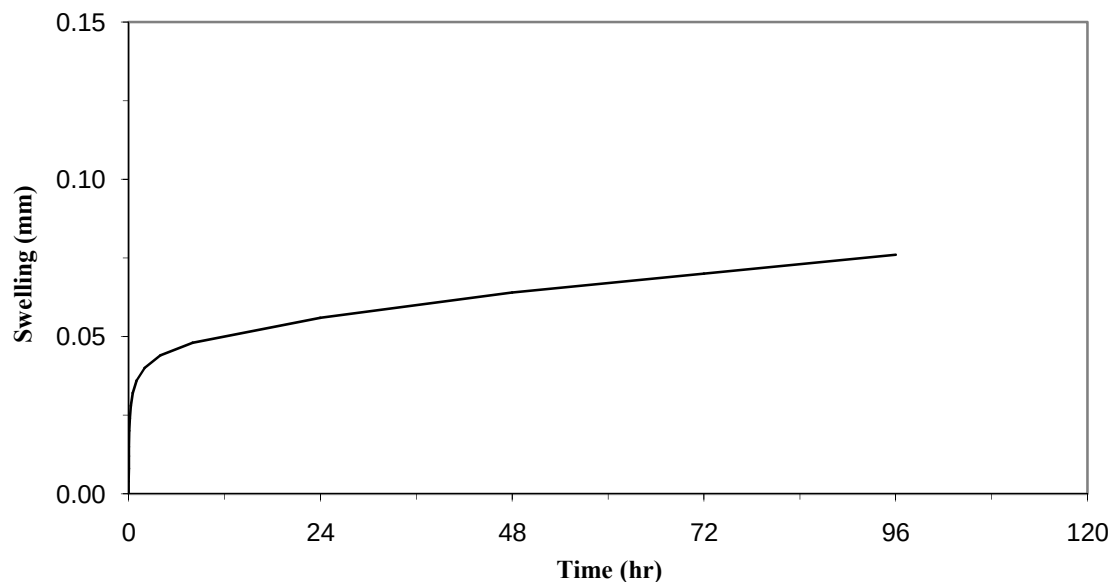


	SOIL ENGINEERING SERVICES (SES)		خدمات مهندسی مکانیک خاک
	PROJ NO: 1347-EE-PEP-GEO-001-B	REV: B	
	SUBJECT: GEOTECHNICAL INVESTIGATION, PHASE I, FACTUAL REPORT, SOUTH AIUMINIUM SMELTER (SALCO) IRAN		

Enclosure Z

Swelling Tests

Borehole No.: BH-2	Depth (m) : 5.00-5.50	Date : 1394/02/16
ω_0 (%) : 21 %	H_0 (cm) : 2.00	PI : 26.0% A_0 (cm ²): 19.63
γ_d (g/cm ³): 1.65	Soil type : CL/CH	Sample type : U1



Swelling Percentage = 0.35

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.000	0.000	0.50	0.032
0.002	0.0000	1.00	0.036
0.003	0.004	2.00	0.04
0.008	0.008	4.00	0.044
0.017	0.012	8.00	0.048
0.033	0.015	24.00	0.056
0.067	0.020	48.00	0.064
0.133	0.024	72.00	0.07
0.250	0.028	96.00	0.076

SWELLING TEST



PROJECT: SOUTH ALUMINUM SMELTER PLANT

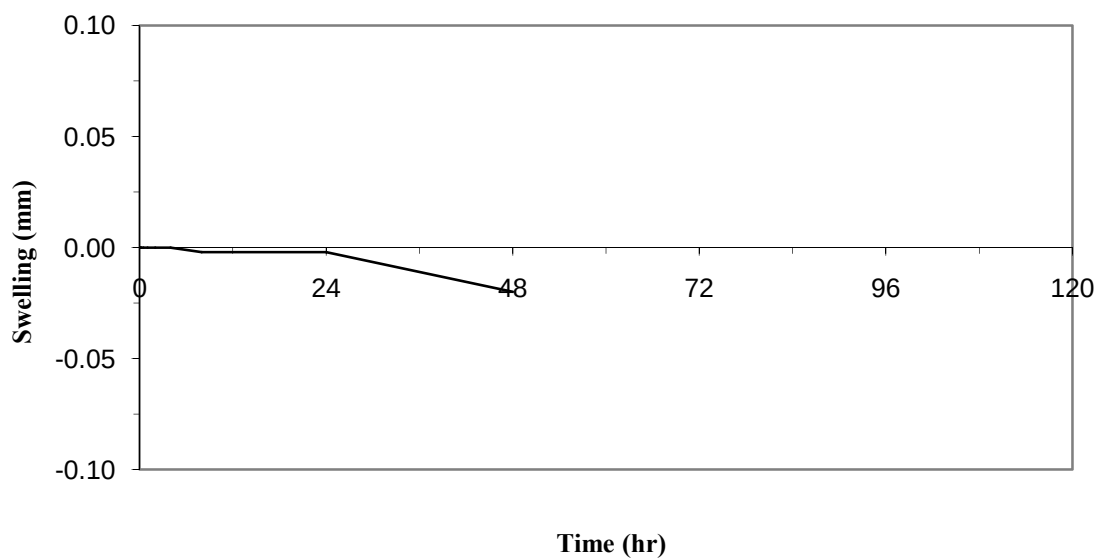
FIGURE: 1

CLIENT : NFC

PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-64	Depth (m) : 6.50-6.95	Date : 1394/03/17	
ω_0 (%) : 24 %	H_0 (cm) : 1.90	PI : 9.0%	A_0 (cm ²): 37.31
γ_d (g/cm ³): 1.59	Soil type : <ML/CL>	Sample type : U2	



Swelling Precentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	0
0.01	0	4.00	-0.002
0.02	0	8.00	-0.002
0.03	0	24.00	-0.02
0.07	0	48.00	-0.022
0.13	0		
0.25	0		
0.50	0		
1.00	0		

