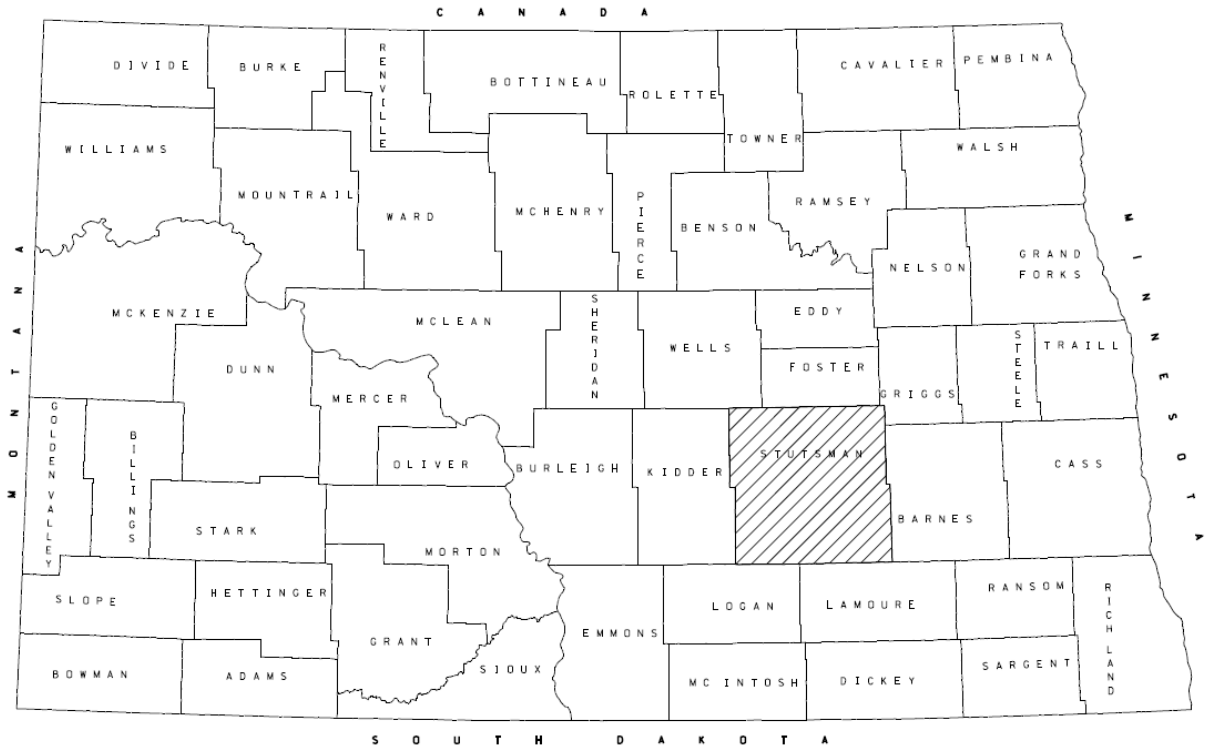
Deep Foundation Report and Analysis

PROJECT NO. IM-2-094(194)260

PCN 23577

COUNTY Stutsman

Bridge #: 0094-260.125 R



PREPARED BY: Riley McAdoo-Roesler

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
MATERIALS AND RESEARCH DIVISION

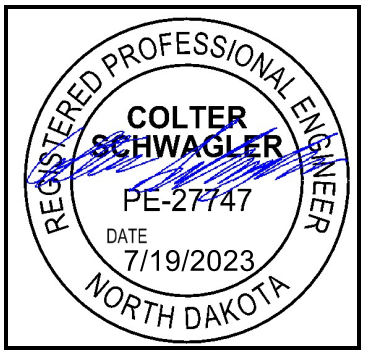
July 2023

IM-2-094(194)260

SE Jamestown Interchange
Bridge #: 0094-260.125 R

CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Colter Schwagler, Registration number PE-27747 on 07/19/2023 and the original document is stored at the North Dakota Department of Transportation.



SE Jamestown Interchange
Deep Foundation Borings

Project: IM-2-094(194)260
PCN: 23577
Bridges: 0094-260.125 R
Scope: Structure Replacement
Location: SE Jamestown Int. - EB

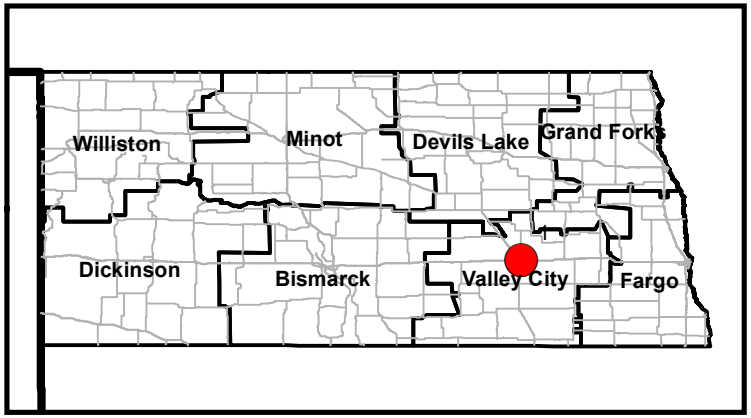


Table of Contents

List of Tables

List of Figures

Appendix

Introduction

The purpose of the project is to address the existing deficiencies of the current structure by removing and replacing the bridge on the same alignment along the I-94 corridor.

This report will provide foundation, settlement, and bridge end slope recommendations for the construction of the new structure.

Existing Structure Information

There is an existing bridge on I-94 that will be removed as part of the project. The information for this structure is below.

Bridge #0094-260.125 R
Main Structure Type: Prestressed Concrete Stringer
Length: 221'
Foundation Type: Treated Timber Piling
Year Constructed: 1958

Soil Borings

A total of 2 borings were completed near the proposed structure. See the project location map for the boring locations.

Boring #1
Boring #1 has an elevation of approximately 1423 feet at the top of boring and is located near the proposed west abutment. This boring extends to a depth of 119.5 feet.

Boring #2
Boring #2 has an elevation of approximately 1426 feet at the top of boring and is located near the proposed east abutment. This boring extends to a depth of 119.6 feet.

Sampling and Testing Procedures:

Shelby tube sampling and split spoon sampling were used to extract the samples from a hollow stem auger.

Shelby tube sampling provides an "undisturbed" sample of fine-grained soils for laboratory testing via a thin wall tube that is slowly pushed into the soils to be sampled. Densities were calculated according to AASHTO test method T-296.

Split spoon samplers are utilized during advancement of the boring to perform the Standard Penetration Test (SPT). The samples are considered "disturbed", due to the driving nature in which they are obtained. The SPT results in an N-value, or number of

blows required to drive the split spoon sampler 1 foot. This N-value is used to estimate the friction angle of non-cohesive soils and define the consistency of cohesive soils.

For cohesive soils, the shear strength values were determined from the Unconsolidated Undrained and Consolidated Undrained tests utilizing Shelby tubes samples.

The samples from the split spoon and Shelby tubes are submitted to the laboratory for determination of AASHTO classification, moisture content, dry density, sieve analysis, and Atterberg limits.

Test Results

A summary of the lab analysis has been included in the Appendix B.

Proposed Structures

Main Structure Type: 4 Span
Foundation Type: Steel H-Piles

Foundation Recommendation

Steel Piling

Pile recommendations are given as termination elevations. The pile sizes that have been analyzed are HP10x42, HP12X53, HP14x73 and HP14x102. See table 3 below for the recommended termination elevations.

The software “APile” was used in conjunction with engineering judgment and past experience in pile driving in these types of soils to estimate the pile lengths. The output from this analysis is available upon request from the NDDOT Geotechnical Section.

Below are simplified soil profiles for each boring that was used to predict the unfactored nominal geotechnical resistance in APile. A graphical representation of the unfactored nominal geotechnical resistance is also shown below in figures 1-3. The nominal geotechnical resistance is used to help predict the pile termination elevations which can be found in table 3 below.

Table 1 - Boring #1 Simplified Soil Profile-West Abutment

Layer	Depth (feet)	Elevation (feet)	Cohesion (lb/ft^2)	Friction Angle	Effective Unit Weight (lb/ft^3)
Loose Moist Brn Clayey Sand	0.0-2.0	1423.4-1421.4	-	ϕ=28°	-
Medium Stiff to Stiff Moist Brn/Gry Lean Clay	2.0-32.0	1421.4-1389.4	c=1200 psf	ϕ=35°	129.1
Medium Stiff to Stiff Moist Brn/Gry Lean Clay	32.0-43.0	1389.4-1380.4	c=1200 psf	ϕ=35°	66.7
Loose to Medium Dense Wet Brn/Gry Silty Sand	43.0-68.0	1380.4-1355.4	-	ϕ=32°	-
Dense Wet Gry Silty Sand	68.0-96.0	1355.4-1327.4	-	ϕ=37°	-
Hard Moist Gry Silt	96.0-106.0	1327.4-1317.4	c=4625 psf	-	-
Hard Moist Gry Fat Clay	106.0-119.5	1317.4-1303.9	c=12500 psf	-	-

Table 2 - Boring #2 Simplified Soil Profile-East Abutment

Layer	Depth (feet)	Elevation (feet)	Cohesion (lb/ft^2)	Friction Angle	Effective Unit Weight (lb/ft^3)
Stiff Moist Brn Lean Clay	0.0-32.0	1426.0-1394.0	c=1500 psf	ϕ=32.3°	129.4
Stiff Moist Brn Lean Clay	32.0-36.0	1394.0-1390.0	c=1500 psf	ϕ=32.3°	67
Stiff to Very Stiff Moist Brn/Gry/Blk Clayey Sand	36.0-53.0	1390.0-1373.0	-	ϕ=33°	-
Medium Dense to Dense Wet Gry Silty Sand	53.0-68.0	1373.0-1358.0	-	ϕ=33°	-
Water Bearing Coal	68.0-86.0	1358.0-1340.0	-	ϕ=34°	-
Medium Dense to Dense Wet Gry Silty Sand	86.0-101.0	1340.0-1325.0	-	ϕ=34°	-
Medium Dense to Dense Moist Gry Clayey Sand	101.0-119.6	1325.0-1306.4	c=12500 psf	-	-

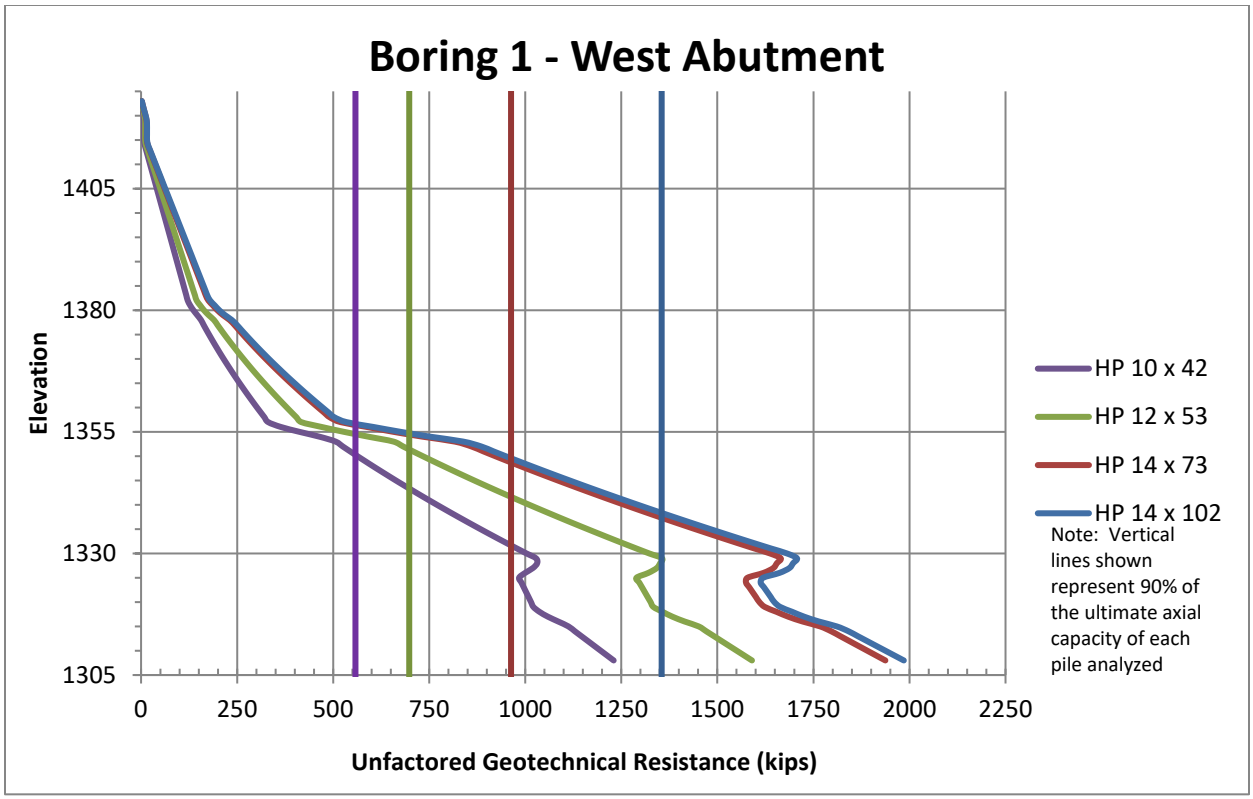


Figure 1: Nominal Resistance for Pile at West Abutment

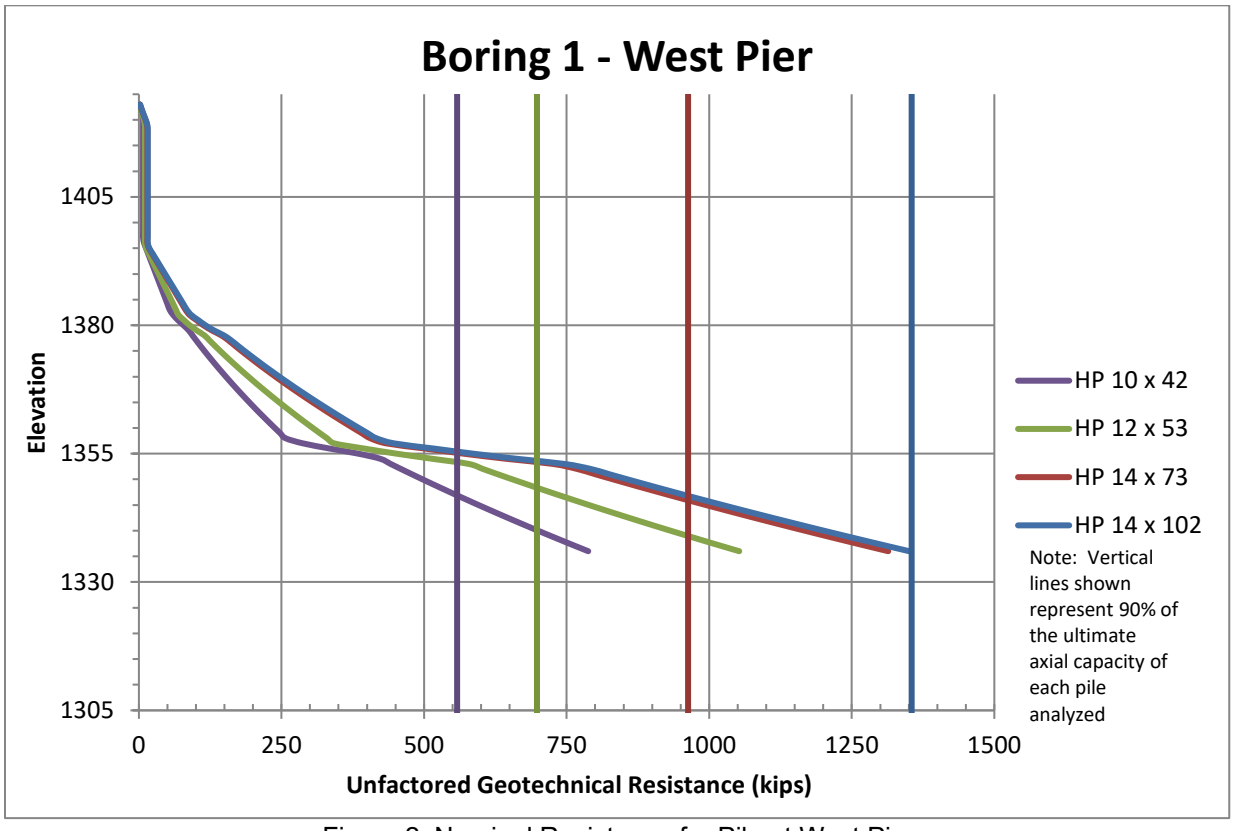


Figure 2: Nominal Resistance for Pile at West Pier

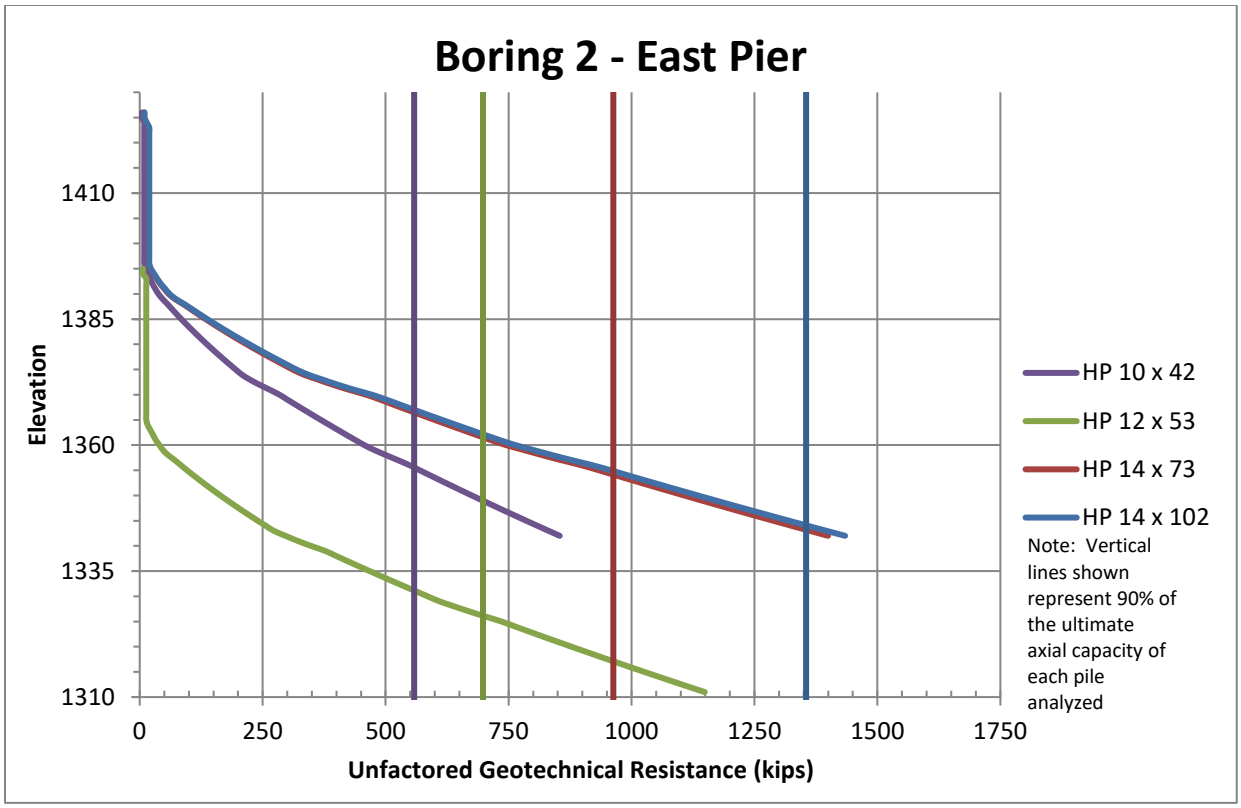


Figure 3: Nominal Resistance for Pile at East Pier

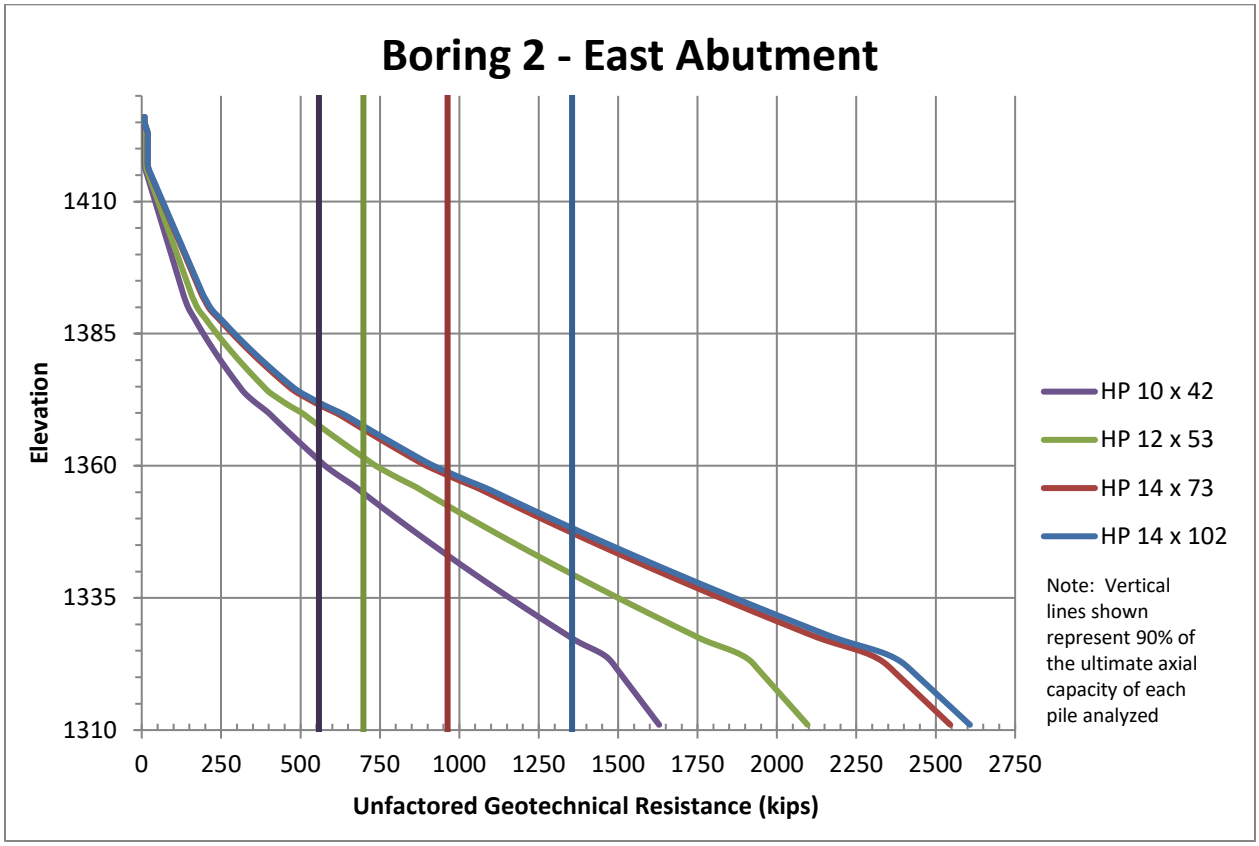


Figure 4: Nominal Resistance for Pile at East Abutment

Based on the Apile information, past experience, and engineering judgement the pile termination elevations were selected as shown in the table below.

Table 3 - Pile Length Information

Pile Type	90% Ultimate Axial Capacity	West Abutment	West & Middle Pier	East Pier	East Abutment
	kips	Termination Elevation	Termination Elevation	Termination Elevation	Termination Elevation
HP10X42	558	1350	1346	1355	1361
HP12X53	698	1351	1348	1357	1361
HP14x73	963	1347	1345	1354	1358
HP14x102	1355	1338	1335	1344	1348

Based on the sandy nature of the soil where some of the piles are estimated to reach bearing, the piles may go deeper than necessary. If the pile has not reached bearing 10 feet beyond the estimated depth, stop driving the pile and wait 24 hours to allow pile setup to occur. After 24 hours warm the hammer with a minimum of 20 blows by striking the ground or timber mats. Restrike the pile with 10 blows to determine if bearing has been achieved. If bearing was not achieved during restrike, continue to drive the pile until bearing is achieved.

Pile Tips

It is not anticipated that pile tips will be required for this bridge.

Downdrag

Due to the minimal amount of fill being placed at the structures downdrag is not applicable.

Scour

This bridge is not over a water crossing therefore there is no scour.

Compaction Recommendation

Compact roadway embankment material to at least 90 percent of the maximum dry density with moisture content no less than the optimum moisture and no more than 5.0 percentage points above the optimum moisture. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T 180.

Compact the aggregate transitions at the bridge ends according to section 714.04 A.10.

Slope Recommendation

A slope stability analysis was conducted with Slope/W developed by Geo-Slope International. The analysis was a two-dimensional limit equilibrium method. Design division requested analysis of 2.5:1 and 2:1 side slopes for the bridge. Slope stability analysis shows that 2:1 slopes do not meet the required factor of safety. Based on our analysis it is recommended to construct slopes no steeper than 2.5:1. The bridge end slopes were also analyzed. It was determined that a 2.5:1 end slope will be sufficient for this structure. The stability analysis outputs can be found in Appendix C.

Drainage Recommendation

The drainage off the bridge should be controlled so that water does not drain directly off the bridge ends and cause erosion around the wing-wall. A combination of inlets, downdrains, and/or deckdrains should be used to control water runoff. Water should not be allowed to drain off the bridge as to allow the in slopes and end slopes to become saturated, which is a common cause of slope failure.

Settlement Analysis/Recommendation

Minimal fill is proposed to be placed with this project, therefore settlement mitigation is not recommended.

Pre-Boring

Minimal fill is proposed to be placed with this project, therefore pre-boring is not recommended.

APPENDIX A

Boring Logs

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

LOG OF BORING B2

PROJECT NUMBER IM-2-094(194)260 **DATE STARTED** **COMPLETED**

PCN 23577 **ELEVATION** 1426 ft

LOCATION Stutsman County

DRILLED BY Dallan **LOGGED BY** Jamie **DRILLING METHOD**

ENGINEER

NOTES East abutment

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	AASHTO	USCS	SAMPLE & NUMBER	RECOVERY (%)	SPT N VALUE	MC / PL / LL / CLAY FRACTION (%)	TESTS & REMARKS
1420	0	Stiff Moist Brn Lean Clay	A-6(5)	SC	378	75	10	19 37	
						0		17 38	
			A-6(10)	CL	379	60	6	20 41	Y=126.5 pcf, UC=4136 psf, c=2068 psf
			A-7-6(10)	CL	380	35		17 40	
	10		A-6(10)	CL	381	60	6	18 38	Y=127.1 psf, UC=1456 psf, c=728psf
			A-6(8)	CL	382	50		16 40	
1410			A-6(11)	CL	383	75	11	18 38	Y=129.9 psf, UU=1532 psf
			A-6(9)	CL	384	85		16 37	
	20		A-6(9)	CL	385	75	9	19 40	Y=131.9 psf, UU=2618psf
			A-6(9)	CL	386	50		19 42	
1400			A-7-6(7)	SC	387	75	10	18 41	Y=129.2 psf, UC=3653 psf, c=1826 psf
			A-7-6(11)	CL	388	75		17 38	
	30		A-6(10)	CL	389	60	11	17 39	Y=131.3 psf, UC=3243 psf, c=1621 psf
			A-6(10)	CL	390	85		16 39	
1390		1390.0 ft 36.0 ft	A-6(11)	CL	391	85	14	17 28	Y=129.6 psf, CU=32.3°, c'=155 psf
		Stiff to Very Stiff Moist Brn/Gry/Blk Clayey Sand	A-2-6(0)	SC	392	85		19 31	
	40		A-2-6(0)	SC	393	100	31	21 31	
			A-2-4(0)	SC	394	100			
1380					395	90	23	21 36	
			A-6(3)	SC	396	100	27	12 27	
			A-4(0)	SC	397	85	14	22 29	
	50		A-4(2)	CL	398	85	15	22 31	
		1373.0 ft 53.0 ft	A-2-4(0)	SC	399	50	7	18 33	
		Medium Dense to Dense Wet Gry Silty Sand	A-6(9)	CL	400	100	16	0	
1370			A-1-b(0)	SW-SM	401	85		0	
	60		A-1-a(0)	SW-SM	402	85	42	0	
			A-1-b(0)	SW-SM	403	85	36		
							37	22 33	
1360		1358.0 ft 68.0 ft	A-2-6(0)	SC	404	90	27	23 0	
			A-1-b(0)	SW-SM	405	90		H	
	70	Water Bearing Coal			406	25	49		
					407	85	42		
1350					408	65	16		
					409	65	46		
	80				410	90	26		
					411	90	30		
		1340.0 ft 86.0 ft			412	100	24		
1340		Medium Dense to Dense Wet Gry Silty Sand					22	0	
	90		A-3(1)	SP-SM	413	75			
							46	0	
1330			A-3(1)	SP-SM	414	90			
							21	0	
	100	1325.0 ft 101.0 ft	A-2-4(0)	SM	415	95			
		Medium Dense to Dense Moist Gry Clayey Sand					47	17 27	
1320			A-4(1)	SC	416	95			
	110							100 17 31	
			A-6(2)	SC	417	100			
								100 27 50	
1310			A-7-6(8)	CH	418	100			
		1306.4 ft 119.6 ft						100 34 66	
			A-7-5(12)	MH	419	67			

Bottom of borehole at 119.6 ft

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

LOG OF BORING B1

PROJECT NUMBER IM-2-094(194)260 **DATE STARTED** **COMPLETED**

PCN 23577 **ELEVATION** 1423.4 ft

LOCATION Stutsman County

DRILLED BY Dallan **LOGGED BY** Jamie **DRILLING METHOD**

ENGINEER

NOTES West

ELEVATION (ft)	DEPTH (ft)	MATERIAL DESCRIPTION	AASHTO	USCS	SAMPLE TYPE & NUMBER	RECOVERY (%)	SPT N VALUE	MC / PL / LL / CLAY FRACTION (%)	TESTS & REMARKS
	0	Loose Moist Brn Clayey Sand	A-2-4(0)	SC	337	50	7	18 37	
		2.0 ft	A-6(8)	CL	338	50		19 42	
1420		1421.4 ft	A-7-6(10)	CL	339	75	6	18 42	Y=129.2 pcf, UC= 4912 psf, c=2457 psf
		Medium stiff to stiff Moist Brn/Gry Lean Clay	A-7-6(11)	CL	340	75		18 40	
	10		A-6(9)	CL	341	75	5	17 40	
			A-6(10)	CL	342	85		20 42	
1410			A-7-6(10)	CL	343	75	5	19 40	Y=128.6 pcf, CU= 35° c'=180 psf
			A-6(9)	CL	344	75		20 42	
	20		A-7-6(11)	CL	345	60	9	18 42	Y=129.3 pcf, UC= 3336 psf, c=1669 psf
			A-7-6(11)	CL	346	65		18 38	
1400			A-6(9)	CL	347	75	15	17 37	Y=129.9 pcf, UC=2416 psf, c=1208psf
			A-6(9)	CL	348	75		19 42	
	30		A-7-6(10)	CL	349	75	14	17 38	Y=128.4 pcf, c=1977 psf
			A-6(10)	CL	350	75		19 41	
1390			A-7-6(11)	CL	351	100	27	21 38	Y=129.0 pcf, c=3210 psf
			A-6(9)	CL	352	85		20 34	
	40		A-6(6)	CL	353	100	7	19 37	
		1380.4 ft 43.0 ft	A-6(10)	CL	354	100	8		
1380		Loose to medium dense Wet Brn/Gry Silty Sand	A-1-b(1)	SP-SM	355	15		0	
							17	0	
	50		A-1-b(0)	SP-SM	356	85	7	2 30	
			A-1-b(1)	SP	357	85			
1370			A-3(1)	SP-SM	358	85	27 21	0 0	
			A-1-b(0)	SP-SM	359	100			
	60		A-1-a(0)	SP-SM	360	100	66	0	
1360							7	2 32	
		1355.4 ft 68.0 ft	A-2-4(0)	SW-SM	362	5	14		
					363	65		96 230	
	70	Dense Wet Gry Silty Sand	A-1-b(0)	SM	364	80	32	0	
			A-1-b(0)	SM	365	75			
1350			A-2-4(0)	SP-SM	366	75	25 33	0 0	
			A-2-4(0)	SM	367	75			
	80		A-2-4(0)	SM	368	50	46 48	0 0	
			A-2-4(0)	SM	369	75			
1340					370	5	54		
							52	0	
	90		A-2-4(0)	SM	371	100			
1330		1327.4 ft 96.0 ft	A-2-4(0)	SM	372	100	38	0	
		Hard Moist Gry Silt							
	100		A-6(5)	SC	373	100	37	18 34	
1320		1317.4 ft 106.0 ft	A-4(0)	CL-ML	374	100	63	25	
		Hard Moist Gry Fat Clay						100 22 37	
	110		A-6(4)	SC	375	77			
1310			A-7-6(16)	CH	376	100		100 27 60	
		1303.9 ft 119.5 ft	A-7-6(25)	CH	377	100		100 26 69	

Bottom of borehole at 119.5 ft

NDDOT LOG - NDDOT_DATATEMP_20180208.GDT - 7/13/23 08:32 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

APPENDIX B

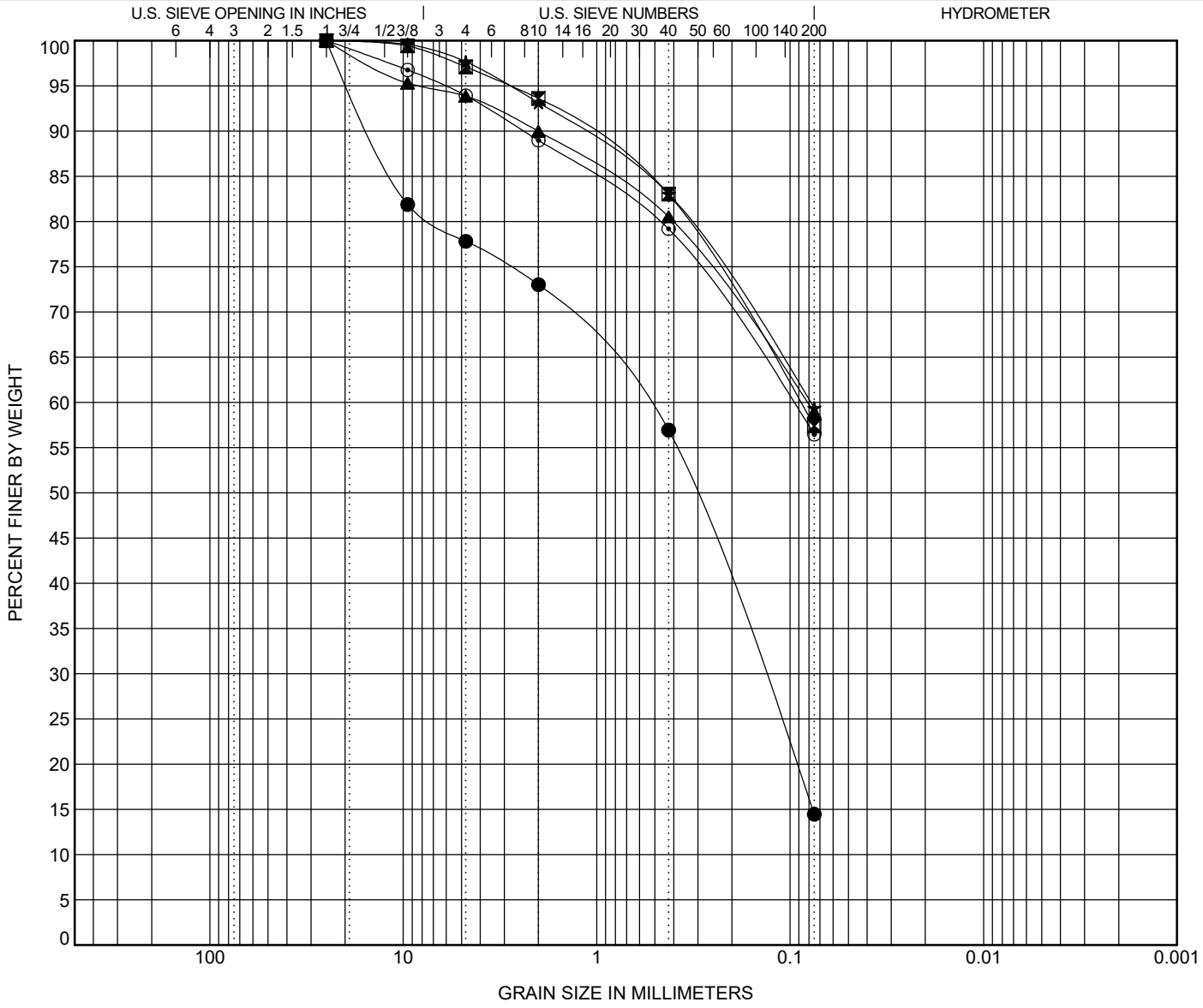
Lab Results

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● B1	0.0	A-2-6 (0)	SC	37	20	17		
⊠ B1	2.0	A-6 (8)	CL	37	18	19		
▲ B1	4.0	A-7-6 (11)	CL	42	19	23		
★ B1	6.0	A-7-6 (11)	CL	42	18	24		
⊙ B1	9.0	A-6 (9)	CL	40	18	22		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● B1	0.0	25	0.32	0.141	0.077	22.2	63.4	14.5	
⊠ B1	2.0	25				2.9	39.7	57.4	
▲ B1	4.0	25				6.1	35.0	58.9	
★ B1	6.0	25				2.3	38.3	59.4	
⊙ B1	9.0	25				6.1	37.5	56.5	

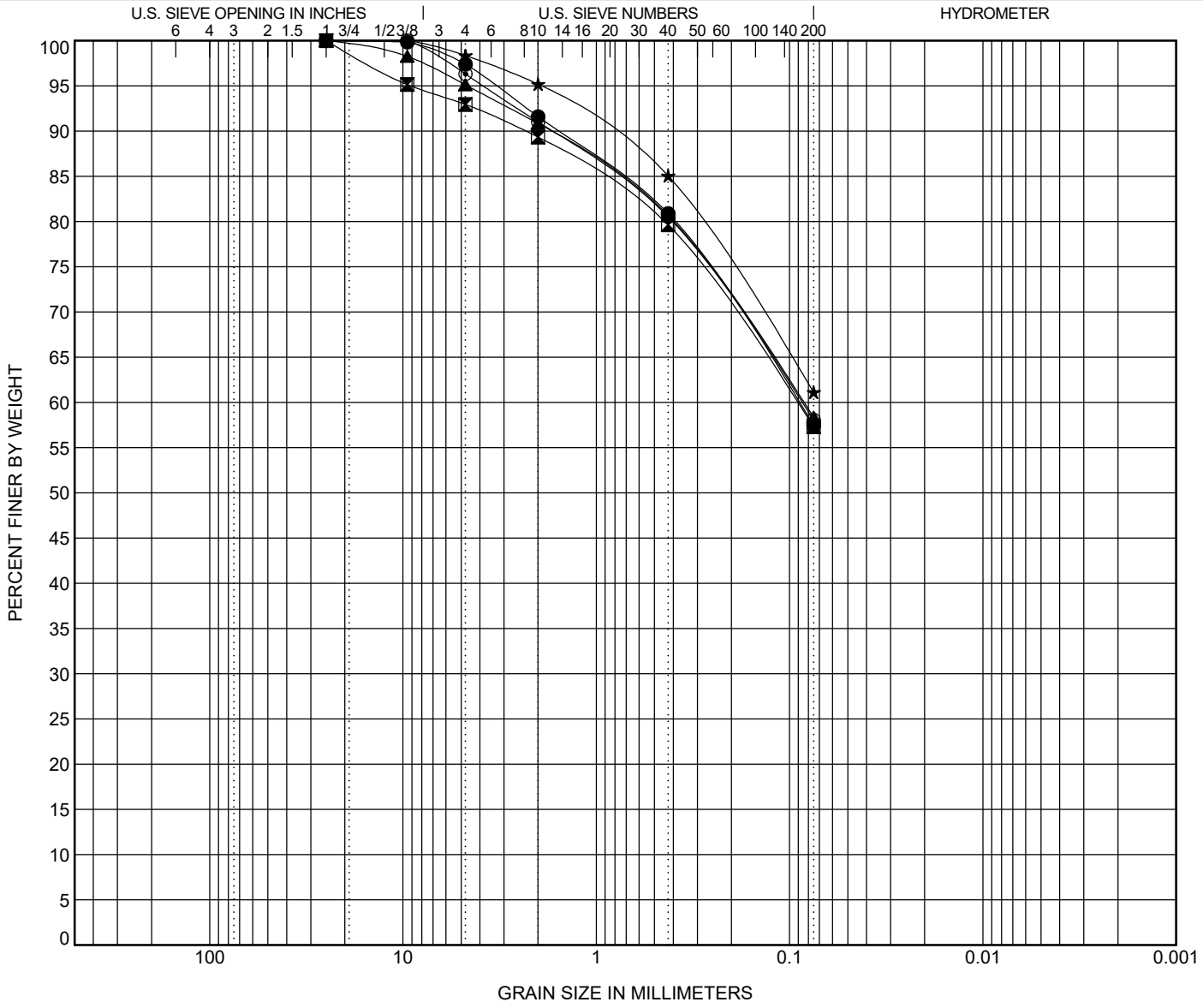
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● B1	11.0	A-6 (10)	CL	40	17	23		
⊠ B1	14.0	A-7-6 (10)	CL	42	20	22		
▲ B1	16.0	A-6 (9)	CL	40	19	21		
★ B1	19.0	A-7-6 (11)	CL	42	20	22		
⊙ B1	21.0	A-7-6 (11)	CL	42	18	24		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● B1	11.0	25				2.6	39.9	57.5	
⊠ B1	14.0	25				7.0	35.7	57.3	
▲ B1	16.0	25				4.9	36.8	58.4	
★ B1	19.0	25				1.6	37.2	61.1	
⊙ B1	21.0	25				3.7	38.3	58.1	

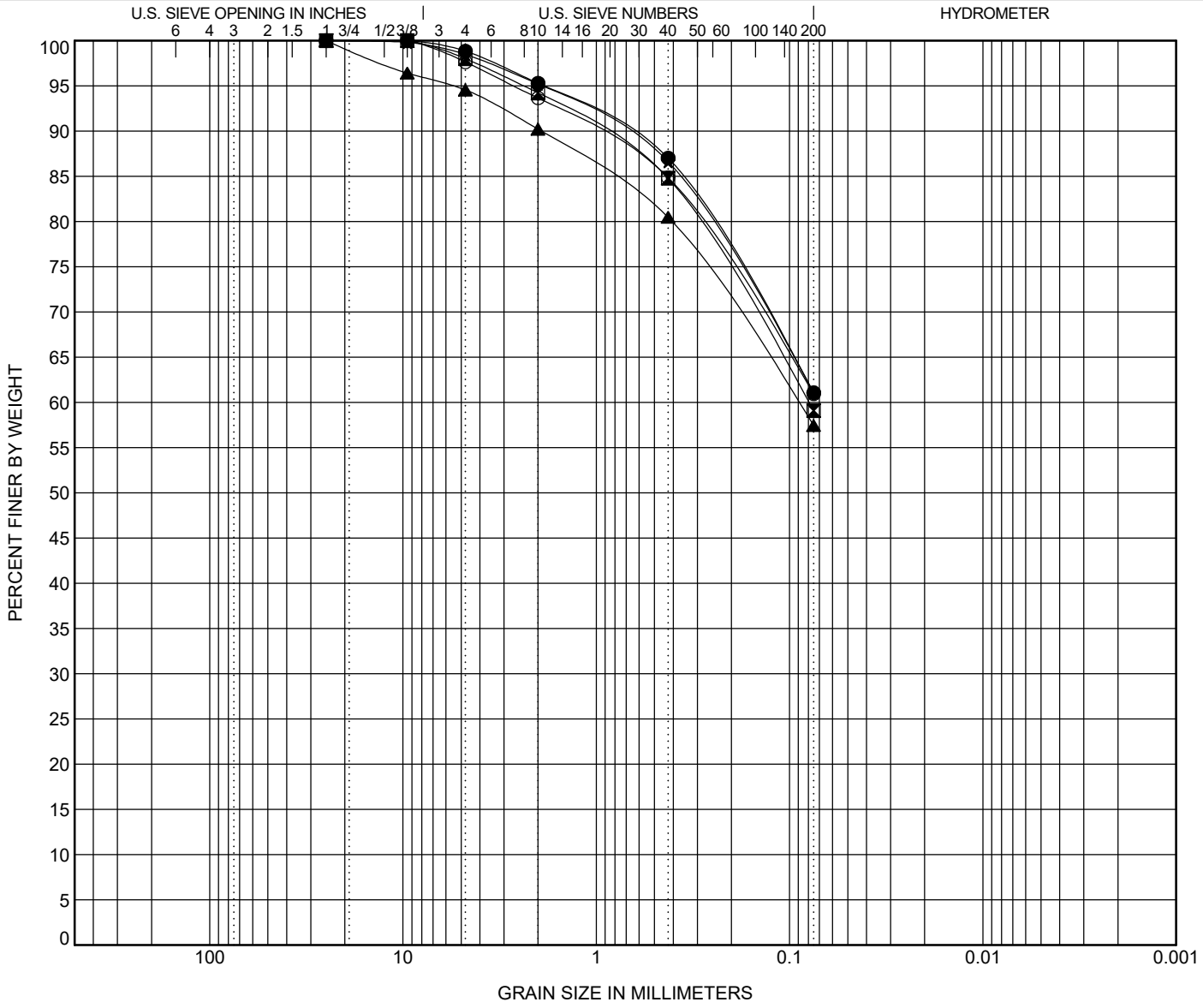
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B1	24.0	A-6 (10)	CL	38	18	20		
⊠	B1	26.0	A-6 (9)	CL	37	17	20		
▲	B1	29.0	A-7-6 (10)	CL	42	19	23		
★	B1	31.0	A-6 (10)	CL	38	17	21		
⊙	B1	34.0	A-7-6 (11)	CL	41	19	22		

