



The Geo-Institute **of the American Society of Civil Engineers**

Presents

The Competition Rules for the 18th *Annual* National GeoPREDICTION at ASCE2027 The Infrastructure and Engineering Experience

Important Dates

GeoPrediction Reports Due.....January 8th, 2027, 6:00 PM EST
Invitation to GeoPrediction Finale..... January 29th, 2027
ASCE2027.....March 1-5, 2027
ASCE2027 Information.....<https://experience.asce.org/>
GeoPrediction Presentations.....March 2, 2027

1. Objective: The objective of the GeoPrediction competition is to develop an accurate prediction of geotechnical behavior given information regarding subsurface, boundary, and initial conditions, as well as the geotechnical/structural/hydraulic loading.

For the 2027 GeoPrediction, the competing teams will develop estimated vertical movements of a spillway structure after construction.

2. Geotech data: Input data for the problem including problem description, cross sections, and soil information are found on the following sheets.

3. Eligibility: A GeoPrediction team will consist of one or two students. Teams of two can include two undergraduate students, or one undergraduate and one graduate student. Two graduate students cannot form a team. However, graduate students can submit their own prediction. Students must be enrolled during the Spring 2027 Semester or Quarter.

4. Submittal: Each GeoPrediction team will submit a GeoPrediction Report that will, at a minimum, contain the following information.

- a. The Report shall be no more than four (4) pages long (not including any references and title page). One inch margins, single spacing, and 12 point Time New Roman font are required.
- b. Include the provided Table 1 and Table 2 (completed) in your report.
- c. The Report shall contain the methods (assumptions, correlations, analytical procedures, numerical procedures, computers software, etc.) that the team employed to develop the GeoPrediction. Methods must be referenced properly.
- d. The cover page must include the name of the institution; names, email addresses, and status (i.e., graduate or undergraduate) of each team member; as well as the name and contact information of the faculty that advised the team in developing their prediction.
- e. Submit your report electronically in PDF format to this Google Form by 6pm Eastern Standard Time on January 8, 2027.

<https://forms.gle/jcoGCSdA2isbZ3i9A>

Sender will receive confirmation of receipt by email. Late submissions are not accepted. Email confirmations will be sent at the end of each week.

5. Judging: The submitted GeoPrediction reports will be judged and ranked by an anonymous panel of faculty and engineers. Initial judging will be based on criterial (a) through (d) below.

- | | |
|---|-----|
| a. Format, length, grammar, English usage | 10% |
| b. Clarity of technical presentation | 15% |
| c. Logical and concise use of appropriate geotechnical methods and principles | 15% |
| d. Accuracy of GeoPrediction | 30% |
| e. Presentation at the 2027 Geo-Congress | 30% |

6. Selection: The winning team will receive the prestigious Mohr’s Circle Award. Up to fifteen (15) teams may be invited to the GeoPrediction Presentation based on the ranking of their GeoPrediction reports. The selected teams will be notified by January 29th, 2027. The top teams (based total score of items a-d listed in section #5) will receive partial reimbursement for student registration and travel (amount and number of total teams to be determined) for up to two team members. Any number of teams from a university may submit a GeoPrediction; however, no more than two teams from the same university may be invited to present.

7. Presentations: Teams invited to present their GeoPrediction Results will prepare an 8 - minute (maximum) presentation that describes their methods and GeoPrediction for viewing by judges and the public. The order and location of the presentations will be determined at the conference site. It is expected that a room with a projector and computer will be used for these presentations.

As noted in Item 5, the Presentation will constitute the final 30% of each invited team’s final GeoPrediction score.

8. Questions: Questions should be emailed to Matthew Sleep (sleepmw@uc.edu).

9. Generative AI: Students may use Generative AI tools to aid in the completion of the GeoPrediction. However, it is expected that the students will be able to explain the tool’s output if asked by the judges. Moreover, any time a Generative AI tool is used to complete the GeoPrediction, the submission must constitute a substantial expansion of what was yielded when the students prompted the Generative AI tool.

A student should include the following statement in the GeoPrediction to credit the use of a Generative AI Tool: “The author(s) would like to acknowledge the use of [Generative AI Tool Name], developed by [Generative AI Tool Provider], in the preparation of this GeoPrediction. The [Generative AI Tool Name] was used in the following way(s) in this GeoPrediction: [e.g., brainstorming, grammatical correction, citation, which portion of the prediction, etc].”

Project Description

A water spillway structure has been constructed at a location. To complete this concrete structure, significant excavation took place. Monitoring of the structure began immediately after construction (Year 0). Since the end of construction, vertical (upward) movements, or heave, have been observed along the spillway.

Your task is to estimate the cumulative vertical movements at Stations A and B since the end of construction (Year 0). At Station A, the vertical movement is to be estimated at the centerline of the structure (A1) and the left wall (A2). At Station B, only the vertical movement of the centerline (B1) is to be estimated. These three predictions should be made 31 years after construction and 53 years after construction. Your completed report should contain Table 1.

In addition, your report must contain a complete Table 2. In this table you may list **up to five** mechanisms for the observed vertical movement. You may list less than five mechanisms. List these in order from largest to smallest contribution to the movement. For each mechanism, provide a title and then a maximum of 20 words explaining the mechanism. In addition, explain, with a maximum of 20 words, how you accounted for this mechanism in your numerical/analytical prediction. In the final column, provide a justification for why this is occurring (i.e. what evidence do you have that this is contributing to the vertical movements?).

Table 1. Estimated cumulative vertical (upward) movements of locations A1, A2, and B1 - 31 and 53 years after construction to be included in your prediction NOTE: Report your estimate to the nearest 0.01.

Station A		
Location	31 Years After Construction (ft)	53 Years After Construction (ft)
A1		
A2		
Station B		
Location	31 Years After Construction (ft)	53 Years After Construction (ft)
B1		

Table 2. Observed movement influencing mechanisms – to be completed in your prediction NOTE: maximum of 25 words in each box

		Mechanism Title	Mechanism Explanation	Mechanism Accounting in Prediction	Justification and Evidence
Largest Influence to Observed Movement	1				
	2				
	3				
	4				
Smallest Influence to Observed Movement	5				

The following information is provided to aid in your prediction.

Figure 1 contains an approximate plan view of the spillway with locations of Stations A and B. Figure 2 is provided to illustrate the approximate dimensions of the concrete portion of the spillway. Figure 3 is a profile of the spillway structure showing the changes in elevation from Stations A and B. Provided on this profile are two generalized lithologic profiles from boring logs and the location of faults identified along the spillway.

Profiles of Station A and B, where you are to create your predictions of vertical movements, are shown in Figures 4 and 5. These profiles contain the original ground surface prior to excavation for the spillway structure. They also show the profile of the spillway and ground surface at the end of excavation.

The geology of the area is consistent with shale and intermittent layers of bentonite. Geotechnical information about this geology is provided in Boring B1. This boring was taken above the left wall of the spillway. You are provided with the boring log, photographs of the cores, and several laboratory datasets. The data includes unconfined compression tests of the shale, tensile tests, pressuremeter tests, direct shear tests, and consolidation tests.

Conveyance Walls (approximate)

Station A •

Station B •

Boring B1

0 Scale (ft) 100

Figure 1 – Plan view of stations A and B along the spillway structure

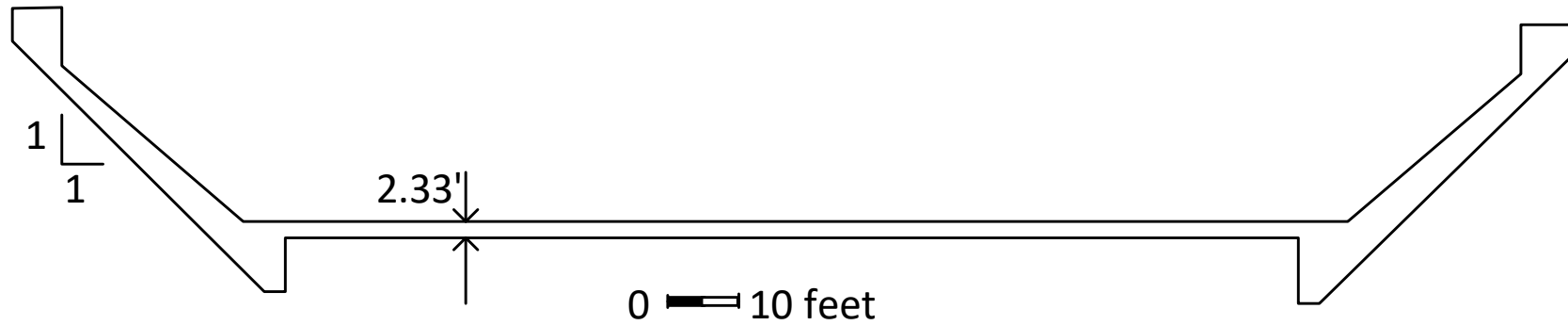


Figure 2 – Typical cross section of concrete spillway

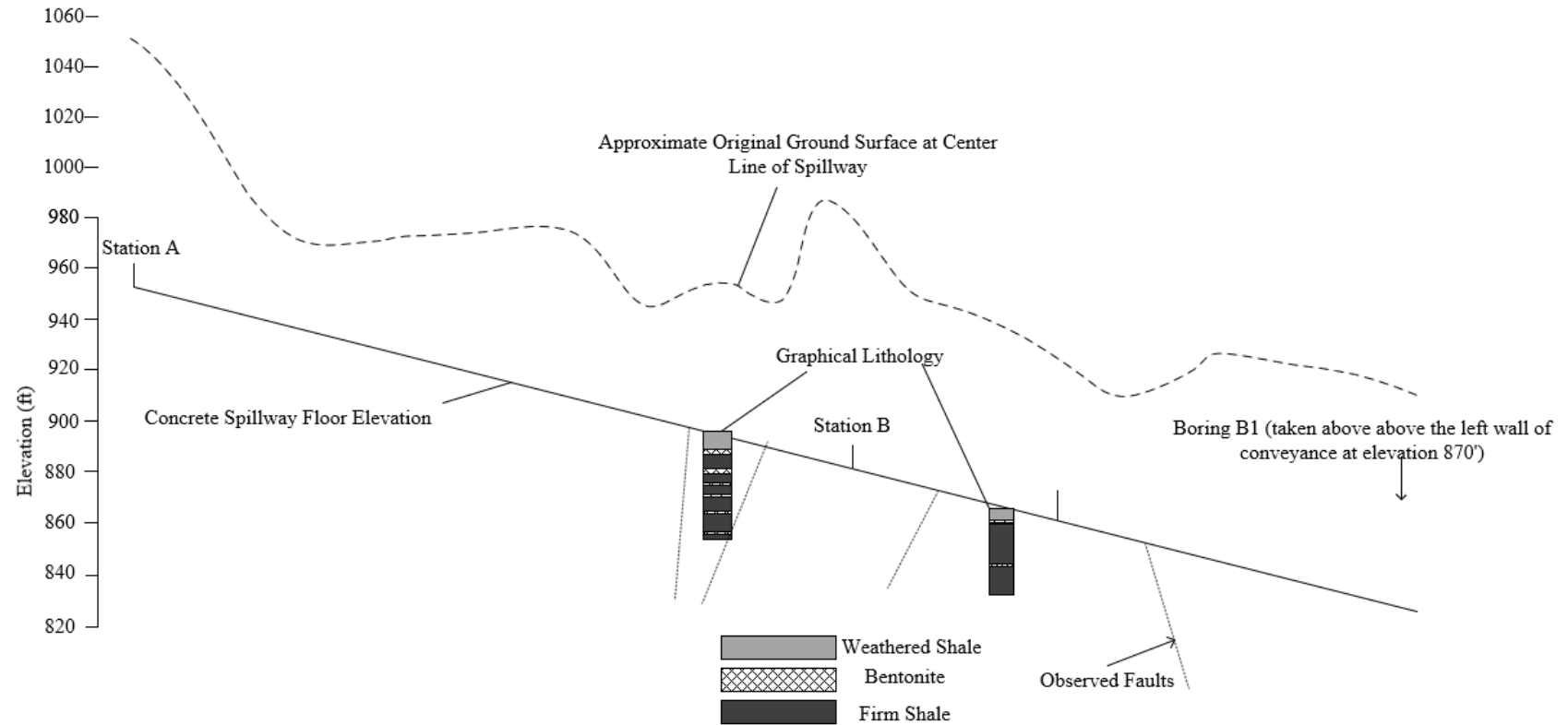


Figure 3 – Profile of spillway structure showing locations of Stations A and B. Note that provided boring B1 is shown at its elevation of 870'