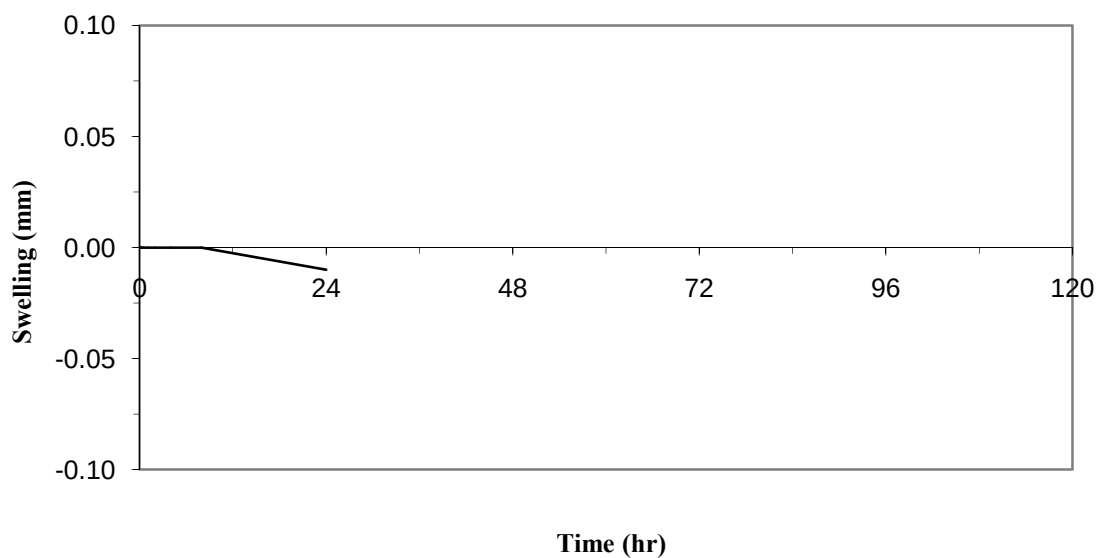
Applied
Pressure=
0.07kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 2
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-100	Depth (m) : 6.00-6.50	Date : 1394/03/15
ω_0 (%) : 25 %	H_0 (cm) : 2.00	PI : 11.0% A_0 (cm ²): 31.81
γ_d (g/cm ³): 1.59	Soil type : <CL/ML>	Sample type : U1



Swelling Precentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	0
0.01	0	4.00	0
0.02	0	8.00	0
0.03	0	24.00	-0.01
0.07	0		
0.13	0		
0.25	0		
0.50	0		
1.00	0		

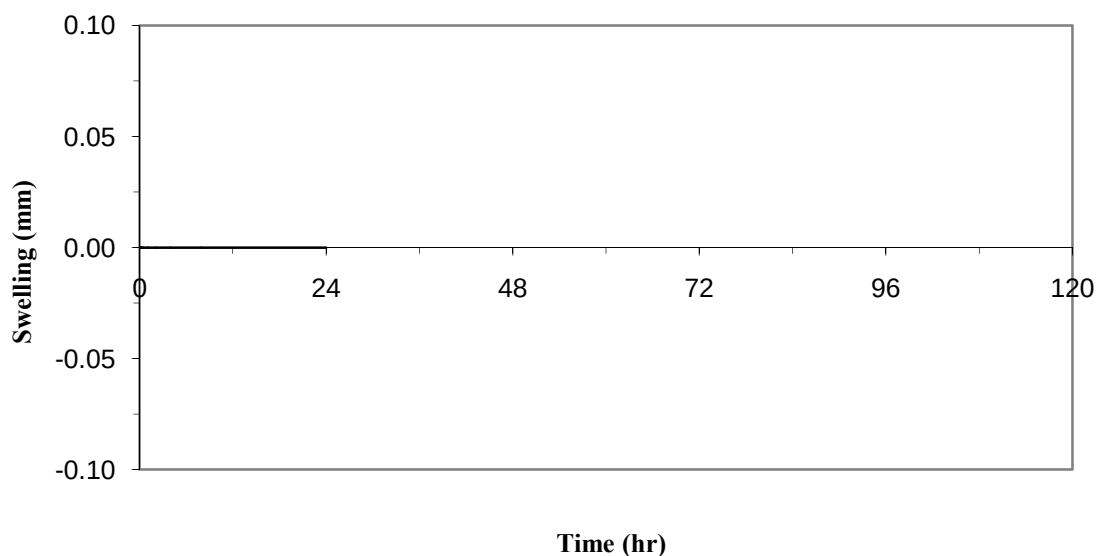
Applied
Pressure=
0.05kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 3
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-111	Depth (m) : 6.50-6.95	Date : 1394/03/18
ω_0 (%) : 25 %	H_0 (cm) : 2.00	PI : 17.0% A_0 (cm ²): 39.27
γ_d (g/cm ³): 1.61	Soil type : <CL/ML>	Sample type : U1



Swelling Precentage = 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	0
0.01	0	4.00	0
0.02	0	8.00	0
0.03	0	24.00	0
0.07	0		
0.13	0		
0.25	0		
0.50	0		
1.00	0		

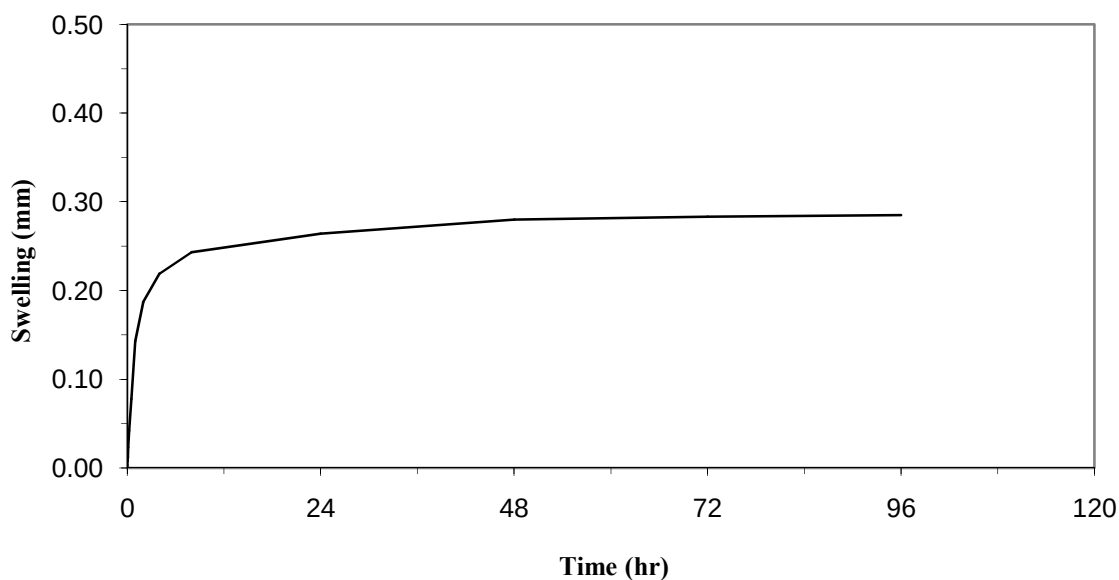
Applied
Pressure=
0.05kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 4
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-151	Depth (m) : 5.20-5.60	Date : 1394/02/16
ω_0 (%) : 23 %	H_0 (cm) : 2.00	PI : 23.0% A_0 (cm ²) : 19.63
γ_d (g/cm ³): 1.57	Soil type : CL	Sample type : CB1



Swelling Precentage = 1.43

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0.000	0.50	0.078
0.002	0.000	1.00	0.143
0.003	0.000	2.00	0.187
0.01	0.002	4.00	0.219
0.02	0.004	8.00	0.243
0.03	0.008	24.00	0.264
0.07	0.012	48.00	0.28
0.13	0.023	72.00	0.283
0.25	0.042	96.00	0.285

