2. CALCULO ESTRUTURAL

2.1. CONDIÇÃO PARA DESIGNIO

FORÇA ADMISSIVEL FERRO $\sigma_{sa} = 1400$ Kg/cm²

CONCRETO $\sigma_{ca} = 70$ Kg/cm²

SHEARING (VIGA) $\tau_a = 6.5$ Kg/cm²

(PRATO) $\tau_a = 8.5$ Kg/cm²

ADERENTE $\tau_{oa} = 7.5$ Kg/cm²

COBERTURA PARA FERRO 5.0 cm

PESO UNITARIO CONCRETO ARMADO 2.40 (t/m³)

CONCRETO SIMPLES 2.30 (t/m³)

SOLO UMIDO 1.80 (t/m³)

SATURADO 2.00 (t/m³)

SUBMERGIDO 1.00 (t/m³)

ANGULO DE FRICÇÃO INTERNO

$\phi = 30°$

FACTOR DE PRESSÃO DA TERRA ATIVO $K_a = \frac{1-\sin\phi}{1+\sin\phi} = 0.333$

FACTOR DE PRESSÃO DA TERRA PASSIVO $K_p = \frac{1+\sin\phi}{1-\sin\phi} = 3.00$

FACTOR DE FRICÇÃO, CONCRETO E TERRENO $\mu = 0.5$

FACTOR DE PRESSÃO DA TERRA EM PAZ $K_r = 0.5$

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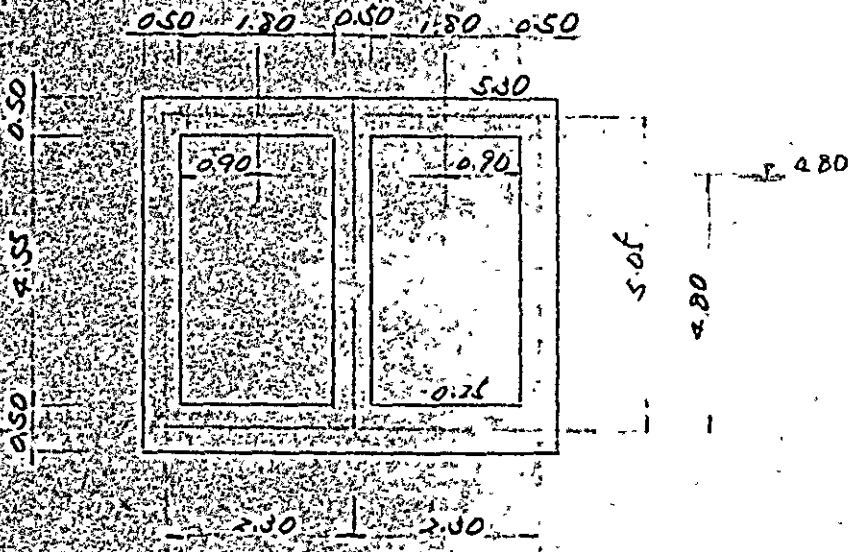
DIA "	DIA (mm.)	AREA SECCIONAL (cm^2)	AREA SECCIONAL @ 300	AREA SECCIONAL @ 150	COMPRIMIENTO CIRCULAR (cm)
3/16	0.48	0.18			1.51
1/4	0.64	0.32			2.0 2.01
5/16	8 mm 0.79	0.49	1.633	3.267	2.5 2.48
3/8	9 mm 0.95	0.71	2.366	4.733	3.0 2.98
1/2	13 mm 1.27	1.27	4.233	8.467	4.0 3.99
5/8	16 mm 1.59	1.98	6.599	13.200	5.0 4.99
3/4	19 mm 1.91	2.85	9.499	19.000	6.0
7/8	22 mm 2.22	3.88	12.932	25.867	7.0
1	25 mm 2.54	5.07	16.898	33.800	8.0
1 1/4	32 mm 3.18	7.93	26.397	52.800	10.0

2.2. CAIXA DE BOMBA

1) FORMA DA SECÇÃO



2) CARGA

a) CARGA EM CIMA DE PRATO ALTO

CARGA DE POVO	0.30	t/m²
PESO DE PRATO ALTO (1)	0.5×2.4 = 1.20	"
CONCRETO SIMPLES	0.2×2.3 = 0.46	
TOTAL w_2	1.96	"

b) PESO DE MAQUINA

PESO DE MAQUINA S.S.P.S	1.4	(t)
COEFICIENTE DE CHOQUE 30%	0.42	
	1.82	(t)

AREA DA BASE
PARA MAQUINA 0.6 m × 1.50 = 0.9 m²

CARGA w_3 = 1.82/0.9 = 2.05 (t/m²)

c) CARGA EXERCIDA CONTRA PAREDE

CARGA AUTOMOVEL (14 t) COEFICIENTE DA CHOQUE 30%

$$q = \frac{14 \times (1.1 \times 0.3)}{2.75 \times 7.0} = 0.95 \ (t/m^2)$$

ALTURA DE CONVERSÃO DO TERRENO (CARGA AUTOMOVEL)

$$h = \frac{q}{\gamma} = \frac{0.95}{1.8} = 0.53 \ m$$

PRESSÃO DA TERRA EM PAZ

PARTE DE PRATO ALTO $P_1 = K_0 \times \gamma_1 \times h_1 = 0.5 \times 1.8 \times (0.53 + 0.25) = 0.70 \ (t/m^2)$

NIVEL DA AGUA NO SUB-SOLO $P_2 = 0.5 \times 1.8 \times (0.53 - 0.50) = 0.03 \ (t/m^2)$

PARTE DE BASE $P_3 = P_2 + 1.0 \times 1.0 \times 4.8 + 0.5 \times 1.0 \times 4.8 = 8.13 \ (t/m^2)$

d) CARGA DE CASA

CARGA POR m^2 $0.6 \times 2.40 = 1.44 \ t/m^2$,

$$P = 1.44 \times \frac{8.3}{2} \times (1.80 + 0.5) = 13.74 \ t$$

$$P = 13.74 / \frac{5.5}{2} = 5.0 \ (t/m)$$

e) PESO DE PAREDE

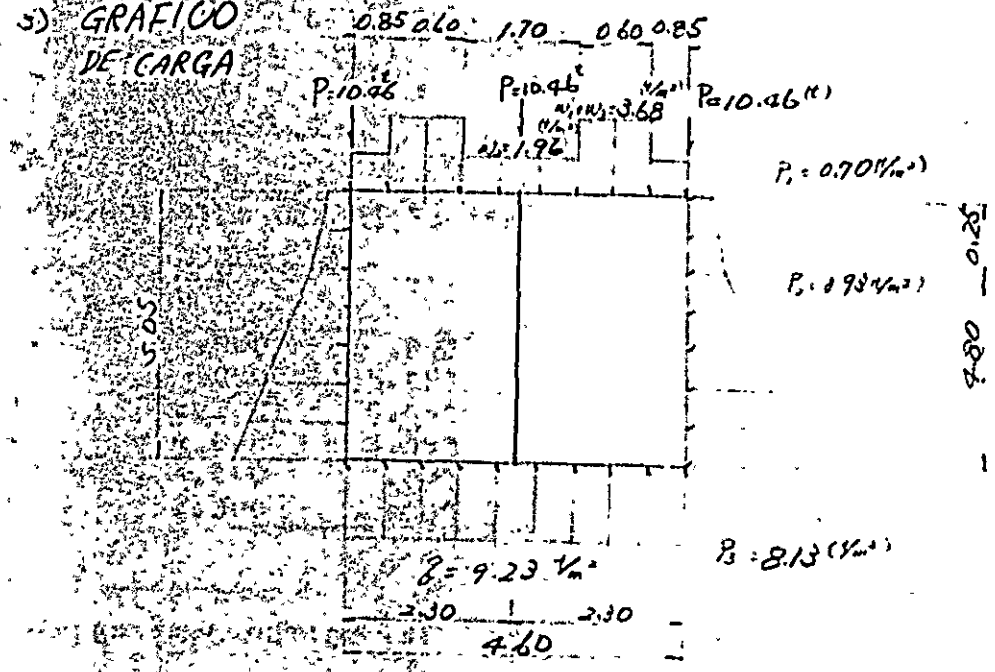
$$P = 0.5 \times 4.55 \times 2.4 = 5.46 \ (t/m)$$

f) FORÇA CONTRARIA DO FUNDO

$$q = \frac{1.96 \times (4.6 - 1.30) + (0.02 + 1.66) \times 1.30 + (5.0 + 5.46) \times 3}{4.60}$$

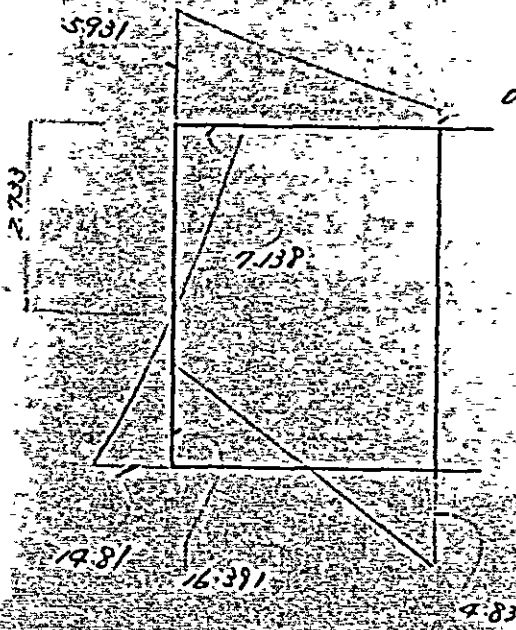
$$= 9.23 \ (t/m^2)$$

3) GRAFICO DE CARGA

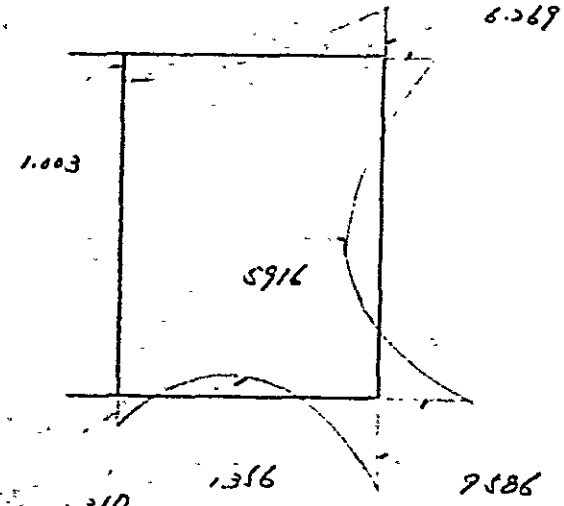


4) QUADRO DA FORÇA DE CISALHAMENTO E MOMENTO

QUADRO - S



QUADRO - M



*** STRUCTURE NO. 3 PLANE FRAME ***

CAIXA DE BOMBA

*** STRUCTURE DATA ***

M	N	NJ	NR	NRJ	E
7	14	6	4	3	2100000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	5.050
3	2.300	5.050
4	4.600	5.050
5	4.600	.000
6	2.300	.000

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.500	.010	5.050
2	2	3	.500	.010	2.300
3	3	4	.500	.010	2.300
4	4	5	.500	.010	5.050
5	5	6	.500	.010	2.300
6	6	1	.500	.010	2.300
7	3	6	.500	.010	5.050

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
6	0	1	0
5	0	1	0

*** LOAD CASE = (1) ***

*** ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
2	.00000	-10.46000	.00000
3	.00000	-10.46000	.00000
4	.00000	-10.46000	.00000

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-M-	-AS-	-PA-	-CS-	-PB-
1	1	2	1	.000E+00	.813E+01	.480E+01	.930E+00
2	1	2	1	.480E+01	.930E+00	.250E+00	.700E+00
3	1	2	2	.000E+00	.196E+01	.230E+01	.196E+01
4	1	2	2	.850E+00	.172E+01	.600E+00	.172E+01
5	1	2	3	.000E+00	.196E+01	.230E+01	.196E+01
6	1	2	3	.850E+00	.172E+01	.600E+00	.172E+01
7	1	2	4	.000E+00	.700E+00	.250E+00	.930E+00
8	1	2	4	.250E+00	.930E+00	.480E+01	.813E+01
9	1	2	5	.000E+00	.923E+01	.230E+01	.923E+01
10	1	2	6	.600E+00	.923E+01	.230E+01	.923E+01

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	.00000E+00	.00000E+00	.14499E-03
2	.16605E-04	.78835E-04	-.15546E-03
3	.32441E-04	.46542E-04	.44409E-15
4	.48076E-04	.78835E-04	.15546E-03
5	.64881E-04	.00000E+00	-.14499E-03
6	.32441E-04	.00000E+00	-.35527E-14

*** MAXIMUS MOMENT ***

MEMBERS		DIST.	M-MAX	- S -	- N -
1	1 2	2.317	6.015	.000	16.391
2	2 3	*********	*********	*********	*********
3	3 4	*********	*********	*********	*********
4	4 5	2.733	6.015	.000	16.391
5	5 6	1.540	1.356	.000	14.810
6	6 1	.760	1.356	.000	14.810
7	3 6	*********	*********	*********	*********

*** CASE NO. 1 ***

-M-	PT	DIST.	- N -	- S -	- M -
1	- 1	.000	16.391	14.810	-9.586
1	- 2	.842	16.391	8.498	.148
1	- 3	1.683	16.391	3.250	5.017
1	- 4	2.525	16.391	-.937	5.916
1	- 5	3.367	16.391	-4.060	3.739
1	- 6	4.208	16.391	-6.121	-.620
1	- 7	5.050	16.391	-7.138	-6.269
2	- 1	.000	7.138	5.931	-6.269
2	- 2	.383	7.138	5.180	-4.139
2	- 3	.767	7.138	4.429	-2.297
2	- 4	1.150	7.138	3.161	-.821
2	- 5	1.533	7.138	1.994	.126
2	- 6	1.917	7.138	1.143	.709
2	- 7	2.300	7.138	.391	1.003
3	- 1	.000	7.138	-.391	1.003
3	- 2	.383	7.138	-1.143	.709
3	- 3	.767	7.138	-1.994	.126
3	- 4	1.150	7.138	-3.161	-.821
3	- 5	1.533	7.138	-4.429	-2.297
3	- 6	1.917	7.138	-5.180	-4.139
3	- 7	2.300	7.138	-5.931	-6.269
4	- 1	.000	16.391	7.138	-6.269
4	- 2	.842	16.391	6.121	-.620
4	- 3	1.683	16.391	4.060	3.739
4	- 4	2.525	16.391	.937	5.916
4	- 5	3.367	16.391	-3.250	5.017
4	- 6	4.208	16.391	-8.498	.148
4	- 7	5.050	16.391	-14.810	-9.586
5	- 1	.000	14.810	16.391	-9.586
5	- 2	.383	14.810	10.675	-4.816
5	- 3	.767	14.810	7.137	-1.402
5	- 4	1.150	14.810	3.598	.655
5	- 5	1.533	14.810	.060	1.356
5	- 6	1.917	14.810	-3.478	.701
5	- 7	2.300	14.810	-4.939	-1.310
6	- 1	.000	14.810	4.939	-1.310
6	- 2	.383	14.810	3.478	.701
6	- 3	.767	14.810	-.060	1.356
6	- 4	1.150	14.810	-3.598	.655
6	- 5	1.533	14.810	-7.137	-1.402
6	- 6	1.917	14.810	-10.675	-4.816
6	- 7	2.300	14.810	-16.391	-9.586
7	- 1	.000	9.677	.000	.000
7	- 2	.842	9.677	.000	.000
7	- 3	1.683	9.677	.000	.000
7	- 4	2.525	9.677	.000	.000
7	- 5	3.367	9.677	.000	.000
7	- 6	4.208	9.677	.000	.000
7	- 7	5.050	9.677	.000	.000