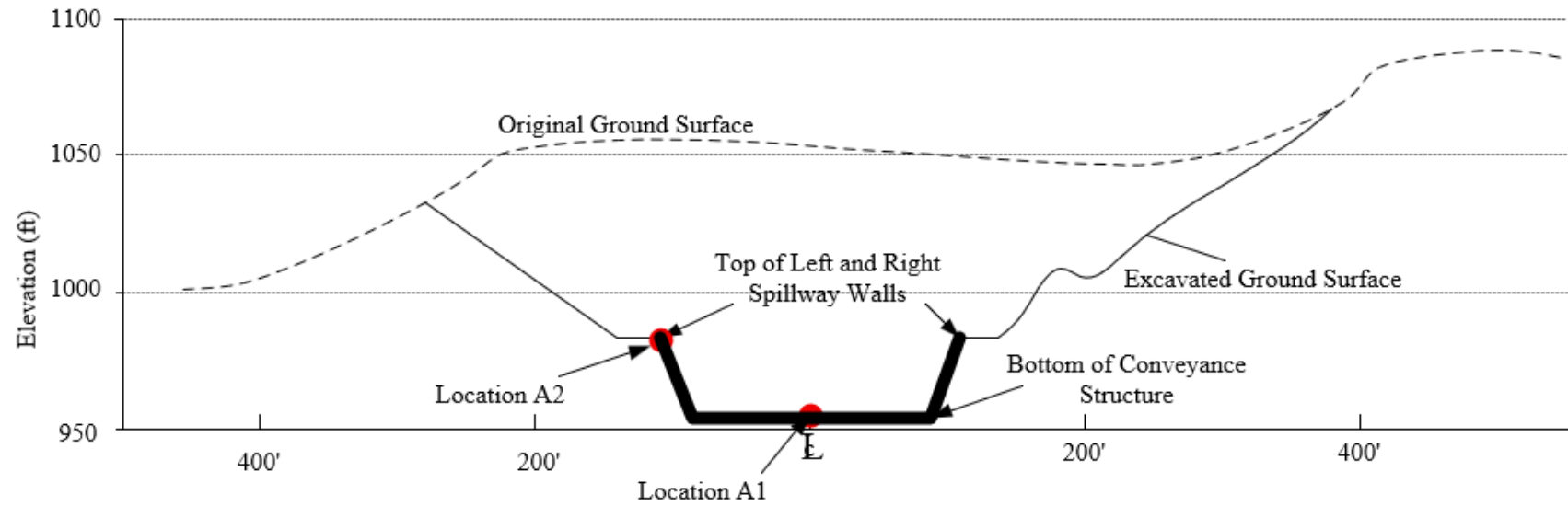


Figure 4 – Cross section at Station A

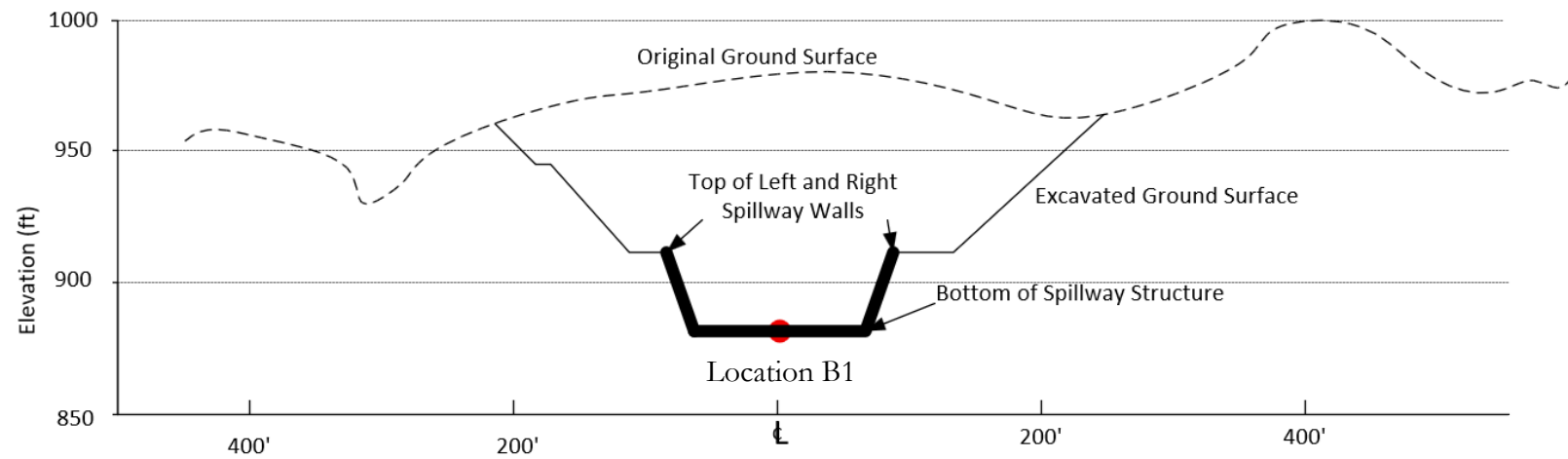
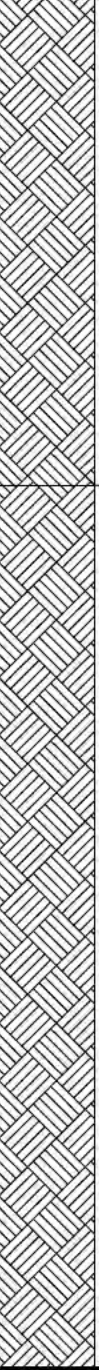


Figure 5 – Cross section at Station B

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 5 SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL) NAD 83 (horiz) NAVD 88 (vert)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number)				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED N/A	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES		15	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER		SEE REMARKS AT END OF LOG	
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE		870	
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING		100 %	
				19. ENGINEER			
ELEVATION	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
	0.3		Bituminous asphalt pavement (3")	5	RUN 1	RUN 1 = 5 min	
	0.6		Aggregate base (4")		0.0		
			Gravel Fill (2'10")		3.2		
	3.2						
			Shale, gray, massive, comprised of subhorizontal layers with occasional bentonite seams, moderately weathered to fresh, extremely soft to soft	0	RUN 2	RUN 2 = 5 min	
			Pyrite noted from 5.2'-10.2'.		3.2	Gravel from above fell into borehole. HWT casing installed to 10.2'.	
				160	RUN 3	RUN 3 = 14 min	
	6.8		Bentonite seam @ 6.7'-6.8'		5.2		
					10.2		
	9.0		80 deg fracture noted @ 8.7'-9.0'				
	9.4		Shell fragments from 9.1'-9.4'				
	10.0		70 deg fracture noted @ 9.4'-10.0'				
				167	RUN 4	RUN 4 = 16 min	
	11.1		Shell fragments @ 11.1'		10.2		
					15.2		
	15.0		Driller notes soft zone @ 14.7'-15'.				
	15.4		Bentonite seam @ 15.2'-15.4' with 40 deg angle noted	167	RUN 5	RUN 5 = 15 min	
					15.2		
					20.2		
				157	RUN 6	RUN 6 = 19 min	
					20.2		
					25.2		
				107	RUN 7	RUN 7 = 22 min	
					25.2	Upper 25.2'-27.1' of core highly fractured due to redrill.	
					29.7		
PROJECT				HOLE NO.			

DRILLING LOG (Cont Sheet)			ELEVATION TOP OF HOLE				
PROJECT		INSTALLATION			SHEET 2 OF 5 SHEETS		
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
	31.0		Shale, gray, massive, comprised of subhorizontal layers with occasional bentonite seams, moderately weathered to fresh, extremely soft to soft (continued) 60 deg fracture noted @ 30.3'-31.0'	154	RUN 8 29.7 35.0	RUN 8 = 17 min	
				225	RUN 9 35.0 38.7	RUN 9 = 19 min	
				556	RUN 10 38.7 40.2	RUN 10 (Coring time not recorded)	
				167	RUN 11 40.2 45.2	RUN 11 = 25 min	
	44.5 44.6		Bentonite seam @ 43.8'-44.6' Increase in percent sand (hard silty sandstone) from 44.0'-44.5'				
				137	RUN 12 45.2 50.2	RUN 12 = 21 min	
				163	RUN 13 50.2 55.2	RUN 13 = 21 min	
	52.2			Fractures noted at 52.1'-52.2'			
				Fracture noted @ 53.1'	167	RUN 14 55.2 60.2	RUN 14 = 36 min
				Widely spaced with no fractures from 60.2'-75.2'.	167	RUN 15 60.2 65.2	RUN 15 = 23 min
				167	RUN 16 65.2	RUN 16 = 25 min	

PROJECT

HOLE NO.

DRILLING LOG (Cont Sheet)			ELEVATION TOP OF HOLE				
PROJECT			INSTALLATION			SHEET 4 OF 5 SHEETS	
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g	
	103.7		Shale, gray, massive, comprised of subhorizontal layers with occasional bentonite seams, moderately weathered to fresh, extremely soft to soft (continued)			RUN 24 = 28 min	
			Shell fragments @ 103.7'				
	106.7			167	RUN 24 105.2 110.2		
	107.7		Shell fragments @ 106.7'				
			Shell fragments @ 107.7'				
				167	RUN 25 110.2 115.2		
	113.4						RUN 26 = 25 min
	113.9			Healed 70 deg fracture (with white mineralization) noted @ 113'-113.4'			
				Bentonite seam @ 113.4'-113.9'.			
					167		
				167	RUN 27 120.2 125.2		
	123.4		Bentonite seam @ 123.3'-123.4'				
				167	RUN 28 125.2 130.2		
	128.3		Shell fragments @ 128.3'				
				167	RUN 29 130.2 135.2		
	135.6		Shell fragments @ 135.6'	167	RUN 30 135.2 140.2		
	136.9		Shell fragments @ 136.9'				
PROJECT				HOLE NO.			



CORE BOX 1 of 15 (0.0' to 14.5')





