



May 13, 2004

Mr. Ron Purkey
Tennessee Valley Authority
1101 Market Street, LP-2G
Chattanooga, TN 37402
Fax (423) 751-7094

Subject: **Laboratory Testing Results**
 Samples from Gypsum Pond at Cumberland Fossil Plant
 TVA Kingston Fossil Plant
 Kingston, Tennessee
 MACTEC Project 3043041009/0001

Dear Mr. Purkey:

We at MACTEC Engineering and Consulting, Inc., (MACTEC) are please to submit the results of laboratory testing that was performed on gypsum material from a gypsum pond at the TVA Cumberland Fossil Plant. Attached to this letter are a summary of the laboratory test results and the individual test result sheets.

The laboratory testing was performed on relatively undisturbed samples which were collected by MACTEC personnel. A total of seven samples were collected from three different areas within the gypsum pond. Initially, the plan was to collect samples representative of coarse gypsum from an area near the discharge into the ditch, samples representative of finer gypsum at the far side of the pond from the discharge, and samples of sedimented gypsum from the interior of the ponds. Samples 1 and 2 were obtained from the area near the discharge. Grain size analysis confirms that this material is coarser than the material from the opposite side of the pond. The tests were performed on Sample 2 which was obtained by direct push. Samples 3, 4, and 4A were obtained on the opposite side of the pond from the finer material. The location where the samples were obtained was a sedimented area that had been allowed to dry and had then been mined to some extent. About 10 feet of material had been removed in the past. Sample 4, which was obtained by direct push, was used for testing from this area. It should be noted that Sample 3 and Sample 4A (which was only 5 feet from Sample 4) had to be driven using a hammer.

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TVA-00004028

May 13, 2004

Attempts at two locations within the interior of the pond to sample sedimented material that had been allowed to dry were not successful with the equipment used. The material surface could not be penetrated with reasonable effort using a post hole digger. Sampling would require use of mechanical augers or coring equipment.

In lieu of sampling this material, after consultation with Parsons personnel, samples were obtained from the cross dike about a fourth of the way from the side farthest from the discharge pipes. Samples 5 and 5A were both direct push of approximately 1 foot. Those samples were combined to test the cast material used to construct the dike.

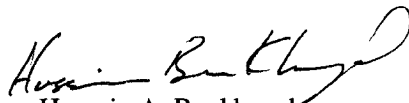
The laboratory tests performed on this material included specific gravity determination, plasticity tests, grain size analysis, permeability tests, and consolidated undrained (CU) triaxial compression tests.


The condition of the sedimented gypsum after it has been allowed to dry and been mined gives an indication of its strength. Near vertical cuts of 20 feet or more show little if any signs of slope failure or even raveling after being exposed for several months.

We appreciate the opportunity to be of continuing service to the Tennessee Valley Authority and will be pleased to discuss the results of the laboratory testing with you at your convenience.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.


Hussein A. Benkhayat
Senior Engineer


Carl D. Tockstein, P.E. *with permission*
Chief Engineer - Tennessee Operations

HAB/CDT:sjm

Attachments: Summary of Laboratory Test Results
Individual Laboratory Test Result Sheets

cc: Mr. Daniel Smith
Parsons Energy & Chemical, Inc.
633 Chestnut Street, Suite 400
Chattanooga, TN 37450-0400
Fax (423) 266-0922

Table 1
Permeability Laboratory Test Results

Sample Location	Dry Density (pcf)	Moisture Content (%)	Permeability (cm/sec)
Hole 2	66.8	34.8	6.65×10^{-4}
Hole 3	69.0	29.0	5.02×10^{-4}
Hole 5A	65.6	34.3	6.65×10^{-4}
Prepared By <u>HAB</u> Date <u>5/13/04</u> Checked By <u>CP</u> Date <u>5/13/04</u>			

Table 2
Triaxial Compression Laboratory Test Results

Sample Location	Specific Gravity	Average Moisture Content (%)	Average Dry Density (pcf)	Triaxial Compression (CU)			
				Total		Effective	
				Cohesion, C (ksf)	Friction Angle, ϕ (degrees)	Cohesion, C' (ksf)	Friction Angle, ϕ' (degrees)
Hole 2	2.36	27.1	68.3	1.9	37.5	0.0	40.4
Hole 4	2.35	40.5	70.0	4.3	23.7	0.77	30.6
Hole 5/5A	2.33	24.9	69.8	0.95	34.8	0.0	37.3
Prepared By <u>HAB</u> Date <u>5/13/04</u> Checked By <u>COT</u> Date <u>5/13/04</u>							

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 20

Date: 05-03-04
 Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum

Sample Data

Location of Sample: Hole #1
 Sample Description: Gypsum
 USCS Class: Liquid limit: NV
 AASHTO Class: Plasticity index: NP

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
 Dry sample and tare= 82.32
 Tare = 0.00
 Dry sample weight = 82.32
 Sample split on number 10 sieve
 Split sample data:
 Sample and tare = 51.72 Tare = 0 Sample weight = 51.72
 Cumulative weight retained tare= 0
 Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.00	100.0
# 10	0.00	100.0
# 20	0.00	100.0
# 40	0.00	100.0
# 60	0.07	99.9
# 140	0.29	99.4
# 200	8.79	83.0

Hydrometer Analysis Data

Separation sieve is number 10
 Percent -# 10 based on complete sample= 100.0
 Weight of hydrometer sample: 51.72
 Calculated biased weight= 51.72
 Table of composite correction values:
 Temp, deg C: 20.0 22.0 24.0

Comp. corr: - 5.5 - 4.8 - 4.0
 Meniscus correction only= 1
 Specific gravity of solids= 2.35
 Specific gravity correction factor= 1.084
 Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

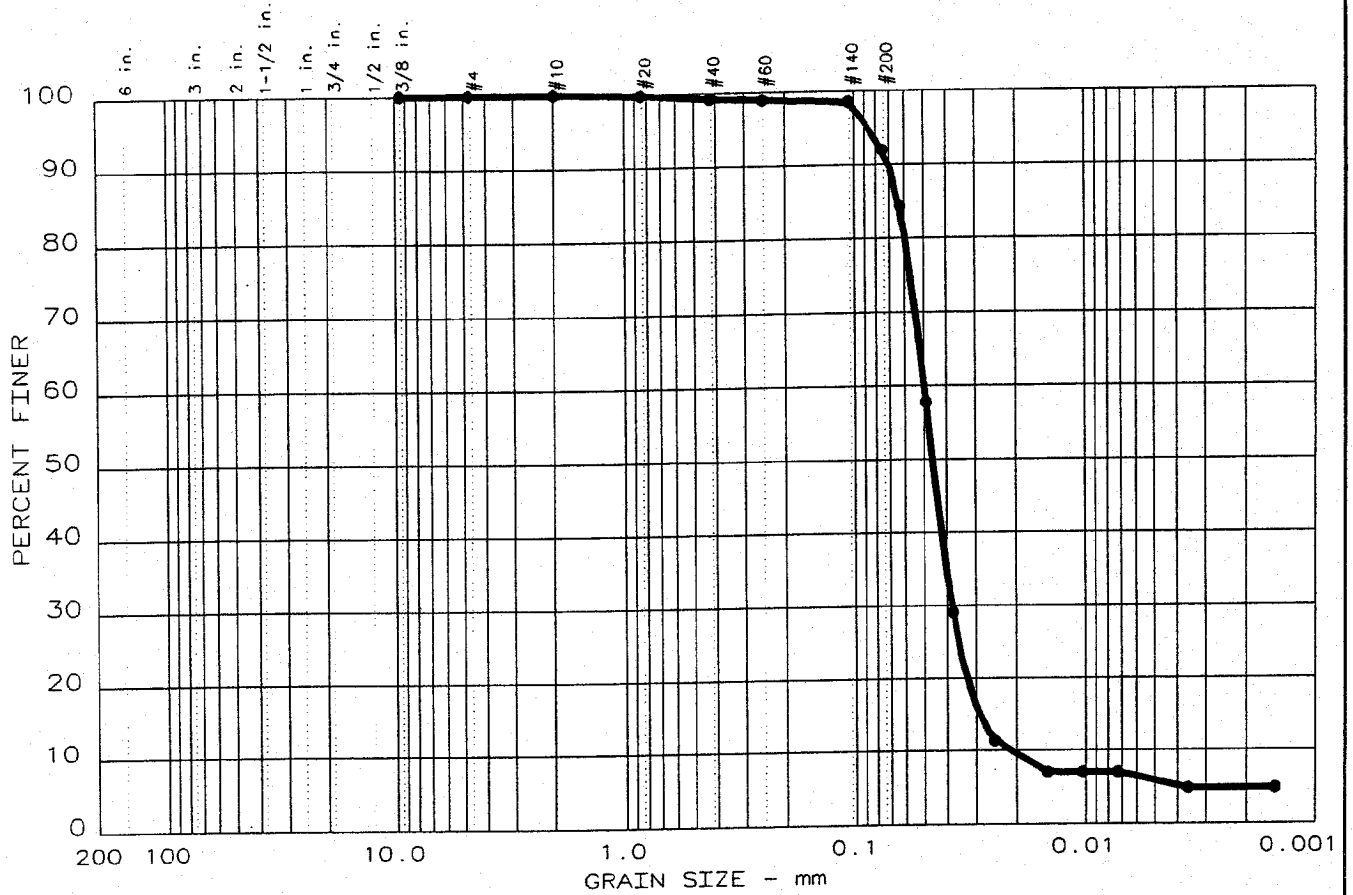
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
0.5	21.9	43.0	38.2	0.0147	44.0	9.1	0.0628	80.0
1.0	21.9	29.0	24.2	0.0147	30.0	11.4	0.0497	50.6
2.0	21.9	15.0	10.2	0.0147	16.0	13.7	0.0385	21.3
5.0	21.9	12.0	7.2	0.0147	13.0	14.2	0.0248	15.0
15.0	21.9	11.0	6.2	0.0147	12.0	14.3	0.0144	12.9
30.0	21.9	11.0	6.2	0.0147	12.0	14.3	0.0102	12.9
60.0	21.9	11.0	6.2	0.0147	12.0	14.3	0.0072	12.9
250.0	21.9	10.0	5.2	0.0147	11.0	14.5	0.0035	10.8
1440.0	21.9	10.0	5.2	0.0147	11.0	14.5	0.0015	10.8

 Fractional Components

Gravel/Sand based on #4 sieve
 Sand/Fines based on #200 sieve
 % + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 17.0
 % SILT = 71.2 % CLAY = 11.8

D85= 0.08 D60= 0.053 D50= 0.049
 D30= 0.0415 D15= 0.02443

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 17	0.0	0.0	8.0	86.2	5.8

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.0632	0.0497	0.0459	0.0377	0.0290	0.0210	1.37	2.4

MATERIAL DESCRIPTION	USCS	AASHTO
● Gypsum		

Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum
 ● Location: Hole #2

Date: 05-03-04

PARTICLE SIZE ANALYSIS REPORT

Remarks:

Fig. No.: _____

HAB

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 17

Date: 05-03-04
 Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum

Sample Data

Location of Sample: Hole #2
 Sample Description: Gypsum
 USCS Class: Liquid limit: NV
 AASHTO Class: Plasticity index: NP

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
 Dry sample and tare= 116.40
 Tare = 0.00
 Dry sample weight = 116.40
 Sample split on number 10 sieve
 Split sample data:
 Sample and tare = 48.99 Tare = 0 Sample weight = 48.99
 Cumulative weight retained tare= 0
 Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.00	100.0
# 10	0.00	100.0
# 20	0.13	99.7
# 40	0.39	99.2
# 60	0.53	98.9
# 140	0.70	98.6
# 200	3.93	92.0

Hydrometer Analysis Data

Separation sieve is number 10
 Percent -# 10 based on complete sample= 100.0
 Weight of hydrometer sample: 48.99
 Calculated biased weight= 48.99
 Table of composite correction values:
 Temp, deg C: 20.0 22.0 24.0

Comp. corr: - 5.5 - 4.8 - 4.0
 Meniscus correction only= 1
 Specific gravity of solids= 2.356
 Specific gravity correction factor= 1.082
 Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

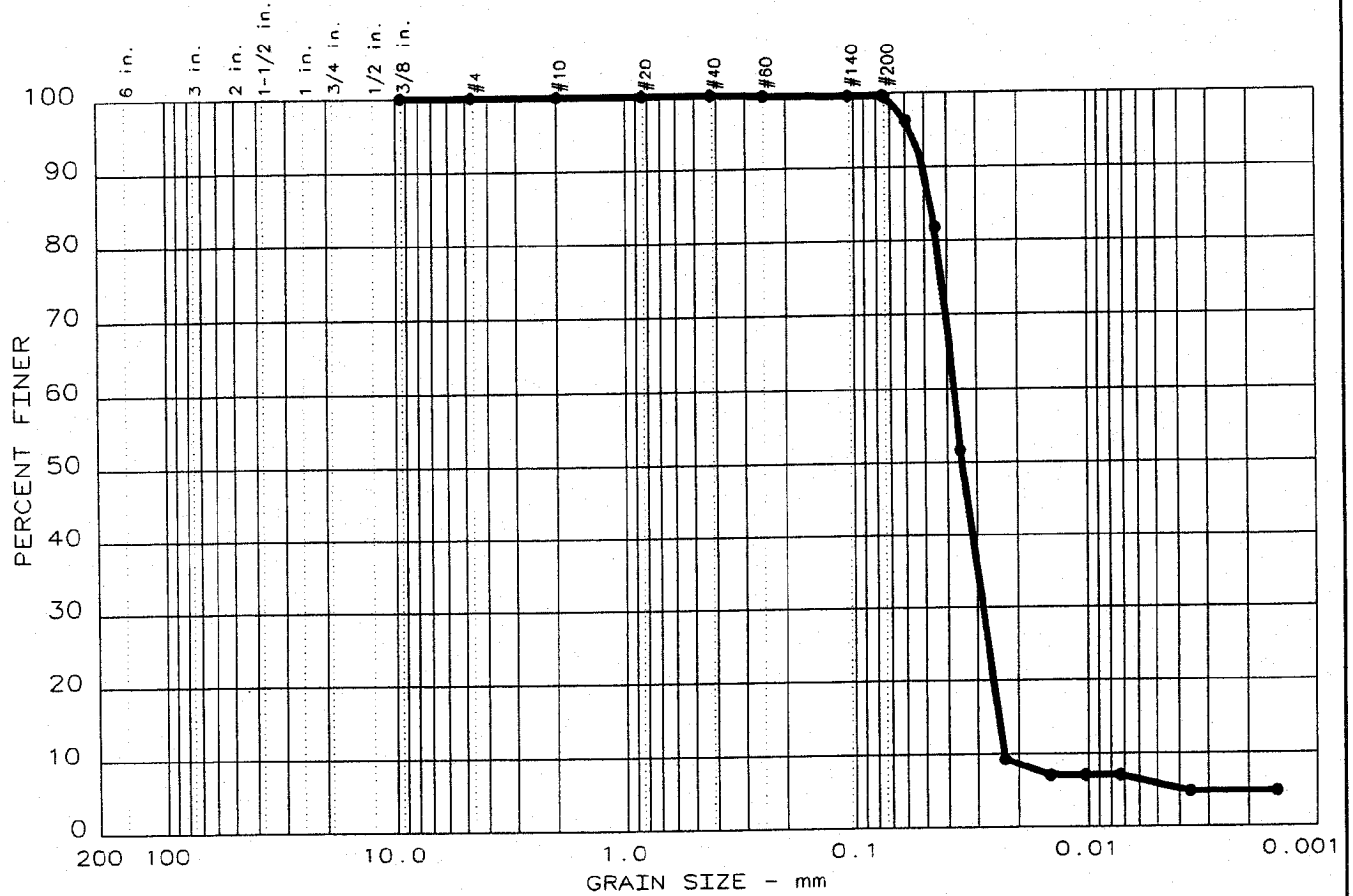
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
0.5	21.9	43.0	38.2	0.0147	44.0	9.1	0.0626	84.3
1.0	21.9	31.0	26.2	0.0147	32.0	11.0	0.0489	57.8
2.0	21.9	18.0	13.2	0.0147	19.0	13.2	0.0377	29.1
5.0	21.9	10.0	5.2	0.0147	11.0	14.5	0.0250	11.4
15.0	21.9	8.0	3.2	0.0147	9.0	14.8	0.0146	7.0
30.0	21.9	8.0	3.2	0.0147	9.0	14.8	0.0103	7.0
60.0	21.9	8.0	3.2	0.0147	9.0	14.8	0.0073	7.0
250.0	21.9	7.0	2.2	0.0147	8.0	15.0	0.0036	4.8
1440.0	21.9	7.0	2.2	0.0147	8.0	15.0	0.0015	4.8

