45.95	45.95
														0.00	0.35	SC			
10	-30.00(+)	0.00	9.00	83.25	0.02	3.22	0.11	5.95	40.00	45.95	0.00	0.000	0.000				45.95	45.95	45.95
11	-12.00(-)	18.00	9.00	83.25	0.02	3.22	0.11	5.95	40.00	45.95	0.00	0.000	0.000				45.95	45.95	45.95
														0.00	0.29	SE			
12	-12.00(+)	0.00	9.00	38.64	0.02	2.10	0.23	5.95	40.00	45.95	0.00	0.000	0.000				45.95	45.95	45.95
13	-4.85	7.15	9.00	38.64	0.02	2.10	0.23	5.95	40.00	45.95	0.00	0.000	0.000				45.95	45.95	45.95
														0.00	0.20	GE			
14	-2.45	2.40	9.00	17.81	0.02	1.20	0.51	5.94	40.00	45.94	0.01	0.000	0.000				45.95	45.95	45.95
15	15.35(-)	17.80	9.00	17.81	0.02	1.20	0.51	5.94	40.00	45.94	0.01	0.000	0.000				45.95	45.95	45.95
														0.00	0.10	IN			
16	15.35(+)	0.00	9.00	595.21	0.03	5.32	0.02	5.95	40.00	45.95	0.00		0.000				45.95		45.95

Non-uniform flow calculation table

Case [Abo Gabal] **Necessary water level 45.94m < 46.30m OK**

SE=Sudden Expantion GE=Gradual Expantion
SC=Sudden Contraction GC=Gradual Contraction
IN=Inflow head loss

№	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m/s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_2 (a)+(b) (m)	Total head at Δx/2: Upstream Φ (a)+(b)+(c) (m)	Total head at Δx/2: Downstream Ψ (a)+(b)-(d) (m)
1	-100.00(-)		7.00	19.09	0.03	1.53	0.37	2.30	43.60	45.90	0.01	0.001					45.91	45.91	
2	-66.50(-)	33.50	7.00	19.11	0.03	1.53	0.37	2.30	43.60	45.90	0.01	0.000	0.001				45.91	45.91	45.91
														0.00	0.05	SE			
3	-66.50(+)	0.00	7.00	14.94	0.02	1.35	0.47	2.30	43.60	45.90	0.01	0.001	0.000				45.91	45.91	45.91
4	-20.80(-)	45.70	7.00	14.95	0.02	1.35	0.47	2.30	43.60	45.90	0.01	0.000	0.001				45.91	45.91	45.91
														0.00	0.05	SE			
5	-20.80(+)	0.00	7.00	11.68	0.02	1.08	0.60	3.89	42.00	45.89	0.02	0.000	0.000				45.91	45.91	45.91
6	-11.40	9.40	7.00	11.68	0.02	1.08	0.60	3.89	42.00	45.89	0.02	0.001	0.000				45.91	45.91	45.91
7	4.20	15.60	7.00	11.68	0.02	1.08	0.60	3.89	42.00	45.89	0.02	0.000	0.001				45.91	45.91	45.91
8	5.20	1.00	7.00	11.68	0.02	1.08	0.60	3.89	42.00	45.89	0.02	0.000	0.000				45.91	45.91	45.91
														0.00	0.20	GC			
9	14.65	9.45	7.00	18.09	0.02	1.45	0.39	3.91	42.00	45.91	0.01	0.000	0.000				45.92	45.92	45.91
														0.01	0.20	GE			
10	16.80(-)	2.15	7.00	8.69	0.02	1.03	0.81	1.74	44.15	45.89	0.03	0.000	0.000				45.92	45.92	45.92
														0.00	0.04	SE			
11	16.80(+)	0.00	7.00	3.44	0.02	0.63	1.02	1.72	44.15	45.87	0.05	0.003	0.000				45.92	45.93	45.92
12	31.00(-)	14.20	7.00	3.45	0.02	0.63	1.01	1.73	44.15	45.88	0.05	0.000	0.003				45.93	45.93	45.93
														0.01	0.10	IN			
13	31.00(+)	0.00	7.00	293.94	0.03	2.78	0.02	2.94	43.00	45.94	0.00		0.000				45.94		45.93

Non-uniform flow calculation table

Case [Irad Delgaw] **Necessary water level 45.95m < 46.30m OK**

SE=Sudden Expantion GE=Gradual Expantion
SC=Sudden Contraction GC=Gradual Contraction
IN=Inflow head loss

No	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m/s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_2 (a)+(b) (m)	Total head at Δx/2: Upstream Φ (a)+(b)+(c) (m)	Total head at Δx/2: Downstream Ψ (a)+(b)-(d) (m)
1	-50.00(-)		9.00	23.78	0.03	1.63	0.38	2.65	43.25	45.90	0.01	0.001					45.91	45.91	
2	-20.80(-)	29.20	9.00	23.80	0.03	1.63	0.38	2.65	43.25	45.90	0.01	0.000	0.001				45.91	45.91	45.91
														0.00	0.10	SC			
3	-20.80(+)	0.00	9.00	31.63	0.02	1.99	0.28	3.91	42.00	45.91	0.00	0.000	0.000				45.91	45.91	45.91
4	-11.40(-)	9.40	9.00	31.63	0.02	1.99	0.28	3.91	42.00	45.91	0.00	0.000	0.000				45.91	45.91	45.91
														0.00	0.07	SE			
5	-11.40(+)	0.00	9.00	11.71	0.02	1.08	0.38	3.90	42.00	45.90	0.01	0.000	0.000				45.91	45.91	45.91
6	4.20(-)	15.60	9.00	11.71	0.02	1.08	0.38	3.90	42.00	45.90	0.01	0.000	0.000				45.91	45.91	45.91
7	5.20	1.00	9.00	11.71	0.02	1.08	0.38	3.90	42.00	45.90	0.01	0.000	0.000				45.91	45.91	45.91
8	14.65	9.45	9.00	8.53	0.02	0.85	0.53	3.90	42.00	45.90	0.01	0.000	0.000				45.91	45.91	45.91
														0.02	0.20	GE			
9	16.80	2.15	9.00	3.37	0.02	0.63	1.33	1.69	44.15	45.84	0.09	0.005	0.001				45.93	45.93	45.91
														0.00	0.10	GC			
10	31.00(-)	14.20	9.00	3.40	0.02	0.63	1.33	1.70	44.15	45.85	0.09	0.000	0.005				45.94	45.94	45.93
														0.01	0.10	IN			
11	31.00(+)	0.00	9.00	294.64	0.03	2.78	0.03	2.95	43.00	45.95	0.00		0.000				45.95		45.94

Non-uniform flow calculation table

Case [Sahelyia] **Necessary water level 45.93m < 46.30m OK**

SE=Sudden Expantion GE=Gradual Expantion
SC=Sudden Contraction GC=Gradual Contraction
IN=Inflow head loss

No	Station name	Interval distance Δx (m)	Quantity of flow Q (m^3/s)	Area of water flow A (m^2)	Complex roughness coefficient n	Hydraulic radius R (m)	Flow velocity U (m/s)	Water depth h (m)	Bed elevation Zb (m)	Water level Zb+h (a) (m)	Velocity head (b) (m)	Friction head loss (c) (m)	Friction head loss (d) (m)	Other head losses: Head loss (m)	Other head losses: Coefficient of loss f	Other head losses: Name of loss	Total head H_2 (a)+(b) (m)	Total head at Δx/2: Upstream Φ (a) (b) (c) (m)	Total head at Δx/2: Downstream Ψ (a)+(b)-(d) (m)
1	-50.00(-)		5.00	19.22	0.03	1.42	0.26	2.10	43.80	45.90	0.00	0.000					45.90	45.90	
2	-22.70(-)	27.30	5.00	19.22	0.03	1.42	0.26	2.10	43.80	45.90	0.00	0.000	0.000				45.90	45.90	45.90
														0.00	0.32	SC			
3	-22.70(+)	0.00	5.00	42.16	0.02	2.28	0.12	5.20	40.70	45.90	0.00	0.000	0.000				45.91	45.91	45.90
4	-11.10(-)	11.60	5.00	42.16	0.02	2.28	0.12	5.20	40.70	45.90	0.00	0.000	0.000				45.91	45.91	45.91
														0.00	0.07	SE			
5	-11.10(+)	0.00	5.00	15.61	0.02	1.16	0.16	5.20	40.70	45.90	0.00	0.000	0.000				45.91	45.91	45.91
6	4.60(-)	15.70	5.00	15.61	0.02	1.16	0.16	5.20	40.70	45.90	0.00	0.000	0.000				45.91	45.91	45.91
7	5.60	1.00	5.00	15.61	0.02	1.16	0.16	5.20	40.70	45.90	0.00	0.000	0.000				45.91	45.91	45.91
8	6.85	1.25	5.00	14.36	0.02	1.09	0.17	5.20	40.70	45.90	0.00	0.000	0.000				45.91	45.91	45.91
														0.01	0.20	GE			
9	10.80	3.95	5.00	2.43	0.02	0.55	1.03	1.21	44.65	45.86	0.05	0.004	0.001				45.92	45.92	45.91
														0.00	0.10	GC			
10	24.00(-)	13.20	5.00	2.44	0.02	0.55	1.02	1.22	44.65	45.87	0.05	0.000	0.003				45.92	45.92	45.92
														0.01	0.10	IN			
11	24.00(+)	0.00	5.00	242.92	0.03	2.32	0.02	2.43	43.50	45.93	0.00		0.000				45.93		45.92

APPENDIX A-2

Examination sheet of Seismic Conditions

Seismic Design of Dairout Regulator

1. MAIN ITEMS USED IN THE SEISMIC DESIGN

First, the main items that used in the seismic design will be reviewed according to the Egyptian code for design and construction of bridges (especially, part (4): loads and forces on bidges).

a) Design Ground Acceleration (a_g):

- The Structure under study lies in Dairout city (Assuit governorate) between Minia and Assuit governorates.
- According to Table (4-9-2-b)
  Assuit ---------- zone (1)
  Minia ---------- zone (1)
  ⟹ Dairout ---------- zone (1)
- According to Table (4-9-2-a)

  Zone (1) ---------- $a_g = 0.1g$

b) Limit State & Working Stress Design Methods:

- The seismic design loads used in the Egyptian loads for bridges are loads for limit state design method.
- For working stress design method, design loads can be divided by 1.40

[clause 4.9.1.1]

c) Importance Factor (γ_I):

The Structure under study is a main structure

$\gamma_I = 1.30$ • •

(Factor is upgraded to 1.4 due to important structure)

[clause 4.9.6]

d) Appropriate Method of Analysis:

- The Structure under study achieves the conditions of uniform structural system.
  [Table (4-9-6)]
- The Structure lies in zone (1).

From Table (4.9.8)

Uniform load method is ⟹ the appropriate method of analysis.

e) Equivalent Live Load:

- Equivalent Live Load can be taken equal to 500 kg/m^2 for roadway bridges.

[clause 4.9.8.1.4]

The percentage of live load (ψ) that used in the design load (W) is equal to 0.20 for roadway bridges.

$\psi = 0.20$

[Table (4-9-7)]

f) Subsoil Class:

- From soil test --------- $50 > N_{SPT} > 15$

According to Table (4.9.8) ⟹ Subsoil class is " C "

g) Type of Response Spectrum:

- The Structure under study lies in Dairout city (Assuit governorate) between Minia and Assuit governorates.

⟹ Type (1) of response spectrum curve is the appropriate type.

[clause 4.9.4.2.1.3]

h) Effective Properties of Cross Section Area (A_{eff} , I_{eff}):

- No reduction in the cross section area due to cracks effect.

  $A_{eff} = A_g$

  Where A_g= gross area of the cross section
- Due to cracks effect, the moment of inertia of the cross section is reduced as follow

  $I_{eff} = 0.70\ I_g$ ------- for reinforced concrete walls

  Where I_g= gross moment of inertia of the cross section

[clause 4.9.8.1.2]

i) Response Modification Factor (R):

- Vertical piers in bending
- $a_s = 9.00/2.50 > 3.00$ ----------ductile supports (piers)

From Table (4.9.9) ⟹ R = 3.50

2. SEISMIC DESIGN USING UNIFORM LOAD METHOD

2.1 Horizontal Components of the seismic action

a. Design criteria

$$F - S(T_1)\frac{W}{g}$$

Where,
F = Equivalent static force
$S(T_1)$ = Horizontal design spectrum
W = Design weight (weight of the bridge + weight of the upper half of piers and abutments + and percentage of equivalent live load)

$$0 \le T \le T_b \qquad S_d(T) = a_g\ \gamma_I\ S\left[\frac{2}{3} + \frac{T}{T_b}\left(\frac{2.5}{R} - \frac{2}{3}\right)\right]$$

$$T_b \le T \le T_c \qquad S_d(T) = a_g\ \gamma_I\ S\ \frac{2.5}{R}$$

$$T_c \le T \le T_d \qquad S_d(T) - a_g\ \gamma_I\ S\ \frac{2.5}{R}\left[\frac{T_c}{T}\right] \ge 0.20\ a_g\ \gamma_I$$

$$T_d \le T \le 4\,\text{sec.} \qquad S_d(T) = a_g\ \gamma_I\ S\ \frac{2.5}{R}\left[\frac{T_c\,T_d}{T^2}\right] \ge 0.20\ a_g\ \gamma_I$$

Using type (1) of response spectrum & for subsoil class "C"
S=1.50

$T_b = 0.10 \qquad T_c = 0.25 \qquad T_d = 1.20$

$$T = 2\pi\sqrt{\frac{M}{K}}$$

Where, M= design mass = W/g

$$K = \frac{L_s}{\Delta}$$

L_s= bridge length in the required direction.
Δ = maximum drift in the required direction.

$$T = 2\pi\sqrt{\frac{528.86 \times 9.81}{9.81 \times 214646}} = 0.312\,\text{sec.}$$

$$(T_c = 0.25) \le (T = 0.312) \le (T_d = 1.20)$$

$$S_d(T) - a_g\ \gamma_I\ S\ \frac{2.5}{R}\left[\frac{T_c}{T}\right] \ge 0.20\ a_g\ \gamma_I$$

$$S_d(T) = (0.1g)\ (1.30)\ (1.50)\ \frac{2.5}{3.50}\left[\frac{0.25}{0.312}\right] = 0.112g \geq (0.20\ a_g\ \gamma_I = 0.026g)$$

$S_d(T) = 0.112g$ Limit State Design

$S_d(T) = 0.112g / 1.40$
$= 0.08g$ Working Stresses Design

b. Horizontal Component perpendicular the Traffic Direction

No need to check the Horizontal Component perpendicular the Traffic Direction because the high stiffness of the structure in this direction

2.2 Vertical Component

The effects of the vertical seismic component on the piers may be omitted in cases of low and moderate seismicity [zones (1), (2) and (3)]. In zones of high seismicity these effects need only to be taken into account if the piers are subject to high bending stresses due to vertical permanent actions of the deck, or when the structure is located within 5 km of an active seism tectonic fault.

[clause 5.3.3.8.2]

APPENDIX A-3

Traffic Survey Report – Dirout Regulator Bridge

Dairut Regulator Bridge - Traffic Study

Input data:

- Classified 24-hr traffic counts for motorized and non-motorized traffic. Traffic counts were conducted during a typical weekday (Monday) and on weekend (Friday). Counts were conducted in April 2010. Counts were projected to year 2016 using 2% annual growth rate.
- Width of the existing Dairut Regulator Bridge is about 12 m.
- Attachment 1 includes the traffic counts.

Assumptions:

- Annual growth rate = 2%
- Width of the existing bridge acts as 2 lanes for motorized traffic with width of 7.0 m, and two walkways (each of 3-m wide) for non-motorized traffic.
- Capacity of one lane deducted for motorized traffic = 1000 passenger car units per hour
- Capacity of each walkway is 60 person per minute considering that the effective width of a walkway is equal 2 m.
- Traffic projection is made every 5 years to year 2050.
- Passenger car unit equivalency to normal car (according to the Egyptian Code for " Rural and Urban Roads " (104-2008) the second volume " Traffic Engineering":

Big Track	Mid Track	Buss	Mini Bus	Normal Car	Tractor	Moto Cycle	Bicycle	Caret
3	2	3	1	1	3	0.5	0.5	3

- Person unit equivalency

Donkey/Horse	Pedestrian
4	1

Findings:

- Peak traffic volumes for both motorized and non-motorized for weekdays are higher than that of Friday.
- The current volume to capacity ratio is almost or exceeding capacity.
- Width of the bridge will need to be doubled by year 2050.

Table 1

Peak-Hour Motorized Traffic

Year	Weekday			Friday		
	E-W	W-E	Total	E-W	W-E	Total
2016	980	1,110	2,090	213	179	392
2020	1,061	1,201	2,262	230	194	424
2025	1,171	1,326	2,497	254	214	468
2030	1,293	1,464	2,757	281	236	517
2035	1,427	1,617	3,044	310	261	571
2040	1,576	1,785	3,361	342	288	630
2045	1,740	1,971	3,711	378	318	696
2050	1,921	2,176	4,097	417	351	768

Volume to Capacity Ratios for Motorized Traffic

Year	Weekday			Friday		
	E-W	W-E	Total	E-W	W-E	Total
2016	98%	111%	104%	21%	18%	20%
2020	106%	120%	113%	23%	19%	21%
2025	117%	133%	125%	25%	21%	23%
2030	129%	146%	138%	28%	24%	26%
2035	143%	162%	152%	31%	26%	29%
2040	158%	179%	168%	34%	29%	32%
2045	174%	197%	186%	38%	32%	35%
2050	192%	218%	205%	42%	35%	38%

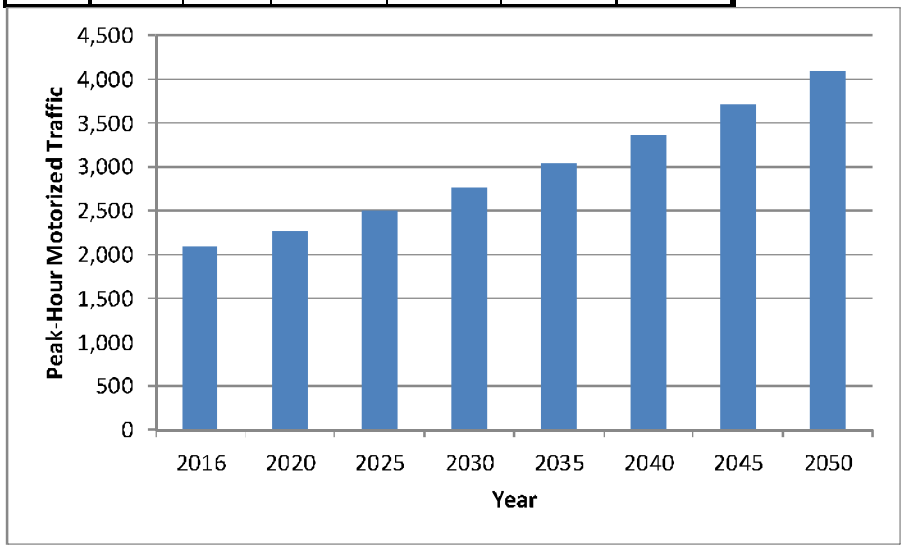


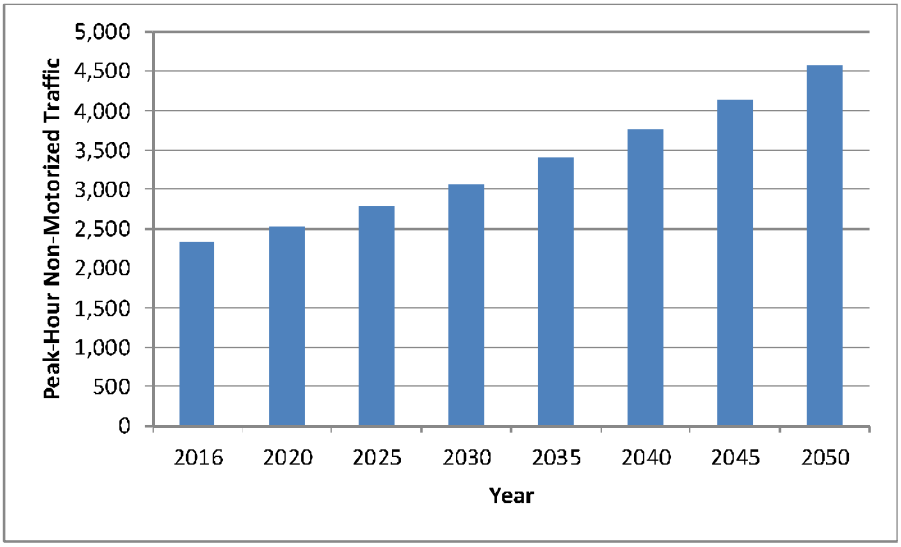
Table 2

Peak-Hour Non-Motorized Traffic

Year	Weekday			Friday		
	E-W	W-E	Total	E-W	W-E	Total
2016	1,617	716	2,333	282	244	526
2020	1,750	775	2,526	305	265	569
2025	1,933	856	2,789	336	292	629
2030	2,134	945	3,079	371	322	694
2035	2,356	1,043	3,399	410	356	766
2040	2,601	1,152	3,753	453	393	846
2045	2,872	1,272	4,144	500	434	934
2050	3,171	1,404	4,575	552	479	1,031

Volume to Capacity Ratios for Non-Motorized Traffic

Year	Weekday			Friday		
	E-W	W-E	Total	E-W	W-E	Total
2016	45%	20%	32%	8%	7%	7%
2020	49%	22%	35%	8%	7%	8%
2025	54%	24%	39%	9%	8%	9%
2030	59%	26%	43%	10%	9%	10%
2035	65%	29%	47%	11%	10%	11%
2040	72%	32%	52%	13%	11%	12%
2045	80%	35%	58%	14%	12%	13%
2050	88%	39%	64%	15%	13%	14%



According to the Egyptian Code for " Rural and Urban Roads" 104-2008) the third volume " Geometric Design " the minimum width of the lane is from 3m to 3.6m, and the sidewalk width is equal to 1.5m, it could be concluded that:

From the traffic prediction the total width of the bridge after 50 years should be 24 meters (which means 8 lanes, 3 meters each) undivided for both directions. This will make conflicts as the traffic is mixed including motorized and non-motorized traffic (caret, donkey/horse ,pedestrian) which needs to be divided by a median or a curb one meter width. Pedestrians also need two sidewalks 1.5m each (according to the Egyptian Code) on each side of the bridge.

With the existing bridge width the current traffic will only be accepted for four years with lot of conflicts and delays.

So it could be concluded the following options:

1- To keep and use the bridge width of 12 meters for another 4 years till 2020.

2- To widen the bridge to be 6 lanes (3 meters each) divided by a median or a curb one meter which make the total width 25 meters.

3- To construct another bridge as the limitation of the existing bridge is 12 meters and cannot be widened.

It should be taken into consideration that the prediction of the traffic after 100 years will be more than double the predicted for the 50 years which needs a full study of the options of using other alternatives depending on the land use, the extension of the city and the growth of population.

Attachment 1

Place Surveyed:		Dairut Regulator Bridge										
Survey Date:		Monday, February 08, 2010										
Direction:		East to West		Westbound								
AM/PM	Time	Big Track	Mid Track	Buss	Mini Bus	Normal Car	Tractor	Moto Cycle	Bicycle	Caret	Donkey/Horse	Pedestrian
PM	6-7	0	37	0	50	22	2	195	24	36	45	270
	7-8	0	89	0	99	86	4	384	42	94	70	779
	8-9	0	66	0	85	43	2	359	42	98	114	980
	9-10	0	23	0	62	20	3	197	20	24	24	791
	10-11	0	7	0	20	2	4	128	6	18	7	724
	11-12	0	17	0	39	34	0	203	4	31	31	522
	12-1	0	24	0	14	7	0	115	12	0	32	339
AM	1-2	0	12	0	15	0	0	39	0	0	0	331
	2-3	0	12	0	14	10	5	86	15	27	25	284
	3-4	0	20	0	18	19	28	117	8	14	8	410
	4-5	0	10	0	18	11	27	106	8	5	4	385
	5-6	0	8	0	7	7	17	94	8	12	4	348
	6-7	0	7	0	10	5	15	114	4	2	2	273
	7-8	0	5	0	8	14	12	69	8	2	0	115
	8-9	0	4	0	12	17	20	104	12	0	0	88
	9-10	0	12	0	7	22	17	70	10	8	0	108
	10-11	0	11	0	12	23	6	87	8	5	0	120
	11-12	0	8	0	5	25	2	65	12	0	0	80
PM	12-1	0	9	0	7	12	0	28	5	0	0	56
	1-2	0	3	0	2	5	0	32	1	0	0	34
	2-3	0	1	0	3	6	0	16	0	0	0	8
	3-4	0	0	0	0	1	0	4	0	0	0	0
	4-5	0	0	0	1	2	0	0	0	16	3	0
	5-6	0	23	0	45	18	0	167	12	23	34	160
Total		0	408	0	553	411	164	2779	261	415	403	7205

Place Surveyed:		Dairut Regulator Bridge										
Survey Date:		Monday, February 08, 2010										
Direction:		West to East		Eastbound								
AM/PM	Time	Big Track	Mid Track	Buss	Mini Bus	Normal Car	Tractor	Moto Cycl	Bicycle	Caret	Donkey/H	Pedestrian
PM	6-7	1	16	0	22	14	0	53	20	16	12	50
	7-8	2	44	0	49	43	2	109	52	52	33	95
	8-9	0	108	0	108	107	0	272	129	118	104	220
	9-10	0	40	0	40	38	1	151	65	46	42	260
	10-11	0	15	0	15	16	0	122	30	21	25	205
	11-12	0	17	0	17	13	1	117	29	22	30	160
	12-1	0	19	0	19	19	1	186	30	20	23	135
AM	1-2	0	51	0	51	41	9	302	57	35	33	331
	2-3	0	61	0	61	48	14	173	32	39	60	178
	3-4	0	40	0	40	68	27	223	47	68	67	253
	4-5	0	46	0	46	53	6	248	18	34	44	303
	5-6	0	38	0	38	43	13	193	22	43	52	281
	6-7	0	23	0	23	56	19	207	28	9	38	193
	7-8	0	13	0	13	63	11	168	24	11	0	87
	8-9	0	9	0	9	18	8	119	13	8	0	121
	9-10	0	18	0	18	57	7	154	16	6	0	168
	10-11	0	6	0	19	45	2	200	12	2	0	156
	11-12	0	3	0	20	34	0	230	8	0	0	140
PM	12-1	0	7	0	9	23	0	170	7	0	0	76
	1-2	0	2	0	7	16	0	76	1	0	0	34
	2-3	0	0	0	3	8	0	34	0	0	0	16
	3-4	0	0	0	0	1	0	0	0	0	0	1
	4-5	0	5	0	0	0	0	0	0	12	3	0
	5-6	0	14	0	13	5	1	65	13	16	9	45
Total		3	595	0	640	829	122	3572	653	578	575	3508

Place Surveyed:		Dairut Regulator Bridge										
Survey Date:		Friday, February 12, 2010										
Direction:		East to West		Westbound								
AM/PM	Time	Big Track	Mid Track	Buss	Mini Bus	Normal Ca	Tractor	Moto Cycl	Bicycle	Caret	Donkey/H	Pedestrian
PM	6-7	0	6	0	9	5	0	20	6	6	9	25
	7-8	0	7	0	7	7	0	33	9	10	23	55
	8-9	0	9	0	7	7	1	60	13	11	23	97
	9-10	0	12	0	6	9	2	64	21	15	15	108
	10-11	1	14	0	12	14	1	97	22	13	12	147
	11-12	0	21	0	14	9	0	104	30	19	12	202
	12-1	0	10	0	7	8	0	59	18	9	7	112
AM	1-2	0	6	0	8	9	0	34	15	10	9	76
	2-3	0	17	0	10	15	2	64	20	12	10	138
	3-4	1	15	0	11	7	0	73	14	10	7	116
	4-5	1	13	0	8	10	2	74	15	8	5	117
	5-6	0	14	0	13	9	0	85	22	13	10	144
	6-7	0	19	0	14	9	0	49	17	10	3	103
	7-8	0	9	0	14	8	0	51	13	4	2	96
	8-9	0	12	0	5	8	0	33	10	5	0	69
	9-10	0	10	0	8	5	0	24	7	5	0	45
	10-11	0	8	0	6	6	0	25	8	7	0	54
	11-12	1	7	1	5	7	0	23	5	3	0	23
PM	12-1	0	3	0	3	3	0	8	6	2	0	18
	1-2	0	1	0	1	2	0	6	2	0	0	21
	2-3	0	0	0	0	1	0	2	1	0	0	5
	3-4	0	0	0	0	0	0	0	0	0	0	0
	4-5	0	0	0	0	1	1	2	0	5	0	0
	5-6	0	4	0	8	3	2	14	4	8	7	25
Total		4	217	1	176	162	11	1004	278	185	154	1796

Place Surveyed:		Dairut Regulator Bridge										
Survey Date:		Friday, February 12, 2010										
Direction:		West to East		Eastbound								
AM/PM	Time	Big Track	Mid Track	Buss	Mini Bus	Normal Car	Tractor	Moto Cycle	Bicycle	Caret	Donkey/Horse	Pedestrian
PM	6-7	2	4	0	4	5	4	10	4	2	5	6
	7-8	1	6	0	7	10	5	36	12	7	7	52
	8-9	0	10	0	7	6	0	44	15	8	7	81
	9-10	0	14	0	9	4	0	68	14	12	3	15
	10-11	0	18	0	12	6	2	78	18	17	8	128
	11-12	0	13	0	8	3	3	76	18	10	4	160
	12-1	0	10	0	4	4	3	85	11	8	9	169
AM	1-2	0	8	0	7	4	2	66	8	6	7	104
	2-3	0	11	0	6	8	5	78	7	9	5	132
	3-4	0	6	0	4	4	1	40	4	5	4	77
	4-5	0	11	0	6	4	2	57	2	6	4	105
	5-6	0	10	0	4	6	1	96	9	9	21	133
	6-7	0	5	0	2	2	0	88	4	3	1	156
	7-8	0	6	0	2	2	1	91	1	2	3	128
	8-9	0	7	0	3	4	0	70	0	3	0	85
	9-10	0	2	0	1	2	0	24	0	2	0	26
	10-11	0	7	0	4	5	0	50	5	6	0	45
	11-12	0	6	0	5	7	0	45	2	3	0	87
PM	12-1	0	3	0	3	3	0	43	0	1	0	34
	1-2	0	6	0	5	5	0	32	0	0	0	12
	2-3	0	5	0	2	1	0	6	0	0	0	5
	3-4	0	2	0	0	0	0	1	0	0	0	1
	4-5	0	1	0	4	0	2	3	1	0	0	0
	5-6	0	5	0	5	4	7	8	6	6	3	15
Total		3	176	0	114	99	38	1195	141	125	91	1756

