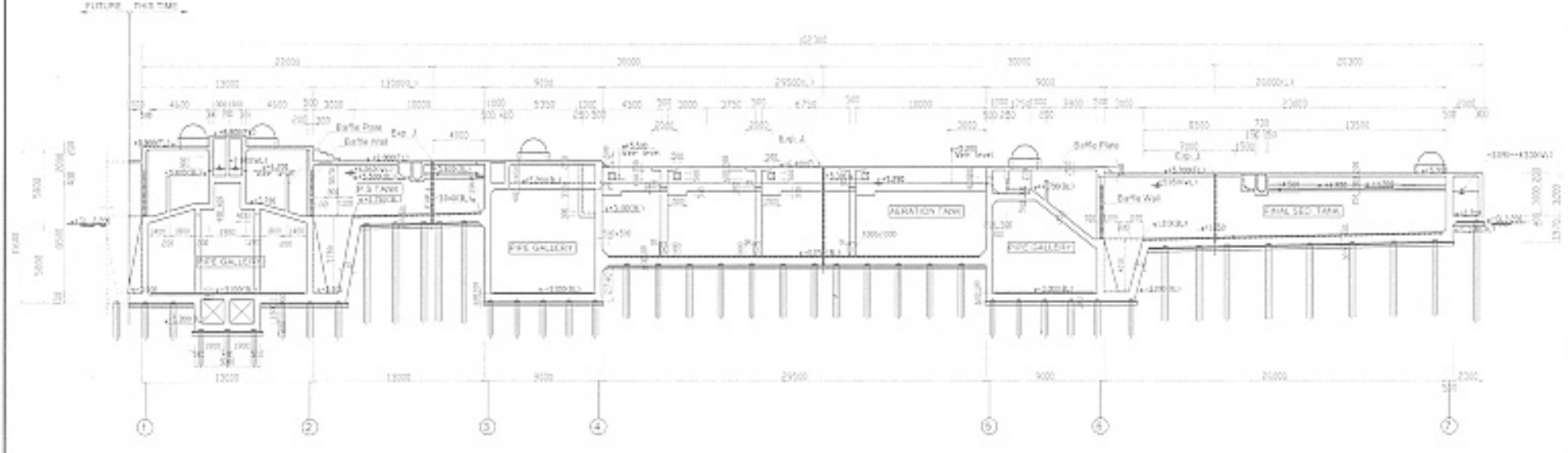
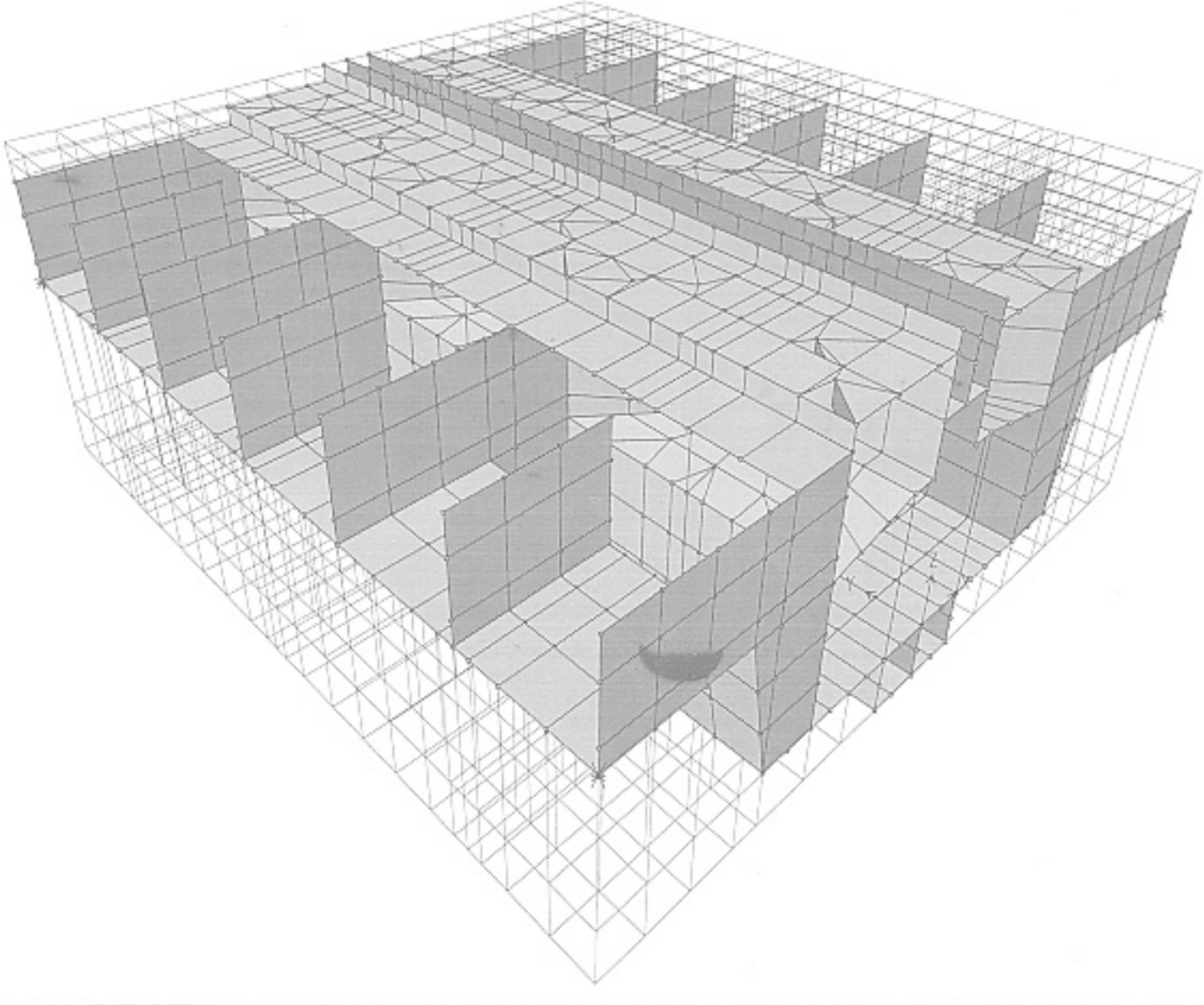
7.1.3

Treatment Plant

STRUCTURAL CALCULATION OF TREATMENT PLANT

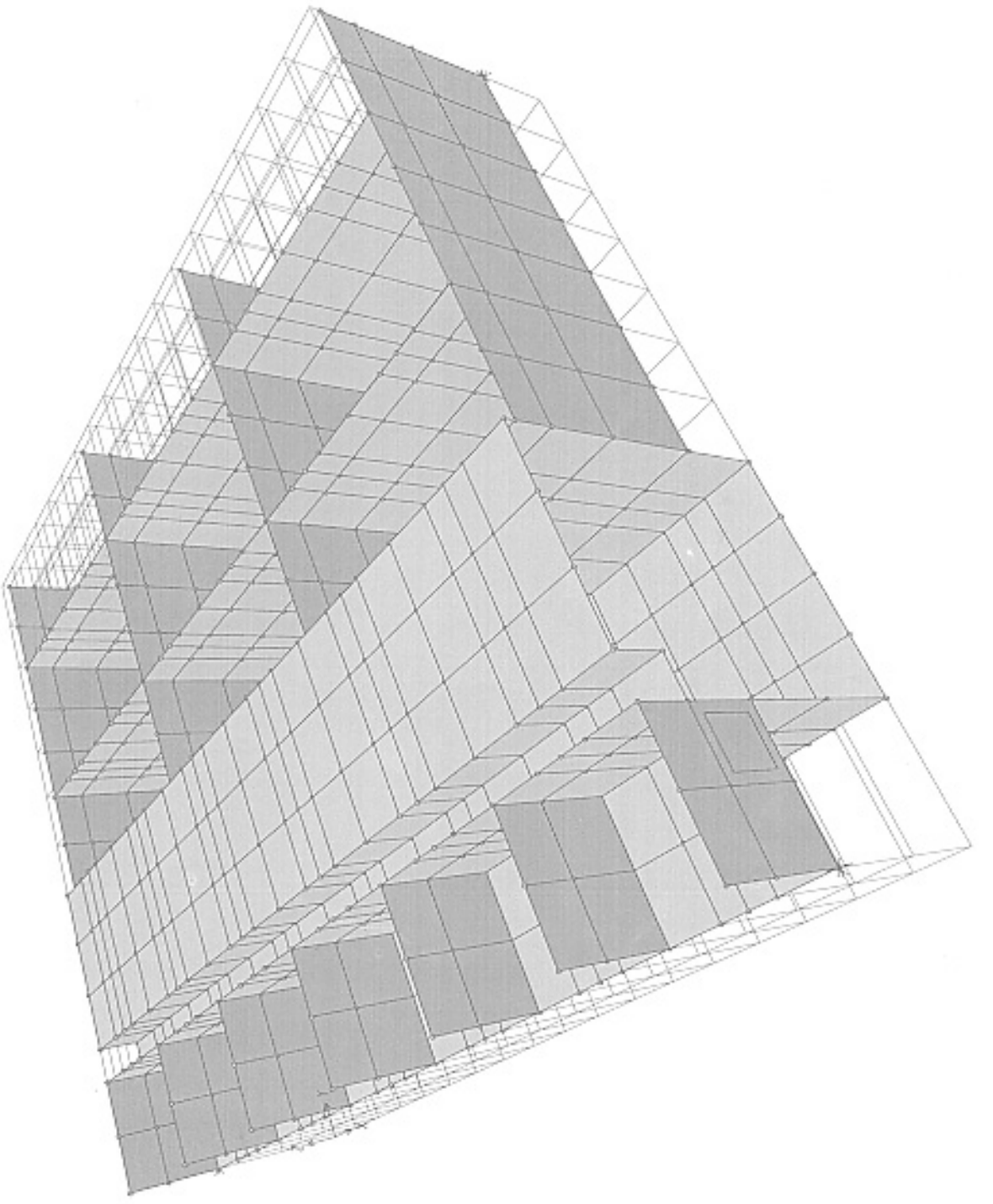
LONGITUDINAL SECTION (WITH HIGHEST WATER LEVEL)





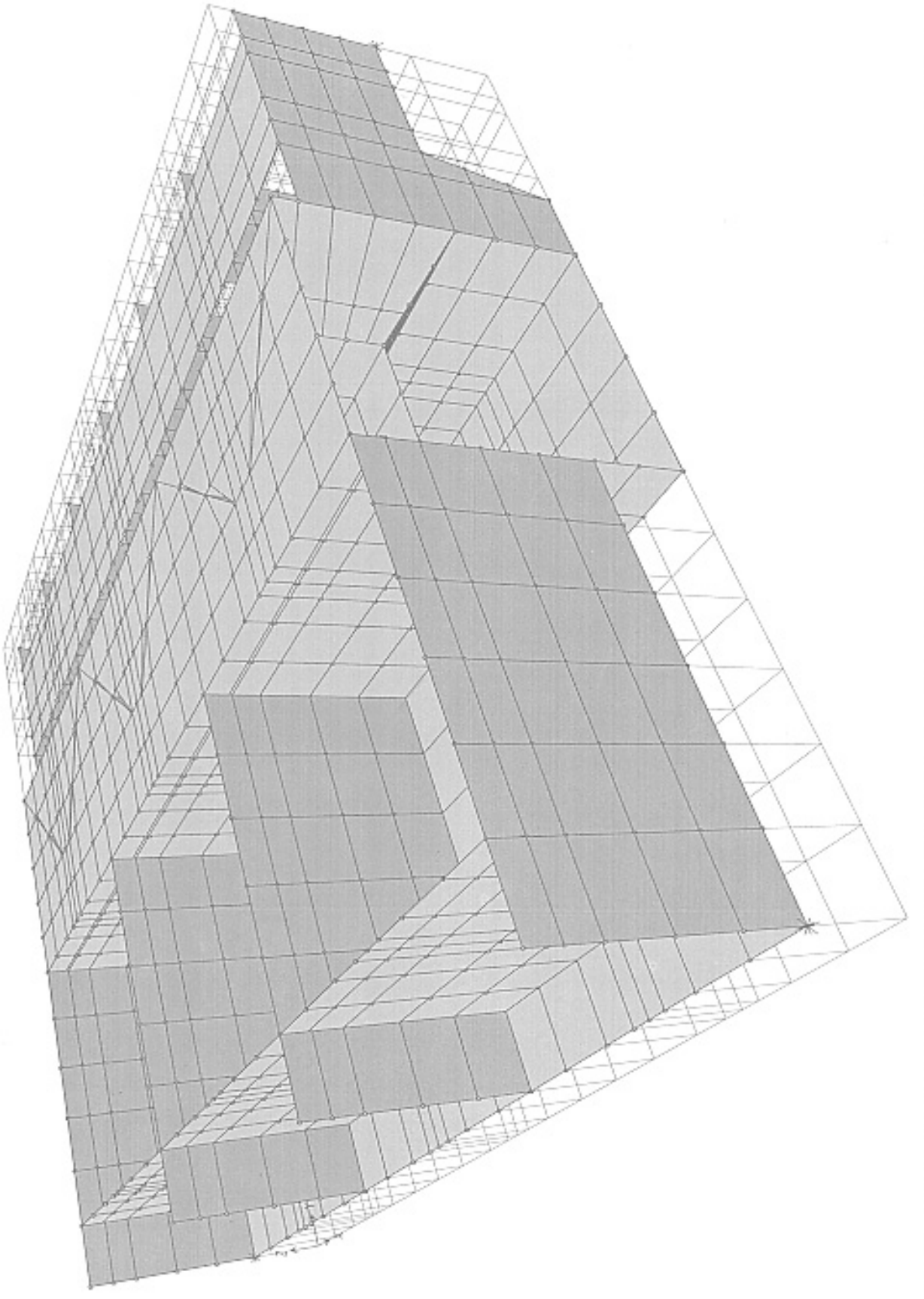
PIPE GALLERY AND PRIMARY SEDIMENTATION TANK

PRIMARY SEDIMENTATION TANK - PIPE GALLERY - AERAION TANK



March 7,2001 17:44

AERAION TANK - PIPE GALLERY - FINAL SEDIMENTATION TANK

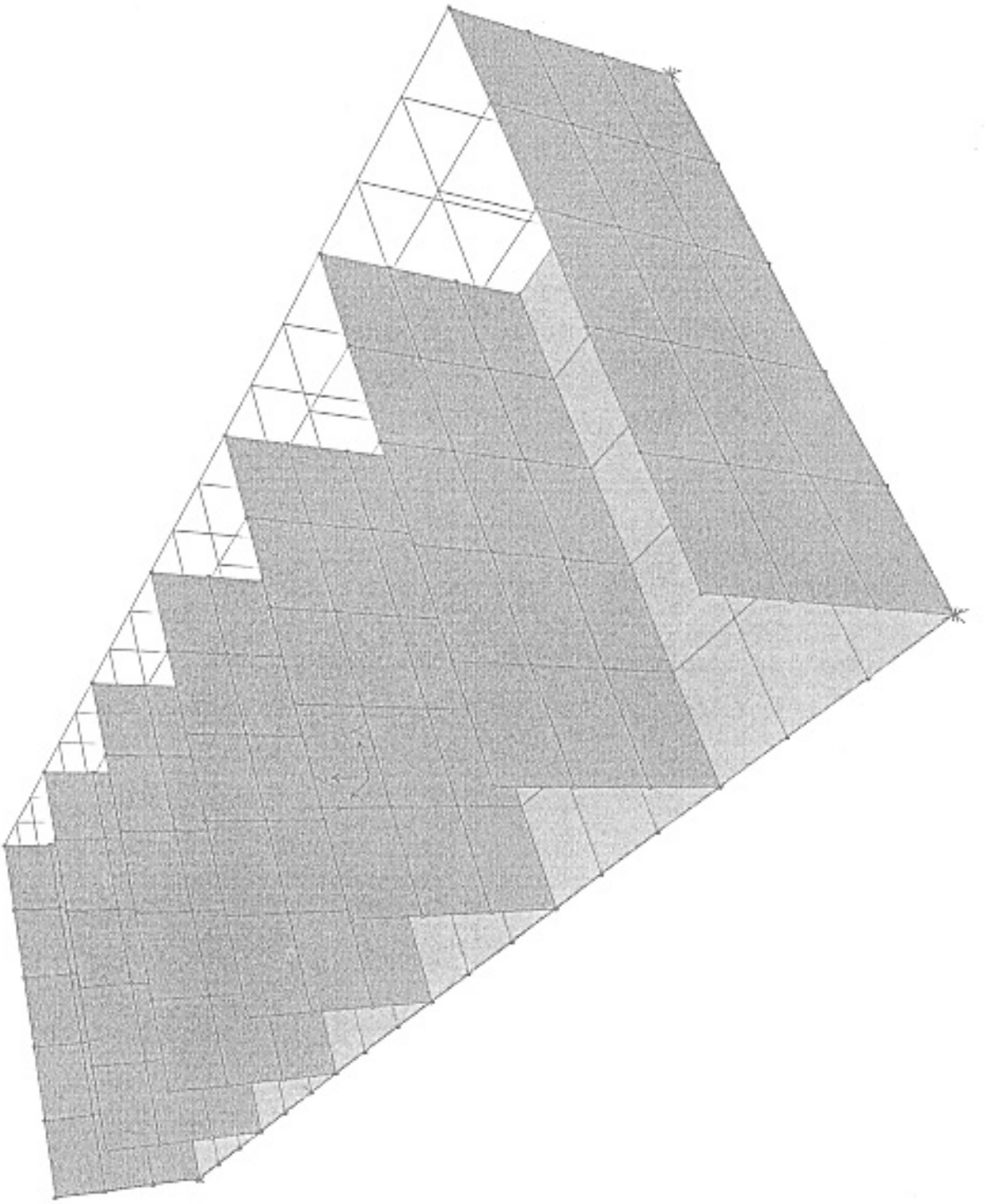


SAP2000

SAP2000 v6.11 - File:p3-rein1 - 3-D View - Ton-m Units

March 9,2001 16:32

FINAL SEDIMENTATION TANK



SAP2000

SAP2000 v6.11 - File:f-s-tank - 3-D View - Ton-m Units

CALCULATION FOR WASTEWATER TREAMENT 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		+ 6.06
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/cm2)
	RS=	3.6	(Kg/cm2)
Reinforcement type JIS:	Ra=	1600	(Kg/cm2)

Back fill sand: γ_s= 1.80T/m3 ; Coeficient of earth pressure at rest K_o 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}=0.8x5.9x0.5 + 5.9x1 = 8.26T/m2

-Uplift pressure to bottom of under inflow waterway:

$p_{uplift}=(H_{ground\ water})x1.0$= 5.90T/m2

-Uplift pressure to bottom of pipegallery:

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

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 machanical supports and cinder concrete)

-Uniform load: $q_{con\ layer}$ 2.5x0.10= 0.250T/m2

3.5-Live load:

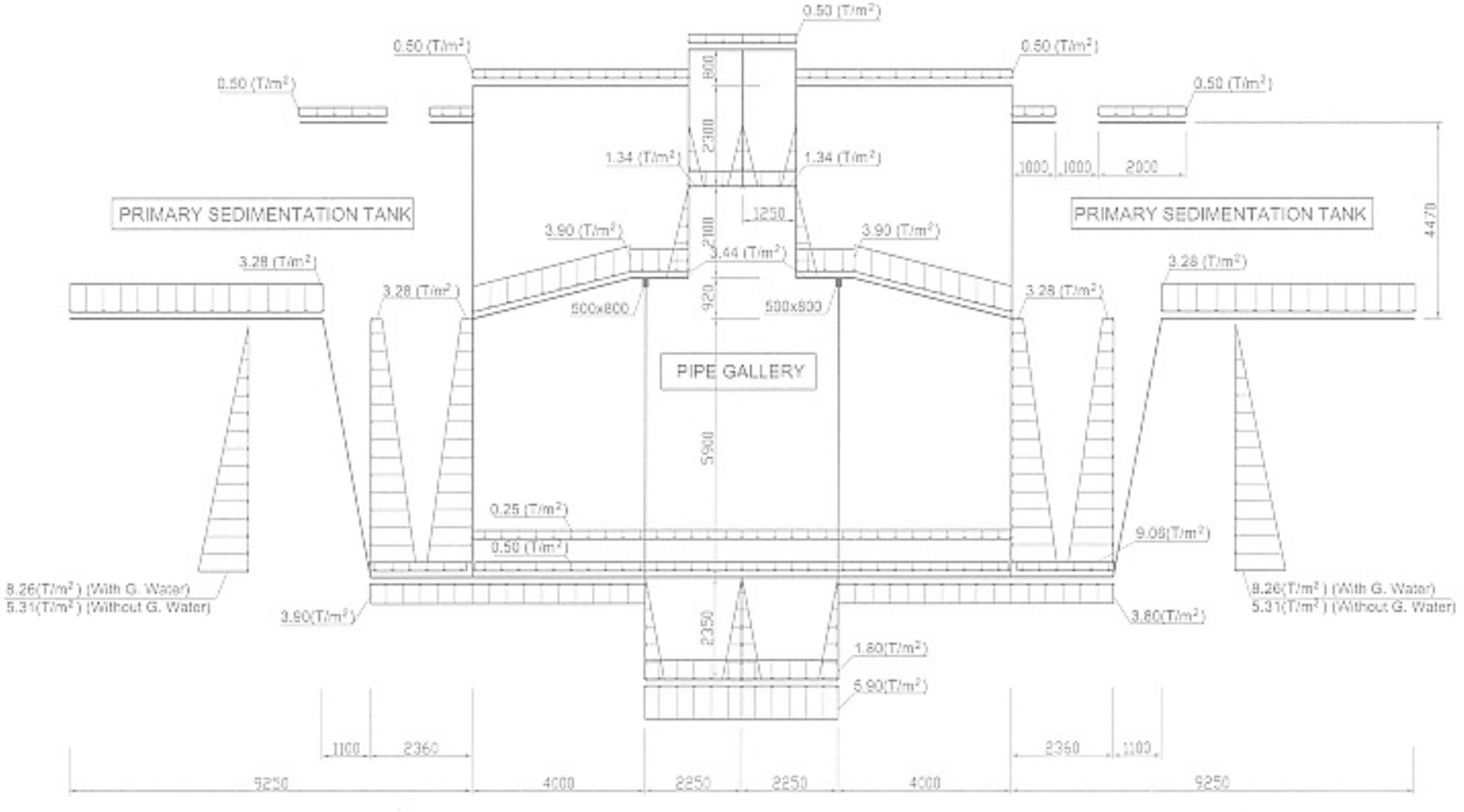
-Live load for all operating floor and walking way : q_{live} = 0.50T/m2

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

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 GALLERRY - PRIMARY SEDIMENTATION TANK



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

SAP2000 v6.11 File: REIN1 Ton-m Units PAGE 1
March 6, 2001 9:50

ABC

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

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD				In case water full in all tanks, no ground water 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 level 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 combo1, combo2, 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 analised by SAP2000, choosing the most dangerous forces for calculation:

$A_o = M/R_n bh_o^2$ 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		Remark
					ϕ(mm)	a(mm)	
(Bottom Slab level -5.3) t=0.50	-6.600	0.0510	0.974	9.85	14	125	
	2.700	0.0267	0.986	4.50	14	250	
(Bottom Slab level -3.00) t=0.40	-2.400	0.0315	0.984	4.62	14	250	
	6.500	0.1184	0.937	15.49	16	125	
t=0.70	-21.200	0.0763	0.960	21.90	20	125	
	-10.000	0.0360	0.982	10.11	20	250	
	14.700	0.0624	0.968	16.37	18	125	
	7.400	0.0314	0.984	8.10	18	250	
	-15.700	0.0667	0.965	17.52	18	125	*Slope*
	21.200	0.0763	0.960	21.90	20	125	*Slope*
	-9.000	0.0382	0.981	9.89	18	250	*Slope*
Pri. Sed. Tank bottom Slab Level +2.78 t=0.60	9.000	0.0558	0.971	12.07	14	125	
	-4.500	0.0229	0.988	5.37	14	250	
	12.800	0.0794	0.959	17.39	18	125	
	-4.500	0.0229	0.988	5.37	14	250	*125*
Slab Level +3.7 t=0.40	-11.100	0.1456	0.921	22.83	20	125	
	4.400	0.0577	0.970	8.59	14	150	*125*
	-10.600	0.1391	0.925	21.71	20	125	
	5.600	0.0735	0.962	11.03	14	125	
Water way floor L+5.8 t=0.30	-2.100	0.0567	0.971	5.88	14	250	
	3.200	0.0864	0.955	9.11	14	150	*125*
Top floor level +8.0 t=0.20	-1.350	0.0857	0.955	5.89	12	150	*125*
	0.900	0.0571	0.971	3.86	14	250	
	-0.800	0.0508	0.974	3.42	12	250	
	0.650	0.0413	0.979	2.77	12	250	
Wall of pri Sed. Tank	9.300	0.0719	0.963	14.04	16	125	
	-9.300	0.0719	0.963	14.04	16	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	
Sed. Tank	-11.100	0.0858	0.955	16.89	22	200	*125*
&Pri.Gallery	-17.300	0.1337	0.928	27.10	22	125	
t=0.50							
Water way wall	5.500	0.0722	0.963	10.82	14	125	
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 >= 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)	Capcity of concrete (ton)	Shearing stresses (Kg/cm2)	Dsgn Shearing stress (Dc) (Kg/cm2)	Compare &Conclude
at x=+1.25	0.8	0.5	0	0.6	0.65	11.2	13.14	3.07	3.6	OK!!!

6- COLUMNS:

A. MATERIAL PROPERTIES:

_ Concrete	Grade	C21	Rn	=	70	(Kg/cm2)
			Eb	=	230000	(Kg/cm2)
_ Reinforcement	type	AII	Ea	=	2800000	(Kg/cm2)
			Ra = Ra'	=	1600	(Kg/cm2)

B. CALCULATION:

(CA§P NO I L§¡C 3 - Nmax-M1ung ùng)

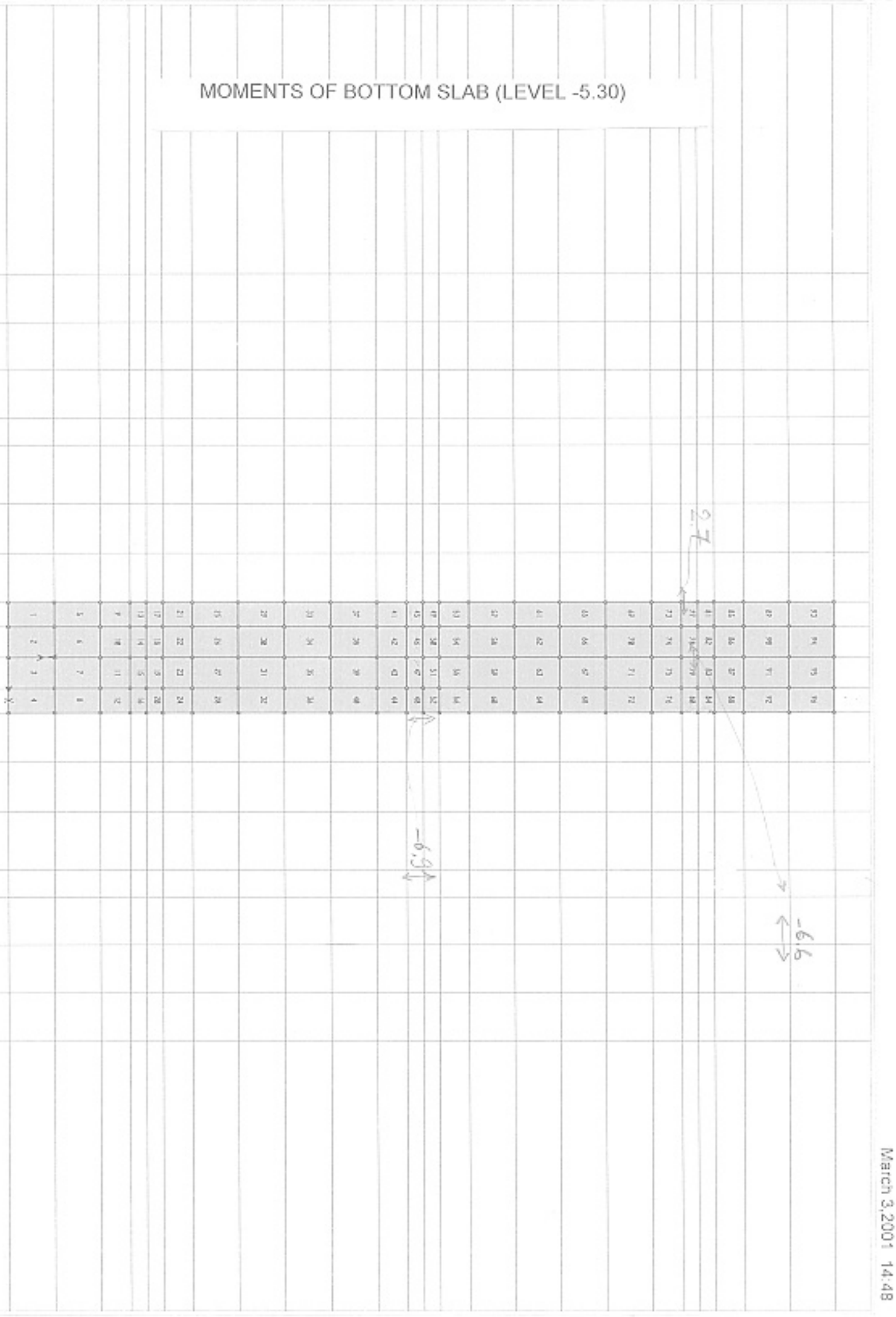
NAME OF COLUMN	POSITION	l (cm)	b (cm)	h (cm)	area (cm)	l_0 (cm)	l_0 (cm)	l_t	m_b	Rn* (Kg/cm2)	α_0	A_0	μ_0 (%)	J_a (cm4)	J_b (cm4)	M (Kg.m)	N (Kg)
	Foot	660	50	50	1	45	475	9.52	1.00	70	0.62	0.43	0.05	4528	520833.3333	0.00E+00	9.14E+04

NAME OF COLUMN	POSITION	θ_0 (cm)	θ_0/h	S	M_{dx} (Kg m)	N_{dx} (Kg)	K_{dx}	N_{dy} (Kg)	η	$P_i \theta_0$ (cm)	θ_{0p}	θ (cm)	x (cm)	$u_x h_0$	X' (cm)	$F_s=F_d$ (cm2)		μ_s (%)	$F_{stirrup}$ (cm2)	μ_s (%)	CHECK	BOTTI DOI XUNG $F_s=F_d$
	Foot	2.0	0.043	0.04	0.0X.E+03	9.14E+04	2.00	1.68E+06	1.056	2.12	14.34	20.1	20.1	20.1	40.8	0.00	+15.6	-0.45		0.00	#DIV/0!	+7 D16 8 D16

