NO.	LOAD NAME		RE-PZ(T) 26	RE-PZ(T) 27	RE-PZ(T) 28	RE-PZ(T) 29	RE-PZ(T) 30	RE-PZ(T) 49	RE-PZ(T) 50
1			22.545	21.286	21.283	22.567	32.141	32.027	22.759
2			57.636	57.760	57.751	57.681	63.365	63.137	58.066
3		(+)	2.044	0.446	0.445	2.044	11.502	11.469	2.098
		(-)	-2.140	-0.537	-0.535	-2.135	-1.079	-1.077	-2.135
4	(RUL)	(+)	135.770	43.036	17.478	5.098	0.601	40.190	136.062
		(-)	-3.650	-3.331	-2.321	-0.944	-5.679	-6.169	-3.604
5	(RUR)	(+)	5.090	17.512	43.032	135.799	40.395	0.582	5.051
		(-)	-0.946	-2.300	-3.313	-3.625	-6.160	-5.673	-0.946
6	(RL1L)	(+)	48.333	14.955	6.069	1.789	0.188	14.009	48.434
		(-)	-1.141	-1.041	-0.725	-0.295	-1.961	-1.928	-1.126
7	(RL1R)	(+)	1.785	6.081	14.952	48.342	14.084	0.182	1.772
		(-)	-0.296	-0.719	-1.035	-1.133	-1.925	-1.958	-0.296
8	(RL2L)	(+)	17.462	3.562	2.052	0.656	0.146	4.887	17.462
		(-)	-0.858	-0.712	-0.502	-0.197	-0.632	-1.253	-0.848
9	(RL2R)	(+)	0.654	2.056	3.558	17.462	4.920	0.143	0.649
		(-)	-0.197	-0.499	-0.710	-0.853	-1.251	-0.629	-0.197
10	(RL'L)	(+)	111.917	42.813	17.280	5.181	0.705	40.203	112.176
		(-)	-4.278	-3.905	-2.721	-1.107	-5.539	-7.234	-4.225
11	(RL'R)	(+)	5.179	17.282	42.802	111.919	40.337	0.682	5.150
		(-)	-1.109	-2.696	-3.884	-4.249	-7.223	-5.520	-1.110
12	(KS16L)	(+)	92.624	35.267	14.805	4.441	0.442	29.676	90.424
		(-)	-2.683	-2.448	-1.706	-0.694	-4.745	-6.323	-3.620
13	(KS16R)	(+)	3.711	13.018	32.841	90.219	29.797	0.428	4.413
		(-)	-0.959	-2.386	-3.429	-3.641	-6.314	-4.728	-0.696
14	(RLL)	(+)	65.795	18.517	8.122	2.444	0.334	18.896	65.895
		(-)	-1.999	-1.753	-1.228	-0.492	-2.594	-3.181	-1.975
15	(RLR)	(+)	2.439	8.137	18.510	65.804	19.004	0.325	2.420
		(-)	-0.493	-1.218	-1.745	-1.986	-3.177	-2.587	-0.493
16	(RU)	(+)	140.860	60.548	60.510	140.898	40.996	40.771	141.113
		(-)	-4.596	-5.631	-5.634	-4.569	-11.840	-11.842	-4.550
17	(RL)	(+)	68.234	26.655	26.631	68.248	19.337	19.222	68.316
		(-)	-2.491	-2.971	-2.973	-2.477	-5.770	-5.769	-2.468
18	(RL')	(+)	117.095	60.095	60.083	117.100	41.041	40.885	117.326
		(-)	-5.387	-6.601	-6.605	-5.356	-12.763	-12.753	-5.334
19	(KS16)	(+)	96.335	48.285	47.645	94.660	30.239	30.104	94.837
		(-)	-3.641	-4.834	-5.135	-4.334	-11.059	-11.051	-4.316
DEA		(+)	93.609	87.763	87.742	93.615	113.136	112.782	94.183
DEA		(-)	-13.428	-8.717	-8.708	-13.367	-17.630	-17.618	-13.358

NO.	LOAD NAME		RE-PZ(T) 51	RE-PZ(T) 52	RE-PZ(T) 53	RE-PZ(T) 54	RE-PZ(T) 73	RE-PZ(T) 74	RE-PZ(T) 75
1			21.362	21.305	22.532	32.084	12.301	8.870	8.489
2			57.909	57.798	57.610	63.252	25.413	23.658	23.598
3		(+)	0.466	0.446	2.043	11.498	4.410	0.736	0.333
		(-)	-0.533	-0.531	-2.143	-1.091	-0.493	-0.832	-0.159
4	(RUL)	(+)	43.167	17.514	5.033	0.577	16.997	76.501	20.142
		(-)	-3.307	-2.302	-0.951	-5.788	-1.627	-0.644	-0.757
5	(RUR)	(+)	17.474	43.057	135.791	40.414	0.135	2.313	7.008
		(-)	-2.308	-3.303	-3.630	-6.156	-2.003	-0.267	-0.597
6	(RL1L)	(+)	14.999	6.082	1.765	0.180	6.157	25.253	7.272
		(-)	-1.033	-0.719	-0.297	-2.000	-0.509	-0.201	-0.237
7	(RL1R)	(+)	6.068	14.961	48.342	14.091	0.042	0.840	2.534
		(-)	-0.721	-1.034	-1.134	-1.924	-0.722	-0.084	-0.186
8	(RL2L)	(+)	3.580	2.057	0.645	0.143	2.691	17.462	2.948
		(-)	-0.709	-0.500	-0.198	-0.647	-0.607	-0.349	-0.300
9	(RL2R)	(+)	2.050	3.563	17.462	4.923	0.053	0.373	1.100
		(-)	-0.501	-0.709	-0.854	-1.251	-0.310	-0.091	-0.227
10	(RL'L)	(+)	42.894	17.286	5.144	0.676	13.906	57.718	17.208
		(-)	-3.877	-2.699	-1.115	-5.595	-2.215	-0.978	-1.055
11	(RL'R)	(+)	17.267	42.809	111.918	40.345	0.163	1.927	5.675
		(-)	-2.705	-3.878	-4.255	-7.219	-1.595	-0.320	-0.717
12	(KS16L)	(+)	32.923	13.019	3.677	0.614	10.929	53.876	14.308
		(-)	-3.423	-2.388	-0.964	-4.339	-1.803	-0.674	-0.848
13	(KS16R)	(+)	14.793	35.264	92.627	34.572	0.099	1.648	4.852
		(-)	-1.696	-2.431	-2.668	-4.525	-1.363	-0.196	-0.439
14	(RLL)	(+)	18.579	8.139	2.410	0.323	8.848	42.715	10.220
		(-)	-1.742	-1.219	-0.495	-2.647	-1.116	-0.550	-0.536
15	(RLR)	(+)	8.117	18.524	65.804	19.014	0.096	1.213	3.634
		(-)	-1.222	-1.742	-1.988	-3.175	-1.032	-0.174	-0.414
16	(RU)	(+)	60.641	60.571	140.824	40.992	17.132	78.813	27.150
		(-)	-5.615	-5.610	-4.581	-11.944	-3.631	-0.911	-1.354
17	(RL)	(+)	26.697	26.663	68.213	19.337	8.944	43.928	13.854
		(-)	-2.964	-2.961	-2.484	-5.821	-2.148	-0.725	-0.950
18	(RL')	(+)	60.160	60.095	117.062	41.022	14.068	59.645	22.883
		(-)	-6.583	-6.577	-5.370	-12.814	-3.809	-1.298	-1.772
19	(KS16)	(+)	47.716	48.283	96.304	35.186	11.028	55.524	19.160
		(-)	-5.119	-4.819	-3.632	-8.864	-3.166	-0.871	-1.287
	DEAD	(+)	87.934	87.764	93.582	113.087	45.011	37.730	35.337
	DEAD	(-)	-8.664	-8.662	-13.441	-17.750	-7.297	-5.203	-3.250

NO.	LOAD NAME		RE-PZ(T) 76	RE-PZ(T) 77	RE-PZ(T) 78
1			8.437	8.767	12.408
2			23.484	23.469	25.630
3		(+)	0.321	0.718	4.459
		(-)	-0.156	-0.845	-0.510
4	(RUL)	(+)	6.989	2.332	0.143
		(-)	-0.594	-0.269	-2.096
5	(RUR)	(+)	20.036	76.388	17.282
		(-)	-0.745	-0.628	-1.655
6	(RL1L)	(+)	2.527	0.847	0.045
		(-)	-0.186	-0.084	-0.756
7	(RL1R)	(+)	7.228	25.205	6.261
		(-)	-0.233	-0.196	-0.517
8	(RL2L)	(+)	1.097	0.375	0.056
		(-)	-0.227	-0.091	-0.324
9	(RL2R)	(+)	2.948	17.462	2.737
		(-)	-0.295	-0.344	-0.617
10	(RL'L)	(+)	5.659	1.942	0.186
		(-)	-0.797	-0.356	-1.669
11	(RL'R)	(+)	17.099	57.592	14.139
		(-)	-0.896	-0.766	-1.988
12	(KS16L)	(+)	4.499	1.496	0.165
		(-)	-0.668	-0.292	-1.352
13	(KS16R)	(+)	14.043	52.699	12.090
		(-)	-0.547	-0.462	-1.216
14	(RLL)	(+)	3.624	1.223	0.101
		(-)	-0.412	-0.175	-1.080
15	(RLR)	(+)	10.176	42.667	8.997
		(-)	-0.528	-0.541	-1.134
16	(RU)	(+)	27.024	78.720	17.425
		(-)	-1.339	-0.897	-3.750
17	(RL)	(+)	13.800	43.890	9.098
		(-)	-0.941	-0.716	-2.215
18	(RL')	(+)	22.757	59.535	14.324
		(-)	-1.693	-1.122	-3.657
19	(KS16)	(+)	18.542	54.195	12.255
		(-)	-1.215	-0.754	-2.568
DEAD		(+)	35.138	37.439	45.545
DEAD		(-)	-3.216	-5.202	-7.507

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

BENDING MOMENT (T.M)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
1	7	16	0.001	18	-0.000
7	1	16	82.959	16	-17.564
7	13	16	82.959	16	-17.564
13	7	16	165.919	16	-35.128
13	19	16	165.919	16	-35.128
19	13	18	37.121	18	-20.822
19	25	18	37.121	18	-20.822
25	19	18	34.058	18	-103.210
25	31	18	34.058	18	-103.210
31	25	18	29.676	18	-53.330
31	37	18	29.676	18	-53.330
37	31	16	76.249	18	-45.054
37	43	16	76.249	18	-45.054
43	37	18	29.822	18	-53.700
43	49	18	29.822	18	-53.700
49	43	18	33.895	16	-103.807
49	55	18	33.895	16	-103.807
55	49	18	35.830	18	-24.450
55	61	18	35.830	18	-24.450
61	55	16	163.223	18	-36.321
61	67	16	163.252	18	-36.327
67	61	16	81.640	18	-18.167
67	73	16	81.640	18	-18.167
73	67	18	0.007	16	-0.029
2	8	16	0.000	16	-0.001
8	2	16	193.051	18	-5.316
8	14	16	193.051	18	-5.316
14	8	16	102.020	18	-10.631
14	20	16	102.024	18	-10.632
20	14	16	113.740	18	-27.781
20	26	16	113.740	18	-27.781
26	20	18	16.814	16	-161.348
26	32	18	16.814	16	-161.348
32	26	16	78.932	18	-56.420
32	38	16	78.932	18	-56.420
38	32	16	44.607	18	-24.047
38	44	16	44.609	18	-24.046
44	38	19	80.680	18	-56.832
44	50	19	80.680	18	-56.832
50	44	18	16.672	16	-162.213
50	56	18	16.672	16	-162.213
56	50	16	113.962	18	-29.880
56	62	16	113.962	18	-29.880
62	56	16	103.506	18	-12.366
62	68	16	103.509	13	-12.366
68	62	16	193.742	18	-6.183
68	74	16	193.742	18	-6.183
74	68	19	0.000	16	-0.001
3	9	16	0.000	16	-0.000
9	3	16	106.179	13	-8.069

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

BENDING MOMENT (T,M)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
9	15	16	106.179	18	-8.069
15	9	16	168.562	18	-16.139
15	21	16	168.561	18	-16.139
21	15	18	43.671	18	-23.927
21	27	18	43.671	18	-23.927
27	21	18	19.239	16	-128.232
27	33	18	19.239	16	-128.232
33	27	18	36.805	18	-53.351
33	39	16	36.805	18	-53.351
39	33	16	93.445	18	-29.431
39	45	16	93.445	18	-29.431
45	39	18	36.887	18	-53.540
45	51	18	36.887	18	-53.540
51	45	18	19.147	16	-128.616
51	57	18	19.147	16	-128.616
57	51	18	43.795	18	-24.618
57	63	18	43.795	18	-24.618
63	57	16	169.186	18	-16.815
63	69	16	169.185	18	-16.815
69	63	16	106.486	18	-8.407
69	75	16	106.486	18	-8.407
75	69	16	0.000	16	-0.000
4	10	16	0.000	16	-0.000
10	4	16	106.172	18	-8.358
10	16	16	106.172	18	-8.358
16	10	16	168.547	18	-16.717
16	22	16	168.548	18	-16.717
22	16	18	43.669	18	-24.577
22	28	18	43.669	18	-24.577
28	22	18	19.204	16	-128.259
28	34	18	19.204	16	-128.259
34	28	18	36.845	18	-53.351
34	40	18	36.845	18	-53.351
40	34	16	93.468	18	-29.389
40	46	16	93.468	18	-29.389
46	40	18	36.826	18	-53.392
46	52	18	36.826	18	-53.392
52	46	18	19.168	16	-128.303
52	58	18	19.168	16	-128.303
58	52	18	43.701	18	-23.974
58	64	18	43.701	18	-23.974
64	58	16	168.639	18	-16.176
64	70	16	168.640	18	-16.177
70	64	16	106.218	18	-8.088
70	76	16	106.218	18	-8.088
76	70	16	0.000	16	-0.000
5	11	19	0.000	16	-0.001
11	5	16	193.032	18	-6.080
11	17	16	193.032	18	-6.080
17	11	16	101.980	18	-12.159

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

BENDING MOMENT (T.M)

I	J	MAX CASE.	MAX FORCE	MIN CASE.	MIN FORCE
17	23	16	101.977	18	-12.159
23	17	16	113.682	18	-29.843
23	29	16	113.682	18	-29.843
29	23	18	16.724	16	-161.416
29	35	18	16.724	16	-161.416
35	29	19	80.621	18	-56.420
35	41	19	80.621	18	-56.420
41	35	16	44.655	18	-24.026
41	47	16	44.652	18	-24.026
47	41	16	78.917	18	-56.367
47	53	16	78.917	18	-56.367
53	47	18	16.741	16	-161.281
53	59	18	16.741	16	-161.282
59	53	16	113.649	18	-27.831
59	65	16	113.649	18	-27.831
65	59	16	101.778	18	-10.646
65	71	16	101.775	18	-10.646
71	65	16	192.928	18	-5.323
71	77	16	192.928	18	-5.323
77	71	16	0.000	16	-0.001
6	12	16	0.000	18	-0.000
12	6	16	82.924	18	-18.450
12	18	16	82.924	18	-18.450
18	12	16	165.847	18	-36.900
18	24	16	165.847	18	-36.900
24	18	18	37.088	18	-24.796
24	30	18	37.088	18	-24.796
30	24	18	33.902	16	-103.349
30	36	18	33.902	16	-103.348
36	30	18	29.730	18	-53.315
36	42	18	29.730	18	-53.315
42	36	16	76.498	18	-44.767
42	48	16	76.498	18	-44.766
48	42	18	29.887	18	-53.371
48	54	18	29.887	18	-53.371
54	48	18	34.044	16	-103.314
54	60	18	34.044	16	-103.315
60	54	18	37.151	18	-21.028
60	66	18	37.151	18	-21.028
66	60	16	165.970	16	-35.689
66	72	16	165.970	16	-35.689
72	66	16	82.985	16	-17.844
72	78	16	82.985	16	-17.844
78	72	16	0.001	18	-0.000
1	2	16	0.000	18	-0.000
2	1	18	0.003	16	-0.027
2	3	16	0.003	16	-0.027
3	2	16	0.031	18	-0.004
3	4	16	0.031	18	-0.004
4	3	18	0.004	16	-0.031

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

BENDING MOMENT (T.M)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
4	5	18	0.004	16	-0.031
5	4	16	0.027	18	-0.003
5	6	16	0.026	18	-0.003
6	5	18	0.000	18	-0.000
13	14	18	0.000	16	-0.000
14	13	16	107.305	16	-17.821
14	15	16	107.308	16	-17.822
15	14	16	33.503	16	-15.399
15	16	16	33.503	16	-15.399
16	15	16	33.503	16	-15.398
16	17	16	33.504	16	-15.398
17	16	16	107.310	16	-17.820
17	18	16	107.308	16	-17.819
18	17	18	0.000	16	-0.000
25	26	16	0.000	18	-0.000
26	25	18	0.013	18	-0.007
26	27	18	0.013	18	-0.007
27	26	18	0.008	18	-0.016
27	28	16	0.008	18	-0.015
28	27	18	0.015	18	-0.008
28	29	18	0.016	18	-0.008
29	28	18	0.007	18	-0.013
29	30	18	0.007	18	-0.013
30	29	16	0.000	18	-0.000
37	38	18	0.000	18	-0.000
38	37	4	86.107	16	-19.151
38	39	4	86.109	16	-19.152
39	38	4	18.731	16	-21.036
39	40	4	18.731	16	-21.035
40	39	16	18.756	16	-20.996
40	41	16	18.756	16	-20.996
41	40	16	86.170	16	-19.064
41	42	16	86.168	16	-19.063
42	41	18	0.000	18	-0.000
49	50	16	0.000	18	-0.000
50	49	18	0.007	18	-0.013
50	51	18	0.007	18	-0.013
51	50	18	0.016	18	-0.008
51	52	18	0.016	18	-0.008
52	51	18	0.008	18	-0.015
52	53	18	0.008	18	-0.016
53	52	18	0.013	18	-0.007
53	54	18	0.013	18	-0.007
54	53	16	0.000	10	-0.000
61	62	16	0.044	18	-0.010
62	61	16	106.175	16	-17.582
62	63	16	106.178	16	-17.583
63	62	16	32.318	16	-15.152
63	64	16	32.318	16	-15.152
64	63	16	33.549	16	-16.187