APPENDIX A-4

Calculation sheet for the Structural Stability of NDGRs

A-4-1. Bahr Yusef and Ibrahimia Regulator

Summary table of result on the stability examination for Bahr Yusef and Ibrahimia Regulator

Pier	Case	Direction	Condition	Vertical force V (kN)	Resistant moment V･x (kN･m)	Horizontal force H (kN)	Torque moment H･y (kN･m)	For the sliding Safe ratio Required ratio		For the fall down Eccentricity e (m)		For the ground reaction Ground reaction Q1 (kN/m2)	Ground reaction Q2 (kN/m2)	Bearing (kN/m2)	Judge	Remarks
									Desing		B/6 (Allowable)					
Bhar Yusef and Ibrahimia Regulator	1	Long.	Regular	91,358.69	1,220,699.63	883.93	9,863.23	1.50	≦ 62.01	-0.48	≦ 4.65	82.72	101.76		OK	
	2	Long.	Regular	88,729.08	1,141,261.14	14,388.83	42,991.19	1.50	≦ 3.70	-0.60	≦ 4.65	78.03	101.14		OK	
	3	Long.	Regular	134,758.39	1,829,038.99	987.46	9,781.09	1.50	≦ 81.88	-0.30	≦ 4.65	127.28	144.84		OK	
	4	Lateral.	Regular	90,408.54	1,604,751.58	724.42	7,830.98	1.50	≦ 74.88	0.09	≦ 5.92	92.67	89.89		OK	
	5	Lateral.	Regular	88,729.08	1,574,941.17	1,777.68	17,865.68	1.50	≦ 29.95	0.20	≦ 5.92	92.61	86.56		OK	
	6	Lateral.	Regular	134,758.39	2,391,961.42	2,506.86	16,645.55	1.50	≦ 32.25	0.12	≦ 5.92	138.82	133.30		OK	
	7	Long.	Seism	85,846.08	1,093,259.19	25,761.42	91,358.30	1.15	≦ 2.00	-0.15	≦ 9.30	83.88	89.47		OK	
	8	Long.	Seism	131,875.39	1,788,821.14	10,550.03	50,299.11	1.15	≦ 7.50	0.00	≦ 9.30	133.15	133.15		OK	
	9	Lateral.	Seism	87,525.54	1,553,578.33	14,202.59	68,505.54	1.15	≦ 3.70	0.78	≦ 11.83	100.02	76.72		OK	
	10	Lateral.	Seism	85,846.08	1,523,767.92	11,091.17	52,615.99	1.15	≦ 4.64	0.61	≦ 11.83	95.61	77.74		OK	
	11	Lateral.	Seism	131,875.39	2,340,788.17	10,550.03	50,299.11	1.15	≦ 7.50	0.38	≦ 11.83	141.70	124.60		OK	
	12	Long.	Seism	89,965.54	1,194,735.08	10,909.75	54,140.20	1.15	≦ 4.95	-0.07	≦ 9.30	89.47	92.20		OK	
	13	Long.	Regular	80,093.13	1,187,305.92	2,811.86	9,431.98	1.50	≦ 17.09	0.99	≦ 4.65	98.08	63.65		OK	Bahr Yusef
	13	Long.	Regular	80,819.68	1,181,724.85	4,765.33	17,219.80	1.50	≦ 10.18	0.88	≦ 4.65	97.04	66.16		OK	Ibrahimia

Note 1) Ground reaction for the bearing capacity should be consideration in Chapter 12

Bahr Yusef and Ibrahimia Regulator / Stability examination

1.Design condition

(1)Dimension of form for abutment Pier 〔unite : m〕

A(1)=	27.90	A(2)=	0.00	A(3)=	1.65	A(4)=	1.00	A(5)=	9.00	A(6)=	1.00	A(7)=	15.25
A(8)=	1.00	A(9)=	24.90	A(10)=	2.00	A(11)=	4.00	A(12)=	1.00	A(13)=	2.40	A(14)=	1.00
A(15)=	16.50	A(16)=	5.00	A(17)=	4.40	A(18)=	18.50	A(19)=	2.15	A(20)=	2.25	A(21)=	1.00
A(22)=	1.00	A(23)=	1.00	A(24)=	0.71	A(25)=	0.60	A(26)=	1.09	A(27)=	7.25	A(28)=	11.25
A(29)=	1.00	A(30)=	1.00	A(31)=	1.00	A(32)=	1.00	A(33)=	1.00	A(34)=	2.00	A(35)=	23.50
B(1)=	3.00	B(2)=	2.00	B(3)=	5.00	B(4)=	2.00	B(5)=	0.85	B(6)=	1.15	B(7)=	0.85
B(8)=	1.15	B(9)=	0.85	B(10)=	1.15	B(11)=	2.00	B(12)=	0.00	B(13)=	1.00		
C(1)=	2.00	C(2)=	8.00	C(3)=	5.00	C(4)=	2.00	C(5)=	0.50	C(6)=	7.50	C(7)=	4.00
C(8)=	1.00	C(9)=	0.50	C(10)=	0.40	C(11)=	0.50	C(12)=	1.60	C(13)=	0.40	C(14)=	0.50
C(15)=	0.50	C(16)=	0.50	C(17)=	0.40								

(2)Dimension of form for Middle Pier〔unite : m〕

D(1)=	27.90	D(2)=	0.50	D(3)=	1.15	D(4)=	1.00	D(5)=	9.00	D(6)=	1.00	D(7)=	15.25
D(8)=	1.25	D(9)=	24.40	D(10)=	1.25	D(11)=	3.25	D(12)=	1.00	D(13)=	2.40	D(14)=	1.00
D(15)=	16.75	D(16)=	4.50	D(17)=	4.40	D(18)=	18.00	D(19)=	2.15	D(20)=	2.25	D(21)=	1.00
D(22)=	1.00	D(23)=	1.00	D(24)=	0.71	D(25)=	0.60	D(26)=	1.09	D(27)=	7.25	D(28)=	10.75
D(29)=	1.00	D(30)=	1.00	D(31)=	1.00	D(32)=	1.00	D(33)=	1.00	D(34)=	2.00	D(35)=	0.50
D(36)=	23.50											
E(1)=	3.00	E(2)=	2.50	E(3)=	3.00	E(4)=	8.50	E(5)=	2.50	E(6)=	0.85	E(7)=	0.80
E(8)=	0.85	E(9)=	0.85	E(10)=	0.80	E(11)=	0.85	E(12)=	0.85	E(13)=	0.80	E(14)=	0.85
E(15)=	0.85	E(16)=	0.80	E(17)=	0.85	E(18)=	1.00	E(19)=	1.00				
F(1)=	2.00	F(2)=	8.00	F(3)=	5.00	F(4)=	2.00	F(5)=	0.50	F(6)=	7.50	F(7)=	4.00
F(8)=	1.00	F(9)=	0.50	F(10)=	0.40	F(11)=	0.50	F(12)=	1.60	F(13)=	0.40	F(14)=	0.50
F(15)=	0.50	F(16)=	0.50	F(17)=	0.40							

(3)Number and slide distance of center for each pier〔unite : m〕

Number of pier : abutment 2 piers
middle 3 piers
Number of vent : 4

Entire regulator width : 35.50 m
Entire regulator length : 27.90 m

	active(y) or not(n)	x (m)	y (m)	z (m)
Right abutment pi	y	0.00	0.00	0.00
Left abutment pier	y	0.00	0.00	35.50
Middle pier 1	y	0.00	0.00	5.00
Middle pier 2	y	0.00	0.00	13.50
Middle pier 3	y	0.00	0.00	22.00

(4)Main level of foundation

Apron bottom : EL37.50m
Gate bottom : EL40.00m

(5)Unite weight 〔unit : kN/m^3〕

RC :	25.00	Soil 〔Wet〕 :	18.00	Soil 〔Saturation〕 :	20.00
Concrete :	23.00	Soil 〔in water〕 :	10.00	Water :	10.00

(6)Seismic co-efficient

KH= 0.08
KH'= 0.08 (submerged condition)

(7)Case of examination

Case	Direction	Water Level			Situation of gate	Condi.	Additional	(m)
Case1	Long.	U.S.	WL47.00m	HWL	Open gate	Regular	—	—
		D.S.	WL47.00m	HWL				
Case2	Long.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL39.50m	Low				
Case3	Long.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case4	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Regular	—	—
		D.S.	WL46.55m	Max.WL				
Case5	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL39.50m	Low				
Case6	Lateral.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case7	Long.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case2	sedimentation	0.3
		D.S.	WL39.50m	Low				
Case8	Long.	U.S.	—	No WL	Open gate	Seism of case3	—	—
		D.S.	—	No WL				
Case9	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case4	—	—
		D.S.	WL46.55m	Max.WL				
Case10	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case5	sedimentation	0.3
		D.S.	WL39.50m	Low				
Case11	Lateral.	U.S.	—	No WL	Open gate	Seism of case6	—	—
		D.S.	—	No WL				
Case12	Long.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case6	—	—
		D.S.	WL46.55m	Max.WL				
Case13	Long.	U.S.	WL46.55m	Max.WL	Maintenace gate	Regular	—	0.3
		D.S.	WL45.82m	Low				

(8)Coefficient of earth pressure

Internal friction : φ= 30°

	Regular case	Seismic case	Seismic (submerged)	Sedimentation
Friction for wall	0°	0°	0°	—
Active EP coe.	0.333	0.411	0.383	0.5
Passive EP coe.	3.000	2.784	2.858	—

(9)Weight of the gate facility

Item of design load		Design load	Remarks			
Gate leaf	(kN/vent)	173.00	Upper	66.00	Lower	107.00
Hiost (Emargency)	(kN/vent)	1186.00	including the hoist weight			
Hiost	(kN/vent)	576.00	including the groove weight			
Actual vent wide	(m)	6.00				
Height of gate	(m)	6.55				
Stop Log gate	(kN/vent)	224.00				

(10)Weight of the bridge

Item of design load		Regular case	Seismic case
Vertical load (body)	(kN/vent)	1752.10	1752.10
Vertical load (body +live load)	(kN/vent)	2472.85	—
Horizontal force by wind	(kN/vent)	83.59	—
Counter force for right angle	(kN)	—	59.20

Height of the handrail= 1.10 (m)
Thick of the bridge= 2.77 (m)

(11)Wind pressure w= 3.0 (kN/m2) [coefficient of form plane: 1.20 round : 0.70]

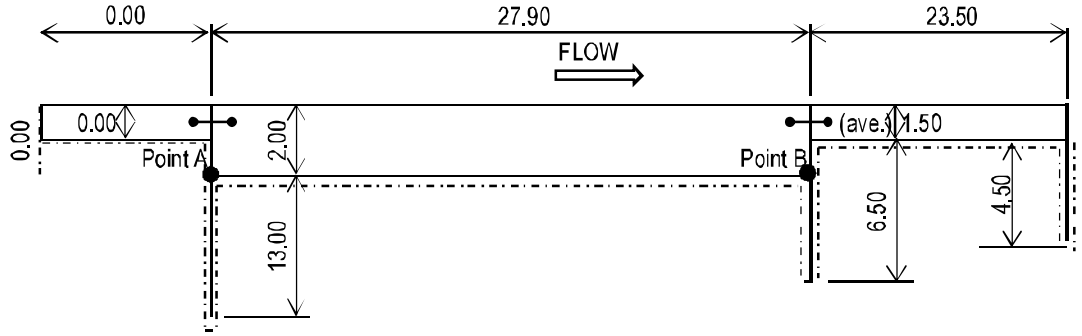
(12)Other load　　Vehicle : q=　10.0 (kN/m2)　Pedestrian : q=　5.0 (kN/m2)

(13)Up-lift condition

Design creep length ΣL = 90.40 (m)

A point ΣLa= 28.00 (m)

B point ΣLb= 55.90 (m)



(13)Bearing of the foundation

Qa= ---- (kN/m2)

(14)Friction coefficient for foundation

μ= 0.60

(15)Grand level of the embankment

採用盛土タイプ : 2

a)Height of the embankment and load

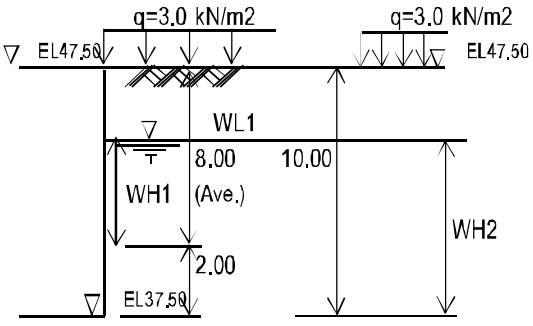
	Embk. H(m)	Load W.(kN/m2)
At case of Weight of sile	8.00	3.0
At case of eath pres.	10.00	3.0

b)Water depth of the condition for embankment

	case1	case2	case3	case4	case5	case6	case7	case8	case9	case10	case11	case12
Design:WL1	WL47.00	WL43.03	—	WL46.55	WL43.03	—	WL43.03	—	WL46.55	WL43.03	—	WL46.55
WH1	7.50	3.53	0.00	7.05	3.53	0.00	3.53	0.00	7.05	3.53	0.00	7.05
WH2	9.50	5.53	0.00	9.05	5.53	0.00	5.53	0.00	9.05	5.53	0.00	9.05

※In case there is difference water level between Up-down stream, average water level of both of them should be applied

case13
WL43.03
3.53
5.53



2.Caluculation of the regulator weight

(1) Enite regulator body weight

Regulator	W	x	W·x	y	W·y	z	W·z
abutment right	19,514.78	14.04	273,987.51	4.23	82,547.52	1.65	32,199.39
abutment left	19,514.78	14.04	273,987.51	4.23	82,547.52	33.85	660,575.30
Midle. 1	27,613.81	13.54	373,890.99	4.03	111,283.65	9.25	255,427.74
Midle. 2	27,613.81	13.54	373,890.99	4.03	111,283.65	17.75	490,145.13
Midle. 3	27,613.81	13.54	373,890.99	4.03	111,283.65	26.25	724,862.51
Σ	121,870.99		1,669,647.99		498,945.99		2,163,210.07

(2) Balance center of entire regulator body

$$X = \Sigma W \cdot x / \Sigma W = \frac{1,669,647.99}{121,870.99} = 13.70(m)$$

$$Y = \Sigma W \cdot y / \Sigma W = \frac{498,945.99}{121,870.99} = 4.09(m)$$

$$Z = \Sigma W \cdot z / \Sigma W = \frac{2,163,210.07}{121,870.99} = 17.75(m)$$

(3) abutment Pier : Right [unite : m]

#	W	x	W·x	y	W·y	z	W·z
1	0.00	0.00	0.00	1.00	0.00	2.50	0.00
2	2912.50	5.83	16979.88	1.00	2912.50	2.50	7281.25
3	4062.50	19.78	80356.25	1.00	4062.50	2.50	10156.25
4	18.75	2.32	43.50	2.17	40.69	3.50	65.63
5	337.50	7.15	2413.13	2.25	759.38	3.50	1181.25
6	37.50	11.98	449.25	2.17	81.38	3.50	131.25
7	16.25	0.33	5.36	2.25	36.56	1.00	16.25
8	12.50	1.98	24.75	2.33	29.13	1.00	12.50
9	12.50	12.32	154.00	2.17	27.13	1.00	12.50
10	381.25	20.28	7731.75	2.25	857.81	1.00	381.25
11	9,960.00	13.45	133,962.00	5.75	57,270.00	1.00	9,960.00
12	750.00	27.90	20,925.00	5.75	4,312.50	1.00	750.00
13	157.08	27.48	4,316.56	6.00	942.48	1.58	248.19
14-1	200.00	5.50	1,100.00	12.00	2,400.00	1.58	316.00
14-2	0.00	5.50	0.00	12.00	0.00	1.58	0.00
15-1	200.00	8.90	1,780.00	12.00	2,400.00	1.58	316.00
15-2	0.00	8.90	0.00	12.00	0.00	1.58	0.00
16	220.00	7.20	1,584.00	14.50	3,190.00	1.58	347.60
16'	25.00	4.67	116.75	14.33	358.25	2.67	66.75
16"	125.00	4.00	500.00	14.75	1,843.75	3.50	437.50
17	112.50	3.50	393.75	9.75	1,096.88	3.50	393.75
17'	112.50	24.40	2,745.00	9.80	1,102.50	3.50	393.75
18	-37.50	3.50	-131.25	9.75	-365.63	3.50	-131.25
18'	-37.50	24.40	-915.00	9.80	-367.50	1.58	-59.25
19	-12.75	3.50	-44.63	6.25	-79.69	1.58	-20.15
19'	-13.60	24.40	-331.84	6.00	-81.60	1.58	-21.49
20	-2.40	3.50	-8.40	2.30	-5.52	1.58	-3.79
21	-30.60	7.20	-220.32	6.25	-191.25	1.58	-48.35
22	-1.80	7.01	-12.62	2.30	-4.14	1.58	-2.84
23	-2.40	3.50	-8.40	1.80	-4.32	1.58	-3.79
Σ	19,514.78		273,908.47		82,623.79		32,176.76

- Balance center of abut regulator

	Right abutment regulator	(slide distance)	Left abutment regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{273,908.47}{19,514.78}$	=14.04(m)	+0.00(m)	=14.04(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{82,623.79}{19,514.78}$	=4.23(m)	+0.00(m)	=4.23(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{32,176.76}{19,514.78}$	=1.65(m)	-35.50(m)	=-33.85(m)

(4) Middle pier : 〔unite : m〕

#	W	x	W·x	y	W·y	z	W·z
1	212.50	0.25	53.13	1.00	212.50	4.25	903.13
2	4,738.75	6.08	28,811.60	1.00	4,738.75	4.25	20,139.69
3	6,906.25	19.78	136,605.63	1.00	6,906.25	4.25	29,351.56
4	37.50	2.32	87.00	2.17	81.38	4.25	159.38
5	675.00	7.15	4,826.25	2.25	1,518.75	4.25	2,868.75
6	75.00	11.98	898.50	2.17	162.75	4.25	318.75
7	0.00	0.45	0.00	2.25	0.00	4.25	0.00
8	265.63	1.98	525.95	2.33	618.92	4.25	1,128.93
9	15.63	12.32	192.56	2.33	36.42	4.25	66.43
10	476.56	20.28	9,664.64	2.25	1,072.26	4.25	2,025.38
11	12,200.00	13.95	170,190.00	6.25	76,250.00	4.25	51,850.00
12	490.87	26.78	13,145.50	6.00	2,945.22	4.25	2,086.20
13	490.87	1.22	598.86	6.00	2,945.22	4.25	2,086.20
14-1	85.00	5.50	467.50	12.00	1,020.00	4.25	361.25
14-2	85.00	5.50	467.50	12.00	1,020.00	4.25	361.25
15-1	85.00	8.90	756.50	12.00	1,020.00	4.25	361.25
15-2	85.00	8.90	756.50	12.00	1,020.00	4.25	361.25
16	275.00	7.20	1,980.00	14.50	3,987.50	4.25	1,168.75
16'	28.13	4.67	131.37	14.33	403.10	4.25	119.55
16"	212.50	4.00	850.00	14.75	3,134.38	4.25	903.13
17	225.00	3.50	787.50	9.75	2,193.75	4.25	956.25
17'	225.00	24.65	5,546.25	9.75	2,193.75	4.25	956.25
18	-75.00	3.50	-262.50	9.75	-731.25	4.25	-318.75
18'	-75.00	24.65	-1,848.75	9.75	-731.25	4.25	-318.75
19	-25.50	3.50	-89.25	6.25	-159.38	4.25	-108.38
19'	-27.20	24.65	-670.48	6.00	-163.20	4.25	-115.60
20	-4.80	3.50	-16.80	2.30	-11.04	4.25	-20.40
21	-61.20	7.20	-440.64	6.25	-382.50	4.25	-260.10
22	-2.88	7.01	-20.19	2.30	-6.62	4.25	-12.24
23	-4.80	24.65	-118.32	1.80	-8.64	4.25	-20.40
Σ	27,613.81		373,875.81		111,287.02		117,358.71

- Balance center of middle regulator

	Middle regulator	(slide distance)	Mid. 1 regulator	(slide distance)	Mid. 2 regulator
$X=\Sigma W\cdot x/\Sigma W=\frac{373,875.81}{27,613.81}$	=13.54(m)	+0.00(m)	=13.54(m)	+0.00(m)	=13.54(m)
$Y=\Sigma W\cdot y/\Sigma W=\frac{111,287.02}{27,613.81}$	=4.03(m)	+0.00(m)	=4.03(m)	+0.00(m)	=4.03(m)
$Z=\Sigma W\cdot z/\Sigma W=\frac{117,358.71}{27,613.81}$	=4.25(m)	+5.00(m)	=9.25(m)	+13.50(m)	=17.75(m)

(slide distance)	Mid. 3 regulator
+0.00(m)	=13.54(m)
+0.00(m)	=4.03(m)
+22.00(m)	=26.25(m)

4.Case of the examination

【CASE 1 : Regular / Longitudinal direction/ H.W.L. / Full OP】

Load	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56			
Gate leaf	692.00	7.15	4,947.80			
Hoist	4,744.00	7.15	33,919.60			
Bridge	9,891.40	16.65	164,691.81			
Weight of water	48,253.05	13.68	660,101.72			
Up-lift pressure	-94,092.75	13.95	-1,312,593.86			
Wind pre.(Reg. body)				223.41	12.83	2,866.35
Wind pre.(Gate. body)				282.96	9.13	2,583.42
Wind pre.(Bridge. body)				334.36	11.94	3,992.26
Wind pre.(Walk bridge. body)				43.20	9.75	421.20
Total	91,358.69		1,220,699.63	883.93		9,863.23

Note : The water pressure should be caneled out for the symmetrical force.

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 62.01 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.47 (m)

Eccentric distance : e=X-B/2= -0.48 (m) ≦ B/6=4.65(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 82.72

Q2=ΣV/B/L(1-6・e/B)= 101.76

【CASE 2 : Regular / Longitudinal direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	121,870.99	13.70	1,669,632.56			
Gate leaf	692.00	7.15	4,947.80			
Hoist	2,304.00	7.15	16,473.60			
Bridge	9,891.40	16.65	164,691.81			
Weight of water	10,575.04	3.02	31,936.62			
Up-lift pressure	-57,233.15	13.07	-748,037.27			
Sedimentation	628.80	2.57	1,616.02			
Wind pre.(Reg. body)				199.89	12.43	2,484.63
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				334.36	11.94	3,992.26
Water pre.(up-st.)				14,537.70	2.54	36,925.76
Water pre.(dw-st.)				-710.00	0.67	-475.70
Earth pre. (sed.)				26.88	2.39	64.24
Total	88,729.08		1,141,261.14	14,388.83		42,991.19

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 3.70 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 13.35 (m)

Eccentric distance : e=X-B/2= -0.60 (m) ≦ B/6=4.65(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 78.03

Q2=ΣV/B/L(1-6·e/B)= 101.14

【CASE 3 : Regular / Longitudinal direction/ Max. water level / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56			
Gate leaf	692.00	7.15	4,947.80			
Hoist	2,304.00	7.15	16,473.60			
Bridge	9,891.40	13.95	137,985.03			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Wind pre.(Reg. body)				370.14	8.66	3,205.41
Wind pre.(Gate. body)				282.96	9.13	2,583.42
Wind pre.(Bridge. body)				334.36	11.94	3,992.26
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	134,758.39		1,829,038.99	987.46		9,781.09

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 81.88 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.65 (m)

Eccentric distance : e=X-B/2= -0.30 (m) ≦ B/6=4.65(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 127.28

Q2=ΣV/B/L(1-6・e/B)= 144.84

【CASE 4 : Regular / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V・z (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	17.75	2,163,210.07			
Gate leaf	692.00	17.75	12,283.00			
Hoist	2,304.00	17.75	40,896.00			
Bridge	9,891.40	17.75	175,572.35			
Weight of water	45,285.89	17.75	803,824.55			
Up-lift pressure	-89,635.74	17.75	-1,591,034.39			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				724.42	10.81	7,830.98
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	90,408.54		1,604,751.58	724.42		7,830.98

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 74.88 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 35.50 (m)

Foundation length : L= 27.90 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 17.84 (m)

Eccentric distance : e=X-B/2= 0.09 (m) ≦ B/6=5.92(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 92.67

Q2=ΣV/B/L(1-6・e/B)= 89.89

【CASE 5 : Regular / Lateral direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	121,870.99	17.75	2,163,210.07			
Gate leaf	692.00	17.75	12,283.00			
Hoist	2,304.00	17.75	40,896.00			
Bridge	9,891.40	17.75	175,572.35			
Weight of water	10,575.04	17.75	187,706.96			
Up-lift pressure	-57,233.15	17.75	-1,015,888.41			
Sedimentation	628.80	17.75	11,161.20			
Wind pre.(Reg. body)				1,777.68	10.05	17,865.68
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	88,729.08		1,574,941.17	1,777.68		17,865.68

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 29.95 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 35.50 (m)

Foundation length : L= 27.90 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 17.95 (m)

Eccentric distance : e=X-B/2= 0.20 (m) ≦ B/6=5.92(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 92.61

Q2=ΣV/B/L(1-6·e/B)= 86.56

【CASE 6 : Regular / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	121,870.99	17.75	2,163,210.07			
Gate leaf	692.00	17.75	12,283.00			
Hoist	2,304.00	17.75	40,896.00			
Bridge	9,891.40	17.75	175,572.35			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				2,506.86	6.64	16,645.55
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)				—	—	—
Sum	134,758.39		2,391,961.42	2,506.86		16,645.55

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 32.25 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 35.50 (m)

Foundation length : L= 27.90 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 17.87 (m)

Eccentric distance : $e=X-B/2=$ 0.12 (m) ≦ B/6=5.92(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 138.82

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 133.30

【CASE 7 : Seism / Longitudinal direction / Max water level / Full CL】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56	9,749.68	4.23	41,241.15
Gate leaf	692.00	7.15	4,947.80	55.36	5.78	319.70
Hoist	2,304.00	7.15	16,473.60	184.32	15.00	2,764.80
Bridge	7,008.40	16.65	116,689.86	560.67	10.00	5,606.70
Weight of water	10,575.04	3.02	31,936.62	—	—	—
Up-lift pressure	-57,233.15	13.07	-748,037.27	—	—	—
Sedimentation	628.80	2.57	1,616.02	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				14,537.70	2.54	36,925.76
Water pre.(dw-st.)				-710.00	0.67	-475.70
Seism Water pre.(up-st.)				1,356.81	3.62	4,911.65
Earth pre. (sed.)				26.88	2.39	64.24
Total	85,846.08		1,093,259.19	25,761.42		91,358.30

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 2.00 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.80 (m)

Eccentric distance : e=X-B/2= -0.15 (m) ≦ B/3=9.30(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 83.88

Q2=ΣV/B/L(1-6・e/B)= 89.47

【CASE 8 : Seism / Longitudinal direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56	9,749.68	4.23	41,241.15
Gate leaf	692.00	7.15	4,947.80	55.36	12.40	686.46
Hoist	2,304.00	7.15	16,473.60	184.32	15.00	2,764.80
Bridge	7,008.40	13.95	97,767.18	560.67	10.00	5,606.70
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Total	131,875.39		1,788,821.14	10,550.03		50,299.11

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

a)Examination for the slide force

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

b)Examint of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.95 (m)

Eccentric distance : e=X-B/2= 0.00 (m) ≦ B/3=9.30(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 133.15

Q2=ΣV/B/L(1-6・e/B)= 133.15

【CASE 9 : Seism / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V・z (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	17.75	2,163,210.07	9,749.68	4.23	41,241.15
Gate leaf	692.00	17.75	12,283.00	55.36	12.40	686.46
Hoist	2,304.00	17.75	40,896.00	184.32	15.00	2,764.80
Bridge	7,008.40	17.75	124,399.10	560.67	10.00	5,606.70
Weight of water	45,285.89	17.75	803,824.55	—	—	—
Up-lift pressure	-89,635.74	17.75	-1,591,034.39	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				647.13	4.82	3,119.17
Seism water pre. (Mid.)				3,005.43	5.02	15,087.26
Earth pre. (sed.)				—	—	—
Total	87,525.54		1,553,578.33	14,202.59		68,505.54

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 3.70 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 35.50 (m)

Foundation length : L= 27.90 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 18.53 (m)

Eccentric distance : $e=X-B/2=$ 0.78 (m) ≦ B/3=11.83(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 100.02

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 76.72

【CASE 10 : Seism / Lateral direction / Max.water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	121,870.99	17.75	2,163,210.07	9,749.68	4.23	41,241.15
Gate leaf	692.00	17.75	12,283.00	55.36	5.78	319.98
Hoist	2,304.00	17.75	40,896.00	184.32	15.00	2,764.80
Bridge	7,008.40	17.75	124,399.10	560.67	10.00	5,606.70
Weight of water	10,575.04	17.75	187,706.96	—	—	—
Up-lift pressure	-57,233.15	17.75	-1,015,888.41	—	—	—
Sedimentation	628.80	17.75	11,161.20	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				165.84	4.82	799.35
Seism water pre. (Mid.)				375.30	5.02	1,884.01
Earth pre. (sed.)				—	—	—
Total	85,846.08		1,523,767.92	11,091.17		52,615.99

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 4.64 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 35.50 (m)

Foundation length : L= 27.90 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 18.36 (m)

Eccentric distance : $e=X-B/2=$ 0.61 (m) ≦ B/3=11.83(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 95.61

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 77.74

【CASE 11 : Seism / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	121,870.99	17.75	2,163,210.07	9,749.68	4.23	41,241.15
Gate leaf	692.00	17.75	12,283.00	55.36	12.40	686.46
Hoist	2,304.00	17.75	40,896.00	184.32	15.00	2,764.80
Bridge	7,008.40	17.75	124,399.10	560.67	10.00	5,606.70
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				—	—	—
Seism water pre. (Mid.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	131,875.39		2,340,788.17	10,550.03		50,299.11

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 35.50 (m)

Foundation length : L= 27.90 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 18.13 (m)

Eccentric distance : e=X-B/2= 0.38 (m) ≦ B/3=11.83(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

Q1=ΣV/B/L(1+6·e/B)= 141.70

Q2=ΣV/B/L(1-6·e/B)= 124.60

【CASE 12 : Seism / Longitudinal direction/ Max.water level / Full OP】

Load	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56	9,749.68	4.23	41,241.15
Gate leaf	692.00	7.15	4,947.80	55.36	12.40	686.46
Hoist	4,744.00	7.15	33,919.60	379.52	15.00	5,692.80
Bridge	7,008.40	16.65	116,689.86	560.67	10.00	5,606.70
Weight of water	45,285.89	13.69	619,963.83	—	—	—
Up-lift pressure	-89,635.74	13.95	-1,250,418.57	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Walk bridge. body)				—	—	—
Seism Water pre.(up-st.)				164.52	5.55	913.09
Total	89,965.54		1,194,735.08	10,909.75		54,140.20

Note : The water pressure should be caneled out for the symmetrical force.

