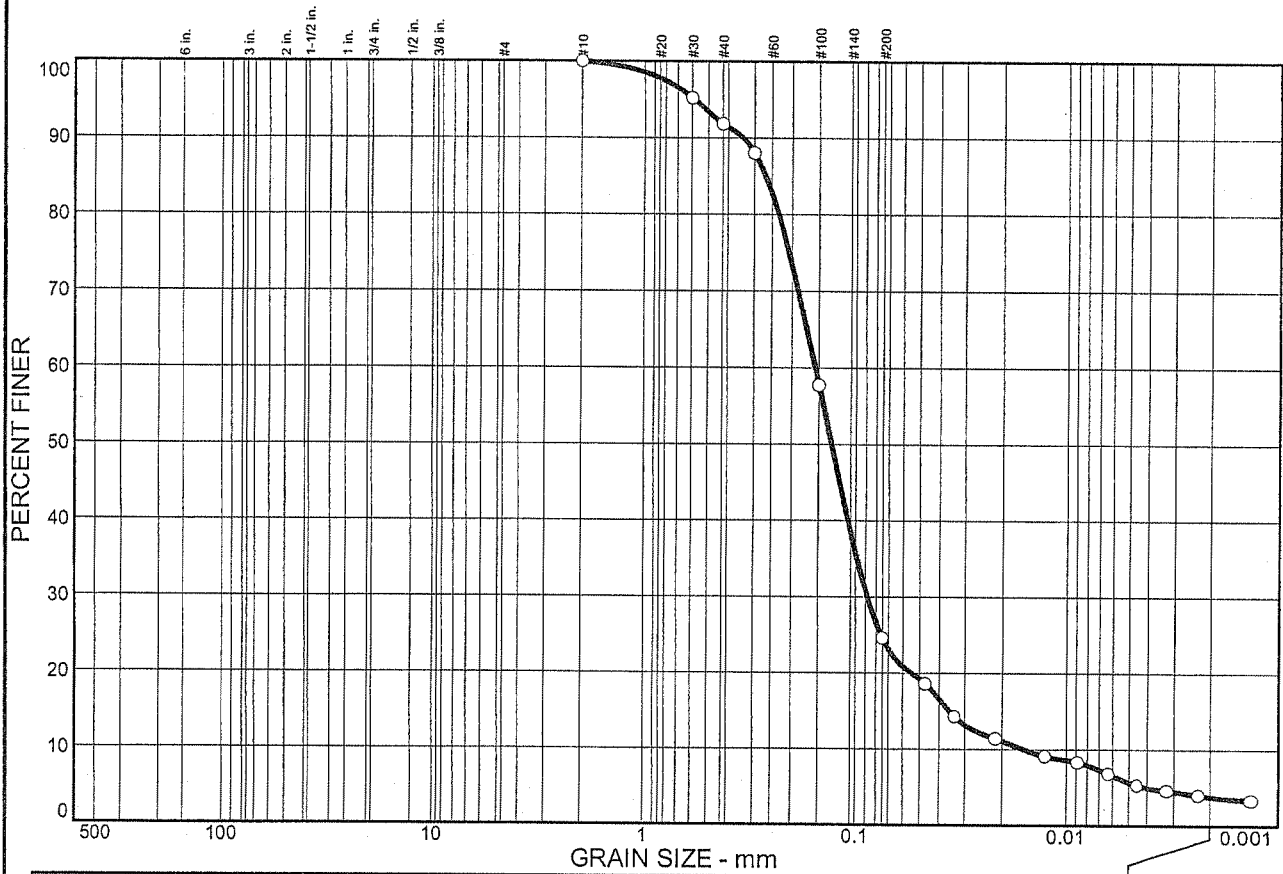


APPENDIX D

Results of Laboratory Tests by Cooper, CERCO, and Geo Test

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	8.2	67.2	20.8	3.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	95.2		
#40	91.8		
#50	88.0		
#100	57.7		
#200	24.6		
0.0469 mm.	18.6		
0.0337 mm.	14.3		
0.0215 mm.	11.4		
0.0125 mm.	9.1		
0.0089 mm.	8.3		
0.0063 mm.	6.8		
0.0046 mm.	5.3		
0.0032 mm.	4.6		
0.0023 mm.	4.0		
0.0013 mm.	3.3		

Soil Description

Light Yellowish Brown Silty SAND (cemented)

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 0.267 D₆₀= 0.156 D₅₀= 0.131
D₃₀= 0.0883 D₁₅= 0.0357 D₁₀= 0.0159
C_u= 9.80 C_c= 3.13

Classification

USCS= AASHTO=

Remarks

* (no specification provided)

Sample No.:
Location:

Source of Sample: LCLS-3A

Date: 9/20/04
Elev./Depth: 32-32.5'

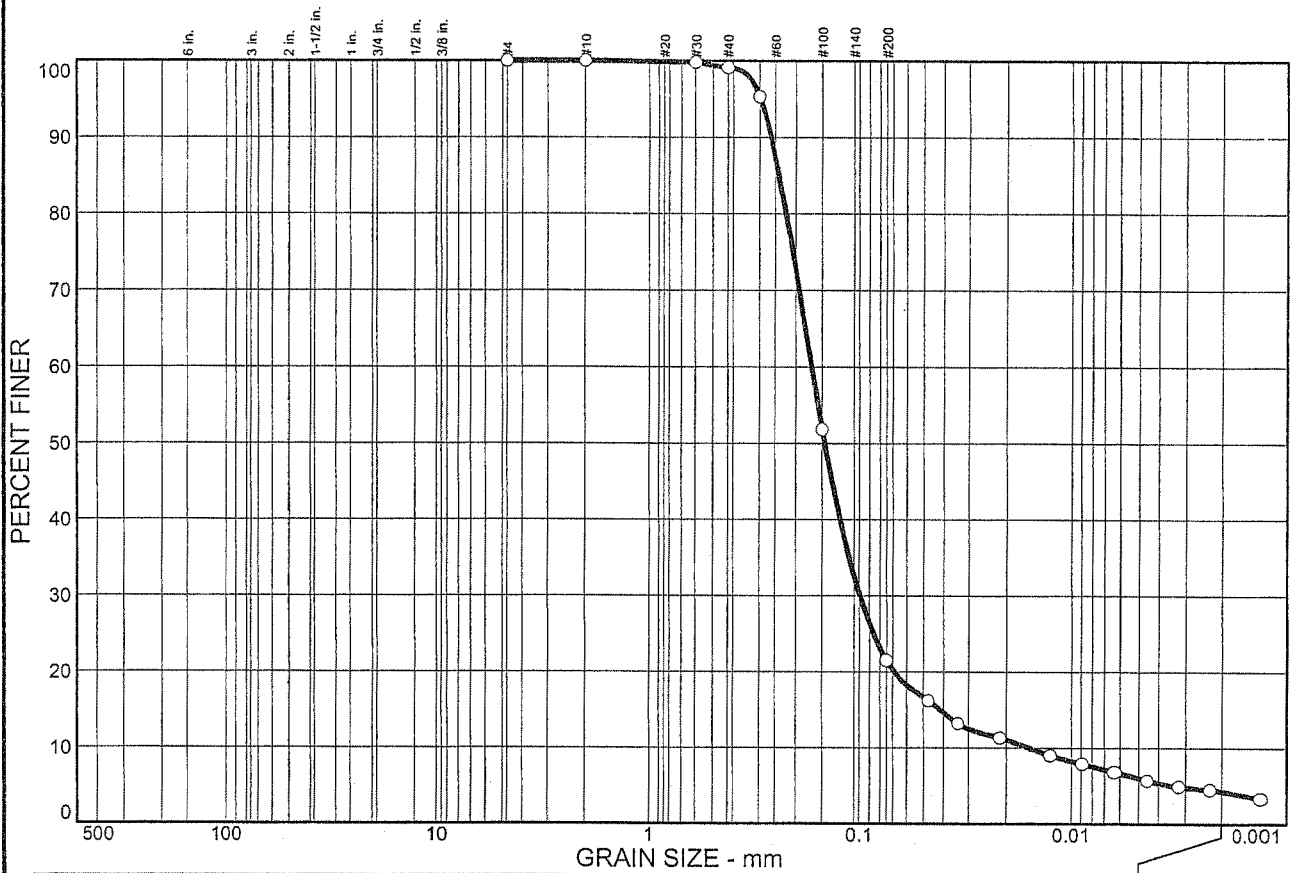
COOPER TESTING LABORATORY

Client: Rutherford & Chekene
Project: SLAC LCLS Tunnel - 2002-060G2

Project No: 335-099

Figure

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.9	77.6	17.2	4.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#30	99.8		
#40	99.1		
#50	95.3		
#100	51.8		
#200	21.5		
0.0473 mm.	16.2		
0.0338 mm.	13.2		
0.0215 mm.	11.3		
0.0125 mm.	9.0		
0.0089 mm.	7.9		
0.0063 mm.	6.8		
0.0046 mm.	5.7		
0.0032 mm.	4.9		
0.0023 mm.	4.5		
0.0013 mm.	3.3		