 Fractional Components

Gravel/Sand based on #4 sieve
 Sand/Fines based on #200 sieve
 % + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 8.0
 % SILT = 86.2 % CLAY = 5.8

D85= 0.06 D60= 0.050 D50= 0.046
 D30= 0.0377 D15= 0.02896 D10= 0.02098
 Cc = 1.3654 Cu = 2.3699

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 19	0.0	0.0	0.4	93.8	5.8

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.0466	0.0375	0.0347	0.0283	0.0244	0.0230	0.93	1.6

MATERIAL DESCRIPTION	USCS	AASHTO
● Gypsum		

Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum
 ● Location: Hole #3
 Date: 05-03-04

Remarks:

PARTICLE SIZE ANALYSIS REPORT

Fig. No.: _____

HAB

GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 19

Date: 05-03-04
 Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum

Sample Data

Location of Sample: Hole #3
 Sample Description: Gypsum
 USCS Class: Liquid limit: NV
 AASHTO Class: Plasticity index: NP

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
 Dry sample and tare= 109.95
 Tare = 0.00
 Dry sample weight = 109.95
 Sample split on number 10 sieve
 Split sample data:
 Sample and tare = 48.54 Tare = 0 Sample weight = 48.54
 Cumulative weight retained tare= 0
 Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.00	100.0
# 10	0.00	100.0
# 20	0.00	100.0
# 40	0.00	100.0
# 60	0.11	99.8
# 140	0.17	99.6
# 200	0.18	99.6

Hydrometer Analysis Data

Separation sieve is number 10
 Percent -# 10 based on complete sample= 100.0
 Weight of hydrometer sample: 48.54
 Calculated biased weight= 48.54
 Table of composite correction values:
 Temp, deg C: 20.0 22.0 24.0

Comp. corr: - 5.5 - 4.8 - 4.0
 Meniscus correction only= 1
 Specific gravity of solids= 2.354
 Specific gravity correction factor= 1.082
 Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

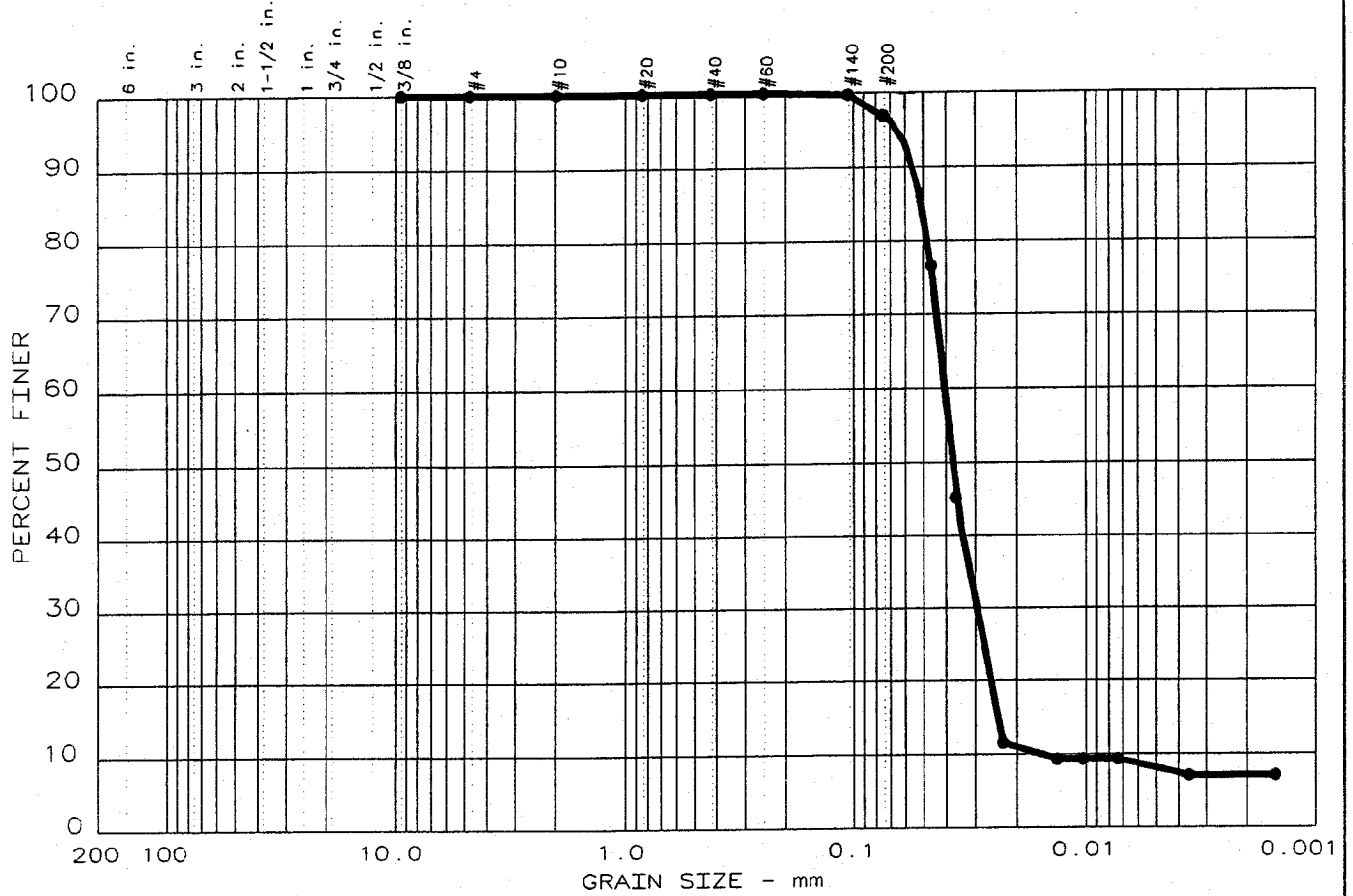
Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
0.5	21.9	48.0	43.2	0.0147	49.0	8.3	0.0598	96.3
1.0	21.9	41.5	36.7	0.0147	42.5	9.3	0.0449	81.8
2.0	21.9	28.0	23.2	0.0147	29.0	11.5	0.0353	51.7
6.0	21.9	9.0	4.2	0.0147	10.0	14.7	0.0230	9.3
15.0	21.9	8.0	3.2	0.0147	9.0	14.8	0.0146	7.1
30.0	21.9	8.0	3.2	0.0147	9.0	14.8	0.0103	7.1
60.0	21.9	8.0	3.2	0.0147	9.0	14.8	0.0073	7.1
250.0	21.9	7.0	2.2	0.0147	8.0	15.0	0.0036	4.8
1440.0	21.9	7.0	2.2	0.0147	8.0	15.0	0.0015	4.8

Fractional Components

Gravel/Sand based on #4 sieve
 Sand/Fines based on #200 sieve
 % + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 0.4
 % SILT = 93.8 % CLAY = 5.8

D85= 0.05 D60= 0.037 D50= 0.035
 D30= 0.0283 D15= 0.02435 D10= 0.02299
 Cc = 0.9320 Cu = 1.6309

PARTICLE SIZE ANALYSIS REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 18	0.0	0.0	3.1	88.8	8.1

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● NV	NP	0.0507	0.0404	0.0376	0.0295	0.0241	0.0156	1.39	2.6

MATERIAL DESCRIPTION	USCS	AASHTO
● Gypsum		

Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum
 ● Location: Hole #5A

Date: 05-03-04

PARTICLE SIZE ANALYSIS REPORT

Remarks:

Fig. No.: _____

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GRAIN SIZE DISTRIBUTION TEST DATA

Test No.: 18

Date: 05-03-04
 Project No.: 3043-04-1009.0001
 Project: TVA Kingston Fossil Plant - CUF Gypsum

Sample Data

Location of Sample: Hole #5A
 Sample Description: Gypsum
 USCS Class: Liquid limit: NV
 AASHTO Class: Plasticity index: NP

Notes

Remarks:

Fig. No.:

Mechanical Analysis Data

Initial
 Dry sample and tare= 84.93
 Tare = 0.00
 Dry sample weight = 84.93
 Sample split on number 10 sieve
 Split sample data:
 Sample and tare = 48.56 Tare = 0 Sample weight = 48.56
 Cumulative weight retained tare= 0
 Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
0.375 inches	0.00	100.0
# 4	0.00	100.0
# 10	0.00	100.0
# 20	0.00	100.0
# 40	0.00	100.0
# 60	0.00	100.0
# 140	0.13	99.7
# 200	1.50	96.9

Hydrometer Analysis Data

Separation sieve is number 10
 Percent -# 10 based on complete sample= 100.0
 Weight of hydrometer sample: 48.56
 Calculated biased weight= 48.56
 Table of composite correction values:
 Temp, deg C: 20.0 22.0 24.0

Comp. corr: - 5.5 - 4.8 - 4.0
 Meniscus correction only= 1
 Specific gravity of solids= 2.334
 Specific gravity correction factor= 1.089
 Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
0.5	21.9	49.0	44.2	0.0148	50.0	8.1	0.0596	99.1
1.0	21.9	39.0	34.2	0.0148	40.0	9.7	0.0462	76.6
2.0	21.9	25.0	20.2	0.0148	26.0	12.0	0.0364	45.2
6.0	21.9	10.0	5.2	0.0148	11.0	14.5	0.0230	11.6
18.0	21.9	9.0	4.2	0.0148	10.0	14.7	0.0134	9.3
30.0	21.9	9.0	4.2	0.0148	10.0	14.7	0.0104	9.3
60.0	21.9	9.0	4.2	0.0148	10.0	14.7	0.0073	9.3
250.0	21.9	8.0	3.2	0.0148	9.0	14.8	0.0036	7.1
1440.0	21.9	8.0	3.2	0.0148	9.0	14.8	0.0015	7.1

 Fractional Components

Gravel/Sand based on #4 sieve
 Sand/Fines based on #200 sieve
 % + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 3.1
 % SILT = 88.8 % CLAY = 8.1

D85= 0.05 D60= 0.040 D50= 0.038
 D30= 0.0295 D15= 0.02410 D10= 0.01556
 Cc = 1.3868 Cu = 2.5942

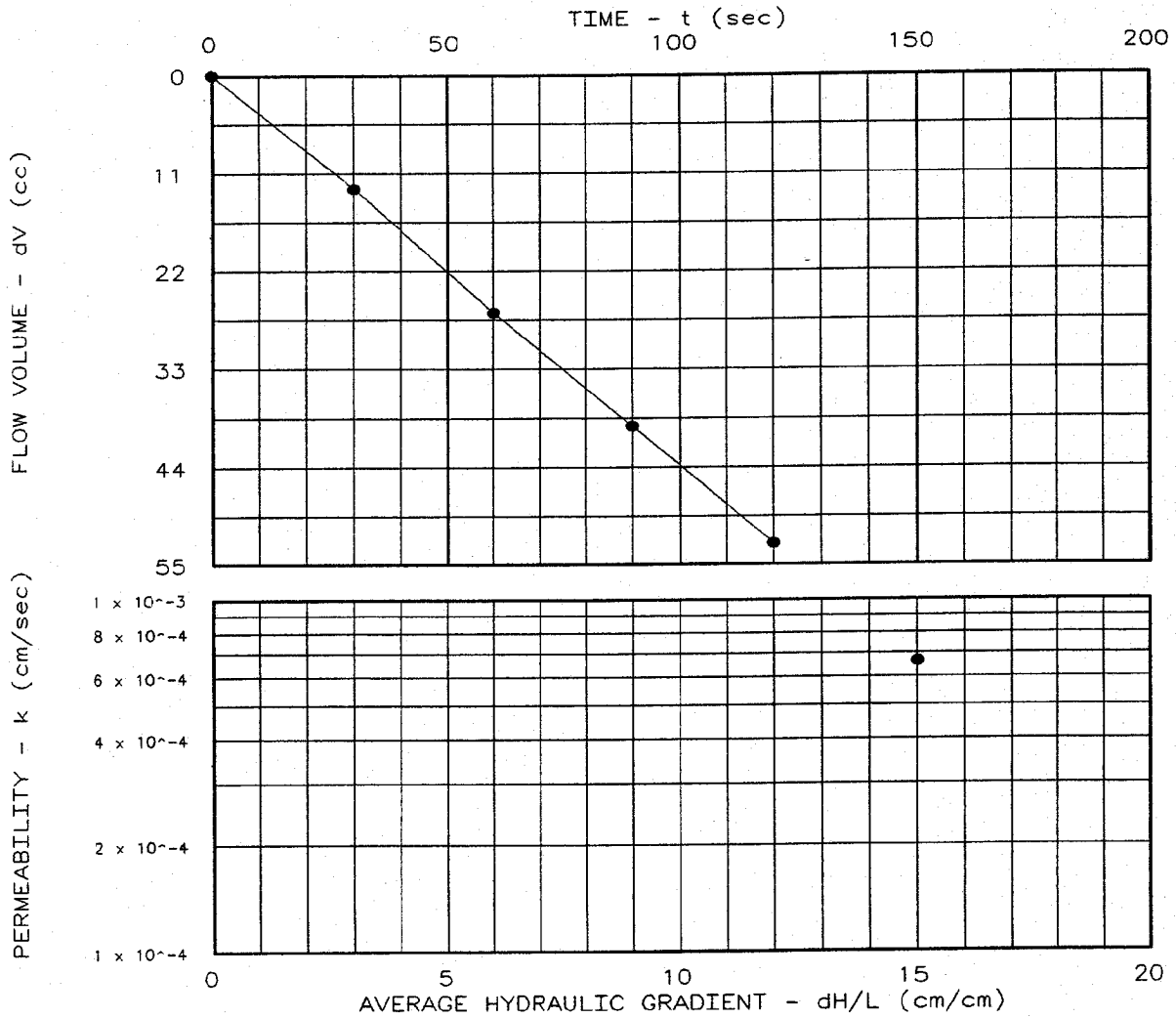
PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 5.87
 Specimen Diameter (cm): 7.24
 Dry Unit Weight (pcf): 66.8
 Moisture Before Test (%): 34.8
 Moisture After Test (%): 54.3
 Run Number: 1 ● 2 ▲
 Cell Pressure (psi): 57.0
 Test Pressure (psi): 52.0
 Back Pressure (psi): 50.7
 Diff. Head (psi): 1.3
 Flow Rate (cc/sec): 4.40×10^{-1}
 Perm. (cm/sec): 6.65×10^{-4}