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 4.95 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.88 (m)

Eccentric distance : e=X-B/2= -0.07 (m) ≦ B/3=9.30(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 89.47

Q2=ΣV/B/L(1-6・e/B)= 92.20

【CASE 13 : Regular / Longitudinal direction/ Max. water level / Maintenace case】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56			
Gate leaf for 3vents	519.00	7.15	3,710.85			
Hoist for 3vents	1,728.00	7.15	12,355.20			
Stoplog Gate of U.S.	224.00	3.50	784.00			
Stoplog Gate of D.S.	224.00	24.40	5,465.60			
Bridge	9,891.40	16.65	164,691.81			
Weight of water	39,929.38	13.59	542,640.27			
Weight of water at stoplog	-8,547.90	1.75	-14,958.83			
Up-lift pressure	-86,283.04	13.89	-1,198,471.43			
Sedimentation	628.80	2.57	1,616.02			
Sedimentation at stoplog	-91.50	1.75	-160.13			
Wind pre.(Reg. body)				199.89	12.43	2,484.63
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				334.36	11.94	3,992.26
Water pre.(up-st.)				14,537.70	2.54	36,925.76
Water pre.(dw-st.)				-12,286.97	2.77	-34,034.91
Earth pre. (sed.)				26.88	2.39	64.24
Total	80,093.13		1,187,305.92	2,811.86		9,431.98

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 17.09 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 14.94 (m)

Eccentric distance : e=X-B/2= 0.99 (m) ≦ B/6=4.65(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 98.08

Q2=ΣV/B/L(1-6・e/B)= 63.65

Ibrahimia reg. only

【CASE 13 : Regular / Longitudinal direction/ Max. water level / Maintenace case】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	121,870.99	13.70	1,669,632.56			
Gate leaf for 3vents	519.00	7.15	3,710.85			
Hoist for 3vents	1,728.00	7.15	12,355.20			
Stoplog Gate of U.S.	224.00	3.50	784.00			
Stoplog Gate of D.S.	224.00	24.40	5,465.60			
Bridge	9,891.40	16.65	164,691.81			
Weight of water	36,665.63	13.27	486,552.91			
Weight of water at stoplog	-7,731.96	1.75	-13,530.93			
Up-lift pressure	-83,108.68	13.83	-1,149,393.04			
Sedimentation	628.80	2.57	1,616.02			
Sedimentation at stoplog	-91.50	1.75	-160.13			
Wind pre.(Reg. body)				199.89	12.43	2,484.63
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				334.36	11.94	3,992.26
Water pre.(up-st.)				14,537.70	2.54	36,925.76
Water pre.(dw-st.)				-10,333.50	2.54	-26,247.09
Earth pre. (sed.)				26.88	2.39	64.24
Total	80,819.68		1,181,724.85	4,765.33		17,219.80

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 10.18 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.90 (m)

Foundation length : L= 35.50 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 14.83 (m)

Eccentric distance : e=X-B/2= 0.88 (m) ≦ B/6=4.65(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 97.04

Q2=ΣV/B/L(1-6・e/B)= 66.16

A-4-2. Badraman Regulator in Badraman canal

Summary table of result on the stability examination for Badraman Regulator in Badraman canal

Pier	Case	Direction	Condition	Vertical force V (kN)	Resistant moment V･x (kN･m)	Horizontal force H (kN)	Torque moment H･y (kN･m)	For the sliding Safe ratio Required ratio		For the fall down Eccentricity e (m)		For the ground reaction Ground reaction Q1 (kN/m2)	Ground reaction Q2 (kN/m2)	Bearing (kN/m2)	Judge	Remarks
									Desing		B/6 (Allowable)					
Badraman Regulator in Badraman canal	1	Long.	Regular	13,430.09	178,984.42	104.09	717.19	1.50	≦ 77.41	-0.72	≦ 4.70	57.61	78.46		OK	
	2	Long.	Regular	14,503.18	198,871.00	756.63	1,496.07	1.50	≦ 11.50	-0.28	≦ 4.70	69.09	77.85		OK	
	3	Long.	Regular	19,551.97	267,435.44	112.37	682.94	1.50	≦ 104.40	-0.39	≦ 4.70	90.83	107.27		OK	
	4	Lateral.	Regular	13,758.58	48,155.04	328.56	1,787.37	1.50	≦ 25.13	0.13	≦ 1.17	77.47	61.93		OK	
	5	Lateral.	Regular	14,503.18	50,761.13	858.16	4,505.34	1.50	≦ 10.14	0.31	≦ 1.17	92.99	53.95		OK	
	6	Lateral.	Regular	19,551.97	68,431.90	421.82	1,615.57	1.50	≦ 27.81	0.08	≦ 1.17	105.84	92.26		OK	
	7	Long.	Seism	13,006.18	178,736.35	2,198.20	4,747.79	1.15	≦ 3.55	0.01	≦ 9.40	66.03	65.75		OK	
	8	Long.	Seism	18,054.97	246,327.74	1,444.40	3,637.76	1.15	≦ 7.50	-0.26	≦ 9.40	86.40	96.52		OK	
	9	Lateral.	Seism	12,261.58	42,915.54	2,025.88	5,283.23	1.15	≦ 3.63	0.43	≦ 2.33	85.01	39.22		OK	
	10	Lateral.	Seism	13,006.18	45,521.63	1,490.28	3,760.28	1.15	≦ 5.24	0.29	≦ 2.33	82.27	49.51		OK	
	11	Lateral.	Seism	18,054.97	63,192.40	1,444.40	3,637.76	1.15	≦ 7.50	0.20	≦ 2.33	107.14	75.78		OK	
	12	Long.	Seism	12,319.58	164,463.54	1,471.21	3,721.86	1.15	≦ 5.02	-0.45	≦ 9.40	56.43	68.38		OK	
	13	Long.	Regular	12,656.70	185,830.14	550.38	1,193.45	1.50	≦ 13.80	0.68	≦ 4.70	73.39	54.84		OK	

Note 1) Ground reaction for the bearing capacity should be consideration in Chapter 12

Badraman Regulator in Badraman canal / Stability examination

1.Design condition

(1)Dimension of form for abutment Pier 〔unite : m〕

A(1)=	28.20	A(2)=	0.00	A(3)=	1.00	A(4)=	1.00	A(5)=	5.35	A(6)=	1.00	A(7)=	19.85
A(8)=	0.50	A(9)=	22.70	A(10)=	4.50	A(11)=	3.50	A(12)=	0.50	A(13)=	0.70	A(14)=	0.50
A(15)=	17.50	A(16)=	4.00	A(17)=	1.70	A(18)=	22.50	A(19)=	0.85	A(20)=	0.85	A(21)=	1.00
A(22)=	1.00	A(23)=	1.00	A(24)=	0.19	A(25)=	0.32	A(26)=	0.20	A(27)=	8.25	A(28)=	14.75
A(29)=	1.00	A(30)=	1.00	A(31)=	1.00	A(32)=	0.50	A(33)=	0.00	A(34)=	0.50	A(35)=	0.00
B(1)=	1.00	B(2)=	1.00	B(3)=	2.00	B(4)=	1.00	B(5)=	0.13	B(6)=	0.87	B(7)=	0.20
B(8)=	0.80	B(9)=	0.20	B(10)=	0.80	B(11)=	1.00	B(12)=	0.00	B(13)=	0.00		
C(1)=	1.50	C(2)=	4.10	C(3)=	3.35	C(4)=	1.50	C(5)=	0.50	C(6)=	3.60	C(7)=	2.85
C(8)=	0.50	C(9)=	0.50	C(10)=	0.13	C(11)=	0.50	C(12)=	0.80	C(13)=	0.30	C(14)=	0.00
C(15)=	0.50	C(16)=	0.50	C(17)=	0.40								

(2)Dimension of form for Middle Pier 〔unite : m〕

D(1)=	28.20	D(2)=	0.50	D(3)=	0.50	D(4)=	1.00	D(5)=	5.35	D(6)=	1.00	D(7)=	19.85
D(8)=	0.50	D(9)=	22.20	D(10)=	0.50	D(11)=	3.00	D(12)=	0.50	D(13)=	0.70	D(14)=	0.50
D(15)=	17.50	D(16)=	4.00	D(17)=	1.70	D(18)=	18.00	D(19)=	0.85	D(20)=	0.85	D(21)=	1.00
D(22)=	1.00	D(23)=	1.00	D(24)=	0.19	D(25)=	0.32	D(26)=	0.20	D(27)=	8.25	D(28)=	9.75
D(29)=	1.00	D(30)=	1.00	D(31)=	1.00	D(32)=	0.50	D(33)=	0.00	D(34)=	0.50	D(35)=	4.00
D(36)=	0.00												
E(1)=	1.00	E(2)=	1.00	E(3)=	1.00	E(4)=	3.00	E(5)=	1.00	E(6)=	0.13	E(7)=	0.74
E(8)=	0.13	E(9)=	0.20	E(10)=	0.60	E(11)=	0.20	E(12)=	0.50	E(13)=	0.00	E(14)=	0.50
E(15)=	0.20	E(16)=	0.60	E(17)=	0.20	E(18)=	0.00	E(19)=	0.00				
F(1)=	1.50	F(2)=	4.10	F(3)=	3.35	F(4)=	1.50	F(5)=	0.50	F(6)=	3.60	F(7)=	2.85
F(8)=	0.50	F(9)=	0.50	F(10)=	0.13	F(11)=	0.50	F(12)=	0.80	F(13)=	0.30	F(14)=	0.00
F(15)=	0.50	F(16)=	0.50	F(17)=	0.30								

(3)Number and slide distance of center for each pier 〔unite : m〕

Number of pier : abutment 2 piers
middle 1 piers
Number of vent : 2

Entire regulator width : 7.00 m
Entire regulator length : 28.20 m

	active(y) or not(n)	x (m)	y (m)	z (m)
Right abutment pi	y	0.00	0.00	0.00
Left abutment pier	y	0.00	0.00	7.00
Middle pier 1	y	0.00	0.00	2.00
Middle pier 2	n	0.00	0.00	0.00
Middle pier 3	n	0.00	0.00	0.00

(4)Main level of foundation

Apron bottom : EL41.90m
Gate bottom : EL43.90m

(5)Unite weight 〔unit : kN/m^3〕

RC :	25.00	Soil 〔Wet〕 :	18.00	Soil 〔Saturation〕 :	20.00
Concrete :	23.00	Soil 〔in water〕 :	10.00	Water :	10.00

(6)Seismic co-efficient

KH= 0.08
KH'= 0.09 (submerged condition)

(7)Case of examination

Case	Direction	Water Level			Situation of gate	Condi.	Additional	(m)
Case1	Long.	U.S.	WL47.00m	HWL	Open gate	Regular	—	—
		D.S.	WL47.00m	HWL				
Case2	Long.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL43.40m	Low				
Case3	Long.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case4	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Regular	—	—
		D.S.	WL46.55m	Max.WL				
Case5	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL43.40m	Low				
Case6	Lateral.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case7	Long.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case2	sedimentation	0.3
		D.S.	WL43.40m	Low				
Case8	Long.	U.S.	—	No WL	Open gate	Seism of case3	—	—
		D.S.	—	No WL				
Case9	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case4	—	—
		D.S.	WL46.55m	Max.WL				
Case10	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case5	sedimentation	0.3
		D.S.	WL43.40m	Low				
Case11	Lateral.	U.S.	—	No WL	Open gate	Seism of case6	—	—
		D.S.	—	No WL				
Case12	Long.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case6	—	—
		D.S.	WL46.55m	Max.WL				
Case13	Long.	U.S.	WL46.55m	Max.WL	Maintenace gate	Regular	—	0.3
		D.S.	WL45.90m	Low				

(8)Coefficient of earth pressure

Internal friction : φ= 30°

	Regular case	Seismic case	Seismic (submerged)	Sedimentation
Friction for wall	0°	0°	0°	—
Active EP coe.	0.333	0.383	0.39	0.5
Passive EP coe.	3.000	2.858	2.84	—

(9)Weight of the gate facility

Item of design load		Design load	Remarks			
Gate leaf	(kN/vent)	9.00	Upper	9.00	Lower	0.00
Hiost (Emargency)	(kN/vent)	53.00	including the hoist weight (300%)			
Hiost	(kN/vent)	24.00	including the groove weight			
Actual vent wide	(m)	2.00				
Height of gate	(m)	2.65				
Stop Log gate	(kN/vent)	9.00				

(10)Weight of the bridge

Item of design load		Regular case	Seismic case
Vertical load (body)	(kN/vent)	509.11	509.11
Vertical load (body +live load)	(kN/vent)	1257.61	—
Horizontal force by wind	(kN/vent)	18.72	—
Counter force for up-to-down st.	(kN)	—	40.73
Counter force for right angle	(kN)	—	40.73

Height of the handrail= 1.10 (m)

Thick of the bridge= 1.50 (m)

(11)Wind pressure w= 3.0 (kN/m2) [coefficient of form plane: 1.20 round : 0.70]

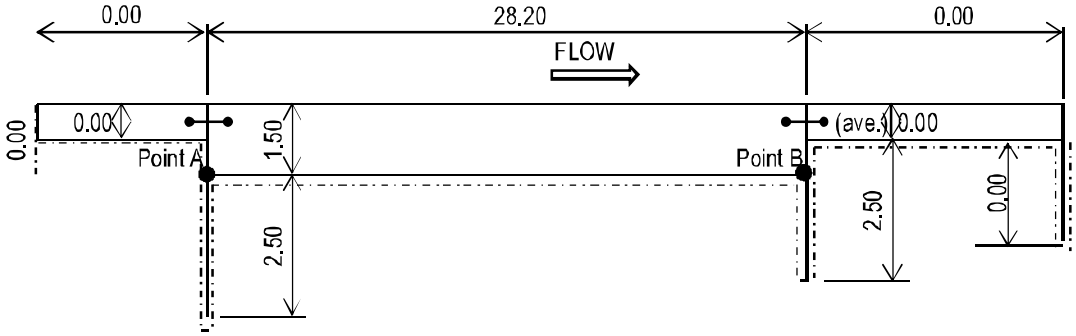
(12)Other load　　Vehicle : q=　10.0 (kN/m2)　Pedestrian : q=　5.0 (kN/m2)

(13)Up-lift condition

Design creep length ΣL = 36.20 (m)

A point ΣLa= 6.50 (m)

B point ΣLb= 34.70 (m)



(13)Bearing of the foundation

Qa= ---- (kN/m2)

(14)Friction coefficient for foundation

μ= 0.60

(15)Grand level of the embankment

採用盛土タイプ： 2

a)Height of the embankment and load

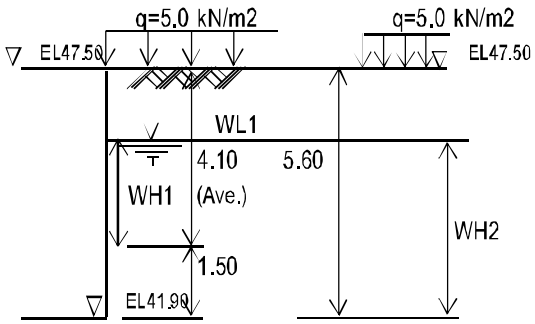
	Embk. H(m)	Load W.(kN/m2)
At case of Weight of sile	4.10	5.0
At case of eath pres.	5.60	5.0

b)Water depth of the condition for embankment

	case1	case2	case3	case4	case5	case6	case7	case8	case9	case10	case11	case12
Design:WL1	WL47.00	WL44.98	—	WL46.55	WL44.98	—	WL44.98	—	WL46.55	WL44.98	—	WL46.55
WH1	3.60	1.58	0.00	3.15	1.58	0.00	1.58	0.00	3.15	1.58	0.00	3.15
WH2	5.10	3.08	0.00	4.65	3.08	0.00	3.08	0.00	4.65	3.08	0.00	4.65

※In case there is difference water level between Up-down stream, average water level of both of them should be applied

case13
WL44.98
1.58
3.08



2.Caluculation of the regulator weight

(1) Enite regulator body weight

Regulator	W	x	W·x	y	W·y	z	W·z
abutment right	5,381.44	14.04	75,555.42	2.31	12,431.13	0.73	3,928.45
abutment left	5,381.44	14.04	75,555.42	2.31	12,431.13	6.27	33,741.63
Midle. 1	6,207.87	12.98	80,578.15	2.19	13,595.24	3.50	21,727.55
Midle. 2	0.00	12.98	0.00	2.19	0.00	1.50	0.00
Midle. 3	0.00	12.98	0.00	2.19	0.00	1.50	0.00
Σ	16,970.75		231,688.99		38,457.50		59,397.63

(2) Balance center of entire regulator body

$$X = \Sigma W \cdot x / \Sigma W = \frac{231,688.99}{16,970.75} = 13.65(m)$$

$$Y = \Sigma W \cdot y / \Sigma W = \frac{38,457.50}{16,970.75} = 2.27(m)$$

$$Z = \Sigma W \cdot z / \Sigma W = \frac{59,397.63}{16,970.75} = 3.50(m)$$

(3) abutment Pier : Right [unite : m]

#	W	x	W·x	y	W·y	z	W·z
1	0.00	0.00	0.00	0.75	0.00	1.00	0.00
2	551.25	3.68	2028.60	0.75	413.44	1.00	551.25
3	1563.75	17.78	27803.48	0.75	1172.81	1.00	1563.75
4	6.25	1.67	10.44	1.67	10.44	1.50	9.38
5	66.88	4.68	313.00	1.75	117.04	1.50	100.32
6	12.50	7.68	96.00	1.67	20.88	1.50	18.75
7	6.25	0.25	1.56	1.75	10.94	0.50	3.13
8	6.25	1.33	8.31	1.83	11.44	0.50	3.13
9	6.25	8.02	50.13	1.67	10.44	0.50	3.13
10	248.13	18.28	4535.82	1.75	434.23	0.50	124.07
11	2,326.75	11.85	27,571.99	3.30	7,678.28	0.50	1,163.38
12	405.00	28.20	11,421.00	3.30	1,336.50	0.50	202.50
13	20.13	27.99	563.44	3.55	71.46	0.58	11.68
14-1	35.63	4.25	151.43	7.03	250.48	0.58	20.67
14-2	0.00	4.25	0.00	7.03	0.00	0.58	0.00
15-1	35.63	5.45	194.18	7.03	250.48	0.58	20.67
15-2	0.00	5.45	0.00	7.03	0.00	0.58	0.00
16	21.25	4.85	103.06	8.70	184.88	0.58	12.33
16'	0.00	4.00	0.00	8.45	0.00	1.33	0.00
16"	12.50	3.75	46.88	8.70	108.75	1.50	18.75
17	37.50	2.50	93.75	5.35	200.63	1.50	56.25
17'	37.50	22.20	832.50	5.40	202.50	1.50	56.25
18	-12.50	2.50	-31.25	5.35	-66.88	1.50	-18.75
18'	-12.50	22.20	-277.50	5.40	-67.50	0.90	-11.25
19	-1.44	2.50	-3.60	3.80	-5.47	0.90	-1.30
19'	-1.64	22.20	-36.41	3.55	-5.82	0.90	-1.48
20	-0.60	2.50	-1.50	1.85	-1.11	0.90	-0.54
21	-0.66	4.85	-3.20	3.80	-2.51	0.94	-0.62
22	-0.32	4.84	-1.55	1.94	-0.62	0.90	-0.29
23	-0.80	2.50	-2.00	1.30	-1.04	0.90	-0.72
Add	12.50	5.45	68.13	8.70	108.75	1.00	12.50
Σ	5,381.44		75,536.69		12,443.42		3,916.94

▪ Balance center of abut regulator

		Right abutment regulator	(slide distance)	Left abutment regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{75,536.69}{5,381.44}$	= 14.04(m)		+0.00(m)	= 14.04(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{12,443.42}{5,381.44}$	= 2.31(m)		+0.00(m)	= 2.31(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{3,916.94}{5,381.44}$	= 0.73(m)		-7.00(m)	=-6.27(m)

(4) Middle pier : 〔unite : m〕

#	W	x	W·x	y	W·y	z	W·z
1	56.25	0.25	14.06	0.75	42.19	1.50	84.38
2	770.63	3.93	3,028.58	0.75	577.97	1.50	1,155.95
3	2,345.63	17.78	41,705.30	0.75	1,759.22	1.50	3,518.45
4	12.50	1.67	20.88	1.67	20.88	1.50	18.75
5	133.75	4.68	625.95	1.75	234.06	1.50	200.63
6	25.00	7.68	192.00	1.67	41.75	1.50	37.50
7	0.00	0.50	0.00	1.75	0.00	1.50	0.00
8	37.50	1.33	49.88	1.83	68.63	1.50	56.25
9	6.25	8.02	50.13	1.83	11.44	1.50	9.38
10	248.13	18.28	4,535.82	1.75	434.23	1.50	372.20
11	2,275.50	12.10	27,533.55	3.80	8,646.90	1.50	3,413.25
12	40.25	23.95	963.99	3.55	142.89	1.50	60.38
13	40.25	0.79	31.80	3.55	142.89	1.50	60.38
14-1	17.81	4.75	84.60	7.03	125.20	1.50	26.72
14-2	17.81	4.75	84.60	7.03	125.20	1.50	26.72
15-1	17.81	5.95	105.97	7.03	125.20	1.50	26.72
15-2	17.81	5.95	105.97	7.03	125.20	1.50	26.72
16	21.25	5.35	113.69	8.70	184.88	1.50	31.88
16'	0.00	4.50	0.00	8.45	0.00	1.50	0.00
16"	18.75	4.25	79.69	8.70	163.13	1.50	28.13
17	75.00	3.00	225.00	5.35	401.25	1.50	112.50
17'	75.00	22.20	1,665.00	5.35	401.25	1.50	112.50
18	-25.00	3.00	-75.00	5.35	-133.75	1.50	-37.50
18'	-25.00	22.20	-555.00	5.35	-133.75	1.50	-37.50
19	-2.88	3.00	-8.64	3.80	-10.94	1.50	-4.32
19'	-3.28	22.20	-72.82	3.55	-11.64	1.50	-4.92
20	-1.20	3.00	-3.60	1.85	-2.22	1.50	-1.80
21	-5.04	5.35	-26.96	3.80	-19.15	1.50	-7.56
22	-0.16	4.84	-0.77	1.94	-0.31	1.50	-0.24
23	-1.20	22.20	-26.64	1.35	-1.62	1.50	-1.80
Add	18.75	5.45	102.19	8.70	163.13	1.50	28.13
Σ	6,207.87		80,549.22		13,624.11		9,311.88

▪ Balance center of middle regulator

	Middle regulator	(slide distance)	Mid. 1 regulator	(slide distance)	Mid. 2 regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{80,549.22}{6,207.87}$	= 12.98(m)	+0.00(m)	= 12.98(m)	+0.00(m)	= 12.98(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{13,624.11}{6,207.87}$	= 2.19(m)	+0.00(m)	= 2.19(m)	+0.00(m)	= 2.19(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{9,311.88}{6,207.87}$	= 1.50(m)	+2.00(m)	= 3.50(m)	+0.00(m)	= 1.50(m)

(slide distance)	Mid. 3 regulator
+0.00(m)	= 12.98(m)
+0.00(m)	= 2.19(m)
+0.00(m)	= 1.50(m)

4.Case of the examination

【CASE 1 : Regular / Longitudinal direction/ H.W.L. / Full OP】

Load	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	13.65	231,650.74			
Gate leaf	18.00	4.85	87.30			
Hoist	106.00	4.85	514.10			
Bridge	2,515.22	13.45	33,829.71			
Weight of water	3,887.52	14.11	54,852.91			
Up-lift pressure	-10,067.40	14.10	-141,950.34			
Wind pre.(Reg. body)				40.37	7.42	299.55
Wind pre.(Gate. body)				19.08	6.33	120.78
Wind pre.(Bridge. body)				37.44	6.90	258.34
Wind pre.(Walk bridge. body)				7.20	5.35	38.52
Total	13,430.09		178,984.42	104.09		717.19

Note : The water pressure should be caneled out for the symmetrical force.

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 77.41 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.38 (m)

Eccentric distance : e=X-B/2= -0.72 (m) ≦ B/6=4.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 57.61

Q2=ΣV/B/L(1-6・e/B)= 78.46

【CASE 2 : Regular / Longitudinal direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	16,970.75	13.65	231,650.74			
Gate leaf	18.00	4.85	87.30			
Hoist	48.00	4.85	232.80			
Bridge	2,515.22	13.45	33,829.71			
Weight of water	516.72	2.07	1,069.61			
Up-lift pressure	-5,640.71	12.08	-68,139.78			
Sedimentation	75.20	1.87	140.62			
Wind pre.(Reg. body)				36.02	7.02	252.86
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				37.44	6.90	258.34
Water pre.(up-st.)				756.80	1.34	1,014.11
Water pre.(dw-st.)				-78.75	0.50	-39.38
Earth pre. (sed.)				5.12	1.98	10.14
Total	14,503.18		198,871.00	756.63		1,496.07

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 11.50 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 13.82 (m)

Eccentric distance : $e=X-B/2=$ -0.28 (m) ≦ B/6=4.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 69.09

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 77.85

【CASE 3 : Regular / Longitudinal direction/ Max. water level / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	13.65	231,650.74			
Gate leaf	18.00	4.85	87.30			
Hoist	48.00	4.85	232.80			
Bridge	2,515.22	14.10	35,464.60			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Wind pre.(Reg. body)				55.85	5.44	303.82
Wind pre.(Gate. body)				19.08	6.33	120.78
Wind pre.(Bridge. body)				37.44	6.90	258.34
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	19,551.97		267,435.44	112.37		682.94

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 104.40 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.71 (m)

Eccentric distance : e=X-B/2= -0.39 (m) ≦ B/6=4.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 90.83

Q2=ΣV/B/L(1-6・e/B)= 107.27

【CASE 4 : Regular / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V･z (kN･m)	H (kN)	y (m)	H･y (kN･m)
Reg. body	16,970.75	3.50	59,397.63			
Gate leaf	18.00	3.50	63.00			
Hoist	48.00	3.50	168.00			
Bridge	2,515.22	3.50	8,803.27			
Weight of water	3,385.71	3.50	11,849.99			
Up-lift pressure	-9,179.10	3.50	-32,126.85			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				328.56	5.44	1,787.37
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	13,758.58		48,155.04	328.56		1,787.37

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV･μ/ΣH= 25.13 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 28.20 (m)

Act point of the total force : X=(ΣV･x+ΣH･y)/ΣV= 3.63 (m)

Eccentric distance : e=X-B/2= 0.13 (m) ≦ B/6=1.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6･e/B)= 77.47

Q2=ΣV/B/L(1-6･e/B)= 61.93

【CASE 5 : Regular / Lateral direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	16,970.75	3.50	59,397.63			
Gate leaf	18.00	3.50	63.00			
Hoist	48.00	3.50	168.00			
Bridge	2,515.22	3.50	8,803.27			
Weight of water	516.72	3.50	1,808.52			
Up-lift pressure	-5,640.71	3.50	-19,742.49			
Sedimentation	75.20	3.50	263.20			
Wind pre.(Reg. body)				858.16	5.25	4,505.34
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	14,503.18		50,761.13	858.16		4,505.34

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 10.14 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 28.20 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 3.81 (m)

Eccentric distance : e=X-B/2= 0.31 (m) ≦ B/6=1.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 92.99

Q2=ΣV/B/L(1-6·e/B)= 53.95

【CASE 6 : Regular / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	3.50	59,397.63			
Gate leaf	18.00	3.50	63.00			
Hoist	48.00	3.50	168.00			
Bridge	2,515.22	3.50	8,803.27			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				421.82	3.83	1,615.57
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)				—	—	—
Sum	19,551.97		68,431.90	421.82		1,615.57

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 27.81 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 28.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 3.58 (m)

Eccentric distance : $e=X-B/2=$ 0.08 (m) ≦ B/6=1.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 105.84

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 92.26

【CASE 7 : Seism / Longitudinal direction / Max water level / Full CL】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	13.65	231,650.74	1,357.66	2.31	3,136.19
Gate leaf	18.00	4.85	87.30	1.44	3.33	4.79
Hoist	48.00	4.85	232.80	3.84	8.95	34.37
Bridge	1,018.22	13.45	13,695.06	81.46	5.60	456.18
Weight of water	516.72	2.07	1,069.61	—	—	—
Up-lift pressure	-5,640.71	12.08	-68,139.78	—	—	—
Sedimentation	75.20	1.87	140.62	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				756.80	1.34	1,014.11
Water pre.(dw-st.)				-78.75	0.50	-39.38
Seism Water pre.(up-st.)				70.63	1.86	131.39
Earth pre. (sed.)				5.12	1.98	10.14
Total	13,006.18		178,736.35	2,198.20		4,747.79

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu/\Sigma H=$ 3.55 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 14.11 (m)

Eccentric distance : $e=X-B/2=$ 0.01 (m) ≦ B/3=9.40(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 66.03

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 65.75

【CASE 8 : Seism / Longitudinal direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	13.65	231,650.74	1,357.66	2.31	3,136.19
Gate leaf	18.00	4.85	87.30	1.44	7.65	11.02
Hoist	48.00	4.85	232.80	3.84	8.95	34.37
Bridge	1,018.22	14.10	14,356.90	81.46	5.60	456.18
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Total	18,054.97		246,327.74	1,444.40		3,637.76

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

a)Examination for the slide force

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

b)Examint of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.84 (m)

Eccentric distance : e=X-B/2= -0.26 (m) ≦ B/3=9.40(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 86.40

Q2=ΣV/B/L(1-6・e/B)= 96.52

【CASE 9 : Seism / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V・z (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	3.50	59,397.63	1,357.66	2.31	3,136.19
Gate leaf	18.00	3.50	63.00	1.44	7.65	11.02
Hoist	48.00	3.50	168.00	3.84	8.95	34.37
Bridge	1,018.22	3.50	3,563.77	81.46	5.60	456.18
Weight of water	3,385.71	3.50	11,849.99	—	—	—
Up-lift pressure	-9,179.10	3.50	-32,126.85	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				130.58	2.76	360.40
Seism water pre. (Mid.)				450.90	2.85	1,285.07
Earth pre. (sed.)				—	—	—
Total	12,261.58		42,915.54	2,025.88		5,283.23

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 3.63 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 28.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 3.93 (m)

Eccentric distance : $e=X-B/2=$ 0.43 (m) ≦ B/3=2.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 85.01

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 39.22

【CASE 10 : Seism / Lateral direction / Max.water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	16,970.75	3.50	59,397.63	1,357.66	2.31	3,136.19
Gate leaf	18.00	3.50	63.00	1.44	3.33	4.80
Hoist	48.00	3.50	168.00	3.84	8.95	34.37
Bridge	1,018.22	3.50	3,563.77	81.46	5.60	456.18
Weight of water	516.72	3.50	1,808.52	—	—	—
Up-lift pressure	-5,640.71	3.50	-19,742.49	—	—	—
Sedimentation	75.20	3.50	263.20	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				22.46	2.76	61.99
Seism water pre. (Mid.)				23.42	2.85	66.75
Earth pre. (sed.)				—	—	—
Total	13,006.18		45,521.63	1,490.28		3,760.28

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 5.24 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 28.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 3.79 (m)

Eccentric distance : $e=X-B/2=$ 0.29 (m) ≦ B/3=2.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 82.27

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 49.51

【CASE 11 : Seism / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	16,970.75	3.50	59,397.63	1,357.66	2.31	3,136.19
Gate leaf	18.00	3.50	63.00	1.44	7.65	11.02
Hoist	48.00	3.50	168.00	3.84	8.95	34.37
Bridge	1,018.22	3.50	3,563.77	81.46	5.60	456.18
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				—	—	—
Seism water pre. (Mid.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	18,054.97		63,192.40	1,444.40		3,637.76

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 28.20 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 3.70 (m)

Eccentric distance : e=X-B/2= 0.20 (m) ≦ B/3=2.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

Q1=ΣV/B/L(1+6·e/B)= 107.14

Q2=ΣV/B/L(1-6·e/B)= 75.78

【CASE 12 : Seism / Longitudinal direction/ Max.water level / Full OP】

Load	V (kN)	x (m)	V･x (kN･m)	H (kN)	y (m)	H･y (kN･m)
Reg. body	16,970.75	13.65	231,650.74	1,357.66	2.31	3,136.19
Gate leaf	18.00	4.85	87.30	1.44	7.65	11.02
Hoist	106.00	4.85	514.10	8.48	8.95	75.90
Bridge	1,018.22	13.45	13,695.06	81.46	5.60	456.18
Weight of water	3,385.71	14.16	47,941.65	—	—	—
Up-lift pressure	-9,179.10	14.10	-129,425.31	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Walk bridge. body)				—	—	—
Seism Water pre.(up-st.)				22.17	1.92	42.57
Total	12,319.58		164,463.54	1,471.21		3,721.86

Note : The water pressure should be caneled out for the symmetrical force.