** RAILWAY BRIDGE **

** PICKUP TABLE **   NO. 1

BENDING MOMENT (T.M)

		MAX		MIN	
I	J	CASE.	FORCE	CASE.	FORCE
64	65	16	33.550	16	-16.187
65	64	16	107.329	16	-18.135
65	66	16	107.326	16	-18.138
66	65	18	0.000	16	-0.000
73	74	16	0.044	18	-0.010
74	73	16	0.023	18	-0.002
74	75	16	0.024	18	-0.002
75	74	18	0.004	16	-0.030
75	76	18	0.004	16	-0.030
76	75	16	0.031	18	-0.004
76	77	16	0.031	18	-0.004
77	76	18	0.003	16	-0.027
77	78	18	0.003	16	-0.026
78	77	16	0.000	18	-0.000

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

SHEARING FORCE (T)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
1	7	16	17.428	16	-3.690
7	1	16	3.690	16	-17.428
7	13	16	17.428	16	-3.690
13	7	16	4.084	16	-20.850
13	19	16	5.039	16	-33.225
19	13	16	28.085	16	-4.426
19	25	16	4.426	16	-28.085
25	19	16	28.085	16	-4.426
25	31	18	19.183	18	-8.912
31	25	18	8.912	18	-19.183
31	37	18	19.183	18	-8.912
37	31	18	9.571	18	-24.036
37	43	18	9.516	18	-24.027
43	37	18	19.179	18	-8.857
43	49	18	8.857	18	-19.179
49	43	18	19.179	18	-8.857
49	55	16	27.370	16	-4.405
55	49	16	4.405	16	-27.870
55	61	16	27.870	16	-4.405
61	55	16	5.013	16	-32.966
61	67	18	4.281	16	-20.512
67	61	16	17.145	18	-3.815
67	73	18	3.815	16	-17.145
73	67	16	17.145	18	-3.815
2	8	16	76.211	18	-1.117
8	2	18	16.794	16	-23.578
8	14	16	23.578	18	-16.794
14	8	16	65.340	18	-6.470
14	20	16	47.342	18	-11.461
20	14	16	40.216	18	-8.914
20	26	18	8.914	16	-40.216
26	20	16	93.817	18	-0.857
26	32	16	85.631	18	-4.554
32	26	17	8.390	16	-33.992
32	38	16	33.992	17	-8.390
38	32	16	50.895	18	-9.973
38	44	16	50.830	18	-10.053
44	38	16	34.050	17	-7.598
44	50	17	7.598	16	-34.050
50	44	16	85.694	18	-4.531
50	56	16	94.001	18	-0.833
56	50	18	8.890	16	-40.465
56	62	16	40.465	18	-8.890
62	56	16	47.061	18	-11.587
62	68	16	65.162	18	-6.515
68	62	16	23.734	18	-16.718
68	74	18	16.718	16	-23.734
74	68	16	76.328	18	-1.299
3	9	16	26.933	18	-1.695
9	3	18	1.695	16	-19.672

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

SHEARING FORCE (T)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
9	15	16	19.672	18	-1.695
15	9	18	3.858	16	-13.212
15	21	18	1.127	16	-27.401
21	15	16	32.944	18	-1.127
21	27	18	1.127	16	-33.088
27	21	16	38.871	18	-1.127
27	33	16	31.608	18	-5.481
33	27	18	5.481	16	-25.522
33	39	16	25.522	18	-5.481
39	33	18	5.481	18	-20.291
39	45	18	5.460	18	-20.303
45	39	16	25.545	18	-5.460
45	51	18	5.460	16	-25.545
51	45	16	31.634	18	-5.460
51	57	16	36.952	18	-1.116
57	51	18	1.116	16	-33.204
57	63	16	33.046	18	-1.116
63	57	18	1.116	16	-27.527
63	69	18	3.732	16	-13.272
69	63	16	19.736	18	-1.766
69	75	18	1.766	16	-19.736
75	69	16	26.984	18	-1.766
4	10	16	26.931	18	-1.756
10	4	18	1.756	16	-19.670
10	16	16	19.670	18	-1.756
16	10	18	3.774	16	-13.210
16	22	18	1.125	16	-27.403
22	16	16	32.946	18	-1.125
22	28	18	1.125	16	-33.090
28	22	16	38.873	18	-1.125
28	34	16	31.614	18	-5.473
34	28	18	5.473	16	-25.527
34	40	16	25.527	18	-5.473
40	34	18	5.473	18	-20.291
40	46	18	5.462	18	-20.284
46	40	16	25.531	18	-5.462
46	52	18	5.462	16	-25.531
52	46	16	31.617	18	-5.462
52	58	16	38.887	18	-1.122
58	52	18	1.122	16	-33.104
58	64	16	32.960	18	-1.122
64	58	18	1.122	16	-27.419
64	70	18	3.860	16	-13.223
70	64	16	19.680	18	-1.699
70	76	18	1.699	16	-19.680
76	70	16	26.941	18	-1.699
5	11	16	76.207	18	-1.277
11	5	18	16.760	16	-23.574
11	17	16	23.574	18	-16.760
17	11	16	65.344	18	-6.465

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

SHEARING FORCE (T)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
17	23	16	47.340	18	-11.461
23	17	16	40.218	18	-8.911
23	29	18	8.911	16	-40.218
29	23	16	93.819	18	-0.854
29	35	16	85.644	18	-4.536
35	29	17	7.596	16	-34.004
35	41	16	34.004	17	-7.596
41	35	16	50.883	18	-9.974
41	47	16	50.884	18	-9.967
47	41	16	33.996	17	-8.387
47	53	17	8.387	16	-33.996
53	47	16	85.635	18	-4.538
53	59	16	93.783	18	-0.849
59	53	18	8.907	16	-40.183
59	65	16	40.183	18	-8.907
65	59	16	47.332	18	-11.422
65	71	16	65.339	18	-6.440
71	65	16	23.552	18	-16.790
71	77	18	16.790	16	-23.552
77	71	16	76.185	18	-1.118
6	12	16	17.421	18	-3.876
12	6	18	3.876	16	-17.421
12	18	16	17.421	18	-3.876
18	12	18	4.349	16	-20.842
18	24	16	5.029	16	-33.235
24	18	16	28.094	16	-4.416
24	30	16	4.416	16	-28.094
30	24	16	28.094	16	-4.416
30	36	18	19.189	18	-8.862
36	30	18	8.862	18	-19.189
36	42	18	19.189	18	-8.862
42	36	18	9.522	18	-24.038
42	48	18	9.524	18	-24.019
48	42	18	19.170	18	-8.865
48	54	18	8.865	18	-19.170
54	48	18	19.170	18	-8.865
54	60	16	28.096	16	-4.498
60	54	16	4.498	16	-28.096
60	66	16	28.096	16	-4.498
66	60	16	5.127	16	-33.238
66	72	16	4.154	16	-20.856
72	66	16	17.434	16	-3.749
72	78	16	3.749	16	-17.434
78	72	16	17.434	16	-3.749
1	2	18	0.001	16	-0.011
2	1	16	0.011	18	-0.001
2	3	16	0.025	18	-0.003
3	2	18	0.003	16	-0.025
3	4	18	0.003	16	-0.026
4	3	16	0.026	18	-0.003

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

SHEARING FORCE (T)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
4	5	16	0.025	18	-0.003
5	4	18	0.003	16	-0.025
5	6	18	0.001	16	-0.011
6	5	16	0.011	18	-0.001
13	14	16	45.331	16	-7.529
14	13	16	7.529	16	-45.331
14	15	18	1.391	16	-31.717
15	14	16	31.717	18	-1.391
15	16	16	19.999	16	-19.998
16	15	16	19.998	16	-19.999
16	17	16	31.718	19	-1.511
17	16	19	1.511	16	-31.718
17	18	16	7.527	16	-45.333
18	17	16	45.333	16	-7.527
25	26	18	0.005	18	-0.003
26	25	18	0.003	18	-0.005
26	27	18	0.006	18	-0.012
27	26	18	0.012	18	-0.006
27	28	18	0.013	18	-0.007
28	27	18	0.007	18	-0.013
28	29	18	0.007	18	-0.012
29	28	18	0.012	18	-0.007
29	30	18	0.005	18	-0.003
30	29	18	0.003	18	-0.005
37	38	4	36.376	16	-8.091
38	37	16	8.091	4	-36.376
38	39	10	1.173	16	-30.108
39	38	16	30.108	10	-1.173
39	40	16	16.155	16	-16.125
40	39	16	16.125	16	-16.155
40	41	16	30.123	18	-1.172
41	40	18	1.172	16	-30.123
41	42	16	8.053	16	-36.402
42	41	16	36.402	16	-8.053
49	50	18	0.003	18	-0.005
50	49	18	0.005	18	-0.003
50	51	18	0.012	18	-0.007
51	50	18	0.007	18	-0.012
51	52	18	0.007	18	-0.013
52	51	18	0.013	18	-0.007
52	53	18	0.012	18	-0.006
53	52	18	0.006	18	-0.012
53	54	18	0.003	18	-0.005
54	53	18	0.005	18	-0.003
61	62	16	44.836	16	-7.424
62	61	16	7.424	16	-44.836
62	63	19	1.515	16	-31.741
63	62	16	31.741	19	-1.515
63	64	16	19.963	16	-19.826
64	63	16	19.826	16	-19.963

** RAILWAY BRIDGE **

** PICKUP TABLE ** NO. 1

SHEARING FORCE (T)

I	J	MAX CASE.	FORCE	MIN CASE.	FORCE
64	65	16	31.677	18	-1.227
65	64	18	1.227	16	-31.677
65	66	16	7.662	16	-45.340
66	65	16	45.340	16	-7.662
73	74	16	0.006	16	-0.013
74	73	16	0.013	16	-0.006
74	75	18	0.003	16	-0.023
75	74	16	0.023	18	-0.003
75	76	16	0.026	18	-0.003
76	75	18	0.003	16	-0.026
76	77	18	0.003	16	-0.024
77	76	16	0.024	18	-0.003
77	78	16	0.011	18	-0.001
78	77	18	0.001	16	-0.011

Railway Bridge

TOTAL MOMENT

POINT	G2 ⑫	U. L. S			S. L. S		
	MOMENT M (kNm)	γ fL	γ 3	MOMENT OF DESIGN Mu=M γ fL γ 3 (kNm)	γ fL	γ 3	DESIGN MOMENT Mu=M γ fL γ 3 (kNm)
DEAD LOAD	1191.7	1.20	1.15	1644.5	1.00	1.00	1191.7
LIVE LOAD RU	1898.3	1.40	1.10	2923.4	1.10	1.00	2088.1
LIVE LOAD RL	0	1.40	1.10	0.0	1.10	1.00	0.0
TOTAL				4567.9 1644.5			3279.8 1191.7
DESIGN MOMENT				4567.9			3279.8
RESISTANCE MOMENT				5076.0			4044.5

TOTAL MOMENT

POINT	G2 ⑨	U. L. S			S. L. S		
	MOMENT M (kNm)	γ fL	γ 3	MOMENT OF DESIGN Mu=M γ fL γ 3 (kNm)	γ fL	γ 3	MOMENT OF DESIGN Mu=M γ fL γ 3 (kNm)
DEAD LOAD	-1264.2	1.20	1.15	-1744.6	1.00	1.00	-1264.2
LIVE LOAD RU	-1589.6	1.40	1.10	-2448.0	1.10	1.00	-1748.6
LIVE LOAD RL		1.40	1.10	0.0	1.10	1.00	0.0
TOTAL				-4192.6 -1744.6			-3012.8 -1264.2
DESIGN MOMENT				-4192.6			-3012.8
RESISTANCE MOMENT				-6765.8			-3645.2

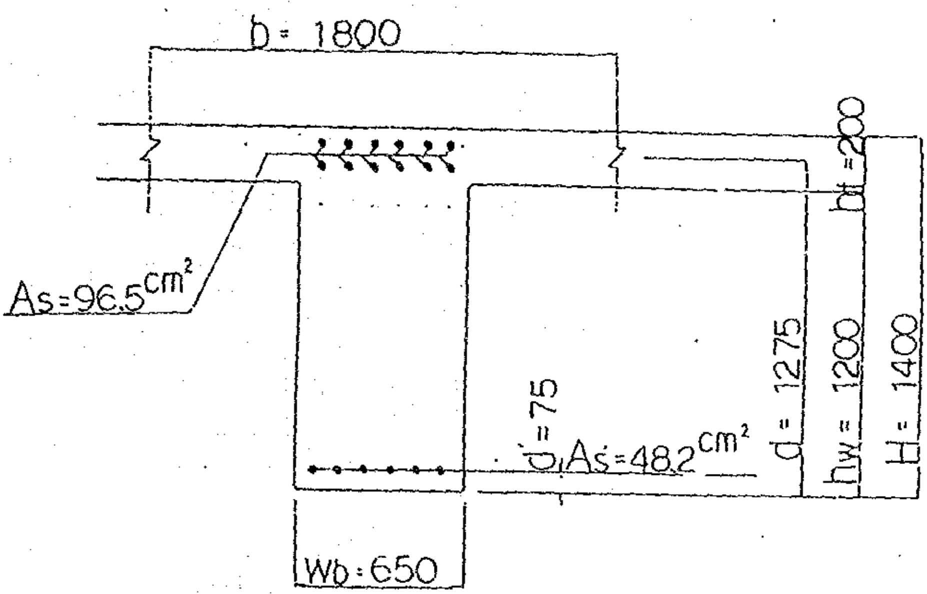
U.FLG b=	180	AS=	96.5
U.FLG hf=	20	fcu=	3000
WEB hw=	120	fy=	41000
WEB Wb=	65	AS'=	50.4
d=	130	d'=	7.5

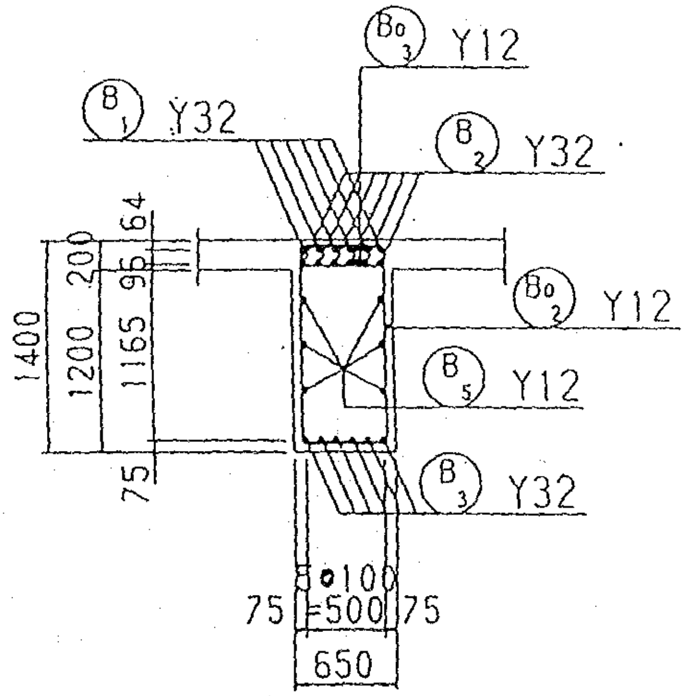
X=0.87*fy*AS/(0.4*fcu*Wb) 48.2

Z=d-1/2*X = 105.9

MRC=0.15*fcu*b*d^2+0.72*fy*AS'*(d-d)
= 6765.8

MRS=0.87*fy*AS*Z = 3645.2



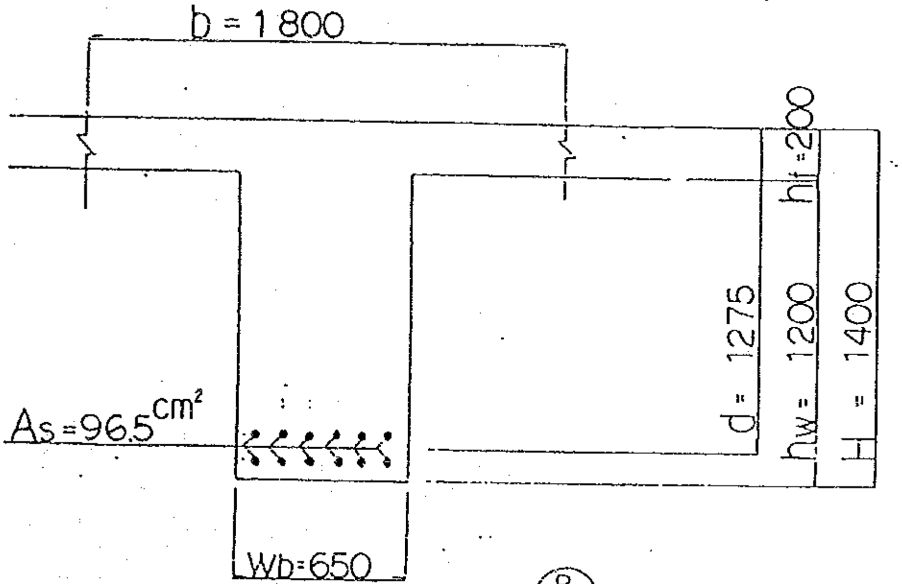


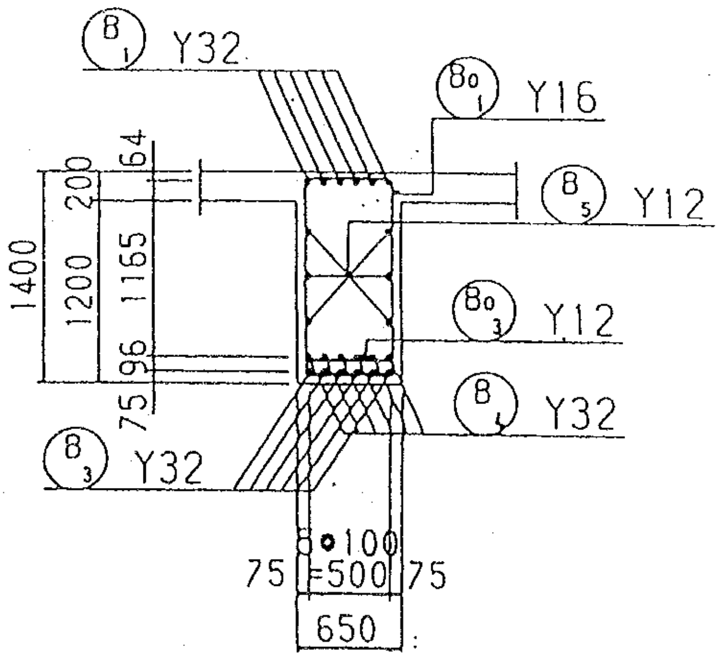
U. FLG b= 180 AS= 96.5
U. FLG hf= 20 fcu= 3000
WEB hw= 120 fy= 41000
d= 127.5