SAMPLE DATA:

Sample Identification: Hole #2
 Visual Description: Gypsum
 Remarks:
 Maximum Dry Density (pcf):
 Optimum Moisture Content (%):
 Percent Compaction:
 Permeameter type: Flexible Wall
 Sample type: Shelby Tube



Project: TVA Kingston Fossil Plant - CUF Gypsum
 Location:
 Date: 05-04-04

Project No.: 3043041009
 File No.: As# 2651
 Lab No.: 6226
 Tested by: JA
 Checked by: MH
 Test: CH - Constant head

PERMEABILITY TEST REPORT

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PERMEABILITY TEST DATA

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PROJECT DATA

Project Name: TVA Kingston Fossil Plant - CUF Gypsum
 File No.: As# 2651
 Project Location:
 Project No.: 3043041009
 Sample Identification: Hole #2
 Lab No.: 6226
 Description: Gypsum
 Sample Type: Shelby Tube
 Max. Dry Dens.:
 Method (D1557/D698):
 Opt. Water Content:
 Date: 05-04-04
 Remarks:
 Permeameter Type: Flexible Wall
 Tested by: JA
 Checked by: MH
 Test type: CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.852 in	in		2.852 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.85 in	7.24 cm		2.85 in	7.24 cm	
Length:	1	2	3	1	2	3
	2.310 in	in	in	2.310 in	in	in
Average:	2.31 in	5.87 cm		2.31 in	5.87 cm	
 Moisture, Density and Sample Parameters:						
Specific Gravity:	2.35					
Wet Wt. & Tare:	348.71			399.35		
Dry Wt. & Tare:	258.77			258.77		
Tare Wt.:	0.00			0.00		
Moisture Content:	34.8 %			54.3 %		
Dry Unit Weight:	66.8 pcf			66.8 pcf		
Porosity:	0.5447			0.5447		
Saturation:	68.3 %			106.7 %		

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 1	Panel No.: 15	Positions: 1
Run Number:	1	2
Cell Pressure:	57.0 psi	0.0 psi
Saturation Pressure:	50.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE		BURET		OUTFLOW/ INFLOW RATIO
				IN	OUT	READING-cc IN	OUT	
S	4/24/ 4	14:00:00	0	52.0	50.0	60.00	60.00	0.00
	4/24/ 4	14:00:30	30	52.0	50.0	72.70	47.30	1.00
	4/24/ 4	14:01:00	60	52.0	50.0	86.70	33.30	1.00
	4/24/ 4	14:01:30	90	52.0	50.0	99.40	20.60	1.00
	4/24/ 4	14:02:00	120	52.0	50.0	112.60	7.40	1.00

Test Pressure = 52.0 psi Differential Head = 1.3 psi, 88.1 cm H2O
 Gradient = 1.501E 01 Flow rate = 4.397E-01 cc/sec R squared = 0.99980
 Permeability, K22.8° = 7.108E-04 cm/sec, K20° = 6.649E-04 cm/sec

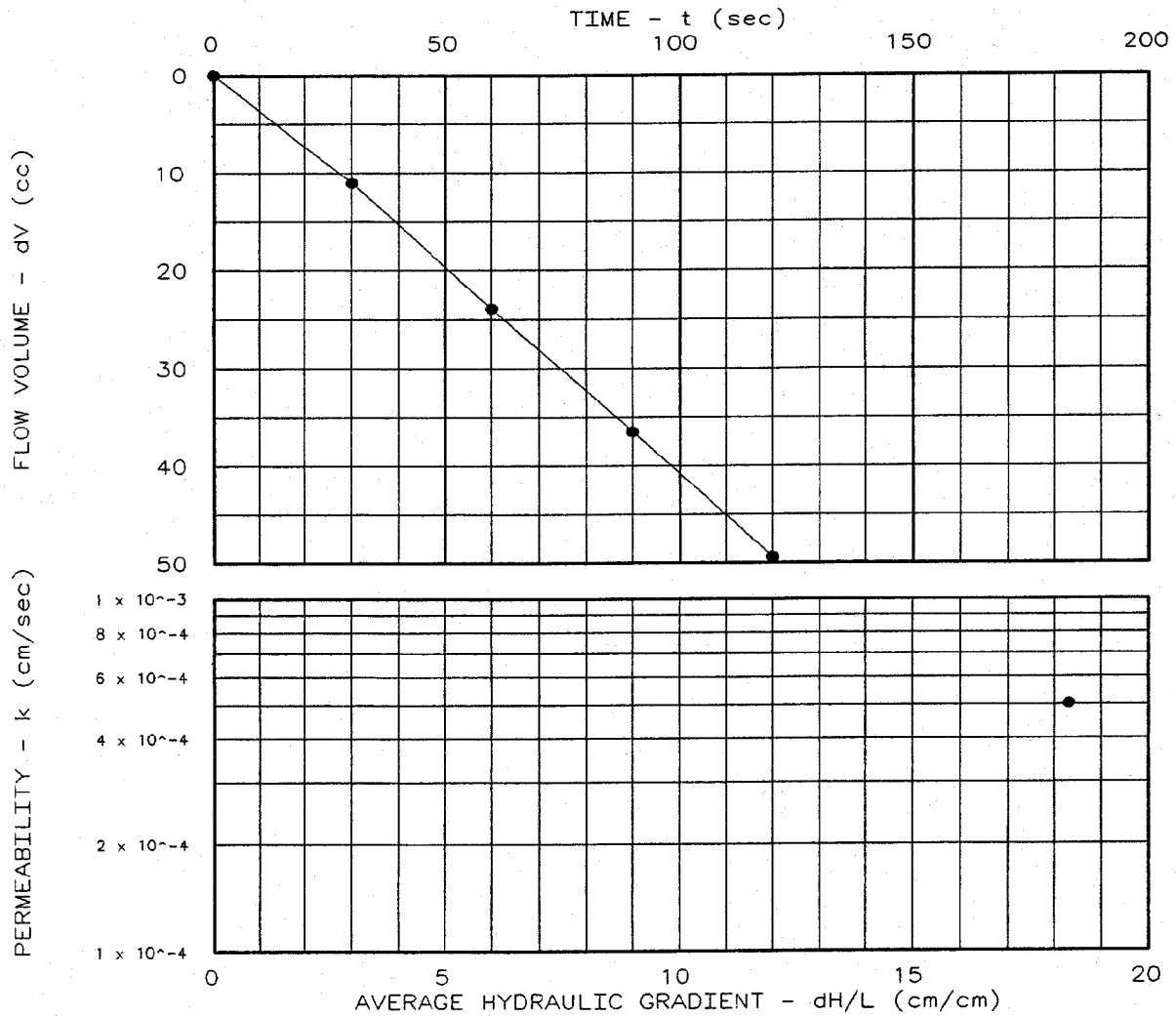
PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 5.04
 Specimen Diameter (cm): 7.33
 Dry Unit Weight (pcf): 69.0
 Moisture Before Test (%): 29.0
 Moisture After Test (%): 48.6
 Run Number: 1 ● 2 ▲
 Cell Pressure (psi): 57.0
 Test Pressure (psi): 52.0
 Back Pressure (psi): 50.7
 Diff. Head (psi): 1.3
 Flow Rate (cc/sec): 4.14×10^{-3}
 Perm. (cm/sec): 5.02×10^{-4}

SAMPLE DATA:

Sample Identification: Hole #3
 Visual Description: Gypsum
 Remarks:
 Maximum Dry Density (pcf):
 Optimum Moisture Content (%):
 Percent Compaction:
 Permeameter type: Flexible Wall
 Sample type: Shelby Tube



Project: TVA Kingston Fossil Plant - CUF Gypsum
 Location:
 Date: 05-04-04

Project No.: 3043041009
 File No.: As# 2651
 Lab No.: 6226
 Tested by: JA
 Checked by: MH
 Test: CH - Constant head

PERMEABILITY TEST REPORT

HAB

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PERMEABILITY TEST DATA

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PROJECT DATA

Project Name: TVA Kingston Fossil Plant - CUF Gypsum
 File No.: As# 2651
 Project Location:
 Project No.: 3043041009
 Sample Identification: Hole #3
 Lab No.: 6226
 Description: Gypsum
 Sample Type: Shelby Tube
 Max. Dry Dens.:
 Method (D1557/D698):
 Opt. Water Content:
 Date: 05-04-04
 Remarks:
 Permeameter Type: Flexible Wall
 Tested by: JA
 Checked by: MH
 Test type: CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.884 in	in		2.884 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.88 in	7.33 cm		2.88 in	7.33 cm	
Length:	1	2	3	1	2	3
	1.985 in	in	in	1.985 in	in	in
Average:	1.99 in	5.04 cm		1.99 in	5.04 cm	
 Moisture, Density and Sample Parameters:						
Specific Gravity:	2.35					
Wet Wt. & Tare:	302.95			349.08		
Dry Wt. & Tare:	234.93			234.93		
Tare Wt.:	0.00			0.00		
Moisture Content:	29.0 %			48.6 %		
Dry Unit Weight:	69.0 pcf			69.0 pcf		
Porosity:	0.5295			0.5295		
Saturation:	60.5 %			101.4 %		

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 15

Panel No.: 2

Positions: 1

Run Number:

1

2

Cell Pressure: 57.0 psi
 Saturation Pressure: 50.0 psi
 Inflow Corr. Factor: 1.00
 Outflow Corr. Factor: 1.00
 Test Temperature: 22.8 °C

0.0 psi
 0.0 psi
 1.00
 1.00
 0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE		BURET		OUTFLOW/ INFLOW RATIO
				IN	OUT	READING-cc IN	OUT	
S	5/ 3/ 4	14:24:00	0	52.0	50.0	50.00	50.00	0.00
	5/ 3/ 4	14:24:30	30	52.0	50.0	61.00	39.00	1.00
	5/ 3/ 4	14:25:00	60	52.0	50.0	73.90	26.10	1.00
	5/ 3/ 4	14:25:30	90	52.0	50.0	86.50	13.50	1.00
	5/ 3/ 4	14:26:00	120	52.0	50.0	99.40	0.60	1.00

Test Pressure = 52.0 psi Differential Head = 1.3 psi, 92.3 cm H2O
 Gradient = 1.831E 01 Flow rate = 4.143E-01 cc/sec R squared = 0.99920
 Permeability, K22.8° = 5.371E-04 cm/sec, K20° = 5.024E-04 cm/sec

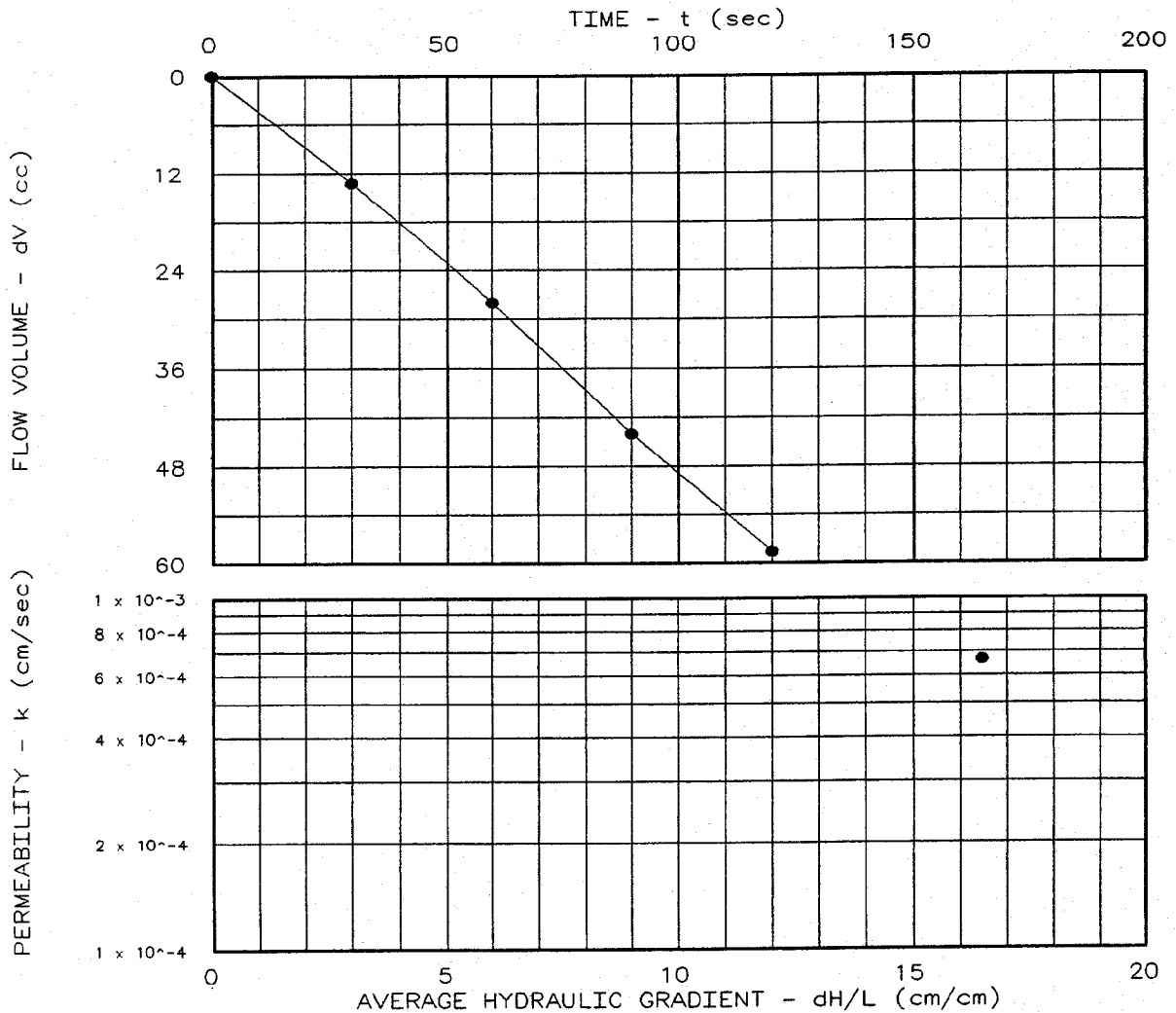
PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 5.05
 Specimen Diameter (cm): 7.33
 Dry Unit Weight (pcf): 65.6
 Moisture Before Test (%): 34.3
 Moisture After Test (%): 51.1
 Run Number: 1 ● 2 ▲
 Cell Pressure (psi): 57.0
 Test Pressure (psi): 52.0
 Back Pressure (psi): 50.8
 Diff. Head (psi): 1.2
 Flow Rate (cc/sec): 4.93×10^{-1}
 Perm. (cm/sec): 6.65×10^{-4}