Box 3 24.1

25.0

29.7

31

33

36.0 Box 3

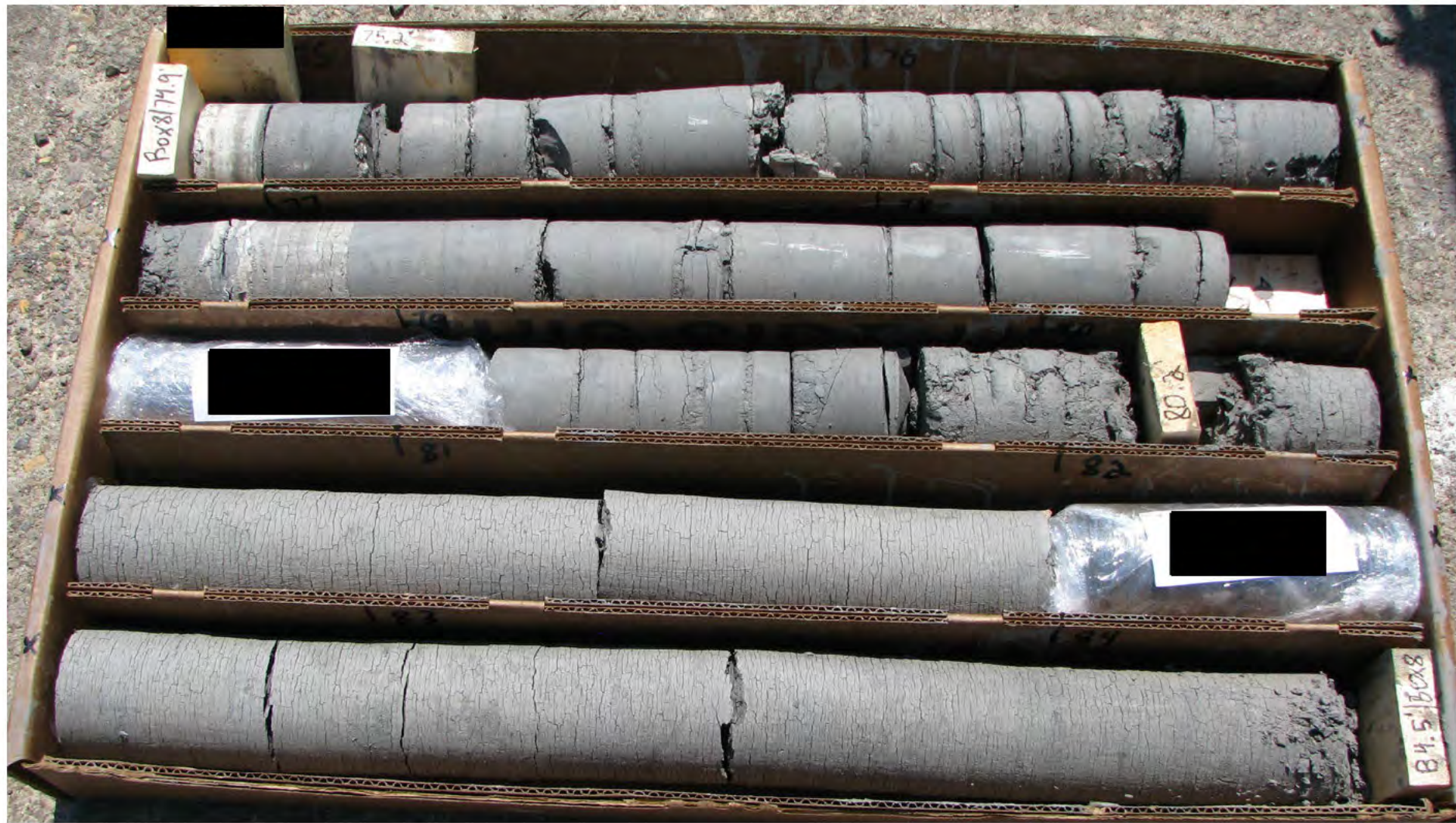
35.0

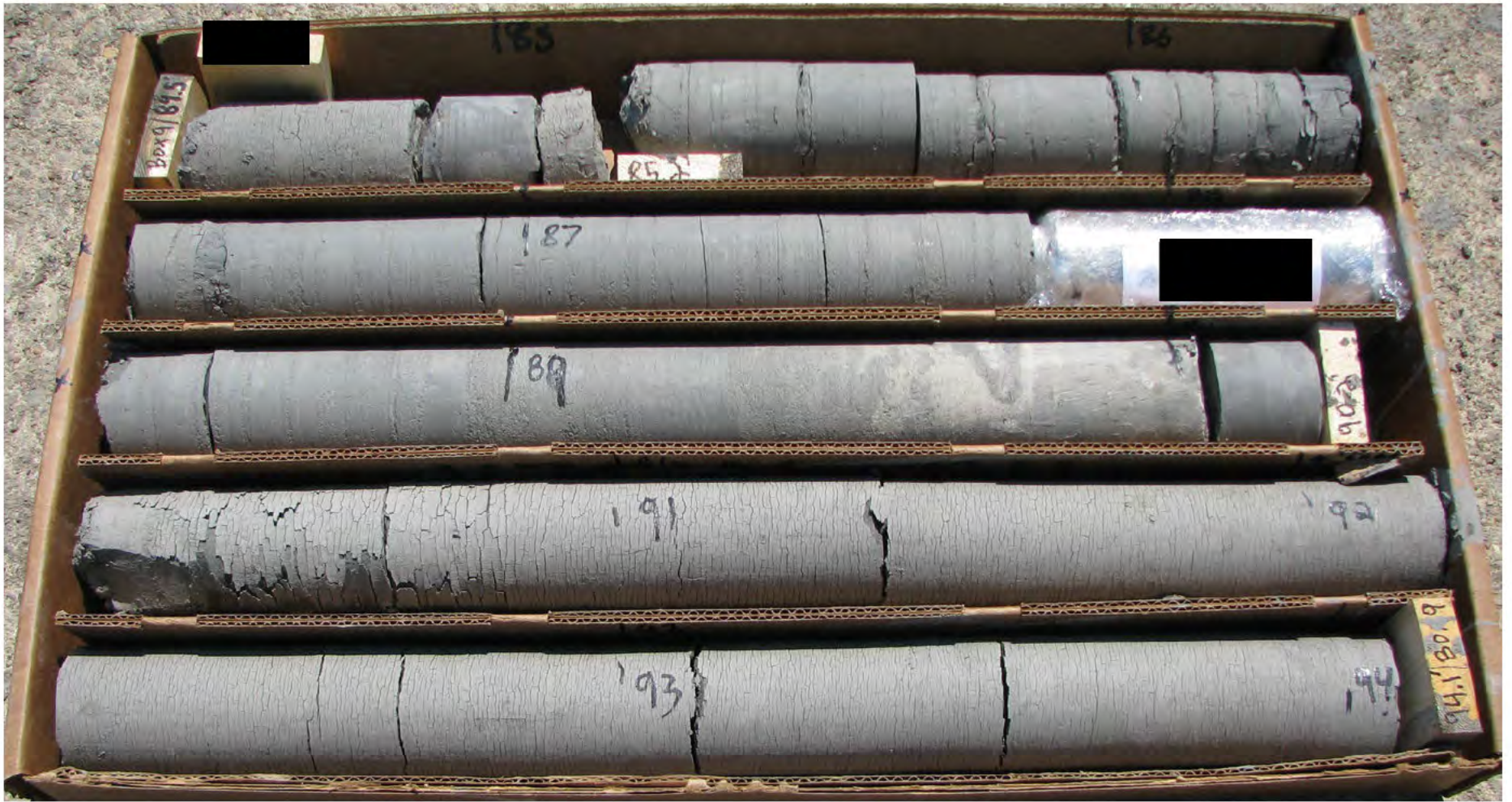








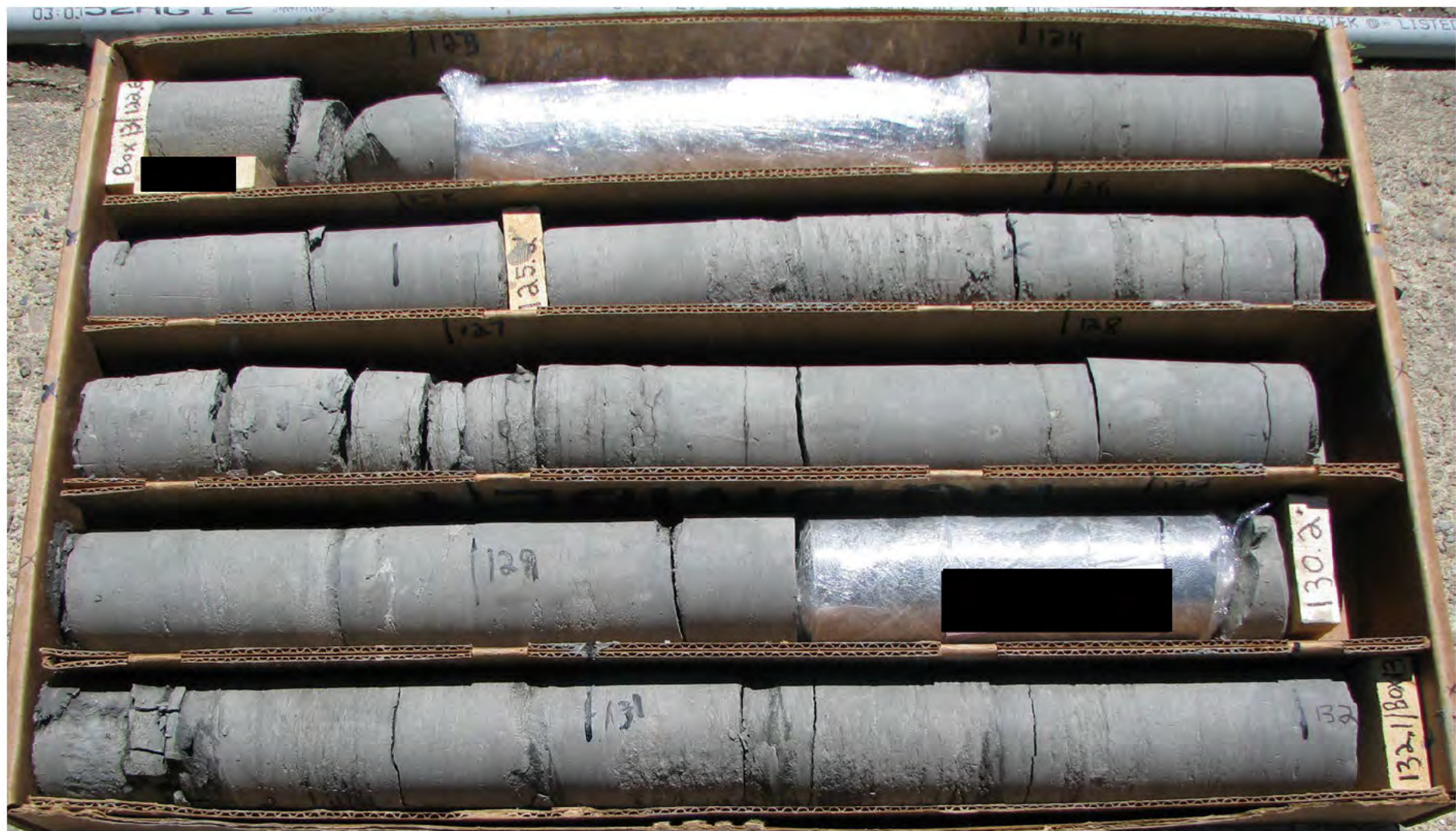




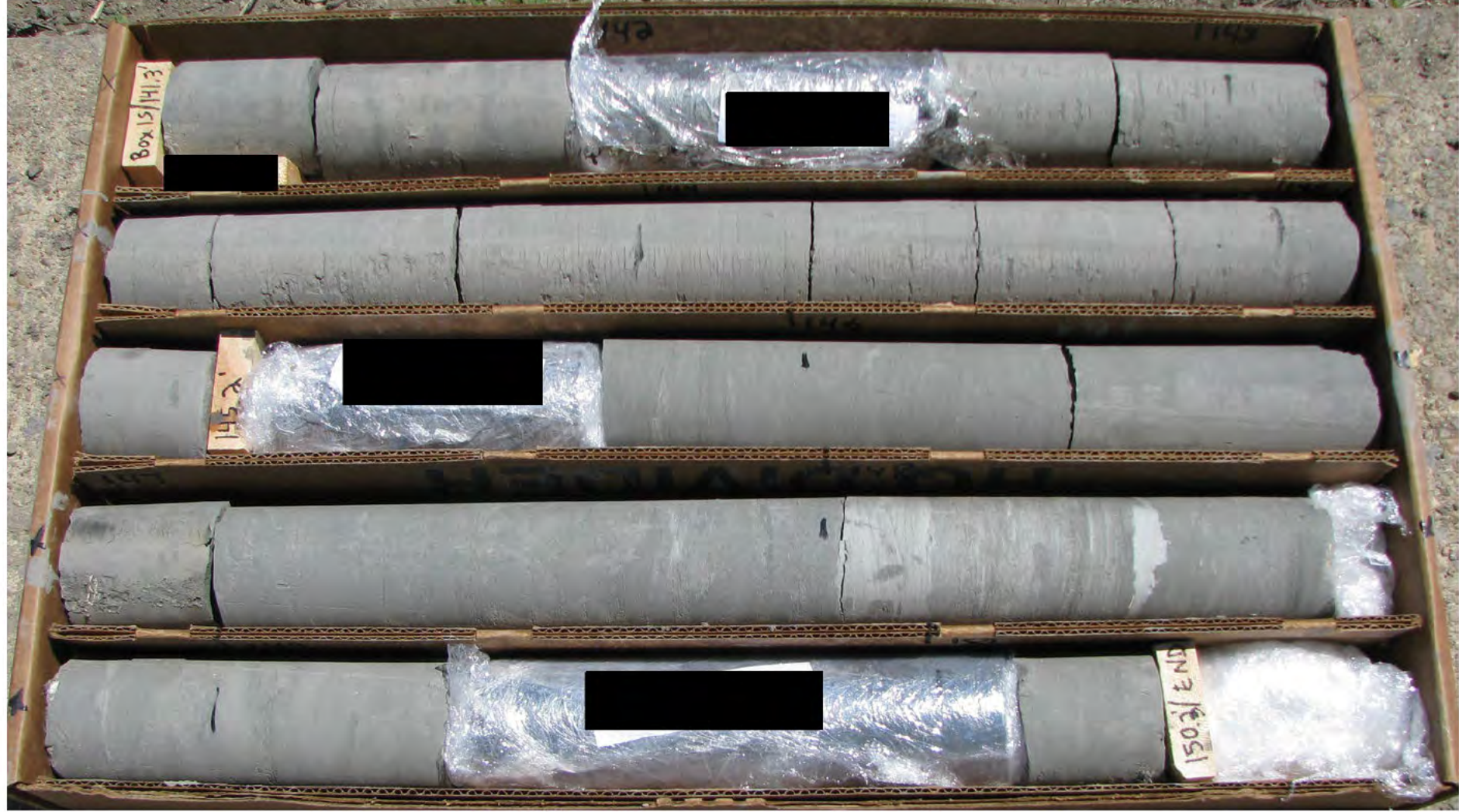












PROJECT NAME:

OPERATOR:

DATE:

PRESSUREMETER TEST RESULTS

BORING NUMBER	DEPTH (ft)	P_o (tsf)	P_f (tsf)	P_l (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P_l	P_l/P_f
B1	22.5-25.0	1.3	¹	-	9079	12523	0.72	-	-
	40.0-42.5	2.2	¹	-	10881	34027	0.32	-	-
	60.5-63.0	2.7	²	-	7121	34757	0.20	-	-
	80.5-83.0	2.7	³	-	20620	No Movement	-	-	-
	99.5-102.0	3.2	³	-	19243	36087	0.53	-	-
	122.0-124.5	5.0	⁴	-	33635	No Movement	-	-	-
	132.5-135.0	6.0	⁴	-	8202	16469	0.50	-	-
	147.5-150.0	6.5	⁵	-	14209	15992	0.89	-	-

¹ Pressurized the test area to 42 tsf and did not reach the P_f .

² Pressurized the test area to 43 tsf and did not reach the P_f .

³ Pressurized the test area to 44 tsf and did not reach the P_f .

⁴ Pressurized the test area to 45 tsf and did not reach the P_f .

⁵ Pressurized the test area to 46 tsf and did not reach the P_f .

**Compressive Strength and Elastic Moduli of Intact Rock Core
Specimens under Varying Stress and Temperatures
ASTM D 7012-07
Method C**

Laboratory Services Group

Project No.: _____
Project Name: _____
Boring No. B1
Depth (ft.): 70.5-71.3
Sample Description: Shale-Gray

Rock Sample Moisture Condition: ☒ As Recovered from core box ☐ See Remarks
☐ Saturated ☐ Oven Dry

TOLERANCE CHECK

End Flatness: Max. Amplitude	1) <u>0.0003</u>	2) <u>0.0003</u>	3) <u>0.0002</u>	in.	<0.0010	<u>Yes</u>
Squarness: >0.01 in. gap at 2 in?	<u>No</u>		If Yes, 0.01 in. at _____ in.			
Sides: Max. Amplitude	1) <u>0.006</u>	2) <u>0.006</u>	3) <u>0.005</u>	in.	< 0.01 in.?	<u>Yes</u>

Angle of Core Axis to Bedding _____ Stress or Strain Rate: 0.03 % / min.

Length (in): 1) 4.639 2) 4.639 4) 4.639 Avg. 4.639 in.

Diameter (in): 1) 2.374 2) 2.374 3) 2.374 Avg. 2.374 in.

Uniaxial Compressive Strength: 200 psi Weight: 798.3 grams

L/D: 2.0 Weight: 1.758 lbs.

Load: 848 lbs. **As Tested**
Unit Weight: 148 pcf

YOUNG'S MODULUS

E_t (50% Co) PSI

POISSON'S RATIO

ν_t (50% Co)

REMARKS: _____

Before



After



**Compressive Strength and Elastic Moduli of Intact Rock Core
Specimens under Varying Stress and Temperatures
ASTM D 7012-07
Method C**

Laboratory Services Group

Project No.: _____
Project Name: _____
Boring No. B1
Depth (ft.): 119.3-120.1
Sample Description: Shale-Gray

Rock Sample Moisture Condition: ☒ As Recovered from core box ☐ See Remarks
☐ Saturated ☐ Oven Dry

TOLERANCE CHECK

End Flatness: Max. Amplitude 1) 0.0002 2) 0.0001 3) 0.0001 in. <0.0010 Yes
Squarness: >0.01 in. gap at 2 in? No If Yes, 0.01 in. at _____ in.
Sides: Max. Amplitude 1) 0.004 2) 0.004 3) 0.003 in. < 0.01 in.? Yes

Angle of Core Axis to Bedding _____ Stress or Strain Rate: 0.03 % / min.

Length (in): 1) 4.675 2) 4.675 4) 4.675 Avg. 4.675 in.

Diameter (in): 1) 2.384 2) 2.384 3) 2.384 Avg. 2.384 in.

Uniaxial Compressive Strength: 330 psi Weight: 695 grams

L/D: 2.0 Weight: 1.531 lbs.

Load: 1450 lbs. As Tested
Unit Weight: 127 pcf

YOUNG'S MODULUS

E_t (50% Co) 7.57E+05 PSI

POISSON'S RATIO

ν_t (50% Co) _____

REMARKS: _____

Before



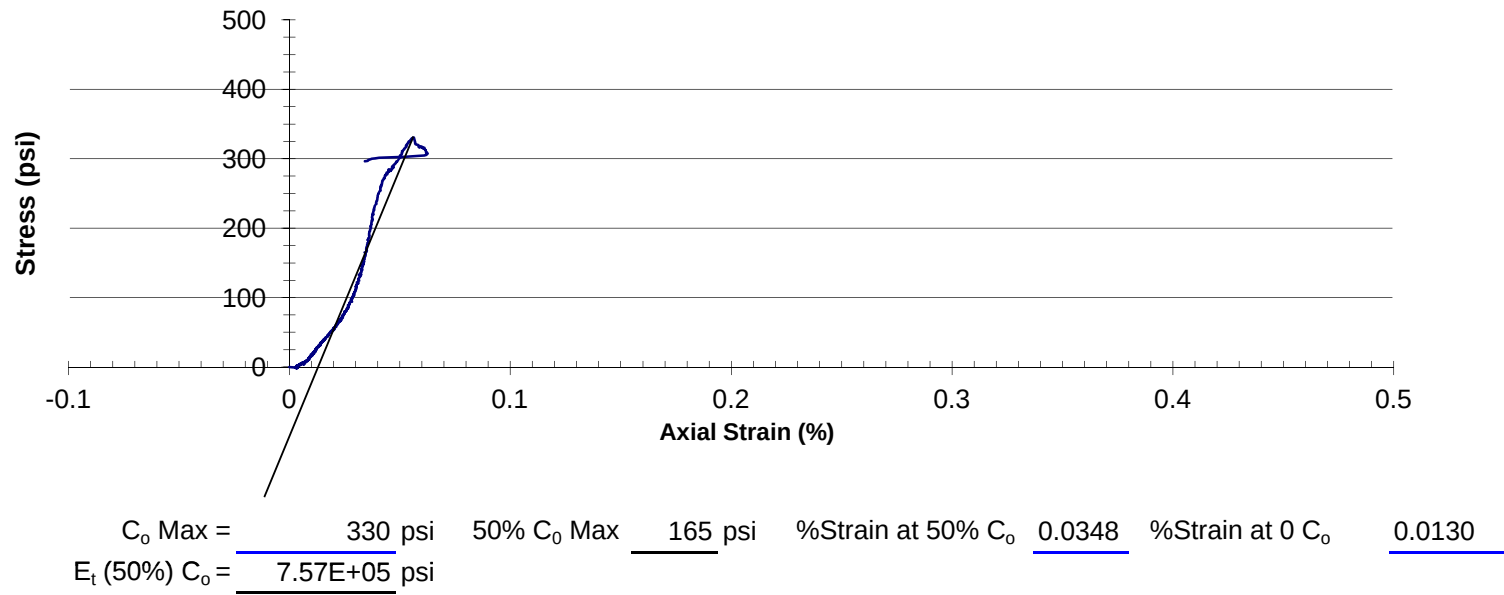
After



Compressive Strength and Elastic Moduli of Intact Rock Core
Specimens under Varying Stress and Temperatures
ASTM D 7012-07
Method D

Project No.:
Project Name:
Boring No. B1
Depth: 119.3-120.1

Stress Vs Axial Strain



**SPLITTING TENSILE STRENGTH OF INTACT ROCK CORE SPECIMENS
(BRAZILIAN DISC TENSILE TEST)
ASTM D 3967**

Project Name: _____
Boring No. B1
Depth: 78.7-78.9
Sample Description: Shale-Gray

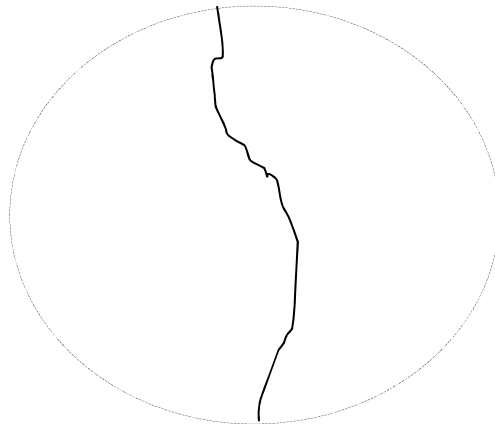
Rock Sample Moisture Condition: ☒ As Recovered from core box ☐ In-Situ
☐ Saturated ☐ Oven Dry

TOLERANCE CHECK

End Flatness: Max. Amplitude	1)	NA	2)	NA	3)	NA	in.;	< 0.01 in.?
Sides: Max. Amplitude	1)	0.002	2)	0.002	3)	0.002	in.	< 0.02 in.?

