7.1.6

Water Supply Facility

CALCULATION FOR WATER SUPPLY FACILITY (FOR UNDER GROUND PART)

(The calculation based on Japanese standard)

1-GEOMETRY DATUM FOR CALCULATION

(As shown on drawings attached):

Ground level:	GL	2.2
Ground water level:	GW	0.0
Bottom level of chlorination house:	BL	-3.1
Bottom level of sand filtration tank:	BL	-2.23
Water level in filtration works:		3.28
Thickness of chlorination house bottom		0.70 m
Thickness of filtration works bottom:		0.70 m

Average thickness of non-reinforced concrete layer (Chlorination house): 0.25 m

2-PARAMETERS FOR CALCULATION:

Concrete: Grade C21, Rn = 70

RS= 3.6

Reinforcement type JIS: Ra= 1600

Back fill sand: γ_s= 1.80T/m3 ; Coefficient of earth pressure at 0.5

Internal friction 20deg

2.1-BOUNDARY CONDITION:

Considering R.C piles as springs for analysing. Please refer to pile calculation part for further information about spring coefficients

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 chlorination house):

$p_{h1}=(\gamma_s-1)x(GWL-BL)xK_o+(GWL-BL)x1.0+p_{h3}$ = 6.32T/m2

-Horizontal triangle distributed load due to earth under ground water level (Outside of filtration works):

$p_{h2}=(\gamma_s-1)x(GWL-BL)xK_o+(GWL-BL)x1.0+p_{h3}$ = 5.10T/m2

-Horizontal triangle distributed load due to earth above ground water level

$p_{h3}=\gamma_s(GL-GWL)K_o$= 1.98T/m2

-Horizontal uniform load due to surcharge load on ground surface:

$p_{h\text{-surch}}$= 0.50T/m2xKo = 0.25T/m2

-Horizontal uniform load due to cover soil:

$p_{h\text{-coversoil}}$= 1.8x1.20 xKo = 1.08T/m2

-Uplift pressure to bottom of chlorination house for this case:

$p_{uplift}=(H_{ground\ water})x1.0$= 3.80T/m2

-Uplift pressure to bottom of filtration work for this case:

$p_{uplift}=(H_{ground\ water})x1.0$= 2.93T/m2

3.3-Water load in filtration works:

-Water load in side tanks:

p_{water} = 5.51T/m2

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

(Due to machanical supports and cinder concrete)

-Uniform load: $q_{con\,la}$ 2.5x0.25= 0.625T/m2

3.5-Live load:

-Live load for all operating floor and walking way : q_{live} = 0.50T/m2

-Live load for electric room: 1.00T/m2

-Live load due to chlorination tank : 4.40T/m2

SAP2000

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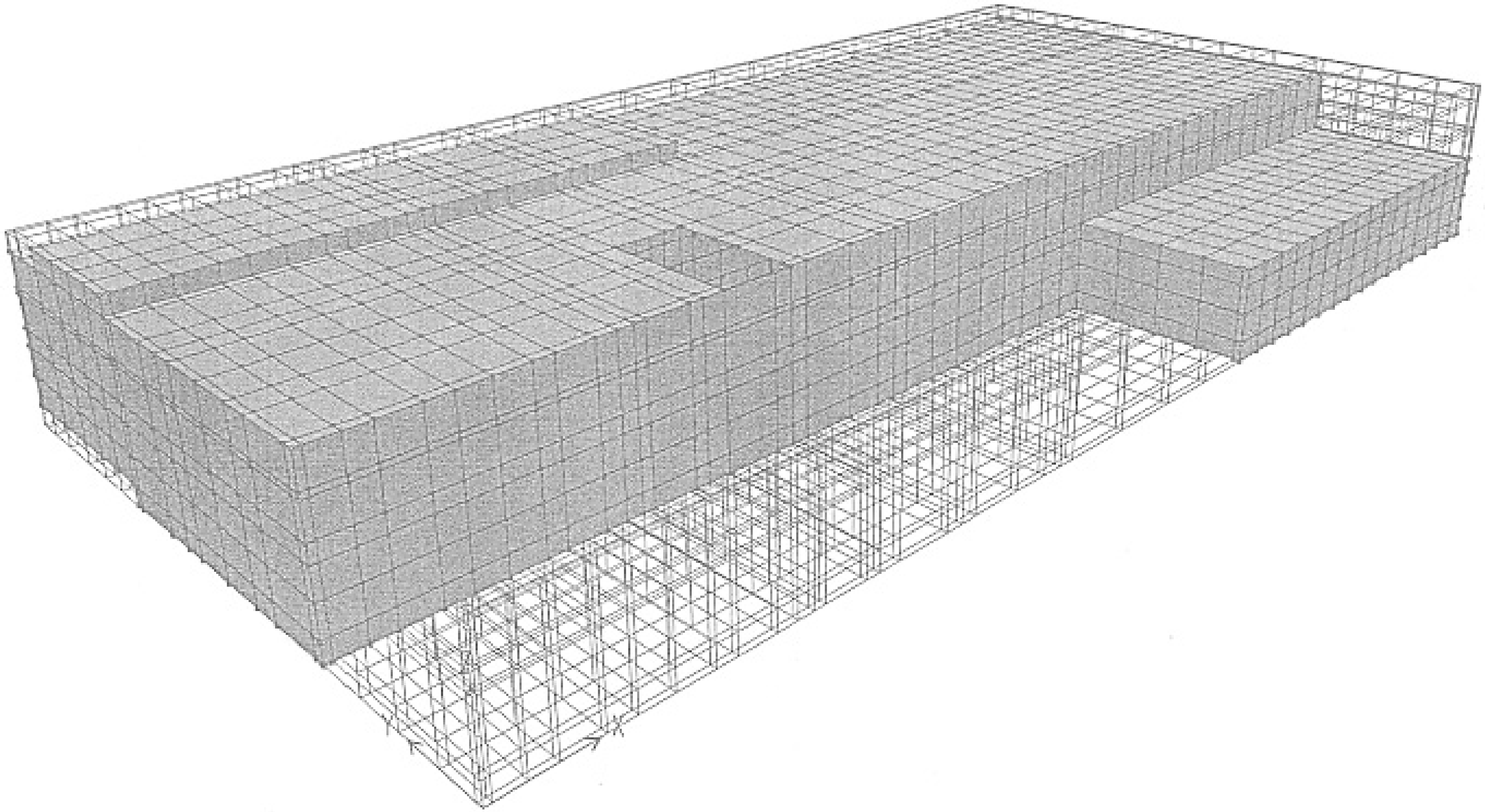

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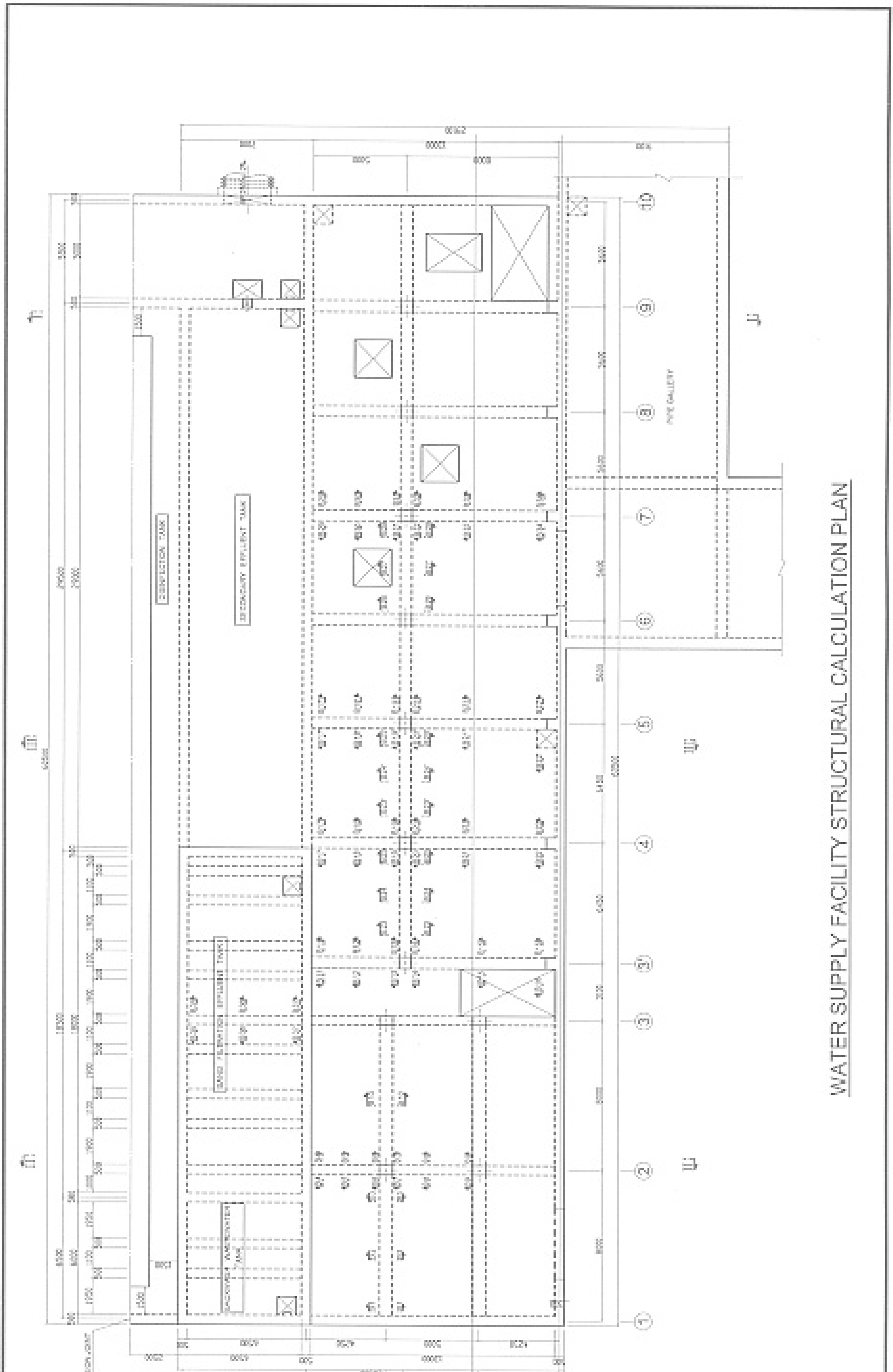
WATER SUPPLY FACILITY STRUCTURAL CALCULATION PLAN
DISINFECTION TANK
SECONDARY EFFLUENT TANK
SAND FILTRATION EFFLUENT TANK
BACKWASH WASTEWATER TANK
PIPE GALLERY
EXPANSION JOINT

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

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

L O A D   C O M B I N A T I O N   M U L T I P L I E R S

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COMBO   TYPE   CASE   FACTOR  TYPE        TITLE

COMB1   ADD                               Disinfection tanks full of water, water supply facility tanks empty, and right wind load
               SELF      1.0000  STATIC(DEAD)
               MANBOTTO  1.0000  STATIC(LIVE)
               WATERDIS  1.0000  STATIC(LIVE)
               EARTH     1.0000  STATIC(OTHER)
               ELECFLOO  1.0000  STATIC(LIVE)
               SURCHARG  1.0000  STATIC(OTHER)
               UPLIFT    1.0000  STATIC(OTHER)
               VVEHICLE  1.0000  STATIC(LIVE)
               ACHITEC2  1.0000  STATIC(OTHER)
               FILTER    1.0000  STATIC(LIVE)
               CHLOTANK  1.0000  STATIC(LIVE)
               BRICKWAL  1.0000  STATIC(DEAD)
               MANFFLOO  1.0000  STATIC(LIVE)
               COVERSOI  1.0000  STATIC(OTHER)

COMB2   ADD                               Water supply facility tanks full of water, disinfection tanks empty, and right wind load
               SELF      1.0000  STATIC(DEAD)
               MANBOTTO  1.0000  STATIC(LIVE)
               EARTH     1.0000  STATIC(OTHER)
               ELECFLOO  1.0000  STATIC(LIVE)
               SURCHARG  1.0000  STATIC(OTHER)
               UPLIFT    1.0000  STATIC(OTHER)
               VVEHICLE  1.0000  STATIC(LIVE)
               ACHITEC2  1.0000  STATIC(OTHER)
               FILTER    1.0000  STATIC(LIVE)
               CHLOTANK  1.0000  STATIC(LIVE)
               BRICKWAL  1.0000  STATIC(DEAD)
               MANFFLOO  1.0000  STATIC(LIVE)
               WATERFIL  1.0000  STATIC(LIVE)
               COVERSOI  1.0000  STATIC(OTHER)

COMB3   ADD                               Disinfection tanks full of water water supply facility tanks empty, and left wind load
               SELF      1.0000  STATIC(DEAD)
               MANBOTTO  1.0000  STATIC(LIVE)
               WATERDIS  1.0000  STATIC(LIVE)
               EARTH     1.0000  STATIC(OTHER)
               ELECFLOO  1.0000  STATIC(LIVE)
               SURCHARG  1.0000  STATIC(OTHER)
               UPLIFT    1.0000  STATIC(OTHER)
               VVEHICLE  1.0000  STATIC(LIVE)
               FILTER    1.0000  STATIC(LIVE)
               CHLOTANK  1.0000  STATIC(LIVE)
               BRICKWAL  1.0000  STATIC(DEAD)
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MANFFLOO 1.0000 STATIC(LIVE)
ACHITEC1 1.0000 STATIC(OTHER)
COVERSOI 1.0000 STATIC(OTHER)

COMB4 ADD Water supply facility tanks full of water, disinfection tanks empty, and left wind load
SELF 1.0000 STATIC(DEAD)
MANBOTTO 1.0000 STATIC(LIVE)
EARTH 1.0000 STATIC(OTHER)
ELECFLOO 1.0000 STATIC(LIVE)
SURCHARG 1.0000 STATIC(OTHER)
VVEHICLE 1.0000 STATIC(LIVE)
FILTER 1.0000 STATIC(LIVE)
CHLOTANK 1.0000 STATIC(LIVE)
BRICKWAL 1.0000 STATIC(DEAD)
MANFFLOO 1.0000 STATIC(LIVE)
ACHITEC1 1.0000 STATIC(OTHER)
WATERFIL 1.0000 STATIC(LIVE)
COVERSOI 1.0000 STATIC(OTHER)

REINENVE ENVE MAX MIN OF ALL COMBOS TO CALCULATE FOR REINFORCEMENT
COMB1 1.0000 COMBO
COMB2 1.0000 COMBO
COMB3 1.0000 COMBO
COMB4 1.0000 COMBO

5-CALCULATION FOR BAR ARRANGEMENT:

Base on attached results of shell forces analised 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:
Fa= M/γRaho Where: $\gamma = 0.5 + ((1-2Ao)^{1/2})/2$

5.1-SLABS AND WALLS:

Moments	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement ϕ(mm)	Bar arrangement a(mm)	Remarks
	17.700	0.0752	0.961	19.85	18	125	
	36.300	0.1542	0.916	42.71	28	125	
	12.000	0.0510	0.974	13.28	16	125	
sect. 1-1	11.400	0.0484	0.975	12.60	16	125	
(Bottom)	8.500	0.0361	0.982	9.33	18	250	
t=0.70	14.400	0.0612	0.968	16.02	16	125	
	12.400	0.0527	0.973	13.73	16	125	
	13.600	0.0578	0.970	15.10	16	125	
	14.900	0.0633	0.967	16.60	18	125	
	6.900	0.0293	0.985	7.55	18	250	
	8.400	0.0357	0.982	9.22	18	250	
	-17.600	0.0633	0.967	18.05	20	150	125
	-12.700	0.0457	0.977	12.90	16	125	
	-9.200	0.0331	0.983	9.28	14	125	

Moments	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement		Remarks
					φ(mm)	a(mm)	
	-8.500	0.0306	0.984	8.57	14	150	125not in Dwg
	-10.500	0.0378	0.981	10.62	14	125	
	-9.800	0.0353	0.982	9.90	14	125	
	-7.700	0.0277	0.986	7.75	14	150	125
	-1.830	0.1162	0.938	8.13	12	125	
sect. 1-1	1.000	0.0635	0.967	4.31	12	250	
(First floor)	-1.310	0.0832	0.957	5.71	12	150	125
t=0.20	-2.560	0.1625	0.911	11.71	14	125	
	1.330	0.0844	0.956	5.80	14	250	
	-2.100	0.1333	0.928	9.43	14	125	
	2.630	0.1670	0.908	12.07	14	125	
	-2.350	0.1492	0.919	10.66	14	125	
	0.900	0.0571	0.971	3.86	12	250	
	1.640	0.1041	0.945	7.23	12	125	not in Dwg
	-4.300	0.2730	0.837	21.41	18	100	125not in Dwg
	-2.600	0.1651	0.909	11.91	14	125	
	-14.200	0.1097	0.942	21.92	20	125	
	12.500	0.0966	0.949	19.14	18	125	
sect. 1-1	4.000	0.0309	0.984	5.91	14	250	
(Wall A)	-2.600	0.0201	0.990	3.82	16	250	
t=0.50	-12.000	0.0927	0.951	18.34	18	125	not in Dwg
	14.000	0.1082	0.943	21.59	20	125	
sect. 1-1	-6.000	0.0464	0.976	8.93	14	150	125
(Wall D)	3.400	0.0263	0.987	5.01	14	250	
t=0.50	-1.750	0.0135	0.993	2.56	12	250	
sect. 1-1	10.470	0.0809	0.958	15.89	18	125	
(Wall E)	-12.000	0.0927	0.951	18.34	18	125	
t=0.50	2.800	0.0216	0.989	4.11	14	250	
	-5.200	0.0402	0.979	7.72	16	250	
	15.700	0.0667	0.965	17.52	24	250	
	15.400	0.0654	0.966	17.18	24	250	
	26.000	0.1104	0.941	29.76	24	125	
sect. 2-2	16.190	0.0688	0.964	18.09	24	250	
(Bottom)	25.200	0.1070	0.943	28.79	24	125	
t=0.70	28.800	0.1223	0.935	33.21	24	125	
	14.600	0.0620	0.968	16.25	18	125	
	9.400	0.0399	0.980	10.34	18	250	
	23.700	0.1006	0.947	26.97	22	125	not in Dwg
	18.700	0.0794	0.959	21.02	20	125	
	8.520	0.0362	0.982	9.35	20	250	
	-9.400	0.0338	0.983	9.49	14	125	
	-14.400	0.0518	0.973	14.68	16	125	
	-13.500	0.0486	0.975	13.74	16	125	
	-9.100	0.0328	0.983	9.18	14	150	
	-9.000	0.0324	0.984	9.08	14	150	
	-14.000	0.0504	0.974	14.26	16	125	not in Dwg
	-10.300	0.0371	0.981	10.42	14	125	
	-8.800	0.0317	0.984	8.87	14	150	125
	-5.230	0.1195	0.936	13.97	16	125	
	3.100	0.0709	0.963	8.05	12	125	

Moments	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement φ(mm)	a(mm)	Remarks
	-2.620	0.0599	0.969	6.76	12	150	
sect. 2-2	1.250	0.0286	0.986	3.17	14	250	
(firstfloor)	-6.400	0.1463	0.921	17.38	18	125	
	-4.920	0.1125	0.940	13.08	16	125	not in Dwg
	-2.940	0.0672	0.965	7.62	16	250	
0.3	1.900	0.0434	0.978	4.86	14	250	
0.25	-3.400	0.1214	0.935	11.36	14	125	
(Sand filtration	1.820	0.0650	0.966	5.89	14	250	
cover slab)	-3.300	0.1179	0.937	11.00	14	125	
	1.500	0.0536	0.972	4.82	14	250	
	1.820	0.0650	0.966	5.89	14	250	
	-5.200	0.1857	0.896	18.13	18	125	not in Dwg
	-3.800	0.1357	0.927	12.81	16	125	
	-3.100	0.1107	0.941	10.29	16	150	
sect.2-2	-15.900	0.1228	0.934	24.74	20	125	
wall A	4.100	0.0317	0.984	6.06	14	250	
0.5	-9.100	0.0703	0.964	13.73	20	200	
	-4.000	0.0309	0.984	5.91	14	250	
sect.2-2	17.500	0.1352	0.927	27.44	22	125	
wall D	-12.000	0.0927	0.951	18.34	18	125	
0.5	5.300	0.0409	0.979	7.87	16	250	
	-2.100	0.0162	0.992	3.08	12	250	
sect.2-2	-14.200	0.1097	0.942	21.92	20	125	
wall E	9.000	0.0695	0.964	13.57	18	150	
0.5	-5.400	0.0417	0.979	8.02	16	250	
	4.520	0.0349	0.982	6.69	16	250	

5.1-BEAMS:

SECTION m2	LOCATION	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement φ(mm)	quantity	Remarks
b=0.70	B1	-15.520	0.0209	0.989	7.97	25	2	
h=1.30	B2	37.860	0.0511	0.974	19.76	25	5	
	B3	-62.820	0.0847	0.956	33.40	24	8	
	B10	45.430	0.0613	0.968	23.84	25	5	
b=0.50	B4	-5.760	0.0586	0.970	7.00	22	2	
h=0.60	B5	5.200	0.0529	0.973	6.30	18	3	
	B6	-6.630	0.0674	0.965	8.10	22	3	
	B7	-5.870	0.0597	0.969	7.14	18	3	
	B8	2.940	0.0299	0.985	3.52	18	2	
	B9	-6.830	0.0695	0.964	8.36	22	3	
b=0.60	B11	-11.700	0.0218	0.989	6.54	22	2	
h=1.20	B12	2.840	0.0053	0.997	1.57	20	2	
	B13	-41.480	0.0773	0.960	23.91	24	6	
	B14	-39.620	0.0739	0.962	22.79	24	6	
	B15	22.420	0.0418	0.979	12.67	20	5	
	B16	-23.750	0.0443	0.977	13.44	24	3	
	B17	-4.850	0.0090	0.995	2.69	24	2	

SECTION m2	LOCATION	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement ϕ(mm)	Bar arrangement quantity	Remarks
	B18	7.190	0.0134	0.993	4.00	22	2	
	B19	-37.580	0.0701	0.964	21.57	24	5	
	B20	-37.640	0.0702	0.964	21.61	24	5	
	B21	30.930	0.0577	0.970	17.63	22	5	
	B22	-31.750	0.0592	0.969	18.11	24	5	
	B17'	-11.470	0.0214	0.989	6.41	24	2	
	B18'	2.050	0.0038	0.998	1.14	22	2	
	B19'	-45.150	0.0842	0.956	26.12	24	6	
	B20'	-46.420	0.0866	0.955	26.89	24	6	
	B21'	40.970	0.0764	0.960	23.60	22	7	
	B22'	-39.660	0.0740	0.962	22.81	24	6	
b=0.60	B23	-9.490	0.0424	0.978	8.30	24	2	
h=0.80	B24	19.880	0.0888	0.953	17.85	24	4	
	B25	-29.990	0.1340	0.928	27.67	24	7	
	B23'	-29.690	0.1327	0.929	27.37	24	7	
	B24'	16.210	0.0724	0.962	14.42	24	4	
	B25'	-18.740	0.0837	0.956	16.78	24	4	
b=0.60	B26	-11.700	0.0992	0.948	14.56	24	4	
h=0.60	B27	5.810	0.0492	0.975	7.03	20	3	
	B28	-11.020	0.0934	0.951	13.67	24	4	
b=0.60	B29	-7.670	0.0211	0.989	5.21	24	2	
h=1.00	B30	0.000	0.0000	1.000	0.00	22	2	
	B31	-30.370	0.0836	0.956	21.34	24	5	
b=0.60	B32	-31.240	0.0860	0.955	21.98	24	5	
h=1.00	B33	25.090	0.0691	0.964	17.49	22	5	
	B34	-27.080	0.0745	0.961	18.93	24	5	
b=0.50	B35	-18.600	0.0771	0.960	14.59	20	5	
h=0.90	B36	31.110	0.1290	0.931	25.17	24	6	
	B37	-15.900	0.0659	0.966	12.40	20	4	

5.1.1-CHECKING SHEAR FORCES:

-Height of hand for supporting beam s, so the section need to be chacked shear bearing capacity is [c/2+(h+s)/2]

- In case Q >= Rsxbxd so the below case is to be considered
- In case concrete is not enough to bear shearing force, stirrups will be considered

Sc/2 + Ss >= Q (shearing force at section calculated)

Where Sc: shearing bearing capacity of concrete (kg)

Ss: shearing bearing capacity of reinforcement (kg)

Ss=AsxRaxjxd/a = Q - Sc/2

As: 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 stresses (Kg/cm2)	Degn Shearin stress (Sc) (Kg/cm2)	Compare &Conclud	Number of stirrup branches	Dia. Of stirrup (mm)	pitch of stirrup (cm)
Frame C	1.3	0.7	0	0.5	0.90	36.63	31.00	4.25	3.6	NOT OK!	2	12	18.3
Frame 2	0.6	0.5	0	0.7	0.65	8.32	9.54	3.14	3.6	OK!!!			
Frame 4	1.2	0.6	0	0.6	0.90	22.45	24.41	3.31	3.6	OK!!!			
Frame 5	1.2	0.6	0	0.6	0.90	29.83	24.41	4.40	3.6	NOT OK!	2	12	20.2
Frame 7	1.0	0.6	0	0.6	0.80	19.56	20.09	3.51	3.6	OK!!!			
Frame B'	1.0	0.6	0	0.6	0.80	19.72	20.09	3.53	3.6	OK!!!			

