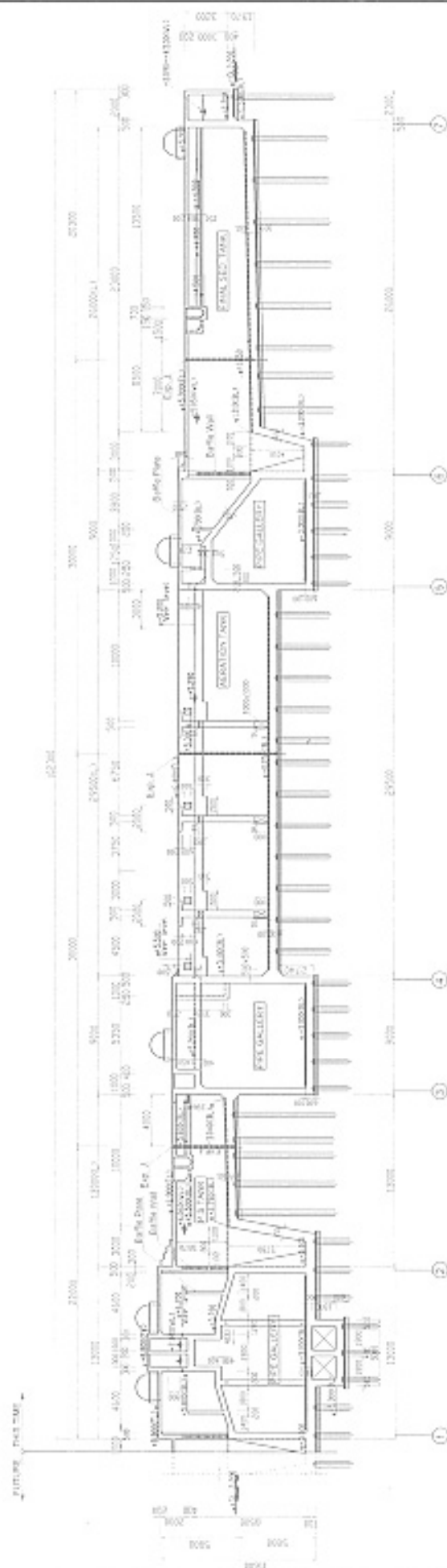
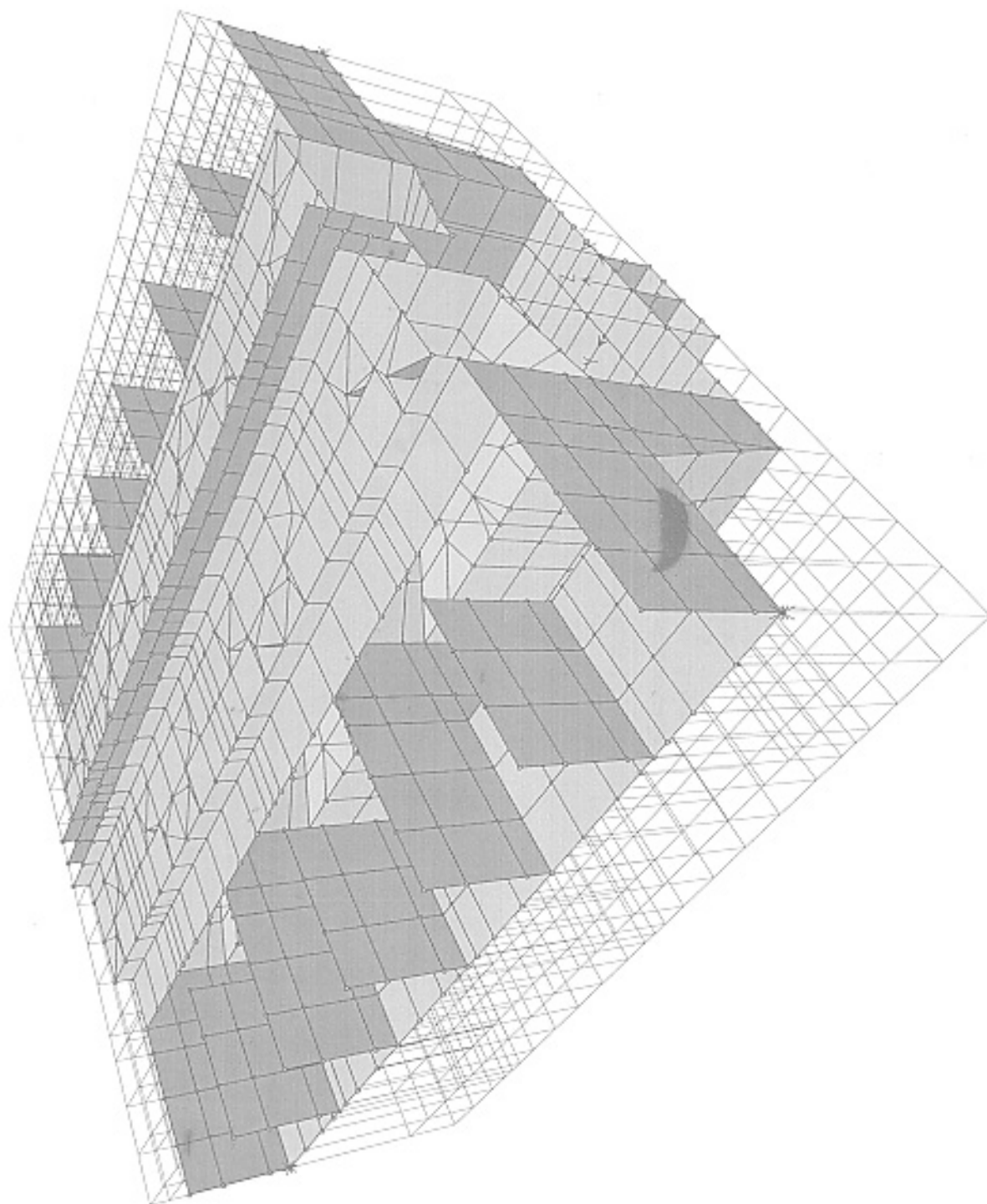


7.1.3

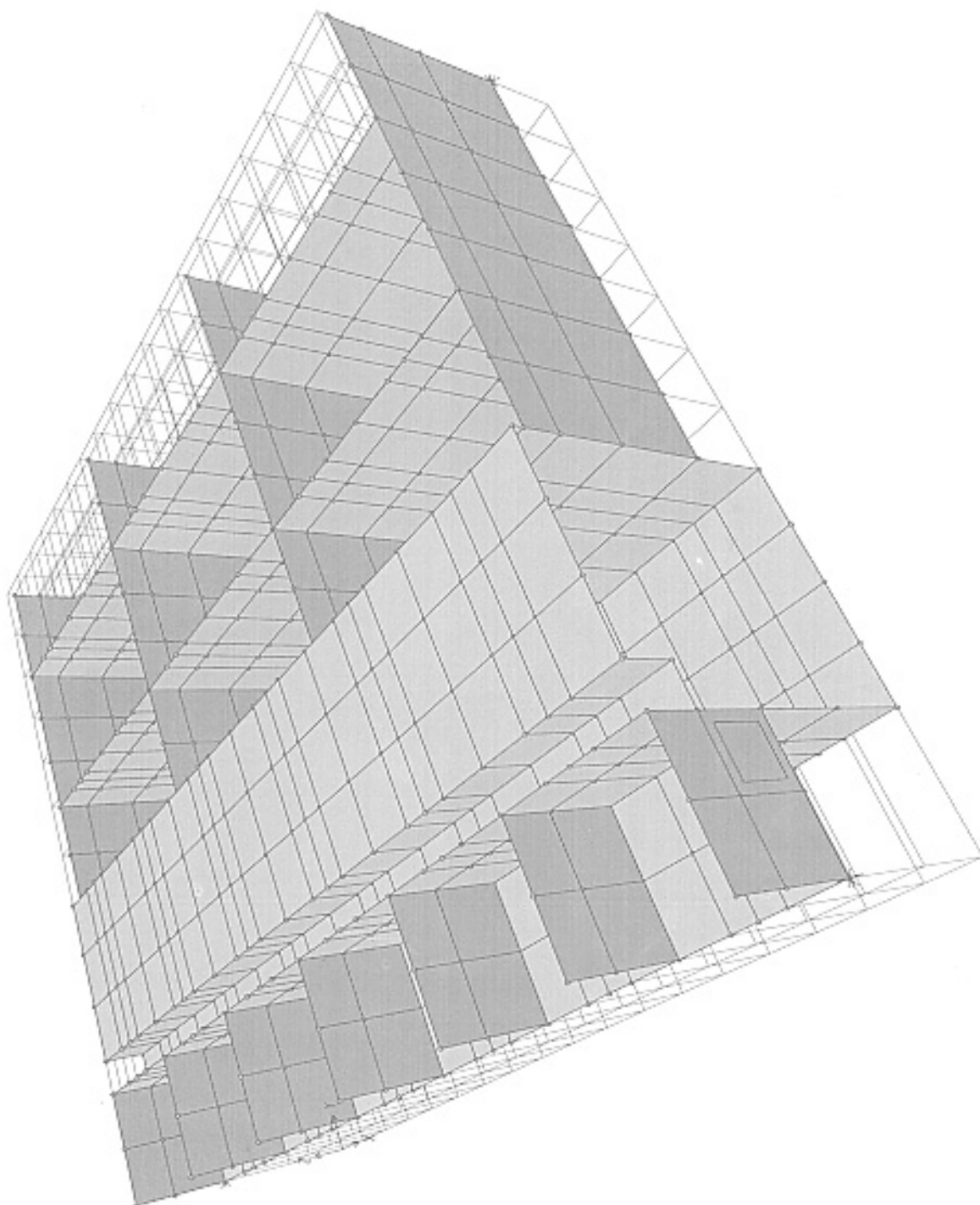
Treatment Plant

STRUCTURAL CALCULATION OF TREATMENT PLANT
LONGITUDINAL SECTION (WITH HIGHEST WATER LEVEL)

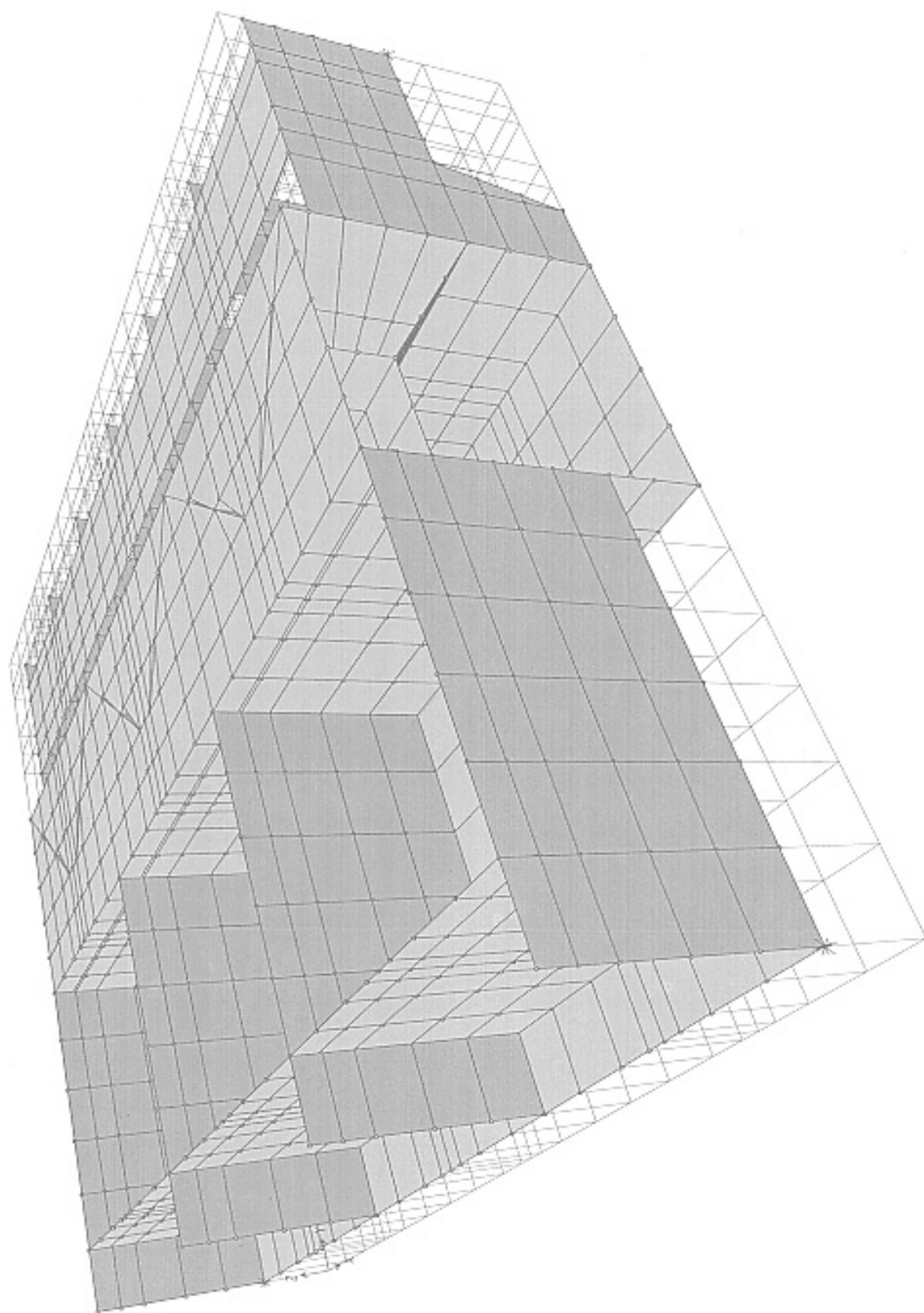
PIPE GALLERY AND PRIMARY SEDIMENTATION TANK



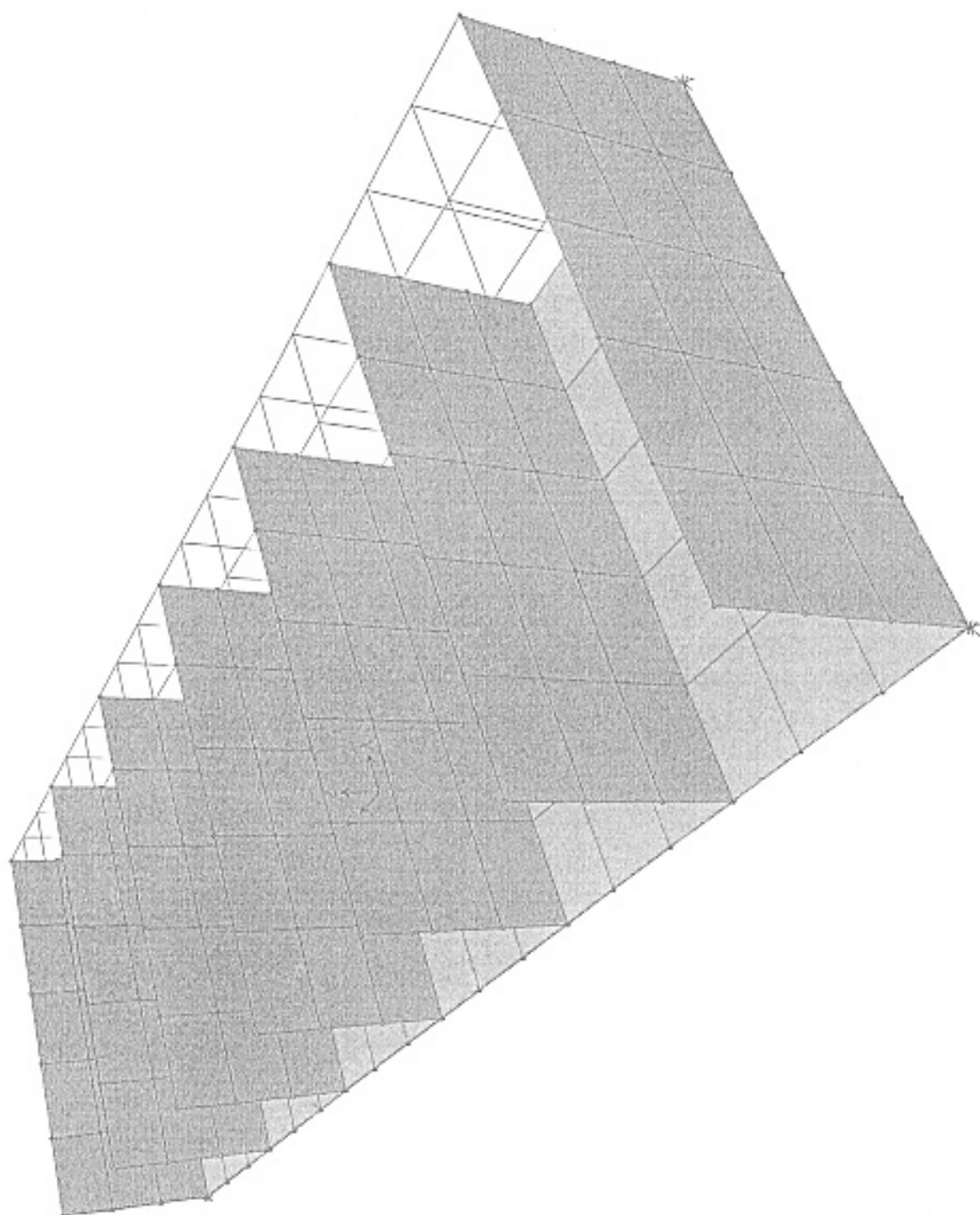
PRIMARY SEDIMENTATION TANK - PIPE GALLERY - AERAION TANK



AERAION TANK - PIPE GALLERY - FINAL SEDIMENTATION TANK



FINAL SEDIMENTATION TANK



CALCULATION FOR WASTEWATER TREATMENT PLANT STRUCTURES**PIPE GALLERY AND PRIMARY SEDIMENTATION TANK**

(The calculation based on Japanese standard)

1-GEOMETRY DIMENSIONS FOR CALCULATION

(As shown on drawings attached):

Ground level:	GL =	+2.20
Ground water level:	GWL=	0.00
Bottom level of pipegallery:	BL =	-3.10
Bottom level of primary sedimentation tank:	BL =	2.78
Bottom level of primary sedimentation tank:	BL =	-5.30
Water level of upper inflow water way:		7.14
Water level of primary sedimentation tank		+ 6.05
Thickness of pipegallery bottom:		0.70 m
Thickness of primary sedimentation tank		0.60 m
Thickness under inflow waterway bottom		0.60 m
Cinder concrete thickness		0.10 m

*And all other dimensions shown on the drawing attached***2-MATERIAL PROPERTIES AND SOIL CONDITIONS:**

Concrete: Grade C21,	Rn =	70 (Kg/cm ²)
	RS=	3.6 (Kg/cm ²)
Reinforcement type JIS:	Ra=	1600 (Kg/cm ²)
Back fill sand: γ_s =	1.80T/m ³	: Coefficient of earth pressure at rest K_0 0.5
	Internal friction	20deg

3-LOAD CALCULATION (BASE ON JAPANESE STANDARD):**3.1- Maximum loads from architect part to be taken in calculation as in analysis****3.2- Soil load:****In case of ground water level at 0.00 (Permanent case):**

-Horizontal triangle distributed load due to earth under ground water level (outside of primary sed. tank):
 $p_{H1} = 0.8 \times 5.9 \times 0.5 + 5.9 \times 1 = 8.26T/m^2$

-Uplift pressure to bottom of under inflow waterway:
 $p_{uplt} = (H_{\text{ground water}}) \times 1.0 = 5.90T/m^2$

-Uplift pressure to bottom of pipegallery:
 $p_{uplt} = (H_{\text{ground water}}) \times 1.0 = 3.80T/m^2$

3.3-Water load

According to highest water level and bottom level as inlustrated in the drawing, water loads to be calculated and shown on the attached drawing.

3.4-Load of non-reinforced concrete layer on bottom slab:

(Due to mechanical supports and cinder concrete)

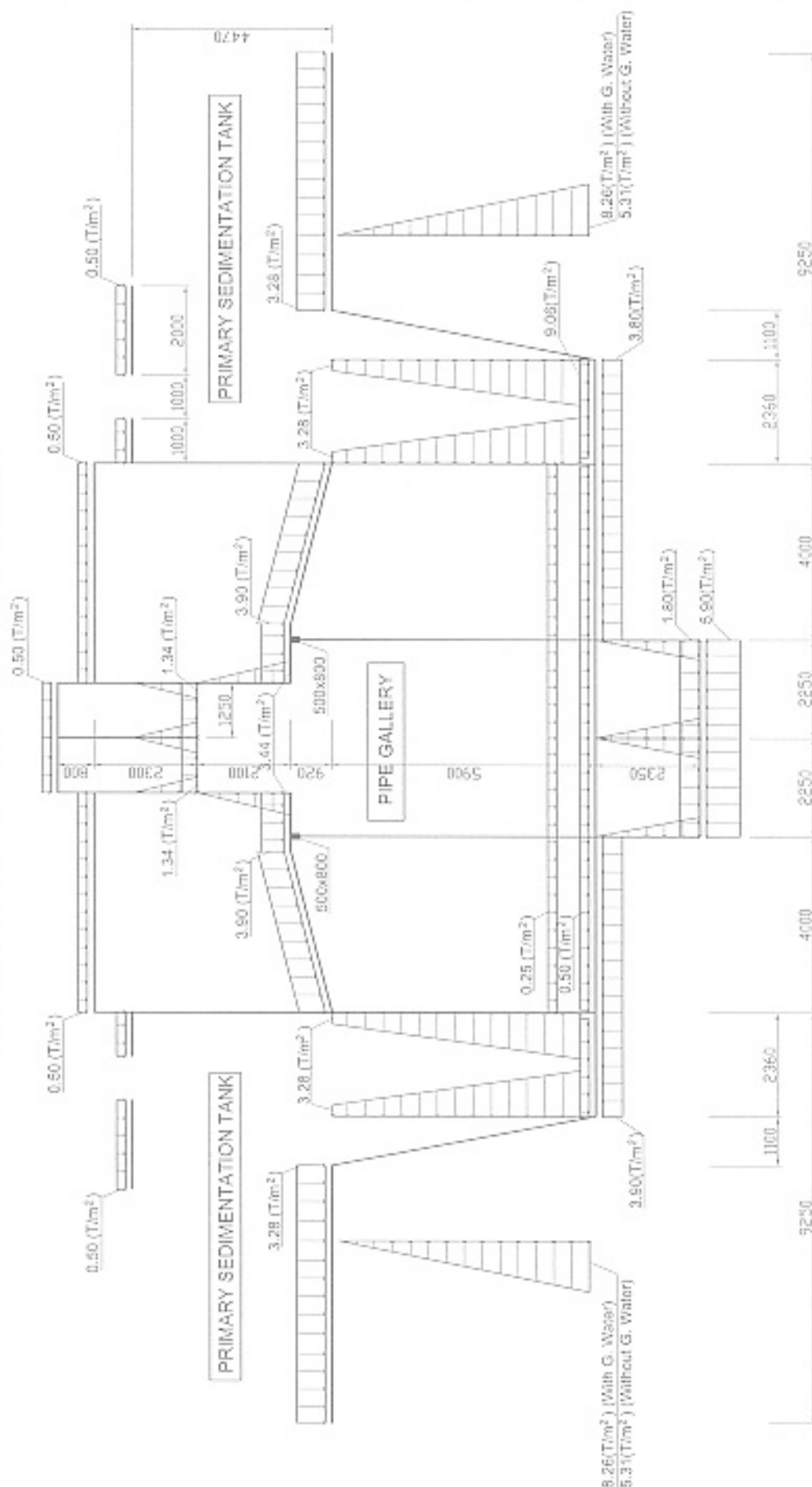
-Uniform load: $q_{\text{con layer}} = 2.5 \times 0.10 = 0.250T/m^2$

3.5-Live load:

-Live load for all operating floor and walking way : $q_{\text{live}} = 0.50T/m^2$

4-ANALYSING BY SAP 2000: THERE ARE 3 COMBOS FOR ANALYSING AS ATTACHED HEREAFTER**ALL THE LOADS, FACTORS, AND OTHER INPUT DATUM TO BE TAKEN IN ANALYSIS AND CALCUL***The reaction results of combo 3 as attached shows that no uplift case happen to the structure*

PIPE GALLERY - PRIMARY SEDIMENTATION TANK



NOTE: THIS FOR VALUES OF LOADS ONLY,
COMBOS ARE TO BE CONSIDERED IN
ANALYSIS BY SAP 2000

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ABC

LOAD COMBINATION MULTIPLIERS

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD				In case water full in all tanks, no ground w
ater outside		SELF	1.0000	STATIC(DEAD)	
		WATER	1.0000	STATIC(LIVE)	
		CINDERCO	1.0000	STATIC(DEAD)	
		MAN	1.0000	STATIC(LIVE)	
COMB2	ADD				In case of tank-full and tank empty. Outside
no ground water		SELF	1.0000	STATIC(DEAD)	
		CINDERCO	1.0000	STATIC(DEAD)	
		MAN	1.0000	STATIC(LIVE)	
		WATER1	1.0000	STATIC(LIVE)	
COMB3	ADD				All tanks are empty, out side ground water 1
eval up to +0.00		SELF	1.0000	STATIC(DEAD)	
		CINDERCO	1.0000	STATIC(DEAD)	
		UPLIFT	1.0000	STATIC(OTHER)	
		EARTHPRE	1.0000	STATIC(OTHER)	
ENVE	ENVE				Maximum and minimum results of combol, combo
2, combo3		COMB1	1.0000	COMBO	
		COMB2	1.0000	COMBO	
		COMB3	1.0000	COMBO	

5-CALCULATION FOR BAR ARRANGEMENT:

Base on attached results of shell forces and frame forces analysed by SAP2000, choosing the most dangerous forces for calculation:

$$A_o = M/R_s b h_o^2$$

Where, M: Maximum bending moment(T.m)

h_o : Effective depth of bearing area(cm)

h_o = (Element thickness-Cover thickness)

b: Width of calculated area(cm)

Required area of reinforcement:

$$F_a = M/\gamma R_a h_o$$

Where: $\gamma = 0.5 + ((1-2A_o)^{1/2})/2$

5-1 SLABS AND WALLS:

Moments	Values (T.m)	A _o	γ	F _a (cm ²)	Bar arrangement		Remark
					ϕ (mm)	a(mm)	
(Bottom Slab level -5.3) t=0.50	-6.600 2.700	0.0510 0.0267	0.974 0.986	9.85 4.50	14 14	125 250	Slope Slope Slope
(Bottom Slab level -3.00) t=0.40	-2.400 6.500	0.0315 0.1184	0.984 0.937	4.62 15.49	14 16	250 125	
t=0.70	-21.200 -10.000 14.700 7.400 -15.700 21.200 -9.000	0.0763 0.0360 0.0624 0.0314 0.0667 0.0763 0.0382	0.960 0.982 0.968 0.984 0.965 0.960 0.981	21.90 10.11 16.37 8.10 17.52 21.90 9.89	20 20 18 18 18 20 18	125 250 125 250 125 125 250	
Pri. Sed. Tank bottom Slab Level +2.78 t=0.60	9.000 -4.500 12.800 -4.500	0.0558 0.0229 0.0794 0.0229	0.971 0.988 0.959 0.988	12.07 5.37 17.39 5.37	14 14 18 14	125 250 125 250	
Slab Level +3.7 t=0.40	-11.100 4.400 -10.600 5.600	0.1456 0.0577 0.1391 0.0735	0.921 0.970 0.925 0.962	22.83 8.59 21.71 11.03	20 14 20 14	125 150 125 125	
Water way floor L+5.8 t=0.30	-2.100 3.200	0.0567 0.0864	0.971 0.955	5.88 9.11	14 14	250 150	
Top floor level +8.0 t=0.20	-1.350 0.900 -0.800 0.650	0.0857 0.0571 0.0508 0.0413	0.955 0.971 0.974 0.979	5.89 3.86 3.42 2.77	12 14 12 12	150 250 250 250	
Wall of pri Sed. Tank	9.300 -9.300	0.0719 0.0719	0.963 0.963	14.04 14.04	16 16	125 125	

Moments	Values (T.m)	Ao	γ	Fa (cm ²)	Bar arrangement		Remark
					ϕ (mm)	a(mm)	
t=0.50							
Wall of pri	9.500	0.0734	0.962	14.36	16	125	125
Sed. Tank	-11.100	0.0858	0.955	16.89	22	200	
&Pri.Gallery	-17.300	0.1337	0.928	27.10	22	125	
t=0.50							
Water way	5.500	0.0722	0.963	10.82	14	125	
wall							
t=0.40							
t=0.30	-2.900	0.0783	0.959	8.22	12	125	

5-2 BEAMS:

AREA m2	LOCATION	Values (T.m)	Ao	γ	Fa (cm ²)	Bar arrangement	
						ϕ (mm)	quantity
b=0.50	At the end	12.300	0.0659	0.966	10.90	20	4
h=0.80	In the mid.	9.980	0.0535	0.972	8.79	18	4

5-2.1-CHECKING SHEAR FORCES:

- Height of hand for supporting coverslab s, so the section need to be checked shear bearing capacity is $[c/2+(h+s)/2]$
- In case $Q \geq R_{sx}bxd$ so the below case is to be considered
- In case concrete is not enough to bear shearing force, stirrups will be considered

$Sc/2 + S_s \geq Q$ (shearing force at section calculated)

Where

Sc: shearing bearing capacity of concrete (kg)

Ss: shearing bearing capacity of reinforcement (kg)

$S_s = A_s x R_{sx} j d / a = Q - Sc/2$

A_s: area of all stirrup in section considered

d: effective height of beam

a: pitch of stirrup (distance between two stirrups)

j: coefficient that consider safety factor (=1/1.15)

=0.87

Frame	height of beam h (m)	Width of beam b (m)	height of hand s (m)	height of column c (m)	c/2+ (h+s)/2	Values (T m) (Q)	Capacity of concrete (ton)	Shearing stress (Kg/cm ²)	Design stress (Kg/cm ²)	Compare & Conclude
at s=1.25	0.8	0.5	0	0.5	0.65	11.2	13.14	3.07	3.6	OK!!!