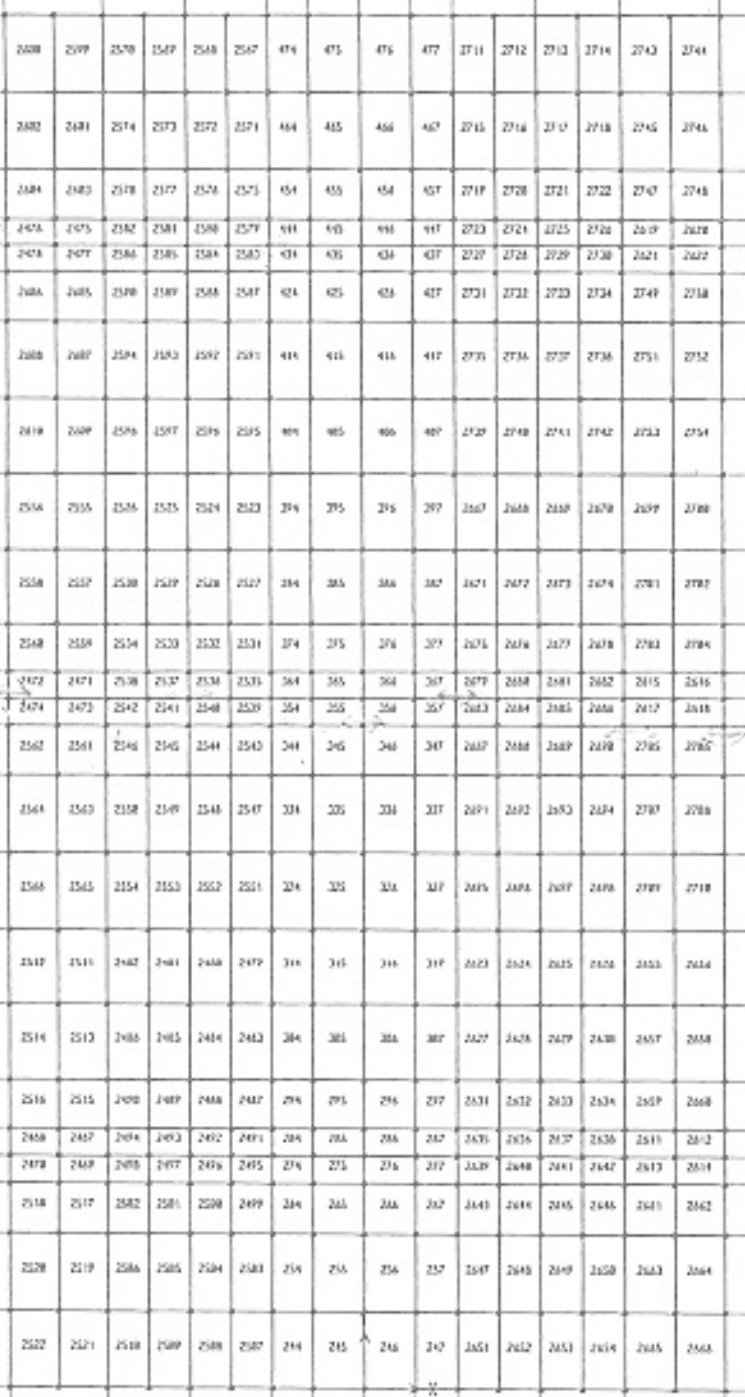
6- CALCULATION FOR PILE NUMBER (as attached sheets):

(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)

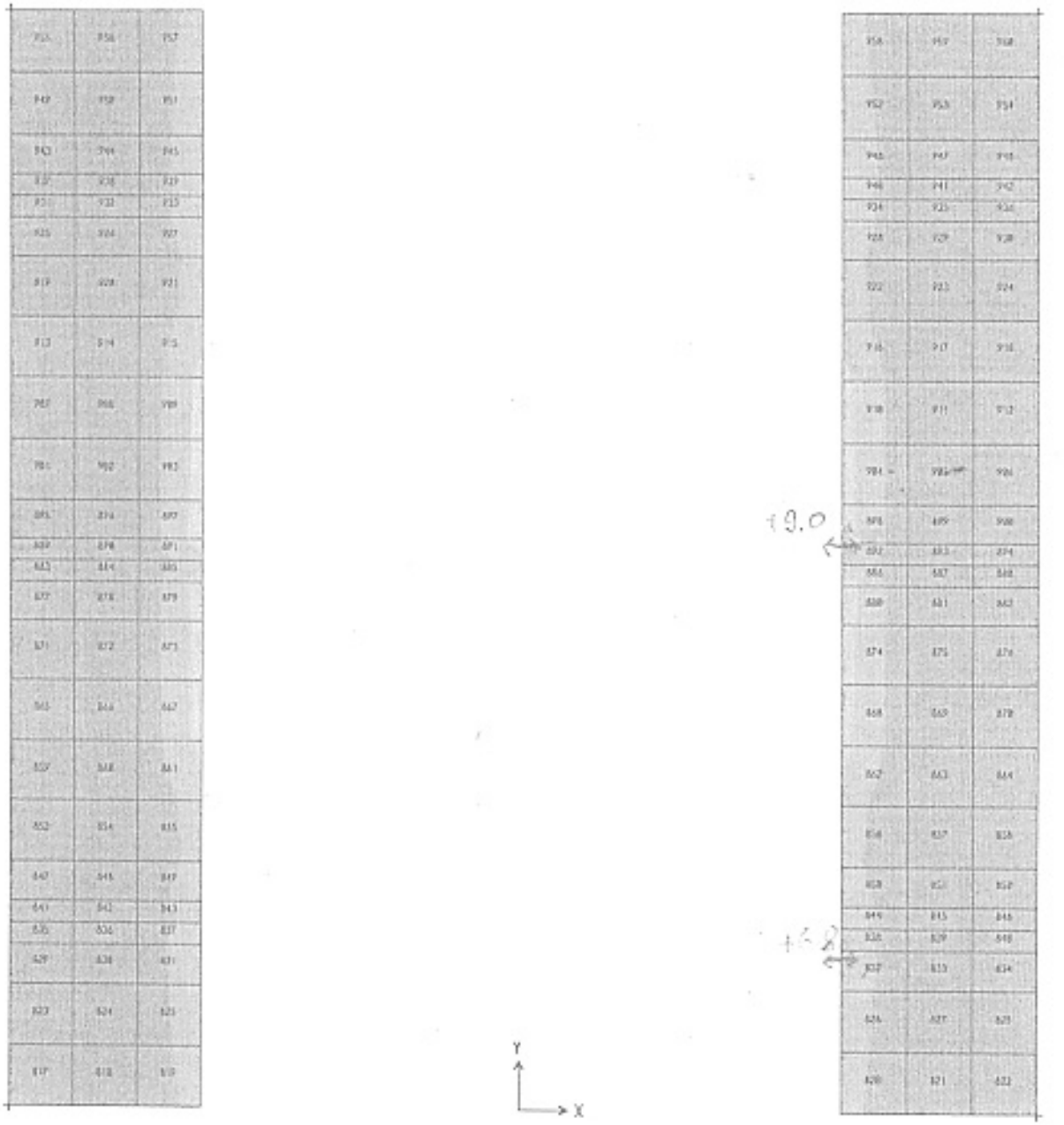


BOTTOM SLAB (LEVEL -3.10)



BOTTOM SLAB (LEVEL +2.78)

(ENVE COMBO Max (M_{11}))

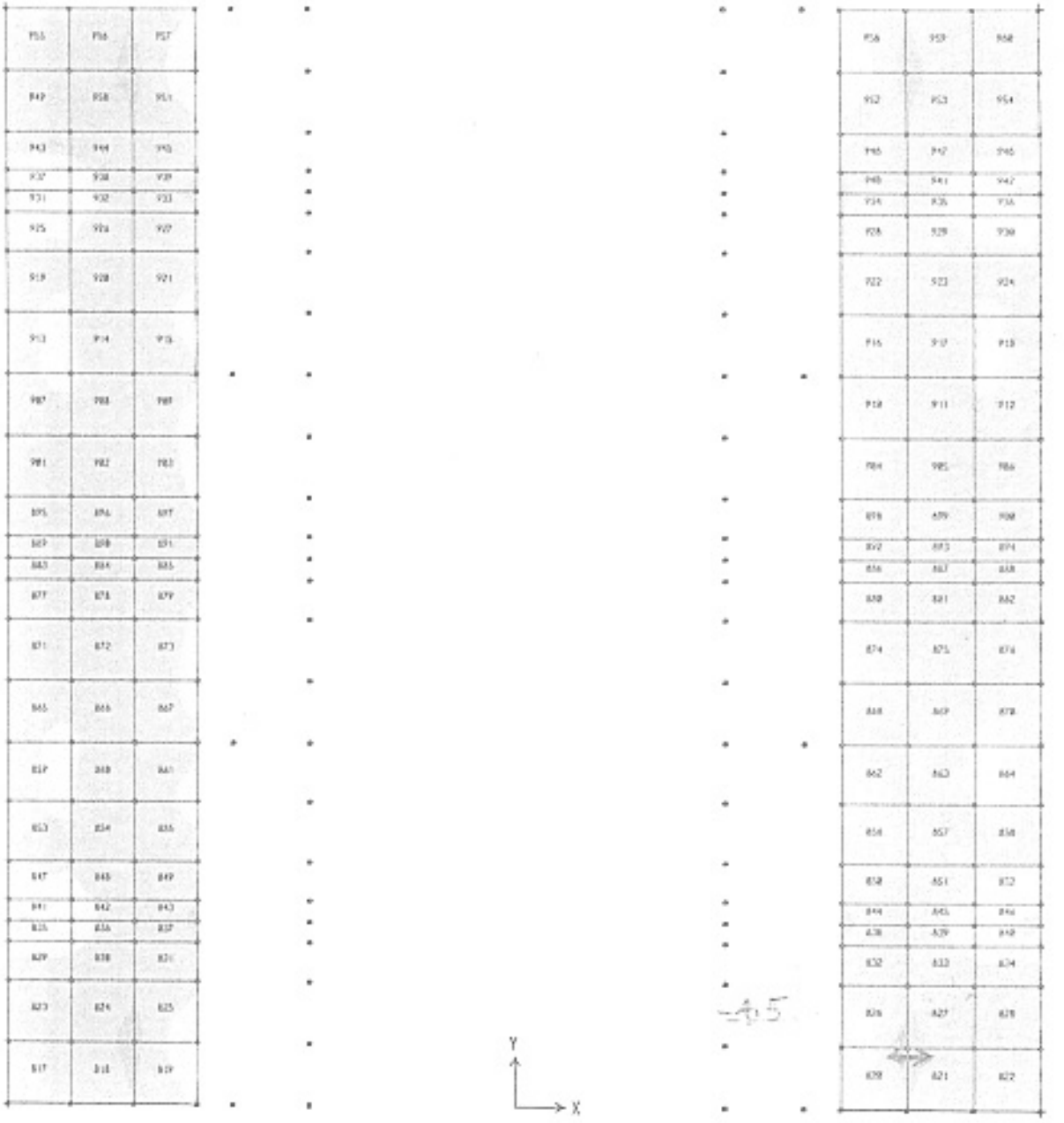


-10.5 -7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5

SAP2000 v6.11 - File:rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

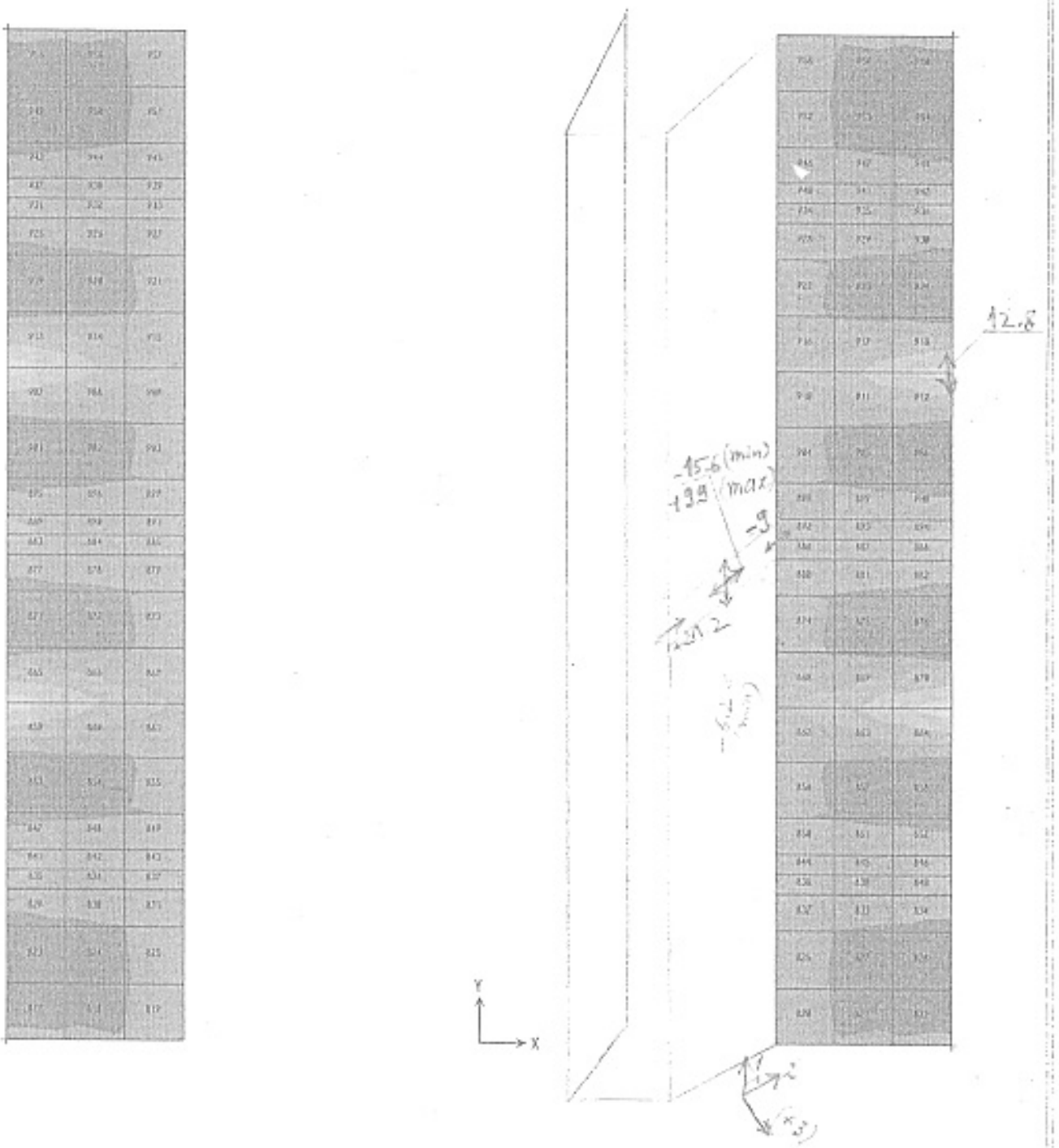
BOTTOM SLAB (LEVEL +2.78)

(ENVE COMBO Min (M_{11}))



BOTTOM SLAB (LEVEL +2.78)

(ENVE COMBO Max (M_{22}))

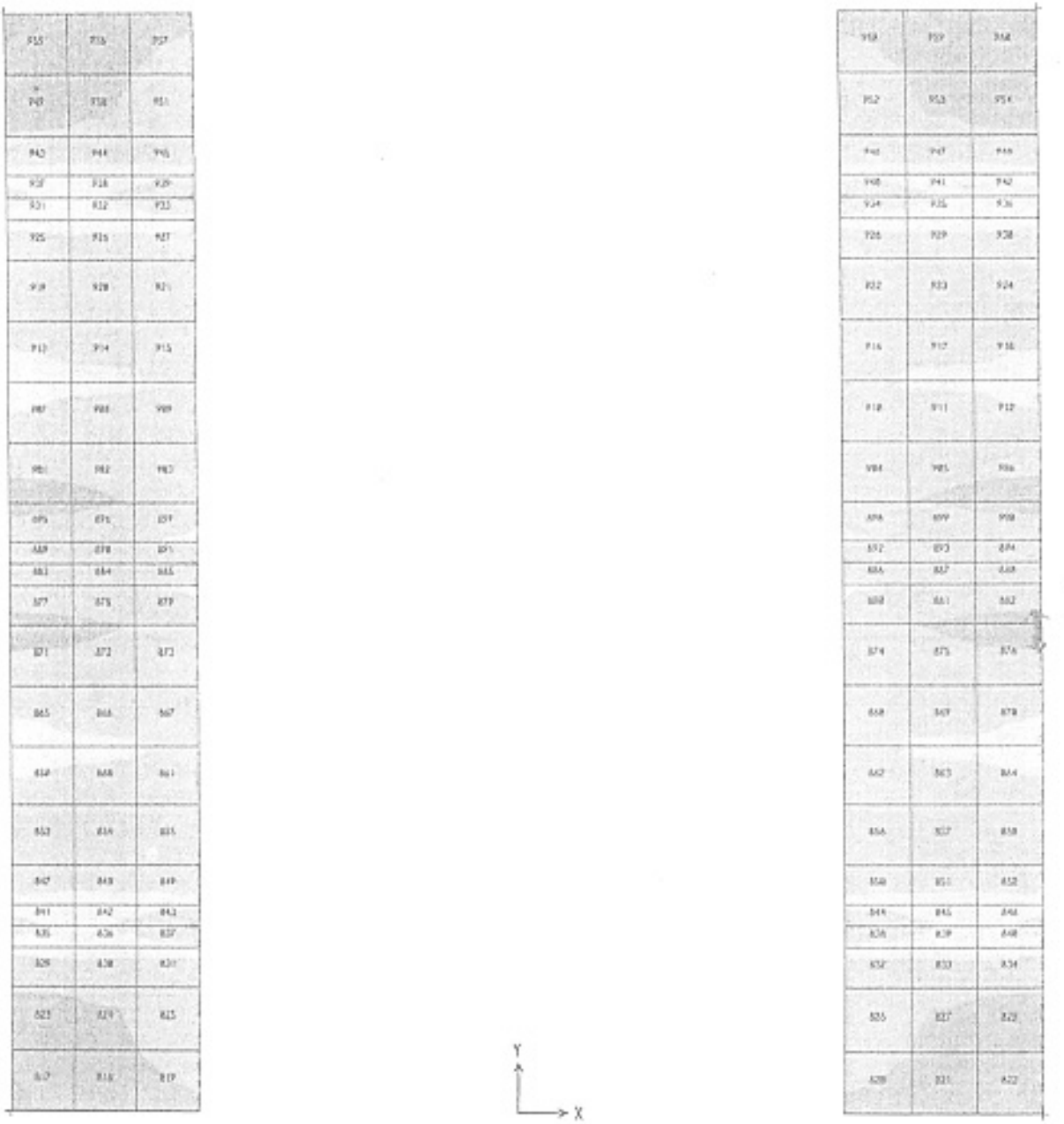


-7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5 21.0

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

BOTTOM SLAB (LEVEL +2.78)

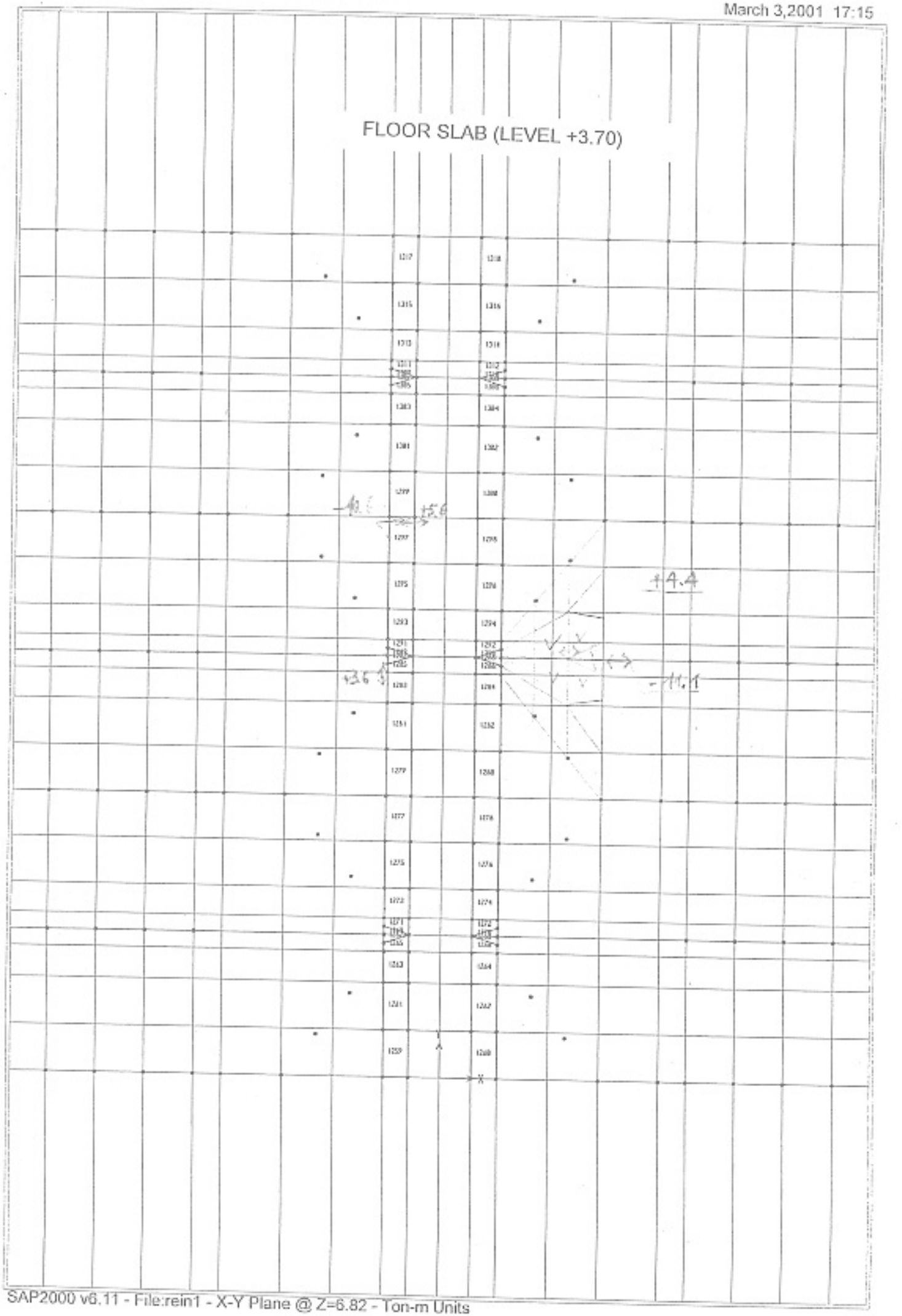
(ENVE COMBO Min (M_{22}))



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

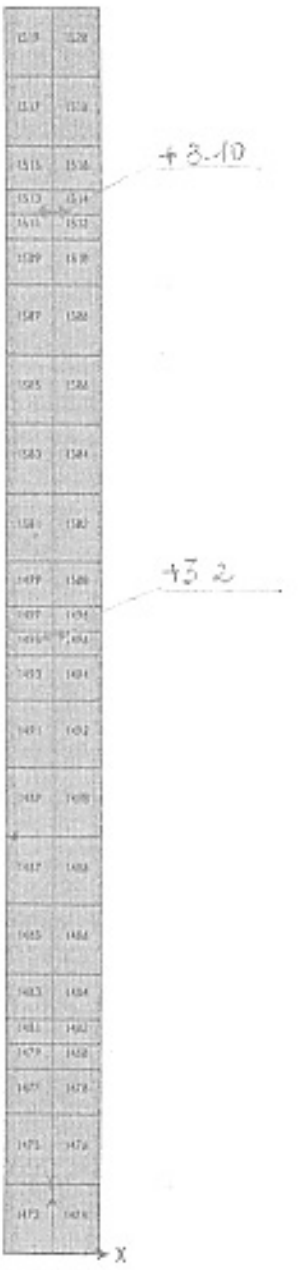
SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

FLOOR SLAB (LEVEL +3.70)



WATERWAY FLOOR LEVEL +5.80)

(ENVE COMBO Max (M_{11}))

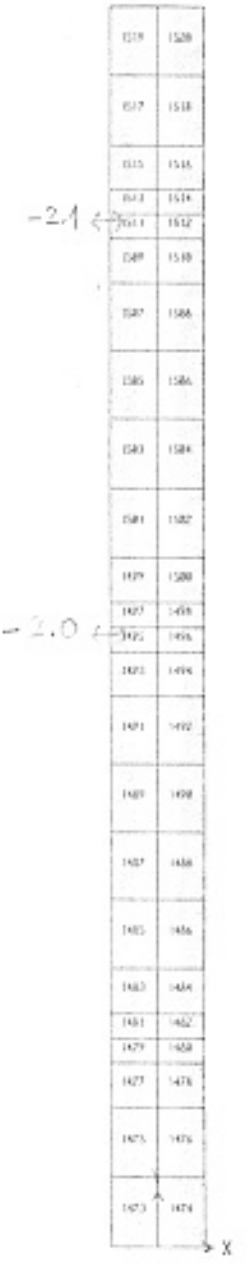


-10.5 -7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5

SAP2000 v6.11 - File:rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

WATERWAY FLOOR LEVEL +5.80)

(ENVE COMBO Min (M_{11}))

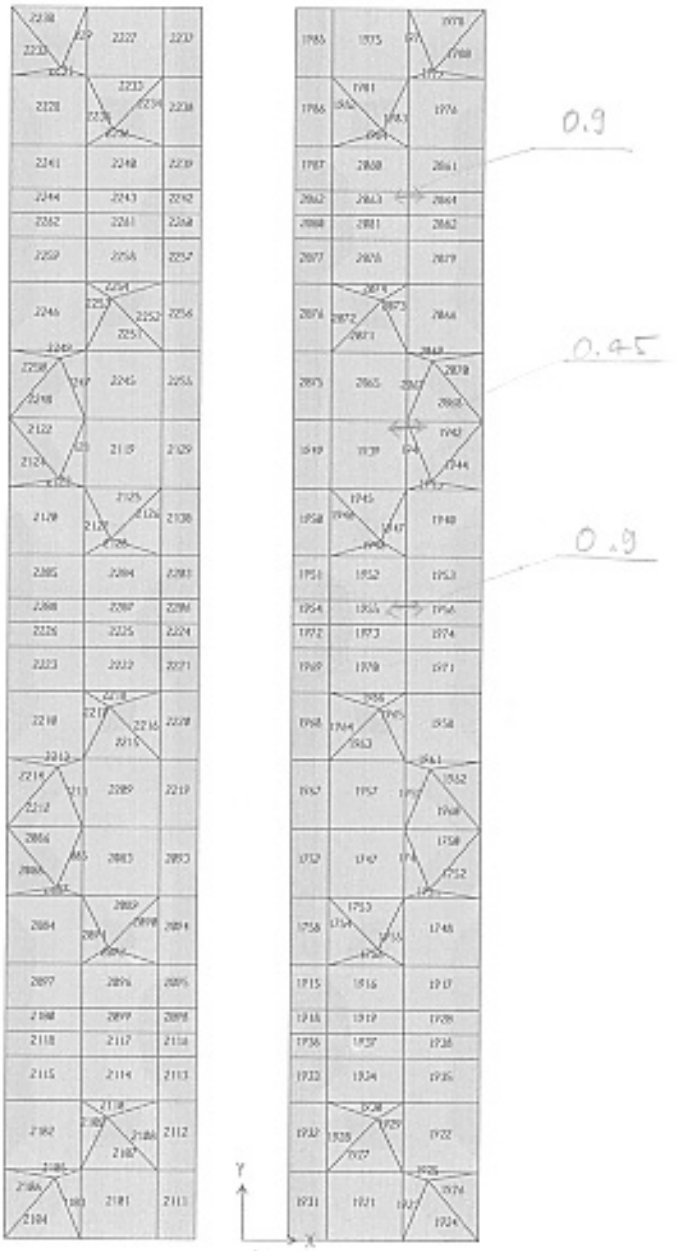


-21.0 -17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0

SAP2000 v6.11 - File:rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

COVER SLAB (LEVEL +8.00)

(ENVE COMBO Max (M_{11}))

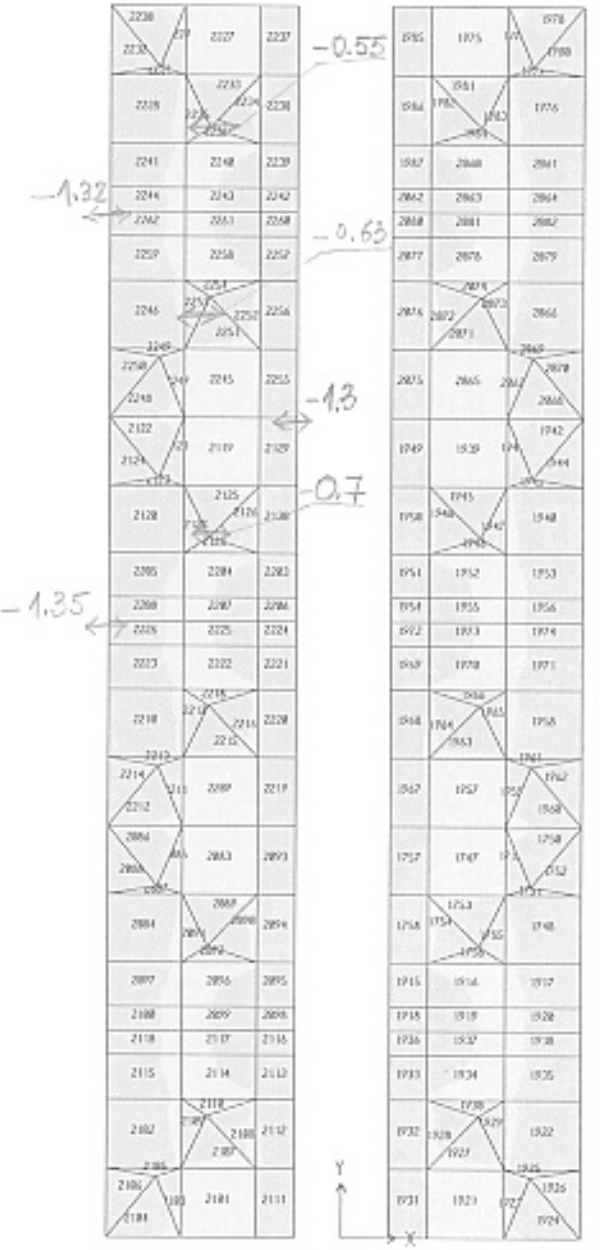


-10.5 -7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5

SAP2000 v6.11 - File:rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

COVER SLAB (LEVEL +8.00)

(ENVE COMBO Min (M_{11}))

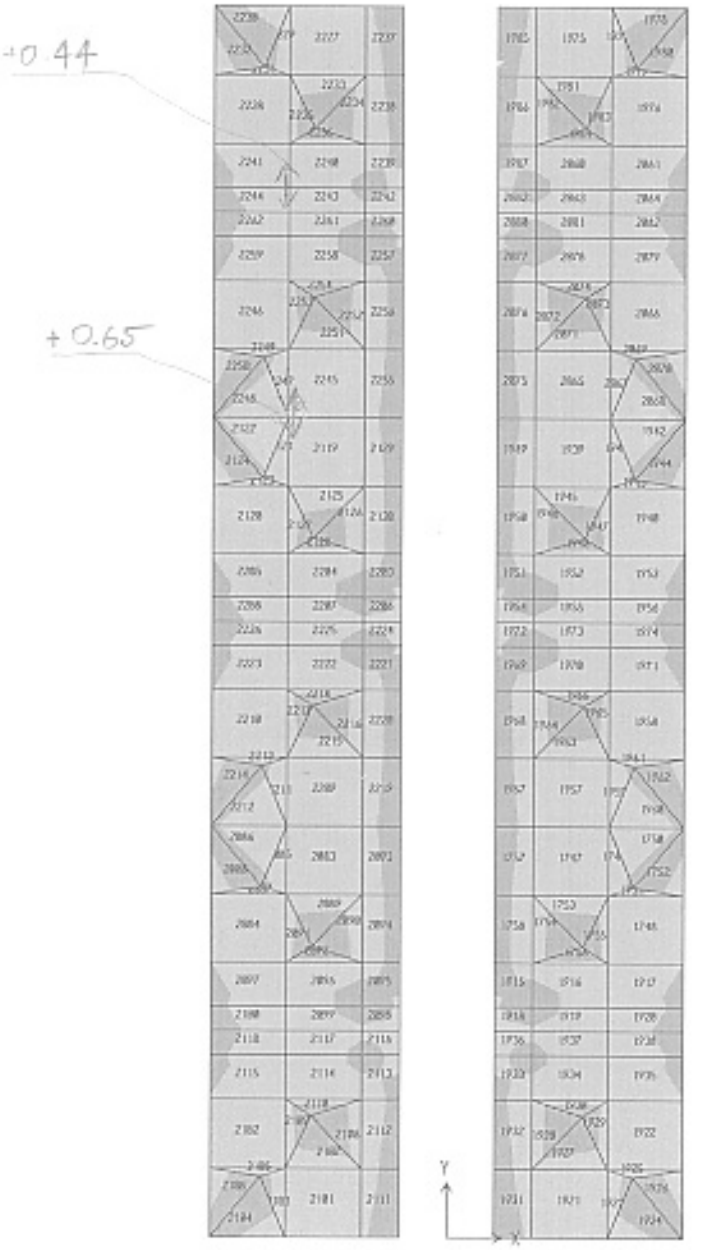


-21.0 -17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0

SAP2000 v6.11 - File:rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

COVER SLAB (LEVEL +8.00)

(ENVE COMBO Max (M_{22}))