BOREHOLE		DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B1	24.0	25				1.2	37.8	61.1	
⊠	B1	26.0	25				2.0	38.9	59.1	
▲	B1	29.0	25				5.4	37.1	57.4	
★	B1	31.0	25				1.5	37.4	61.1	
⊙	B1	34.0	25				2.4	36.7	60.9	

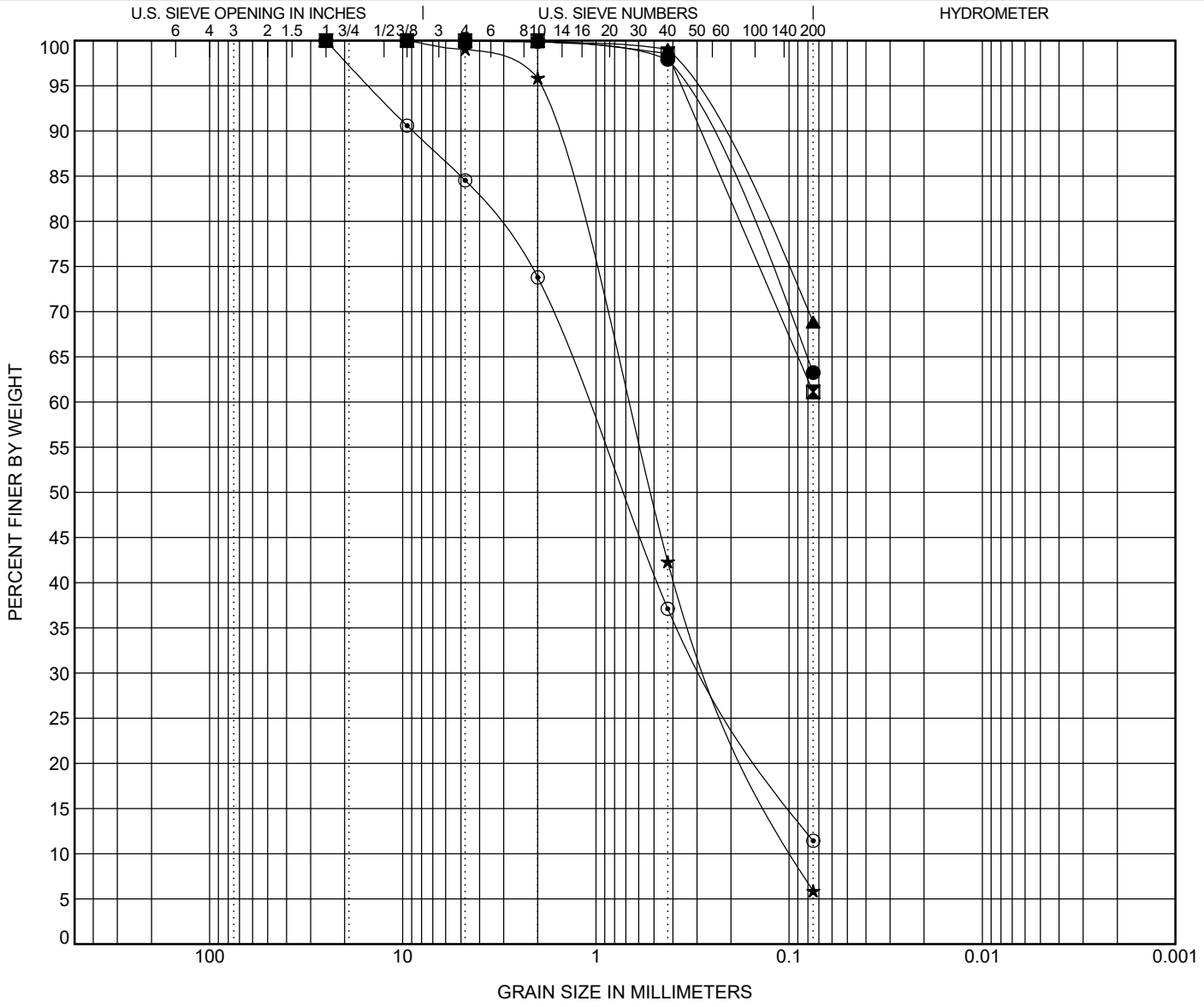
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B1	36.0	A-6 (9)	CL	38	21	17		
⊠	B1	39.0	A-6 (6)	CL	34	20	14		
▲	B1	41.0	A-6 (11)	CL	37	19	18		
★	B1	44.0	A-1-b (0)	SP-SM	NP	NP	NP	0.86	7.77
⊙	B1	49.0	A-1-b (0)	SP-SM	NP	NP	NP	0.91	16.41

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B1	36.0	25				0.0	36.7	63.3	
⊠	B1	39.0	25				0.0	38.9	61.1	
▲	B1	41.0	25				0.0	31.2	68.8	
★	B1	44.0	25	0.531	0.236	0.116	0.9	93.2	5.9	
⊙	B1	49.0	25	0.732	0.263	0.095	15.5	73.1	11.4	

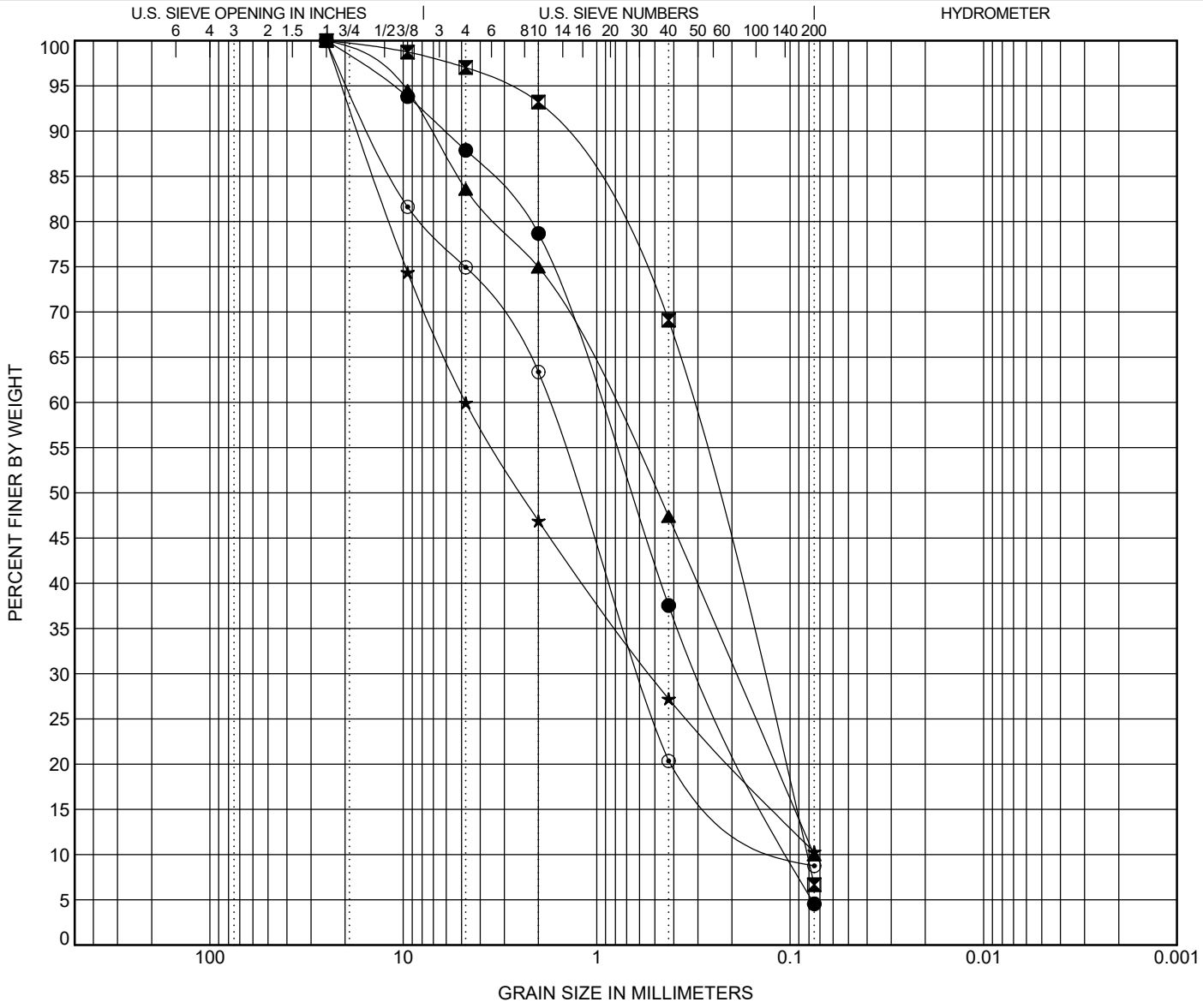
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● B1	51.0	A-2-4 (0)	SP	30	21	9	0.83	9.91
⊠ B1	54.0	A-3 (0)	SP-SM	NP	NP	NP	0.76	4.01
▲ B1	56.0	A-1-b (0)	SP-SM	NP	NP	NP	0.56	11.48
★ B1	59.0	A-1-a (0)	SP-SM	NP	NP	NP	0.81	65.53
⊙ B1	64.0	A-2-4 (0)	SW-SM	32	24	8	2.26	19.62

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● B1	51.0	25	0.679	0.286	0.13	12.1	83.3	4.5	
⊠ B1	54.0	25	0.25	0.143	0.095	3.0	90.4	6.7	
▲ B1	56.0	25	0.492	0.19	0.095	16.4	73.6	10.0	
★ B1	59.0	25	2.457	0.529	0.121	40.1	49.6	10.3	
⊙ B1	64.0	25	1.236	0.602	0.191	25.1	66.2	8.8	

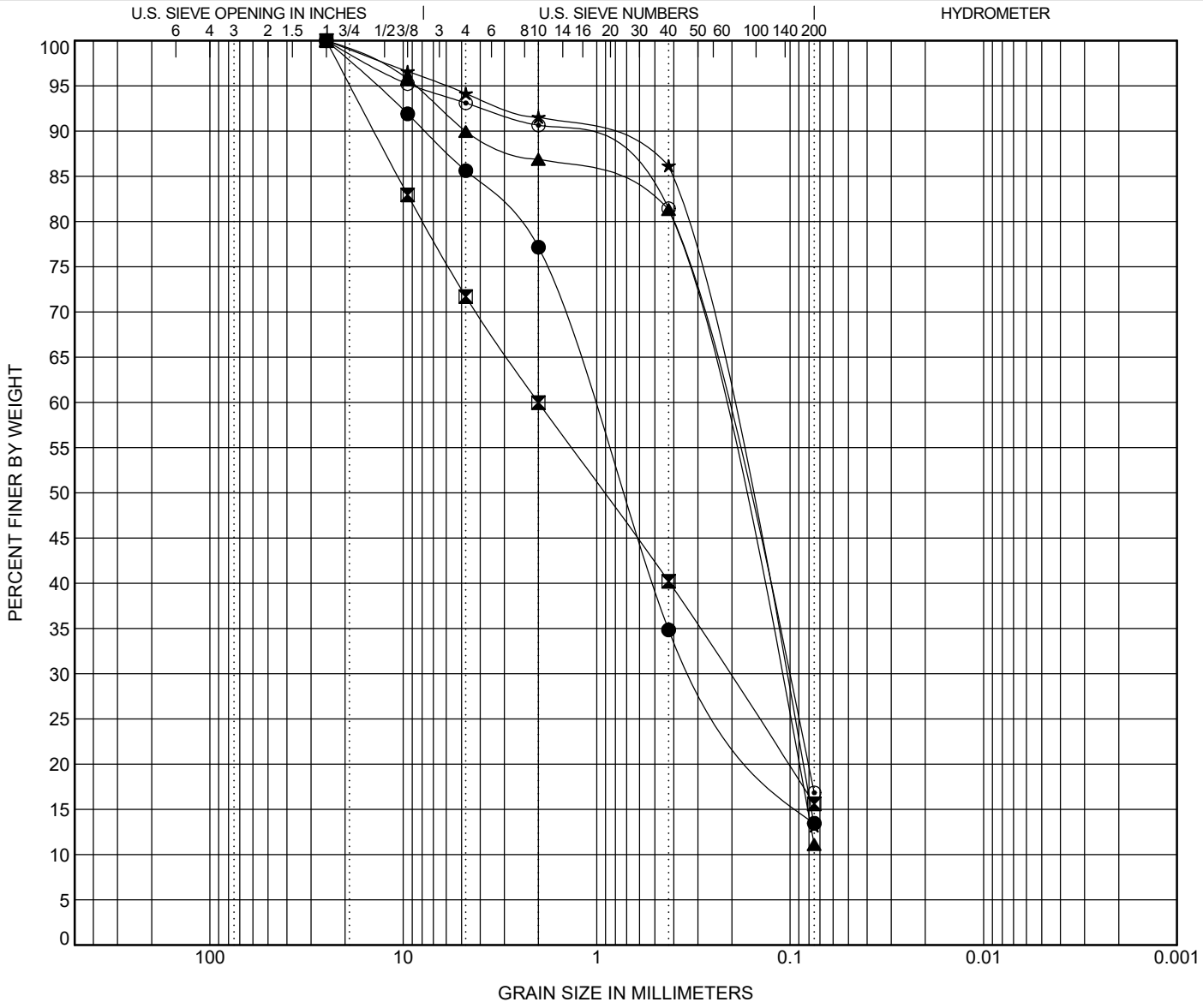
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B1	69.0	A-1-b (0)	SM	30	24	6		
⊠	B1	71.0	A-1-b (0)	SM	NP	NP	NP		
▲	B1	74.0	A-2-4 (0)	SP-SM	NP	NP	NP	0.78	3.44
★	B1	76.0	A-2-4 (0)	SM	NP	NP	NP		
⊙	B1	79.0	A-2-4 (0)	SM	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B1	69.0	25	0.74	0.287	0.085	14.4	72.2	13.5	
⊠	B1	71.0	25	0.915	0.207		28.3	56.1	15.6	
▲	B1	74.0	25	0.196	0.12	0.083	10.0	78.8	11.1	
★	B1	76.0	25	0.18	0.112	0.078	5.8	81.0	13.2	
⊙	B1	79.0	25	0.183	0.107		6.9	76.3	16.8	

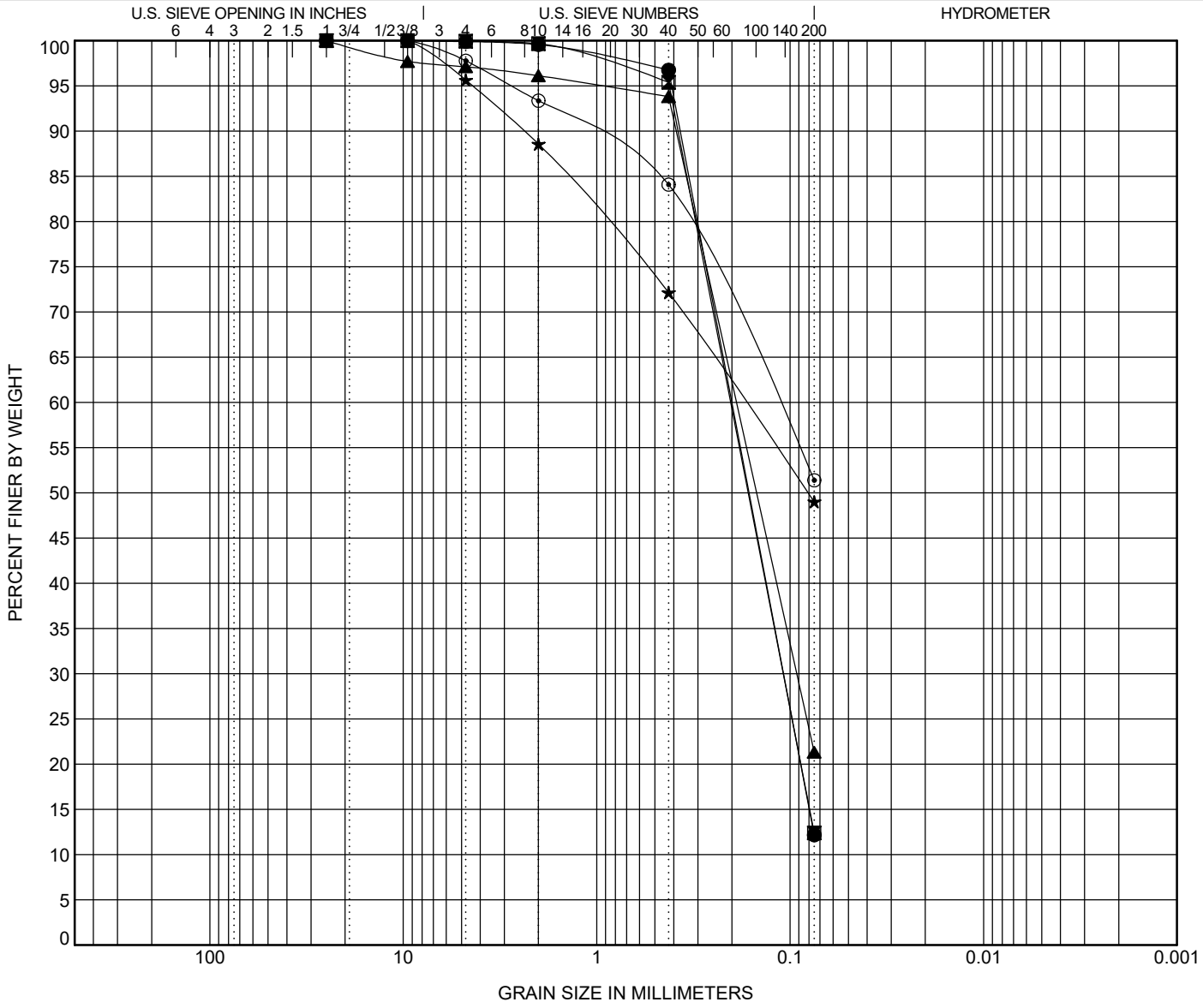
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B1	81.0	A-2-4 (0)	SM	NP	NP	NP	0.81	2.79
⊠	B1	89.0	A-2-4 (0)	SM	NP	NP	NP	0.81	2.84
▲	B1	94.0	A-2-4 (0)	SM	NP	NP	NP		
★	B1	99.0	A-6 (4)	SC	34	18	16		
⊙	B1	104.0	A-4 (0)	CL-ML	25	21	4		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B1	81.0	25	0.163	0.108	0.079	0.1	87.7	12.2	
⊠	B1	89.0	25	0.165	0.108	0.079	0.1	87.5	12.4	
▲	B1	94.0	25	0.149	0.092		2.9	75.8	21.3	
★	B1	99.0	25	0.081			4.4	46.6	49.0	
⊙	B1	104.0	25				2.2	46.4	51.4	

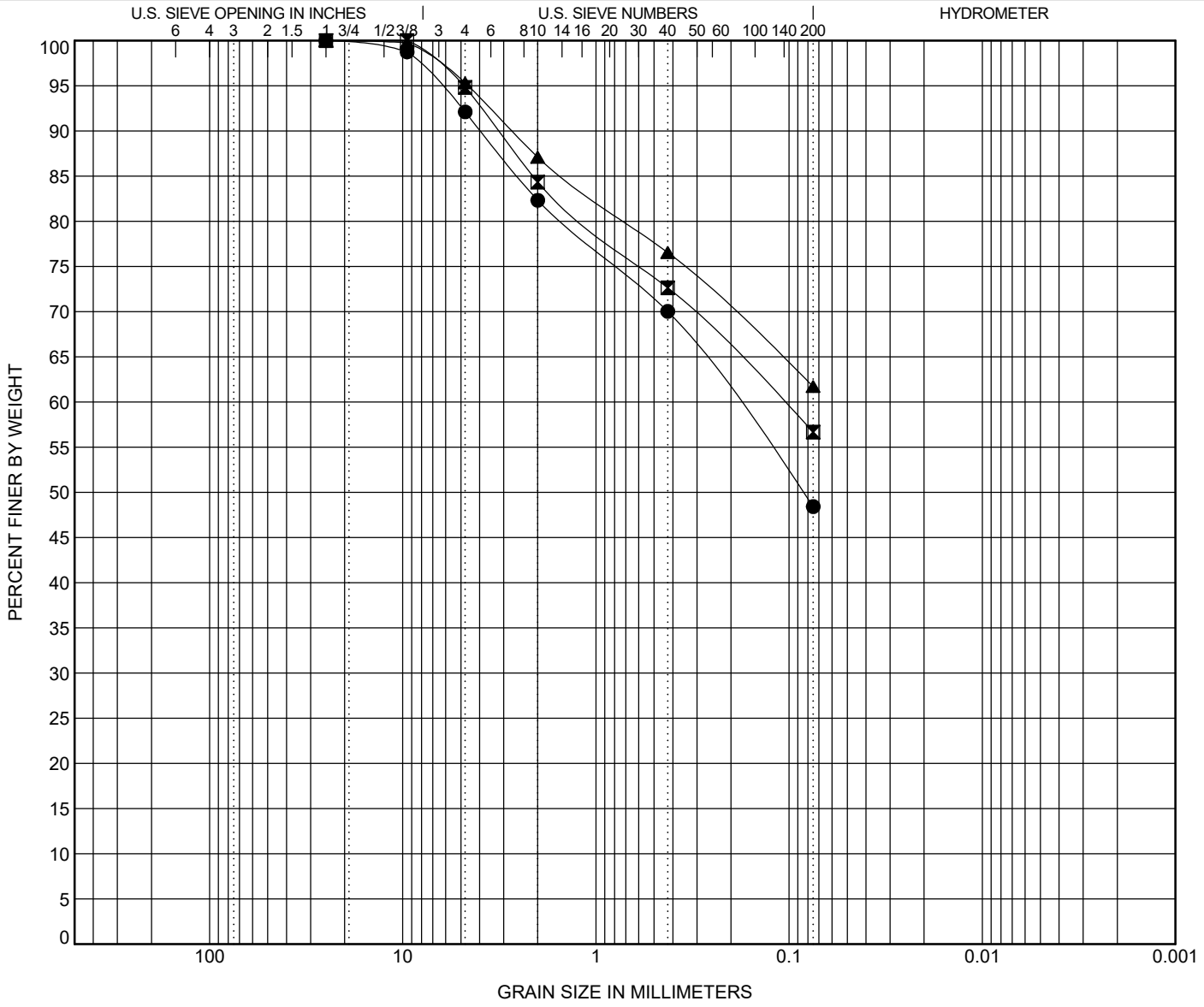
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B1	109.0	A-6 (4)	SC	37	22	15		
⊠	B1	114.0	A-7-6 (16)	CH	60	27	33		
▲	B1	119.0	A-7-6 (25)	CH	69	26	43		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B1	109.0	25	0.085			7.9	43.7	48.4	
⊠	B1	114.0	25				5.2	38.2	56.7	
▲	B1	119.0	25				4.7	33.6	61.7	

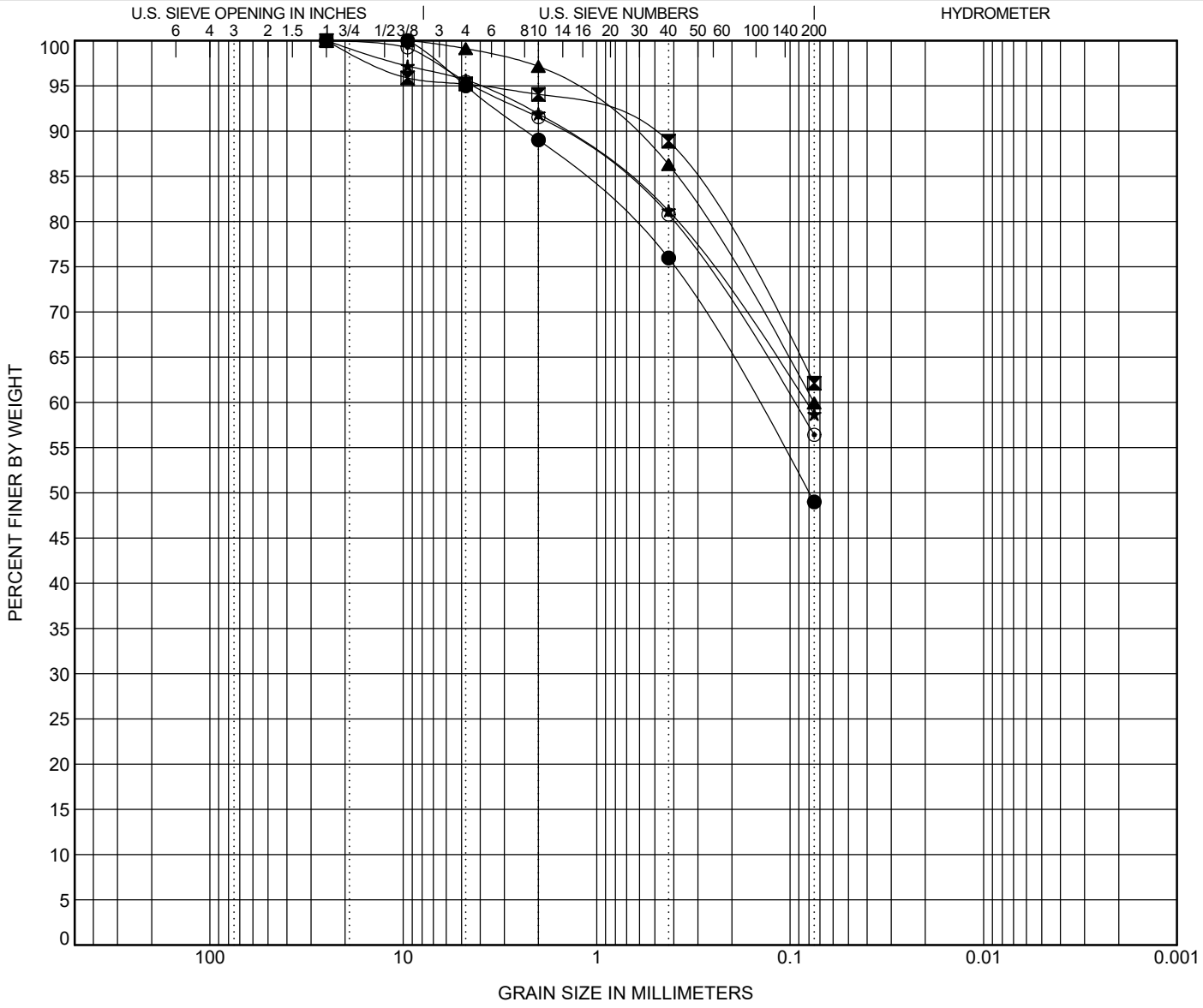
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:33 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 1.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B2	0.0	A-6 (5)	SC	37	19	18		
⊠	B2	4.0	A-6 (10)	CL	38	17	21		
▲	B2	6.0	A-7-6 (10)	CL	41	20	21		
★	B2	9.0	A-6 (11)	CL	40	17	23		
⊙	B2	11.0	A-6 (8)	CL	38	18	20		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B2	0.0	25	0.08			5.0	46.0	49.0	
⊠	B2	4.0	25				4.8	33.1	62.1	
▲	B2	6.0	25				0.9	39.2	59.9	
★	B2	9.0	25				4.4	36.9	58.7	
⊙	B2	11.0	25				4.6	39.0	56.4	

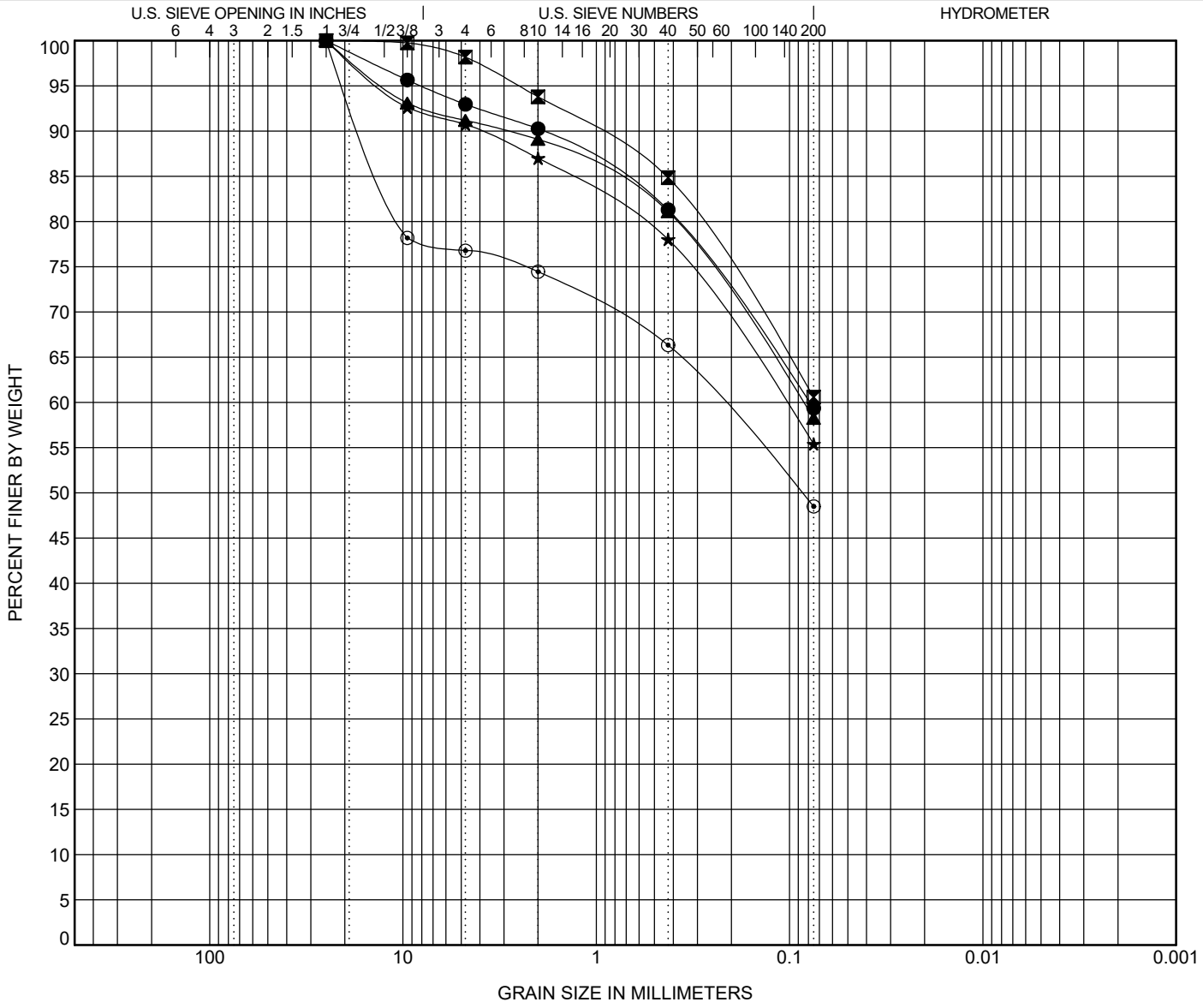
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:42 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 2.GPJ

GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation
NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B2	14.0	A-6 (11)	CL	40	16	24		
⊠	B2	16.0	A-6 (10)	CL	38	18	20		
▲	B2	19.0	A-6 (9)	CL	37	16	21		
★	B2	21.0	A-6 (8)	CL	40	19	21		
⊙	B2	24.0	A-7-6 (7)	SC	42	19	23		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B2	14.0	25				7.0	33.6	59.4	
⊠	B2	16.0	25				1.8	37.6	60.6	
▲	B2	19.0	25				8.8	32.9	58.2	
★	B2	21.0	25				9.3	35.3	55.4	
⊙	B2	24.0	25	0.087			23.2	28.3	48.5	

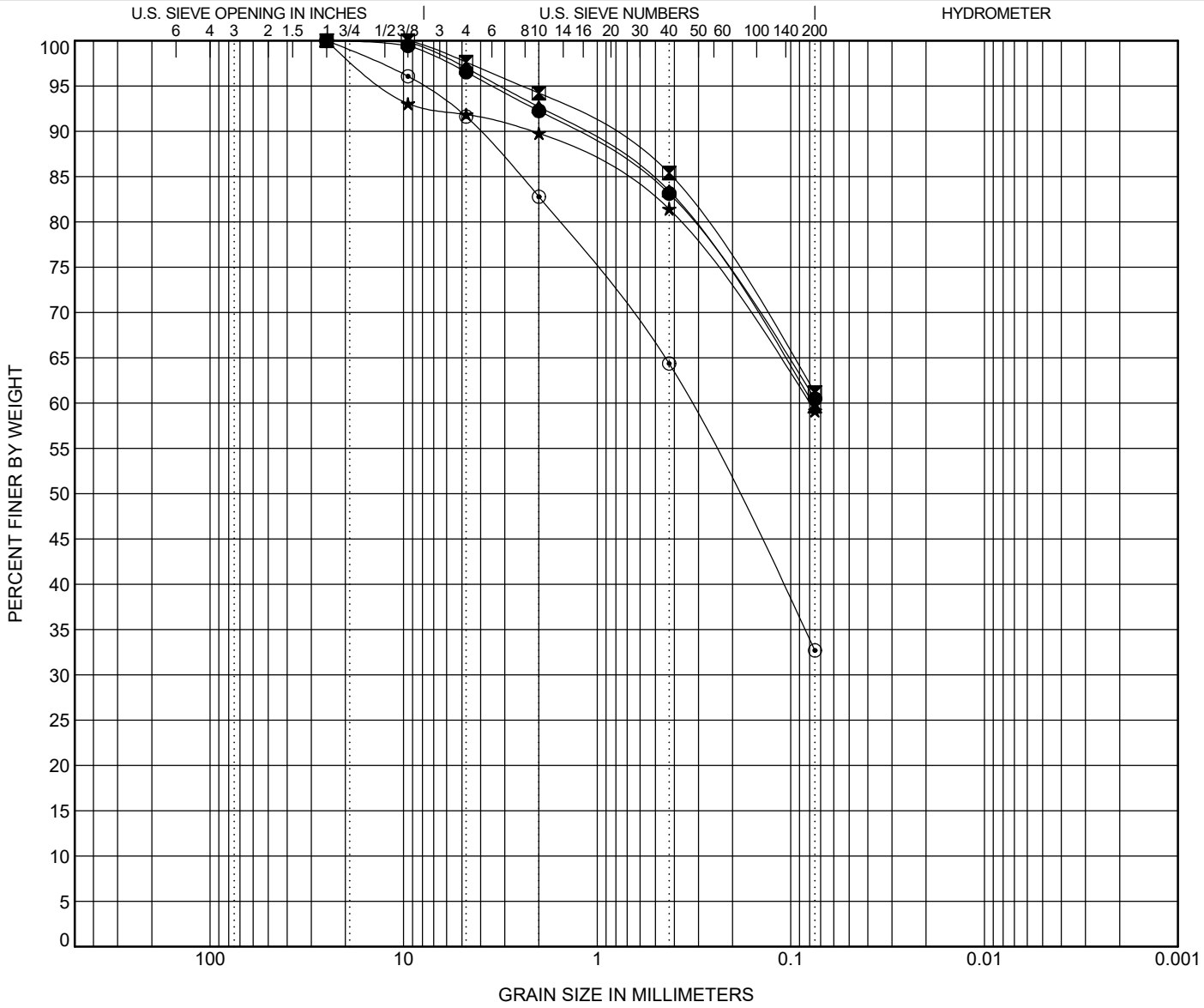
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:42 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 2.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B2	26.0	A-7-6 (11)	CL	41	18	23		
⊠	B2	29.0	A-6 (10)	CL	38	17	21		
▲	B2	31.0	A-6 (10)	CL	39	17	22		
★	B2	34.0	A-6 (10)	CL	39	16	23		
⊙	B2	36.0	A-2-6 (0)	SC	28	17	11		

	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B2	26.0	25				3.5	36.1	60.5	
⊠	B2	29.0	25				2.4	36.5	61.1	
▲	B2	31.0	25				3.0	37.4	59.6	
★	B2	34.0	25				8.1	32.7	59.1	
⊙	B2	36.0	25	0.193			8.4	58.9	32.7	

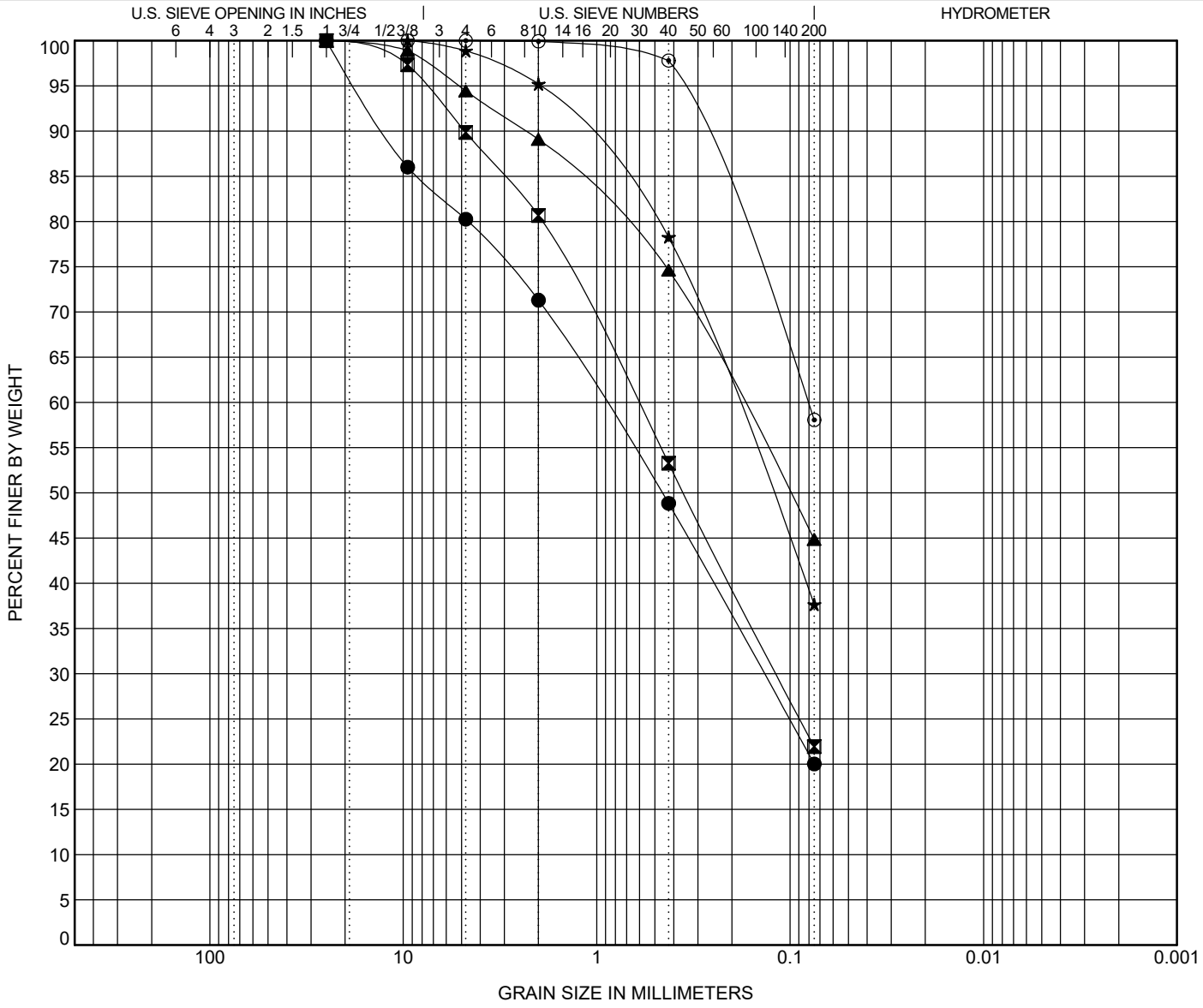
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:42 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 2.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
● B2	39.0	A-2-6 (0)	SC	31	19	12		
⊠ B2	40.0	A-2-4 (0)	SC	31	21	10		
▲ B2	45.0	A-6 (3)	SC	36	21	15		
★ B2	47.0	A-4 (0)	SC	27	18	9		
⊙ B2	49.0	A-4 (2)	CL	29	21	8		

BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
● B2	39.0	25	0.46	0.137		19.7	60.2	20.0	
⊠ B2	40.0	25	0.355	0.117		10.1	67.9	21.9	
▲ B2	45.0	25	0.101			5.6	49.6	44.8	
★ B2	47.0	25	0.127			1.1	61.2	37.7	
⊙ B2	49.0	25				0.0	41.9	58.1	

GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:42 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 2.GPJ

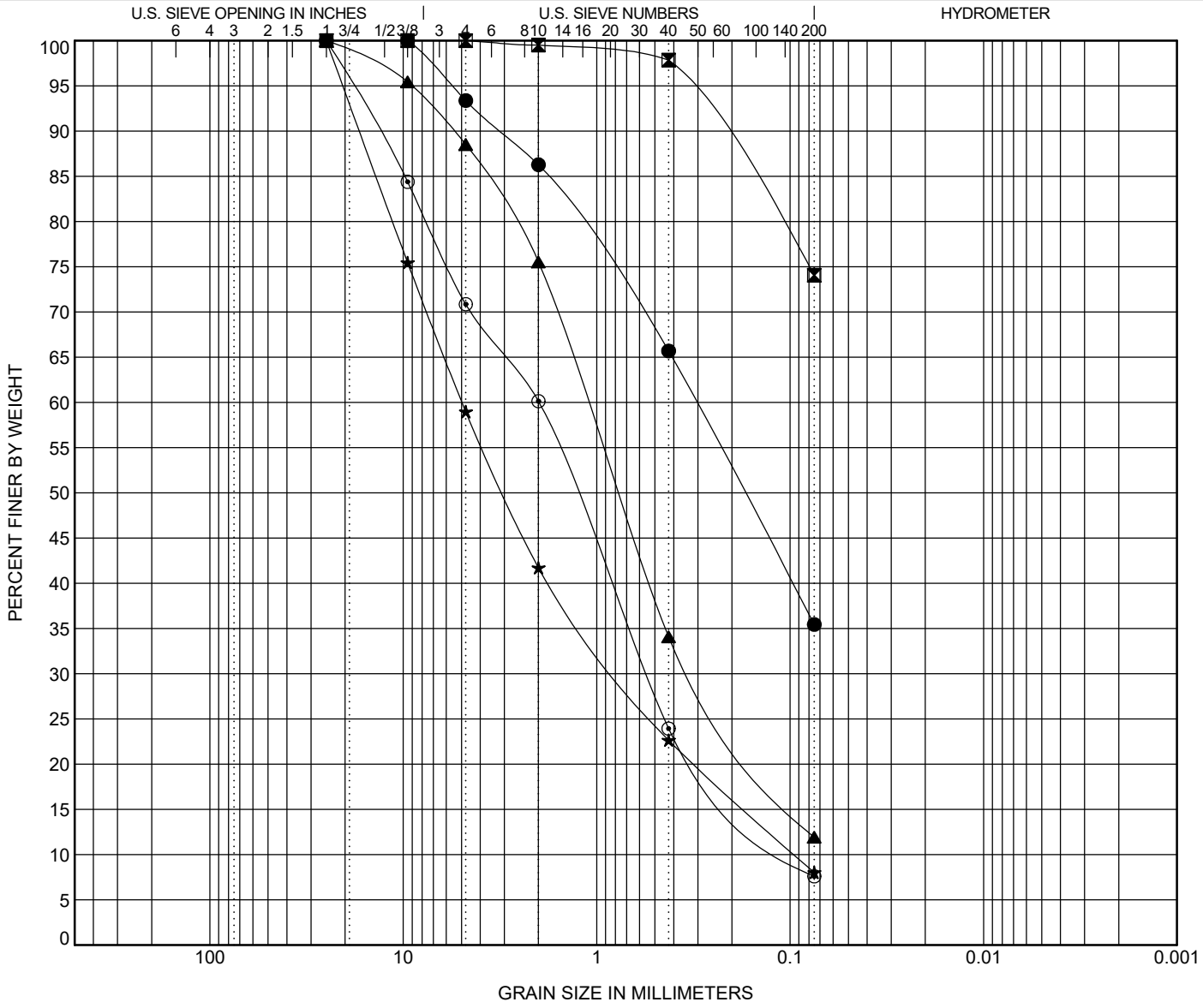
GRAIN SIZE DISTRIBUTION

NDDOT North Dakota Department of Transportation

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B2	51.0	A-2-4 (0)	SC	31	22	9		
⊠	B2	54.0	A-6 (9)	CL	33	18	15		
▲	B2	56.0	A-1-b (0)	SW-SM	NP	NP	NP	1.32	17.34
★	B2	59.0	A-1-a (0)	SW-SM	NP	NP	NP	1.27	52.32
⊙	B2	61.0	A-1-b (0)	SW-SM	NP	NP	NP	1.58	20.55

BOREHOLE		DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B2	51.0	25	0.173			6.6	57.9	35.4	
⊠	B2	54.0	25				0.0	25.9	74.1	
▲	B2	56.0	25	0.77	0.309	0.095	11.5	76.6	11.9	
★	B2	59.0	25	3.03	0.772	0.172	41.0	50.9	8.0	
⊙	B2	61.0	25	1.296	0.551	0.165	29.1	63.3	7.6	