Soil Description

Yellowish Brown Silty SAND (cemented)

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 0.241 D₆₀= 0.169 D₅₀= 0.146

D₃₀= 0.0996 D₁₅= 0.0415 D₁₀= 0.0158

C_u= 10.65 C_c= 3.71

Classification

USCS= AASHTO=

Remarks

* (no specification provided)

Sample No.:
Location:

Source of Sample: LCLS-5&6

Date: 9/20/04
Elev./Depth: approx. 109'

COOPER TESTING LABORATORY

Client: Rutherford & Chekene
Project: SLAC LCLS Tunnel - 2002-060G2

Project No: 335-099

Figure



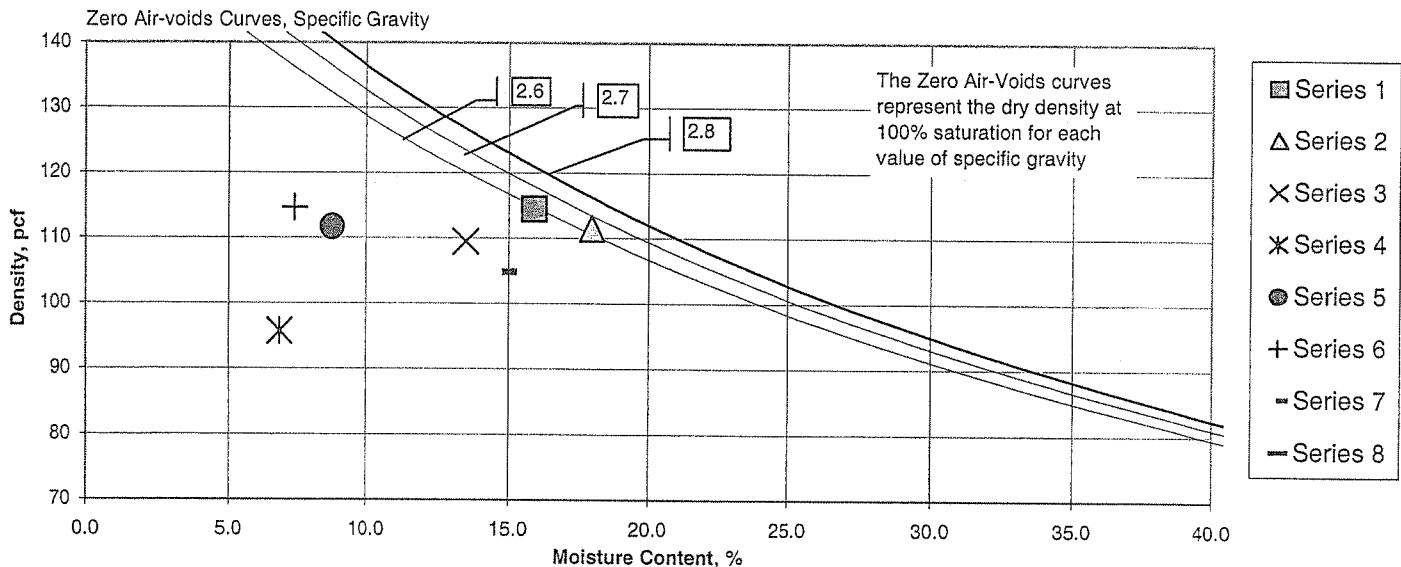
Moisture-Density-Porosity Report

Cooper Testing Labs, Inc.

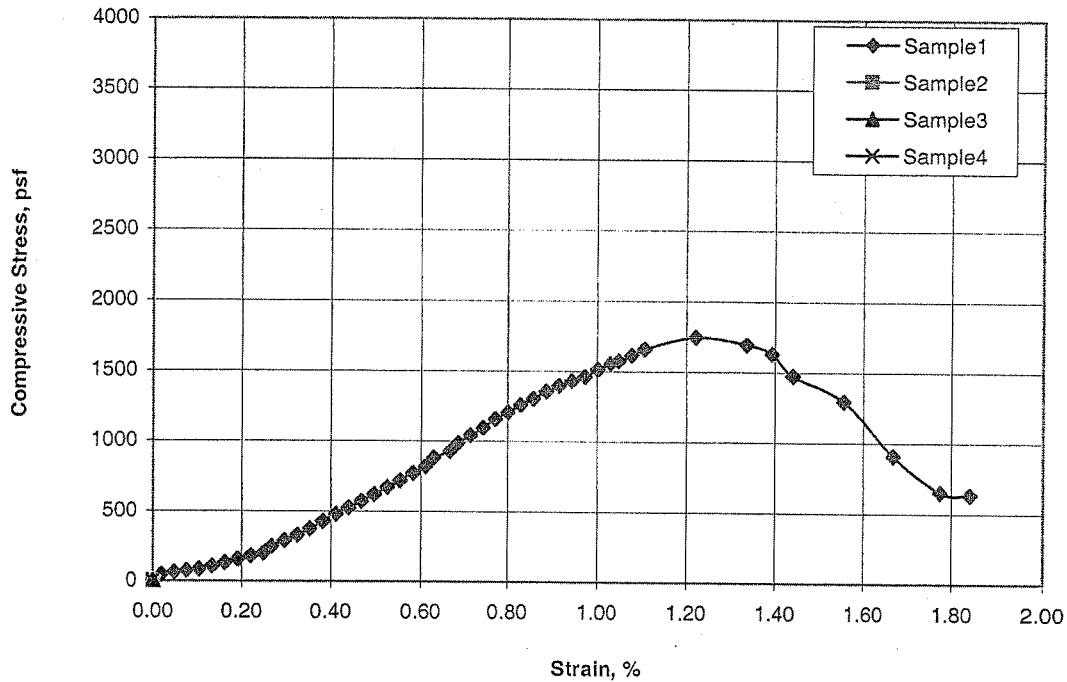
Job No: 335-097 **Date:** 09/17/04
Client: Rutherford & Chekene **By:** PJ
Project: SLAC LCLS Tunnel - 2002-060G2 **Remarks:** LCLS-1 @ 13': Not long enough for triax. MD only.

Boring:	LCLS-3A	LCLS-4	LCLS-4	LCLS-5	LCLS-5	LCLS-6	LCLS-1	
Sample:								
Depth, ft:	12.3	16.8	33.5	19	36.5	56.5	13	
Visual Description:	Brown Sandstone	Brown Silty SAND (weathered sandstone)	Brown Silty SAND (weathered sandstone)	Brown Silty SAND	Brown Silty SAND (weathered sandstone)	Brown Sandstone	Gray Silty SAND	
Actual G_s								
Assumed G_s	2.70	2.70	2.70	2.70	2.70	2.70	2.70	
Total Vol cc	330.51	216.48	149.62	147.15	419.82	211.81	215.86	
Vol Solids, cc	224.24	143.01	97.11	83.51	277.95	143.94	134.11	
Vol Voids, cc	106.27	73.47	52.52	63.64	141.87	67.87	81.75	
Moisture, %	15.9	18.0	13.5	6.8	8.7	7.4	14.8	
Wet Unit wt, pcf	132.6	131.5	124.3	102.3	121.4	123.1	120.3	
Dry Unit wt, pcf	114.4	111.4	109.5	95.7	111.7	114.6	104.8	
Saturation, %	90.6	94.4	67.4	24.2	46.2	42.2	65.6	
Porosity, %	32.2	33.9	35.1	43.2	33.8	32.0	37.9	
Void Ratio	0.474	0.514	0.541	0.762	0.510	0.471	0.610	
Series	1	2	3	4	5	6	7	8

Moisture-Density



Unconfined Compressive Strength

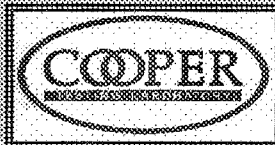


Sample No.:	1	2	3	4
Unconfined Compressive Strength, psf	1745			
Unconfined Compressive Strength, psi	12.1			
Undrained Shear Strength, psf	873			
Failure Strain, %	1.2			
Strain Rate, % per minute	1.0			
Strain Rate, inches/minute	0.04			
Moisture Content, %	15.4			
Dry Density, pcf	106.9			
Saturation, %	71.8			
Void Ratio	0.577			
Specimen Diameter, inches	1.880			
Specimen Height, inches	4.06			
Height to Diameter Ratio	2.2			
Assumed Specific Gravity	2.70			

Sample Location				Soil Description
	Boring	Sample	Depth, ft.	
1	LCLS-5		87.5 +/-	Brown Silty SAND
2				
3				
4				