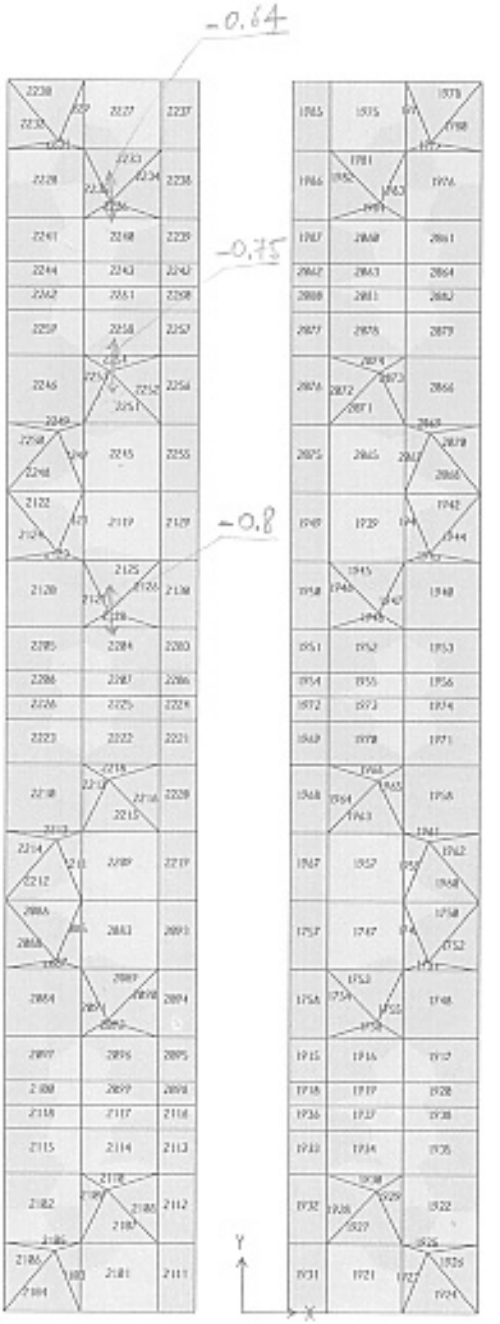


-7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5 21.0

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

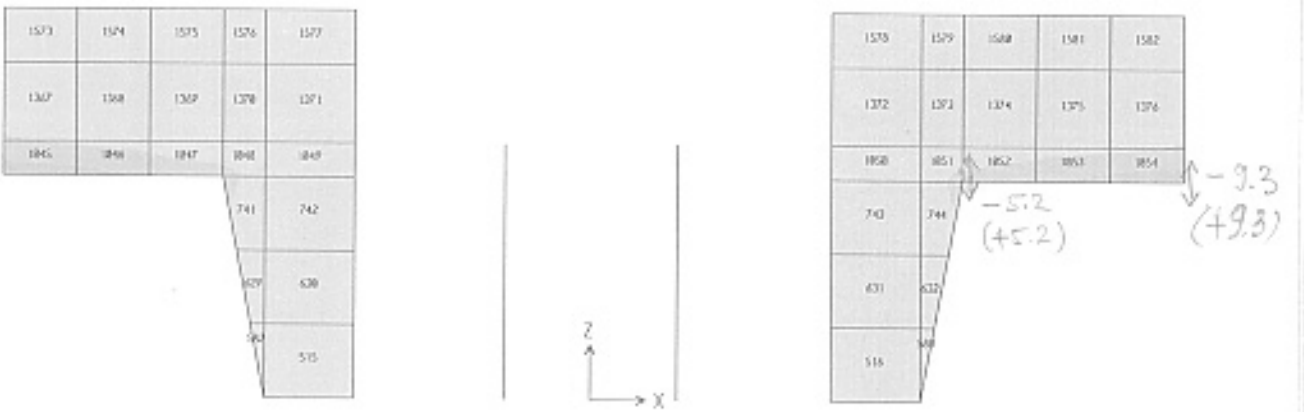
COVER SLAB (LEVEL +8.00)

(ENVE COMBO Min (M_{22}))



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

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units



WALL OF PRIMARY SED. TANK

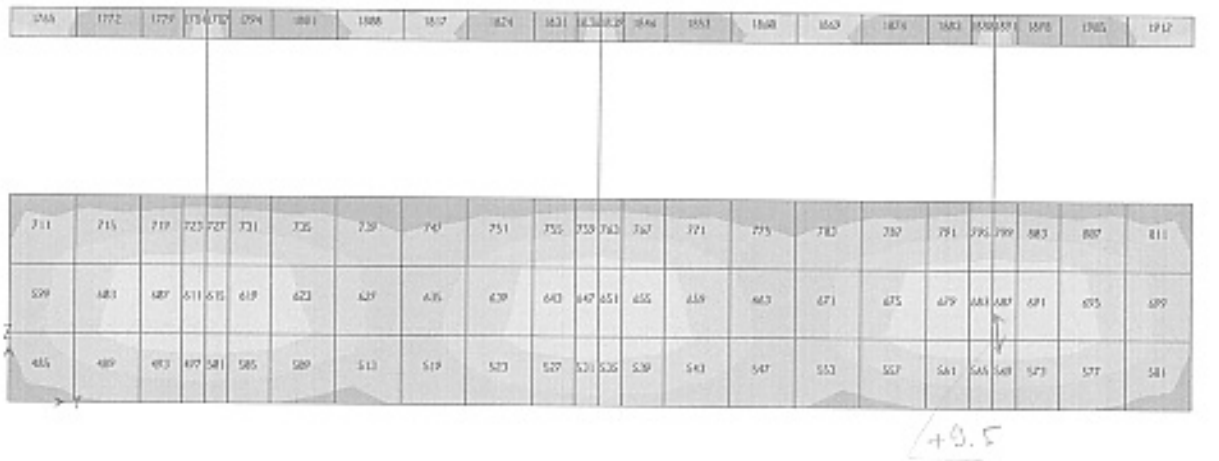
(ENVE COMBO Max, Min) (y=+11.00)

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

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

WALL OF PIPE GALLERY AND PRIMARY SED. TANK

(ENVE COMBO MAX M_{2-2}) x = +6.25



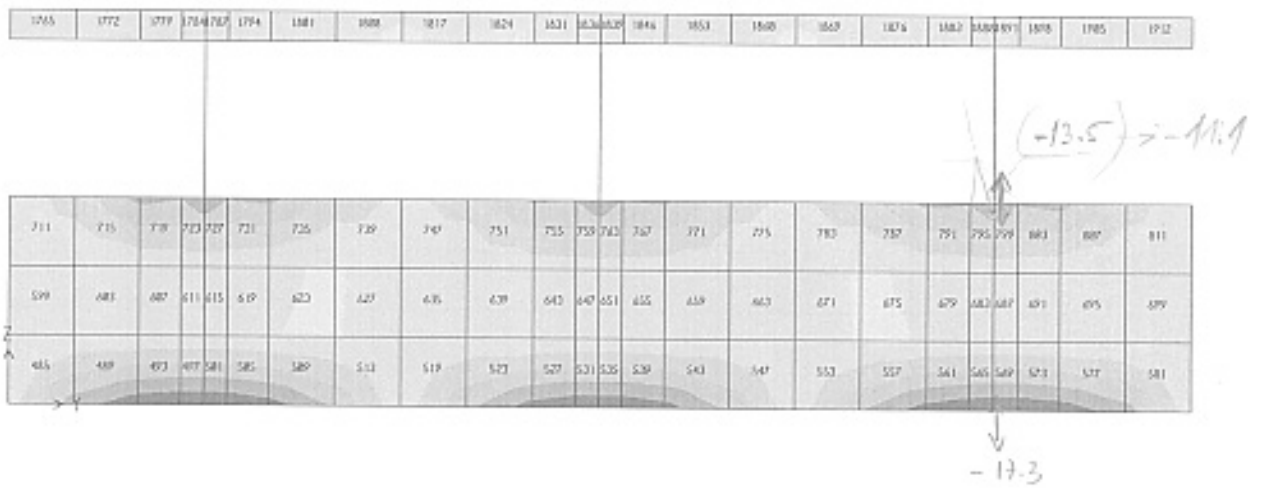
M_{22}

-7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5 21.0

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

WALL OF PIPE GALLERY AND PRIMARY SED. TANK

(ENVE COMBO MAX M_{2-2}) x = +6.25



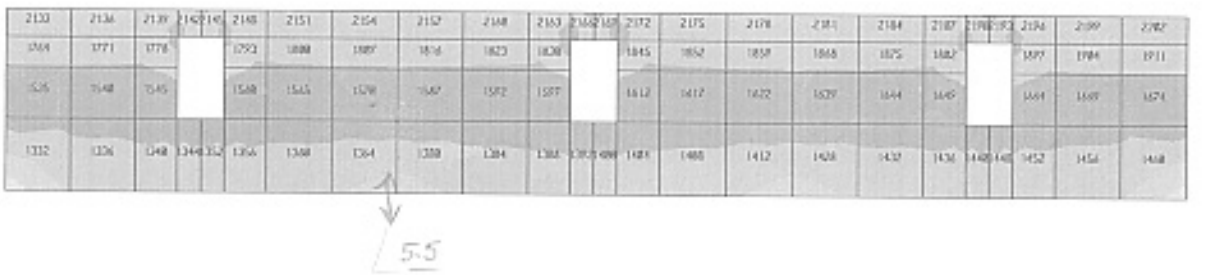
M_{2-2}

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

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

WALL OF WATER WAY

(ENVE COMBO MAX M_{2-2}) x=1.25

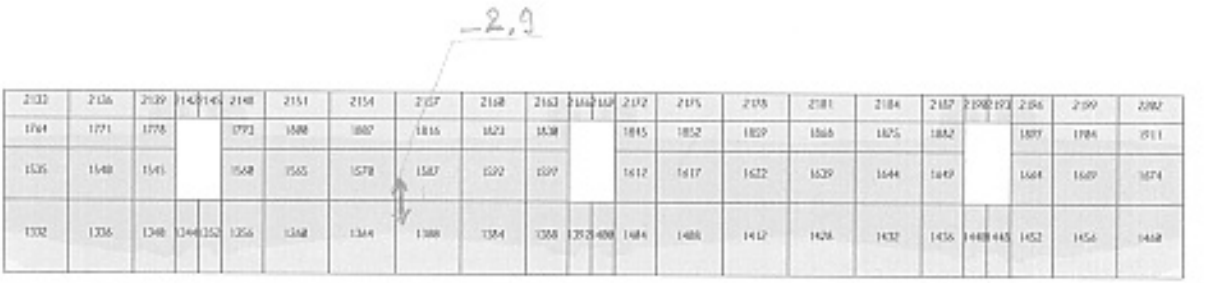


-7.0 -3.5 0.0 3.5 7.0 10.5 14.0 17.5 21.0

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

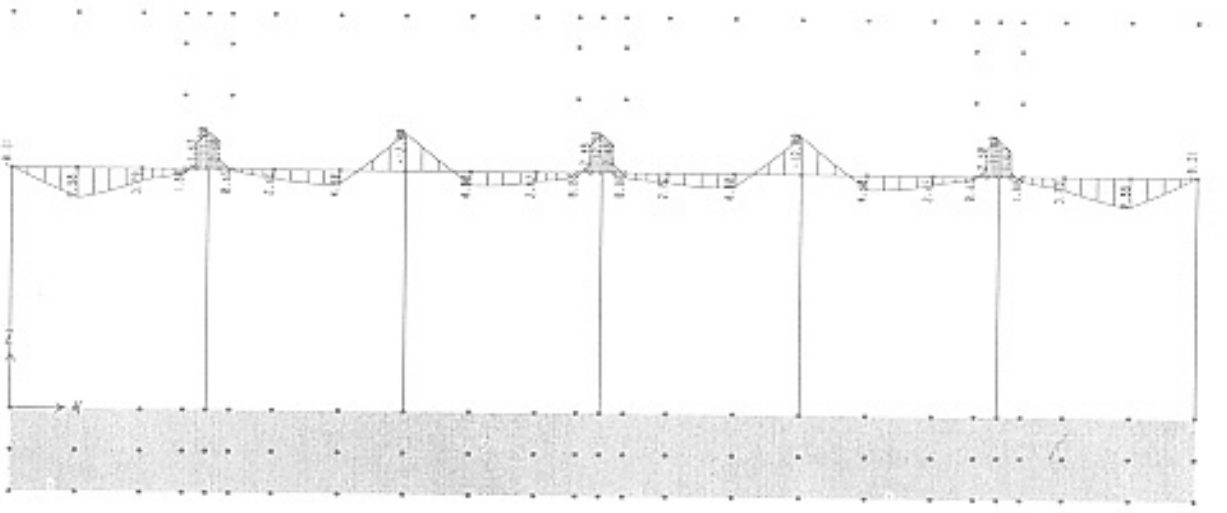
WALL OF WATER WAY

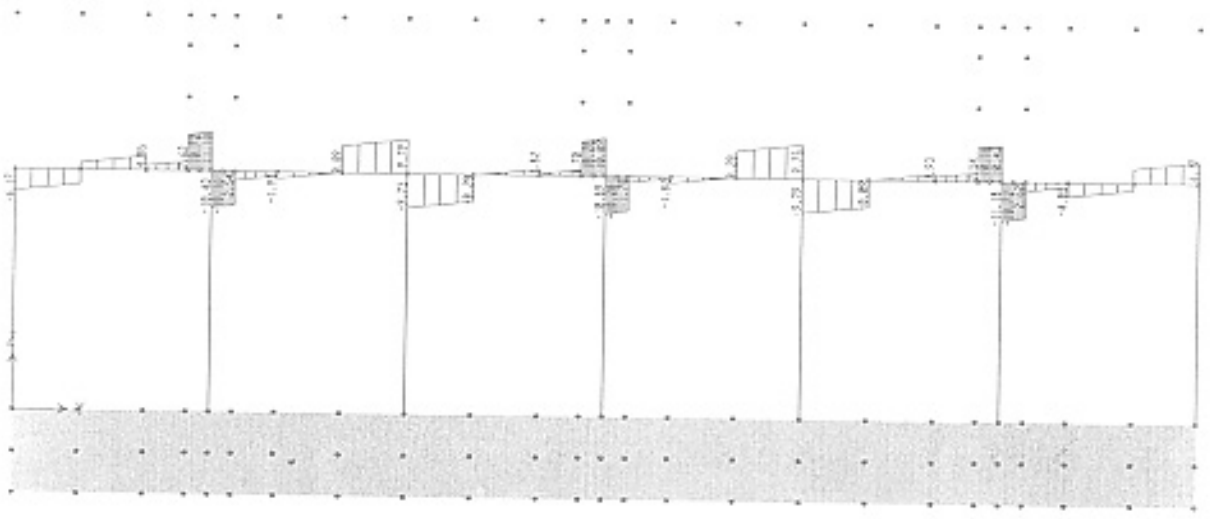
(ENVE COMBO MAX) x=1.25

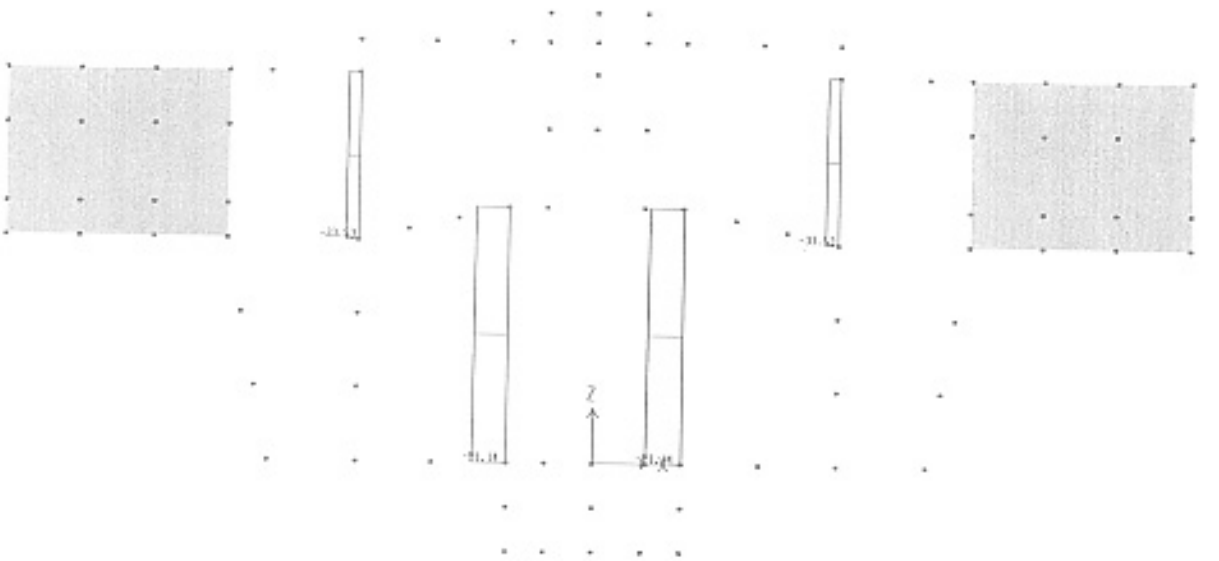


-17.5 -14.0 -10.5 -7.0 -3.5 0.0 3.5 7.0 10.5

SAP2000 v6.11 - File:rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

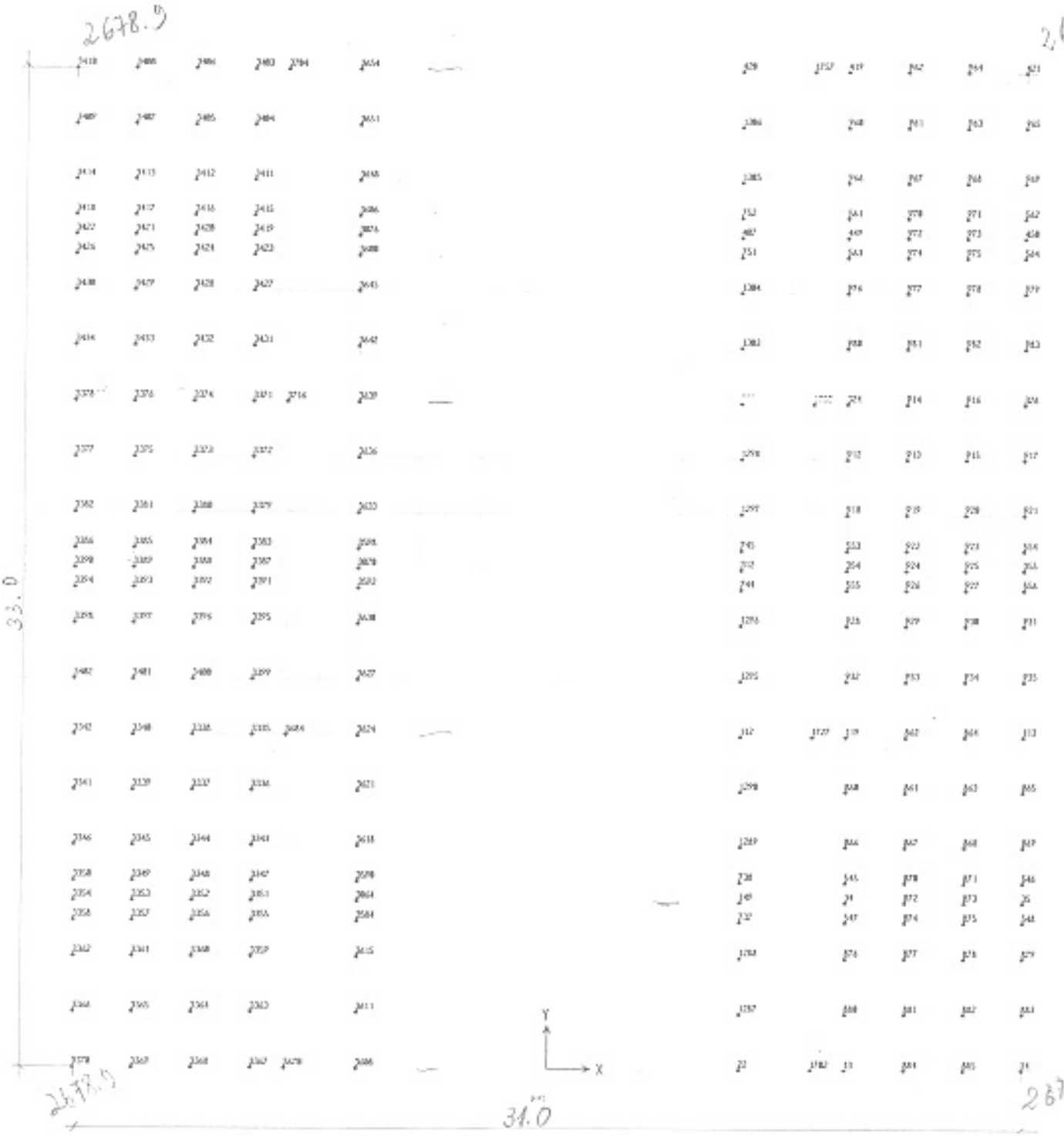





Z

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

SAP2000 v6.11 File: P1 Ton-m Units PAGE 1
January 5, 2001 17:16

ABC

LOAD COMBINATION MULTIPLIERS

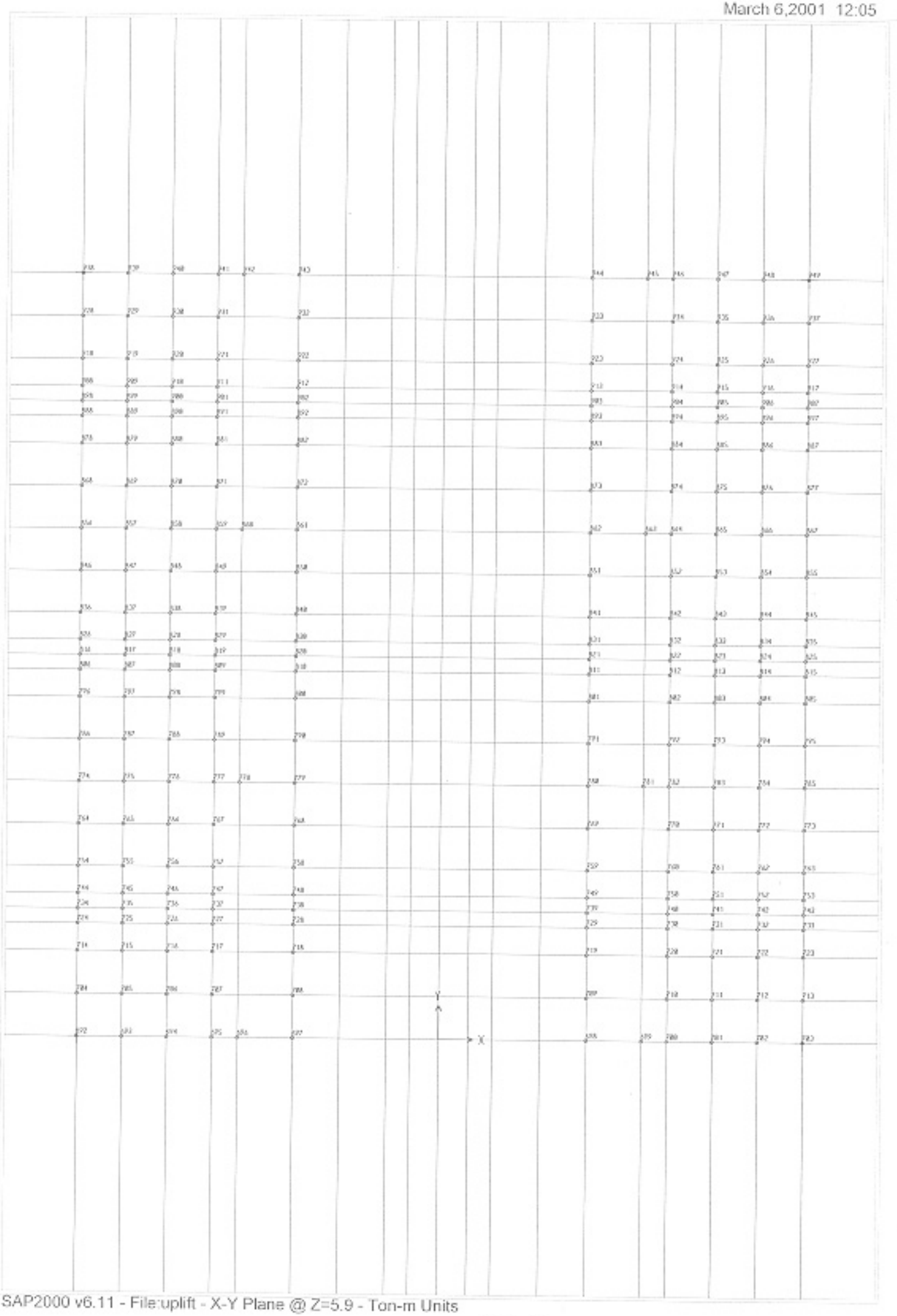
COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
PILECOMB	ADD				for calculating number of piles
	SELF		1.0000	STATIC(DEAD)	
	WATER		1.0000	STATIC(DEAD)	
	CINDERCO		1.0000	STATIC(DEAD)	
	MAN		1.0000	STATIC(DEAD)	

SAP2000 v6.11 File: P1 Ton-m Units PAGE 2
January 5, 2001 17:16

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	98.8898	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	78.8529	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	-98.8898	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


Y
X

CALCULATION FOR WASTEWATER TREAMENT 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/cm2)

RS= 3.6 (Kg/cm2)

Reinforcement type AII : Ra= 1600 (Kg/cm2)

Back fill sand: γ_s= 1.80T/m3 ; Coeficient of earth pressure at rest K_o 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}=0.8x6.1x0.5 + 6.1x1 = 8.54T/m2

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

p_{h1}=0.8x2.75x0.5 + 2.75x1 = 3.9T/m2

-Uplift pressure to bottom of pipegallery:

p_{uplift}=($H_{ground\ water}$)x1.0= 3.70T/m2

-Uplift pressure to bottom of aeration tank:

p_{uplift}=($H_{ground\ water}$)x1.0= 1.0T/m2

3.3-Water load

According to highest water level and bottom level as inlustrated 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:

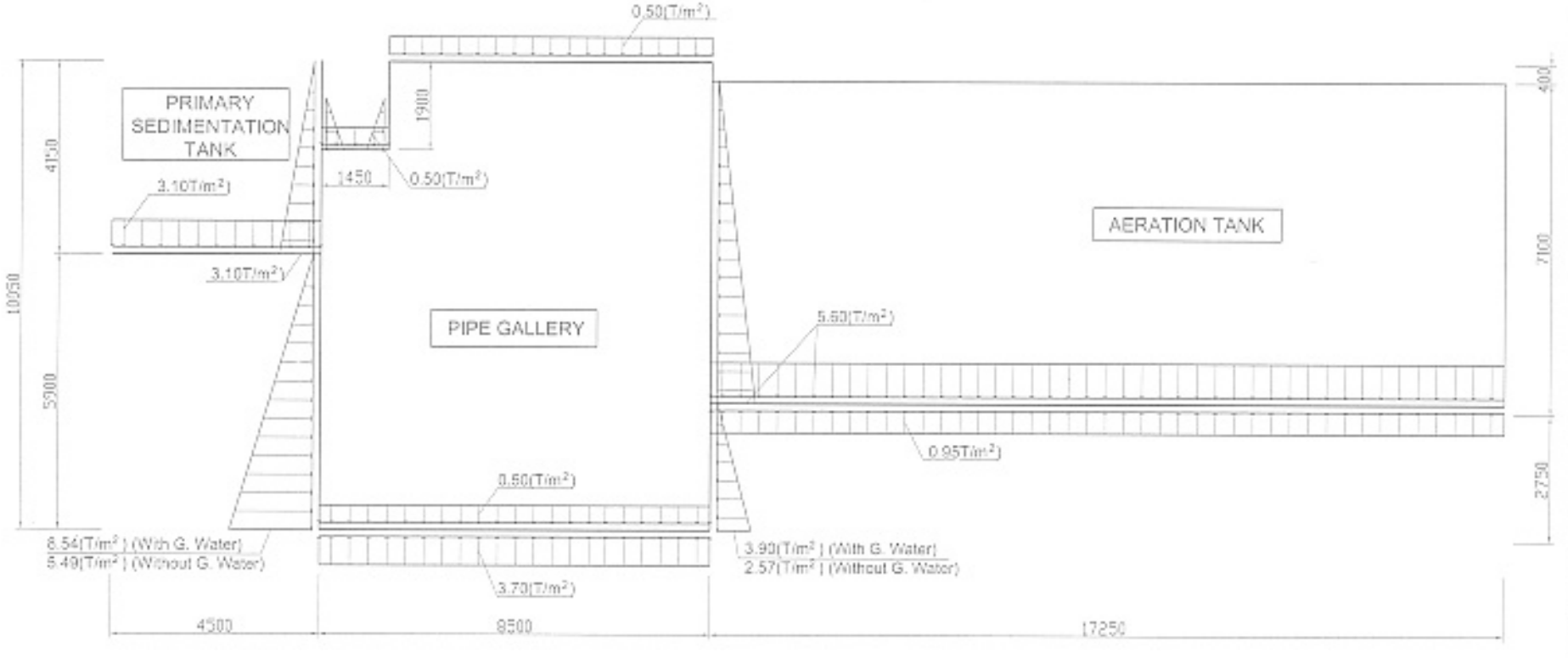
(Due to mechanical supports and cinder concrete)

-Uniform load: $q_{con\ layer}$ 2.5x0.10= 0.25T/m2

3.5-Live load:

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

PRIMARY SEDIMENTATION TANK - PIPE GALLERY - AERATION TANK



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

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

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

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:

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

$Fa = M/\gamma Raho$ Where: $\gamma = 0.5 + ((1-2Ao)^{1/2})/2$

5-1 SLABS AND WALLS:

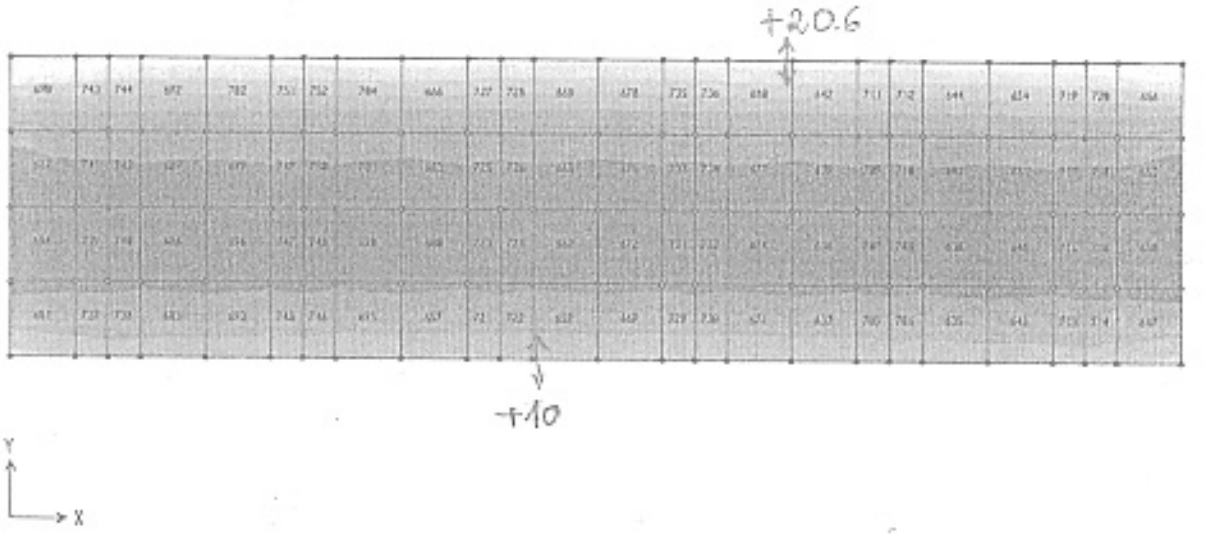
Moments	Values (T.m)	Ao	γ	Fa (cm^2)	r arrangement ϕ(mm)	a(mm)	
(Bottom	21.000	0.1302	0.930	29.40	22	125	24a125
Slab level	10.000	0.0620	0.968	13.45	22	250	24a250
-3.10)	-10.200	0.0519	0.973	12.36	16	125	
t=0.60							
aeration	19.000	0.1178	0.937	26.40	22	125	Not in DWG.
tank bottom	12.300	0.0763	0.960	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)