6-COLUMNS:

A. MATERIAL PROPERTIES:

_ Concrete	Grade	E21	Rn	=	70 (Kg/cm2)
			Eb	=	230000 (Kg/cm2)
_ Reinforcement	Grada	All	Ea	=	2000000 (Kg/cm2)
			Ra = Ra'	=	1600 (Kg/cm2)

B. CALCULATION:

NAME OF COLUMN	POSITION	l (cm)	b (cm)	h (cm)	a=a' (cm)	h_0 (cm)	l_0 (cm)	l_h	m_s	Rn* (Kg/cm2)	α_0	A_0	μ_{gt} (%)	J_a (cm4)	J_b (cm4)	M (Kg.m)	N (Kg)	e_0 (cm)	e_0/h
A-5	Upper	670	60	100	7	93	469	4.690	1.00	70	0.62	0.428	0.62	63968	5000000.00	3.19E+04	2.03E+04	159.8	1.598
	Lower	670	60	100	7	93	469	4.690	1.00	70	0.62	0.428	0.4	41270	5000000.00	2.42E+04	2.30E+04	109.1	1.091
B'4	Upper	670	60	60	7	53	469	7.817	1.00	70	0.62	0.428	0.2	3364	1080000.00	2.25E+03	1.10E+05	4.4	0.074
	Lower	670	60	60	7	53	469	7.817	1.00	70	0.62	0.428	0.2	3364	1080000.00	4.02E+03	1.17E+05	5.8	0.097
C2	Upper	670	50	70	7	63	469	6.700	1.00	70	0.62	0.428	0.2	4939	1429166.67	4.59E+03	1.16E+05	6.8	0.097
	Lower	670	50	70	7	63	469	6.700	1.00	70	0.62	0.428	0.2	4939	1429166.67	5.65E+03	1.22E+05	7.4	0.106

NAME OF COLUMN	POSITION	S	M_{dh} (Kg.m)	N_{dh} (Kg)	K_{dh}	N_{th} (Kg)	η	$h.e_0$ (cm)	e_{0gh}	e (cm)	x (cm)	$\alpha_o.h_o$	x' (cm)	Fa=Fa' (cm2)		μ_{tt} (%)	$F'_{a\ chosen}$ (cm2)		μ_{t} (%)	CHECK	Same arrangement Fa=Fa'
A-5	Upper	0.16	3.19E+04	2.05E+04	2.00	6.48E+06	1.003	160.27	26.94	117.3	4.9	57.7	57.7	LTL	17.4	0.63			0.00	OK !	4 f25
	Lower	0.19	2.42E+04	2.30E+04	2.00	5.62E+06	1.004	109.54	26.94	66.5	5.5	57.7	57.7	LTL	11.1	0.40			0.00	OK !	3 f25
B'4	Upper	0.73	2.25E+03	1.10E+05	2.00	2.84E+06	1.040	4.62	16.86	27.6	26.3	32.9	53.1	LTL	-18.4	-1.15			0.00	RECH	-4 f26
	Lower	0.66	4.02E+03	1.17E+05	2.00	2.57E+06	1.048	6.12	16.86	29.1	27.8	32.9	50.8	LTL	-15.8	-1.00			0.00	RECH	-3 f27
C2	Upper	0.66	4.59E+03	1.16E+05	2.00	3.44E+06	1.035	7.00	19.38	35.0	33.1	39.1	59.6	LTL	-14.8	-0.94			0.00	RECH	-3 f28
	Lower	0.63	5.65E+03	1.22E+05	2.00	3.32E+06	1.038	7.71	19.38	35.7	34.9	39.1	58.5	LTL	-13.4	-0.85			0.00	RECH	-3 f29

7- CALCULATION FOR PILE NUMBER

(Pile number to be decided by pile capacity as calculated, please refer to pile calculation part in the "Design report" for more information)

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J O I N T   R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
2	Minima	0.0000	0.0000	1138.4926	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
2	Maxima	0.0000	0.0000	1140.0933	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
13	Minima	0.0000	238.0364	797.2947	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
13	Maxima	0.0000	241.0088	797.5787	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
44	Minima	-137.6070	0.0000	117.1416	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
44	Maxima	-45.2618	0.0000	134.6723	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
219	Minima	0.0000	0.0000	1666.9232	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
219	Maxima	0.0000	0.0000	1674.2565	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
303	Minima	0.0000	0.0000	473.2465	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
303	Maxima	0.0000	0.0000	475.9105	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
450	Minima	0.0000	0.0000	233.7308	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE
450	Maxima	0.0000	0.0000	233.8615	0.0000	0.0000	0.0000
		PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE	PILEENVE

$\sum_{i=2-450} Ri =$ 4664.4T So reaction pressure is: 4664.4/(25.5x23)= 7.953 (T/m2)

Pile capacity= 45 ton for one pile so one pile can bear for an area less tha 45/7.953= 5.66m2
So the R.C piles to be arranged as on DWG No. PE-WWTP-254-01

8- CHECKING UPLIFT IN CASE GROUND WATER LEVEL UPTO +2.2

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LOAD COMBINATION MULTIPLIERS

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
UPLIFT	ADD				Checking uplift, when ground water level upto +2.2
		SELF	1.0000	STATIC(DEAD)	
		ELECFLOO	1.0000	STATIC(LIVE)	
		ACHITEC2	1.0000	STATIC(OTHER)	
		FILTER	1.0000	STATIC(LIVE)	
		CHLOTANK	1.0000	STATIC(LIVE)	
		BRICKWAL	1.0000	STATIC(DEAD)	
		COVERSOI	1.0000	STATIC(OTHER)	
		MAXUPLIF	1.0000	STATIC(OTHER)	

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JOINT REACTIONS

JOINT	LOAD	F1	F2	F3	M1	M2	M3
2	Minima	0.0000	0.0000	248.5001	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
2	Maxima	0.0000	0.0000	248.5001	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
4	Minima	0.0000	334.3679	38.4905	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
4	Maxima	0.0000	334.3679	38.4905	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
13	Minima	0.0000	290.5133	-5.0094	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
13	Maxima	0.0000	290.5133	-5.0094	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
14	Minima	-21.9829	0.0000	-26.8673	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
14	Maxima	-21.9829	0.0000	-26.8673	0.0000	0.0000	0.0000
		UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
44	Minima	92.4739	0.0000	110.2682	0.0000	0.0000	0.0000

	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
44 Maxima	92.4739	0.0000	110.2682	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
219 Minima	0.0000	0.0000	-132.7863	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
219 Maxima	0.0000	0.0000	-132.7863	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
220 Minima	0.0000	0.0000	-280.6315	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
220 Maxima	0.0000	0.0000	-280.6315	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
303 Minima	0.0000	0.0000	-22.8851	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
303 Maxima	0.0000	0.0000	-22.8851	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
304 Minima	0.0000	0.0000	-224.3280	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
304 Maxima	0.0000	0.0000	-224.3280	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
429 Minima	0.0000	0.0000	58.6100	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
429 Maxima	0.0000	0.0000	58.6100	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
450 Minima	0.0000	0.0000	-11.9780	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
450 Maxima	0.0000	0.0000	-11.9780	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
451 Minima	0.0000	0.0000	-44.6212	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
451 Maxima	0.0000	0.0000	-44.6212	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
2822 Minima	0.0000	0.0000	-342.6094	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT
2822 Maxima	0.0000	0.0000	-342.6094	0.0000	0.0000	0.0000
	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT	UPLIFT

Total uplift upto the bottom slab = -635.85 Ton

Tensile capacity of one pile as calculated is 20 ton (In case the pile be pulled up)

So the number of piles needed for preventing structure from uplifting is : 31.8 piles, but as numbe piles calculated in part 7 above is 352 piles for water supply facility foundation, so uplift will never occur

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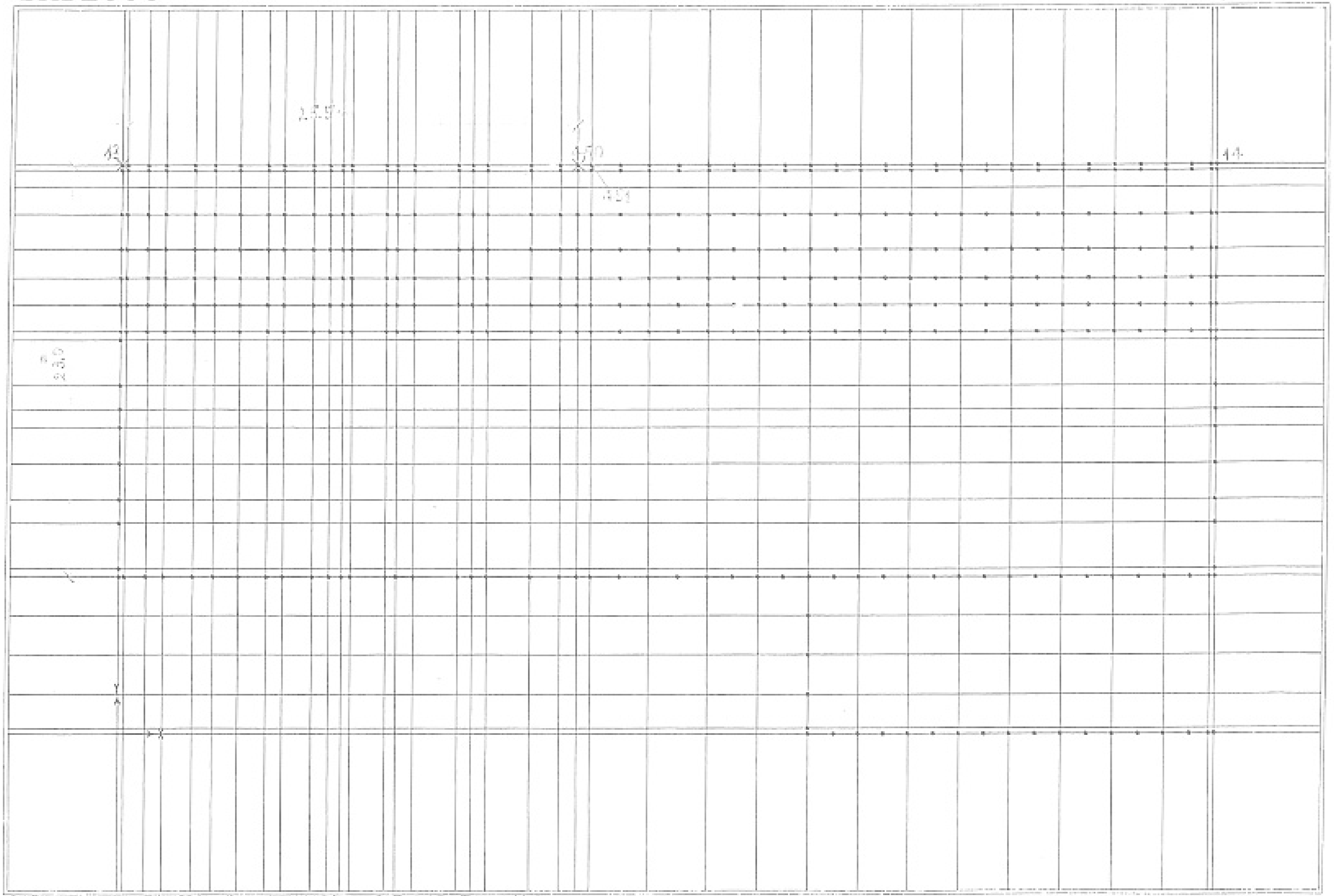

SAP2000 v6.11 - File:Chlo-pile-cal - X-Y Plane @ Z=0.87 - Ton-m Units

SAP2000

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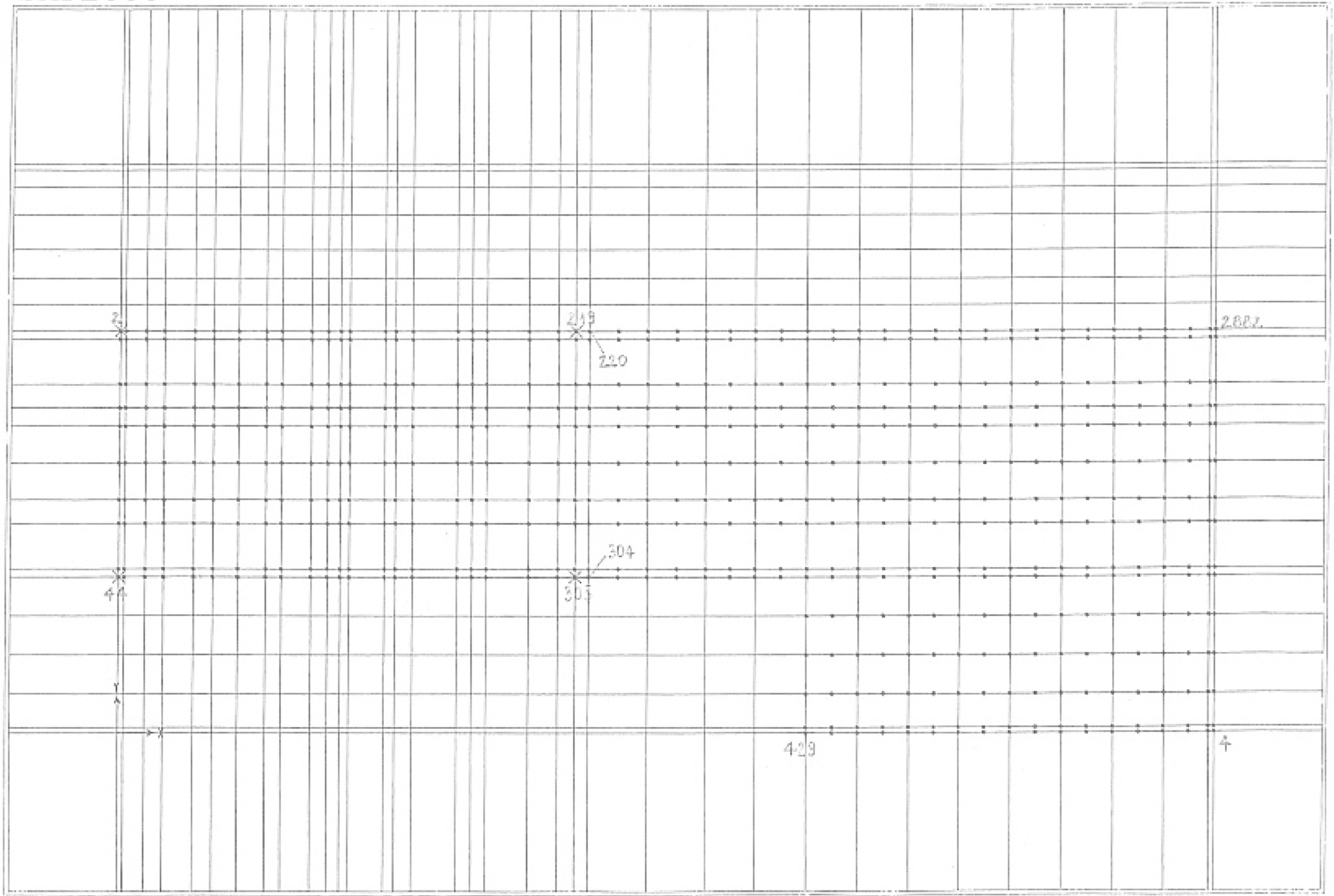

SAP2000 v6.11 - File:Chio-pile-cal - X-Y Plane @ Z=0 - Ton-m Units

SAP2000 v6.11 - File:Chlbprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units

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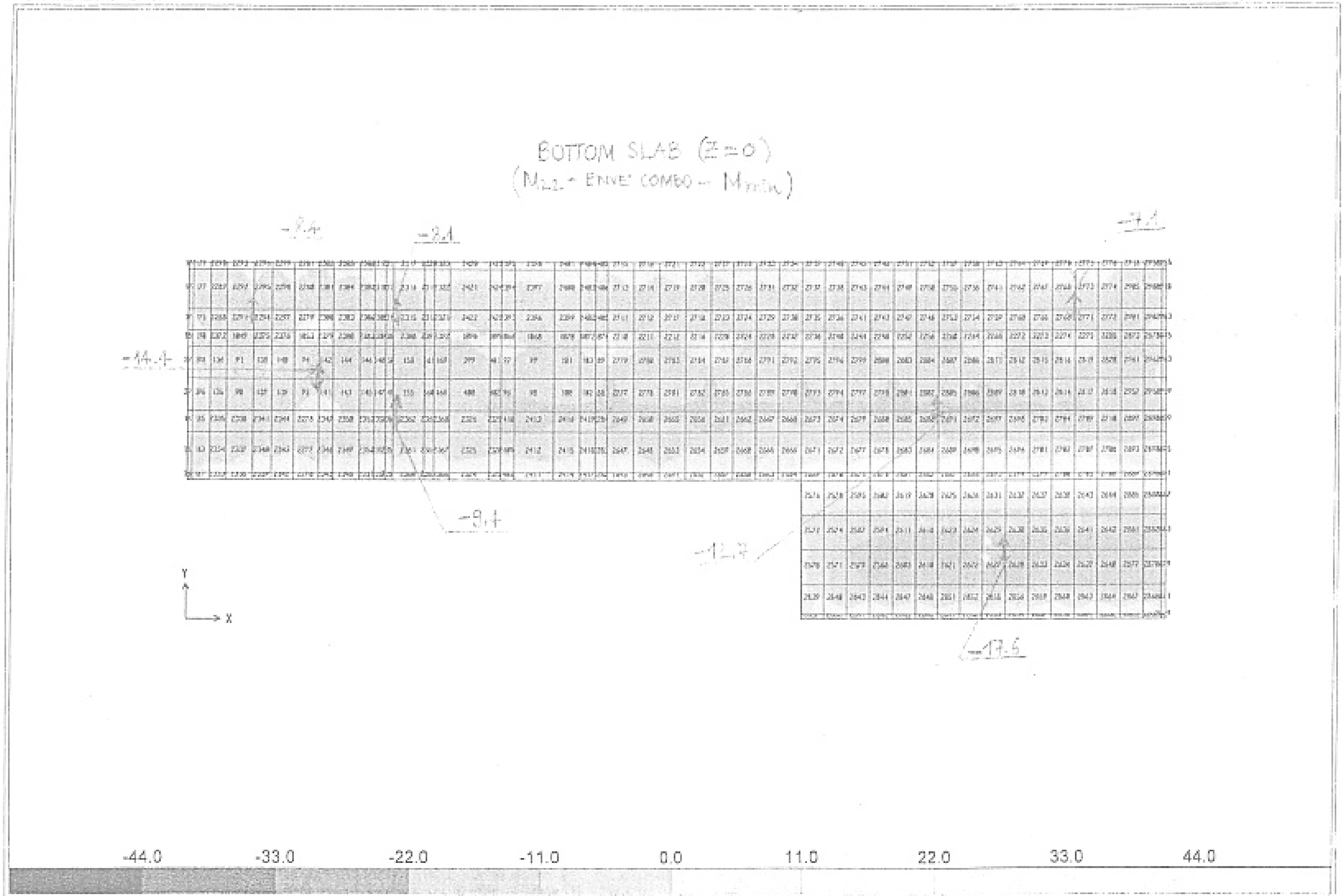
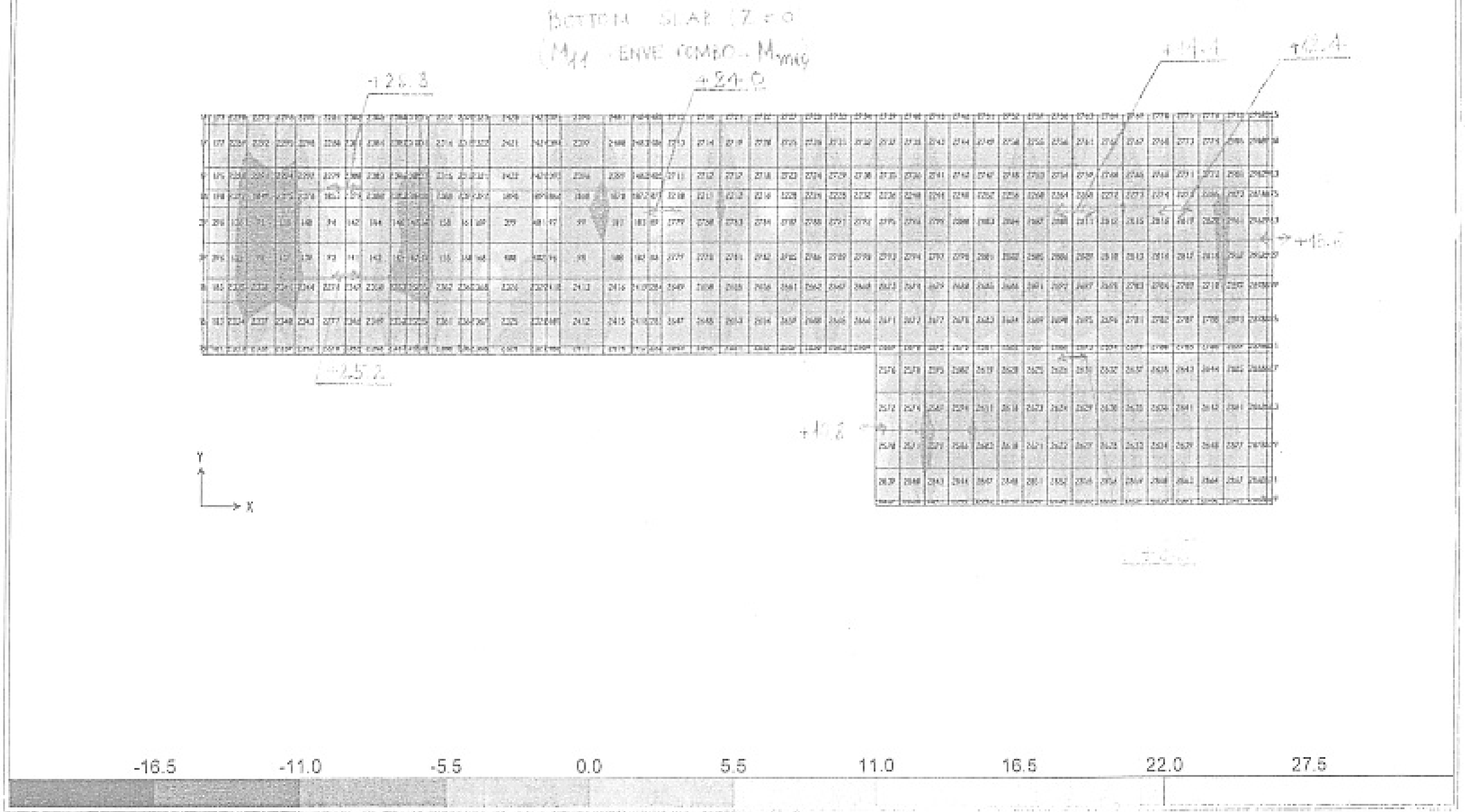