TEST RESULTS

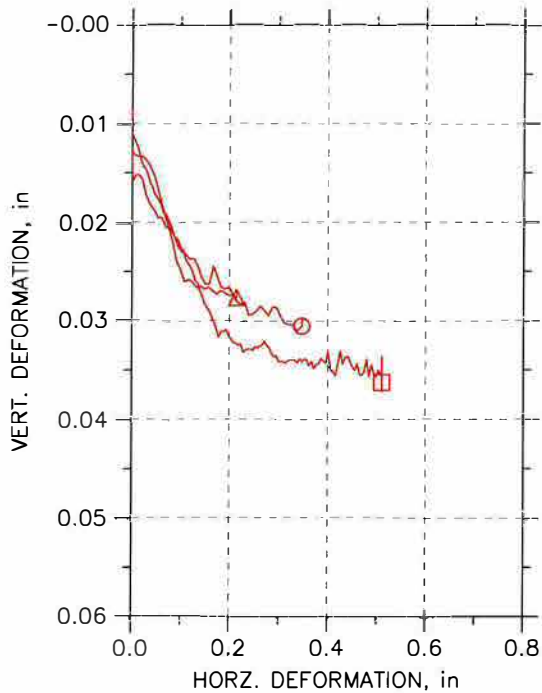
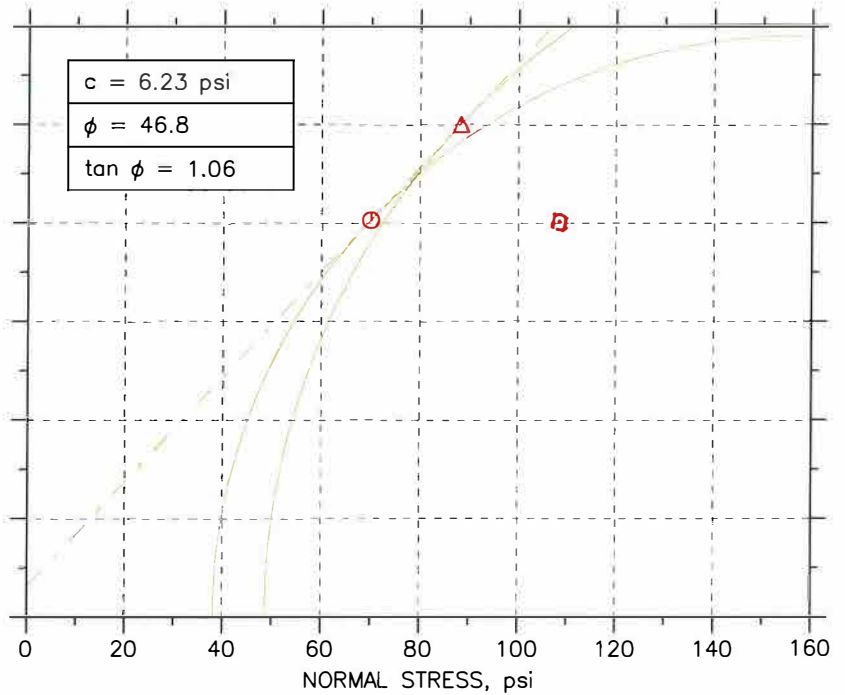
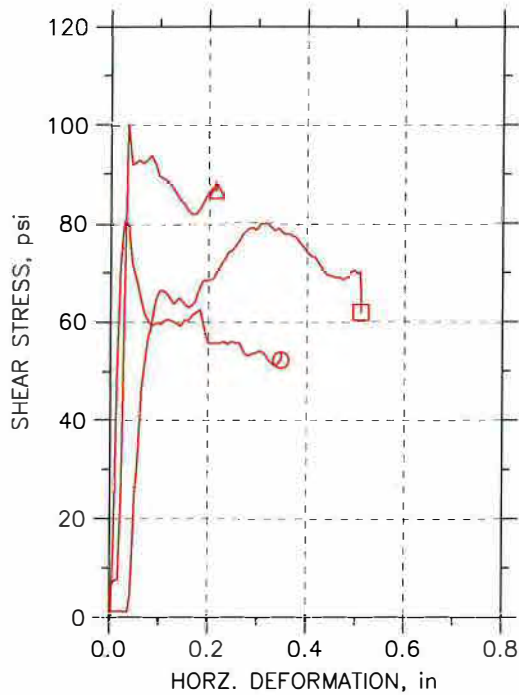
Average Sample Thickness, t	1.04	Inches
Average Sample Diameter, D	2.34	Inches
Angle Core Axis To Bedding		Degrees
Load At Failure, P	326	Lbs.
t/D Between 0.2 to 0.75	0.44	
Tensile Strength	85	PSI



**FAILURE
PATTERN**

REMARKS:

DIRECT SHEAR TEST REPORT

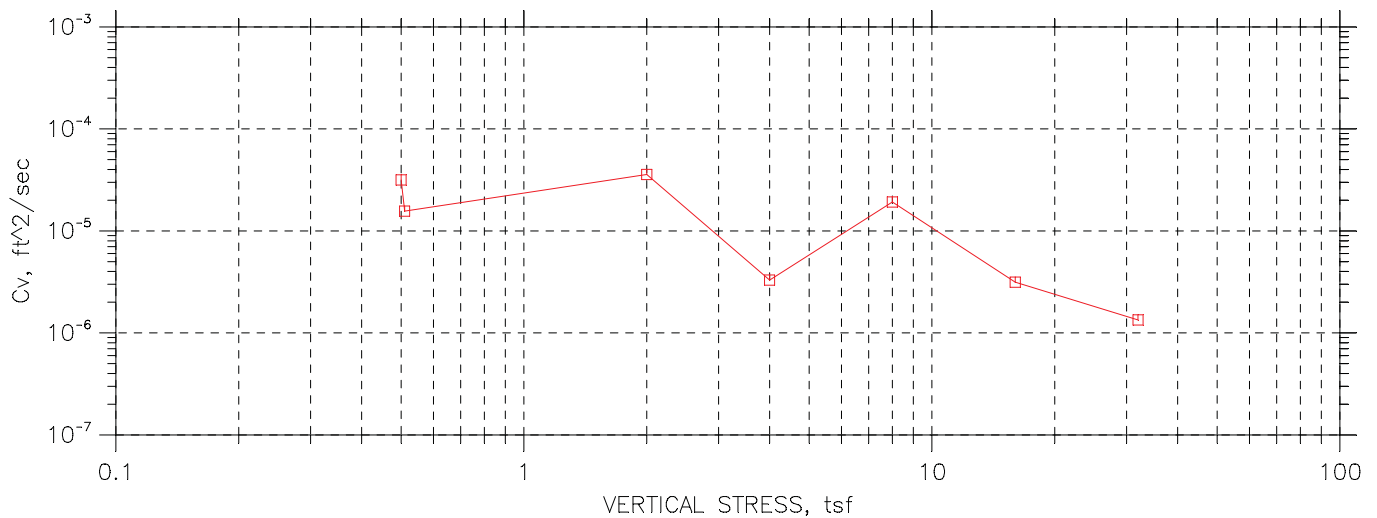
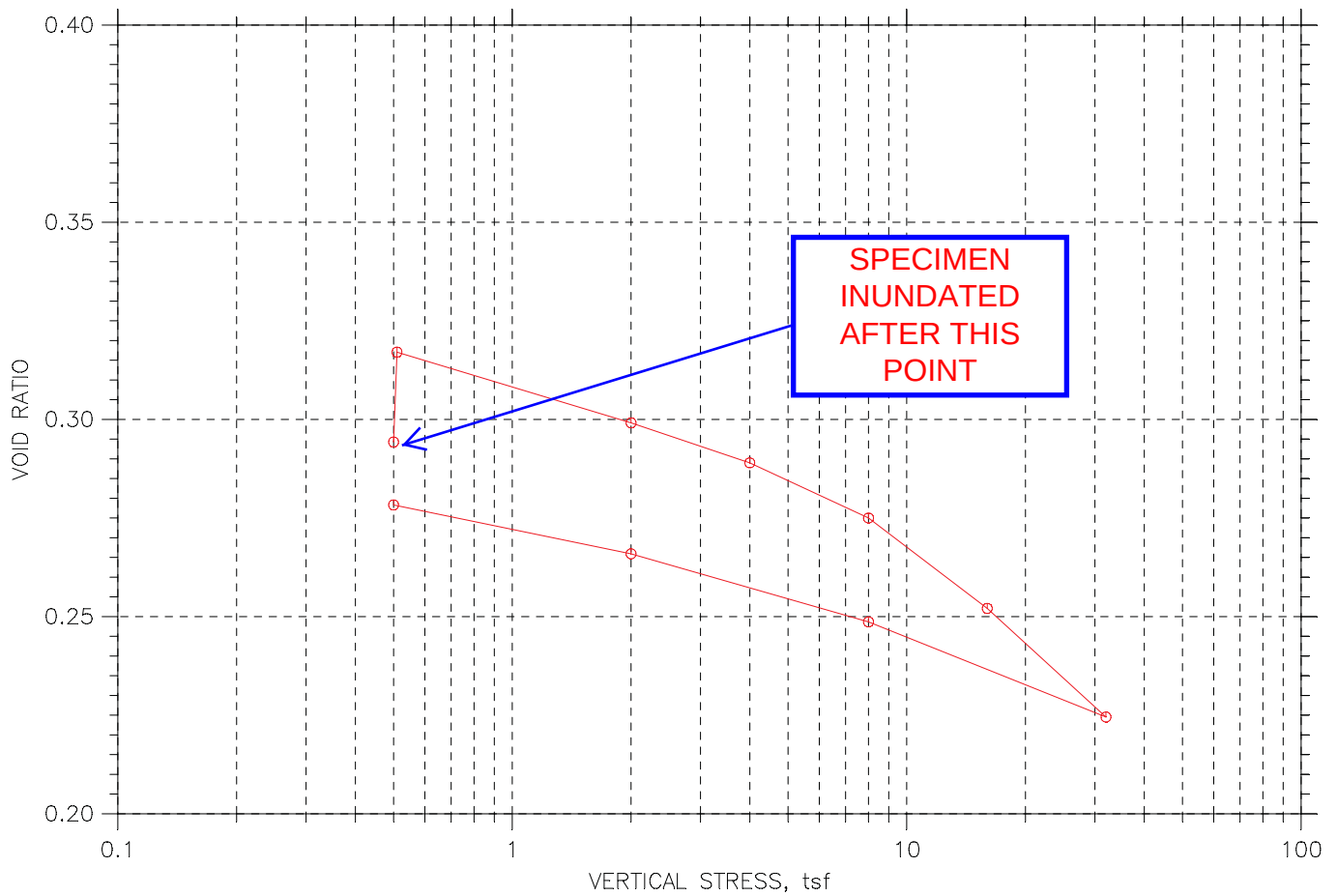


Symbol	○	△	□	
Test No.	70 PSI	90 PSI	110 PSI	
Sample No.				
Shape	Circular	Circular	Circular	
Initial	Dimension, in	1.78	1.79	1.7919
	Area, in ²	2.4885	2.5165	2.5217
	Height, in	1	1.0106	1.0078
	Water Content, %	30.69	29.69	30.91
	Dry Density, pcf	93.12	91.76	93.02
	Saturation, %	100.06	93.76	100.52
	Void Ratio	0.84352	0.87085	0.84562
	Consol. Height, in	0.98512	0.99796	0.99912
	Consol. Void Ratio	0.8161	0.84739	0.82981
Final	Water Content, %	32.34	31.58	30.91
	Dry Density, pcf	96.06	94.35	96.49
	Saturation, %	112.97	105.97	109.10
	Void Ratio	0.78717	0.81966	0.77915
	Normal Stress, psi	69.999	88.246	109.77
	Max. Shear Stress, psi	80.675	100.08	79.947
	Ult. Shear Stress, psi	52.42	86.835	61.855
	Time to Failure, min	538	538	4138
	Disp. Rate, in/min	0.0024	0.0024	0.0024
	Estimated Specific Gravity	2.75	2.75	2.75
	Liquid Limit	---	---	---
	Plastic Limit	---	---	---
	Plasticity Index	---	---	---

Location:	
Project No.: Boring No. B1	
135.5' - 136.5'	
Description: SOFT SHALE WITH BENTONITE LAYERS - DARK GRAY	
Remarks: TEST PERFORMED AS PER ASTM D3080	

CONSOLIDATION TEST DATA

SUMMARY REPORT



B1 Elevation 137.5'			
	Description: SHALE - DK GRAY SWELL OF 1.76% STRAIN NOTED SUBSEQUENT OF INUNDATION @ .5 TSF		
	TEST PERFORMED AS PER ASTM D2435		