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV･μ/ΣH= 5.02 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV･x+ΣH･y)/ΣV= 13.65 (m)

Eccentric distance : e=X-B/2= -0.45 (m) ≦ B/3=9.40(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6･e/B)= 56.43

Q2=ΣV/B/L(1-6･e/B)= 68.38

【CASE 13 : Regular / Longitudinal direction/ Max. water level / Maintenace case】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	16,970.75	13.65	231,650.74			
Gate leaf for 3vents	9.00	4.85	43.65			
Hoist for 3vents	24.00	4.85	116.40			
Stoplog Gate of U.S.	9.00	2.50	22.50			
Stoplog Gate of D.S.	9.00	22.20	199.80			
Bridge	2,515.22	13.45	33,829.71			
Weight of water	2,784.40	13.72	38,201.97			
Weight of water at stoplog	-1,267.65	1.25	-1,584.56			
Up-lift pressure	-8,448.72	13.82	-116,761.31			
Sedimentation	75.20	1.87	140.62			
Sedimentation at stoplog	-23.50	1.25	-29.38			
Wind pre.(Reg. body)				36.02	7.02	252.86
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				37.44	6.90	258.34
Water pre.(up-st.)				756.80	1.34	1,014.11
Water pre.(dw-st.)				-285.00	1.20	-342.00
Earth pre. (sed.)				5.12	1.98	10.14
Total	12,656.70		185,830.14	550.38		1,193.45

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 13.80 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 28.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 14.78 (m)

Eccentric distance : $e=X-B/2=$ 0.68 (m) ≦ B/6=4.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 73.39

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 54.84

A-4-3. Badraman Regulator in Diroutiah canal

Summary table of result on the stability examination for Badraman Regulator in Diroutiah canal

Pier	Case	Direction	Condition	Vertical force V (kN)	Resistant moment V・x (kN・m)	Horizontal force H (kN)	Torque moment H・y (kN・m)	For the sliding Safe ratio Required ratio		For the fall down Eccentricity e (m)		For the ground reaction Ground reaction Q1 (kN/m2)	Ground reaction Q2 (kN/m2)	Bearing (kN/m2)	Judge	Remarks
									Desing		B/6 (Allowable)					
Badraman Regulator in Diroutiah canal	1	Long.	Regular	17,457.71	226,559.63	143.26	947.66	1.50	≦ 73.12	-0.82	≦ 4.62	51.83	74.22		OK	
	2	Long.	Regular	18,666.57	249,465.22	944.36	1,737.70	1.50	≦ 11.86	-0.39	≦ 4.62	61.70	73.08		OK	
	3	Long.	Regular	25,481.45	339,837.04	152.98	901.14	1.50	≦ 99.94	-0.48	≦ 4.62	82.43	101.56		OK	
	4	Lateral.	Regular	17,904.87	89,524.35	428.96	2,204.85	1.50	≦ 25.04	0.12	≦ 1.67	69.29	59.98		OK	
	5	Lateral.	Regular	18,666.57	93,332.85	897.86	4,471.34	1.50	≦ 12.47	0.24	≦ 1.67	77.09	57.68		OK	
	6	Lateral.	Regular	25,481.45	127,407.25	763.28	2,785.97	1.50	≦ 20.03	0.11	≦ 1.67	98.06	85.92		OK	
	7	Long.	Seism	17,021.07	227,333.25	2,835.85	5,811.79	1.15	≦ 3.60	-0.15	≦ 9.23	59.45	63.44		OK	
	8	Long.	Seism	23,835.95	317,046.87	1,906.87	4,620.87	1.15	≦ 7.50	-0.35	≦ 9.23	79.53	92.57		OK	
	9	Lateral.	Seism	16,259.37	81,296.85	2,799.11	7,039.36	1.15	≦ 3.49	0.43	≦ 3.33	73.84	43.55		OK	
	10	Lateral.	Seism	17,021.07	85,105.35	1,958.83	4,752.73	1.15	≦ 5.21	0.28	≦ 3.33	71.77	51.12		OK	
	11	Lateral.	Seism	23,835.95	119,179.75	1,906.87	4,620.87	1.15	≦ 7.50	0.19	≦ 3.33	95.86	76.24		OK	
	12	Long.	Seism	16,322.37	211,761.19	1,933.29	4,704.88	1.15	≦ 5.07	-0.59	≦ 9.23	51.39	66.46		OK	
	13	Long.	Regular	17,020.59	235,905.48	601.16	1,265.34	1.50	≦ 16.99	0.08	≦ 4.62	62.51	60.38		OK	

Badraman Regulator in Diroutiah canal / Stability examination

1.Design condition

(1)Dimension of form for abutment Pier 〔unite : m〕

A(1)=	27.70	A(2)=	0.00	A(3)=	1.00	A(4)=	1.00	A(5)=	5.35	A(6)=	1.00	A(7)=	19.35
A(8)=	0.50	A(9)=	22.70	A(10)=	4.50	A(11)=	3.50	A(12)=	0.50	A(13)=	0.70	A(14)=	0.50
A(15)=	17.50	A(16)=	4.00	A(17)=	1.70	A(18)=	22.50	A(19)=	0.85	A(20)=	0.85	A(21)=	1.00
A(22)=	1.00	A(23)=	1.00	A(24)=	0.19	A(25)=	0.32	A(26)=	0.20	A(27)=	8.25	A(28)=	14.25
A(29)=	1.00	A(30)=	1.00	A(31)=	1.00	A(32)=	0.50	A(33)=	0.00	A(34)=	0.50	A(35)=	0.00
B(1)=	1.00	B(2)=	1.00	B(3)=	2.00	B(4)=	1.00	B(5)=	0.13	B(6)=	0.87	B(7)=	0.20
B(8)=	0.80	B(9)=	0.20	B(10)=	0.80	B(11)=	1.00	B(12)=	0.00	B(13)=	0.00		
C(1)=	1.50	C(2)=	3.80	C(3)=	3.35	C(4)=	1.50	C(5)=	0.50	C(6)=	3.30	C(7)=	2.85
C(8)=	0.50	C(9)=	0.50	C(10)=	0.13	C(11)=	0.50	C(12)=	0.80	C(13)=	0.30	C(14)=	0.00
C(15)=	0.50	C(16)=	0.50	C(17)=	0.40								

(2)Dimension of form for Middle Pier〔unite : m〕

D(1)=	27.70	D(2)=	0.50	D(3)=	0.50	D(4)=	1.00	D(5)=	5.35	D(6)=	1.00	D(7)=	19.35
D(8)=	0.50	D(9)=	22.20	D(10)=	0.50	D(11)=	3.00	D(12)=	0.50	D(13)=	0.70	D(14)=	0.50
D(15)=	17.50	D(16)=	3.50	D(17)=	1.70	D(18)=	18.00	D(19)=	0.85	D(20)=	0.85	D(21)=	1.00
D(22)=	1.00	D(23)=	1.00	D(24)=	0.19	D(25)=	0.32	D(26)=	0.20	D(27)=	8.25	D(28)=	9.75
D(29)=	1.00	D(30)=	1.00	D(31)=	1.00	D(32)=	0.50	D(33)=	0.00	D(34)=	0.50	D(35)=	4.00
D(36)=	0.00												
E(1)=	1.00	E(2)=	1.00	E(3)=	1.00	E(4)=	3.00	E(5)=	1.00	E(6)=	0.13	E(7)=	0.74
E(8)=	0.13	E(9)=	0.20	E(10)=	0.60	E(11)=	0.20	E(12)=	0.50	E(13)=	0.00	E(14)=	0.50
E(15)=	0.20	E(16)=	0.60	E(17)=	0.20	E(18)=	0.00	E(19)=	0.00				
F(1)=	1.50	F(2)=	3.80	F(3)=	3.35	F(4)=	1.50	F(5)=	0.50	F(6)=	3.30	F(7)=	2.85
F(8)=	0.50	F(9)=	0.50	F(10)=	0.13	F(11)=	0.50	F(12)=	0.80	F(13)=	0.30	F(14)=	0.00
F(15)=	0.50	F(16)=	0.50	F(17)=	0.30								

(3)Number and slide distance of center for each pier〔unite : m〕

Number of pier : abutment 2 piers
middle 2 piers
Number of vent : 3

Entire regulator width : 10.00 m
Entire regulator length : 27.70 m

	active(y) or not(n)	x (m)	y (m)	z (m)
Right abutment pi	y	0.00	0.00	0.00
Left abutment pier	y	0.00	0.00	10.00
Middle pier 1	y	0.00	0.00	2.00
Middle pier 2	y	0.00	0.00	5.00
Middle pier 3	n	0.00	0.00	0.00

(4)Main level of foundation

Apron bottom : EL42.20m
Gate bottom : EL44.20m

(5)Unite weight 〔unit : kN/m^3〕

RC :	25.00	Soil 〔Wet〕 :	18.00	Soil 〔Saturation〕 :	20.00
Concrete :	23.00	Soil 〔in water〕 :	10.00	Water :	10.00

(6)Seismic co-efficient

KH= 0.08
KH'= 0.09 (submerged condition)

(7)Case of examination

Case	Direction	Water Level			Situation of gate	Condi.	Additional	(m)
Case1	Long.	U.S.	WL47.00m	HWL	Open gate	Regular	—	—
		D.S.	WL47.00m	HWL				
Case2	Long.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL43.70m	Low				
Case3	Long.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case4	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Regular	—	—
		D.S.	WL46.55m	Max.WL				
Case5	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL43.70m	Low				
Case6	Lateral.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case7	Long.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case2	sedimentation	0.3
		D.S.	WL43.70m	Low				
Case8	Long.	U.S.	—	No WL	Open gate	Seism of case3	—	—
		D.S.	—	No WL				
Case9	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case4	—	—
		D.S.	WL46.55m	Max.WL				
Case10	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case5	sedimentation	0.3
		D.S.	WL43.70m	Low				
Case11	Lateral.	U.S.	—	No WL	Open gate	Seism of case6	—	—
		D.S.	—	No WL				
Case12	Long.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case6	—	—
		D.S.	WL46.55m	Max.WL				
Case13	Long.	U.S.	WL46.55m	Max.WL	Maintenace gate	Regular	—	0.3
		D.S.	WL45.90m	Low				

(8)Coefficient of earth pressure

Internal friction : φ= 30°

	Regular case	Seismic case	Seismic (submerged)	Sedimentation
Friction for wall	0°	0°	0°	—
Active EP coe.	0.333	0.383	0.39	0.5
Passive EP coe.	3.000	2.858	2.84	—

(9)Weight of the gate facility

Item of design load		Design load	Remarks			
Gate leaf	(kN/vent)	8.00	Upper	8.00	Lower	0.00
Hiost (Emargency)	(kN/vent)	45.00	including the hoist weight (300%)			
Hiost	(kN/vent)	24.00	including the groove weight			
Actual vent wide	(m)	2.00				
Height of gate	(m)	2.35				
Stop Log gate	(kN/vent)	8.00				

(10)Weight of the bridge

Item of design load		Regular case	Seismic case
Vertical load (body)	(kN/vent)	509.05	509.05
Vertical load (body +live load)	(kN/vent)	1057.55	—
Horizontal force by wind	(kN/vent)	18.72	—
Counter force for up-to-down st.	(kN)	—	40.72
Counter force for right angle	(kN)	—	40.72

Height of the handrail= 1.10 (m)

Thick of the bridge= 1.50 (m)

(11)Wind pressure w= 3.0 (kN/m2) [coefficient of form plane: 1.20 round : 0.70]

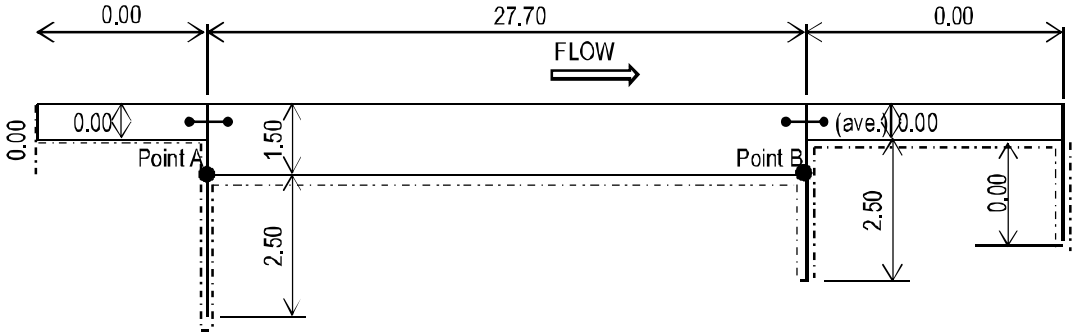
(12)Other load　　Vehicle : q=　10.0 (kN/m2)　Pedestrian : q=　5.0 (kN/m2)

(13)Up-lift condition

Design creep length ΣL = 35.70 (m)

A point ΣLa= 6.50 (m)

B point ΣLb= 34.20 (m)



(13)Bearing of the foundation

Qa= ---- (kN/m2)

(14)Friction coefficient for foundation

μ= 0.60

(15)Grand level of the embankment

採用盛土タイプ： 2

a)Height of the embankment and load

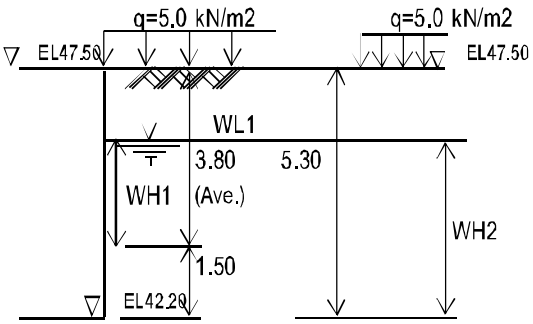
	Embk. H(m)	Load W.(kN/m2)
At case of Weight of sile	3.80	5.0
At case of eath pres.	5.30	5.0

b)Water depth of the condition for embankment

	case1	case2	case3	case4	case5	case6	case7	case8	case9	case10	case11	case12
Design:WL1	WL47.00	WL45.13	—	WL46.55	WL45.13	—	WL45.13	—	WL46.55	WL45.13	—	WL46.55
WH1	3.30	1.43	0.00	2.85	1.43	0.00	1.43	0.00	2.85	1.43	0.00	2.85
WH2	4.80	2.93	0.00	4.35	2.93	0.00	2.93	0.00	4.35	2.93	0.00	4.35

※In case there is difference water level between Up-down stream, average water level of both of them should be applied

case13
WL45.13
1.43
2.93



2.Caluculation of the regulator weight

(1) Enite regulator body weight

Regulator	W	x	W·x	y	W·y	z	W·z
abutment right	5,132.51	13.85	71,085.26	2.20	11,291.52	0.74	3,798.06
abutment left	5,132.51	13.85	71,085.26	2.20	11,291.52	9.26	47,527.04
Midle. 1	5,973.89	12.82	76,585.27	2.10	12,545.17	3.50	20,908.62
Midle. 2	5,973.89	12.82	76,585.27	2.10	12,545.17	6.50	38,830.29
Midle. 3	0.00	12.82	0.00	2.10	0.00	1.50	0.00
Σ	22,212.80		295,341.06		47,673.38		111,064.01

(2) Balance center of entire regulator body

$$X = \Sigma W \cdot x / \Sigma W = \frac{295,341.06}{22,212.80} = 13.30(m)$$

$$Y = \Sigma W \cdot y / \Sigma W = \frac{47,673.38}{22,212.80} = 2.15(m)$$

$$Z = \Sigma W \cdot z / \Sigma W = \frac{111,064.01}{22,212.80} = 5.00(m)$$

(3) abutment Pier : Right [unite : m]

#	W	x	W·x	y	W·y	z	W·z
1	0.00	0.00	0.00	0.75	0.00	1.00	0.00
2	551.25	3.68	2028.60	0.75	413.44	1.00	551.25
3	1526.25	17.53	26755.16	0.75	1144.69	1.00	1526.25
4	6.25	1.67	10.44	1.67	10.44	1.50	9.38
5	66.88	4.68	313.00	1.75	117.04	1.50	100.32
6	12.50	7.68	96.00	1.67	20.88	1.50	18.75
7	6.25	0.25	1.56	1.75	10.94	0.50	3.13
8	6.25	1.33	8.31	1.83	11.44	0.50	3.13
9	6.25	8.02	50.13	1.67	10.44	0.50	3.13
10	241.88	18.03	4361.10	1.75	423.29	0.50	120.94
11	2,156.50	11.85	25,554.53	3.15	6,792.98	0.50	1,078.25
12	371.25	27.70	10,283.63	3.15	1,169.44	0.50	185.63
13	18.65	27.49	512.69	3.40	63.41	0.58	10.82
14-1	35.63	4.25	151.43	6.73	239.79	0.58	20.67
14-2	0.00	4.25	0.00	6.73	0.00	0.58	0.00
15-1	35.63	5.45	194.18	6.73	239.79	0.58	20.67
15-2	0.00	5.45	0.00	6.73	0.00	0.58	0.00
16	21.25	4.85	103.06	8.40	178.50	0.58	12.33
16'	0.00	4.00	0.00	8.15	0.00	1.33	0.00
16"	12.50	3.75	46.88	8.40	105.00	1.50	18.75
17	37.50	2.50	93.75	5.05	189.38	1.50	56.25
17'	37.50	21.70	813.75	5.10	191.25	1.50	56.25
18	-12.50	2.50	-31.25	5.05	-63.13	1.50	-18.75
18'	-12.50	21.70	-271.25	5.10	-63.75	0.90	-11.25
19	-1.32	2.50	-3.30	3.65	-4.82	0.90	-1.19
19'	-1.52	21.70	-32.98	3.40	-5.17	0.90	-1.37
20	-0.60	2.50	-1.50	1.85	-1.11	0.90	-0.54
21	-0.60	4.85	-2.91	3.65	-2.19	0.94	-0.56
22	-0.32	4.84	-1.55	1.94	-0.62	0.90	-0.29
23	-0.80	2.50	-2.00	1.30	-1.04	0.90	-0.72
Add	12.50	4.95	61.88	8.40	105.00	1.00	12.50
Σ	5,132.51		71,093.34		11,295.31		3,773.73

▪ Balance center of abut regulator

	Right abutment regulator	(slide distance)	Left abutment regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{71,093.34}{5,132.51}$	= 13.85(m)	+0.00(m)	= 13.85(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{11,295.31}{5,132.51}$	= 2.20(m)	+0.00(m)	= 2.20(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{3,773.73}{5,132.51}$	= 0.74(m)	-10.00(m)	=-9.26(m)

(4) Middle pier : 〔unite : m〕

#	W	x	W·x	y	W·y	z	W·z
1	56.25	0.25	14.06	0.75	42.19	1.50	84.38
2	770.63	3.93	3,028.58	0.75	577.97	1.50	1,155.95
3	2,289.38	17.53	40,132.83	0.75	1,717.04	1.50	3,434.07
4	12.50	1.67	20.88	1.67	20.88	1.50	18.75
5	133.75	4.68	625.95	1.75	234.06	1.50	200.63
6	25.00	7.68	192.00	1.67	41.75	1.50	37.50
7	0.00	0.50	0.00	1.75	0.00	1.50	0.00
8	37.50	1.33	49.88	1.83	68.63	1.50	56.25
9	6.25	8.02	50.13	1.83	11.44	1.50	9.38
10	241.88	18.03	4,361.10	1.75	423.29	1.50	362.82
11	2,109.00	12.10	25,518.90	3.65	7,697.85	1.50	3,163.50
12	37.31	23.45	874.92	3.40	126.85	1.50	55.97
13	37.31	0.79	29.47	3.40	126.85	1.50	55.97
14-1	17.81	4.25	75.69	6.73	119.86	1.50	26.72
14-2	17.81	4.25	75.69	6.73	119.86	1.50	26.72
15-1	17.81	5.45	97.06	6.73	119.86	1.50	26.72
15-2	17.81	5.45	97.06	6.73	119.86	1.50	26.72
16	21.25	4.85	103.06	8.40	178.50	1.50	31.88
16'	0.00	4.00	0.00	8.15	0.00	1.50	0.00
16"	18.75	3.75	70.31	8.40	157.50	1.50	28.13
17	75.00	2.50	187.50	5.05	378.75	1.50	112.50
17'	75.00	21.70	1,627.50	5.05	378.75	1.50	112.50
18	-25.00	2.50	-62.50	5.05	-126.25	1.50	-37.50
18'	-25.00	21.70	-542.50	5.05	-126.25	1.50	-37.50
19	-2.64	2.50	-6.60	3.65	-9.64	1.50	-3.96
19'	-3.04	21.70	-65.97	3.40	-10.34	1.50	-4.56
20	-1.20	2.50	-3.00	1.85	-2.22	1.50	-1.80
21	-4.62	4.85	-22.41	3.65	-16.86	1.50	-6.93
22	-0.16	4.84	-0.77	1.94	-0.31	1.50	-0.24
23	-1.20	21.70	-26.04	1.35	-1.62	1.50	-1.80
Add	18.75	5.45	102.19	8.40	157.50	1.50	28.13
Σ	5,973.89		76,604.97		12,525.75		8,960.90

▪ Balance center of middle regulator

	Middle regulator	(slide distance)	Mid. 1 regulator	(slide distance)	Mid. 2 regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{76,604.97}{5,973.89}$	= 12.82(m)	+0.00(m)	= 12.82(m)	+0.00(m)	= 12.82(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{12,525.75}{5,973.89}$	= 2.10(m)	+0.00(m)	= 2.10(m)	+0.00(m)	= 2.10(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{8,960.90}{5,973.89}$	= 1.50(m)	+2.00(m)	= 3.50(m)	+5.00(m)	= 6.50(m)

(slide distance)	Mid. 3 regulator
+0.00(m)	= 12.82(m)
+0.00(m)	= 2.10(m)
+0.00(m)	= 1.50(m)

4.Case of the examination

【CASE 1 : Regular / Longitudinal direction/ H.W.L. / Full OP】

Load	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	13.30	295,430.24			
Gate leaf	24.00	4.85	116.40			
Hoist	135.00	4.85	654.75			
Bridge	3,172.65	13.45	42,672.14			
Weight of water	5,209.26	13.79	71,835.70			
Up-lift pressure	-13,296.00	13.85	-184,149.60			
Wind pre.(Reg. body)				50.92	7.18	365.61
Wind pre.(Gate. body)				25.38	6.18	156.85
Wind pre.(Bridge. body)				56.16	6.60	370.66
Wind pre.(Walk bridge. body)				10.80	5.05	54.54
Total	17,457.71		226,559.63	143.26		947.66

Note : The water pressure should be caneled out for the symmetrical force.

