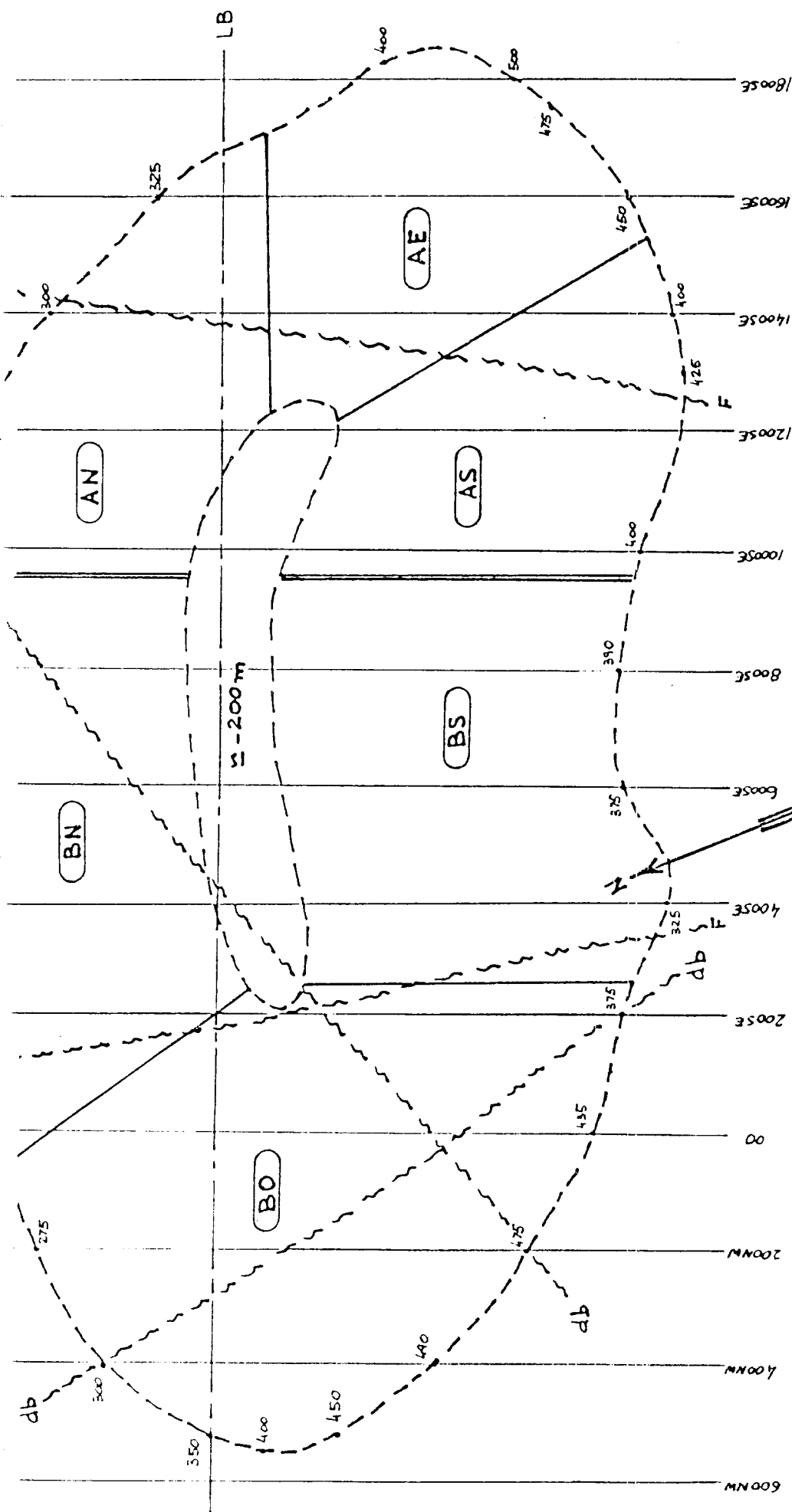


ANEXO 14

DEPARTAMENTAÇÃO GEOMECÂNICA