CONSOLIDATION TEST DATA

Depth: 137.5-138.2

Soil Description: SHALE - DK GRAY SWELL OF 1.76% STRAIN NOTED SUBSEQUENT OF INUNDATION @ .5 TSF

Estimated Specific Gravity: 2.78
Initial Void Ratio: 0.33
Final Void Ratio: 0.28

Liquid Limit: ---
Plastic Limit: ---
Plasticity Index: ---

Initial Height: 0.75 in
Specimen Diameter: 1.97 in

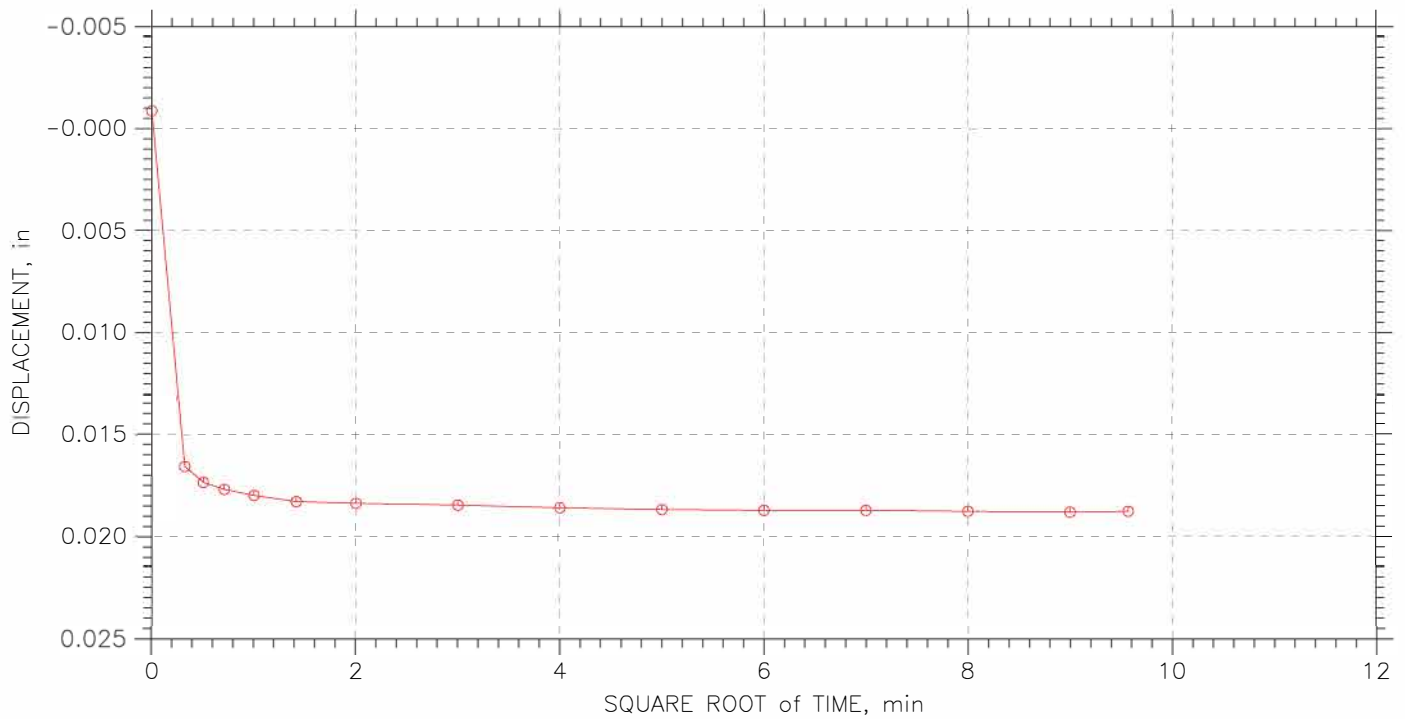
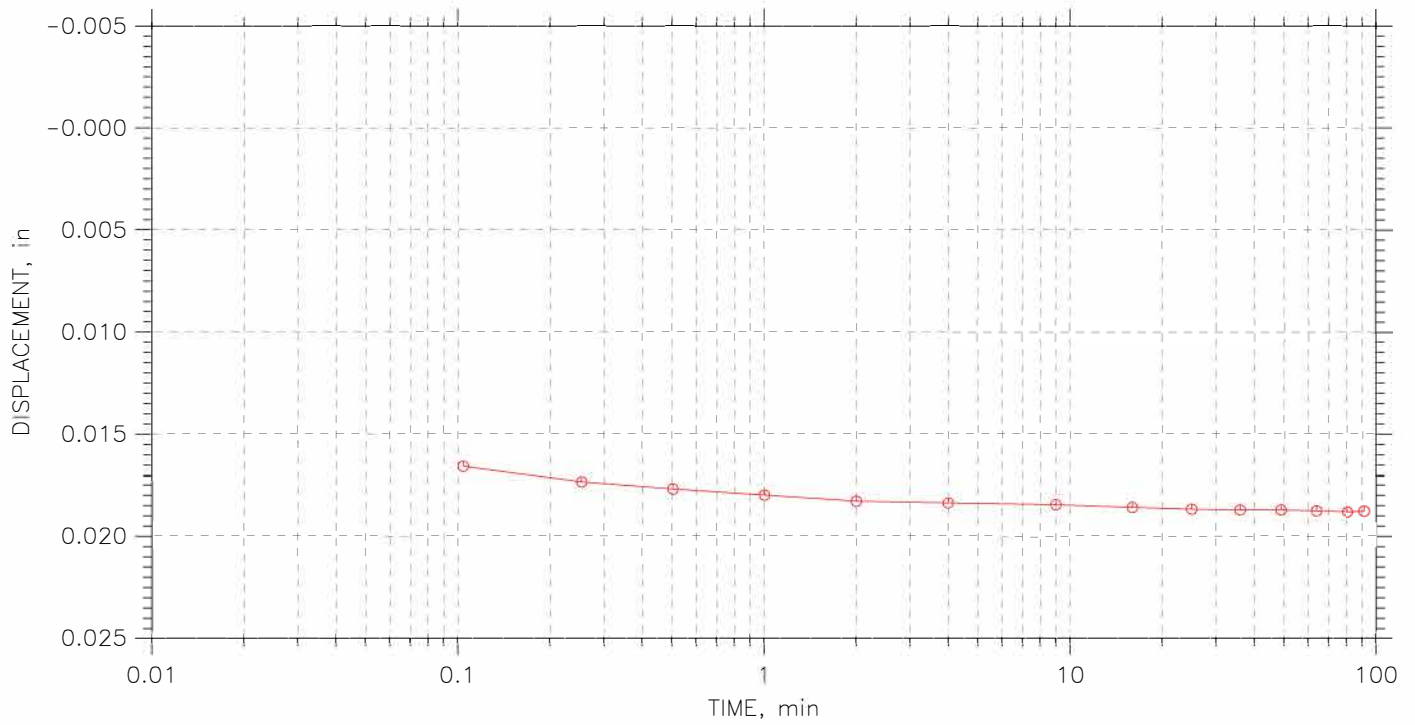
	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	B-15	RING	RING	X-9
Wt. Container + Wet Soil, gm	98.79	145.36	147.01	129.93
Wt. Container + Dry Soil, gm	94.84	139.21	139.21	122.25
Wt. Container, gm	49.41	60.34	60.34	44.61
Wt. Dry Soil, gm	45.43	78.868	78.868	77.64
Water Content, %	8.69	7.80	9.89	9.89
Void Ratio	---	0.33	0.28	---
Degree of Saturation, %	---	66.24	98.80	---
Dry Unit Weight, pcf	---	130.75	135.76	---

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 10

Stress: 0.5 tsf

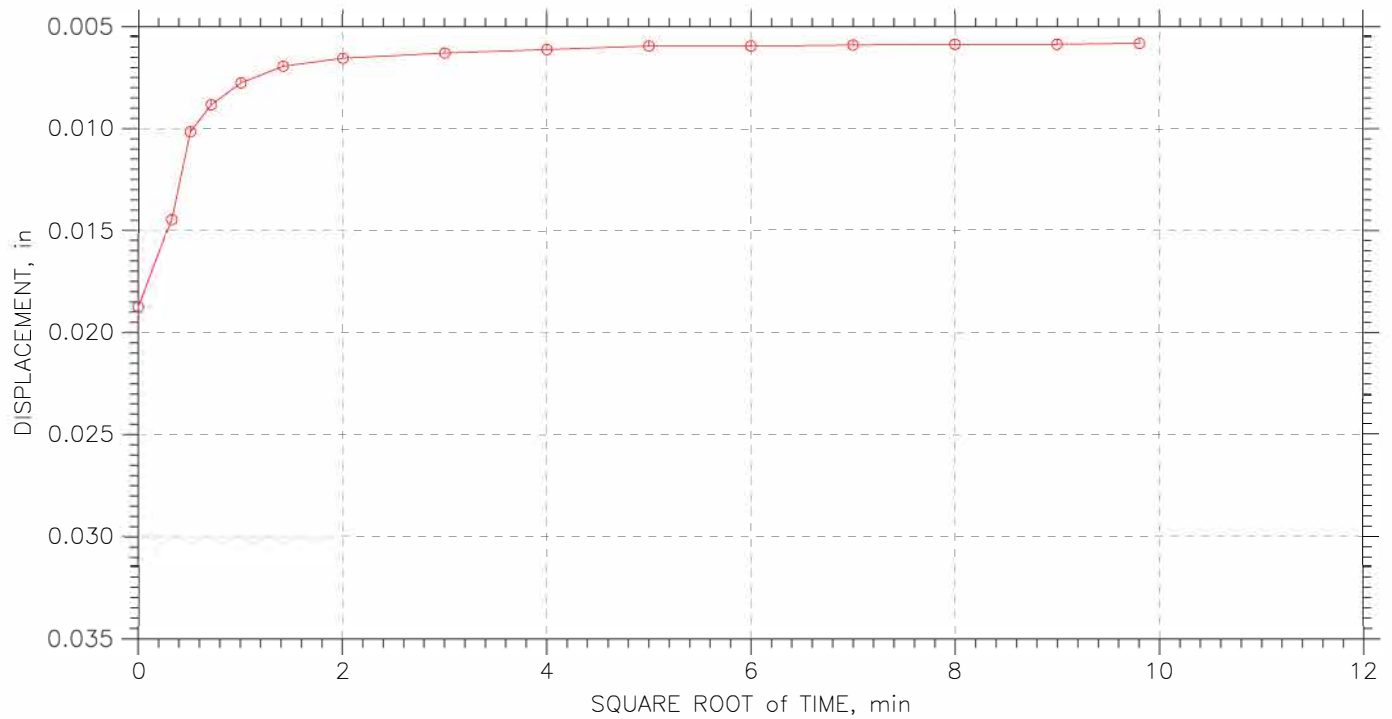
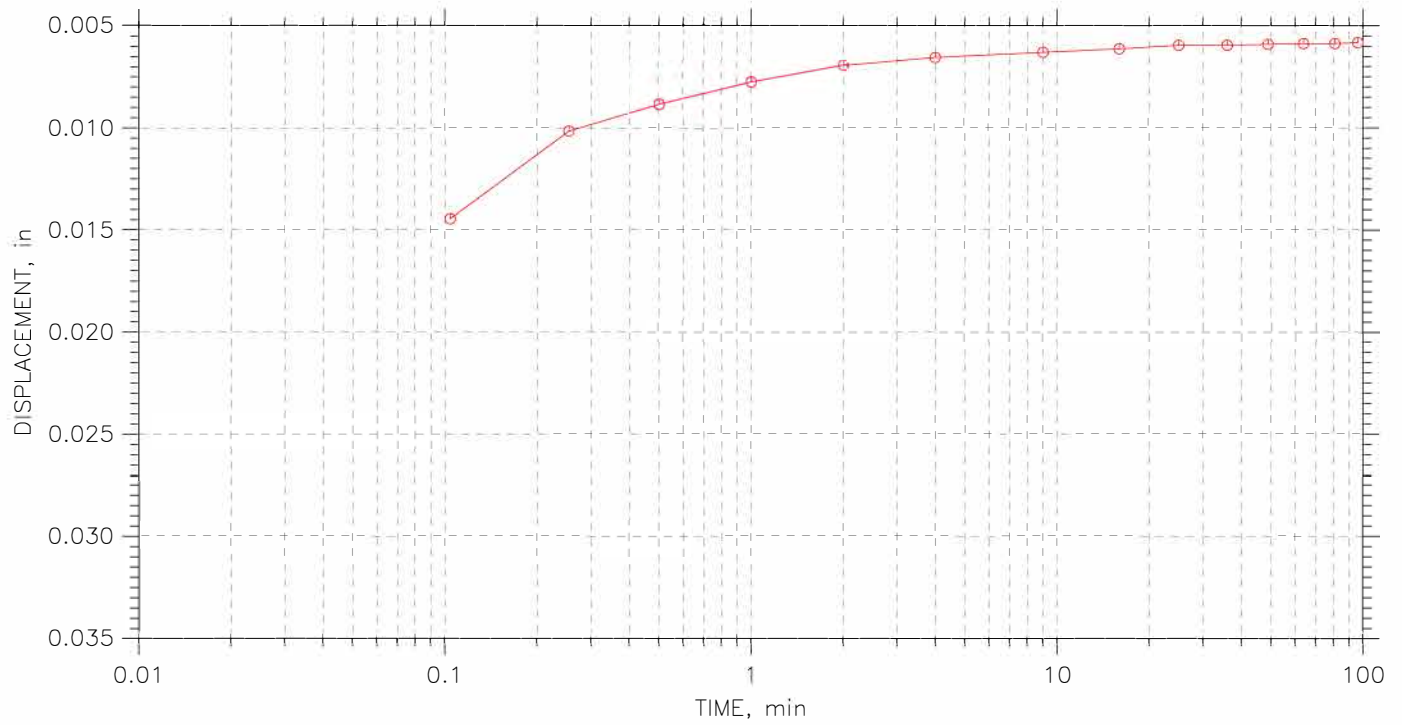