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 73.12 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 13.03 (m)

Eccentric distance : e=X-B/2= -0.82 (m) ≦ B/6=4.62(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 51.83

Q2=ΣV/B/L(1-6·e/B)= 74.22

【CASE 2 : Regular / Longitudinal direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	13.30	295,430.24			
Gate leaf	24.00	4.85	116.40			
Hoist	72.00	4.85	349.20			
Bridge	3,172.65	13.45	42,672.14			
Weight of water	634.46	1.84	1,167.41			
Up-lift pressure	-7,549.64	11.98	-90,444.69			
Sedimentation	100.30	1.74	174.52			
Wind pre.(Reg. body)				47.52	6.77	321.71
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				56.16	6.60	370.66
Water pre.(up-st.)				946.14	1.15	1,088.06
Water pre.(dw-st.)				-112.50	0.50	-56.25
Earth pre. (sed.)				7.04	1.92	13.52
Total	18,666.57		249,465.22	944.36		1,737.70

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 11.86 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 13.46 (m)

Eccentric distance : $e=X-B/2=$ -0.39 (m) ≦ B/6=4.62(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 61.70

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 73.08

【CASE 3 : Regular / Longitudinal direction/ Max. water level / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	22,212.80	13.30	295,430.24			
Gate leaf	24.00	4.85	116.40			
Hoist	72.00	4.85	349.20			
Bridge	3,172.65	13.85	43,941.20			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Wind pre.(Reg. body)				71.44	5.23	373.63
Wind pre.(Gate. body)				25.38	6.18	156.85
Wind pre.(Bridge. body)				56.16	6.60	370.66
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	25,481.45		339,837.04	152.98		901.14

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 99.94 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.37 (m)

Eccentric distance : e=X-B/2= -0.48 (m) ≦ B/6=4.62(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 82.43

Q2=ΣV/B/L(1-6・e/B)= 101.56

【CASE 4 : Regular / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V·z (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	5.00	111,064.00			
Gate leaf	24.00	5.00	120.00			
Hoist	72.00	5.00	360.00			
Bridge	3,172.65	5.00	15,863.25			
Weight of water	4,472.92	5.00	22,364.60			
Up-lift pressure	-12,049.50	5.00	-60,247.50			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				428.96	5.14	2,204.85
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	17,904.87		89,524.35	428.96		2,204.85

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 25.04 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 10.00 (m)

Foundation length : L= 27.70 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 5.12 (m)

Eccentric distance : $e=X-B/2=$ 0.12 (m) ≦ B/6=1.67(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 69.29

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 59.98

【CASE 5 : Regular / Lateral direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	5.00	111,064.00			
Gate leaf	24.00	5.00	120.00			
Hoist	72.00	5.00	360.00			
Bridge	3,172.65	5.00	15,863.25			
Weight of water	634.46	5.00	3,172.30			
Up-lift pressure	-7,549.64	5.00	-37,748.20			
Sedimentation	100.30	5.00	501.50			
Wind pre.(Reg. body)				897.86	4.98	4,471.34
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	18,666.57		93,332.85	897.86		4,471.34

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 12.47 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 10.00 (m)

Foundation length : L= 27.70 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 5.24 (m)

Eccentric distance : e=X-B/2= 0.24 (m) ≦ B/6=1.67(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 77.09

Q2=ΣV/B/L(1-6·e/B)= 57.68

【CASE 6 : Regular / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	5.00	111,064.00			
Gate leaf	24.00	5.00	120.00			
Hoist	72.00	5.00	360.00			
Bridge	3,172.65	5.00	15,863.25			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				763.28	3.65	2,785.97
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)				—	—	—
Sum	25,481.45		127,407.25	763.28		2,785.97

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 20.03 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 10.00 (m)

Foundation length : L= 27.70 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 5.11 (m)

Eccentric distance : e=X-B/2= 0.11 (m) ≦ B/6=1.67(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 98.06

Q2=ΣV/B/L(1-6·e/B)= 85.92

【CASE 7 : Seism / Longitudinal direction / Max water level / Full CL】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	22,212.80	13.30	295,430.24	1,777.02	2.20	3,909.44
Gate leaf	24.00	4.85	116.40	1.92	3.18	6.10
Hoist	72.00	4.85	349.20	5.76	8.65	49.82
Bridge	1,527.15	13.45	20,540.17	122.17	5.30	647.50
Weight of water	634.46	1.84	1,167.41	—	—	—
Up-lift pressure	-7,549.64	11.98	-90,444.69	—	—	—
Sedimentation	100.30	1.74	174.52	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				946.14	1.15	1,088.06
Water pre.(dw-st.)				-112.50	0.50	-56.25
Seism Water pre.(up-st.)				88.30	1.74	153.60
Earth pre. (sed.)				7.04	1.92	13.52
Total	17,021.07		227,333.25	2,835.85		5,811.79

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu/\Sigma H=$ 3.60 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 13.70 (m)

Eccentric distance : e=X-B/2= -0.15 (m) ≦ B/3=9.23(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 59.45

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 63.44

【CASE 8 : Seism / Longitudinal direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	22,212.80	13.30	295,430.24	1,777.02	2.20	3,909.44
Gate leaf	24.00	4.85	116.40	1.92	7.35	14.11
Hoist	72.00	4.85	349.20	5.76	8.65	49.82
Bridge	1,527.15	13.85	21,151.03	122.17	5.30	647.50
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Total	23,835.95		317,046.87	1,906.87		4,620.87

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

a)Examination for the slide force

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

b)Examint of the total force : X=(ΣV・x+ΣH・y)/ΣV= 13.50 (m)

Eccentric distance : e=X-B/2= -0.35 (m) ≦ B/3=9.23(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 79.53

Q2=ΣV/B/L(1-6・e/B)= 92.57

【CASE 9 : Seism / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V・z (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	22,212.80	5.00	111,064.00	1,777.02	2.20	3,909.44
Gate leaf	24.00	5.00	120.00	1.92	7.35	14.11
Hoist	72.00	5.00	360.00	5.76	8.65	49.82
Bridge	1,527.15	5.00	7,635.75	122.17	5.30	647.50
Weight of water	4,472.92	5.00	22,364.60	—	—	—
Up-lift pressure	-12,049.50	5.00	-60,247.50	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				105.00	2.64	277.20
Seism water pre. (Mid.)				787.24	2.72	2,141.29
Earth pre. (sed.)				—	—	—
Total	16,259.37		81,296.85	2,799.11		7,039.36

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 3.49 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 10.00 (m)

Foundation length : L= 27.70 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 5.43 (m)

Eccentric distance : e=X-B/2= 0.43 (m) ≦ B/3=3.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 73.84

Q2=ΣV/B/L(1-6・e/B)= 43.55

【CASE 10 : Seism / Lateral direction / Max.water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	5.00	111,064.00	1,777.02	2.20	3,909.44
Gate leaf	24.00	5.00	120.00	1.92	3.18	6.11
Hoist	72.00	5.00	360.00	5.76	8.65	49.82
Bridge	1,527.15	5.00	7,635.75	122.17	5.30	647.50
Weight of water	634.46	5.00	3,172.30	—	—	—
Up-lift pressure	-7,549.64	5.00	-37,748.20	—	—	—
Sedimentation	100.30	5.00	501.50	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				18.38	2.64	48.52
Seism water pre. (Mid.)				33.58	2.72	91.34
Earth pre. (sed.)				—	—	—
Total	17,021.07		85,105.35	1,958.83		4,752.73

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 5.21 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 10.00 (m)

Foundation length : L= 27.70 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 5.28 (m)

Eccentric distance : e=X-B/2= 0.28 (m) ≦ B/3=3.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

Q1=ΣV/B/L(1+6·e/B)= 71.77

Q2=ΣV/B/L(1-6·e/B)= 51.12

【CASE 11 : Seism / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	5.00	111,064.00	1,777.02	2.20	3,909.44
Gate leaf	24.00	5.00	120.00	1.92	7.35	14.11
Hoist	72.00	5.00	360.00	5.76	8.65	49.82
Bridge	1,527.15	5.00	7,635.75	122.17	5.30	647.50
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				—	—	—
Seism water pre. (Mid.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	23,835.95		119,179.75	1,906.87		4,620.87

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 10.00 (m)

Foundation length : L= 27.70 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 5.19 (m)

Eccentric distance : e=X-B/2= 0.19 (m) ≦ B/3=3.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

Q1=ΣV/B/L(1+6·e/B)= 95.86

Q2=ΣV/B/L(1-6·e/B)= 76.24

【CASE 12 : Seism / Longitudinal direction/ Max.water level / Full OP】

Load	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	22,212.80	13.30	295,430.24	1,777.02	2.20	3,909.44
Gate leaf	24.00	4.85	116.40	1.92	7.35	14.11
Hoist	135.00	4.85	654.75	10.80	8.65	93.42
Bridge	1,527.15	13.45	20,540.17	122.17	5.30	647.50
Weight of water	4,472.92	13.84	61,905.21	—	—	—
Up-lift pressure	-12,049.50	13.85	-166,885.58	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Walk bridge. body)				—	—	—
Seism Water pre.(up-st.)				21.38	1.89	40.41
Total	16,322.37		211,761.19	1,933.29		4,704.88

Note : The water pressure should be caneled out for the symmetrical force.

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 5.07 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 13.26 (m)

Eccentric distance : e=X-B/2= -0.59 (m) ≦ B/3=9.23(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 51.39

Q2=ΣV/B/L(1-6·e/B)= 66.46

【CASE 13 : Regular / Longitudinal direction/ Max. water level / Maintenace case】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	22,212.80	13.30	295,430.24			
Gate leaf for 3vents	16.00	4.85	77.60			
Hoist for 3vents	48.00	4.85	232.80			
Stoplog Gate of U.S.	8.00	2.50	20.00			
Stoplog Gate of D.S.	8.00	21.70	173.60			
Bridge	3,172.65	13.45	42,672.14			
Weight of water	3,580.38	13.40	47,977.09			
Weight of water at stoplog	-1,083.01	1.25	-1,353.76			
Up-lift pressure	-11,023.20	13.56	-149,474.59			
Sedimentation	100.30	1.74	174.52			
Sedimentation at stoplog	-19.33	1.25	-24.16			
Wind pre.(Reg. body)				47.52	6.77	321.71
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				56.16	6.60	370.66
Water pre.(up-st.)				946.14	1.15	1,088.06
Water pre.(dw-st.)				-455.70	1.16	-528.61
Earth pre. (sed.)				7.04	1.92	13.52
Total	17,020.59		235,905.48	601.16		1,265.34

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 16.99 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 27.70 (m)

Foundation length : L= 10.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 13.93 (m)

Eccentric distance : $e=X-B/2=$ 0.08 (m) ≦ B/6=4.62(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 62.51

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 60.38

A-4-4. Abo Gabal Regulator

Summary table of result on the stability examination for Abo Gabal Regulator

Pier	Case	Direction	Condition	Vertical force V (kN)	Resistant moment V･x (kN･m)	Horizontal force H (kN)	Torque moment H･y (kN･m)	For the sliding Safe ratio Required ratio	For the sliding Safe ratio Desing	For the fall down Eccentricity e (m)	For the fall down B/6 (Allowable)	For the ground reaction[Note 1)] Ground reaction Q1 (kN/m2)	For the ground reaction Ground reaction Q2 (kN/m2)	For the ground reaction Bearing (kN/m2)	Judge	Remarks
Abo Gabal Regulator	1	Long.	Regular	14,280.64	118,050.05	222.51	1,726.95	1.50	≦ 38.51	0.29	≦ 2.70	75.09	60.53		OK	
	2	Long.	Regular	16,190.06	131,176.82	1,861.31	3,835.16	1.50	≦ 5.22	0.24	≦ 2.70	83.71	70.04		OK	
	3	Long.	Regular	20,949.17	171,879.71	245.56	1,692.48	1.50	≦ 51.19	0.19	≦ 2.70	106.47	92.47		OK	
	4	Lateral.	Regular	14,531.51	94,454.82	403.70	2,652.31	1.50	≦ 21.60	0.18	≦ 2.17	74.73	63.27		OK	
	5	Lateral.	Regular	16,190.06	105,235.40	714.26	4,449.84	1.50	≦ 13.60	0.27	≦ 2.17	86.46	67.30		OK	
	6	Lateral.	Regular	20,949.17	136,169.61	914.61	4,015.14	1.50	≦ 13.74	0.19	≦ 2.17	108.20	90.75		OK	
	7	Long.	Seism	16,154.06	130,782.62	3,541.61	7,509.83	1.15	≦ 2.74	0.46	≦ 5.40	89.77	63.64		OK	
	8	Long.	Seism	20,913.17	171,588.11	1,673.05	4,606.68	1.15	≦ 7.50	0.33	≦ 5.40	111.44	87.17		OK	
	9	Lateral.	Seism	14,495.51	94,220.82	2,273.50	6,474.08	1.15	≦ 3.83	0.45	≦ 4.33	83.12	54.53		OK	
	10	Lateral.	Seism	16,154.06	105,001.40	1,815.29	5,032.07	1.15	≦ 5.34	0.31	≦ 4.33	87.68	65.73		OK	
	11	Lateral.	Seism	20,913.17	135,935.61	1,673.05	4,606.68	1.15	≦ 7.50	0.22	≦ 4.33	109.39	89.22		OK	
	12	Long.	Seism	14,635.51	120,995.69	1,717.28	4,796.56	1.15	≦ 5.11	0.50	≦ 5.40	82.36	56.63		OK	
	13	Long.	Regular	14,043.24	121,596.92	967.19	2,203.10	1.50	≦ 8.71	0.72	≦ 2.70	84.46	48.90		OK	

Note 1) Ground reaction for the bearing capacity should be consideration in Chapter 12

Abo Gabal Regulator / Stability examination

1.Design condition

(1)Dimension of form for abutment Pier 〔unite : m〕

A(1)=	16.20	A(2)=	0.00	A(3)=	1.85	A(4)=	0.00	A(5)=	3.75	A(6)=	0.21	A(7)=	10.39
A(8)=	0.50	A(9)=	15.70	A(10)=	0.00	A(11)=	3.50	A(12)=	1.20	A(13)=	0.17	A(14)=	0.50
A(15)=	10.50	A(16)=	4.00	A(17)=	1.70	A(18)=	10.50	A(19)=	0.85	A(20)=	0.85	A(21)=	1.00
A(22)=	1.00	A(23)=	1.00	A(24)=	0.27	A(25)=	0.17	A(26)=	0.27	A(27)=	5.25	A(28)=	5.25
A(29)=	0.00	A(30)=	0.30	A(31)=	1.35	A(32)=	0.65	A(33)=	0.00	A(34)=	0.65	A(35)=	0.00
B(1)=	1.00	B(2)=	1.00	B(3)=	2.00	B(4)=	1.00	B(5)=	0.25	B(6)=	0.75	B(7)=	0.20
B(8)=	0.80	B(9)=	0.20	B(10)=	0.80	B(11)=	1.00	B(11')=	0.75	B(12)=	0.00	B(13)=	0.00
C(1)=	1.50	C(2)=	4.75	C(3)=	3.95	C(4)=	1.50	C(5)=	0.85	C(6)=	3.90	C(7)=	3.45
C(8)=	0.50	C(9)=	0.50	C(10)=	0.25	C(11)=	0.85	C(12)=	0.80	C(13)=	0.25	C(14)=	0.00
C(15)=	0.50	C(16)=	0.00	C(17)=	0.25								

(2)Dimension of form for Middle Pier 〔unite : m〕

D(1)=	16.20	D(2)=	0.50	D(3)=	1.35	D(4)=	0.00	D(5)=	3.75	D(6)=	0.21	D(7)=	10.39
D(8)=	0.50	D(9)=	15.20	D(10)=	0.00	D(11)=	3.00	D(12)=	1.20	D(13)=	0.17	D(14)=	0.50
D(15)=	10.50	D(16)=	3.50	D(17)=	1.70	D(18)=	10.50	D(19)=	0.85	D(20)=	0.85	D(21)=	1.00
D(22)=	1.00	D(23)=	1.00	D(24)=	0.27	D(25)=	0.17	D(26)=	0.27	D(27)=	5.25	D(28)=	5.25
D(29)=	0.00	D(30)=	0.30	D(31)=	1.35	D(32)=	0.65	D(33)=	0.00	D(34)=	0.65	D(35)=	0.00
D(36)=	0.00												
E(1)=	1.00	E(2)=	1.00	E(3)=	1.00	E(4)=	3.00	E(5)=	1.00	E(6)=	0.25	E(7)=	0.50
E(8)=	0.25	E(9)=	0.20	E(10)=	0.60	E(11)=	0.20	E(12)=	0.25	E(13)=	0.50	E(14)=	0.25
E(15)=	0.20	E(16)=	0.60	E(17)=	0.20	E(18)=	0.00	E(19)=	0.00				
F(1)=	1.50	F(2)=	4.75	F(3)=	3.95	F(4)=	1.50	F(5)=	0.85	F(6)=	3.90	F(7)=	3.45
F(8)=	0.50	F(9)=	0.50	F(10)=	0.25	F(11)=	0.85	F(12)=	0.80	F(13)=	0.25	F(14)=	0.00
F(15)=	0.50	F(16)=	0.00	F(17)=	0.25								

(3)Number and slide distance of center for each pier 〔unite : m〕

Number of pier : abutment 2 piers
middle 3 piers
Number of vent : 4

Entire regulator width : 13.00 m
Entire regulator length : 16.20 m

	active(y) or not(n)	x (m)	y (m)	z (m)
Right abutment pi	y	0.00	0.00	0.00
Left abutment pier	y	0.00	0.00	13.00
Middle pier 1	y	0.00	0.00	2.00
Middle pier 2	y	0.00	0.00	5.00
Middle pier 3	y	0.00	0.00	8.00

(4)Main level of foundation

Apron bottom : EL41.25m
Gate bottom : EL43.60m

(5)Unite weight 〔unit : kN/m^3〕

RC :	25.00	Soil 〔Wet〕 :	18.00	Soil 〔Saturation〕 :	20.00
Concrete :	23.00	Soil 〔in water〕 :	10.00	Water :	10.00

(6)Seismic co-efficient

KH= 0.08
KH'= 0.09 (submerged condition)

(7)Case of examination

Case	Direction	Water Level			Situation of gate	Condi.	Additional	(m)
Case1	Long.	U.S.	WL47.00m	HWL	Open gate	Regular	—	—
		D.S.	WL47.00m	HWL				
Case2	Long.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL42.75m	Low				
Case3	Long.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case4	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Regular	—	—
		D.S.	WL46.55m	Max.WL				
Case5	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL42.75m	Low				
Case6	Lateral.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case7	Long.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case2	sedimentation	0.3
		D.S.	WL42.75m	Low				
Case8	Long.	U.S.	—	No WL	Open gate	Seism of case3	—	—
		D.S.	—	No WL				
Case9	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case4	—	—
		D.S.	WL46.55m	Max.WL				
Case10	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case5	sedimentation	0.3
		D.S.	WL42.75m	Low				
Case11	Lateral.	U.S.	—	No WL	Open gate	Seism of case6	—	—
		D.S.	—	No WL				
Case12	Long.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case6	—	—
		D.S.	WL46.55m	Max.WL				
Case13	Long.	U.S.	WL46.55m	Max.WL	Maintenace gate	Regular	—	0.3
		D.S.	WL45.90m	Low				

(8)Coefficient of earth pressure

Internal friction : φ= 30°

	Regular case	Seismic case	Seismic (submerged)	Sedimentation
Friction for wall	0°	0°	0°	—
Active EP coe.	0.333	0.383	0.39	0.5
Passive EP coe.	3.000	2.858	2.84	—

(9)Weight of the gate facility

Item of design load		Design load	Remarks
Gate leaf	(kN/vent)	10.00	Upper 10.00 Lower 0.00
Hiost (Emargency)	(kN/vent)	64.00	including the hoist weight
Hiost	(kN/vent)	29.00	including the groove weight
Actual vent wide	(m)	2.00	
Height of gate	(m)	2.95	
Stop Log gate	(kN/vent)	10.00	

(10)Weight of the bridge / note : Include to weight of regulator body

Item of design load		Regular case	Seismic case
Vertical load (body)	(kN/vent)	—	—
Vertical load (live load only)	(kN/vent)	9.00	0.00
Horizontal force by wind	(kN/vent)	18.72	—
Counter force for up-to-down st.	(kN)	—	—
Counter force for right angle	(kN)	—	—

Height of the handrail= 1.10 (m)

Thick of the bridge= 1.50 (m)

Note : Bridge weight is included to Regulator body weight

(11)Wind pressure w= 3.0 (kN/m2) [coefficient of form plane: 1.20 round : 0.70]

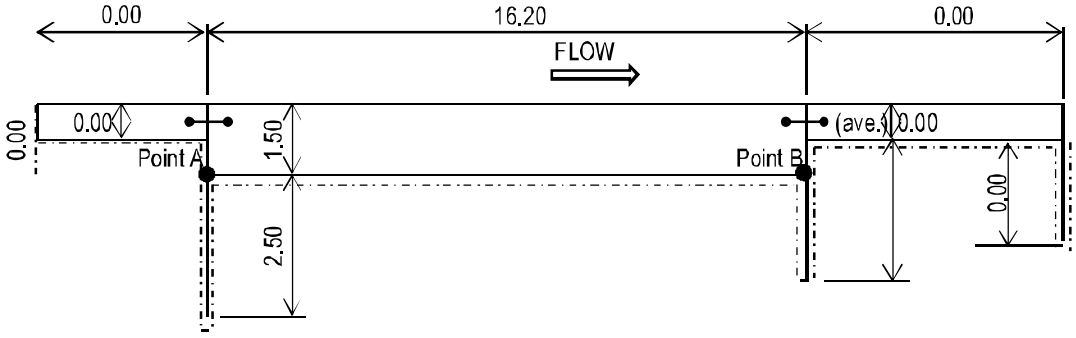
(12)Other load　　Vehicle : q=　10.0 (kN/m2)　Pedestrian : q=　5.0 (kN/m2)

(13)Up-lift condition

Design creep length ΣL = 24.20 (m)

A point ΣLa= 6.50 (m)

B point ΣLb= 22.70 (m)



(13)Bearing of the foundation

Qa= ---- (kN/m2)

(14)Friction coefficient for foundation

μ= 0.60

(15)Grand level of the embankment

a)Height of the embankment and load

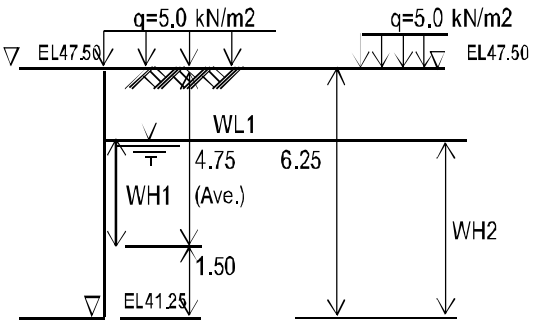
	Embk. H(m)	Load W.(kN/m2)
At case of Weight of sile	4.75	5.0
At case of eath pres.	6.25	5.0

b)Water depth of the condition for embankment

	case1	case2	case3	case4	case5	case6	case7	case8	case9	case10	case11	case12
Design:WL1	WL47.00	WL44.65	—	WL46.55	WL44.65	—	WL44.65	—	WL46.55	WL44.65	—	WL46.55
WH1	4.25	1.90	0.00	3.80	1.90	0.00	1.90	0.00	3.80	1.90	0.00	3.80
WH2	5.75	3.40	0.00	5.30	3.40	0.00	3.40	0.00	5.30	3.40	0.00	5.30

※In case there is difference water level between Up-down stream, average water level of both of them should be applied

case13
WL44.65
1.90
3.40



2.Caluculation of the regulator weight

(1) Enite regulator body weight

Regulator	W	x	W·x	y	W·y	z	W·z
abutment right	3,744.46	8.17	30,592.24	2.70	10,110.04	0.74	2,770.90
abutment left	3,744.46	8.17	30,592.24	2.70	10,110.04	12.26	45,907.08
Midle. 1	4,422.75	8.27	36,576.14	2.78	12,295.25	3.50	15,479.63
Midle. 2	4,422.75	8.27	36,576.14	2.78	12,295.25	6.50	28,747.88
Midle. 3	4,422.75	8.27	36,576.14	2.78	12,295.25	9.50	42,016.13
Σ	20,757.17		170,912.90		57,105.83		134,921.62

(2) Balance center of entire regulator body

$$X = \Sigma W \cdot x / \Sigma W = \frac{170,912.90}{20,757.17} = 8.23(m)$$

$$Y = \Sigma W \cdot y / \Sigma W = \frac{57,105.83}{20,757.17} = 2.75(m)$$

$$Z = \Sigma W \cdot z / \Sigma W = \frac{134,921.62}{20,757.17} = 6.50(m)$$

(3) abutment Pier : Right [unite : m]

	#	W	x	W·x	y	W·y	z	W·z
	1	0.00	0.00	0.00	0.75	0.00	1.00	0.00
	2	420.00	2.80	1176.00	0.75	315.00	1.00	420.00
	3	795.00	10.90	8665.50	0.75	596.25	1.00	795.00
	4	0.00	1.85	0.00	1.78	0.00	1.50	0.00
	5	79.69	3.73	297.24	1.93	153.80	1.50	119.54
	6	4.46	5.67	25.29	1.78	7.94	1.50	6.69
	7	28.69	0.68	19.51	1.93	55.37	0.50	14.35
	8	0.00	1.85	0.00	2.07	0.00	0.50	0.00
	9	2.23	5.74	12.80	1.78	3.97	0.50	1.12
	10	220.79	11.01	2430.90	1.93	426.12	0.50	110.40
	11	1,864.38	8.35	15,567.57	3.45	6,432.11	0.50	932.19
	12	0.00	16.20	0.00	3.45	0.00	0.50	0.00
	13	23.32	15.99	372.89	3.88	90.48	0.58	13.53
	14-1	77.63	4.60	357.10	7.98	619.49	1.63	126.15
	14-2	0.00	4.60	0.00	7.98	0.00	0.58	0.00
	15-1	43.13	5.45	235.06	7.98	344.18	1.50	64.70
	15-2	0.00	5.45	0.00	7.98	0.00	0.58	0.00
	16	21.25	4.85	103.06	9.95	211.44	0.58	12.33
	16'	0.00	4.00	0.00	9.70	0.00	1.33	0.00
	16"	16.25	3.68	59.80	9.95	161.69	1.50	24.38
	17	37.50	2.50	93.75	6.00	225.00	1.50	56.25
	17'	0.00	15.38	0.00	6.13	0.00	1.50	0.00
	18	-12.50	2.50	-31.25	6.00	-75.00	1.50	-18.75
	18'	0.00	14.70	0.00	6.13	0.00	0.90	0.00
	19	-1.56	2.50	-3.90	4.30	-6.71	0.90	-1.40
	19'	-0.57	15.38	-8.77	3.88	-2.21	0.90	-0.51
	20	-0.50	2.50	-1.25	2.23	-1.12	0.90	-0.45
	21	-1.37	4.85	-6.64	4.30	-5.89	0.88	-1.21
	22	-0.09	4.85	-0.44	2.23	-0.20	0.90	-0.08
	23	-0.15	2.50	-0.38	1.38	-0.21	0.90	-0.14
Bridge	Add1	81.25	14.95	1,214.69	4.60	373.75	1.50	121.88
Deck	Add2	8.13	5.95	48.37	9.95	80.89	1.00	8.13
Side	Add3	37.50	-0.50	-18.75	3.13	117.38	-0.50	-18.75
	Σ	3,744.46		30,608.15		10,123.52		2,785.35

- Balance center of abut regulator

	Right abutment regulator	(slide distance)	Left abutment regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{30,608.15}{3,744.46}$	=8.17(m)	+0.00(m)	=8.17(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{10,123.52}{3,744.46}$	=2.70(m)	+0.00(m)	=2.70(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{2,785.35}{3,744.46}$	=0.74(m)	-13.00(m)	=-12.26(m)

(4) Middle pier : 〔unite : m〕

#	W	x	W·x	y	W·y	z	W·z
1	56.25	0.25	14.06	0.75	42.19	1.50	84.38
2	573.75	3.05	1,749.94	0.75	430.31	1.50	860.63
3	1,192.50	10.90	12,998.25	0.75	894.38	1.50	1,788.75
4	0.00	1.85	0.00	1.78	0.00	1.50	0.00
5	159.38	3.73	594.49	1.93	307.60	1.50	239.07
6	8.93	5.67	50.63	1.78	15.90	1.50	13.40
7	18.06	0.93	16.80	1.93	34.86	1.50	27.09
8	0.00	1.85	0.00	2.07	0.00	1.50	0.00
9	2.23	5.74	12.80	2.07	4.62	1.50	3.35
10	220.79	11.01	2,430.90	1.93	426.12	1.50	331.19
11	1,805.00	8.60	15,523.00	4.30	7,761.50	1.50	2,707.50
12	0.00	16.20	0.00	3.88	0.00	1.50	0.00
13	46.63	0.79	36.84	3.88	180.92	1.50	69.95
14-1	51.75	4.60	238.05	7.98	412.97	1.50	77.63
14-2	0.00	4.60	0.00	7.98	0.00	1.50	0.00
15-1	10.78	5.45	58.75	7.98	86.02	1.13	12.13
15-2	10.78	5.45	58.75	7.98	86.02	1.88	20.21
16	21.25	4.85	103.06	9.95	211.44	1.50	31.88
16'	0.00	4.00	0.00	9.70	0.00	1.50	0.00
16"	24.38	3.68	89.72	9.95	242.58	1.50	36.57
17	75.00	2.50	187.50	6.00	450.00	1.50	112.50
17'	0.00	15.38	0.00	6.25	0.00	1.50	0.00
18	-25.00	2.50	-62.50	6.00	-150.00	1.50	-37.50
18'	0.00	14.70	0.00	6.25	0.00	1.50	0.00
19	-3.12	2.50	-7.80	4.30	-13.42	1.50	-4.68
19'	-1.14	14.70	-16.76	3.88	-4.42	1.50	-1.71
20	-1.00	2.50	-2.50	2.23	-2.23	1.50	-1.50
21	-2.73	4.85	-13.24	4.30	-11.74	1.50	-4.10
22	-0.17	4.62	-0.79	2.23	-0.38	1.50	-0.26
23	-0.30	14.70	-4.41	1.38	-0.41	1.50	-0.45
Add1	162.50	14.95	2,429.38	4.60	747.50	1.50	243.75
Add2	16.25	5.95	96.69	9.95	161.69	1.50	24.38
Σ	4,422.75		36,581.61		12,314.02		6,634.16

▪ Balance center of middle regulator

	Middle regulator	(slide distance)	Mid. 1 regulator	(slide distance)	Mid. 2 regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{36,581.61}{4,422.75}$	= 8.27(m)	+0.00(m)	= 8.27(m)	+0.00(m)	= 8.27(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{12,314.02}{4,422.75}$	= 2.78(m)	+0.00(m)	= 2.78(m)	+0.00(m)	= 2.78(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{6,634.16}{4,422.75}$	= 1.50(m)	+2.00(m)	= 3.50(m)	+5.00(m)	= 6.50(m)

(slide distance)	Mid. 3 regulator
+0.00(m)	= 8.27(m)
+0.00(m)	= 2.78(m)
+8.00(m)	= 9.50(m)

4.Case of the examination

【CASE 1 : Regular / Longitudinal direction/ H.W.L. / Full OP】

Load	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	8.23	170,831.51			
Gate leaf	40.00	4.85	194.00			
Hoist	256.00	4.85	1,241.60			
Bridge	—	10.95	—			
Weight of water	5,336.97	8.22	43,869.89			
Up-lift pressure	-12,109.50	8.10	-98,086.95			
Wind pre.(Reg. body)				90.75	8.37	759.58
Wind pre.(Gate. body)				42.48	7.43	315.63
Wind pre.(Bridge. body)				74.88	7.55	565.34
Wind pre.(Walk bridge. body)				14.40	6.00	86.40
Total	14,280.64		118,050.05	222.51		1,726.95

Note : The water pressure should be caneled out for the symmetrical force.