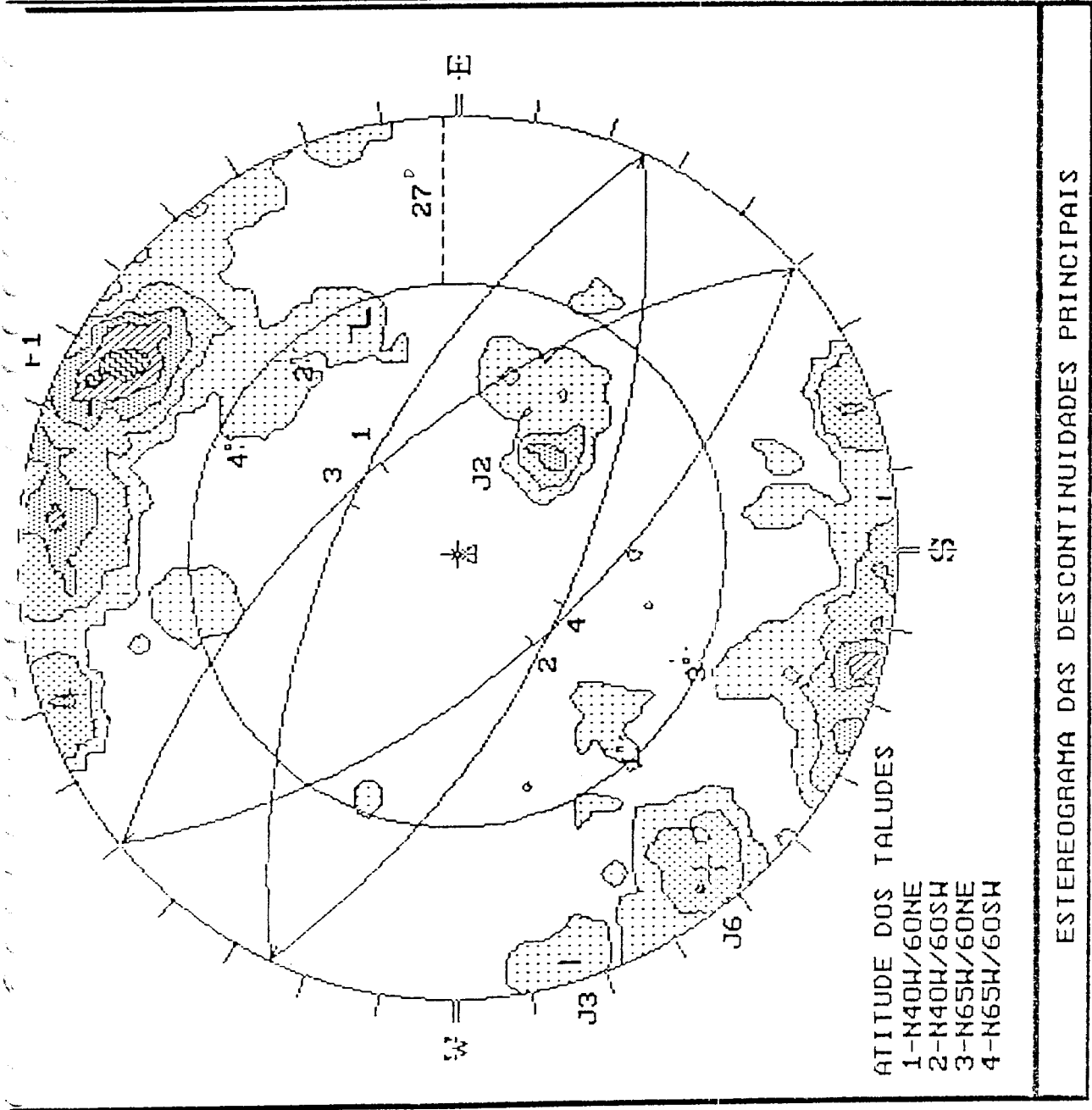
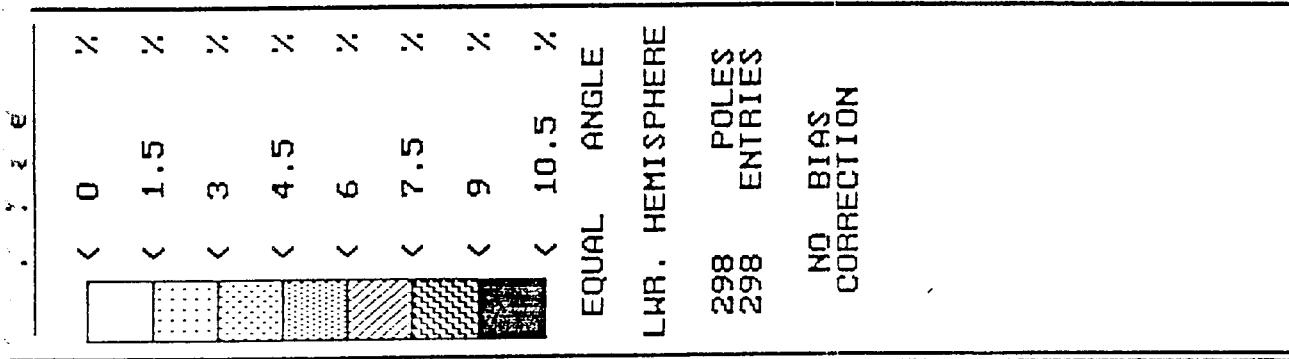
STEREOGRAMA DE FRATURAS