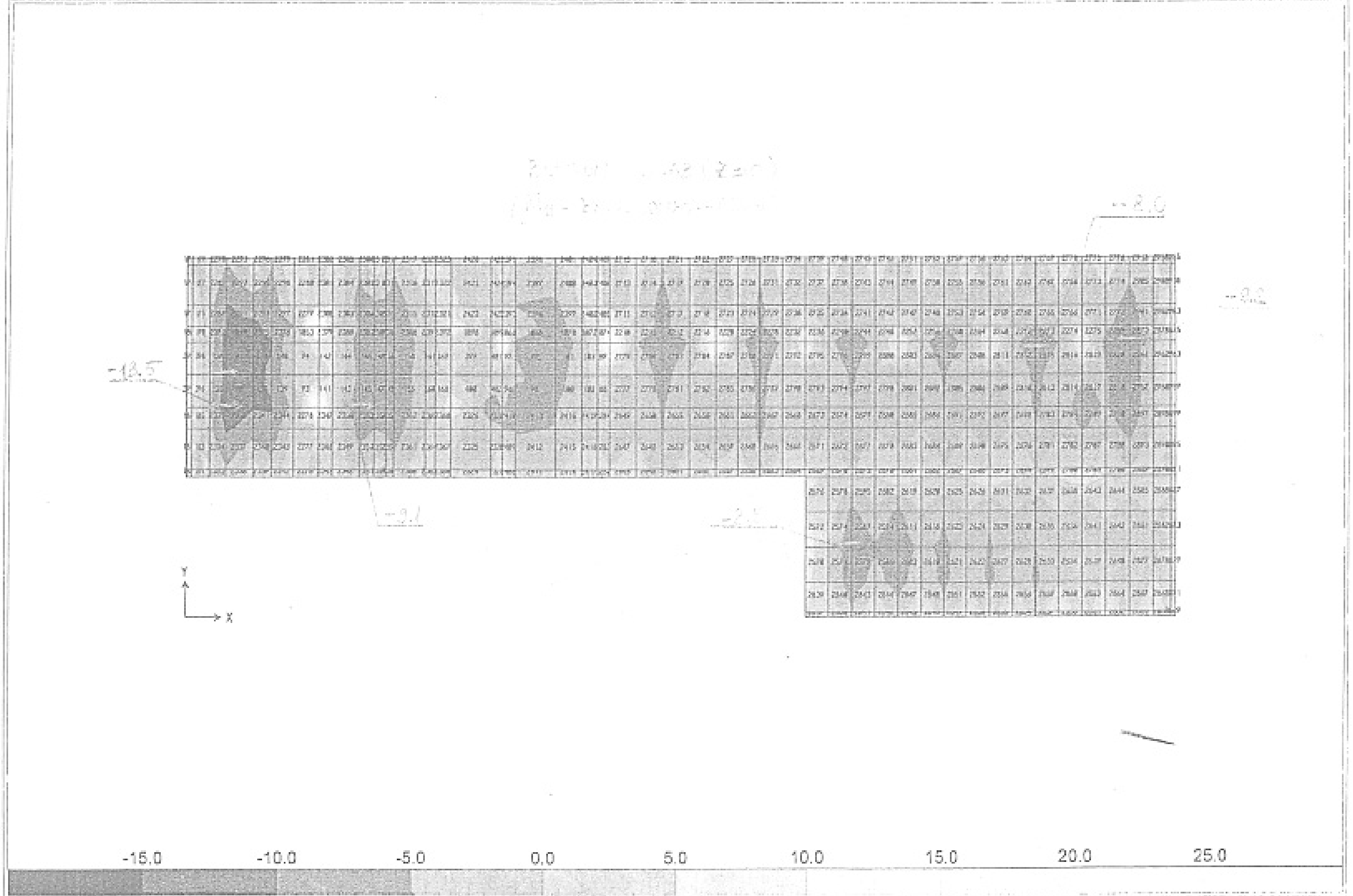
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units



SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

SAP2000

March 22,2001 13:40



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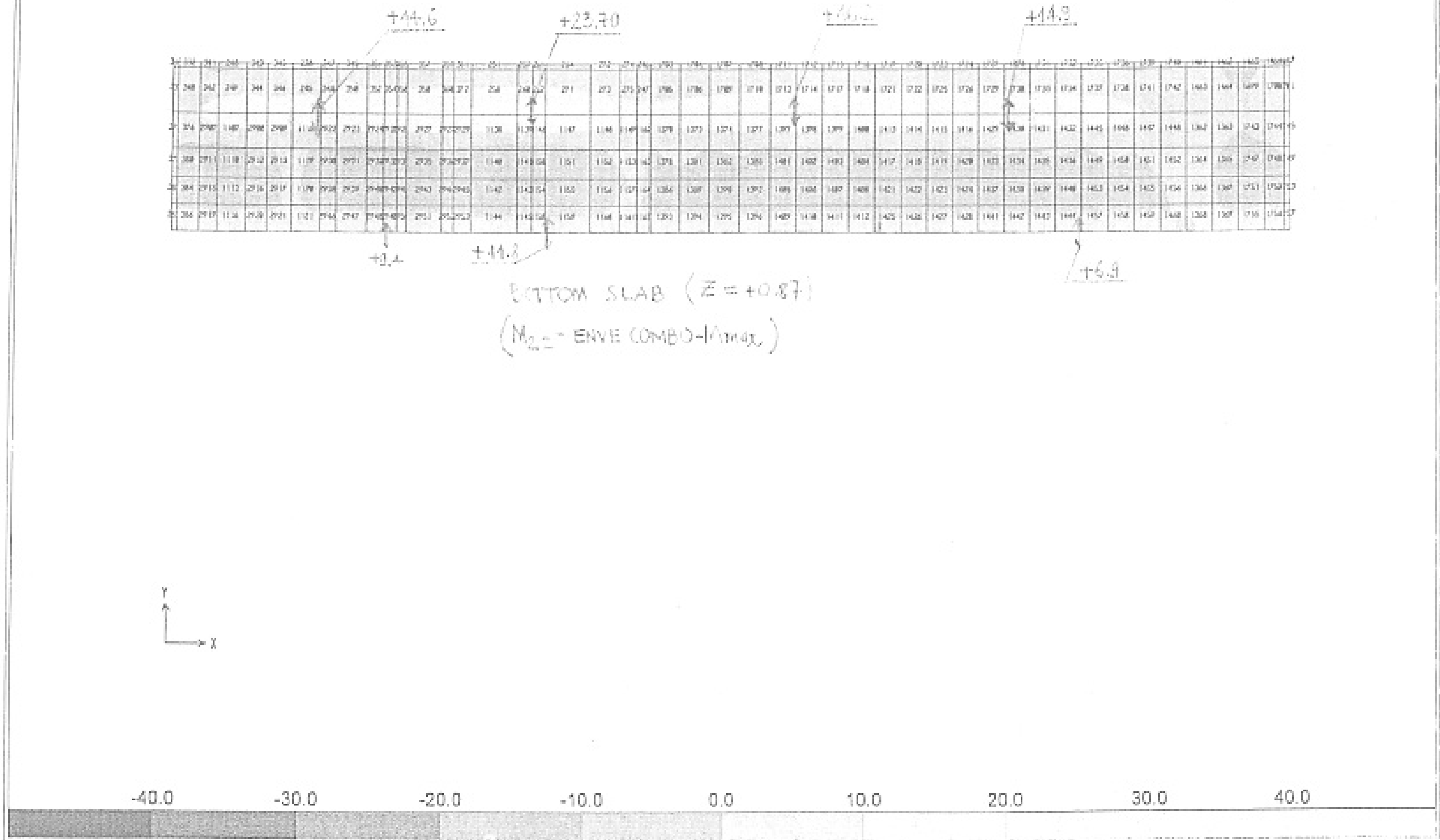

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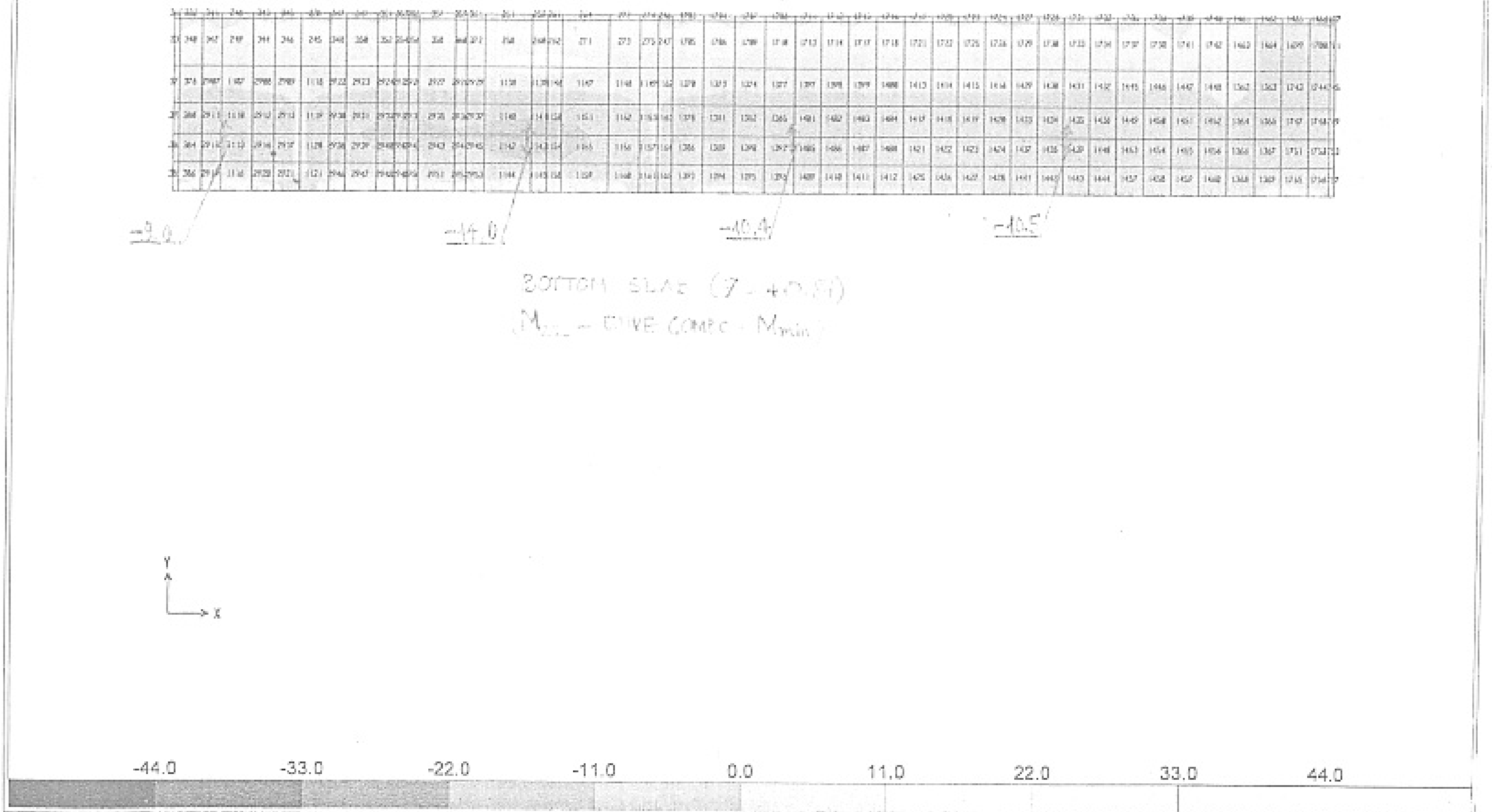

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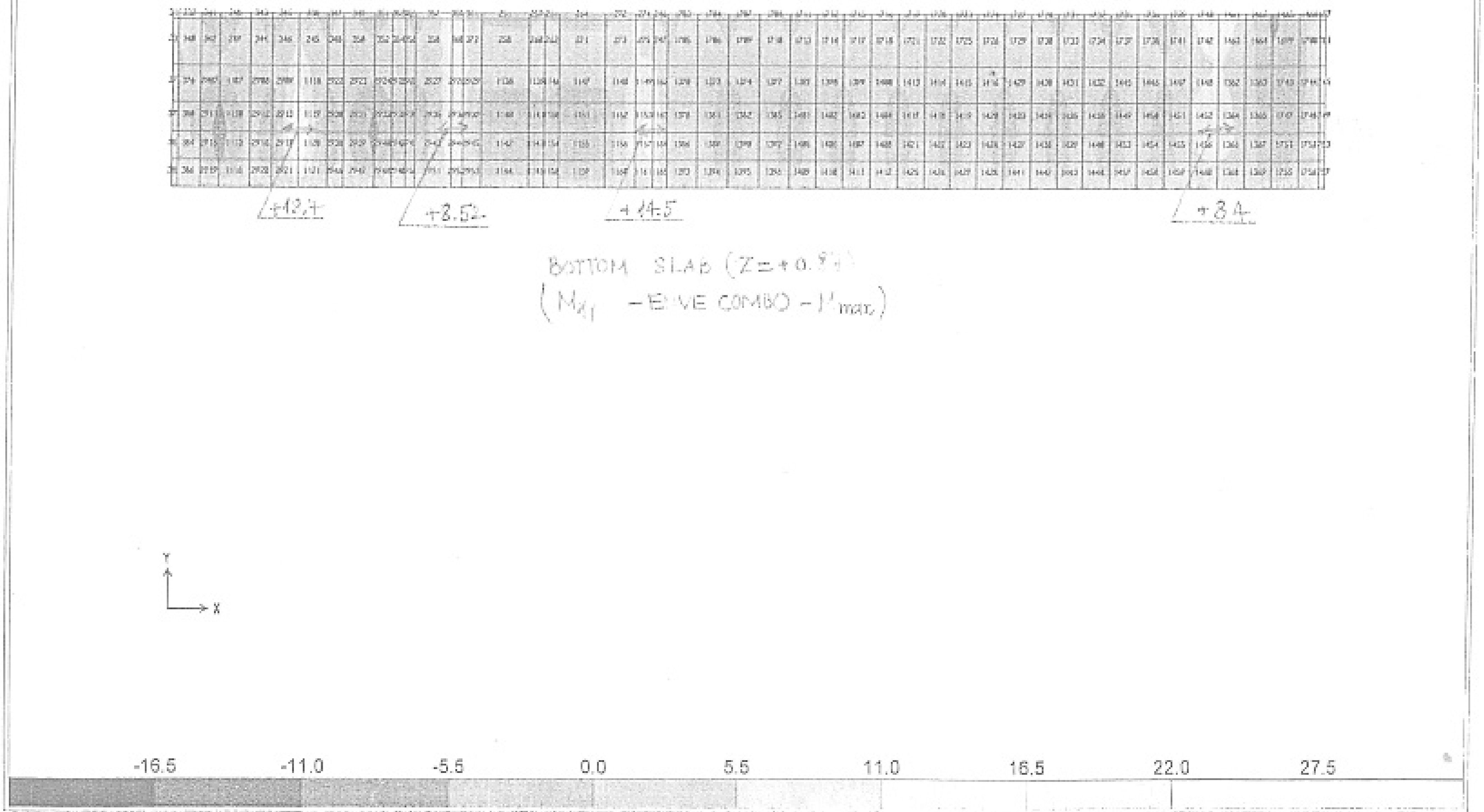

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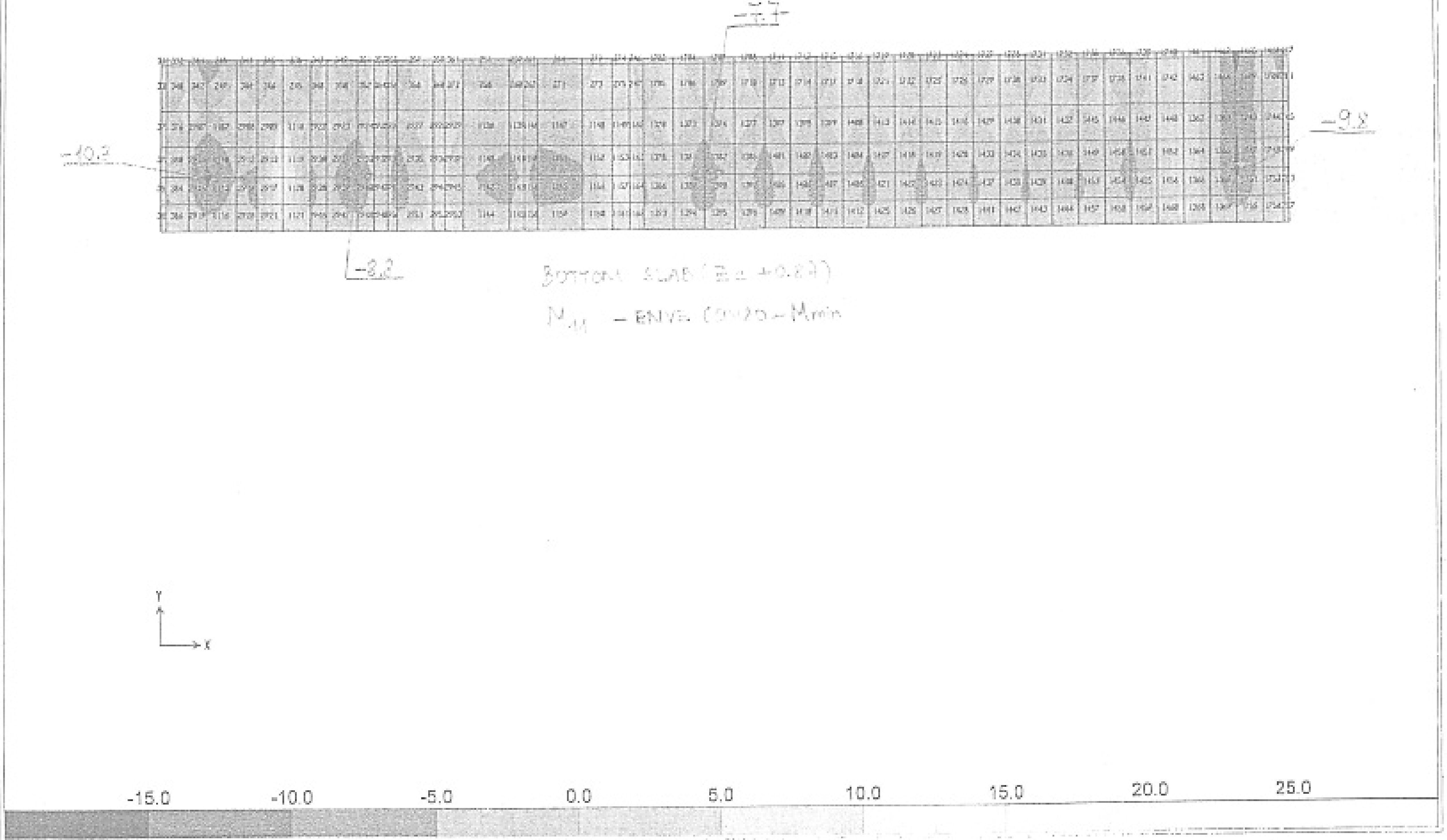