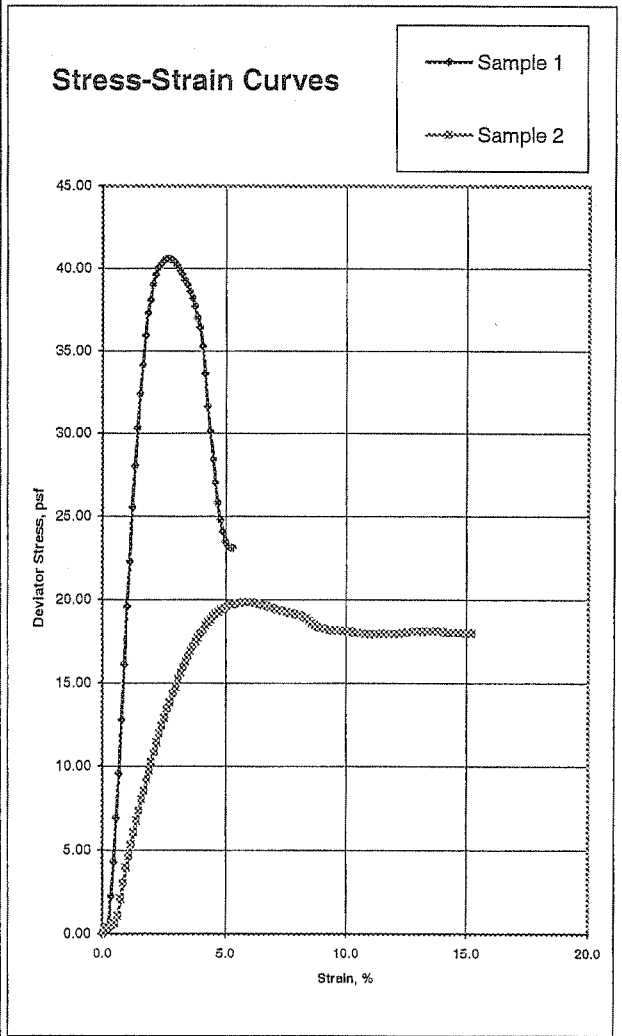
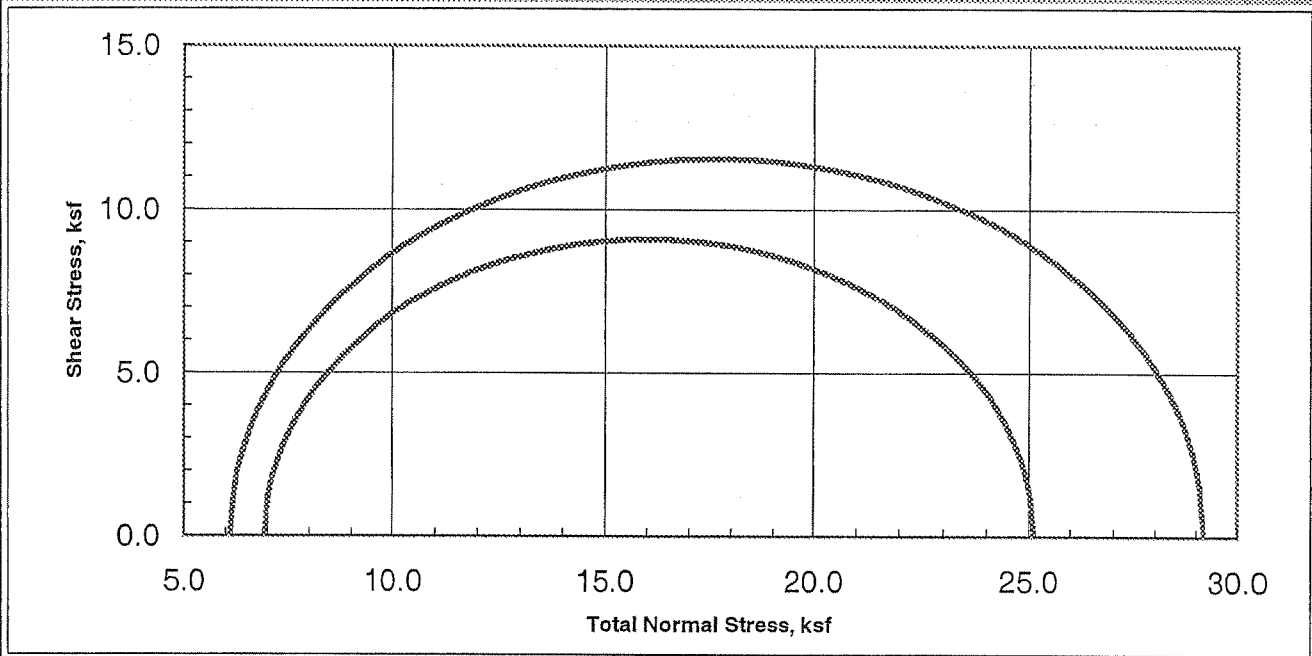
Job No.:	335-091	Type of Sample	Undisturbed
Client:	Rutherford & Chekene	Remarks:	
Project:	SLAC LCLS Tunnel 2002-060G2		
Date:	8/4/2004		





Unconsolidated-Undrained Triaxial Test

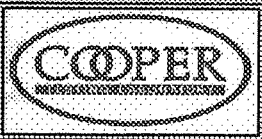
ASTM D-2850



Sample Data				
	1	2	3	4
Moisture %	10.4	15.7		
Density pcf	110.2	116.7		
Void Ratio	0.530	0.444		
Saturation %	52.9	95.7		
Height in	5.00	5.00		
Diameter in	2.44	2.34		
Cell psi	42.3	48.1		
Strain %	2.60	5.90		
Deviator ksf	40.574	19.844		
Rate %/min	1.00	1.00		
in/min	0.050	0.050		
Job No.:	335-094			
Client:	Rutherford & Chekene			
Project:	SLAC LCLS Tunnel - 2002-060G2			
Boring:	LCLS-5	LCLS-5		
Sample:				
Depth ft:	96 +/-	109 +/-		

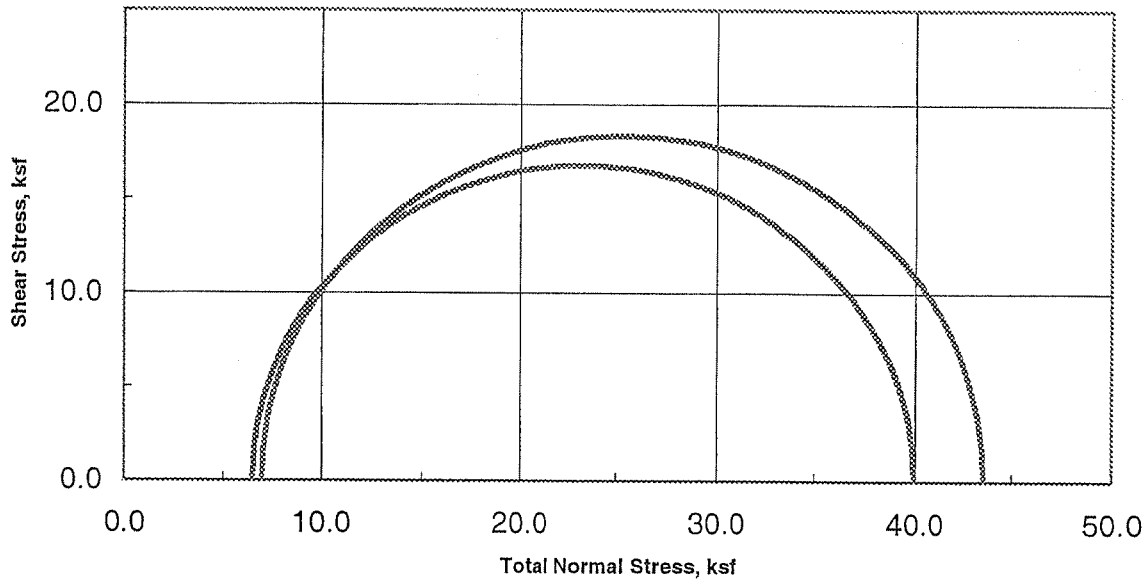
Visual Soil Description	
Sample #	
1	Brown Cemented Silty SAND
2	Brown Silty Fine SAND (fines slightly plastic)
3	
4	

Remarks:

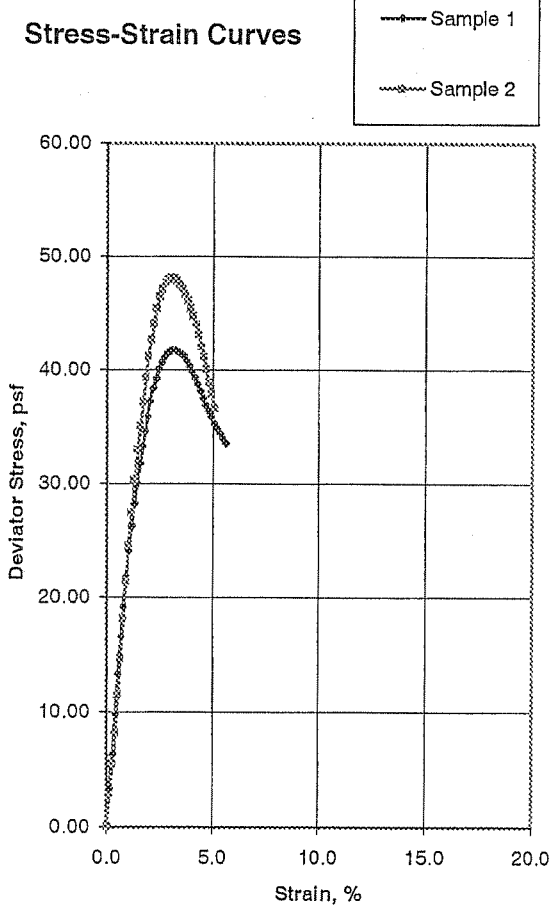


Unconsolidated-Undrained Triaxial Test

ASTM D-2850



Stress-Strain Curves



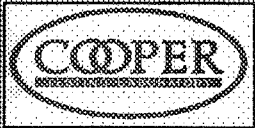
Sample Data

	1	2	3	4
Moisture %	14.4	12.7		
Density pcf	116.4	117.9		
Void Ratio	0.448	0.430		
Saturation %	86.6	79.5		
Height in	4.00	4.00		
Diameter in	2.00	2.00		
Cell psi	44.8	48.2		
Strain %	3.10	3.00		
Deviator, ksf	41.678	48.107		
Rate %/min	1.00	1.00		
in/min	0.040	0.040		
Job No.:	335-098b			
Client:	Rutherford & Chekene			
Project:	SLAC LCLS Tunnel - 2002-060G2			
Boring:	LCLS-6	LCLS-6		
Sample:				
Depth ft:	101.5	109.4		