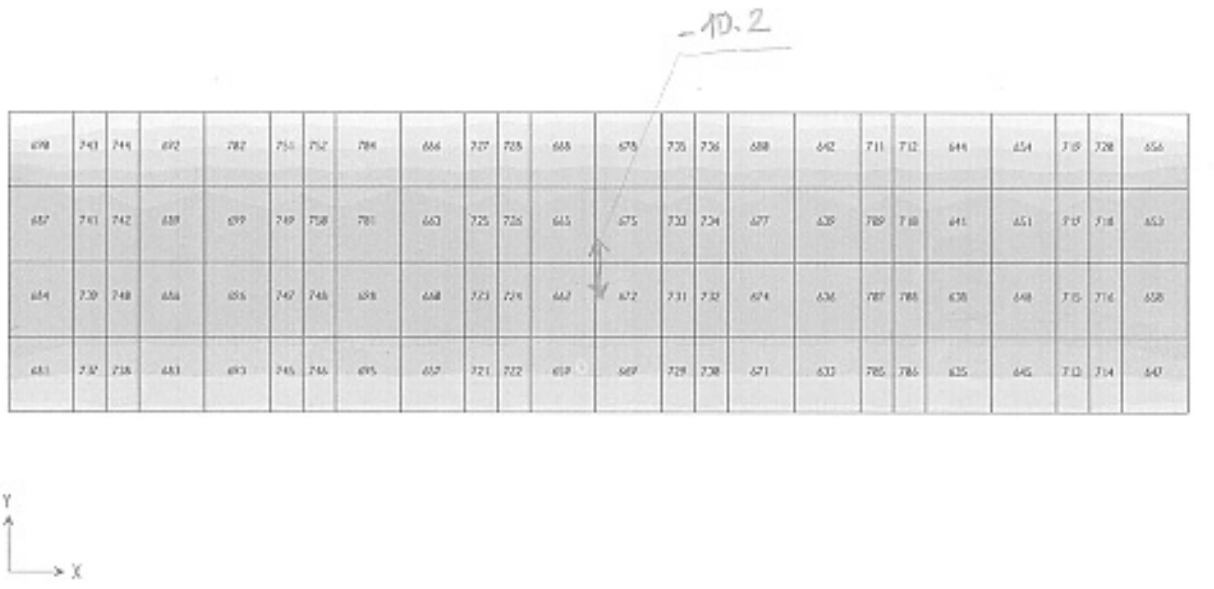
BOTTOM SLAB OF PIPE GALLERY(LEVEL - 3.1)

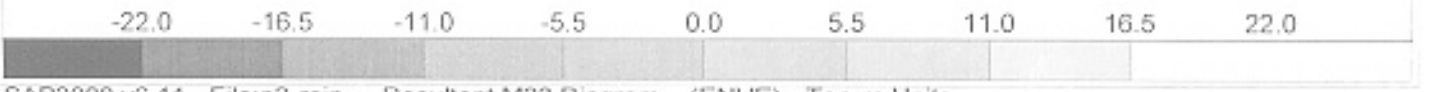
(ENVE COMBO MAX)



BOTTOM SLAB OF PIPE GALLERY(LEVEL - 3.1)

(ENVE COMBO MIN)

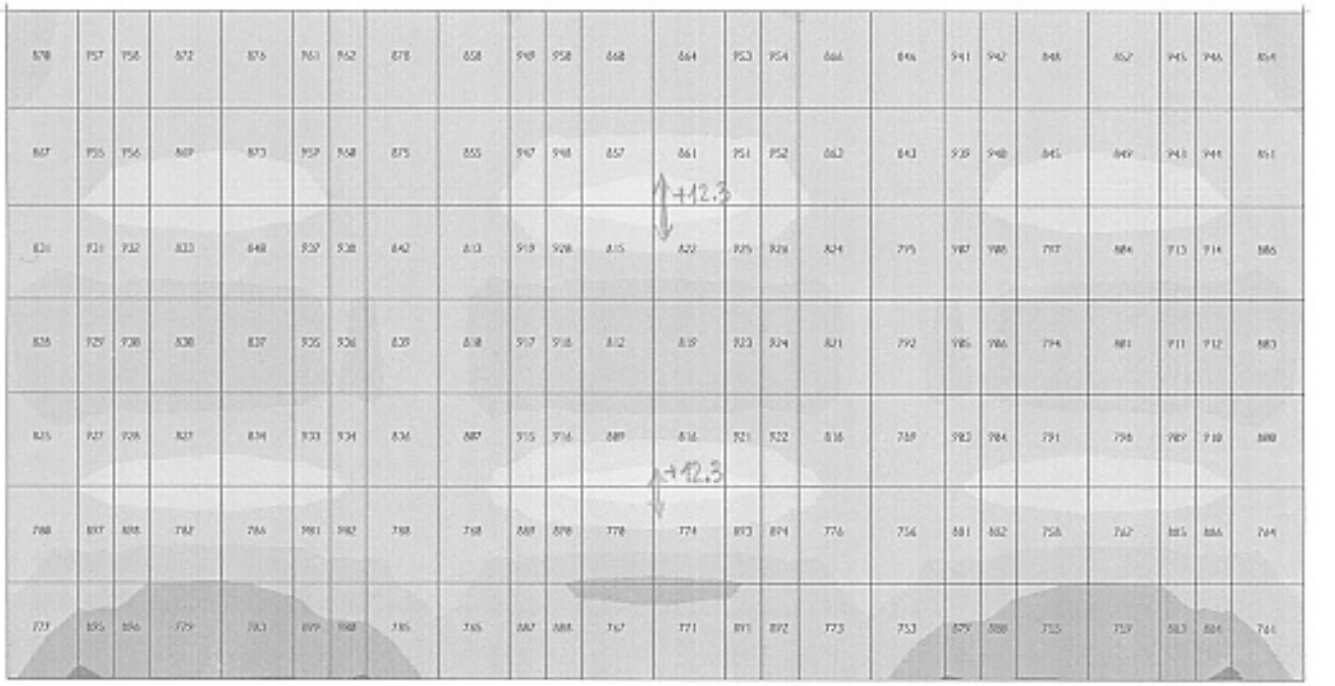




SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.35

(ENVE COMBO MAX)

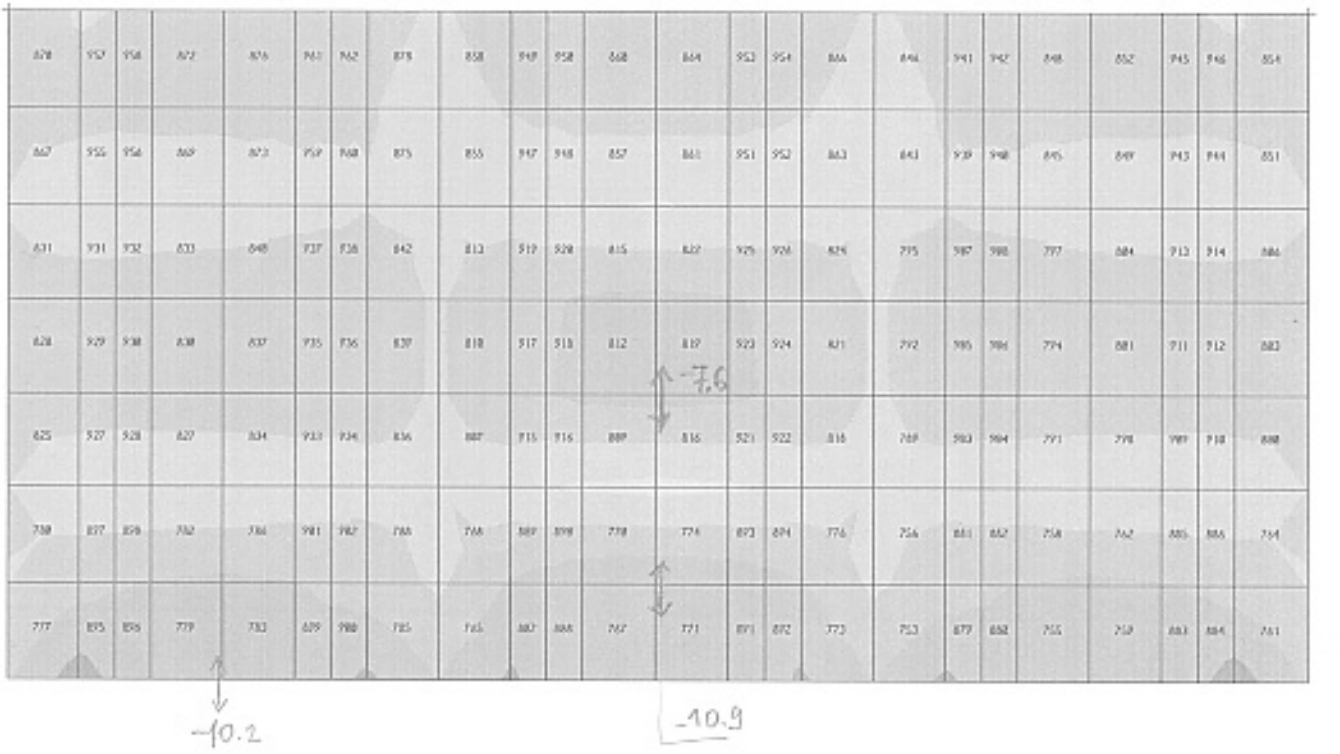


-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.35

(ENVE COMBO MIN)

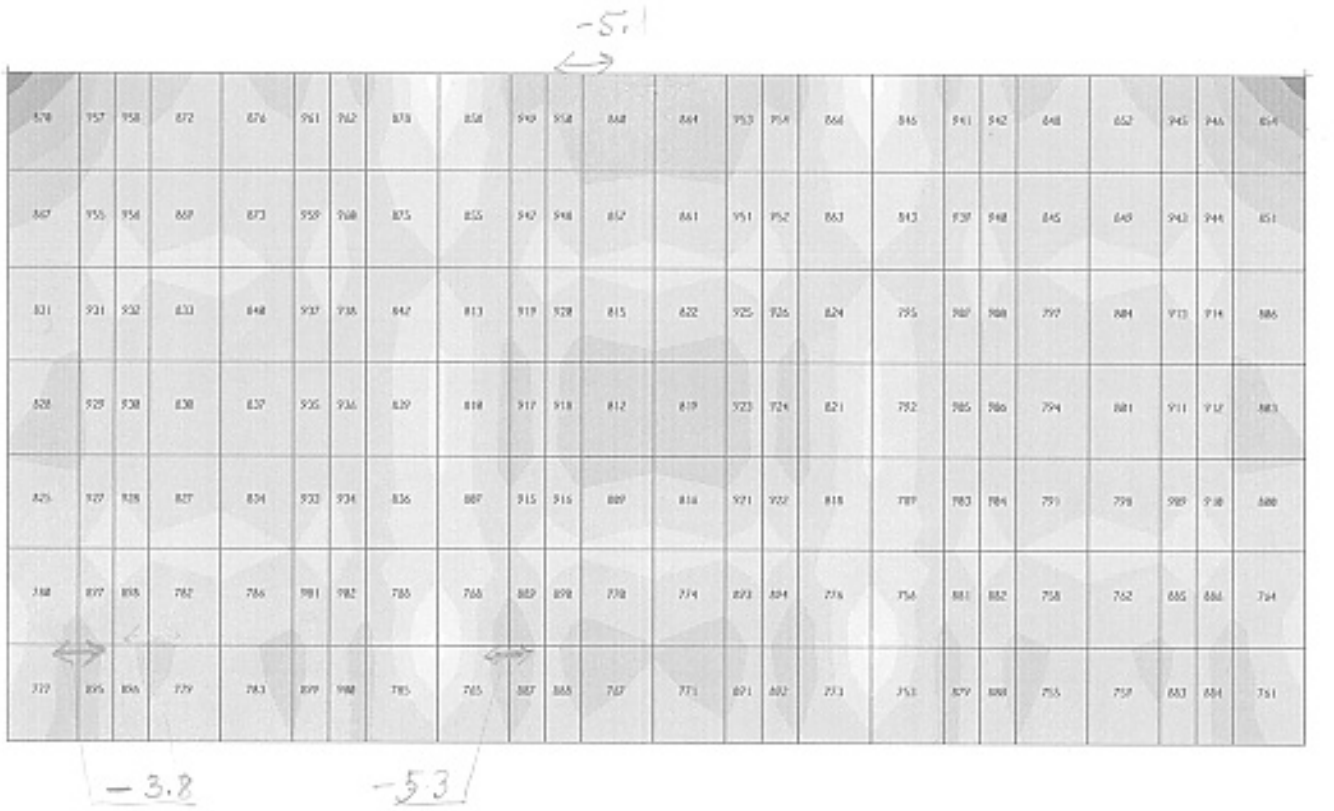


-22.0 -16.5 -11.0 -5.5 0.0 5.5 11.0 16.5 22.0

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.35

(ENVE COMBO MIN)

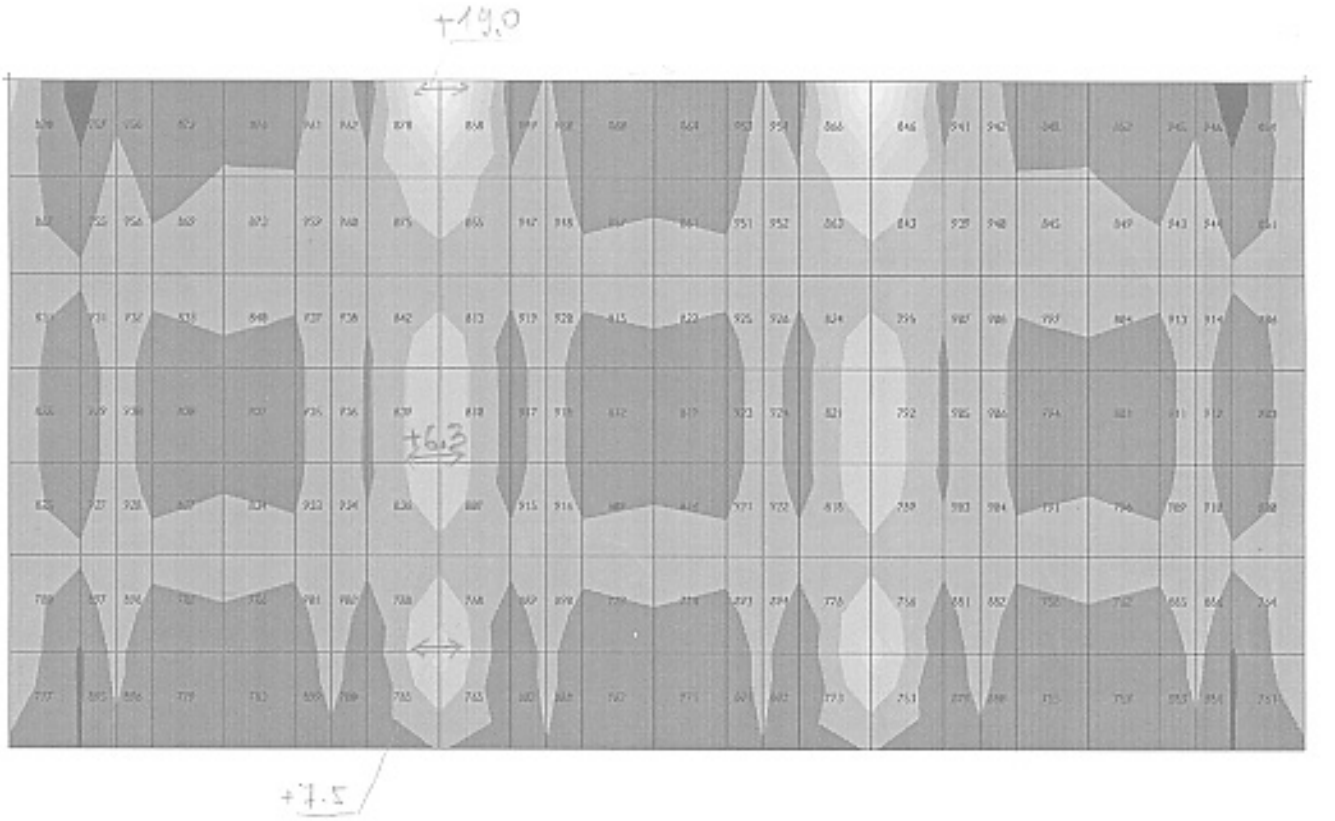


-13.0 -10.4 -7.8 -5.2 -2.6 0.0 2.6 5.2 7.8

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.35

(ENVE COMBO MAX)

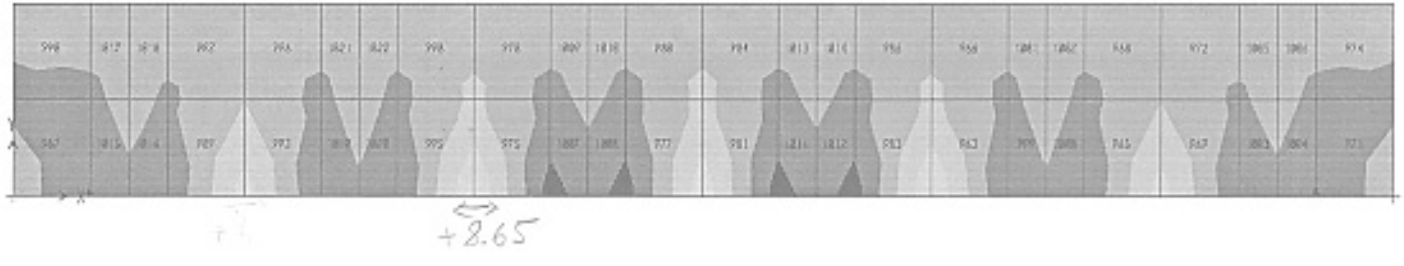


-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units

PRIMARY SEDIMENTATION TANK BOTTOM SLAB LEVEL +2.78

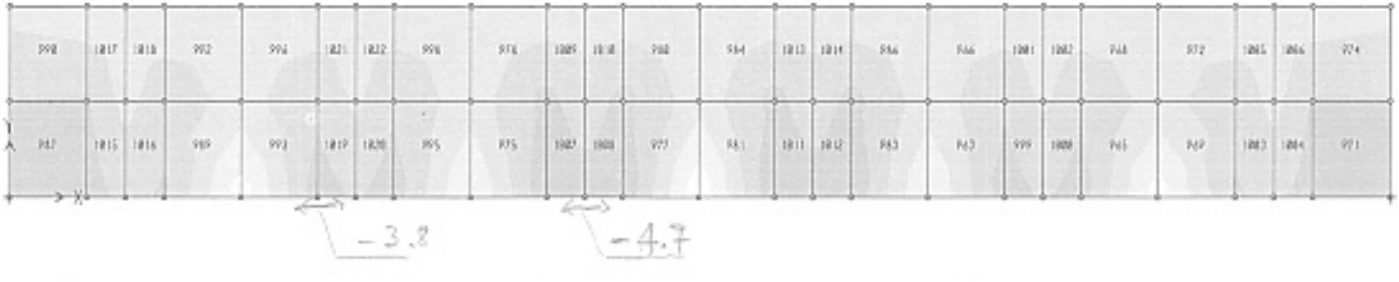
(ENVE COMBO MAX M11)



-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

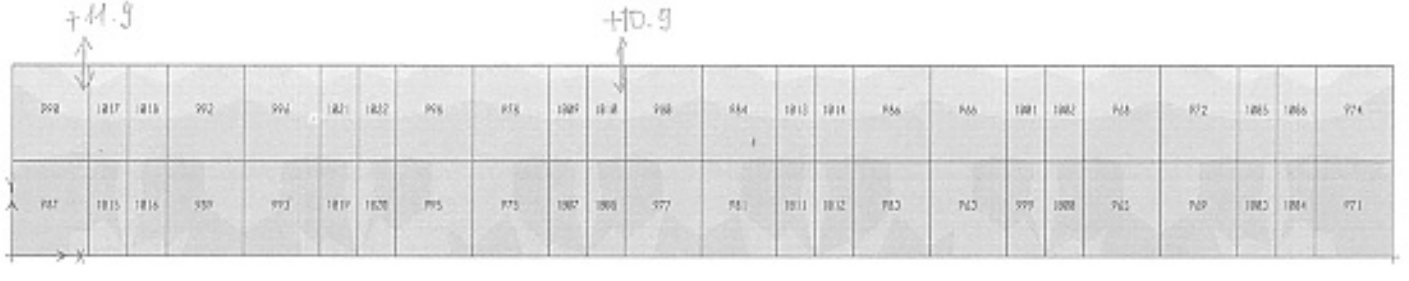
SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units

Primary sedimentation tank bottom slab level +2.78
(Envr combo min)



PRIMARY SEDIMENTATION TANK BOTTOM SLAB LEVEL +2.78

(ENVE COMBO MIN M_{11})

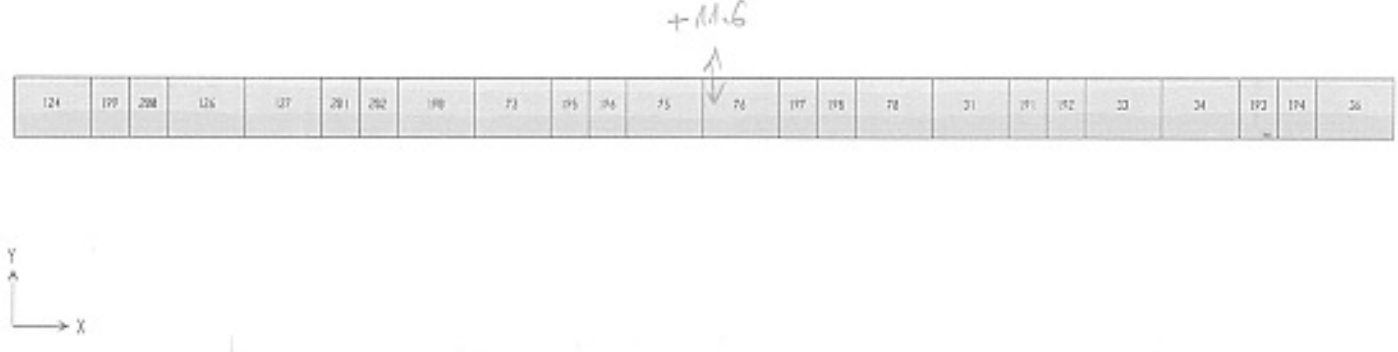


PRIMARY SEDIMENTATION TANK BOTTOM SLAB LEVEL +2.78

(ENVE COMBO MAX M_{22})

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

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

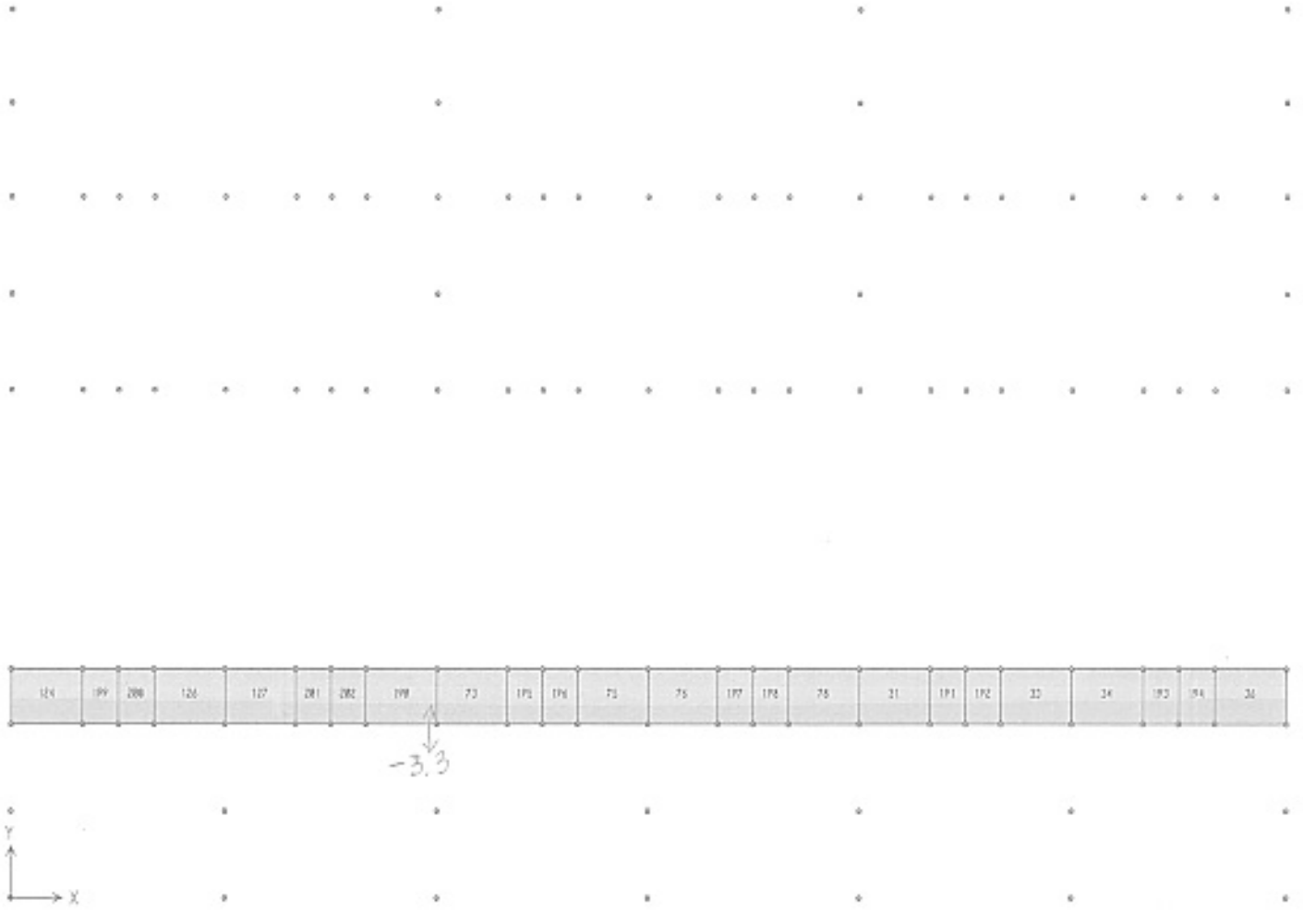


WATERWAY BOTTOM SLAB (LEVEL +5.2)

(ENVE COMBO MAX M_{22})

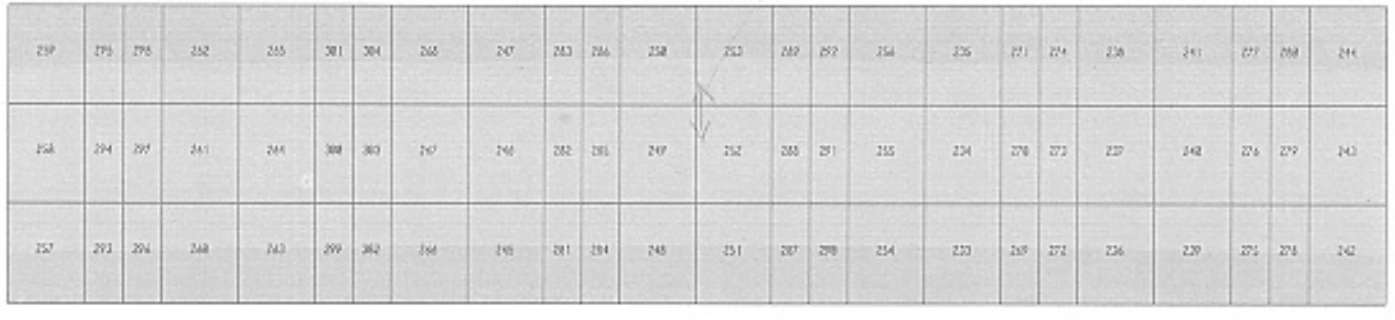
-13.5 -9.0 -4.5 0.0 4.5 9.0 13.5 18.0 22.5

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units



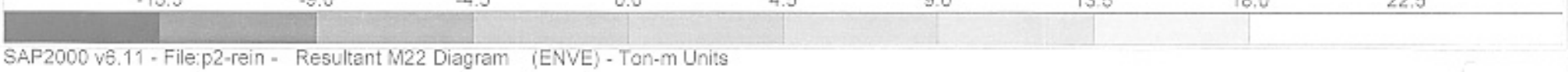
WATERWAY BOTTOM SLAB (LEVEL +5.2)

(ENVE COMBO MIN M_{11})



COVER SLAB (LEVEL +6.9)

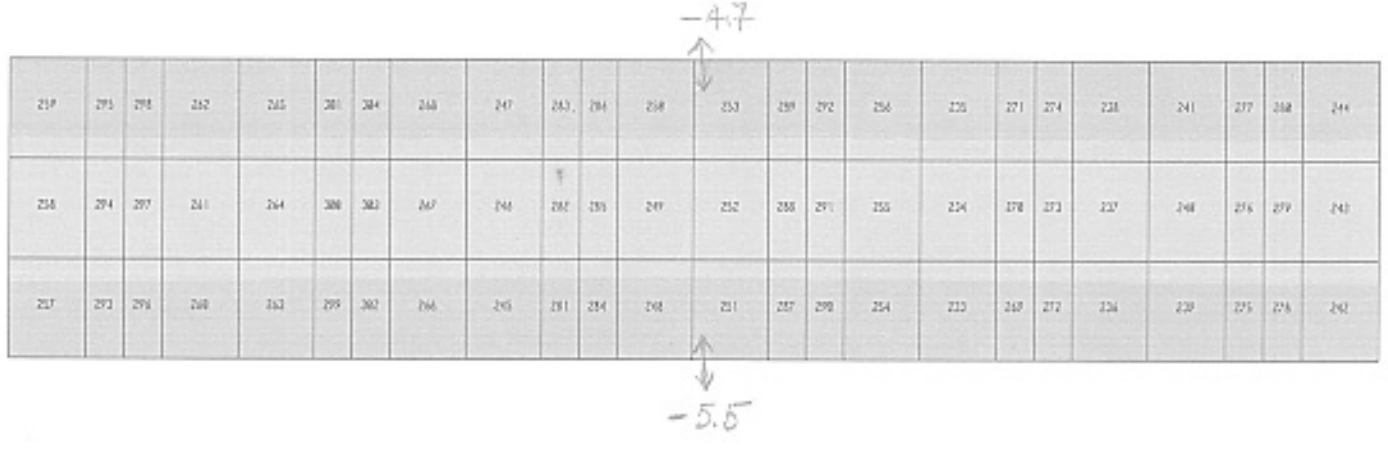
(ENVE COMBO MAX M_{22})

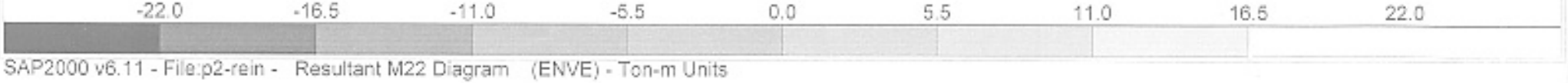


SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

COVER SLAB (LEVEL +6.9)

(ENVE COMBO MIN M_{22})