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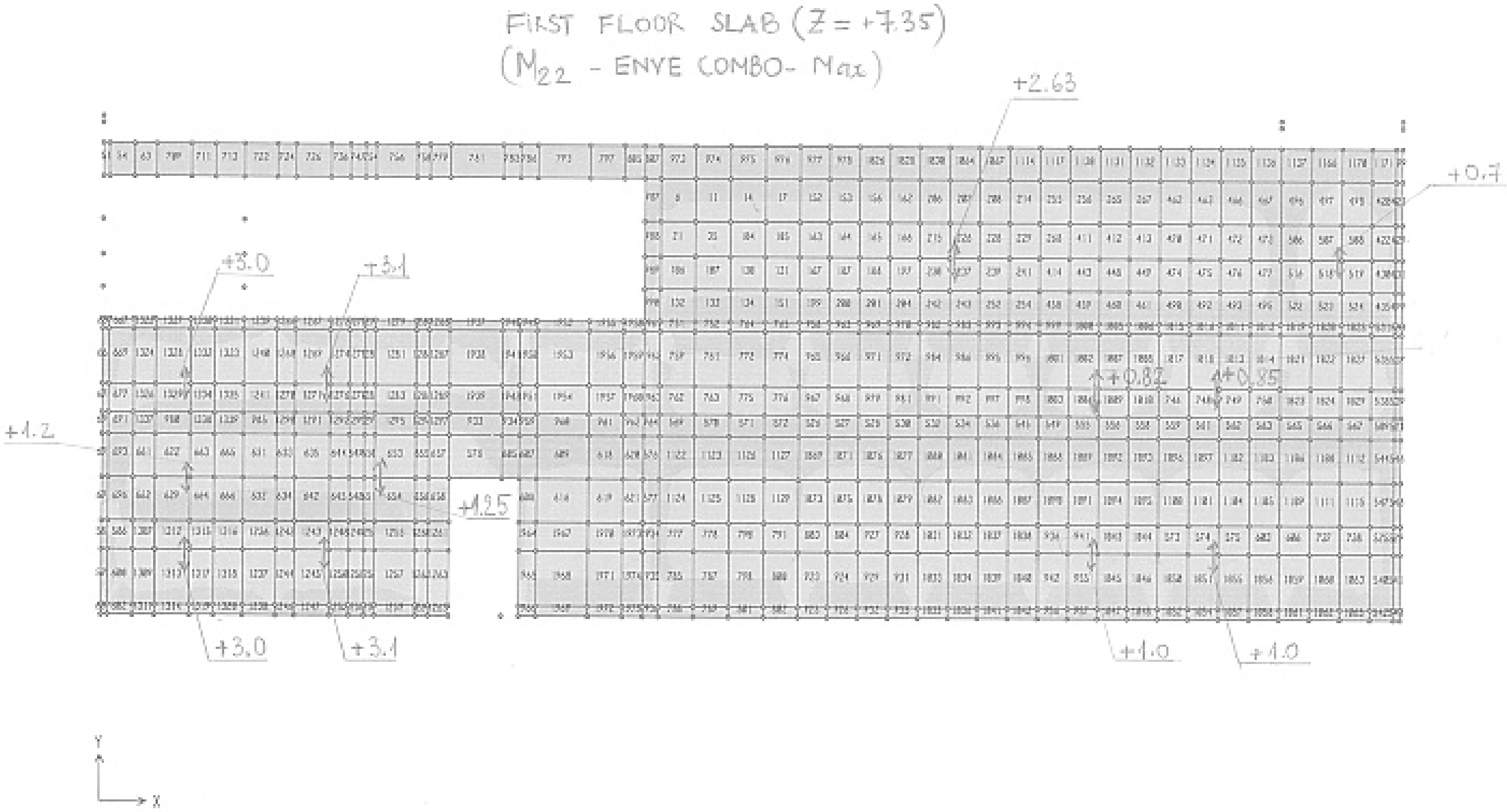

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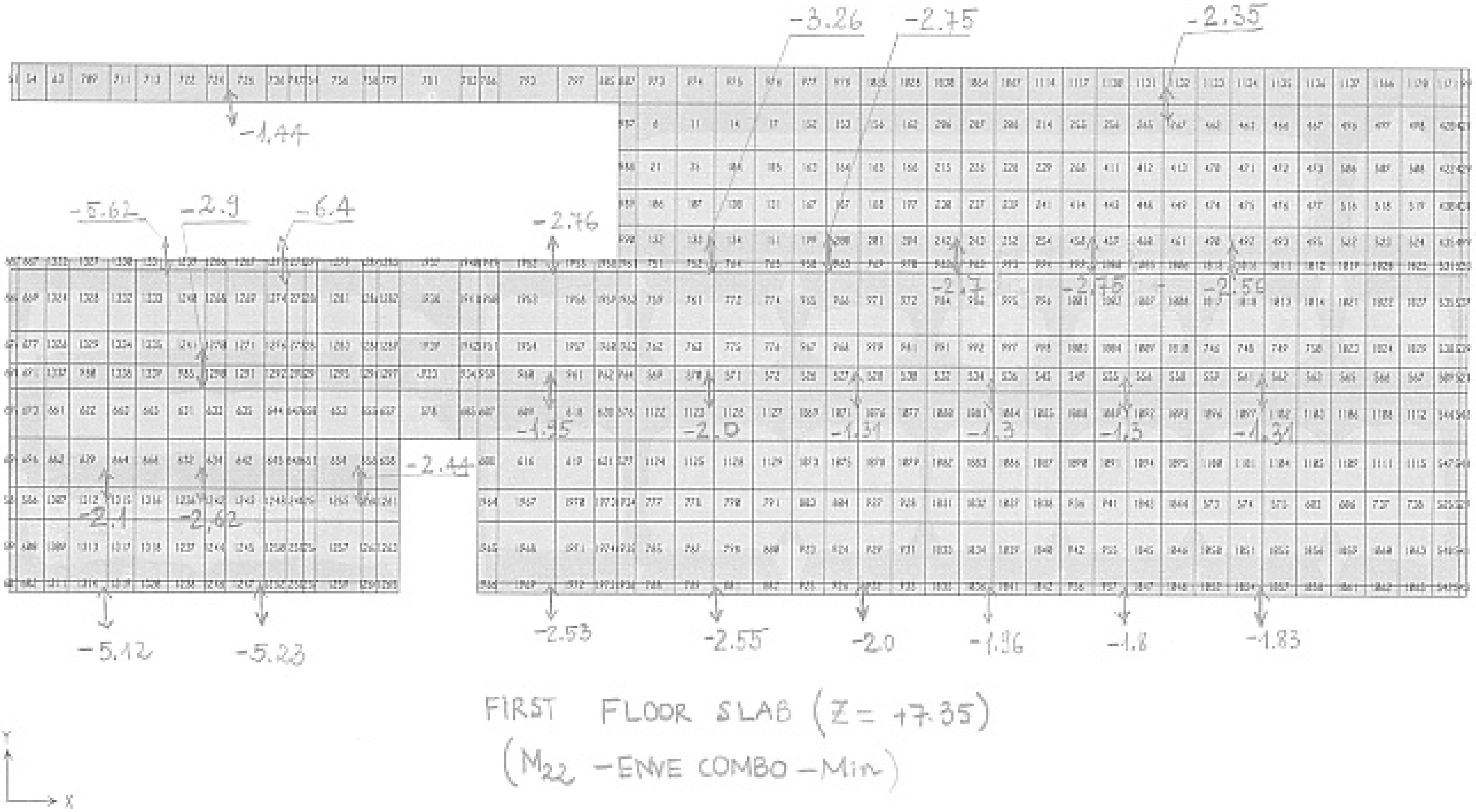
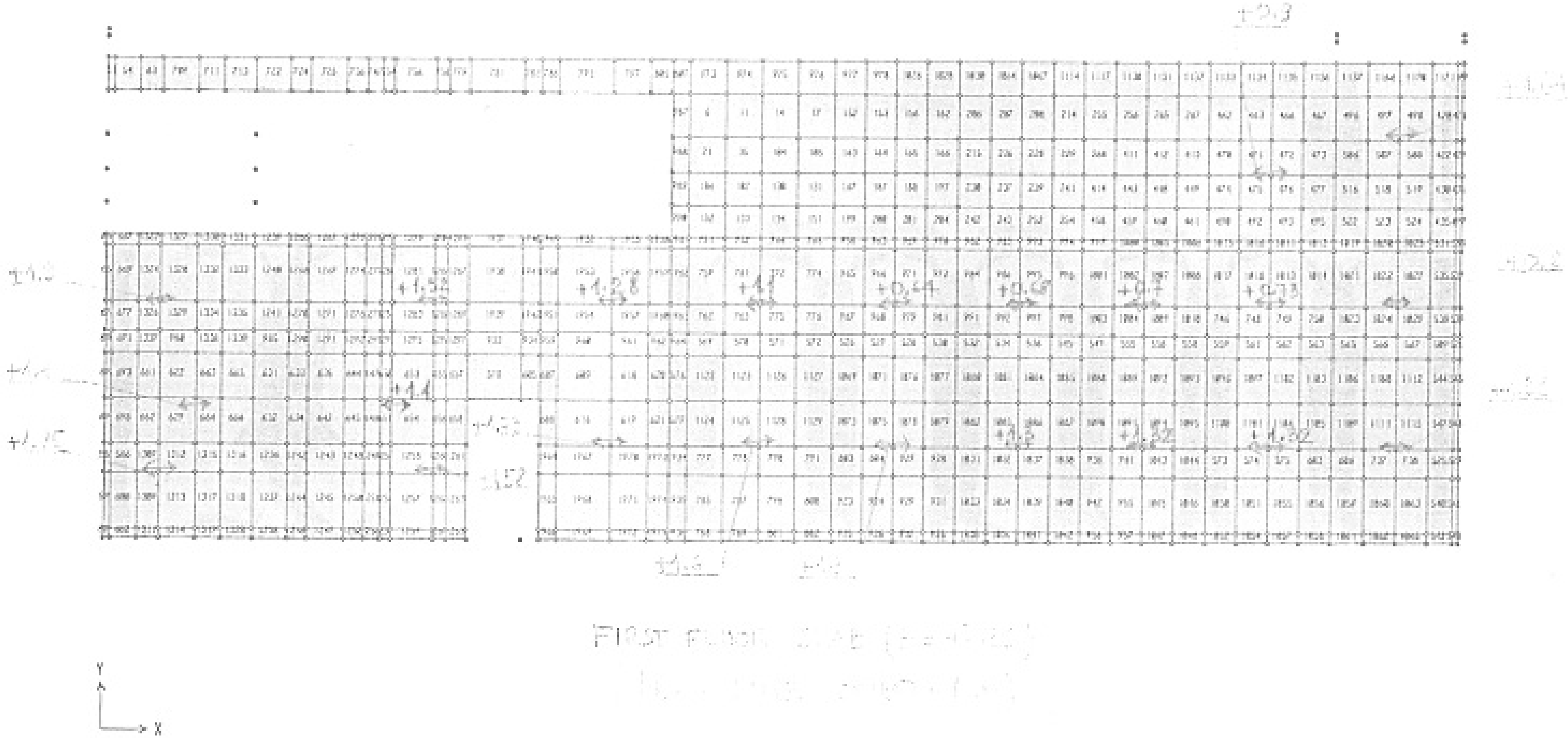


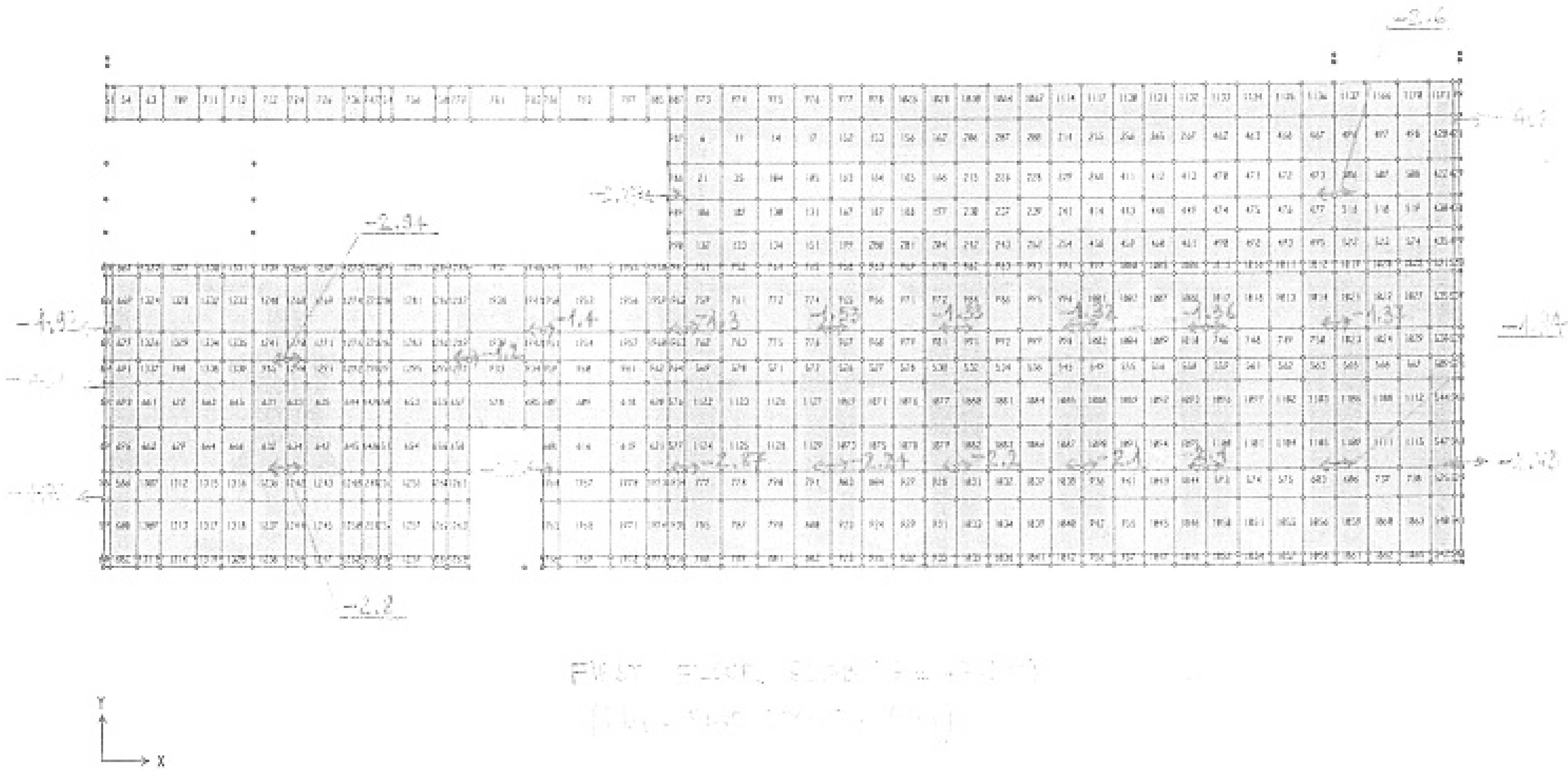
FIRST FLOOR SLAB (Z = +7.35)
(M_{22} - ENVE COMBO - Min)

-44.0	-33.0	-22.0	-11.0	0.0	11.0	22.0	33.0	44.0

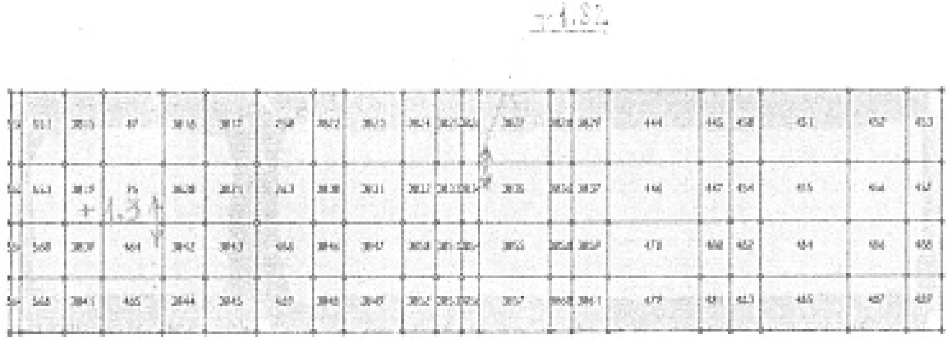
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units



SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

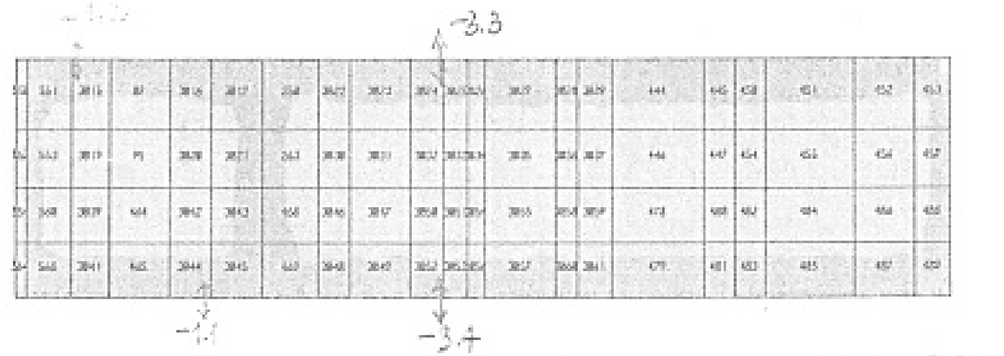


SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units



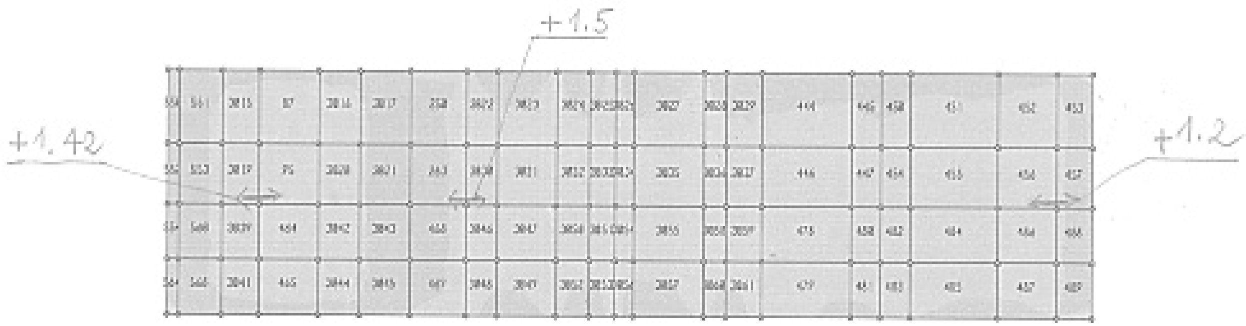
COVER SLAB OF SAND FILTRATION TANK (M = +2.1)
(M_{22} - ENVE COMBO - Max)

SAP2000 March 21,2001 19:11

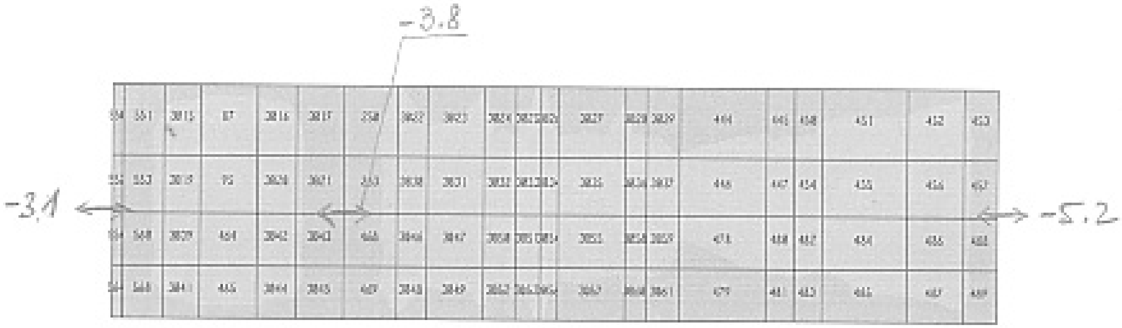


COVER SLAB OF SAND FILTRATION TANK (Z=+8.15)
(M_{22} — ENVE COMBO — Min)

SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units



COVER SLAB OF SAND FILTRATION TANK (z=+8.15)
(M_{11} – ENVE COMBO – Max)

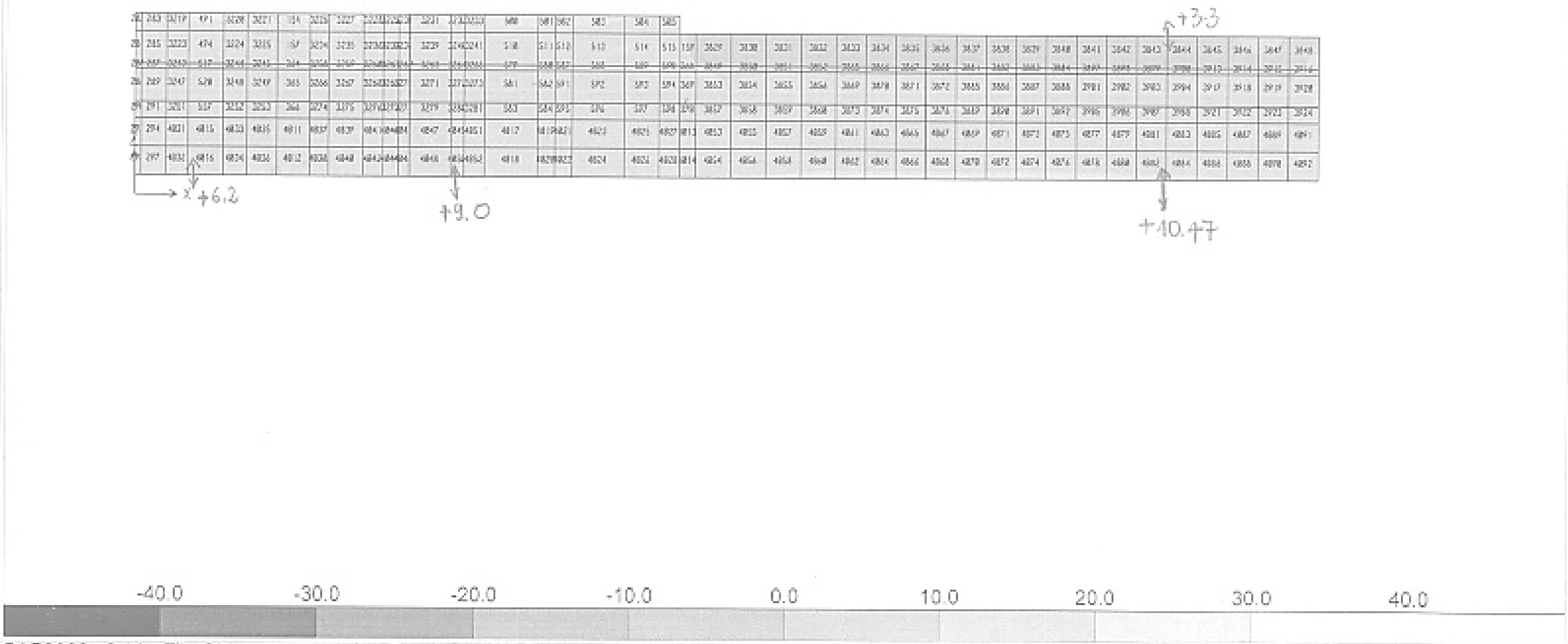


COVER SLAB OF SAND FILTRATION TANK (Z = + 8.15)