**MÉTODO PARA CÁLCULO DE RELAÇÃO DE TALUDES DE
LOCAL E GLOBAL**



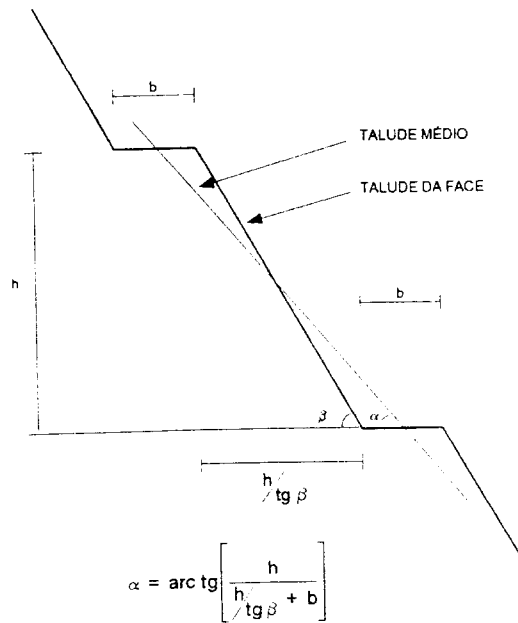
MINA DO SALOBO
 COMPARTIMENTAÇÃO DOS
 TALUDES DA CAVA

ESC. 1:1000
 X 210 - COTA DA CRISTA
 --- FALHAS (d.b.c./DIABÁSIO)
 [] DOMÍNIOS GEOMECÂNICOS



RELAÇÕES ÂNGULO DA FACE x ÂNGULO MÉDIO DO TALUDE

β (°)	h (m)	b (m)	α (°)	β (°)	h (m)	b (m)	α (°)
60	15	5	47.68	70	15	5	55.11
		7.5	42.87			7.5	49.17
		10	38.79			10	44.14
		12.5	35.33			12.5	39.87
		15	32.37			15	36.25
	20	27.63	20		30.51		
	30	5	53.35		30	5	62.05
		7.5	50.40			7.5	58.45
		10	47.68			10	55.11
		12.5	45.17			12.5	52.02
		15	42.87			15	49.17
	20	38.79	20		44.14		
	45	5	55.45		45	5	64.59
		7.5	53.35			7.5	62.05
		10	51.36			10	59.62
		12.5	49.47			12.5	57.31
		15	47.68			15	55.11
	20	44.38	20		51.05		
	60	5	56.55		60	5	65.90
		7.5	54.92			7.5	63.94
10		53.35	10	62.05			
12.5		51.84	12.5	60.22			
15		50.40	15	58.45			
20	47.68	20	55.11				
75	5	57.22	75	5	66.70		
	7.5	55.89		7.5	65.11		
	10	54.60		10	63.56		
	12.5	53.35		12.5	62.05		
	15	52.14		15	60.58		
20	49.84	20	57.78				
65	15	5	51.35	75	15	5	58.98
		7.5	45.98			7.5	52.48
		10	41.43			10	46.94
		12.5	37.58			12.5	42.24
		15	34.29			15	38.26
	20	29.06	20		31.98		
	30	5	57.67		30	5	66.51
		7.5	54.39			7.5	62.62
		10	51.35			10	58.98
		12.5	48.56			12.5	55.60
		15	45.98			15	52.48
	20	41.43	20		46.94		
	45	5	60.00		45	5	69.24
		7.5	57.67			7.5	66.51
		10	55.45			10	63.89
		12.5	53.35			12.5	61.38
		15	51.35			15	58.98
	20	47.67	20		54.53		
	60	5	61.21		60	5	70.84
		7.5	59.40			7.5	68.55
10		57.67	10	66.51			
12.5		55.99	12.5	64.53			
15		54.39	15	62.62			
20	51.35	20	58.98				
75	5	61.94	75	5	71.50		
	7.5	60.48		7.5	69.80		
	10	59.05		10	68.14		
	12.5	57.67		12.5	66.51		
	15	56.32		15	64.92		
20	53.76	20	61.87				