6- COLUMNS:

A. MATERIAL PROPERTIES:

Concrete	Grade	C21	Rm	=	70 (Kg/cm ²)
Reinforcement	Type	A1	E _s	=	200000 (Kg/cm ²)
			E _a	=	2000000 (Kg/cm ²)
			R _a = R _a '	=	1600 (Kg/cm ²)

B. CALCULATION:

(CAAP NO / LỊCH 3 - Kmax-Mở rộng)

NAME OF COLUMN	POSITION	l (cm)	b (cm)	h (cm)	a _{ra} (cm)	P ₀ (cm)	b ₀ (cm)	l _e	m ₀	R _a ² (Kg/cm ²)	a ₀	A ₀	h ₀ (%)	J _a (cm ⁴)	-b ₀ (cm ⁴)	M (Kg.m)	N (Kg)
Foot		640	50	50	1	45	415	9.32	1.00	70	0.12	0.45	0.75	453	5380.003	0.00E+00	9.14E+04

NAME OF COLUMN	POSITION	ϕ_2 (cm)	ϕ_{2h}	S	M_{2h} (Kg m)	N_{2h} (Kg)	K_{2h}	H_{2h} (Kg)	η	$\pi \cdot \phi_2$ (cm)	R_{2h}	ϕ (cm)	$\alpha \cdot R_0$	X' (cm)	$F_{2h} F_{2h}$ (mm)	u_2 (%)	$F_{2h, \text{max}}$ (cm ²)	u_2 (%)	CHECK	BO TRIDDI XANG $F_{2h} F_{2h}$ $\gamma \cdot D18$
F022		2.0	0.043	0.036	0.033 (100)	0.142 (100)	2.00	1.00E+06	0.016	2.77	14.34	20.1	20.7	40.8	0.011	0.158	0.001	0.001	0.001	0.001

6- CALCULATION FOR PILE NUMBER (as attached sheets):

(Pile number to be decided by pile calculation sheet, please refer to pile calculation sheet for more information)

MOMENTS OF BOTTOM SLAB (LEVEL -5.30)

53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100
101	102	103	104
105	106	107	108
109	110	111	112
113	114	115	116
117	118	119	120
121	122	123	124
125	126	127	128
129	130	131	132
133	134	135	136
137	138	139	140
141	142	143	144
145	146	147	148
149	150	151	152
153	154	155	156
157	158	159	160
161	162	163	164
165	166	167	168
169	170	171	172
173	174	175	176
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213	214	215	216
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253	254	255	256
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265	266	267	268
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297	298	299	300
301	302	303	304
305	306	307	308
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337	338	339	340
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393	394	395	396
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413	414	415	416
417	418	419	420
421	422	423	424
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445	446	447	448
449	450	451	452
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461	462	463	464
465	466	467	468
469	470	471	472
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485	486	487	488
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497	498	499	500
501	502	503	504
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557	558	559	560
561	562	563	564
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573	574	575	576
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581	582	583	584
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593	594	595	596
597	598	599	600
601	602	603	604
605	606	607	608
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613	614	615	616
617	618	619	620
621	622	623	624
625	626	627	628
629	630	631	632
633	634	635	636
637	638	639	640
641	642	643	644
645	646	647	648
649	650	651	652
653	654	655	656
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665	666	667	668
669	670	671	672
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677	678	679	680
681	682	683	684
685	686	687	688
689	690	691	692
693	694	695	696
697	698	699	700
701	702	703	704
705	706	707	708
709	710	711	712
713	714	715	716
717	718	719	720
721	722	723	724
725	726	727	728
729	730	731	732
733	734	735	736
737	738	739	740
741	742	743	744
745	746	747	748
749	750	751	752
753	754	755	756
757	758	759	760
761	762	763	764
765	766	767	768
769	770	771	772
773	774	775	776
777	778	779	780
781	782	783	784
785	786	787	788
789	790	791	792
793	794	795	796
797	798	799	800
801	802	803	804
805	806	807	808
809	810	811	812
813	814	815	816
817	818	819	820
821	822	823	824
825	826	827	828
829	830	831	832
833	834	835	836
837	838	839	840
841	842	843	844
845	846	847	848
849	850	851	852
853	854	855	856
857	858	859	860
861	862	863	864
865	866	867	868
869	870	871	872
873	874	875	876
877	878	879	880
881	882	883	884
885	886	887	888
889	890	891	892
893	894	895	896
897	898	899	900
901	902	903	904
905	906	907	908
909	910	911	912
913	914	915	916
917	918	919	920
921	922	923	924
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961	962	963	964
965	966	967	968
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973	974	975	976
977	978	979	980
981	982	983	984
985	986	987	988
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993	994	995	996
997	998	999	1000
1001	1002	1003	1004
1005	1006	1007	1008
1009	1010	1011	1012
1013	1014	1015	1016
1017	1018	1019	1020
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1097	1098	1099	1100
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1105	1106	1107	1108
1109	1110	1111	1112
1113	1114	1115	1116
1117	1118	1119	1120
1121	1122	1123	1124
1125	1126	1127	1128
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1133	1134	1135	1136
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1141	1142	1143	1144
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1149	1150	1151	1152
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1185	1186	1187	1188
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1193	1194	1195	1196
1197	1198	1199	1200
1201	1202	1203	1204
1205	1206	1207	1208
1209	1210	1211	1212
1213	1214	1215	1216
1217	1218	1219	1220
1221	1222	1223	1224
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1285	1286	1287	1288
1289	1290	1291	1292
1293	1294	1295	1296
1297	1298	1299	1300
1301	1302	1303	1304
1305	1306	1307	1308
1309	1310	1311	1312
1313	1314	1315	1316
1317	1318	1319	1320
1321	1322	1323	1324
1325	1326	1327	1328
1329	1330	1331	1332
1333	1334	1335	1336
1337	1338	1339	1340
1341	1342	1343	13

BOTTOM SLAB (LEVEL -3.10)

2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525
2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543
2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561
2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579
2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597
2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615
2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633
2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651
2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669
2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687
2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705
2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723
2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741
2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759
2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777
2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795
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2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	2990	2991	2992	2993
2994	2995	2996	2997	2998	2999	3000	3001	3002	3003	3004	3005	3006	3007	3008	3009	3010	3011
3012	3013	3014	3015	3016	3017	3018	3019	3020	3021	3022	3023	3024	3025	3026	3027	3028	3029
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3084	3085	3086	3087	3088	3089	3090	3091	3092	3093	3094	3095	3096	3097	3098	3099	3100	3101
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3120	3121	3122	3123	3124	3125	3126	3127	3128	3129	3130	3131	3132	3133	3134	3135	3136	3137
3138	3139	3140	3141	3142	3143	3144	3145	3146	3147	3148	3149	3150	3151	3152	3153	3154	3155
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3372	3373	3374	3375	3376	3377	3378	3379	3380	3381	3382	3383	3384	3385	3386	3387	3388	3389
3390	3391	3392	3393	3394	3395	3396	3397	3398	3399	3400	3401	3402	3403	3404	3405	3406	3407
3408	3409	3410	3411	3412	3413	3414	3415	3416	3417	3418	3419	3420	3421	3422	3423	3424	3425
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3588	3589	3590	3591	3592	3593	3594	3595	3596	3597	3598	3599	3600	3601	3602	3603	3604	3605
3606	3607	3608	3609	3610	3611	3612	3613	3614	3615	3616	3617	3618	3619	3620	3621	3622	3623
3624	3625	3626	3627	3628	3629	3630	3631	3632	3633	3634	3635	3636	3637	3638	3639	3640	3641
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3696	3697	3698	3699	3700	3701	3702	3703	3704	3705	3706	3707	3708	3709	3710	3711	3712	3713
3714	3715	3716	3717	3718	3719	3720	3721	3722	3723	3724	3725	3726	3727	3728	3729	3730	3731
3732	3733	3734	3735	3736	3737	3738	3739	3740	3741	3742	3743	3744	3745	3746	3747	3748	3749
3750	3751	3752	3753	3754	3755	3756	3757	3758	3759	3760	3761	3762	3763	3764	3765	3766	3767
3768	3769	3770	3771	3772	3773	3774	3775	3776	3777	3778	3779	3780	3781	3782	3783	3784	3785
3786	3787	3788	3789	3790	3791	3792	3793	3794	3795	3796	3797	3798	3799	3800	3801	3802	3803
3804	3805	3806	3807	3808	3809	3810	3811	3812	3813	3814	3815	3816	3817	3818	3819	3820	3821
3822	3823	3824	3825	3826	3827	3828	3829										

BOTTOM SLAB (LEVEL +2.78)
(ENVE COMBO Max (M₁₁))

735	756	757
849	852	851
943	944	945
107	108	109
925	921	923
925	924	927
919	928	931
913	914	915
987	986	989
981	982	983
985	974	997
939	978	971
935	974	985
927	973	979
971	972	973
965	966	967
957	968	961
952	954	955
947	945	949
941	942	943
935	936	937
929	938	931
923	924	925
917	918	919

956	957	958
952	953	954
945	947	946
946	941	942
934	935	936
928	929	928
922	923	924
916	917	918
910	911	912
904	905	906
901	902	903
895	896	898
892	893	894
885	887	886
880	881	882
874	875	876
868	869	870
862	863	864
856	857	858
853	854	855
845	846	847
840	839	841
837	838	839
836	837	838
830	831	832

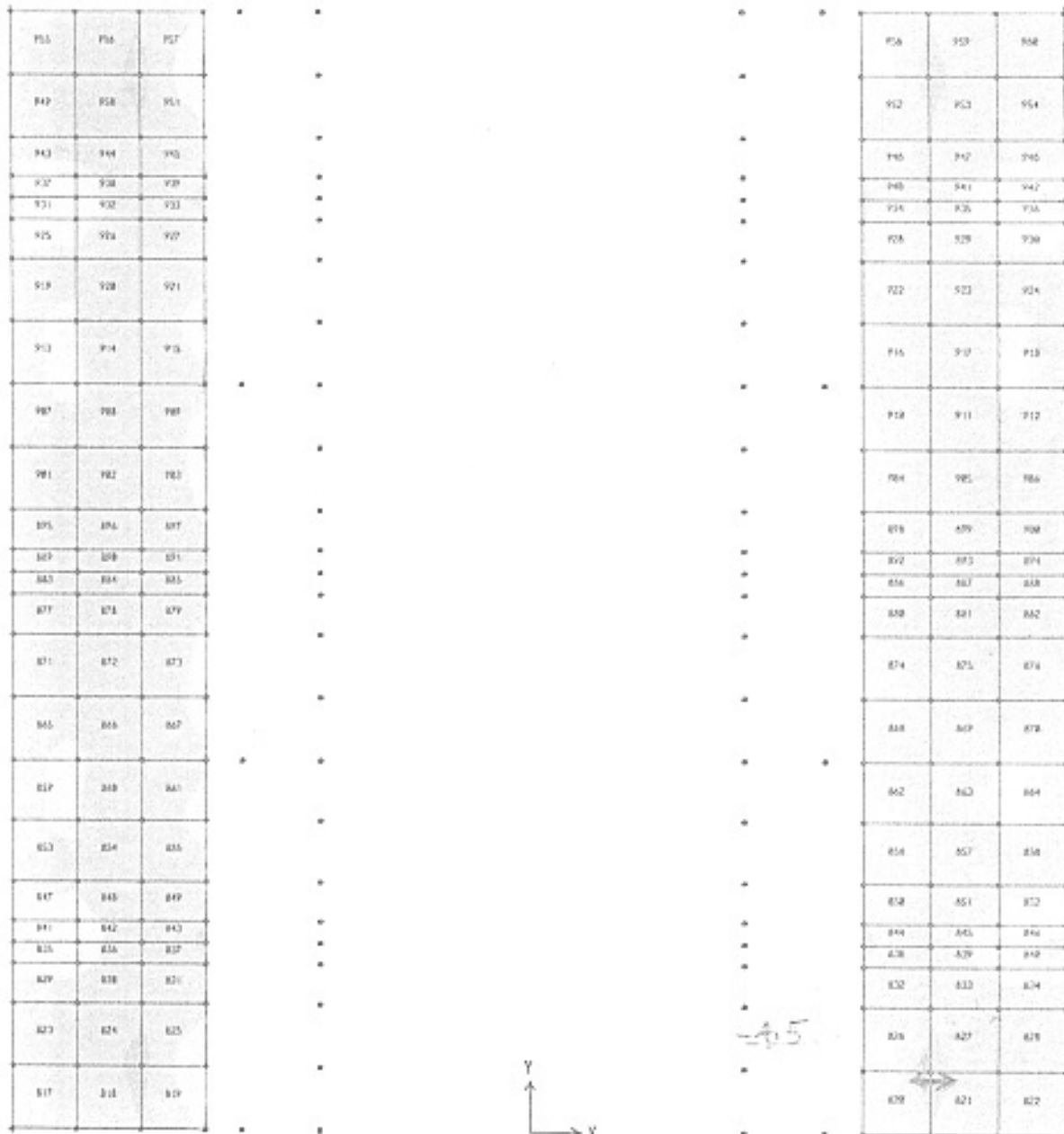


19.0

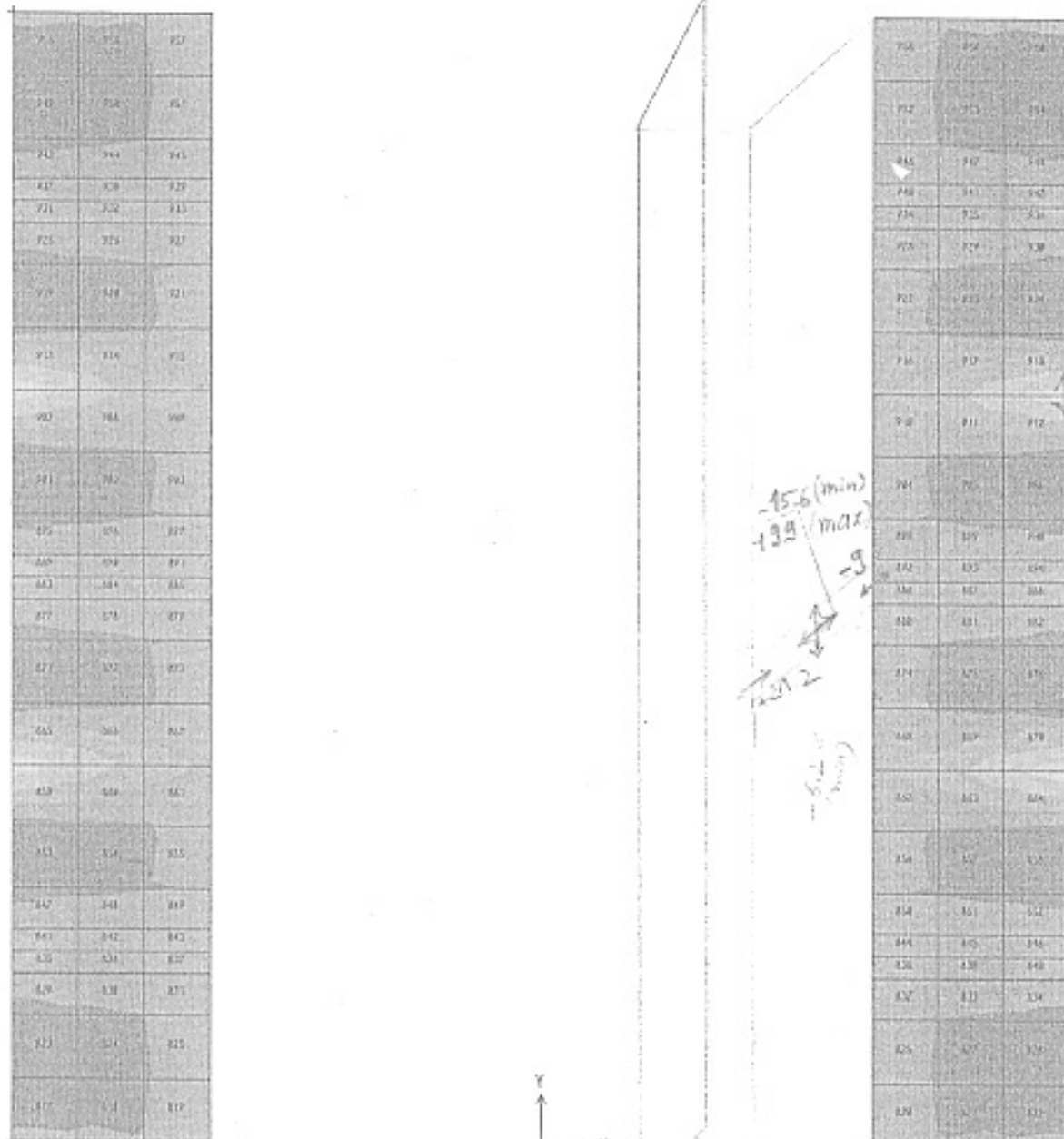
16.8

-10.5 -7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5

BOTTOM SLAB (LEVEL +2.78)
(ENVE COMBO Min (M_{11}))



BOTTOM SLAB (LEVEL +2.78)
(ENVE COMBO Max (M₂₂))



-7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5 21.0

BOTTOM SLAB (LEVEL +2.78)
(ENVE COMBO Min (M₂₂))

915	916	917
918	919	920
921	922	923
924	925	926
927	928	929
930	931	932
933	934	935
936	937	938
939	940	941
942	943	944
945	946	947
948	949	950
951	952	953
954	955	956
957	958	959
960	961	962
963	964	965
966	967	968
969	970	971
972	973	974
975	976	977
978	979	980
981	982	983
984	985	986
987	988	989
990	991	992
993	994	995
996	997	998
999	1000	1001

915	916	917
918	919	920
921	922	923
924	925	926
927	928	929
930	931	932
933	934	935
936	937	938
939	940	941
942	943	944
945	946	947
948	949	950
951	952	953
954	955	956
957	958	959
960	961	962
963	964	965
966	967	968
969	970	971
972	973	974
975	976	977
978	979	980
981	982	983
984	985	986
987	988	989
990	991	992
993	994	995
996	997	998
999	1000	1001



-17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0 10.5

FLOOR SLAB (LEVEL +3.70)

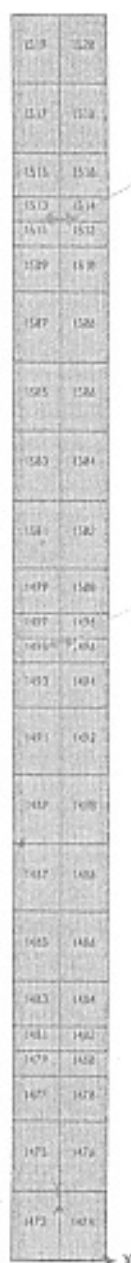
1207 1208
1315 1316
1313 1314
1211 1212
1209 1210
1205 1206
1203 1204
1201 1202
1299 1200
1297 1298
1295 1296
1293 1294
1291 1292
1289 1290
1287 1288
1285 1286
1283 1284
1281 1282
1279 1280
1277 1278
1275 1276
1273 1274
1271 1272
1269 1270
1267 1268
1265 1266
1263 1264
1261 1262
1259 1260

+4.4

-11.1

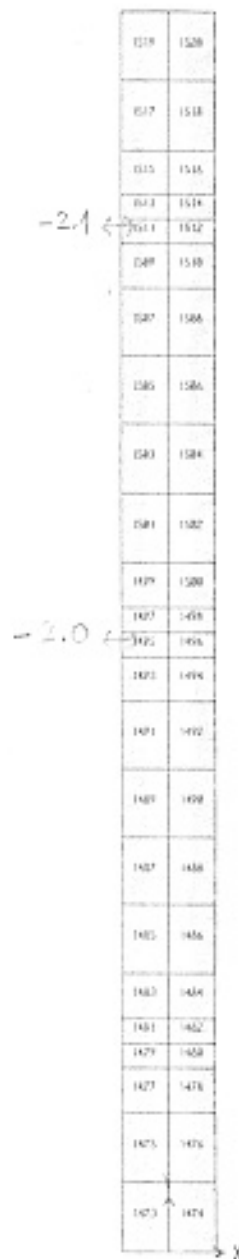
+3.5

WATERWAY FLOOR LEVEL +5.80)

(ENVE COMBO Max (M₁₁))

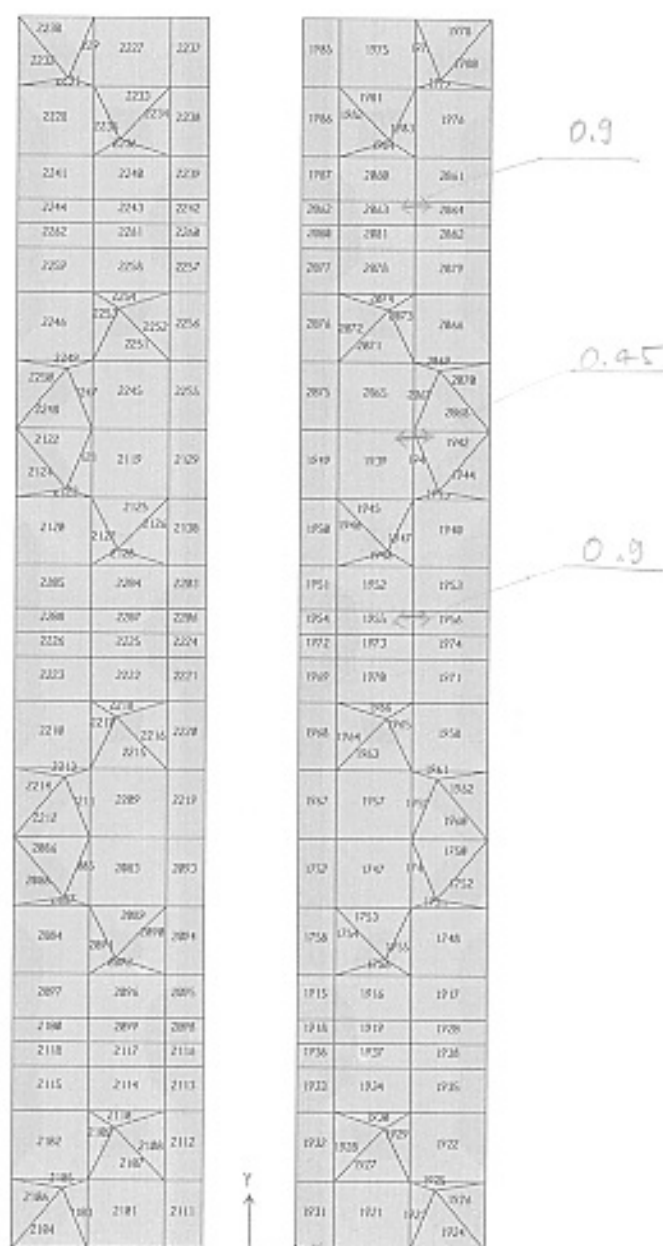
-10.5 -7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5

WATERWAY FLOOR LEVEL +5.80)

(ENVE COMBO Min (M₁₁))

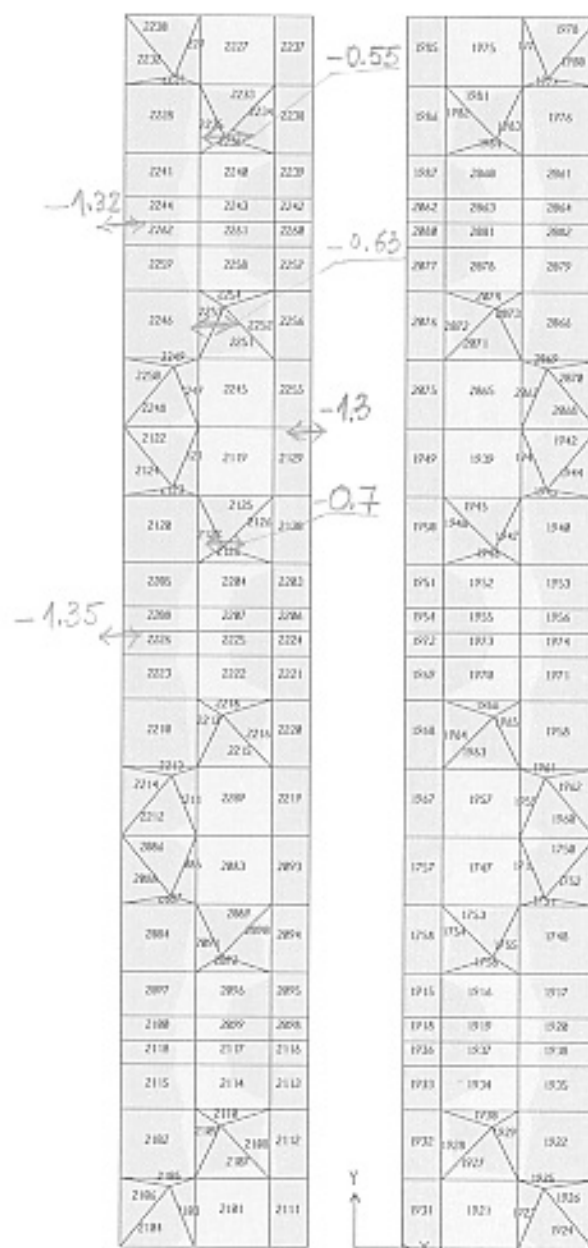
-21.0 -17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0

COVER SLAB (LEVEL +8.00)
(ENVE COMBO Max (M₁₁))