SAMPLE DATA:

Sample Identification: Hole #5-A
 Visual Description: Gypsum
 Remarks:
 Maximum Dry Density (pcf):
 Optimum Moisture Content (%):
 Percent Compaction:
 Permeometer type: Flexible Wall
 Sample type: Shelby Tube



Project: TVA Kingston Fossil Plant - CUF Gypsum
 Location:
 Date: 05-04-04

Project No.: 3043041009
 File No.: As# 2651
 Lab No.: 6226
 Tested by: JA
 Checked by: MH
 Test: CH - Constant head

PERMEABILITY TEST REPORT

HAB

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PERMEABILITY TEST DATA

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PROJECT DATA

Project Name: TVA Kingston Fossil Plant - CUF Gypsum
 File No.: As# 2651
 Project Location:
 Project No.: 3043041009
 Sample Identification: Hole #5-A

Lab No.: 6226
 Description: Gypsum

Sample Type: Shelby Tube
 Max. Dry Dens.:
 Method (D1557/D698):
 Opt. Water Content:
 Date: 05-04-04
 Remarks:

Permeameter Type: Flexible Wall
 Tested by: JA
 Checked by: MH
 Test type: CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.884 in	in		2.884 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.88 in	7.33 cm		2.88 in	7.33 cm	
Length:	1	2	3	1	2	3
Average:	1.987 in	in	in	1.987 in	in	in
Average:	1.99 in	5.05 cm		1.99 in	5.05 cm	
 Moisture, Density and Sample Parameters:						
Specific Gravity:	2.33					
Wet Wt. & Tare:	300.06			337.60		
Dry Wt. & Tare:	223.37			223.37		
Tare Wt.:	0.00			0.00		
Moisture Content:	34.3 %			51.1 %		
Dry Unit Weight:	65.6 pcf			65.6 pcf		
Porosity:	0.5493			0.5493		
Saturation:	65.6 %			97.8 %		

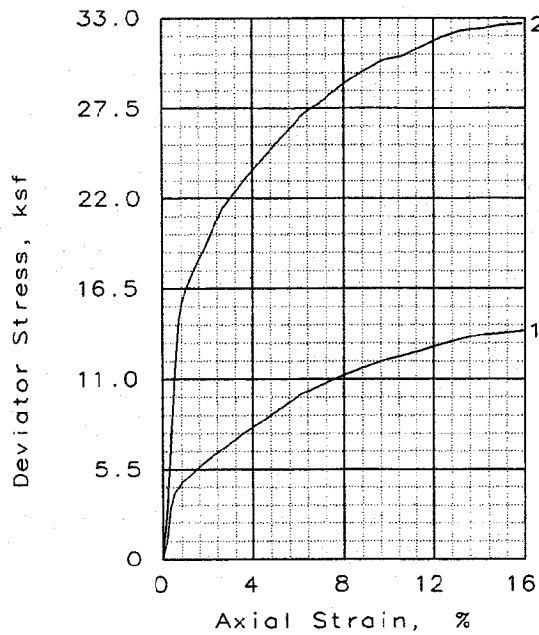
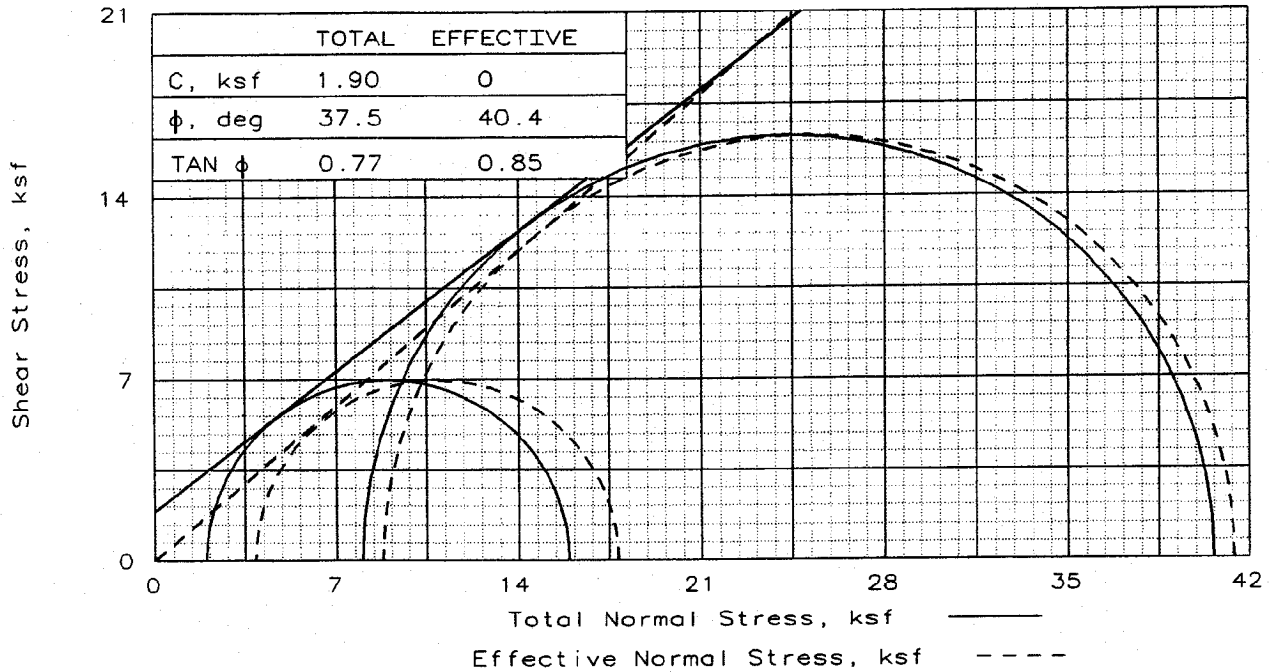
CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2	Panel No.: 2	Positions: 1
Run Number:	1	2
Cell Pressure:	57.0 psi	0.0 psi
Saturation Pressure:	50.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi		BURET READING-cc		OUTFLOW/ INFLOW RATIO
				IN	OUT	IN	OUT	
S	4/27/ 4	13:00:00	0	52.0	50.0	60.00	60.00	0.00
	4/27/ 4	13:00:30	30	52.0	50.0	73.20	46.80	1.00
	4/27/ 4	13:01:00	60	52.0	50.0	88.00	32.00	1.00
	4/27/ 4	13:01:30	90	52.0	50.0	104.00	16.00	1.00
	4/27/ 4	13:02:00	120	52.0	50.0	118.60	1.40	1.00

Test Pressure = 52.0 psi Differential Head = 1.2 psi, 83.1 cm H2O
 Gradient = 1.646E 01 Flow rate = 4.933E-01 cc/sec R squared = 0.99904
 Permeability, K22.8° = 7.110E-04 cm/sec, K20° = 6.651E-04 cm/sec



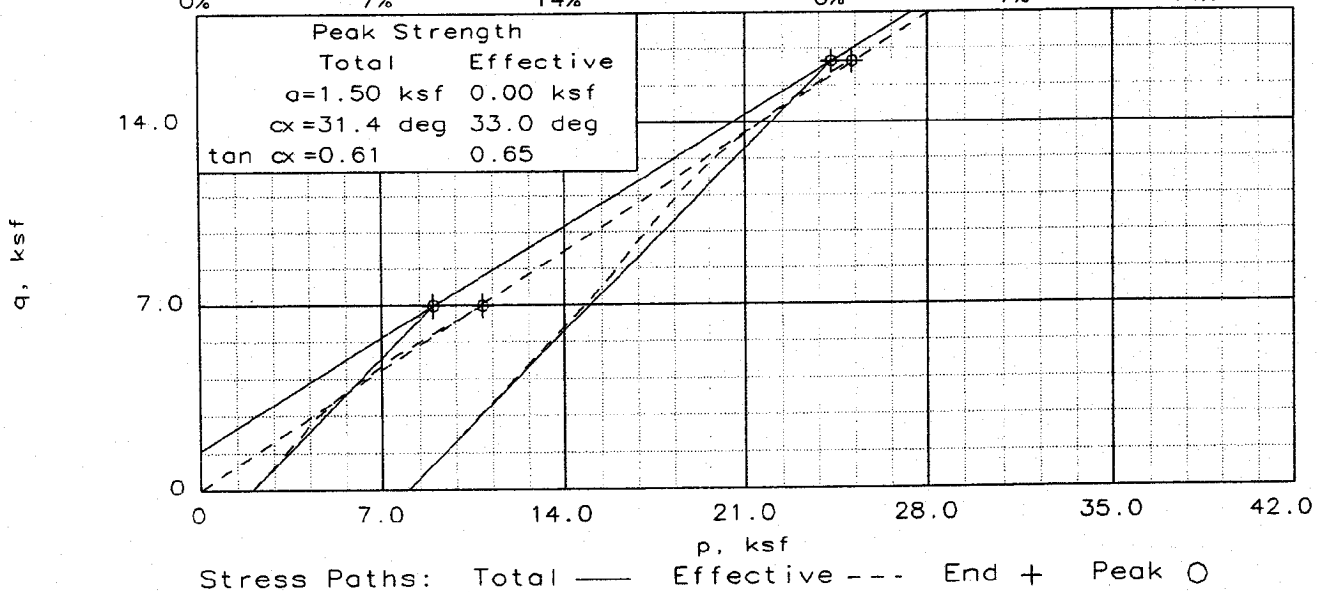
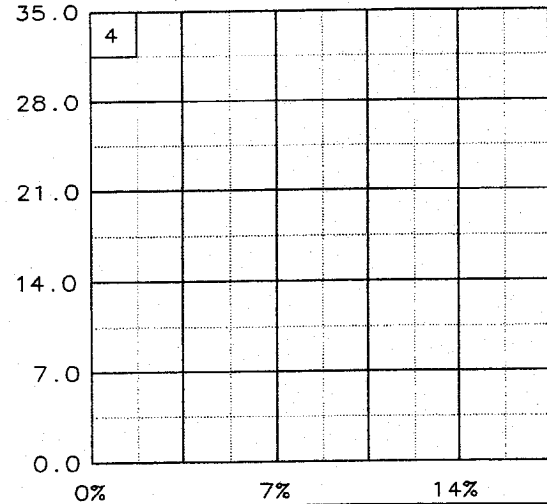
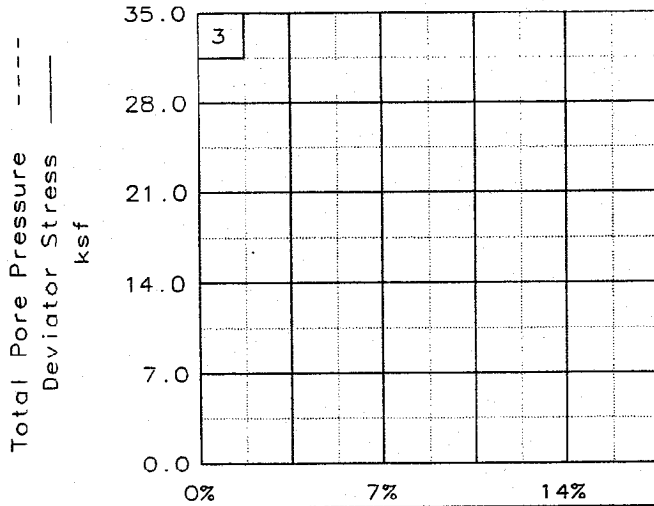
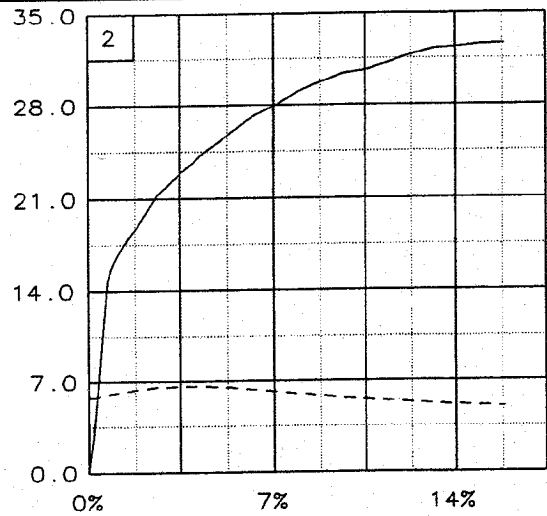
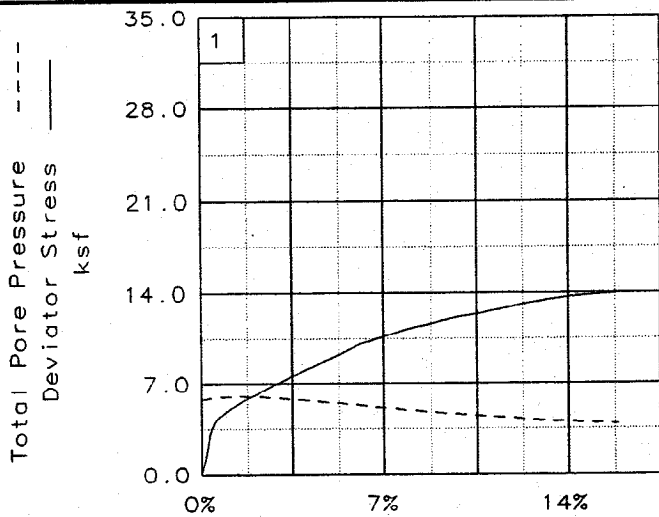
	1	2	
SAMPLE NO.:	1	2	
INITIAL	WATER CONTENT, %	25.9	28.3
	DRY DENSITY, pcf	68.7	67.9
	SATURATION, %	53.4	57.2
	VOID RATIO	1.142	1.166
	DIAMETER, in	2.88	2.88
	HEIGHT, in	5.75	5.75
AT TEST	WATER CONTENT, %	43.3	44.4
	DRY DENSITY, pcf	72.8	71.9
	SATURATION, %	100.0	100.0
	VOID RATIO	1.020	1.045
	DIAMETER, in	2.82	2.82
	HEIGHT, in	5.67	5.67
Strain rate, %/min	0.05	0.05	
BACK PRESSURE, ksf	5.8	5.8	
CELL PRESSURE, ksf	7.8	13.8	
FAIL. STRESS, ksf	13.9	32.6	
TOTAL PORE PR., ksf	3.9	5.0	
ULT. STRESS, ksf			
TOTAL PORE PR., ksf			
$\bar{\sigma}_1$ FAILURE, ksf	17.8	41.4	
$\bar{\sigma}_3$ FAILURE, ksf	3.9	8.8	