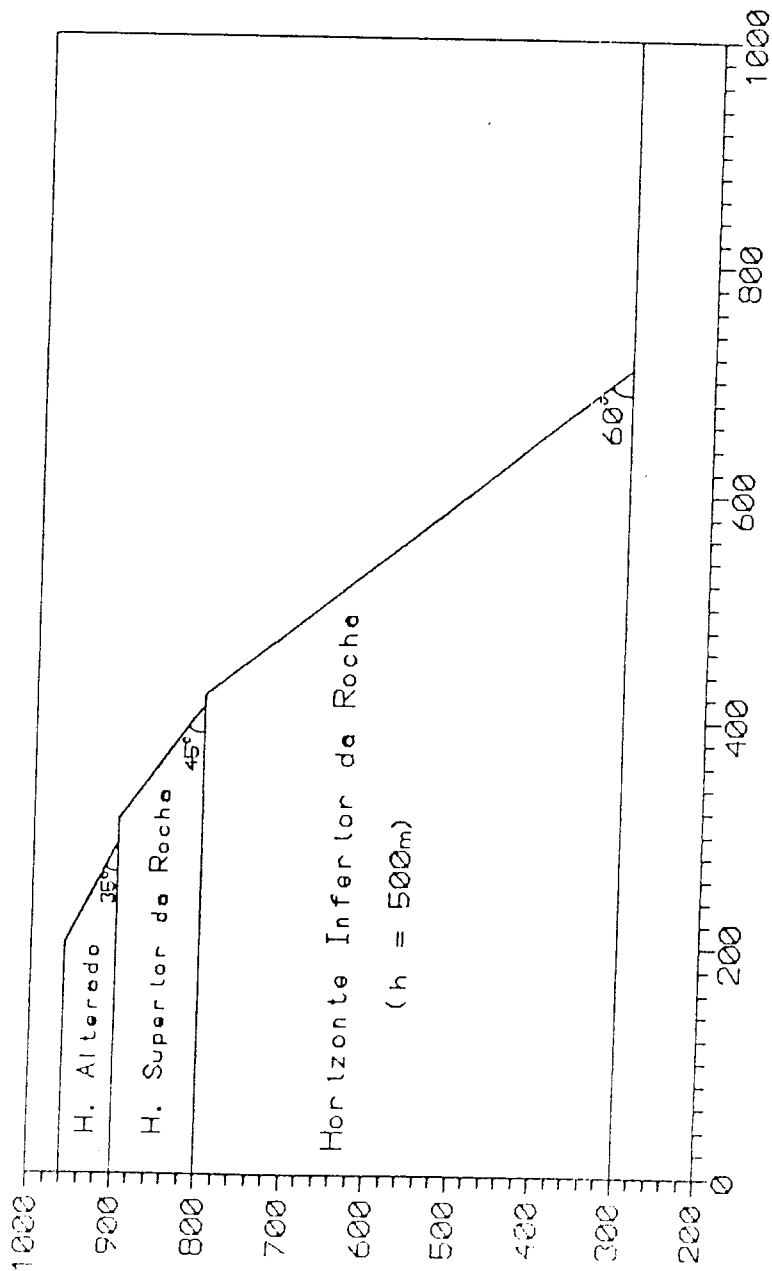


ANEXO 15

GEOMETRIA DOS TALUDES ROCHOSOS

MINA DO SALOBO

GEOMETRIA DO TALUDE COMPOSTO POR QUARTZITO



MACIÇO: Gnaiss

CLASSE	Q	RMR	R. comp Intacta	mi	m	s
II	30.30	74.70	150	22.00	3.611	0.014748
I/II	58.57	80.63	150	22.00	5.516	0.039638

CLASSE	Sigma c mr	Sigma t mr	E (GPa)		
			N	S e P	B
II	18.216	-0.612	26.69	41.45	49.40
I/II	29.864	-1.077	31.65	58.32	61.26

CLASSE: II

Profund (m)	Sigma n (MPa)	C				ϕ (°)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.38	2.39	1.19	0.80	0.48	60.74	4.84	3.65	3.25	2.93
100	2.75	2.88	1.44	0.96	0.58	56.98	7.11	5.67	5.19	4.81
150	4.13	3.37	1.68	1.12	0.67	54.33	9.12	7.43	6.87	6.42
200	5.50	3.85	1.93	1.28	0.77	52.26	10.96	9.03	8.39	7.88
250	6.88	4.32	2.16	1.44	0.86	50.56	12.68	10.52	9.80	9.22
300	8.25	4.78	2.39	1.59	0.96	49.11	14.31	11.92	11.12	10.48
350	9.63	5.23	2.62	1.74	1.05	47.84	15.86	13.25	12.37	11.68
400	11.00	5.67	2.84	1.89	1.13	46.71	17.35	14.51	13.57	12.81
450	12.38	6.10	3.05	2.03	1.22	45.70	18.78	15.73	14.72	13.90
500	13.75	6.52	3.26	2.17	1.30	44.78	20.17	16.91	15.82	14.95
550	15.13	6.94	3.47	2.31	1.39	43.93	21.51	18.04	16.89	15.96
600	16.50	7.35	3.68	2.45	1.47	43.15	22.82	19.15	17.92	16.94
650	17.88	7.75	3.88	2.58	1.55	42.43	24.09	20.22	18.92	17.89
700	19.25	8.15	4.08	2.72	1.63	41.75	25.33	21.26	19.90	18.81

CLASSE: I/II

Profund (m)	Sigma n (MPa)	C				ϕ (°)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.38	3.72	1.86	1.24	0.74	62.16	6.32	4.46	3.84	3.35
100	2.75	4.16	2.08	1.39	0.83	59.13	8.76	6.68	5.99	5.43
150	4.13	4.63	2.32	1.54	0.93	56.88	10.96	8.64	7.87	7.25
200	5.50	5.11	2.56	1.70	1.02	55.09	12.99	10.44	9.58	8.90
250	6.88	5.59	2.80	1.86	1.12	53.58	14.91	12.11	11.18	10.44
300	8.25	6.06	3.03	2.02	1.21	52.27	16.73	13.70	12.69	11.88
350	9.63	6.53	3.26	2.18	1.31	51.12	18.47	15.20	14.12	13.24
400	11.00	6.99	3.49	2.33	1.40	50.10	20.14	16.65	15.48	14.55
450	12.38	7.44	3.72	2.48	1.49	49.16	21.76	18.04	16.80	15.81
500	13.75	7.89	3.94	2.63	1.58	48.31	23.33	19.38	18.07	17.02
550	15.13	8.33	4.16	2.78	1.67	47.53	24.85	20.68	19.30	18.19
600	16.50	8.76	4.38	2.92	1.75	46.80	26.33	21.95	20.49	19.32
650	17.88	9.19	4.60	3.06	1.84	46.12	27.78	23.18	21.65	20.42
700	19.25	9.62	4.81	3.21	1.92	45.48	29.19	24.38	22.78	21.50