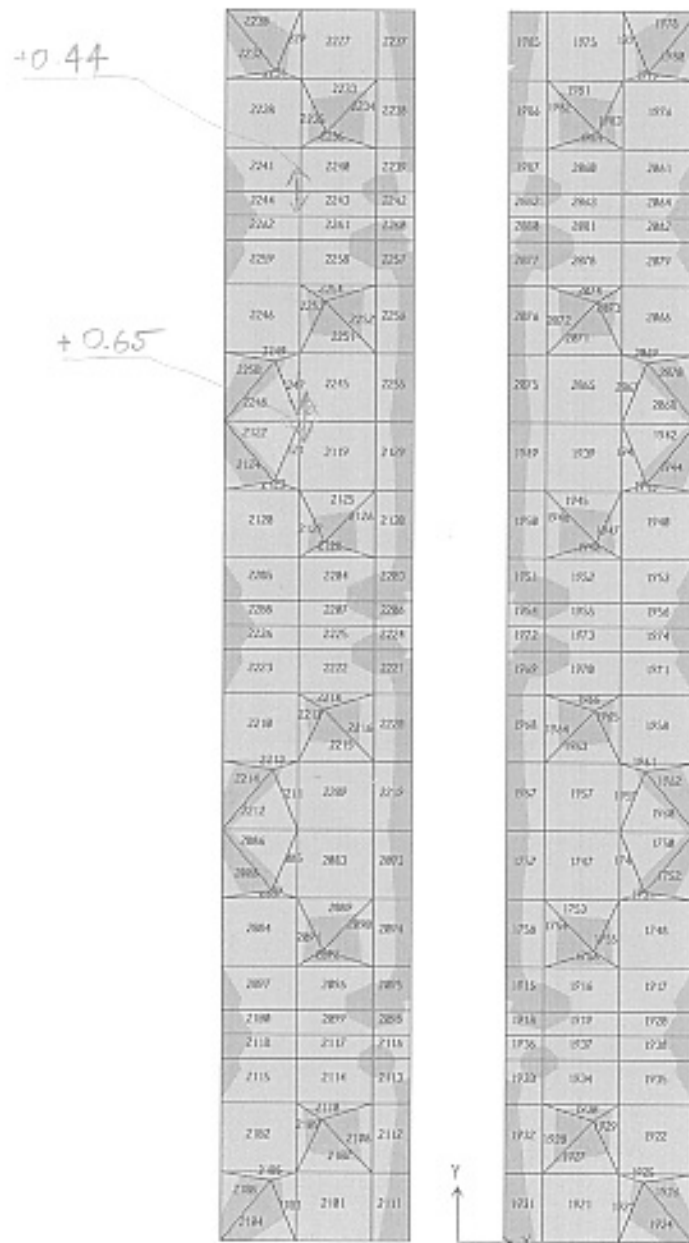


-10.5 -7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5

COVER SLAB (LEVEL +8.00)

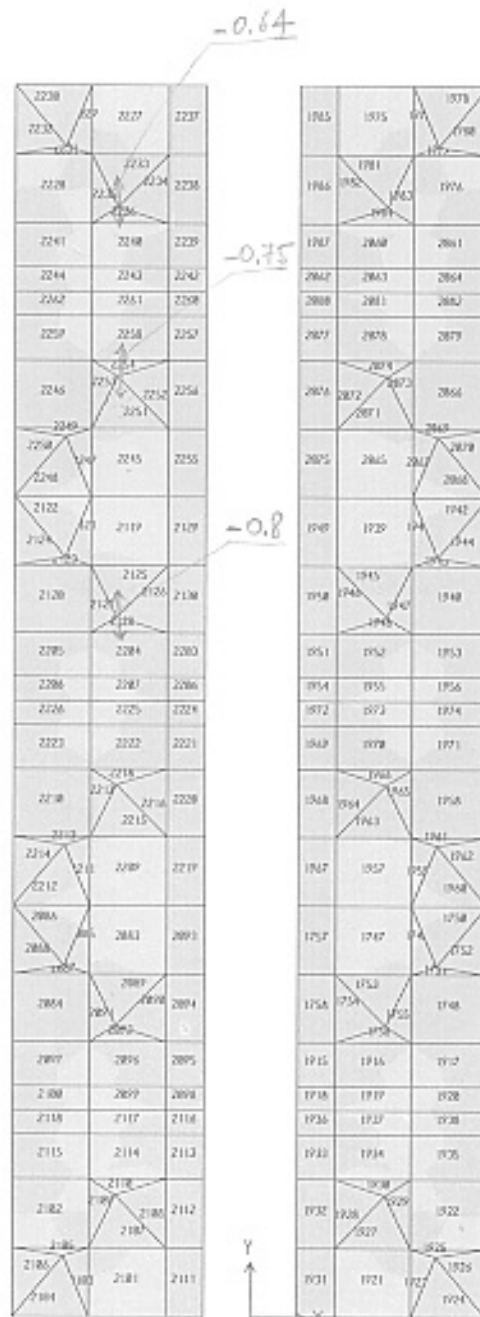
(ENVE COMBO Min (M_{11}))

COVER SLAB (LEVEL +8.00)
(ENVE COMBO Max (M_{22}))



-7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5 21.0

COVER SLAB (LEVEL +8.00)
(ENVE COMBO Min (M₂₂))



-17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0 10.5

1573	1574	1575	1576	1577
1367	1368	1369	1370	1371
1845	1846	1847	1848	1849
			741	742
			627	628
			513	515



1573	1579	1580	1581	1582
1372	1373	1374	1375	1376
1850	1851	1852	1853	1854
743	744			
631	632			
515	516			

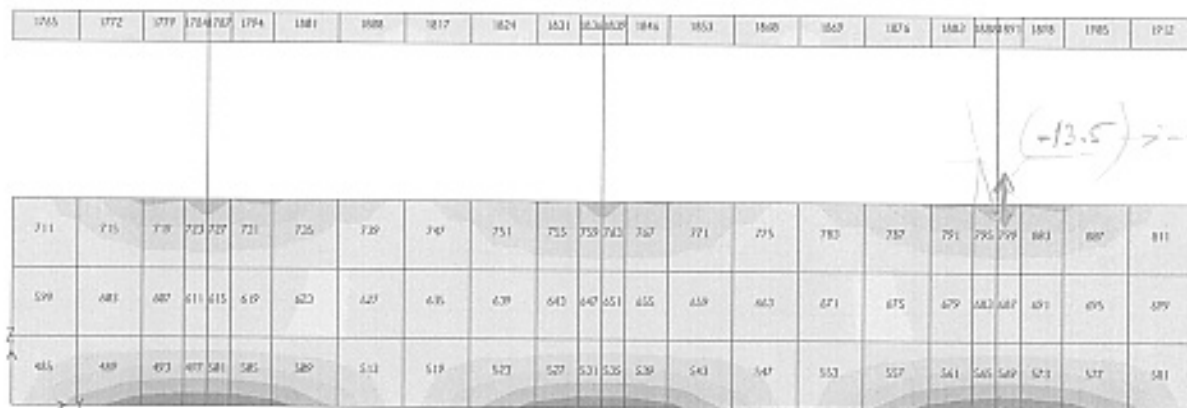
-5.2
(+5.2)

-9.3
(+9.3)

WALL OF PRIMARY SED. TANK
(ENVE COMBO Max, Min) (y=+11.00)

-17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0 10.5

WALL OF PIPE GALLERY AND PRIMARY SED. TANK

(ENVE COMBO MAX M₂₋₂) x = +6.25

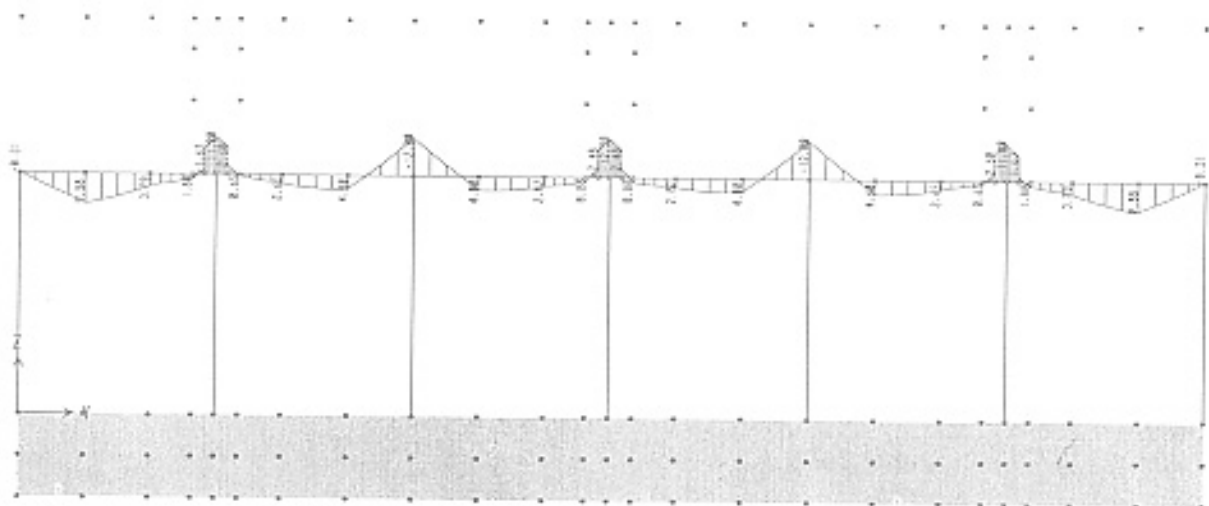
WALL OF WATER WAY (ENVE COMBO MAX) x=1.25

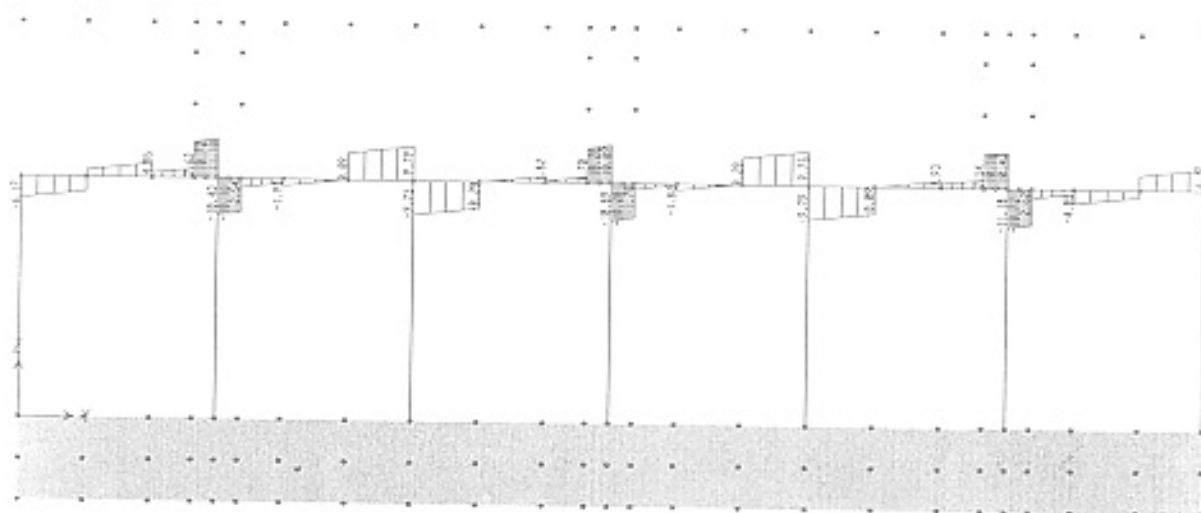
-2.9

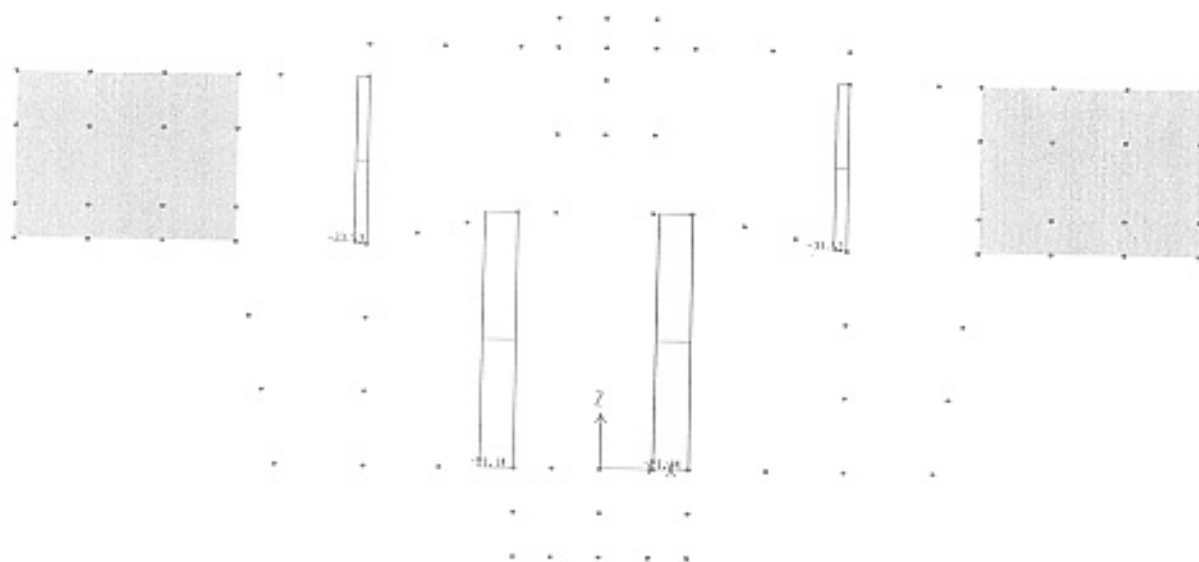
2132	2136	2139	1421	1421	2148	2151	2154	2157	2168	2163	2163	2163	2172	2175	2178	2181	2184	2187	2190	2193	2196	2199	2202
1764	1771	1778			1792	1808	1827	1846	1873	1898			1945	1952	1959	1966	1975	1982			1997	1994	2011
1536	1548	1541			1568	1565	1578	1587	1592	1597			1612	1617	1622	1629	1644	1649			1664	1667	1674
1332	1336	1348	1348	1352	1356	1368	1364	1388	1384	1388	1393	1408	1404	1417	1426	1432	1436	1448	1445	1452	1456	1468	



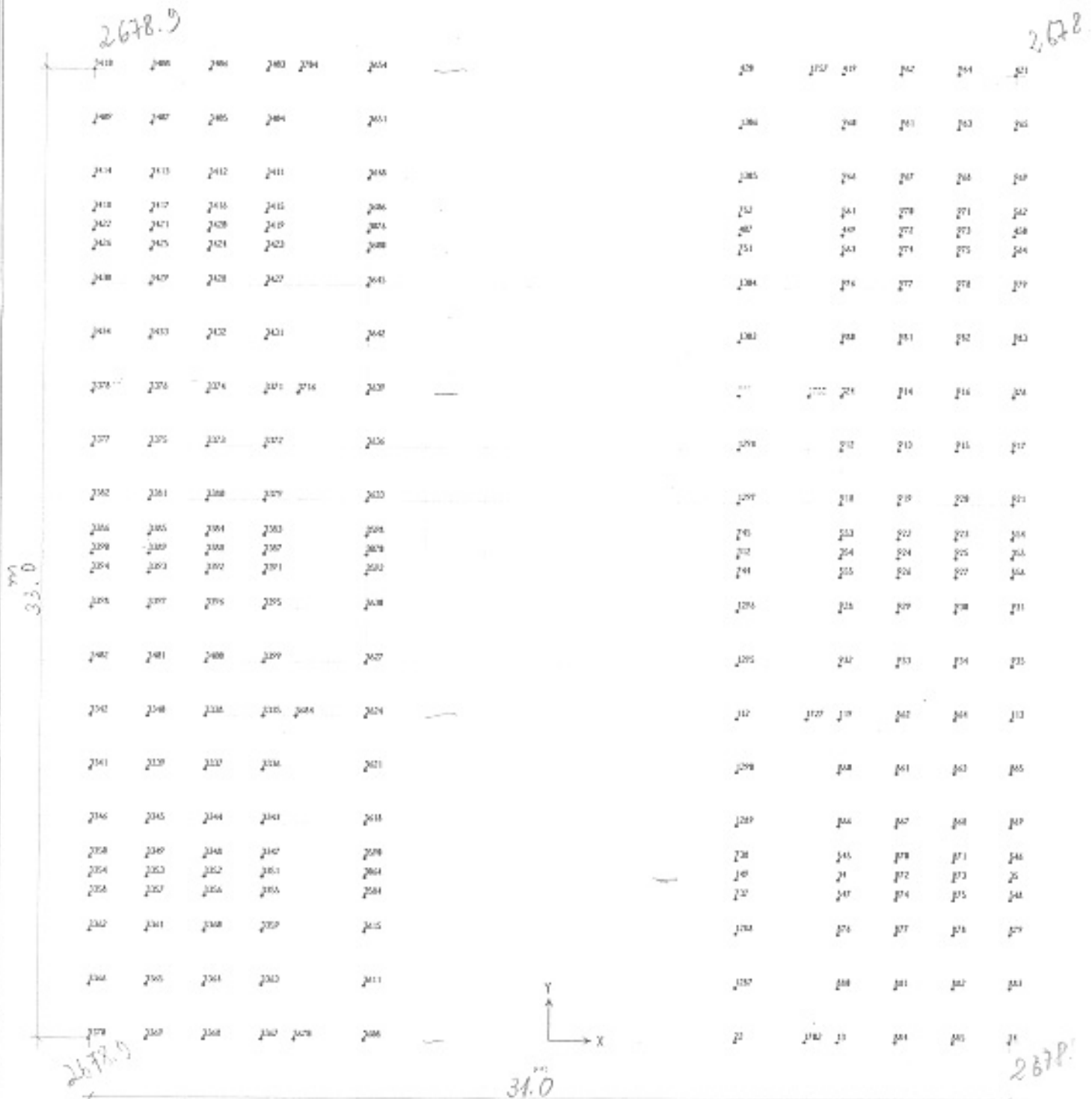
-17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0 10.5







CALCULATION FOR PILE NUMBER PIPE GALLERY - PRIMARY SEDIMENTATION TANK



Preaction = 10.50 T/m² and Pile Capacity = 45 T/pile

⇒ Area of one pile that can used for an area of 4.29 m²

⇒ The arrangement may be (2x2)m. Please refer to pile arrangement No. PE - WWTP - 252 - 01

No. PE - WWTP - 252 - 02

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ABC

LOAD COMBINATION MULTIPLIERS

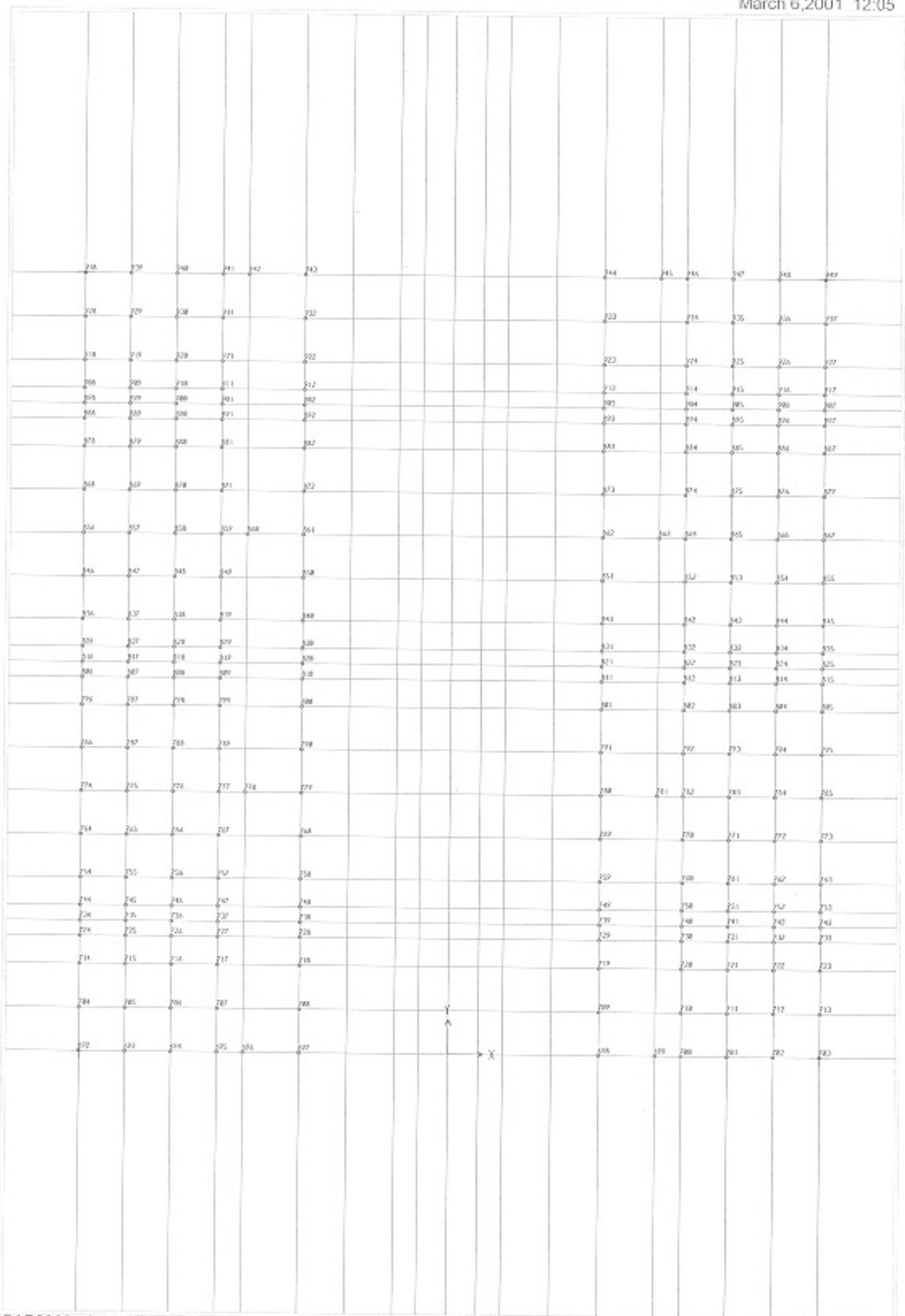
COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
PILECOMB	ADD				for calculating number of piles
	SELF	1.0000	STATIC(DEAD)		
	WATER	1.0000	STATIC(DEAD)		
	CINDERCO	1.0000	STATIC(DEAD)		
	MAN	1.0000	STATIC(DEAD)		

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ABC

JOINT REACTIONS

JOINT	LOAD	F1	F2	F3	M1	M2	M3
14	SELF	98.8886	-331.0898	1513.8496	0.0000	0.0000	0.0000
14	WATER	58.0416	-187.2215	1026.9735	0.0000	0.0000	0.0000
14	CINDERCO	3.3893	-6.5370	25.7813	0.0000	0.0000	0.0000
14	MAN	12.1968	-26.8121	112.2825	0.0000	0.0000	0.0000
14	UPLIFT	-78.8528	189.9668	-793.8298	0.0000	0.0000	0.0000
14	PILECOMB	172.5163	-551.6603	2678.8870	0.0000	0.0000	0.0000
421	SELF	98.8888	331.0898	1513.8496	0.0000	0.0000	0.0000
421	WATER	58.0411	187.2215	1026.9735	0.0000	0.0000	0.0000
421	CINDERCO	3.3894	6.5370	25.7813	0.0000	0.0000	0.0000
421	MAN	12.1971	26.8121	112.2825	0.0000	0.0000	0.0000
421	UPLIFT	-78.8538	-189.9668	-793.8298	0.0000	0.0000	0.0000
421	PILECOMB	172.5174	551.6603	2678.8870	0.0000	0.0000	0.0000
3370	SELF	-98.8886	-331.0898	1513.8496	0.0000	0.0000	0.0000
3370	WATER	-58.0416	-187.2215	1026.9735	0.0000	0.0000	0.0000
3370	CINDERCO	-3.3893	-6.5370	25.7813	0.0000	0.0000	0.0000
3370	MAN	-12.1968	-26.8121	112.2825	0.0000	0.0000	0.0000
3370	UPLIFT	78.8528	189.9668	-793.8298	0.0000	0.0000	0.0000
3370	PILECOMB	-172.5163	-551.6603	2678.8870	0.0000	0.0000	0.0000
3410	SELF	-98.8888	331.0898	1513.8496	0.0000	0.0000	0.0000
3410	WATER	-58.0411	187.2215	1026.9735	0.0000	0.0000	0.0000
3410	CINDERCO	-3.3894	6.5370	25.7813	0.0000	0.0000	0.0000
3410	MAN	-12.1971	26.8121	112.2825	0.0000	0.0000	0.0000
3410	UPLIFT	78.8538	-189.9668	-793.8298	0.0000	0.0000	0.0000
3410	PILECOMB	-172.5174	551.6603	2678.8870	0.0000	0.0000	0.0000



CALCULATION FOR WASTEWATER TREATMENT PLANT STRUCTURES**PRIMARY SEDIMENTATION TANK-PIPE GALLERY-AERATION TANK**

(The calculation based on Japanese standard)

1-GEOMETRY DIMENSIONS FOR CALCULATION

(As shown on drawings attached):

Ground level:	GL =	+ 2.20
Ground water level:	GWL=	0.00
Bottom level of pipegallery:	BL =	-3.10
Bottom level of primary sedimentation tank: BL		2.94
Bottom level of aeration tank: BL =		-0.35

Water level of primary sedimentation tank	+ 6.06
Water level of aeration tank:	5.28

Thickness of primary sedimentation tank	0.60 m
Thickness of pipegallery bottom:	0.60 m
Thickness of aeration tank bottom	0.60 m
Cinder concrete thickness	0.10 m

*And all other dimensions shown on the drawing attached***2-MATERIAL PROPERTIES AND SOIL CONDITIONS:**

Concrete: Grade C21,	Rn =	70 (Kg/cm ²)
	RS=	3.6 (Kg/cm ²)
Reinforcement type All :	Ra=	1600 (Kg/cm ²)
Back fill sand: $\gamma_s =$	1.80T/m ³	; Coefficient of earth pressure at rest K_0 0.5
Internal friction	20deg	

3-LOAD CALCULATION (BASE ON JAPANESE STANDARD):**3.1- Maximum loads from architect part to be taken in calculation as in analysis****3.2- Soil load:****In case of ground water level at 0.00 (Permanent case):**

-Horizontal triangle distributed load due to earth under ground water level (under primary sed. tank):

$$p_{h1} = 0.8 \times 6.1 \times 0.5 + 6.1 \times 1 = 8.54 \text{ T/m}^2$$

-Horizontal triangle distributed load due to earth under ground water level (under aeration tank):

$$p_{h1} = 0.8 \times 2.75 \times 0.5 + 2.75 \times 1 = 3.9 \text{ T/m}^2$$

-Uplift pressure to bottom of pipegallery:

$$p_{upth} = (H_{\text{ground water}}) \times 1.0 = 3.70 \text{ T/m}^2$$

-Uplift pressure to bottom of aeration tank:

$$p_{upth} = (H_{\text{ground water}}) \times 1.0 = 1.0 \text{ T/m}^2$$

3.3-Water load

According to highest water level and bottom level as illustrated in the drawing, water loads to be calculate and shown on the attached drawing.