SWELLING TEST



PROJECT: SOUTH ALUMINUM SMELTER PLANT

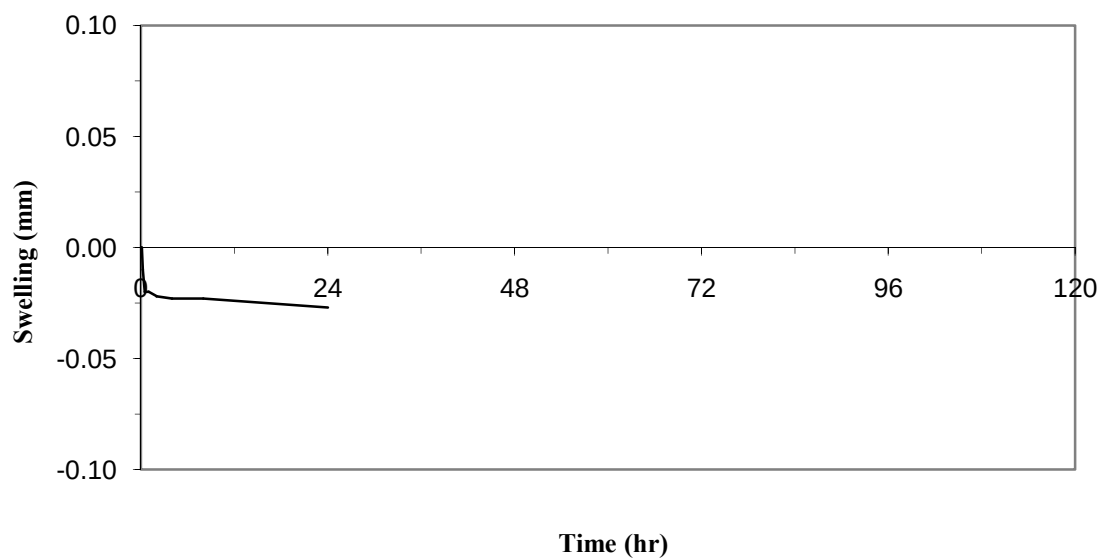
FIGURE: 5

CLIENT : NFC

PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-164	Depth (m) : 5.5-6.00	Date : 1394/03/10
ω_0 (%) : 25 %	H_0 (cm) : 2.00	PI : 16.0% A_0 (cm ²): 39.27
γ_d (g/cm ³): 1.61	Soil type : <CL/ML>	Sample type : U1

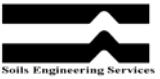


Swelling Precentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	-0.022
0.01	0	4.00	-0.023
0.02	0	8.00	-0.023
0.03	0	24.00	-0.027
0.07	0		
0.13	0		
0.25	-0.01		
0.50	-0.02		
1.00	-0.02		

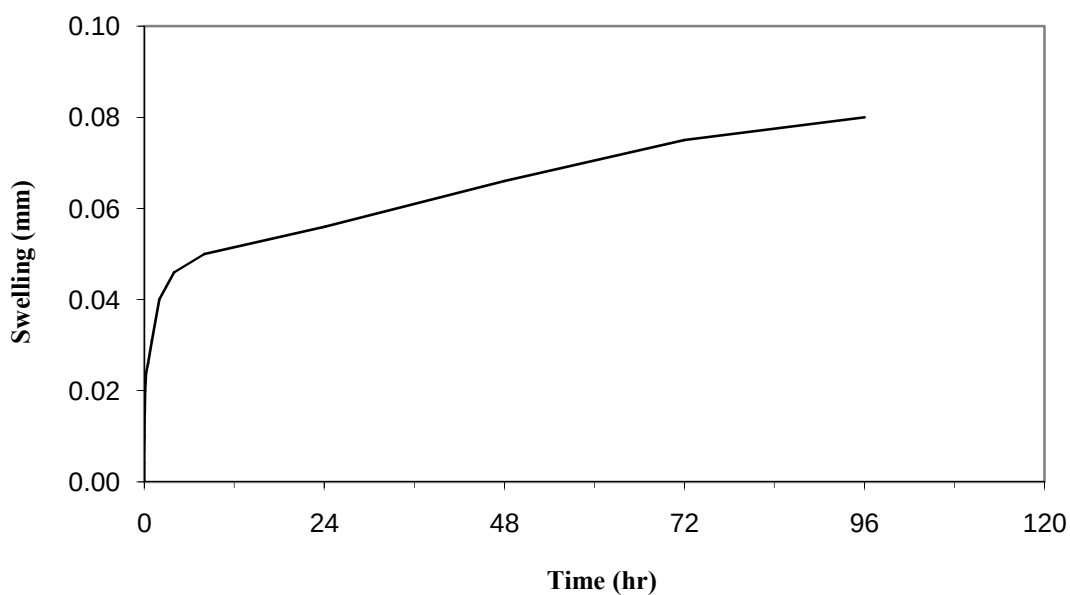
Applied
Pressure=
0.05kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 6
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-166	Depth (m) : 7.00-7.50	Date : 1394/02/16
ω_0 (%) : 22 %	H_0 (cm) : 2.00	PI : 15.0% A_0 (cm ²) : 19.63
γ_d (g/cm ³) : 1.66	Soil type : CL	Sample type : U1



Swelling Percentage = 0.38

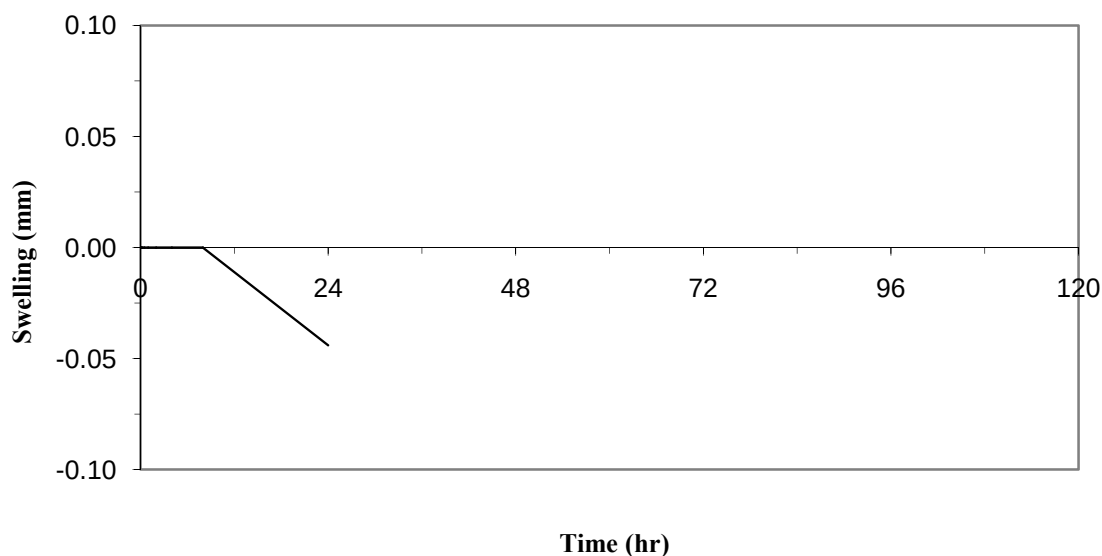
Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	0.50	0.026
0.00	0	1.00	0.031
0.00	0.004	2.00	0.04
0.01	0.007	4.00	0.046
0.02	0.01	8.00	0.05
0.03	0.013	24.00	0.056
0.07	0.016	48.00	0.066
0.13	0.02	72.00	0.075
0.25	0.024	96.00	0.08