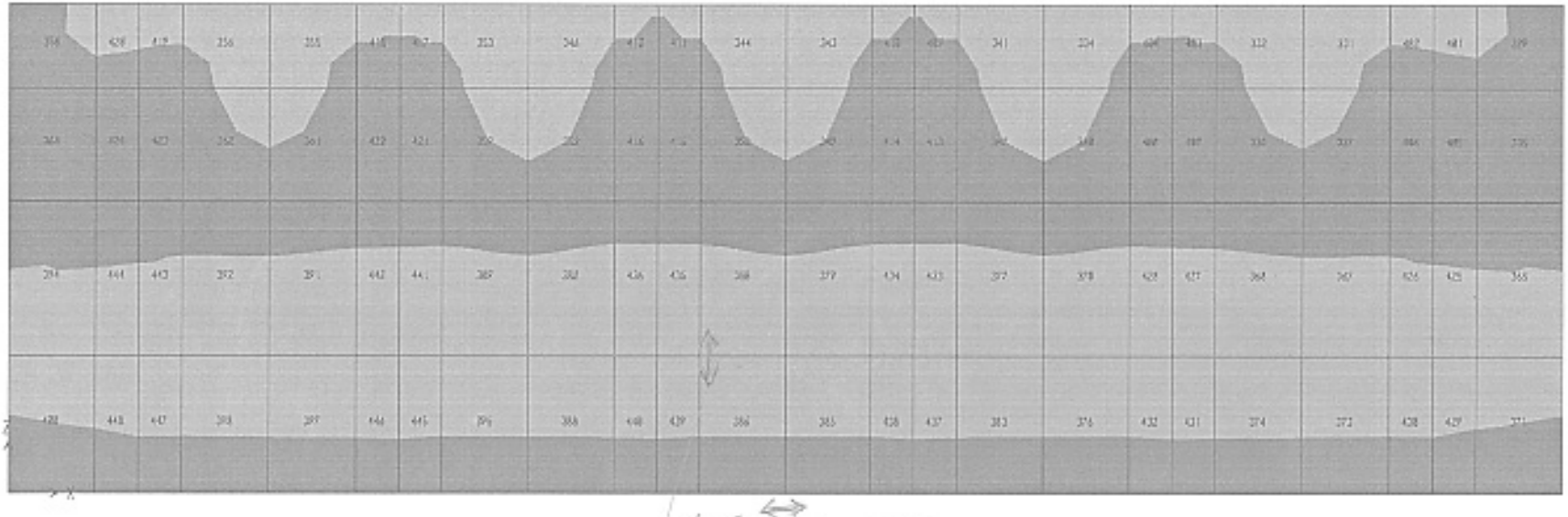




SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

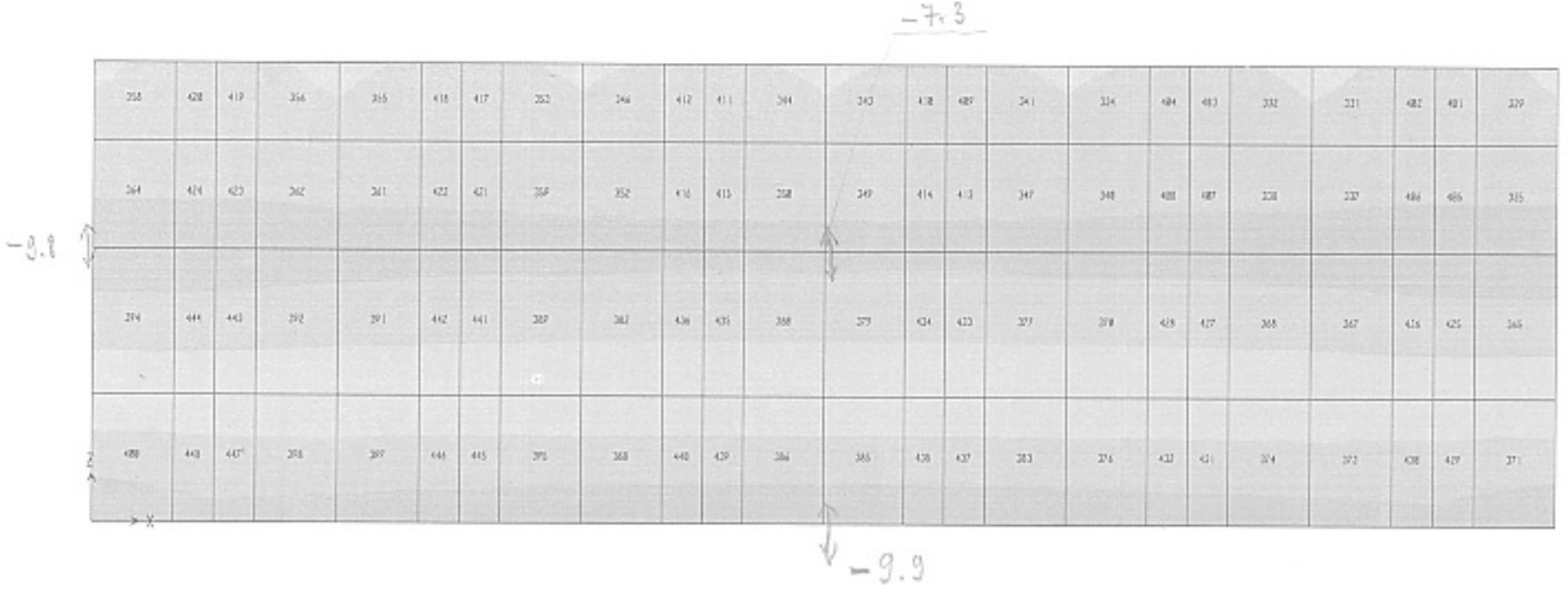
WALL OF PRIMARY SED. TANK & PIPE GALLERY AXIS 3 (Y= +4.5)

(ENVE COMBO MAX, MIN M_{11})



-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units

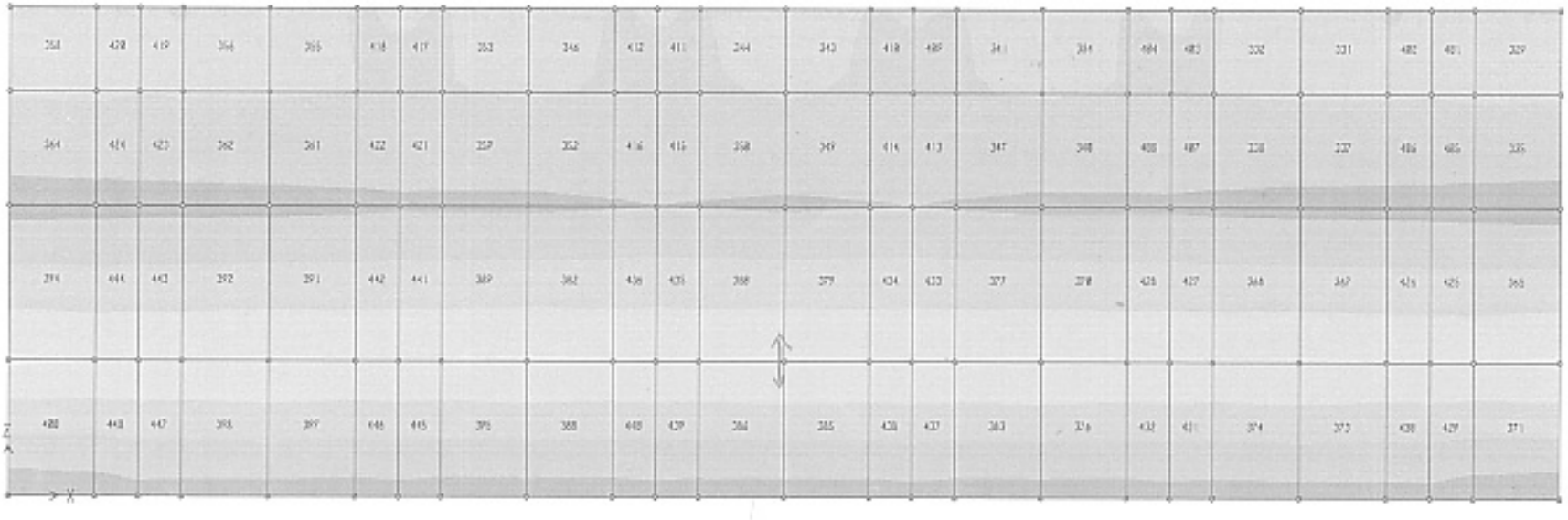


WALL OF PRIMARY SED. TANK & PIPE GALLERY AXIS 3 (Y= +4.5)

(ENVE COMBO MIN M_{22})

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

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units



+9.51

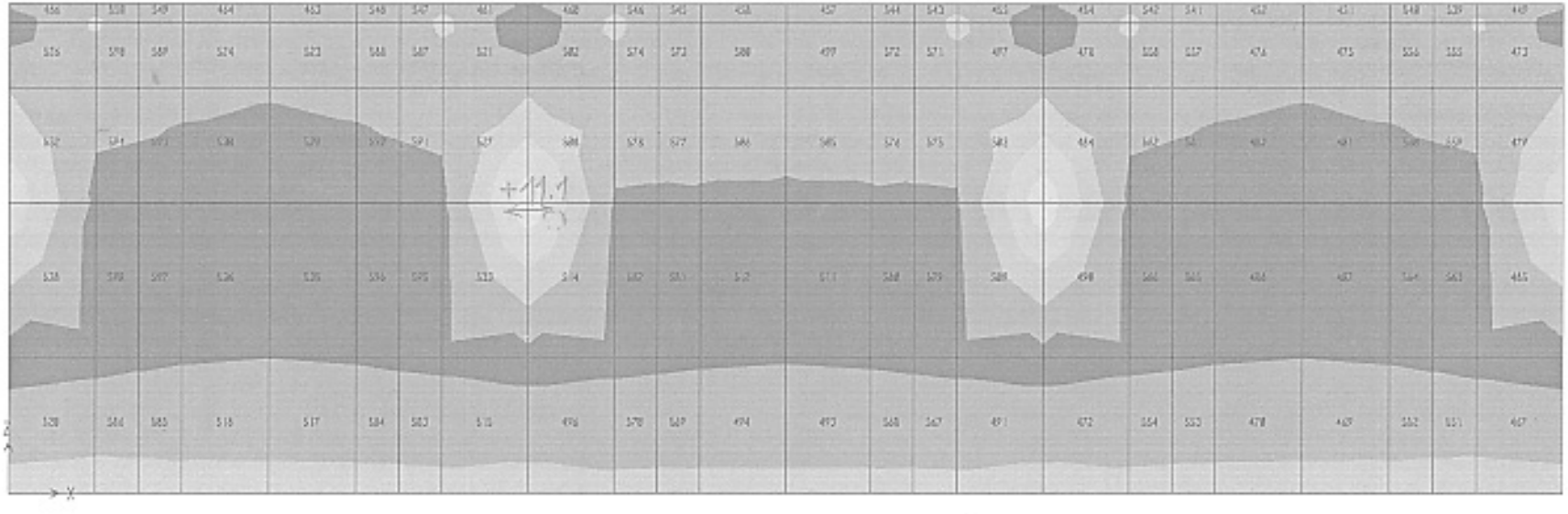
WALL OF PRIMARY SED. TANK & PIPE GALLERY AXIS 3 (Y= +4.5)

(ENVE COMBO MAX M22)

WATERWAY WALL

(ENVE COMBO MAX, MIN M_{22})

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

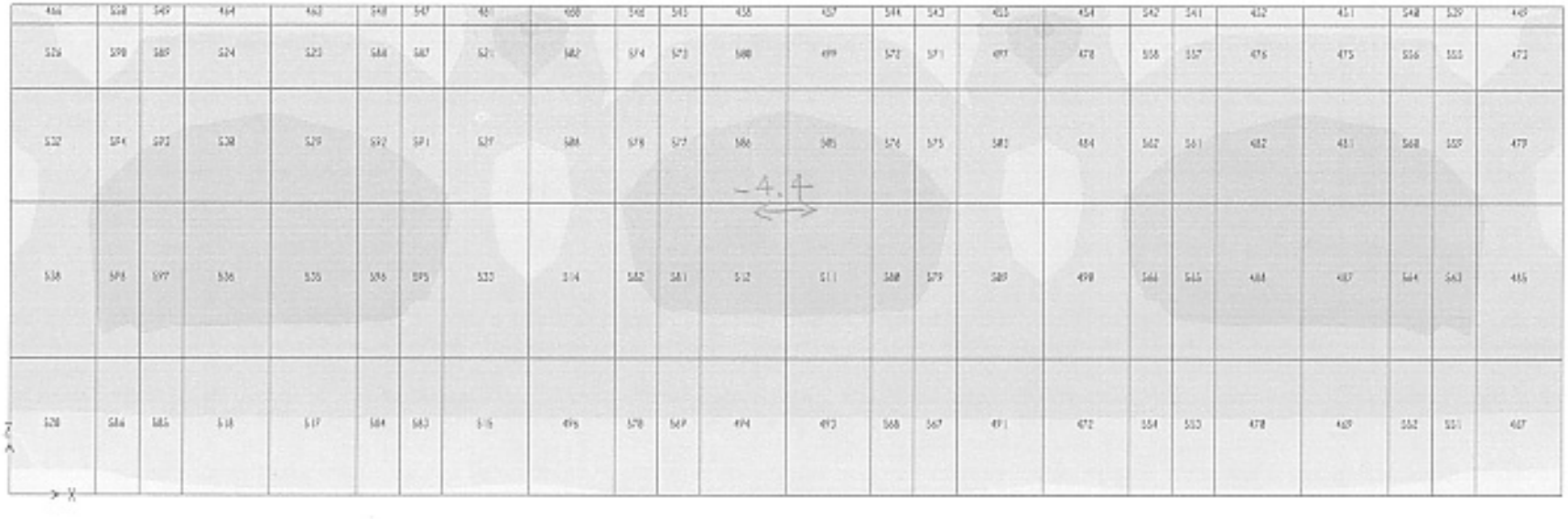


WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MAX M_{11})

-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units

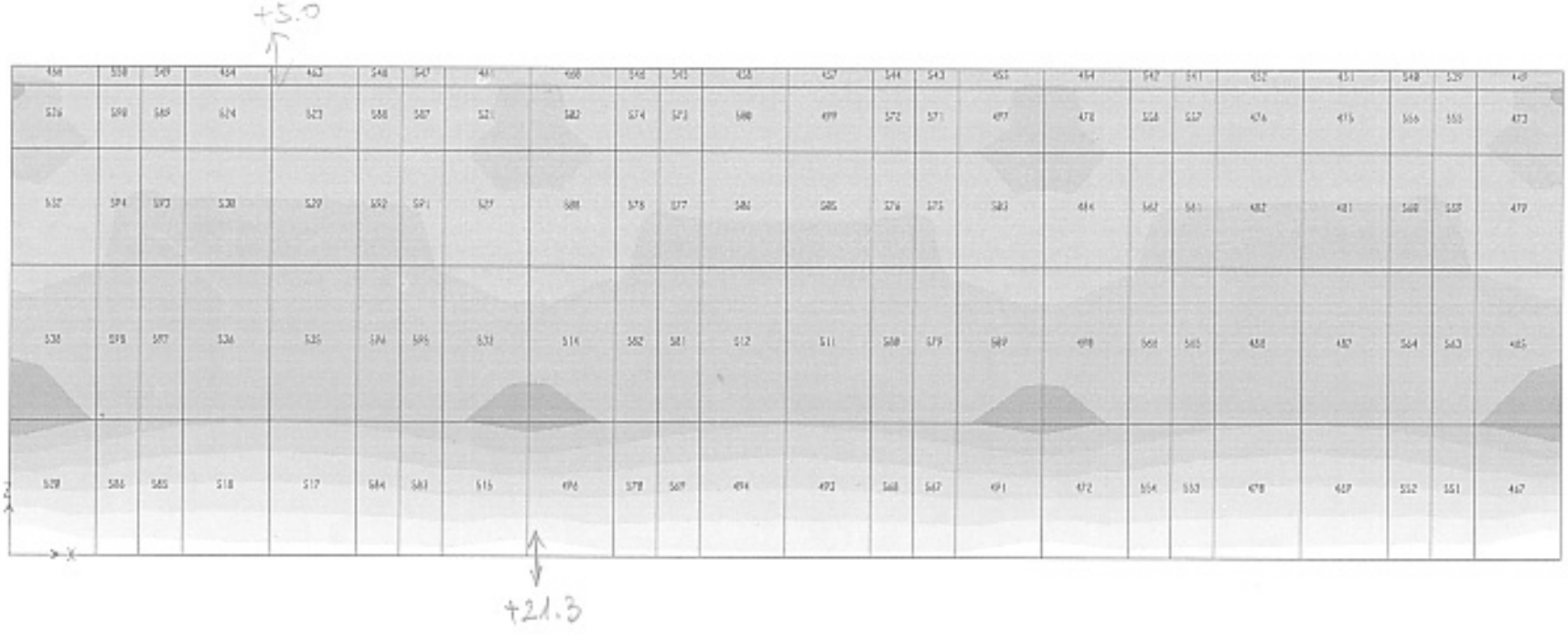


WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MIN M_{11})

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

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units



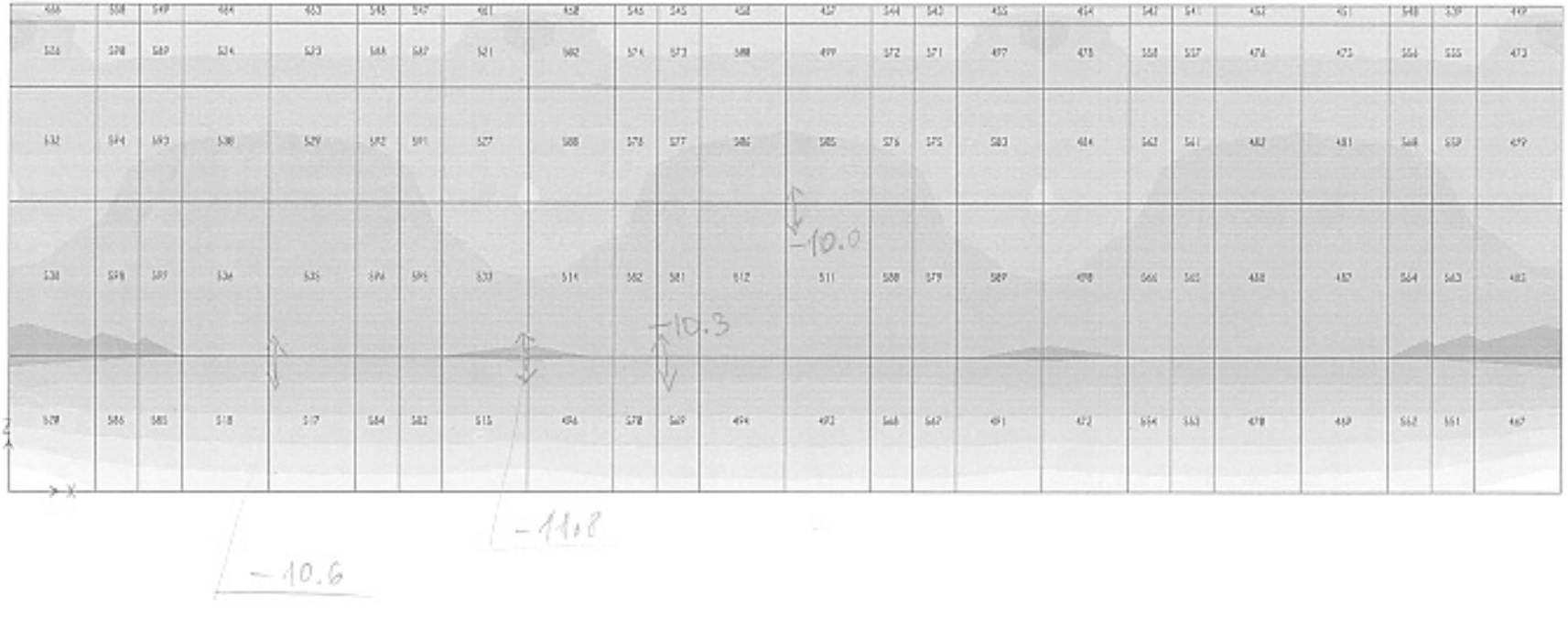
WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MAX M22)

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

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

7.1.92

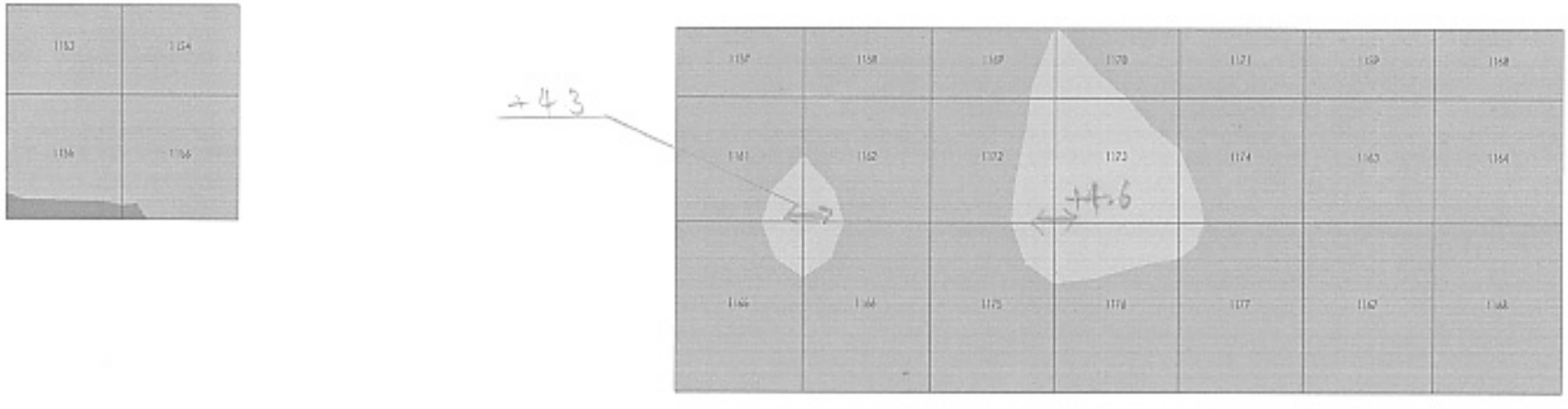


WALL OF PIPE GALLERY AND AERATION TANK(Y=+13)

(ENVE COMBO MIN M_{22})

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

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

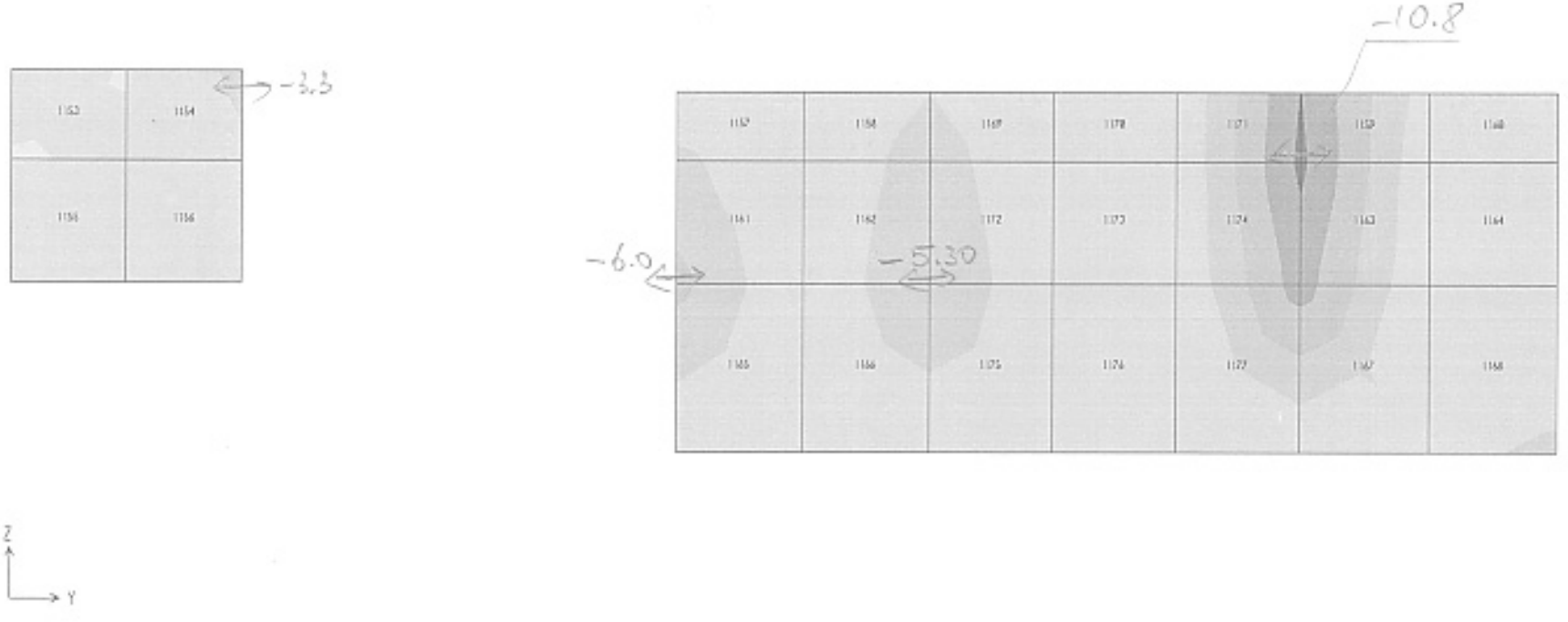


LONGITUDINAL WALL OF PRIMARY SED. TANK AND AERATION TANK X= +22

(ENVE COMBO MAX M_{11})

-3.0 0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units

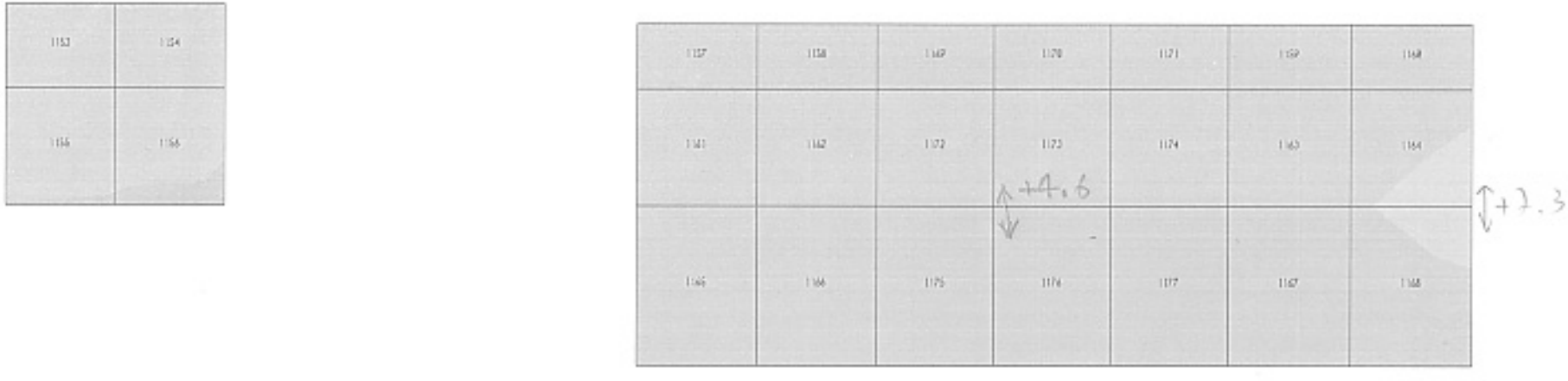


LONGITUDINAL WALL OF PRIMARY SED. TANK AND AERATION TANK X= +22

(ENVE COMBO MIN M_{11})

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

SAP2000 v6.11 - File:p2-rein - Resultant M11 Diagram (ENVE) - Ton-m Units



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

(ENVE COMBO MAX M_{22})

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

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

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

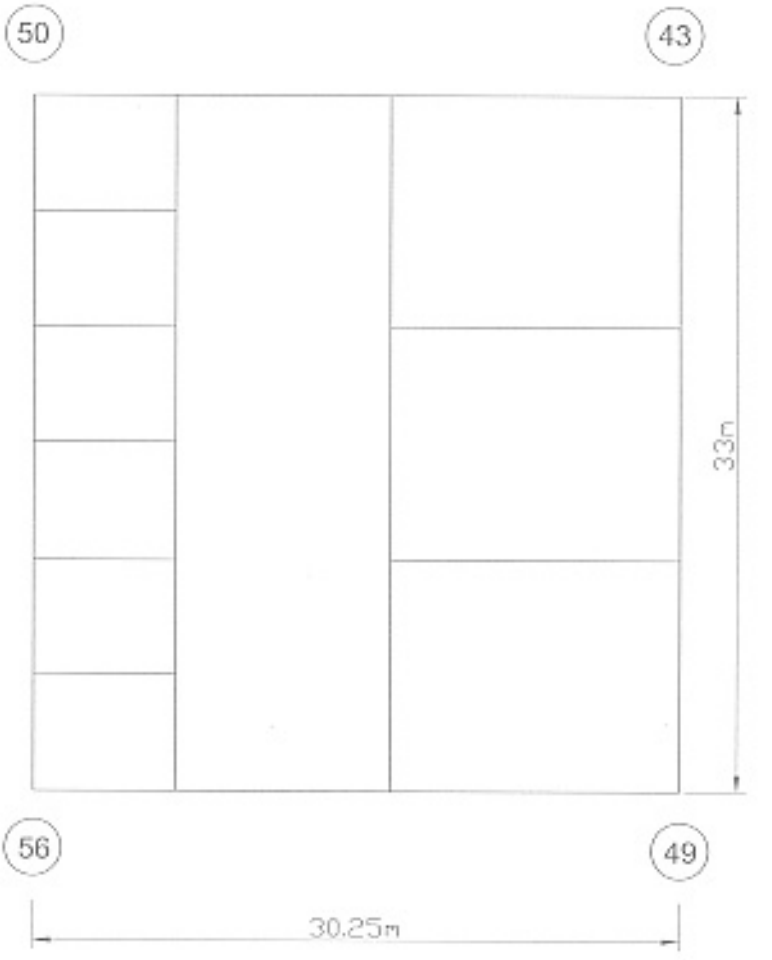
(ENVE COMBO MIN M_{22})

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

SAP2000 v6.11 - File:p2-rein - Resultant M22 Diagram (ENVE) - Ton-m Units

7-1-97

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 TREAMENT 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 CALCULATTION:

Concrete: C21,	Rn =	70	(Kg/cm2)
	RS=	3.6	(Kg/cm2)
Reinforcement type AII:	Ra=	1600	(Kg/cm2)

Back fill sand: γ_s= 1.80T/m3 ; Coeficient 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}=0.8x2.15x0.5 +2.15x1 = 3.01T/m2

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

p_{h1}=0.8x3.8x0.5 + 3.8x1 = 5.32T/m2

-Uplift pressure to bottom of pipegallery:

$p_{uplift}=(H_{ground\ water})x1.0=$ 3.70T/m2

-Uplift pressure to bottom of aeration tank:

$p_{uplift}=(H_{ground\ water})x1.0=$ 2.5T/m2

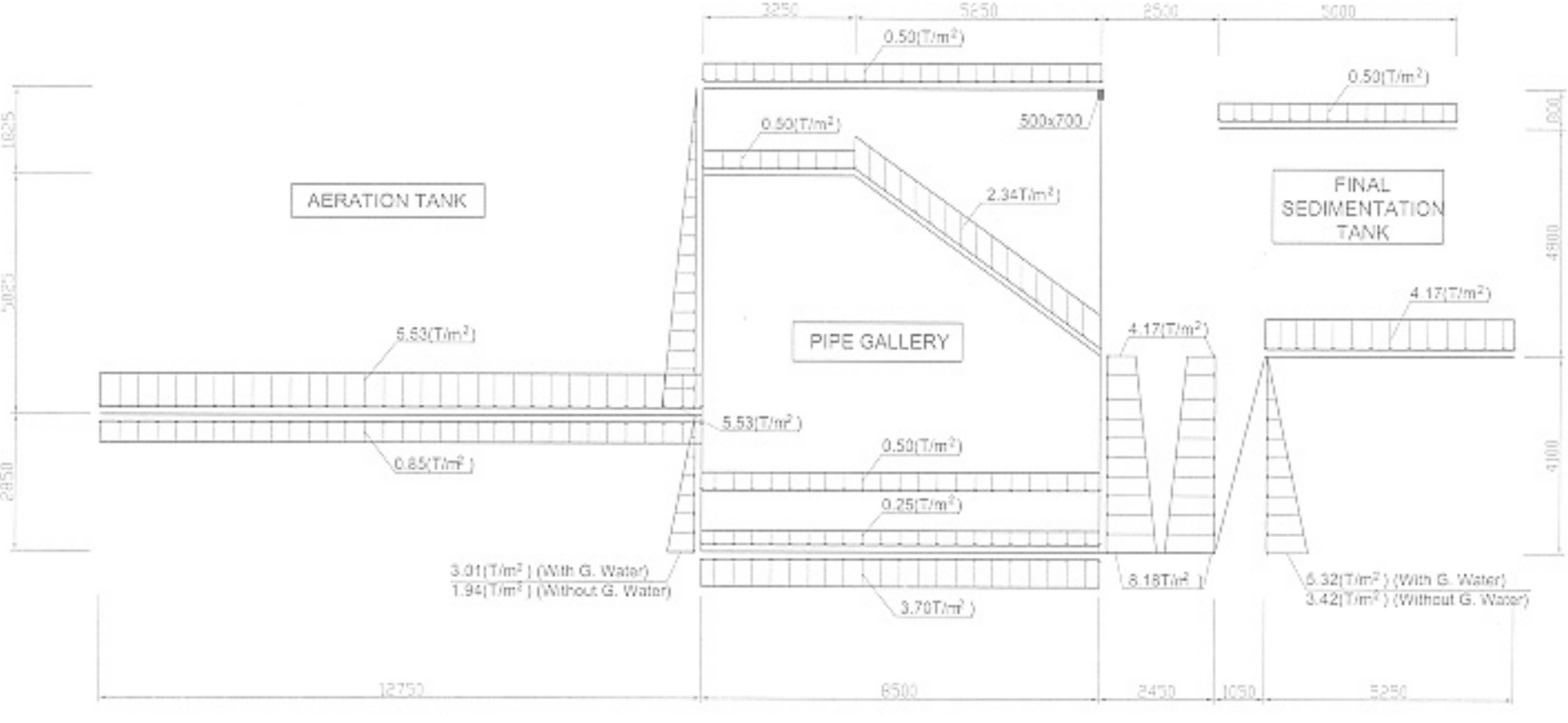
3.3-Water load

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

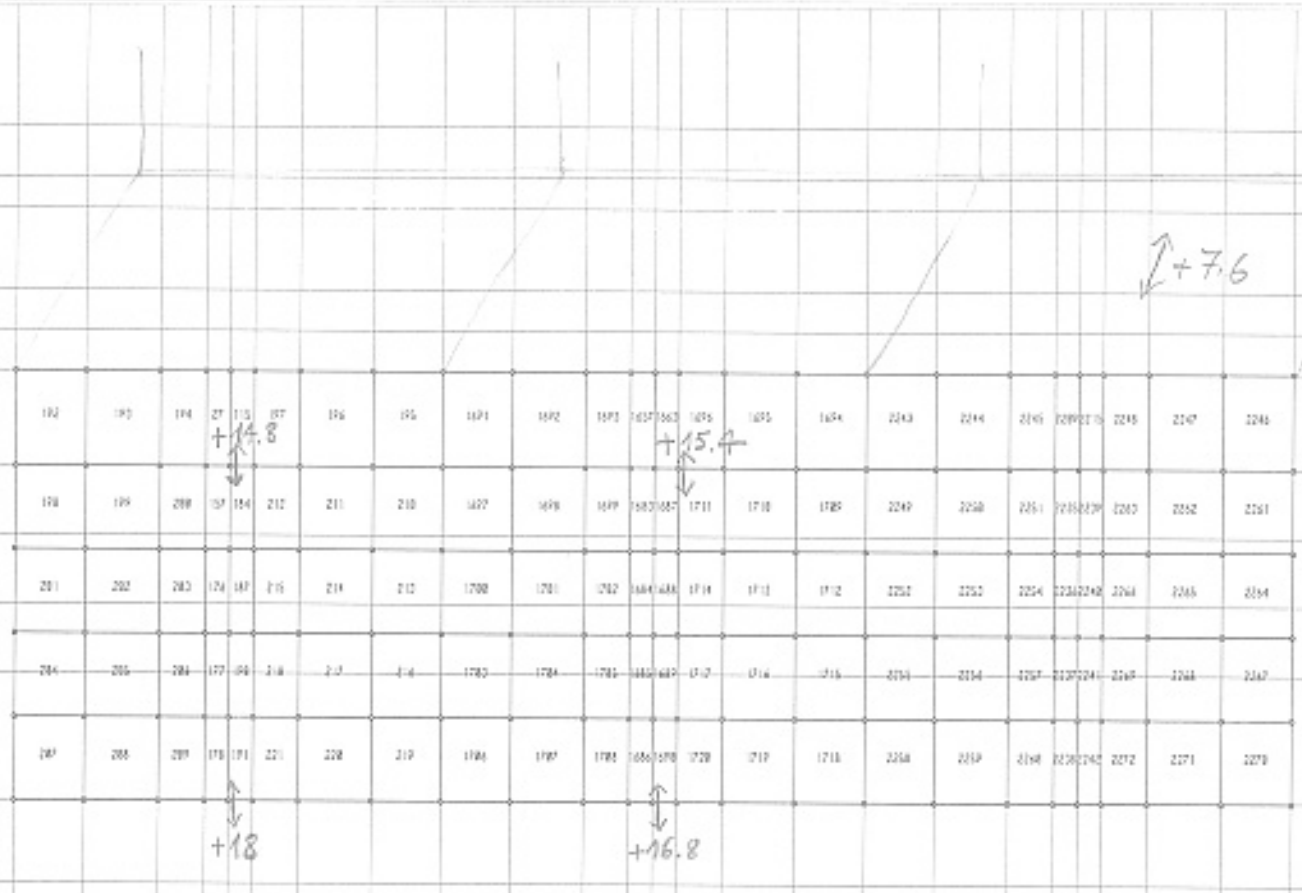
3.4-Load of non-reinforced concrete layer on bottom slab:

(Due to mechanical supports and cinder concrete)

AERATION TANK - PIPE GALLERY - FINAL SEDIMENTATION TANK



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



PILE GALLERY BOTTOM SLAB LEVEL -3.10

(ENVE COMBO MAX M_{22})

-Uniform load: $q_{con.layer}$ 2.5x0.10= 0.25T/m2

3.5-Live load:

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

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

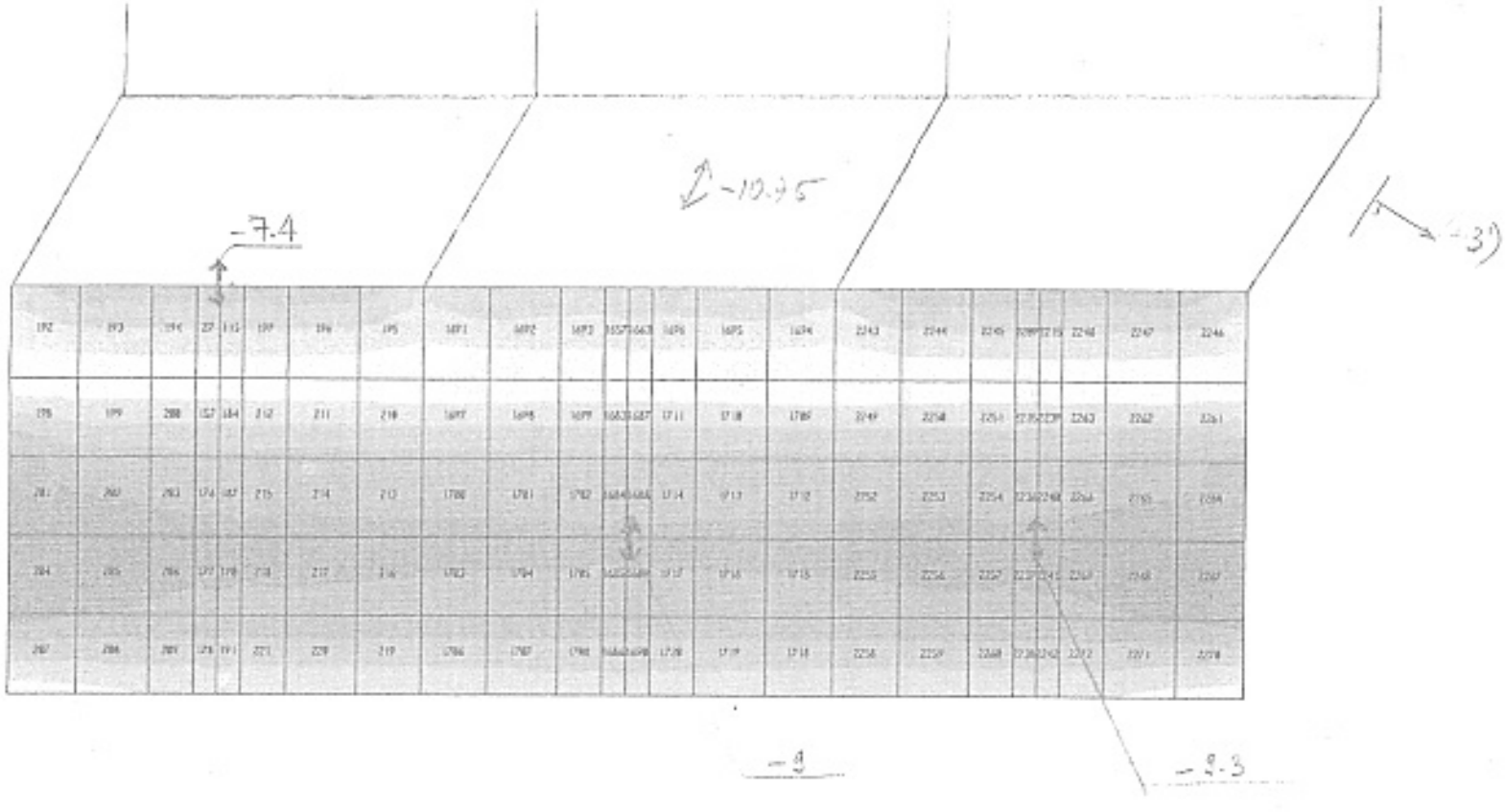
5-1 SLABS AND WALLS:

Moments	Values (T.m)	Ao	γ	Fa (cm^2)	Bar arrangement		Remarks
					ϕ(mm)	a(mm)	
(Bottom	18.000	0.1116	0.941	24.92	20	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	20@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	125
	-10.750	0.0547	0.972	13.04	16	125	
Aeration	12.800	0.0794	0.959	17.39	18	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	125
0.6	16.300	0.1011	0.947	22.42	20	125	*Not in Dwg*
Final sed.	17.800	0.1104	0.941	24.62	20	125	
tank bottom	16.600	0.1029	0.946	22.86	20	125	*Not in Dwg*
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	
of water way	-9.300	0.0920	0.952	16.07	16	125	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	@125
Cover slab	-3.400	0.2159	0.877	16.16	18	125	
of final sed.	1.400	0.0889	0.953	6.12	14	250	
tank lv +5.9							
0.2							
Cover slab	-3.500	0.2222	0.873	16.71	12	50	*Beam*
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	
Aeration Tank	-7.400	0.0572	0.971	11.08	22	250	
& pipe ga.	-5.800	0.0448	0.977	8.63	14	150	@125
0.5	12.300	0.0950	0.950	18.82	16	100	*Wall*

	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	a125
& pipe ga.	-5.400	0.0417	0.979	8.02	14	150	a125
0.5	2.900	0.0224	0.989	4.26	14	250	
	-4.300	0.0332	0.983	6.36	12	150	a125
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	a125
	3.100	0.0240	0.988	4.56	14	250	
	1.800	0.0139	0.993	2.63	12	250	

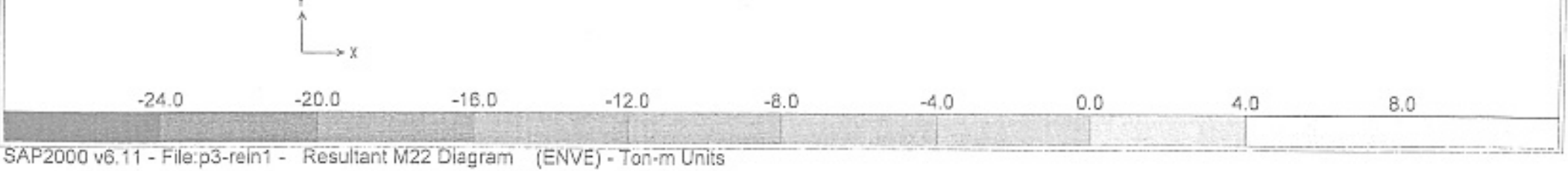
6- CALCULATION FOR PILE NUMBER (as attached sheets):

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

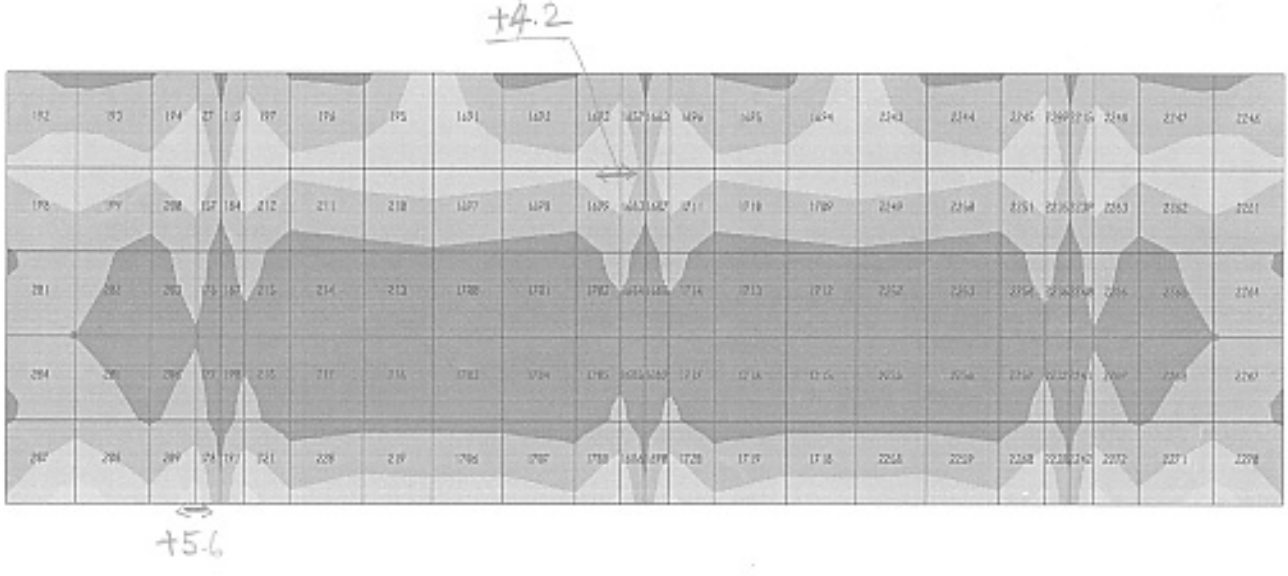


PIPE GALLERY BOTTOM SLAB LEVEL -3.10

(ENVE COMBO MIN M_{22})



SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units



PIPE GALLERY BOTTOM SLAB LEVEL -3.10

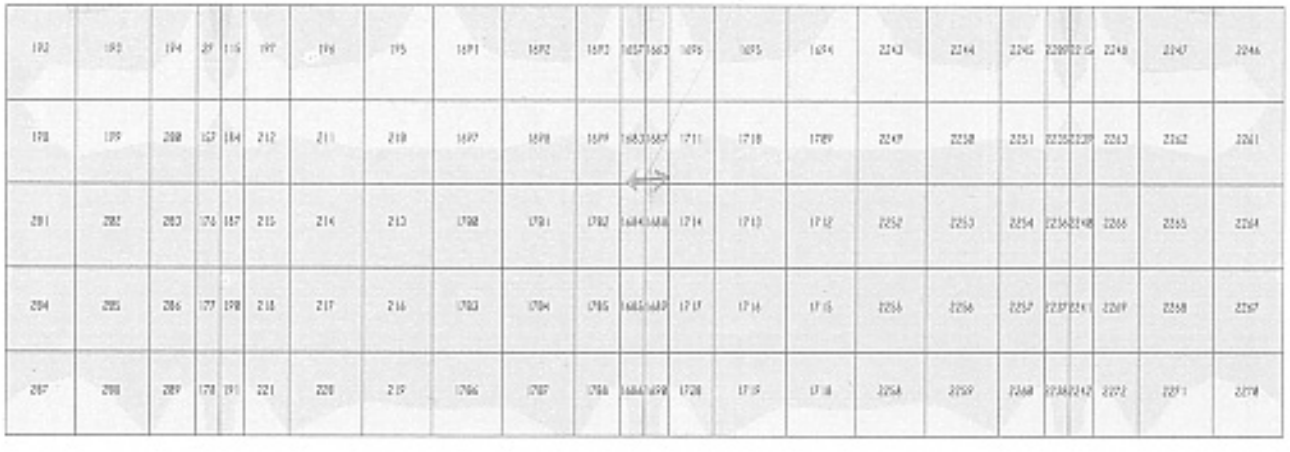
(ENVE COMBO MAX M_{11})

Y
X

-2.2 0.0 2.2 4.4 6.6 8.8 11.0 13.2 15.4

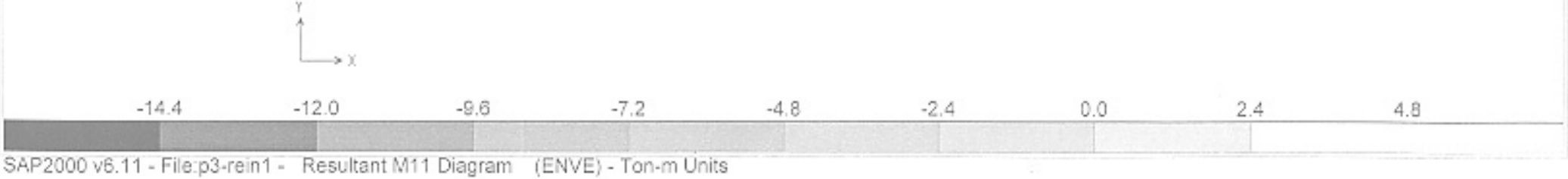
SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

-2.4



PIPE GALLERY BOTTOM SLAB LEVEL -3.10

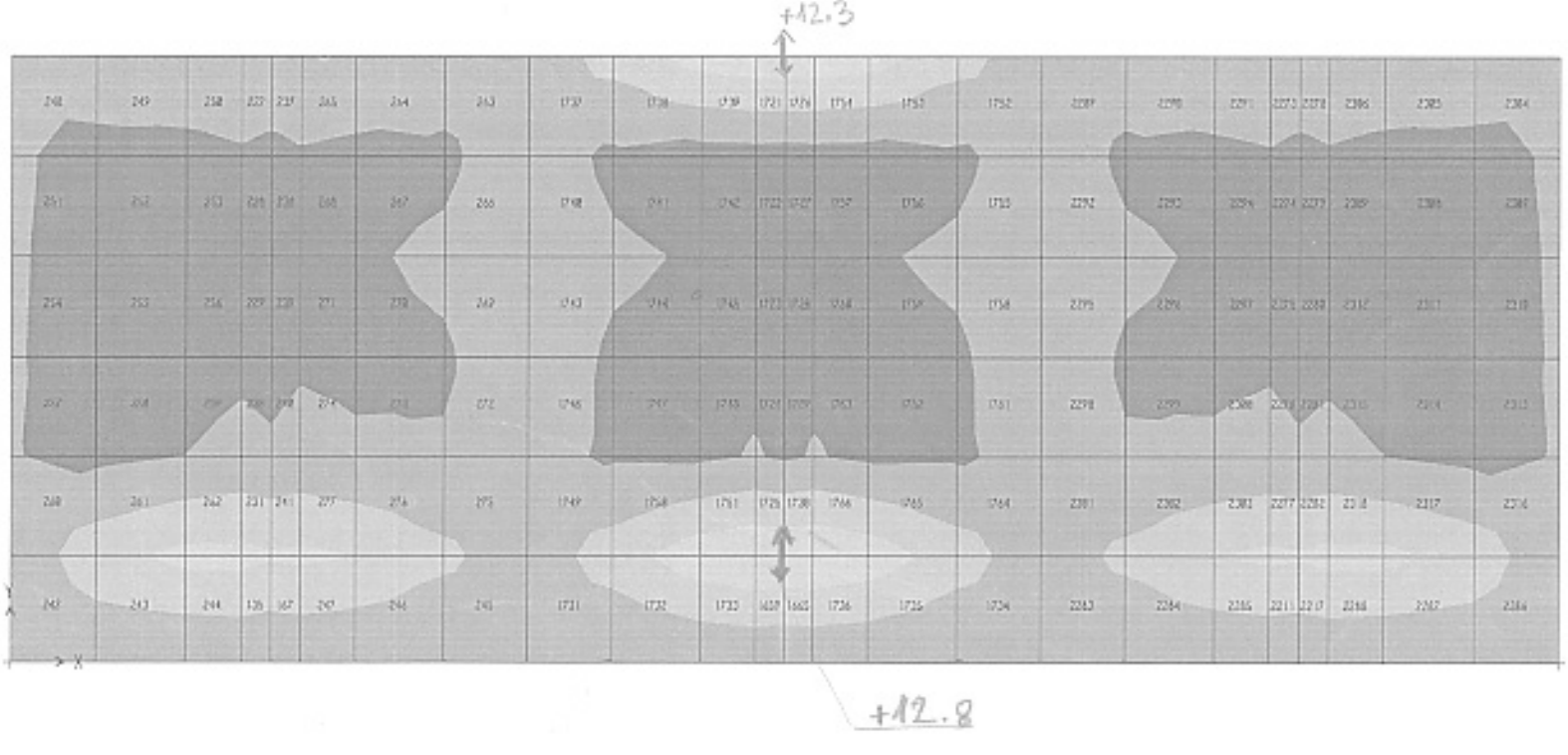
(ENVE COMBO MIN M_{11})



SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.25

(ENVE COMBO MAX M22)

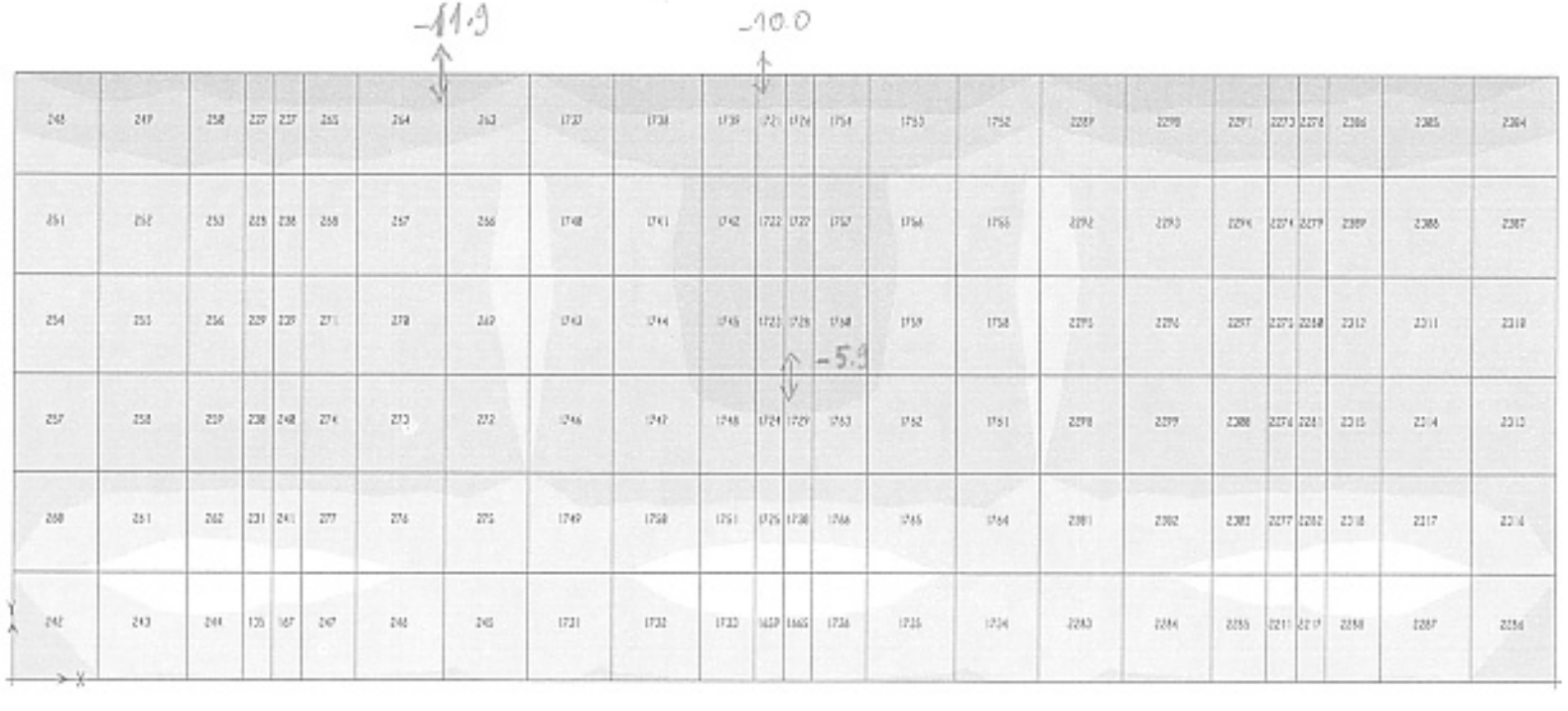


-4.5 0.0 4.5 9.0 13.5 18.0 22.5 27.0 31.5

SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.25

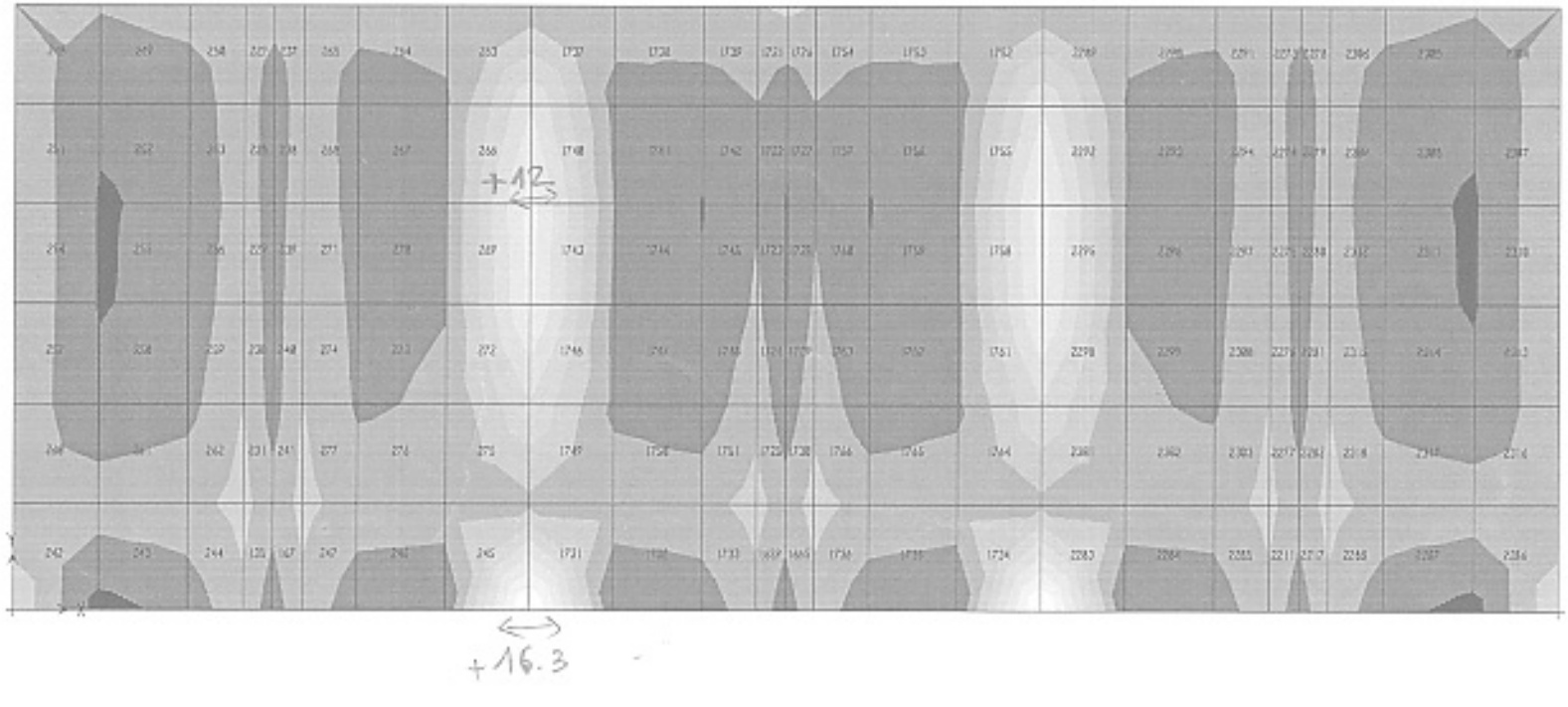
(ENVE COMBO MIN M22)



SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

AERATION TANK BOTTOM SLAB LEVEL -0.25

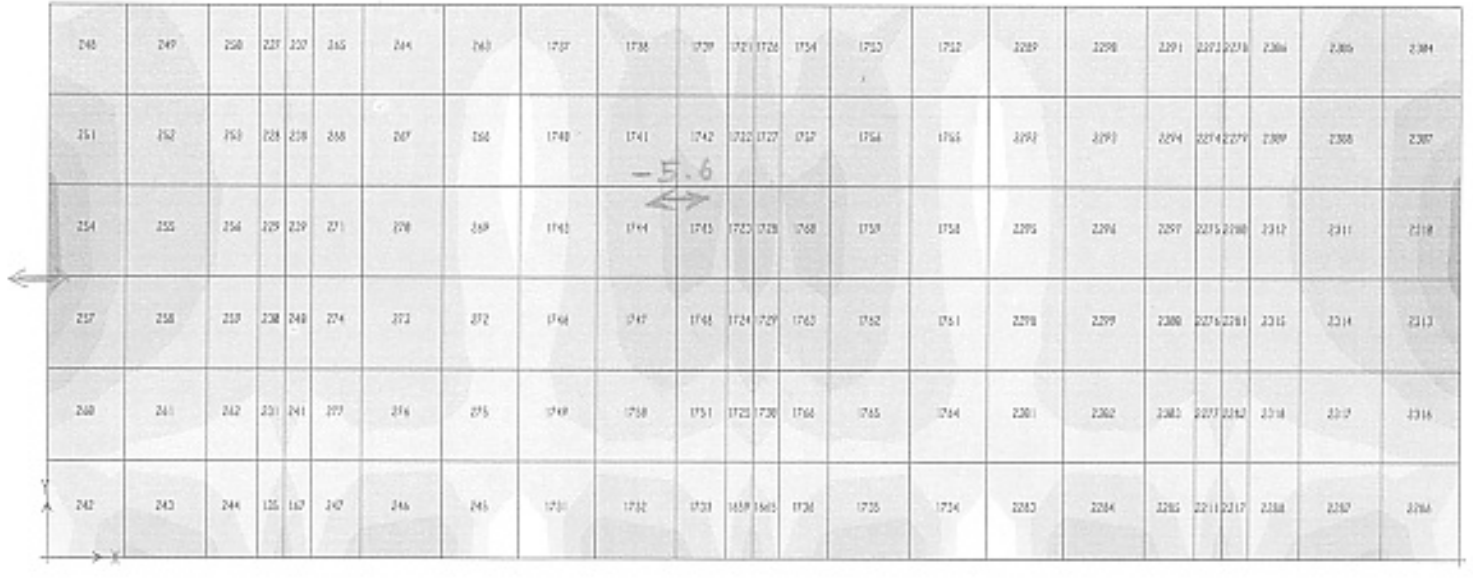
(ENVE COMBO MAX M_{11})



SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

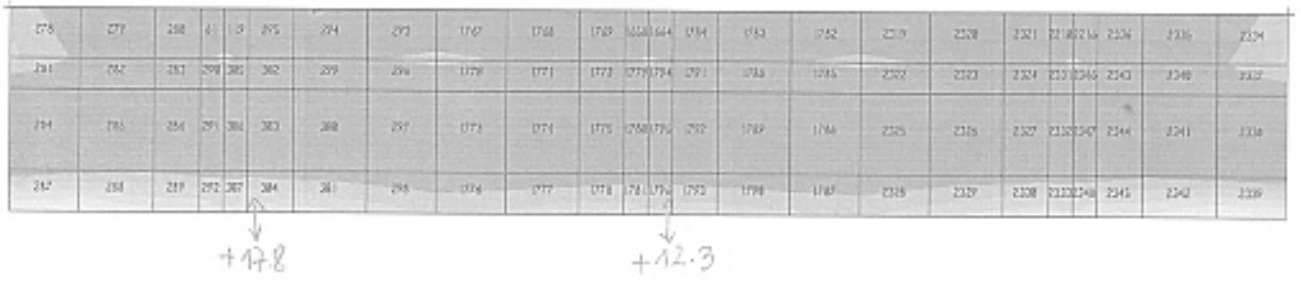
AERATION TANK BOTTOM SLAB LEVEL -0.25

(ENVE COMBO MIN M_{11})



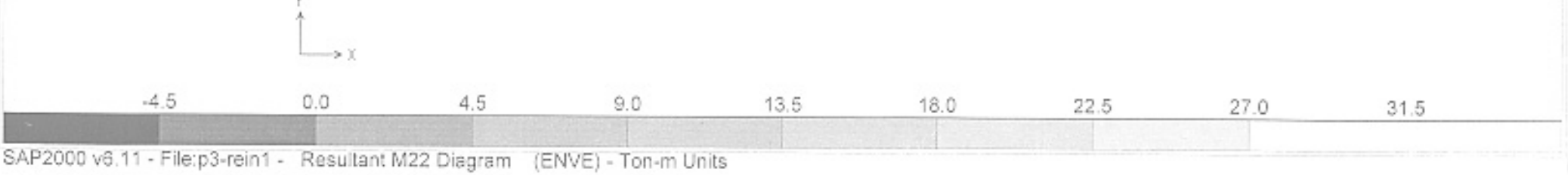
-14.4 -12.0 -9.6 -7.2 -4.8 -2.4 0.0 2.4 4.8

SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

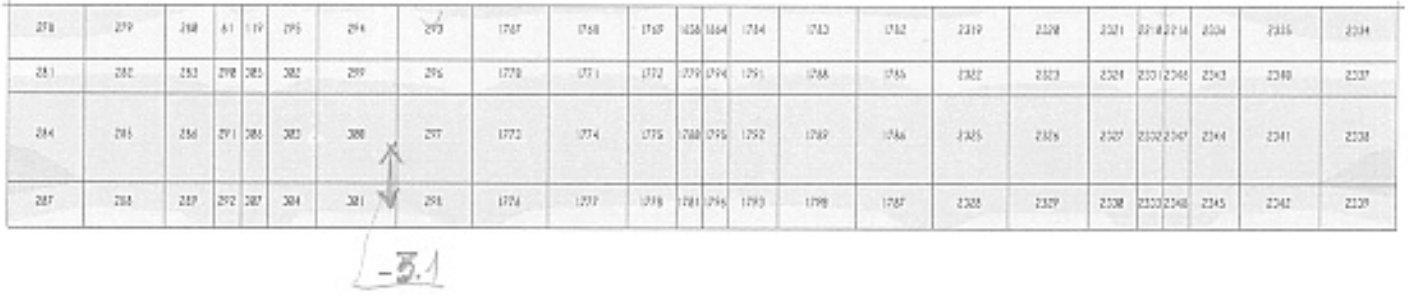


FINAL SED. TANK BOTTOM SLAB LEVEL +1.01

(ENVE COMBO MAX M_{22})

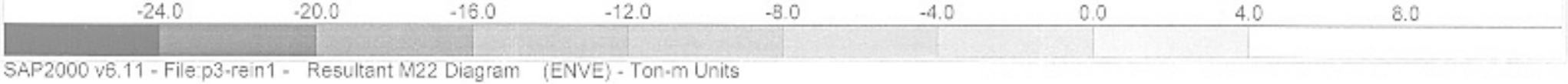


SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

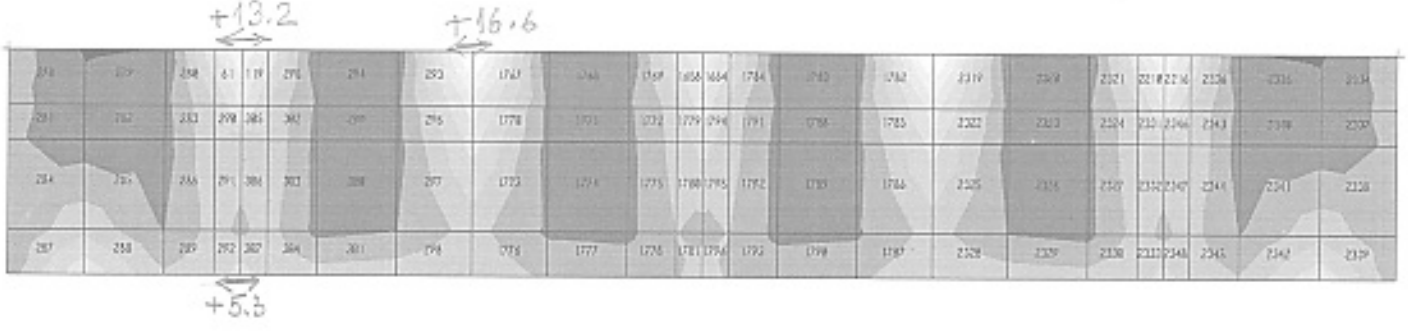


FINAL SED. TANK BOTTOM SLAB LEVEL +1.01

(ENVE COMBO MIN M_{22})



SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

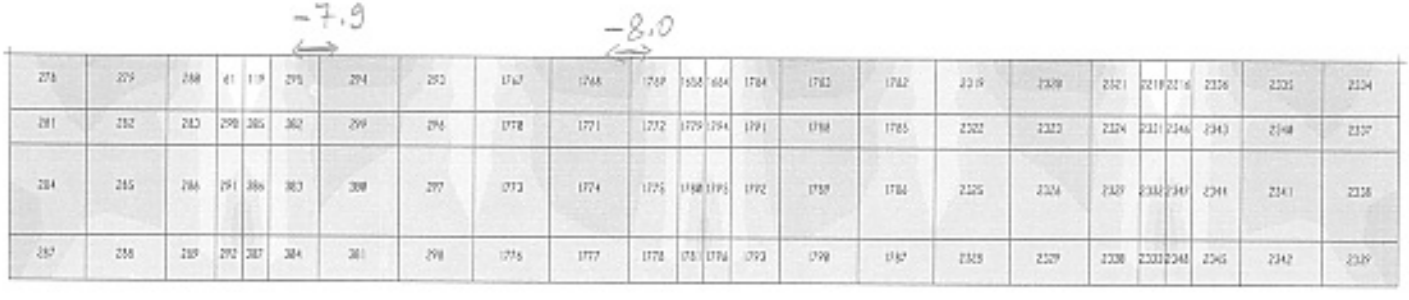


FINAL SED. TANK BOTTOM SLAB LEVEL +1.01

(ENVE COMBO MAX M_{11})

-2.2 0.0 2.2 4.4 6.6 8.8 11.0 13.2 15.4

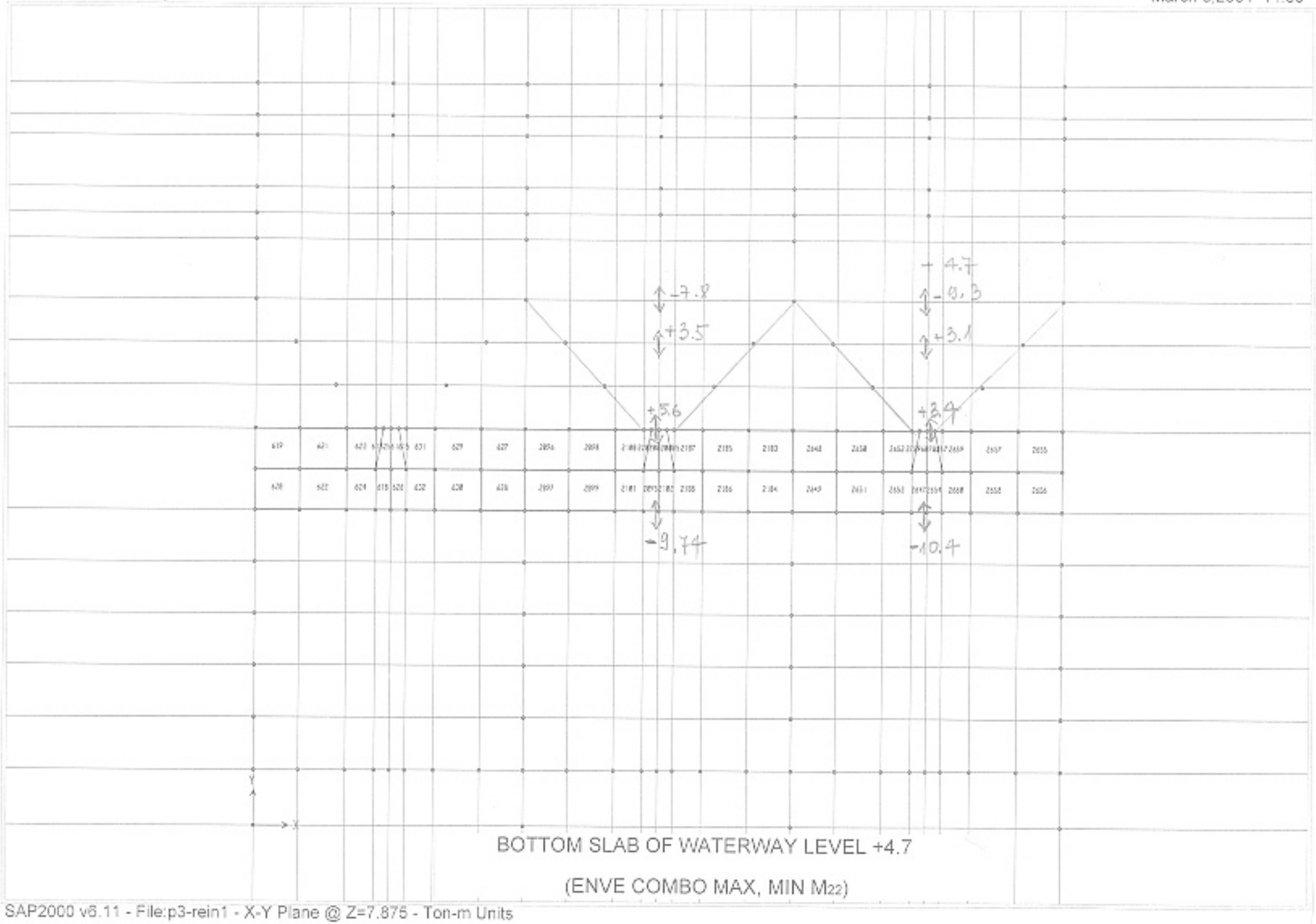
SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units



FINAL SED. TANK BOTTOM SLAB LEVEL +1.01

(ENVE COMBO MIN M_{11})

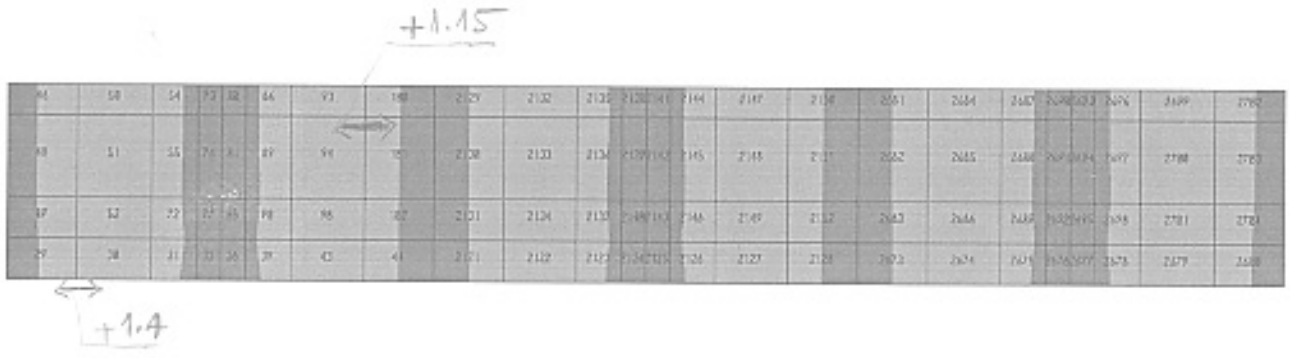
SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units



BOTTOM SLAB OF WATERWAY LEVEL +4.7

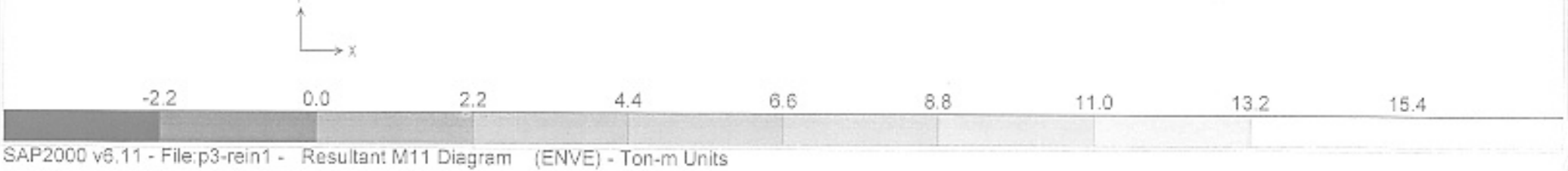
(ENVE COMBO MAX, MIN M_{22})

SAP2000 v6.11 - File:p3-rein1 - X-Y Plane @ Z=7.875 - Ton-m Units



COVER SLAB OF FINAL SED. TANK LEVEL +5.9

(ENVE COMBO MAX M_{11})

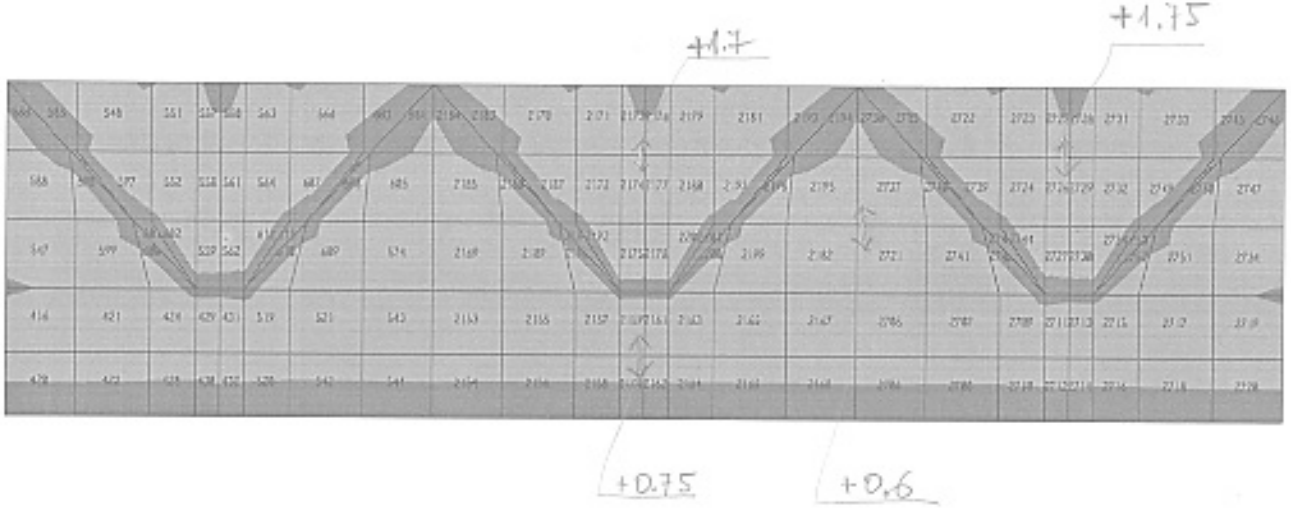


SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

COVER SLAB OF FINAL SED. TANK LEVEL +5.9

(ENVE COMBO MIN M_{11})

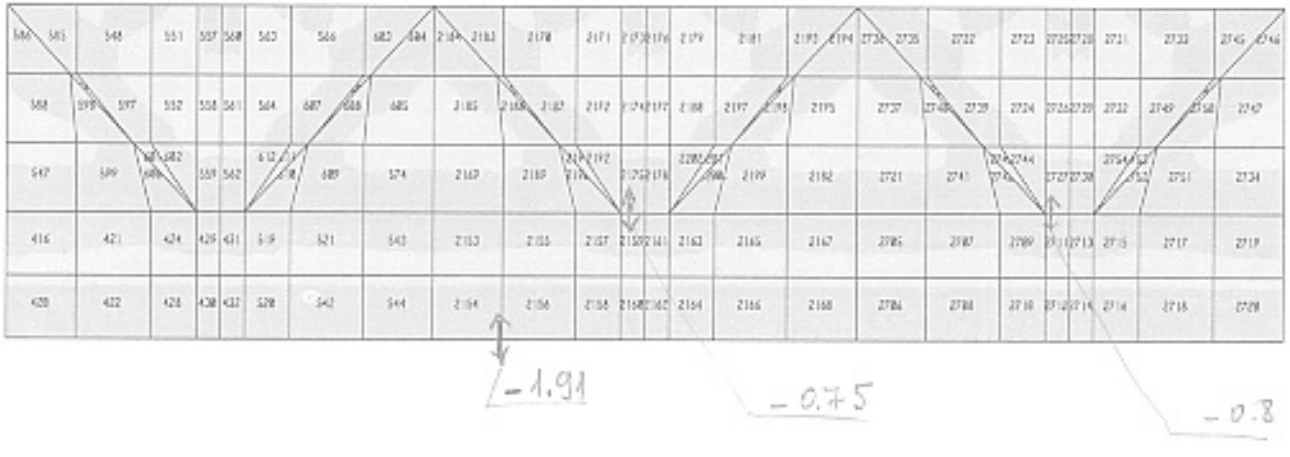
SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units



COVER SLAB OF FINAL SED. TANK LEVEL +6.4

(ENVE COMBO MAX M_{22})

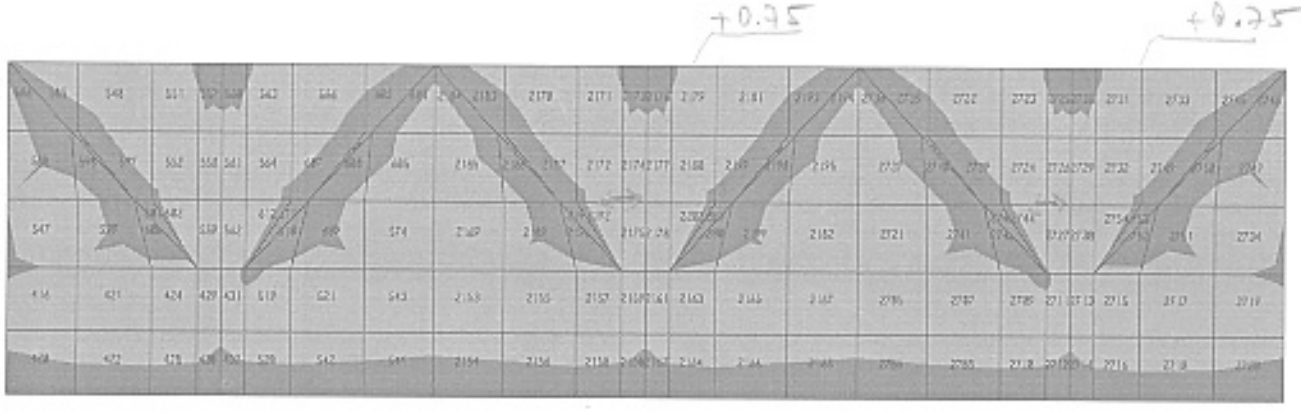
SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units



COVER SLAB OF FINAL SED. TANK LEVEL +6.4

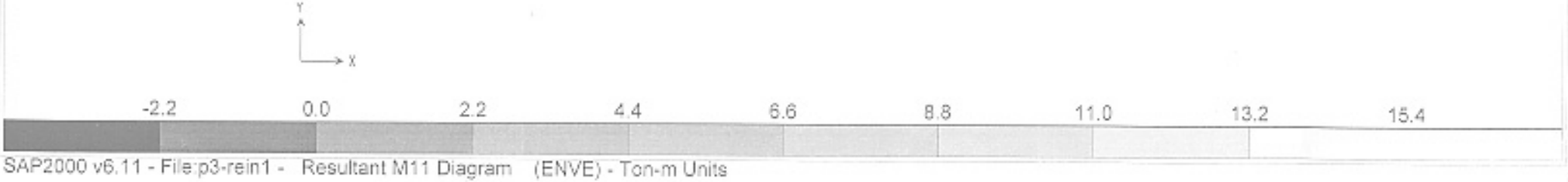
(ENVE COMBO MIN M_{22})

SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units



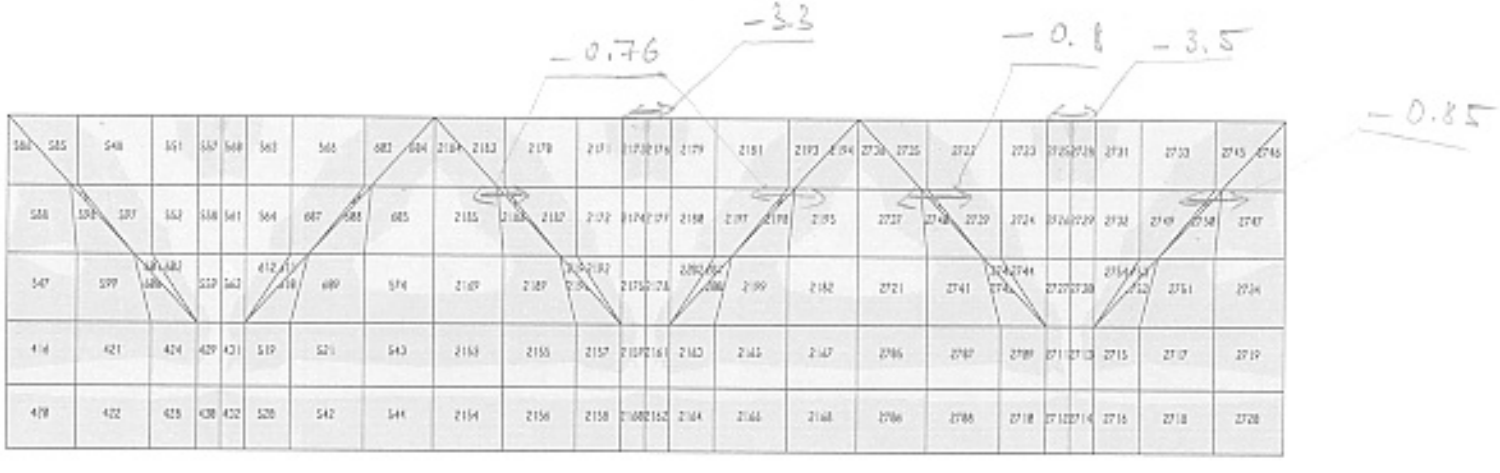
COVER SLAB OF FINAL SED. TANK LEVEL +6.4

(ENVE COMBO MAX M_{11})



SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

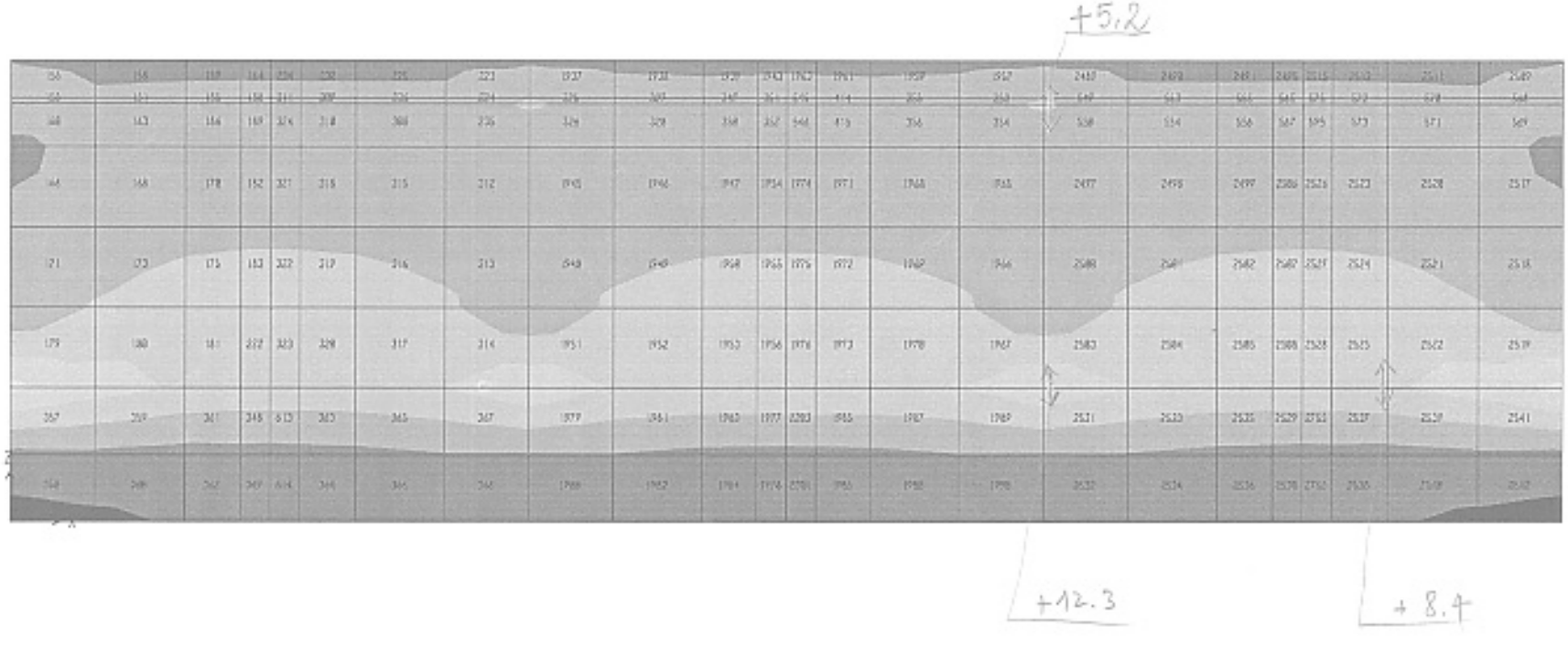
COVER SLAB OF PIPE GALLERY LEVEL +6.4
(ENVE COMBO Min M_{11})



COVER SLAB OF FINAL SED. TANK LEVEL +6.4

(ENVE COMBO MIN M_{11})

SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

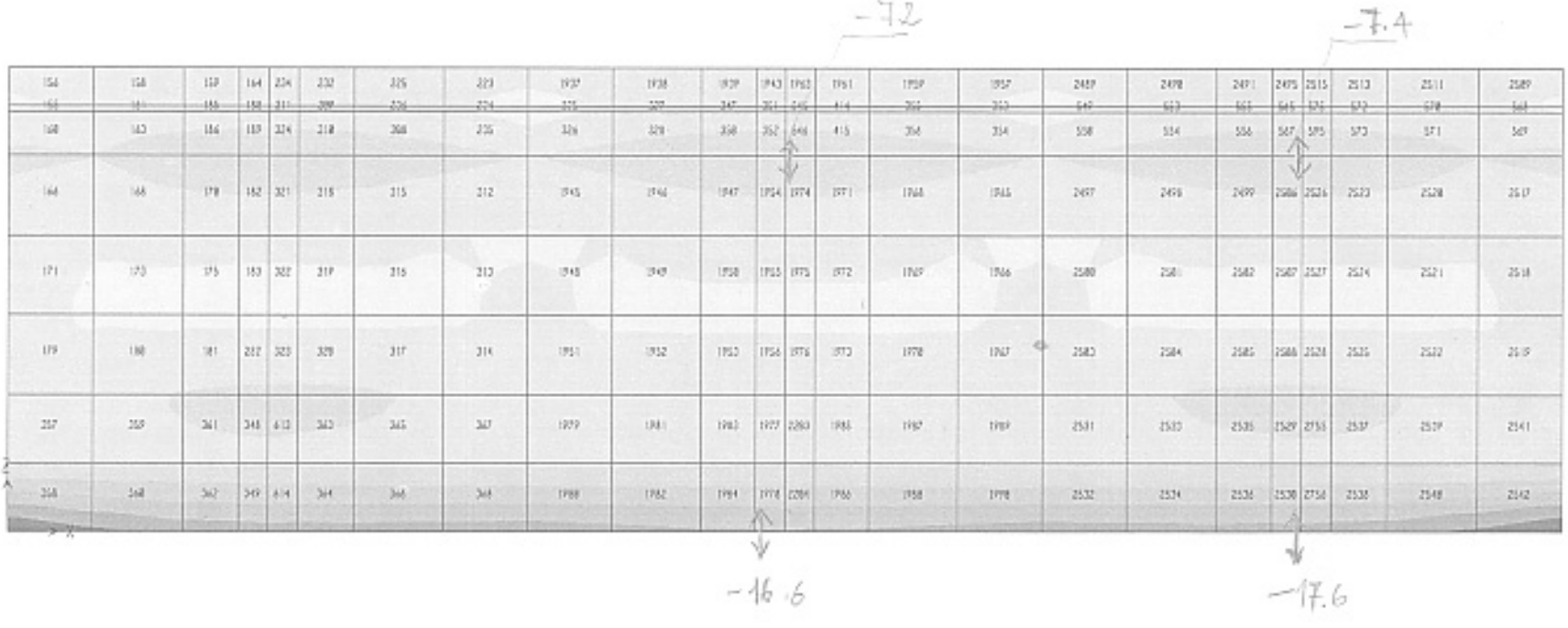


WALL OF AERATION TANK AND PIPE GALLERY Y =+12.75

(ENVE COMBO MAX M_{22})

-4.5 0.0 4.5 9.0 13.5 18.0 22.5 27.0 31.5

SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

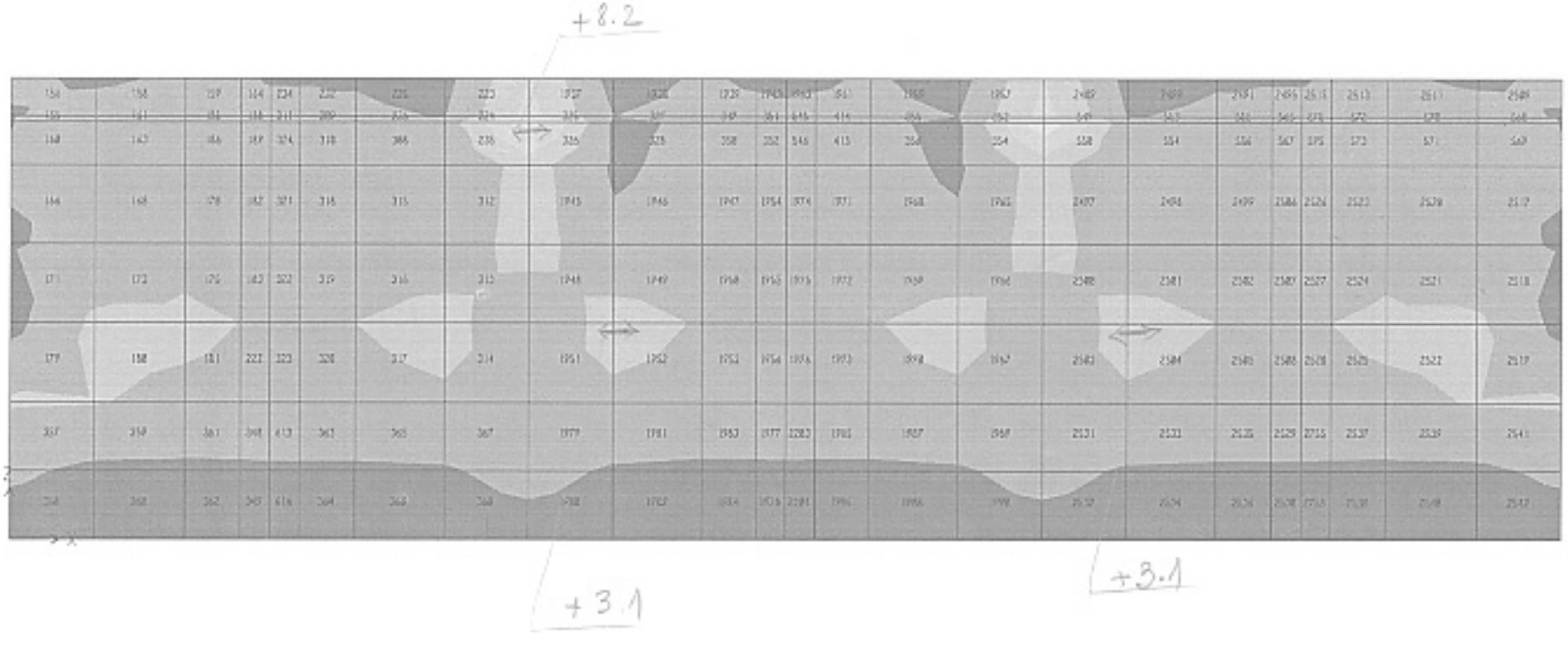


WALL OF AERATION TANK AND PIPE GALLERY Y =+12.75

(ENVE COMBO MIN M22)