Z=d-1/2*hf = 117.5

MRC=0.4*fcu*b*hf*Z= 5076.0

MRS=0.87*fy*AS*Z = 4044.5





Calculation of deck slab for Main bridge

1. Span and bending moment

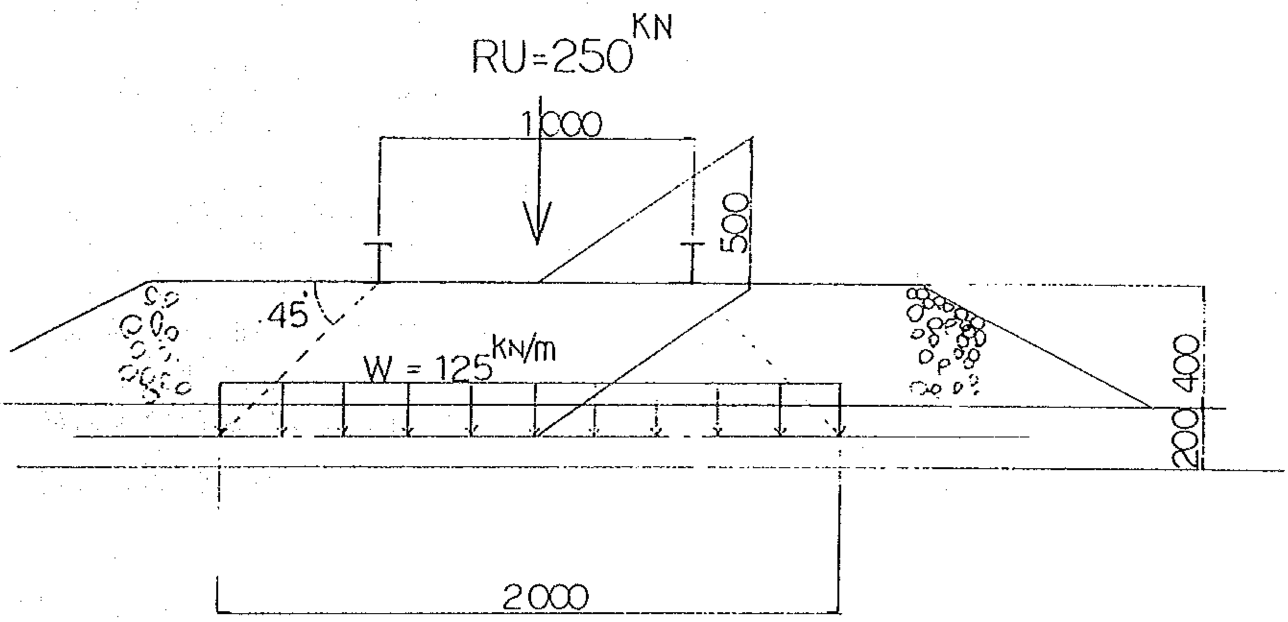
   a) Span L=1.800 - 0.65 = 1.150 ≈1.200m

   b) Load

Dead load 1 (Rail, sleeper and ballst)	W1=	7.47 kn/m
Dead load 2 (slab)	W2=	4.72 kn/m
live load (RU P=250 kn:W=125 kn/m)	Wl=	125.00 nk/m
	ΣW =	137.19 nk/m

   c) Moment (Middle span and each fulcrum)

   M=(1/10*W*L*L)*1.5*1.1 = (1/10*137.2*1.2*1.2)*1.5*1.1 = 32.6 knm/m



2. Calculation of stress

a) middle span $b = 100^{cm}$ $h = 20$ $d = 15.0$ $d' = 5.0$

$As = Y_{12} - 150^{ctc} = 1.131/0.150 = 7.540\ cm^2$

$$P = \frac{7.540}{100 \times 15.0} \times 100 = 0.503\ \%$$

$$x = \frac{0.87 \times 41000 \times 7.540}{0.40 \times 3000 \times 100} = 2.4^{cm}$$

$$Z = 15.0 - \frac{1}{2} \times 2.4 = 13.8^{cm} < 0.95 \times 15 = 14.25^{cm}$$

$M_{RS} = 0.87 \times 41000 \times 7.54 \times 13.8 \times 10^{-5} = 37.1^{KNm} > 32.6^{KNm}$

$M_{RC} = 0.40 \times 3000 \times 100 \times 2.4 \times 13.8 \times 10^{-5} = 39.7^{KNm} > 32.6^{KNm}$ OK

b) each fulcrum $b = 100^{cm}$ $h = 20$ $d = 16.0$ $d' = 4.0$

$As = Y_{16} - 150^{ctc} = 2.011/0.150 = 13.407\ cm^2$

$$P = \frac{13.407}{100 \times 16.0} \times 100 = 0.838\ \%$$

$$x = \frac{0.87 \times 41000 \times 13.407}{0.4 \times 3000 \times 100} = 4.0^{cm}$$

$$Z = 16.0 - \frac{1}{2} \times 4.0 = 14.0^{cm} < 0.95 \times 16.0 = 15.2^{cm}$$

$M_{RS} = 0.87 \times 41000 \times 13.407 \times 14.0 \times 10^{-5} = 66.9^{KNm} > 32.6^{KNm}$

$M_{RC} = 0.40 \times 3000 \times 100 \times 4.0 \times 14.0 \times 10^{-5} = 67.2^{KNm} > 32.6^{KNm}$ OK

Calculation of deck slab (S.L.S) : Check

Span $\ell \fallingdotseq$ m … review of fulcrum for bending moment

moment $M = \left\{ \frac{1}{10} \times 137.2 \times 1.2^2 \right\} = 19.8^{KNm}$

Calculation of stress

$b = 100^{cm}$ $h = 20$ $d = 16.0$ $d' = 4.0$

$As = Y_{16} - 150^{ctc} = 13.407\ cm^2$

$P = \frac{13.407}{100 \times 16.0} \times 100 = 0.838\ \%$

$X = \frac{0.80 \times 41000 \times 13.407}{0.25 \times 3000 \times 100} = 6.3^{cm}$

$Z = 16.0 - \frac{1}{3} \times 6.3 = 12.9^{cm}$

$M_{RS} = 0.80 \times 41000 \times 13.407 \times 12.9 \times 10^{-5} = 56.7^{KNm} > 19.8^{KNm}$

$M_{RC} = 0.25 \times 3000 \times 100 \times 6.3 \times 12.9 \times 10^{-5} = 60.9^{KNm} > 19.8^{KNm}$ OK

Calculation of Shoe

1) quantity of expantion between
Girder-edge and Parapet face of abutment

quantity of expantion or shrinkage (maximum)

for temperature	: $dt = a \times T \times L = (1.0 \times 10^{-5} \times 15.0 \times L)^{m}$	$= (0.150 \times L)^{mm}$
for shrinkage	: $ds = a \times T \times L \times b = (1.0 \times 10^{-5} \times 20.0 \times L \times 0.8)$	$= (0.160 \times L)$ "
for creep	: $dc = \frac{P}{E \times A} \times \phi \times L \times b = \frac{750}{2.7 \times 10^{6}} \times 1.9 \times L \times 0.8$	$= (0.430 \times L)$ "
for other	: $do =$	$= 5.0$ "
total	$dL =$	$= (0.80L + 5.0)^{mm}$

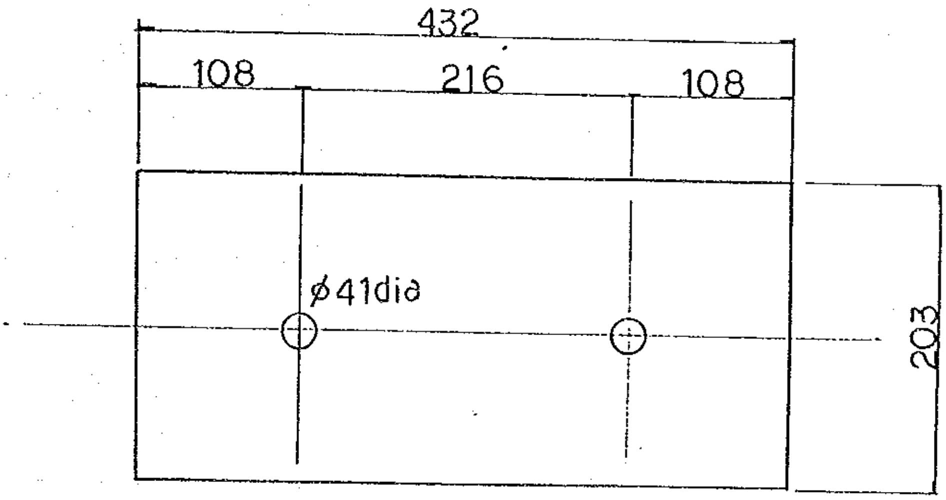
where
a = coefficient of thermal expantion or shrinkage
T = quantity of temperature variance
L = girder length
b = coefficient of decrease
E = young's modulus
$P/A = 0.5\,fcu/2 = 0.5 \times 300/2 = 750^{N/cm^2}$
ϕ = creep factor
fcu = strength of concrete ($30^{N/mm^2}$)

RAILWAY－bridge

calculation of shoe

edge fulcrum	Rd	= 2006.1／6 ×1.1	= 367.8 KN／choe
(MOV)	RL1	= 1894.3／6 ×1.1	= 347.2 〃
	Rmax	=	= 715.0 〃
	∴ dL	= (0.80L＋5)＝(0.80× 28.5＋5)	= 28 mm
middle fulcrum	Rd	= 4997.0／6×1.1	= 916.2 KN／choe
(Fix)	RL1	= 4278.7／6×1.1	= 784.3 〃
	Rmax	=	= 1700.5 〃
	∴ dL	= 0	

1) edge fulcrum (MOV) = 432mm ×203×65
(A1,A2)



vertical pressur

$$AS = 43.2\times 20.3 - \frac{\pi}{4}\times 4.1^2\times 2 = 850.5\ cm^2$$

$$VC = \frac{Rmax}{AC} = \frac{715.0\times 10^3}{850.5} \fallingdotseq 800\ N/cm^2 \fallingdotseq Vca = 800\ N/cm^2$$

Dowel bar ----- φ 20mm × 500mm × 2 NO／shoe

$$Ab = \frac{\pi}{4}\times 2.0^2\times 2 = 6.283\ cm^2$$

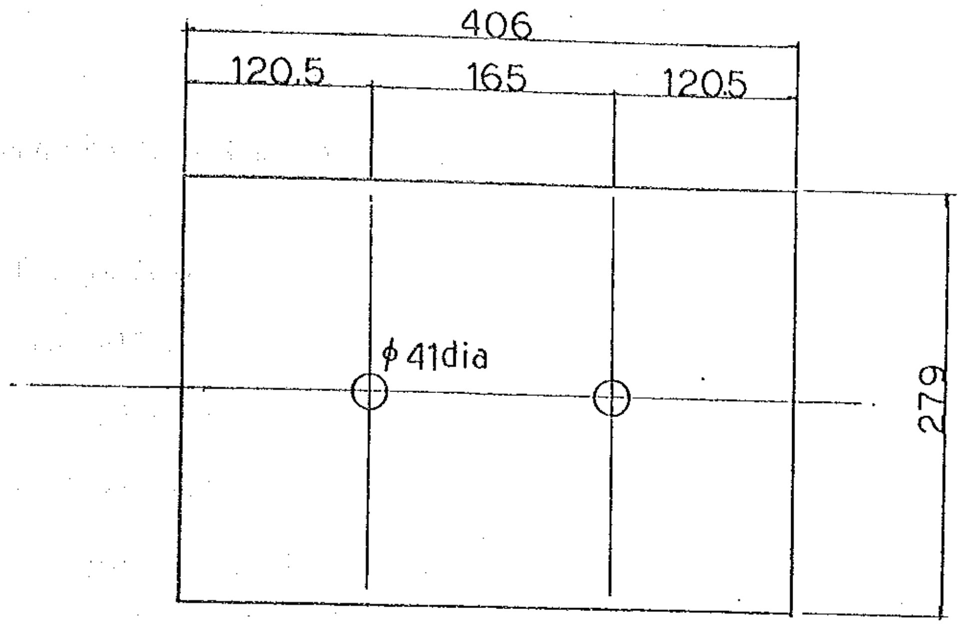
$Hd = 367.8\times 0.12/1.1 = 40.2$ --- temperaature state

shearing stress

$$\tau s = \frac{1.43Hd}{Ab} = \frac{1.43\times 40.1\times 10^3}{6.283} \fallingdotseq 9000\ N/cm^2 < 9000\ N/cm^2$$

anchor cap ----- φ 80mm × 500mm × 2 NO／shoe

2) middle fulcrum (Fix): 406mm × 279 × 18
(P1, P2)



Vertical pressure

$$AS = 40.6 \times 27.9 - \frac{\pi}{4} \times 4.1^2 \times 2 = 1106.335\ cm^2$$

$$YC = \frac{Rmax}{AC} = \frac{1700.5 \times 10^3}{1106.335} = 1540\ N/cm^2 \quad < \quad Yca = 1600\ N/cm^2$$

Dowel bar ----- φ 40mm × 900mm × 2 NO/shoe

$$Ab = \frac{\pi}{4} \times 4.0^2 \times 2 = 25.133\ cm^2$$

$$Hd = (367.8 + 916.2) \times 0.12 / 1.1 = 140.0\ KN/choe$$

shearing stress

$$\tau s = \frac{1.54Hd}{Ab} = \frac{1.54 \times 140.0 \times 10^3}{25.133} = 8580\ N/cm^2 \quad < \quad 9000\ N/cm^2$$

anchor cap ----- φ 50mm × 450mm × 2 NO/shoe

Reaction from Superstructure

1) For A_1 Abut (Movable) ··· S.L.S

a) For all width of A_1 Abut ($B = 18.300^m$)

dead load : $Rd = 2006.1$ KN

live load : $R\ell = 2002.1$ KN

total : $R = 4008.2$ KN

b) For Unit width of A_1 Abut

(1) For Vertical load

$$Rd = \frac{2006.1}{18.30} = 109.623^{KN/m}$$

$$R\ell = \frac{2002.1}{18.30} = 109.405^{KN/m}$$

$$R = \quad = 219.028^{KN/m}$$

(2) For Horizontal force for temperature or Seismic

$$H_T = H_D = 109.623 \times 0.15 = 16.444 \ ^{KN/m}$$

2. For A_2 Abut (Movable) … S.L.S

a) For all width of A_2 Abut ($B = 18.000^{m}$)

dead load : $R_d = 2005.1$ KN

live load : $R_\ell = 2000.2$ KN

total : $R = 4005.3$ KN

b) For Unit width of A_2 Abut

(1) For Vertical load

$$R_d = \frac{2005.1}{18.00} = 111.395^{KN/m}$$

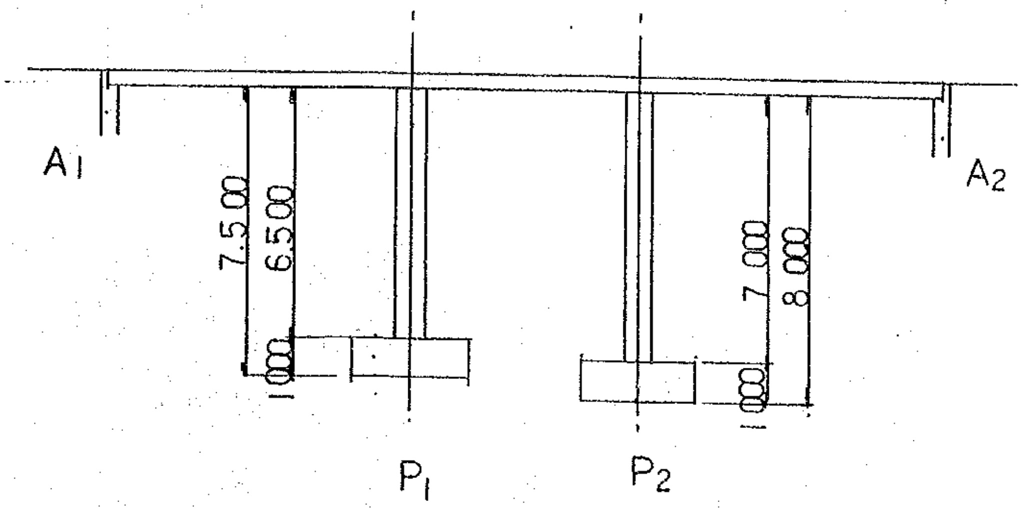
$$R_\ell = \frac{2000.2}{18.00} = 111.122^{KN/m}$$

$$R = 222.517^{KN/m}$$

(2) For Horizontal force for temperature or Seismic

$$H_T = H_D = 111.395 \times 0.15 = 16.710^{KN/m}$$

3. For P_1 Pier and P_2 Pier … S.L.S



Reaction of each pier (Vertical load)

Pier / load	P_1	P_2
dead load	$R_d = 4994.1^{KN}$	$R_d = 4997.0^{KN}$
live load	$R_\ell = 4549.1^{KN}$	$R_\ell = 4554.1^{KN}$
total	$R = 9543.2^{KN}$	$R = 9551.1^{KN}$

$$\Sigma R_d = 2006.1 + 4994.1 + 4997.0 + 2005.1 = 14002.3^{KN}$$

Horizontal load of seismic state

$$H_{p1} = \Sigma R_d \cdot k_H \frac{hp^3}{hp_1{}^3 + hp_2{}^3}$$

$$= 14002.3 \times 0.12 \times \frac{7.00^3}{6.50^3 + 7.00^3} = 933.2^{KN}$$

$$H_{p2} = \Sigma R_d \cdot k_H \frac{hp_1{}^3}{hp_1{}^3 + hp_2{}^3}$$

$$= 14002.3 \times 0.12 \times \frac{6.50^3}{6.50^3 + 7.00^3} = 747.2^{KN}$$

or

$$< H_{p2} = \Sigma R_d \cdot k_H / 2 = 14002.3 \times 0.12 / 2 = 840.2^{KN}$$ … adopt