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 38.51 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 8.39 (m)

Eccentric distance : e=X-B/2= 0.29 (m) ≦ B/6=2.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 75.09

Q2=ΣV/B/L(1-6・e/B)= 60.53

【CASE 2 : Regular / Longitudinal direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	8.23	170,831.51			
Gate leaf	40.00	4.85	194.00			
Hoist	116.00	4.85	562.60			
Bridge (Live load only)	36.00	10.95	394.20			
Weight of water	1,332.49	2.16	2,878.18			
Up-lift pressure	-6,333.81	6.96	-44,083.32			
Sedimentation	242.21	1.65	399.65			
Wind pre.(Reg. body)				88.30	8.06	711.70
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				74.88	7.55	565.34
Water pre.(up-st.)				1,825.85	1.42	2,592.71
Water pre.(dw-st.)				-146.25	0.50	-73.13
Earth pre. (sed.)				18.53	2.08	38.54
Total	16,190.06		131,176.82	1,861.31		3,835.16

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 5.22 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 8.34 (m)

Eccentric distance : e=X-B/2= 0.24 (m) ≦ B/6=2.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 83.71

Q2=ΣV/B/L(1-6・e/B)= 70.04

【CASE 3 : Regular / Longitudinal direction/ Max. water level / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	8.23	170,831.51			
Gate leaf	40.00	4.85	194.00			
Hoist	116.00	4.85	562.60			
Bridge (Live load only)	36.00	8.10	291.60			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Wind pre.(Reg. body)				128.20	6.33	811.51
Wind pre.(Gate. body)				42.48	7.43	315.63
Wind pre.(Bridge. body)				74.88	7.55	565.34
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	20,949.17		171,879.71	245.56		1,692.48

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 51.19 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 8.29 (m)

Eccentric distance : e=X-B/2= 0.19 (m) ≦ B/6=2.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 106.47

Q2=ΣV/B/L(1-6・e/B)= 92.47

【CASE 4 : Regular / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V･z (kN･m)	H (kN)	y (m)	H･y (kN･m)
Reg. body	20,757.17	6.50	134,921.61			
Gate leaf	40.00	6.50	260.00			
Hoist	116.00	6.50	754.00			
Bridge (Live load only)	36.00	6.50	234.00			
Weight of water	4,744.14	6.50	30,836.91			
Up-lift pressure	-11,161.80	6.50	-72,551.70			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				403.70	6.57	2,652.31
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	14,531.51		94,454.82	403.70		2,652.31

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV･μ/ΣH= 21.60 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 13.00 (m)

Foundation length : L= 16.20 (m)

Act point of the total force : X=(ΣV･x+ΣH･y)/ΣV= 6.68 (m)

Eccentric distance : e=X-B/2= 0.18 (m) ≦ B/6=2.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6･e/B)= 74.73

Q2=ΣV/B/L(1-6･e/B)= 63.27

【CASE 5 : Regular / Lateral direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	20,757.17	6.50	134,921.61			
Gate leaf	40.00	6.50	260.00			
Hoist	116.00	6.50	754.00			
Bridge (Live load only)	36.00	6.50	234.00			
Weight of water	1,332.49	6.50	8,661.19			
Up-lift pressure	-6,333.81	6.50	-41,169.77			
Sedimentation	242.21	6.50	1,574.37			
Wind pre.(Reg. body)				714.26	6.23	4,449.84
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	16,190.06		105,235.40	714.26		4,449.84

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 13.60 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 13.00 (m)

Foundation length : L= 16.20 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 6.77 (m)

Eccentric distance : e=X-B/2= 0.27 (m) ≦ B/6=2.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 86.46

Q2=ΣV/B/L(1-6·e/B)= 67.30

【CASE 6 : Regular / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	6.50	134,921.61			
Gate leaf	40.00	6.50	260.00			
Hoist	116.00	6.50	754.00			
Bridge (Live load only)	36.00	6.50	234.00			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				914.61	4.39	4,015.14
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)				—	—	—
Sum	20,949.17		136,169.61	914.61		4,015.14

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 13.74 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 13.00 (m)

Foundation length : L= 16.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 6.69 (m)

Eccentric distance : $e=X-B/2=$ 0.19 (m) ≦ B/6=2.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 108.20

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 90.75

【CASE 7 : Seism / Longitudinal direction / Max water level / Full CL】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	8.23	170,831.51	1,660.57	2.70	4,483.54
Gate leaf	40.00	4.85	194.00	3.20	3.83	12.24
Hoist	116.00	4.85	562.60	9.28	10.20	94.66
Bridge	—	10.95	—	—	6.25	—
Weight of water	1,332.49	2.16	2,878.18	—	—	—
Up-lift pressure	-6,333.81	6.96	-44,083.32	—	—	—
Sedimentation	242.21	1.65	399.65	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				1,825.85	1.42	2,592.71
Water pre.(dw-st.)				-146.25	0.50	-73.13
Seism Water pre.(up-st.)				170.43	2.12	361.27
Earth pre. (sed.)				18.53	2.08	38.54
Total	16,154.06		130,782.62	3,541.61		7,509.83

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 2.74 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 8.56 (m)

Eccentric distance : e=X-B/2= 0.46 (m) ≦ B/3=5.40(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 89.77

Q2=ΣV/B/L(1-6・e/B)= 63.64

【CASE 8 : Seism / Longitudinal direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	8.23	170,831.51	1,660.57	2.70	4,483.54
Gate leaf	40.00	4.85	194.00	3.20	8.90	28.48
Hoist	116.00	4.85	562.60	9.28	10.20	94.66
Bridge	—	8.10	—	—	6.25	—
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Total	20,913.17		171,588.11	1,673.05		4,606.68

Note : Bridge weight is included to Regulator body weight

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

a)Examination for the slide force

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

b)Examint of the total force : X=(ΣV・x+ΣH・y)/ΣV= 8.43 (m)

Eccentric distance : e=X-B/2= 0.33 (m) ≦ B/3=5.40(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 111.44

Q2=ΣV/B/L(1-6・e/B)= 87.17

【CASE 9 : Seism / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V·z (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	20,757.17	6.50	134,921.61	1,660.57	2.70	4,483.54
Gate leaf	40.00	6.50	260.00	3.20	8.90	28.48
Hoist	116.00	6.50	754.00	9.28	10.20	94.66
Bridge	—	6.50	—	—	6.25	—
Weight of water	4,744.14	6.50	30,836.91	—	—	—
Up-lift pressure	-11,161.80	6.50	-72,551.70	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				109.17	3.02	329.69
Seism water pre. (Mid.)				491.28	3.13	1,537.71
Earth pre. (sed.)				—	—	—
Total	14,495.51		94,220.82	2,273.50		6,474.08

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 3.83 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 13.00 (m)

Foundation length : L= 16.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 6.95 (m)

Eccentric distance : $e=X-B/2=$ 0.45 (m) ≦ B/3=4.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 83.12

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 54.53

【CASE 10 : Seism / Lateral direction / Max.water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	20,757.17	6.50	134,921.61	1,660.57	2.70	4,483.54
Gate leaf	40.00	6.50	260.00	3.20	3.83	12.26
Hoist	116.00	6.50	754.00	9.28	10.20	94.66
Bridge	—	6.50	—	—	6.25	—
Weight of water	1,332.49	6.50	8,661.19	—	—	—
Up-lift pressure	-6,333.81	6.50	-41,169.77	—	—	—
Sedimentation	242.21	6.50	1,574.37	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				32.68	3.02	98.69
Seism water pre. (Mid.)				109.56	3.13	342.92
Earth pre. (sed.)				—	—	—
Total	16,154.06		105,001.40	1,815.29		5,032.07

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 5.34 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 13.00 (m)

Foundation length : L= 16.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 6.81 (m)

Eccentric distance : $e=X-B/2=$ 0.31 (m) ≦ B/3=4.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 87.68

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 65.73

【CASE 11 : Seism / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	20,757.17	6.50	134,921.61	1,660.57	2.70	4,483.54
Gate leaf	40.00	6.50	260.00	3.20	8.90	28.48
Hoist	116.00	6.50	754.00	9.28	10.20	94.66
Bridge	—	6.50	—	—	6.25	—
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				—	—	—
Seism water pre. (Mid.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	20,913.17		135,935.61	1,673.05		4,606.68

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 7.50 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 13.00 (m)

Foundation length : L= 16.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 6.72 (m)

Eccentric distance : $e=X-B/2=$ 0.22 (m) ≦ B/3=4.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 109.39

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 89.22

【CASE 12 : Seism / Longitudinal direction/ Max.water level / Full OP】

Load	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	20,757.17	8.23	170,831.51	1,660.57	2.70	4,483.54
Gate leaf	40.00	4.85	194.00	3.20	8.90	28.48
Hoist	256.00	4.85	1,241.60	20.48	10.20	208.90
Bridge	—	10.95	—	—	6.25	—
Weight of water	4,744.14	8.25	39,139.16	—	—	—
Up-lift pressure	-11,161.80	8.10	-90,410.58	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Walk bridge. body)				—	—	—
Seism Water pre.(up-st.)				33.03	2.29	75.64
Total	14,635.51		120,995.69	1,717.28		4,796.56

Note : The water pressure should be caneled out for the symmetrical force.

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 5.11 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 8.60 (m)

Eccentric distance : e=X-B/2= 0.50 (m) ≦ B/3=5.40(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 82.36

Q2=ΣV/B/L(1-6·e/B)= 56.63

【CASE 13 : Regular / Longitudinal direction/ Max. water level / Maintenace case】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	20,757.17	8.23	170,831.51			
Gate leaf for 3vents	30.00	4.85	145.50			
Hoist for 3vents	87.00	4.85	421.95			
Stoplog Gate of U.S.	10.00	2.50	25.00			
Stoplog Gate of D.S.	10.00	15.38	153.80			
Bridge (Live load only)	36.00	10.95	394.20			
Weight of water	4,151.83	7.92	32,882.49			
Weight of water at stoplog	-899.31	1.25	-1,124.14			
Up-lift pressure	-10,335.21	7.98	-82,474.98			
Sedimentation	242.21	1.65	399.65			
Sedimentation at stoplog	-46.45	1.25	-58.06			
Wind pre.(Reg. body)				65.95	8.09	533.54
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				74.88	7.55	565.34
Water pre.(up-st.)				1,825.85	1.42	2,592.71
Water pre.(dw-st.)				-1,018.02	1.50	-1,527.03
Earth pre. (sed.)				18.53	2.08	38.54
Total	14,043.24		121,596.92	967.19		2,203.10

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu/\Sigma H=$ 8.71 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 16.20 (m)

Foundation length : L= 13.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 8.82 (m)

Eccentric distance : $e=X-B/2=$ 0.72 (m) ≦ B/6=2.70(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 84.46

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 48.90

A-4-5. Sahelyia Regulator

Summary table of result on the stability examination for Sahelyia Regulator

Pier	Case	Direction	Condition	Vertical force V (kN)	Resistant moment V・x (kN・m)	Horizontal force H (kN)	Torque moment H・y (kN・m)	For the sliding Safe ratio Required ratio		For the fall down Eccentricity e (m)		For the ground reaction[cle1)] Ground reaction Q1 (kN/m2)	Ground reaction Q2 (kN/m2)	Bearing (kN/m2)	Judge	Remarks
									Desing		B/6 (Allowable)					
Sahelyia Regulator	1	Long.	Regular	9,296.64	72,509.84	129.69	1,193.07	1.50	≦ 43.01	0.33	≦ 2.53	98.76	75.99		OK	
	2	Long.	Regular	10,778.76	82,364.34	1,517.09	3,776.88	1.50	≦ 4.26	0.39	≦ 2.53	116.90	85.71		OK	
	3	Long.	Regular	13,479.82	103,926.34	149.64	1,190.92	1.50	≦ 54.05	0.20	≦ 2.53	136.69	116.69		OK	
	4	Lateral.	Regular	9,411.63	32,940.71	243.00	1,941.57	1.50	≦ 23.24	0.21	≦ 1.17	104.38	72.53		OK	
	5	Lateral.	Regular	10,778.76	37,725.67	615.62	4,543.28	1.50	≦ 10.51	0.42	≦ 1.17	137.77	64.83		OK	
	6	Lateral.	Regular	13,479.82	47,179.37	362.13	1,897.56	1.50	≦ 22.33	0.14	≦ 1.17	141.89	111.49		OK	
	7	Long.	Seism	10,763.76	82,207.59	2,639.74	6,633.25	1.15	≦ 2.45	0.65	≦ 5.07	127.12	75.21		OK	
	8	Long.	Seism	13,464.82	103,812.34	1,077.19	3,360.93	1.15	≦ 7.50	0.36	≦ 5.07	144.53	108.57		OK	
	9	Lateral.	Seism	9,396.63	32,888.21	1,529.00	4,980.70	1.15	≦ 3.69	0.53	≦ 2.33	128.43	48.19		OK	
	10	Lateral.	Seism	10,763.76	37,673.17	1,204.34	3,804.37	1.15	≦ 5.36	0.35	≦ 2.33	131.51	70.81		OK	
	11	Lateral.	Seism	13,464.82	47,126.87	1,077.19	3,360.93	1.15	≦ 7.50	0.25	≦ 2.33	153.67	99.43		OK	
	12	Long.	Seism	9,498.63	74,072.27	1,127.58	3,572.45	1.15	≦ 5.05	0.57	≦ 5.07	109.36	69.19		OK	
	13	Long.	Regular	8,513.80	73,537.34	389.29	1,397.34	1.50	≦ 13.12	1.20	≦ 2.53	117.92	42.11		OK	

Note 1) Ground reaction for the bearing capacity should be consideration in Chapter 12

Sahelyia Regulator / Stability examination

1.Design condition

(1)Dimension of form for abutment Pier 〔unite : m〕

A(1)=	15.20	A(2)=	0.00	A(3)=	1.85	A(4)=	0.00	A(5)=	3.75	A(6)=	0.36	A(7)=	9.24
A(8)=	0.50	A(9)=	14.70	A(10)=	0.00	A(11)=	3.50	A(12)=	1.20	A(13)=	0.22	A(14)=	0.50
A(15)=	9.50	A(16)=	4.00	A(17)=	1.70	A(18)=	9.50	A(19)=	0.85	A(20)=	0.85	A(21)=	1.00
A(22)=	1.00	A(23)=	1.00	A(24)=	0.27	A(25)=	0.17	A(26)=	0.22	A(27)=	4.75	A(28)=	4.75
A(29)=	0.00	A(30)=	0.70	A(31)=	0.15	A(32)=	0.65	A(33)=	0.00	A(34)=	0.65	A(35)=	0.00
B(1)=	1.00	B(2)=	1.00	B(3)=	2.00	B(4)=	1.00	B(5)=	0.25	B(6)=	0.75	B(7)=	0.20
B(8)=	0.80	B(9)=	0.20	B(10)=	0.80	B(11)=	1.00	B(11')=	0.75	B(12)=	0.00	B(13)=	0.00
C(1)=	1.50	C(2)=	5.95	C(3)=	4.55	C(4)=	1.50	C(5)=	1.45	C(6)=	4.50	C(7)=	4.05
C(8)=	0.50	C(9)=	0.50	C(10)=	0.25	C(11)=	1.45	C(12)=	0.80	C(13)=	0.25	C(14)=	0.00
C(15)=	0.50	C(16)=	0.00	C(17)=	0.25								

(2)Dimension of form for Middle Pier 〔unite : m〕

D(1)=	15.20	D(2)=	0.50	D(3)=	1.35	D(4)=	0.00	D(5)=	3.75	D(6)=	0.36	D(7)=	9.24
D(8)=	0.50	D(9)=	14.20	D(10)=	0.00	D(11)=	3.00	D(12)=	1.20	D(13)=	0.22	D(14)=	0.50
D(15)=	9.50	D(16)=	3.50	D(17)=	1.70	D(18)=	9.50	D(19)=	0.85	D(20)=	0.85	D(21)=	1.00
D(22)=	1.00	D(23)=	1.00	D(24)=	0.27	D(25)=	0.22	D(26)=	0.22	D(27)=	4.75	D(28)=	4.75
D(29)=	0.00	D(30)=	0.70	D(31)=	0.15	D(32)=	0.65	D(33)=	0.00	D(34)=	0.65	D(35)=	0.00
D(36)=	0.00												
E(1)=	1.00	E(2)=	1.00	E(3)=	1.00	E(4)=	3.00	E(5)=	1.00	E(6)=	0.25	E(7)=	0.50
E(8)=	0.25	E(9)=	0.20	E(10)=	0.60	E(11)=	0.20	E(12)=	0.25	E(13)=	0.50	E(14)=	0.25
E(15)=	0.20	E(16)=	0.60	E(17)=	0.20	E(18)=	0.00	E(19)=	0.00				
F(1)=	1.50	F(2)=	5.95	F(3)=	4.55	F(4)=	1.50	F(5)=	1.45	F(6)=	4.50	F(7)=	4.05
F(8)=	0.50	F(9)=	0.50	F(10)=	0.25	F(11)=	1.45	F(12)=	0.80	F(13)=	0.25	F(14)=	0.00
F(15)=	0.50	F(16)=	0.00	F(17)=	0.25								

(3)Number and slide distance of center for each pier 〔unite : m〕

Number of pier : abutment 2 piers
middle 1 piers
Number of vent : 2

Entire regulator width : 7.00 m
Entire regulator length : 15.20 m

	active(y) or not(n)	x (m)	y (m)	z (m)
Right abutment pi	y	0.00	0.00	0.00
Left abutment pier	y	0.00	0.00	7.00
Middle pier 1	y	0.00	0.00	2.00
Middle pier 2	n	0.00	0.00	0.00
Middle pier 3	n	0.00	0.00	0.00

(4)Main level of foundation

Apron bottom : EL40.05m
Gate bottom : EL43.00m

(5)Unite weight 〔unit : kN/m^3〕

RC : 25.00 Soil 〔Wet〕 : 18.00 Soil 〔Saturation〕 : 20.00
Concrete : 23.00 Soil 〔in water〕 : 10.00 Water : 10.00

(6)Seismic co-efficient

KH= 0.08
KH'= 0.09 (submerged condition)

(7)Case of examination

Case	Direction	Water Level			Situation of gate	Condi.	Additional	(m)
Case1	Long.	U.S.	WL47.00m	HWL	Open gate	Regular	—	—
		D.S.	WL47.00m	HWL				
Case2	Long.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL41.55m	Low				
Case3	Long.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case4	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Regular	—	—
		D.S.	WL46.55m	Max.WL				
Case5	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Regular	sedimentation	0.3
		D.S.	WL41.55m	Low				
Case6	Lateral.	U.S.	—	No WL	Open gate	Regular	—	—
		D.S.	—	No WL				
Case7	Long.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case2	sedimentation	0.3
		D.S.	WL41.55m	Low				
Case8	Long.	U.S.	—	No WL	Open gate	Seism of case3	—	—
		D.S.	—	No WL				
Case9	Lateral.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case4	—	—
		D.S.	WL46.55m	Max.WL				
Case10	Lateral.	U.S.	WL46.55m	Max.WL	Close gate	Seism of case5	sedimentation	0.3
		D.S.	WL41.55m	Low				
Case11	Lateral.	U.S.	—	No WL	Open gate	Seism of case6	—	—
		D.S.	—	No WL				
Case12	Long.	U.S.	WL46.55m	Max.WL	Open gate	Seism of case6	—	—
		D.S.	WL46.55m	Max.WL				
Case13	Long.	U.S.	WL46.55m	Max.WL	Maintenace gate	Regular	—	0.3
		D.S.	WL45.90m	Low				

(8)Coefficient of earth pressure

Internal friction : φ= 30°

	Regular case	Seismic case	Seismic (submerged)	Sedimentation
Friction for wall	0°	0°	0°	—
Active EP coe.	0.333	0.383	0.390	0.5
Passive EP coe.	3.000	2.858	2.84	—

(9)Weight of the gate facility

Item of design load		Design load	Remarks			
Gate leaf	(kN/vent)	12.00	Upper	12.00	Lower	0.00
Hiost (Emargency)	(kN/vent)	86.00	including the hoist weight (300%)			
Hiost	(kN/vent)	35.00	including the groove weight			
Actual vent wide	(m)	2.00				
Height of gate	(m)	3.55				
Stop Log gate	(kN/vent)	12.00				

(10)Weight of the bridge / note : Include to weight of regulator body

Item of design load		Regular case	Seismic case
Vertical load (body)	(kN/vent)	—	—
Vertical load (live load only)	(kN/vent)	7.50	0.00
Horizontal force by wind	(kN/vent)	18.72	—
Counter force for up-to-down st.	(kN)	—	—
Counter force for right angle	(kN)	—	—

Height of the handrail= 1.10 (m)

Thick of the bridge= 1.50 (m)

Note : Bridge weight is included to Regulator body weight

(11)Wind pressure w= 3.0 (kN/m2) [coefficient of form plane: 1.20 round : 0.70]

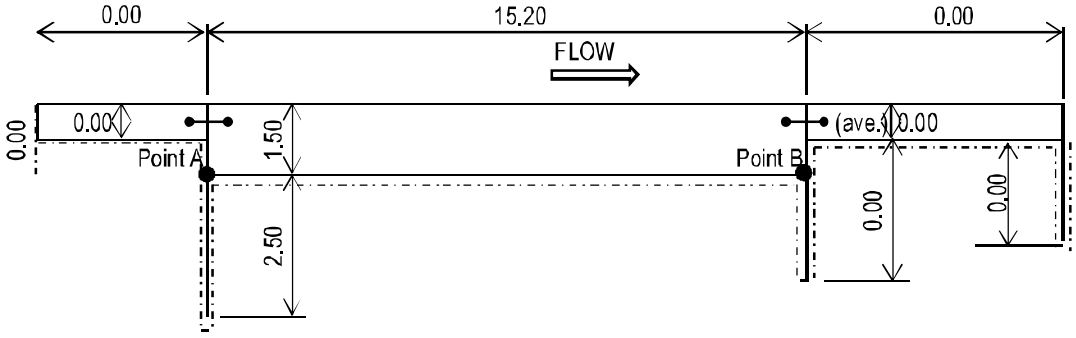
(12)Other load　　Vehicle : q=　10.0 (kN/m2)　Pedestrian : q=　5.0 (kN/m2)

(13)Up-lift condition

Design creep length ΣL = 23.20 (m)

A point ΣLa= 6.50 (m)

B point ΣLb= 21.70 (m)



(13)Bearing of the foundation

Qa= ---- (kN/m2)

(14)Friction coefficient for foundation

μ= 0.60

(15)Grand level of the embankment

a)Height of the embankment and load

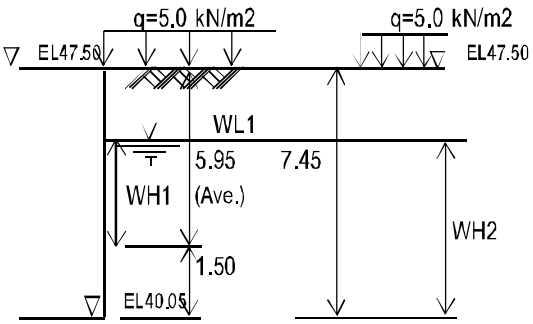
	Embk. H(m)	Load W.(kN/m2)
At case of Weight of sile	5.95	5.0
At case of eath pres.	7.45	5.0

b)Water depth of the condition for embankment

	case1	case2	case3	case4	case5	case6	case7	case8	case9	case10	case11	case12
Design:WL1	WL47.00	WL44.05	—	WL46.55	WL44.05	—	WL44.05	—	WL46.55	WL44.05	—	WL46.55
WH1	5.45	2.50	0.00	5.00	2.50	0.00	2.50	0.00	5.00	2.50	0.00	5.00
WH2	6.95	4.00	0.00	6.50	4.00	0.00	4.00	0.00	6.50	4.00	0.00	6.50

※In case there is difference water level between Up-down stream, average water level of both of them should be applied

case13
WL44.05
2.50
4.00



2.Caluculation of the regulator weight

(1) Enite regulator body weight

Regulator	W	x	W·x	y	W·y	z	W·z
abutment right	4,220.52	7.72	32,582.41	3.06	12,914.79	0.73	3,080.98
abutment left	4,220.52	7.72	32,582.41	3.06	12,914.79	6.27	26,462.66
Midle. 1	4,929.78	7.76	38,255.09	3.43	16,909.15	3.50	17,254.23
Midle. 2	0.00	7.76	0.00	3.43	0.00	1.50	0.00
Midle. 3	0.00	7.76	0.00	3.43	0.00	1.50	0.00
Σ	13,370.82		103,419.91		42,738.73		46,797.87

(2) Balance center of entire regulator body

$$X = \Sigma W \cdot x / \Sigma W = \frac{103,419.91}{13,370.82} = 7.73(m)$$

$$Y = \Sigma W \cdot y / \Sigma W = \frac{42,738.73}{13,370.82} = 3.20(m)$$

$$Z = \Sigma W \cdot z / \Sigma W = \frac{46,797.87}{13,370.82} = 3.50(m)$$

(3) abutment Pier : Right [unite : m]

	#	W	x	W·x	y	W·y	z	W·z
	1	0.00	0.00	0.00	0.75	0.00	1.00	0.00
	2	420.00	2.80	1176.00	0.75	315.00	1.00	420.00
	3	720.00	10.40	7488.00	0.75	540.00	1.00	720.00
	4	0.00	1.85	0.00	1.98	0.00	1.50	0.00
	5	135.94	3.73	507.06	2.23	303.15	1.50	203.91
	6	13.05	5.72	74.65	1.98	25.84	1.50	19.58
	7	48.94	0.68	33.28	2.23	109.14	0.50	24.47
	8	0.00	1.85	0.00	2.47	0.00	0.50	0.00
	9	6.53	5.84	38.14	1.98	12.93	0.50	3.27
	10	334.95	10.58	3543.77	2.23	746.94	0.50	167.48
	11	2,186.63	7.85	17,165.05	3.75	8,199.86	0.50	1,093.32
	12	0.00	15.20	0.00	3.75	0.00	0.50	0.00
	13	29.21	14.99	437.86	4.48	130.86	0.58	16.94
	14-1	91.13	4.60	419.20	9.48	863.91	1.63	148.09
	14-2	0.00	4.60	0.00	9.48	0.00	0.58	0.00
	15-1	50.63	5.45	275.93	9.48	479.97	1.50	75.95
	15-2	0.00	5.45	0.00	9.48	0.00	0.58	0.00
	16	21.25	4.85	103.06	11.75	249.69	0.58	12.33
	16'	0.00	4.00	0.00	11.50	0.00	1.33	0.00
	16"	16.25	3.68	59.80	11.75	190.94	1.50	24.38
	17	37.50	2.50	93.75	7.20	270.00	1.50	56.25
	17'	0.00	14.78	0.00	7.33	0.00	1.50	0.00
	18	-12.50	2.50	-31.25	7.20	-90.00	1.50	-18.75
	18'	0.00	14.70	0.00	7.33	0.00	0.90	0.00
	19	-1.80	2.50	-4.50	5.20	-9.36	0.90	-1.62
	19'	-1.67	14.78	-24.68	4.48	-7.48	0.90	-1.50
	20	-0.50	2.50	-1.25	2.83	-1.42	0.90	-0.45
	21	-1.46	4.88	-7.12	5.20	-7.59	0.88	-1.28
	22	-0.09	4.88	-0.44	2.83	-0.25	0.90	-0.08
	23	-0.35	2.50	-0.88	1.38	-0.48	0.90	-0.32
Bridge	Add1	81.25	14.95	1,214.69	4.60	373.75	1.50	121.88
Deck	Add2	8.13	5.95	48.37	11.75	95.53	1.00	8.13
Side	Add3	37.50	-0.50	-18.75	3.73	139.88	-0.50	-18.75
	Σ	4,220.52		32,589.74		12,930.81		3,073.23

- Balance center of abut regulator

		Right abutment regulator	(slide distance)	Left abutment regulator
$X = \Sigma W \cdot x / \Sigma W = \frac{32,589.74}{4,220.52}$	=7.72(m)	+0.00(m)	=7.72(m)
$Y = \Sigma W \cdot y / \Sigma W = \frac{12,930.81}{4,220.52}$	=3.06(m)	+0.00(m)	=3.06(m)
$Z = \Sigma W \cdot z / \Sigma W = \frac{3,073.23}{4,220.52}$	=0.73(m)	-7.00(m)	=-6.27(m)

(4) Middle pier : 〔unite : m〕

	#	W	x	W·x	y	W·y	z	W·z
	1	56.25	0.25	14.06	0.75	42.19	1.50	84.38
	2	573.75	3.05	1,749.94	0.75	430.31	1.50	860.63
	3	1,080.00	10.40	11,232.00	0.75	810.00	1.50	1,620.00
	4	0.00	1.85	0.00	1.98	0.00	1.50	0.00
	5	271.88	3.73	1,014.11	2.23	606.29	1.50	407.82
	6	26.10	5.72	149.29	1.98	51.68	1.50	39.15
	7	30.81	0.93	28.65	2.23	68.71	1.50	46.22
	8	0.00	1.85	0.00	2.47	0.00	1.50	0.00
	9	6.53	5.84	38.14	2.47	16.13	1.50	9.80
	10	334.95	10.58	3,543.77	2.23	746.94	1.50	502.43
	11	2,112.25	8.10	17,109.23	5.20	10,983.70	1.50	3,168.38
	12	0.00	15.20	0.00	4.48	0.00	1.50	0.00
	13	58.41	0.79	46.14	4.48	261.68	1.50	87.62
	14-1	60.75	4.60	279.45	9.48	575.91	1.50	91.13
	14-2	30.38	4.60	139.75	9.48	288.00	1.50	45.57
	15-1	12.66	5.45	69.00	9.48	120.02	1.50	18.99
	15-2	12.66	5.45	69.00	9.48	120.02	1.50	18.99
	16	21.25	4.85	103.06	11.75	249.69	1.50	31.88
	16'	0.00	4.00	0.00	11.50	0.00	1.50	0.00
	16"	24.38	3.68	89.72	11.75	286.47	1.50	36.57
	17	75.00	2.50	187.50	7.20	540.00	1.50	112.50
	17'	0.00	14.78	0.00	7.45	0.00	1.50	0.00
	18	-25.00	2.50	-62.50	7.20	-180.00	1.50	-37.50
	18'	0.00	14.70	0.00	7.45	0.00	1.50	0.00
	19	-3.60	2.50	-9.00	5.20	-18.72	1.50	-5.40
	19'	-3.33	14.70	-48.95	4.48	-14.92	1.50	-5.00
	20	-1.00	2.50	-2.50	2.83	-2.83	1.50	-1.50
	21	-3.13	4.85	-15.18	5.20	-16.28	1.50	-4.70
	22	-0.22	4.59	-1.01	2.83	-0.62	1.50	-0.33
	23	-0.70	14.70	-10.29	1.38	-0.97	1.50	-1.05
Bridge	Add1	162.50	14.95	2,429.38	4.60	747.50	1.50	243.75
Deck	Add2	16.25	5.95	96.69	11.75	190.94	1.50	24.38
	Σ	4,929.78		38,239.45		16,901.84		7,394.71

▪ Balance center of middle regulator

	Middle regulator	(slide distance)	Mid. 1 regulator	(slide distance)	Mid. 2 regulator
$X=\Sigma W\cdot x/\Sigma W=\frac{38,239.45}{4,929.78}$	=7.76(m)	+0.00(m)	=7.76(m)	+0.00(m)	=7.76(m)
$Y=\Sigma W\cdot y/\Sigma W=\frac{16,901.84}{4,929.78}$	=3.43(m)	+0.00(m)	=3.43(m)	+0.00(m)	=3.43(m)
$Z=\Sigma W\cdot z/\Sigma W=\frac{7,394.71}{4,929.78}$	=1.50(m)	+2.00(m)	=3.50(m)	+0.00(m)	=1.50(m)

(slide distance)	Mid. 3 regulator
+0.00(m)	=7.76(m)
+0.00(m)	=3.43(m)
+0.00(m)	=1.50(m)

4.Case of the examination

【CASE 1 : Regular / Longitudinal direction/ H.W.L. / Full OP】

Load	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	13,370.82	7.73	103,356.44			
Gate leaf	24.00	4.85	116.40			
Hoist	172.00	4.85	834.20			
Bridge	—	10.45	—			
Weight of water	3,124.62	7.81	24,403.28			
Up-lift pressure	-7,394.80	7.60	-56,200.48			
Wind pre.(Reg. body)				59.49	9.84	585.38
Wind pre.(Gate. body)				25.56	8.93	228.25
Wind pre.(Bridge. body)				37.44	8.75	327.60
Wind pre.(Walk bridge. body)				7.20	7.20	51.84
Total	9,296.64		72,509.84	129.69		1,193.07

Note : The water pressure should be caneled out for the symmetrical force.