ALLOWANCE STRESS

SSA = 1400.00
SCA = 70.00
TAUA = 6.50
TAUOA = 7.50
SSA' = .00

MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

MEMBER	DIST	MS	N	S	TT	OD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
1	.000	-12.866	16.391	14.810	50.00	5.00	31.64	20.45	34.76	51.50	12.26	.00		½"@300
1	.842	-11.199	16.391	8.498	50.00	5.00	8.39	11.73	.40	29.55	.00	.00		⅜"@300
1	1.683	-8.726	16.391	3.250	50.00	5.00	25.41	4.49	22.42	11.30	3.75	.00		
1	2.525	-5.195	16.391	-.937	50.00	5.00	26.75	1.29	24.84	3.26	5.42	.00		
1	3.367	-2.917	16.391	-4.060	50.00	5.00	23.37	5.61	18.96	14.12	1.36	.00		½"@150
1	4.208	-.620	16.391	-6.121	50.00	5.00	6.95	8.45	1.68	21.29	.00	.00		
1	5.050	-9.547	16.391	-7.138	50.00	5.00	27.26	9.86	25.80	24.82	6.08	.00		
2	.000	-7.696	7.138	5.931	50.00	5.00	24.48	8.19	20.80	20.63	9.24	.00		½"@300
2	.383	-5.547	7.138	5.180	50.00	5.00	20.82	7.15	15.04	18.01	5.27	.00		⅝"@300
2	.767	-3.725	7.138	4.429	50.00	5.00	17.03	6.12	10.07	15.40	1.84	.00		
2	1.150	-.821	7.138	3.161	50.00	5.00	7.99	4.37	2.22	10.99	.13	.00		⅝"@300
2	1.533	.126	7.138	1.894	50.00	5.00	3.14	2.62	.34	6.59	.00	.00		
2	1.917	.769	7.138	1.143	50.00	5.00	7.43	1.58	1.91	3.97	.04	.00		
2	2.300	2.439	7.138	.391	50.00	5.00	13.75	.54	6.57	1.36	.36	.00		⅛"@300
3	.000	2.439	7.138	-.391	50.00	5.00	13.75	.54	6.57	1.36	.36	.00		
3	.383	.769	7.138	-1.143	50.00	5.00	7.43	1.58	1.91	3.97	.04	.00		
3	.767	.126	7.138	-1.894	50.00	5.00	3.14	2.62	.34	6.59	.00	.00		
3	1.150	-.821	7.138	-3.161	50.00	5.00	7.99	4.37	2.22	10.99	.13	.00		
3	1.533	-3.725	7.138	-4.429	50.00	5.00	17.03	6.12	10.07	15.40	1.84	.00		
3	1.917	-5.547	7.138	-5.180	50.00	5.00	20.82	7.15	15.04	18.01	5.27	.00		
3	2.300	-7.696	7.138	-5.931	50.00	5.00	24.48	8.19	20.80	20.63	9.24	.00		
4	.000	-9.547	16.391	7.138	50.00	5.00	27.26	9.86	25.80	24.82	6.08	.00		
4	.842	-6.620	16.391	6.121	50.00	5.00	6.95	8.45	1.68	21.29	.00	.00		
4	1.683	-2.917	16.391	4.060	50.00	5.00	23.37	5.61	18.96	14.12	1.36	.00		
4	2.525	-.195	16.391	.937	50.00	5.00	26.75	1.29	24.84	3.26	5.42	.00		
4	3.367	2.296	16.391	-3.250	50.00	5.00	25.41	4.49	22.42	11.30	3.75	.00		
4	4.208	4.141	16.391	-8.498	50.00	5.00	3.39	11.73	.40	29.55	.00	.00		
4	5.050	-12.865	16.391	-14.810	50.00	5.00	31.64	20.45	34.76	51.50	12.26	.00		
5	.000	-12.549	14.810	16.391	50.00	5.00	31.25	22.63	33.91	57.00	12.80	.00		½"@300
5	.383	-7.775	14.810	13.675	50.00	5.00	24.61	14.74	21.02	37.12	3.91	.00		⅜"@300
5	.767	-1.442	14.810	7.137	50.00	5.00	10.45	9.85	3.79	24.82	.04	.00		
5	1.150	.689	14.810	3.598	50.00	5.00	7.14	4.97	1.77	12.51	.00	.00		⅝@300
5	1.533	1.396	14.810	.060	50.00	5.00	10.27	.08	3.66	.21	.02	.00		
5	1.917	.771	14.810	-3.478	50.00	5.00	7.39	4.80	1.89	12.10	.00	.00		
5	2.300	-1.310	14.810	-4.939	50.00	5.00	10.10	6.68	3.54	16.83	.01	.00		⅜"@300
6	.000	-1.310	14.810	4.939	50.00	5.00	10.10	6.68	3.54	16.83	.01	.00		⅜"@300
6	.383	.771	14.810	3.478	50.00	5.00	7.39	4.80	1.89	12.10	.00	.00		
6	.767	1.396	14.810	-.060	50.00	5.00	10.27	.08	3.66	.21	.02	.00		
6	1.150	.689	14.810	-3.598	50.00	5.00	7.14	4.97	1.77	12.51	.00	.00		⅝"@300
6	1.533	-1.442	14.810	-7.137	50.00	5.00	10.45	9.85	3.79	24.82	.04	.00		
6	1.917	-7.775	14.810	-13.675	50.00	5.00	24.61	14.74	21.02	37.12	3.91	.00		
6	2.300	-12.549	14.810	-16.391	50.00	5.00	31.25	22.63	33.91	57.00	12.80	.00		½"@300

MEMBER	DIST	- S -	- N -	- S -	TT	OD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
7	.000	-.010	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		
7	.842	-.060	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		
7	1.683	-.010	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		
7	2.525	.000	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		
7	3.367	.000	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		
7	4.208	-.010	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		
7	5.050	.020	9.677	.000	50.00	5.00	.00	.00	.00	.00	.00	.00		

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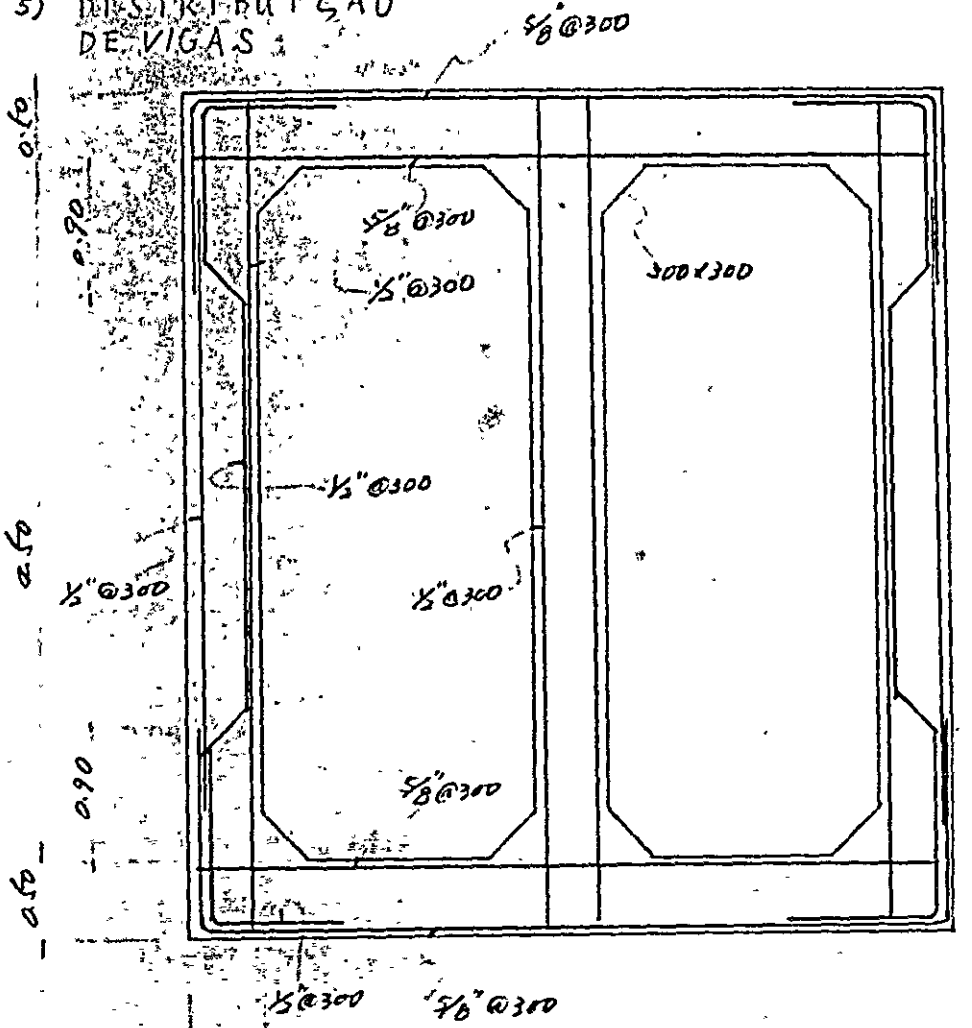
5) QUADRO DE DISTRIBUIÇÃO DE VIGAS :



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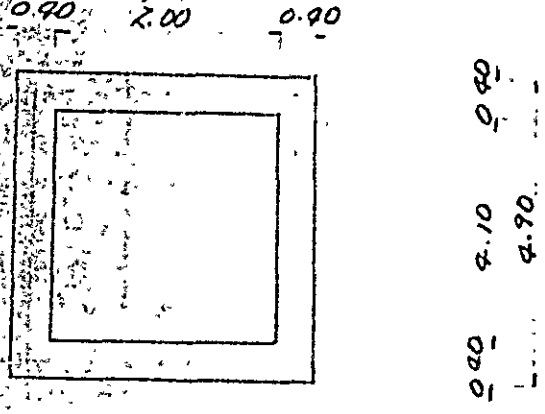
2.3 TANQUE DE (parte inferior)

CONTROLE DE PRESSÃO

1) Forma da secção



2). Carga

Pressão da terra
- Parte superficial RL 5.30
- Parte inferior RL -1.00
- NIVEL SUBTERRANEO RL 4.80

Nivel subterrâneo $P_1 = K_r \cdot \gamma_t \cdot (0.50 + 0.63)$

$= 0.5 \times 1.8 \times 1.03 = 0.93 (t/m^2)$

Parte inferior $P_2 = P_1 + K_r \times \gamma_s \times 5.80 + \gamma_w \times 5.80$

$= 0.93 + 0.5 \times 1.0 \times 5.8 + 1.0 \times 5.80$

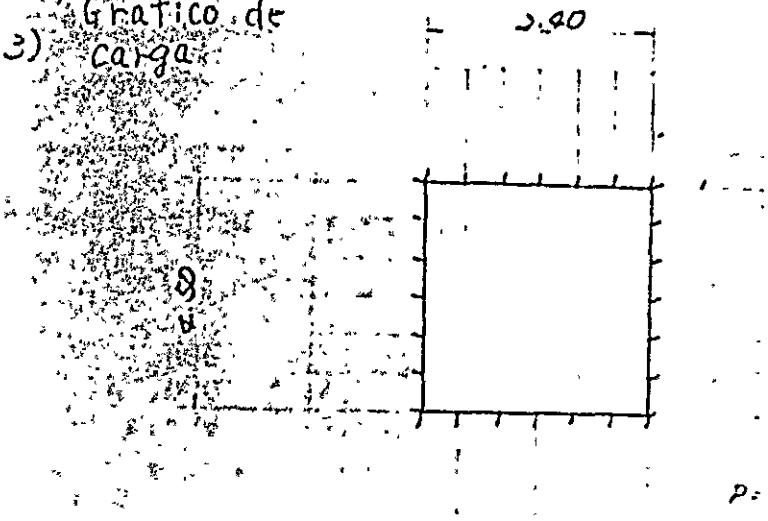
$= 9.63 (t/m^2)$

Pressão d'água — Nivel minimo de água RL 0.20

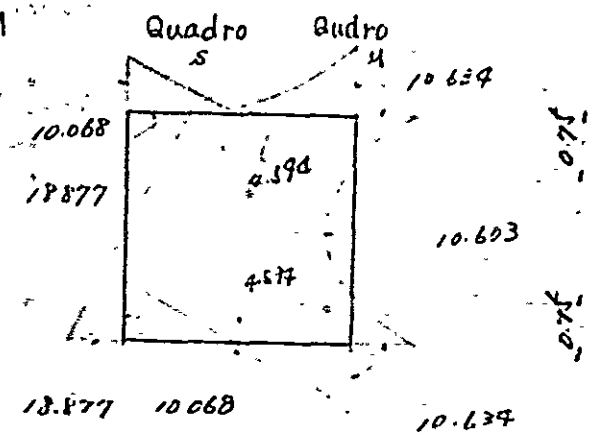
Pressão interna d'água $P_3 = 1.0 \times 1.24 = 1.24 (t/m^2)$

Carga diferencial $P = P_2 - P_3 = 9.63 - 1.24 = 8.39 (t/m^2)$

3) Gráfico de carga



4) Quadro S Quadro M



*** STRUCTURE NO. 1 3 PLANE FRAME ***

Tanque de controle de pressão (Parte inferior)

*** STRUCTURE DATA ***

NJ	NM	NJR	E
4	4	2	2100000.0

***CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	4.500
3	2.400	4.500
4	2.400	.000

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.400	.005	4.500
2	2	3	.400	.005	2.400
3	3	4	.400	.005	4.500
4	4	1	.400	.005	2.400

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
4		1	0

*** LOAD CASE - (1) ***

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-TH-	-AS-	-PA-	-CS-	-PH-
1	1	2	1	.000E+00	.839E+01	.450E+01	.839E+01
2	1	2	2	.000E+00	.839E+01	.240E+01	.839E+01
3	1	2	3	.000E+00	.839E+01	.450E+01	.839E+01
4	1	2	4	.000E+00	.839E+01	.240E+01	.839E+01

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	.00000E+00	.00000E+00	.70835E-03
2	-.47622E-11	.53936E-04	-.70835E-03
3	.53936E-04	.53936E-04	.70835E-03
4	.53936E-04	.00000E+00	-.70835E-03

*** MAXIMUM MOMENT ***

MEMBERS			DIST.	M-MAX	- S -	- N -
1	1	2	2.250	10.603	.000	10.068
2	2	3	1.200	-4.594	.000	18.878
3	3	4	2.250	10.603	.000	10.068
4	4	1	1.200	-4.594	.000	18.878

*** CASE NO. 1 ***

PT DIST.	- R -	- S -	- P -
1 - 1 .000	10.068	18.878	-10.634
1 - 2 .750	10.068	12.585	1.164
1 - 3 1.500	10.068	6.293	8.243
1 - 4 2.250	10.068	.000	10.603
1 - 5 3.000	10.068	-6.292	8.243
1 - 6 3.750	10.068	-12.585	1.164
1 - 7 4.500	10.068	-18.877	-10.634
2 - 1 .000	18.878	10.068	-10.634
2 - 2 .400	18.878	6.712	-7.278
2 - 3 .800	18.878	3.356	-5.265
2 - 4 1.200	18.878	-.000	-4.594
2 - 5 1.600	18.878	-3.356	-5.265
2 - 6 2.000	18.878	-6.712	-7.278
2 - 7 2.400	18.878	-10.068	-10.634
3 - 1 .000	10.068	18.878	-10.634
3 - 2 .750	10.068	12.585	1.164
3 - 3 1.500	10.068	6.293	8.243
3 - 4 2.250	10.068	.000	10.603
3 - 5 3.000	10.068	-6.292	8.243
3 - 6 3.750	10.068	-12.585	1.164
3 - 7 4.500	10.068	-18.877	-10.634
4 - 1 .000	18.878	10.068	-10.634
4 - 2 .400	18.878	6.712	-7.278
4 - 3 .800	18.878	3.356	-5.265
4 - 4 1.200	18.878	-.000	-4.594
4 - 5 1.600	18.878	-3.356	-5.265
4 - 6 2.000	18.878	-6.712	-7.278
4 - 7 2.400	18.878	-10.068	-10.634