** RAILWAY-A1-ABUT **

(1) SHAPE AND SIZE

H0 =	11.500 (m)	B0 =	6.500 (m)
H1 =	1.500 (m)	B1 =	2.000 (m)
H2 =	0.000 (m)	B2 =	1.300 (m)
H3 =	0.000 (m)	B3 =	0.300 (m)
H4 =	9.000 (m)	B4 =	3.200 (m)
H5 =	0.000 (m)	B5 =	1.000 (m)
H6 =	1.000 (m)	B6 =	0.000 (m)
BW1 =	1.000 (m)	HU1 =	0.000 (m)
BW2 =	1.000 (m)	HU2 =	0.000 (m)
HW1 =	1.000 (m)		
HW2 =	1.000 (m)		

NOTE: THE DIMENSION(t)BE EXCHANG TO DIMENSION(KN) INTO THIS CALCULATION

REACTION OF DEAD LOAD	RL =	109.405 (t)
〃 LIVE LOAD	RD =	109.623 (t)
HORIZONTAL FORCE FOR	HT =	16.444 (t)
TEMPERATURE . SEISMIC	HD =	16.444 (t)
SITUATION OF REACTION	RX =	0.450 (m)
AND HORIZONTAL FORCE	RY =	1.300 (m)
	QL =	0.000 (t/m^2)
	QD =	0.000 (t/m^2)
SEISMIC COEFFICIENT	KH =	0.12
	KHS =	0.00
UNITVOLUME WEIGHTS		
FOR CONCRETE	GAMC =	23.600 (t/m^3)
FOR BACK FILL	GAM1 =	19.600 (t/m^3)
〃 (UNDERWATER)	GAM1S =	10.800 (t/m^3)
INTERNAL FRICTION ANGLE	FAi =	35.000 (°)
FOR ABOVE TOE SLAB	GAM2 =	18.600 (t/m^3)
〃 (UNDERERWATER)	GAM2S =	9.800 (t/m^3)
FOR WATER	WATS =	9.800 (t/m^3)
FOR FOUNDATION GROUND		
COHESIVE DOWER	C =	0.00 (t/m^2)
FRICTION FACTER	tanφB =	0.500
ALLOWABLE PRESSURE	Qa =	350.00 (t/m^2)

CALCULATION OF WEIGHT AND FORCE OR LOAD

(1) CONCRETE

NO.	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
1	10.620	1.274	3.150	10.750	33.453	13.700
4	276.120	33.134	2.650	5.500	731.718	182.239
8	153.400	18.408	3.250	0.500	498.550	9.204
Σ1	440.140	52.817			1263.720	205.143

V = X*Y*BW*GAM1　　H = V*KH
MX = V*X　　MY = H*Y

(2) EARTH

a) BACK FILLING

NO.	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
1	94.080	11.290	4.900	10.750	460.992	121.363
4	564.480	67.738	4.900	5.500	2765.950	372.557
Σ2	658.560	79.027			3226.940	493.920

b) SURCHAGE OF TOE SLAB

NO.	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
6	37.200	0.000	1.000	1.500	37.200	0.000
Σ3	37.200	0.000			37.200	0.000

V = X*Y*BW*GAM1　　H = V*KHS
MX = V*X　　MY = H*Y

(3) REACTION

STATE	RV(t)	RH(t)	RMX(t·m)	RMY(t·m)
ORDINARY	219.028	0.000	558.521	0.000
TEMPERATURE	219.028	16.444	558.521	185.817
SEISMIC	109.623	16.444	279.539	185.817

RV :　　RH :
RMX= RV*X　　RMY= RH*Y

(4) EARTH PRESSURE FACTOR

	ORDINARY OR TEMPERATURE		SEISMIC	
	0.2497	0.2508	0.3191	0.3403
SIN (δ)	0.5736	0.2022	0.3007	0.0000
COS (δ)	0.8192	0.9793	0.9537	1.0000

(5) EARTH PRESSURE

	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
	185.637	265.117	6.500	3.833	1206.640	1016.280
	154.756	221.015	6.500	4.500	1005.910	994.565
	30.251	43.203	6.500	0.496	196.630	21.417
	124.358	394.413	6.500	3.833	808.327	1511.920
	103.671	328.802	6.500	4.500	673.850	1479.610
	20.265	64.272	6.500	0.496	131.722	31.862

(6) BUOYANCY

	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
	-63.700	0.000	3.250	0.000	-207.025	0.000
	-63.700	0.000	3.250	0.000	-207.025	0.000

TOTAL OF ACTION FORCE

1. EXCLUDE BUOYANCY

(1) ORDINARY···FOR FOUNDATION

LOAD	V(t)	H(t)	MX(t·m)	MY(t·m)
Σ 1	440.140	0.000	1263.720	0.000
Σ 2	658.560	0.000	3226.940	0.000
EARTHPRE	185.637	265.117	1206.640	1016.280
REACTION	219.028	0.000	558.521	0.000
Σ 3	37.200	0.000	37.200	0.000
TOTAL	1540.570	265.117	6293.030	1016.280

$Mo = \Sigma MX - \Sigma MY = 5276.740$ (t·m)

(2) ORDINARY···FOR INVERSION OR SLIDE

	V(t)	H(t)	MX(t·m)	MY(t·m)
SAME 1 (1)	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	185.637	265.117	1206.640	1016.280
	109.623	0.000	279.539	0.000
	37.200	0.000	37.200	0.000
	1431.160	265.117	6014.040	1016.280

$Mo = \Sigma MX - \Sigma MY = 4997.760$ (t·m)

(3) TEMPERATURE···FOR FOUNDATION

	V(t)	H(t)	MX(t·m)	MY(t·m)
SAME 1 (1)	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	185.637	265.117	1206.640	1016.280
	219.028	16.444	558.521	185.817
	37.200	0.000	37.200	0.000
	1540.570	281.561	6293.030	1202.100

$Mo = \Sigma MX - \Sigma MY = 5090.930$ (t·m)

(4) TEMPERATURE···INVERSION OR SLIDE

	V(t)	H(t)	MX(t·m)	MY(t·m)
SAME 1 (1)	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	185.637	265.117	1206.640	1016.280
	109.623	16.444	279.539	185.817
	37.200	0.000	37.200	0.000
	1431.160	281.561	6014.040	1202.100

$Mo = \Sigma MX - \Sigma MY = 4811.940$ (t·m)

(5) SEISMIC

	V(t)	H(t)	MX(t·m)	MY(t·m)
SAME 1 (1)	440.140	52.817	1263.720	205.143
	658.560	79.027	3226.940	493.920
	124.358	394.413	808.327	1511.920
	109.623	16.444	279.539	185.817
	37.200	0.000	37.200	0.000
	1369.880	542.701	5615.730	2396.800

$Mo = \Sigma MX - \Sigma MY = 3218.930$ (t·m)

2. INCLUDE BUOYANCY

(1) ORDINARY

	V(t)	H(t)	MX(t·m)	MY(t·m)
	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	154.756	221.015	1005.910	994.565
	30.251	43.203	196.630	21.417
	219.028	0.000	558.521	0.000
	37.200	0.000	37.200	0.000
	-63.700	0.000	-207.025	0.000
	1476.230	264.217	6081.910	1015.980

Mo = ΣMX − ΣMY = 5065.920 (t·m)

(2) ORDINARY

	V(t)	H(t)	MX(t·m)	MY(t·m)
	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	154.756	221.015	1005.910	994.565
	30.251	43.203	196.630	21.417
	109.623	0.000	279.539	0.000
	37.200	0.000	37.200	0.000
	-63.700	0.000	-207.025	0.000
	1366.830	264.217	5802.920	1015.980

Mo = ΣMX − ΣMY = 4786.940 (t·m)

(3) TEMPERATURE

	V(t)	H(t)	MX(t·m)	MY(t·m)
	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	154.756	221.015	1005.910	994.565
	30.251	43.203	196.630	21.417
	219.028	16.444	558.521	185.817
	37.200	0.000	37.200	0.000
	-63.700	0.000	-207.025	0.000
	1476.230	280.661	6081.910	1201.800

Mo = ΣMX − ΣMY = 4880.110 (t·m)

(4) TEMPERATURE

	V(t)	H(t)	MX(t·m)	MY(t·m)
	440.140	0.000	1263.720	0.000
	658.560	0.000	3226.940	0.000
	154.756	221.015	1005.910	994.565
	30.251	43.203	196.630	21.417
	109.623	16.444	279.539	185.817
	37.200	0.000	37.200	0.000
	-63.700	0.000	-207.025	0.000
	1366.830	280.661	5802.920	1201.800

Mo = ΣMX − ΣMY = 4601.120 (t·m)

(5) SEISMIC

	V(t)	H(t)	MX(t·m)	MY(t·m)
	440.140	52.817	1263.720	205.143
	658.560	79.027	3226.940	493.920
	103.671	328.802	673.860	1479.610
	20.265	64.272	131.722	31.862
	109.623	16.444	279.539	185.817
	37.200	0.000	37.200	0.000
	-63.700	0.000	-207.025	0.000
	1305.760	541.362	5405.960	2396.350

$Mo = \Sigma MX - \Sigma MY = 3009.610$ (t·m)

TOTAL FORCE FOR UNDER FOUNDATION CENTER

LOAD	V(t)	H(t)	Mo(t·m)	e(m)	Mc(t·m)
A					
1	1540.570	265.117	5276.740	-0.175	-269.907
2	1431.160	265.117	4997.760	-0.242	-346.491
3	1540.570	281.561	5090.930	-0.055	-84.090
4	1431.160	281.561	4811.940	-0.112	-160.674
5	1369.880	542.701	3218.930	0.900	1233.180
B					
1	1476.230	264.217	5065.920	-0.182	-268.160
2	1366.830	264.217	4786.940	-0.252	-344.743
3	1476.230	280.661	4880.110	-0.056	-82.342
4	1366.830	280.661	4601.120	-0.116	-158.926
5	1305.760	541.362	3009.610	0.945	1234.110

$e = B0/2 - Mo/V$: $Mc = V * e$

WHERE

A AND B:EXCLUDE OF BOUYANCY
OR INCLUDE BOUYANCY

1. ORDINARY : FOR FOUNDATION
2. 〃 : FOR INVERSION OR SLIDE
3. TENPERATURE : STATE OF 1
4. 〃 : 〃 2
5. SEISMIC

Calculation for Vertical wall … U.L.S.

1. action force

a) state of normal load … only earth pressure

$$M=\frac{1}{6}\times 19.6\times 0.251\times 10.50^3\times 1.5\times 1.1 = 1566.2^{KNm}$$

$$S=\frac{1}{2}\times 19.6\times 0.251\times 10.50^2\times 1.5\times 1.1 = 447.5^{KN}$$

b) state of Temperature and nomal load

$$M=1566.2+16.444\times 10.30\times 1.3\times 1.1 = 1808.4^{KNm}$$

$$S= 447.5+16.444\times 1.3\times 1.1 = 471.1^{KN}$$

c) state of Seismic

$$M= (\frac{1}{6}\times 19.6\times 0.341\times 10.50^3+16.444\times 10.30)\times 1.25\times 1.1= 2006.0^{KNm}$$

$$S= (\frac{1}{2}\times 19.6\times 0.341\times 10.50^2+16.444)\times 1.25\times 1.1 = 529.3^{KN}$$

Calculation of stress for U.L.S

section $b = 100^{cm}$ $h = 130$ $d = 122.5$ $d' = 7.5^{cm}$

$As = Y_{32} - 125^{ctc} = 8.042/0.125 = 64.336\ cm^2$

$$P = \frac{As}{b\ d} \times 100 = \frac{64.336}{100 \times 122.5} \times 100 = 0.525\ \%$$

$$x = \frac{0.87fy \cdot As}{0.40fcu \cdot b} = \frac{0.87 \times 41000 \times 64.336}{0.40 \times 2500 \times 100} = 23.0^{cm}$$

$$Z = d - \frac{x}{2} = 122.5 - \frac{23.0}{2} = 111.0^{cm} < 0.95d = 0.95 \times 122.5 = 116.4^{cm} \text{ OK}$$

$$M_{RS} = 0.87fy \cdot As \cdot Z = 0.87 \times 41000 \times 64.336 \times 111.0 \times 10^{-5}$$
$$= 2547.3^{KNm} > Mu = 2006.0^{KNm}$$

$$M_{RC} = 0.40fcubxZ = 0.40 \times 2500 \times 100 \times 23.0 \times 111.0 \times 10^{-5}$$
$$= 2553.0^{KNm} > Mu = 2006.0^{KNm} \text{ OK}$$

$$Vc = \frac{S}{bd} = \frac{529.3 \times 10^3}{100 \times 122.5} = 43.2\ N/cm^2$$

$$< Vca = 50.0 + 15.0 \left(\frac{0.525 - 0.50}{0.50}\right) = 50.8\ N/cm^2 \quad \text{OK}$$

Calculation of stability for S.L.S.

1) action force for bottom of Foundation

(from output of computer)

load / State	N^{KN}	H^{KN}	M^{KNm}
Normal	1540.6	265.2	—
Temperature	1540.6	281.6	—
Seismic	1369.9	542.7 ×0.8 =434.1	※ 753.8

※ $M=\left\{\frac{6.50}{2}-(5615.8-2396.8\times0.8)/1369.9\right\}\times1369.9=753.8\ ^{KNm}$

2) stability of Foundation

(1) Normal and Temperature state

$$e = 0.0^{m}$$

$$q=\frac{1540.6}{6.50}=237.1\ KN/m^2 \quad < qa = 350\ KN/m^2$$

$$Fs=\frac{1540.6\times0.50}{281.6} = 2.7 > 1.5$$

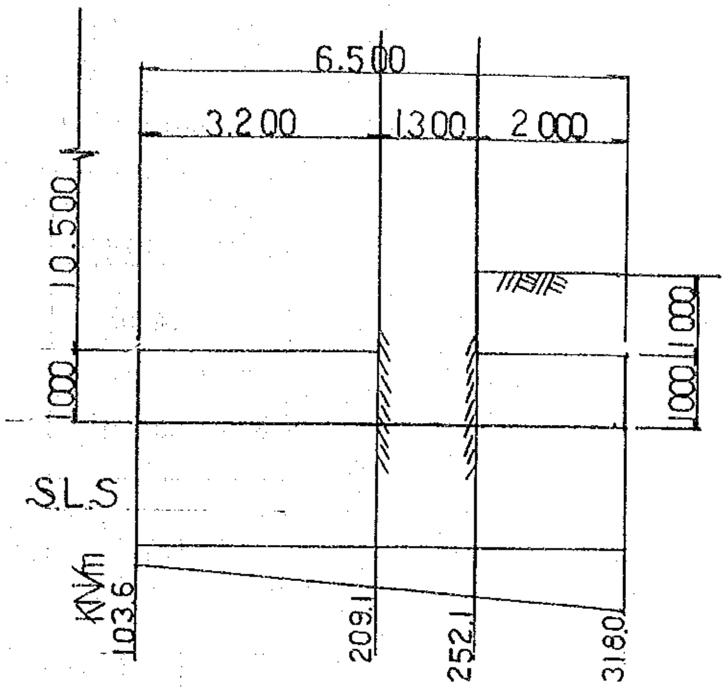
(2) Seismic state

$$e=\frac{753.8}{1369.9}=0.551^{m} > \frac{B}{6}=\frac{6.50}{6}=1.083^{m}$$

$$q=\frac{1369.9}{6.50}\left(1\pm\frac{6\times0.551}{6.50}\right)=\begin{cases}318.0\ KN/m^2\\103.6\ KN/m^2\end{cases} < qa = 350\ KN/m^2$$

$$Fs=\frac{1369.9\times0.50}{434.1} = 1.58 > 1.5$$

Calculation of action force for each section … seismic state



(1) Surcharge load

a) toe footing slab

$$\omega = (23.6 \times 1.00 + 18.6 \times 1.00)$$
$$= 42.200 \ ^{KN/m}$$

b) heel footing slab

$$\omega = (23.6 \times 1.00 + 19.6 \times 10.50)$$
$$= 229.400 \ ^{KN/m}$$

(2) Calculation of bending moment and shearing force

a) toe footing slab

$$M = \frac{2.00^2}{6}(2 \times 318.0 + 252.1) - \frac{2.00^2}{2} \times 42.200 = 507.7^{KNm}$$

$$S = \frac{2.00}{2}(318.0 + 252.1) - 2.00 \times 42.200 = 485.7^{KN}$$

b) heel footing slab

$$M = \frac{3.20^2}{2} \times 229.4 - \frac{3.20^2}{6}(2 \times 103.6 + 209.1) = 464.1^{KNm}$$

$$S = 3.20 \times 229.4 - \frac{3.20}{2}(103.6 + 209.1) = 233.8^{KN}$$

Calculation of stability for U.L.S.