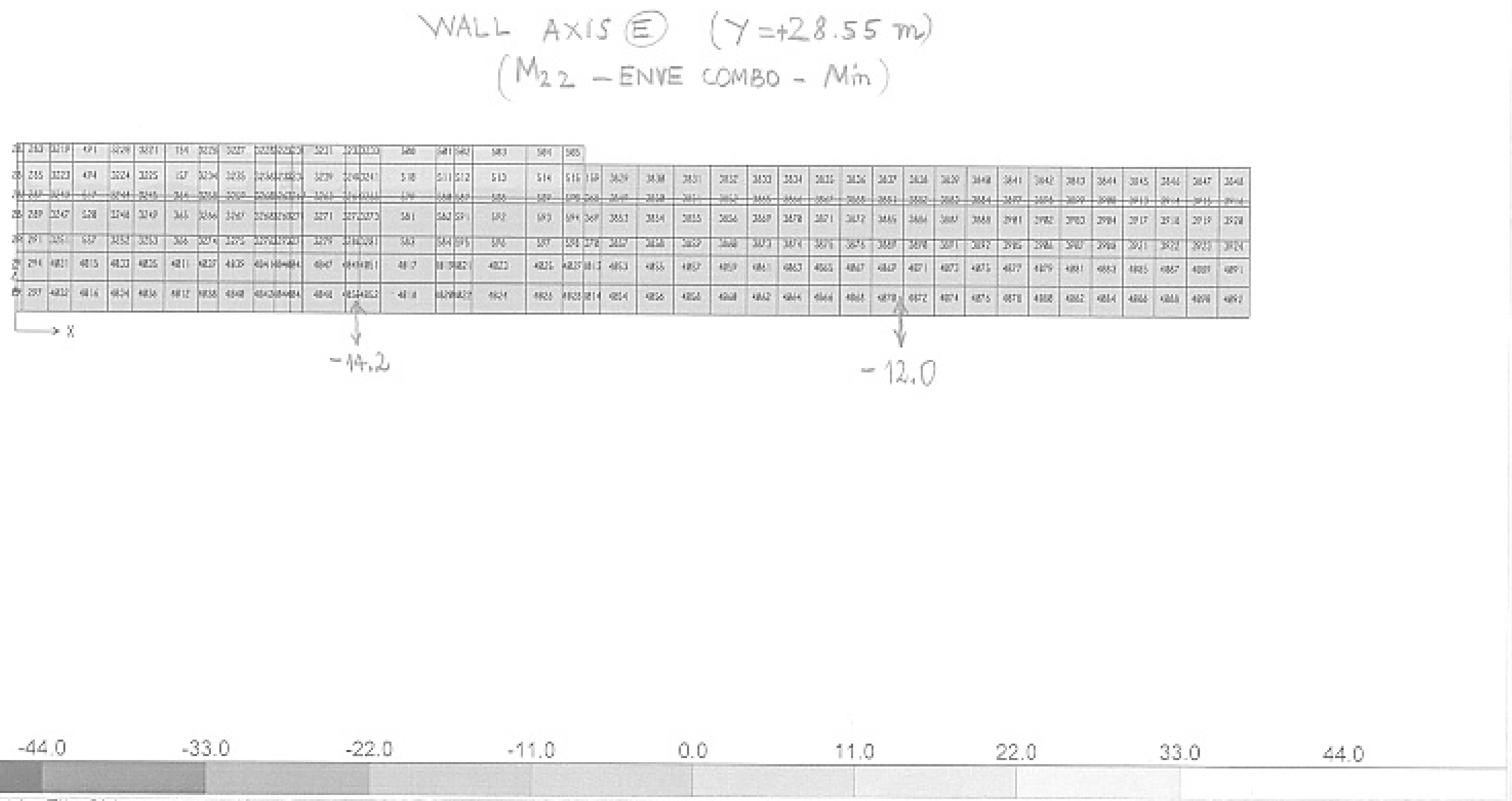
(M_{11} – ENVE COMBO – Min)

SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

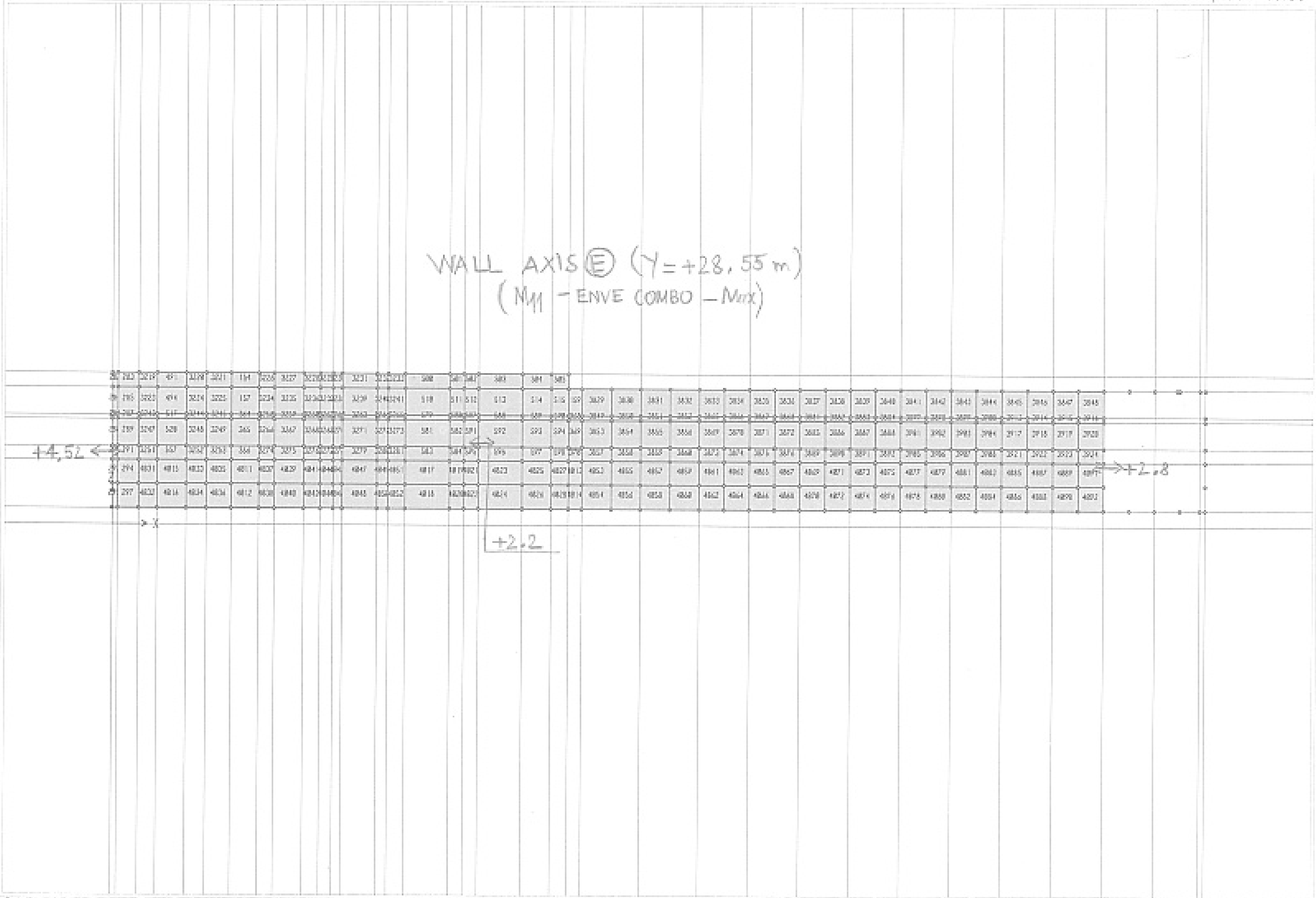
WALL AXIS E (Y = 28.55 m)
(M22 - ENVE COMBO - Max)



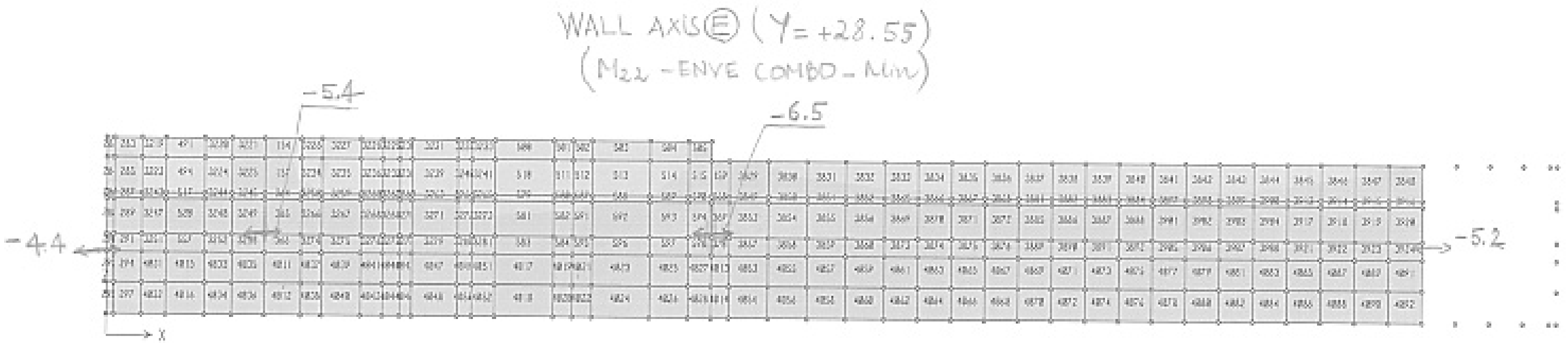
SAP2000 v6.11 - File:Chlprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units



SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units

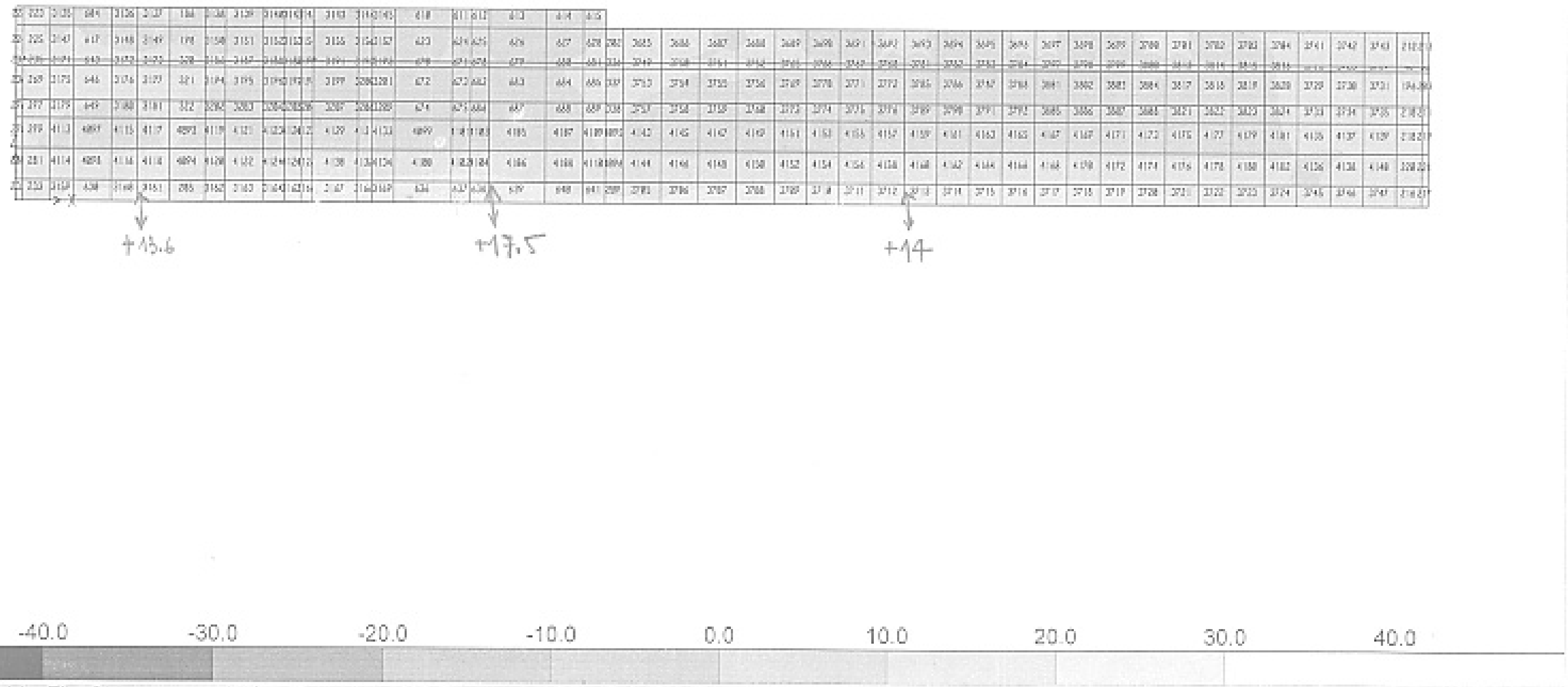


SAP2000 v6.11 - File:Chloprecasted-1f - X-Z Plane @ Y=28.55 - Ton-m Units



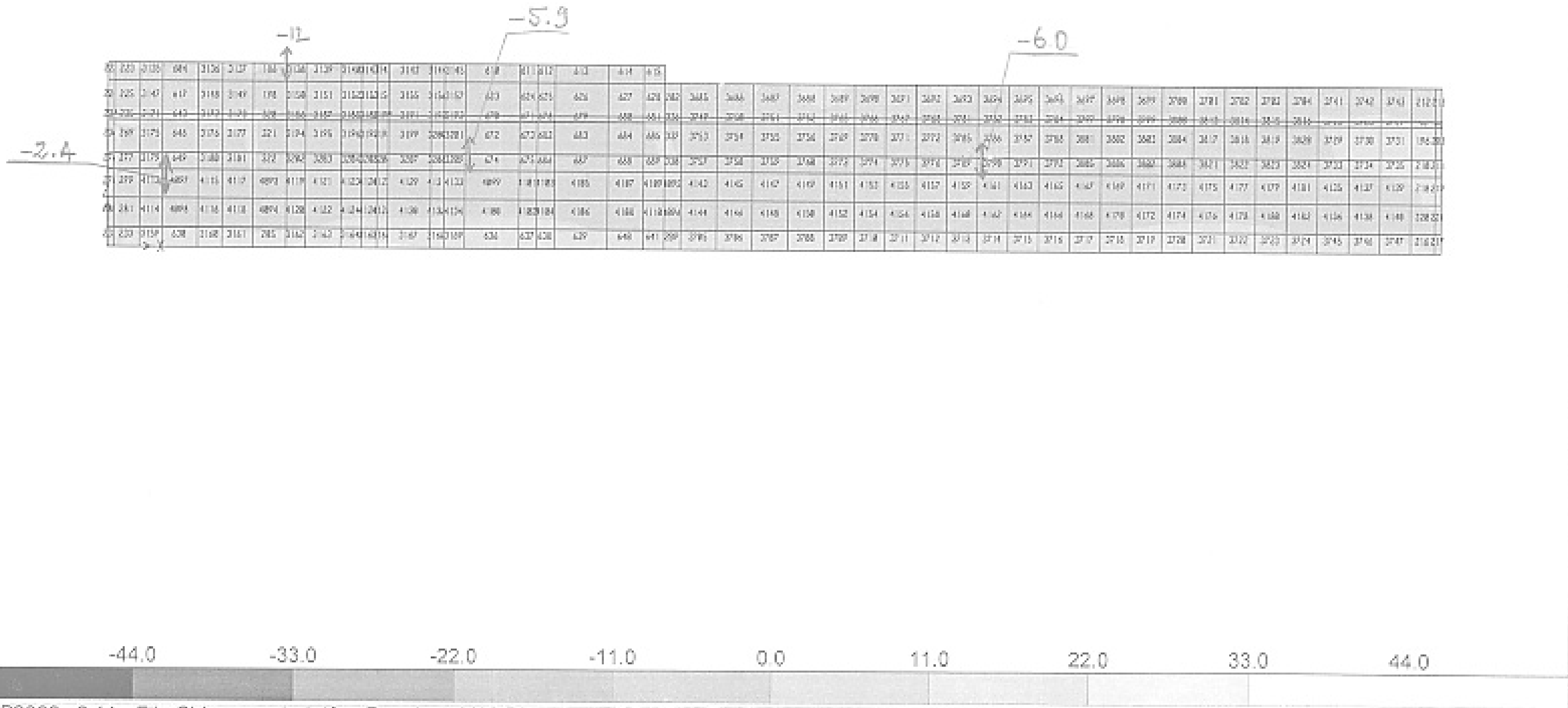
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

WALL AXIS D (Y=+22.05)
(M_{22}- ENVE COMBO- Max)

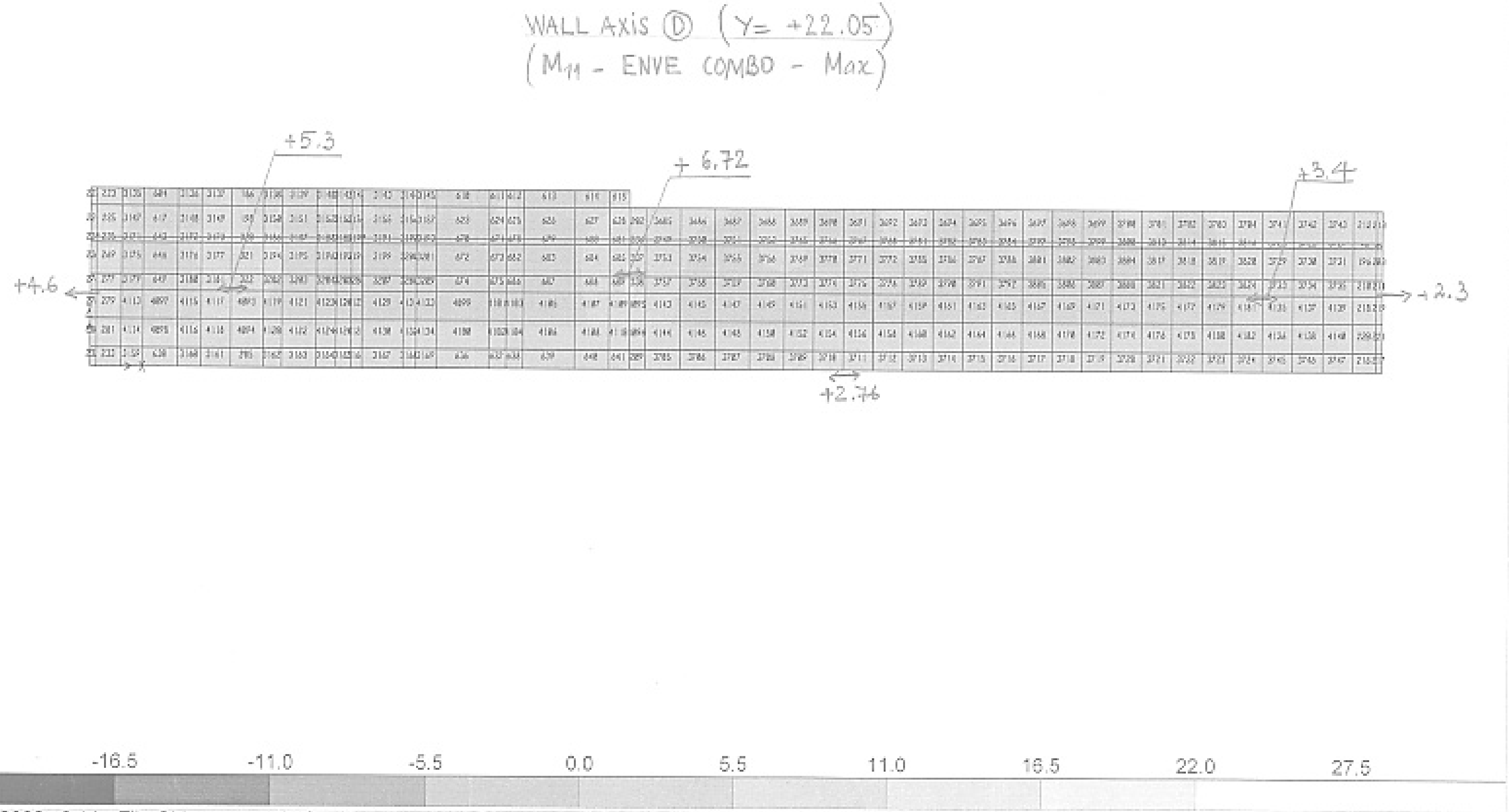


SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units

WALL AXIS ① (Y = +22.05)
(M22 - ENVE COMBO - Min)