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 7
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-169	Depth (m) : 5.50-6.00	Date : 1394/03/15
ω_0 (%) : 25 %	H_0 (cm) : 1.90	PI : 17.0% A_0 (cm ²) : 37.31
γ_d (g/cm ³) : 1.54	Soil type : <CL/ML>	Sample type : U1



Swelling Precentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	0
0.01	0	4.00	0
0.02	0	8.00	0
0.03	0	24.00	-0.044
0.07	0		
0.13	0		
0.25	0		
0.50	0		
1.00	0		

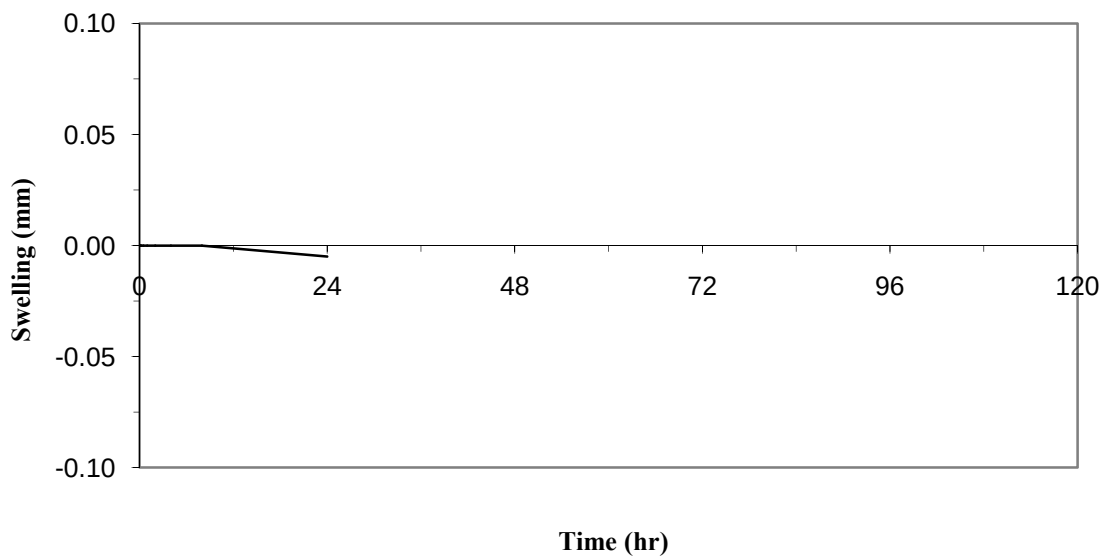
Applied
Pressure=
0.07kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 8
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-254	Depth (m) : 4.00-4.50	Date : 1394/03/14
ω_0 (%) : 22 %	H_0 (cm) : 2.00	PI : 22.0% A_0 (cm ²): 31.81
γ_d (g/cm ³): 1.65	Soil type : <CL/ML>	Sample type : U1



Swelling Precentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	0
0.01	0	4.00	0
0.02	0	8.00	0
0.03	0	24.00	-0.005
0.07	0		
0.13	0		
0.25	0		
0.50	0		
1.00	0		

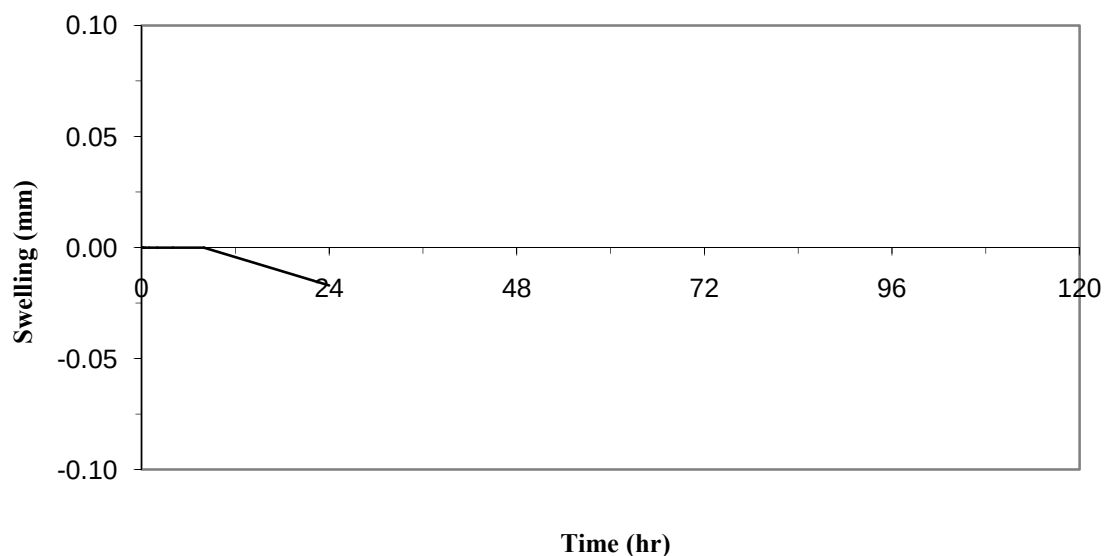
Applied
Pressure=
0.05kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 9
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-262	Depth (m) : 6.00-6.50	Date : 1394/03/14
ω_0 (%) : 25 %	H_0 (cm) : 2.00	PI : 13.0% A_0 (cm ²): 39.27
γ_d (g/cm ³): 1.61	Soil type : <ML/CL>	Sample type : U1



Swelling Precentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	0
0.01	0	4.00	0
0.02	0	8.00	0
0.03	0	24.00	-0.017
0.07	0		
0.13	0		
0.25	0		
0.50	0		
1.00	0		