TYPE OF TEST:
 CU with Pore Pressures
 SAMPLE TYPE: Shelby Tube
 DESCRIPTION: Gypsum
 SPECIFIC GRAVITY= 2.356
 REMARKS:

CLIENT: TVA
 PROJECT: TVA Kingston Fossil Plant
 CUF Gypsum
 SAMPLE LOCATION: Hole #2
 PROJ. NO.: 3043-04-1009.0001 DATE: 05-03-04
 TRIAXIAL SHEAR TEST REPORT

Fig. No.: _____

AAB



Client: TVA

Project: TVA Kingston Fossil Plant CUF Gypsum

Location: Hole #2

File: TVACUF-2

Project No.: 3043-04-1009.0001 Fig. No.: _____



MACTEC Engineering and Consulting
2801 Yorkmont Road
Suite 100
Charlotte, NC 28208

JOB NO. 3043-D4-1009 SHEET _____ OF _____

PHASE _____ TASK _____

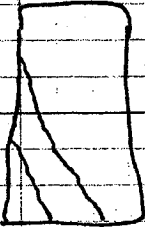
JOB NAME TVA Kingston Fossil Plant

BY MH DATE 5/13/04

CHECKED BY _____ DATE _____

Failure Sketch Hole 2

sample #1



sample #2



TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

5-03-2004
10:54 am

Project and Sample Data

Date: 05-03-04
Client: TVA
Project: TVA Kingston Fossil Plant CUF Gypsum
Sample location: Hole #2
Sample description: Gypsum
Remarks:

Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube
Specific gravity= 2.36 LL= NV PL= NP PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	849.340			970.860
Wt. dry soil and tare:	674.820			674.820
Wt. of tare:	0.000			0.000
Weight, gms:	849.3			
Diameter, in:	2.880	2.800	2.816	
Area, in ² :	6.514	6.156	6.227	
Height, in:	5.746	5.746	5.669	
Net decrease in height, in:		0.000	0.077	
Net decrease in water volume, cc:		-118.700	1.200	
% Moisture:	25.9	43.5	43.3	43.9
Wet density, pcf:	86.4	104.3	104.3	
Dry density, pcf:	68.7	72.7	72.8	
Void ratio:	1.1416	1.0237	1.0195	
% Saturation:	53.4	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 53.90 psi = 7.76 ksf
Consolidation back pressure = 40.00 psi = 5.76 ksf
Consolidation effective confining stress = 2.00 ksf
Strain rate, %/min = 0.05
FAIL. STRESS = 13.94 ksf at reading no. 26
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Effective Stresses Major ksf	Effective Stresses 1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.0	0.00	2.00	2.00	1.00	40.00	2.00	0.00
1	0.0100	0.010	66.0	47.5	0.2	1.10	1.96	3.06	1.56	40.30	2.51	0.55
2	0.0200	0.020	191.0	137.5	0.4	3.17	1.87	5.04	2.69	40.90	3.46	1.58
3	0.0300	0.030	246.0	177.1	0.5	4.07	1.83	5.90	3.23	41.20	3.87	2.04
4	0.0400	0.040	268.0	193.0	0.7	4.43	1.79	6.22	3.48	41.50	4.00	2.22
5	0.0500	0.050	286.0	205.9	0.9	4.72	1.77	6.49	3.66	41.60	4.13	2.36
6	0.0600	0.060	301.0	216.7	1.1	4.96	1.76	6.72	3.82	41.70	4.24	2.48
7	0.0700	0.070	315.0	226.8	1.2	5.18	1.74	6.92	3.97	41.80	4.33	2.59
8	0.0800	0.080	329.0	236.9	1.4	5.40	1.74	7.14	4.10	41.80	4.44	2.70
9	0.0900	0.090	343.0	247.0	1.6	5.62	1.74	7.36	4.23	41.80	4.55	2.81
10	0.1000	0.100	355.0	255.6	1.8	5.81	1.76	7.56	4.31	41.70	4.66	2.90
11	0.1500	0.150	416.0	299.5	2.6	6.74	1.81	8.56	4.72	41.30	5.19	3.37
12	0.2000	0.200	475.0	342.0	3.5	7.63	1.96	9.59	4.90	40.30	5.77	3.82
13	0.2500	0.250	531.0	382.3	4.4	8.45	2.12	10.57	4.99	39.20	6.34	4.23
14	0.3000	0.300	588.0	423.4	5.3	9.27	2.29	11.56	5.05	38.00	6.93	4.64
15	0.3500	0.350	648.0	466.6	6.2	10.12	2.46	12.59	5.11	36.80	7.52	5.06
16	0.4000	0.400	689.0	496.1	7.1	10.66	2.66	13.33	5.00	35.40	8.00	5.33
17	0.4500	0.450	732.0	527.0	7.9	11.22	2.85	14.07	4.94	34.10	8.46	5.61
18	0.5000	0.500	767.0	552.2	8.8	11.64	3.01	14.65	4.87	33.00	8.83	5.82
19	0.5500	0.550	806.0	580.3	9.7	12.12	3.15	15.27	4.84	32.00	9.21	6.06
20	0.6000	0.600	833.0	599.8	10.6	12.40	3.30	15.70	4.76	31.00	9.50	6.20
21	0.6500	0.650	864.0	622.1	11.5	12.74	3.44	16.18	4.70	30.00	9.81	6.37
22	0.7000	0.700	899.0	647.3	12.3	13.12	3.56	16.68	4.69	29.20	10.12	6.56
23	0.7500	0.750	931.0	670.3	13.2	13.45	3.67	17.12	4.66	28.40	10.40	6.73
24	0.8000	0.800	958.0	689.8	14.1	13.70	3.76	17.46	4.65	27.80	10.61	6.85
25	0.8500	0.850	976.0	702.7	15.0	13.81	3.83	17.65	4.61	27.30	10.74	6.91
26	0.9000	0.900	995.0	716.4	15.9	13.94	3.90	17.84	4.57	26.80	10.87	6.97

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	856.890			956.490
Wt. dry soil and tare:	667.800			667.800
Wt. of tare:	0.000			0.000
Weight, gms:	856.9			
Diameter, in:	2.880	2.824	2.818	
Area, in ² :	6.514	6.264	6.238	
Height, in:	5.752	5.752	5.671	
Net decrease in height, in:		0.000	0.081	
Net decrease in water volume, cc:		-117.900	10.700	
% Moisture:	28.3	46.0	44.4	43.2
Wet density, pcf:	87.1	103.1	103.8	
Dry density, pcf:	67.9	70.6	71.9	
Void ratio:	1.1663	1.0831	1.0453	
% Saturation:	57.2	100.0	100.0	

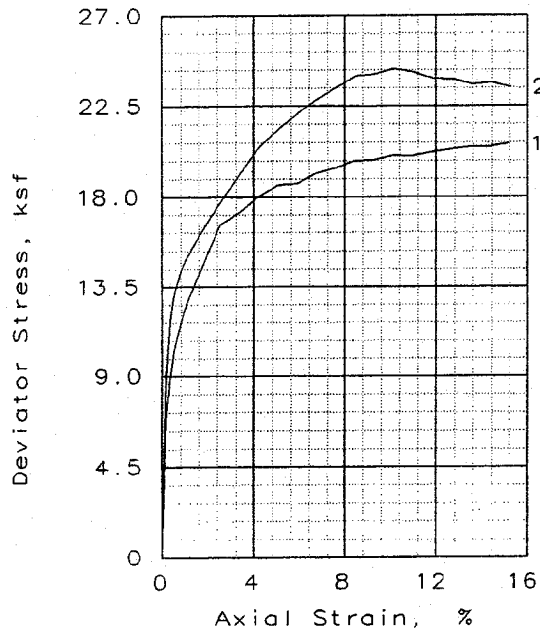
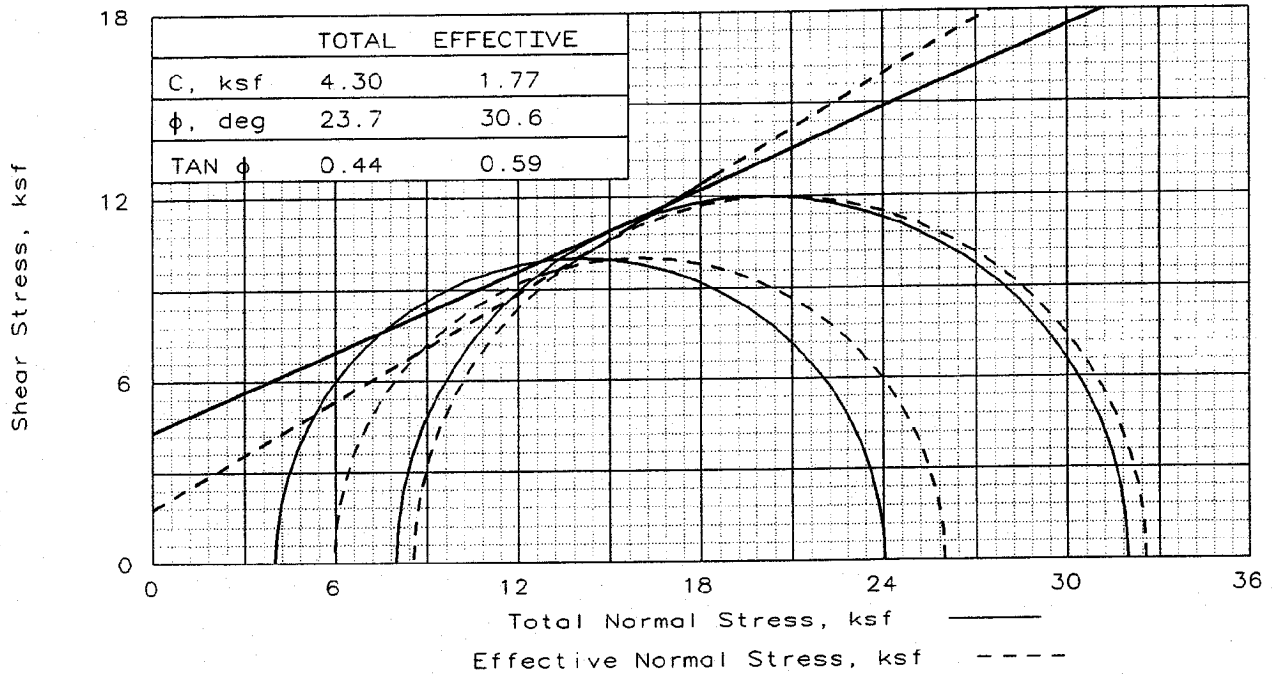
Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
 Primary load ring constant= 2.8 lbs per input unit
 Secondary load ring constant= 0 lbs per input unit
 Crossover reading for secondary load ring= 0 input units
 Membrane modulus = 0.14000 kN/cm²
 Membrane thickness = 0.012 cm
 Consolidation cell pressure = 95.50 psi = 13.75 ksf
 Consolidation back pressure = 40.00 psi = 5.76 ksf
 Consolidation effective confining stress = 7.99 ksf
 Strain rate, %/min = 0.05
 FAIL. STRESS = 32.63 ksf at reading no. 26
 ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	7.99	7.99	1.00	40.00	7.99	0.00
1	0.0100	0.010	41.00	114.8	0.2	2.65	7.98	10.62	1.33	40.10	9.30	1.32
2	0.0200	0.020	105.00	294.0	0.4	6.76	7.92	14.68	1.85	40.50	11.30	3.38
3	0.0300	0.030	169.00	473.2	0.5	10.87	7.86	18.73	2.38	40.90	13.29	5.43
4	0.0400	0.040	228.00	638.4	0.7	14.63	7.78	22.41	2.88	41.50	15.09	7.32
5	0.0500	0.050	247.00	691.6	0.9	15.82	7.70	23.53	3.05	42.00	15.62	7.91
6	0.0600	0.060	258.00	722.4	1.1	16.50	7.63	24.13	3.16	42.50	15.88	8.25
7	0.0700	0.070	268.00	750.4	1.2	17.11	7.56	24.67	3.26	43.00	16.11	8.55
8	0.0800	0.080	277.00	775.6	1.4	17.65	7.50	25.15	3.35	43.40	16.33	8.83
9	0.0900	0.090	286.00	800.8	1.6	18.19	7.46	25.65	3.44	43.70	16.55	9.10
10	0.1000	0.100	293.00	820.4	1.8	18.60	7.40	26.01	3.51	44.10	16.70	9.30
11	0.1500	0.150	339.00	949.2	2.6	21.33	7.21	28.55	3.96	45.40	17.88	10.67
12	0.2000	0.200	368.00	1030.4	3.5	22.95	7.14	30.09	4.21	45.90	18.62	11.47
13	0.2500	0.250	395.00	1106.0	4.4	24.40	7.17	31.58	4.40	45.70	19.37	12.20
14	0.3000	0.300	421.00	1178.8	5.3	25.77	7.26	33.03	4.55	45.10	20.14	12.89
15	0.3500	0.350	447.00	1251.6	6.2	27.11	7.42	34.52	4.66	44.00	20.97	13.55
16	0.4000	0.400	466.00	1304.8	7.1	27.99	7.57	35.57	4.70	42.90	21.57	14.00
17	0.4500	0.450	487.00	1363.6	7.9	28.98	7.76	36.74	4.73	41.60	22.25	14.49
18	0.5000	0.500	505.00	1414.0	8.8	29.76	7.93	37.70	4.75	40.40	22.82	14.88
19	0.5500	0.550	521.00	1458.8	9.7	30.41	8.14	38.54	4.74	39.00	23.34	15.20
20	0.6000	0.600	531.00	1486.8	10.6	30.69	8.24	38.93	4.73	38.30	23.58	15.34