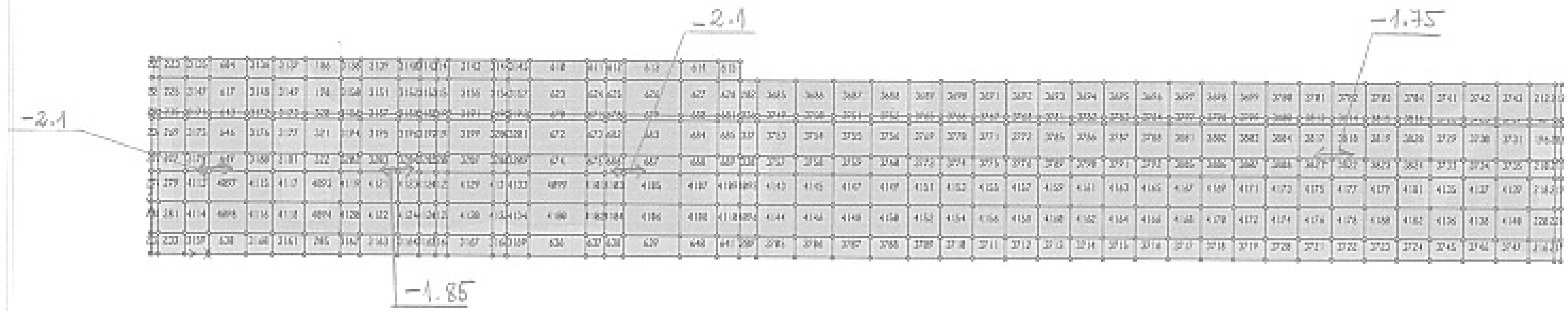


SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units



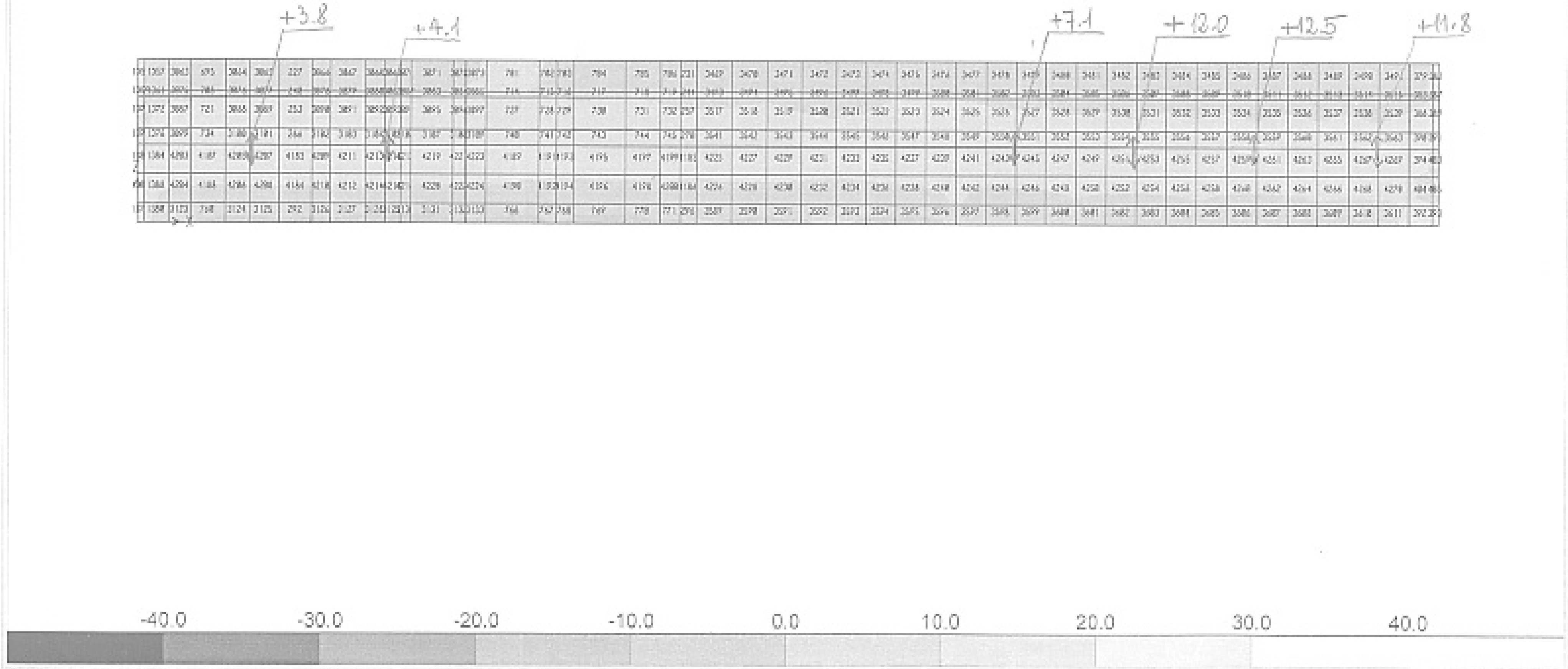
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

WALL AXIS D (Y= +22.05)
(M11 - ENVE COMBO - Min)



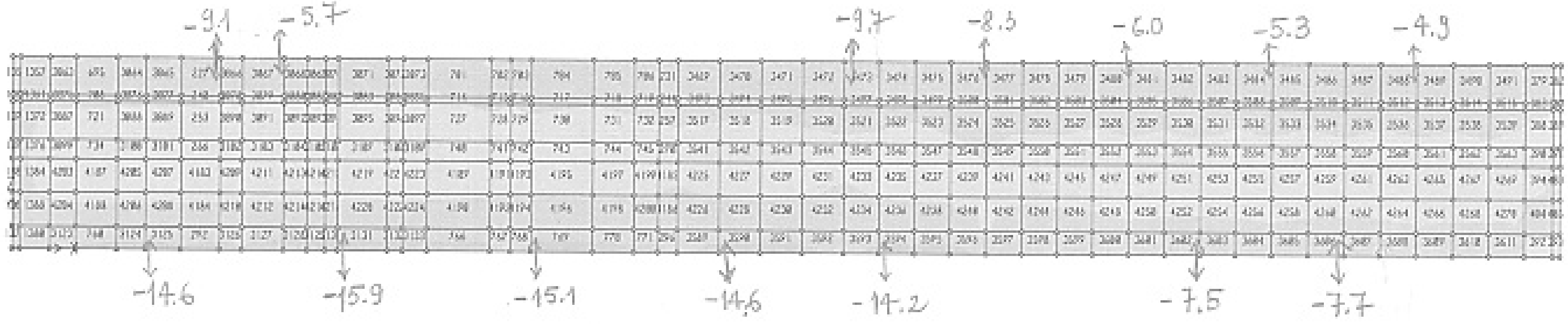
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

WALL AXIS Ⓐ (Y = +8.55)
(M_{22} – ENVE COMBO – Max)



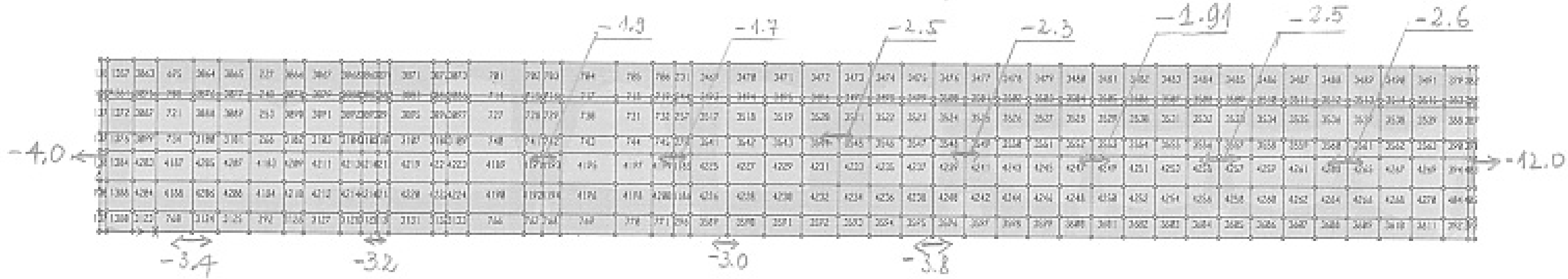
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units

WALL AXIS Ⓐ ($Y = +8.55$)
(M_{22} - ENVE COMBO - Min)



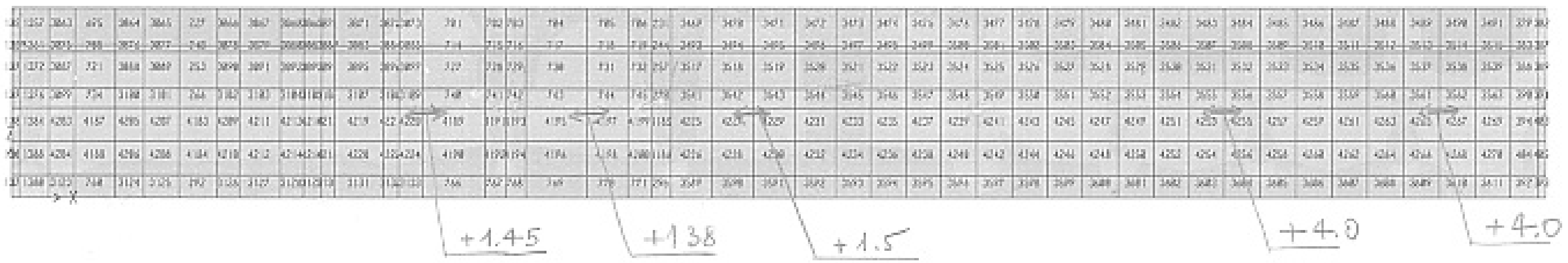
SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units

WALL AXIS (A) (Y= +8.55)
(M11 - ENVE COMBO - Min)



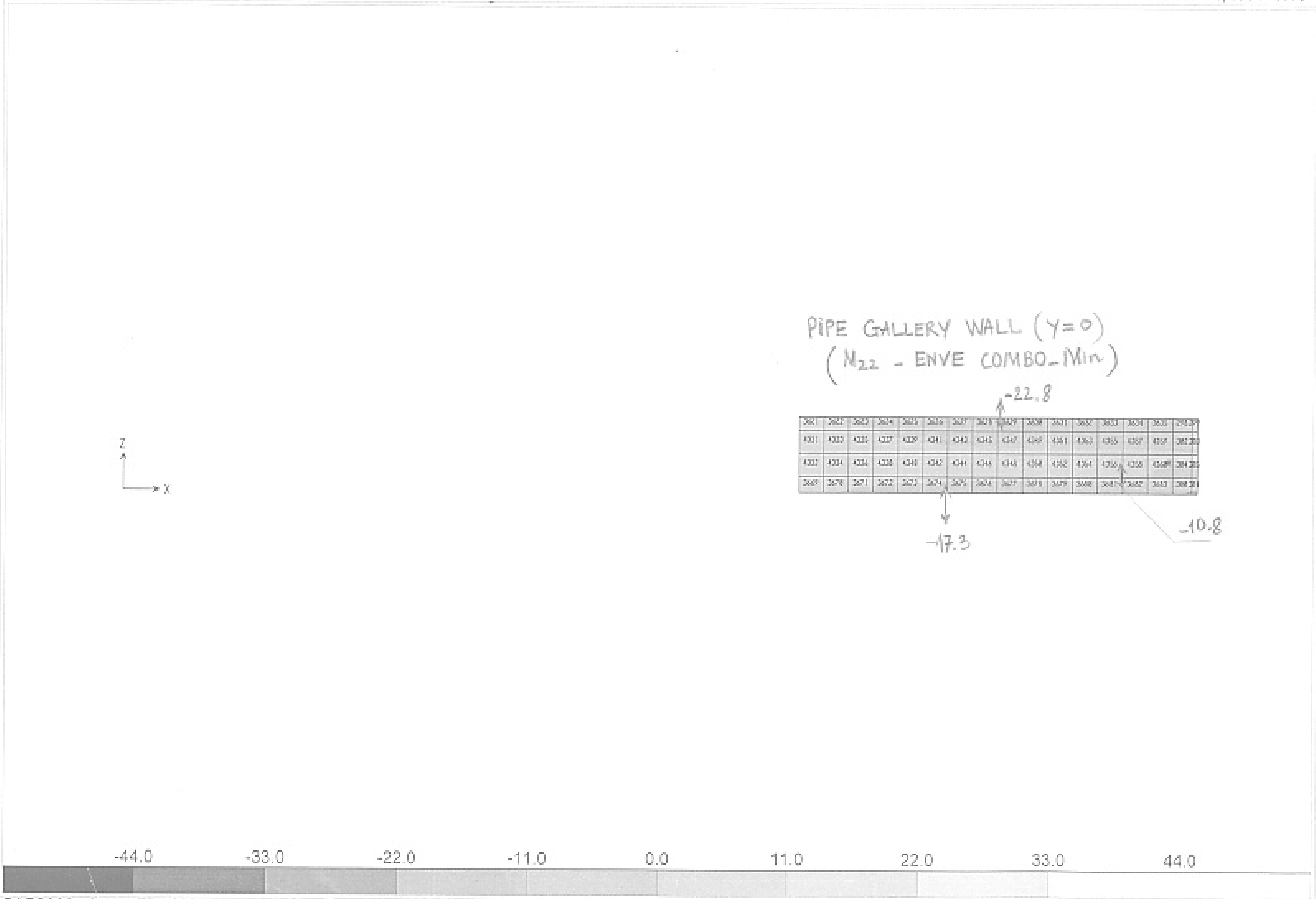
SAP2000 v6.11 - File:Chlcprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

WALL AXIS (A) (Y = +8.55)
(M_{11} - ENVE COMBO - Max)



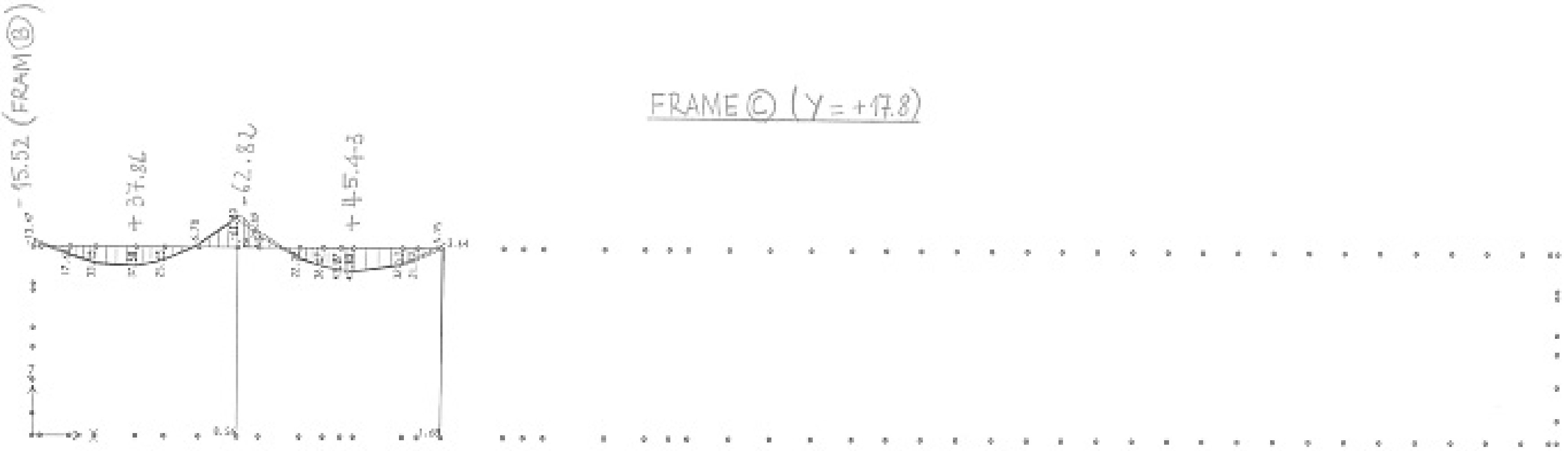
-16.5 -11.0 -5.5 0.0 5.5 11.0 16.5 22.0 27.5

SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M11 Diagram (REINENVE) - Ton-m Units

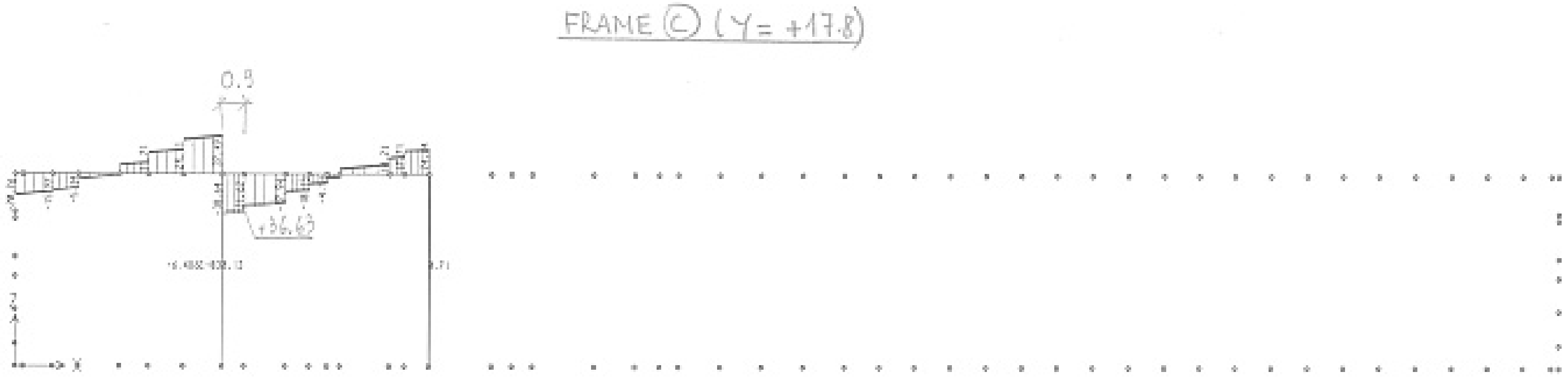


SAP2000 v6.11 - File:Chloprecasted-1f - Resultant M22 Diagram (REINENVE) - Ton-m Units

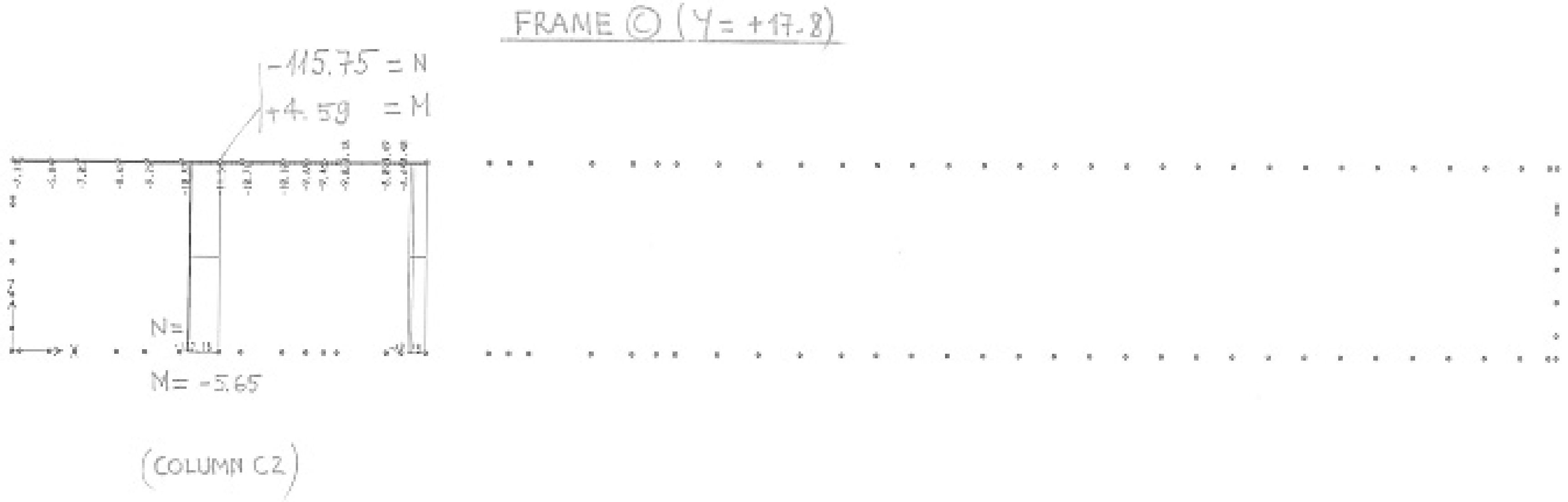
FRAME © (Y = +17.8)



SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

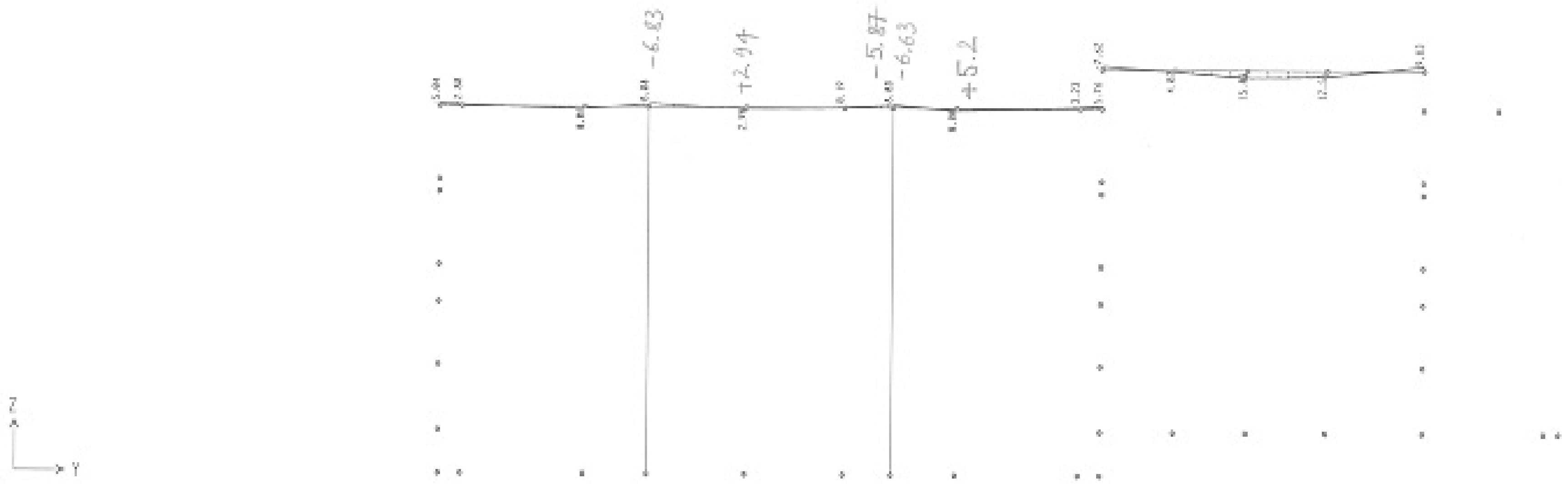


SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units



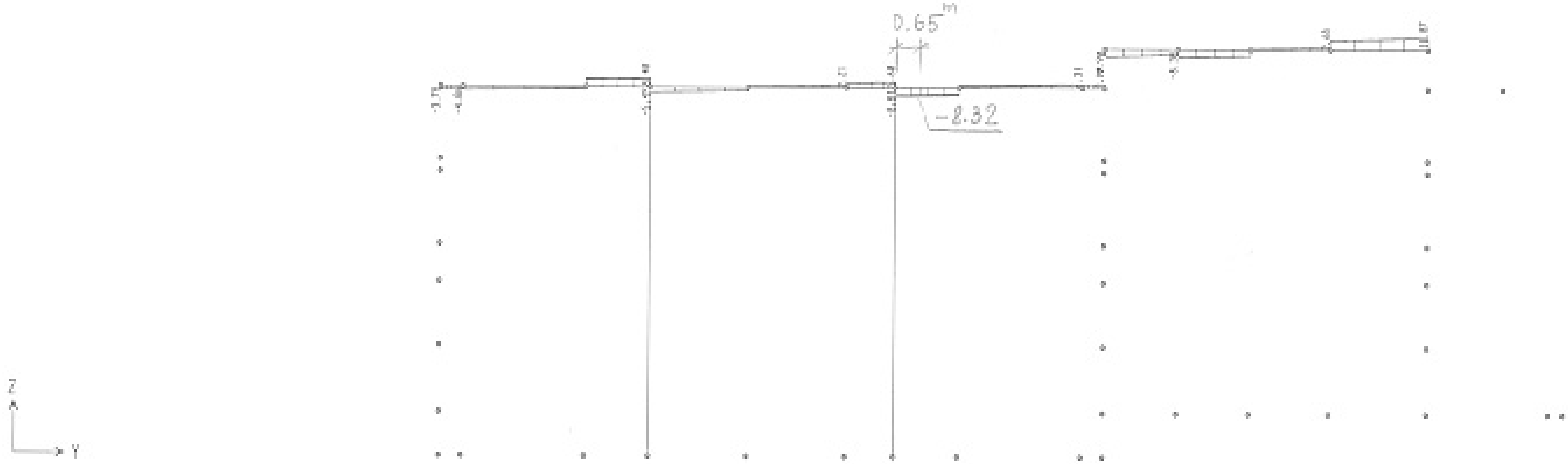
SAP2000 v6.11 - File:Chloprecasted-1f - Axial Force Diagram (REINENVE) - Ton-m Units