3.4-Load of non-reinforced concrete layer on bottom slab:

(Due to mechanical supports and cinder concrete)

$$\text{-Uniform load: } q_{\text{con layer}} = 2.5 \times 0.10 = 0.25 \text{ T/m}^2$$

3.5-Live load:

$$\text{-Live load for all operating floor and walking way : } q_{\text{live}} = 0.50 \text{ T/m}^2$$

4-ANALYSING BY SAP 2000: THERE ARE 3 COMBOS FOR ANALYSING AS ATTACHED HEREAFTER:

ALL THE LOADS, FACTORS, AND OTHER INPUT DATUM TO BE TAKEN IN ANALYSIS AND CALCULATED BY SAP 2000

The reaction results of combo 2 as attached shows that no uplift case happen to the structure

LOAD COMBINATION MULTIPLIERS

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD				In case of all tanks are full of water, no ground water outside
		WATER	1.0000	STATIC(LIVE)	
		CINDERCO	1.0000	STATIC(DEAD)	
		MAN	1.0000	STATIC(LIVE)	
		SELF	1.0000	STATIC(DEAD)	
		ONLYSOIL	1.0000	STATIC(OTHER)	
COMB2	ADD				In case of all tanks are empty, ground water level is up to 0.00
		CINDERCO	1.0000	STATIC(DEAD)	
		SELF	1.0000	STATIC(DEAD)	
		UPLIFT	1.0000	STATIC(OTHER)	
		SUBMSOIL	1.0000	STATIC(OTHER)	
COMB3	ADD				In case of tank-empty and tank-full, no ground water
		CINDERCO	1.0000	STATIC(DEAD)	
		SELF	1.0000	STATIC(DEAD)	
		WATER1	1.0000	STATIC(LIVE)	
		MAN	1.0000	STATIC(LIVE)	
		ONLYSOIL	1.0000	STATIC(OTHER)	
ENVE	ENVE				Max min of all combos to calculate for reinforcement
		COMB1	1.0000	COMBO	
		COMB2	1.0000	COMBO	
		COMB3	1.0000	COMBO	

5-CALCULATION FOR BAR ARRANGEMENT:

Base on attached results of shell forces and frame forces analised by SAP2000, choosing the most dangerous forces for calculation:

$$A_o = M/R_n b h_o^2 \quad \text{Where, } M: \text{Maximum bending moment(T.m)}$$

$$h_o: \text{Effective depth of bearing area(cm)}$$

$$h_o = (\text{Element thickness} - \text{Cover thickness})$$

$$b: \text{Width of calculated area(cm)}$$

Required area of reinforcement:

$$F_a = M/\gamma R_a h_o \quad \text{Where: } \gamma = 0.5 + ((1 - 2A_o)^{1/2})/2$$

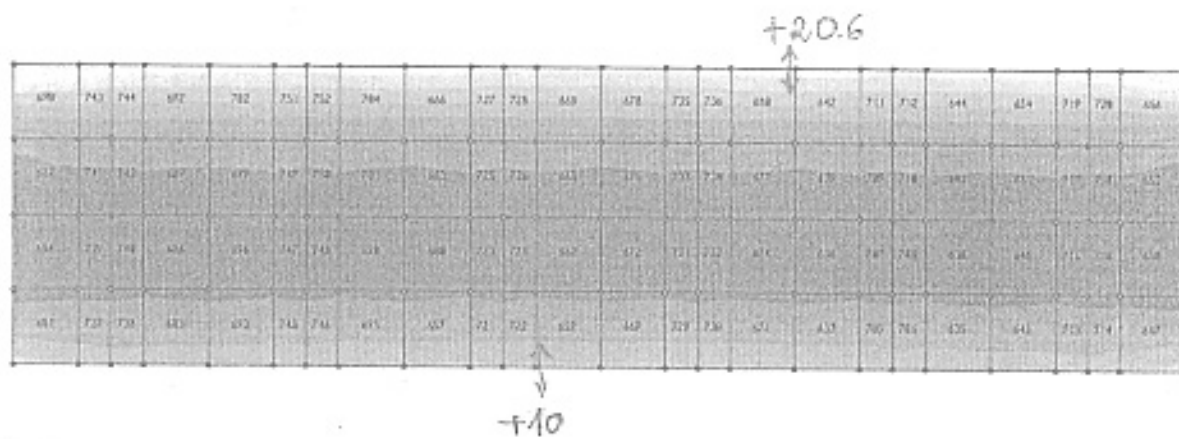
5-1 SLABS AND WALLS:

Moments	Values (T.m)	Ao	γ	Fa (cm ²)	r arrangement		
					ϕ (mm)	a(mm)	
(Bottom	21.000	0.1302	0.930	29.40	22	125	243-125
Slab level	10.000	0.0620	0.968	13.45	22	250	243-250
-3.10)	-10.200	0.0519	0.973	12.36	16	125	
t=0.60							
aeration	19.000	0.1178	0.937	26.40	22	125	Not in DWG
tank bottom	12.300	0.0763	0.960	16.68	18	125	
slab	-5.300	0.0270	0.986	6.34	14	200	a-125
level +0.35	7.500	0.0465	0.976	10.00	14	125	
t=0.60	-10.900	0.0554	0.971	13.23	16	125	
Pri. Sed.	10.900	0.0676	0.965	14.71	16	125	
tank bottom	8.650	0.0536	0.972	11.58	14	125	
Level +2.78	-4.700	0.0239	0.988	5.61	12	200	a-125
t=0.60							
Water way							
bottom slab	11.600	0.1522	0.917	23.96	20	125	
0.4	-3.300	0.0433	0.978	6.39	16	250	a-125
Cover slab	-5.500	0.1964	0.890	19.32	18	125	
t=0.25	-4.700	0.1679	0.908	16.18	18	125	
	2.250	0.0804	0.958	7.34	12	125	
Wall for pri.	9.600	0.0742	0.961	14.51	16	125	
sed. Tank	-9.900	0.0765	0.960	14.99	24	250	
& pipe ga.	-7.400	0.0572	0.971	11.08	20	250	
0.5							
Wall of							
water way	-5.500	0.0722	0.963	10.82	14	125	
0.4	11.600	0.1522	0.917	23.96	20	125	
Wall of Pipe	11.100	0.0858	0.955	16.89	18	125	
gallery and	21.300	0.1646	0.910	34.04	24	125	
aeration tank	-11.800	0.0912	0.952	18.01	18	125	
0.5	5.000	0.0386	0.980	7.41	16	250	
	-4.400	0.0340	0.983	6.51	16	250	
Longitudinal	-6.000	0.0464	0.976	8.93	14	150	a-125
wall	-6.200	0.0479	0.975	9.24	14	125	
0.5	7.300	0.0564	0.971	10.93	14	125	

6- CALCULATION FOR PILE NUMBER (as attached sheets):

(Pile number to be decided by pile calculation sheet, please refer to pile calculation sheet for more information)

BOTTOM SLAB OF PIPE GALLERY(LEVEL - 3.1)
(ENVE COMBO MAX)



BOTTOM SLAB OF PIPE GALLERY(LEVEL - 3.1)
(ENVE COMBO MIN)

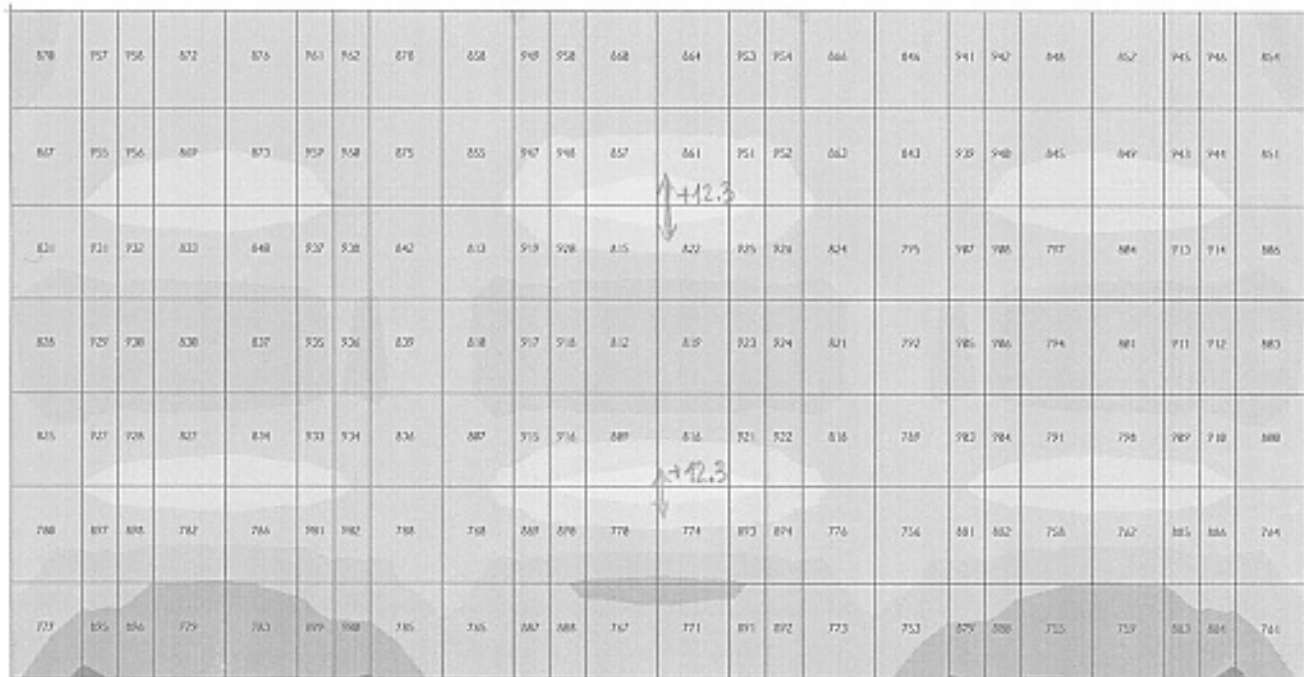
-10.2

698	741	744	692	782	751	752	786	666	727	725	665	675	725	726	688	642	711	712	646	654	715	728	656
687	741	742	689	699	749	758	781	663	725	725	665	675	733	734	677	639	789	748	641	651	715	718	652
684	720	748	654	695	747	745	698	668	723	724	662	672	731	732	674	636	787	785	638	648	715	716	658
683	737	738	683	693	745	745	695	657	721	722	659	669	729	738	671	633	785	785	635	645	712	714	647



-22.0 -16.5 -11.0 -5.5 0.0 5.5 11.0 16.5 22.0

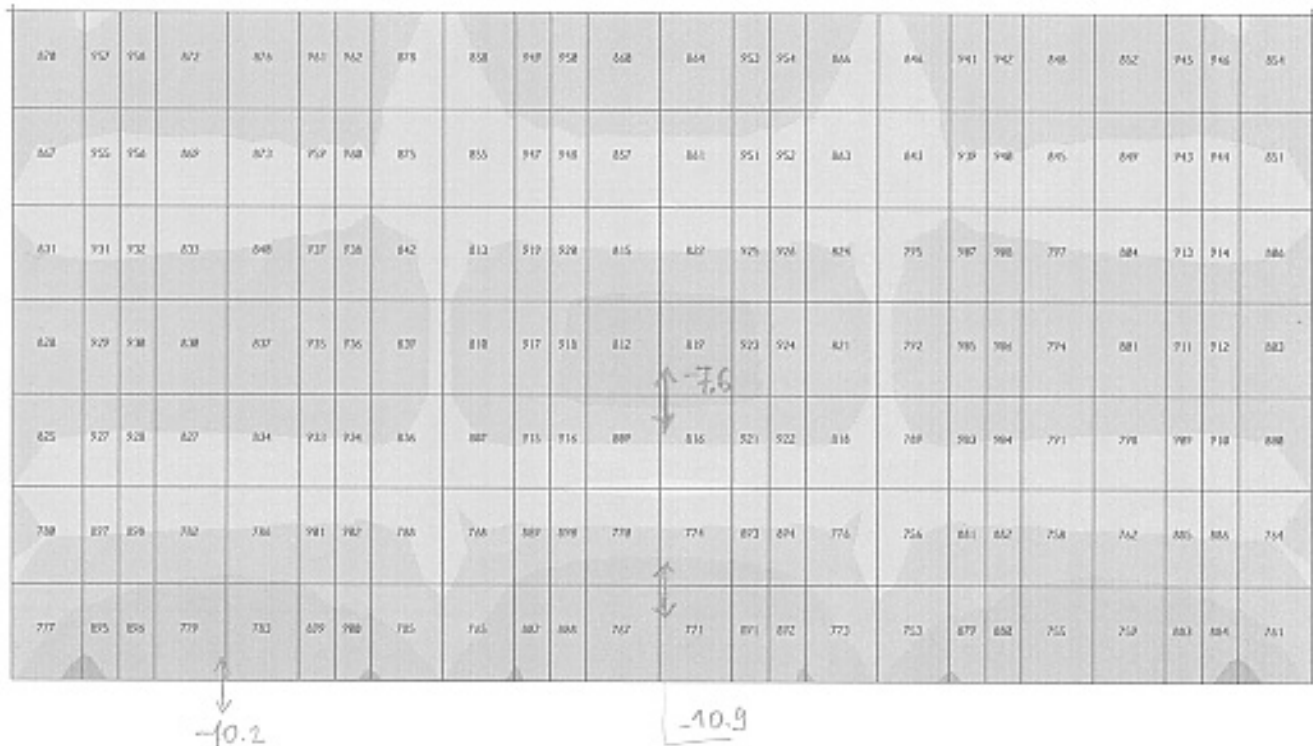
AERATION TANK BOTTOM SLAB LEVEL -0.35
(ENVE COMBO MAX)



-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5

AERATION TANK BOTTOM SLAB LEVEL -0.35

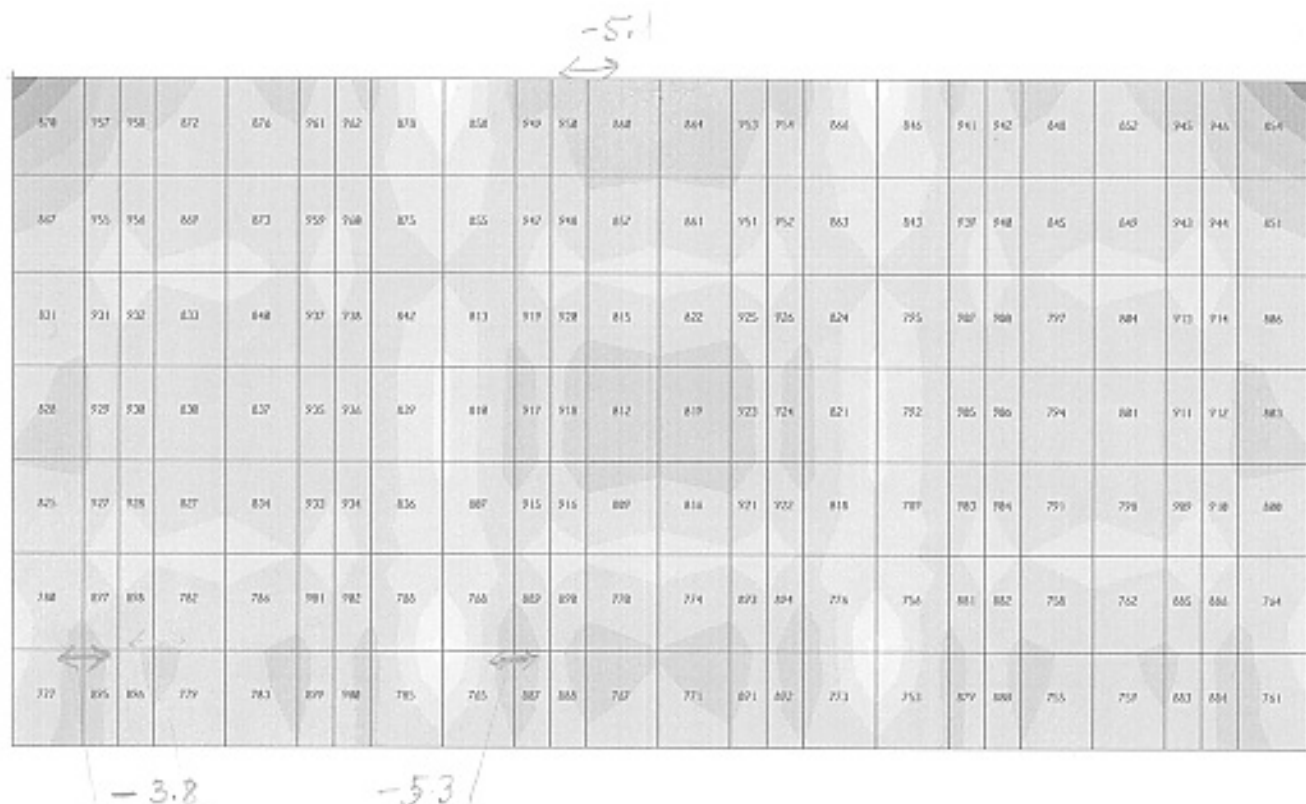
(ENVE COMBO MIN)



-22.0 -16.5 -11.0 -5.5 0.0 5.5 11.0 16.5 22.0

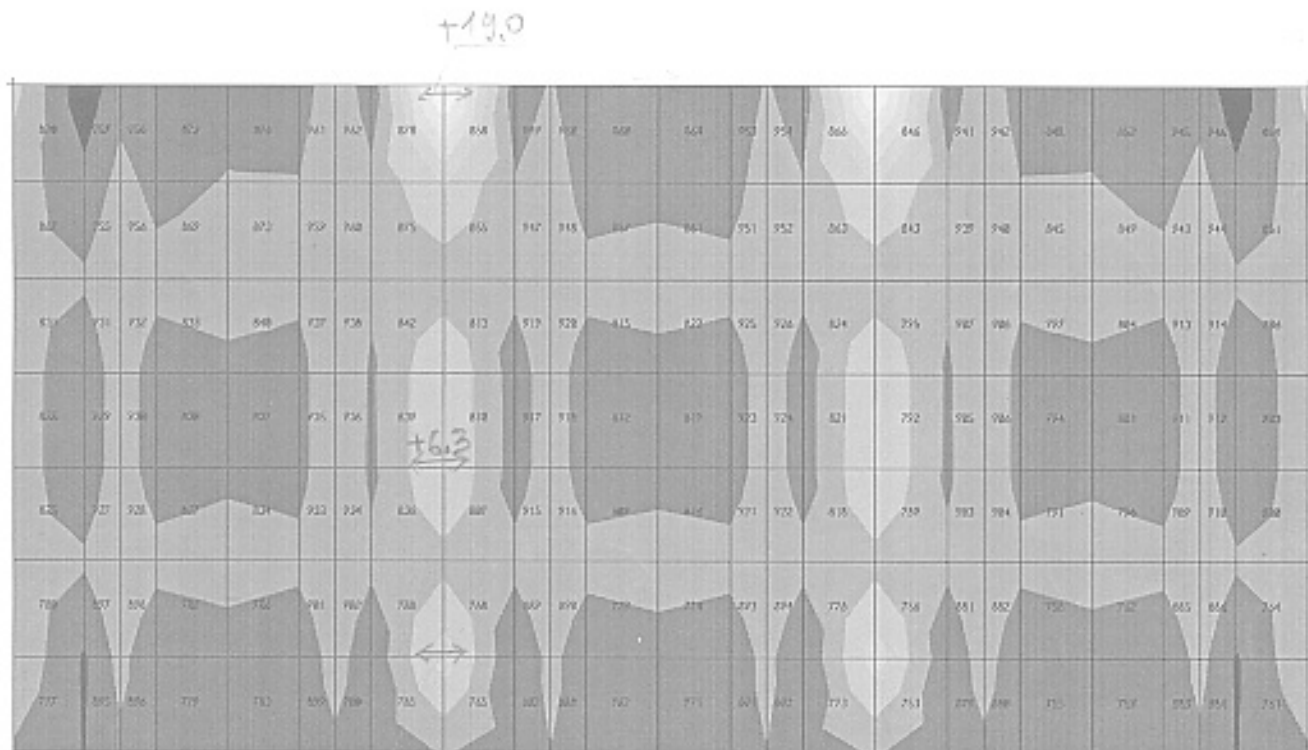
AERATION TANK BOTTOM SLAB LEVEL -0.35

(ENVE COMBO MIN)

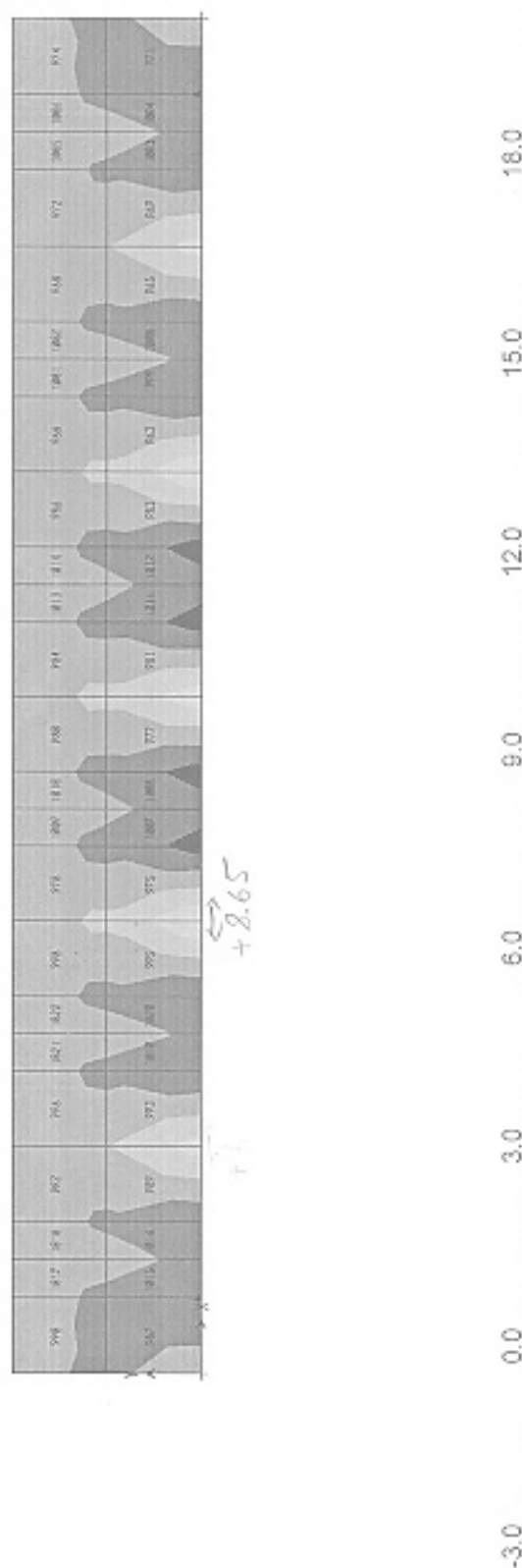


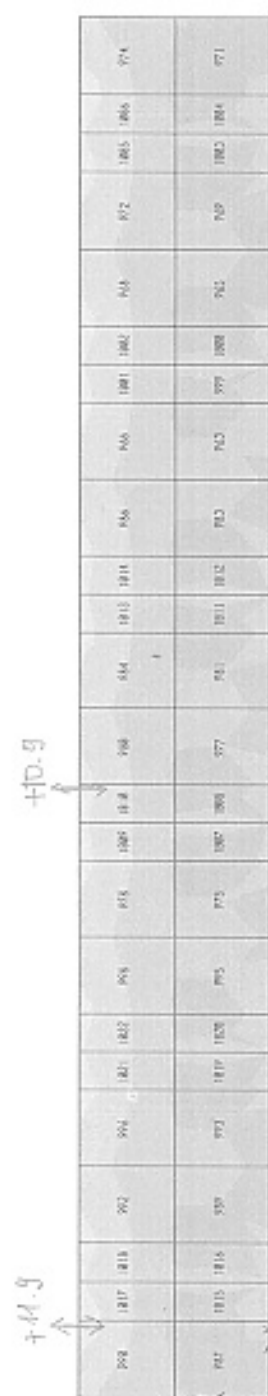
-13.0 -10.4 -7.8 -5.2 -2.6 0.0 2.6 5.2 7.8

AERATION TANK BOTTOM SLAB LEVEL -0.35
(ENVE COMBO MAX)



PRIMARY SEDIMENTATION TANK BOTTOM SLAB LEVEL +2.78
(ENVE COMBO MAX M11)

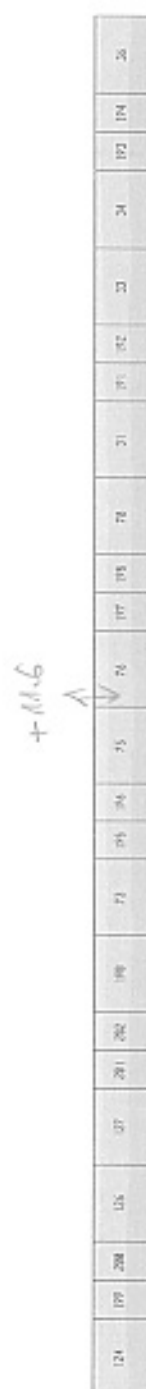




PRIMARY SEDIMENTATION TANK BOTTOM SLAB LEVEL +2.78

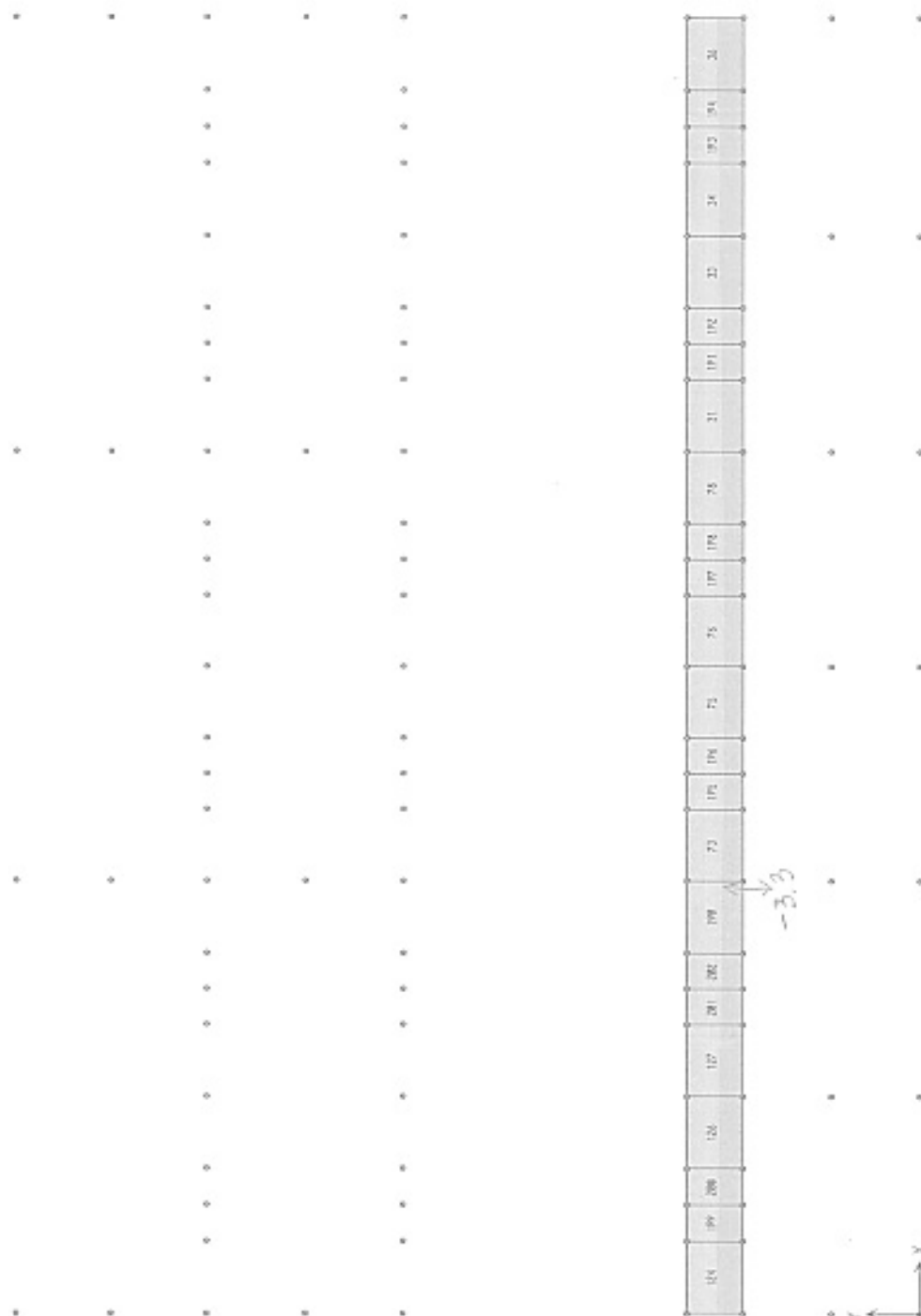
(ENVE COMBO MAX M22)