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	546.00	1528.8	11.5	31.24	8.34	39.58	4.75	37.60	23.96	15.62
22	0.7000	0.700	562.00	1573.6	12.3	31.84	8.45	40.29	4.77	36.80	24.37	15.92
23	0.7500	0.750	575.00	1610.0	13.2	32.25	8.57	40.82	4.76	36.00	24.69	16.12
24	0.8000	0.800	583.00	1632.4	14.1	32.37	8.65	41.02	4.74	35.40	24.84	16.18
25	0.8500	0.850	593.00	1660.4	15.0	32.58	8.73	41.31	4.73	34.90	25.02	16.29
26	0.9000	0.900	600.00	1680.0	15.9	32.63	8.80	41.42	4.71	34.40	25.11	16.31



SAMPLE NO.:		1	2
INITIAL	WATER CONTENT, %	38.8	42.1
	DRY DENSITY, pcf	70.3	69.6
	SATURATION, %	83.7	89.4
	VOID RATIO	1.091	1.110
	DIAMETER, in	2.88	2.88
AT TEST	HEIGHT, in	6.00	6.00
	WATER CONTENT, %	51.5	48.1
	DRY DENSITY, pcf	66.4	68.9
	SATURATION, %	100.0	100.0
	VOID RATIO	1.212	1.132
Strain rate, %/min	DIAMETER, in	2.98	2.93
	HEIGHT, in	5.94	5.89
BACK PRESSURE, ksf		0.17	0.17
CELL PRESSURE, ksf		5.8	5.8
FAIL. STRESS, ksf		9.8	13.8
TOTAL PORE PR., ksf		20.0	24.0
ULT. STRESS, ksf		3.8	5.2
$\bar{\sigma}_1$ FAILURE, ksf		26.0	32.6
$\bar{\sigma}_3$ FAILURE, ksf		5.9	8.6

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Shelby Tube
DESCRIPTION: Gypsum

SPECIFIC GRAVITY= 2.354

REMARKS:

Fig. No.: _____

CLIENT: TVA

PROJECT: TVA Kingston Fossil Plant
CUF Gypsum

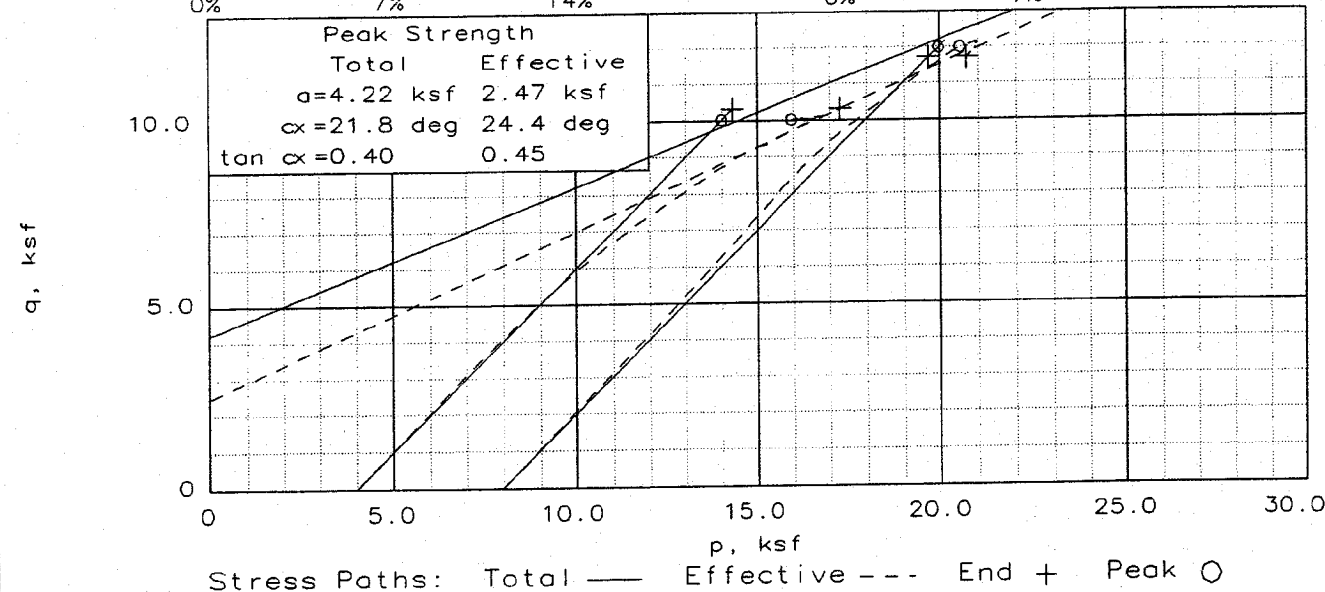
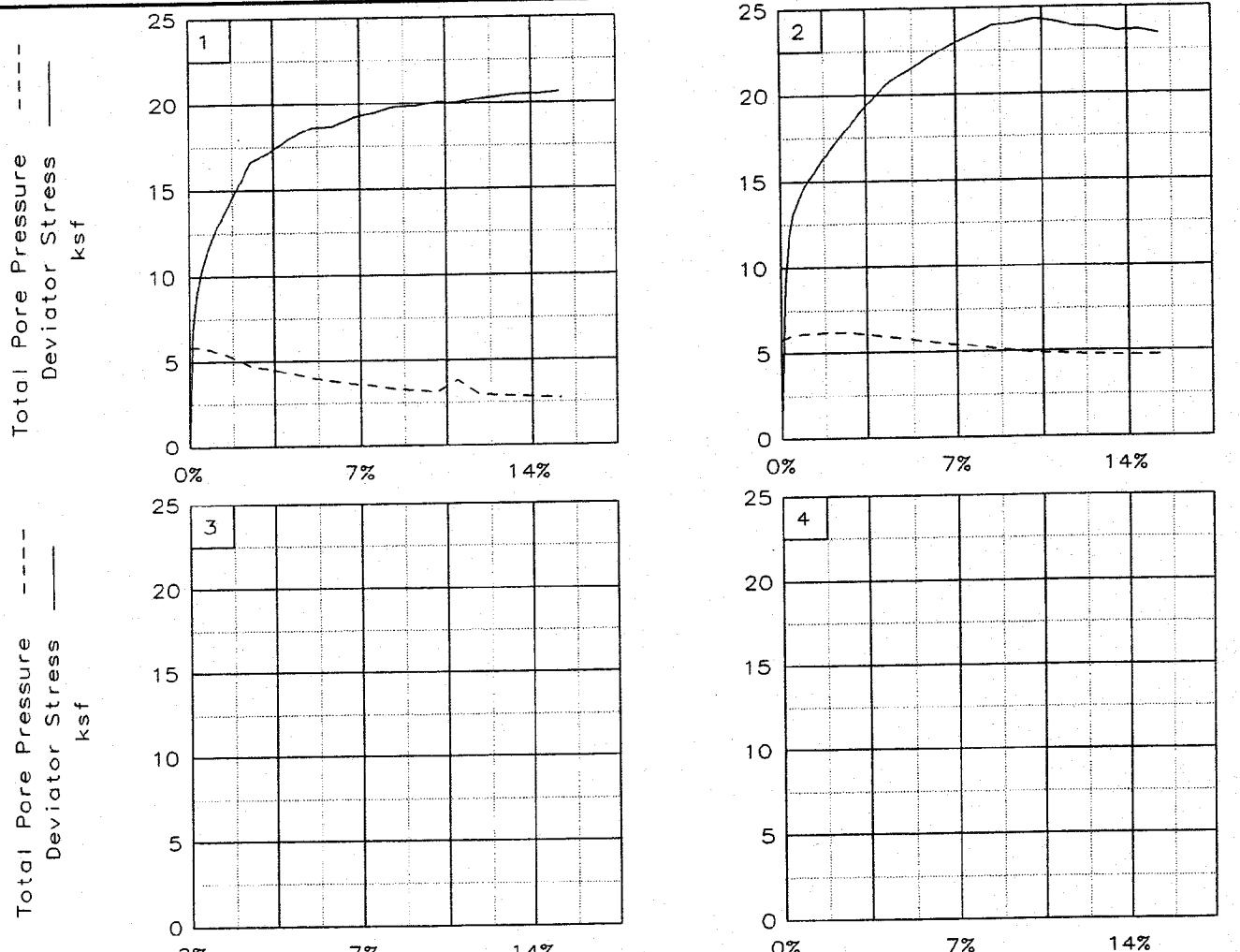
SAMPLE LOCATION: Hole 4

PROJ. NO.: 3043-04-1009.0001

DATE: 05-03-04

TRIAxIAL SHEAR TEST REPORT

HAB



Client: TVA
 Project: TVA Kingston Fossil Plant CUF Gypsum
 Location: Hole 4
 File: TVACUF-3 Project No.: 3043-04-1009.0001 Fig. No.: _____

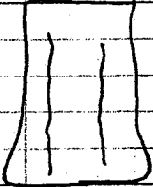


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2801 Yorkmont Road
Suite 100
Charlotte, NC 28208

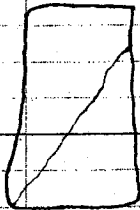
JOB NO. 3043-D4-1009 SHEET _____ OF _____
PHASE _____ TASK _____
JOB NAME TVA Kingston Fossil Plant
BY MH DATE 5/13/04
CHECKED BY _____ DATE _____

Failure Sketch Hole 4

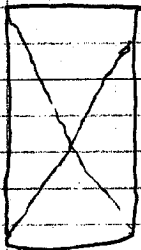
Sample #1



Sample #2



Sample #3



TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

5-04-2004
3:17 pm

Project and Sample Data

Date: 05-03-04
Client: TVA
Project: TVA Kingston Fossil Plant CUF Gypsum
Sample location: Hole 4
Sample description: Gypsum
Remarks:

Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube
Specific gravity= 2.35 LL= NV PL= NP PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1003.620			1091.170
Wt. dry soil and tare:	723.090			723.090
Wt. of tare:	0.000			0.000
Weight, gms:	1003.6			
Diameter, in:	2.884	2.972	2.982	
Area, in ² :	6.533	6.935	6.986	
Height, in:	6.001	6.001	5.936	
Net decrease in height, in:		0.000	0.065	
Net decrease in water volume, cc:		-94.300	2.500	
% Moisture:	38.8	51.8	51.5	50.9
Wet density, pcf:	97.5	100.5	100.6	
Dry density, pcf:	70.3	66.2	66.4	
Void ratio:	1.0913	1.2202	1.2121	
% Saturation:	83.7	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.82 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 67.80 psi = 9.76 ksf
Consolidation back pressure = 40.00 psi = 5.76 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 20.03 ksf at reading no. 21
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial	Def. in	Load Dial	Load lbs	Strain %	Deviator Stress	Effective Stresses			Pore Pres.	P ksf	Q ksf
	Units		Units			ksf	Minor ksf	Major ksf	1:3 Ratio	psi		
0	0.0000	0.000	0.00	0.0	0.0	0.00	4.00	4.00	1.00	40.00	4.00	0.00
1	0.0100	0.010	118.00	332.8	0.2	6.85	3.92	10.76	2.75	40.60	7.34	3.42
2	0.0200	0.020	154.00	434.3	0.3	8.92	3.93	12.85	3.27	40.50	8.39	4.46
3	0.0300	0.030	177.00	499.1	0.5	10.24	3.97	14.21	3.58	40.20	9.09	5.12
4	0.0400	0.040	192.00	541.4	0.7	11.09	4.00	15.09	3.77	40.00	9.55	5.54
5	0.0500	0.050	204.00	575.3	0.8	11.76	4.08	15.83	3.89	39.50	9.95	5.88
6	0.0600	0.060	215.00	606.3	1.0	12.37	4.16	16.53	3.97	38.90	10.35	6.19
7	0.0700	0.070	225.00	634.5	1.2	12.93	4.22	17.14	4.06	38.50	10.68	6.46
8	0.0800	0.080	233.00	657.1	1.3	13.36	4.31	17.67	4.10	37.90	10.99	6.68
9	0.0900	0.090	242.00	682.4	1.5	13.85	4.38	18.23	4.16	37.40	11.30	6.93
10	0.1000	0.100	250.00	705.0	1.7	14.29	4.45	18.74	4.21	36.90	11.59	7.14
11	0.1500	0.150	293.00	826.3	2.5	16.60	5.05	21.66	4.28	32.70	13.36	8.30
12	0.2000	0.200	307.00	865.7	3.4	17.25	5.23	22.47	4.30	31.50	13.85	8.62
13	0.2500	0.250	324.00	913.7	4.2	18.04	5.50	23.54	4.28	29.60	14.52	9.02
14	0.3000	0.300	337.00	950.3	5.1	18.60	5.79	24.39	4.21	27.60	15.09	9.30
15	0.3500	0.350	341.00	961.6	5.9	18.65	5.95	24.60	4.14	26.50	15.27	9.33
16	0.4000	0.400	354.00	998.3	6.7	19.19	6.15	25.34	4.12	25.10	15.74	9.60
17	0.4500	0.450	362.00	1020.8	7.6	19.45	6.25	25.70	4.11	24.40	15.97	9.72
18	0.5000	0.500	372.00	1049.0	8.4	19.80	6.44	26.24	4.08	23.10	16.34	9.90
19	0.5500	0.550	376.00	1060.3	9.3	19.83	6.52	26.36	4.04	22.50	16.44	9.92
20	0.6000	0.600	384.00	1082.9	10.1	20.07	6.65	26.72	4.02	21.60	16.69	10.03
21	0.6500	0.650	387.00	1091.3	11.0	20.03	5.95	25.98	4.37	26.50	15.96	10.02
22	0.7000	0.700	394.00	1111.1	11.8	20.20	6.78	26.99	3.98	20.70	16.88	10.10
23	0.7500	0.750	401.00	1130.8	12.6	20.37	6.84	27.21	3.98	20.30	17.02	10.18
24	0.8000	0.800	407.00	1147.7	13.5	20.47	6.90	27.37	3.97	19.90	17.13	10.24
25	0.8500	0.850	411.00	1159.0	14.3	20.47	6.96	27.43	3.94	19.50	17.19	10.24
26	0.9000	0.900	418.00	1178.8	15.2	20.62	7.00	27.61	3.95	19.20	17.31	10.31