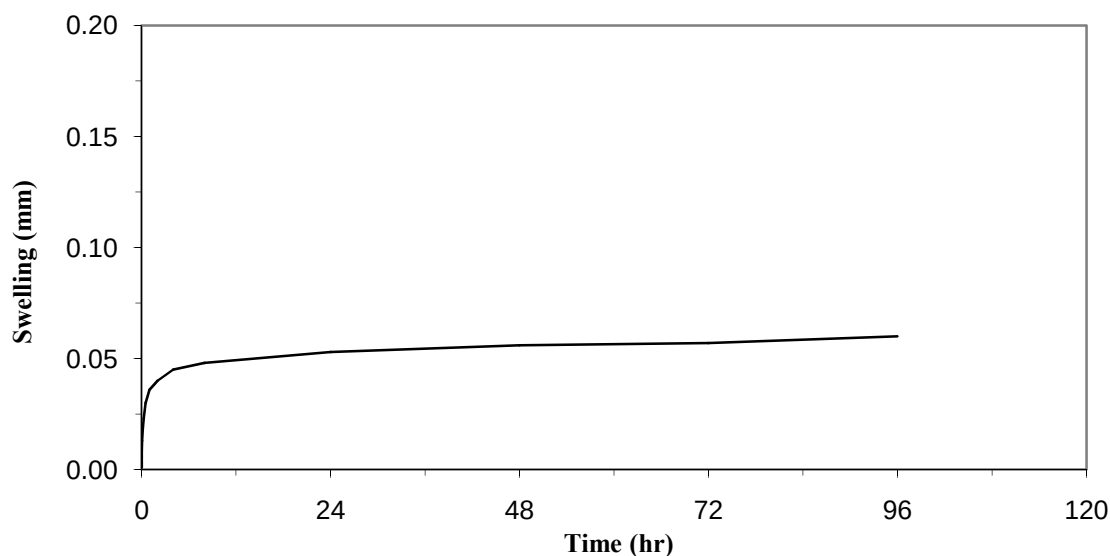
Applied
Pressure=
0.05kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 10
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-282	Depth (m) : 4.00-4.50	Date : 1394/02/16
ω_0 (%) : 25 %	H_0 (cm) : 1.97	PI : 13.0% A_0 (cm ²): 19.63
γ_d (g/cm ³): 1.59	Soil type : <CL>	Sample type : U1



Swelling Precentage = 0.29

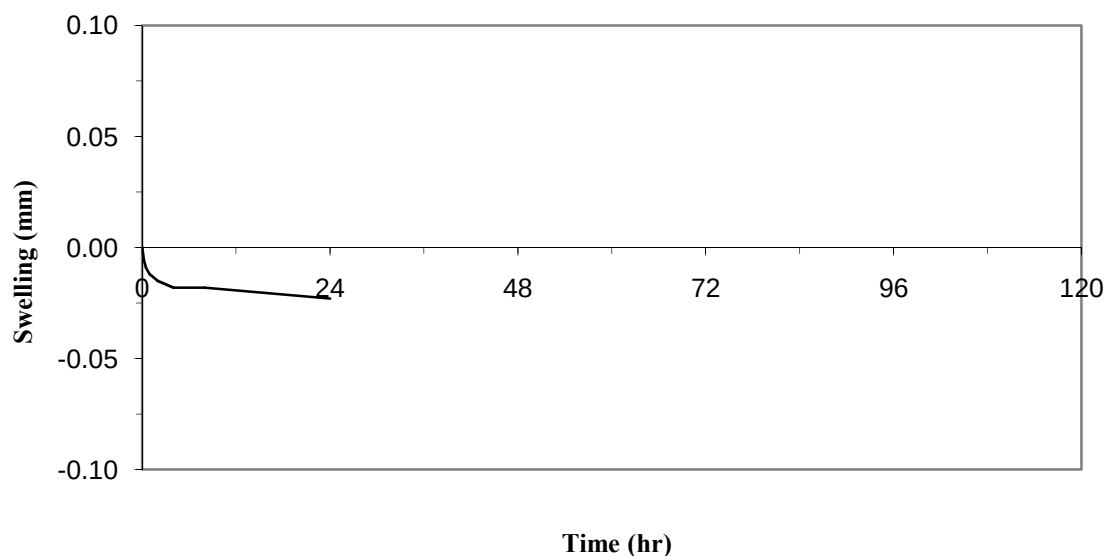
Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	0.50	0.03
0.002	0.001	1.00	0.036
0.003	0.002	2.00	0.04
0.01	0.003	4.00	0.045
0.02	0.006	8.00	0.048
0.03	0.008	24.00	0.053
0.07	0.013	48.00	0.056
0.13	0.018	72.00	0.057
0.25	0.023	96.00	0.06

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 11
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

Borehole No.: BH-284	Depth (m) : 6.00-6.50	Date : 1394/03/17
ω_0 (%) : 25 %	H_0 (cm) : 2.00	PI : 13.0% A_0 (cm ²): 39.27
γ_d (g/cm ³): 1.57	Soil type : <ML/CL>	Sample type : U1



Swelling Percentage $\approx$ 0.00

Time (hr)	Swelling (mm)	Time (hr)	Swelling (mm)
0.00	0	2.00	-0.015
0.01	0	4.00	-0.018
0.02	0	8.00	-0.018
0.03	0	24.00	-0.023
0.07	0		
0.13	-0.003		
0.25	-0.006		
0.50	-0.009		
1.00	-0.012		