Visual Soil Description

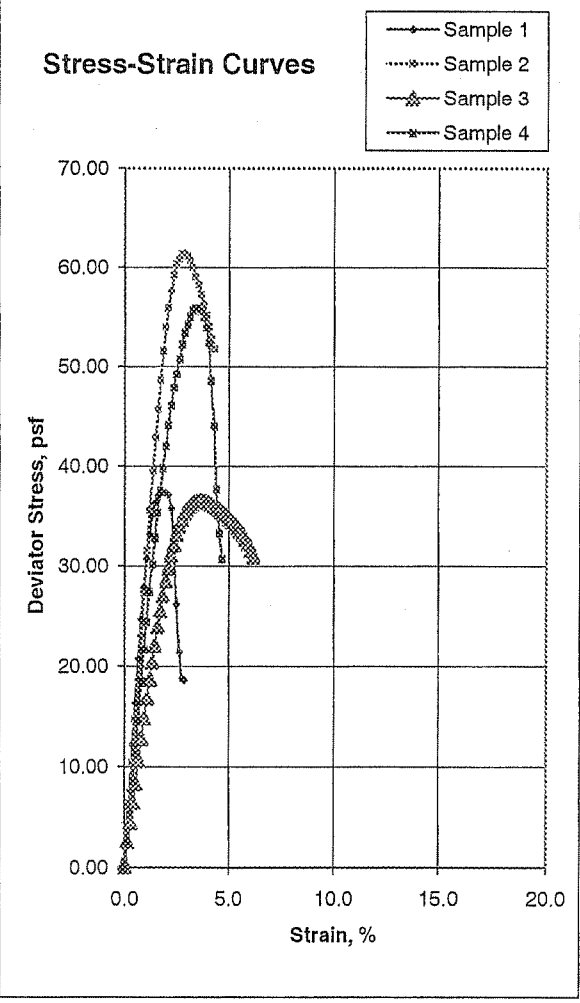
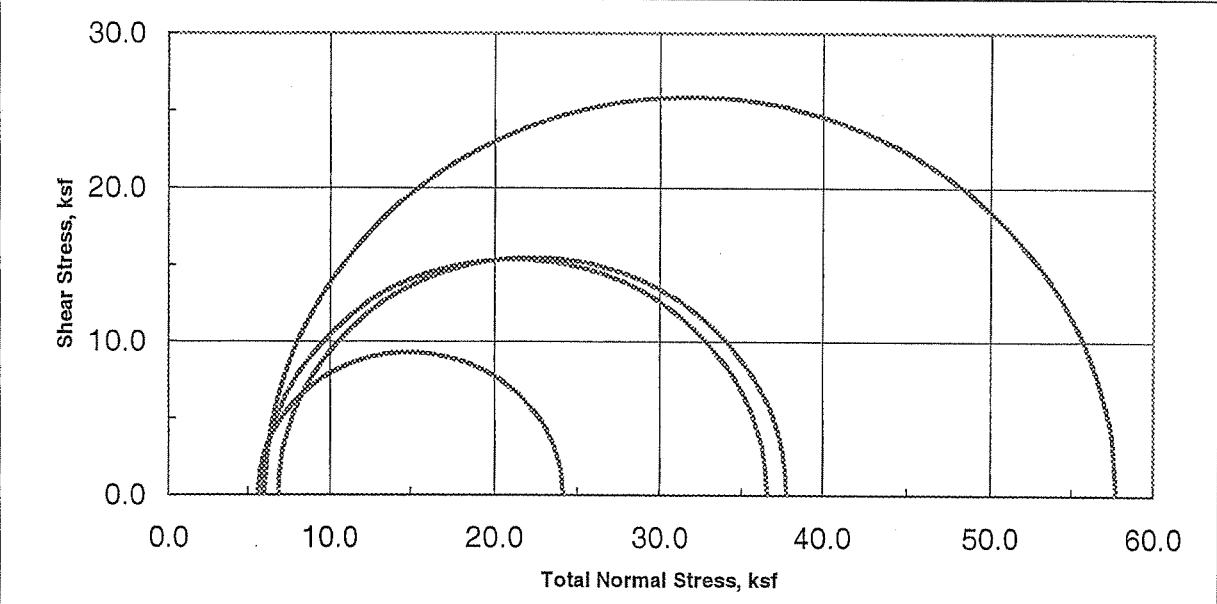
Sample #	Description
1	Yellowish Brown Silty SAND near SAND with Silt
2	Yellowish Brown SAND with Silt
3	
4	

Remarks:



Unconsolidated-Undrained Triaxial Test

ASTM D-2850



Sample Data				
	1	2	3	4
Moisture %	13.9	10.6	14.9	11.1
Density pcf	110.9	122.7	114.6	120.4
Void Ratio	0.521	0.373	0.471	0.400
Saturation %	72.1	76.5	85.1	74.7
Height in	4.00	4.00	4.00	4.00
Diameter in	1.97	2.00	2.00	2.00
Cell psi	38.6	41.7	47.4	40.7
Strain %	1.80	2.90	3.50	3.40
Deviator, ksf	37.370	61.327	36.493	55.957
Rate %/min	1.00	1.00	1.00	1.00
in/min	0.040	0.040	0.040	0.040
Job No.:	335-098a			
Client:	Rutherford & Chekene			
Project:	SLAC LCLS Tunnel - 2002-060G2			
Boring:	LCLS-6	LCLS-6	LCLS-6	LCLS-6
Sample:				
Depth ft:	87.5	94.6	107.5	92.2
Visual Soil Description				
Sample #				
1	Yellowish Brown Silty SAND (cemented)			
2	Brown SAND with Silt (cemented)			
3	Dark Yellowish Brown Silty SAND (cemented)			
4	Yellowish Brown Silty SAND grading to SAND with Silt (cemented)			
Remarks:				



**Slake Durability
ASTM D 4644-87**

CTL Job No: 335-097

Project No.: 2002-060G2

Client: Rutherford & Chekene

Date: 9/15/2004

Project Name: SLAC LCLC Tunnel

By: PJ

Boring:	LCLS-4	LCLS-6				
Sample:						
Depth, ft:	36.5-37.4	88 - 89				
Soil Description:	Yellowish Brown Silty SAND (weathered sandstone)	Mottled Light Yellowish Brown Silty SAND (weathered sandstone)				

NATURAL MOISTURE CONTENT OF SAMPLE:

DrumNo.	1	2			
Drum wt. (g)	1747.5	1724.4			
Total wet wt. (g)	2289.3	2207.2			
Total dry wt (g)	2225	2156.1			
Natural % H2O	13.5	32.6			

Cycle # 1

Beginning H2O Temp (°C)	22.2	22.2			
Ending H2O Temp (°C)	22.0	22.0			
Average H2O Temp (°C)	22.1	22.1			
Drum & Dry Rock (g)	1747.5	1724.4			

Cycle # 2

Beginning H2O Temp (°C)	-	-			
Ending H2O Temp (°C)	-	-			
Average H2O Temp (°C)	-	-			
Drum & Dry Rock (g)	1747.5	1724.4			

SLAKE DURABILITY INDEX (second cycle)	0	0	Note: 100% of both samples broke down during the first cycle.			
--	---	---	--	--	--	--

Standard Verbal Description and comments (Type I - Retained pieces remain virtually unchanged) (Type II - Retained material consists of large & small pieces. (Type III - Retained material is exclusively small fragments)	Type III	Type III				
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Shrink-Swell / Expansion Pressure ASTM D 3877