-24.0 -20.0 -16.0 -12.0 -8.0 -4.0 0.0 4.0 8.0

SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

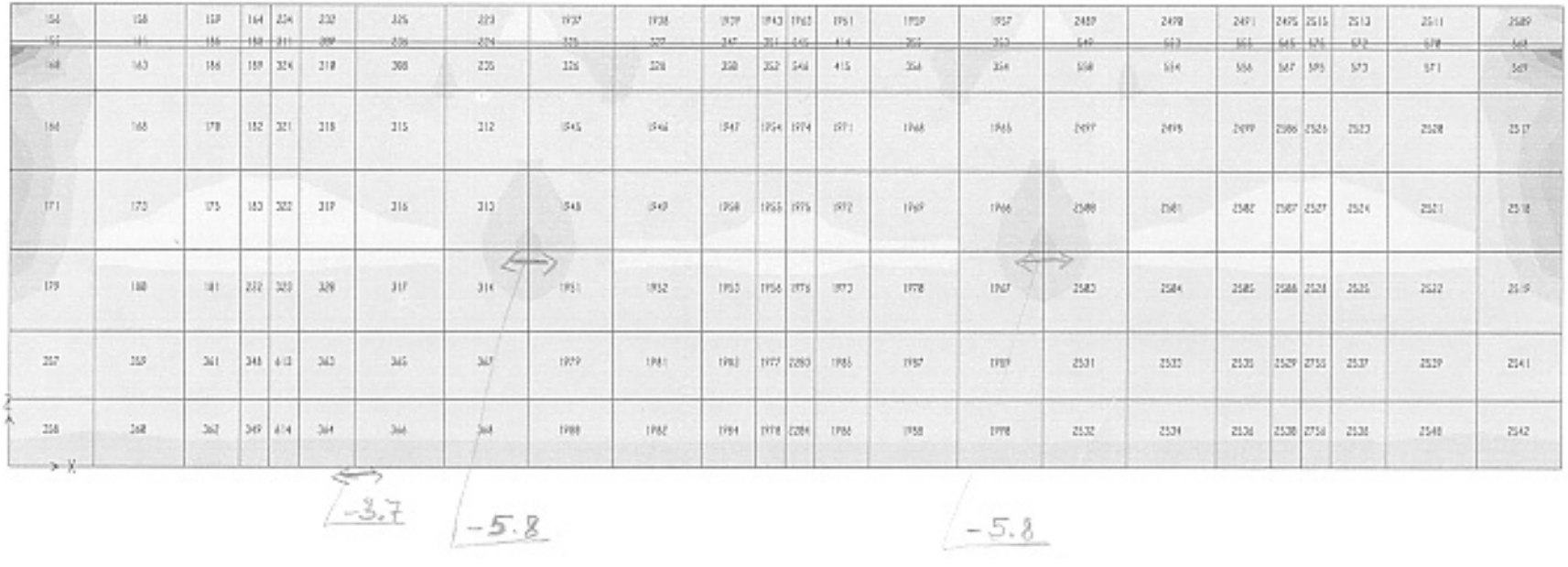


WALL OF AERATION TANK AND PIPE GALLERY Y =+12.75

(ENVE COMBO MAX M11)

-2.2 0.0 2.2 4.4 6.6 8.8 11.0 13.2 15.4

SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

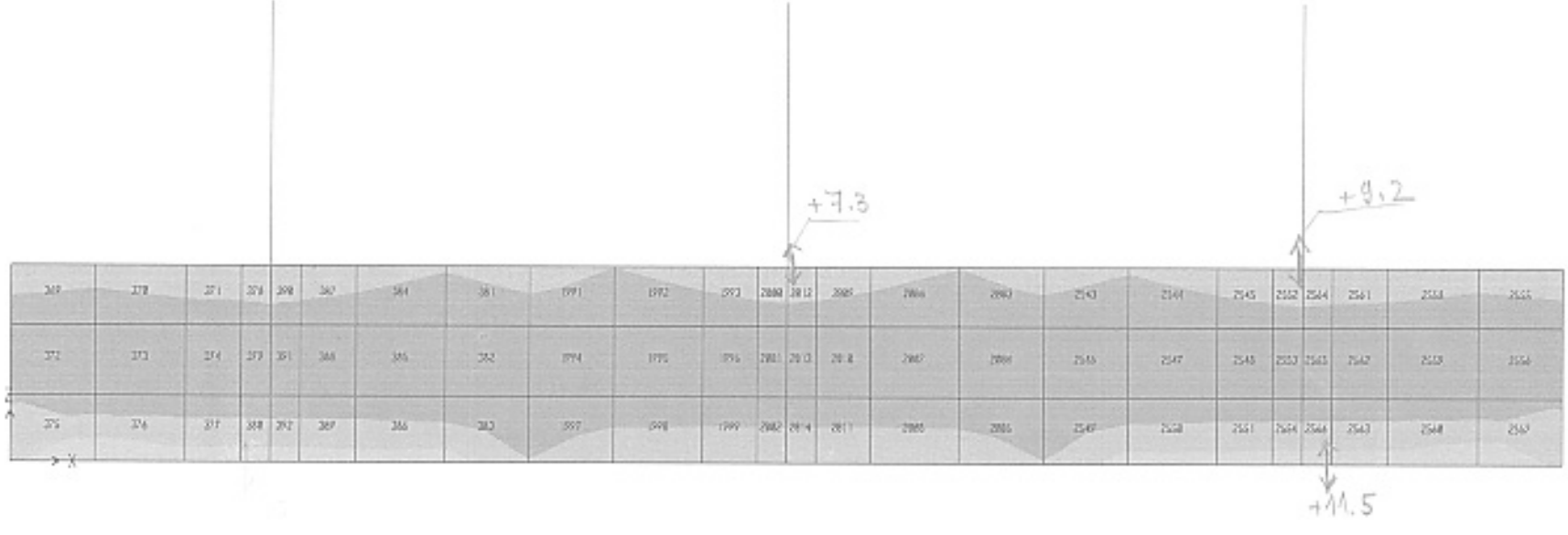


WALL OF AERATION TANK AND PIPE GALLERY Y =+12.75

(ENVE COMBO MIN M_{11})

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

SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units



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

(ENVE COMBO MAX M_{22})

-4.5 0.0 4.5 9.0 13.5 18.0 22.5 27.0 31.5

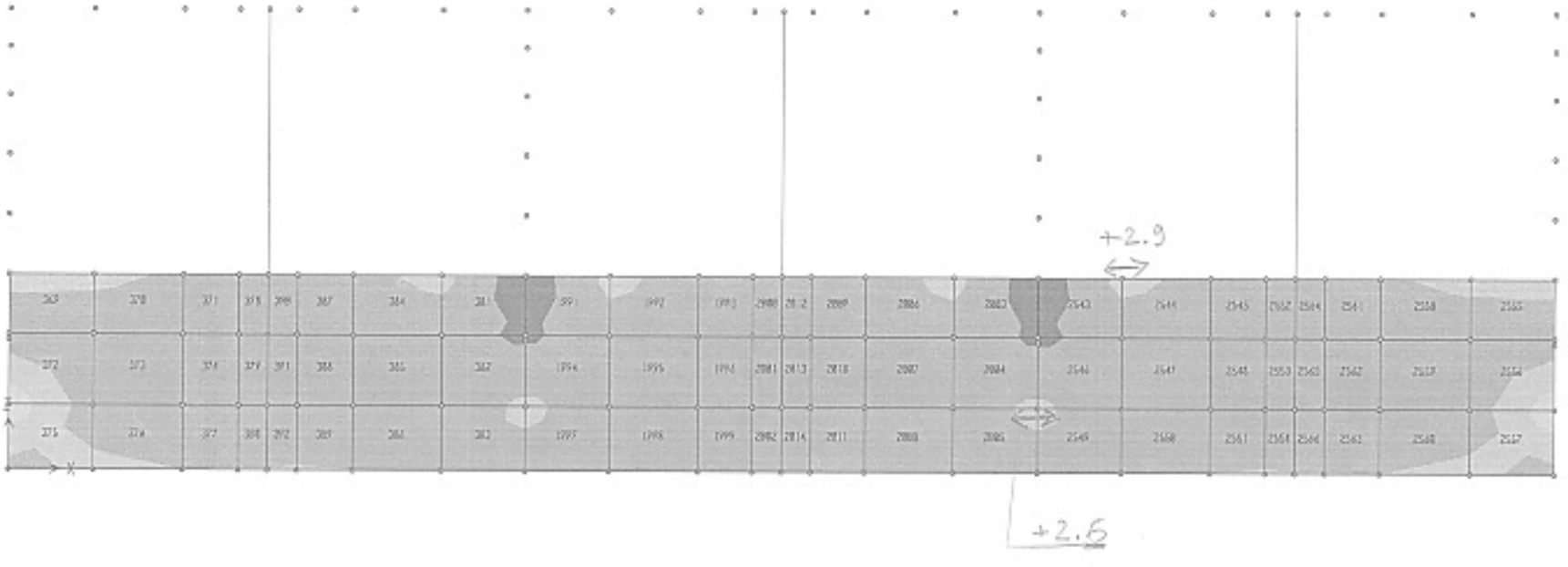
SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units

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

(ENVE COMBO MIN M_{22})

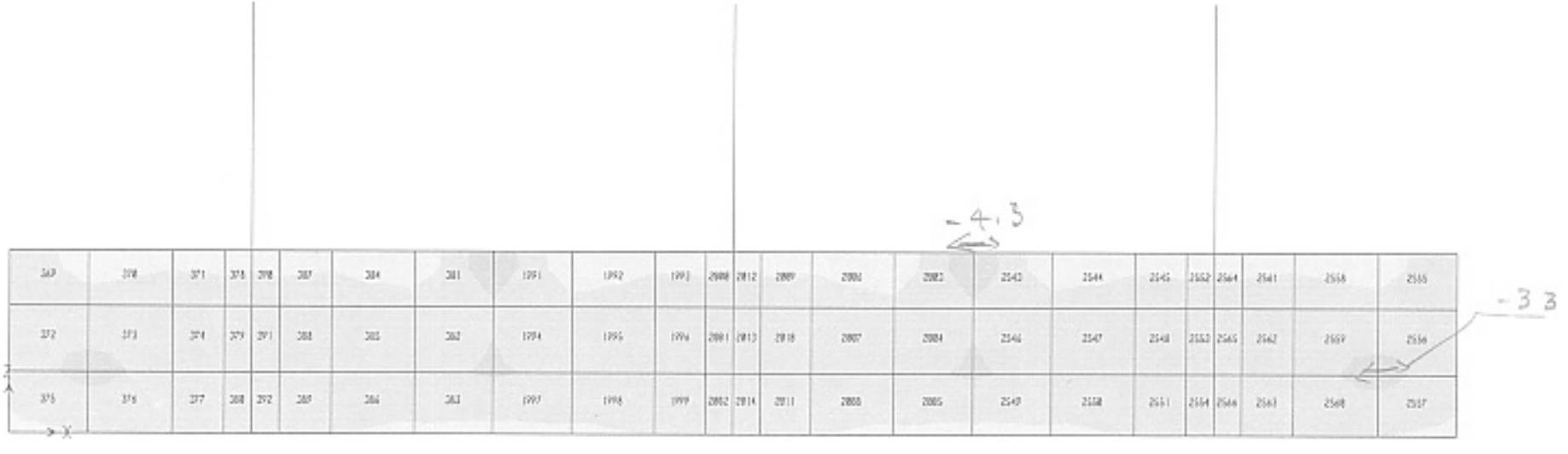
-24.0 -20.0 -16.0 -12.0 -8.0 -4.0 0.0 4.0 8.0

SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units



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

(ENVE COMBO MAX M_{11})

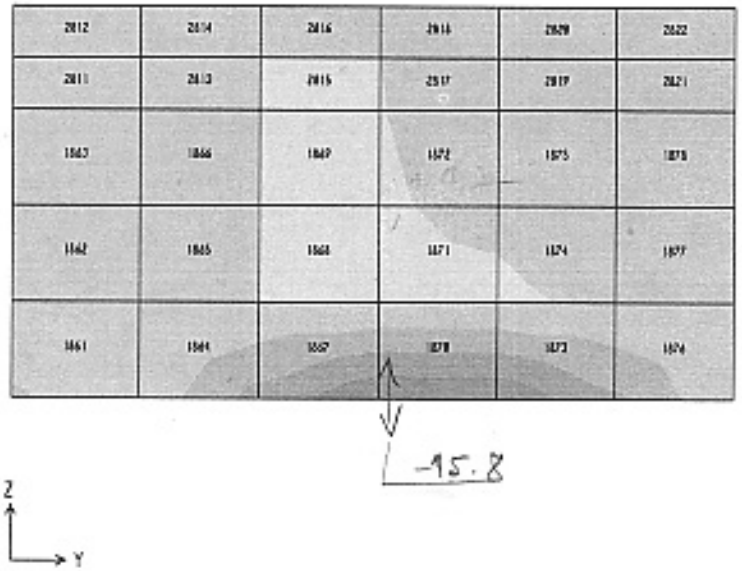


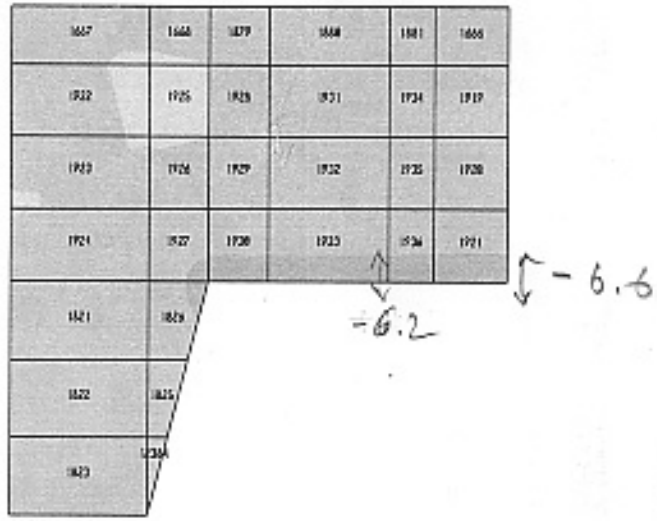
WALL OF PIPE GALLERY AND FINAL SED. TANK Y=+21.25

(ENVE COMBO MIN M11)

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

SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units



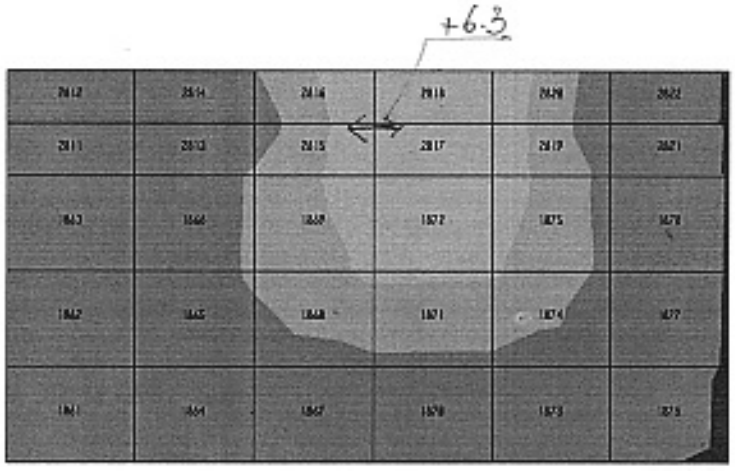


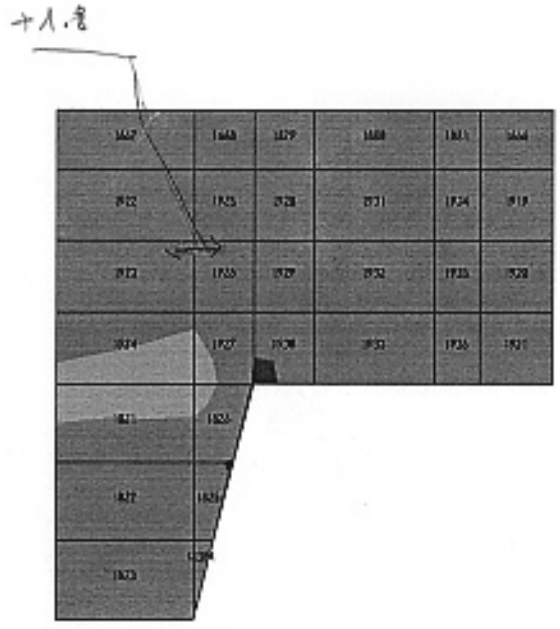
LONGITUDINAL WALL OF AERATIONTANK AND FINAL SED. TANK X=+2.2

(ENVE COMBO MIN M_{22})

-24.0 -20.0 -16.0 -12.0 -8.0 -4.0 0.0 4.0 8.0

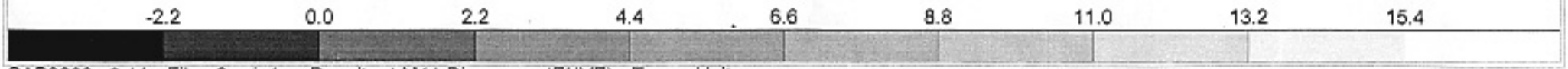
SAP2000 v6.11 - File:p3-rein1 - Resultant M22 Diagram (ENVE) - Ton-m Units



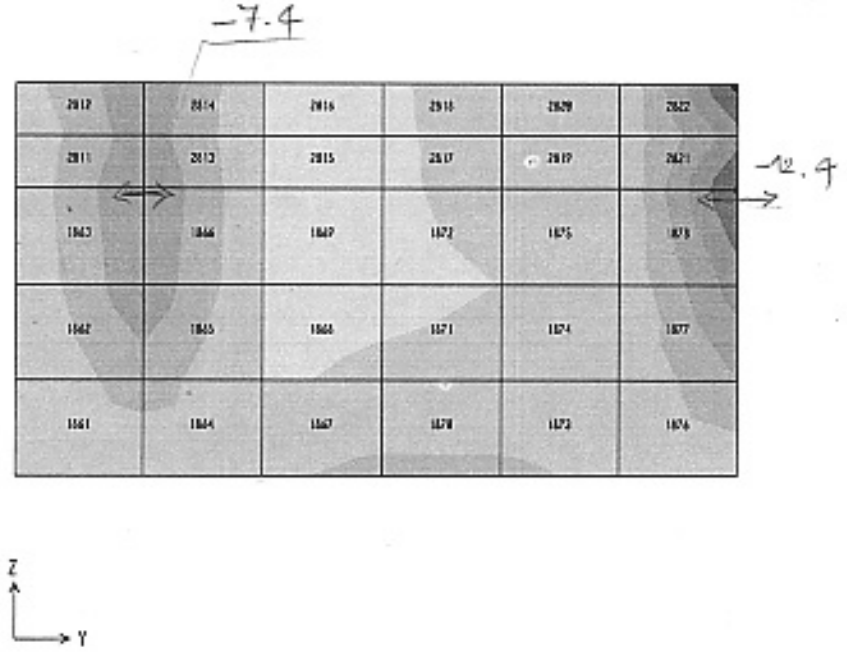


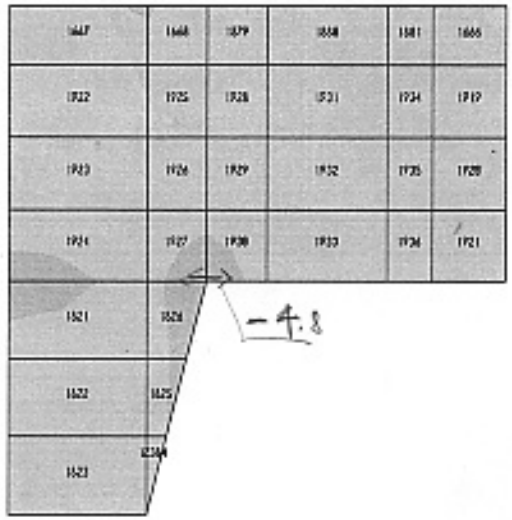
LONGITUDINAL WALL OF AERATIONTANK AND FINAL SED. TANK X=+2.2

(ENVE COMBO MAX M_{11})



SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units





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

(ENVE COMBO MIN M_{11})

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

SAP2000 v6.11 - File:p3-rein1 - Resultant M11 Diagram (ENVE) - Ton-m Units

SAP2000 v6.11 File: P3 Ton-m Units PAGE 1
March 9, 2001 15:50

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

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

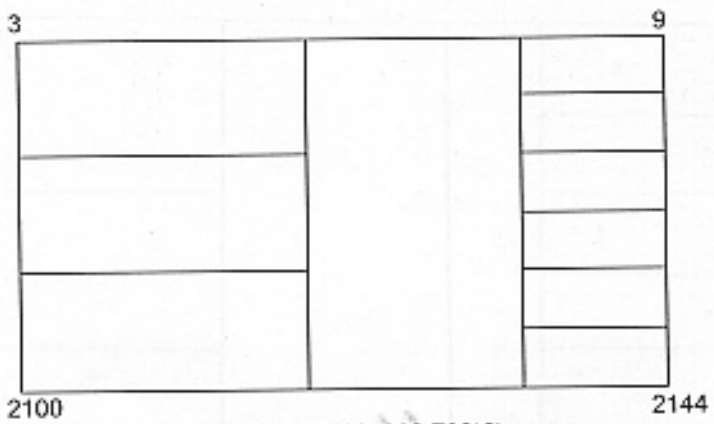
COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD				In case of all tanks are full of water, no ground water outside
		SELF	1.0000	STATIC(DEAD)	
		WATER	1.0000	STATIC(OTHER)	
		CINDERCO	1.0000	STATIC(DEAD)	
		MAN	1.0000	STATIC(LIVE)	
		SOILPRES	1.0000	STATIC(OTHER)	
COMB2	ADD				In case of all tanks are empty, 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)	
PILECOMB	ADD				For calculating number of piles
		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)	

SAP2000 v6.11 File: P3 Ton-m Units PAGE 2
March 9, 2001 15:50

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

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

JOINT	LOAD	F1	F2	F3	M1	M2	M3
3	COMB1	724.1208	1399.9983	2134.1050	0.0000	0.0000	0.0000
3	COMB2	198.7584	399.6479	583.8505	0.0000	0.0000	0.0000
3	COMB3	511.5924	1057.6506	1860.6935	0.0000	0.0000	0.0000
3	PILECOMB	724.1208	1399.9983	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	1796.3124	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	-198.7587	399.6480	583.8503	0.0000	0.0000	0.0000
2100	COMB3	-511.5953	1057.6517	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



$$\text{Preaction} = 4.31^{*}\frac{1.1(1023.31^{*}2+968.782^{*}2)}{30^{*}33} = 8.8(T/m^2)$$

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

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

-PE - WWTP - 252 - 02

CALCULATION FOR WASTEWATER TREAMENT 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, Rn = 70 (Kg/cm2)

RS= 3.6 (Kg/cm2)

Reinforcement type JIS: Ra= 1600 (Kg/cm2)

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

Internal friction 20deg

3-LOAD CALCULATION (BASE ON JAPANESE STANDARD):

3.1-Water load

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

3.2-Live load:

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

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.

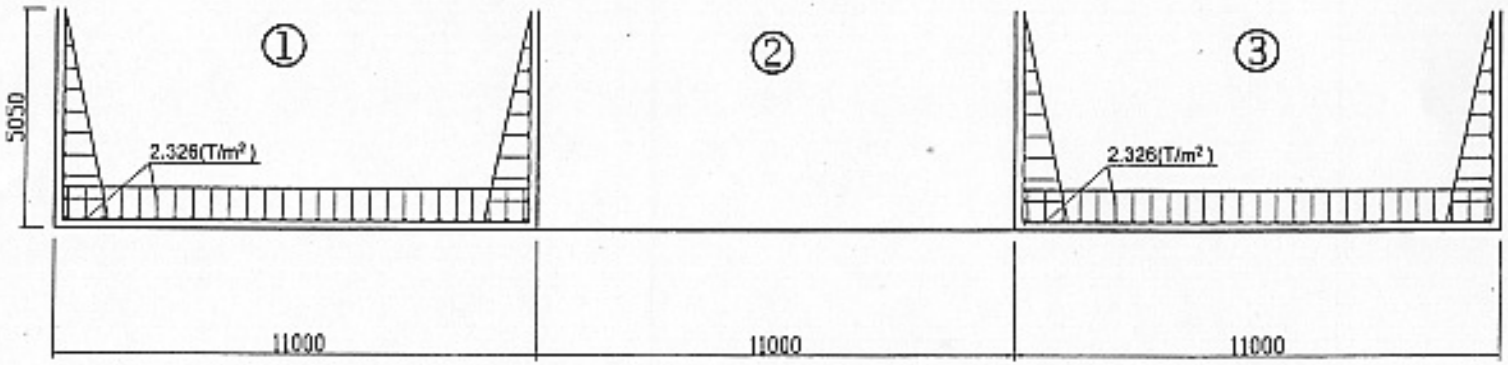
LOAD COMBINATION MULTIPLIERS

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 analised by SAP2000, choosing the most dangerous forces for calculation:

$A_o = M/R_n bh_o^2$ Where, M: Maximum bending moment(T.m)

h_n: Effective depth of bearing area(cm)

h_o= (Element thickness-Cover thickness)

b: Width of calculated area(cm)

Required area of reinforcement:

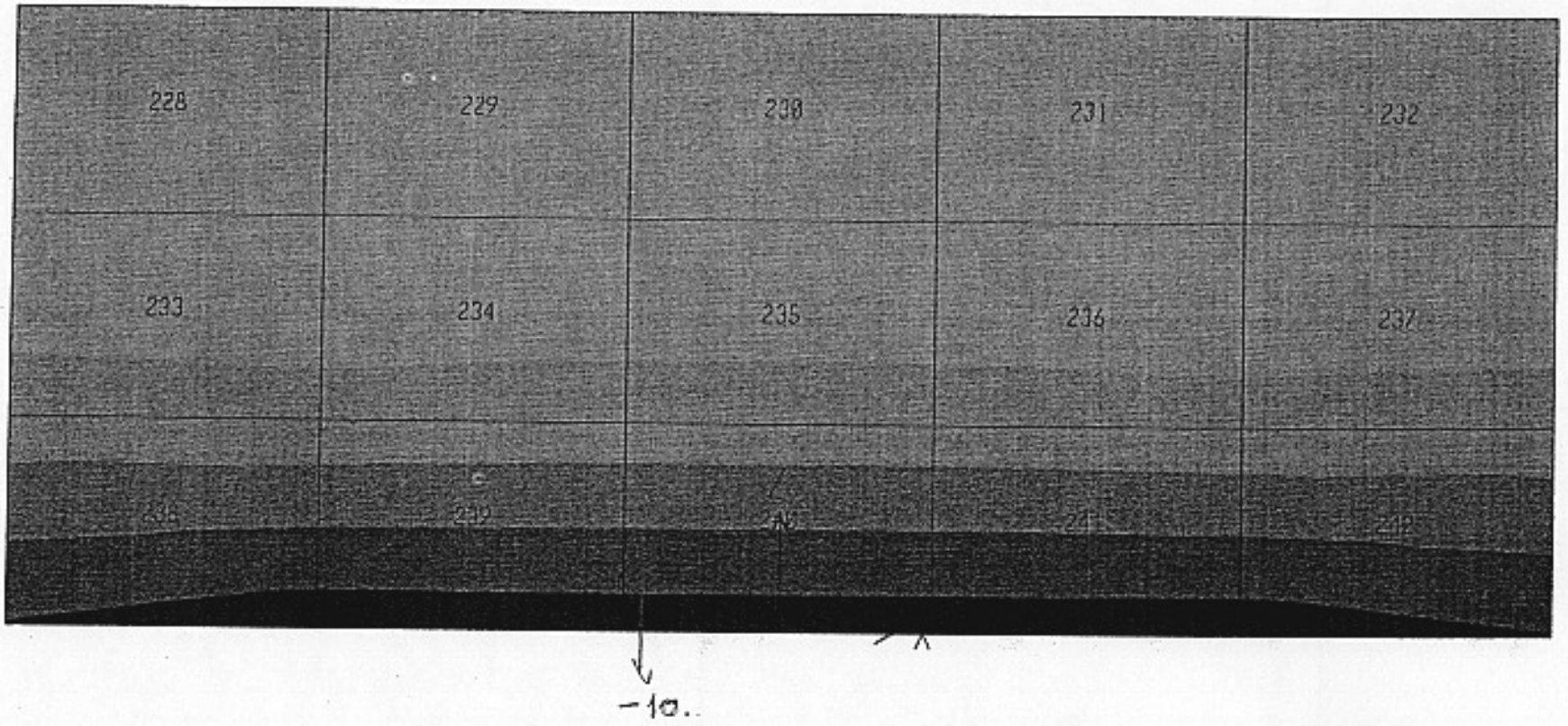
Fa= M/γRaho Where: $\gamma = 0.5 + ((1-2Ao)^{1/2})/2$

5-1 SLABS AND WALLS:

Moments	Values (T.m)	Ao	γ	Fa (cm^2)	r arrangement ϕ(mm)	a(mm)	
(Bottom	-10.500	0.0651	0.966	14.15	16	125	
Slab level	-4.100	0.0209	0.989	4.89	12	200	a125
+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)



WALL OF FINAL SED. TANK

(ENVE COMBO MAX, MIN M_{22})

-8.80 -6.60 -4.40 -2.20 0.00 2.20 4.40 6.60 8.80

SAP2000 v6.11 - File:f-s-tank - Resultant M22 Diagram (ENVE) - Ton-m Units

SAP2000 v6.11 File: F-S-TANK Ton-m Units PAGE 1
March 9, 2001 17:35

FINAL SED. TANK

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

COMBO	TYPE	CASE	FACTOR	TYPE	TITLE
COMB1	ADD				All tans 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	

SAP2000 v6.11 File: F-S-TANK Ton-m Units PAGE 2
March 9, 2001 17:35

FINAL SED. TASK

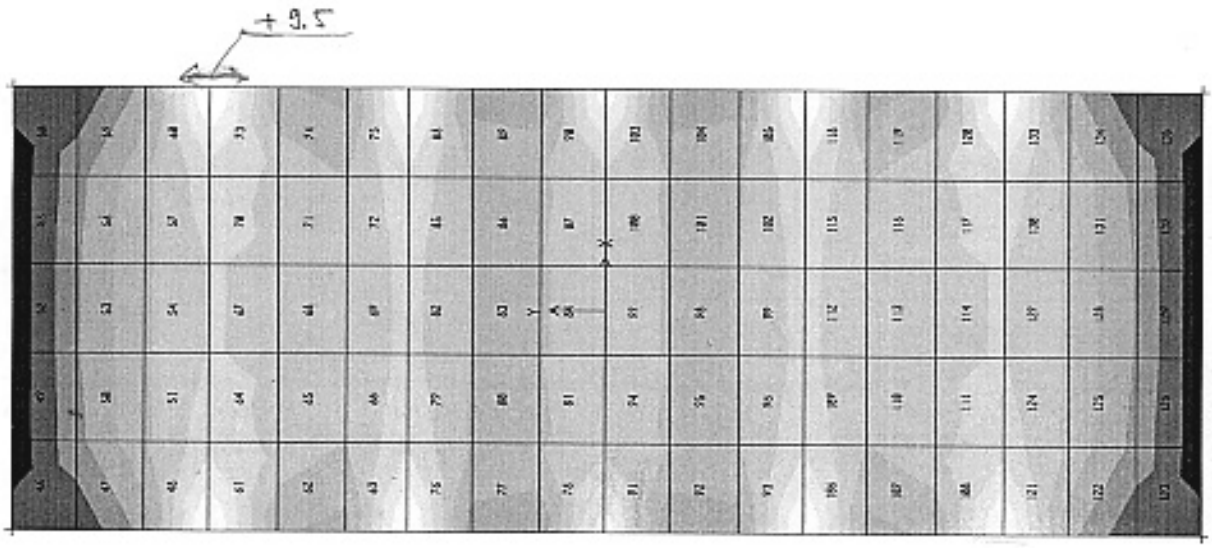
S H E L L E L E M E N T R E S U L T A N T S

SHELL	LOAD	JOINT	F11	F22	F12	M11	M22	M12	V13	V23
239	Minima		-3.39	-2.83	-4.51	-2.08	-10.16	-8.413E-03	-3.745E-01	-4.38
			ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE
239	Maxima		3.34	1.82	-3.638E-02	2.986E-02	2.793E-03	4.145E-02	2.751E-02	1.141E-02
			ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE
240	Minima		-1.66	-2.60	-5.630E-01	-1.99	-10.08	-2.138E-02	0.00	-4.18
			ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE
240	Maxima		3.04	-4.964E-01	5.630E-01	1.461E-03	-3.596E-03	2.138E-02	0.00	-1.253E-02
			ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE	ENVE

March 9,2001 17:50

BOTTOM SLAB OF FINAL SED. TANK

(ENVE COMBO MAX M_{22})



8.80
6.60
4.40
2.20
0.00
-2.20
-4.40
-6.60
-8.80

SAP2000 v6.11 - File:f-s-tank - Resultant M22 Diagram (ENVE) - Ton-m Units

March 9,2001 17:55

BOTTOM SLAB OF FINAL SED. TANK

(ENVE COMBO MIN M_{22})