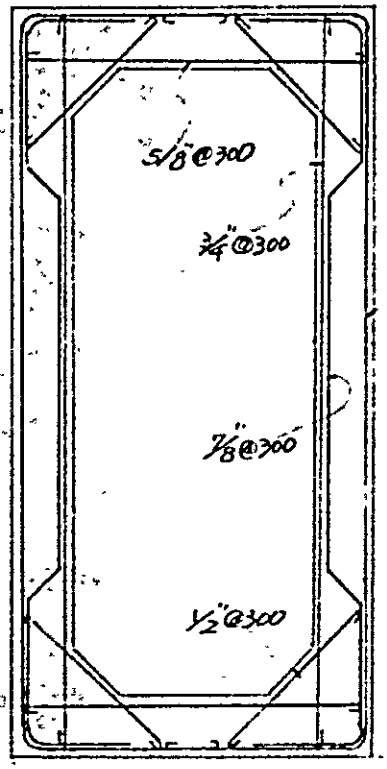
*** CALCULATION OF REINFORCEMENT ***

ALLOWABLE STRESS SSA = 1400.00 SCA = 70.00 TAUA = 8.50 TAUDA = 7.50 SSA' = .00

MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

MEMBER	FIST	- S -	- N -	- S -	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2	
1	.000	-12.146	10.068	18.877	40.00	5.00	30.75	26.07	54.25	84.41	21.90	.00			(3/4" @300
1	.750	2.674	10.068	12.585	40.00	5.00	14.43	17.38	11.95	56.27	.56	.00			7/8" @300
1	1.500	9.793	10.068	6.293	40.00	5.00	27.55	8.69	43.57	28.14	16.17	.00			
1	2.250	12.113	10.068	.000	40.00	5.00	30.71	.00	54.11	.00	21.82	.00			
1	3.000	9.793	10.068	-6.292	40.00	5.00	27.55	8.69	43.57	28.14	16.17	.00			
1	3.750	2.674	10.068	-12.585	40.00	5.00	14.43	17.38	11.95	56.27	.56	.00			
1	4.500	-12.146	10.068	-18.877	40.00	5.00	30.75	26.07	54.25	84.41	21.90	.00			(3/4" @300
2	.000	-13.466	10.878	10.068	40.00	5.00	32.38	13.90	60.15	45.02	18.77	.00			7/8" @300
2	.400	-11.116	10.878	6.712	40.00	5.00	28.05	9.27	45.16	30.01	10.73	.00			(3/4" @300
2	.800	-8.596	10.878	3.356	40.00	5.00	25.10	4.63	36.16	15.01	5.91	.00			7/8" @300
2	1.200	-7.425	10.878	-.000	40.00	5.00	24.04	.00	33.17	.00	4.30	.00	7/8" @ 300		
2	1.600	-8.596	10.878	-3.356	40.00	5.00	25.10	4.63	36.16	15.01	5.91	.00			
2	2.000	-11.116	10.878	-6.712	40.00	5.00	28.05	9.27	45.16	30.01	10.73	.00			
2	2.400	-13.466	10.878	-10.068	40.00	5.00	32.38	13.90	60.15	45.02	18.77	.00			(3/4" @300
3	.000	-12.146	10.068	18.877	40.00	5.00	30.75	26.07	54.25	84.41	21.90	.00			7/8" @300
3	.750	2.674	10.068	12.585	40.00	5.00	14.43	17.38	11.95	56.27	.56	.00			
3	1.500	9.793	10.068	6.293	40.00	5.00	27.55	8.69	43.57	28.14	16.17	.00			
3	2.250	12.113	10.068	.000	40.00	5.00	30.71	.00	54.11	.00	21.82	.00			
3	3.000	9.793	10.068	-6.292	40.00	5.00	27.55	8.69	43.57	28.14	16.17	.00			
3	3.750	2.674	10.068	-12.585	40.00	5.00	14.43	17.38	11.95	56.27	.56	.00			
3	4.500	-12.146	10.068	-18.877	40.00	5.00	30.75	26.07	54.25	84.41	21.90	.00			
4	.000	-13.466	10.878	10.068	40.00	5.00	32.38	13.90	60.15	45.02	18.77	.00			
4	.400	-11.116	10.878	6.712	40.00	5.00	28.05	9.27	45.16	30.01	10.73	.00			
4	.800	-8.596	10.878	3.356	40.00	5.00	25.10	4.63	36.16	15.01	5.91	.00			
4	1.200	-7.425	10.878	-.000	40.00	5.00	24.04	.00	33.17	.00	4.30	.00			
4	1.600	-8.596	10.878	-3.356	40.00	5.00	25.10	4.63	36.16	15.01	5.91	.00			
4	2.000	-11.116	10.878	-6.712	40.00	5.00	28.05	9.27	45.16	30.01	10.73	.00			
4	2.400	-13.466	10.878	-10.068	40.00	5.00	32.38	13.90	60.15	45.02	18.77	.00			

5) Distribuisão das Vigas



0.20

3/4"@300

4.10 x 90

0.20

0.90 2.00 0.90

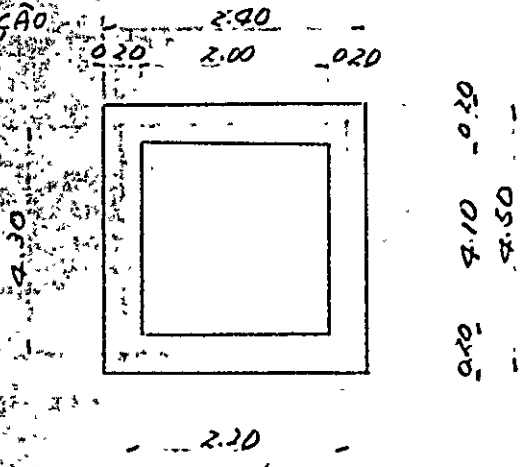
2.80

BAR Distribuisão 1/2"@300

7.4 TANQUE DE CONTROLE DE PRESSÃO (PARTE SUPERIOR)

Fazer o cálculo na superficie do terreno

1) Forma da secção



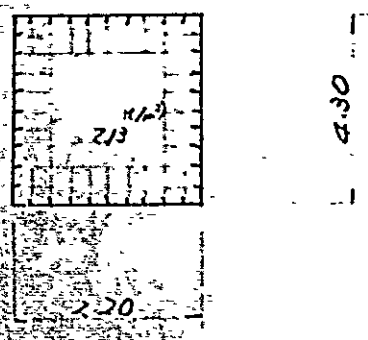
2) Carga

Nivel máximo interno da água RL 7.43

Superficie do terreno RL 5.30

Pressão interna d'água $p = 1.0 (7.43 - 5.30) = 2.13$ (t/m^2)

3) Quadro da carga



*** STRUCTURE NO. 3 PLANE FRAME ***

Tanque de controle de pressão (Parte superior)

*** STRUCTURE DATA ***

N	NJ	NR	IRJ	E
4	9	4	3	2	2100000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	4.300
3	2.200	4.300
4	2.200	.000

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.200	.001	4.300
2	2	3	.200	.001	2.200
3	3	4	.200	.001	4.300
4	4	1	.200	.001	2.200

*** RESTRAINTS ***

RL1	RL2	RL3
1	1	0
0	1	0

*** LOAD CASE - (1) ***

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-B-	-AS-	-PA-	-CS-	-PB-
1	1	2	1	.000E+00	-.213E+01	.430E+01	-.213E+01
2	1	2	2	.000E+00	-.213E+01	.220E+01	-.213E+01
3	1	2	3	.000E+00	-.213E+01	.430E+01	-.213E+01
4	1	2	4	.000E+00	-.213E+01	.220E+01	-.213E+01

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	.000000E+00	.000000E+00	-.12531E-02
2	-.239096E-11	-.239065E-04	.12531E-02
3	-.239865E-04	-.239865E-04	-.12531E-02
4	-.239238E-04	.000000E+00	.12531E-02

*** MAXIMUM MOMENT ***

MEMBERS		DIST.	M-MAX	- S -	- N -
1	2	2.150	-2.461	.000	-2.343
2		1.100	1.173	.000	-4.579
3		2.150	-2.461	.000	-2.343
4		1.100	1.173	.000	-4.580

*** CASE NO. 1 ***

M- PT	DIST.	- N -	- S -	- F -
1 - 1	.000	-2.343	-4.579	2.462
1 - 2	.717	-2.343	-3.053	-.273
1 - 3	1.433	-2.343	-1.526	-1.914
1 - 4	2.150	-2.343	-.000	-2.461
1 - 5	2.867	-2.343	1.526	-1.914
1 - 6	3.583	-2.343	3.053	-.273
1 - 7	4.300	-2.343	4.579	2.462
2 - 1	.000	-4.579	-2.343	2.462
2 - 2	.367	-4.579	-1.562	1.746
2 - 3	.733	-4.579	-.781	1.316
2 - 4	1.100	-4.579	.000	1.173
2 - 5	1.467	-4.579	.781	1.316
2 - 6	1.833	-4.579	1.562	1.746
2 - 7	2.200	-4.579	2.343	2.462
3 - 1	.000	-2.343	-4.579	2.462
3 - 2	.717	-2.343	-3.053	-.273
3 - 3	1.433	-2.343	-1.526	-1.914
3 - 4	2.150	-2.343	-.000	-2.461
3 - 5	2.867	-2.343	1.526	-1.914
3 - 6	3.583	-2.343	3.053	-.273
3 - 7	4.300	-2.343	4.579	2.462
4 - 1	.000	-4.580	-2.343	2.462
4 - 2	.367	-4.580	-1.562	1.746
4 - 3	.733	-4.580	-.781	1.316
4 - 4	1.100	-4.580	.000	1.173
4 - 5	1.467	-4.580	.781	1.316
4 - 6	1.833	-4.580	1.562	1.746
4 - 7	2.200	-4.580	2.343	2.462

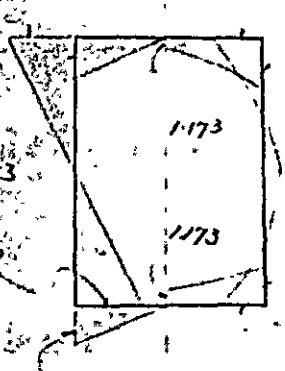
*** CALCULATION OF REINFORCEMENT ***

* ALLOWABLE STRESS SSA = 1400.00 MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SCA = 70.00 SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
TAUA = 8.50 CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
TAUIA = 7.50 U ... CIRCUMFERENCE OF REINFORCEMENT
SSA' = .00

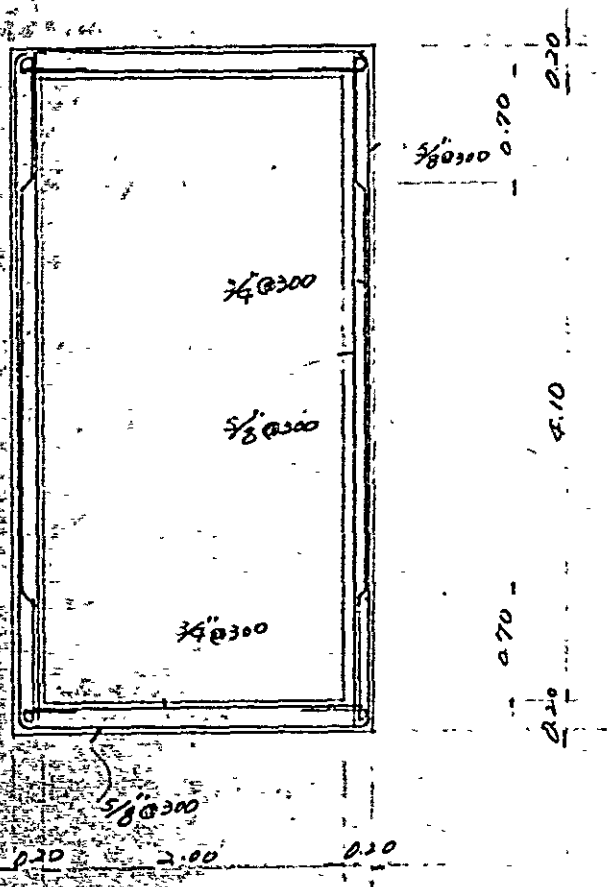
MEMBER	IST	IS	IM	S	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2	
1	.000	2.343	-2.343	-4.579	20.00	5.00	13.51	6.32	57.02	47.78			14.78	.00	5/8" @300
1	.717	-.116	-2.343	-3.053	20.00	5.00	3.48	4.22	3.79	31.85			2.54	.00	3/4"@300
1	1.433	-1.797	-2.343	-1.526	20.00	5.00	11.83	2.11	43.70	15.93			11.72	.00	
1	2.150	-2.344	-2.343	-.000	20.00	5.00	13.51	.00	57.00	.00			14.77	.00	(7/8"@300
1	2.867	-1.797	-2.343	1.526	20.00	5.00	11.83	2.11	43.70	15.93			11.72	.00	3/4"@300
1	3.583	-.116	-2.343	3.053	20.00	5.00	3.48	4.22	3.79	31.85			2.54	.00	
1	4.300	2.343	-2.343	4.579	20.00	5.00	13.51	6.32	57.02	47.78			14.78	.00	(5/8"@300
															3/4"@300
2	1.000	2.223	-4.579	-2.343	20.00	5.00	13.18	3.24	54.30	24.44			15.75	.00	5/8"@300
2	.267	1.517	-4.579	-1.562	20.00	5.00	10.87	2.16	36.89	16.30			11.75	.00	3/4"@300
2	.733	1.007	-4.579	-.781	20.00	5.00	9.20	1.08	26.45	8.15			9.35	.00	
2	1.100	.944	-4.579	.000	20.00	5.00	8.57	.00	22.96	.00			8.55	.00	3/4"@300
2	1.467	1.007	-4.579	.781	20.00	5.00	9.20	1.08	26.45	8.15			9.35	.00	
2	1.833	1.517	-4.579	1.562	20.00	5.00	10.87	2.16	36.89	16.30			11.75	.00	
2	2.200	2.223	-4.579	2.343	20.00	5.00	13.18	3.24	54.30	24.44			15.75	.00	5/8"@300
															3/4"@300
3	.000	2.343	-2.343	-4.579	20.00	5.00	13.51	6.32	57.02	47.78			14.78	.00	
3	.717	-.116	-2.343	-3.053	20.00	5.00	3.48	4.22	3.79	31.85			2.54	.00	
3	1.433	-1.797	-2.343	-1.526	20.00	5.00	11.83	2.11	43.70	15.93			11.72	.00	
3	2.150	-2.344	-2.343	-.000	20.00	5.00	13.51	.00	57.00	.00			14.77	.00	
3	2.867	-1.797	-2.343	1.526	20.00	5.00	11.83	2.11	43.70	15.93			11.72	.00	
3	3.583	-.116	-2.343	3.053	20.00	5.00	3.48	4.22	3.79	31.85			2.54	.00	
3	4.300	2.343	-2.343	4.579	20.00	5.00	13.51	6.32	57.02	47.78			14.78	.00	
4	.000	2.223	-4.579	-2.343	20.00	5.00	13.18	3.24	54.30	24.44			15.75	.00	
4	.267	1.517	-4.579	-1.562	20.00	5.00	10.87	2.16	36.89	16.30			11.75	.00	
4	.733	1.007	-4.579	-.781	20.00	5.00	9.20	1.08	26.45	8.15			9.35	.00	
4	1.100	.944	-4.579	.000	20.00	5.00	8.57	.00	22.96	.00			8.55	.00	
4	1.467	1.007	-4.579	.781	20.00	5.00	9.20	1.08	26.45	8.15			9.35	.00	
4	1.833	1.517	-4.579	1.562	20.00	5.00	10.87	2.16	36.89	16.30			11.75	.00	
4	2.200	2.223	-4.579	2.343	20.00	5.00	13.18	3.24	54.30	24.44			15.75	.00	

4) QUADRO S e QUADRO M,

QUADRO S. QUADRO M



5) QUADRO DA DISTRIBUIÇÃO DAS VIGAS



2.5. Fundo do tanque do CONTROLE DE PRESSÃO

Calcular apenas dois lados dos quatro lados fixos

vão 2.40m x 4.50m

Comparação comprimentox altura = $ly/lx = 0.53$

1). Carga

Tanque de controle de pressão parte inferior cfr.