NOTA: Cálculo de E
 N = Nieble
 S e P = Serafim e Pereira
 B = Bieniawski

c/FR = coesão dividida por Fator de Redução

MACIÇO: RQF e Quatzito

CLASSE	Q	RMR	R. comp Intacta	mi	m	s
II / III	15.00	68.37	200	18.00	1.880	0.005137
II	30.30	74.70	200	18.00	2.954	0.014749
I / II	58.57	80.63	200	18.00	4.513	0.039638

CLASSE	Sigma c mr	Sigma t mr	E (GPa)		
			N	S e P	B
II / III	14.335	-0.546	21.87	28.79	36.74
II	24.289	-0.997	26.69	41.45	49.40
I / II	39.819	-1.753	31.65	58.32	61.26

CLASSE: II / III

Profund (m)	Sigma n (MPa)	C				ϕ ($^{\circ}$)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.40	2.05	1.03	0.68	0.41	58.32	4.32	3.30	2.95	2.68
100	2.80	2.53	1.26	0.84	0.51	54.19	6.41	5.14	4.72	4.39
150	4.20	3.00	1.50	1.00	0.60	51.33	8.25	6.75	6.25	5.85
200	5.60	3.46	1.73	1.15	0.69	49.12	9.93	8.20	7.62	7.16
250	7.00	3.90	1.95	1.30	0.78	47.31	11.49	9.54	8.89	8.37
300	8.40	4.34	2.17	1.45	0.87	45.77	12.97	10.80	10.08	9.50
350	9.80	4.76	2.38	1.59	0.95	44.44	14.37	11.99	11.20	10.56
400	11.20	5.18	2.59	1.73	1.04	43.26	15.72	13.13	12.27	11.58
450	12.60	5.58	2.79	1.86	1.12	42.20	17.01	14.22	13.29	12.54
500	14.00	5.98	2.99	1.99	1.20	41.25	18.26	15.27	14.27	13.47
550	15.40	6.37	3.19	2.12	1.27	40.38	19.47	16.28	15.22	14.37
600	16.80	6.76	3.38	2.25	1.35	39.57	20.64	17.26	16.14	15.24
650	18.20	7.13	3.57	2.38	1.43	38.83	21.78	18.22	17.03	16.07
700	19.60	7.51	3.75	2.50	1.50	38.14	22.89	19.14	17.89	16.89

CLASSE: II

Profund (m)	Sigma n (MPa)	C				ϕ ($^{\circ}$)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.40	3.26	1.63	1.09	0.65	60.05	5.68	4.06	3.51	3.08
100	2.80	3.69	1.84	1.23	0.74	56.72	7.95	6.11	5.49	5.00
150	4.20	4.14	2.07	1.38	0.83	54.29	9.99	7.91	7.22	6.67
200	5.60	4.60	2.30	1.53	0.92	52.35	11.86	9.56	8.79	8.18
250	7.00	5.06	2.53	1.69	1.01	50.74	13.63	11.10	10.25	9.58
300	8.40	5.51	2.76	1.84	1.10	49.35	15.30	12.54	11.62	10.89
350	9.80	5.96	2.98	1.99	1.19	48.14	16.89	13.91	12.92	12.13
400	11.20	6.39	3.20	2.13	1.28	47.05	18.42	15.23	14.16	13.31
450	12.60	6.82	3.41	2.27	1.36	46.07	19.90	16.49	15.36	14.45
500	14.00	7.25	3.62	2.42	1.45	45.18	21.33	17.71	16.50	15.54
550	15.40	7.66	3.83	2.55	1.53	44.36	22.72	18.89	17.61	16.59
600	16.80	8.07	4.04	2.69	1.61	43.60	24.07	20.04	18.69	17.61
650	18.20	8.48	4.24	2.83	1.70	42.89	25.39	21.15	19.74	18.60
700	19.60	8.88	4.44	2.96	1.78	42.23	26.68	22.23	20.75	19.57