-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5



WATERWAY BOTTOM SLAB (LEVEL +5.2)
(ENVE COMBO MAX M₂₂)

-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5



WATERWAY BOTTOM SLAB (LEVEL +5.2)
(ENVE COMBO MIN M₁₁)

22.25

219	275	276	252	255	301	304	305	297	253	256	258	253	262	252	254	255	271	274	276	277	269	244
220	274	267	261	266	300	303	297	290	252	255	259	252	265	251	255	254	270	272	273	275	279	243
221	271	264	268	263	299	302	296	289	245	251	255	251	267	250	254	253	265	272	273	275	278	242



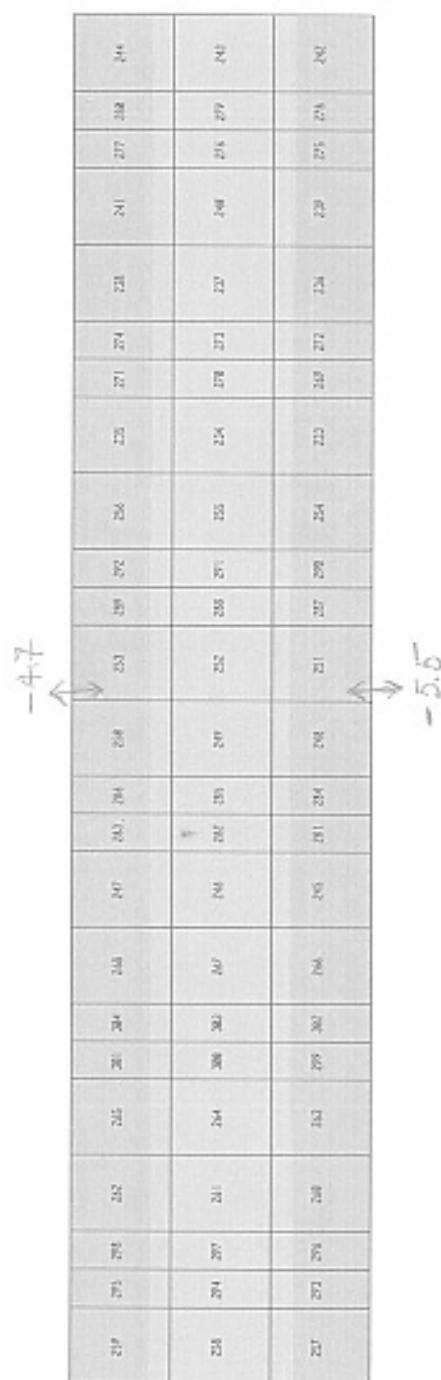
COVER SLAB (LEVEL +6.9)

(ENVE COMBO MAX M22)

-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5

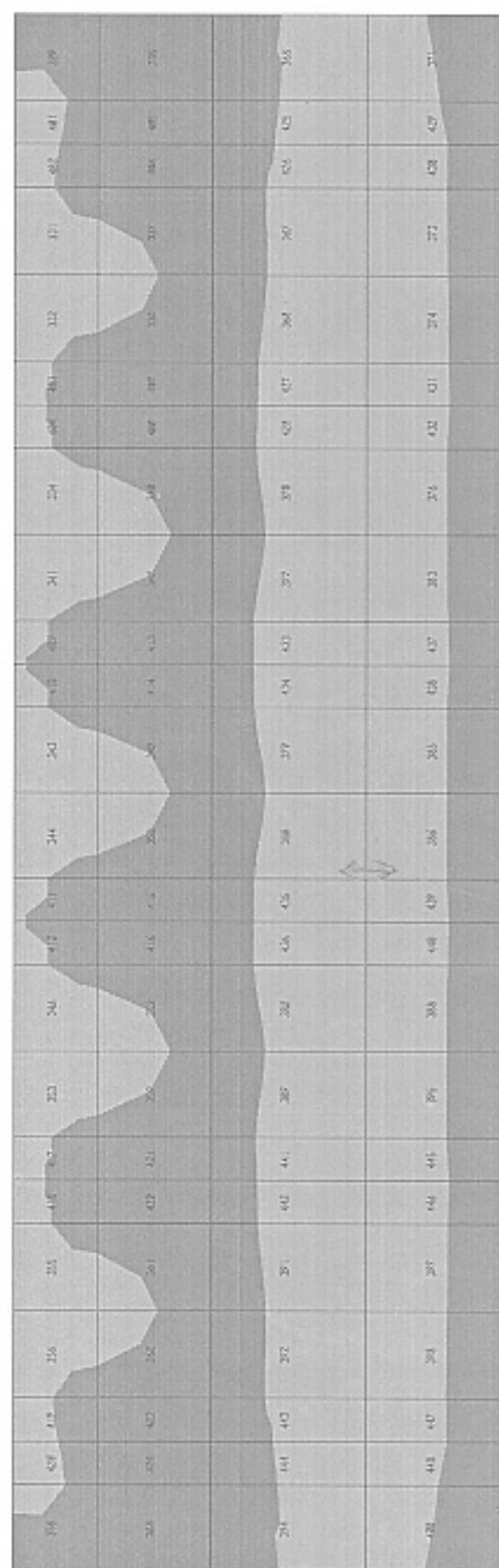
COVER SLAB (LEVEL +6.9)

(ENVE COMBO MIN M22)

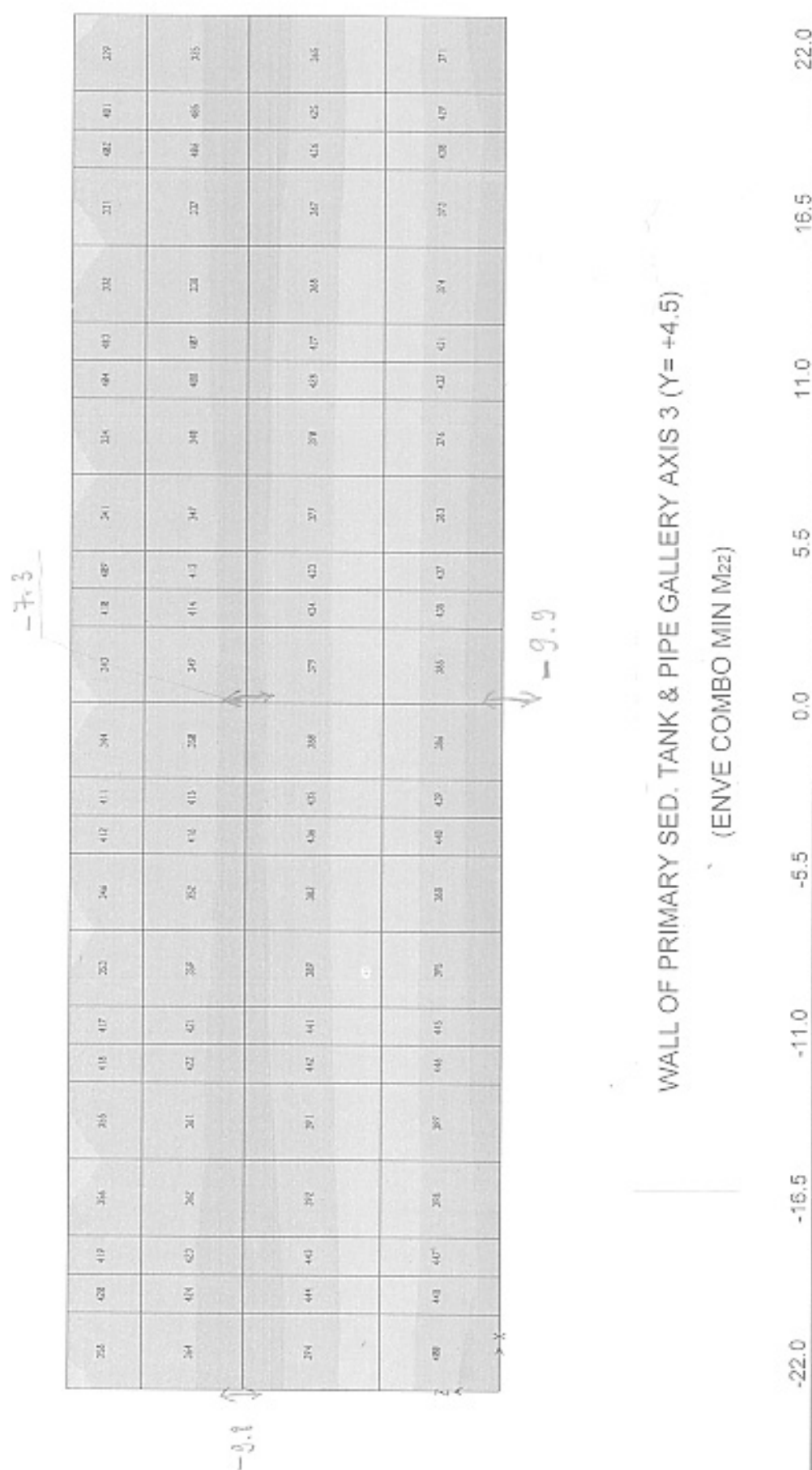


-22.0 -16.5 -11.0 -5.5 0.0 5.5 11.0 16.5 22.0

WALL OF PRIMARY SED. TANK & PIPE GALLERY AXIS 3 (Y= +4.5)
(ENVE COMBO MAX, MIN M₁₁)



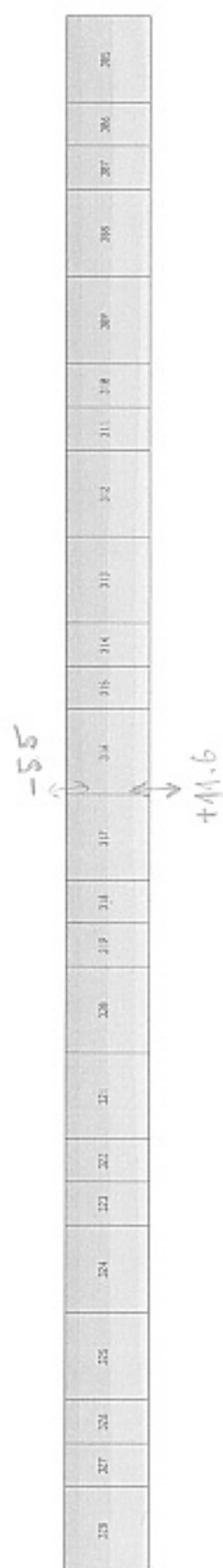
-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

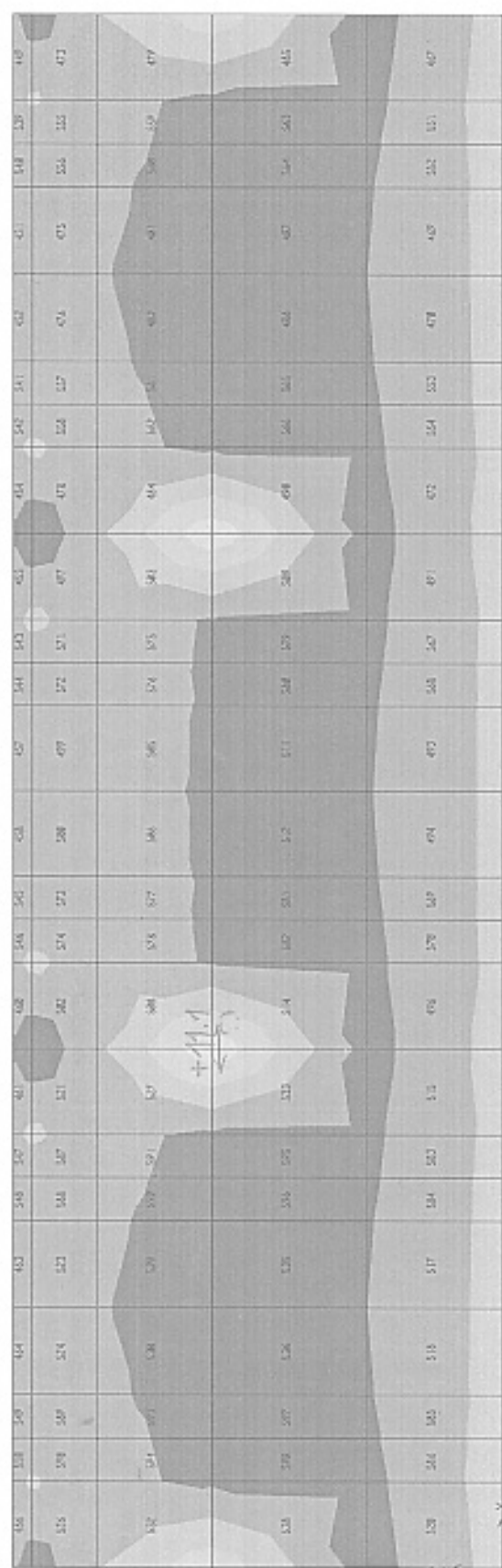


23	428	419	394	365	418	417	353	346	412	411	344	343	418	486	341	316	464	483	332	331	482	481	329
544	414	423	382	361	422	421	329	323	414	415	338	346	414	413	344	348	485	487	328	327	484	485	335
214	444	443	392	351	442	441	389	382	436	435	388	379	434	433	357	378	435	437	344	342	434	435	343
425	443	440	393	387	446	445	395	388	449	439	384	385	438	437	383	376	432	431	374	373	438	437	371

+9.51

WALL OF PRIMARY SED. TANK & PIPE GALLERY AXIS 3 (Y= +4.5)
(ENVE COMBO MAX M_{zz})





WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MAX M11)

-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

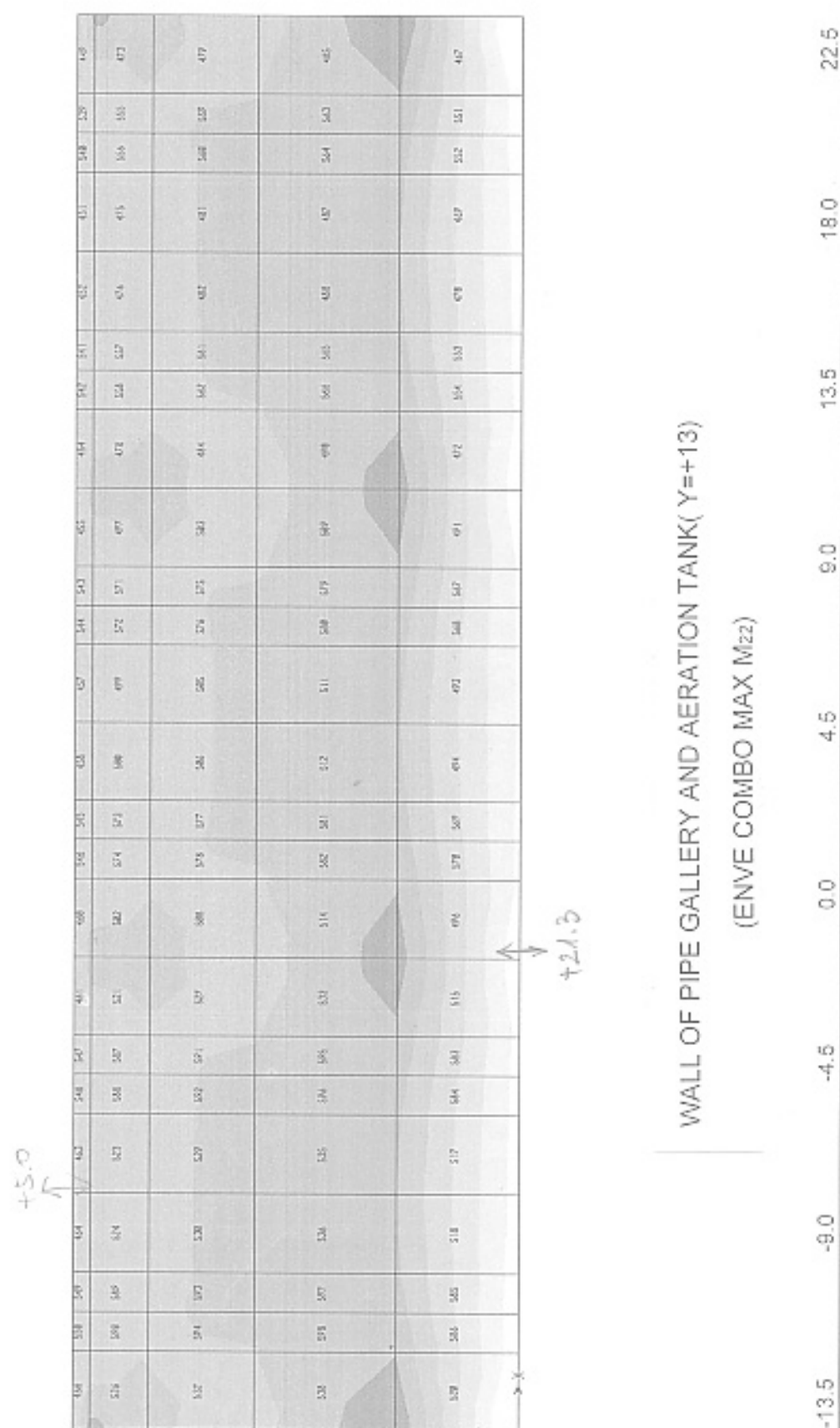
464	528	545	464	462	540	547	461	600	542	541	463	454	542	541	462	451	540	539	460
535	539	545	524	523	544	547	521	542	544	547	520	473	545	547	475	475	546	545	472
537	544	552	528	525	552	551	527	546	549	552	542	484	547	549	482	481	548	545	477
536	546	557	536	535	555	555	523	544	542	541	532	498	548	546	484	487	544	543	485
528	544	545	518	517	544	543	515	495	540	549	494	472	541	543	478	489	542	541	487

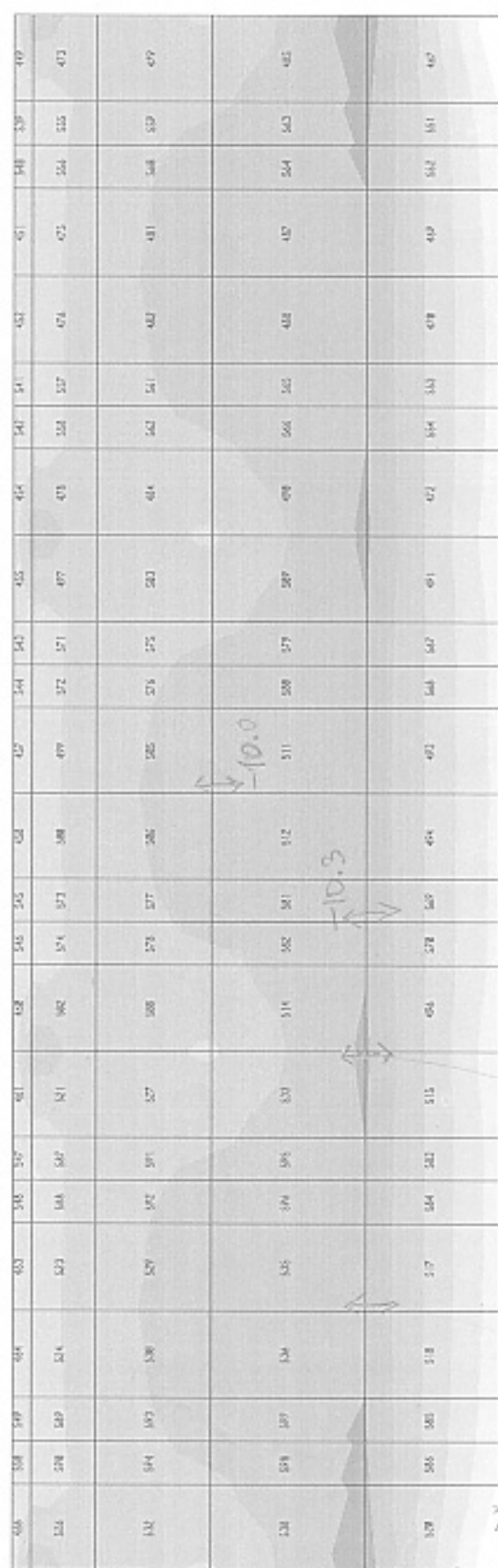
-4.4

WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MIN M11)

-13.0 -10.4 -7.8 -5.2 -2.6 0.0 2.6 5.2 7.8

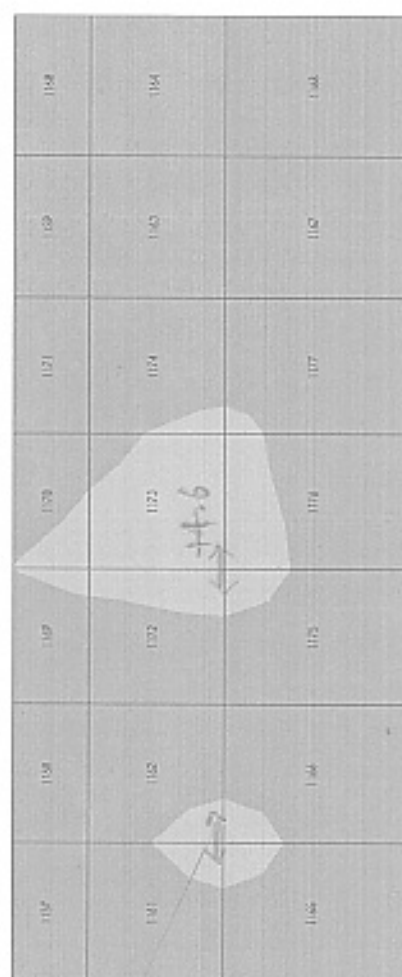




WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MIN M22)

-22.0 -16.5 -11.0 -5.5 0.0 5.5 11.0 16.5 22.0

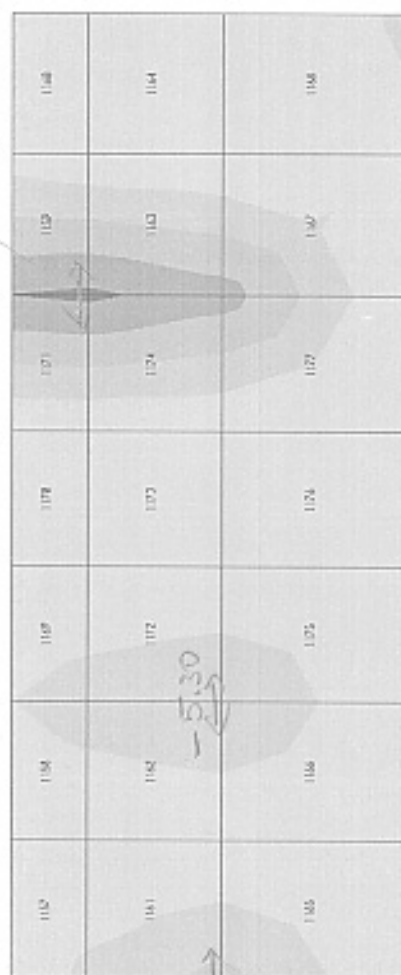


LONGITUDINAL WALL OF PRIMARY SED. TANK AND AERATION TANK X= +22
(ENVE COMBO MAX M₁₁)

-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

← -3.5

113	114
115	116



LONGITUDINAL WALL OF PRIMARY SED. TANK AND AERATION TANK X= +22

(ENVE COMBO MIN M₁₁)



113	114
115	116

117	118	119	120	121	122	123
124	125	126	127	128	129	130
131	132	133	134	135	136	137



LONGITUDINAL WALL OF PRIMARY SED. TANK AND AERATION TANK X= +22
(ENVE COMBO MAX M22)

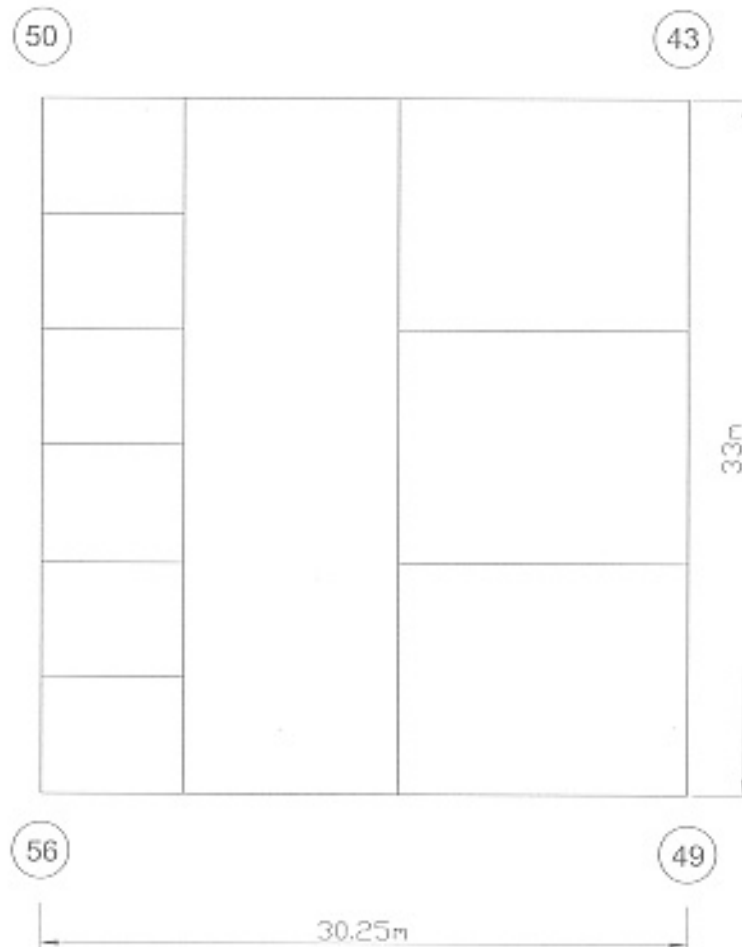
-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5



LONGITUDINAL WALL OF PRIMARY SED. TANK AND AERATION TANK X= +22
(ENVE COMBO MIN M22)



PILE ARRANGEMENT CALCULATION



Preaction = 9.2 Ton/m² and Pile Capacity = 45(Ton)

⇒ one pile can bear for an area of 4.9m²

⇒ R.C pile to be arranged as on drawing No. | -PE - WWTP - 252 - 01
 | -PE - WWTP - 252 - 02

CALCULATION FOR WASTEWATER TREATMENT PLANT STRUCTURES

AERATION TANK - PIPE GALLERY - FINAL SEDIMENTATION TANK

(The calculation based on Japanese standard)

1-GEOMETRY DIMENSIONS FOR CALCULATION

(As shown on drawings attached):

Ground level:	GL =	+ 2.20
Ground water level:	GWL =	0.00
Bottom level of pipegallery:	BL =	-3.10
Bottom level of aeration tank:	BL =	-0.25
Bottom level of final sedimentation tank:	BL =	1.01

Water level of aeration tank	+ 5.28
Water level of final sedimentation tank:	5.18

Thickness of pipegallery bottom:	0.60 m
Thickness of aeration tank bottom	0.60 m
Thickness of final sedimentation tank	0.60 m
Cinder concrete thickness	0.10 m

And all other dimensions shown on the drawing attached

2-PARAMETERS FOR CALCULATION:

Concrete: C21,	Rn =	70 (Kg/cm ²)
	RS =	3.6 (Kg/cm ²)
Reinforcement type All:	Ra =	1600 (Kg/cm ²)
Back fill sand: $\gamma_s =$	1.80T/m ³	: Coefficient of earth pressure at rest 0.5
Internal friction	20deg	

3-LOAD CALCULATION (BASE ON JAPANESE STANDARD):

3.1- Maximum loads from architect part to be taken in calculation as in analysis

3.2- Soil load:

In case of ground water level at 0.00 (Permanent case):

-Horizontal triangle distributed load due to earth under ground water level (Under aeration tank):

$$p_{H1} = 0.8 \times 2.15 \times 0.5 + 2.15 \times 1 = 3.01 \text{ T/m}^2$$

-Horizontal triangle distributed load due to earth under ground water level (Under final sedimentation tank):

$$p_{H1} = 0.8 \times 3.8 \times 0.5 + 3.8 \times 1 = 5.32 \text{ T/m}^2$$

-Uplift pressure to bottom of pipegallery:

$$p_{\text{uplift}} = (H_{\text{ground water}}) \times 1.0 = 3.70 \text{ T/m}^2$$

-Uplift pressure to bottom of aeration tank:

$$p_{\text{uplift}} = (H_{\text{ground water}}) \times 1.0 = 2.5 \text{ T/m}^2$$

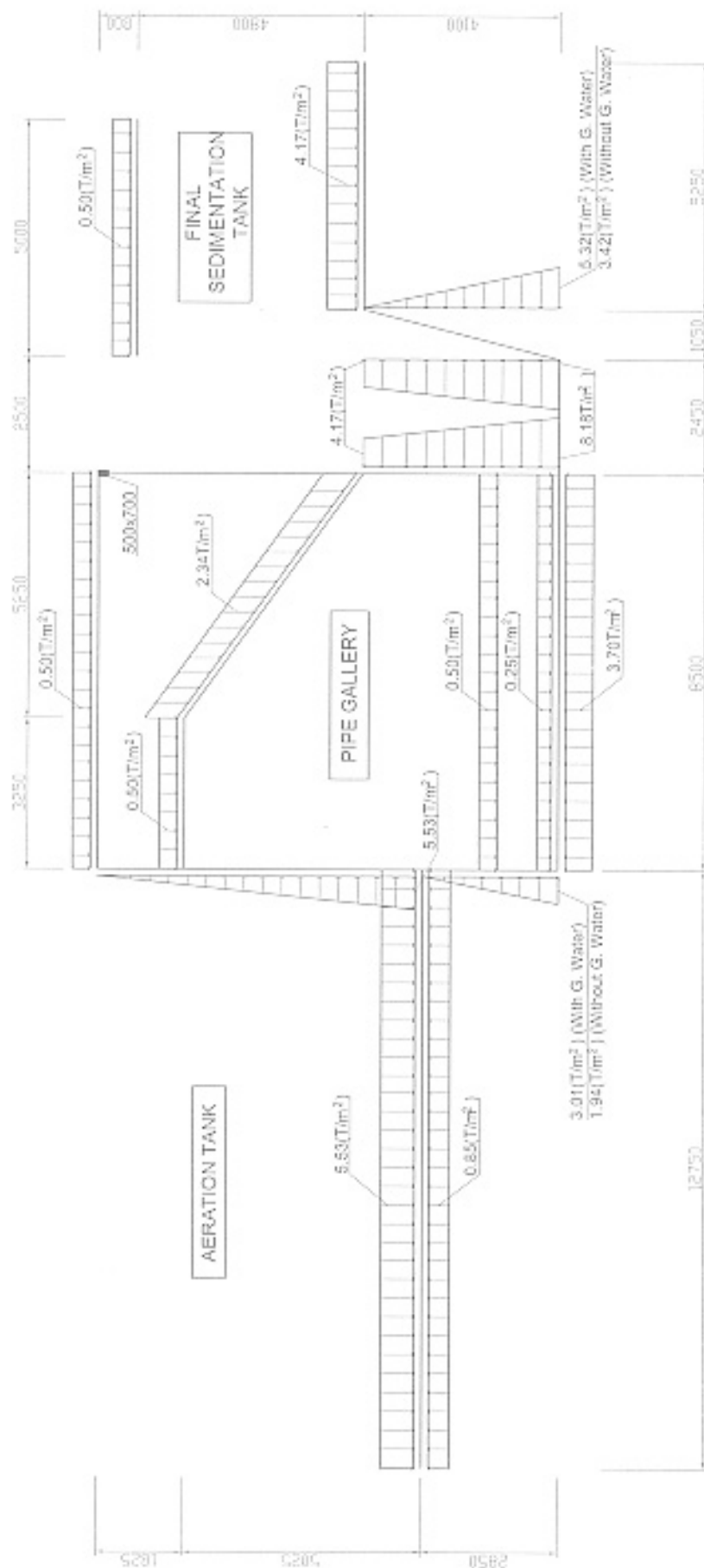
3.3-Water load

According to highest water level and bottom level as illustrated in the drawing, water loads to be calculated and shown on the attached drawing.

3.4-Load of non-reinforced concrete layer on bottom slab:

(Due to mechanical supports and cinder concrete)

AERATION TANK - PIPE GALLERY - FINAL SEDIMENTATION TANK



NOTE: THIS FOR VALUES OF LOADS ONLY.
COMBOS ARE TO BE CONSIDERED IN
ANALYSIS BY SAP 2000

↑ +7.6

182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343	1344	134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-Uniform load: $q_{\text{con. layer}} = 2.5 \times 0.10 = 0.25 \text{ T/m}^2$

3.5-Live load:

-Live load for all operating floor and walking way : $q_{\text{live}} = 0.50 \text{ T/m}^2$

4-ANALYSING BY SAP 2000: THERE ARE 3 COMBOS FOR ANALYSING AS ATTACHED HEREAFTER:

ALL THE LOADS, FACTORS, AND OTHER INPUT DATUM TO BE TAKEN IN ANALYSIS AND CALCULATED BY SAP 2000

The reaction results of combo 2 as attached shows that no uplift case happen to the structure

AERATION TANK - PIPE GALLERY - FINAL SEDIMENTATION TANK
COMBOS

LOAD COMBINATION MULTIPLIERS

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
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COMB1	ADD				In case of all tanks are full of water, no ground water outside
	SELF	1.0000		STATIC(DEAD)	
	WATER	1.0000		STATIC(OTHER)	
	CINDERCO	1.0000		STATIC(DEAD)	
	MAN	1.0000		STATIC(LIVE)	
	SOILPRES	1.0000		STATIC(OTHER)	

COMB2	ADD				In case of all tanks are empty, ground water level is up to 0.00
	SELF	1.0000		STATIC(DEAD)	
	CINDERCO	1.0000		STATIC(DEAD)	
	SUSOILPR	1.0000		STATIC(OTHER)	
	UPLIFT	1.0000		STATIC(OTHER)	

COMB3	ADD				In case of tank-empty and tank-full, no ground water
	SELF	1.0000		STATIC(DEAD)	
	CINDERCO	1.0000		STATIC(DEAD)	
	SOILPRES	1.0000		STATIC(OTHER)	
	MAN	1.0000		STATIC(LIVE)	
	WATER1	1.0000		STATIC(OTHER)	

ENVE	ENVE				Max min of all combos to calculate for reinforcement
	COMB1	1.0000		COMBO	
	COMB2	1.0000		COMBO	
	COMB3	1.0000		COMBO	

5-CALCULATION FOR BAR ARRANGEMENT:

Base on attached results of shell forces analysed by SAP2000, choosing the most dangerous forces for calculation:

$$A_s = \frac{M}{R_n b h_o^2} \quad \text{Where, } M: \text{Maximum bending moment(T.m)}$$

$$h_o: \text{Effective depth of bearing area(cm)}$$

$h_c = (\text{Element thickness} - \text{Cover thickness})$
 $b: \text{Width of calculated area (cm)}$

Required area of reinforcement:

$$F_a = M/\gamma R_a h_o$$

$$\text{Where: } \gamma = 0.5 + ((1 - 2A_o)^{1/2})/2$$

5-1 SLABS AND WALLS:

Moments	Values (T.m)	A _o	γ	F _a (cm ²)	Bar arrangement		Remarks
					φ(mm)	a(mm)	
(Bottom	18.000	0.1116	0.941	24.92	20	125	125
Slab level	15.400	0.0955	0.950	21.11	20	125	
-3.10)	5.600	0.0347	0.982	7.42	12	125	
t=0.60	7.600	0.0471	0.976	10.14	18	250	
	-9.300	0.0473	0.976	11.24	16	150	
	-7.400	0.0376	0.981	8.90	12	125	
	-2.400	0.0122	0.994	2.85	12	250	
	-10.750	0.0547	0.972	13.04	16	125	
Aeration	12.800	0.0794	0.959	17.39	18	125	125
tank bottom	12.300	0.0763	0.960	16.68	18	125	
Level -.25	12.000	0.0744	0.961	16.25	18	125	
	-11.900	0.0605	0.969	14.49	16	125	
	-5.600	0.0285	0.986	6.70	12	150	
0.6	16.300	0.1011	0.947	22.42	20	125	
Final sed.	17.800	0.1104	0.941	24.62	20	125	Not in Dwg
tank bottom	16.600	0.1029	0.946	22.86	20	125	
slab	5.300	0.0329	0.983	7.02	12	125	
level +1.01	-8.000	0.0407	0.979	9.63	14	125	
0.6							
Bottom slab	-10.400	0.1029	0.946	18.09	18	125	125
of water way	-9.300	0.0920	0.952	16.07	16	125	
level +4.7	5.600	0.0554	0.971	9.48	14	125	
0.45	3.500	0.0346	0.982	5.86	12	150	
Cover slab	-3.400	0.2159	0.877	16.16	18	125	250
of final sed.	1.400	0.0889	0.953	6.12	14	250	
tank lv +5.9							Beam
0.2							
Cover slab	-3.500	0.2222	0.873	16.71	12	50	
of pipe ga.	-0.850	0.0540	0.972	3.64	12	250	
level +6.4	-1.910	0.1213	0.935	8.51	12	125	
0.2	1.750	0.1111	0.941	7.75	12	125	
	0.750	0.0476	0.976	3.20	12	250	
Wall of	-17.600	0.1360	0.927	27.61	22	125	125
Aeration Tank	-7.400	0.0572	0.971	11.08	22	250	
& pipe ga.	-5.800	0.0448	0.977	8.63	14	150	
0.5	12.300	0.0950	0.950	18.82	16	100	

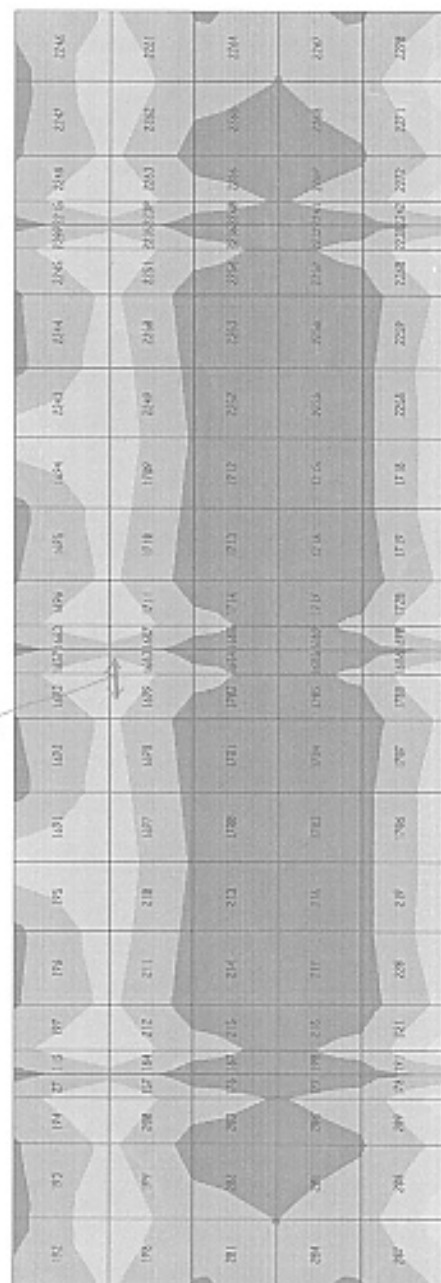
	8.200	0.0634	0.967	12.32	16	125	
	8.400	0.0649	0.966	12.63	16	125	
Wall of	11.500	0.0889	0.953	17.53	18	125	
Final sed. Tank	9.200	0.0711	0.963	13.88	18	150	a 125
& pipe ga.	-5.400	0.0417	0.979	8.02	14	150	a 125
0.5	2.900	0.0224	0.989	4.26	14	250	
	-4.300	0.0332	0.983	6.36	12	150	a 125
Longitudinal	-15.800	0.1221	0.935	24.57	20	125	
wall	6.300	0.0487	0.975	9.39	14	125	
0.5	-12.400	0.0958	0.950	18.98	18	125	
	-7.400	0.0572	0.971	11.08	14	125	
	-6.600	0.0510	0.974	9.85	14	125	
	-4.800	0.0371	0.981	7.11	12	125	a 125
	3.100	0.0240	0.988	4.56	14	250	
	1.800	0.0139	0.993	2.63	12	250	

6- CALCULATION FOR PILE NUMBER (as attached sheets):

(Pile number to be decided by pile calculation sheet, please refer to pile calculation sheet for more information)



+4.2



+5.6

PIPE GALLERY BOTTOM SLAB LEVEL -3.10
(ENVE COMBO MAX M₁₁)

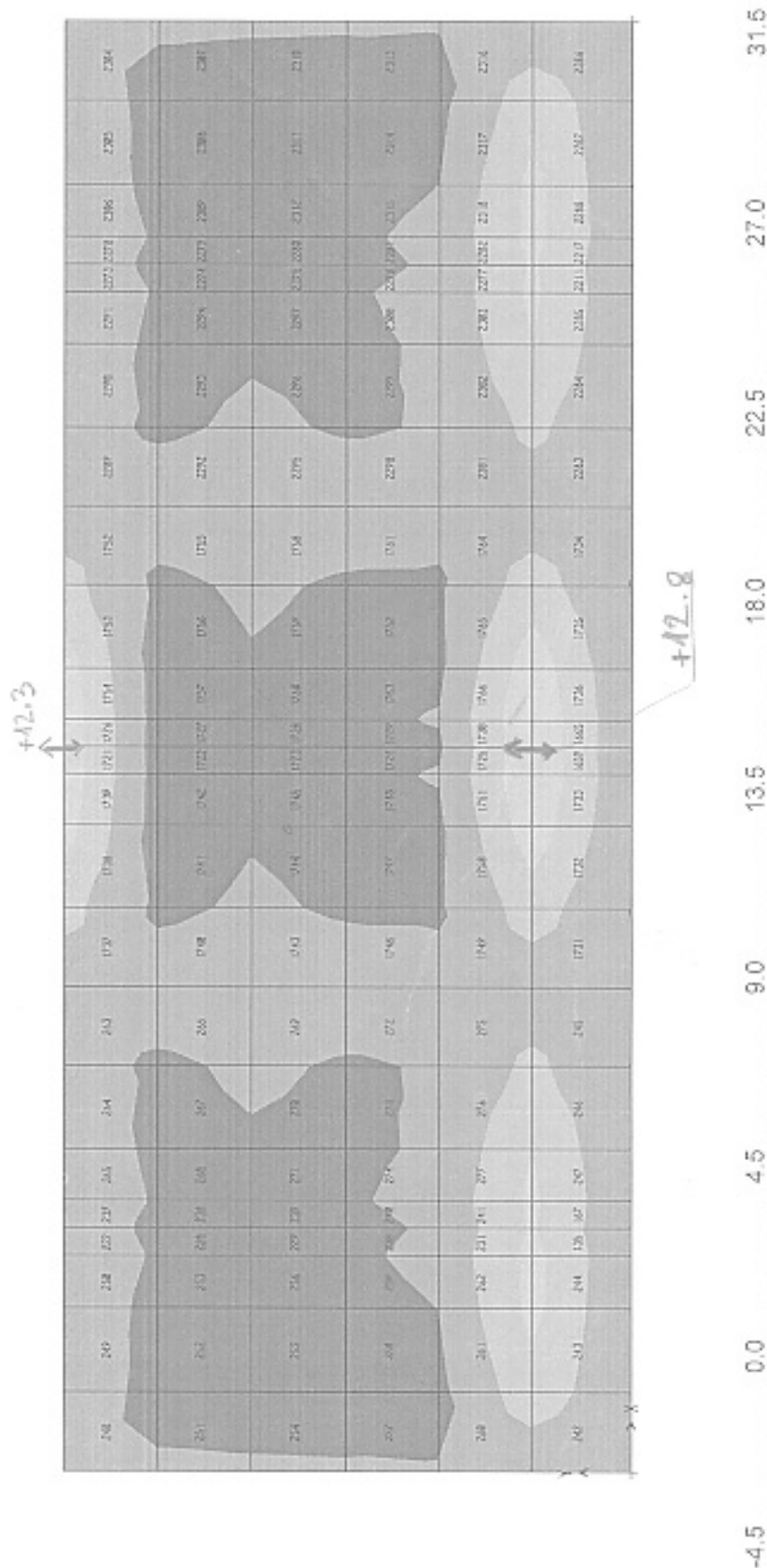


-2.2 0.0 2.2 4.4 6.6 8.8 11.0 13.2 15.4

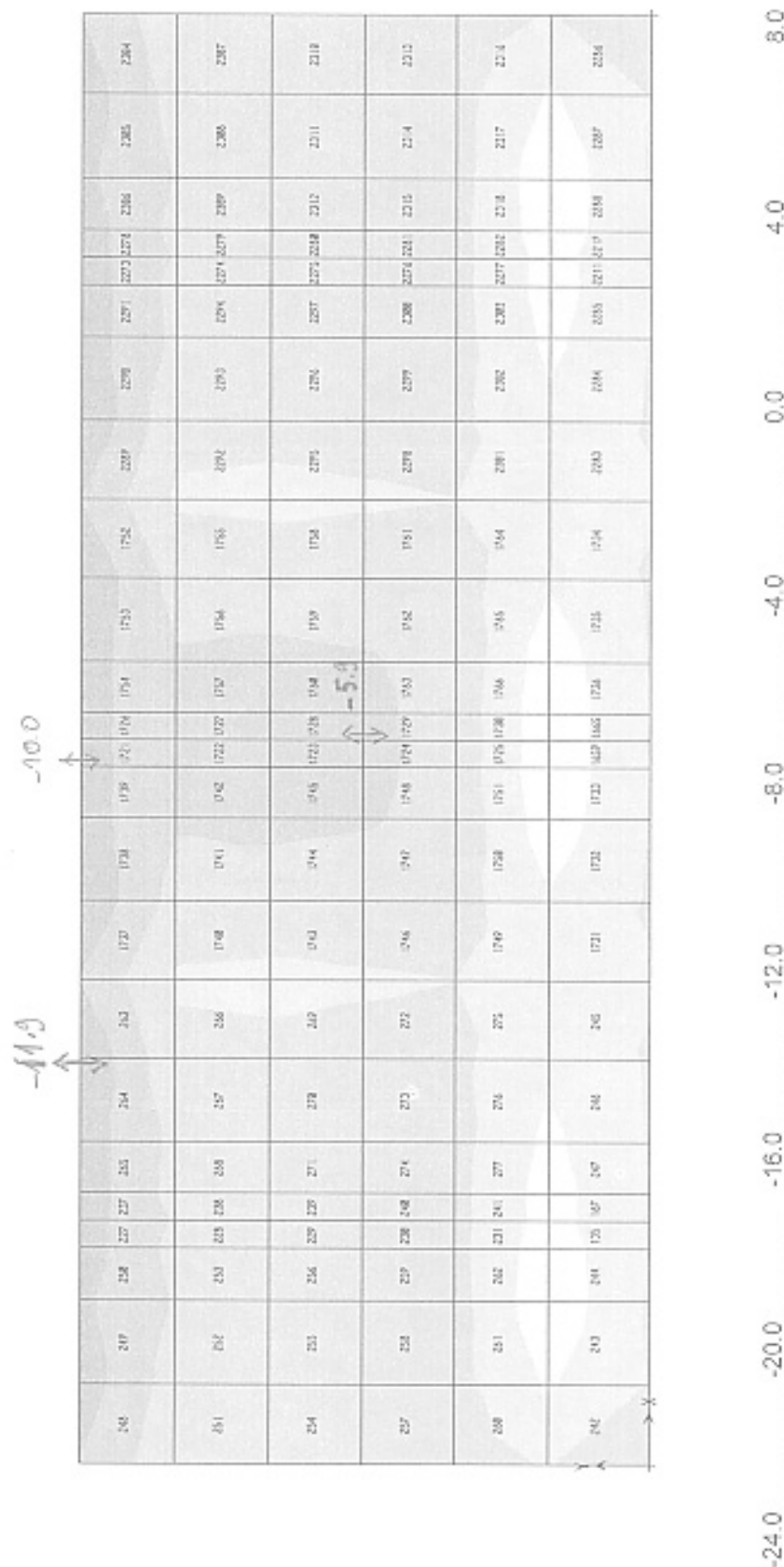
- 2.4

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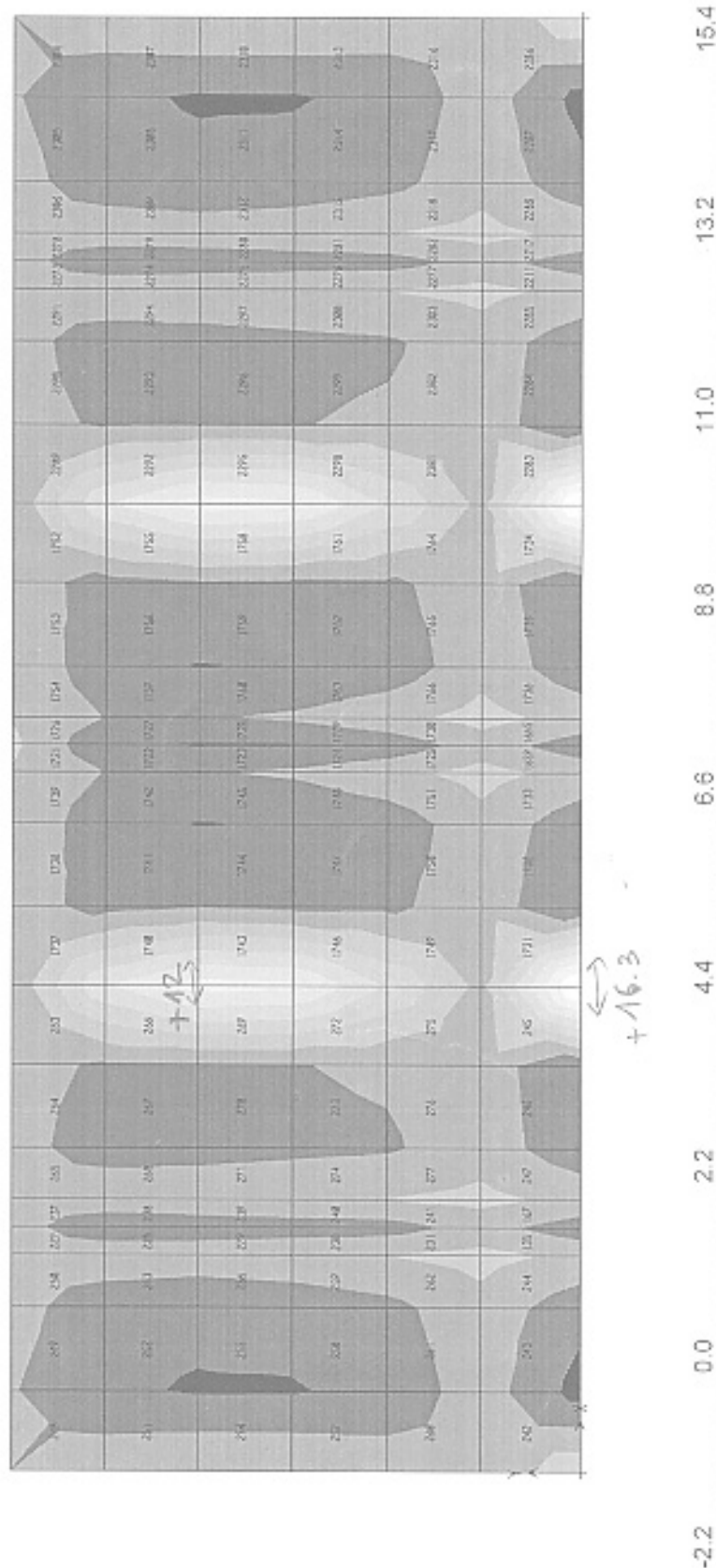
AERATION TANK BOTTOM SLAB LEVEL -0.25
(ENVE COMBO MAX M₂₂)

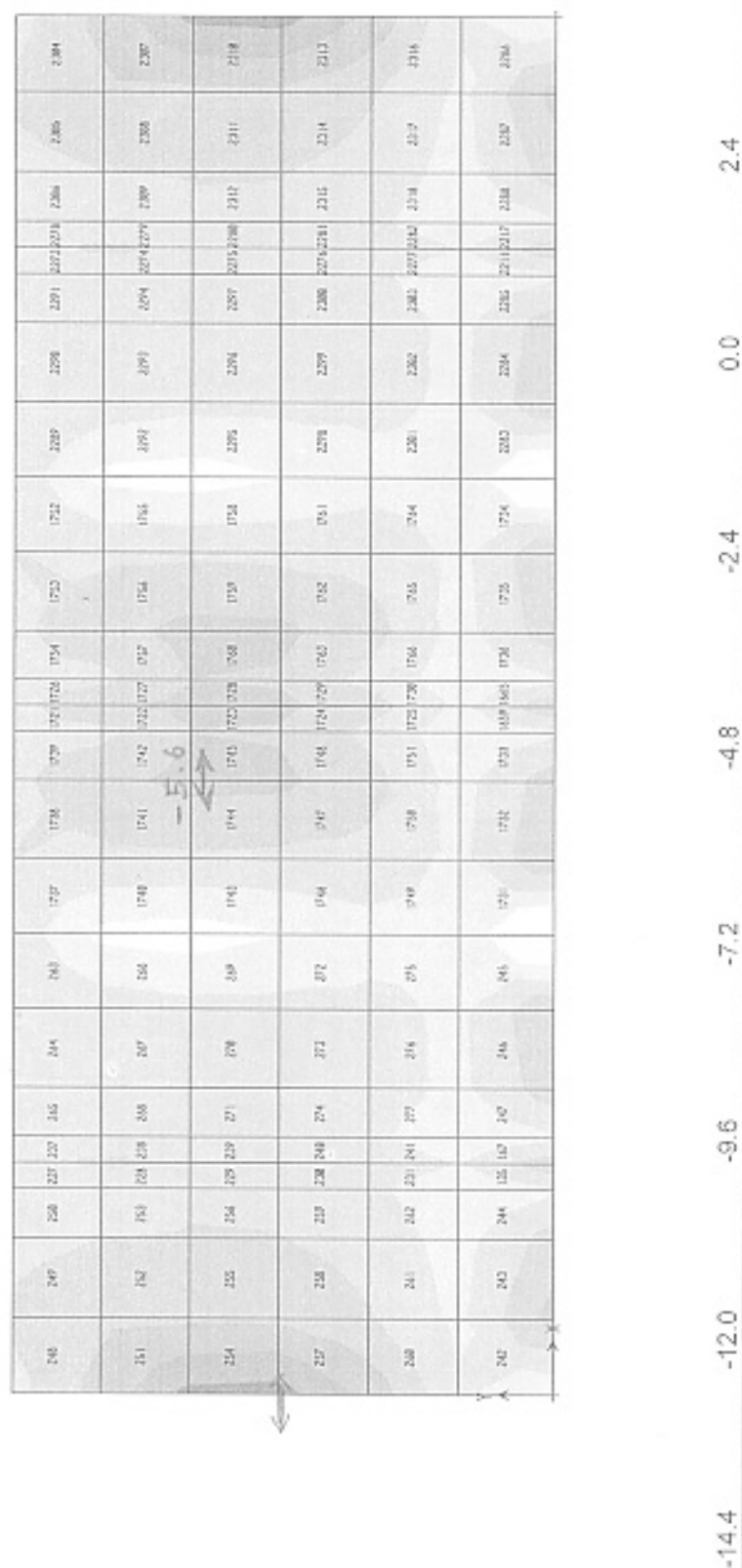


AERATION TANK BOTTOM SLAB LEVEL -0.25
(ENVE COMBO MIN M22)