$W = 8.39 \ t/m^2$

2). Momento da curvatura

Momento máximo, Apartir do gráfico $\alpha = 0.0044$ $\beta = 0.0336$

$M_{max} = \alpha \cdot w \cdot l_x^2 = 0.0044 \times 8.39 \times 4.50^2 = 0.75 \ t\text{-m}$

$M_{max} = \alpha \cdot \beta \cdot l_y^2 = 0.0336 \times 8.39 \times 2.40^2 = 1.62 \ t\text{-m}$

Momento maximo da extremidade $r = 0.1147$, $\delta = 0.8853$

$M_{max} = \frac{1}{12} \times r \cdot w \cdot l_x^2 = \frac{1}{12} \times 0.1147 \times 8.39 \times 4.50^2 = 1.621 \ t\text{-m}$

$M_{max} = \frac{1}{12} \times \delta \cdot w \cdot l_y^2 = \frac{1}{12} \times 0.8853 \times 8.39 \times 2.40^2 = 3.57 \ t\text{-m}$

3) Cálculo da quantidade de vigas de ferro

Calculo da espessura útil

$$d = C_1 \sqrt{\frac{M}{b}} = 0.279 \sqrt{\frac{357000}{100}} = 16.67 \ cm < 40 - 5 = 35.0 \ cm$$

Quantidade de vigas ferro

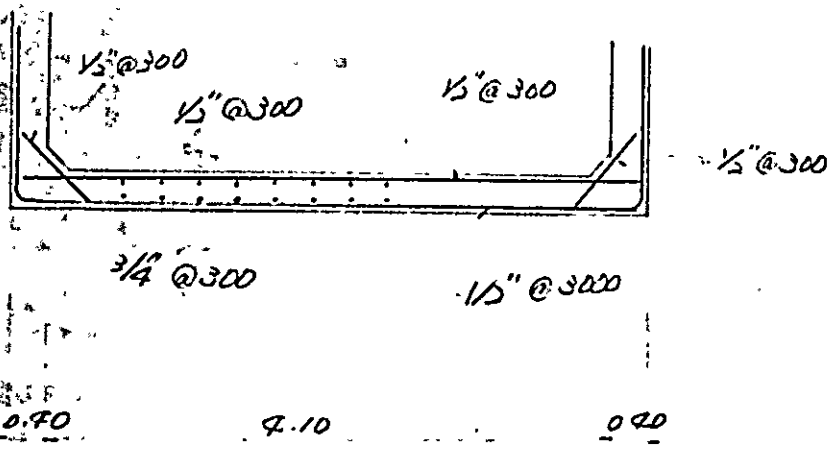
parte CENTRO $A_s = \frac{M}{\sigma_{sa} \cdot j \cdot d} = \frac{162000}{1400 \times 0.862 \times 31} = 3.84 \ cm^2$

1/2" @300 $A_s = 4.23 \ cm^2$

Extremidade: $A_s = \frac{M}{\sigma_{sa} \cdot j \cdot d} = \frac{357000}{1900 \times 0.862 \times 35} = 8.45 \text{ cm}^2$

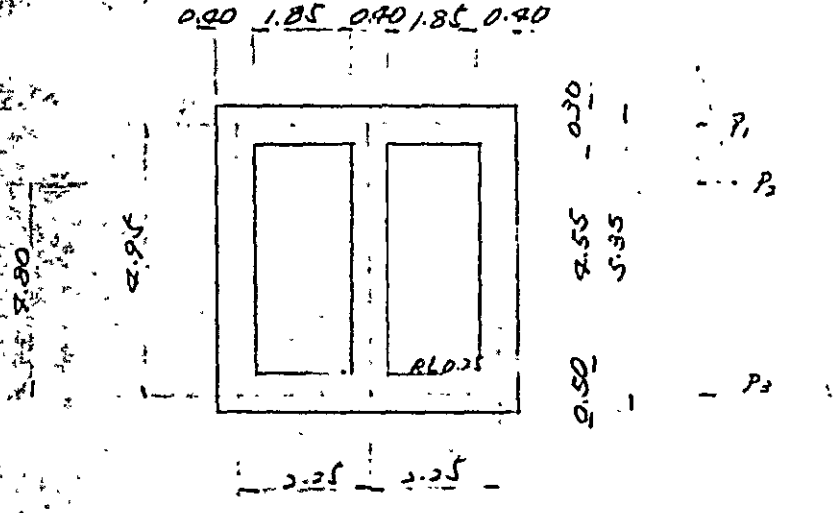
3/4" @300 $A_s = 9.49 \text{ cm}^2$

4) Quadro de distribuisāu de vigas



2.6. PARTE DE ENTRADA 1

1) Forma de secção



2) Carga

Carga do automóvel 14(t) $\ell = 2.25^{m}$

Coeficiente de choque $i = \frac{7}{20+\ell} = \frac{7}{22.25} = 0.31$

Carga do fio $P = 3.5$ (t)

Carga de distribuição $p = 0.245$ (t/m^2)

Carga de distribuição uniforme

$$W_L = \left(\frac{2P}{\ell} + p\right)(1+i) = \left(\frac{2\times 3.5}{2.25} + 0.245\right)(1+0.31)$$

$$= 4.40 \ (t/m^2)$$

PESO DE PRATO BASE $W_1 = 0.3 \times 2.4 = 0.72 \ (t/m^2)$

FORÇA DE PRESSÃO DO TERRENO

Tomando em conta a pressão de terra em PAZ.
altura da conversão do terreno é a carga de veículo
$h' = 0.53$ (m)

$P_1 = K_1 \cdot h \cdot (0.15 + 0.3) = 0.5 \times 1.8 \times 0.68 = 0.61 \ (t/m^2)$

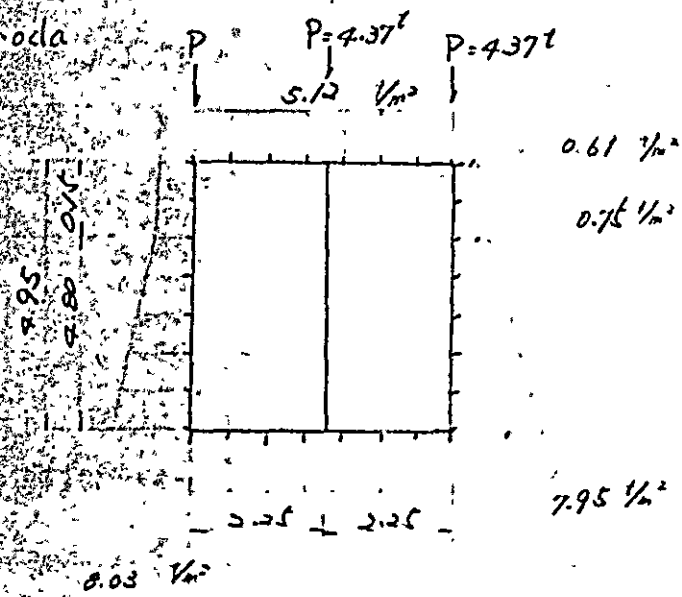
$P_2 = 0.5 \times 1.8 \times (0.53 + 0.30) = 0.75 \ (t/m^2)$

$P_3 = P_2 + K_1 \gamma_s \cdot 4.80 + 1.0 \times 4.80 = 0.75 + 7.20 = 7.95 \ (t/m^2)$

PESO DE PAREDES $P_p = 0.4 \times 4.55 \times 2.4 = 11.37\ t$

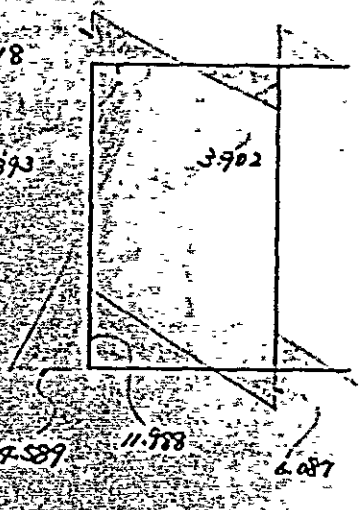
Folga contrária do fundo $q = (W_L + W)_1 \frac{3P_p}{4.50} = 4.40 + 0.72 + 2.91 = 8.03\ t/m^2$

3) Quadro da carga

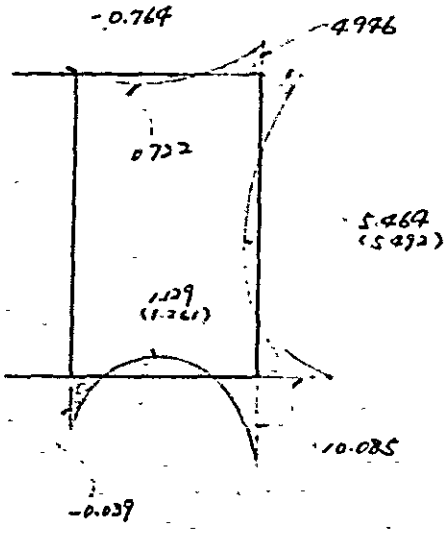


4) Quadro S. Quadro M.

Quadro S.



Quadro M



*** STRUCTURE NO. 3 PLANE FRAME ***

Parte de ENTRADA 1

*** STRUCTURE DATA ***

NP	NM	NJ	NR	NRJ	E
7	14	6	4	3	2100000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	4.950
3	2.250	4.950
4	4.500	4.950
5	4.500	.000
6	2.250	.000

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.400	.005	4.950
2	2	3	.300	.002	2.250
3	3	4	.300	.002	2.250
4	4	5	.400	.005	4.950
5	5	6	.500	.010	2.250
6	6	1	.500	.010	2.250
7	3	6	.400	.005	4.950

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
6	0	1	0
5	0	1	0

*** LOAD CASE - (1). ***

***ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
2	.00000	4.3700	.00000
3	.00000	4.37000	.00000
4	.00000	4.37000	.00000

***ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-N-	-AS-	-PA-	-CS-	-PB-
1	1	2	1	.000E+00	.795E+01	.480E+01	.750E+00
2	1	2	1	.480E+01	.750E+00	.150E+00	.610E+00
3	1	2	2	.000E+00	.512E+01	.225E+01	.512E+01
4	1	2	3	.000E+00	.512E+01	.225E+01	.512E+01
5	1	2	4	.000E+00	.610E+00	.150E+00	.750E+00
6	1	2	4	.150E+00	.750E+00	.480E+01	.795E+01
7	1	2	5	.000E+00	.803E+01	.225E+01	.803E+01
8	1	2	6	.000E+00	.803E+01	.225E+01	.803E+01

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	.00000E+00	.00000E+00	.17216E-03
2	.24295E-05	.70646E-04	-.33088E-03
3	.31262E-04	.71735E-04	.10392E-12
4	.54094E-04	.70646E-04	.33088E-03
5	.62529E-14	.00000E+00	-.17216E-03
6	.31262E-04	.00000E+00	-.26645E-13

*** MAXIMUM MOMENT ***

MEMBERS	DIST.	M-MAX	- S -	- N -
1	1 2	2.351	5.492	.000	11.988
2	2 3	1.408	.722	.000	6.393
3	3 4	.762	.722	.000	6.393
4	4 5	2.589	5.492	.000	11.988
5	5 6	1.681	1.261	.000	14.589
6	6 1	.569	1.261	.000	14.589
7	3 2	********	********	********	********

*** CASE NO. 1 ***

PT	DIST.	N	S	P
1	1 .000	11.988	14.589	-10.085
1	2 .825	11.988	8.541	-.614
1	3 1.650	11.988	3.513	4.288
1	4 2.475	11.988	-.493	5.464
1	5 3.300	11.988	-3.479	3.755
1	6 4.125	11.988	-5.443	.005
1	7 4.950	11.988	-6.393	-4.946
2	1 .000	6.393	7.618	-4.946
2	2 .375	6.393	5.698	-2.449
2	3 .750	6.393	3.778	-.672
2	4 1.125	6.393	1.858	.385
2	5 1.500	6.393	-.062	.722
2	6 1.875	6.393	-1.982	.339
2	7 2.250	6.393	-3.902	-.764
3	1 .000	6.393	3.902	-.764
3	2 .375	6.393	1.982	.339
3	3 .750	6.393	.062	.722
3	4 1.125	6.393	-1.858	.385
3	5 1.500	6.393	-3.778	-.672
3	6 1.875	6.393	-5.698	-2.449
3	7 2.250	6.393	-7.618	-4.946
4	1 .000	11.988	6.393	-4.946
4	2 .825	11.988	5.443	.005
4	3 1.650	11.988	3.479	3.755
4	4 2.475	11.988	.493	5.464
4	5 3.300	11.988	-3.513	4.288
4	6 4.125	11.988	-8.541	-.614
4	7 4.950	11.988	-14.589	-10.085
5	1 .000	14.589	11.988	-10.085
5	2 .375	14.589	10.487	-5.587
5	3 .750	14.589	7.476	-2.219
5	4 1.125	14.589	4.465	.020
5	5 1.500	14.589	1.453	1.129
5	6 1.875	14.589	-1.558	1.110
5	7 2.250	14.589	-6.087	-.039
6	1 .000	14.589	6.087	-.039
6	2 .375	14.589	1.558	1.110
6	3 .750	14.589	-1.453	1.129
6	4 1.125	14.589	-4.465	.020
6	5 1.500	14.589	-7.476	-2.219
6	6 1.875	14.589	-10.487	-5.587
6	7 2.250	14.589	-11.988	-10.085
7	1 .000	12.173	.000	.000
7	2 .375	12.173	.000	.000
7	3 .750	12.173	.000	.000
7	4 1.125	12.173	.000	.000
7	5 1.500	12.173	.000	.000
7	6 1.875	12.173	.000	.000
7	7 2.250	12.173	.000	.000

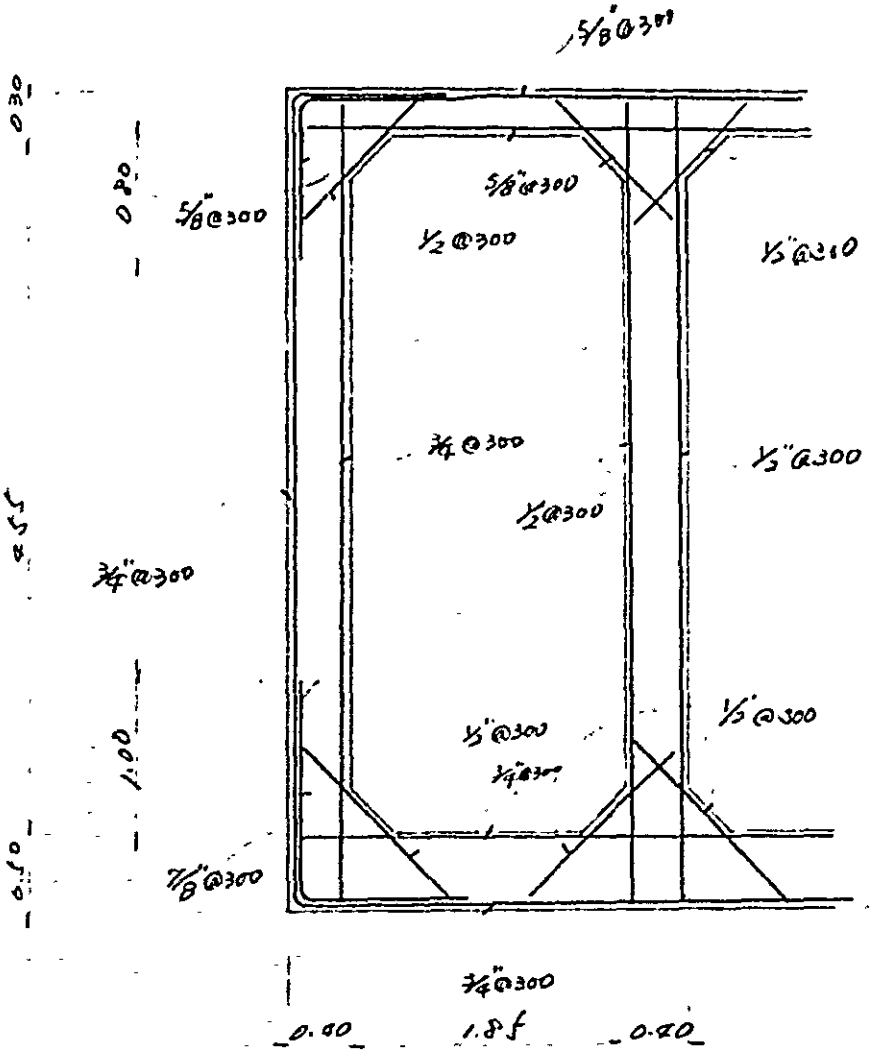
ALLOWABLE STRESS — SSA = 1400.00; RCA = 70.00; TAUA = 8.50; TAUDA = 7.50; SSA' = .00