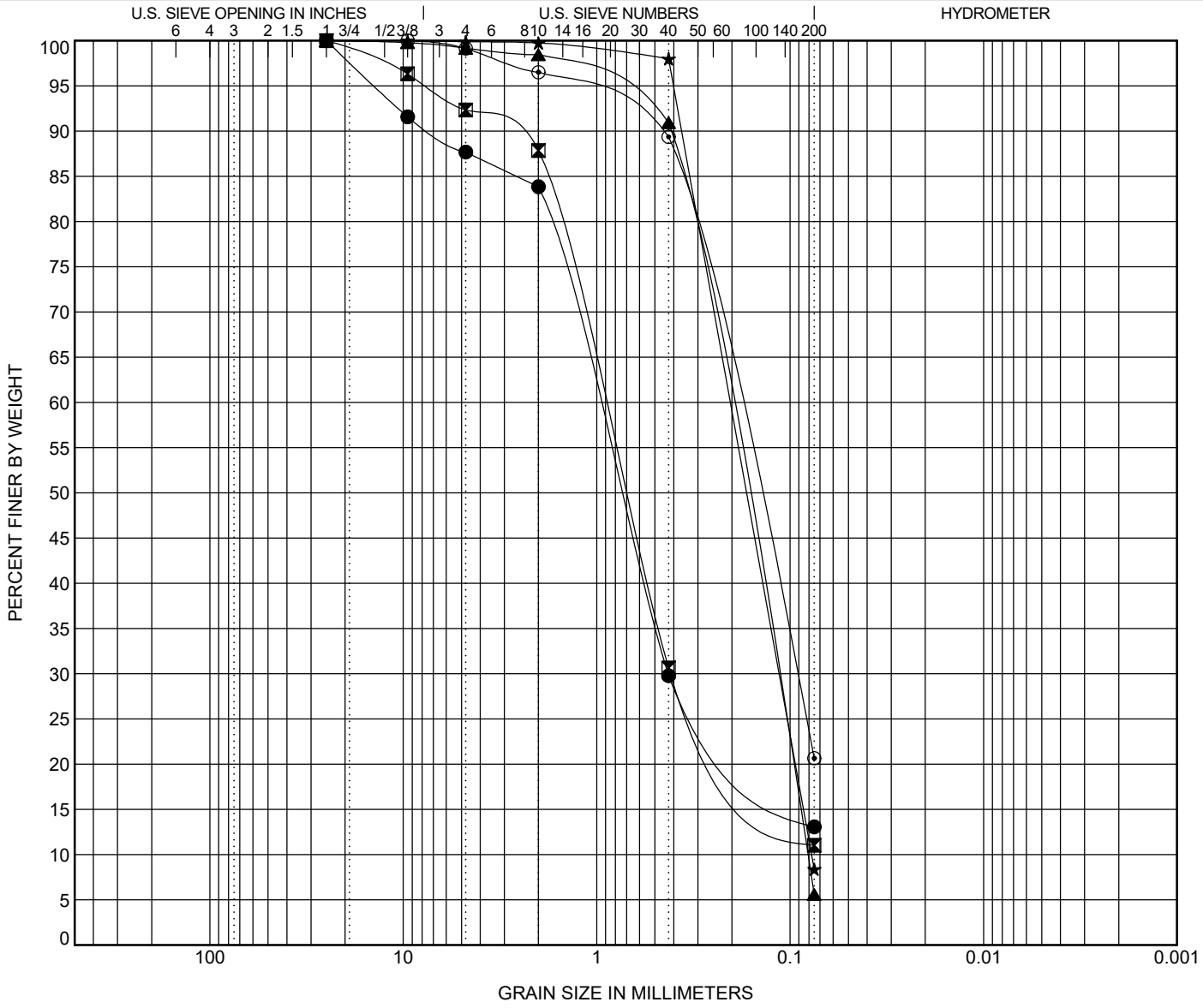
GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:42 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 2.GPJ

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B2	64.0	A-2-6 (0)	SC	33	22	11		
⊠	B2	66.0	A-1-b (0)	SW-SM	30	25	5	2.51	13.75
▲	B2	89.0	A-3 (0)	SP-SM	NP	NP	NP	0.82	2.76
★	B2	94.0	A-3 (0)	SP-SM	NP	NP	NP	0.82	2.63
⊙	B2	99.0	A-2-4 (0)	SM	NP	NP	NP		

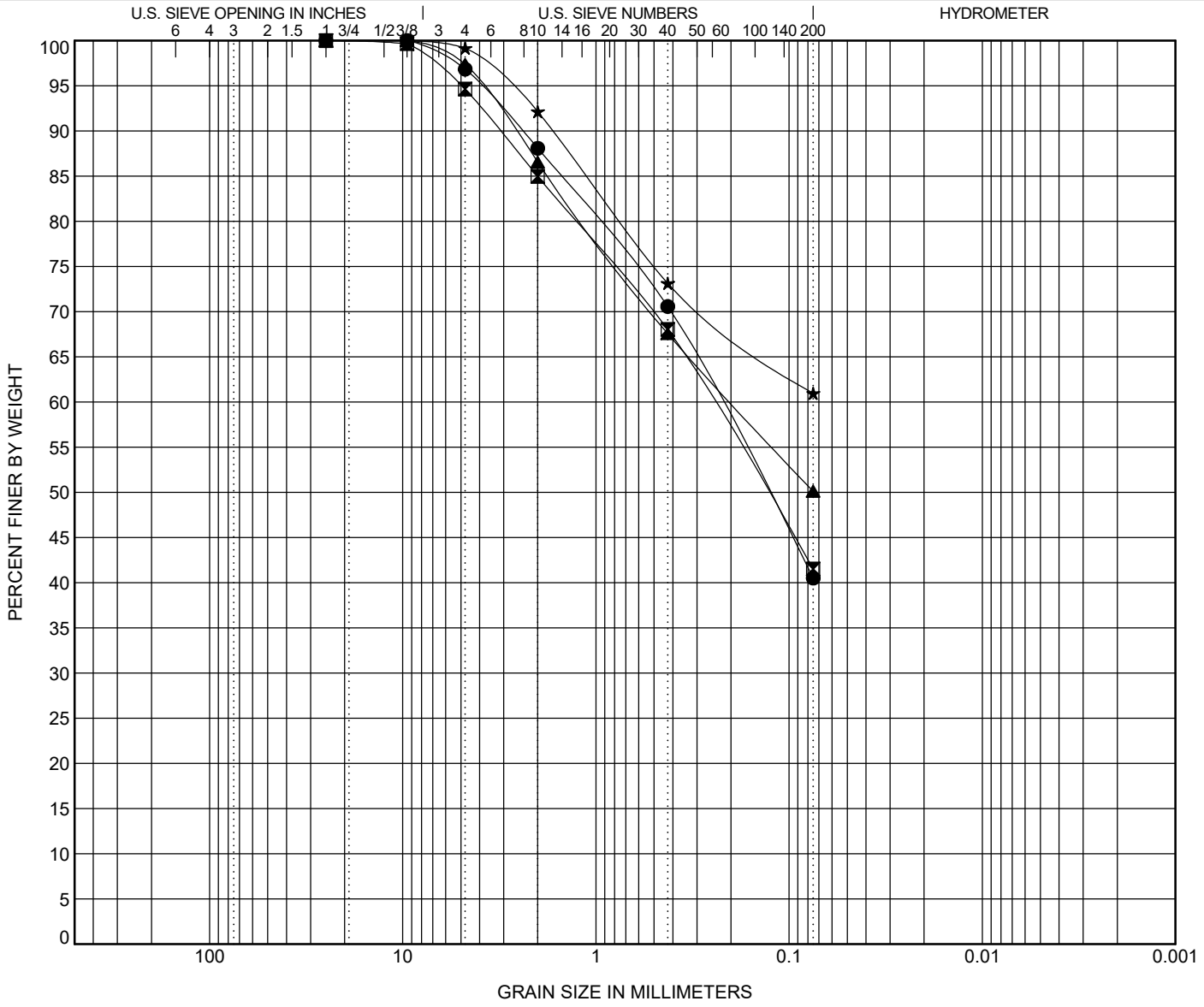
	BOREHOLE	DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B2	64.0	25	0.759	0.428	0.092	12.3	74.6	13.1	
⊠	B2	66.0	25	0.718	0.402	0.107	7.7	81.3	11.0	
▲	B2	89.0	25	0.185	0.123	0.091	0.8	93.6	5.6	
★	B2	94.0	25	0.168	0.114	0.085	0.1	91.5	8.4	
⊙	B2	99.0	25	0.157	0.095		0.9	78.5	20.7	

GRAIN SIZE DISTRIBUTION

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	AASHTO Classification	USCS Classification	LL	PL	PI	Cc	Cu
●	B2	104.0	A-4 (1)	SC	27	17	10		
⊠	B2	109.0	A-6 (2)	SC	31	17	14		
▲	B2	114.0	A-7-6 (8)	CH	50	27	23		
★	B2	119.0	A-7-5 (19)	MH	66	34	32		

BOREHOLE		DEPTH	D100	D50	D30	D15	%Gravel	%Sand	%Silt	%Clay
●	B2	104.0	25	0.13			3.2	56.3	40.5	
⊠	B2	109.0	25	0.131			5.4	53.1	41.5	
▲	B2	114.0	25				2.6	47.3	50.1	
★	B2	119.0	25				0.8	38.2	61.0	

GRAIN SIZE D ADJUSTED - 20171219.GDT - 7/13/23 08:42 - R:\PROJECT\20094260.194\MATERIAL\GEOTECH\DEEP FOUNDATION\VOID\BORING 2.GPJ

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

PCN 23577

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B1	0.0	37	20	17	25	14	A-2-6 (0)	SC					
B1	2.0	37	18	19	25	57	A-6 (8)	CL					
B1	4.0	42	19	23	25	59	A-7-6 (11)	CL					
B1	6.0	42	18	24	25	59	A-7-6 (11)	CL					
B1	9.0	40	18	22	25	56	A-6 (9)	CL					
B1	11.0	40	17	23	25	57	A-6 (10)	CL					
B1	14.0	42	20	22	25	57	A-7-6 (10)	CL					
B1	16.0	40	19	21	25	58	A-6 (9)	CL					
B1	19.0	42	20	22	25	61	A-7-6 (11)	CL					
B1	21.0	42	18	24	25	58	A-7-6 (11)	CL					
B1	24.0	38	18	20	25	61	A-6 (10)	CL					
B1	26.0	37	17	20	25	59	A-6 (9)	CL					
B1	29.0	42	19	23	25	57	A-7-6 (10)	CL					
B1	31.0	38	17	21	25	61	A-6 (10)	CL					
B1	34.0	41	19	22	25	61	A-7-6 (11)	CL					
B1	36.0	38	21	17	25	63	A-6 (9)	CL					
B1	39.0	34	20	14	25	61	A-6 (6)	CL					
B1	41.0	37	19	18	25	69	A-6 (11)	CL					
B1	44.0	NP	NP	NP	25	6	A-1-b (0)	SP-SM					
B1	49.0	NP	NP	NP	25	11	A-1-b (0)	SP-SM					
B1	51.0	30	21	9	25	5	A-2-4 (0)	SP					
B1	54.0	NP	NP	NP	25	7	A-3 (0)	SP-SM					
B1	56.0	NP	NP	NP	25	10	A-1-b (0)	SP-SM					
B1	59.0	NP	NP	NP	25	10	A-1-a (0)	SP-SM					
B1	64.0	32	24	8	25	9	A-2-4 (0)	SW-SM					
B1	69.0	30	24	6	25	13	A-1-b (0)	SM					
B1	71.0	NP	NP	NP	25	16	A-1-b (0)	SM					
B1	74.0	NP	NP	NP	25	11	A-2-4 (0)	SP-SM					
B1	76.0	NP	NP	NP	25	13	A-2-4 (0)	SM					
B1	79.0	NP	NP	NP	25	17	A-2-4 (0)	SM					
B1	81.0	NP	NP	NP	25	12	A-2-4 (0)	SM					
B1	89.0	NP	NP	NP	25	12	A-2-4 (0)	SM					
B1	94.0	NP	NP	NP	25	21	A-2-4 (0)	SM					
B1	99.0	34	18	16	25	49	A-6 (4)	SC					
B1	104.0	25	21	4	25	51	A-4 (0)	CL-ML					
B1	109.0	37	22	15	25	48	A-6 (4)	SC					
B1	114.0	60	27	33	25	57	A-7-6 (16)	CH					
B1	119.0	69	26	43	25	62	A-7-6 (25)	CH					

SUMMARY OF LABORATORY RESULTS

NORTH DAKOTA DEPARTMENT OF TRANSPORATION
300 AIRPORT ROAD
BISMARCK, ND 58504

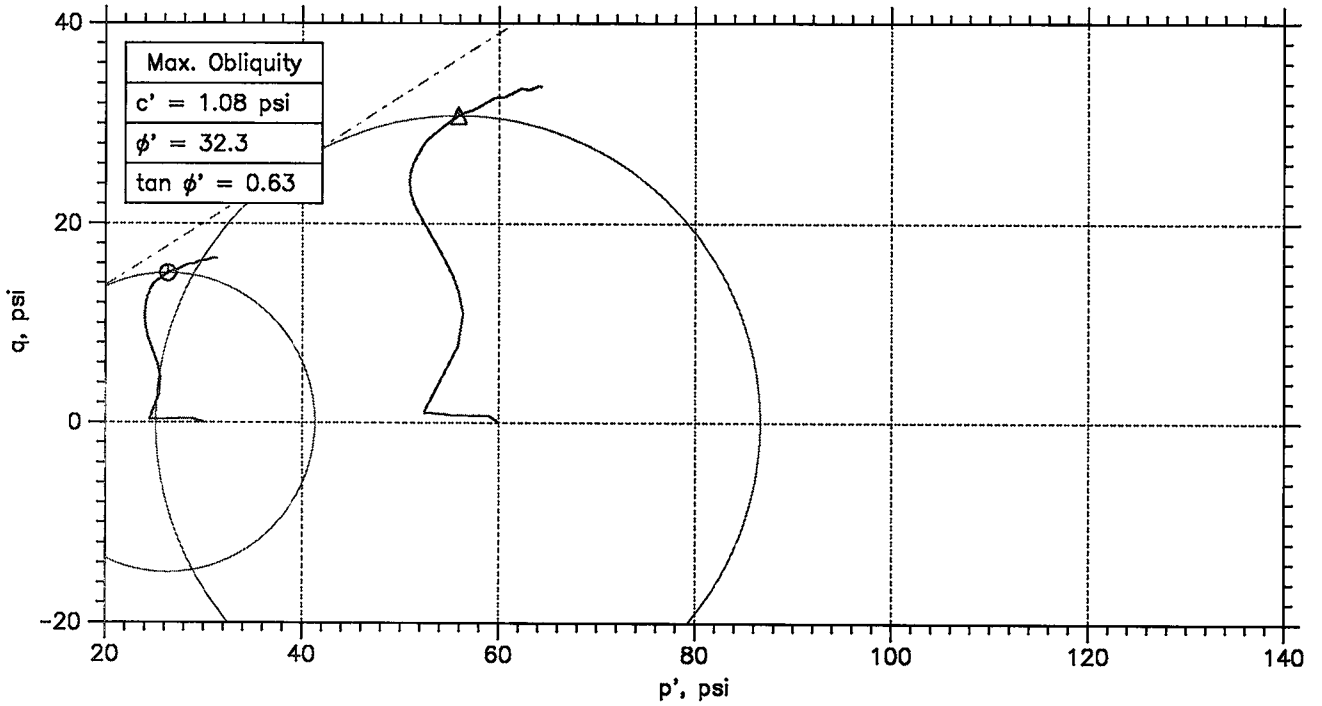
PROJECT NUMBER IM-2-094(194)260 **LOCATION** Stutsman County

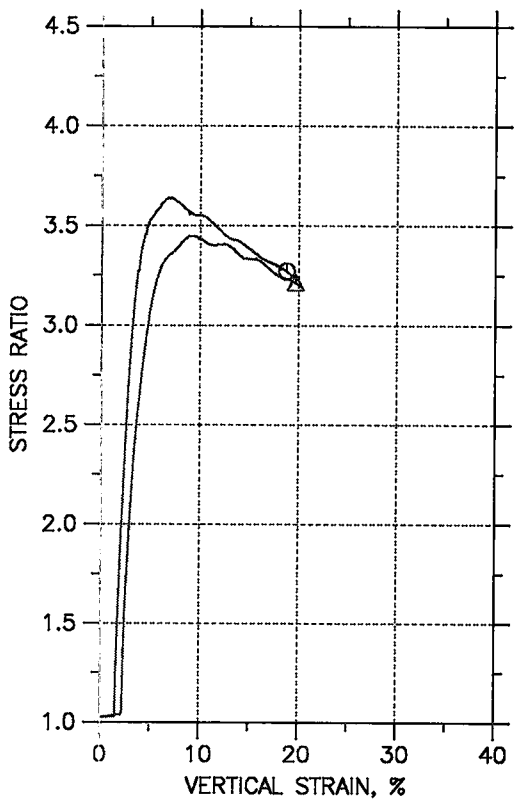
PCN 23577

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	AASHTO Classification	USCS Class-ification	Water Content (%)	Avg. Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B2	0.0	37	19	18	25	49	A-6 (5)	SC					
B2	4.0	38	17	21	25	62	A-6 (10)	CL					
B2	6.0	41	20	21	25	60	A-7-6 (10)	CL					
B2	9.0	40	17	23	25	59	A-6 (11)	CL					
B2	11.0	38	18	20	25	56	A-6 (8)	CL					
B2	14.0	40	16	24	25	59	A-6 (11)	CL					
B2	16.0	38	18	20	25	61	A-6 (10)	CL					
B2	19.0	37	16	21	25	58	A-6 (9)	CL					
B2	21.0	40	19	21	25	55	A-6 (8)	CL					
B2	24.0	42	19	23	25	48	A-7-6 (7)	SC					
B2	26.0	41	18	23	25	60	A-7-6 (11)	CL					
B2	29.0	38	17	21	25	61	A-6 (10)	CL					
B2	31.0	39	17	22	25	60	A-6 (10)	CL					
B2	34.0	39	16	23	25	59	A-6 (10)	CL					
B2	36.0	28	17	11	25	33	A-2-6 (0)	SC					
B2	39.0	31	19	12	25	20	A-2-6 (0)	SC					
B2	40.0	31	21	10	25	22	A-2-4 (0)	SC					
B2	45.0	36	21	15	25	45	A-6 (3)	SC					
B2	47.0	27	18	9	25	38	A-4 (0)	SC					
B2	49.0	29	21	8	25	58	A-4 (2)	CL					
B2	51.0	31	22	9	25	35	A-2-4 (0)	SC					
B2	54.0	33	18	15	25	74	A-6 (9)	CL					
B2	56.0	NP	NP	NP	25	12	A-1-b (0)	SW-SM					
B2	59.0	NP	NP	NP	25	8	A-1-a (0)	SW-SM					
B2	61.0	NP	NP	NP	25	8	A-1-b (0)	SW-SM					
B2	64.0	33	22	11	25	13	A-2-6 (0)	SC					
B2	66.0	30	25	5	25	11	A-1-b (0)	SW-SM					
B2	89.0	NP	NP	NP	25	6	A-3 (0)	SP-SM					
B2	94.0	NP	NP	NP	25	8	A-3 (0)	SP-SM					
B2	99.0	NP	NP	NP	25	21	A-2-4 (0)	SM					
B2	104.0	27	17	10	25	41	A-4 (1)	SC					
B2	109.0	31	17	14	25	42	A-6 (2)	SC					
B2	114.0	50	27	23	25	50	A-7-6 (8)	CH					
B2	119.0	66	34	32	25	61	A-7-5 (19)	MH					

55-391-16

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△		
Sample No.		SS-391-16	SS-391-16		
Test No.		CU-8-16	CU-9-16		
Depth		34.3-34.8	34.8-35.3		
Initial	Diameter, in	2.85	2.863		
	Height, in	5.719	5.738		
	Water Content, %	19.2	18.5		
	Dry Density, pcf	107.7	110.4		
	Saturation, %	94.9	98.2		
	Void Ratio	0.535	0.498		
Before Shear	Water Content, %	20.0	18.9		
	Dry Density, pcf	108.2	110.3		
	Saturation*, %	100.0	100.0		
	Void Ratio	0.529	0.5		
	Back Press., psi	60.95	51.01		
Ver. Eff. Cons. Stress, psi		30.02	59.98		
Shear Strength, psi		16.52	33.73		
Strain at Failure, %		18.8	19.7		
Strain Rate, %/min		0.075	0.075		
B-Value		0.95	0.95		
Estimated Specific Gravity		2.65	2.65		
Liquid Limit		---	---		
Plastic Limit		---	---		

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260

Location:

Project No.:

Boring No.: 2

Sample Type:

Description: T. L. 22" Brn Sandy Clay with I.O. & coal deposits, rock upto 3/4"

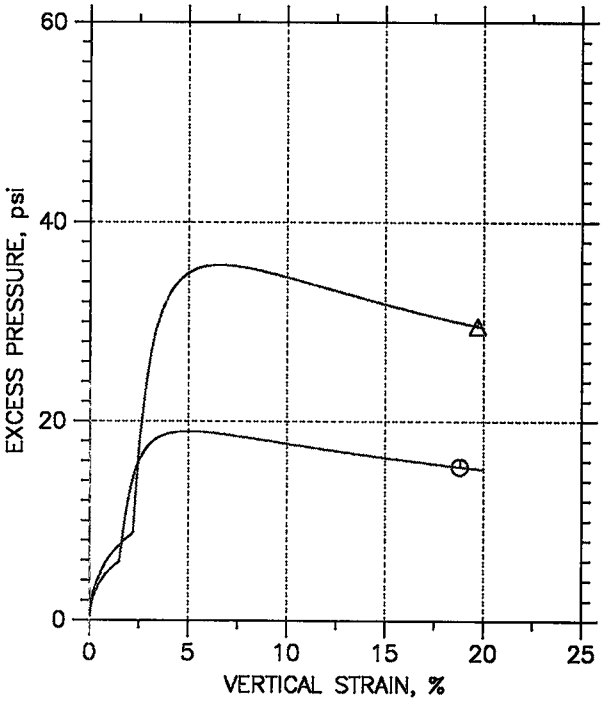
Remarks:

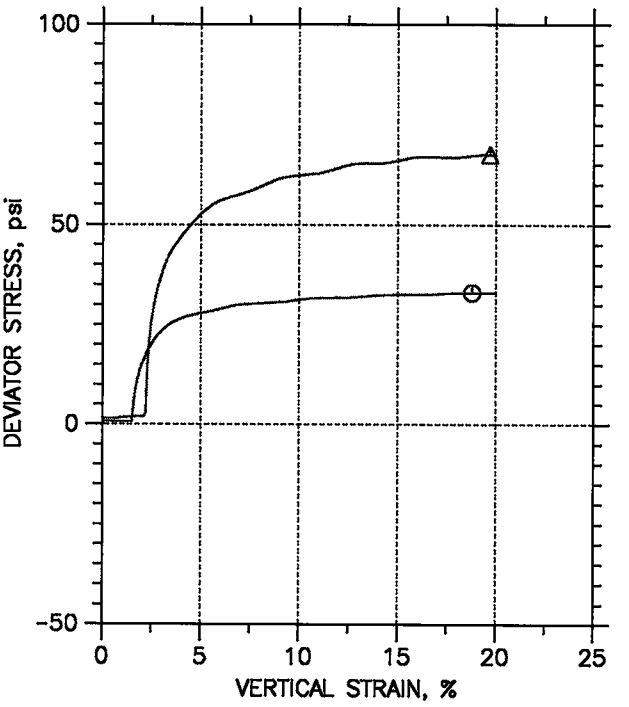
Phase calculations based on start and end of test.

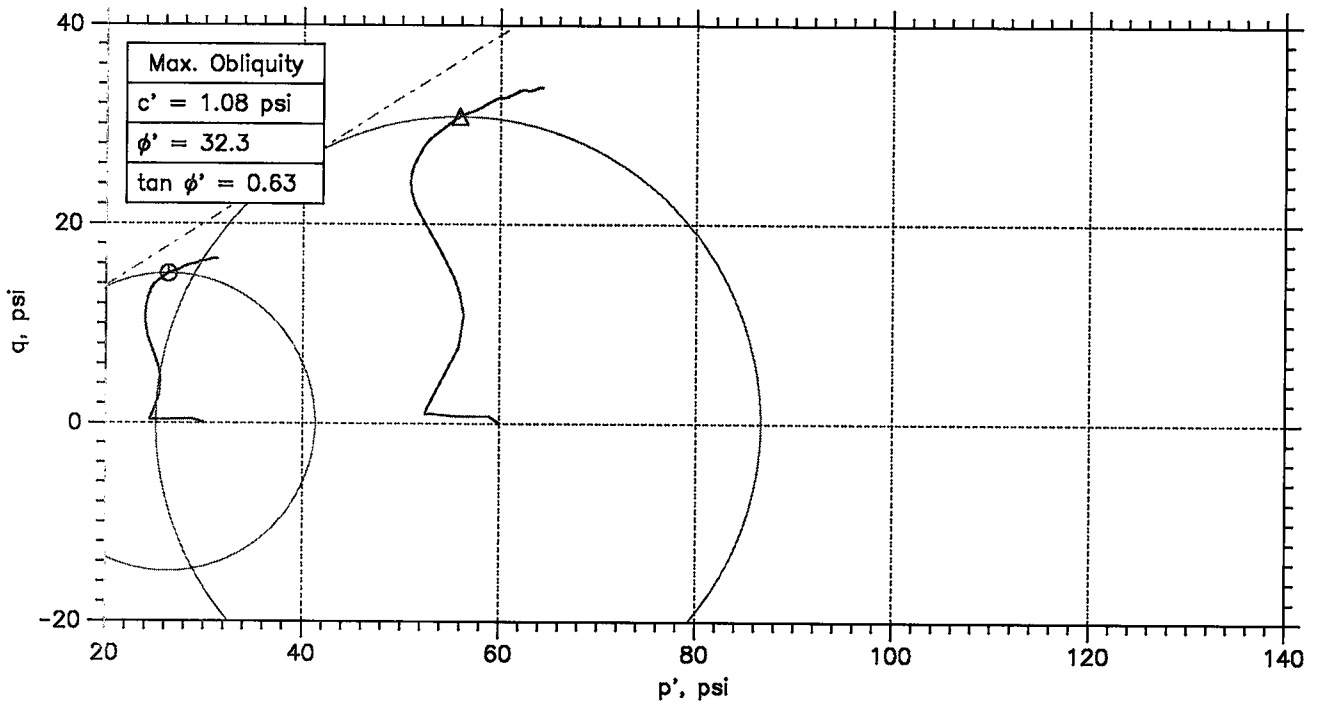
* Saturation is set to 100% for phase calculations.

Tue, 14-JUN-2016 09:52:31

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







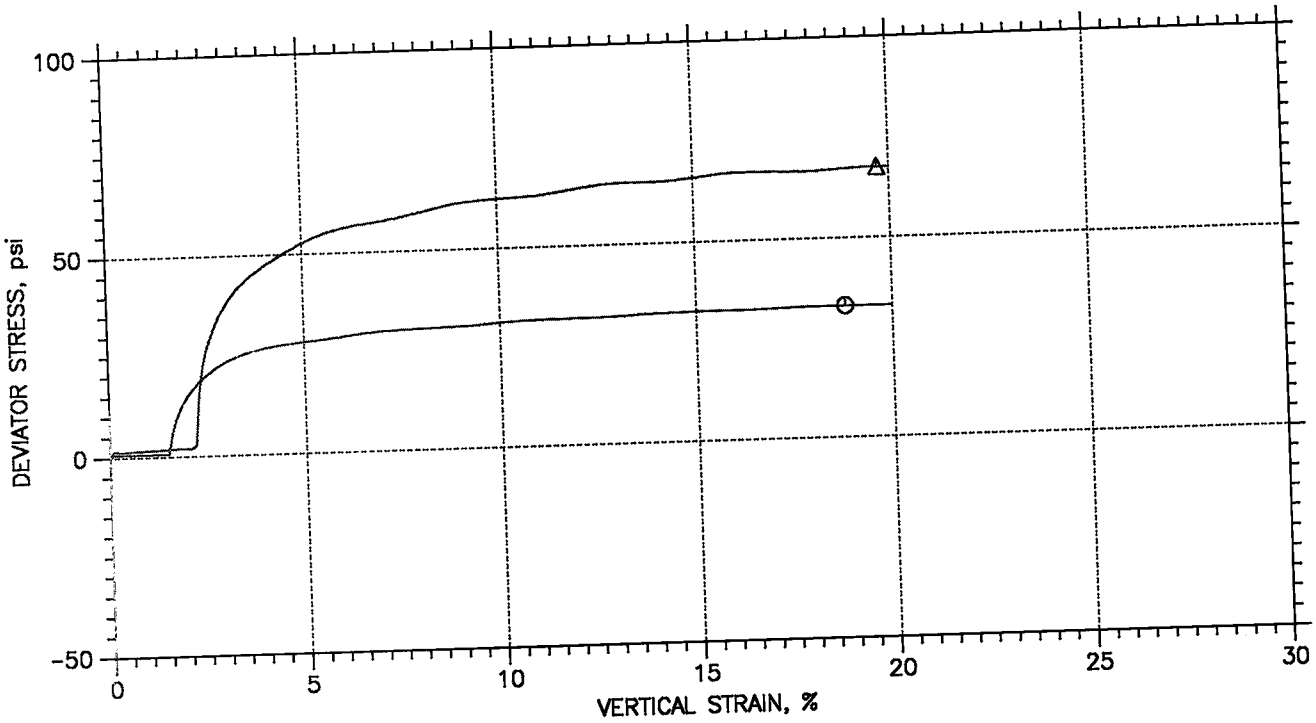
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-391-16	CU-8-16	34.3-34.8	Dan	5/25/16	Matt		CU-8-16.dat
△	SS-391-16	CU-9-16	34.8-35.3	Dan	6/1/16	Matt		CU-9-16.dat

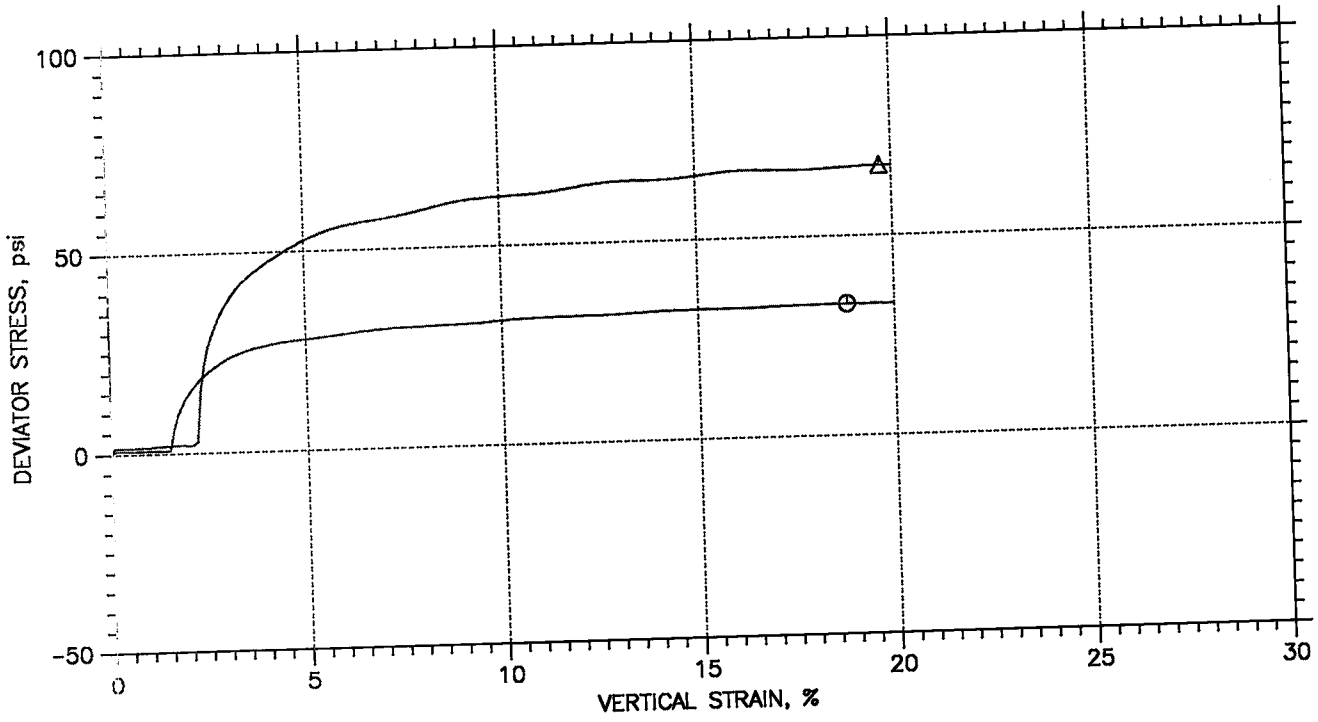
NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Sample Type:	
Description: T. L. 22" Brn Sandy Clay with I.O. & coal deposits, rock upto 3/4"		
Remarks:		

Tue, 14-JUN-2016 09:52:31

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-391-16	CU-8-16	34.3-34.8	Dan	5/25/16	Matt		CU-8-16.dat
△	SS-391-16	CU-9-16	34.8-35.3	Dan	6/1/16	Matt		CU-9-16.dat

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Sample Type:	
Description: T. L. 22" Brn Sandy Clay with I.O. & coal deposits, rock upto 3/4"		
Remarks:		

Tue, 14-JUN-2016 09:52:32

TRIAXIAL UU(Q) CCU(R) CD(S)

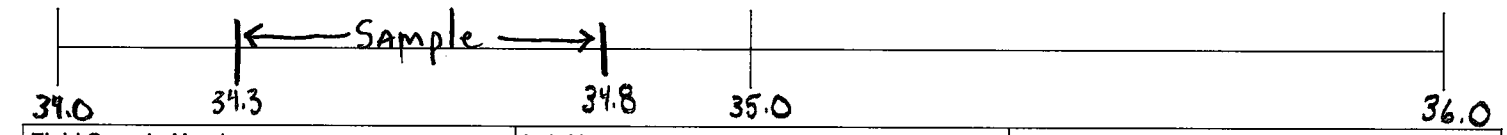
North Dakota Department of Transportation, Materials & Research
SFN 50459 (5-2016)

56	29.66	
Wet Wt	172.62	Project Number: IM-2-094(143)260
Dry Wt	148.83	Boring Number: 2

After Test Wt. 1230.79

Field Sample Number: SS-391-16			Lab Number: CU-8-16		Depth: 34.3 to 34.8
Weight of Sample: 1229.69			Confining Pressure: 30		Test Number: 1 of 3
Diameter	2.856	2.846	Height	5.718	Moisture Can Number: S35
	2.850	2.840		5.718	Wet Wt + Can: 65.46
	2.851	2.856		5.720	Dry Wt + Can: 57.69
	Average: 2.850		Average: 5.719		Wt of Can: 17.16

Total Length: 22" Brn Sandy Cly with I.O+ Coal Deposits, Rock up to 3/4"

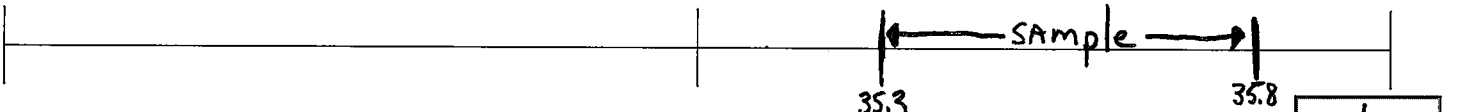


Field Sample Number: SS-391-16			Lab Number: CU-9-16		Depth: 34.8 to 35.3
Weight of Sample: 1268.35			Confining Pressure: 60		Test Number: 2 of 3
Diameter	2.856	2.878	Height	5.739	Moisture Can Number: S36
	2.853	2.868		5.736	Wet Wt + Can: 62.35
	2.857	2.866		5.739	Dry Wt + Can: 55.34
	Average: 2.863		Average: 5.738		Wt of Can: 17.40

Total Length: After Test Wt. 1258.36 | Can S42 | Tare Wt. 29.59 | Wet Wt. 180.34 | Dry Wt. 156.40

Field Sample Number: SS-391-16			Lab Number: CU-10-16		Depth: 35.3 to 35.8	
Weight of Sample: 1263.04			Confining Pressure: 90		Test Number: 3 of 3	
Diameter	2.847	2.866	Height	5.736	Moisture Can Number: S66	S5
	2.851	2.867		5.731	Wet Wt + Can: 59.80	CAN 176.31 1244.63
	2.857	2.866		5.734	Dry Wt + Can: 52.74	153.56
	Average: 2.859		Average: 5.734		Wt of Can: 15.38	17.27

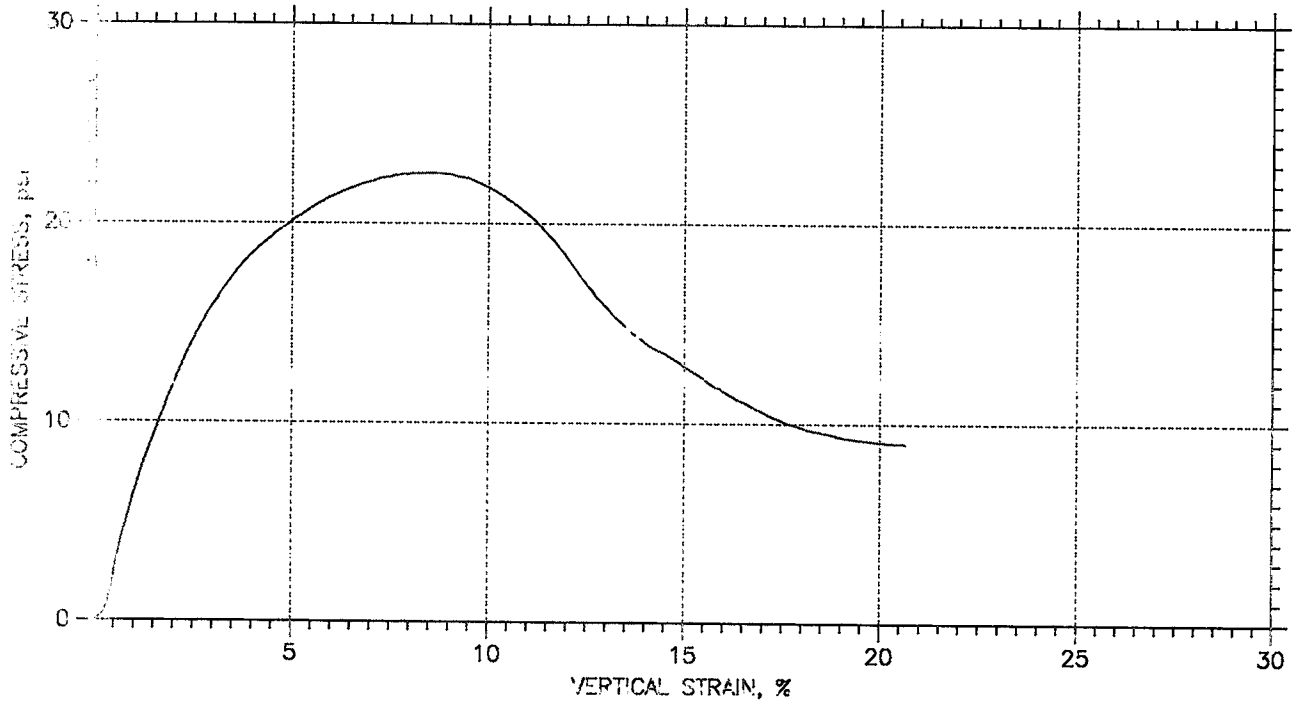
Total Length:



AASHTO T-234 Tested By: DT / MD

55-389-16

UNCONFINED COMPRESSION TEST REPORT

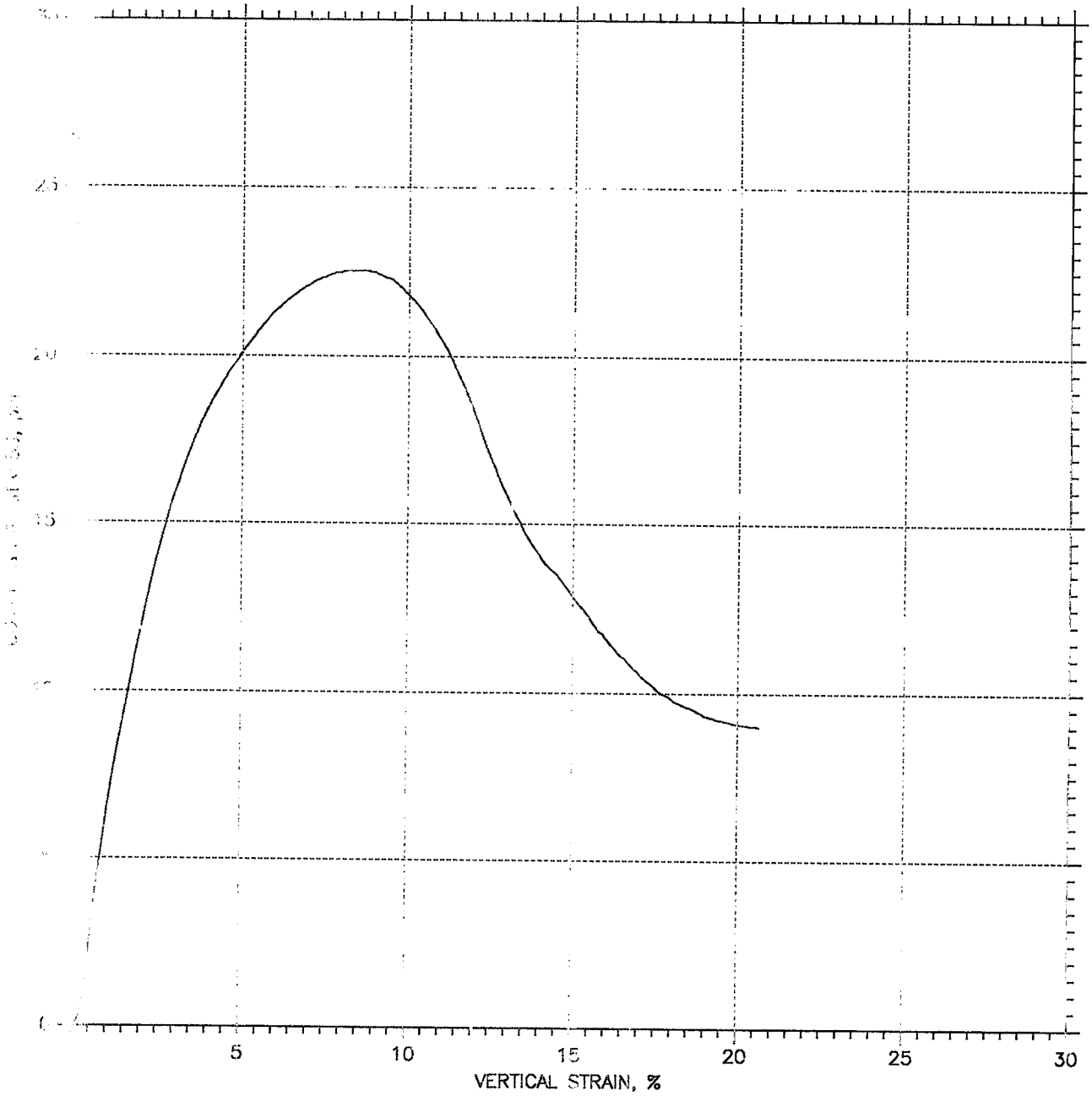


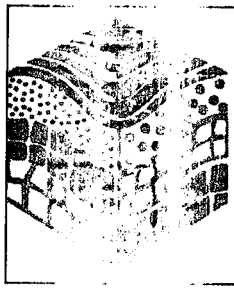
Symbol					
Test No.		UC-24-16			
Initial	Diameter, in	2.864			
	Height, in	5.732			
	Water Content, %	17.11			
	Dry Density, pcf	112.1			
	Saturation, %	95.38			
	Void Ratio	0.475			
Unconfined Compressive Strength, psi		22.52			
Undrained Shear Strength, psi		11.26			
Time to Failure, min		8.3358			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					

Project: IM-2-094(143)260
Location:
Project No.:
Boring No.: 2
Sample Type: Undisturbed
Description: T. L. 16" Brn Clay with 1/2" rock,
Remarks:

SS-389-16

UNCONFINED COMPRESSION TEST REPORT





Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Tested By: DT	Checked By: MD
Sample No.: SS-389-16	Test Date: 6/7/2016	Depth: 29.5-30.0
Test No.: UC-24-16	Sample Type: Undisturbed	Elevation:
Description: T. L. 16" Brn Clay with 1/2" rock,		
Remarks:		

UNCONFINED COMPRESSION TEST

55-389-16

Project: [illegible]260
Boring No.:
Sample No.: [illegible]
Test No.: [illegible]

Location:
Tested By: DT
Test Date: 6/7/2016
Sample Type: Undisturbed

Project No.:
Checked By: MD
Depth: 29.5-30.0
Elevation:

Soil Description: [illegible] L. 16" Brn Clay with 1/2" rock,
Remarks:

Specimen Height: 5.73 in
Specimen Area: [illegible] inA2
Specimen Volume: [illegible].12 cc

Liquid Limit: 0
Plastic Limit: 0
Measured Specific Gravity: 2.65

Cap Mass: 0 gm

Water Content Information

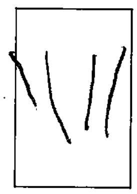
Container	s14
Wt. Container, gm	16.92
Wt. Container + Wet Soil, gm	65.24
Wt. Container + Dry Soil, gm	58.18
Wt. Dry Soil, gm	41.26
Water Content, %	17.11
Void Ratio	0.48
Degree of Saturation, %	95.38
Wet Unit Weight, pcf	131.31
Dry Unit Weight, pcf	112.13

UNCONFINED COMPRESSION

North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

Project Number	IM-2-094(143)260
Boring Number	2

Field Sample Number	SS-389-16	Lab Number	UC-24-16	Depth	29.5 - 30.0
Weight of Sample	1272.85	Test Number	1 of 1	AASHTO T-208 Tested by:	DT
Diameter	1. 2.867 / 4. 2.857	Height	1. 5.729	Moisture Can Number	514
	2. 2.869 / 5. 2.862		2. 5.737	Wet Wt + Can	65.24
	3. 2.866 / 6. 2.866		3. 5.730	Dry Wt + Can	58.18
	Average 2.864	Average	5.732	Wt of Can	16.92



Total Length:

16" Brn Clay w/ 1/2" rock.