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 43.01 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 7.93 (m)

Eccentric distance : e=X-B/2= 0.33 (m) ≦ B/6=2.53(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 98.76

Q2=ΣV/B/L(1-6・e/B)= 75.99

【CASE 2 : Regular / Longitudinal direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	7.73	103,356.44			
Gate leaf	24.00	4.85	116.40			
Hoist	70.00	4.85	339.50			
Bridge (Live load only)	15.00	10.45	156.75			
Weight of water	815.93	2.11	1,721.61			
Up-lift pressure	-3,682.50	6.40	-23,568.00			
Sedimentation	165.51	1.46	241.64			
Wind pre.(Reg. body)				55.14	9.51	524.38
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				37.44	8.75	327.60
Water pre.(up-st.)				1,478.75	1.96	2,898.35
Water pre.(dw-st.)				-78.75	0.50	-39.38
Earth pre. (sed.)				24.51	2.69	65.93
Total	10,778.76		82,364.34	1,517.09		3,776.88

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 4.26 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 7.99 (m)

Eccentric distance : $e=X-B/2=$ 0.39 (m) ≦ B/6=2.53(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 116.90

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 85.71

【CASE 3 : Regular / Longitudinal direction/ Max. water level / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	13,370.82	7.73	103,356.44			
Gate leaf	24.00	4.85	116.40			
Hoist	70.00	4.85	339.50			
Bridge (Live load only)	15.00	7.60	114.00			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Wind pre.(Reg. body)				86.64	7.33	635.07
Wind pre.(Gate. body)				25.56	8.93	228.25
Wind pre.(Bridge. body)				37.44	8.75	327.60
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	13,479.82		103,926.34	149.64		1,190.92

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 54.05 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV・x+ΣH・y)/ΣV= 7.80 (m)

Eccentric distance : e=X-B/2= 0.20 (m) ≦ B/6=2.53(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 136.69

Q2=ΣV/B/L(1-6・e/B)= 116.69

【CASE 4 : Regular / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V･z (kN･m)	H (kN)	y (m)	H･y (kN･m)
Reg. body	13,370.82	3.50	46,797.87			
Gate leaf	24.00	3.50	84.00			
Hoist	70.00	3.50	245.00			
Bridge (Live load only)	15.00	3.50	52.50			
Weight of water	2,847.81	3.50	9,967.34			
Up-lift pressure	-6,916.00	3.50	-24,206.00			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				243.00	7.99	1,941.57
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	9,411.63		32,940.71	243.00		1,941.57

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV･μ/ΣH= 23.24 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 15.20 (m)

Act point of the total force : X=(ΣV･x+ΣH･y)/ΣV= 3.71 (m)

Eccentric distance : e=X-B/2= 0.21 (m) ≦ B/6=1.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6･e/B)= 104.38

Q2=ΣV/B/L(1-6･e/B)= 72.53

【CASE 5 : Regular / Lateral direction/ Max. water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	3.50	46,797.87			
Gate leaf	24.00	3.50	84.00			
Hoist	70.00	3.50	245.00			
Bridge (Live load only)	15.00	3.50	52.50			
Weight of water	815.93	3.50	2,855.76			
Up-lift pressure	-3,682.50	3.50	-12,888.75			
Sedimentation	165.51	3.50	579.29			
Wind pre.(Reg. body)				615.62	7.38	4,543.28
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)	—	—	—	—	—	—
Earth pre. (sed.)				—	—	—
Total	10,778.76		37,725.67	615.62		4,543.28

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 10.51 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 15.20 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 3.92 (m)

Eccentric distance : e=X-B/2= 0.42 (m) ≦ B/6=1.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 137.77

Q2=ΣV/B/L(1-6·e/B)= 64.83

【CASE 6 : Regular / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	3.50	46,797.87			
Gate leaf	24.00	3.50	84.00			
Hoist	70.00	3.50	245.00			
Bridge (Live load only)	15.00	3.50	52.50			
Weight of water	—	—	—			
Up-lift pressure	—	—	—			
Sedimentation	—	—	—			
Wind pre.(Reg. body)				362.13	5.24	1,897.56
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(canal side)				—	—	—
Water pre.(embk. side)				—	—	—
Earth pre. (Embk.)				—	—	—
Sum	13,479.82		47,179.37	362.13		1,897.56

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 22.33 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 15.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 3.64 (m)

Eccentric distance : $e=X-B/2=$ 0.14 (m) ≦ B/6=1.17(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 141.89

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 111.49

【CASE 7 : Seism / Longitudinal direction / Max water level / Full CL】

Laod	V (kN)	x (m)	V･x (kN･m)	H (kN)	y (m)	H･y (kN･m)
Reg. body	13,370.82	7.73	103,356.44	1,069.67	3.06	3,273.19
Gate leaf	24.00	4.85	116.40	1.92	4.73	9.07
Hoist	70.00	4.85	339.50	5.60	12.00	67.20
Bridge	—	10.45	—	—	7.45	—
Weight of water	815.93	2.11	1,721.61	—	—	—
Up-lift pressure	-3,682.50	6.40	-23,568.00	—	—	—
Sedimentation	165.51	1.46	241.64	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				1,478.75	1.96	2,898.35
Water pre.(dw-st.)				-78.75	0.50	-39.38
Seism Water pre.(up-st.)				138.04	2.60	358.89
Earth pre. (sed.)				24.51	2.69	65.93
Total	10,763.76		82,207.59	2,639.74		6,633.25

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV･μ/ΣH= 2.45 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV･x+ΣH･y)/ΣV= 8.25 (m)

Eccentric distance : e=X-B/2= 0.65 (m) ≦ B/3=5.07(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6･e/B)= 127.12

Q2=ΣV/B/L(1-6･e/B)= 75.21

【CASE 8 : Seism / Longitudinal direction / No water / Full OP】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	13,370.82	7.73	103,356.44	1,069.67	3.06	3,273.19
Gate leaf	24.00	4.85	116.40	1.92	10.70	20.54
Hoist	70.00	4.85	339.50	5.60	12.00	67.20
Bridge	—	7.60	—	—	7.45	—
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Water pre.(up-st.)				—	—	—
Water pre.(dw-st.)				—	—	—
Total	13,464.82		103,812.34	1,077.19		3,360.93

Note : Bridge weight is included to Regulator body weight

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV・μ/ΣH= 7.50 ≧ Fsa=1.15 ⇒OK

a)Examination for the slide force

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

b)Examint of the total force : X=(ΣV・x+ΣH・y)/ΣV= 7.96 (m)

Eccentric distance : e=X-B/2= 0.36 (m) ≦ B/3=5.07(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6・e/B)= 144.53

Q2=ΣV/B/L(1-6・e/B)= 108.57

【CASE 9 : Seism / Lateral direction / Max. water level / Full OP】

Laod	V (kN)	z (m)	V·z (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	3.50	46,797.87	1,069.67	3.06	3,273.19
Gate leaf	24.00	3.50	84.00	1.92	10.70	20.54
Hoist	70.00	3.50	245.00	5.60	12.00	67.20
Bridge	—	3.50	—	—	7.45	—
Weight of water	2,847.81	3.50	9,967.34	—	—	—
Up-lift pressure	-6,916.00	3.50	-24,206.00	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				177.33	3.50	620.66
Seism water pre. (Mid.)				274.48	3.64	999.11
Earth pre. (sed.)				—	—	—
Total	9,396.63		32,888.21	1,529.00		4,980.70

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 3.69 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 15.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 4.03 (m)

Eccentric distance : $e=X-B/2=$ 0.53 (m) ≦ B/3=2.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 128.43

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 48.19

【CASE 10 : Seism / Lateral direction / Max.water level / Full CL】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	3.50	46,797.87	1,069.67	3.06	3,273.19
Gate leaf	24.00	3.50	84.00	1.92	4.73	9.08
Hoist	70.00	3.50	245.00	5.60	12.00	67.20
Bridge	—	3.50	—	—	7.45	—
Weight of water	815.93	3.50	2,855.76	—	—	—
Up-lift pressure	-3,682.50	3.50	-12,888.75	—	—	—
Sedimentation	165.51	3.50	579.29	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				56.58	3.50	198.03
Seism water pre. (Mid.)				70.57	3.64	256.87
Earth pre. (sed.)				—	—	—
Total	10,763.76		37,673.17	1,204.34		3,804.37

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 5.36 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 15.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 3.85 (m)

Eccentric distance : $e=X-B/2=$ 0.35 (m) ≦ B/3=2.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 131.51

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 70.81

【CASE 11 : Seism / Lateral direction / No water / Full OP】

Laod	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	3.50	46,797.87	1,069.67	3.06	3,273.19
Gate leaf	24.00	3.50	84.00	1.92	10.70	20.54
Hoist	70.00	3.50	245.00	5.60	12.00	67.20
Bridge	—	3.50	—	—	7.45	—
Weight of water	—	—	—	—	—	—
Up-lift pressure	—	—	—	—	—	—
Sedimentation	—	—	—	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Op. deck body)				—	—	—
Seism water pre. (Abut)				—	—	—
Seism water pre. (Mid.)				—	—	—
Earth pre. (sed.)				—	—	—
Total	13,464.82		47,126.87	1,077.19		3,360.93

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 7.50 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 7.00 (m)

Foundation length : L= 15.20 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 3.75 (m)

Eccentric distance : $e=X-B/2=$ 0.25 (m) ≦ B/3=2.33(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 153.67

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 99.43

【CASE 12 : Seism / Longitudinal direction/ Max.water level / Full OP】

Load	V (kN)	x (m)	V·x (kN·m)	H (kN)	y (m)	H·y (kN·m)
Reg. body	13,370.82	7.73	103,356.44	1,069.67	3.06	3,273.19
Gate leaf	24.00	4.85	116.40	1.92	10.70	20.54
Hoist	172.00	4.85	834.20	13.76	12.00	165.12
Bridge	—	10.45	—	—	7.45	—
Weight of water	2,847.81	7.84	22,326.83	—	—	—
Up-lift pressure	-6,916.00	7.60	-52,561.60	—	—	—
Wind pre.(Reg. body)				—	—	—
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				—	—	—
Wind pre.(Walk bridge. body)				—	—	—
Seism Water pre.(up-st.)				42.23	2.69	113.60
Total	9,498.63		74,072.27	1,127.58		3,572.45

Note : The water pressure should be caneled out for the symmetrical force.

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : Fs=ΣV·μ/ΣH= 5.05 ≧ Fsa=1.15 ⇒OK

b)Examination for the fall down

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : X=(ΣV·x+ΣH·y)/ΣV= 8.17 (m)

Eccentric distance : e=X-B/2= 0.57 (m) ≦ B/3=5.07(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

Q1=ΣV/B/L(1+6·e/B)= 109.36

Q2=ΣV/B/L(1-6·e/B)= 69.19

【CASE 13 : Regular / Longitudinal direction/ Max. water level / Maintenace case】

Laod	V (kN)	x (m)	V・x (kN・m)	H (kN)	y (m)	H・y (kN・m)
Reg. body	13,370.82	7.73	103,356.44			
Gate leaf for 3vents	12.00	4.85	58.20			
Hoist for 3vents	35.00	4.85	169.75			
Stoplog Gate of U.S.	12.00	2.50	30.00			
Stoplog Gate of D.S.	12.00	14.78	177.36			
Bridge (Live load only)	15.00	10.45	156.75			
Weight of water	2,578.00	7.61	19,618.58			
Weight of water at stoplog	-1,122.15	1.25	-1,402.69			
Up-lift pressure	-6,495.72	7.51	-48,782.86			
Sedimentation	165.51	1.46	241.64			
Sedimentation at stoplog	-68.66	1.25	-85.83			
Wind pre.(Reg. body)				46.39	9.51	441.17
Wind pre.(Gate. body)				—	—	—
Wind pre.(Bridge. body)				37.44	8.75	327.60
Water pre.(up-st.)				1,478.75	1.96	2,898.35
Water pre.(dw-st.)				-1,197.80	1.95	-2,335.71
Earth pre. (sed.)				24.51	2.69	65.93
Total	8,513.80		73,537.34	389.29		1,397.34

Note : Bridge weight is included to Regulator body weight

a)Examination for the slide force

Fc. for sliding : μ=0.60

Safe ratio : $Fs=\Sigma V \cdot \mu / \Sigma H=$ 13.12 ≧ Fsa=1.5 ⇒OK

b)Examination for the fall down

Foundation width : B= 15.20 (m)

Foundation length : L= 7.00 (m)

Act point of the total force : $X=(\Sigma V \cdot x+\Sigma H \cdot y)/\Sigma V=$ 8.80 (m)

Eccentric distance : $e=X-B/2=$ 1.20 (m) ≦ B/6=2.53(m) ⇒OK

(Checked by absolute value)

c)Examination for the bearing on foundation (kN/m2)

$Q1=\Sigma V/B/L(1+6 \cdot e/B)=$ 117.92

$Q2=\Sigma V/B/L(1-6 \cdot e/B)=$ 42.11

APPENDIX A-5

Examination sheet of Bearing Capacity

A-5-1. Bahr Yusef Regulator

Examination of bearing capacity by Japanese of Terzaghi method

Bahr Yusef by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)		Judge
Nor.	1.0	0	0	150.66	150.66	3	**50.2**	<	**144.84**	NG
Nor.	1.0	0	0	119.63	119.63	3	**39.9**	<	**138.82**	NG
Sei.	1.0	0	0	119.83	119.83	2	**59.9**	<	**133.15**	NG
Sei.	1.0	0	0	101.54	101.54	2	**50.8**	<	**141.7**	NG

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	27.90	35.50	134,758.39	987.46	0.3	6
Lateral	Normal	10	10	27.90	35.50	134,758.39	2,506.86	0.12	6
Long.	Seism	10	10	27.90	35.50	131,875.39	10,550.03	0	6
Lateral	Seism	10	10	27.90	35.50	131,875.39	10,550.03	0.38	6

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le or Le/Be)	β 1-0.4·(Be/Le or Le/Be)	k (Df=0) 1-0.3(Df/Be or Df/Le)	qu=N/0.082	φ=√(12N)+15
Long.	Normal	27.30	35.50	0.01	1.231	0.692	1.000	73.17	23
Lateral	Normal	27.90	35.26	0.02	1.379	0.494	1.000	73.17	23
Long.	Seism	27.90	35.50	0.08	1.236	0.686	1.000	73.17	23
Lateral	Seism	27.90	34.74	0.08	1.374	0.502	1.000	73.17	23

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*
Long.	Normal	0	0.00	0.00	4.80	0.33	27.30	0.00	0.00	0.00
Lateral	Normal	0	0.00	0.00	4.50	0.30	35.26	0.00	0.00	0.00
Long.	Seism	0	0.00	0.00	3.80	0.33	27.90	0.00	0.00	0.00
Lateral	Seism	0	0.00	0.00	3.80	0.31	34.74	0.00	0.00	0.00

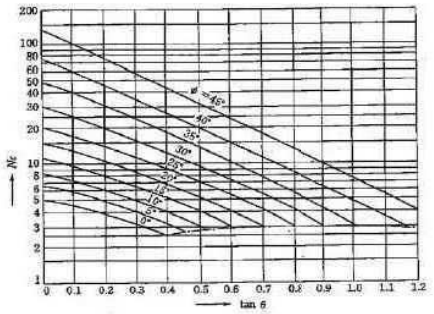


図-解 10.3.1　支持力係数 N_c を求めるグラフ

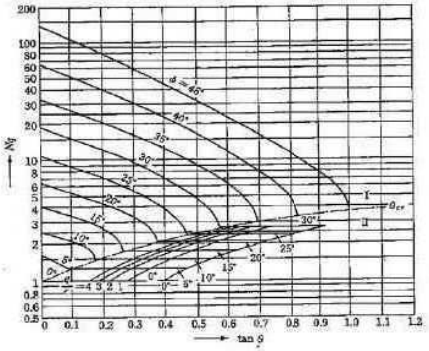


図-解 10.3.2　支持力係数 N_q を求めるグラフ

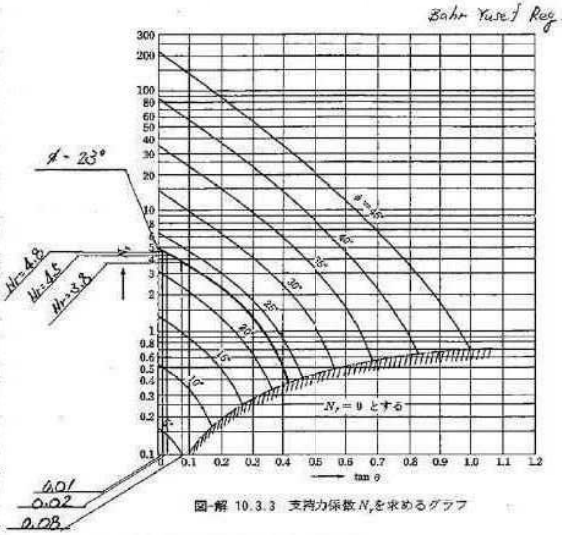


図-解 10.3.3　支持力係数 N_γ を求めるグラフ

(v) 支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数 N_c 及び N_q がかかる項には寸法の次元を持つ定数が含まれていないが[5]，いずれの支持力係数も地盤のせん断抵抗角 ϕ の関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発揮する ϕ の値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^\lambda \\ S_q &= (q^*)^\mu \\ S_\gamma &= (B^*)^\mu \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \text{(解 10.3.3)}$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Bahr Yusef by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda_q \cdot i_q + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda_r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

		1st term $c \cdot Nc \cdot \lambda c \cdot ic$	2nd term $\gamma 1 \cdot Df \cdot Nq \cdot \lambda q \cdot iq$	3rd term $\gamma 2 \cdot Be \cdot Nr \cdot \lambda r \cdot ir$	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)		Judge
Nor.		0	0	668.07	668.07	2.5	**267.2**	≧	**144.84**	OK
Nor.		0	0	672.91	672.91	2.5	**269.2**	≧	**138.82**	OK
Sei.		0	0	539.93	539.93	1.8	**300.0**	≧	**133.15**	OK
Sei.		0	0	551.10	551.10	1.8	**306.2**	≧	**141.7**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	27.90	35.50	134,758.39	987.46	0.3	6
Lateral	Normal	10	10	27.90	35.50	134,758.39	2,506.86	0.12	6
Long.	Seism	10	10	27.90	35.50	131,875.39	10,550.03	0	6
Lateral	Seism	10	10	27.90	35.50	131,875.39	10,550.03	0.38	6

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	27.30	35.50	0.01	1.231	0.769	0.00	73.17	23
Lateral	Normal	27.90	35.26	0.02	1.379	0.621	0.00	73.17	23
Long.	Seism	27.90	35.50	0.08	1.236	0.764	0.00	73.17	23
Lateral	Seism	27.90	34.74	0.08	1.374	0.626	0.00	73.17	23

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	0	18.05	8.66	3.25	0.98	0.9847	0.98	2.50	0.00
Lateral	Normal	0	18.05	8.66	3.25	0.96	0.96	0.95	2.50	0.00
Long.	Seism	0	18.05	8.66	3.25	0.82	0.84	0.78	1.80	0.00
Lateral	Seism	0	18.05	8.66	3.25	0.82	0.84	0.78	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$

A-5-2. Ibrahimia Regulator

Examination of bearing capacity by Japanese of Terzaghi method

Ibrahimia by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)		Judge
Nor.	1.0	0	0	285.03	285.03	3	**95.0**	<	**144.84**	NG
Nor.	1.0	0	0	225.97	225.97	3	**75.3**	<	**138.82**	NG
Sei.	1.0	0	0	220.75	220.75	2	**110.4**	<	**133.15**	NG
Sei.	1.0	0	0	187.04	187.04	2	**93.5**	<	**141.7**	NG

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	27.90	35.50	134,758.39	987.46	-0.3	13
Lateral	Normal	10	10	27.90	35.50	134,758.39	2,506.86	0.12	13
Long.	Seism	10	10	27.90	35.50	131,875.39	10,550.03	0	13
Lateral	Seism	10	10	27.90	35.50	131,875.39	10,550.03	0.38	13

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le or Le/Be)	β 1-0.4·(Be/Le or Le/Be)	k (Df'=0) 1-0.3(Df/Be or Df/Le)	qu=N/0.082	φ=√(12N)+15
Long.	Normal	28.50	35.50	0.01	1.241	0.679	1.000	158.54	27
Lateral	Normal	27.90	35.26	0.02	1.379	0.494	1.000	158.54	27
Long.	Seism	27.90	35.50	0.08	1.236	0.686	1.000	158.54	27
Lateral	Seism	27.90	34.74	0.08	1.374	0.502	1.000	158.54	27

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*
Long.	Normal	0	0.00	0.00	9.00	0.33	28.50	0.00	0.00	0.00
Lateral	Normal	0	0.00	0.00	8.50	0.30	35.26	0.00	0.00	0.00
Long.	Seism	0	0.00	0.00	7.00	0.33	27.90	0.00	0.00	0.00
Lateral	Seism	0	0.00	0.00	7.00	0.31	34.74	0.00	0.00	0.00

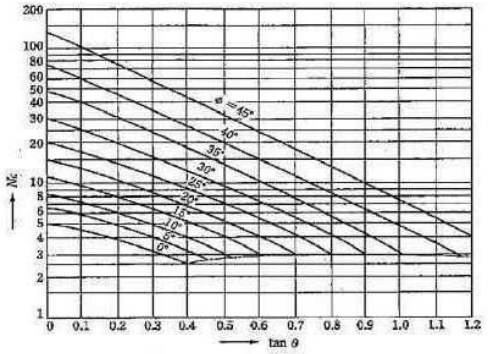


図-解 10.3.1　支持力係数N_cを求めるグラフ

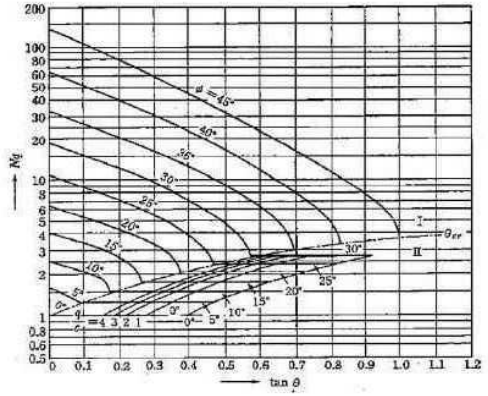


図-解 10.3.2　支持力係数N_qを求めるグラフ

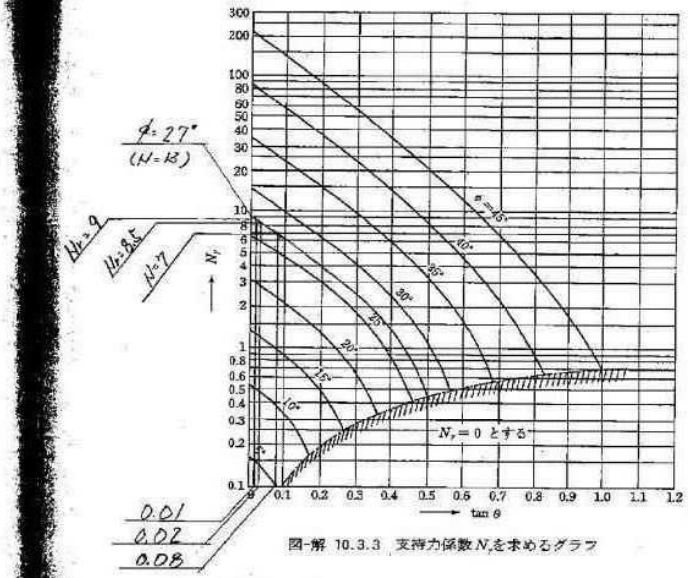


図-解 10.3.3　支持力係数N_γを求めるグラフ

iv）支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数N_c及びN_qがかかる項に仕寸法の次元を持つ定数が含まれていないが，いずれの支持力係数も地盤のせん断抵抗角ϕの関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発現するϕの値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^\mu \\ S_q &= (q^*)^\mu \\ S_\gamma &= (B^*)^\mu \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (解\ 10.3.3)$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Ibrahimia by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda_q \cdot i_q + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda_r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

		1st term $c \cdot Nc \cdot \lambda c \cdot ic$	2nd term $\gamma 1 \cdot Df \cdot Nq \cdot \lambda q \cdot iq$	3rd term $\gamma 2 \cdot Be \cdot Nr \cdot \lambda r \cdot ir$	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)		Judge
Nor.		0	0	1278.66	1,278.66	2.5	**511.5**	≧	**144.84**	OK
Nor.		0	0	1281.78	1,281.78	2.5	**512.7**	≧	**138.82**	OK
Sei.		0	0	1031.50	1,031.50	1.8	**573.1**	≧	**133.15**	OK
Sei.		0	0	1053.85	1,053.85	1.8	**585.5**	≧	**141.7**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	27.90	35.50	127,556.95	920.94	0.28	13
Lateral	Normal	10	10	27.90	35.50	127,556.95	2,506.86	0.13	13
Long.	Seism	10	10	27.90	35.50	126,836.95	10,146.96	0.01	13
Lateral	Seism	10	10	27.90	35.50	126,836.95	10,146.96	0.36	13

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	27.34	35.50	0.01	1.231	0.769	0.00	158.54	27
Lateral	Normal	27.90	35.24	0.02	1.379	0.621	0.00	158.54	27
Long.	Seism	27.88	35.50	0.08	1.236	0.764	0.00	158.54	27
Lateral	Seism	27.90	34.78	0.08	1.374	0.626	0.00	158.54	27

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	0	23.94	13.20	6.22	0.98	0.9849	0.9785	2.50	0.00
Lateral	Normal	0	23.94	13.20	6.22	0.96	0.96	0.94	2.50	0.00
Long.	Seism	0	23.94	13.20	6.22	0.83	0.84	0.78	1.80	0.00
Lateral	Seism	0	23.94	13.20	6.22	0.83	0.84	0.78	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$

Examination of bearing capacity by Japanese of Terzaghi method

Ibrahimia (L) by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

Note) Much of much of eccentricity and stress cause to ground failure and is not allowed to usual foundation type

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)		Judge
Nor.	1.0	0	0	6.65	6.65	3	**2.2**	<	**68.53**	NG
Nor.+ Uplift	1.0	0	0	0.00	0.00	3	**N/A**	≧	**68.49**	**N/A**
Sei.	1.0	0	0	6.83	6.83	2	**3.4**	<	**82.84**	NG
Sei.+U plift	1.0	0	0	0.00	0.00	2	**N/A**	≧	**34.86**	**N/A**

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Lateral	Normal	10	10	7.50	23.50	11,750.00	5,376.60	0.035	9
Lateral	Normal	10	10	7.50	23.50	6,021.88	7,168.48	1.256	9
Lateral	Seism	10	10	7.50	23.50	12,976.04	6,245.61	-0.156	9
Lateral	Seism	10	10	7.50	23.50	3,962.58	5,376.00	0.688	9

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le)	β 1-0.4·(Be/Le)	k (Df=0) 1+0.3(Df/Be)	qu=N/0.082	φ=√(12N)+15
Lateral	Normal	7.43	23.50	0.46	1.095	0.874	1.000	109.76	25
Lateral	Normal	7.50	20.99	**1.19**	1.107	0.857	1.000	109.76	25
Lateral	Seism	7.81	23.50	0.48	1.100	0.867	1.000	109.76	25
Lateral	Seism	7.50	22.12	**1.36**	1.102	0.864	1.000	109.76	25

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*
Lateral	Normal	0	0.00	0.00	0.40	0.51	7.43	0.00	0.00	0.00
Lateral	Normal	0	0.00	0.00	0.00	0.51	7.50	0.00	0.00	0.00
Lateral	Seism	0	0.00	0.00	0.40	0.50	7.81	0.00	0.00	0.00
Lateral	Seism	0	0.00	0.00	0.00	0.51	7.50	0.00	0.00	0.00

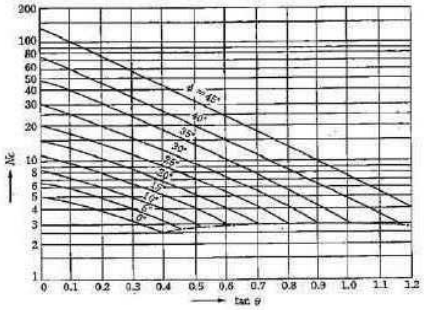


図-解 10.3.1　支持力係数 N_c を求めるグラフ

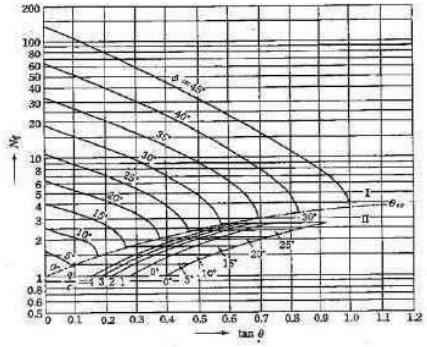


図-解 10.3.2　支持力係数 N_q を求めるグラフ

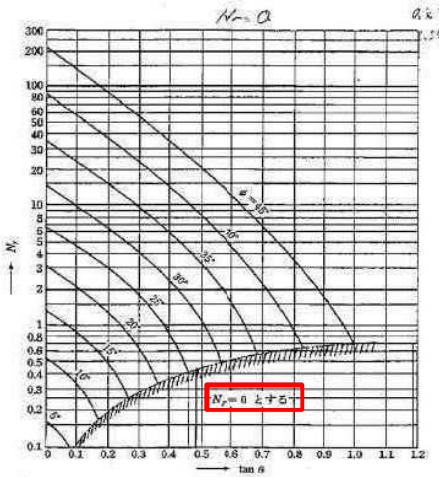


図-解 10.3.3　支持力係数 N_γ を求めるグラフ

iv）支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数 N_c 及び N_q にかかる項には寸法の次元を持つ定数が含まれていないが，いずれの支持力係数も地盤のせん断抵抗角 ϕ の関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発現する ϕ の値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^{\lambda} \\ S_q &= (q^*)^{\mu} \\ S_\gamma &= (B^*)^{\nu} \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (解\ 10.3.3)$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Ibrahimia (L) by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda_q \cdot i_q + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda_r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

Note) Much of much of eccentricity and stress cause to ground failure and is not allowed to usual foundation type

		1st term c·Nc·λc·ic	2nd term γ1·Df·Nq·λq·iq	3rd term γ2·Be·Nr·λr·ir	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)		q (actual stress) (kN/m2)	Judge
Nor.		0	0	48.36	48.36	2.5	**19.3**	<	**68.53**	NG
Nor.		0	0	-5.83	-5.83	2.5	**-2.33**	<	**68.49**	**N/A**
Sei.		0	0	44.22	44.22	1.8	**24.6**	<	**82.84**	NG
Sei.		0	0	-40.64	-40.64	1.8	**-22.58**	<	**34.86**	**N/A**