FRAME ② (X=+8)

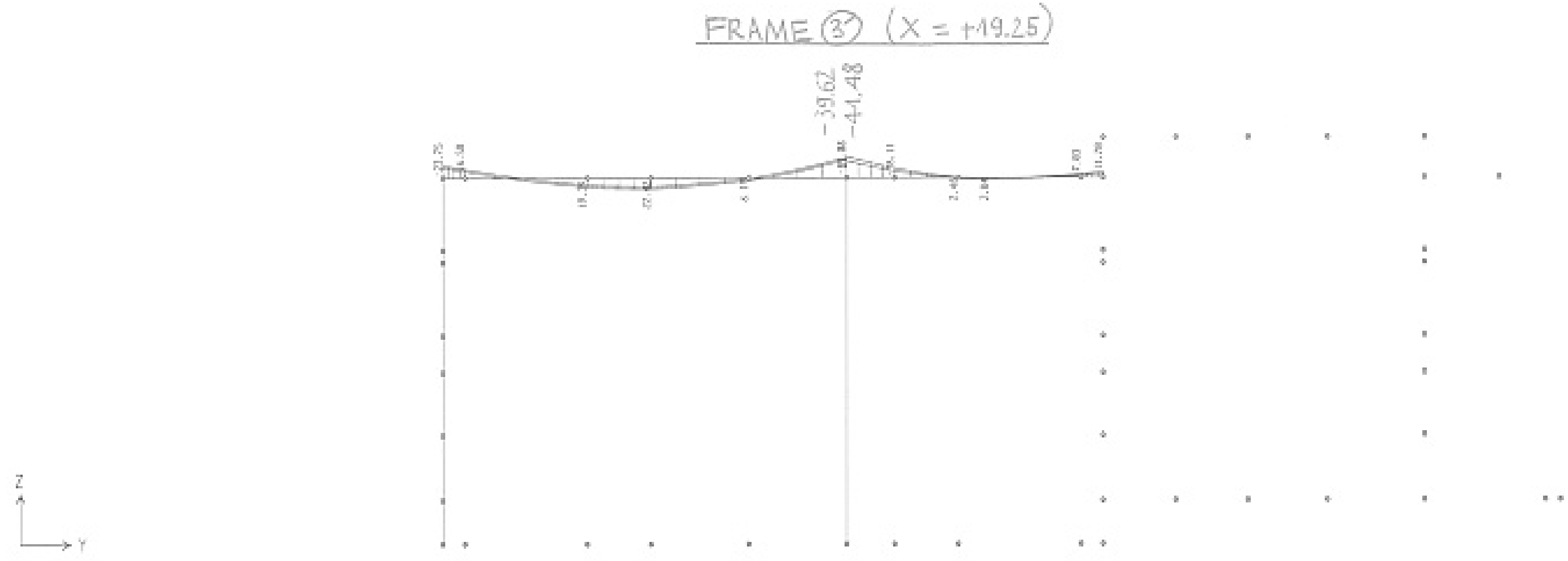


SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

FRAME 2 (X=+8)



SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units



SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

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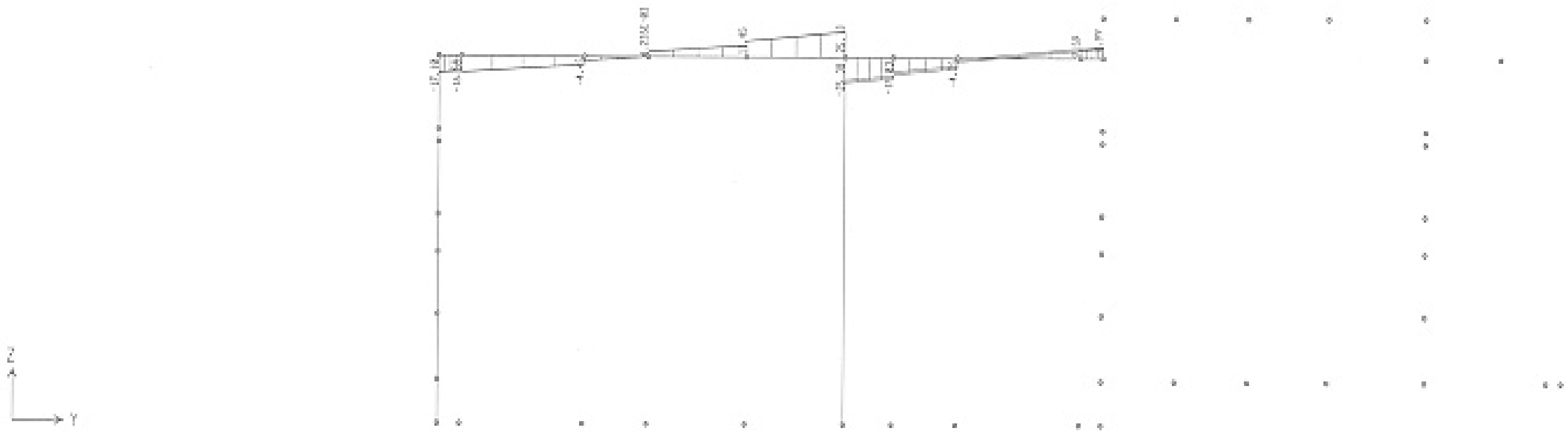
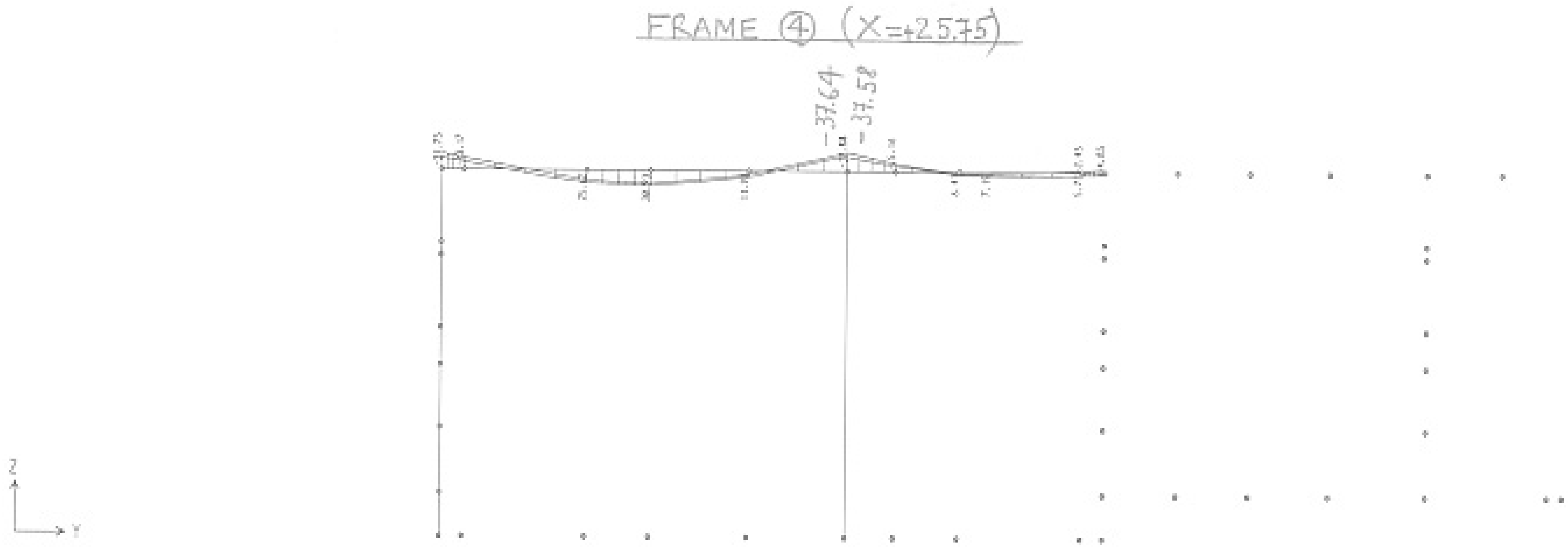
FRAM (3) (X=+19.25)

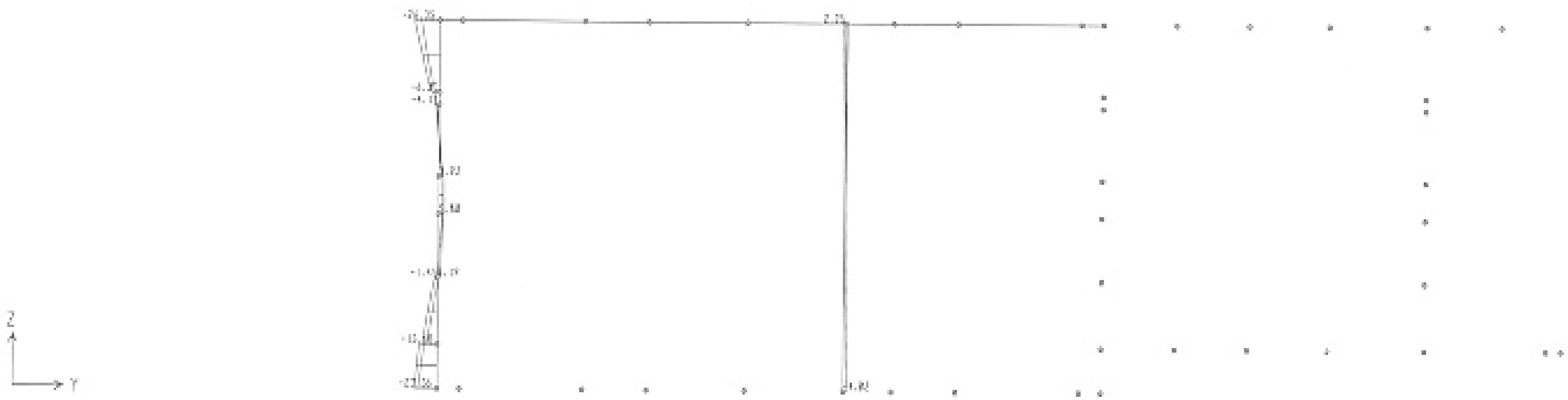


SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units

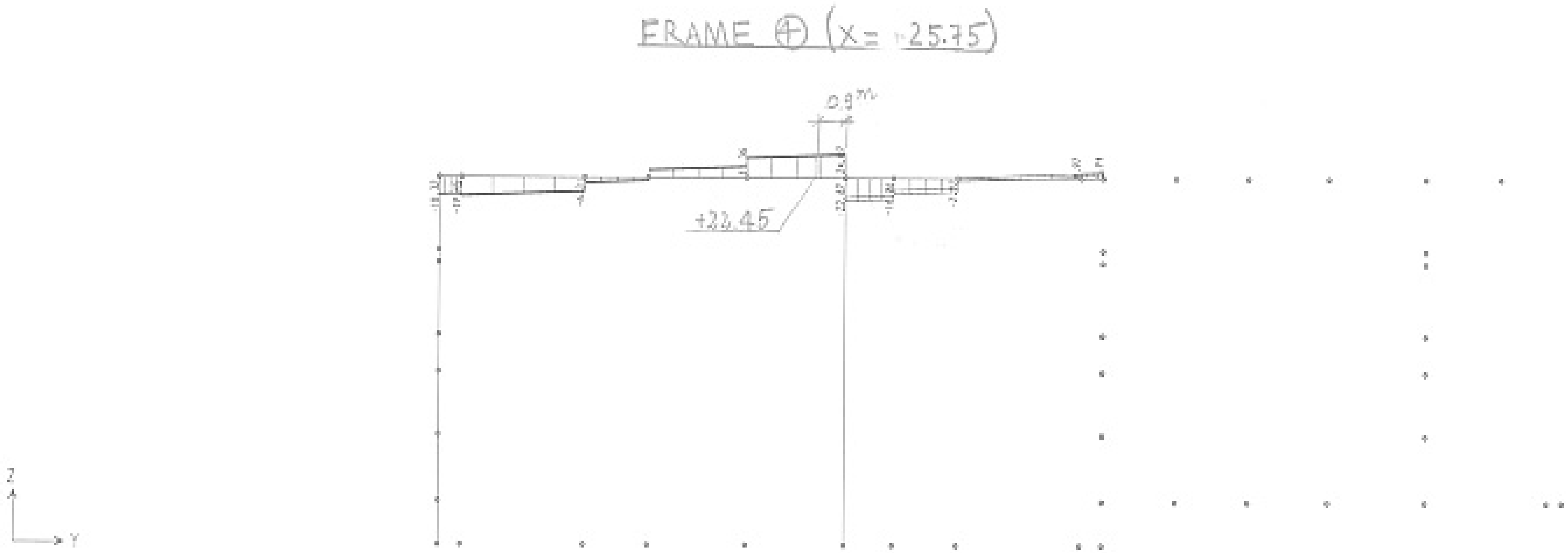


SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

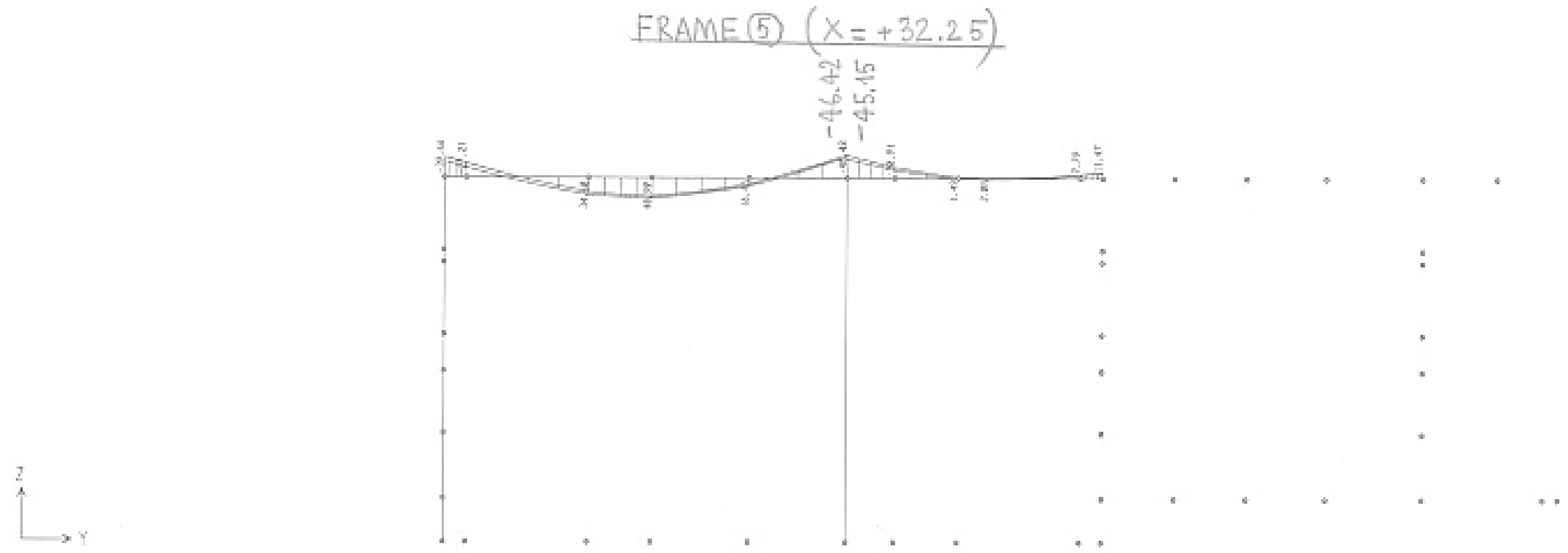
FRAME ④ (X=+25.75)



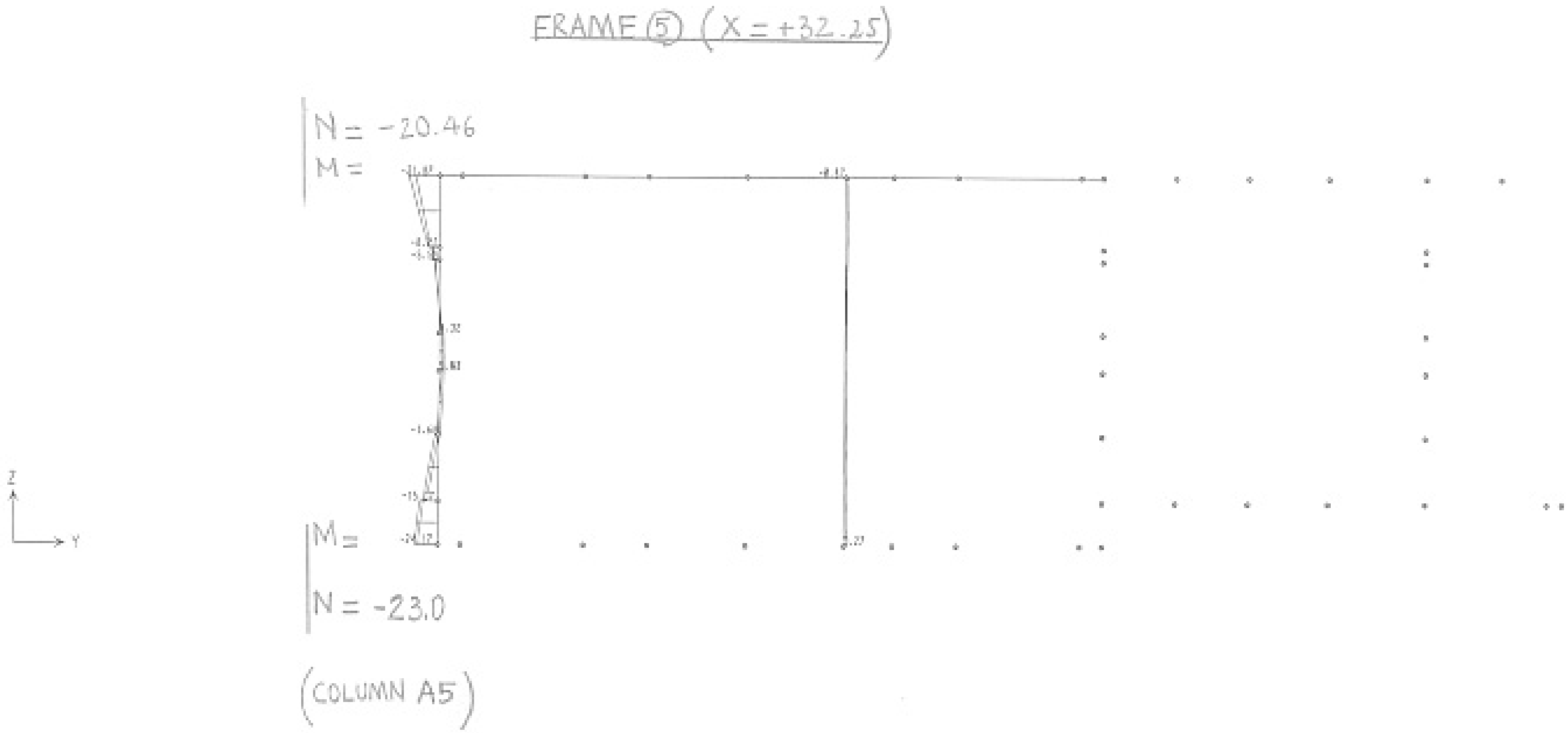
SAP2000 v6.11 - File:Chloprecasted-1f - Moment 2-2 Diagram (REINENVE) - Ton-m Units



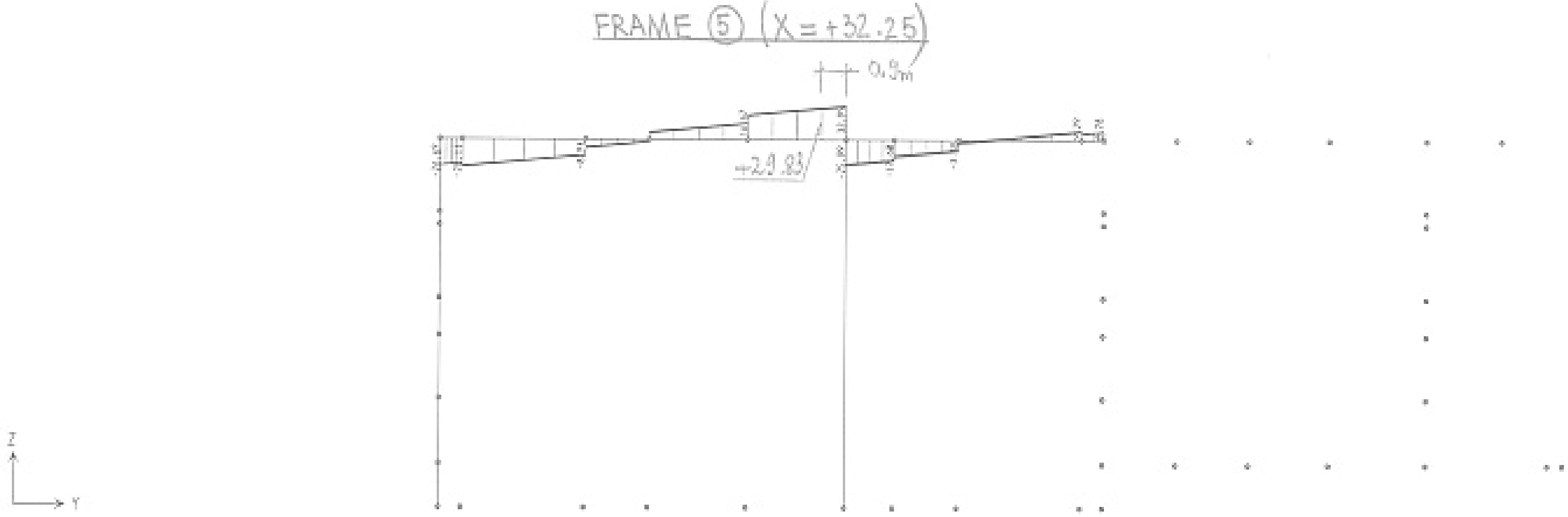
SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units



SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

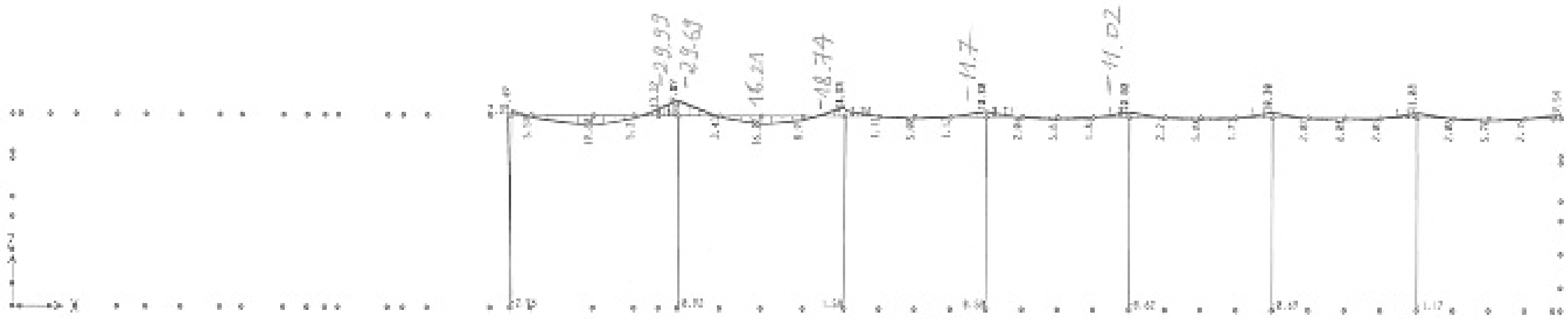


SAP2000 v6.11 - File:Chloprecasted-1f - Moment 2-2 Diagram (REINENVE) - Ton-m Units



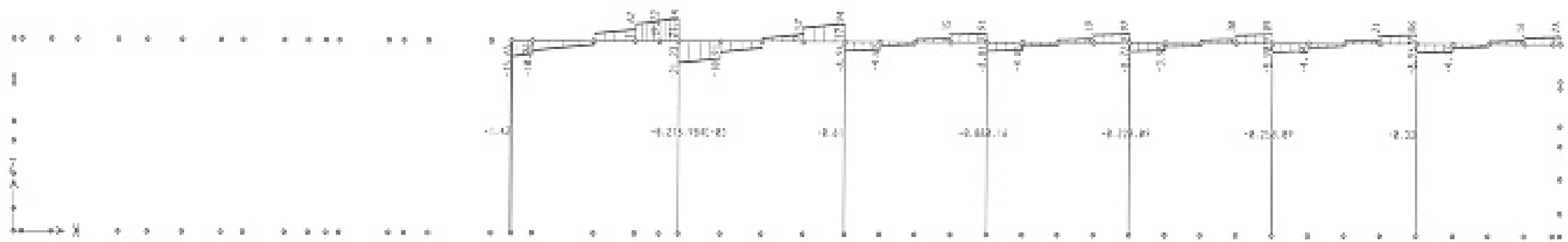
SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units

FRAME (B) (Y = +16.8)

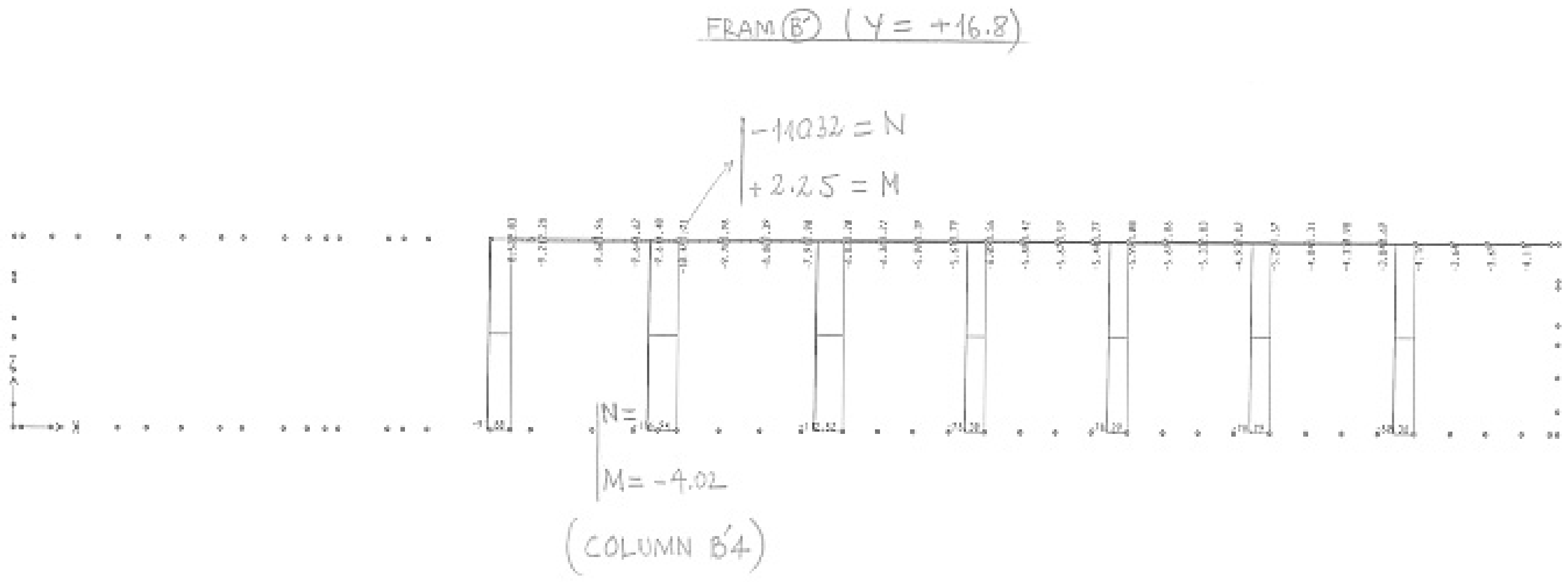


SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

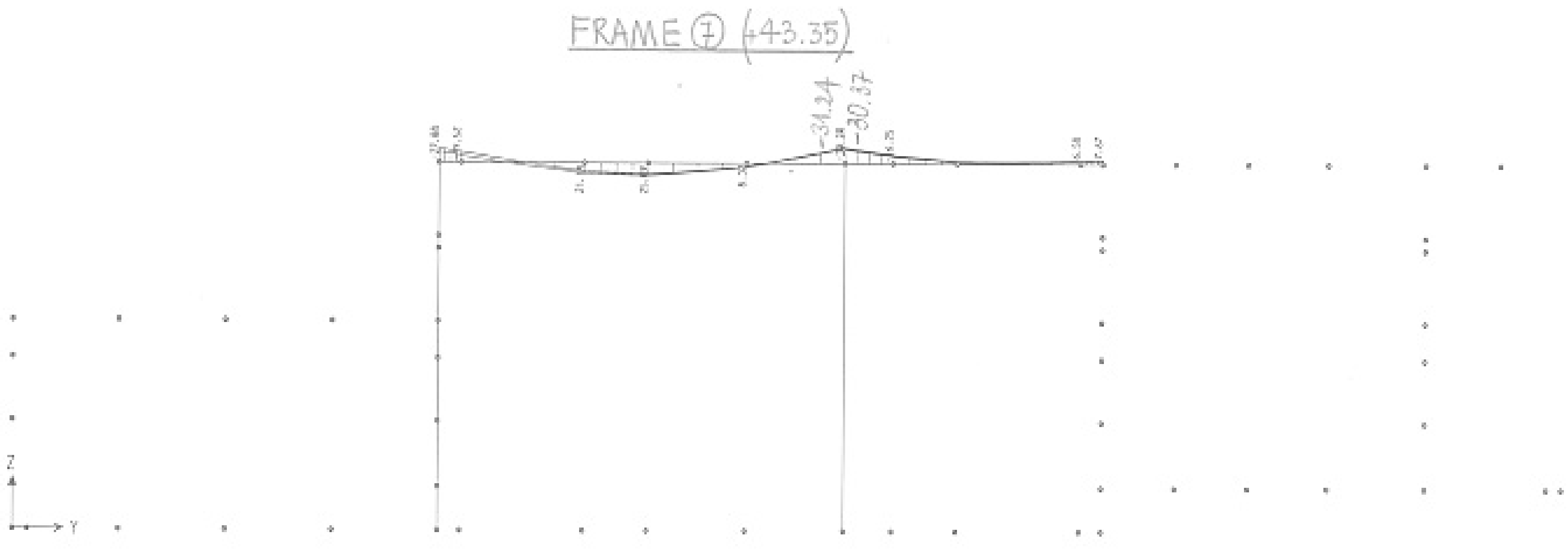
FRAME (B) (Y = +16.8)



SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units

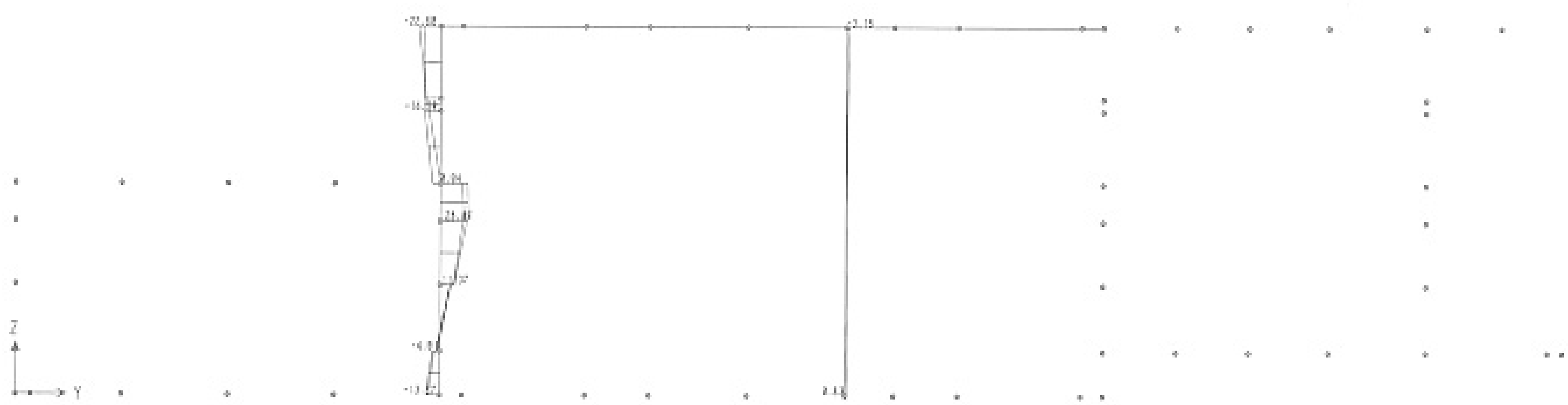


SAP2000 v6.11 - File:Chloprecasted-1f - Axial Force Diagram (REINENVE) - Ton-m Units

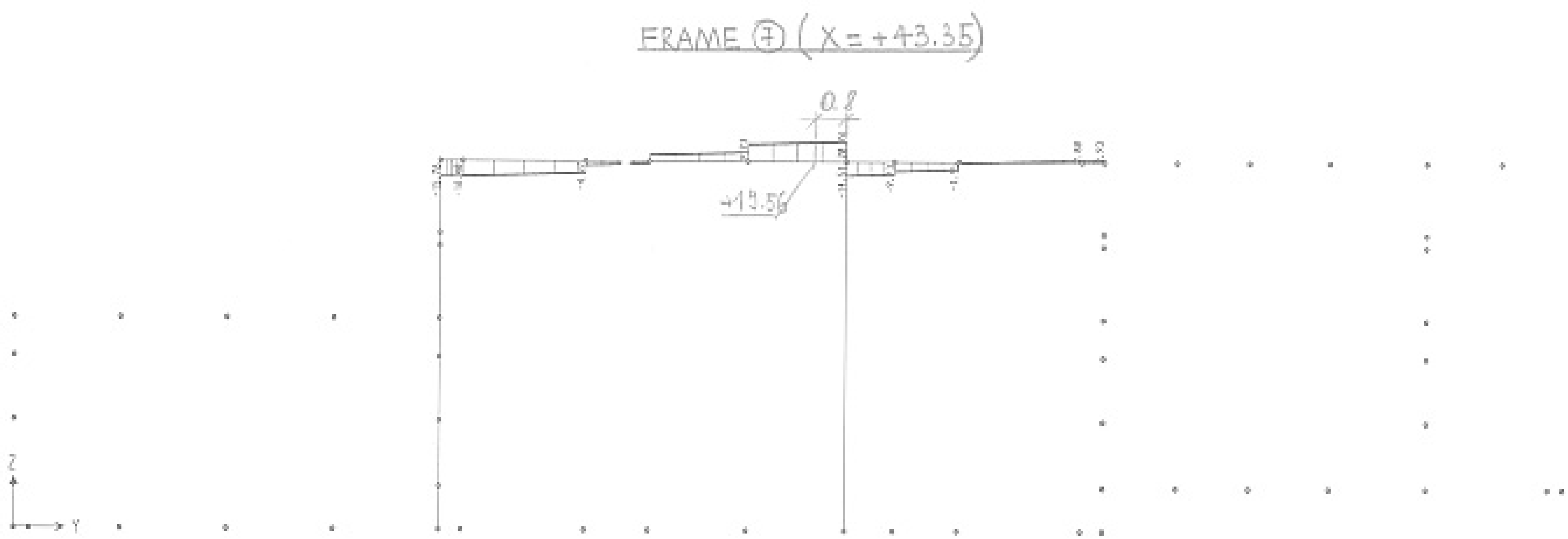


SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

FRAME ⑦ (+43.35)

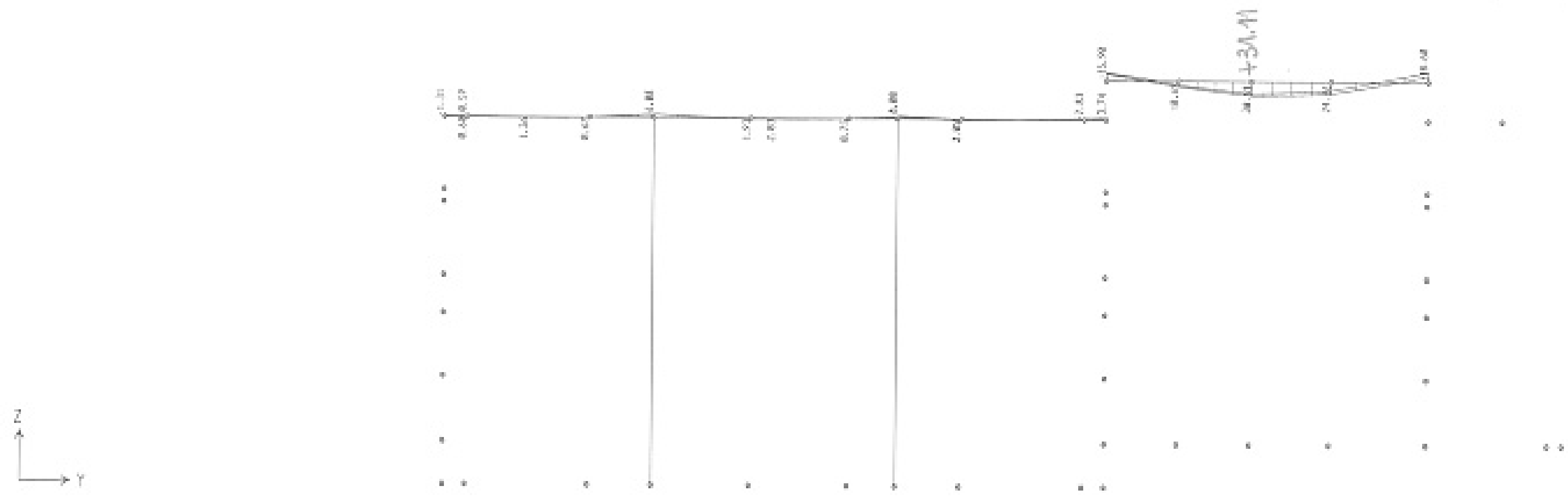


SAP2000 v8.11 - File:Chloprecasted-1f - Moment 2-2 Diagram (REINENVE) - Ton-m Units

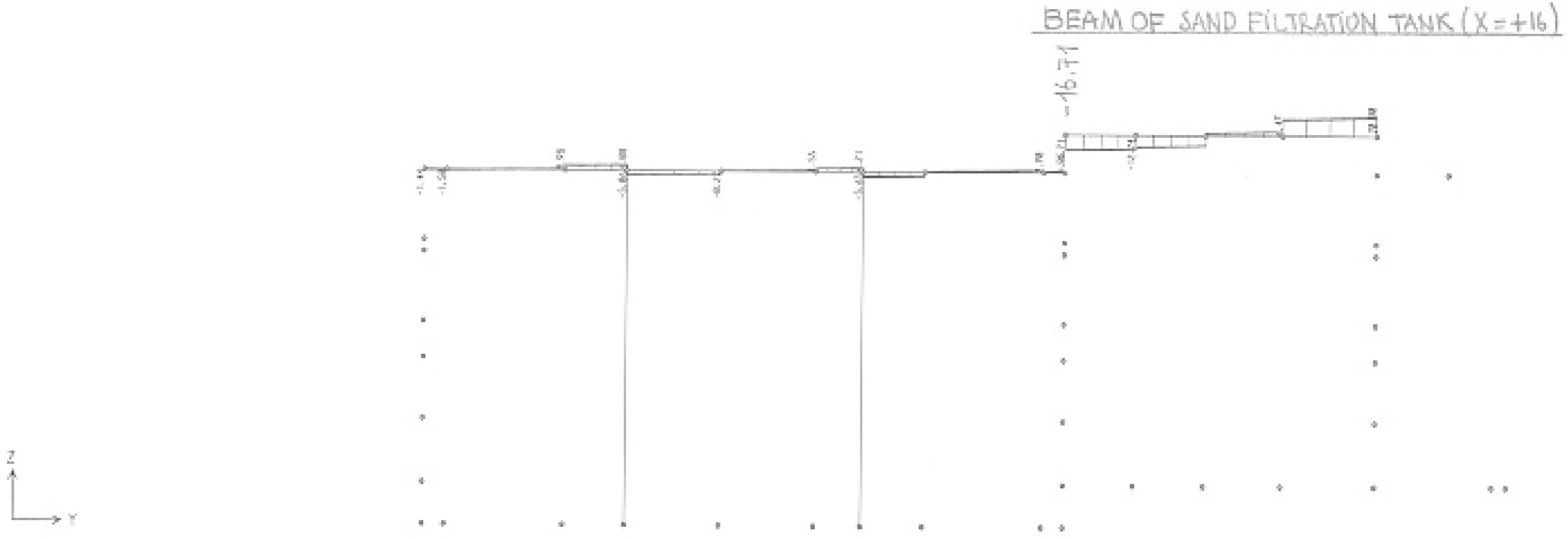


SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units

BEAM OF SAND FILTRATION TANK (X = +16)

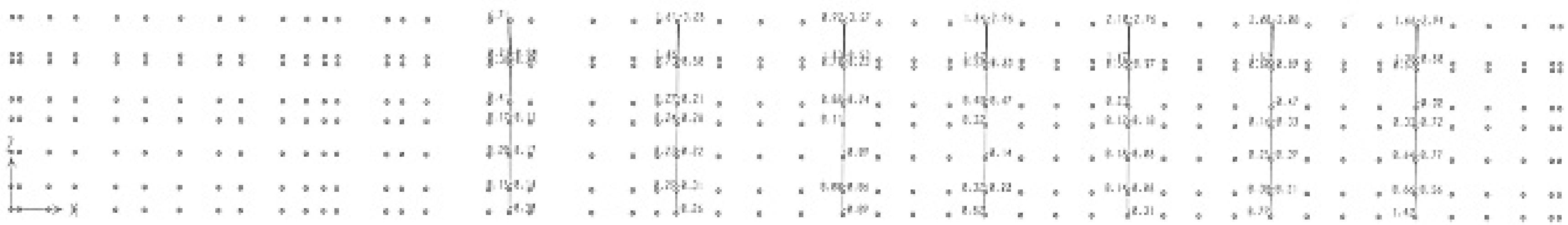


SAP2000 v6.11 - File:Chloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units



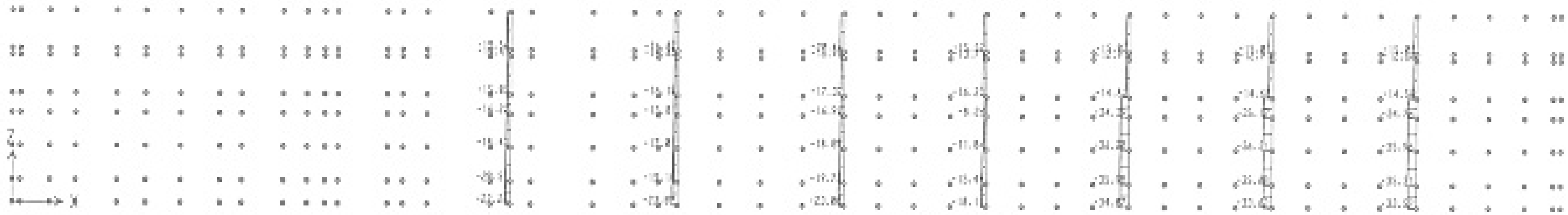
SAP2000 v6.11 - File:Chloprecasted-1f - Shear Force 2-2 Diagram (REINENVE) - Ton-m Units

FRAME (A) (Y= + 8.55)



SAP2000 v6.11 - File:Chlloprecasted-1f - Moment 3-3 Diagram (REINENVE) - Ton-m Units

FRAME (A) (Y=+8.55)



SAP2000 v6.11 - File:Chloprecasted-1f - Axial Force Diagram (REINENVE) - Ton-m Units