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 10

Stress: 0.51 tsf

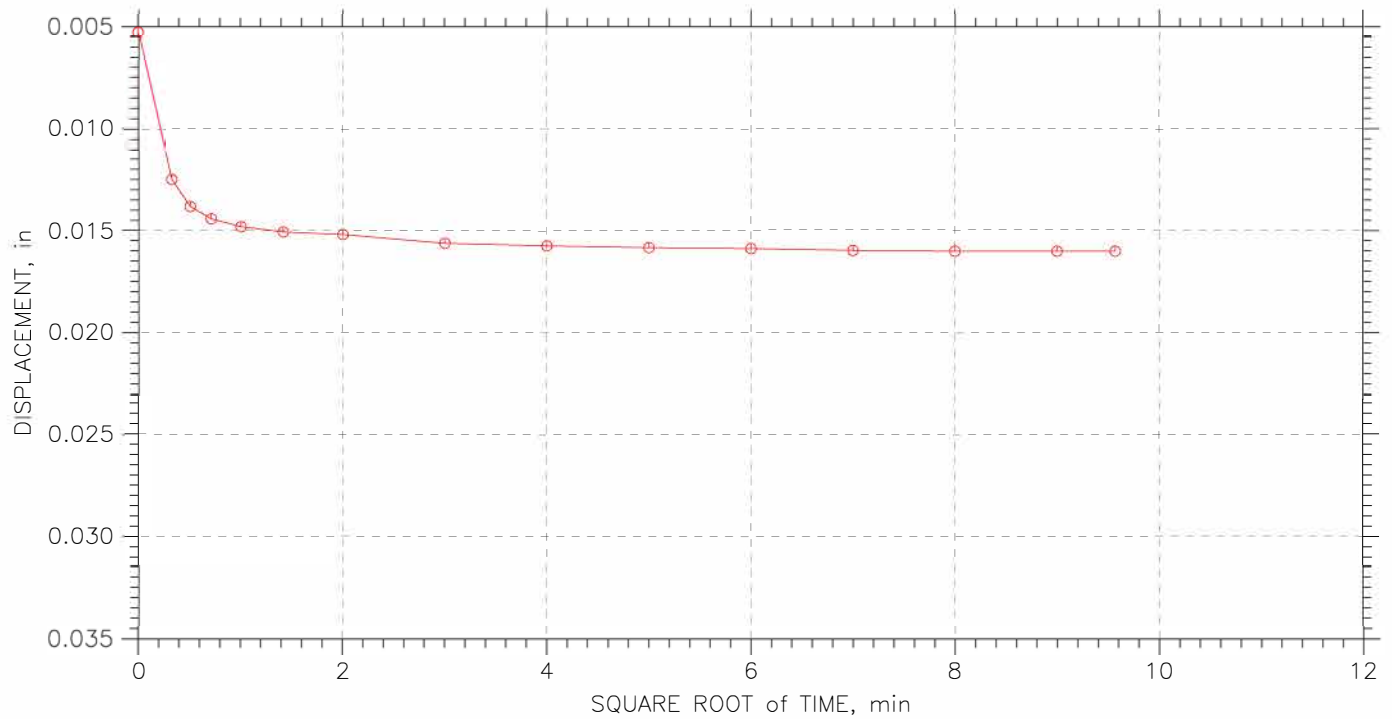
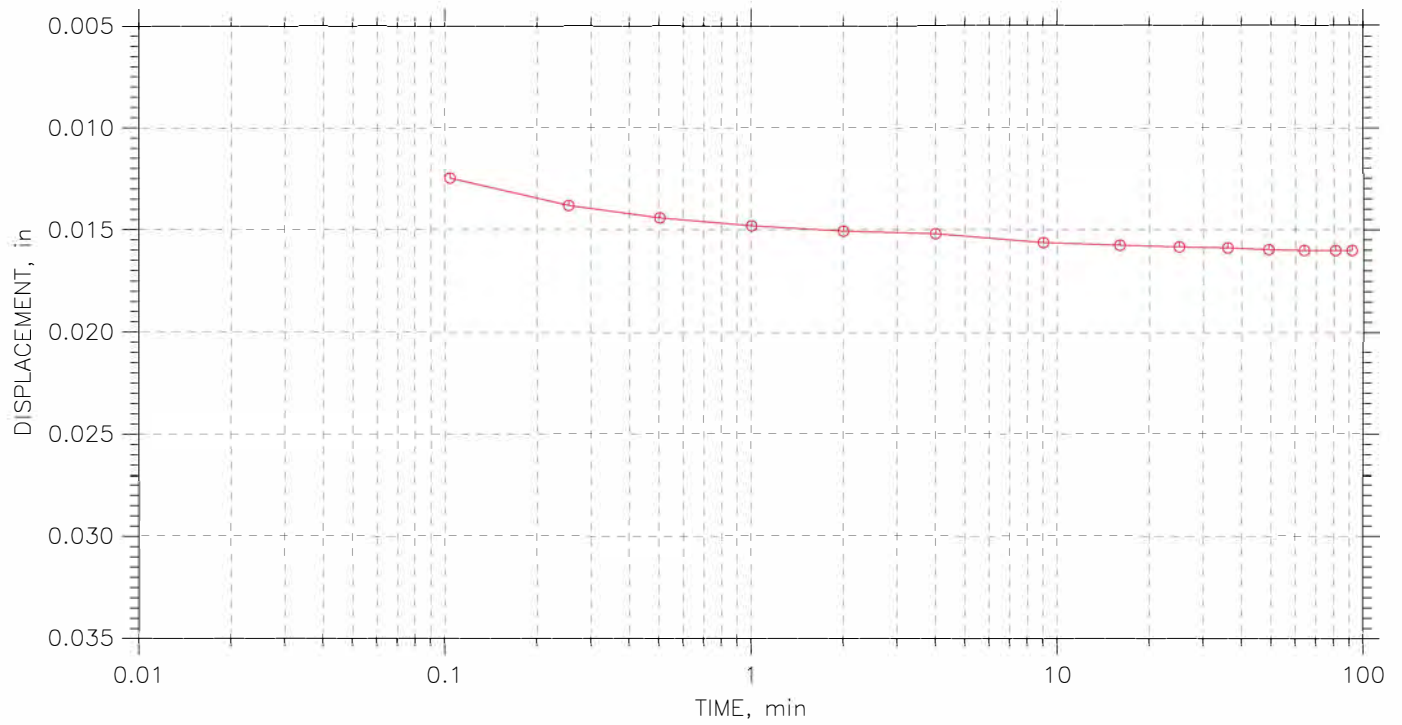


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 10

Stress: 2. tsf

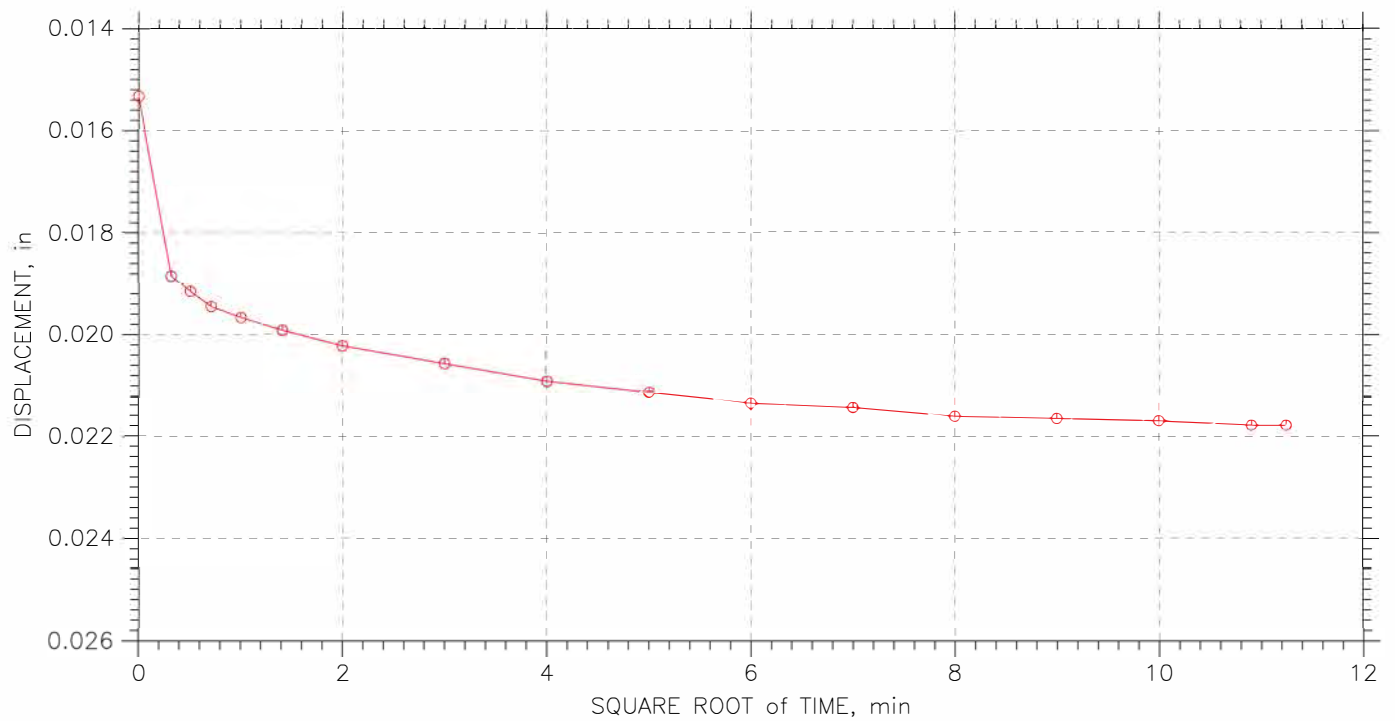
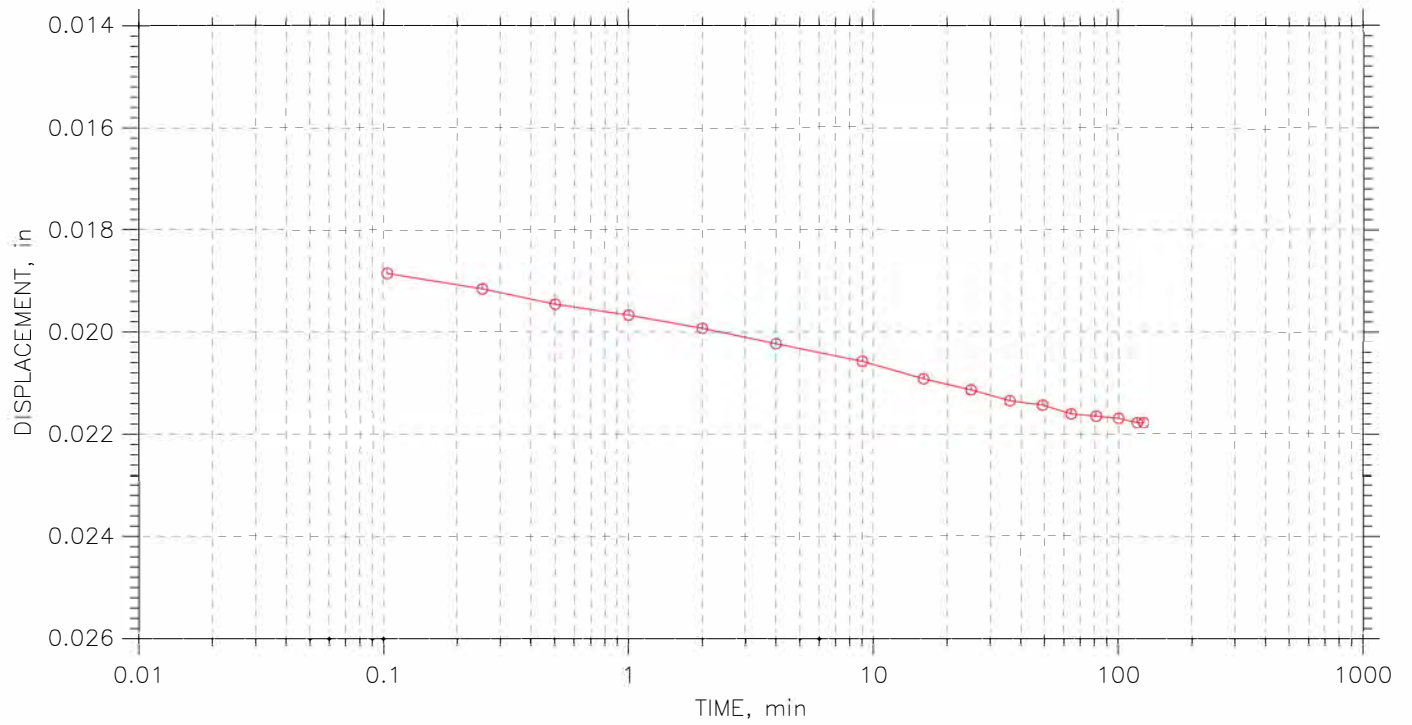