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1018.450			1061.580
Wt. dry soil and tare:	716.470			716.470
Wt. of tare:	0.000			0.000
Weight, gms:	1018.5			
Diameter, in:	2.884	2.928	2.926	
Area, in ² :	6.533	6.733	6.724	
Height, in:	6.000	6.000	5.889	
Net decrease in height, in:		0.000	0.111	
Net decrease in water volume, cc:		-55.700	13.200	
% Moisture:	42.1	49.9	48.1	48.2
Wet density, pcf:	99.0	101.3	102.1	
Dry density, pcf:	69.6	67.6	68.9	
Void ratio:	1.1103	1.1752	1.1318	
% Saturation:	89.4	100.0	100.0	

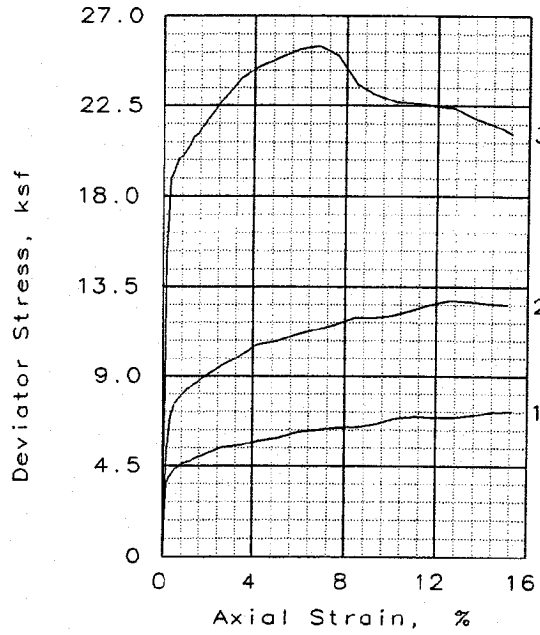
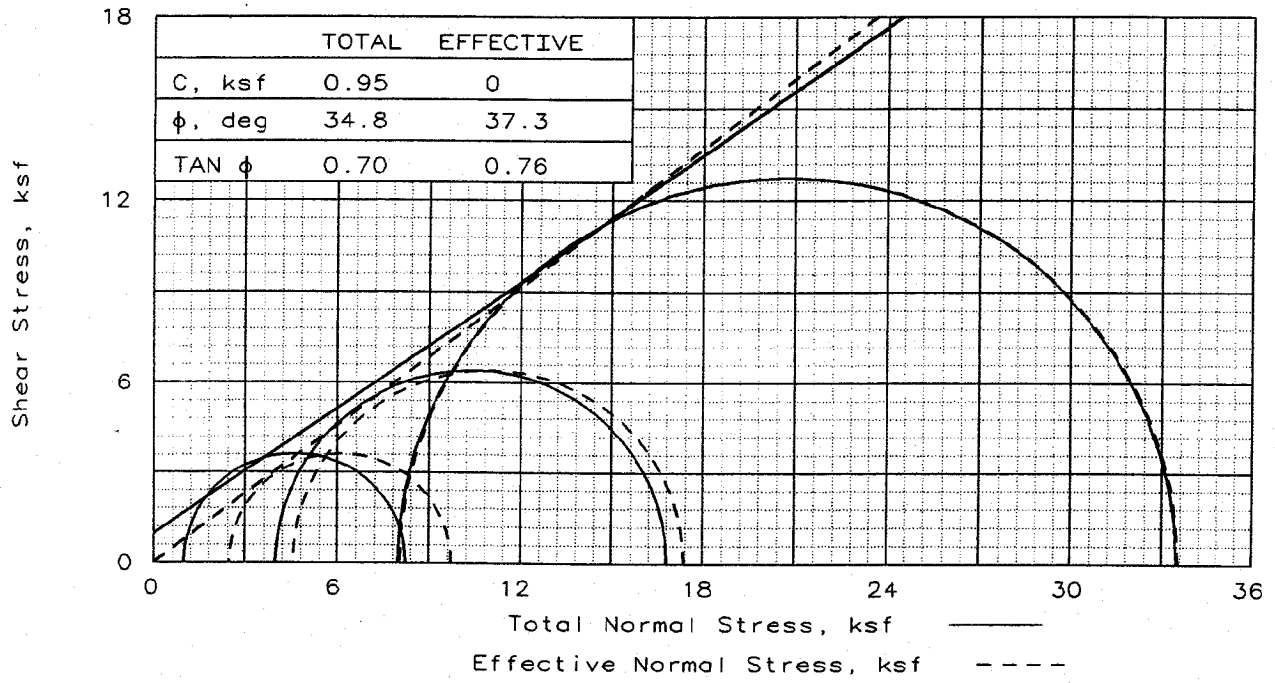
Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
 Primary load ring constant= 2.82 lbs per input unit
 Secondary load ring constant= 0 lbs per input unit
 Crossover reading for secondary load ring= 0 input units
 Membrane modulus = 0.14000 kN/cm²
 Membrane thickness = 0.012 cm
 Consolidation cell pressure = 95.50 psi = 13.75 ksf
 Consolidation back pressure = 40.00 psi = 5.76 ksf
 Consolidation effective confining stress = 7.99 ksf
 Strain rate, %/min = 0.17
 FAIL. STRESS = 23.99 ksf at reading no. 18
 ULT. STRESS = not selected

No. Def.	Def.	Load	Load	Strain	Deviator	Effective Stresses			Pore	P ksf	Q ksf	
Dial	in	Dial	lbs	%	Stress	Minor	Major	1:3	Pres.			
Units		Units			ksf	ksf	ksf	Ratio	psi			
0	0.0000	0.000	0.00	0.0	0.00	7.99	7.99	1.00	40.00	7.99	0.00	
1	0.0100	0.010	148.00	417.4	0.2	8.92	7.83	16.76	2.14	41.10	12.30	4.46
2	0.0200	0.020	196.00	552.7	0.3	11.80	7.75	19.54	2.52	41.70	13.65	5.90
3	0.0300	0.030	218.00	614.8	0.5	13.10	7.70	20.80	2.70	42.00	14.25	6.55
4	0.0400	0.040	230.00	648.6	0.7	13.80	7.66	21.46	2.80	42.30	14.56	6.90
5	0.0500	0.050	240.00	676.8	0.8	14.37	7.63	22.00	2.88	42.50	14.82	7.19
6	0.0600	0.060	247.00	696.5	1.0	14.77	7.62	22.38	2.94	42.60	15.00	7.38
7	0.0700	0.070	254.00	716.3	1.2	15.16	7.60	22.76	2.99	42.70	15.18	7.58
8	0.0800	0.080	260.00	733.2	1.4	15.49	7.59	23.08	3.04	42.80	15.33	7.74
9	0.0900	0.090	267.00	752.9	1.5	15.88	7.57	23.45	3.10	42.90	15.51	7.94
10	0.1000	0.100	273.00	769.9	1.7	16.21	7.56	23.77	3.14	43.00	15.66	8.10
11	0.1500	0.150	302.00	851.6	2.5	17.78	7.56	25.34	3.35	43.00	16.45	8.89
12	0.2000	0.200	329.00	927.8	3.4	19.20	7.65	26.84	3.51	42.40	17.24	9.60
13	0.2500	0.250	354.00	998.3	4.2	20.47	7.82	28.29	3.62	41.20	18.06	10.24
14	0.3000	0.300	373.00	1051.9	5.1	21.38	7.98	29.36	3.68	40.10	18.67	10.69
15	0.3500	0.350	390.00	1099.8	5.9	22.15	8.14	30.29	3.72	39.00	19.21	11.08
16	0.4000	0.400	406.00	1144.9	6.8	22.86	8.31	31.16	3.75	37.80	19.74	11.43
17	0.4500	0.450	420.00	1184.4	7.6	23.43	8.42	31.85	3.78	37.00	20.14	11.71
18	0.5000	0.500	434.00	1223.9	8.5	23.99	8.57	32.55	3.80	36.00	20.56	11.99
19	0.5500	0.550	440.00	1240.8	9.3	24.09	8.73	32.82	3.76	34.90	20.77	12.05
20	0.6000	0.600	449.00	1266.2	10.2	24.36	8.83	33.18	3.76	34.20	21.00	12.18

Test Readings Data for Specimen No. 2

No.	Def.	Def.	Load	Load	Strain	Deviator	Effective Stresses			Pore	P ksf	Q ksf
	Dial	in	Dial	lbs			%	Stress	Minor			
	Units		Units			ksf	ksf	ksf	Ratio	psi		
21	0.6500	0.650	450.00	1269.0	11.0	24.18	8.88	33.06	3.72	33.80	20.97	12.09
22	0.7000	0.700	448.00	1263.4	11.9	23.84	8.94	32.78	3.67	33.40	20.86	11.92
23	0.7500	0.750	452.00	1274.6	12.7	23.82	8.99	32.81	3.65	33.10	20.90	11.91
24	0.8000	0.800	452.00	1274.6	13.6	23.59	9.00	32.59	3.62	33.00	20.80	11.80
25	0.8500	0.850	458.00	1291.6	14.4	23.67	9.01	32.68	3.63	32.90	20.85	11.83
26	0.9000	0.900	458.00	1291.6	15.3	23.43	9.01	32.45	3.60	32.90	20.73	11.72



SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	24.0	28.9	21.7
	DRY DENSITY, pcf	74.9	67.9	66.7
	SATURATION, %	59.2	58.8	42.7
	VOID RATIO	0.946	1.145	1.186
	DIAMETER, in	2.88	2.88	2.88
AT TEST	HEIGHT, in	5.99	6.05	5.99
	WATER CONTENT, %	43.8	50.2	41.2
	DRY DENSITY, pcf	72.0	67.1	74.3
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.023	1.171	0.961
ULT. STRESS, ksf	DIAMETER, in	2.97	2.92	2.75
	HEIGHT, in	5.88	5.97	5.89
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	5.8	5.8	5.8
	CELL PRESSURE, ksf	6.8	9.8	13.8
	FAIL. STRESS, ksf	7.2	12.8	25.5
	TOTAL PORE PR., ksf	4.3	5.2	5.7
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	9.7	17.4	33.5
	$\bar{\sigma}_3$ FAILURE, ksf	2.5	4.6	8.0

TYPE OF TEST:
 CU with Pore Pressures
 SAMPLE TYPE: Shelby Tube
 DESCRIPTION: Gypsum

SPECIFIC GRAVITY= 2.334

REMARKS:

Fig. No.: _____

CLIENT: TVA

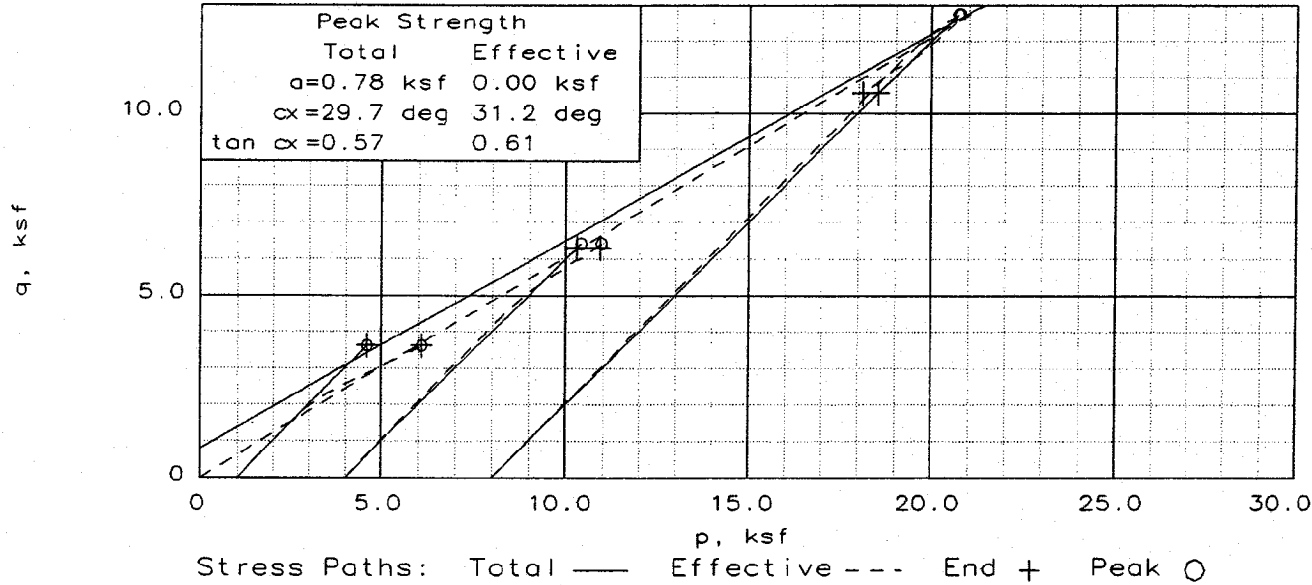
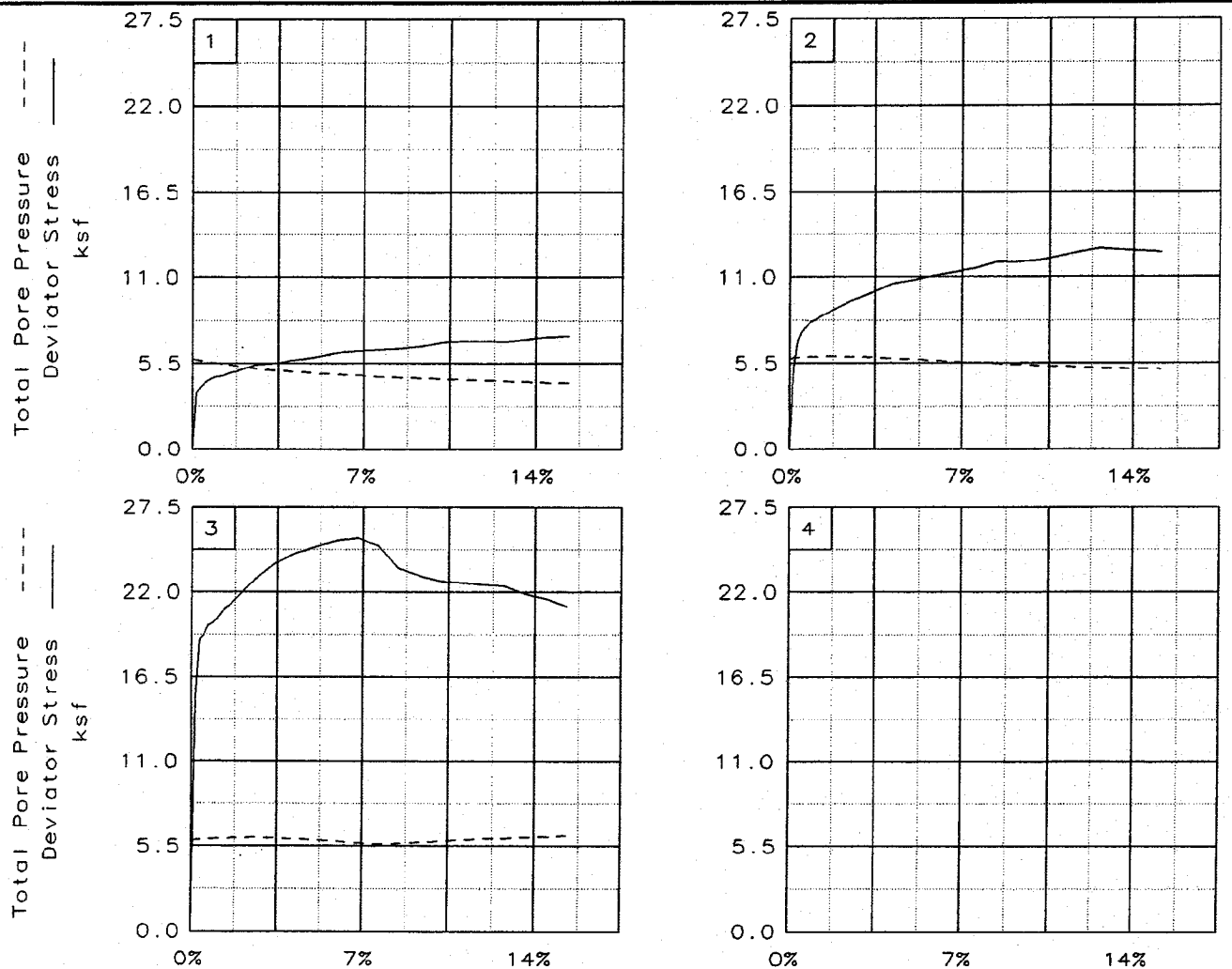
PROJECT: TVA Kingston Fossil Plant
 CUF Gypsum