29.0 — 30.0 — 31.0

← sample →

Field Sample Number		Lab Number		Depth	
Weight of Sample		Test Number	of	AASHTO T-208 Tested by:	
Diameter	1. / 4.	Height	1.	Moisture Can Number	
	2. / 5.		2.	Wet Wt + Can	
	3. / 6.		3.	Dry Wt + Can	
	Average	Average		Wt of Can	

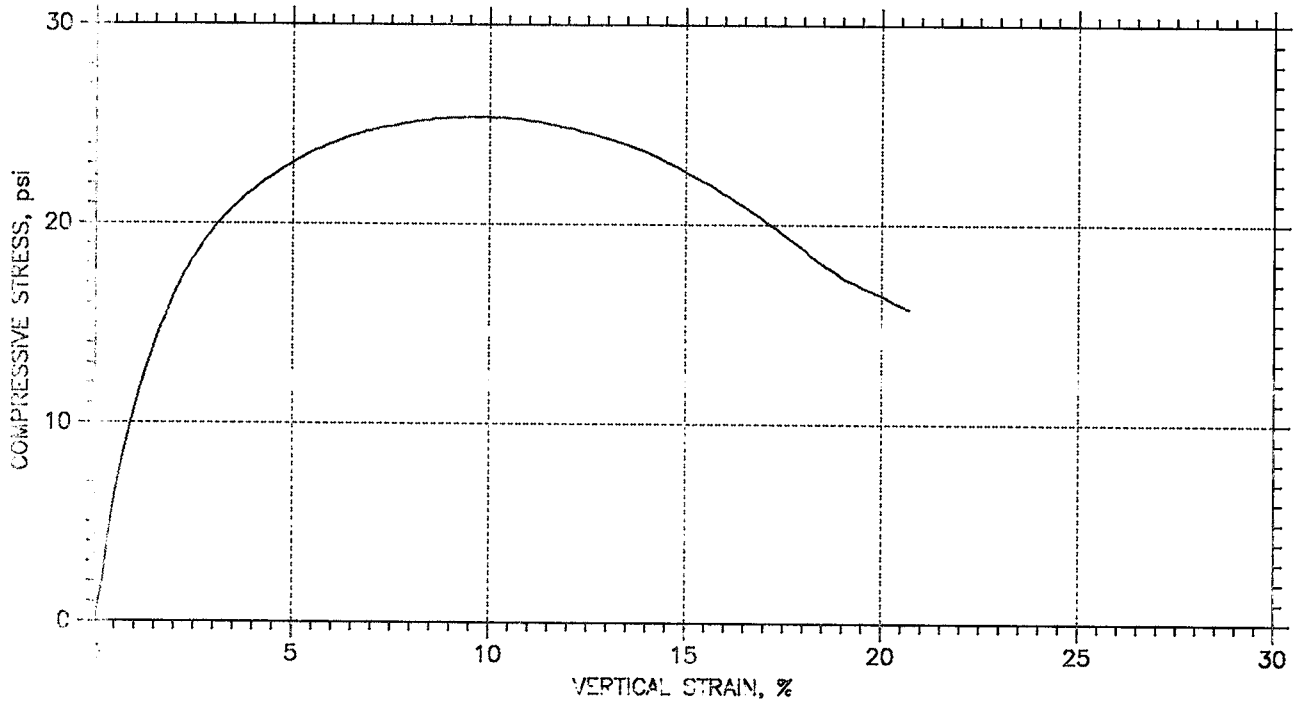
Total Length:

Field Sample Number		Lab Number		Depth	
Weight of Sample		Test Number	of	AASHTO T-208 Tested by:	
Diameter	1. / 4.	Height	1.	Moisture Can Number	
	2. / 5.		2.	Wet Wt + Can	
	3. / 6.		3.	Dry Wt + Can	
	Average	Average		Wt of Can	

Total Length:

SS-387-16

UNCONFINED COMPRESSION TEST REPORT



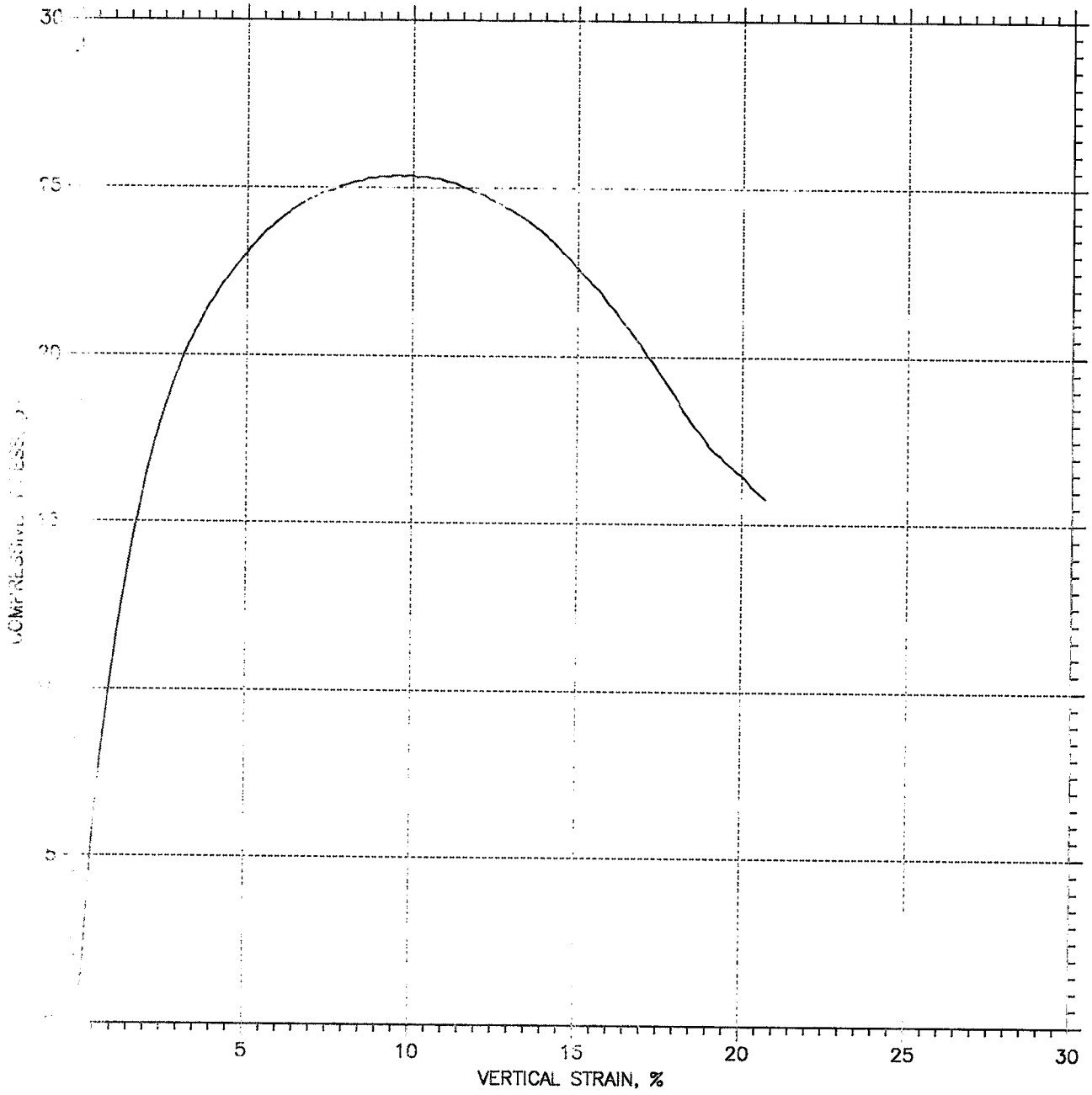
Symbol					
Test No.		UC-23-16			
Initial	Diameter, in	2.849			
	Height, in	5.742			
	Water Content, %	19.66			
	Dry Density, pcf	108.			
	Saturation, %	97.82			
	Void Ratio	0.532			
Unconfined Compressive Strength, psi		25.37			
Undrained Shear Strength, psi		12.68			
Time to Failure, min		9.6706			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					

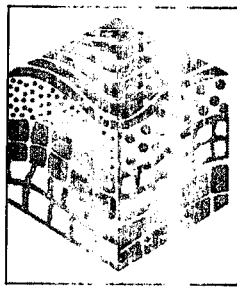
Project: IM-2-094(143)260	
Location:	
Project No.:	
Boring No.: 2	
Sample Type: Undisturbed	
Description: T. L. 15 1/2" Brn Cly with I.O. & Coa Deposits, rock up to 2"	
Remarks:	

Mon, 13-JUN-2016 09:45:16

SS-387-16

UNCONFINED COMPRESSION TEST REPORT





Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Tested By: DT	Checked By: MD
Sample No.: SS-387-16	Test Date: 6/6/2016	Depth: 24.5-25.0
Test No.: UC-23-16	Sample Type: Undisturbed	Elevation:
Description: T. L. 15 1/2" Brn Cly with I.O. & Coal Deposits, rock up to 2"		
Remarks:		

Mon, 13-JUN-2016 08:25:16

SS-387-16

UNCONFINED COMPRESSION TEST

Project: IM-2-094(...)260
Boring No.: 2
Sample No.: SS-387-16
Test No.: UC-23-16

Location:
Tested By: DT
Test Date: 6/6/2016
Sample Type: Undisturbed

Project No.:
Checked By: MD
Depth: 24.5-25.0
Elevation:

Soil Description: ... L. 15 1/2" Brn Cly with I.O. & Coal Deposits, rock up to 2"
Remarks:

Specimen Height: 5.74 in
Specimen Area: 6.3... inA2
Specimen Volume: 5...0.85 cc

Liquid Limit: 0
Plastic Limit: 0
Measured Specific Gravity: 2.65

Cap Mass: 0 gm

Water Content Information

Container ID	S 48
Wt. Container, gm	17.01
Wt. Container + Wet Soil, gm	76.24
Wt. Container + Dry Soil, gm	66.52
Wt. Dry Soil, gm	49.5
Water Content, %	19.66
Void Ratio	0.53
Degree of Saturation, %	97.82
Wet Unit Weight, pcf	129.17
Dry Unit Weight, pcf	107.95

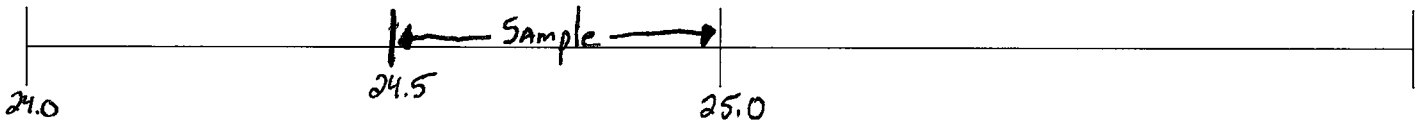
UNCONFINED COMPRESSION

North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

Project Number	
IM-2-094(143)260	
Boring Number	
2	

Field Sample Number			Lab Number		Depth
SS-387-16			UC-23-16		24.5 to 25.0
Weight of Sample			Test Number 1 of 1		AASHTO T-208 Tested by: DT/MD
1241.15					
Diameter	1. 2.860	4. 2.826	Height	1. 5.740	Moisture Can Number S48
	2. 2.857	5. 2.848		2. 5.745	Wet Wt + Can 76.24
	3. 2.854	6. 2.850		3. 5.741	Dry Wt + Can 66.51
	Average 2.849		Average 5.742		Wt of Can 17.01

Total Length: 15½" Brn Cly with I.O. + Coal Deposits, Rock up to 2"



Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number of		AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

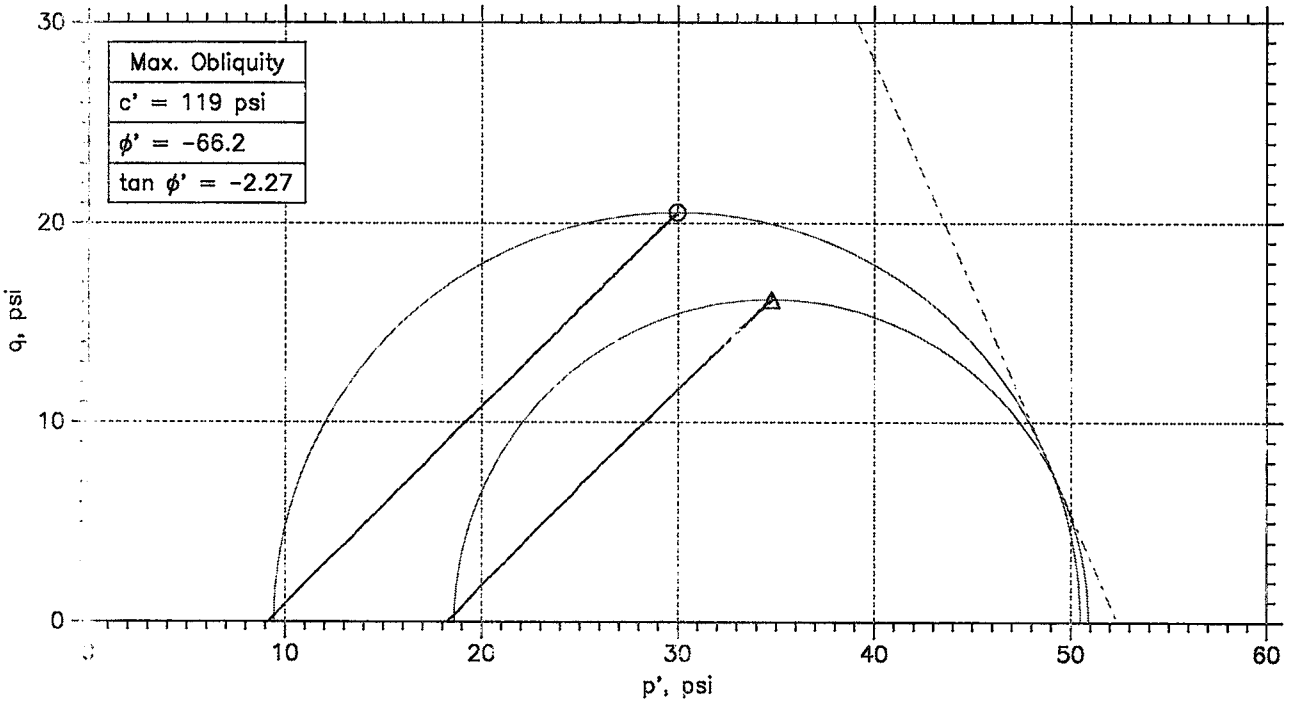
Total Length:

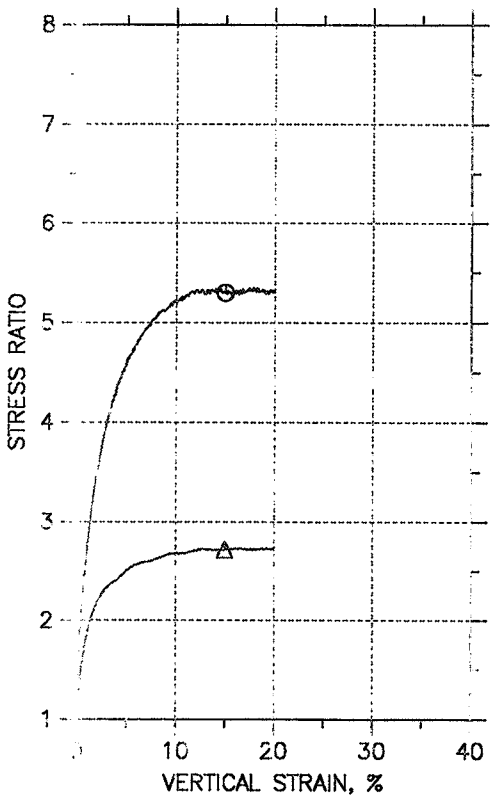
Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number of		AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

Total Length:

SS-385-16

Test File





Symbol		⊙	△
Sample No.		SS-385-16	SS-385-16
Test No.		UU-41-16	UU-42-16
Depth		19.3-19.8	19.8-20.3
Initial	Diameter, in	2.845	2.836
	Height, in	5.751	5.749
	Water Content, %	18.8	20.9
	Dry Density, pcf	111.9	108.3
	Saturation, %	104.2	105.0
	Void Ratio	0.478	0.528
Before Shear	Water Content, %	18.0	19.9
	Dry Density, pcf	112.	108.3
	Saturation*, %	100.0	100.0
	Void Ratio	0.478	0.528
	Back Press., psi	.0	.0
Ver. Eff. Cons. Stress, psi		9.186	13.27
Shear Strength, psi		20.36	16.
Strain at Failure, %		15	15
Strain Rate, %/min		1	1
B-Value		----	----
Estimated Specific Gravity		2.65	2.65
Liquid Limit		---	---
Plastic Limit		---	---

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260

Location:

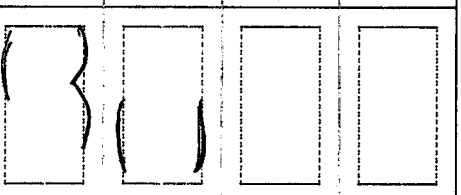
Project No.:

Boring No.: 2

Sample Type:

Description: T.L. 19 3/4" Brn Cly with LO deposits, Rock up to 3/4"

Remarks:



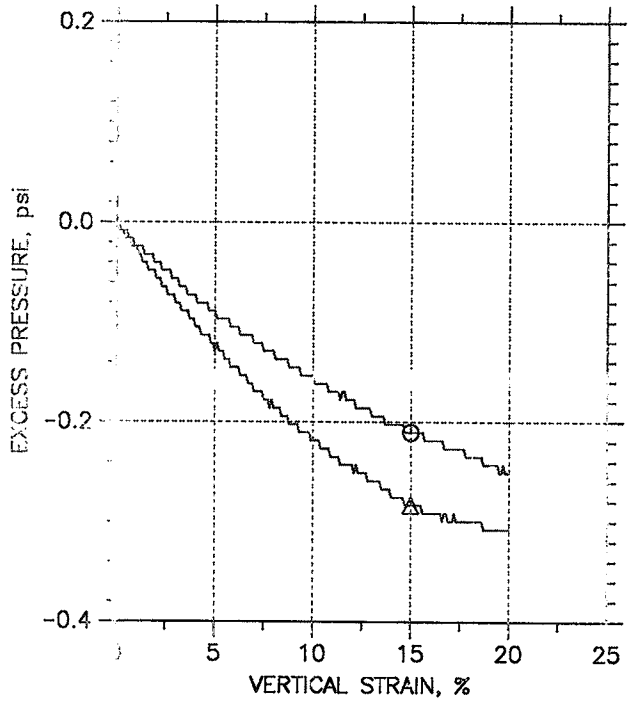
Phase calculations based on start and end of test.

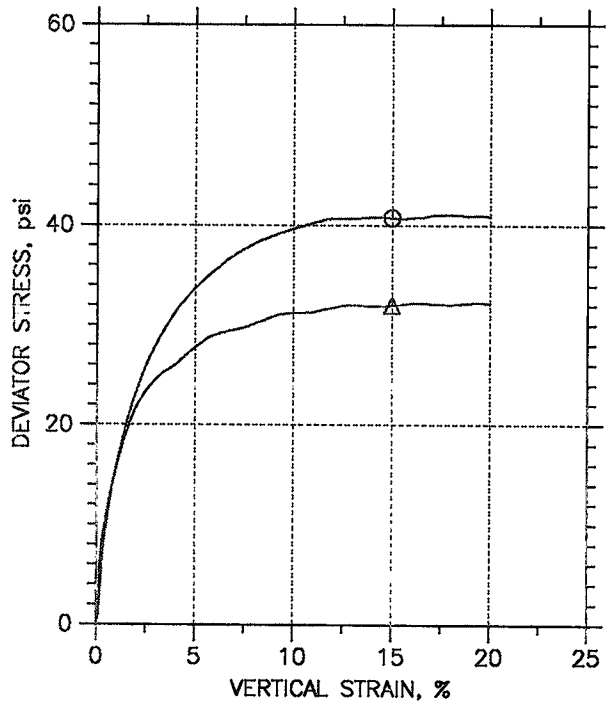
* Saturation is set to 100% for phase calculations.

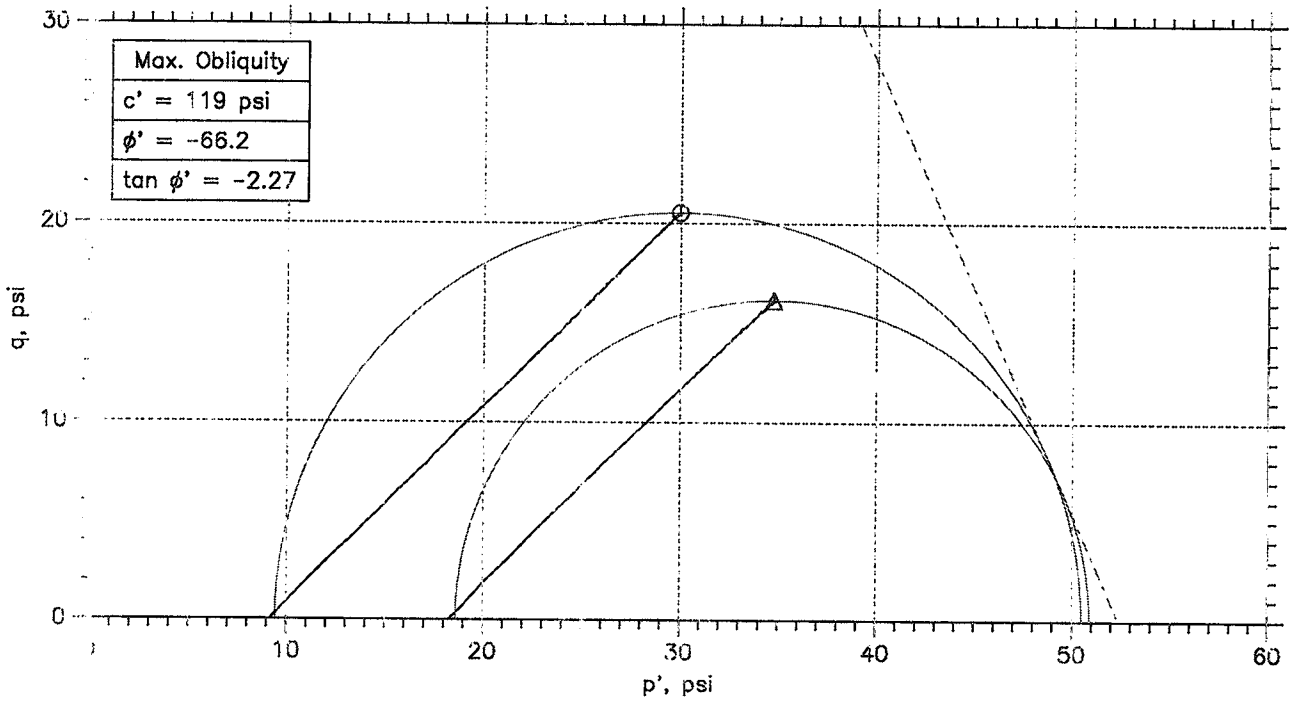
Mon, 13-JUN-2016 09:26:29

SS-385-16

Test File







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-385-16	UU-41-16	19.3-19.8	DT	6/6/16	MD		UU-41-2016.dat
△	SS-385-16	UU-42-16	19.8-20.3	DT	6/6/16	MD		UU-42-2016.dat

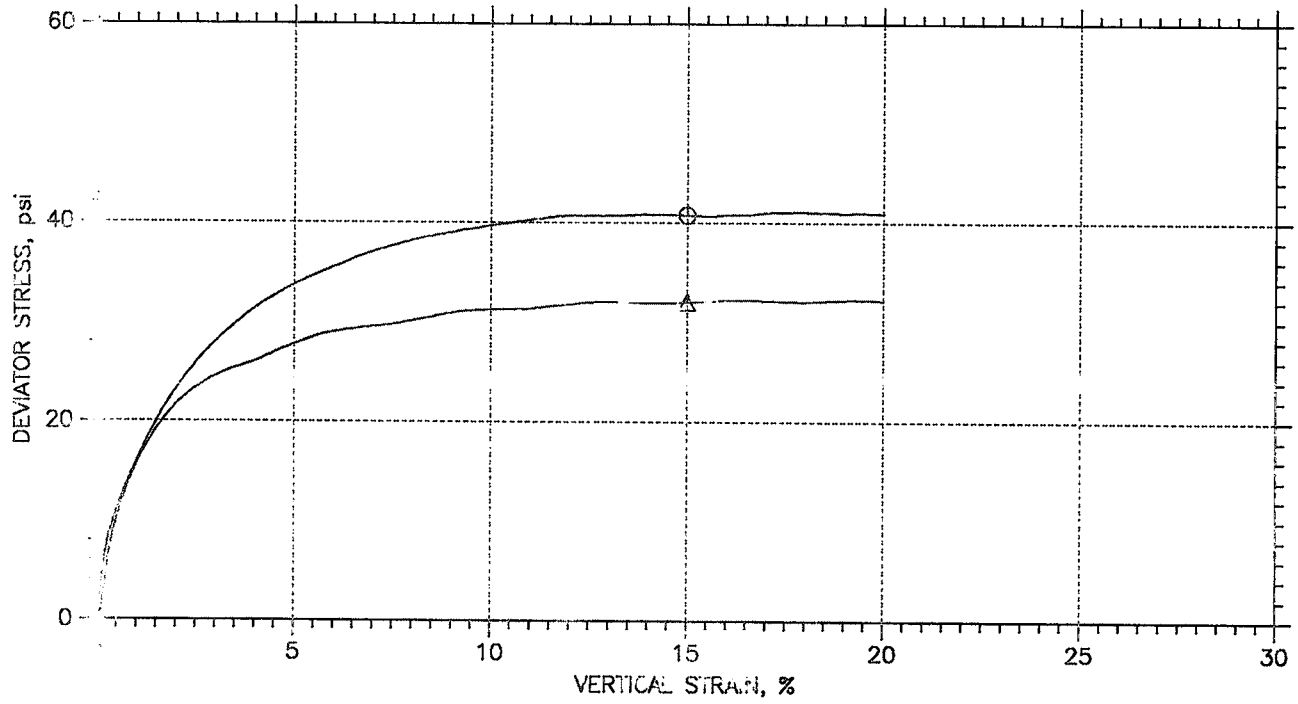
NDDOT North Dakota Department of Transportation

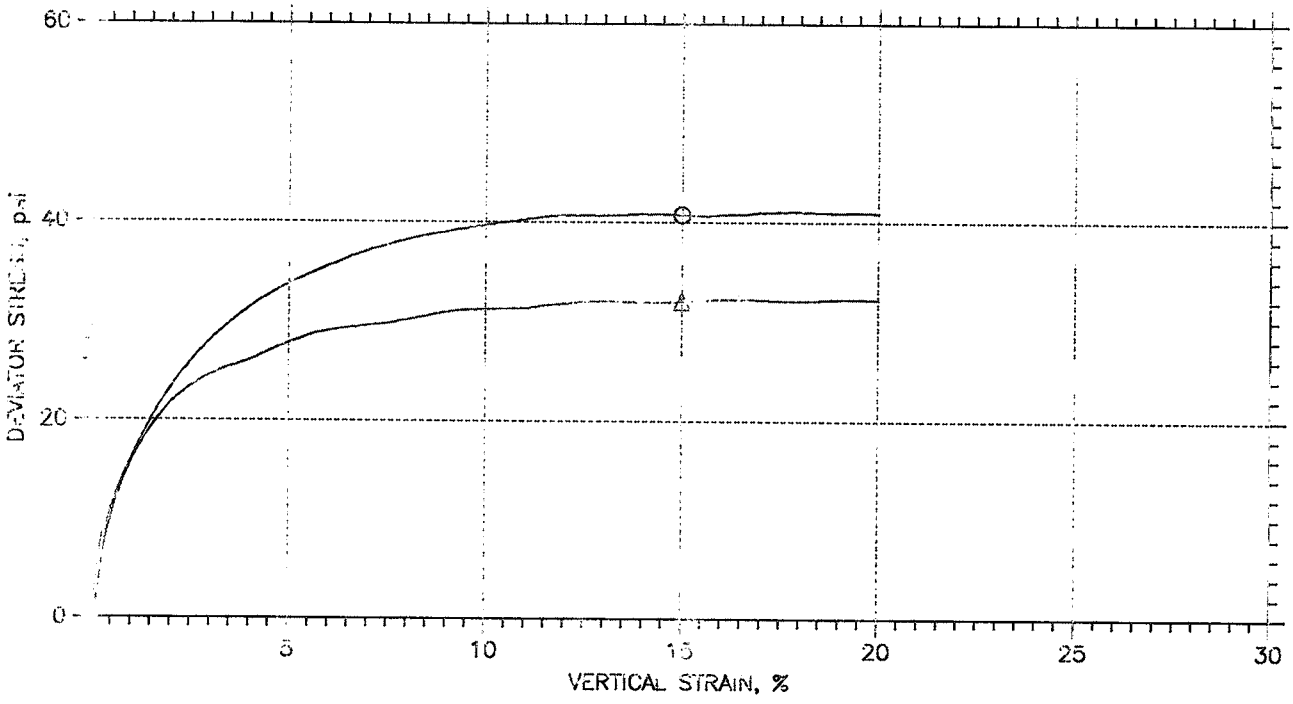
Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Sample Type:	
Description: T.L. 19 3/4" Brn Cly with I.O deposits, Rock up to 3/4"		
Remarks:		

Mon, 13-JUN-2016 08:13:29

SS-385-16

Test File





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-385- 6	UU-41-16	19.3-19.8	DT	6/6/16	MD		UU-41-2016.dat
△	SS-385 - 6	UU-42-16	19.8-20.3	DT	6/6/16	MD		UU-42-2016.dat

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Sample Type:	
Description: T.L. 19 3/4" Brn Cly with I.O deposits, Rock up to 3/4"		
Remarks:		

Mon, 13-JUN-2016 09:29

SS-385-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 2 | Tested By: DT | Checked By: MD
Sample No.: SS-385-16 | Test Date: 6/6/16 | Depth: 19.3-19.8
Test No.: UU-41-1 | Sample Type: | Elevation:

Soil Description: T.L. 19 3/4" Brn Cly with I.O deposits, Rock up to 3/4"
Remarks:

Specimen Height: 5.75 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.36 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 599.10 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 40	---		
Wt. Container + Wet Soil, gm	68.57	---	---	0
Wt. Container + Dry Soil, gm	60.4	---	---	0
Wt. Container, gm	16.93	---	---	0
Wt. Wet Soil, gm	51.64	1276.1	1074.2	0
Wt. Dry Soil, gm	43.47	1074.2	1074.2	0
Wt. Water, gm	8.17	201.89	0	0
Water Content, %	18.79	18.79	0.00	0.00
Void Ratio	---	0.48	0.48	---
Degree of Saturation, %	---	104.20	0.00	---
Dry Unit Weight, pcf	---	111.93	111.96	---

Initial

Height: 5.751 in
Area: 6.357 in^2
Volume: 599.1 cc

Moisture: 18.79 %
Void Ratio: 0.48
Dry Unit Weight: 111.93 pcf
Saturation: 104.20 %

End of Initialization
Time: 4.9895 min
Total Vertical Stress: 9.186 psi
Total Horizontal Stress: 9.1869 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 9.186 psi
Effective Horizontal Stress: 9.1869 psi

Height Change: 0.000416 in
Area Change: 0 in^2
Volume Change: 0.13001 cc
Water Change: 0.0080445 cc
Correction: 8.2621 cc

Height: 5.7506 in
Area: 6.357 in^2
Volume: 598.97 cc

Moisture: 18.02 %
Void Ratio: 0.48
Dry Unit Weight: 111.96 pcf
Saturation: 100.00 %

End of Consolidation/A
Time: 4.8885 min
Total Vertical Stress: 9.186 psi
Total Horizontal Stress: 9.1869 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 9.186 psi
Effective Horizontal Stress: 9.1869 psi

Height Change: 0.000416 in
Area Change: 0 in^2
Volume Change: 0.13001 cc
Water Change: 0.0080445 cc
Correction: 8.2621 cc

Height: 5.7506 in
Area: 6.357 in^2
Volume: 598.97 cc

Moisture: 18.02 %
Void Ratio: 0.48
Dry Unit Weight: 111.96 pcf
Saturation: 100.00 %

End of Saturation
Time: 4.8885 min
Total Vertical Stress: 9.186 psi
Total Horizontal Stress: 9.1869 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 9.186 psi
Effective Horizontal Stress: 9.1869 psi

Height Change: 0.000416 in
Area Change: 0 in^2
Volume Change: 0.13001 cc
Water Change: 0.0080445 cc
Correction: 8.2621 cc

Height: 5.7506 in
Area: 6.357 in^2
Volume: 598.97 cc

Moisture: 18.02 %
Void Ratio: 0.48
Dry Unit Weight: 111.96 pcf
Saturation: 100.00 %

End of Consolidation/B
Time: 4.8885 min
Total Vertical Stress: 9.186 psi
Total Horizontal Stress: 9.1869 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 9.186 psi
Effective Horizontal Stress: 9.1869 psi

Height Change: 0.000416 in
Area Change: 0 in^2
Volume Change: 0.13001 cc
Water Change: 0.0080445 cc
Correction: 8.2621 cc

Height: 5.7506 in
Area: 6.357 in^2
Volume: 598.97 cc

Moisture: 18.02 %
Void Ratio: 0.48
Dry Unit Weight: 111.96 pcf
Saturation: 100.00 %

End of Shear
Time: 25.119 min
Total Vertical Stress: 50.138 psi
Total Horizontal Stress: 9.2595 psi
Pore Pressure: -0.5093 psi
Effective Vertical Stress: 50.438 psi
Effective Horizontal Stress: 9.5105 psi

Height Change: 1.1607 in
Area Change: -1.3885 in^2
Volume Change: 0.13001 cc
Water Change: 0.0080445 cc
Correction: 201.88 cc

Height: 4.6003 in
Area: 7.9455 in^2
Volume: 598.97 cc

Moisture: 0.00 %
Void Ratio: 0.48
Dry Unit Weight: 111.96 pcf
Saturation: 0.00 %

At Failure
Time: 20.135 min
Total Vertical Stress: 49.999 psi
Total Horizontal Stress: 9.2746 psi
Pore Pressure: -0.51046 psi
Effective Vertical Stress: 50.209 psi
Effective Horizontal Stress: 9.4851 psi

Height Change: 0.863 in
Area Change: -1.1223 in^2
Volume Change: 0.13001 cc
Water Change: 0.0080445 cc
Correction: 0 cc

Height: 4.888 in
Area: 7.4793 in^2
Volume: 598.97 cc

Moisture: 18.02 %
Void Ratio: 0.48
Dry Unit Weight: 111.96 pcf
Saturation: 100.00 %

SS-385-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 2 | Tested By: DT | Checked By: MD
Sample No.: SS-38[illegible]-16 | Test Date: 6/6/16 | Depth: 19.8-20.3
Test No.: UU-42-[illegible] | Sample Type: | Elevation:

Soil Description: T.L. 19 3/4" Brn Cly with I.O and Coal deposits, Rock up to 3/4"
Remarks:

Specimen Height: .75 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.[illegible]2 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: [illegible]95.11 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 28	---		
Wt. Container + Wet Soil, gm	74.69	---	---	0
Wt. Container + Dry Soil, gm	64.45	---	---	0
Wt. Container, gm	15.47	---	---	0
Wt. Wet Soil, gm	59.22	1248.3	1032.4	0
Wt. Dry Soil, gm	48.98	1032.4	1032.4	0
Wt. Water, gm	10.24	215.84	0	0
Water Content, %	20.91	20.91	0.00	0.00
Void Ratio	---	0.53	0.53	---
Degree of Saturation, %	---	105.02	0.00	---
Dry Unit Weight, pcf	---	108.3	108.3	---

Initial
Height: 5.749 in
Area: 6.3169 in^2
Volume: 595.11 cc
Moisture: 20.91 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 105.02 %

End of Consolidation
Time: 4.9946 min
Total Vertical Stress: 18.27 psi
Total Horizontal Stress: 18.269 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 18.27 psi
Effective Horizontal Stress: 18.269 psi
Height Change: 0 in
Area Change: 0 in^2
Volume Change: 0 cc
Water Change: 0.24509 cc
Correction: 10.081 cc
Height: 5.749 in
Area: 6.3169 in^2
Volume: 595.11 cc
Moisture: 19.91 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 100.00 %

End of Consolidation/A
Time: 4.9946 min
Total Vertical Stress: 18.27 psi
Total Horizontal Stress: 18.269 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 18.27 psi
Effective Horizontal Stress: 18.269 psi
Height Change: 0 in
Area Change: 0 in^2
Volume Change: 0 cc
Water Change: 0.24509 cc
Correction: 10.081 cc
Height: 5.749 in
Area: 6.3169 in^2
Volume: 595.11 cc
Moisture: 19.91 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 100.00 %

End of Consolidation
Time: [illegible] min
Total Vertical Stress: 18.27 psi
Total Horizontal Stress: 18.269 psi
Pore Pressure: [illegible] psi
Effective Vertical Stress: 18.27 psi
Effective Horizontal Stress: 18.269 psi
Height Change: 0 in
Area Change: 0 in^2
Volume Change: 0 cc
Water Change: 0.24509 cc
Correction: 10.081 cc
Height: 5.749 in
Area: 6.3169 in^2
Volume: 595.11 cc
Moisture: 19.91 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 100.00 %

End of Consolidation/B
Time: 4.9946 min
Total Vertical Stress: 18.27 psi
Total Horizontal Stress: 18.269 psi
Pore Pressure: [illegible] psi
Effective Vertical Stress: 18.27 psi
Effective Horizontal Stress: 18.269 psi
Height Change: 0 in
Area Change: 0 in^2
Volume Change: 0 cc
Water Change: 0.24509 cc
Correction: 10.081 cc
Height: 5.749 in
Area: 6.3169 in^2
Volume: 595.11 cc
Moisture: 19.91 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 100.00 %

End of Shear
Time: 25.[illegible] min
Total Vertical Stress: 50.557 psi
Total Horizontal Stress: 18.414 psi
Pore Pressure: -0.[illegible]076 psi
Effective Vertical Stress: 50.864 psi
Effective Horizontal Stress: 18.722 psi
Height Change: 1.1301 in
Area Change: -1.5797 in^2
Volume Change: 0 cc
Water Change: 0.24509 cc
Correction: 215.6 cc
Height: 4.5989 in
Area: 7.8965 in^2
Volume: 595.11 cc
Moisture: 0.00 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 0.00 %

At Failure
Time: 20.[illegible]5 min
Total Vertical Stress: 50.338 psi
Total Horizontal Stress: 18.343 psi
Pore Pressure: -0.[illegible]8331 psi
Effective Vertical Stress: 50.622 psi
Effective Horizontal Stress: 18.626 psi
Height Change: 0.86235 in
Area Change: -1.1117 in^2
Volume Change: 2.9422e-017 cc
Water Change: 0.24509 cc
Correction: 0 cc
Height: 4.8866 in
Area: 7.4286 in^2
Volume: 595.11 cc
Moisture: 19.91 %
Void Ratio: 0.53
Dry Unit Weight: 108.3 pcf
Saturation: 100.00 %

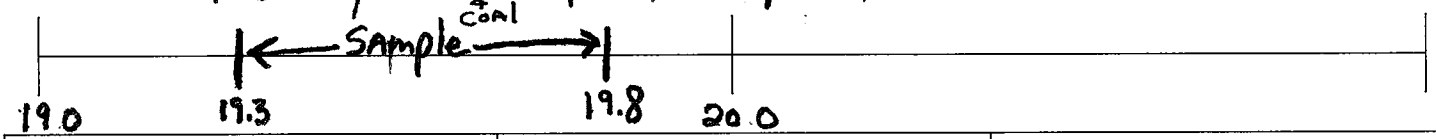
TRIAXIAL UU(Q) CCU(R) CD(S)

North Dakota Department of Transportation, Materials & Research
SFN 50459 (5-2016)

Project Number	
IM-2-094(143)260	
Boring Number	
2	

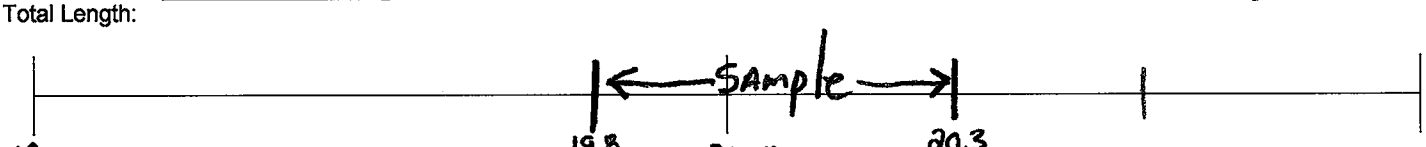
Field Sample Number			Lab Number		Depth	
SS-385-16			UU-41-16		19.3 to 19.8	
Weight of Sample			Confining Pressure		Test Number	of
1276.07			9.2		1	1
Diameter	2.836	2.851	Height	5.754	Moisture Can Number	
	2.837	2.855		5.751	540	
	2.857	2.834		5.747	Wet Wt + Can	
	Average		Average		68.57	
	2.845		5.751		Dry Wt + Can	
					60.40	
					Wt of Can	
					16.93	

Total Length: 19¾" Brn Cly with I.O. Deposits, Rock up to ¾" Coal



Field Sample Number			Lab Number		Depth	
SS-385-16			UU-42-16		19.8 to 20.3	
Weight of Sample			Confining Pressure		Test Number	of
1248.26			18.3		2	2
Diameter	2.864	2.843	Height	5.751	Moisture Can Number	
	2.838	2.816		5.743	528	
	2.823	2.832		5.752	Wet Wt + Can	
	Average		Average		74.69	
	2.836		5.749		Dry Wt + Can	
					64.45	
					Wt of Can	
					15.47	

Total Length:



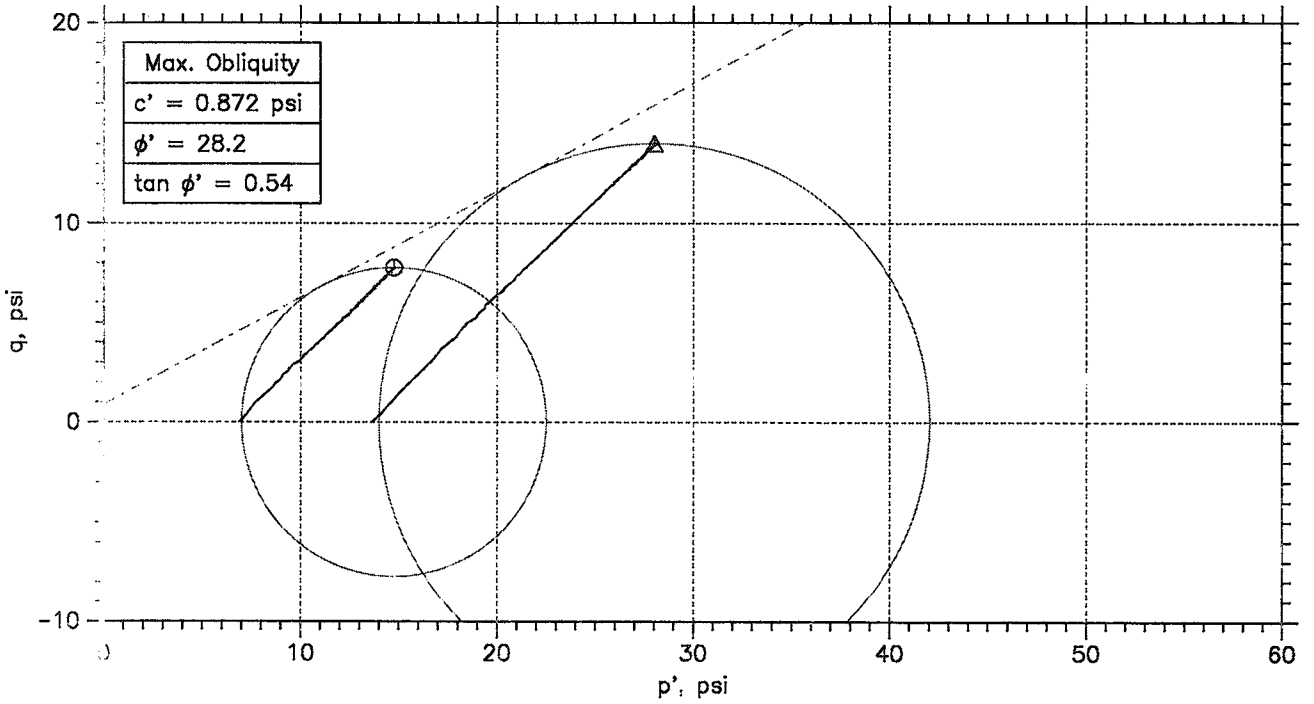
Field Sample Number			Lab Number		Depth	
Weight of Sample			Confining Pressure		Test Number	of
Diameter			Height		Moisture Can Number	
					Wet Wt + Can	
					Dry Wt + Can	
	Average		Average		Wt of Can	

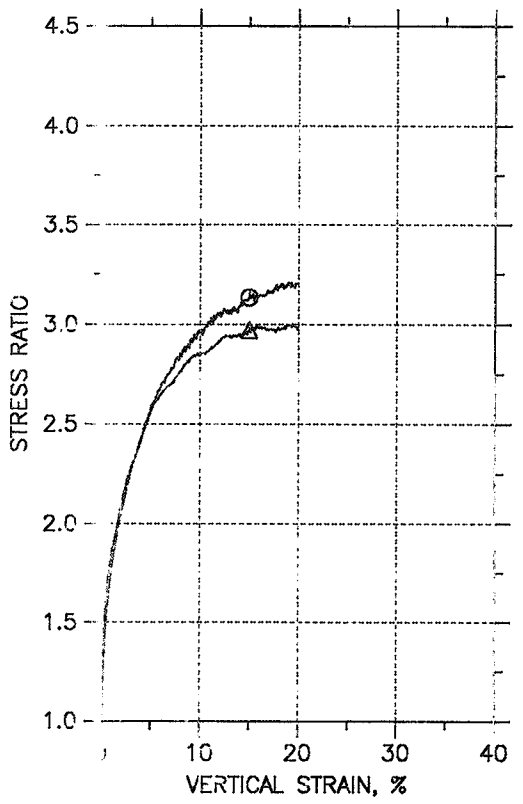
Total Length:

AASHTO T-234 Tested By:

SS-383-16

Test File





Symbol		⊙	△		
Sample No.		SS-383-16	SS-383-16		
Test No.		UU-39-16	UU-40-16		
Depth		14.3-14.8	14.8-15.3		
Initial	Diameter, in	2.817	2.846		
	Height, in	5.734	5.735		
	Water Content, %	20.1	20.7		
	Dry Density, pcf	107.4	108.3		
	Saturation, %	98.3	103.9		
	Void Ratio	0.541	0.527		
Before Shear	Water Content, %	20.0	19.9		
	Dry Density, pcf	107.4	108.4		
	Saturation*, %	98.2	100.0		
	Void Ratio	0.54	0.525		
	Back Press., psi	-.008095	.0		
Ver. Eff. Cons. Stress, psi		6.867	13.67		
Shear Strength, psi		7.483	13.8		
Strain at Failure, %		15	15		
Strain Rate, %/min		1	1		
B-Value		---	---		
Estimated Specific Gravity		2.65	2.65		
Liquid Limit		---	---		
Plastic Limit		---	---		

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260

Location:

Project No.:

Boring No.: 2

Sample Type:

Description: T.L. 19 1/4" Brn Cly with LO deposits, Rock up to 1/2"

Remarks:

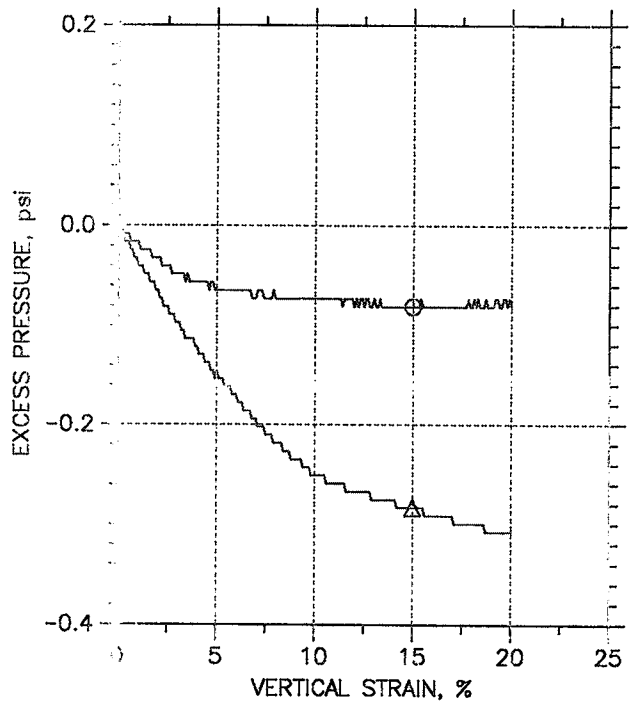
Phase calculations based on start and end of test.