1) action force for bottom of Foundation

State \ load	N^{KN}	H^{KN}	M^{KNm}
Normal	$1540.6\times1.2\times1.15 = 2126.0$	$265.2\times1.5\times1.1 = 437.6$	※1 0.0
Temperature	2126.0	$281.6\times1.5\times1.1 = 464.7$	※2 208.7
Seismic	$1369.9\times1.2\times1.15 = 1890.5$	$542.7\times1.25\times1.1 = 746.3$	※3 1690.0

※1 $M = \left\{\frac{6.50}{2} - (6293.0\times1.38 - 1016.3\times1.65)/2126.0\right\}\times2126.0 \fallingdotseq 0.0^{KNm}$

※2 $M = \left\{\frac{6.50}{2} - (6293.0\times1.38 - 1202.1\times1.65)/2126.0\right\}\times2126.0 \fallingdotseq 208.7^{KNm}$

※3 $M = \left\{\frac{6.50}{2} - (5615.8\times1.38 - 2396.8\times1.375)/1890.5\right\}\times1890.5 = 1690.0^{KNm}$

2) stability of Foundation

(1) Normal and Temperature

$$e = \frac{208.7}{2126.0} = 0.099^{m} > \frac{B}{6} = \frac{6.50}{6} = 1.083^{m}$$

$$q = \frac{2126.0}{6.50}\left(1 \pm \frac{6\times0.099}{6.50}\right) = \begin{cases} 357.0\ KN/m^2 \\ 297.2\ KN/m^2 \end{cases} < qa = 525.0\ KN/m^2$$

$$Fs = \frac{2126.0\times0.50}{464.7} = 2.3 > 1.1$$

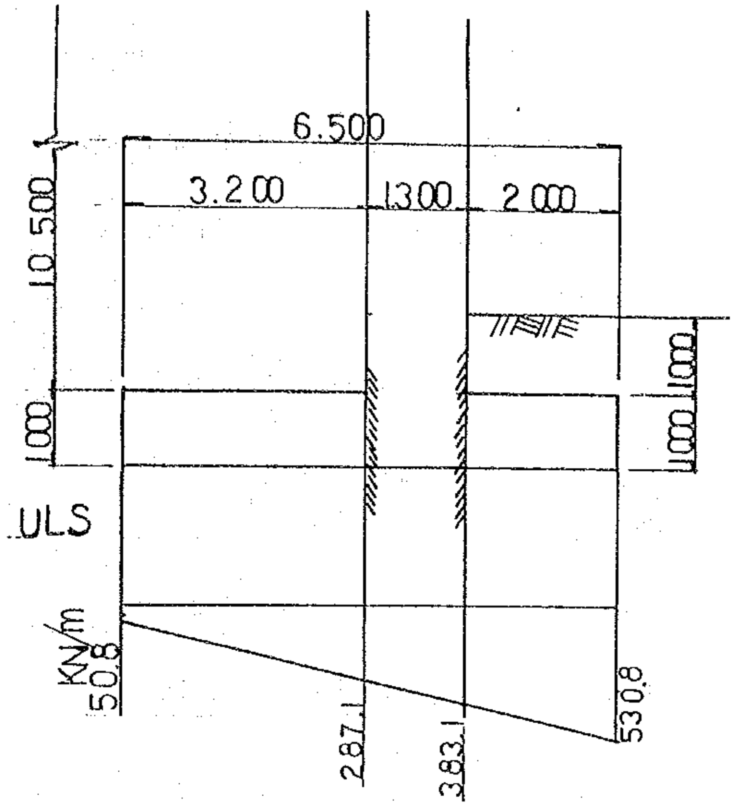
(2) Seismic state

$$e = \frac{1690.0}{1890.5} = 0.894^{m} > \frac{B}{6} = 1.083^{m}$$

$$q = \frac{1890.5}{6.50}\left(1 \pm \frac{6\times0.894}{6.50}\right) = \begin{cases} 530.8\ KN/m^2 \\ 50.8\ KN/m^2 \end{cases} \fallingdotseq qa = 525\ KN/m^2$$

$$Fs = \frac{1890.5\times0.50}{746.3} = 1.26 > 1.1$$

Calculation of action force for each section ··· seismic state



(1) Surcharge load

a) toe footing slab

$$\omega = (23.6 \times 1.00 + 18.6 \times 1.00) \times 1.380 = 58.236 \ ^{KN/m}$$

b) heel footing slab

$$\omega = (23.6 \times 1.00 + 19.6 \times 10.50) \times 1.380 = 316.572 \ ^{KN/m}$$

(2) Calculation of bending moment and shearing force

a) toe footing slab

$$M = \frac{2.00^2}{6}(2 \times 530.8 + 383.1) - \frac{2.00^2}{2} \times 58.236 = 846.7^{KNm}$$

$$S = \frac{2.00}{2}(530.8 + 383.1) - 2.00 \times 58.236 = 797.5^{KN}$$

b) heel footing slab

$$M = \frac{3.20^2}{2} \times 316.572 - \frac{3.20^2}{6}(2 \times 50.8 + 287.1) = 957.5^{KNm}$$

$$S = 3.20 \times 316.572 - \frac{3.20}{2}(50.8 + 287.1) = 472.4^{KN}$$

Calculation of stress for footing slab … U.L.S.

toe and heel footing slab

section $b = 100^{cm}$ $h = 100$ $d = 93.5$ $d' = 6.5$

$As = Y_{25} - 125^{ctc} = 4.909 / 0.125 = 39.27\ cm^2$

$$P = \frac{As}{b\ d} \times 100 = \frac{39.27}{100 \times 93.5} \times 100 = 0.419\ \%$$

$$x = \frac{0.87 fy \cdot As}{0.40 fcu \cdot b} = \frac{0.87 \times 41000 \times 39.27}{0.40 \times 2500 \times 100} = 14.0^{cm}$$

$$Z = d - \frac{x}{2} = 93.5 - \frac{14.0}{2} = 86.5^{cm} < 0.95d = 0.95 \times 93.5 = 88.8^{cm}$$

$$M_{RS} = 0.87 fyAs \cdot Z = 0.87 \times 41000 \times 39.27 \times 86.5 \times 10^{-5} = 1211.7^{KNm} > Mu = 957.5^{KNm}$$

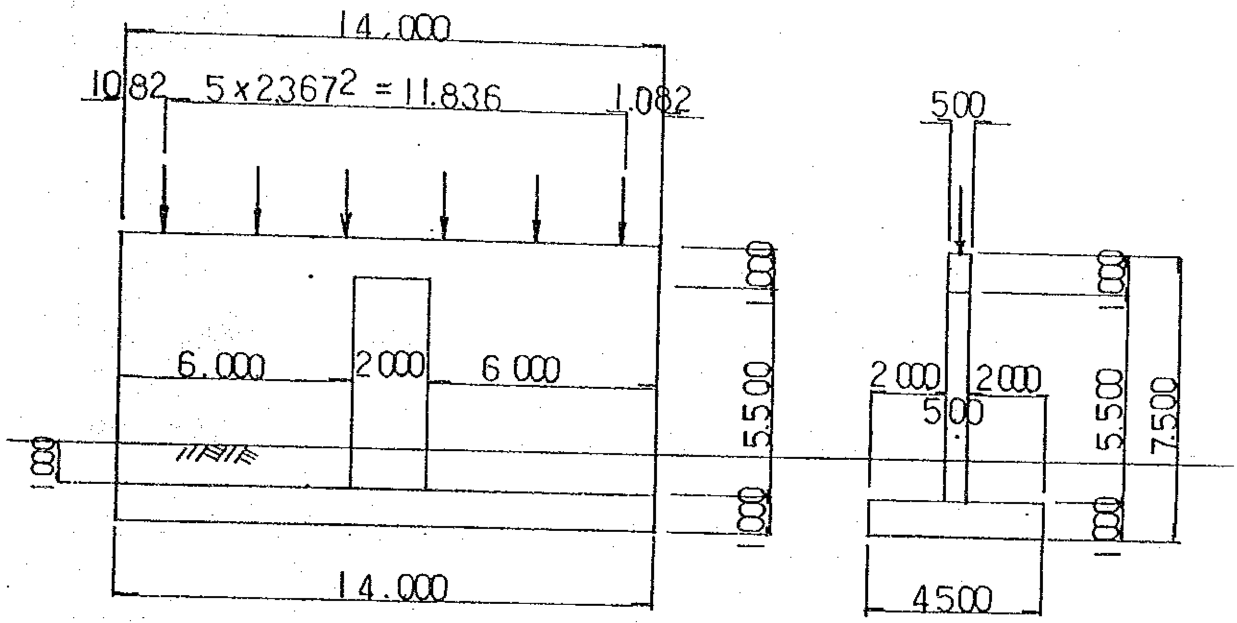
$$M_{RC} = 0.40 fcubx \cdot Z = 0.40 \times 2500 \times 100 \times 14.0 \times 86.5 \times 10^{-5} = 1211.0^{KNm} > Mu = 957.5^{KNm}\ \text{OK}$$

$$Vc = \frac{S}{bd} = \frac{797.5 \times 10^3}{100 \times 93.5} = 85.3\ N/cm^2$$

$$< Vca = \left\{ 35.0 + 15.0 \left(\frac{0.419 - 0.25}{0.25} \right) \right\} \times 2 = 90.3\ N/cm^2 \quad \text{OK}$$

Calculation of P_1 PIER

1. Shape and size



2. Calculation of Beam

$A_{sn} = 0.25\%bd = 0.25\% \times 50 \times 92.0 = 11.50\ cm^2$

$< A_{su} = A'_{su} = Y25 - 4^{NO} = 4.909 \times 4 = 19.636\ cm^2$

3. Calculation of pillar

1) action force for bottom of pillar

a) for S.L.S of seismic state

	N^{KN}	H^{KN}	y^{m}	$M = H \cdot y^{KNm}$
Reaction of superstructure	4994.1	933.2	7.800	7279.0
Pillar	23.6×14.00 ×0.50×6.50 =1073.8	128.9	3.250	419.0
〃	−23.6×2.00 ×0.50×5.50 =−129.8	−15.6	2.750	−42.9
Total	5938.1	1046.5	−	7655.1

b) for U.L.S of seismic strate

load	N^{KN}	H^{KN}	M^{KNm}
seismic state	$5938.1\times1.2\times1.15 = 8194.6$	$1046.5\times1.4\times1.1 = 1611.6$	$7655.1\times1.4\times1.1 \fallingdotseq 11789.0$

2) Calculation of stress … U.L.S.

section $b = 600\times2=1200^{cm}$ $h=50$ $d=42.5$ $d'=7.5$

$$As = As' = Y_{32}-65^{NO}\times2 = 130^{NO} = 8.042\times130^{NO} = 1045.46\ cm^2$$

$$Ma = M+N\left(d-\frac{h}{2}\right) = 11789.0+8194.6\left(42.5-\frac{50.0}{2}\right)\times10^{-2} = 13223.0^{KNm}$$

$$x = \frac{(0.87-0.72)\,fy\cdot As}{0.40fcu\cdot b} = \frac{(0.87-0.72)\times41000\times1045.46}{0.40\times2500\times1200} = 5.4^{cm}$$

$$Z = d-\frac{x}{2} = 42.5-\frac{5.4}{2} = 39.8^{cm} < 0.95d = 0.95\times42.5 = 40.4^{cm}\quad OK$$

$$M_{RS} = 0.87fyAsZ = 0.87\times41000\times1045.46\times39.8\times10^{-5}$$
$$= 14840^{KNm} > Ma = 13223.0^{KNm}$$

$$M_{RC} = (0.72\times41000\times1045.46\times35.0+0.40\times2500\times1200$$
$$\times5.4\times39.8)\times10^{-5} = 13380^{KNm} > Ma = 13223.0^{KNm}\quad OK$$

$$Asn = Asn' = 1045.46-\frac{8194.6\times10^3}{0.87\times41000} = 815.8\ cm^2$$

$$< Asu = A'su = Y_{32}-59^{NO}(100^{ctc})\times2 = 8.042\times59\times2 = 949.0\ cm^2\quad OK$$

$$P = \frac{Asu}{b\ d}\times100 = \frac{949.0}{1200\times42.5}\times100 = 1.86\ \%$$

$$Vc = \frac{S}{bd} = \frac{1611.6\times10^3}{1200\times42.5} = 31.6\ N/cm^2$$

$$< Vca = 65.0+20.0\left(\frac{0.86-1.00}{1.00}\right) = 82.2\ N/cm^2\quad OK$$

4. Calculation of Foundation

1) Calculation of stability for bottom of foundation

A) Longitudinal direction

(1) action force for bottom of foundation

a) for S.L.S

load		N^{KN}	H^{KN}	y^{m}	$M=H\cdot y^{KNm}$
Super structure	Rd	4994.1	933.2	8.800	8212.2
	Rℓ	4549.1	—	—	—
Pillar		1073.8	128.9	4.250	547.9
〃		−129.8	− 15.6	3.750	−58.5
footing		23.6×1.400 ×4.50 ×1.00=1486.8	178.5	0.500	89.4
Surcharge		18.6×1.40×4.50 ×1.00=1171.8	—	—	—
State	Normal	13145.8	—	—	—
	Seismic	8596.7	1225.0	—	8791.0

b) for U.L.S

State \ load	N^{KN}	H^{KN}	M^{KNm}
Normal	8596.7×1.2 ×1.15 +4549.1×1.4 ×1.1 =18869.1	—	—
Seismic	8596.7×1.2 ×1.15 =11863.5	1225.0×1.4 ×1.1 =1886.5	8791.0×1.4 ×1.1 =13538.2

(2) Stability for foundation

a) for S.L.S

Normal state

$$q=\frac{N}{L\cdot B}=\frac{13145.8}{14.00\times 4.50}=208.7\ \ KN/m^2$$

Seismic state

$$e=\frac{M}{N}=\frac{8791.0}{8596.7}=1.023^m > \frac{B}{6}=\frac{4.50}{6}=0.750^m$$

$$x=\frac{B}{2}-e=\frac{4.50}{2}-1.023=1.227\ ^m$$

$$q_{max}=\frac{2N}{3x\cdot L}=\frac{2\times 8596.7}{3\times 1.227\times 14.00}=333.7\ KN/m^2 < qa=350\ KN/m^2$$

$$Fs=\frac{N\cdot\mu}{H}=\frac{8596.7\times 0.50}{1225.0}=3.5 > 1.5\qquad OK$$

b) for U.L.S

Normal state

$$q=\frac{N}{L\cdot B}=\frac{18869.1}{14.00\times 4.50}=299.5\ \ KN/m^2$$

Seismic state

$$e=\frac{M}{N}=\frac{13538.2}{11863.5}=1.141^m > \frac{B}{6}=0.750^m$$

$$x=\frac{B}{2}-e=\frac{4.50}{2}-1.141=1.109\ ^m$$

$$q_{max}=\frac{2N}{3\cdot x\cdot L}=\frac{2\times 11863.5}{3\times 1.109\times 14.00}=509.4\ KN/m^2 < qa=525\ KN/m^2$$

$$Fs=\frac{N\cdot\mu}{H}=\frac{11863.5\times 0.50}{1886.5}=3.1 > 1.1\qquad OK$$

B) Crossing direction

(1) action force for bottom of foundation

a) for S.L.S

load		N^{KN}	H^{KN}	y^{m}	$M=H\cdot y^{KNm}$
Super structure	Rd	4994.1	599.3	8.800	5273.9
	R ℓ	4549.1/2 =2274.6	—	(χ=3.551)	(N·x=2274.6×3.551 =8077.1)
Pillar		1073.8	128.9	4.250	547.9
〃		−129.8	−15.6	3.750	−58.5
footing		1486.8	178.5	0.500	89.3
Surcharge		1171.8	—	—	—
State	Normal (partial)	10871.3	—	—	8077.1
	Seismic	8596.7	891.1	—	5852.6

b) for U.L.S

State \ load	N^{KN}	H^{KN}	M^{KNm}
Normal (partial loaded)	8596.7×1.2 ×1.15 +2274.6×1.4 ×1.1 =15366.4	—	8077.1×1.4 ×1.1 =12438.8
Seismic	8596.7×1.2 ×1.15 =11863.5	891.1×1.4 ×1.1 =1372.3	5852.6×1.4 ×1.1 = 9013.0

(2) Stability for Foundation

a) for S.L.S

Normal state

$$e=\frac{M}{N}=\frac{8077.1}{10871.3}=0.743^{m} < \frac{B}{6}=\frac{14.00}{6}=2.333^{m}$$

$$q=\frac{N}{B\cdot L}(1\pm\frac{6e}{B})=\frac{10871.3}{14.00\times4.50}=(1\pm\frac{6\times0.743}{14.00})=\begin{cases}227.5KN/m^2\\117.6KN/m^2\end{cases}< qa=350KN/m^2$$

Seismic state

$$e=\frac{M}{N}=\frac{5852.6}{8596.7}=0.681^{m} < \frac{B}{6}=2.333^{m}$$

$$q=\frac{N}{B\cdot L}(1\pm\frac{6e}{B})=\frac{8596.7}{14.00\times4.50}=(1\pm\frac{6\times0.681}{14.00})=\begin{cases}176.3KN/m^2\\96.7KN/m^2\end{cases}< qa=350\ KN/m^2$$

$$Fs=\frac{N\cdot\mu}{H}=\frac{8596.7\times0.50}{891.1}=4.8 > 1.5$$

b) for U.L.S

Normal state

$$e=\frac{M}{N}=\frac{12438.8}{15366.4}=0.810^{m} < \frac{B}{6}=2.333^{m}$$

$$q=\frac{N}{B\cdot L}(1\pm\frac{6e}{B})=\frac{15366.4}{14.00\times4.50}=(1\pm\frac{6\times0.810}{14.00})=\begin{cases}328.6KN/m^2\\159.3KN/m^2\end{cases}< qa=525KN/m^2$$