HD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

PERIOD	DIST	S	M	T	TT	DD	HD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2	
1	.000	-11.900	11.900	14.589	40.00	5.00	30.41	20.14	53.08	65.23	19.90	.00			#4@3"
1	.375	-7.614	11.988	8.541	40.00	5.00	6.91	11.79	2.74	38.19	.00	.00			#7@6"
1	1.000	-5.006	11.988	3.513	40.00	5.00	21.77	4.85	27.19	15.71	6.02	.00			
1	1.500	-3.503	11.988	-.493	40.00	5.00	23.78	.68	32.44	2.20	8.83	.00			#4@6"
1	1.875	-2.625	11.988	-3.479	40.00	5.00	20.79	4.80	24.81	15.55	4.74	.00			
1	2.250	-1.744	11.988	-5.443	40.00	5.00	.61	7.52	.02	24.34	.00	.00			
1	2.500	-1.160	11.988	-6.393	40.00	5.00	22.91	8.83	30.12	28.59	7.59	.00			#4@3"
2	.000	-5.505	6.393	-7.618	30.00	5.00	20.85	10.52	48.89	47.69	14.16	.00			#4@3"
2	.375	-3.002	6.393	-5.448	30.00	5.00	15.50	7.87	27.03	35.67	5.79	.00			#7@6"
2	.750	-1.311	6.393	-3.278	30.00	5.00	10.10	5.22	11.48	23.65	.66	.00			
2	1.125	.385	6.393	-1.058	30.00	5.00	5.48	2.57	3.37	11.63	.04	.00			#4@6"
2	1.500	1.361	6.393	.062	30.00	5.00	10.29	.09	11.92	.39	.80	.00			
2	1.875	.339	6.393	-1.982	30.00	5.00	5.14	2.74	2.97	12.40	.00	.00			
2	2.250	-1.403	6.393	-3.902	30.00	5.00	10.45	5.39	12.29	24.42	.14	.00			#4@3"
3	.000	-1.403	6.393	3.902	30.00	5.00	10.45	5.39	12.29	24.42	.14	.00			
3	.375	.339	6.393	1.982	30.00	5.00	5.14	2.74	2.97	12.40	.00	.00			
3	.750	1.361	6.393	.062	30.00	5.00	10.29	.09	11.92	.39	.80	.00			
3	1.125	.385	6.393	-1.858	30.00	5.00	5.48	2.57	3.37	11.63	.04	.00			
3	1.500	-1.311	6.393	-3.778	30.00	5.00	10.10	5.22	11.48	23.65	.66	.00			
3	1.875	-3.008	6.393	-5.648	30.00	5.00	15.50	7.87	27.03	35.67	5.79	.00			
3	2.250	-5.505	6.393	-7.618	30.00	5.00	20.85	10.52	48.89	47.69	14.16	.00			
4	.000	-6.744	11.988	6.393	40.00	5.00	22.91	8.83	30.12	28.59	7.59	.00			
4	.375	.065	11.988	5.443	40.00	5.00	.61	7.52	.02	24.34	.00	.00			
4	1.000	5.593	11.988	3.479	40.00	5.00	20.79	4.80	24.81	15.55	4.74	.00			
4	1.500	7.762	11.988	.493	40.00	5.00	23.78	.68	32.44	2.20	8.83	.00			
4	1.875	6.856	11.988	-3.513	40.00	5.00	21.77	4.85	27.19	15.71	6.02	.00			
4	2.250	-.614	11.988	-8.541	40.00	5.00	6.91	11.79	2.74	38.19	.00	.00			
4	2.500	-11.900	11.988	-14.589	40.00	5.00	30.41	20.14	53.08	65.23	19.90	.00			
5	.000	-13.000	14.589	11.988	50.00	5.00	31.81	16.55	35.13	41.69	13.80	.00			#4@3"
5	.375	-9.497	14.589	10.467	50.00	5.00	25.73	14.48	22.98	36.47	5.42	.00			#7@6"
5	.750	-5.137	14.589	7.476	50.00	5.00	20.06	10.32	13.88	26.00	.97	.00			
5	1.125	-.924	14.589	4.485	50.00	5.00	1.23	6.17	.05	15.53	.00	.00			#4@6"
5	1.500	1.113	14.589	1.493	50.00	5.00	9.38	2.01	3.05	5.05	.00	.00			
5	1.875	1.113	14.589	-1.498	50.00	5.00	9.29	2.15	3.00	5.42	.00	.00			
5	2.250	-.924	14.589	-4.487	50.00	5.00	1.75	8.40	.11	21.17	.00	.00			#4@3"
6	.000	-5.137	14.589	4.487	50.00	5.00	1.75	8.40	.11	21.17	.00	.00			
6	.375	1.113	14.589	1.498	50.00	5.00	9.29	2.15	3.00	5.42	.00	.00			
6	.750	1.113	14.589	-1.493	50.00	5.00	9.38	2.01	3.05	5.05	.00	.00			
6	1.125	-.924	14.589	-4.485	50.00	5.00	1.23	6.17	.05	15.53	.00	.00			
6	1.500	-5.137	14.589	-7.476	50.00	5.00	20.06	10.32	13.88	26.00	.97	.00			
6	1.875	-9.497	14.589	-10.467	50.00	5.00	25.73	14.48	22.98	36.47	5.42	.00			
6	2.250	-13.000	14.589	-11.988	50.00	5.00	31.81	16.55	35.13	41.69	13.80	.00			

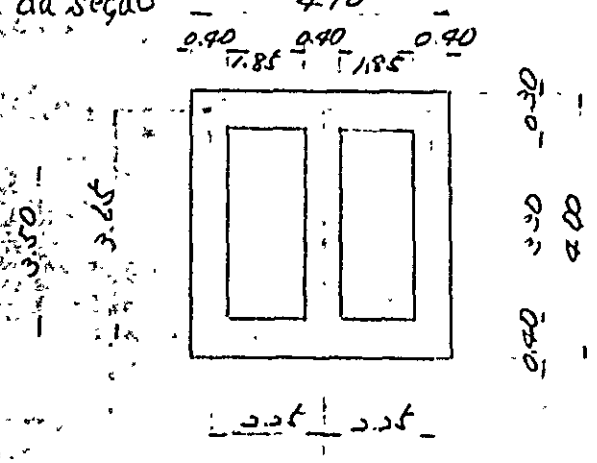
MEMBER	DIST	E	N	S	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
7	.000	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	.825	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	1.650	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	2.475	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	3.300	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	4.125	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	4.950	-.000	12.173	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		

5) Quadro da distribuição das vigas



2.7 PARTE DE ENTRADA

1) Forma da seção



2) Carga

Carga do veículo 14 t. $q_L = 4.90$ t/m²)

Precaução com o leito $w_1 = 0.72$ t/m²)

Parte do entrada 1 (cfr.)

força da pressão da terra $P_1 = 0.61$ t/m²

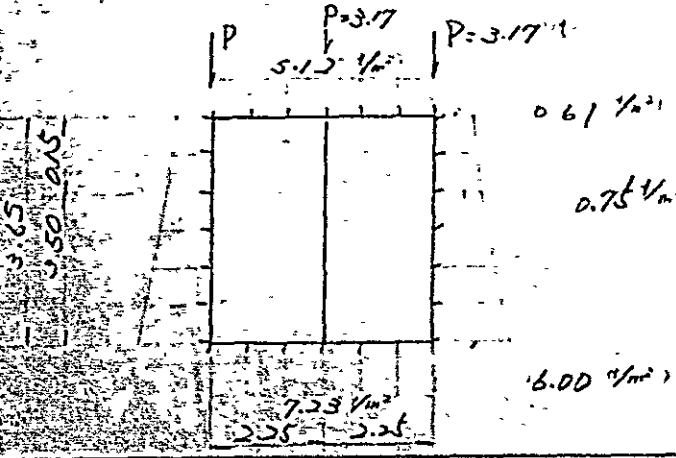
$P_2 = 0.75$ t/m²

$P_3 = 0.75 + K_0 \gamma_s 3.50 + 1.0 \times 3.50 = 6.00$ (t/m²)

Precaução com a parede $P_p = 0.4 \times 3.3 \times 2.4 = 3.17$ t)

Força contrária do leito $q = w_L + w_1 + \frac{3 \times P_p}{4.5} = 4.90 + 0.72 + \frac{3 \times 3.17}{4.5} = 7.23$ t/m²)

3) Quadro de carga



*** STRUCTURE NO. 3 PLANE FRAME ***

Parte de entrada 2.

*** STRUCTURE DATA ***

NM	NJ	NR	NRJ	E
7	14	6	4	3	2100000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	3.650
3	2.250	3.650
4	4.500	3.650
5	4.500	.000
6	2.250	.000

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.400	.005	3.650
2	2	3	.300	.002	2.250
3	3	4	.300	.002	2.250
4	4	5	.400	.005	3.650
5	5	6	.400	.005	2.250
6	6	1	.400	.005	2.250
7	3	6	.400	.005	3.650

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
6	0	1	0
5	0	1	0

*** LOAD CASE - (31) ***

*** ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
2	.00000	3.17000	.00000
3	.00000	3.17000	.00000
4	.00000	3.17000	.00000

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-M-	-AS-	-PA-	-CS-	-PB-
1	1	2	1	.000E+00	.600E+01	.350E+01	.750E+00
2	1	2	1	.350E+01	.750E+00	.150E+00	.610E+00
3	1	2	2	.000E+00	.512E+01	.225E+01	.512E+01
4	1	2	3	.000E+00	.512E+01	.225E+01	.512E+01
5	1	2	4	.000E+00	.610E+00	.150E+00	.750E+00
6	1	2	4	.150E+00	.750E+00	.350E+01	.600E+01
7	1	2	5	.000E+00	.723E+01	.225E+01	.723E+01
8	1	2	6	.000E+00	.723E+01	.225E+01	.723E+01

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS.	Y-DIS	ROTA.
1	.00000E+00	.00000E+00	.45298E-04
2	.72103E-05	.40480E-04	-.51131E-04
3	.21327E-04	.60473E-04	-.23315E-13
4	.35443E-04	.40480E-04	.51131E-04
5	.42653E-04	.00000E+00	-.45298E-04
6	.21327E-04	.00000E+00	-.57732E-14

*** MAXIMUM MOMENT ***

MEMBERS		DIST.	M-MAX	- S -	- N -
1	1 2	1.680	2.143	.000	9.316
2	2 3	1.20	.987	.000	3.953
3	3 4	1.050	.987	.000	3.953
4	4 5	1.97	2.143	.000	9.316
5	5 6	1.208	1.325	.000	7.962
6	6 1	1.042	1.325	.000	7.962
7	3 6	********	*********	********	*********

*** CASE NO. 1 ***

- I - PT - DIST -	- N -	- S -	- M -
1 - 1 .000	9.316	7.962	-3.952
1 - 2 .678	9.316	4.589	-.162
1 - 3 1.217	9.316	1.772	1.745
1 - 4 1.825	9.316	-.490	2.107
1 - 5 2.433	9.316	-2.197	1.761
1 - 6 3.042	9.316	-3.349	-.454
1 - 7 3.650	9.316	-3.953	-2.701
2 - 1 .000	3.953	6.146	-2.701
2 - 2 .375	3.953	4.226	-.757
2 - 3 .750	3.953	2.306	.468
2 - 4 1.125	3.953	.386	.973
2 - 5 1.500	3.953	-1.534	.757
2 - 6 1.875	3.953	-3.454	-.178
2 - 7 2.250	3.953	-5.374	-1.833
3 - 1 .000	3.953	5.374	-1.833
3 - 2 .375	3.953	3.454	-.178
3 - 3 .750	3.953	1.534	.757
3 - 4 1.125	3.953	-.386	.973
3 - 5 1.500	3.953	-2.306	.468
3 - 6 1.875	3.953	-4.226	-.757
3 - 7 2.250	3.953	-6.146	-2.701
4 - 1 .000	9.316	3.953	-2.701
4 - 2 .678	9.316	3.349	-.454
4 - 3 1.217	9.316	2.197	1.761
4 - 4 1.825	9.316	.490	2.107
4 - 5 2.433	9.316	-1.772	1.745
4 - 6 3.042	9.316	-4.589	-.162
4 - 7 3.650	9.316	-7.962	-3.952
5 - 1 .000	7.962	9.316	-3.952
5 - 2 .375	7.962	6.823	-1.184
5 - 3 .750	7.962	3.312	.566
5 - 4 1.125	7.962	.601	1.300
5 - 5 1.500	7.962	-2.110	1.017
5 - 6 1.875	7.962	-4.822	-.283
5 - 7 2.250	7.962	-6.959	-2.599
6 - 1 .000	7.962	6.959	-2.599
6 - 2 .375	7.962	4.822	-.283
6 - 3 .750	7.962	2.110	1.017
6 - 4 1.125	7.962	-.601	1.300
6 - 5 1.500	7.962	-3.312	.566
6 - 6 1.875	7.962	-6.023	-1.184
6 - 7 2.250	7.962	-9.316	-3.952
7 - 1 .000	13.918	.000	-.000
7 - 2 .678	13.918	.000	-.000
7 - 3 1.217	13.918	.000	-.000
7 - 4 1.825	13.918	.000	-.000
7 - 5 2.433	13.918	.000	.000
7 - 6 3.042	13.918	.000	.000
7 - 7 3.650	13.918	.000	.000

*** CALCULATION OF REINFORCEMENT ***

* ALLOWABLE STRESS

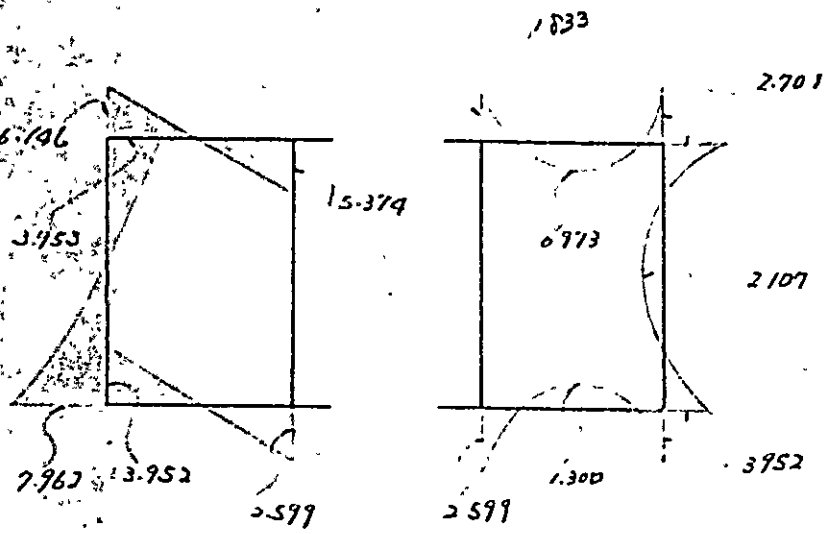
SSA = 1400.00
SCA = 70.00
TAUA = 8.50
TAUDA = 7.50
SSA' = .00