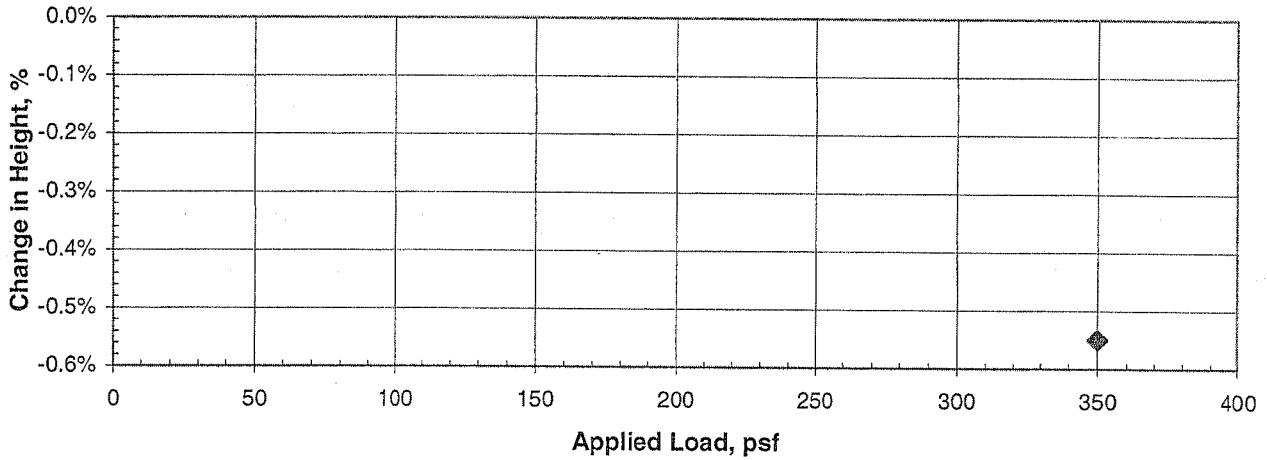
Job No.: 335-097 LL Date: 9/15/2004
 Client: Rutherford & Chekene PL By: MD
 Project: SLAC LCLS Tunnel - 2002-060G2 PI Checked By: PJ Assumed Determined
 Boring: LCLS-4 Sample: Depth,ft: 51.25 Specific Gravity: 2.7
 Soil Desc. Brown Silty SAND (cemented)

Load, psf: 350
 Exp., % -0.5

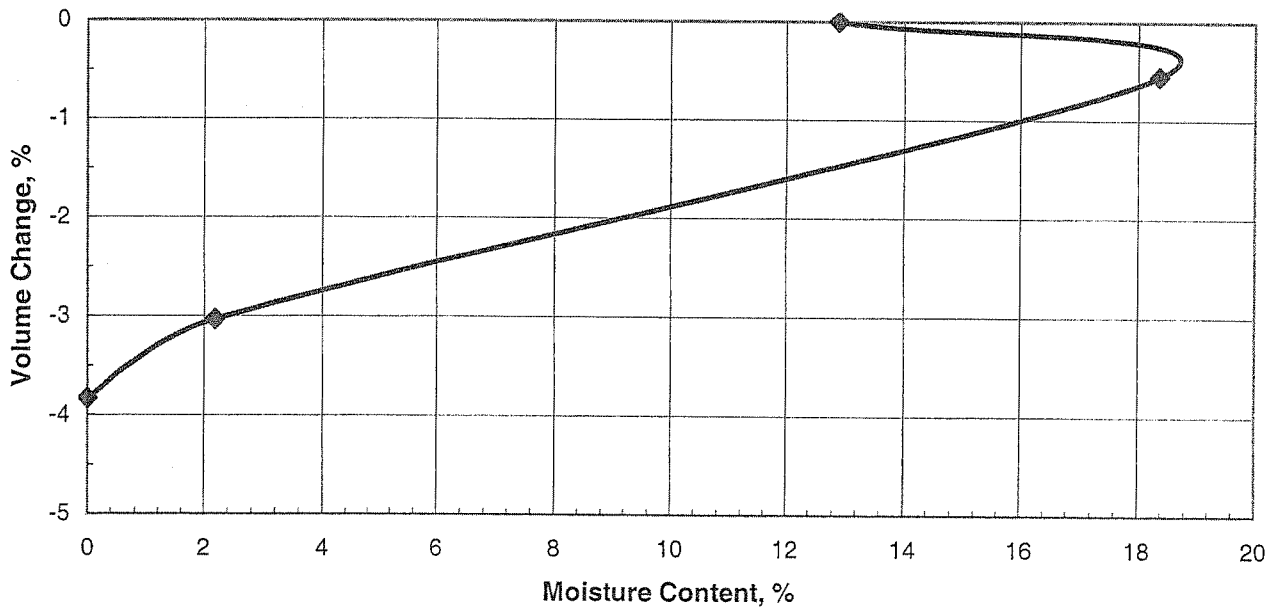
	Field	Saturated	Air-Dry	Oven-Dry
Moisture %:	12.9	18.4	2.2	0.0
Density, pcf	105.9	106.5	109.2	110.1
Saturation	58.7	84.9	10.8	0.0
Void Ratio	0.593	0.584	0.544	0.532
Volume Change	0.0	-0.5	-3.0	-3.8

Remarks:

Expansion Pressure



Volume Change





Shrink-Swell / Expansion Pressure ASTM D 3877

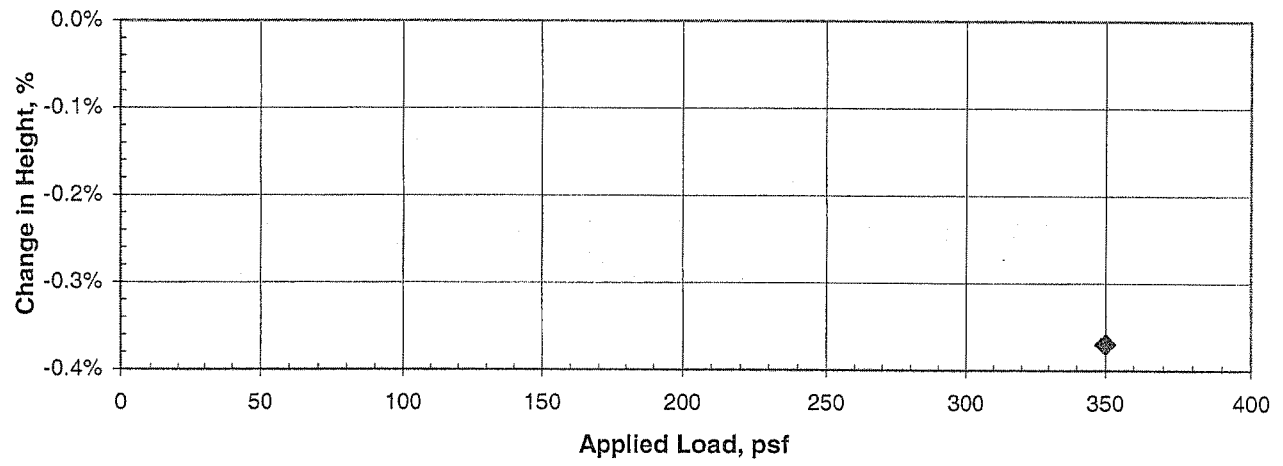
Job No.: 335-097 LL _____ Date: 9/15/2004
 Client: Rutherford & Chekene PL _____ By: MD
 Project: SLAC LCLS Tunnel - 2002-060G2 PI _____ Checked By: PJ Assumed Determined
 Boring: LCLS-3A Sample: _____ Depth,ft: 34 Specific Gravity: 2.7
 Soil Desc. Light Brown Sandstone

Load, psf: 350
 Exp., % -0.4

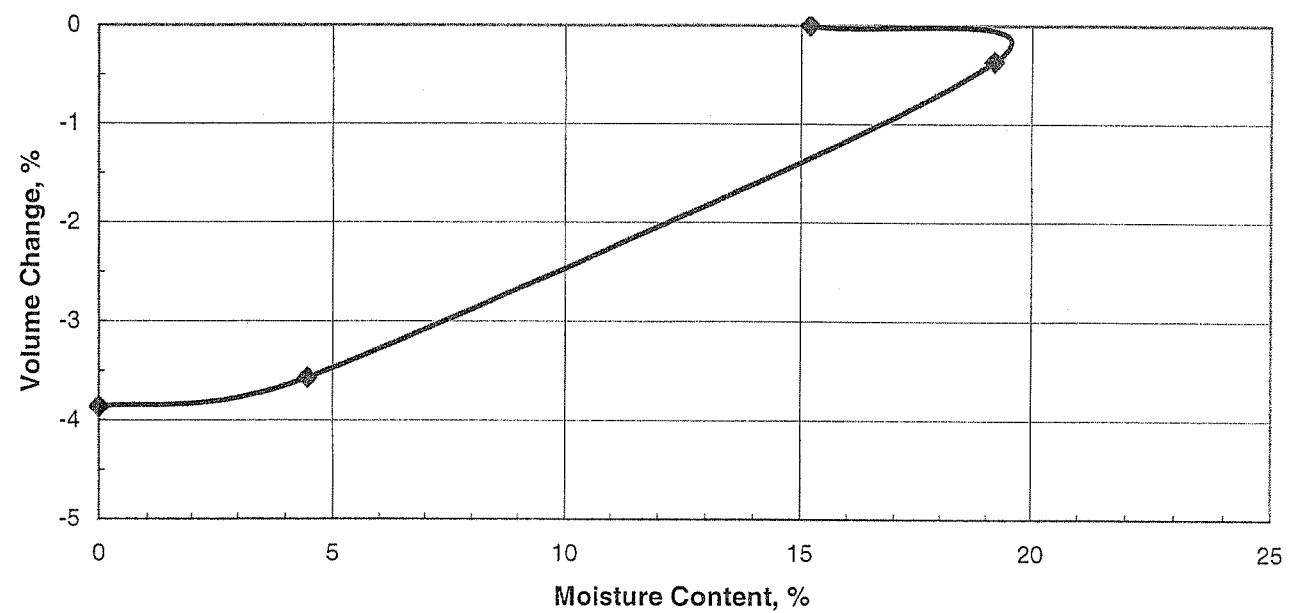
	Field	Saturated	Air-Dry	Oven-Dry
Moisture %:	15.2	19.2	4.5	0.0
Density, pcf	108.3	108.7	112.3	112.7
Saturation	73.6	93.8	24.0	0.0
Void Ratio	0.557	0.552	0.502	0.497
Volume Change	0.0	-0.4	-3.6	-3.9