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	7.50	23.50	11,750.00	5,376.60	0.035	9
Lateral	Normal	10	10	7.50	23.50	6,021.88	7,168.48	1.256	9
Long.	Seism	10	10	7.50	23.50	12,976.04	6,245.61	-0.156	9
Lateral	Seism	10	10	7.50	23.50	3,962.58	5,376.00	0.688	9

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	7.43	23.50	0.46	1.095	0.905	0.00	109.76	25
Lateral	Normal	7.50	20.99	1.19	1.107	0.893	0.00	109.76	25
Long.	Seism	7.81	23.50	0.4813186	1.100	0.900	0.00	109.76	25
Lateral	Seism	7.50	22.12	1.3566919	1.102	0.898	0.00	109.76	25

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	0	20.72	10.66	4.51	0.24	0.3140	0.1596	2.50	0.00
Lateral	Normal	0	20.72	10.66	4.51	-0.10	0.00	-0.01	2.50	0.00
Long.	Seism	0	20.72	10.66	4.51	0.22	0.29	0.14	1.80	0.00
Lateral	Seism	0	20.72	10.66	4.51	-0.10	0.00	-0.05	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$

A-5-3. Badraman Regulator

Examination of bearing capacity by Japanese of Terzaghi method

Badraman at Badraman C. by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.	1.0	585.09	0	0.00	585.09	3	**195.03**	≧ **107.27**	OK
Nor.	1.0	1184.09	0	0.00	1,184.09	3	**394.70**	≧ **105.84**	OK
Sei.	1.0	563.15	0	0.00	563.15	2	**281.57**	≧ **96.52**	OK
Sei.	1.0	1154.51	0	0.00	1,154.51	2	**577.25**	≧ **107.14**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	7.00	28.20	19,551.97	112.37	0.39	18
Lateral	Normal	10	10	7.00	28.20	19,551.97	421.82	0.08	18
Long.	Seism	10	10	7.00	28.20	18,054.97	1,444.40	0.26	18
Lateral	Seism	10	10	7.00	28.20	18,054.97	1,444.40	0.2	18

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le or Le/Be)	β 1-0.4·(Be/Le or Le/Be)	k (Df=0) 1+0.3(Df/Be or Df/Le)	qu=N/0.082	φ=√(12N)+15	
Long.	Normal	6.22	28.20	0.01	1.066	0.912	1.000	219.51	0	Clay
Lateral	Normal	7.00	28.04	0.02	2.202	1.000	1.000	219.51	0	Clay
Long.	Seism	6.48	28.20	0.08	1.069	0.908	1.000	219.51	0	Clay
Lateral	Seism	7.00	27.80	0.08	2.191	1.000	1.000	219.51	0	Clay

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*	Sc
Long.	Normal	109.76	5.00	0.00	0.00	0.54	6.22	0.00	0.00	1.00	1.00
Lateral	Normal	109.76	4.90	0.00	0.00	0.33	28.04	0.00	0.00	1.00	1.00
Long.	Seism	109.76	4.80	0.00	0.00	0.54	6.48	0.00	0.00	1.00	1.00
Lateral	Seism	109.76	4.80	0.00	0.00	0.33	27.80	0.00	0.00	1.00	1.00

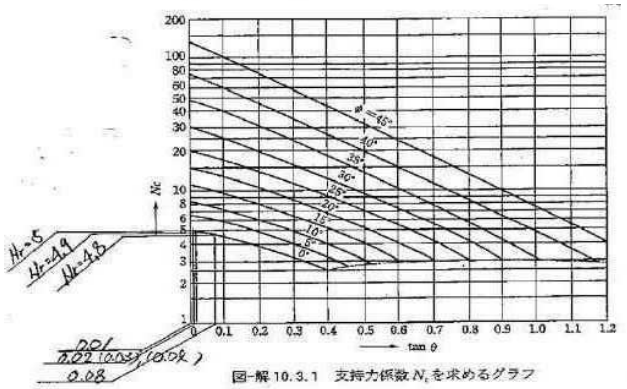


図-解 10.3.1 支持力係数 N_c を求めるグラフ

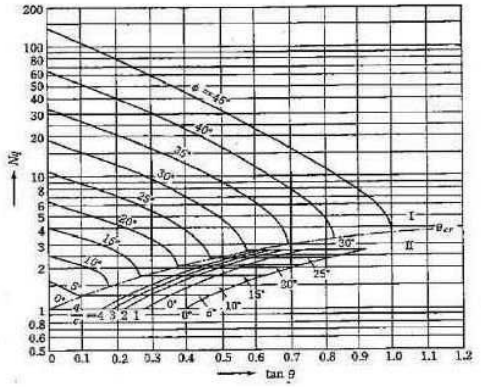


図-解 10.3.2 支持力係数 N_q を求めるグラフ

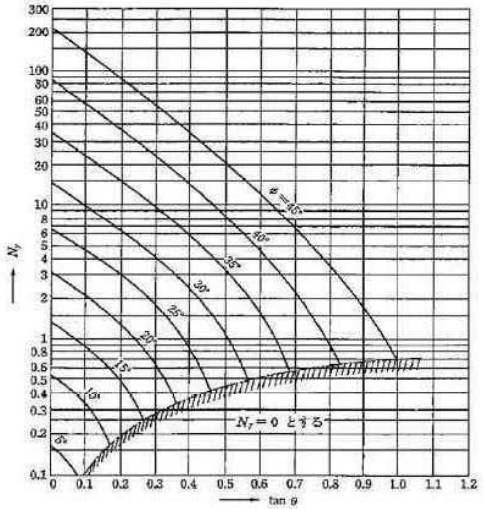


図-解 10.3.3 支持力係数 N_γ を求めるグラフ

iv) 支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数 N_c 及び N_q がかかる項には寸法の次元を持つ定数が含まれていないが，いずれの支持力係数も地盤のせん断抵抗角 ϕ の関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発現する ϕ の値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^{\lambda} \\ S_q &= (q^*)^{\mu} \\ S_\gamma &= (B')^{\mu} \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (解\ 10.3.3)$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Badraman at Badraman C. by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda q \cdot iq + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

		1st term $c \cdot Nc \cdot \lambda c \cdot ic$	2nd term $\gamma 1 \cdot Df \cdot Nq \cdot \lambda q \cdot iq$	3rd term $\gamma 2 \cdot Be \cdot Nr \cdot \lambda r \cdot ir$	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.		598.10	0	0.00	598.10	2.5	**239.24**	≧ **107.27**	OK
Nor.		1217.69	0	0.00	1,217.69	2.5	**487.07**	≧ **105.84**	OK
Sei.		571.31	0	0.00	571.31	1.8	**317.39**	≧ **96.52**	OK
Sei.		1175.24	0	0.00	1,175.24	1.8	**652.91**	≧ **107.14**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	7.00	28.20	19,551.97	112.37	0.39	18
Lateral	Normal	10	10	7.00	28.20	19,551.97	421.82	0.08	18
Long.	Seism	10	10	7.00	28.20	18,054.97	1,444.40	0.26	18
Lateral	Seism	10	10	7.00	28.20	18,054.97	1,444.40	0.2	18

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	6.22	28.20	0.01	1.066	0.934	0.00	219.51	0.001
Lateral	Normal	7.00	28.04	0.02	2.202	1.000	0.00	219.51	0.001
Long.	Seism	6.48	28.20	0.08	1.069	0.931	0.00	219.51	0.001
Lateral	Seism	7.00	27.80	0.08	2.191	1.000	0.00	219.51	0.001

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	109.76	5.14	1.00	0.00	0.99	1.0000	1.0000	2.50	0.00
Lateral	Normal	109.76	5.14	1.00	0.00	0.98	1.00	1.00	2.50	0.00
Long.	Seism	109.76	5.14	1.00	0.00	0.95	1.00	1.00	1.80	0.00
Lateral	Seism	109.76	5.14	1.00	0.00	0.95	1.00	1.00	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$

Examination of bearing capacity by Japanese of Terzaghi method

Badraman at Dairutiah C. by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.	1.0	468.62	0	0.00	468.62	3	**156.21**	≧ **101.56**	OK
Nor.	1.0	763.13	0	0.00	763.13	3	**254.38**	≧ **98.06**	OK
Sei.	1.0	451.03	0	0.00	451.03	2	**225.51**	≧ **92.57**	OK
Sei.	1.0	745.59	0	0.00	745.59	2	**372.80**	≧ **95.86**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	10.00	27.70	25,481.45	152.98	0.48	14
Lateral	Normal	10	10	10.00	27.70	25,481.45	763.28	0.11	14
Long.	Seism	10	10	10.00	27.70	23,835.95	1,906.87	0.35	14
Lateral	Seism	10	10	10.00	27.70	23,835.95	1,906.87	0.19	14

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le or Le/Be)	β 1-0.4·(Be/Le or Le/Be)	k (Df=0) 1+0.3(Df/Be or Df/Le)	qu=N/0.082	φ=√(12N)+15	
Long.	Normal	9.04	27.70	0.01	1.098	0.869	1.000	170.73	0	Clay
Lateral	Normal	10.00	27.48	0.03	1.824	1.000	1.000	170.73	0	Clay
Long.	Seism	9.30	27.70	0.08	1.101	0.866	1.000	170.73	0	Clay
Lateral	Seism	10.00	27.32	0.08	1.820	1.000	1.000	170.73	0	Clay

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*	Sc
Long.	Normal	85.37	5.00	0.00	0.00	0.48	9.04	0.00	0.00	1.00	1.00
Lateral	Normal	85.37	4.90	0.00	0.00	0.33	27.48	0.00	0.00	1.00	1.00
Long.	Seism	85.37	4.80	0.00	0.00	0.48	9.30	0.00	0.00	1.00	1.00
Lateral	Seism	85.37	4.80	0.00	0.00	0.33	27.32	0.00	0.00	1.00	1.00

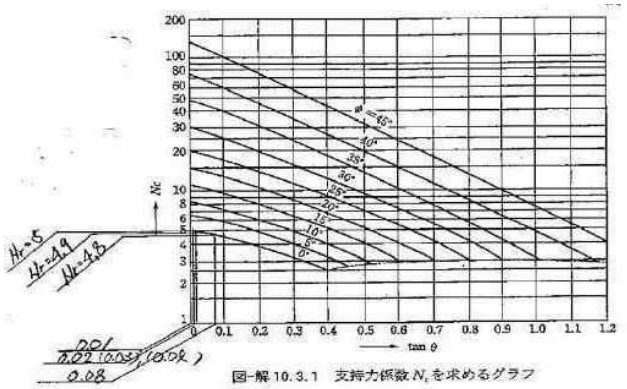


図-解 10.3.1 支持力係数 N_c を求めるグラフ

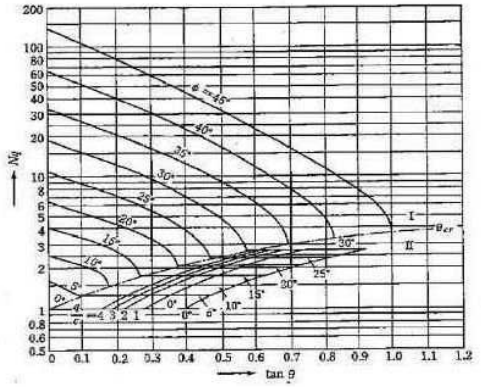


図-解 10.3.2 支持力係数 N_q を求めるグラフ

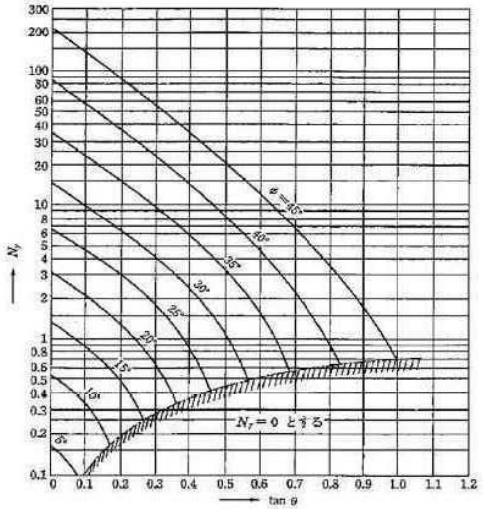


図-解 10.3.3 支持力係数 N_γ を求めるグラフ

iv) 支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数 N_c 及び N_q がかかる項には寸法の次元を持つ定数が含まれていないが，いずれの支持力係数も地盤のせん断抵抗角 ϕ の関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発現する ϕ の値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^{\lambda} \\ S_q &= (q^*)^{\mu} \\ S_\gamma &= (B^*)^{\mu} \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (解\ 10.3.3)$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Badraman at Dairutiah C. by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda q \cdot iq + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

		1st term c·Nc·λc·ic	2nd term γ1·Df·Nq·λq·iq	3rd term γ2·Be·Nr·λr·ir	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)		q (actual stress) (kN/m2)	Judge
Nor.		478.39	0.00	0.00	478.39	2.5	**191.36**	≧	**101.56**	OK
Nor.		774.19	0.00	0.00	774.19	2.5	**309.68**	≧	**98.06**	OK
Sei.		452.35	0.00	0.00	452.35	1.8	**251.30**	≧	**92.57**	OK
Sei.		750.68	0.00	0.00	750.68	1.8	**417.04**	≧	**95.86**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	10.00	27.70	25,481.45	152.98	0.48	14
Lateral	Normal	10	10	10.00	27.70	25,481.45	763.28	0.11	14
Long.	Seism	10	10	10.00	27.70	23,835.95	1,906.87	0.35	14
Lateral	Seism	10	10	10.00	27.70	23,835.95	1,906.87	0.19	14

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	9.04	27.70	0.01	1.098	0.902	0.00	170.73	0.001
Lateral	Normal	10.00	27.48	0.03	1.824	0.176	0.00	170.73	0.001
Long.	Seism	9.30	27.70	0.08	1.101	0.899	0.00	170.73	0.001
Lateral	Seism	10.00	27.32	0.08	1.820	0.180	0.00	170.73	0.001

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	85.37	5.14	1.00	0.00	0.99	1.0000	1.0000	2.50	0.00
Lateral	Normal	85.37	5.14	1.00	0.00	0.97	1.00	1.00	2.50	0.00
Long.	Seism	85.37	5.14	1.00	0.00	0.94	1.00	1.00	1.80	0.00
Lateral	Seism	85.37	5.14	1.00	0.00	0.94	1.00	1.00	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$

A-5-4. Abo Gabal Regulator

Examination of bearing capacity by Japanese of Terzaghi method

Abo Gabal by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.	1.0	940.04	0	0.00	940.04	3	**313.35**	≧ **106.47**	OK
Nor.	1.0	1021.37	0	0.00	1,021.37	3	**340.46**	≧ **108.2**	OK
Sei.	1.0	898.10	0	0.00	898.10	2	**449.05**	≧ **111.44**	OK
Sei.	1.0	996.81	0	0.00	996.81	2	**498.41**	≧ **109.39**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	13.00	16.20	20,949.17	245.56	0.2	25
Lateral	Normal	10	10	13.00	16.20	20,949.17	914.61	0.14	25
Long.	Seism	10	10	13.00	16.20	20,913.17	1,673.05	0.36	25
Lateral	Seism	10	10	13.00	16.20	20,913.17	1,673.05	0.25	25

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le or Le/Be)	β 1-0.4·(Be/Le or Le/Be)	k (Df=0) 1+0.3(Df/Be or Df/Le)	qu=N/0.082	φ=√(12N)+15	
Long.	Normal	12.60	16.20	0.01	1.233	0.689	1.000	304.88	0	Clay
Lateral	Normal	13.00	15.92	0.04	1.367	0.510	1.000	304.88	0	Clay
Long.	Seism	12.28	16.20	0.08	1.227	0.697	1.000	304.88	0	Clay
Lateral	Seism	13.00	15.70	0.08	1.362	0.517	1.000	304.88	0	Clay

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*	Sc
Long.	Normal	152.44	5.00	0.00	0.00	0.43	12.60	0.00	0.00	1.00	1.00
Lateral	Normal	152.44	4.90	0.00	0.00	0.40	15.92	0.00	0.00	1.00	1.00
Long.	Seism	152.44	4.80	0.00	0.00	0.43	12.28	0.00	0.00	1.00	1.00
Lateral	Seism	152.44	4.80	0.00	0.00	0.40	15.70	0.00	0.00	1.00	1.00

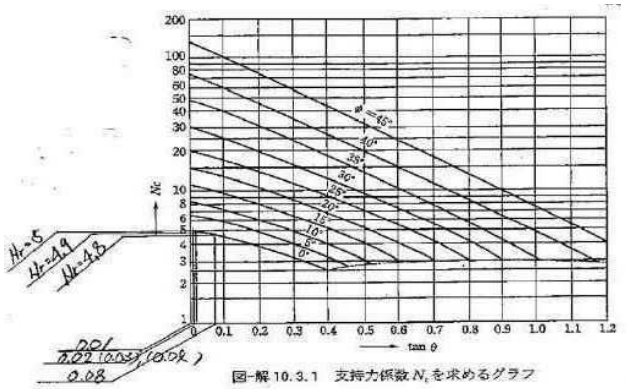


図-解 10.3.1　支持力係数 N_c を求めるグラフ

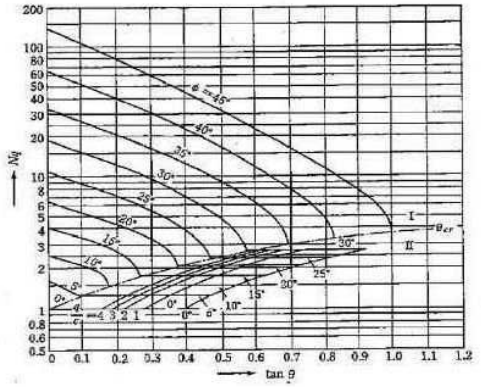


図-解 10.3.2　支持力係数 N_q を求めるグラフ

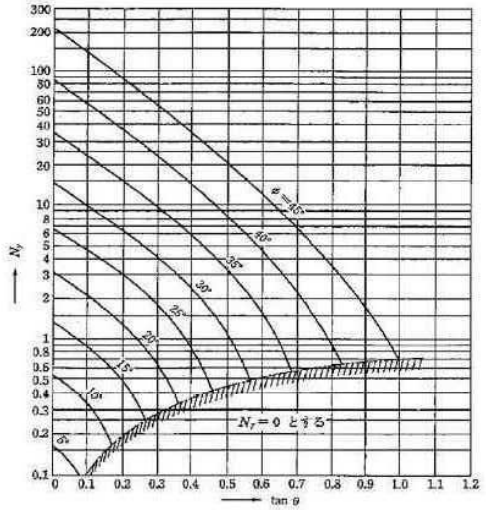


図-解 10.3.3　支持力係数 N_γ を求めるグラフ

iv）支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数 N_c 及び N_q がかかる項には寸法の次元を持つ定数が含まれていないが，いずれの支持力係数も地盤のせん断抵抗角 ϕ の関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発現する ϕ の値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^{\lambda} \\ S_q &= (q^*)^{\mu} \\ S_\gamma &= (B')^{\mu} \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (解\ 10.3.3)$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Abo Gabal by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda_q \cdot i_q + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda_r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

		1st term $c \cdot Nc \cdot \lambda c \cdot ic$	2nd term $\gamma 1 \cdot Df \cdot Nq \cdot \lambda q \cdot iq$	3rd term $\gamma 2 \cdot Be \cdot Nr \cdot \lambda r \cdot ir$	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.		959.21	0.00	0.00	959.21	2.5	**383.69**	≧ **106.47**	OK
Nor.		1038.09	0.00	0.00	1,038.09	2.5	**415.24**	≧ **108.2**	OK
Sei.		924.06	0.00	0.00	924.06	1.8	**513.37**	≧ **111.44**	OK
Sei.		1026.79	0.00	0.00	1,026.79	1.8	**570.44**	≧ **109.39**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	13.00	16.20	20,949.17	245.56	0.19	25
Lateral	Normal	10	10	13.00	16.20	20,949.17	914.61	0.19	25
Long.	Seism	10	10	13.00	16.20	20,913.17	1,673.05	0.33	25
Lateral	Seism	10	10	13.00	16.20	20,913.17	1,673.05	0.22	25

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	12.62	16.20	0.01	1.234	0.766	0.00	304.88	0.001
Lateral	Normal	13.00	15.82	0.04	1.365	0.635	0.00	304.88	0.001
Long.	Seism	12.34	16.20	0.08	1.229	0.771	0.00	304.88	0.001
Lateral	Seism	13.00	15.76	0.08	1.364	0.636	0.00	304.88	0.001

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	152.44	5.14	1.00	0.00	0.99	1.0000	1.0000	2.50	0.00
Lateral	Normal	152.44	5.14	1.00	0.00	0.97	1.00	1.00	2.50	0.00
Long.	Seism	152.44	5.14	1.00	0.00	0.96	1.00	1.00	1.80	0.00
Lateral	Seism	152.44	5.14	1.00	0.00	0.96	1.00	1.00	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$

A-5-5. Sahelyia Regulator

Examination of bearing capacity by Japanese of Terzaghi method

Sahelyia by JP

Equation 1 : $qu=Qu/Ae = (\alpha \cdot k \cdot c \cdot N_c \cdot S_c + k \cdot q \cdot N_q \cdot S_q + 1/2 \cdot r1 \cdot \beta \cdot B_e \cdot N_r \cdot S_r)$

Equation 2 : $qa = 1/n \cdot qu$

	Ae (m2)	1st term α·k·c·Nc·Sc	2nd term k·q·Nq·Sq	3rd term 1/2·r1·β·(Be or Le)·Nr·Sr	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.	1.0	549.81	0	0.00	549.81	3	**183.27**	≧ **139.69**	OK
Nor.	1.0	786.60	0	0.00	786.60	3	**262.20**	≧ **141.89**	OK
Sei.	1.0	525.60	0	0.00	525.60	2	**262.80**	≧ **144.53**	OK
Sei.	1.0	766.53	0	0.00	766.53	2	**383.26**	≧ **153.67**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	7.00	15.20	7,999.49	95.23	0.28	16
Lateral	Normal	10	10	7.00	15.20	7,999.49	176.47	0.07	16
Long.	Seism	10	10	7.00	15.20	7,981.49	638.52	0.40	16
Lateral	Seism	10	10	7.00	15.20	7,981.49	638.52	0.17	16

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	α 1+0.3·(Be/Le or Le/Be)	β 1-0.4·(Be/Le or Le/Be)	k (Df=0) 1+0.3(Df/Be or Df/Le)	qu=N/0.082	φ=√(12N)+15	
Long.	Normal	6.44	15.20	0.01	1.127	0.831	1.000	195.12	0	Clay
Lateral	Normal	7.00	15.06	0.02	1.645	0.139	1.000	195.12	0	Clay
Long.	Seism	6.20	15.20	0.08	1.122	0.837	1.000	195.12	0	Clay
Lateral	Seism	7.00	14.86	0.08	1.637	0.151	1.000	195.12	0	Clay

case		C kN/m2	Nc (by graph)	Nq (by graph)	Nr (by graph)	Sr (B*)^(-1/3)	B* Be/1 or Le/1	Df (m)	q (kN/m2)	C*	Sc
Long.	Normal	97.56	5.00	0.00	0.00	0.54	6.44	0.00	0.00	1.00	1.00
Lateral	Normal	97.56	4.90	0.00	0.00	0.40	15.06	0.00	0.00	1.00	1.00
Long.	Seism	97.56	4.80	0.00	0.00	0.54	6.20	0.00	0.00	1.00	1.00
Lateral	Seism	97.56	4.80	0.00	0.00	0.41	14.86	0.00	0.00	1.00	1.00

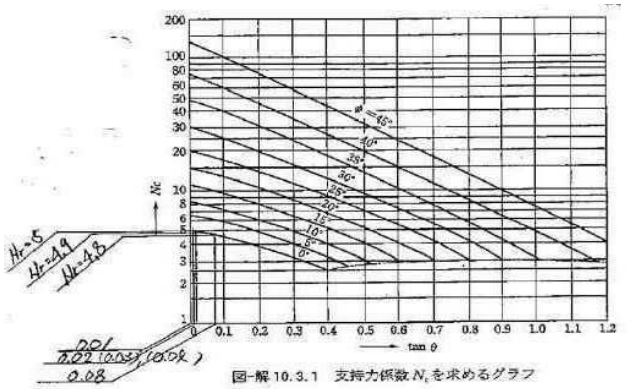


図-解 10.3.1　支持力係数 N_c を求めるグラフ

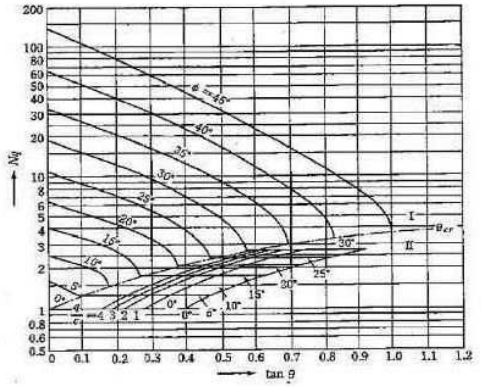


図-解 10.3.2　支持力係数 N_q を求めるグラフ

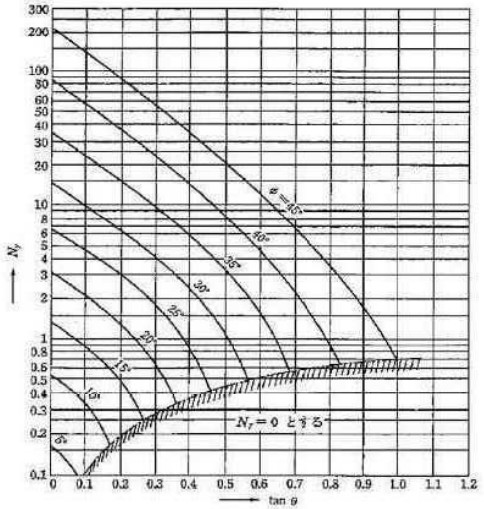


図-解 10.3.3　支持力係数 N_γ を求めるグラフ

iv）支持力係数の寸法効果に関する補正係数

支持力係数の寸法効果は，式（解 10.3.3）で求められる補正係数を支持力係数に乗じることによって考慮するものとした。ここで，式（10.3.1）において，支持力係数 N_c 及び N_q がかかる項には寸法の次元を持つ定数が含まれていないが，いずれの支持力係数も地盤のせん断抵抗角 ϕ の関数であり，基礎幅に比例してすべり線の長さが変化し，そのすべり線上で発現する ϕ の値が異なることから寸法効果が生じるものである。

$$\left.\begin{aligned} S_c &= (c^*)^{\lambda} \\ S_q &= (q^*)^{\mu} \\ S_\gamma &= (B')^{\mu} \end{aligned}\right\} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (解\ 10.3.3)$$

Examination of bearing capacity by Egyptian code of Terzaghi method

Sahelyia by EGY

Equation 1 : $qu = c \cdot N_c \cdot \lambda c \cdot ic + \gamma 1 \cdot Df \cdot N_q \cdot \lambda_q \cdot i_q + \gamma 2 \cdot B_e \cdot N_r \cdot \lambda_r \cdot ir$

Equation 2 : $qa = 1/n \cdot qu$

		1st term $c \cdot Nc \cdot \lambda c \cdot ic$	2nd term $\gamma 1 \cdot Df \cdot Nq \cdot \lambda q \cdot iq$	3rd term $\gamma 2 \cdot Be \cdot Nr \cdot \lambda r \cdot ir$	qu (kN/m2)	n (safety ratio)	qa (allowable) (kN/m2)	q (actual stress) (kN/m2)	Judge
Nor.		558.14	0.00	0.00	558.14	2.5	**223.25**	≧ **139.69**	OK
Nor.		792.56	0.00	0.00	792.56	2.5	**317.02**	≧ **141.89**	OK
Sei.		515.87	0.00	0.00	515.87	1.8	**286.60**	≧ **144.53**	OK
Sei.		753.17	0.00	0.00	753.17	1.8	**418.43**	≧ **153.67**	OK

case		r1 (kN/m3)	r2 (kN/m3)	B (m)	L (m)	V (kN)	H (kN)	e (m)	N
Long.	Normal	10	10	7.00	15.20	13,479.82	149.64	0.2	16
Lateral	Normal	10	10	7.00	15.20	13,479.82	362.13	0.14	16
Long.	Seism	10	10	7.00	15.20	13,464.82	1,077.19	0.36	16
Lateral	Seism	10	10	7.00	15.20	13,464.82	1,077.19	0.25	16

case		Be=B or B-2e (m)	Le=L or L-2e (m)	tanθ H/V	λq,λc 1+0.3·(Be/Le or Le/Be)	λr 1-0.3·(Be/Le or Le/Be)	Df	qu=N/0.082	φ=√(12N)+15
Long.	Normal	6.60	15.20	0.01	1.130	0.870	0.00	195.12	0.001
Lateral	Normal	7.00	14.92	0.03	1.639	0.361	0.00	195.12	0.001
Long.	Seism	6.28	15.20	0.08	1.124	0.876	0.00	195.12	0.001
Lateral	Seism	7.00	14.70	0.08	1.630	0.370	0.00	195.12	0.001

case		C kN/m2	Nc (1)	Nq (2)	Nr (3)	ic (4)	iq (5)	ir (6)	Fb	q
Long.	Normal	97.56	5.14	1.00	0.00	0.98	1.0000	1.0000	2.50	0.00
Lateral	Normal	97.56	5.14	1.00	0.00	0.96	1.00	1.00	2.50	0.00
Long.	Seism	97.56	5.14	1.00	0.00	0.91	1.00	1.00	1.80	0.00
Lateral	Seism	97.56	5.14	1.00	0.00	0.92	1.00	1.00	1.80	0.00

(1) $Nc=(Nq-1) / \tan\phi$

(2) $Nr=(Nq-1) \tan\phi$

(3) $Nq=e^{\pi \cdot \tan\phi} \cdot \tan^2(45+\phi/2)$

(4) $ic=iq-(1-iq)/(Nq-1)$

(5) $iq=\{1-0.7 \cdot (H*Fb/(V*Fb+A \cdot c \cdot \cot\phi))\}^3$

(6) $ir=\{1-(Hb/(Vb+A \cdot c \cdot \cot\phi))\}^3$