CLASSE: I / II

Profund (m)	Sigma n (MPa)	C				ϕ ($^{\circ}$)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.40	5.25	2.63	1.75	1.05	61.06	7.79	5.16	4.28	3.58
100	2.80	5.62	2.81	1.87	1.12	58.50	10.19	7.38	6.44	5.69
150	4.20	6.03	3.02	2.01	1.21	56.52	12.38	9.37	8.36	7.56
200	5.60	6.47	3.23	2.16	1.29	54.89	14.43	11.20	10.12	9.26
250	7.00	6.91	3.46	2.30	1.38	53.50	16.37	12.92	11.76	10.84
300	8.40	7.36	3.68	2.45	1.47	52.29	18.22	14.54	13.32	12.34
350	9.80	7.80	3.90	2.60	1.56	51.21	20.00	16.10	14.80	13.75
400	11.20	8.25	4.12	2.75	1.65	50.24	21.71	17.59	16.21	15.11
450	12.60	8.69	4.34	2.90	1.74	49.35	23.37	19.02	17.57	16.41
500	14.00	9.13	4.56	3.04	1.83	48.54	24.97	20.41	18.89	17.67
550	15.40	9.56	4.78	3.19	1.91	47.79	26.54	21.76	20.16	18.89
600	16.80	9.99	4.99	3.33	2.00	47.09	28.06	23.07	21.40	20.07
650	18.20	10.41	5.21	3.47	2.08	46.44	29.55	24.34	22.61	21.22
700	19.60	10.84	5.42	3.61	2.17	45.82	31.01	25.59	23.78	22.34

NOTA: Cálculo de E
N = Nieble
S e P = Serafim e Pereira
B = Bieniawski

c/FR = coesão dividida por Fator de Redução

MACIÇO: Xisto Indiferenciado (X5)

CLASSE	Q	RMR	R. comp Intacta	mi	m	s
II	30.30	80.70	150	20.00	5.039	0.040090
I/II	58.57	86.63	150	20.00	7.697	0.107747

CLASSE	Sigma c mr	Sigma t mr	E (GPa)		
			N	S e P	B
II	30.034	-1.192	31.71	58.55	61.40
I/II	49.237	-2.096	37.10	82.38	73.26

CLASSE: II

Profund (m)	Sigma n (MPa)	C				ϕ (°)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.75	3.98	1.99	1.33	0.80	60.33	7.05	5.06	4.40	3.87
100	3.50	4.53	2.27	1.51	0.91	56.98	9.92	7.65	6.90	6.29
150	5.25	5.12	2.56	1.71	1.02	54.54	12.49	9.93	9.08	8.39
200	7.00	5.70	2.85	1.90	1.14	52.60	14.85	12.00	11.05	10.29
250	8.75	6.28	3.14	2.09	1.26	50.98	17.08	13.94	12.89	12.05
300	10.50	6.85	3.42	2.28	1.37	49.59	19.18	15.76	14.62	13.70
350	12.25	7.41	3.70	2.47	1.48	48.38	21.19	17.49	16.26	15.27
400	14.00	7.96	3.98	2.65	1.59	47.29	23.13	19.15	17.82	16.76
450	15.75	8.50	4.25	2.83	1.70	46.31	24.99	20.74	19.32	18.19
500	17.50	9.03	4.52	3.01	1.81	45.42	26.79	22.27	20.77	19.56
550	19.25	9.56	4.78	3.19	1.91	44.60	28.54	23.76	22.17	20.89
600	21.00	10.08	5.04	3.36	2.02	43.84	30.24	25.20	23.52	22.18
650	22.75	10.59	5.30	3.53	2.12	43.13	31.90	26.61	24.84	23.43
700	24.50	11.10	5.55	3.70	2.22	42.47	33.52	27.98	26.13	24.65

CLASSE: I/II

Profund (m)	Sigma n (MPa)	C				ϕ (°)	τ (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.75	6.41	3.20	2.14	1.28	61.39	9.62	6.41	5.34	4.49
100	3.50	6.88	3.44	2.29	1.38	58.79	12.65	9.22	8.07	7.15
150	5.25	7.41	3.70	2.47	1.48	56.79	15.43	11.72	10.49	9.50
200	7.00	7.96	3.98	2.65	1.59	55.15	18.02	14.04	12.71	11.65
250	8.75	8.53	4.26	2.84	1.71	53.76	20.47	16.20	14.78	13.64
300	10.50	9.10	4.55	3.03	1.82	52.54	22.80	18.25	16.74	15.52
350	12.25	9.66	4.83	3.22	1.93	51.46	25.04	20.21	18.60	17.31
400	14.00	10.22	5.11	3.41	2.04	50.49	27.20	22.09	20.38	19.02
450	15.75	10.78	5.39	3.59	2.16	49.60	29.29	23.90	22.10	20.66
500	17.50	11.33	5.67	3.78	2.27	48.79	31.31	25.65	23.76	22.25
550	19.25	11.88	5.94	3.96	2.38	48.03	33.29	27.35	25.37	23.78
600	21.00	12.42	6.21	4.14	2.48	47.33	35.21	29.00	26.93	25.27
650	22.75	12.96	6.48	4.32	2.59	46.68	37.08	30.60	28.44	26.72
700	24.50	13.49	6.75	4.50	2.70	46.06	38.92	32.17	29.93	28.13