Seismic state

$$e=\frac{M}{N}=\frac{9013.0}{11863.5}=0.760^{m} < \frac{B}{6}=2.333^{m}$$

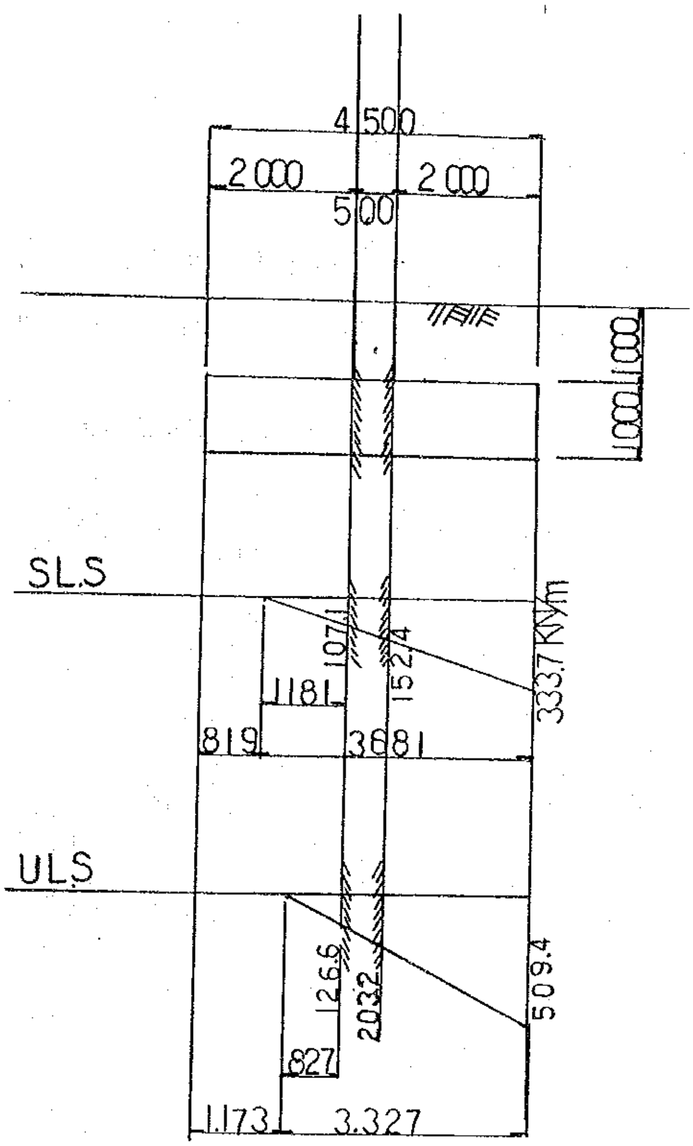
$$q=\frac{N}{B\cdot L}(1\pm\frac{6e}{B})=\frac{11863.5}{14.00\times4.50}=(1\pm\frac{6\times0.760}{14.00})=\begin{cases}249.7KN/m^2\\127.0KN/m^2\end{cases}< qa=525KN/m^2$$

$$Fs=\frac{N\cdot\mu}{H}=\frac{11863.5\times0.50}{1372.3}=4.3 > 1.1$$

all OK

2) Calculation of stress for each section

A) Longitudinal direction - Seismic state



(1) Surcharge load

a) for S.L.S

$\omega = (23.6 \times 1.00 + 18.6 \times 1.00)$

$= 42.200$ KN/m

b) for U.L.S

$\omega = (23.6 \times 1.00 + 18.6 \times 1.00)$

$\times 1.2 \times 1.15 = 58.236$ KN/m

(2) Calculation of bending moment and shearing force

a) for S.L.S

$$M=\frac{2.00^2}{6}(2\times 333.7+152.4)-\frac{2.00^2}{2}\times 42.200 = 462.2^{KNm}$$

$$S=\frac{2.00}{2}(333.7+152.4)-2.00\times 42.200 = 401.7^{KN}$$

$$M=\frac{2.00^2}{2}\times 42.200-\frac{1.181^2}{6}\times 107.1 = 59.5^{KNm}$$

$$S=2.00\times 42.200-\frac{1.181}{2}\times 107.1 = 21.2^{KN}$$

b) for U.L.S

$$M=\frac{2.00^2}{6}(2\times 509.4+203.2)-\frac{2.00^2}{2}\times 58.236 = 698.2^{KNm}$$

$$S=\frac{2.00}{2}(509.4+203.2)-2.00\times 58.236 = 596.2^{KN}$$

$$M=\frac{2.00^2}{2}\times 58.236-\frac{0.827^2}{6}\times 126.6 = 73.2^{KNm}$$

$$S=2.00\times 58.236-\frac{0.827}{2}\times 126.6 = 64.1^{KN}$$

(3) Calculation of stress for Seismic state

a) for S.L.S

section　　b $=100^{cm}$　h $=100$　d $=94.0$　d' $=6.0$

$As = Y_{25}-200^{ctc} = 4.909/0.200 = 24.545\ cm^2$

$$P = \frac{As}{b\ d}\times 100 = \frac{24.545}{100\times 94.0}\times 100 = 0.261\ \%$$

$$\chi = \frac{0.80fy\cdot As}{\frac{1}{2}\times 0.50fcu\cdot b} = \frac{0.80\times 41000\times 24.545}{\frac{1}{2}\times 0.50\times 2500\times 100} \fallingdotseq 14.1^{cm}$$

$$Z = d-\frac{\chi}{3} = 94.0-\frac{14.1}{3} = 89.3^{cm} \fallingdotseq 0.95d = 0.95\times 94.0 = 89.3^{cm}$$

$$M_{RS} = 0.80fyAsZ = 0.80\times 41000\times 24.545\times 89.3\times 10^{-5}$$
$$= 717.3^{KNm} > Ms = 462.2^{KNm}$$

$$M_{RC} = \frac{1}{2}\times 0.50fcubxZ = \frac{1}{2}\times 0.50\times 2500\times 100\times 14.1\times 89.3\times 10^{-5}$$
$$= 787.0^{KNm} > Ms = 462.2^{KNm}\ \text{OK}$$

b) for U.L.S

$$\chi = \frac{0.87fy\cdot As}{0.40fcu\cdot b} = \frac{0.87\times 41000\times 24.545}{0.40\times 2500\times 100} = 9.4^{cm}$$

$$Z = d-\frac{\chi}{2} = 94.0-\frac{9.4}{2} = 89.3^{cm} \leqq 0.95d = 0.95\times 94.0 = 89.3^{cm}$$

$$M_{RS} = 0.87fyAs\cdot Z = 0.87\times 41000\times 24.545\times 89.3\times 10^{-5}$$
$$= 781.8^{KNm} > Mu = 698.2^{KNm}$$

$$M_{RC} = 0.40fcubx\cdot Z = 0.40\times 2500\times 100\times 9.4\times 89.3\times 10^{-5}$$
$$= 839.4^{KNm} > Mu = 698.2^{KNm}\ \text{OK}$$

$$Vc = \frac{S}{bd} = \frac{596.2\times 10^3}{100\times 94.0} = 63.4\ N/cm^2$$

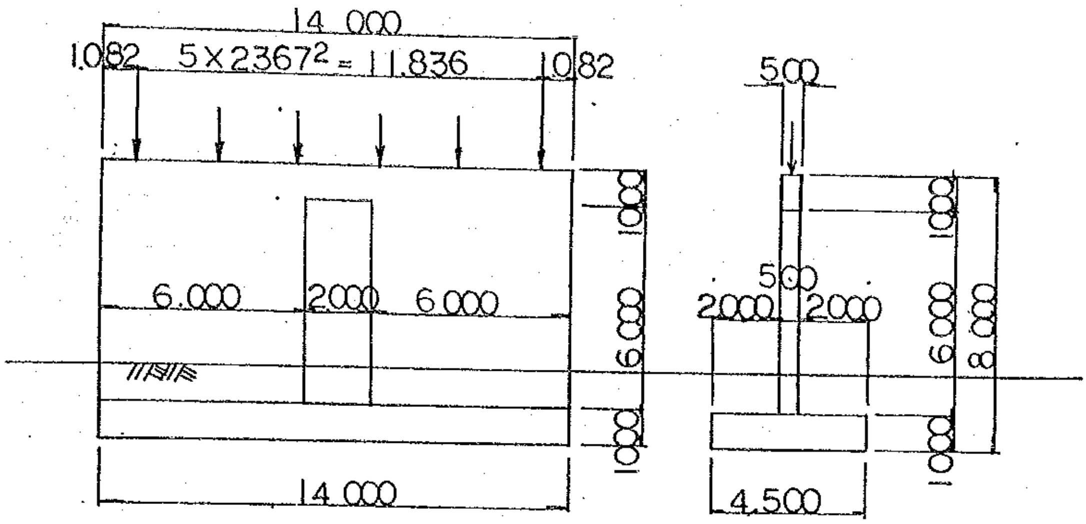
$$< Vca = \left\{35.0+15.0\left(\frac{0.261-0.25}{0.25}\right)\right\}\times 2 = 71.3\ N/cm^2\quad \text{OK}$$

B) Crossing direction

Notice : this case is abridge.

Calculation of P_2 PIER

1. Shape and Size



2. Calculation of pillar

1) action force for bottom of pillar

a) for S.L.S of seismic state

	N^{KN}	H^{KN}	y^{m}	$M=H\cdot y^{KNm}$
Reaction of Superstructure	4997.0	840.2	8.300	6973.7
Pillar	23.6×14.00 ×0.50 ×7.00=1156.4	138.8	3.500	485.8
〃	23.6×2.00×0.50 ×6.00=−141.6	− 17.0	3.000	−51.0
Total	6011.8	972.0	−	7408.5

b) for U.L.S of seismic state

	N^{KN}	H^{KN}	M^{KNm}
Seismic state	6011.8×1.2 ×1.15 =8296.3	972.0 ×1.4 ×1.1 ≒1497.0	7408.5×1.4 ×1.1 ≒11409.0

3. Calculation of stress … U.L.S

Notice : this case is abridge for small action force or near than P_1 Pier of this Bridge and is similar for footing slab.

** RAILWAY-A2-ABUT

(1)

H0	=	10.500 (m)	B0	=	6.000 (m)
H1	=	1.500 (m)	B1	=	2.000 (m)
H2	=	0.000 (m)	B2	=	1.300 (m)
H3	=	0.000 (m)	B3	=	0.300 (m)
H4	=	8.000 (m)	B4	=	2.700 (m)
H5	=	0.000 (m)	B5	=	1.000 (m)
H6	=	1.000 (m)	B6	=	0.000 (m)
BW1	=	1.000 (m)	HU1	=	0.000 (m)
BW2	=	1.000 (m)	HU2	=	0.000 (m)
HW1	=	1.000 (m)			
HW2	=	1.000 (m)			

RL	=	111.122 (t)
RD	=	111.395 (t)
HT	=	16.710 (t)
HD	=	16.710 (t)
RX	=	0.450 (m)
RY	=	1.300 (m)
QL	=	0.000 (t/m^2)
QD	=	0.000 (t/m^2)
KH	=	0.12
KHS	=	0.00

GAMC	=	23.600 (t/m^3)
GAM1	=	19.600 (t/m^3)
GAM1S	=	10.800 (t/m^3)
FAi	=	35.000 (°)
GAM2	=	18.600 (t/m^3)
GAM2S	=	9.800 (t/m^3)
WATS	=	9.800 (t/m^3)

C	=	0.00 (t/m^2)
tanφB	=	0.500
Qa	=	350.00 (t/m^2)

NOTE: THE DIMENSION(t) BE EXCHANG TO DIMENSION(KN) INTO THIS CALCULATION

(1)

NO.	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
1	10.620	1.274	3.150	9.750	33.453	12.425
4	245.440	29.453	2.650	5.000	650.416	147.264
8	141.600	16.992	3.000	0.500	424.800	8.496
	397.660	47.719			1108.670	168.185

V = X*Y*BW*GAM1　　H = V*KH
MX = V*X　　MY = H*Y

(2)

a)

NO.	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
1	79.380	9.526	4.650	9.750	369.117	92.875
4	423.360	50.803	4.650	5.000	1968.620	254.016
	502.740	60.329			2337.740	346.891

b)

NO.	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
6	37.200	0.000	1.000	1.500	37.200	0.000
	37.200	0.000			37.200	0.000

V = X*Y*BW*GAM1　　H = V*KHS
MX = V*X　　MY = H*Y

(3)

	RV(t)	RH(t)	RMX(t·m)	RMY(t·m)
	222.517	0.000	567.418	0.000
	222.517	16.710	567.418	172.113
	111.395	16.710	284.057	172.113

RV :　　RH :
RMX= RV*X　　RMY= RH*Y

(4)

	0.2497	0.2508	0.3191	0.3403
SIN (δ)	0.5736	0.2022	0.3007	0.0000
COS (δ)	0.8192	0.9793	0.9537	1.0000

(5)

	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
	154.756	221.015	6.000	3.500	928.535	773.551
	126.682	180.921	6.000	4.167	760.094	753.838
	27.443	39.193	6.000	0.495	164.660	19.413
	103.671	328.802	6.000	3.500	622.025	1150.810
	84.864	269.155	6.000	4.167	509.186	1121.480
	18.384	58.308	6.000	0.495	110.306	28.880

(6)

	V(t)	H(t)	X(m)	Y(m)	MX(t·m)	MY(t·m)
	-58.800	0.000	3.000	0.000	-176.400	0.000
	-58.800	0.000	3.000	0.000	-176.400	0.000

1.

(1)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	154.756	221.015	928.535	773.551
	222.517	0.000	567.418	0.000
	37.200	0.000	37.200	0.000
	1314.870	221.015	4979.560	773.551

Mo = ΣMX − ΣMY = 4206.010 (t·m)

(2)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	154.756	221.015	928.535	773.551
	111.395	0.000	284.057	0.000
	37.200	0.000	37.200	0.000
	1203.750	221.015	4696.200	773.551

Mo = ΣMX − ΣMY = 3922.650 (t·m)

(3)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	154.756	221.015	928.535	773.551
	222.517	16.710	567.418	172.113
	37.200	0.000	37.200	0.000
	1314.870	237.725	4979.560	945.664

Mo = ΣMX − ΣMY = 4033.900 (t·m)

(4)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	154.756	221.015	928.535	773.551
	111.395	16.710	284.057	172.113
	37.200	0.000	37.200	0.000
	1203.750	237.725	4696.200	945.664

Mo = ΣMX − ΣMY = 3750.540 (t·m)

(5)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	47.719	1108.670	168.185
	502.740	60.329	2337.740	346.891
	103.671	328.802	622.025	1150.810
	111.395	16.710	284.057	172.113
	37.200	0.000	37.200	0.000
	1152.670	453.560	4389.690	1838.000

Mo = ΣMX − ΣMY = 2551.700 (t·m)

2.

(1)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	126.682	180.921	760.094	753.838
	27.443	39.193	164.660	19.413
	222.517	0.000	567.418	0.000
	37.200	0.000	37.200	0.000
	-58.800	0.000	-176.400	0.000
	1255.440	220.114	4799.380	773.251

$Mo = \Sigma MX - \Sigma MY = 4026.130$ (t·m)

(2)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	126.682	180.921	760.094	753.838
	27.443	39.193	164.660	19.413
	111.395	0.000	284.057	0.000
	37.200	0.000	37.200	0.000
	-58.800	0.000	-176.400	0.000
	1144.320	220.114	4516.020	773.251

$Mo = \Sigma MX - \Sigma MY = 3742.770$ (t·m)

(3)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	126.682	180.921	760.094	753.838
	27.443	39.193	164.660	19.413
	222.517	16.710	567.418	172.113
	37.200	0.000	37.200	0.000
	-58.800	0.000	-176.400	0.000
	1255.440	236.824	4799.380	945.364

$Mo = \Sigma MX - \Sigma MY = 3854.020$ (t·m)

(4)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	0.000	1108.670	0.000
	502.740	0.000	2337.740	0.000
	126.682	180.921	760.094	753.838
	27.443	39.193	164.660	19.413
	111.395	16.710	284.057	172.113
	37.200	0.000	37.200	0.000
	-58.800	0.000	-176.400	0.000
	1144.320	236.824	4516.020	945.364

$Mo = \Sigma MX - \Sigma MY = 3570.660$ (t·m)

(5)

	V(t)	H(t)	MX(t·m)	MY(t·m)
	397.660	47.719	1108.670	168.185
	502.740	60.329	2337.740	346.891
	84.864	269.155	509.186	1121.480
	18.384	58.308	110.306	28.880
	111.395	16.710	284.057	172.113
	37.200	0.000	37.200	0.000
	-58.800	0.000	-176.400	0.000
	1093.440	452.221	4210.760	1837.550

$$Mo = \Sigma MX - \Sigma MY = 2373.210 \ (t \cdot m)$$

	V(t)	H(t)	Mo(t·m)	e(m)	Mc(t·m)
1	1314.870	221.015	4206.010	-0.199	-261.394
2	1203.750	221.015	3922.650	-0.259	-311.399
3	1314.870	237.725	4033.900	-0.068	-89.281
4	1203.750	237.725	3750.540	-0.116	-139.285
5	1152.670	453.560	2551.700	0.786	906.301
1	1255.440	220.114	4026.130	-0.207	-259.804
2	1144.320	220.114	3742.770	-0.271	-309.809
3	1255.440	236.824	3854.020	-0.070	-87.691
4	1144.320	236.824	3570.660	-0.120	-137.696
5	1093.440	452.221	2373.210	0.830	907.121

RAILWAY － ABUT(A_2)

Calculation for Vertical wall … U.L.S.

1. action force

a) state of normal load … only earth pressure

$$M=\frac{1}{6}\times 19.6\times 0.251\ \times 9.5^3\times 1.5\ \times 1.1\ =\ 1160.0^{KNm}$$

$$S=\frac{1}{2}\times 19.6\times 0.251\ \times 9.5^2\times 1.5\ \times 1.1\ =\ 366.3^{KN}$$

b) state of Temperature and normal load

$$M=1160.0+16.710\times 9.30\times 1.3\ \times 1.1\ =\ 1382.3^{KNm}$$

$$S=\ 366.3+16.710\times 1.3\ \times 1.1\ =\ 390.2^{KN}$$

c) state of Seismic

$$M=\ (\frac{1}{6}\times 19.6\times 0.341\ \times 9.50^3\ +16.710\times 9.30)\ \times 1.25\times 1.1=\ 1527.0^{KNm}$$

$$S=\ (\frac{1}{2}\times 19.6\times 0.341\ \times 9.50^2\ +16.710)\ \times 1.25\times 1.1\ =\ 437.7^{KN}$$

Calculation of stress for U.L.S.

section $b = 100^{cm}$ $h = 130$ $d = 122.5$ $d' = 7.5$

$As = Y_{32} - 150^{ctc} = 8.042 / 0.150 = 53.613\ cm^2$

$$P = \frac{As}{b \cdot d} \times 100 = \frac{53.613}{100 \times 122.5} \times 100 = 0.437\ \%$$

$$x = \frac{0.87 fy \cdot As}{0.40 fcu \cdot b} = \frac{0.87 \times 41000 \times 53.613}{0.40 \times 2500 \times 100} = 19.2^{cm}$$

$$Z = d - \frac{x}{2} = 122.5 - \frac{19.2}{2} = 112.9^{cm} < 0.95d = 0.95 \times 122.5 = 116.4^{cm}$$

OK

$M_{RS} = 0.87 fyAsZ = 0.87 \times 41000 \times 53.613 \times 112.9 \times 10^{-5}$
$= 2159.0^{KNm} > Mu = 1527.0^{KNm}$

$M_{RC} = 0.40 fcubxZ = 0.40 \times 2500 \times 100 \times 19.2 \times 112.9 \times 10^{-5}$
$= 2167.6^{KNm} > Mu = 1527.0^{KNm}$ OK

$$Vc = \frac{S}{bd} = \frac{437.7 \times 10^3}{100 \times 122.5} = 35.8\ N/cm^2$$

$$< Vca = 35.0 + 15.0 \left(\frac{0.437 - 0.25}{0.25} \right) = 46.2\ N/cm^2$$ OK

Calculation of stability for S.L.S.