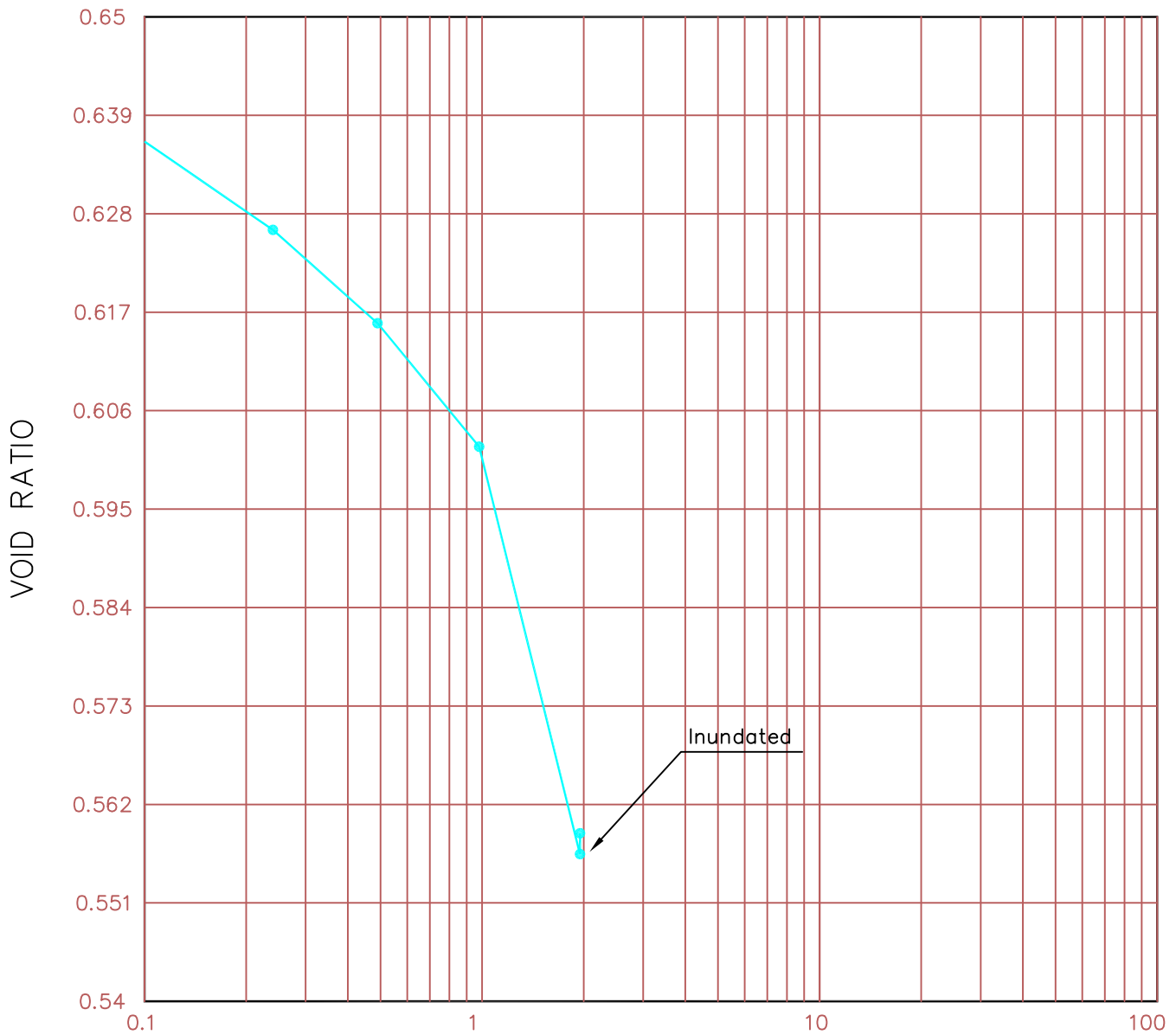
Applied
Pressure=
0.05kg/cm²

SWELLING TEST

	PROJECT: SOUTH ALUMINUM SMELTER PLANT	FIGURE: 12
	CLIENT : NFC	PROJ. No. : 1347

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

PRESSURE kg/cm^2



BORING NO.	SAMPLE NO.	DEPTH (m)	SOIL TYPE	SAMPLE CONDITION	SPECIFIC GRAVITY	INITIAL DEGREE OF SATURATION PERCENT
BH-130	U01	4.00-4.50	<CL/ML>	UNDISTURBED	2.70	100

INITIAL MOIST CONTENT IN PERCENT OF DRY WEIGHT	INITIAL WET DENSITY t/m^3	INITIAL DRY DENSITY t/m^3	e_o	REMARKS:
24	2.04	1.65	0.638	

SWELLING TEST DATA



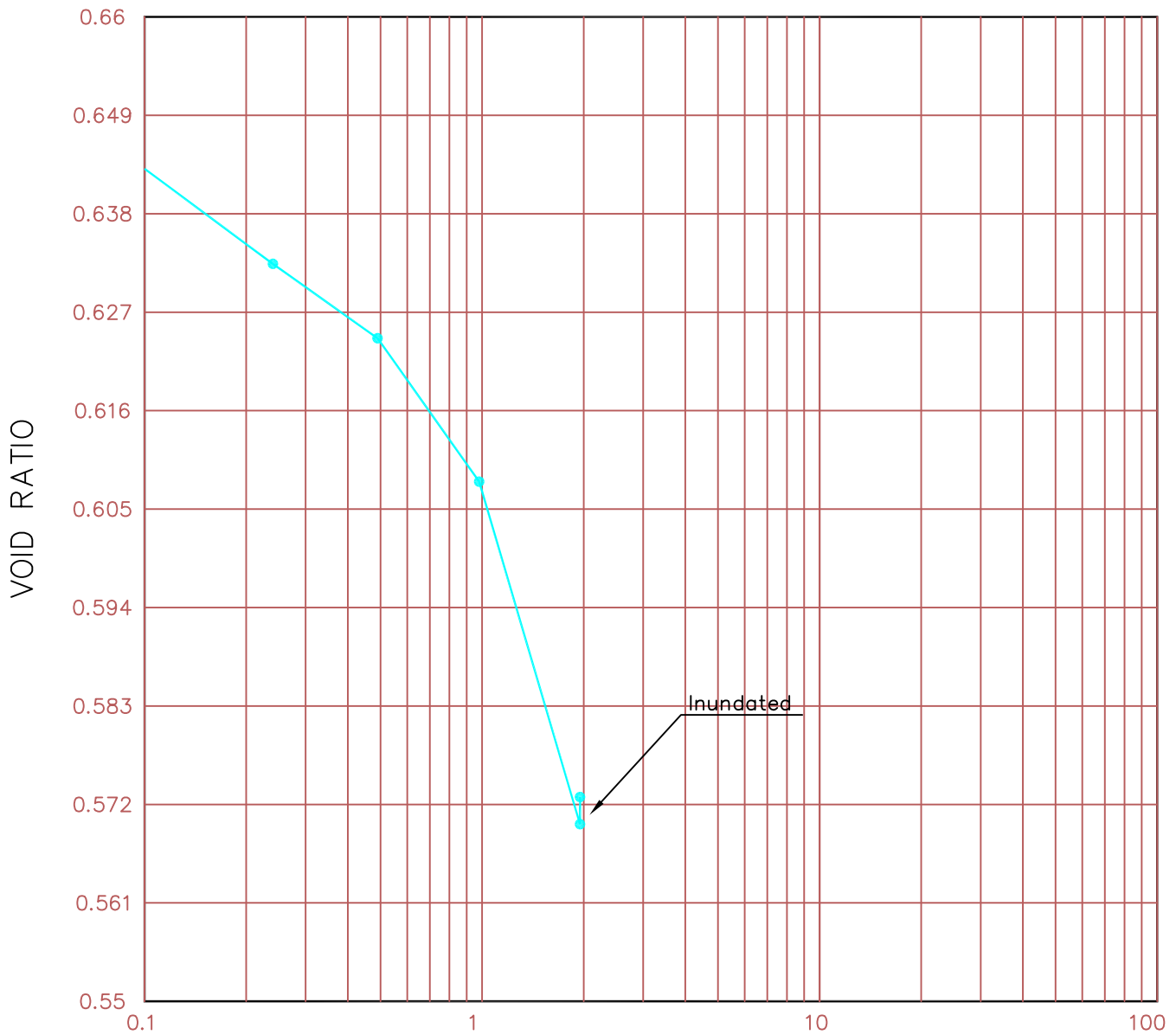
PROJECT : SOUTH ALUMINUM SMELTER PLANT
CLIENT : NFC

Figure No.
1

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

PROJ No.:1347

PRESSURE kg/cm^2



BORING NO.	SAMPLE NO.	DEPTH (m)	SOIL TYPE	SAMPLE CONDITION	SPECIFIC GRAVITY	INITIAL DEGREE OF SATURATION PERCENT
BH-249	U01	4.00-4.50	<CL/ML>	UNDISTURBED	2.70	94

INITIAL MOIST CONTENT IN PERCENT OF DRY WEIGHT	INITIAL WET DENSITY t/m^3	INITIAL DRY DENSITY t/m^3	e_o	REMARKS:
23	2.01	1.64	0.645	