NOTA: Cálculo de E

N = Nieble

S e P = Serafim e Pereira

B = Bieniawski

c/FR = coesão dividida por Fator de Redução

MACIÇO: Xisto Mineralizado

CLASSE	Q	RMR	R. comp Intacta	mi	m	s
III	8.11	62.84	150	17.00	1.196	0.002042

CLASSE	Sigma c mr	Sigma t mr	E (GPa)		
			N	S e P	B
III	6.779	-0.256	18.04	20.94	25.68

CLASSE: III

Profund (m)	Sigma n (MPa)	C				ϕ (°)	T (MPa)			
		c/FR					c/1	c/2	c/3	c/5
		FR=1	FR=2	FR=3	FR=5					
50	1.75	1.34	0.67	0.45	0.27	52.34	3.61	2.94	2.71	2.54
100	3.50	1.91	0.95	0.64	0.38	46.93	5.65	4.70	4.38	4.12
150	5.25	2.44	1.22	0.81	0.49	43.42	7.41	6.19	5.78	5.46
200	7.00	2.94	1.47	0.98	0.59	40.82	8.99	7.52	7.03	6.64
250	8.75	3.42	1.71	1.14	0.68	38.76	10.44	8.73	8.16	7.71
300	10.50	3.88	1.94	1.29	0.78	37.05	11.80	9.87	9.22	8.70
350	12.25	4.32	2.16	1.44	0.86	35.60	13.09	10.93	10.21	9.63
400	14.00	4.75	2.38	1.58	0.95	34.33	14.31	11.94	11.15	10.51
450	15.75	5.17	2.58	1.72	1.03	33.22	15.48	12.90	12.04	11.35
500	17.50	5.58	2.79	1.86	1.12	32.22	16.61	13.82	12.89	12.14
550	19.25	5.98	2.99	1.99	1.20	31.32	17.69	14.70	13.71	12.91
600	21.00	6.37	3.18	2.12	1.27	30.50	18.74	15.56	14.49	13.65
650	22.75	6.75	3.37	2.25	1.35	29.76	19.75	16.38	15.26	14.36
700	24.50	7.12	3.56	2.37	1.42	29.07	20.74	17.18	15.99	15.04