AERATION TANK BOTTOM SLAB LEVEL -0.25
(ENVE COMBO MAX M₁₁)



(ENVE COMBO MIN M_{t+1})

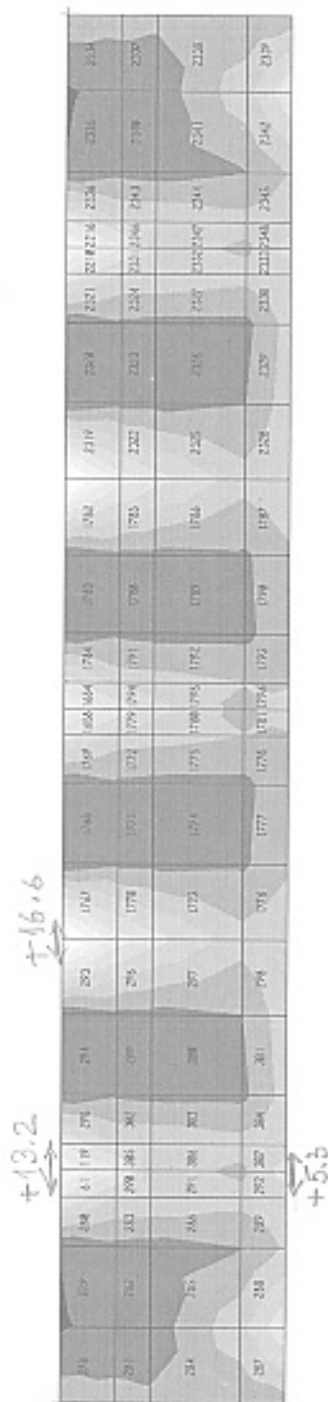
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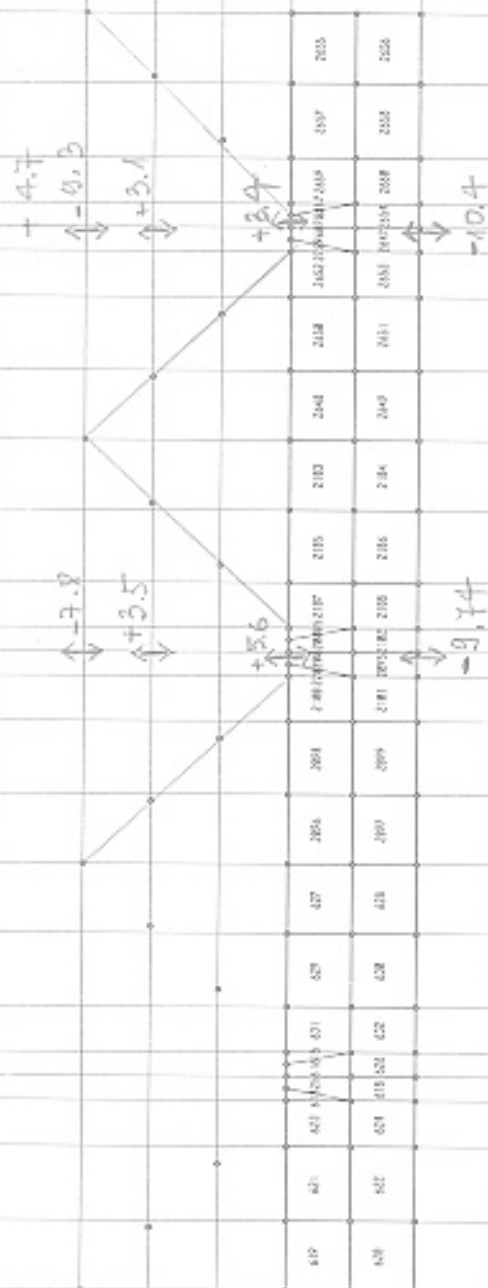
FINAL SED. TANK BOTTOM SLAB LEVEL +1.01
(ENVE COMBO MIN M22)





FINAL SED. TANK BOTTOM SLAB LEVEL +1.01
(ENVE COMBO MIN M₁₁)





BOTTOM SLAB OF WATERWAY LEVEL +4.7

(ENVE COMBO MAX, MIN M22)

46	28	54	72	80	84	92	100	2129	2128	2125	2120	2114	2108	2102	2096	2090	2084	2078
45	21	55	74	81	85	94	101	2130	2122	2124	2109	2103	2097	2091	2085	2079	2073	2067
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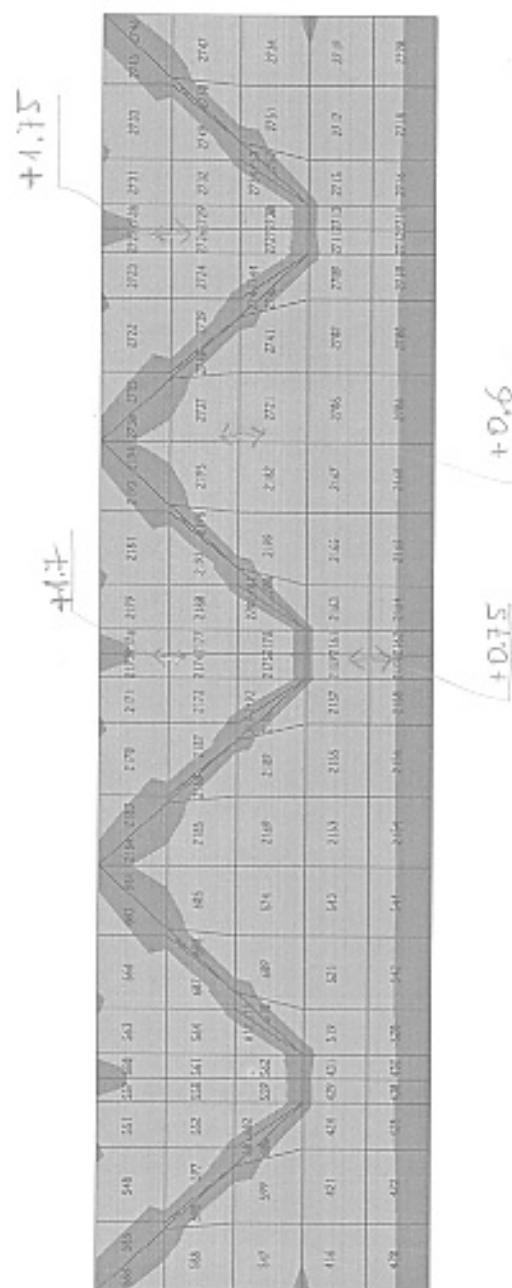
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-3.4

COVER SLAB OF FINAL SED. TANK LEVEL +5.9
(ENVE COMBO MIN M11)

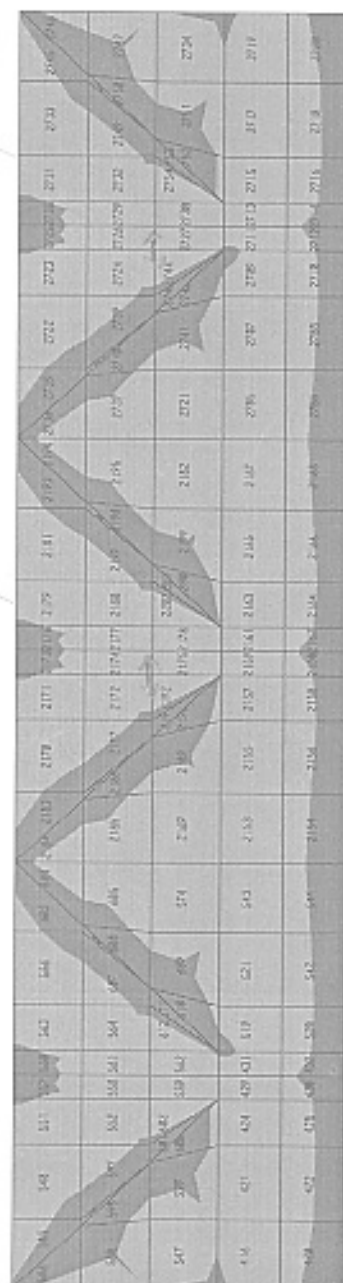


-14.4 -12.0 -9.6 -7.2 -4.8 -2.4 0.0 2.4 4.8



+0.25

+0.25

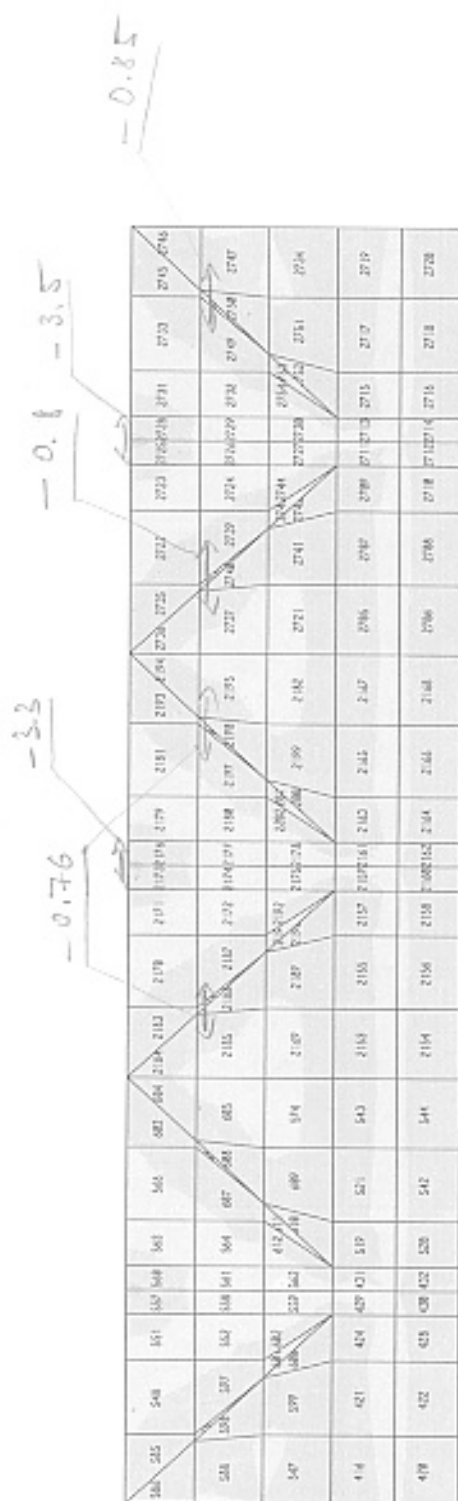


COVER SLAB OF FINAL SED. TANK LEVEL +6.4
(ENVE COMBO MAX M11)



-2.2 0.0 2.2 4.4 6.6 8.8 11.0 13.2 15.4

COVER SLAB OF PIPE GALLERY LEVEL +6.4
(ENVE COMBO Min M11)



COVER SLAB OF FINAL SED. TANK LEVEL +6.4
(ENVE COMBO MIN M11)



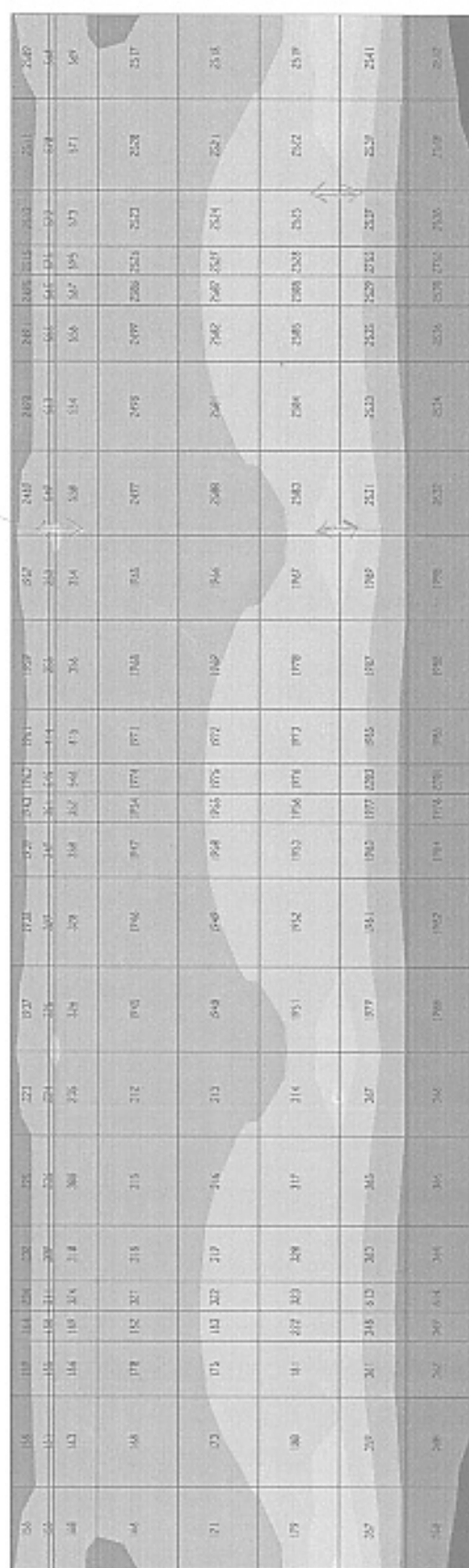
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+5.2

+12.3

+8.4

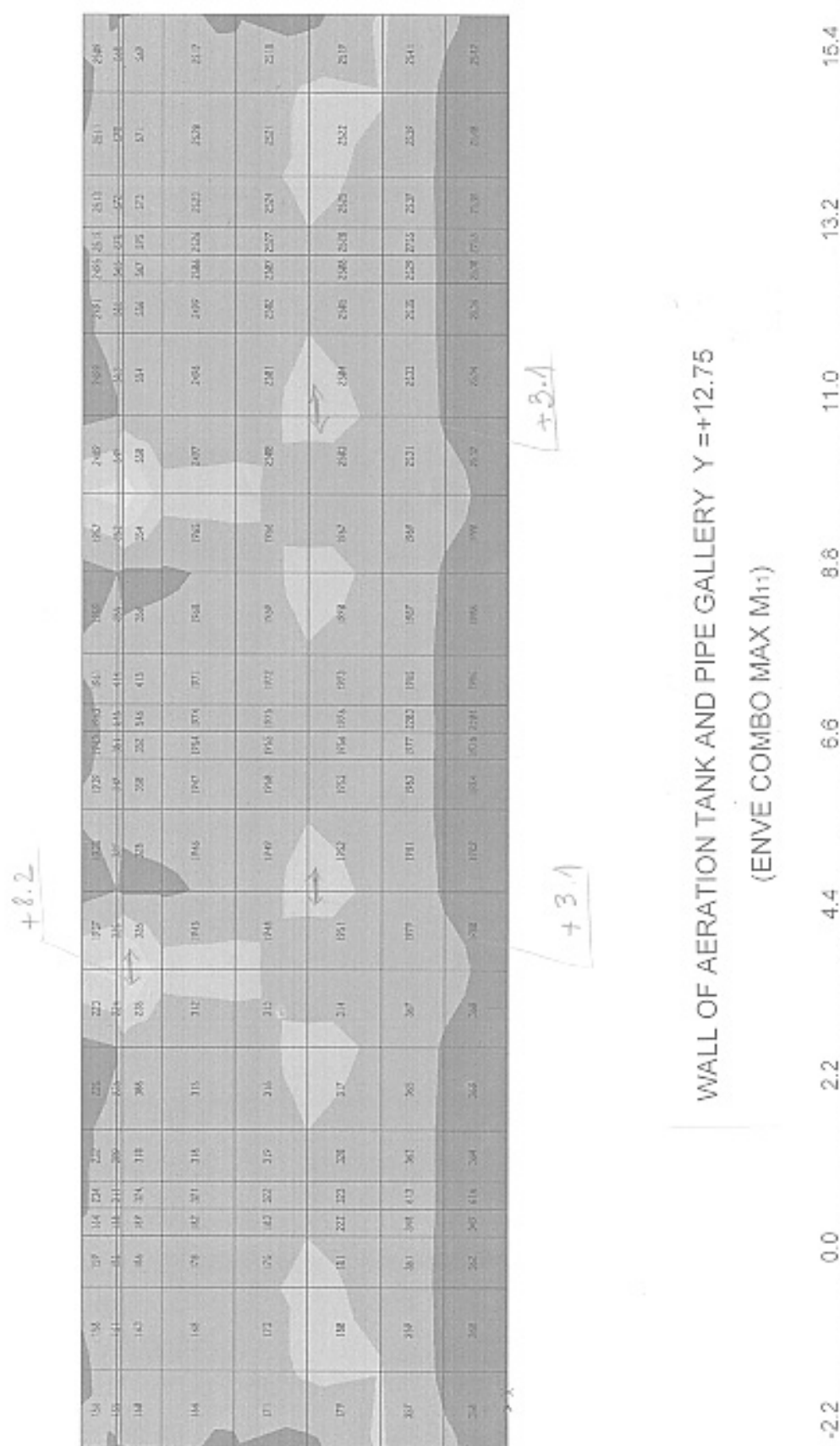
WALL OF AERATION TANK AND PIPE GALLERY Y=+12.75
(ENVE COMBO MAX M22)



-7.4

-7.2

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60	227	230	231	242	245	247	357	361	362	1915	1915	1912	1987	1986	2532	2531	2530	2532	2530	2529	2528
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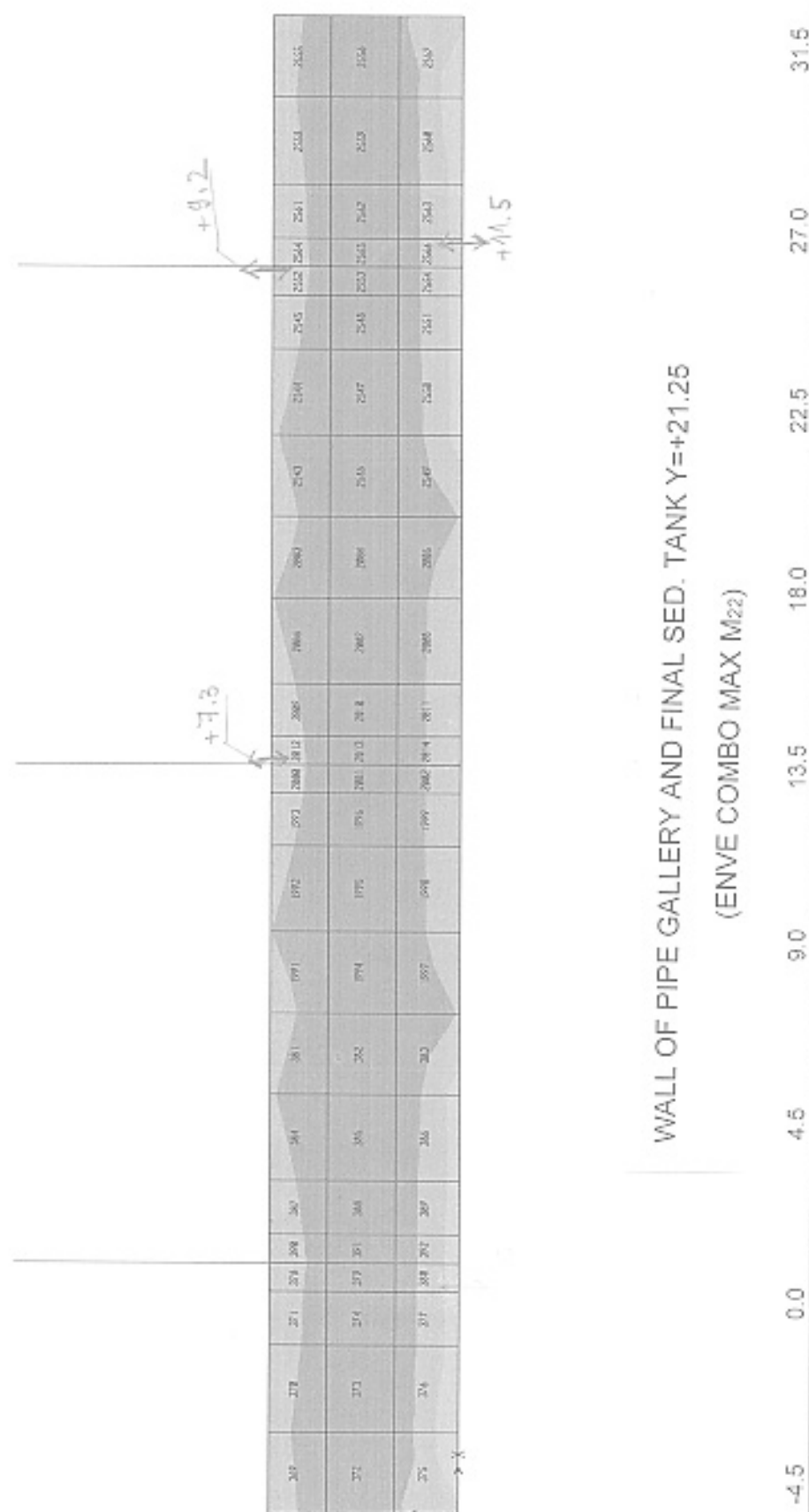
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-3.7

WALL OF AERATION TANK AND PIPE GALLERY Y = +12.75

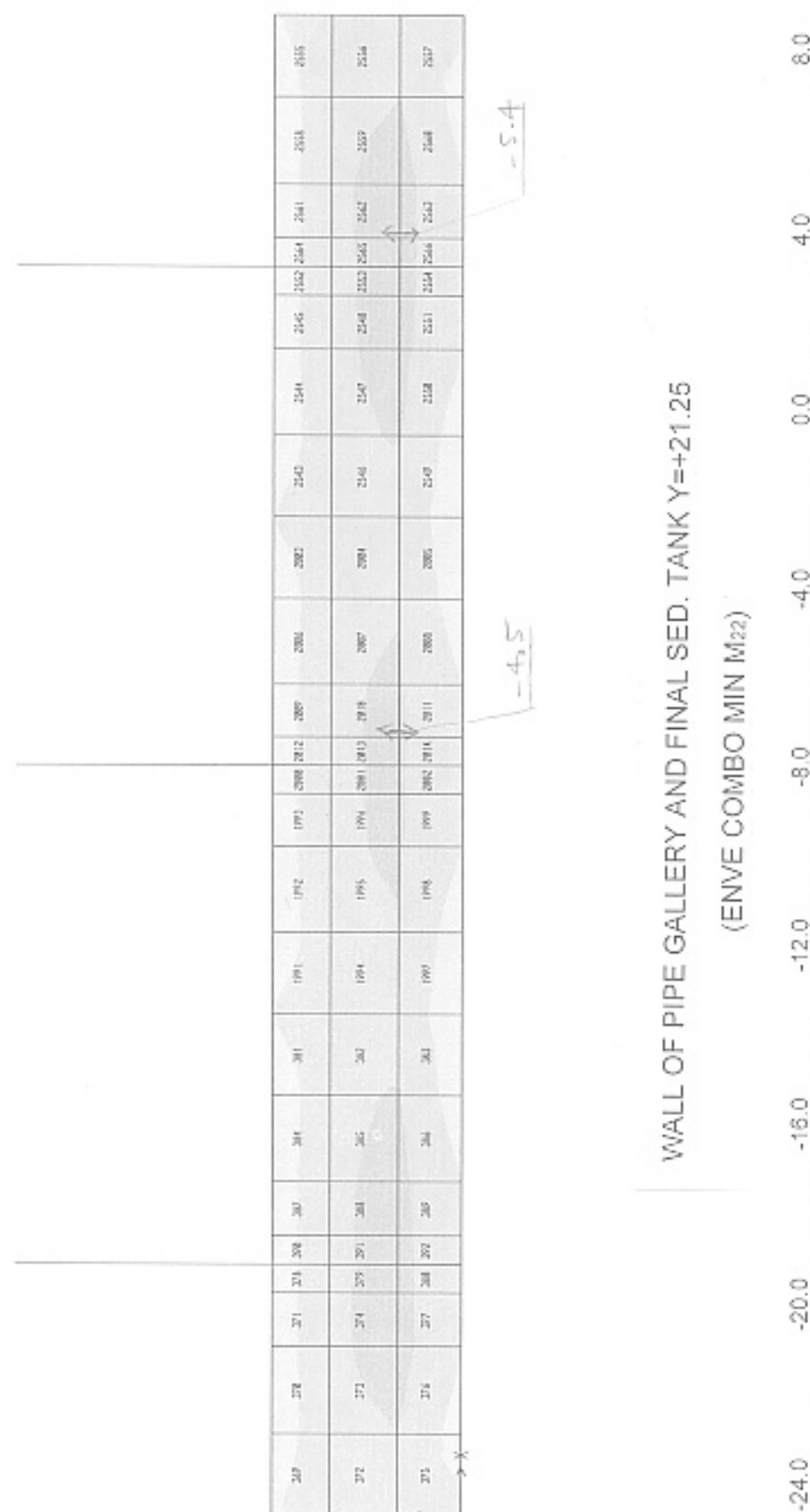
(ENVE COMBO MIN M11)

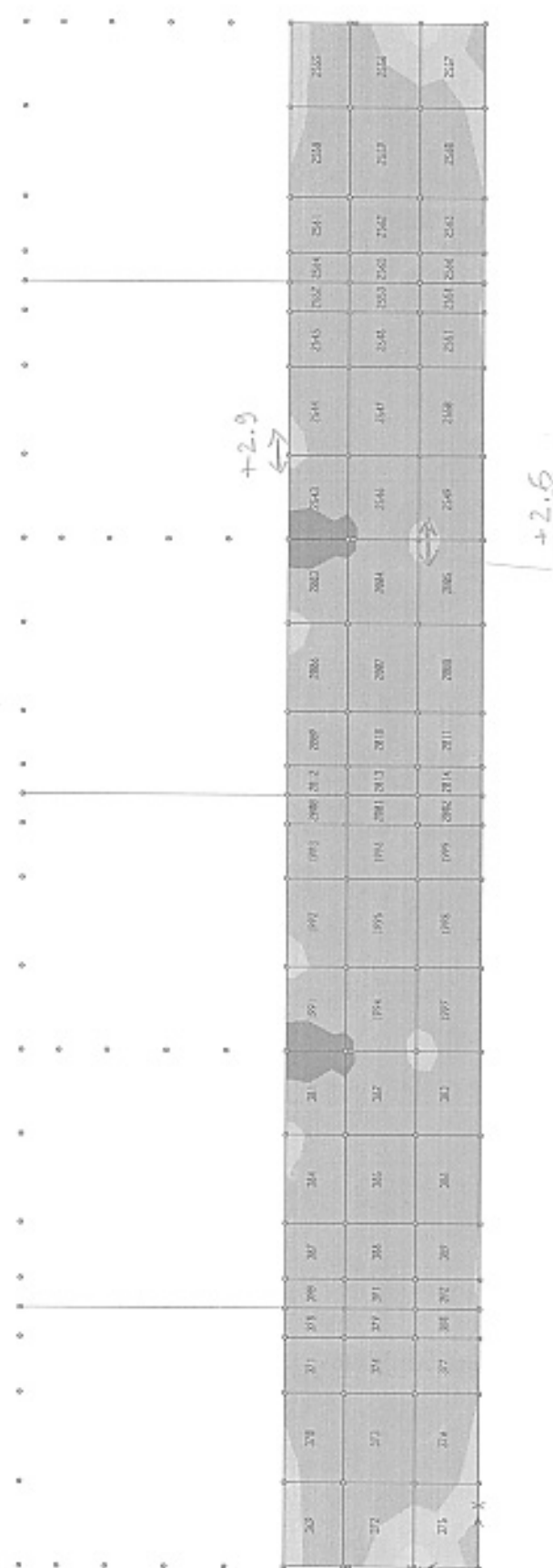
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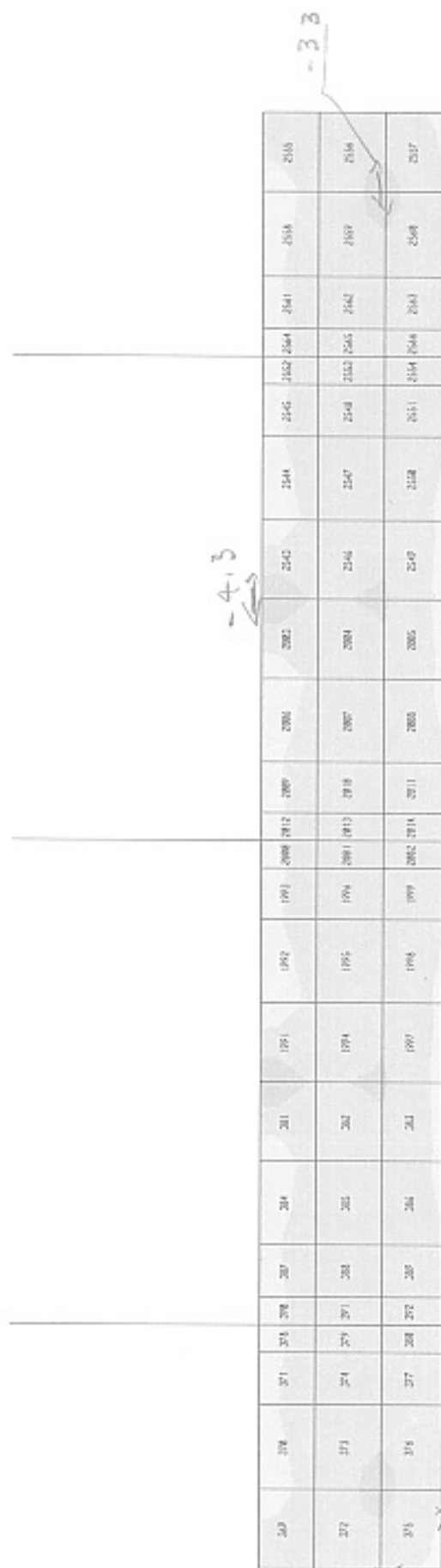
WALL OF PIPE GALLERY AND FINAL SED. TANK Y=+21.25