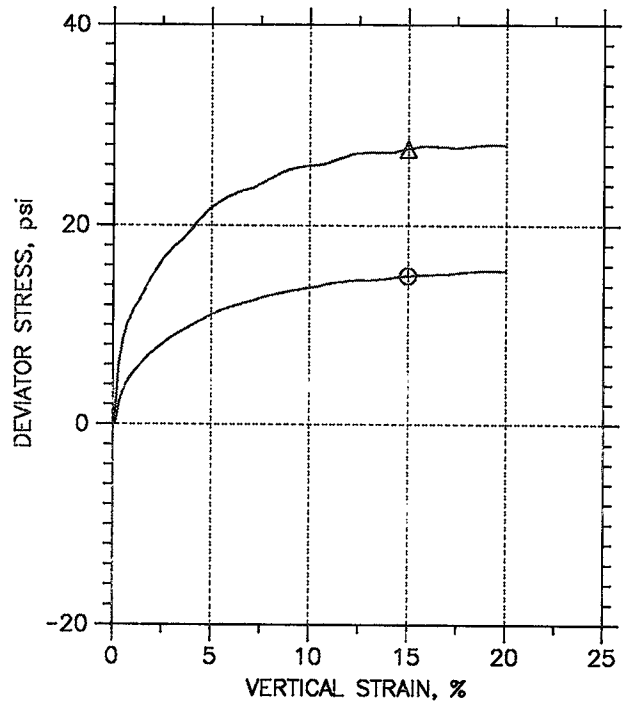
* Saturation is set to 100% for phase calculations.

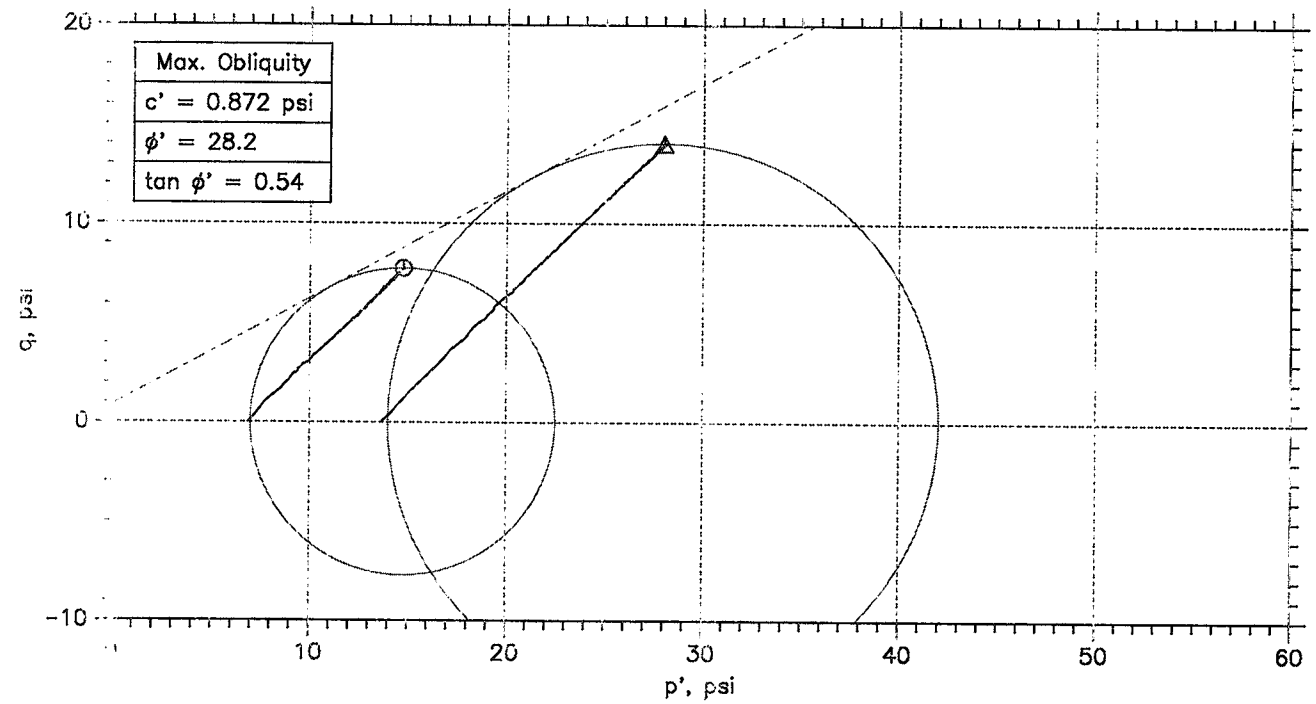
Mon, 13-JUN-2016 09:11:30

55-383-16

Test File







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-383-16	UU-39-16	14.3-14.8	DT	6/6/16	MD		UU-39-2016.dat
△	SS-383-16	UU-40-16	14.8-15.3	DT	6/6/16	MD		UU-40-2016.dat

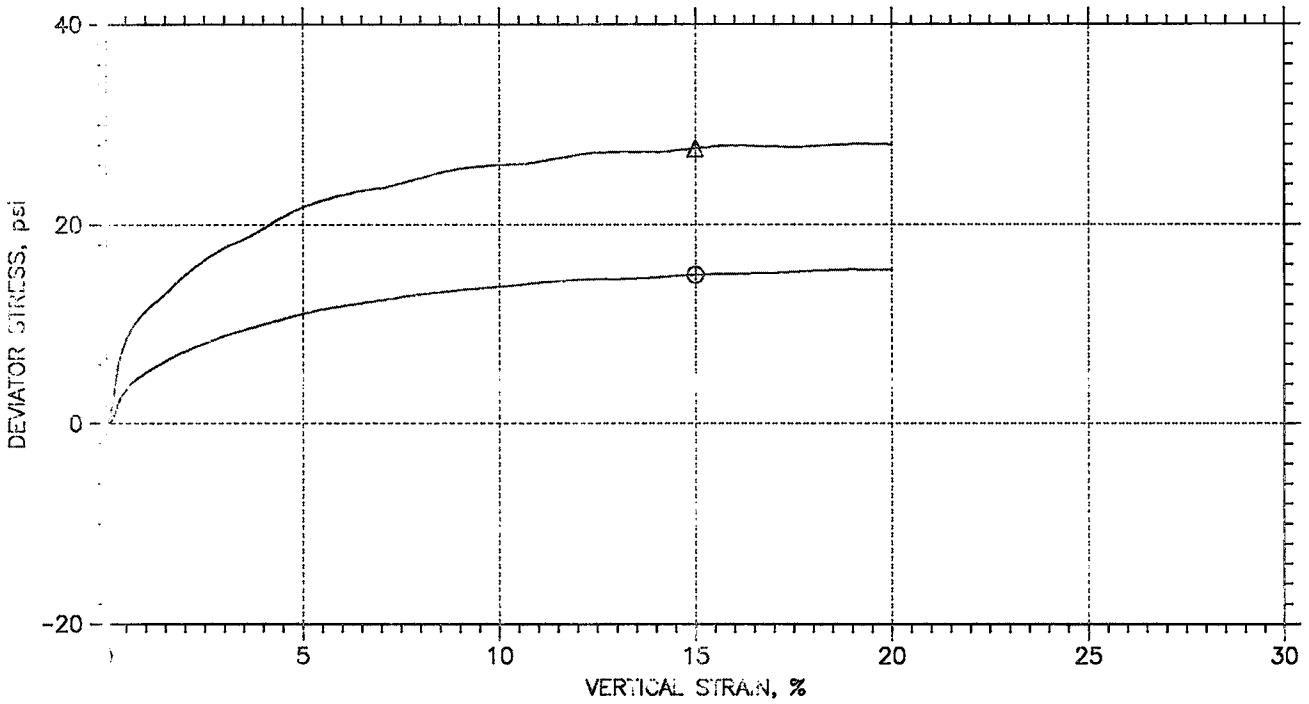
NDDOT
North Dakota Department of Transportation

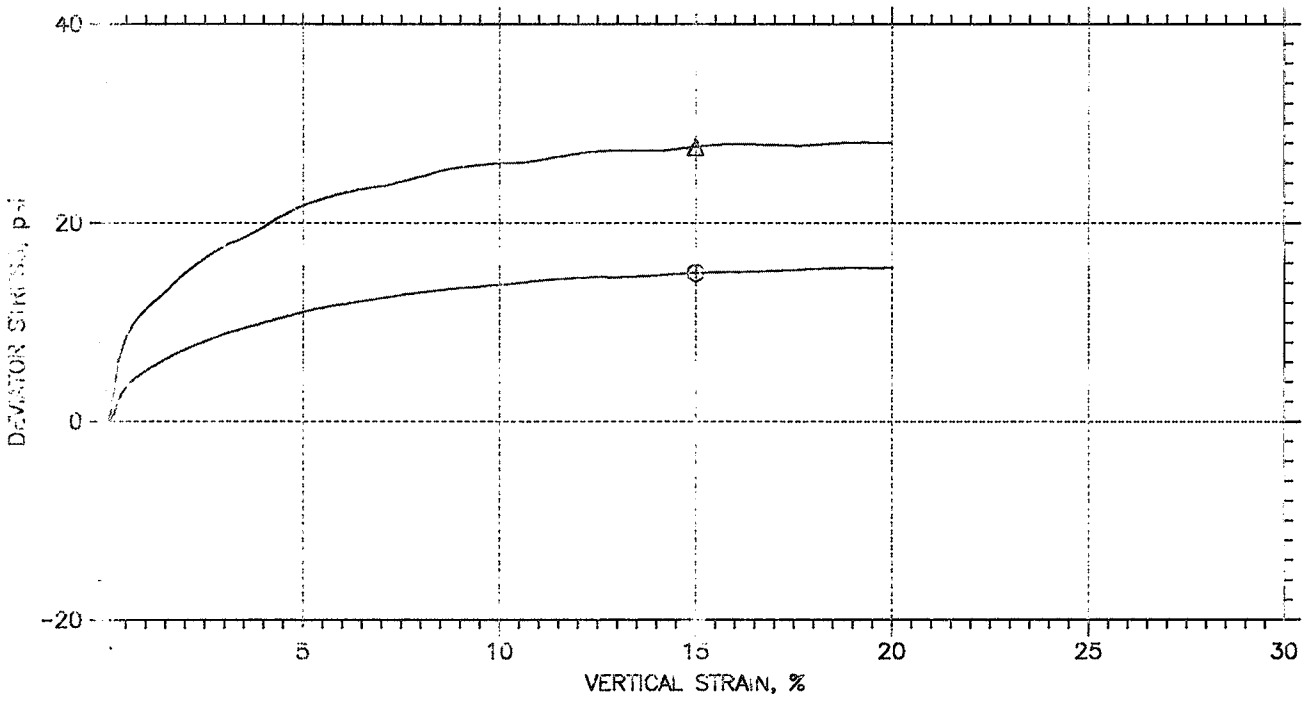
Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Sample Type:	
Description: T.L. 19 1/4" Brn Cly with I.O deposits, Rock up to 1/2"		
Remarks:		

Mon, 13-JUN-2016 09:11:30

SS-383-16

Test File





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊕	SS-383-16	UU-39-16	14.3-14.8	DT	6/6/16	MD		UU-39-2016.dat
△	SS-383-16	UU-40-16	14.8-15.3	DT	6/6/16	MD		UU-40-2016.dat

NDDOT
North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Sample Type:	
Description: T.L. 19 1/4" Brn Cly with I.O deposits, Rock up to 1/2"		
Remarks:		

Mon, 13-JUN-2016 09:11:30

SS-383-16

TRIAXIAL TEST

Project: [illegible] 143)260 | Location: | Project No.:
Boring No.: 2 | Tested By: DT | Checked By: MD
Sample No.: SS-38[illegible]-16 | Test Date: 6/6/16 | Depth: 14.3-14.8
Test No.: UU-39-1[illegible] | Sample Type: | Elevation:

Soil Description: [illegible].L. 19 1/4" Brn Cly with I.O deposits, Rock up to 1/2"
Remarks:

Specimen Height: [illegible].73 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.[illegible]3 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: [illegible]85.63 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 11	---		
Wt. Container + Wet Soil, gm	82.91	---	---	0
Wt. Container + Dry Soil, gm	71.88	---	---	0
Wt. Container, gm	16.89	---	---	0
Wt. Wet Soil, gm	66.02	1209.3	1007.2	0
Wt. Dry Soil, gm	54.99	1007.2	1007.2	0
Wt. Water, gm	11.03	202.03	0	0
Water Content, %	20.06	20.06	0.00	0.00
Void Ratio	---	0.54	0.54	---
Degree of Saturation, %	---	98.29	0.00	---
Dry Unit Weight, pcf	---	107.37	107.4	---

Initial
Height: 5.734 in | Moisture: 20.06 %
Area: 6.2325 in^2 | Void Ratio: 0.54
Volume: 585.63 cc | Dry Unit Weight: 107.37 pcf
Saturation: 98.29 %

End of Initialization
Time: 11.[illegible]9 min
Total Vertical Stress: 6.8587 psi | Height Change: 0.00046222 in | Height: 5.7335 in | Moisture: 20.04 %
Total Horizontal Stress: 6.8619 psi | Area Change: 0 in^2 | Area: 6.2325 in^2 | Void Ratio: 0.54
Pore Pressure: -0.0080946 psi | Volume Change: 0.14162 cc | Volume: 585.49 cc | Dry Unit Weight: 107.4 pcf
Effective Vertical Stress: 6.8668 psi | Water Change: 0.22203 cc | Saturation: 98.25 %
Effective Horizontal Stress: 6.87 psi | Correction: 0 cc

End of Consolidation/A
Time: 11.129 min
Total Vertical Stress: 6.8587 psi | Height Change: 0.00046222 in | Height: 5.7335 in | Moisture: 20.04 %
Total Horizontal Stress: 6.8619 psi | Area Change: 0 in^2 | Area: 6.2325 in^2 | Void Ratio: 0.54
Pore Pressure: -0.0080946 psi | Volume Change: 0.14162 cc | Volume: 585.49 cc | Dry Unit Weight: 107.4 pcf
Effective Vertical Stress: 6.8668 psi | Water Change: 0.22203 cc | Saturation: 98.25 %
Effective Horizontal Stress: 6.87 psi | Correction: 0 cc

End of Saturation
Time: 11.129 min
Total Vertical Stress: 6.8587 psi | Height Change: 0.00046222 in | Height: 5.7335 in | Moisture: 20.04 %
Total Horizontal Stress: 6.8619 psi | Area Change: 0 in^2 | Area: 6.2325 in^2 | Void Ratio: 0.54
Pore Pressure: -0.0080946 psi | Volume Change: 0.14162 cc | Volume: 585.49 cc | Dry Unit Weight: 107.4 pcf
Effective Vertical Stress: 6.8668 psi | Water Change: 0.22203 cc | Saturation: 98.25 %
Effective Horizontal Stress: 6.87 psi | Correction: 0 cc

End of Consolidation/B
Time: 11.129 min
Total Vertical Stress: 6.8587 psi | Height Change: 0.00046222 in | Height: 5.7335 in | Moisture: 20.04 %
Total Horizontal Stress: 6.8619 psi | Area Change: 0 in^2 | Area: 6.2325 in^2 | Void Ratio: 0.54
Pore Pressure: -0.0080946 psi | Volume Change: 0.14162 cc | Volume: 585.49 cc | Dry Unit Weight: 107.4 pcf
Effective Vertical Stress: 6.8668 psi | Water Change: 0.22203 cc | Saturation: 98.25 %
Effective Horizontal Stress: 6.87 psi | Correction: 0 cc

End of Shear
Time: 31.[illegible]79 min
Total Vertical Stress: 22.43 psi | Height Change: 1.1476 in | Height: 4.5864 in | Moisture: 0.00 %
Total Horizontal Stress: 6.9588 psi | Area Change: -1.5576 in^2 | Area: 7.7901 in^2 | Void Ratio: 0.54
Pore Pressure: -0.0080946 psi | Volume Change: 0.14162 cc | Volume: 585.49 cc | Dry Unit Weight: 107.4 pcf
Effective Vertical Stress: 22.531 psi | Water Change: 0.22203 cc | Saturation: 0.00 %
Effective Horizontal Stress: 7.0397 psi | Correction: 201.81 cc

At Failure
Time: 26.347 min
Total Vertical Stress: 21.903 psi | Height Change: 0.86049 in | Height: 4.8735 in | Moisture: 20.04 %
Total Horizontal Stress: 6.9358 psi | Area Change: -1.0977 in^2 | Area: 7.3302 in^2 | Void Ratio: 0.54
Pore Pressure: -0.0080946 psi | Volume Change: 0.14162 cc | Volume: 585.49 cc | Dry Unit Weight: 107.4 pcf
Effective Vertical Stress: 21.984 psi | Water Change: 0.22203 cc | Saturation: 98.25 %
Effective Horizontal Stress: 7.0168 psi | Correction: 0 cc

SS-383-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 2 | Tested By: DT | Checked By: MD
Sample No.: SS-38 -16 | Test Date: 6/6/16 | Depth: 14.8-15.3
Test No.: UU-40-1 | Sample Type: | Elevation:

Soil Description: T.L. 19 1/4" Brn Cly with I.O deposits, Rock up to 1/2"
Remarks:

Specimen Height: .74 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.36 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 597.85 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 17	---		
Wt. Container + Wet Soil, gm	83.79	---	---	0
Wt. Container + Dry Soil, gm	72.36	---	---	0
Wt. Container, gm	17.04	---	---	0
Wt. Wet Soil, gm	66.75	1251.8	1037.5	0
Wt. Dry Soil, gm	55.32	1037.5	1037.5	0
Wt. Water, gm	11.43	214.36	0	0
Water Content, %	20.66	20.66	0.00	0.00
Void Ratio	---	0.53	0.53	---
Degree of Saturation, %	---	103.88	0.00	---
Dry Unit Weight, pcf	---	108.33	108.4	---

Initial
Height: 5.735 in
Area: 6.3615 in^2
Volume: 597.85 cc
Moisture: 20.66 %
Void Ratio: 0.53
Dry Unit Weight: 108.33 pcf
Saturation: 103.88 %

End of Initialization
Time: 4.2565 min
Total Vertical Stress: 13.674 psi
Total Horizontal Stress: 13.667 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 13.674 psi
Effective Horizontal Stress: 13.667 psi
Height Change: 0.0012018 in
Area Change: 0 in^2
Volume Change: 0.37584 cc
Water Change: 0.0058993 cc
Correction: 8.3791 cc
Height: 5.7338 in
Area: 6.3615 in^2
Volume: 597.48 cc
Moisture: 19.85 %
Void Ratio: 0.53
Dry Unit Weight: 108.4 pcf
Saturation: 100.00 %

End of Consolidation/A
Time: 4.2565 min
Total Vertical Stress: 13.674 psi
Total Horizontal Stress: 13.667 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 13.674 psi
Effective Horizontal Stress: 13.667 psi
Height Change: 0.0012018 in
Area Change: 0 in^2
Volume Change: 0.37584 cc
Water Change: 0.0058993 cc
Correction: 8.3791 cc
Height: 5.7338 in
Area: 6.3615 in^2
Volume: 597.48 cc
Moisture: 19.85 %
Void Ratio: 0.53
Dry Unit Weight: 108.4 pcf
Saturation: 100.00 %

End of Saturation
Time: 4.2565 min
Total Vertical Stress: 13.674 psi
Total Horizontal Stress: 13.667 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 13.674 psi
Effective Horizontal Stress: 13.667 psi
Height Change: 0.0012018 in
Area Change: 0 in^2
Volume Change: 0.37584 cc
Water Change: 0.0058993 cc
Correction: 8.3791 cc
Height: 5.7338 in
Area: 6.3615 in^2
Volume: 597.48 cc
Moisture: 19.85 %
Void Ratio: 0.53
Dry Unit Weight: 108.4 pcf
Saturation: 100.00 %

End of Consolidation/B
Time: 4.2565 min
Total Vertical Stress: 13.674 psi
Total Horizontal Stress: 13.667 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 13.674 psi
Effective Horizontal Stress: 13.667 psi
Height Change: 0.0012018 in
Area Change: 0 in^2
Volume Change: 0.37584 cc
Water Change: 0.0058993 cc
Correction: 8.3791 cc
Height: 5.7338 in
Area: 6.3615 in^2
Volume: 597.48 cc
Moisture: 19.85 %
Void Ratio: 0.53
Dry Unit Weight: 108.4 pcf
Saturation: 100.00 %

End of Shear
Time: 24.3682 min
Total Vertical Stress: 41.769 psi
Total Horizontal Stress: 13.788 psi
Pore Pressure: -0.2076 psi
Effective Vertical Stress: 42.077 psi
Effective Horizontal Stress: 14.096 psi
Height Change: 1.148 in
Area Change: -1.5871 in^2
Volume Change: 0.37584 cc
Water Change: 0.0058993 cc
Correction: 214.35 cc
Height: 4.587 in
Area: 7.9486 in^2
Volume: 597.48 cc
Moisture: 0.00 %
Void Ratio: 0.53
Dry Unit Weight: 108.4 pcf
Saturation: 0.00 %

At Failure
Time: 19.8315 min
Total Vertical Stress: 41.325 psi
Total Horizontal Stress: 13.725 psi
Pore Pressure: -0.18331 psi
Effective Vertical Stress: 41.608 psi
Effective Horizontal Stress: 14.008 psi
Height Change: 0.86127 in
Area Change: -1.1241 in^2
Volume Change: 0.37584 cc
Water Change: 0.0058993 cc
Correction: 0 cc
Height: 4.8737 in
Area: 7.4856 in^2
Volume: 597.48 cc
Moisture: 19.85 %
Void Ratio: 0.53
Dry Unit Weight: 108.4 pcf
Saturation: 100.00 %

TRIAXIAL UU(Q) CCU(R) CD(S)

North Dakota Department of Transportation, Materials & Research
SFN 50459 (5-2016)

Project Number	
IM-2-094(143)260	
Boring Number	
2	

Field Sample Number			Lab Number		Depth
SS-383-16			UU-39-16		14.3 to 14.8
Weight of Sample			Confining Pressure		Test Number 1 of 2
1209.25			6.9		
Diameter	2.784	2.815	Height	5.732	Moisture Can Number 511
	2.822	2.829		5.734	Wet Wt + Can 82.91
	2.822	2.832		5.735	Dry Wt + Can 71.88
	Average 2.817		Average	5.734	Wt of Can 16.89

Total Length: 19¼" Ban Cly with I.O. Deposits Rock up to ½"

14.0 — 14.3 ←Sample→ 14.8 — 15.0

Field Sample Number			Lab Number		Depth
SS-383-16			UU-40-16		14.8 to 15.3
Weight of Sample			Confining Pressure		Test Number 2 of 2
1251.84			13.7		
Diameter	2.848	2.841	Height	5.736	Moisture Can Number 517
	2.850	2.845		5.736	Wet Wt + Can 83.79
	2.847	2.842		5.732	Dry Wt + Can 72.36
	Average 2.846		Average	5.735	Wt of Can 17.04

Total Length:

14.0 — 14.8 ←Sample→ 15.0 — 15.3

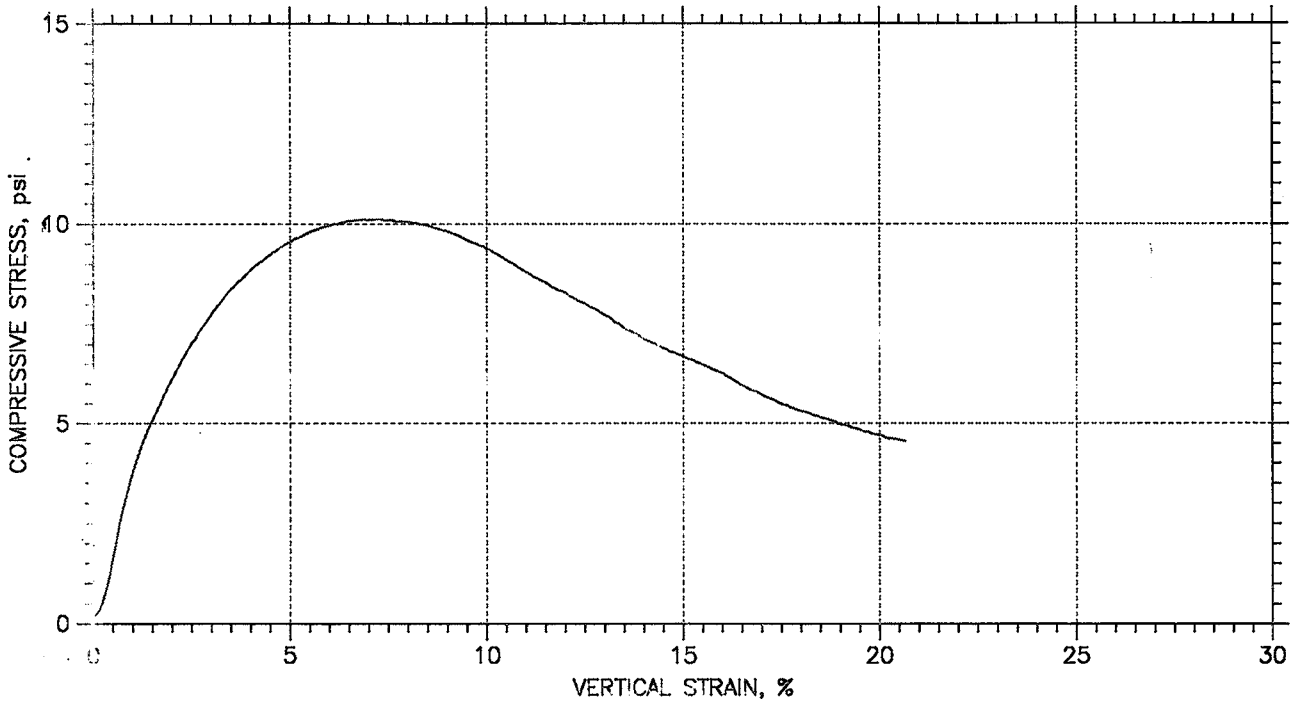
Field Sample Number			Lab Number		Depth
Weight of Sample			Confining Pressure		Test Number of
Diameter			Height		Moisture Can Number
					Wet Wt + Can
					Dry Wt + Can
	Average		Average		Wt of Can

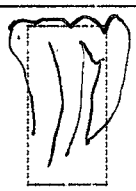
Total Length:

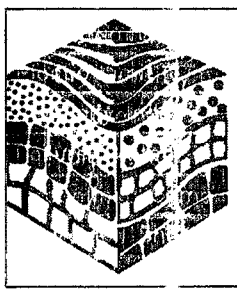
AASHTO T-234 Tested By:

SS-381-16

UNCONFINED COMPRESSION TEST REPORT



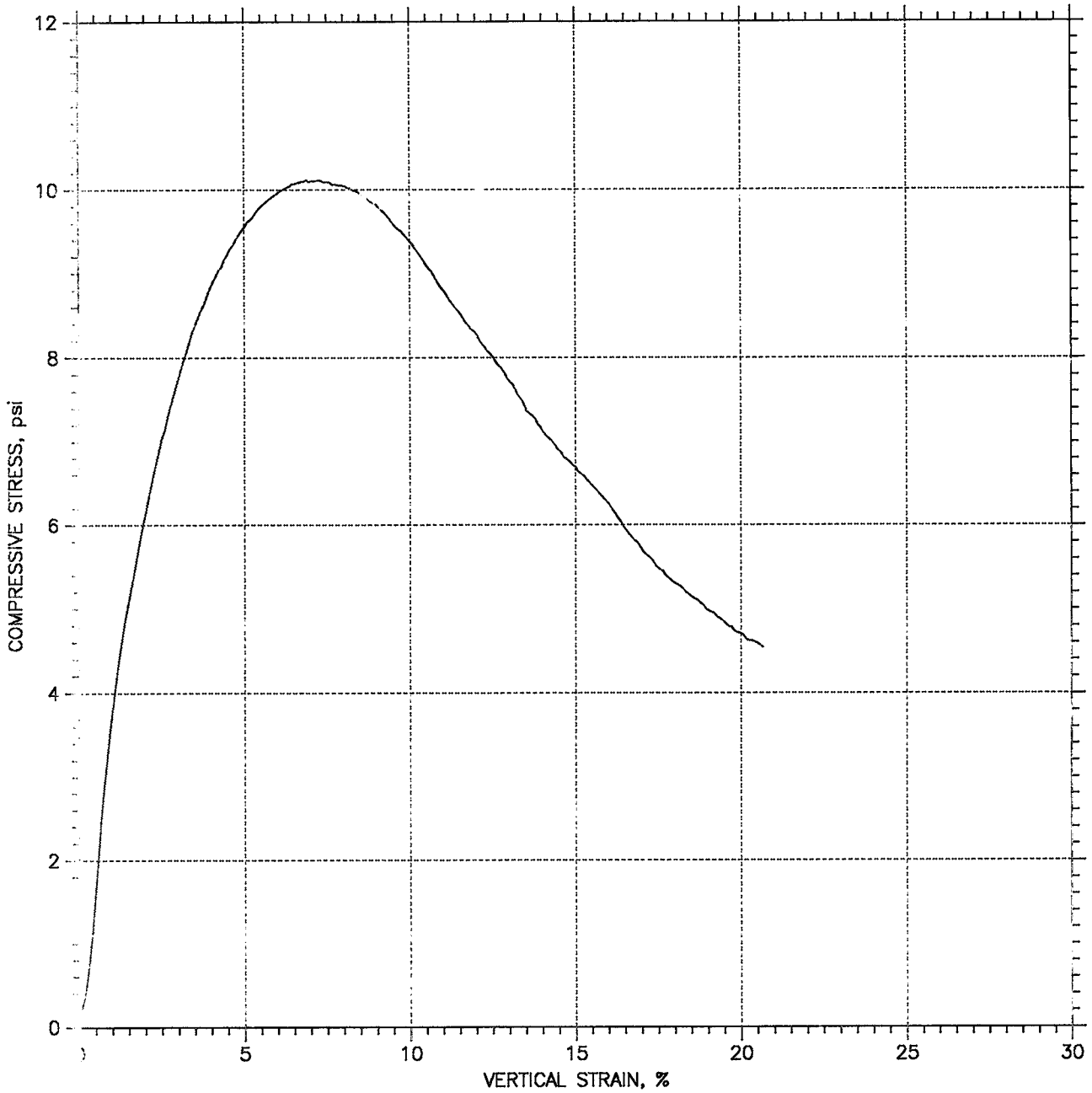
Symbol					
Test No.		UC-22-16			
Initial	Diameter, in	2.835			
	Height, in	5.737			
	Water Content, %	22.71			
	Dry Density, pcf	103.6			
	Saturation, %	100.72			
	Void Ratio	0.598			
Unconfined Compressive Strength, psi		10.11			
Undrained Shear Strength, psi		5.056			
Time to Failure, min		7.0849			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					

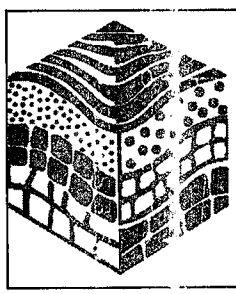


Project: IM-2-094(143)260
Location:
Project No.:
Boring No.: 2
Sample Type: Undisturbed
Description: T. L. 14 1/2" Brn Cly, rock up to 3/4"
Remarks:

Mon, 13-JUN-2016 08:43:38

UNCONFINED COMPRESSION TEST REPORT





Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 2	Tested By: DT	Checked By: MD
Sample No.: SS-381-16	Test Date: 6/6/2016	Depth: 9.3-9.8
Test No.: UC-22-16	Sample Type: Undisturbed	Elevation:
Description: T. L. 14 1/2" Brn Cly, rock up to 3/4"		
Remarks:		

Mon, 13-JUN-2016 08:33:38

UNCONFINED COMPRESSION TEST

SS-381-16

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 2 | Tested By: DT | Checked By: MD
Sample No.: SS-381-16 | Test Date: 6/6/2016 | Depth: 9.3-9.8
Test No.: UC-22-16 | Sample Type: Undisturbed | Elevation:

Soil Description: T. L. 14 1/2" Brn Cly, rock up to 3/4"
Remarks:

Specimen Height: 5.74 in | Liquid Limit: 0 | Cap Mass: 0 gm
Specimen Area: 6.31 in^2 | Plastic Limit: 0
Specimen Volume: 593.45 cc | Measured Specific Gravity: 2.65

Water Content Information

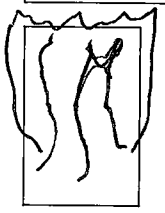
Container ID	S 65
Wt. Container, gm	15.33
Wt. Container + Wet Soil, gm	93.4
Wt. Container + Dry Soil, gm	78.95
Wt. Dry Soil, gm	63.62
Water Content, %	22.71
Void Ratio	0.60
Degree of Saturation, %	100.72
Wet Unit Weight, pcf	127.07
Dry Unit Weight, pcf	103.55

UNCONFINED COMPRESSION

North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

Project Number	IM-2-094(143)260
Boring Number	2
Depth	9.3 to 9.8
AASHTO T-208 Tested by:	DT/MD
Moisture Can Number	565
Wet Wt + Can	93.40
Dry Wt + Can	78.95
Wt of Can	15.33

Field Sample Number	SS-381-16		Lab Number	UC-22-16	
Weight of Sample	1207.96		Test Number	1 of 1	
Diameter	1. 2.827	4. 2.830	Height	1. 5.737	
	2. 2.826	5. 2.828		2. 5.733	
	3. 2.850	6. 2.850		3. 5.742	
	Average 2.835		Average	5.737	



Total Length: 14½" Brn Cly, Rock up to ¾"

Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number	of	AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

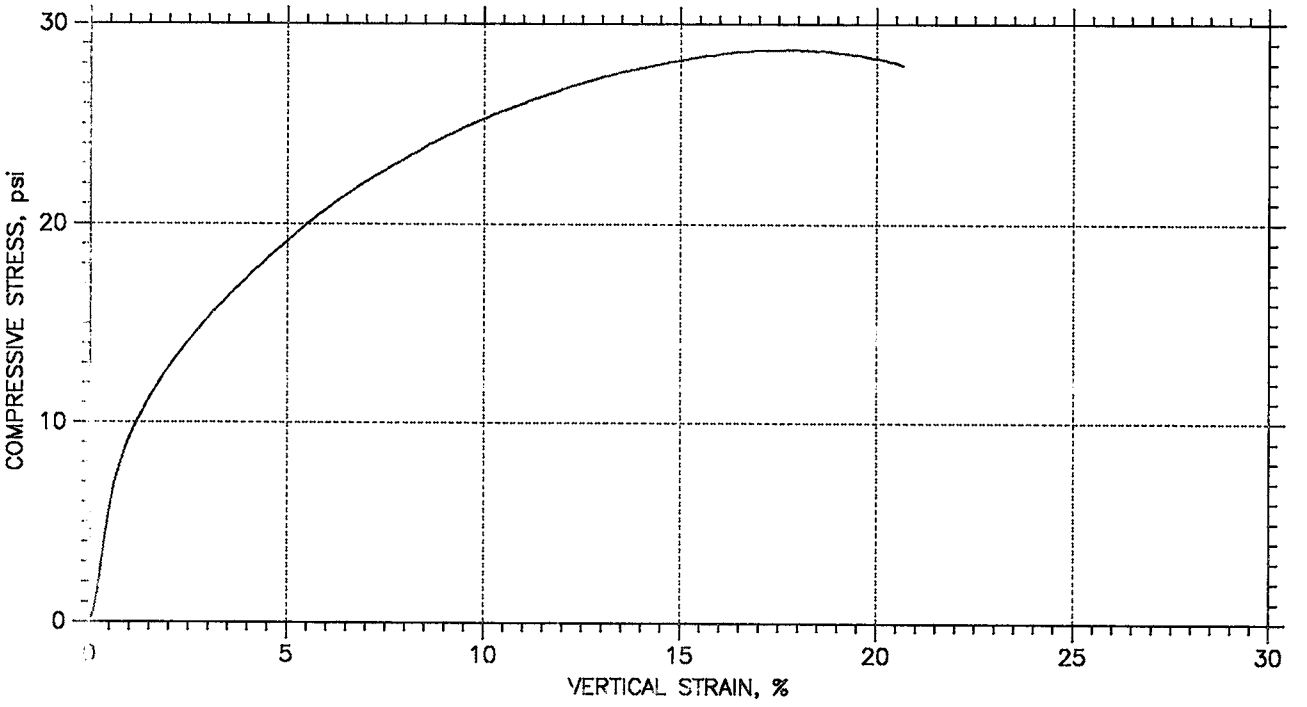
Total Length:

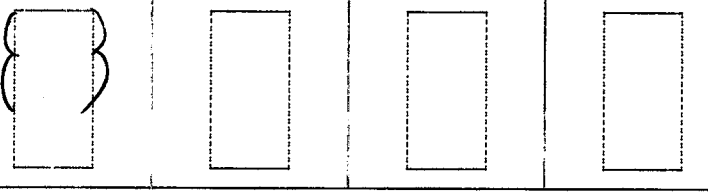
Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number	of	AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

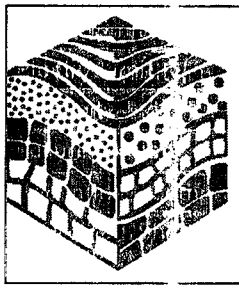
Total Length:

55-379-16

UNCONFINED COMPRESSION TEST REPORT



Symbol					
Test No.		UC-21-16			
Initial	Diameter, in	2.829			
	Height, in	5.733			
	Water Content, %	26.14			
	Dry Density, pcf	100.3			
	Saturation, %	106.65			
	Void Ratio	0.649			
Unconfined Compressive Strength, psi		28.72			
Undrained Shear Strength, psi		14.36			
Time to Failure, min		17.334			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					



Project: IM-2-094(143)260
Location:
Project No.:
Boring No.: 2
Sample Type: Undisturbed
Description: T. L. 14 3/4" Brn Blk Cly, rock up to 1"
Remarks:

UNCONFINED COMPRESSION TEST

SS-379-16

Project: IM-2-094(143)260
Boring No.: 2
Sample No.: SS-379-16
Test No.: UC-21-16

Location:
Tested By: DT
Test Date: 6/6/2016
Sample Type: Undisturbed

Project No.:
Checked By: MD
Depth: 4.6-5.1
Elevation:

Soil Description: T. L. 14 3/4" Brn Blk Cly, rock up to 1"
Remarks:

Specimen Height: 5.73 in
Specimen Area: 6.29 in^2
Specimen Volume: 590.53 cc

Liquid Limit: 0
Plastic Limit: 0
Measured Specific Gravity: 2.65

Cap Mass: 0 gm

Water Content Information

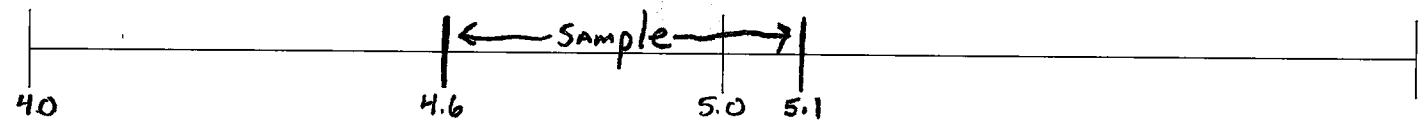
Container ID	S 56
Wt. Container, gm	17.09
Wt. Container + Wet Soil, gm	74.28
Wt. Container + Dry Soil, gm	62.43
Wt. Dry Soil, gm	45.34
Water Content, %	26.14
Void Ratio	0.65
Degree of Saturation, %	106.65
Wet Unit Weight, pcf	126.51
Dry Unit Weight, pcf	100.3

UNCONFINED COMPRESSION

North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

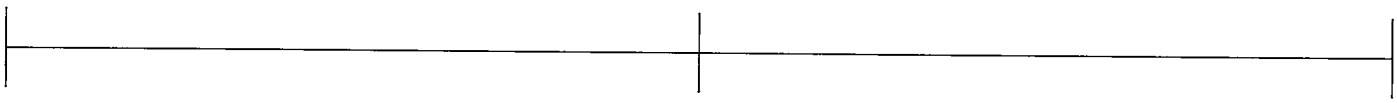
Project Number: IM-2-094(143) 260					
Boring Number: 2					
Field Sample Number: SS-379-16			Lab Number: UC-21-16		Depth: 4.6 to 5.1
Weight of Sample: 1196.72			Test Number: 1 of 1		AASHTO T-208 Tested by: OT/MD
Diameter	1. 2.843	4. 2.813	Height	1. 5.736	Moisture Can Number: S56
	2. 2.835	5. 2.820		2. 5.728	Wet Wt + Can: 74.28
	3. 2.846	6. 2.816		3. 5.735	Dry Wt + Can: 62.43
	Average 2.829		Average 5.733		Wt of Can: 17.09

Total Length: 14 3/4" BAN BLK Cly with Rock up to 1"



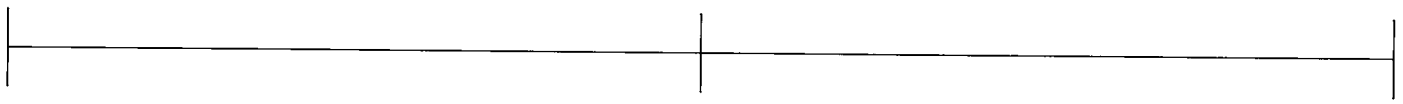
Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number of		AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

Total Length:



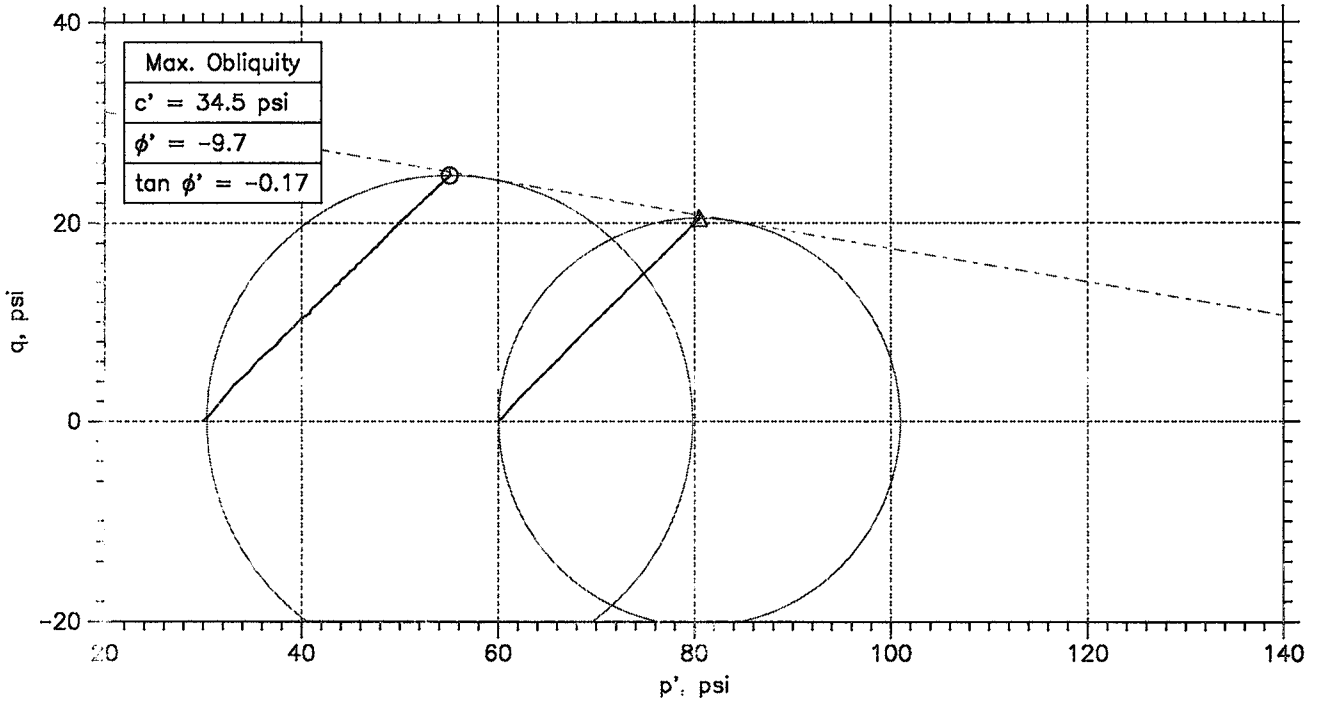
Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number of		AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

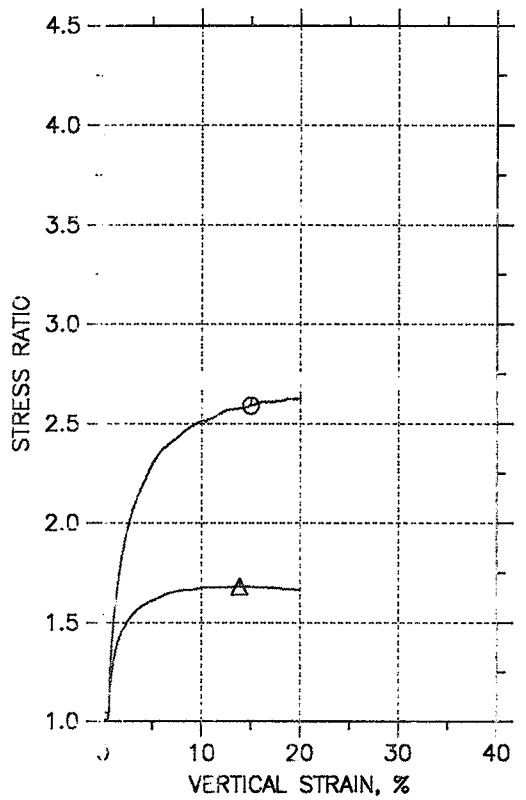
Total Length:



SS-351-16

Test File





Symbol		⊙	△		
Sample No.		SS-351-16	SS-351-16		
Test No.		UU-35-16	UU-36-16		
Depth		34.1-34.6	34.6-35.1		
Initial	Diameter, in	2.862	2.865		
	Height, in	5.747	5.752		
	Water Content, %	16.4	15.3		
	Dry Density, pcf	109.5	113.2		
	Saturation, %	84.8	87.8		
	Void Ratio	0.511	0.462		
Before Shear	Water Content, %	16.3	15.1		
	Dry Density, pcf	109.5	113.4		
	Saturation*, %	84.7	87.0		
	Void Ratio	0.511	0.459		
	Back Press., psi	.0	.0		
Ver. Eff. Cons. Stress, psi		29.99	59.97		
Shear Strength, psi		24.13	20.46		
Strain at Failure, %		15	13.9		
Strain Rate, %/min		1	1		
B-Value		---	---		
Estimated Specific Gravity		2.65	2.65		
Liquid Limit		---	---		
Plastic Limit		---	---		

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260

Location:

Project No.:

Boring No.: 1

Sample Type:

Description: T.L. 24" Brn Clay with I.O. deposits, Rock upto 1/2".