1) action force for bottom of Foundation

load / State	N^{KN}	H^{KN}	M^{KNm}
Normal	1314.9	221.1	–
Temperature	1314.9	237.8	–
Seismic	1152.7	453.6 ×0.8 =362.9	※ 538.8

※ $M=\left\{\frac{6.00}{2}-(4389.7-1838.0\times0.8)/1152.7\right\}\times1152.7=538.8$ KNm

2) Stability for Foundation

(1) Normal and Temperature state

$$e= 0.0^{m}$$

$$q=\frac{1314.9}{6.00}=219.2\ KN/m^2 \quad < \quad qa= 350\ KN/m^2$$

$$Fs=\frac{1314.9\times0.50}{237.8} = 2.7 > 1.5 \qquad OK$$

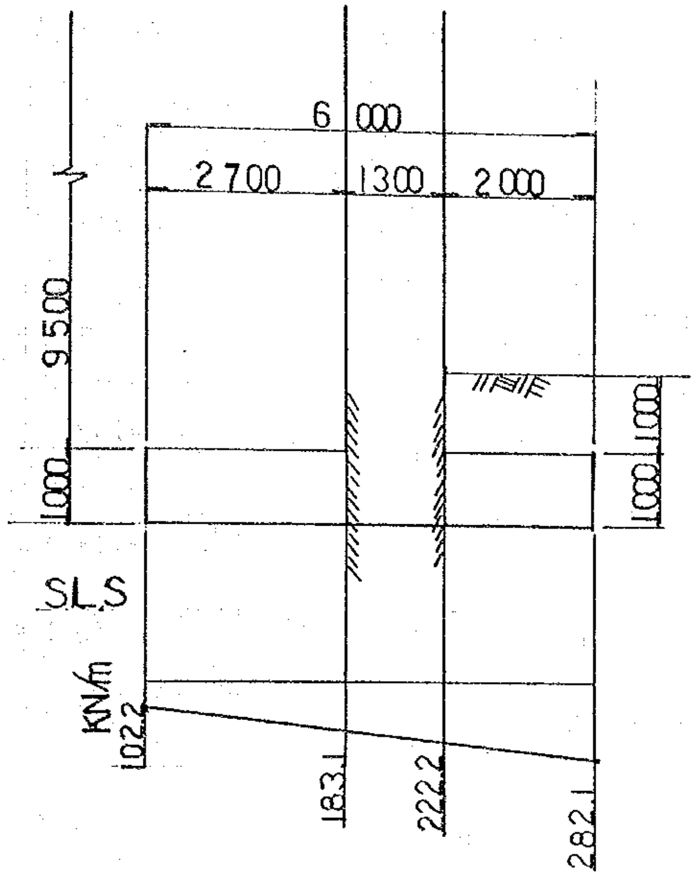
(2) Seismic state

$$e=\frac{538.8}{1152.7}= 0.468^{m} > \frac{B}{6}=\frac{6.00}{6}= 1.000^{m}$$

$$q=\frac{1152.7}{6.00}\left(1\pm\frac{6\times0.468}{6.00}\right)=\begin{cases}282.1\ KN/m^2\\102.2\ KN/m^2\end{cases} < \quad qa= 350\ KN/m^2$$

$$Fs=\frac{1152.7\times0.50}{362.9} = 1.59 > 1.5$$

Calculation of action force for each section … seismic state



(1) Surcharge load

a) toe footing slab

$\omega = (23.6 \times 1.00 + 18.6 \times 1.00)$

$= 42.200$ KN/m

b) heel footing slab

$\omega = (23.6 \times 1.00 + 19.6 \times 9.50)$

$= 209.800$ KN/m

(2) Calculation of bending moment and shearing slab

a) toe footing slab

$$M = \frac{2.00^2}{6}(2 \times 282.1 + 222.2) - \frac{2.00^2}{2} \times 42.200 = 440.0^{KNm}$$

$$S = \frac{2.00}{2}(282.1 + 222.2) - 2.00 \times 42.200 = 419.9^{KN}$$

b) heel footing slab

$$M = \frac{2.70^2}{2} \times 209.800 - \frac{2.70^2}{6}(2 \times 102.2 + 183.1) = 294.0^{KNm}$$

$$S = 2.70 \times 209.800 - \frac{2.70}{2}(102.2 + 183.1) = 181.3^{KN}$$

Calculation of stability for U.L.S.

1) action force for bottom of Foundation

load / State	N^{KN}	H^{KN}	M^{KNm}
Normal	1314.9×1.2 ×1.15 =1814.6	221.1 ×1.5 ×1.1 =364.8	※1 0.0
Temperature	1814.6	237.8 ×1.5 ×1.1 =392.4	※2 132.4
Seismic	1152.7×1.2 ×1.15 =1590.8	453.6 ×1.25×1.1 =623.7	※3 1241.9

※1 $M=\left\{\frac{6.00}{2}-(4979.6\times1.38-773.6\times1.65)/1814.6\right\}\times1814.6\fallingdotseq 0.0^{KNm}$

※2 $M=\left\{\frac{6.00}{2}-(4979.6\times1.38-945.7\times1.65)/1814.6\right\}\times1814.6\fallingdotseq 132.4^{KNm}$

※3 $M=\left\{\frac{6.00}{2}-(4389.7\times1.38-1838.0\times1.375)/1590.8\right\}\times1590.8=1241.9^{KNm}$

2) Stability for Foundation

(1) Normal and Temperature state

$$e=\frac{132.4}{1814.6}=0.073^{m} < \frac{B}{6}=\frac{6.00}{6}=1.000^{m}$$

$$q=\frac{1814.6}{6.00}\left(1\pm\frac{6\times0.073}{6.00}\right)=\begin{cases}324.5\ KN/m^2\\280.4\ KN/m^2\end{cases} < qa=350\ KN/m^2$$

$$Fs=\frac{1814.6\times0.50}{392.4}=2.3>1.1\quad OK$$

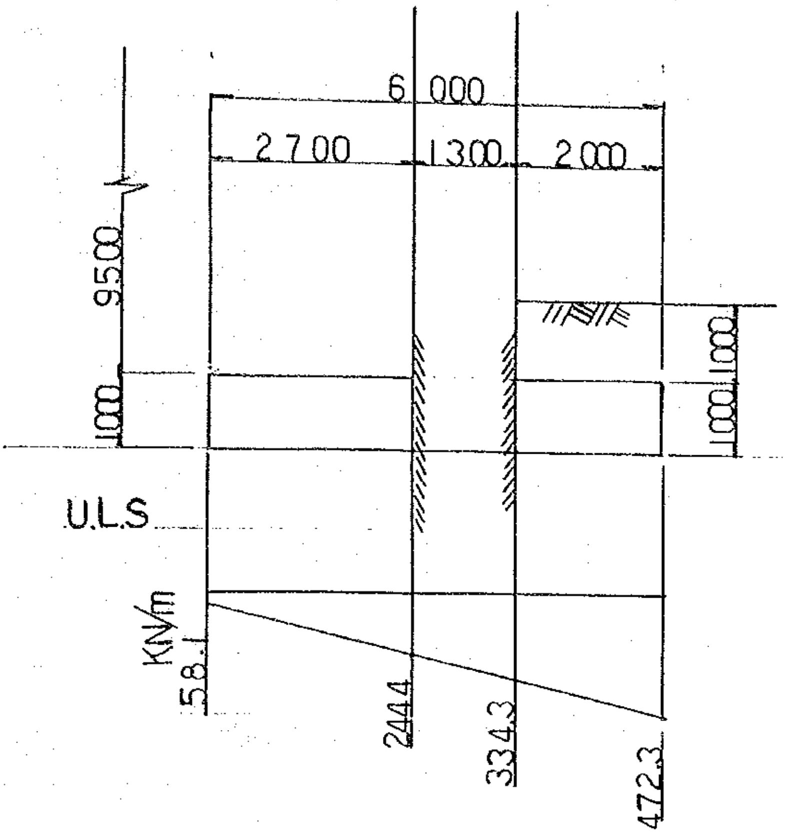
(2) Seismic state

$$e=\frac{1241.9}{1590.8}=0.781^{m} > \frac{B}{6}=1.000^{m}$$

$$q=\frac{1590.8}{6.00}\left(1\pm\frac{6\times0.781}{6.00}\right)=\begin{cases}472.3\ KN/m^2\\58.1\ KN/m^2\end{cases} < qa=525.0\ KN/m^2$$

$$Fs=\frac{1590.8\times0.50}{623.7}=1.27>1.1$$

Calculation of action force for each section … Seismic state



(1) Surcharge load

a) toe footing slab

$$\omega = (23.6 \times 1.00 + 18.6 \times 1.00) \times 1.380 = 58.236 \ ^{KN/m}$$

b) heel footing slab

$$\omega = (23.6 \times 1.00 + 19.6 \times 9.50) \times 1.380 = 289.524 \ ^{KN/m}$$

(2) Calculation of bending moment and shearing force

a) toe footing slab

$$M = \frac{2.00^2}{6} (2 \times 472.3 + 334.3) - \frac{2.00^2}{2} \times 58.236 = 736.2^{KNm}$$

$$S = \frac{2.00}{2} (472.3 + 334.3) - 2.00 \times 58.236 = 688.2^{KN}$$

b) heel footing slab

$$M = \frac{2.70^2}{2} \times 289.524 - \frac{2.70^2}{6} (2 \times 58.1 + 244.4) = 617.2^{KNm}$$

$$S = 2.70 \times 289.524 - \frac{2.70}{2} (58.1 + 244.4) = 373.4^{KN}$$

Calculation of stress for footing slab (U.L.S)

toe and heel footing slab

section $b = 100^{cm}$ $h = 100$ $d = 93.5$ $d' = 6.5$

$$As = Y_{25} - 150^{ctc} = 4.909 / 0.150 = 32.727 cm^2$$

$$P = \frac{As}{b\ d} \times 100 = \frac{32.727}{100 \times 93.5} \times 100 = 0.350\ \%$$

$$x = \frac{0.87fy \cdot As}{0.40fcu \cdot b} = \frac{0.87 \times 41000 \times 32.727}{0.40 \times 2500 \times 100} = 11.6^{cm}$$

$$Z = d - \frac{x}{2} = 93.5 - \frac{11.6}{2} = 87.7^{cm} < 0.95d = 0.95 \times 93.5 = 88.8^{cm} \quad OK$$

$$M_{RS} = 0.87fyAs \cdot Z = 0.87 \times 41000 \times 32.727 \times 87.7 \times 10^{-5}$$
$$= 1023.8^{KNm} > M = 736.2^{KNm}$$

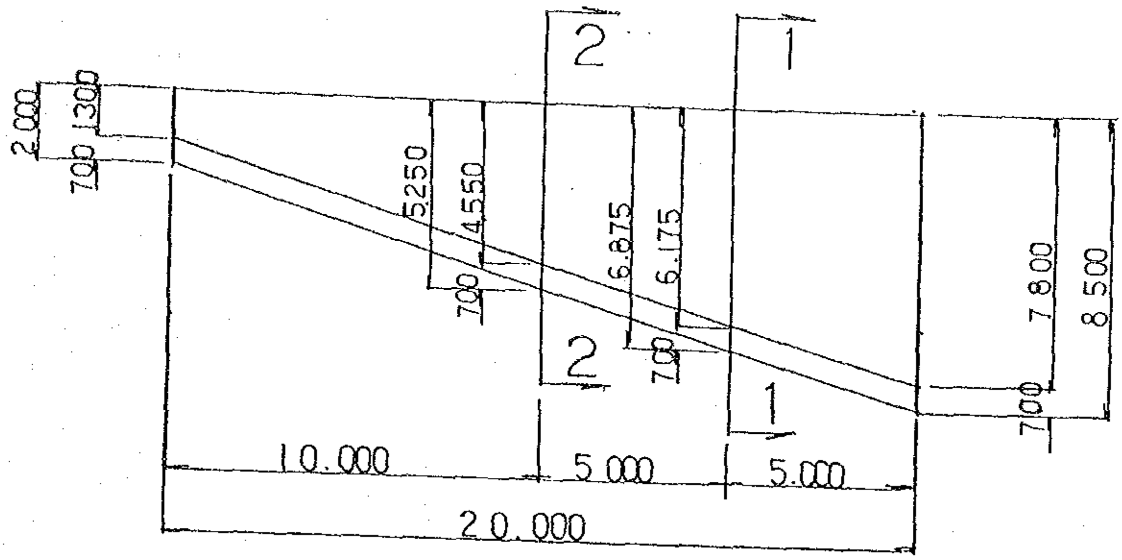
$$M_{RC} = 0.40fcubx \cdot Z = 0.40 \times 2500 \times 100 \times 11.6 \times 87.7 \times 10^{-5}$$
$$= 1017.3^{KNm} > M = 736.2^{KNm}$$

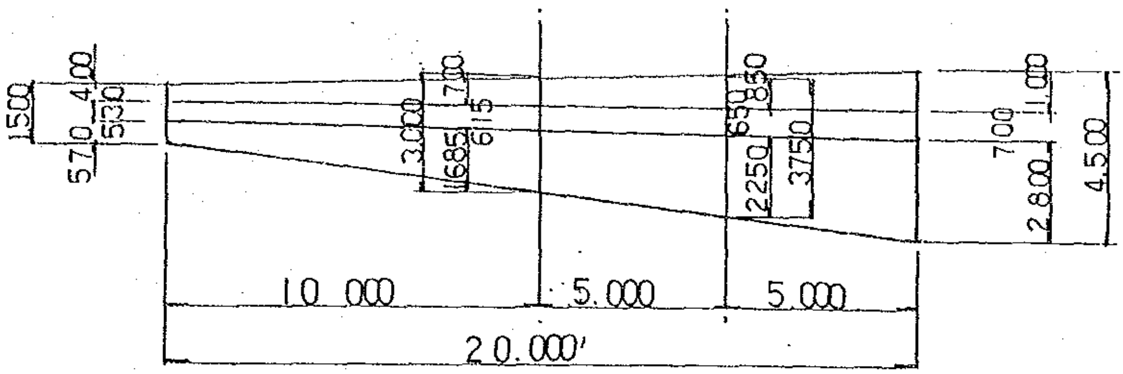
$$Vc = \frac{S}{bd} = \frac{688.2 \times 10^3}{100 \times 93.5} = 73.6\ N/cm^2$$

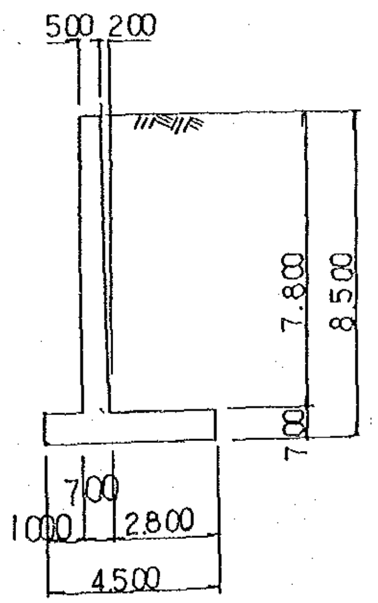
$$< Vca = \left\{ 35.0 + 15.0 \left(\frac{0.350 - 0.25}{0.25}\right) \right\} \times 2 = 82.0\ N/cm^2 \quad OK$$

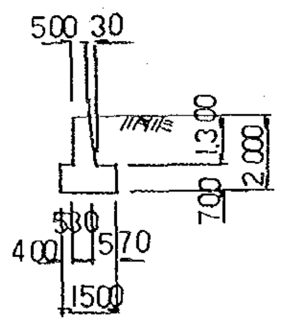
Retaining wall

of Railway Bridge



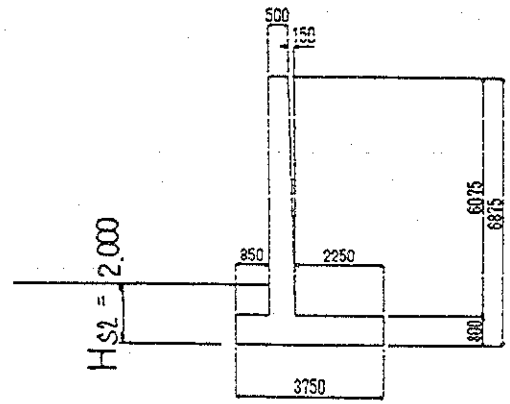






BOTH EDGE

for section(1)



GAMC	=	23.600	(t/m^3)
GAM1	=	19.600	(t/m^3)
GAM1S	=	10.780	(t/m^3)
FAi	=	30.000	(°)
GAM2	=	18.600	(t/m^3)
GAM2S	=	9.780	(t/m^3)
WATS	=	9.800	(t/m^3)

C	=	0.000	(t/m^2)
$\tan\phi B$	=	0.600	
Qa	=	350.000	(t/m^2)

β	=	0.000	(°)
HS2	=	2.000	(m)
HW1	=	0.000	(m)

NOTE: THE DIMENSION(t)BE EXCHANG TO

DIMENSION(KN) INTO THIS CALCULATION

ϕ : 30.000 (°)

δ :

= 0.000 (°)

β : 0.000 (°)

θ : 0.000 (°)

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

= 0.333

Ka : 0.333

δ : 0.000 (°)

θ : 0.000 (°)

H : 6.875 (m)

γo : 19.600 (t/m^3)

C : 0.000 (t/m^2)

Q : 0.000 (t/m^2)

$p = Ka*\gamma o*H - 2*C*\sqrt{Ka} + Ka*Q$

p1 = 0.000 (t/m^2)

p2 = 44.917 (t/m^2)

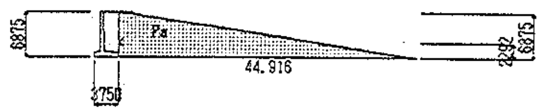
P = (p1+p2) * H / 2 = 154.401 (t/m)

Ph = 154.401 (t/m)

Pv = 0.000 (t/m)

y = 2.292 (m)

x = 0.000 (m)



(1)

NO.	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
1	70.800	0.000	1.875	0.400	132.750	0.000
6	71.685	0.000	1.100	3.838	78.854	0.000
7	10.753	0.000	1.400	2.825	15.054	0.000
	153.238	0.000			226.657	0.000

V = Xi*Yi*GAMC　　H = V*KH1
Mx = V*x　　My = H*y

(2)

NO.	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
2	8.930	0.000	1.450	4.850	12.949	0.000
3	267.908	0.000	2.625	3.838	703.257	0.000
	276.838	0.000			716.206	0.000

V = Xi*Yi*GAM1　　H = V*KH1
Mx = V*x　　My = H*y

(3)