SAMPLE LOCATION: Hole 5A/5B Combined

PROJ. NO.: 3043-04-1009.0001 DATE: 05-03-04

TRIAxIAL SHEAR TEST REPORT

HAB



Client: TVA

Project: TVA Kingston Fossil Plant CUF Gypsum

Location: Hole 5A/5B Combined

File: TVACUF-1

Project No.: 3043-04-1009.0001

Fig. No.: _____



MACTEC Engineering and Consulting
2801 Yorkmont Road
Suite 100
Charlotte, NC 28208

JOB NO. 3043-04-1009 SHEET _____ OF _____

PHASE _____ TASK _____

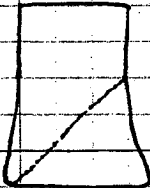
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BY MH DATE 5/13/04

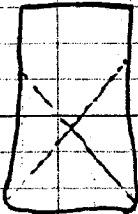
CHECKED BY _____ DATE _____

Failure Sketch Hole 5

sample #1



sample #2



sample #3



TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

5-03-2004
10:33 am

Project and Sample Data

Date: 05-03-04
Client: TVA
Project: TVA Kingston Fossil Plant CUF Gypsum
Sample location: Hole 5A/5B Combined
Sample description: Gypsum
Remarks:

Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube
Specific gravity= 2.33 LL= NV PL= NP PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	836.020			953.930
Wt. dry soil and tare:	674.160			674.160
Wt. of tare:	0.000			0.000
Weight, gms:	953.9			
Diameter, in:	2.884	2.943	2.969	
Area, in ² :	6.533	6.803	6.925	
Height, in:	5.991	5.991	5.876	
Net decrease in height, in:		0.000	0.115	
Net decrease in water volume, cc:		-153.600	1.100	
% Moisture:	24.0	44.0	43.8	41.5
Wet density, pcf:	92.9	103.5	103.6	
Dry density, pcf:	74.9	71.9	72.0	
Void ratio:	0.9459	1.0264	1.0231	
% Saturation:	59.2	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 46.90 psi = 6.75 ksf
Consolidation back pressure = 40.00 psi = 5.76 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 7.25 ksf at reading no. 26
ULT. STRESS = not selected

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	905.400			1031.070
Wt. dry soil and tare:	702.630			702.630
Wt. of tare:	0.000			0.000
Weight, gms:	905.4			
Diameter, in:	2.880	2.916	2.917	
Area, in ² :	6.514	6.676	6.685	
Height, in:	6.050	6.050	5.965	
Net decrease in height, in:		0.000	0.085	
Net decrease in water volume, cc:		-158.100	8.500	
% Moisture:	28.9	51.4	50.2	46.7
Wet density, pcf:	87.5	100.3	100.8	
Dry density, pcf:	67.9	66.3	67.1	
Void ratio:	1.1454	1.1987	1.1705	
% Saturation:	58.8	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant = 1 in per input unit
 Primary load ring constant = 2.8 lbs per input unit
 Secondary load ring constant = 0 lbs per input unit
 Crossover reading for secondary load ring = 0 input units
 Membrane modulus = 0.14000 kN/cm²
 Membrane thickness = 0.012 cm
 Consolidation cell pressure = 67.80 psi = 9.76 ksf
 Consolidation back pressure = 40.00 psi = 5.76 ksf
 Consolidation effective confining stress = 4.00 ksf
 Strain rate, %/min = 0.17
 FAIL. STRESS = 12.81 ksf at reading no. 23
 ULT. STRESS = not selected

No. Def.	Def.	Load	Load	Strain	Deviator	Effective Stresses			Pore	P ksf	Q ksf	
Dial	in	Dial	lbs	%	Stress	Minor	Major	1:3	Pres.			
Units		Units			ksf	ksf	ksf	Ratio	psi			
0	0.0000	0.000	0.00	0.0	0.00	4.00	4.00	1.00	40.00	4.00	0.00	
1	0.0100	0.010	86.00	240.8	0.2	5.18	3.90	9.08	2.33	40.70	6.49	2.59
2	0.0200	0.020	116.00	324.8	0.3	6.97	3.87	10.85	2.80	40.90	7.36	3.49
3	0.0300	0.030	126.00	352.8	0.5	7.56	3.87	11.44	2.95	40.90	7.65	3.78
4	0.0400	0.040	131.00	366.8	0.7	7.85	3.87	11.72	3.03	40.90	7.80	3.92
5	0.0500	0.050	135.00	378.0	0.8	8.07	3.86	11.93	3.09	41.00	7.90	4.04
6	0.0600	0.060	138.00	386.4	1.0	8.24	3.84	12.08	3.14	41.10	7.96	4.12
7	0.0700	0.070	141.00	394.8	1.2	8.41	3.84	12.25	3.19	41.10	8.05	4.20
8	0.0800	0.080	144.00	403.2	1.3	8.57	3.83	12.40	3.24	41.20	8.12	4.28
9	0.0900	0.090	146.00	408.8	1.5	8.67	3.83	12.50	3.26	41.20	8.17	4.34
10	0.1000	0.100	149.00	417.2	1.7	8.84	3.83	12.67	3.31	41.20	8.25	4.42
11	0.1500	0.150	161.00	450.8	2.5	9.47	3.84	13.31	3.46	41.10	8.58	4.73
12	0.2000	0.200	171.00	478.8	3.4	9.97	3.89	13.86	3.56	40.80	8.87	4.98
13	0.2500	0.250	183.00	512.4	4.2	10.58	3.97	14.55	3.66	40.20	9.26	5.29
14	0.3000	0.300	188.00	526.4	5.0	10.77	4.02	14.79	3.68	39.90	9.40	5.38
15	0.3500	0.350	195.00	546.0	5.9	11.07	4.10	15.18	3.70	39.30	9.64	5.54
16	0.4000	0.400	201.00	562.8	6.7	11.31	4.18	15.49	3.71	38.80	9.83	5.66
17	0.4500	0.450	208.00	582.4	7.5	11.60	4.23	15.83	3.74	38.40	10.03	5.80
18	0.5000	0.500	216.00	604.8	8.4	11.94	4.31	16.24	3.77	37.90	10.27	5.97
19	0.5500	0.550	218.00	610.4	9.2	11.94	4.36	16.30	3.74	37.50	10.33	5.97
20	0.6000	0.600	222.00	621.6	10.1	12.04	4.45	16.49	3.71	36.90	10.47	6.02

Test Readings Data for Specimen No. 2

No.	Def.	Load	Load	Strain	Deviator	Effective Stresses			Pore	P	Q	
	Dial	Dial	lbs	%	Stress	Minor	Major	1:3	Pres.	ksf	ksf	
	in	Units			ksf	ksf	ksf	Ratio	psi			
21	0.6500	0.650	229.00	641.2	10.9	12.31	4.46	16.77	3.76	36.80	10.62	6.15
22	0.7000	0.700	237.00	663.6	11.7	12.62	4.52	17.14	3.79	36.40	10.83	6.31
23	0.7500	0.750	243.00	680.4	12.6	12.81	4.56	17.38	3.81	36.10	10.97	6.41
24	0.8000	0.800	244.00	683.2	13.4	12.74	4.59	17.34	3.77	35.90	10.97	6.37
25	0.8500	0.850	245.00	686.0	14.2	12.67	4.62	17.29	3.74	35.70	10.96	6.34
26	0.9000	0.900	246.00	688.8	15.1	12.60	4.64	17.24	3.72	35.60	10.94	6.30

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	833.040			994.200
Wt. dry soil and tare:	684.650			684.650
Wt. of tare:	0.000			0.000
Weight, gms:	833.0			
Diameter, in:	2.884	2.788	2.754	
Area, in ² :	6.533	6.106	5.958	
Height, in:	5.990	5.990	5.893	
Net decrease in height, in:		0.000	0.097	
Net decrease in water volume, cc:		-157.600	24.000	
% Moisture:	21.7	44.7	41.2	45.2
Wet density, pcf:	81.1	103.2	104.9	
Dry density, pcf:	66.7	71.3	74.3	
Void ratio:	1.1860	1.0431	0.9613	
% Saturation:	42.7	100.0	100.0	

Test Readings Data for Specimen No. 3

Deformation dial constant = 1 in per input unit
 Primary load ring constant = 2.8 lbs per input unit
 Secondary load ring constant = 0 lbs per input unit
 Crossover reading for secondary load ring = 0 input units
 Membrane modulus = 0.14000 kN/cm²
 Membrane thickness = 0.012 cm
 Consolidation cell pressure = 95.50 psi = 13.75 ksf
 Consolidation back pressure = 40.00 psi = 5.76 ksf
 Consolidation effective confining stress = 7.99 ksf
 Strain rate, %/min = 0.17
 FAIL. STRESS = 25.49 ksf at reading no. 16
 ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	7.99	7.99	1.00	40.00	7.99	0.00
1	0.0100	0.010	225.00	630.0	0.2	15.20	7.85	23.05	2.94	41.00	15.45	7.60
2	0.0200	0.020	280.00	784.0	0.3	18.89	7.82	26.70	3.42	41.20	17.26	9.44
3	0.0300	0.030	287.00	803.6	0.5	19.32	7.82	27.14	3.47	41.20	17.48	9.66
4	0.0400	0.040	296.00	828.8	0.7	19.90	7.80	27.70	3.55	41.30	17.75	9.95
5	0.0500	0.050	298.00	834.4	0.8	20.00	7.79	27.79	3.57	41.40	17.79	10.00
6	0.0600	0.060	303.00	848.4	1.0	20.30	7.78	28.07	3.61	41.50	17.92	10.15
7	0.0700	0.070	308.00	862.4	1.2	20.60	7.78	28.37	3.65	41.50	18.07	10.30
8	0.0800	0.080	314.00	879.2	1.4	20.96	7.75	28.71	3.71	41.70	18.23	10.48
9	0.0900	0.090	317.00	887.6	1.5	21.13	7.75	28.87	3.73	41.70	18.31	10.56
10	0.1000	0.100	322.00	901.6	1.7	21.42	7.73	29.16	3.77	41.80	18.44	10.71
11	0.1500	0.150	345.00	966.0	2.5	22.75	7.70	30.46	3.95	42.00	19.08	11.38
12	0.2000	0.200	365.00	1022.0	3.4	23.86	7.73	31.60	4.09	41.80	19.66	11.93
13	0.2500	0.250	378.00	1058.4	4.2	24.50	7.79	32.29	4.14	41.40	20.04	12.25
14	0.3000	0.300	388.00	1086.4	5.1	24.92	7.86	32.78	4.17	40.90	20.32	12.46
15	0.3500	0.350	398.00	1114.4	5.9	25.34	7.95	33.28	4.19	40.30	20.62	12.67
16	0.4000	0.400	404.00	1131.2	6.8	25.49	8.05	33.54	4.17	39.60	20.79	12.74
17	0.4500	0.450	400.00	1120.0	7.6	25.00	8.14	33.14	4.07	39.00	20.64	12.50
18	0.5000	0.500	380.00	1064.0	8.5	23.54	8.09	31.63	3.91	39.30	19.86	11.77
19	0.5500	0.550	375.00	1050.0	9.3	23.01	8.02	31.03	3.87	39.80	19.53	11.51
20	0.6000	0.600	373.00	1044.4	10.2	22.67	7.92	30.59	3.86	40.50	19.26	11.34

Test Readings Data for Specimen No. 3

No.	Def.	Def.	Load	Load	Strain	Deviator	Effective Stresses			Pore	P ksf	Q ksf
	Dial	in	Dial	lbs	%	Stress	Minor	Major	1:3	Pres.		
	Units		Units			ksf	ksf	ksf	Ratio	psi		
21	0.6700	0.670	376.00	1052.8	11.4	22.55	7.82	30.37	3.88	41.20	19.10	11.28
22	0.7000	0.700	377.00	1055.6	11.9	22.48	7.78	30.26	3.89	41.50	19.02	11.24
23	0.7500	0.750	379.00	1061.2	12.7	22.39	7.75	30.13	3.89	41.70	18.94	11.19
24	0.8000	0.800	374.00	1047.2	13.6	21.88	7.69	29.56	3.84	42.10	18.63	10.94
25	0.8500	0.850	372.00	1041.6	14.4	21.54	7.65	29.19	3.82	42.40	18.42	10.77
26	0.9000	0.900	368.00	1030.4	15.3	21.10	7.59	28.69	3.78	42.80	18.14	10.55