Remarks:

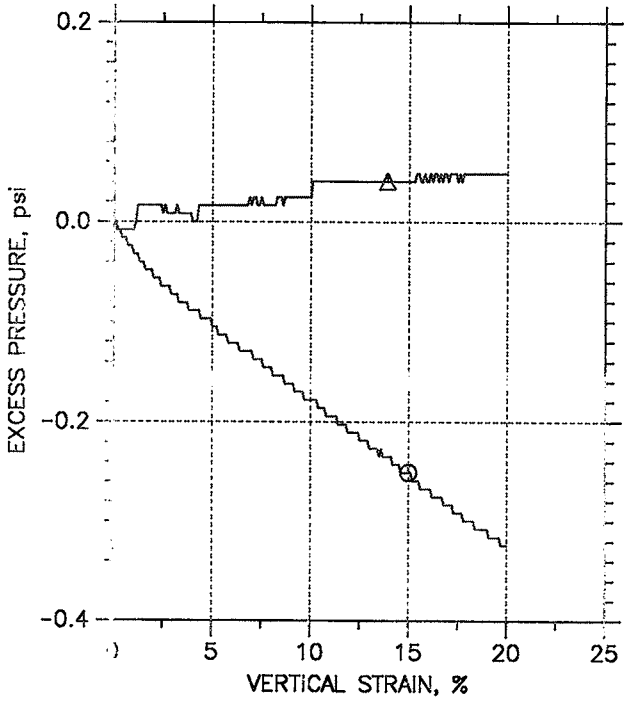
Phase calculations based on start and end of test.

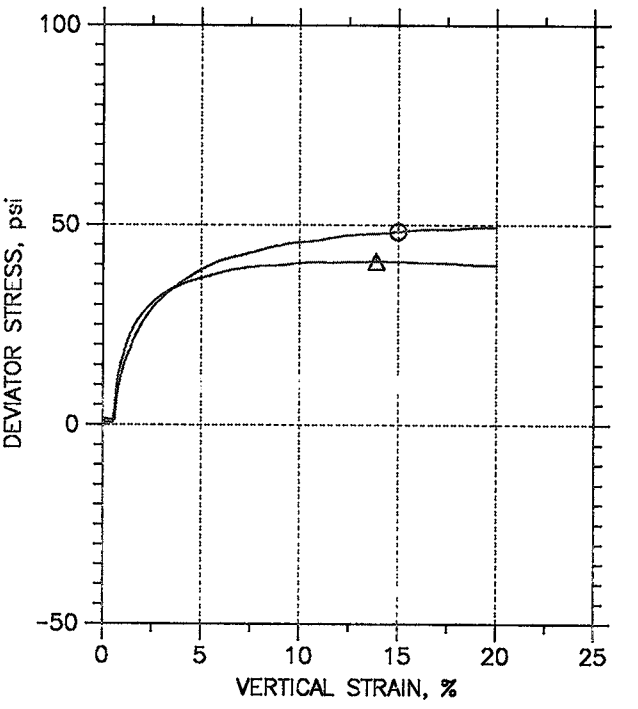
* Saturation is set to 100% for phase calculations.

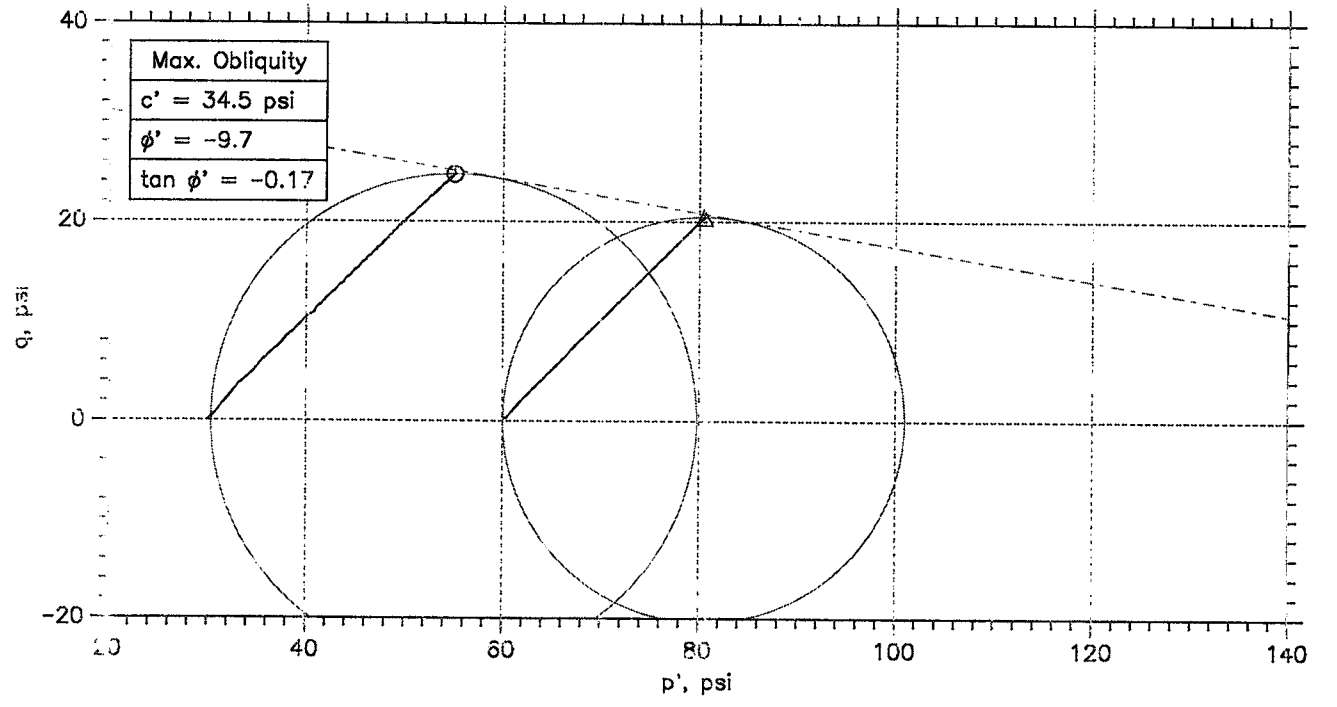
Tue, 31-MAY-2016 07:-2:00

SS-351-16

Test File







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-351-16	UU-35-16	34.1-34.6	DT	5/26/16	MD		UU-35-2016.dat
△	SS-351-16	UU-36-16	34.6-35.1	DT	5/26/16	MD		UU-36-2016.dat

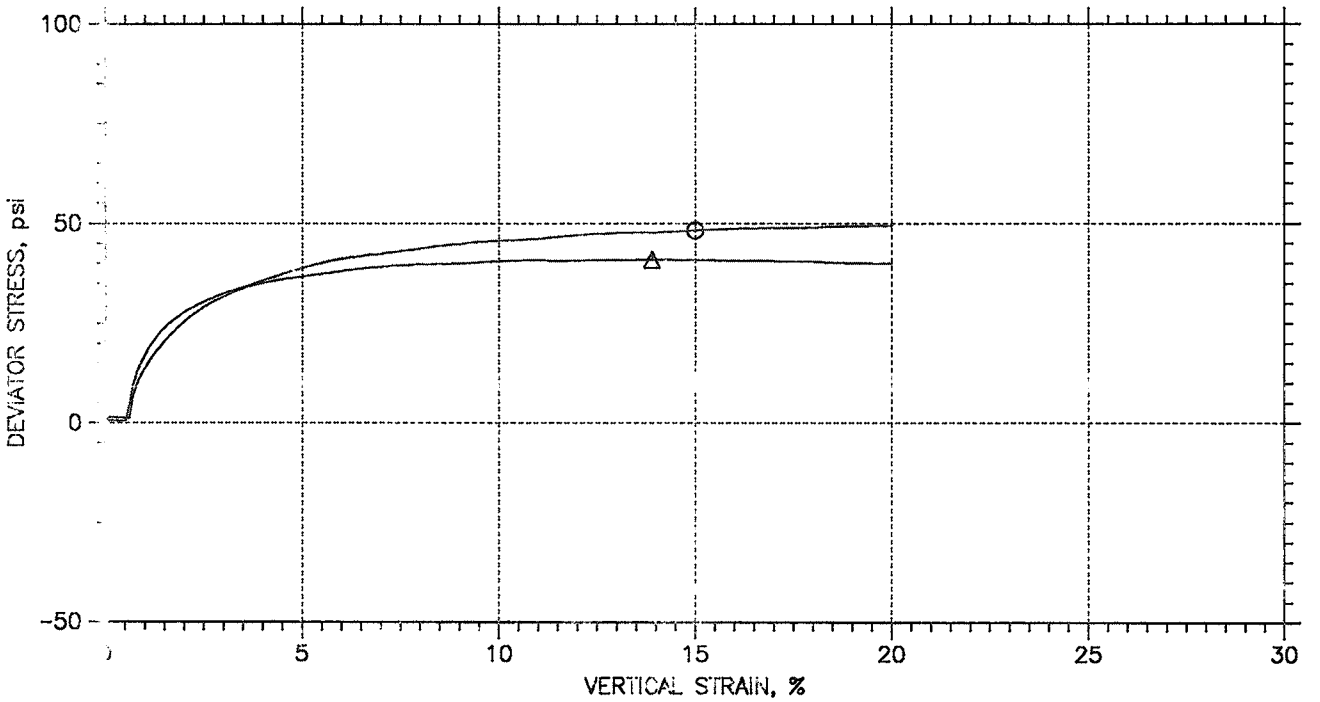
NDDOT North Dakota Department of Transportation

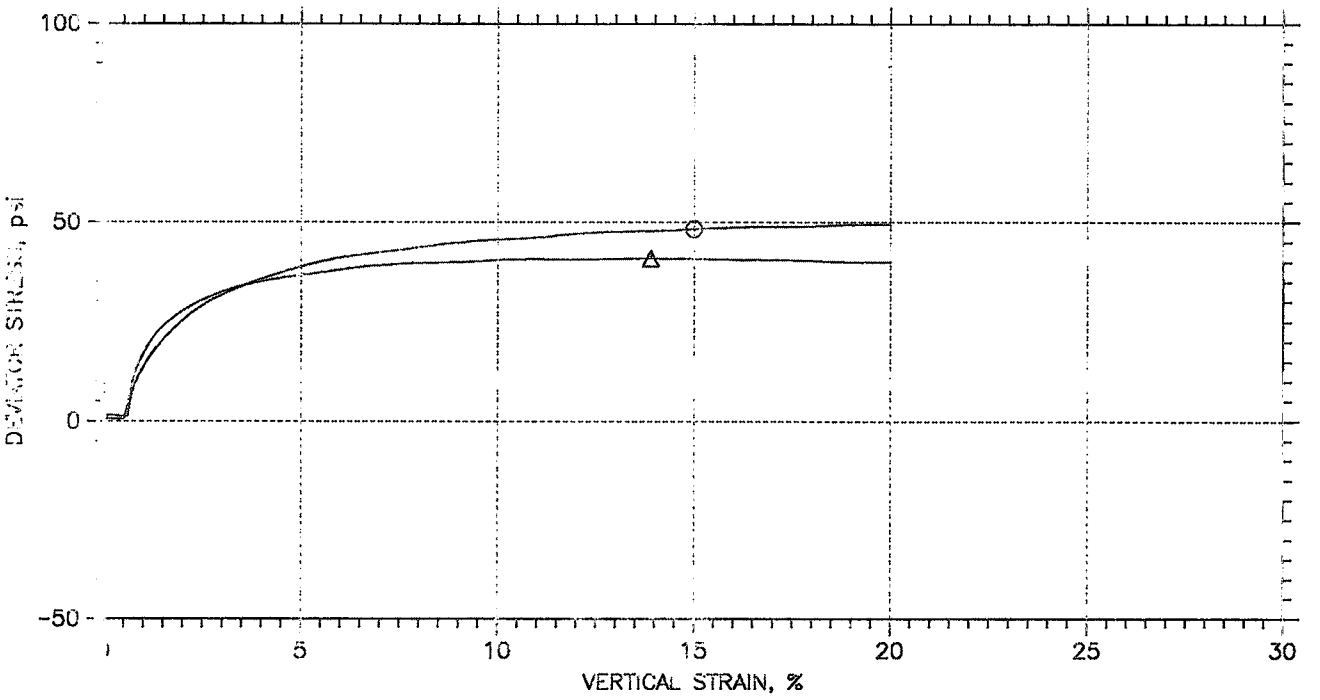
Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Sample Type:	
Description: T.L. 24" Brn Clay with I.O. deposits, Rock upto 1/2".		
Remarks:		

Tue, 31-MAY-2016 07: 2:00

SS-351-16

Test File





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-351-16	UU-35-16	34.1-34.6	DT	5/26/16	MD		UU-35-2016.dat
△	SS-351-16	UU-36-16	34.6-35.1	DT	5/26/16	MD		UU-36-2016.dat

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Sample Type:	
Description: T.L. 24" Brn Clay with I.O. deposits, Rock upto 1/2".		
Remarks:		

Tue, 31-MAY-2016 07:12:00

TRIAXIAL UU(Q) CCU(R) CD(S)

North Dakota Department of Transportation, Materials & Research
SFN 50459 (5-2016)

Project Number	
IM-2-094(143)260	
Boring Number	
1	

Field Sample Number			Lab Number		Depth	
SS-351-16			UU-35-16		34.1 to 34.6	
Weight of Sample			Confining Pressure		Test Number	of
1236.02			30.00		1	2
Diameter	2.850	2.858	Height	5.744	Moisture Can Number	
	2.859	2.869		5.748	S 49	
	2.863	2.871		5.749	Wet Wt + Can	
	Average		Average		74.94	
	2.862		5.747		Dry Wt + Can	
					66.56	
					Wt of Can	
					15.33	

Total Length: 24" Brn Cly with I.O. Deposits, Rock up to ½"

34.0 — Sample — 35.0 — Sample — 36.0

34.1 — 34.6 — 35.1 — 35.4 Gay Blk Cly loam with Organics

Field Sample Number			Lab Number		Depth	
SS-351-16			UU-36-16		34.6 to 35.1	
Weight of Sample			Confining Pressure		Test Number	of
1270.25			60.00		2	2
Diameter	2.859	2.863	Height	5.756	Moisture Can Number	
	2.872	2.866		5.748	S 21	
	2.869	2.863		5.752	Wet Wt + Can	
	Average		Average		62.29	
	2.865		5.752		Dry Wt + Can	
					56.28	
					Wt of Can	
					16.99	

Total Length: 3'

Field Sample Number			Lab Number		Depth	
Weight of Sample			Confining Pressure		Test Number	of
Diameter			Height		Moisture Can Number	
					Wet Wt + Can	
					Dry Wt + Can	
	Average		Average		Wt of Can	

Total Length:

AASHTO T-234 Tested By:

SS-351-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 1 | Tested By: DT | Checked By: MD
Sample No.: SS-351-16 | Test Date: 5/26/16 | Depth: 34.1-34.6
Test No.: UU-35-16 | Sample Type: | Elevation:

Soil Description: T.L. 24" Brn Clay with I.O. deposits, Rock upto 1/2".
Remarks:

Specimen Height: 5.75 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.43 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 605.86 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	s49	---		
Wt. Container + Wet Soil, gm	74.94	---	---	0
Wt. Container + Dry Soil, gm	66.56	---	---	0
Wt. Container, gm	15.33	---	---	0
Wt. Wet Soil, gm	59.61	1236	1062.3	0
Wt. Dry Soil, gm	51.23	1062.3	1062.3	0
Wt. Water, gm	8.38	173.76	0	0
Water Content, %	16.36	16.36	0.00	0.00
Void Ratio	---	0.51	0.51	---
Degree of Saturation, %	---	84.76	0.00	---
Dry Unit Weight, pcf	---	109.46	109.47	---

Initial
Height: 5.747 in
Area: 6.4332 in^2
Volume: 605.86 cc
Moisture: 16.36 %
Void Ratio: 0.51
Dry Unit Weight: 109.46 pcf
Saturation: 84.76 %

End of Initialization
Time: 11.072 min
Total Vertical Stress: 29.993 psi
Total Horizontal Stress: 29.982 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 29.993 psi
Effective Horizontal Stress: 29.982 psi
Height Change: 0.00018489 in
Area Change: 0 in^2
Volume Change: 0.058474 cc
Water Change: 0.16679 cc
Correction: 0 cc
Height: 5.7468 in
Area: 6.4332 in^2
Volume: 605.8 cc
Moisture: 16.34 %
Void Ratio: 0.51
Dry Unit Weight: 109.47 pcf
Saturation: 84.70 %

End of Consolidation/A
Time: 11.072 min
Total Vertical Stress: 29.993 psi
Total Horizontal Stress: 29.982 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 29.993 psi
Effective Horizontal Stress: 29.982 psi
Height Change: 0.00018489 in
Area Change: 0 in^2
Volume Change: 0.058474 cc
Water Change: 0.16679 cc
Correction: 0 cc
Height: 5.7468 in
Area: 6.4332 in^2
Volume: 605.8 cc
Moisture: 16.34 %
Void Ratio: 0.51
Dry Unit Weight: 109.47 pcf
Saturation: 84.70 %

End of Saturation
Time: 11.072 min
Total Vertical Stress: 29.993 psi
Total Horizontal Stress: 29.982 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 29.993 psi
Effective Horizontal Stress: 29.982 psi
Height Change: 0.00018489 in
Area Change: 0 in^2
Volume Change: 0.058474 cc
Water Change: 0.16679 cc
Correction: 0 cc
Height: 5.7468 in
Area: 6.4332 in^2
Volume: 605.8 cc
Moisture: 16.34 %
Void Ratio: 0.51
Dry Unit Weight: 109.47 pcf
Saturation: 84.70 %

End of Consolidation/B
Time: 11.072 min
Total Vertical Stress: 29.993 psi
Total Horizontal Stress: 29.982 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 29.993 psi
Effective Horizontal Stress: 29.982 psi
Height Change: 0.00018489 in
Area Change: 0 in^2
Volume Change: 0.058474 cc
Water Change: 0.16679 cc
Correction: 0 cc
Height: 5.7468 in
Area: 6.4332 in^2
Volume: 605.8 cc
Moisture: 16.34 %
Void Ratio: 0.51
Dry Unit Weight: 109.47 pcf
Saturation: 84.70 %

End of Shear
Time: 31.422 min
Total Vertical Stress: 79.485 psi
Total Horizontal Stress: 30.047 psi
Pore Pressure: -0.02379 psi
Effective Vertical Stress: 79.809 psi
Effective Horizontal Stress: 30.371 psi
Height Change: 1.1498 in
Area Change: -1.6082 in^2
Volume Change: 0.058474 cc
Water Change: 0.16679 cc
Correction: 173.59 cc
Height: 4.5972 in
Area: 8.0414 in^2
Volume: 605.8 cc
Moisture: 0.00 %
Void Ratio: 0.51
Dry Unit Weight: 109.47 pcf
Saturation: 0.00 %

At Failure
Time: 26.434 min
Total Vertical Stress: 78.354 psi
Total Horizontal Stress: 30.095 psi
Pore Pressure: -0.25093 psi
Effective Vertical Stress: 78.605 psi
Effective Horizontal Stress: 30.346 psi
Height Change: 0.86221 in
Area Change: -1.1334 in^2
Volume Change: 0.058474 cc
Water Change: 0.16679 cc
Correction: 0 cc
Height: 4.8848 in
Area: 7.5667 in^2
Volume: 605.8 cc
Moisture: 16.34 %
Void Ratio: 0.51
Dry Unit Weight: 109.47 pcf
Saturation: 84.70 %

SS-351-16

TRIAXIAL TEST

Project: EM-2-094(143)260 | Location: | Project No.:
Boring No : 1 | Tested By: DT | Checked By: MD
Sample No.: SS-351-16 | Test Date: 5/26/16 | Depth: 34.6-35.1
Test No.: UU-36-16 | Sample Type: | Elevation:

Soil Description: T.L. 24" Brn Clay with I.O. deposits, Rock upto 1/2"
Remarks:

Specimen Height: 5.75 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.45 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 607.66 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	s21	---		
Wt. Container + Wet Soil, gm	62.29	---	---	0
Wt. Container + Dry Soil, gm	56.28	---	---	0
Wt. Container, gm	16.99	---	---	0
Wt. Wet Soil, gm	45.3	1270.3	1101.7	0
Wt. Dry Soil, gm	39.29	1101.7	1101.7	0
Wt. Water, gm	6.01	168.53	0	0
Water Content, %	15.30	15.30	0.00	0.00
Void Ratio	---	0.46	0.46	---
Degree of Saturation, %	---	87.81	0.00	---
Dry Unit Weight, pcf	---	113.19	113.39	---

Initial

Height: 5.752 in
Area: 6.4467 in^2
Volume: 607.66 cc

Moisture: 15.30 %
Void Ratio: 0.46
Dry Unit Weight: 113.19 pcf
Saturation: 87.81 %

End of Initialization
Time: 11.107 min
Total Vertical Stress: 59.966 psi
Total Horizontal Stress: 59.973 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 59.966 psi
Effective Horizontal Stress: 59.973 psi

Height Change: 0.0035129 in
Area Change: 0 in^2
Volume Change: 1.1133 cc
Water Change: 2.5281 cc
Correction: 0 cc

Height: 5.7485 in
Area: 6.4467 in^2
Volume: 606.54 cc

Moisture: 15.07 %
Void Ratio: 0.46
Dry Unit Weight: 113.39 pcf
Saturation: 87.00 %

End of Consolidation/A
Time: 11.107 min
Total Vertical Stress: 59.966 psi
Total Horizontal Stress: 59.973 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 59.966 psi
Effective Horizontal Stress: 59.973 psi

Height Change: 0.0035129 in
Area Change: 0 in^2
Volume Change: 1.1133 cc
Water Change: 2.5281 cc
Correction: 0 cc

Height: 5.7485 in
Area: 6.4467 in^2
Volume: 606.54 cc

Moisture: 15.07 %
Void Ratio: 0.46
Dry Unit Weight: 113.39 pcf
Saturation: 87.00 %

End of Saturation
Time: 11.107 min
Total Vertical Stress: 59.966 psi
Total Horizontal Stress: 59.973 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 59.966 psi
Effective Horizontal Stress: 59.973 psi

Height Change: 0.0035129 in
Area Change: 0 in^2
Volume Change: 1.1133 cc
Water Change: 2.5281 cc
Correction: 0 cc

Height: 5.7485 in
Area: 6.4467 in^2
Volume: 606.54 cc

Moisture: 15.07 %
Void Ratio: 0.46
Dry Unit Weight: 113.39 pcf
Saturation: 87.00 %

End of Consolidation/B
Time: 11.107 min
Total Vertical Stress: 59.966 psi
Total Horizontal Stress: 59.973 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 59.966 psi
Effective Horizontal Stress: 59.973 psi

Height Change: 0.0035129 in
Area Change: 0 in^2
Volume Change: 1.1133 cc
Water Change: 2.5281 cc
Correction: 0 cc

Height: 5.7485 in
Area: 6.4467 in^2
Volume: 606.54 cc

Moisture: 15.07 %
Void Ratio: 0.46
Dry Unit Weight: 113.39 pcf
Saturation: 87.00 %

End of Shear
Time: 31.441 min
Total Vertical Stress: 99.848 psi
Total Horizontal Stress: 60.022 psi
Pore Pressure: 0.48568 psi
Effective Vertical Stress: 99.8 psi
Effective Horizontal Stress: 59.973 psi

Height Change: 1.1533 in
Area Change: -1.602 in^2
Volume Change: 1.1133 cc
Water Change: 2.5281 cc
Correction: 166 cc

Height: 4.5987 in
Area: 8.0487 in^2
Volume: 606.54 cc

Moisture: 0.00 %
Void Ratio: 0.46
Dry Unit Weight: 113.39 pcf
Saturation: 0.00 %

At Failure
Time: 25.735 min
Total Vertical Stress: 101.01 psi
Total Horizontal Stress: 60.094 psi
Pore Pressure: 0.40473 psi
Effective Vertical Stress: 100.97 psi
Effective Horizontal Stress: 60.054 psi

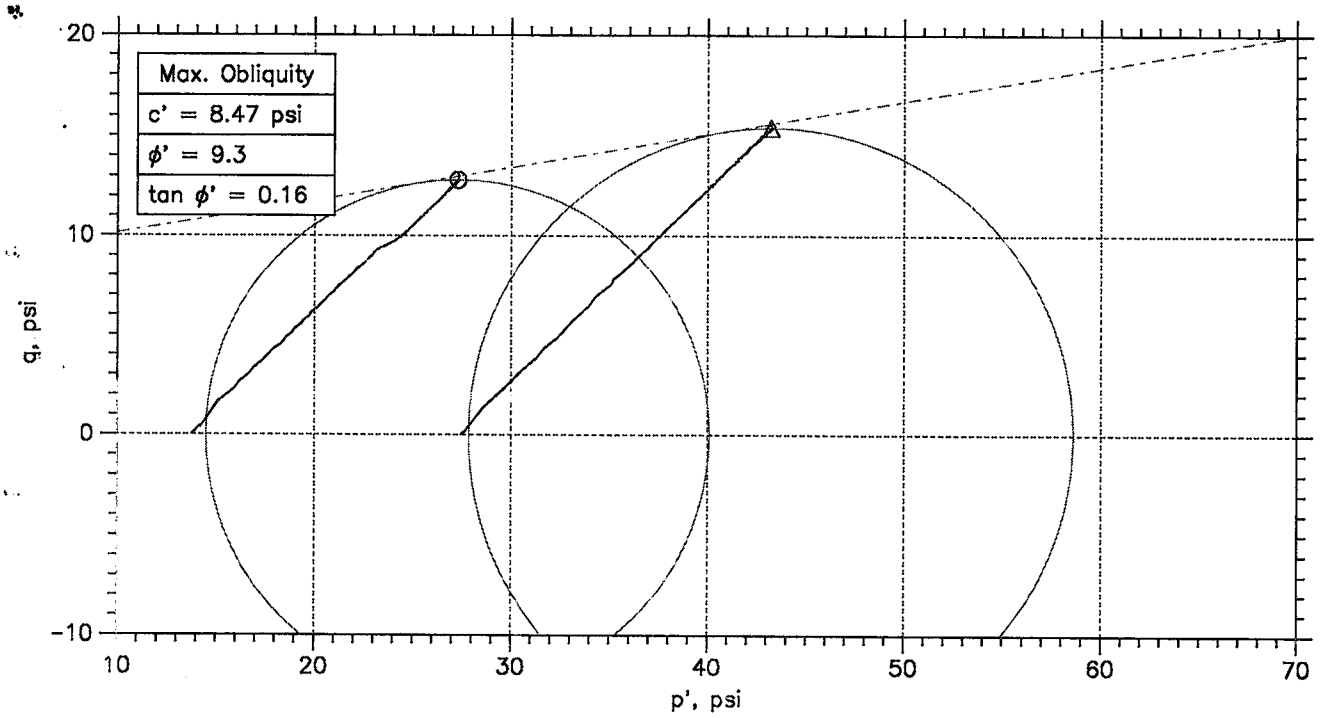
Height Change: 0.80256 in
Area Change: -1.0142 in^2
Volume Change: 1.1133 cc
Water Change: 2.5281 cc
Correction: 0 cc

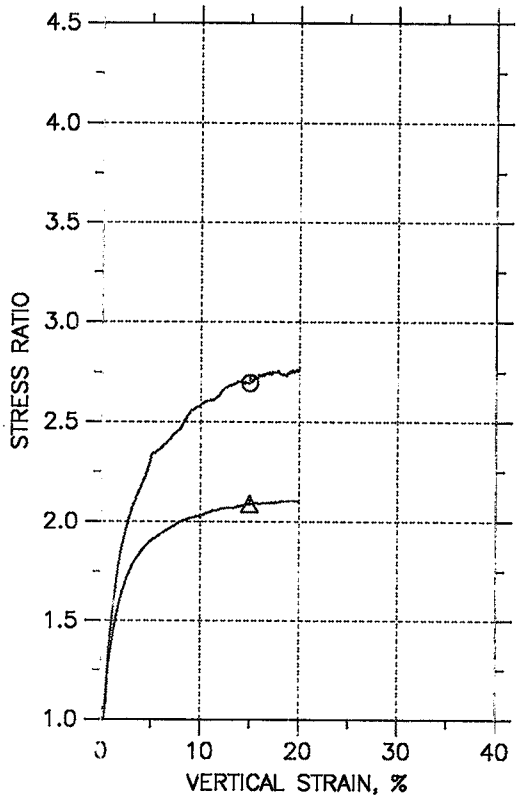
Height: 4.9494 in
Area: 7.4609 in^2
Volume: 606.54 cc

Moisture: 15.07 %
Void Ratio: 0.46
Dry Unit Weight: 113.39 pcf
Saturation: 87.00 %

SS-349-16

Test File





Symbol		⏀	△		
Sample No.		SS-349-16	SS-349-16		
Test No.		UU-37-16	UU-38-16		
Depth		29.2-29.7	29.8-30.3		
Initial	Diameter, in	2.837	2.851		
	Height, in	5.748	5.737		
	Water Content, %	20.3	21.1		
	Dry Density, pcf	106.3	106.4		
	Saturation, %	96.7	100.9		
	Void Ratio	0.556	0.555		
Before Shear	Water Content, %	20.3	20.8		
	Dry Density, pcf	106.3	106.7		
	Saturation*, %	96.8	100.0		
	Void Ratio	0.556	0.55		
	Back Press., psi	.0	.0		
Ver. Eff. Cons. Stress, psi		13.72	27.39		
Shear Strength, psi		12.32	15.14		
Strain at Failure, %		15	15		
Strain Rate, %/min		1	1		
B-Value		---	---		
Estimated Specific Gravity		2.65	2.65		
Liquid Limit		---	---		
Plastic Limit		---	---		

NDDOT North Dakota Department of Transportation

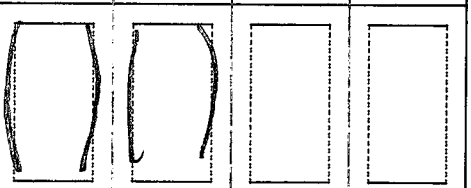
Project: IM-2-094(143)260

Location:

Project No.:

Boring No.: 1

Sample Type:



Description: T.L. 20" Brn Silty Clay with I.O.& Coal deposits, Rock up to 1/2"

Remarks:

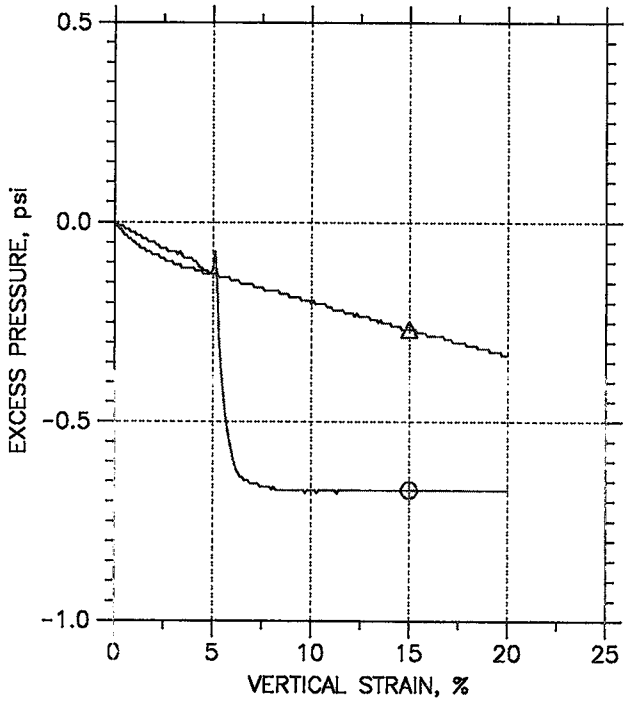
Phase calculations based on start and end of test.

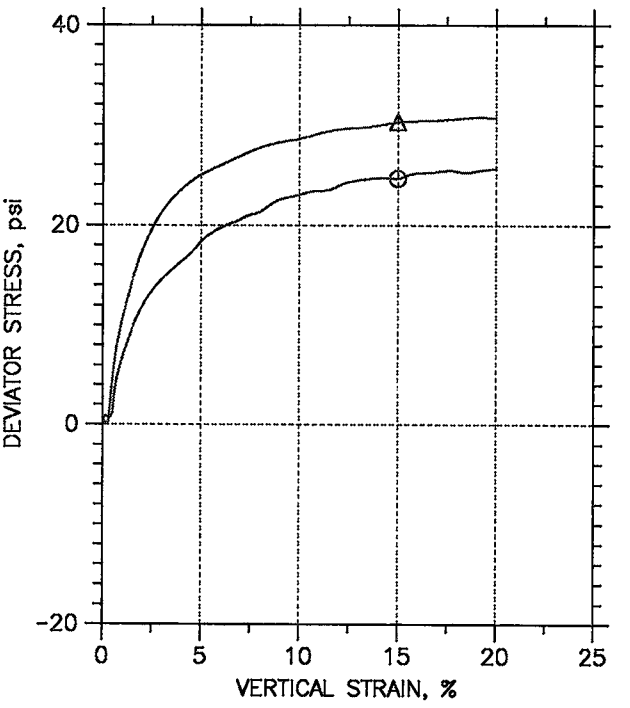
* Saturation is set to 100% for phase calculations.

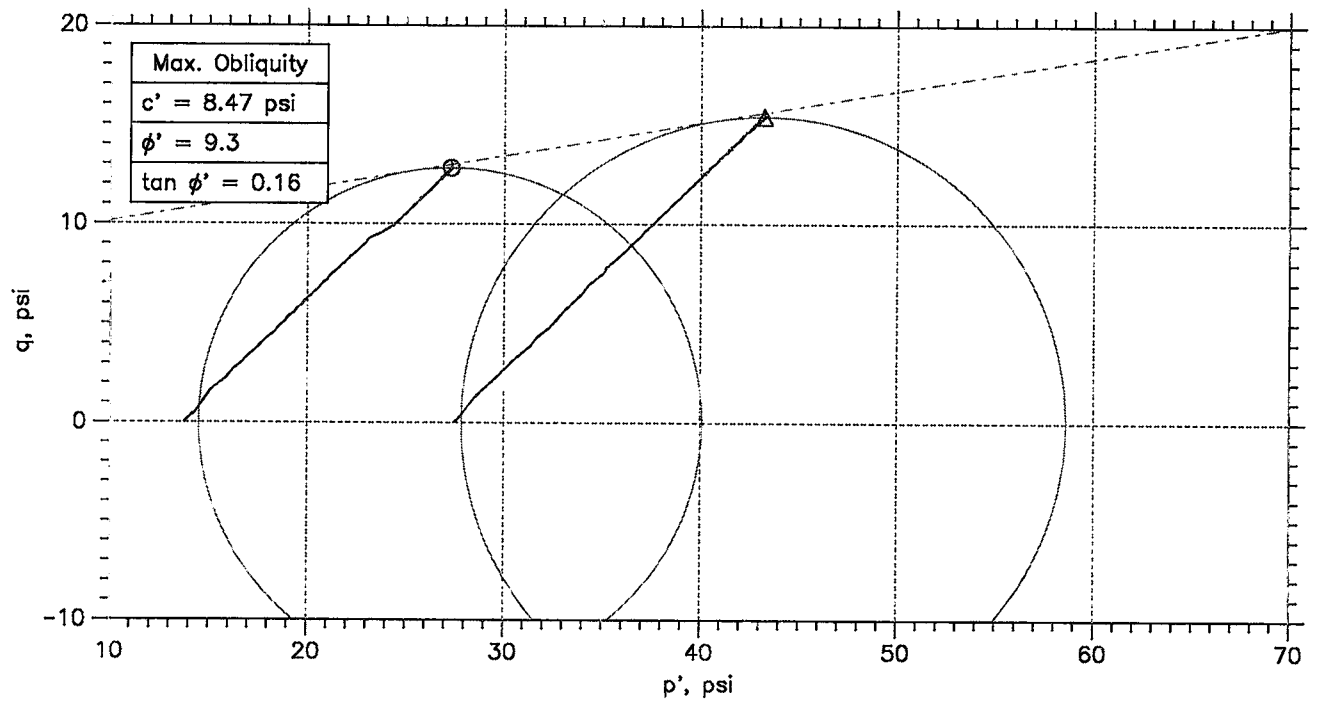
Tue, 31-MAY-2016 07:14:27

SS-349-16

Test File







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-349-16	UU-37-16	29.2-29.7	DT	5/26/16	MD		UU-37-2016.dat
△	SS-349-16	UU-38-16	29.8-30.3	DT	5/26/16	MD		UU-38-2016.dat

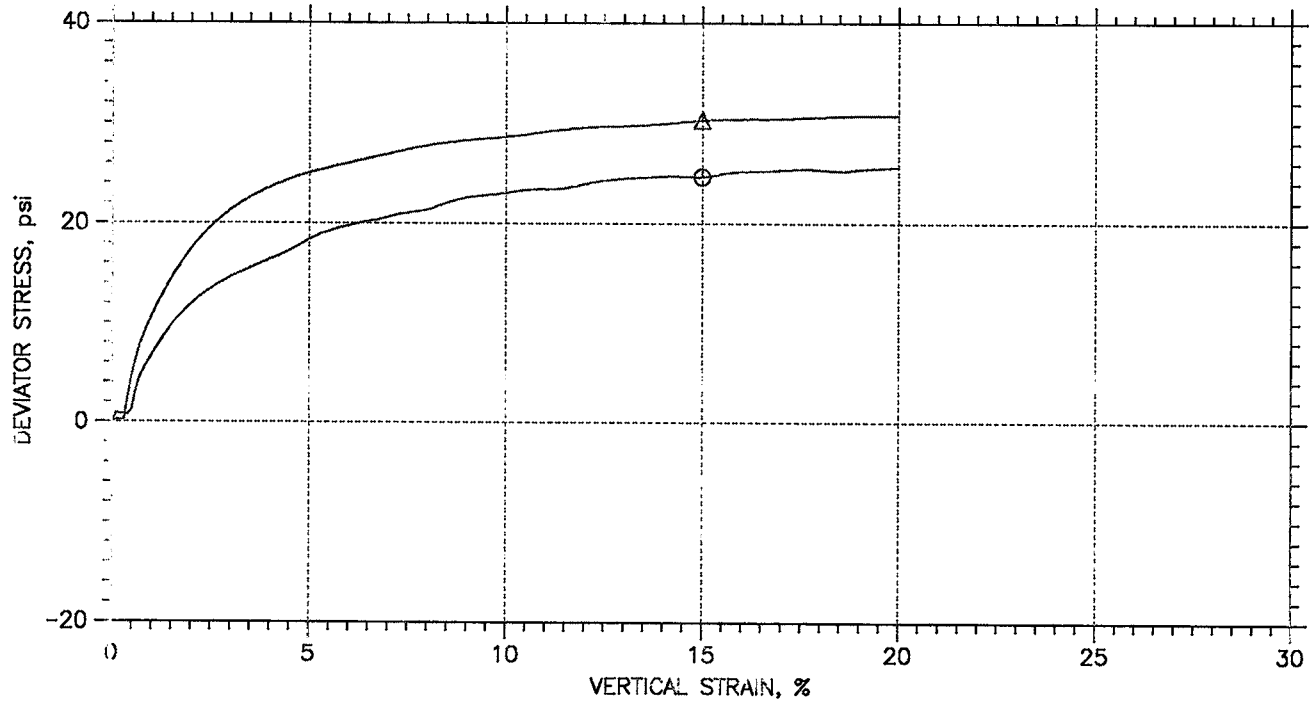
NDDOT North Dakota Department of Transportation

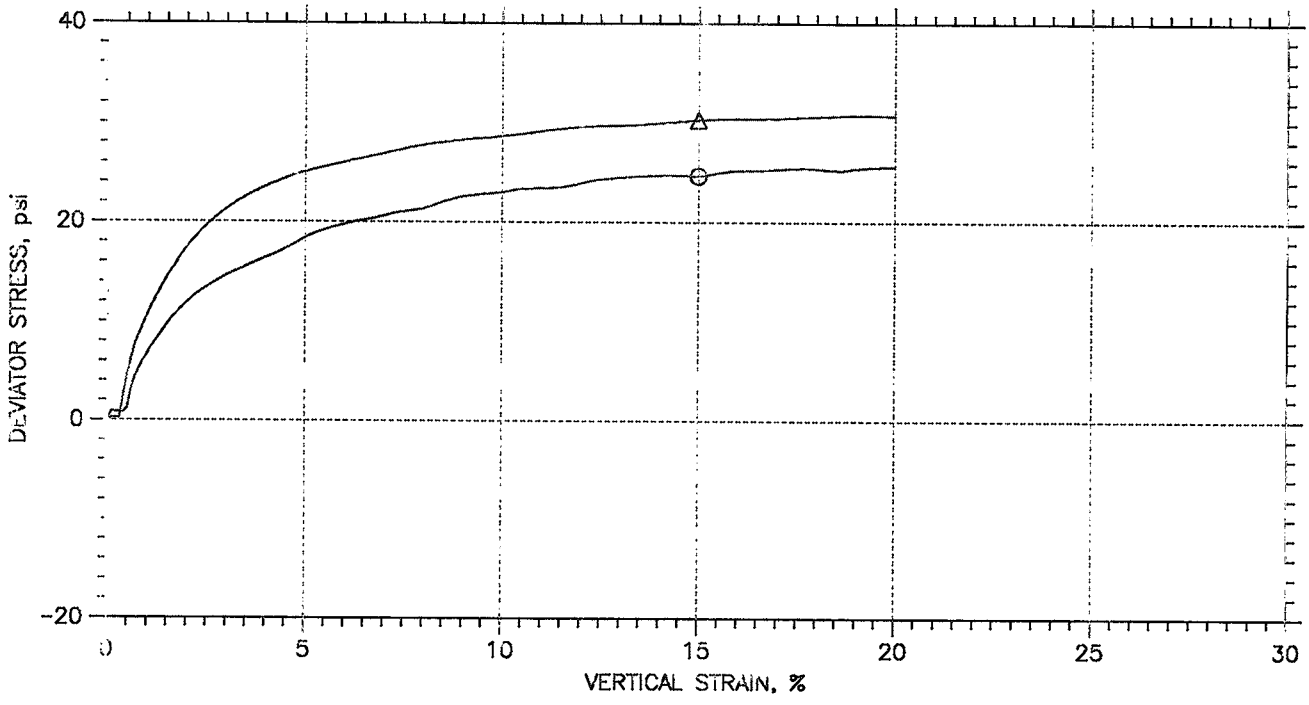
Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Sample Type:	
Description: T.L. 20" Brn Silty Clay with I.O.& Coal deposits, Rock up to 1/2"		
Remarks:		