NO.	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
2	18.972	0.000	0.425	0.000	8.063	0.000
	18.972	0.000			8.063	0.000

V = Xi*Yi*GAM2　　H = V*KH2
Mx = V*x　　My = H*y

(4)

	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
	0.000	154.401	3.750	2.292	0.000	353.836

(1)

	V(t)	H(t)	Mx(t·m)	My(t·m)
	153.238		226.657	
	276.838		716.206	
	18.972		8.063	
	0.000	154.401	0.000	353.836
	449.048	154.401	950.927	353.836

Mo = ΣMx - ΣMy = 597.091 (t·m)

	V(t)	H(t)	e(m)	Mc(t·m)
2	449.048	154.401	0.545	244.873

e = B0/2 - Mo/V　:　Mc = V * e

B0 :

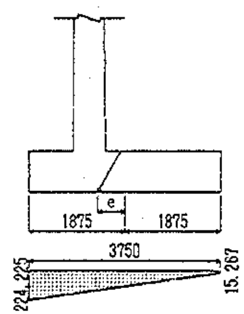
	V(t)	Mc(t·m)	e(m)
	449.048	244.873	0.545 < 0.625

e = Mc/V

B (m)	3.750
L (m)	1.000
V (t)	449.048
H (t)	154.401
Mc (t·m)	244.873
e (m)	0.545
X (m)	3.750
Qmax(t/m^2)	224.225
Qmin(t/m^2)	15.267
	29.400

Q = V/(B*L) + 6*Mc/(L*B*B)

Q = 2*V/(L*X) : X = 3*(B/2-Mc/V)



	D(m)	V(t)	H(t)	Hu(t)	Fs
	3.750	449.048	154.401	269.429	1.745 > 1.5

C = 0.00 (t/m^2) tan(δ) = 0.60

Hu = C*D+ V*tan(δ)

Fs = Hu/H

Lalculation of stability for section(1)

U.L.S

Load	N(KN)	H(KN)	Mx(KN·m)	MY(KN·m)
concrete of stnuctuve surcherge of heel slab and toe slab	449.048×1.2×1.15 =619.686	–	950.927×1.2×1.15 =1312.279	–
Earth pressure	–	154.401×1.5×1.10 =266.341	–	353.836×1.5×1.10 =610.367
total Load	619.7	266.4	1312.3	610.4

for inversion

$$Fin = \frac{950.9}{610.4} = 1.55 > 1.00 \quad \text{OK}$$

For Reaction

$$X = \frac{1312.3 - 610.4}{619.7} = 1.133 > \frac{3.75}{6} = 0.625\text{m}$$

$$< \frac{3.75}{3} = 1.250\text{m}$$

$$q_{max} = \frac{2 \times 619.7}{3 \times 1.133 \times 1.00} = 364.7 \ \text{KN/m}^2$$

for sliding

$$Fsl = \frac{619.7 \times 0.6}{266.4} = 1.395 > 1.2$$

For vertical force

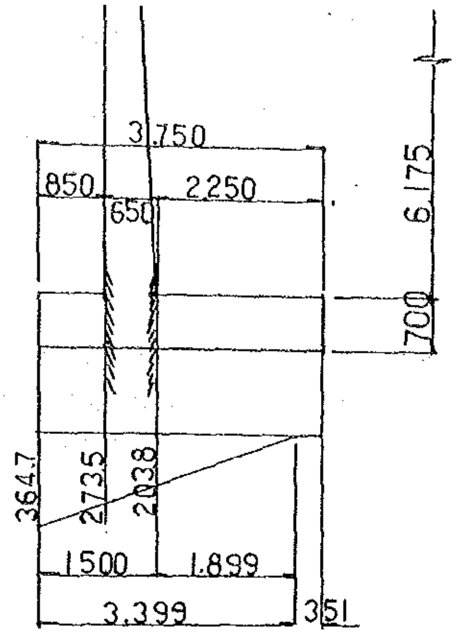
$$Na = 294 \times 1.5 \times 1.00 \times ※0.65 \{3.75 - (\frac{3.75}{2} \quad 1.133) \times 2\} = \underline{649.6 > 619.7 \text{ KN}}$$

critical

Where

※ relieving factor for slope (1:1.4)

Calculation of stress for each member (U.L.S)



$W1 = (23.6\times 0.70 + 18.6\times 1.30)\times 1.2\times 1.15 = 56.856$ KN/m

$W2 = (23.6\times 0.70 + 19.6\times 6.175)\times 1.2\times 1.15 = 190.371$ KN/m

a) vertical wall

$$M = \frac{1}{6}\times 19.6\times 0.333\times 6.175^3\times 1.5\times 1.15 = 441.9 \text{ KN·m}$$

$$S = \frac{1}{2}\times 19.6\times 0.333\times 6.175^2\times 1.5\times 1.15 = 214.7 \text{ KN}$$

b) toe footing slab

$$M = \frac{0.85^2}{6}(2\times 364.7 + 273.5) - \frac{0.85^2}{2}\times 56.856 = 100.3 \text{ KN·m}$$

$$S = \frac{0.85}{2}(364.7 + 273.5) - 0.85\times 56.856 = 222.9 \text{ KN}$$

C) heel footing slab

$$M = \frac{2.25^2}{2}\times 190.371 - \frac{1.899^2}{6}\times 203.8 = 359.4 \text{ KN·m}$$

$$S = 2.25\times 190.371 - \frac{1.899}{2}\times 203.8 = 234.9 \text{ KN}$$

Calculation of stress for each members

a) Vertical wall

$b=100cm$ $h=65.8$ $d=59.3$ $d'=6.5$

$AS = Y25-150^{ctc} = 4.909/0.150 = 32.727\ cm^2$

$$P = \frac{32.727}{100\times 59.3}\times 100 = 0.552\ \%$$

$$X = \frac{0.87\times 41000\times 32.727}{0.40\times 2500\times 100} = 11.8\ cm$$

$$Z = 59.3\times \frac{1}{2}\times 11.8 = 53.4\ cm < 0.95\times 59.3 = 56.3\ cm \quad OK$$

$MRS = 0.87\times 41000\times 32.727\times 53.4\times 10^{-5} = 623.4\ KNm > 441.9\ KNm$

$MRS = 0.40\times 2500\times 100\times 11.8\times 53.4\times 10^{-5} = 630.1\ KNm > 441.9\ KNm$

$$\tau = \frac{214.7\times 10^3}{100\times 59.3} = 36.2\ N/cm^2 < \tau a = 50+15\times \frac{(0.552-0.500)}{0.50} = 51.5\ N/cm^2$$

b) toe footing slab

$b=100cm$ $h=70$ $d=64.0$ $d'=6.0$

$As = Y20-150^{ctc} = 3.1416/0.15 = 20.944\ cm^2$

$$P = \frac{20.944}{100\times 64.0}\times 100=0.327\ \%$$

$$\tau = \frac{222.9\times 10^3}{100\times 64.0} = 34.8\ N/cm^2 < \tau a= 35.0+15.0\frac{(0.327-0.25)}{0.25} = 39.6\ N/cm^2$$

c) heel footing slab

$b=100cm$ $h=70$ $d=64.0$ $d'=6.0$

$AS = Y20-150^{CTC} = 3.1416/0.150 = 20.944\ cm^2$

$$P = \frac{20.944}{100\times 64.0}\times 100 = 0.327\%$$

$$X = \frac{0.87\times 41000\times 20.944}{0.40\times 2500\times 100} =7.6cm$$

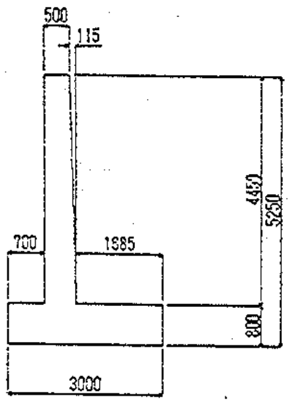
$$Z = 64.0-\frac{1}{2}\times 7.6 = 60.2\ cm < 0.95\times 64.0 = 60.8\ cm$$

$MRS = 0.87\times 41000\times 20.944\times 60.2\times 10^{-5} = 449.7\ KNm > 359.4\ KNm$

$MRC = 0.40\times 2500\times 100\times 7.6\times 60.2\times 10^{-5} = 457.5\ KNm > 359.4\ KNm$

$$\tau = \frac{234.9\times 10^3}{100\times 64.0} = 36.7\ N/cm^2 < \tau a = 35.0+15.0\frac{(0.327-0.25)}{0.25} = 39.6\ N/cm^2$$

for section(2)



GAMC	=	23.600	(t/m³)
GAM1	=	19.600	(t/m³)
GAM1S	=	10.780	(t/m³)
FAi	=	30.000	(°)
GAM2	=	18.600	(t/m³)
GAM2S	=	9.780	(t/m³)
WATS	=	9.800	(t/m³)

C	=	0.000	(t/m²)
tanφB	=	0.600	
Qa	=	350.000	(t/m²)

β = 0.000 (°)

常 時

HS2	=	2.000	(m)
HW1	=	0.000	(m)

ϕ : 30.000 (°)

δ :

= 0.000 (°)

β : 0.000 (°)

θ : 0.000 (°)

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

= 0.333

Ka : 0.333

δ : 0.000 (°)

0 : 0.000 (°)

H : 5.250 (m)

γo : 19.600 (t/m^3)

C : 0.000 (t/m^2)

Q : 0.000 (t/m^2)

$p = Ka * \gamma o * H - 2 * C * \sqrt{Ka} + Ka * Q$

p1 = 0.000 (t/m^2)

p2 = 34.300 (t/m^2)

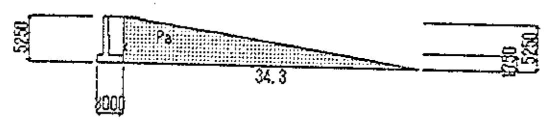
P = (p1+p2) * H / 2 = 90.038 (t/m)

Ph = 90.038 (t/m)

Pv = 0.000 (t/m)

y = 1.750 (m)

x = 0.000 (m)



(1)

NO.	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
1	56.640	0.000	1.500	0.400	84.960	0.000
6	52.510	0.000	0.950	3.025	49.885	0.000
7	6.039	0.000	1.238	2.283	7.478	0.000
	115.189	0.000			142.322	0.000

V = Xi*Yi*GAMC　　H = V*KH1
Mx = V*x　　My = H*y

(2)

NO.	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
2	5.015	0.000	1.277	3.767	6.403	0.000
3	146.966	0.000	2.158	3.025	317.079	0.000
	151.981	0.000			323.481	0.000

V = Xi*Yi*GAM1　　H = V*KH1
Mx = V*x　　My = H*y

(3)

NO.	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
2	15.624	0.000	0.350	0.000	5.468	0.000
	15.624	0.000			5.468	0.000

V = Xi*Yi*GAM2　　H = V*KH2
Mx = V*x　　My = H*y

(4)

	V(t)	H(t)	x(m)	y(m)	Mx(t·m)	My(t·m)
	0.000	90.038	3.000	1.750	0.000	157.566

	V(t)	H(t)	Mx(t·m)	My(t·m)
	115.189		142.322	
	151.981		323.481	
	15.624		5.468	
	0.000	90.038	0.000	157.566
	282.793	90.038	471.272	157.566

$Mo = \Sigma Mx - \Sigma My = 313.706$ (t·m)

	V(t)	H(t)	e(m)	Mc(t·m)
2	282.793	90.038	0.391	110.484

e = B0/2 - Mo/V　:　Mc = V * e

	V(t)	Mc(t·m)	e(m)
	282.793	110.484	0.391 < 0.500

e = Mc/V

	D(m)	V(t)	H(t)	Hu(t)	Fs
	3.000	282.793	90.038	169.676	1.885 > 1.5

C = 0.00 (t/m^2) tan(δ) = 0.60

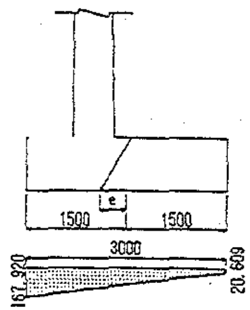
Hu = C*D+ V*tan(δ)

Fs = Hu/H

	常時
B (m)	3.000
L (m)	1.000
V (t)	282.793
H (t)	90.038
Mc (t·m)	110.484
e (m)	0.391
X (m)	3.000
Qmax(t/m^2)	167.920
Qmin(t/m^2)	20.609
	29.400

Q = V/(B*L) + 6*Mc/(L*B*B)

Q = 2*V/(L*X) : X = 3*(B/2-Mc/V)



Lalculation of stability for section(2)

U.L.S

Load	N(KN)	H(KN)	Mx(KN·m)	MY(KN·m)
concrete of construction surcherge of heel slab and toe slab	382.793×1.2×1.15 =390.255	–	471.272×1.2×1.15 = 650.355	–
Earth pressure	–	90.038×1.5×1.10 = 155.315	–	157.566×1.5×1.10 = 271.802
total Load	390.3	155.3	650.4	271.8

for inversion

$$F_{in} = \frac{471.3}{271.8} = 1.73 > 1.00 \quad \text{OK}$$

For Reaction

$$X = \frac{650.4 - 271.8}{390.3} = 0.970 \text{ m} > \frac{3.00}{6} = 0.500\text{m}$$

$$< \frac{3.00}{3} = 1.000\text{m}$$

$$q_{max} = \frac{2 \times 390.3}{3 \times 0.970 \times 1.00} = 268.3 \ \text{KN/m}^2$$

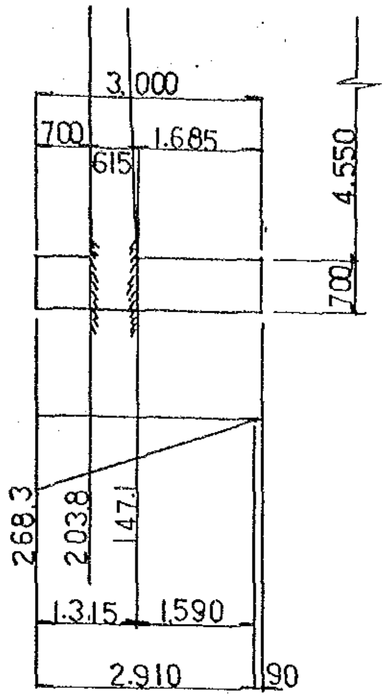
for sliding

$$F_{sl} = \frac{390.3 \times 0.6}{155.3} = 1.50 > 1.20$$

For vertical force

$$Na = 294 \times 1.5 \times 1.00 \times 0.65 \{3.00 - (\frac{3.00}{2} - 0.970) \times 2\} = 556.1 \text{ KN} > 390.3 \text{ KN}$$

Calculation of stress for each member (U.L.S)



$$W1 = (23.6\times 0.70 + 18.6\times 1.30)\times 1.2\times 1.15 = 56.856\ KN/m$$

$$W2 = (23.6\times 0.70 + 19.6\times 4.55)\times 1.2\times 1.15 = 146.418\ KN/m$$

a) vertical wall

$$M = \frac{1}{6}\times 19.6\times 0.333\times 4.55^3\times 1.5\times 1.15 = 176.8\ KN\cdot m$$

$$S = \frac{1}{2}\times 19.6\times 0.333\times 4.55^2\times 1.5\times 1.15 = 116.6\ KN$$

b) toe footing slab

$$M = \frac{0.70^2}{6}(2\times 268.3 + 203.8) - \frac{0.70^2}{2}\times 56.856 = 46.6\ KN\cdot m$$

$$S = \frac{0.70}{2}(268.3 + 203.8) - 0.70\times 56.856 = 125.5\ KN$$

C) heel footing slab

$$M = \frac{1.685^2}{2}\times 146.418 - \frac{1.595^2}{6}\times 147.1 = 145.5\ KN\cdot m$$

$$S = 1.685\times 146.418 - \frac{1.595}{2}\times 147.1 = 129.4\ KN$$

Calculation of stress for each members

a) Vertical wall

b=100cm h=61.5 d=55.0 d'=6.5

$AS = Y25-300^{ctc} = 4.909/0.30 = 16.362\ cm^2$

$$P = \frac{16.362}{100\times55.0}\times100 = 0.297\ \%$$

$$X = \frac{0.87\times41000\times16.362}{0.40\times2500\times100} = 6.0\ cm$$

$$Z = 55.0-\frac{1}{2}\times6.0 = 52.0\ cm < 0.95\times55.0 = 52.2\ cm \quad OK$$

$MRS = 0.87\times41000\times16.362\times52.0\times10^{-5} = 303.5\ KNm > 176.8\ KNm$

$MRC = 0.40\times2500\times100\times6.0\times52.0\times10^{-5} = 312.0\ KNm > 176.8\ KNm$

$$\tau = \frac{116.6\times10^3}{100\times55.0} = 21.2\ N/cm^2 < \tau a = 35.0+15.0\times\frac{(0.297-0.25)}{0.25} = 37.8\ N/cm^2$$

b) toe footing slab

b=100cm h=70 d=64.0 d'=6.0

$As = Y20-300^{ctc} = 3.1416/0.30 = 104.72\ cm^2$

$$P = \frac{10.472}{100\times64.0}\times100 = 0.164\ \% > 0.15\ \%$$

$$\tau = \frac{125.5\times10^3}{100\times64.0} = 19.6\ N/cm^2 < \tau a = 35.0\times\frac{0.164}{0.250} = 23.0N/cm^2$$

c) heel footing slab

b=100cm h=70 d=64.0 d'=6.0

$AS = Y20-300^{CTC} = 3.1416/0.30 = 10.472cm^2$

$$P = \frac{10.472}{100\times64.0}\times100 = 0.164\ \% > 0.15\%$$

$$X = \frac{0.87\times41000\times10.472}{0.40\times2500\times100} = 6.4\ cm$$

$$Z = 64.0-\frac{1}{2}\times6.4 = 60.8\ cm = 0.95\times64.0 = 60.8\ cm$$

$MRS = 0.87\times41000\times10.472\times60.8\times10^{-5} = 227.1\ KNm > 145.5\ KNm$

$MRC = 0.40\times2500\times100\times6.4\times60.8\times10^{-5} = 389.1\ KNm > 145.5\ KNm$

$$\tau = \frac{129.4\times10^3}{100\times64.0} = 20.2\ N/cm^2 < \tau a = 35.0\times\frac{0.164}{0.250} = 23.0\ N/cm^2$$