SWELLING TEST DATA



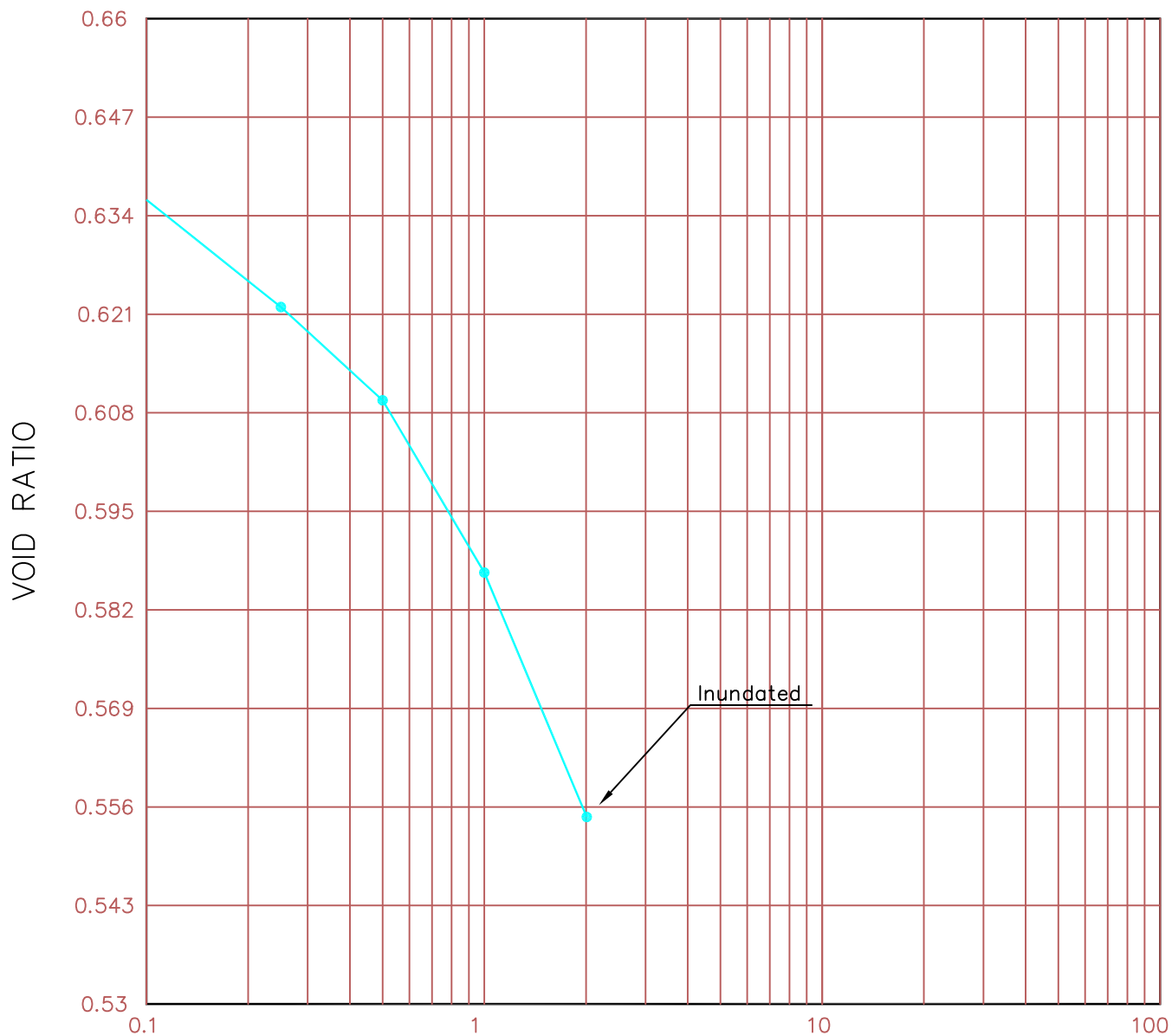
PROJECT : SOUTH ALUMINUM SMELTER PLANT
CLIENT : NFC

Figure No.
2

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

PROJ No.:1347

PRESSURE kg/cm^2



BORING NO.	SAMPLE NO.	DEPTH (m)	SOIL TYPE	SAMPLE CONDITION	SPECIFIC GRAVITY	INITIAL DEGREE OF SATURATION PERCENT
BH-279	U01	3.50-4.00	<CL/ML>	UNDISTURBED	2.76	100

INITIAL MOIST CONTENT IN PERCENT OF DRY WEIGHT	INITIAL WET DENSITY t/m^3	INITIAL DRY DENSITY t/m^3	e_o	REMARKS:
23	2.07	1.68	0.641	