ND ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

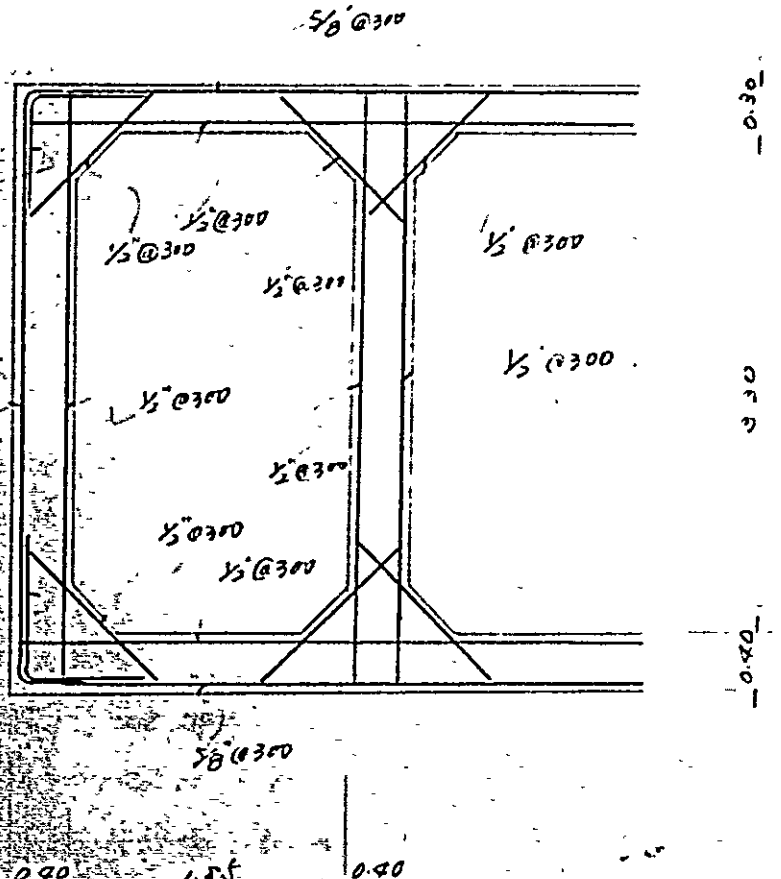
MEMBER	DIST	-S-	-N-	-S-	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2	
1	.000	-5.340	9.316	7.962	40.00	5.00	20.40	10.99	23.89	35.60	6.16	.00			5/8" @300
1	.688	-4.162	9.316	4.589	40.00	5.00	3.55	6.34	.72	20.52	.00	.00			
1	1.417	3.142	9.316	1.772	40.00	5.00	15.64	2.45	14.04	7.92	.87	.00			
1	1.875	3.504	9.316	-.490	40.00	5.00	16.52	.68	15.65	2.19	1.74	.00			1/2 @300
1	2.433	2.617	9.316	-2.197	40.00	5.00	14.39	3.03	11.88	9.82	.87	.00			
1	3.042	-.494	9.316	-3.349	40.00	5.00	5.94	4.62	2.03	14.98	.00	.00			
1	3.050	-4.099	9.316	-3.953	40.00	5.00	17.86	5.46	18.31	17.67	3.16	.00			1/2" @300
2	.000	-3.097	3.953	6.146	30.00	5.00	15.53	8.49	27.11	38.47	7.56	.00			1/2" @300
2	.375	-1.152	3.953	4.726	30.00	5.00	9.47	5.84	10.09	26.45	1.04	.00			5/8" @300
2	.750	.843	3.953	2.906	30.00	5.00	8.20	3.18	7.56	14.43	.07	.00			
2	1.125	1.368	3.953	.086	30.00	5.00	10.32	.53	11.98	2.42	1.76	.00			1/2" @300
2	1.500	1.157	3.953	-1.534	30.00	5.00	9.47	2.12	10.09	9.60	1.04	.00			
2	1.875	-.178	3.953	-3.454	30.00	5.00	3.72	4.77	1.56	21.62	.00	.00			
2	2.250	-2.229	3.953	-5.374	30.00	5.00	13.17	7.42	19.51	33.64	4.65	.00			5/8" @300
3	.000	-2.229	3.953	5.374	30.00	5.00	13.17	7.42	19.51	33.64	4.65	.00			
3	.375	-.178	3.953	3.454	30.00	5.00	3.72	4.77	1.56	21.62	.00	.00			
3	.750	1.157	3.953	1.534	30.00	5.00	9.47	2.12	10.09	9.60	1.04	.00			
3	1.125	1.368	3.953	-.086	30.00	5.00	10.32	.53	11.98	2.42	1.76	.00			
3	1.500	.843	3.953	-2.906	30.00	5.00	8.20	3.18	7.56	14.43	.07	.00			
3	1.875	-1.152	3.953	-4.726	30.00	5.00	9.47	5.84	10.09	26.45	1.04	.00			
3	2.250	-3.097	3.953	-6.146	30.00	5.00	15.53	8.49	27.11	38.47	7.56	.00			
4	.000	-4.099	9.316	3.953	40.00	5.00	17.86	5.46	18.31	17.67	3.16	.00			
4	.688	-4.494	9.316	3.349	40.00	5.00	5.94	4.62	2.03	14.98	.00	.00			
4	1.417	2.617	9.316	2.197	40.00	5.00	14.39	3.03	11.88	9.82	.87	.00			
4	1.875	3.504	9.316	.490	40.00	5.00	16.52	.68	15.65	2.19	1.74	.00			
4	2.433	3.142	9.316	-1.772	40.00	5.00	15.64	2.45	14.04	7.92	.87	.00			
4	3.042	-.162	9.316	-4.589	40.00	5.00	3.55	6.34	.72	20.52	.00	.00			
4	3.050	-5.340	9.316	-7.962	40.00	5.00	20.40	10.99	23.89	35.60	6.16	.00			
5	.000	-5.146	7.962	9.316	40.00	5.00	20.01	12.86	22.99	41.65	6.64	.00			5/8 @300
5	.375	-2.329	7.962	6.923	40.00	5.00	13.61	8.37	10.63	26.93	.01	.00			1/2" @300
5	.750	.564	7.962	3.312	40.00	5.00	6.64	4.57	2.53	14.81	.01	.00			
5	1.125	2.494	7.962	.601	40.00	5.00	13.93	.83	11.14	2.69	.29	.00			1/2" @300
5	1.500	2.211	7.962	-2.119	40.00	5.00	13.12	2.91	9.88	9.44	.62	.00			
5	1.875	-.217	7.962	-4.872	40.00	5.00	4.69	6.66	1.26	21.56	.00	.00			
5	2.250	-3.794	7.962	-6.959	40.00	5.00	17.18	9.61	16.95	31.12	3.40	.00			5/8" @300
6	.000	-3.794	7.962	6.959	40.00	5.00	17.18	9.61	16.95	31.12	3.40	.00			
6	.375	-.217	7.962	4.822	40.00	5.00	4.69	6.66	1.26	21.56	.00	.00			
6	.750	2.211	7.962	2.119	40.00	5.00	13.12	2.91	9.88	9.44	.62	.00			
6	1.125	2.494	7.962	-.601	40.00	5.00	13.93	.83	11.14	2.69	.29	.00			
6	1.500	.564	7.962	-3.312	40.00	5.00	6.64	4.57	2.53	14.81	.01	.00			
6	1.875	-2.329	7.962	-6.923	40.00	5.00	13.61	8.32	10.63	26.93	.01	.00			
6	2.250	-5.146	7.962	-9.316	40.00	5.00	20.01	12.86	22.99	41.65	6.64	.00			

MEMBER	DIST	AS	N	S	TT	UD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2
7	.000	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	.608	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	1.217	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	1.825	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	2.433	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	3.042	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		
7	3.650	-.000	13.918	.000	40.00	5.00	.00	.00	.00	.00	.00	.00		

4) QUADROS. QUADRO M1.

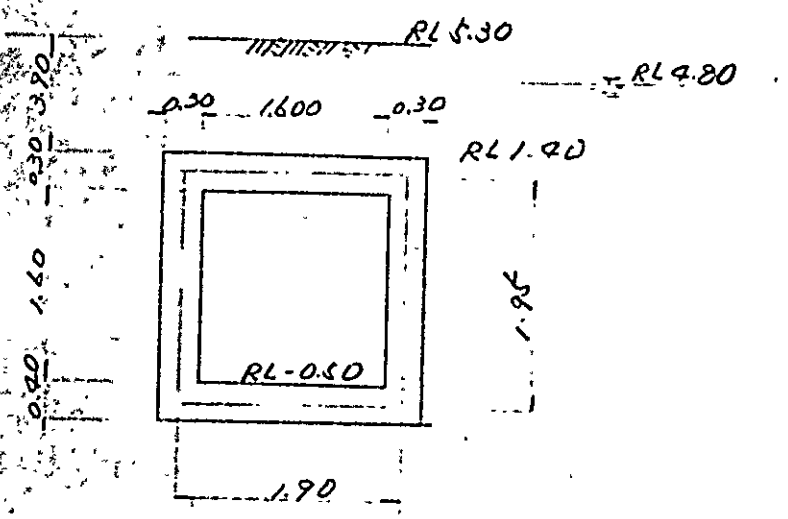


5) QUADRO DE DISTRIBUIÇÃO DE VIGAS



2.8 CONDUTO PARA DRENAGEM USUAL

1) Forma da seção



2). Carga

a) Carga exercida sobre o alto

Altura de conversão do terreno $\gamma = 1.4^{T}$ $h' = 0.65^{m}$

carga do veículo

Carga carregada ω_1 $1.8 \times (0.65 - 0.5) = 1.85$

$20 \times 5.4 = 6.80$

Total $8.65^{T}/m^2$

Precaução do ω_2 $2.4 \times 0.3 = 0.72\ T/m^2$

Ponto alto Total final $9.37\ (T/m^2)$

b) Carga exercida sobre parede

PRESSÃO DE TERRENO

NIVEL DA ÁGUA NO SUB SOLO $P_1 = 1.8 \times 0.5 \times (0.53 + 0.5) = 0.93\ (T/m^2)$

(PRESSÃO DA TERRA EM PAZ)

Parte superior $P_2 = P_1 + 1.0 \times 0.5 \times 3.55 + 1.0 \times 3.55 = 6.26\ (T/m^2)$

Parte inferior $P_3 = P_1 + 1.0 \times 0.5 \times 5.5 + 1.0 \times 5.5 = 9.18\ (T/m^2)$

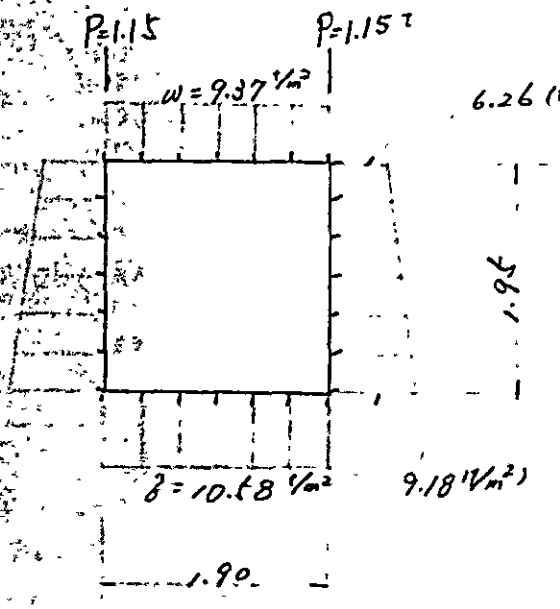
c) Koraga contrária do fundo

Precaução com as paredes $P = 2.4 \times 0.8 \times 1.6 = 1.15^{t}$

Força contrária do fundo δ

$$\delta = 9.37 + \frac{2 \times 1.15}{1.90} = 10.58 \ (t/m^2)$$

3) Gráfico de Carga

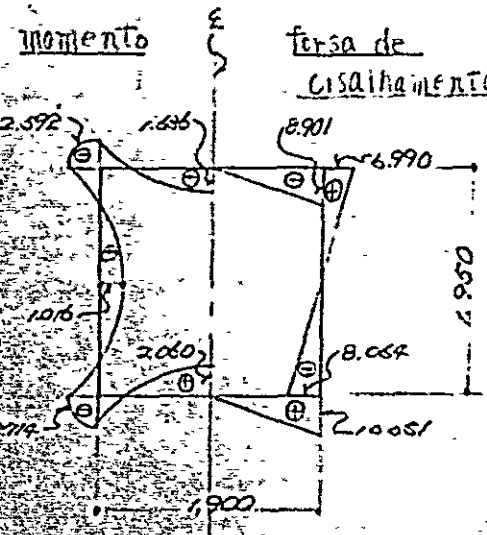


4) Quadro da força de cisalhamento e momento

momento { força de cisalhamento

unid momento --- t-m

força de cisalhamento --- t



*** STRUCTURE NO. 3 PLANE FRAME ***

CONDUTO PARA DRENAGEM USUAL

*** STRUCTURE DATA ***

NJ	NM	NSUP	NRJ	E
4	4	3	2	2100000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	1.950
3	1.900	1.950
4	1.900	.000

*** MEMBER INCIDENCES ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.300	.002	1.950
2	2	3	.300	.002	1.900
3	3	4	.300	.002	1.950
4	4	1	.300	.005	1.900

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
4	0	1	0

*** LOAD CASE = (1) ***

*** ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
2	.00000	1.15000	.00000
3	.00000	1.15000	.00000

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-M-	-AS-	-PA-	-CS-	-PB-
1	1	2	1	.000E+00	.918E+01	.195E+01	.626E+01
2	1	2	2	.000E+00	.937E+01	.190E+01	.937E+01
3	1	2	3	.000E+00	.626E+01	.195E+01	.918E+01
4	1	2	4	.000E+00	.106E+02	.190E+01	.106E+02

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	.00000E+00	.00000E+00	-.39782E-04
2	-.14203E-05	.31117E-04	.45578E-04
3	.19600E-04	.31112E-04	-.45578E-04
4	.18240E-04	.00000E+00	.39782E-04

*** MAXIMUM MOMENT ***

MEMBERS			DIST.	M-MAX	- S -	- N -
1	1	2	.952	1.018	.000	10.051
2	2	3	.952	1.636	.000	6.990
3	3	4	.998	1.018	.000	10.051
4	4	1	.952	2.260	.000	8.064

*** CASE NO. 12 ***

M - PT	DIST.	N -	S -	M -
1 - 1	.000	10.051	8.064	-2.714
1 - 2	.325	10.051	5.160	-.570
1 - 3	.650	10.051	2.413	.457
1 - 4	.975	10.051	-.175	1.016
1 - 5	1.300	10.051	-2.605	.560
1 - 6	1.625	10.051	-4.876	-.660
1 - 7	1.950	10.051	-6.990	-2.592
2 - 1	.000	6.990	8.902	-2.592
2 - 2	.317	6.990	5.934	-.243
2 - 3	.633	6.990	2.967	1.166
2 - 4	.950	6.990	.000	1.636
2 - 5	1.267	6.990	-2.967	1.166
2 - 6	1.583	6.990	-5.934	-.243
2 - 7	1.900	6.990	-8.901	-2.592
3 - 1	.000	10.051	6.990	-2.592
3 - 2	.325	10.051	4.876	-.660
3 - 3	.650	10.051	2.605	.560
3 - 4	.975	10.051	.175	1.016
3 - 5	1.300	10.051	-2.413	.457
3 - 6	1.625	10.051	-5.160	-.570
3 - 7	1.950	10.051	-8.064	-2.714
4 - 1	.000	8.064	10.051	-2.714
4 - 2	.317	8.064	6.701	-.062
4 - 3	.633	8.064	3.350	1.530
4 - 4	.950	8.064	.000	2.060
4 - 5	1.267	8.064	-3.350	1.530
4 - 6	1.583	8.064	-6.701	-.062
4 - 7	1.900	8.064	-10.052	-2.714