Remarks:

Expansion Pressure



Volume Change



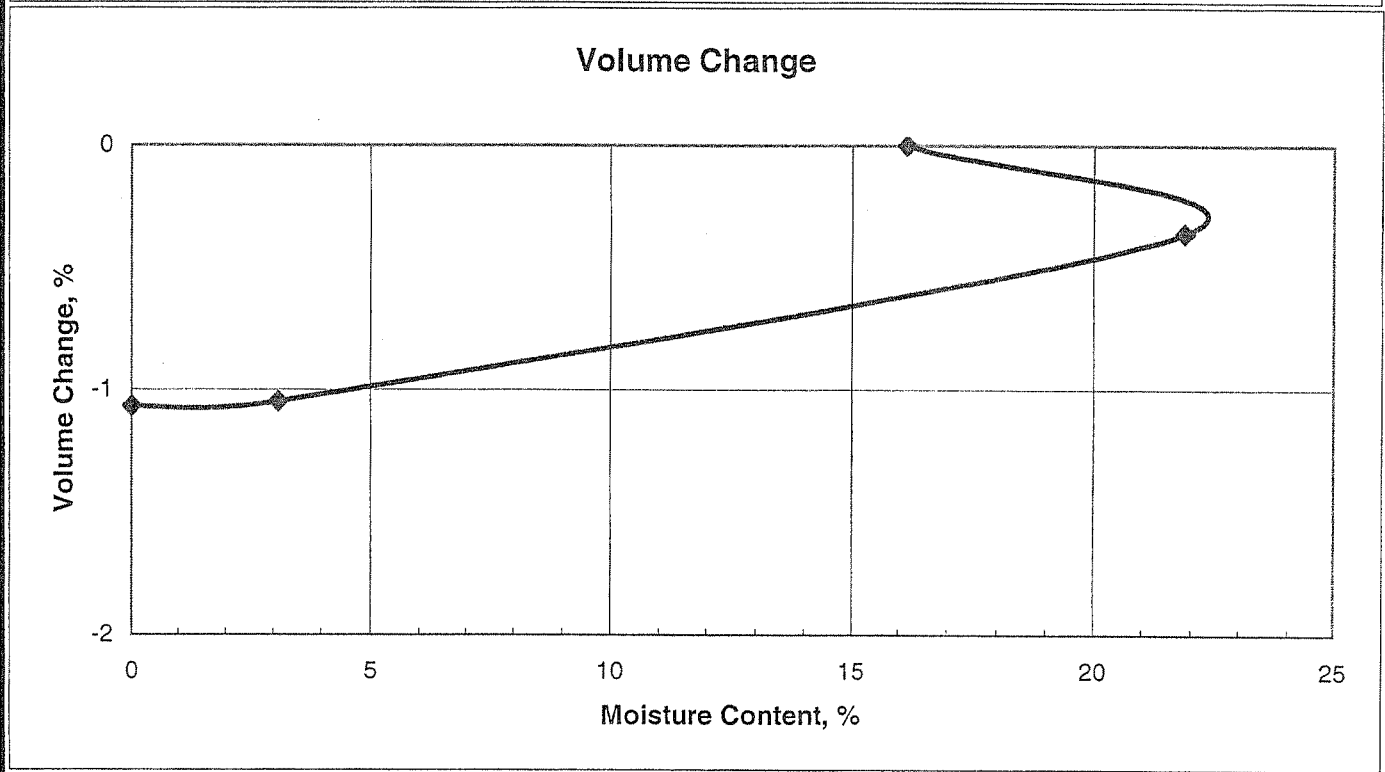
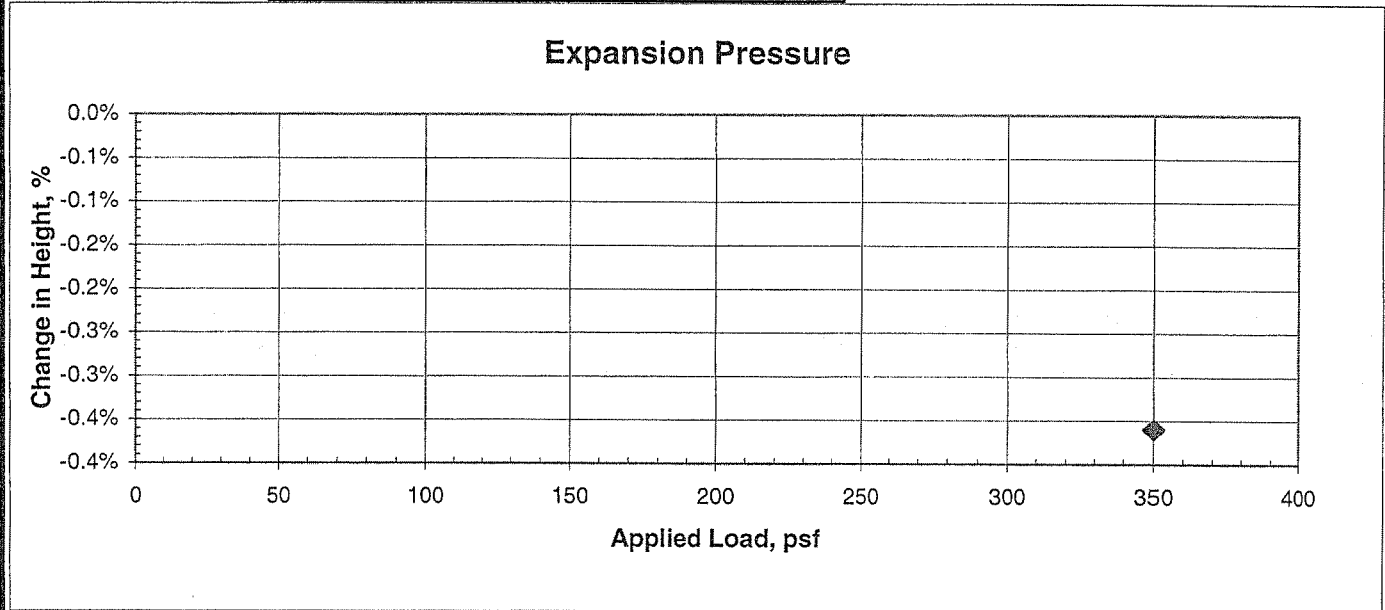


Shrink-Swell / Expansion Pressure ASTM D 3877

Job No.: 335-097 LL Date: 9/22/2004
 Client: Rutherford & Chekene PL By: MD
 Project: SLAC LCLS Tunnel - 2002-060G2 PI Checked By: DC Assumed Determined
 Boring: LCLS 5-6 Sample: Depth,ft: approx. 109' Specific Gravity: 2.7
 Soil Desc. Yellowish Brown Silty SAND