(ENVE COMBO MAX M22)





WALL OF PIPE GALLERY AND FINAL SED. TANK Y=+21.25
(ENVE COMBO MAX M₁₁)



WALL OF PIPE GALLERY AND FINAL SED. TANK Y=+21.25
(ENVE COMBO MIN M11)

-14.4 -12.0 -9.6 -7.2 -4.8 -2.4 0.0 2.4 4.8

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2011	2013	2015	2017	2019	2021
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-15.8

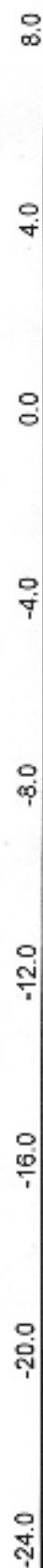


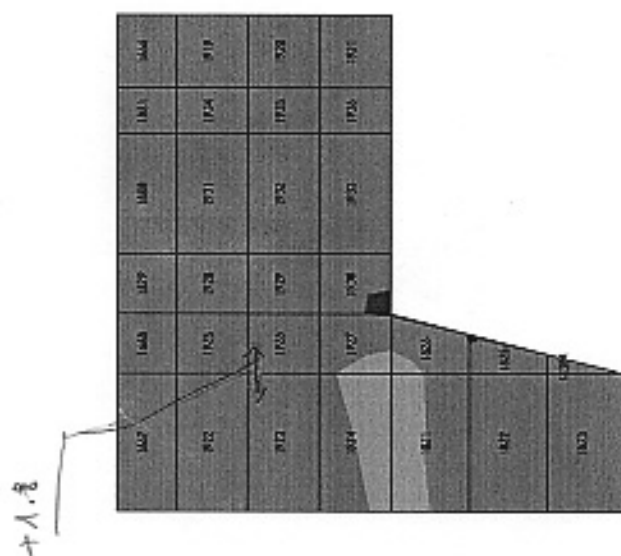
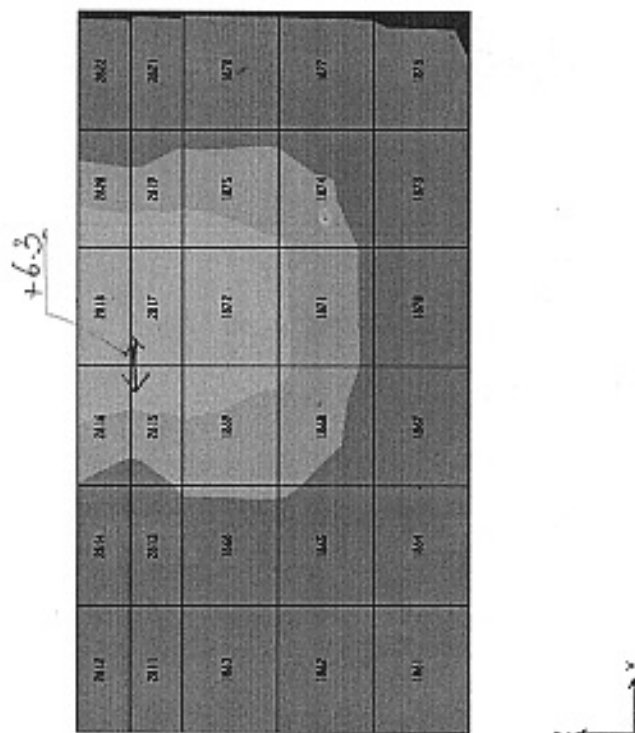
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1841	1844	1847	1850	1853
1821	1824	1827	1830	1833
1822	1825	1828	1831	1834
1823	1826	1829	1832	1835

-6.2

-6.2

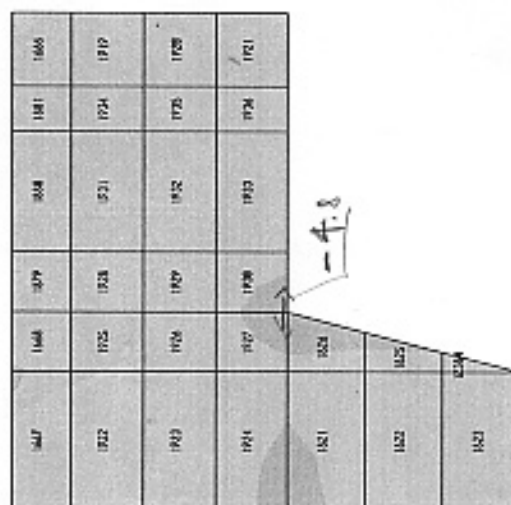
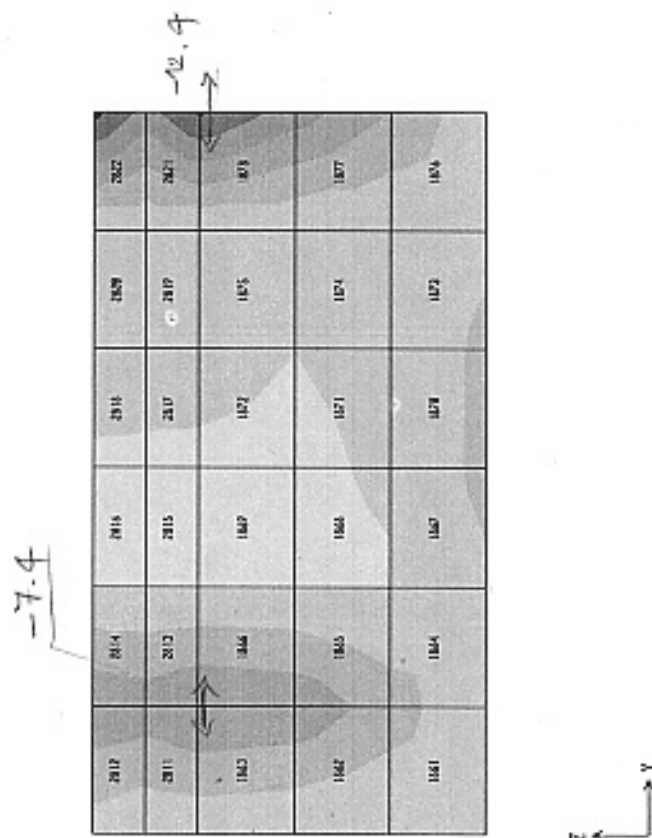
LONGITUDINAL WALL OF AERATION TANK AND FINAL SED. TANK X=+2.2

(ENVE COMBO MIN M_{zz})



LONGITUDINAL WALL OF AERATION TANK AND FINAL SED. TANK X=+2.2
(ENVE COMBO MAX M11)

-2.2 0.0 2.2 4.4 6.6 8.8 11.0 13.2 15.4



LONGITUDINAL WALL OF AERATION TANK AND FINAL SED. TANK X=+2.2
(ENVE COMBO MIN M11)

-14.4 -12.0 -9.6 -7.2 -4.8 -2.4 0.0 2.4 4.8

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AERATION TANK - PIPE GALLERY - FINAL SED. TANK
For calculating pile quantity

LOAD COMBINATION MULTIPLIERS

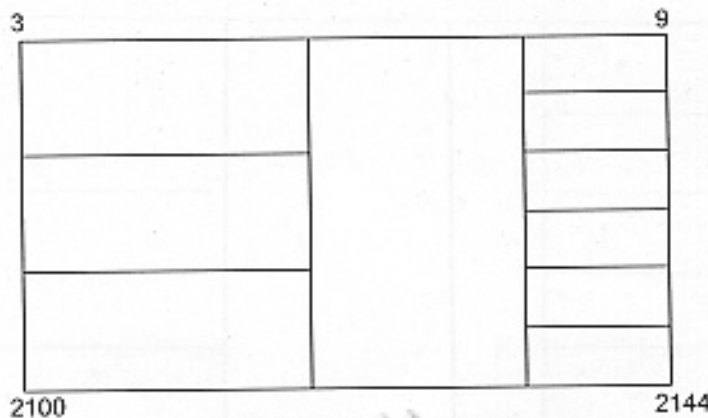
CASE	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD	SELF	1.0000	STATIC(DEAD)	In case of all tanks are full of water, no ground water outside
		WATER	1.0000	STATIC(OTHER)	
		CINDERCO	1.0000	STATIC(DEAD)	
		MAN	1.0000	STATIC(LIVE)	
		SOILPRES	1.0000	STATIC(OTHER)	
COMB2	ADD	SELF	1.0000	STATIC(DEAD)	In case of all tanks are empty, ground water level is up to 0.00
		CINDERCO	1.0000	STATIC(DEAD)	
		SUSOILPS	1.0000	STATIC(OTHER)	
		UPLIFT	1.0000	STATIC(OTHER)	
COMB3	ADD	SELF	1.0000	STATIC(DEAD)	In case of tank-empty and tank-full, no ground water
		CINDERCO	1.0000	STATIC(DEAD)	
		SOILPRES	1.0000	STATIC(OTHER)	
		MAN	1.0000	STATIC(LIVE)	
		WATER1	1.0000	STATIC(OTHER)	
PILECOMB	ADD	SELF	1.0000	STATIC(DEAD)	For calculating number of piles
		WATER	1.0000	STATIC(OTHER)	
		CINDERCO	1.0000	STATIC(DEAD)	
		MAN	1.0000	STATIC(LIVE)	
		SOILPRES	1.0000	STATIC(OTHER)	

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AERATION TANK - PIPE GALLERY - FINAL SED. TANK
For calculating pile quantity

JOINT REACTIONS

JOINT	LOAD	F1	F2	F3	M1	M2	M3
3	COMB1	724.1208	1399.9903	2134.1050	0.0000	0.0000	0.0000
3	COMB2	190.7584	399.8479	583.8503	0.0000	0.0000	0.0000
3	COMB3	511.5524	1057.6506	1860.6975	0.0000	0.0000	0.0000
3	PILECOMB	724.1208	1399.9903	2134.1050	0.0000	0.0000	0.0000
9	COMB1	-41.1836	-754.5016	2009.3687	0.0000	0.0000	0.0000
9	COMB2	36.5820	-290.4719	450.8175	0.0000	0.0000	0.0000
9	COMB3	230.0840	-1156.5034	1796.3134	0.0000	0.0000	0.0000
9	PILECOMB	-41.1836	-754.5016	2009.3687	0.0000	0.0000	0.0000
2100	COMB1	-724.1241	1400.0000	2134.1042	0.0000	0.0000	0.0000
2100	COMB2	-190.7507	399.8480	583.8503	0.0000	0.0000	0.0000
2100	COMB3	-511.5953	1057.8517	1860.6960	0.0000	0.0000	0.0000
2100	PILECOMB	-724.1241	1400.0000	2134.1042	0.0000	0.0000	0.0000
2144	COMB1	41.1870	-754.4969	2009.3677	0.0000	0.0000	0.0000
2144	COMB2	-36.5817	-290.4714	450.8176	0.0000	0.0000	0.0000
2144	COMB3	-230.0809	-1156.4993	1796.3134	0.0000	0.0000	0.0000
2144	PILECOMB	41.1870	-754.4969	2009.3677	0.0000	0.0000	0.0000



$$\text{Preaction} = 4.31 \times \frac{1.1(1023.31^2 + 988.782^2)}{30 \times 33} = 8.8 (\text{T/m}^2)$$

Pile capacity = 45 ton \Rightarrow one pile can be used for an area of 5.1m²

\Rightarrow R.C pile to be arranged as on drawing No. -PE - WWTP - 252 - 01

-PE - WWTP - 252 - 02

CALCULATION FOR WASTEWATER TREATMENT PLANT STRUCTURES**FINAL SEDIMENTATION TANK**

(The calculation based on Japanese standard)

1-GEOMETRY DIMENSIONS FOR CALCULATION

(As shown on drawings attached):

Ground level: GL = ± 2.20 Bottom level of final sedimentation tank: BL = 1.15 Water level of final sedimentation tank: 5.05 Thickness of final sedimentation tank 0.60 m *And all other dimensions shown on the drawing attached***2-PARAMETERS FOR CALCULATION:**Concrete: Grade C21, $R_n = 70\text{ (Kg/cm}^2\text{)}$ $R_s = 3.6\text{ (Kg/cm}^2\text{)}$ Reinforcement type JIS: $R_a = 1600\text{ (Kg/cm}^2\text{)}$ Back fill sand: $\gamma_s = 1.80\text{ T/m}^3$; Coefficient of earth pressure at rest $K 0.5$ Internal friction 20 deg **3-LOAD CALCULATION (BASE ON JAPANESE STANDARD):****3.1-Water load**

According to highest water level and bottom level as illustrated in the drawing, water loads to be calculated and shown on the attached drawing.

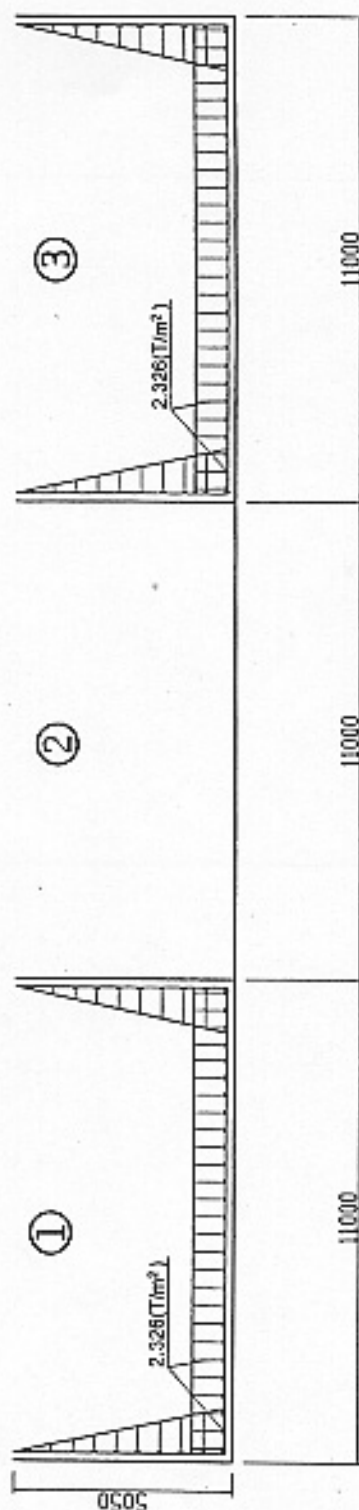
3.2-Live load:-Live load for all operating floor and walking way: $q_{live} = 0.50\text{ T/m}^2$ **4-ANALYSING BY SAP 2000: THERE ARE 3 COMBOS FOR ANALYSING AS ATTACHED HEREAFTER:****ALL THE LOADS, FACTORS, AND OTHER INPUT DATUM TO BE TAKEN IN ANALYSIS AND CALCULATED BY SAP 2000***There no need to check uplift for final sed. Tank, because the tank is to be put not deeply in ground.***LOAD COMBINATION MULTIPLIERS**

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD				All tanks full of water
	SELF	1.0000		STATIC(DEAD)	
	WATER	1.0000		STATIC(OTHER)	
COMB2	ADD				tan full, tank empty
	SELF	1.0000		STATIC(DEAD)	
	WATER1	1.0000		STATIC(OTHER)	
ENVE	ENVE				max min of combos to calculate for reinforcement
	COMB1	1.0000		COMBO	
	COMB2	1.0000		COMBO	

FINAL SEDIMENTATION TANK

Case 1: Tanks ①③ Full, Tank ② Empty

Case 2: All Tanks ①②③ Full of Water



NOTE: THIS FOR VALUES OF LOADS ONLY,
COMBOS ARE TO BE CONSIDERED IN
ANALYSIS BY SAP 2000

5-CALCULATION FOR BAR ARRANGEMENT:

Base on attached results of shell forces analysed by SAP2000, choosing the most dangerous forces for calculation:

$$A_o = M/R_n b h_o^2$$

Where, M: Maximum bending moment(T.m)

h_o : Effective depth of bearing area(cm)

h_o = (Element thickness-Cover thickness)

b: Width of calculated area(cm)

Required area of reinforcement:

$$F_a = M/\gamma R_a h_o$$

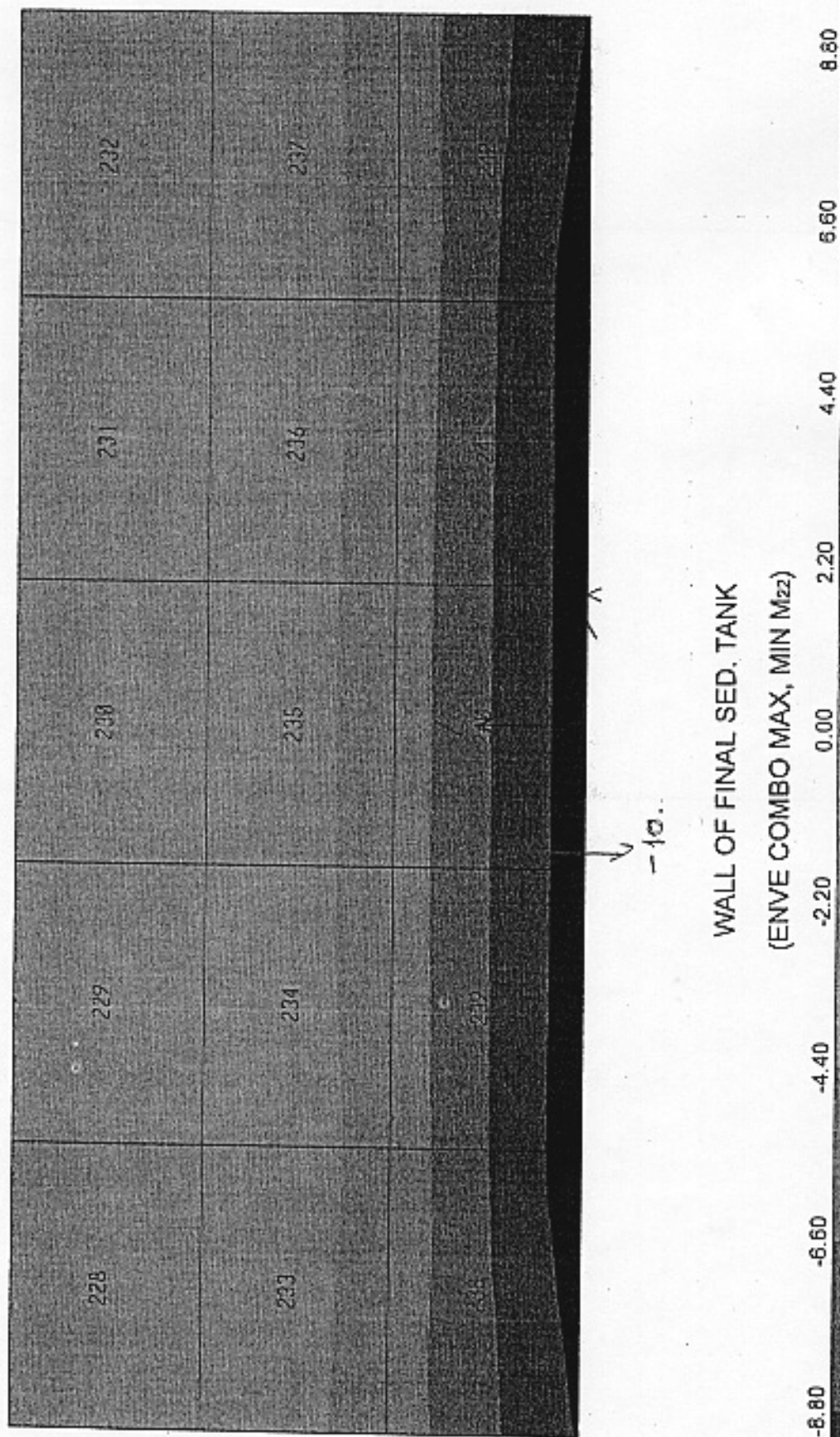
Where: $\gamma = 0.5 + ((1-2A_o)^{1/2})/2$

5-1 SLABS AND WALLS:

Moments	Values (T.m)	A _o	γ	F _a (cm ²)	r arrangement		
					ϕ (mm)	a(mm)	
(Bottom	-10.500	0.0651	0.966	14.15	16	125	a125
Slab level	-4.100	0.0209	0.989	4.89	12	200	
+1.15)	9.500	0.0589	0.970	12.76	16	125	
0.6							
Wall of	-10.100	0.0780	0.959	15.30	16	125	
Tank							
0.5							

6- CALCULATION FOR PILE QUANTITY (as attached sheets):

(Pile number to be decided by pile calculation sheet, please refer to pile calculation sheet for more information)



f-s-tank

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FINAL SED. TANK

LOAD COMBINATION MULTIPLIERS

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD	SELF	1.0000	STATIC(DEAD)	All tanks full of water
		WATER	1.0000	STATIC(OTHER)	
COMB2	ADD	SELF	1.0000	STATIC(DEAD)	tank full, tank empty
		WATER1	1.0000	STATIC(OTHER)	
ENVE	ENVE	COMB1	1.0000	COMBO	max min of combos to calculate for reinforcement
		COMB2	1.0000	COMBO	

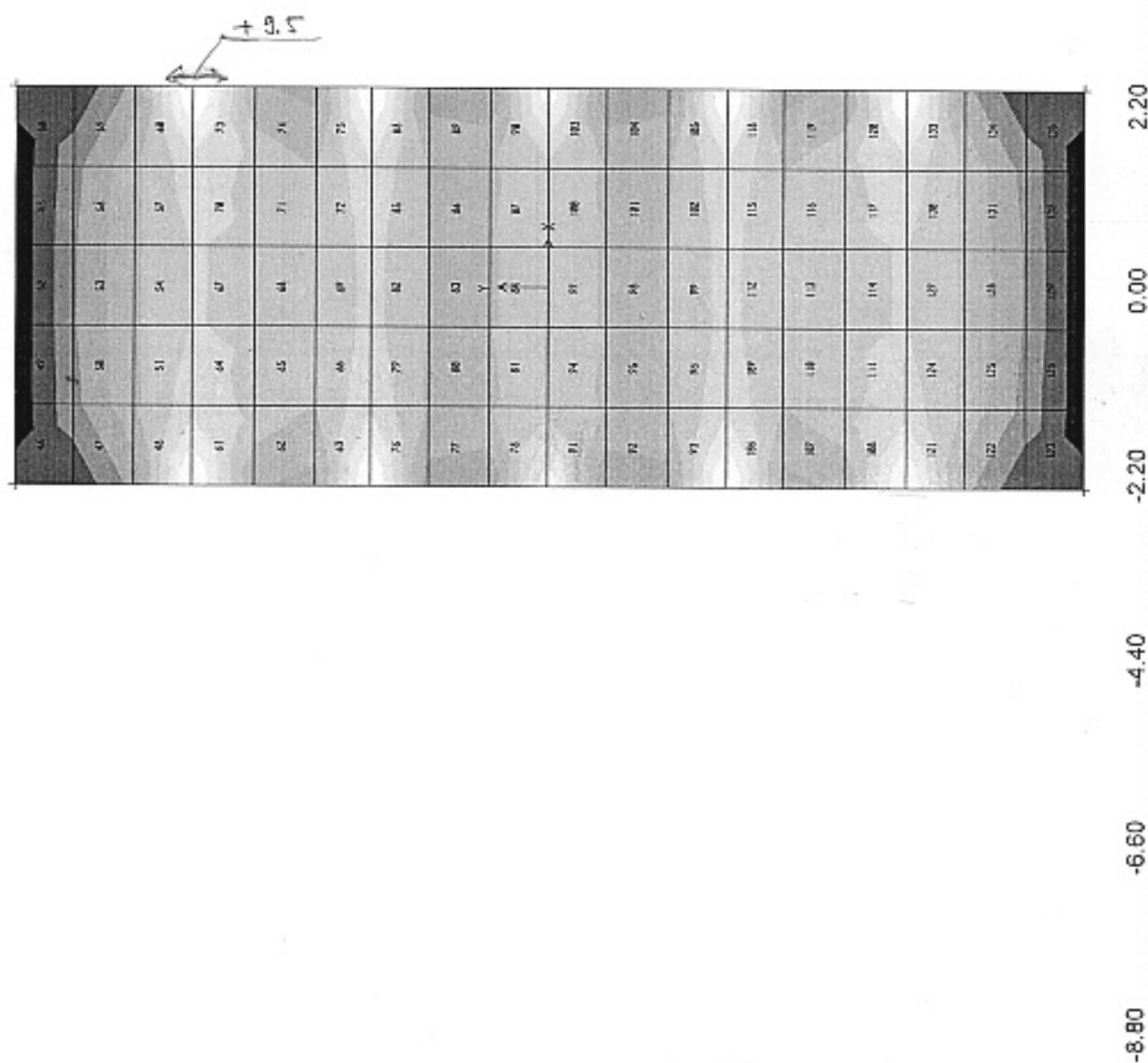
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FINAL SED. TANK

SHELL ELEMENT RESULTS

SHELL	LOAD	JOINT	F11	F22	F12	M11	M22	M12	V13	V23
239	Minima		-3.39	-2.83	-4.51	-2.00	-10.16-8.433E-03	-3.745E-01		-4.38
		ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE
239	Maxima		3.34	1.82-1.438E-02	2.986E-02	2.793E-03	4.745E-02	2.751E-02	1.141E-02	
		ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE
240	Minima		-1.66	-2.60-5.630E-01		-1.99	-10.09-2.138E-02	0.00		-4.18
		ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE
240	Maxima		3.04-4.964E-01	5.630E-01	1.461E-03	3.596E-01	2.138E-02	0.00-1.253E-02		
		ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE

BOTTOM SLAB OF FINAL SED. TANK
(ENVE COMBO MAX M₂₂)



BOTTOM SLAB OF FINAL SED. TANK
(ENVE COMBO MIN M22)