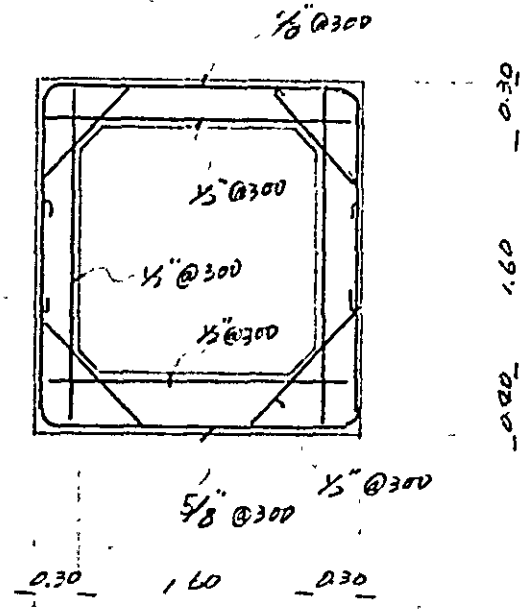
*** CALCULATION OF REINFORCEMENT ***

* ALLOWABLE STRESS SSA = 1400.00 MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SCA = 70.00 SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
TAUA = 8.50 CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
TAUOA = 7.50 U ... CIRCUMFERENCE OF REINFORCEMENT
SSA' = .00

MEMBER	DIST	S	N	S	TT	OD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2	
1	.000	-3.719	10.051	3.064	30.00	5.00	17.01	11.14	32.56	50.48	5.29	.00			5/8" @300
1	.325	-.570	10.051	5.160	30.00	5.00	6.66	7.12	4.99	32.30	.03	.00			
1	.650	.569	10.051	2.413	30.00	5.00	7.15	3.33	5.75	15.11	.13	.00			
1	.975	2.021	10.051	-.175	30.00	5.00	12.54	.24	17.70	1.09	.93	.00			1/2" @300
1	1.300	.669	10.051	-2.595	30.00	5.00	6.60	3.60	4.91	16.30	.02	.00			
1	1.625	-.669	10.051	-5.776	30.00	5.00	7.17	6.73	5.77	30.52	.13	.00			
1	1.950	-3.527	10.051	-8.970	30.00	5.00	16.73	9.65	31.49	43.76	4.88	.00			5/8" @300
2	.000	-3.291	8.999	8.902	30.00	5.00	16.01	12.29	28.81	55.72	6.04	.00			5/8" @300
2	.317	-.242	8.999	5.934	30.00	5.00	4.35	8.19	2.13	37.15	.00	.00			
2	.633	1.805	8.999	2.967	30.00	5.00	12.05	4.10	16.33	18.57	1.26	.00			
2	.950	2.335	8.999	.000	30.00	5.00	13.48	.00	20.44	.00	2.84	.00			
2	1.267	1.805	8.999	-2.967	30.00	5.00	12.05	4.10	16.33	18.57	1.26	.00			1/2" @300
2	1.583	-.243	8.999	-5.934	30.00	5.00	4.35	8.19	2.13	37.15	.00	.00			
2	1.900	-3.291	8.999	-8.901	30.00	5.00	16.01	12.29	28.81	55.72	6.04	.00			5/8" @300
3	.000	-3.527	10.051	8.970	30.00	5.00	16.73	9.65	31.49	43.76	4.88	.00			
3	.325	-.669	10.051	5.776	30.00	5.00	7.17	6.73	5.77	30.52	.13	.00			
3	.650	.569	10.051	2.595	30.00	5.00	6.60	3.60	4.91	16.30	.02	.00			
3	.975	2.021	10.051	.175	30.00	5.00	12.54	.24	17.70	1.09	.93	.00			
3	1.300	.669	10.051	-2.413	30.00	5.00	7.15	3.33	5.75	15.11	.13	.00			
3	1.625	-.570	10.051	-5.160	30.00	5.00	6.66	7.12	4.99	32.30	.03	.00			
3	1.950	-3.719	10.051	-8.064	30.00	5.00	17.01	11.14	32.56	50.48	5.29	.00			
4	.000	-3.974	8.064	10.051	40.00	5.00	17.48	13.88	17.53	44.94	3.64	.00			5/8" @300
4	.317	-.062	8.064	6.701	40.00	5.00	2.19	9.25	.28	29.96	.00	.00			
4	.633	2.719	8.064	3.350	40.00	5.00	14.60	4.63	12.24	14.98	.80	.00			
4	.950	3.270	8.064	.000	40.00	5.00	15.95	.00	14.61	.00	2.07	.00			1/2" @300
4	1.267	2.719	8.064	-3.350	40.00	5.00	14.60	4.63	12.24	14.98	.80	.00			
4	1.583	-.062	8.064	-6.701	40.00	5.00	2.19	9.25	.28	29.96	.00	.00			
4	1.900	-3.974	8.064	-10.052	40.00	5.00	17.48	13.88	17.53	44.94	3.64	.00			5/8" @300

JAPAN IRRIGATION & RECLAMATION CONSULTANTS TOKYO JAPAN	SUBJECT				PROJECT
	COMPUTED	DATE	CHECKED	DATE	FILE NO
					PAGE OF PAGES

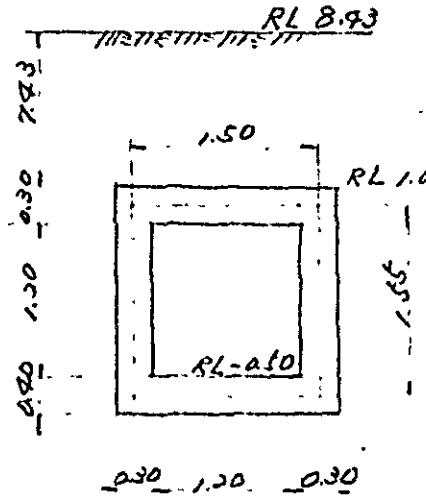
5) QUADRO DE DISTRIBUIÇÃO DE VIGAS



JIRCO

2.9. Conduto de descarga

1) FORMA DE SECÇÃO



2) Carga

a) Altura de conversão do terreno (carga do veículo)

Carga carregada w_1 $1.8 \times (8.43 - 4.80) = 6.53$ t/m²

$2.0 \times (4.80 - 1.00) = 7.60$ t/m²

Total 14.13 (t/m²)

Precaução no alto w_2 $2.4 \times 0.3 = 0.72$ (t/m²)

Total 14.85 (t/m²)

b) Carga exercida sobre parede

PRESSÃO DO TERRENO — Nivel Subtetrâneo $P_1 = 1.8 \times (8.43 - 4.8) \times 0.5 = 3.27$ t/m²

Pressão da terra em Paz — Parte superior $P_2 = P_1 + 1.0 \times 0.5 \times 3.95 + 1.0 \times 3.95 = 9.20$ t/m²

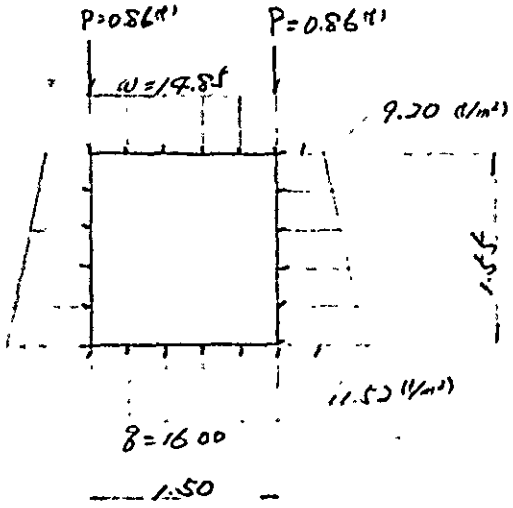
Parte inferior $P_3 = P_1 + 1.0 \times 0.5 \times 5.5 + 1.0 \times 1.5 = 11.52$ t/m²

c) FORÇA CONTRÁRIA DO fundo

PRECAUÇÃO COM AS PAREDES $P = 0.5 \times 24 \times 1.2 = 0.86$ (t)

FORÇA CONTRÁRIA DO FUNDO $q = 14.85 + \frac{2 \times 0.86}{1.50} = 16.00$ (t/m²)

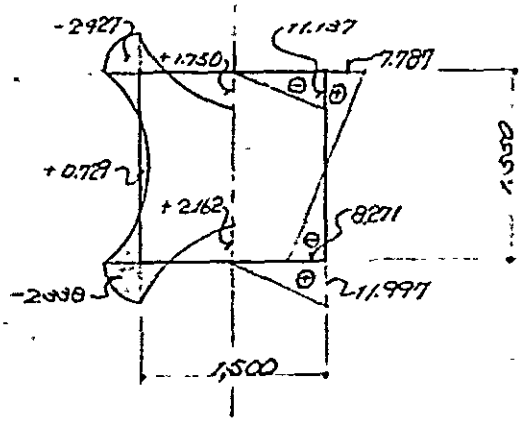
3) QUADRO DE CARGA



4) QUADRO DA FORGA DE cisalhamento e momento

QUADRO de momento QUADRO DA FORGA DE cisalhamento

unidade momento... t·m
forga de cisalhamento... t



*** STRUCTURE NO. 3 PLANE FRAME ***

Conducto de descarga

*** STRUCTURE DATA ***

NJ	NM	IIJ	NR	NMD	E
4	3	4	3	2	2100000.0

*** CO-ORDINATES OF JOINTS ***

JOINT	X	Y
1	.000	.000
2	.000	1.550
3	1.500	1.550
4	1.500	.000

*** MEMBER INFORMATION ***

MEMBER	JJ	JK	AX	IZ	-L-
1	1	2	.300	.002	1.550
2	2	3	.300	.002	1.500
3	3	4	.300	.002	1.550
4	4	1	.400	.005	1.500

*** JOINT RESTRAINTS ***

JOINT	RL1	RL2	RL3
1	1	1	0
4	0	1	0

*** LOAD CASE - (1-A) ***

*** ACTIONS APPLIED AT JOINTS ***

JOINT	X-DIRECTION	Y-DIRECTION	Z-DIRECTION
2	.00000	.06000	.00000
3	.00000	.06000	.00000

*** ACTIONS APPLIED AT MEMBERS ***

NO.	K1	K2	-M-	-AS-	-PA-	-CS-	-PB-
1	1	2	1	.000E+00	.115E+02	.155E+01	.920E+01
2	1	2	2	.000E+00	.148E+02	.150E+01	.148E+02
3	1	2	3	.000E+00	.920E+01	.155E+01	.115E+02
4	1	2	4	.000E+00	.160E+02	.150E+01	.160E+02

*** JOINT DISPLACEMENTS ***

JOINT	X-DIS	Y-DIS	ROTA.
1	.00000E+00	.00000E+00	-.44366E-04
2	-.18649E-05	.29518E-04	.56744E-04
3	.16655E-04	.29518E-04	-.56744E-04
4	-.14770E-04	.00000E+00	.44366E-04

*** MAXIMUM MOMENT ***

MEMBERS		DIST.	M-MAX	- S -	- N -
1	1	2	.755	.731	.000	11.997
2	2	3	.750	1.750	.000	7.787
3	3	4	.795	.731	.000	11.997
4	4	1	.750	2.162	.000	8.271

*** CASE NO. 1 ***

PT DIST.	- N -	- S -	- E -
1 - 1 .000	11.997	8.271	-2.338
1 - 2 .258	11.997	5.345	-.581
1 - 3 .517	11.997	2.519	.432
1 - 4 .775	11.997	-.207	.129
1 - 5 1.033	11.997	-2.934	.334
1 - 6 1.292	11.997	-5.360	-.127
1 - 7 1.550	11.997	-7.787	-2.427
2 - 1 .000	7.787	11.137	-2.427
2 - 2 .250	7.787	7.425	-.107
2 - 3 .500	7.787	3.713	1.286
2 - 4 .750	7.787	.000	1.750
2 - 5 1.000	7.787	-3.712	1.286
2 - 6 1.250	7.787	-7.425	-.107
2 - 7 1.500	7.787	-11.137	-2.427
3 - 1 .000	11.997	7.787	-2.427
3 - 2 .258	11.997	5.360	-.127
3 - 3 .517	11.997	2.934	.334
3 - 4 .775	11.997	.207	.129
3 - 5 1.033	11.997	-2.519	.432
3 - 6 1.292	11.997	-5.345	-.581
3 - 7 1.550	11.997	-8.271	-2.338
4 - 1 .000	8.271	11.997	-2.338
4 - 2 .250	8.271	8.000	.162
4 - 3 .500	8.271	4.000	1.662
4 - 4 .750	8.271	.000	2.162
4 - 5 1.000	8.271	-4.000	1.662
4 - 6 1.250	8.271	-8.000	.162
4 - 7 1.500	8.271	-11.997	-2.338

*** CALCULATION OF REINFORCEMENT ***

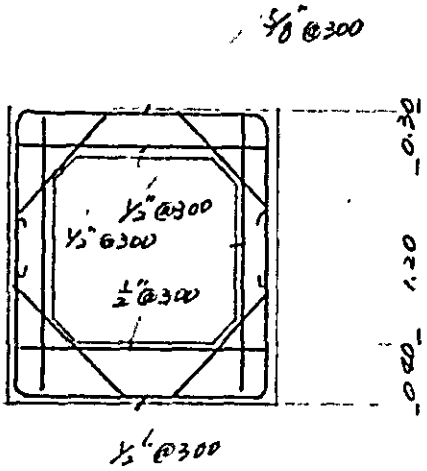
* ALLOWABLE STRESS

SSA = 1400.00
SCA = 70.00
TAUA = 8.50
TAUDA = 7.50
SSA' = .00

MD ... EFFECTIVE DEPTH DUE TO BENDING MOMENT
SD ... EFFECTIVE DEPTH DUE TO SHEARING FORCE
CD ... COMPRESSIVE STRESS DUE TO BENDING MOMENT
U ... CIRCUMFERENCE OF REINFORCEMENT