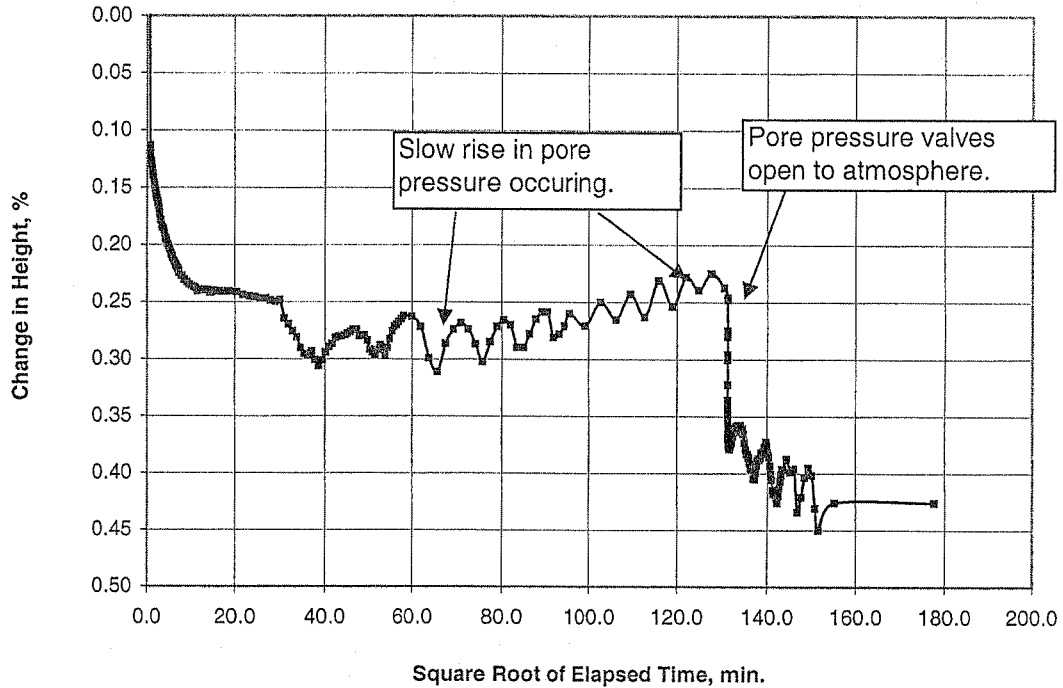
Load, psf: 350
 Exp., % -0.4

	Field	Saturated	Air-Dry	Oven-Dry	Remarks: Measurements may be affected by the noncohesive nature of the material.
Moisture %:	16.2	21.9	3.1	0.0	
Density, pcf	100.6	100.9	101.6	101.6	
Saturation	64.4	87.9	12.7	0.0	
Void Ratio	0.678	0.671	0.660	0.660	
Volume Change	0.0	-0.4	-1.0	-1.1	



CREEP TEST REPORT (ASTM D 5202)

% Strain vs. Square Root of Time



CREEP TEST SAMPLE INFORMATION

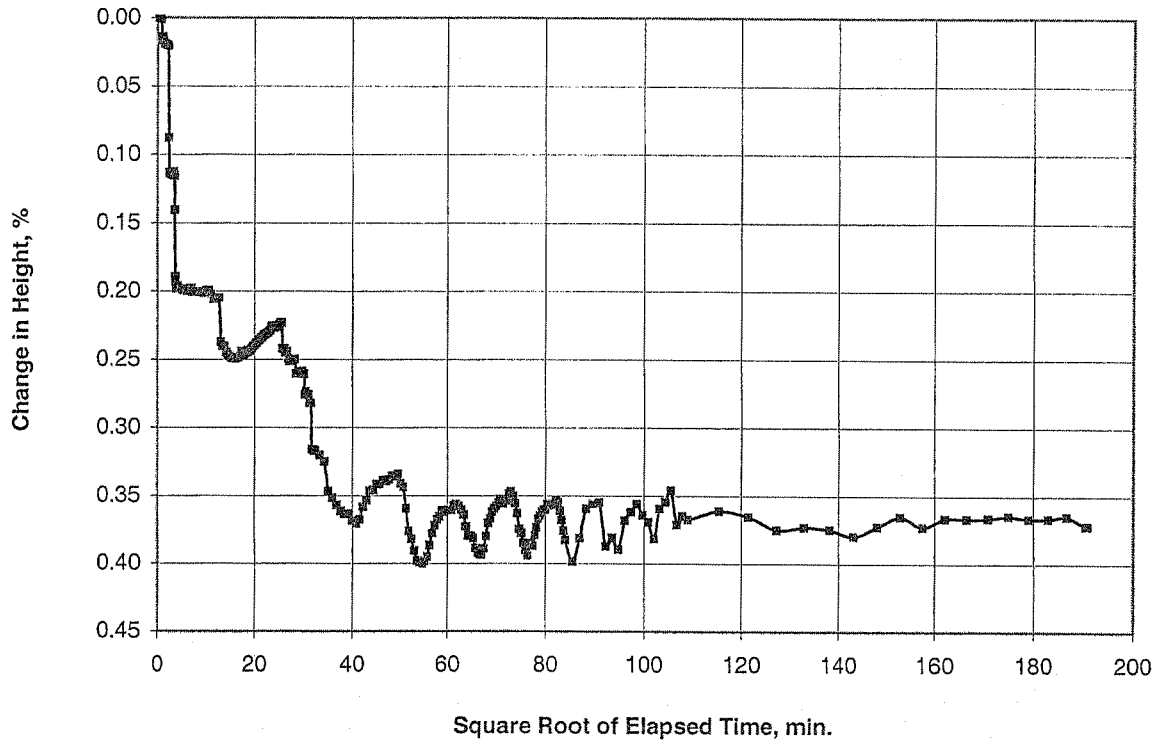
Boring	Sample	Depth ft.	Soil Description
LCLS-5		85.5	Yellowish Brown Silty SAND (cemented)
Specimen Diameter, inches		2.40	
Specimen Height, inches		6.03	
Height to Diameter Ratio		2.51	
Moisture Content, %		13.6	
Dry Density, pcf		113.1	
Saturation, %		74.8	
Void Ratio		0.490	
Short-Term Unconfined Compressive Strength, psf		1745	
Short-Term Unconfined Compressive Strength, psi		12.1	
Short-Term Undrained Shear Strength, psf		873	
Applied Axial Load for Creep Test, psf		654.8	
Applied Axial Load for Creep Test, psi		4.5	
Creep Test Load as % of Short Term Ultimate Strength		37.5	
Job No.:	335-091	Type of Sample	Undisturbed
Client:	Rutherford & Chekene	Assumed Spec. Gravity	2.7
Project:	SLAC LCLS Tunnel		
Date:	9/16/2004	By:	PJ



Remarks: The cyclical fluctuations in height are due to the cell pressure regulator being impacted by temperature fluctuations. Pore pressures were slowly rising during the test possibly due to dissolved air in the cell water migrating through the latex membrane. To counteract this, the pore pressure valves were open to atmospheric pressure on day 12.

CREEP TEST REPORT (ASTM D 5202)

% Strain vs. Square Root of Time



CREEP TEST SAMPLE INFORMATION

Boring	Sample	Depth ft.	Soil Description
LCLS-6		86.2 - 87	Yellowish Brown Silty SAND (cemented)
Specimen Diameter, inches		2.04	
Specimen Height, inches		5.16	
Height to Diameter Ratio		2.53	
Moisture Content, %		14.0	
Dry Density, pcf		111.1	
Saturation, %		73.1	
Void Ratio		0.517	
Short-Term Unconfined Compressive Strength, psf		1745	
Short-Term Unconfined Compressive Strength, psi		12.1	
Short-Term Undrained Shear Strength, psf		873	
Applied Axial Load for Creep Test, psf		1309.2	
Applied Axial Load for Creep Test, psi		9.1	
Creep Test Load as % of Short Term Ultimate Strength		75.0	
Job No.:	335-091	Type of Sample	Undisturbed
Client:	Rutherford & Chekene	Assumed Spec. Gravity	2.7
Project:	SLAC LCLS Tunnel		
Date:	10/6/2004	By:	PJ



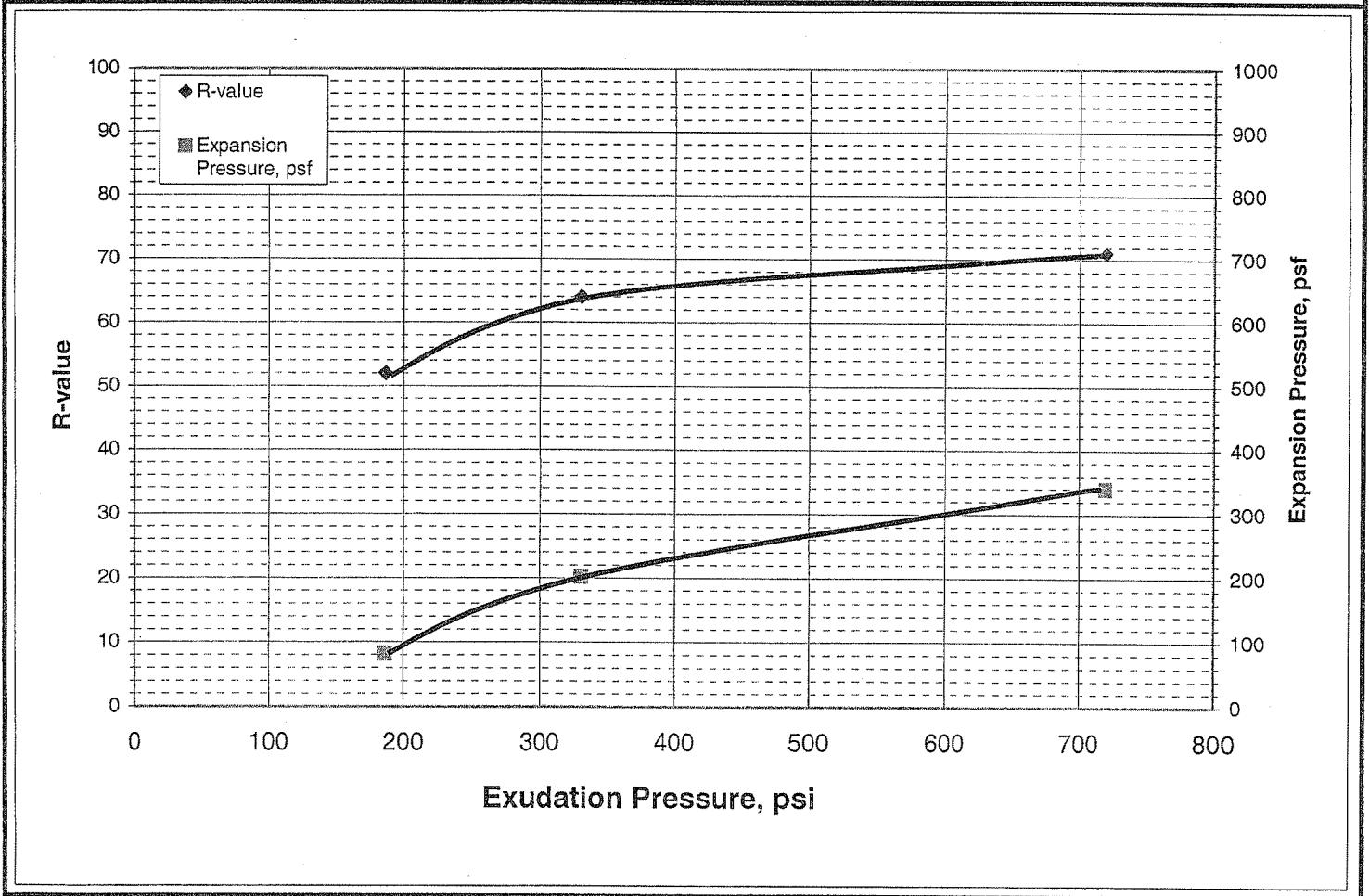
Remarks: The cyclical fluctuations in height are due to the cell pressure regulator being impacted by temperature fluctuations. In order to avoid a slow rise in pore pressure, the pore pressure valves were open to atmospheric pressure throughout the test.