Tue, 31-MAY-2016 07:14:27

SS-349-16

Test File





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-349-16	UU-37-16	29.2-29.7	DT	5/26/16	MD		UU-37-2016.dat
△	SS-349-16	UU-38-16	29.8-30.3	DT	5/26/16	MD		UU-38-2016.dat

NDDOT
North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Sample Type:	
Description: T.L. 20" Brn Silty Clay with I.O.& Coal deposits, Rock up to 1/2"		
Remarks:		

Tue, 31-MAY-2016 07: 4:27

SS-349-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 1 | Tested By: DT | Checked By: MD
Sample No.: SS-349-16 | Test Date: 5/26/16 | Depth: 29.2-29.7
Test No.: UU-37-16 | Sample Type: | Elevation:

Soil Description: T.L. 20" Brn Silty Clay with I.O.& Coal deposits, Rock up to 1/2"
Remarks:

Specimen Height: 5.75 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.32 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 595.42 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 61	---		
Wt. Container + Wet Soil, gm	81.13	---	---	0
Wt. Container + Dry Soil, gm	70.02	---	---	0
Wt. Container, gm	15.3	---	---	0
Wt. Wet Soil, gm	65.83	1219.8	1013.9	0
Wt. Dry Soil, gm	54.72	1013.9	1013.9	0
Wt. Water, gm	11.11	205.86	0	0
Water Content, %	20.30	20.30	0.00	0.00
Void Ratio	---	0.56	0.56	---
Degree of Saturation, %	---	96.74	0.00	---
Dry Unit Weight, pcf	---	106.31	106.33	---

Initial
Height: 5.748 in | Moisture: 20.30 %
Area: 6.3213 in^2 | Void Ratio: 0.56
Volume: 595.42 cc | Dry Unit Weight: 106.31 pcf
Saturation: 96.74 %

End of Initialization
Time: 4.3227 min
Total Vertical Stress: 13.718 psi | Height Change: 0.000416 in | Height: 5.7476 in | Moisture: 20.30 %
Total Horizontal Stress: 13.724 psi | Area Change: 0 in^2 | Area: 6.3213 in^2 | Void Ratio: 0.56
Pore Pressure: 0 psi | Volume Change: 0.12928 cc | Volume: 595.29 cc | Dry Unit Weight: 106.33 pcf
Effective Vertical Stress: 13.718 psi | Water Change: 0.041295 cc | Saturation: 96.78 %
Effective Horizontal Stress: 13.724 psi | Correction: 0 cc

End of Consolidation/A
Time: 4.3227 min
Total Vertical Stress: 13.718 psi | Height Change: 0.000416 in | Height: 5.7476 in | Moisture: 20.30 %
Total Horizontal Stress: 13.724 psi | Area Change: 0 in^2 | Area: 6.3213 in^2 | Void Ratio: 0.56
Pore Pressure: 0 psi | Volume Change: 0.12928 cc | Volume: 595.29 cc | Dry Unit Weight: 106.33 pcf
Effective Vertical Stress: 13.718 psi | Water Change: 0.041295 cc | Saturation: 96.78 %
Effective Horizontal Stress: 13.724 psi | Correction: 0 cc

End of Saturation
Time: 4.3227 min
Total Vertical Stress: 13.718 psi | Height Change: 0.000416 in | Height: 5.7476 in | Moisture: 20.30 %
Total Horizontal Stress: 13.724 psi | Area Change: 0 in^2 | Area: 6.3213 in^2 | Void Ratio: 0.56
Pore Pressure: 0 psi | Volume Change: 0.12928 cc | Volume: 595.29 cc | Dry Unit Weight: 106.33 pcf
Effective Vertical Stress: 13.718 psi | Water Change: 0.041295 cc | Saturation: 96.78 %
Effective Horizontal Stress: 13.724 psi | Correction: 0 cc

End of Consolidation/B
Time: 4.3227 min
Total Vertical Stress: 13.718 psi | Height Change: 0.000416 in | Height: 5.7476 in | Moisture: 20.30 %
Total Horizontal Stress: 13.724 psi | Area Change: 0 in^2 | Area: 6.3213 in^2 | Void Ratio: 0.56
Pore Pressure: 0 psi | Volume Change: 0.12928 cc | Volume: 595.29 cc | Dry Unit Weight: 106.33 pcf
Effective Vertical Stress: 13.718 psi | Water Change: 0.041295 cc | Saturation: 96.78 %
Effective Horizontal Stress: 13.724 psi | Correction: 0 cc

End of Shear
Time: 24.621 min
Total Vertical Stress: 39.43 psi | Height Change: 1.15 in | Height: 4.598 in | Moisture: 0.00 %
Total Horizontal Stress: 13.837 psi | Area Change: -1.5793 in^2 | Area: 7.9007 in^2 | Void Ratio: 0.56
Pore Pressure: -0.67185 psi | Volume Change: 0.12928 cc | Volume: 595.29 cc | Dry Unit Weight: 106.33 pcf
Effective Vertical Stress: 40.102 psi | Water Change: 0.041295 cc | Saturation: 0.00 %
Effective Horizontal Stress: 14.509 psi | Correction: 205.82 cc

At Failure
Time: 19.539 min
Total Vertical Stress: 38.513 psi | Height Change: 0.86255 in | Height: 4.8854 in | Moisture: 20.30 %
Total Horizontal Stress: 13.877 psi | Area Change: -1.1156 in^2 | Area: 7.4369 in^2 | Void Ratio: 0.56
Pore Pressure: -0.67185 psi | Volume Change: 0.12928 cc | Volume: 595.29 cc | Dry Unit Weight: 106.33 pcf
Effective Vertical Stress: 39.184 psi | Water Change: 0.041295 cc | Saturation: 96.78 %
Effective Horizontal Stress: 14.549 psi | Correction: 0 cc

SS-349-16

TRIAXIAL TEST

Project: IM-2-094(143)260
Boring No.: 1
Sample No.: SS-349-16
Test No.: UU-38-16

Location:
Tested By: DT
Test Date: 5/26/16
Sample Type:

Project No.:
Checked By: MD
Depth: 29.8-30.3
Elevation:

Soil Description: T.L. 20" Brn Silty Clay with I.O.& Coal deposits, Rock up to 1/2"
Remarks:

Specimen Height: 5.74 in
Specimen Area: 6.38 in^2
Specimen Volume: 600.16 cc

Piston Area: 0.16 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 psi
Membrane Correction: 4.20 lb/in
Correction Type: Uniform

Liquid Limit: ---

Plastic Limit: ---

Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 69	---		
Wt. Container + Wet Soil, gm	79.14	---	---	0
Wt. Container + Dry Soil, gm	68.01	---	---	0
Wt. Container, gm	15.36	---	---	0
Wt. Wet Soil, gm	63.78	1238.7	1022.5	0
Wt. Dry Soil, gm	52.65	1022.5	1022.5	0
Wt. Water, gm	11.13	216.15	0	0
Water Content, %	21.14	21.14	0.00	0.00
Void Ratio	---	0.56	0.55	---
Degree of Saturation, %	---	100.86	0.00	---
Dry Unit Weight, pcf	---	106.36	106.73	---

Initial

Height: 5.737 in
Area: 6.3839 in^2
Volume: 600.16 cc

Moisture: 21.14 %
Void Ratio: 0.56
Dry Unit Weight: 106.36 pcf
Saturation: 100.86 %

End of Initialization
Time: 3.5448 min
Total Vertical Stress: 27.387 psi
Total Horizontal Stress: 27.391 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 27.387 psi
Effective Horizontal Stress: 27.391 psi

Height Change: 0.006656 in
Area Change: 0 in^2
Volume Change: 2.0889 cc
Water Change: -0.016625 cc
Correction: 3.9462 cc

Height: 5.7303 in
Area: 6.3839 in^2
Volume: 598.08 cc

Moisture: 20.76 %
Void Ratio: 0.55
Dry Unit Weight: 106.73 pcf
Saturation: 100.00 %

End of Consolidation/A
Time: 3.5448 min
Total Vertical Stress: 27.387 psi
Total Horizontal Stress: 27.391 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 27.387 psi
Effective Horizontal Stress: 27.391 psi

Height Change: 0.006656 in
Area Change: 0 in^2
Volume Change: 2.0889 cc
Water Change: -0.016625 cc
Correction: 3.9462 cc

Height: 5.7303 in
Area: 6.3839 in^2
Volume: 598.08 cc

Moisture: 20.76 %
Void Ratio: 0.55
Dry Unit Weight: 106.73 pcf
Saturation: 100.00 %

End of Saturation
Time: 3.5448 min
Total Vertical Stress: 27.387 psi
Total Horizontal Stress: 27.391 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 27.387 psi
Effective Horizontal Stress: 27.391 psi

Height Change: 0.006656 in
Area Change: 0 in^2
Volume Change: 2.0889 cc
Water Change: -0.016625 cc
Correction: 3.9462 cc

Height: 5.7303 in
Area: 6.3839 in^2
Volume: 598.08 cc

Moisture: 20.76 %
Void Ratio: 0.55
Dry Unit Weight: 106.73 pcf
Saturation: 100.00 %

End of Consolidation/B
Time: 3.5448 min
Total Vertical Stress: 27.387 psi
Total Horizontal Stress: 27.391 psi
Pore Pressure: 0 psi
Effective Vertical Stress: 27.387 psi
Effective Horizontal Stress: 27.391 psi

Height Change: 0.006656 in
Area Change: 0 in^2
Volume Change: 2.0889 cc
Water Change: -0.016625 cc
Correction: 3.9462 cc

Height: 5.7303 in
Area: 6.3839 in^2
Volume: 598.08 cc

Moisture: 20.76 %
Void Ratio: 0.55
Dry Unit Weight: 106.73 pcf
Saturation: 100.00 %

End of Shear
Time: 23.868 min
Total Vertical Stress: 58.427 psi
Total Horizontal Stress: 27.593 psi
Pore Pressure: -0.33188 psi
Effective Vertical Stress: 58.758 psi
Effective Horizontal Stress: 27.925 psi

Height Change: 1.1528 in
Area Change: -1.5775 in^2
Volume Change: 2.0889 cc
Water Change: -0.016625 cc
Correction: 216.17 cc

Height: 4.5842 in
Area: 7.9614 in^2
Volume: 598.08 cc

Moisture: 0.00 %
Void Ratio: 0.55
Dry Unit Weight: 106.73 pcf
Saturation: 0.00 %

At Failure
Time: 18.78 min
Total Vertical Stress: 57.839 psi
Total Horizontal Stress: 27.561 psi
Pore Pressure: -0.26712 psi
Effective Vertical Stress: 58.106 psi
Effective Horizontal Stress: 27.828 psi

Height Change: 0.86621 in
Area Change: -1.1355 in^2
Volume Change: 2.0889 cc
Water Change: -0.016625 cc
Correction: 0 cc

Height: 4.8708 in
Area: 7.5194 in^2
Volume: 598.08 cc

Moisture: 20.76 %
Void Ratio: 0.55
Dry Unit Weight: 106.73 pcf
Saturation: 100.00 %

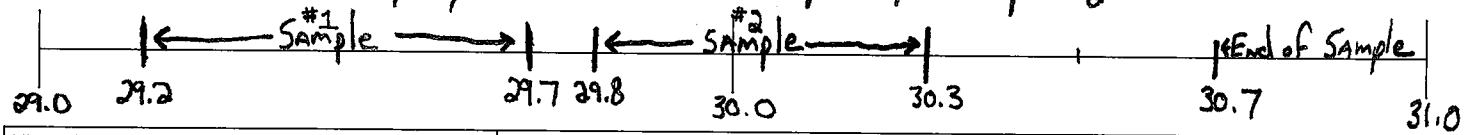
TRIAXIAL UU(Q) CCU(R) CD(S)

North Dakota Department of Transportation, Materials & Research
SFN 50459 (5-2016)

Project Number	
IM-2-094(143)260	
Boring Number	
1	

Field Sample Number			Lab Number		Depth	
SS-349-16			UU-37-16		29.2 to 29.7	
Weight of Sample			Confining Pressure		Test Number	of
1219.81			13.8		1	2
Diameter	2.840	2.840	Height	5.746	Moisture Can Number	
	2.830	2.834		5.747	S61	
	2.837	2.842		5.751	Wet Wt + Can	
	Average		Average		81.13	
	2.837		5.748		Dry Wt + Can	
					70.02	
					Wt of Can	
					15.30	

Total Length: 20" Brn Silty Cly with I.O. + Coal Deposits, Rock up to ½"



Field Sample Number			Lab Number		Depth	
SS-349-16			UU-38-16		29.8 to 30.3	
Weight of Sample			Confining Pressure		Test Number	of
1238.66			27.5		2	2
Diameter	2.862	2.836	Height	5.738	Moisture Can Number	
	2.850	2.846		5.738	S69	
	2.863	2.850		5.736	Wet Wt + Can	
	Average		Average		79.14	
	2.851		5.737		Dry Wt + Can	
					68.01	
					Wt of Can	
					15.36	

Total Length:

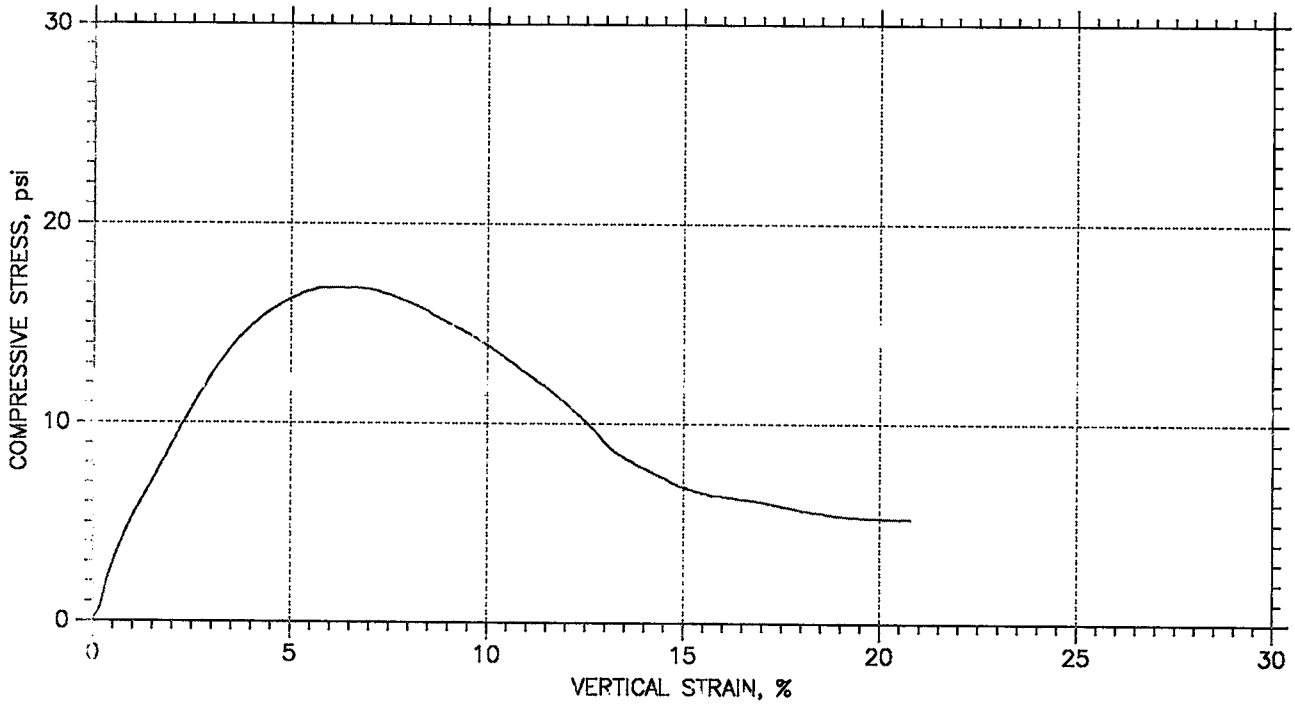
Field Sample Number			Lab Number		Depth	
Weight of Sample			Confining Pressure		Test Number	of
Diameter			Height		Moisture Can Number	
					Wet Wt + Can	
					Dry Wt + Can	
	Average		Average		Wt of Can	

Total Length:

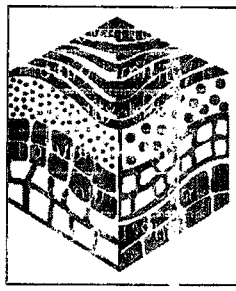
AASHTO T-234 Tested By:

55-347-16

UNCONFINED COMPRESSION TEST REPORT



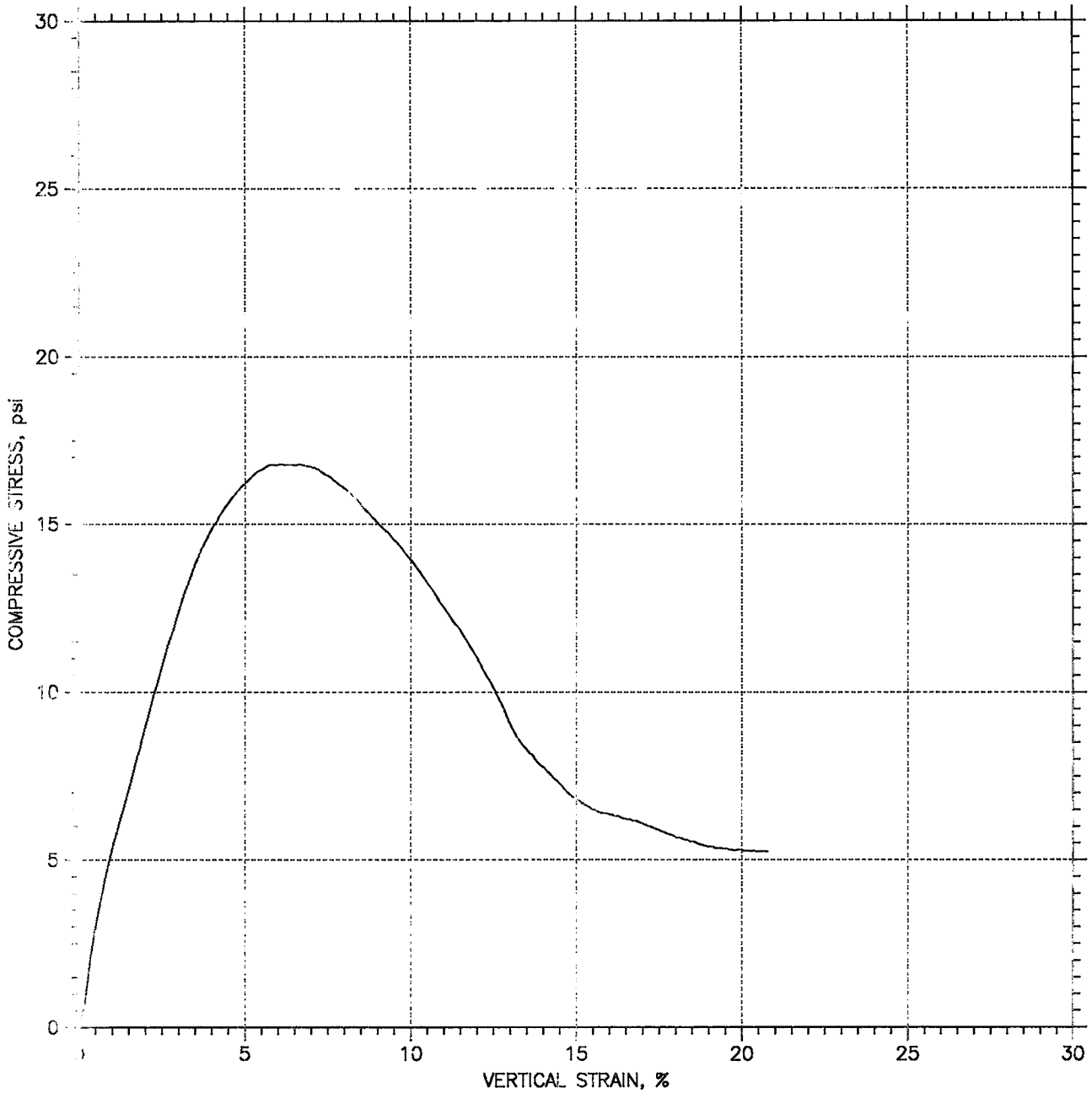
Symbol					
Test No.		UC-20-16			
Initial	Diameter, in	2.848			
	Height, in	5.738			
	Water Content, %	19.87			
	Dry Density, pcf	108.4			
	Saturation, %	100.22			
	Void Ratio	0.525			
Unconfined Compressive Strength, psi		16.78			
Undrained Shear Strength, psi		8.39			
Time to Failure, min		5.918			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					



Project: IM-2-094(143)260
Location:
Project No.:
Boring No.: 1
Sample Type: Undisturbed
Description: T. L. 18" Brn Silty Clay with I.O. deposits, rock up to 1/2".
Remarks:

SS-347-16

UNCONFINED COMPRESSION TEST REPORT



	Project: IM-2-094(143)260	Location:	Project No.:
	Boring No.: 1	Tested By: DT	Checked By: MD
	Sample No.: SS-347-16	Test Date: 5/26/2016	Depth: 24.2-24.7
	Test No.: UC-20-16	Sample Type: Undisturbed	Elevation:
	Description: T. L. 18" Brn Silty Clay with I.O. deposits, rock up to 1/2".		
	Remarks:		

Tue, 31-MAY-2016 07:13:49

SS-347-16

UNCONFINED COMPRESSION TEST

Project: IM-2-094(343)260 | Location: | Project No.:
Boring No.: 1 | Tested By: DT | Checked By: MD
Sample No.: SS-347-16 | Test Date: 5/26/2016 | Depth: 24.2-24.7
Test No.: UC-20-16 | Sample Type: Undisturbed | Elevation:

Soil Description: T. L. 18" Brn Silty Clay with I.O. deposits, rock up to 1/2".
Remarks:

Specimen Height: 5.74 in | Liquid Limit: 0 | Cap Mass: 0 gm
Specimen Area: 6.3[illegible] in^2 | Plastic Limit: 0
Specimen Volume: [illegible]9.01 cc | Measured Specific Gravity: 2.65

Water Content Information

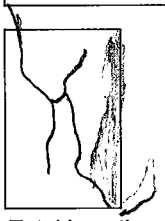
Container ID	s42
Wt. Container, gm	16.95
Wt. Container + Wet Soil, gm	87.22
Wt. Container + Dry Soil, gm	75.57
Wt. Dry Soil, gm	58.62
Water Content, %	19.87
Void Ratio	0.53
Degree of Saturation, %	100.22
Wet Unit Weight, pcf	130
Dry Unit Weight, pcf	108.45

UNCONFINED COMPRESSION

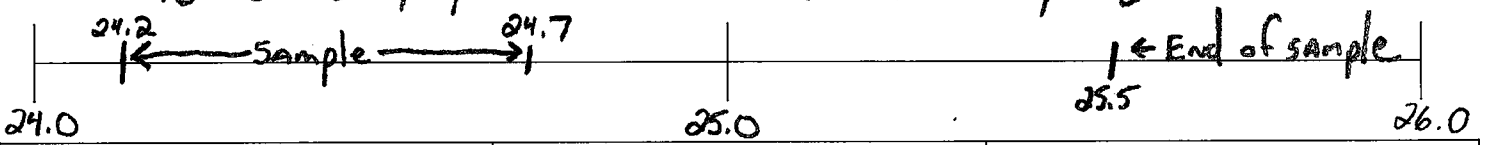
North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

Project Number	IM-2-094(143)260
Boring Number	1

Field Sample Number	SS-347-16		Lab Number	UC-20-16	Depth 24.2 to 24.7
Weight of Sample	1247.37		Test Number	1 of 1	AASHTO T-208 Tested by: DT/MD
Diameter	1. 2.853	4. 2.840	Height	1. 5.740	Moisture Can Number 542
	2. 2.846	5. 2.850		2. 5.737	Wet Wt + Can 87.22
	3. 2.857	6. 2.843		3. 5.738	Dry Wt + Can 75.57
	Average 2.848			Average 5.738	Wt of Can 16.95



Total Length: 18" Brn Silty Cly with I.O. & Coal Deposits, Rock up to 1/2"



Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number	of	AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average			Average	Wt of Can

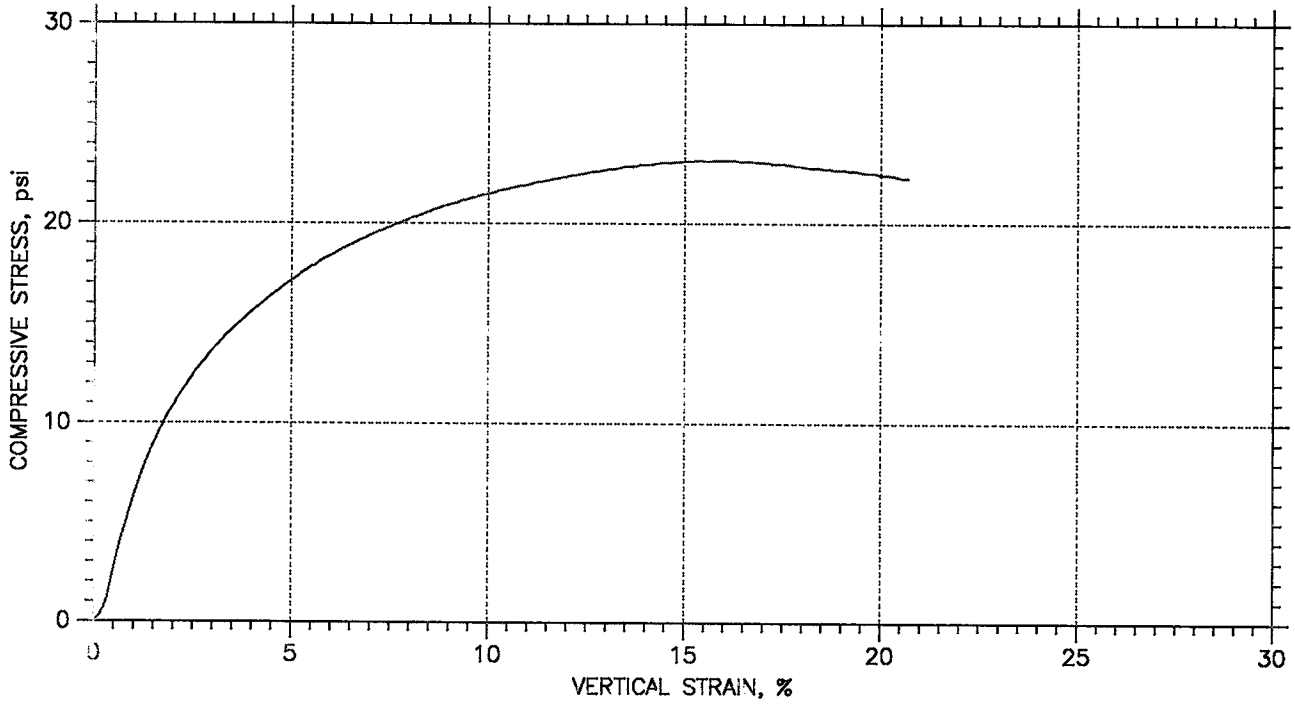
Total Length:

Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number	of	AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average			Average	Wt of Can

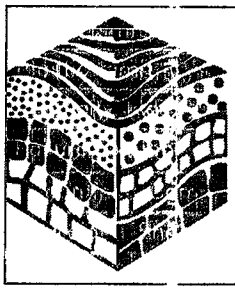
Total Length:

55-345-16

UNCONFINED COMPRESSION TEST REPORT



Symbol					
Test No.		UC-19-16			
Initial	Diameter, in	2.847			
	Height, in	5.715			
	Water Content, %	21.56			
	Dry Density, pcf	106.4			
	Saturation, %	103.03			
	Void Ratio	0.555			
Unconfined Compressive Strength, psi		23.17			
Undrained Shear Strength, psi		11.59			
Time to Failure, min		14.917			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					



Project: IM-2-094(143)260

Location:

Project No.:

Boring No.: 1

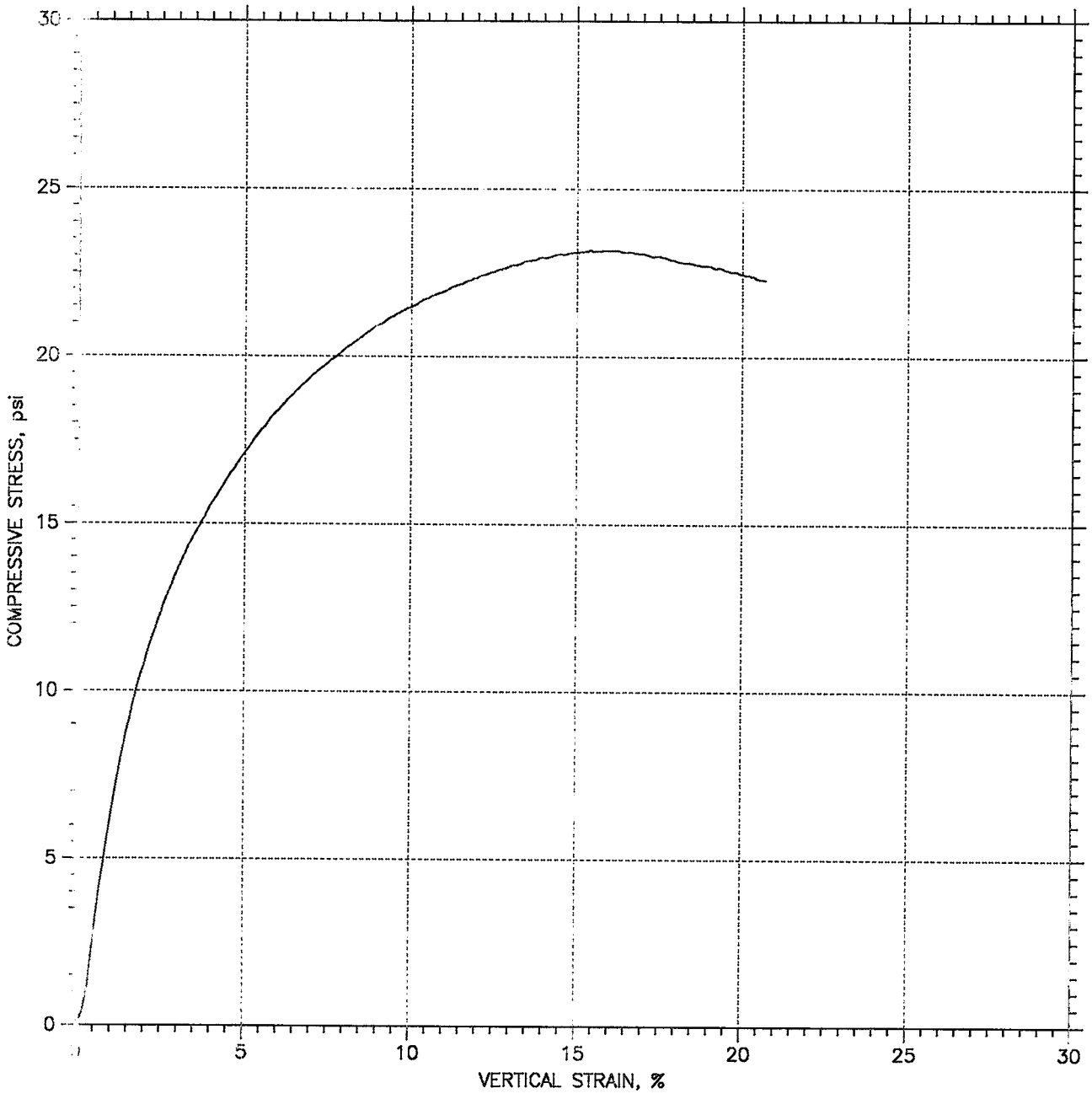
Sample Type: Undisturbed

Description: T. L. 17" Brn Clay with I.O. deposits, rock up to 1 3/4"

Remarks:

SS-345-16

UNCONFINED COMPRESSION TEST REPORT



Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Tested By: DT	Checked By: MD
Sample No.: SS-345-16	Test Date: 5/26/2016	Depth: 19.9-20.4
Test No.: UC-19-16	Sample Type: Undisturbed	Elevation:
Description: T. L. 17" Brn Clay with I.O. deposits, rock up to 1 3/4"		
Remarks:		

SS-345-16

UNCONFINED COMPRESSION TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 1 | Tested By: DT | Checked By: MD
Sample No.: SS-345-16 | Test Date: 5/26/2016 | Depth: 19.9-20.4
Test No.: UC-19-16 | Sample Type: Undisturbed | Elevation:

Soil Description: T. L. 17" Brn Clay with I.O. deposits, rock up to 1 3/4"
Remarks:

Specimen Height: 5.71 in | Liquid Limit: 0 | Cap Mass: 0 gm
Specimen Area: 6.37 in^2 | Plastic Limit: 0
Specimen Volume: 596.19 cc | Measured Specific Gravity: 2.65

Water Content Information

Container ID	s13
Wt. Container, gm	17.04
Wt. Container + Wet Soil, gm	64.96
Wt. Container + Dry Soil, gm	56.46
Wt. Dry Soil, gm	39.42
Water Content, %	21.56
Void Ratio	0.55
Degree of Saturation, %	103.03
Wet Unit Weight, pcf	129.36
Dry Unit Weight, pcf	106.42

UNCONFINED COMPRESSION

North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

Project Number	IM-2-094(143)260
Boring Number	1

Field Sample Number	SS-345-16		Lab Number	UC-19-16	Depth	19.9-20.4
Weight of Sample	1235.41		Test Number	1 of 1	AASHTO T-208 Tested by:	
Diameter	1. 2.835	4. 2.830	Height	1. 5.718	Moisture Can Number	S13
	2. 2.855	5. 2.849		2. 5.713	Wet Wt + Can	64.96
	3. 2.866	6. 2.852		3. 5.713	Dry Wt + Can	56.46
	Average 2.847		Average	5.715	Wt of Can	17.04

Total Length:

17" Brn, Clay with I.O. deposits rock upto 1 3/4"

19.0 — 1 3/4" Rock — 20.0 sample — 21.0

Field Sample Number			Lab Number		Depth	
Weight of Sample			Test Number	of	AASHTO T-208 Tested by:	
Diameter	1.	4.	Height	1.	Moisture Can Number	
	2.	5.		2.	Wet Wt + Can	
	3.	6.		3.	Dry Wt + Can	
	Average		Average		Wt of Can	

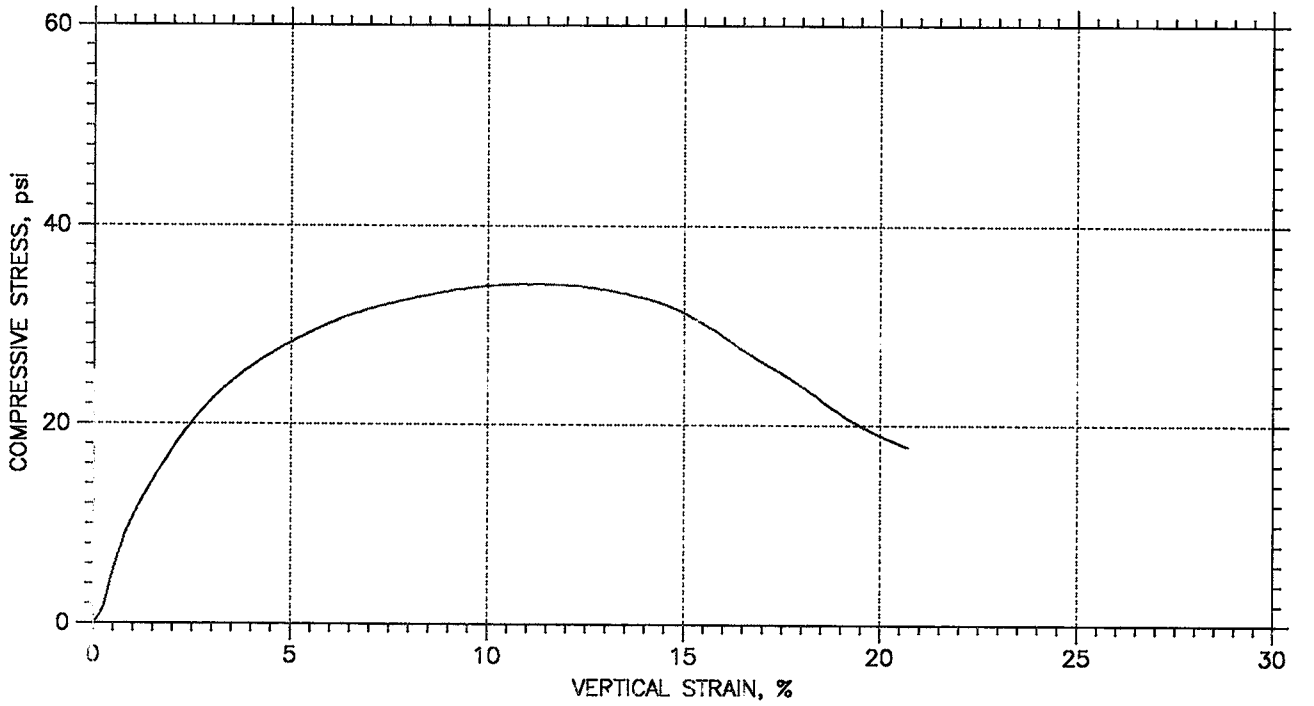
Total Length:

Field Sample Number			Lab Number		Depth	
Weight of Sample			Test Number	of	AASHTO T-208 Tested by:	
Diameter	1.	4.	Height	1.	Moisture Can Number	
	2.	5.		2.	Wet Wt + Can	
	3.	6.		3.	Dry Wt + Can	
	Average		Average		Wt of Can	

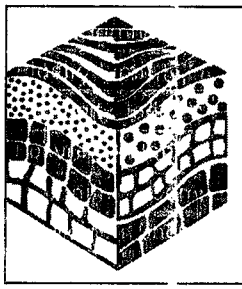
Total Length:

SS-339-16

UNCONFINED COMPRESSION TEST REPORT



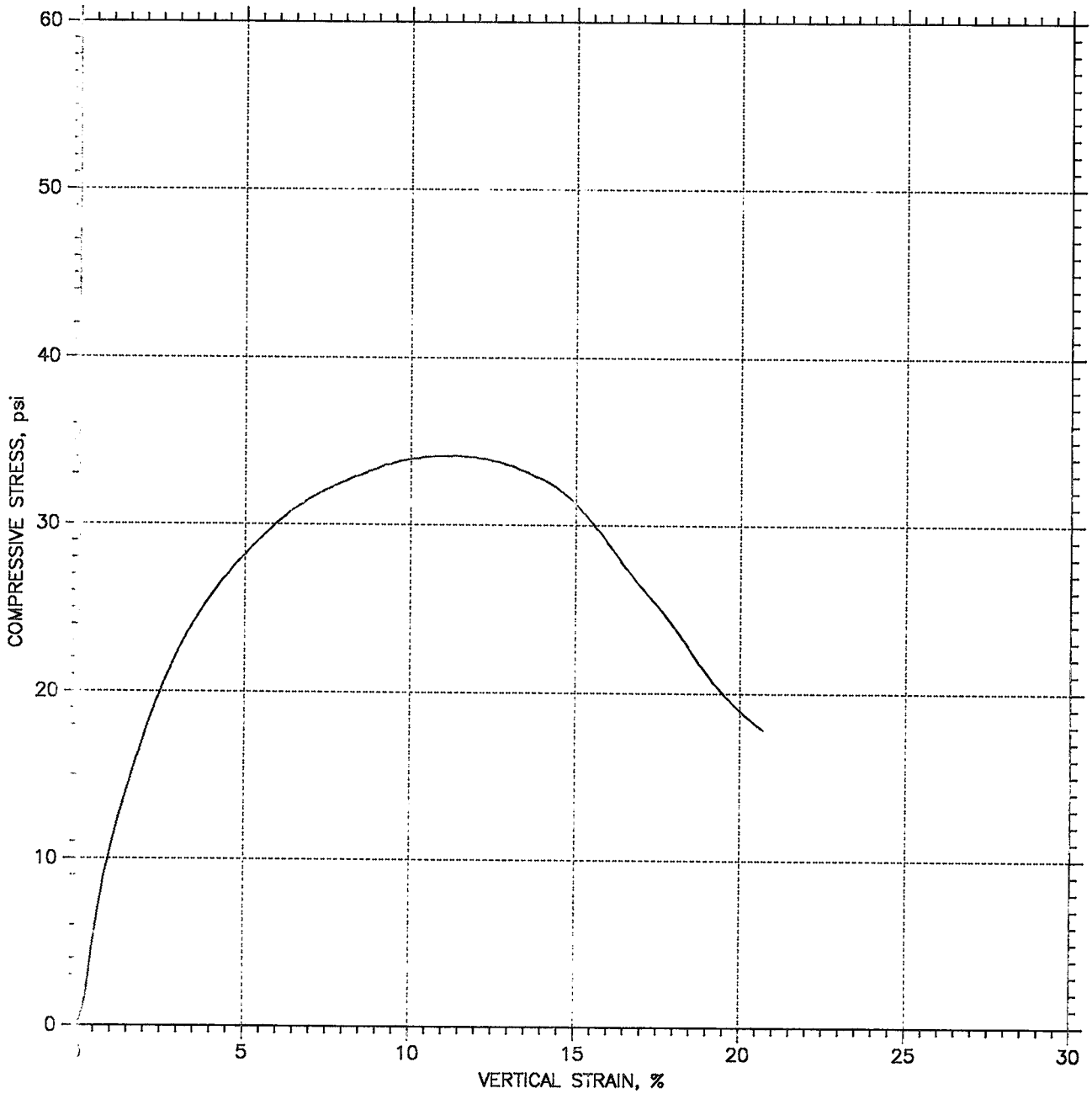
Symbol					
Test No.		UC-18-16			
Initial	Diameter, in	2.857			
	Height, in	5.739			
	Water Content, %	19.72			
	Dry Density, pcf	107.9			
	Saturation, %	97.93			
	Void Ratio	0.534			
Unconfined Compressive Strength, psi		34.11			
Undrained Shear Strength, psi		17.06			
Time to Failure, min		10.917			
Strain Rate, %/min		1			
Measured Specific Gravity		2.65			
Liquid Limit		0			
Plastic Limit		0			
Plasticity Index		0			
Failure Sketch					

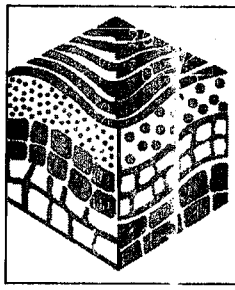


Project: IM-2-094(143)260
Location:
Project No.:
Boring No.: 1
Sample Type: Undisturbed
Description: T. L. 14" Brn Clay with I.O. Deposits, rock up to 1/2"
Remarks:

SS-339-16

UNCONFINED COMPRESSION TEST REPORT





Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Tested By: DT	Checked By: MD
Sample No.: SS-339-16	Test Date: 5/26/2016	Depth: 4.4-4.9
Test No.: UC-18-16	Sample Type: Undisturbed	Elevation:
Description: T. L. 14" Brn Clay with I.O. Deposits, rock up to 1/2"		
Remarks:		

Tue, 31-MAY-2016 07:13:59

SS-339-16

UNCONFINED COMPRESSION TEST

Project: IM-2-094(143)260
Boring No.: 1
Sample No.: SS-339-16
Test No.: UC-18-16

Location:
Tested By: DT
Test Date: 5/26/2016
Sample Type: Undisturbed

Project No.:
Checked By: MD
Depth: 4.4-4.9
Elevation:

Soil Description: T. L. 14" Brn Clay with I.O. Deposits, rock up to 1/2"
Remarks:

Specimen Height: 5.74 in
Specimen Area: 6.41 in^2
Specimen Volume: 602.90 cc

Liquid Limit: 0
Plastic Limit: 0
Measured Specific Gravity: 2.65

Cap Mass: 0 gm

Water Content Information

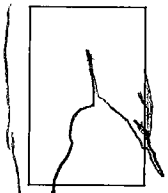
Container ID	s39
Wt. Container, gm	16.89
Wt. Container + Wet Soil, gm	68.06
Wt. Container + Dry Soil, gm	59.63
Wt. Dry Soil, gm	42.74
Water Content, %	19.72
Void Ratio	0.53
Degree of Saturation, %	97.93
Wet Unit Weight, pcf	129.14
Dry Unit Weight, pcf	107.86

UNCONFINED COMPRESSION

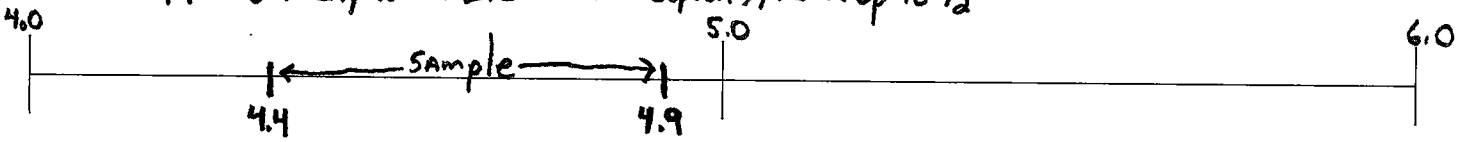
North Dakota Department of Transportation, Materials & Research
SFN 50460 (5-2016)