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 10

Stress: 4. tsf

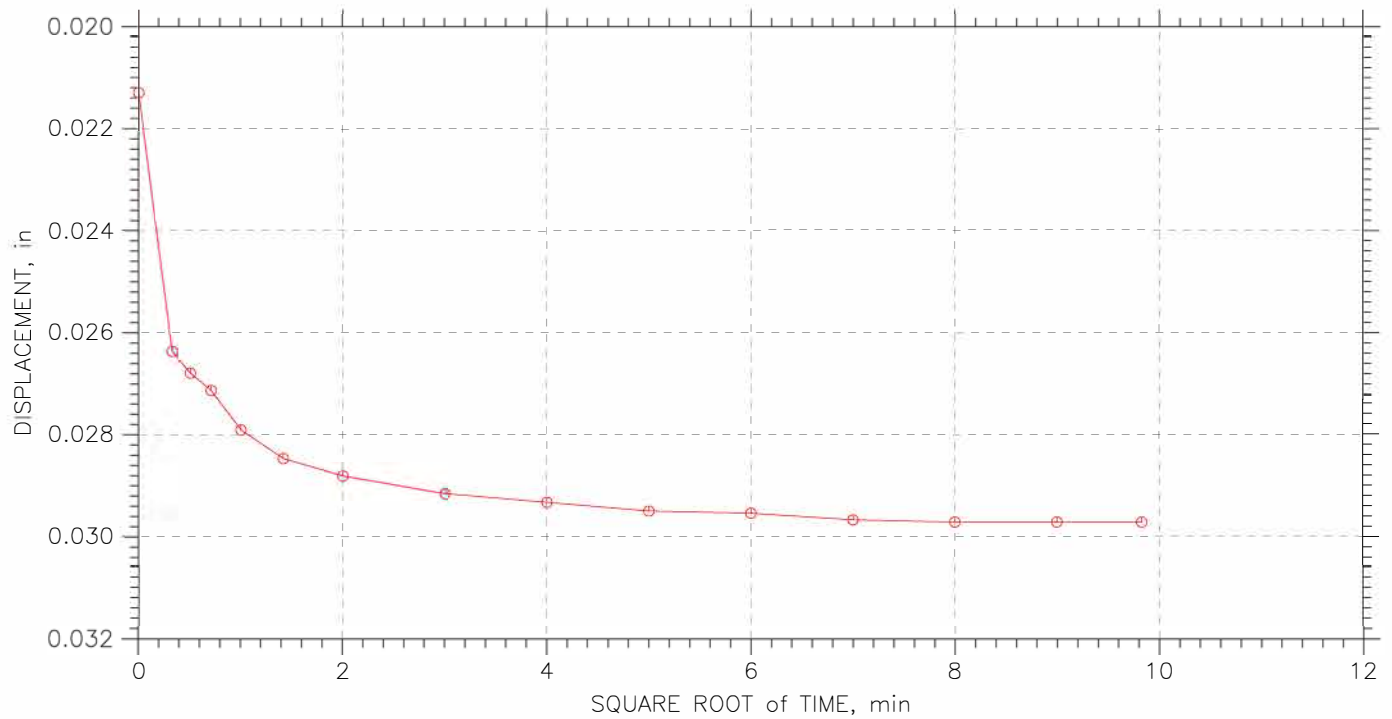
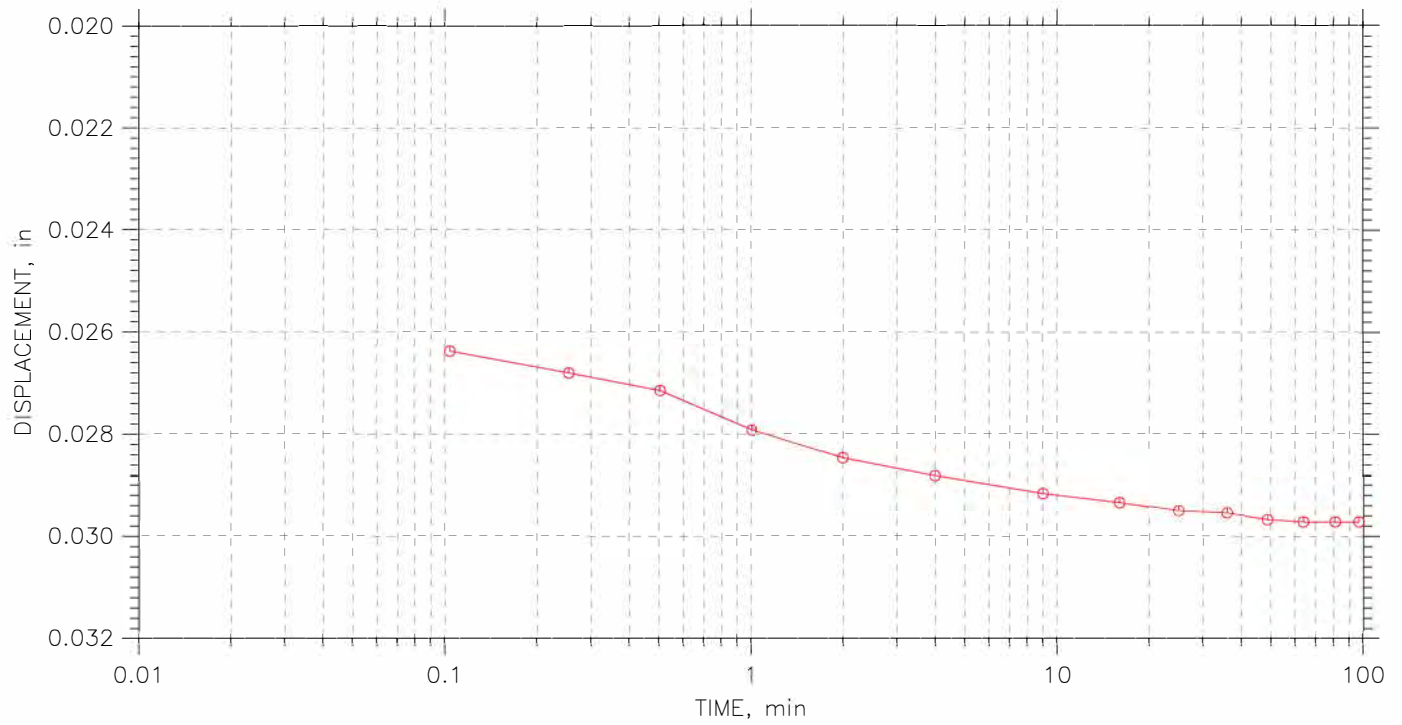


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 10

Stress: 8. tsf

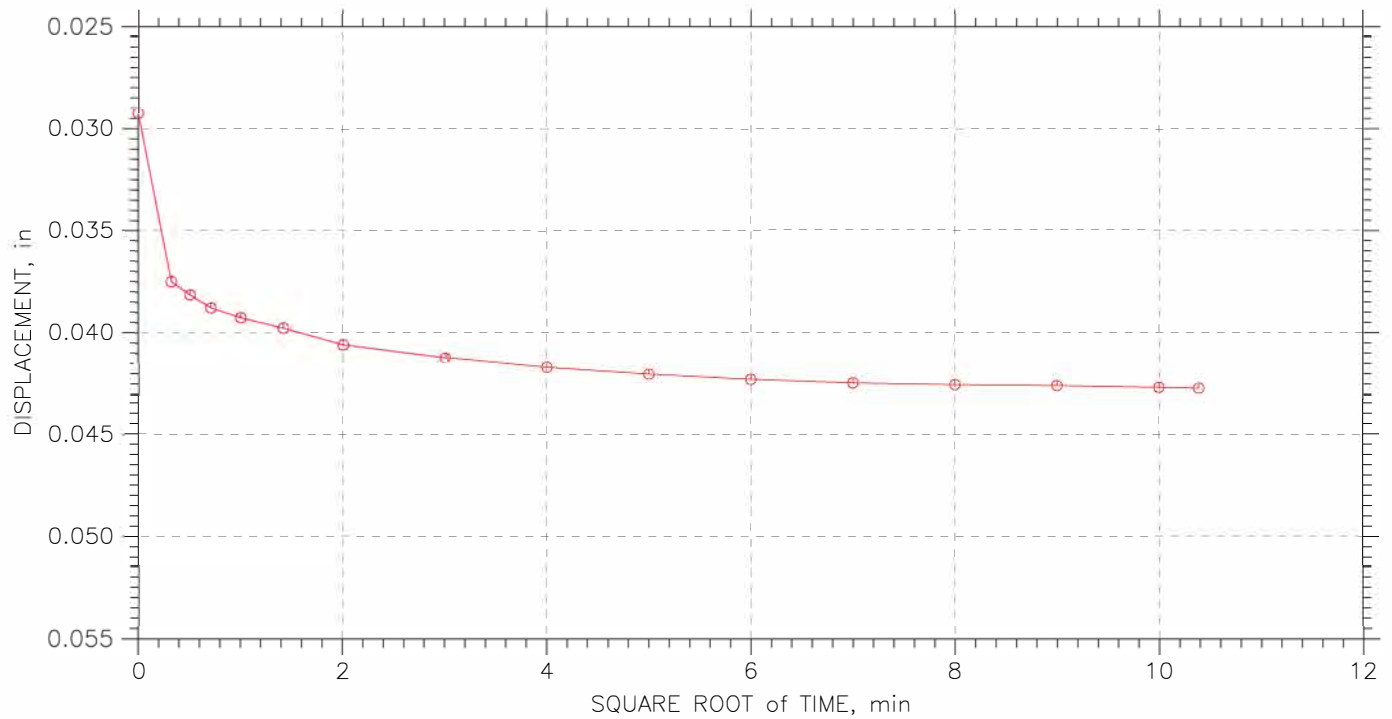
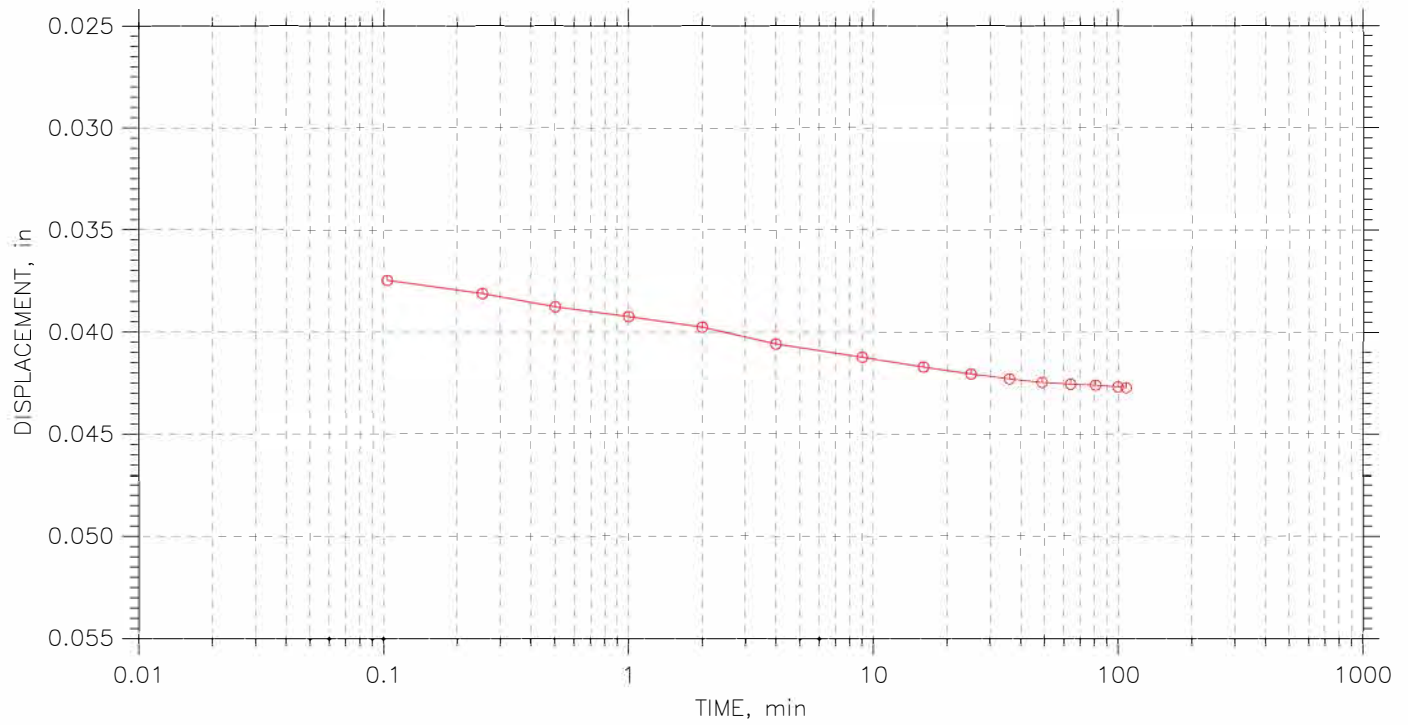


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 10

Stress: 16. tsf

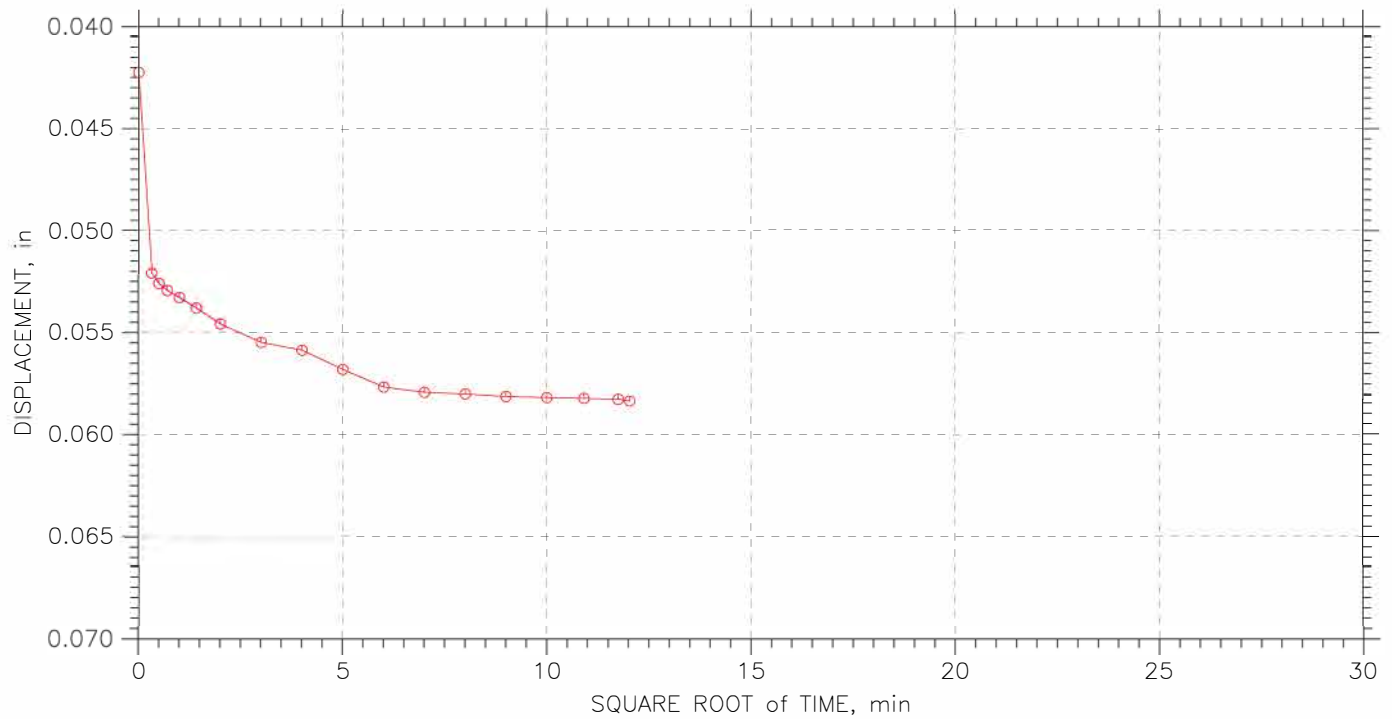
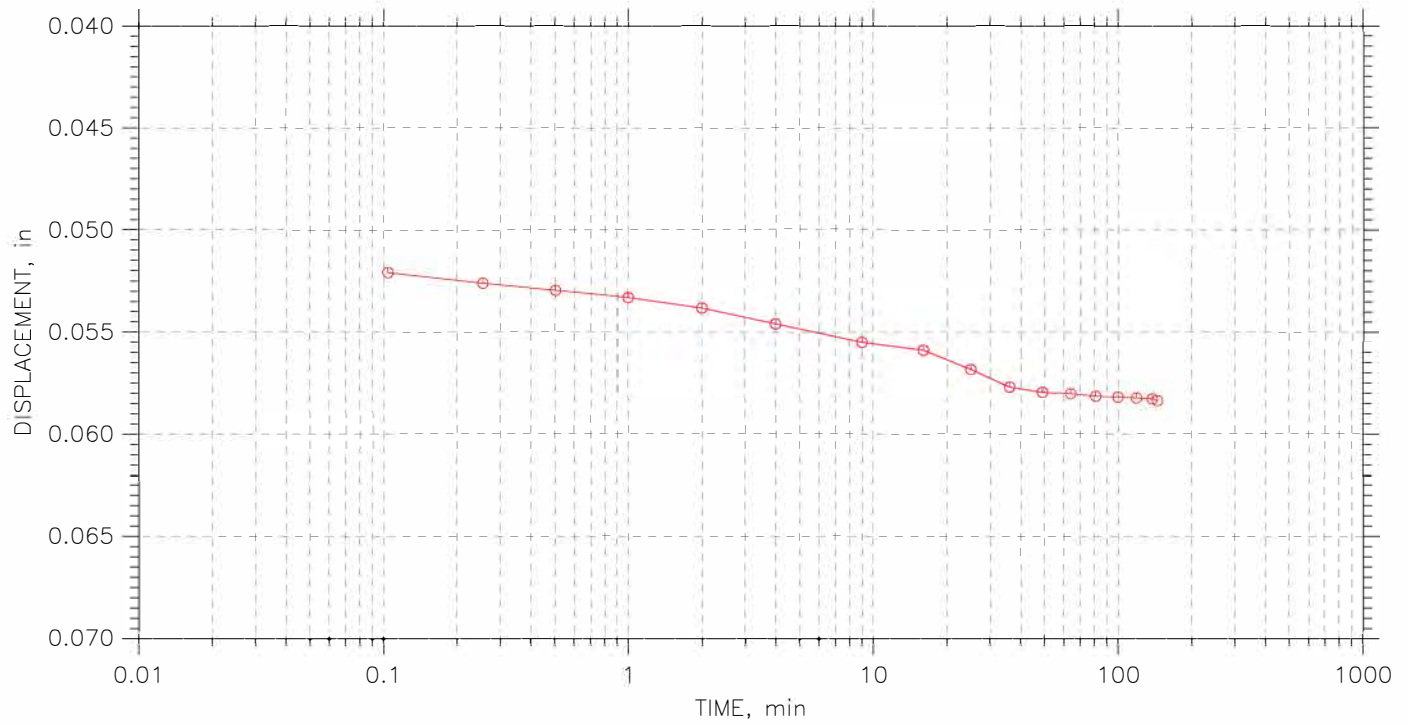