NOTA: Cálculo de E
 N = Nieble
 S e P = Serafim e Pereira
 B = Bieniawski

c/FR = coesão dividida por Fator de Redução

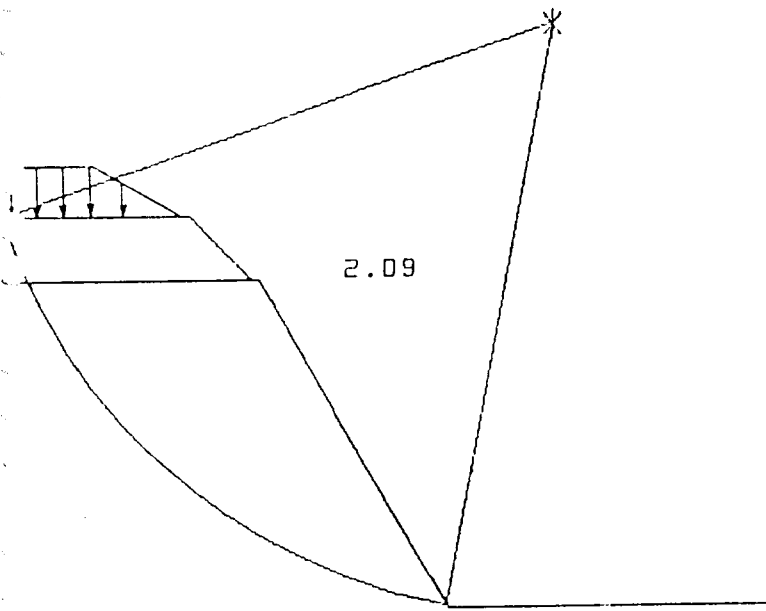
ANEXO 17

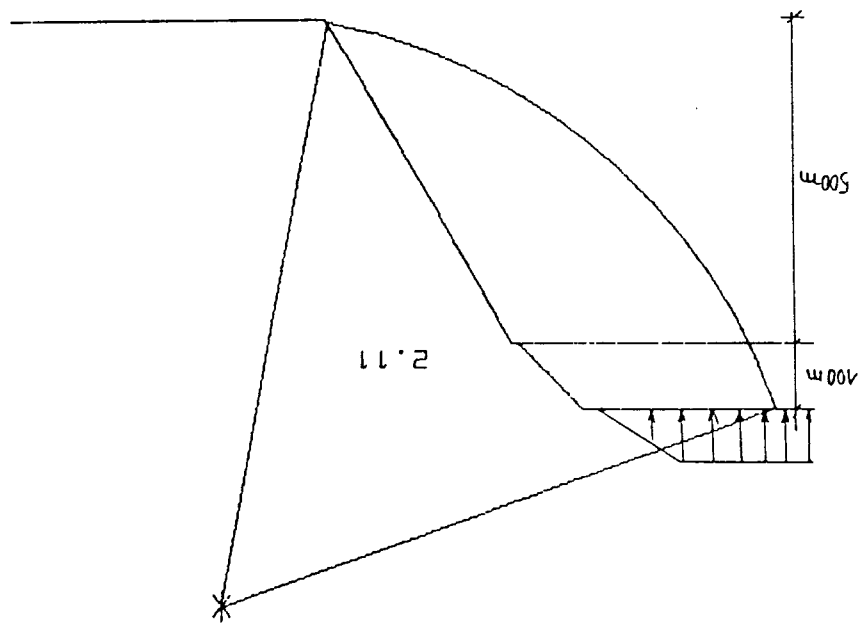
RESULTADOS DE ANÁLISE DE ESTABILIDADE

TALUDES ROCHOSOS

TALUDES EM QUARTZITO/RQF

CASO 1a





CASO 1b

3 A L 0 8 0 - MACICO ROCHOSO, CIRCULO CRITICO e SEM TRINCA
 QUARZITO, H = 100 + 500m, ALFA = 45, ENV. MAO LINEAR

 * NEW MATERIAL PROPERTY DATA *

DATA FOR MATERIAL TYPE 1

Unit weight of material = .028

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	1.000	1.410
2	1.400	2.630
3	2.800	4.390
4	4.200	5.950
5	5.600	7.150
6	7.000	8.370
7	8.400	9.500
8	9.800	10.500

No (or zero) pore water pressures

DATA FOR MATERIAL TYPE 2

Unit weight of material = .028

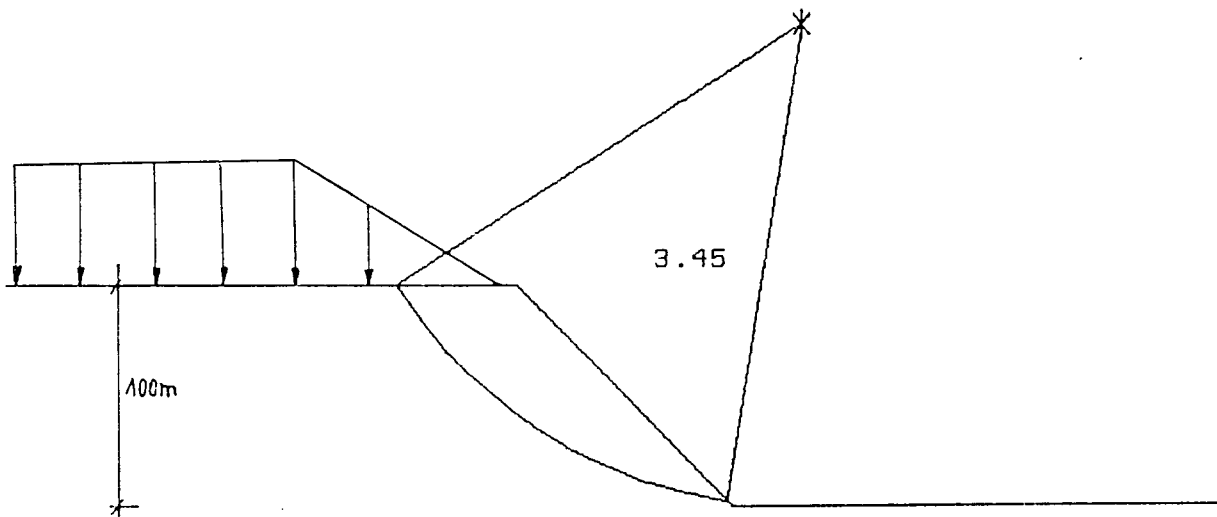
---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	1.000	1.652
2	1.400	3.080
3	2.800	5.000
4	4.200	6.670
5	5.600	8.100
6	7.000	9.500
7	8.400	10.890
8	9.800	12.130
9	11.200	13.310
10	12.600	14.450
11	14.000	15.540
12	15.400	16.590
13	16.800	17.610
14	18.200	18.600
15	19.600	19.570

No (or zero) pore water pressures

***** FINAL CRITICAL CIRCLE INFORMATION *****
 X Coordinate of Center - - - - - 870.000
 Y Coordinate of Center - - - - - 1200.000
 Radius - - - - - 910.000
 Factor of Safety - - - - - 2.111

CASO 1c



S A L P E O - MACIO ROCHOSO, CIRCULO CRITICO e TRINCA
QUARTZITO, H = 100m, ALFA = 45, ENV. NAO LINEAR

* NEW MATERIAL PROPERTY DATA *

DATA FOR MATERIAL TYPE 1

Unit weight of material = .028

---- NONLINEAR SHEAR STRENGTH ENVELOPE ----

Point	Normal Stress	Shear Stress
1	.000	.410
2	1.400	2.600
3	2.800	4.290
4	4.200	5.950
5	5.600	7.160
6	7.000	8.370
7	8.400	9.500
8	9.800	10.560

No (or zero) pore water pressures

**** FINAL CRITICAL CIRCLE INFORMATION ****
X Coordinate of Center - - - - - 440.000
Y Coordinate of Center - - - - - 1020.000
Radius - - - - - 220.000
Factor of Safety - - - - - 3.446