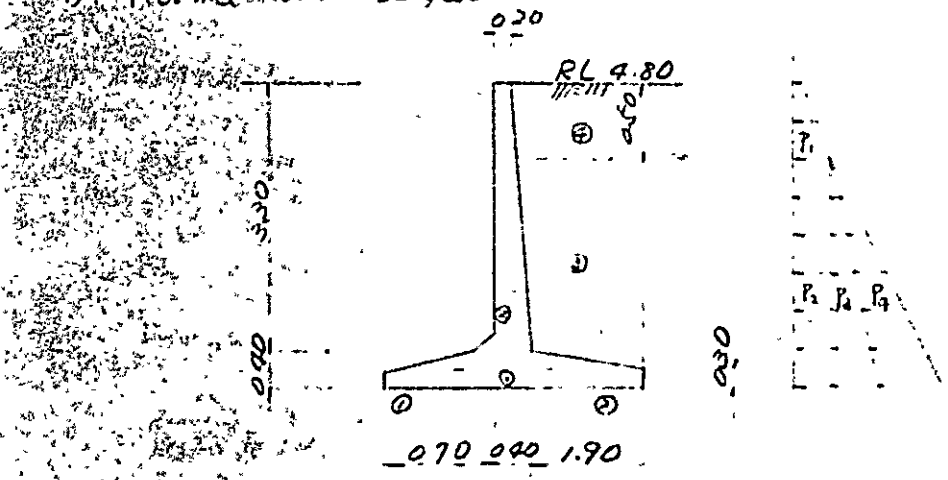
MEMBER	DIST	S	N	S	TT	DD	MD	SD	CD	U	COMPRESSION S1	COMPRESSION S2	TENSION S1	TENSION S2	
1	.000	-3.533	11.997	8.271	30.00	5.00	16.59	11.42	30.97	51.78	3.29	.00			½"@300
1	.258	-.591	11.997	5.345	30.00	5.00	6.73	7.38	5.09	33.46	.00	.00			
1	.517	.432	11.997	2.419	30.00	5.00	5.80	3.48	3.79	15.77	.00	.00			
1	.775	.729	11.997	-.507	30.00	5.00	7.53	.29	6.38	1.30	.08	.00			½"@300
1	1.033	.336	11.997	-2.834	30.00	5.00	5.10	3.91	2.92	17.74	.00	.00			
1	1.292	-.772	11.997	-5.360	30.00	5.00	7.52	7.40	6.36	33.55	.08	.00			
1	1.550	-3.627	11.997	-7.787	30.00	5.00	16.80	10.75	31.75	48.74	3.59	.00			⅝"@300
2	.000	-3.206	7.787	11.137	30.00	5.00	15.80	15.38	28.06	69.72	5.19	.00			⅝"@300
2	.450	-.107	7.787	7.425	30.00	5.00	2.88	10.25	.93	46.48	.00	.00			
2	.900	2.044	7.787	3.712	30.00	5.00	12.68	5.13	18.07	23.24	1.36	.00			
2	1.350	2.520	7.787	.000	30.00	5.00	14.03	.00	22.14	.00	2.92	.00			½"@300
2	1.800	2.044	7.787	-3.712	30.00	5.00	12.68	5.13	18.07	23.24	1.36	.00			
2	2.250	-.107	7.787	-7.425	30.00	5.00	2.88	10.25	.93	46.48	.00	.00			
2	2.700	-3.206	7.787	-11.137	30.00	5.00	15.80	15.38	28.06	69.72	5.19	.00			⅝"@300
3	.000	-3.627	11.997	7.787	30.00	5.00	16.80	10.75	31.75	48.74	3.59	.00			
3	.258	-.772	11.997	5.360	30.00	5.00	7.52	7.40	6.36	33.55	.08	.00			
3	.517	.336	11.997	2.834	30.00	5.00	5.10	3.91	2.92	17.74	.00	.00			
3	.775	.729	11.997	.207	30.00	5.00	7.53	.29	6.38	1.30	.08	.00			
3	1.033	.432	11.997	-2.419	30.00	5.00	5.80	3.48	3.79	15.77	.00	.00			
3	1.292	-.591	11.997	-5.345	30.00	5.00	6.73	7.38	5.09	33.46	.00	.00			
3	1.550	-3.533	11.997	-8.271	30.00	5.00	16.59	11.42	30.97	51.78	3.29	.00			
4	.000	-3.579	8.271	11.997	40.00	5.00	16.69	16.57	15.98	53.64	2.66	.00			½"@300
4	.450	.162	8.271	8.000	40.00	5.00	3.55	11.05	.72	35.77	.00	.00			
4	.900	2.903	8.271	4.000	40.00	5.00	15.03	5.52	12.97	17.89	1.05	.00			
4	1.350	3.481	8.271	.000	40.00	5.00	16.28	.00	15.20	.00	2.24	.00			½"@300
4	1.800	2.903	8.271	-4.000	40.00	5.00	15.03	5.52	12.97	17.89	1.05	.00			
4	2.250	.162	8.271	-8.000	40.00	5.00	3.55	11.05	.72	35.77	.00	.00			
4	2.700	-3.579	8.271	-11.997	40.00	5.00	16.69	16.57	15.98	53.64	2.66	.00			½"@300

5). Quadro da distribuição das vigas



2.10 PAREDE PARA PROTEÇÃO

1) Formato da seção



2) Calculo - estável

a) Força Horizontal e momento de inversão

Altura de conversão do terreno carga do veículo $h' = 0.53$ m

	P (t/m²)		P (t/m)		Braço (m)		Momento (t-m)
P_1	0.333×1.8×1.03	0.62	$\frac{1}{2}$×P×1.03	0.32	$\frac{1}{3}$×1.03+3.20	3.54	1.13
P_2		0.62	P×3.20	1.98	$\frac{1}{2}$×3.20	1.60	3.17
P_3	0.333×1.0×3.20	1.07	$\frac{1}{2}$×P×3.20	1.71	$\frac{1}{3}$×3.20	1.07	1.83
P_4	1.0×1.0×3.20	3.20	$\frac{1}{2}$×P×3.20	5.12	$\frac{1}{3}$×3.20	1.07	5.48
計				9.13			11.61

b) Momento de resistência

Parte	V (t)		Braço (m)		Momento (t-m)
① concreto	0.35×3.0×2.4	2.52	$\frac{1}{2}$×3.0	1.50	3.78
② "	0.30×3.3×2.4	2.38	$\frac{1}{2}$×0.30+0.70	0.85	2.02
③ terra	2.85×3.00×2.0	11.40	$\frac{1}{2}$×2.00+1.00	2.00	22.80
④ terra	0.5×2.20×1.8	1.98	$\frac{1}{2}$×2.20+0.90	2.00	3.96
total		18.38			32.56

c) ESTABILIDADE CONTRA INVERSÃO

$$F_S = \frac{\text{momento de resistencia}}{\text{momento de queda}} = \frac{32.56}{11.61} = 2.80 > 1.5 \quad \text{O.K}$$

d) ESTABILIDADE CONTRA DESLIZAMENTO

$$F_S = \frac{\mu \Sigma V}{\Sigma H} = \frac{0.5 \times 18.28}{9.13} = 1.00 < 1.5 \quad \text{NO}$$

Por conseguinte, é preciso receber com chave

e) Força contrânia do solo

Ponto de ação de FORÇAS $\chi = \frac{\Sigma M}{\Sigma V} = \frac{32.56 - 11.61}{18.28} = 1.15$ m

Quantidade excentrica $e = \frac{b}{2} - \chi = \frac{3.0}{2} - 1.15 = 0.35$ m

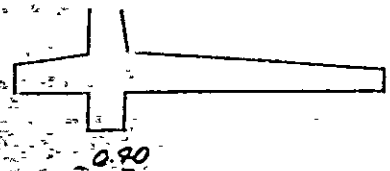
$$\frac{6 \times e}{b} = \frac{6 \times 0.35}{3.00} = 0.70 < 1.0$$

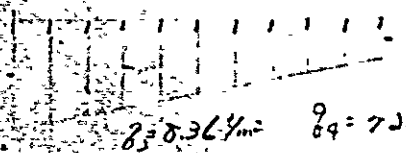
força contrânia do solo $q = \frac{\Sigma V}{b}\left(1 \mp \frac{6 \times e}{b}\right) = \frac{18.28}{3.0}(1 \mp 0.70) = \begin{cases} 10.35 \ (t/m^2) \\ 1.83 \ (t/m^2) \end{cases}$

f) Cálculo da chave

altura da chave. $h_K = 0.2 \times b = 0.60$ m

Posição da chave, Colocar justamente abaixo de parede reta





R - FORÇA, RESISTENCIA HORIZONTAL

$$R = \frac{q_1 + q_2}{2} \times K_P \times h_K + \frac{q_3 + q_3}{2} \times l_1 \times \mu$$

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$= \frac{10.35+8.36}{2} \times 3.0 \times 0.60 + \frac{8.36+1.83}{2} \times 2.30 \times 0.5$

$= 16.89 + 5.86 = 22.70$ (t)

Factor de segurança

$F_S = \frac{R}{\Sigma H} = \frac{22.70}{9.13} = 2.49 > 2.0$ OK

3) Calculo da quantidade de vigas de ferro

a) Parede

Momento

	P (t/m²)		P (t/m)		braço (m)		Momento (t·m)
P_1	$0.333 \times 1.8 \times 1.03$	0.62	$\frac{1}{2} \times P_1 \times 1.03$	0.32	$\frac{1}{3} \times 1.03 + 2.80$	3.14	1.00
P_2	"	0.62	$P_2 \times 2.80$	1.74	$\frac{1}{2} \times 2.80$	1.40	2.44
P_3	$0.333 \times 1.0 \times 2.80$	0.93	$\frac{1}{2} P_3 \times 2.80$	1.30	$\frac{1}{3} \times 2.80$	0.93	1.21
P_4	$1.0 \times 1.0 \times 2.80$	2.80	$\frac{1}{2} P_4 \times 2.80$	3.92	$\frac{1}{3} \times 2.80$	0.93	3.65
Σ				7.28			8.30

$M_{max} = 8.30$ (t·m)

$S_{max} = 7.28$ (t)

Exame da espessura do material da Parte util.

$d = C_1 \sqrt{\frac{M_{max}}{b}} = 0.279 \sqrt{\frac{830000}{100}} = 25.42$ cm $< 40 - 5 = 35$ cm

$A_S = \frac{M_{max}}{\sigma_{sa} \cdot j \, d} = \frac{830000}{1400 \times 0.862 \times 35} = 19.65$ (cm²)

7/8" @300
3/4" @300
} $A_S = 22.91$ (cm²)

$\sigma = \frac{S_{max}}{b \cdot j \cdot d} = \frac{7280}{100 \times 0.862 \times 35} = 2.41 < 6.5$ kg/cm²

OK

$$\tau_0 = \frac{S_{max}}{U\,j\,d} = \frac{7280}{43.3 \times 0.862 \times 37} = 5.57 < 7.5 \text{ Kg/cm}^2$$

b) Ponto da 2.0m a partir da parede, da parte mais alta.

Momento

	P (t/m²)		P (t)		BRAÇO (m)		MOMENTO
P_1	$0.333 \times 1.8 \times 1.03$	0.62	$\frac{1}{2} P \times 1.03$	0.32	$\frac{1}{3} 1.03 + 1.50$	1.84	0.59
P_2	"	0.62	$P \times 1.50$	0.93	$\frac{1}{2} \times 1.50$	0.75	0.70
P_3	$0.333 \times 1.0 \times 1.5$	0.50	$\frac{1}{2} P \times 1.50$	0.38	$\frac{1}{3} \times 1.50$	0.50	0.19
P_4	$1.0 \times 1.0 \times 1.5$	1.50	$\frac{1}{2} P \times 1.50$	1.13	$\frac{1}{3} \times 1.50$	0.50	0.57
				2.76			2.05

$M_{max} = 2.05$ t (t-m)

$S_{max} = 2.76$ t

Cálculo de quantidade de vigas de ferro $d = 37$ cm

$$A_s = \frac{M}{\sigma_{sa}\,j\,d} = \frac{205000}{1400 \times 0.862 \times 37} = 6.39 \text{ cm}^2$$

ϕ 3/4 @300 $\quad A_s = 9.49$ cm²

c) PRATO DE BASE 1.

Momento

$$M = g_2 \times l \times \frac{1}{2} l + (g_1 - g_2) \times \frac{1}{2} \times l \times \frac{2}{3} l$$

$$= 8.36 \times 0.7 \times 0.35 + (10.35 - 8.36) \times 0.5 \times 0.7 \times \frac{2}{3} \times 0.7$$

$$= 2.05 + 0.33 = 2.38$$

Cálculo de quantidade de vigas de ferro

$$A_s = \frac{M}{\sigma_{sa}\,j\,d} = \frac{238000}{1400 \times 0.862 \times 37} = 5.63 \text{ cm}^2$$

5/8" @300 $\quad A_s = 6.19$ cm²

d) PRATO DE BASE ↗.

Carga acarretada util

$w = 0.60 \times 1.8 + 2.0 \times 2.85 + 0.35 \times 2.4 = 7.77$ (t/m²)

$g_3 = 1.83$ t/m², $g_4 = 7.23$ (t/m²)

Momento

$M = (w - g_4) \times l \times \frac{1}{2} l + \frac{1}{2}(w - g_3) \times l \times \frac{2}{3} l$

$= (7.77 - 7.23) \times 1.9 \times 0.95 + \frac{1}{2}(7.77 - 1.83) \times 1.9 \times \frac{2}{3} \times 1.9$

$= 0.38 + 6.75 = 7.13$ (t-m)

Exame da espessura do material da parte util

$d = C_1 \sqrt{\frac{M}{b}} = 0.279 \sqrt{\frac{713000}{100}} = 23.56 < 40 - 5 = 35$ cm

ok

Quantidade de vigas de ferro

$A_s = \frac{M}{\sigma_{sa} j d} = \frac{713000}{1400 \times 0.862 \times 35} = 16.88$ cm²

7/8" @ 300 $A_s = 19.51$ cm²

5/8" @ 300

e) Chave

Momento

$M = \Sigma H \times \frac{1}{2} h = 9.13 \times \frac{1}{2} \times 0.6 = 2.74$ (t-m)

Quantidade de vigas d ferro

$A_s = \frac{M}{\sigma_{sa} j d} = \frac{274000}{1400 \times 0.862 \times 35} = 6.49$ cm²

3/4" @ 300 $A_s = 9.49$ cm²

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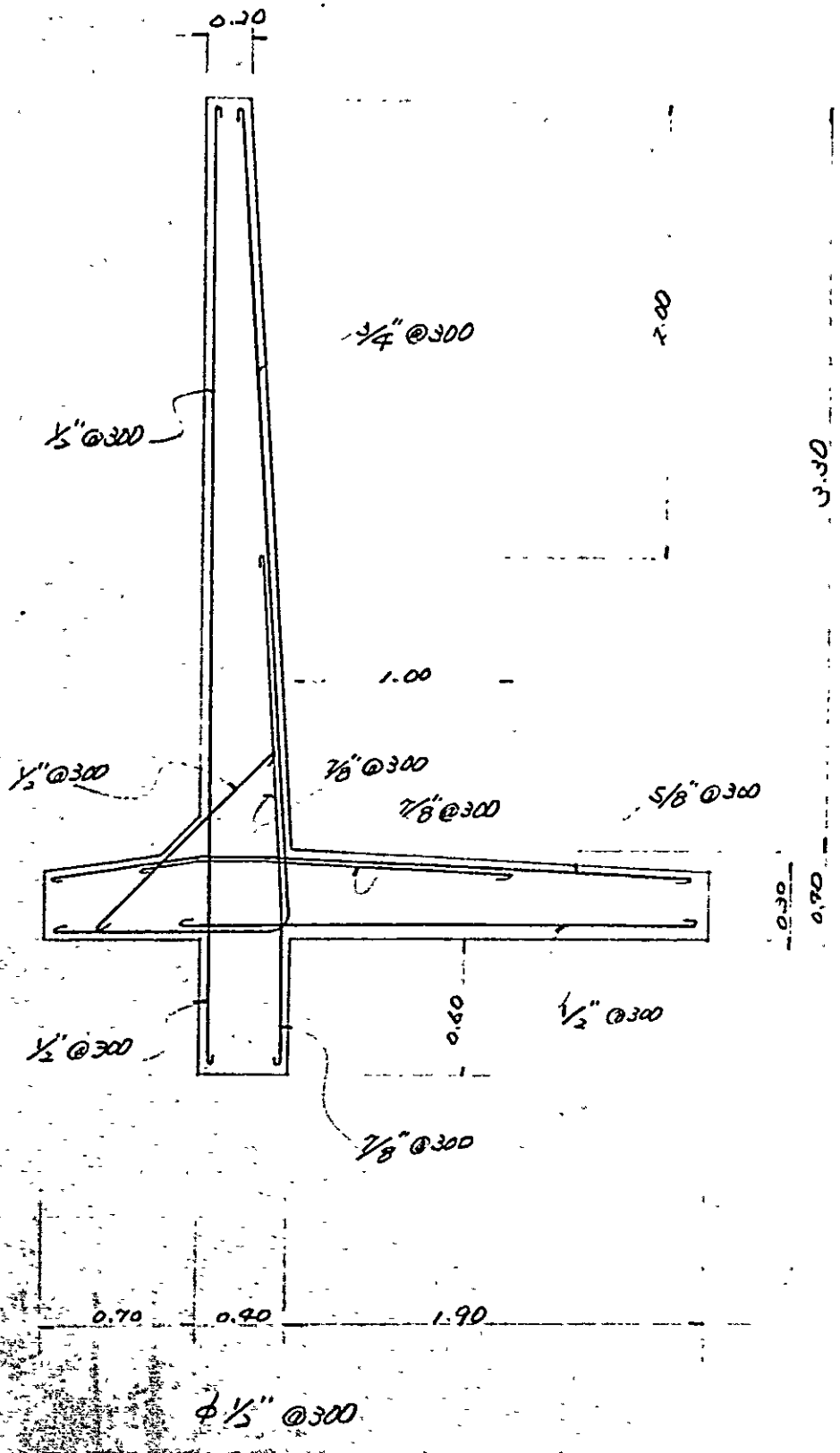
Quadro da 4. distribuição das vigas S = 1/300



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