R-value Test Report (Caltrans 301)

Job No.:	335-092a	Date:	08/09/04	Initial Moisture,	14.3%
Client:	Rutherford & Chekene	Tested	MD	R-value	63
Project:	SLAC - 2002-060G2	Reduced	MJ	Expansion Pressure	190 psf
Sample	Area 1	Checked	DC		
Soil Type: Brown Silty SAND with Gravel, highly organic					

Specimen Number	A	B	C	D	Remarks:
Exudation Pressure, psi	331	187	720		
Prepared Weight, grams	1200	1200	1200		
Final Water Added, grams/cc	20	40	0		
Weight of Soil & Mold, grams	3101	3169	3123		
Weight of Mold, grams	2081	2111	2095		
Height After Compaction, in.	2.55	2.63	2.5		
Moisture Content, %	16.2	18.1	14.3		
Dry Density, pcf	104.3	103.2	109.0		
Expansion Pressure, psf	202.1	81.7	339.7		
Stabilometer @ 1000					
Stabilometer @ 2000	41	60	33		
Turns Displacement	4.13	4.4	3.93		
R-value	64	52	71		

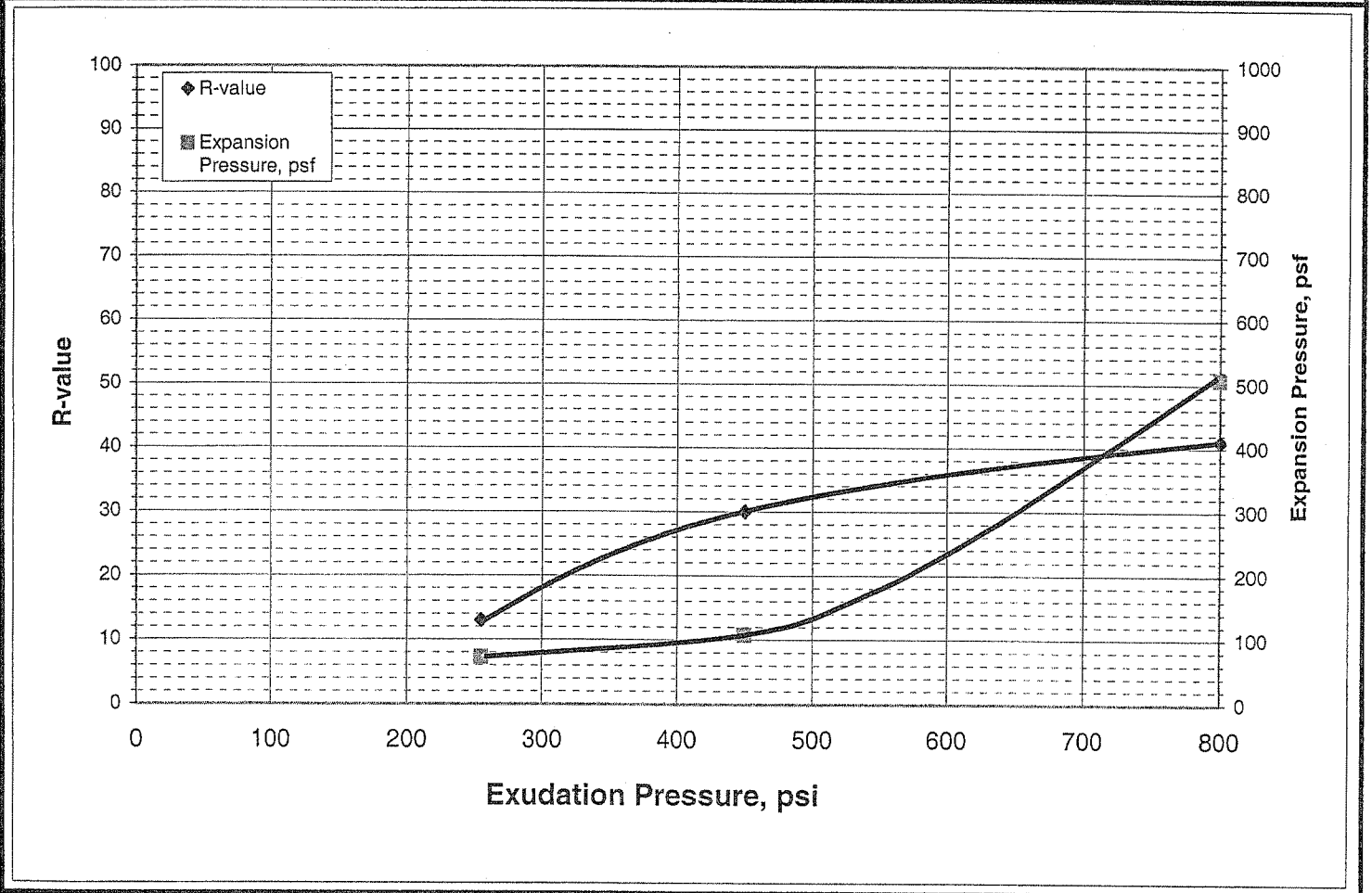




R-value Test Report (Caltrans 301)

Job No.:	335-092b	Date:	08/09/04	Initial Moisture,	14.9%
Client:	Rutherford & Chekene	Tested	MD	R-value	18
Project:	SLAC LCLS Tunnel - 2002-060G2	Reduced	MJ	Expansion Pressure	80 psf
Sample	Area 2	Checked	DC		
Soil Type: Brown Clayey SAND / Sandy CLAY with organics					

Specimen Number	A	B	C	D	Remarks:
Exudation Pressure, psi	800	450	254		
Prepared Weight, grams	1200	1200	1200		
Final Water Added, grams/cc	20	40	75		
Weight of Soil & Mold, grams	3201	3153	3152		
Weight of Mold, grams	2089	2075	2090		
Height After Compaction, in.	2.54	2.52	2.58		
Moisture Content, %	16.9	18.8	22.1		
Dry Density, pcf	113.4	109.1	102.1		
Expansion Pressure, psf	507.4	107.5	73.1		
Stabilometer @ 1000					
Stabilometer @ 2000	90	108	132		
Turns Displacement	2.79	2.82	3.48		
R-value	41	30	13		





R-value Test Report (Caltrans 301)

Job No.:	335-092c	Date:	08/09/04	Initial Moisture,	11.5%
Client:	Rutherford & Chekene	Tested	MD	R-value	50
Project:	SLAC LCLS Tunnel - 2002-060G2	Reduced	MJ	Expansion Pressure	165 psf
Sample	Area 3	Checked	DC		
Soil Type: Brown Silty SAND, highly organic					

Specimen Number	A	B	C	D	Remarks:
Exudation Pressure, psi	401	251	184		
Prepared Weight, grams	1200	1200	1200		
Final Water Added, grams/cc	20	30	40		
Weight of Soil & Mold, grams	3178	3212	3209		
Weight of Mold, grams	2110	2123	2104		
Height After Compaction, in.	2.51	2.53	2.6		
Moisture Content, %	13.3	14.2	15.2		
Dry Density, pcf	113.7	114.1	111.7		
Expansion Pressure, psf	193.5	141.9	73.1		
Stabilometer @ 1000					
Stabilometer @ 2000	47	70	77		
Turns Displacement	3.83	3.92	4.42		
R-value	61	45	40		