Project Number	
IM-2-094(143)260	
Boring Number	
1	

Field Sample Number			Lab Number		Depth
SS-339-16			UC-18-16		4.4 to 4.9
Weight of Sample			Test Number 1 of 1		AASHTO T-208 Tested by: DT/MD
1247.16					
Diameter	1. 2.853	4. 2.857	Height	1. 5.740	Moisture Can Number 539
	2. 2.852	5. 2.863		2. 5.738	Wet Wt + Can 68.06
	3. 2.855	6. 2.862		3. 5.741	Dry Wt + Can 59.63
	Average 2.857		Average 5.739		Wt of Can 16.89

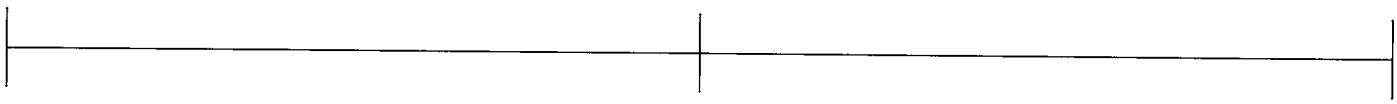


Total Length: 14" Bar Cly with I.O. + Coal Deposits, Rock up to ½"



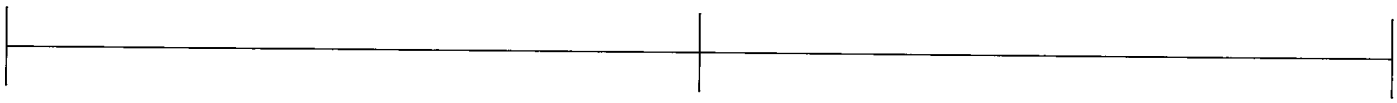
Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number of		AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

Total Length:



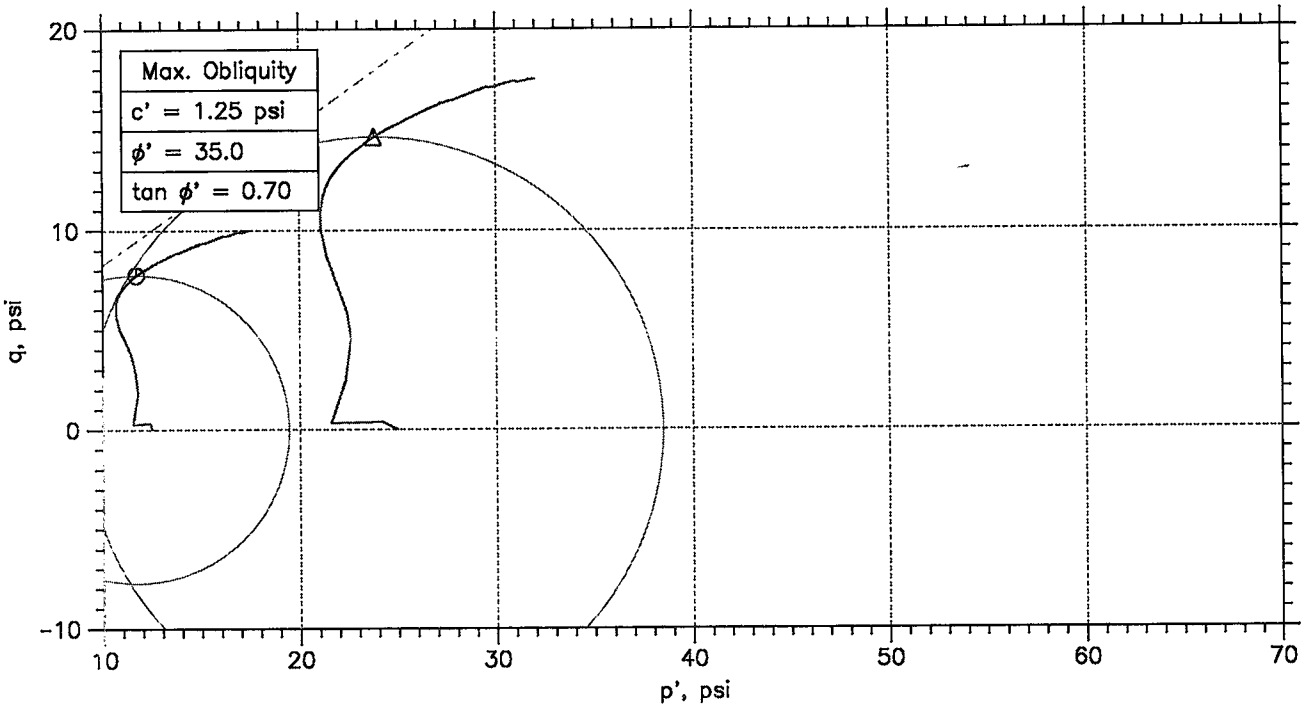
Field Sample Number			Lab Number		Depth
Weight of Sample			Test Number of		AASHTO T-208 Tested by:
Diameter	1.	4.	Height	1.	Moisture Can Number
	2.	5.		2.	Wet Wt + Can
	3.	6.		3.	Dry Wt + Can
	Average		Average		Wt of Can

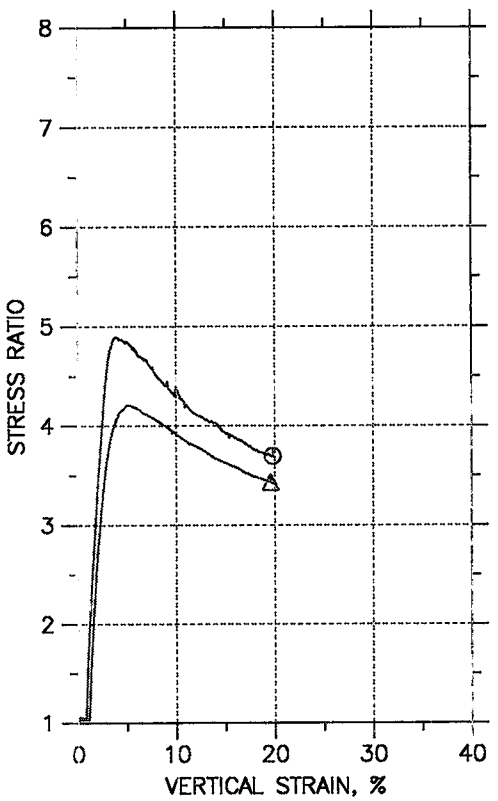
Total Length:



SS-343-16

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△		
Sample No.		SS-343-16	SS-343-16		
Test No.		CU-6-16	CU-7-16		
Depth		14.1-14.6	14.6-15.1		
Initial	Diameter, in	2.833	2.85		
	Height, in	5.739	5.73		
	Water Content, %	22.0	23.0		
	Dry Density, pcf	104.6	105.3		
	Saturation, %	100.2	106.5		
	Void Ratio	0.582	0.571		
Before Shear	Water Content, %	23.5	20.6		
	Dry Density, pcf	101.9	107.		
	Saturation*, %	100.0	100.0		
	Void Ratio	0.623	0.545		
	Back Press., psi	60.92	61.02		
Ver. Eff. Cons. Stress, psi		12.57	24.96		
Shear Strength, psi		9.989	17.52		
Strain at Failure, %		19.8	19.6		
Strain Rate, %/min		0.075	0.075		
B-Value		0.95	0.96		
Estimated Specific Gravity		2.65	2.65		
Liquid Limit		---	---		
Plastic Limit		---	---		

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260

Location:

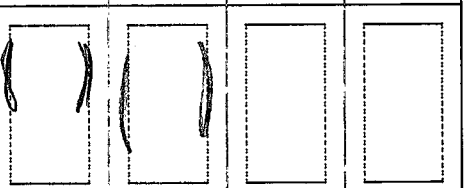
Project No.:

Boring No.: 1

Sample Type:

Description: T. L. 18" Brn Silty Clay with I.O. Coal Deposits, Rock upto 3/4"

Remarks:



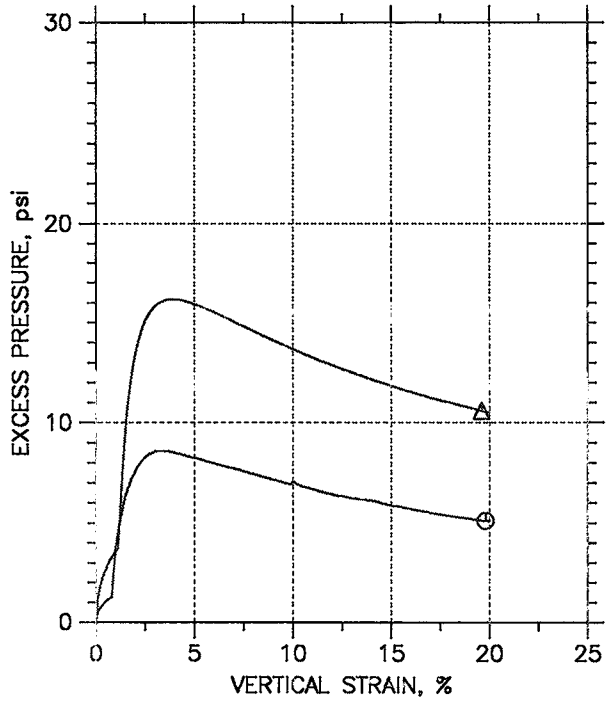
Phase calculations based on start and end of test.

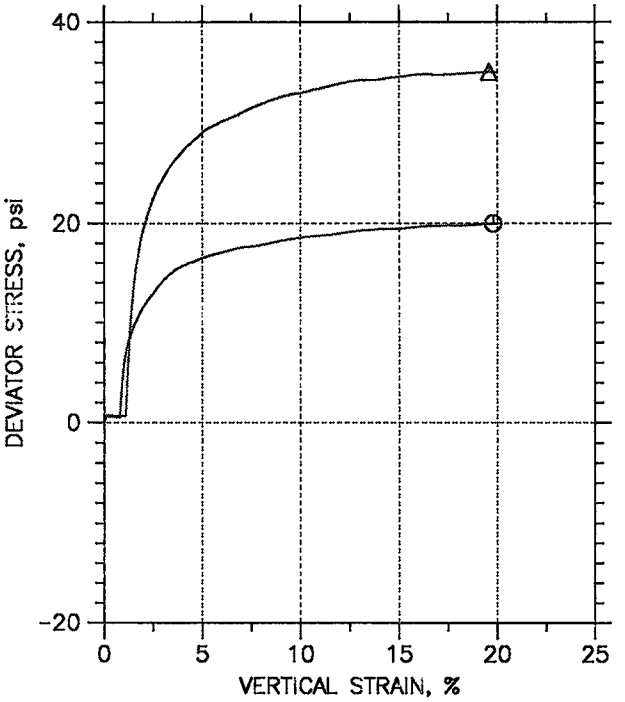
* Saturation is set to 100% for phase calculations.

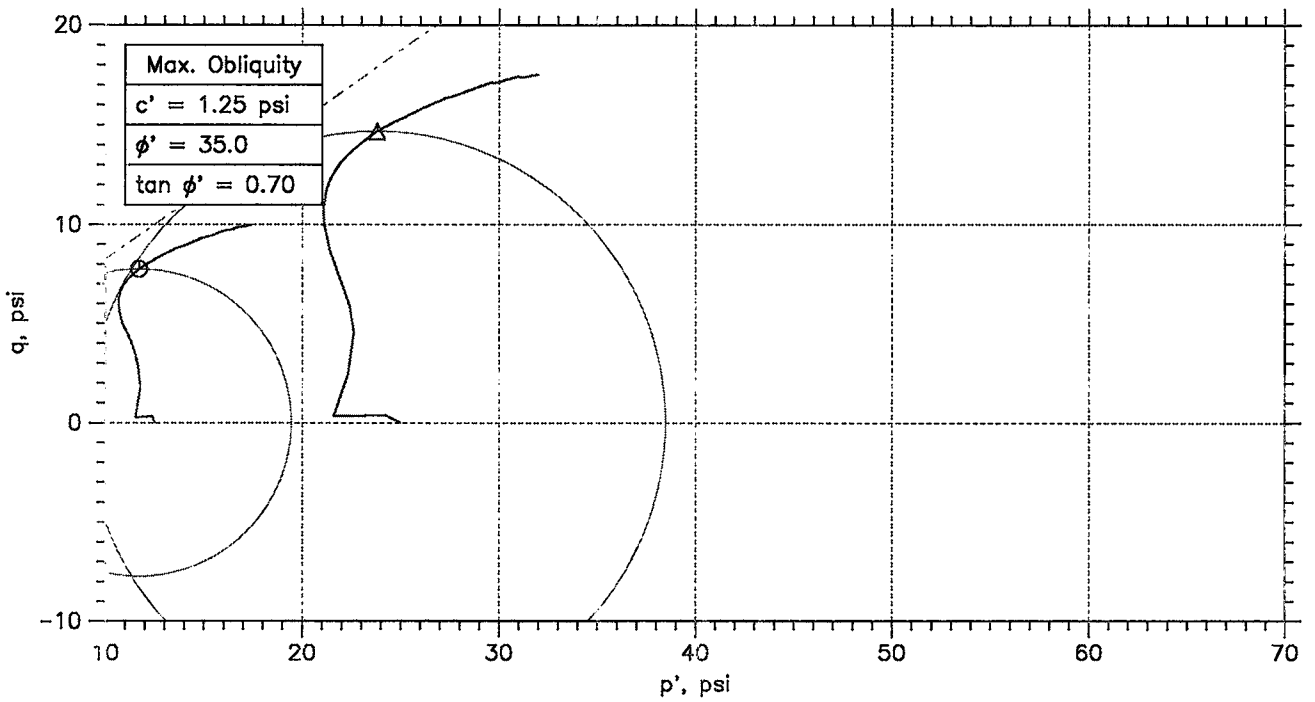
Tue, 31-MAY-2016 07:03:11

SS-343-16

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-343-16	CU-6-16	14.1-14.6	Dan	5/23/16	Matt		CU-6-16.dat
△	SS-343-16	CU-7-16	14.6-15.1	Dan	5/25/16	Matt		CU-7-16.dat

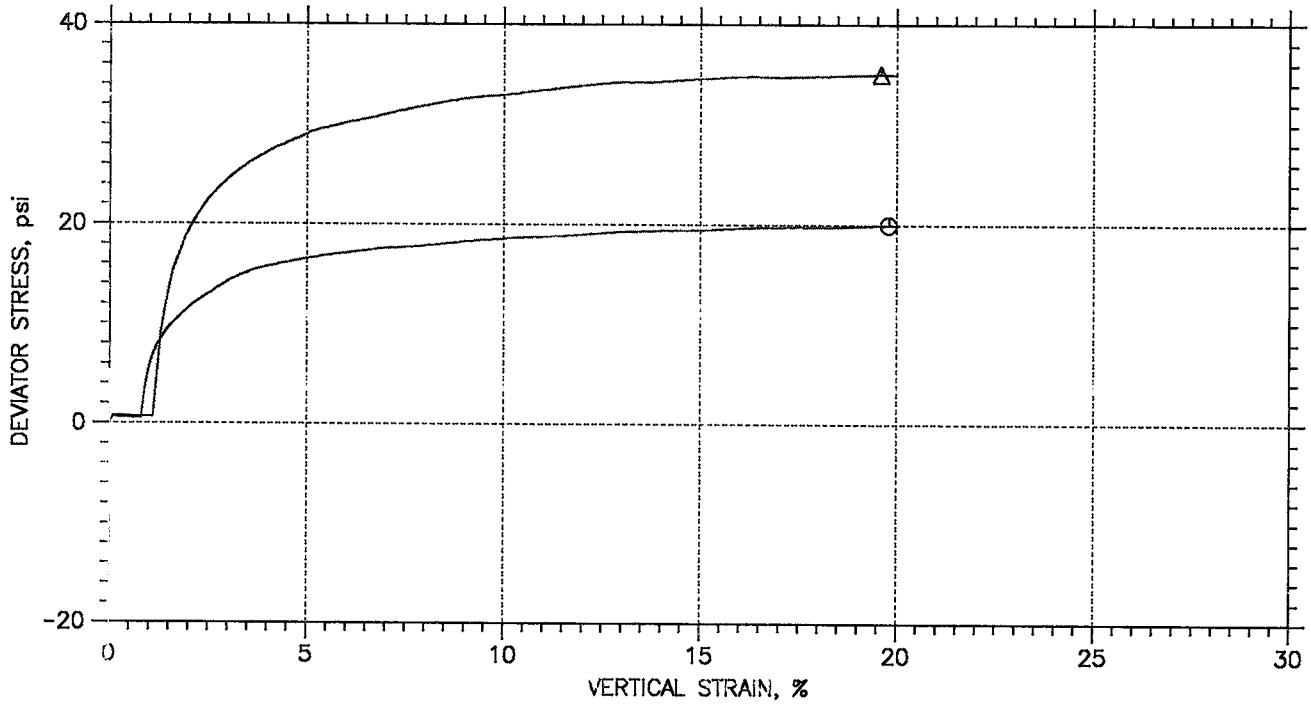
NDDOT North Dakota Department of Transportation

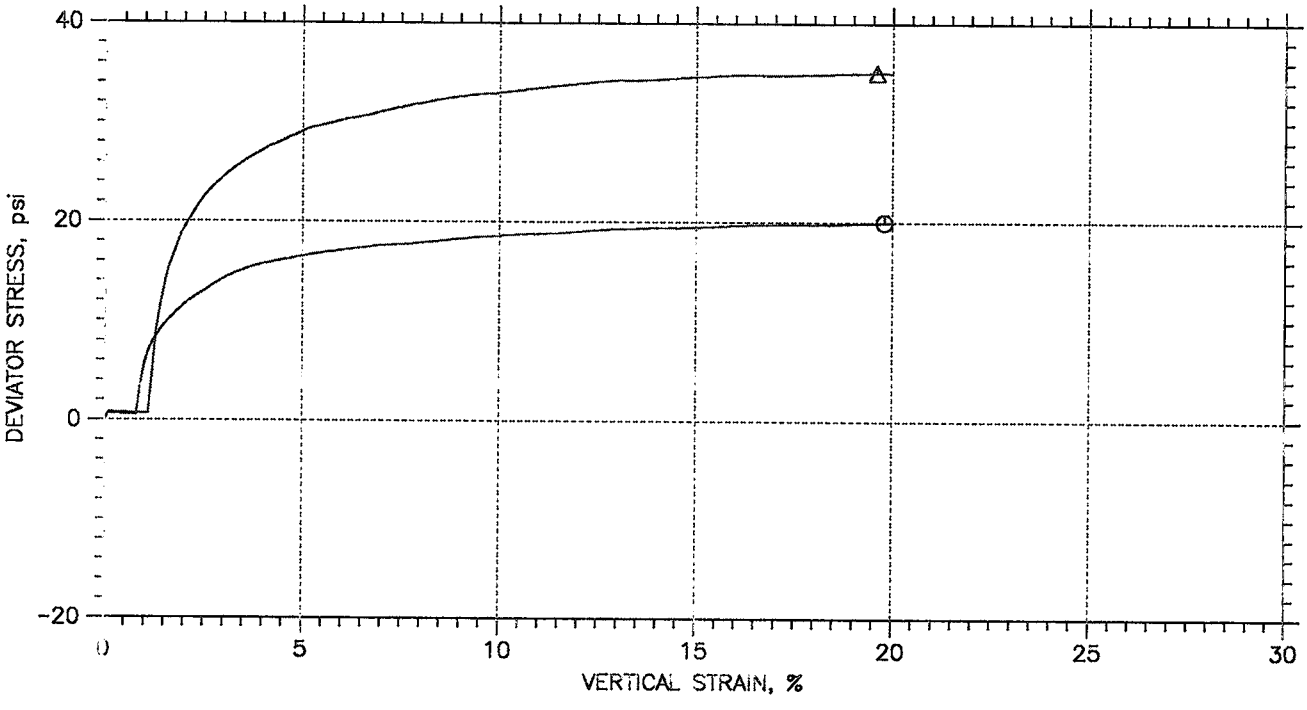
Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Sample Type:	
Description: T. L. 18" Brn Silty Clay with I.O. Coal Deposits, Rock upto 3/4"		
Remarks:		

Tue, 31-MAY-2016 07:03:11

SS-343-16

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	SS-343-16	CU-6-16	14.1-14.6	Dan	5/23/16	Matt		CU-6-16.dat
△	SS-343-16	CU-7-16	14.6-15.1	Dan	5/25/16	Matt		CU-7-16.dat

NDDOT North Dakota Department of Transportation

Project: IM-2-094(143)260	Location:	Project No.:
Boring No.: 1	Sample Type:	
Description: T. L. 18" Brn Silty Clay with l.O. Coal Deposits, Rock upto 3/4"		
Remarks:		

Tue, 31-MAY-2016 07:03:11

SS-343-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 1 | Tested By: Dan | Checked By: Matt
Sample No.: SS-343-16 | Test Date: 5/23/16 | Depth: 14.1-14.6
Test No.: CU-6-16 | Sample Type: | Elevation:

Soil Description: T. L. 18" Brn Silty Clay with I.O. Coal Deposits, Rock upto 3/4"
Remarks:

Specimen Height: 5.74 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.30 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 592.82 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	s61	---		s6
Wt. Container + Wet Soil, gm	73.37	---	---	164.81
Wt. Container + Dry Soil, gm	62.89	---	---	139.07
Wt. Container, gm	15.3	---	---	29.66
Wt. Wet Soil, gm	58.07	1211.6	1226.5	135.15
Wt. Dry Soil, gm	47.59	992.94	992.94	109.41
Wt. Water, gm	10.48	218.66	233.6	25.74
Water Content, %	22.02	22.02	23.53	23.53
Void Ratio	---	0.58	0.62	---
Degree of Saturation, %	---	100.25	100.00	---
Dry Unit Weight, pcf	---	104.56	101.9	---

Initial
Height: 5.739 in
Area: 6.3035 in^2
Volume: 592.82 cc
Moisture: 22.02 %
Void Ratio: 0.58
Dry Unit Weight: 104.56 pcf
Saturation: 100.25 %

End of Initialization
Time: 4.2388 min
Total Vertical Stress: 2.9907 psi
Total Horizontal Stress: 2.995 psi
Pore Pressure: 0.99564 psi
Effective Vertical Stress: 1.995 psi
Effective Horizontal Stress: 1.9994 psi
Height Change: 0.0017564 in
Area Change: 0 in^2
Volume Change: 0.5443 cc
Water Change: 0.36683 cc
Correction: 0.71495 cc
Height: 5.7372 in
Area: 6.3035 in^2
Volume: 592.27 cc
Moisture: 21.91 %
Void Ratio: 0.58
Dry Unit Weight: 104.66 pcf
Saturation: 100.00 %

End of Consolidation/A
Time: 4.2388 min
Total Vertical Stress: 2.9907 psi
Total Horizontal Stress: 2.995 psi
Pore Pressure: 0.99564 psi
Effective Vertical Stress: 1.995 psi
Effective Horizontal Stress: 1.9994 psi
Height Change: 0.0017564 in
Area Change: 0 in^2
Volume Change: 0.5443 cc
Water Change: 0.36683 cc
Correction: 0.71495 cc
Height: 5.7372 in
Area: 6.3035 in^2
Volume: 592.27 cc
Moisture: 21.91 %
Void Ratio: 0.58
Dry Unit Weight: 104.66 pcf
Saturation: 100.00 %

End of Saturation
Time: 701.54 min
Total Vertical Stress: 62.975 psi
Total Horizontal Stress: 62.992 psi
Pore Pressure: 60.993 psi
Effective Vertical Stress: 1.9823 psi
Effective Horizontal Stress: 1.9993 psi
Height Change: -0.0019876 in
Area Change: 0 in^2
Volume Change: -0.61592 cc
Water Change: -10.204 cc
Correction: 10.125 cc
Height: 5.741 in
Area: 6.3035 in^2
Volume: 593.43 cc
Moisture: 22.03 %
Void Ratio: 0.58
Dry Unit Weight: 104.46 pcf
Saturation: 100.00 %

End of Consolidation/B
Time: 1021.6 min
Total Vertical Stress: 73.493 psi
Total Horizontal Stress: 73.495 psi
Pore Pressure: 60.92 psi
Effective Vertical Stress: 12.573 psi
Effective Horizontal Stress: 12.575 psi
Height Change: -0.0023111 in
Area Change: -0.16198 in^2
Volume Change: -15.479 cc
Water Change: -1.1085 cc
Correction: -13.832 cc
Height: 5.7413 in
Area: 6.4655 in^2
Volume: 608.3 cc
Moisture: 23.53 %
Void Ratio: 0.62
Dry Unit Weight: 101.9 pcf
Saturation: 100.00 %

End of Shear
Time: 1292.1 min
Total Vertical Stress: 92.998 psi
Total Horizontal Stress: 73.503 psi
Pore Pressure: 66.06 psi
Effective Vertical Stress: 26.938 psi
Effective Horizontal Stress: 7.4429 psi
Height Change: 1.146 in
Area Change: -1.7784 in^2
Volume Change: -15.479 cc
Water Change: -1.1091 cc
Correction: -13.832 cc
Height: 4.593 in
Area: 8.082 in^2
Volume: 608.3 cc
Moisture: 23.53 %
Void Ratio: 0.62
Dry Unit Weight: 101.9 pcf
Saturation: 100.00 %

At Failure
Time: 1289.4 min
Total Vertical Stress: 93.472 psi
Total Horizontal Stress: 73.495 psi
Pore Pressure: 66.076 psi
Effective Vertical Stress: 27.396 psi
Effective Horizontal Stress: 7.4186 psi
Height Change: 1.1345 in
Area Change: -1.5678 in^2
Volume Change: -15.478 cc
Water Change: -1.1091 cc
Correction: 0 cc
Height: 4.6045 in
Area: 7.8713 in^2
Volume: 608.29 cc
Moisture: 23.53 %
Void Ratio: 0.62
Dry Unit Weight: 101.9 pcf
Saturation: 100.00 %

SS-343-16

TRIAXIAL TEST

Project: IM-2-094(143)260 | Location: | Project No.:
Boring No.: 1 | Tested By: Dan | Checked By: Matt
Sample No.: SS-343-16 | Test Date: 5/25/16 | Depth: 14.6-15.1
Test No.: CU-7-16 | Sample Type: | Elevation:

Soil Description: T. L. 18" Brn Silty Clay with I.O. Coal Deposits, Rock upto 3/4"
Remarks:

Specimen Height: 5.73 in | Piston Area: 0.16 in^2 | Filter Strip Correction: 0.00 psi
Specimen Area: 6.38 in^2 | Piston Friction: 0.00 lb | Membrane Correction: 4.20 lb/in
Specimen Volume: 599.01 cc | Piston Weight: 0.00 lb | Correction Type: Uniform

Liquid Limit: --- | Plastic Limit: --- | Estimated Specific Gravity: 2.65

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	S 39	---		s12
Wt. Container + Wet Soil, gm	67.92	---	---	188.9
Wt. Container + Dry Soil, gm	58.39	---	---	161.7
Wt. Container, gm	16.89	---	---	29.56
Wt. Wet Soil, gm	51.03	1242.3	1218.3	159.34
Wt. Dry Soil, gm	41.5	1010.3	1010.3	132.14
Wt. Water, gm	9.53	232.01	207.97	27.2
Water Content, %	22.96	22.96	20.58	20.58
Void Ratio	---	0.57	0.55	---
Degree of Saturation, %	---	106.55	100.00	---
Dry Unit Weight, pcf	---	105.3	107.04	---

Initial
Height: 5.73 in
Area: 6.3794 in^2
Volume: 599.01 cc
Moisture: 22.96 %
Void Ratio: 0.57
Dry Unit Weight: 105.3 pcf
Saturation: 106.55 %

End of Initialization
Time: 15.638 min
Total Vertical Stress: 2.9803 psi
Total Horizontal Stress: 2.995 psi
Pore Pressure: 0.99564 psi
Effective Vertical Stress: 1.9847 psi
Effective Horizontal Stress: 1.9994 psi
Height Change: 9.2444e-005 in
Area Change: 0 in^2
Volume Change: 0.028992 cc
Water Change: 0.81142 cc
Correction: 13.478 cc
Height: 5.7299 in
Area: 6.3794 in^2
Volume: 598.98 cc
Moisture: 21.55 %
Void Ratio: 0.57
Dry Unit Weight: 105.3 pcf
Saturation: 100.00 %

End of Consolidation/A
Time: 15.638 min
Total Vertical Stress: 2.9803 psi
Total Horizontal Stress: 2.995 psi
Pore Pressure: 0.99564 psi
Effective Vertical Stress: 1.9847 psi
Effective Horizontal Stress: 1.9994 psi
Height Change: 9.2444e-005 in
Area Change: 0 in^2
Volume Change: 0.028992 cc
Water Change: 0.81142 cc
Correction: 13.478 cc
Height: 5.7299 in
Area: 6.3794 in^2
Volume: 598.98 cc
Moisture: 21.55 %
Void Ratio: 0.57
Dry Unit Weight: 105.3 pcf
Saturation: 100.00 %

End of Saturation
Time: 386.29 min
Total Vertical Stress: 62.99 psi
Total Horizontal Stress: 62.992 psi
Pore Pressure: 60.993 psi
Effective Vertical Stress: 1.997 psi
Effective Horizontal Stress: 1.9993 psi
Height Change: -0.0042987 in
Area Change: 0 in^2
Volume Change: -1.3481 cc
Water Change: -3.9466 cc
Correction: 16.859 cc
Height: 5.7343 in
Area: 6.3794 in^2
Volume: 600.36 cc
Moisture: 21.69 %
Void Ratio: 0.57
Dry Unit Weight: 105.06 pcf
Saturation: 100.00 %

End of Consolidation/B
Time: 534.83 min
Total Vertical Stress: 85.978 psi
Total Horizontal Stress: 86 psi
Pore Pressure: 61.017 psi
Effective Vertical Stress: 24.961 psi
Effective Horizontal Stress: 24.983 psi
Height Change: -0.0055929 in
Area Change: 0.1103 in^2
Volume Change: 9.7821 cc
Water Change: 13.475 cc
Correction: 10.568 cc
Height: 5.7356 in
Area: 6.2691 in^2
Volume: 589.23 cc
Moisture: 20.58 %
Void Ratio: 0.55
Dry Unit Weight: 107.04 pcf
Saturation: 100.00 %

End of Shear
Time: 805.73 min
Total Vertical Stress: 120.77 psi
Total Horizontal Stress: 86 psi
Pore Pressure: 71.492 psi
Effective Vertical Stress: 49.28 psi
Effective Horizontal Stress: 14.508 psi
Height Change: 1.1416 in
Area Change: -1.457 in^2
Volume Change: 9.7816 cc
Water Change: 13.474 cc
Correction: 10.568 cc
Height: 4.5884 in
Area: 7.8364 in^2
Volume: 589.23 cc
Moisture: 20.58 %
Void Ratio: 0.55
Dry Unit Weight: 107.04 pcf
Saturation: 100.00 %

At Failure
Time: 800.31 min
Total Vertical Stress: 121.04 psi
Total Horizontal Stress: 86.008 psi
Pore Pressure: 71.589 psi
Effective Vertical Stress: 49.454 psi
Effective Horizontal Stress: 14.419 psi
Height Change: 1.1187 in
Area Change: -1.3693 in^2
Volume Change: 9.7827 cc
Water Change: 13.474 cc
Correction: 0 cc
Height: 4.6113 in
Area: 7.7487 in^2
Volume: 589.23 cc
Moisture: 20.58 %
Void Ratio: 0.55
Dry Unit Weight: 107.04 pcf
Saturation: 100.00 %

TRIAXIAL UU(Q) CCU(R) CD(S)
Department of Transportation, Materials & Research Division
SFN 50459 (Rev. 10-2015)

Field Sample Number	55-343-16
Test Number	1 of 2

Project Number	IM-2-094(143)260
Boring Number	1
Lab Number	CU-6-16
Depth	14.1 to 14.6
Confining Pressure	12.5

Diameter		
	2.812	2.850
	2.821	2.851
	2.811	2.851
Avg	2.833	

Wt of Sample	1211.60	
Height	5.740	L.L
	5.741	L.L.
	5.737	
Avg	5.739	
Specific Gravity @ 20°C		

Trimmings

Moisture Can Number	561
Wet Wt + Can	73.37
Dry Wt + Can	62.89
Wt of Can	15.30

After Test = 1211.88
SG 29.66 wet 164.81
Dry 139.07

DESCRIPTION OF SAMPLE Total Length 18"
Brn Silty Cly with I.O. & Coal Deposits, Rock up to 3/4"

REMARKS

Test Number	2 of 2

Lab Number	CU-7-16
Depth	14.6 to 15.1

Confining Pressure		
Diameter	2.856	2.842
	2.855	2.850
	2.846	2.850
Avg	2.850	

Wt of Sample	1242.35	
Height	5.727	L.L
	5.734	L.L.
	5.728	
Avg	5.730	
Specific Gravity @ 20°C		

Trimmings

Moisture Can Number	539
Wet Wt + Can	67.92
Dry Wt + Can	58.39
Wt of Can	16.89

After test 1237.66
S 12 W 188.90
D 161.70
Tare Wt. 29.56

DESCRIPTION OF SAMPLE

REMARKS

Test Number	of

Lab Number	
Depth	

Confining Pressure		
Diameter		
Avg		

Wt of Sample		
Height		L.L
		L.L.
Avg		
Specific Gravity @ 20°C		

Trimmings

Moisture Can Number	
Wet Wt + Can	
Dry Wt + Can	
Wt of Can	

DESCRIPTION OF SAMPLE

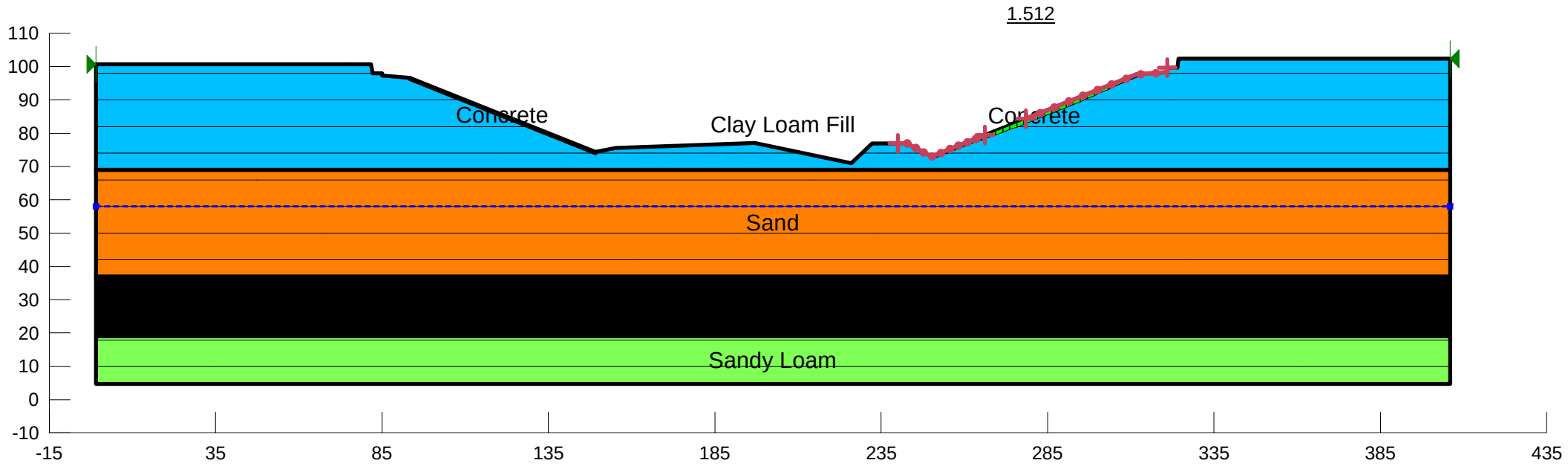
REMARKS

AASHTO T-234 Tested By: ____

APPENDIX C

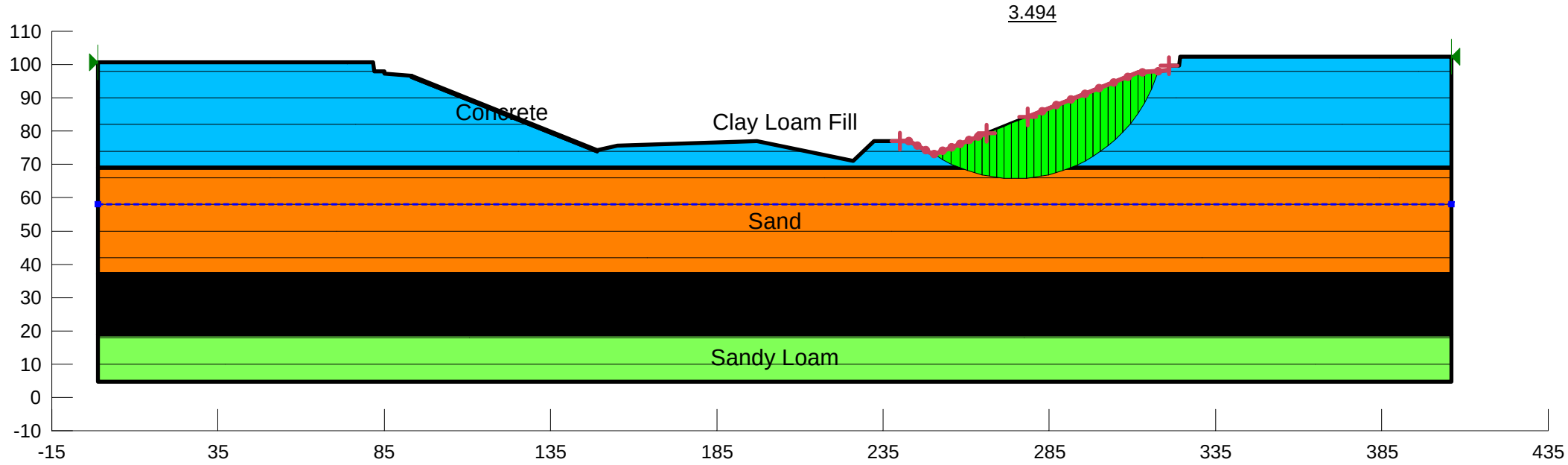
Stability Analysis Outputs

East ESA



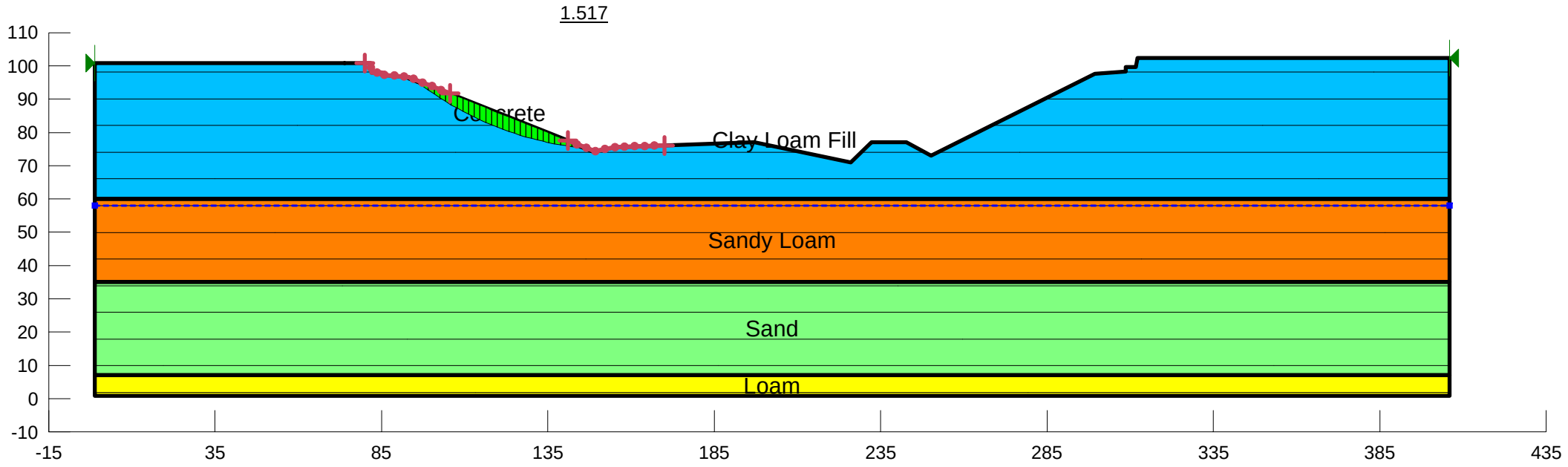
Name: Clay Loam Fill Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Sand Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Coal Unit Weight: 130 pcf Cohesion': 0 psf Phi': 34 °
Name: Sandy Loam Unit Weight: 130 pcf Cohesion': 0 psf Phi': 34 °
Name: Concrete Unit Weight: 140 pcf Cohesion': 50 psf Phi': 0 °

East TSA



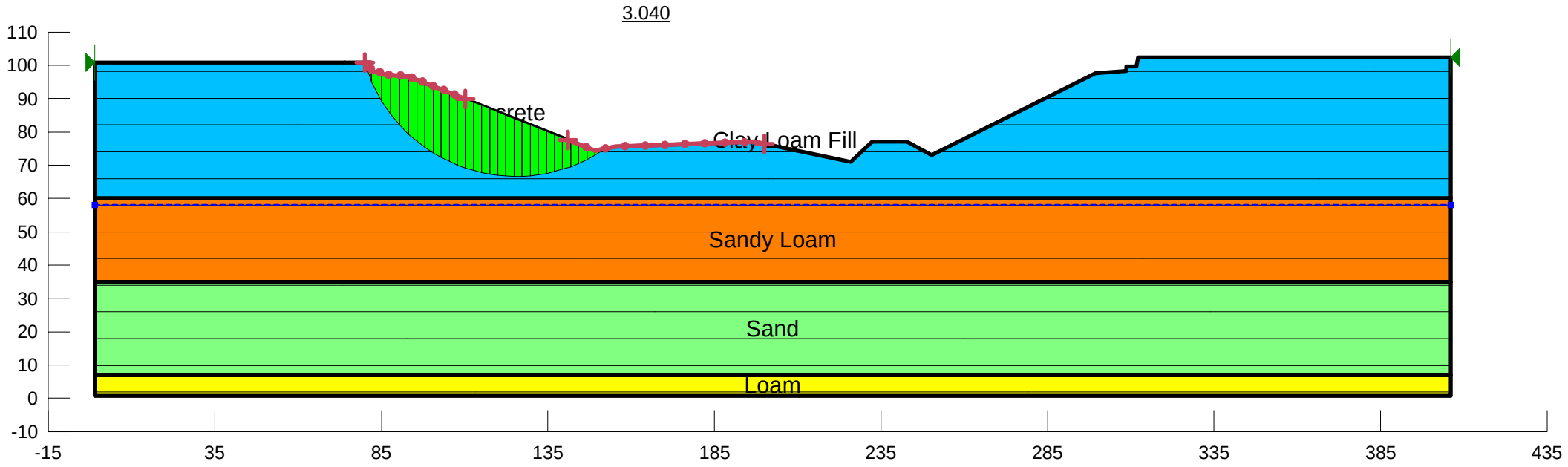
Name: Clay Loam Fill Unit Weight: 130 pcf Cohesion': 1,500 psf Phi': 0 °
Name: Sand Unit Weight: 130 pcf Cohesion': 0 psf Phi': 33 °
Name: Coal Unit Weight: 130 pcf Cohesion': 0 psf Phi': 34 °
Name: Sandy Loam Unit Weight: 130 pcf Cohesion': 0 psf Phi': 34 °
Name: Concrete Unit Weight: 140 pcf Cohesion': 1,000 psf Phi': 0 °

West ESA



Name: Clay Loam Fill Unit Weight: 130 pcf Cohesion': 0 psf Phi': 30 °
Name: Sandy Loam Unit Weight: 130 pcf Cohesion': 0 psf Phi': 32 °
Name: Sand Unit Weight: 130 pcf Cohesion': 0 psf Phi': 37 °
Name: Loam Unit Weight: 130 pcf Cohesion': 0 psf Phi': 20 °
Name: Concrete Unit Weight: 140 pcf Cohesion': 50 psf Phi': 0 °

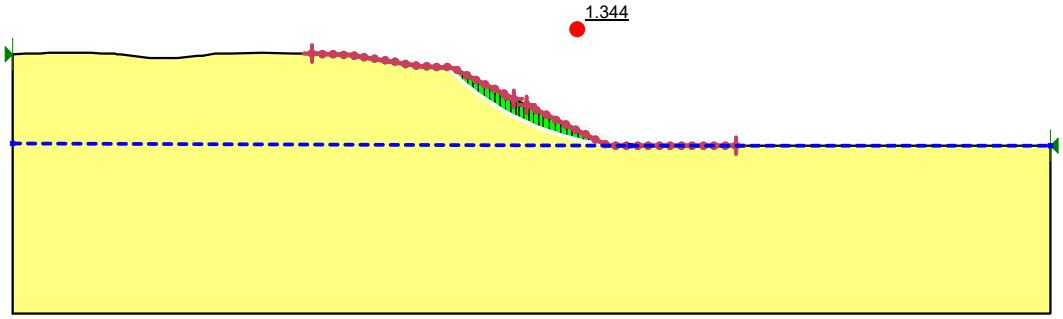
West TSA



Name: Clay Loam Fill Unit Weight: 130 pcf Cohesion': 1,200 psf Phi': 0 °
Name: Sandy Loam Unit Weight: 130 pcf Cohesion': 0 psf Phi': 32 °
Name: Sand Unit Weight: 130 pcf Cohesion': 0 psf Phi': 37 °
Name: Loam Unit Weight: 130 pcf Cohesion': 4,625 psf Phi': 0 °
Name: Concrete Unit Weight: 140 pcf Cohesion': 1,000 psf Phi': 0 °

2:1 slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	New Material	Mohr-Coulomb	120	0	32.3	0	1



2.5:1 slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	New Material	Mohr-Coulomb	120	0	32.3	0	1