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 10

Stress: 32. tsf

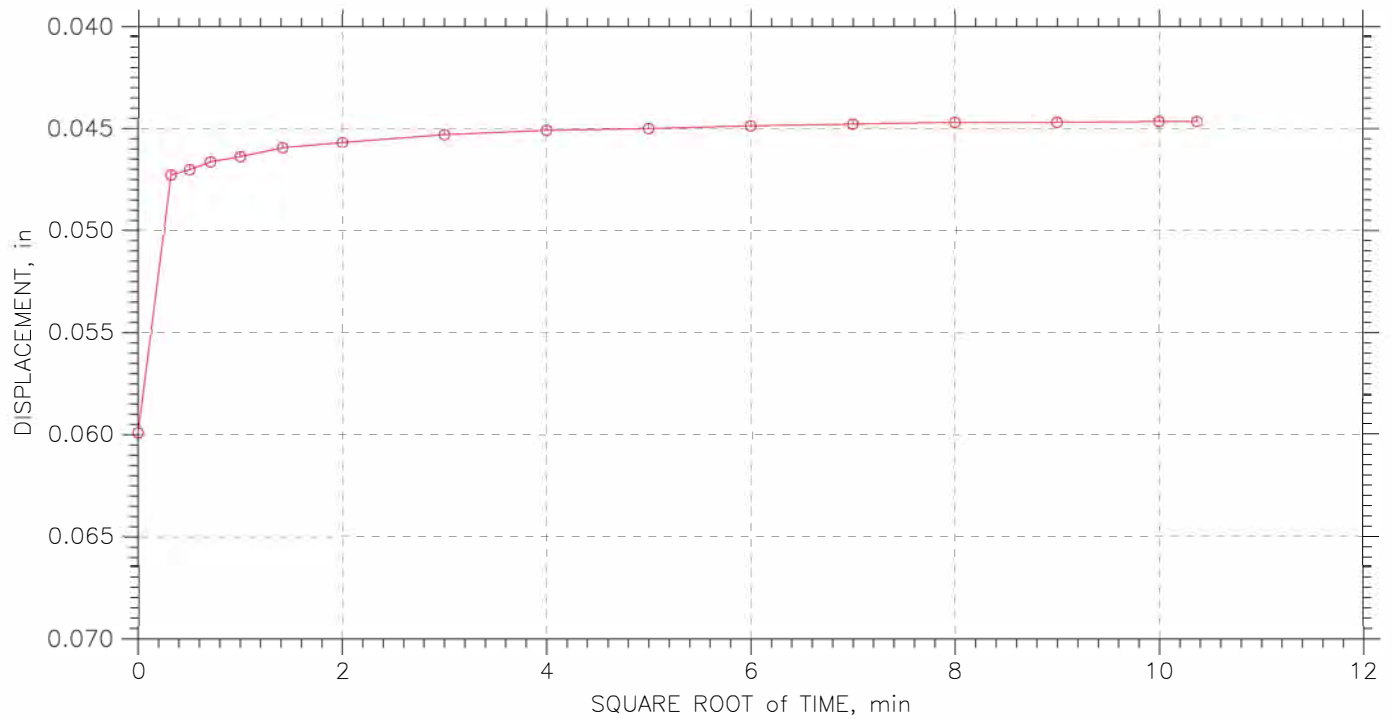
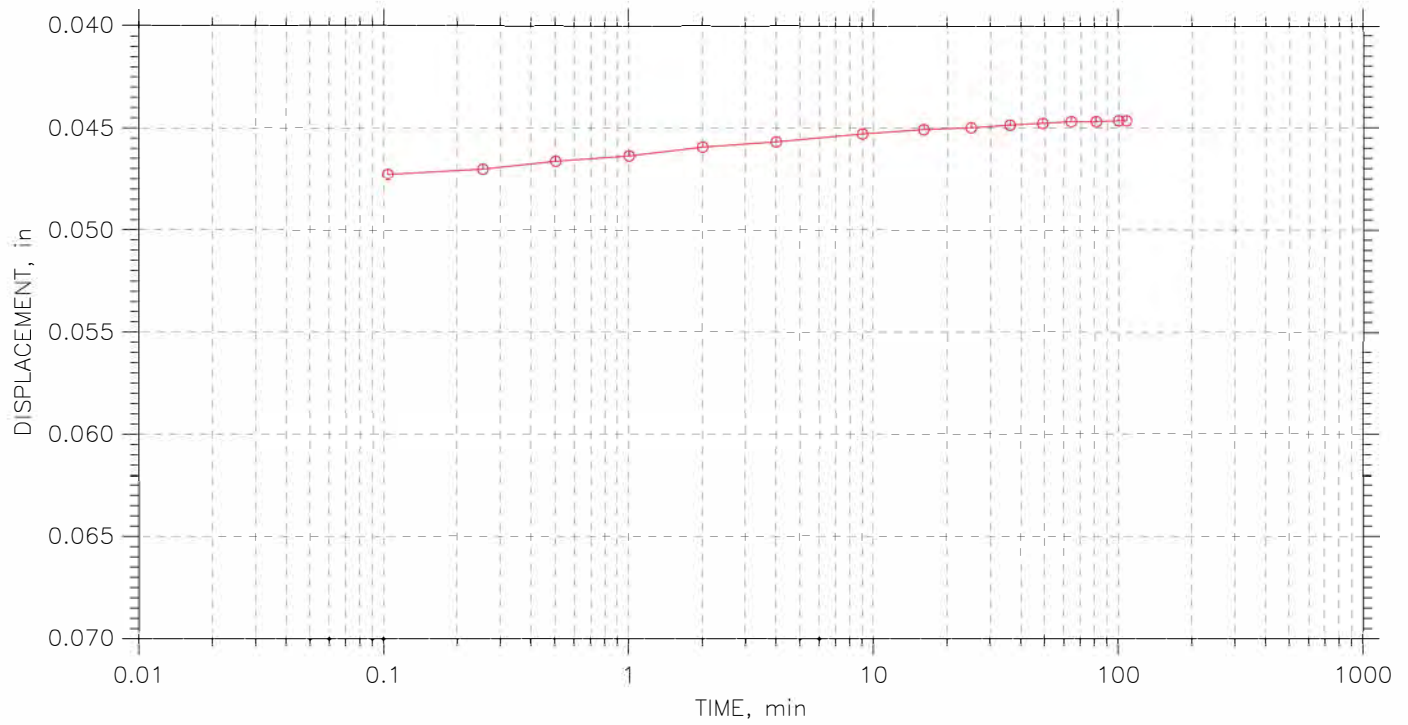


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 10

Stress: 8. tsf

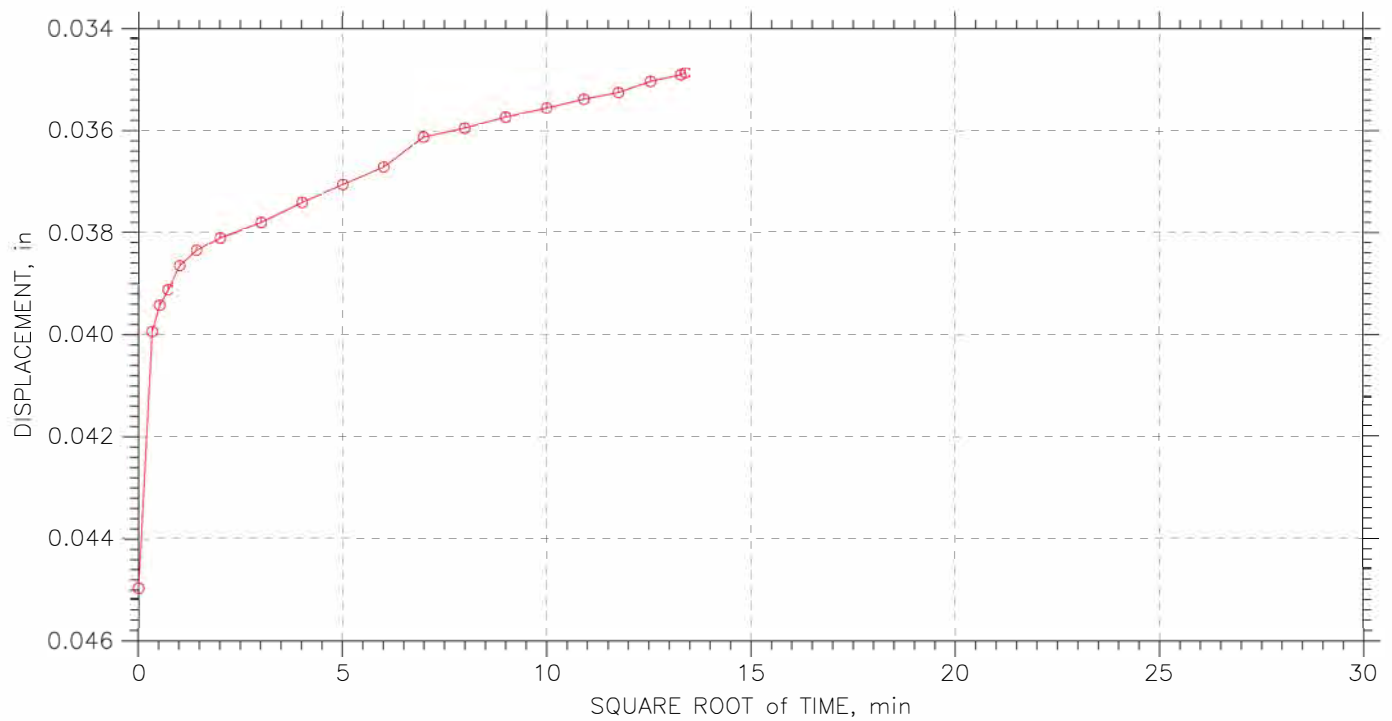
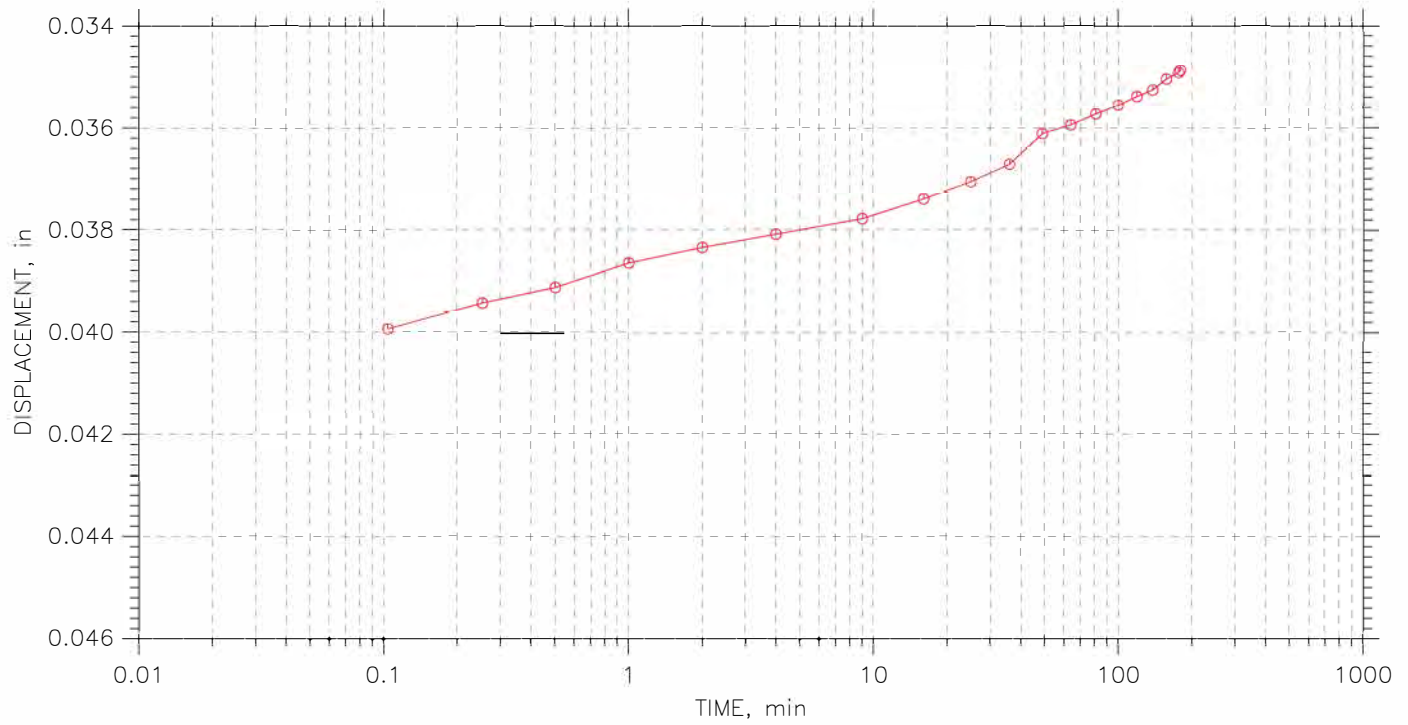


CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 9 of 10

Stress: 2. tsf



CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 10 of 10

Stress: 0.5 tsf