SWELLING TEST DATA



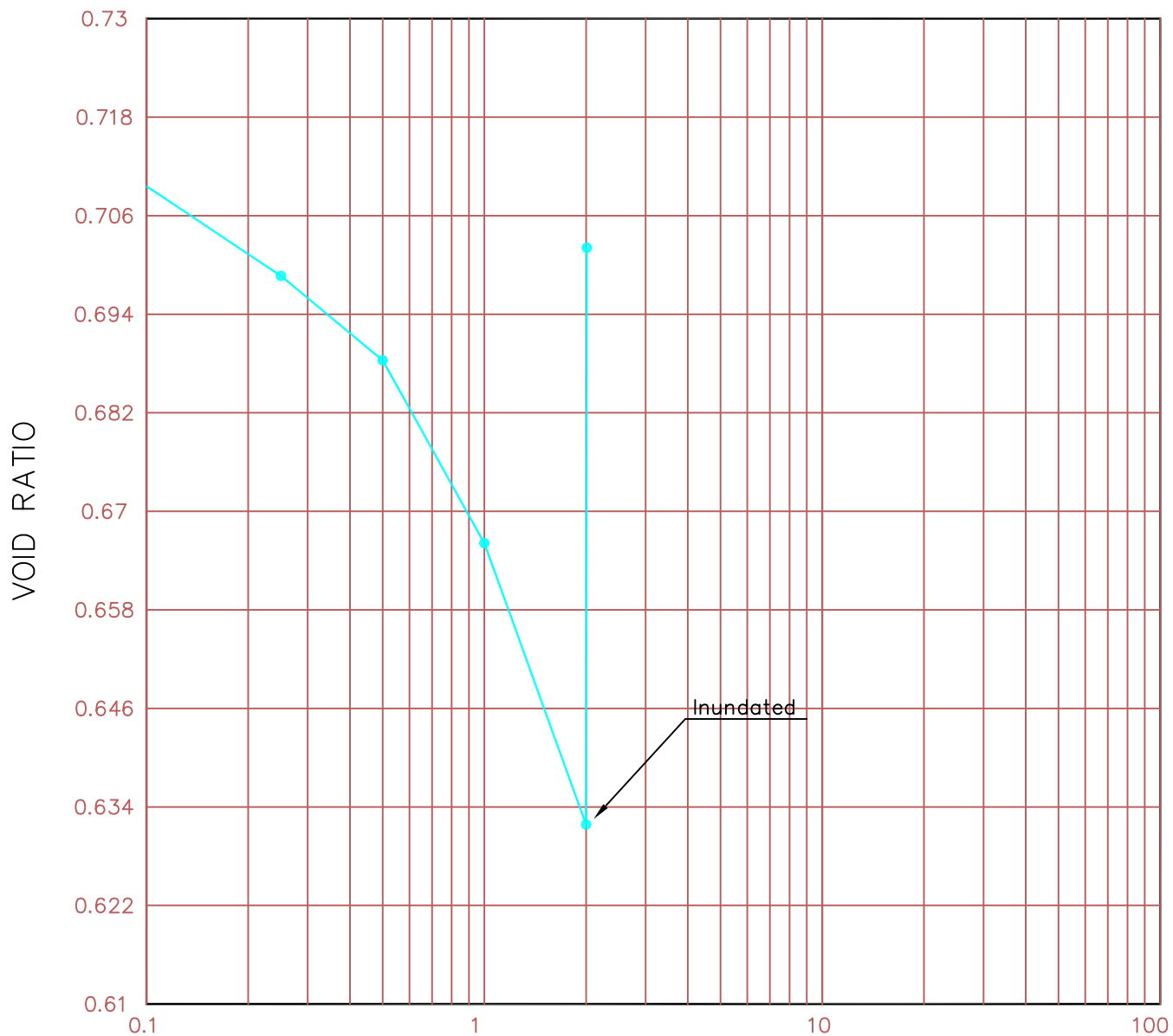
PROJECT : SOUTH ALUMINUM SMELTER PLANT
CLIENT : NFC

Figure No.
3

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

PROJ No.:1347

PRESSURE kg/cm^2



BORING NO.	SAMPLE NO.	DEPTH (m)	SOIL TYPE	SAMPLE CONDITION	SPECIFIC GRAVITY	INITIAL DEGREE OF SATURATION PERCENT
BH-329	U01	4.00-4.50	<ML>	UNDISTURBED	2.70	88

INITIAL MOIST CONTENT IN PERCENT OF DRY WEIGHT	INITIAL WET DENSITY t/m^3	INITIAL DRY DENSITY t/m^3	e_o	REMARKS:
23	1.94	1.58	0.713	

SWELLING TEST DATA



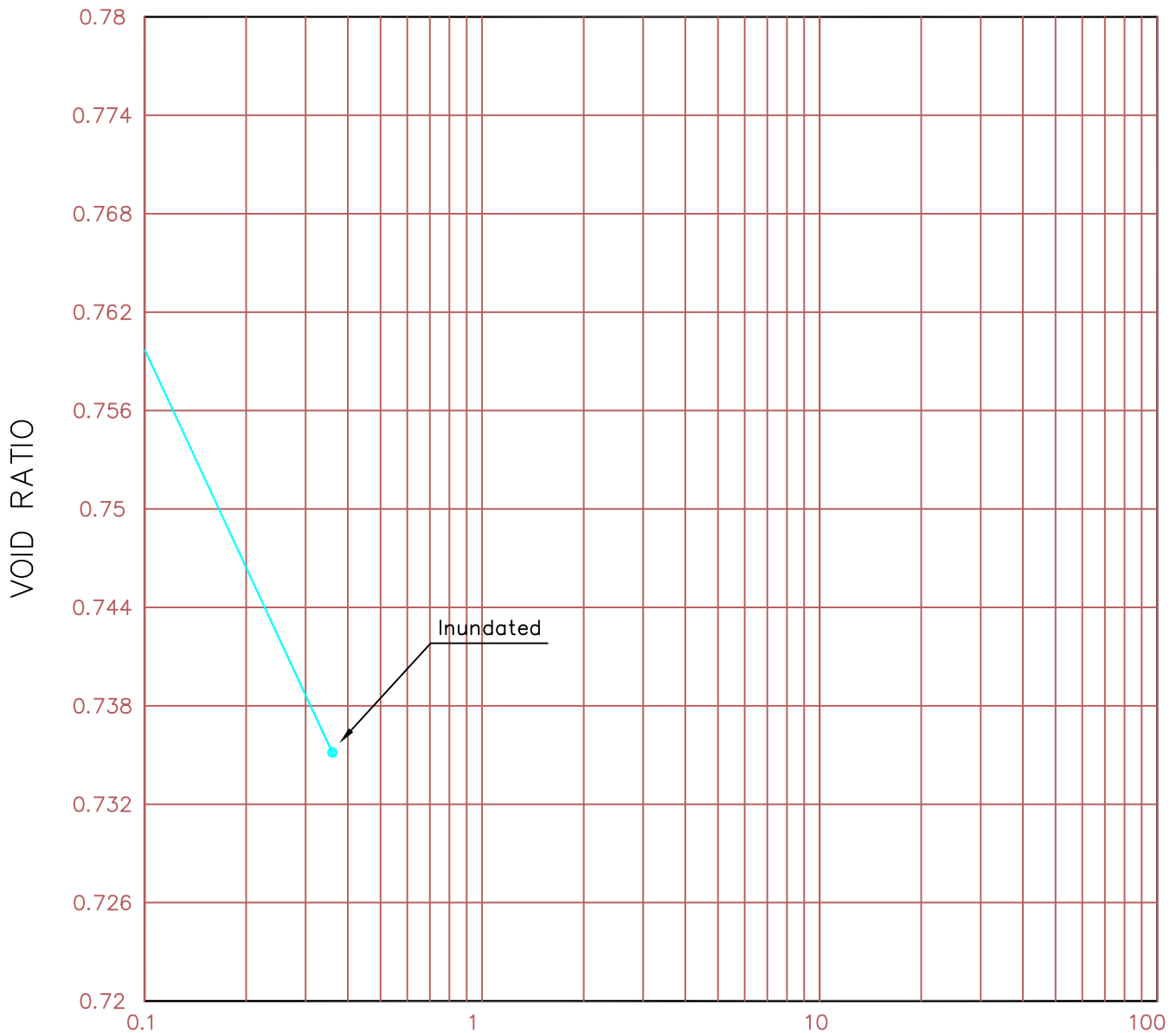
PROJECT : SOUTH ALUMINUM SMELTER PLANT
CLIENT : NFC

Figure No.
4

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

PROJ No.:1347

PRESSURE kg/cm^2



BORING NO.	SAMPLE NO.	DEPTH (m)	SOIL TYPE	SAMPLE CONDITION	SPECIFIC GRAVITY	INITIAL DEGREE OF SATURATION PERCENT
BH-251	U01	4.00-4.450	<CL/ML>	UNDISTURBED	2.70	85

INITIAL MOIST CONTENT IN PERCENT OF DRY WEIGHT	INITIAL WET DENSITY t/m^3	INITIAL DRY DENSITY t/m^3	e_o	REMARKS:
24	1.90	1.53	0.761	

SWELLING TEST DATA



PROJECT : SOUTH ALUMINUM SMELTER PLANT
CLIENT : NFC

Figure No.
1

SOIL ENGINEERING SERVICES CONSULTING ENGINEERS

PROJ No.:1347